ANNEX D

Rural Infrastructures, Irrigation and Drainage

THE STUDY ON JALAUR IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT

ANNEX D

Rural Infrastructures, Irrigation and Drainage

Table of Contents

List of Tables

List of Figures

1. PRESENT CONDITION IN THE PROJECT AREA

1.1 Irrigation and Drainage

1.1.1 Current Irrigation Service Area

The present irrigated services areas of the Jalaur and Suague RISs are estimated at 8,826 ha and 2,958 ha, respectively. The irrigated service area is basically divided in division areas of about 500 ha. This is in accordance with the current water management practices. The Suague RIS has 4 division areas, while the Jalaur proper RIS has 11 division areas.

However, the irrigated service areas of the Jalaur proper RIS have 3 lateral canals as damaged, namely: E4, E5 and G. The service area of these 3 canals have not been supplied with irrigation water for more than 10 years because the middle sections of the lateral canals have been flushed out by typhoons. To date, the NIAs rehabilitation and maintenance work has not been done at all. The service area is estimated at about 440†ha.

The lack of the NIAs rehabilitation and maintenance activity is mainly affected by its failure to provide sufficient amount of irrigation water at the tail portion of the service area. This is largely due to technical problem on water distribution. The budgetary constraints also one factor for inadequate maintenance of the system.

The pump irrigation areas are extended along the head sections of the main canals in both the RISs. This is also extended along the middle sections of the lateral canal E of the Jalaur proper RIS. The main purpose of pump irrigation is to make supplemental irrigation water. The irrigation water is being absorbed from the NIAs canals by using portable pumps. Moreover, the pumped illegal water is brought in the downstream through a syphon that crosses the Jalaur river. This is facilitated using illegal turnout and pump. Presently, the areas that used to be sugarcane farms are being converted to paddy fields. The total area is estimated at 144 ha. The Jalaur - Suague RIS office has already tolerated the use of such illegal irrigation water in the said areas. However, it considers only the water supply as supplemental irrigation.

1.1.2 Non Formal Irrigation Services Area

The pump irrigation and illegal turnout areas mentioned above are not included in the formal irrigation services areas of the Jalaur -Suague RIS. However, the irrigation service fee (ISF) that is being collected is charged to the benefited areas of the RISs at a discounted rate.

The non-formal irrigation areas are estimated at 144 ha in the Jalaur proper RIS and at 39 ha in the Suague RIS. The area of the Jalaur proper RIS consists of the following: pump irrigated areas of 44 ha along the head sections of the main canal; pump irrigated area of 50 ha in the middle sections of the lateral canal E; and the illegal turnout area of 50 ha in the lateral canal E. The area of the Suague RIS comprises the pump irrigated area of 39 ha in the head section of the main canal.

It should be noted that the water being absorbed by these areas disturbs the distribution of irrigation water and integration of the service areas of both the RISs to be able to sustain proper water management.

1.1.3 Diversion Dam

The Jalaur and Suague diversion dams are currently being maintained by the Jalaur - Suague RIS office. Funds for the maintenance of these dams come from the ISOP II and local budget of the NIA. The current improvement works consist only of

minor activities such as replacement of gate driven machine, minor repair of gate, minor improvement of scouring sluice and retaining wall, etc. This is due to limited fund. The salient features of the dams are described below.

Description	unit	Jalaur	Suague
Diversion Weir		Ogee type with main gates	Ogee type
Main gate	nos./size	13/H 3.5 X W 5 ~ 6	
Scouring sluice			
Right bank		Open channel type	Open channel type
Left bank		Under sluice	-
Gate	nos./size	2/H 1.82 x W 4.26	1/H 2.6 x W 5.2
Length of weir	m	174	150
High water channel section	m	78	134
Low water channel section	m	96	16
Height of weir			
High water channel section	m	5.15	1.8
Low water channel section	m	3.42	1.6
Intake method/structure		Orifice type	
Intake gate	nos./size	2/left bank 10/right bank	2/H 1.8 x W 1.45 right bank
Intake discharge			
Right bank	m3/sec	13.5	4.5
Left bank	m3/sec	4.0	-
Measuring devices		Staff guage	Staff guage
Settling basin		No installation	No installation

(1) Jalaur diversion dam

The main gates consisting of 13 nos. and scouring sluice gates of 2 nos. have already been repaired using the ISOP II fund. New lifting machine driven are provided at the 5 main gates and 2 sluice gates. The old motors stationed at the main gate which are evaluated to be over their economic life are still being used. Some sections of the dam such as the downstream apron from dam, the retaining wall, etc. have been repaired and/or improved using likewise the fund of the ISOP II. Minor repair work of the intake gate is scheduled to be carried out using the same fund in 1998.

The intake gate is installed in 10 nos. at the right bank and 2 nos. at left bank. The gate is manually operated. The intake gates installed at the left bank have technical problem on the cable suspension for lifting during gate operation. The manual operation system and technical problem on the gate lifting affects the proper operation of the gate. The improvement of the gate lifting and the mechanized system for gate operation are needed at the main and intake gates.

The trashracks are not provided in front of all the intake gates. The pile of debris and rubbish affects the off-taking of irrigation water. Furthermore, communication facilities such as wireless radio, telephone, etc. are not installed at the gate keepers house. This somehow creates difficulty in sustaining proper gate operation and the effective water management between the NIAs office and the gate keeper. The details are shown in Table D.1.1.

(2) Suague diversion dam

The gate of the scouring sluice and intake gates are manually operated. The rubber seal of the scouring sluice gate is rotten, and the gate lifting system of the scouring sluice has technical problem on the cable suspension. The intake gate has 2 sluice gates, and the lifting portion of one (1) gate is damaged. The retaining wall at the right bank has been damaged and cracked. The repair work is being carried out using the fund of the ISOP II.

The other damaged portions of the dam such as abrasion of the concrete, the exposed steel sheet pile, missing cut - off wall occur at the sections of the floor of the scouring sluice, downstream apron and riverbed protection.

As regards the trashracks of the intake gates and communication facilities located at the gate keepers house, the conditions are similar to the Jalaur diversion dam. The details are shown in Table D.1.1.

(3) Erosion of right bank of the Suague diversion dam

The course of the Suague river meanders in the upstream of the dam. The right bank is heavily eroded on sections of about 280 m of the dam due to main current. The left bank of the dam is heavily silted and the area is converted to agricultural land. The erosion of the right bank is measured approximately 120 m from the scouring sluice way of the dam. The Jalaur - Suague RIS office has remedied the erosion problem by constructing the gabion protection. The facilities, however, have been destroyed by the recent flood.

1.1.4 Irrigation Canals and Related Structures

The irrigation canal networks of both the RISs consist of main and lateral canals (secondary canal), main farm ditch (tertiary canal) and farm ditch. All irrigation canals are earth canals. The design discharge of the main and lateral canals ranges from about 0.1 m3/sec to 4.5 m3/sec in the Suague RIS and from about 0.1 m3/sec to 13.5 m3/sec in Jalaur proper RIS. The main canal networks of the both RISs consist of one (1) main canal and 9 lateral canals in the Suague RIS and one (1) main canal and 28 lateral canals in the Jalaur proper RIS. Total length of the canals is respectively estimated at 121 km for the Jalaur proper RIS and about 40.9 km for the Suague RIS as shown in Table D.1.2.

The Suague RIS is located in the western area from the Jalaur proper RIS and connects with the Jalaur proper RIS area along the main canal of the Jalaur proper RIS. The Suague RIS extends in an area whose topography is higher than the Jalaur proper RIS area. Out of the main and lateral canals of the Suague RIS, the main and the 2 lateral canals, namely the lateral canal B-3 and the lateral canal B are directly connected with the main canal of the Jalaur proper RIS to spill out excess water.

All canals of both RISs have technical problems on the low embankment, siltation in the canal and open-cut of embankment. This is primarily due to the lack of proper maintenance and illegal turnouts. These problems affect proper water operation, specially the slow water run in the main and lateral canals and insufficient water discharge to the irrigation service areas. In accordance with the interview survey, it was clarified that the distribution of irrigation water takes around one (1) day to 2 days to reach the tail portion of the irrigation service area from the intake of both RISs areas. This happens even in case of smooth water operation.

In addition, the tail sections of the 3 lateral canals , namely lateral canal E4a, E5 and G are damaged and lost. This was due to the flushing water that was brought about by a typhoon around 10 years ago. The supply of irrigation water to the downstream from the damaged canal sections has not been carried out due to lack of technical skills on water operation, water management problems in the upstream areas and limited fund of NIA.

The related structures consist of head gates, turnouts, check structures, syphons, aqueducts, culverts, drop structures, etc. The head gate is constructed at 9 nos. in the Suague RIS and 24 nos. in the Jalaur proper RIS. A few partial flume is constructed in the downstream from the head gate as the measuring device. However, all partial flumes are not functional and are abandoned due to complicated operation. In lieu of the partial

flume, the staff gauge is used at several head gates. The staff gauge is curved in the retaining wall at the downstream.

Turnout is constructed at 79 nos. in the Suague RIS and 250 nos. in the Jalaur proper RIS. Majority of the turnouts are double-gate type. Majority of the turnouts are not being used by the farmers due to the complicated operation of the double gates, the non functional gate condition, the choking of the barrel by debris, etc.. Moreover, the gates have already been severely deteriorated and some gates and its parts were lost. The control and monitoring of irrigation water discharge is not conducted at all at the turnouts. The gates and /or stop log of check structures are also severely deteriorated and the some gates and stop logs were lost. The deterioration and loss of the gates causes improper water operation. The other related structures are functional.

In addition, the settling basin at the downstream from the intake structure, spillway and trashrack of syphon are not constructed in both the RISs.

(1) Jalaur proper RIS

The canal network consists of the main canal and 28 lateral canals. The total canal length is approximately 121.3 km.

The main problems affecting the supply of irrigation water are: (a) over-flowing of irrigation water at some canal sections due to the low embankment and the back water caused by improper operation of water level at head gates and/or turnout; and (b) siltation in canals and open-cut of embankment due to provision of illegal turnout. The low embankment occurs at about 39 km along the main and 12 lateral canals. The problems on siltation and open-cut embankment are extended in all of the canals.

The other problem of the RISs is the flushed out canal sections of 3 lateral canals, notably lateral canals E4a, E5 and G. The damage occurred around 10 years ago due to the flushing water from the river caused by a typhoon. As a result, the supply of irrigation water has been abandoned at the downstream areas of the canals. Total length of the damaged and abandoned canals is estimated at about 3.7 km for the 3 canals, and the areas of about 440 ha have become rainfed paddy fields.

The main structures are head gate, turnout, check structure and syphon. Majority of the head gates and turnouts deteriorated and lack measuring devices. Erosion problem also occurs at the outlet section of the head gate. The head gate for lateral canal C is severely deteriorated and considered non-functional. In addition, the head section of lateral canal C is stretched along the main canal in reverse direction from the downstream to the upstream of the main canal. Concerned farmers complain of the slow delivery of water and insufficient water discharge at the head gate.

The existing syphons constructed at the main canal and lateral canal E do not experience choking problem at the barrel portion. This is in accordance with the result of the discharge measuring test on irrigation water. However, the trashrack at the inlet section and manhole are not maintained. An aqueduct in lateral G has erosion problem at abutment due to overtopping of irrigation water from the upstream. The details are described in Tables D.1.3 to D.1.4.

(2) Suague RIS

The Suague RIS has maintained 9 lateral canals. The total canal length is approximately 40.9 km.

The main problem of the network is over-flowing of irrigation water at some canal sections. This is due to low embankment and siltation. The problem occurs at

canal sections, sta. 0+280 of lateral canal B during full supply of water. The canal sections of the over-flow expands to about 150 m.

The siltation problem also occurs on sections of all the canals. The Jalaur - Suague RIS office has carried out desilting works. However, proper maintenance work has not been done due to limited budget. The open-cut of the embankment occurs along the canal. This caused by the illegal turnout and drain inlet, especially at canal section sta. 1+650 of lateral canal B.

The existing structures are generally maintained, except for the gates at the head and turnout. The gates of the head and turnout are severely deteriorated. The body structure of the head gate is generally fine. Erosion, however, occurs at the outlet section of the structure. The measuring device is practically missing in all of the head gates, except for the head gate of lateral canal A. The turnout is mainly a double-gate type. The measuring device near the turnout is also missing.

The main and 2 lateral canals, namely lateral canal B and lateral canal B-3 cross the old railway with culvert structure. The barrel portion of the 2 culverts of the lateral canals are destroyed due to overloading. The supply of irrigation water in the downstream area from the damaged culverts is restricted.

A drop structure constructed at sta. 1+200 of lateral B-4 has been damaged. Erosion around the structure occurs and this is extended to about 10 m along the canal. The detailed information are shown in Table D.1.5.

1.1.5 Existing Pump Irrigation and Portable Pump Use

The existing pump irrigation projects (PIP) are operated at 2 sites. The total service area of these pump irrigation projects, namely Inagdangan PIP and Jalaud-balud PIP is estimated at about 180 ha. One (1) pump is being operated at the Jalaur proper RIS under the NIAs technical assistance. The purpose of the pump irrigation project is to provide supplemental irrigation at the tail portion of the Jalaur proper RIS. The water source of the pump irrigation project is the river of the Jalaur and the drainage water coming from the Jelicuon creek.

The other PIP is being operated to provide supplemental irrigation water at lateral canal G. This is being managed under the technical assistance of the NIA provincial office (PIO). The IA is also being organized, at present. The water resource is the Jalaur river water, and the irrigation area is about 60 ha.

On the other hand, a number of shallow tube wells are existing in both the RIS areas. Total number are about 80 tube wells in the Suague RIS area and about 600 tube wells in the Jalaur proper RIS area. Shallow ground water is the supplemental water source of irrigation. The irrigation area of shallow tube well is estimated at about 140 ha in the Suague RIS area and approximately 1,200 ha in the Jalaur proper RIS area. Users of shallow tube well involve 2 to 3 households per one (1) unit. The shallow ground water is being used as the supplemental irrigation water at the downstream area of each canal in the Suague RIS area for 2 months, i.e. January to February. The use of shallow ground water has been localized which has affected the water management activities in the Jalaur proper RIS. Such localization has specified the utilization in each division area. The supplemental irrigation water is conducted during the months of November to March due to the shortage and /or the lack of irrigation water supply at the downstream irrigation areas of lateral canals E, E4a, E4b, E5, E5a, G and I. The detailed information is shown in Table D. 1.6.

1.1.6 Drainage Canal and Related Structures

The present drainage canal network of both the RIS areas consists of natural rivers, streams, creeks, an old lateral canal of the Jalaur proper RIS and farm drainage canals. The main drainage canal network of the Suague RIS is connected with the Jalaur proper RIS because of similar topographic condition and basins of the natural rivers and creeks. The natural rivers and creeks of 11 nos. are extended in the areas as the main drainage canals. The 3 rivers that are excluded are Janipan-an river in the Suague RIS area, and Jalaur and Dumangas rivers in the Jalaur proper RIS area. The 3 rivers also have drainage function for both the RIS areas through their linkage with existing secondary drainage canals and farm drains. The total length of the main drainage canals in both the RIS areas is estimated at approximately 90 km as shown in Table D.1.7.

The current problems on the drainage canal networks are primarily inland inundation and back water. The inundation is mainly caused by: the choking of the flow sections at the related structures; temporary diversion dams for irrigation use; and clogging of the drainage canals. The inundation occurs along the highways near Pototan, Pototan - Barotac Nuevo and Zarraga - Barotac Nuevo. The main reasons for the flooding near the Pototan are depressed topographic condition and limited flow capacity of the existing cross drain and drainage canal. The inundation occurring along the other highways is caused by the choking of the existing cross drains constructed at the high ways.

Back water sometimes limits the irrigation service areas of lateral canals C and C-1 during heavy rainfall in the rainy season. The back water is caused by the insufficient flow capacity of the river section at the bridge of the highway, Pototan - Passi. The inundation has been reported to stay for 2 - 3 days.

Similarly the lowland irrigation service areas within Zarraga - Dumagas is also affected by back water. This occurs in the simultaneous period of spring tide and heavy rainfall during the rainy season. The other back water which occurs due to temporary diversion dams constructed along the small creeks, restricts the service areas near Dumangas in the rainy season.

Small inundation and poor drainage condition are taking place in the low land area of Zarraga - Dumangas. This is caused by over cultivation of paddy in the depressed areas.

The related structures of the main drainage network are bridge and cross drain. All the bridges, except for the bridge along the high way, Pototan - Passi, do not experience problems on back water and inundation. However, a temporary wooden bridge constructed at the old highway section, Pototan - Donsol, would be replaced. Similarly, the bridge along the highway, Pototan - Passi, would also be constructed in line with the improvement of the river section.

All cross drains, except for the 2 cross drains of the Jalaur proper RIS are functional. The existing cross drains of the main and lateral canal D of the Jalaur RIS have choking problem at the barrel portion due to sedimentation. The details are described in Table D.1.8.

1.1.7 Farm Ditch and Farm Drain

The canal system of the on-farm basically consists of the main farm and supplemental farm ditches. These structures are for providing irrigation and farm drainage. The separation of the farm ditch from the farm drain has already been carried out during the 1970s. However, the separated canal system of the irrigation and drain is not realized in each turnout service area (TSA). Majority of the main farm ditches have double functions of water conveyance: (a) supply of irrigation water in the upstream

sections; and (b) conveyance of drainage water from the paddy field in the downstream sections. Due to these double functions, water management problems such as improper and inadequate water operation and poor drainage condition prevail during the harvest season.

On the other hand, the illegal tapping of water is perpetuated by the construction of illegal turnouts. The irrigation water in the canal is also diverted by the use of portable pumps. These problems are happening due to insufficient water distribution in each farm. The dysfunction in water distribution is prevalent during the dry season. The main reasons are the lack of turnout and main farm ditches. With reference to the result of interview survey, the present irrigation service areas of the Jalaur proper RIS is estimated at 8,676 ha and 2,861 ha in the Suague RIS. The average command area of a turnout is, accordingly, estimated at about 34.7 ha in the Jalaur proper RIS and 36.2 ha in the Suague RIS. This is based on the estimated numbers of the existing turnouts. The average command area is rather big and this has to be reduced to sustain proper water distribution.

Description	unit	Jalaur proper	Suague
Service area	ha	8,676	2,861
No. of turnout	nos.	250	79
Average commannd area	ha	34.7	36.2

1.1.8 Service Road and Rural Road

(1) Service road

The service road of an irrigation canal has essentially two (2) functions: (a) inspection road for the irrigation facilities; and (b) farm to market road for both the RIS areas. The service roads apparently are not constructed along all the main and lateral canals. There are 25 road sections consisting of 6 in the Suague RIS area and 19 in the Jalaur RIS area. Total length of the road is approximately 36 km in the Suague RIS and 112 km in the Jalaur proper RIS. A road, originally classified according to the two (2) types has different width (e.g. 4 m - width or 3 m - width). At present, majority of the road sections, including the pavements have deteriorated. Total length of damaged road sections that render them impassable during the rainy season is estimated at about 31 km in the Suague RIS and approximately 73 km in the Jalaur proper RIS.

The status of the linkage of the service road with the rural road such as barangay, municipal and provincial roads is also in poor condition. It is impassable during the rainy season and mobility is hampered due to the lack of the access to the existing rural roads. The farmers appreciate the need for service and access roads that can sustain the function of farm to market road. The details are shown in Tables D.1.9 to D.1.10.

(2) Rural road

The rural road extends in both the RIS areas. The isolated barangays are not located in the rural road network of both the RISs. In addition, some barangay and municipal roads are not linked with the service road due to severe deterioration. The most deteriorated rural roads adjacent to the service road and can potentially serve the function of a farm to market road are: (a) one (1) barangay road near laterals B4 and B5 of the Suague RIS; and (b) one (1) barangay road near lateral E3 of the Jalaur proper RIS. The road length is about 1.2 km in the Suague RIS and about 2.1 km in the Jalaur proper RIS. The details are shown in Tables D.1.9 to D.1.10.

1.2 Flood and Inundation

1.2.1 Flood and Inundation Area

The RIS areas are affected by flood of the Jalaur river during typhoon and storm in the rainy season. The flood of the Jalaur river occurs at the middle sections of the river near the Barotac Nuevo and Donsol. The flood expands in the Jalaur proper and extension RIS areas and affects the downstream area of both the RIS areas. In the Jalaur proper RIS area, the flood water flows down into the irrigation areas of the lateral canals E 4 to E 5. The flood water is mainly retained in the irrigation areas of the lateral canals E4 to E 5 for 2- 3 days. The flood water which was occurred at the other sections of the river around 10 years ago flushed out some canal sections of 3 lateral canals, namely: lateral canal E, E4a and G. Presently, there are no maintenance works being carried out on sections of the said canals due to the technical and financial constraints.

The inundation in both the RIS areas is mainly caused by two factors such as the back water influenced by the choking at drainage canal sections and drainage structures and the spring tide during the rainy season. The total irrigation area affected is estimated at about 400 ha. The inundation in the irrigation area of lateral canals C and C-1 is caused by the back water in the Abangay river. The affected area is estimated at about 120 ha. Normally, the flooding period is 2 to 3 days. The inundation in the irrigation service area of lateral canals E 4, E 5 and G is caused by spring tide during heavy rainfall. The affected area is estimated at about 210 ha, and the period of flooding ranges from 1 day to 3 days. The occurrence of the inundation is not frequently experienced because of the simultaneous period of spring tide and heavy rainfall during the rainy season. The inundation in the other areas is caused by topographic consideration and choking at the drainage structures. The detailed information is shown in Table D.1.11.

1.2.2 Flood and Inundation Damage

The flood of the Jalaur river flows into the urban areas of Barotac Nuevo and Donsol. The inundation stays for a few day. The flood affects partial sections of the rural road and induces sedimentation in low land area such as city area, sugarcane and paddy field. However, no severe damage to the irrigation facilities and irrigation service areas of the Jalaur proper RIS has been noted.

The irrigation service areas of both the RISs are partially affected by inundation caused by the choking at drainage canal and related structures and the spring tide. The latter occurs at heavy rainfall during the rainy season. The service area is submerged for 1 to 2 days. The flooding, however, has not caused damage to paddy production.

1.3 Land Conversion

Land conversion is apparent at the tail portion of lateral canal B3 of the Suague RIS and at the tail portion of the main and lateral canals I of the Jalaur proper RIS. Both portions are adjacent to the municipalities of Pototan and Zarraga. Incidentally, there is growing urbanization in these areas. Total area of lands converted is estimated at 175 ha consisting of 81 ha in the Suague RIS area and 94 ha in the Jalaur proper RIS area.

1.4 Plan and Design Standard on Irrigation and Drainage Water

1.4.1 Current Estimation Method of Irrigation Water Requirement

The operation and maintenance plan on the supply of irrigation water is prepared by the Jalaur - Suague RIS office every year before the commencement of water

delivery. Taking into consideration this plan, the irrigation water requirement was estimated by the modified Penman method, based on the cropping calendar.

The percolation is assumed at 1.5 mm/day for the first paddy season and 2 mm/day for the second paddy season. The puddling requirement is estimated at about 85 mm for the first paddy season and about 120 mm for the second paddy season, referring to the technical guidelines on the operation and maintenance of NIA.

The irrigation requirement is estimated using the standard figures of irrigation requirement in the NIAs guidelines. The standard figures of the irrigation requirement was adopted taking into consideration the characteristics of soils, scale of the project, etc. The typical figure of the irrigation requirement ranges from 1.5 to 1.8 lit./sec./ha. within the Project area.

1.4.2 Percolation and Canal Seepage

The percolation test which has been carried out at the NIAs Donsol station during the first paddy season, gave an average percolation rate of 1.2 mm/day to 1.4 mm/day. The test area was covered by clayey soils which are common soils in both the RIS areas. It was observed that the percolation of the paddy field in both the RIS areas is comparatively low.

The canal seepage observed through the field test during the Study was estimated at 0.0003 to 0.0004 lit./sec./m2 in earth canal and 0.0001 lit./sec./m2 in concrete lining canal. The field test was carried out in lateral canal A of the Jalaur proper RIS and main and lateral canals B of the Aganan RIS. It can be inferred that the canal seepage is relatively low. The soil structures of the earth canal section is much stable, except for the disturbance of the canal embankment which will be caused by the farmers and rats.

1.4.3 Current Irrigation Method

In an ordinary hydrological year, the irrigation water in the Jalaur RIS area is simultaneously supplied for paddy cultivation. The water supply in the Suague RIS area is likewise operated by simultaneous supply during the first paddy season and rotational supply during the second paddy season. This is being done due to availability of water for irrigation. When sufficient irrigation water can not be off-taken at each diversion dam during the dry season, rotational irrigation supply is implemented in both the RIS areas.

1.4.4 Current Estimation Method of Drainage Water Requirement

In accordance with the 1979 Design Guides and Criteria for Irrigation Canal of the NIA, the probable daily rainfall, with reliability of 10 % chance, was adopted in the estimation for the drainage requirement in paddy field. Out of the probable rainfall, 100 mm - rainfall depth was assumed to be retained in the paddy field. Furthermore, the drainage requirement was determined by modifying the drainage module based on a 10-year storm. The standard figure of the drainage module is recommended on the regional base.

In addition, with reference to the guidelines on the important drainage crossing structures such as cross drain and bridge of the specified rural road and highway, it is recommended to adopt the drainage discharge of the storm with a 25-year return period. This is to avoid choking problem at the section.

2. CONSTRAINTS TO DEVELOPMENT

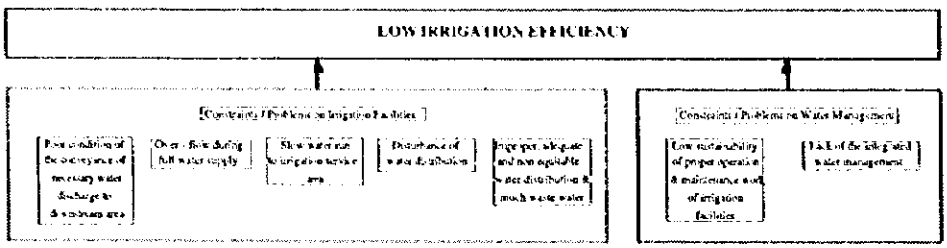
2.1 Eroded Right Bank in Upstream from the Suague Diversion Dam

At present, the erosion of the right bank in the upstream of the Suague diversion dam is generally not considered a direct constraint to irrigation and water management. However, the erosion is being developed from flooding, and the river course shifts to the edge portion of the small hill which lays at the right bank of the main canal. The width of the small hill is roughly estimated at about 30 m between the river and the main canal. The possibility of severe erosion of the small hill caused by further floods and the occurrence of the damage on the diversion dam and main irrigation canal is pointed out, if the current river course is sustained.

The erosion development at the right bank should be prevented to sustain the irrigation function of the diversion dam and main canal.

2.2 Low Irrigation Efficiency

The present overall irrigation efficiency for both the RISs is considered to be low. This limits the irrigation service areas in both systems. The main reasons of the low irrigation efficiency are essentially due to the deterioration of irrigation facilities and poor water management practices. Specifically, the main concerns on the irrigation facilities are: (i) poor conveyance condition of the water discharge to the downstream area; (ii) over - flow at the canal sections during the full delivery of water; (iii) slow velocity of water to the irrigation service area; (iv) disturbance of the water distribution; and (v) improper, inadequate and non equitable distribution of water. The main constraints on water management, meanwhile are: (i) low sustainability of proper operation and maintenance works of irrigation facilities; and (ii) lack of integrated water management as shown below.



