Table G-8-2 Open Drain (2/2)

Drain	Length km	Catchment Area ha	Designed Discharge m3/sec	Notes
(Lateral drainage canal)				
C - 1	1.6	110	0.076	
C - 2	2.6	150	0.104	
C - 3	1.8	50	0.035	
C - 4	1.6	80	0.056	
C - 5	1.0	80	0.056	
J - 1	2.0	80	0.056	
A - 1	1.1	70	0.049	
B - 1	1.7	60	0.042	
B - 2	1.2	70	0.049	
B - 3	2.0	90	0.062	
B - 4	1.5	80	0.056	
S - 1	1.9	40	0.028	
S - 2	1.2	20	0.014	
S - 3	0.8	40	0.028	
P - 1	0.9	30	0.021	
L - 1	1.3	50	0.035	
Sub-total	47.4			
Total	63.5			

Figure G-2-1 DIAGRAM OF EXISTING IRRIGATION SYSTEM

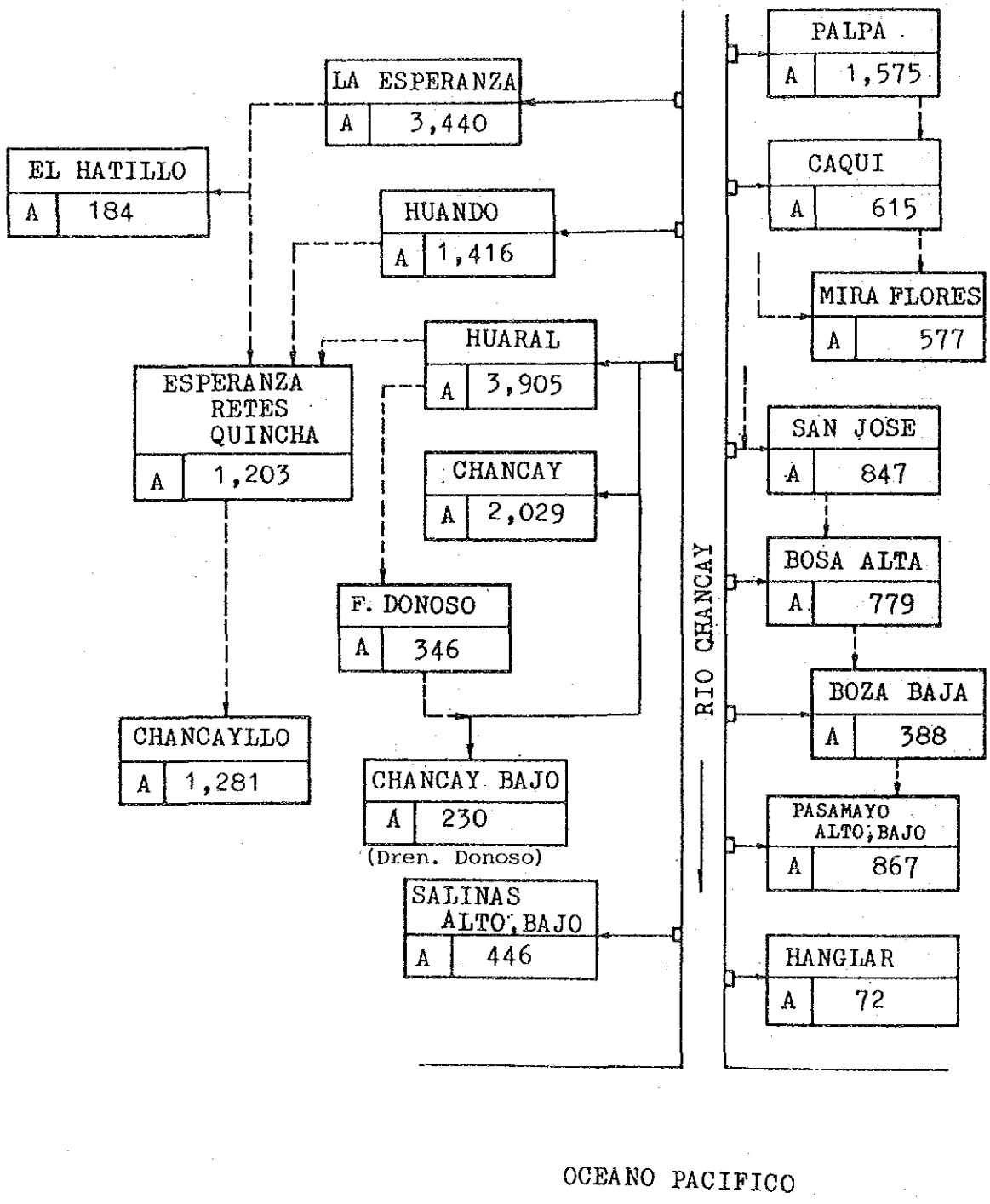


Figure G-2-2 Annual Water Utilization

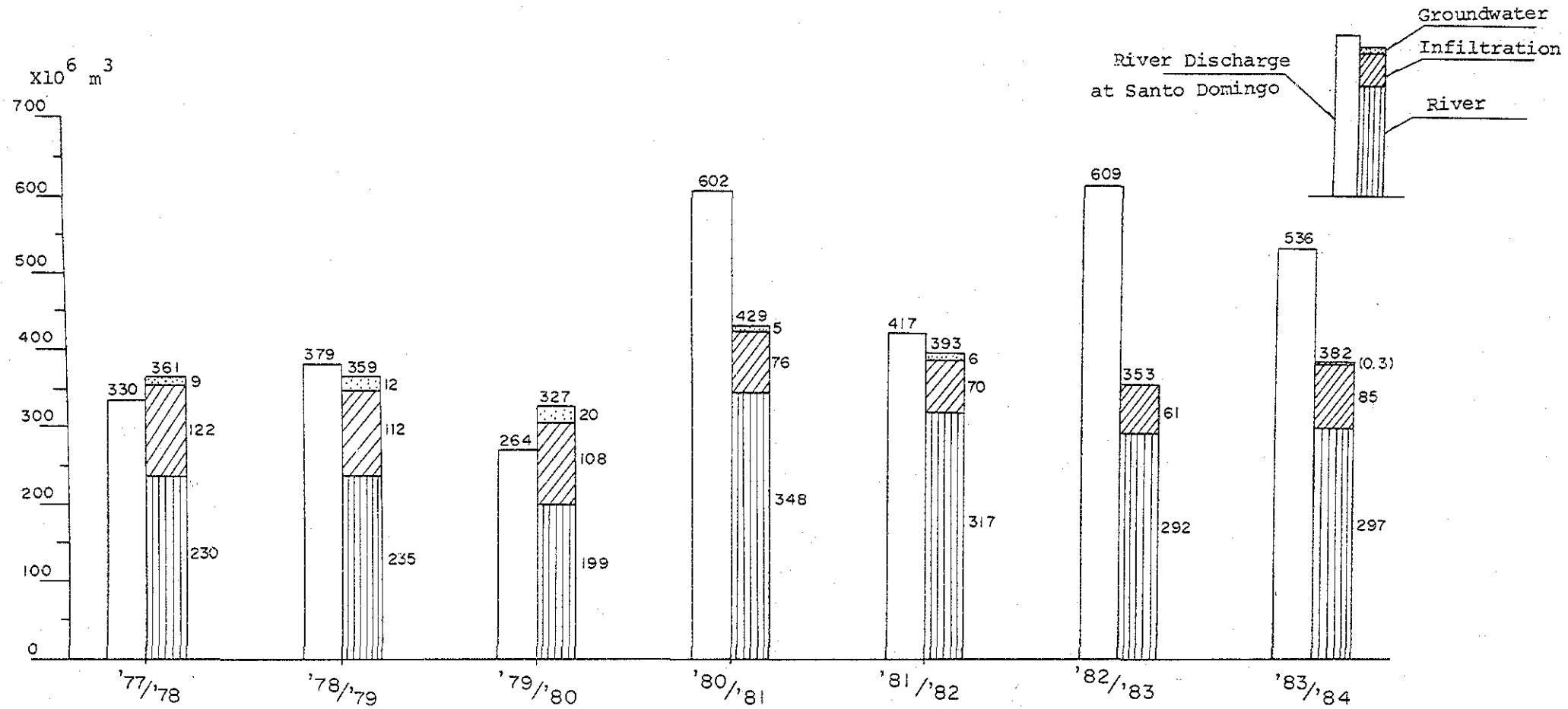


Figure G-2-3 Annual Discharge at Santo Domingo

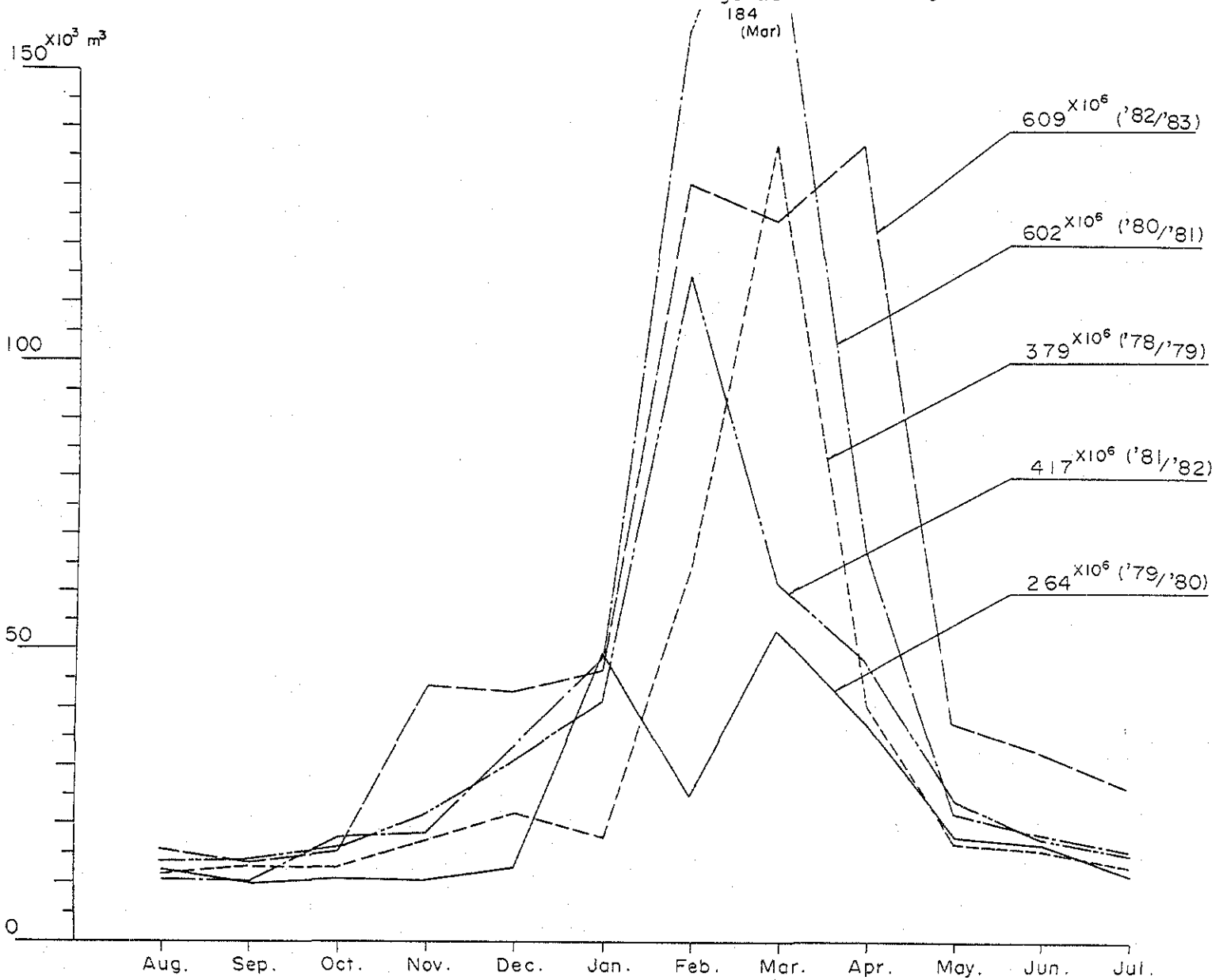


Figure G-2-4 Annual Utilization for Agriculture

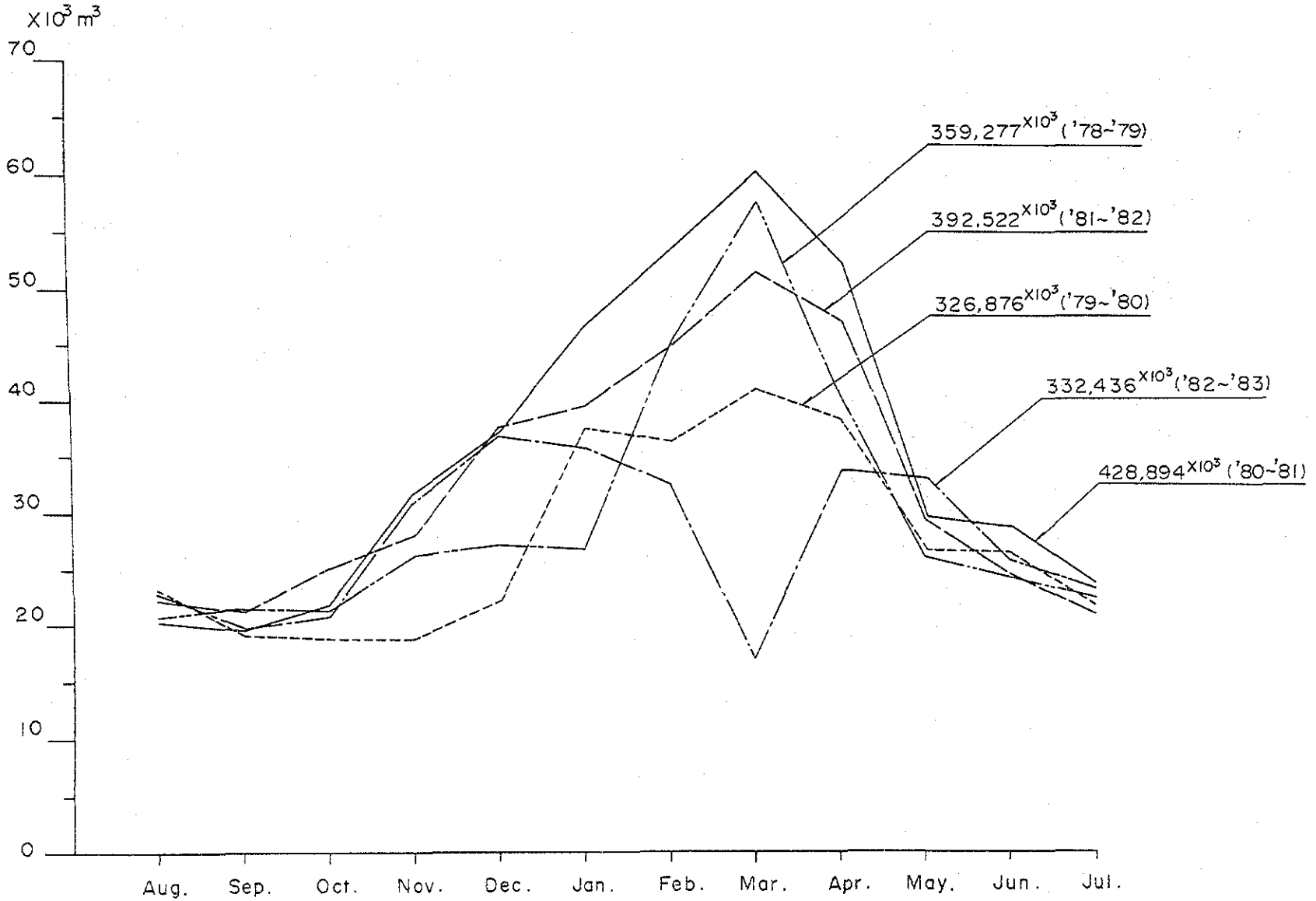
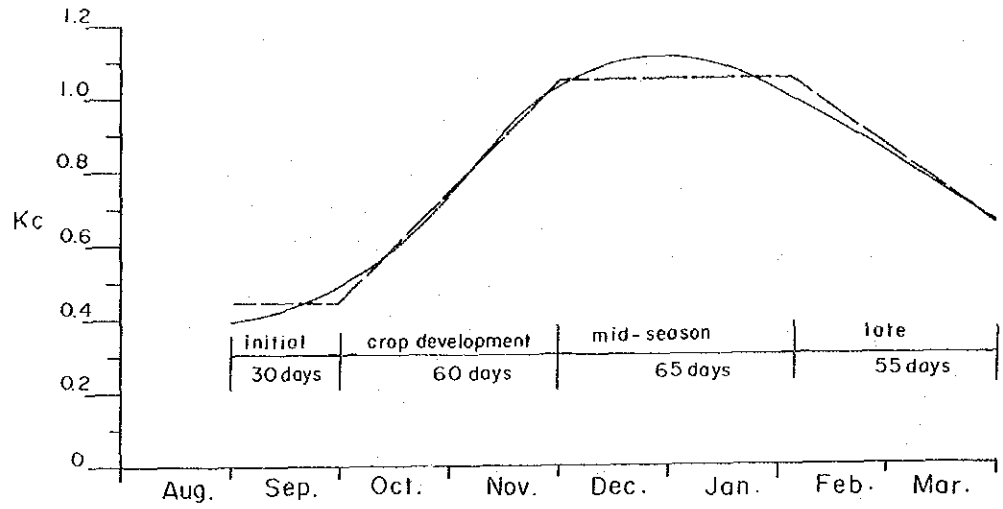


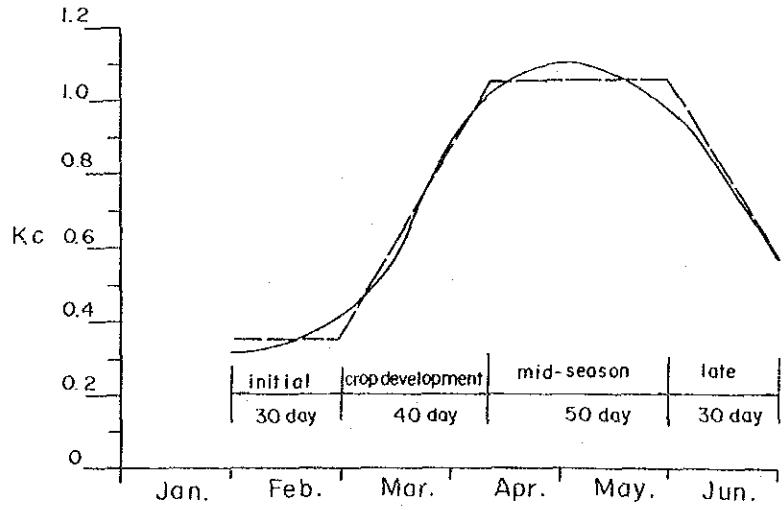
Figure G-5-1 (1) Kc Value

Kc : Cotton



Kc		0.45	0.60	0.90	1.05	1.07	0.95	0.75

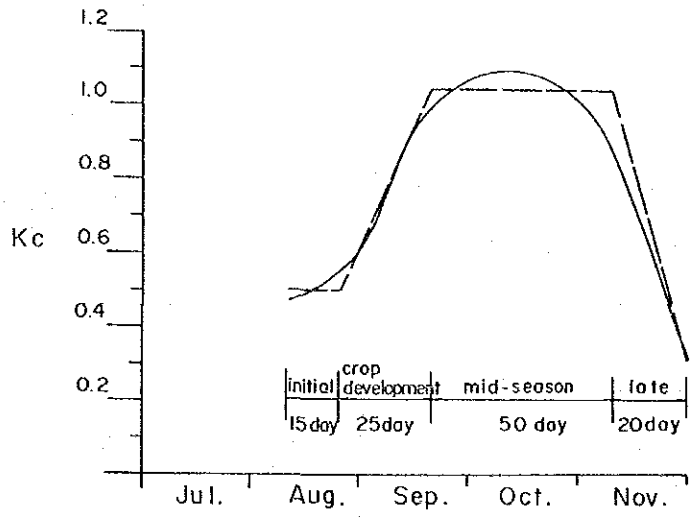
Kc : Maiz



Kc		0.35	0.60	1.02	1.05	0.75

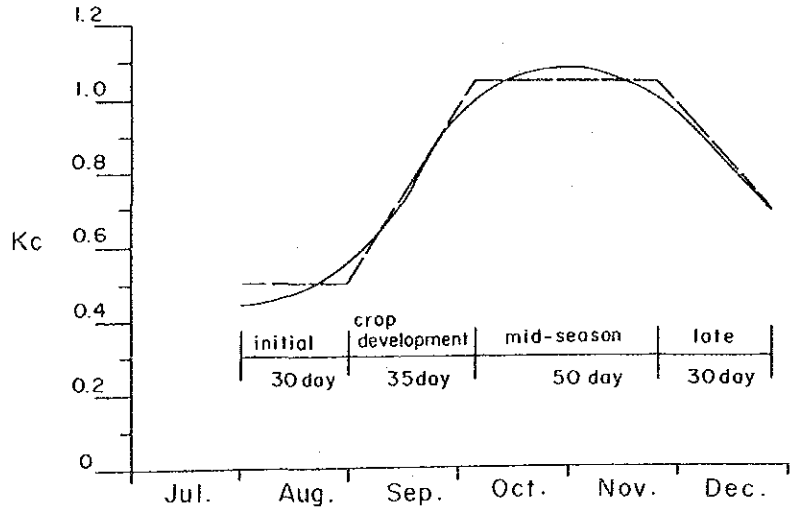
Figure G-5-1 (2) Kc Value

Kc : Beans



Kc		0.50	0.90	1.07	0.75

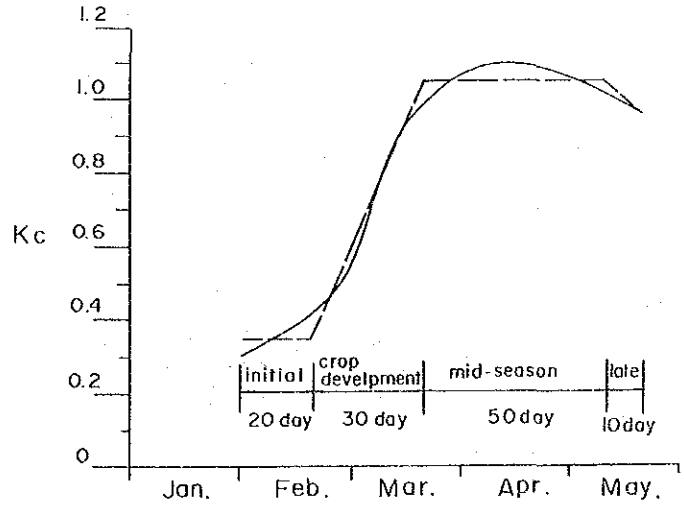
Kc : Potato



Kc		0.50	0.75	1.05	1.03	0.85

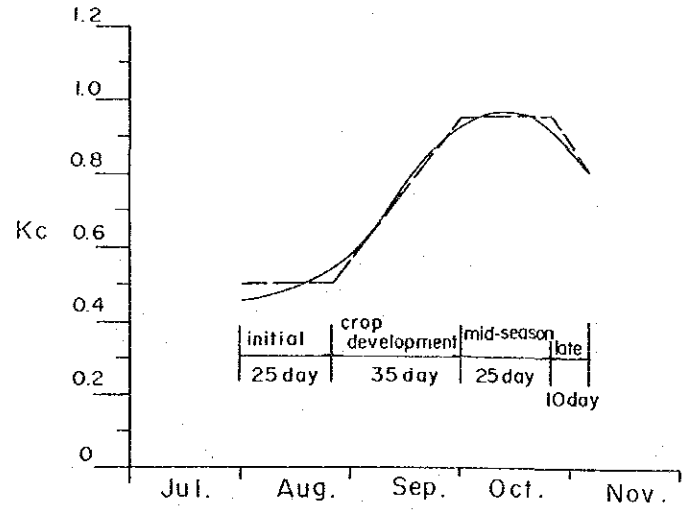
Figure G-5-1 (3) Kc Value

Kc : Choclo



Kc		0.40	0.90	1.07	1.00

Kc : Green Manure



Kc		0.50	0.75	0.95	0.80

Figure G-5-2 Annual Pattern of Discharge at Santo Domingi (Present)

