

ANNEX.C

IRRIGATION AND DRAINAGE

ANNEX - C

IRRIGATION AND DRAINAGE

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1. PROFILE OF THE PUMP IRRIGATION SYSTEMS

1.1 General

The National Irrigation Administration (NIA) is undertaking operation and maintenance (O&M) of 135 National Irrigation Systems (NISs) in the Philippines. Out of the 135 NISs, 12 NISs are being served partially or entirely by 16 pumping irrigation systems (PISs). The NISs consisting only of the pump irrigation system are the Bonga Pump #1, Bonga Pump #2, Bonga Pump #3, Iguig, Alcala-Amulung, Solana, Cabuyao East and Libmanan-Cabusao PISs. While the NISs involving PIS as a part are the Magat River Integrated Irrigation System (MARIIS), Upper Pampanga River Integrated Irrigation System (UPRIIS), Angat-Maasim River Irrigation System (AMRIS), Sta. Cruz River Irrigation System (RIS) and Sta. Maria RIS. MARIIS has three (3) PISs: Pump #1, #2 and #3. UPRIIS covers the Penaranda PIS. The Bustos-Pandi, Buenavista and Tibagan PISs are in AMRIS. The Sta. Cruz RIS is composed of one (1) gravity irrigation system and one (1) pump irrigation system having two (2) pumping stations. The Sta. Maria RIS is composed of two (2) gravity irrigation systems and one (1) pumping irrigation system with two (2) pumping stations.

Among the 16 PISs, six (6) PISs; Bonga Pump #1, Bonga Pump #2, and Bonga Pump #3 PISs, Alcala-Amulung, Solana, and Libmanan Cabusao PISs, have been taken up as high priority projects for feasibility study through screening works. This is discussed in ANNEX-A IDENTIFICATION OF THE PROBLEMS AND SELECTION OF THE HIGH PRIORITY PROJECTS.

The profiles of the six (6) PISs are tabulated in Table 1.1 and are briefed below.

1.2 Bonga Pump #1 Irrigation System

The Bonga Pump #1 Irrigation System (IS), relying on the Bonga river as the water source, is located in the municipalities of Sarrat and San Nicolas in the Ilocos Norte Province.

The system was constructed during 1974-1979. The service area was initially designed to be 426 ha. However, it has been reduced to 298 ha because a commanding area of the Lateral A was eliminated from the originally generated area of 426 ha. Operation of the system commenced immediately after the completion of the pumping station in 1977. After the completion of the system, no substantial rehabilitation has been made so far. The system has been in turn-over stage-2 since December, 1985.

1.3 Bonga Pump #2 Irrigation System

The Bonga Pump #2 Irrigation System (IS), being adjacent to the Bonga Pump #1 IS, extends on the left bank of the lower reaches of the Bonga river, from which irrigation water for the system is being tapped. It administratively falls under the jurisdiction of the municipality of San Nicolas in the same province as above.

The system with pumps driven by diesel engines was originally constructed in 1953. Rehabilitation of the system and renovation of the pumping station were made during 1974-1979. In its renovation, the pump equipment was changed with motor driven pumps. Further, the main and lateral canals were lined with concrete under a sub-project of the National Irrigation System Improvement Project, Phase I (NISIP I) during 1978-1987. The sub-project was turned over to the Regional Irrigation

Office (NIA, Region I) for its operation and maintenance in October, 1984. NIA Region I entrusted, in December 1985, O&M of the system to the Irrigators' Association except for the pump operation which is being undertaken by the system office as a sort of subsidies from NIA. It is now in turn-over stage-2. The service area of the system was initially designed and generated to be 1,200 ha. However, it has been reduced to some 670 ha in 1986.

1.4 Bonga Pump #3 Irrigation System

The Bonga Pump #3 Irrigation System (IS), sharing its boundary with the Bonga Pump #2 IS on the east, is located on the left bank of the Bonga river, on which the system depends for water source.

Its service area of 202 ha is administratively covered by the municipality of Laoag in the Ilocos Norte Province. The system was constructed during 1974-1979. No data are available on its design and construction. Substantial pump operation was commenced in 1977. The system has been in turn-over stage-2 since April, 1986.

1.5 Alcala-Amulung Pump Irrigation System

The Alcala-Amulung PIS is located in two (2) municipalities of Alcala and Amulung in the Cagayan Province and extends over the right bank of the Cagayan river. Water source of the system is the unregulated flow of the Cagayan river.

The service area of the system was designed to be 2,350 ha at its initial stage. In 1986, however, it had decreased to 1,840 ha. The Alcala-Amulung PIS was constructed during 1979-1983 along with the Iguig PIS as part of the irrigation component of the Cagayan Integrated Agricultural Development Project (CIADP). Operation of the system commenced in November 1982. However, the turnover from the project to the system was made only in January, 1987. The management of the system has not been turned over yet to the Irrigator's Associations.

1.6 Solana Pump Irrigation System

The Solana PIS, tapping water from the Cagayan river, extends over the left bank of the same river and is located opposite Tuguegarao. It is included in the municipality of Solana in the Cagayan Province.

Construction of the canal system was initiated in 1973, while construction of the pumping station was started in 1976. The canal system and the pumping station were completed in 1979 and 1977, respectively. Due to troubles happening during the test run of the pumping station, however, substantial operation of the system was delayed to May 1980. The service area of the system in 1986 was said to be only 1,320 ha, although it had been designed to be some 3,100 ha at its initial stage.

NIA entered into a contract with the Irrigator's Association on July 16, 1988 on full management of the operation and maintenance of the Solana PIS by an Irrigator's Association (contract for turn-over stage-3). Under this contract, NIA has been released from all the duties and responsibilities relating to the operation and maintenance for the Solana PIS. Special provisions of the contract, however, prescribe that NIA takes responsibilities of continuing and completing all the remaining rehabilitation works and system improvement.

1.7 Libmanan-Cabusao Pump Irrigation System

The Libmanan-Cabusao PIS is located about 15 km southeast of Naga city. It lies on the flat alluvial plains extending on the left bank of the Bicol river near its estuary. Administratively, it belongs to the municipalities of Libmanan and Cabusao in the Camarines Sur Province.

The system was implemented during May 1976- March 1981 as an irrigation component of the Bicol River Basin Development Program. The service area of the system has decreased from 4,523 ha at initial stage to 2,195 ha at present due to various reasons.

The system is being served by the Awayan main pumping station on the Libmanan river, and two (2) minor pumping stations; the Handong pumping station on the Libmanan river and the Cuisa pumping station on a creek. The Awayan pumping irrigation system has not been turned over to the Irrigator's Associations yet for its operation and maintenance, while the Handong and Cuisa pumping irrigation systems have been in turn-over stage-3 since June 1987 and January 1986, respectively.

2. PRESENT CONDITION OF THE IRRIGATION AND DRAINAGE FACILITIES

2.1 Pumping Station

There exist six (6) pumping stations with 19 units of pumps in total. Out of these 19; i) six (6) units, consisting of one unit each in Bonga Pump #2, and #3 ISs, and two (2) units each in Solana, and Libmanan-Cabusao PISs, are not operational due to various reasons such as failure of motor, defect of control panel board, vibration of pump axle, damage of bowl, etc. Further, four (4) units, comprising two (2) units in Bonga Pump #1 IS, one (1) unit each in Bonga Pump #2, and Solana ISs, have discharge capacity decreasing to less than 80% of the rated one.

All the six (6) PISs depend for water sources on the unregulated flow of the rivers.

A closed conduit type intake without sand settling basin is common for all the pumping stations although tapping of water is made directly from rivers. This type of intake structure is subject to be silted because of difficulty in desilting works, and consequently expedites abrasion of impellers resulting in lowering of pump efficiency.

Pump motors of many of the pumping stations, have unequal current among the three (3) phases and are, therefore, easily overheated.

Only the pumping station of the Alcala-Amulung PIS is supplied with electricity directly from the National Power Corporation (NAPOCOR) through a substation constructed and maintained for exclusive use by NIA, while the other five (5) pumping stations depend for power source on Electric Cooperatives. The average power rate of NAPOCOR is estimated at 1.2-1.3 Pesos per kwh, and that of the Cooperatives is reported to be 2.3 Pesos per kwh. In case of the pumping stations with electricity supplied by the Cooperatives, pump operation is generally not allowed during the peak demand period (17:00-22:00) in the evening because of insufficient capacity of the Cooperative's substations and is often interrupted due mainly to interruption of electric supply.

The power transmission line from NAPOCOR's substation to the Alcala-Amulung PIS has been constructed and maintained by NIA, while those to other pumping stations by the Electric Cooperatives. Their lengths vary widely from less than 1 km to 30 km. In any case, the cost of transmission loss is borne by the system offices.

Neither spare parts nor elements for pumps are stored in any of the system offices, and this prolongs unexpected suspension of pump operation.

Salient features of the pumping stations are summarized in Table 2.1.

2.2 Irrigation Canals and Related Structures

The present conditions of the irrigation and drainage facilities are described in Tables 2.2 to 2.11.

The Bonga Pump #2 and #3 ISs have fully lined canals, while the Bonga Pump #1 IS has only partially lined canal. Concrete lining is commonly adopted, and neither brick lining nor stone masonry are seen in any of the lined canals. Insufficient embankment height is observed in most of the systems, even in the lined canal portions. Siltation due to

lack of maintenance is also quite common in any of the systems. Scouring is also found at downstream end of most of related structures such as siphons, culverts, checks, headgates, etc.

The irrigation canals of all the systems have been constructed with a concept of continuous water supply (24 hr/day consecutive pump operation) and simultaneous water distribution. The unit discharge capacity of most of the canals is within a range from 2.5 m³/s²/ha to 1.5 m³/s²/ha with an exception of 4.13 m³/s/ha for the main canal of the Bonga Pump #1 IS. The unit discharge of lateral canals varies from system to system ranging from 5.53 m³/s²/ha at maximum to 0.8 m³/s²/ha at minimum and is different from each other even within a system.

There exist about 1,060 nos. of structures including some 460 turnouts for the six (6) PISs with an aggregated maximum service area of about 8,500 ha. A commanding area of a turnout is some 20 ha on an average, ranging from 50.5 ha at maximum in the Solana PIS to 4.6 ha at minimum in the Bonga Pump #2 IS. Although the commanding area of a turnout varies by system, even by turnout, the turnouts are generally well located. In the Solana, and Libmanan-Cabusao PIS, however, illegal turnouts are seen at many places.

Out of 450 turnouts, some 110 are equipped with double orifice gates, while the remaining 350 turnouts consist only of a pipe culvert and a steel slide gate. A precast concrete pipe culvert with 12", 18" or 24" diameter is common in all the turnouts. The gates of the turnouts are in fairly good condition. About 20% of the turnouts have damaged gates or no gates.

There are 40 headgates and 100 checkgates in total, and they are maintained well as a whole.

2.3 Drainage Canals and Related Structures

Drainage canals have been constructed for the Alcala-Amulung, Solana, and Libmanan-Cabusao PISs. Natural creeks or streams are utilized for discharging excess water for the Bonga Pump #1, #2, and #3 ISs.

Lowland areas of the Alcala-Amulung and Solana PISs are incidentally inundated with flood water from the Cagayan river during the wet season.

The Libmanan-Cabusao PIS has drainage problem in some lower part of the service area because of deterioration of flap-gates installed on the drainage canals or creeks near the estuary coupled with insufficient discharge capacity of those canals and creeks.

As for the other PISs, no specific drainage problems are reported and observed during the current study period.

2.4 Service Roads

Service roads have been well constructed in all the systems except for the Bonga Pump #1 and #3 systems, for which existing "barangai" roads function as service roads. The service roads for the Bonga Pump #2 IS, Alcala-Amulung and Libmanan-Cabusao PISs are more than 3 m wide, which is enough for traffic of vehicles and O&M equipment and are paved with gravel. As for the Solana PIS, the roads have a width between 2.5 - 3.0 m and about 50 % of them are not practicable.

2.5 On-farm Facilities

On-farm facilities in the PISs are composed of main and supplementary farm ditches, farm drains and related structures such as division boxes, farm outlets, end checks, culverts, etc. Although farm ditches have been constructed in any of the PISs, their density varies widely from a system to another from 99 m/ha at maximum in the Bonga Pump #3 IS to 42 m/ha at minimum in the Bonga Pump #2 IS. On the contrary, farm drains have been provided only in the Alcalá-Amulung and Libmanan-Cabusao PISs at a density of 19 m/ha and 11 m/ha, respectively. Considerable portions of the farm ditches are poor in condition due to lack of maintenance and lack of perception on the importance of farm ditches for effective and efficient water use.

Provision of division boxes is limited to the Bonga #1, Alcalá-Amulung and Libmanan-Cabusao PISs. No farm outlets are installed in any of the systems.

3. REHABILITATION AND IMPROVEMENT PLAN

3.1 General

The principal objectives of improvement of O&M of the pumping irrigation systems are:

- i) To improve the financial status of the benefited farmers who bear much higher irrigation service fee than those who are enjoying benefit accrued from gravity irrigation system;
- ii) To improve the financial status of the O&M offices which have fallen into imbalance; and
- iii) To make the O&M offices sustainable.

The above target would be achieved through; a) reduction of operation and maintenance costs, b) improvement of land productivity, and c) reinforcement or establishment of proper system management.

There are so many elements relating to operation and maintenance cost of the systems, and those are complexly intertwined. Those elements are broadly classified into facilities, equipment, system management, and organization and staffing. Reduction of operation and maintenance costs (O&M costs) mentioned-above would mainly be accomplished only by comprehensive improvement of the systems including rehabilitation and improvement of irrigation and drainage facilities, and improvement of system management.

Judging from the fact that energy cost for pump operation accounts for about 80% of the total O&M costs, minimizing power rate and pump operation hours would be essential to reduce the O&M costs.

Besides, timely and equitable distribution of irrigation water would be indispensable to increase the ratios of effective rainfall and irrigation efficiency to reduce the O&M costs eventually.

The improvement plan to reduce the O&M cost would cover the following aspects;

- Improvement of pumping facilities to increase pump efficiency,
- Improvement of irrigation and drainage facilities to increase irrigation efficiency,
- Improvement of power supply system to decrease power rate,
- Improvement of water management to increase ratio of effective rainfall and irrigation efficiency, and
- Improvement of operation and maintenance of facilities.

In this ANNEX, discussion is concentrated on the above first three (3) items. The rest is discussed along with the system management plan in ANNEX-E SYSTEM MANAGEMENT.

Improvement of land productivity would be accomplished by means of introducing proper farming activities coupled with introduction of high profitable crops, as discussed in ANNEX-D AGRICULTURE AND AGRO-ECONOMY.

Reinforcement or establishment of proper system management which is discussed in ANNEX-E SYSTEM MANAGEMENT, would include;

- Water management,
- Monitoring and communication system,
- O&M equipment,
- Structure of system office,
- Maintenance of irrigation and drainage facilities, and
- Training of both O&M staff and IA farmers.

3.2 Delineation of the Irrigation Area

3.2.1 Generated and Service Areas

In the Interim Report prepared in march 1988, two (2) alternatives areas were considered as the objective areas for screening priority systems for further study. One is the generated area, and the other is the service area in 1986. The former is defined as the area of an irrigation project wherein the facilities have been completed and which could be provided with irrigation and drainage services. The latter is defined as the area of the irrigation system presently provided with irrigation and drainage facilities which could already be under operation. The objective areas delineated for screening purpose in the Interim Report are tabulated below;

Name of System	S.A (ha)	G.A (ha)
Bonga Pump #1 Irrigation System	298	426
Bonga Pump #2 Irrigation System	674	1,200
Bonga Pump #3 Irrigation System	202	218
Alcala-Amulung Pump Irrigation System	1,840	2,279
Solana Pump Irrigation System	1,320	2,865
Libmanan-Cabusao Pump Irrigation System	2,195	4,102

A.S : Service area in 1986.
G.A : Generated area.

3.2.2 Delineation of the Irrigation Areas

(1) General

The above mentioned respective objective areas have been scrutinized by using topographic maps on a scale of 1:4000, parcellary maps on an approximate scale of 1:2000 or 1:4000 and/or schematic irrigation diagrams. They have been delineated as "firmed-up service area" and "maximum service area" for feasibility study as follows:

Name of System	S.A (ha)	G.A (ha)
Bonga Pump #1 Irrigation System	298	426
Bonga Pump #2 Irrigation System	674	674
Bonga Pump #3 Irrigation System	202	202
Alcala-Amulung Pump Irrigation System	1,652	2,158
Solana Pump Irrigation System	1,100	1,960
Libmanan-Cabusao Pump Irrigation System	1,838	3,085

F.S.A ; Firmed up service area.
M.S.A ; Maximum service area.

The firmed-up service area is defined, for this study, as the area managed by the system office at present. The maximum service area is the part of the generated area which is delineated by eliminating higher lands, habitual inundation areas, residential areas and the areas being or to be served by small pumps.

The improvement plan of the systems will be formulated for both the firmed-up service areas and the maximum service areas as alternatives.

(2) Bonga Pump #1 Irrigation System

The firmed-up and maximum service areas are the same with respective service and generated areas. Since no detailed topographic maps are available for the Bonga Pump #1 IS, the areas for both cases are confirmed based on the schematic irrigation diagrams provided by Ilocos Norte Irrigation Service (INIS) office.

(3) Bonga Pump #2 Irrigation System

Although the generated area for the Bonga Pump #2 IS is reported to be 1,200 ha, neither detailed topographic maps nor schematic irrigation diagram are available for the generated area. Only a schematic irrigation diagram for the service area of 674 ha is available. Confirmation of the objective area for this system has, therefore, been made only for the firmed-up service area by using the said schematic irrigation diagram.

(4) Bonga Pump #3 Irrigation System

Similarly to the Bonga Pump #1, area confirmation has been made based on the schematic irrigation diagram.

(5) Alcala-Amulung Pump Irrigation System

In the Alcala-Amulung PIS, a maximum service area of 2,158 ha is delineated by eliminating higher lands, habitual inundation areas, residential areas, etc. from the result of the lot survey (parcellary maps) conducted by the system office in 1987. Topographic maps of 1:4000 scale and parcellary maps of approximate scale of 1:4000 were referred to for this work. A firmed up service area of 1,652 ha has been determined by eliminating uncultivated lands and corn lands without irrigation from the maximum service area.

(6) Solana Pump Irrigation System

It is said that in the Solana PIS, the generated area and the service area between 1983 and 1986 are 2,865 ha and 1,320 ha, respectively. However, no basis of these figures has been clarified in any of the relevant offices. The system office could only identify the rotation areas being served by the office and the actually irrigated areas. To delineate the firmed-up service area and maximum service area, each rotation area has been measured by planimeter on the topographic map of 1:4000 scale.

The commanding area of Lat.B has been excluded from both service areas since the area is higher than the water surface elevation of the existing canal.

Except for the commanding area of Lat.B (354 ha), all the rotation areas corresponding to the generated area amount to 2,530 ha. The route survey for the main canal conducted during current field survey period revealed that 570 ha out of 2,530 ha are higher than the existing canal elevation. This area was originally designed to be served by the lower

section of the main canal (between the diversion point to Lat.C and the end point). This area would not become irrigable topographically even after the existing system is restored to the original design unless an appropriate countermeasure such as installation of a booster pump with a total head of 1.5-2.0 m is taken. The maximum service area has been consequently delineated to be 1,960 ha by eliminating 570 ha from the aggregated service area of 2,530 ha.

(7) Libmanan-Cabusao Pump Irrigation System

A maximum service area of 3,084 ha in the Libmanan-Cabusao PIS has been worked out by eliminating i) the entire rotation areas to be served by the Handong and Cuisa pumps, ii) the whole or part of rotation areas to be served by nine (9) small pumps to be installed under the Accelerated Agricultural Production Project (AAPP) from the generated area of 4,102 ha delineated by using the topographic map of 1:4000 scale.

A firmed up service area of 1,838 ha for the same system has been delineated by deducting the service area of the existing Handong and Cuisa pumping systems and the nine (9) small pumping systems proposed under AAPP from the service area of 2,204 ha in 1986, which corresponds to the service area of 2,195 ha presented in the Interim Report.

3.3 Rehabilitation and Improvement Plan

3.3.1 Basic Concept

(1) Pumping Facilities

The basic concept for rehabilitation and improvement of the pumping facilities is to restore the pumping capacity to meet the proposed diversion water requirement and to maximize pump efficiency by means of replacement or rehabilitation of pump equipment.

The rehabilitation and improvement plan is formulated with the following condition and presumptions;

- Implementation of the project would start in 1990,
- Construction period would last 2-3 years,
- In case the useful life of the equipment expires in or before 1990, the equipment should be replaced with new one,
- The number of pump units to be replaced should not exceed the existing one,
- More than one (1) unit of pump should be placed at a pumping station.

Useful life of the equipment is indicated in Table 3.1.

(2) Power Supply System

The power supply system for the pumping station consists of a substation and a transmission line. In case electricity for the pumping station is being supplied through the Cooperative, improvement plan for the power supply system will also be studied for the case of direct tapping of electricity from NAPOCOR's grid. Legal background of the "direct tapping" is the Presidential Decree No.395 An Act Revising the Charter of the National Power Corporation (NAPOCOR).

As discussed in the Report on the Power Study - Re: Direct Power Connection of Libmanan-Cabusao Irrigation System Pumping Equipment with NPC Line, the conceivable "direct tapping" system is; i) Direct NIA-NAPOCOR System, or ii) so called Tripartite System.

i) Direct NIA-NAPOCOR System

This system implies that NIA taps directly its power requirement from NAPOCOR's grid through NIA's or NAPOCOR's own substation and NIA's own transmission line. It is presumed, in this study, that a new substation be constructed under the project because the existing NAPOCOR's substation is located inconveniently for connecting directly the pumping station with the substation.

ii) Tripartite System

Under this system, which is treated as "direct tapping", NIA utilizes the existing transmission line connecting the pumping station with the Cooperative's substation. In this case, it is proposed that NIA finances the procurement of an additional substation for the Cooperative to secure stable power supply even during the period of peak power demand (17:00 - 22:00) because the Cooperative forces NIA at present to suspend pump operation during the peak demand period due to shortage of capacity.

In case of "indirect tapping", no specific improvement plan will be formulated because both the substation and the transmission line are owned and maintained by the Cooperative.

(3) Irrigation and Drainage Facilities

The facilities to be rehabilitated and/or improved are irrigation canals and related structures, drainage canals and related structures, service roads (O&M roads), and on-farm facilities.

It is the general concept for all the systems to restore the capacity and function of the facilities to meet the proposed design discharge. In case the existing canal has insufficient flow capacity to meet the proposed design discharge, its flow capacity will be increased in such a way as to minimize additional right of way as follows:

- i) First, to increase the flow capacity by canal lining without substantial change in existing flow area,
- ii) Secondly, to increase the flow capacity by canal lining with change in existing inside slope from 1:1.5 to 1:1.0, in case the proposed design discharge is not satisfied with the above (i), and
- iii) Finally, to increase the flow capacity by canal lining and widening of canal section, in case the proposed design discharge is not satisfied with the above (ii).

In case the existing turnouts haven't sufficient flow capacity to meet the proposed design discharge, additional turnouts should be installed adjoining the existing ones instead of replacing the turnouts.

Service roads should be constructed along the whole routes of the main and lateral/sub-lateral canals as a rule.

All regulating structures such as headgates, checks and turnouts, should be equipped with steel gates. Calibrated staff gages should be installed immediately downstream of each headgate and check.

Main and supplementary farm ditches are estimated to be 70 m/ha, while farm drains are considered to be 60 m/ha. Structures related to on-farm canals are division boxes, farm outlets, end checks, and others.

3.3.2 Design Discharge

(1) Design Discharge for Irrigation Facilities

The design discharges for the pumps are determined to be the peak volume of the weekly diversion water requirements discussed in chapter 6.3.3 of ANNEX-E SYSTEM MANAGEMENT, and are shown in Table 3.2. Similar to the design discharges for the pumps, those for the irrigation canals and structures are also determined to be the peak volume the weekly water requirements, which have been worked out on the basis of proposed unit water requirement, water distribution plan and cropping pattern and calendar. The proposed design discharges for each of the systems are shown schematically in Figs. 3.1 to 3.10.

(2) Design Discharge for Drainage Facilities

The unit drainage water requirement is estimated with the following assumptions and procedure:

- i) Daily rainfall data at the following four (4) rain gages are adopted for estimating drainage requirement of respective PISs.

Name of PIS	Location of Rain Gages
Bonga Pump #1	Laoag, Ilocos Norte
Bonga Pump #2	Laoag, Ilocos Norte
Bonga Pump #3	Laoag, Ilocos Norte
Alcala-Amulung	Tuguegarao, Cagayan
Solana	Tuguegarao, Cagayan
Libmanan-Cabusao	Pasacao, Camarines Sur

- ii) Design stormy rainfall adopted in the present study is a 3-day probable rainfall with a 5-year return period and a 1-day probable rainfall with a 10-year return period for estimating drainage discharge from respective paddy and hilly lands.

Rain Gage	Probable Stormy Rainfall (mm)	
	3-day (5-year)	1-day (10-year)
Laoag	485	-
Tuguegarao	310	-
Pasacao	355	310

- iii) Assuming that retention of rainfall in the paddy fields is allowed up to 100 mm and taking submergence tolerance of rice into account (See IR-306), the unit drainage requirement in the paddy field is computed by the following equation:

$$q_1 = (R - 0.8 * D) / 8.64 * T$$

where, q_1 : unit design discharge (l/s/ha)
 R : 3-day stormy rainfall (mm)
 D : retention depth of rainfall (100 mm)
 0.8 : paddy field ratio to gross drainage area
 T : drainage period (3 days)

The unit drainage requirement thus estimated for each system is presented in Table 3.3.

- iv) Drainage requirement from the hilly lands is estimated by using the Rational Formula with a 1-day stormy rainfall.

3.4 Proposed Rehabilitation and Improvement Works

3.4.1 Pumping Facilities

Proposed works related to pumping facilities are; i) replacement of pumps, ii) replacement of electric motors, and iii) installation of new electric equipment. The electric equipment is needed for stable power distribution to respective motors and for safety control of the same, and consists of High voltage switch gear, Transformer, Low voltage incoming switch gear, Pump panel, Auxiliary panel, and Battery charger panel. No discharge pipe would be replaced because they are sufficiently good in condition. Since the existing discharge pipe and a nozzle of the proposed pump are different in their diameter, a taper flange adopter would be used for joining them.

General layouts of the pumping stations to be rehabilitated are given in Figs. 3.11 to 3.15. Proposed works for each PIS are shown in Table 3.4, and summarized below:

Name of System	Replacement (unit)				Installation (unit)	
	Pumps		Motor		Electric Equipment	
	F.S	M.S	F.S	M.S	F.S	M.S
Bonga Pump #1	2	2	2	2	2	2
Bonga Pump #2	3	3	3	3	3	3
Bonga Pump #3	2	2	2	2	2	2
Alcala-Amulung	-	-	-	-	-	-
Solana	3	4	3	4	3	4
Libmanan-Cabusao	-	-	1	1	4	4

F.S : Firmed-up service area
 M.S : Maximum service area

3.4.2 Power Supply System

(1) Comparative Study

Excepting the Alcala-Amulung PIS for which power supply system is directly connected with NAPOCOR's grid, comparative study for power supply system of the other five (5) PISs has been made for both the Direct NIA-NAPOCOR System and the Tripartite System.

i) Direct NIA-NAPOCOR system

A substation (115 kV/13.8 kV, 1,200 kVA) is proposed to be constructed on the Payas Road at Barangai 16, San Nicolas for the Bonga Pump #1, #2, and #3 PISs. Electricity tapped at the substation would be distributed to each of the PISs through a proposed 13.8 kV transmission line with a total length of 17.1 km.

For the Solana PIS, a substation (69 kV/440 V) with a transformer capacity of 1,750 kVA for the maximum service area or 1,200 kVA for the firm-up service area would be constructed adjacently to the existing pumping station. Since the NAPOCOR's 69 kV line is aligned nearby the pumping station, no transmission line would be needed for this case.