The constraints on the irrigation facilities are aggravated by the siltation in the canal due to absence of settling basin, low embankment, the long length of main and lateral canals, the improper layout of farm ditch, the illegal turnout, the deteriorated gates at head gates and turnout, the lack of the measuring devices, the limited period of rotational water distribution in the dry season, the portable water use in canals, etc.

The constraints on water management are further compounded by lack of monitoring system, shortage of O & M equipment, shortage of O & M budget, insufficient information and lack of communication on water distribution. The details are shown in Table D.2.1 and Figure D. 2.1.

2.3 Heavy Siltation in Canals and Low Embankment

Heavy siltation in canals and low embankment aggravate the poor condition of irrigation water conveyance. This also hampers the discharge of sufficient irrigation water to the irrigation areas in the downstream of the canals.

The heavy siltation practically covers all the canals due to the lack of settling basin and/or silt excluder along the main canal and improper maintenance works. The siltation inhibits the flow capacity of canals. This also put pressure on the work load of the NIAs periodic maintenance work.

On the other hand, several sections of the main and lateral canals have low embankment caused by the shortage and lack of maintenance work. The low embankment causes over-flowing of irrigation water during delivery of full water. As a result, significant losses in irrigation water occur. Finally, the irrigation water can not sufficiently reach the service areas in the downstream of the canals.

2.4 Deterioration of Gates and Lack of Measuring Devices

The deterioration and loss of the gates at the head gates and turnouts, including non-functional measuring devices normally affects proper water distribution. As a result, inequitable water distribution is generally perpetuated in both the RISs. Such deterioration of facilities and measuring devices is directly considered as one of the technical considerations of the low irrigation efficiency in both the RISs.

2.5 Deterioration and Shortage of Service Road

The NIA's service road has double functions: (a) inspection road for the irrigation facilities; and (b) farm to market road in the irrigation service area. The deterioration and shortage of service roads prevents efficient transport of agriculture inputs and outputs in the rural areas. This happens especially during the rainy season where the roads become impassable. As such, the quality of paddy that are normally dried along the streets deteriorates quickly as they can not be brought immediately to secure areas. As a consequence, post-harvest losses significantly reduce the farm gate price of paddy specially during the rainy season where the roads become impassable. As such, the quality of paddy that are normally dried.

3. BASIC IMPROVEMENT APPROACH

The basic improvement approach towards irrigation and drainage is to increase the overall irrigation efficiency. This would be achieved by improving existing irrigation facilities and strengthening the current water management skills of the NIA and IAs in both the RISs. To attain this purpose, the following elements are essential:

i) Rehabilitation and improvement of existing irrigation facilities, especially the gates at the head gates. including the measuring devices to have effective and efficient water management,
ii) Renewal of existing turnout and provision of additional turnouts, including the measuring devices and feeder canals to have effective and efficient water management,
iii) Minor repair of the diversion dams, especially the improvement of the intake gates,
iv) Construction of settling basin to reduce the siltation in canals,
v) Improvement of canal sections including canal lining and
vi) Improvement of the main farm ditch and drain with removal of illegal turnout.

To sustain proper water management and enhance the use of the return flow from the irrigation service area, supplemental irrigation facilities such as farm ponds and small ponds are constructed around the head sections of the canals and in the creeks.

In addition and taking into account the effective use of both the water resources of the affected rivers, the conjunctive use of water would be verified to increase the cropping intensity during the dry season.

To address the inundation problem in both the RIS areas, additional secondary drains and related structures such as cross drains and bridges are suggested to be constructed

The improvement of the existing services roads is recommended to be carried out to strengthen the function of the farm to market road in the RIS areas. This will be pursued by establishing the link road system connected with the rural road. The following approaches are recommended:

i) Improvement of the existing services roads
ii) Minor improvement of the adjacent rural road
iii) Provision of additional rural road to support the linkage of the service roads with the rural roads.

4. DEVELOPMENT POTENTIAL

In general, the land resource comprising the boundaries of the gravity irrigation system is almost developed in both the RIS areas. However, the portions consisting the elevated agricultural lands located along the main canals of both the RISs and the low agriculture lands in the downstream from the syphon of the lateral E crossing the Jalaur river are still untapped. The total area of the elevated and the low lands is estimated at 183 ha in both the RIS areas. These areas have informally been using the irrigation water coming from the concerned irrigation canals. Irrigation service fee is currently being collected by the NIA office from the users of the irrigation water. In this regard, these areas can be technically integrated as part and parcel of the irrigation service areas of both the RISs. This is suggested by providing additional turnout and main farm ditch in the low lands. Coupled with the provision of the facility, the institutional development of the concerned IA in the elevated lands is also recommended for integration. The integration of the areas is expected to enhance the total irrigation service areas of both the RISs. The irrigation service area of the Jalaur proper and Suague RISs is estimated to reach 8,820 ha and 2,900 ha, especially, in view of the land potential.

It is to be noted that the surface water resource for irrigation purpose for both the RISs has reached its maximum utilization. This finding is based on the result of the Study of new water resource development in the upper reaches of both rivers. The potential of other alternative sources of water resource development notably shallow and deep ground water is reportedly not promising. However, the water resource is not much expected, taking into consideration of the current shallow ground water use for irrigation, the need of ground water for municipal water use and the financial aspect of paddy cultivation such as the investment cost of tube well and O & M cost of pumps. Therefore, it can be inferred that the available water for irrigation use is almost the same as the current water resources for both the RISs.

The Jalaur river has relatively plenty of water. On the other hand, the Suague RIS encounters reduced supply of water during the dry season. In accordance with the result of the Study on water balance for irrigation use, the available water in Jalaur river can be allocated to the Suague RIS area for irrigation purpose under the with and without improvement plan conditions on the Jalaur extension RIS. The maximum water discharge to be allocated is estimated to cover the requirement of paddy cultivation area of about 200 ha in the dry season. The irrigation service area of 200 ha can be extended to the Suague RIS area by using the water coming from the Jalaur river.

As a whole, the development potential area for irrigation is finally increased to 9,020 ha for the Jalaur proper RIS. This includes the area of 200 ha proposed to be supplied with water from the Jalaur proper RIS. The Suague RIS is estimated to have a development potential of 2,700 ha.

5. IMPROVEMENT PLAN

5.1 Irrigation Improvement Plan

5.1.1 Proposed Irrigation Service Area

As described in Chapter 4, the irrigation service area of each RIS is as follows: (a) 9,020 ha for the Jalaur proper RIS including the additional area of 200 ha to be trusted to the water supply of the Jalaur proper RIS; and (b) 2,700 ha for the Suague RIS.

5.1.2 Irrigation Water Requirement

The irrigation water requirement was estimated using the guidelines of the FAO on irrigation and drainage paper No. 24. The requirement was based on the proposed cropping patterns for both the RISs. The potential evapo-transpiration (ETo) was estimated by the Modified Penman method using meteorological data from the Iloilo airport covering the periods 1961 to 1995. The data were published by PAGASA. The irrigation requirement is estimated through the same formula as mentioned in the Annex A.

The percolation rate is assumed at 1.5 mm/day for the first paddy season and 2.0 mm/day for the second paddy season. The puddling requirement was estimated at 150 mm for both the paddy seasons. The effective rainfall for paddy field was estimated by applying the relationship curve derived from the water balance calculation in the model for paddy field as shown in Figure D.5.1. The relationship curve employed short-term meteorological data (10 years) from the Iloilo airport. The irrigation efficiency of the paddy field is assumed at 50 %, consisting of conveyance efficiency of 72 % and operation and application efficiency of 70 %. The assumptions took into account the irrigation method, water management and canal lining.

As regards the irrigation water requirement of mung bean, it is assumed that water will only be required for germination of the bean. This is in consonance with the present farming practice on the mung bean cultivation and water availability during the dry season. The initial water requirement is assumed at 27 mm/time sufficient to supply the soil saturation requirement. This is based on the NIAs annual operation and maintenance plan. The effective rainfall for mung bean was estimated using the USDA SCS method. The irrigation efficiency of mung bean is assumed at 50 %, the same as the paddy, taking into consideration water conveyance condition and irrigation method.

The peak irrigation water requirement is estimated at 1.69 lit./sec./ha under the condition of double paddy cultivation for the Jalaur proper RIS and 0.55 lit./sec./ha under the conditions of double paddy cultivation in an area of 900 ha and first paddy - mung bean cultivation in an area of 1,800 ha for the Suague RISs. The details are shown in Tables D.5.1 to D.5.2. The seasonal water requirement is estimated below.

unit: mm

	The First Paddy	The Second Paddy
Suague RIS	305/332	1,101
Jalaur proper RIS	306	1,250

5.1.3 Crop Rotation in the Suague RIS area

The irrigation water is absolutely short of the total requirement for the second paddy cultivation in the Suague RIS area. The irrigation service area for the second paddy is extended only to about 900 ha. This is equivalent to only one third of the total area. The mung bean cultivation is proposed to be implemented in the other irrigation service area with water to be supplied only for the germination of the bean. In this regard, crop rotation of paddy is strongly recommended to permit and sustain good

agriculture and proper water management in the RIS area. The crop rotation during the second paddy is proposed to be conducted on an irrigation division basis with interval of 2 years.

5.1.4 Diversion Dam

The common activities of the improvement plan on both the diversion dams are the repair of gates installed at scouring sluice and/or intake gates, and the improvement of the mechanized-driven lifting at the main, scouring sluice and intake gates. The gates and incidental facilities are replaced or repaired to sustain proper water management for irrigation. The repair and replacement of the gates and incidental facilities are summarized below.

RIS	Main Gate	Scouring Sluice Gate		Intake Gate
	Minor Improvement of Driven Lifting	Improvement of Driven Lifting	Minor Repairing	Improvement of Driven Lifting
Suague RIS	-	1 no.	1 no.	2 nos.
Jalaur proper RIS	8 nos.	-	-	12 nos.

In the Suague diversion dam, the river improvement work envisages the straightening out of the existing river course through dredging in the upstream from the weir. The length and width of the dredged river course are respectively planned at about 280 m and 40 m. The gabion mattress revetments of about 280 m and the gabion groins cum. gabion revetment of 70 m are also installed at meandering river sections of right bank in the upstream from the weir. In accordance with the NIA's information, the flood water level is EL 42.05 m at the crest of the diversion dam. The top surface elevation of the gabion mattress and the groin is EL 42.5 m. The current river course is closed by gabion & concrete stopper and filled up by the dredged materials, and the back side of the gabion mattress is also filled up by the same dredged materials until EL 42.5 m.

In addition, the trashracks of intake gate and communication facilities are provided to sustain the proper water management and maintenance.

5.1.5 Main and Lateral Irrigation Canals

The existing canal sections will be re-shaped to sustain sufficient flow capacity, and the required water level is verified at each head gate and turnout to include the head loss of the newly installed measuring devices.

The straightening out of the canal route, except for the head section of the lateral canal C of the Jalaur proper RIS is not implemented in both the RISs. The lateral canal C extends along the main canal in the reverse direction from the downstream to the upstream of the main canal. The current canal layout at head section is defective and the farmers also complain of poor water distribution. The existing head gate is also severely deteriorated. Therefore, the existing head gate is moved to the upstream of about 40 m. The head sections of the lateral canal C is straightened out to serve as the canal course from the new head gate.

The canal lining is provided in the long canal which has the significant role of a water conveyance for both the RISs. This is to accelerate the water run, to reduce seepage loss and to sustain the proper canal section. The canal lining is made in the main canals of both the RISs, the lateral canal B of the Suague RIS and lateral canals E and E4. The length of canal lining is about 6.3 km in the Suague RIS area and about 29.3 km in the Jalaur proper RIS area. Total length of canal lining is about 36 km as shown below.

RIS/Canal	Length (m)	RIS/Canal	Length (m)
Suague RIS		Jalaur proper RIS	
- Main canal	3,250	- Main canal	20,900
- Lateral B	3,050	- Lateral E	7,850
		- Lateral E4	550
Subtotal	6,300	Subtotal	29,300
		Total	35,600

In addition to the canal lining, a special canal, namely a feeder canal is constructed to improve the water supply to the TSAs to cope with he problems on the slow water run from the lateral canals and/or the insufficient water discharge distribution due to illegal turnouts and improper canal layout. The feeder canal is constructed at about 7.4 km (7 canals) in the Suague RIS area and about 24.3 km (24 canals) in the Jalaur proper RIS area as shown in Table D. 5.3.

5.1.6 Irrigation Structures

Main improvement works of related structures are as followings.

i) Construction of the settling basin
ii) Replacement and new installation of gates at the head gates
iii) Repairing of riprap in the outlet portion of the head gate
iv) Renewal of existing turnout and additional turnout
v) Construction of measuring devices at head gates and turnout
vi) Repairing and rehabilitation of the damaged structures

The settling basin of each basin is constructed in the head section of main canal. The type of the settling basin is natural flushing for the Jalaur proper RIS and mechanical for the Suague. The use of different types is due to the different elevation between the base floor of settling basin and river bed. In case of the settling basin of the Suague, it can not sustain the sufficient deference of the elevation to flush out the sediments automatically. The settling basins of both the RISs have the following dimension.

RIS	Type	Dimension (m) W x L x MaxD	No. of Lane
Jalaur Proper RIS	Natural flushing	22.7 x 62.0 x 4.5	8
Suague	Mechanical	6. 8 x 47.0 x 2.6	2

The measuring device of the broad crest weir type is provided at the outlet portion of the settling basin to confirm the water discharge of irrigation. The gate operation of the intake structure is always coincided with measuring device of the settling basin.

The deteriorated gates of the head gate are estimated at about 71 nos. in both the RIS areas. The gate to be replaced due to sever deterioration is 37 nos., and the new gates to be installed is 34 nos. in both the RISs. The gate to be replaced is 12 nos. of the 6 head gates in the Suague RIS area and 25 nos. of the 12 head gates in the Jalaur proper RIS area. The new gates to be installed is 7 nos. of the 5 head gates in the Suague RIS area and 27 nos. of the 14 head gates in the Jalaur proper RIS area. The details are shown in Table D.5.4.

RIS	Head Gate	Check Structure		Intake Structure		Total
		Replacement	New Installation	Replacement	New Installation	
Jalaur proper RIS	24	19	12	6	15	52
Suague RIS	9	5	5	7	2	19
Total	33	24	17	13	17	71

The deteriorated riprap of the head gate structures estimated at about 260 m in both the RIS areas is improved to sustain the structure. The details are shown in Table D.5.4.

In addition, the head gate of lateral canal C is moved about 40 m to the upstream of the main canal.

The existing turnouts estimated at about 267 nos. in both the RIS areas are renewed. The additional turnouts of 117 nos. consisting of 41 nos. in the Suague RIS area and 76 nos. in the Jalaur proper RIS area is also constructed to accelerate the irrigation water run from the main canal or the lateral canals to each TSA and sustain proper water distribution in the each TSA. This is in line with the construction of the feeder canals. The details are shown in Table D.5.5.

The measuring devices of the broad crest weir type is adopted, taking into consideration simple operation method. They are installed at the outlet portion of the settling basin as well as at the outlet portion of each head gate and turnout.

The damaged structures such as the culverts of lateral canals B and B3 crossing the old railway; drop structure of the lateral B4 in the Suague RIS area; and aqueduct of the lateral canal G in the Jalaur proper RIS area are improved. Screen for syphons of the main canal and the lateral canal E and spillway is also provided.

5.1.7 Supplemental Irrigation Facilities

Taking into consideration the absolute water shortage for irrigation in the Suague RIS area during the dry season and the transition period of the improvement of water management skills for both the RISs, supplemental irrigation facilities are provided to address the above problems. The proposed facilities are small pond (namely farm pond) along irrigation canals and pond in main drains and creeks.

The farm pond is constructed to cope with the slow water run which takes around one (1) day to 2 days to reach the tail portion of the service areas. The pond is proposed to support the water need during the puddling season, and the pond capacity is capable to store the water demand of land soaking during the initial 2 days for each concerned irrigation service area. The initial soaking requirement is assumed at 100 mm/time referring to the NIA's information, and the storage capacity of pond is estimated at 1.5 mm/day. The farm pond is constructed at 13 sites in the Jalaur proper RIS area and 7 sites in the Suague RIS areas. The total area is about 18 ha for both the RISs as shown in Table D.5.6.

The return flow of the irrigation water can also serve as supplemental water supply in the irrigation service area. The annual return flow is estimated at about 17. 6 MCM in the Jalaur proper RIS area and 2.4 MCM in the Suague RIS area This is based on the assumption of the 25 % loss discharge of irrigation water. However, the main drains have comparatively deep drain sections, and it is difficult to supply the drainage water in the downstream of the service area by gravity irrigation system. This is because of the need to provide a long head race of irrigation canal and the far location of the irrigation service area caused due to flat topography. On the other hand, the use of portable pumps for supplemental irrigation is common among the farmers in both the RIS areas, especially in areas adjacent to the rivers and creeks. In this regard, small ponds are provided along creeks and main drains. These is small permanent dams which can prevent flooding and over-flowing along the creeks and main drains. The ponds are constructed at 4 sites in the Jalaur proper RIS and 2 sites in the Suague RIS as shown in Table D. 5.6.

5.1.8 On-Farm Improvement

The command area of the turnout is improved. It will be reduced by constructing additional turnout and feeder canals to prevent the illegal tapping and/or stealing of water and at the same time to accelerate the water run. The average command area of the turnout will be adjusted to become less than 35 ha. The average area is estimated at about 28 ha in the Jalaur proper RIS and 27 ha in the Suague RIS area as shown below.

Description	unit	Jalaur proper	Suague
Service area	ha	9,020	2,700
No. of turnout	nos.	326	120
Average commannd area	ha	27.7	22.5

In line with the arrangement of the command area of the turnout, the layout on the main farm ditch and main farm drain is improved to separate the functions of irrigation water supply and conveyance of the drainage water. The maximum length of the main farm ditch is 700 m.

5.2 Drainage Improvement Plan

5.2.1 Drainage Requirement

The drainage requirement for the secondary and farm drains is determined in accordance with the Design Guides and Criteria for Irrigation Canal (1979 NIA). The following assumptions are given taking into consideration the prevention of damage on flooding and inundation to paddy.

i) Probable daily rainfall with a return period of 10-year, and drainage period of 1.5 days
ii) Allowable retaining water depth in the paddy field is 100 mm.

The probable daily rainfall with a return period of 10-year is estimated at 204 mm by Hazen method using the daily rainfall data at Donsol station. The drainage requirement is estimated at 8.1 lit./sec./ha.

The drainage requirement of the creeks and main drains is estimated by the unit hydrograph method. The drainage requirement of the significant crossing structures at the high way is estimated based on the probable daily rainfall with a return period of 25-year.

5.2.2 Main and Secondary Drains

In accordance with the results of the interview survey, it was observed that minor floods and inundation are caused by the lack of secondary drains and drainage facilities. This partially restricts the irrigation service areas. In this regard, secondary drains of about 54 km (58 nos.) are constructed in both the RIS areas as shown below. Majority of the secondary drains have small drain discharge of less than 1.0 m3/sec. The details are shown in Table D.5.7.

Main Drain	No. of additional Sec. Drain	Length (m)	Proposed Structures	
			Bridge	Cross Drain
Drain No. 1 (Janipa-an River)	7	6,950	0	1
Drain No.2 (Sigangao Creek)	17	10,700	0	0
Drain No.3 (Old lateral canal G)	1	1,100	1	0
Drain No.4	0	0	0	1
Jalaur river	18	12,100	1	5
Drain No.5	10	12,650	0	1
Drain No.6 (Binaobao creek)	2	2,900	0	0
Dumangas river	3	7,500	0	4
Total	58	53,900	2	12

In addition, the irrigation service area of lateral canals C and C-1 of the Jalaur proper RIS is experiencing back water from the Abangay creek. The back water is caused by insufficient creek sections around the bridge of the high way, i.e. Pototan - Passi. The creek sections is improved to either enlarge the sections and/or construct river bank. This will be verified by hydraulic calculation of the creek.

5.2.3 Drainage Structures

The improvement work of the related structures is the construction of new bridge and cross drain. The bridges of 2 nos. and cross drains of 12 nos. are constructed at the high ways and the lateral canals in both the RIS areas as shown in Table D.5.7.

5.3 Road Improvement Plan

5.3.1 Improvement of Service Road

The improvement work of the service roads are divided into categories: (i) improvement of gravel pavement; (ii) improvement of road section and gravel pavement; and (iii) new construction of the service road. Three types of service road are proposed depending on the road width, e.g., the 3 m, 4m and 6 m. The service road will be provided at a suitable section of embankment in the head section of the main canal of both the RISs. This is to facilitate access for ordinary maintenance work. The improvement work will be made along the 11 service roads of the Suague RIS area and the 23 roads of the Jalaur proper RIS area including the 2 feeder canals. The total length of the work is about 45 km for the Suague RIS and about 127 km for the Jalaur proper RIS. The details are shown in Tables D. 5.8 to D.5.10.

RIS	Canal Concerned (nos.)	Gravel Pavement only (m)	Road Section & Pavement (m)	New Construction (m)	Total (m)
Suague RIS	11	7,980	26,540	10,210	44,730
Jalaur proper RIS	23	36,100	73,300	17,500	126,900
Total	34	44,080	99,840	27,710	171,630

5.3.2 Improvement Works of Rural Road

The improvement work of the rural road is divided into 2 types. These include work on the existing barangay roads and access roads to the existing service road. The barangay roads to be improved are selected in accordance with following criteria:

i) The barangay road is located adjacent to the service roads of both the RISs and

ii) The barangay road has the potential role of the farm to market road

The proposed barangay roads for improvement are: (i) about 1.2 km (one road) between lateral canals B and B5 for the Suague RIS; and (ii) about 2.1 km (one road) between the tail portion of the lateral canal E and high way Zarraga - Barotac Nuevo for the Jalaur proper RIS.

The access road to the existing service road will be provided at about 0.7 km (one road) to the lateral canal B2 of the Suague RIS and about 2.8 km (5 roads) to lateral canals C1, D1, B3, E4b and H of the Jalaur proper RIS.

The rural roads will be improved based on the following width: 3-m road and the 4-m road with gravel pavement. The details are shown in Tables D.5.8 to D. 5.9.

6. DESIGN CONCEPT AND STANDARD

6.1 Design Concept and Design Standard

Design for rehabilitation of irrigation and drainage facilities is made consistent with the proposed water management system and to be carried out for easy and economical construction, taking into account the rehabilitation status of the Project. Design is made with reference to the "Design Manual for Canals & Canal Structures" issued by NIA principally, and the standards issued by the Ministry of Agriculture, Forestry and Fishery of Japan as supplementary.

6.2 Design

6.2.1 Improvement of Diversion Dam

Improvement of the Suague diversion dam involves river treatment in the upstream from the dam and minor repair of the downstream apron.

As for the river treatment, new channel and river bank revetment are respectively designed to provide about 280 m in the upstream from the dam and at right bank to straighten the river course. The width of the channel is designed into trapezoidal section with a width of 40 m and inside slope of 1 : 2.0. The channel depth is designed to sustain the current riverbed elevation. The river revetment is designed to provide at right bank with gabion mattress cum situ-concrete pile. A gabion mattress measures 17.5 m in length and 1. 0 m in width, and each 5 m-edge portion of gabion is sustained at the top of bank and the river bottom by concrete pile. The thickness of the gabion is 1.0 m. The elevation of top surface of the mattress is designed to sustain EL. 42.5 m which is the same as the flood surface water elevation estimated in the original plan. The back side area of the revetment is designed to fill up the same elevation with dredged materials.

In addition, the gabion groin is designed for the upper edge of river revetment of the upstream area to reduce the river current and change the course of river flow to the more left direction. The elevation of the groin is designed to EL 42.5 m, and 3 lane groins which total length of 120 m are designed initially. A groin is designed to consist of 3 layers of the gabion mattress with a thickness of 1.0 m.

Additional concrete apron is provided with another sheet pile cum cut-off wall in the downstream from the existing concrete apron to protect from erosion and the sinking of river bed. C concrete block and gabion are added in the downstream from the additional concrete apron for river bed treatment. The length and width of the additional concrete apron are respectively 20 m and 84 m. River bed treatment of concrete block is 50 m (refer to Figure D. 6.1).

Scouring sluice gate (H 2.6 m x W 5.2 m) and two (2) intake slide gates (H 1.8 m x W 1.45 m) are also designed to replace the existing gates with mechanical lift driven gates with spindle. Trash rack is also newly provided at the intake gate.

6.2.2 Irrigation Canal and Related Structures

(1) Design discharge and hydraulic formula

Design discharge of each canal is calculated to multiply the peak irrigation water requirement (q = 1.69 l/sec/ha) by irrigation area. Hydraulic calculation of an open channel is made by using Manning formula.

$Q = A \times V, \quad V = 1/n \times R^{2/3} \times I^{1/2}$

Q: Discharge (m^3/sec.)	n: Coefficient of roughness
V: Mean velocity (m/s)	R: Hydraulic radius (m)
A: Cross-section area (m^2)	I : Hydraulic gradient (canal bed slope)

Maximum allowable velocities of canal are determined to be 0.9 m/sec. for earth canal and 1.2 m/sec. for concrete lining canal. Roughness coefficient of canal are adopted to be 0.025 for earth canal and 0.018 for concrete lining canal.

(2) Canal profile and cross section

Design water levels are determined based on the minimum water level required at each head gate and turnout, after verifying present canal condition and current hydraulic condition of canal. The required water level at turnout is assumed to add head loss at measuring device of 20 cm and standing water of 10 cm in paddy field to the elevation of original ground surface at the head section of main farm ditch.

Canal cross sections are also designed taking into consideration existing canal sections and construction cost of earthwork. The canal sections are broadly divided into two types such as earth canal and lined canal with trapezoidal section. Inside slope of canal is designed at 1 : 1.5, referring to existing canal condition. Bed width and height of canal are respectively to range from 1.0 m to 8.2 m and from 1.0 m to 2.5 m except for the main farm ditches. Minimum freeboard is designed to range 16 cm to 21 cm depending on the design discharge of canals. Typical cross sections of canal are shown in Figure D.6.2.

Main canals in both the RIS have deep cut sections of 1,770 m in totality, and existing service road is situated at original ground in these sections. This situation of service road is so weak to sustain proper maintenance activities by O & M equipment. To sustain easier access and more effective maintenance work of canal and related structures, the situation of service road is changed from top of canal bank to berm of canal. Typical profiles of canals are shown in Figures D. 6.3 to D.6.6.

(3) Canal lining

Canal lining is given to canals which have important function to convey irrigation water to the irrigation area and have the design discharges of more than 2.0 m3/sec in the Jalaur proper RIS and 1.0 m3/sec in the Suague RIS. The lining is provided at three faces of canal such as canal base and inside slopes.