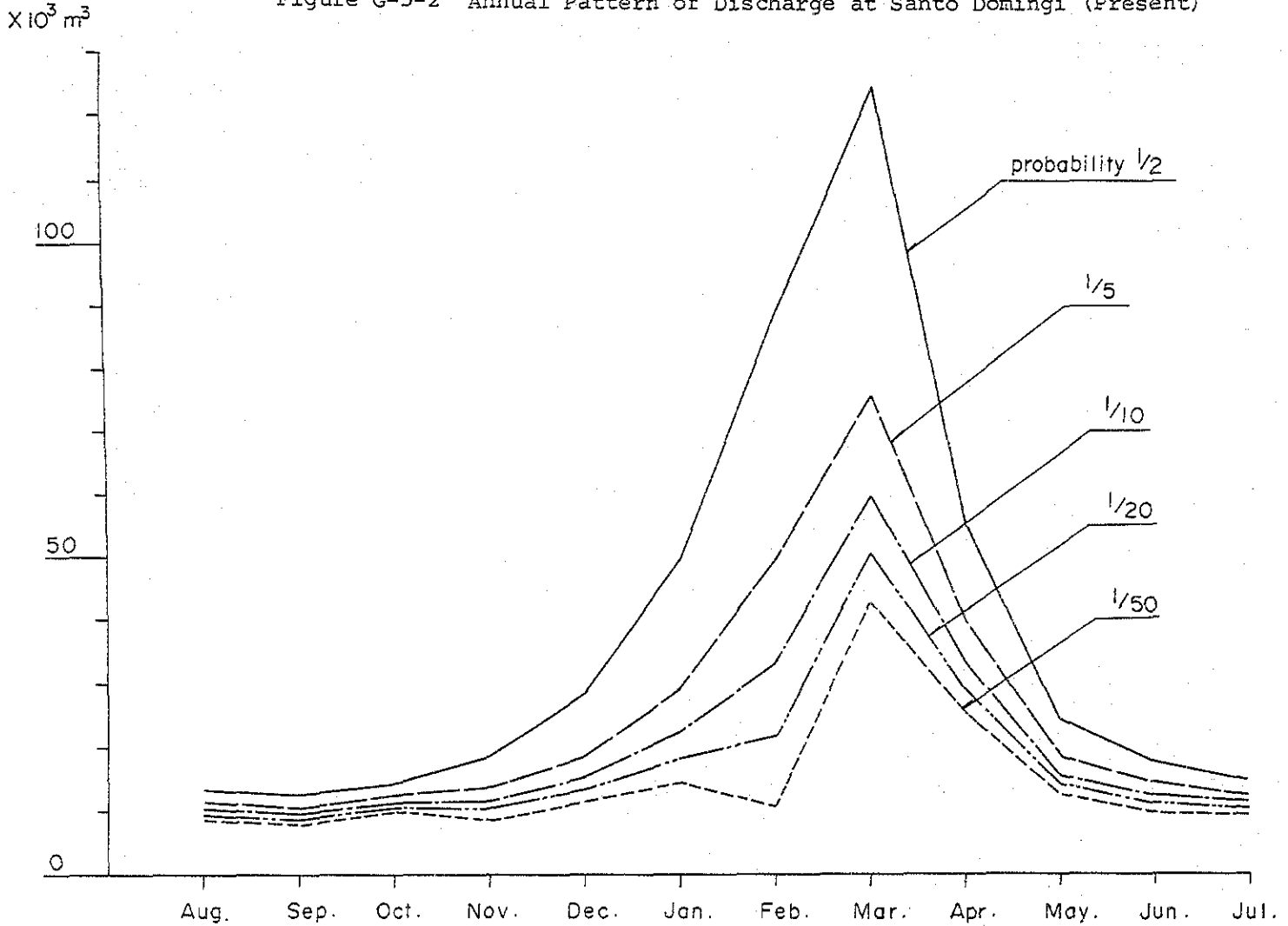


Figure G-5-3 Correlation between river Discharge and Ratio of Recycle

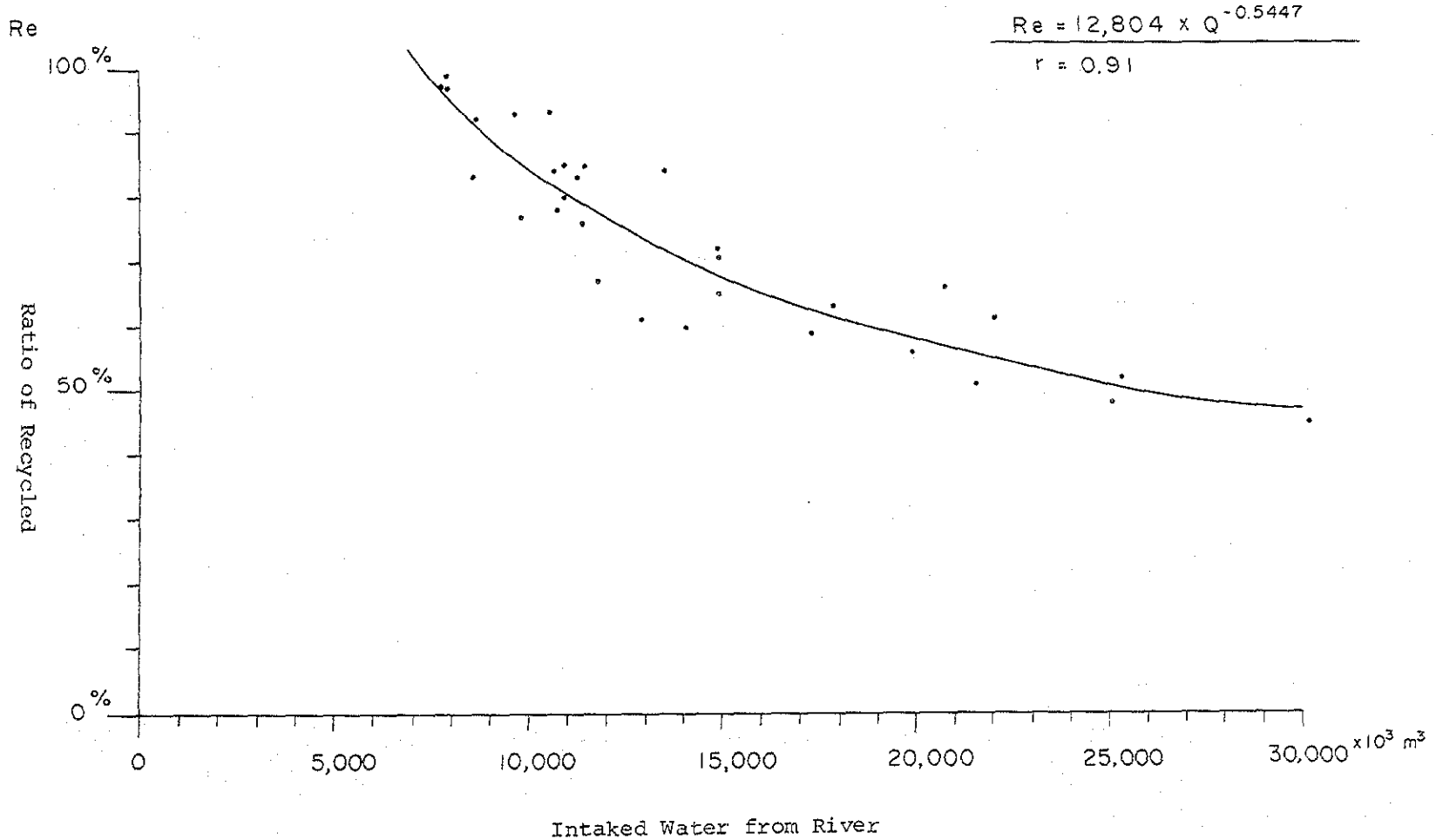


Figure G-5-4 DIAGRAM OF PROPOSED IRRIGATION SYSTEM

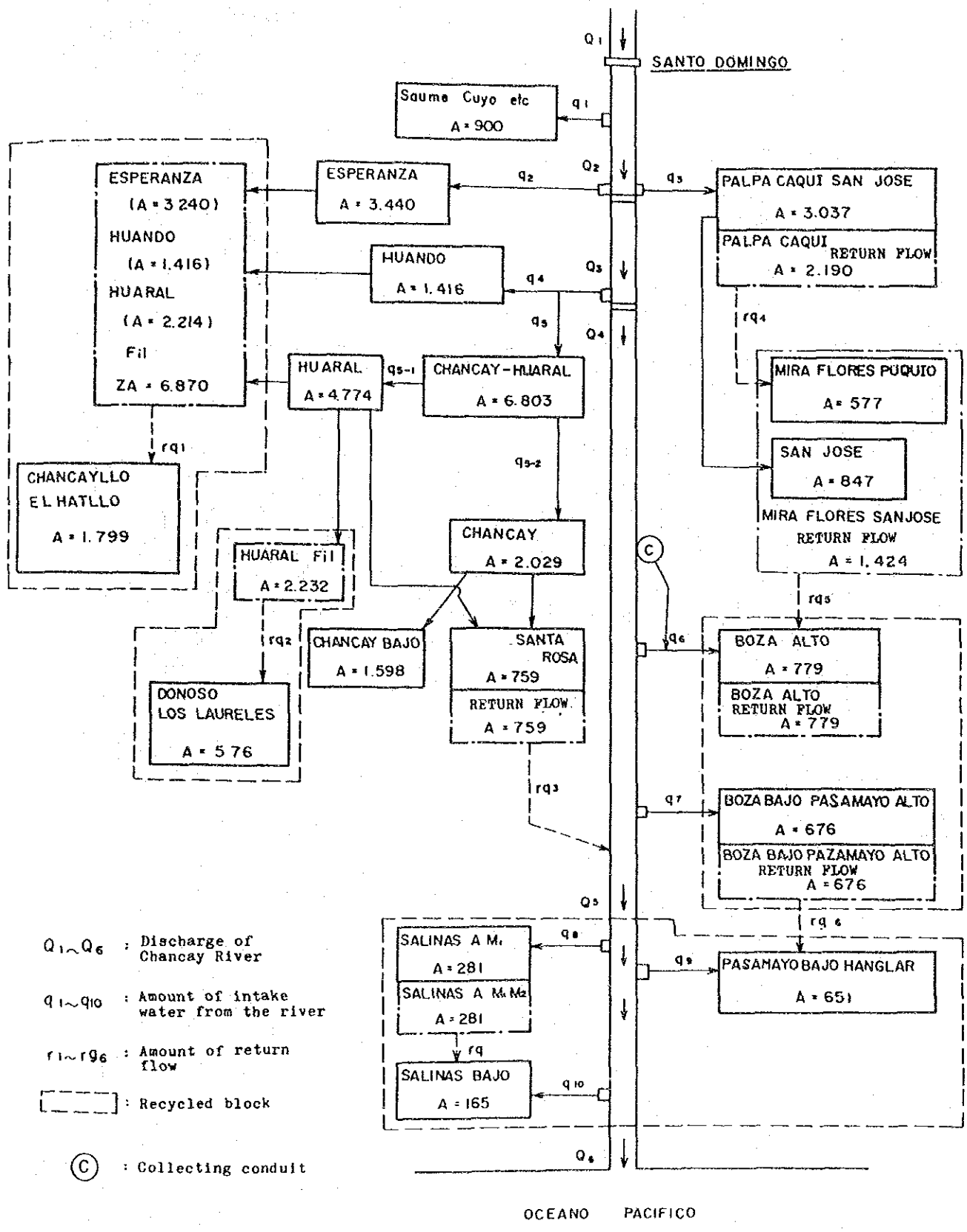


Figure G-5-5 Proposed Irrigation System

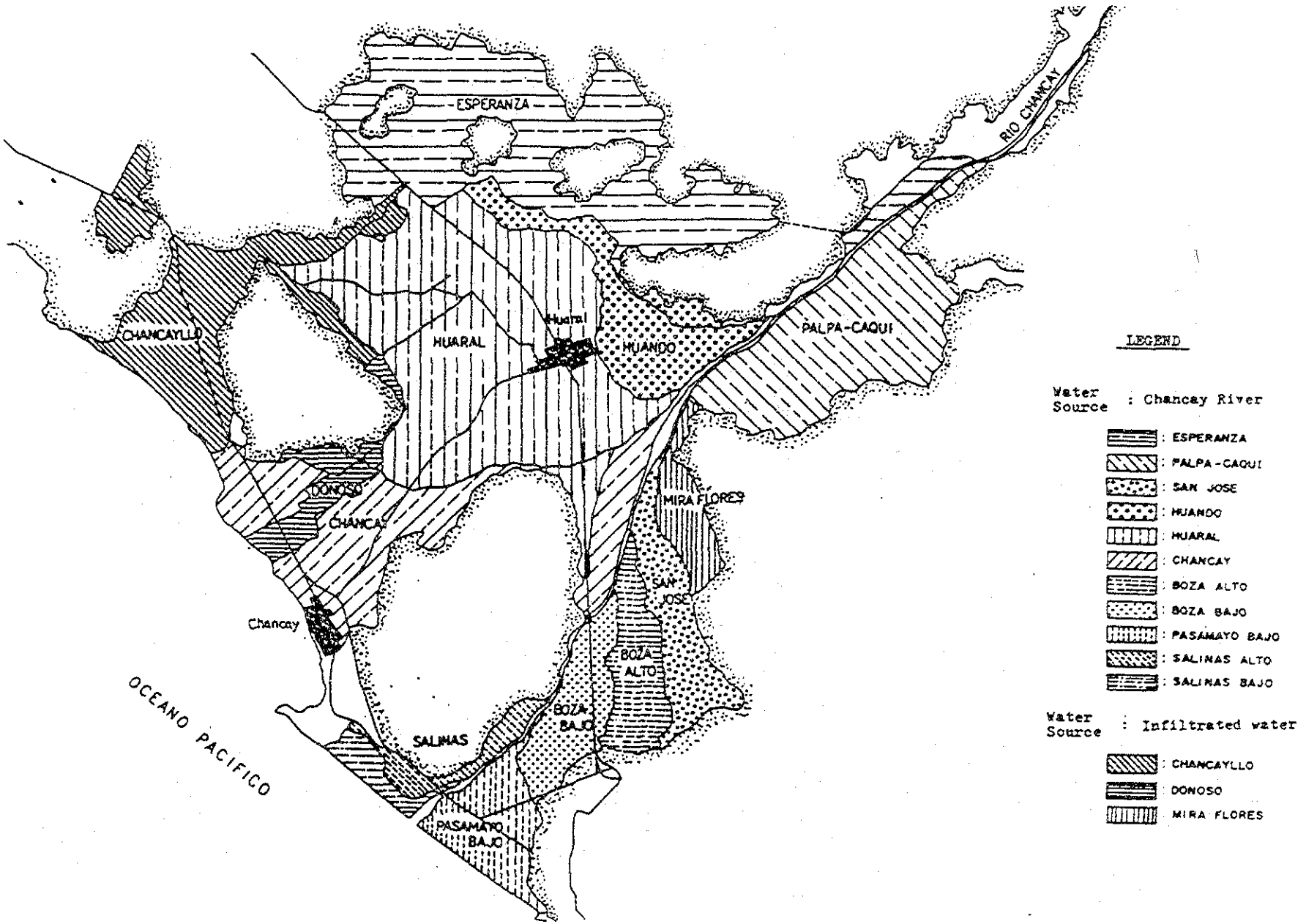
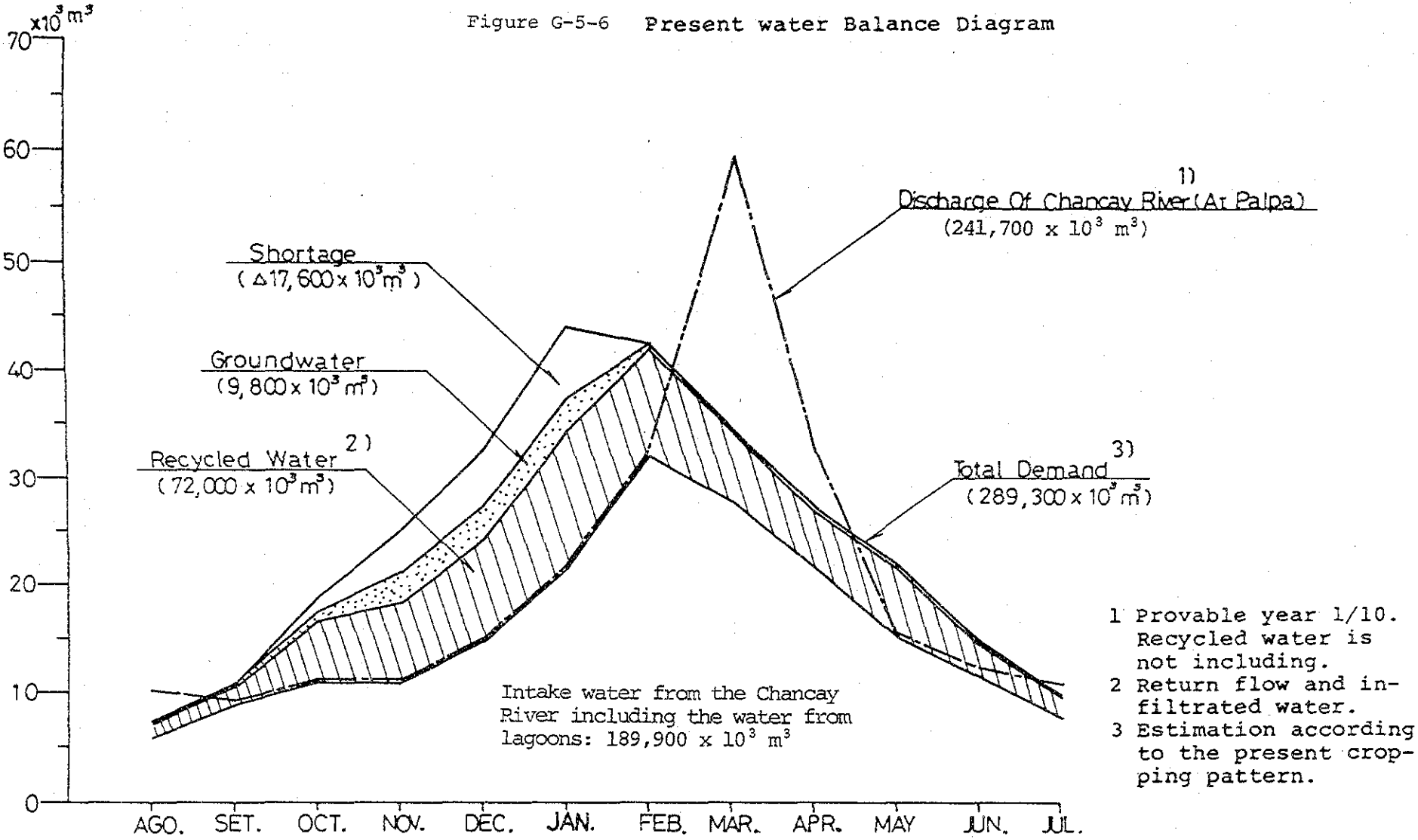
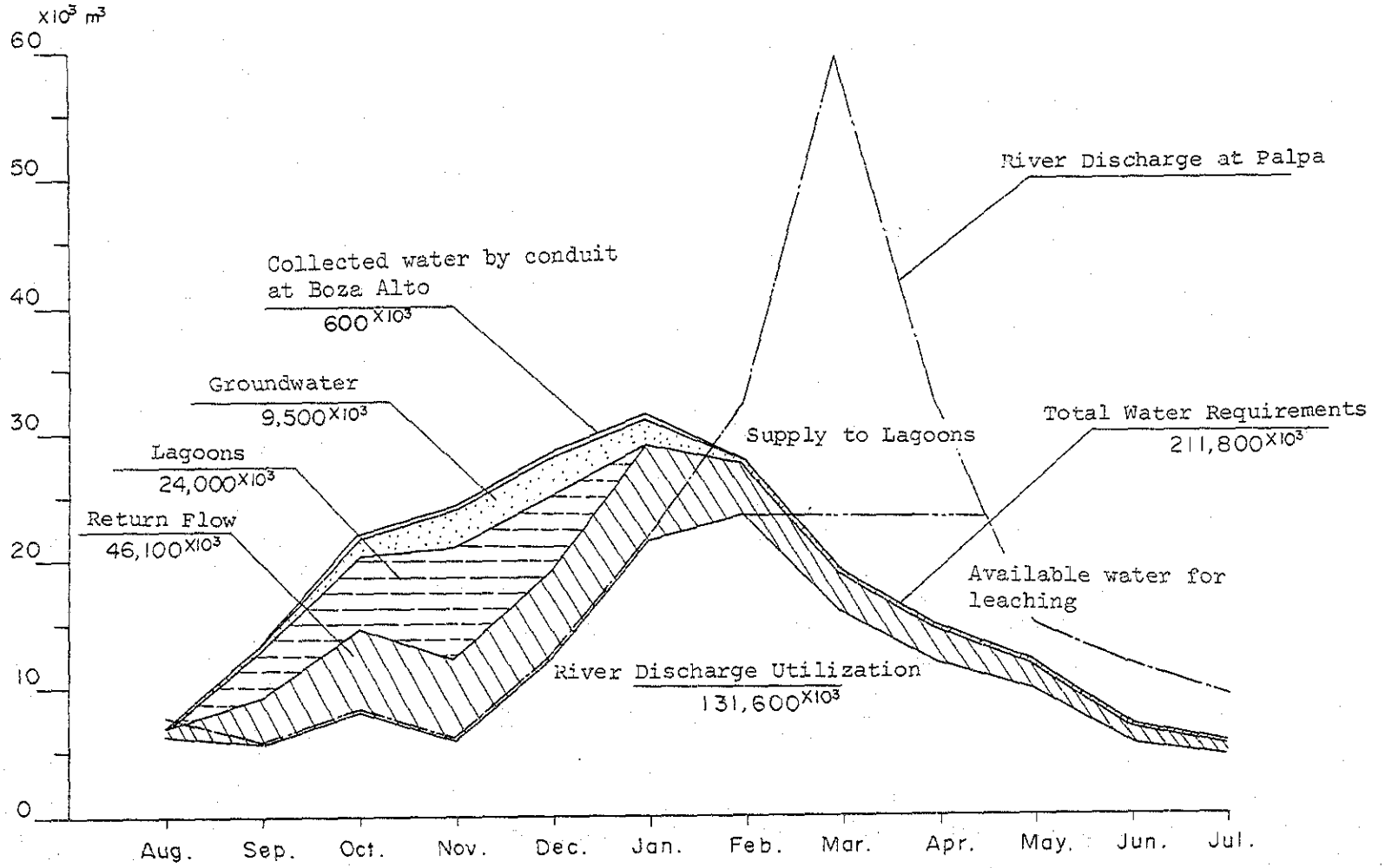


Figure G-5-6 Present water Balance Diagram



1 Provable year 1/10. Recycled water is not including.
2 Return flow and infiltrated water.
3 Estimation according to the present cropping pattern.

Figure G-5-7 Proposed Water Balance (Probability; 10 Years)



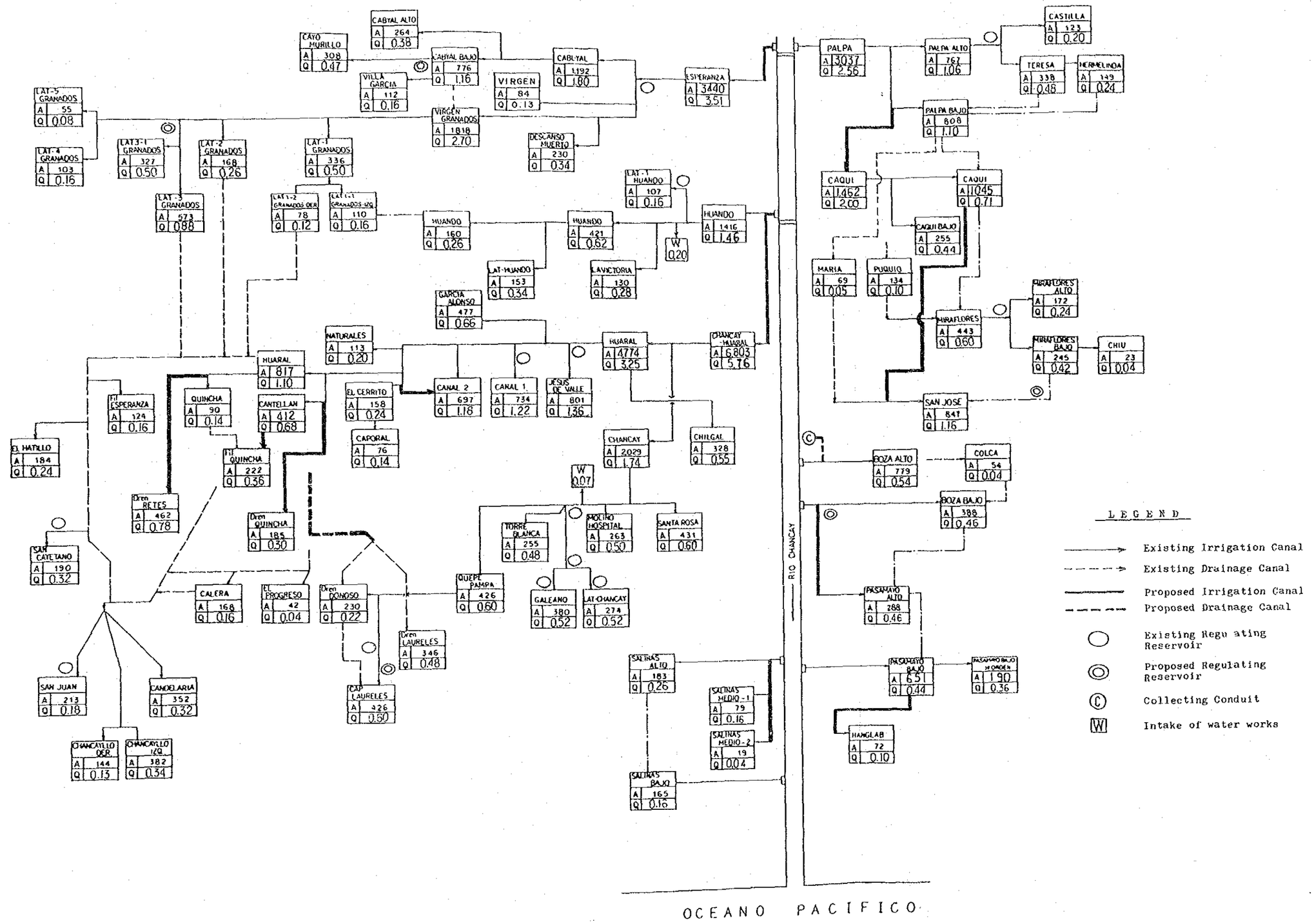


Fig. G-5-8 Modified Irrigation Network

Figure G-5-9 Distribution System (for Example)

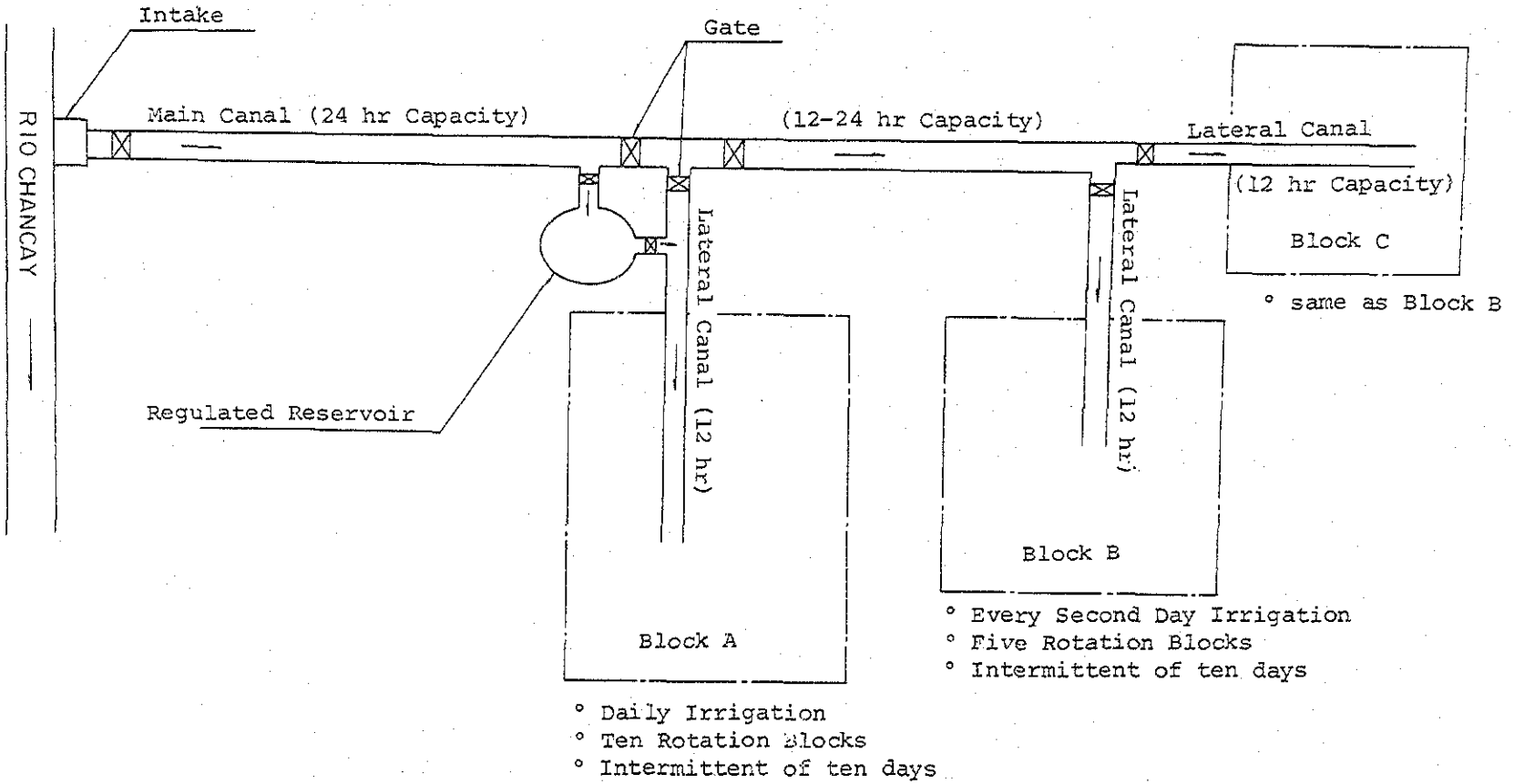


Figure G-5-10 (1) Intake Rate (Quincha)

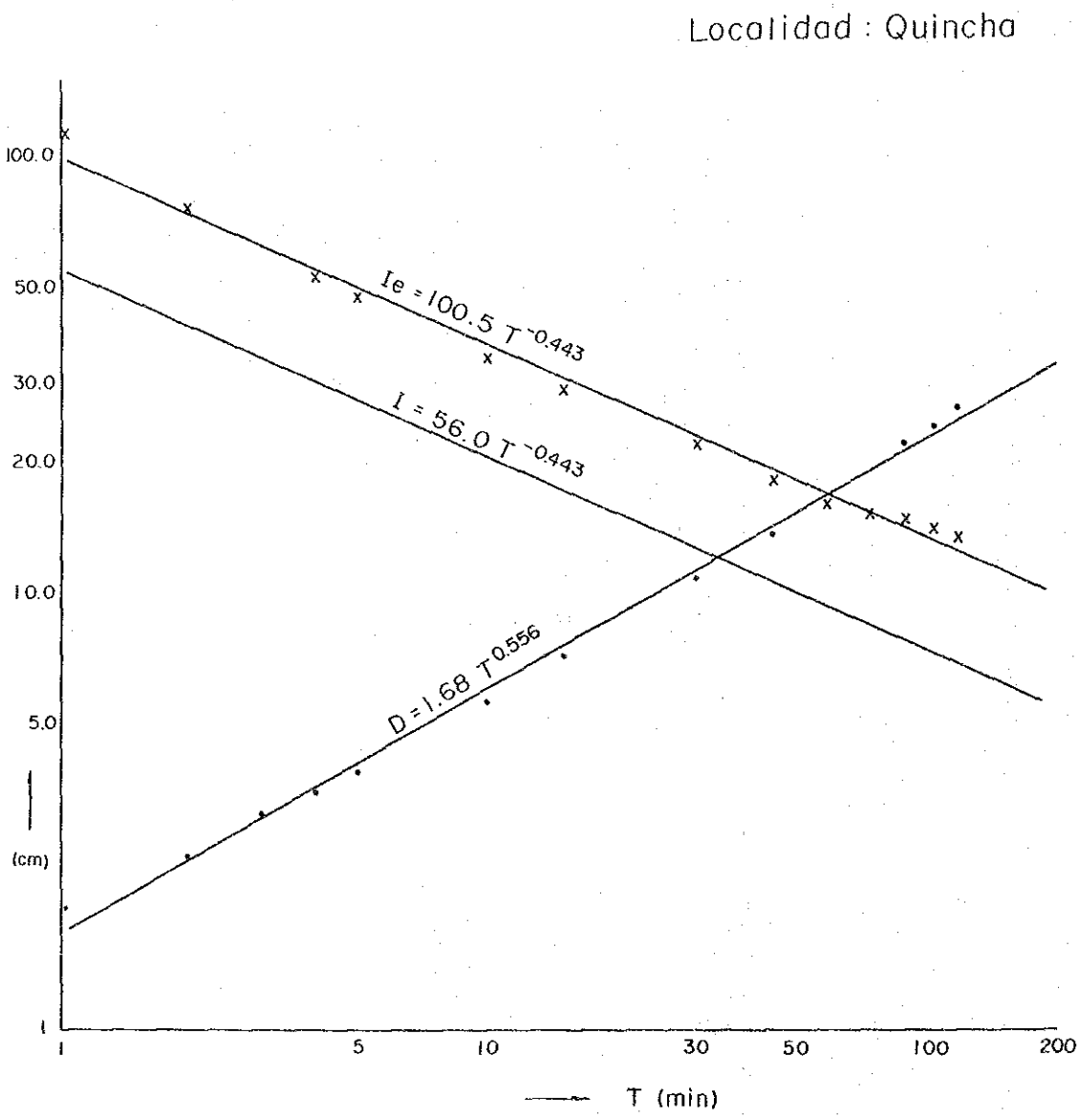


Figure G-5-10 (2) Intake Rate (Donoso)

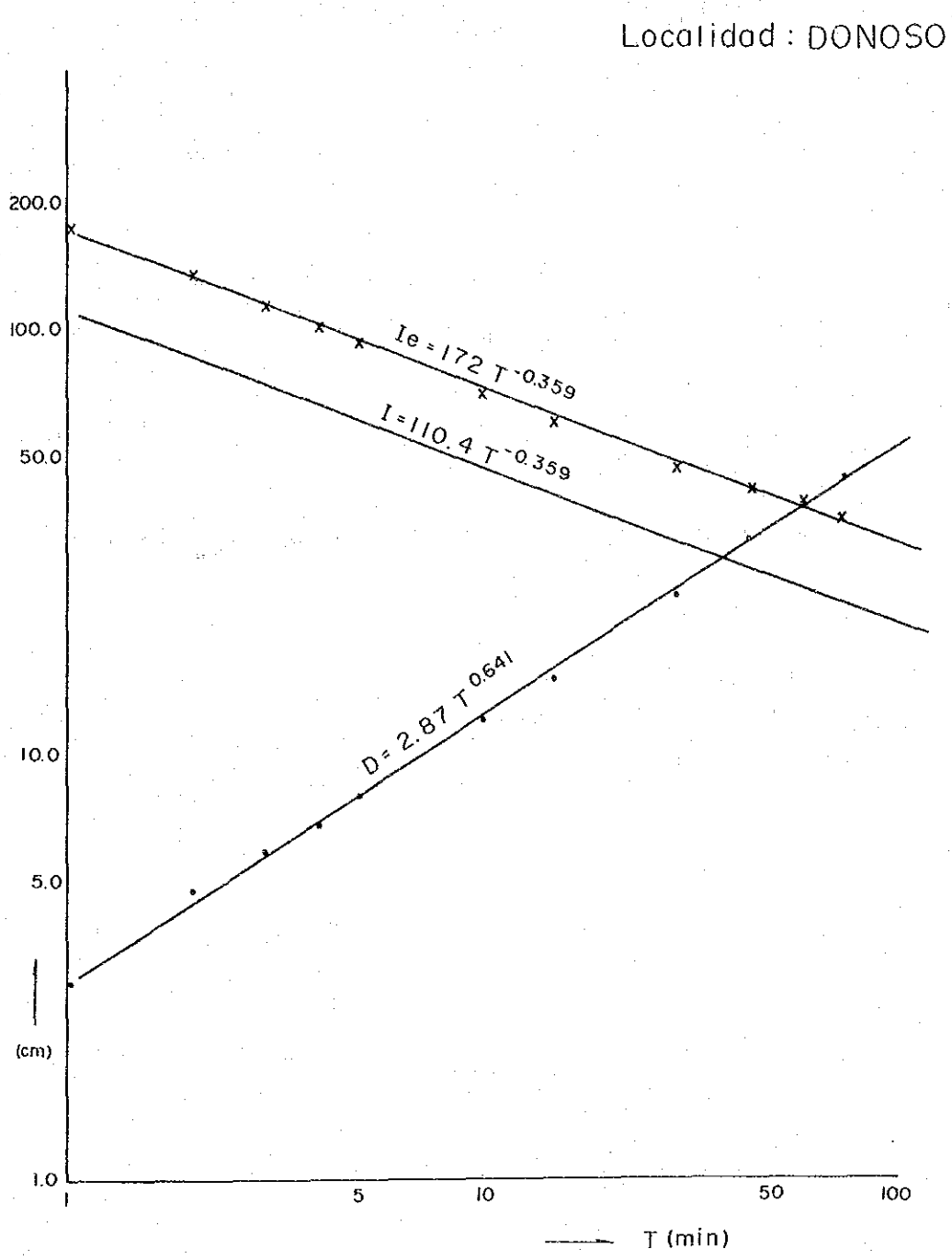


Figure G-5-11 Sprinkler Irrigation System (For Example)

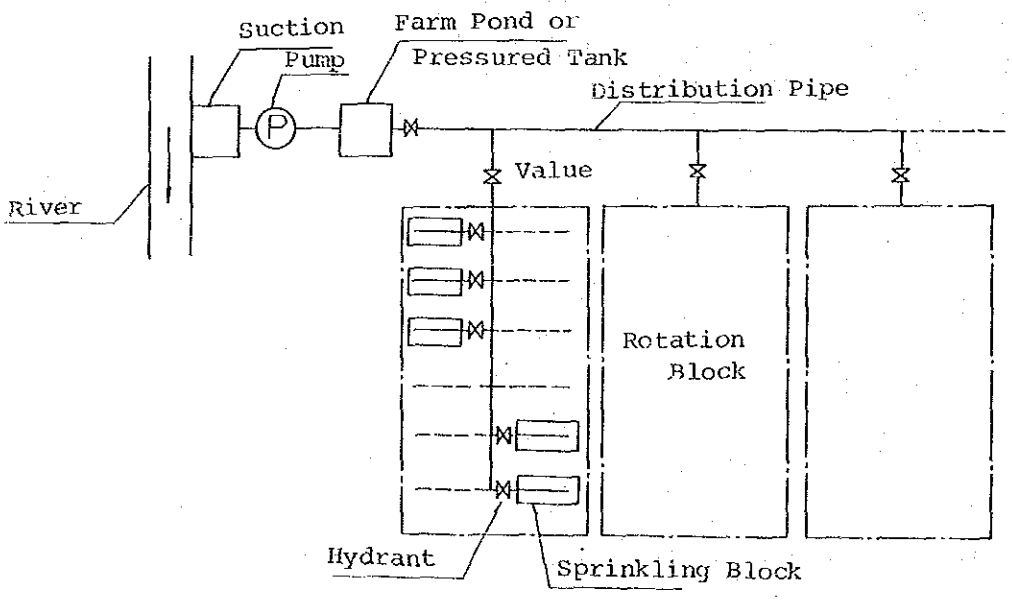
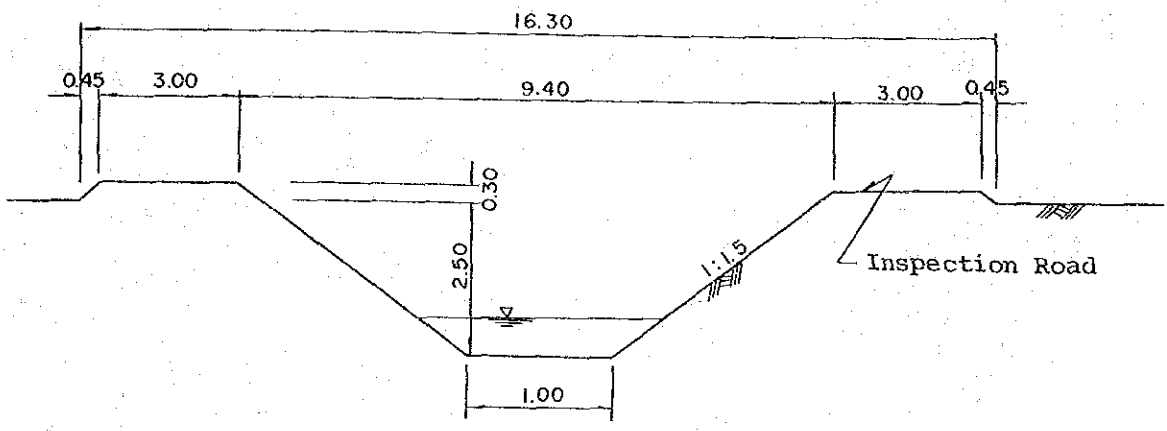


Figure G-8-1 Typical Section of Open Drain

Unit : m

Catch Drain and Main Drainage Canal



Lateral Drainage Canal

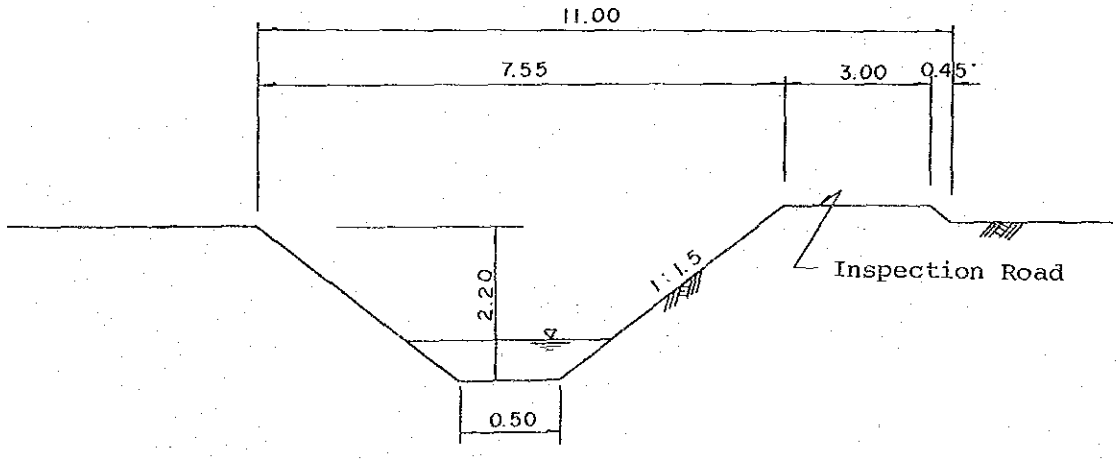
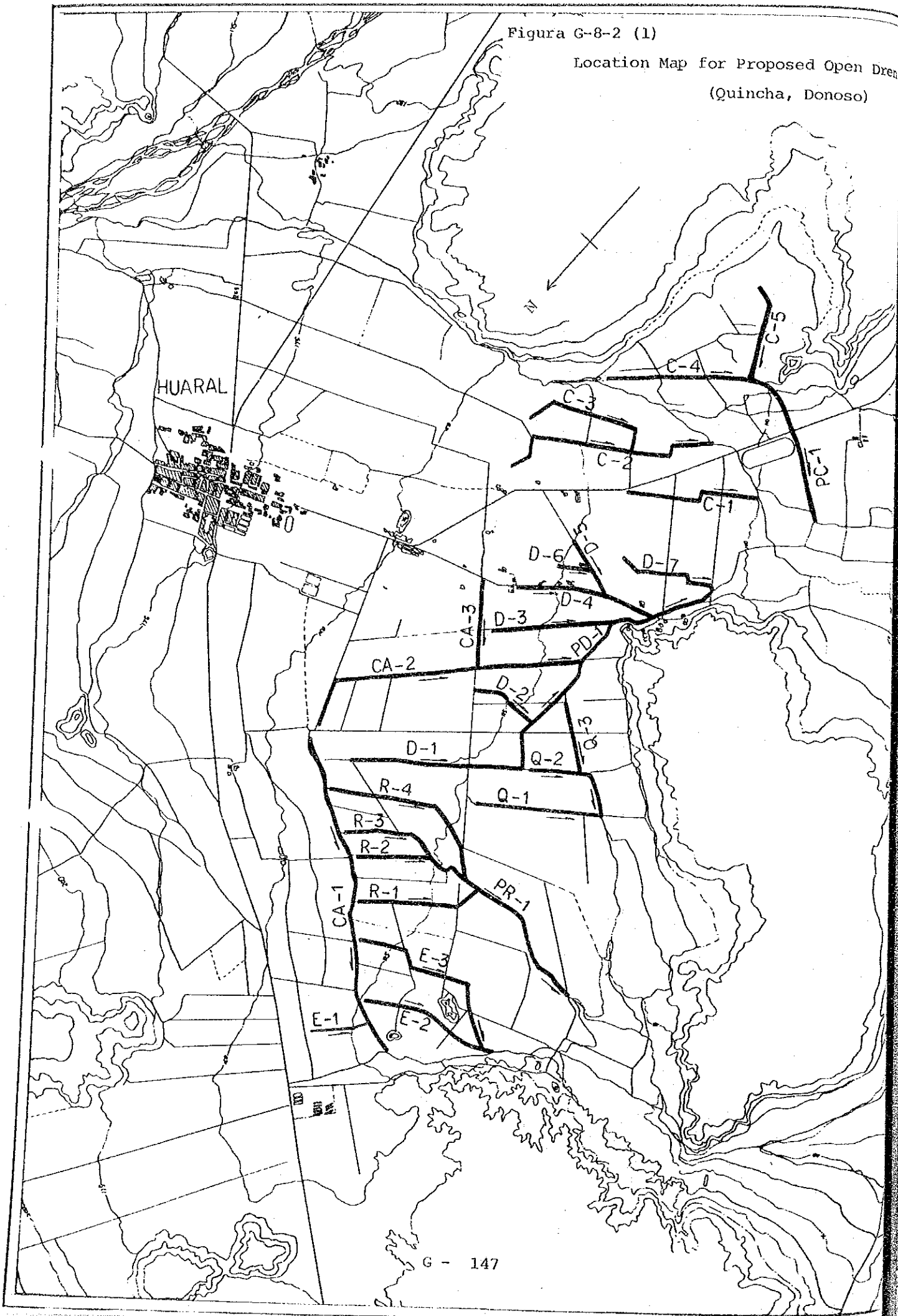