An independent substation (69 kV/13.8 kV, 1,200 kVA) would be constructed nearby the Bahay substation of the CASURECO I for the Libmanan-Cabusao PIS. A 15.0 km long 13.8 kV transmission line connecting the substation with the pumping station would also be constructed for exclusive use.

ii) Tripartite system

An additional substation (69 kV/13.8 kV, 5,000 kVA) would be constructed for each of the existing substations of Ilocos Norte Electric Cooperative Inco. (INECO) at Lingkurang Patubig, Cagayan Electric Cooperative Inco. (CAGELCO) at Maddarulug Solana, and Camarines Sur 1 Electric Cooperative Inco. (CASURECO I) at Bahay. The electricity stepped down at Lingkurang Patubig substation would be conveyed to each pumping station through the existing 13.8 kV transmission lines and a new 13.8 kV transmission line connecting the Bonga pump #2 with Bonga pump #3. The existing 13.8 kV transmission lines would be used between the other substations and the relevant pumping stations. The lengths of the transmission lines connecting respective substations with pumping stations are shown in Table 2.1.

iii) Cost comparison

Construction cost for both power supply systems has been estimated based on the above plans and summarized in Table 3.5.

(2) Proposed Works

Considering the result of the cost comparison discussed above and the final draft of the Tripartite Agreement among NIA, NAPOCOR, and CASURECO I on the proposed NIA direct tapping to NAPOCOR for Libmanan-Cabusao PIS dated May 13, 1988, the Tripartite System is proposed for the Bonga Pump #1, #2, and #3 PISs and Libmanan-Cabusao PIS, while the Direct NIA-NAPOCOR System is adopted for the Solana PIS.

General maps of the proposed power supply system for each PIS are shown in Figs. 3.16 to 3.18. Proposed single line diagrams for the respective substations and pumping stations are illustrated in Figs. 3.19 to 3.21.

3.4.3 Irrigation and Drainage Facilities

The major proposed works relating to irrigation and drainage facilities are; i) increasing flow capacity of irrigation canals, ii) replacing gates, iii) installing additional turnouts, iv) installing calibrated staff gages at every diversion point, v) increasing discharge capacity of the drainage canals, and vi) increasing density of farm ditches. Besides, a 30 m bank protection is proposed on the left bank of the Bonga river immediately upstream of the Bonga Pump #3 pumping station.

The proposed works are presented in Figs. 3.22 to 3.31 and Tables 3.6 to 3.15, and are summarized below:

Work Items	Unit	Work Volume	
		F.S	M.S
Increasing flow capacity of irrigation canals	km	68.0	92.3
Construction of irrigation canals	km	0.8	2.2
Replacing gates of turnouts	nos.	137	185
Replacing/Installing other gates	nos.	16	8
Installing turnouts	nos.	26	43
Installing staff gages	nos.	70	82
Increasing discharge capacity of drainage canals	km	56.1	75.8
Construction of drainage canals	km	25.3	29.2
Increasing density of farm ditches	km	90	176
Increasing density of farm drains	km	349	572

F.S ; Firmed-up service area
M.S ; Maximum service area

Table 1.1 PROFILE OF PUMP IRRIGATION SYSTEMS IN NATIONAL IRRIGATION SYSTEMS

National Irrigation System - Pump Irrigation System											
Name	Service Area (ha)*	Name	Generated Area (ha)	Service Area (ha)**	Location			Main Source of Water	Date of Completion	Date of Start Operation	
					Municipality	Province	Region				
1 Bonga Pump #1 IS	238	Bonga Pump #1 IS	426	298	Sarrat, San Nicolas	Ilocos Norte	I	Bonga R.	July '79	'77	
2 Bonga Pump #2 IS	674	Bonga Pump #2 IS	1,200	674	San Nicolas	- do -	- do -	Bonga E.	'79	'77	
3 Bonga Pump #3 IS	202	Bonga Pump #3 IS	?	202	Laog	- do -	- do -	Bonga E.	June '79	'77	
4 Iguig, Alcala-Amulung PIS	2,443	Iguig PIS	775	603	Iguig	Cagayan	II	Cagayan E.	October '83	Nov. '83	
		Alcala-Amulung PIS	2,350	1,840	Alcala, Amulung	- do -	- do -	Cagayan E.	October '83	Nov. '82	
5 Solana Tuguegarao PIS	1,320	Solana PIS	3,080	1,320	Solana	- do -	- do -	Cagayan E.	December '79	May '80	
6 Libmanan-Cabusao PIS	2,195	Libmanan-Cabusao PIS	4,100	2,195	Libmanan, Cabusao	Casuarines Sur	V	Libmanan E.	March '81	May '81	

* ; Service area of the National Irrigation System in 1986

** ; Service area of the Pump Irrigation System in 1986

Table 2.1 SALIENT FEATURES AND PRESENT CONDITION OF PUMPING STATION

Name of Pumping Station	Generated Area (ha)	Service Area (ha)†	Type	Total Head (m)	Bore Capacity (m ³ /min)	Nos. of Unit	Power (kw)	Nos. of Unit	Power Supplier	Location of sub-station	Transmission Voltage (kv)	Length (km)	Remarks	Power Supply		
														Motor	Pump	
(1) Bonga Pump #1	426	298	Vertical Turbine	11.9	600	2	37.85 (12.2) (20.5)	2 (1) (1)	93.8	2	INECO	13.2	22.6	-Discharge capacities of both units are extremely low compared with the rated one.		
(2) Bonga Pump #2	1,200	674	Vertical Turbine	12.8	650	2	56.77 (0.0) (47.7)	2 (1) (1)	149.0	2	INECO	13.2	27.7	-One unit of pump is not operational due to abrasion of bearing in a gear box.		
(3) Bonga Pump #3	?	202	Vertical Turbine	7.9	600	2	34.10 (0.0) (31.0)	2 (1) (1)	56.0	2	INECO	13.2	7.3	-One unit of pump is not operational due to failure in a motor.		
(4) Alcala-Anulung P/S	2,350	1,840	Vertical Volute	20.5 13.6	600 800	3 1	70.5 80.0 (72.5)	3 1 (1)	315.0 240.0	3	HAPOCOR	11.8	0.8			
(5) Solana P/S	3,080	1,320	Vertical Mixed Flow	6.5	900	4	102.2 (85.3) (78.4) (0.0)	4 (1) (1) (2)	373.0	4	CAGECO	13.2	1.5	-Two units of pumps are not operating due to excessive vibration for one unit and defect of control panel for the other.		
(6) Libanan-Cabusao P/S	4,100	2,195	Vertical Mixed Flow	7.8	900	4	91.5 (86) (0.0)	4 (2) (2)	149.2	4	CASUBECO	13.8	15.0	-Two units of pumps are not operational, because of failure in electricity and in motor, respectively.		

† ; Service area in 1986.
 INECO ; Ilocos Norte Electric Cooperative Incorporation
 HAPOCOR ; National Power Corporation
 CASUBECO I ; Casuarines Sur I Electric Cooperative Incorporation

Table 2.2 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #1 IS; Firmed up Service Area)

1. Irrigation System (Irrigable Area: 298 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures	
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken		
1	Main canal	1.00	298	3,380	20	(13)	(7)	2	(2)	(0)	1	(1)	(0)	22	
2	Lat. A	-	-	-	-	-	-	0	(0)	(0)	0	(0)	(0)	3	
3	Lat. B	0.09	114	800	5	(0)	(5)	0	(0)	(0)	0	(0)	(0)	3	
Total					4,180	25	(13)	(12)	2	(2)	(0)	1	(1)	(0)	28

2. Drainage System (Catchment Area: 530 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
- None -						
Total						

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	3,380	3,380	4.0
Total		0	3,380	3,380	-

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable Area		Density (m/ha)
			Area (ha)	Density (m/ha)	
1	Farm ditch	11,830	298	39.7	0
2	Farm drain	0	0	0	0

Table 2.3 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #1 IS; Maximum Service Area)

1. Irrigation System (Irrigable Area: 426 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures	
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken		
1	Main canal	1.00	426	3,380	20	(13)	(7)	2	(2)	(0)	1	(1)	(0)	22	
2	Lat A	0.125	128	5,020	19	(0)	(19)	0	(0)	(0)	0	(0)	(0)	30	
3	Lat B	0.08	114	1,060	5	(0)	(5)	0	(0)	(0)	0	(0)	(0)	3	
Total					9,460	44	(13)	(31)	2	(2)	(0)	1	(1)	(0)	55

2. Drainage System (Catchment Area: 530 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
- None -						
Total						

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
- None -					
Total					

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable Area		Density (m/ha)
			Area (ha)	Density (m/ha)	
1	Farm ditch	16,920	426	39.7	0
2	Farm drain	0	426	0	0

Table 2.4 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #2 IS; Firmed-up and Maximum Service Area)

1. Irrigation System (Irrigable Area: 674 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures	
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken		
1	Main canal	2.95-0.82	674	9,000	54	(47)	(7)	3	(3)	(0)	3	(3)	(0)	46	
2	Lat A	0.17	25	2,730	30	(25)	(5)	0	(0)	(0)	3	(3)	(0)	8	
3	Lat B	0.89	313	5,250	40	(34)	(6)	3	(3)	(0)	5	(5)	(0)	14	
4	Lat B-1	0.16	31	3,290	19	(15)	(4)	0	(0)	(0)	2	(2)	(0)	5	
5	Lat B-2	Un known	18	1,010	5	(5)	(0)	0	(0)	(0)	0	(0)	(0)	6	
6	Lat B-Extra	0.10	29	1,940	7	(5)	(2)	0	(0)	(0)	0	(0)	(0)	5	
7	Lat C	0.18	12	1,450	6	(6)	(0)	0	(0)	(0)	0	(0)	(0)	6	
8	Lat D	-	-	-	-	-	-	-	-	-	-	-	-	-	
				- Out of the firmed-up / maximum service area -											
Total					24,660	161	(137)	(24)	6	(6)	(0)	13	(13)	(0)	90

2. Drainage System (Catchment Area: 930 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
- None -						
Total						

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	7,935	2,194	10,129	4.0
2	Lat A	351	1,538	1,889	4.0
3	Lat B	1,548	1,773	3,321	4.0
4	Lat B-1	2,208	804	3,012	4.0
5	Lat B-extra	0	1,300	1,300	4.0
6	Lat D	364	348	710	4.0
Total		12,406	7,957	20,363	-

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable	
			Area (ha)	Density (m/ha)
1	Farm ditch	28,628	674	42.4
1	Farm drain	0	674	0

Table 2.5 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #3 IS; Firmed-up and Maximum Service Area)

1. Irrigation System (Irrigable Area: 202 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures	
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken		
1	Main canal	0.47-0.27	202	4,750	32	(6)	(26)	2	(1)	(1)	2	(2)	(0)	11	
2	Lat A	0.08	36	1,920	9	(0)	(9)	0	(0)	(0)	0	(0)	(0)	11	
3	Lat B	0.08	23	1,450	6	(0)	(6)	0	(0)	(0)	0	(0)	(0)	11	
Total					8,070	47	(6)	(41)	2	(1)	(1)	2	(2)	(0)	40

* The canal was washed away by flood at the ending portion from 57.4+150 to 57.5+160.

2. Drainage System (Catchment Area: 320 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
- None -						
Total						

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	3,380	3,380	4.0
Total		0	3,380	3,380	-

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable	
			Area (ha)	Density (m/ha)
1	Farm ditch	21,622	202	107
2	Farm drain	0	0	0

Table 2.6 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Alcala-Awulung Pump IS; Firm-up Service Area)

1. Irrigation System (Irrigable Area: 1,652 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken	
1	Main canal	2.86-1.13	1,163	9,870	16	(15)	(1)	4	(4)	(0)	0	(0)	(0)	22
2	lat A	1.47	489	2,720	7	(7)	(0)	3	(3)	(0)	1	(1)	(0)	3
3	lat A-1	1.30	145	1,280	4	(4)	(0)	0	(0)	(0)	1	(1)	(0)	2
4	lat A-2	0.23	77	1,710	3	(3)	(0)	0	(0)	(0)	1	(1)	(0)	3
5	lat A-3	0.35	86	1,290	2	(2)	(1)	0	(0)	(0)	2	(2)	(0)	2
6	lat B	0.52	224	5,880	7	(3)	(4)	0	(0)	(0)	1	(1)	(0)	17
7	lat C	0.24	100	2,800	3	(3)	(0)	0	(0)	(0)	2	(2)	(0)	8
8	lat C-Extra	0.01	24	1,900	1	(1)	(0)	0	(0)	(0)	0	(0)	(0)	6
9	lat D	0.85	384	3,200	10	(10)	(0)	1	(1)	(0)	1	(1)	(0)	3
10	lat D-1	0.09	32	1,180	1	(1)	(0)	0	(0)	(0)	1	(1)	(0)	1
Total					53	(49)	(4)	8	(8)	(0)	10	(10)	(0)	67

2. Drainage System (Catchment Area: 2,500 ha)

No.	Name of Drain	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Structure	
					Flapgate	Other Structure
1	MDC-1	33.61	1,246	9,870	0	0
2	DC-1	5.50	112	430	0	0
3	DC-2	1.58	191	2,670	0	1
4	DC-3	3.10	488	3,580	0	0
5	DC-4	2.17	325	3,040	0	1
6	DC-5	1.13	237	1,570	0	0
7	DC-6	0.86	158	1,260	0	0
8	DC-7	1.70	307	3,720	0	1
9	DC-8	0.97	65	2,190	0	1
10	DC-9	1.21	144	1,470	0	1
Total					0	5

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	4,906	4,906	3.0
2	lat A-2	0	1,006	1,006	3.0
3	lat B	0	4,973	4,973	3.0
4	lat C	2,400	0	2,400	3.0
5	lat C-Extra	0	1,900	1,900	3.0
6	lat D	133	1,646	1,779	3.0
7	lat D-1	1,184	0	1,184	3.0
Total					3,717

4. On-farm Facilities

No.	Item	Irrigable		
		Distance (m)	Area (ha)	Density (m/ha)
1	Farm ditch	95,070	1,652	57.6
2	Farm drain	27,940	1,652	16.9

Table 2.7 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Alcala-Awulung Pump IS; Maximum Service Area)

1. Irrigation System (Irrigable Area: 2,518 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken	
1	Main canal	2.86-1.13	1,505	9,870	16	(15)	(1)	4	(4)	(0)	0	(1)	(0)	22
2	lat A	1.47	653	2,720	7	(7)	(0)	3	(3)	(0)	1	(1)	(0)	3
3	lat A-1	1.30	156	1,280	4	(4)	(0)	0	(0)	(0)	1	(1)	(0)	2
4	lat A-2	0.23	119	1,710	3	(3)	(0)	0	(0)	(0)	1	(1)	(0)	3
5	lat A-3	0.35	151	1,290	2	(2)	(1)	0	(0)	(0)	2	(2)	(0)	2
6	lat B	0.52	263	5,880	7	(3)	(4)	0	(0)	(0)	1	(1)	(0)	17
7	lat C	0.24	128	2,800	3	(3)	(0)	0	(0)	(0)	2	(2)	(0)	8
8	lat C-Extra	0.01	42	1,900	1	(1)	(0)	0	(0)	(0)	0	(0)	(0)	6
9	lat D	0.85	421	3,200	10	(10)	(0)	1	(1)	(0)	1	(1)	(0)	3
10	lat D-1	0.09	32	1,180	1	(1)	(0)	0	(0)	(0)	1	(1)	(0)	1
Total					56	(50)	(6)	8	(8)	(0)	10	(11)	(0)	67

2. Drainage System (Catchment Area: 2,500 ha)

No.	Name of Drain	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of structure	
					Flapgate	Other Structure
1	MDC-1	33.61	1,246	9,870	0	0
2	DC-1	5.50	112	430	0	0
3	DC-2	1.58	191	2,670	0	1
4	DC-3	3.10	488	3,580	0	0
5	DC-4	2.17	325	3,040	0	1
6	DC-5	1.13	237	1,570	0	0
7	DC-6	0.86	158	1,260	0	0
8	DC-7	1.70	307	3,720	0	1
9	DC-8	0.97	65	2,190	0	1
10	DC-9	1.21	144	1,470	0	1
Total					0	5

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	4,906	4,906	3.0
2	lat A-2	0	1,006	1,006	3.0
3	lat B	0	4,973	4,973	3.0
4	lat C	2,400	0	2,400	3.0
5	lat C-Extra	0	1,900	1,900	3.0
6	lat D	133	1,646	1,779	3.0
7	lat D-1	1,184	0	1,184	3.0
Total					3,717

4. On-farm Facilities

No.	Item	Irrigable		
		Distance (m)	Area (ha)	Density (m/ha)
1	Farm ditch	144,912	2,518	57.6
2	Farm drain	42,585	2,518	16.9

Table 2.8 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Solana Pump 13; Firmed-up Service Area)

1. Irrigation System (Irrigable Area: 1,100 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken	
1	Main canal	5.33-1.85	1,100	12,510	21	(9)	(12)	2	(2)	(0)	8	(8)	(0)	44
2	Lat A	0.48	149	2,080	4	(0)	(4)	0	(0)	(0)	1	(1)	(0)	2
3	Lat A-Extra	1.08	374	3,480	9	(4)	(5)	1	(1)	(0)	7	(7)	(0)	11
4	Lat A-1Extra	0.56	205	2,400	4	(0)	(4)	0	(0)	(0)	3	(3)	(0)	1
5	Lat A-2Extra													
6	Lat B													
7	Lat C													
8	Lat D													
9	Lat D-1													
Total				20,470	39	(13)	(25)	3	(3)	(0)	19	(19)	(0)	58

2. Drainage System (Catchment Area: 2,450 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
1	DC #1	4,520	1.73	678	0	0
2	DC #2	1,800	Un known	270	0	0
3	DC #3					
4	DC #4	400	Un known	30	0	1
5	DC #5	1,800	Un known	394	0	1
6	DC #6					
7	DC #7	2,400	Un known	727	0	1
8	DC #8	2,200	3.70	2,449	0	0
Total				13,120	0	3

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	11,710	11,710	2.5-3.0
2	Lat A	0	2,050	2,050	2.5
3	Lat A Extra	0	3,478	3,478	2.5
4	Lat A-1Extra	0	2,400	2,400	2.5
Total				19,638	19,638

4. On-Farm Facilities

No.	Item	Distance	Irrigable	
			Area (ha)	Density (m/ha)
1	Farm ditch	47,265	1,100	43
2	Farm drain	0	1,100	0

Table 2.9 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Solana Pump 15; Maximum Service Area)

1. Irrigation System (Irrigable Area: 1,960 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken	
1	Main canal	5.33-1.18	1,960	15,360	24	(9)	(15)	3	(3)	(0)	18	(18)	(0)	38
2	Lat A	0.48	149	2,080	4	(0)	(4)	0	(0)	(0)	1	(1)	(0)	2
3	Lat A Extra	1.08	851	7,600	12	(4)	(8)	2	(1)	(1)	11	(10)	(1)	22
4	Lat A-1 Extra	0.56	205	2,400	4	(0)	(4)	0	(0)	(0)	2	(2)	(0)	2
5	Lat A-2 Extra	0.39	180	2,300	3	(0)	(3)	0	(0)	(0)	2	(2)	(0)	1
6	Lat B													
7	Lat C	0.42	270	2,100	4	(0)	(4)	0	(0)	(0)	2	(2)	(0)	2
8	Lat D													
9	Lat D-1													
Total				31,940	51	(13)	(38)	5	(4)	(1)	36	(35)	(1)	67

2. Drainage System (Catchment Area: 2,450 ha)

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
1	DC #1	5,120	1.73	678	0	0
2	DC #2	1,800	Un known	270	0	0
3	DC #3	2,400		251	0	0
4	DC #4	400		30	0	1
5	DC #5	1,800		394	0	1
6	DC #6	2,400		214	0	0
7	DC #7	2,400		727	0	1
8	DC #8	2,200	3.70	2,450	0	0
Total				18,520	0	3

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	0	11,710	11,710	2.5-3.0
2	Lat A	0	2,050	2,050	2.5
3	Lat A Extra	0	7,600	7,600	2.5
4	Lat A-1 Extra	0	2,400	2,400	2.5
5	Lat A-2 Extra	0	2,400	2,400	2.5
6	Lat B				
7	Lat C	0	2,100	2,100	2.5
8	Lat D				
9	Lat D-1				
Total				28,260	28,260

4. On-Farm Facilities

No.	Item	Distance	Irrigable	
			Area (ha)	Density (m/ha)
1	Farm ditch	84,220	1,960	43
2	Farm drain	0	1,960	0

Table 2.10 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Libmanan-Cabusao Pump IS; Firmed-up Service Area)

1. Irrigation System (Irrigable Area: 1,838 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout		No. of Headgate		No. of Checkgate			No. of Other Structures		
					Total	Functional Broken	Total	Functional Broken	Total	Functional Broken	Broken			
1	Main canal	6.05-0.14	1,838	11,170	5	(3)	(2)	5	(4)	(1)	3	(3)	(0)	26
2	Lat A	-	-	-	Out of the firmed-up service area									
3	Lat B	1.43	280	9,700	10	(8)	(2)	1	(1)	(0)	9	(9)	(0)	35
4	Lat B-Extra	0.12	26	1,200	2	(2)	(0)	0	(0)	(0)	0	(0)	(0)	2
5	Lat C	3.13	1,046	8,720	22	(13)	(9)	4	(2)	(2)	10	(10)	(0)	7
6	Lat C-Extra	-	-	-	To be main farm ditch									
7	Lat C-Extra2	0.13	41	960	2	(2)	(0)	0	(0)	(0)	0	(0)	(0)	2
8	Lat C-Extra3	0.20	40	1,240	2	(1)	(1)	0	(0)	(0)	0	(0)	(0)	3
9	Lat C-1	0.87	409	3,100	5	(1)	(4)	1	(0)	(1)	3	(3)	(0)	7
10	Lat C-1 Extra1	0.15	212	2,750	3	(3)	(0)	0	(0)	(0)	0	(0)	(0)	4
11	Lat C-2	0.95	171	2,840	3	(3)	(0)	2	(2)	(0)	2	(2)	(0)	12
12	Lat C-2A	0.30	90	890	3	(3)	(0)	0	(0)	(0)	0	(0)	(0)	4
13	Lat C-2B	0.32	43	70	1	(1)	(0)	0	(0)	(0)	0	(0)	(0)	4
14	Lat C2 Extra1	-	-	-	Out of the firmed-up service area									
15	Lat D	0.83	251	3,310	7	(4)	(3)	0	(0)	(0)	5	(5)	(0)	4
16	Lat E	0.11	117	1,300	4	(2)	(2)	0	(0)	(0)	1	(1)	(0)	6
17	Lat F	0.51	74	980	4	(0)	(4)	0	(0)	(0)	1	(1)	(0)	1
18	Lat B1H	-	-	-	out of the firmed-up service area									
19	Lat BRH	-	-	-	-									
	Total	-	-	48,230	77	(48)	(29)	13	(9)	(4)	0	(0)	(0)	117

2. Drainage System (Catchment Area: 4,300 ha)

A) Protection Dike						
No.	Name of protection dike	length (m)	Height (m)	Width at the top	Side slope	No. of Drainage crossing
1	Protection dike #1	6,561	2.2	4	1:3.0	9
2	Protection dike #2	8,700	2.2	4	1:3.0	5

B) Drainage canal

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Other Structure
1	Interceptor Channel	8,760	33.00	(722)	1	9
2	D-A	2,520	3.72	469	1	11
3	D-B	4,280	5.90	985	1	74
4	D-C	1,200	3.05	297	1	9
5	D-D	2,800	2.68	463	1	14
6	D-D-1	2,550	1.12	236	0	11
7	D-E	-	-	-	Out of the firmed-up service area	
8	D-F	2,920	2.81	210	2	13
9	D-G	3,200	3.12	451	1	12
10	D-I	4,580	4.28	230	0	8
11	D-J	7,220	11.67	1,244	0	18
12	D-J-1	1,420	4.03	188	0	10
13	D-J-2	1,050	2.10	318	0	4
14	D-J-2a	970	No data	130	0	4
15	D-J-2b	980	3.27	145	0	3
16	D-K	-	-	-	Out of the firmed-up service area	
	Total	35,690	-	-	8	131

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)	
		Right	Left	Total		
1	Main canal	4,120	7,053	11,173	7.0	
2	Lat A	-	-	-	Out of the firmed-up service area	
3	Lat B	6,890	0	6,890	4.0	
4	Lat C	6,530	0	6,530	4.0	
5	Lat C-1	0	3,100	3,100	4.0	
6	Lat C-2a	0	890	890	4.0	
7	Lat C-2b	0	310	310	4.0	
8	Lat D	0	2,970	2,970	4.0	
	Total	17,540	14,323	31,863	-	

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable Area	
			(ha)	Density (m/ha)
1	Farm ditch	116,230	1,838	63.2
2	Farm drain	26,420	1,838	14.4

Table 2.11 PRESENT CONDITION OF IRRIGATION AND DRAINAGE FACILITIES
(Libmanan-Cabusao Pump 19; Maximum Service Area)

1. Irrigation System (Irrigable Area: 3,085 ha)

No.	Name of Canal	Designed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)	No. of Turnout			No. of Headgate			No. of Checkgate			No. of Other Structures
					Total	Functional	Broken	Total	Functional	Broken	Total	Functional	Broken	
1	Main canal	6.05-0.14	3,085	11,170	5	(2)	(2)	5	(4)	(2)	3	(3)	(0)	25
2	Lat A	0.12	67	3,320	3	(0)	(3)	0	(0)	(0)	0	(0)	(0)	19
3	Lat B	1.43	337	9,700	10	(6)	(2)	1	(1)	(0)	9	(9)	(0)	35
4	Lat B-Extra	0.12	52	1,200	2	(2)	(0)	0	(0)	(0)	0	(0)	(0)	2
5	Lat C	3.13	2,036	8,720	22	(13)	(9)	4	(3)	(1)	10	(9)	(1)	18
6	Lat C-Extral	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Lat C-Extra2	0.13	153	1,900	4	(3)	(1)	0	(0)	(0)	0	(0)	(0)	1
8	Lat C-Extra3A	0.20	102	1,240	3	(2)	(1)	0	(0)	(0)	0	(0)	(0)	3
9	Lat C-1	0.07	648	3,920	14	(5)	(9)	1	(0)	(1)	3	(3)	(0)	7
10	Lat C-1Extral	0.15	230	2,750	6	(4)	(2)	0	(0)	(0)	0	(0)	(0)	4
11	Lat C-2	0.95	523	3,540	6	(6)	(0)	2	(2)	(0)	2	(2)	(0)	12
12	Lat C-2A	0.30	106	1,760	5	(5)	(0)	0	(0)	(0)	0	(0)	(0)	4
13	Lat C-2B	0.32	152	1,800	4	(1)	(3)	0	(0)	(0)	0	(0)	(0)	4
14	Lat C2Extral	0.20	102	2,450	4	(0)	(4)	0	(0)	(0)	0	(0)	(0)	3
15	Lat D	0.83	263	3,310	7	(4)	(3)	0	(0)	(0)	5	(5)	(0)	4
16	Lat E	0.11	119	1,300	4	(2)	(2)	0	(0)	(0)	1	(1)	(0)	6
17	Lat F	0.14	139	980	4	(0)	(4)	0	(0)	(0)	1	(1)	(0)	1
18	Lat BBR	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Lat BRR	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	-	59,460	102	(38)	(45)	14	(10)	(4)	34	(33)	(0)	148

2. Drainage System (Catchment Area: 6,000 ha)

A) Protection dike

No.	Name of protection dike	Length (m)	Right (m)	Width at the top (m)	Side slope	No. of structure
						Drainage crossing
1	Protection dike #1	6,561	2.2	4	1:3.0	9
2	Protection dike #2	8,700	2.2	4	1:3.0	4

B) Drainage canal

No.	Name of Drain	Distance (m)	Designed Discharge (m ³ /s)	Commanding Area (ha)	No. of Structure	
					Flapgate	Structure
1	Interceptor channel	8,760	33.00	722	0	9
2	D - A	2,520	3.72	469	0	11
3	D - B	4,280	5.90	985	0	24
4	D - C	1,200	3.06	297	0	9
5	D - D	2,800	2.88	463	0	14
6	D - D-1	2,550	1.12	236	0	11
7	D - E	2,110	0.80	136	0	5
8	D - F	2,920	2.81	210	0	13
9	D - G	3,200	3.12	451	0	12
10	D - I	4,580	4.20	210	0	9
11	D - J	7,220	11.67	1,244	0	19
12	D - J-1	1,420	4.03	188	0	10
13	D - J-2	1,050	2.10	318	0	4
14	D - J-2a	970	No data	130	0	4
15	D - J-2b	980	No data	145	0	3
16	D - K	3,540	8.30	150	0	25
	Total	50,100	-	-	0	181