For the selection of canal lining type, the available materials of lining are selected in and around the Study area, and the materials of the lining are verified in view of technical and financial aspects and maintenance works aspects. The available materials are clayey soils, cement and concrete. Typical lining section for each alternative is designed under the following typical hydraulic conditions of canal.

Design discharge	6.35 m^3/sec.		
Design condition			
Concrete lining	thickness of lining	10 cm	
Soil cement	thickness of lining	10 cm	
Earth lining	thickness of lining	50 cm	
Canal section			
	bottom width (m)	height (m)	inside slope
Concrete lining	4.0	1.6	1 : 1.5
Soil cement lining	4.0	1.7	1 : 1.5
Earth lining	4.0	1.9	1 : 1.5

	Earth Lining	Soil Cement Lining	Concrete Lining
Construction	Difficult	Difficult	Easy
Roughness Coefficient	0.025	0.020	0.018
Velocity (m/sec)	0.65	0.73	0.82
Desilting and Reshaping	Hard	Moderately Easy	Easy
Sustainablility in Proper Canal Section	Hard	Moderately Easy	Easy
Cost (peso/m)	1,640 *1	225	2,665
Durability	Short term	Short term	Long term

*1 Material cost including hauling cost, distance = about 10 km

Based on the comparison result described above, concrete lining is adopted. Because it can be appreciated that concrete lining has advantageous points for O & M works and water management such as the advantages in water run, the easiness in desilting/reshaping and the sustainability in proper canal section, even though concrete lining is rather expensive.

The lining section is designed to sustain the top of lining above the design water surface, and the minimum freeboard is given to range 16 cm to 21 cm depending on the scale of canal section. Thickness of lining is broadly divided into two types such as 10 cm and 8 cm in accordance with the design discharge of canal as shown below.

Discharge (m^3/s)	Width of Canal Bed	Thickness
10 ~ 3	more than 4 m	10 cm
3 ~ 0.3	less than 4 m	8 cm

Weep hole is provided in excavation section of the lined canals. Typical cross section of concrete lined canal is show in Figure D.6.2.

(4) Settling basin

Taking into consideration the topographic condition of the area for settling basin, different types of the setting basins are designed in each RIS. Settling basin is mechanical desilting type for Suague RIS and the natural flushing type for Jalaur proper RIS. Design of the settling basin is made based on the following conditions.

	Jalaur proper RIS	Suague RIS
Design Discharge	15.24 m^3/s	1.49 m^3/s
Minimum Grain Size	0.30 mm	0.30 mm
Maximum Grain Size	50.0 mm	50.0 mm
Amount of Suspended Soil	14,041. m^3/year	1,925. m^3/year
Desilting Method	Natural flushing	Mechanical

Width of lane of the settling basin is determined by the following formula.

(a) Case of Mechanical Desilting: $B=Q/(h \times u)$

where,

B: width of sedimentation ditch (m)
h: water depth at the allowable critical limit (m)
Q: design discharge (m^3/sec)
u: critical tractive force for suspended solid (m/sec)

(b) Case of Natural Flushing: $B=(h^2+a \times Q^2/(k \times h^2))^{1/2}-h$

where,

B: width of sedimentation ditch (m)
h: water depth at the allowable critical limit (m)
Q: design discharge (m^3/sec)
a = 1.0, velocity discharge coefficient
k = $T_c/(pi)$
T_c: critical tractive force (t/m^2)
p: unit weight of water ($t \times sec^2/ m^4$)
i: gradient of sedimentation ditch (I>1/100)

Length of lane of the settling basin is determined by the following formula on the basis of detaching length of the flow on gapped bed.

$$L = l_1 + l_2 + l_3$$

where,

L: length of sedimentation ditch (m)
l_1: length of sediment terrace (m)
l_2: distance from terrace front to the point further than whom there is no re-floating of sediment (m) ($l2 = 10 \times W_1$)
W: gap height at the beginning of sedimentation ditch,
W_1: height of terrace front ($W_1 = W$)
l_3: excess length (m), about gap height at the end of the sedimentation ditch

Determined length is verified by the empirical formula as follows.

$$L = 20 \times Q^{1/2}$$

where,

L: length of sedimentation ditch (m)
Q: design discharge in the ditch (m^3/sec)

Settling capacity of basins is determined in accordance with allowable settling limit. The settling basins are designed as follows.

	Jalaur proper RIS	Suague RIS
Number of Lane	8	2
Width of Lane	2.5 m	2.95 m
Length of Lane	40 m	25 m
Water Depth	3.5 m	1.8 m

Broad-crested weirs are also provided at the end of sedimentation ditch as measuring devices. Typical sections of the settling basins are shown in Figures D.6.7 to D.6.8.

Furthermore, the desilting methods of settling basin i.e. natural flushing method or mechanical desilting method are verified for the settling basin of the Jalaur proper RIS through comparison under an economic condition for 20 - year operation and compared in view of the initial investment and O & M cost aspects. Comparison study is made taking into consideration the followings .

1. As for the natural flushing method, construction cost of flushing conduit and incidental facilities such as flushing gates only is considered.
2. As for mechanical desilting method, desilting works is assumed to carry out by sand pump
3. Operation interval of desilting works is assumed to be each 10 days, taking into account current weekly operation system of irrigation water supply.
4. O & M costs of gate and sand pump are estimated based on labor fee, fuel cost, etc.

unit : peso

	Natural Flushing	Mechanical Desilting
Construction Cost of Flushing Conduit	6,921,020	0
Operation Cost		
Desilting by Sand Pump	0	2,938,906
O/M Cost	579,203	5,267,984
Total Cost	7,500,223	8,206,890

Initial investment cost of the natural flushing method is higher compared with mechanical desilting method, but its' O & M cost is cheaper, and estimated at about 10 % of O & M cost of the mechanical desilting method. Total cost of natural flushing methods including the O & M cost for 20 years is cheaper than the same total cost of the mechanical desilting method. Therefore, the natural flushing method is adopted for Jalaur proper RIS.

The natural flushing facility is designed as a flushing conduit of concrete box culvert, and two lane box culverts are provided. The flushing discharge is 1.91 m^3/sec, and the height and width of a culvert box are respectively designed to be 2.5 m and 1.0 m.

The mechanical desilting of the settling basin in the Suague RIS is designed to be carried out by sand pump based on the economic comparison of alternative the O & M equipment.

(5) Head gates and measuring devices

A for the existing head gates, only slide gates of the head gates are designed to replace based on the results of the inventory survey of the head gates and verification of the required water level at each head gate.

Types of measuring devices are selected to compare from view points of easy operation and appreciated accuracy for measuring water discharge, because IA's members will be in charge of the operation.

For the comparison study, the three types of the measuring devices such as constant head orifice, broad-crested weir and Parshall flume are selected as the alternatives in view of easy operation and present status of the measuring devices.

	Constant Had Orifice	Broad-crested Weir	Parshall Flume
Operation	Complicated	Easy	Complicated
Construction	Easy	Easy	Difficult
Construction Cost	Expensive	Low	Medium
Error in Rating Curve	> 7%	2%	3%

The broad-crested weir type is comparatively appreciated to be easy for the operation and sustains the accepted high accuracy for the measuring the water discharge as described above. Therefore, the broad-crested weir type is selected.

(6) Turnout and measuring devices

All existing turnouts are planned to be renewed and additional turnouts are also provided in accordance with the design water level of canals. Turnout is designed to be equipped with one slide gate at inlet section of the conduit and a broad-crested weir at outlet section of the conduit to make easy and simple operation. The conduit is designed as reinforced concrete pipe for small water discharge of less than or equal to 1.0 m^3/sec and/or box culvert for big water discharge of more than 1.0 m^3/sec. Typical sections of turnout are shown in Figures D.6.9 to D.6.10.

(7) Other related structures

Existing damaged structures are designed to be renovated and improved into necessary dimension depending on the damage condition. New related structures such as check gates, drop structures, box culverts, spillways, drain inlets, etc., totaling of 135 structures are designed in accordance with the design water level of canals. Typical sections of related structures are shown in Figures D.6.10 to D.6.13.

As for the existing syphon, manhole is designed newly to be installed at conduit section for maintenance. Spillway is also newly designed at upstream section from the syphon to cope with emergency and /or miss water operation, and trash rack is designed to be installed at the inlet section of syphon. In addition, riprap is provided at the downstream of the existing and newly established structures. Stoplogs are also designed to be provided for all existing structures because most of them have disappeared.

(8) Supplemental irrigation facilities

Farm ponds are designed as earth structures with depth of 2.5 m to serve as supplemental facilities. Width and slopes of the bank are respectively designed to be 2.0 m and 1 : 2.0. Typical sections of farm pond are shown in Figure D.6.14.

Ponds to be placed in the natural creek are designed as concrete check structures because they must be durable at flood time. The top elevation of the check structure is designed and determined to sustain safety hydraulic condition in the creek during the flood time.

(9) On-farm facilities

On-farm facilities consist of main farm ditches, secondary farm ditches, drains and small related structures. The farm ditches are designed as earth canal with trapezoidal section, and the width of ditch bottom and inside slope of the ditch are respectively designed to be 0.4 m and 1 : 1.0. Canal density is designed to be about 125 m/ha.

6.2.3 Drainage Canal and Related Structures

(1) Drain cross section

Drainage canal is earth canal with trapezoidal section, and inside slope is 1:1.0. The maximum velocity is assumed at 2.0 m/sec during peak discharge.

The creek sections of the Abangay are improved to enlarge the sections and construct spoil bank. The creek section is enlarged to sustain sufficient bottom width of 25.0 m in all creek sections, and spoil bank is newly designed to provide at topographic depressed original creek bank. The spoil bank is designed to be 5,400 m at both banks.

(2) Related structures

New bridges and cross drains are provided at crossing points with roads and canals. The bridges are designed in accordance with the DPWH's standard. The bridge has two spans, and the length of each span is respectively 30.0 m and 20 m as shown in Figure D.6.15.

In the selection of conduit type, the conduit is designed as box culvert for big design discharge of more than 1.5 m^3/sec. In case of design discharge of less than 1.5 m^3/sec, reinforced concrete pipe type is designed.

6.2.4 Service Road and Related Structures

(1) Service roads

Service roads of main and lateral canals are broadly divided into three types depending on the design discharge of canal. The three types are classified by the total width of the road such as 3-m, 4-m and 6-m width. The effective width of the road is designed as gravel pavement with 20 cm - thickness as shown below. Typical sections of the road are shown in Figure D.6.2.

Discharge (m^3/s)	Total Width of Road	Effective Width
30 ~ 10	6.0 m	4.5 m
10 ~ 0.3	4.0 m	3.0 m
less than 0.3	3.0 m	2.0 m

(2) New rural road as access road to service road

New rural road is one of the access road to and from service road and constructed on the existing paddy field. The road section is designed to sustain high road surface elevation which is 50 cm higher than the original ground surface elevation. However, the current land use of the proposed road sections is paddy field, and the soils are very weak to become the foundation of the road. Therefore, the surface of paddy field shall be replaced with the appreciated and approved materials. Thickness of stripping is estimated at about 50 cm.

6.2.5 Project Works

Improvement works of the Jalaur proper RIS is scheduled to excute since 1998 under the WRDP fund, but the improvement works proposed by NIA are minor works for canal and related structures which are evaluated as one of maintenance works such as canal desilting works, minor rehabilitation works of related structures, etc. Allocated budget for the works is about Pesos 29.4 million for the 3 years from 1998 to 2000. Therefore, the works of the WRDP is excluded in the improvement plan of irrigation and drainage. The Project works is summarized in Table D.6.1.

Tables

Table D.1.1 Present Condition and Constraint of Diversion Dam

Name	Items	Present Condition	Problem / Constraint
Jalaur Diversion Da	Main gate	New machine driven lifting (5 gates)	
		Old machine driven lifting (8 gates, 1968-)	
		Motors are over life duration (8 gates)	Shortage of fund for replacement of motors
	Scouring sluice gate	New machine driven lifting (2 gates)	
	Apron	Fine condition	
	Intake gates (right side)	Skin plate of gate is damaged (10 gates) & will be repaired under ISPO II	
		Manual lifting system (10 gates)	Shortage of fund for installation of machines
	Intake gates (left side)	Technical trouble of lifting system (2 gates) due to cable suspension	Shortage of fund for replacement of machine &stem
	Trashrack	No installation	
	Communication System	No facilities	
Suague Diversion D	Scouring sluice gate	Rubber seals is rotten	Shortage of fund
		Technical trouble of lifting system due to cable suspension	Shortage of fund for replacement of machine &stem
	Scouring sluice	Floor slab at the scouring sluice is abraded.	Shortage of fund
	Apron	Floor slab at the downstream apron is abraded.	Shortage of fund
		No cut-off wall at the downstream from scouring sluice (right bank)	Shortage of fund
	Retaining wall	Crack of retaining wall (right bank) under repairing (ISOP II)	
		Damaged retaining wall (right bank) under repairing (ISOP II)	
		Scouring occurs at righ bank in downsream from rataining wall	Addtional gabion / concreste revetement, but shortage of fund
	Riverbed Protection	Steel sheet pile is exposed.	Shortage of fund
		Concrete block length is insufficient along the scouring sluice.	
		Steel sheet pile at downstream is exposed.	
	Intake gates	Lifting portion of gate are damaged	Shortage of fund
		Manual lifting system (2 gates)	Shortage of fund for replacement of machine &stem
	Trashrack	No installation	
	Communication System	No facilities	

Table D.1.2 Existing Canal Length

No.	Canal	Length (m)	No.	Canal	Length (m)	No.	Canal	Length (m)
Suague RIS area			Jalaur Proper RIS area					
1	Main Canal	9,542	1	Main Canal	24,000	19	Lateral F	4,139
2	Lateral A	7,274	2	Lateral A	3,160	20	Lateral G	10,326
3	Lateral B	6,680	3	Lateral C	4,641	21	Lateral G-1	1,600
4	Lateral B-1	1,589	4	Lateral C-1	1,406	22	Lateral G-2	1,960
5	Lateral B-2	1,062	5	Lateral D	4,590	23	Lateral G-3	700
6	Lateral B-3	7,122	6	Lateral D-1	2,575	24	Lateral H	2,971
7	Lateral B-3a	1,540	7	Lateral D-2	2,040	25	Lateral I	8,630
8	Lateral B-3b	1,234	8	Lateral E	10,730	26	Lateral I-1	1,238
9	Lateral B-4	2,080	9	Lateral E-1	1,600	27	Lateral I-2	1,286
10	Lateral B-5	2,800	10	Lateral E-2	357	28	Lateral I-3	1,285
	Total	40,923	11	Lateral E-3	2,427	29	Lateral J	2,501
			12	Lateral E-4	3,989		Subtotal	36,636
			13	Lateral E-4a	6,438		Total	121,261
			14	Lateral E-4b	4,551			
			15	Lateral E-4b1	904			
			16	Lateral E-4b2	963			
			17	Lateral E-5	5,498			
			18	Lateral E-5a	2,925			
			19	Lateral E-5a1	1,831			
				Subtotal	84,625			

Table D.1.3 Present Condition of Irrigation Canal and Related Structures

Jalaur Proper RIS area

Description	Canal concerned	Location	Condition
1 Canal Section			
1-1 Low embankment	Main canal	sta.8 - sta.9, downstream 30 m from syphon of Suague, head gate of Lateral D 100 m, sta. 15+316 - sta. 15+972, upstream from Lateral G 100m, sta.17+962 - sta.18+933, sta.20+875 - sta.24+318	Overtopping of irrigation water occurs during full water supply at the sections. Total length of low embankment is about 6,300 m equivalent to about 26 % of total length of main canal.
	Lateral A	sta.1+093 - sta.2+002, sta.416 - sta.3+22	Overtopping of irrigation water occurs during full water supply at the sections. Total length of low embankment is about 1,500 m equivalent to about 48 % of total length of the Lateral canal
	Lateral C	sta.1+661 - sta.2+520	Total length of low embankment is about 860 m equivalent to about 19 % of total length of the Lateral canal
	Lateral D	sta.0+359 - sta.1+148, sta.1+571 - provincial road 200 m, sta.1+875 - sta.3+308	Total length of low embankment is about 2,420 m equivalent to about 53 % of total length of the Lateral canal
	Lateral E	sta.1+172 - sta.3+601, head gate of Lateral E-2 100m, sta. 5+185 - sta.7+836, sta. 8+046 - sta.10+725	Total length of low embankment is about 7,860 m equivalent to about 73 % of total length of the Lateral canal
	Lateral E-4	sta.0 - sta. 0+506, sta.2+924 - drainage canal 1,500 m	Total length of low embankment is about 2,000 m equivalent to about 50 % of total length of the Lateral canal
	Lateral E-4b	sta.2+266 - sta.3+600	Total length of low embankment is about 1,330 m equivalent to about 29 % of total length of the Lateral canal
	Lateral E-5a	sta.0+972 - sta.1+962	Total length of low embankment is about 990 m equivalent to about 34 % of total length of the Lateral canal
	Lateral F	sta.1+340 - sta.3+517	Total length of low embankment is about 2,180 m equivalent to about 53 % of total length of the Lateral canal
	Lateral G	sta.1+100 - sta.1+650, sta.2+200 - sta.3+891, sta.4+050 site 150 m, sta.5+090 - sta 6+953	Total length of low embankment is about 4,250 m equivalent to about 41 % of total length of the Lateral canal

Description	Canal concerned	Location	Condition
	Lateral G-3	All sections	Total length of low embankment is about 500 m.
	Lateral H	sta.1+000 - sta.2+971	Total length of low embankment is about 1,970 m equivalent to about 66 % of total length of the Lateral canal
	Lateral I	sta.1+405 - sta.6+111, sta.6+483 - sta.8+528	Total length of low embankment is about 6,750 m equivalent to about 78 % of total length of the Lateral canal
1-2 Siltation	All canals		Siltation expands in all main and lateral canals.
1-3 Open cut of embankment	All canals		Illegal drain inlet from TSA affects embankment. Illegal turnout (open cut) affect canal embankment.
1-4 Flushed our canals	Lateral E-4a	sta.4+400 -	The canal section was flushed out during typhoon attacked more 10 years ago, and the canal sections of tail portion from the sections are not function due to the lack of maintenance and water management. Missing canal length is about 2,000 m.
	Lateral E-5	sta.4+494 -	The canal section was flushed out during typhoon attacked more 10 years ago, and the canal sections of tail portion from the sections are not function due to the lack of maintenance and water management. Missing canal length is about 1,000 m.
	Lateral G	sta.9+604 -	The canal section was flushed out during typhoon attacked more 10 years ago, and the canal sections of tail portion from the sections are not function due to the lack of maintenance and water management. Missing canal length is about 700 m.
1-5 Change in layout of canal	Lateral C	sta. 0 - sta. 0+100	Minor change in canal layout need due to the relocation of head gate, and the changing in canal lenght is about 100 m.
2 Related Structure			
2-1 Head gates	Refer to Table	1.4..3	
2-2 Turnout & Check	All canals		A majority of gates (double gate system) of turnout and check are deteriorated.
2-3 Syphon	Main canal & Lateral E		Barrel portion is fine, but lack of screen and manhole for maintenance
2-4 Aqueduct	Lateral G	sta.4+050	Erosion occurs at abutment due to overtopping water from canal.
2-5 Cross drain	Main canal	sta. 18+933	Low flow capacity of drain, Casalsagan creek

Table D.1.4 Present Condition of Head Gates

Jalaur Proper RIS area

Head Gate for	Canal Concerned Mother canal	Check Structures		Intake structure		
		Gate	Structure body	Gate	Structure body	Measuring devices
Lateral A	Main canal	Out of 4 units gate, 2 units deteriorated (stem portion)	Fine condition	Functional condition (1 unit)	Fine condition	No installation
Lateral C	Main canal	All gates (4 units) are deteriorated.	Retaining wall and barrel portion (left side) are damaged.	Functional condition (1 unit)	Fine condition	No installation
Lateral C-1	Lateral C	Loss of gate (1 unit)	Erosion occurs (15m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of gate (1 unit)	Fine condition	No installation
Lateral D	Main canal	Out of 4 units gate, 1 unit deteriorated (stem portion)	Erosion occurs (25m) at outlet portion of structure. Barrel portion of structure is fine.	Stop log system (original design)	Fine condition	No installation
Lateral D-1	Lateral D	Loss of gates (2 units)	Erosion occurs (15m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of gate (1 unit)	Fine condition	No installation
Lateral D-2	Lateral D	Stop log system (original design)	Fine condition	Functional condition (1 unit)	Fine condition	No installation
Lateral E	Main canal	All gates (4 units) are functional.	Erosion occurs (20 m) at outlet portion of structure. Barrel portion of structure is fine.	Functional condition (2 units)	Erosion occurs (15m) at outlet portion of structure. Barrel portion of structure is fine.	Staff gauge curved in retaining wall
Lateral E-1	Lateral E	Stop log system (original design)	Erosion occurs (10 m) at outlet portion of structure. Barrel portion of structure is fine.	Functional condition (1 unit)	Fine condition	No installation
Lateral E-2	Lateral E	Out of 3 units gate, 2 units deteriorated (stem portion) All gate seal are rotten.	Fine condition	Functional condition (1 unit)	Fine condition	No installation
Lateral E3	Lateral E	Out of 3 units gate, 2 units deteriorated (stem and spindle portions)	Erosion occurs (15 m) at outlet portion of structure. Barrel portion of structure is fine.	Functional condition (1 unit)	Fine condition	No installation
Lateral E4	Lateral E	All gates (2 units) are deteriorated. (stem and spindle)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	All gates (2 units) are deteriorated. (stem and spindle)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	No installation

Head Gate	Canal Concerned	Check Structures		Intake structure		
for	Mother canal	Gate	Structure body	Gate	Structure body	Measuring devices
Lateral E5	Lateral E	Gates (1 unit) is deteriorated. (stem and spindle)	Fine condition	Loss of gate (1 unit)	Fine condition	No installation
Lateral E-4a	Lateral E-4	All gates (2 units) are deteriorated. (stem and spindle)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	Gates (1 unit) is deteriorated. (stem and spindle)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	No installation
Lateral E-4b	Lateral E-4	Gates (1 unit) is deteriorated. (spindle)	Erosion occurs (10 m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of gates (2 units)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	No installation
Lateral E4b-1 & E4b-2	Lateral E-4b	Loss of gate (1 unit)	Fine condition	Loss of gates (2 units for both Lateral canals)	Fine condition	No installation
Lateral E-5a	Lateral E-5	Loss of gate (1 unit)	Erosion occurs (5 m) at outlet portion of structure. retaining portion of structure is fine.	Loss of gate (1 unit)	Fine condition	No installation
Lateral E-5a1	Lateral E-5a	Stop log system (original design)	Fine condition	Loss of gate (1 unit)	Fine condition	No installation
Lateral F	Main Canal	Stop log system in stead of sluice gate (original design)	Fine condition	Functional condition (1 unit)	Fine condition	No installation
Lateral G	Main canal	Out of 3 units gate, 1 unit deteriorated (stem portion)	Erosion occurs (15 m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of all gates (2 units)	Fine condition	Staff gauge curved in retaining wall
Lateral G-1	Lateral G	Stop log system (original design)	Fine condition	Loss of gate (1 unit)	Fine condition	No installation
Lateral G-2	Lateral G	Stop log system (original design)	Erosion occurs (20 m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of gate (1 unit)	Fine condition	No installation
lateral G-3	Lateral G	Loss of gates (2 units)	Erosion occurs (5 m) at outlet portion of structure. Barrel portion of structure is fine.	Loss of gate (1 unit)	Fine condition	No installation
Lateral H	Main canal	All gates (3 units) are functional.	Fine condition	Out of 2 gates, one (1) gate is deteriorated. (stem)	Fine condition	No installation
Lateral J & I	Main canal	Gate (1 units) is functional.	Erosion occurs (10 m) at outlet portion of structure. Barrel portion of structure is fine.	Lateral I All gates (2 units) are deteriorated. (stem and spindle) Lateral J Functional condition (1 unit)	Fine condition Fine condition	No functiona partial flume No installation

Table D.1.5 Present Condition of Irrigation Canal and Related Structures

Suague RIS area

Description	Canal concerned	Location	Condition
1 Canal Section			
1-1 Low embankment	Lateral B	Sta.0 +850	Overtopping of irrigation water occurs during full water supply at sections of about 150 m before the head gate of lateral B-2.
1-2 Siltation	All canals		Siltation expands in all main and lateral canals.
1-3 Open cut of embankmen	Lateral B	Sta. 1+650	Illegal drain inlet from TSA affects embankment.
2 Major Related Structure			
2-1 Head gates	Lateral A		Deteriorated gates of 2 units at check structure (deteriorated skin plate, bending stem, no spindle)
			Sluice gate without spindle at intake structure
			Measuring devices curved at retaining wall of Lateral A
	Lateral B		Deteriorated gates of unit at check structure (bending stem)
			Sluice gate of 2 units without spindle at intake structure and one gate is not functional
			Only one (1) gate is manually operated without spindle
			No installation of measuring devices
	Lateral B1		Gate of 2 units are not functional at check structures, and One gate is missing. The other gate has bending stem.
			Deteriorated gate of 1unit at intake structure (deteriorated skin plate and no spindle)
			No installation of measuring devices
			Eroded canal section of about 5 m in downstream of check structure
	Lateral B2		Eroded canal section of about 10 m in downstream of check structure
			No installation of measuring devices
	Lateral B3		Deterioratedgate of1 unit at check structure (bending stem and no spindle)
			Deteriorated gates of 2 units at intake structure (deteriorated skin plate and no spindle)
			No installation of measuring devices
			Eroded canal section of about 5 m in downstream of check structure
	Lateral B3a		Missing of 1 unit gate at check structure
			Eroded canal section of about 10 m in downstream of check structure
			Deteriorated gate of 1 unit at intake structure (stem and spindle)
			No installation of measuring devices
	Lateral B3b		Missing of gate (1 unit) at each check and intake structures
			No installation of measuring devices
	Lateral B4		No sluice gate at intake structure
			No installation of measuring devices
			Eroded canal section of about 10 m in downstream of check structure
	Lateral B5		Missing gate at check structure
			No spindle of sluice gate at intake structure
			No installation of measuring devices
			Eroded canal section of about 10 m in downstream of check structure and about 5 m in downstream of intake structure.
2-2 Turnout & Check	all canals		A majority of gates (double gate system) of turnout and check are deterirated.
2-2 Culvert	Lateral B	Sta. 6 + 44	Concrete pipe of the culvert is damaged due to heavy load, and sufficient water can not flow.
	Lateral B-3	Sta. 5	Concrete pipe of the culvert is damaged due to heavy load, and sufficient water can not flow.
2-3 Drop structures	Lateral B-4	Sta. 1+200	Turnover of the structure and scoured sections expand about 10 m.