Figura G-8-2 (1)

Location Map for Proposed Open Dren

(Quincha, Donoso)



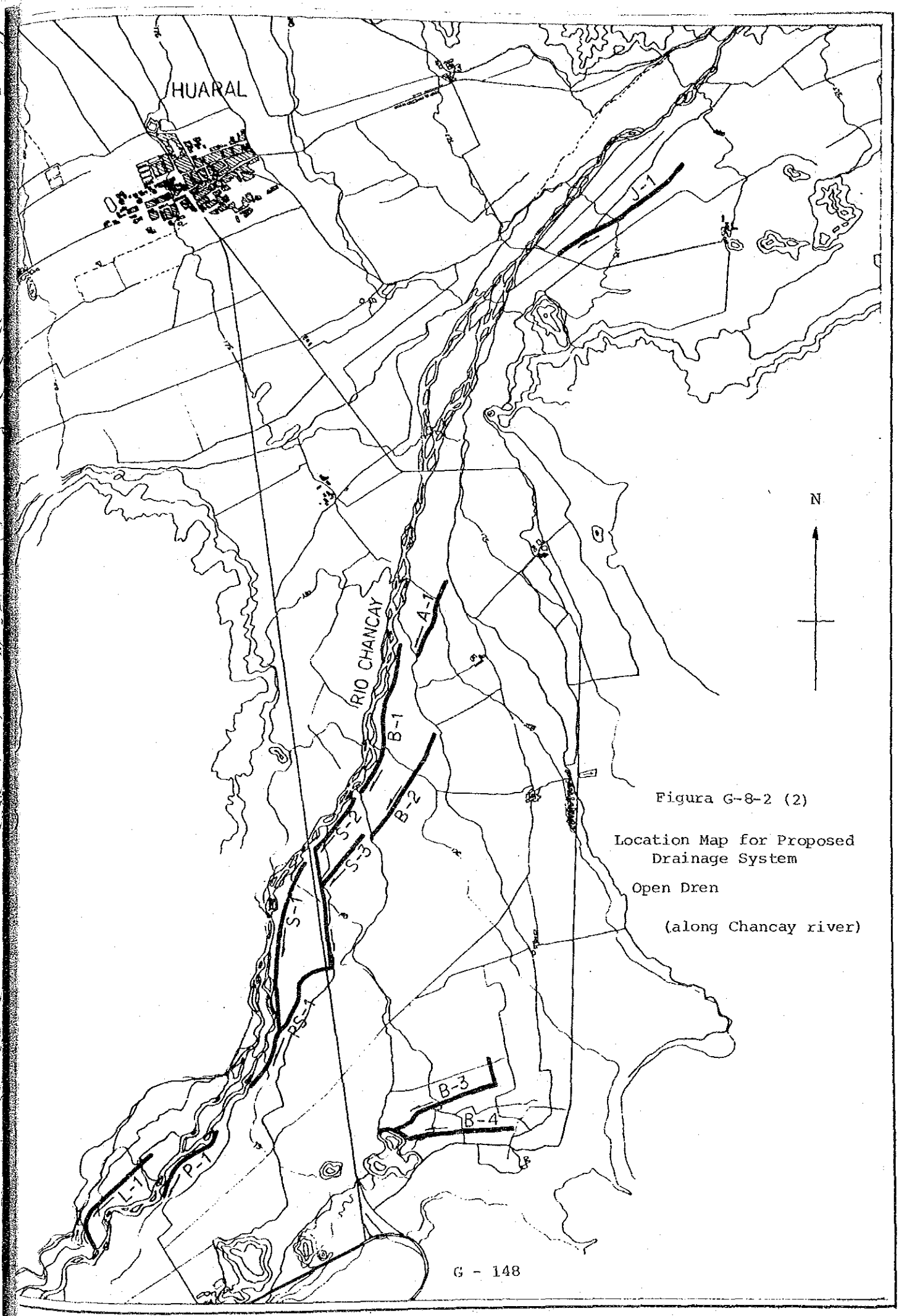


Figura G-8-2 (2)

Location Map for Proposed Drainage System

Open Dren

(along Chancay river)

Fig. G-8-3 Typical Section of drainage System

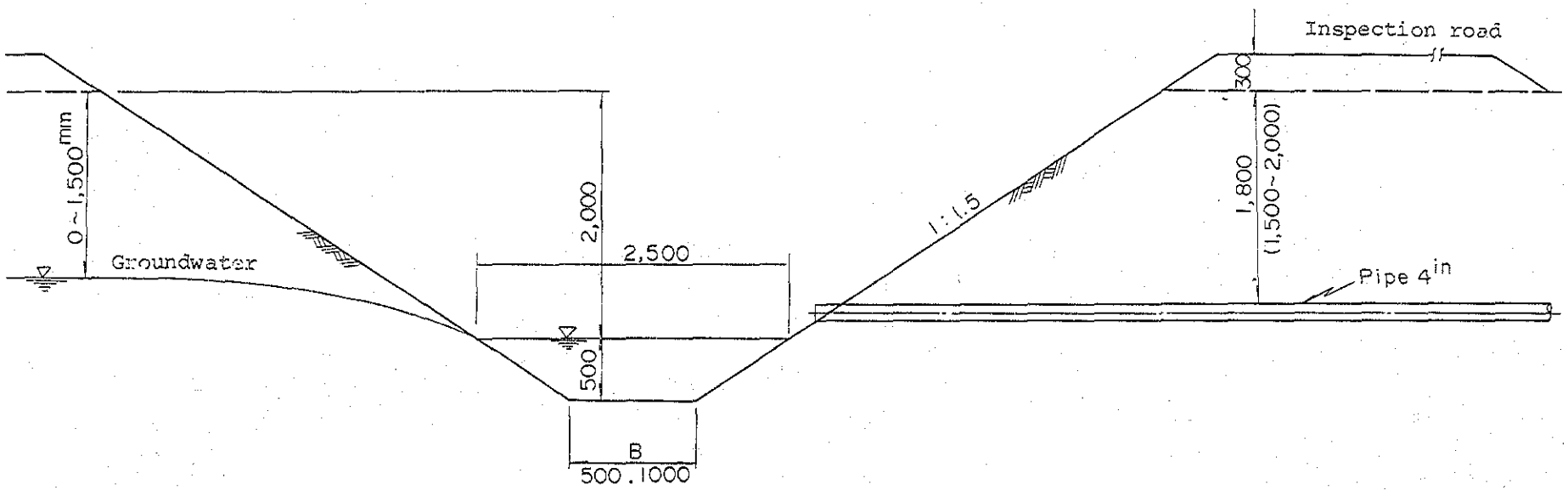
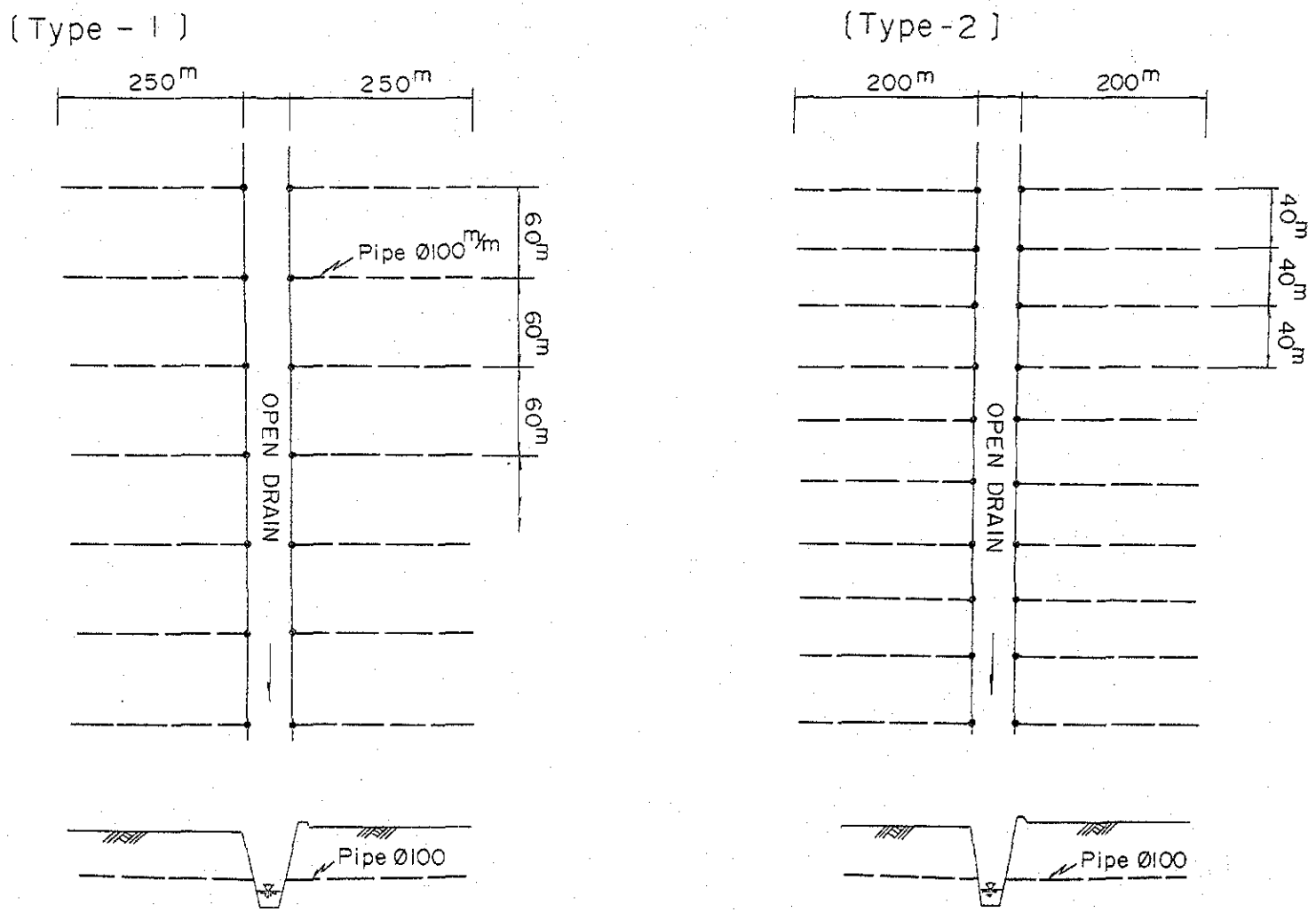


Fig. G-8-4 Typical Plan of Drainage System



ANNEX H

INFRASTRACTURE

C O N T E N T S

ANNEX H Infrastructure

ANNEX H

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ANNEX H INFRASTRUCTURE

1. General

The majority of infrastructures planned for use in the project will be rehabilitation of the existing structures. The Project area is already under cultivation. Accordingly, infrastructures including irrigation facilities have been established. However, these facilities are insufficient in number and the majority are too old to fulfill their function. Deterioration is particularly evident in the existing facilities such as intakes and certain portions of the canals. For effective use of water resources, reduced maintenance cost and increased adaptable productivity, rehabilitation of existing facilities is planned along with construction of new structures.

Major infrastructures to be rehabilitated in the Proejct area are as follows:

- Diversion works
- Irrigation and drainage canals
- Reservoirs
- Facilities for drainage improvement
- Roads and its bridges

As mentioned facilities, rehabilitation plan will be formed based on the field survey.

2. Present Condition and Problems of Infrastructures

2-1 Intake facilities

The existing intakes in the Project area are 17 in total numbers which are located both banks along the Chancay River; 9 in left bank, 8 in right bank. Among these intakes, 4 intakes are concrete structures while the others are conventional one. In the high-water season, diversion facility of Huando and intakes of Esperanza and Chancay-Huaral in the right bank and Palpa in the left bank are concrete structures and of which intake water is controlled by gates, but others are not controlled.

Conditions of the existing facilities and intake water are as follows;

- The intake structures of La Esperanza and Chancay-Huaral
  These structures are constructed on riverbed deposits and unstable site. Inlet basin and sand sluiceway are cheked and buried with sedimentation including gravels and stones during and after floods. Therefore it is difficult to divert the designed water amount. Moreover, intake and sluiceway gates are not operated properly due to deterioration of structures. Approximately 100m long of head race canal in the Esperanza diversion structure was flashed away by flood recorded in February 1984.

- Huando diversion facility and Palpa intake
  Huando and Palpa diversion weir are solid because they are constructed on the bedrock. The locaitons are suitable for taking water. However, driving canal in the riverbed is necessary due to unsatisfactory facilities.

- Caqui and San Jose Intakes
  Intakes facilities of Caqui and San Jose - Aucallama are not permanent facilities. Though these intake structures are protected with gabion and temporary dyke, they were burried with sedimentation of the rivers by the flooding in 1984. Therefore

required irrigaiton water could not be diverted.

- Other minor intakes
  Other minor intakes except above mentioned are comparatively small scale structures;
  The existing 4 intakes in right bank and 6 intakes in left bank are as follows:

  Right bank: Salinas Alta, Salinas M_1, Salinas M_2, Salinas Bajo.
  Left bank: Boza Alta, Boza Baja, Pasamayo Alto, Monte Chico, Pasamayo Bajo, Hanglar.

While the intakes location the downstream are collecting return flow which is oozed out in the river when dry season. For maintenance of the above mentioned diversion weir and intakes,a great amount of cost is usually needed to remove the large volume of stones and soil sedimented during floods due to rapid stream of the Chancay River.

Intakes is easily filled with soil and stones and the main channel of river have changed every time, so naturally, reconstruciton of during canal is necessary in riverbed. The natural open cut intakes are particularly prone to washouts when river discharge exceeds $100m^3/sec$. Concrete intakes, and related facilities are inperfect, and moreover, the structures are antiquated and incapable of controlling water during floods, occasionally resulting in suffering damage. Therefore, early rehabilitation of above is urgently required. Present condition and locaiton of the existing diversion weir and intakes are shown in Fig. H-2-1 -- 12.

2-2 Irrigation canal

Total length of irrigaiton canals in the Project area is about 340km except on farm canals. Some parts have been rehabilitated; however, some cracks occur in the concrete lined canals, fallen stones of the masonry canal is removed, and unlined canals are eroded while broken or damaged divisions are also observed. Consequently, water management in these areas is inefficient. Most of the canals, except in the lower

portion of the Project area, are alinged in coarse textured soil with good percolation, causing leakages in some parts. Therefore, lining of the canals is indispensable.

Total length of irrigation canals for each section is as follows:

La Esperanza	66.96 km
Huando	26.20 km
Chancay-Huaral	83.72 km
Chancayllo	40.40 km
Salinas	18.10 km
Palpa,Caqui,San Jose	62.96 km
Miraflores	12.17 Km
Boza	11.00 km
Pasamayo,Hangral	16.05 km
Total	337.56 km

These canals are classified into three groups as follows according to the degree of deterioration.

Group I

This group consists of masonry and lined canals where partial rehabilitation is insufficient to repair damages or to restore their former function. The same also includes functionally impaired unlined canals which were damaged by excessive erosion and related structures like divisions which are broken or damaged. They require urgent rehabilitation or improvement work.

Total canal length of Group I is about 162km and the features of each canal are shown in Table H-2-13.

Group II

Compared to group I, these canals are in good condition and can fulfil their function with adequate maintenance.

Total canal length of group II is about 102km, and features of each canal are shown in Table H-2-13.

Group III

The same consists of recently reconstructed or newly constructed

canals. They are well maintained and functioning adequately.

Total canal length of group III is about 72km, and features of each canal are shown in Table H-2-13.

Present condition of existing canals is shown in Table H-2-14.

The canals connecting with intakes along the Chancay River, on the other hand, all suffer from excessive deposits during flood. Although the same are dredged by the farmers association two or three times a year, more reliable canal maintenance is required to maintain canal function. This is especially true for canals which collect filtration water.

2-3 Reservoir

There are 25 reservoirs, including that owned by private sector in the Project area, 13 reservoirs among 15 public reservoirs are in function.

The reservoirs are filled with water at night which is used for irrigation in the day time. Total capacity of the reservoirs is 221,400m^3; however, their function is reduced by excessive deposit (according to the survey in 1984, total volume of deposit is 71,000m^3). Moreover, most inlet and outlet facilities for these reservoirs function are inadequately and are observed leakage surroundings of outlet conduit. In order to fulfill their functions, dredge, bank improvement and facilities (inlet and outlet) rehabilitation will be necessary. Present condition of the reservoirs are shown in Table H-2-15.

2-4 Drainage Facilities

(1) Poor drainage area

Drainage in the middle to lower portion of the foothills and the lower terrace of the Chancay River are of poor and the goundwater table is within 1.5m from the ground surface. The poor drainage area totals about 2,180ha. Pipe drains have been installed in part of the poor drainage area but the same is insufficient for land improvement. In addition, this area also suffers from salinity problems. Poor drainage area are shown in Table G-6-1 of Annex G.

(2) Drainage canals

Drainage canals in the Project area are unlined and their total length is about 52km. The same run along the steep natural land slope and consequently, many portions are scoured and eroded. The Experanza-Jecuan drainage canal (L = 4.20km), and Aurora canal are required urgent rehabilitation to prevent conserved upland field along the canal from damage caused by continued erosion.

Canals designated as group I in Table H-2-16 (L = 6.50km) evidence excessive erosion of the canal bed or side slope and accordingly do not function satisfactorily. Total length of group II canals is 39.3km. The side slopes of the same are slightly damaged but presently no structural problem if the canal is sufficiently maintained. Group III canals, which have a total length of 6.2 km, are used only during flood.

Present condition of existing drainage canals is shown in Table H-2-17.

(3) Flood damage

Although there are partial flood protection levee on both banks of the Chancay River, the river is generally unconfined.

The Esperanza intake as well as 3 other intakes were damaged by flood in 1984, and about 400ha of land was eroded. The Palpa area along the river has been damaged by each flood occuring since early 1970.

Total damaged area, depending flood scale, is about 290ha.

Moreover, certain portion of irrigation canal of Caqui, San Jose and Chancay Area along the river were washed away by flood in 1984. Present condition of Protection Levee in the Chancay River is shown in Table H-2-18.

2-5 Road network and bridges

(1) Road network

There are five asfalt paved roads including Panamerican highway, which has road width of 9 - 24m in the project area. Total length is approximately 56km and locaiton of the roads is as follows;

- Pasamayo - Hatillo
- Pasamayo - Huaral
- Chancay - Hural
- Hural - Huando
- Hural - Granados

Except above mentioned roads, there are all unpaved roads which are 3 to 9 meters in width and road surface is irregular. Existing raod width and length to be improved are shown in Table H-2-19.

Farm roads are arranged at center of arable land and farm boundry. According to the stady density of farm road is estimated at about 200m/ha to 500m/ha.

The density of farm road is shown in Table H-2-20.

(2) Bridges

a) Bridges crossing the Chancay River

There are four bridges (Chancay, Huaral, San Jose and Palpa) crossing the Chancay River in the Project area. Chancay and Huaral bridges are not necessary to be improved. San Jose and Palpa are used to be old

railroad bridge putting only timbers on the tracks of railroad for pasing, and its width are 2.3m and 2.7m respectively. These bridges are not only so good trafficable put also hard to pass due to damaged floorboard. Present condition of above-mentioned bridges are shown in Table H-2-21.

The bridge of San Jose and Palpa are important for daily life of people who live in dotting villages in the left bank such as Palpa, Caqui and Miraflores.

Therefore, floorboard will be replaced by steel floorboard for smooth passing.

According to traffic count, its volume is 210 cars/day (July 22, 1984) at San Jose and 180 cars per day (July 29, 1984) at Palpa. The traffic counts are shown in Table H-2-22.

b) Crossing bridge of canal

Aqueduct crossing the road has been almost superannuated and impedes the traffic. Bridges has been constructed with Slab of concrete and/or wood.

3. Rehabilitation Plan of Infrastructures

In view of the foregoing, and its actual condition, rehabilitation plan of the infrastructures will be formulated as follows.

3-1 Intake Facilities

3-1-1 Rehabilitation and unification of Intakes

In formulating an intake rehabilitation and combination plan, 5 alternatives were examined from view of technical and economical standpoint as follows;

- Unification at geologicaily and topographically stable place to intake water

- Unification for proper water management and operation and maintenance

- Unification for better use of recycle water resources, such as available collection return flow, and groundwater from the river at lower zone of the Project area

- Economical standpoint of view

Case 1 All existing intakes will be rehabilitated at their present locations.

Case 2 The intake will be unified in the present location of Cuyo intake (16km upstream from the Esperanza intake) due to its geologically and topographically stability and feasibility for installation of a both side intake.

Case 3 4 of large scale intakes ($Q > 1.0\ m^3/sec$) in the upstream area will be rehabilitated in their present locations while all of small-scale intakes located in the downstream area will be combined into 5 intakes. A total of 9 intakes will be combined

and rehabilitated.

Case 4 Three intakes, Esperanza, Huando and Chancay-Huaral, will be combined into one diversion at Palpa. In this case, a connecting canal is necessary for abolished intakes. Small-scale intakes located in the downstream area will also be integrated into one intake on the right bank and one intake on the left bank. A total of 3 diversions will thus be proposd.

Case 5 The Esperanza diversion will be unified with the Palpa intake, while the Chancay-Huaral diversion will be combined with the Huando diversion. In this case, the connecting canal (L = 5.6km) will be necessary. In the downstream, small-scale intakes will be reconstructed or combined including 2 on the right bank and 3 on the left bank, amounting to a total of 7 diversions or intakes.

Location of the diversions in each case are shown in Fig. H-3-1.

The study results of the above mentioned 5 alternatives are as follows ;

Case 1 Although water rights complications are avoided by this alternative, the number of intakes is still so many, and the maintenance cost is higher than that of the other cases.

Case 2 The cost for constrution of the connecting canal is excessive and this alternative is not considered to be economically viable.

Case 3 Same as case 1, maintenance cost is too high and not economically viable.

Case 4 Construction cost of the connecting canal (including the tunnel, between Esperanza and Huando L = 2.5km) is too high. Moreover, if 3 existing diversions are combined at Palpa the total intake capacity of the canal should be 10.73m^3/sec. In this case,

intake width shall be required about 43m and sediment into the canal would be increased due to the lack of balance between riverbed and canal bed. Therefore, this unification plan is not adequate. As for integration of 2 intakes in the lower stream, water management would also be difficult.

Case5 Integration of the Esperanza diversion at Palpa and Chncay-Huaral at Huando can allow to take stable water.

The small scale intakes downstreams (2 on the right bank and 3 on the left bank) are situated in the most effective location in terms of return flow. In addition, Case 5 is of the most economical construction cost.

Comparison of Construction Cost

(Unit price US$)

Description	Case 1	Case 2	Case 3	Case 4	Case 5
Rehabilitation cost of diversion weir	5,600,000	1,910,000	4,720,000	2,580,000	3,600,000
Construction cost for connecting canal	0	5,450,000	340,000	3,160,000	850,000
Total	5,600,000	7,360,000	5,060,000	5,740,000	4,450,000

Detailed study of construction cost is shown in Table H-3-1 -- 5.

Based on the evaluation, therefore, Case 5 is recommended for the Project. Moreover, in addition to the rehabilitation plan, collecting conduit will be set up in the Boza Alto intake area to collect the underflow water of the Chancay River, as run off water at the River during the dry season is low.

The location and intake water amount of integrated intakes and collecting conduit are shown in Table H-3-6.

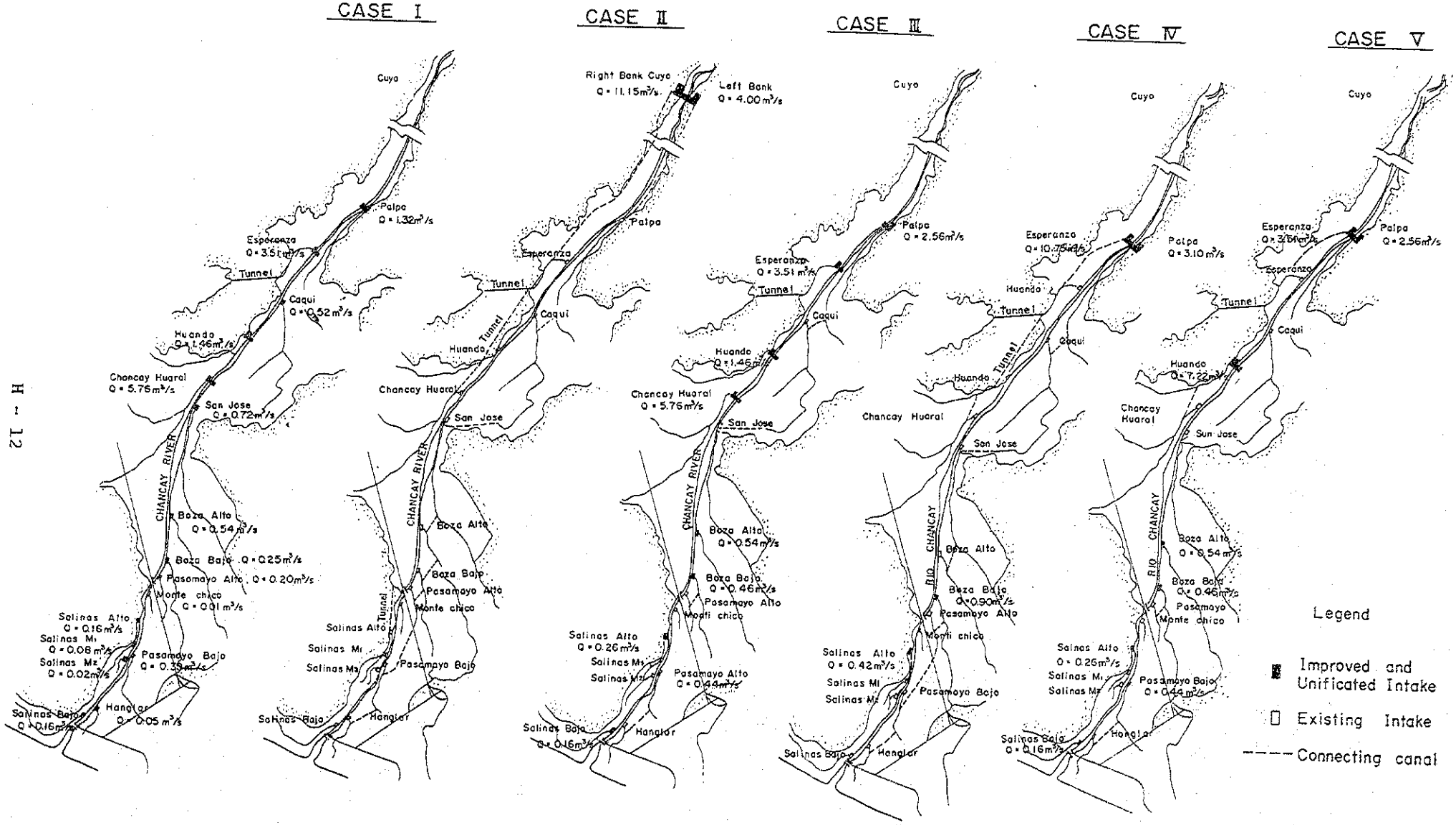


Fig. H-3-1 LOCATION OF INTAKE

Table H-3-6 LOCATION OF INTAKES AND THEIR CAPACITIES

Integrated Intake	Location	Intake Water (m^3/sec)
Palpa & Espranza	Palpa	2.56 (Palpa)
		3.51 (Esperonza)
Huando & Chancay-Huaral	Huando	7.72
Salinas Alto	Salinas Alto	0.26
Salinas Bajo	Salinas Bajo	0.16
Boza Alto	Boza Alto	0.54
Boza Bajo	Boza Bajo	0.46
Pasamayo Bajo	Pasamayo Bajo	0.44
Boza Collecting Conduit	Boza Alto	0.10

3-1-2 Diversion Weir

(1) Design flood discharge

A design flood discharge of 450m^3/sec with a probability of 50 years will be applied for the diversion wier design. Past maximum flood discharge is 480 m^3/sec in Santo Domingo. Also the same probability of flood discharge is applied by the similar projects of PE-REHATIC.

(2) Geological condition

Seismic survey was conducted at Palpa and Huando diversion sites where new diversion weirs will be proposed. The stratum is divided into three classes; namely; soil stratum where Vp = 0.43 - 0.73 km/sec, alluvium stratum where Vp = 2.21 - 2.51 km/sec and bedrock stratum where Vp = 4.29 - 5.24 km/sec.

Depth of soil stratum ranges from 2 - 4m, alluvium straum from 20 - 60m and bedrock from 20 - 100m. A diorite outcrop occurs at the diversion intakes and the dense alluvium stratum underlying the riverbed is expected to provide adequate structural support.

(3) Structure

a) Type of intake

Although the slope of the Chancay River is comparatively steep, between 1/60 and 1/80, considerablly meandering in the river course due to the shallow riverbed. Moreover, the amount of suspended substance with diameters ranging from 0.5m to fine silt is large. Generally, the normal diversion method under such conditions is the mountain torrent type (Example; Tirol type, Scoop type etc.); however, which is not suitable in consideration of flow conditions in the Chancay River, as the following reasons.

- Although riverbed slope is comparatively steep, there is no platform in the area for the mountain torrent type.

- The Chancay riverbed is shallow, and the river channel is frequently meandering in the river course.

- Flow with a large amount of suspended substance occurs over along period wet season, resulting in sedimentation at the intake mouth.

- During the dry season, the entire river flow must occassionally be diverted to obtain sufficient water for irrigation.

For the above reasons, the intake at Palpa and Huando will consist of permanent weir which will raise the intake water level A sand sluiceway will also be installed on the intake gate side to maintain the river course and reduce sediment deposit in the intake mouth. As for the Palpa diversion wier, intake structure will be installed on both the Palpa and Esperanza side. Construction of partial weir is necessary for other small-scale intakes as the design intake water amount is less than 0.7 m^3/sec.

These intake structures comprising a partial weir, sand sluiceway and intake gate are shown in Fig. H-3-2.

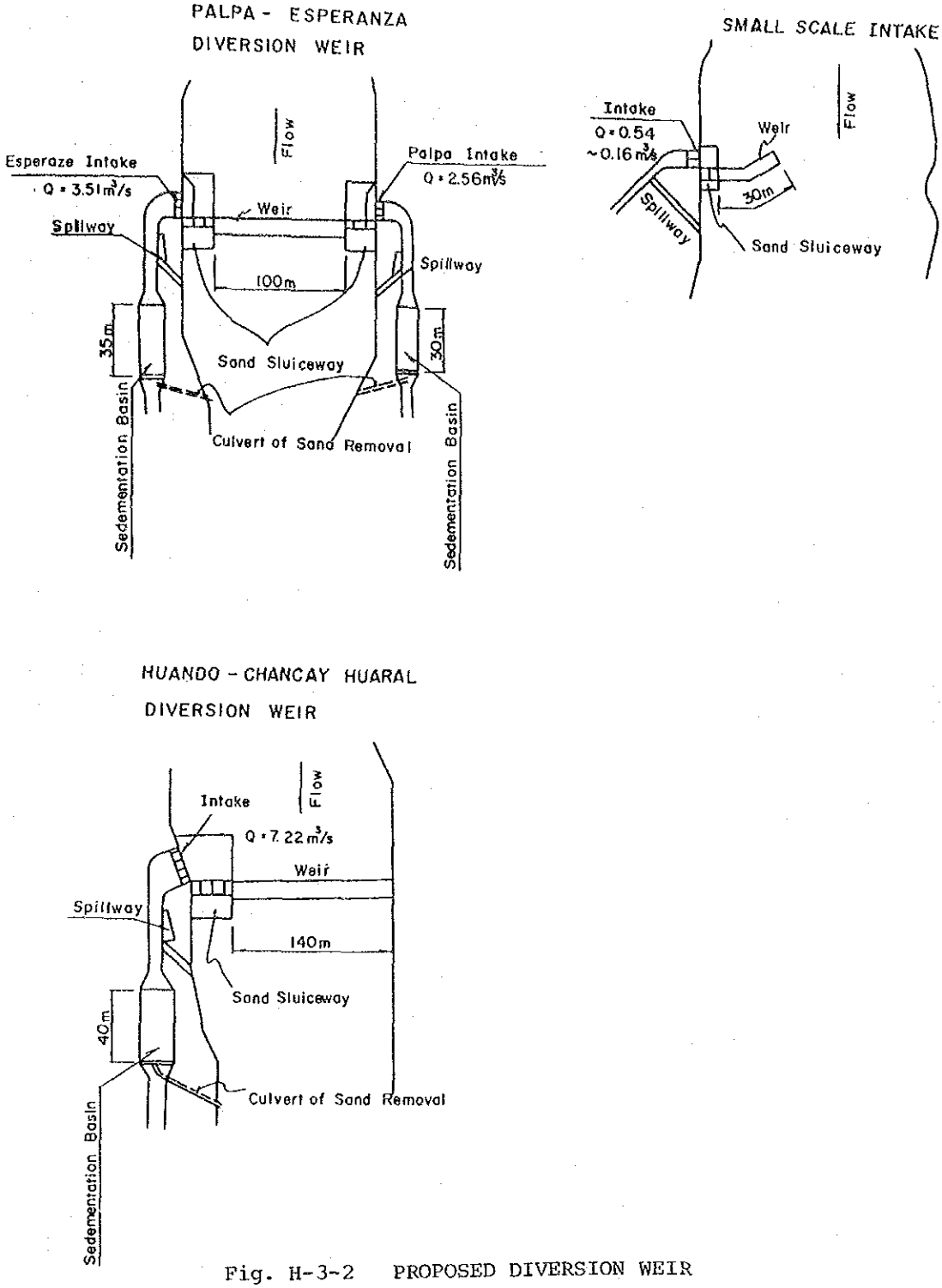


Fig. H-3-2 PROPOSED DIVERSION WEIR

(3) Design

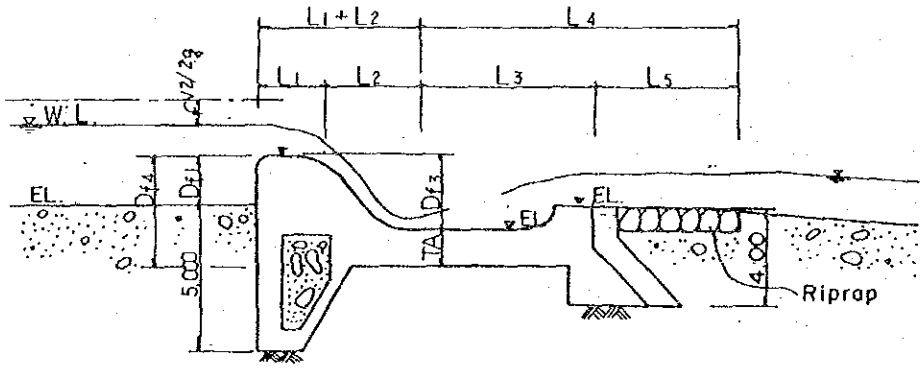
a) Fixed weir

The permanent weir will made of concrete. As the foundation rock lies at 50 to 100m below the riverbed, a floating type permanent weir will be designed. After study of the most effective hydrodynamics section, apron length and piping, the weir section will be designed according to the Bligh's formula. The downstream apron will be the water cushion type to reduce the impact of water energy and of flowing stones.