3. Service/Access Road

No.	Name of Canal	Distance (m)			Width (m)
		Right	Left	Total	
1	Main canal	4,120	7,053	11,173	7.0
2	Lat A	3,720	0	3,720	4.0
3	Lat B	6,892	0	6,892	4.0
4	Lat C	8,720	0	8,720	4.0
5	Lat C-1	0	3,920	3,920	4.0
6	Lat C-2a	0	1,760	1,760	4.0
7	Lat C-2b	0	1,020	1,020	4.0
8	Lat D	0	3,310	3,310	4.0
	Total	23,452	17,063	40,515	

4. On-Farm Facilities

No.	Item	Distance (m)	Irrigable	
			Area (ha)	Density (m/ha)
1	Farm ditch	195,090	3,085	63.2
2	Farm drain	44,350	3,085	14.4

Table 3.1

USEFUL LIFE OF EQUIPMENT

Item	Useful Life (Years)
1. Pumping Facilities	
1.1. Pump Equipment	15
1.2. Electric equipment	35
2. Sub-s-station	
2.1. Transformer	35
2.2. Electric Equipment	35
2.3. Transmission Line	35
3. O & M Equipment	
3.1. Heavy Equipment	10
3.2. Light Equipment	10
3.3. Miscellaneous	10
4. Communication Equipment	
4.1. Radio set	10
5. Monitoring Equipment	
5.1. Staff Gauge	10
5.2. Rain Gauge	10
5.3. Current Meter	15

Table 3.2 DIVERSION WATER REQUIREMENT

Unit ; m³/sec

Name of System	Maximum Service Area	Firmed-up Service Area
Bonga Pump #1	1.17	0.96
Bonga Pump #2	1.85	1.85
Bonga Pump #3	0.53	0.53
Alcala-Amulung	4.02	3.81
Solana	5.47	3.03
Libmanan-Cabusao	5.04	4.66

Table 3.3 UNIT DRAINAGE REQUIREMENT

Unit : l/s/ha

Name of System	Unit Drainage Requirement
Bonga Pump #1	15.6
Bonga Pump #2	15.6
Bonga Pump #3	15.6
Alcala-Amulung	8.9
Solana	8.9
Libmanan-Cabusao	10.5

Table 3.4 SALIENT FEATURES OF PUMPING FACILITIES AND SUB-STATION

of ISA	Pump Capacity (m ³ /min)	Nos of Unit (nos)	Total Capacity (m ³ /min)	Total Head (m)	Pump Efficiency (%)	Motor Power (KW)	Power Factor (%)	Transformer Step-down Rate P.S	Transformer Capacity (KVA) P.S	Transformer Step-down Rate S.S	Transformer Capacity (KVA) S.S	Transmis- sion Line KV/km
Case - 1 (Firmed-up Service Area)												
Bonga Pump #1 ISA	28.8	2	57.6	11.2	76	80	90	13.8KV/440V	200	69KV/13.8KV	5000	13.8/8.8
Bonga Pump #2 ISA	37.0	3	110.0	10.5	79	90	90	13.8KV/440V	400	69KV/13.8KV	*	*
Bonga Pump #3 ISA	15.9	2	31.8	7.93	79	37	90	13.8KV/440V	100	69KV/13.8KV	*	*
Alcala Anulung Pump ISA	70.5	3	291.5	20.5	87	315	90	13.2KV/460V	2000	69KV/13.2KV	3000	-
	80.0	1		13.6	85	240						
Solana Pump ISA	60.6	3	181.8	16.6	80	230	90	69KV/440V	1200	-	-	69/0.2
Libmanan Cabusao Pump ISA	91.6	4	366.4	7.82	81	149	89	13.2KV/460V	750	69KV/13.8KV	5000	-
Case - 2 (maximum Service Area)												
Bonga Pump #1 ISA	35.1	2	70.2	11.1	76	95	90	13.8KV/440V	250	69KV/13.8KV	5000	13.8/8.8
Bonga Pump #2 ISA	37.0	3	111.0	10.5	79	90	90	13.8KV/440V	400	69KV/13.8KV	*	*
Bonga Pump #3 ISA	15.9	2	31.8	7.93	79	37	90	13.8KV/440V	100	69KV/13.8KV	*	*
Alcala Anulung Pump ISA	70.5	3	291.5	20.5	87	315	90	13.2KV/460V	2000	69KV/13.2KV	3000	-
	80.0	1		13.6	85	240						
Solana Pump ISA	82.05	4	328.2	16.8	81	310	90	69KV/440V	1750	-	-	69/0.2
Libmanan Cabusao Pump ISA	91.6	4	366.4	7.82	81	149	89	13.2KV/460V	750	69KV/13.8KV	5000	-

Remarks : * Bonga Sub-station distribute for Bonga #1, #2, #3 Pumping Systems. P.S : Pumping Station. S.S : Sub-station

Table 3.5 COST COMPARISON FOR POWER SUPPLY SYSTEM

(Unit : 1000 pesos)

Name of System	Specification	Direct NIA-NAPOCOR System			Tripartite System			
		Transmis- sion Line	Sub Station	Total	Specification	Transmis- sion Line	Sub Station	Total
(I) Firmed-up Service Area								
Bonga Pump #1	* 13.8 KV, 5.0 Km **115KV/13.8KV, 1200KVA	1,001	6,868	7,869	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	528	4,105	4,633
Bonga Pump #2	* 13.8 KV, 3.3 Km **115KV/13.8KV, 1200KVA	527	7,911	8,438	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	660	5,132	5,792
Bonga Pump #3	* 13.8 KV, 5.5 Km **115KV/13.8KV, 1200KVA	940	1,043	1,983	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	132	1,026	1,158
Alcala Amulung	-	0	0	0	-	0	0	0
Solana	* 69 KV, 150m **69KV/440V, 1200KVA	120	6,279	6,399	- **69KV/13.8KV, 5000KVA	0	9,723	9,723
Libmanan Cabusao	* 13.8 KV, 15 Km **69KV/13.8KV, 1200KVA	18,907	9,615	28,522	- **69KV/13.8KV, 5000KVA	0	9,723	9,723
(II) Maximum Service Area								
Bonga Pump #1	* 13.8 KV, 5.0 Km **115KV/13.8KV, 1200KVA	1,001	6,868	7,869	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	528	4,105	4,633
Bonga Pump #2	* 13.8 KV, 3.3 Km **115KV/13.8KV, 1200KVA	527	7,911	8,438	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	660	5,132	5,792
Bonga Pump #3	* 13.8 KV, 5.5 Km **115KV/13.8KV, 1200KVA	940	1,043	1,983	* 13.8 KV, 8.8 Km (1) **69KV/13.8KV, 5000KVA	132	10,126	10,258
Alcala Amulung	-	0	0	0	-	0	0	0
Solana	* 69 KV, 150m **69KV/440V, 1750KVA	120	6,365	6,485	- **69KV/13.8KV, 5000KVA	0	9,723	9,723
Libmanan Cabusao	* 13.8 KV, 15 Km **69KV/13.8KV, 1200KVA	18,907	9,615	28,522	- **69KV/13.8KV, 5000KVA	0	9,723	9,723

Remarks : * Specification for Transmi: ** Specification for Sub-station

: (1) New Transmission Line between Bonga #2 and #3, the total cost shall be shared with Bonga #1, #2 and #3.

: One Sub-station for Bonga #1, #2 and #3 all be shared Bonga #1, #2 and #3.

Table 3.6 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #1 IS: Firmed up Service Area)

1. Irrigation System (Irrigable Area: 298 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Turnout			No. of Headgate			No. of Checkgate			No. of other structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	Main canal	0.86	298	3,380	(0)	(0)	20	(7)	(0)	2	(0)	(0)	1	(1)	(0)	24	(0)	2
2	Lat A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Lat B	0.40	114	800	(800)	(0)	7	(5)	(2)	0	(0)	(0)	0	(0)	(0)	4	(0)	1
Total				4,180	(800)	(0)	27	(12)	(2)	2	(0)	(0)	1	(1)	(0)	28	(0)	(3)

2. Drainage System (Catchment Area: 530 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Flopgate			No. of Other structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	D-A	8.25	529	2,900	(0)	(2,900)	0	(0)	(0)	1	(0)	(1)
2	D-B	2.43	156	2,200	(0)	(2,200)	0	(0)	(0)	0	(0)	(0)
Total				5,100	(0)	(5,100)	0	(0)	(0)	1	(0)	(1)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)		Distance (Left) (m)		Total Distance (m)		Width			
		Total	(Reh)	(New)	Total	(Reh)	(New)				
1	Main canal	0	(0)	(0)	3,380	(1,190)	(0)	3,380	(1,190)	(0)	4.0
2	Lat B	0	(0)	(0)	800	(0)	(800)	800	(0)	(800)	3.0
Total		0	(0)	(0)	4,180	(1,190)	(800)	4,180	(1,190)	(800)	-

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)	
		Total	(Reh)			(New)
1	Farm ditch	20,860	(0)	(9,030)	298	70
2	Farm drain	20,860	(0)	(20,860)	298	70

Table 3.7 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump #1 IS: Maximum Service Area)

1. Irrigation System (Irrigable Area: 426 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Turnout			No. of Headgate			No. of Checkgate			No. of other structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	Main canal	0.84	426	3,380	(368)	(0)	20	(7)	(0)	2	(0)	(0)	0	(1)	(1)	25	(0)	(3)
2	Lat A	0.30	128	5,020	(5,020)	(0)	19	(19)	(0)	0	(0)	(0)	0	(0)	(0)	21	(0)	(1)
3	Lat B	0.37	114	1,060	(0)	(0)	7	(5)	(2)	0	(0)	(0)	0	(0)	(0)	4	(0)	(1)
Total				9,460	(5,388)	(0)	46	(31)	(2)	2	(0)	(0)	0	(1)	(1)	50	(0)	(5)

2. Drainage System (Catchment Area: 530 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Flopgate			No. of Other Structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	D-A	8.25	529	2,900	(0)	(2,900)	0	(0)	(0)	1	(0)	(1)
2	D-B	2.43	156	2,200	(0)	(2,200)	0	(0)	(0)	0	(0)	(0)
3	D-C	3.03	194	2,100	(0)	(2,100)	0	(0)	(0)	4	(0)	(4)
4	D-D	1.86	119	1,800	(0)	(1,800)	0	(0)	(0)	2	(0)	(2)
Total				9,000	0	(9,000)	0	(0)	(0)	7	(0)	(7)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)		Distance (Left) (m)		Total Distance (m)		Width			
		Total	(Reh)	(New)	Total	(Reh)	(New)				
1	Main canal	0	(0)	(0)	3,380	(1,190)	(0)	3,380	(1,190)	(0)	4.0
2	Lat A	0	(0)	(0)	1,250	(1,250)	(0)	1,250	(1,250)	(0)	3.0
3	Lat B	0	(0)	(0)	800	(0)	(800)	800	(0)	(800)	3.0
Total		0	(0)	(0)	5,430	(2,440)	(800)	5,430	(2,440)	(800)	-

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)	
		Total	(Reh)			(New)
1	Farm ditch	29,820	(0)	(12,900)	426	70
2	Farm drain	29,820	(0)	(28,800)	426	70

Table 3.8 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump # 2 IS; Firmed-up and Maximum Service Area)

1. Irrigation System (Irrigable Area: 674 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Turnout			No. of Headgate			No. of Checkgate			No. of other Structure				
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	
1	Main canal	1.95	674	9,000	(0)	(0)	54	(7)	(0)	3	(0)	(0)	3	(0)	(0)	49	(0)	(3)	
2	Lat A	0.15	25	2,750	(0)	(0)	30	(5)	(0)	0	(0)	(0)	3	(0)	(0)	9	(0)	(1)	
3	Lat B	0.30	313	5,350	(0)	(0)	40	(6)	(0)	3	(0)	(0)	5	(0)	(0)	18	(0)	(4)	
4	Lat B-1	0.22	31	3,200	(3,200)	(0)	19	(4)	(0)	0	(0)	(0)	2	(0)	(0)	6	(0)	(1)	
5	Lat B-2	0.11	15	1,010	(1,010)	(0)	5	(0)	(0)	0	(0)	(0)	0	(0)	(0)	7	(0)	(1)	
6	Lat B Extra	0.14	29	1,940	(1,940)	(0)	7	(2)	(0)	0	(0)	(0)	0	(0)	(0)	6	(0)	(1)	
7	Lat C	0.07	12	1,450	(0)	(0)	6	(0)	(0)	0	(0)	(0)	0	(0)	(0)	7	(0)	(1)	
8	Lat D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total				24,560	(6,230)	(0)	161	(24)	(0)	6	0	(0)	(0)	13	(0)	(0)	102	(0)	(12)

2. Drainage System (Catchment Area: 830 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Flapgate			No. of Other Structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	D-A	3.35	215	3,100	(0)	(3,100)	0	(0)	(0)	3	(0)	(3)
2	D-B	3.84	246	1,100	(0)	(1,100)	0	(0)	(0)	1	(0)	(1)
3	D-C	2.01	129	2,300	(0)	(2,300)	0	(0)	(0)	0	(0)	(0)
4	D-D	0.81	52	1,500	(0)	(1,500)	0	(0)	(0)	1	(0)	(1)
5	D-E	0.88	56	700	(0)	(700)	0	(0)	(0)	0	(0)	(0)
6	D-F	0.67	43	1,500	(0)	(1,500)	0	(0)	(0)	1	(0)	(1)
7	D-G	1.36	87	1,200	(0)	(1,200)	0	(0)	(0)	0	(0)	(0)
8	D-E	1.57	101	1,700	(0)	(1,700)	0	(0)	(0)	0	(0)	(0)
9	D-F	1.87	120	1,500	(0)	(1,500)	0	(0)	(0)	1	(0)	(1)
Total				14,600	(0)	(14,600)	0	(0)	(0)	7	(0)	(7)

3. Service/Access Road

No.	Name of Canal	Total	Distance (Right) (m)		Distance (Left) (m)		Total Distance (m)		Width (m)		
			(Reh)	(New)	(Reh)	(New)	Total	(Reh)		(New)	
1	Main canal	7,935	(0)	(0)	2,194	(0)	(0)	10,129	(0)	0	4.0
2	Lat A	1,351	(0)	(0)	1,538	(0)	(0)	1,889	(0)	0	4.0
3	Lat B	1,548	(0)	(0)	1,773	(0)	(0)	3,321	(0)	0	4.0
4	Lat B-1	2,208	(0)	(0)	804	(0)	(0)	3,012	(0)	0	4.0
5	Lat B- Extra	0	(0)	(0)	1,300	(0)	(0)	1,300	(0)	0	4.0
6	Lat D	264	(0)	(0)	348	(0)	(0)	710	(0)	0	4.0
Total		12,406	(0)	(0)	7,957	(0)	(0)	20,361	(0)	0	-

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)	
		(Reh)	(New)			
1	Farm ditch	47,180	(0)	(18,550)	674	70
2	Farm drain	47,180	(0)	(47,180)	674	70

Table 3.9 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Bonga Pump # 3 IS; Firmed-up and Maximum Service Area)

1. Irrigation System (Irrigable Area: 202 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Turnout			No. of Headgate			No. of Checkgate			No. of other Structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	Main canal	0.53	202	5,160	(2,000)	(310)	32	(26)	(0)	0	(0)	(0)	0	(0)	(0)	21	(0)	(3)
2	Lat A	0.14	36	1,920	(1,920)	(0)	9	(9)	(0)	0	(0)	(0)	0	(0)	(0)	12	(0)	(1)
3	Lat B	0.09	23	1,400	(1,000)	(0)	6	(6)	(0)	0	(0)	(0)	0	(0)	(0)	12	(0)	(1)
Total				8,480	(4,920)	(310)	47	(41)	(0)	0	(0)	(0)	0	(0)	(0)	45	(0)	(5)

2. Drainage System (Catchment Area: 320 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Flapgate			No. of Other Structure			
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	D-A	4.93	316	3,600	(0)	(3,600)	0	(0)	(0)	6	(0)	(6)
2	D-B	0.42	27	700	(0)	(700)	0	(0)	(0)	1	(0)	(1)
Total				4,300	(0)	(4,300)	0	(0)	(0)	7	(0)	(7)

3. Service/Access Road

No.	Name of Canal	Total	Distance (Right) (m)		Distance (Left) (m)		Total Distance (m)		Width (m)		
			(Reh)	(New)	(Reh)	(New)	Total	(Reh)		(New)	
1	Main canal	0	(0)	(0)	1,000	(0)	(1,000)	1,000	(0)	(1,000)	4.0
Total		0	(0)	(0)	1,000	(0)	(1,000)	1,000	(0)	(1,000)	-

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)	
		(Reh)	(New)			
1	Farm ditch	21,650	(0)	(0)	202	107
2	Farm drain	14,100	(0)	(14,100)	202	70

Table 3.10 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Alcala-Aaulung Pump IS: Flood-up Service Area)

1. Irrigation System (Irrigable Area: 1,652 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Turnout			No. of Resgate			No. of Checkgate			No. of other Structure		
				Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New
1	Main canal	2.79	1,163	9,870	(5,145)	(0)	17	(1)	(1)	4	(0)	(0)	0	(0)	(0)	28	(0)	(5)
2	Lat A	1.16	489	2,720	(0)	(0)	8	(0)	(1)	3	(0)	(0)	1	(0)	(0)	7	(0)	(4)
3	Lat A-1	0.51	145	1,280	(1,280)	(0)	5	(0)	(1)	0	(0)	(0)	1	(0)	(0)	3	(0)	(1)
4	Lat A-2	0.39	77	1,710	(1,710)	(0)	3	(0)	(0)	0	(0)	(0)	1	(0)	(0)	4	(0)	(1)
5	Lat A-3	0.46	86	1,290	(0)	(0)	3	(1)	(0)	0	(0)	(0)	2	(0)	(0)	3	(0)	(1)
6	Lat B	0.70	224	5,880	(5,880)	(0)	8	(4)	(1)	0	(0)	(0)	1	(0)	(0)	18	(0)	(1)
7	Lat C	0.36	100	2,800	(2,800)	(0)	3	(0)	(0)	0	(0)	(0)	2	(0)	(0)	11	(0)	(3)
8	Lat C-Extra	0.19	24	1,900	(1,900)	(0)	1	(0)	(0)	0	(0)	(0)	0	(0)	(0)	7	(0)	(1)
9	Lat D	1.13	384	3,200	(3,200)	(0)	12	(0)	(2)	1	(0)	(0)	1	(0)	(0)	5	(0)	(2)
10	Lat D-1	0.63	32	1,180	(0)	(0)	1	(0)	(0)	0	(0)	(0)	1	(0)	(0)	2	(0)	(1)
Total				31,830	(21,915)	(0)	61	(5)	(5)	8	(0)	(0)	10	(0)	(0)	88	(0)	(21)

2. Drainage System (Catchment Area: 2,500 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Flapgate			No. of other Structure		
				Total	Reh	New	Total	Reh	New	Total	Reh	New
1	MDC-1	31.09	1,246	9,870	(3,870)	(0)	0	(0)	(0)	0	(0)	(0)
2	DC-1	5.99	112	1,530	(0)	(1,100)	0	(0)	(0)	0	(0)	(0)
3	DC-2	1.70	191	2,670	(2,670)	(0)	0	(0)	(0)	1	(1)	(0)
4	DC-3	4.43	488	3,580	(3,580)	(0)	0	(0)	(0)	0	(0)	(0)
5	DC-4	2.90	325	3,040	(3,040)	(0)	0	(0)	(0)	1	(1)	(0)
6	DC-5	2.11	237	1,570	(1,570)	(0)	0	(0)	(0)	0	(0)	(0)
7	DC-6	1.41	158	1,260	(0)	(0)	0	(0)	(0)	0	(0)	(0)
8	DC-7	2.73	307	3,720	(0)	(0)	0	(0)	(0)	1	(1)	(0)
9	DC-8	0.58	65	2,190	(0)	(0)	0	(0)	(0)	1	(1)	(0)
10	DC-9	1.28	144	1,470	(0)	(0)	0	(0)	(0)	1	(1)	(0)
Total				30,900	(14,730)	(1,100)	0	(0)	(0)	5	(5)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)			Distance (Left) (m)			Total Distance (m)			Width (m)	No. of Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)		
		Total	Reh	New	Total	Reh	New	Total	Reh	New			Total	Reh				
1	Main canal	0	(0)	(0)	4,906	(0)	(0)	4,906	(0)	(0)	3.0	1	Farm ditch	115,640	(0)	(20,570)	1,652	70
2	Lat A-2	0	(0)	(0)	1,006	(0)	(0)	1,006	(0)	(0)	3.0	2	Farm drain	115,640	(0)	(87,700)	1,652	70
3	Lat B	0	(0)	(0)	4,973	(0)	(0)	4,973	(0)	(0)	3.0							
4	Lat C	2,400	(0)	(0)	0	(0)	(0)	2,400	(0)	(0)	3.0							
5	Lat C-Extra	0	(0)	(0)	1,900	(0)	(0)	1,900	(0)	(0)	3.0							
6	Lat D	133	(0)	(0)	1,646	(0)	(0)	1,779	(0)	(0)	3.0							
7	Lat D-1	1,184	(0)	(0)	0	(0)	(0)	1,184	(0)	(0)	3.0							
Total		3,717	(0)	(0)	14,431	(0)	(0)	18,148	(0)	(0)	-							

4. On-Farm Facilities

Table 3.11 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Alcala-Aaulung Pump IS: Maximum Service Area)

1. Irrigation System (Irrigable Area: 2,518 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Turnout			No. of Resgate			No. of Checkgate			No. of other Structure		
				Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New
1	Main canal	2.98	1,505	9,870	(7,585)	(0)	18	(1)	(2)	4	(0)	(0)	0	(0)	(0)	28	(0)	(5)
2	Lat A	1.16	459	2,720	(1,005)	(0)	9	(0)	(2)	3	(0)	(0)	1	(0)	(0)	7	(0)	(4)
3	Lat A-1	0.51	156	1,280	(1,280)	(0)	5	(0)	(1)	0	(0)	(0)	1	(0)	(0)	3	(0)	(1)
4	Lat A-2	0.39	118	1,710	(1,710)	(0)	3	(0)	(0)	0	(0)	(0)	1	(0)	(0)	4	(0)	(1)
5	Lat A-3	0.46	151	1,290	(1,290)	(0)	4	(1)	(0)	0	(0)	(0)	2	(0)	(0)	3	(0)	(1)
6	Lat B	0.70	263	5,880	(5,880)	(0)	8	(4)	(1)	0	(0)	(0)	1	(0)	(0)	18	(0)	(1)
7	Lat C	0.36	128	2,800	(2,800)	(0)	3	(0)	(0)	0	(0)	(0)	2	(0)	(0)	11	(0)	(3)
8	Lat C-Extra	0.19	42	1,900	(1,900)	(0)	1	(0)	(0)	0	(0)	(0)	0	(0)	(0)	7	(0)	(1)
9	Lat D	1.13	421	3,200	(3,200)	(0)	11	(0)	(1)	1	(0)	(0)	1	(0)	(0)	5	(0)	(2)
10	Lat D-1	0.13	32	1,180	(1,180)	(0)	1	(0)	(0)	0	(0)	(0)	1	(0)	(0)	2	(0)	(1)
Total				31,830	(27,830)	(0)	63	(6)	(7)	8	(0)	(0)	10	(0)	(0)	88	(0)	(21)

2. Drainage System (Catchment Area: 2,500 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Flapgate			No. of other Structure		
				Total	Reh	New	Total	Reh	New	Total	Reh	New
1	MDC-1	31.09	1,246	9,870	(3,370)	(0)	0	(0)	(0)	0	(0)	(0)
2	DC-1	5.99	112	1,530	(0)	(1,100)	0	(0)	(0)	0	(0)	(0)
3	DC-2	1.70	191	2,670	(2,670)	(0)	0	(0)	(0)	1	(1)	(0)
4	DC-3	4.43	488	3,580	(3,580)	(0)	0	(0)	(0)	0	(0)	(0)
5	DC-4	2.90	325	3,040	(3,040)	(0)	0	(0)	(0)	1	(1)	(0)
6	DC-5	2.11	237	1,570	(0)	(0)	0	(0)	(0)	0	(0)	(0)
7	DC-6	1.41	158	1,260	(0)	(0)	0	(0)	(0)	0	(0)	(0)
8	DC-7	2.73	307	3,720	(0)	(0)	0	(0)	(0)	1	(1)	(0)
9	DC-8	0.58	65	2,190	(0)	(0)	0	(0)	(0)	1	(1)	(0)
10	DC-9	1.28	144	1,470	(0)	(0)	0	(0)	(0)	1	(1)	(0)
Total				30,900	(12,660)	(1,100)	0	(0)	(0)	5	(5)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)			Distance (Left) (m)			Total Distance (m)			Width (m)	No. of Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)		
		Total	Reh	New	Total	Reh	New	Total	Reh	New			Total	Reh				
1	Main canal	0	(0)	(0)	4,906	(0)	(0)	4,906	(0)	(0)	3.0	1	Farm ditch	176,260	(0)	(31,300)	2,518	70
2	Lat A-2	0	(0)	(0)	1,006	(0)	(0)	1,006	(0)	(0)	3.0	2	Farm drain	176,260	(0)	(123,700)	2,518	70
3	Lat B	0	(0)	(0)	4,973	(0)	(0)	4,973	(0)	(0)	3.0							
4	Lat C	2,400	(0)	(0)	0	(0)	(0)	2,400	(0)	(0)	3.0							
5	Lat C-Extra	0	(0)	(0)	1,900	(0)	(0)	1,900	(0)	(0)	3.0							
6	Lat D	133	(0)	(0)	1,646	(0)	(0)	1,779	(0)	(0)	3.0							
7	Lat D-1	1,184	(0)	(0)	0	(0)	(0)	1,184	(0)	(0)	3.0							
Total		3,717	(0)	(0)	14,431	(0)	(0)	18,148	(0)	(0)	-							

4. On-Farm Facilities

Table 3.12 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Solana Pump 15; Firm-ed-up Service Area)

1. Irrigation System (Irrigable Area: 1,100 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Turnout			No. of Headgate			No. of Checkgate			No. of other Structure		
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	Main canal	3.03	1100	12,510	(0)	(0)	24	(12)	(3)	2	(0)	(0)	8	(0)	(0)	48	(0)	(4)
2	Lat A	0.61	149	2,080	(2,080)	(0)	6	(4)	(2)	0	(0)	(0)	1	(0)	(0)	3	(0)	(1)
3	Lat A-Extra	1.02	374	3,480	(0)	(0)	11	(5)	(2)	1	(0)	(0)	7	(0)	(0)	13	(0)	(2)
4	Lat A-1Extra	0.85	205	2,400	(2,400)	(0)	6	(4)	(2)	0	(0)	(0)	3	(0)	(0)	2	(0)	(1)
5	Lat A-2Extra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Lat B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Lat C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Lat D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Lat D-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total				20,470	(4,480)	(0)	47	(25)	(9)	3	(0)	(0)	19	(0)	(0)	66	(0)	(8)

2. Drainage System (Catchment Area: 2,450 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Flapgate			No. of Other Structure		
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	DC-#1	3.24	678	4,520	(4,520)	(0)	0	(0)	(0)	0	(0)	(0)
2	DC-#2	2.40	270	1,800	(1,800)	(0)	0	(0)	(0)	0	(0)	(0)
3	DC-#3	-	-	-	-	-	-	-	-	-	-	-
4	DC-#4	0.27	30	400	(400)	(0)	0	(0)	(0)	1	(0)	(0)
5	DC-#5	3.50	394	1,800	(1,800)	(0)	0	(0)	(0)	1	(0)	(0)
6	DC-#6	-	-	-	-	-	-	-	-	-	-	-
7	DC-#7	6.47	727	2,400	(2,400)	(0)	0	(0)	(0)	1	(0)	(0)
8	DC-#8	21.80	2,449	2,200	(2,200)	(0)	0	(0)	(0)	0	(0)	(0)
Total				13,120	(13,120)	(0)	0	(0)	(0)	3	(0)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)			Distance (Left) (m)			Total Distance (m)			Width (m)
		Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	
1	Main canal	0	(0)	(0)	11,710	(0)	(0)	11,710	(0)	(0)	2.5-3.0
2	Lat A	0	(0)	(0)	2,050	(0)	(0)	2,050	(0)	(0)	2.5
3	Lat A-Extra	0	(0)	(0)	3,478	(0)	(0)	3,478	(0)	(0)	2.5
4	Lat A-1Extra	0	(0)	(0)	2,400	(0)	(0)	2,400	(0)	(0)	2.5
Total		0	(0)	(0)	19,638	(0)	(0)	19,638	(0)	(0)	-