Table D.1.6 Present Shallow Ground Water Use

RIS area	Division	No. of Tube Well	Tube Well Owner's area (ha)	Canal concerned	Operation period
Suague RIS					
	1	17	26.0	Lateral A	Depending to the need
	2	21	31.0	Main canal	April / Jan. - Feb.
	3	19	32.0	Lateral B /B-2 / B-3	Dec.- Feb.
	4	20	50.0	Lateral B /B-5	Jan. - Feb.
	Total	77.0	139.0		
Jalaur proper RIS					
	1	4	6.5	Lateral A /C	Dec. - Jan.
	2	13	32.0	Lateral D /D-1/D-2/E	Apr.-May
	3	74	181.5	Main canal / Lateral E / E-2/ F	Dec.-Mar. / May
	4	11	20.0	Lateral G / H	Jan. - Mar./May-Jun.
	5	28	101.0	Lateral G / G-3	Dec.-Feb.
	6	6	25.0	Main canal / Lateral J	Jan.-Jun
	7	64	141.0	Lateral I / I-2 / I-3 /J	Nov.
	8	24	50.0	Lateral E / E-3	Depending to the need, specially irregular water operation period
	9	238	423.5	Lateral E-5 / E-5a	Apr. - Jun. / Nov. - Feb.
	10	62	73.5	Lateral E-4/ E-4a	Jan.-Mar. / May - Jun.
	11	72	119.5	Lateral E / E-4a	Depending to the need, specially irregular water operation period
	Total	596.0	1173.5		

Table D.1.7 Main Drain in the Suague and Jalaur Proper RIS Areas

No.	RIS	River / Creek	Main Drainage Canal	Secondary Drainage Canal	Length (km)	Catchment Area (ha)
	Suague RIS area					
		Janipan - an river				
1		tributary of Janipan - an river	No.1		3.9	835
	Suague - Jalaur Proper RISs					
2		Sigangao Creek			13.5	4,659
3			Casalsagan creek (No.4)		15.3	1,689
4			Old lateral G		16.2	1,880
5			tributary of Old lateral G	No. 3-6	7.2	559
6			tributary of Old lateral G	No. 3-1	6.3	822
		Jalaur river	River sections concerned		41.5 **1	
7			small tributary of Jalaur river	No. J-4	9.6	771
		Suague river	River sections concerned		21.1 **1	
8			Abangay creek / Maniniw river			13,000
9		Dumangas river	River sections concerned		30 **1	
10		tributary of Dumangas river	No.5-2		9.6	210
11			Binaobao creek		5.1	542
				Total	86.7	

Note : **1 Rversectioned concerned with both the RIS areas

Table D.1.8 Present Problem and Constraint on Drainage Canal

Suague and Jalaur Proper RIS areas

Description	Present Problem and Constraint	Main Reason	Approach / Solution
Main & Lateral Drainage Canals	Inundation along the highway near Pototan in the Suague RIS area during the rainy season	Topographic depressed area Shortage of the flow capacity of cross drain and drains Land acquisition problem in drainage canal course Institutional problem	New layout of drainage canal Provision of the additional cross drains
	Inundation along the highway Zarraga - Dumangas in Jalaur Proper RIS area during the heavy rain	Shortage of the flow capacity of cross drain and drains	Provision of the additional cross drains Improvement of existing drains
	Inundation around the Abangay creek area and irrigation areas of the lateral C and C-1	Back water from the Abangay creek caused due to choking at bridge of the highway Pototan - Pssi	Improvement of river section at the bridge
	Inundation along high way Pototan - Barotac Nuebo during the heavy rain	Choking at bridge	Improvement of existing bridge section
	Back water suffers the low land area, Zarraga - Dumangas for 2-3 days during the heavy rain	heavy rain at the high tide in the rainy season	
	Back water suffers paddy field along the lateral canal E4 a	Temporary diversion dam in the creek near the Dumangas	Technical extension to owners of temporary diversion dam
	Paddy field affects the drain courses & Non continuos drainage canals in the low land area of Zarraga - Dumangas	Farmers' maximum land use for paddy cultivation and shortage of irrigation water supply	Improvement of drain layout, improvement irrigation canal and strengthening the water management skills
	Inundation along creeks and small rivers	Small ridge prepared by farmers along the creek and rivers	Provision of simple drainage pipe and improvement of drainage networks
Related Structures	Inundation in the upstream from main canal of the Jalaur RIS near the head gate for the lateral canal G	Sedimentation in barrel portion of cross drain	Improvement of drainage culvert
	Small flood and inundation along the lateral canal D	Shortage of the flow capacity of the existing cross drain	replacement of the cross drain & improvement of drainage canal
	No operation method and facilities to cope with over distribution of irrigation water supply in main and lateral canals	Non spillway	Provision of spillway
On - farm Drain	Non timely drainage	Insufficient and improper layout of main farm drain	Improvement of on-farm layout (separation of irrigation and drainage canal systems)

Table D.1.9 Present Condition of Service Road and Rural Road

Area / Roads	No.	Canal concerned	Present Condition		Length of Road (m)	Total width (m)
Suague RIS area						
(1) Service road						
	1	Main canal	Narrow road sections along upper canal route of main canal		3,000	3.0 - 4.0
			Deteriorated gravel pavement (sta. 3 - sta. 6)	△	3,200	3.0 - 4.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		3,000	3.0 - 4.0
			Linkage with highway at the end of road section			
	2	Lateral - A	No passable in rainy season due to muddy condition & deterioration of road section sta. 0 to barangay road from Mina		3,000	3.0 - 4.0
			Bottle neck section 3 km from barangay road		3,000	3.0 - 4.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		2,400	3.0 - 4.0
			Linkage with municipal road at the end of road section			
	3	Lateral - B	Good maintained road sta 0 - sta. 2	○	1,980	4.0
			Bottle neck section for transportation		2,000	2.5 - 4.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		2,640	2.5 - 4.0
			Linkage with highway at the end of road section			
	4	Lateral - B1	Bottle neck section for transportation		700	2.5 - 3.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		2,300	2.5 - 3.0
		Lateral - B2	No service road		-	-
			Poor road network of barangay road			
	5	Lateral - B3	Bottle neck section for transportation		1,200	2.5 - 3.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		4,000	2.5 - 3.0
		Lateral - B3a	No service road		-	-
		Lateral - B3b	No service road		-	-
		Lateral - B4	No service road		-	-
	6	Lateral - B5	Bottle neck section for transportation		2,000	2.5 - 3.0
			No passable in rainy season due to muddy condition & deterioration of road section in tail area		1,500	2.5 - 3.0
			Linkage with highway at the end of road section			
			Total		35,920	
(2) Rural road (Access road)						
	7	Lateral - B2	Adjacent existing barangay road is deteriorated and no passable in rainy season due to muddy condition & deterioration of road section.		640	2.5 - 3.0
			The farm to market road is not available in the irrigation area.			
	8	Lateral B4 - B5	Adjacent existing barangay road is deteriorated and no passable in rainy season due to muddy condition & deterioration of road section.		1,200	2.5 - 3.0
			The farm to market road is not available in the irrigation area.			
			Total		1,840	
			Grand Total		37,760	

Note △ Deterioration of gravel pavement only

○ Road maintained well

Table D.1.10 Present Condition of Service Road and Rural Road

Area / Roads	No.	Canal concerned	Improvement Works		Length of Road (m)	Total width (m)
Jalaur Proper RIS area						
(1) Service road						
	1	Main canal	Non passable section due to siphon & narrow sections of canal embankment caused by deterioration of embankment		7,200	3.0 - 5.0
			Deterioration of gravel pavement (sta 0 - sta. 11)	△	11,000	6.0
			No passable in the rainy season due to muddy condition caused by deterioration of embankment (sta.16+720 - sta.19+303)		2,600	3.0 - 5.0
			No services road at tail section of main canal (about 4,800 m)		-	-
	2	Lateral - A	Minor deterioration of canal embankment & muddy condition in the rainy season		3,000	2.5 - 3.0
	3	Lateral - C / C-1	Narrow section and muddy condition in the rainy season around 2,100 m due to deterioration of canal embankment.		2,100	1.0 - 3.0
			Good maintenance road of about 2,400 m sustained.	<>	2,400	
			No farm to market road linked with the service road			
	4	Lateral - D	Narrow section and muddy condition in the rainy season due to deterioration of canal embankment.		6,000	2.0 - 3.0
			No farm to market road linked with the service road		-	-
		Lateral - D1	No service road		-	-
		Lateral - D2	No service road		-	-
	5	Lateral - E	Deterioration of gravel pavement (sta 0 - sta. 3)		3,000	3.0 - 5.0
			Minor deterioration of service road & muddy condition in the rainy season		8,000	3.0 - 4.0
			No passable in the rainy season due to muddy condition caused by deterioration of embankment (sta 26 - sta 30)		4,000	2.5 - 3.0
	6	Lateral - E3	Deteriorated service road & muddy condition in the rainy season		2,200	2.5 - 4.0
			No passable in the rainy season due to muddy condition caused by the deterioration of the road			
	7	Lateral - E4	Deteriorated service road & muddy condition in the rainy season		4,000	2.5 - 3.0
			No farm to market road linked with the service road		-	-
	8	Lateral - E4a	Deterioration of gravel pavement	△	1,700	2.5 - 3.0
			No passable in the rainy season due to muddy condition caused by the deterioration of the road		7,500	2.5 - 3.0
	9	Lateral - E4b	Deterioration of gravel pavement	△	2,800	2.5 - 3.0
			No passable in the rainy season due to muddy condition caused by the deterioration of the road		700	2.5 - 3.0
			Missing service road and no farm to market road linked with barangay road		-	
	10	Lateral - E5a	Deterioration of gravel pavement	△	2,400	2.5 - 3.0
			No passable in the rainy season due to muddy condition caused by the deterioration of the road		4,200	2.5 - 3.0
	11	Lateral - E5a.1	No passable in the rainy season due to muddy condition caused by the deterioration of the road		1,400	2.5 - 3.0
			Missing service road and no farm to market road linked with barangay road		-	2.5 - 3.0
	12	Lateral - F	No passable in the rainy season due to muddy condition caused by the deterioration of the road		4,200	2.5 - 3.0
	13	Lateral - G	Deterioration of gravel pavement (sta 0 - sta.4)	△	4,000	2.5 - 3.0
			No passable in the rainy season due to muddy condition caused by the deterioration of the road		4,600	2.5 - 3.0
			Missing service road and no farm to market road linked with barangay road		-	-
	14	Lateral - G1	Deterioration of gravel pavement (sta 0 - sta 2)	△	2,400	2.5 - 3.0
	15	Lateral - G3	Deterioration of gravel pavement	△	600	2.5 - 3.0
	16	Lateral - H	No passable in the rainy season due to muddy condition caused by the deterioration of the road		3,600	2.5 - 3.0
	17	Lateral - I	Deterioration of gravel pavement	△	11,200	2.5 - 3.0
	18	Lateral - I.1	No passable in the rainy season due to muddy condition caused by the deterioration of the road		1,800	2.0 - 2.5

Area / Roads	No.	Canal concerned	Improvement Works		Length of Road (m)	Total width (m)
	19	Lateral - J	No passable in the rainy season due to muddy condition caused by the deterioration of the road		3,200	2.5 - 3.0
			Total		111,800	
(2) Rural road (Access road)						
	20	Lateral - C1	Missing farm to market road due to no linked road with rural road		900	-
	21	Lateral - D1	Missing farm to market road due to no linked road with rural road		400	-
	22	Lateral - E3	Deteriorated road section of rural road in the center of irrigation area.		600	2.5 - 3.0
	23	Lateral E3 -	Deteriorated road section of rural road in the center of irrigation area, and the rural road has the significant role as the farm to market road in the area.		2,100	2.0 - 2.5
	24	Lateral - E4b	Missing farm to market road due to no linkage road system with rural road.		200	2.5 - 3.0
	25	Lateral - H	Deteriorated road section of rural road in the center of irrigation area, and the rural road has the significant role as the farm to market road in the area.		700	2.5 - 3.0
			Total		4,900	
			Grand Total		116,700	

Note △ Deterioration of gravel pavement only

○ Road maintained well

Table D.1.11 Condition of Inundation and Flood

No. Location	Lateral canal concerned	Estimated Area (ha)	Land use	Period (month)	Main reason of inundation / flood	Inundation period (days)	Estimated water depth (m)	Flood damage	Remarks
1	JP / Lateral C & C-1	120	Irrigated Paddy field	Oct. - Nov.	Back water from the Abanguy river during heavy rainfall and typhoon Choking section of the creek is found out at the bridge of national highway Pototan - Passi.	2-3 days	1 - 1.5 m	Submergence of paddy field	
2	SU / Lateral B-4	15	Irrigated paddy field and swampy area	Sept. - Dec.	Topographic depression area and development of drainage canal has been suffered from land acquisition problem.	2-3 days	0.8 -1.2 m	Submergence of paddy field	
3	JP / Lateral D-1	20	Irrigated paddy field	Oct. - Nov.	Topographic depression area and existing drainage outlet has insufficient capacity.	1-2 days	0.6 - 1.0 m	Submergence of paddy field	
4	JP / Lateral D-2	5	Irrigated paddy field	Oct. - Nov.	Drainage culvert has insufficient capacity.	1-2 days	0.3 - 0.5 m	Submergence of paddy field	
5	JP / Lateral E, E-4 & E-5	50	Irrigated paddy field	Oct. - Nov.	Topographic depression area (old river course) and paddy field is converted from old river course due to agrarian reform program. Inundation is much affected by high tide during only heavy rainfall.	1-2 days	0.3 - 0.6 m	Submergence of paddy field	
6	JP / Lateral E-4a & E-4b	25	Irrigated paddy field	Oct. - Nov.	Topographic depression area (old river course) and paddy field is converted from old river course due to agrarian reform program. Inundation is much affected by high tide during only heavy rainfall.	1-2 days	0.3 - 0.6 m	Submergence of paddy field	
7	JP / Lateral E-4a	20	Irrigated paddy field and village area	Oct. - Nov.	Small flood occurred by temporary diversion dams in the creek. Inundation is much affected by high tide during only heavy rainfall.	1-2 days	0.6 - 1.0 m	Submergence of paddy field	Lateral canal E-4a has been damaged by typhoon, and irrigation water supply has suspended for about 10 years.
8	JP / Lateral E-4b	10	Irrigated paddy field and swampy area	Oct. - Nov.	Topographic depression area	1-2 days	0.5 - 1.0 m	Submergence of paddy field	
9	JP / Lateral E	20	Irrigated paddy field	Oct. - Nov.	Existing drainage system is suffered from highway, and drainage culverts of the highway have insufficient capacity.	2-3 days	0.7 - 1.0 m	Submergence of paddy field	Lateral canal E-5 has been damaged by typhoon, and irrigation water supply has suspended for about 10 years.
10	JP / Lateral E5a	70	Irrigated paddy field	Oct. - Nov.	Topographic depression area and existing drainage outlet has insufficient capacity. Inundation is much affected by high tide during only heavy rainfall.	2-3 days	0.5 - 1.0 m	Submergence of paddy field	
11	JP / Lateral G	50	Irrigated paddy field	Oct. - Nov.	Topographic depression area and inundation is much affected by high tide during only heavy rainfall.	2-3 days	0.7 - 1.0 m	Submergence of paddy field	Lateral canal G has been damaged by typhoon, and irrigation water supply has suspended for about 10 years.
	TOTAL	405							

Table D.2.1 Problem on Low Irrigation Efficiency

Description		Present Problem concerned	Main Reason	Approach / Solution
Hard aspect	Seepage in canal	Non	-	-
	Percolation	Non	-	-
	Main and lateral canals	Poor condition of conveyance of necessary water discharge	Siltation in canal and improper maintenance	Provision of settling basin and
		Overflow during full water supply	Low embankment due to lack of proper maintenance works for long period	Improvement of canal section
			Improper water distribution and back water occurred by improper gate operation	Upgrading of technical knowledge NIA staff and IA member
		Slow water run to irrigation service area and / or the on-farm	Much miss operation during water conveyance in canals and long length of main and lateral canals	Improvement of operation skillfulness and provision of water control structures Sustaining well maintained canal section by lining and proper maintenance
		Thieving of irrigation water and disturbance of water operation	Illegal turnout at lateral canals and illegal drain inlet	Provision of additional canal (feeder canals) and additional turnout Expansion of drainage canal net-works.
	Related structures	Improper water distribution at exist head gate / turnout	Deterioration of gates at head gate / turnout and lack of measuring devices	Replacement of gates and improvement of structures
			Unsuitable and complicate operation method for users	Construction of more suitable measuring devices for users
		Non equitable water distribution in the dry season	Limited water distribution and portable pump use	Provision of additional canal (feeder canals) and additional turnout
	On-farm canals	Slow water run	Improper canal layout and insufficient flow area of canal section	Establishment of farm ditch network excluding farm drainage system In addition, upgrading of main and long lateral canals by lining
			Irrigation water is supplied though farm to farm in tail portion of TSA due to lack of farm ditch	Provision of additional turnout & feeder canals Provision of farm pond and small pond in creek as supplementary facility in the dry season and or emergency water use
		Improper irrigation water distributi under rotational irrigation system	Non measuring devices at turnout and lack of farm ditch	Improvement and construction of structures
Soft aspect NIA side	Water distribution	Much water waste and non timely water distribution	Insufficient information and lack of communication on water distribution	Provision of communication facility and staff training Provision of farm pond and small pond in creek as supplementary facility
		No integrated water distribution management	Lack of monitoring system and analysis of problem / constraints Lack of measuring devices Budgetary constraint and low technical skillfulness	Staff training and establishment of monitoring and analysis system
			Unsuitable and complicate operation method of measuring devices at turnout	Provision of water control gates and suitable measuring devices Improper maintenance works
		Low technical skillfulness	Absence of operation manual due to budgetary constraints and lack of appreciation to the manual	Provision of manual and training program by the establishment of the model / demonstration area and necessary facilities.

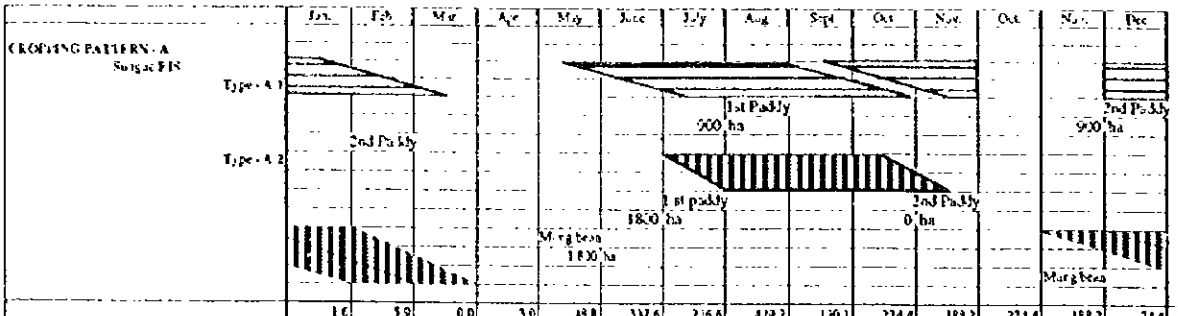
Description		Present Problem concerned	Main Reason	Approach / Solution
	Maintenance	Low sustainability of proper maintenance work on irrigation and drainage facilities	Lack of monitoring system and analysis of problem / constraints Budgetary constraint Shortage of maintenance equipment and poor supply of spare parts due to budgetary constraints	Staff training and establishment of monitoring and analysis system Provision of O & M equipment & spare parts
		Low technical activities on maintenance works	Absence of maintenance manual Low technical knowledge	Provision of manual and training program by the establishment of the model/demonstration area and necessary facilities.
	Human resources	Shortage of technical staff and low technical knowledge on O & M	Budgetary constraint	Staff training and provision of additional personnel
IA side	Water distribution	Much water waste and non timely and non equitable water receiving	Insufficient information and communication on water distribution Low technical knowledge Lack of monitoring system	Establishment of communication system and training of IA member Establishment of monitoring system and training of IA member Provision of manual and training program by the establishment of the model / demonstration area and necessary facilities.
	Maintenance	Low activities on maintenance work on the contract base	Low technical knowledge Lack of monitoring system	Provision of manual and training program by the establishment of the model / demonstration area and necessary facilities.
	Human resources	Low management skillfulness	IA member's low technical knowledge on O & M	Training of IA member

Table D.5.1 Irrigation Water Requirement

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Oct.	Nov.	Dec.	
CROPPING PATTERN - A														
Jalaur pro. RIS														
	2nd Paddy							1st Paddy					2nd Paddy	
							8,820	ha				8,820	ha	
					For Suague RIS		200	ha		For Suague RIS		200	ha	
Probable Monthly Rainfall	1.6	5.9	0.0	3.0	48.8	337.6	226.6	449.2	190.1	224.4	224.4	188.2	74.4	1,750
Potential Evapo-transpiration	155.0	154.0	213.9	307.0	179.8	138.0	120.9	133.3	117.0	130.2	130.2	120.0	139.5	1808.6
CROPPING PATTERN - A														
2nd Paddy														
Crop Coefficient (Kc)	1.18	1.20	1.10								0.83	1.01	1.07	
Crop Evapotranspiration (ETcrop)	182.9	184.8	235.3								133.3	121.2	149.3	987
Percolation	62.0	56.0	62.0								62.0	60.0	62.0	364
Effective Rainfall *	1.6	5.9	0.0								150.3	131.2	67.7	367
Area Factor	0.94	0.50	0.06								0.30	0.80	1.00	
Puddring Water											75.0	75.0		150
Net Irrigation Requirement	228	117	19								30	93	141	630
1st Paddy														
Crop Coefficient (Kc)					0.90	0.98	1.09	1.18	1.18	1.16				
Crop Evapo-transpiration (ETcrop)					161.8	135.2	131.8	148.0	138.1	151.0				866
Percolation					46.5	45	46.5	46.5	45	45				275
Effective Rainfall *					43.9	168.8	158.6	202.1	142.6	150.3				866
Area Factor					0.10	0.40	0.90	1.00	0.82	0.33				
Puddring Water					37.5	75.0	37.5							150
Net Irrigation Requirement				0	20	35	51	0	33	15				154
Irrigation Efficiency	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Conveyance Efficiency 72 % **	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Application Efficiency 70 % of paddy field **	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
Gross Irrigation Requirement (mm)	453	233	37	0	40	69	102	0	66	29	59	183	285	1555.5
(lit/sec/ha)	1.69	0.96	0.14	0.00	0.15	0.26	0.38	0.00	0.25	0.11	0.22	0.70	1.06	
Irrigation Service Area (ha)	9,020	9,020	9,020		9,020	9,020	9,020	9,020	9,020	9,020	9,020	9,020	9,020	
Seasonal Requirement (m3/sec)	15.24	8.69	1.24		1.35	2.39	3.44	0.00	2.29	1.03	2.00	6.36	9.59	

J	F	M	A	M	J	J	A	S	O	N	D
15.24	8.69	1.24	0.00	1.35	2.39	3.44	0.00	2.29	1.03		
									2.00	6.36	9.59
15.24	8.69	1.24	0.00	1.35	2.39	3.44	0.00	2.29	3.03	6.36	9.59

Table D.5.2 Irrigation Water Requirement



	Jan.	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Oct	Nov	Dec	
Potential Evapotranspiration	1.6 155.0	5.9 154.0	0.0 213.9	3.0 207.0	48.8 179.8	337.6 138.0	216.6 153.0	419.2 133.3	130.1 117.0	224.4 130.2	183.2 130.0	224.4 130.2	158.2 120.0	24.4 139.5	1,936 1,978.6
CROPPING PATTERN - A1															
2nd Paddy															
Crop Coefficient (Kc)	1.18	1.16	1.10						0.90	0.98	1.09			1.11	
Crop Evapotranspiration (ETcrop)	182.9	178.6	235.3						105.3	127.6	130.8			154.8	1,115
Percolation	62.0	56.0	62.0						62.0	62.0	62.0			62.0	426
Effective Rainfall *	1.6	5.9	0.0						142.6	150.3	141.2			67.7	509
Area Factor	0.82	0.33	0.00						0.10	0.40	0.90			1.00	
Padding Water									37.5	75.0	37.5				150
Net Irrigation Requirement	200	74	0						6	46	80			143	555
Irrigation Efficiency	0.50	0.50	0.50						0.50	0.50	0.50	0.50	0.50	0.50	
Conveyance Efficiency 72 % **	0.72	0.72	0.72						0.72	0.72	0.72	0.72	0.72	0.72	
Application Efficiency 70 % of paddy field **	0.70	0.70	0.70						0.70	0.70	0.70	0.70	0.70	0.70	
Gross Irrigation Requirement 1 (mm)	396	148	0						12	91	159	0	0	286	
(l/s/ha)	1.48	0.61	0.00						0.05	0.35	0.61	0.00	0.00	1.10	
1st Paddy															
Crop Coefficient (Kc)					0.90	0.98	1.09	1.11	1.18	1.16					
Crop Evapotranspiration (ETcrop)					161.8	135.2	131.8	148.0	138.1	151.0					866
Percolation					46.5	45	46.5	46.5	45	45					275
Effective Rainfall *					43.9	168.8	158.6	202.1	142.6	150.3					866
Area Factor					0.10	0.40	0.90	1.00	0.82	0.33					
Padding Water					37.5	75.0	37.5								150
Net Irrigation Requirement					29	35	51	0	33	19					154
Irrigation Efficiency	0.50	0.50	0.50		0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Conveyance Efficiency 72 % **	0.72	0.72	0.72		0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Application Efficiency 70 % of paddy field **	0.70	0.70	0.70		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
Gross Irrigation Requirement (mm)	396	148	0		40	69	102	0	78	120	159	0	0	286	1407.9
(l/s/ha)	1.48	0.61	0.00		0.15	0.26	0.38	0.00	0.30	0.46	0.61	0.00	0.00	1.10	
Irrigable Service Area (ha)	900	900	900		900	900	900	900	900	900				900	
									900	900	900				
Seasonal Requirement (m3/sec)	1.33	0.55	0.00		0.14	0.24	0.34	0.00	0.27	0.40	0.55	0.00	0.00	0.99	
CROPPING PATTERN - A2															
1st Paddy															
Crop Coefficient (Kc)							1.00	1.10	1.18	1.09	1.02				
Crop Evapotranspiration (ETcrop)							120.9	146.6	137.5	141.3	127.4				669
Percolation							60.0	62.0	60.0	62.0	60.0				304
Effective Rainfall *							158.6	202.1	142.6	150.3	141.2				795
Area Factor							0.50	1.00	1.00	0.50	0.00				
Padding Water							150.0								150
Net Irrigation Requirement							86	6	55	26	0				174
Irrigation Efficiency	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
Conveyance Efficiency 72 % **	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	
Application Efficiency 70 % of paddy field **	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
Gross Irrigation Requirement (mm)	0	0	0	0	0	0	171	13	109	53	0	0	0	0	345.2
(l/s/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.05	0.42	0.20	0.00	0.00	0.00	0.00	
Irrigable Service Area (ha)	0						1,800	1,800	1,800	1,800	1,800			0	
Seasonal Requirement (m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.09	0.76	0.36	0.00	0.00	0.00	0.00	
Mungbean															
Crop Coefficient (Kc)	0.00	0.00	0.00										0.00	0.00	
Crop Evapotranspiration (ETcrop)	0.0	0.0	0.0										0.0	0.0	0
Effective Rainfall *	0.0	0.0	0.0										74.0	58.0	132
Area Factor	1.00		0.00										1.00	1.00	
Supplemental water for germination	9.0												0.0	9.0	
Net Irrigation Requirement	9	0	0										0	0	9
Irrigation Efficiency	0.50	0.50	0.50										0.50	0.50	
Conveyance Efficiency 72 % **	0.72	0.72	0.72										0.72	0.72	
Application Efficiency 70 % **	0.70	0.70	0.70										0.70	0.70	
Gross Irrigation Requirement 2 (mm)	18	0	0										0	0	17.9
(l/s/ha)	0.07	0.00	0.00										0.00	0.00	
Irrigable Service Area (ha)	1,800	1,800	1,800										1,800	1,800	
Seasonal Requirement 2 (m3/sec)	0.12	0.00	0.00										0.00	0.00	