Table H-3-7 PROFILE OF PERMANENT WEIRS

Diversion weir	Height of Back water (m)	Length of Permanent Weir (m)	Overflow head (m)	Depth of overflow (m)
Palpa & Esperanza	1.70	100	1.75	1.30
Huando & Chancay-Huaral	2.00	140	1.50	1.20
Small-scale Intake	1.00	30	-	-

Standard section of permanent weir is presented below.



The dimension of permanent weir, length of apron and riprap are tabulated below.

DIMENSION OF PERMANENT WEIR

(Unit: m)

Weir	Df1	Df2	Df3	L1	L2	L3	L4	L5	TA
Palpa & Esperanza	1.7	4.2	2.7	2.6	6.0	7.0	13.0	5.0	1.5
Huando & Chancay-Huaral	2.0	4.5	3.0	2.8	6.5	7.5	13.5	5.0	1.5
Small-scale intake	1.0	2.0	1.0	1.2	3.0	6.0	9.0	3.0	1.0

Above mentioned the dimensions are calculated in Table H-3-8 and 9.

b) Sand sluiceway

The width of the sand sluiceway gate is designed at 3m to flush away deposits of 0.1m diameter in normal discharge (7.8 m^3/sec) and deposits of 0.3m diameter during floods (16.8 m^3/sec). This width also permits manual operation. Two or three gates will be installed, the number being related to the intake width. These figures are summarized below ;

DIMENSION OF SAND SLUICEWAY

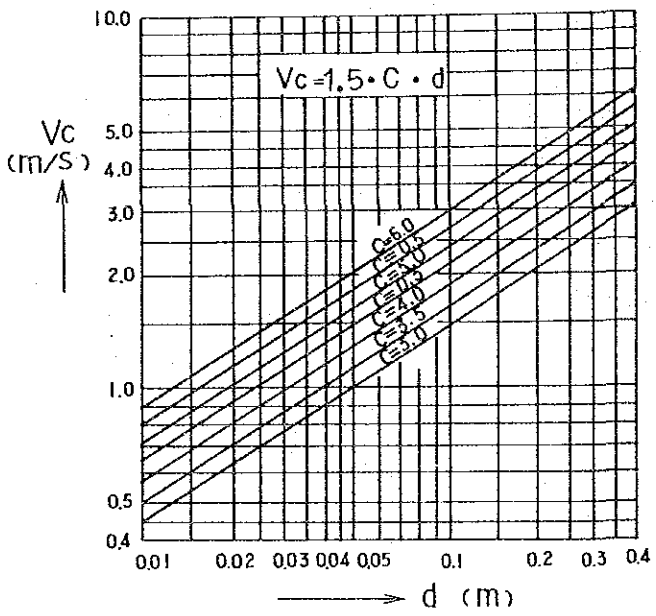
Diversion weir	Gate width (m)	Number of gates	Gate height (m)	Design diameter of Deposit (m)
Palpa &	3.0	4	1.7	0.1 - 0.3
Esperanza	2.0	2	1.7	0.1 - 0.3
Huando &	3.0	3	2.0	0.1 - 0.3
Chacay-Huaral	2.0	1	2.0	0.1 - 0.3
Small-scale Intake	2.0	2	1.0	0.1 - 0.3

i) Required velocity for flushing sedimentation through sand sluiceway

The flow velocity for flushing sand and stone is shown as follows;

Discharge Q (m^3/sec)	Grain size d (m)	Coefficient C	Velocity Vc (m/sec)
7.8	0.1	4.0	2.3
16.8	0.3	4.0	3.8

Relationship between required flow velocity and grain size is presented below.



ii) Width of sand sluiceway

In designing a width of sand dluiceway, discharge per unit width and flow velosity will be adopted.

Discharge m^3/sec	Velocity Vc (m/sec)	Discharge $q=Vc^3/g$ (m^3/sec)	Width of sand sluiceway Q/q > Bs (m)
7.8	2.3	1.3	3.0
16.8	3.8	4.4	3.0

iii) Gradient of sand sluiceway (I)

Critical gradient of sand sluiceway will be calculated by relationship between discharge per unit width (m^3/sec) and coefficient of roughness (n).

Discharge Q(mq^3/sec)	Width B (m)	Q/B(mq^3/sec)	n	$N^2g^{1.1}/q^{0.22}<I$
7.8	3.0	2.6	0.04	1/60
16.8	3.0	5.6	0.04	1/60

iv) Gate

In order to smoothly operation and washing away of sediment at the mouth of the intake, automatically operated sand sluiceway gates should be installed Palpa-Esperanza and Huando-Chancay Huaral.

c) Intake structure

A large sediment deposits will occur at the mouth of the intake as the riverbed and canal bed are at almost the same level as the existing intake. For removing sedimentation effectively, the elevation of the canal bed at Palpa and Huando will be designed more than 1.0m above the level of the riverbed, and 0.5m for small-scale intakes. In take velocity is designed between 0.5 to 1.0m/sec. A screen should be set up in front of the gate to check the driftwood in the flow, etc.

Table H-3-10 General Condition of Proposed Intakes

Intake	Intake water amount (m^3/sec)	Width of gate (m)	No. of gates	Height (*h) (m)	Intake velocity (m/sec)
Palpa	2.56	2.50	3	1.0	0.70
Esperanza	3.51	2.50	4	1.0	0.70
Huando & Chancay-Huaral	7.22	2.50	5	1.0	0.70

Small-scale Intake-I (2)	0.26	1.20	1	0.8	0.60
Small-scale Intake-II (3)	0.46	1.20	2	0.8	0.60

* h is height between riverbed (sand sluice way) and canal bed (Intake mouth)

In order to smoothly operation and control intake gates of Palpa & Esperanza and Huando & Chancay Huaral should be operated by electric motor.

d) Sedimentation basin

Sedimentation basin will be installed in headrace in case of a large scale intake; namely, Palpa, Esperanza and Huando. The minimum diameter of deposit is 0.03 cm and the gravity drainage method will be used. The dimension of the structure are as belows ;

DIMENSION OF SEDIMENATION BASIN

Intake	Width (m)	Length (m)	Depth (m)	Box culvert (m)
Palpa	6.0	30	3.0	50
Esperanza	10.0	35	3.0	40
Huando-Chancay	18.0	40	3.0	60

Outlet gate of sedimentation basin should be planed by electric motor in order to enhance utility-efficiency and the maintenance.

3-1-3 Collecting conduit

A collecting conduit will be constructed at Boza Alto intake area where surface runoff from the Chancay river becomes groundwater during

about 0.1 m^3/sec which is water demand. The collecting conduit will be installed 4 - 5m depth below ground surface and a filter will be installed around the pipeline to prevent obstruction.

$Q = 0.5 \times q \times L$

where: Q: Total amount of intake water

q = Collecting water per unit width 0.0007 m^3/sec

L = Length of perforated pipe

0.5: safety factor

$Q = 0.5 \times 0.0007 \times 300 = 0.105\ m^3/sec > 0.10\ m^3/sec$

Standard section of collecting conduit is shown in Fig. H-3-3

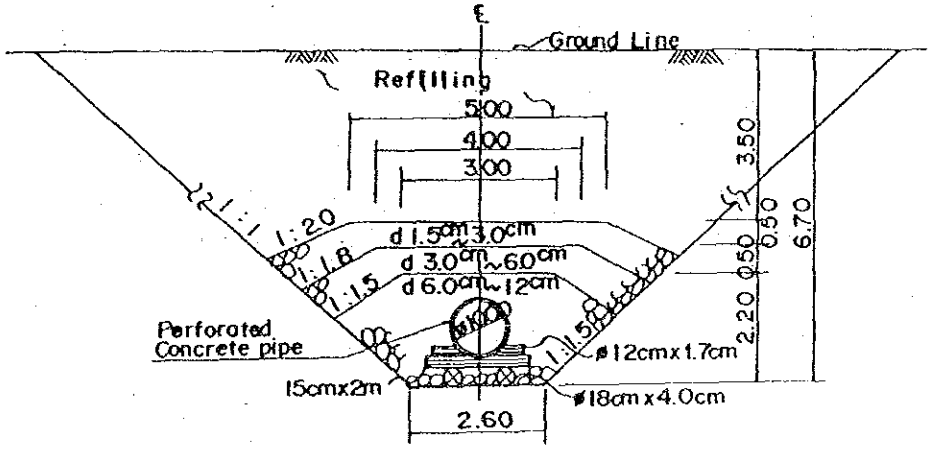


Fig.H-3-3 COLLECTING CONDUIT

3-2 Irrigation Canal

3-2-1 Length of Irrigation Canal

Among the existing canals, 39 routes canals, with a total length of 162.40km which are classified as Group I according to degree of demage will be rehabilitated to increase canal conductivity and reduce maintenance cost (See: 2.Present Condition and Problems of Infrastructures). Both the degree of canal damages and economic feasibility were evaluated in determination of the canal length for rehabilitation work.

At planning of rehabilitation for irrigation canal, naturally, to utilize infiltrated water and return flow as in the past are taken into fully consideration. (Refer to G-5-5)

Having studied on the canal structure, the structure correspond to malfunction and damaged condition would be proposed.

In particular, unlined canal in order to give full play to its ability would be proposed for canal of infiltrated water.

The new canals will be constructed as enumerate below;

Name of Canal	Length (Km)	Capacity (m3/s)	Note
1.According to the unification of intake facility			
La Esperanza Connecting Canal	4.0	3.51	1/
Chancay-Huaral Connecting Canal	1.6	7.22	2/
Sub Total	5.6		

2.According to the modification of the irrigation system

Lat. Canal 2'	1.0	1.18	3/
Dren. Quincha	2.5	0.30	4/
Dren. Retes	2.5	0.78	5/
Filt. Quincha	1.0	0.36	6/
Sub Total	7.0		
Total	12.6		

Note: - Dren Quincha and Dren Rates are placed in parallel with the existing drainage canal due to maintain potencial of water level.

- Reason of modification as change route of the existing Lat. Canal 2 is passing through the residencial area in Huaral and sawage water flow into the canal.

1/ : From the new intake to No. 0.5 of existing main canal of La Esperanza

2/ : From the Huando intake to No. 0.25 of existing main canal of Chancay-Huaral

3/ : From the cerrito to Lat. Canal 2
Irrigation area is 697 ha

4/ : Diverted from the Cantellan Canal
Irrigation area is 185 ha

5/ : Diverted from the Huaral Canal
Irrigation area is 462 ha

6/ : Diverted from the Cantellan Canal
Irrigation area is 222 ha

The canals of Palpa Bajo, Caqui and San Jose are proposed to be connected as shown on the drawing No.1 (Location Map) and the construction cost for them are included in the cost of rehabilitation for respective canal.

Tha Pasamayo Alto Canal is connected with the Bosa Bajo Canal by the reservoir, which will be newly constructed between the both canals as shown on the Draw. No.1.

As a result, the length of canals which will be rehabilitated and

newly constructed is 175 Km in total. Detailes are shown in Table H-3-12.

3-2-2 Canal capacity and canal structure

Design discharge of each irrigation canal is tabulated in Table H-3-11. Twenty-four hours operation will be implemented for both main canals and lateral canals which have reservoirs on the way to the field. Some lateral canals will be operated for 12 hours after outlet of the reservoirs. Canal discharge will be the same in the irrigation block or section (100 -- 200ha).

Existing irrigation canals have been constructed on permeable foundations, so all rehabilitated canals will be lined except those upstream of the San Jose canal, Boza Alto canal and Boza Bajo canal.

Moreover, drops in the canal bed slope will be required to maintain an adaptable velocity of the canal flow as the natural land slope is steep. Because, if a chute type canal following the natural slope is used, it is difficult to distribute at diversion site due to high velocity of 3 -- 4 m/sec. In case of a chute type canal, 20cm thickness of concrete lining will be necessary and construction cost is higher than drop type canal.

According to design discharge and design velocity, gradient of canal bed are designed as follows.

Design discharge (m^3/sec)	Design velocity (m/sec)	Gradient of Canal bed	Material
Q < 1.0	V < 1.0	1/400 - 1/900	Masonry
1.0 - 2.0	V < 1.2	1/700 - 1/1100	do
2.0 < Q	V < 1.5	1/800	Concrete lining (t = 10cm)

Based on the Design Standards No.3 of USBR, 10cm thickness is designed for concrete lining considering construction mode prevailing in

Peru and actual example implemented in similar projects of PE-REHATIC.

Features of each canal and related structures are presented in Table H-3-11 -- 12 respectively, and canal classification is as follows:

Type	Discharge	Design	Roughness Coefficient
I	More than $4m^3/sec$	Concrete lined canal (1:1.0)	0.015
II	4 -- $2m^3/sec$	Concrete lined canal (1:1.0)	0.015
III	Less than $2m^3/sec$	Masonry with mortar (1:0.5)	0.016

Adopted formula for discharge is Manning formula and typical cross sections of canals are shown in Fig.H-3-4.

Canal design study was based upon the characteristic of each canal and field study. Major canals are mentioned below.

(1) La Esperanza canal

As the Esperanza intake will be integrated with the Palpa diversion, a connecting canal with a length of 4km will be constructed.

The existing canal and connecting canal will be joined at point 500m from the existing intake, and the existing canal will be rehabilitated as far as the reservoir excluding the tunnel and sedimentation basin. Total rehabilitated canal length is 1.2km while total canal length of the new canal and existing canal is 5.2km. 18 drops, with a head of 2m each will also be constructed. Mean canal slope will be 1/1000 and mean velocity at design discharge will be maintained at 1.46 m/sec. The canal will be type II.

(2) Cabuyal canal

This canal will be rehabilitated from the starting point to its termini excluding the tunnel portion (L = 700m). Total ehabilitated

canal length will thus be 4.65km. This canal runs along the contour line and accordingly arrangement of the canal bed slope will not be required. Design discharge will be 1.8 m^3/sec and canal type III will be adopted.

(3) Cabuyal Bajo canal

The Cabuyal canal divides into the Cabuyal Alto and Cabuyal Bajo canals at its termini. Canal slope of the Cabuyal Bajo canal is excessively steep, and therefore 50 drops (head: 2m) will be constructed to maintain a canal bed slope of 1/800.

Chutes were studied; however, based on the necessity for diversion works on the canal, and technical and economical evaluations, the drop type was considered most suitable. Total rehabilitated canal length is 4.73km and canal type III will be adopted.

(4) Granados canal

This canal begins at the end of the La Esperanza canal, and total length of 15.5km.

The upstream portion, requires no improvement leaving a total length of 9.92km for rehabilitation.

Natural land slope as far as the diversion works of the 1st Lat.Granados (L = 4.04km) is steep and accordingly 15 drops (Head: 1.5m) will be constructed and design discharge will be 2.7m^3/sec. The canal bed slope will be 1/800 and canal type II will be adopted. From the 1st Lat. Granados to the canal termini (L = 5.88km) canal bed slope will remain unchanged (I = 1/1500) and canal type II will be adopted.

(5) Huando canal

Irrigation water for the Huando section and Chancay-Huaral section will be introduced at the Huando intake. A length of 950m in the upstream portion of the Huand canal will require reconstruction for both

irrigation sections. Design discharge will be 7.22 m^3/sec and canal type I will be adopted. The canal will be rehabilitated from the divergent point resulting in a total rehabilitated canal length of 12.05km. Canal rehabilitation will not be undertaken within the residential zone (L = 350m). Design discharge will be changed at the three main diversion works to 1.46 m^3/sec, 0.62 m^3/sec and 0.26 m^3/sec, respectively. To achieve a canal bed slope of 1/900 to 1/700, 40 drops will be constructed on the canal. Canal type III will be adopted.

(6) Chancay Huaral canal

As for the Chancay-Huaral section, irrigation water will be introduced at the Huando Intake, connecting canal will be constructed as far as the existing canal (L = 1.6km). Design discharge is 5.76 m^3/sec and canal type I will be adopted. The connecting canal will join the existing canal 0.25km downstream from the Chancay-Huaral intake and irrigation water will be distributed via diversion works into the Huaral and Chancay canals. 15 drops will be constructed for a canal bed slope of 1/1300.

There is 13 m ground level difference in this profile, it is considered that the small scale hydro-power station will be able to install at this place.

(7) Huaral canal

The Huaral canal divides into the Jesus del Valle canal and the Garcia Alonso canal in front of the Jesus del Valle Reservoir 2.50km downstream from the Chancay-Huaral diversion works. Upto this point, design canal capacity is 3.25 m^3/sec. The canal bed slope is designed at 1/900 and 22 drops will be constructed (head: 2m). Canal type II will be adopted. From 6.25km downstream to 9.32 km, design discharge is 1.10 m^3/sec and canal type III will be adopted. From 9.32 km downstream to the end of the canal, reconstruction is unnecessary as this section was constructed recently. Total rehabilitated canal length will therefore be 9.32 km, and total number of drops will be 40 to allow a canal bed slope of 1/900 -- 1/700.

(8) Chancay canal

From the Chancay-Huaral diversion works, this canal extends to the Buena Vista Reservoir which is located 11.67 km downstream. Design discharge of the canal is 1.67 m^3/sec and canal type III will be adopted. 61 drops will be constructed for a canal bed slope of 1/1000. At 1.75 km downstream, the Sta. Rosa canal divides. At the end of the Chancay canal, irrigation water is distributed to the Galeano and Quepepampa canals. Inipa drainage canal will be joined to the Quepepampa canal.

(9) Palpa canal

In the Project, irrigation water for the Palpa area, Caqui area and San Jose area will be diverted at the Palpa Intake. Irrigation water for the San Jose area comes through the Palpa Bajo and Caqui canals and at the end of the Caqui canals irrigation water is diverted into the San Jose canal.

Design discharge of Palpa canal is 2.56 m^3/sec from Palpa intake to the Palpa diversion works (L = 180 m) and canal type II will be adopted. At 180 m downstream, this canal divides into the Palpa Alta and Palpa Baja canals. Total canal length of Palpa Alta for planned rehabilitation is 6.87 km. The Palpa Reservoir is located at the end of Palpa Alta canal. 16 drops will be constructed in the latter for a canal bed slope of 1/700.

Design discharge of the Palpa Baja canal is 1.55 m^3/sec up to the diversion works at Caqui canal and length of this portion is 5.3km. Canal type III will be adopted with construction of 25 drops planned for a canal bed slope of 1/900.

Canal length is 8.11 km from the Caqui diversion works to the end of the canal, and design discharge is 1.1 m^3/sec. Canal type III will be adopted and 31 drops will be constructed for a canal bed slope of 1/700.

(10) Caqui canal

Irrigation water for the San Jose area is also conveyed by the Caqui canal, and design discharge of the same is 2.00 m^3/sec upstream (L = 2.75km) and 1.42 m^3/sec downstream (L = 7.9km).

Design canal bed slopes are 1/700 upstream and 1/900 downstream. Drops will be constructed according to these slopes with 8 drops upstream and 29 downstream. Canal type III will be adopted.

(11) San Jose canal

As infiltration water is collected in the upstream portion of this canal, unlined canals is recommended for a length of 3.5km. The downstream portion will be lined to end of the canal covering the remaining length of 6.9km. Design discharge is 1.16 m^3/sec and canal type III will be adopted. 19 drops will be constructed for a canal bed slope of 1/800.

(12) Boza Alto canal

Collecting conduit will be installed at upper part of the Boza Alto intake. Upstream of this canal also has a function for collecting water, so canal will be be unlined up to point 2.5 km downstream then it will be lined to the end of the Canal type III. Design discharge is 0.54 m^3/sec, and 15 drops will be constructed for adjusting canal bed slope at about 1/600.

(13) Boza Bajo canal

Irrigation water for the Pasamayo area will be diverted at Boza Bajo Intake.

The Pasamayo Alto canal being at 2.9km downstream. Design discharge is 0.46 m^3/sec up to this point. From this point to the end of the canal (L = 2.4 km), design discharge is 0.46 m^3/sec and canal type III

will be adopted. As infiltration water is collected in the upstream portion of this canal, unlined canals is recommended for a length of 2.5 km. New regulation reservoir will be constructed near the distribution point to the Pasamayo canal.

(14) Pasamayo Bajo canal

In the Project, irrigation water for the Hanglar area will be diverted at the Pasamayo Bajo intake. The Hanglar canal will be divided from the Pasamayo canal at the point of 1.1 km downstream from the intake. Design discharge is 0.44 m^3/sec up to this point. Total canal length to be rehabilitated will therefore be 4.8km. After the division works, design discharge is 0.32 m^3/sec.

(15) Salinas canal

Three intakes will be integrated at the Salinas Alto Intake. Design discharge of the Salinas Alto canal is 0.26 m^3/sec. Total rehabilitated canal length is 2.0km and canal type III will be adopted.

3-2-3 Drop structure

The components of a drop structure are the inlet, the veritcal overall seciton and the outlet. The minimum width of the inlet of a drop structure is equal to the bottom width of the irrigation canal. Water falls into a stilling basin, which is an essential part of an erosion control structure.

The length of the stilling basin is nearly 0.95 -- 1.43 times the height of the drop. Drop structures often set up eddy currents in the irrigation stream and these currents tend to cause erosion of the canal section immediately down stream from the structure, so that it shall be necessary detail hydraulical check in detail design stage.

There are many small drop structures to no purpose in the Project area, and also they are insufficiency of depth and length of stilling basin which cause of damage. Specially in the Cabuyal Bajo canal, all

of the drops are too damaged by high speed stream, so it will be necessary all reconstruction. Each drop should be located in an adopted place that maximum height of a drop is less than two meters.

(1) Number of drop

The number of drops has been estimated in consideration of the present and proposed slope based on the topo-map (1:10,000) made by PE REHATIC (Refer to Table H-3-12).

(2) Type of drop

The type of drops will be decided by the topographical condition, economic construction, hydraulic condition, drop head and discharge in the canals, etc.In this Project, the drop head and discharge are not so large, therefore, the stilling pool type is recommendable.

Type of drop	Discharge (m^3/sec)
I	6.0 - 4.0
II	4.0 - 3.0
III	3.0 - 2.0
IV	2.0 - 1.0
V	1.0 - 0.5
VI	0.5 - 0.2

3-2-4 Distribution devices

Existing distribution devices are made of concrete, and irrigation water is distributed and regulated by sluice gates. Besides, there is parshall flume on a comparatively large scale division, which has been maintained by the Administracion Tecnica del Distrito Riego Chancay-Huaral. There are some distribution devices which had been improved in these years, though most of them are too old and be required to reconstruct. Distribution devices facilities are to be designed according to capacities to be regulated, and will be provided according to the installation criteria as shown in Table H-3-13.

Table H-3-13 INSTALLATION CRITERIA OF DISTRIBUTION DEVICES

Type (m^3/sec)	Required facilities	Number	Remarks (approximately distributed capacity) (m^3/sec)
Distribution device-I	2 Sluice gate and parshall flume	59	$0.5 \leq Q$
Distribution device-II	Check gate and intake gate	60	$0.1 \leq Q < 0.5$
Turnout	Intake gate	*	$Q < 0.1$

* Turnout are installed five numbers per one kilometer on the average.

3-2-5 Geological condition

Canals and related structures are comparatively small-scale structures and accordingly, there will be no problem in the foundation of the same.

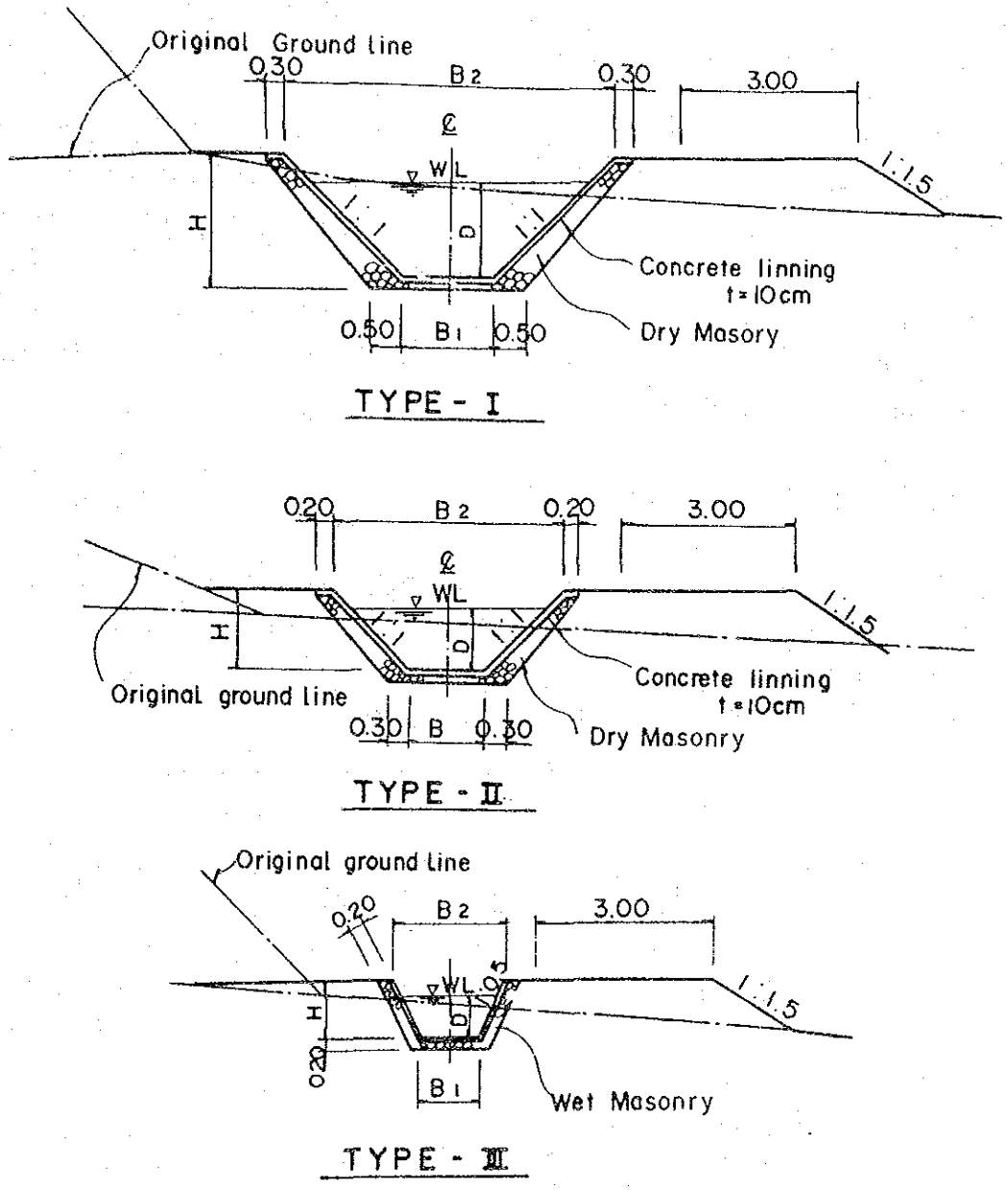


Fig. H-3-4 TYPICAL CROSS SECTION OF CANAL

3-3 Reservoir

3-3-1 Improvement of existing reservoirs

For the irrigation plan, all reservoirs will be dredged and the storage capacity of six reservoirs will be increased to provide the irrigation water requirement. Total storage capacity will be 250,000 m^3 with the capacity of each reservoir as shown in Table H-3-14. In addition, as inlet and outlet gates have deteriorated greatly, the same will be improved, while the head race canal of the Palpa reservoir will be sectionally changed to raise the storage water level.

3-3-2 New reservoirs

Five more new reservoirs will be constructed in irrigation water shortage areas, namely, Esperanza Baja, Aucallama, Chancay and Los Laureles. Total storage capacity will be 92,000m^3, details of which are presented in Table H-3-15. As the reservoirs will be constructed on a permeable foundation, concrete lining of the inside slope and Pond bed (t = 5cm in thickness) is recommended.

Table H-3-15 CAPACITY OF NEW RESERVOIRS

Reservoir	Location	Required capacity (m^3)	Design capacity (m^3)
Granados 1	Esperanza Bajo	13,850	16,900
Granados 2	Esperanza Bajo	18,800	21,700
Aucallama	Aucallama	16,420	19,200
Los Laureles	Laureles	12,700	14,700
Boza Bajo	Boza	14,510	19,200
Total		76,280	91,700

3-3-3 Geological condition

As the reservoir foundations are laid upon river terrace, sufficient bearing power for structural is expected. River terrace consists of gravel, sand and loam.

However soil deposits in the reservoir and local soils which will be used for bank materials have a high silt content. Therefore, material test and careful selection of construction method will be required.

3-4 Improvement of Road

3-4-1 Road network

As road network in the Project area to consolidate main road and secondary road will be proposed. These road network will be utilized mainly for transportation of agricultural inputs and farm outputs.

Under the road improvement plan, 6 main roads and 25 secondary roads which connect the main roads to villages will be improved.

Improvement will mainly involve rehabilitation of existing roads which will be arranged sectionally extended in which are paved with gravel.

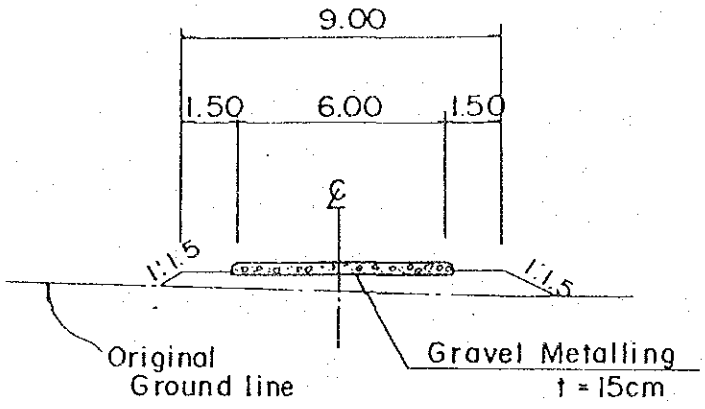
Length of road to be consolidated will be schemed about 49 km the main road and 125km secondary road respectively.

The length and location of each road are shown in Table H-3-16 and 17. Structure and dimension of consolidated road will be planned with the following design criteria.

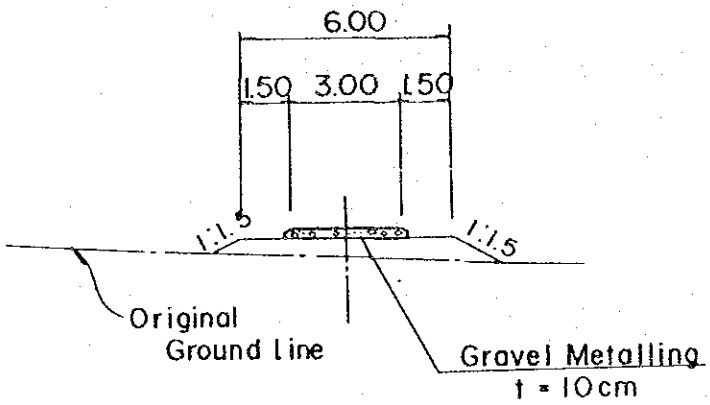
DESIGN CRITERIA OF ROADS

Kind of road	Dimension of Structure	
Main road	Gravel pavement: width	6.0m
	: depth	15 cm
	Shoulder : width	1.5m
	Total road width	9.0m
Secondary road	Gravel pavement: width	3.0m
	: depth	10 cm
	Shoulder : width	1.5m
	Total road width	6.0m

Typical cross section of roads are shown below ;



Main Road



Secondary Road

Fig. H-3-5 Typical Cross Section of Road

2) Bridges

i) San Jose and Palpa bridges

The bridge of San Jose and Palpa are of importance as necessities to the living road of people who live in dotting villages in the left bank such as Palpa, Caqui and Miraflores. Huaral bridge is utilized for transportation of agricultural inputs - and farm outputs in the Project area.

As mentioned two bridges are paved by of timbers for passing traffic, and due to the poor condition of the same for transport, rehabilitation works is urgently required.

Therefore, floorboard will be changed to steel floorboard for smooth passing.

Small scale bridges crossing over canals made of wood or concrete which have been deteriorated will be rehabilitated by concrete slab. Table H-3-18 presents the details of the bridge rehabilitation plan.

Table H-3-18 DIMENSION OF BRIDGE

Bridge	Length (m)	Width (m)	Rehabilitation works
Palpa bridge	109.0	2.7	Wooden boards will be replaced by steel floor-board
San Jose bridge	129.0	2.3	ditto
Main road bridge	8.5-2.7	7.0	Concrete slab type
Secondary road bridge	8.5-2.7	4.0	ditto
Farm road bridge	8.5-2.7	2.5	ditto

3-5 Drainage Facilities

3-5-1 Flood protection

1) Plan of levee

Flood protection embankments will be constructed at Palpa and Chancay-Huaral as these areas are frequently damaged by floods and portions of canals have been washed away.

In order to defend the arable land from flooding, protection levee will construct and overflow section which is distinguished by the survey. Total length of the levee is 13.5km.

In this case, design height of protection levee is schemed by $450m^3$ per second in probability of 50 years.

The location and length of protection levee are shown in Table H-3-19.

2) Structure

Existing protection levee has constructed by concrete wall, masonry and gabion, etc. Concrete wall has tumbled by erosion in case of shallow depth foundation and gabion is destroyed by cutting of warpping wire. However, masonry, which is laid by 1.0 to 1.5m in diameter of stone, is not swept a way and is comparatively stable levee.

Taking into account condition of existing protection levee, depth of foundation for concrete wall will be necessary at least 2.0m, and embankments with lining of rock or gabion will be constructed using locally available rock material. Some rocks may also be obtained from road improvement work in the Esperanza area.

The typical sections of proposed levees are shown in Fig. H-3-6. The types of levee are applied corresponding to the conditions of the behind area of the same. Further the type III to use gabion has disagreeable point in the aspect of durability. However, protection for erosion of farm land along the river and improvement of farm land with sedimentation which inundate to farm land by superficial foodings would be adopted as follows:

TYPE OF LEVEE

Type	Length (km)	Location
Concrete levee (Type I)	1.5	Palpa
Stone block levee (Type II)	3.0	Palpa, San Jose Huando
Gabion levee (Type III)	9.0	Chancay-Huaral
Total	13.5	

Typical section of levee is shown in Fig. H-3-6.