4. On-farm facilities

Item	Distance (m)			Irrigation Area (ha)	Density (m/ha)
	Total	(Reh)	(New)		
1 Farm ditch	77,000	(0)	(29,700)	1,100	70
2 Farm drain	77,000	(0)	(77,000)	1,100	70

Table 3.13 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Solana Pump 15; Maximum Service Area)

1. Irrigation System (Irrigable Area: 1,560 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Turnout			No. of Headgate			No. of Checkgate			No. of other Structure		
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	Main canal	5.47	1,560	15,360	(0)	(0)	29	(15)	(5)	3	(0)	(0)	18	(0)	(0)	43	(0)	(5)
2	Lat A	0.88	149	2,080	(2,080)	(0)	6	(4)	(2)	0	(0)	(0)	1	(0)	(0)	3	(0)	(1)
3	Lat A Extra	2.11	851	7,600	(7,600)	(0)	20	(8)	(8)	3	(1)	(0)	11	(1)	(0)	25	(0)	(3)
4	Lat A-1Extra	1.00	205	2,400	(2,400)	(0)	7	(4)	(3)	0	(0)	(0)	2	(0)	(0)	3	(0)	(1)
5	Lat A-2Extra	0.86	180	2,300	(2,300)	(0)	5	(3)	(2)	0	(0)	(0)	2	(0)	(0)	2	(0)	(1)
6	Lat B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Lat C	1.10	270	2,100	(2,100)	(0)	9	(4)	(5)	0	(0)	(0)	2	(0)	(0)	3	(0)	(1)
8	Lat D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Lat D-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total				31,840	(16,480)	(0)	76	(39)	(25)	6	(1)	(0)	36	(1)	(0)	79	(0)	(12)

2. Drainage System (Catchment Area: 2,450 ha)

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Flapgate			No. of Other Structure		
				Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)
1	DC-#1	6.04	678	5,120	(5,120)	(0)	0	(0)	(0)	0	(0)	(0)
2	DC-#2	2.40	270	1,800	(1,800)	(0)	0	(0)	(0)	0	(0)	(0)
3	DC-#3	2.24	251	2,400	(2,400)	(0)	0	(0)	(0)	0	(0)	(0)
4	DC-#4	0.27	30	400	(400)	(0)	0	(0)	(0)	1	(0)	(0)
5	DC-#5	3.50	394	1,800	(1,800)	(0)	0	(0)	(0)	1	(0)	(0)
6	DC-#6	1.90	214	2,400	(2,400)	(0)	0	(0)	(0)	0	(0)	(0)
7	DC-#7	6.47	727	2,400	(2,400)	(0)	0	(0)	(0)	1	(0)	(0)
8	DC-#8	21.80	2,449	2,200	(2,200)	(0)	0	(0)	(0)	0	(0)	(0)
Total				18,520	(18,520)	(0)	0	(0)	(0)	3	(0)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)			Distance (Left) (m)			Total Distance (m)			Width (m)
		Total	(Reh)	(New)	Total	(Reh)	(New)	Total	(Reh)	(New)	
1	Main canal	0	(0)	(0)	11,710	(0)	(0)	11,710	(0)	(0)	2.5-3.0
2	Lat A	0	(0)	(0)	2,050	(0)	(0)	2,050	(0)	(0)	2.5
3	Lat A Extra	0	(0)	(0)	3,478	(0)	(0)	3,478	(0)	(0)	2.5
4	Lat A-1Extra	0	(0)	(0)	2,400	(0)	(0)	2,400	(0)	(0)	2.5
5	Lat A-2Extra	0	(0)	(0)	2,400	(0)	(0)	2,400	(0)	(0)	2.5
6	Lat B	-	-	-	-	-	-	-	-	-	-
7	Lat C	0	(0)	(0)	2,100	(0)	(0)	2,100	(0)	(0)	2.5
8	Lat D	-	-	-	-	-	-	-	-	-	-
9	Lat D-1	-	-	-	-	-	-	-	-	-	-
Total		0	(0)	(0)	28,260	(0)	(0)	28,260	(0)	(0)	-

4. On-Farm Facilities

No.	Item	Distance (m)			Irrigation Area (ha)	Density (m/ha)
		Total	(Reh)	(New)		
1	Farm ditch	176,260	(0)	(92,040)	1,960	70
2	Farm drain	176,260	(0)	(176,260)	1,960	70

Table 3.14 PROPOSED PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Libnanan (Libnanan-cabusso pump IS ; Firmed-up service area)

1. Irrigation System (Irrigable Area: 1,838 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Turnout			No. of Turnout			No. of Checkgate			No. of other Structure				
				Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New				
1	Main canal	4.66	1,838	11,170	(4,170)	(0)	5	(2)	(0)	5	(1)	(0)	3	(0)	(0)	37	(0)	(0)	
2	Lat A	-	-	-	-	-	12	(2)	(2)	1	(0)	(0)	9	(0)	(0)	3	(0)	(1)	
3	Lat B	1.92	280	9,700	(0)	(0)	2	(0)	(0)	0	(0)	(0)	0	(0)	(0)	12	(0)	(1)	
4	Lat B-Extra	0.18	26	1,200	(1,200)	(0)	23	(9)	(1)	4	(2)	(0)	10	(1)	(0)	12	(0)	(5)	
5	Lat C	3.71	1,048	8,720	(8,720)	(0)	-	-	-	-	-	-	-	-	-	-	-	-	
6	Lat C-Extra1	-	-	-	-	-	2	(0)	(0)	0	(0)	(0)	0	(0)	(0)	3	(0)	(1)	
7	Lat C-Extra2	0.28	41	950	(950)	(0)	2	(1)	(0)	0	(0)	(0)	0	(0)	(0)	4	(0)	(1)	
8	Lat C-Extra3	0.27	40	1,240	(1,240)	(0)	7	(4)	(2)	1	(1)	(0)	3	(0)	(0)	9	(0)	(2)	
9	Lat C-1	1.54	499	3,100	(2,800)	(0)	7	(2)	(2)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)	
10	Lat C-1Extra1	0.85	212	2,750	(2,750)	(0)	2	(0)	(0)	1	(0)	(0)	1	(0)	(1)	3	(0)	(3)	
11	Lat C-1Extra2	0.37	54	500	(0)	(500)	3	(0)	(0)	2	(0)	(0)	2	(0)	(0)	14	(0)	(2)	
12	Lat C-2	1.17	171	2,840	(2,240)	(0)	5	(0)	(0)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)	
13	Lat C-2A	0.61	90	890	(890)	(0)	2	(0)	(1)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)	
14	Lat C-2B	0.26	43	70	(0)	(0)	7	(3)	(0)	0	(0)	(0)	5	(0)	(0)	7	(0)	(1)	
15	Lat C2Extra1	-	-	-	-	-	5	(2)	(1)	0	(0)	(0)	1	(0)	(0)	7	(0)	(2)	
16	Lat D	1.17	257	3,310	(3,310)	(0)	4	(4)	(0)	0	(0)	(0)	1	(0)	(0)	2	(0)	(1)	
17	Lat E	0.53	117	1,300	(1,300)	(0)	-	-	-	-	-	-	-	-	-	-	-	-	
18	Lat F	0.34	74	980	(980)	(0)	-	-	-	-	-	-	-	-	-	-	-	-	
19	Lat BRH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
20	Lat BRH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Total				48,730	(30,560)	(500)	38	(23)	(3)	14	(4)	(1)	35	0	(1)	(1)	145	(0)	(28)

* : New canal

2. Drainage System (Catchment Area: 4,300 ha)

A) Protection dike

No.	Name of Drain	length (m)	height (m)	width at the top	Side slope	Number of structure Drainage crossing
1	Protection dike #1	6,561	2	4	1:3.0	9
2	protection dike #2	8,700	2	4	1:3.0	5

B) Drainage Canal

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)		No. of Flapgate			No. of Other structures			
				Total	Reh	New	Total	Reh	New	Total	Reh	New
1	Interceptor channel	40.00	722	0	(0)	(0)	1	(1)	(0)	3	(0)	(0)
2	D-A	4.93	469	2,520	(2,520)	(0)	1	(1)	(0)	11	(0)	(0)
3	D-B	10.34	985	4,280	(4,280)	(0)	1	(1)	(0)	24	(0)	(0)
4	D-C	3.11	297	1,200	(0)	(0)	1	(1)	(0)	9	(0)	(0)
5	D-D	4.86	463	2,800	(2,800)	(0)	1	(1)	(0)	14	(0)	(0)
6	D-D-1	2.48	236	2,550	(2,550)	(0)	0	(0)	(0)	11	(0)	(0)
7	D-E	-	-	-	-	-	-	-	-	-	-	-
8	D-F	2.21	210	2,920	(0)	(0)	2	(2)	(0)	13	(0)	(0)
9	D-G	4.73	451	3,200	(3,200)	(0)	1	(1)	(0)	12	(0)	(0)
10	D-I	2.21	210	4,580	(4,580)	(0)	0	(0)	(0)	8	(0)	(0)
11	D-J	13.01	1,244	7,220	(5,320)	(0)	0	(0)	(0)	19	(0)	(0)
12	D-J-1	1.98	188	1,420	(0)	(0)	0	(0)	(0)	10	(0)	(0)
13	D-J-2	3.34	318	1,050	(1,050)	(0)	0	(0)	(0)	4	(0)	(0)
14	D-J-2a	1.36	130	970	(970)	(0)	0	(0)	(0)	4	(0)	(0)
15	D-J-2b	1.52	145	980	(980)	(0)	0	(0)	(0)	3	(0)	(0)
16	D-K	-	-	-	-	-	-	-	-	-	-	-
Total				35,690	(28,250)	(0)	8	(8)	(0)	151	(0)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right/ft)		Distance (Left/ft)		Total Distance (m)		Width (m)		
		Total	Reh	New	Total	Reh	New			
1	Main canal	4,120	(0)	(0)	7,050	(0)	(0)	11,170	(0)	4.0
2	Lat B	6,890	(0)	(0)	0	(0)	(0)	6,890	(0)	3.0
3	Lat B-Extra	0	(0)	(0)	1,200	(0)	(1,200)	1,200	(0)	3.0
4	Lat C	6,530	(0)	(0)	0	(0)	(0)	6,530	(0)	3.0
5	Lat C-Extra1	1,900	(0)	(1,900)	0	(0)	(0)	1,900	(0)	3.0
6	Lat C-Extra2	1,240	(0)	(1,240)	0	(0)	(0)	1,240	(0)	3.0
7	Lat C-1	0	(0)	(0)	3,100	(0)	(0)	3,100	(0)	3.0
8	Lat C-1Extra	0	(0)	(0)	2,750	(0)	(2,750)	2,750	(0)	3.0
9	Lat C2a	0	(0)	(0)	890	(890)	(0)	890	(890)	3.0
10	Lat C2b	0	(0)	(0)	310	(70)	(0)	310	(70)	3.0
11	Lat D	0	(0)	(0)	2,970	(0)	(0)	2,970	(0)	3.0
12	Lat E	0	(0)	(0)	1,300	(0)	(1,300)	1,300	(0)	3.0
13	Lat F	0	(0)	(0)	980	(0)	(980)	980	(0)	3.0
Total		20,680	(0)	(3,140)	20,550	(960)	(6,230)	41,230	(960)	(3,370)

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)
		Total	Reh		
1	Farm ditch	128,660	(0)	(12,430)	1,838
2	Farm drain	128,660	(0)	(102,240)	1,838

Table 3.15 PROPOSED FEATURE OF IRRIGATION AND DRAINAGE FACILITIES
(Libanan-Cabusao Pump 15; Maximum Service Area)

1. Irrigation System (Irrigable Area: 3,085 ha)

No.	Name of Canal	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Turnout			No. of Roadgate			No. of checkgate			No. of other structures		
				Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New	Total	Reh	New
1	Main canal	5.04	3,085	11,170	(4,170)	(0)	5	(2)	(0)	6	(2)	(0)	3	(0)	(0)	31	(0)	(6)
2	Lat A	0.22	67	3,720	(0)	(0)	3	(3)	(0)	0	(0)	(0)	0	(0)	(0)	20	(0)	(1)
3	Lat B	1.09	337	9,700	(0)	(0)	10	(2)	(0)	1	(1)	(0)	9	(0)	(0)	37	(0)	(2)
4	Lat B-Extra	0.15	52	1,200	(1,200)	(0)	2	(0)	(0)	0	(0)	(0)	0	(0)	(0)	3	(0)	(1)
5	Lat C	3.76	2,036	8,720	(8,720)	(0)	23	(9)	(1)	4	(1)	(0)	10	(1)	(0)	23	(0)	(5)
6	Lat C-Extra1	- Out of the Maximum service area -																
7	Lat C-Extra2	0.49	153	1,900	(1,900)	(0)	4	(1)	(0)	0	(0)	(0)	0	(0)	(0)	2	(0)	(1)
8	Lat C-Extra3A	0.33	102	1,240	(1,240)	(0)	3	(1)	(0)	0	(0)	(0)	0	(0)	(0)	4	(0)	(1)
9	Lat C-1	1.57	648	3,920	(0)	(0)	15	(9)	(1)	1	(0)	(0)	3	(0)	(0)	10	(0)	(3)
10	Lat C-1Extra	0.56	230	2,750	(2,750)	(0)	6	(2)	(0)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)
11	Lat C-1Extra2	0.31	96	900	(0)	(900)	4	(0)	(4)	1	(0)	(1)	1	(0)	(1)	0	(0)	(3)
12	Lat C-2	1.14	523	3,540	(3,540)	(0)	6	(0)	(0)	2	(0)	(0)	2	(0)	(0)	16	(0)	(4)
13	Lat C-2A	0.30	106	1,760	(0)	(0)	5	(0)	(0)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)
14	Lat C-2B	0.40	152	1,800	(800)	(1,000)	4	(3)	(0)	0	(0)	(0)	0	(0)	(0)	5	(0)	(1)
15	Lat C2-Extra1	0.28	102	2,450	(2,450)	(0)	5	(4)	(1)	0	(0)	(0)	0	(0)	(0)	4	(0)	(1)
16	Lat D	0.85	263	3,310	(0)	(0)	7	(3)	(0)	0	(0)	(0)	5	(0)	(0)	5	(0)	(1)
17	Lat E	0.45	139	1,300	(1,300)	(0)	6	(2)	(2)	0	(0)	(0)	1	(0)	(0)	7	(0)	(1)
18	Lat F	0.51	138	980	(980)	(0)	4	(4)	(0)	0	(0)	(0)	1	(0)	(0)	2	(0)	(1)
19	Lat BLH	- Out of the Maximum service area -																
20	Lat BRH	-																
Total				60,360	(32,360)	(11,200)	112	(45)	(9)	15	(4)	(1)	35	(1)	(1)	179	(0)	(34)

2. Drainage System (Catchment Area: 6,000 ha)

No. Drain	Name of Drain	Length (m)	Height (m)	Width at the top (m)	Side slope	No. of structure Drainage crossing
1	Protection Dike #1	5.51	2.00	4.00	1:3.0	9
2	Protection Dike #2	8.70	2.00	4.00	1:3.0	4

3) Drainage Canal

No.	Name of Drain	Proposed Discharge (m ³ /s)	Commanding Area (ha)	Distance (m)			No. of Flapgate			No. of Other structure		
				Total	Reh	New	Total	Reh	New	Total	Reh	New
1	Interceptor Channel	40.00	722	8,760	(8,760)	(0)	1	(1)	(0)	9	(0)	(0)
2	D-A	4.93	469	2,520	(2,520)	(0)	1	(1)	(0)	11	(0)	(0)
3	D-B	10.24	985	4,280	(4,280)	(0)	1	(1)	(0)	24	(0)	(0)
4	D-C	3.11	297	1,200	(0)	(0)	1	(1)	(0)	9	(0)	(0)
5	D-D	4.86	463	2,800	(2,800)	(0)	1	(1)	(0)	14	(0)	(0)
6	D-D-1	2.48	236	2,550	(2,550)	(0)	0	(0)	(0)	11	(0)	(0)
7	D-E	1.43	136	2,110	(2,110)	(0)	1	(1)	(0)	5	(0)	(0)
8	D-F	2.21	210	2,920	(0)	(0)	2	(2)	(0)	13	(0)	(0)
9	D-G	4.73	451	3,200	(3,200)	(0)	1	(1)	(0)	12	(0)	(0)
10	D-I	2.21	210	4,580	(0)	(0)	0	(0)	(0)	8	(0)	(0)
11	D-J	13.07	1,244	7,220	(7,220)	(0)	0	(0)	(0)	19	(0)	(0)
12	D-J-1	1.98	188	1,420	(0)	(0)	0	(0)	(0)	16	(0)	(0)
13	D-J-2	3.34	318	1,050	(1,050)	(0)	0	(0)	(0)	4	(0)	(0)
14	D-J-2a	1.36	130	970	(970)	(0)	0	(0)	(0)	4	(0)	(0)
15	D-J-2B	1.52	145	980	(980)	(0)	0	(0)	(0)	3	(0)	(0)
16	D-K	8.20	150	3,540	(0)	(0)	0	(0)	(0)	25	(0)	(0)
Total				50,100	(44,560)	(0)	9	(9)	(0)	181	(0)	(0)

3. Service/Access Road

No.	Name of Canal	Distance (Right) (m)			Distance (Left) (m)			Total Distance (m)			Width (m)
		Total	Reh	New	Total	Reh	New	Total	Reh	New	
1	Main canal	4,120	(0)	(0)	7,050	(0)	(0)	11,170	(0)	(0)	7.0
2	Lat A	3,720	(3,720)	(0)	0	(0)	(0)	3,720	(3,720)	(0)	4.0
3	Lat B	6,890	(0)	(0)	0	(0)	(0)	6,890	(0)	(0)	4.0
4	Lat B-Extra	0	(0)	(0)	1,200	(0)	(1,200)	1,200	(0)	(1,200)	4.0
5	Lat C	8,720	(0)	(0)	0	(0)	(0)	8,720	(0)	(0)	4.0
6	Lat C-Extra2	1,900	(0)	(1,900)	0	(0)	(0)	1,900	(0)	(1,900)	3.0
7	Lat C-Extra3	1,240	(0)	(1,240)	0	(0)	(0)	1,240	(0)	(1,240)	3.0
8	Lat C-1	0	(0)	(0)	3,920	(0)	(0)	3,920	(0)	(0)	4.0
9	Lat C-1Extra	0	(0)	(0)	2,750	(0)	(2,750)	2,750	(0)	(2,750)	3.0
10	Lat C2a	0	(0)	(0)	1,760	(1,760)	(0)	1,760	(1,760)	(0)	4.0
11	Lat C2b	0	(0)	(0)	1,800	(800)	(1,000)	1,800	(800)	(1,000)	4.0
12	Lat D	0	(0)	(0)	3,310	(0)	(0)	3,310	(0)	(0)	4.0
13	Lat E	0	(0)	(0)	1,300	(0)	(1,300)	1,300	(0)	(1,300)	4.0
14	Lat F	0	(0)	(0)	980	(0)	(980)	980	(0)	(980)	4.0
Total		26,590	(3,720)	(3,140)	24,020	(2,560)	(7,230)	50,660	(6,280)	(10,370)	-

4. On-Farm Facilities

No.	Item	Distance (m)		Irrigation Area (ha)	Density (m/ha)
		Total	Reh		
1	Farm ditch	215,950	(0)	(20,860)	3,085
2	Farm drain	215,950	(0)	(171,600)	3,085

Fig. 3.1

DESIGN DISCHARGE OF BONGA PUMP #1 IS
(FIRMED-UP SERVICE AREA)

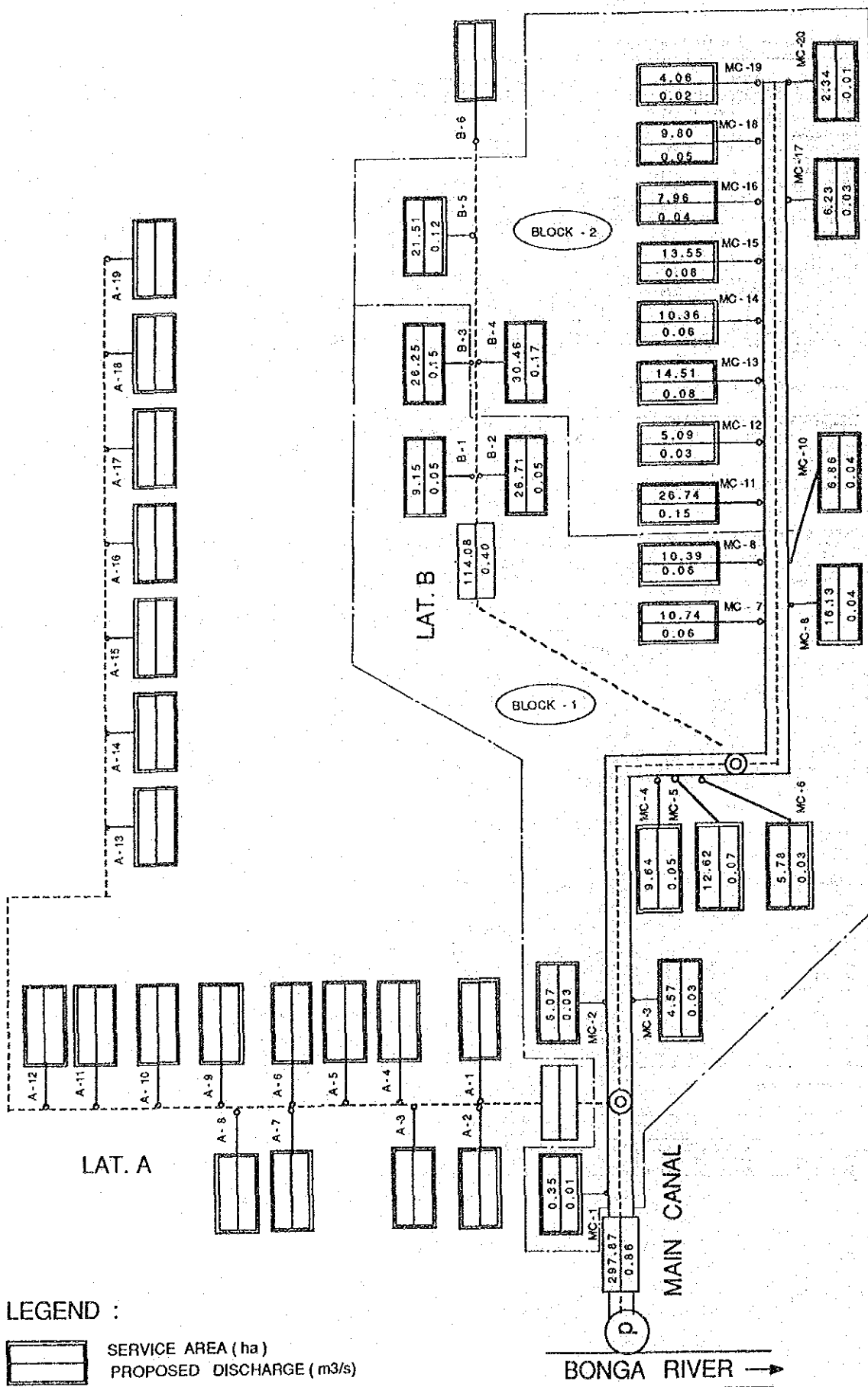


Fig. 3.2 DESIGN DISCHARGE OF BONGA PUMP #1 IS (MAX. SERVICE AREA)

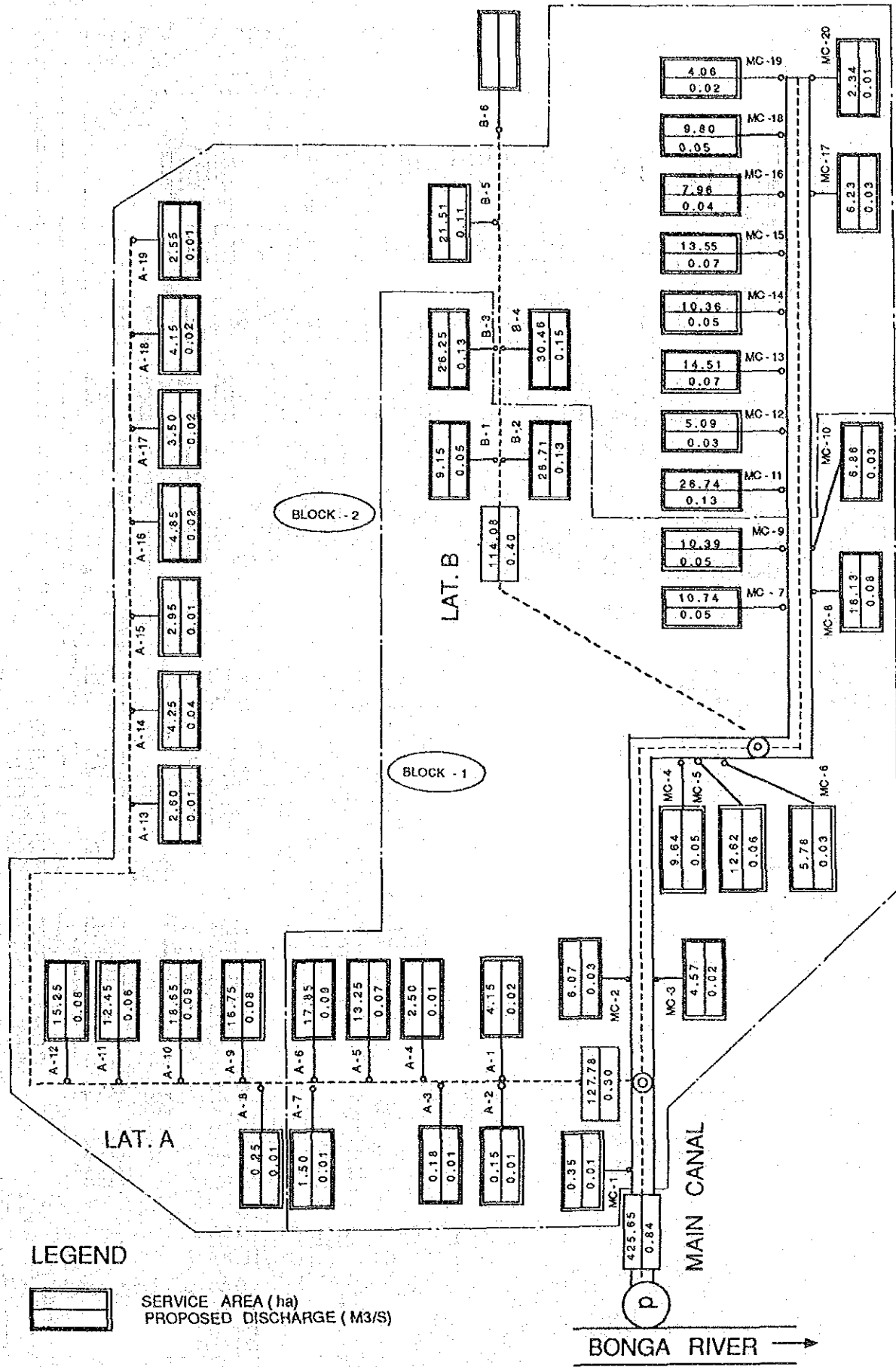


Fig. 3.3

DESIGN DISCHARGE OF BONGA PUMP #2 IS
(FIRMED-UP/MAX. SERVICE AREA)