	J	F	M	A	M	J	J	A	S	O	N	D
1st and 2nd paddy (Type A1)	1.33	0.55	0.00	0.00	0.14	0.24	0.34	0.00	0.27	0.40	0.55	
										0.00	0.00	0.00
1st and 2nd paddy (Type A2)	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.09	0.76	0.36	0.00	
										0.00	0.00	0.00
Mungbean	0.12	0.00	0.00								0.00	0.00
	1.45	0.55	0.00	0.00	0.14	0.24	1.49	0.09	1.03	0.77	0.55	0.00

Table D.5.3 Proposed Feeder Canal

Area	Canal concerned	Feeder Canal	Length (m)	Irrigation Service Area (ha)
Suague RIS area				
	Main canal	FC - 1	3,300	120
	Lateral A	FSA - 1	800	19
		FSA - 2	600	33
		FSA - 3	700	36
		FSA - 4	450	31
	Lateral B	FSB - 1	700	25
		FSB - 2	800	20
	Subtotal		7,350	284
Jalaur Proper RIS area				
	Main canal	FPM - 1	600	8
		FPM - 2	500	18
		FPM - 3	500	41
		FC - 2	5,900	200
	Lateral C	FPC - 1	1,200	18
		FPC - 2	1,200	14
	Lateral D-1	FPD - 1	1,200	48
	Lateral E	FPE - 1	500	15
		FPE 2-1	500	38
	Lateral E4a	FPE 4a - 1	1,200	25
	Lateral E4b	FPE 4b - 1	700	44
		FPE 4b - 2	800	36
	Lateral E5	FPE 5 - 1	1,000	53
		FPE 5 - 1a	500	20
		FPE 5 - 1b	500	15
		FPE 5 - 2	1,700	41
		FPE 5 - 3	1,200	34
	Lateral E5a - 1	FPE 5a - 1	500	32
		FPE 5a1 - 1	500	20
		FPE 5a1 - 2	600	38
	Lateral G	FPG - 1	500	24
	Lateral I	FPI - 1	700	50
		FPI - 2	800	24
	Lateral 1 - 3	FPI3 - 1	1,000	15
	Subtotal		24,300	871
	Total		31,650	1,155

Table D.5.4 Gates to be Replaced and Improvement of Riprap

RIS	Head Gate	Check structure		Intake Structure		Riprap to be
		Replacement	New Installation	Replacement	New Installation	Improved (m)
Jalaur proper RIS						
	Lateral A	2	-	-	-	-
	Lateral C	4	-	-	-	-
	Lateral C-1	-	1	-	1	15
	Lateral D	1	-	-	1	25
	Lateral D-1	-	2	-	1	15
	Lateral D-2	-	1	-	-	-
	Lateral E	-	-	-	-	35
	Lateral E-1	-	-	-	-	10
	Lateral E-2	3	-	-	-	-
	Lateral E3	2	-	-	-	15
	Lateral E4	2	-	2	-	10
	Lateral E5	1	-	-	1	-
	Lateral E-4a	2	-	1	-	10
	Lateral E-4b	1	-	-	2	15
	Lateral E4b-1 & E4b-2	-	1	-	2	-
	Lateral E-5a	-	1	-	1	5
	Lateral E-5a1	-	1	-	1	-
	Lateral F	-	1	-	-	-
	Lateral G	1	-	-	2	15
	Lateral G-1	-	1	-	1	-
	Lateral G-2	-	1	-	1	20
	lateral G-3	-	2	-	1	5
	Lateral H	-	-	1	-	-
	Lateral J & I	-	-	2	-	10
	Subtotal	19	12	6	15	205
Suague RIS						
	Lateral A	2	-	1	-	-
	Lateral B	1	-	2	-	-
	Lateral B1	1	1	1	-	5
	Lateral B2	-	-	-	-	10
	Lateral B3	1	-	1	-	5
	Lateral B3a	-	1	1	-	10
	Lateral B3b	-	1	-	1	-
	Lateral B4	-	1	-	1	10
	Lateral B5	-	1	1	-	15
	Subtotal	5	5	7	2	55
	Total	24	17	13	17	260

Table D.5.5 Proposed Turnout

No.	Canal	Turnout		
		Renewal	Addtional	Total
	Suague RIS area			
1	Main Canal	14	17	31
2	Lateral A	21	6	27
3	Feeder FS-1	0	11	11
4	Lateral B	13	2	15
5	Lateral B-1	6	1	7
6	Lateral B-2	2	1	3
7	Lateral B-3	8	1	9
8	Lateral B-3a	5	0	5
9	Lateral B-3b	4	0	4
10	Lateral B-4	3	1	4
11	Lateral B-5	3	1	4
	Total	79	41	120

No.	Canal	Turnout		
		Renewal	Addtional	Total
	Jalaur Proper RIs area			
1	Main Canal	40	9	49
2	Lateral A	10	1	11
3	Feeder FS-2	0	9	9
4	Lateral C	6	0	6
5	Lateral C-1	2	0	2
6	Lateral D	8	2	10
7	Lateral D-1	5	0	5
8	Lateral D-2	3	0	3
9	Lateral E	18	5	23
10	Lateral E-1	1	1	2
11	Lateral E-2	2	1	3
12	Lateral E-3	6	2	8
13	Lateral E-4	11	5	16
14	Lateral E-4a	15	2	17
15	Lateral E-4b	12	5	17
16	Lateral E-4b1	2	0	2
17	Lateral E-4b2	4	1	5
18	Lateral E-5	14	2	16
19	Lateral E-5a	3	3	6
20	Lateral E-5a1	5	1	6
	Subtotal	167	49	216

No.	Canal	Turnout		
		Renewal	Addtional	Total
	Jalaur Proper RIs area			
20	Lateral F	11	5	16
21	Lateral G	29	1	30
22	Lateral G-1	2	0	2
23	Lateral G-2	1	4	5
24	Lateral G-3	0	4	4
25	Lateral H	8	2	10
26	Lateral I	22	5	27
27	Lateral I-1	0	2	2
28	Lateral I-2	3	0	3
29	Lateral I-3	3	2	5
30	Lateral J	4	2	6
	Subtotal	83	27	110
	Total	250	76	326

Table D.5.6 Proposed Farm Ponds and Ponds in Creeks

FARM PONDS

RIS	No.	Farm Pond	Canals concerned	Irrigation Service Area (ha)	Pond Capacity (m³)	Pond area (ha)	Present Land Use
Farm Pond							
Jalaur proper RIS	1	FPJ - 1	Lateral D / D1 / D2	590	18,880	1.3	Elevated paddy field
	2	FPJ - 2	Lateral G	690	22,080	1.5	Elevated land
	3	FPJ - 3	Main canal, Lateral I / H / J	770	24,640	1.6	Irrigated paddy field
	4	FPJ - 4	Lateral E	500	16,000	1.1	Irrigated paddy field
	5	FPJ - 5	Lateral E	410	13,120	0.9	Irrigated paddy field
	6	FPJ - 6	Lateral E4 / E4b	470	15,040	1.0	Irrigated paddy field
	7	FPJ - 7	Lateral E5a	500	16,000	1.1	Irrigated paddy field
	8	FPJ - 8	Lateral G	320	10,240	0.7	Irrigated paddy field
	9	FPJ - 9	Lateral I	310	9,920	0.7	Irrigated paddy field
	10	FPJ - 10	Lateral H	360	11,520	0.8	Elevated land
	11	FPJ - 11	Lateral I /I2 / I3	500	16,000	1.1	Irrigated paddy field
	12	FPJ - 12	Lateral E4b	300	9,600	0.6	Elevated land
	13	FPJ - 13	Lateral E4a	320	10,240	0.7	Irrigated paddy field
		Subtotal				12.9	
Suague RIS	1	FPS - 1	Lateral A	240	7,680	0.5	Elevated paddy field
	2	FPS - 2	Main canal, Lateral B1 / B2	540	17,280	1.2	Elevated paddy field
	3	FPS - 3	Lateral B3 / B4	210	6,720	0.4	Elevated land
	4	FPS - 4	Lateral B3	170	5,440	0.4	Elevated land
	5	FPS - 5	Lateral B / B5	430	13,760	0.9	Irrigated paddy field
	6	FPS - 6	Main canal	240	7,680	0.5	Elevated paddy field
	7	FPS - 7	Lateral A	410	13,120	0.9	Elevated paddy field
		Subtotal				4.8	
		Total				17.7	

PONDS IN MAIN DRAINS AND CREEKS

RIS	No.	Pond	Drains and / or Creeks concerned
Jalaur proper RIS	1	PRJ-1	Old lateral canal G
	2	PRJ-2	Sigangao Creek
	3	PRJ-3	Sigangao Creek
	4	PRJ-4	Sigangao Creek
Suague RIS	1	PRS-1	DSB-1 / topographic depression area
	2	PRS-2	Casalsagan Creek

Table D.5.7 Proposed Secondary Drainage Canal and Related Structures

Main Drainage Area	No.	Additional Secondary Drain	Catchment area (ha)	Design Discharge (m3/sec)	Length (m)	Proposed Structures		Remarks
						Bridge	Cross Drain	
Drain No. 1 (Janipa-an River)								
	1	DPI 1	183	0.95	2,300	-	1	
	2	DPI 2	157	1.26	800	-	-	
	3	DPI 2-1	50	0.20	1,100	-	-	
	4	DPI 2-2	207	1.26	150	-	-	
	5	DPI 3	48	0.39	500	-	-	
	6	DPI 4	67	0.54	700	-	-	
	7	DPI 5	130	1.04	1,400	-	-	
		Subtotal			6,950	0	1	
Drain No.2 (Sigangao Creek)								
	8	DPI 6	71	0.57	800	-	-	
	9	DPI 7	65	0.52	700	-	-	
	10	DPI 8	43	0.35	700	-	-	
	11	DPI 9	38	0.31	600	-	-	
	12	DPI 10	29	0.23	500	-	-	
	13	DPI 11	25	0.20	300	-	-	
	14	DPI 12	41	0.33	500	-	-	
	15	DPG 1	48	0.39	700	-	-	
	16	DPG 2	53	0.43	800	-	-	
	17	DPG 3	36	0.29	650	-	-	
	18	DPG 4	93	0.75	600	-	-	
	19	DPG 5	31	0.25	1,100	-	-	
	20	DPG 6	34	0.27	450	-	-	
	21	DPG 7	38	0.31	700	-	-	
	22	DPG 8	32	0.26	500	-	-	
	23	DPG 9	26	0.21	600	-	-	
	24	DPG 10	37	0.30	500	-	-	
		Subtotal			10,700	0	0	
Drain No.3 (Old lateral canal G)								
	25	DSB 1	496	3.98	1,100	1	0	
Drain No.4								Replacement of cross drain at main canal / 1 no.
Jalaur river								
	26	DPD 1	183	1.47	1,200	-	-	
	27	DPF 1	332	2.66	1,700	-	-	
	28	DPE 1	94	0.75	750	-	-	
	29	DPE 2	277	2.22	1,250	-	-	Replacement of culvert / 2 nos. & bridge / 1no.
	30	DPE 2-1	108	0.87	600	-	-	
	31	DPE 2-2	49	0.39	300	-	-	
	32	DPE 5-1	40	0.32	500	-	-	
	33	DPE 5-2	47	0.38	600	-	-	
	34	DPE 5-4	87	0.70	200	-	-	
	35	DPE 5-4.1	79	0.63	450	-	1	
	36	DPE 5-4.2	79	0.63	900	-	-	
	37	DPE 5-5	166	1.33	500	-	-	
	38	DPG 11	46	0.37	300	-	1	
	39	DPG 11-1	23	0.18	1,100	-	-	
	40	DPG 11-2	23	0.18	400	-	-	
	41	DPG 12	35	0.28	400	-	1	
	42	DPG 12-1	17	0.14	800	-	-	
	43	DPG 12-2	18	0.14	150	-	-	
		Subtotal			12,100	0	3	

Main Drainage Area	No	Additional Secondary Drain	Catchment area (ha)	Desiga Discharge (m3/sec)	Length (m)	Proposed Structures		Remarks
						Bridge	Cross Drain	
Drain No.5								
	44	DPE 4-1	186	1.49	1,400	-	1	
	45	DPE 5-3	223	1.79	400	-	-	
	46	DPE 5-3.1	44	0.35	500	-	-	
	47	DPE 5-3.2	36	0.29	450	-	-	
	48	DPE 5-3.3	128	1.03	1,600	-	-	
	49	DPE 5-6	139	1.12	1,450	-	-	
	50	DPE 5-7	170	1.36	1,100	-	-	
	51	DPE 5-8	75	0.60	1,150	-	-	
	52	DPE 5-9	84	0.67	700	-	-	
	53	DPE 5-10	253	2.03	3,900	-	-	
		Subtotal			12,650	0	1	
Drain No.6 (Binaobao creek)								
	54	DPE 4-2	185	1.48	2,200	-	-	
	55	DPE 4-3	118	0.95	700	-	-	
		Subtotal			2,900	0	0	
Dumangas river								
	56	DPE 4-4	256	2.05	3,200	-	1	
	57	DPE 4-5	44	0.35	1,300	-	1	New cross drain
	58	DPE 4-6	140	0.00	3,000	0	1	1 no. / D-4
		Subtotal			7,500	0	3	
		Total			53,900	1	8	Cross drain / 4 nos. + Bridge / 1 no.

Table D.5.8 Proposed Improvement Works of Service Road and Rural Road

Area / Roads	No.	Canal concerned	Improvement Works	Length of Road (m)	Total width (m)	Effective width (m) (pavement width)	Additional Cross drain	Additional Culvert
Sungue RIS area								
(1) Service road								
	1	Main canal	Improvement of gravel pavement	6,000	4.0	3.0		
			Improvement of road section & gravel pavement	3,200	4.0	3.0		
			Subtotal	9,200				
	2	Lateral - A	Improvement of road section & gravel pavement	7,000	4.0	3.0		
			New construction with gravel pavement	1,400	4.0	3.0		
			Subtotal	8,400				
	3	Feeder FS-1	New construction with gravel pavement	3,600	4.0	3.0	9	
	4	Lateral - B	Improvement of gravel pavement	1,980	4.0	3.0		
			Improvement of road section & gravel pavement	4,640	4.0	3.0		
			Subtotal	6,620				
	5	Lateral - B1	Improvement of road section & gravel pavement	3,000	4.0	3.0		
	6	Lateral - B2	New construction with gravel pavement	3,030	4.0	3.0	4	
	7	Lateral - B3	Improvement of road section & gravel pavement	5,200	3.0 - 4.0	2.5 - 3.0		
	8	Lateral - B3a	New construction with gravel pavement	420	4.0	3.0		2
	9	Lateral - B3b	New construction with gravel pavement	700	4.0	3.0	2	2
	10	Lateral - B4	New construction with gravel pavement	1,060	4.0	3.0	2	2
	11	Lateral - B5	Improvement of road section & gravel pavement	3,500	4.0	3.0		
			Total	44,730			17	6
(2) Rural road (Access road)								
	12	Lateral - B2	New construction with gravel pavement	640	4.0	3.0	2	
	13	Lateral B - B5	Improvement of road section & gravel pavement	1,200	4.0	3.0		
			Total	1,840			2	0
			Grand Total	46,570			19	6

Table D.5.9 Proposed Improvement Works of Service Road and Rural Road

Area / Roads	No.	Canal concerned	Improvement Works	Length of Road (m)	Total width (m)	Effective width (m) (pavement width)	Additional Cross drain
Jalaur Proper RIS Area							
(1) Service road							
	1	Main canal	Improvement of gravel pavement	7,000	4.0 - 6.0	3.0 - 4.0	
			Improvement of road section & gravel pavement	13,800	4.0 - 6.0	3.0 - 4.0	
			New construction with gravel pavement	4,800	4.0	3.0	
			Subtotal	25,600			
	2	Lateral - A	Improvement of road section & gravel pavement	3,000	4.0	3.0	
	3	Lateral - C / C-1	Improvement of road section & gravel pavement	2,100	4.0	3.0	
	4	Feeder IS - 2	New construction with gravel pavement	1,900	4.0	3.0	
	5	Lateral - D	Improvement of road section & gravel pavement	6,000	4.0	3.0	
			New construction with gravel pavement	700	4.0	3.0	3
			Subtotal	6,700			
	6	Lateral - D1	New construction with gravel pavement	3,500	4.0	3.0	10
	7	Lateral - D2	New construction with gravel pavement	1,600	4.0	3.0	3
	8	Lateral - E	Improvement of road section & gravel pavement	15,000	6.0	4.0	
	9	Lateral - E3	Improvement of road section & gravel pavement	2,200	4.0	3.0	
	10	Lateral - E4	Improvement of gravel pavement	4,000	4.0	3.0	
			New construction with gravel pavement	1,000	4.0	3.0	4
			Subtotal	5,000			
	11	Lateral - E4a	Improvement of gravel pavement	1,700	4.0	3.0	
			Improvement of road section & gravel pavement	7,500	4.0	3.0	
			Subtotal	9,200			
	12	Lateral - E4b	Improvement of gravel pavement	2,800	4.0	3.0	
			Improvement of road section & gravel pavement	700	4.0	3.0	
			New construction with gravel pavement	1,000	4.0	3.0	3
			Subtotal	4,500			
	13	Lateral - E5a	Improvement of gravel pavement	2,400	4.0	3.0	
			Improvement of road section & gravel pavement	4,200	4.0	3.0	
			Subtotal	6,600			
	14	Lateral - E5a 1	Improvement of road section & gravel pavement	1,400	4.0	3.0	
			New construction with gravel pavement	1,000	4.0	3.0	4
			Subtotal	2,400			
	15	Lateral - F	Improvement of road section & gravel pavement	4,200	4.0	3.0	
	16	Lateral - G	Improvement of gravel pavement	4,000	4.0	3.0	
			Improvement of road section & gravel pavement	4,600	4.0	3.0	
			New construction with gravel pavement	2,000	4.0	3.0	
			Subtotal	10,600			
	17	Lateral - G1	Improvement of gravel pavement	2,400	4.0	3.0	
	18	Lateral - G3	Improvement of gravel pavement	600	4.0	3.0	
	19	Lateral - H	Improvement of road section & gravel pavement	3,600	4.0	3.0	1
	20	Lateral - I	Improvement of gravel pavement	11,200	4.0	3.0	
	21	Lateral - I 1	Improvement of road section & gravel pavement	1,800	4.0	3.0	
	22	Lateral - J	Improvement of road section & gravel pavement	3,200	4.0	3.0	
			Total	126,900			28

Area / Roads	No.	Canal concerned	Improvement Works	Length of Road (m)	Total width (m)	Effective width (m) (pavement width)	Additional Cross drain
(2) Rural road (Access road)							
	23	Lateral - C1	New construction with gravel pavement	900	4.0	3.0	5
	24	Lateral - D1	New construction with gravel pavement	400	4.0	3.0	1
	25	Lateral - E3	Improvement of road section & gravel pavement	600	4.0	3.0	
	26	Lateral E3 -	Improvement of road section & gravel pavement	2,100	3.0	2.5	
	27	Lateral - E4b	Improvement of road section & gravel pavement	200	4.0	3.0	
	28	Lateral - I1	Improvement of road section & gravel pavement	200	4.0	3.0	
			Total	4,900			6
			Grand Total	131800			34

Table D.5.10 Length of the Service Road to be Improved

Unit : m

RIS	No.	Canal concerned	Gravel pavement only	Road section & pavement	New construction
Suague RIS	1	Main canal	6,000	3,200	
	2	Lateral A	-	7,000	1,400
	3	Feeder FS-1	-	-	3,600
	4	Lateral B	1,980	4,640	-
	5	Lateral B 1	-	3,000	-
	6	Lateral B 2	-	-	3,030
	7	Lateral B 3	-	5,200	-
	8	Lateral B 3a	-	-	420
	9	Lateral B 3b	-	-	700
	10	Lateral B 4	-	-	1,060
	11	Lateral B 5	-	3,500	-
		Subtotal	7,980	26,540	10,210
Jalaur proper	1	Main canal	7,000	13,800	4,800
RIS	2	Lateral A	-	3,000	-
	3	Lateral C / C 1	-	2,100	-
	4	Feeder FS-2	-	-	1,900
	5	Lateral D	-	6,000	700
	6	Lateral D 1	-	-	3,500
	7	Lateral D 2	-	-	1,600
	8	Lateral E	-	15,000	-
	9	Lateral E 3	-	2,200	-
	10	Lateral E 4	4,000	-	1,000
	11	Lateral E 4a	1,700	7,500	-
	12	Lateral E 4b	2,800	700	1,000
	13	Lateral E 5a	2,400	4,200	-
	14	Lateral E 5a -1	-	1,400	1,000
	15	Lateral F	-	4,200	-
	16	Lateral G	4,000	4,600	2,000
	17	Lateral G 1	2,400	-	-
	18	Lateral G 3	600	-	-
	19	Lateral H	-	3,600	-
	20	Lateral I	11,200	-	-
	21	Lateral I 1	-	1,800	-
	22	Lateral J	-	3,200	-
		Subtotal	36,100	73,300	17,500
		Total	44,080	99,840	27,710

Table D.6.1 Project Works

Description	Unit	Jalaur proper RIS	Suague RIS	Total
Improvement Plan of Irrigation/Drainage and Rural Road				
1 Diversion Dam				
1.1 Replacement of slide gate for main gate, scouring sluice gate, intake gates	nos.	20	4	24
1.2 River Treatment				
Length of river treatment	m		280	280
Gabion mattress & groins	m		350	350
1.3 Trashrack	nos.	2	1	3
2 Main/Lateral Canals and Related Structures				
2.1 Improvement of canals	km	121.3	39.4	160.7
2.2 Feeder canals	km	24.3	7.4	31.7
2.3 Canal lining	km	29.3	6.3	35.6
2.4 Settling basin	nos.	1	1	2
2.5 Replacement and installation of gates at head gate / turnout	nos.	52	19	71
2.6 Additional turnout	nos.	76	41	117
2.7 Additional related structures	nos.	102	33	135
2.8 Farm pond (supplemental facilities)	nos.	13	7	20
2.9 Pond (supplemental facilities)	nos.	4	2	6
3 Main/Secondary Drains and Related Structures				
3.1 Additional secondary drains	km	53.9 common for both the RIS		
3.2 Enlargement of Abangay creek	km		8	8
3.3 Bridge	nos.	1	1	2
3.4 Cross drain	nos.	11	1	12
4 Service road and rural road				
Service road				
4.1 Improvement of gravel pavement	km	36.1	8	44.1
4.2 Improvement of road	km	73.3	26.5	99.8
4.3 New construction	km	17.5	10.2	27.7
Rural road				
4.4 Improvement of road	km	3.6	1.2	4.8
4.5 New construction	km	1.3	0.7	2
Institutional Development Plan				
1 Buildings				
1.1 Renovation of NIA training center	m2	730 common for both the RIS		
1.2 IA office	nos.	20 common for both the RIS		