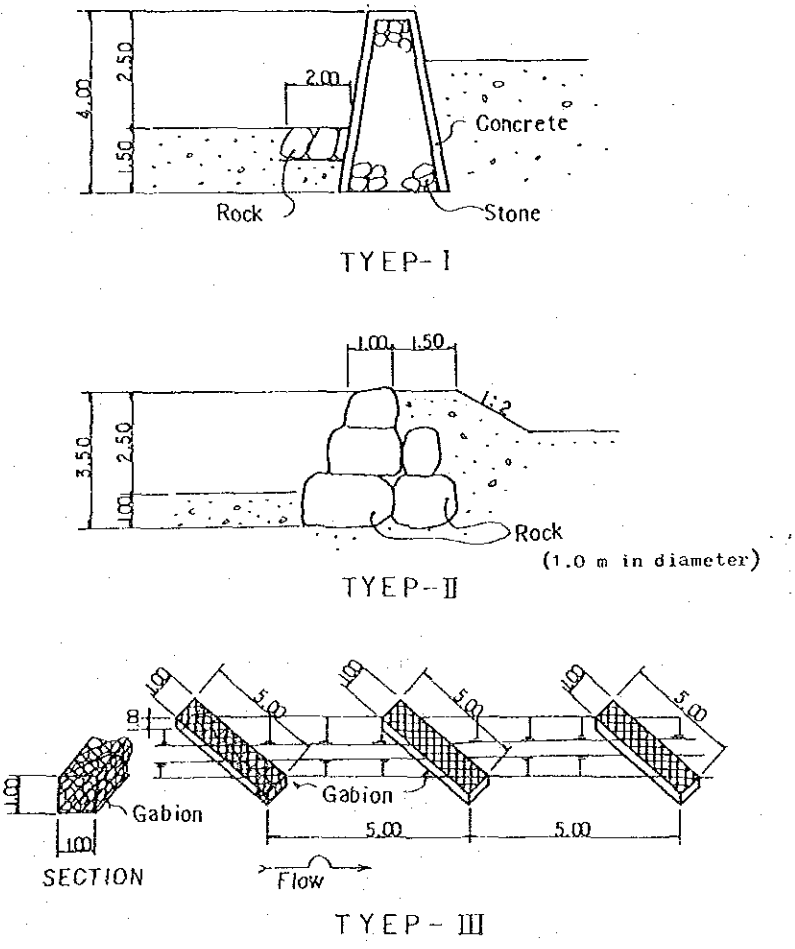


Fig. H-3-6 TYPICAL SECTION OF LEVEE

3-5-2 Drainage canal

Among the existing drainage canals, the Esperanza - Jecuan drainage canal has been damaged by excessive erosion, and accordingly a concrete panel fence with gabion will be installed (each 300 -- 400 m) to protect the same from erosion. As Aurora drain in Palpa is buried by flood, the drainage canal will be excavated to improve drainage.

In poor drainage areas, several drainage canals will be improved with designed depth of more than 2.50m for collecting water from pipe drains. the length of canal improved is 22.6 Km in total as shown below;

Drainage canal	Length (km)	Remarks
Esperanza-Jecuan	4.2	Concrete panel fence with gabion
Aurora	2.3	Canal section improvement
Intercepting canal and Main Drainage Canal	16.1	ditto
Total	22.6	

* Drains of poor drainage area are shown in Annex G-6.

3-5-3 Improvement of poor drainage area

New drainage open canal and pipe drainage system will be adopted for land improvement in the approximately 2,180ha of poor drainage area where the ground water table is less than 1.5m from the ground surface.

The drainage canal will be planned with depth 2.5m from ground surface and flow velocity will be designed less than 0.8 m/sec. As the topographical slope is steep (1/100 -- 1/400), a considerable number of drops is required to adjust to a reasonable slope due to protect erosion and scour of canal bed and its sides.

And drainage water is used for irrigation in the downstream area, therefore, the determination of profil of drainage canal would be prudently examined.

Length of new drainage canal is 47.4km. Location and canal section

are shown in Annex G-8-2. Design criteria of them are shown below ;

Design Discharge (m^3/sec)	Design Velocity (m/sec)	Gradient of Canal Slope	Width of Canal bed (m)
$Q < 0.1$	0.8	1/100 - 1/200	0.5
$Q \geq 0.1$	0.8	1/200 - 1/400	1.0

In the pipe drainage system, perforated pipe will be adopted as the drainage method. The collected water will be drained into the drainage canal. Each pipe will be installed at a depth of 1.8m from ground surface and spacing will be at 40 and/or 60 m depending on soil texture.

SUMMARY OF PIPE DRAINAGE SYSTEM

Pipe	Soil Texture	Interval (m)	Area (ha)	Length (m/ha)	Length (km)
Perforated Vinyl chloride Currgate pipe ϕ100mm	Coarse & Mudium	60	1,720	170	292
	Fine	40	460	250	115
Total			2,180		407

Typical cross section of drainage canal and the pipe drains are shown in Fig. H-3-7.

Drain pipe is necessary to cary out washing sediments, which is deposited into the pipe, with jet type washer once few year. The diameter of dren pipe is not changed in the same lane because of disdesireable to change the diameter on the way.

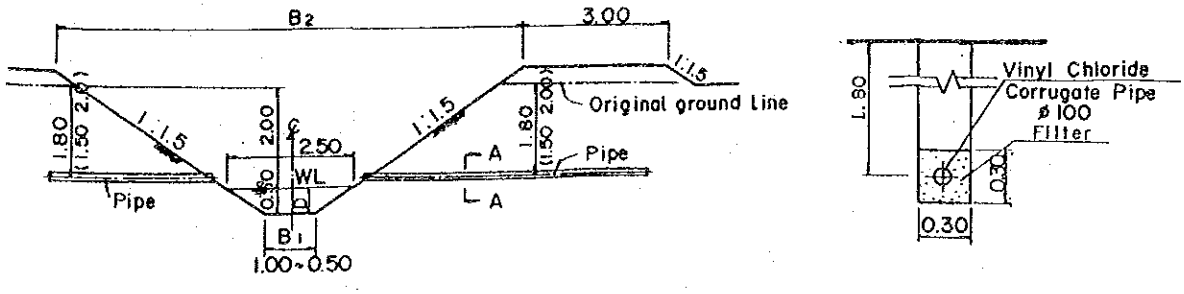


Fig. H-3-7 TYPCAL CROSS SECTION OF DAINAGE CANAL AND PIPE DRAIN

Table H-2-1 Summary of Existing Intake

	Intake	Bank	Discharge (m^3/sec)	Structure
1	Esperanza	Right Bank	4.0	Sluce way gate 2sets Intake gate 4sets
2	Malaca	"	0.1	Intake without Diversion Dam
3	Huando	"	3.5	Fixed Weir ℓ=76m Intake gate 1 set
4	Chancay Huaral	"	7.0	Intake gate 4 sets
5	Salinas Alto	"	0.3	Intake without Diversion Dam
6	Salinas M_1	"	0.6	"
7	Salinas M_2	"	0.008	"
8	Salinas Bajo	"	0.4	Intake with Concrete Canal
9	Palpa	Left Bank	2.5	Fixed Weir ℓ=29m Intake gate 1 set
10	Caqui	"	0.5	Intake without Diversion Dam
11	San Jose	"	0.8	Intake with Concrete Canal
12	Boza Alto	"	0.6	Intake without Diversion Dam
13	Boza Bajo	"	0.5	"
14	Pasamayo Alto	"	0.4	"
15	Monte Chico	"	0.1	"
16	Pasamayo Bajo	"	0.6	"
17	Hanglar	"	0.1	"

* Discharge is based on the water right.

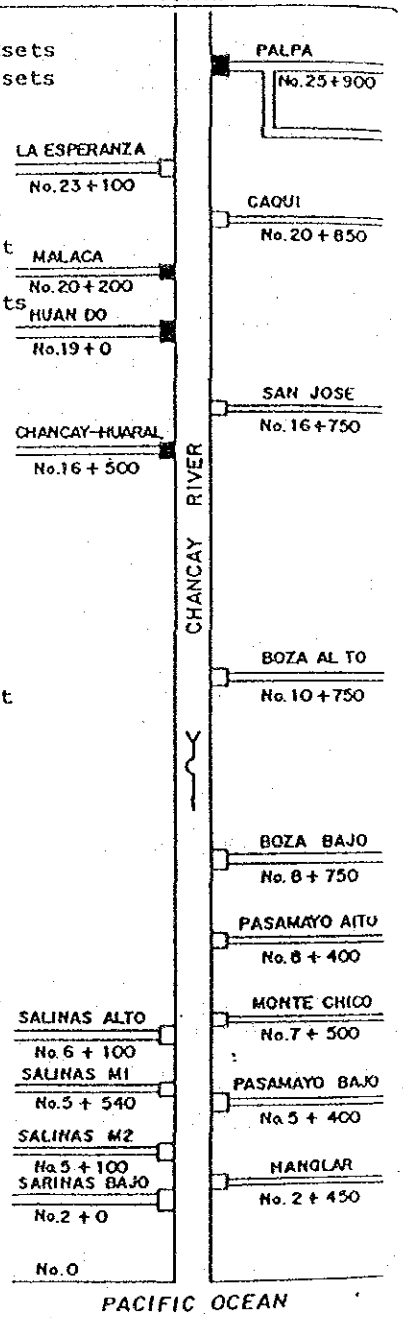


Table H-2-2 Condition of La Esperanza Intake

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	4.0 m^3/sec.
Material of Intake facilities	:	Concrete
Gates	:	3 Intake gates, 2 Sand Sluiceway gates
Fixed Weir or Temporary Weir	:	Without
Size of Canal	:	B = 4.0 m H = 2.5 m

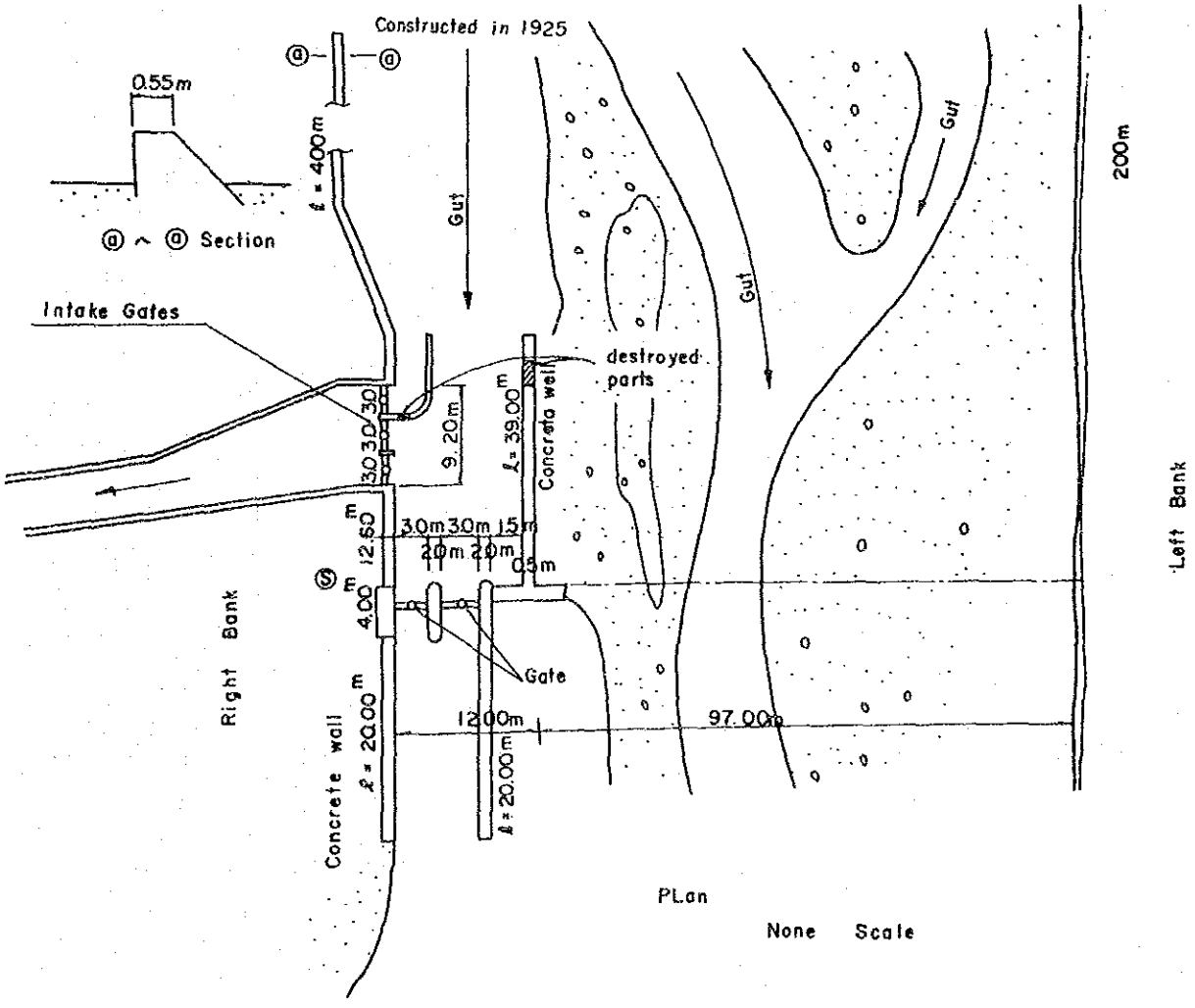
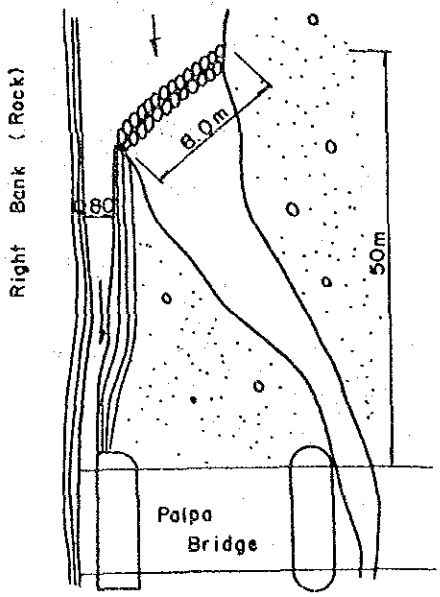


Table H-2-3 Condition of Malaca Ribera Intake

Malaca

Items		Specification
Location	:	Right Bank
Amount of Intake facilities	:	0.1 m^3/sec.
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.8 m, H = 0.3 m (wd = 0.15 m)

Plan (None Scale)

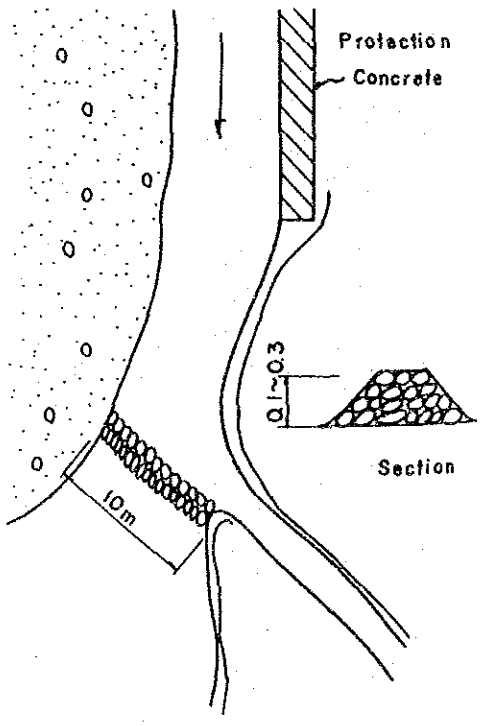


Section

Ribera

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.01 m^3/sec.
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone
Size of Canal	:	B = 1.0 m, H = 0.30 m (wd = 0.15 m)

Plan (None Scale)



Section

Table H-2-4 Condition of Huando Intake

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	3.5 m^3/sec.
Material of Intake Facilities	:	Concrete
Gate	:	1 Intake Gate
Fixed Weir Temporary Weir	:	Fixed Weir
Material of Weir	:	Concrete
Size of Canal	:	B = 2.6 m H = 1.8 m (Wd = 0.65 m)

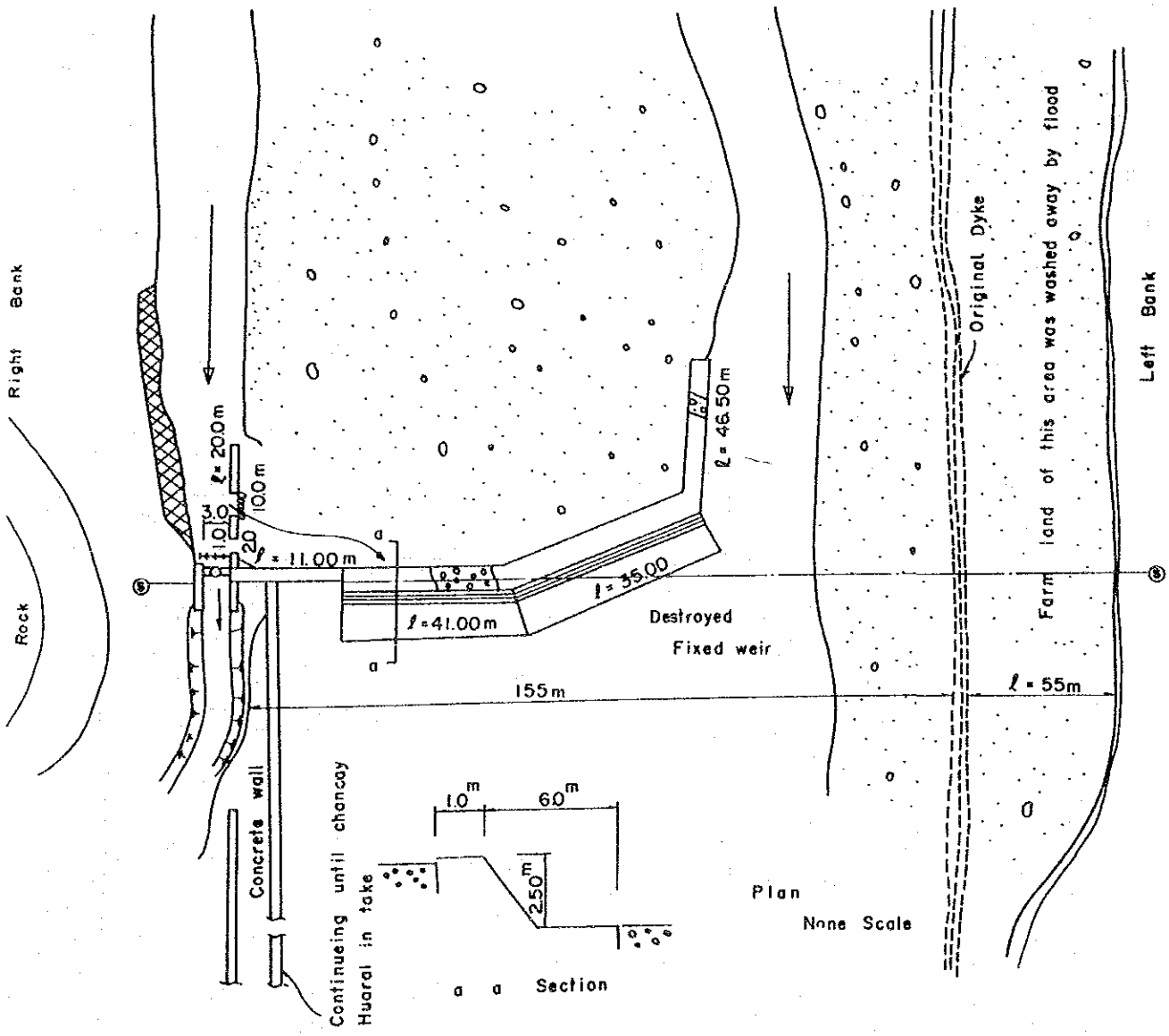


Table H-2-5 Condition of Chancay Huaral Intake

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	7.0 m^3/sec.
Material of Intake facilities	:	Concrete
Gate	:	4 Intake gates, 2 Sand Sluiceway gates
Fixed Weir or Temporary Weir	:	Fixed Weir (foot protection)
Material of Weir	:	Concrete
Size of Canal	:	4.0 m, H = 1.0 m (wd = 0.35 m)

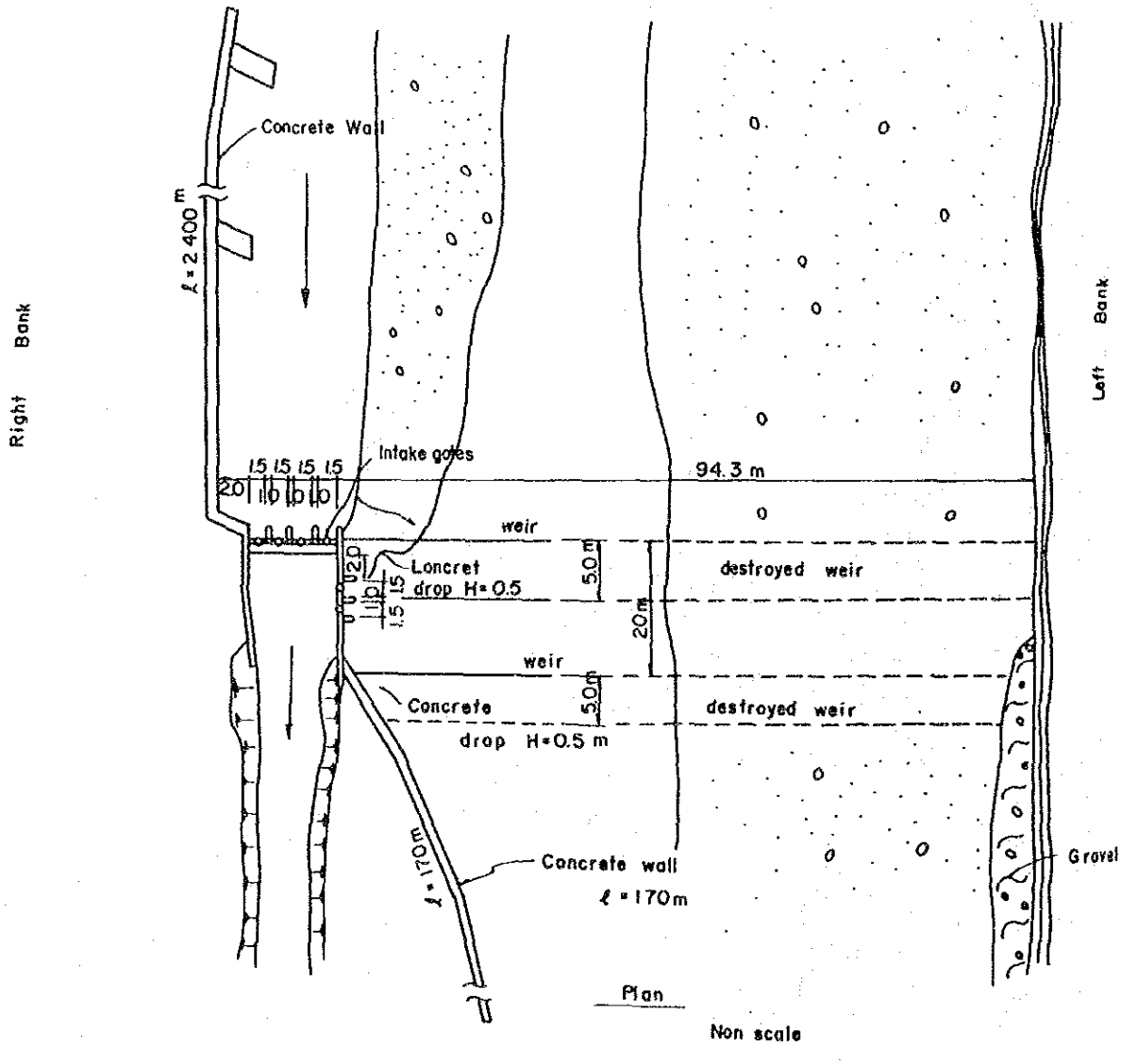
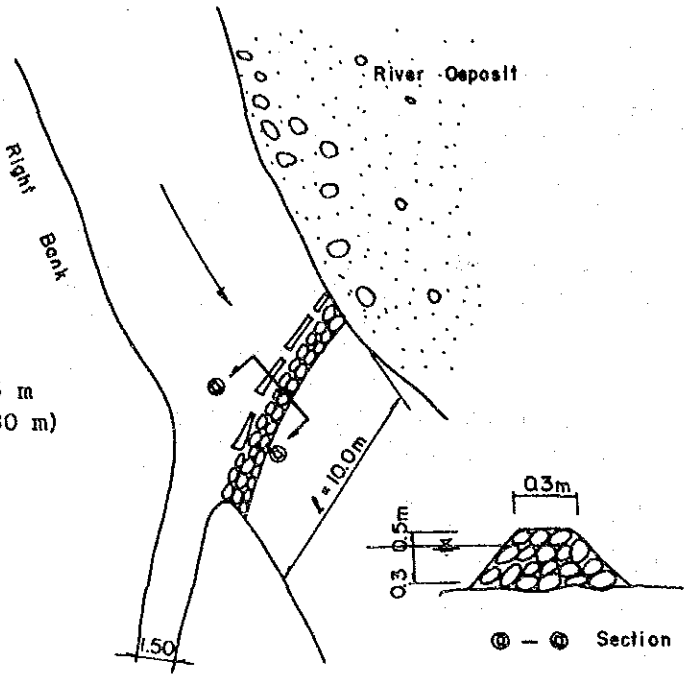


Table H-2-6 Condition of Salina Alta and Salinas Intake

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	0.3 m^3/sec.
Intake Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 1.5 m, H = 0.5 m (wd = 0.30 m)

Plan (None Scale)



Salinas M1

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	0.06 m^3/sec.
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.5 m, H = 0.6 m (wd = 0.3 m)

Plan (None Scale

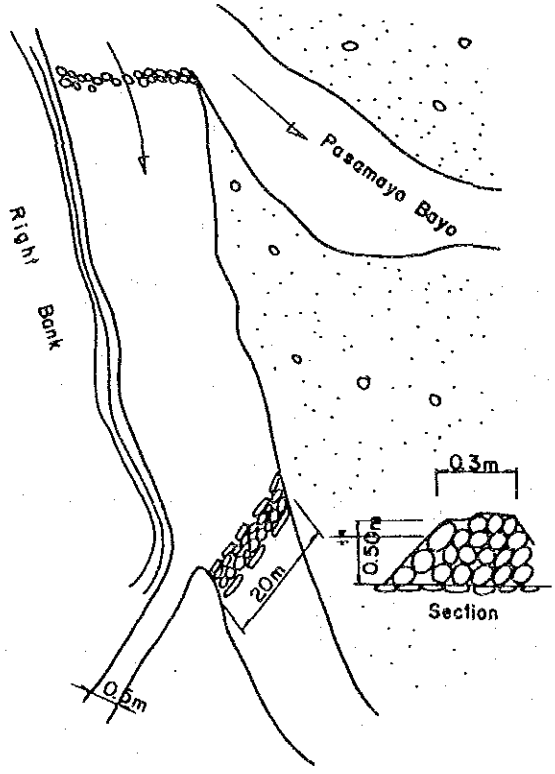
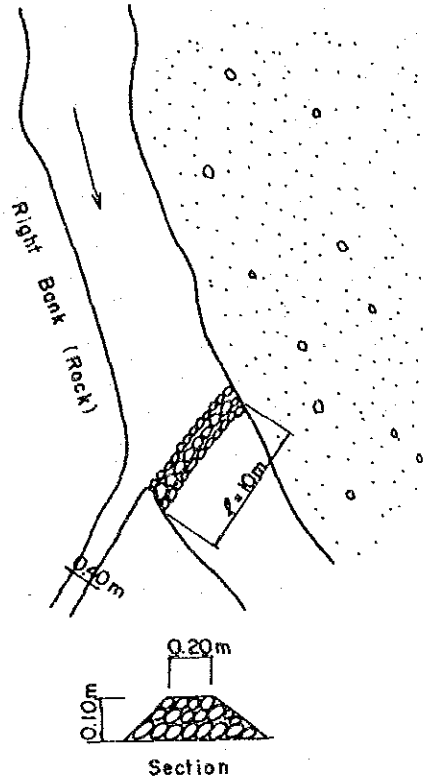


Table H-2-7 Condition of Salinas M2 and Salinas Bajo Intake

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	0.008 m^3/sec.
Gate	:	Without
Fixed Weir of Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Sand
Size of Canal	:	B = 0.40 m, H = 0.3 m (wd = 0.1 m)

Plan (None Scale)



Salinas Bajo

Items		Specification
Location	:	Right Bank
Amount of Intake Water	:	0.4 m^3/sec.
Material of Intake facilities	:	Concrete Canal
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.7 m, H = 0.6 m (wd = 0.35 m)

Plan (None Scale)

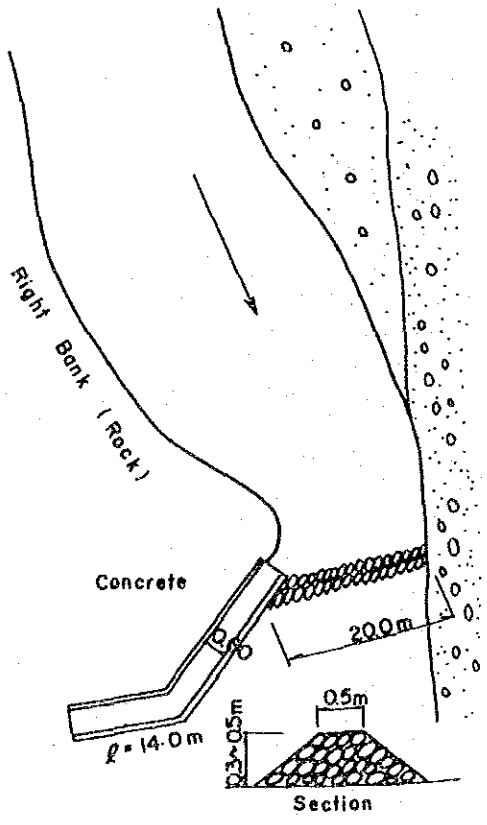
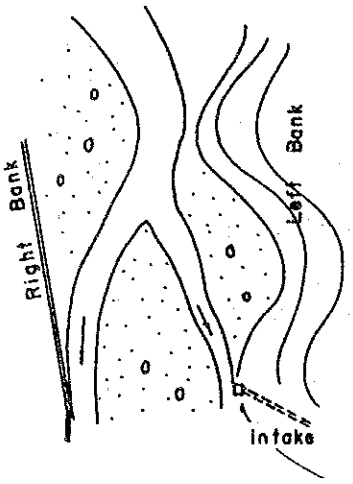


Table H-2-8 Condition of Palpa Intake

Item	Specification
Location	: Left Bank
Amount of Intake water	: 2.5 m^3/sec.
Material of Intake facilities	: Concrete
Gate	: 1 set
Fixed Weir or Temporary Weir	: Fixed Weir (foot protection)
Material of Weir	: Concrete
Size of Canal	: B = 2.0 m H = 1.8 m (wd = 0.8 m)

Plan (None Scale)



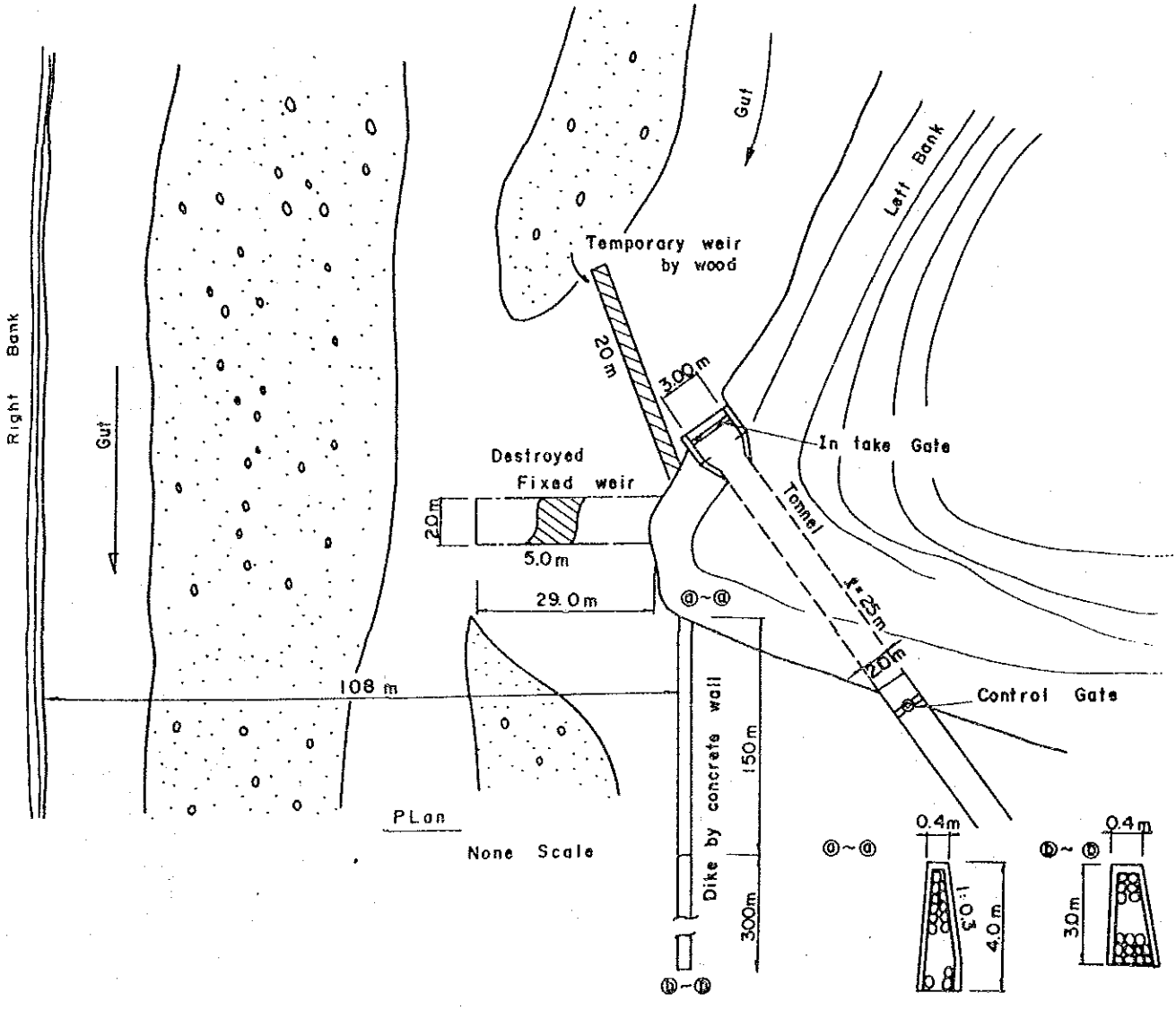
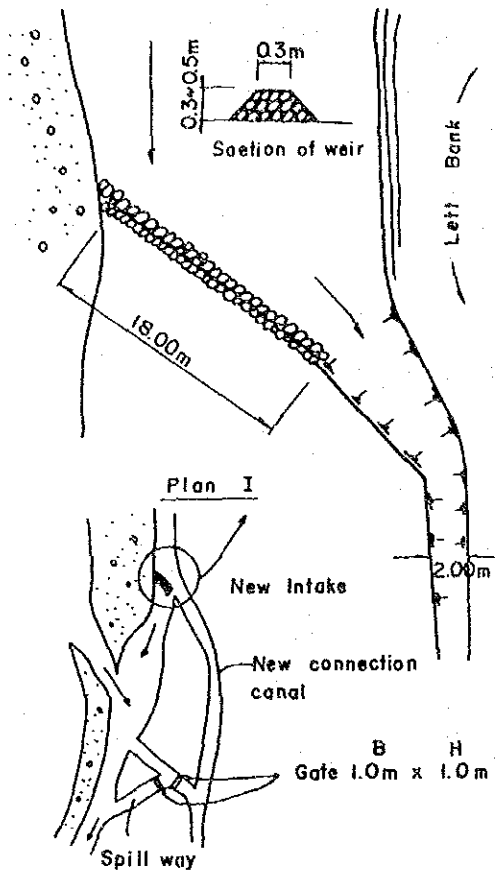