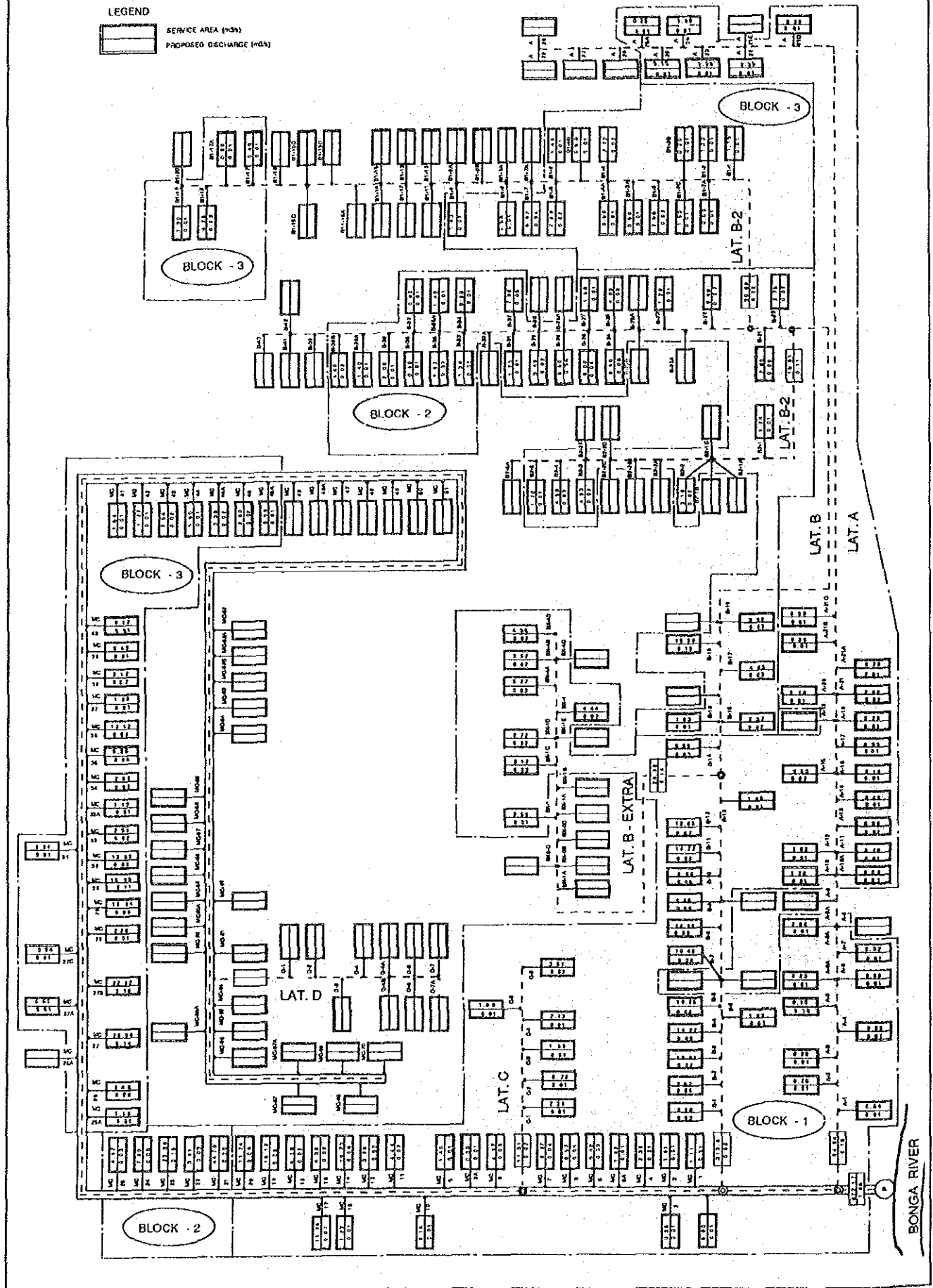


Fig. 3.4 DESIGN DISCHARGE OF BONGA PUMP #3 IS (FIRMED-UP/MAX. SERVICE AREA)

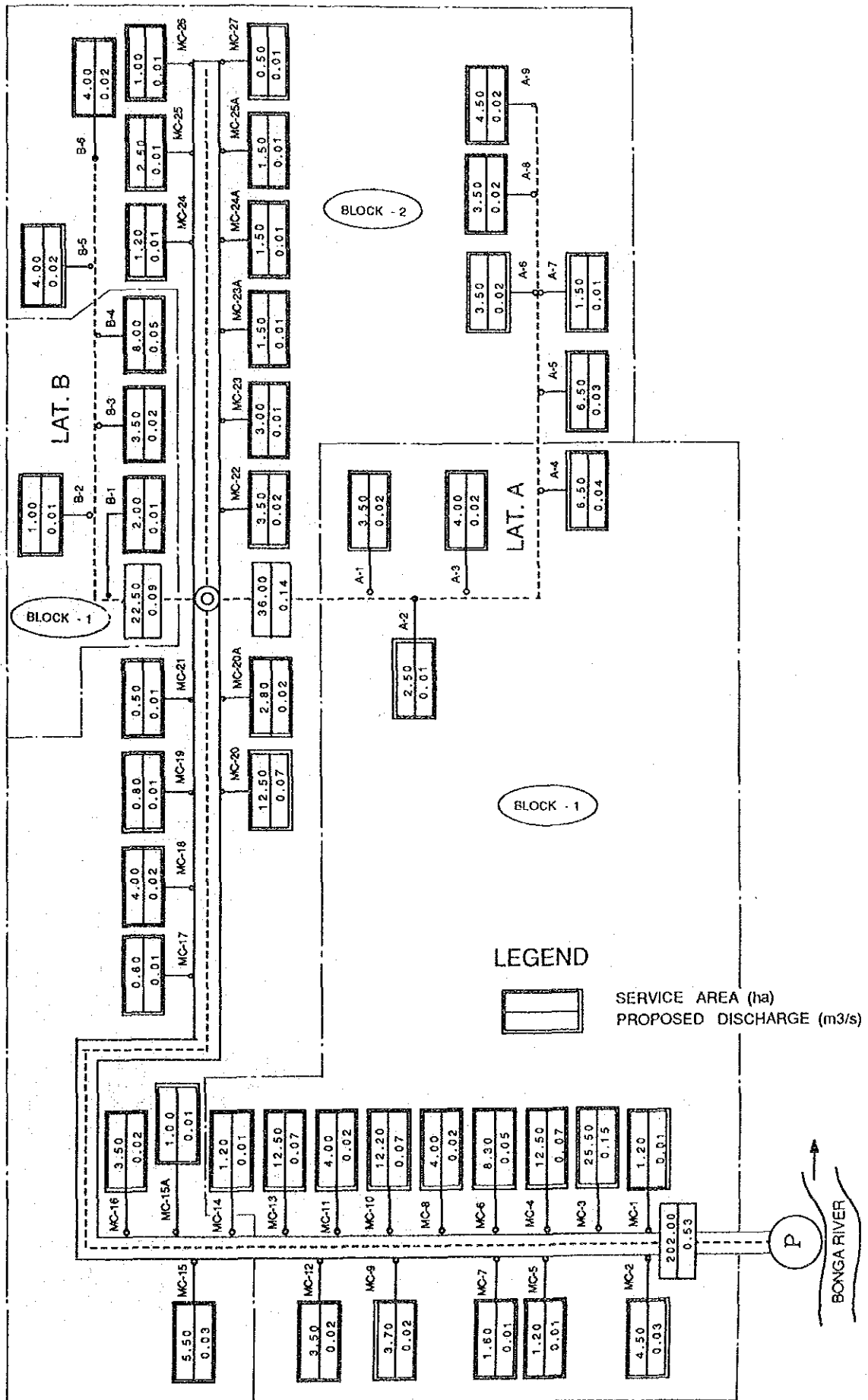
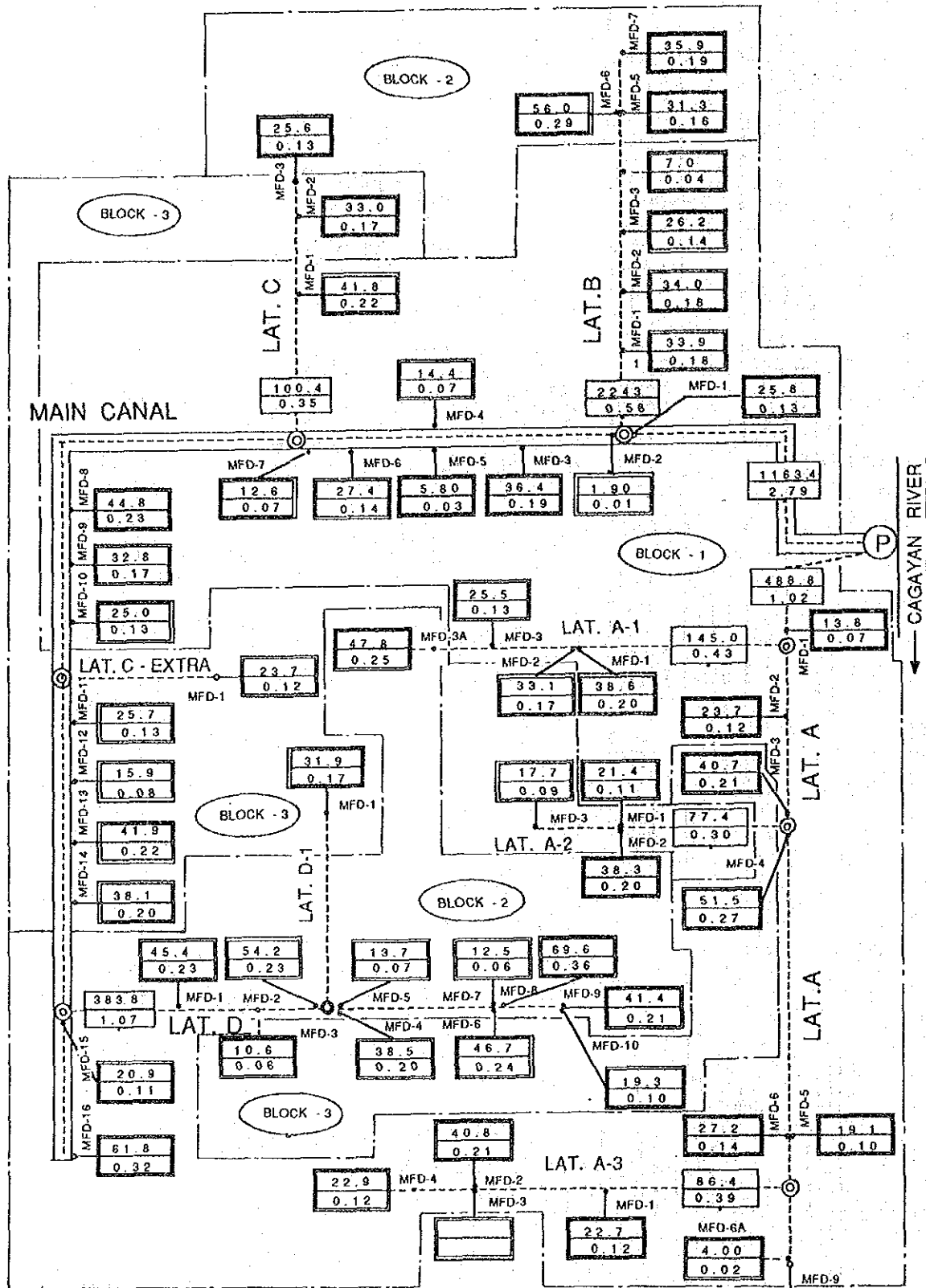


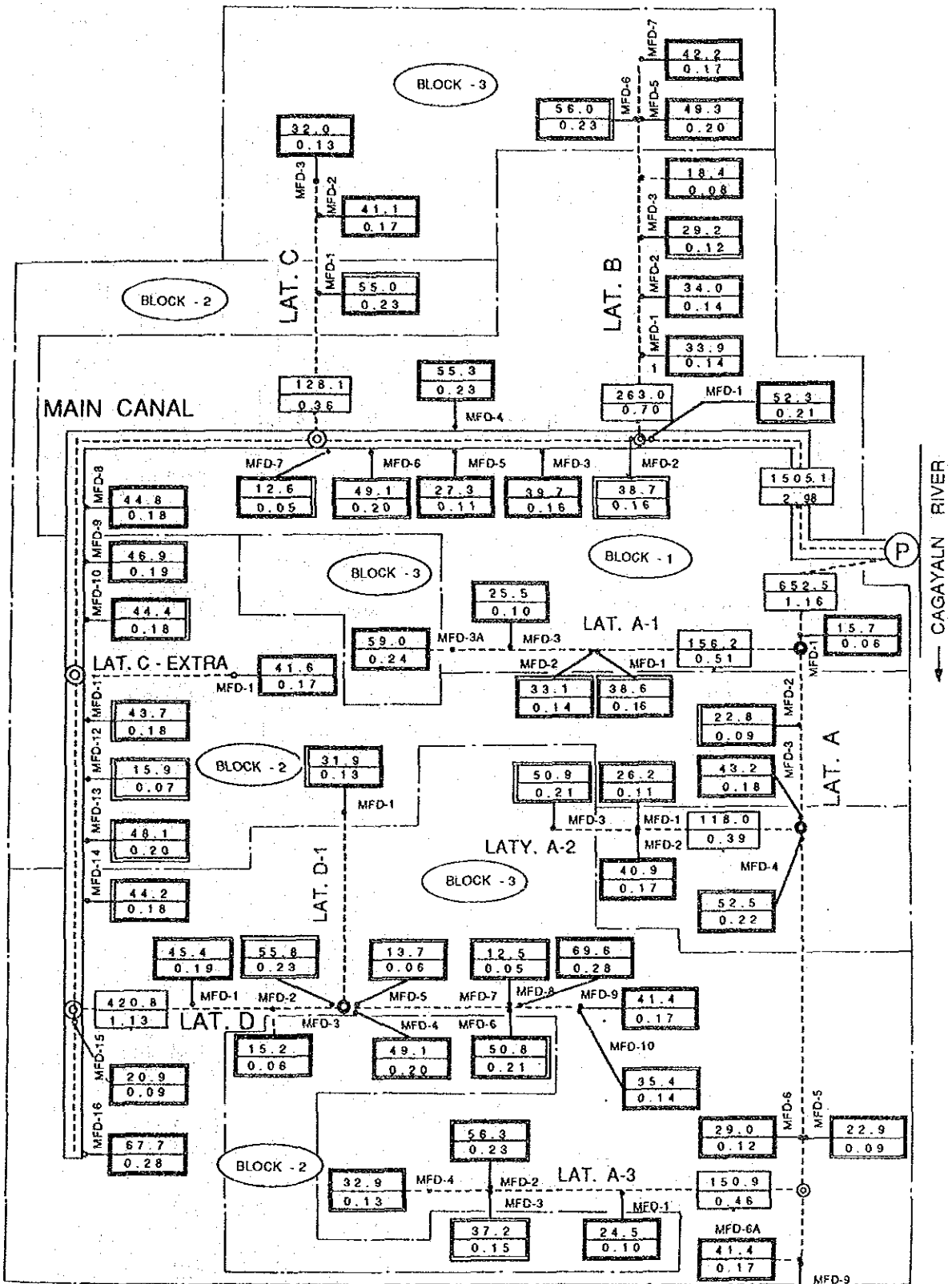
Fig. 3.5 DESIGN DISCHARGE OF ALCALA-AMULUNG PIS (FIRMED-UP SERVICE AREA)



LEGEND

- SERVICE AREA (ha)
- PROPOSED DISCHARGE (m³/s)

Fig. 3.6 DESIGN DISCHARGE OF ALCALA-AMULUNG PIS (MAX SERVICE AREA)



LEGEND

- SERVICE AREA (ha)
- PROPOSED DISCHARGE (m³/s)

Fig. 3.7 DESIGN DISCHARGE OF SOLANA PIS (FIRMED-UP SERVICE AREA)

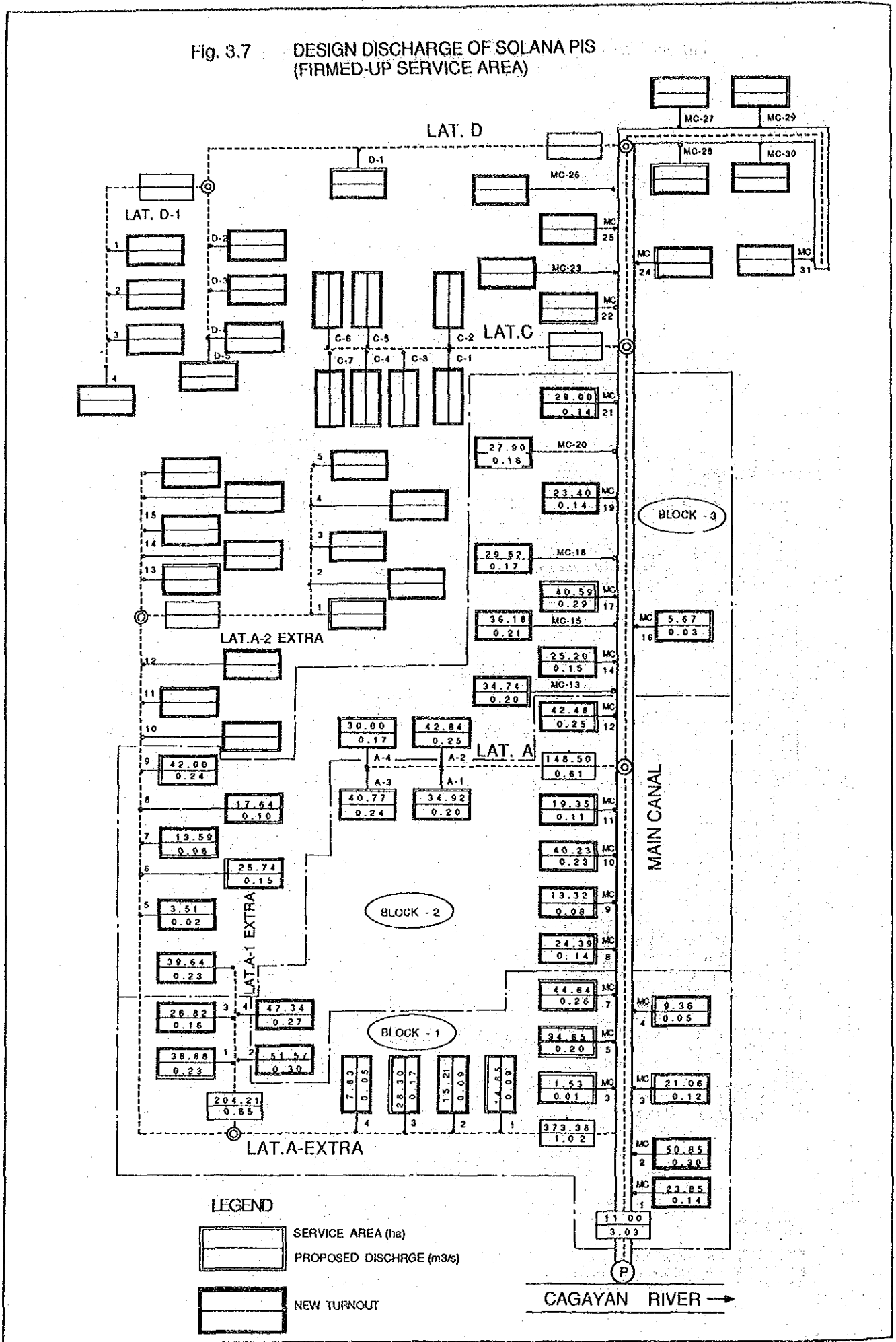
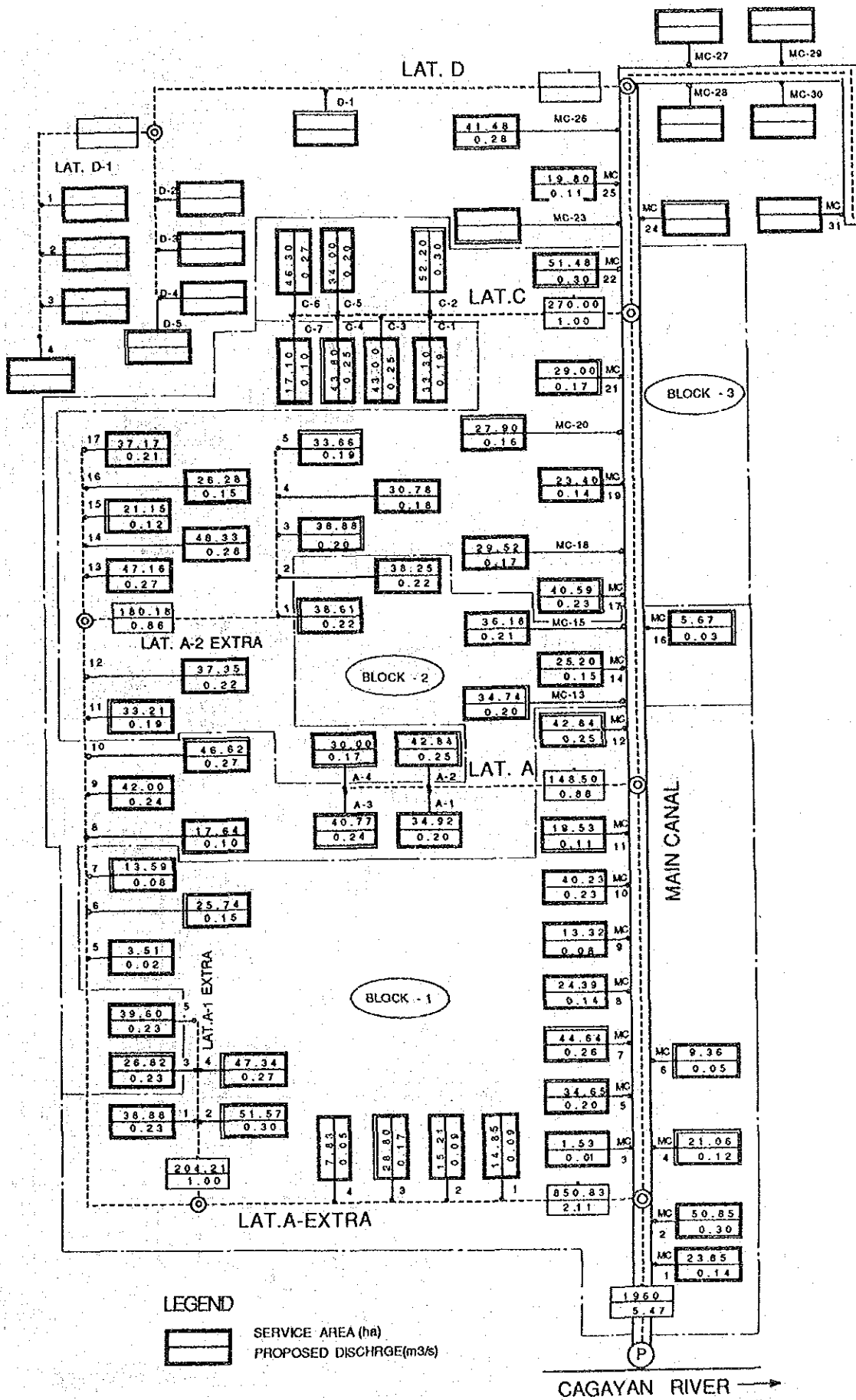


Fig. 3.8 DESIGN DISCHARGE OF SOL'ANA PIS (MAX. SERVICE AREA)



LEGEND

- SERVICE AREA (ha)
- PROPOSED DISCHARGE (m³/s)

Fig. 3.9 DESIGN DISCHARGE OF LIBMANAN-CABUSAO PIS (FIRMED-UP SERVICE AREA)

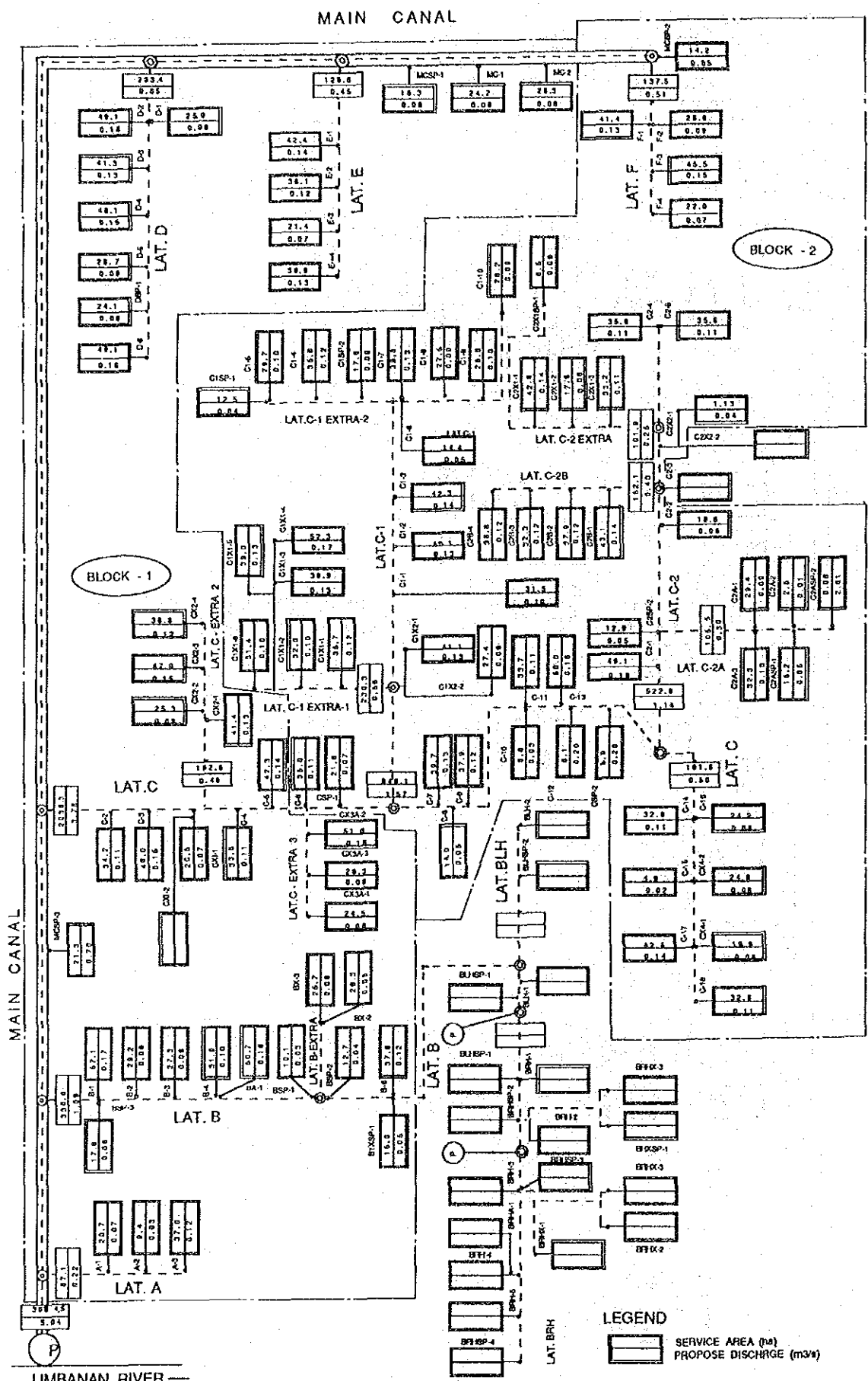


Fig. 3.10 DESIGN DISCHARGE OF LIBMANAN-CABUSAO PIS (MAX SERVICE AREA)