Figures

Figure D.2.1 Constraint and Main Reason of the Low Irrigation Efficiency

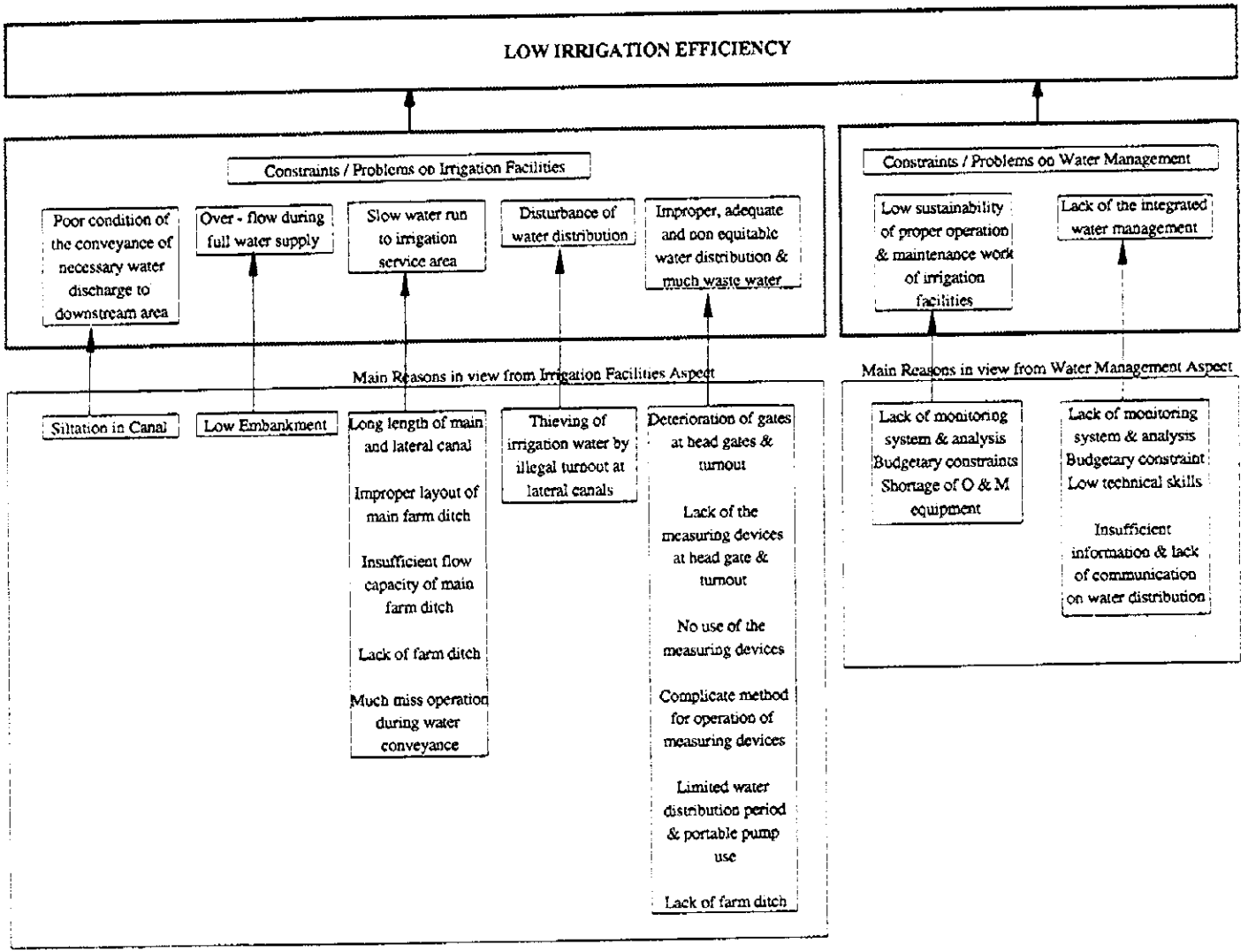
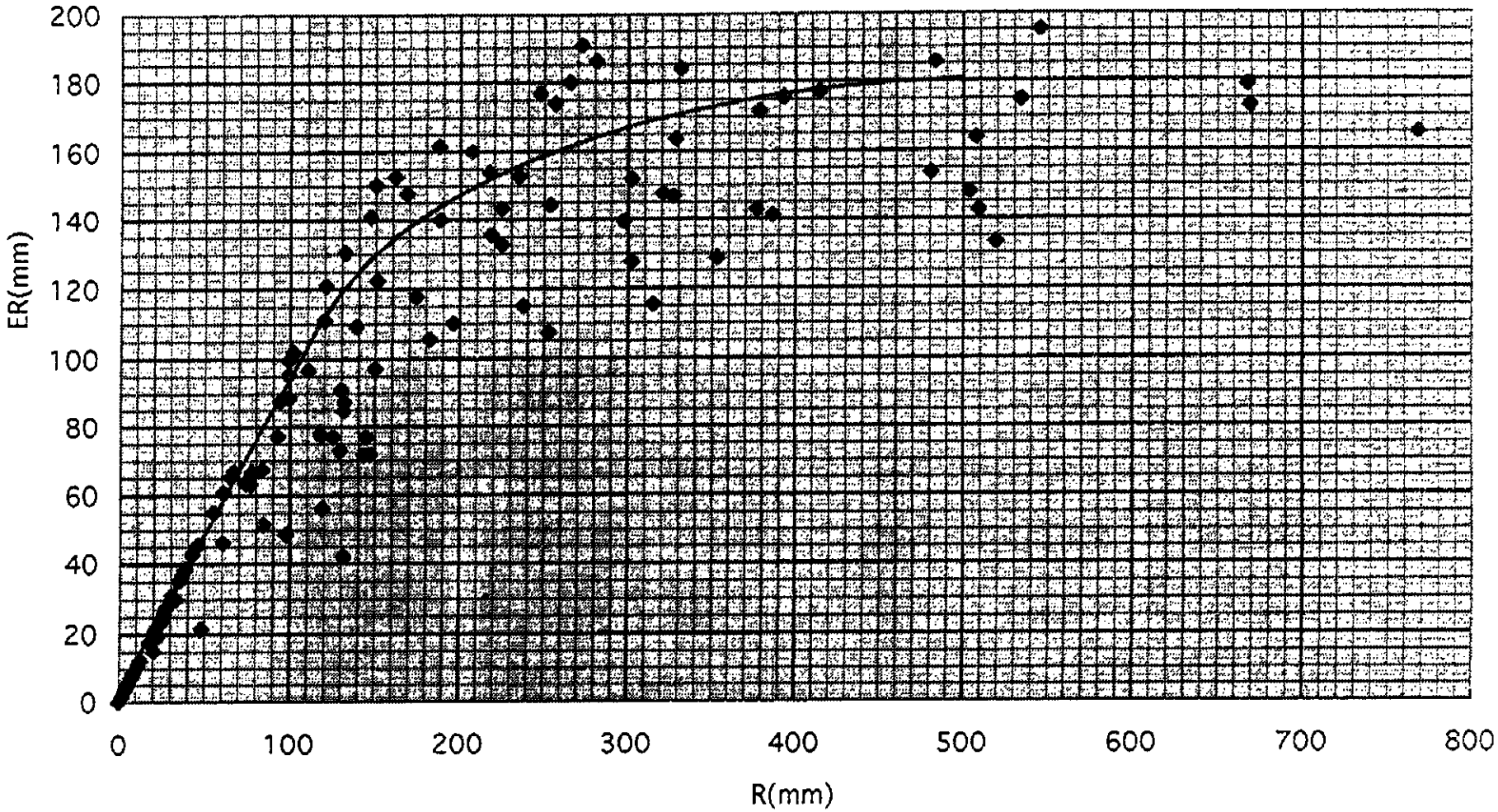
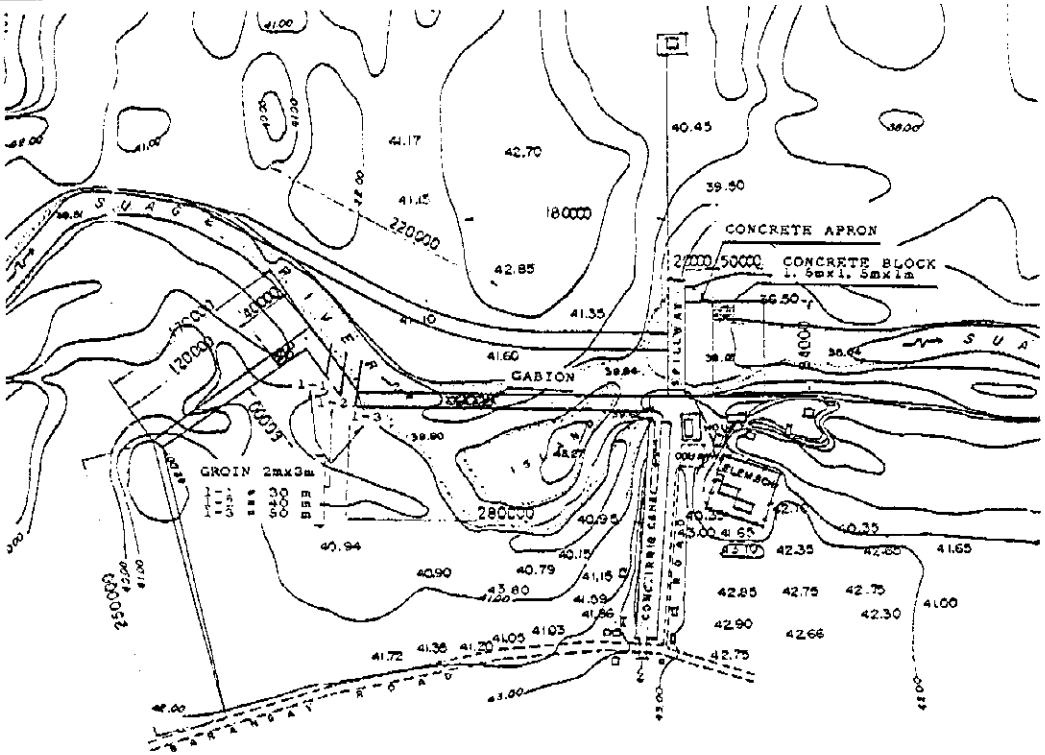
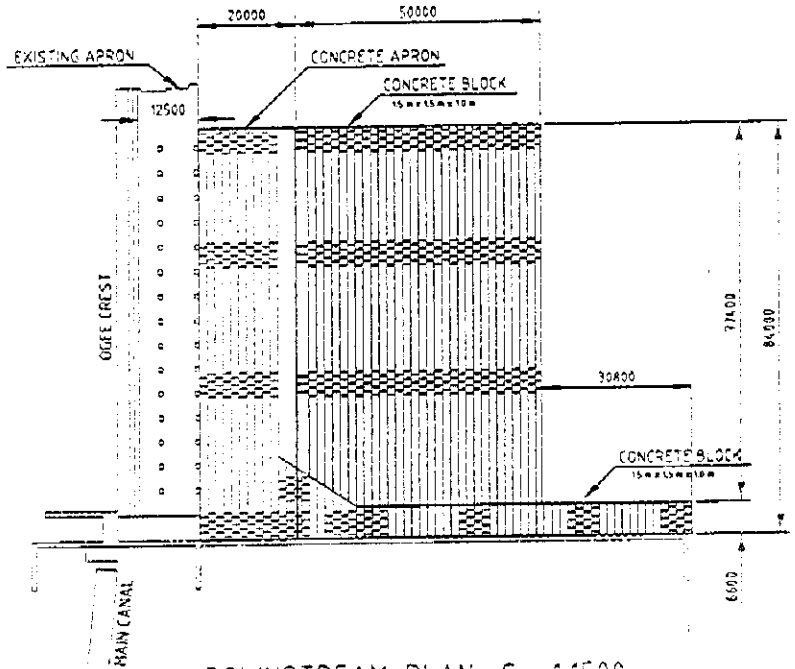


Figure D.5.1 Estimation Curve of Effective Rainfall

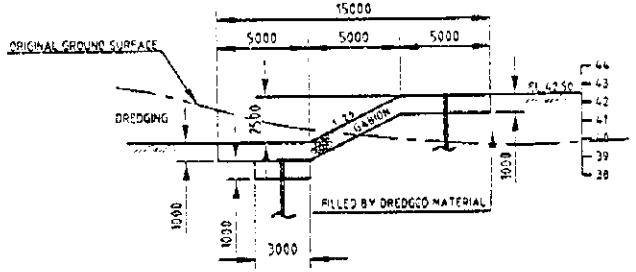




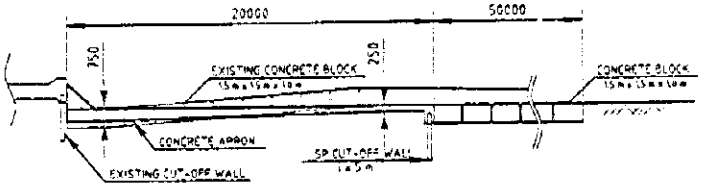
SUAGUE DIVERSION DAM: GENERAL PLAN



DOWNSTREAM: PLAN S = 1:500



UPSTREAM: SECTION A-A S = 1:400



DOWNSTREAM: SECTION S = 1:400

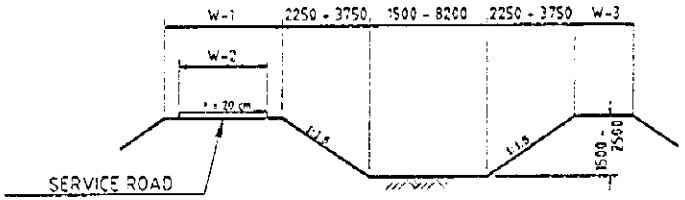
THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

JALAUR RIVER IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

TYPE OF DRAWING:
SUAGUE DIVERSION DAM

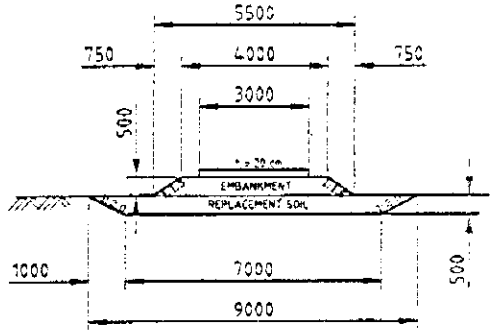
Figure D. 5. 1

TYPICAL CROSS SECTIONS

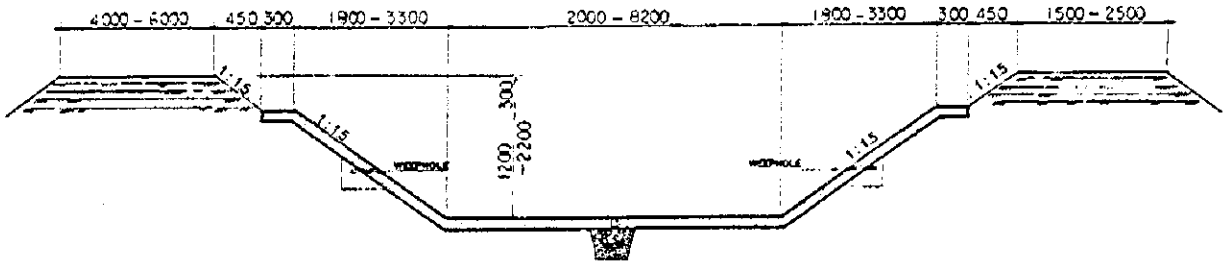


DISCHARGE m³/sec	TOTAL WIDTH W-1	EFFECTIVE WIDTH W-2	INSPECTION PATH W-3
30 ~ 10	6.0 m	4.5 m	2.5 m
10 ~ 5	4.0 m	3.0 m	2.5 m
5 ~ 3	4.0 m	3.0 m	2.0 m
3 ~ 1	4.0 m	3.0 m	1.5 m
1 ~ 0.3	4.0 m	3.0 m	1.0 m
less than 0.3	3.0 m	2.0 m	1.0 m

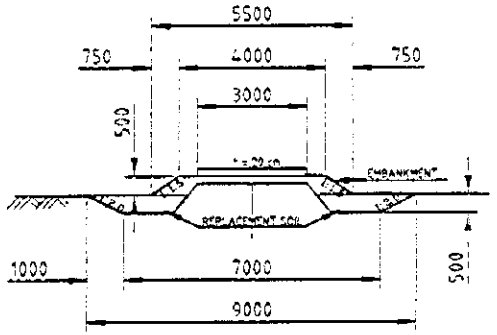
IRRIGATION CANAL WITH SERVICE ROAD



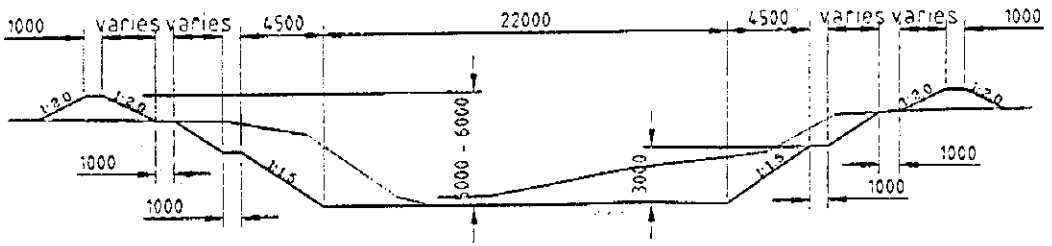
RURAL ROAD: NEW CONSTRUCTION



IRRIGATION CANAL: CONCRETE LINING



RURAL ROAD: IMPROVEMENT



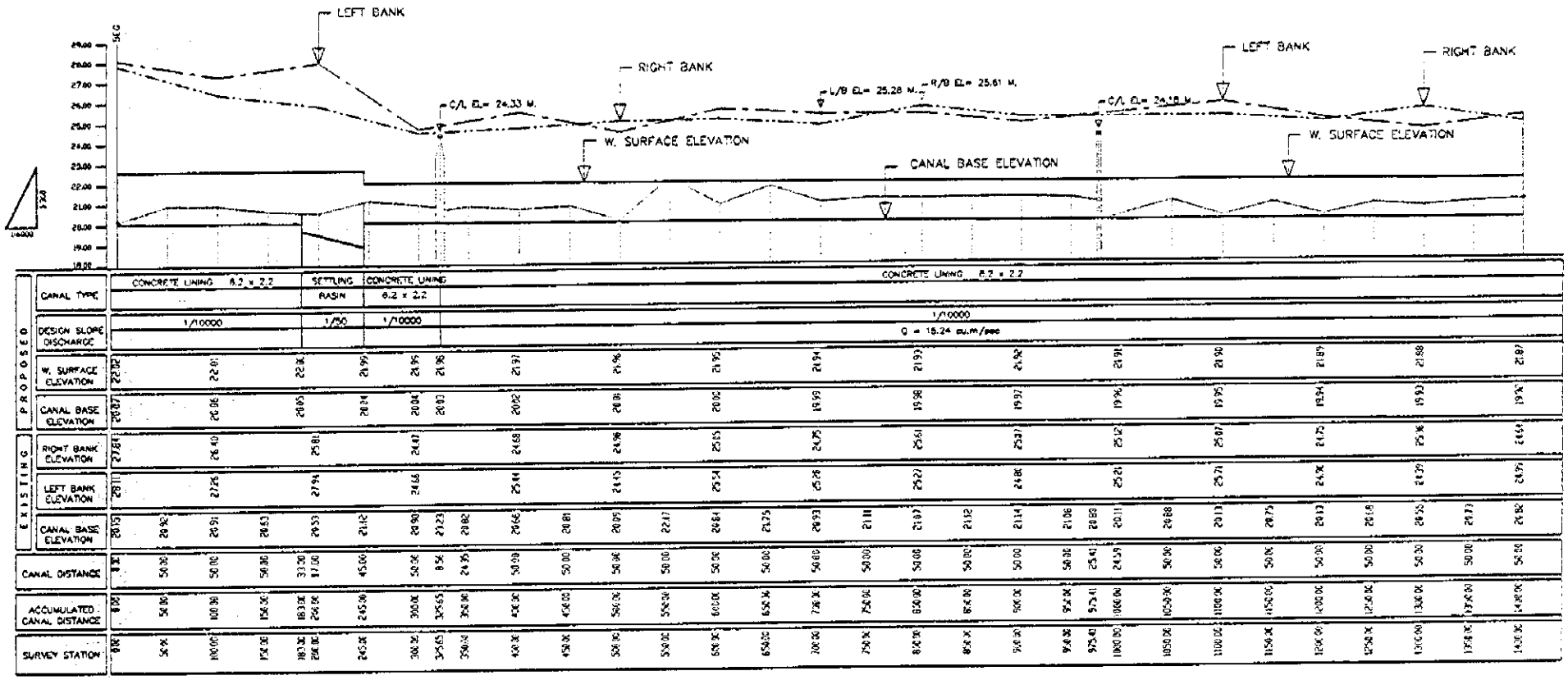
AVANGAY CREEK (MAIN DRAINAGE)

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

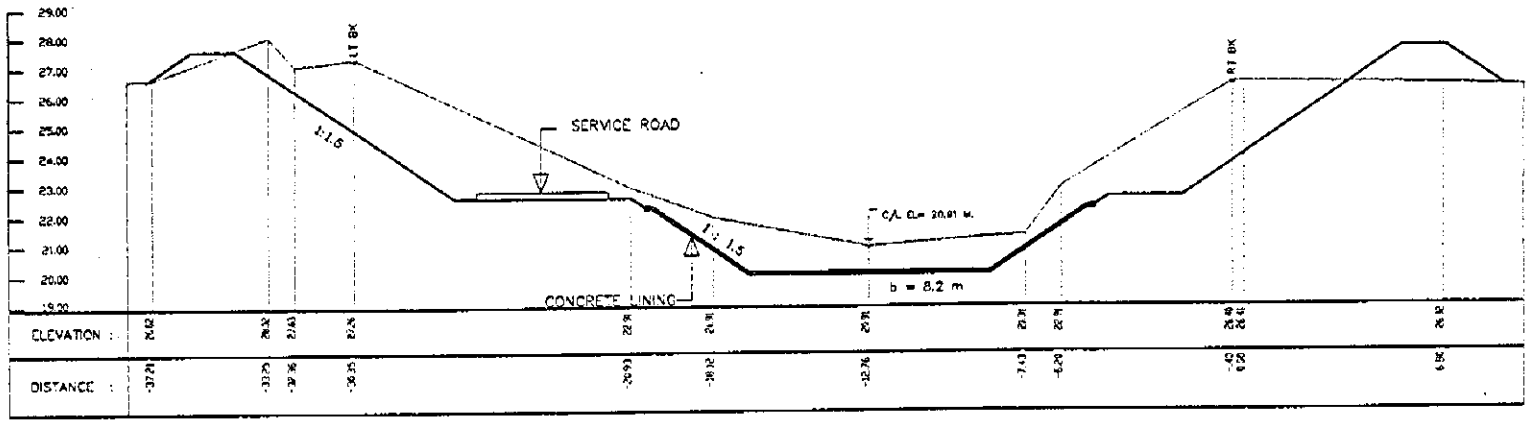
JALAUR RIVER IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING:
TYPICAL SECTIONS OF CANAL,
DRAIN AND ROAD

Figure D. 6. 2



PROFILE



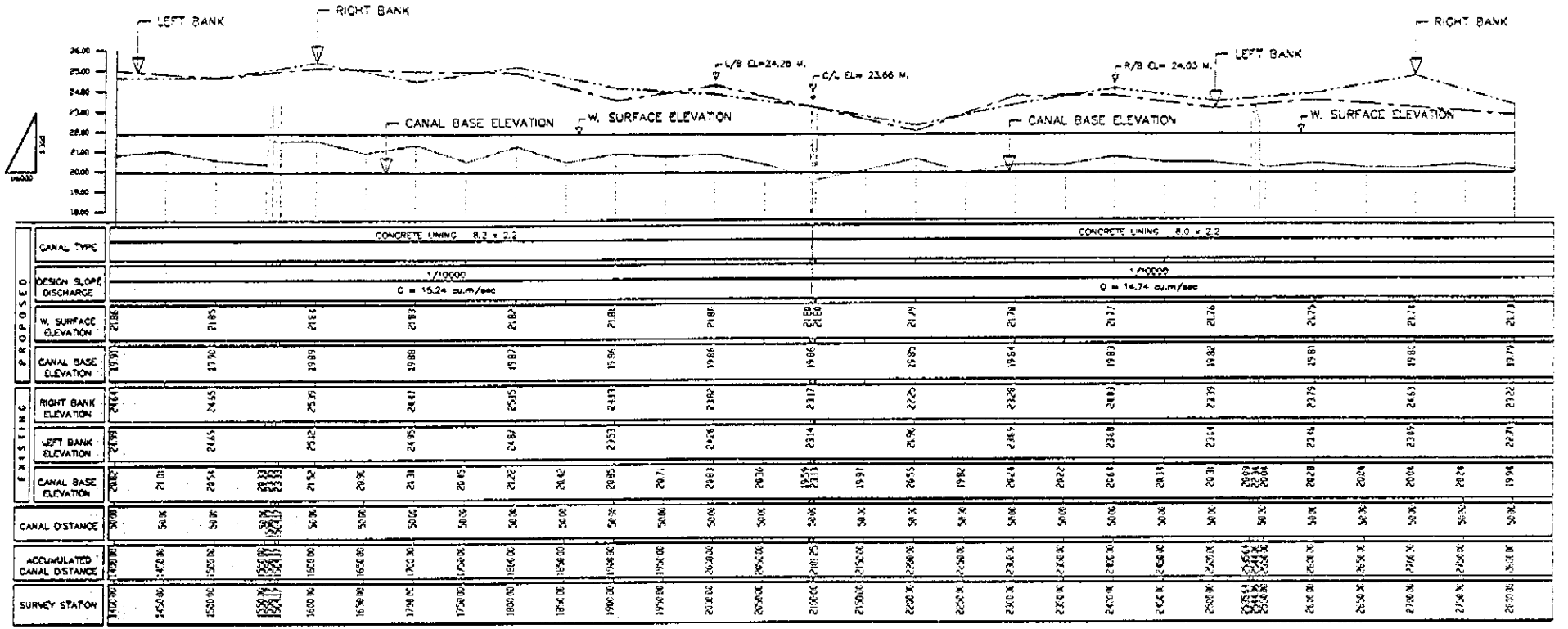
CROSS SECTION 0+100.00 S = 1:250

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

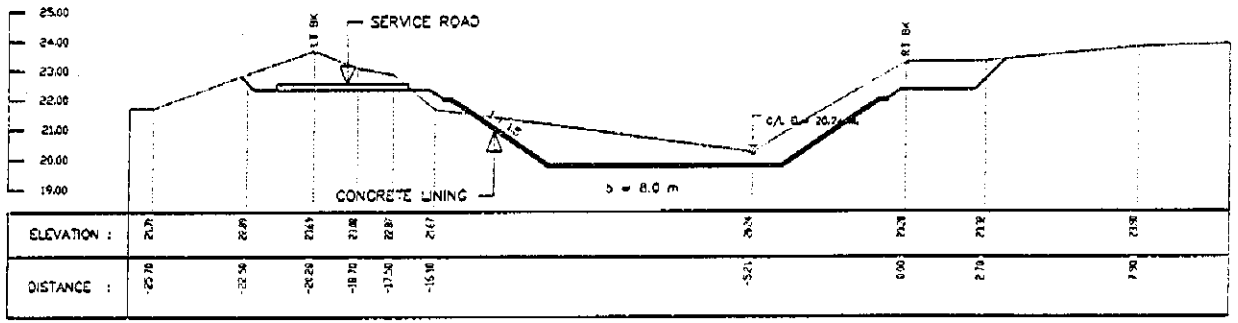
JALAUR RIVER IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING:
LONGITUDINAL SECTION OF JALAUR MAIN CANAL
STA. 0+000.00 TO 1+400.00

Figure D. 6. 3

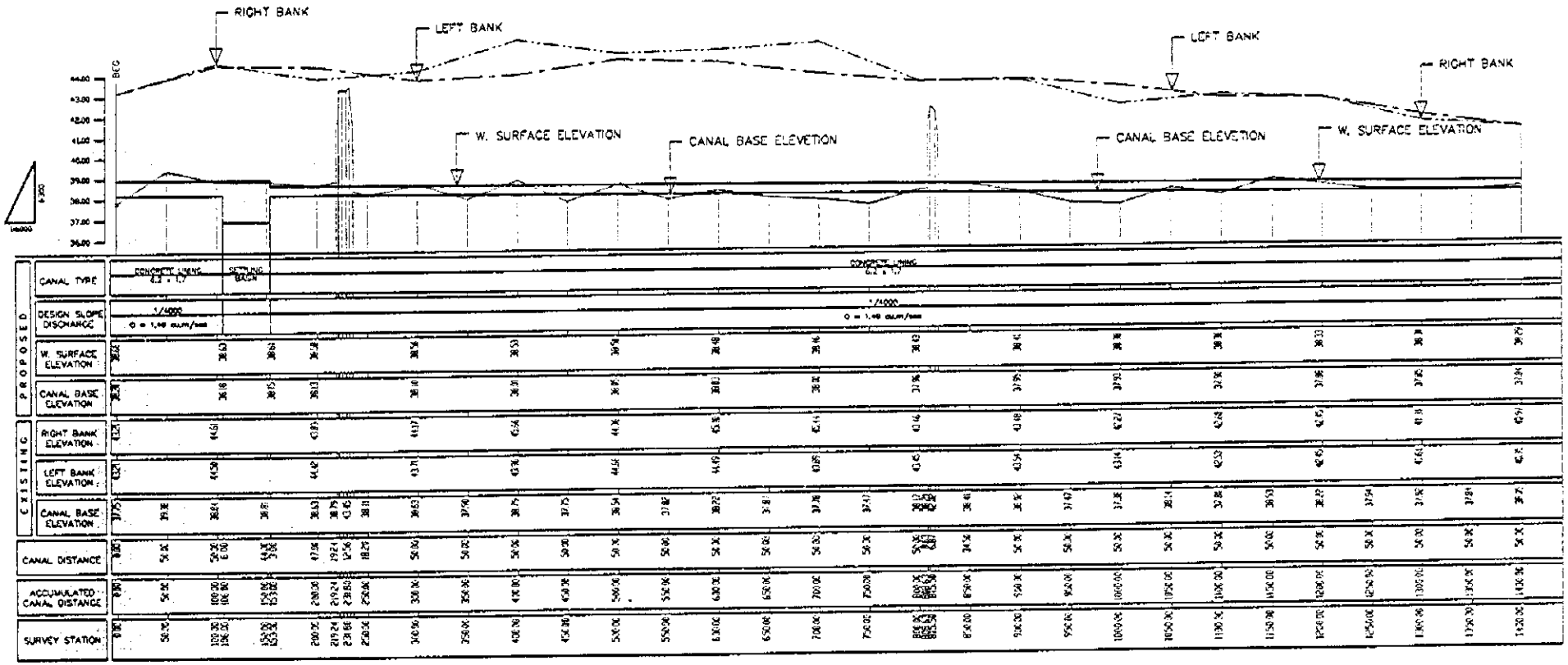


PROFILE

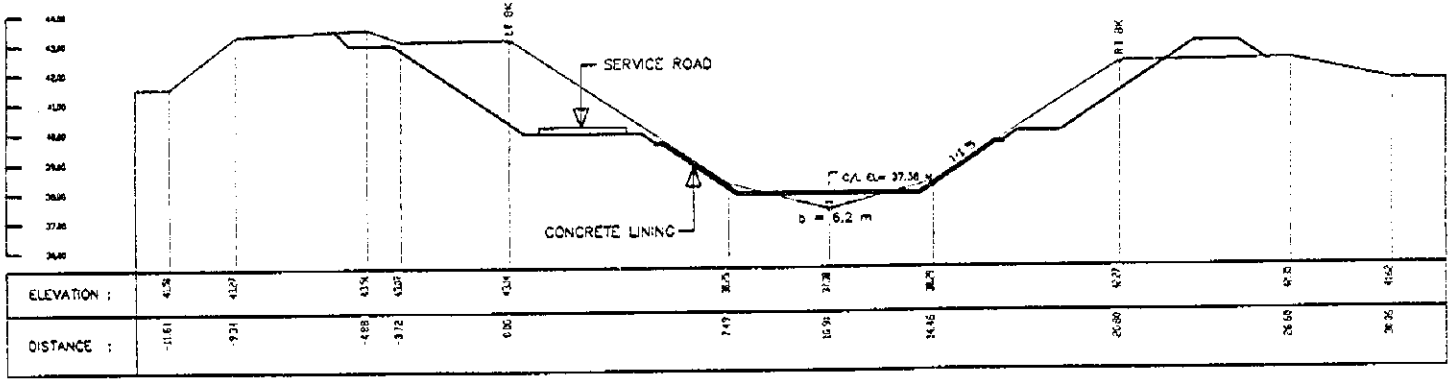


CROSS SECTION 2+300.00 S = 1:250

THE REPUBLIC OF THE PHILIPPINES NATIONAL IRRIGATION ADMINISTRATION
JALAUR RIVER IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT
TITLE OF DRAWING: LONGITUDINAL SECTION OF JALAUR MAIN CANAL STA. 1+400.00 TO 2+800.00
Figure D. 6. 4