Table H-2-9 Condition of Caqui and San Jose Intake

Caqui

Items		Specification
Location	:	Left Bank
Amount or Intake Water	:	0.5 m^3/sec.
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 2.00 m, H = 0.50 m (wd = 0.35 m)

Plan (None Scale)



San Jose

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.8 m^3/sec.
Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone
Size of Canal	:	B = 0.90 m, H = 1.20 m

Plan (None Scale)

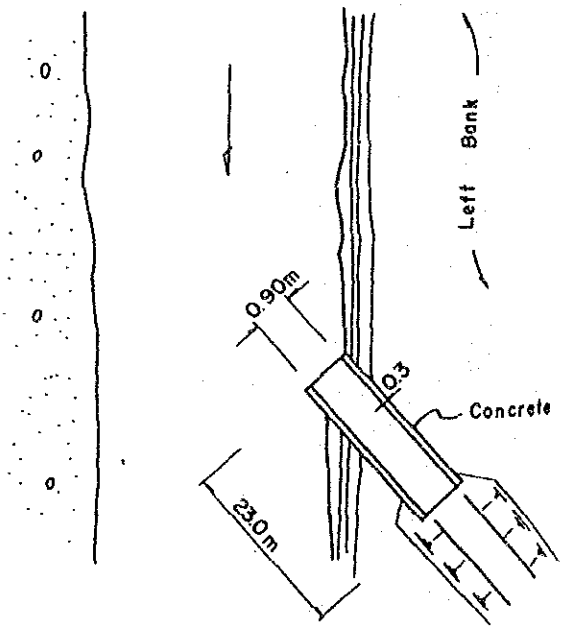
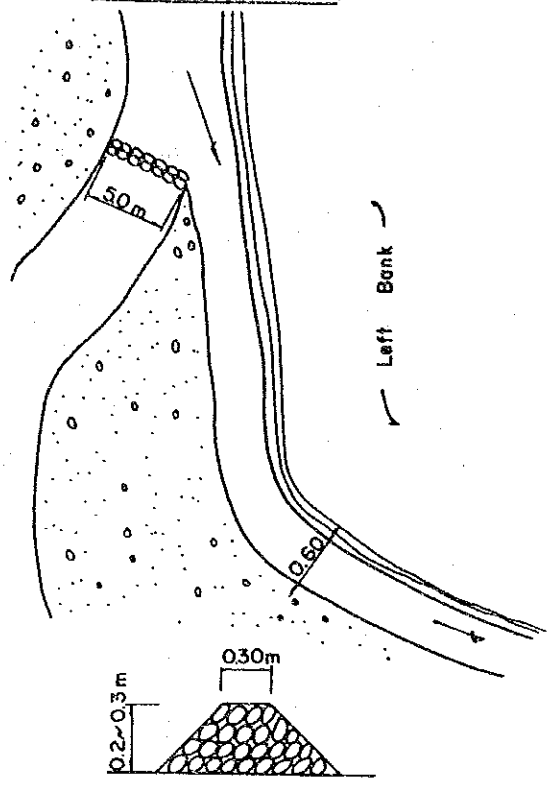


Table H-2-10 Condition of Boza Alta and Boza Bajo Intake

Boza Alta

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.6 m^3/sec.
Gate	:	Without
Fixed weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.6 m, H = 0.6 m (wd = 0.1 m)

Plan (None Scale)

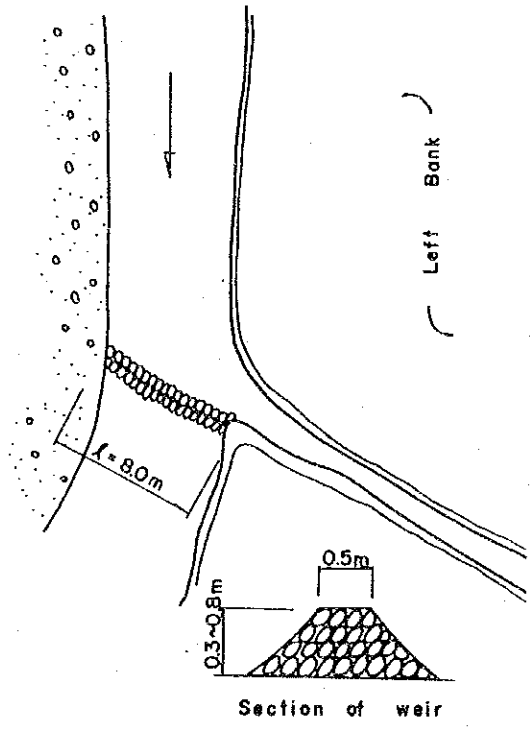


Section of weir

Boza Baja

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.6 m^3/sec.
Gates	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and wood
Size of Canal	:	B = 0.8 m, H = 0.6 m (wd = 0.4 m)

Plan (None Scale)



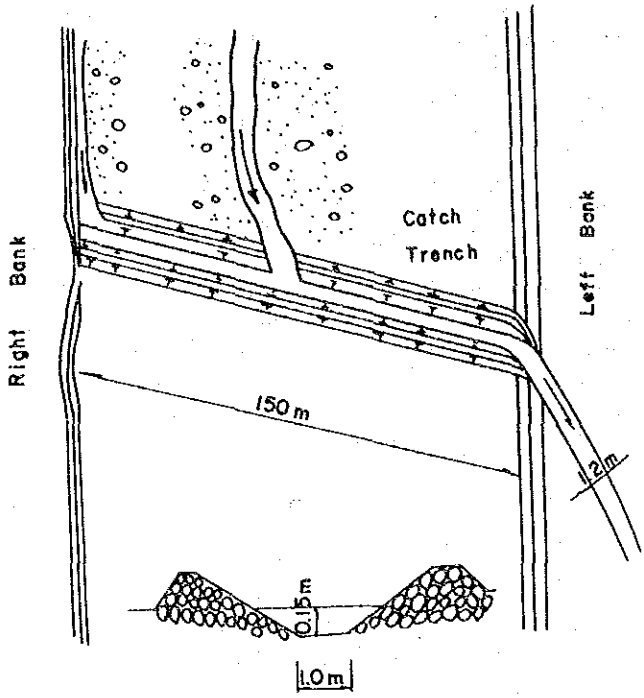
Section of weir

Table H-2-11 Condition of Pasamayo Alto and Bajo Intake

Pasamayo Alto

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.4 m^3/sec.
Intake Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir (trench)
Material of Weir	:	Stone Ang Wood
Size of Canal	:	B = 1.2 m

Plan (Note Scale)

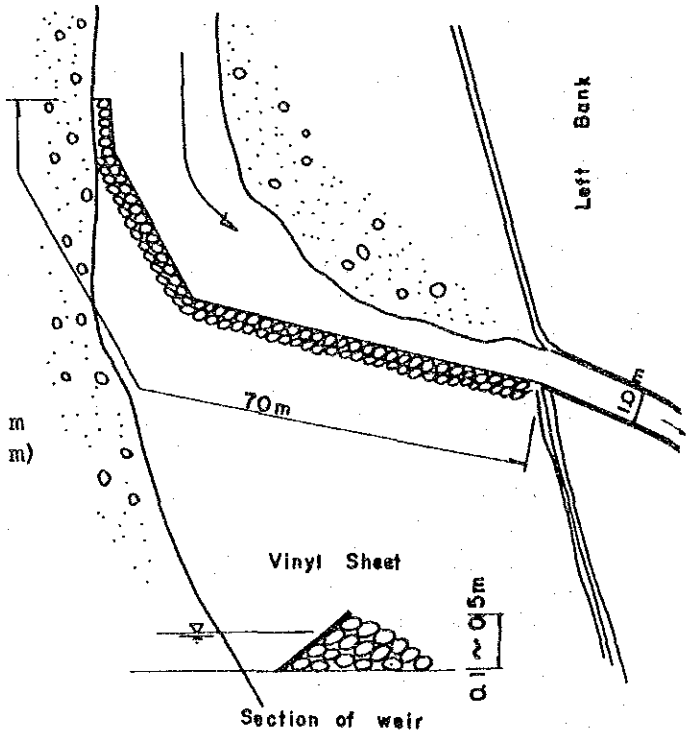


Section of Trench

Pasamayo Bajo

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.6 m^3/sec.
Intake Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone
Size of Canal	:	B = 1.0 m, H = 0.6 m (wd = 0.3 m)

Plan (None Scale)



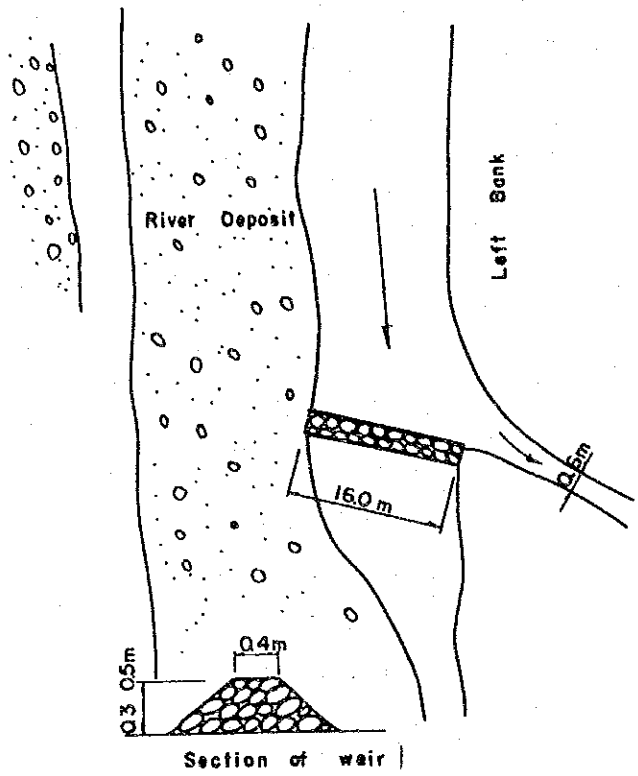
Section of weir

Table H-2-12 Condition of Hangler and Monte Chico Intake

Hanglar

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.1 m^3/sec.
Intake Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.6 m, H = 0.5 m (wd = 0.3 m)

Plan (None Scale)



Monte Chico

Items		Specification
Location	:	Left Bank
Amount of Intake Water	:	0.1 m^3/sec.
Intake Gate	:	Without
Fixed Weir or Temporary Weir	:	Temporary Weir
Material of Weir	:	Stone and Wood
Size of Canal	:	B = 0.6 m, H = 0.2 m (wd = 0.15 m)

Plan (None Scale)

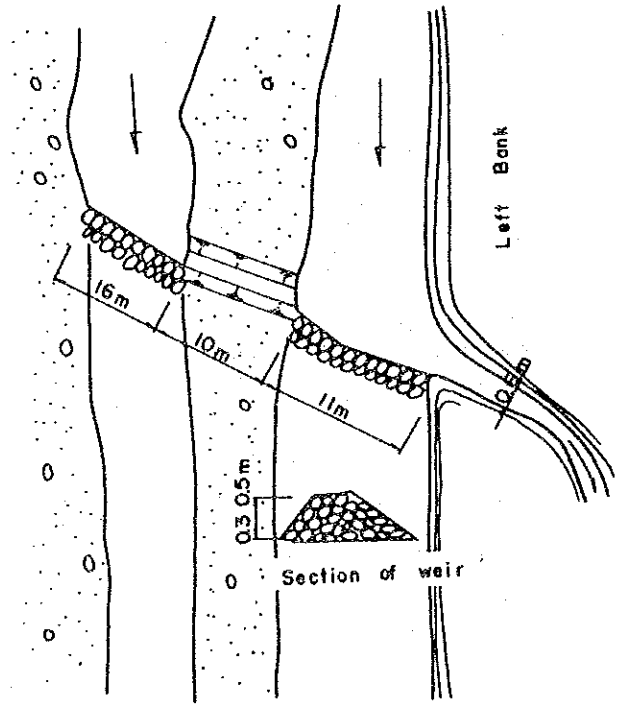


Table II-2-13(1) SUMMARY OF EXISTING IRRIGATION CANALS

Area	Canal	Total Length (km)	Irrigation Area (km)	Lined of Unlined	Soil Texture	Ranking of Rehabilitation 1 (km)	2 (km)	3 (km)
ESPERANZA	1. La Esperanza	4.10	3,250	lined	MS	*1.20(05)	-	2.40
	2. Cabuyal	5.35	1,192	lined	CS	4.65	-	0.70
	3. Cabuyal Alto	3.12	264	lined	CS	-	3.12	-
	4. Cabuyal Bajo	4.73	776	lined	CS	4.73	-	-
	5. Villa Garcia	2.55	112	lined	CS	-	-	2.55
	6. Cayo Murillo	7.70	308	lined	CS	-	-	7.70
	7. Granados	15.50	1,818	lined	CS	9.92	-	5.58
	8. La Virgen	1.35	84	lined	CS	-	-	1.35
	9. Descansa Muerto (Bajo)	3.10	230	lined	CS	-	3.10	-
	10. 1st. Lateral Granados	2.60	336	lined	CS	2.60	-	-
	11. Lateral 1.1 Granados	2.11	110	lined	CS	-	2.11	-
	12. Lateral 1.2 Granados	1.50	78	lined	CS	-	-	1.50
	13. 2nd. Lateral Granados	3.10	168	lined	CS	-	3.10	-
	14. 3rd. Lateral Granados	3.10	573	lined	CS	3.10	-	-
	15. Lateral 3.1 Granados	3.60	327	unlined	CS	3.60	-	-
	16. 4th. Lateral Granados	2.05	103	unlined	CS	2.05	-	-
	17. 5th. Lateral Granados	1.40	55	unlined	CS	1.40	-	-
HUANDO	18. Huando	13.35	1,416	unlined	MS	13.00	-	0.35
	19. 1st. Lateral Huando	3.20	107	lined	MS	-	3.20	-
	20. Victoria	5.00	130	unlined	MS	-	5.00	-
	21. 2nd. Lateral Huando	4.65	153	unlined	MS	-	4.65	-
CHANCAY-HUARAL	22. Chancay-Huaral	1.15	5,934	unlined	MS	*0.90(0.25)	-	-
	23. Huaral	12.00	3,905	unlined	MS	9.32	2.68	-
	24. Jesus Del Valle	5.29	801	unlined	MS	3.34	-	1.95
	25. Garcia Alonso	9.48	477	unlined	MS	9.48	-	-
	26. Acequia Garcia Alonso	3.00	-	unlined	MS	-	3.00	-
	27. Los Naturales	3.70	113	unlined	MS	-	3.70	-
	28. El Cerrito	1.72	158	unlined	MS	-	1.72	-
	29. Caporal	0.95	76	unlined	MS	-	-	0.95
	30. Cantellan	3.15	412	unlined	FS	-	3.15	-
	31. Quincha	3.05	90	unlined	FS	-	-	3.05
	32. Chancay	11.67	2,029	unlined	MS	11.67	-	-
	33. Quepepampa	2.89	426	unlined	FS	2.89	-	-
	34. Torre Blanca	2.30	255	unlined	FS	0.35	1.95	-
	35. Galeano	3.45	380	lined	MS	3.45	-	-
	36. Lat. Chancay	2.72	274	unlined	MS	-	2.72	-
	37. Sta. Rosa	7.15	431	unlined	MS	7.15	-	-
FILT. ESPERANZA -JECUAN	38. Dren. Quincha	-	185		FS	-	-	-
	39. Dren. Retes	-	462		FS	-	-	-
	40. Filt. Quincha	-	222		MS	-	-	-
	41. Dren. Esperanza	-	124		MS	-	-	-
	42. Calera	3.00	168	unlined	MS	-	3.00	-
	43. El Progreso	1.15	42	unlined	FS	-	-	1.15
LOS RAURELES	44. Los Raureles (Filt. Donoso)	5.90	346	unlined	MS	5.90	-	-
	45. Dren Donoso	-	230		MS	-	-	-
CHANCAY	46. Hatillo	12.50	184	lined	CS	-	-	12.50
	47. San Cayetano	7.30	190	unlined	CS	-	7.30	-
	48. San Juan	4.50	213	unlined	CS	-	4.50	-
	49. Chancayllo Derecho	4.95	144	unlined	MS	-	4.95	-
	50. Chancayllo Izquierda	5.05	382	unlined	MS	-	5.05	-
	51. Candelaria Baja	6.10	352	unlined	CS	-	6.10	-
SALINAS	52. Salinas Alto	9.00	183	unlined	MS	2.00	7.00	-
	53. Salinas Medio 1	3.00	79	unlined	MS	-	-	3.00
	54. Salinas Medio 2	0.50	19	unlined	MS	-	-	0.50
	55. Salinas Bajo	5.60	165	unlined	MS	-	5.60	-

Table H-2-13 (2)

PALPA	56. Palpa Alta	7.05	767	unlined	MS	7.05	-	-
	57. Palpa Baja	13.41	808	unlined	MS	13.41	-	-
	58. Teresa	2.50	338	unlined	MS	2.50	-	-
	59. Sta. Hermelinda	6.00	149	unlined	FS	-	6.00	-
	60. Juan Castilla	4.20	123	unlined	MS	-	4.20	-
CAQUI	61. Caqui	10.65	615	unlined	MS	10.65	-	-
	62. Caqui Bajo	2.95	255	unlined	MS	-	2.95	-
	63. Maria	2.40	69	unlined	MS	-	-	2.40
	64. San Jose	13.80	847	unlined	MS	10.30	-	3.50
PASAMAYO	65. Pasamayo Alto	6.80	288	unlined	MS	-	-	6.80
	66. Pasamayo Bajo	4.80	579	unlined	MS	4.80	-	-
	67. Pasamayo Bajo lst. Orden	2.00	118	unlined	MS	-	2.00	-
MIRAFLORES								
	68. Miraflores	1.25	443	lined	CS	-	-	1.25
	69. Miraflores Alto	4.97	172	lined	CS	-	-	4.97
	70. Miraflores Bajo	4.65	245	unlined	CS	-	-	4.65
	71. (Lat. Miraflores)	1.30	23	unlined	CS	-	-	1.30
BOZA	72. Boza Alto	5.70	779	unlined	MS	5.70	-	-
	73. Boza Bajo	5.30	388	unlined	MS	5.30	-	-
HANGLAR	74. Hanglar	2.45	72	unlined	MS	-	-	2.45
	Total	337.56	20,000			*162.41 (0.75)	101.85	72.55

Note: 1. Canal is demaged by erosion and leakage. Urgent rehabilitation is necessary.

2. Under good maintenance, rehabilitation is not necessary.

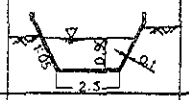
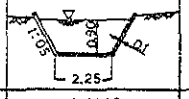
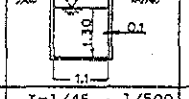
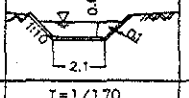
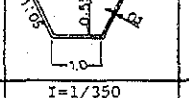
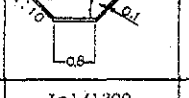
3. Structurally problem is not observed. Good maintenance.

Soil Texture
CS Coarse textured soils
MS Medium textured soils
FS Fine textured soils

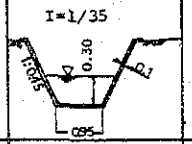
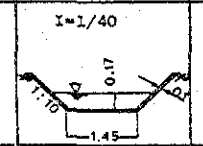
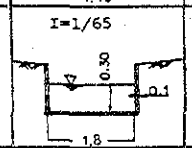
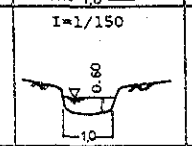
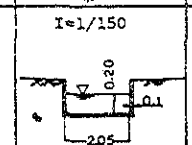
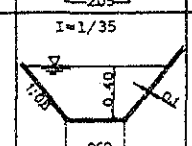
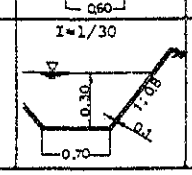
* - Connecting canal of La Esperanza will be jointed with the maine canal at No. 0.5, therefore, 500 m of upper reaches will be remained as it is.

- Connecting canal between the Huando intake and Chancay-Huaral maine Canal will be jointed at No. 0.25 of the maine canal than 250 m of upper reaches will be reamined as it is.

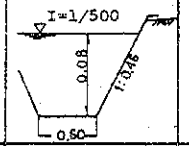
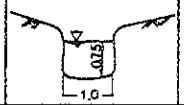
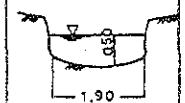
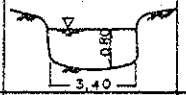
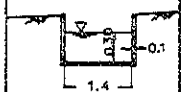
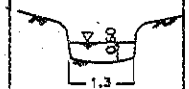
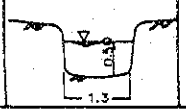
Table H-2-14 CONDITION OF EXISTING IRRIGATION CANAL (1)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
ESPERANZA	LA ESPERANZA	4.10	I=1/340 	Lined	3,240	4 - 1	MS [Upper Reaches]	1.70	-	2.40	Washed away by the flood 500m length. Necessary to repair 4 gates in sand settling basin. Many parts of wet masonry, mortal have been fallen and leakages are observed. From No. 950 to No. 2450 there are cruck in side slope and canal bed, so be afraid of sinking of canal. Without tunnel improvement (L=1650m)
"	CABUYAL	5.35	I=1/1150 	Lined	1,192	13 - -	CS	4.65	-	0.70	Be observed leakages by damage of side slope and canal bed. Necessary to improve inspection road. Without tunnel improvement (L=700m)
"	CABUYAL ALTO	3.12	I=1/400 	Lined	264	20 - -	CS	-	3.12	-	This canal is running along the contour line. Leakage and erosion are not observed.
"	BABUYAL BAJO	4.73	I=1/45 - 1/500 	Lined	776	10 13 -	CS	4.73	-	-	Canal bed slope is too steep. Canal bed and all of the drops are damaged by wash load and stone.
"	VILLA GARCIA	2.55	I=1/170 	Lined	112	5 2 1	CS	-	-	2.55	Born from the right bank of the Cabuyal Bajo canal. Canal bed slope is moderate. Structurally problem is not observed.
"	CAYO MURILLO	7.70	I=1/350 	Lined	308	14 - 1	CS	-	-	7.70	Division with one metalic gate in regular condition. Structurally problem is not observed.
"	GRANADOS	15.50	I=1/1200 	Lined	2,048	39 2 1	CS	9.92	-	-	The division is in a good condition, the gate which regulates the abundance of La Virgen canal is of wood. From B.P. to No. 1380, structurally problem is not observed. From No. 1380 to No. 5580, there is in a good maintenance and structurally problem is not observed. From No. 5580 to end of canal, side slope is damaged by erosion and some part of side slopes are slipped.

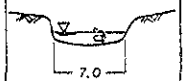
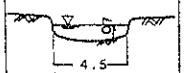
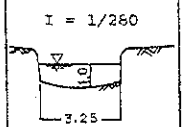
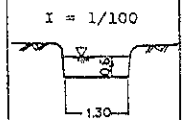
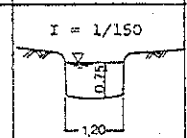
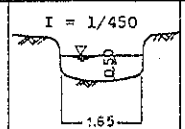
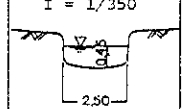
CONDITION OF EXISTING IRRIGATION CANAL (2)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
ESPERANZA	LA VIRGEN	1.35	I=1/35 	Lined	84	1 1 -	CS	-	-	1.35	Parallel road improvement is necessary. Water is running for shoot, but structurally problem is not observed.
"	DESCANZA MUERTO (BAJO)	3.10	I=1/40 	Lined	230	10 25 -	CS	-	3.10	-	Structurally problem is not observed.
"	1ST LATERAL GRANADOS	2.60	I=1/65 	Lined	336	4 2 1	CS	2.60	-	-	Slipped or fallen of mortal lining is to much. Canal bed slope is too steep. Erosion of canal bed is observed, and some parts of canal, leakage is observed.
"	LATERAL 1-1 GRANADOS	2.11	I=1/150 	Some portions are lined	110	2 - 2	CS	-	2.11	-	Structurally problem is not observed.
"	LATERAL 1-2 GRANADOS	1.50	I=1/150 	Lined	78	2 - 1	CS	-	-	1.50	Structurally problem is not observed. Maintenance is good.
"	2ND LATERAL GRANADOS	3.10	I=1/35 	Lined	168	4 - 1	CS	-	3.10	-	Water is running for shoot, but structurally problem is not observed. Not necessary urgent canal improvement work.
"	3RD LATERAL GRANADOS	3.10	I=1/30 	Lined	573	7 - 1	CS	3.10	-	-	One of the urgent canal improvement work. Inspection road is damaged by leakage. All of the intake gates of lateral canals are damaged, and have problem for irrigation water control.

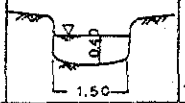
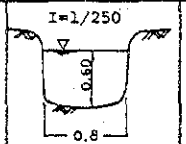
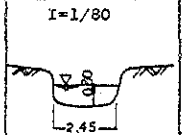
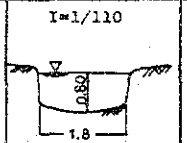
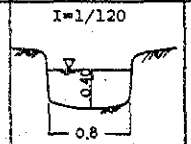
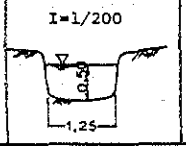
CONDITION OF EXISTING IRRIGATION CANAL (3)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
ESPERANZA	LATERAL 3-1 GRANADOS	3.45	I=1/500 	Unlined	327	17 - 1	CS	3.45	-	-	From the right bank of the 3rd LAT. Granados canal. Necessary canal lining for upgrading of irrigation efficiency because northern part of Esperanza Baja is shortage of irrigation water.
"	4TH LATERAL GRANADOS	2.05	I=1/500 	Unlined	103	10 - 1	CS	2.05	-	-	Canal bed slope is too steep. Canal slope is damaged by earth pressure which had embanked at canal crean work. Side slope is damaged by erosion.
"	5TH LATERAL GRANADOS	1.40	I=1/1300 	Unlined	55	3 - 1	CS	1.40	-	-	Most of the canal bed and side slope is damaged by erosion.
HUANDO	HUANDO	13.35	I=1/360 - 1/175 	Unlined	1,416	42 1 1	MS	13.00	-	0.35	Most of the canal bed and side slope is slipped and damaged by erosion. Rehabilitation of the inspection road is necessary. Inside of household, canal maintenance is good and without improvement work (L=350m)
"	1ST LATERAL HUANDO	3.20	I=1/120 	Lined	107	15 - -	MS	-	3.20	-	Bad maintenance. The bank is completely vegetated.
"	VICTORIA	5.00	I=1/100 	Unlined	130	11 - -	MS	-	5.00	-	Structurally problem is not observed. Small structures are in a good condition.
"	2ND LATERAL HUANDO	4.65	I=1/270 	Unlined	153	6 - -	MS	-	4.65	-	Some parts of the canal is protected with stone and wet masonry works. The borders are vegetated with reed grass.

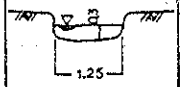
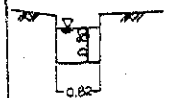
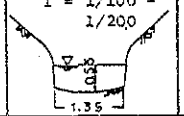
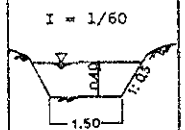
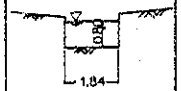
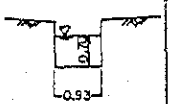
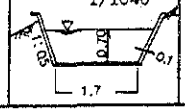
CONDITION OF EXISTING IRRIGATION CANAL (4)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
CHANCAY-HUARAL	CHANCAY-HAURAL	1.15	I = 1/80 	Unlined	5,934	- - 1	MS	1.15	-	-	From the right bank of the Chancay river. Exist a parshall flume, in a good condition, the throat length is W=35m, the max. mark in the measure holds are: Ha=0.86m, Hb=0.38m. Side slope is too much damaged and erosion is observed. Too much sedimentation. Principal division is sinking.
CHANCAY-HAURAL	HUARAL	12.00	I = 1/120 	Unlined	3,903	14 1 1	MS [Upper Reaches]	9.32	2.68	-	Side slope is too much damaged and erosion is observed. Maintenance is bad. Too much sedimentation. Leakage is observed at hill side. Up to point No. 700, the canal borders are completely vegetated by reed grass, and brave reed. Being very difficult the access to the canal to down stream of this point.
CHANCAY-HAURAL	GARCIA ALONSO	9.48	I = 1/280 	Unlined	477	45 2 -	MS	9.48	-	-	Side slope is too much damaged. Erosion is observed from No. 6500 to No. 9480. Leakage is also observed. Canal maintenance is regular.
CHANCAY-HAURAL	JESUS DEL VALLE	5.29	I = 1/100 	Unlined	401	10 - -	MS	5.29	-	-	Drosion is observed. Side slope is damaged by sheet erosion,
CHANCAY-HAURAL	SEQUIA GARCIA ALONSO	3.00	I = 1/150 	Unlined	734	20 - -	MS	-	3.00	-	Structurally problem is not observed at related structures. Good maintenance.
CHANCAY-HAURAL	LOS NATURALES	3.70	I = 1/450 	Unlined	113	9 - -	MS	-	3.70	-	Born from the right bank of the Garcia Alonsocanal Good maintenance.
CHANCAY-HAURAL	EL CERRITO	1.72	I = 1/350 	Unlined	158	2 - -	MS	-	1.72	-	Maintenance is not good, but side slope and canal bed is not damaged by erosion for low velocity (less than 0.90 m/sec)

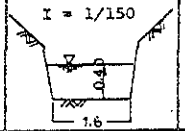
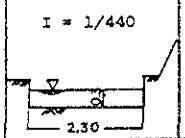
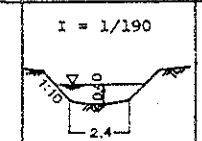
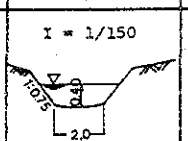
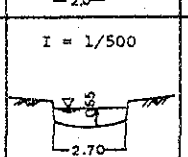
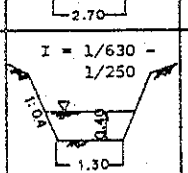
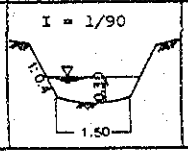
CONDITION OF EXISTING IRRIGATION CANAL (5)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
CHANCAY-HUARAL	CANTELIAN	3.15	I=1/125 	Unlined	190	4 - -	FS	-	3.15	-	Borders are covered with weeds, shrub trees. Erosion is not observed.
"	QUINCHA	3.05	I=1/120 	Unlined	90	2 - -	FS	-	-	3.05	Borders are covered with weeds, shrub trees. Erosion is not observed.
"	INIPA	0.83	I=1/250 	Unlined	263	- - -	MS	(0.83)	-	-	Located end of San Jose and Chancay canal. Necessary canal improvement for using filtration water.
"	CHANCAY	11.67	I=1/80 	Unlined	2,029	4 - -	FS	11.67	-	-	Too much erosion is observed. Damaged side slope for all canal line. Too much sedimentation. Necessary to rehabilitate of the inspection road.
"	QUEPEPAMPA	2.89	I=1/110 	Unlined	426	7 1 2	FS	2.89	-	-	Canal bed slope is too steep, and erosion and leakage are observed.
"	TORRE BLANCA	2.30	I=1/120 	Unlined	255	6 - -	FS	0.35	1.95	-	From B.P. to No. 350, erosion is observed. Maintenance is good.
"	LOS LAURELES	5.90	I=1/200 	Unlined	346	10 - -	MS	5.90	-	-	Canal bed slope is moderate, but erosion is observed. Some parts of side slope is slipped. Structurally problem is not observed at related structure. Maintenance is good.

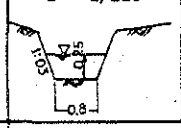
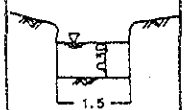
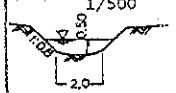
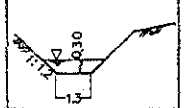
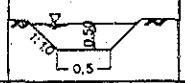
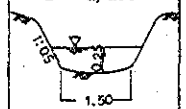
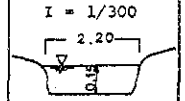
CONDITION OF EXISTING IRRIGATION CANAL (6)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km)			Remarks
								I	II	III	
CHANCAY-HAURAL	CAPORAL	0.95	I = 1/280 	Unlined	76	1 - -	MS	-	-	0.95	Maintenance is not good, but side slope and canal bed is not damaged by erosion for low velocity (less than 0.70 m/sec)
CHANCAY-HAURAL	GALEANO	3.45	I = 1/100 	Unlined	380	7 - 1	MS	3.45	-	-	Canal slope is steep. Erosion is observed at canal bed and side slope. Good maintenance. Small scale division exists in No. 3450, without gate.
CHANCAY-HAURAL	LAT. CHANCAY	2.72	I = 1/100 - 1/200 	Unlined	274	3 - -	MS	-	2.72	-	Not necessary urgent rehabilitation owrk under good maintenance.
CHANCAY-HAURAL	STA. ROSA	7.15	I = 1/60 	Unlined	431	13 - -	MS	7.15	-	-	Side slope is damaged too much by erosion.
CHANCAY-HAURAL	CALERA	3.00	I = 1/2500 - 1/145 	Unlined	168	6 - -	MS	-	3.00	-	This canal is born to the left bank of the Quincha drainage canal. In No. 620, exist pumping station.
CHANCAY-HAURAL	EL PROGRESO	1.15	I = 1/800 	Unlined	42	- - -	FS	-	-	1.15	This canal is born at the hold of dissipation of pumping station, located in the well. In this well collecting water from Quincha drainage are comping up.
CHANCAYLLO	HATILLO	12.50	I = 1/2500 - 1/1040 	Lined	184	- 1 1	CS	-	-	12.50	From Esperanza drainage canal. Good maintenance. Structurally problem is not observed.

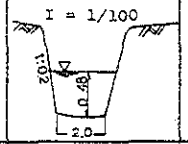
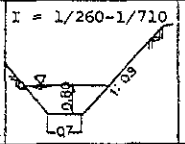
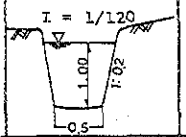
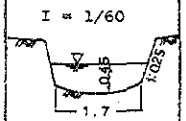
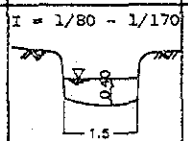
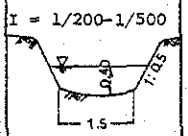
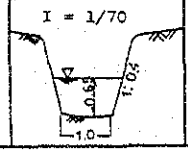
CONDITION OF EXISTING IRRIGATION CANAL (7)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
CHANCAYLLO	SAN CAYETANO	7.30	I = 1/150 	Unlined	190	21 - 1	CS	-	7.30	-	Erosion is not observed. Regular pendent of canal bed slope. Borders are covered with grass. Canal bed is crushed stone.
CHANCAYLLO	SAN JUAN	4.50	I = 1/440 	Unlined	213	11 - -	CS	-	4.50	-	Canal bed slope is moderate and erosion is not observed.
CHANCAYLLO	CHANCAYLLO DER.	4.95	I = 1/190 	Unlined	144	17 3 -	MS	-	4.95	-	Erosion is not observed. Good maintenance.
CHANCAYLLO	CHANCAYLLO IZQ.	5.05	I = 1/150 	Unlined	382	9 - -	MS	-	5.05	-	Erosion is not observed. Good maintenance.
CHANCAYLLO	CANDELARIA BAJA	6.10	I = 1/500 	Unlined	352	12 - -	CS	-	6.10	-	Born from Quincha drain. Regular maintenance, moderate pendent. Canal bed is of crushed stone. Erosion is not observed.
SALINAS	SALINAS ALTO	8.5	I = 1/630 - 1/250 	Unlined	183	18 1 -	MS	2.00	7.00	-	Washed away by the flood a part of upstream. Up to No. 2000 will be constructed newly. Too much sedimentation.
SALINAS	SALINAS MEDIO 1	3.0	I = 1/90 	Unlined	79	4 - -	MS	-	-	3.00	Not necessary canal improvement works after the connection canal from Salinas Alto.