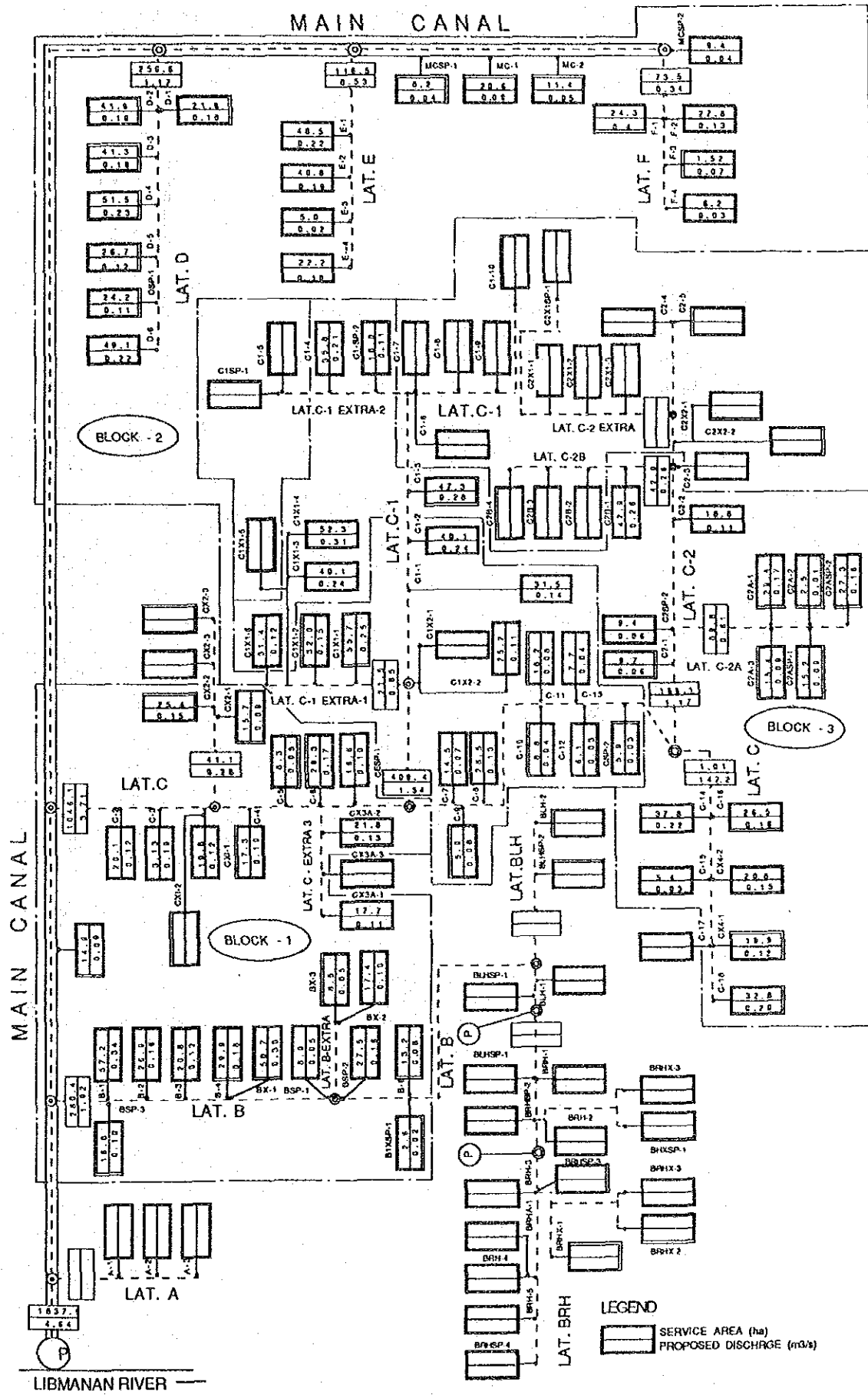
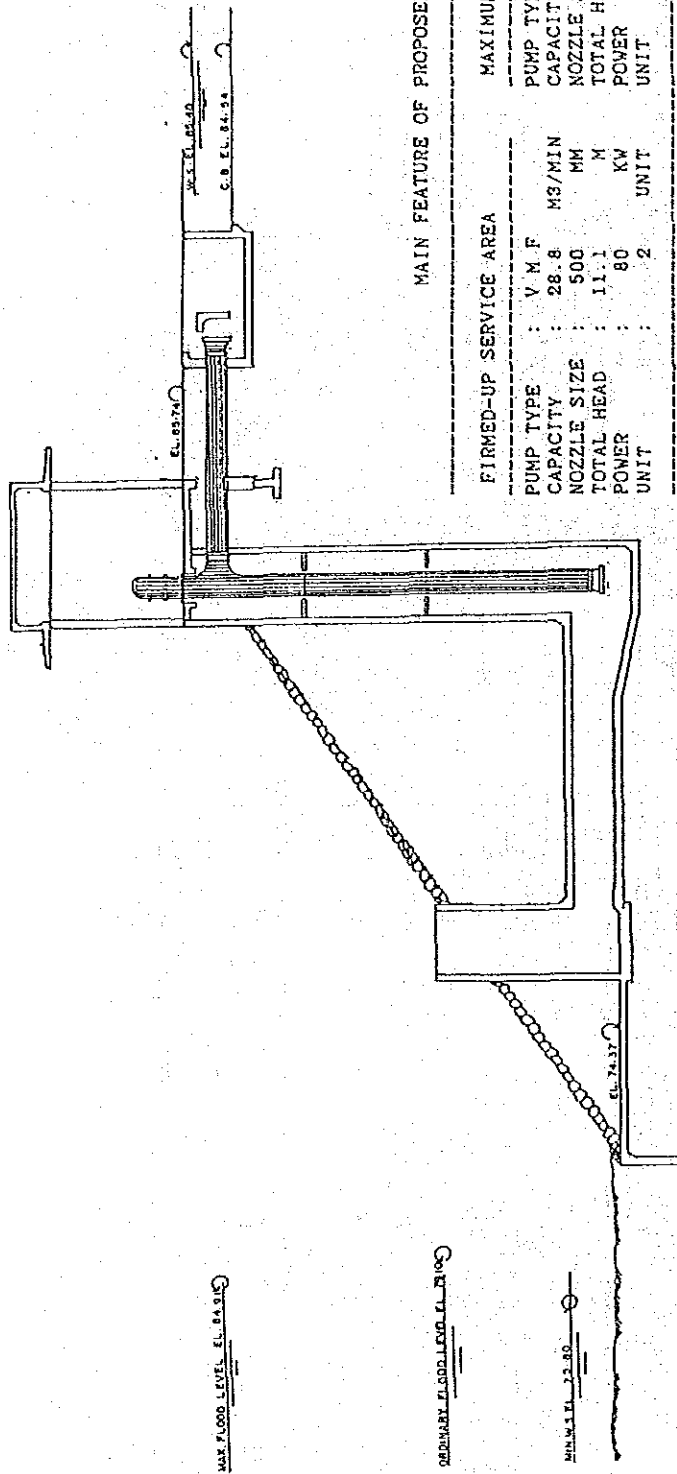


FIG 3.11 GENERAL LAYOUT PUMPING STATION
BONGA PUMP #.1 ISA



MAIN FEATURE OF PROPOSED PUMPS

FIRMED-UP SERVICE AREA		MAXIMUM SERVICE AREA	
PUMP TYPE	: V.M.F	PUMP TYPE	: V.M.F
CAPACITY	: 28.8 M3/MIN	CAPACITY	: 35.1 M3/MIN
NOZZLE SIZE	: 500 MM	NOZZLE SIZE	: 500 MM
TOTAL HEAD	: 11.1 M	TOTAL HEAD	: 11.2 M
POWER	: 80 KW	POWER	: 95 KW
UNIT	: 2	UNIT	: 2

SECTION

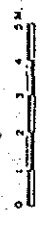
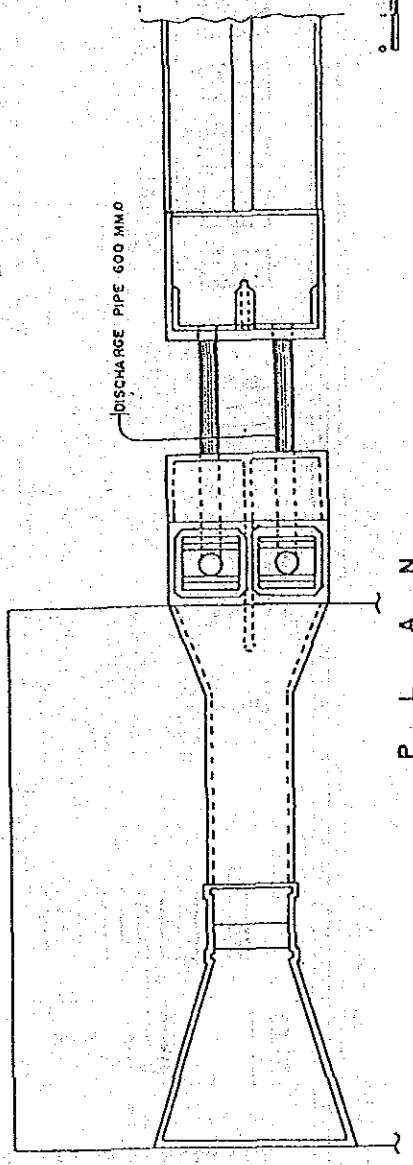
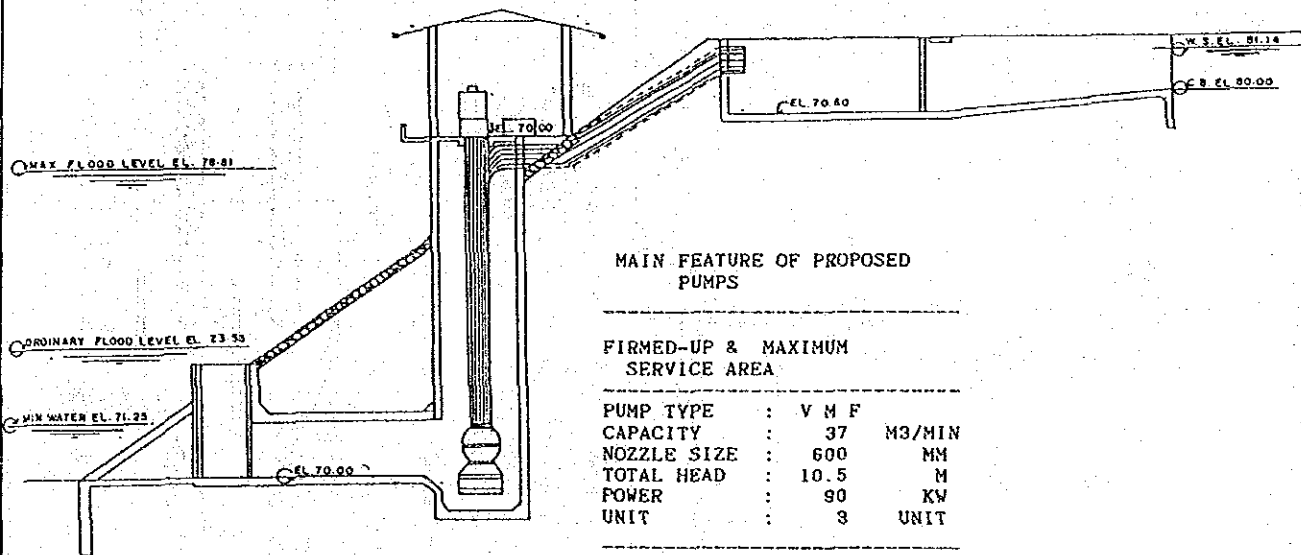
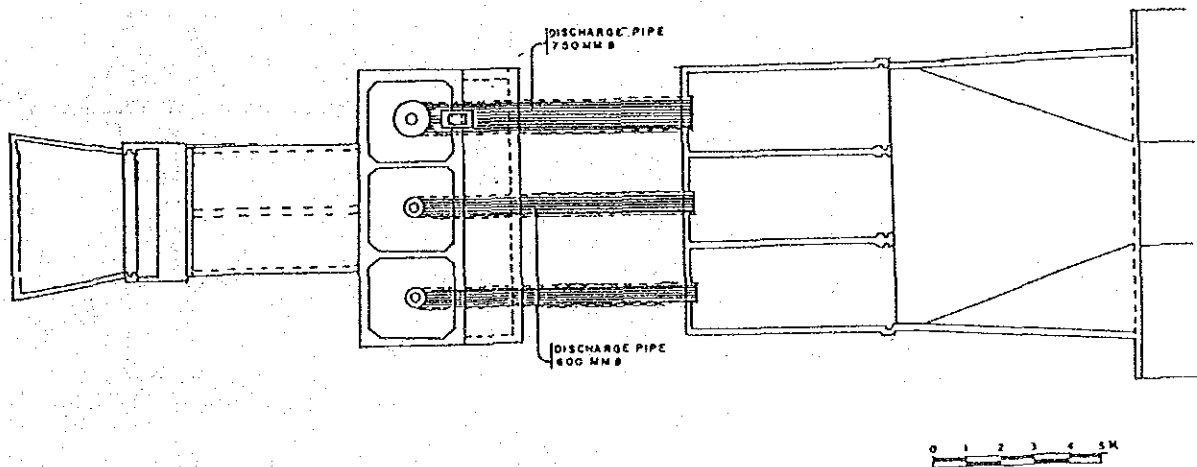


Fig 3.12 GENERAL LAYOUT OF PUMPING STATION
BONGA PUMP #. 2ISA



SECTION



P L A N

Fig 3.13 GENERAL LAYOUT OF PUMPING STATION
BONGA PUMP #.3.15A

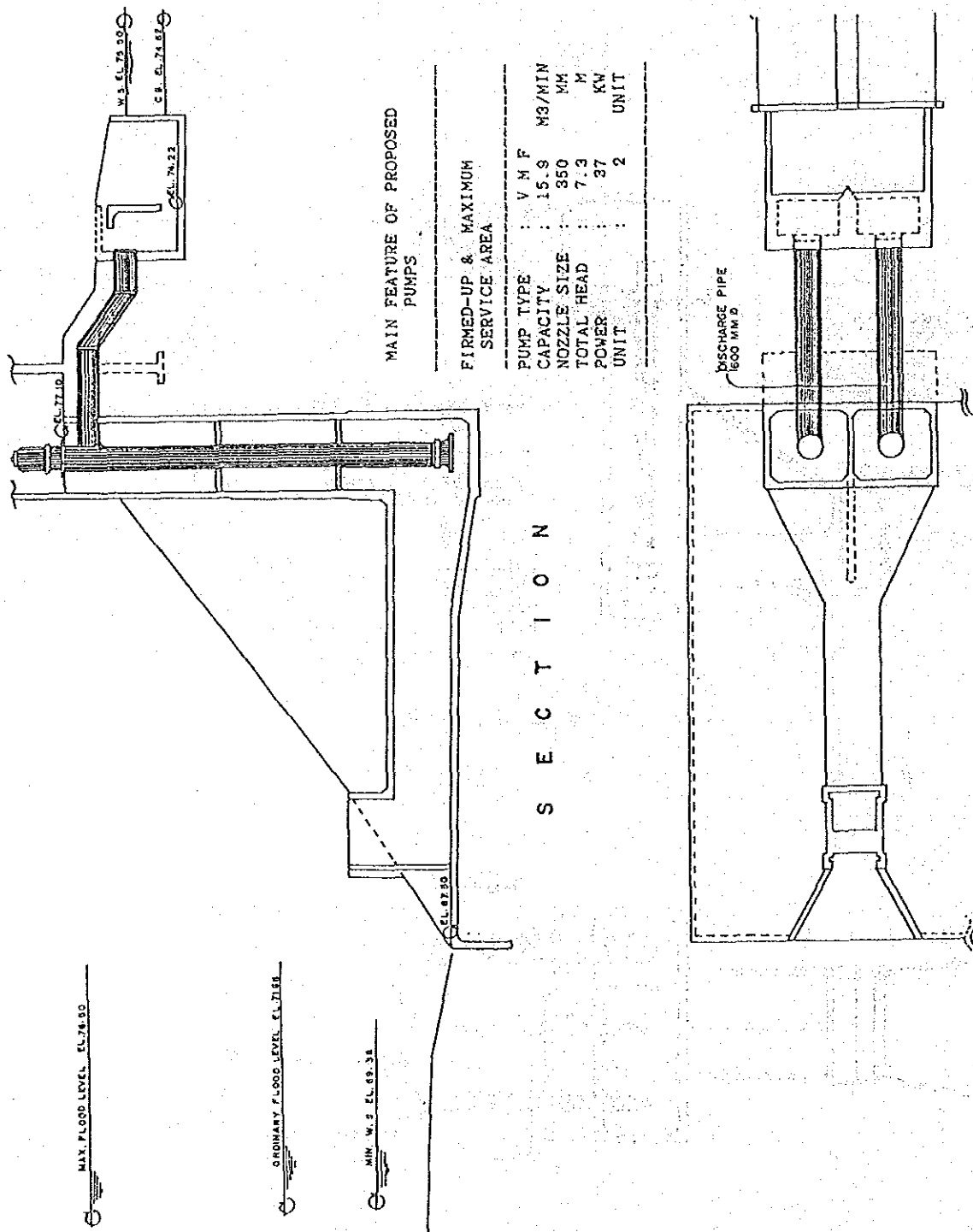
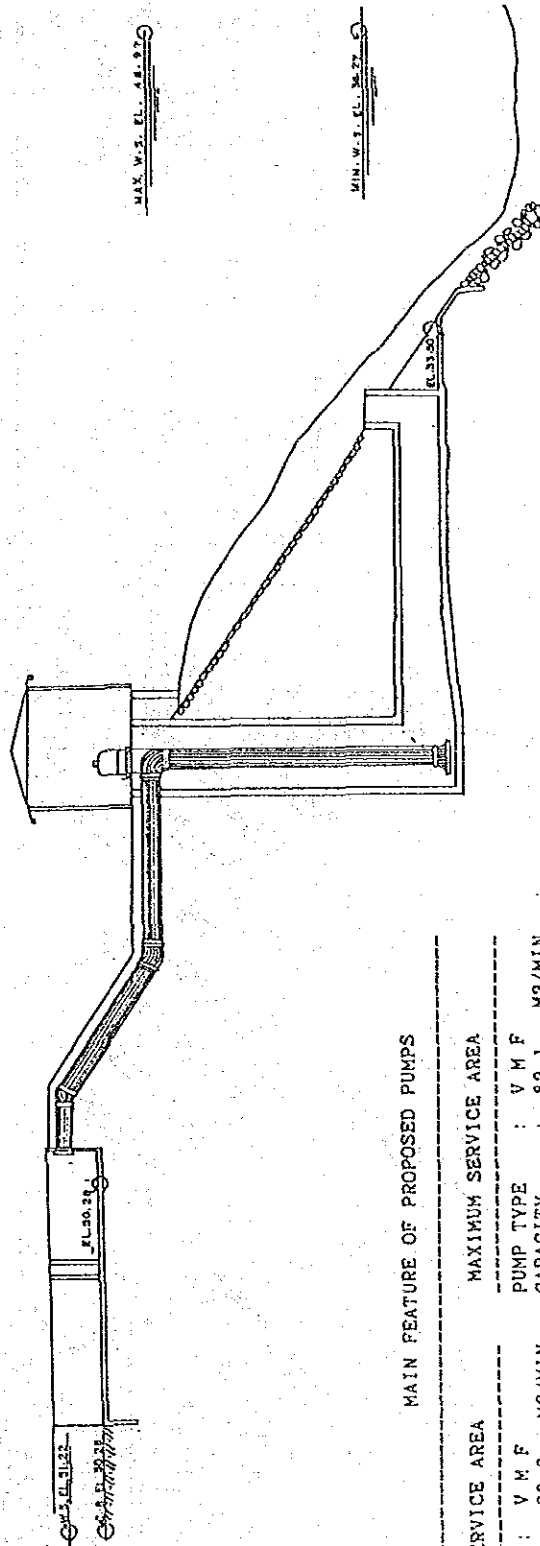


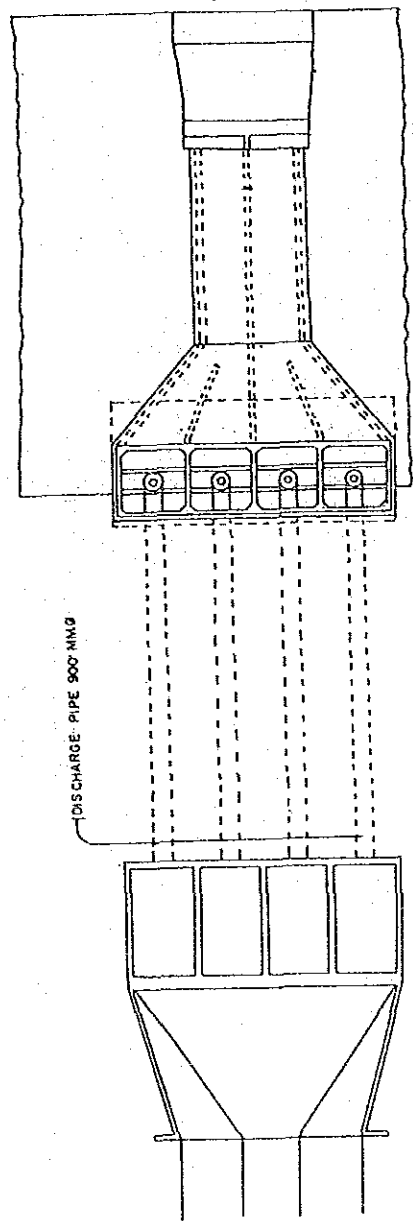
FIG 3.14 GENERAL LAYOUT OF PUMPING STATION
SOLANA PUMP 15A



MAIN FEATURE OF PROPOSED PUMPS

FIRMED-UP SERVICE AREA		MAXIMUM SERVICE AREA	
PUMP TYPE	V M F	PUMP TYPE	V M F
80.8	M3/MIN	82.1	M3/MIN
700	MM	800	MM
16.7	M	16.8	M
230	KW	310	KW
3	UNIT	4	UNIT

SECTION



PLAN



Fig 3.15 GENERAL LAYOUT OF PUMPING STATION
LIBMANAN - CABUSAO PUMP ISA

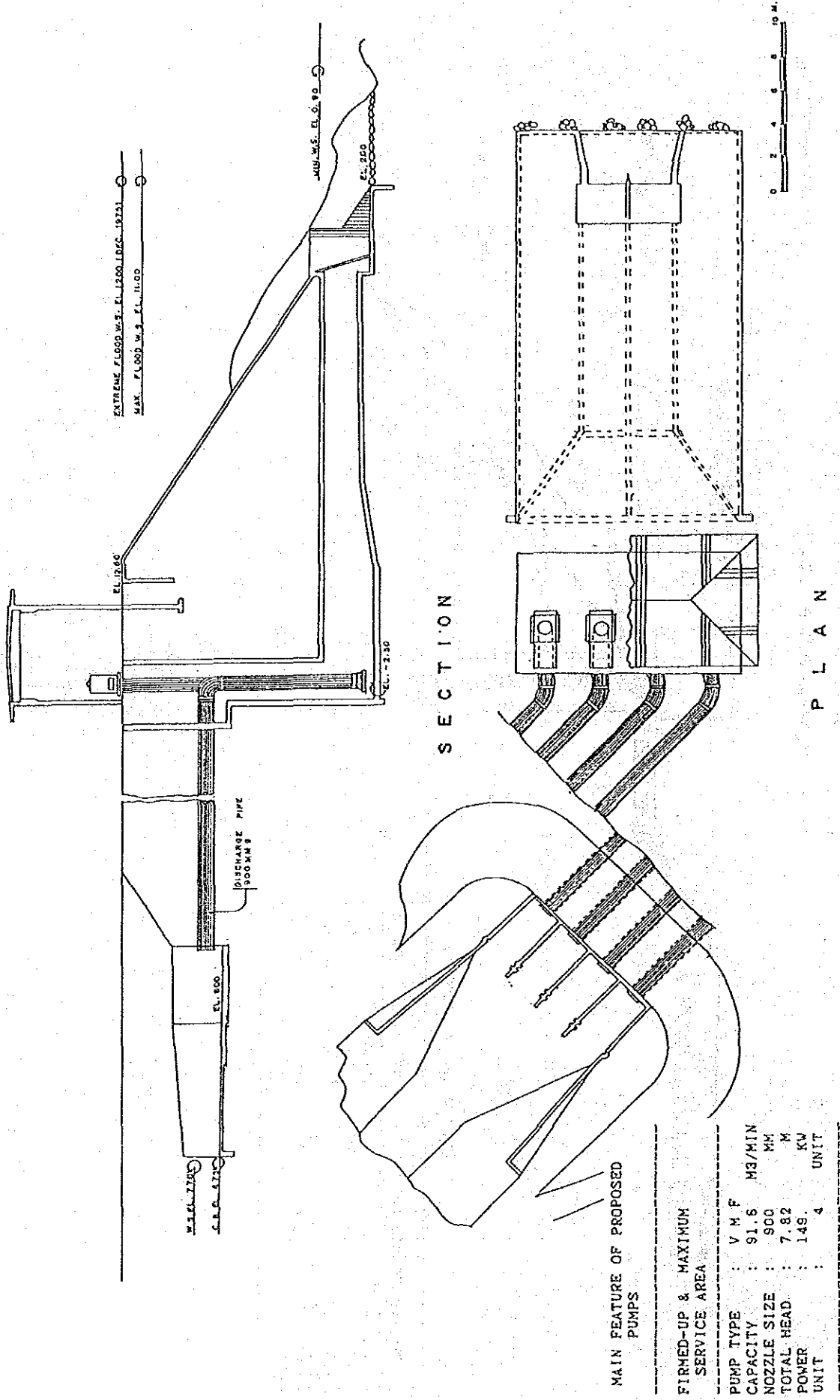


Fig. 3.16 GENERAL MAP OF POWER SUPPLY SYSTEM
BONGA PUMP #1, #2 AND #3 IS

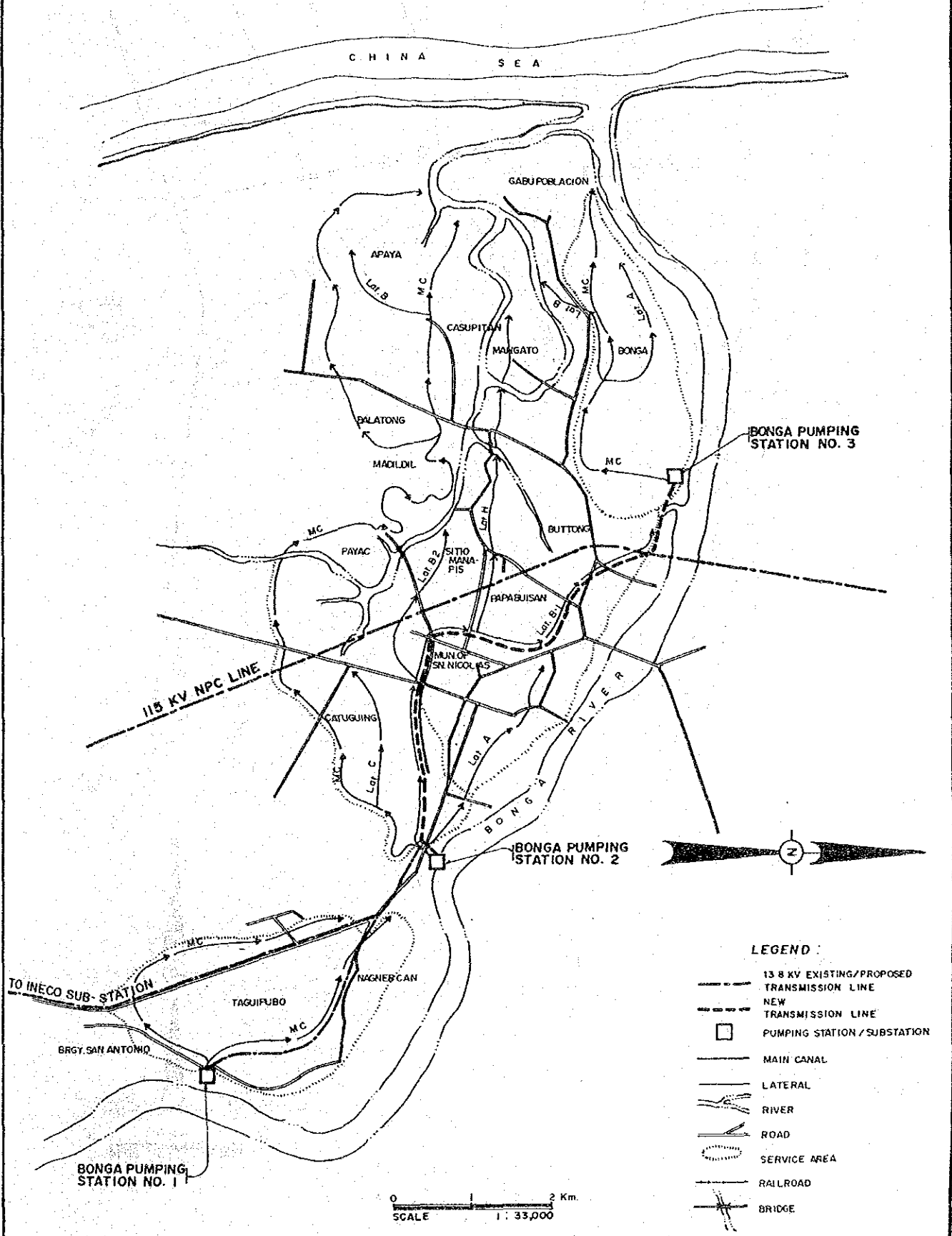


Fig. 3.17 GENERAL MAP OF POWER SUPPLY SYSTEM
SOLANA PIS

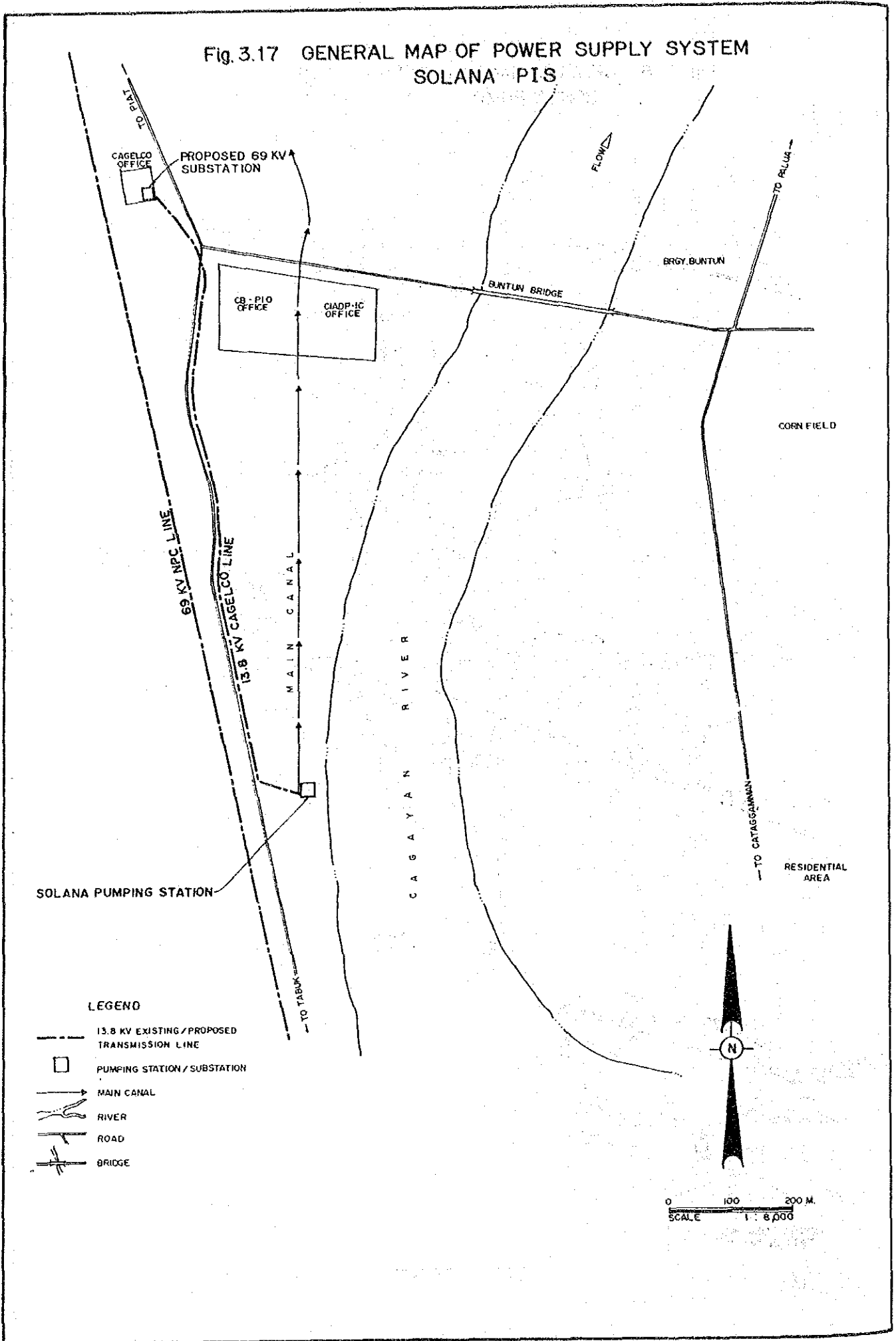


Fig. 3.18 GENERAL MAP OF POWER SUPPLY SYSTEM
LIBUMANAN CABUSAO PIS

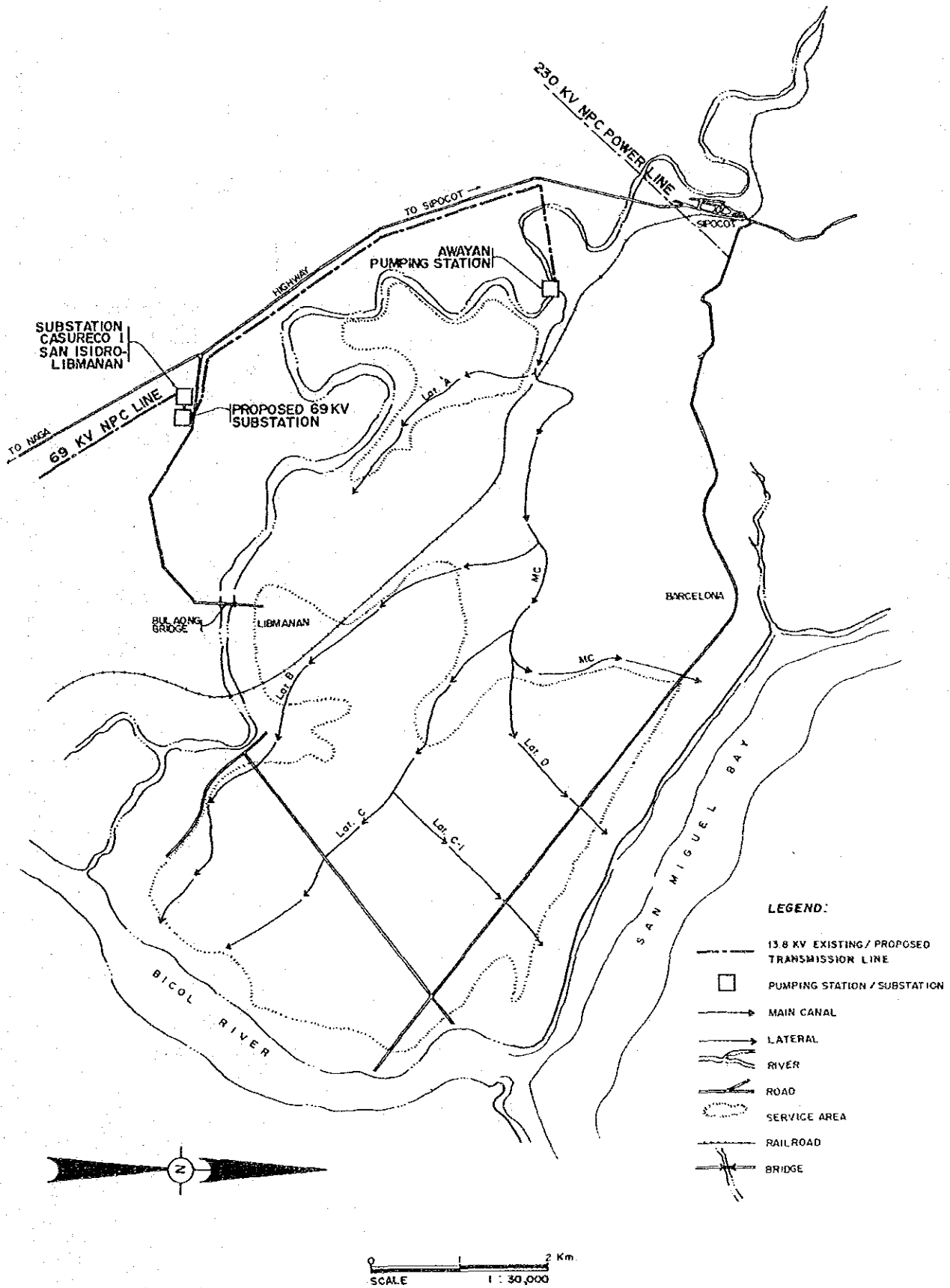


Fig. 3.19 SINGLE LINE DIAGRAM FOR SUB - STATION OF BONGA PUMP #1, #2, #3 AND LIBUMANAN CABUSAO PUMP ISA

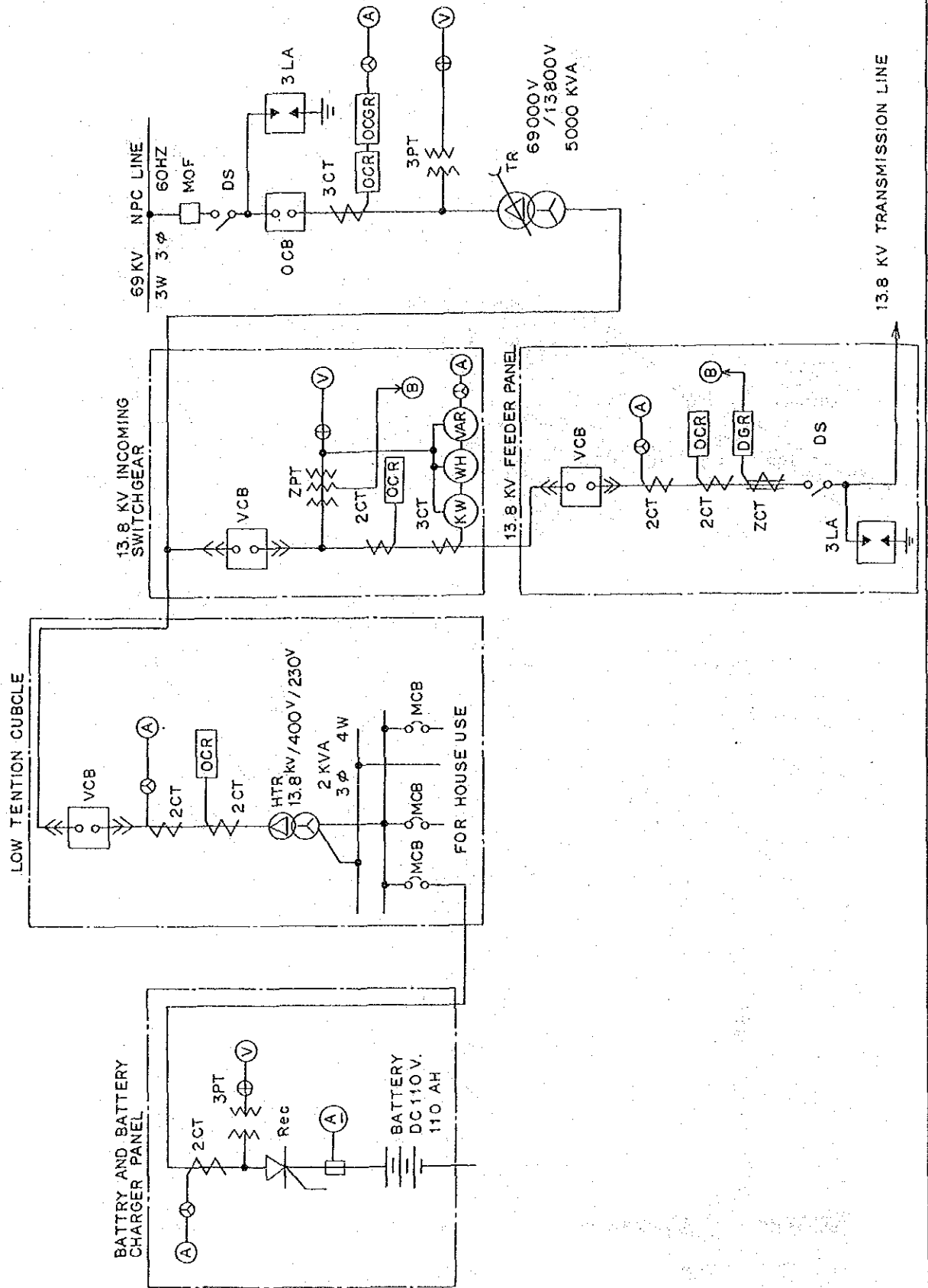


Fig. 3.20 SINGLE LINE DIAGRAM FOR PUMPING STATION OF BONGA PUMP #1, #2, #3 AND LIBUMANAN CABUSAO PUMP ISA

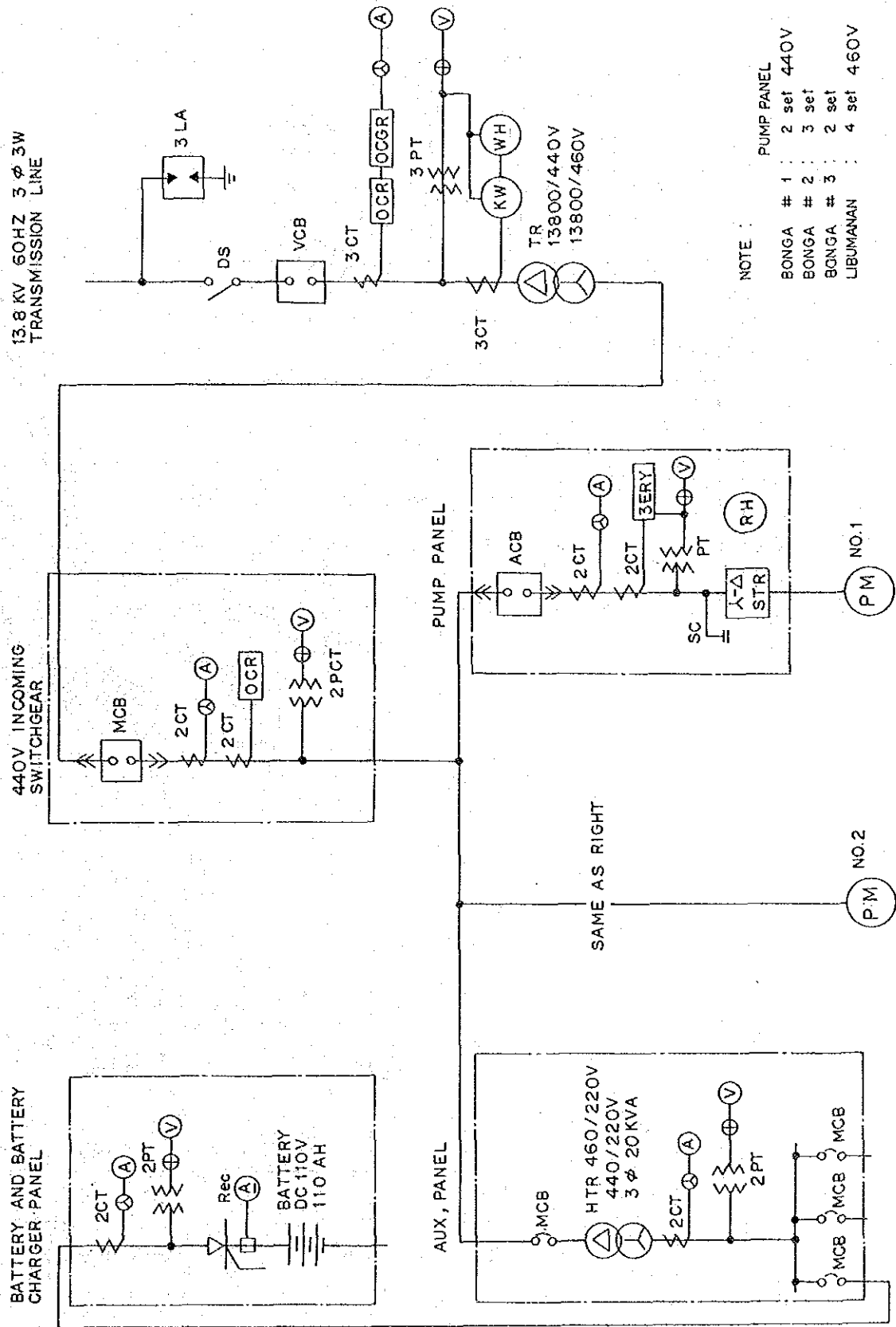


Fig. 3.21 SINGLE LINE DIAGRAM FOR SOLANA PUMPING STATION

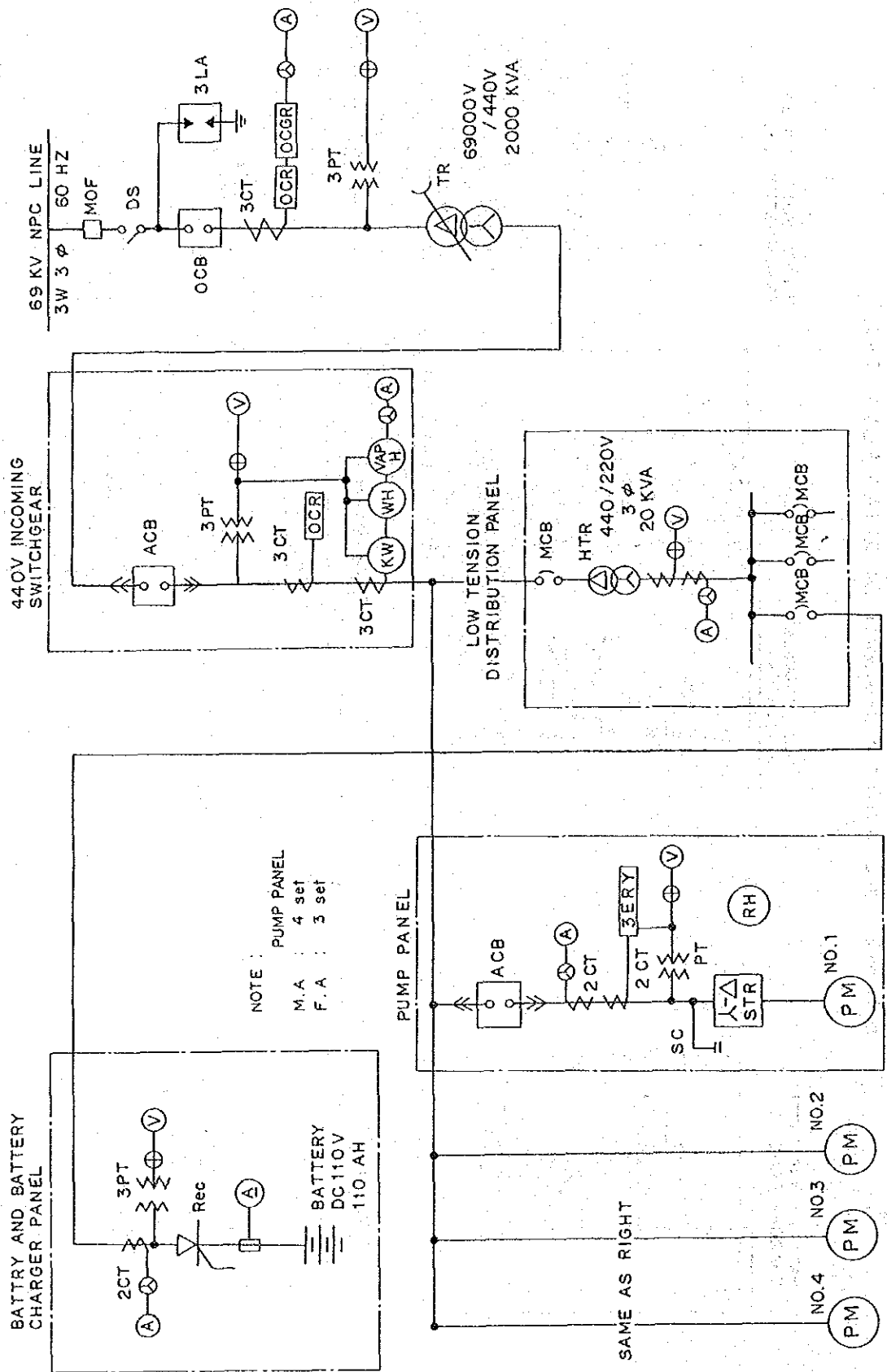
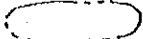
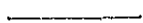
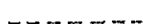


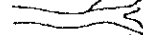
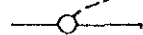
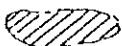

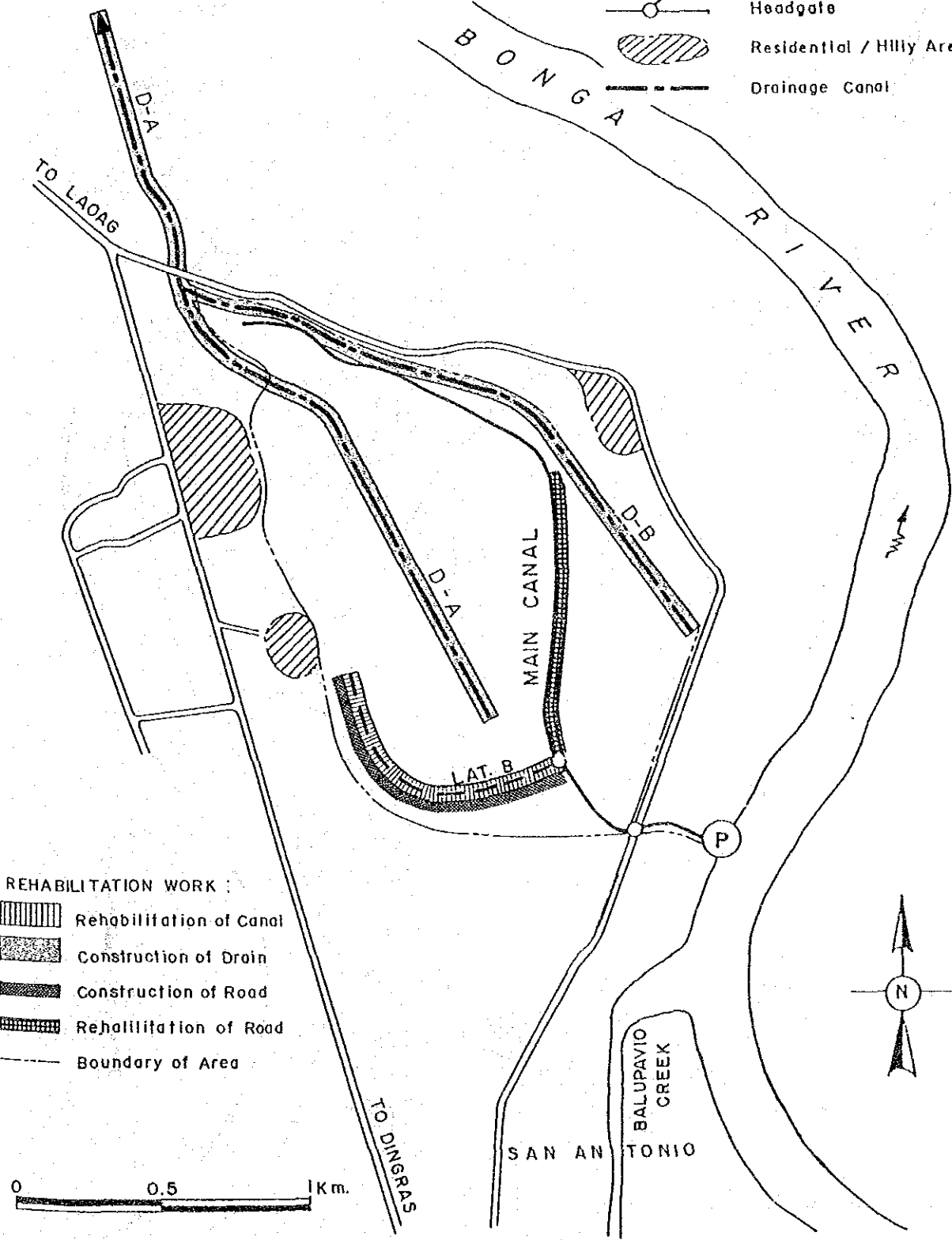


Fig. 3.22 PROPOSED GENERAL LAYOUT OF BONGA PUMP #1 IS
(FIRMED-UP SERVICE AREA)

LEGEND :

-  Irrigation Area
-  Main Canal
-  Lateral / Sublateral Canal
-  Pump Station
-  Road
-  River / Creek
-  Headgate
-  Residential / Hilly Area
-  Drainage Canal













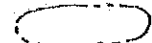



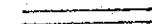
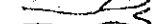

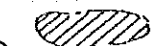

- REHABILITATION WORK :
-  Rehabilitation of Canal
 -  Construction of Drain
 -  Construction of Road
 -  Rehabilitation of Road
 -  Boundary of Area

Fig. 3.23 PROPOSED GENERAL LAYOUT OF BONGA PUMP #1 IS
(MAXIMUM SERVICE AREA)

REHABILITATION WORK

-  Rehabilitation of Canal
-  Construction of Drain
-  Construction of Road
-  Rehabilitation of Road
-  Boundary of Area

LEGEND :

-  Irrigation Area
-  Main Canal
-  Lateral / Sublateral Canal
-  Pump Station
-  Road
-  River / Creek
-  Headgate
-  Residential / Hilly Area
-  Drainage Canal

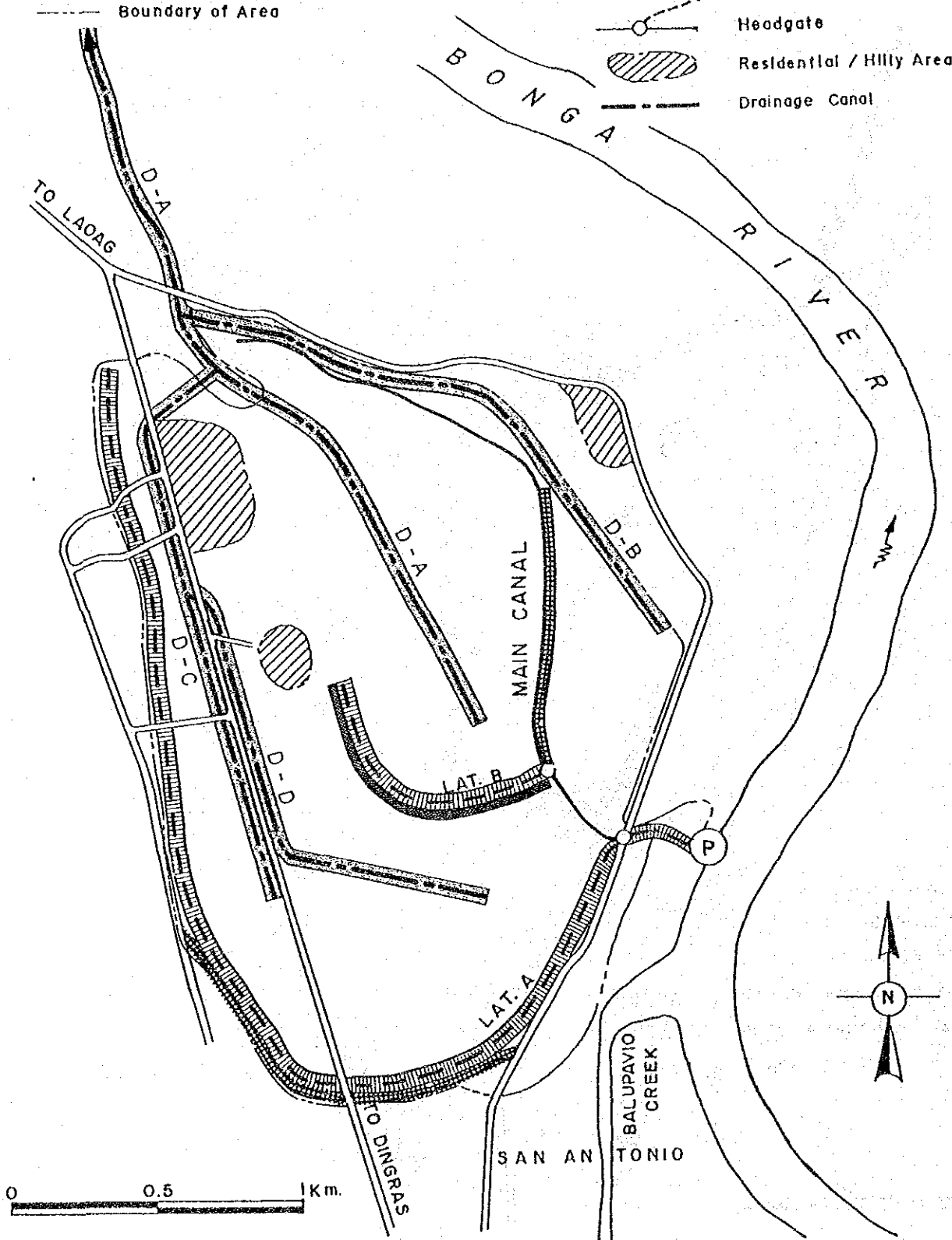
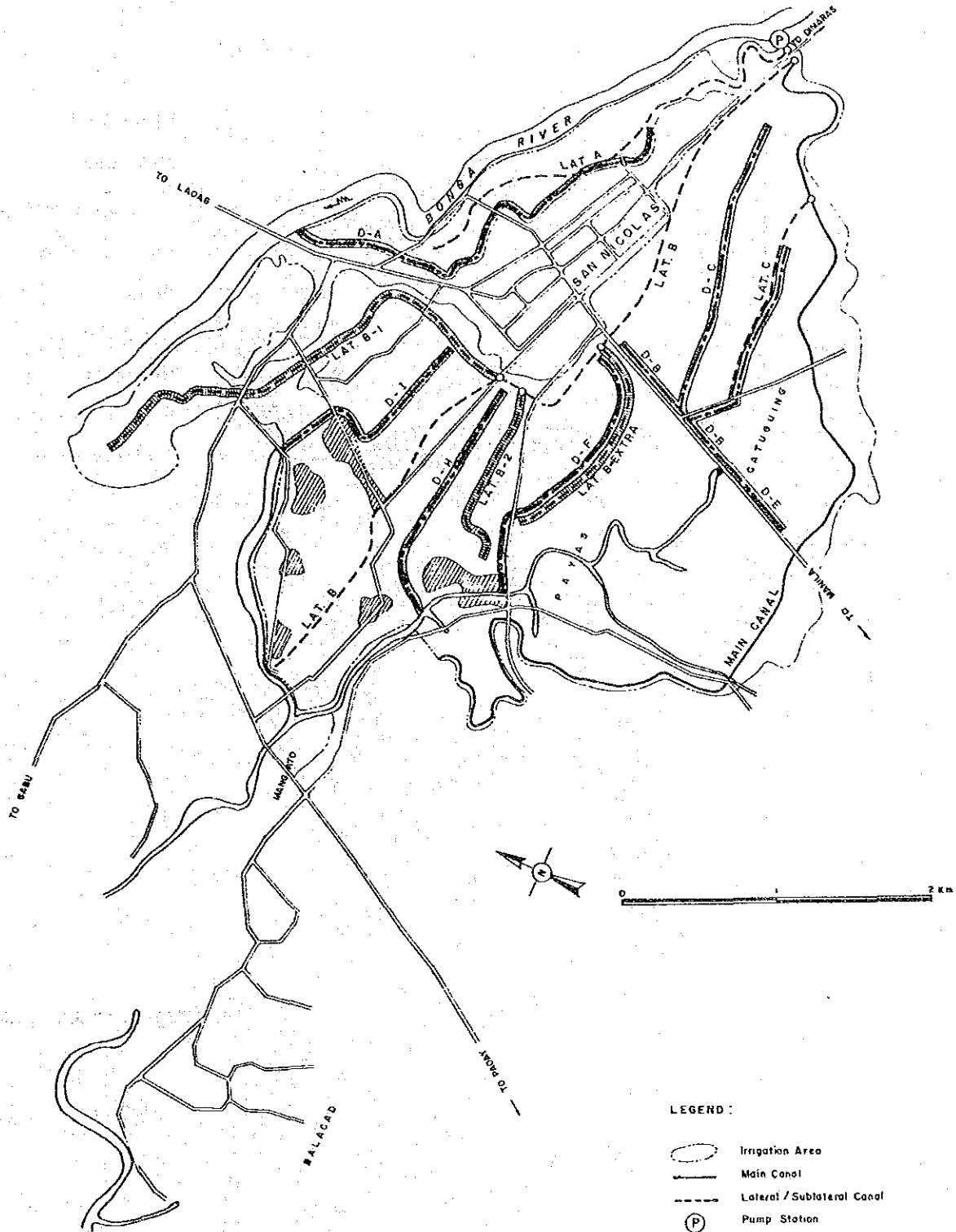


Fig. 3.24 PROPOSED GENERAL LAYOUT OF BONGA PUMP #2 IS
(FIRMED-UP/MAXIMUM SERVICE AREA)



- LEGEND :**
- Irrigation Area
 - Main Canal
 - Lateral / Sublateral Canal
 - Pump Station
 - Road
 - River / Creek
 - Headgate
 - Residential / Hilly Area
 - Drainage Canal
- REHABILITATION WORK**
- Rehabilitation of Canal
 - Construction of Drain
 - Boundary of Area

Fig. 3.25 PROPOSED GENERAL LAYOUT OF BONGA PUMP #3 IS
(FIRMED-UP/MAXIMUM SERVICE AREA)

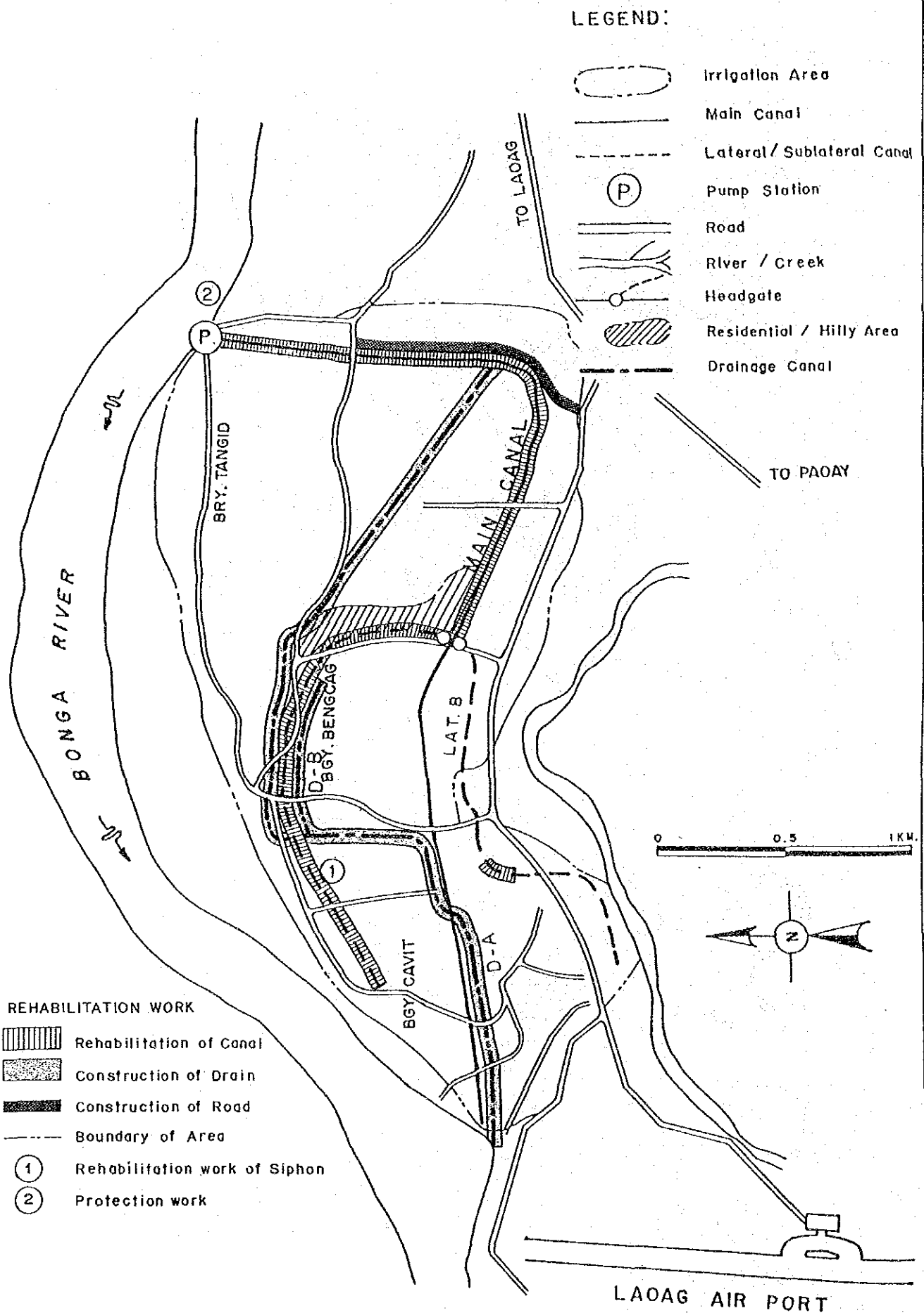


Fig. 3.26 PROPOSED GENERAL LAYOUT OF ALCALA-AMULUNG PIS
(FIRMED-UP SERVICE AREA)

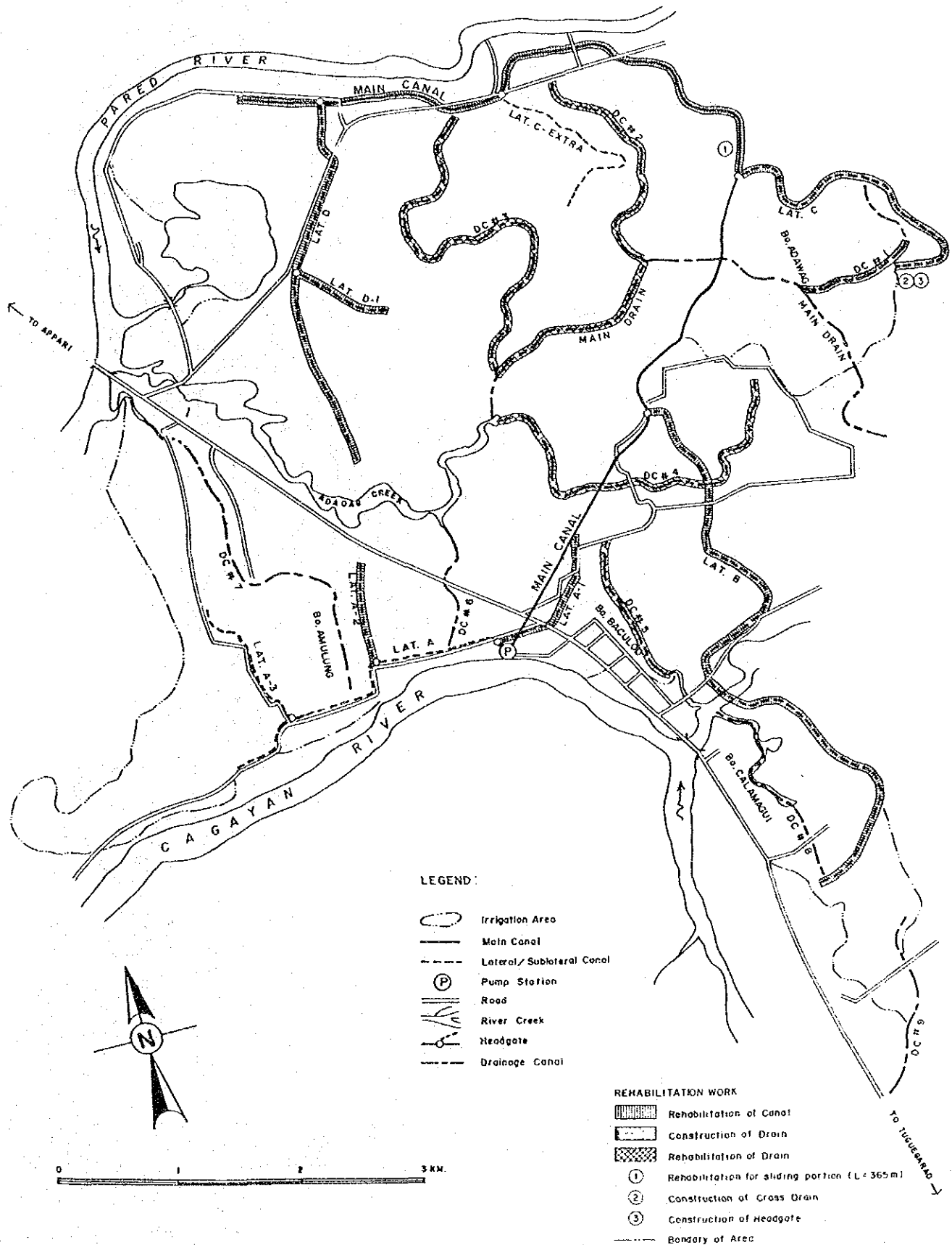


Fig. 3.27 PROPOSED GENERAL LAYOUT OF ALCALA-AMULUNG PIS
(MAXIMUM SERVICE AREA)

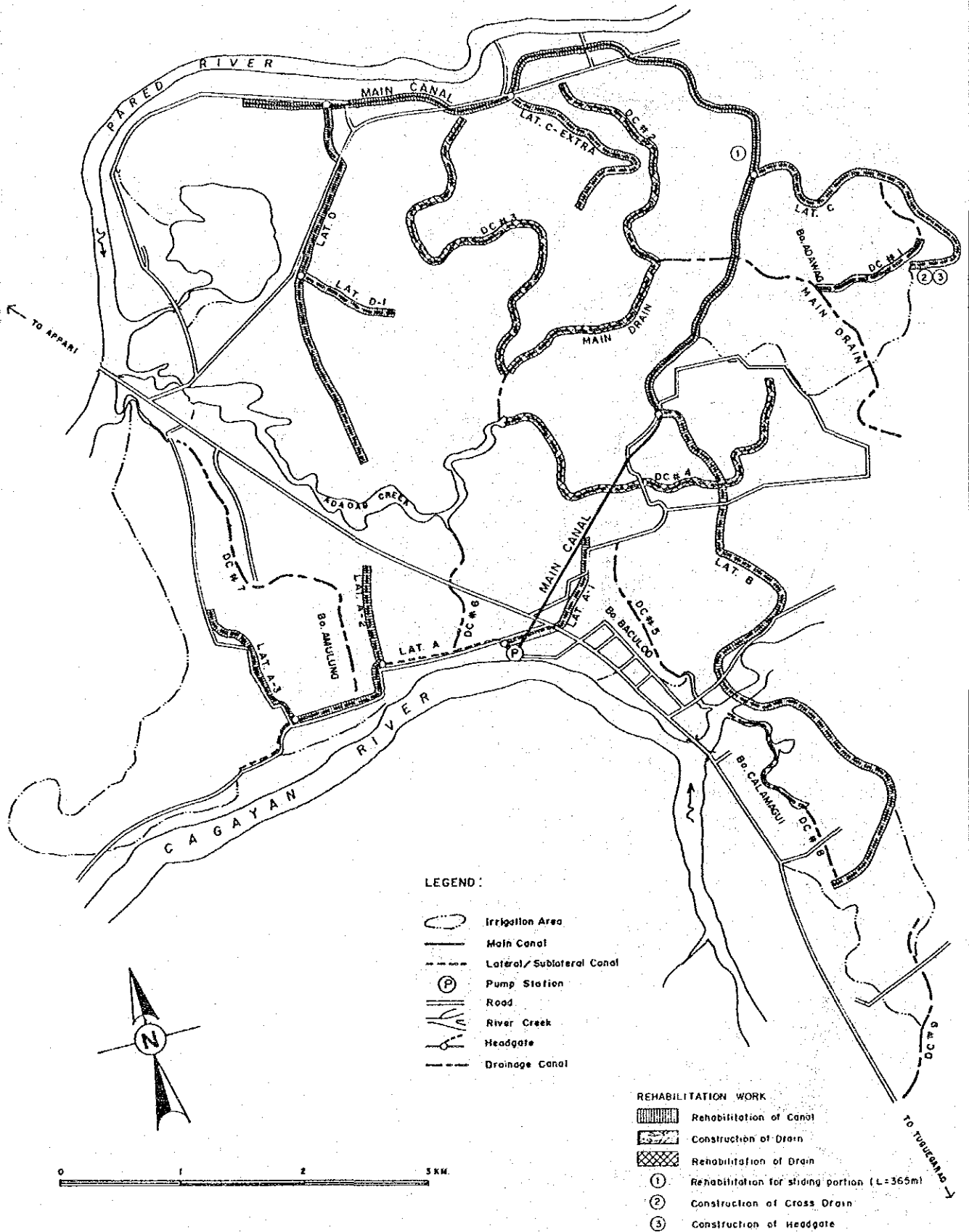


Fig. 3.28 PROPOSED GENERAL LAYOUT OF SOLANA PIS
(FIRMED-UP SERVICE AREA)

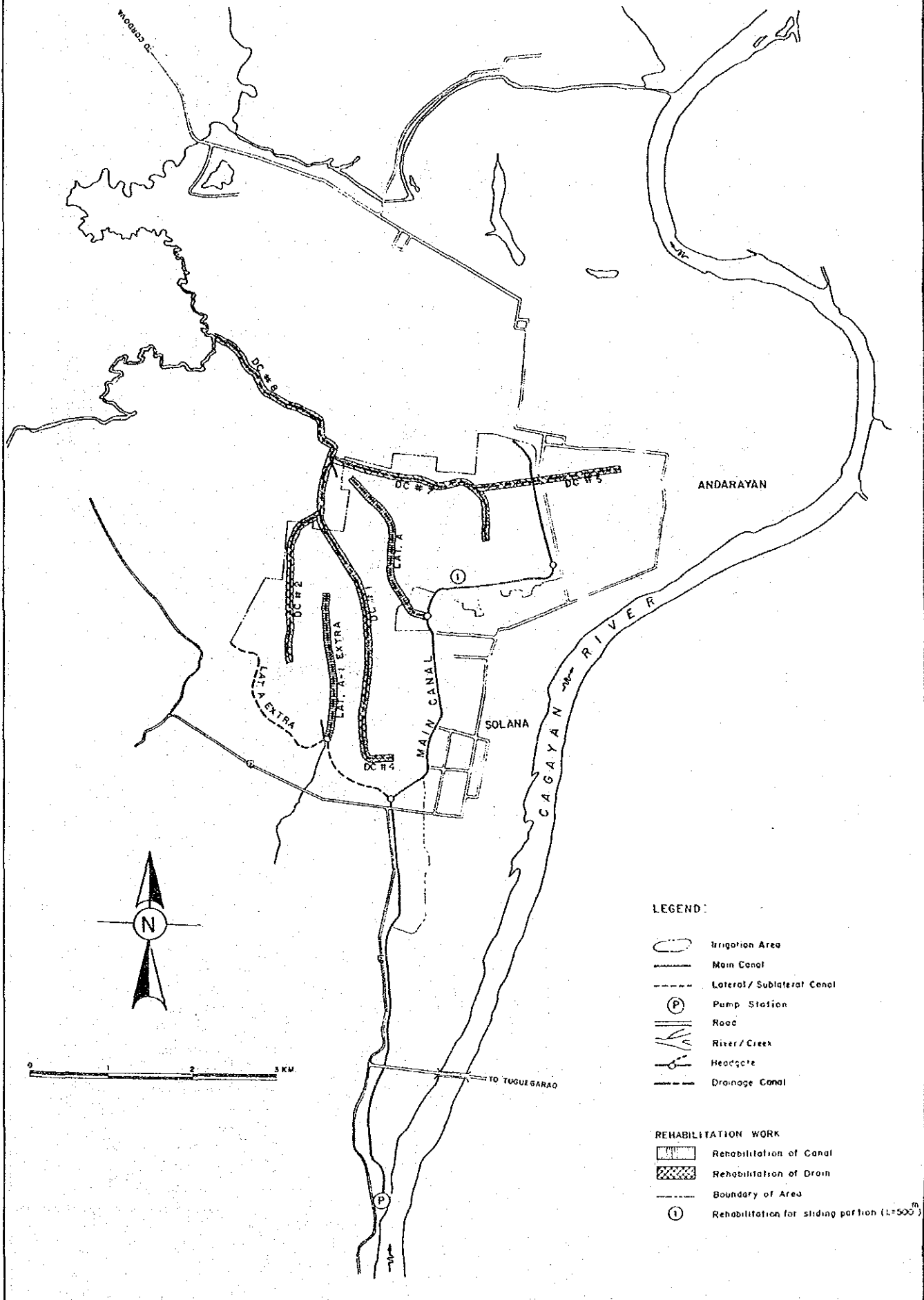


Fig. 3.29 PROPOSED GENERAL LAYOUT OF SOLANA PIS
(MAXIMUM SERVICE AREA)

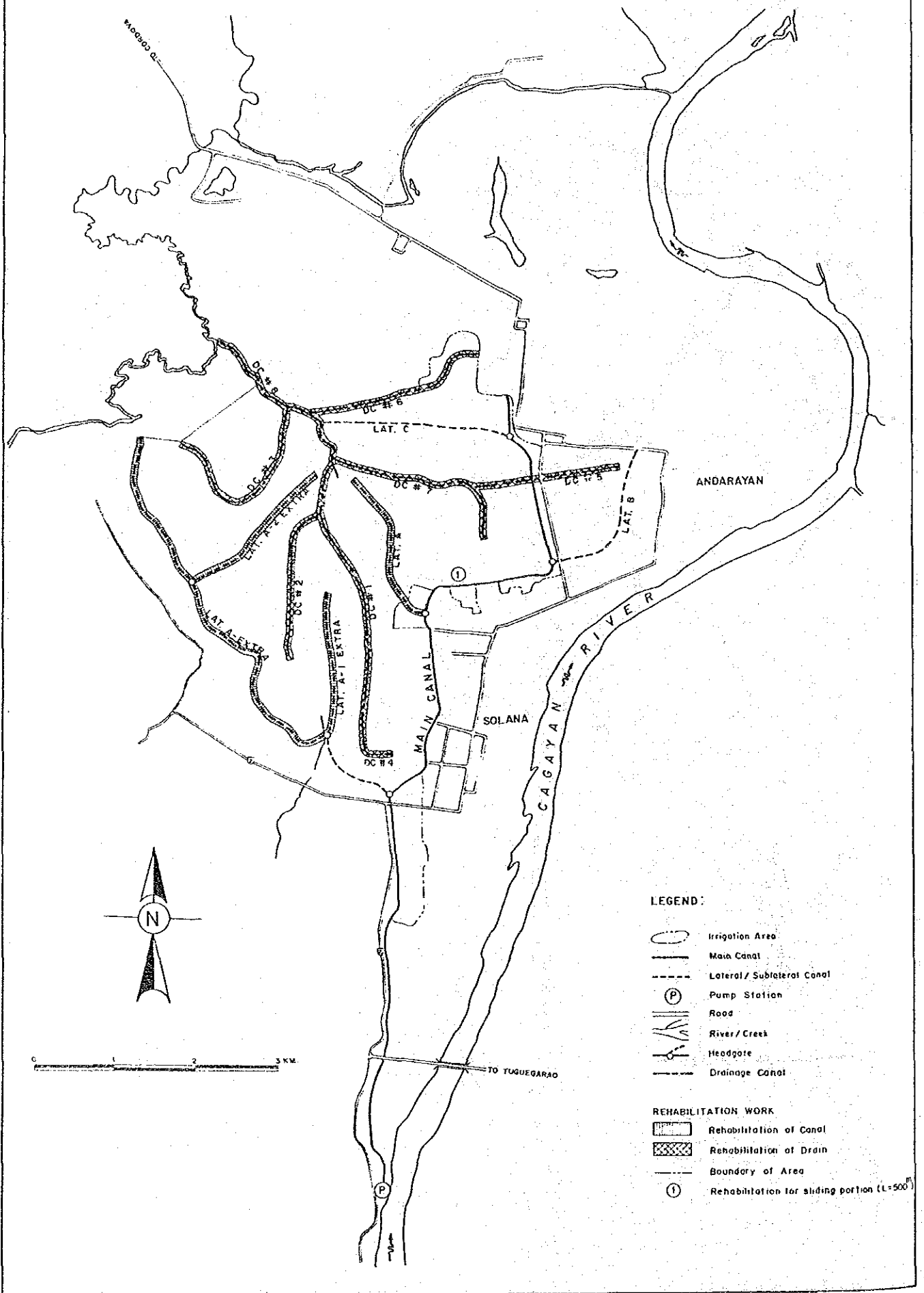


Fig. 3.30 PROPOSED GENERAL LAYOUT OF LIBMANAN-CABUSAO PIS (FIRMED-UP SERVICE AREA)

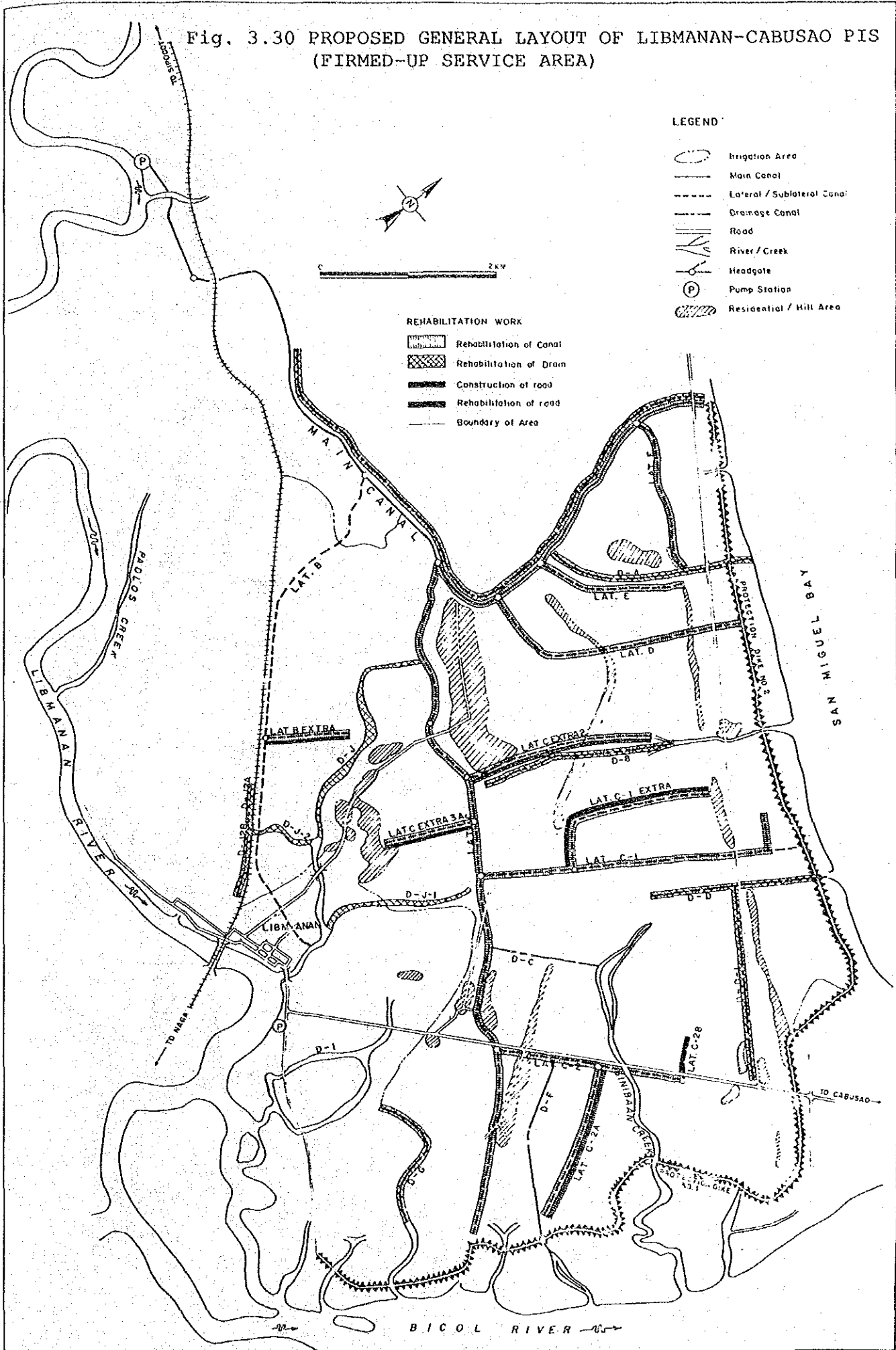


Fig. 3.31 PROPOSED GENERAL LAYOUT OF LIBMANAN-CABUSAO PIS (MAXIMUM SERVICE AREA)