PROFILE



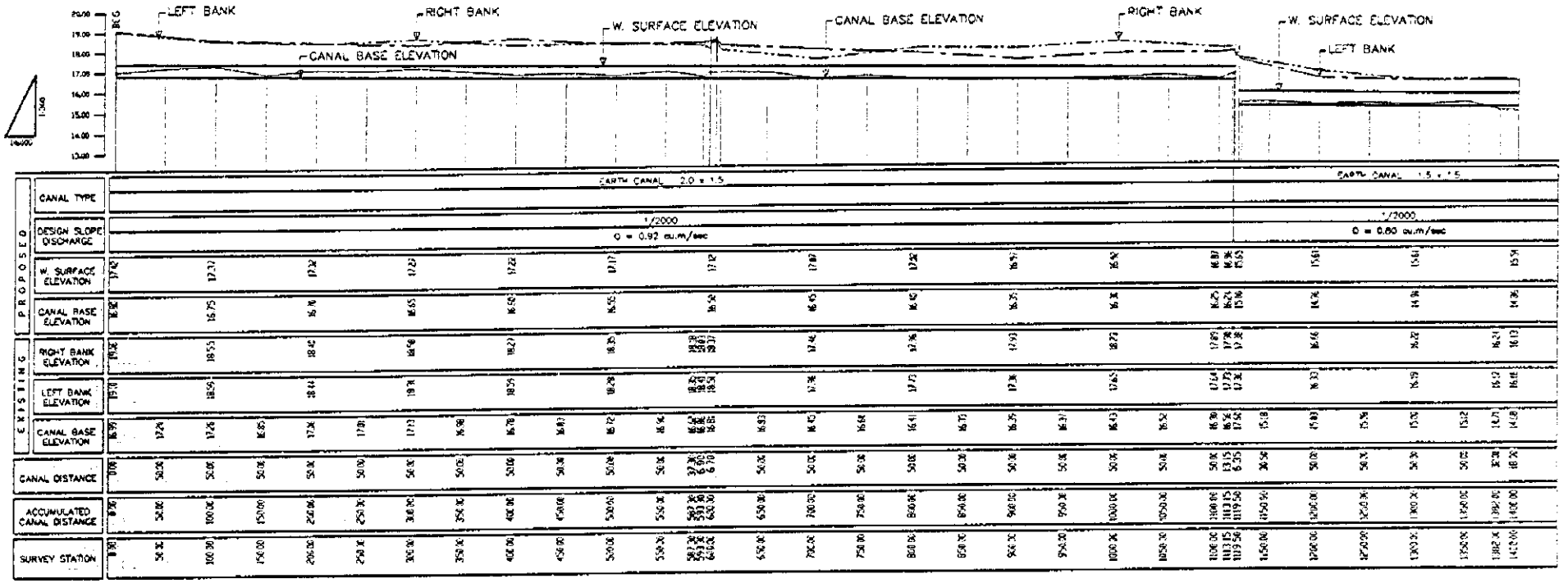
CROSS SECTION 1+000.00 S = 1:250

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

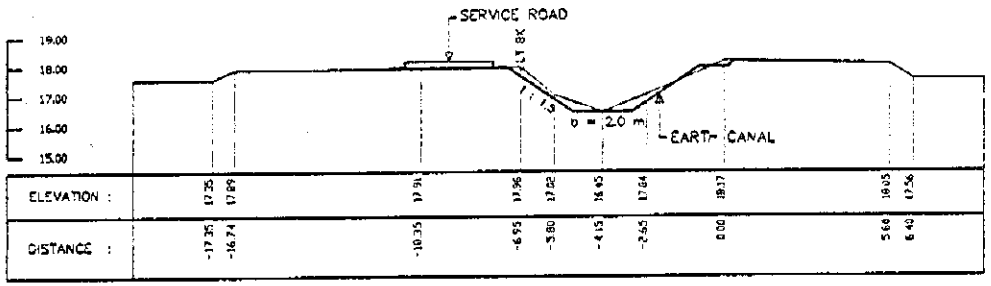
JALAUR RIVER IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING:
LONGITUDINAL SECTION OF SUACUE MAIN CANAL
STA. 0+000.00 TO 1+400.00

Figure D. 6. 5

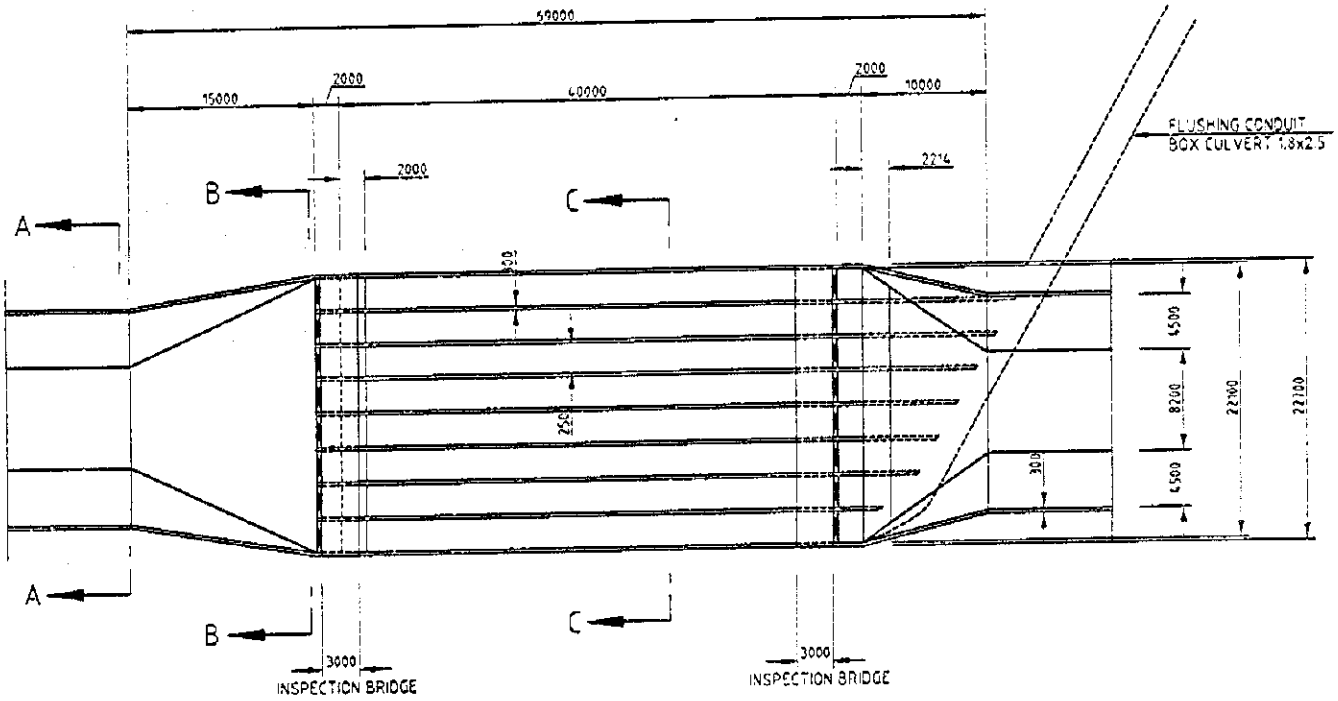


PROFILE

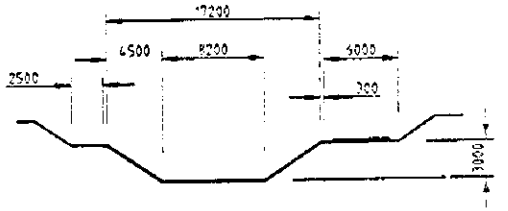


CROSS SECTION 0+700.00 S = 1:250

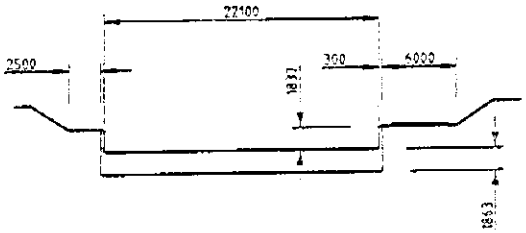
THE REPUBLIC OF THE PHILIPPINES NATIONAL IRRIGATION ADMINISTRATION
JALAUR RIVER IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT
TITLE OF DRAWING: LONGITUDINAL SECTION OF JALAUR LATERAL D STA. 0+000.00 TO 1+400.00
Figure D. 6. 6



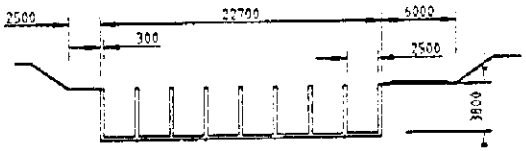
PLAN S = 1:600



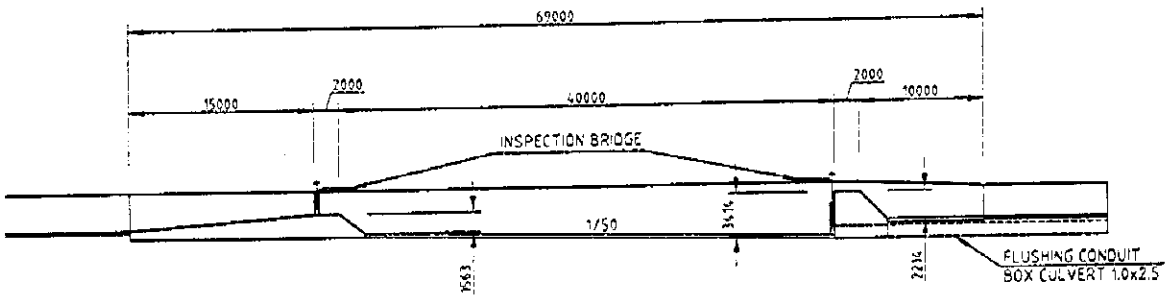
SECTION A-A
S = 1:600



SECTION B-B
S = 1:600



SECTION C-C
S = 1:600



SECTION S = 1:600

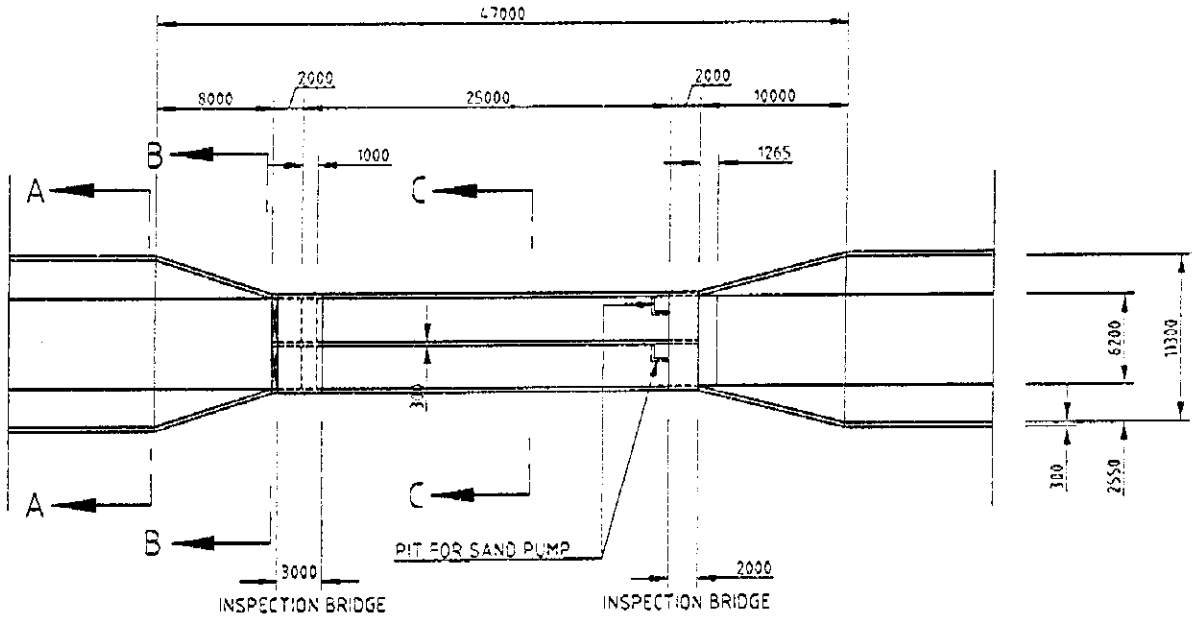
THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

JALAUR IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

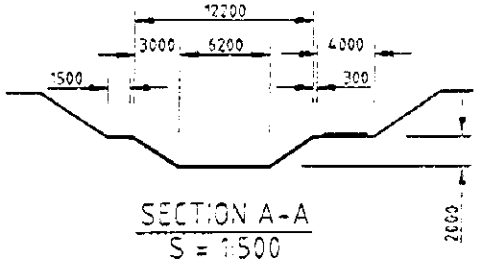
TITLE OF DRAWING

SETTLING BASIN - JALAUR PROPER RIS

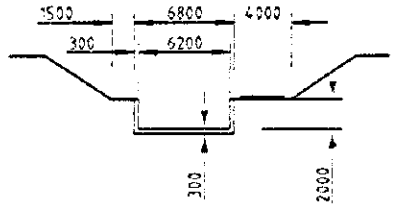
Figure D 6.7



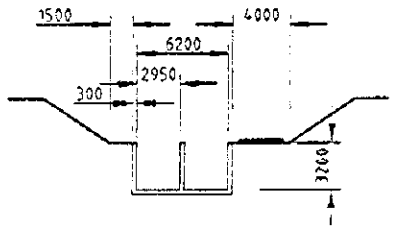
PLAN S = 1:500



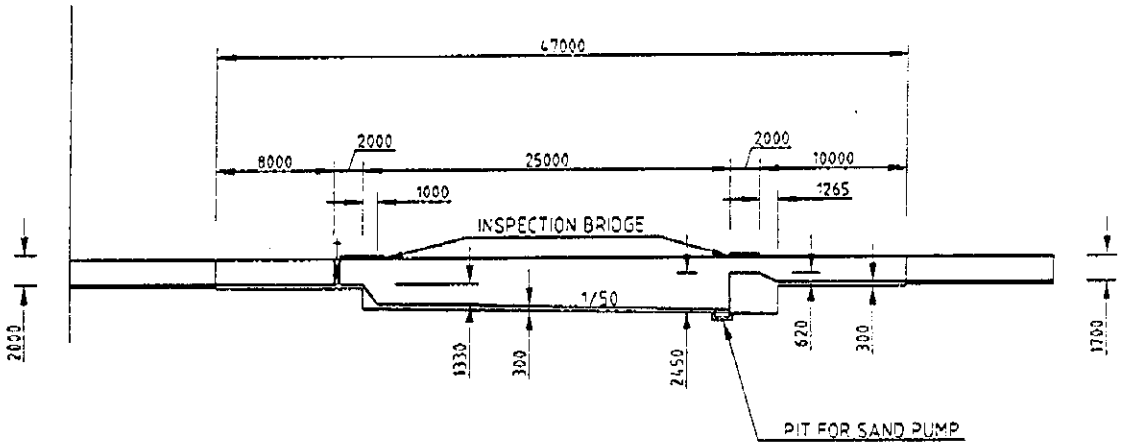
SECTION A-A
S = 1:500



SECTION B-B
S = 1:500



SECTION C-C
S = 1:500



SECTION S = 1:500

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

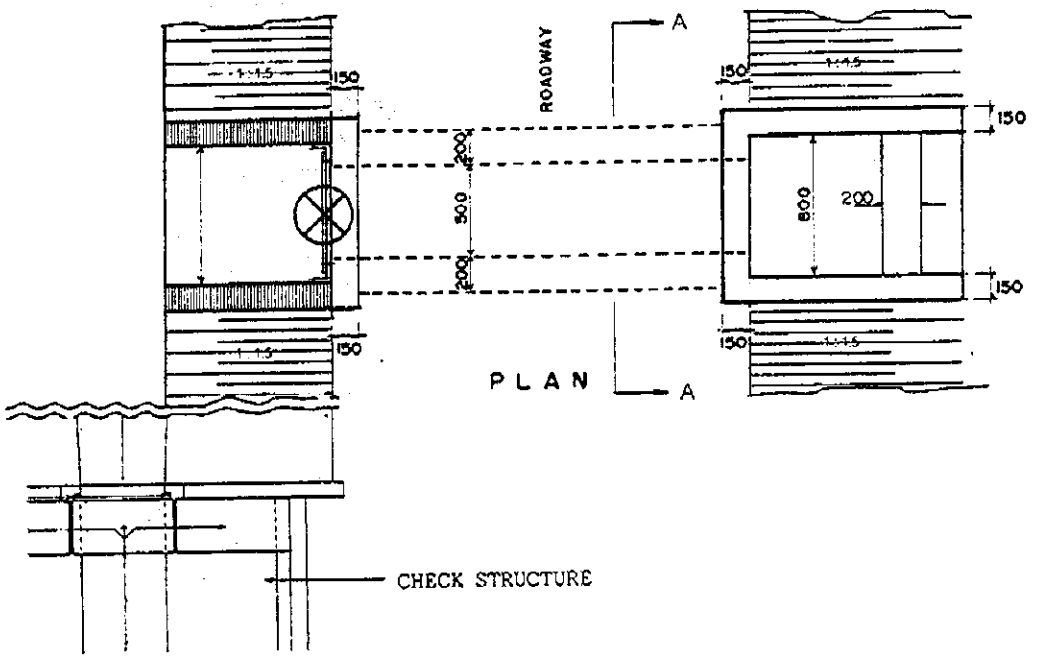
JALAUR IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING

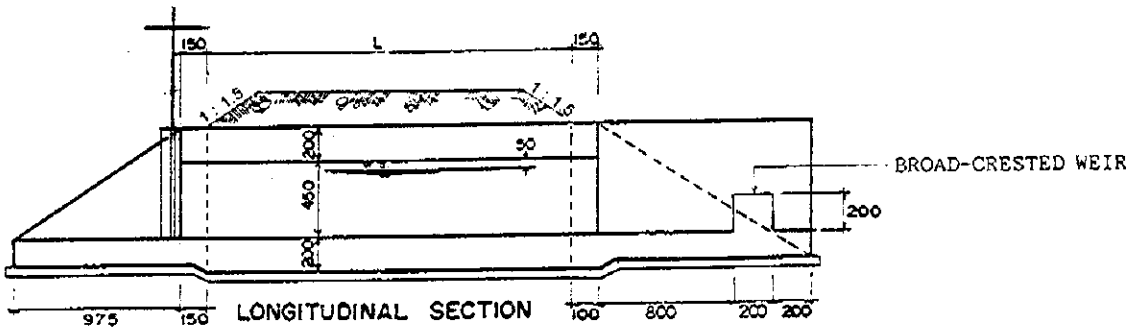
SETTLING BASIN - SUAGUE RIS

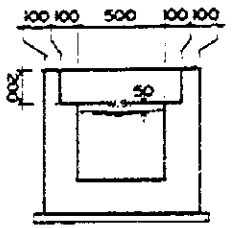
Figure D. 6. 8.

DF - 10



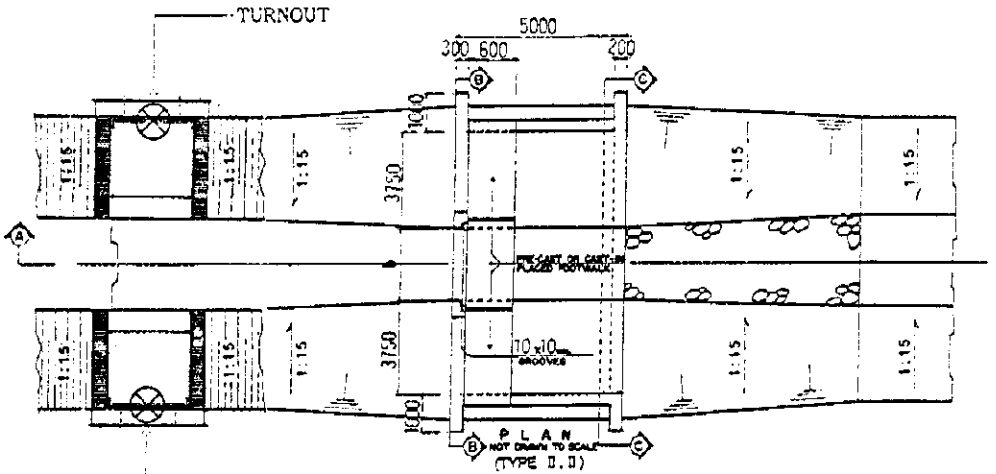
TYPES	LENGTH. (L.)
A	6000 mm.
B	4000 mm.
C	3000 mm.
D	2500 mm.
E	2000mm
F	1500 mm
G	1000 mm

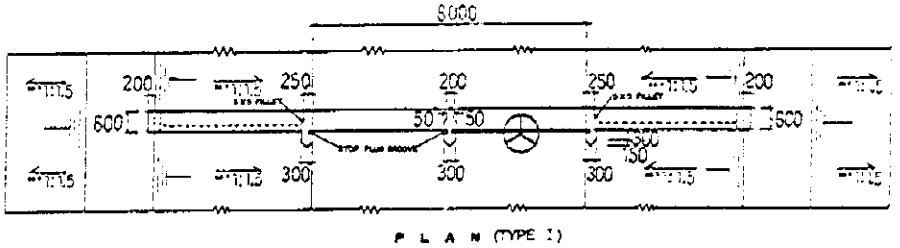


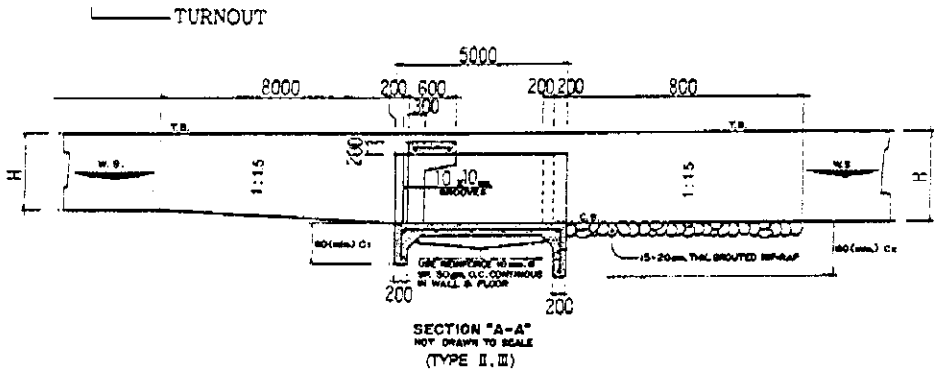


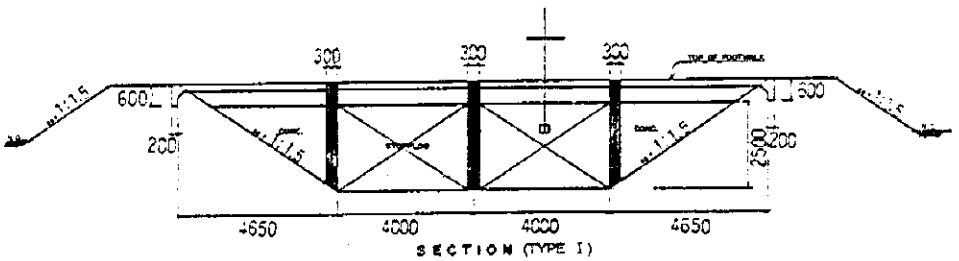
SECTION A - A

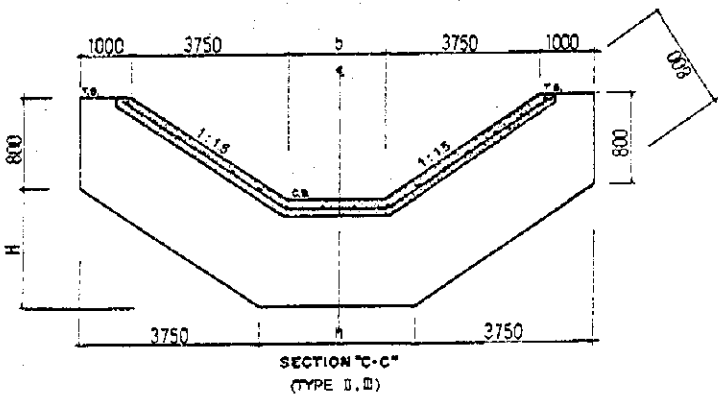
THE REPUBLIC OF THE PHILIPPINES NATIONAL IRRIGATION ADMINISTRATION JALAUR IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT
TITLE OF DRAWING TURNOUT
Figure D.6.9

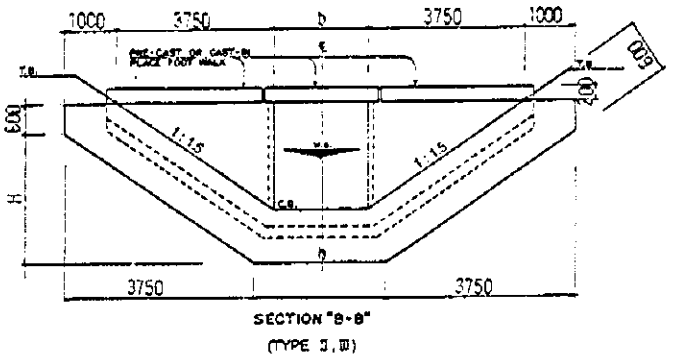




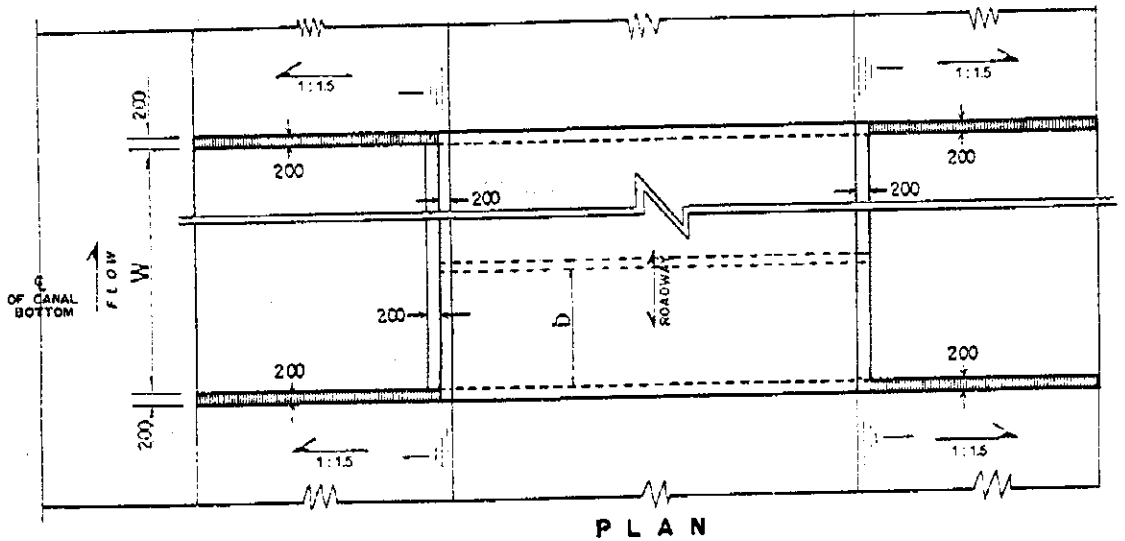






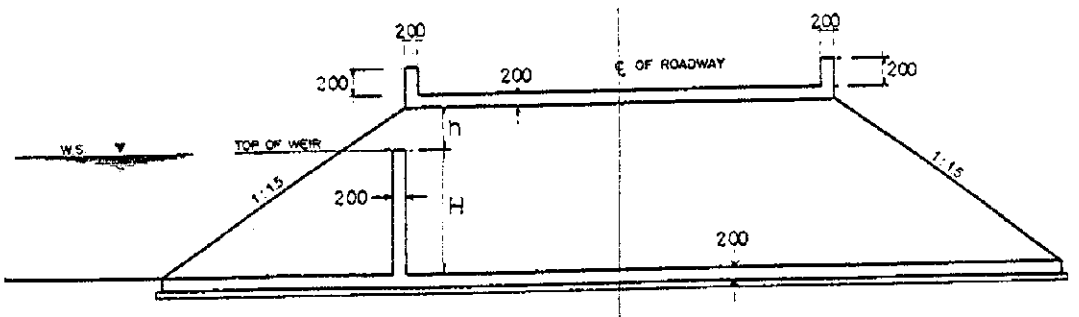


THE REPUBLIC OF THE PHILIPPINES NATIONAL IRRIGATION ADMINISTRATION
JALAUR IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT
TITLE OF DRAWING CHECK STRUCTURE
Figure D. 6. 10

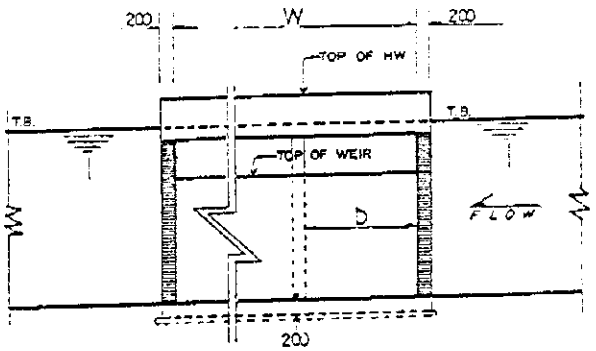


PLAN

TYPE	CANAL DISCHARGE (m³/sec)	OVERFLOW DISCHARGE (m³/sec)	W (m)	b (m)	WEIR HEIGHT H (m)	h (m)
I	14.00	2.00	9.80	2.30 (x 4)	1.90	0.25
II	5.00	1.15	6.10	1.90 (x 3)	1.30	0.20
III	1.00	0.45	0.70	0.70 (x 1)	0.50	0.18



LONGITUDINAL SECTION

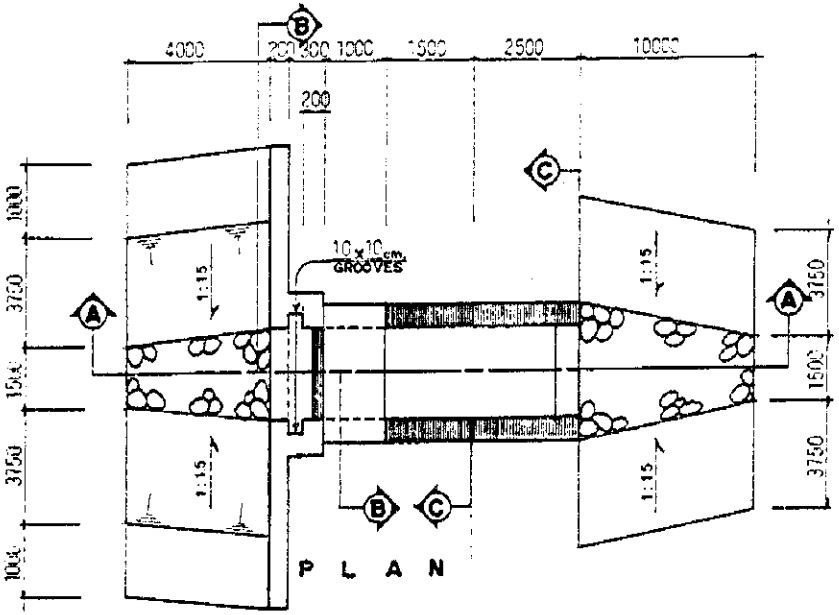


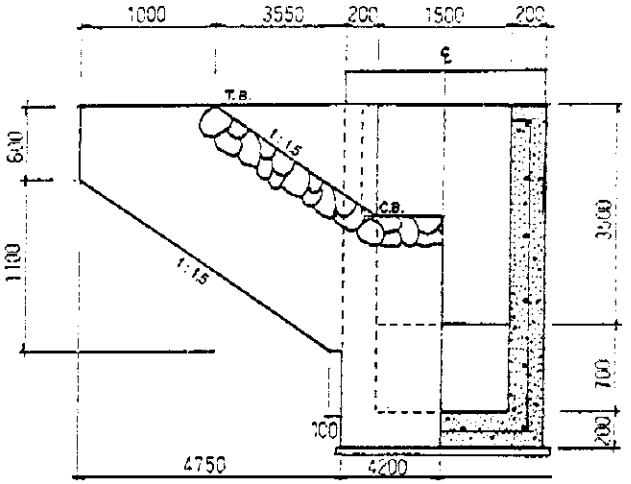
CROSS SECTION

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION
JALAUR IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT

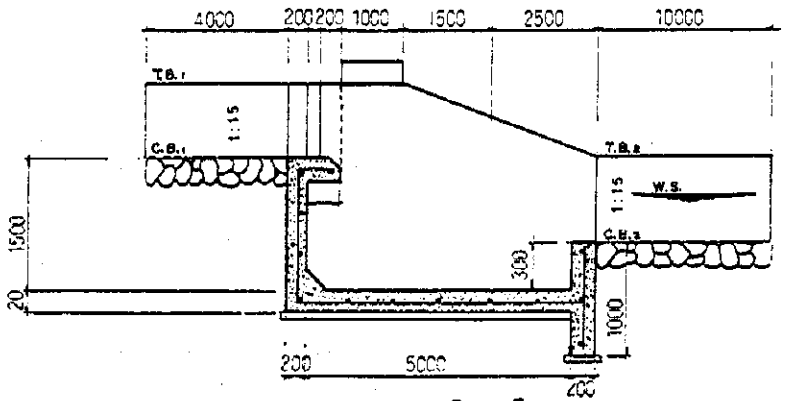
TITLE OF DRAWING
SPILLWAY

Figure D. 6. 11

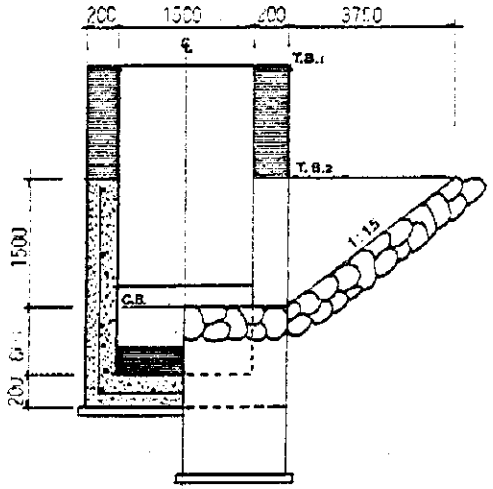




SECTION "B-B"

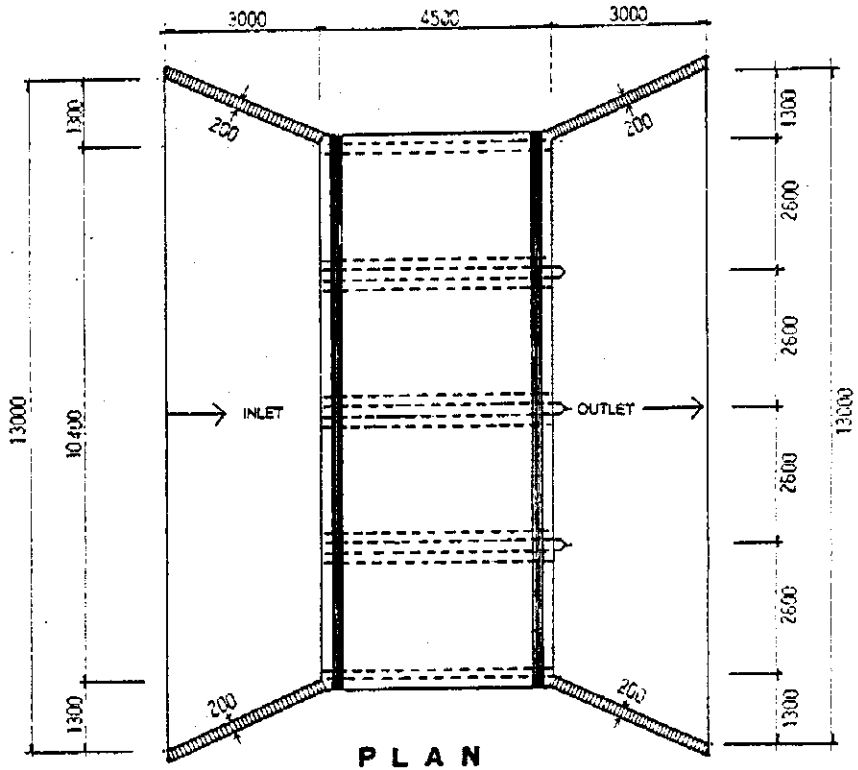


SECTION "A-A"

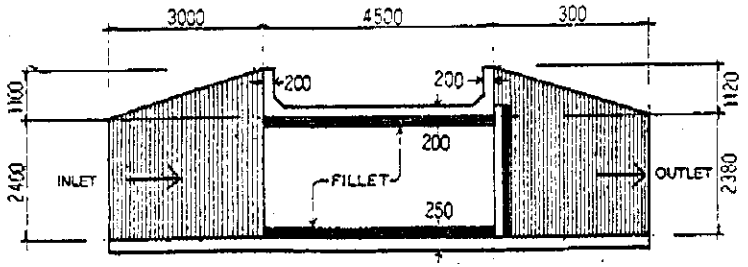


SECTION "C-C"

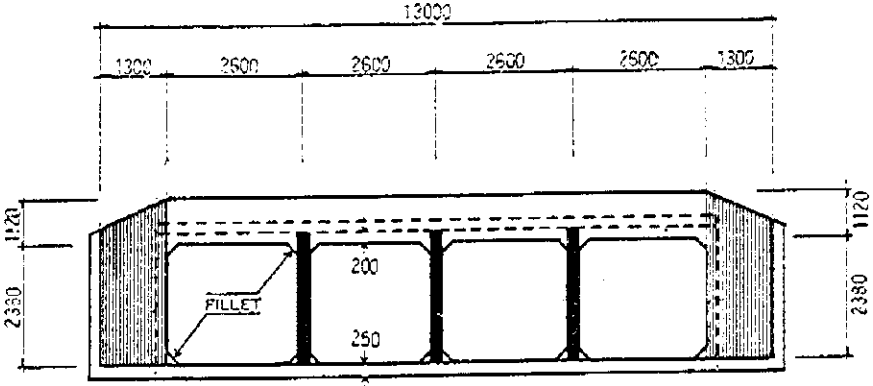
THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION
JALAUR IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT
TITLE OF DRAWING
DROP STRUCTURE
Type III
Figure D. 6. 12



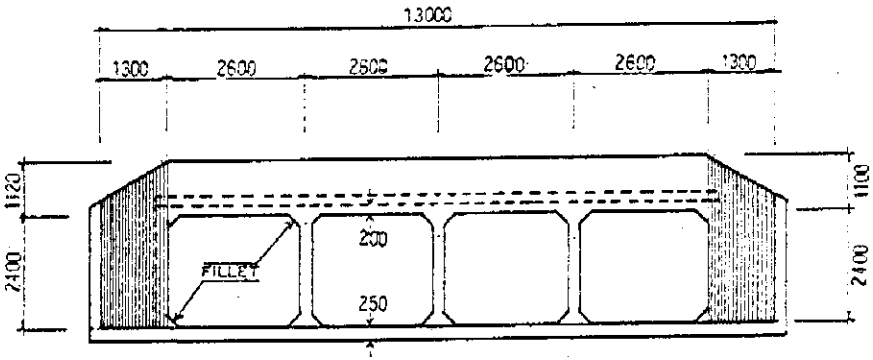
PLAN



LONGITUDINAL SECTION

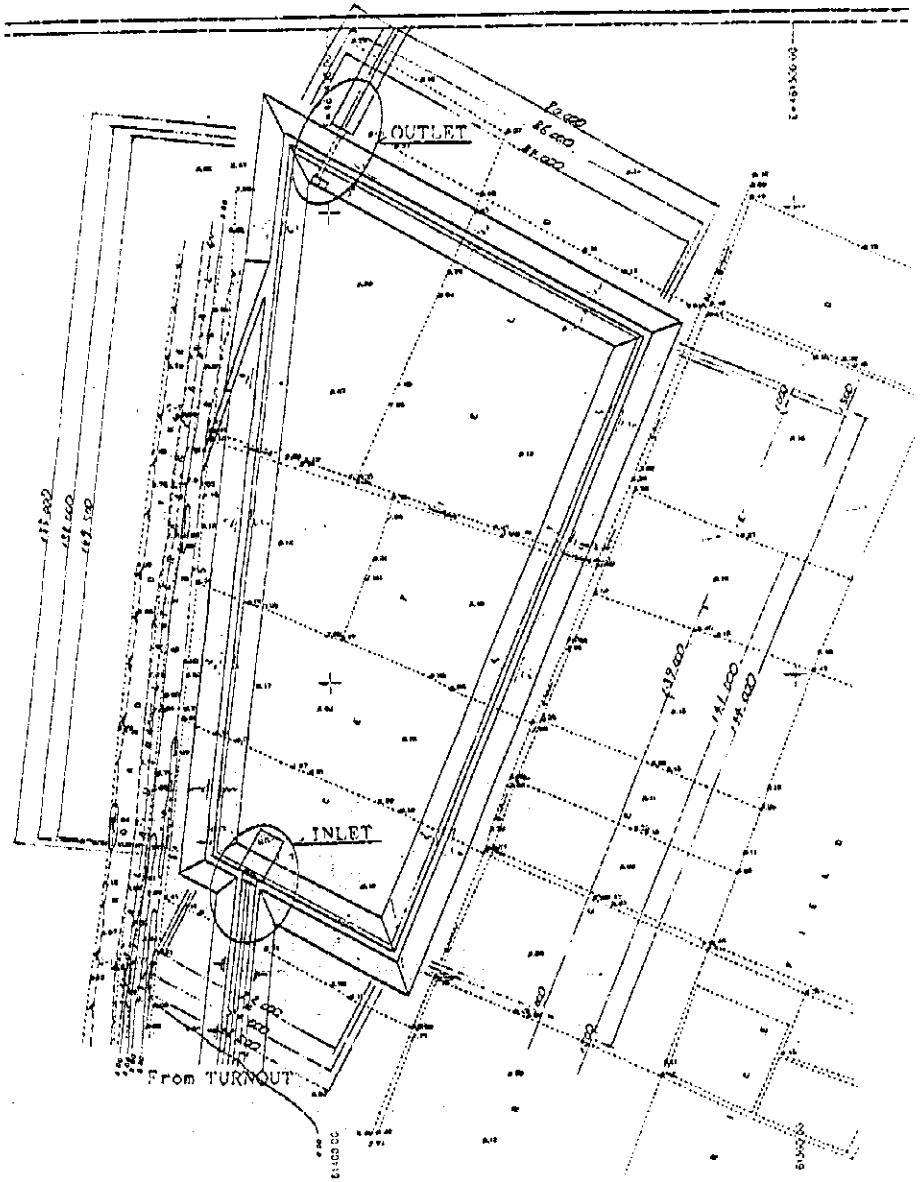


INLET SECTION

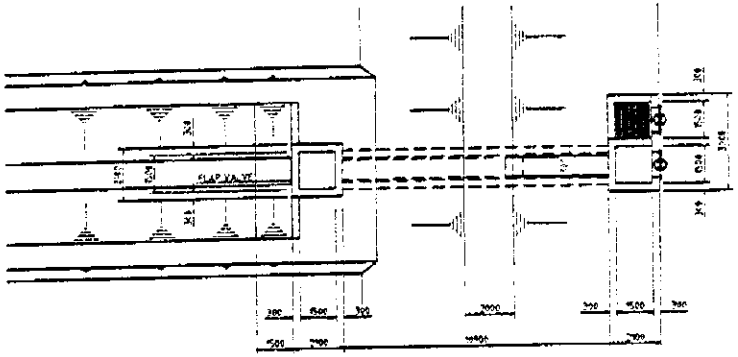


OUTLET SECTION

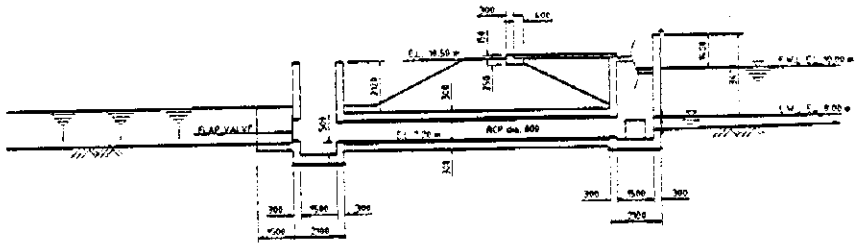
THE REPUBLIC OF THE PHILIPPINES NATIONAL IRRIGATION ADMINISTRATION
JALAUR IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT
TITLE OF DRAWING BOX CULVERT
Figure D. 6. 13



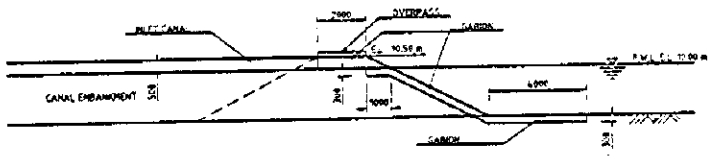
GENERAL PLAN



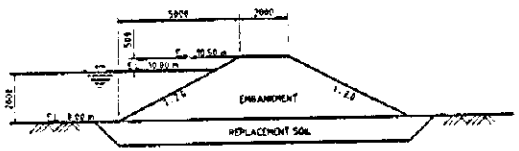
OUTLET PLAN S = 1:300



OUTLET PROFILE S = 1:300



INLET PROFILE S = 1:300



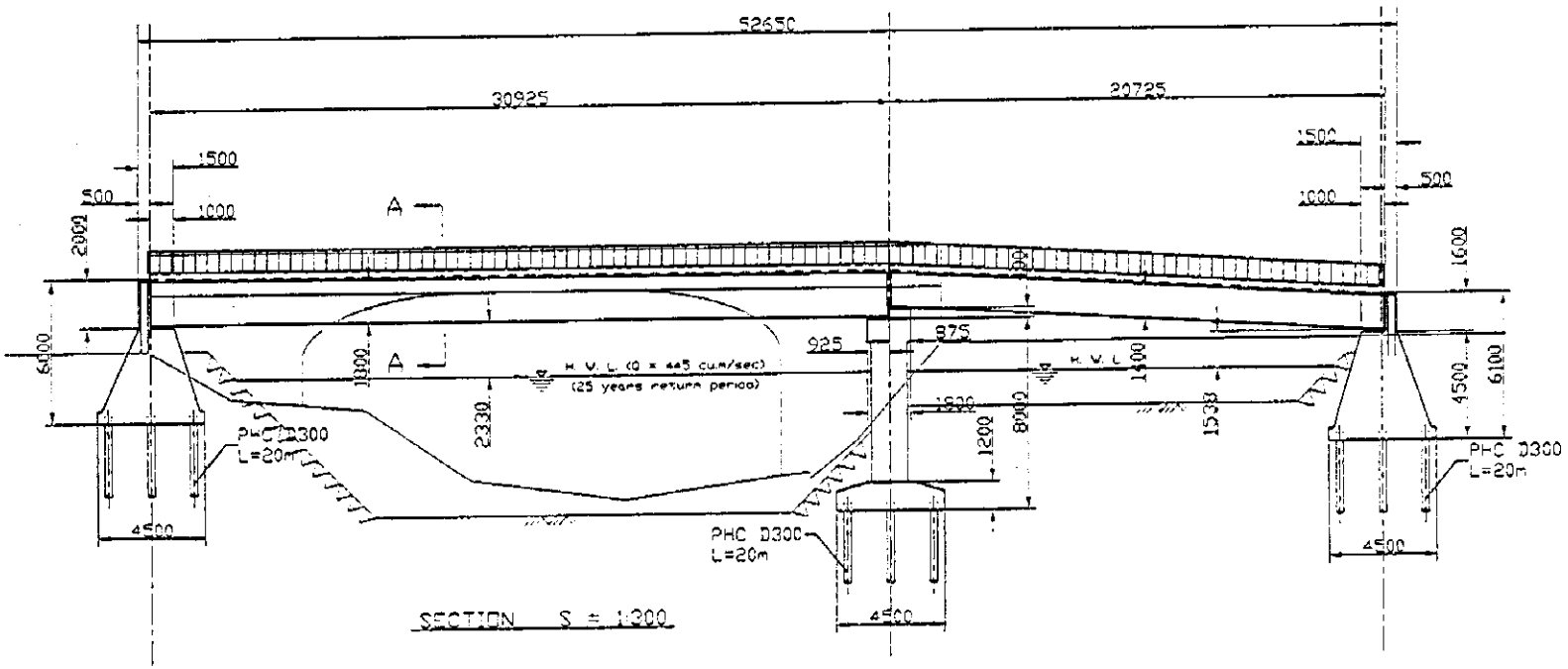
TYPICAL CROSS SECTION S = 1:300

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

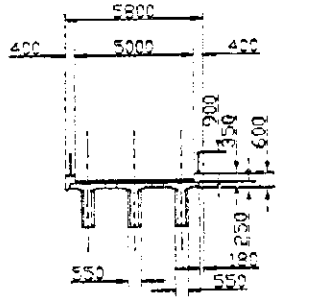
JALAUR RIVER IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING:
FARM POND
FPJ – 4

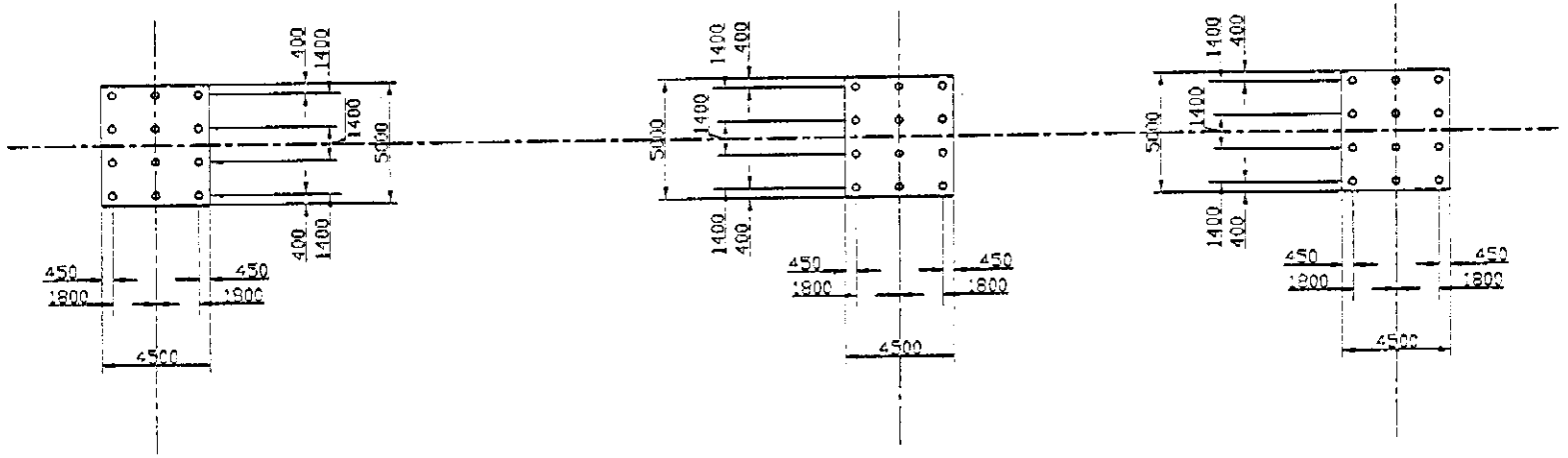
Figure D. 6. 14



SECTION S = 1:300



SECTION A-A S = 1:300



PILE DISPOSITION S = 1:300

THE REPUBLIC OF THE PHILIPPINES
NATIONAL IRRIGATION ADMINISTRATION

JALAUR IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT

TITLE OF DRAWING

BRIDGE - ABANGAY CREEK

Figure D. 6. 15