CONDITION OF EXISTING IRRIGATION CANAL (8)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
SALINAS	SALINAS MEDIO 2	0.5	I = 1/120 	Unlined	19	2 - -	MS	-	-	0.50	Bad maintenance. Not necessary canal improvement work after the connection canal from Salinas Alto.
SALINAS	ALINAS BAJO	5.6	I = 1/200 	Unlined	165	12 - -	MS	-	5.60	-	Intake facility is located on hill skirt's rock and keep stability to intake water. Pendent of canal bed slope is not steep. Erosion is not observed. Too much sedimentation at downstream.
PALPA	PALPA-PALPA ALTA	7.05	I = 1/130 - 1/500 	Unlined	767	14 - 1	MS	7.05	-	-	Canal bed consists of stone and its pendent is steep. Necessary some drops in adapt places. End of the canal exists Palpa reservoir. Up to No. 180 (division) canal is lined by concrete. Structurally problem is not observed. After unification of intakes, it is necessary to reconstruct of principal canal.
PALPA	PALPA BAJA	13.41	I = 1/330 	Unlined	808	16 - -	MS	13.41	-	-	Some parts of the canal, pendent are too steep, and erosion is observed. Too much sedimentation. As having of large benefited area, it is necessary canal improvement works.
PALPA	TERESA	2.50	I = 1/200 	Unlined	338	5 1 -	MS	2.50	-	-	Canal bed and side slopes are damaged by erosion. Too much sedimentation. Bad maintenance. Structural problem is not observed at chute structure.
PALPA	STA. HERMELINDA	6.0	I = 1/250 	Unlined	149	12 - -	FS	-	6.00	-	Erosion is not observed, however maintenance is not good.
PALPA	JUAN CASTILLA	4.20	I = 1/300 	Unlined	123	4 - -	MS	-	4.20	-	Canal bed slope is not steep, and erosion is not observed for little discharge.

CONDITION OF EXISTING IRRIGATION CANAL (9)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
CAQUI	CAQUI	10.65		Unlined	615	18 - -	MS	10.25	-	-	Upstream of this canal had been washed wway by the flood. Small scale division or intake is necessary to reconstruct. Side slopes are damaged by erosion. borders are covered with grass and bad maintenance.
CAQUI	CAQUI BAJO	2.95		Unlined	255	4 - -	MS	-	2.95	-	Erosion and leakage are not observed, however maintenance is not good.
CAQUI	MARIA	2.95		Unlined	69	3 - -	MS	-	-	2.90	Erosion and leakage are not observed, however maintenance is not good.
CAQUI	SAN JOSE	13.80		Unlined	847	25 1 -	MS	12.20	- [Upper Reaches]	3.50	Upstream of this canal (3.5km) is used for collecting canal. As Boza area is shortage of irrigation water, urgent canal improvement work is necessary. Side slope is damaged by erosion.
PASAMAYO	PASAMAYO ALTO	6.80		Unlined	288	12 - -	MS	-	-	6.80	Drosion and leakage are not observed. Not necessary urgent canal improvement work.
PASAMAYO	PASAMAYO BAJO	4.80		Unlined	579	7 - -	MS	4.80	-	-	Too much damaged side slope. Urgent canal improvement work is necessary. Bad maintenance.
PASAMAYO	PASAMAYO BAJO lst ORDEN	2.00		Unlined	118	7 1 -	MS	-	2.00	-	Erosion or sheet erosion is not observed, however maintenance is not good. Not necessary urgent canal improvement work.

CONDITION OF EXISTING IRRIGATION CANAL (10)

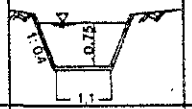
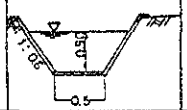
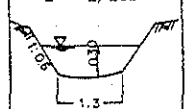
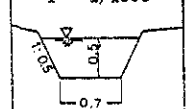
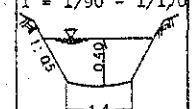
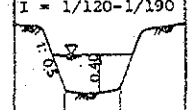
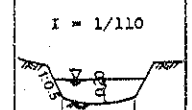
Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
MIRAFLORES	MIRAFLORES	1.25	I = 1/1000 	Lined	443	3 - -	CS	-	-	1.25	This canal is lined by concrete. Structurally problem is not observed. Pendent of canal bed slope is gentle, and canal is not damaged. Good maintenance.
MARAFLORES	MIRAFLORES ALTO	4.97	I = 1/2000 	Lined	172	14 - -	CS	-	-	4.97	This canal is lined by concrete. Structurally problem is not observed. Pendent is canal bed slope is gentle, and canal is not damaged. Good maintenance.
MARAFLORES	MIRAFLORES BAJO	4.65	I = 1/135 	Unlined	245	7 - -	CS	-	-	4.65	This canal is lined by concrete. Structurally problem is not observed. Pendent of canal bed slope is gentle, and canal is not damaged. Good maintenance.
MARAFLORES	LATERAL MIRAFLORES	1.30	I = 1/1000 	Unlined	23	3 - -	CS	-	-	1.30	Structurally problem is not observed.
BOZA	BOZA ALTO	5.70	I = 1/90 - 1/170 	Unlined	779	12 - -	MS	5.70	-	-	Irrigation efficiency is low. Most of benefited area is under shortage of irrigation water because there is too much sedimentation in the canal, and bad maintenance.
BOZA	BOZA BAJO	5.30	I = 1/120-1/190 	Unlined	388	11 - -	MS	5.30	-	-	Irrigation efficiency is low. Side slope is slipped by sheet erosion. Too much sedimentation. Maintenance is not good.
HANGLAR	HANGLAR	2.45	I = 1/110 	Unlined	72	5 1 -	MS	-	-	2.45	Erosion and leakage are not observed, however maintenance is not good.

Table H-2-15 Condition of Existing Reservoirs

Reservoir	Location	Existing Storage Capacity	Sediment	Storage Capacity	Remarks
Esperanza	Esperanza	30,000 (m^3)	12,000 (m^3)	42,000 (m^3)	Percolating around conduit
Huanddo	Huando	11,300	2,300	13,600	
Jesvs Del. Valle	Huaral	19,000	5,600	24,600	
Cerrito	Huaral	9,000	3,000	12,000	
Quepe Pampa	Quepe Pampa	8,700	2,100	10,800	
Buena Vista	Torre Blanca	6,100	4,000	11,300	
Torre Blanca	Torre Blanca	-	-	-	Not using
Galeano	Torre Blanca	8,000	4,500	12,000	
Laureles	Laureles	13,600	2,700	16,300	
Chancay Bajo	Chancay Bajo	2,900	4,400	7,300	
Chancayllo-I	Chancayllo	8,700	3,300	12,000	
Chancayllo-II	Chancayllo	-	-	-	Not using
San Juan	Chancayllo	2,500	2,500	5,000	
Palpa	Palpa	16,900	16,900	33,800	
Miraflores	Miraflores	13,000	7,700	20,700	
Total		149,700	71,000	221,400	

Table H-2-16 Summary of Existing Drainage Canals

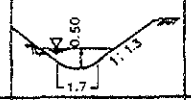
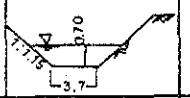
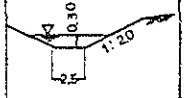
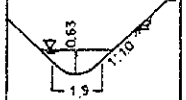
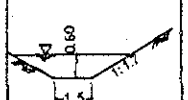
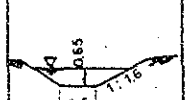
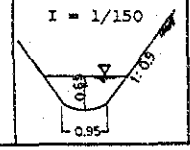
No.	Canal	Total Length (km)	Catchment Area (ha)	Lined or Unlined	Soil Texture	Rehabilitation Ranking (km) I	II	III
1.	La Esperanza-Jecuan	4.65	124	unlined	MS	4.20	0.80	-
2.	Esperanza Der.	0.77	65	unlined	MS	-	0.77	-
3.	Esperanza Izq.	0.50	59	unlined	MS	-	0.50	-
4.	Retes	5.65	462	unlined	MS	-	5.65	-
5.	Quincha	8.47	407	unlined	MS	-	8.47	-
6.	Donoso	3.70	230	unlined	FS	-	3.70	-
7.	INIPA. Der.	1.65	130	unlined	MS	-	1.65	-
8.	INIPA. Izq.	2.20	132	unlined	MS	-	2.20	-
9.	Pisquillo	6.22	from Orcon river	unlined	MS	-	-	6.22
10.	Aurora	4.00	from Pisquillo	unlined	MS	2.30	1.70	-
11.	Puquio	4.62	134	unlined	MS	-	4.62	-
12.	San Jose	1.40	from Maria, Aurora	unlined	MS	-	1.40	-
13.	Gramadal	2.20	120	unlined	MS	-	2.20	-
14.	Vasquez	1.25	79	unlined	MS	-	1.25	-
15.	San Luis	2.00	120	unlined	MS	-	2.00	-
16.	Colca	1.40	54	unlined	MS	-	1.40	-
17.	Platanal	1.00	120	unlined	MS	-	1.00	-
	Total	51.68 km				6.50	39.31	6.22

Note: 1. Canal is damaged by erosion and leakage. Urgent rehabilitation is necessary.

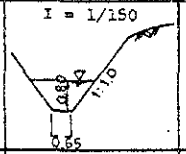
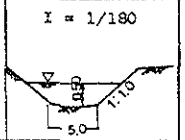
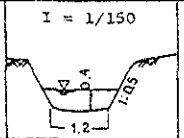
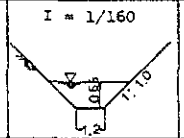
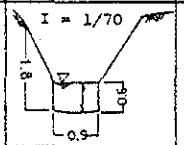
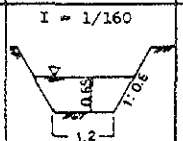
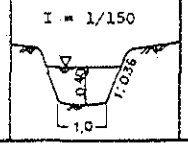
2. Under good maintenance, rehabilitation is not necessary.

3. Structural problem is not observed. Good maintenance.

Table H-2-17 Condition of Existing Drainage Canal (1)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
ESPERANZA	DRAINAGE LA ESPERANZA JECUAN	4.20	I = 1/100 	Unlined	124	- - -	MS	4.20	-	-	Canal bed is too deep from land level about 10m. Necessary slope protection work length of 250m. Pendent of canal bed slope is too steep.
ESPERANZA	DRAINAGE ESPERANZA DER.	0.77	I = 1/150 	Unlined	65	- - -	MS	-	0.77	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
ESPERANZA	DRAINAGE ESPERANZA IZQ.	0.50	I = 1/150 	Unlined	59	- - 1	MS	-	0.50	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's functions.
ESPERANZA	DRAINAGE RETES	5.65	I = 1/250 	Unlined	462	- - -	MS	-	5.65	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function. Necessary excavation Soft pendent.
QUINCHA & CONOSO	DRAINAGE QUINCHA	8.47	I = 1/140-1/100 	Unlined	407	5 - 1	MS	-	8.47	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function. Borders are completely covered with weed. Necessary excavation
QUINCHA & CONOSO	DRAINAGE DONOSO	3.70	I = 1/185 	Unlined	230	- - -	FS	-	3.73	-	Drain is born from the land filtrations in bad conditions of drainage and salinity. To 200m from the first section exist a confluence of drain, and therefor increase the water tight. Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
QUINCHA & CONOSO	DRAINAGE INIPA DER.	1.65	I = 1/150 	Unlined	130	1 - -	MS	-	1.65	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.

CONDITION OF EXISTING DRAINAGE CANAL (2)

Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km) I	II	III	Remarks
QUINCHA & CONOSO	DRAINAGE INIPA IZQ.	2.20	I = 1/150 	Unlined	132	- - -	MS	-	2.20	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
PALPA	DRAINAGE PISQUILLO	6.22	I = 1/180 	Unlined	from Orcon river	- - -	MS	-	-	6.22	Annual discharge of Orcon Pisquillos is too small. Not necessary urgent canal improvement work.
PALPA	DRAINAGE AURORA	4.0	I = 1/150 	Unlined	from Pisquillo	- - -	MS	2.30	1.90	-	Collecting canal of Palpa and Caqui area. Canal bed and side slopes are damaged by erosion or sheet erosion Necessary excavation.
PALPA	DRAINAGE PUQUIO	4.62	I = 1/160 	Unlined	134	- - -	MS	-	4.62	-	Not necessary urgent canal improvement work. Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
SAN JOSE	DRAINAGE SAN JOSE	1.40	I = 1/70 	Unlined	from Maria canal and Aurora canal	- 1 -	MS	-	1.40	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
SAN JOSE	DRAINAGE GRAMADAL	2.20	I = 1/160 	Unlined	120	- - -	MS	-	2.20	-	Side slope is a little bit dmaged by erosion, but fulfil drainage canal's function.
SAN JOSE	DRAINAGE VASQUEZ	1.25	I = 1/150 	Unlined	79	- - -	MS	-	1.25	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.

CONDITION OF EXISTING DRAINAGE CANAL (3)

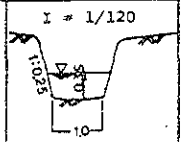
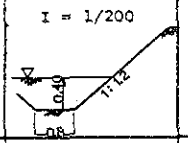
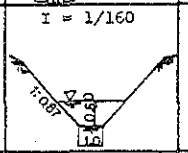
Area	Canal	Length (km)	Canal Section	Lined or Unlined	Net Irrigation Area or Catchment Area (ha)	Numbers of Turnout, Drop & Division	Soil Texture	Ranking of Rehabilitation (Km)			Remarks
								I	II	III	
BOZA & PASAMAYO	DRAINAGE SAN LUIS	2.00	I = 1/120 	Unlined	120	- - -	MS	-	2.00	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
BOZA & PASAMAYO	DRAINAGE COLCA	1.40	I = 1/200 	Unlined	54	- - -	MS	-	1.40	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.
BOZA & PASAMAYO	DRAINAGE PLATANAL	1.00	I = 1/160 	Unlined	120	- - -	MS	-	1.00	-	Side slope is a little bit damaged by erosion, but fulfil drainage canal's function.

Table H-2-18 Summary of Existing Levee(1)

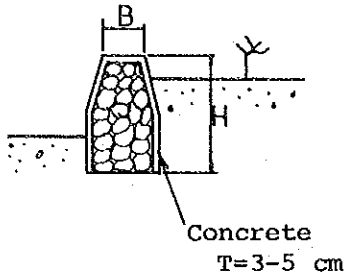
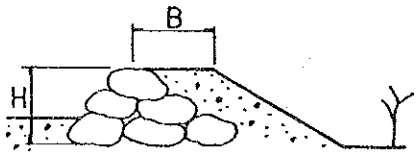
Location	Structure (m)	Length (km)	Remarks
Right Bank			
-Upstream of Esperanza Intake	Concrete (B=0.5,H=2.0 - 3.0)	0.50	(Constructed in 1925) 
-Downstream of Puente Palpa	Concrete (B=0.8,H=2.0)	0.06	
-Between Huando and Chancay Intake	Concrete (B=0.5 - 0.8, H=2.0 - 3.0)	2.38	
-Downstream of Chancay Intake	Concrete (B=0.3 - 0.5, H=3.0)	0.20	
	(B=0.3, H=2.0)	0.90	Sinked and/or
	(Rubble works H=3.0)	0.30	destroyed
	(Concrete B=0.5,H=2.5)	0.09	2m in Diameter of stone
-Upstream of Puente Huaral	Rubble works H=3.6	0.13	1.0 m in Diameter of stone
-Downstream of Puente Huaral	Rubble works H=3.5	0.12	- do - 
-Upstream of Puente Chancay	Concrete (B=1.3, H=1.5)	0.04	
-Downstream of Puente chancay	Rubble works H=3.6	0.18	1.0 m in Diameter of stone
Total		4.90 km	

Table II-2-18 Summary of Existing Levee(2)

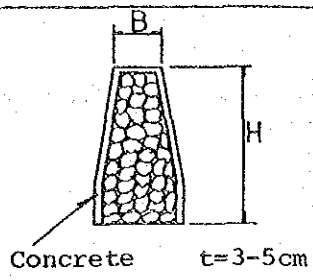
Location	Structure (m)	Length (km)	Remarks
Left Bank			
- Downstream of Palpa Intake	Concrete (B=0.4 - 0.5, H=4.0)	0.15	
	(B=0.4 - 1.0, H=2.0 -3.0)	0.30	
- Upstream of Esperanza Intake	Rubble works H=2.5	0.20	2m - 1.5 m in Diameter of stone
- Upstream of Puente Huaral	Rubble works H=3.5	0.15	1.0m in Diameter of stone
- Downstream of Puente Huaral	Rubble works H=3.4	0.10	1.0 m in Diameter of stone
- Upstream of Puente Chancay	Concrete (B=1.8, H=3.5)	0.60	
- Downstream of Puente Chancay	Rubble works H=3.0	0.30	0.5m in Diameter of stone
Total		1.80 km	

Table H-2-19 Summary of Existing Roads (1)

No.	Location		Width (m)	Length (Km)	Road Surface	Remarks
1.	Panamerican Road		24.0	25.0	Asphalt pavement	Asphalt 16m
2.	Chancay-Huaral		9.0	9.5	ditto	" 6m
3.	Pasamayo-Huaral		9.2	12.0	ditto	" 6m
4.	Huaral-Huando		9.5	2.3	ditto	" 6m
5.	Huaral-Esperanza		10.0	7.0	ditto	" 6m
6.	Huando-Esperanza Alta.		3.0-5.0	6.4	Sand Road	
7.	Esperanza Alta-Palpa.		6.0-9.0	2.5	ditto	
8.	Pasamayo-Palpa	A	5.0-7.50	8.0	ditto	Boza-Miraflores
		B	3.0	3.0	ditto	Miraflores-Caqui without 1.0 Km.
		C	2.0-4.5	5.8	ditto	Caqui-Palpa.
9.	Huando-Garcia		4.0-8.3	5.0	ditto	
10.	Garcia-Granados-Esperanza		7.0	10.8	ditto	
11.	Esquivel-Jecuan		4.0	7.2	ditto	
12.	Esquivel-Retes-Esperanza		4.5-7.0	6.8	ditto	
13.	Chacra Grande (Retes)		3.0	1.8	ditto	
14.	Quincha (Retes)		6.3	1.3	ditto	
15.	Chancayllo-Jecuan -Esperanza		3.0-5.5	8.2	ditto	
16.	Los Laureles-Quepepampa-Esquivel		6.0-7.4	6.4	ditto	
17.	Quepepampa		5.4	1.6	ditto	
18.	Chancayllo		3.0-7.0	5.0	ditto	
19.	Cerro-Prietochico		4.0-7.0	4.0	ditto	

Table H-2-19 Summary of Existing Roads (2)

No.	Location	Width (m)	Length (km)	Road Surface	Remarks
20.	Querencia-Santafe	5.2	3.9	Sand road	
21.	Cabuyal - Maria Paz	5.5	3.8	ditto	
22.	Esperanza - Huerequeque	4.0	3.6	ditto	
23.	Huando - Esperanza	7.5-9.0	12.4	ditto	
24.	Los Naturales	4.0	3.8	ditto	
25.	Huaral-Caqui	5.0-6.2	4.5	ditto	
26.	La Huaca - Miraflores	6.0-7.0	3.3	ditto	
27.	Huando (Interno)	3.0	2.3	ditto	
28.	Caqui - Palpa (A) (Interno)	3.0-4.0	5.0	ditto	without 1.0km
29.	Caqui-Palpa (B)	6.0-3.0	7.0	ditto	
30.	Palpa-Bocatoma Palpa	3.0-5.0	5.8	ditto	
31.	Boza-Aucayama	3.0-5.0	9.0	ditto	
32.	Boza-San Jose	8.0	6.6	ditto	
33.	Chacramar-Boza	3.0-5.0	4.9	ditto	
34.	Esquivel-Jesusdelvalle	3.0-5.0	4.7	ditto	
35.	Torre Blanca	3.0-4.0	2.3	ditto	
36.	Donoso-Quincha	3.0-4.0	7.0	ditto	
	Total		229.5 km		

Table H-2-20 Network of Existing Farm Road

No.	Area	Farm Road (km)	Remarks
1.	CHACRA MAR	5.2	per 100 ha
2.	- do -	2.8	- do -
3.	BOZA	2.8	- do -
4.	- do -	1.6	- do -
5.	PASAMAYO	2.1	- do -
6.	- do -	1.8	- do -
7.	HUACA-BOZA	2.9	- do -
8.	- do -	2.4	- do -
9.	QUEPEPAMPA-CHANCAYLLO	2.6	- do -
10.	- do -	3.5	- do -
11.	ESQUIBEL-JESUS DEL VALLE	3.7	- do -
12.	- do -	1.8	- do -
13.	PALPA	1.5	- do -
14.	- do -	2.4	- do -
15.	ESPERANZA-NATURALES	5.9	- do -
16.	- do -	4.0	- do -
17.	PALPA	1.5	- do -
18.	- do -	2.4	- do -
19.	ESPERANZA	1.4	- do -
20.	- do -	4.1	- do -

Average length per unit 100 ha is 2.82 km.

Table H-2-21 Existing Bridges across Chancay River

Bridges	Length (m)	Width (m)	No. of Span	Structure (upper)	Remarks
1. Chancay	57.0	16.4	3	Concrete	Concrete Slab
2. Huaral	99.0	11.5	3	Concrete	ditto
3. San Jose	129.0	2.3	8	Steel frame	Wood floorboad
4. Palpa	109.4	2.7	4	Steel frame	ditto

Table H-2-22 Volume of Traffic(1)

Place : San Jose Bridge

Date : 22 July 1984, AM 6:00-PM 6:00

Time	Sedan	Small size truck	Track	Micro bus
6:00 - 7:00	13	6	5	3
7:00 - 8:00	10	2	3	4
8:00 - 9:00	4	3	1	2
9:00 - 10:00	7	4	-	-
10:00 - 11:00	5	3	2	2
11:00 - 12:00	6	1	2	5
12:00 - 13:00	3	7	4	1
13:00 - 14:00	4	8	3	3
14:00 - 15:00	9	5	7	5
15:00 - 16:00	6	-	4	6
16:00 - 17:00	9	7	4	2
17:00 - 18:00	11	4	2	3
Total	87	50	37	36

Table H-2-22 volume of Traffic(2)

Place : Palpa Bridge

Date : 29 July 1984, AM 6:00 - PM 6:00

Time	Section I	Section II	Remarks
6:00 - 7:00	6	8	
7:00 - 8:00	20	10	
8:00 - 9:00	11	7	
9:00 - 10:00	16	9	
10:00 - 11:00	12	10	
11:00 - 12:00	17	10	
12:00 - 13:00	14	9	
13:00 - 14:00	18	12	
14:00 - 15:00	13	6	
15:00 - 16:00	21	7	
16:00 - 17:00	12	5	
17:00 - 18:00	13	11	
Total	173	104	

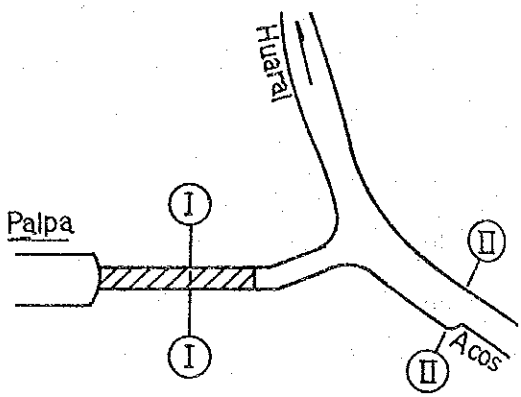


Table H-3-1 SUMMARY OF UNIFIED INTAKES

(All dimentions are shown in meter)

Existing Intake	Discharge Intake (m^3/sec)	CASE I	CASE II	CASE III	CASE IV	CASE V
Right Bank		-Esperanza Q=3.51m^3/sec Fixed weir H=1.7,l=115 Sand Sluiceway B=14.0 Gates 3.0 x 1.7 2 NOS. 2.0 x 1.7 1 NO. Intake B=15 Gates 25x1.0 4 NOS.	-Cuyo Q1=11.15m^3/sec Q2=4.00m^3/sec Fixed Weir H=2.5, l=60 Sand Sluiceway B_1=14.0(Left Bank) B_2=18.5(Right Bank) Gates 3 x 2.5 5 NOS. 2 x 2.5 2 NOS.	-Esperanza Q=3.51m^3/sec Intake facility is same CASE I.	-Palpa & Esperanza Q_1=3.1m^3/sec Q_2=10.73m^3/sec Fixed Weir H=1.7, l=96 Sand Sluiceway B_1=14.0(Palpa) B_2=18.5 (Esperanza) Gates 3.0 x 1.7 5 NOS. 2.0 x 1.7 2 NOS. Intake B_1=15.0 (Palpa) B_2=43.0 (Esperanza) Gates 3.0 x 1.7 15 NOS. Sedimentation Basin 2 No.	-Palpa & Esperanza Q_1=3.51m^3/sec Q_2=2.56m^3/sec Fixed Weir H=1.7, l=100 Sand Sluiceway B=14 (Palpa) B=14 (Esperanza) Gate 3.0 x 1.7 4 NOS. 2.0 x 1.7 2 NOS. Intake B_1=11.5m (Palpa) B_2=15.0 (Esperanza) Gates 2.5 x 1.0 7 NOS. Sedimentation Basin 2 NOS.
1. Espranza	3.51					
2. Malaca	0.08					
3. Huando	1.46	-Huando Q=1.46m^3/s Fixed weir H=2.0 l=140 Sand Sluiceway B=14 Gates 3.0 x 2.0 2 NOS. 2.0 x 2.0 1 NO. Intake B=6.0 Gates 3.0x1.0 1 NO. Sedimentation Basin 1 NO.	Intake B_1=11.5(Left Bank) B_2=25.5(Right Bank) Gates 2.5 x 1.0 15 NOS. Sedimatation Basin 2 NOS.	-Huando Q=1.46m^3/sec Intake facility is same CASE I.		-Huando & Chancay-Huaral Q=7.22 m^3/sec Fixed Weir H=2.0, l=140 Sand Sluiceway B=18.5 Gates 3.0 x 2.0 3 NOS. 2.0 x 2.0 1 NO. Intake B=18.5 Gates 2.5 x 1.0 7 NOS. Sedimentation
4. Chancay-Huaral	5.76	-Chancay-Huaral Q=5.76m^3/s Fixed weir H=1.0,l=120 Sand Sluiceway B=18.5 Gates 3.0 x 1.0 3 NOS. 2.0 x 1.0 1 NO. Intake B=18.5 Gates 2.5 x 1.0 7 NOS. Sedimentation Besin 1 NO.		-Chancay-Huaral Q=5.76m^3/sec Intake facility is same CASE I.		
5. Salinas Alto	0.16					
6. Salinas M_1						
7. Salinas M_2						
8. Salinas Bajo	0.16					
Left Bank						
9. Palpa	1.33	-Palpa Q=1.32 m^3/sec Fixed weir H=1.7 l=115 Sand Sluiceway B=14 Gates 3.0 x 1.7 2 NOS. 2.0 x 1.7 1 NO. Intake B=14 Gates 2.5 x 1.0 3 NOS. Sedimentation Basin 1 NO.		-Palpa Q=2.56m^3/sec Intake facility is same CASE I.	-Small Scale TYPE-II Intake facility is same CASE II 1 NO.	-Small Scale TYPE-I Intake facility is same CASE I. 2 NOS.
10. Caqui						
11. San Jose Aucallama	0.71					
12. Bozu Alto	0.54					
13. Boza Bajo	0.26					
14. Pasamayo Alto	0.26	-Small Scale TYPE - I Q=0.3m^3/sec 8.No. Fixed Weir H=1.0, l=30 Sand Sluiceway B=8.5 Gates 2.0 x 1.0 2 NOS. Intake B=3.2 Gate 1.2 x 0.8 1 NO.	-Small scale TYPE-I Intake facility is same CASE I. 2 NOS.	-Small scale TYPE-I Intake facility is same CASE I. 2 NOS.	-Small Scale TYPE-III Q=0.9m^3/sec Fixed weir H=1.0, l=30 Sand Sluiceway B=8.5 Gate 2.0 x 1.0 2 NOS. Intake B=8.5 Gates 1.5 x 0.8 3 NOS. 1 NO.	-Small Scale TYPE-II Intake facility is same CASE I. 3 NOS.
15. Monte Chico	0.10					
16. Pasamayo Bajo	0.44					
17. Hunglar	0.10	-Small Scale TYPE - II Q=0.6m^3/sec 4 NOS. Fixed Weir H=1.0, l=30 Sand Sluiceway B=8.5 Gates 2.0 x 1.0 2 NOS. Intake B=5.4 Gates 1.2 x 0.8 2 NOS.		-Small scale TYPE II Intake facility is same CASE I. 3 NOS.		

Table H-3-2 CONSTRUCTION COST OF CASE I

(Unit : $)

INTAKE	Excavation-I		Excavation-II		Back Fill		Plain Concrete		Reinforced Concrete		Stone Pitching		Protection Wall TYPE - I		Protection Wall TYPE - II		Gate		Other		Total Cost
	Unit Price 0.95		Unit Price 3.26		Unit Price 1.38		Unit Price 57.81		Unit Price 116.02		Unit Price 16.51		Unit Price 132.22		Unit Price 81.06		Unit Price 6,736.5		Unit Price		
	Q'ty (m^3)	Cost	Q'ty (m^3)	Cost	Q'ty (m^3)	Cost	Q'ty (m^3)	Cost	Q'ty (m^3)	Cost	Q'ty (m^3)	Cost	Q'ty (m)	Cost	Q'ty (m)	Cost	Q'ty (m^2)	Cost	Q'ty	Cost	
(Right Bank)																			(wet masonry m^3)	(19.67)	
1.Esperanza	11,000	10,450	4,000	13,040	4,500	6,210	5,780	334,141	1,820	212,248	670	11,061	350	46,277	800	64,848	48.10	324,025	610	11,998	1,034,298
2.Malaca	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
3.Huando	9,390	8,920	4,500	14,670	4,100	5,658	6,820	394,264	990	115,453	790	13,042	200	26,444	500	40,530	29.00	195,358	980	19,276	833,615
4.Chancay-Huaral	9,000	8,550	3,000	9,780	3,600	4,968	6,550	378,655	3,230	376,682	720	11,887	350	46,277	800	64,848	59.40	400,148	630 (Gabion m^2)	12,392 (18.75)	1,314,187
5.Salinas Alto	780	741	200	652	300	414	758	43,819	320	37,318	180	2,971	-	-	-	-	6.56	44,191	100	1,875	131,981
6.Salinas M_1	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	131,981
7.Salinas M_2	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	131,981
8.Salinas Bajo (Left Band)	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	" (wet mansonry m^3) 610	" (19.67) 11,998	
9.Palpa	7,070	6,716	4,000	13,040	3,300	4,554	5,650	326,626	990	115,453	660	10,896	315	41,649	500	40,530	26.60	179,190	(Tunnel) 40m (Gabion) $100m^3$	(673.6) 26,944 (13.75) 1,875	777,596
10.Caqui	856	813	200	652	300	414	780	45,091	368	42,916	180	2,971	-	-	-	-	7.52	50,658	"	"	145,390
11.San Jose	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,390
12.Boza Alto	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,390
13.Boza Bajo	780	741	"	"	"	"	758	43,819	320	37,318	"	"	-	-	-	-	6.56	44,191	"	"	131,981
14.Pasamayo Alto	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	131,981
15.Monte Chico	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	131,981
16.Pasamayo Bajo	856	813	"	"	"	"	780	45,091	368	42,916	"	"	-	-	-	-	7.52	50,658	"	"	145,390
17.Hunglar	780	741	"	"	"	"	758	43,819	320	37,318	"	"	-	-	-	-	6.56	44,191	"	"	131,981
Total		43,816		58,354		26,358		1,964,602		1,290,044		82,538		160,647		210,756		1,654,881		105,108	5,597,104

Table H-3-3 CONSTRUCTION COST OF CASE II and CASE III

(Unit : $)

INTAKES	Excavation-I		Excavation-II		Back Fill		Plain Concrete		Reinforced Concrete		Stone Pitching		Protection Wall TYPE - I		Protection Wall TYPE - II		Gate		Other		Total Cost
	Unit Price 0.95		Unit Price 3.26		Unit Price 1.38		Unit Price 57.81		Unit Price 116.02		Unit Price 16.51		Unit Price 132.22		Unit Price 81.06		Unit Price 6,736.5		Unit Price		
	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost	
	(m^3)		(m^3)		(m^3)		(m^3)		(m^3)		(m^3)		(m)		(m)		(m^2)				
Case - II																			(Tunnel) 50m (wet masonry)	(673.6) 33,680 (19.67)	
1. Cuyo	16,000	15,200	4,900	15,974	6,300	8,694	6,240	36,073	7,170	836,165	490	8,089	315	41,649	500	40,530	127.25	857,219	600m^3	11,802	1,905,075
Case - III																					
1. Esperanza	11,000	10,450	4,000	13,040	4,500	6,210	5,780	334,141	1,820	212,248	670	11,061	350	46,277	800	64,848	48.10	324,025	610	11,998	1,034,298
2. Huando	9,390	8,920	4,500	14,670	4,100	5,658	6,820	394,264	990	115,453	790	13,042	200	26,444	500	40,530	29.00	195,358	980	19,276	833,615
3. Chancay-Huaral	9,000	8,550	3,000	9,780	3,600	4,968	6,550	378,655	3,230	376,682	720	11,887	-	-	-	-	59.40	400,148	630 Gabion m^2	12,392 (18.75)	1,203,062
4. Salinas Alto	780	741	200	652	300	414	758	43,819	320	37,318	180	2,971	-	-	-	-	6.56	44,191	100	1,875	131,981
5. Salinas Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	" (wet masonry) 610m^3	" (19.67) 11,998	131,981
6. Palpa	9,800	9,310	3,400	11,084	3,960	5,464	5,710	330,095	1,610	187,758	670	11,061	315	41,649	500	40,530	40.10	270,133	Tunnel 40m	(673.6) 26,944	946,026
7. Boza Alto	856	813	200	652	300	414	780	45,091	368	42,916	180	2,971	-	-	-	-	7.52	50,658	Gabion 100m^3	(18.75) 1,875	145,390
8. Boza Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,390
9. Pasamaya Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,390
Total		41,151		51,834		24,370		1,660,066		1,095,525		61,906		114,370		145,908		1,430,020		91,983	4,717,133

Table H-3-4 CONSTRUCTION COST OF CASE IV and CASE V

(Unit : $)

INTAKE	Excavation-I Unit Price 0.95 Q'ty (m^3)	Excavation-I Cost	Excavation-II Unit Price 3.26 Q'ty (m^3)	Excavation-II Cost	Back Fill Unit Price 1.38 Q'ty (m^3)	Back Fill Cost	Plain Concrete Unit Price 57.81 Q'ty (m^3)	Plain Concrete Cost	Reinforced Concrete Unit Price 116.02 Q'ty (m^3)	Reinforced Concrete Cost	Stone Pitching Unit Price 16.51 Q'ty (m^3)	Stone Pitching Cost	Protection Wall TYPE - I Unit Price 132.22 Q'ty (m)	Protection Wall TYPE - I Cost	Protection Wall TYPE - II Unit Price 81.06 Q'ty (m)	Protection Wall TYPE - II Cost	Gate Unit Price 6,736.5 Q'ty (m^2)	Gate Cost	Other Unit Price Q'ty	Other Cost	Total Cost
Case IV																			(wet masonry) 690m^3 (Tunnel) 40m (Gabion) m^2	(19.67) 13,572 (673.6) 26,944 (18.75)	
1. Palpa & Esperanza	24,000	22,800	5,600	18,256	8,500	11,730	6,910	399,467	6,420	748,700	690	11,391	315	41,649	500	40,530	136.55	919,869			2,254,908
2. Salinas Alto	856	813	200	652	300	414	780	45,091	368	42,916	180	2,971	-	-	-	-	7.52	50,658	100	1,875	145,390
3. Boza Bajo	940	893	"	"	350	483	857	49,543	430	50,146	180	"	-	-	-	-	10.50	70,733	100	"	177,296
Total		24,506		19,560		12,627		494,101		841,762		17,333		41,649		40,530		1,041,260		44,266	2,577,594
Case V																			(wet masonry) m^3 530 (Tunnel) 40m	(19.67) 10,425 (673.6) 26,944	
1. Palpa & Esperanza	14,700	13,965	3,500	11,410	5,400	17,604	6,060	350,328	3,430	400,006	680	11,226	315	41,649	500	40,530	88.20	594,159			1,518,246
2. Huando & Chancay-Hural	14,800	14,060	3,800	12,388	5,600	18,256	7,730	446,871	3,140	366,186	700	11,557	200	26,444	500	"	62.50	421,031	(wet masonry) 980 m^3 (Gabion)	(19.67) 19,276 (18.75)	1,376,599
3. Salinas Alto	780	741	200	652	300	978	753	43,819	320	37,318	180	2,971	-	-	-	-	6.56	44,191	100 m^2	1,875	132,545
4. Salinas Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	132,545
5. Boza Alto	856	813	"	"	"	"	780	45,091	368	42,916	"	"	-	-	-	-	7.52	50,658	"	"	145,954
6. Boza Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,954
7. Pasamayo Bajo	"	"	"	"	"	"	"	"	"	"	"	"	-	-	-	-	"	"	"	"	145,954
Total		31,946		27,058		40,750		1,020,110		969,576		37,638		68,093		81,060		1,255,546		66,020	3,597,797

Table H-3-5 Construction Cost of Connecting Canal

(Unit : $)

Case Study	TYPE - A		TYPE - B		TYPE - C		TYPE - D		TYPE - E		Tunnel		TOTAL
	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost	
	(Km)		(Km)		(Km)		(Km)		(Km)		(Km)		
Case - I	-	-	-	-	-	-	-	-	-	-	-	-	-
Case - II	16.0	1,956,800	2.5	247,500	16.0	1,209,600	9.0	206,100	8.0	144,800	2.5	1,684,000	5,448,800
Case - III	-	-	-	-	-	-	6.0	137,400	11.0	199,100	-	-	336,500
Case - IV	3.5	428,050	2.5	247,500	6.0	453,600	9.0	206,100	8.0	144,800	2.5	1,684,000	3,164,050
Case - V	-	-	2.5	247,500	3.5	264,600	6.0	137,400	11.0	199,100	-	-	848,600

Unit Price of Canal

(Unit: $)

Connecting Canal	Unit Price (Km)
Type - A	122,300
Type - B	99,000
Type - C	75,600
Type - D	22,900
Type - E	18,100
Tunnel	673,600

Table H-3-8 Dimension of Permanent Weir(1)

Weir	Df_1	Df_2	Df_3	C	L_1	L_2	L_3	L_4	L_5	Remarks
					$0.62 \times Df_2$	$(0.62+0.8) \times Df_2 < L_2$	$0.6 \times C \cdot \sqrt{Df_3} < L_3$	$0.67 \times C \times \sqrt{Df_3 \times q}$	$L_4 - L_3$	Discharge per unit width $q=Q/B$
	(m)	(m)			(m)	(m)	(m)	(m)		(m^3/sec)
Palpa and Esperanza	1.7	4.2	2.7	6	2.6	6.0	7.0	13.0	5.0	450/116=3.9
Huando and Chancay Huarol	2.0	4.5	3.0	6	2.8	6.5	7.5	3.5	5.0	450/151=3.0
Small scale Intake	1.0	2.0	1.0	6	1.2	3.0	6.0	9.0	3.0	450/100=4.5

where : C = Bligh's C

Bedrock	Grain size	C value
Fine sand particles and/or silt	0.005 to 0.01 mm	18
Fine sand	0.1 to 0.25 mm	15
Coarse sand	0.5 to 1.0 mm	12
Mixture of gravels and sand		9
Boulders, gravels and sand		4 to 6

Table H-3-9 Dimension of Permanent Weir(2)

Weir	$\Delta h_{(m)}$	$S_{(m)}$	r_{ton/m^3}	hf_1	$\frac{4}{3}\frac{\Delta h-hf}{r-1} < T_A$
Palpa and Esperanza	2.7	18.5	2.3	1.61	1.5
Huando and Chancay-Huaral	3.0	19.5	2.3	1.77	1.5
Small scale Intake	1.0	13.0	2.3	0.49	1.0

Where

$$S > C\ \Delta h$$

S = Percolation path;s length

Δh = Water level diffierence between upstream and down stream

C = Blight;s C : 6

$$T_A = \frac{4}{3}\frac{\Delta h-hf}{r-1}$$

T_A = Thickness of fore apron

r = Specific gravity of apron's material

hf = Loss head at arbitrary point

$$hf : (\Delta h/s) \cdot S'$$

S' = Length of the percolation path of calculation point

Table H-3-11 (1) DIMENSION OF IRRIGATION CANAL

Area	No.	Canal	Net Irrigation Area (ha)	Discharge (m^3/sec)	Canal Type	Canal Dimention b (m)	D (m)	Z (1:m)	v (m/sec)	n	Fb (m)	Gradient of Canal I	Hight H (m)	Design Hight H (m)
Esperanza	1.	La Esperanza	3,440	3.51	II	1.10	1.097	1:1.0	1.455	0.015	0.313	1/1000	1.409	1.40
	2.	Cabuyal	1,192	1.80	III	1.20	0.937	1:0.5	1.148	0.016	0.264	1/1100	1.203	1.20
	3.	Cabuyal Bajo	776	1.16	III	1.10	0.693	1:0.5	1.156	0.016	0.253	1/800	0.946	0.95
	4.	Grandos 1	1,818	2.70	II	1.00	0.940	1:1.0	1.481	0.015	0.353	1/800	1.293	1.30
	5.	Grandos 2	-	2.70	II	0.90	1.134	1:1.0	1.171	0.015	0.340	1/1500	1.474	1.50
	6.	1st Lat. Granados	336	0.50	III	0.70	0.584	1:0.5	0.836	0.016	0.225	1/1000	0.809	0.80
	7.	3rd Lat. Granados	573	0.88	III	0.70	0.584	1:0.5	1.033	0.016	0.251	1/900	0.895	0.90
	8.	Lat. 3-1 Granados	327	0.50	III	0.80	0.465	1:0.5	1.042	0.016	0.225	1/600	0.690	0.70
	9.	4th Lat. Granados	103	0.16	III	0.50	0.275	1:0.5	0.911	0.016	0.184	1/400	0.459	0.50
	10.	5th Lat. Granados	55	0.16	III	0.60	0.360	1:0.5	0.571	0.016	0.171	1/1400	0.530	0.60
Huando	11.	Huando 1	8,219	7.22	I	1.60	1.483	1:0.5	1.579	0.015	0.450	1/1300	1.933	2.00
	12.	Huando 2	1,416	1.46	III	1.20	0.783	1:0.5	1.172	0.016	0.288	1/900	1.080	1.10
	13.	Huando 3	421	0.62	III	0.80	0.553	1:0.5	1.041	0.016	0.238	1/700	0.792	0.80
	14.	Huando 4	160	0.26	III	0.60	0.391	1:0.5	0.837	0.016	0.194	1/700	0.585	0.60
Chancay-	15.	Chancay-Huaral	6,803	5.76	I	1.40	1.385	1:1.0	1.493	0.015	0.421	1/1300	1.807	1.80
	16.	Huaral 1	4,774	3.25	II	1.10	1.028	1:1.0	1.485	0.015	0.367	1/900	1.395	1.40
	17.	Huaral 2	817	1.10	III	1.10	0.645	1:0.5	1.198	0.016	0.270	1/700	0.915	1.00
	18.	Garcia Alonso	477	0.66	III	0.90	0.558	1:0.5	1.004	0.016	0.235	1/800	0.793	0.80
	19.	Jesus Del Valle	801	1.36	III	1.20	0.750	1:0.5	1.151	0.016	0.280	1/900	1.030	1.10
	20.	Chancay	2,029	1.67	III	1.20	0.874	1:0.5	1.167	0.016	0.301	1/1000	1.175	1.20
	21.	Sta. Rosa	431	0.60	III	0.80	0.491	1:0.5	1.167	0.016	0.243	1/700	0.734	0.80
	22.	Quepe Pampa	426	0.60	III	0.80	0.491	1:0.5	1.167	0.016	0.243	1/700	0.734	0.80
	23.	Torre Blanca	255	0.48	III	0.80	0.454	1:0.5	1.031	0.016	0.222	1/600	0.676	0.70
	24.	Galeano	380	0.52	III	0.80	0.476	1:0.5	1.053	0.016	0.228	1/600	0.704	0.70
	25.	Lat. Canal No. 2'	697	1.18	III	1.10	0.701	1:0.5	1.161	0.016	0.274	1/800	0.974	1.00
	26.	Dren. Quincha	185	0.30	III	0.60	0.425	1:0.5	0.868	0.016	0.202	1/700	0.627	0.70
	27.	Dren. Retes	462	0.78	III	1.0	0.531	1:0.5	1.161	0.016	0.248	1/600	0.779	0.80
	28.	Filt. Quincha	222	0.36	III	0.50	0.445	1:0.5	1.121	0.16	0.231	1/400	0.675	0.70
Los Laureles	29.	Los Laureles (Filt. Donoso)	346	0.48	III	0.80	0.454	1:0.5	1.031	0.016	0.222	1/600	0.676	0.70

Table H-3-11 (2) DIMENSION OF IRRIGATION CANAL

Salinas	30. Salinas Alto	281	0.26	III	0.60	0.030	1:0.5	1.029	0.016	0.204	1/500	1.530	0.60
Palpa	31. Palpa	3,037	2.56	II	0.90	0.947	1:1.0	1.463	0.015	0.273	1/800	1.275	1.30
	32. Palpa Alta	767	1.06	III	1.00	0.668	1:0.5	1.190	0.016	0.272	1/700	0.740	1.00
	33. Palpa Baja 1	2,270	1.55	III	1.20	0.811	1:0.5	1.191	0.016	0.294	1/900	1.105	1.00
	34. Palpa Baja 2	808	1.10	III	1.10	0.645	1:0.5	1.198	0.016	0.270	1/700	0.915	1.00
	35. Teresa	338	0.86	III	0.80	0.641	1:0.5	1.198	0.016	0.269	1/600	0.910	1.00
Caqui	36. Caqui 1	1,462	2.00	III	1.00	0.780	1:1	1.442	0.015	0.323	1/700	1.102	1.20
	37. Caqui 2	1,045	1.42	III	0.90	0.902	1:0.5	1.165	0.016	0.305	1/900	1.207	1.30
San Jose	38. San Jose	847	1.16	III	1.10	0.693	1:0.5	1.156	0.016	0.272	1/800	0.966	1.00
Boza	39. Boza Alto	779	0.54	III	0.80	0.487	1:0.5	1.063	0.016	0.231	1/600	0.717	0.80
	40. Boza Bajo 1	676	0.46	III	0.80	0.493	1:0.5	1.020	0.016	0.219	1/600	0.662	0.70
	41. Boza Bajo 2	388	0.46	III	0.80	0.418	1:0.5	1.089	0.016	0.223	1/500	0.642	0.70
Pasamayo	42. Pasamayo Bajo 1	651	0.44	III	0.70	0.466	1:0.5	1.012	0.016	0.222	1/600	0.688	0.70
	43. Pasamayo Bajo 2	461	0.32	III	0.60	0.374	1:0.5	1.086	0.016	0.216	1/400	0.591	0.60

Table H-3-12 (1) SUMMARY OF CANALS AND THEIR RELATED STRUCTURE

Area	No.	Canal	Length of Canal (m)	Related Structure					
				Drop			Division	Parshall Flume	
				Type		Nos.	Type	Nos.	Type	Nos.
Esperanza	1.	La Esperanza	5,200	I	2.0	18	-	-	-	-
	2.	Cabuyal	4,650		-	-	-	-	-	-
	3.	Cabuyal Bajo	4,730	IV	2.0	50	A'	4	A	4
	4.	Grandos 1	4,040	III	1.5	15	-	-	-	-
	5.	Grandos 2	5,880		-	-	-	-	-	-
	6.	1st Lat. Granados	2,600	VI	2.0	22	-	-	-	-
	7.	3rd Lat. Granados	3,100	V	2.0	33	B	3	B	3
	8.	Lat. 3-1 Granados	3,600	VI	1.5	1	-	-	-	-
	9.	4th Lat. Granados	2,050	VI	1.5	1	-	-	-	-
	10.	5th Lat. Granados	1,400		-	-	-	-	-	-
Huando	11.	Huando 1	950		-	-	A	1	A	1
	12.	Huando 2	5,000	IV	2.0	26	B	1	B	1
	13.	Huando 3	3,210	V	2.0	4	B	1	B	1
	14.	Huando 4	3,840	VI	2.0	10	-	-	-	-
Chancay Huaral	15.	Chancay-Huaral	2,500	I	2.0	15	A	1	A	1
	16.	Huaral 1	6,250	II	2.0	22	A'	2	A	2
	17.	Huaral 2	3,070	IV	1.5	18	B	3	B	3
	18.	Garcia Alonso	9,480	V	1.5	26	B	5	B	5
	19.	Jesus del Valle	3,340	IV	2.0	32	A'	3	A	3
	20.	Chancay	11,670	IV	2.0	61	A'	4	A	4
	21.	Sta. Rosa	7,150	V	2.0	34	C	2	C	2
	22.	Quepe Pampa	2,890	V	2.0	11	C	3	C	3
	23.	Torre Blanca	350		-	-	-	-	-	-
	24.	Galeano	3,450	V	2.0	17	C	2	C	2
	25.	Lat. Canal No. 2'	1,000	V	1.5	4	-	-	-	-
	26.	Dren. Quincha	2,500	VI	1.5	10	D	1	C	1
	27.	Dren. Retes	2,500	V	1.5	10	D	1	C	1
	28.	Filt. Quincha	1,000	VI	1.5	7	-	-	-	-
Los Laureles	29.	Los Laureles (Filt. Donoso)	5,900	VI	2.0	31	C	2	C	2

Table H-3-12 (2) SUMMARY OF CANALS AND THEIR RELATED STRUCTURE

Salinas	30.	Salinas Alto	2,000	VI	2.0	8	C	2	C	2
Palpa	31.	Palpa	180		-	-	A'	1	A	1
	32.	Palpa Alta	6,870	IV	1.5	16	B	2	B	2
	33.	Palpa Baja 1	5,300	IV	1.5	25	A'	2	A	2
	34.	Plapa Baja 2	8,110	IV	1.5	31	B	2	B	2
	35.	Teresa	2,500	V	1.5	17	C	1	C	1
Caqui	36.	Caqui 1	2,750	III	2.0	8	B	2	B	2
	37.	Caqui 2	7,900	IV	2.0	29	-	-	-	-
	38.	San Jose	10,300	IV	2.0	19	A', C	2, 2	A', C	2, 2
Boza	39.	Boza Alto	5,700	V	1.5	15	C	2	C	2
	40.	Boza Bajo 1	2,900	VI	2.0	5	C	2	C	2
	41.	Boza Bajo 2	2,400	VI	1.5	11	-	-	-	-
Pasamayo	42.	Pasamayo Bajo 1	1,100	VI	1.5	24	C	2	C	2
	43.	Pasamayo Bajo 2	3,700	VI	2.0	42	-	-	-	-
		Total	175,000			720		61		61

Table H-3-14 Capacity of Rehabilitation Reservoirs

Reservoir	Existing Storage Capacity	Sediment	Storage Capacity After Dredged	Requiered Storage Capacity	Shortage Capacity	Improvement Plan		
						Dyke	Inlet	Outlet
	(m^3)	(m^3)	*(m^3)	(m^3)	(m^3)			
Esperanza	30,000	12,000	42,000*	39,300			o	o
Huando	11,300	2,300	13,600*	13,400			o	o
Jesus del Valle	19,000	5,600	24,600	34,100*	9,500	o	o	o
Cerrito	9,000	3,000	12,000	17,700*	5,700	o	o	o
Quepepampa	8,700	2,100	10,800	13,800*	3,000	o	o	o
Buena Vista	6,100	4,000	11,300*	10,400			o	o
Galeano	8,000	4,500	12,000*	10,400			o	o
Laureles	13,600	2,700	16,300*	11,200			o	o
Chancay Bajo	2,900	4,400	7,300	9,300*	2,000	o	o	o
Chancayllo-I	8,700	3,300	12,000*	6,500			o	o
San Juan	2,500	2,500	5,000	7,300*	2,300	o	o	o
Palpa	16,900	16,900	33,800	40,200*	6,400	o	o	o
Miraflores	13,000	7,700	20,700*	19,700				
Total	149,700	71,000	221,400 (127,900*)	233,300 (122,400*)	10,700			

Note: o The mark shows that improvement is necessity.

* Amount of storage capacity after improvement is 250,300 (127,900 + 122,400)

Table H-3-16 Plan of Main Road

No.	Location	Road Width: Width of Gravel Pavement (m)	Road Width: Shoulder (m)	Road Width: Total (m)	Road Length (km)
M-1	Huando-Esperanza Alta	6.0	1.5 x 2	9.0	6.4
M-2	Pasamayo-Palpa	6.0	1.5 x 2	9.0	16.8
M-3	Esperanza Alto -Palpa	6.0	1.5 x 2	9.0	2.5
M-4	Huando-Garucia	6.0	1.5 x 2	9.0	5.0
M-5	Garucia-Granados -Esperanza	6.0	1.5 x 2	9.0	10.8
M-6	Esquivel-Jecuan	6.0	1.5 x 2	9.0	7.2
	Total				48.7 km

Table H-3-17 Plan of Secondary Road (1)

No.	Location	Road Width: Width of Gravel pavement (m)	Road Width: Shoulder (m)	Road Width: Total (m)	Road Length (km)
SR-1	Esquivel-Retes - Esperanza	3.0	1.5 x 2	6.0	6.8
S-2	Charca Grande-Quincha	3.0	1.5 x 2	6.0	3.1
S-3	Chancayllo-Jecuan	3.0	1.5 x 2	6.0	8.2
S-4	Los Laureles - Quepe Pampa-Esperanza	3.0	1.5 x 2	6.0	6.4
S-5	Quepe Pampa	3.0	1.5 x 2	6.0	1.6
S-6	Torre Blanca	3.0	1.5 x 2	6.0	2.3
S-7	Donoso-Quincha	3.0	1.5 x 2	6.0	7.0
S-8	Chancayllo	3.0	1.5 x 2	6.0	5.0

- continue -

Table H-3-17 Plan of Secondary Road (2)

No.	Location	Road Width			Road Length (km)
		Width of Gravel pavement (m)	Shoulder (m)	Total (m)	
S-9	Querencia-Samtafe	3.0	1.5 x 2	6.0	3.9
S-10	Cabuyal-Mariapaz	3.0	1.5 x 2	6.0	3.8
S-11	Esperanza-Herequeque	3.0	1.5 x 2	6.0	3.6
S-12	Huando-Esperanza	3.0	1.5 x 2	6.0	12.4
S-13	Huaral-Victoria	3.0	1.5 x 2	6.0	3.8
S-14	Esquivel-Jesus Del Valle	3.0	1.5 x 2	6.0	4.7
S-15	Huaral-caqui	3.0	1.5 x 2	6.0	4.5
S-16	Huando (Interno)	3.0	1.5 x 2	6.0	2.3
S-17	La Huaca-Miraflores	3.0	1.5 x 2	6.0	3.3
S-18	Cerro-Prietechico	3.0	1.5 x 2	6.0	4.0
S-19	Palpa - Palpa Bocatoma	3.0	1.5 x 2	6.0	5.8
S-20	Caqui-Palpa (Interno)	3.0	1.5 x 2	6.0	5.0
S-21	Caqui-Palpa	3.0	1.5 x 2	6.0	7.0
S-22	Boza-San Jose	3.0	1.5 x 2	6.0	6.6
S-23	Chacramar-Boza	3.0	1.5 x 2	6.0	4.9
S-24	Boza-Aucallama	3.0	1.5 x 2	6.0	9.0
	Total				125.0

Table H-3-19 Plan of Levee

Location	Length (km)	Structure	Remarks
Upstream of Palpa Intake	1.0	Concrete	
(Right Bank)	1.0	Gabion	
Downstream of Palpa Intake	0.5	Concrete	
(Right Bank)	0.3	Masonry	
Downstream of Palpa Intake (Left Bank)	0.4	Masonry	
Upstream of Caqui Intake (Left Bank)	0.2	Masonry	
Downstream of Caqui Intake (Left Bank)	0.6	Masonry	1 - 2 m in Diameter of stone
Upstream of Huando Intake (Right Bank)	0.3	Masonry	1 - 2 m in Diameter of stone
Upstream of Huando Intake (Left Bank)	1.0	Masonry	1 - 2 m in Diameter of stone
Downstream of Huando	0.2	Masonry	1 - 2 m in Diameter of stone
Downstream of San Jose	4.0	Gabion	
Chancay	3.0	Gabion	
Intake of samll size	1.0	Gabion	5 place
Total			

Note: Concrete = 1.5 km
Gabion = 9.0 km
Masonry = 3.0 km

ANNEX I

PROJECT IMPLEMENTATION AND COST ESTIMATION

C O N T E N T S

ANNEX I Project Implementation and Cost Estimation

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I. Project Implementation and Cost Estimation

1 Project Organization and Implementation

It is normal procedure in Peru to establish what is known as a special project for large and complex projects. In this way, one department of Ministry, which would have the legal and administrative power to carry out all activities required, has a full and direct responsibility for executing the construction stage of the project. This procedure makes a certain autonomy in managing the planning, contracting , supervision of construction and coordinating the participation of other agencies easy.

In the case of the proposed project, the department in the Ministry of Agriculture (MAG) would be the Instituto Nacional de Ampliacion de la Frontera Agricola (INAF) and the special project would be known as the "Plan de Rehabilitacion de Tierras Costeras " (PLANREHATIC). The special project would have legal authority to enter into contracts and expend funds in payment for completed works, purchase of equipments and materials and supplies, and for other services from a budget for the project approved by the international financing agency.

The special project would also have authority to call on other departments of MAG or other agencies for specific assistants required to execute the project, viz, execution and management of the project including land settlement, cropping patterns, allocation of water, project charges and training local staff for operation and maintenance.

Food production plan, marketing, price control of agricultural products and mechanization services by Ministerio de Agricultura (MAG), and farm credit to the farmers by Banco Agrario del Peru (BAP) would be necessary to obtain a full success of the project.

Further, needless to say, farmers themselves would make an effort to introduce the adequate and rational operation and maintenance, and improvement of cultivation supported by the government agencies.

1-1 Project Implementing Agencies

It would be assumed that the government agencies should be responsible for the following functions:

(1) Ministerio de Agricultura (MAG)

The Ministry of Agriculture (MAG) is the executing agency for the project.

(a) Instituto Nacional de Ampliacion de la Frontera Agricola (INAF)

INAF, which is one of the institution of MAG, would have mainly responsibility for the implementation of the project as land recuperation and rehabilitation of irrigation and land reclamation. Direction directiva del Proyecto Especial de Rehabilitacion de Tierras Costeras (DEPE-REHATIC), which has been established under the administration of INAF, would take the responsibility for construction works ; viz, field survey, planning for the proposed works, preparation of specification and tender documents, evaluating bids and letting contracts and supervision.

DEPE-REHATIC would have charge of construction works of the project, and its organization would be proposed as shown in Fig. I-1-1. The scope of its responsible work would be conformed to the PLANREHATIC I.

(b) Administracion Tecnica del Distrito de Riego (ATDR)

ATDR Chancay-Huaral is responsible for operation and maintenance of irrigation and drainage system, and to supervise the Junta de Usuarios del Distrito Valle Chancay-Huaral (Refer to J-1).

From the standpoint to carry out operation and maintenance for rehabilitated irrigation facilities in future, it would be

proposed that ATDR Chancay-Huaral will keep close cooperation with DEPE-REHATIC in the process of the project impelementation.

(c) Centro de Investigacion y Promocion Agropecuaria (CIPA)

Chancay-Huaral, a subordinate agency of INIPA (Refer to F-2(2)), is responsible for farm technical assistance and extension to the farmers.

The strengthning of extension in the project area and improvement of Huaral Experimental Station would be proposed. And it is to be desired that the project such as Plan de extension agricola del INIPA en apoyo a las actividades del PE-REHATIC would be introduced in the project area.

(2) Banco Agrario del Peru (BAP)

Agente Huaral of BAP be carried out to provide the farm credit and technical assistance for individual farmers and cooperatives in the project area (refer to F-2(3)).

Agente Huaral of BAP would give indierect support to the project through providing agricultural credit for individual farmers and cooperatives. The other hand, the introduction of a similar project as Proyecto de asistencia privada in Canete would be proposed.

(3) Junta de Usuarios

Junta de Usuarios de Distrito Valle Chancay-Huaral, a water user's organization in the project area, would be carried out the determination of water distribution, collection of water charge, and operation and maintenance of irrigation and drainage facilities under control by the ATDR Chancay-Huaral (Refer to F-3(4) and J-1).

(4) Other agencies

Oficina Nacional de Evaluacion de Recursos Naturales (ONERN)

ONERN is responsible for investigations and surveys of natural resources, including soils and water, and general planning for the rational use and conservation of these resources.

1-2 Implementation of Civil Works

The civil works consisting of diversion weir, irrigation system, drainage system, road network and flood protection work have been carried out under the control of DEPE-REHATIC.

The civil works will be implemented with a loan from an international financing agency, since the civil works require a high construction cost. The detailed design and construction supervision of the civil works will be carried out by Consultant employed by DEPE-REHATIC under the engineering service loan.

The construction of the civil works will be executed on a Contract Basis due to smooth and on time as compared with a Force Account Basis, since the civil works include diversion weir, irrigation and drainage system, etc. on a large scale.

To smoothly execute the works, project office would be established in the PE-REHATIC. The project office would carry out all the field works, such as additional survey & investigation, land acquisition, detailed design and construction supervision. The project office would consist of head office, and branch office in the service area in keeping pace with the progress of construction works. The organization, number of personnel and transport facilities of the above office would be proposed as shown in Fig. I-1-2. The required number of personnel who engaged in the project implementation is at least 38 persons.

Project organization chart for implementation is shown in Figure I-1-1.

1-3 Consulting Services

A Consultant will be required for the detailed design and construction supervision of the civil works.

(1) Detailed design

The detailed design works will be made under the engineering service loan by an international financing agency and would be commenced after completion of procedure for the engineering service loan and the tendering for the recruitment of Consultant.

The detailed design works by a Consultant include the survey and investigation works for the structures, definitive plan for the project, the detailed design of each project structure and preparation of tender documents.

The detailed design work will be completed in 13 months from beginning of 1986 until end of January, 1987.

The detailed design work schedule and manning schedule are shown in Figure I-1-2 and I-1-3.

(2) Construction supervision

The construction supervision will be made by the same Consultant who carries out the detailed design works.

The tendering works including prequalification, site explanation and tender evaluation for the tenderers will be carried out after the detailed design works. Then the supervision works for construction to be carried out by the Contractor will be made during the construction period of five years.

A Consultant would also be required for the maintenance period of six months after completion of construction to inspect the repairing of defective work by the Contractor, and guide the water management of the

service area.

The manning schedule for the construction supervision is shown in Figure I-1-4.

1-4 Project Implementation Schedule

The project implementation schedule is proposed on the basis of the civil works, which will be financed by an international agency.

The construction of the civil works will be commenced about two and half years after completion of the Feasibility Study taking into account the loan procedure, the preparation for implementation, the detailed design and tendering for construction. The construction of civil works would have been completed in five years.

The implementation schedule for the project is shown in Figure I-1-5. Assumed that it would take much time for loan procedures compared with the original, the implementation schedule as alternative (I) is shown in Figure I-1-6.

2 Construction Plan

2-1 Civil Works

The construction of civil works consisting of a diversion weir, irrigation system, drainage system, road network and flood protection work is carried out by the Contractor under the supervision of Consultant who assists DEPE-REHATIC.

The following conditions and methods for construction will be considered:

(1) Preparatory works

The buildings including office, residence, warehouse, laboratory, etc. for the supervisory body of DEPE-REHATIC and Consultant will be

constructed by the Contractor at the beginning stage of construction and maintained by the Contractor during the construction period.

(2) Temporary works

Contractor's camp and office, access road, transmission line for electricity, water supply system, etc. will be provided by the Contractor at their own expense.

(3) Available construction materials

- Concrete aggregate, metalling material for road and filter material for pipe drain are produced at the suitable site along Chancay river, with a result of geological investigations.

- Sand material for concrete are purchased, since it is difficult to get in the site.

- Excavated material is available for its fill.

- Cement, reinforcement, steel material, etc. are transported from the manufacturing factory in the vicinity of the project site.

- Gate, except turnout, to be installed at the diversion weir, irrigation canal and regulated reservoir is purchased from the foreign manufacturers, gate for turnout from local.

2-2 Construction Plan

Construction plan of each facility would be shown below. The construction schedule is presented in Figure I-2-1.

(1) Diversion weir

Seven diversion weirs are proposed . The work volume of Palpa & Esperanza and Huando & Chancay-Huaral weir, which has large quantity compared with others such as Salinas Alto, Salinas Bajo, Boza Alto, Boza

Bajo and Pasamayo Bajo, is as follows:

Description	Unit	Work Volume	
		P & E	H & C-H
Common Excavation	cu.m	14,700	14,800
Trench Excavation	cu.m	3,500	3,800
Fill & Backfill	cu.m	5,400	5,600
Reinforced Concrete	cu.m	3,430	3,140
Plain Concrete	cu.m	6,060	7,730
Stone Pitching	cu.m	680	700
Protection Levee	m	815	1,000
Sluice Gate	sq.m	88	63

- Since it is flood period from December to April, each diversion weir must be completed during the dry season from May to November, including earth works, concrete works and gate installation, etc.

- Concrete is mixed at each site and placed by the Truck Crane.

- Material for stone pitching is used the excavated rock of road.

- There will be no particular attention paid to carrying out the construction works due to the diversion weir with a low height.

(2) Irrigation system

Irrigation system consists of irrigation canal and regulated reservoir.

Construction volume of irrigation canal in each commanding area in system wide is shown below.

Commanding Area	No. of Canal	Length	Lining Concrete	Masonry	Excavation	Filling
		km	m3	m3	m3	m3
Palpa, Caqui & San Jose	8	43.9	4,616	24,327	41,416	87,207
Esperanza	10	37.3	9,932	23,912	52,860	90,727
Huando & Chancay - Huaral	19	76.0	11,673	43,922	88,534	161,463
Boza & Pasamayo	5	15.8	1,118	5,896	7,680	31,603
Salinas	1	2.3	161	843	3,510	18,000
Total	43	175.0	27,500	98,900	189,000	389,000

- Main irrigation canal will be rehabilitated provided temporary canal. Secondary canal, however, will be improved under the condition that irrigation water is stopped for a constant period, in principle.

  In case that by-pass canal can be used, it is the best to use that as possible.

- It is desired to construct the main canals when consumptive use is comparative small, since the main canals affect the downstream service area.

- The construction of irrigation canal would be carried out taking into account the adequate construction blocks, because the irrigation canal has long distance of 175 km in total.

- Concrete works at each section of the canal etc. are carried out by providing a number of portable mixers with a small capacity, placed by man-power.

On the other hand, regurated reservoirs are proposed, improvement of 13 places and newly constructed of 5 places. There will be no particular attention paid to carrying out the construction works except bank embankment. Bank embankment of newly constructed reservoir should be done carefully.

(3) Drainage system

Drainage system is composed of open drain such as catch drain, main drainage canal and lateral drainage canal, and pipe drain.

Open drain of 70 km in total length is constructed or improved in the first half of the construction stage. And then, taking into consideration the variation of groundwater level caused by open drain, pipe drain of 407 km would be installed two to three years thereafter. Pipe drain will be constructed by the Trencher. The construction of drainage system would be carried out without particular attention.

(4) Road network

Road of 174 km would be rehabilitated in the first half of the construction stage for the convenience of construction equipments traffic. Both trunk and secondary roads are metalled, thickness of 10 to 15 cm, by the gravel from the proposed crushing plant.

(5) Flood protection work

The construction of protection levee of 14 km in total length will be suspended from December to April because of the flood season. No particular attention would be paid to carry out.

3 Cost Estimation

3-1 Basic Rate

The basic rate for labor, material and construction equipment is estimated on the basis of the prevailing rate, as of 1984, in the central Peru, as follows:

(1) Wage rate per day

The following wage rate is the unit rate per day (8 hours), including social insurance.

Foreman	S/. 39,760
Skilled labor	34,380
Common labor	26,750
Operator for heavy equipment	34,380
Assistant operator	26,750
Driver	29,620
Steel worker	29,620
Carpenter	29,620
Electrician	34,380
Mechanic	34,380

(2) Material rate

Description	Unit	Rate (S/.)
Portland cement	ton	294,300
Reinforcement	ton	2,386,000
Binding wire	kg	3,680
Light oil	liter	730
Gasoline	liter	930
Lubricant	liter	8,200
Sand	cu.m	15,000
Timber	cu.m	786,000
Dynamite	kg	13,000
Detonator	pc.	1,400
Drain pipe 100 mm	m	12,000

(3) Construction equipment rate

Description	Capital Cost ($\times 10^3$ S/.)	Hourly Rate (S/.)
Bulldozer, 8 ton	144,200	44,462
- do - , 11 ton	186,100	47,488
Swamp Bulldozer, 9 ton	154,000	44,606
Back-hoe Shovel, 0.4 m^3	184,500	41,341
- do - , 0.6 m^3	234,400	52,523
Tractor Shovel , 0.4 m^3	69,600	21,433
- do - , 0.8 m^3	103,900	32,587
Dump Truck, 6 ton	58,400	16,598
- do - , 8 ton	81,000	21,742
- do - , 10 ton	119,300	30,767
Concrete Mixer, 0.2 m^3	9,000	22,000
- do - , 1.0 m^3	94,400	230,756
Truck Crane, 10 ton	196,000	45,267
Trencher, D=250 cm	580,000	384,250

Note; Unit rate for Concrete mixer is the rate per day.

The construction equipment rate per hour is estimated, based on the capital cost, the ratio for depreciation, repair and maintenance for equipment operations.

The detailed estimation of construction equipment rate is shown in Table I-3-14.

(4) Foreign and local currency portions for basic rate

The foreign and local currency portions for the basic rate are estimated, taking into consideration the shadow price in Peru, as follows: