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THE CITANDUY RIVER BASIN
DEVELOPMENT PROJECT

CENTRAL JAVA IRRIGATION SYSTEMS REHABILITATION AND IMPROVEMENT FEASIBILITY REPORT

CONTRACT NO. KAB 9/2/14

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PRC ENGINEERING CONSULTANTS, INC.
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CENTRAL JAVA IRRIGATION SYSTEMS

REHABILITATION AND IMPROVEMENT

FEASIBILITY REPORT

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CHAPTER I

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The feasibility report for the rehabilitation of the existing Central Java systems within the Citanduy River Basin boundaries has been prepared according to the Contract, Kab. 9/2/14, dated February 10, 1977, between the Directorate General of Water Resources Development in the Ministry of Public Work and Engineering Consultants, Inc. (ECI). A substantial part of the work in preparing this report was done by members of the counterpart team of Proyek Citanduy. The cooperation of Mr. Muslim, BIE, and Mr. Sutrisno, BIE, and the staff of the Seksi Irigasi Citanduy office of the Wilayah Banyumas in field reconnaissance and in providing data and information is highly appreciated. Assistance and help extended by Ir. Rachardjo and the staff of Proyek Citanduy, Ir. Martopo and the staff of the Public Works Office of Central Java in Semarang, and the Directorate of Rivers and USAID in Jakarta, is gratefully acknowledged.

Objectives of the report are:

(1) Presentation of the project plan for the rehabilitation and further development of the existing irrigation systems in the Central Java area within the Citanduy River Basin boundaries;

(2) Description of plan formulation;

(3) Evaluation of the benefits to be expected and the resources needed to implement the plan;

(4) Presentation of conclusions and recommendations.

The Citanduy River Basin Masterplan [1/] (ECI, 1975) as well as the Terms of Reference of the Contract mention eight existing systems. However, a field cross-check revealed that it would be more appropriate to consolidate the study into four systems as follows:

1/ "MASTERPLAN for the Citanduy River Basin Development Project" by Engineering Consultants, Inc., May 1975.

(1) Cileumeuh

(2) Cilopadang

(3) Cijalu

(4) Cilaca

These names are presently used at the Public Works - Central Java Office in Semarang.

All these systems have run-of-the river type weirs in rivers of similar names. The discrepancy between eight systems mentioned in the Masterplan and the now identified four systems is due to; (a) double counting of some areas as separate systems; (b) counting of area not yet under command of a technical system as technical; and (c) because of extension of Cijalu-area due to construction of the new weir during the period 1977-1980. Two systems in the region, the Cigeugeumeuh and Mungkalmeong systems are Sederhana projects. They were not mentioned in the Masterplan and thus are outside the scope of the contract for irrigation rehabilitation, but need to be considered in the improvement of drainage facilities for the above mentioned Central Java systems. The rehabilitation plan for the existing systems takes into account the proposed plans (as far as available) under the Pelita III program works by the Wilayah Banyumas Irrigation Office.

The Cilaca system lies partly within the Wanareja swamp. This swamp, through overflow spillways in Citanduy and Cikawung levees, will in the future function as the temporary flood water storage basin, an agreed function which is outlined in the Flood Control Scheme 2/. This function for the area is retained in the feasibility study for the Cilaca system. In this report, the Cilaca system will sometimes be referred to as the Wanareja project area. The Cileumeuh, Cilopadang and Cijalu systems are all located around Majenang, and for reasons of drainage and flood control are sometimes referred to in this report as the Majenang project area.

2/ "Design Report Flood Control Scheme", the Citanduy River Basin Development Project, by Engineering Consultants, Inc., November 1976.

The feasibility plans for these two project areas are directed towards improvement of the irrigation systems and better drainage for the project lands and existing swamps. Also, local flood control rehabilitation and improved water management in the system through additional provision of secondary and lateral canals and "on-farm" distribution systems are needed and planned for. Through these improvements increased rice yields and less damage due to local uncontrolled flooding at the lower end of the systems can be anticipated.

The scope of the project plan is mainly concerned with technical irrigation and drainage facilities, local flood control and O & M. However, in order to obtain the maximum benefits from this project additional attention should be given to (a) agro infrastructure and extension to reach more farmers; (b) increased availability of necessary inputs to obtain higher yields, combined with proper credit availability; (c) an early implementation of construction of "on-farm" irrigation facilities; and (d) off-farm employment with focus on the landless and near landless, and group and cooperative farming, to name some of the important development issues.

Summary

Project Plan

The Central Java System Project Plan will be primarily an irrigation rehabilitation and development, drainage and flood protection project. In addition, improvement of overland transportation to facilitate easier access to certain parts of project areas is envisaged. The ultimate goal of project plans, for both the Majenang and Wanareja project areas, is: (a) to raise the rice yields by better water management, (b) provide better flood protection and drainage capabilities to limit crop losses, and (c) expand the economy and raise the standard of living of people in the areas concerned. The existing facilities have limited water management and drainage capabilities. This feasibility study identified a project plan which is concerned mainly with the total development of the water distribution system and provision of adequate drainage and flood protection.

Irrigation water for the projects will be diverted from the existing Cileumeuh and Cilopadang weirs, the Cijalu weir presently under construction, and the Cilaca free intake (to be replaced by a new weir during the Pelita III period). At present only primary canals of the Cileumeuh, Cilopadang and Cilaca system exist. The primary canals (left and right) for Cijalu system and secondary and lateral distribution systems for all systems need to be developed.

Summary information on the rehabilitation and development for each of the project areas is presented in the following tables;

Table I-1 : Project Command Area

Table I-2 : Project Agriculture

Table I-3 : Project Engineering Features

Table I-4 : Project Economic Costs

The rehabilitation and extension of the Central Java Irrigation Systems is proposed to be carried out in three years. The construction will start in year 1981 and completed in year 1984. The financial cost for budgetary purposes was computed based on inflation factors for domestic and foreign components. The financial cost for the two project areas are as follows:

	Total Costs	Foreign Component
Majenang Project Area		
- Million Rupiahs -	3,537.700	820.522
- Million Dollars -	5.660	1.313
Wanareja Project Area		
- Million Rupiahs -	843.360	116.007
- Million Dollars -	1.349	0.185

(Note: 1 US $ = 625 Rupiahs)

The total financial costs for the Central Java Project is 4,381.060 Million Rupiahs or 7.009 Million Dollars.

Conclusions

1. At present the existing technical facilities in both project areas of Majenang and Wanareja provide irrigation water to an area of about 2800 hectares of ricelands through rural type distribution systems. Based on topography and the limited data available to estimate water supply in the feeder rivers to the four systems, a total of 3792 hectares has been identified within the two project areas as suitable for irrigation. All of the land is presently under rice cultivation. The systems have at present little or no water management capability at secondary, lateral and on-farm levels.

2. The major crop in the irrigable command area is and will remain to be rice with project plan. The major constraints to grow HYV - varieties extensively will be removed. With these varieties with a growing season of 100 to 125 days from seeding to maturity, two rice crops can be grown between the start of the wet season (October) and the end of dry season (June). Upland crops (Palawija) are not included in the proposed cropping calendar, because at present these crops are not grown in the irrigable command area. However, in years in which dry season rice crop is harvested in the beginning of June due to early start of wet season crop, upland crops can be planted after the dry season rice crop over part of the project area depending on residual moisture in soil and availability of supplemental irrigation water at weir sites.

3. Little reliable information exists regarding present cropping intensity. It is estimated that the present cropping intensity (harvested area) ranges from approximately 1.2 in extreme dry and wet years (dry years result in less water, but less area is continuously flooded, and in wet years there is more water, but more area is continuously flooded in both project areas) to 1.6 in years with well-distributed average rainfall. The present average cropping intensity is taken to be 1.4. With the project, the cropping intensity is anticipated to be 1.60 over the project life period. The increase of the cropping intensity of 0.2 will be possible (1) due to better watermanagement which will be obtained with the project plan; this capability allows for a shorter

time-span needed to grow two rice crops on part of the project area in one year; (2) provision of increased drainage capacity and levee improvement for the frequently flooded areas.

4. The social evaluation identified the needs of the farmers in the project areas. Of primary importance to achieve development in the area will be alleviation of flood and drainage problems, the elimination of the lack of water management capability and an assured and adequate water supply. In all 9000 families will benefit directly from the project. A strong water management program will minimize disputes regarding water distribution during low flows. The overall social conclusion is an unqualified support for the objectives of the project plan for both areas by the beneficiaries.

5. The water availability analysis shows that sufficient water is available for irrigating 70 percent of the irrigable areas in the dry season and 100 percent of area in the wet season. The cropping intensity used for benefit computation was lowered from a possible 1.70 to 1.60 over project life, to account for flood damage from larger than 1-day rainfall, 10-year frequency floods.

6. In the project areas high yielding varieties are grown on approximately 10 percent of the area. Average HYV-yields are 3680 and 3275 kilograms per hectare dry rough rice for wet and dry season, respectively. Farmer reluctance to use these varieties more extensively is based on a number of reasons: drainage and flood problems, lack of adequate water supply in dry periods, lack of good quality HYV-seed, fertilizer, insecticide, sprayers, etc. The project plan will resolve the water associated problems, whereas the problem of inputs availability need to be considered by concerned agencies, if the proposed yields are to be achieved.

7. Presently the major problem in both project areas is lack of adequate drainage and frequent flooding due to insufficient river and drainage

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flow discharge capacity. Levees are to be provided along the rivers in locations, where computations and past flood experience show a need to provide 10-year frequency flood protection.

Drainage excavation costs to provide for flood water removal of below 10-year rainfall frequency within a 3 day-period are included in the cost estimates for both project areas. The future dual function of the Cilaca system (Wanareja project area) as a technical rice irrigation system and part of the service area as flood detention basin to spill flood flows from Citanduy into Wanareja has been incorporated in benefit/cost analysis. The main drainage channel in Cilaca System (the Kali Serang with existing flapgate) will be improved so as to be able to pass local flood water and the flood water received in Wanareja area through the spillways to be constructed in Citanduy left levee and Cikawung right levee.

8. The possibility that limited flooding still can occur in the service area with the project (and consequently result in crop damage) has been taken into account in determining the cropping intensity of 1.6 over the 50 years project life. The absence of river data such as cross-section, discharge and water surface elevation prevented the prediction of drainage performance to the degree of accuracy desired. If the proposed drainage and flood control works perform better than can be predicted at present, the cropping intensity (harvested area) with the project will increase beyond the 1.6 proposed in this study.

9. The high degree of interaction of the drainage aspects of the Cijalu, Cilopadang and Cileumeuh system is the reason to treat these systems as a single project and it is therefore believed that the rehabilitation of these three systems in Majenang area should be undertaken as one project.

10. At present irrigation water in the Cilaca system is extensively used in the Wanareja village. It is suggested to keep seven of the existing turnouts in the future for village water supply use, as the Wanareja village will depend on this water for domestic use. No new source

for village water supply was identified. The use of the irrigation water is an established practice and will continue. Regulation of water use by the village in dry times needs to be established.

11. The net annual benefits per hectare due to project implementation have been computed to be Rp. 423,000. A large share of this benefit is due to the higher cropping intensity considered possible because of the better drainage for the low areas of the systems concerned and increased yield from the areas currently affected by floods.

12. The internal rate of return (IRR) analysis for the Majenang Project Area with the project plan is 25.0 percent, while the IRR for the Wanareja Project Area is computed to be 28.7 percent. Sensitivity analysis with respect to cost overruns, lower yields, longer development period, longer construction period, change in rice prices, show that neither of the project economic viability is affected. The lowest resulting IRR in sensitivity analysis for both project area are due to lower rice yields, 4.0 ton per hectare per crop from the predicted 4.5 ton per hectares per crop. At this lower yield level, the IRR for the Majenang area is 19.5 percent and 22.5 percent for the Wanareja Project Area.

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Recommendations

Based on the studies and conclusion of this report it is recommended, that,

1. The implementation of the plan for the Majenang Project area (Cileumeuh, Cilopadang and Cijalu systems) should be undertaken as a single project because of the high degree of drainage and flood control interaction at the end of the two major systems in the area, the Cijalu and Cileumeuh system. Only then can full project benefits be expected;

2. The proposed improvements of road surfacing over access roads into the systems and two new single lane vehicular traffic bridges over Cileumeuh and Cilopadang rivers be considered an integral part of the irrigation and drainage rehabilitation plan;

3. The operation and maintenance capability of the Seksi Irigasi office Majenang be expanded, according to plan, to be able to handle the large volume of additional O & M work as a result of project implementation;

4. Hydrologic data collection on the feeder rivers at the weir sites should be started immediately to obtain information on the water availability and dependability for each system;

5. The availability of the physical farm inputs (other than water) for increased agricultural production be adjusted to project needs, and that the extension service be strengthened to meet its new, larger task;

6. The use of the water available in Cilaca river in periods of low flow should be regulated and priorities established for the Cilaca system and the upstream Mungkalmeong Sederhana system; as both divert water from the Cilaca river.

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7. Priorities be established to regulate water use within Cilaca system, as presently home owners in Wanareja village and the farmers cultivating land in this system compete for water in dry periods. An effort has been made in this feasibility study to provide water to Wanareja village which can be stored in ponds for dry period use, but this needs to be discussed to prevent conflicting water interest in dry periods.

TABLE I-1

PROJECT COMMAND AREA

Project Area	Name of system	Command Area: Present Hectare	Command Area: Extension Hectare	Command Area: Total Hectare
Majenang Project Area (Cikawung basin)	1. Cileumeuh	1159	312	1471
	2. Cilopadang	221	-	221
	3. Cijalu	1262 1/	-	1262
	Subtotal	2642	312	2954
Wanareja Project Area (Wanareja Sub-basin)	Cilaca	626	212	838
	T o t a l	3268 2/	524	3792

1/ After weir completion

2/ This is based on figures and command area boundaries given by Seksi Irigasi Citanduy Office, Majenang. However, large areas in Cijalu system and areas at the end of the Cileumeuh system do not receive water from the diversion. Thus, this figure of 3268 hectares is believed to be too high. Area receiving irrigation water at present is estimated to be 2800 hectares.

3/ The hectarage for the net irrigable area was obtained by planimetering the 1 : 5000 maps which indicate ricelands and substracting 6 percent of the area to account for lands for canals, drainage channels, benchs, village roads, etc.

TABLE I-2

PROJECT AGRICULTURE

Cropping Intensity (rice)

	Wet Season	Dry Season	Total
Present	0.85	0.55	1.4
Future without project	0.85	0.55	1.4
Future with project	0.95	0.65	1.6

Rice Yields (ton per hectare) 1/

	Wet Season	Dry Season
Present	2.060	1.740
Future without project	2.500	2.100
Future with project	4.500	4.500

Project Benefits (Based on 1.6 cropping intensity)	Annual Amount (Million Rupiahs)
Majenang project area (2954 hectares)	1,250.280
- Cileumeuh system	
- Cilopadang system	
- Cijalu system	
Wanareja project area (838 hectares)	354.908
- Cilaca system	
Net benefit per hectare	0.423

1/ Yield in dry rough rice, Gabah.

TABLE I-3

PROJECT ENGINEERING FEATURES

ITEM	MAJENANG PROJECT AREA		WANAREJA PROJECT AREA	
	REHAB.	NEW	REHAB.	NEW
CANALS				
Primary (km)	10.475	4.775	4.500	-
Secondary (km)	7.985	14.460	9.560	7.650
Lateral (km)	18.085	26.020	10.600	13.715
Totals	36.545	45.255	24.660	21.365
DRAINS				
Primary (km)	2.600	8.710		1.400
Secondary (km)	11.500	15.490	2.700	.435
Lateral (km)	7.600	43.110		17.045
Totals	21.700	67.310	2.700	18.880
STRUCTURES				
Turnouts (Romijn)	4			
Turnout (Slide)	12	10	7	6
Farm turnouts		84		28
Checks		3		5
Drops		106		5
Check & Drops		7		15
Drain crossings	10	16		
Parshall Flumes		27		16
Flumes		2		
Road culverts	18	21	13	3
Drain inlets	1	49	1	18
Junctions		8		4
Bridges	2	3		
Wasteways		24		10

RIVER AS DRAINAGE CANAL

Rivers		Length (km)
Cikanday	(Majenang)	4.450
Cijalu	(Majenang)	7.100
Cilopadang	(Majenang)	7.350
Cileumeuh	(Majenang)	4.800
Cikawung	(Majenang)	4.400
Kaliserang	(Wanareja)	2.200
Cilaca	(Wanareja)	2.000
	Total	32.300

TABLE I-4

PROJECT ECONOMIC COSTS

(Million Rupiahs)

Majenang Project Area	
Canals	728.994
Structures (incl. on-farm facilities)	747.396
Flood improvements	1,092.195
Sub-total	2,568.585 1/
Cost of Pelita II - Works and Pelita III - Year 1979-1980 (Cijalu Weir, etc.)	441.100
Total	3,009.685
Foreign Component (direct field costs) of sub-total	682.376
Yearly O & M Costs full development	60.000
Wanareja Project Area	
Canalization (Including Kali Serang improvement)	367.887
Structures (Including on-farm facilities)	233.502
Sub-total	601.389 1/
Cost of Pelita II - Work and Pelita III - Year 1979-1980 (Cilaca Weir etc.)	100.200
Total	701.589
Foreign Component (direct field costs) of sub-total	96.476
Yearly O & M full development	17.000

Notes: 1/ Costs of proposed work include contingencies (15 percent) and Eng. + Adm. Costs (15 percent)
The estimated costs are at January 1, 1979 price level.

CHAPTER II

GENERAL DESCRIPTION

Physiography

The project plan for the Central Java Irrigation Systems deals with the rehabilitation and development of 4 (four) existing systems, all located within the Central Java Province and within the watershed boundaries of the Citanduy River Basin.

The following systems are concerned:

Name	Hydrologic Basin	Project Area Designation
(1) Cileumeuh	Cikawung basin	Majenang Project Area
(2) Cilopadang	Cikawung basin	Majenang Project Area
(3) Cijalu	Cikawung basin	Majenang Project Area
(4) Cilaca	Wanareja sub-basin	Wanareja Project Area

The first three systems use water from rivers which are tributaries to the Cikawung river, and as such are within the Cikawung basin. The Cilaca system is within the small Wanareja sub-basin of the Citanduy River Basin. The names of the streams supplying water are the same as the names of the systems. The Cilaca system is bounded by Citanduy river to the south-east, the Cilaca river to the west, the foothills of the east-west dividing mountain ridge of the island of Java in the north and the north-east, and by Cikawung basin and Cikawung river on the east and the south-east. The Cikawung is a major tributary to the Citanduy river and has a watershed basin area of 550 square kilometers at its confluence with Citanduy River. In this report, the first three system areas will be referred to as the Majenang Project Area, because of the hydrologic entity and closeness to Majenang. The Cilaca system area will be referred to as the Wanareja Project Area.

The Cilaca system lies partly within the Wanareja swamp, an area which in the past has served as a natural location for detention and attenuation of Citanduy flood peaks. The Wanareja sub-basin has a watershed area of approximately 160 square kilometers.

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The project lands of all the systems are situated in the extreme west of the Central Java Province, wholly within the Cilacap district. All the irrigable land areas are with the Majenang and Wanareja subdistricts. Majenang, located about 35 kilometers east of Banjar on the Bandung-Yogyakarta highway, is the commercial centre for all of the areas in the Central Java Irrigation Systems.

Climate

Rainfall data for Majenang and Wanareja indicate that the average annual rainfall in the Majenang area is about 2837 millimeters, and for the Wanareja area is about 2296 millimeters. Approximately 80 percent of the rainfall occurs in the October through May period. Comparison of the average annual rainfall amount for these two areas show differences, which can be explained partly by the orographic differences such as the hillsides enclosing the Majenang area in a north to south direction, while the Wanareja area is more open to the south. The average monthly rainfall is fairly even during November through March, reaches a minimum during August and September and increases rapidly in October. Generally, the monthly averages over the November-March period vary little, but the standard deviation of the average for each of these months indicate a substantial variation in time and amounts of rainfall. This fact also applies to the rainfall during the remaining months.

The mean annual temperature taken from Cilacap climatological data, is approximately 27 degrees Celsius. High winds seldom occur in the project area. The hills separating the Cikawung basin from the Sidareja-Cihaur area decrease the average wind velocity of 7 knots at Cilacap to a lesser value.

Short term records at Cilacap indicate that sunshine occurs about 57 percent of the time between 8 a.m. and 4 p.m. with percentage varying from about 70 percent in September to about 40 percent in December. The relative humidity averages about 83 percent and varies between monthly averages of 84 percent in April and 81 percent in February/March.

Streams and Watersheds

The physiography of the project area lends itself into grouping the project area into two sub-areas, the Cikawung basin or Majenang project area, and the Wanareja sub-basin or Wanareja project area. Hence, it is appropriate to discuss the streams and watershed characteristics by these areas.

Majenang Project Area

Three tributaries of the Cikawung river, the Cileumeuh, the Cilopadang and the Cijalu rivers form the feeding rivers to the systems. Existing weirs in the Cileumeuh and Cilopadang rivers and a weir under construction in the Cijalu river (to be completed in 1980-1981) divert water into the primary canals of these systems. All three weirs are located at a point where the rivers leave the hill range, just north of the Banjar-Wangon road, close to Majenang. The watershed drainage area at the weirsite is 94 square kilometers for the Cileumeuh weir, 32 square kilometers for the Cilopadang weir and 59 square kilometers for the Cijalu weir, respectively.

The Cileumeuh river joins the Cilopadang river to form the Cilopadang, and the Cijalu river confluences with the Cilanggir river which then in turn joins the Cikawung river at a point upstream of the location where Cikawung river breaks through a range of hills, extending north-west to south-east, separating the Cikawung basin from the Sidareja-Cihaur project area and Wanareja sub-basin. This range of hills, reaching elevations between 150 and 300 meters msl, isolates the Cikawung basin from its neighboring basins. From the point where the Cikawung river finds its away through these hills, it flows approximately seven kilometers before it joins the Citanduy river, just upstream of railroad bridge 1452, carrying the Bandung-Yogyakarta railway line. See Figure II-1 for the overview of the area.

After the three rivers, Cileumeuh, Cilopadang and Cijalu, cross the Banjar-Wangon road they enter the plains area in which most of the rice growing lands of the systems are located. The relative flat slope at the lower end of the plains, blocked by the range of hills in the south-west of the Cikawung basin, cause flooding at the points of confluence and in the surrounding area as well as at the point where the Cikawung leaves its own basin.

Sediment deposition from the flood waters in the low-lying area of the Cikawung basin has resulted in a slow but steady rise of the elevations of the regularly flooded lands and limits capacity of the channels of these rivers in the basin. This has enlarged the areas with swampy conditions at a slow but progressive rate. The flooding is even more pronounced when, at high flood stage of both the Citanduy and the Cikawung rivers, the high water surface elevation in the Citanduy prevents the Cikawung from fully discharging into the Citanduy. This creates backwater resulting in reduced velocities in the Cikawung river and its tributaries within the Cikawung basin. The backwater effect also causes over-topping of embankment within the Cikawung basin, flooding the low-lying areas in the basin, and giving the sediment an opportunity to deposit before the flood-waters are drained.

Large volumes of sediment are produced by severe erosion in the upper watersheds of the Citanduy basin, including the Cikawung river sub-basin. The Cikawung basin is one of the more critical erosion areas in the Citanduy basin. This has caused aggregacion of stream bedchannels.

Wanareja Project Area

The drainage area of the Cilaca weir is about 23 square kilometers and lies immediately north of Wanareja village. At present two free intakes for irrigation water supply are located in the river. The upstream one is used for the Wanareja irrigation system and is operated by the Seksi Irigasi Citanduy office, Majenang. A second free intake less than a kilometer downstream is built and operated by the people of the Cikudapaeh area adjacent to the Wanareja (Cilaca) system and is shown on Figure II-1 . In recent times (1975-1979) the Mungkalmeong Sederhana system has been constructed. This is located north of the Banjar-Majenang road and is indicated on Figure II-1. For this system a weir with a gabion crest was built about four kilometers upstream of the present Cilaca-system free intake. This weir diverts water from the Cilaca river to the west of the Cilaca basin to serve an area of about 600 hectares.

Existing Facilities

This feasibility study was undertaken to identify the rehabilitation and improvement works needed to upgrade the rice production capability of the Central Java Irrigation systems. An attempt will be made in this section to describe the existing irrigation and drainage facilities for each of the two project areas identified. Based on this, general problems and needs of systems in both areas are presented. The Chapter VI, Engineering Plans and Costs Estimates, will present an outline of the proposed structures and works considered necessary to improve irrigation distribution and thus optimize the benefits from the area. Summary data regarding the existing facilities are presented on Table II-1. Maps presenting a lay-out of existing canals and drain channels for each system can be found in the Appendix to this report.

Majenang Project Area

This project area represents three systems:

1. Cileumeuh
2. Cilopadang
3. Cijalu

Cileumeuh System. The weir on the Cileumeuh river, just north of the Majenang-Wangon road, was built in 1965-1966. In 1979 structural changes were carried out. The abutment wall was raised to five meters above weir crest elevation, to prevent overflow as occured during the 1978 flood. The weir has a 42 meter wide crest, an undersluice 2.5 meters wide and an intake 1.3 meter wide. The regulator, located on the left bank, serves the area on the east side of the river. A 0.8 meter diameter pipe embedded in the weir crest transports water from the left intake to the west side of river for irrigation of a relative small section of land (approx. 150 hectares) which otherwise can not be irrigated. The weir is presently in very good condition and needs only proper O & M. At the weir site the catchment area is 96 square kilometers. The one day-rainfall 25-year frequency flood has a discharge of 260 cubic meters per second. A small sediment trap (slipzak) immediately downstream of the intake at the weir has a length of 50 meters and will only remove the coarser sand particles from the diverted river water, it regularly cleaned and undersluice properly operated.

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The existing primary canal of 8.90 kilometers length is lined with riprap along its sides over 2.4 kilometers, from the sediment trap. Plans exist within the Seksi Irigasi Wilayah Banyumas to provide riprap protection for the remaining 6.5 kilometers during this Pelita III period. The primary canal has seven turnouts, of the Romijn gate type, which serve areas ranging from 31 hectares to over 200 hectares. Just south of the point where the river and the primary canal cross the main road, a side channel spillway in the river diverts flood flow at high water level in the Cileumeuh river (uncontrolled) into the former channel of the Cileumeuh river (Cileumeuh mati). At present the spillway entrance is silted up reducing the diversion capabilities. For this spillway, a large 2 barrel culvert is provided under the primary canal.

Except for the above mentioned technical facilities the remainder of the I & D system is of a rural type irrigation nature, with little or no water management or water measurement capability beyond the existing turnouts on the primary canal.

Cilopadang System. The weir was built in 1917 and has undergone several rehabilitations since that time. It is still functioning properly and no major upgrading is envisaged. However, just north of the weir the river has the tendency to leave its course after flood stage and thus bypass the weir. The weir is located about 1.30 kilometers north of the Majenang-Wangon road in the Desa Cilopadang. It has an intake on the left bank with a single slide gate. The design capacity of the intake is 1.87 cubic meters per second. A small desilting basin is located immediately after the intake and is riprap lined. Flushing capability into the river exists at a point 150 meters from the intake. The drainage from the hills on the left bank over the first kilometer is discharged into the river through two side spillways at points of 0 + 300 and 0 + 750 meters in the canal. This section of one kilometer is riprap lined along its side and is well maintained.

At station 1 + 050 from the weir, the primary canal divides into two secondary canals; the right secondary canal is lined (since 1978) over the first 200 meters and has access steps down its bank for washing and bathing purposes. Except for this lined section, the remainder of the secondary canals are not lined.

Cijalu System. The Cijalu weir is under construction since 1974 and is planned for completion in 1980. This will replace two rural type intakes on the right and left side of the Cijalu river, just north and south of the new weir. The new weir is divided into four overflow weir sections with the intake in the middle of the weir; and has an operating bridge span 1.5 meters wide. From this intake, two pipes 1.2 meters diameter and embedded in the weir crest, carry water to the left and right side of the weir. The pipes discharge into a small sediment trap with hydraulic flushing capability into the river for removal of deposited sediment.

Wanareja Project Area

This area has presently one irrigation system (Cilaca), classified as technical and under the responsibility of the Seksi Irigasi Citanduy Office in Majenang. Adjacent to this system is the Cikudapaeh rural irrigation system, built and operated by the Desa Wanareja. Because there exists the possibility of combining these two systems which divert water from Cilaca river, (diverting water from the Cilaca weir to be constructed in 1979-1981), the existing facilities of each of the system is presented below.

Cilaca System. Presently, a free intake in the Cilaca weir, north-west of the Wanareja village, diverts water into the primary canal. This free intake will be replaced during 1979-1981 by a weir to be located at the point of the free intake. The free intake has an undersluice but has no sediment trap. The relevant dimensions of the proposed weir are presented on Table II-1. The present two meter wide approach section of the free intake in the river can function as a sediment trap because the waterlevel in the sediment trap can be controlled and will not be dependent on river water level, once the new weir is constructed.

The primary canal is riprap lined (implemented in the Pelita II - period) over the entire length of 3.0 kilometers; at various points steps are provided to enable people to reach the water supply. The canal runs in hilly terrain just north of the Wanareja village. Because of this, a number of drainage over-chutes have been constructed to carry excess runoff water from hills over the canal into drains running through the village.

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Eight turnouts with slide gate are located in the primary canal, and deliver water to rural type earth canals. These ditches go through the Wanareja village to serve the area south of the Banjar-Majenang road. The service area has no technical structures.

Cikudapaeh Rural System. Approximately 0.7 kilometers downstream of the Cilaca free intake, a rural intake was constructed in the Cilaca river by the Desa Wanareja to provide water to the Cikudapaeh area which serves about 215 hectares. The system is operated and maintained by the villages. Various small structures such as culverts and spillways have been built with local money in the period 1970-1973.

Problems and Needs

This study is directed towards rehabilitation and further development of the existing irrigation systems in the area concerned, and towards better drainage and flood control measures for the service area. In addition to the problems and needs associated with this, field observations and interviews with local officials and farmers revealed that other problems and needs exists within the project areas; problems of agro infrastructure, inputs for increased agricultural production, employment, education, health, credit and so forth. Attainment of full benefits of the proposed project plans will depend on the measures taken to lift these constraints on increased agricultural production and the welfare of the people in the total project area. These points are discussed Chapter IV-Social Considerations.

The main problem in the areas are related to water. Existing facilities allow water diversion from rivers into primary canals. However, the rural type distribution systems have little or no water management capability. To obtain this, remodeling and upgrading of the systems is required. The most striking problem is the lack of adequate drainage and flood control measures in both project areas. Channel widening of existing drains is needed badly, along with new drains. Levee protection for prevention of regular flooding of both village lands and rice land is required. Both project areas suffer serious damage each year due to the inadequate drainage. The Cilaca system in the Wanareja swamp and the Cijalu system

in Majenang area are affected most. Presented below are the detailed needs of both project areas with respect to irrigation, drainage and flood control, and specific needs of the area.

Majenang Project Area Needs

The following technical needs are identified and plans have been made and are presented in Engineering Plans and Costs Estimate chapter. These are;

1. Water Management capability - to assure accurate and timely water delivery to irrigation blocks of approximately 30 hectares (all systems). Upgrading canal capacities and provision of structures considered necessary.
2. River training over a section of the Cilopadang river, just north of the present weir, to prevent bypassing of the weir by the river water during floods.
3. Enlargement of BTY-1 (present code) canal in Cileumeuh system (new code: H-I-2) to extend the command area of 68 hectares to 380 hectares, the area recommended for irrigation.
4. Levee protection along Cileumeuh river in Benda village to prevent flooding of dense housing areas.
5. River training and levee protection at the confluence of the Cilopadang-Cileumeuh rivers to prevent present overflow of water into the Cijalu system.
6. Extensive drainage rehabilitation and new drains in all systems, with emphasis for the Cijalu system in the Pahonjean-Cilanggir area.
7. Road surfacing and a new bridge for vehicular traffic at Benda village to provide easier access to Cileumeuh system from Jenang, Sindangsari and Cilopadang Desas.
8. Provision of a permanent foot bridge across the Cileumeuh at the confluence with the Cilopadang, to facilitate foot and motorcycle traffic between the systems.

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9. Channel improvement of the rivers located in the Cilanggir-Pahonjean area in order to pass larger flows. Capacity to be based on 10-year one day rainfall.

10. Provision of levees along Cilangir-Ciglagah, Cilopadang, Cijalu to pass a flow of 200 cubic meters per second into the Cikawung river. The need for a number of small flapgates and drain inlets with flash-boards has been identified in these levees.

11. New culvert at present culvert site on the Banjar-Wangon road between Cilanggir and Pahonjean in Cijalu system in order to drain the present swamp more effectively.

Wanareja Project Area Needs

For the rehabilitation and improvement of the Cilaca system in the Wanareja Project Area, the following problems and needs have been identified:

1. Extension of the irrigation facilities to obtain water management capabilities in the irrigated area.

   At present, the primary canal (being the only technical facility) runs north of the Wanareja Village along the hills. Beyond the turnouts on the primary canal the system is a rural-type system. Excessive seepage losses occur because of soil conditions, along with water diversion by villagers to houses and fishponds. The distribution system intermingles with the drains of the village. These drains carry water collected in the hills north of the primary canal and cross the canal at various points by way of overchutes. The remainder of irrigation and drainage water, not used in the village, is collected in ditches along the Banjar-Majenang road and crosses the road through a number of small culverts. In the irrigation area itself almost no technical structures exist except for rural type culverts and bridges.

2. Regulation of canal water use by Wanareja village for non-irrigation purposes.

   In the village area water is diverted from the combined irrigation-drainage canals and through extensive and elaborate bamboo pipe networks to provide houses and fishponds with water. Permanent

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locally built concrete structures for water diversion from canals can be found at several locations along the primary canal. Use of irrigation water by the villagers occurs at other places, but not to the extent as in the Wanareja Village. This problem is recognized by the village head, who tries to maintain a balance between the villagers and the farmers needs in the area, but with present facilities, he cannot regulate the water use properly.

The problems mentioned under point 1 and 2 are interrelated and an engineering solution for water management and seepage problems in the village, will require the consensus of the parties involved.

3. Drainage and flood problems.

The major problem which affects people and agriculture the most is related to the swampy area in the middle of the Cilaca system, immediately south of the Wanareja Village. This is created by insufficient and inadequate drains to remove local rainfall water carried from the hillsides north of the system and overflow from the Citanduy and the Cikawung river at (low) floodstage. A large area varying in size from 100 to over 300 hectares is frequently flooded for long periods, and the swamp area never really reduces to less than 100 hectares, except during dry periods. In the future, the Wanareja swamp will have protection by new higher levees, scheduled for construction during the implementation of the Citanduy Flood Control Scheme in fiscal year 1980-1981. As presented in Chapter VII, it is necessary to keep the Wanareja swamp as a flood detention off-channel storage basin through spillways in the Citanduy left levee and the Cikawung right levee. For removal of the excess water collected in Cilaca system, the Kali Serang drain needs extensive widening and deepening and the unfinished flapgate needs to be completed.

4 Regulation of water use from the Cilaca river.
The Mungkalmeong weir competes for water with the Cilaca system. Priorities need to be established in order to obtain full benefits from the rehabilitation of the Cilaca system.

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TABLE II-1

OVERVIEW DATA EXISTING FACILITIES

	Wanareja Project Area		Majenang Project Area	
System	Cilaca	Cijalu	Cilopadang	Cileumeuh
Weir				
Year Constructed	1979 - 1981 1/	1974 - 1980 2/	1917	1966 3/
Width (m)	22.00	77.00	± 16.00	42.00
Height (m)	1.70	2.90	± 2.00	5.00
Crest Elevation	+ 29.10	+ 41.40	- 4/	+ 27.20
Desilting Basin (Slipzak)	1	2	1	2
Canal & Structures				
Length (m)	24,660	13,195	3,550	17,800
Bed Width (m)	0.60 - 1.50	-	0.85 - 1.44	0.90 - 1.85
Capacity (cms)	0.05 - 1.73	1.25 - 1.90	0.50 - 1.87	0.66 - 1.54
Turnouts	8	1	4	7
Farm Turnouts	-	-	-	-
Culverts	3	2	2	7
Side Spillways	4	-	3	-
Drain Overchutes	5	-	-	-
Drain Culverts	2	-	6	5
Bridges	-	1	2	1
Overchutes	1	-	-	-

1/ Presently free intake; to be replaced by weir in 1979 - 1981 period.

2/ Planned for completion 1980.

3/ Structural change of abutments in 1979 for additional flood protection.

4/ Information unknown.

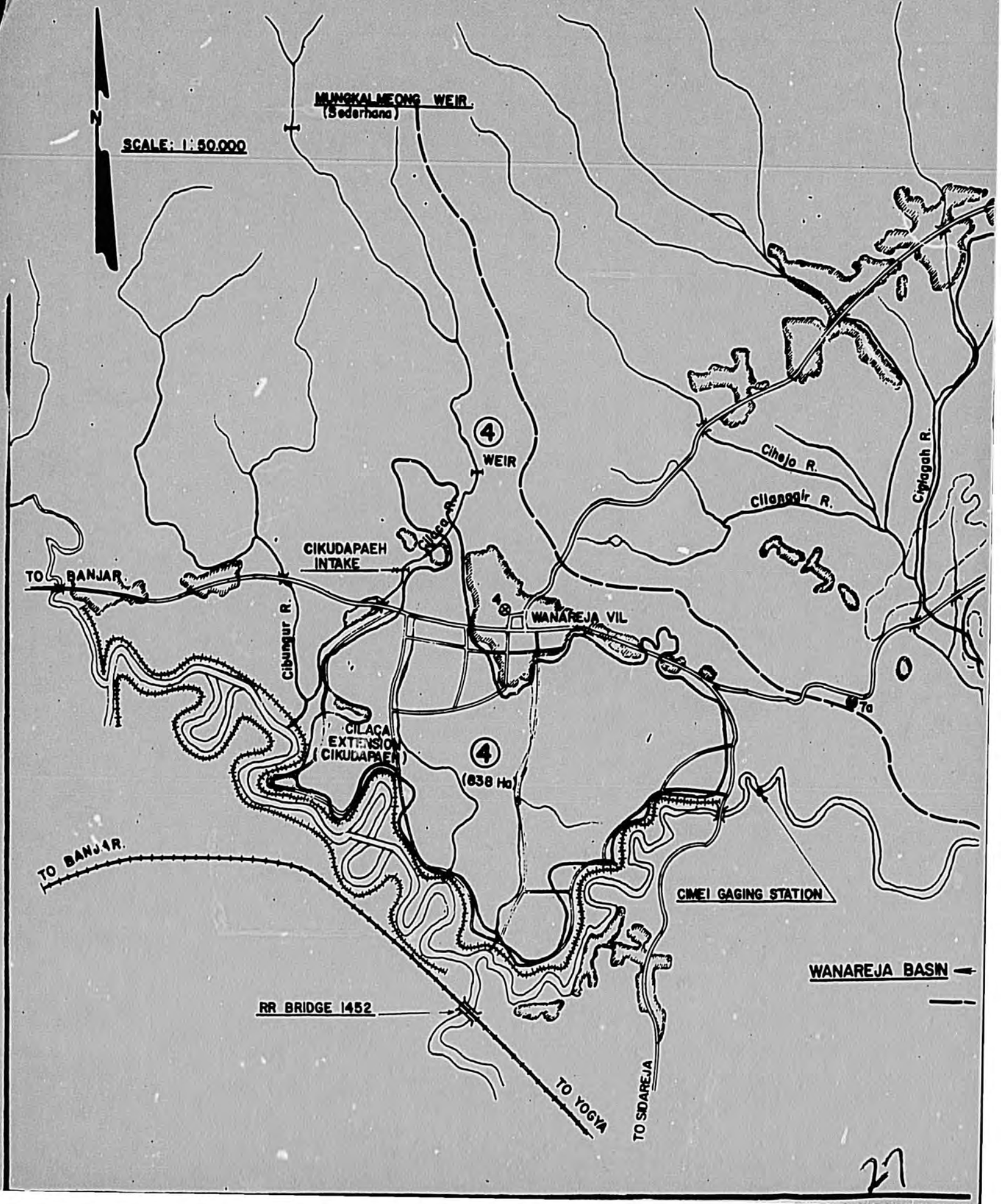
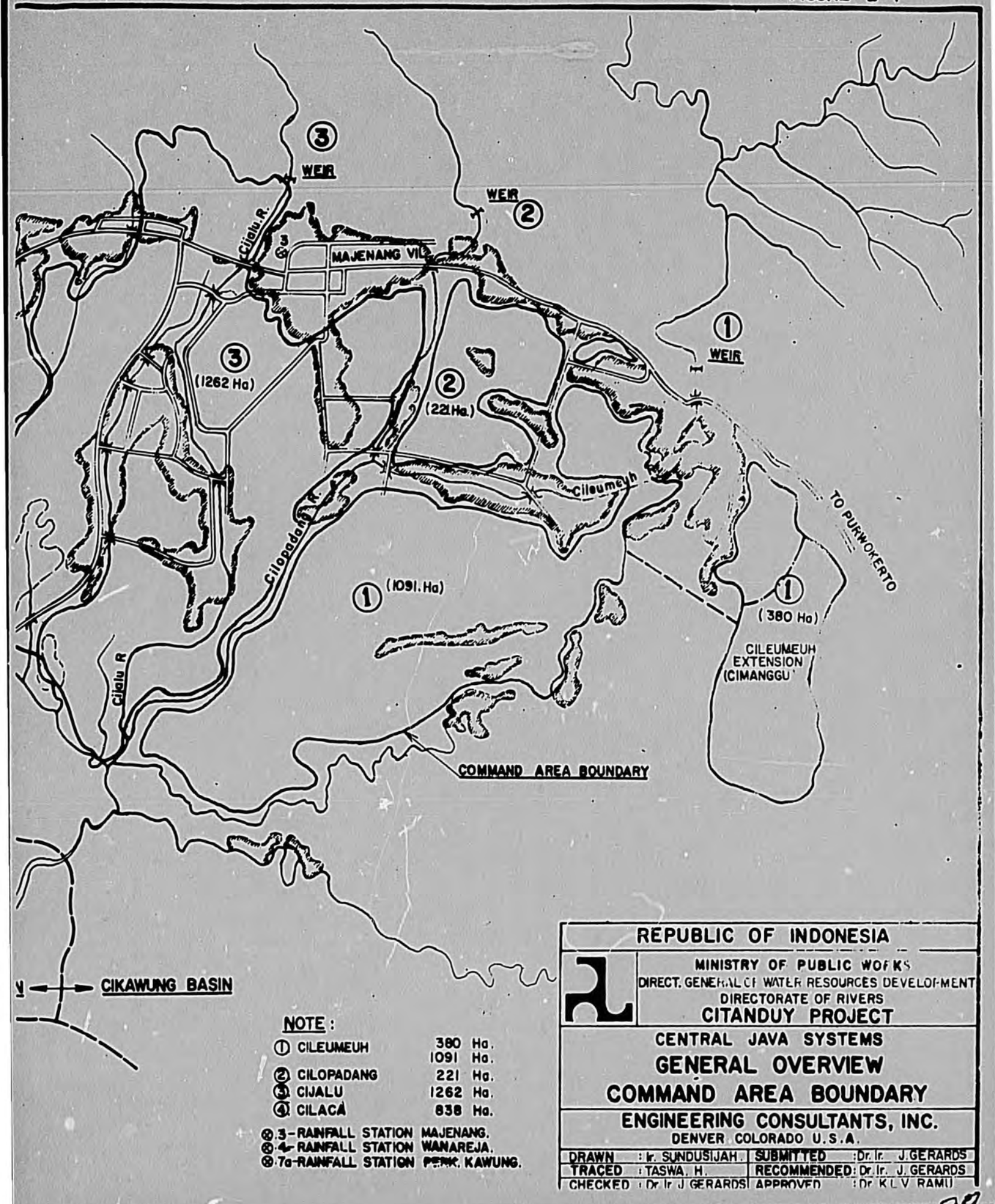

N
SCALE: 1:50,000
MUNGKALMEONG WEIR
(Sederhana)
4
WEIR
Cihejo R.
Cilanggir R.
Cipagah R.
Cilaca R.
CIKUDAPAEH
INTAKE
TO BANJAR
WANAREJA VIL
Cibungur R.
Ta
CILACA
EXTENSION
(CIKUDAPAEH)
4
(838 Ha)
TO BANJAR
CIMEI GAGING STATION
WANAREJA BASIN
RR BRIDGE 1452
TO YOGYA
TO SIDAREJA

FIGURE II-1


WEIR
WEIR
WEIR
Cijalu R.
MAJENANG VIL
(1262 Ha)
(221 Ha.)
Cileumeuh
Cilopadang R.
(1091. Ha)
(380 Ha)
TO PURWOKERTO
CILEUMEUH EXTENSION (CIMANGGU
Cijalu R
COMMAND AREA BOUNDARY
CIKAWUNG BASIN
NOTE :
① CILEUMEUH 380 Ha. 1091 Ha.
② CILOPADANG 221 Ha.
③ CIJALU 1262 Ha.
④ CILACA 838 Ha.
⊗ 3-RAINFALL STATION MAJENANG.
⊗ 4-RAINFALL STATION WANAREJA.
⊗ 7a-RAINFALL STATION PERK. KAWUNG.
REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECT. GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT
CENTRAL JAVA SYSTEMS
GENERAL OVERVIEW
COMMAND AREA BOUNDARY
ENGINEERING CONSULTANTS, INC.
DENVER COLORADO U.S.A.
DRAWN : Ir. SUNDUSIJAH.
TRACED : TASWA. H.
CHECKED : Dr. Ir. J. GERARDS
SUBMITTED : Dr. Ir. J. GERARDS
RECOMMENDED : Dr. Ir. J. GERARDS
APPROVED : Dr. K.L.V. RAMII

CHAPTER III

LAND AND AGRICULTURE

Introduction

This chapter presents information pertaining to the soils, land use and type of farming in both project areas. Based on data collected from various sources and studies, the yields, which can be expected in the future without and with the project, are discussed. The cropping calendar proposed for the project is presented at the end of the chapter.

The land areas under command have a flat terrain, mainly consisting of rice paddies, broken by villages, gardens, roads, drainage features and low spots with drainage problems. Present land use is intensive during both seasons with rice being the predominant crop grown. However, the high intensity cultivation does not mean that a rice crop is harvested over the total command area nor more than two crops obtained in a year. Very little upland crop is grown in the command area.

The agricultural potential of the land is based on the existing soils, their physical and chemical deficiencies, fertility and the possible degree of alleviation of frequent flooding problems and overall future management.

Existing problems that limit present crop production consist of chemical and physical deficiencies of the soil, excess surface water during both seasons in part of area, and/or lack of moisture during the dry season. Contributing to these problems are the reluctance by some of the farmers to use high yielding variety (HYV) seed and chemical fertilizers or the recommended amounts of fertilizers. Also, the activities of the agricultural extension services to promote better crop and land practices may not be optimal. In addition, the agricultural survey for both project areas revealed a lack of sufficient HYV seed, lack of sprayers and insecticides, and insufficient credit availability to purchase the necessary physical inputs for the HYV-package. This, together with an unsure water supply explains part of the farmers' reluctance to use the high yielding varieties.

Area under irrigation at present was estimated to be 3268 hectares. This is based on information provided by the Seksi Irigasi Citanduy Office, Majenang and measurements from the 1 : 5000 scale maps available for both project areas

(Majenang and Wanareja). However, field investigation and interviews of the officials in the villages indicated that the area presently obtaining irrigation supplies is somewhat less, approximately 2800 hectares. The area subjected to flooding amounts to about 150 hectares in the Cilaca system in Wanareja Area and about 300 hectares in the Cijalu and Cileumeuh systems in the Majenang Area. These swamp areas vary in size, depending on intensity and distribution of rainfall.

Soils

Soil Survey

A detailed field investigation and soil sampling program was not conducted for both project areas. Since the project is concerned with rehabilitation and improvement of irrigation system for rice-production, land classification to determine for what crops the project area soils are suitable was not deemed necessary. However, the soils expert of the consultant has travelled through both areas extensively for field reconnaissance of soils. The following observation is based on the field reconnaissance information.

Soil Classification

The agricultural soils in the command area of both project will have increased crop production potential after the existing problems, primarily due to excess drainage water, have been corrected. Crop production can be expected to increase to double present yields, once required inputs (seed, fertilizer, water management, incecticides, etc.) are used properly and applied in appropriate time sequence.

Soils in the project area are either

R 1,	- Majority of area (approximately 80%).
R2d(1) or	- In areas with drainage problems (remainder
R3ds (1)	of project area - 20%).

where R stands for rice lands;

1 for class 1, no major deficiency;
2 for class 2, due to drainage deficiency;
3 for class 3, due to soil and drainage deficiency;
d for drainage deficiency (excess surface water);
s for soil deficiency (chemical), and
(1) for class 1 after deficiency has been corrected.

The soils consist of recent and subrecent alluvium and other sediments deposited by flooding of rivers and smaller streams. The soil in the area have a distinct brown, dark brown and reddish-brown color, and are considered good rice and garden soils.

Surface drainage of the R2d and R3ds soils will be necessary if optimum production is to be expected. Excess water in the paddies will not enable rice plants to grow at a normal rate. High-yielding varieties require a controlled water level if plant growth and yield potential are to be obtained.

With provision for drainage and flood control works, one major constraint for adaption of use of HYV will be lifted, and all soils in the project area can be classified as R1, if project plan is implemented.

Land Use

Present land for agriculture in the command area is almost solely under rice cultivation with some garden crops. The villages consists of houses surrounded by coconut, banana and other fruit trees, with little land devoted to the production of vegetables. Table III-1 presents the land use in both project areas with respect to ricelands, villages with gardens, and wasteland. The information as presented in Table III-1 was obtained from field reconnaissance and planimetering of areas from the available 1 : 5000 scale maps.

The irrigated area in the command area is 3268 hectares. Two new extensions totaling 524 hectares have been proposed to include additional areas under irrigable command based on technical feasibility and on the needs expressed by the local people and by the Central Java Irrigation authorities. This result in a total irrigated area for rehabilitation and improvement of 3792 hectares of which 2954 hectares are located in the Majenang Project Area and 838 hectares in the Wanareja Project Area. Further, limited extension of the command area to include rainfed riceland is possible in the Cileumeuh system, but should be considered in the future, after data on the Cileumeuh river flow and other smaller streams have been collected over a number of year to determine water

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availability in crucial periods of rice production. In the Majenang Project Area, eight villages have part or all of the village and rice lands within the command area. The Cilaca system in the Wanareja Project Area falls totally within the boundaries of the Wanareja village. Table III-2 presents the gross area of the village and the rice land in the village, along with the rice land area and village area within the project command area. The total village areas and the village rice land areas were obtained from village records. The rice and village areas within the command area were found by transferring the reported village boundaries to the available 1 : 5000 scale maps and consequently by planimetering. The results of this investigation are reported in Table III-2. This table also shows the precentage of gross village area and rice area of a village in the command area. Figure in the appendix shows political village boundaries and command area boundaries for the various villages situated in the project area.

Type of Farming

The major crop grown in the project command area is rice. The farming as practiced is highly labor intensive. Farms are small, and almost all of the work performed is by manual operations. Some farmers own water buffalo which are used for plowing and harrowing. Seedling from nurdery beds are transplanted to the prepared seed bed. Fertilizer is applied, but generally in insufficient quantities. Harvest is by ani-ani knife for local varieties, and sickle harvesting for HYV varieties. The rice paddies are kept full continously as long as water is available from rainfall or irrigation. Most farmers plant a second crop, but this may not be harvested or there may be decrease in yield because of water shortage.

The obtain full benefits from the HYV varieties, projects which assure adequate water supply are most important. The Government of Indonesia has farm level programs to encourage the use of HYV with good management inputs, and an ordinary program for the use of local varieties.

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A survey of the villages, with riceland wholly or partly within the project command areas, was made in April 1979 to obtain information on:

1. Rice varieties used in village,
2. Yields obtained in metric ton per hectare per crop for local and HYV for both wet and dry seasons,
3. Area under riceland cultivation in each village.

The results of this survey are shown below. Presented are the average yields per hectare for wet and dry season for both Majenang and Wanareja project area. All yields are in dry rough rice ready for milling - Gabah Kering Giling Pabrik.

	Wet season		Dry Season	
	Local Varieties	HYV	Local Varieties	HYV
Yield (ton/ha)	1.880	3.680	1.575	3.275
Percent of harvested area	90	10	90	10
Average	2.060		1.745	

Present rice production is based on local varieties and a limited number of HYV varieties. It is estimated from sub-district records and data provided by local village officials that ten percent of the project area is cropped to HYV. Crop yield for high yielding varieties approximate 70 to 80 percent of possible yields when proper water management and other physical inputs are used. Farmers' use of chemical fertilizer is a common practice when Pelita or IR varieties are grown, but recommended amounts are not always used. The fact that local varieties are still used on 90 percent of the command area can be attributed to the lack of water management capability, lack of water supply at times, drainage and flood problems, taste, resistance to insect infestations, mice, lack of seed, lack of fertilizer, sprayers, insecticides, etc. Because of these problems the farmers are continuing to use local varieties and accepting the decreased yields.

Next in importance to the rehabilitation of existing facilities, distribution and on-farm system development, and drainage and flood provisions is an active agricultural extension service which will help assist the farmers in increasing rice yields beyonds present level.

Crop Yields

The basis for evaluating the effect of the project requires an estimation of the expected future crop yields without the project and with the project. The future crop yields without the project will be different from the present crop yields. The existing crop yields as described serves as a starting point. Principal differences between the present and the future crop yields, without the project plan, are the effect that ongoing trends in the adoption of agricultural technology will have on production efficiencies and level of output. All yields discussed refer to rice crop yield in Gabah Kering Giling di Pabrik - Dry rough rice dried to 14 percent moisture.

Without Project

The main constraints on increased agricultural production will continue to be flooding and poor drainage in wet season due to insufficient and inadequate drains, and uneven or lack of water supply in the dry season, resulting in low water management capability. High yielding varieties are best adapted to controlled water supplies. Improved management and fertilizer can be made available but the rate of adoption is expected to continue at a relatively slow pace and may reach a ceiling in the near future. For the future without the project an increase in the average yield of 20 percent has been forecast in the project area, resulting in (rounded figures) 2500 kilogarms per hectare for wet season and 2100 kilograms per hectare for dry season.

Cropping intensity in future without project is dependent on water availability in the feeder rivers and upon the quantity and distribution of the rainfall in the dry season. Also, the degree of flooding and drainage in both project areas may reduce the cropping intensity over the area considerably during wet years. As long as the constraints on adoption of HYV are not lifted, local varieties with their longer growing season will continue to be used, resulting in the probability of insufficient moisture during the period June-September.

With Project

With present facilities, resulting in poor water management it is felt that the average yield for HYV and local varieties per hectare per crop can not be improved much further nor will the local varieties be replaced by HYV varieties over the entire area. With the project, the potential exists to increase agricultural production in the project areas by overcoming the major constraints,i.e., lack of adequate Water management capability, and lack of proper drainage. The project will assure a higher level of water management capability and will remove excess water in the frequently flooded portions of the command areas.

The principal limitation hampering use of HYV, fertilizer and insecticides is financing. Farmers lack the financial resources to purchase these inputs. Under the government program for mass guidance (BIMAS),farmers in technical irrigated rice areas can qualify for loans or subsidized prices. A follow-up program is available to farmers to promote continued intensification practices (INMAS).

The future rice yields with the project are based on the following project features and institutional arrangements.

1. Availability of an adequate water supply.
2. Construction of an efficient distribution system with tertiaries for irrigation blocks averaging 20 to 40 hectares and providing financing for construction of on-farm facilities.
3. Construction of a drainage system to accomodate ten year flood frequencies, where possible.
4. Construction of water management structures in the distribution system and proportional flow dividers in the tertiary systems. Develop a comprehensive water management program with scheduled water deliveries on a rotational basis.
5. Expansion of improved Agricultural Extension Service for the improvement and implementation of farm irrigation practices.
6. Additional local BIMAS representation and crop inputs and strengthening of credit facilities.

Research and Testing Results. The IRRI Research Newsletter of December 1977 report farm yields of 5.9 tons per hectare of IR 26 variety in Indramayu and of 5.6 tons per hectare for C4-63G. These varieties were planted as gogo rancah (direct seeded on moist aerobic soil). By using the gogo rancah technique farmers were able to plant 15 days earlier with these 125 day maturity varieties and had higher yields than with Pelita I/1.

Recent studies by CRIA of farm yields in the Indramayu area of West Java with Pelita I/1 in 1977 show the following results :

Irrigation Supply Seven Months	Yield in kg/ha Wet Season	Dry Season
Farmer management	5,497	6,551
Two crops/year	3,400	2,700
Three crops/year	4,710	3,710

The IRRI is continuing to develop new improved rice varieties. The "Indonesian Times" July 12, 1978 reported on IR 36 VEM (Very Early Maturing), maturing in 100 days, yielded 5,800 kilograms per hectare. It is very resistant to rice tungro disease, bacterial leaf blight and insects such as green and brown leafhoppers. It is also tolerant to zinc, phosphate and iron deficiencies. This variety outyielded all other early maturing varieties at 22 locations in the Philippines in the wet season of 1975. The Philippine Ministry of Agriculture has ordered nationwide use of this variety.

Constraints to HYV Rice Yields. Generally the rice yields achieved by farmers are lower than those obtained on experimental plots. Even where the adoption of HYV is relatively high the farmers' yields are still lower.

The IRRI has studied this problem in Pakistan, India, Malaysia, Thailand, Philippines and Indonesia to determine the reasons,. It was determined in early studies that HYV are more widely grown in the dry than the wet season. The farmers consider pests and diseases their most serious constraints and IRRI reasearch

confirmed this. In the dry season in the Phillipnes, with IRRI recommended practices, rice yielded 7.28 tons per hectare compared with farmer practices yielding 3.9 tons per hectare or a difference of 3.38 tons per hectare. During the wet season weed control was the most important factor.

The reduction of farmers' crop due to various constraints in the dry season are summarized as follows:

	Ton per hectare	Percent
Insects and diseases	1.19	35
Water	0.88	26
Nitrogen	0.71	21
Weed control	0.30	9
Seedling management	0.30	9
T o t a l	3.38	100

This indicates that with the project, crop yields somewhat less than research plot results must be anticipated depending upon the extent of Agricultural and credit support available to the farmers.

Estimated Crop Yields. The data collected indicated that approximately ten percent of the areas was planted with HYV varieties during both wet and dry season during the past four years, and that yields obtained on these areas were relatively good. The average yield during the wet and dry season was reported to be 3680 kg/ha and 3275 kg/ha respectively for the HYV's. With assured additional water supply and water management capability, and the recommended drainage and flood control works, these yields can be further increased to levels similar to those obtained in other rice producing area where proper inputs are used extensively.

Rice yields were reported for seven villages in the North Lakbok Irrigation area of Proyek Citanduy for the period 1974-1977. Yields for class 1 lands (Indonesia land classification standards for tax purposes) ranged from 4,000 kilograms per hectare to 2,800 kilograms per hectare of dry rough rice. These yields are yields for all varieties for wet and dry season.

Rice test plots by the Agricultural Extension Service of the Cilacap district during the wet season 1977 and 1978 are summarized in Table III-3.

Dry rough yields for irrigated rice with the BIMAS program for the Ciamis district show that no significant differences exist in average yields for the wet and for the dry season, with irrigation and proper drainage; neither can one conclude that a significant trend exists in the seven years of data. Based on the survey in both project areas and the above facts it was determined that an average yeild of 4,500 kilograms per hectare for the wet as well as the dry season be used with the development of the project.

The average crop yields used in this study are:

	Present	Future Without Project kg/ha	Future With Project kg/ha
Rice			
Wet Season	2,060	2,500	4,500
Dry Season	1,740	2,100	4,500

(Yields are in Dry Rough Rice - Gabah Kering Giling di Pabrik, dried to 14 percent moisture).

Cropping Calendar

The agricultural information and the water availability study was used to develop an appropriate cropping calendar. The proposed cropping calendar is based on the following.

1. The main crop in the irrigable command area is and should remain rice.
2. Short-term HYV should be grown over the entire project area in order to achieve full benefits. For the wet season crop a rice variety of 125 days growing season is suggested, whereas for the dry season in order to prevent irrigation extending into the months of July and August, a 100-days variety of HYV is recommended.

3. The normal start of the wet season crop will be the beginning of October and the delayed start around November beginning if the month of October is dry. Rainfall data for the two project areas and the Cimei gaging data of the Cikawung river indicate this possibility of delayed start one out of three years, as discussed in Chapter V.

4. Taking into account a 30-day land preparation period for each crop, and the HYV growing season length as recommended, the dry season crop would be harvested during June 1 to first week of July for the normal start, and from last week of June to August 1, if delayed start of wet season crop occurs.

5. From the analyses and discussion in Chapter V and VII on Water Requirements and Supplies, and on Flood Control Plan Formulation respectively it was determined that for the economic evaluation of the future with the project a cropping intensity of 1.60 per year is considered realistic. For the wet season the intensity is taken to be 0.95 and 0.65 for the dry season crop. The dry season cropping intensity of 0.65 does not mean that only 65 percent of the command area will be planted to rice in the dry season. Normally all the area will be planted to rice in both seasons. The rainfall data for the project areas show that for a large number of years (about 50 percent of time) the rainfall in May and June is sufficient to provide, with some supplemental irrigation, enough water to be able to harvest close to 100 percent of area with full yield. For benefit computation, only 65 percent of areas is assumed to be harvested with full yield during the dry season.

6. At present very little upland (palawija) crop is grown in the irrigable command area. Introducing an upland crop on a large scale has not been considered in this feasibility because all farmers are not familiar with its production nor will the farmers grow an upland crop over large areas without local demand. However, excluding the upland crop from the cropping calendar, does not mean it will not be grown after the project is constructed and operational. Over part of the area, which is harvested in the beginning of June (after normal start of wet season rice crop),

an upland crop can be planted when sufficient soil moisture and water for supplemental irrigation diversion at weir site is available.

The proposed cropping calendar is shown in Figure III-1.

TABLE III-1

LAND USE IN COMMAND AREA

	Majenang Project Area		Wanareja Project Area	
Description	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Village 1/	1219	27	535	34
Rice land 2/	2954	66	838	54
Waste land 3/	316	7	192	12
T o t a l	4489	100	1565	100

1/ includes houses, roads within villages, house gardens, fishponds, etc.

2/ includes the areas with present drainage problems which project plan attempts to alleviate.

3/ includes rivers, levees, drains, roads between villages, etc.

TABLE III-2

VILLAGE LANDS AND RICELANDS IN COMMAND AREA

Villages	Gross area			Rice land area		
	Village (ha)	Village in command area (ha)	Percent	Village (ha)	Command area (ha) 2/	Percent
Majenang Project Area						
Jenang	751	691	92.0	455	455	100
Sindangsari	865	599	69.3	532	430	80.8
Pahonjean	818	818	100.0	462	698	100 1/
Cilopadang	1619	1428	88.2	732	711	97.1
Cibeunjing	1163	204	17.5	211	163	77.3
Salebu	1470	69	23.2	341	65	19.1
Cileumpuyang	1262	356	28.2	367	176	48.0
Cimanggu	2990	324	10.8	662	256	38.7
Subtotal	10938	4489	41.0	3762	2954	70.5
Wanareja Project Area						
Wanareja	2644	1565	59.2	978	838	85.7
Total	13582	6054	44.6	4740	3792	80.0

1/ The reported village riceland area for Pahonjean is less as the measured ricelands of the command area, from maps as village officials subtracted the present swamp area in Pahonjean-Cilanggir area from the possible riceland area, after swamp drained.

2/ The hectarage for the net irrigable area was obtained by planimetering the map indicated ricelands under command and consequent substracting of 6% of area to account for wasteland as canals, drainage channels, bunds, village roads, etc.

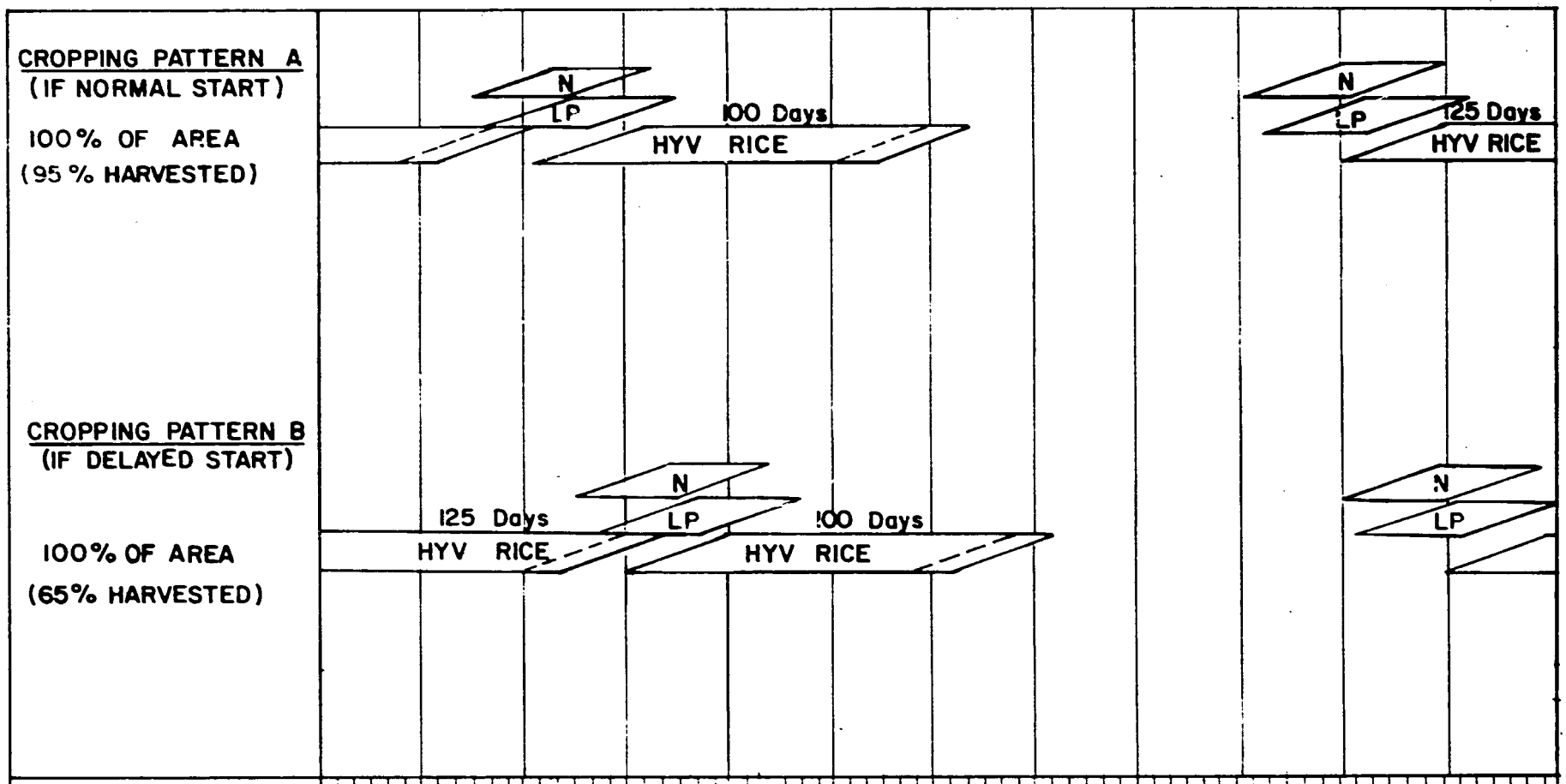
TABLE III-3

TEST PLOT RICE YIELDS WET SEASON WITH 200 KILOGRAMS UREA PER HECTARE

		Wet Season Average Yield kg/ha	
Location	Variety	1977	1978
Wanareja	Pelita I/1	4,888	5,808
	P.B. 5		3,760
Kedungreja	P.B. 5		5,840
Sidareja	Pelita I/1	3,080	4,784
Gandrungmangu	Pelita I/1		3,440
Kawunganten	Pelita I/1	3,640	
Cilacap	Pelita I/1	4,032	
	P.B. 5		5,725
Average all plots		3,910	4,893

Source : Agricultural Extension Service, Cilacap District.

CROPPING CALENDER CENTRAL JAVA PROJECT



MONTHLY CALENDAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC.
AVERAGE	WANAREJA	295	264	288	213	177	113	88	52	71	154	263	318
RAINFALL	MAJENANG	360	328	356	290	204	151	44	87	83	221	357	401

N = NURSERY. HYV = HIGH YIELDING VARIETY.
LP = LAND PREPARATION

SHUT - OFF IRRIGATION

ENGINEERING CONSULTANTS, INC.

FIGURE III-1

CHAPTER IV

SOCIAL CONSIDERATIONS

Introduction

This chapter assesses social aspects of the project area and the project. The purpose is to determine if the project will be acceptable and beneficial, and if it is adequate to achieved desired social effects. The description and analysis are based on data obtained through the Cilacap District Planning Office, from village offices, and from field discussions with Irrigation Service officials and village officials, village irrigation managers, and farmers in eight of the nine villages involved.

The analysis leads to an unqualified endorsement of the project. The impact of irrigation system rehabilitation and expansion, and drainage improvements, will be significant and widespread. The major problems are commonly understood and agreed upon, and the project addresses them adequately. Virtually all farmers within the circumscribed areas will benefit, but those who will benefit the most are the smallest landowners located at the tail ends of the systems, the ones who get no water during times of shortage, and whose fields are inundated during periods of abundant rainfall. Although the project itself will bring about a substantial improvement in the condition of local farmers, its impact will be magnified if concomitant improvements are made in the extension, credit, input and marketing systems.

The body of the chapter is divided into five sections. The first discusses people and resources in the project area, setting the basis for subsequent evaluation. The second section analyzes the current irrigation situation, covering management of the four systems, problems and needs. The third reviews goals and implementation mechanisms of the project itself. The fourth section analyzes the anticipated aftermath of the project, identifying beneficiaries and institutional demands which will result from it.

Finally, the fifth section is a summary social assessment, covering project assets, limitations, and recommendations.

Before starting the analysis, a word about data sources is in order. The statistics used in this chapter were obtained from three sources: village-level data tables compiled by sub-district offices under the direction of the Cilacap District Planning Office; standard village statistics posted on chalkboard tables in village offices (Monografi); and discussions with village officials. Unfortunately, the three data sets are different from each other in many regards. On one hand, the categories sometimes differ, which makes both comparison and verification difficult. On the other hand, many tables utilizing similar categories had discrepant entries, which raises serious questions about reliability. The problems stem from a number of sources, including both collection and reporting inconsistencies. Wherever possible, the tables have been reconciled for presentation here. Where reconciliation was impossible, the data set thought to be most accurate was arbitrarily chosen to represent the phenomenon. In some instances, fragmentary data obtained from village officials is presented, even though they appear to contradict other statistics. In such cases, the fragmentary figures are thought to be more reliable than the others, but too incomplete to use as a substitute. In light of such difficulties, the data must be seen as indicative, not precise measurements.

Whereas the data from the Cilacap Planning Office were available before the start of field discussions, the Monografi were gathered in the field. The overall purpose of field inquiries was to obtain an understanding of village organization, current water management operations and problems, the distribution of resources, farming practices, and alternative income sources, as well as special local circumstances which became apparent in the field. Discussions with officials of the Irrigation Service, Majenang Section, preceded the village visits and provided a valuable backdrop for inquiries. In total, the variety of contacts, pace of discussions, and frequency of field visits contributed to a picture of the situation which is adequate both for its own purposes, and as a basis for judging the value of the different data sets.

The Area -- People and Resources

The area affected by the project includes lowland portions of nine villages located near the western border of Central Java Province, in the Sub-Districts of Wanareja, Majenang and Cimanggu, in Cilacap District. The nine villages cover 135.8 square kilometers, had a total population of 115,104 in mid-1978, and had an average population density of 848 persons per square kilometer, (Table IV-1). The immediate project area and population are somewhat smaller than village totals, and population density in the immediate project area is somewhat greater than indicated. Nonetheless, whole village statistics will be used throughout the discussions.

With the exception of the segments of project area in Cileumpuyang and Cimanggu, at the west end of a continuous plain, the areas involved in the project are natural topological units consisting of paddylands bordered by hills, rivers and roads. Cilopadang Irrigation System is located entirely within the village of the same name, and the Cilaca System is entirely within the village of Wanareja, but the Cijalu and Cileumeuh Systems each intersect a number of village boundaries.

Elements of the irrigation systems date from different time periods, the oldest of which originated under Dutch rule, around 1912, when the colonial administration initiated a program to establish sugar cane estates in the area. The sugar cane scheme never came to fruition, thus wetland rice has remained the principal crop in the irrigated areas, and the principal source of livelihood for the population.

The local economy is based on agriculture, although the proportion of farmers varies from one village to another, as do standards of living. In general, people in the areas under irrigation enjoy higher standards of living than people in rainfed areas, and the Wanareja-Majenang complex has a higher standard of living than places to the south (Sidareja-Cihaur Plains) or the immediate east, beyond Cimanggu. Compared to Sidareja-Cihaur, the economy in the Wanareja-Majenang complex is more diversified, reflecting greater internal markets, better access to external markets, and additional exploitable

resources. However, in recent years the situation has worsened. Erosion on the uplands has led to silt deposition on the riverbeds, with subsequent flooding of increasing severity and frequency in the lower reaches of the project area; it has also contributed to the deterioration of the irrigation systems, depriving people in the tail ends of the systems of water during shortages. Meanwhile, tremendous population growth has increased pressure on local resources, leading to the increased incidence of landlessness, in general, the sale of marginally-sized holdings to outsiders in some areas, and much migratory labor movement.

This discussion of the area covers five general topics: population; work; land use and ownership; social resources; and infrastructure. The next section differentiates the four irrigation systems more specifically.

Population

The project area under discussion consists of two units: the village of Wanareja, which includes the Cilaca Irrigation System; and the group of villages comprising and surrounding the sub-district center of Majenang, in which the other three systems are located. Majenang actually consists of two practically indistinguishable villages of Jenang and Sindangsari, which are flanked on the east and west by progressively less urbanized villages; sometimes they will be identified individually, otherwise they will be referred to by the aggregate designation. The project population is concentrated in the two centers of Majenang and Wanareja, along the two roads which connect them, and along smaller feeder roads which lead to the ricefields. The immediate project area includes approximately 50 percent of the total area of the 9 villages, 80 percent of the people, and almost 85 percent of the paddyland.

Wanareja and Cimanggu are the largest villages (26.4 and 29.9 square kilometers, respectively), but most of Cimanggu is located east of the project area. The smallest village is Jenang (7.5 square kilometers), which is flanked by the next smallest villages of Pahonjean (8.2 square kilometers) and Sindangsari (8.7 square kilometers); most of these villages, and the village of Cilopadang, lie within the project area.

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The nine villages had a combined population of 115,104 people in mid-1978. Wanareja has the largest population (20,431, or 18 percent of the total), and Cibeunying has the smallest population (5,746, or 5 percent of the total). Twenty-four percent of the population lives in Jenang and Sindangsari.

Population Growth. The population in the nine villages increased 28 percent between 1966 and 1976, the most reliable benchmark years, from 89,536 to 114,831, which represents an annual growth rate of 2.5 percent (Table IV-2). Cilopadang had the greatest increase during that period (up 44 percent) and Pahonjean had the smallest (up 6 percent). The corresponding growth rates are 3.7 percent in Cilopadang and 0.6 percent in Pahonjean.

Except for Salebu and Sindangsari, the population in each village grew at a substantially higher rate during the first five years of the decade (1966-1971), than the last five years. In aggregate, the growth rate was 3.1 percent for all villages between 1966 and 1971, and 1.9 percent between 1971 and 1976, both of which are higher than the 1961-1971 population growth rate in Central Java of 1.7 percent. Population growth rates were extraordinarily high in Cileumpuyang, Wanareja and Cilopadang between 1966 and 1971 (6.7, 4.9 and 4.7 percent per year, respectively), and dropped markedly during the next five years (to 0.6, 1.7 and 2.7 percent per year, respectively). At the 10-year rate, the project population could be expected to double in 28 years, but at the 1971-1976 rate, it would double in 37 years. In general, the urbanized areas have had phenomenal population increases. However, the rates have declined rapidly, and should continue to do so, if the 1976-1977 increase (0.05 percent) is any indication. Nevertheless, the proportion of young people means that growth will still be a problem for quite some time.

Age Distribution, Sex Ratios and Family Size. The population in the nine villages is relatively young, but not compared to Central Java as a whole. In early 1978, 42 percent of the project village population was under 15 years of age, compared to 44 percent in Central Java in 1977 (Table IV-3) Sindangsari and Wanareja have the youngest populations (52 percent and 51 percent under 15 years old, respectively), but Pahonjean has an inordinately

low proportion of people under 15 (21 percent). The overall sex ratio (number of males per 100 females) is 94, varying from 79 in Pahonjean to 112 in Sindangsari (Table IV-4). Average family size varies from 4.6 persons per family in Wanareja to 5.7 persons per family in Cimanggu.

Population Density. The area is very densely populated. Aggregate population density in the nine villages in mid-1978 was 848 persons per square kilometer. In 1971, the combined population density in the villages was 769 persons per square kilometer, compared to an average of 634 in the whole of Central Java (Table IV-5). Only Salebu, Cibeunying and Cimanggu had population densities lower than the provincial average in 1971, all of which are located on the outskirts of the project area. The three villages in the center are almost twice as dense as average. In 1978, population densities ranged from a high of 1,918 persons per square kilometer in Jenang to a low of 409 in Cimanggu, which is half forests and plantations.

Religion. The people are virtually homogeneous with regard to religion. Almost 99 percent of the people are Moslem (Table IV-6). Only Sindangsari have a noticeable concentration of Catholics (5 percent) or Protestants (2 percent). About one percent of the people in Jenang, Wanareja, Colopadang and Cileumpuyang are also Catholic.

Summary. In summary, the population is rapidly growing, very dense, relatively young, and Moslem. The variations in population growth rates and age distribution indicate the effects of out-migration in some cases, due both to push and pull factors (increased population pressure locally, and new work opportunities elsewhere), as well as the diversified, growing economy at the center of Majenang. Unfortunately, migration statistics do not illuminate the situation significantly.

Work

The work force statistics available are not very reliable for a number of reasons which emanage from problems of classification, as well as inconsistencies in record-keeping and reporting. Classification is problematical because individuals are supposed to be counted in a single occupational

group, even though they may actually perform a number of economic roles, often in different seasons. The work force is officially defined as the number of people between the ages of 15 and 55 who are gainfully employed, and have been so employed, for a certain amount of time before the census is taken. Village statistics seem to be rather less systematic, however, and aggregate statistics either ignore the age limits or classify some individuals more than once. Using a synthetic occupational profile, obtained by combining different elements of three tables, work force participation was calculated (Table IV-7). Overall, 87 percent of the people in the nine villages between the ages of 15 and 55 would seem to be in the active work force, according to the calculation, varying from 56 percent in Cimanggu, to a dubious 176 percent in Sindangsari.

Occupational Distribution. The synthetic occupational profile shows that most people work in agriculture (77 percent), followed by commerce (9 percent), public service (3 percent), small manufacturing labor (2 percent) and construction labor (2 percent). Pahonjean has the largest proportion of people in agriculture (92 percent) and Jenang has the lowest (64 percent). Cilopadang and Cimanggu have a number of plantation workers hidden in the residual "other" category, Sindangsari has a number of tiny traders in that category, and Selabu has stone crackers placed there, all of which confuse the other classifications in each case.

The occupational profile does not capture the reality of work, however. Some of the largest landowners in the area are large traders. Many farm laborers keep busy in slack seasons by tending to homegarden production and small-scale home industry work. In addition, construction and other workers participate in the agricultural cycle. Unemployment figures are unavailable, but actual unemployment is thought to be rare and underemployment is common. People must be resourceful in order to survive, as there are virtually no unemployment or retirement benefits available.

Both women and men engage in remunerative activities. Women carry out much of the agricultural labor and tend to petty commerce and food processing, but the division is labor is rather flexible, especially within an

individual family unit. A great variety of products are made and sold within the villages, as well as to middlemen for transport to cities. Some examples are palm sugar, coconut oil, copra, soy sauce, tempe (fermented soybean cake), crackers, thatching, bamboo poles, mats, winnowers, clothes, bricks, road stones, and floor tiles. In most cases, both men and women make the products, and women handle much of the marketing, in addition to working in the fields. Clearly women will be directly affected by the project, as much or more than men.

Agricultural Work Force. The agricultural work force varies in composition from one village to another. Table IV-8 illustrates the relative percentage of owner-operators, renters, sharecroppers and farm laborers, although in practice, renters and sharecroppers generally fall into one of the other two categories, thus they may be counted twice. Land ownership is most common (51 percent), followed by laboring (37 percent) and renting (6 percent), which is normally contracted as a way of debt repayment. Cilopadang has the highest incidence of ownership (78 percent), and Pahonjean has the lowest (28 percent). The situation is just the reverse in terms of laborers. Renting is most common in Salebu and Cimanggu (15 percent in each) and sharecropping uncommon, except in Wanareja (10 percent). The "other" agricultural people in Cibeunying, Pahonjean, Cilopadang and Cimanggu are believed to be forestry and plantation workers.

The rice production cycle dominates agricultural life in the project area. Other crops are grown around the cycle, such as in homegardens, or between rice crops in the paddys. All of the farm work is labor intensive, and rice is much more so than other crops. Some fields are prepared with water buffalo (there were 595 water buffalo in the nine villages in early 1978, or about one for every 37 landowners), but most land preparation is done by hand, with a short-handled hoe (cangkul). Once the land is prepared, seedlings are transplanted, weeded and harvested, all by hand, mostly by women. After harvest, rice bundles are carried home, where they are dried in the sun before thrashing and milling, or storing. Mechanical hulling and polishing replaced hand milling in the early 1970's. Some thrashing is done by machine, but even high yielding varieties are thrashed by hand.

Work Relations. Traditionally, different aspects of rice production and handling constituted vital mechanisms for redistributing resources within communities, and thus for guaranteeing the survival of landless people, as well as landowners. For example, although large landowners employed many laborers, even small holders utilized hired labor at various stages, even though everything could be done by family members. Furthermore, the harvest has been open to everyone who appears. Although the force of some welfare traditions has declined in some areas, many still thrive in the project area, as can be seen by reviewing the nature of work relations during the rice cycle.

Land preparation is performed by teams of cangkulers who are organized by the landowner in advance. Workers are paid a fixed rate per day (Rp. 300-400) and two or three meals. Small landowners often work in groups which move from one member's fields to another's; the landowner provides meals in this case, but does not pay wages. In Sindangsari, about 40 percent of the land is prepared under a fixed fee contract (borongan) arranged between the landowner and the team leader, who thereafter pays team members.

Once the fields are prepared, seedlings are transplanted, generally by teams of women who may be family members or neighbors. Non-family transplanters are paid a set daily wage for the work (Rp. 150-250). While the rice grows and tillers, the fields are weeded by hand two or three times, always by groups of women who are either contacted and paid a daily wage in advance (Rp. 150-250), or appear at the field early in the morning and are admitted to the weeding group.

Harvesting is the most lucrative form of labor, and harvesters are paid in kind, either 1/6 (Wanareja) or 1/7 (Sindangsari) share, measured in bunches. Traditional varieties are invariably harvested with an ani-ani, and fields are open to whoever appears. High yielding varieties may be harvested by sickle (arit), in which case the landowner may restrict the number of harvesters to a small selected group. This occurs in perhaps 10 percent of the irrigated fields, according to Irrigation Service personnel. Contrary to practices in the other villages, some landowners in Cimanggu restrict harvest participation to the people who have weeded earlier in the season,

similar to the ngepak-ngedok system identified by Collier and others. This seems to be an established tradition in Cimanggu, dating from times of relative labor scarcity and difficult transportation, and does not seem to be spreading to the other villages.

After harvesting, harvesters carry the bunched heads to the home of the landowner, where his wife divides the shares. She enjoys a modicum of discretion in the division, and frequently allows friends and relatives to keep the oversized bunches they invariably set aside for themselves. High yielding varieties shatter too easily for such treatment, thus harvesters may thrash them in the fields, where the yield may be weighed and divided according to the same 1/6 or 1/7 formula. Weighing is rather rare, occurring in perhaps 5 percent of the irrigated fields, according to irrigation officials.

Most of the suitable paddyland is planted in rice two times a year, although the success of each crop obviously varies greatly, depending on rainfall patterns and pests, as well as soil conditions. Farmers in flood-prone areas sometimes have to start a crop several times in a season; farmers at the tail ends of the irrigation systems normally obtain limited yields during dry years. Regardless of yields, however, rice cultivation appears to be virtually continuous, and work in the fields requires varying amounts of labor input throughout the calendar year. When slack times appear, they are usually filled with voluntary labor, village or private, work in home-gardens, or some of the processing tasks identified above.

The project does not threaten to change the current labor-intensive situation, as people are already familiar with high yielding varieties and yet have deliberately refrained from introducing the sickle on a wide-scale, apparently in deference to the employment needs of most families. However, with the large and growing population, and growing incidence of landlessness, any technological changes such as introducing more water buffalo, tractors, weeders or sickles could have disastrous repercussions on the well-being of much of the population. In addition, the very factors which cause the potential introduction of labor-saving devices constitute a real threat and

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underscore the need to enact supplementary development programs in the area to create additional non-agricultural employment opportunities for both men and women. The project will stimulate a rise in employment opportunities, but it cannot possibly meet the great overall need which exists, let alone future employment needs which will arise when today's youth enter the work force.

Land Use and Ownership

Land is the most important local resource. Land ownership confers a modicum of security, as well as community obligations; landlessness virtually guarantees economic marginality, or at least insecurity. The prevaluence of landlessness is impossible to document with precision, but officials in some villages offered the following estimates of the proportion of family units which do not own land:

Wanareja	20%
Pahonjean	10%
Jenang	10-20%
Sindangsari	60%
Cilopadang	50%
Cimanggu	75%.

Whatever the actual number, it is universally agreed that landlessness is increasing, and it is getting to be more common in areas of greatest pressure on resources. The village head of Sindangsari estimates that the proportion of landless families has grown from 50 percent to 60 percent in the last five years. The problem is more acute in the eastern part of the project area (Sindangsari, Cilopadang, and Cimanggu) than the western part, and relative family sizes indicate that it will become progressively more acute in the future.

Land Use. Although 35 percent of the land in the nine villages is used for wetland rice (paddyland) and 20 percent for homegardens (Table IV-9), the concentration of those land use types is much greater in the project area proper than in the village totals. Land use patterns in Pahonjean, Jenang and Sindangsari are more representative of the immediate situation than the other villages; paddyland accounted for 56, 60, and 61 percent of the land, respectively, in those three villages.

Irrigation. Thirty-six percent of the paddyland in the nine villages is considered to be under technical irrigation at present, and 27 percent is under semi-technical irrigation (Table IV-10). The technical classification refers to the area currently included under the four systems, as does some of the land in the semi-technical classification. For the most part, the designations exaggerate the effectiveness of the systems somewhat. That is, large segments of the Cilaca, Cijalu and Cileumeuh Systems were never completed to technical standards, and others have since deteriorated. This makes the classification sound better than the reality facing water users. When completed, the project will bring existing irrigated areas up to technical specifications, and will bring some presently rainfed fields under irrigation, especially in Cimanggu, Jenang, Pahonjean and Wanareja.

Land Ownership. According to available statistics, seventy-seven percent of the land in the nine villages is privately owned, 8 percent of which by non-residents of the villages; 20 percent is owned by the government; and 2 percent is owned by the villages (Table IV-11). The government land consists of forests and plantations. The village land is cropland which is apportioned to village officials in lieu of cash salaries or, in some cases, rented to farmers to provide cash income for the village administration.

Official records show that total private land ownership varies from 46 percent in Cimanggu to 98 percent in Janang, and the amount owned by outsiders varies from one percent in Wanareja to 21 percent in Jenang. However, village officials contend that these data are out of date or misleading. For example, the village head of Sindangsari contends that about 12 percent of his village is owned by outsiders, rather than 0 percent; officials in Cimanggu maintain that as much as 80 percent of project land in that village is owned by people from outside the village, compared to an overall average of 17 percent; and officials in Cileumpuyang estimate that 40 percent of the private land in the village is owned by non-residents, rather than 11 percent. For the most part, outside ownership does not really mean absentee ownership, because the owners either come to the village to care for the land (most common) or place it in the hands of relatives in the village. Nonetheless, village officials unanimously contend that non-residents in general have a poorer record of paying land taxes and community assessments than do residents.

Unit Size. Landowning units are predominantly very small (Table IV-12). They average 0.43 hectares in the nine villages, varying from 0.25 hectares in Jenang to 0.66 nectares in Cibeunying. In total, 65 percent of the land holding units are under 0.5 hectares, and account for 42 percent of the private land. Eighty-three percent of the units in Jenang and Sindangsare are under a half hectare, and account for 67 and 69 percent, respectively, of the total. In contrast, 45 percent of the units in Wanareja are under a half hectare, accounting for 43 percent of the total, and 75 percent of the units in Pahonjean comprise 14 percent of the private land. However, in Pahonjean, the 3-5 hectare units (one percent) cover 12 percent of the land.

The tiny size of most landholding units makes the few relatively larger ones seem huge by comparison. Moreover, the differential income-generating potential between large and small units is even greater than apparent. For example, the average landholding in Sindangsari and Cilopadang are 0.35 and 0.38 hectares, respectively, which is considered to be less than enough to provide adequately for an average family. Thus, a couple of poor harvests can put marginal landowners in debt and cause them to lose their land. Since the 1950's, the rate of landlessness has been accelerated by this process in Sindangsari, Cilopadang, Cileumpuyang and Cimanggu, which has resulted in outside landowners becoming more prevalent in the latter three villages.

Two additional factors relate to this question. First, although 3 hectares is the legal maximum holding of paddyland, a few people own more than the maximum in most of the the villages. In Wanareja, 10 people each own 5 hectares and 4 families own 7.5 hectares; in Pahonjean, one person owns 7.5 hectares; in Jenang, 5 own 3.5 hectares each; in Sindangsari, the largest holding is 14 hectares, but five people own over 7 hectares, including the village head, and five own between 3.5 and 7 hectares; the largest holding in Cilopadang is 10.5 hectares, one of four units larger than 7 hectares; in Cileumpuyang, 11 people own more than 3 hectares; and 6 people own 4 or more hectares in Cimanggu, including one person who owns a total of 25 hectares, 15 hectares of paddyland and 10 of dryland. Consequently, the mean size is undoubtedly smaller than the average in each village, with concomitant results in terms of family security.

Second, the largest landholdings are located in the best areas. That is, large private holdings and village lands assigned to village heads are invariably found on the best-drained lands, close to major irrigation outlets. They get best access to the water, and they never get flooded. In contrast, smaller holdings are concentrated in lower areas, at the tail of irrigation systems, and in flood-prone sections.

Implications. These factors have three important implications for the project. First, the qualitative impact of the project will be greatest on the landowners located at the tail end of irrigation systems, outside the existing systems, or in poorly drained areas -- the smallest landowners. Larger landowners already have more favorable water conditions, thus the project will not affect them as much as small landowners, in relative terms. Second, because village leaders and economically influential people benefit from existing inequities, they cannot be expected to spearhead a move to create active water user associations unless they receive both encouragement and assistance. Third, many small farmers undoubtedly maintain control over their land because conditions are too poor to invite buyers. The project may alter the situation, leaving many people vulnerable to pressures to sell their land, perhaps from outsiders. Thus, without careful monitoring of the situation, the project could accelerate the growth of landlessness, as well as the proportion of outside ownership.

Social Resources

This section considers some things which relate generally to the personal well-being of the people in the project area. It discusses per capita income, housing, education and public health facilities.

Income. Per capita income is calculated for each village. Calculations are based on the value of goods and services in the market, thus they do not include goods consumed directly, private exchanges, or various non-monetary forms of remuneration. Nonetheless, the figures are somewhat useful for comparative purposes. Table IV-5 shows agricultural and non-agricultural per capita incomes in 1977 in the nine villages. Agricultural incomes ranged from Rp. 288,000 in Sindangsari to Rp. 139,000 in Pahonjean, and

non-agricultural incomes ranged from Rp. 288,000 in Sindangsari to Rp. 54,000 in Cibeunying. These aggregate statistics obviously do not indicate the great income discrepancies between the landless and the larger landowners. However, the per capita statistics may exaggerate differential income levels somewhat. For example, a higher proportion of rice produced in Sindangsari would end up in the market, due to the presence of a number of larger landowners and the dependability of water supply, than would the proportion of rice produced in Jenang, which has relatively smaller landowners, many producing under unfavorable conditions. Nonetheless, the relative ranking of the villages, according to per capita income, corresponds roughly to visual impressions of relative standard of living.

Housing. Housing is another indicator of standard of living. Most nuclear families own a home, although they do not necessarily own the land upon which it is located. In such cases, the landowner concedes space without requiring an exchange of goods or services. Most of the homes are made of local materials, with clay tile roofs and whitewashed walls.

Houses are classified as either permanent (stucco), semi-permanent (part stucco, part bamboo), wood, or bamboo (Table IV-13). Village records indicate an overall average of 11 percent permanent, 13 percent semi-permanent, 14 percent wood and 63 percent bamboo houses. Cilopadang has the highest proportion of permanent homes (25 percent), Jenang has the highest percentage of semi-permanent homes (35 percent), and Pahonjean has the highest percentage of bamboo houses (94 percent). About 5 percent of the houses have electricity, centered primarily in Jenang (21 percent) and Sindangsari (11 percent).

Education. Education levels are generally low in the nine project villages, but they vary considerably (Table IV-14). According to village records, 21 percent of the population have not yet attended school, 27 percent have been to elementary school but not completed it, 36 percent completed primary school, and 21 percent have had no school. Cimanggu has the highest proportion of people without any education (67 percent) and Pahonjean has the highest proportion of people who completed elementary school (59 percent). A total of 124 people in the nine villages have had some post-secondary education, and 773 (1 percent) have completed secondary school.

There are 119 schools in the nine villages, 91 percent of which are elementary schools (64 percent public and 23 percent Islamic)(Table IV-15). There are 8 middle schools (7 percent) and two each of vocational and secondary schools. Elmementary schools are scattered throughout the area, the others are centered around Wanareja and Majenang.

Eighty-three percent of the students are in elementary school (Table IV-16) and approximately 67 percent of the people between the ages of 5 and 15 are attending school. Although school is supposed to be free, various entrance fees and assessments make the cost of education prohibitive for many families, and traveling distances to middle and secondary schools also act as impediments to school attendance beyond primary school.

Public Health Facilities. Health statistics were not gathered for this report. Thus the proliferation of public health facilities is used as a crude indicator of the availability of health care. In general, the people enjoy better health than might be suggested by the articulation of the delivery system or income levels.

There are 3 public health clinics, 3 family planning clinics, and 5 mother-child clinics in the project area, one of each in Wanareja, Jenang, and Cileumpuyang (Table IV-17).Most of all the public health personnel are also located in the three villages. Only the 72 traditional midwives are scattered throughout the villages.

The public health clinics treat people and dispense medications for a fixed fee of Rp. 150, which seems modest, perhaps, but represents a day's wages for weeding or transplanting, and thus is not such a small sum. Relatively few people are thought to turn to the public health system for treatment, although the number is probably growing.

Infrastructure

Increasing agricultural production requires a number of other inputs besides water, and raising rural income levels requires more than merely increasing agricultural production. Production increases depend on the

availability of information about improved agricultural practices; inputs, such as improved seed varieties, fertilizer and pesticides; credit to obtain inputs; markets to sell the produce; and transport to reach the markets. Increasing standards of living generally requires increased production and marketing, redistribution of resources, and the creation of alternative income sources. The purpose of this section is to review briefly the local infrastructure to determine whether necessary elements are present; to what extent they are adequate or need improvement; and to what extent project benefits will be stimulated or limited by the infrastructure. In general, the infrastructure needs improvement, but will not present a major obstacle to realizing minimal project benefits. The following topics are discussed: transport, communications, farmer support, and markets.

Transport. The project area has a fairly well-developed road network. All villages except Salebu and Cibeunying are located along the Provincial Bandung/Yogyakarta Highway, the main southern trans-Java route. Cibeunying and Salebu are situated on the District road connecting Majenang and Wanareja, and both are easily accessible to the Provincial road. Both roads have all-weather asphalt surfaces, although the District road is decidedly inferior to the Provincial one. The Provincial road is currently under rehabilitation as part of the Trans-Java Road Betterment Program, the first stage of which was the construction of a new reinforced concrete bridge over the Cilanggi River in the southwest corner of Pahonjean. The raised roadbed north of the new bridge in Pahonjean currently restricts water flow toward the southeast, contributing to flooding problems in the village. It is planned that this rehabilitation program will resolve the problem.

In total, there are almost 20 kilometers of Provincial roads (13 percent), 18 kilometers of District roads (11 percent), and 120 kilometers of village roads (76 percent) in the nine villages. That equals one kilometer of road for every 1.2 square kilometers, varying from 0.9 (Jenang and Cimanggu) to 1.7 (Sindangsari) kilometers per square kilometer (Table IV-18).

Village roads vary in quality. Most have dirt or rock surfaces, and most are usually passable for one-way traffic. The most prevalent means of

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transportation off the highway are bicycles and horse carts, with becak penetration at some points. Movement across the lower reaches of the project area is restricted by the many rivers which lace through the area. Vehicles can go back and forth to the highway, but the bamboo and log bridges across rivers within the irrigated areas only allow foot traffic. The road network will be improved as part of the irrigation rehabilitation project, which will be beneficial. However, the roads are not presently felt to hinder traffic to markets or the internal movement of transporters and middlemen.

The project has a relatively high incidence of vehicle ownership (Table IV-19), primarily centered in Wanareja, Jenang, Sindangsari and Cilopadang. Bicycles are most prevalent (one for every 27 people), followed by motorcycles (one per 168 people) and becak (one per 398 people), the three-wheeled pedicabs used to transport people and goods. The ownership of motorcycles, becak and colt (minibuses) have increased markedly in the last few years, making public transportation along main roads both convenient and rapid. The project may facilitate becak and colt transport into the irrigated areas, but the most densely populated areas are along the roads already served, thus internal traffic patterns are not expected to change significantly as the result of the project, except in the case of truck traffic, which should increase.

Communications. Information travels primarily by word-of-mouth throughout the project area. Official government pronouncements are passed down through the village hierarchy, and both official and unofficial news passes quickly from marketplaces through the kampung (Table IV-20).

Radio and television ownership indicate a mixed pattern of mass media exposure. At last count, there were 2,255 radios and 190 televisions in the nine villages, the equivalent of one radio for every 51 persons and one television for every 606 persons. Pahonjean has the highest incidence of radio ownership (one per 27 persons) and Cileumpuyang has the lowest (one for every 84 people). Cimanggu has the highest incidence of television ownership (one per 298 people) and Pahonjean has the lowest (one per 5,252 people). Television ownership is a new phenomenon in the area, and is growing at a much faster rate than radio ownership. Although radio listener

groups may exist in the project area, as they do in other parts of the Citanduy River Basin, they were never mentioned in discussions in the villages, thus they are believed to have little impact, if any. Their formation should be encouraged as part of the process of organizing small units of village water user assocations, however. Project and extension staff should utilize farm radio broadcasts to supplement other methods of informing farmers about system management, maintenance, improved practices, and other common problems.

Farmer Support. The principle vehicles for promoting rice production increases are the BIMAS Program, which provides a package of recommended inputs (HYV seed, fertilizer and pesticides), credit for input purchases, and a small living allowance, and the INMAS Program, which provides the inputs without credit. The recommendations are diffused through the Agricultural Extension Service (by PPLs); the KUD/BUUD system handles the inputs; and a government bank provides credit to landowners certified by the PPL and village head.

The input distribution system for BIMAS-INMAS seems to be adequate for current enrollments, and fertilizer and pesticides are also available in regular stores in Majenang and Wanareja. However, the system will have to be expanded and decentralized somewhat, concurrent with project implementation. In particular, more inputs must be made available in Cimanggu and Cileumpuyang, possibly through the KUD/BUUD in Cileumpuyang, and in Wanareja and Salebu.

Credit is a chronic problem in the project area. BIMAS credit repayment rates were not obtained, but several references in discussions to a growing cycle of farmer indebtedness, exacerbated by BIMAS, leads one to expect that repayment rates are not very high, or at least fluctuate from season to season. Alternative credit sources are available at high or exploitative interest rates. Both private credit sources and the government pawnshop in Majenang are utilized for family crises and celebrations, not to purchase agricultural inputs. Water user associations, reconstituted during project implementation, should be encouraged to form village credit unions to provide local sources for non-exploitative production investment credit.

Although credit and input delivery are problems which may be exacerbated by the advent of the project, the greatest farmer support problems result from intrinsic deficiencies in the recommendation package, as well as its promulgating agency, the Extension Service. BIMAS-INMAS enrollment data for two wet seasons (1975-76 and 1976-77) and two dry seasons (1976 and 1977) reveal that enrollment coincides pretty closely with access to dependable irrigation water supplies (Table IV-21). Over the two years, BIMAS-INMAS involved 46 and 41 percent of paddyland during the two wet seasons, respectively, and 34 and 30 percent during the dry seasons. The villages with the best water regimes (Cibeunying, Jenang and Cilopadang) had the highest precentages of enrollment, overall, and enrollments seem to be increasing in each.

What BIMAS-INMAS enrollments do not reveal is that the package of recommendations itself has weaknesses, which are magnified by problems in the extension system. The BIMAS-INMAS package consists of a standard nationwide recommendation, the contents of which have changed over time with the introduction of different HYV seeds. The first varieties were widely adopted, which led to subsequent infestations of brown hoppers (wereng), and the introduction of wereng-resistant varieties (called VUTW). The newer varieties are not as popular as earlier susceptible varieties for aesthetic reasons, as well as more practical ones. That is, in Sindangsari, at least, many farmers dislike the short stalks which hide the panicles in masses of leaves; others are dissatisfied by low yields, blamed on their inability to maintain optimal water conditions. Throughout the area, however, the supply of sprayers provided by the Extension Service is inadequate for local needs, thus rendering farmers vulnerable to pest infestations which are encouraged by the very process of crop intensification.

Besides its deficiencies in planning and supply, the Extension Service has insufficient manpower to cover the area well. Furthermore, although they are well-intentioned and well-regarded, the PPLs do not have adequate training to enable them to respond effectively to local problems. Their role is to promulgate a program, after which they have little time to troubleshoot, and no preparation for troubleshooting. For example, during the rat infestations which appeared in parts of the project area in 1978,

PPLS could do little more than recommend that farmers organize to chase the rats out of the fields and try to kill them, an apparently innocuous procedure. The point to be made here is that technological advances such as HYVs also require a similarly advanced support system. Without a good support system, farmers who adopt the recommended improvements risk worsening their situation.

Cilacap District has officially adopted the Extension Service revision which revolves around village (WILUD) and smaller physically-defined (WILKEL) units, and incorporates different levels of demonstration and experimental plots. However, the pattern has not been implemented in the project area. It it strongly recommended that the system be implemented as quickly as possible, along with greater emphasis on the role of PPLs to identify and resolve local problems.

Markets and Commerce. The commercial structure in the project area is rather well-articulated, and can be expected to expand concurrent with project implementation, without intervention. Commerce is centered primarily along the Provincial Highway in Wanareja, Majenang, Cilopadang and Cileumpuyang. The center of Cimanggu is essentially outside of the project area. More particularly, Sindangsari and Wanareja are the effective marketing centers.

There are both daily and weekly markets in Wanareja and Sindangsari (Table IV-22), including an animal market in the latter. There are also weekly markets in Pahonjean (2), Cilopadang, Cileumpuyang, and Cimanggu (2). The markets are the real center of the local economy. People buy and sell there to locals and to outside middlemen who appear on market days.

In addition to the markets, there are stores in the main village centers which generally sell a wide variety of manufactured products. There are also many small stalls scattered throughout the area which generally sell vegetables and fruit or prepared food. The stalls range from separate units consisting of a small table and bench under a thatched roof, to tiny stores in the front of homes. As one might expect, the stores in Wanareja and Sindangsari are more specialized, and have more varied and costly inventories, than the stores in other villages. We can obtain an idea of the variety of

stores or merchants from records in the villages of Pahonjean, Jenang and Sindangsari:

Store/Trade	NUMBER OF UNITS Pahonjean	Jenang	Sindangsari
Wood	29	40	18
Radio	4	15	7
Bicycle	3	6	8
Barber	4	25	6
Jewelry	3	10	7
Mechanic	2	3	4

Not surprising, the jewelry stores are among the busiest on market days.

In addition to the trade carried on in fixed places, much trade is transacted by middlemen who appear at marketplaces and roam the countryside. At different seasons, for different crops, middlemen come to the area from Jakarta, Bandung, and other less distant marketing centers. Local merchants also act as middlemen. Rice is generally sold in the market, to middlemen, or to the BUUD, depending on such factors as the size of the harvest, time of the year, market price, and the producer's financial situation. There are no producers cooperatives in the project area, which tends to keep low the farmer's share of the retail value of his produce. The formation of producers cooperatives should be encouraged, based on the reconstituted water user associations.

Summary. The local infrastructure is sufficiently articulated so that it will not constitute a serious impediment to achieving aggregate project benefits. The transport network allows internal travel and connects the area to major external markets. The potential exists for new information to flow into the area. The agricultural input network is functioning and farmers are at least familiar with improved technology and are able to differentiate appropriate from inappropriate technology. And the commercial and marketing systems will be able to adjust to increases in production and disposable income.

However, the infrastructure needs significant modification to serve better the needs of local farmers and to return to them a greater share of

the value of their products. Four things need improvement. First, radio listener activities should be emphasized and radio programs geared to helping cope with local problems. Second, the Extension Service should reorganize priorities and structures so as to enable it to respond to local problems adequately. Third, credit sources must be improved, and the terms of credit must be made more advantageous to farmers. Farmer credit unions may be one mechanism to achieve this. Fourth, producers cooperatives should be formed to increase the share of production value which accrues to the farmers. In each case, the reconstituted village water user associations could constitute the nucleus for accomplishing the needed changes.

Current Water Management

Most of the area affected by the project is already irrigated by one of the four systems, at least in theory, and most of the beneficiaries have some experience in irrigation water management, however nominal. Thus, at most, the project will require a modification of current practices, rather than the introduction of a whole new technology. The purpose of this section is to outline relevant social aspects of existing water management practices and problems and to identify areas which will require changes. This discussion covers four topics: the organization of water management on the village level, and between village; the organization, shortcomings and problems of the existing systems; the new areas to be incorporated in the systems as the result of the project; and recommended changes.

Villages and Irrigation

The village (desa) is the elemental administrative unit in Indonesia, and the main unit in irrigation water management. In government systems such as the ones under consideration, the Irrigation Service deals with physical structures directly, but has no rapport with water users. The Irrigation Service deals with village heads (lurah) and village irrigation officers (ulu-ulu), who communicate with farmers directly, or through local organizations; likewise, farmers communicate their needs and problems to associations, ulu-ulu and lurah, not to the Irrigation Service. Each of the three elements will be discussed in turn.

Village Officials. The lurah and ulu-ulu are the principal village officials concerned with irrigation questions, except in Cileumpuyang and Cimanggu. The lurah is elected and the ulu-ulu is appointed. The lurah handles general policy questions, adjudicates infractions of rules, and has major overseeing functions. The ulu-ulu arranges for maintenance and repairs of tertiary canals and drains, oversees rotation, if necessary, and manages other day-to-day problems within the villages and between the village and the Irrigation Service. There are no set criteria for the appointment of ulu-ulu, nor do appointees receive technical or administrative training. Villages with large irrigated tracts may have two or more ulu-ulu; villages without technical irrigation may have none. Two of the project villages have one ulu-ulu (Pahonjean and Sindangsari), one has three (Cilopadang), three have two (Wanareja, Salebu and Jenang), and two have none (Cibeunying and Cimanggu). In Cileumpuyang, the agricultural officer (pamong tani desa -- PTD) performs ulu-ulu functions, and the same occurs in Cimanggu.

The lurah and ulu-ulu are part of a remunerated village administration which contains two or three main levels (Table IV-23). At the village level are the lurah, village clerk (carik), treasurer (tukang uang), PTD and ulu-ulu. Some villages also have an intermediate position (bau) corresponding to vice-lurah. Finally, each village has from three to ten sub-village units (grumbul or kebawan), sometimes called hamlets. The sub-village generally includes a sub-village head (kepala grumbul, bau or kuwu), police (polisi), public works organizer (kebayan) and religious officer (kayim). For their services, all of the officials, numbering from 22 to 48 in the eight project villages for which we have data) receive use rights to village land (tanah bengkok desa), payments in rice collected from paddy farmers, or both. Where rice collection prevails, all paddyland owners are assessed by size and sometimes quality of holding, but non-residents are assessed much more than residents (Table IV-24). Compensation for the lurah is normally much higher than compensation for other officials. If payment is in land, the lurah's land is invariably in the best area and consists of paddyland, whereas the other officials may receive land in more marginal areas (Salebu) or dryland tracts (Cimanggu, Pahonjean). In most cases, ulu-ulu are among the lowest paid village officials, often equivalent to lower sub-village officials. Only in

Pahonjean is the ulu-ulu among the higher paid officials; the the general payment level is lower in that village than the others, however.

The institutional arrangement has two implications for water management. First, the ulu-ulu is beholden to the lurah, not to water users, who have no impartial means at their disposal either to assure the conscientiousness of the ulu-ulu, or to redress inequities. Second, the lurah has vested interests in water distribution, deriving from control over prized lands, which may cause him to ignore questions of distribution equity in times of water shortage. There are no indications that this situation poses immediate problems in the project area, but traditional patterns of deference to authority as well as the reality of administrative power, effectively prevent the likelihood of redress were such problems to exist.

For system maintenance and repair, the ulu-ulu enlists the assistance of sub-village heads and kebayan to organize farmers to perform the needed work. Work is performed without pay on a gotong-royong, community service basis. Landowners can substitute hired laborers in their stead, and large landowners sometimes supply food or refreshments for work teams. Maintenance and distribution within small blocks (5 to 10 hectares) are handled by assistant ulu-ulu (ili-ili), who receive small payments in kind for their services. Where water user associations (Dharma Tirta) exist, they replace the ili-ili.

Each village under irrigation has a set of operating rules, however formal, which identifies the responsibilities of water users (maintenance and repair) and outlines prohibited behavior (theft). Infractions and negligence are supposed to result in sanctions or withdrawl of service. However, sanctions are virtually never imposed and water service is never cut off. At most, someone caught stealing water (usually this means diverting it to a fishpond or a field, out of rotation) is taken before the lurah, who lectures the violator and issues a stern warning against repeating the theft. Lurah in several villages contend that such occurrences are rare, and repeat visits even rarer still.

Dharma Tirta. Dharma Tirta is the official water user association format promulgated by the Governor of Central Java in 1971 and modified in 1975. Theoretically, a Dharma Tirta is an autonomous village association consisting of members organized according to irrigation blocks and a small elected representative group which plans, coordinates and organizes different functions related to maintaining the operating the irrigation system, in consultation with the lurah and ulu-ulu. In practice, Dharma Tirta range from very effective single-village units (Blimbeng, near Solo) and multi-village units (Gambungan, near Sragen), to isolated block units within villages, to meaningless paper village units.

Five villages in the project area have Dharma Tirta of some sort. They range from scattered individual block units (Wanaraja and Cilopadang) to whole village units either based roughly on the official model (Salebu) or based on traditional paternalistic, lurah-centered organizational principles (Pahonjean and Sindangsari). In aggregate, the impact of the Dharma Tirta in the villages is negligible and, without significant organizational input from the outside, even less promising.

Officials in the Majenang Irrigation Service Office believe that the Cilopadang and Sindangsari Dharma Tirta are the most effective ones in the four systems, and Pahonjean is the least effective. A review of organizations in the five villages yields little support for such a contention, however. Cilopadang has a few block units, but they are rapidly deteriorating, according to the ulu-ulu. In Sindangsari, the formal organizational structure persists, but fewer members pay their dues from one year to the next, and the village committee is both ineffective and demoralized. The lurah, who organized the association, has little hope for its survival. In Pahonjean, the association is little more than a group of ili-ili, who each have jurisdiction over a certain service area, under the guidance of the lurah and ulu-ulu. In this case, the structure is viable, but it is not really a Dharma Tirta. In Salebu, the official model was adopted for the purpose of entering the Governor's biennial competition, but it has never become operational in the village, in spite of a neat organizational chart in the village office. The lurah has advocated block units in his village, and a couple have formed during the last

couple of years. However, even if they are as effective as he claims, a claim disputed by the ulu-ulu, there is no plan to organize a village-wide association or to make the units autonomous.

Thus it is clear that water user associations are either ineffective or non-existent in the project area. Ulu-ulu and lurah consequently are the organizers and spokespeople for water users. This should be changed, as indicated below.

Villages and the Irrigation Service. The Irrigation Service office in Majenang is reponsible for the physical maintenance of primary and secondary irrigation structures and arranges for rotation in times of shortage -- particularly during the dry season and for land preparation. It works directly with ulu-ulu in the single-village systems (Cilaca and Cilopadang) and supposedly has special inter-village ulu-ulu who oversee inter-village coordination in the two multi-village systems (Cijalu and Cileumeuh).

Each year, the Irrigation Service is supposed to meet with appropriate ulu-ulu (and/or lurah) to establish mutually acceptable plans for water rotation during shortages, and to establish maintenance and repair priorities. During shortages, the same people work out and execute detailed weekly schedules. Meanwhile, where the rotations seem irregular, or shortfalls become frequent, the ulu-ulu goes to the office to inquire. There seems to be little other sustained village-Irrigation Service interaction, however, which leads to suspicion and conflict, as outlined below in the discussion of the Cileumeuh System.

The Systems -- Organization, Shortcomings, Problems

The two project areas (Majenang and Wanareja) clearly need rehabilitation, up-grading and expansion of the irrigation part to obtain watermanagement capability, but an equally pressing need is to improve the drainage situation in certain areas. Each project area will be discussed in turn.

The Wanareja Project Area

Cilaca. The Cilaca system lies entirely within Wanareja village. It is operationally divided into sections, each managed by an ulu-ulu. During shortages, each ulu-ulu schedules rotation between blocks in his section. The small eastern section has the most dependable water conditions, in general,

although there is considerable discrepancy within the section. That is, the lands near the highway, closest to the secondary canals, normally have adequate water and drainage; however, the lower parts often do not receive water during shortages and they are also subject to periodic flooding from the Cikawung River. The larger western section contains a variety of conditions. A couple blocks near the main canals have the best water conditions in the village, the best maintenance records, and the most congenial social conditions; others have very little control over the water, suffering alternating floods and shortages. Parts of the western section regularly receive overflow water when the Citanduy River is high. Approximately 200 hectares of cropped paddyland suffer flood damage sometimes during a dry year, and as much as 500 hectares of crops are damaged during a wet year like the 1977-78 wet and dry seasons.

In each section, water rotation produces conflict and invites water theft, although most problems are resolved by the ulu-ulu. Only 25 percent of the paddyland in Wanareja is classified as being under technical irrigation, and 40 percent is semi-technical. Consequently, although most farmers can obtain two rice crops during a good year, they have not been able to do so in 6 of the last 10 years. This reflects a cropping intensity of 1.4. Because of the poor water control and drainage problems, about 10 percent of production is in HYVs; the remainder are more hearty local varieties.

The Majenang Project Area

Cijalu. The Cijalu System suffers similar internal disparities, but it has the added problem of multiple jurisdictions. Pahonjean, Cibeunying, Jenang and Sindangsari are served by the Cijalu System in two units: Pahonjean and Cibeunying on the west canal; and Jenang and Sindangsari on the east canal. The Irrigation Service has assigned an inter-village ulu-ulu to manage relations between the villages, but discussions in villages failed to elicit any recognition of the significance of that position. Nonetheless, coordination is not a major problem.

Pahonjean and Cibeunying have very different conditions. Sixty-one percent of Cibeunying's paddyland is technically irrigated, and 22 percent is semi-technically irrigated. It is in a favored position in terms of obtaining adequate water, as well as drainage. In contrast, only 33 percent of

Pahonjean's paddyland is classified as technical and 18 percent as semi-technical. The northern half of the village receives water from the Cijalu System, but the supply is frequently inadequate during dry years. Nonetheless, HYVs comprise about 80 percent of the rice in that area. The lower half of the village has major flooding problems, both west of the highway, surrounding the permanent swampland, and east of the highway, near the confluences of the Cilanggir, Cijalu, Cilopadang, Cileumeuh and Cikawung Rivers. One ulu-ulu manages water problems in Pahonjean, in close association with the lurah. The village is divided into three units, which are each subdivided into five blocks containing 3 to 5 smaller divisions. The village Dharma Tirta has 15 members, the managers of each of the 15 blocks; except for the name, they function much like ili-ili in other villages.

During shortages, the Irrigation Service alternates service between Cibeunying and Pahonjean. There is no system of water rotation within the village, however, thus farmers at the tail of the irrigated areas get short-changed. The ulu-ulu manages maintenance and repair in the area currently served by the Cijalu System, as well as the lower areas which sometimes obtain water from temporary diversion weirs on the Cijalu River. There are three main problems in Pahonjean: flooding, water shortages, and water theft. Flooding occurs beyond the area presently served by the Cijalu System, on land that is included in the project area. Water shortages currently affect both the present service area and the lower reaches which will be served by the project. Water theft occurs during shortages, taking two forms. First, people who maintain fishponds near the Cijalu River divert water from the canal to their fishponds. Second, some farmers cut off water flow to their neighbor's fields. In each case, if the culprit is identified, the local Dharma Tirta member calls the ulu-ulu, who then may call the lurah.

Compared to Pahonjean, Jenang and Sindangsari have very favored conditions. Both villages have high percentages of paddyland under technical or semi-technical regimes; both are served by the Cijalu System in the north and the Cileumeuh System in the south; and farmers in both obtain two rice crops per year with considerable regularity. During water shortages, water from the Cijalu System is diverted to one village at a time in 12-hour cycles.

Jenang has two ulu-ulu, one responsible for the Cijalu System, and one for the Cileumeuh; Sindangsari has one ulu-ulu who handles both. Ulu-ulu in both villages manage system maintenance and repair. However, the Cijalu ulu-ulu in Jenang also schedules rotation within his section, but rotation is managed by sub-village heads in Sindangsari. Dharma Tirta are not significant in either village. They were formed in Sindangsari, but are ineffective and thus not supported by members. Water supplies are generally adequate in the Cijalu System areas of the two villages, and water theft is consequently insignificant there. However, some parts of each village at the tail end of the Cijalu System do not receive water during shortages, and thus experience crop failures. Flooding and inter-village coordination are not thought to be problems in the Cijalu System portions of the two villages, but local maintenance and repair procedures do need improvement.

Cilopadang. The Cilopadang System is located totally within the Cilopadang village. The system is small, managed by a single ulu-ulu, who arranges for maintenance, repair and, in times of shortage, rotation within the system. It is the least problematical of the four systems, organizationally, although it needs considerable physical up-grading.

Cileumeuh. The Cileumeuh System has the most promise of the four systems, but it also has the most problems. It has promise because its present condition comes closest to resembling a technical irrigation system, as such. Its problems stem both from physical factors and organizational factors. Physically, the system consists of two canals. The small west canal serves a samll area entirely within Cilopadang village (Cileumeuh) which rarely, if ever, experiences water shortages, and rarely has organizational problems. The large east canal serves a large, diversified area, located in a number of villages. It periodically suffers shortages mainly in the period July-September, which are accompanied by problems of jurisdiction, coordination, and rule infraction. The organization and problems deserve elaboration.

The Cileumeuh east canal essentially serves 7 distinct areas. Just south of the Provincial highway, one secondary canal goes east to serve one

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section in Cileumpuyang (rated as semi-technical) and a paddy at the Kawung Plantation (rated technical). The remainder travels south and west, serving three sections in Cilopadang (Benda Wedan, Benda Kulong, and Banjarsari), and one section each in Sindangsari and Jenang. Two ulu-ulu manage the Cilopadang portion of the service area -- one handles Cileumeuh and Benda Kulong, the other handles Benda Wedan and Banjarsari. During shortages, water is rotated within Cileumeuh, and between the other units. The rotation turn generally consists of a 75 percent flow, while the remaining 25 percent continues to flow to the other sections. In theory, the rotation schedule is negotiated at the Irrigation Service office near the Cileumeuh Weir by representatives from Cilopadang, Jenang and Sindangsari, and generally results in alternating turns between Jenang/Sindangsari and Cilopadang. In practice, Jenang and Sindangsari are served after Benda Kulong and Benda Wedan are served, which means that the areas most frequently experiencing shortages are Banjarsari, Sindangsari and Jenang. Farmers in those three sections are the most difficult to organize in the system (those in Banjarsari are the most problematical) and they most frequently resort to water theft to serve fields or fishponds. The ulu-ulu of each of the three villages frequently complain to the Irrigation Service about scheduling failures, unauthorized diversions, or other problems.

The real focus for most criticism, however, is the Kawung Plantation, which is believed to obtain water even though the other three villages and Cileumpuyang experience shortages. Officials in Cilopadang, Sindangsari and Cileumpuyang contend that the Irrigation Service negotiates fair agreements, but then gives preference to the plantation at the expense of their villages. The plantation uses the water to irrigate a very intensive year-round rice project. According to the Camat of Cimanggu, the 115-hectare plot will be planted in coconuts in 1980, thereby eliminating the irrigation demand. In the meantime, it is a constant source of conflict. When village ulu-ulu complain to the Irrigation Service, Irrigation personnel are believed to reduce the plantation's flow temporarily, only to increase it again after the complaints cease. During shortages, the plantation is supposed to alternate with Cileumpuyang in 12-hour shifts --Cileumpuyang gets served in the daytime, and the plantation at night. However, the reality is much less consistent.

Thus the Cileumeuh System contains a number of elements which precipitate social problems: multiple jurisdictions, inconsistent distribution access criteria; conflicting private and corporate (plantation) interests; and conflicting village/bureaucratic interests. The problems become clear during dry periods, but then seem to disappear after the crises pass, without being resolved.

System Expansion Areas

In practical terms, the bulk of the project consists of efforts to extend technical irrigation capability to the whole area being served -- it is in this sense an irrigation system expansion project, as well as a rehabilitation project. In addition, however, other areas presently outside of the service area will be incorporated into the systems. In particular, the Cilaca System will expand to cover more of Wanareja; the Cijalu System will incorporate parts of Salebu, Pahonjean and Jenang that are now untouched or poorly covered; and the Cileumeuh will expand to Pahonjean, improve coverage in Jenang, Sindangsari and Cileumpuyang, and incorporate new land in Cimanggu. This section briefly reviews the situation in each village.

Wanareja. The Cilaca Extension will cover a large area in the southwestern part of the village, much of which borders the Citanduy River. Parts of the area are frequently flooded by water from the Cilaca and other Citanduy River tributaries which back up during high water periods. The area consists of small holdings, most of which yield one crop per year. There is some attempt made by farmers to utilize Cilaca River water for irrigation by constructing temporary diversions, but the efforts are inconsistent, as are results. Drainage and flood control will necessarily play an important part in the Cilaca Extension plan.

Salebu. The area of Salebu to be incorporated into the Cijalu System is a narrow strip of land along the east side of the Ciglaca River, bordered by Cibeunying on the northeast and Pahonjean on the southeast. Approximately 140 hectares in the northern section are presently served by Ciglaca River water diverted by temporary local structures contructed under the supervision of one of the village ulu-ulu. The unirrigated lower area is flood prone.

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A small part of the lower area consists of village land assigned to village officials (except the lurah, whose land is on higher, irrigated land), but is presently unproductive because of flooding. As in Wanareja, the land under question is already overseen by an ulu-ulu, thus no administrative changes are required.

Pahonjean. Pahonjean village, with a very low per capita income, will derive the most widespread benefits from the project. Improved drainage will reduce flood damage in the lower part of the village, east and west of the Provincial Highway. In addition, the area covered by the Cijalu west canal will be extended as far as the Cilanggir River, including land now irrigated by tiny local systems or rainfed. The extension of the Cijalu east canal will bring water to the area between the Cijalu and Cilopadang rivers, currently rainfed. Finally, the Cileumeuh System will be extended to cover the small rainfed area south of the Cilopadang River. When completed, the project will put virtually all of the village's paddyland under technical irrigation. The change will require some administrative expansion, perhaps to include another ulu-ulu to manage land covered by the Cijalu east canal and the Cileumeuh System.

Jenang, Sindangsari. Jenang has some flooding problems in the lower area which will be reduced by the project, but Sindangsari has no frequently flooded areas. Land in each village presently under semi-technical irrigation will be given better coverage, and parts of Jenang under simple systems or rainfed conditions will be brought into the Cijalu and Cileumeuh Systems. Jenang is administratively prepared for the change, but Sindangsari should add another ulu-ulu to the village staff.

Cileumpuyang. The main change in Cileumpuyang will consist of upgrading the area currently served by the Cileumeuh System from semi-technical to technical status. The PTD currently handles water management in the village, in addition to normal PTD duties. An ulu-ulu should be appointed to assume the irrigation responsibilities, however.

Cimanggu. The Cileumeuh System will be expanded to incorporate the area between the present Cileumpuyang tract and the sub-village of Karantengah in Cimanggu. The land currently is rainfed except for a small section covered by simple irrigation. The PTD manages water problems in Cimanggu, but an ulu-ulu should be appointed to do so. As previously indicated, the area under question is predominantly owned by people who live outside Cimanggu, primarily in villages located to the east and north. The high rate of non-resident ownership may complicate the role of the ulu-ulu, adding special problems related to communication, coordination and labor mobilization.

Needed Changes

In order to facilitate project implementation and to maximize the magnitude and distribution of project benefits, special attention should be paid to the following problems.

First, strong, autonomous village water user associations should be formed in early stages of project planning, patterned after the Dharma Tirta model. They should be contacted to identify local problems to be considered during design stages, and they should be actively involved in setting the final boundaries of 50-hectare on-farm irrigation units.

Second, Dharma Tirta leaders, ulu-ulu, lurah and sub-village heads should receive training in system management and on-farm water management. This should include site visits to existing systems which have successful Dharma Tirta. They should then pass on the information through mini-courses, arranged with the help of members of the District soil and water conservation staff, as well as through informal discussions.

Third, the inter-village rapport must be improved. The currrent relationship between villages served by the same system is unnecessarily "official," reflecting the bureaucratic character of the Irrigation Service, rather than the legitimate needs of system users. When problems arise, interested parties (ulu-ulu or lurah) should meet directly and decide what to do, rather than meet indirectly through Irrigation Service staff, who then make the decision. There should be two or three levels of interaction: lurah

and/or ulu-ulu from each interested village; and water user association representatives. Irrigation Service officials should participate in discussions, but in the capacity of technical advisors, not final arbitrators.

Fourth, the rapport between villages and the Irrigation Service must be strengthened and modified. The Irrigation Service has very little continuing contact with village officials, and even less contact with farmers. It provides technical assistance for village irrigation projects, if requested, but does not help train ulu-ulu or provide ongoing assistance to them. Moreover, its own planning seems to be done without consulting village officials, although sub-district officials apparently are apprised of such planning. The fact that officials in several villages harbor the suspicion that the Irrigation Service gives preference to the Kawung Plantation, regardless of the accuracy of the claim, indicates the pervasiveness of the problem of poor communication between the Irrigation Service and villages. Finally, village officials must be given more decision-making authority in the operation of the systems, to insure that questions like the plantation problem can be resolved directly without suspicion.

Fifth, if it does not eliminate the rice project in 1980 as planned, the Kawung Plantation should be denied irrigation water until all other users have received adequate amounts. Under no condition should the plantation be allowed to compete with villages and private citizens for water from government-sponsored facilities like these.

The Project -- Goals and Implementation

The project aims to increase rural incomes and standards of living in the area by changing conditions which limit rice production. Both the goals and methods to be used are acceptable to the target population. Furthermore, the implementing institution is adequate to carry the project to fruition. However, supplementary programs should also be implemented to make certain that the project yields maximum benefits and that the benefits are distributed widely.

Goals

Poor water conditions in the project area now limit agricultural production. Some areas are flood-prone, others obtain insufficient irrigation water for optimal growth, or delivery is sporadic. The uncertain and inconsistent conditions result in reduced yields and crop failures in some sections, and prevent farmers from using HYVs at all, or severely limit their ability to use them effectively.

The project will improve water conditions by up-grading existing irrigation systems, enabling farmers to obtain more dependable supplies and increase water use efficiency; by expanding the existing systems to serve additional areas which are now rainfed or served by simple irrigation systems; by improving drainage in the area to lessen the frequency and severity of flood damage to rice crops and homesteads.

With improved water control, farmers will be able to increase production levels each season, they will be assured of two crops per year, and they will therefore increase their incomes. Farm laborers will find additional employment opportunities, at the same time.

Acceptability

There is no question about the socicultural feasibility of the project. Farmers and officials in the project area concur on the nature of the problems they face, and the project will help them by addressing the problems. The project will be acceptable to the target groups. It will enable farmers to grow more rice, something they do now and something they want to do. It will not introduce a new technology, but it will improve an existing one and will make possible subsequent welcomed improvements.

Implementation -- Motivators and Executors

The impetus for the present study comes from the ECI-Proyek Citanduy Master Plan of 1975, which identified the rehabilitation needs of eight existing irrigation systems in Central Java. Since the Master Plan, the Irrigation Service has initiated rehabilitation of two of the eight systems through the auspices of the Sederhana Irrigation and Land Development Project, and has

arranged for the design and construction of a new weir on the Cijalu River (Cijalu System). The four systems under consideration comprise the remaining six identified in the Master Plan, the outlines of which have been prepared by the Irrigation Service.

The Irrigation Service's action in the interim period since the Master Plan is indicative of three things. First, it is staffed by people who are committed to improving the systems they manage. Second, the staff has the expertise and back-up assistance to evaluate local needs and to organize and execute programs designed to meet them. Finally, the action also shows that the Irrigation Service is chronically short of funds for maintenance, repair and up-grading, thus it must search for external or extraordinary funding sources in order to carry out activities it is otherwise qualified to manage.

Until the present, the Irrigation Service has managed the planning and scheduling of system improvements without significant consultation with local leaders or Project Citanduy. The Camats have been informed of plans, but other interested parties have not been informed. This procedure needs to change for several reasons. First it is wasteful. Farmers and village officials know more details about soil types, drainage and social interaction patterns -- all of which affect irrigation system operating effectiveness-- than Irrigation Service personnel or their contractors. Thus it is wasteful not to tap such an important font of knowledge. Second, preventing people from being informed can prove counter-productive if, as in the case of irrigation systems, those very people are subsequently expected to contribute time and energy to help maintain the system. Involving water users in decisions is not only good public relations, it is also good operational strategy because it helps build and sustain enthusiasm and commitment. Third, although the Irrigation Service is capable of bringing the project to fruition, the Service cannot supply the additional inputs which will be needed to achieve maximum benefits. Thus other responsible entities will have to be forewarned in time to mobilize resources. In particular, the Irrigation Service cannot organize the water user associations which will be needed, although it recognizes their value; it cannot provide the additional farmer support that will be needed; and

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the Irrigation Service cannot directly generate additional maintenance and operating money from water users, however badly it is needed. Other entities must provide the inputs or approval, for which they must be given advanced warning.

However, there is an additional reason to involve village, sub-district and district governments as partners in planning and implementation: Projett Citanduy will be the implementing organization. After completion, the Irrigation Service will be responsible for operation and maintenance of the four systems, but Project Citanduy will design and execute the project with the assistance of consultants and contractors. Although it is an experienced and capable organization, Project Citanduy is even less knowledgeable about local problems and resources than the Irrigation Service, and less able to arrange for additional inputs. This is problematical because, while it is more removed from the local situation, Project Citanduy has a mandate to complete the systems down to smaller units than those with which the Irrigation Service is used to working. Thus, in order to design workable on-farm turnout units, Project Citanduy will need even more consultation with farmers and village leaders than the Irrigation Service has had. The ongoing precedent of weak communication and poor consultation must therefore be broken. To design the systems properly and expediently, Project Citanduy personnel will require continued access to other governmental entities, and to farmers; arranging to provide additional inputs will also require much communication and consultation.

If the project is planned conscientiously, involving all interested parties, and if different inputs are coordinated systematically, it can easily achieve expected benefit levels.

Aftermath -- Beneficiaries, Institutions, Spread Effects

This section is concerned with the anticipated impact of the project once it is completed and functioning. It covers three questions. First, who is going to benefit from the project? Second, will it require or precipitate institutional changes? And third, to what extent will the benefits be spread beyond the immediate area, and how? In a word, the principal direct

beneficiaries will be landowners and farm laborers, but the impact of the benefit will vary; the project will not necessarily change institutions, but it is hoped that it will result in the creation of viable water user associations; its impact is not expected to spread noticeably beyond the area. It is a worthy, unpretentious project which will help raise the incomes of rural Javanese, although not only the poorest.

Beneficiaries

Four groups of people will benefit directly from the project -- farmers, contractors and construction workers, local leaders, and merchants. Unless the project precipitates widespread adoption of HYVs which require harvesting by sickle, it should not have any significant adverse effects. If sickle use does proliferate, many families will be deprived of the substantial amount of income earned at harvest time.

Direct Beneficiaries. Farmers comprise the largest group of people who will benefit directly from the project, but they are a heterogeneous group composed of people living under a wide range of conditions, thus their benefits will vary. In general, improved water control will enable more farmers to attain higher yields more often than occurs under present conditions. It will raise the threshold of attainable yields, increase the number of people who can reach the threshold, and increase the regularity of doing so. This will increase the amount of rice produced and marketed, and increase labor demand for land preparation, transplanting, weeding and harvesting. For purposes of analysis, farmers are divided into two main groups: landowners and laborers.

Based on village data regarding paddyland owners, we can estimate that approximately 9,000 family heads who own paddyland in the project area, and their 35,000 dependents, will benefit directly from the project. This includes almost 40 percent of the landowners, and 40 percent of the population in the nine villages, and varies from about 10 percent of the families in Cimanggu to over 50 percent of the families in Pahonjean. The actual village percentages may be smaller if the records are out-dated, or if they disguise multiple landholdings, but the estimate is reasonable, nonetheless.

All paddyland owners will not benefit equally, of course. A farmer's absolute benefit will depend primarily on the size of his holding and his land's current water situation. Farmers with large holdings will benefit more than small holders, and those who now get one crop a year will feel the impact more markedly than those who now get two crops a year. Smaller landowners will overwhelmingly obtain the greatest relative benefits from the project, however. For the most part, large holdings are located in advantaged areas, but small holdings are in rainfed, flood-prone areas, and at the tail ends of existing systems. As a result of the project, all farmers in the four systems will have the capability to grow 2 to 2½ high yielding crops per year, on a regular basis. The qualitative impact thus will be greatest on the smallest, poorest landholders. Nonetheless, the absolute income levels of small farmers will not be high after the project, and the income differential between large and small landholders may in fact increase. Small farmers will not become rich as the result of the project, but they will become less susceptible to economic ruin.

Most of the 16,000 agricultural laborers in the village will also benefit directly from the additional labor demand generated by intensified cropping and higher yields. The amount of benefit will vary, depending on present conditions, additional income sources (opportunity costs), and other factors. The project's impact on laborers in Pahonjean and Wanareja will be greater than the impact on laborers in Sindangsari and Cilopadang, for example, because double cropping is already the norm in the latter villages. In general, women will benefit more than men from the increased labor demand.

Construction workers and contractors will be the second largest group of beneficiaries. The size of the work force will fluctuate during construction phases. It is hoped that local residents will be employed as much as possible, and that construction schedules will be set to maximize local labor input. The impact of this temporary employment will be significant, but short-lived.

The third group of direct beneficiaries comprises the lurah, sub-village heads, ulu-ulu and Dharma Tirta officials, especially the ketua

kelompok, who will monitor irrigation use within small blocks. They will all receive water management training before the systems resume operation. In some cases, the training will enable them to manage the irrigation systems more efficiently; in other cases, it will prepare them to diffuse information about water management principles and practices throughout the villages.

Finally, merchants and middlemen will benefit from the project, directly and indirectly. Direct benefits will accrue to the people who sell construction supplies and to those who market the increased production; indirect benefits will accrue to the people who expand their businesses, or start new businesses, in response to the increase in disposable income.

Adversely Affected. This project is not likely to have direct adverse effects on anyone. Land loss and residential displacement will be negligible. However, an indirect adverse effect may appear which could have very grave consequences -- widespread use of the sickle. If dwarf HYVs, such as IR-36, are adopted on a wide scale, harvesting practices may change. Ani-ani are now used to harvest most of the rice in the area, including many HYVs. The ani-ani is thought to be good because it allows virtually unlimited participation in the harvest. But using the ani-ani can be problematical with dwarf varieties like IR-36 because the stalks are too short to reach comfortably, the leaves get in the way, and the panicles tend to shatter too easily. Sickles are better suited for such varieties, but when sickles are used, the landowner normally limits the number of harvesters to about 15 per hectare. At the moment, growing IR-36 is not a viable option for most farmers. Their water control is not adequate, pest control is not adequate, yields have been lower than those obtained with other HYVs, and local people do not care for the quality of the grain. Nevertheless, after the project is completed, circumstances might change such that farmers would find it reasonable for them to grow IR-36 or its dwarf successors. If this were to happen suddenly, great numbers of harvesters (women) would be out of work, without alternative sources of income. This could have devastating repercussions throughout the area, and thus should not be encouraged.

Patterns of sickle adoption and response elsewhere in Java are far too unclear to support either optimistic or pessimistic predictions, and such predictions fail to take into account the genuine resourcefulness of people. However, even if the scenario sketched above were to materialize, it would not justify a negative evaluation of the rehabilitation project. The prospect of sickle adoption does illustrate the necessity of considering a broader range of programs to meet local needs, however, in addition to the project itself.

Institutions

In broad terms, the institutional framework needed to make the project function is already in place. With few minor institutional modifications, such as adding ulu-ulu, and increasing village-Irrigation Service interaction, the enlarged and improved irrigation systems will be able to return to "business as usual." Nonetheless, some changes are recommended to make the systems work better than they did before rehabilitation and expansion, and to continue to work well for a long time. The recommendations are made to highlight discontinuities and thus to suggest points of leverage from which to facilitate institution formation.

It is clear that existing water user associations are innocuous; but they are also ineffective. And yet they are needed. During shortages, farmers are at the mercy of the ulu-ulu, lurah, Irrigation Service and each other; they really have no institutional leverage at all. In addition, while one of the main reasons for the existence of the associations should be to maintain and improve the systems, there is no evidence that the existing groups do this successfully. To the contrary, it seems that farmers are conscientious about keeping up the system when there is good reason to do so (that is, when the system already delivers water well), but they are not conscientious when there is no reason to be. That is, a faulty physical structure provides a deficient basis for social organization in government-sponsored irrigation systems. Existing Dharma Tirta in the nine villages have little impact on conscientiousness or solidarity, thus they should be reconstituted during the process of project planning and implementation.

First, the system will be completed down to on-farm turnout units which average 50 hectares, smaller than existing ones. Thus old farmer working groups will be broken up and new ones will have to be formed, both on the 50-hectare turnout level, and the 10-hectare kelompok level. The boundaries of such units should be discussed with farmers before the designs are completed so that they can assist in creating viable working groups. This interaction will lay the groundwork for establishing active Dharma Tirta units. This initial basis is critical for two reasons: first, it allows people who will have to work together to indicate their choice of cohorts, thus creating sympathetic bonds, as well as practical ones; second, it later provides a moral basis for enforcing group discipline.

Second, the working units of the Dharma Tirta (kelompok and turnout block) should be organized into village associations, according to whichever form villagers find congenial. If the village is served by two systems, the association should have two sections.

Third, the Dharma Tirta should work with the ulu-ulu to manage, maintain and repair the system, but it should remain independent of the village administration.

Fourth, with an independent base, the Dharma Tirta can protect and advocate the interests of its members and then expand to initiate other collective activities, such as credit unions, cooperatives, or processing facilities.

Meanwhile, the rest of the institutional framework will remain virtually unchanged: the Irrigation Service, ulu-ulu and lurah will be in place, ready to assume their traditional responsibilities, and better able to do so after receiving technical training. Indeed, one can argue strongly that reconstituted Dharma Tirta will add significantly to the operation of the irrigation systems, and that they can contribute greatly to the welfare of their members, the water users. However, one cannot argue that the Dharma Tirta are absolutely indispensible for the successful operation of the systems

after the project is completed. The basic institutional apparatus is already complete, but this additional component should be added for the benefit of farmers.

Spread Effects

This project has a modest mission and a limited perspective: it will provide improved and expanded irrigation service and drainage to the farmers to enable them to increase rice production. It addresses an important local problem, water control, a critical limiting factor in local agricultural development. But it does not address all local problems, nor should it be expected to.

The tremendous population growth in recent decades has precipitated a number of conditions, such as shrinking landholding size, increasing incidence of landlessness, and environmental degredation. These and other problems will become even more acute as the children of today mature. The agricultural sector will not be able to absorb a high proportion of farmers' children, especially if they expect to send their own children to school. The project will stimulate some labor demand in agriculture and other sectors, but not nearly enough to absorb the people who seek work now, let alone those who will be joining the labor force shortly. Emigration to the cities is not a solution to the problem of rural population pressure; it merely changes the location of the problem. There are no easy answers, but surely programs will have to be enacted in the area to do a number of things: to provide gainful employment locally, at decent wages, perhaps by encouraging the development of small industries, traditional and non-traditional; to reduce exploitation of the poor by moneylenders and others, by creating alternative credit sources; to remove the hidden costs of education and make it truly free; to provide adequate health care; and to improve the quality of water and sanitation.

The project cannot meet such objectives, but it will contribute to local well-being by providing more rice, by expanding the local market, and by allowing a number of small landholders to break the cycle of indebtedness which would otherwise cause them to lose their land. By stimulating

agricultural development, the project will not achieve the broader rural development goals outlined above, but it is a necessary and worthy first step. Rural development cannot occur without agricultural development. After the project, much remains to be done.

Social Assessment

The first four sections of this chapter discussed the area, the current irrigation situation, the projects, and its anticipated aftermath. This section reviews assets of the project, and outlines problem areas and recommendations.

Assets

This project will rehabilitate and expand the four irrigation systems, and articulate them down to 50-hectare on-farm turnout units. It will supply dependable irrigation water to farmers in Wanareja, Majenang, and villages surrounding Majenang. It will also improve drainage, which is even more critical in parts of the project area. Currently, both water and yields are unpredictable throughout most of the project area. When the project is completed, all farmers will have dependable water for 2 to 2½ rice crops per year. All farmers should consequently increase their yields, and those farmers who have been reluctant to risk investment in inputs and HYVs will have greater incentive to do so. Prospects are good for achieving projected yield levels for three reasons. First, most of the farmers affected by the project already have experience in irrigation water management; they will need to up-grade practices somewhat to increase efficiency, but that should not be a problem if the recommended village leader training program is executed. Second, the infrastructure should not be an obstacle to improving yields. Transport, marketing and input facilities already in place will be able to respond to increased demands made upon them. Only the extension-information-technology input is problematical, as indicated below. Finally, the institutional structure is also essentially adequate to allow the project to achieve minimal goals. Improvements should be made in order to stimulate the participation of farmers and villages, as indicated below,

but the project will succeed even without the improvements. In summary, this project is needed, it is wanted, and it will be welcomed.

Problem Areas and Recommendations

Despite the overall favorable prognosis for the project, there are seven problem areas which should be addressed during project planning and implementation in order to magnify its positive impact.

Coordination. Coordination on two levels will be important -- external and internal. External coordination will be needed to secure improvements in the extension system and to guarantee that credit and agronomic inputs will be sufficient. The Extension Service is too busy with narrow BIMAS-INMAS activities to identify and respond to local problems. BIMAS-INMAS recommendations are inappropriate in many regards, but PPLs are unable by mandate and training to improvise or draw upon additional resources. PPL-village contacts are too infrequent and too superficial, and rest upon a diffusion system which rarely works. Coordination for extension and irrigation now is possible at the sub-district level, but Project Citanduy is not represented there.

Internal coordination will be needed to assure that the designs of the 50-hectare turnout units respond to local realities.

Coordination Recommendations. First, Project Citanduy should initiate a process of communicating with sub-district and district officials to apprise them of the scope and timetable of the project, and to outline additional needs, particularly for credit, inputs and pest control apparatus. Second, Project Citanduy should encourage the Extension Service to reorganize its contact structure in the project area, along the new official format, in units to correspond to new irrigation system units. Third, Project Citanduy should complete final on-farm boundary designs in the field in consultation with village leaders and farmers. The inconvenience this brings will be amply rewarded in the product obtained, as well as in the cooperation and commitment it evokes among farmers and village leaders.

Participation. Participation in the existing systems is hierarchical, and largely "top down." The Irrigation Service coordinates villages, and the lurah and ulu-ulu manage within villages, with assistance. Farmers either accept the management or clandestinely oppose it, but they can do little more. Even the Dharma Tirta which persist were organized as working groups whose purpose was to fulfill given responsibilities, not to define the responsibilities, and certainly not to demand reciprocity. Farmers have no way to hold village officials or the Irrigation Service accountable for poor water delivery, and no way to make sure that rotation schedules are adhered to. They can protest by withholding tax payments or, in some places, Dharma Tirta assessments, or they can resort to water theft, but they are all futile or counter-productive gestures.

Credit and marketing are corollary systems which leave the farmers equally dependent.

Participation Recommendations. Project Citanduy should encourage district officials responsible for Dharma Tirta affairs to organize/reconstitute them in the villages, and offer assistance. The process should start with formal and informal village leaders exchanging visits with people in other villages which have functioning Dharma Tirta, and proceed through local education campaigns. Project Citanduy-farmer contact regarding on-farm boundaries should coincide, as it will help stimulate interest and lend credence to the effort.

Once they are organized, efforts should be made to stimulate Dharma Tirta Committees to form credit unions and cooperatives to serve their members.

Village Water Management. In all cases, village level water management needs improvement. Delivery is not always equitable and maintenance is generally inadequate, and both may be exacerbated by system rehabilitation, unless changed. The Dharma Tirta are intended as vehicles to diffuse responsibility and authority for much village water management. However, the ulu-ulu will still have a major role, as will the lurah, sub-village heads, and perhaps kebayan. Even though the lurah and sub-village

heads do not have the daily operational responsibilities of the ulu-ulu, they perform traditional paternalistic roles of legitimating and instructing which are essential in attempts to organize people, thus they must be made integral parts of any organizing campaigns in the villages. Unless all of the responsible people understand fully the responsibilties and demands of the system, and agree upon allocation and procedural questions, the systems cannot work smoothly through dry seasons -- the critical periods.

Village Water Management Recommendations. As soon as Dharma Tirta units are formed in the kelompok and organized on the village level, a cadre of villagers should attend a two-week training session in water management techniques. The course should include a week of on-line experience at an operating system with a Dharma Tirta, so that people learn about social, organizational problems, as well as technical ones. The ulu-ulu, lurah, sub-village heads, kebayan, Dharma Tirta Committee members and ketua kelompok should all attend.

Inter-Village Cooperation. Inter-village cooperation now seems to be directly related to the availability of water. Although relations do not appear to be highly volatile even during shortages, it is clear that the existing arrangement of communicating through the Irrigation Service is not satisfactory, especially in the Cileumeuh System. The root of the problem, however, is the impotence of the villages. They can agree to rotation arrangements, but then have no way to monitor the Irrigation Service's execution. The Irrigation Service must be made accountable to the villages.

Inter-Village Cooperation Recommendations. A committee should be formed in each system of representatives of the villages served (ulu-ulu and lurah or sub-village heads). The committee should meet regularly with the Irrigation Service to approve schedules of rotation and maintenance shut-downs, and to monitor actual operations.

Additionally, representatives of village Dharma Tirta should form a committee in each of the multiple-village systems, to oversee the decisions

of officials and to consult regularly with the Irrigation Service. In single-village systems, the Dharma Tirta Committee should perform the consulting role outlined.

Financing. The Irrigation Service is chronically short of maintenance funds, which leads eventually to system deterioration and subsequently increases both repair and maintenance costs. This situation shortens the effective operational lives of systems, in general, and threatens to do the same to the ones in question.

Financing Recommendations. If water is indeed delivered as psomised, and farmers obtain satisfactory yields, and they feel that they have some control over the system, farmers can be expected to contribute regularly to defray maintenance expenses. Collections of a fixed amount of rice (or money) per hectare per crop could be collected by the ulu-ulu at the end of each season. The maintenance assessment should not be collected by the Dharma Tirta, as it would violate the principle of autonomy, and would be confused with the Dharma Tirta assessment. Similarly, the irrigation assessment should go directly to the Irrigation Service, rather than filter through successive governmental hierarchies, lest they extract administrative fees along the way.

The water user fee should be explained clearly to farmers and Dharma Tirta before the systems resume operation, but fees should not be collected until after at least 3 seasons. This would give people time to get used to the system, and time to obtain benefits. It would also give farmers enough time to be convinced that the deliveries arrive on time and are adequate. Until they are convinced, it is futile to try to extract still another hidden tax from them.

Competition. The current perception that villages in the Cileumeuh System are competing unsuccessfully with the Kawung Estate for water is problematical and may not be resolved even if the project increases the amount of water available. If the perception is inaccurate, it is indicative of poor communications, which should be rectified. If the perception is

accurate, however, and the Kawung Estate is indeed being given preference, then it highlights a serious inequity which must be stopped.

Competition Recommendations. There are indications that the Kawung Estate will cease rice production in 1980, and thus may not need the irrigation water. If the Estate wants to continue to use the Cileumeuh System, is should only be allowed to do so after the needs of all other water users have been met.

Ecological Deterioration. Erosion in the upper watershed has contributed significantly to most of the water-related problems in the project area, from poor drainage and irrigation system inefficiency, to abbreviated periods of water availability. Current farming practices and deforestration are principal causes of the erosion. Unless the erosion is curtailed, the same problems will reappear after the project is implemented.

Ecological Deterioration Recommendations. This project and most of the other activities of Project Citanduy underscore the critical need of an upper watershed management program which combines reforestration, bench terracing, and the diffusion of improved agricultural techniques. Any single element will not suffice. Likewise, any program which does not concentrate on providing incentives to cause farmers to maintain the terraces, and to protect the watershed, is doomed to failure. A comprehensive upper watershed program should be promulgated as soon as an adequate organizational structure is developed, as soon as enough people are trained to execute it, and as soon as appropriate cropping recommendations have been developed for local conditions.

TABLE IV-1

SUMMARY STATISTICS -- PROJECT VILLAGES

Sub-District	Village	Population Mid-1978	Area (Km^2)	Persons/ Km^2	Population Growth 1966-1976 %	%/yr.	Percent Agriculture
Wanareja	Wanareja	20.431	26.4	774	38	3.3	69
Majenang	Salebu	9.523	14.7	648	16	1.5	88
	Cibeunying	5,746	11.6	495	29	2.6	88
	Pahonjean	10,503	8.2	1,281	6	0.6	92
	Jenang	14,388	7.5	1,918	20	1.8	64
	Sindangsari	13,394	8.7	1,540	41	3.5	86
	Cilopadang	19,003	16.2	1,173	44	3.7	60
Cimanggu	Cileumpuyang	9.882	12.6	784*	43	3.7	80
	Cimanggu	12,234	29.9	409*	13	1.3	76
Total		115,104	135.8	848	28	2.5	78

*Essentially half of Cileumpuyang and Cimanggu are forests and plantations, so the actual population density is higher than indicated.

Source: Village data compiled for Cilacap District Planning Office and village records (Monografi).

TABLE IV-2

POPULATION GROWTH

Village	Population 1966	Population 1971	Population 1976	Population Growth Rates - % Per Year: 5 Years 1966-71	5 Years 1971-76	10 Years 1966-76	1 Year 1976-77	Population Doubling Time 1966-1976 Growth Rate
Wanareja	15,027	19,309	20,719	5.1	1.4	3.3	-1.0	21 yr.
Salebu	8,031	8,063	9,298	0.1	2.9	1.5	0.2	47 yr.
Cibeunying	4,393	5,228	5,670	3.5	1.6	2.6	-0.5	27 yr.
Pahonjean	9,865	10,221	10,485	0.7	0.5	0.6	0.06	116 yr
Jenang	11,951	13,285	14,318	2.1	1.5	1.8	0.5	39 yr.
Sindangsari	9,513	11,062	13,415	3.3	3.9	3.5	-0.2	20 yr.
Cilopadang	13,170	16,115	18,908	4.1	3.3	3.7	0.4	19 yr.
Cileumpuyang	6,927	9,576	9,925	6.7	0.7	3.7	0.3	19 yr.
Cimanggu	10,659	11,538	12,093	1.6	0.9	1.3	1.0	54 yr.
Total	89,536	104,397	114,831	3.1	1.9	2.5	0.08	28 yr.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-3

AGE DISTRIBUTION

Village	Number	Percent in Each Age Group 0-4	5-9	10-14	15-24	25-54	55+	Total	Percent Under 15	Percent 15-55
Wanareja	20,416	15	21	15	18	25	7	101	51	43
Salebu	9,319	25	10	6	7	44	7	99	41	51
Cibeunying	5,642	10	17	17	28	19	9	100	44	47
Pahonjean	10,491	8	5	8	20	53	7	101	21	73
Jenang	14,384	23	15	11	11	28	11	99	49	39
Sindangsari	12,394	22	16	14	18	24	6	100	52	42
Cilopadang	18,990	13	13	13	22	31	8	100	39	53
Cileumpuyang	9,953	14	12	12	18	36	9	101	38	54
Cimanggu	11,810	15	12	12	18	37	7	101	39	55
Total	113,399	16	13	12	18	33	8	100	42	51

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-4

SEX RATIOS AND MEAN FAMILY SIZE

Village	Sex Ratios* Age Group 0-14	15-24	25-54	55+	Total	Mean Family Size (Persons/family)
Wanareja	95	90	92	90	93	4.6
Salebu	99	97	100	97	99	4.8
Cibeunying	99	83	93	133	96	4.9#
Pahonjean	89	83	111	65	79	5.0
Jenang	82	64	92	100	84	5.0
Sindangsari	112	85	138	105	112	5.0
Cilopadang	100	92	99	98	98	5.5
Cileumpuyang	96	96	96	96	96	5.4
Cimanggu	89	88	89	89	89	5.7
Total	96	87	92	95	94	5.1#

*Number of males per 100 females.

#Estimate; number of family units in Cibeunying not available.

Source: Village data compiled for Cilacap District Planning Office and Village Records (Monografi).

TABLE IV-5

POPULATION DENSITY AND PER CAPITA INCOME

Village	Population Density (Persons/Km^2) 1966	1971	1976	1978	Per Capita Income - 1977 Agriculture	Non-Agriculture
Wanareja	569	731	785	774	180,000	252,000
Salebu	546	549	633	648	144,000	145,000
Cibeunying	379	451	489	495	155,000	54,000
Pahonjean	1,203	1,246	1,279	1,281	139,000	127,000
Jenang	1,593	1,771	1,909	1,918	153,000	192,000
Sindangsari	1,093	1,271	1,542	1,540	288,000	288,000
Cilopadang	813	1,024	1,167	1,173	172,000	168,500
Cileumpuyang*	550	760	788	784	168,000	90,000
Cimanggu*	356	386	404	409	180,000	84,000
Total	659	769	846	848		

*Cileumpuyang and Cimanggu are essentially half forests and plantations, thus the effective population density is higher than indicated.

Source: Population density calculated from village data compiled for Cilacap District Planning Office (1978 obtained from Monografi); income data reported as received from Cilacap District Planning Office.

TABLE IV-6

RELIGIOUS AFFILIATION

Village	Percent Distribution				Number
	Islam	Protestant	Catholic	Total	
Wanareja	99	*	1	100	22,431
Salebu	100	--	*	100	9,264
Cibeunying	100	--	--	100	5,744
Pahonjean	100	--	--	100	10,360
Jenang	98	1	1	100	14,393
Sindangsari	93	2	5	100	13,485
Cilopadang	99	--	1	100	18,986
Cileumpuyang	99	*	1	100	9,882
Cimanggu	99	*	*	99	12,244
Total	98.5	0.5	1	100	116,789
Number	115,033	529	1,190		

*Less than 0.5%; total also includes 37 Buddhist in Wanareja.
Source: Calculated from Village Records (Monografi).

TABLE IV-7

(SYNTHESIS) OCCUPATIONAL DISTRIBUTION - PERCENT

Village	Agriculture	Commerce	Entrepreneurs	Industry	Construction	Public Service	Pension	Other**	Total	Number	% of Pop. 15-55
Wanareja	69	13	*	5	5	6	*	1	99	9,031	104
Salebu	88	1	*	3	2	2	*	4	100	5,025	106
Cibeunying	88	5	-	1	2	1	*	3	100	3,938	149
Pahonjean	92	2	-	-	2	2	*	2	100	6,798	90
Jenang	64	23	*	3	1	4	4	1	100	5,966	106
Sindangsari	86	3	*	1	*	2	*	9	101	9,212	176
Cilopadang	60	15	1	1	3	2	1	17	100	8,036	80
Cileumpuyang	80	12	-	2	2	4	*	-	100	3,469	65
Cimanggu	76	5	*	1	*	3	1	14	100	3,663	56
Total	77	9	*	2	2	3	1	6	100	55,138	87
Number	42,485	5,013	91	1,078	1,236	1,568	380	3,287			

Source: Calculated from a synthetic distribution table obtained by combining Village Records (Monografi), and occupation and agricultural work force tables compiled for Cilacap District Planning Office.

TABLE IV-8

AGRICULTURAL WORK FORCE

Village	Owners	Laborers	Renters	Share-croppers	Other**	Total	Number
	Distribution - Percent						
Wanareja	62	27	1	10	-	100	6,991
Salebu	53	32	15	*	-	99	4,452
Cibeunying	37	40	11	*	11	100	3,879
Pahonjean	28	64	2	1	5	100	6,444
Jenang	64	31	4	1	-	100	4,004
Sindangsari	38	54	8	*	-	100	6,347
Cilopadang	78	18	2	*	2	100	4,974
Cileumpuyang	70	30	-	-	-	100	2,584
Cimanggu	44	20	15	-	22	101	3,268
Total	51	37	6	2	4	100	42,953
Number	22,046	16,026	2,533	812	1,536		

*Less than o.5%.
**Believed to be forestry and plantation employees.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-9

LAND USE

Village	Wetland Rice	Home-gardens	Dry-land	Fish-ponds	Forests	Estates	Other	Total	Hectares
	Distribution - Percent								
Wanareja	37	30	21	*	*	9	2	99	2,644
Salebu	23	15	46	3	14	-	-	101	1,470
Cibeunying	18	8	58	*	8	6	2	100	1,163
Pahonjean	56	27	17	*	-	-	-	100	818
Jenang	60	26	11	*	-	-	2	99	751
Sindangsari	61	34	-	*	-	-	4	99	865
Cilopadang	45	28	20	*	5	-	1	99	1,619
Cileumpuyang	29	20	3	*	48	-	*	100	1,262
Cimanggu	22	7	21	*	7	43	-	100	2,990
Total	35	20	23	1	9	12	1	101	13,582
Hectares	4,725	2,725	3,131	70	1,191	1,583	158		

*Less than o.5%.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-10

PADDYLAND WATER REGIME

Village	Hectares					Distribution - Percent				
	Technical	Semi-Technical	Simple	Rainfed	Total	Technical	Semi-Tech.	Simple	Rainfed	Total
Wanareja	250	399	235	106	990	25	40	24	11	100
Salebu	-	249	89	-	338	-	74	26	-	100
Cibeunying	125	45	26	8	204	61	22	13	4	100
Pahonjean	151	82	115	106	454	33	18	25	23	99
Jenang	200	100	75	75	450	44	22	17	17	100
Sindangsari	264	246	9	9	528	50	47	2	2	101
Cilopadang	709	-	20	-	729	97	-	3	-	100
Cileumpuyang	-	130	46	184	360	-	36	13	51	100
Cimanggu	-	-	65	601	666	-	-	10	90	100
Total	1,699	1,251	680	1,089	4,719	36	27	14	23	100

Source: Village Records (Monografi).

TABLE IV-11

LAND OWNERSHIP - PERCENT DISTRIBUTION

Village	Private Village	Private Resident	Private Absentee	State	Other	Total	Hectares**
Wanareja	1	88	1	9	1	100	2,644
Salebu	3	81	2	14	1	101	1,441
Cibeunying	1	77	7	15	-	100	1,162
Pahonjean	4	87	9	*	-	100	818
Jenang	2	77	21	*	-	100	792
Sindangsari#	3	97	-	*	-	100	865
Cilopadang	*	96	1	3	-	100	1,545
Cilempuyang	*	40	11	49	-	100	1,262
Cimanggu	3	29	17	50	2	101	2,979
Total	2	69	8	20	1	100	13,508

*Less than 0.5%.

**Differences between these totals for Salebu, Cilopadang and Cimanggu, and totals in other tables, were not reconcilable.

#Village Head says that absentee ownership accounts for about 12% of the land in Sindangsari.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-12

LANDHOLDING UNIT SIZE

Village	Ave. Size (ha)	Units - Percent 0-0.5 ha.	0.5-1 ha.	1-3 ha.	3-5 ha.	Total	Number	Land - Percent in Units 0-0.5 ha.	0.5-1 ha.	1-3 ha.	3-5 ha.	Total	Hectares
Wanareja	0.53	45	37	11	6	100	4,355	43	7	7	43	100	2,315
Salebu	0.48	69	19	8	4	100	2,441	28	24	20	28	100	1,190
Cibeunying	0.66	59	24	13	3	99	1,443	25	22	32	21	100	907
Pahonjean	0.36	75	16	7	1	99	2,156	14	34	40	12	100	777
Jenang	0.25	83	16	*	-	100	2,580	67	29	4	-	100	647
Sindangsari	0.35	83	12	4	1	100	2,415	69	16	6	9	100	865
Cilopadang	0.38	50	45	4	1	100	3,983	50	35	8	7	100	1,537
Cileumpuyang	0.34	80	14	5	1	100	1,862	38	28	24	9	99	650
Cimanggu	0.61	68	26	5	1	100	1,424	43	30	19	8	100	871
Total	0.43	65	26	7	2	100	22,659	42	23	16	20	101	9,759

*Less than 0.5%.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-13

HOUSING

Village	Distribution - Percent: Permanent (Mortar)	Semi-Permanent	Wood	Bamboo	Total	Number	Percent With Electricity
Wanareja	9	6	13	75	100	4,305	2
Salebu	12	4	2	82	100	1,950	0
Cibeunying	7	9	33	51	100	543*	0
Pahonjean	4	1	0	94	100	2,185	0.2
Jenang	11	35	32	22	100	2,263	21
Sindangsari	10	15	0	75	100	2,523	11
Cilopadang	25	33	41	1	100	3,447	1
Cileumpuyang	4	3	0	93	100	1,869	7
Cimanggu	10	1	2	88	100	2,442	7
Total	11	13	14	63	101	21,527	5
Number	2,324	2,777	2,936	13,490			

*Believed to be closer to 1200.

Source: Village Records (Monografi).

TABLE IV-14

EDUCATIONAL ATTAINMENT

Distribution - Percent

Village	Not Yet School	No School	Some Primary	Primary	Middle	Secon-dary	Post-Secondary (Number)	Total	Number
Wanareja	26	14	8	48	4	1	(25)	101	20,439
Salebu	14	3	45	34	3	1	(18)	100	9,298
Cibeunying	6	5	54	34	1	*	(0)	100	4,996
Pahonjean	8	7	24	59	1	1	(12)	100	9,449
Jenang	26	14	12	32	15	1	(14)	100	14,385
Sindangsari**	21	-	25	53	*	*	(18)	99	13,351
Cilopadang	18	5	53	22	2	1	(18)	101	19,386
Cileumpuyang#	32	4	31	30	3	1	(12)	101	9,882
Cimanggu	22	67	2	7	2	*	(7)	100	8,080
Total	21	12	27	36	4	1	(124)	101	109,266

* Less than 0.5%.

** The Primary category and No School category are both thought to be incorrect; the former is too high and the latter is far too low.

#The Not Yet School category is probably too high.

Source: Village Records (Monografi).

TABLE IV-15

SCHOOLS

Village	Kinder-garten	Primary (Public)	Primary (Islamic)	Middle	Vocational	Secondary	Total
Wanareja	2	15	4	1	1	-	23
Salebu	-	7	2	-	-	-	9
Cibeunying	-	5	2	-	-	1	8
Pahonjean	-	6	3	1	-	-	10
Jenang	-	11	2	3	-	1	17
Sindangsari	1	7	4	1	1	-	14
Cilopadang	1	9	8	-	-	-	18
Cileumpuyang	-	5	2	1	-	-	8
Cimanggu	-	11	-	1	-	-	12
Total	4	76	27	8	2	2	119
Percent	3%	64%	23%	8%	2%	2%	101%

Source: Village Records (Monografi).

TABLE IV-16

STUDENTS AND ATTENDANCE RATIO

Village	Distribution of Students by School Level - Percent: Kinder-garten	Primary (Public)	Primary (Islamic)	Mid.	Voc.	Secon-dary	Total	Students-Number	Children 5-15 yr.	Attendance Ratio*
Wanareja	1	80	11	6	3	-	101	4,013	7,247	55
Salebu	-	79	21	-	-	-	100	1,503	1,616	93
Cibeunying	-	67	6	-	27	-	100	1,205	564	214
Pahonjean	4	73	18	5	-	-	100	1,095	1,381	79
Jenang	3	65	10	14	-	-	100	3,061	3,891	79
Sindangsari	2	73	*	17	8	-	100	2,418	3,672	66
Cilopadang	#	#	#	#	#	#	#	3,559	2,680	133
Cileumpuyang	-	70	15	15	-	-	100	1,516	1,015	149
Cimanggu	2	86	-	13	-	-	101	1,864	2,896	64
Total	2	74	9	9	2	4	99	16,675	24,962	67

*Number of students per 100 children ages 5-15.

#Not available.

Source: Village Records (Monografi).

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TABLE IV-17

PUBLIC HEALTH SYSTEM COMPONENTS

Village	Public Health Clinics	Mother-Child Clinics	Family Planning Clinics	Doctors	Doctors Asst.	Nurses	Midwives	Midwives
Wanareja	1	1	1	1	3	1	3	23
Salebu	-	1	-	-	1	-	-	7
Cibeunying	-	-	-	-	-	2	-	4
Pahonjean	-	-	-	-	-	-	-	4
Jenang	1	1	1	2	1	9	2	15
Sindangsari	-	-	-	-	-	-	-	7
Cilopadang	-	1	-	-	-	-	-	-
Cileumpuyang	1	1	1	1	3	1	1	6
Cimanggu	-	-	-	-	-	-	-	6
Total	3	5	3	4	8	13	6	72

Source: Village Records (Monografi).

TABLE IV-18

ROADS

Village	Kilometers Provincial	District	Village	Total	Road Density (Km/Km^2)
Wanareja	6	7	16	29	1.1
Salebu	-	4	17	21	1.4
Cibeunying	-	1.5	15	16.5	1.4
Pahonjean	4.5	-	8	12.5	1.5
Jenang	-	2	5	7	0.9
Sindangsari	1	3	11	15	1.7
Cilopadang	3	-	13	16	1.0
Cileumpuyang	4	-	8	12	1.0
Cimanggu	1.2	-	27	28.2	0.9
Total	19.7	17.5	120	157.2	1.2
Percent	13%	11%	76%	100%	

Source : Village data compiled for Cilacap District Planning Office.

TABLE IV-19

VEHICLE OWNERSHIP -- 1977-78

	Private Use			Public Use					
Village	Bicycle	Motor-Cycle/ Scooter	Car	Becak	Horse-cart	Taxi	Colt	Bus	Truck
Wanareja	648	48	2	45	3	-	16	-	5
Salebu	216	34	-	20	7	-	-	2	-
Cibeunying	277	12	-	17	4	-	1	-	-
Pahonjean	370	25	-	50	10	-	2	-	2
Jenang	1,470	376	35	35	5	5	15	4	15
Sindangšari	429	62	11	64	-	14	47	15	11
Cilopadang	433	46	1	47	37	-	9	-	4
Cileumpuyang	214	43	-	9	42	-	7	-	4
Cimanggu	254	39	-	2	28	-	3	-	4
Total	4,311	685	49	289	136	19	100	21	45
Persons/ Vehicle	27	168	2,345	398	845	6,047	1,149	5,471	2,553

Source: Village Records (Monografi).

TABLE IV-20

RADIO AND TELEVISION OWNERSHIP -- 1977-78

Village	Number of Units		Persons per Unit	
	Radio	Television	Radio	Television
Wanareja	309	46	66	444
Salebu	300	3	32	3,174
Cibeunying	185	6	31	958
Pahonjean	79	2	27	5,252
Jenang	386	24	37	600
Sindangsari	412	41	33	327
Cilopadang	238	14	80	1,357
Cileumpuyang	118	13	84	760
Cimanggu	228	41	54	298
Total	2,255	190	51	606

Source: Numbers and calculations from Village Records (Monografi).

TABLE IV-21

BIMAS-INMAS ENROLLMENT

Village	Total Paddyland (Hectares)	Percent of Paddyland Under BIMAS-INMAS							
		Target				Actual*			
		1975-76	1976	1976-77	1977	1975-76	1976	1976-77	1977
Wanareja	990	25	24	27	24	23	16	20	12
Salebu	338	37	49	61	61	46	54	65	73
Cibeunying	204	44	44	44	44	57	31	31	31
Pahonjean	455	28	28	16	9	29	35	20	32
Jenang	450	57	54	53	72	53	38	62	69
Sindangsari	528	57	52	50	32	42	61	48	33
Cilopadang	729	34	48	48	48	34	48	51	49
Cileumpuyang	360	42	21	42	42	35	16	37	8
Cimanggu	666	44	10	40	10	36	8	59	4
Total	4,720	39	34	40	34	46	34	41	30

* Targets reached or exceeded are underlined.

Source: Calculated from village data compiled for Cilacap District Planning Office.

TABLE IV-22

STORES AND MARKETS

Village	Stores			Markets	
	Food	Non-Food	Stalls	Daily	Weekly
Wanareja	4	4	48	1	1
Salebu	7	3	*	-	-
Cibeunying	18	3	*	-	-
Pahonjean	5	3	43	-	2
Jenang	5	11	*	-	-
Sindangsari	12	135	*	1	1
Cilopadang	5	7	50	-	1
Cileumpuyang	9	36	*	-	1
Cimanggu	3	-	20	-	2
Total	68	202	161+	2	8

* Uncertain; village accountings are fragmentary.

Source: Village Records (Monografi) and village data compiled for Cilacap District Planning Office.

TABLE IV-23

VILLAGE ADMINISTRATIVE HIERARCHIES

Position	Village*							
	Wanareja	Salebu	Pahonjean	Jenang	Sindangsari	Cilopadang	Cileumpuyang	Cimanggu
Lurah (Village Head)	1	1	1	1	1	1	1	1
Carik (Clerk)	2	1	1	1	2	2	1	2
Tukang Uang (Treasurer)	-	1	1	1	1	1	1	1
Ulu-ulu (Irrigation)	2	2	1	2	1	3	#	#
Pamong Tani Desa (Agriculture)	1	1	1	1	1	**	1	1
Bau (Vice-Lurah)	1	2	2	3	-	-	-	-
Bau, Kuwu (Sub-Village Head)	10	8	5	3	3	6	4	6
Polisi (Police)	4	4	5	3	4	15	7	6
Kebayan (Public Works)	16	17	6	3	5	11	5	6
Kayim (Religion)	9	1	6	3	3	8	5	6
Staf Kantor (Office Staff)	-	1	4	3	1	-	-	-
Total	46	39	33	24	22	47	25	29

*Cibeunying data not obtained.
#Pamong Tani Desa performs Ulu-ulu duties.
**One Polisi doubles as Pamong Tani Desa

Source: Field notes.

TABLE IV-24

REMUNERATION OF VILLAGE OFFICIALS

Payment Method	Wanareja	Salebu[a]	Pahonjean	Jenang	Sindangsari	Cilopadang	Cileumpuyang	Cimanggu[c]
	Village							
Village Land								
Paddyland	X	X	Ulu-ulu	X	X			Lurah
Dryland			Others					Others
Milled Rice[b]	X	a)	X			X	X	X
Position	Hectares or Hectare-Equivalents							
Lurah	5.6	4.5+	2.6	3.5	4.2	6.7	3.9	9.9
Carik I	2.8	2.4+	1.8	1.8	1.4	3.1	2.5	5.5
Carik II	1.4	-	-	-	0.4	2.2	-	4.7
Tukang Uang	-	1.5+	1.6	1.1	0.7	2.2	0.8	4.7
Ulu-ulu	0.7	0.7+	1.0	0.5	0.4	1.1	-	-
Pamong Tani Desa	d)	0.8+	1.0	0.4	0.4	-	0.3	2.6
Bau	2.1	2.0+	1.6	1.1	-	-	-	-
Bau, Kuwu	1.1	0.8+	1.3	0.8	0.8	1.1	0.7	3.9
Polisi	0.6	1.0+	1.1	0.8	0.4	1.1	0.6	2.5
Kebayan	0.6	0.6+	1.1	0.8	0.4	1.1	0.6	2.0
Kayim	0.6	0.7+	0.8	0.7	0.4	0.6	0.2	1.6
Staf Kantor	-	0.7	0.6	e)	0.2	-	-	-

a) In addition to village land, the Salebu administration splits rice obtained from non-resident landowners: Lurah, 50%; Carik, 25%; others divide 25%. Amounts listed for Ulu-ulu, Bau-Kuwu, Polisi, Kebayan and Kayim are averages.
b) For comparability, rice has been converted to hectares at 1.75 Ton/Ha. in table.
c) Bau-Kuwu, Polisi, Kebayan, Kayim amounts in Cimanggu are averages.
d) Paid Rp. 5,000 per month.
e) Not obtained.

Source: Field notes.

CHAPTER V

WATER REQUIREMENTS AND SUPPLIES

This chapter presents the water requirements and the water availability analysis for the project areas. The water requirements have been computed based on the cropping calendar of two rice crops, presented in Chapter III.

Water Requirements

Water requirement is defined as the total amount of water required to produce optimum crop growth from pre-planting to harvest without regard to the source of water. Factors of importance for the computation of the water requirement of a crop are the climatic conditions in the area, such as rainfall, temperature, sunshine, wind velocity, etc. (determining the evapotranspiration of the crop) and soil type (deep percolation and saturation requirement for wetland rice).

Determination of the water requirement should lead to the depth of water (in millimeter), which needs to be supplied by irrigation. This depth is called the crop irrigation requirement. This together with the systems conveyance and field application efficiency in turn determines the diversion water requirements for the areas under command of the respective weirs. The diversion water requirement can then be compared with estimates of available water supplies at the weir-sites. The comparison results in determination of the cropping intensity which can be achieved over the project life and which can be used for benefit computations in the economic evaluation.

Climatic Factors

The climatological data used in determining the water requirement were obtained from the Cilacap station which is located 44 kilometers southeast of the project area. The climatic condition over most of the irrigable area is believed to be reflected by the Cilacap data. Monthly mean values of temperature, relative humidity, sunshine and wind velocity are available for the 1961-1970 period while for the years 1971-1977 daily records were available. The mean monthly values of these climatic factors are presented in Table V-1.

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Length of Period

For the computation of the crop irrigation water requirements, every month of the year has been divided into three periods; the first two periods of each month consisting of 10 days each, and the third period containing the remaining number of days for each particular month. This length of period was selected to balance the accuracy of evapotranspiration as computed from mean monthly values, and the rainfall data for which daily observations are available. In finding the effective rainfall, using a longer period would result in a statistical distortion. Also, since the irrigation water is diverted from a weir the variation in stream flow requires that water availability be studied for shorter duration thus necessitating computation of water requirement for a shorter period. It is assumed that rotational distribution will be used between laterals and irrigation blocks and hence, considering these aspects, a 10-day period was selected for computing water requirement.

Rainfall. Within the project area there are three rainfall stations for which daily rainfall data were available. The location of these rainfall stations is shown in Figure II-1 and relevant data about these stations are presented below.

Station Code No.	Rainfall Station	Approximate elevation in m msl	Period of record
3	Majenang	23	1951-1978
4	Wanareja	25	1942-1970
7a	Kawung	25	1943-1970

The monthly rainfall data at Majenang, Wanareja and Kawung stations for the period of observation are presented in Tables V-2, V-3 and V-4. These data have been used to analyse frequencies of drought periods. The ten-day period rainfall values for Majenang and Wanareja stations for the period of records have been used in computing the irrigation requirements for the project area.

The annual rainfall for the Majenang project area varies from 1672 to 4645 millimeters, with a mean value of approximately 2930 millimeters. During the dry period (June through September) one out of three months has almost no rainfall, which is reflected in the average rainfall during this period which amounts to only 14 percent of the average annual rainfall.

Analyses of the 28 years of rainfall records for Majenang and Wanareja show that one out of three years have droughts extending over a period of two to five months (June thorugh October).

Based on monthly rainfall patterns for the Majenang and Wanareja stations three seasons can be distinguished using the following criteria :

Wet season	: Average monthly rainfall exceeds 200 millimeters.
Intermediate season	: Average monthly rainfall is between 100 and 200 millimeters, or majority of the months have rainfall less than 200 millimeters.
Dry season	: Average monthly rainfall is less than 100 millimeters, or the majority of the months in that period have rainfall less than 100 millimeters.

The seasonal limits of 100 millimeters and 200 millimeters were selected for the following reasons : (1) 200 millimeters (or more) is equal to 6.7 millimeters per day, which is normally adequate to grow a wetland rice crop without irrigation; (2) with 100 millimeters (3.3 millimeters per day) or less, irrigation is needed for rice; (3) with rainfall between 100 (3.3 millimeters per day) and 200 millimeters (6.7 millimeters per day), wetland rice needs supplemental irrigation while upland crops can be grown without irrigation.

The seasons defined according to the above criteria are :

Wet season	: October through May
Intermediate season	: June
Dry season	: July through September

Sunshine. Solar energy can be the limiting factor for plant production when all other environmental factors that affect plant growth are optimum. Investigations by IRRI (1970) and Barker, et. al. (1970) show a very close correlation between high grain yield and high solar radiation 45 days before harvest. If all crop factors are optimum, the highest grain yield for rice can be expected for crops harvested in May/June as April and May show a high percentage of sunshine duration (see Table V-1).

Temperature. The mean annual temperature is 26.7° Celsius. The monthly mean varies from a maximum of 27.6° Celsius in the month of February to a minimum of 25.2° Celsius in August. Mean maximum and minimum daily temperatures are 31.5° Celsius and 23.8° Celsius for February and 28.1° Celsius and 22.3° Celsius for August.

Relative Humidity. The mean monthly relative humidity varies from 84 percent in April to 81 percent in February/March. The annual relative humidity amounts to about 83 percent.

Wind Velocity. Gentle winds are benficial to plant growth because of in increased carbon dioxide (CO_2) supply, whereas high velocity winds will cause damage to the plants and reduce yield. Wind velocity measured at the Cilacap Station varies from an average of 3 knots (130 kilometers per day) during the month of March to about 9 knots (410 kilometers per day) in the months of July through September. The wind velocities become somewhat lesser in inland areas.

Water Requirement for Wetland Rice

The water requirement for wetland rice is defined as the sum of evapotranspiration, percolarion and land soaking requirement.

Land Preparation. The amount of water required for land preparation is calculated using Wen's modified formula. With this formula the water requirement for a given area is constant during the whole land preparation period. To obtain equal daily water requirements the size of the area supplied with land soaking water must decrease with time. A land preparation time of 30 days is adopted in the recommended cropping pattern (see proposed cropping pattern Figure III-1).

The amount of water required for soil saturation and puddling depends on the soil depth to be saturated, residual moisture content, submergence depth in the field, and water losses due to evapotranspiration and percolation. The soil moisture content after the prolonged dry season of 1977 and under field saturated conditions were determined from soil sample for the Sidareja-Cihaur area *. Based on these data the residual soil moisture at the beginning of the land preparation was computed using the soil moisture balance method. Depth to be saturated was assumed at 40 centimeters and submergence depth in the field at 50 millimeters. For crops transplanted in September/October and January/February the land soaking requirement varies from 50 millimeters to 350 millimeters including 50 millimeters submergence depth in the field. The land preparation requirement was computed using Wen's modified formula for 30 days duration. It varies from 200 to 465 millimeters and 140 to 200 millimeters for crops transplanted in October/November and February/March respectively.

Potential Evapotranspiration. The potential evapotranspiration for the project area has been calculated using the modified Penman Method (FAO, 1977). Data on temperature, relative humidity, sunshine duration and wind velocity were obtained from the records available for the Cilacap climatological station. Where data were missing monthly average values over the period of observation were used. The daily potential evapotranspiration on a monthly basis has been determined for 1970 to 1977 period. Average monthly values vary from 4.3 millimeters per day in June to 5.5 millimeters per day in October.

Percolation. No data on percolation in the irrigable area are available. It is estimated that the medium to heavy clays in the area have a percolation rate of about 1 millimeter per day. This has been used in the water requirement calculations.

Crop Coefficient. Crop coefficients for submerged rice in Indonesia have been published by PROSIDA and have been used in deriving the crop evepotranspiration in the irrigable area. This crop coefficient curve by PROSIDA is presented in Figure V-1. Also in Figure V-1 the crop coefficient curve as suggested by the Directorate of Irrigation is presented : using this curve would result in somewhat lesser Irrigation Water Requirements.

* immediately south of the project area.

Crop Irrigation Requirements. The crop irrigation requirement is defined as the crop water requirement minus the effective rainfall. 80 percent of ten-day period rainfall for the 13 driest years of the 26 years of complete rainfall records, which is equal or less than the water requirements, is counted as effective rainfall. This ten-day period crop irrigation requirements for the rice crops in the recommended cropping pattern were calculated for the years 1970 through 1977. Incorporated were the following considerations :

1. In order to reduce the peak irrigation requirement (normally occuring during land preparation) and peak labor and animal draft requirements the transplanting of the system is staggered over a 30-day period.
2. Two fertilizer applications at 15 and 35 days after transplanting have been considered. Fields are drained before each application. An additional irrigation water application of 50 millimeters is necessary after the fertilizer is applied to bring water depth in the field up to its optimum level.
3. Irrigation is shut off ten days before harvest and the fields are drained.

The project water requirements have been computed using the Cilacap Climatological data and the Majenang rainfall station data, for which daily observations are available. The results of these computations is presented in Table V-5 for normal start (October 1) and in Table V-6 for delayed start. The start of the cropping season is derived from the rainfall and streamflow data analysis, which showed that the month of September generally has insufficient rainfall to provide water for land preparation at weir sites. The rainfall increases however rapidly from September to November, thus justifying the concept of normal start in October and delayed start in November, which would occur once in three years.

The crop irrigation requirement for the first (wet season) rice crop varies from 131 millimeters to 500 millimeters, averaging 330 millimeters. The average crop irrigation requirement for the second rice crop amounts to 260 millimeters. About 38 percent of the water requirement of the first crop has to be supplied by irrigation, while for the second rice crop it amounts to 35 percent. The closeness of both figures can be explained by the fact that the irrigation requirement for

land preparation for the first rice crop (after the dry season) is much larger than for the second crop while the irrigation requirement during the crop growth stage of the second crop is larger than for the first crop.

Irrigation Diversion Requirement

The irrigation diversion requirement is the crop irrigation requirement increased by the application and distribution losses in the service area units and the conveyance losses in the supply and delivery system. Little or no field data are available in the Citanduy River Basin to determine present farm and conveyance efficiencies. The farm irrigation requirement has been worked out based on a 50 percent efficiency during normal irrigation practice for a rice crop. It is anticipated that the farm efficiency during land preparation for the rice crop and at the end of the dry season can be increased to 80 percent. The reasoning behind the anticipated increase in efficiency is that each time rainfall is minimal farmers will handle the available irrigation water more carefully. These efficiencies are based on the consultant's experience and data collected on many projects in Southeast Asian countries. Thus, the overall efficiency during land preparation and at the end of the dry season amount to 64 percent and for the crop growth stage it will be 40 percent.

Based on the foregoing it is possible to determine the value of the irrigation diversion requirement (IDR) in liters per second per hectare for critical periods. The value of IDR can be found by converting the crop irrigation requirement (CIR) from depth of water (in millimeter) per hectare per period length to liters per seconds per hectare. The CIR-value is given in column 9 of Table V-5 and V-6. These tables were prepared for one complete crop calendar. Table V-5 is for the normal start of the wet season rice crop and Table V-6 is for the delayed start of the wet season rice crop.

Using the assumed efficiencies, the maximum irrigation diversion requirement for October (normal start) and November (delayed start), and for the months of June and July (end of dry season) season is presented below. This has been worked out both with and without the effective rainfall.

Month	Period	Normal Start		Delayed Start	
		With E.R.F.	Without E.R.F.	With E.R.F.	Without E.R.F.
		IDR (l/sec/ha)	IDR (l/sec/ha)	IDR (l/sec/ha)	IDR (l/sec/ha)
October	2	1.59	2.08	-	-
November	1	-	-	0.74	2.08
June	1	0.49	1.16	0.89	1.56
July	1	-	-	0.80	1.18

Note: 1/ For the last three periods for each crop for both normal and delayed start, the IDR for command area will be less, as less than total command area needs irrigation water because of harvest start over part of area in third last period.

2/ E.R.F. = Effective Rainfall

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Water Supplies

The irrigation water supply for the four project systems, Cileumeuh , Cilopadang, Cijalu and Cilaca, will be obtained from weirs in rivers which carry similar names. At present, weirs in Cileumeuh and Cilopadang exist. The Cijalu weir is under construction and is scheduled for completion in 1980. The Cilaca free intake will be replaced by a weir in the year 1979-1981. Construction of the Cijalu and Cilaca weirs will be under the supervision of the Central Java Irrigation authorities, with funds provided under the Pelita II/III program. Thus, if it is decided to implement the project plan as proposed in this feasibility study, weirs for irrigation water diversion for all four systems will be existing and operational by the time the recommended rehabilitation and improvement is taken up.

Flow Data and Approach.

The drainage area of the rivers at the weirsites was obtained from 1:25,000 scale maps and is as follows:

River	Drainage Area at weirsites (km^2)
Cileumeuh	94
Cilopadang	32
Cijalu	59
Cilaca	23
Cikawung at Cimei gaging station	550

Stream flow gaging data are not available on any of the four rivers which supply irrigation water to the project areas. The only information available on river flow are the gaging data at the Cimei gaging station in the Cikawung river, after it has left its own basin, just before the confluence with the Citanduy.

These data, collected by the DPMA, cover the period 1969-1977, and present daily measured discharge in cubic meter per second. The Cimei data have been used in an effort to determine characteristics of the critical periods of water availability at the weir sites for the proposed agricultural calendar. The underlying assumption in the analysis, using the Cimei data, is that the rainfall-runoff relationship for each catchment area at the weirsite is similar to that of the total catchment area at the Cimei gage, and hence the runoff at the weirs is proportional to these catchment areas. This assumption considers the characteristics of the catchment area as topography, soils, vegetation conditions, subsurface geologic structure, and so forth, to be similar. It is known that these parameters determine the runoff characteristics from surface and subsurface storage. Different characteristics will have a different storage release and runoff pattern from a catchment area. Because of the lack of runoff data on the various streams, this approach has been used to determine water availability.

It is appropriate to also stress the following. In the years 1969-1977 (the period of Cimei data being used in the analysis) diversion were already occuring at the various weirsites including the Cijalu with its free intakes. The diversion data at the weirsites are not available. The flow data at Cimei represent the runoff of the Cikawung basin minus the diverted water at the weirsites. Therefore flow computation at the various weirsites based on Cimei data will represent a lower value. The actual discharge at the weirsites will be significantly higher. However, the method followed allows for the determination of water supply with some degree of reliance and since the present diversion is not considered, the water availability studies will be on the conservative side.

In computing the water availability for rice irrigation, where both wet and dry season short-term HYV (100 to 125 days growing season) are proposed, the following periods of critical water availability can be identified:

1. Start of the wet season crop, to assess the occurence of delayed start for land preparation, the period September through November.

2. The period from December through April of the wet and dry season crop.

3. The end of the dry season for the dry season crop May through July.

These three periods were analysed for water availability to determine a reasonable cropping intensity for the project areas.

Flow Duration Analysis at Cimei

Flow duration curves for the various months were developed based on eight years observed daily flow data. For the years of records for these months, the daily observed discharges at Cimei were divided by the average discharge of that particular month. The dimensionless values thus obtained for a particular month over the data period were arranged in an descending order. From this value the flow duration curves were drawn. These are shown on Figure V-2 to Figure V-7 for the months of May, June, July, September, October and November. The mean monthly flow at Cimei gage is shown on Figure V-8.

The curves present the observed daily discharge Q non-dimensionalized by the mean discharge $\bar{Q}$ ($Q/\bar{Q}$) versus the percent of time a particular value of $Q/\bar{Q}$ is exceeded. For any given discharge during a month, the percent time exceeded can be read from the curves. Thus, for example from the month of May (Figure V-5), the time a flow of ten cubic meter per second is exceeded is found by $Q/\bar{Q}$ = 10/28.42 = 0.352, which on the curve coincides with 90 percent of the period of record.

Water Availability at Weirsites

The development of the flow duration curves for each month at Cimei permits now to proceed with water availability analysis at the weirsites. For analysis an 80 percent dependability was considered appropriate. For this the 80 percent time exceeded value of the discharge (Q_{80}) at Cimei was computed for each month. This value of Q_{80} was multiplied by the watershed ratio at the weirsites, obtained by dividing the catchment area at weirsites by the Cikawung catchment area at Cimei. From this the Q_{80} at weirsite was obtained, in liters per second. This Q_{80} value can now be compared with the Irrigation Diversion Requirement (IDR) at the weirsites. The IDR-value at weirsites for any given period was obtained by multiplying the irrigation diversion requirement per hectare for that period as developed in the section on Water Requirements with the area irrigated in each system.

The comparison of maximum irrigation diversion requirement and 80 percent dependable flow is shown in Table V-7 for the systems in the Majenang Project Area. The IDR-value used is the value developed from the crop water requirement, assuming zero effective rainfall.

Table V-7 together with the rainfall data presented in Table V-2, V-3 and V-4 for the project area rainfall station, and Figure V-8, provide the basis for the following comclusions:

1). Land preparation will start in the month of October two out of three years, considering the availability of effective rainfall. The rainfall and flow data indicates that delayed start at end of October and beginning of November will occur once in three years.

2). The period December through April shows sufficient flow (Figure V-8) and sufficient rainfall consistently such that no shortage of water is anticipated in any of the system during this period. Only minor irrigation diversion requirements are required, as shown in Table V-5 and V-6.

3). From the water requirements the first period of June (with normal start) and the first period of July (with delayed start) are considered the crucial periods in the period May-July. In this period, according to foregoing analysis presented in Table V-7, approximately 55 percent of Cileumeuh command area, 100 percent of Cilopadang area, and 40 percent of the Cijalu command area can be served. The average for the three areas works out to 52 percent.

As stated before, the Cimei data used results in a lower water availability the weirsites. The reduction in the computed flow is a matter of judgement. ›m the observations of irrigation officials over the years in the area, and the :t that shortage in one period of 10 days will not affect the crop yield it is ıcluded that in the month of June approximately 70 percent of the total system :a can be irrigated.

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Water Supply for Cilaca System

The complete lack of flow data in the Cilaca river prevents a similar analysis for the water supply of the Cilaca system in the Wanareja project area as was carried out in the previous section for the Majenang project area. However, the watershed of the Cilaca system which is adjacent to the Majenang Area, can be assumed to be similar to the Cijalu system in the Majenang project area for purposes of determining the water availability.

Based on experience by irrigation and local village officials, and the rainfall data for the Wanareja area (Table V-3) the month of July, August and September are crucial months with high probability of little or no water availability, whereas the month of June on the average has sufficient water to irrigate a major portion of the command area. Hence, it is anticipated that water availability in June will not be as critical as in the Majenang Area.

However, the Cilaca system since 1976 experiences competition for water by the Mungkalmeong Sederhana Weir. This problem is discussed in Chapter II and a decision on priorities of water use is needed. It is believed sufficient flow is available to meet the demands of both these systems if operated properly.

Cropping Intensity

Because of the yearlong growing temperature, it is possible to harvest several crops from the same plot each year, provided there is adequate rainfall or irrigation water supply. Farmers plant a second rice crop, but realization of the crop and its yields is not quaranteed because of water shortages or floods in many years.

Based on the agricultural data survey, interviews with local irrigation officials and field observations, the cropping intensity for both the project areas was estimated. For the Majenang and Wanareja project area the present cropping intensity is estimated to be about 1.4. This estimate for example, for the Wanareja area is substantiated by the fact that no dry season crop has been harvested in six out of the last ten years, due to floods and droughts.

A major problem to increase the present 1.4 cropping intensity is that, with use of local varieties and lack of water, water management capability, and drainage and flood problems, farmers need often more than 12 months to grow two crops. If it is possible to resolve the water distribution & management problems and provide guidance in the introduction of the HYV-package more fully, the farmers would be able to grow two crops within a shorter period.

The month of June is considered the most critical period with respect to water supply, with or without delayed start. From the foregoing analysis on water availability, it is estimated that the wet season rice crop can be harvested over the entire area where as for the second rice crop (dry season), about 70 percent of this area can be harvested. This will amount to a cropping intensity of 1.70.

To correct for the uncertainly of the water availability analysis and for future functioning of the proposed drainage and flood control measures, which are based on insufficient data, the cropping intensity was reduced to 1.60 per year over the project life for both project areas. Hence, for the economic analysis the following cropping intensities have been used:

	Cropping intensity
Present and future without project	1.40
Future with project	1.60

Further Hydrologic Data Collection for Project Areas

The previous section on Water Supplies indicates that the present information on river flows in project areas is insufficient which results in a degree of uncertainty about water availability.

To correct this it is suggested that flow gaging stations be installed at the diversion sites, just upstream of weirsites at suitable locations, and start collecting daily discharge data. Also, rainfall stations in each of the watershed areas should be installed. The data from these gages will assist in assessing more clearly flow characteristics of the rivers and rainfall in each watershed. This will then permit a more accurate prediction of water supply availability for cropping

calendar and cropping intensity. The data would also assist in operation of the system with respect to water allocations and possible extension of the irrigated area (Cileumeuh system) and/or increase in cropping intensity. The lack of additional hydrologic data has been the reason for keeping the rehabilitation and improvement of these system limited to the areas presently considered to be under command of the respective weirs, with some minor additional extensions.

Observations on Flows at Weirsite Versus Measured Rainfall

Personal communication with the former head of the Seksi Irigasi Citanduy Office, Majenang, Mr. Muslim, BIE, and his assistants revealed that rainfall data as collected at the Majenang rainfall station seem to be a poor indication of the magnitude of flow at the weirsites. Often when little or no rain was recorded at the stations (Majenang and Wanareja), large flows were observed at the weirsites. Frequently rainfall occurs in the higher elevations of the watershed of these rivers with little or no rain in the service area. In general, the yearly recorded amount of rainfall is larger at higher elevations in Java. Mr. Muslim also observed that with respect to water supply for irrigation, the period October - November up to the month of June has sufficient water to meet irrigation diversion requirements. The period of July to September, sometimes into the month of October was the period during which most often only 30 to 40 percent of the irrigation water requirements could be meet over the area under command of Cijalu and Cileumeuh. His observations and statements confirm the belief that in order to successfully irrigate the rice crop during wet and dry season, the two rice crops should be grown within the period of October to June. This can only be accomplished if short term HYV varieties are used over all of the irrigated area.

TABLE V-1

CLIMATOLOGICAL DATA CILACAP STATION

Month	Temperature °C			Relative Humidity %			Sunshine %	Wind Knot
	Mean	Max.	Min.	Mean	Max.	Min.		
Jan.	27.2	30.9	23.5	84	96.0	71.4	48	4
Feb.	27.6	31.5	23.8	81	96.1	68.0	54	4
Mar.	27.5	31.2	23.8	81	95.2	70.3	51	3
Apr.	27.5	31.0	24.0	84	96.7	71.8	62	4
May	27.1	30.1	24.2	83	96.6	73.7	67	6
Jun.	26.5	29.3	23.6	83	95.0	75.3	61	7
Jul.	25.6	28.5	22.6	82	93.2	74.4	54	9
Aug.	25.2	28.1	22.3	83	92.2	73.2	66	9
Sep.	26.0	28.9	23.1	82	92.0	72.5	66	9
Oct.	26.6	29.6	23.6	82	92.6	73.1	57	8
Nov.	27.0	30.0	23.9	84	95.5	74.5	53	4
Dec.	27.1	30.4	23.8	84	96.3	72.2	57	6
Annual	26.7	30.0	23.5	83	94.8	72.5	57	6

TABLE V-2

MAJEMANG (3)

MONTHLY RAINFALL

Month	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Mean
Jan. (mm)	483	290	236	429	319	350	410	406	252	561	297	376	206	234	529	575	282	351	392	294	-	477	446	318	413	262	360	179	360
Feb. (mm)	331	376	239	438	144	337	204	237	437	530	356	-	489	295	150	428	383	481	387	134	386	135	286	406	227	437	317	286	328
Mar. (mm)	207	277	476	283	469	375	403	395	560	305	-	428	322	397	341	236	203	488	198	416	111	416	350	234	655	257	465	350	356
Apr. (mm)	204	143	260	529	340	545	88	332	157	238	-	450	192	392	134	336	305	250	334	245	-	363	357	251	424	115	331	230	290
May (mm)	146	76	239	273	121	305	14	249	390	305	-	51	21	175	117	206	65	485	194	262	304	138	354	167	299	24	233	284	204
Jun. (mm)	333	85	18	178	112	230	29	82	153	240	-	142	31	96	70	74	0	623	206	208	197	0	158	8	89	71	147	492	151
Jul. (mm)	118	31	120	100	267	185	395	198	54	86	-	0	0	1	91	0	0	387	0	0	42	0	184	60	34	0	0	177	94
Aug. (mm)	34	111	0	117	223	162	113	413	0	5	-	0	0	1	0	0	0	269	0	-	0	0	198	206	255	5	0	146	87
Sep. (mm)	55	151	3	110	151	89	1	100	57	6	-	0	0	35	18	18	3	125	18	-	13	0	324	342	316	37	3	194	83
Oct. (mm)	68	279	3	186	258	234	161	255	169	208	-	-	18	505	33	440	36	176	127	-	519	58	208	332	566	407	12	261	221
Nov. (mm)	137	590	530	642	366	434	139	391	336	384	-	-	161	247	436	77	554	550	312	-	381	164	257	474	254	627	254	237	357
Dec. (mm)	555	272	231	325	269	450	401	750	533	234	-	-	232	327	610	334	629	460	327	-	336	397	309	300	467	254	533	491	401
Annual	2671	2681	2355	3610	3039	3696	2358	3808	3096	3102	*		*1672	2705	2529	2724	2460	4645	2495	*		*2148	3436	3098	3999	2496	2655	3327	2932

Year with uncomplete data

TABLE V-3

WANAREJA (4)

MONTHLY RAINFALL

Month	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Mean
Jan. (mm)	265	328	275	439	289	331	255	322	-	403	310	159	316	293	332	321	255	324	357	242	457	169	149	243	294	247	238	340	318	295
Feb. (mm)	362	386	332	304	451	261	268	317	-	198	228	163	254	129	289	270	242	361	411	197	127	159	212	117	295	314	301	240	214	264
Mar. (mm)	227	486	253	238	285	248	387	289	-	154	210	-	161	366	359	375	398	415	277	154	236	198	385	356	298	137	362	173	345	288
Apr. (mm)	216	140	178	231	193	276	107	195	-	240	156	-	364	197	418	90	164	164	120	316	427	97	241	126	264	318	105	229	176	213
May (mm)	161	117	60	209	74	112	89	298	-	78	96	311	234	190	346	116	203	-	342	282	93	19	268	81	153	71	406	123	235	177
Jun. (mm)	63	245	0	0	5	2	48	117	-	330	34	-	182	136	267	22	85	175	223	39	91	22	100	70	153	3	362	75	197	113
Jul. (mm)	148	186	4	15	38	-	88	18	-	65	11	77	-	-	201	428	-	114	58	0	138	0	7	55	0	4	384	7	63	88
Aug. (mm)	10	289	7	10	1	-	2	6	-	40	62	0	180	-	146	76	-	0	51	2	106	0	35	0	20	0	264	3	0	52
Sep. (mm)	49	64	14	225	17	-	18	-	-	165	233	0	208	-	197	2	51	89	28	0	17	0	221	0	31	0	40	16	73	71
Oct. (mm)	384	454	74	201	46	-	15	-	-	34	201	-	-	-	231	79	191	122	125	100	237	25	366	2	310	30	147	71	87	154
Nov. (mm)	361	266	276	-	338	-	227	-	-	104	313	209	-	-	375	187	345	287	287	207	223	143	288	259	221	331	161	345	296	263
Dec. (mm)	311	134	297	-	448	-	453	-	-	623	207	-	227	-	284	366	-	-	149	174	497	165	271	533	419	384	273	222	248	318
Annual	2557	3095	1770		*2185		*1957		* -	2434	2061	*		*	*3445	2332		*	*2428	1718	2649	995	2543	1842	2458	1839	3043	1944	2252	2296

Year with uncomplete data

TABLE V-4

KAWUNG (7a)

MONTHLY RAINFALL

Month	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	Mean
Jan. (mm)	404	197	507	370	290	333	368	410	387	397	382	276	265	345	286	-	185	253	336	333
Feb. (mm)	380	257	263	78	314	272	318	321	435	212	161	385	191	203	397	-	509	252	257	289
Mar. (mm)	214	425	160	405	471	517	679	523	389	258	431	295	306	356	330	155	386	185	356	360
Apr. (mm)	168	256	443	265	367	122	206	195	217	362	299	196	230	138	413	328	328	258	181	262
May (mm)	87	-	177	219	257	106	320	244	475	149	41	53	279	117	113	51	171	118	265	177
Jun. (mm)	164	69	111	133	264	50	145	141	155	46	122	31	72	25	206	-	446	94	237	140
Jul. (mm)	18	68	60	229	192	453	225	170	76	0	95	0	1	99	1	0	458	0	116	119
Aug. (mm)	100	3	141	330	106	122	255	0	9	0	112	0	17	0	1	0	165	0	0	72
Sep. (mm)	79	0	30	194	82	8	118	60	13	0	40	0	121	0	19	8	80	14	65	49
Oct. (mm)	234	6	179	336	167	117	232	238	153	49	264	19	455	10	569	59	170	57	186	184
Nov. (mm)	355	287	581	290	432	279	509	292	425	188	406	150	211	301	332	328	444	500	350	350
Dec. (mm)	252	157	300	329	216	362	760	486	163	309	495	174	311	595	371	398	324	310	349	351
Annual	2455		2892	3178	3158	2740	4135	3080	2897	1970	2848	1579	2479	2189	3038		3666	2041	2698	2767

.Year with uncomplete data

TABLE V-5

PROJECT WATER REQUIREMENTS

NORMAL START CROPPING CALENDER

(Based on Cilacap Climatological data and Majenang rainfall station data)

		1	2	3	4	5	6	7	8	9
Month	Period	$Et_{p/day}$ mm	Days	$Et_{p/prd}$ mm	Kc	$Et_{a/prd}$ mm	D.P. mm	C.W.R. mm	E.R.F. mm	CIR mm
Jan	1	5.2	10	52	1.35	70	10	80	95	-
	2	5.2	10	52	1.30	68	10	78	93	-
	3	5.2	11	57.2	1.20	69	11	80	102	-
Feb.	1	5.2	10	52	1.10	57	10	67	101	-
	2	5.2	10	52	1.05	55	10	65	86	-
	3	5.1	8	40.8	1.00	41	8	49	69	-
Mar.	1	5.1	10	51		70	10	70	62	8
	2	5.2	10	52		70	10	70	92	-
	3	5.3	11	58.3		70	11	70	102	-
April	1	5.3	10	53	1.07	57+17	10	84	102	-
	2	5.1	10	51	1.16	59+17	10	86	62	24
	3	5.0	10	50	1.25	63+17	10	90	37	53
May	1	4.9	10	49	1,34	66+17	10	93	34	59
	2	4.7	10	47	1.40	66+17	10	93	37	56
	3	4.6	11	50.6	1.31	66+17	11	94	34	60
June	1	4.4	10	44	1.22	54	10	64	37	27
	2	4.3	10	43	1.13	49	10	59	20	39
	3	4.3	10	43	1.04	45	10	55	14	41
July	1	4.5	10	45	0.95	43	10	53	21	32
	2	4.5	10	45			10		17	
	3	4.7	11	51.7			11		8	
Aug.	1	5.0	10	50			10		12	
	2	5.1	10	51			10		9	
	3	5.2	11	57.2			11		25	
Sep.	1	5.3	10	53			10		6	
	2	5.4	10	54			10		6	
	3	5.5	10	55			10		9	
Oct.	1	5.5	10	55		115	10	115	49	66
	2	5.5	10	55		115	10	115	27	88
	3	5.4	11	59.4		115	11	115	53	62
Nov.	1	5.4	10	54	1.07	58+17	10	85	74	11
	2	5.3	10	53	1.13	60+17	10	87	96	-
	3	5.2	10	52	1.20	62+17	10	89	92	-
Dec.	1	5.2	10	52	1.27	66+17	10	93	96	-
	2	5.1	10	51	1.34	68+17	10	95	86	9
	3	5.1	11	56.1	1.40	79+17	11	107	119	-

1. Average potential evapotranspiration per day (Et_p/day) in millimeter, obtained from Cilacap Climatological data for period 1970-1977.
2. Number of days per period
3. $Et_{p/period}$ in millimeter
4. Crop coefficient per period, obtained from curve suggested by Prosida
5. Actual evapotranspiration per period in millimeter
6. Deep percolation (D.P.) water loss per period in millimeter
7. Crop Water Requirement (C.W.R.) per period in millimeter
8. Effective rainfall (E.R.F.) per period in millimeter
9. Crop Irrigation Requirement (CIR) per period in millimeter

TABLE V-6

PROJECT WATER REQUIREMENTS
DELAYED START CROPPING CALENDER

(Based on Cilacap Climatological data and Majenang rainfall station data)

		1	2	3	4	5	6	7	8	9
Month	Period	Et_p/day mm	Days	Et_p/prd. mm	Kc	Et_a/prd mm	D.P. mm	C.W.R. mm	E.R.F. mm	CIR mm
Jan.	1	5.2	10	52	1.27	66+17	10	93	95	-
	2	5.2	10	52	1.34	70+17	10	97	93	4
	3	5.2	11	57.2	1.40	80+17	11	108	102	6
Feb.	1	5.2	10	52	1.35	70	10	80	101	-
	2	5.2	10	52	1.30	68	10	78	86	-
	3	5.1	8	40.8	1.20	49	8	57	69	-
Mar.	1	5.1	10	51	1.10	56	10	66	62	4
	2	5.2	10	52	1.05	55	10	65	92	27
	3	5.3	11	58.3	1.00	58	11	69	102	-
Apr.	1	5.3	10	53		70	10	70	102	-
	2	5.1	10	51		70	10	70	62	8
	3	5.0	10	50		70	10	70	37	23
May	1	4.9	10	49	1.07	52+17	10	79	34	45
	2	4.7	10	47	1.16	55+17	10	82	37	45
	3	4.6	11	50.6	1.25	63+17	11	91	34	57
June	1	4.4	10	44	1.34	59+17	10	86	37	49
	2	4.3	10	43	1.40	60+17	10	87	20	67
	3	4.3	10	43	1.31	56+17	10	83	14	69
July	1	4.5	10	45	1.22	55+17	10	65	71	44
	2	4.5	10	45	1.13	51	10	61	17	44
	3	4.7	11	51.7	1.04	54	11	65	8	57
Aug.	1	5.0	10	50	0.95	48	10	58	12	46
	2	5.1	10	51			10		9	-
	3	5.2	11	57.2			11		25	
Sep.	1	5.3	10	53			10		6	
	2	5.4	10	54			10		6	
	3	5.5	10	55			10		9	
Oct.	1	5.5	10	55			10		49	
	2	5.5	10	55			10		27	
	3	5.4	11	59.4			11		53	
Nov.	1	5.4	10	54		115	10	115	74	41
	2	5.3	10	53		115	10	115	96	19
	3	5.2	10	52		115	10	115	92	23
Dec.	1	5.2	10	52	1.07	56+17	10	83	96	-
	2	5.1	10	51	1.13	58+17	10	85	86	-
	3	5.1	11	56.5	1.120	63+17	11	91	119	-

1. Average potential evapotranspiration per day (Et_p/day) in millimeter, obtained from Cilacap Climatological data for period 1970-1977.
2. Number of days per period
3. Et_p/period in millimeter
4. Crop coefficient per period, obtained from curve suggested by Prosida
5. Actual evapotranspiration per period in millimeter
6. Deep percolation (D.P.) water loss per period in millimeter
7. Crop Water Requirement (C.W.R.) per period in millimeter
8. Effective rainfall (E.R.F.) per period in millimeter
9. Crop Irrigation Requirement (CIR) per period in millimeter

TABLE V-7

WATER AVAILABILITY ANALYSIS

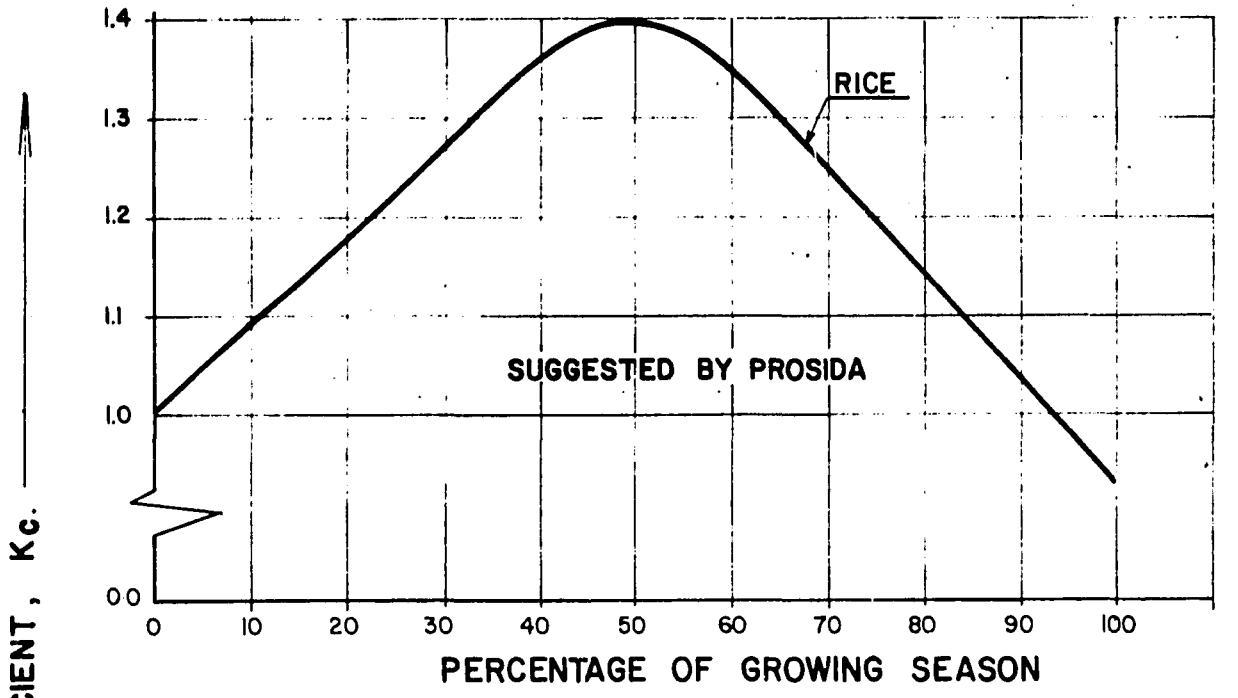
(Start for wet season and end of dry season)

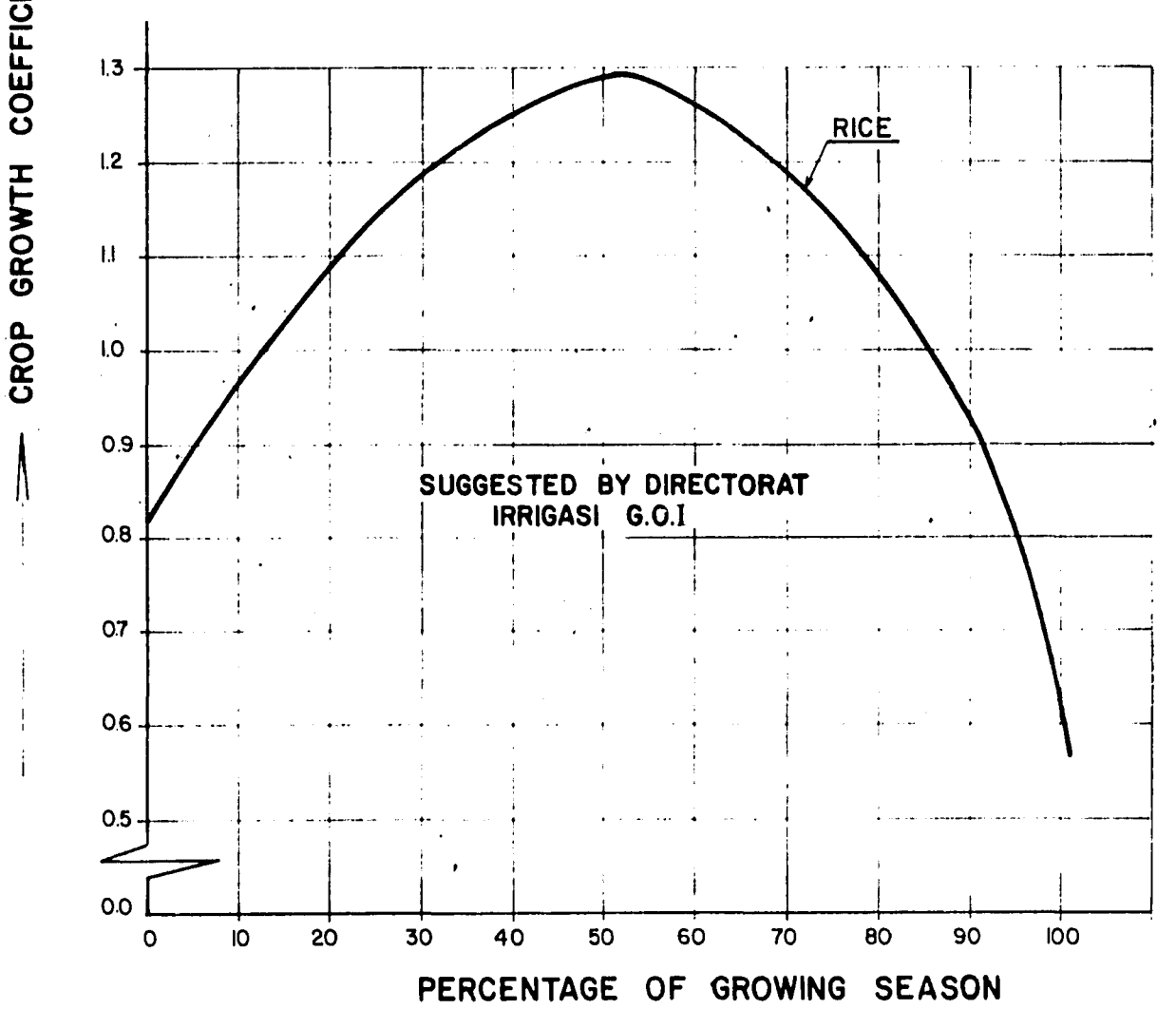
System	Month	$\bar{Q}$ Cimei (m^3/sec) (I)	$Q_{80}/\bar{Q}$ (2)	Watershed ratio (3)	Q_{80} at weir site (l/sec/ha) (4)	IDR (l/sec/ha) (5)	IDR at weir (l/sec) (6)	Q_{80}/IDR at weir (percent) (7)
	October	34.0	0.273	0.171	1588	2.08	3060	51.9
Cileumeuh	November	56.2	0.483	0.171	4642	2.08	3060	151.7
(1,471 ha)	June	16.9	0.461	0.171	1332	1.56	2295	58.0
	July	9.3	0.605	0.171	962	1.18	1736	55.4
	October	34.0	0.273	0.058	538	2.08	460	116.9
	November	56.2	0.483	0.058	1574	2.08	460	342.2
Cilopadang	June	16.9	0.461	0.058	452	1.56	345	131.0
(221 ha)	July	9.3	0.605	0.058	326	1.18	261	124.9
	October	34.0	0.273	0.107	993	2.08	2625	37.8
	November	56.2	0.483	0.107	2905	2.08	2625	110.7
Cijalu	June	16.9	0.461	0.107	834	1.56	1969	42.4
(1,262 ha)	July	9.3	0.605	0.107	602	1.18	1489	40.4

Notes: 1/ Column (4) obtained from (1) x (2) x (3) x 1000

2/ Column (6) obtained from (5) x irrigable area

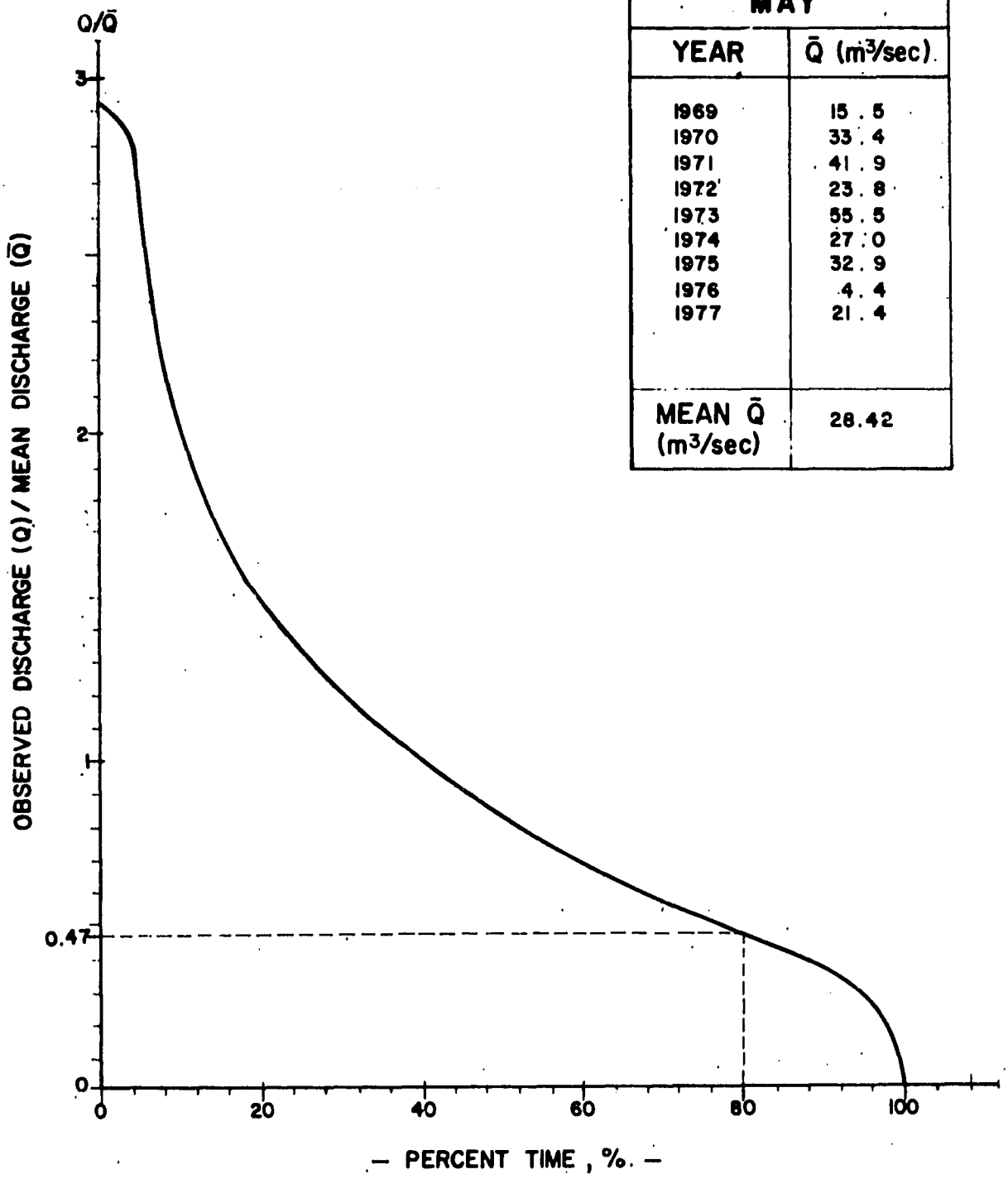
3/ Column (7) obtained from [(4) . (6)] x 100





CROP GROWTH COEFFICIENT, K_c.

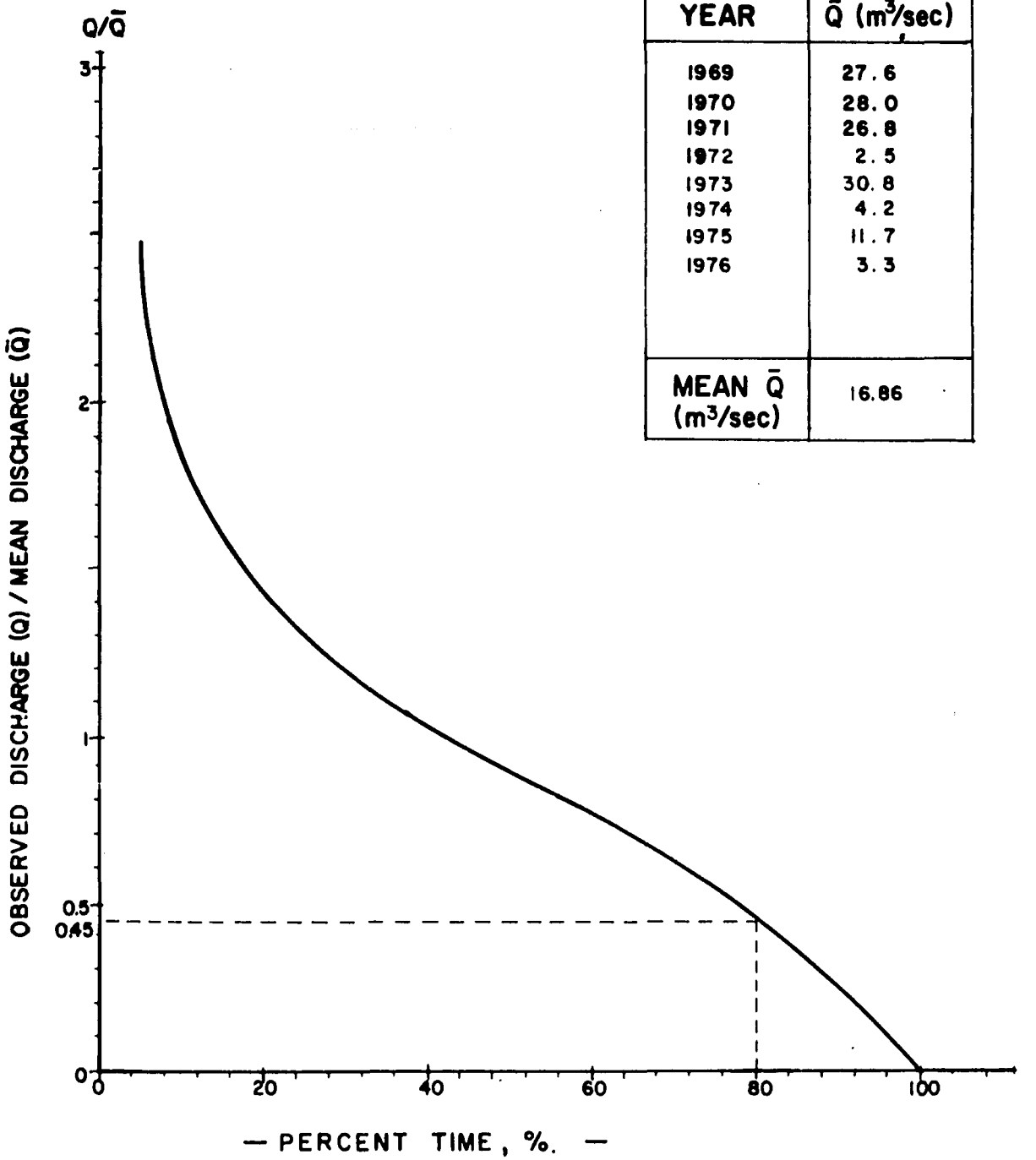
CROP GROWTH COEFFICIENT, K_c.



MAY	
YEAR	Q̄ (m³/sec)
1969	15.5
1970	33.4
1971	41.9
1972	23.8
1973	55.5
1974	27.0
1975	32.9
1976	4.4
1977	21.4
MEAN Q̄ (m³/sec)	28.42

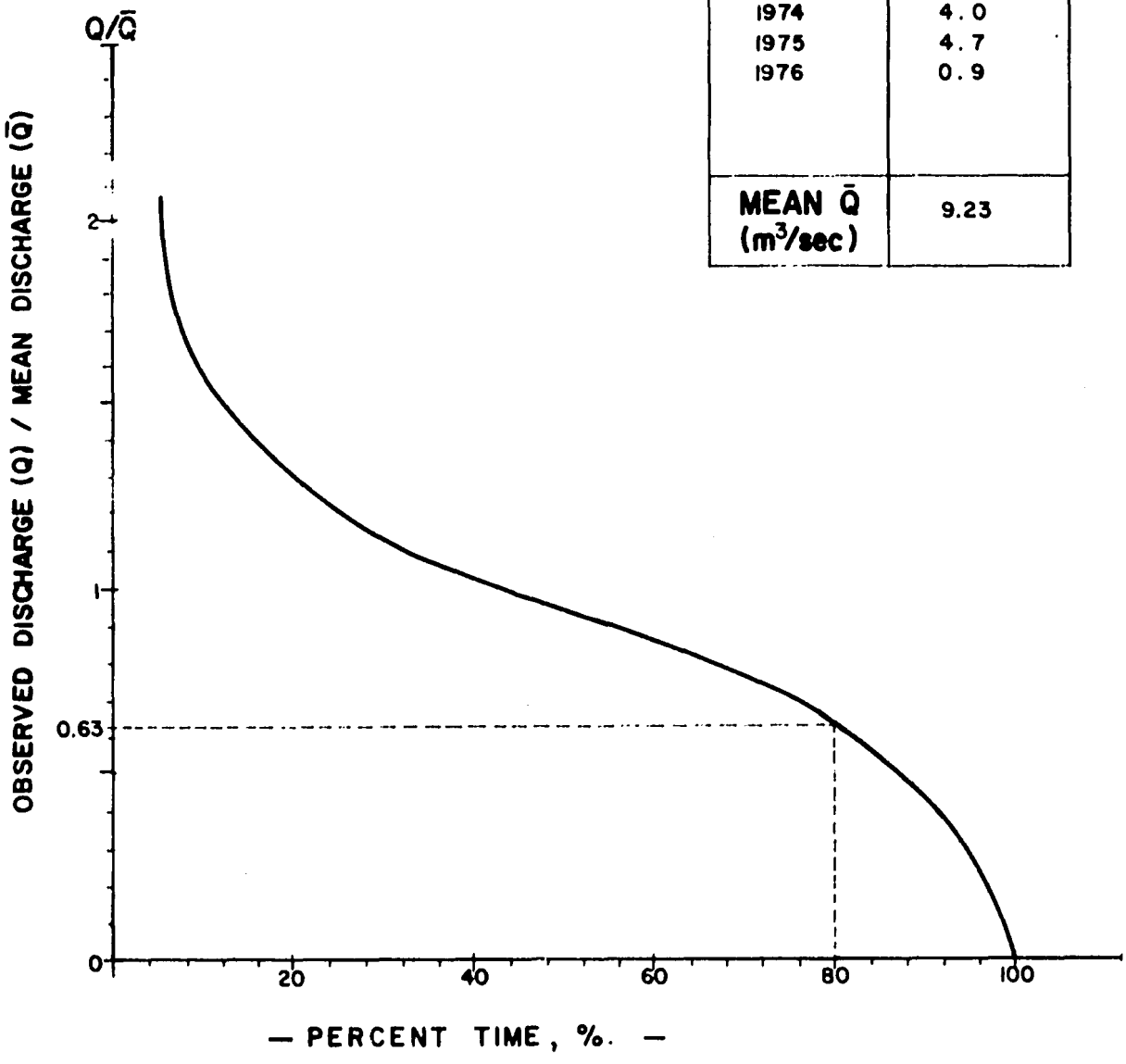
TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
— MONTH OF MAY (Period 1969-1977) —

JUNE	
YEAR	$\bar{Q}$ (m^3/sec)
1969	27.6
1970	28.0
1971	26.8
1972	2.5
1973	30.8
1974	4.2
1975	11.7
1976	3.3
MEAN $\bar{Q}$ (m^3/sec)	16.86

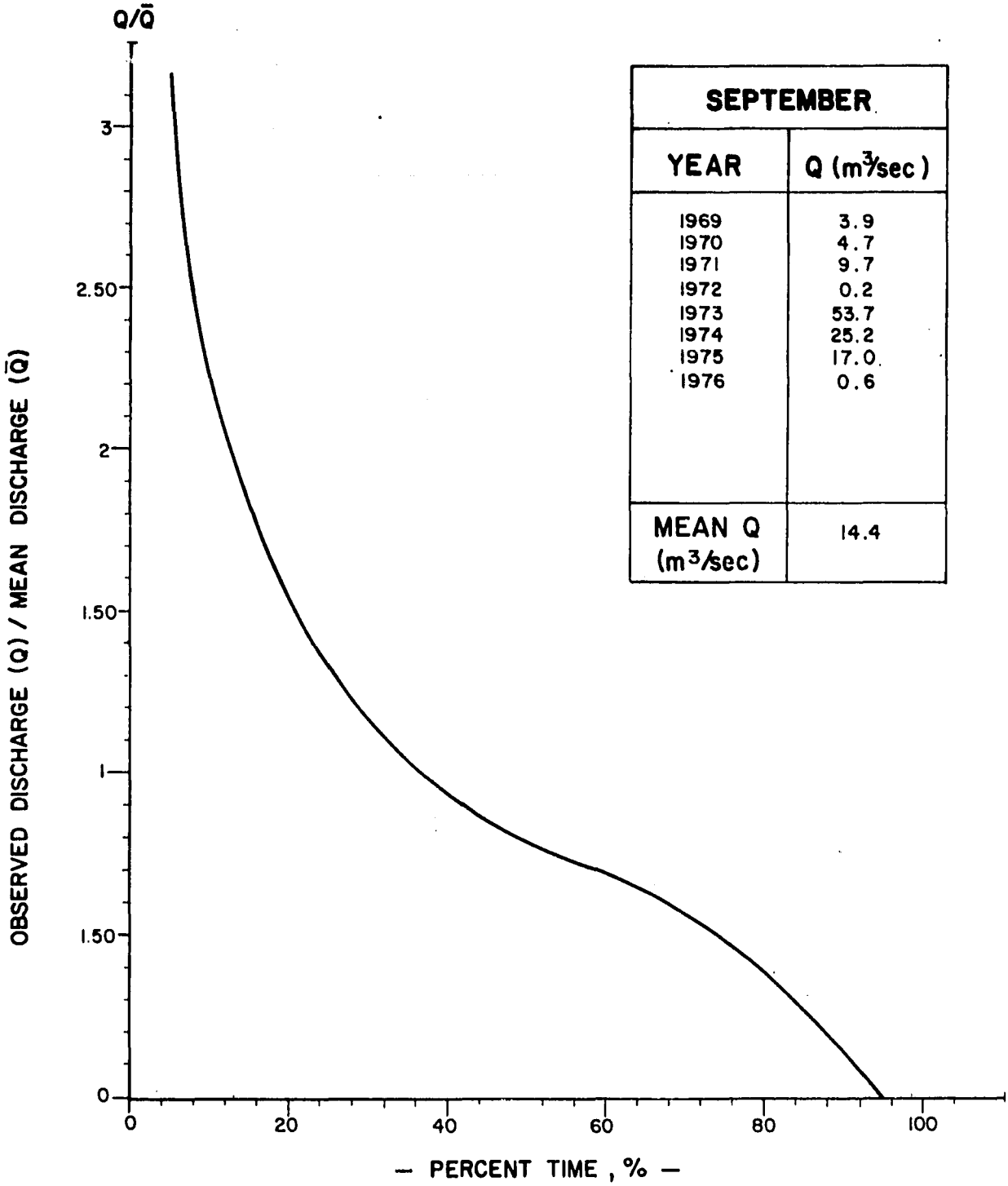


TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
— MONTH OF JUNE (Period 1969-1976) —

JULY	
YEAR	$\bar{Q}$ (m^3/sec)
1969	6.2
1970	20.5
1971	9.4
1972	1.7
1973	26.6
1974	4.0
1975	4.7
1976	0.9
MEAN $\bar{Q}$ (m^3/sec)	9.23

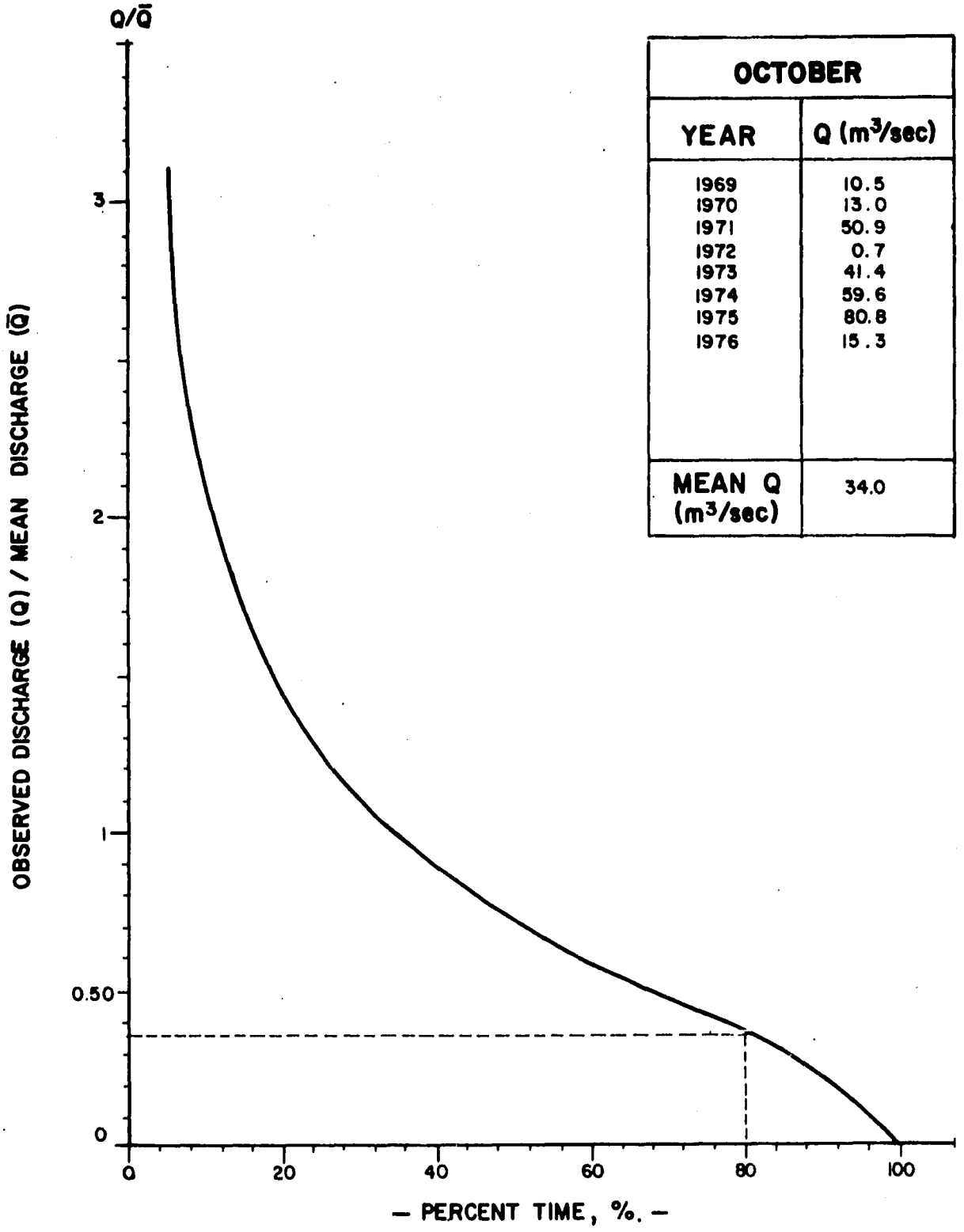


TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
— MONTH OF JULY (Period 1969 - 1976) —



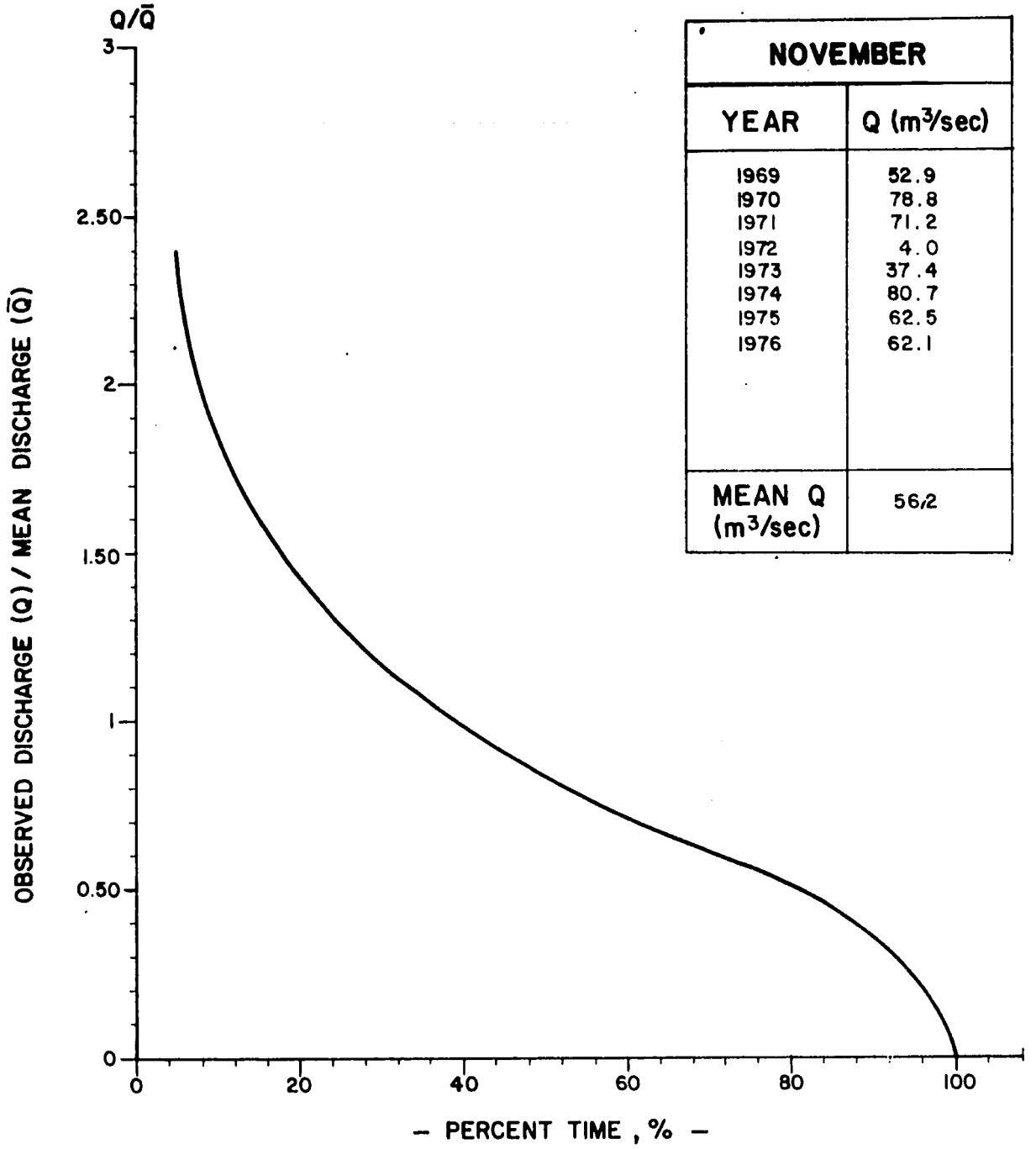
SEPTEMBER	
YEAR	Q (m^3/sec)
1969	3.9
1970	4.7
1971	9.7
1972	0.2
1973	53.7
1974	25.2
1975	17.0
1976	0.6
MEAN Q (m^3/sec)	14.4

TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
— MONTH OF SEPTEMBER (Period 1969-1976) —



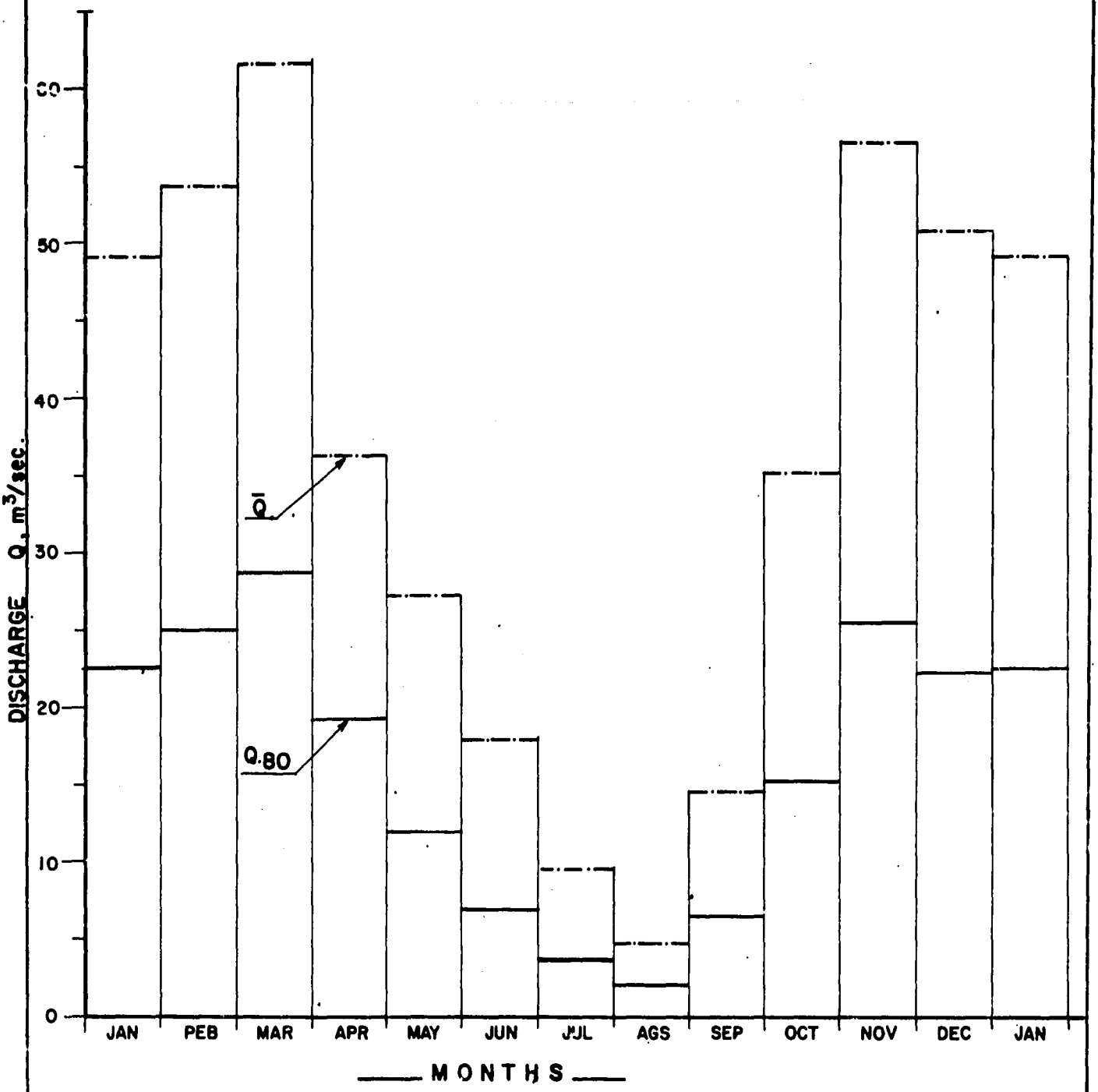
OCTOBER	
YEAR	Q (m^3/sec)
1969	10.5
1970	13.0
1971	50.9
1972	0.7
1973	41.4
1974	59.6
1975	80.8
1976	15.3
MEAN Q (m^3/sec)	34.0

TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
—MONTH OF OCTOBER (Period 1969 – 1976) –



NOVEMBER	
YEAR	Q (m^3/sec)
1969	52.9
1970	78.8
1971	71.2
1972	4.0
1973	37.4
1974	80.7
1975	62.5
1976	62.1
MEAN Q (m^3/sec)	56.2

TIME EXCEEDENCE CURVE OF DISCHARGE Q AT
CIMEI GAGING STATION IN CIKAWUNG RIVER
— MONTH OF NOVEMBER (Period 1969 1976) —



CENTRAL JAVA IRRIGATION SYSTEM

MEAN MONTHLY FLOW

HISTOGRAM OF $\bar{Q}$ AND $Q_{.80}$
FOR AVERAGE DISCHARGE (m^3/s)
PERIOD 1969 – 1977

CIKAWUNG RIVER
AT CIMEI GAGING STATION

CHAPTER VI

ENGINEERING PLANS AND COST ESTIMATES

In preparing the engineering plans and cost estimates, an attempt has been made to upgrade and rehabilitate the existing facilities such that they will be able to perform water conveyance and water management functions properly over a long period, with a high degree of efficiency. This took into consideration the integration of the new designs for the distribution systems (secondary and lateral canals) with the existing facilities in part of the systems. A consequence of this will be that the diversity of type of structure in the systems after plan implementation will be somewhat larger as compared to a total new design with new structures. An underlying thought has been that as long as proper water management capability is achieved with minimal expenditures on rehabilitation, a larger diversity of structures is economical and technically acceptable.

Design Considerations

The design of irrigation, drainage and flood control facilities has been based on selecting the types of facilities that will best conform to the primary project purposes and provide dependable and economical service. Locations for the facilities have been selected based on cost effectiveness consistent with planning constraints and the social and ecological aspects of the area. In locating and designing the facilities, consideration was also given to the availability of local construction materials and local construction practices.

Data Availability

Full use has been made of available information concerning topography, meteorology, geology and construction materials. Needs for additional data especially for streamflow data have been identified in the course of the investigation and steps need to be taken to obtain these data.

Detailed topographic maps (1:5,000 scale with one half meter contour intervals) were available for this feasibility study in January 1979 for all of the Majenang and Wanareja service area.

Information concerning construction materials and structure foundation was obtained from interpretation of geological maps and reports, from field observation, from information supplied by Seksi Irigasi Citanduy Office, Majenang and from the Proyek Citanduy construction section.

Hydrologic data concerning stream and drainage flood discharges was computed using rainfall data based on the dimensionless hydrograph method (Snyder method). Drainage and flood channels were designed to safely pass flood flows that are expected to occur with a frequency of 10 years.

Construction Considerations

In designing channels and structures, consideration was given to the economics of construction, the availability and cost of materials, conventional local construction methods, labor requirements and probable future maintenance needs and costs. One of the major alternatives involving materials is the selection between concrete and masonry for certain structural uses in future designs. Stones and rock for stone masonry construction and road surfacing are available both in the Majenang project area (Cijalu river) and in the Wanareja area (Cilaca river). Both sources of material are presently used for construction material for Manganti weir in the Sidareja-Cihaur project and by the Contractor for the Banjar-Pangandaran road construction project. A major foundation problem relates to the unconsolidated condition of the fine-grained sediments when additional loads are placed on these materials.

Project construction will require that some of the materials be transported over 2 to 5 kilometers distance from source in the general construction area. Possible sources have been considered and used in the cost estimate but exact locations have not been identified. Construction access to many portions of the area will be difficult without improvement of existing roads or road surfacing of present village roads. Necessary rehabilitation of roads within the system has been considered and included in cost estimates for Majenang and Wanareja project area.

Because of the need to elevate certain reaches of canals and laterals for service of project land in Cileumpuyang area of the Cileumeuh system, construction of the canal and laterals will require that embankment materials be obtained from outside the normal canal and construction areas. There will be excess excavation in a few short reaches of canals, but since there is an economic limit concerning the distance to which the excavated materials can be hauled, this material can not be used in the filling reaches.

Construction of drains will generally have excess excavation than will be required for embankment. Some of the excess material can be used in canal construction but it will not be practical to haul all of the material to canal construction areas because of distance, and economic limitations. Most of the excess materials from construction that will not be used for canal construction can be placed in dikes or roadways along the drains, or it may be used to fill local depressions in the land. It will be necessary to designate areas from which materials may be borrowed.

Right-of-Way

Because of existing technical facilities and an existing rural distribution and drainage system, the right of way requirement to use land for construction and operation of canals, laterals and drains and flood control levees is substantially reduced. The area to be acquired has been included in the cost estimates. Insofar as practicable, location for project facilities were selected to avoid the more highly developed area, particularly those utilized for commercial and residental purposes.

Design Criteria

To the extent applicable canals, laterals, drains, levees and structures were located and designed in accordance with criteria established previously for the Citanduy River Project.

Irrigation Canals and Laterals. A major objective in establishing location for irrigation canals and laterals has been to irrigate the maximum land area based on water availability and economic justification. Because of the economic and operational problems associated with pumping, a second objective has been to provide all irrigation service, insofar as practicable by gravity systems. The lack of hydrologic and streamflow data at the weir sites makes it difficult to determine the optimum area that can be irrigated.

Location of primary and secondary canal and laterals were established to efficiently convey and deliver water to the main farm ditches so as to:

(1) provide adequate irrigation service to individual blocks generally between 20 to 60 hectares in extent;

(2) align the canals on high ground to reduce embankment requirements and provide irrigation service to the higher areas;

(3) when practical, avoid crossing streams and drains, and passing through commercial and residental areas and other improved areas.

After establishment of the general location and grades for the canals, the alignments were adjusted in accordance with the following factors:

(1) provision of service for adjacent land,
(2) provision for balance depth of excavation and, height of embankment.
(3) provision of desired approaches to structures.

Because the soils in the project area are generally tight, even though poorly consolidated, excessive loss of water through seepage from canals and laterals is not expected. However, provision of lining in some small reaches of the canals is desirable to (1) reduce the minor seepage losses that will occur and thus increase the stability of the embankment; (2) improve the hydraulics by lowering the friction factor to either reduce grades or increase velocities.

Deposition of the sediments in canals and laterals due to the high sediment loads of the rivers and the flat slopes of the irrigable land will constitute an operational problem. Although the existing or planned sedimentation basins will remove some of the coarser materials from the flow, large quantities of the finer sediments will enter the canal system. The primary canals have been designed with sufficient grades and velocities where possible to prevent sedimentation. These canals should be operated under full capacity flow when sufficient water is available for diversion. The river flow may be insufficient for full capacity flow in the canals during the dry period however sediment concentration in the river will be lower and canal sedimentation will be less critical at these times. Check structures are provided in the canals. They should be operated when less than full capacity flow is available to obtain sufficient head at turnouts.

Some sedimentation in the secondary canals and laterals will occur because the costs for the provision of sufficient grade and velocities (lining) in many of the canals and laterals would be excessive. Full capacity flow operation is also recommended for these canals as it will reduce sedimentation. Increased annual maintenance will be necessary to keep the secondary canals and laterals in a good operable condition.

The design capacities of the irrigation canals in rice growing areas are generally determined by the land preparation requirement. The criteria used in previous design of irrigation systems in the Citanduy River Basin state a design capacity of 1.65 liters per second per hectare plus losses in supply and delivery canals. Based on available rainfall data, computed evapotranspiration and residual soil moisture, the land preparation irrigation requiremnts were determined for the recommended cropping patterns. Compared to the above mentioned design capacity, the computed land preparation irrigation requirements would exceed this value an average of about three 10-day periods per year. Because of these relatively infrequent periods and because the maximum monthly normal irrigation requirement will not exceed the 1.65 liter per second per hectare, this value plus canal losses has been adopted as the design capacity. The design for the farm ditches is 1.65 liters per second per hectare modified by the Tegal Curve factor. The freeboard of the canals can be used for providing the higher than 1.65 liter per second per hectare water duty during land preparation period.

Drains. Drain locations were established as necessary to properly relieve flooding and provide adequate drainage. In many cases this required realignment and enlargement of existing drainages or re-establishment of channels that previously had been filled by sedimentation and/or farming operations. Since some of the land is located in natural depressions, it was necessary to establish drain locations through higher adjacent grounds. Provision of a drainage system for these areas will have to be accompanied by local flood control system to prevent overflow onto the lands.

The large quantities of sediment carried by the river and drainage flows, especially those originating in the hills above the project area, will be deposited in the lower reaches of the stream channels and drains due to the flat slopes and backwater effect of Citanduy, when at flood stage.

The primary, secondary and lateral drains have been designed to convey flood flows which occur with an average 10 years frequency. The design drainage intensity for areas under wetland rice cultivation amounts to 7 liters per second per hectare. This value was computed based on the following data and assumptions: (1) rainfall depth - duration relationship for one to five days with a ten year frequency were derived from rainfall data for Majenang and Wanareja stations; (2) the allowable increase in water depth in the paddy is limited to 125 millimeters; (3) flooding duration should not exceed three days. Flooding of rice fields was limited to three days since damage to the rice plants from such flooding will be negligible.

Structures. Where possible use has been made of standard structures prepared for the Citanduy River Basin project in previous design studies. These standard structures include: checks, turnouts, drop structures, parshall flumes, and foot bridges. Structures designed for use in this feasibility study include: wasteways, culverts, cross drainage structures, bridges, syphons and elevated flumes.

A short description of some of the design features of these structures is given below.

Checks have been provided to maintain design water levels in the canals at times when insufficient water is available from river for full capacity flow. Distances between checks have been determined allowing a 20 percent encroachment on the freeboard of the canal at the check location as the check will be only used for short periods every year. The structure will be constructed from stone masonry with the exception of the weir and operating platform. The checks will have stoplog provisions to facilitate repair and replacement of the control slide gates. For discharges greater than one cubic meter per second, multiple bay check structures are used in the design.

Design of the checks with drop structure is similar to the checks discussed above. For drops less than one meter, a vertical drop has been provided while for larger elevation differences, an inclined drop has been used. For the latter drop structures suitable energy dissipation devices have been provided. The stilling basins will be constructed of stone masonry with chute blocks of reinforced concrete.

Two types of turnouts have been used in the design : (1) turnouts delivering water from one conveyance canal to another and (2) farm turnouts delivering water from a conveyance canal to a main farm ditch, commanding one irrigation service unit. The turnouts will have a stone masonry inlet channel with a raised sill for the conveyance canal turnouts and a downward sloping inlet floor for the farm turnout. Both types of turnouts will be provided with rectangular slide gates and stoplog provisions. Measuring gages will be installed at the upstream and downstream ends of the turnout structure to provide for flow measurements, in case no other measuring device is installed.

Drops without checks provided will be of the inclined type and will be constructed of stone masonry, with exception of the chute blocks and baffles in the stilling basin, which will be reinforced concrete.

Parshall flumes will be installed in canals where sufficient hydraulic gradient is available to allow for the head losses.

This measuring device was selected as it has a relatively small head loss, higher degree of accuracy and is easy to operate and maintain. The flume will be constructed of reinforced concrete.

Wasteways have been provided at the end of the irrigation canals and other suitable locations. The wasteway structures located at the ends of the canals will be similar to the check structures but will have only timber stoplog provisions. Side channel spillways are existing at several locations along primary canals in Cilopadang and Cilaca to permit cross drainage flow entering canal to be discharged into drains. The crest of the spillway is approximately at 0.2 meter above design water level. From the side channel spillways water enters into drainage canal. At some locations slide gates are provided for complete or partial drainage of the irrigation canals. For full capacity wasteways a check structure is provided a short distance downstream of the wasteway. The structure has been designed in reinforced concrete.

Culverts have been used to convey canal and drainage flow under roadways. Concrete pipes were used in the design of the small capacity road crossings. Inlets and outlets will have stone masonry headwalls with riprap protection in the upstream and downstream transitions. A design velocity of 1.5 meters per second was assumed for these culverts. The length of the pipe culverts range from about 2.50 to 5.00 meters.

Numerous cross drainage culverts have been identified along Cijalu canals, Cilopadang primary canal and Cileumeuh canals. These culverts vary from single barrel pipes 0.5 meters in diameter to double barrel pipes 1.20 meters in diameter. Inlet and outlet transitions will be constructed of reinforced concrete. The design velocity was assumed as three meters per second for full flow condition. Clearance between the canal bottom and the top of the drainage concrete pipe will normally be one meter.

Cross-drainage overchute have been used in places where the drainage channel invert will be higher than the design water level in the irrigation canals. The overchute consist of a rectangular stone masonry flume section, supported by a reinforced concrete slab over stone masonry piers. Inlet and outlet transitions as well as the stilling basin will be constructed of stone masonry.

Single lane bridges have been provided as roadway crossing for Cileumeuh and Cilopadang rivers. The bridges will be provided with side walks and railings. Piers and abutments will be constructed of reinforced concrete. As the foundation in the project area is generally poor, concrete pile foundations have been used in the preliminary design for these structures.

Syphons have been provided in places where crossings by flumes were not possible. The syphons were designed with multiple rectangular barrels with slide gates at the inlet. A minimum cover of 1.5 meters was provided over the syphon barrel. A design velocity of two meters per second has been assumed. During periods of low water availability, one or more barrels should be closed to maintain sufficient velocity in the syphon.

Improvement of Project Facilities

The project irrigation water supply will be obtained from the feeder rivers at the existing weirs (Cileumeuh and Cilopadang systems) or from the weirs under construction (Cijalu and Cilaca systems). The irrigation water will be conveyed through a system of canals which, in accordance to their size and function, are classified as primary and secondary canals and laterals. From these canals water is released through farm turnouts to main farm ditches for delivery to farm ditches and finally to the fields. Table VI-1 presents the total length of canals and laterals which need rehabilitation and additional length of canals which are to be designed and constructed for both project areas.

Project Features

Various tables, figures and maps have been prepared to provide detailed information on the engineering features of both project areas. The project engineering features are based on the problems and needs, as identified for both project areas in Chapter II, and on the rehabilitation and design considerations presented previously. The hydraulic design parameters of the irrigation canals have been computed and these are presented in the Appendix. In Chapter VII, information on recommended drainage and levee improvements is presented. The number of structures, which are to be rehabilitated and new structures to be designed and constructed is shown on Table VI-1.

The Figure VI-1, VI-2 and VI-3 show the schematic layouts for all the four systems. These are:

Figure	System Schematic Layout
VI-1	Cileumeuh & Cilopadang
VI-2	Cijalu
VI-3	Cilaca

These schematic layouts with legend show areas irrigated from each identified canal and farm turnout with design discharges. In the design discharges the Tegal-curve factor for areas under 150 hectares has been incorporated. All other major structures are also shown. The system layouts showing existing facilities and proposed facilities for each system is presented in the Appendix volume.

Existing Facilities

A study of the available design and construction drawings of the existing facilities and field inspection revealed that intake and conveyance capacities for the Cileumeuh and Cilaca system are sufficient to handle the proposed extensions.

Cileumeuh System. The weir intake and the primary canal upto the new bifurcation site (present code: BTY 1, and new code: H-I-1 and H-I-2 - bifurcation) have sufficient capacity to convey the proposed flows. The H-I-2 - primary canal will need enlargement in order to serve the Cileumpuyang-Cimanggu area extension. The existing Romiyn gate turnouts along the H-I-1 canal will be changed to slide gate turnouts with measuring devices downstream of the turnout. Costs for upgrading the existing facilities, where needed, have been provided.

Cilaca System. The designs for the new weir made available by the Central Java Irrigation Authorities have been studied. This shows that the proposed intake and weir crest height do not need to be changed in order to accommodate the additional flow for the Cikudapaeh extension. The existing overchute over the Cilaca river is also of sufficient capacity for this purpose. A chute-type drop structure will be required after the turnout for the A-II-1 canal which will serve the Cikudapaeh area. This drop structure will have a design capacity of 450 liter per second and the drop height is approximately 8 (eight) meters.

Desilting Facilities

All of the existing systems, at the present time have small desilting basins (slipzaks) whose effectiveness and efficiencies are unknown. There are no data available on sediment load in the river water nor in the water entering the irrigation systems.

These existing sediment removal devices are designed to be cleaned periodically by sluicing the seposited sediments back into the river. Often this has not been done on a regular basis, thus making them 100 percent ineffective, if full.

It is the normal practice in Indonesia to permit the silt and clay fractions of the sediment to be transported through the supply systems to the tertiary and "on-farm" systems for deposition on the paddy's and for the use and disposal by the farmer. Research by DPMA indicates that with proper undersluicing technique a large percentage of sand fraction can be prevented from entering the supply canal.

Alteration or replacement of these existing sediment traps would be expensive and benefits gained due to alteration are impossible to evaluate at this time due to the lack of data.

The consultants recommend that the existing desilting basins should be used and incorporated into the new design with the additional recommendation that in case plan for rehabilitation is accepted the O & M section should implement a positive plan of periodic cleaning and sluicing in combination with a definite program of sampling and testing of the river water prior and subsequent to passing through the devices. Data thus gathered and evaluated in conjuction with the status and planned effectiveness of the upper watershed program would permit, at some future date, to reevaluate the need for redesign of the existing sediment removal facilities.

Information on Proposed Alignments.

In the Appendix, information is provided regarding the proposed irrigation canal alignments. Table A-1 through A-13 show the hydraulic profile data of the irrigation canals (primaries, secondaries and laterals) for all four project systems. Tables B-1 through B-27 present the canal elevations and structures locations along the alignments. These tables in combination with the Figure VI-1, VI-2 and VI-3, and the system maps with proposed facilities in the Appendix, provide relevant information on the engineering aspects and will form the basis for pre-design survey and subsequent design activities.

Construction Cost Estimates and Schedule

The construction quantities for the project features were computed in detail where possible. Estimation of project cost and quantities in some instances are based on average values for construction items in neighboring areas when sufficient detail was not available. All estimating has been done to feasibility level.

Estimating Procedures

The project features have been grouped for cost estimation into canalization (irrigation canal and drainage channels), structures (including on-farm facilities), levee canalization (for flood control on system rivers) and improvement (for drainage channels excavation and levees) for the Pahonjean-Cilanggir areas.

The "basic cost" for each of the individual construction features was based on the computed quantities and unit costs. The unit cost includes for labor, materials and equipment. The construction cost includes contingency factor to cover cost for engineering, administration and overhead.

Quantities

Quantities for the unit price items were generally obtained by direct computation of material or labor involved in construction. Earthwork quantities and right-of-way for canals and other maps where available. In areas were little or no topographical data was available, data from field investigations and/or data from adjacent areas were used to estimate earthwork quantities.

Quantities such as concrete, masonry, steel, timber, etc. for structures were calculated from standard design drawings used presently in the construction of irrigation and drainage systems in the Citanduy River Basin and from preliminary designs made for this feasibility study.

Quantities for the on-farm facilities were developed for a few sample areas and applied on a per hectare basis.

Unit Price

The unit prices used are January 1979 prices with a conversion rate of one US dollar to 625 Indonesian Rupiahs. Many of the unit prices were developed during the feasibility study from material costs and labor costs for similar items of work which were supplied by the Citanduy Project Office. Some unit prices were obtained from contractor bids.

Contingencies

To cover the difference between the estimated and actual quantities, addition of work items, unforseen difficulties at the construction site, change in unit prices and other uncertainties, a contingency factor is added to the basic cost. A contingency factor of 15 percent has been applied.

Engineering, Administration, and Overhead

An amount of 15 percent has been provided on the sum of the basic costs and contingencies to allow for engineering, administration and overhead. Engineering cost include the costs of preparation of final designs, construction drawings and specifications. It also includes cost of coordination, supervision, and control of construction, construction survey, laboratory testing as well as safety inspection activities. The administrative costs include general supervision, procurement of supplies and equipment, personnel support, cost accounting, progamming of funds and work load, legal service and general office services.

Cost Estimate Summary

The total project cost for the Majenang and Wanareja project area has been estimated to be Rp. 2,568.6 million, and Rp. 601.4 million respectively. These total costs include the contingencies of 15 percent and the Engineering and Administration overhead of 15 percent. Also included in these costs are the development and construction of on-farm facilities.

The above costs are the economic costs, based on January 1979 price-levels.

The cost tables are broken down into canalization (irrigation canals and drainage channels), structures (including on-farm facilities) and flood improvement. The costs breakdown is presented in Tables VI-2 through VI-5 for canalization, and Tables VI-6 through VI-9 for structures, for each of the four project systems separately. The envisaged flood improvement works for the Majenang Project Area consists of provision of levees along the Cileumeuh.

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Cilopadang, Cijalu and Cilanggir-Ciglagah rivers, and of excavation required to route the Ciglagah-Cilanggir river through the present swamp and waterlogged area in the southern part of the Cijalu system. Also included are the costs of the flapgates and drain inlets identified in the proposed levees, and the costs for the proposed bridges. A cost breakdown for the proposed flood improvements is provided in Table VI-10 through VI-13. These flood improvements for the Majenang project area are shown in Figure VII-1 of Chapter VII on Flood Control Plan Formulation.

The Wanareja Project plan has no major costs associated with flood improvements, as the upgrading of the Citanduy left and Cikawung right levee bordering the Cilaca system, will be implemented in the period 1980-1982 under the Citanduy Flood Control Scheme. Relevant aspects of the flood improvements for the Majenang project area and for the protection provided to the Wanareja Project area by the Citanduy Flood Control Scheme are presented in Chapter VII.

The costs of canalization for the Cilaca system (Table VI-5) include the required channel widening of the Kali Serang drain in order to carry flood waters from the area more rapidly.

Table VI-14 presents the construction costs of the Majenang and Wanareja project areas, with a breakdown of the total costs for canalization, structures, and the flood improvements by systems. The Tables VI-1 to VI-11 together with Figures VI-1, VI-2 and VI-3, showing the schematic layouts, and the figures in appendix provides the details of project features and cost at the feasibility level for all the systems.

Unit costs used are indicated in the construction cost estimate tables. Unit costs and construction amount are broken down into total costs and the foreign component (F.C.) of the total costs. The foreign component costs are Rp. 682.376 million (US $ 1.092 million) for the Majenang Project Area, and Rp. 96.476 million (US $ 0.154 million) for the Wanareja Project Area.

Construction Schedule

A project of this size can be constructed in a three year period. This is based on consultants review of ongoing projects and capabilities of the concerned agencies. Based on this, expenditures were distributed as 20, 45, and 35 percent of the total construction cost in the three consecutive years. The construction of the flood improvements will be influenced most by weather conditions. Hence, these works should be started in the first construction year to permit a longer construction period. It is anticipated that if the project plan is accepted, construction can start in fiscal year 1981-1982.

The above construction schedule of expenditure has been used in the preparation of the budget with breakdown in domestic and foreign component costs adjusted for inflation in Chapter X of Financial Analysis as well as in setting up the cost stream for economic analysis.

Integration Pelita II/III Expenditures with Engineering Costs Estimates

During the period 1974-1979 (Pelita II - period) and the fiscal year 1979-1980 (first year of Pelita III - period) expenditures have been made on the rehabilitation and upgrading of the existing facilities in the area. Also, the new Cijalu weir construction was started in this period and is planned for completion by 1980. These costs (spent or anticipated in 1979-1980 combined) are presented in Table I-4.

In the project economic evaluation, these costs have been included. The amounts for each project area (Majenang and Wanareja) are incorporated in the cost of the first year of the construction schedule. Thus, they are considered an integral part of the project costs. Major expenditure has been on the Cijalu weir. The agricultural and economic evaluation are based on data before the Cijalu weir was operational. The future without project predictions have been based on this condition, as it is difficult to estimate Cijalu system performance with only the weir as an existing facility. Thus, to counteract this uncertainty, inclusion of project cost of Cijalu weir is logical and justified.

Planned Pelita-III expenditures for period 1980-1984 have not been included in any of the economic evaluations. Depending on the further evaluation of this feasibility study, the Provincial and District Pelita III budget may need alteration, if a decision is made to implement the proposed plan outlined in this feasibility study.

Regulation of the Wanareja Village Water Supply

In the problems and needs section of Chapter II for the Wanareja Project Area, it was indicated that at present the irrigation water flowing through the village to the irrigated areas is extensively used by the villagers for domestic purposes. In addition, the irrigation canals mix with drainage channels to become drains. These drains reach the irrigated areas through culverts under the Banjar-Majenang road and provide irrigation supplies to the ricelands.

The primary canal runs immediately north of the village between the foothills and the housing areas. Beyond the existing 10 turnouts in this canal, no watermanagement capability exists. Drop in elevation is considerable between the primary canal and area irrigated south of the Banjar-Majenang road. From an engineering point of view, it is suggested in the proposed plans to extend, through secondary canals, to the actual service area. The first secondary canal turnout (A-II-1) will provide irrigation water to the Cikudapaeh extension area and will be new design. The remaining two secondaries (A-II-2 and A-II-3) will take off from existing turnouts which will be modified. These three secondary canals are necessary to serve the total area, and to minimize number of structures and house reallocation. Various drop structures are identified along these secondary canals to accomodate the elevation differences. The seven remaining turnouts are not needed for irrigation supply to areas in the future. These turnouts could be removed, but this would result in loss of means to provide water to village houses at various points. It is suggested to use and regulate these turnouts in future for village water supply (VWS), which is indicated in Figure VI-4. In times of excess water supply, the turnouts (to be modified to ten liter per second discharge each) can be used continuously for village water supply. These discharges are incorporated in the primary canal design capacity under rehabilitation. In times of limited water, the diversion of water through these turnouts should be regulated such that the villagers and farmers are in agreement. The head of the village has been consulted in this matter, and stated

that once the means for regulation are available, the regulation itself could be achieved. It is realized that the use of the diverted water from Cilaca weir by villagers is an established custom, and that the village, in future, needs water for village municipal use. No other economical water source could be identified. Thus, it seems appropriate to keep the existing irrigation turnouts for use in the future as village water supply turnouts.

TABLE VI-1

PROJECT ENGINEERING FEATURES

	Majenang Project Area						Wanareja Project Area	
	Cileumeuh		Cilopadang		Cijalu		Cilaca	
	Rehab	New	Rehab	New	Rehab	New	Rehab	New
Canals 1/								
Primary	5.700	-	-	-	4.775	4.775	4.500	-
Secondary	6.735	7.365	1.250	-	-	7.095	9.560	7.650
Laterals	6.365	9.045	3.300	5.400	8.420	11.575	10.600	13.715
	18.800	16.410	4.550	5.400	13.195	23.445	24.660	21.365
Drains 1/								
Primary	2.600	2.960	-	5.100	-	650	-	1.400
Secondary	6.200	8.280	-	2.670	5.300	4.540	2.700	435
Laterals	3.960	17.210	-	11.150	3.700	14.750	-	17.045
	12.760	28.450		18.920	9.000	19.940	2.700	18.880
Turnout (Romijn) 2/	2	-	-	-	2	-	-	-
Turnout (Slide)	6	3	3	3	3	4	7	6
Farm turnouts	-	28	-	9	-	47	-	28
Checks	-	-	-	3	-	-	-	5
Drops	-	8	-	4	-	94	-	5
Check & Drops	-	3	-	-	-	4	-	5
Parshall Flumes	-	12	-	3	-	12	-	16
Flumes	1	2	-	-	-	-	1	-
Roads culverts	8	7	2	-	8	6	13	7
Drain inlets	-	16	-	7	-	26	1	18
Junctions	-	-	-	-	-	8	-	4
Bridge	-	-	-	-	-	-	-	-
Wasteways	-	9	-	3	-	12	-	10

1/ Canals and drains in kilometers.

2/ Structures, each.

TABLE VI-2

COST ESTIMATE - CANALIZATION

System: CILEUMEUH

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	21,928	285	125	6.249	2.741
2.	Excavation	m^3					
	a. Canal & Drain	m^3	228,234	580	0	132.376	0
	b. Side borrow	m^3					
	c. Haul borrow (3 km)	m^3	10,552	1,285	1,030	13.559	10.869
3.	Clearing & Stripping	m^2	48,610	65	0	3.160	0
4.	Road Surfacing	m^2	40,550	1,400	740	56.770	30.007
5.	Sodding	m^2	255,918	70	0	17.914	0
6.	Row	m^2	144,180	190	0	27.394	0
				Direct Field Cost		257.422	43.617
				Contingencies (15%)		38.613	
				Sub-total		296.035	
				Eng. + Adm (15%)		44.405	
				Total Amount		340.440	

Note: F.C. = Foreign Component

TABLE VI-3

COST ESTIMATE - CANALIZATION

System: CILOPADANG

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	10,383	285	125	2.959	1.298
2.	Excavation	m^3					
	a. Canal & Drain	m^3	15,618	580	0	9.058	0
	b. Side borrow	m					
	c. Haul borrow (2 km)	m^3	4,984	1,000	885	4.984	4.411
3.	Clearing & Stripping	m^2	47,960	65	0	3.117	0
4.	Road Surfacing	m^2	11,900	1,400	740	16.660	8.806
5.	Sodding	m^2	69,264	70	0	4.848	0
6.	Row	m^2	25,190	190	0	4.786	0
				Direct Field Cost		46.412	14.515
				Contingencies (15%)		6.962	
				Sub-total		53.374	
				Eng. + Adm (15%)		8.006	
				Total Amount		61.380	

TABLE VI-4

COST ESTIMATE - CANALIZATION

System: CIJALU

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	88,982	285	125	25.360	11.123
2.	Excavation	m^3					
	a. Canal & Drain	m^3	64,892	580	0	37.637	0
	b. Side borrow	m^3					
	c. Haul borrow (3 km)	m^3	60,100	1,285	1,030	77.229	61.903
3.	Clearing & Stripping	m^2	12,200	65	0	0.793	0
4.	Road Surfacing	m^2	45,200	1,400	740	63.280	33.448
5.	Sodding	m^2	317,195	70	0	22.204	0
6.	Row	m^2	109,930	190	0	20.887	0
				Direct Field Cost		247.390	106.474
				Contingencies (15%)		37.109	
				Sub-total		284.449	
				Eng. + Adm. (15%)		42.675	
				Total Amount		327.174	

TABLE VI-5

COST ESTIMATE - CANALIZATION

System: CILACA

Wanareja Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	25,418	285	125	7.244	3.177
2.	Excavation	m^3					
	a. Canal & Drain	m^3	123,470	580	0	71.613	0
	b. Channel Improvement	m^3	89,793	580	0	52.080	0
	c. Haul borrow (2 km)	m^3	16,229	1,000	885	16.229	14.363
3.	Clearing & Stripping	m^2	51,220	65	0	3.329	0
4.	Road Surfacing	m^2	52,500	1,400	740	73.500	38.850
5.	Sodding	m^2	165,861	70	0	11.610	
6.	Row	m^2	155,260	190	0	29.499	0
7.	Row, Flood Control, Kali Serang	m^2	68,800	190	0	13.072	0
				Direct Field Cost		278.176	56.390
				Contingencies (15%)		41.726	
				Sub-total		319.902	
				Eng. + Adm. (15%)		47.985	
				Total Amount		367.887	

TABLE VI-6

COST ESTIMATE - STRUCTURES

System: CILEUMEUH

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Farm turnouts	EA	28	-	-	8.052	4.234
2.	Parshall flumes	EA	12	-	-	3.250	1.336
3.	Culverts	EA	7	-	-	2.345	1.197
4.	Turnouts	EA	3	-	-	5.100	2.400
5.	Flumes	EA	2	-	-	6.700	2.880
6.	Syphons	EA	3	-	-	2.411	1.004
7.	Drop	EA	8	-	-	4.652	2.034
8.	Check & Drop	EA	3	-	-	2.802	1.252
9.	Check						
10.	Wasteways	EA	9	291,000	151,000	2.619	1.359
11.	Drain inlets	EA	16	79,000	36,000	1.264	0.576
12.	On-farm facilities	Ha	1,471	143,000	17,000	210.353	25.007
				Direct Field Cost		249.548	43.279
				Contingencies (15%)		37.432	
				Sub-total		286.980	
				Eng. + Adm. (15%)		43.047	
				Total Amount		330.027	

TABLE VI-7

COST ESTIMATE - STRUCTURES

System: CILOPADANG

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Farm turnouts	EA	9	-	-	2.412	1.278
2.	Parshall flumes	EA	3	-	-	0.766	0.315
3.	Culverts						
4.	Turnouts						
5.	Flumes						
6.	Syphons						
7.	Drop	EA	4	-	-	1.399	0.611
8.	Check & Drop						
9.	Check	EA	3	-	-	1.545	0.753
10.	Wasteways	EA	3	291,000	151,000	0.873	0.453
11.	Drain inlets	EA	7	79,000	36,000	0.553	0.252
12.	On-farm facilities	Ha	221	143,000	17,000	31.603	3.757
				Direct Field Cost		39.151	7.419
				Contingencies (15%)		5.873	
				Sub-total		45.024	
				Eng. + Adm. (15%)		6.754	
				Total Amount		51.778	

TABLE VI-8

COST ESTIMATE - STRUCTURES

System: CIJALU

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Farm turnouts	EA	47	-	-	12.757	6.737
2.	Parshall flumes	EA	12	-	-	3.188	1.310
3.	Culverts	EA	14	-	-	5.781	2.910
4.	Turnouts	EA	7	-	-	8.305	3.699
5.	Flumes						
6.	Syphons						
7.	Drop	EA	94	-	-	53.435	23.369
8.	Check & Drop	EA	4	-	-	3.793	1.693
9.	Junctions	EA	8	396,000	180,000	3.168	1.440
10.	Wasteways	EA	12	291,000	151,000	3.492	1.812
11.	Drain inlets	EA	26	79,000	36,000	2.054	0.936
12.	On-farm facilities	Ha	1,262	143,000	17,000	180.466	21.454
				Direct Field Cost		276.439	65.360
				Contingencies (15%)		41.466	
				Sub-total		317.905	
				Eng. + Adm. (15%)		47.686	
				Total Amount		365.591	

TABLE VI-9

COST ESTIMATE - STRUCTURES

System: CILACA

Wanareja Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Farm turnouts	EA	28	-	-	7.665	4.039
2.	Parshall flumes	EA	16	-	-	4.075	1.677
3.	Culverts	EA	20	-	-	5.644	2.870
4.	Turnouts	EA	6	-	-	6.846	3.024
5.	Flumes						
6.	Drop A II-1, 0 + 400 (12.5 km)	EA	1	-	-	3.704	1.296
7.	Drop	EA	46	-	-	21.679	9.478
8.	Check & Drop						
9.	Check	EA	5	-	-	2.639	1.281
10.	Wateways	EA	10	291,000	151,000	2.910	1.510
11.	Drain inlets	EA	18	79,000	36,000	1.422	0.648
12.	On-farm facilities	Ha	839	143,000	17,000	119.977	14.263
				Direct Field Cost		176.561	40.086
				Contingencies (15%)		26.484	
				Sub-total		203.045	
				Eng. + Adm (15%)		30.457	
				Total Amount		233.502	

TABLE VI-10

COST ESTIMATE - LEVEE CANALIZATION

River: CILEUMEUH

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	21,080	285	125	6.008	2.635
2.	Excavation	m^3					
	a. Canal	m^3					
	b. Side borrow	m^3					
	c. Haul borrow (2 km)	m^3	25,296	1,000	885	25.296	22.387
3.	Clearing & Stripping	m^2	24,400	65	0	1.586	0
4.	Road Surfacing	m^2					
5.	Sodding	m^2	13,000	70	0	0.910	0
6.	Row	m^2	24,400	190	0	4.636	0
				Direct Field Cost		38.436	25.022
				Contingencies (15%)		5.765	
				Sub-total		44.201	
				Eng. + Adm. (15%)		6.630	
				Total Amount		50.831	

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TABLE VI-11

COST ESTIMATE - LEVEE CANALIZATION

River: CILOPADANG

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	101,000	285	125	28.785	12.625
2.	Excavation	m^3					
	a. Canal	m^3					
	b. Side borrow	m^3					
	c. Haul borrow (2 km)	m^3	121,200	1,000	885	121.200	107.262
3.	Clearing & Stripping	m^2	61,100	65	0	3.972	0
4.	Road Surfacing	m^2					
5.	Sodding	m^2	65,400	70	0	4.578	0
6.	Row	m^2	61,100	190	0	11.609	0
				Direct Field Cost		170.144	119.887
				Contingencies (15%)		25.522	
				Sub-total		195.666	
				Eng. + Adm. (15%)		29.350	
				Total Amount		225.016	

TABLE VI-12

COST ESTIMATE - LEVEE CANALIZATION

River: CIJALU & CILANGGIR

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs		Amount Million Rupiahs	
				Total	F.C.	Total	F.C.
1.	Compacted Embankment	m^3	123,000	285	125	35.055	15.375
2.	Excavation	m^3					
	a. Canal	m^3					
	b. Side borrow	m^3					
	c. Haul borrow (3 km)	m^3	147,600	1,285	1,030	189.666	152.028
3.	Clearing & Stripping	m^2	97,400	65	0	6.331	0
4.	Road Surfacing	m^2					
5.	Sodding	m^2	66,000	70	0	4.620	0
6.	Row	m^2	97,400	190	0	18.506	0
				Direct Field Cost		254.178	167.403
				Contingencies (15%)		38.127	
				Sub-total		292.305	
				Eng. + Adm. (15%)		43.846	
				Total Amount		336.151	

TABLE VI-13

COST ESTIMATE - FLOOD IMPROVEMENT

Majenang Project Area

Item No.	Cost Item	Unit	Quantity	Unit Cost Rupiahs Total	Unit Cost Rupiahs F.C.	Unit Cost Million Rupiahs Total	Unit Cost Million Rupiahs F.C.	Amount Million Rupiahs Total	Amount Million Rupiahs F.C.
1.	Excavation	m^3	258,203	580	0	-	-	149.758	-
2.	Row	m^3	36,000	190	0	-	-	6.840	-
3.	Flapgate Cilanggir	EA	1	-	-	31.5	9.4	31.5	9.4
4.	Flapgate (small)	EA	7	-	-	10.0	4.5	70.0	31.5
5.	Drain inlets flash board	EA	5	-	-	5.0	2.0	25.0	10.0
6.	Bridges (single-lane)	EA	2	-	-	40.0	19.25	80.0	38.5
				Direct Field Costs				363.098	89.40
				Contingencies (15 percent)				54.465	
				Sub-total				417.563	
				Eng. + Adm. (15 percent)				62.634	
				Total Amount				480.197	

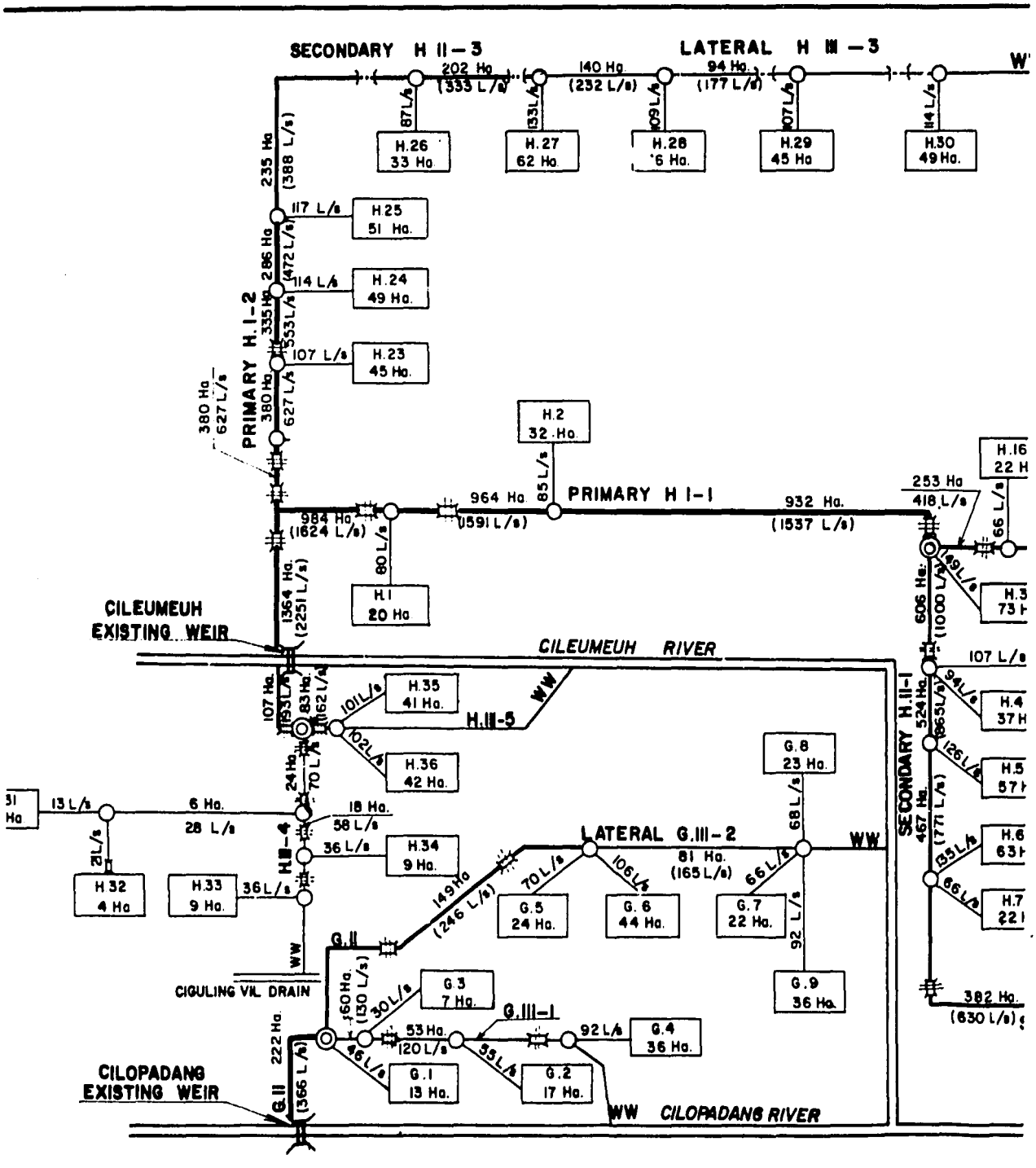
TABLE VI-14

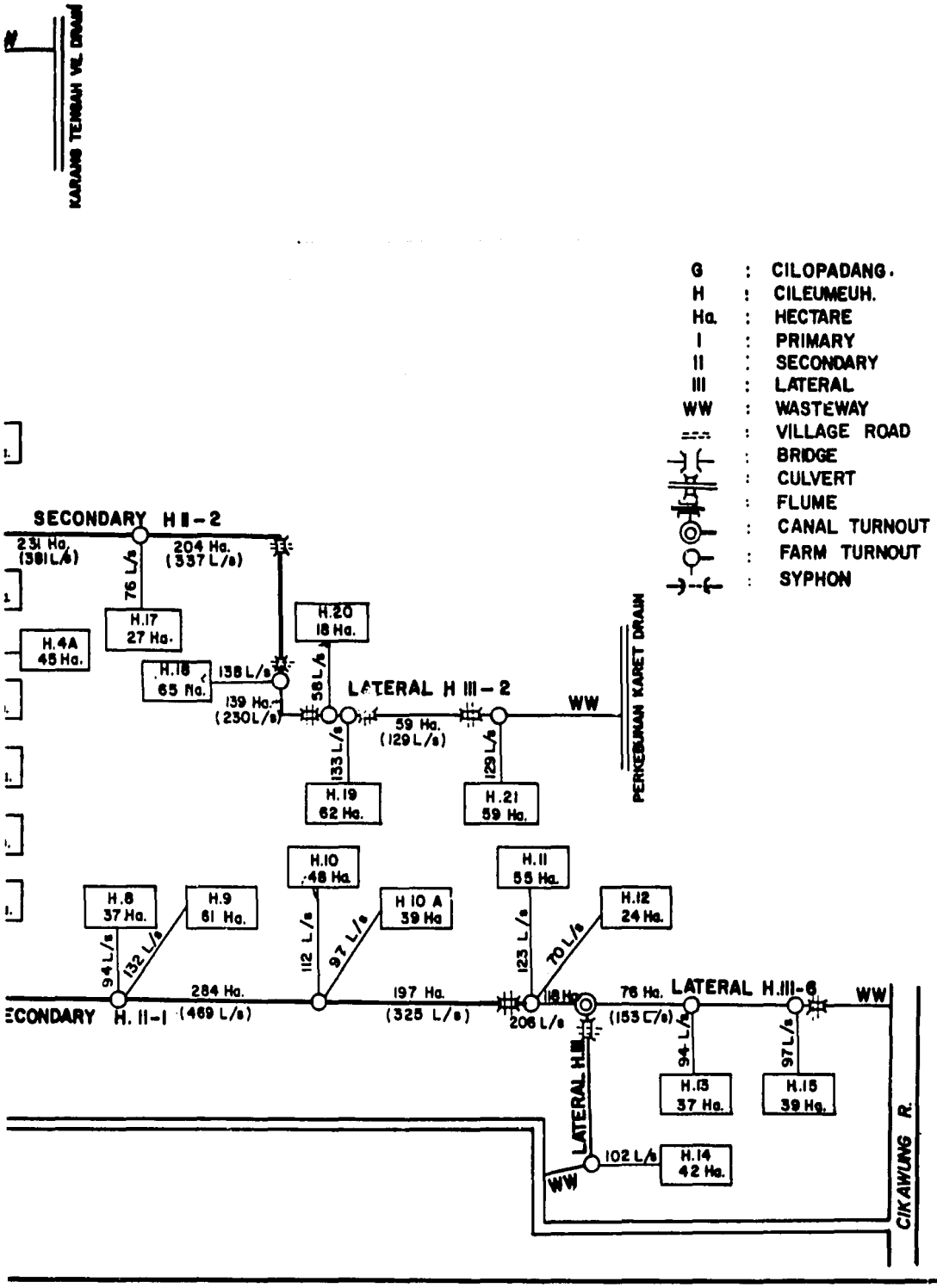
TOTAL COSTS

Total Costs = Direct Field Costs, Contingencies (15 percent) and Engineering + Administration overhead (15 percent)

	Table Reference for Breakdown Costs	Total Cost Million Rupiahs	Foreign Component Million Rupiahs
Majenang Project Area			
1. Cileumeuh			
a. Canalization	VI - 2	340.440	43.617
b. Structures	VI - 6	330.027	43.279
2. Cilopadang			
a. Canalization	VI - 3	61.380	14.515
b. Structures	VI - 7	51.778	7.419
3. Cijalu			
a. Canalization	VI - 4	327.174	106.474
b. Structures	VI - 8	365.591	65.360
4. Flood Improvements (including bridges and flap gates)	VI - 10 VI - 11 VI - 12 VI - 13	1,092.195	401.712
Total Cost - (Million Rupiahs)		2,568.585	682.376
Total Cost - (Million US Dollars)		4.110	1.092
Wanareja Project Area			
1. Cilaca			
a. Canalization	VI - 5	367.887	56.390
b. Structures	VI - 9	233.502	40.086
Total Cost (Million Rupiahs)		601.389	96.476
Total Cost (Million US Dollars)		0.962	0.154

Note: 1 US Dollar = 625 Rupiahs.


SECONDARY H II-3
LATERAL H III-3
202 Ha
(333 L/s)
140 Ha
(232 L/s)
94 Ha
(177 L/s)
87 L/s
133 L/s
109 L/s
107 L/s
114 L/s
H.26
33 Ha
H.27
62 Ha
H.28
6 Ha.
H.29
45 Ha
H.30
49 Ha.
235 Ha
(388 L/s)
117 L/s
H.25
51 Ha.
286 Ha
(472 L/s)
114 L/s
H.24
49 Ha.
335 Ha
553 L/s
107 L/s
H.23
45 Ha
PRIMARY H.I-2
380 Ha
627 L/s
380 Ha
627 L/s
H.2
32 Ha.
85 L/s
964 Ha
(1591 L/s)
PRIMARY H I-1
932 Ha.
(1537 L/s)
984 Ha
(1624 L/s)
80 L/s
H.1
20 Ha
1364 Ha.
(2251 L/s)
253 Ha
418 L/s
66 L/s
H.16
22 H
49 L/s
606 Ha.
(1000 L/s)
H.3
73 H
CILEUMEUH
EXISTING WEIR
CILEUMEUH RIVER
107 L/s
107 Ha.
193 L/s
83 Ha.
162 L/s
101 L/s
H.35
41 Ha.
WW
H.III-5
102 L/s
H.36
42 Ha.
24 Ha.
70 L/s
SECONDARY H.II-1
524 Ha.
865 L/s
94 L/s
H.4
37 H
126 L/s
H.5
57 H
467 Ha.
(771 L/s)
135 L/s
H.6
63 H
66 L/s
H.7
22 H
382 Ha.
(630 L/s)
G.8
23 Ha.
68 L/s
31
Ha
13 L/s
6 Ha.
28 L/s
18 Ha.
58 L/s
21 L/s
H.32
4 Ha
H.33
9 Ha.
36 L/s
H.III-4
36 L/s
H.34
9 Ha.
LATERAL G.III-2
81 Ha.
(165 L/s)
WW
66 L/s
149 Ha
(246 L/s)
70 L/s
106 L/s
G.5
24 Ha.
G.6
44 Ha.
G.7
22 Ha.
92 L/s
G.9
36 Ha.
WW
CIGULING VIL. DRAIN
G.II
160 Ha.
(130 L/s)
30 L/s
G.3
7 Ha.
G.III-1
53 Ha.
120 L/s
92 L/s
G.4
36 Ha.
222 Ha.
(366 L/s)
46 L/s
G.1
13 Ha.
53 L/s
G.2
17 Ha.
CILOPADANG
EXISTING WEIR
G.II
WW
CILOPADANG RIVER



NOTES:

1. FEASIBILITY LEVEL LAYOUT.
2. MAY NEED CHANGE DURING DESIGN.
3. G-II, H-I, H-I-I AND H-I-2. ARE EXISTING CANAL ALIGNMENTS.

REPUBLIC OF INDONESIA

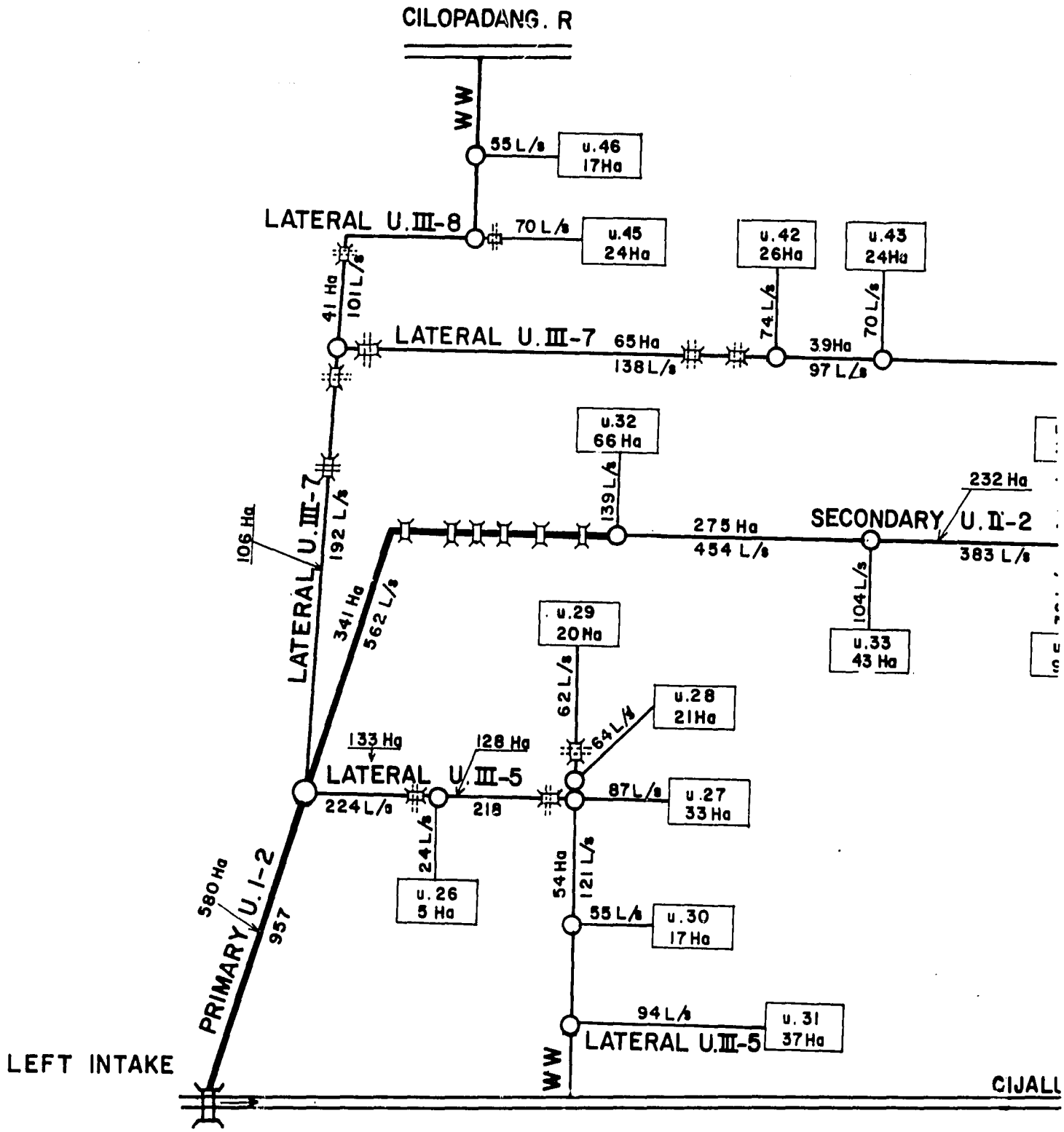
MINISTRY OF PUBLIC WORKS
DIRECT. GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS

CITANDUY PROJECT

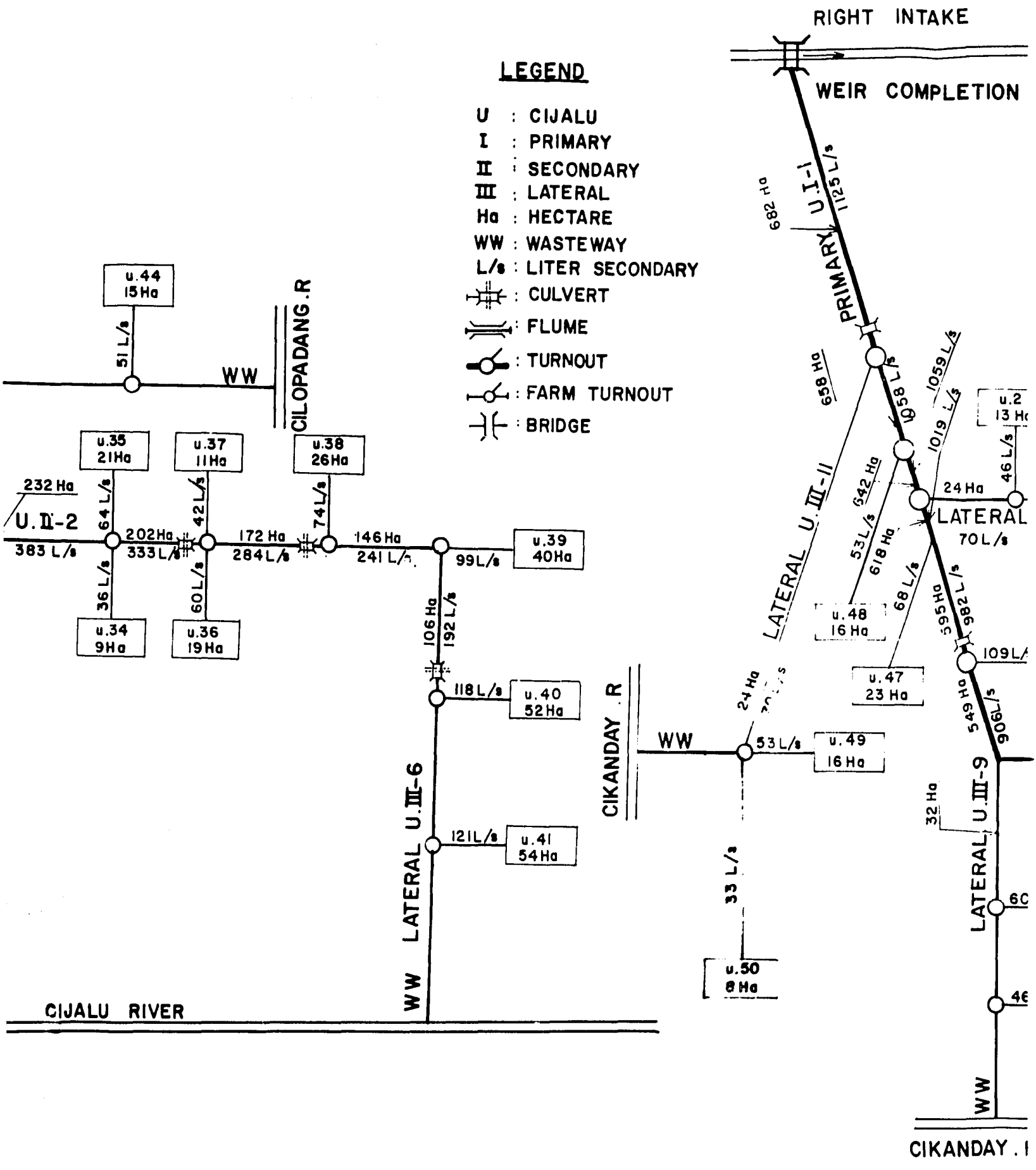
CENTRAL JAVA SYSTEMS
CILEUMEUH & CILOPADANG
IRRIGATION SYSTEM
SCHEMATIC LAYOUT

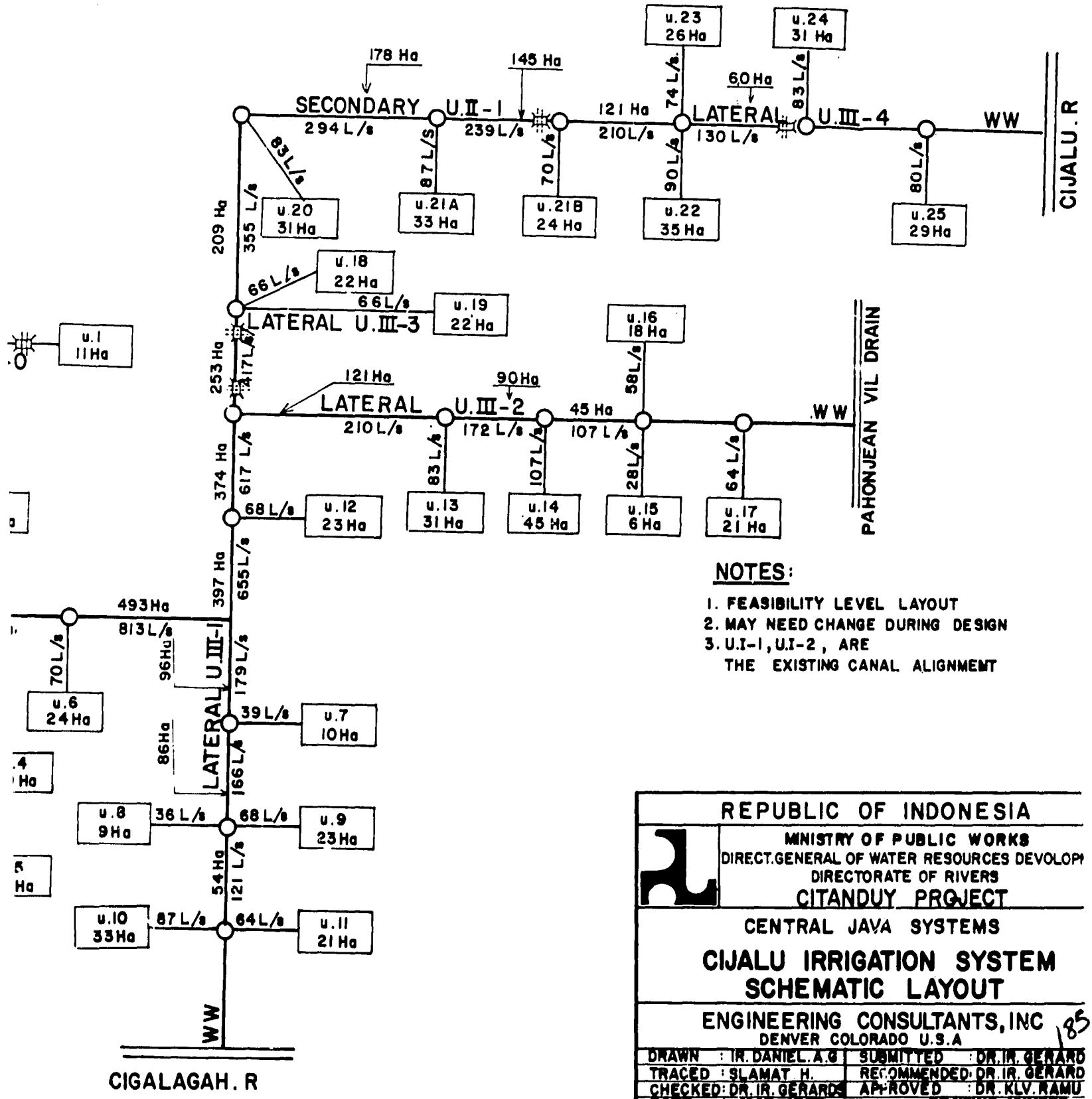
ENGINEERING CONSULTANTS. INC.
DENVER COLORADO U.S.A.

DRAWN	: IR. DANIEL. A.G.	SUBMITTED	: DR. IR. GERARDS
TRACED	: TASWA HERD.	RECOMMENDED	: DR. IR. GERARDS.
CHECKED	: DR. IR. GERARDS.	APPROVED	: DR. K.L.V. RAMU.
DATE	: MAY 1979.	DRAWING NO.	:



WEIR COMPLETION 1981


LEGEND
U : CIJALU
I : PRIMARY
II : SECONDARY
III : LATERAL
Ha : HECTARE
WW : WASTEWAY
L/s : LITER SECONDARY
: CULVERT
: FLUME
: TURNOUT
: FARM TURNOUT
: BRIDGE
RIGHT INTAKE
WEIR COMPLETION
U.I-1
1125 L/s
682 Ha
PRIMARY
658 Ha
1058 L/s
1059 L/s
1019 L/s
u.2
13 Ha
46 L/s
24 Ha
LATERAL
70 L/s
642 Ha
53 L/s
618 Ha
68 L/s
LATERAL U.III-11
u.48
16 Ha
u.47
23 Ha
595 Ha
982 L/s
109 L/s
549 Ha
906 L/s
LATERAL U.III-9
32 Ha
60
46
WW
CIKANDAY . I
u.44
15 Ha
51 L/s
WW
CILOPADANG.R
u.35
21 Ha
u.37
11 Ha
u.38
26 Ha
232 Ha
U.II-2
64 L/s
42 L/s
74 L/s
383 L/s
202 Ha
333 L/s
172 Ha
284 L/s
146 Ha
241 L/s
99 L/s
u.39
40 Ha
36 L/s
60 L/s
u.34
9 Ha
u.36
19 Ha
106 Ha
192 L/s
118 L/s
u.40
52 Ha
121 L/s
u.41
54 Ha
WW LATERAL U.III-6
CIJALU RIVER
CIKANDAY . R
WW
24 Ha
53 L/s
u.49
16 Ha
33 L/s
u.50
8 Ha



NOTES:

1. FEASIBILITY LEVEL LAYOUT
2. MAY NEED CHANGE DURING DESIGN
3. U.I-1, U.I-2, ARE THE EXISTING CANAL ALIGNMENT

REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS
DIRECT.GENERAL OF WATER RESOURCES DEVOLOPI
DIRECTORATE OF RIVERS
CITANDUY PROJECT

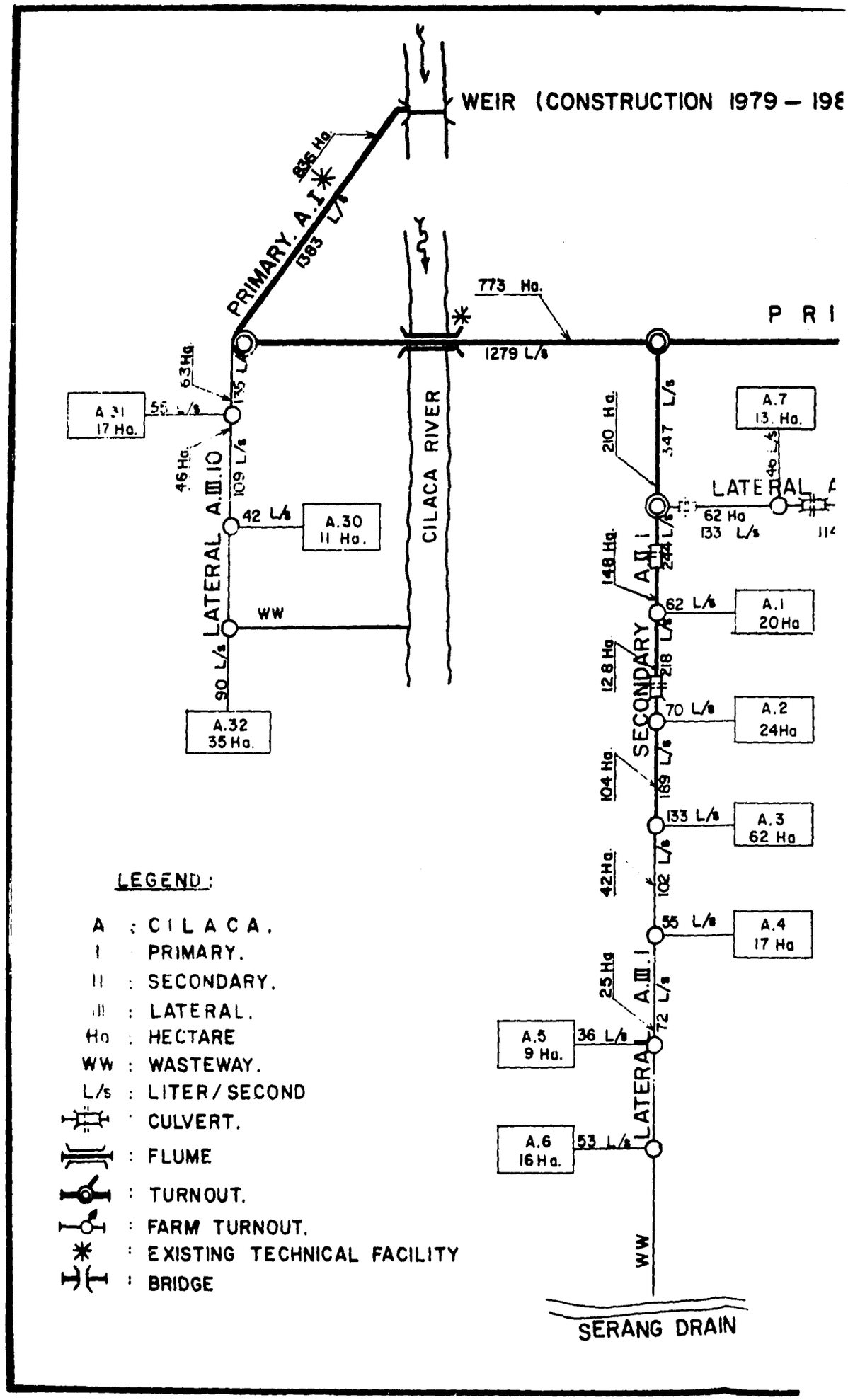
CENTRAL JAVA SYSTEMS

CIJALU IRRIGATION SYSTEM SCHEMATIC LAYOUT

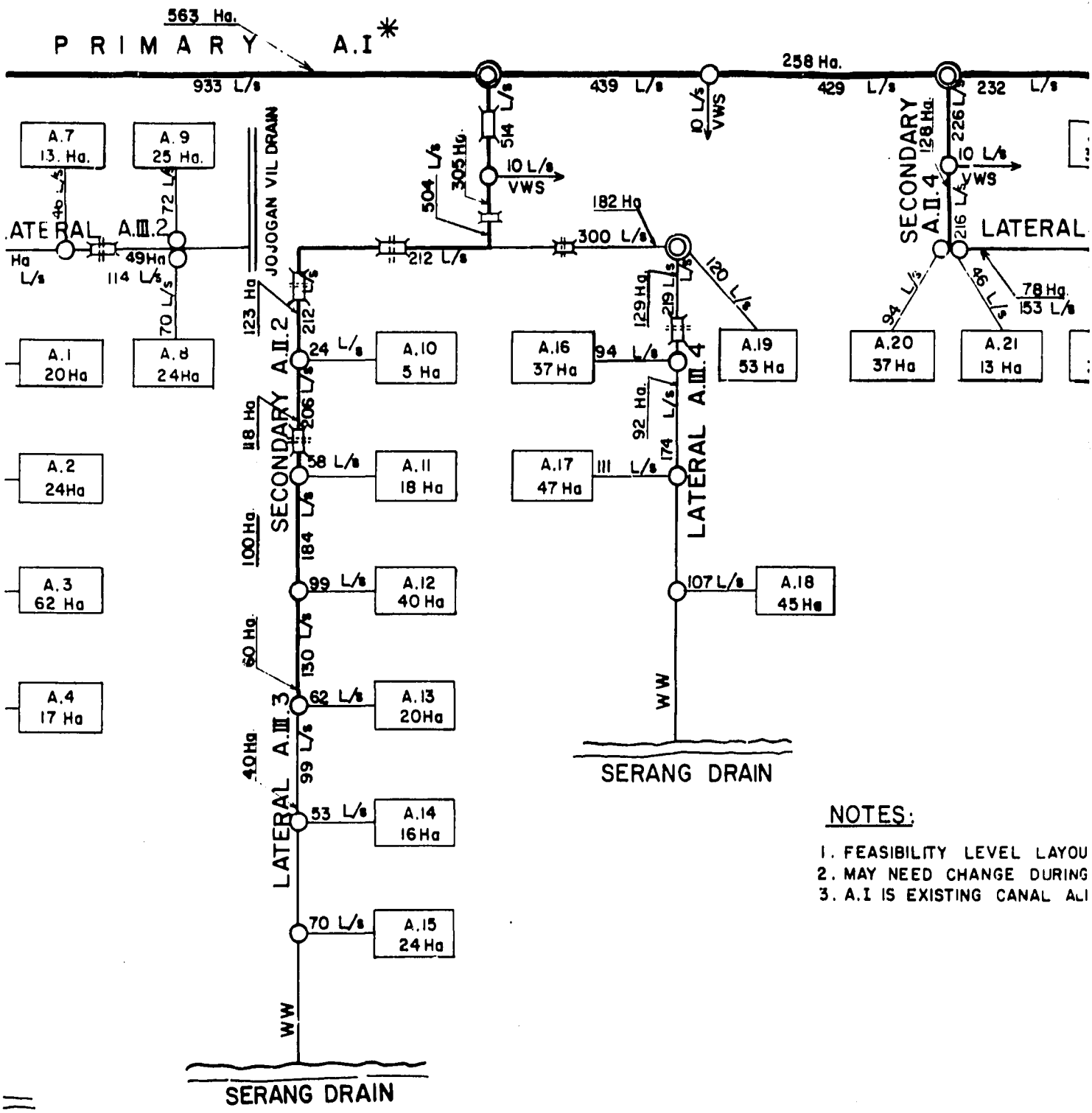
ENGINEERING CONSULTANTS, INC
DENVER COLORADO U.S.A

DRAWN	: IR. DANIEL. A.G	SUBMITTED	: DR. IR. GERARD
TRACED	: SLAMAT. H.	RECOMMENDED	: DR. IR. GERARD
CHECKED	: DR. IR. GERARDS	APPROVED	: DR. KLV. RAMU
DATE	: MAY 1979	DRAWING NUMBER	

85


WEIR (CONSTRUCTION 1979 – 198
PRIMARY. A.I
836 Ha.
1383 L/s
773 Ha.
1279 L/s
CILACA RIVER
63 Ha.
135 L/s
A.31
17 Ha.
46 Ha.
109 L/s
LATERAL A.III.10
42 L/s
A.30
11 Ha.
WW
90 L/s
A.32
35 Ha.
210 Ha.
347 L/s
A.7
13. Ha.
LATERAL
62 Ha
133 L/s
148 Ha.
A.II.1
224 L/s
62 L/s
A.1
20 Ha
SECONDARY
128 Ha.
218 L/s
70 L/s
A.2
24Ha
104 Ha.
189 L/s
133 L/s
A.3
62 Ha
42 Ha.
102 L/s
55 L/s
A.4
17 Ha
25 Ha
A.III.1
72 L/s
A.5
9 Ha.
36 L/s
LATERAL
A.6
16 Ha.
53 L/s
WW
SERANG DRAIN
LEGEND:
A : CILACA.
I : PRIMARY.
II : SECONDARY.
III : LATERAL.
Ha : HECTARE
WW : WASTEWAY.
L/s : LITER/SECOND
CULVERT.
FLUME
TURNOUT.
FARM TURNOUT.
EXISTING TECHNICAL FACILITY
BRIDGE

1979 – 1981)

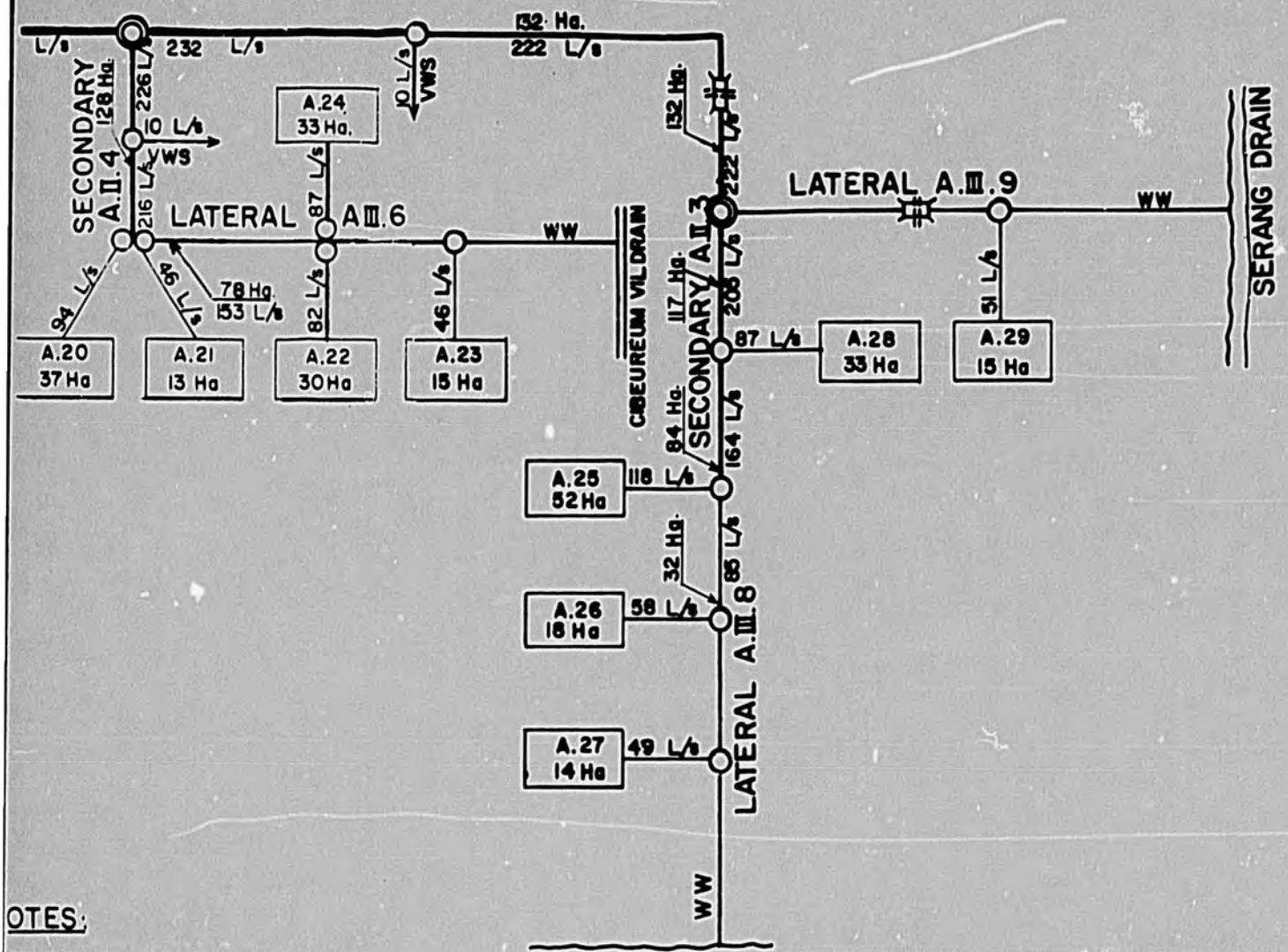


NOTES:

1. FEASIBILITY LEVEL LAYOU
2. MAY NEED CHANGE DURING
3. A.I IS EXISTING CANAL ALI

IN

FIGURE VI - 3



OTES:

EASIBILITY LEVEL LAYOUT.
MAY NEED CHANGE DURING DESIGN
A.I IS EXISTING CANAL ALIGNMENT.

REPUBLIC OF INDONESIA

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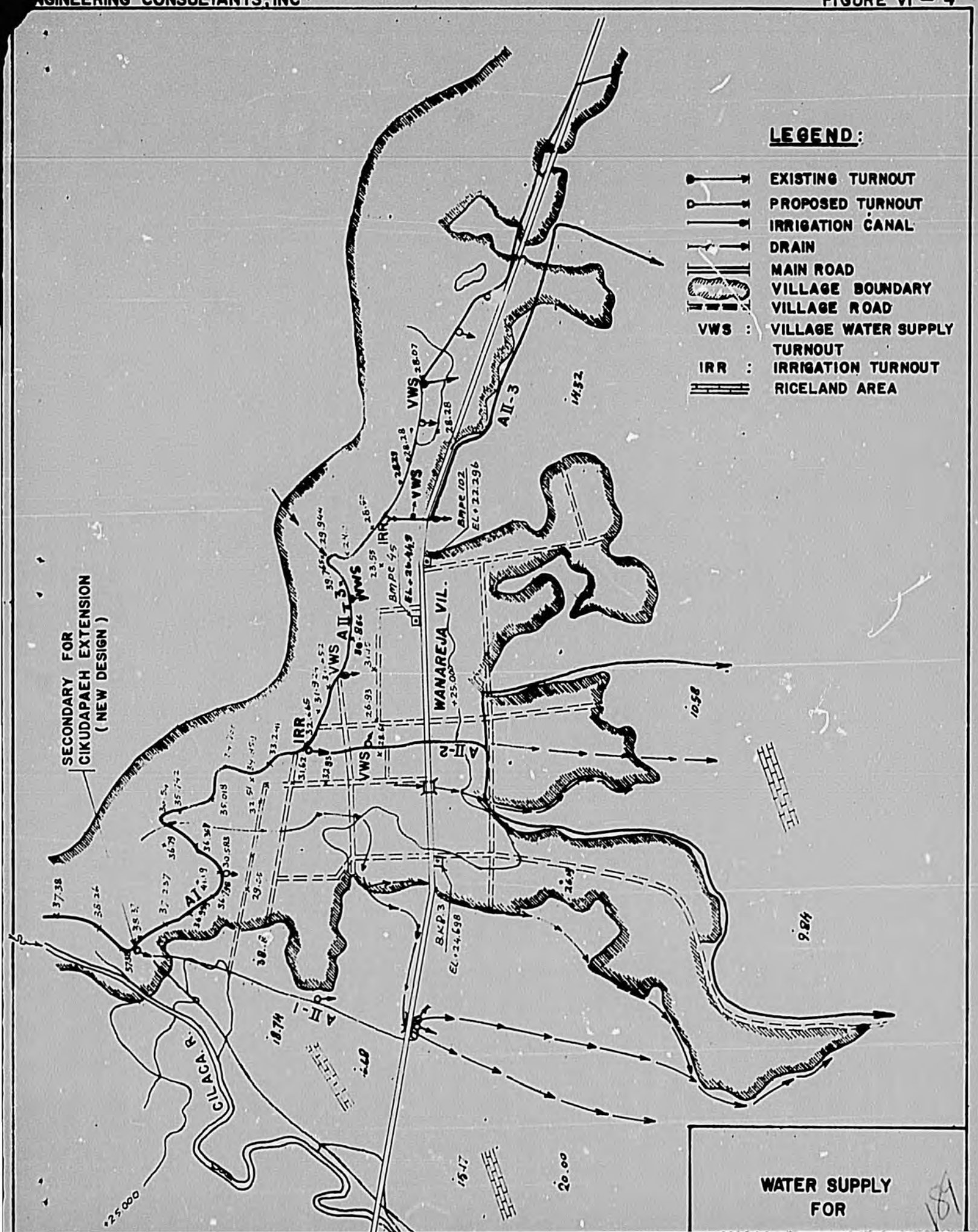
DIRECT GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

CENTRAL JAVA SYSTEMS

CILACA IRRIGATION SYSTEM
SCHEMATIC LAYOUT

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO U.S.A.

DRAWN : IR. SUNDUSIYAH.	SUBMITTED : DR. IR. GERARDS
TRACED : TASWA H.	RECOMMENDED: DR. IR. GERARDS
CHECKED: DR. IR. GERARDS.	APPROVED : DR. KLV RAMU
DATE : MAY 1973	DRAWING No :


LEGEND:
EXISTING TURNOUT
PROPOSED TURNOUT
IRRIGATION CANAL
DRAIN
MAIN ROAD
VILLAGE BOUNDARY
VILLAGE ROAD
VWS : VILLAGE WATER SUPPLY TURNOUT
IRR : IRRIGATION TURNOUT
RICELAND AREA
SECONDARY FOR CIKUDAPAEH EXTENSION (NEW DESIGN)
WANAREJA VIL.
CILACA R.
AII-3
AII-2
AII-1
VWS
IRR
Bmpc 102
EL. + 22.296
Bmpc 45
EL. + 24.698
B.K.P. 3
EL. + 24.698
+25.000
WATER SUPPLY FOR

CHAPTER VII

FLOOD CONTROL PLAN FORMULATION

Introduction

The need for local flood control protection was presented in Chapter II. The existing and the proposed flood control measures will be discussed for each project area separately.

In this chapter the background information and the procedures followed which lead to the proposed flood control measures for the Majenang Project Area are discussed. Also presented are those aspects of the Citanduy River Basin Flood Control Scheme 1/, which relate to the Wanareja Project Area. The proposed flood control measures comprise a significant percentage of the total construction costs for the Majenang Project Area. The Wanareja Project Area will need considerable upgrading of its main drain, the Kaliserang river, in order to discharge accumulated flood waters quickly into the Cikawung, through the newly constructed flapgate.

Implementation of the flood control measures are considered essential for the project benefits to be achieved.

Majenang Project Area and Local Flood Control Works

General

The section on streams and watersheds in Chapter II - described the problems experienced with the Cikawung river and its tributaries upstream of the point where the Cikawung breaks through the range of hills. Floods occur at this point because of (a) the general low elevations of the project lands, (b) insufficient channel capacity of the local rivers, (c) increased water levels in the rivers due to backwater effect from the Citanduy river, when at flood stage.

1/ "Citanduy River Basin Flood Control Scheme, Design Report" by Engineering Consultants, Inc., November 1976.

Rivers and drainage channels are silted up considerably, because during flood stage sediment deposits due to backwater effect, low capacity and reduced velocities in certain reaches. This sedimentation also enlarges the swamp area. Due to this flooding over 300 hectares, mainly at the end of the Cijalu system and a small part of the Cileumeuh system, is almost continuously waterlogged. Only over a prolonged dry period of more than 30 days can most of the water in the area be drained.

Available Information

The available information used in the plan formulation for the flood control measures consisted of the following;

1. Daily Cikawung discharge data at the Cimei gaging station, collected by DPMA, over the period 1969-1977;
2. Gage readings at eight hour interval at Kubangtapen gaging station, operated by Proyek Citanduy, over the period 1974-1979. (gage was damaged during May 1979-floods);
3. Rainfall data for the Majenang area from the Majenang station no. 3, period 1952-1978;
4. 10- and 25-year frequency floods peaks from one day rainfall computed for the Citanduy river at Railroad bridge 1452 in the Master Plan and Flood Control Scheme for Citanduy River Basin;
5. 1:5,000 scale maps for the project area with spot elevations. These were compared with high flood marks and flood observations by local people;
6. 1:25,000 scale maps to determine watershed area and characteristics of tributaries to Cikawung river for hydrograph computations;
7. Observed backflow into Cijalu system from Cilopadang river during flood stage of both Cikawung and Citanduy river.

In addition to this information, the following assumptions were made to arrive at flood design discharges in the concerned rivers;

1. The Snyder method for computation of the river hydrolograph is appropriate;
2. The travel time of the computed peak flow from weir site to station G_E in Figure VII-2 is same for all the rivers;
3. The river has a Manning's n of 0.035 for its channel, and 0.120 for its flood plain.
4. Slope of river bed was approximated from ground surface slope along the river;
5. Reasonable estimates of cross-sections for rivers were made from field reconnaissance (no surveyed cross-sections were available).

Based on the available information and the assumptions, the 1-day rainfall, 10-year frequency hydrographs were computed for the rivers at the weir sites. Table VII-1 provides information for the hydrograph computations. Figure VII-1 presents an overview of the suggested flood improvements. Table VII-2 and Figure VII-2 show detailed information on levee dimensions and flood design discharges.

Quantity estimates and consequent estimated cost for levee construction for the rivers in the Majenang Project Area are presented in Table VI-10 through VI-13 in Chapter VI under Cost Estimates. Table VI-10, VI-11 and VI-12 show the quantities and cost for levee construction, in compacted embankment, hauling of materials, clearing and stripping, sodding and ROW-purchases. A certain percentage of the material needed for compacted embankment can be obtained from excavation in the existing flood plains. However, because no information was available on the suitability and quantity of the flood plain material, all soil for dike construction is assumed to be hauled for cost estimate purposes. Table VI-13 shows the costs for excavation for river levee embankment materials, the estimated costs for the small flapgates and drain inlets with flashboards and the costs for the single-lane bridges over the Cilopadang and Cileumeuh rivers.

The range of discharges through the small flapgates is 0.40 to 6.00 cubic meter per second; the drain inlets with flashboards, chosen for small drains with high bed elevation compared to rivers in which they drain, range in discharge from 0.20 to 3.00 cubic meter per second. One larger flapgate has been identified in the new right levee along the Ciglagah-Cilanggir river, just upstream of the existing bridge in Banjar-Wangon road at Pahonjean village. This flapgate will have 2 gates of 2 by 3 meter and will have a design discharge of 22 cubic meter per second.

Cost of road surfacing is included in the canal cost estimate for each system for future infra-structural improvements. This road surfacing is also necessary to facilitate hauling of embankment material for levee construction.

The flood and drainage problems in the Cijalu or Cileumeuh system will be alleviated only if levees are provided over all the suggested reaches, where hydraulic computations showed a need. Only then can the benefits due to reclamation of present swamps and drainage of other frequent waterlogged areas be expected.

The flood protection provided and the improved drainage anticipated have been the basis for increasing the cropping intensity in wet season from present intensity of 0.85 to 0.95 in future with project. The reduction of five percent in intensity from the full is to account for the flood damage expected from floods with higher than 1-day rainfall, 10-year frequency river discharge. This is also the reason to decrease the cropping intensity in dry season from 0.70 to 0.65 in future with project.

The Wanareja Project Area and the Citanduy Flood Control Scheme

The Cilaca system in the Wanareja Project Area is bounded in the south-west and south-east by respectively the Citanduy and Cikawung rivers, which join just to the south of the Cilaca system. Presently farmer constructed levees provide some protection to the system, but levee overtopping and breaks occur regularly.

As part of the overall Citanduy River Flood Control Scheme (see reference to design report in bibliography), these levees will be raised and upgraded to contain the 1-day rainfall, 25-year frequency flood discharge. However, just south of the Citanduy-Cikawung confluence, bridge 1452 is located over the Citanduy for the crossing of the railroad line connecting Bandung and Yogyakarta. From hydraulic computations and on-site flood discharge measurements, the river discharge capacity under the bridge was estimated at 1,300 cubic meter per second. The design discharge for the Citanduy levees upstream of the bridge was determined to be 2,120 cubic meter per second. Raising of the bridge deck to accomodate the difference between these two discharges was not considered feasible. Thus, it was decided in the design of the Citanduy flood control scheme to temporarily store the excess volume of flood upstream of the railroad bridge. For this purpose, the Wanareja Swamp was selected as a detention basin as this swamp has already served in the past as an uncontrolled flood attenuation basin. Under the new scheme controlled side channel spillway overflow sections were designated in the Citanduy left levee between the confluence of Citanduy-Cijolang and Citanduy-Cikawung, and in the Cikawung right levee before its confluence with the Citanduy. Of these overflow sections, the following will discharge into the Cilaca system service area;

Overflow section	Levee	Station	Max design discharge (m^3/sec)
No. IV	Citanduy left	Km 22 + 290	210
No V	Cikawung right	Km 0 + 394	220
No. IV	Cikawung right	KM 3 + 308	220

The location of the overflow sections is shown in the maps for both the existing and proposed facilities for the Cilaca system, as this flood control scheme is presently being implemented.

Water released from these rivers into the Cilaca system for temporary storage will be drained through the Kali Serang Drainage Channel. This drainage channel outlet is provided with a drainage inlet structure into the Citanduy river. All further information is outlined in the Design Report of the Citanduy Flood Control Scheme.

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This design report presents all the relevant data and reasoning for providing partial flood protection to Wanareja swamp.

Figure VII-3 shows the areas in Wanareja swamp which will be temporarily flooded from the Citanduy under this scheme. Subarea I and II are within the Cilaca system. With the 25-year frequency flood in the Citanduy the volume discharged into the Wanareja Project Area (Cilaca system) is estimated to be 12.5 million cubic meters. The Kali Serang drainage channel has been designed to discharge this volume within 3 days, and for this purpose will have a drainage capacity of 55 cubic meter per second. Water surface elevation due to temporary storage in the area will increase to about + 13.00 msl. The flapgate will open at a head differential of 0.50 meter to pass the flood waters into Citanduy River.

Cost for the channel widening and upgrading of the Kali Serang drain to handle the needed 55 cubic meter per second discharge from present estimated discharge of about 8 cubic meter per second has been provided in the canal cost estimate for the Cilaca system in Table VI-5. The flapgate on the Kali Serang is presently not functioning properly, as 2 of the 4 gates cannot close due to improper counter balance and unfinished steel framework. This should be corrected as soon as possible to prevent backflow into the Cilaca system when Citanduy flow is high. This flapgate structure can accomodate the proposed 55 cubic meter per second design capacity of the Kali Serang drainage channel.

Due to the use of part of the Cilaca system area below elevation + 13.00 meter msl in the future for Citanduy flood water storage, the cropping intensity for future with project has been determined as 0.95 for wet season and 0.65 in dry season. This compares to the maximum cropping intensity in wet season of 1.00 and 0.7 meter dry season, possible from water supply availability viewpoint.

It should be realized that, as stated in the Citanduy Flood Control Scheme Design Report, the partial protection of the Wanareja Swamp will result in a 4 percent chance of flooding each year as against 30 to 35 percent chance of flooding for the 25 year frequency flood.

TABLE VII-1

HYDROGRAPH PARAMETERS AND PEAK DISCHARGE

MAJENANG PROJECT AREA RIVERS

Basin	Area in Km^2	L in Km	Lc in Km	S	Ct	Basin Lag in Hours	3 Hour Unit Graph Peak Discharge m^3/s	Peak Discharge in m^3/s
Cijalu	54	16.75	13.25	0.00313	0.35	6.0	13.8	124
Cilopadang	29	12.50	8.75	0.00400	0.35	4.5	9.4	89
Cileumeuh	95	22.50	11.75	0.00220	0.35	7.0	21.4	200
Cilanggir	52.5	14.1	8.20	0.00100	0.35	5.7	13.4	120
Ciglagah	64.5	17.75	9.20	0.00450	0.35	4.8	20.0	158

TABLE VII-2

LEVEE AND RIVER CHANNEL DIMENSIONS

FLOOD IMPROVEMENT

MAJENANG PROJECT AREA

River	Reach	Capacity (m^3/s)		Bed Width (m)		Flood Plain (m)	(m)		Remarks
		Existing	Future With Levee	Exist	Future	Width	Depth	Slope	
1	2	3	4	5	6	7	8	9	10
Cijalu									0+000 Start from Geblogan village to the confluence with the Cikawung River
$U_A - U_B$	0+000-4+000	89	124	15	16.0	10	4.52	0.00080	
$U_B - U_C$	4+000-6+000	62	124	10	16.0	10	4.50	0.00060	
Cilopadang									
$G_A - G_B$	0+000-0+900	74	89	10	13.5	10	4.00	0.00080	
$G_B - G_C$	0+900-2+700	69	89	12	17.3	10	4.00	0.00050	0+000 Start from Banjar - Wangon road to the confluence with Cilanggir River
$G_C - G_D$	2+700-7+200	266	289	30	30.0	10	4.50	0.00075	
$G_D - G_E$	7+200-8+400	162	289	25	44.0	10	4.50	0.00040	
$G_E - G_F$	8+400-8+800	162	338	40	50.0	10	4.55	0.00040	
Cileumeuh									0+000 Start from the bridge in Benda village to the confluence with Cilopadang River
$H_A - H_B$	0+000-1+000	57	200	19	22.0	10	4.50	0.00080	
$H_B - H_C$	1+000-2+000	57	200	20	23.5	10	4.50	0.00070	
Cilanggir									
$R_A - R_B$	0+000-1+000	6	15	4	10.0	10	2.00	0.00026	0+000 Start from new bridge to the confluence with Cikawung River
$R_B - R_C$	1+000-2+000	9	25	6	16.0	10	2.20	0.00026	
$R_C - R_D$	2+000-2+400	20	49	8	19.0	10	2.95	0.00026	
$R_D - R_E$	2+400-3+400	33	49	10	19.0	10	2.95	0.00026	

Additional Information:
1) Mannings' n - channel = 0.035
   - flood plain = 0.120
2) Topwidth levee embankment - 3.5 m
3) Side slope levee embankment - 2H : 1V

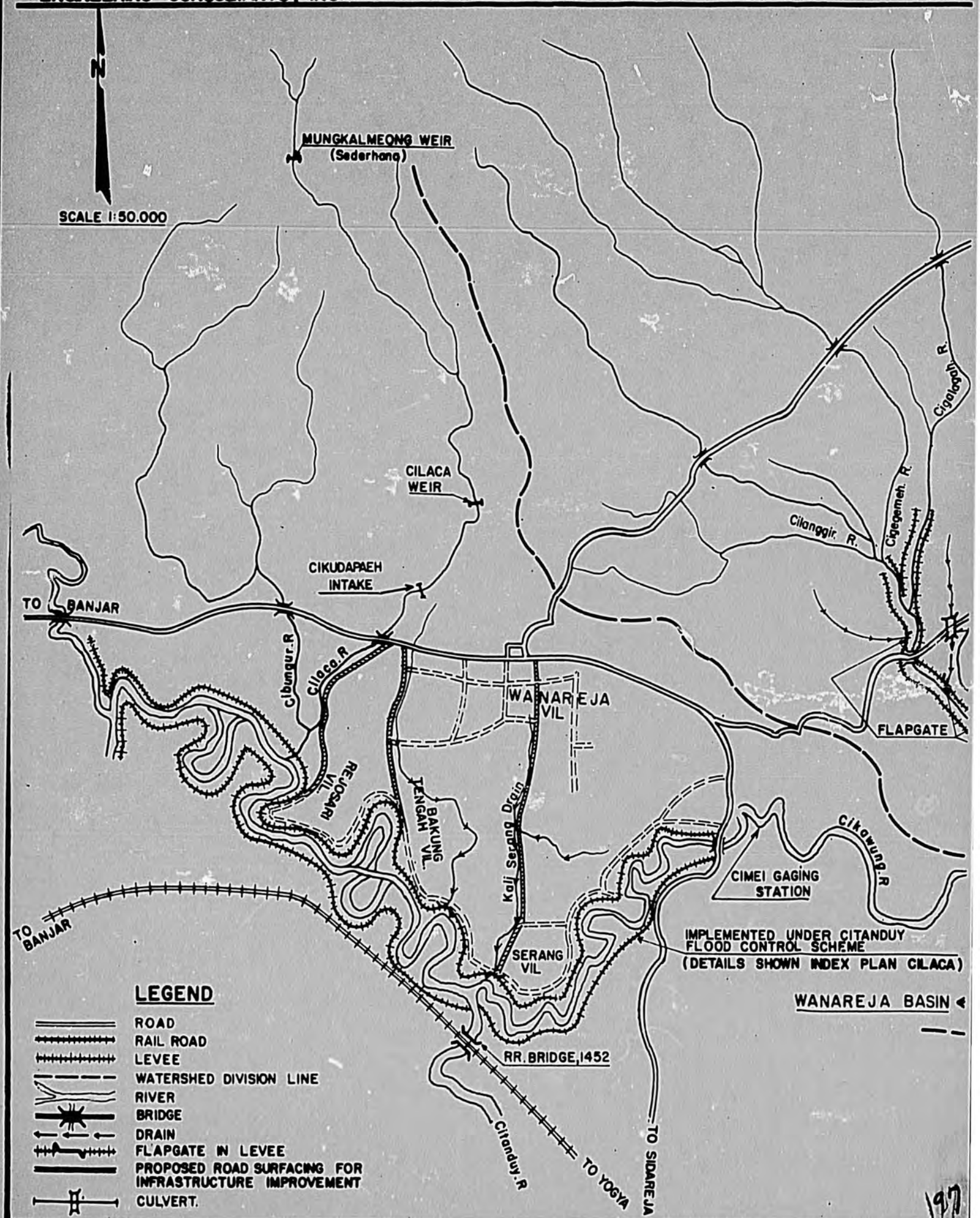
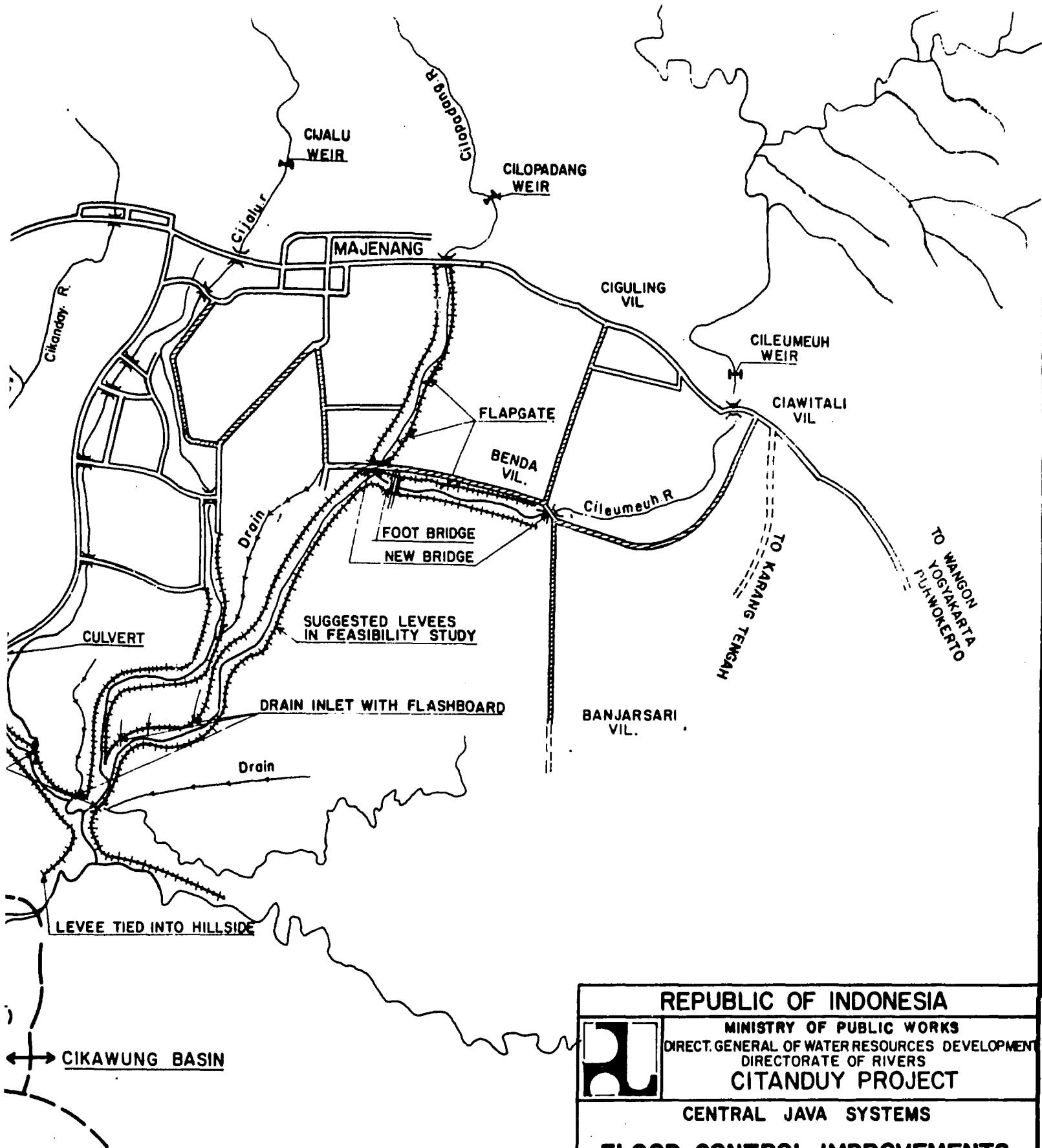

N
SCALE 1:50.000
MUNGKALMEONG WEIR
(Sederhana)
CILACA
WEIR
CIKUDAPAEH
INTAKE
TO BANJAR
Cibungur. R
Cilaca. R
WANAREJA
VIL
REJOSARI
VIL
TENGAH VIL.
BAKUNG
Kali Serang Drain
SERANG
VIL
Cilanggir. R.
Cigegemeh. R.
Cigalogah. R.
FLAPGATE
Cikawung. R
CIMEI GAGING
STATION
IMPLEMENTED UNDER CITANDUY
FLOOD CONTROL SCHEME
(DETAILS SHOWN INDEX PLAN CILACA)
WANAREJA BASIN
TO BANJAR
RR. BRIDGE, 1452
Citanduy. R
TO YOGYA
TO SIDAREJA
LEGEND
ROAD
RAIL ROAD
LEVEE
WATERSHED DIVISION LINE
RIVER
BRIDGE
DRAIN
FLAPGATE IN LEVEE
PROPOSED ROAD SURFACING FOR
INFRASTRUCTURE IMPROVEMENT
CULVERT.

FIGURE VII-1



REPUBLIC OF INDONESIA

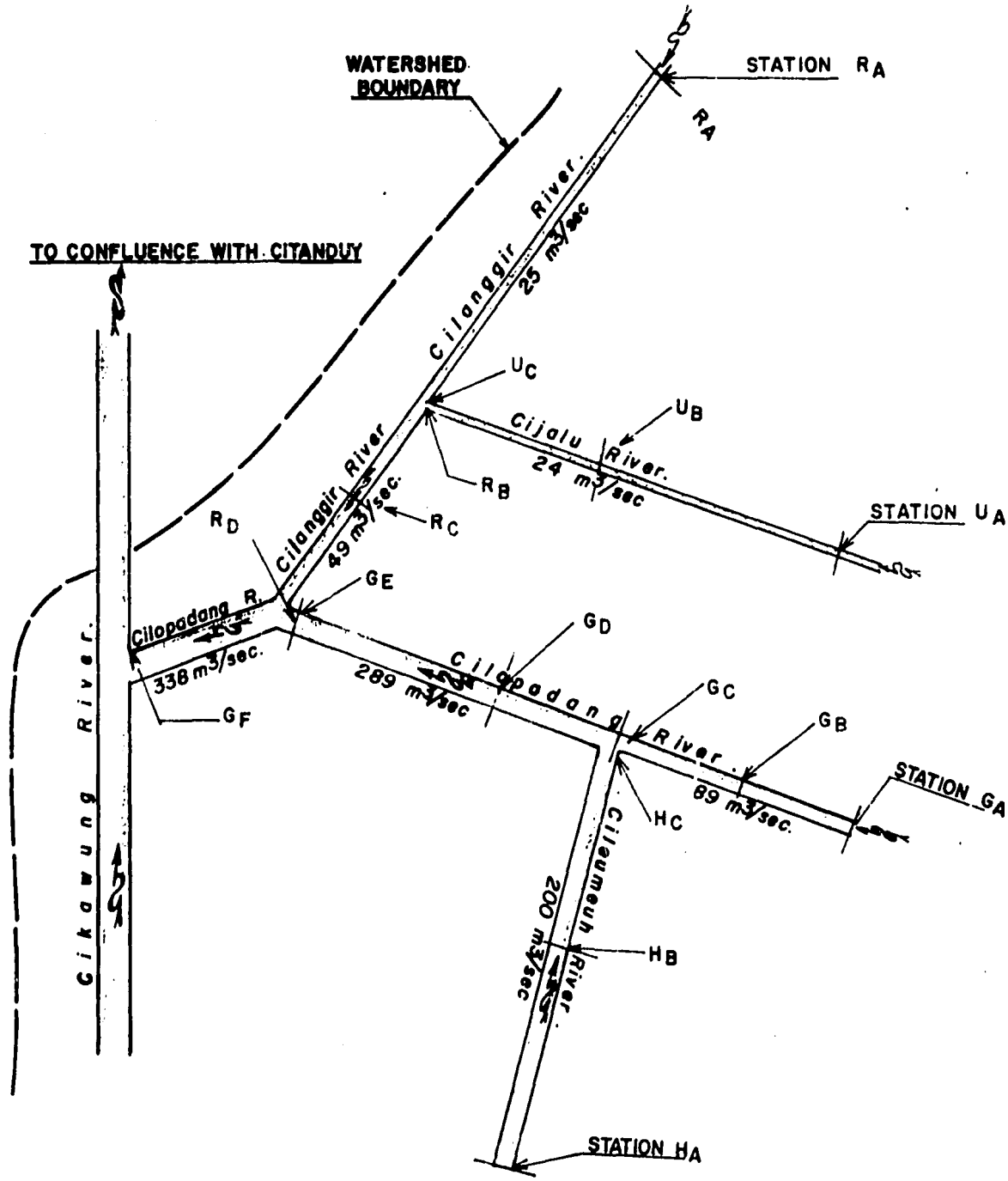
MINISTRY OF PUBLIC WORKS
DIRECT. GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

CENTRAL JAVA SYSTEMS

FLOOD CONTROL IMPROVEMENTS

ENGINEERING CONSULTANTS, INC
DENVER COLORADO U.S.A

DRAWN	: IR. SUNDUSIYAH.	SUBMITTED	: DR. IR. GERARDS.
TRACED	: TASWA. H.	RECOMMENDED	: DR. IR. GERARDS.
CHECKED	: DR. IR. GERARDS	APPROVED	: DR. K.L.V. RAMU.
DATE	: MAY 1979	DRAWING NO	



NOTE:

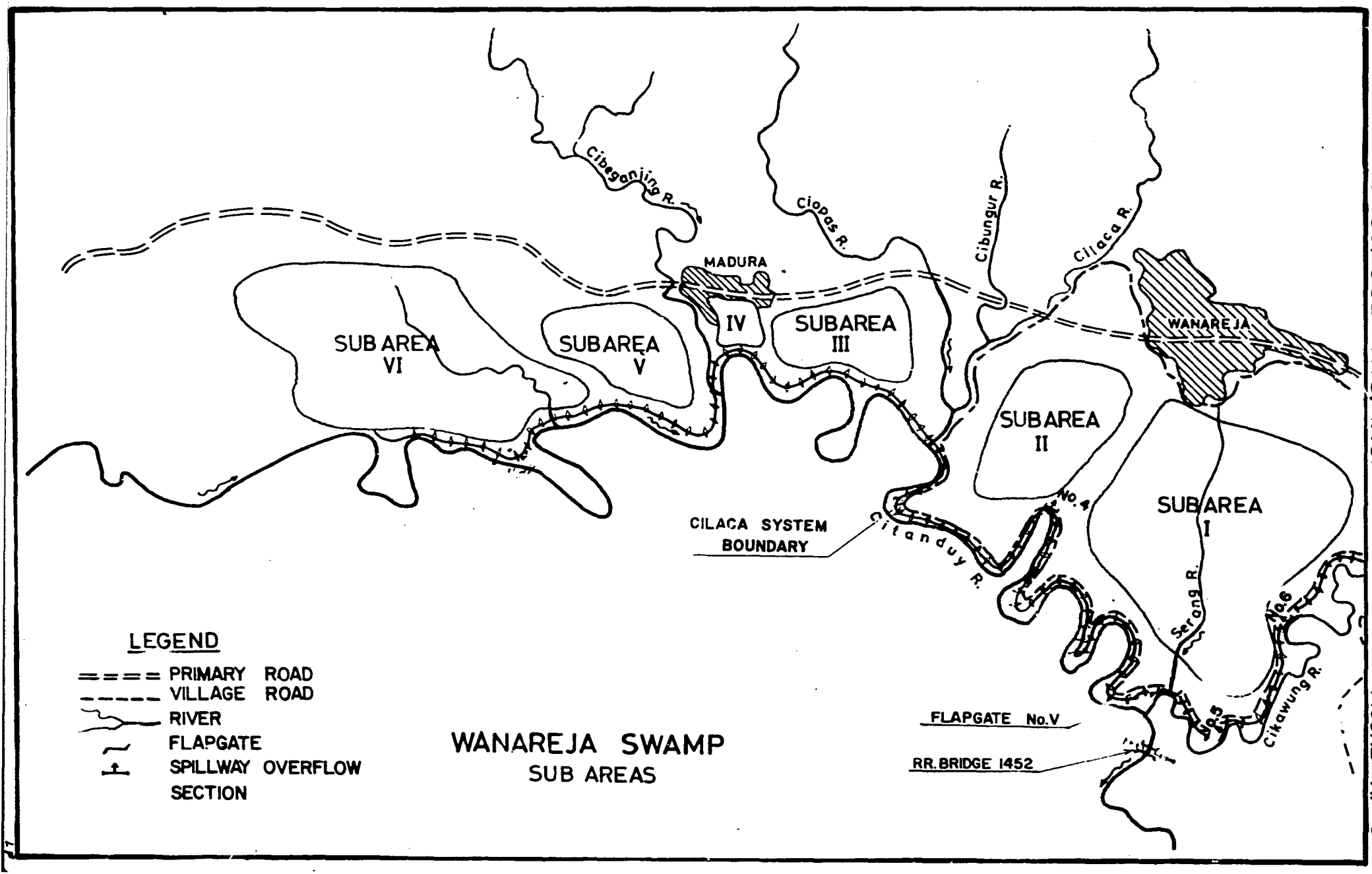
STATIONS COINCIDE
WITH REACHES AS GIVEN IN TABLE VII-2

SCHEMATIC LAYOUT FOR RIVERS

1-DAY RAINFALL, 10-YEAR FREQUENCY

FLOOD DISCHARGE FOR LEVEE IMPROVEMENT

MAJENANG PROYECT AREA



ENGINEERING CONSULTANTS, INC.

FIGURE VII-3

CHAPTER VIII

OPERATION AND MAINTENANCE

Introduction

Project Citanduy, under the Directorate of River, has the assigned responsibility for the design and construction of the civil works for the rehabilitation and improvement 3,792 hectares of wet rice lands identified in the four Central Java Irrigation Systems within the Citanduy River Basin boundary. Project Citanduy will design and construct the technical irrigation and drainage works that will be operated and maintained by the Irrigation Service Section with headquaters at Majonang. The technical irrigation and drainage systems will receive water from 4 existing weirs, convey these waters through primary, secondary, and lateral canals to irrigation blocks of paddy lands that will average 20 to 40 hectares in size. Project Citanduy will also design and construct "on-farm" irrigation and drainage works within the irrigation blocks that will be operated and maintained by the 9 Dharma Tirta Village Water Users Associations, who will be assisted by the Ulu-Ulus representing the 9 village Lurahs, as well as the Agriculture Extension Agents (PPLs) of The Directorate of Food Crops.

Operation and Maintenance

Operation and maintenance of the technical irrigation and drainage works will be tranferred from Project Citanduy to the Irrigation Service Section at Majenang as the construction work is completed, tested, and accepted from the contractor. The Irrigation Section gate operator works with the 9 Village Ulu-Ulus to transmit water through the "on-farm" systems that are also to be constructed by Project Citanduy and operated and maintained by various Ili-Ili employees of the 9 Dharma Tirta Village Water Users Associations.

The Directorate of Food Crops has the assigned responsibility of organizing and training the farmers and forming Dharma Tirta Village Water Users Association Units for the operation and maintenance of each irrigation block and which are further organized into Dharma Tirta Village Irrigation Committees. The Agriculture Extension Agents (PPLs) are responsible for fertility trials, cropping patterns, variety selections, and irrigation water requirements that are approved by the farmers and coordinated with the Irrigation Service Section at Majenang.

Severe erosion problems exist in the upperwatershed on rivers within the project watershed. Both the Directorates of Forestry and Food Crops should be assigned responsibilities to work with the upland farmers in terracing and reforestation to alleviate erosion problems that complicate the irrigation system operation and maintenance work.

The Department of Home Affairs should be assigned the responsibility of coordinating the timely activities of each of these specialist technical agencies, including the planning and preparation of a matrix budget that would insure the successful operation and maintenance functions of the project. It is the recommendation of this report that the Bupati Cilacap be assigned the responsibility of coordinating the various activities through a Coordinating Board that would meet and evaluate reports and data after each harvest and as often as required at other times.

Problems Identified

Operation and maintenance problem areas that need to be identified for further detailed discussion are briefly summarized below.

First. Suspended silt that passes through the sediment traps at the headworks at each primary canal will be transported through the primary and secondary canals and into the lateral canals and the "on-farm" distribution and drainage systems. Sufficient grades and velocities exist in most of the technical systems where siltation will not be a major problem and the burden of silt removal will be the responsibility of the farmers within the various irrigation blocks. Silt storage areas should be included in right of way purchases for construction work.

Second. Operation, maintenance, and replacement of structure components will need full consideration during design for access of necessary equipment and materials. New bridges and road improvements will provide access for light equipment and motorcycle access. Turn-arounds and access ramps on the levees and road system should also be included in the design of the improved road network.

Third. Dharma Tirta Village Water Users Associations must be organized by the Directorate of Food Crops, through their Agriculture Extension Agents (PPLs), well in advace of construction operations. Approximately 15,000 farmers must be prepared to operate within 9 Dharma Tirta Village Water Users Association that will govern approximately 125 irrigation blocks, each of which will average 30 hectares of net farm area.

In addition to training farmers, the Directorate of Food Crops should train the village government officials to understand and assist the independent Dharma Tirta Village Irrigation Committees and the Dharma Tirta Confederation to achieve their objectives. The Dharma Tirta Village Water Users Associations cannot exist and function without the approval and support of the Department of Home Affairs, including the Lurah, the Camat and the Bupati. A informational training cost estimate of the manpower and resources required by the Directorate of Food Crops is presented in Table VIII-8.

The Irrigation Service Section with headquarters in Majenang, must expand its staff with additional personnel well trained in the principles of "on-farm" water management. The Irrigation Service must coordinate their work with the village Ulu-Ulus and the village government structure.

The Directorate of Food Crops and the Irrigation Service training activities should also be funded during the first year of construction.

Fourth. The Bupati Cilacap needs to be the recognized coordinator and financial supervisor for all activities of the technical agencies of the various Directorates involved in the operation and maintenance work for the rehabilitation and improvement for the four Central Java Irrigation System in the Wanareja-Majenang areas.

Funding will, of necessity, come from two sources. The Bupati may collect water use taxes to pay for operation and maintenance costs of this irrigation project and the Bupati should then review and support the supplemental budget requests of the technical services to their Directorate Officers.

Finally. Local officials must feel a sense of responsibility for the goal accomplishment of the project. Local farmers, through the Agriculture Extension Service (PPLs) and the water users associations need to be involved and consulted during the design and construction phases of the work, especially new canal locations with respect to village boundaries. Irrigation or water use taxes must be returned to finance the operation and maintenance work within the project area and to fully staff the Irrigation Service and the Agriculture Extension Service activities. Tenant farmers and absentee owners also impose special problems that require special measures to collect taxes and provide Dharma Tirta labor contributions.

Operation

The duties and inter-related responsibilities of the several technical agencies as related to the four Central Java Systems rehabilitation and improvement project, shown on Figure VIII-1, are described in some additional detail in the following Sections.

Project Citanduy

Project Citanduy, under the Directorate of Rivers will design and construct the civil engineering works of the rehabilitation and improvement work for the four Central Java Irrigation Systems over a three year construction program. As certain phases of the work are completed, there will be an orderly transfer of operation and maintenance from Project Citanduy to the Irrigation Service Section at Majenang for the technical irrigation systems transporting water to the various irrigation blocks that will average about 30 hectares in size.

Also, as the "on-farm" distribution and drainage systems within the 30 hectares irrigation blocks are accepted by Project Citanduy from the contractor, these systems will be transferred to the 9 Dharma Tirta Village Water Users Associations for operation and maintenance.

The Irrigation Service

The Irrigation Service Section with headquarters in Majenang will operate and maintain the technical systems as construction is completed by Project Citanduy. The Irrigation Section gate operator will work with the Village Ulu-Ulu and the Dharma Tirta Ili-Ili to receive irrigation water for the "on-farm" distribution and drainage systems that are to be operated and maintained by the 9 Dharma Tirta Village Water Users Associations. The relationship between the Directorate of Irrigation, the Directorate of Food Crops, and the Department of Home Affairs at several levels of authority is shown on Figure VIII-1.

The Directorate of Food Crops

The Agriculture Extension Service has the assigned responsibility of organizing and training approximately 15,000 farmers who are to be organized into approximately 125 irrigation blocks, each averaging 30 hectares in area. The farmers are to receive training in "on-farm" water management and irrigation efficiency. The farmers will also receive assistance and encouragement in variety selections, fertility trials, and daily irrigation requirements that are balanced with effective rainfall for maximum production within each irrigation block.

The PPL's working with the Village Ulu-Ulus and the Dharma Tirta Ili-Ilis and the water gate operators will be able to assist the Dharma Tirta in estimating and scheduling the irrigation requirements for each crop cycle from land preparation through harvest.

The Dharma Tirta

The Dharma Tirta Village Water Users Association has a typical membership structure and a representative Village Irrigation Committee as shown on Figure VIII-3.

All landowners and tenant farmers are automatically members of one of the 9 Dharma Tirta Village Water Users Associations. The elected leader of each irrigation block is responsible for organizing the membership and representing them to the Dharma Tirta Village Irrigation Committee. The Ili-Ili, traditionally an assistant to the Ulu-Ulu, is now independent of the village government and is both a paid employee of the Dharma Tirta Village Water Users Association and an elected representative of the irrigation block farmers to the Village Irrigation Committee.

The Dharma Tirta Village Irrigation Committee is organized by the block leader and Ili-Ili from each irrigation block. Village officials do not serve on the Dharma Tirta Village Irrigation Committee, but are responsive to the Committee requests for the work of the Ulu-Ulu in scheduling water service to the various irrigation blocks. The Committee would also refer violations of water management rules and regulations to the Lurah for hearings before the Rembug Desa for the levying of fines and sanctions for violations severe enough to warrant police prosecution.

O & M fees or assessments for irrigation block expenses are levied by the Dharma Tirta Village Irrigation Committee, normally a flat fee per member per crop, and usually payable after each harvest. O & M Irrigation Committee fees are separate from government water use charges contained in the IPEDA tax and are entirely controlled by the Committee.

Each elected Dharma Tirta Village Irrigation Committee Chairman and Vice Chairman are also members of the Dharma Tirta Confederation that is to be formed to represent all of the 9 Dharma Tirta Village Water Users Associations in the rehabilitation and improvement project. The Dharma Tirta Confederation would be able to present problems and needs to the Camat and the Bupati Cilacap, and to the District Agriculture Extension Service, the Irrigation Sections at Majenang and Purwokerto,and also to resolve differences that may arise between Dharma Tirta Village Irrigation Committees who may differ over village boundaries, scheduling of water deliveries, and maintenance shutdown of irrigation block distribution and drainage systems.

The elected Chairman and Vice chairman of the Dharma Tirta Confederation are also members of the Coordinating Board of Technical Agencies with the Bupati Cilacap as the Chairman. The Dharma Tirta Confederation members would be fully informed of the area wide administrative problems of the project and able to support the budget requests of the technical agencies.

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Directorate of Forestry

To the extent that the Directorate of Forestry is involved, in an erosion control program of the watershed north and east of the project area, membership is extended to the Bupati Cilacap Coordinating Board.

Irrigation Project Water Management

Water management consists of delivery, application, and disposal functions of an irrigation project. The water management functions of a technical system include diversion, conveyance, regulation, and measurement to provide optimum crop production conditions. Good water management reduces wastage of water, makes allowance for rainfall received, increases irrigation efficiencies, and assures equal distribution to the individual irrigation blocks during periods of short supply.

"On-Farm" Water Management

Proper water management in a irrigation system can only be possible if "on-farm" terminal distribution systems, water measuring devices, and drainage systems are completely installed. This is the stated goal of the Directorate of Rivers in providing for the design, and construction of the "on-farm" distribution systems as well as the technical systems rehabilitation and improvement of the four Central Java Irrigation Systems.

Irrigation efficiency is highest when maximum use is made of effective rainfall to supplement irrigation water requirements for evapotranspiration and deep percolation losses. Rainfall up to 10 centimeters deep can be stored in the rice paddy without harm to the crop before drainage overflow starts.

Optimum water levels in paddy rice vary from 2.5 to 5 centimeters deep and irrigation deficiencies in each block may be calculated through the use of lysemeters located near the turnout of each irrigation block. The Dharma Tirta Ili-Ili can be trained to make these calculations and irrigation changes can be ordered through the Village Ulu-Ulu and the Irrigation Section Canal Tender.

Overall "on-farm" water management also includes credit availability and technical production inputs from the Agricultural Extension Service PPL's such as timely advice on seeds, fertilizers, pesticides, as well as wise irrigation and drainage practices to insure increased rice production.

Personnel

The existing Irrigation Service Section Office at Majenang would continue to operate and maintain the four Central Java System but with an expanded staff to fulfill the greater responsibility that the rehabilitated and improved irrigation project with "on-farm" irrigation and drainage distribution systems will require.

The relationship of the Irrigation Service Authority to other government agencies is shown on Figure VIII-1 and the expanded staff organization of the Majenang Irrigation Section is shown on Figure VIII-2.

Rules and Regulations

Rules and regulations for the Dharma Tirta Water Users Associations should be nearly the same for all associations in Central Java, being modified only within a uniform policy approved by the Governor. The following suggested rules and regulations are extracts from proceedures established for the Blimbing area of Central Java and recorded by Mr. Soekotjo Harmony, Dinas Pertanian Rakyat, Propinsi Jawa Tengah in May, 1977. Mr. Soekotjo's report is presented in the appendix volume to this report for ready reference for those concerned who will prepare a complete set of rules and regulations for the operation and maintenance of the four Central Java Systems.

The rules and regulations, as adopted, should be uniformly considered, discussed, and approved within each village through full participation and majority approval of all members.

Proposed rules and regulations for the 9 Dharma Tirta Village Water Users Associations should contain the following elements and principles:

1. Fair and equal distribution of all irrigation water available according to public and published procedures known to all. The Ulu-Ulu and the various Ili-Ili must be free from undue influences and pressure to vary from established rules and regulations.

   Each farmer member should be trained in water measurement methods and devices such as weirs, flumes, and rated sections so that he can observe and verify the fairness of water distribution within his particular irrigation block.

2. Maintenance and repairs to the "on-farm" irrigation and drainage systems within the irrigation blocks are the responsibility of each group of farmers within that area. Procedures are to be defined and contributions made in the form of either money or labor. Cash contributions from absentee owners and tenant sharecroppers must be collected in advance and expenditures credited to their account. The construction of new ditches, or additional structures, or modifying the existing system may also be desirable with the same procedures to secure equal participation of all members either through cash donations or Gotong Royong labor.

3. An assessment shall be made upon each member of the Dharma Tirta Water Users Associations after each harvest, payable either in rice or in cash to provide an operating budget for each irrigation block with additional assessments for the Dharma Tirta Village Irrigation Committee and the Dharma Tirta Confederation. Assessments are established after budget deliberations and agreements reached in open membership meetings.

   Additional assessments may be levied to provide funds for a cooperative loan fund for the credit needs of members for seed, fertilizer, and pesticides and other emergency needs of the members.

Most of the routine expenses may be met through assessments of about 10 kilograms of dry paddy rice in the wet season and 15 kilograms of dry paddy rice in the dry season, per member.

In case of extra expenses to repair or replace some structures or measuring devices or provide for other emergencies, the farmers have been willing to assess themselves as much as 100 kilograms of dry paddy rice per hectare per season in order to speed up the completion of needed improvements. Each ownership plot should have a water measuring device such as a weir or a flume to insure the equal distribution of water. The maintenance and replacement of these measuring devices is the responsibility of the Ili-Ili for the irrigation blocks and are the property of the water users association rather than individual ownership.

4. Some form of discipline must be agreed upon by the members to enforce the rules and regulations and provide penalties for infractions such as:

    1. Stealing water or disturbing the irrigation diversions.
    2. Damaging legumes planted along the ditch banks.
    3. Trespass or damage another field or crops.

Some recommended penalties include:

    1. The first trespass will result in a warning.
    2. The second trespass will result in a fine, as much as ten times the value of the damage, and in case of taking water out of turn the result will be a delay in rotation up to 10 days.
    3. The third trespass will be brought to the Village Irrigation Committee session for appropriate action that may include denial of water for the rest of the year or referral to the Rembug Desa for trial and police prosecution.

Water Rights

A special problem exists between the diversion rights of the Mungkalmeong Weir and the Cilaca Weir at Wanareja. A clear division of water rights diversions should be written into the rules and regulations that will identify and protect the prior right downstream needs of the Wanareja system from diversions made upstream on the Cilaca River by the newly constructed Mungkalmeong Sederhana Project. This problem will become very acute during periods of low flow during the dry season and when there is an interuption of the Wanareja Village water supply. The prior use of the Cilaca irrigation system and the Wanareja Village water supply should be protected with accurate measuring devices at both the Mungkalmeong and the Cilaca Weirs, and the authority of the Irrigation Service Section at Majenang should be established to make the necessary diversion regulations at the Mungkalmeong Sederhana Weir.

Maintenance

General

Continuing maintenance for the four Central Java Irrigation Systems, after rehabilitation and improvement to civil engineering works has been completed by Project Citanduy, will be the responsibility of the Irrigation Section with headquarters at Majenang. When construction activities are completed the Irrigation Service will assume responsibility for flood warning and cooperate and assist Project Citanduy in the maintenance of flood protection levees on the Cikawung River.

The 9 Dharma Tirta Village Water Users Associations will maintain the "on-farm" irrigation and drainage systems within the irrigation blocks. The Dharma Tirta Confederation will establish policy for the 9 member village Associations, approve rules and regulations, and arbitrate problems with the Irrigation Service and other technical agencies before they come to the Coordinating Board of the Bupati Cilacap.

Some light construction and transportation equipment has been provided for the maintenance section as listed in Table VIII-3. Project Citanduy will maintain a heavy equipment pool at Pataruman near Banjar in West Java that may be made available to the Irrigation Service Section at Majenang at the prevailing equipment rental rates for work beyond the scope of local capabilities.

Emphasis has been placed on the utilization of hand labor for repairing and maintaining canals, drains, structures, and roads. This has the added advantage of using local labor and their identification with the irrigation system, better control of grades, and reduction in the cost of equipment use. Approximately 40 additional seasonal laborers may be required in addition to the recommended permanen staff shown in Table VIII-4.

Road Maintenance

The rehabilitation and improvement work for the four Central Java Irrigation Systems will improve the existing road system within the area through road surfacing and new bridges in the Majenang area. Generally, the existing road net works parallel the existing primary and secondary canals and no new roadway construction is necessary. However, 32.2 kilometers of new river levees will be constructed with one lane roadways on the top of the levee bank that will be included in the overall O & M program of the Irrigation Section.

Improved roadways and new bridges should be constructed to Bina Marga standards, and, when they are completed, returned to the Directorate General of Highways for maintenance for general public use.

Structure Repairs

Routine structure maintenance will consist mainly of gate maintenance, gate replacement, rip-rap replacement, and masonry repairs to structure transitions and canal lining as well as painting of structures where required. Gate maintenance will consist mainly of greasing the moving parts of gates and inspection for cavitation and corrosion. All gates should be fully operated at regular intervals to flush out accumulated debris and silt and to check water tightness of closure. This work is normally conducted by the gate operator with maintenance assistance on call for replacement or painting for protection against rust and corrosion.

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Stoplog maintenance can be a problem in areas where there is a firewood shortage. Stoplogs should be marked, inventoried, a secure storage place provided near the structure and a system of accountability established with the canal tender for replacement when needed.

It should be noted that the improvement work and the new areas added to the four Central Java Systems will add 585 new structures to the system where only 68 structures exist under the present system. This will increase the burden of both operation and maintenance to the Irrigation Section and will require an increased budget for personnel and materials to accomplish this new work load.

Sediment Removal

Small desilting basins have been constructed near the weir headgate of each of the existing systems. These sediment basins are designed to be cleaned by flushing the sediment back into the river below the diversion weir. A regular cleaning schedule should be included in the O & M work plan and hand labor utilized while irrigation is in progress, so that diversions are increased to compensate for flushed water returned to the river.

A sampling program to determine particle size in suspension should be conducted throughout the irrigation and drainage system to estimate silt removal. Canal design velocities are slow and sedimentation may occur throughout the technical irrigation system and the "on-farm" distribution systems to varying degrees. Seasonal hand labor will be used for silt removal from the technical systems and cooperative efforts of the farmers will be needed for silt removal from "on-farm" ditches within the irrigation blocks.

Areas for silt disposal from future canal cleaning operations should be estimated and acquired during property purchasing for construction and defended from farmer enroachment and planting. An agressive program of erosion control in the upper watershed areas will reduce costs for sediment removal within the irrigation system areas.

Flood Control Levees and Flood Warning

Twenty five year flood protection to the various kompongs, villages and irrigated areas will be provided by the construction of 33.2 kilometers of levees within the project area. As this new protection is provided, the levees must be patrolled in times of flooding so that property and crops are protected. As drainage is improved and new areas developed, the value of the new improvements must be defended by a system organized from within the Dharma Tirta Associations ans supported by skills and materials from the Irrigation Service Section at Majenang. The Irrigation Section may call upon Project Citanduy for support and assistance in the event of an emergency. The Irrigation Section should maintain close contact with Project Citanduy for rainfall-runoff data on the Cikawung River that will relate to flood danger within the irrigation project area.

The Irrigation Service Section at Majenang should, as the level of danger increases, plan the following activities:

1. Activate a flood watch communications center
2. Notify the Camat Majenang
3. Communicate with the Kepala Desa for each of the 9 Villages in the project area and arrange for reports from the Desa levee patrols.
4. Mobilize special equipment, materials and work forces for immediate repairs of reported leaks in the levee systems.
5. Assist the Camat and Kepala Desas in evacuation, property protection and loss of life prevention in the local populations.

Maintenance by the Dharma Tirta

The maintenance of the "on-farm" irrigation and drainage system within the irrigation blocks is the responsibility of each of the 9 Dharma Tirta Village Water Users Associations. This work will require on-going advice by the Agriculture Service PPL's after operation of the system has begun. One problem that contributes to neglected maintenance is related to the different cropping cycles of individual farmers within the irrigation blocks. Wet and dry season cropping cycles are usually not well defined, and crops tend to be planted continuously

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throughout the year. As a result, the "on-farm" ditch closures for maintenance is often complicated and not always completed. The PPLs can help resolve this matter by promoting the planting of similar varieties at nearly the same time.

The Irrigation Service gate operator should, from time to time, inspect the condition of the irrigation block distribution system for state of maintenance. Neglected maintenance, first apparent through inability to receive design irrigation flows as measured at the farm turnout, should first be discussed with the Ulu-Ulu and the Dharma Tirta Village Irrigation Committee by the Irrigation Service Canal Inspector. Where corrective action is not taken within an agreed time, a written notice and citatation is issued according to established rules and regulations; the irrigation supply should be shut off at the farm turnout until suitable corrective work has been completed.

Training Program - Irrigation Service

All personnel should receive as much continuing education as possible. Each supervisor should be responsible for training his subordinates in job related skills and discussions of related experiences. Official policies established by the Section Chief should be understood by all employees. Rules and regulations, approved by the Department of Public Works and published by the Provincial Section of the Irrigation Service, should be well known and the relationship of each employee to counterpart staff in other agencies should be well established.

Employees should be given every opportunity and encouraged to upgrade their skills and quality for promotions or transfers to other positions within the Irrigation Service.

O & M Equipment

Selection

Minimum transportation in the form of jeeps, pick-up trucks, motorcycles, and bicycles have been provided in a descending order of supervisory responsibility. A telephone system has also been provided for supplemental supervision and control

of operations and maintenance work, maintaining contact between the Majenang headquarters, weir sites and other key locations and diversion points within the system of irrigation and drainage works.

Equipment has been provided for a small maintenance and service shop capable of third echelon maintenance work for light equipment. The Irrigation Section at Majenang would be supported in other maintenance requirements by Proyek Citanduy from their maintenance center at Pataruman, near Banjar. Where equipment needs exceed Irrigation Section capability, Project Citanduy equipment is available at standard rental rates published in the P.5, Edisi I, PEDOMAN POKOK PELAKSAAN PEKERJAAN DENGAN MENGGUNAKAN PERALATAN by the Directorate Jenderal Pengairan, 3 December 1977. Further training guidance is also published in P.4, Edisi I, PEDOMAN POKOK PEMELIHARAAN PERLATAN by the Directorate Jenderal Pengairan, December 3, 1977.

Procurement

Bid procedures for equipment procurement will be expedited by the use of equipment standards and specifications already used by the Directorate of Rivers in the purchase of similar equipment for the Citanduy Project 4th and 5th Echelon Maintenance Headquarters at Pataruman.

The administrative time factor within the various government offices for equipment procurement is of critical importance. Listed equipment can probably be purchased, delivered to Majenang, and become fully operational within a 16 to 24 month period, based upon experience and existing administrative, logistical and financial policies and procedures in Jakarta.

Personnel

Personnel requirements for the improved and expanded irrigation project are shown on Figure VIII-2. Maintenance crews will perform their many maintenance duties and respond to emergencies as required.

Operation, Maintenance and Replacement Costs

Cost tabulations presented in Table VIII-1 summarize the information found in six following tables VIII-2 to VIII-7 related to operations, maintenance, and replacement costs for the four Central Java Systems rehabilitation and improvement work.

O & M & R expenditures in each of the four following categories are assumed to occur one year after the start of construction and increase at the same rate established for the construction program over a three year period: 20 percent, 45 percent and 35 percent of the total annual O & M costs estimated for this irrigation project.

The O & M & R costs are grouped into four categories: (1) Equipment, (2) Management and Labor, (3) Buildings and Grounds, and (4) Materials.

Equipment

Based upon an estimate of a revised and expanded method of operation and maintenance of the rehabilitated and improved four Central Java Irrigation Systems, a minimum equipment list shown in Tables VIII-2 and VIII-3 has been provided to assist the Irrigation Section in Majenang to fulfill many new responsibilities.

Some equipment rental has been estimated from the Citanduy Project, and some new equipment has been listed for purchase.

A ten year life is assumed for most equipment, with a 5 year life for some construction and communication equipment, with zero salvage value. However, with prudent care, the useful equipment life may be extended to 15 or 20 years with only normal overhaul and necessary spare parts replacement. Ownership of this equipment is essential to respond to emergencies and to limit crop damage. Rented equipment, for silt removal in the river channels, can be scheduled when equipment is available from Project Citanduy.

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The annual equipment operating cost is based on hourly charges that provide funds for fuel and lube expenses, overhauls as required, and spare parts replacement and inventory stock.

The annual depreciation cost is intended to replace equipment at the end of its useful service life and thus provide funds for perpetual ownership.

Annual budget funds for operations and depreciation costs should be placed in a sinking fund and allowed to accumulate each year until funds on deposit are adequate for equipment replacement, equipment repair, and spare parts replacement.

Total First Cost of Equipment

US $	227,400
Million Rupiahs	142.12

Total Annual O & M & R Cost of Equipment

US $	48,585
Million Rupiahs	30.37

Management and Labor

The proposed organization for the improved and rehabilitated four Central Java Systems is shown on Figure VIII-2 and cost extensions are shown in Table VIII-4. A total of 93 employees is recommended to responsibly operate and maintain this expanded and rehabilitated irrigation project of identified 3,792 hectares. Additional seasonal, temporary help will be required on an as needed basis for intensive labor required for weeding, grass cutting, and silt removal in canals that are inaccessable to equipment. This intensive labor may be contracted with the Dharma Tirta Village Water Users Associations near the place of work.

Slightly higher than prevailing wages are recommended to recruit the best labor available and to protect the training investment in personnel with a low turnover rate. All of the permanent staff need to be decision makers within their assigned responsibilities. This delegated trust and independent responsibility requires a high degree of intelligence and faithfull performance of assigned duties that justifies a higher salary.

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Total Annual Cost Management and Labor

US $	$ 61,987
Million Rupiahs	38.74

Buildings and Grounds

No new buildings have been provided under this expanded irrigation project for the four Central Java Systems. Budget funds have been provided, however, for the maintenance upkeep and small improvements for existing administrative, garage and storage buildings. An annual sum of 1,300,000 Rupiah has been provided for this purpose, with 600,000 Rupiah expended every 5 years (3,000,000) for minor repairs and 700,000 Rupiahs expended every 25 years (17,500,000) for major building repairs or renovations.

Total Annual Cost

US $	2,080
Million Rupiahs	1.30

Expended 5 years

US $	4,800
Million Rupiahs	3.00

Expended 25 years

US $	28,000
Million Rupiahs	17.50

Materials.

The estimated First Cost of the O & M & R materials listed in Table VIII-5 is scheduled, for purchase of capital outlay items over a 3 year period, as previously described, in 20 percent, 45 percent and 35 percent increment one year following the start of the scheduled construction work.

Thereafter, the Percent Annual Use column of Table VIII-5 reflects the materials cost required to sustain an annual replacement program for structures and components of structures, buildings,and road repairs in accord with the estimated life of the expendable assets of the irrigation project.

Operations, Maintenance, and Replacement Cost Stream

Each of the cost items previously described have been prorated on a hectarage ratio basis between the Majenang Project Area (2954/3792) and the Wanareja Project Area (838/3792) and listed in Tables VIII-6 and VIII-7 under the years of scheduled expenditure over the 50 year life of the project.

Budget for Training

An information budget for a training program to be conducted by the Directorate of Food Crops Agriculture Extension Service (PPLs) to organize and train the more than 15,000 farmers in 9 Dharma Tirta Village Water Users Associations is presented in Table VIII-8.

It is estimated that a PPL team of 17 men will be able to train 500 farmers per year and over a 3 year period 10 PPL training teams will be required. The estimated sum of Rp. 206,745,000 (US $ 330,792) is an annual sum necessary each year for the recommended 3 year program.

The 10 PPL teams should work through the Village Government Structure and utilize the assistance of the Camat and the Lurah and other village officials. The irrigation block farmers should be organized within the 9 Dharma Tirta Village Water Users Associations and trained to relate to the Village Government structure as shown on Figure VIII-3.

The budget estimate for the PPL training effort has not been included in the cost estimates for the four Central Java Irrigation Systems Rehabilitation and Improvement Project. Neither have the costs for the operation expenses of the 15,000 farmers operating through 125 irrigation blocks and 9 Dharma Tirta Village Water Users Associations and the One Dharma Tirta Confederation Committee been included in cost data evaluations of this report. The training costs will terminate

at the end of the 3 year start up period, and the normal staffing of one PPL and two Assistants to work with each of the 9 Village Agricultural Representatives (Pamong Tani) will continue.

The PPL training program for the farmers must be started in the irrigation project in advance, or at least concurrent with, the construction program. Some confusion should be anticipated in the transition from a rural irrigation system to a technical irrigation system including the intense construction activity, disruptions to previous routines, and the intensive training program necessary to operate the irrigation project efficiently as the phased construction work is completed. This transition will be accomplished through the best efforts of many people who must cooperate throughout this time of change and intense management activity.

Conclusions for Operation and Maintenance

1. Project Citanduy, under the Directorate of Rivers, is assigned to design, and the civil engineering works for the rehabilitation and improvement of the four Central Java Irrigation Systems. Project Citanduy will also provide limited maintenance work until the construction work has been completed, accepted from the contractor, and transfered to the Irrigation Service for operation and maintenance.

   In a like manner, Project Citanduy will also transfer the newly constructed "on-farm" distribution systems for operation and maintenance to the 9 Dharma Tirta Village Water Users Associations that have been organized and trained by the Agriculture Extension Service.

2. The importance of establishing a working relationship and close coordination between the various government agencies cannot be over emphasized. Rules and regulations, established by higher authority and understood and accepted by all concerned, must relate to and serve the farmer on his farm.

3. The importance of advanced training is obvious. The implementation of water use taxes and an understanding of the duties and responsibilities of each involved individual, together with approved rules and regulations, is dependent upon a good and timely training program.

4. O & M financing for the Irrigation Service and the PPL program for the Agriculture Extension Service for the Directorate of Food Crops are most important to the overall success of the project. The Bupati should review budget preparations and endorse budget justifications with counterpart officials of both the Irrigation Service and the Agriculture Service. Water service charges required to fully support the budget requirements for both the Irrigation Service and the Agriculture Extension Service should be collected by the Bupati and returned to the services to supplement their budgets.

Recommendations for Operation and Maintenance

1. This report recommends the annual sum of Rp. 20,100 per hectare for the O & M budget required for the Irrigation Service to fully operate and maintain the primary, secondary, and lateral canals and related drainage systems of the four Central Java Irrigation Systems. This cost has been included in the O & M & R cost-benefit evaluations of this report.

   The O & M costs for the "on-farm" distribution and drainage systems will also require annual expenditures through the 9 Dharma Tirta Village Water Users Associations. It is assumed that the Dharma Tirta would be self supporting through budget assessments established, collected, and administered by each Dharma Tirta Village Irrigation Committee.

   The Agriculture Extension Service (PPL's) will also require budget funds committed for the extensive training and administrative expenses related to the Dharma Tirta activities from water use charges collected and administered by the Bupati Cilacap. These additional costs for the Dharma Tirta and the PPL expenses have not been included in the cost-benefit considerations of this report.

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Before the annual water charge has been established, the cost should be presented to the farmers through the 9 Dharma Tirta Village Irrigation Committees for discussion and approval. Again, it is important for the farmers to be involved in the budget processes and to have some representative voice in decisions that will provide benefits through increased crop production.

2. The training programs, to implement and operate this irrigation project, are vital to the successful achievement of project benefits and must be fully planned and fully financed. The full training program will involve more than 15,000 farmers and will require the best efforts of many PPL teachers.

   A combined training program should also include representatives from the Irrigation Service and the village administrative staff along with the Dharma Tirta farmer training so that a spirit of team work is established for future cooperation.

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TABLE VIII-1

FIRST COST AND ANNUAL BUDGET SUMMARY

OPERATIONS, MAINTENANCE AND REPLACEMENT COSTS 1/

Item	First Cost US $	Annual Depr. Cost US $	Annual Operations Cost US $	Total Annual O&M Cost US $	First Cost Million Rp.	Annual Depr. Cost Million Rp.	Annual Operations Cost Million Rp.	Total Annual O & M Cost Million Rp.
Equipment	227,400	23,940	24,645	48,585	142.125	14.962	15.403	30.366
Management and Labor	63,254		63,254	63,254	39.534		39.534	39.534
Buildings and Grounds		2,080		2,080		1.300		1.300 3/
Materials	24,280		10,360	10,360	15.175		6.475	6.475
Total 2/	314,934	26,020	98,259	124,279	196.834	16.262	61.412	77.675

First O&M&R Cost Per Hectare

$ $\frac{314,934}{3,792\text{ha}}$ = $ 83.05/ha Rp. $\frac{196.834}{3,792\text{ha}}$ = Rp. 51,907/ha

Annual O&M&R Cost Per Hectare

$ $\frac{124,279}{3,792\text{ ha}}$ = $ 32.77/ha Rp. $\frac{77,675}{3,792\text{ha}}$ = Rp. 20,484/ha

1/ January, 1979 Prices adusted for devaluation Rp. 625/415.
2/ Initial Cost Allocations 20-45-35% of total starting one year after construction. and prorated between Majenang and Wanareja 78-22% of total and posted in Tables 6 and 7.
3/ 1,300,000Rp. for maintenance of existing buildings annually-600,000Rp./Yr./5yrs. and 700,000 Rp/Yr./25yrs.

TABLE VIII-2

O & M EQUIPMENT

COST SUMMARY

Item	Total First Cost US $	Annual Depr. Cost US $	Annual Opr. Cost US $	Total Annual O&M Cost US $	Total First Cost Million Rp.	Annual Depr. Cost Million Rp.	Annual Opr. Cost Million Rp.	Total Annual O&M Cost Million Rp.
Heavy Equipment	114,000	11,400	9,875	21,275	71.250	7.125	6.172	13.297
Transportation Equipment	66,400	6,640	13,220	19,860	41.500	4.150	8.262	12.413
Construction Equipment	18,000	2,850	1,550	4,400	11.250	1.781	0.969	2.750
Service	25,000	2,500	-	2,500	15.625	1.562	-	1.562
Communication Equipment	4,000	550	-	550	2.500	0.344	-	0.344
Total	227,400	23,940	24,645	48,585	142.125	14.962	15.403	30.366

TABLE VIII-3

O&M EQUIPMENT COSTS

Item	Capacity	Number	Unit Price US $	Total Cost US $	Annual Cost US $	Est Annual Hours Operations	Hourly Rate US $	Operations Cost US $	Total Annual O & M Costs US $	Total Cost Million Rp.	Annual Cost Million Rp.	Oprtations Cost Million Rp.	Total Annual O & M Costs Million Rp
HEAVY EQUIPMENT													
Rental													
Dragline	3/4 m^3	1				100	25	2,500	2,500	-	-	-	1.562
Bulldozer	D4	1				100	15	1,500	1,500	-	-	-	0.938
Truck Tractor		1				25	16	400	400	-	-	-	0.250
		1				25	3	75	75	-	-	-	0.047
Purchase													
Backhoes	1/2 m^3	1	30,000	30,000	3,000	200	20	4,000	7,000	18.750	1.875	2.500	4.375
Flatbed Truck	2t	1	15,000	15,000	1,500	100	2	200	1,700	9.375	0.938	0.125	1.062
Dump Trucks	5t	2	30,000	60,000	6,000	100	10	1,000	7,000	37.500	3.750	0.675	4.375
Tilt Trailer	5t	1	9,000	9,000	900	100	2	200	1,100	5.625	0.562	0.125	0.687
Total				114,000	11,400			9,875	21,275	71.250	7.125	6.172	13.296
TRANSPORTATION EQUIPMENT													
Jeeps		3	9,000	27,000	2,700	1,000	3	3,000	5,700	16.875	1.688	1.875	3.563
Pickup Trucks		1	12,000	12.000	1,200	500	3	1,500	2,700	7.500	0.750	0.938	1.688
Motor cycles		14	1,500	21,000	2,100	8,400	1	8,400	10,500	13.125	1.312	0.525	6.562
Bicycles		40	160	6,400	640	-	-	320	960	4.000	0.400	0.200	0.600
Total				66,400	6,640			13,220	19,860	41.500	4.150	8.262	12.412
CONSTRUCTION EQUIPMENT													
Concrete mixer		1	2,500	2,500	500	100	5	500	1,000	1.562	0.312	0.313	0.625
Hand Compactors		5	1,500	7,500	750	250	3	750	1,500	4.868	0.489	0.469	0.938
Sump Pumps		2	1,500	3,000	600	100	3	300	900	1.875	0.375	0.188	0.562
Hand Tools, Lanterns		50	100	5,000	1,000	-	-	-	1,000	3.125	0.625	-	0.625
Totals				18,000	2,850			1,550	4,400	11.250	1.781	0.969	2.750
SHOP EQUIPMENT													
Service Shop		1	L.S.	25,000	2,500	-	-	-	2,500	15.625	1.562	-	1.562
Total				25,000	2,500				2,500	15.625	1.562	-	1.562
COMMUNICATION EQUIPMENT													
Walkie-Talkie Stations	10.0w	5	300	1,500	300	-	-	-	300	0.938	0.188	-	0.188
Telephones		25	100	2,500	250	-	-	-	250	1.562	0.156	-	0.156
Total				4,000	550			-	550	2.500	0.344	-	0.344

TABLE VIII-4

PERSONNEL ORGANIZATION

MANAGEMENT AND LABOR

Position	Number Employees	Daily Wage Rate Rp.	Monthly Wage Rate Rp.	Yearly Wage Rate Million Rp.	Total Annual Salaries Million Rp.	Total Annual Salaries US $
Chief of Irrigation Section	1	8,500	187,000	2.244	2.244	3,590
Asst. Chief of Section	1	7,000	154,000	1.848	1.848	2,957
Hydrologists	2	3,500	77,000	0.924	1.848	2,957
Draftsmen	1	2,000	44,000	0.528	0.528	845
Chief Accountant	1	4,000	88,000	1.056	1.056	1,690
Book Keeper	1	2,250	49,500	0.594	0.594	950
Clerk Typist	3	1,500	33,000	0.396	1.188	1,901
Irrigation Inspector	1	4,500	99,000	1.198	1.188	1,901
Operations Foremen	7	2,500	55,000	0.660	4.620	7,392
Canal, Drain, and Levee Tender	38	1,000	22,000	0.264	10.032	16,050
Operations Laborers	12	750	16,500	0.188	2.376	3,802
Shop and Equipment Foreman	1	3,500	77,000	0.924	0.924	1,478
Mechanic	1	2,000	44,000	0.528	0.528	845
Equipment Operators	5	3,000	66,000	0.792	3.960	6,336
Drivers	5	1,500	33,000	0.396	1.980	3,168
Maintenance Foremen	2	3,000	66,000	0.792	1.584	2,534
Clerk Typists	1	1,500	33,000	0.396	0.396	634
Maintenance Laborers	10	1,000	22,000	0.264	2.640	4,224
Total	93				39.534	63,254

TABLE VIII-5

O & M MATERIALS INVENTORY

Item	Unit	No. Units	Units Cost US $	Total Cost US $	Annual Use %	Annual Opr. Cost US $	Unit Cost Rp.	Total Cost Million Rp.	Annual Opr. Crop Million Rp.
Stop Logs	m^3	37	300	11.100	10	1,110	107,500	6.938	0.694
Steel Gates		25	150	3,750	100	3,750	93,750	2.344	2.344
Cement	SK	200	3.50	750	100	750	2,200	0.469	0.469
Sand and Gravel	m^3	200	1.60	320	50	160	1,000	0.200	0.100
Structural Steel	Kg	200	1.45	290	100	290	900	0.181	0.181
Wire	Kg	200	0.20	40	100	40	125	0.025	0.025
Reinforcing Steel	Kg	400	0.60	240	50	120	375	0.150	0.075
Paint	Kg	50	4.15	210	100	210	2,600	0.131	0.131
Measuring Gages	Pr	20	16.95	340	50	170	10,600	0.212	0.106
Drain Tile	L.m	200	0.55	110	50	55	340	0.069	0.034
Bamboo	m^3	200	1.20	240	50	120	750	0.150	0.075
Sandbags	SK	2,000	0.35	750	10	75	220	0.469	0.047
Rock Riprap	m^3	200	8.40	1,680	50	840	5,250	1.050	0.525
Masonry Rock	m^3	200	10.55	2,110	15	320	6,600	1.319	0.198
Lime	m^3	20	9.60	190	100	190	6,000	0.119	0.119
Aspahlt	bbl	20	28	560	100	560	500	0.350	0.350
Crushed Rock Base	m^3	100	16	1,600	100	1,600	10,000	1.000	1.000
Total				24,280		10,360		15.175	6.475

TABLE VIII-6

CONSTRUCTION OPERATION, MAINTENANCE AND REPLACEMENT
COST STREAM, MAJENANG SYSTEMS
(All Costs in Million Rupiahs)

(20-45-35%)	Construction Year	O&M Year	Construction Schedule	Construction Costs	O&M Schedule Hectares	Capital Outlay O&M&R	Reference Table	O & M Costs I & D	Replacement Cost 5 yr	Replacement Cost 10 yr	Replacement Cost 25 yr	O&M&R Costs	Construction Costs	Sum Total All Costs
Design														
Design & Pre Cost														
Pre Construction														
Construction	1		590	954.817*									954.817	954.817
Construction	2	1	1,330	1,155.863	590	30.706	VIII-1	9.580				40.286	1,155.863	1,196.149
Construction	3	2	1,034	899.005	1,330	69.089	VIII-1	31.130				100.219	899.005	999.224
	4	3			1,034	53.576	VIII-1	47.901				101.477		101.477
	5	4						47.901				47.901		47.901
	6	5						47.901	2.340			50.241		50.241
	7	6						47.901				47.901		47.901
		7						47.901				47.901		47.901
		8						47.901				47.901		47.901
		9						47.901				47.901		47.901
		10						47.901	2.340	116.708		166.949		166.949
		11						47.901				47.901		47.901
		12						47.901				47.901		47.901
		13						47.901				47.901		47.901
		14						47.901				47.901		47.901
		15						47.901	2.340			50.241		50.241
		16						47.901				47.901		47.901
		17						47.901				47.901		47.901
		18						47.901				47.901		47.901
		19						47.901				47.901		47.901
		20						47.901	2.340	116.708		166.949		166.949
		21						47.901				47.901		47.901
		22						47.901				47.901		47.901
		23						47.901				47.901		47.901
		24						47.901				47.901		47.901

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TABLE VIII-6 (Cont'd)

CONSTRUCTION, OPERATION, MAINTENANCE AND REPLACEMENT
COST STREAM, MAJENANG SYSTEMS
(All Costs in Million Rupiahs)

Construction Year	O&M Year	Construction Schedule Hectares	Construction Costs	O&M Schedule Hectares	Capital Outlay O&M&R	Reference Table	O & M Costs I & D	Replacement Costs. 5 yr	10 yr	25 yr	O&M&R Costs	Construction Costs	Sum Total All Cost
	25						47.901	2.340		13.650	63.891		63.891
	26						47.901				47.901		47.901
	27						47.901				47.901		47.901
	28						47.901				47.901		47.901
	29						47.901				47.901		47.901
	30						47.901	2.340	116.708		166.949		166.949
	31						47.901				47.901		47.901
	32						47.901				47.901		47.901
	33						47.901				47.901		47.901
	34						47.901				47.901		47.901
	35						47.901	2.340			50.241		50.241
	36						47.901				47.901		47.901
	37						47.901				47.901		47.901
	38						47.901				47.901		47.901
	39						47.901				47.901		47.901
	40						47.901	2.340	116.708		166.949		166.949
	41						47.901				47.901		47.901
	42						47.901				47.901		47.901
	43						47.901				47.901		47.901
	44						47.901				47.901		47.901
	45						47.901	2.340			50.241		50.241
	46						47.901				47.901		47.901
	47						47.901				47.901		47.901
	48						47.901				47.901		47.901
	49						47.901				47.901		47.901
	50						47.901	2.340	116.708	13.650	180.599		180.599
	51						47.901				47.901		47.901
	52						47.901				47.901		47.901
	53						47.901				47.901		47.901

* Include 441.1 Million Rupiah for Weir Construction by Otners

TABLE VIII-7

CONSTRUCTION, OPERATION, MAINTENANCE AND REPLACEMENT COST STREAM, WANAREJA SYSTEMS

(All Costs in Million Rupiahs)

(20-45-35%)	Construction Year	O&M Year	Construction Schedule Hectares	Construction Costs	O&M Schedule Hectares	Capital Outlay O&M&R	Reference Table	O & M Costs I & D	Replacement Costs 5 yr	10 yr	25 yr	O&M&R Costs	Construction Costs	Sum Total All Costs
Design														
Design & Pre Const.														
Pre Construction														
Construction	1		168	220.478*								11.363	220.478	220.478
Construction	2	1	377	270.625	168	8.661	VIII-1	2.702				11.363	270.625	281.988
Construction	3	2	293	210.486	377	19.486	VIII-1	8.782				28.268	210.486	238.754
	4	3			293	15.156	VIII-1	13.511				13.511		13.511
	5	4						13.511				13.511		13.511
	6	5						13.511	0.660			14.171		14.171
	7	6						13.511				13.511		13.511
		7						13.511				13.511		13.511
		8						13.511				13.511		13.511
		9						13.511				13.511		13.511
		10						13.511	0.660	32.917		47.088		47.088
		11						13.511				13.511		13.511
		12						13.511				13.511		13.511
		13						13.511				13.511		13.511
		14						13.511				13.511		13.511
		15						13.511	0.660			14.171		14.171
		16						13.511				13.511		13.511
		17						13.511				13.511		13.511
		18						13.511				13.511		13.511
		19						13.511				13.511		13.511
		20						13.511	0.660	32.917		47.088		47.088
		21						13.511				13.511		13.511
		22						13.511				13.511		13.511
		23						13.511				13.511		13.511
		24						13.511				13.511		13.511
		25						13.511	0.660		3.850	18.021		18.021

TABLE VIII-7 (Cont'd)

CONSTRUCTION, OPERATION, MAINTENANCE AND REPLACEMENT
COST STEAM, WANAREJA SYSTEMS

(All Costs in Million Rupiahs)

Sheet 2 of 2

(20-45-35%)	Construction Year	O&M Year	Construction Schedule Hectares	Construction Costs Hectares	O&M Schedule Hectares	Capital Outlay O&M&R	Reference Table	O&M Costs I&D	Replacement Costs 5 yr	Replacement Costs 10 yr	Replacement Costs 25 yr	O&M&R Costs	Construction Costs	Sum Total All Costs
		26						13.511				13.511		13.511
		27						13.511				13.511		13.511
		28						13.511				13.511		13.511
		29						13.511				13.511		13.511
		30						13.511	0.660	32.917		47.088		47.088
		31						13.511				13.511		13.511
		32						13.511				13.511		13.511
		33						13.511				13.511		13.511
		34						13.511				13.511		13.511
		35						13.511	0.660			14.171		14.171
		36						13.511				13.511		13.511
		37						13.511				13.511		13.511
		38						13.511				13.511		13.511
		39						13.511				13.511		13.511
		40						13.511	0.660	32.917		47.088		47.088
		41						13.511				13.511		13.511
		42						13.511				13.511		13.511
		43						13.511				13.511		13.511
		44						13.511				13.511		13.511
		45						13.511	0.660			14.171		14.171
		46						13.511				13.511		13.511
		47						13.511				13.511		13.511
		48						13.511				13.511		13.511
		49						13.511				13.511		13.511
		50						13.511	0.660	32.917	3.850	50.938		50.938
		51						13.511				13.511		13.511
		52						13.511				13.511		13.511
		53						13.511				13.511		13.511

* Includes 100.2 Million Rupiah for Weir Construction by Others.

TABLE VIII-8

ESTIMATED BUDGET REQUIRED FOR AGRICULTURE SERVICE TO ESTABLISH 9 DHARMA TIRTA VILLAGE WATER USERS ASSOCIATIONS FOR THE CENTRAL JAVA SYSTEMS IRRIGATION PROJECT

1. PPL Training Team Costs of of Operation for one year.

		Monthly	Annual
Salaries			Rp. 5,520,000
PPL Supervisor	(1)	Rp. 40,000	480,000
PPLs	(5)	150,000	1,800,000
Asst. PPLs	(10)	250,000	3,000,000
Driver	(1)	20,000	240,000
	(17)		
Overhead Expenses			Rp. 4,000,000
House and Office Rental			500,000
Office Supplies and Furniture			1,500,000
Miscellaneous			1,000,000
Travel Expense			1,000,000
Transportation Expense			Rp. 4,000,000
Jeep	(1)		1,000,000
Motorcycles	(10)		1,000,000
Maintenance, fuel and lube			2,000,000
T o t a l			Rp.13,520,000

2. Assume 1 PPL Training Team to teach and train 500 Farmers/Year

$$\frac{15,000}{500 \times 3 \text{ years}} = 10 \text{ PPL Training Teams}$$

3. Total Estimate Cost/Year			Rp. 206,745,000
PPL Teams (13,520,000)	(10)		130,520,000
Contingencies	20%		26,105,000
Materials	20%		31,325,000
Supervision	10%		18,795,000
Annual Training Cost		Rp. 206,745,000 = $ 330,792.00	

FIGURE VIII-1

INTER AGENCY COOPERATION FOR THE 4 CENTRAL JAVA SYSTEMS

Government Level	Home Affairs Authority		Ministry of Public Works			Ministry of Agriculture		Dharma Tirta Water Users Associations	
			Rivers Authority	Irrigation Authority		Agriculture Authority			
	Location	Office		Location	Office	Location	Office	Location	Office
Province	Semarang	Governor	Directorate (Jakarta)	Semarang	Dept. of Public Works	Semarang	Dinas Pertanian		
Region	Banyumas	Resident		Purwokerto	Irrigation Region (60,000 - 100,000 Ha)	Purwokerto			
District	Cilacap	Bupati	Project Citanduy Banjar	Majenang	Irrigation Section (4 Central Java Irrg. System 3,792 Ha)	Cilacap	District Department		Dharma Tirta Confederation Representative
Camat	Sidareja	Camat		Majenang	Irrigation Inspector	Majenang	Sub District Department		Dharma Tirta Confederation
Villages	(Various)	Kepala Desa		Villages	Irrigation Inspector	Sidareja	Sub District Department PPLs	Villages	Irrigation Committees 50 hectares 27
Villages	(Various)	Desa Irrigation Committee		Villages	Canal Supervisor	Villages		Villages	Irrigation Blocks 50 hectares 397
Villages	(Various)	Ulu-ulu		Villages	Canal Tender			Villages	Ili-ili

Sidareja Cihaur Irrigation Project

Coordinating Board

Chairman : BUPATI Cilacap
Secretary : BAPPEMKA Cilacap
Members : Project Citanduy
Irrigation Service
Agriculture Service
Forestry Service (As Required)
Dharma Tirta Confederation Representative

Directorate of Rivers

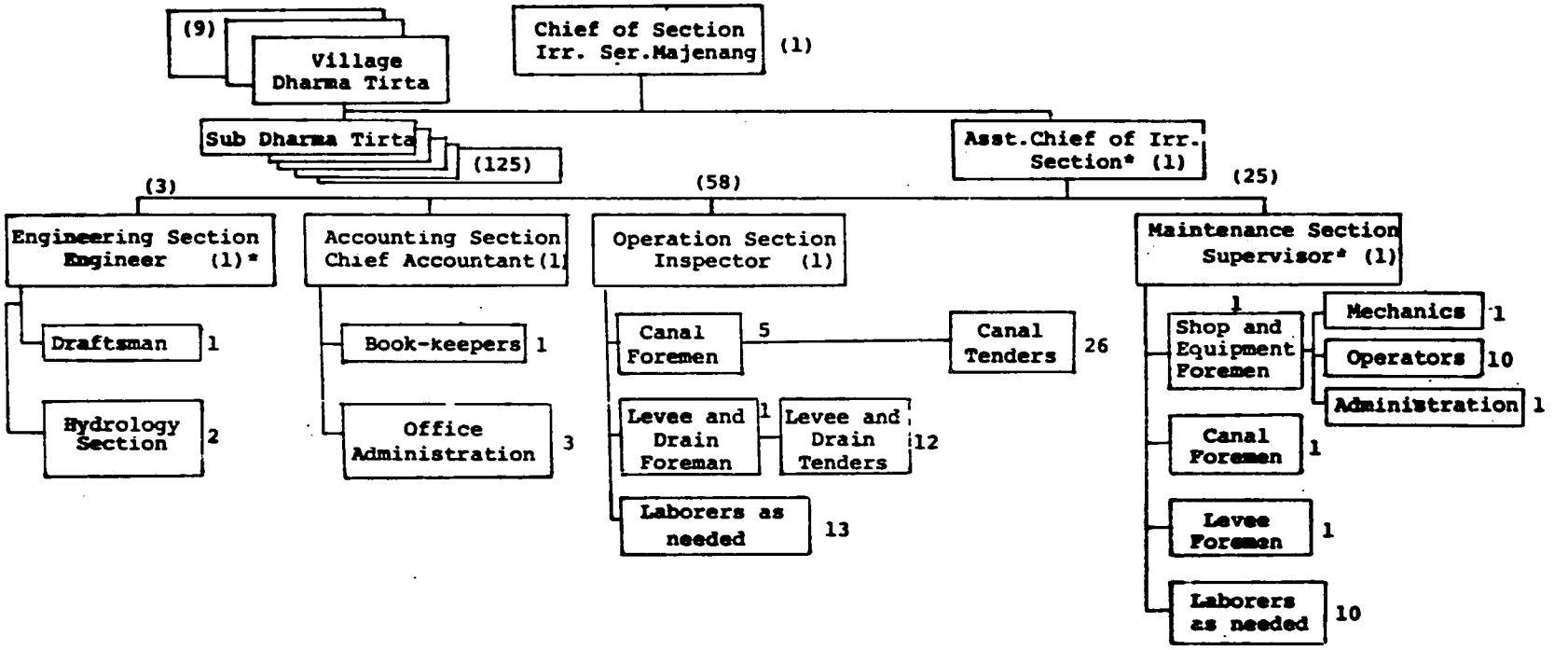
Project Citanduy

Design and Construction of Civil Works
Flood Control Levees and Structures
Irrigation and Drainage Systems
Maintenance of Works under Construction and Rehabilitation

FIGURE VIII-2

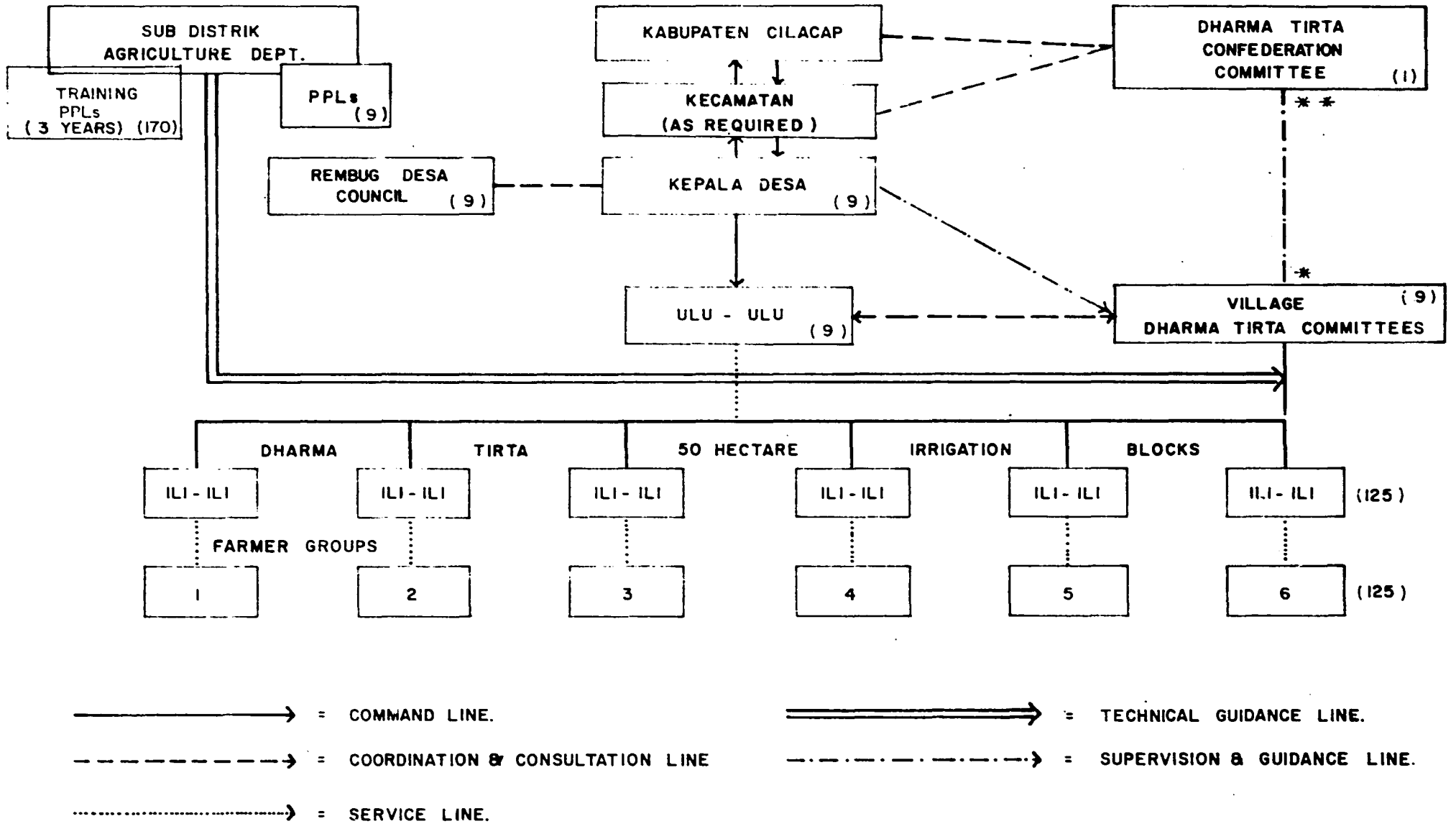
PERSONNEL ORGANIZATION ON CHART OF 4 CENTRAL JAVA SYSTEMS

FOR 93 PERMANENT EMPLOYEES



*Note: The Asst. Chief of Section is also the Maintenance Section Supervisor and the Section Engineer

FIGURE VIII- 3 : TYPICAL ORGANIZATION CHART FOR DHARMA TIRTA VILLAGE WATER USERS ASSOCIATIONS



* EACH D.T VILLAGE COMMITTEE WILL AVERAGE 30 MEMBERS, 1 ELECTED MEMBER AND, 1 ILI-ILI

** THE D.T CONFEDERATION COMMITTEE WILL HAVE 2 MEMBER REPRESENTATIVES FROM EACH VILLAGE *

CHAPTER IX

ECONOMIC EVALUATION

Introduction

The information, analyses and conclusions presented in the previous chapters permits an economic evaluation of the proposed plans. The objectives of this evaluation are:

1. Analysis of benefits from irrigation, drainage and flood control works, as proposed;
2. Analysis of net farm income improvement and repayment capability;
3. Determination of the economic justification of the project.

The economic evaluation will be done for the two identified project areas (Majenang project area with the Cileumeuh, Cilopadang and Cijalu systems and Wanareja project area with the Cilaca system). Thus,an economic evaluation for the three systems in the Majenang project area will not be attemped separately, since the implementation of the complex interrelated drainage and flood control works for the three systems combined will result in full benefits. Implementation of only the suggested drainage and flood control measures, for example, the Cileumeuh system would result in worse flooding in the Cijalu system, and vice versa. Because the Majenang project area is being one hydrologic unit, it should consequently be developed as a single unit.

Viewpoint of Economic Analysis

Economic studies are made from the viewpoint of the overall national economy. Therefore only "real" costs are included. Items which are transfers in the economy, such as taxes, customs duties and social welfare outlays are disregarded.

The evaluations are based on the most important and representative crops grown in the area. For the economic analysis, the fixed costs of production are disregarded since it is important only to know the incremental costs and benefits. Thirdly, factor costs are taken at market values under the assumption that over the long run market price reflects value, and all residual profits are attributed to be project induced benefits. Finally, prices used are economic prices, inasmuch as subsidies have been eliminated. The prices for crops are projected to 1985 world market prices at 1978 constant dollars.

The national viewpoint embraces long-run effects, assumes the absence of war or severe economic depressions, and requires application of known technology in management of project construction and operation. This infers conventional economic rates of progress in construction.

Construction of the project is expected to be carried on using appropriate technology for the situation. This would involve a proper combination of labor-intensive and capital-intensive methods.

The incidence of benefits and costs is immaterial to the economic analysis. So long as all beneficial and adverse effects are internalized in the economic study, it is of no consequence, in the national economic viewpoint to whom the effects accrue. However, it is of considerable interest from the national social viewpoint whether the benefits are distributed among the lower income groups of society.

Land Use

All of the irrigable land included in the project areas is presently under rice cultivation. The national goal is to become self-sufficient in rice. Rice has a broad market, both domestically and internationally. It is the major crop grown and is the most profitable field crop that the farmers grow. Accordingly, it is projected that farmers will expand their rice cropping intensity to 1.6 crops per year from the present intensity of 1.4 crops per year.

The estimated land use without the project and with the project is as follows:

	Intensity	Hectares harvested	
		Majenang area	Wanareja area
Future without project			
Rice wet season	0.85	2511	712
Rice dry season	0.55	1625	461
Total	1.40	4136	1173
Future with project			
Rice wet season	0.95	2806	796
Rice dry season	0.65	1920	545
Total	1.60	4726	1341

Market Prospects

Indonesia's rice production has been unable to satisfy demand for many decades. Since 1968 imports have ranged between 0.5 and 1.3 million tons annually. Substantial imports will continue to be required for subsequent years because growth rates of population are exceeding yield increases and cropping availability and intensity. No difficulties are foreseen in milling, storing and marketing because present management and capital will assure the opportunities in these profitable services.

Prices

Rice is a widely traded commodity in international markets. This vital food product is in short supply in Indonesia and should there be an abundance it will find a ready export market. From an economic point of view, rice is valued on the basis of its import substitution value. This is considered a shadow price or hypothetical price reflecting the real economic cost to society or the national economy.

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For the economic analysis farm inputs have been valued at January 1979 prices. Rice and fertilizer prices are based on IBRD 1985 projections at 1978 constant dollars. For rice this is $410 per ton for 5 percent broken, f.o.b. Bangkok. The rice price is adjusted for transportation differentials and marketing costs between Bangkok and Indonesian farm gate values. It is also adjusted for estimated average quality of rice produced locally.

The price of the local quality of rice is computed to be $347 per ton and results in a farmgate price for economic analysis of Rp. 143,488, as presented in Table IX-1.

The prices of urea and T.S.P. are also shadow priced for economic analysis. The economic price is calculated to be Rp. 149,370 ($238) per ton of urea and Rp. 136,870 ($218) per ton of T.S.P. and are shown in Table IX-2.

Farm Budget

Labor - Estimates of the man days labor needed to produce a hectare of rice is derived for each of the project situations: present, future without, and future with the project. Total man days labor needed for the production of one crop by season is estimated by the various operations performed such as nursery preparation, land preparation, maintenance, and harvest. The various operations within these broad groups are further broken down into practices and whether performed by men or women. Total days of labor are then distributed by months and the total estimate of the labor required is derived. Table IX-3 presents the labor requirement by month for the future with project.

The farm labor day is assumed to be a 7 hour work day. Plowing or cangkuling is done by men and is estimated at Rp. 400 per day. The cost of other cultural operations performed by men is estimated at Rp. 350 per day with two meals included. The cost of a day's labor for women is estimated Rp. 300 per day with one meal included.

For purposes of estimating farm furnished family labor it is assumed that the family consists of husband, wife and 2 children. Monthly labor availability is estimated to be 26 man days and 20 woman days per month.

Custom plowing and harrowing of land by water buffalo (kerbau) and 2 drivers (1 man and 1 boy) is available at a cost of Rp. 1,250 per day for a 5 hour day. Cost of production studies assume that custom plowing by buffalo will comprise one eighth without the project and one fourth with the project.

Seed - Rice varieties are assumed to be of high yielding variety (HYV) such as Pelita or P.B. 26. The cost of seed is estimated at Rp. 150 per kilo and the seeding rate is 25 kilos per hectare.

Fertilizers - The economic prices are used in the benefit analysis and financial prices in the financial analysis. Farm gate economic and financial prices are estimated to be as follows;

	Economic price Rp/kg	Financial price Rp/kg
Urea (45% N)	150	70
TSP (46% P_2O_5)	137	70

The economic price is based on IBRD projection to 1985 at 1978 constant monetary value.

Insecticide - Various rates of use of insecticides are estimated for the crop budgets since yields are dependent upon insect control. The cost of insecticide is estimated at Rp. 1125 per liter.

Rodenticide - Rodents must be controlled and 0.1 liter rodenticide per hectare per crop has been included, at a price of Rp. 2,900 per liter. Application rates for fertilizers, seeds, insecticide etc. used in future with project and future without project are presented in Table IX-4.

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Harvest labor - The harvester's share of the rice crop harvested was reported as one sixth or 16.67 percent of total rice crop production in the socio-economic survey. This share of crop production is shown as a cost in the financial studies.

Miscellaneous costs - 10 percent of subtotal of all other costs is added to account for contingency costs.

Agricultural Benefits

The primary function of the project is to provide a reliable irrigation water supply with water management capability in the irrigable command of both project areas. Construction, operation, and maintenance of the project will reduce flood damages, provide drainage and flood control and, in combination, will improve the general economy of the area. It is not possible to approach these benefits separately because of their interrelationships, but with the project facilities the change in the agricultural production is analyzed as the difference in the net farm income without the project and with the project. The combined benefits are therefore described as the agricultural benefits.

The economic analysis considers the total return of productivity or profitability to the whole society or economy of Indonesia. All the resources committed to the project are counted regardless of who in society contributes them and regardless of who in Indonesia receives the benefits. The economic analysis basically allows for remuneration to farm labor and other farm inputs such as seed, fertilizers, pest control and miscellaneous cash expenses.

Cost of Production and Crop Benefits

The data for cost of production studies on rice were assembled from a variety of sources. The major source was the file material and basic data available on other project studies in the region.

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The recommended level of production inputs in the BIMAS package were adopted for this study. While the fertilizer types and inputs may have to be modified from place to place according to soil fertility requirements, the cost specified for fertilizer is adequate for any reasonable fertilization program in the range of crop yields projected for this analysis.

Labor inputs are based on local farming practices. There is an absence of mechanization of field work. The amounts of labor required for different yield levels are modified according to whether a particular labor operation is fixed or variable. To a considerable extent the labor requirements are relatively inelastic. Based on the costs per day of plowing by buffalo or man labor, the rate by buffalo is 3.3 times the rate per day for man labor. On heavy work, however animal power is generally considered 5 to 10 times as effective and in the future more animal power is expected to be used. Buffalo labor is used for one eighth of the land preparation requirements without the project, and for one fourth of the land preparation with the project. Presently many farmers lack the capital to utilize this improved practice.

The estimated cost of production and net income per hectare per rice crop for the future without the project has been calculated for the wet season and the dry season. The net farm income for rice in the wet season was calculated to be Rp. 243,946 ($390) and in the dry season Rp. 225,683 ($361) per hectare. These are presented in Table IX-5 and IX-6. With the project it was estimated that the net farm income per hectare of rice in the wet and dry season would be Rp. 471,800 ($755) for each crop as is shown in Table IX-7.

When the above values are properly considered in the without project and with project conditions the annual agricultural benefits for the two project areas amount to

Majenang Project Area	Rp. 1,250.280 million
Wanareja Project Area	Rp. 354.908 million

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This results in a net benefit of Rp. 423,200 ($677) per hectare for the project area. The computations for the annual agricultural benefits is presented in Table IX-8 for the Majenang Project Area, and for the Wanareja Project Area in Table IX-9. The implementation of the project will increase the area of harvested rice from 4136 hectares to 4726 hectares for the Majenang Project Area, and from 1173 hectares to 1314 hectares for the Wanareja Project Area. The total production of dry rough rice will increase from 8,000 tons at present to 19,578 tons for the Majenang Project Area, an increase of 11,578 tons. For the Wanareja Project Area, this increase in production of dry rough rice will be 3,285 tons, from 2,269 tons at present to 5,554 tons with project. The increase in rice production with project in both project area is 2.44 times the present production and 2.19 times the production as estimated without project. This information is presented in Table IX-10.

Although the harvesting shares are costs to the farmers, they are also benefits to the harvesters. With the harvesters receiving an average of one sixth of the harvest this amounts to 2,477 additional tons of rice with the project than without the project, for both project areas combined. This rice, valued at $230 per ton, is worth $569,710 (Rp. 356.069 million) per year. The crop income to the harvesters should certainly benefit many people including the landless agricultural laborers.

With 20 days of harvest labor per ton of dry rough rice there would be an increase of 297,260 labor days for the harvesters share which amounts to $569,710 or $1.92 (Rp. 1,200) per labor day. Obviously this will be good wages and provides another measure of the benefits of the project in both project areas.

Project Justification

The objective of the economic justification is to demonstrate that the expenditure of the project costs including operation, maintenance and replacement costs are warranted by the estimated improvement in future conditions attributable to the project. Evidence is presented that the proposed plan will create project benefits in excess of project costs by improving the use of natural resources.

Water and land resource development is undertaken to satisfy human needs and desires by increasing economic returns and human satisfaction. It is assumed that there will be an expanding economy, a continuing population growth and improvements in the levels of living.

Internal Rate of Return

The preferable measure of the economic justification of a project is the internal rate of return. This is a procedure using discounted cash flows to find the discount rate that makes the net present worth of the cash flow equal to zero. This discount rate is termed the internal rate of return and, in a sense, represents the average earning power of the money used in the project over the life of the project. For this part of the analysis the internal economic rate of return is derived.

The schedule of project construction costs and yearly benefits achieved is shown on Table IX-11. All construction will be completed at start of fourth year, including the "on-farm" facilities. Although service will be provided, the farmers are not expected to achieve projected yields and benefits immediately. The benefits are therefore counted as full hectare equivalents from the fourth to the seventh year increasing from 50 percent to 100 percent over the four years. The extension service and Bimas programs should be expanded during the construction period. Full agricultural benefits are assumed to be attained in year seven and continue through the 50 year period of analysis. Irrigation operation and maintenance costs are uniform over the years, and the replacement costs added at intervals of 5, 10, and 25 years are averaged for this purpose from the seven to 50 year. Costs for the Pelita II/III improvement works in each project area are placed as costs accrued during the first year of the cash flow analysis, and are considered on integral part of the total costs for IRR - analysis.

The internal economic rate of return, computed from cash flows which are based on Table IX-11, for the recommended plans for each project area resulted in:

Majenang Project Area

Internal Rate of Return		25.0 percent
Costs: a. Construction Costs	(Million Rupiahs)	2,568.585
b. Pelita II/III-works	(Million Rupiahs)	441.100
Total Costs	(Million Rupiahs)	3,009.685

Wanareja Project Area

Internal Rate of Return		28.7 percent
Costs: a. Construction Costs	(Million Rupiahs)	601.389
b. Pelita II/III- works	(Million Rupiahs)	100.200
Total Costs	(Million Rupiahs)	701.589

The benefits and costs stream and the IRR-computations are given in Table IX-12 for the Majenang Project Area, and in Table IX-13 for Wanareja Project Area.

Benefit-Cost Ratio

Comparison of project benefits and costs is another measure of the degree of project justification. Since the costs and benefits accrue at different points in time, a common time basis for discounting is needed. The interest or discounting rate employed to find the net present worth of costs and benefits for benefit-cost ratio calculation is 12 percent, for a 50 year analysis period. This resulted in:

Majenang Project Area

Present worth benefits at 12 percent	: 6,643.827 Million Rupiahs
Persent worth Costs including O & M at 12 percent	: 2,810.932 Million Rupiahs
Net Present worth at 12 percent	: 3,832.895 Million Rupiahs
Benefit/cost ratio at 12 percent	: 2.36

Wanareja Project Area

Persent worth benefits at 12 percent	: 1,885.264 Million Rupiahs
Persent worth Costs including O & M at 12 percent	: 672.753 Million Rupiahs
Net Present Worth at 12 percent	: 1,212.511 Million Rupiahs
Benefit/Cost ratio at 12 percent	: 2.80

Sensitivity Tests

The economic analyses were based on the best information available and cross checked where possible. Still, of necessity, many assumptions and projections had to made. The sensitivity to significant changes in some of the basic assumptions was tested to show what the effects might be. The tests show that the viability of the project is not affected by any of the variations introduced. Results of the sensitively tests for both project areas are shown in Table IX-14 (Majenang) and Table IX -15 (Wanareja).

The most unfavorable effect would be reduced project yield of 4.0 ton per hectare or a lowering of crop prices. It is not likely, however, that crop prices will be reduced as much as 20 percent over the long run. In view of the foreseeable world population growth and inflation trends, crop prices may well increase. Also, rice yields of 4 ton per hectare still leaves the internal rate of return in excess of 19 percent for Majenang project area and 22 percent for the Wanareja project area.

TABLE IX-1

RICE PRICE STRUCTURE, INDONESIA

(Metric Ton)

	Rupiah
International price, f.o.b. export point	217,500 1/
Ocean freight and insurance	11,875
Imported Rice	229,375
Port handling charges	5,188
Transport	1,556
Less transport from mill	- 2,594
Price ex-mill	233,525
Conversion to gabah (x.63)	147,120
Less milling cost	- 2,594
Less transport farm to mill	- 1,038
Farm gate economic price	143,488
Dollars (Rp. 625 = $ 1)	$ 229.58

1/ IBRD 1985 projection at 1978 constant dollars for rice f.o.b. Bangkok $410/t for 5 percent broken, $348/t for local quality (20-25 precent broken).

2/ $1.00 = Rp. 625

Table IX-2

FERTILIZER PRICE STRUCTURE, INDONESIA

(Metric Ton)

	Urea	TSP
International price, f.o.b. US Gulf Port	Rp. 115,625 1/	Rp. 103,125 1/
Ocean freight and insurance	22,500	22,500
Important price	138,125	125,625
Port handling charges	3,110	3,110
Transportation to distribution center	2,950	2,950
Handling at distribution center	3,110	3,110
Transportation to farm	2,075	2,075
Economic price	Rp. 149,370	Rp. 136,870
Financial (local) price	Rp. 70,000	Rp. 70,000
Dollars 2/	$ 112.00	$ 112.00

1/ IBRD 1985 projection at 1978 constant dollars.

2/ $ 1.00 = Rp. 625

TABLE IX-3

LABOR DISTRIBUTION FOR IRRIGATED RICE CROP, FUTURE WITH PROJECT

Activity	Months:	Days of Labor Required (Per Hectare)									
		1		2		3		4		Total	
		M	W	M	W	M	W	M	W	M	W
Nursery:											
Preparation		6	-	-	-	-	-	-	-	6	-
Sowing seed		-	2	-	-	-	-	-	-	-	2
Spraying		1	-	-	-	-	-	-	-	1	-
Land Preparation:											
Plow (2)*		18	-	-	-	-	-	-	-	18	-
Harrow (2)*		12	-	-	-	-	-	-	-	12	-
Repair dikes		8	-	-	-	-	-	-	-	8	-
Level		4	-	-	-	-	-	-	-	4	-
Fertilizer		2	-	-	-	-	-	-	-	2	-
Mark		-	-	3	-	-	-	-	-	3	-
Transplant		-	-	3	25	-	-	-	-	3	25
Maintenance:											
Weeding		-	-	1	19	1	19	-	-	2	38
Top dressing		-	-	3	5	2	5	-	-	5	10
Spraying		-	-	1	-	2	-	-	-	3	-
Manage water		2	-	8	-	6	-	4	-	20	-
Harvest:											
Ani-ani cut		-	-	-	-	-	-	4	90	4	90
Transport		-	-	-	-	-	-	9	-	9	-
Total Required		53	2	19	49	11	24	17	90	100	165

* Buffalo used for 25 percent of plowing and harrowing. M = Man W = Woman

TABLE IX-4

FERTILIZER AND INSECTICIDE APPLICATION RATES

	RICE	
	Wet Season	Dry Season
Future Without Project		
Urea, kilogram/hectare	150	40
TSP, kilogram/hectare	75	0
Diazanon, liters/hectare/application	3	3
Rodenticide, liters/hectare	0.1	0.1
Future With Project		
Urea, kilogram/hectare	300	300
TSP, kilogram/hectare	100	100
Diazanon, liters/hectare/application	3	3
Rodenticide, liters/hectare	0.1	0.1

TABLE IX-5

ECONOMIC ANALYSIS

Estimated Cost of Production and

Net Income per Hectare per Rice Crop

Future Without Project

Wet Season

Gross Return			
Yield ton		Price per ton	Value
2.5		Rp. 143,488	Rp. 358,720
Cost of Production			
Labor days			
Man	74 @ Rp. 350 per day		Rp. 25,900
Women	115 @ Rp. 300 per day		Rp. 34,500
Buffalo	3 @ Rp.1,250 per day		Rp. 3,750
Materials			
Seed	25 kilograms @ Rp. 150 per kilogram		Rp. 3,750
Urea	150 kilograms @ Rp. 150 per kilogram		Rp. 22,500
T.S.P.	75 kilograms @ Rp. 137 per kilogram		Rp. 10,275
Insecticide	3 liters @ Rp.1,125 per liter		Rp. 3,375
Rodenticide	0.1 liters @ Rp.2,900 per liter		Rp. 290
		Subtotal	Rp. 104,340
Other cost 10% of above production cost			Rp. 10,434
		Total Cost	Rp. 114,774
Net Income			Rp. 243,946
			($ 390)

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TABLE IX-6

ECONOMIC ANALYSIS

Estimated Cost of Production and

Net Income per Hectare per Rice Crop

Future Without Project

Dry Season

Gross Return			
Yield ton		Price per ton	Value
2.1		Rp. 143,488	Rp. 301,325
Cost of Production			
Labor days			
Man	66 @ Rp. 350 per day		Rp. 23,100
Women	95 @ Rp. 300 per day		Rp. 28,500
Buffalo	3 @ Rp.1,250 per day		Rp. 3,750
Materials			
Seed	25 kilograms @ Rp. 150 per kilogram		Rp. 3,750
Urea	40 kilograms @ Rp. 150 per kilogram		Rp. 6,000
T.S.P.	0 kilograms @ Rp. 137 per kilogram		Rp. -
Insecticide	3 liters @ Rp.1,125 per liter		Rp. 3,375
Rodenticide	0.1 liters @ Rp.2,900 per liter		Rp. 290
		Subtotal	Rp. 68,765
Other cost 10% of above production cost			Rp. 6,877
		Total Cost	Rp. 75,642
Net income			Rp. 225,683
			($ 361)

TABLE IX-7

ECONOMIC ANALYSIS

Estimated Cost of Production and

Net Income per Hectare per Rice Crop.

Future With Project

Wet and Dry Season

Gross Return			
Yield ton		Price per ton	Value
4.5		Rp. 143,488	Rp. 645,696
Cost of Production			
Labor days			
Man	100 @ Rp. 350 per day		Rp. 35,000
Women	165 @ Rp. 300 per day		Rp. 49,500
Buffalo	6 @ Rp.1,250 per day		Rp. 7,500
Materials			
Seed	25 kilograms @ Rp. 150 per kilogram		Rp. 3,750
Urea	300 kilograms @ Rp. 150 per kilogram		Rp. 45,000
T.S.P.	100 kilograms @ Rp. 137 per kilogram		Rp. 13,700
Insecticide	3 liters @ Rp.1,125 per liter		Rp. 3,375
Rodenticide	0.1 liters @ Rp.2,900 per liter		Rp. 290
		Subtotal	Rp. 158,115
Other cost 10% of above production cost			Rp. 15,811
		Total Cost	Rp. 173,926
Net income			Rp. 471,770
			($ 755)

TABLE IX-8

SUMMARY OF ANNUAL AGRICULTURAL BENEFITS

for Recommended Plan for Majenang Project Area

Cijalu-Cilopadang-Cileumeuh System

Irrigable Command Area: 2954 hectares

	Intensity	Hectares	Net Farm Income Per ha Rp.	Net Farm Income Total Million Rupiahs
With Project				
Wet season rice	0.95	2806	471,800	1,323.871
Dry season rice	0.65	1920	471,800	905.856
			Total 1	2,229.727
Without Project				
Wet season rice	0.85	2511	244,000	612.684
Dry season rice	0.55	1625	225,700	366.763
			Total 2	979.447
Annual Agricultural Benefits (Comparison with/without project: Total 1 - Total 2)				1,250.280

TABLE IX-9

SUMMARY OF ANNUAL AGRICULTURAL BENEFITS

for Recommended Plan

for Cilaca System/Wanareja Project Area

Irrigable Command Area: 838 hectares

	Intensity	Hectares	Net arm Income Per ha Rp.	Total Million Rupiahs
With Project				
Wet season rice	0.95	796	471,800	375.553
Dry season rice	0.65	545	471,800	257.131
			Total 1	632.684
Without Project				
Wet season rice	0.85	712	244,000	173.728
Dry season rice	0.55	461	225,700	104.048
			Total 2	277.776
Annual Agricultural Benefits (Comparison with/without project: Total 1 - Total 2)				354.908

TABLE IX-10

PRESENT AND FUTURE PRODUCTION

Rice

	Intensity	Hectares	Yield (kg/ha)	Production (ton)
Present				
Wet Season	0.85	3,223	2,060	6,639
Dry Season	0.55	2,086	1,740	3,630
Total Harvested	1.40	5,309		10,269
Future without Project				
West Season	0.85	3,223	2,500	8,058
Dry Season	0.55	2,086	2,100	4,381
Total Harvested	1.40	5,309		12,439
Future with Project				
Wet Season	0.95	3,602	4,500	16,209
Dry Season	0.65	2,465	4,500	11,093
Total Harvested	1.6	6,067		27,302
Total increase in rice production (ton)				
(Total Future with Project - Total Future without Project)				14,863
increase in rice production, Majenang Project Area (ton)				11,578
increase in rice production, Wanareja Project Area (ton)				3,285

Note: Yields are in Dry Rough Rice (Gabah)

TABLE IX-11

YEARLY BENEFITS ACHIEVED, in percent, and
YEARLY CONSTRUCTION COSTS, in percent, used
for IRR-Calculations over
50-year Project life

Year	Yearly Benefits Achieved (percent)	Project Costs Yearly Expenditures (percent)	O & M Costs Over Area (percent)	Pelita II/III Works (percent) 1/
1	-	20	-	100
2	-	45	20	-
3	-	35	60	-
4	50	-	100	-
5	66 1/3	-	100	-
6	83 2/3	-	100	-
7-50	100	-	100	-

1/ for IRR-Calculations with and without the project including the expenditures on Cijalu Weir.

TABLE IX-12

INTERNAL RATE OF RETURN COMPUTATION

Cash Flow and Present Value
Majenang Project Area
Benefits - Costs (including O&M)

Condition: Project Plan - Benefits/Costs flows as computed from Table IX-11

Year	Benefits Million Rupiahs	Costs Million Rupiahs (including O&M Costs)	B-C Cash-Flow Million Rupiah	Present Value at 25% Million Rupiahs	Present Value at 25.05% Million Rupiahs
1.	-	954.817	- 954.817	- 763.850	- 763.548
2.	-	1,167.863	-1,167.863	- 747.440	- 746.835
3.	-	935.005	- 935.005	- 478.720	- 478.218
4.	625.140	60.000	+ 565.140	+ 231.480	+ 231.112
5.	833.520	60.000	+ 773.520	+ 253.470	+ 253.961
6.	1,046.068	60.000	+ 986.068	+ 258.490	+ 257.872
7-50	1,250.280	60.000	+1,190.280	+1,248.030	+1,242.556
			Total	+ 1.460	- 4.100

Internal Rate of Return 25.0 percent

TABLE IX-13

INTERNAL RATE OF RETURN COMPUTATION

Cash Flow and Present Value
Wanareja Project Area

Benefits - Costs (including O & M)

Condition: Project Plan - Benefits/Costs flows as computed from Table IX-11

Year	Benefits Million Rupiahs	Costs Million Rupiahs (Including O&M Costs)	B-C Cash-Flow Million Rupiahs	Present Value at 29% Million Rupiahs	Present Value at 28% Million Rupiahs
1.	-	220.478	- 220.478	- 170.913	- 172.248
2.	-	274.025	- 274.025	- 163.669	- 167.252
3.	-	220.686	- 220.686	- 102.803	- 105.231
4.	177.454	17.000	160.454	+ 57.942	+ 59.773
5.	235.421	17.000	218.421	+ 61.143	+ 63.659
6.	296.941	17.000	279.941	+ 60.747	+ 63.652
7 - 50	354.908	17.000	337.908	+ 252.847	+ 274.392
			Total	- 5.706	+ 16.655

Internal Rate of Return 28.7 percent

TABLE IX-14

SENSITIVITY TESTS

Majenang Project Area

	Internal Rate of Return (Percent)
1. Basic Project Plan	25.0
2. Construction schedule changed from 3 to 4 years with 1 year delay in start in benefits	22.0
3. Full benefits reached after 8 years instead of 7 years	24.4
4. Without project yields increased from 2.5 to 3.0 ton per hectare - wet season, and from 2.1 to 2.5 ton per hectare - dry season.	20.6
5. With project yields decreased from 4.5 to 4 ton per hectare	19.5
6. Economic substitution price of rice per ton changed by:	
a) - 10 percent	22.4
b) - 20 percent	19.6
c) + 10 percent	27.5
7. Cost overrun of 10 percent on estimated costs (Not on Pelita II/III - Costs - period 1974 - 1980)	23.7

TABLE IX-15

SENSITIVTY TESTS

Wanareja Project Area

	Internal Rate of Return (percent)
1. Basic Project Plan	28.7
2. Construction schedule changed from 3 to 4 years with 1 year delay in benefits	25.0
3. Full benefits reached after 8 years instead of 7 years	27.9
4. Without project yields increased from 2.5 to 3.0 ton per hectare - wet season and from 2.1 to 2.5 ton per hectare - dry season	25.6
5. With project yields decreased from 4.5 to 4 ton per hectare	22.5
6. Economic substitution price of rice per ton changed by:	
a) - 10 percent	25.8
b) - 20 percent	22.5
c) + 10 percent	31.5
7. Cost overrun of 10 percent on estimated costs (Not on Pelita II/III - Costs - period 1974 - 1980)	27.2

CHAPTER X

FINANCIAL ANALYSIS

Financial Analysis of Project Farmers

In the financial analysis the individual financial entities, which participate in a project, are considered. Primarily these are the project farmers and the Government of Indonesia and each is concerned about the return on the inputs they contribute.

For the financial analysis, which relates to the farmer's private viewpoint, the budget includes all the costs which are relevant to achieving the production. Again, only incremental costs are important, but taxes and other transfers must be included as production costs. Prices reflect the effects of subsidies and controlled prices. The financial analysis reveals the farmer's gain or loss from the project and can be used as a gage for determining his disposable income and his ability to pay for operation, maintenance and replacement costs and to contribute to the repayment of project costs.

The financial analysis of the representative project farmer indicates the incremental disposable income available for improved farm family living and payment of water charges. The Government of Indonesia does not have a formal policy for repayment of irrigation project construction costs. In the past the capital costs were not expected to be repaid by the water users, but attempts were made to obtain some reasonable contribution toward the annual operation and maintenance expenses through the IPEDA tax. Direct charges have not been made in the past.

Farmers pay taxes to the sub-district government in the form of an annual assessment levied against the land (IPEDA). The tax base is an approximate productivity classification, divided into eight classes.

The present IPEDA payment per hectare is estimated to be Rp. 4,000 for wet season rice areas without the project, and Rp. 8,000 per year for the projected irrigated areas with the project (2 crops per year). The tax is allocated one half to wet season and one half to dry season rice crops. The landowner pays IPEDA tax.

The financial analysis for the farms in the service area includes this form of tax in the production expenses, and therefore it has been allowed before deriving the disposable income.

The hired labor and buffalo hire is also costed out as expenses. The buffalo and drivers are hired at Rp. 1,250 per work day in the local area, which is broken down into the current rate of Rp. 350 for man and Rp. 900 for animal.

Local subsidized costs for fertilizer are used at prices financed by the BIMAS program. The local farmgate or domestic price of rice is used to evaluate production, as these are the actual costs and prices the farmer is confronted with. Both urea and TSP are priced at Rp. 70 per kilogram while rice is priced at Rp. 150 per kilogram.

The cost of operating credit is figured from the amount of cash costs for labor and materials borrowed for 3 months (for each crop) at the subsidized BIMAS interest rate of one percent per month.

The majority of the farm operators are owners (87 percent), with the remaining 13 percent as renters (10 percent) and share croppers (3 percent). Little information was available on renting and share cropping agreement and these groups are therefore excluded in further financial analysis.

Most of the remainder of the people in agriculture in both project areas are landless laborers, over 37 percent of the total. They work for wages or payment in kind depending on the activity. Harvesting is paid in kind. Harvesters bunch the stalks as they work. When they have finished, they carry the total harvest to the house of the landowner, where it is divided. The most common rate in the project is 1 per 6 (the harvester gets one bunch out of six), but it varies from 1 per 5 to 1 per 10, depending upon the yield and the quality of the harvest, the shortage of labor, and local tradition.

All hired labor is included as a variable production expense. The current wage rate of field labor is around Rp. 350 for a man-day and Rp. 300 for a woman-day.

The rates are lower during periods of slack labor demand. The return to the family is included in the disposable income.

Production expenses are figured on a cost per hectare basis and the values thus obtained are utilized in setting up the representative farm budgets for owners. Tables X-1 through X-5 are based on the foregoing information and assist in arriving at a comparison (with and without project) of the disposable income for owner operated situations, as summarized in Table X-6. The average landholding for an owner operated farm was determined to be 0.43 hectare (Table IV-12).

The owner of a farm of 0.43 hectare would have 2.2 times as much with ($ 515) as without the project ($ 229). A part of this difference should be available to pay towards the project construction, operation and maintenance costs if this becomes the policy of the Government.

Schedule of Project Construction Costs

The project construction schedule covers a period of three years. The major factor influencing rate of progress on the irrigation facilities is the capability of the local organization to mobilize for the accomplishment of the work within the resources available to them. The rate of progress which has been scheduled requires that the fullest efforts and coordination be brought to bear on the job. The construction schedule for both project areas is discussed in Chapter IX and shown in Table IX-11. The financial cost of the project is based on the assumption that construction of the project start in 1981.

Domestic and Foreign Cost Breakdown

For capital budgeting purposes, project costs are broken down according to domestic and foreign components as shown in Table X-8. Foreign costs include the estimated costs for capital items that would have to be purchased outside Indonesia. These costs were estimated for the economic analysis at January 1979 prices.

Table X-7 shows a projection of inflation during the period of construction. It was assumed that construction would begin in 1981 and be completed in 1984. Costs are adjusted from the 1979 price level basis to 1981 and thereafter on the basis of projected inflation for domestic and foreign components.

The delay of the start of construction from 1979 to 1981 will add 44 percent to the domestic component and 20 percent to the foreign component of the financial costs. If the project is completed in 1984 the total financial costs are estimated to increase to 3,537.7 million Rupiahs for the Majenang project area, or 37.7 percent more, and to 843.340 million Rupiahs for the Wanareja project Area (also 37.7 percent more), above the construction cost estimate at February 1979 prices. Details for the schedule on Foreign and Domestic Costs, adjusted for inflation and based on Table X-7, are presented in Table X-8, which can be used for budgeting purposes.

TABLE X-1

FINANCIAL ANALYSES VARIABLE EXPENSES PER HECTARE PER CROP RICE

FUTURE WITH PROJECT WET AND DRY SEASON, YIELD 4.5 TON

	No.	Unit	Price/Unit	
FARM EXPENSES				
Hired Labor				
Man	32	days	Rp. 350	Rp. 11,200
Woman	15	days	Rp. 300	Rp. 4,500
Buffalo	6	days	Rp. 1,250	Rp. 7,500
Seed	25	Kg	Rp. 150	Rp. 3,750
Fertilizer				
Urea	300	Kg	Rp. 70	Rp. 21,000
T.S.P.	100	Kg	Rp. 70	Rp. 7,000
Pesticides	3	Liter	Rp. 1,125	Rp. 3,375
Rodenticides	0.1	Liter	Rp. 2,900	Rp. 290
			SUBTOTAL	Rp. 58,615
Operating Credit 3 percent of Subtotal				Rp. 1,758
Miscellaneous 10 percent of Subtotal				Rp. 5,862
			T O T A L	Rp. 66,235

TABLE .X-2

FINANCIAL ANALYSES VARIABLE EXPENSES PER HECTARE PER CROP RICE

FUTURE WITHOUT PROJECT WET SEASON, YIELD 2.5 TON

	No.	Unit	Price/Unit	
FARM EXPENSES				
Hired Labor				
Man	32	days	Rp. 350	Rp. 11,200
Woman	15	days	Rp. 300	Rp. 4,500
Buffalo	3	days	Rp. 1,250	Rp. 3,750
Seed	25	Kg	Rp. 100	Rp. 2,500
Fertilizer				
Urea	150	Kg	Rp. 70	Rp. 10,500
T.S.P.	70	Kg	Rp. 70	Rp. 4,900
Pesticides	3	Liter	Rp. 1,125	Rp. 3,375
Rodenticides	0.1	Liter	Rp. 2,900	Rp. 290
			SUBTOTAL	Rp. 41,015
	Operating Credit 3 percent of Subtotal			Rp. 1,230
	Miscellaneous 10 percent of Subtotal			Rp. 4,102
			T O T A L	Rp. 46,347

TABLE X-3

FINANCIAL ANALYSES VARIABLE EXPENSES PER HECTARE PER CROP RICE
FUTURE WITHOUT PROJECT DRY SEASON, YIELD 2.1 TON

	No.	Unit	Price/Unit	
FARM EXPENSES				
Hired Labor				
Man	32	days	Rp. 350	Rp. 11,200
Woman	15	days	Rp. 300	Rp. 4,500
Buffalo	3	days	Rp. 1,250	Rp. 3,750
Seed	25	Kg	Rp. -	Rp. -
Fertilizer				
Urea	40	Kg	Rp. 70	Rp. 2,800
T.S.P.	-	-	Rp. -	Rp. -
Pesticides	3	Liter	Rp. 1,125	Rp. 3,375
Rodenticides	0.1	Liter	Rp. 2,900	Rp. 290
			SUBTOTAL	Rp. 25,915
Operating Credit 3 percent of Subtotal				Rp. 777
Miscellaneous 10 percent of Subtotal				Rp. 2,592
			T O T A L	Rp. 29,284

TABLE X-4

FINANCIAL ANALYSES

DISPOSABLE INCOME PER HECTARE, RICE

FUTURE WITH PROJECT

OWNER OPERATED

Per Hectare Per Crop

Wet and Dry Season Rice	- 4.5 ton per hectare	
Gross Income per ton	- Rp. 143,488	Rp. 645,696
EXPENSES		
Harvest Cost (1/6 of gross income)		Rp. 107,616
Variable Cost(Table X-1)		Rp. 66,235
IPEDA Tax	(Rp. 8,000 per year per hectare)	Rp. 4,000
	T O T A L	Rp. 177,851
Disposable Income (Gross Income - Total Expenses)		Rp. 467,845

TABLE X-5

FINANCIAL ANALYSES

DISPOSABLE INCOME PER HECTARE, RICE

FUTURE WITHOUT PROJECT

OWNER OPERATED

Wet Season - 2.5 ton per hectare	
Gross Income per ton - Rp. 143,488	Rp. 358,720
EXPENSES	
Harvest Cost (1/6 gross income)	Rp. 59,787
Variable Cost (Table IX-2)	Rp. 46,347
IPEDA Tax (Rp. 4,000)	Rp. 4,000
T O T A L	Rp. 110,134
Disposable Income (gross income - Total Expenses)	Rp. 248,586

Dry Season - 2.1 ton per hectare	
Gross Income per ton - Rp. 143,488	Rp. 301,325
EXPENSES	
Harvest Cost (1/6 of gross income)	Rp. 50,221
Variable Cost (Table IX-3)	Rp. 29,284
IPEDA Tax (-)	Rp. 0
T O T A L	Rp. 79,505
Disposable Income (Gross Income - Total Expenses)	Rp. 221,820

TABLE X-6

FINANCIAL ANALYSES - DISPOSABLE INCOME

OWNER OPERATED

Without Project

	Intensity	Income per hectare	Income (Weighted)
Rice Wet Season	0.85	Rp. 248,586	Rp. 211,298
Rice Dry Season	0.55	Rp. 221,820	Rp. 122,001
Total	1.40		Rp. 333,299
Farm 0.43 hectare			Rp. 143,319
			$ 229

With Project

Rice Wet Season	0.95	Rp. 467,845	Rp. 444,453
Rice Dry Season	0.65	Rp. 467,845	Rp. 304,099
Total	1.60		Rp. 748,552
Farm 0.43 hectare			Rp. 321,877
			$ 515

Increase disposable Income per owner:

Per Farm (0.43 hectare)

Income (weighted) with project - Income (weighted) without project =

Rp. 321,877 - Rp. 143,319 = Rp. 178,558

$ 286

TABLE X-7

PROJECTED INDEX OF INFLATION 1979-1984 1/

		Index of Inflation			
		Domestic		International	
Calender year	Construction year	Yearly percent change	Compounding rate	Yearly percent change	Compounding rate
1979 2/		15.0	1.000	6.0	1.000
1980		12.0	1.150	6.0	1.060
1981	1	10.0	1.288	6.0	1.124
1982	2	10.0	1.417	6.0	1.191
1983	3	10.0	1.558	6.0	1.262

1/ Based on IBRD projections, and adjusted for rupiah devaluation of November 1978.

2/ Prices used in cost estimates are February 1979 prices. Therefore, compounding rate is computed from February 1, 1979. Inflation percentage shown for 1979 is estimate for period February 1, 1979 to December 31, 1979.

TABLE X-8

SCHEDULE OF FOREIGN AND DOMESTIC FINANCIAL COSTS

INFLATION ADJUSTED (See Table X-7)

	Million Rupiahs		
	Domestic	Foreign	Total
Majenang Project Area			
Construction Year			
Year 1 (1981)	485.887	153.398	639.285
Year 2 (1982)	1,202.741	365.719	1,568.460
Year 3 (1983)	1,028.550	301.405	1,329.955
Total Million Rupiahs	2,717.178	820.522	3,537.700
Total Million Dollars	4.347	1.313	5.660
Wanareja Project Area			
Construction Year			
Year 1 (1981)	130.066	21.688	151.754
Year 2 (1982)	321.958	51.706	373.664
Year 3 (1983)	275.329	42.613	317.942
Total Million Rupiahs	727.353	116.007	843.360
Total Million Dollars 1/	1.164	0.185	1.349

1/ 1 US $ = 625 Rupiahs.

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APPENDIX

RURAL WATER MANAGEMENT DEVELOPMENT
UNDER THE "DHARMA TIRTA" SYSTEM
IN THE VILLAGE OF BLIMBING
CENTRAL JAVA

Report Prepared by Soekotjo Harmoni
Dinas Pertanian Rakyat, Propinsi Jawa Tengah

RURAL WATER MANAGEMENT DEVELOPMENT UNDER THE "DHARMA TIRTA" SYSTEM IN THE VILLAGE OF BLIMBING

Subdistrict : Gatak
District : Sukohardjo
Province : Central Java
Country : Indonesia

May 1977

This paper was prepared featuring the village of Blimbing on it's success to develop their community irrigation under the Dharma Tirta System characterized by it's victory over the latest Dharma Tirta contest throughout Central Java in 1976 (as the first winner). The contest was carried out by the Governor of Central Java every two years in an attempt to evaluate how far this institution has played it's role and gave it's contribution to the national program to increase the foodcrop production in general and to rise the welfare of the farmers themselves in particular.

General Data

1. Location.

The village of Blimbing lies some 10 kilometers from Solo City to the west in the sub-district of Gatak, district of Sukoharjo in the province of Central Java, Indonesia. This village is a flat and low plain which consists of fertile paddy field and rich in tobacco plantation where the product is exported in the world market in Bremen (West Germany) comprises of 2,289 kilometer squares.

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2. Population.

Year	Male			Female			Total
	Children	Adult	Total	Children	Adult	Total	
1975	741	1,197	1,938	770	1,230	2,000	3,938
1976	718	1,132	1,850	756	1,302	2,058	3,908

3. Population based on Profession.

Farmer	= 393	persons
Worker/official	= 108	persons
Merchant	= 152	persons
Skilled labourer	= 245	persons
Others	= 268	persons
Total	=1,166	persons

4. Land ownership

Rice field 0.5 hectares	=	277 persons
Rice field 0.5 - 1 hectares	=	2 persons
Rice field more than 1 hectare	=	nil
Average of landownership	=	wetland (rice field) = 0.25 hectares per family.
	=	dryland (non irrigated) = 0.08 hectares per family.

5. Land Use

Irrigated/rice field	=	158 hectares
Non irrigated/upland	=	nil
Yards	=	48.32 hectares
Others	=	6.71 hectares
Total	=	213.03 hectares

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6. **Water Resources.**

a. River	=	Bedodo and Brambang
b. Spring	=	-
c. Public Works Irrigation Canal	=	-

Physical Progress on Irrigation Structures.

Up to now this village shows a promising achievement on the work of establishment, rehabilitation as well as operation and maintenance of the irrigation structures at the farm level within the village, among which we can mention as follows :

a. Water distribution boxes:

1. Tertiary distribution box with sluice gate	= 4 units
2. Quarternary distribution box with sluice gate	= 43 units

b. Conveyance ditch/canal:

1. Tertiary ditch	
- lined with cement/concrete	= 4,650 meters
- non cemented	= 200 meters
Total	= 4,850 meters
2. Quarternary ditch (distribution ditch)	
- lined with cement/concrete	= 7,500 meters
- non cemented	= 5,000 meters
Total	= 12,500 meters
Note: Total of conveyance/distribution ditch	= 17,350 meters

c. Drainage canal/ditch:

1. Tertiary drainage ditch	= 1,353 meters
2. Quarternary drainage ditch	= 2,100 meters
Total	= 3,453 meters

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Note: Total of the ditches (conveyance and drainage)

in the village = 20,853 meters

canal density in the tertiary unit $= \frac{20{,}853 \text{ meters}}{158 \text{ hectares}} = \frac{132 \text{ meters}}{\text{Hectares}}$

d. Other structures:

1. Aqueduct = 5 units
2. Syphon = 65 units
3. Farm bridges - permanent 4 units
   - temporary 1 units
4. Public toilet (installed in the canals) = 6 units

e. Water measuring devices

1. Rectangular Weir (model Cipolletti) = 4 pcs.
2. Triangular Weir (model Thompson) = 315 pcs.

f. Permanent dam

The local Dharma Tirta has succeeded to build one big permanent dam across the Bedodo River, which was financed by the farmers themselves and this dam has the capacity to irrigate 113.6 hectares of rice fields (completed in 1965).

The Establishment of the Dharma Tirta Organization in Blimbing

Before the Dharma Tirta are (which in Central Java was formally legalized since 1971, although in Surakarta generally and in the district of Sragen particularly has initiated to form the "Pre Dharma Tirta" institution known as Sukowati Water Regulation in 1950 where thereafter came the Dharma Tirta), the operation of the water distribution in the village was carried out and managed by the Ulu-ulu system.

Ulu-ulu is a man who has the responsibility to serve the farmer in the village in acquiring water to irrigate his field. This was the only single purpose institution within the Dutch Colonial time in the management of the rural irrigation system. This Ulu-ulu was appointed by the Lurah (Head of the

village) and was paid by the desa/village by means of having the right to cultivate the bengkok (rice field belongs to the inventory of the village) as long as the ulu-ulu serves the duty.

In the years of 1966-1967 this village were suffering long severe drought which were worrying the farmers. Water problems brought as special attention so that in 1968 the local farmers had make up their minds and agreed to set up an association which may manage the water distribution effectively and efficiently.

Their committee were as follows:

- The Head of the village as the adviser
- The Ulu-ulu as the Leader
- Representatives of the farmers as the other committees members.

In 1971 by the issue of the Governor's decree on the establishment of the Dharma Tirta system in Central Java, this organization has readjusted their organization structure to this decree. In this decree, the members of the Dharma Tirta Committee may not come from the formal leader in the village, therefore the Lurah and the Ulu-ulu also was forbidden to become the member of the committee. So Dharma Tirta is a pure and independent body in the village in the aspect of water management, where the principles of democracy are practiced. The irrigation affairs in the village should be done by, from and for the farmers themselves without the interferrence of the formal leaders.

In the above decree, Dharma Tirta was still complemented by the establishment of the Irrigation Committees on each level (Sub district, district and residential) which has the function to make coordinations, supervisions, consultations and synchronizations dealing with the irrigations problems on each level. This committee consists of: the Government administrator as the head, Department of Public Service as secretary and Department of Agriculture, Head of the Police, Rural Community Development and Agraria Department respectively as members.

Finally in 1975 the Governor of Central Java has issued the last decree concerning the Dharma Tirta system. This final decree was issued after the

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Governor made several surveys and seminars conducted by scientist (University of Satyawacana, Diponegoro and Gajah Mada), these was made in an effort how this institution can match and give a more perfect performance in the aspect of water management at the farm level and also aimed in order Dharma Tirta will have the scientific orientation and argumentation.

This final decree has four main chapters, briefly can be outlined as follows:

1. The omition of the previous decree (about the Dharma Tirta and the Irrigation committee, decree in 1971).
2. The guideline on the water management for irrigation in Central Java.
3. The guideline on the supervision and development of the Dharma Tirta system in Central Java.
4. The management of the Water Funds for irrigation.

Based on this, the local irrigation association is Blimbing village, had held a plenary session on the 22nd of January 1976 to make a review on the structure of the organization symultaneously inaugurated the new Dharma Tirta under the name of:

"TIRTA ADHI GUNA", which literally means:

Tirta = Water

Adhi = Good

Guna = Benefit

Water as the source of any life, should be carefully utilyzed.

Structure of Organization.

The local organization has 288 members covering an area of 158 hectares of rice fields. This is divided into 13 groups, where each group has the maximum members up to 50 persons and has an area of maximum 15 hectares.

The basic committees consists of:

Supervisor : Mr. Soemadi H.S., Head of the village

Chairman : Mr. Harjosoedarmo.

Deputy Chairman	:	Mr. Wirodikromo
Secretary	:	Mr. Moelyono Is, B.A.
Deputy Secretary	:	Mr. Padmosoeharto
Treasurer	:	Mr. Harjosoewito
Deputy treasurer	:	Mr. Sibaweh
Group leaders	:	13 persons
Assistants	:	13 persons

The Ulu-Ulu receives water from the gate operator (Public Works) in the tertiary canal according to the scheduled allocation. Further on this man distributes the water to the assistant Ulu-Ulu (each group has this man) into the quaternary ditch, and finally the assistant Ulu-Ulu will distribute the water to each plot of the rice field owned by the farmers. On each junction of the canal/ ditch was installed with the water measuring devices, and also each plot of the rice field was supplied with the Thompson (Triangular) weir, so that each liter of the water distributed were measured. This will guarantee the even and just distribution of water to each of the rice plots.

In case of water supply is limited (mid summer) there will be a rotational rationings, but all were considered and agreed by the farmers themselves through a peaceful negotiation in routine or incidental meetings. By this system, frictions among the farmers can be avoided. Furthermore the formal leaders in the village can not use their powers to occupy water for the sake of their own necessity, also bribery can no longer exist.

During the turn of the farmer to get his ration of water, he can spare his time instead of watching the water whole night they as agreed to do before the Dharma Tirta. If he feels that he has not or get sufficient amount of water, all he has just to do is to make claims to the assistant Ulu-Ulu. To get a better idea with the structure of the organization please observe the diagram of the Dharma Tirta structure attached to this paper.

CHAPTER I

CONSTITUTION OF THE ORGANIZATION

Name and Service Area

Verse 1

(1) This organization has a name Dharma Tirta "TIRTA ADHI GUNA".

(2) The service area of this organization covering the irrigation network on the farm level, comprising the village of Blimbing, subdistrict Gatak, district Sukoharjo.

Verse 2

This association based on the mutual ground and founded on Panca Sila (The Five Principles of the Indonesian Life).

Verse 3

This association aims to succeed the effort in the Agricultural Development to raise the Social Welfare in general and the farmers in particular.

Verse 4

Target of this association is the supply and management of the irrigation water continuously, just and evenly.

CHAPTER II

Scope of Activity

Verse 5

The scope of activity of this association covering: the occupation, direction, management, utilization, and the security of the water following it's resources on the irrigation system at the farm level.

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CHAPTER III

Membership

Verse 6

Condition to be considered as a member:

a. All the farmers who cultivate the rice field which receives water directly from the irrigation system at the farm local concerned.
b. The membership is legally acknowledged if registered in the book of membership by the committee.

Verse 7

Membership ends, whenever:

a. Not to cultivate anymore the concerned land.
b. Died.
c. The association is liquidated.

Verse 8

Every member has the same responsibility, in this connection:

a. To think over and carry out the building up, rehabilitation, exploitation, and maintenance of the irrigation system at the farm level in his working area.
b. To dedicate, regardfull and subject to all the constitutions of the association and every decision made by the members on every meetings.
c. To assist to develop the association.
d. To pay the water fee attentively and the other needed funds decided by the members meetings.
e. To fulfill the penalties/sanction which has been decided by the members meetings on account of transpassing the regulation of the association.
f. Present and actively taking part in every members meeting.

Verse 9

Every member has the same right for:

a. Acquiring service particularly in the water distribution.

b. To pass his opinion and gives voices in the members meetings.

c. To inspect on the course of the association.

d. To elect and being elected as committees.

CHAPTER IV

Committees

Verse 10

Dharma Tirta Committees are elected from, by and for the members in the service time of the committees which is regulated in the household constitutions of the organization.

Verse 11

Conditions to be elected or assigned as member of the association committees are:

a. Belongs to the membership of the Dharma Tirta Association concerned.

b. Possessing the leadership characters.

c. Outside of the village authority.

Verse 12

(1) The structure of the Committees at least must consist of:

- Chairman
- Secretary
- Treasurer
- General assistants

(2) If needed, could form sections according to requirements.

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Verse 13

Duties and responsibilities of the committees are :

a. To lead and to develop the association.

b. To carry out the basic constitution, household constitution, special regulation and all the decisions made by the members meeting.

c. To plan, manage and serve the members necessities particularly in the distribution of water equally and proportionally in accordance with the requirements.

d. To plan, and to arrange the operations of the establishment, rehabilitation, exploitation and maintenance of the irrigation system at the farm level which are under their responsibility.

e. To prepare the register book for members and committees.

f. To k p and deposit as well as possible all the wealth and treasures of the association.

g. To replace the loss of the association due to his neglect, carelessness, fault, falseness and missuse of his authority.

h. To bring all the decisions and instructions of the Irrigation Committee to the members.

i. To carry out and execute all the instructions and decisions of the Irrigation Committee.

j. To execute all sanctions/penalties to the member who trespasses the regulations and to supervise the execution.

k. To give report and responsibility all having to do with the life of the organization as a result of the committee's work.

Verse 14

The committees have the rights in:

a. The receive rewards for their service. The form and the amount of the honorary is regulated in the household constitution of the association.

b. To elect and being elected.

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CHAPTER V

Funds Budgets

Verse 15

The funds budget of the association derived from:

a. Members fee.

b. Funds collection mutually obtained from the members in the form of cash or goods decided by the member meeting (incidental collection).

c. Fines from the transgressors or tresspassers.

d. Other resources.

CHAPTER VI

Guidance and Supervision

Verse 16

Guidance and supervision to the Dharma Tirta Association is done by the Irrigation Committee.

CHAPTER VII

Conclusion

Verse 17

Members meeting decides the household constitution and or special regulation which contains the regulations on the execution of the chapters in this Basic Constitution should not be contradiction.

Blimbing, 22nd of January 1976

Committees:

Chairman	Secretary
Signed	Signed
HARJOSOEDARMO	MOELYONO IS, B.A.

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CHAPTER I

THE HOUSEHOLD CONSTITUTION

Budgeting and Water Fee Collection

Verse 1

The source of budget is obtained from the members fee collection and other such as reforestation, subsidies from the government as well as from private.

Verse 2

1. Water fee from each member is decided as mush as 100 rupiahs per plot of rice field and paid after harvest time.
2. The committee agreed by the members is allowed to collect special funds for the establishment of the irrigation structures.

Verse 3

The expenditures of the funds is used as follows:

1. 50 percents is used for constructions.
2. 5 percents for reserve fund/saving.
3. 5 percents for the honorary of the committees.
4. 40 percents for the honorary of the assistants Ulu-Ulu (field worker).

Verse 4

1. Honorary for the Committees is paid once every 6 months after the harvest time.
2. Honorary for the assistants is paid every month.
3. The amount of the honorary is paid in proportion with the service area.

Verse 5

Fringe benefits for the Committees is decided 10 percent out of the 5 percent of saving.

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CHAPTER II

Prohibitations and Sanctions

Verse 6

All of the members of the Dharma Tirta "TIRTA ADHI GUNA" have to be obedient and subject to all regulations which has been decided and legalized by the members meetings.

Verse 7

1. The member is prohibited to damage/steal and diturb the course of the water.
2. The member is prohibited to damage the legumes planted along the banks of the ditch/canals, ridges, dykes and the irrigation structures.
3. Trespasses against verse 7 number 1 and 2 above will be imposed with sanctions as mentioned in the verse 8 below.

Verse 8

Whosoever trespasses verse 7 number 1 and 2 above will be imposed with the following sanctions:

1. The first trespass will be strictly warned.
2. The second trespass will be fined as much as tenfold of the stolen or damage value, in case of water this every the turn of getting water will be delayed as long as ten days.
3. The third trespass will be brought to the Committees session and plenary members meeting to be considered.

Compiled from the book of the Basic and household Constitution of the Association.

Blimbing, 22nd of January 1976

Chairman
Signed
HARJOSOEDARMO

Secretary
Signed
MOELYONO IS, B.A.

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The Source of Irrigation Water

This village is supported by 4 main dams which enables the farmers to enjoy this blessing i.e. owning an abundent of water supply.

1. Nyaem dam, constructed in 1961 by the Public Works Service, having the capacity to irrigate 360.1 hectares covering 4 villages in the two sub district: Gatak dan Wonosari.
2. Badada dam, built privately by the farmers from the village of Blimbing and Trosemi (96 percent financed by the farmers) in 1965. It allows to irrigate 113.6 hectares of Rice field.
3. Sentene dam, established by the Public Works Service in 1961 to irrigate 3 villages covering 250.2 hectares.
4. Klone Gading dam, constructed by Public Works Service in 1970 and rehabilitated in 1975 as an auxiliary dam to support the village in case of suffering severe droughts.

Out of the above dams, it had been constructed the primary canals 200 meters long and secondary canals 2.5 Kilometers long both were permanently lined with cement concrete.

Budget and Financial Record

1. From 1967 up to 1973 (before the Dharma Tirta was established) the establishment of the water structure cost to Rp.13,802,500.- out of this amount Rp.9,940,000,- came from the village budget and only 30 percent i.e. Rp.3,862,500.- was contributed from the farmers.
2. From 1972 up to 1976 (4 years after Dharma Tirta was set up), in contrast to the above case, the development had cost to Rp.4,542,500,- and from this Rp.2,739,500.- came from the farmers contribution and only Rp.1,803,500.- derived from the village budget. It means 60 percent from the farmers and only 30 percents from the village. Reviewing the above figures, we may draw a conclusion that Dharma Tirta has succeeded to give a real and stronger contribution in the area of the National Development Program.

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Some Other Highlights in the Success of this Association

It is worthwhile to be told, that there are some other goals achieved by this institution:

1. The productivity of rice has been doubled within the last six years, in 1969 per hectares only produced 4.5 tons of stalk rice, while in 1976 it produced 8.5 tons of raw rice.
2. The whole 158 hectares of rice fields has been planted with high yielding varieties. In 1976 it was recorded that the plantation were as follows:
   IR 26 = 110 hectares, IR 28 = 15 hectares, IR 29 = 3 hectares, IR 30 = 30 hectares and IR 34 = 5 hectares, the rest was planted with tobacco.
3. Some of the farmers raise fresh water fish by practicing mixed farming.
4. The planting of shade trees along the farms road which máy yields extra income to the association: Sesbania 10.000 trees, Samanea 700 trees and Flamboyant 150 trees.
5. To form groups of listeners to the Rural Broadcasting Program.
6. To raise village seed farm to supply the farmers with the high yielding varieties seed.

The Key Factors of the Success

The supervision and guidance given by the formal leaders (government administrators and the technical service); the active and real participation of the farmers, the role of the existance of the informal leaders (progressive farmers, farmers groups, etc.) and the natural resources are the main key factors to the success of the development which has been achieved by this association.

Conclusion

It is hoped that this short and very simple report may bring benefits to whom it may concerned.

Soekotjo Harmoni
Dinas Pertanian Rakyat
Propinsi Jawa Tengah

APPENDIX

TABLES AND DRAWINGS

TABLE A-1

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM
MAJENANG PROJECT AREA

System: Cileumeuh

Canal Code: H-1 (Primary) (refer also to schematic layout and index plan) **Canal Alignment Profile Dimension**

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
HI									
0 + 000 - 0 + 625	2612	3.00	1.08	0.55	0.00050	1	0.03	0.59	4.41
HI-1									
0 + 000 - 2 + 400	1711	2.10	1.00	0.50	0.00053	1	0.031	0.55	3.10
HI-2									
0 + 000 - 0 + 400	901	1.25	0.86	0.45	0.00064	1	0.032	0.50	1.81
0 + 400 - 2 + 400	673	1.10	0.78	0.45	0.00066	1	0.032	0.46	1.47

TABLE A-2

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM
MAJENANG PROJECT AREA

System: Cileumeuh

Canal Code: H-II (Secondary) (refer also to schematic layout and index plan)

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	Canal Alignmnet Profile Dimension z	n	Velocity V (m/s)	Area A_2 (m^2)
H II-1									
0 + 000 - 0 + 940	1064	1.95	0.80	0.50	0.00055	1	0.031	0.48	2.20
0 + 940 - 2 + 380	924	1.30	0.86	0.50	0.00064	1	0.032	0.50	1.86
2 + 380 - 3 + 400	680	1.20	0.76	0.50	0.00066	1	0.032	0.46	1.49
3 + 400 - 4 + 230	502	1.00	0.69	0.45	0.00070	1	0.033	0.43	1.17
4 + 230 - 5 + 090	347	0.90	0.58	0.40	0.00076	1	0.033	0.40	0.86
H II-2									
0 + 000 - 0 + 920	561	1.20	0.67	0.45	0.00069	1	0.033	0.45	1.25
0 + 920 - 2 + 100	287	0.70	0.60	0.45	0.00075	1	0.033	0.39	0.78
H II-3									
0 + 000 - 1 + 450	439	0.75	0.70	0.45	0.00076	1	0.033	0.43	0.105
1 + 450 - 1 + 900	288	0.70	0.59	0.40	0.00075	1	0.033	0.38	0.75

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TABLE A-3

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM
MAJENANG PROJECT AREA

System: Cileumeuh

Canal Code: H-III Lateral (refer also to schematic layout and index plan)

Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A (m²)
H III-1									
0 + 000 - 0 + 340	128	0.46	0.44	0.40	0.00082	1	0.033	0.32	0.40
0 + 340 - 1 + 320	107	0.41	0.41	0.40	0.00086	1	0.033	0.32	0.34
0 + 000 - 1 + 300	162	0.52	0.48	0.40	0.00080	1	0.033	0.34	0.48
H III-2									
0 + 000 - 1 + 720	236	0.65	0.54	0.40	0.00078	1	0.033	0.37	0.63
1 + 720 - 3 + 400	133	0.50	0.44	0.40	0.00082	1	0.033	0.32	0.41
H III-3									
0 + 000 - 0 + 350	236	0.65	0.54	0.40	0.00078	1	0.033	0.37	0.63
0 + 350 - 0 + 625	150	0.55	0.55	0.40	0.00080	1	0.033	0.50	0.50
H III-4									
0 + 000 - 1 + 110	208	0.60	0.52	0.40	0.00078	1	0.033	0.36	0.58

TABLE A-4

HYDRAULIC DATA OF IRRIGATION CANAL
CILOPADANG SYSTEM
MAJENANG PROJECT AREA
(refer also to schematic layout and index plan)

System: Cilopadang
Canal Code: G

Canal Alignmnet Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
G II									
0 + 000 - 0 + 250	365	0.85	0,61	0.40	0.00076	1	0.033	0.41	0.89
G III-1									
0 + 000 - 0 + 575	135	0.46	0.45	0.40	0.00082	1	0.033	0.33	0.41
0 + 575 - 1 + 825	124	0.48	0.43	0.40	0.00085	1	0.033	0.33	0.39
G III-2									
0 + 000 - 1 + 800	251	0.65	0.56	0.40	0.00077	1	0.033	0.37	0.68
1 + 800 - 2 + 810	165	0.55	0.48	0.40	0.00081	1	0.033	0.35	0.49
2 + 810 - 3 + 710	96	0.40	0.39	0.40	0.00086	1	0.033	0.31	0.31

TABLE A-5

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM
MAJENANG PROJECT AREA

System: Cijalu

Canal Code: U-1 (Primary) (refer also to schematic layout and index plan) Canal Alignmnet Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
U I-1									
0 + 000 - 1 + 420	1200	1.80	0.88	0.50	0.00053	1	0.031	0.51	2.36
1 + 420 - 2 + 900	1046	1.90	0.80	0.50	0.00055	1	0.031	0.48	2.16
U I-2									
0 + 000 - 0 + 975	1023	1.85	0.81	0.50	0.00052	1	0.031	0.47	2.15
0 + 975 - 1 + 875	606	1.05	0.75	0.45	0.00067	1	0.032	0.45	1.35

TABLE A-6

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM
MAJENANG PROJECT AREA

System: Cijalu

Canal Code: U-II (Secondary) (refer also to schematic layout and index plan)

Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A (m^2)
U II-1									
0 + 000 - 1 + 600	909	1.20	0.88	0.45	0.00064	1	0.032	0.50	1.83
1 + 600 - 2 + 680	658	1.10	0.76	0.45	0.00066	1	0.032	0.50	1.41
2 + 680 - 3 + 080	447	0.80	0.69	0.40	0.00076	1	0.033	0.43	1.03
3 + 080 - 3 + 950	271	0.90	0.60	0.40	0.00076	1	0.033	0.41	0.90
U II-2									
0 + 000 - 1 + 455	489	0.76	0.73	0.45	0.00079	1	0.033	0.45	1.09
1 + 455 - 3 + 175	408	0.70	0.69	0.40	0.00076	1	0.033	0.43	0.96

TABLE A-7

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM
MAJENANG PROJECT AREA

System: Cijalu

Canal Code: U-III (Lateral) (refer also to schematic layout and index plan)

Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
U III-1									
0 + 000 - 0 + 800	199	0.60	0.51	0.40	0.00079	1	0.033	0.35	0.57
0 + 800 - 1 + 550	75	0.375	0.36	0.40	0.00079	1	0.033	0.28	0.28
U III-2									
0 + 000 - 1 + 110	218	0.65	0.51	0.40	0.00078	1	0.033	0.37	0.59
1 + 100 - 2 + 800	178	0.60	0.48	0.40	0.00077	1	0.033	0.34	0.52
U III-3									
0 + 000 - 1 + 150	68	0.40	0.35	0.40	0.00079	1	0.033	0.26	0.26
U III-4									
0 + 000 - 1 + 150	139	0.50	0.44	0.40	0.00082	1	0.033	0.34	0.41
1 + 150 - 1 + 550	85	0.40	0.39	0.40	0.00079	1	0.033	0.30	0.31

TABLE A-8

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM
MAJENANG PROJECT AREA

System: Cijalu

Canal Code: U-III (Lateral) (refer also to schematic layout and index plan)

Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
U III-5									
0 + 000 - 0 + 500	126	0.55	0.42	0.40	0.00079	1	0.033	0.31	0.41
0 + 500 - 1 + 380	97	0.40	0.39	0.40	0.00086	1	0.033	0.31	0.31
U III-6									
0 + 000 - 0 + 200	256	0.65	0.56	0.40	0.00077	1	0.033	0.37	
0 + 200 - 1 + 000	199	0.60	0.51	0.40	0.00076	1	0.033	0.35	0.57
1 + 000 - 2 + 000	126	0.55	0.42	0.40	0.00079	1	0.033	0.31	0.41
U III-7									
0 + 000 - 1 + 700	143	0.60	0.44	0.40	0.00077	1	0.033	0.33	0.46
U III-8									
0 + 000 - 1 + 150	104	0.41	0.41	0.40	0.00082	1	0.033	0.32	0.40
1 + 150 - 1 + 550	58	0.40	0.39	0.40	0.00081	1	0.033	0.27	0.41

TABLE A-9

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM
WANAREJA PROJECT AREA

System: Cilaca

Canal Code: A-1 (Primary) (refer also to schematic layout and index plan) Canal Alignmnet Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
0 + 000 - 0 + 810	1512	2.00	0.96	0.50	0.00053	1	0.031	0.53	2.84
0 + 810 - 2 + 200	1355	2.00	0.91	0.50	0.00053	1	0.031	0.51	2.65
2 + 200 - 4 + 500	346	0.90	0.58	0.45	0.00076	1	0.033	0.40	0.86

TABLE A-10

HYDRAULIC DATA OF IRRIGATION CANAL

CILACA SYSTEM/WANAREJA PROJECT AREA

SYSTEM: Cilaca

CANAL CODE: A-II (Secondary) (refer also to schematic layout and index plan) Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope S (-)	Z	n	Velocity V (m/s)	Area A (m^2)
A II-1									
0+000 - 0+110	374	0.90	0.61	0.40	0.00076	1	0.033	0.41	0.91
0+110 - 1+300	228	0.65	0.53	0.40	0.00078	1	0.033	0.37	0.63
1+300 - 1+750	197	0.60	0.50	0.40	0.00079	1	0.033	0.36	0.55
A II-2									
0+500	418	0.71	0.71	0.40	0.00076	1	0.033	0.43	1.02
600 - 1900	219	0.65	0.51	0.40	0.00078	1	0.033	0.37	0.59
A II-2 L									
0+000 - 1+000	289	0.85	0.55	0.40	0.00071	1	0.033	0.38	0.77
A II-3									
0+000 - 1+860	270	0.80	0.54	0.40	0.00071	1	0.033	0.37	0.72

TABLE A-11

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM
WANAREJA PROJECT AREA

System: Cilaca

Canal Code: A-III (Lateral) (refer also to schematic layout and index plan) Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope s (-)	z	n	Velocity V (m/s)	Area A (m²)
A III-1									
0 + 000 - 1 + 900	107	0.50	0.40	0.40	0.00076	1	0.033	0.30	0.36
A III-2									
0 + 000 - 2 + 600	139	0.50	0.45	0.40	0.00076	1	0.033	0.32	0.43
A III-3									
0 + 000 - 2 + 800	135	0.50	0.44	0.40	0.00077	1	0.033	0.32	0.41
A III-4									
0 + 000 - 1 + 050	229	0.65	0.53	0.40	0.00078	1	0.033	0.37	0.63
A III-5									
0 + 000 - 0 + 810	109	0.50	0.40	0.40	0.00076	1	0.033	0.30	0.36

TABLE A-12

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM
WANAREJA PROJECT AREA

System: Cilaca

Canal Code: A-III (Lateral) (refer also to schematic layout and index plan) Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb ( )	Slope s (-)	z	n	Velocity V (m/s)	Area A_2 (m^2)
A III-6									
0 + 000 - 1 + 110	89	0.40	0.40	0.40	0.00081	1	0.033	0.29	0.32
A III-7									
0 + 000 - 0 + 920	51	0.40	0.39	0.40	0.00081	1	0.033	0.26	0.21
A III-8									
0 + 000 - 0 + 925	146	0.60	0.44	0.40	0.00077	1	0.033	0.33	0.46

TABLE A-13

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM/WANAREJA PROJECT AREA

SYSTEM: Cilaca

CANAL CODE: A-III (Lateral) (refer also to schematic layout and index plan) Canal Alignment Profile Dimension

Station	Discharge Q (l/s)	Width b (m)	Depth d (m)	Free Board fb (m)	Slope S (-)	Z	n	Velocity V (m/s)	Area A (m^2)
A III-5									
0+000 - 0+250	124	0.48	0.43	0.40	0.00085	1	0.033	0.33	0.39
A III-6									
0+000 - 1+110	109	0.41	0.41	0.40	0.00086	1	0.033	0.34	0.34
A III-7									
0+000 - 1+375	90	0.40	0.40	0.40	0.00081	1	0.033	0.29	0.32
A III-8									
0+000 - 0+925	89	0.40	0.40	0.40	0.00081	1	0.033	0.29	0.32
A III-9									
0+000 - 0+920	51	0.40	0.39	0.40	0.00076	1	0.033	0.26	0.21
A III-10									
0+000 - 0+925	146	0.60	0.44	0.40	0.00077	1	0.033	0.33	0.46

TABLE B-1

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Primary H I-1 and H I-2 (Continued) Canal Elevation Alignmnet and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
H I-1						
0 + 000	29.09	28.99	29.99	29.49		
0 + 050	29.09	28.27	29.27	29.82	Parshall Flume	1.83 m width
0 + 200	27.90	28.19	29.19	29.55		
0 + 400	28.50	28.09	29.09	29.69		
0 + 600	27.55	27.99	28.99	29.49		
0 + 800	27.90	27.89	28.89	29.29		
1 + 000	27.63	27.79	28.79	29.19		
1 + 075	27.60	27.76	28.76	29.16	FTO	
1 + 200	26.76	26.69	27.69	28.09	1.0 m drop	
1 + 400	26.81	25.48	26.48	26.88		
1 + 600	26.10	25.38	26.38	26.78	0.50 m drop	
1 + 800	25.70	24.77	25.77	26.27		
1 + 900	25.70	24.76	25.72	26.22	FTO	
2 + 000	25.15	24.67	25.67	26.07	0.50 m drop	
2 + 200	24.60	24.06	25.06	25.56	0.50 m drop	
2 + 400	24.58	23.45	24.45	24.95	FTO	
H I-2						
0 + 000	29.09	27.06	27.88	28.33		
0 + 050	29.09	27.01	27.87	28.32	Parshall Flume	0.91 m width
0 + 200	29.00	26.75	27.61	28.06		
0 + 400	28.90	26.71	27.57	28.02		
0 + 550	28.90	26.63	27.49	27.94	FTO	
0 + 600	28.00	26.58	27.36	27.81		
0 + 800	27.50	26.45	27.23	27.68		
1 + 000	27.00	26.32	27.10	27.55		
1 + 200	27.50	26.19	26.97	27.43		

TABLE B-2

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Primary

Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of			Structures	Remarks
		Bed Elv.	Water Surface Elv.	Top Bank Elv.		
1 + 370	27.50	26.08	26.82	27.27	Siphon	
1 + 400	26.50	26.06	26.84	27.29		
1 + 490	26.50	26.00	26.78	27.23	FTO	
1 + 600	24.55	25.93	26.71	27.16		
1 + 800	25.50	25.79	26.57	27.02		
1 + 890	25.46	25.73	26.51	26.96	Siphon	
2 + 000	25.62	25.66	26.44	26.89		
2 + 200	26.20	25.53	26.31	26.76		
2 + 300	26.38	25.46	26.24	26.49		
2 + 400	26.30	25.40	26.18	26.63		

TABLE B-3

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Secondary H II-1 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structure	Remarks
H II-1						
0 + 000	24.58	23.98	24.78	25.28		
0 + 050	24.54	23.95	24.75	25.25	Parshall Flume	1.52 m width
0 + 200	24.10	23.69	24.49	24.99		
0 + 400	23.04	22.78	23.58	24.08	0.8 m drop	
0 + 600	22.40	22.67	23.47	23.97		
0 + 625	22.40	22.66	23.46	23.96	FTO	
0 + 800	22.30	22.11	22.91	23.41	0.45 m drop	
0 + 900	22.30	21.93	22.73	23.23	FTO	
1 + 000	22.27	21.89	22.69	22.19		
1 + 200	21.81	21.76	22.56	23.06		
1 + 270	21.80	21.73	22.53	23.03	2 FTO	
1 + 400	21.23	21.64	22.44	22.94		
1 + 600	20.80	21.51	22.31	22.81		
1 + 800	20.73	21.38	22.18	22.68		
2 + 000	20.68	21.25	22.05	22.55		
2 + 080	20.68	21.20	22.00	22.50	Culvert	
2 + 200	20.52	21.12	21.92	22.42		
2 + 380	20.46	21.04	21.84	22.34	Turnout	
2 + 400	20.36	20.97	21.73	22.23		
2 + 470	20.36	20.93	21.69	22.19	2 FTO	
2 + 600	20.44	20.83	21.59	22.09		
2 + 800	19.41	20.70	21.46	21.96		
3 + 000	19.32	20.57	21.33	21.83		
3 + 200	19.33	20.44	21.20	21.70		
3 + 370	19.24	20.39	21.08	21.58		
3 + 400	19.24	20.38	21.07	21.57		

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TABLE B-4

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Secondary H II-2 (Continued)

Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
3 + 600	19.25	20.14	20.83	21.28		
3 + 800	18.50	19.98	20.67	21.12		
4 + 000	18.90	19.86	20.55	21.00		
4 + 200	19.38	19.72	20.41	21.86	2 FTO	
4 + 300	18.74	19.65	20.34	20.74		
4 + 400	18.24	19.67	20.26	20.66		
4 + 600	18.29	19.42	20.11	20.51		
4 + 800	18.31	19.27	19.96	20.36		
5 + 000	18.20	19.11	19.18	20.20		
5 + 090	18.80	19.05	19.74	20.14	2 FTO	
H II-2						
0 + 000	24.58	24.06	24.73	25.28		
0 + 050	24.54	24.03	24.70	25.15	Parshall Flume	0.91 m width
0 + 200	24.40	23.74	24.41	24.86		
0 + 400	23.50	23.60	24.27	24.72		
0 + 500	23.50	23.54	24.21	24.66	FTO	
0 + 600	22.60	22.67	23.34	23.79	0.80 m drop	
0 + 800	21.65	21.63	22.30	22.75	0.90 m drop	
0 + 920	21.70	21.45	22.12	22.57	TO and FTO	
1 + 000	21.16	21.36	21.96	22.41		
1 + 200	21.04	20.70	21.31	21.76	0.50 m drop	
1 + 400	21.00	20.48	21.16	21.61		
1 + 550	21.00	20.36	21.04	21.49	Culvert	
1 + 600	20.25	20.33	21.01	21.46		
1 + 800	20.04	19.76	20.36	20.81	0.50 m drop	

TABLE B-5

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Secondary H II-3 — Canal Elevation Alignmnet and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
2 + 000	19.32	19.61	20.21	20.66		
2 + 080	19.30	19.56	20.16	20.61	Culvert	
2 + 100	19.10	19.54	20.14	20.59	FTO	
H II-3						
0 + 000	26.38	25.88	26.58	27.03		
0 + 050	26.37	25.84	26.54	26.99	Parshall Flume	0.61 m width
0 + 200	25.60	25.54	26.24	26.69		
0 + 400	26.55	25.39	26.09	26.54		
0 + 490	26.55	25.32	26.02	26.47	Siphon	
0 + 600	26.40	25.23	25.93	26.38		
0 + 740	26.35	25.20	25.90	26.35	FTO	
0 + 800	25.75	24.78	25.48	25.93	0.30 m drop	
1 + 000	25.10	24.63	25.33	25.78		
1 + 190	25.10	24.49	25.19	25.64	FTO	
1 + 200	25.05	24.41	25.11	25.57	Siphon	
1 + 400	24.65	24.33	25.03	25.48		
1 + 450	25.10	24.29	24.99	25.39	FTO	
1 + 600	25.00	24.18	24.77	25.17		
1 + 800	24.70	24.03	24.62	25.02		
1 + 900	24.80	23.88	24.47	24.87		

TABLE B-6

HYDRAULIC DATA OF IRRIGATION CANAL
CALEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral H III-1 Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structure	Remarks
H III-1						
0 + 000	18.24	18.00	18.44	18.84		
0 + 050	18.30	17.96	18.40	18.80	Parshall Fluem	0.30 m width
0 + 200	18.40	17.72	18.16	18.56		
0 + 340	18.45	17.60	18.04	18.54		
0 + 400	18.50	17.08	17 89	18.29		
0 + 600	18.47	17.31	17.72	18.12		
0 + 800	18.40	17.13	17.54	17.94		
1 + 000	19.19	16.96	17.37	17.77		
1 + 200	19.01	16.79	17.20	17.62		
1 + 400	18.61	16.62	17.03	17.03		
1 + 600	18.30	16.45	16.86	17.26		
1 + 800	18.23	16.27	16.68	17.08		
2 + 000	17.82	16.10	16.51	16.91		
2 + 200	17.95	15.93	16.34	16.74		
2 + 300	17.80	15.84	16.25	16.65	FTO	
2 + 320	17.72	15.83	16.24	16.64	Wasteway	

TBALE B-7

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral H III-4 and H III-5 — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
H III-4						
0 + 000	29.40	29.06	29.60	30.00		
0 + 050	29.30	29.04	29.56	29.96	Parshall Flume	0.30 m width
0 + 200	28.50	28.08	28.46	28.86	Culvert	
0 + 210	28.50	28.08	28.46	28.86	0.80 m drop	
0 + 400	27.15	26.78	27.30	27.70	1.00 m drop	
0 + 450	26.25	26.20	26.72	27.12	0.55 m drop	
0 + 600	25.15	25.28	25.80	26.20	0.80 m drop	
0 + 775	25.10	25.66	26.06	FTO		
0 + 800	25.10	25.12	25.64	26.04		
0 + 900	24.75	25.04	25.56	25.96		
0 + 930	24.70	25.02	25.54	25.94	FTO	
1 + 000	24.50	24.97	25.49	25.89	FTO	
1 + 100	24.25	24.89	25.41	25.81	Wasteway	To Cigunung vill drain
H III-5						
0 + 000	29.40	29.07	29.60	30.00		
0 + 050	29.40	29.03	29.50	29.96	Parshall Flume	0.30 m width
0 + 200	28.74	28.91	29.32	29.72		
0 + 400	28.15	27.75	28.16	28.56	1.0 m drop	
0 + 600	28.10	27.59	28.04	28.44	2 FTO	
0 + 800	27.90	27.43	27.92	28.32		
1 + 000	27.28	27.27	27.80	28.10		
1 + 200	27.35	27.11	27.68	28.08		
1 + 400	26.95	25.95	27.56	27.96		
1 + 600	25.59	25.79	27.44	27.84		
1 + 645	25.20	24.63	27.32	27.72	Wasteway	To Cileumeuh River

TABLE B-8

HYDRAULIC DATA OF IRRIGATION CANAL
CILEUMEUH SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral H III-6 Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Deisgn of Bed Elv.	Deisgn of Water Surface Elv.	Deisgn of Top Bank Elv.	Structures	Remarks
H III-6						
0 + 000	19.01	17.96	18.44	18.84		
0 + 050	18.79	17.77	18.25	18.65	Parshall Flume	0.30 m width
0 + 200	18.50	17.17	17.65	18.05		
0 + 400	17.60	17.01	17.49	17.89	FTO	
0 + 600	17.00	16.85	17.33	17.73		
0 + 800	17.00	16.69	17.17	17.57		
1 + 000	17.00	16.53	17.01	17.41		
1 + 200	17.00	16.37	16.85	17.25		
1 + 300	17.50	16.53	16.69	17.09		
1 + 400	17.80	16.05	16.53	16.93	FTO	
1 + 485	17.70	15.89	16.37	17.77	Wasteway	To Cikawung River

TABLE B-9

HYDRAULIC DATA OF IRRIGATION CANAL
CILOPADANG SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral G III-1 and G III-2 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Water Surface Elv.	Top Bank Elv.	Structures	Remarks
G III-1						
0 + 000	25.43	25.18	25.63	26.03		
0 + 050	25.41	25.14	25.59	25.99	Parshall Flume	0.31 m width
0 + 100	25.00	24.93	25.43	25.75		
0 + 200	24.50	24.90	25.35	25.75	0.90 m drop	
0 + 300	24.05	23.92	24.37	24.77		
0 + 375	23.99	23.86	24.31	24.71	FTO	
0 + 400	23.70	23.83	24.28	24.68		
0 + 500	23.57	23.75	24.20	24.60		
0 + 575	23.57	23.69	24.14	24.54	FTO	
0 + 600	23.40	23.59	24.02	24.58		
0 + 700	22.70	22.01	22.44	22.82	1.50 m drop	
0 + 775	22.60	21.95	22.38	22.76	FTO	
0 + 900	21.35	21.84	22.27	22.67	1.00 m drop	
1 + 000	21.30	19.75	20.18	20.58		
1 + 200	21.25	19.58	20.01	20.41		
1 + 400	21.45	19.41	19.84	20.24		
1 + 600	21.40	19.24	19.67	20.07		
1 + 625	21.36	19.22	19.65	20.05	FTO	
1 + 825	21.29	19.05	19.48	19.88	Wasteway	To Cilopadang River
G III-2						
0 + 000	25.43	25.07	25.63	26.03	Culvert and Turnout	
0 + 050	25.43	25.03	25.59	25.99	Parshall Flume	0.61 m width
0 + 100	25.80	24.85	25.41	25.81		
0 + 200	25.90	24.78	25.34	25.74		
0 + 400	26.30	24.62	25.18	25.58		
0 + 600	25.10	24.47	25.03	25.43		
0 + 800	25.00	24.31	24.87	25.27		

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TABLE B-10

HYDRAULIC DATA OF IRRIGATION CANAL

CILOPADANG SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral G III-2 Canal Elevation Alignmnet and **Structure Location**

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
G III-2						
1 + 000	25.36	24.16	24.72	25.12		
1 + 200	24.50	24.01	24.57	24.97		
1 + 400	23.85	23.35	23.91	24.31	0.50 m drop	
1 + 600	23.00	23.20	23.76	24.16		
1 + 800	23.50	23.05	23.61	24.01	FTO	
2 + 000	23.20	22.98	23.46	23.86		
2 + 200	23.65	22.89	23.42	23.82		
2 + 400	23.50	22.75	23.42	23.82		
2 + 600	23.50	22.61	23.42	23.82	Check	
2 + 800	24.10	22.36	22.84	23.24		
2 + 810	24.10	22.36	22.84	23.24	FTO	
3 + 000	23.60	22.26	22.89	23.24		
3 + 200	23.65	22.33	22.89	23.29	Check	
3 + 400	23.50	22.16	22.30	22.70		
3 + 600	23.50	21.98	22.13	22.53		
3 + 700	23.00	21.90	22.04	22.44		
3 + 710	23.00	21.89	22.03	23.43	2 FTO	
3 + 800	24.10	21.81	21.96	22.36		
4 + 000	23.60	21.64	21.79	22.19		
4 + 200	22.70	21.14	21.63	22.03		
4 + 600	20.80	20.88	21.38	21.78		
4 + 800	20.60	20.71	21.20	21.60	Wasteway	

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TABLE B-11

HYDRAULIC DATA OF IRRIGATION CANAL
CIJAKI SYSTEM, MAJENANG PROJECT AREA

Canal Code: Primary U I-1 — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
U I-1						
0 + 000	45.00	44.69	45.57	46.07	Intake	Design
0 + 050	40.00	44.47	45.35	45.85	Parshall Flume	1.52 m width
0 + 200	41.90	41.46	42.34	42.84	3.0 m drop	
0 + 300	39.82	38.43	39.31	39.81	Intake and 3.0m drop	Existing canal
0 + 330	37.50	36.42	37.30	37.80	FTO	
0 + 370	37.00	36.41	37.29	37.79	TO	
0 + 410	35.54	34.40	35.28	35.78	FTO	
0 + 600	33.50	32.85	33.73	34.23	2.00 m drop	
0 + 800	32.11	30.80	31.68	32.18	2.00 m drop	
1 + 000	29.10	27.86	28.74	29.24	2.00 m drop	
1 + 200	28.00	26.81	27.69	28.19	1.00 m drop	
1 + 400	27.25	26.76	27.64	28.14		
1 + 450	27.02	25.80	26.20	26.70	1.40 m drop	
1 + 525	26.00	25.84	26.14	26.64	FTO	
1 + 600	26.05	21.28	21.08	22.58	2.45 m drop and FTO	
1 + 625	26.00	20.82	21.62	22.12	FTO	
1 + 800	25.80	20.74	21.54	22.04		
1 + 900	25.60	20.68	21.48	21.98		
2 + 000	24.75	20.62	21.42	21.92		
2 + 200	23.60	20.51	21.31	21.81		
2 + 400	22.95	20.40	21.20	21.70		
2 + 600	22.40	20.33	21.13	21.67		
2 + 800	21.20	20.26	21.06	21.56		
2 + 900	21.00	19.20	20.00	20.50	1.0 m drop; Bifurcation	

TABLE B-12

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Primary and Secondary U I-2 and U II-1 Canal Elevation, Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
U I-2						
0 + 000	48.83	44.76	45.57	46.07		
0 + 115	43.73	44.32	45.31	45.63	Romijn gate	Existing
0 + 150	43.50	44.24	45.05	45.55	Parshall Flume	1.52 m width
0 + 200	43.80	43.21	44.02	44.52	1 m drop	
0 + 400	39.92	40.11	40.92	41.42	3.0 m drop	
0 + 600	37.10	37.01	37.82	38.32	3.0 m drop	
0 + 800	34.95	36.91	37.72	38.22	2.0 m drop	
0 + 925	31.70	36.85	37.66	38.16	Culvert and TO	Existing
1 + 000	31.80	33.67	34.42	34.92	3.0 m drop	
1 + 200	28.48	30.57	31.32	31.82	3.0 m drop	
1 + 235	28.90	27.55	28.30	28.80	Culvert	Existing
1 + 400	27.60	27.60	27.21	27.71	1.0 m drop	
1 + 555	26.40	25.36	26.11	26.61	Culvert	Existing
1 + 600	26.40	25.33	20.08	26.58	1.0 m drop	
1 + 800	26.00	25.20	25.95	26.45	Culvert	
1 + 875	25.25	24.15	24.90	25.40	1.0 m drop	
Canal Code: Secondary						
U II-1						
0 + 000	21.00	20.32	21.20	21.70	Intake and FTO	
0 + 150	20.60	19.99	20.87	21.37	Parshall Flume	0.91 m width
0 + 180	23.30	19.97	20.85	21.35	FTO	
0 + 200	20.60	19.75	20.63	21.13		
0 + 400	21.00	19.62	20.50	21.00	TO and Culvert	
0 + 600	20.10	19.29	20.17	20.67		
0 + 800	21.00	19.16	20.04	20.54		

TABLE B-13

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Secondary U II-2 — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
2 + 000	19.05	17.78	18.54	19.04		
2 + 200	19.40	17.65	18.41	18.91		
2 + 350	19.00	17.55	18.31	18.81	FTO	
2 + 400	19.00	17.42	18.18	18.58		
2 + 600	18.40	17.29	18.05	18.55		
2 + 800	18.10	17.21	17.90	18.40		
3 + 000	18.30	17.06	17.75	18.25		
3 + 200	18.68	16.99	17.68	18.18		
3 + 400	18.05	16.84	17.53	18.03		
3 + 550	17.16	16.73	17.42	17.92		
3 + 600	17.30	16.78	17.38	17.88		
3 + 640	17.00	16.76	17.36	17.86	FTO	
3 + 800	17.20	16.64	17.24	17.74		
3 + 900	17.30	16.56	17.16	17.66		
3 + 950	17.50	16.52	17.12	17.62		
U II-2						
0 + 000	25.25	25.02	25.75	26.20	FTO	
0 + 050	25.15	24.78	25.51	25.96	Parshall Flume	0.61 m width
0 + 200	24.00	23.67	24.40	24.85	1.00 m drop	
0 + 400	22.75	22.52	23.25	23.60	2.00 m drop	
0 + 550	21.75	21.52	22.25	22.60	FTO and 0.7 m drop	
0 + 600	21.09	21.48	22.21	22.76	0.50 m drop	
0 + 800	20.30	20.33	21.05	21.50		
1 + 000	19.60	19.17	19.90	20.35	1.0 m drop	
1 + 200	19.40	19.02	19.75	20.20		
1 + 400	19.02	18.86	19.59	20.04		
1 + 600	18.67	18.71	19.44	19.99		
1 + 700	18.75	18.50	19.19	19.64	2 FTO	
1 + 800	19.19	18.42	19.11	19.51		

TABLE B-14

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Secondary and Lateral U III-1 and U III-2 Canal Elevation Alignmnet and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
2 + 000	19.05	18.27	18.95	19.35		
2 + 200	18.90	18.12	18.81	19.26		
2 + 300	18.99	18.04	18.73	19.13	2 FTO and Culvert	
2 + 400	19.15	17.89	18.58	18.98		
2 + 600	18.42	17.74	18.43	18.83		
2 + 800	18.65	17.59	18.28	18.68		
3 + 000	18.91	17.44	18.13	18.53		
3 + 100	18.60	17.36	18.05	18.45		
3 + 145	18.40	17.53	18.02	18.42	FTO	
LATERAL						
U III-1						
0 + 000	21.00	21.89	22.40	21.80	FTO	
0 + 050	21.00	20.68	21.19	21.59	Parshall Flume	o.30 m width
0 + 200	18.90	21.56	21.07	21.47	1.50 m drop	
0 + 400	19.60	20.40	20.91	21.39		
0 + 600	18.80	19.24	19.75	20.15	1 m drop	
0 + 800	19.20	19.09	19.60	20.00	2 FTO	
1 + 000	18.80	18.99	19.35	19.75		
1 + 200	18.00	18.33	18.69	19.09	0.50 m drop	
1 + 400	17.60	17.68	18.04	18.44	0.50 m drop	
1 + 550	17.70	17.56	17.92	18.32	2 FTO and 0.50 m drop	
1 + 600	17.50	17.52	17.88	18.28	Waste way	To Cigalagah Riv
U III-2						
0 + 000	20.45	20.51	21.02	21.42		
0 + 050	20.45	20.29	20.80	21.20	Parshall Flume	o.30 m width
0 + 200	18.90	20.17	20.68	21.08		

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TABLE B-15

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-3 — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
0 + 400	19.60	20.01	20.53	20.93		
0 + 500	20.52	19.94	20.45	20.85	FTO	
0 + 600	18.80	19.61	20.12	20.52		
0 + 800	19.20	19.53	20.04	20.44		
1 + 000	18.18	19.38	19.99	20.39		
1 + 110	17.15	19.29	19.80	20.20	FTO	
1 + 200	17.70	19.25	19.73	20.13		
1 + 400	17.00	18.10	18.58	18.98	1.00 m drop	
1 + 600	17.20	17.94	18.42	18.82		
1 + 800	16.50	17.79	18.27	18.67		
2 + 000	16.00	17.14	17.62	18.02	0.5 m drop	
2 + 120	17.15	16.96	17.42	17.82	2 FTO	
2 + 200	16.60	16.88	17.36	17.76		
2 + 400	15.40	16.72	17.20	17.60		
2 + 600	13.25	15.57	16.05	16.45	1.00 m drop	
2 + 800	15.00	15.09	15.57	15.97	FTO	
2 + 850	15.00	15.05	15.53	15.93	Wasteway	
U III-3						
0 + 000	19.70	20.62	21.02	21.42	FTO	
0 + 050	19.70	20.44	20.84	21.24	Parshall Flume	0.300 m drop
0 + 200	19.00	19.32	19.72	20.12	1 m drop	
0 + 400	18.65	19.16	19.56	19.96		
0 + 600	18.00	19.01	19.41	19.81	1 m drop	
0 + 800	18.30	17.85	18.25	18.65		
1 + 000	17.50	17.69	18.09	18.49		
1 + 150	17.50	17.57	17.97	18.37	Culvert	
1 + 200	17.60	17.53	17.93	18.33	0.40 m drop	
1 + 275	17.30	16.97	17.37	17.77	Culvert and FTO	

TABLE B-16

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-4 and U III-5 (Continued) Canal Elevation Alignmnet and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
U III-4						
0 + 000	17.50	17.76	18.20	18.60		
0 + 050	17.50	17.59	18.03	18.43	Parshall Flume	0.30 m width
0 + 200	16.90	17.47	17.91	18.31		
0 + 310	17.29	17.38	17.82	18.22	2 FTO	
0 + 400	16.40	17.21	17.64	18.04		
0 + 600	16.35	17.05	17.49	17.89		
0 + 800	16.15	17.89	17.33	17.73		
1 + 000	16.05	16.73	17.17	17.57		
1 + 200	16.75	16.57	17.01	17.41		
1 + 325	16.02	16.52	16.91	18.31	Siphon	Cross Drain
1 + 400	16.65	16.46	16.85	17.25		
1 + 525	16.57	16.36	16.75	17.05	FTO	
1 + 550	16.55	16.34	16.73	17.03	Wasteway	To Cijalu River
U III-5						
0 + 000	43.75	41.75	42.17	42.57		
0 + 025	43.75	41.73	42.15	42.55		
0 + 050	41.70	41.59	42.01	42.41	Parshall Flume	0.30 m width
0 + 200	40.50	38.47	38.89	39.29	3 m drop	
0 + 400	37.00	35.31	35.73	36.13	3.00 m drop	
0 + 450	35.00	35.07	35.49	35.89	Bifurcation and culvert	
0 + 500	29.22	32.03	32.45	32.85	FTO and 3.00 m drop	
0 + 600	33.45	28.97	29.36	29.76	3.00 m drop	
0 + 800	31.05	25.41	25.80	26.20	3.00 m drop	
1 + 000	28.50	25.24	25.63	26.03		
1 + 200	27.40	25.06	25.45	25.85		
1 + 380	25.00	24.91	25.30	25.70	FTO and Culvert	
1 + 400	27.50	24.78	25.17	25.57	Wasteway	

TABLE B-17

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-6 and U III-7 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
0 + 450	35.00	35.07	35.49	35.89	Bifurcation and Culvert	
0 + 500	29.22	32.03	32.45	32.85	FTO and 3.00 m drop	
0 + 600	33.45	28.97	29.36	29.76	3.00 m drop	
0 + 800	31.05	25.41	25.80	26.20	3.00 m drop	
1 + 000	28.50	25.24	25.63	26.03		
1 + 200	27.40	25.06	25.45	25.86		
1 + 380	25.00	24.91	25.30	25.70	FTO and culvert	
1 + 400	27.50	24.78	25.17	25.57	Wasteway	To Cijalu River
U III-6						
0 + 000	18.40	18.13	18.69	19.09		
0 + 050	18.35	17.88	18.44	18.84	Parshall Flume	0.30 m width
0 + 200	18.20	17.76	18.32	18.72	FTO	
0 + 400	17.95	17.61	18.22	18.62		
0 + 600	18.00	17.45	18.06	18.46		
0 + 800	18.00	17.30	17.91	18.31		
1 + 000	18.30	17.33	17.75	18.15	FTO	
1 + 200	17.00	17.17	17.59	17.99		
1 + 400	16.60	17.02	17.44	17.84		
1 + 600	16.75	16.86	17.28	17.68		
1 + 800	16.75	16.70	17.12	17.52	FTO	
2 + 000	16.30	16.54	16.76	17.16		
2 + 050	16.00	16.30	16.72	17.12	Wasteway	To Cijalu River
U III-7						
0 + 000	43.81	40.00	40.44	40.84		
0 + 050	43.75	39.83	40.27	40.67	Parshall Flume	0.30 m width
0 + 200	41.00	36.71	37.15	37.55	3.00 m drop	

TABLE B-18

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-8 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
0 + 350	41.00	36.60	37.11	37.44	Culvert	
0 + 400	41.10	36.56	37.00	37.40		
0 + 600	36.90	36.41	36.85	37.25	Culvert	
0 + 800	32.05	32.25	32.69	33.09	4.00 m drop	
1 + 000	28.95	29.10	29.53	29.93	4.00 m drop	
1 + 030	28.95	29.08	29.51	29.91	Culvert	
1 + 200	27.25	28.94	29.38	29.78		
1 + 400	26.40	26.79	27.23	27.63	2 m drop	
0 + 450	26.51	26.55	26.99	27.39	FTO	
1 + 600	25.50	26.43	26.87	27.27		
1 + 800	23.40	23.28	23.72	24.17	3.00 m drop	
2 + 000	22.00	21.62	22.06	22.46	1.50 m drop	
0 + 050	21.50	21.60	21.93	22.33	FTO	
2 + 200	21.90	21.27	21.75	22.11		
2 + 400	22.00	21.12	21.56	21.96		
2 + 600	21.50	19.97	20.41	20.81	1.00 m drop	
2 + 700	20.87	19.61	20.05	20.45	FTO	
2 + 800	20.50	19.46	19.90	20.30		
3 + 000	20.00	19.30	19.74	20.14		
3 + 200	20.00	19.15	19.59	19.99		
3 + 400	20.00	19.00	19.44	19.84		
3 + 500	20.00	18.92	19.36	19.76	Wateway	To Cilopadang River
U III-8						
0 + 000	41.00	38.00	38.41	38.81		
0 + 050	40.50	37.86	38.27	38.67	Parshall Flume	0.30 m width
0 + 200	37.50	32.74	32.15	32.55	5.00 m drop	
0 + 400	33.65	31.58	31.99	32.39		
0 + 600	29.50	28.41	28.82	29.22	3.00 m drop	
0 + 800	27.10	25.25	25.66	26.06	3.00 m drop	

TABLE B-19

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-8; U III-9; U III-10 and U III-11 (Continued)

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Canal Elevation Alignment and Structure Location: Structures	Remarks
U III-8						
1 + 000	25.00	24.08	24.49	24.89	1.00 m drop	
1 + 200	23.50	23.92	24.33	24.73	FTO	
1 + 250	24.60	23.60	23.99	24.39	FTO	
1 + 400	24.25	23.48	23.87	24.27		
1 + 560	23.80	23.35	23.74	24.14	Wasteway	To Cilopadnag River
U III-9						
0 + 000	25.60	25.93	26.33	26.73		
0 + 050	25.40	25.82	26.22	26.62	Parshall Flume	0.30 m width
0 + 200	25.70	25.69	26.09	26.49		
0 + 210	26.10	25.67	26.07	26.47	FTO	
0 + 400	24.50	23.90	24.30	24.70	1.00 m drop	
0 + 550	23.80	23.73	24.17	24.57	FTO	
0 + 560	3.60	23.71	24.15	24.55	Wasteway	To Cikanday River
U III-10						
0 + 000	32.11	31.15	31.50	31.90		
0 + 050	32.00	31.01	31.41	31.81	Parshall Flume	0.30 m width
0 + 200	29.90	28.88	29.28	29.68	1 FTO and 2.00 m drop	
0 + 400	28.60	28.71	29.11	29.51		
0 + 600	27.60	26.03	26.43	26.83	2.50 m drop	
0 + 790	26.50	25.87	26.27	26.47	FTO	
U III-11						
0 + 000	39.75	40.10	40.50	40.90		
0 + 050	39.00	39.99	40.39	40.79	Parshall Flume	0.30 m width
0 + 200	36.50	36.82	37.22	37.62	3.00 m drop	
0 + 400	33.50	33.64	34.04	34.44	3.00 m drop	

TABLE B-20

HYDRAULIC DATA OF IRRIGATION CANAL
CIJALU SYSTEM, MAJENANG PROJECT AREA

Canal Code: Lateral U III-11 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of			Structures	Remarks
		Bed Elv.	Water Surface Elv.	Top Bank Elv.		
U III-11						
0 + 600	32.00	32.47	32.87	33.27	1.00 m drop	
0 + 800	32.50	32.30	32.70	33.10		
1 + 000	30.52	30.13	30.53	30.93	2.00 m drop	
1 + 170	30.30	29.98	30.38	30.78	FTO	
1 + 200	31.50	29.86	30.26	30.66		
1 + 400	31.00	28.29	28.59	28.99		
1 + 600	29.00	29.01	3.41	28.81	FTO	
1 + 635	27.00	27.88	28.28	28.68	Wasteway	To Cikanday River

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TABLE B-21

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Primary canal A - I — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Deisgn of Bed Elv.	Deisgn of Water Surface Elv.	Deisgn of Top Bank Elv.	Structures	Remarks
A - I						Existing canal
0 + 000	40.50	40.50	41.50	42.00	Scoop	Existing
0 + 100	40.50	38.58	40.48	40.98	Bifurcation	Existing
0 + 225	39.59	37.59	38.00	39.59	Flume	Existing
0 + 260	39.82	36.80	37.30	39.00	2.50 m drop	Existing
0 + 810	33.37	32.66	33.62	34.87	Intake with drop	
1 + 000	36.99	32.65	33.61	34.86		
1 + 200	34.34	32.59	33.50	34.00		
1 + 400	33.35	32.48	33.39	33.89		
1 + 600	35.01	32.38	33.29	33.79		
1 + 800	34.86	32.27	33.18	33.68		
2 + 000	32.67	32.17	33.08	33.58	Turnout	A II-1
2 + 200	31.92	31.86	32.77	33.27	Farm turnout	Kampung serve
2 + 400	30.68	31.82	33.40	32.85		
2 + 500	30.13	31.71	32.29	32.74	Farm turnout	Kampung serve
2 + 800	28.97	31.49	32.07	32.52	Farm turnout	Kampung serve
3 + 000	28.33	31.30	31.88	32.33		
3 + 200	28.29	31.15	31.73	32.18		
3 + 400	28.19	31.00	31.58	31.98		
3 + 600	27.92	30.84	31.42	31.82		
3 + 800	27.77	30.69	31.27	31.67		
4 + 000	27.36	30.54	31.12	31.57		
4 + 200	27.07	30.39	30.96	31.36		
4 + 400	26.48	30.24	29.66	30.06		
4 + 500	26.61	29.00	29.58	30.03	Concrete canal	Existing

TABLE B-22

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Secondary A II-1 and A II-2 — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Deisgn of Bed Elv.	Deisgn of Water Surface Elv.	Deisgn of Top Bank Elv.	Structures	Remarks
A II-1						
0 + 000	32.67	29.27	29.88	30.28	Intake with 2.80 m drop	
0 + 050	27.20	26.43	27.04	27.44	Parshall Flume	0.61 m width
0 + 110	25.60	22.19	22.80	23.20	Bifurcation with 3.400 m drop	
0 + 300	23.97	22.12	22.65	23.15	Farm turnout	
0 + 400	23.59	21.96	22.49	22.89		
0 + 600	20.90	19.81	20.34	20.74	2.0 m drop	
0 + 800	17.99	19.65	20.18	20.58		
1 + 000	17.14	19.50	20.03	20.43		
1 + 200	16.86	19.34	19.87	20.27	2.0 m drop	
1 + 290	15.84	16.27	16.80	17.20	Bridge	
1 + 300	15.84	16.27	16.80	17.20	FTO	
1 + 500	15.81	15.51	15.88	16.28		
1 + 700	15.77	15.38	15.88	16.28		
1 + 750	16.13	15.34	15.84	16.24	FTO	
A II-2						
0 + 000	32.66	32.31	33.08	33.53	3.0 m drop	
0 + 050	31.01	28.51	29.28	29.73	Parshall Flume	0.61 m width
0 + 120	29.28	28.23	29.00	29.45	Culvert	
0 + 200	28.67	25.68	26.45	26.90	2.50 m drop	
0 + 420	27.12	25.53	26.30	26.75	Culvert	
0 + 440	27.12	25.52	26.29	26.74	T.O.	To II-2L
0 + 600	24.69	24.41	25.18	25.63	Bifurcation with 1.00 m drop	A IIR & A II-4

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TABLE B-23

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Secondary A II-2R and A II-2L — Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
A II-2R						
0 + 000	24.69	24.41	25.18	25.63		
0 + 050	24.09	23.32	24.03	24.48	Culvert and 1.00 m drop	
0 + 100	23.09	23.09	23.80	24.25	Parshall Flume	0.61 m width
0 + 200	22.34	22.01	22.72	23.17	1.00 m drop and culvert	50 m distance
0 + 250	20.80	18.97	19.69	20.14	3.00 m drop and FTO	25 m distance
0 + 400	19.43	18.65	19.36	19.81		
0 + 600	17.85	15.70	61.41	16.96	3.00 m drop	
0 + 760	15.58	16.29	16.29	16.74	Culvert	A 11
0 + 770	15.41	15.56	16.27	16.72	FTO	
0 + 800	14.07	12.44	12.15	14.60	2.00 m drop	
1 + 000	11.00	12.28	12.99	12.44	1.00 m drop	
1 + 200	12.20	12.12	12.83	13.28		
1 + 285	12.84	12.05	12.76	13.21	FTO	A 12
1 + 400	12.98	12.03	12.67	13.12		
1 + 600	11.98	12.00	12.51	12.96		
1 + 800	11.53	11.84	12.35	12.80		
1 + 900	11.39	11.77	12.27	12.72	Cross drian & FTO	A 12
A II-2L						
0 + 000	27.12	25.54	26.09	26.49		
0 + 050	27.12	25.50	26.05	26.45	Parshall Flume	0.30 m width
0 + 100	26.18	25.25	25.80	26.20	Culvert	
0 + 200	26.27	22.18	22.73	23.13	3.00 m drop	
0 + 400	24.50	19.04	19.58	19.98	3.00 m drop	
0 + 550	23.81	18.93	19.48	19.88	Culvert	
0 + 600	19.99	17.90	18.45	18.85	FTO with 1.00 m drop	A 20
0 + 800	17.42	17.75	18.30	18.70		

TABLE B-24

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Lateral A III-1 and A III-2 (Continued) Canal Elevation Alignmnet and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
A III-1						
0 + 000	16.30	16.10	16.50	16.90	Intake and FTO	A 3
0 + 050	16.30	15.95	16.46	16.86	Parshall Flume	0.30 m width
0 + 200	16.30	15.75	16.26	16.66		
0 + 400	18.88	15.00	16.11	16.51		
0 + 600	16.00	14.44	15.95	16.35		
0 + 800	14.25	13.79	14.30	14.70	1.50 m drop	
0 + 900	13.66	12.72	14.23	14.63		
1 + 000	13.38	12.64	13.15	13.55	1.00 m drop	
1 + 200	13.20	12.49	13.00	13.40		
1 + 275	13.20	12.43	12.94	13.34	FTO	
1 + 400	12.80	12.34	12.85	13.25		
1 + 600	13.50	12.18	12.69	13.09		
1 + 800	13.20	12.03	12.54	12.94		
1 + 900	13.75	11.88	12.39	12.79	FTO	
1 + 950	13.75	12.81	12.32	12.72	Wasteway	
A III-2						
0 + 000	22.82	22.35	22.80	23.20	Intake	
0 + 050	22.82	22.31	22.76	23.16	Parshall Flume	0.30 m width
0 + 100	22.03	21.27	22.59	22.99	0.85 m drop	
0 + 210	24.06	21.20	21.67	22.07	Culvert	Existing
0 + 300	19.40	18.12	18.59	18.99	3.0 m drop	
0 + 400	17.75	17.05	17.72	18.12	0.80 m drop	
0 + 500	17.02	16.97	17.04	17.44	FTO and 0.6 m drop	
0 + 600	16.90	15.89	16.96	17.36		
0 + 700	16.05	15.97	16.89	17.29		
0 + 800	15.75	14.89	15.81	16.21	Culvert and 1 m drop	
0 + 900	15.48	14.82	15.74	16.14		
0 + 975	15.25	14.76	15.68	16.08	2 FTO	
1 + 025	15.15	14.74	15.66	16.06	Wasteway	To Jojogan vill drain

TABLE B-25

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Lateral A III-3 and A III-4 (Continued) Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
A III-3						
0 + 000	12.64	12.76	13.20	13.60		
0 + 050	12.60	12.60	13.04	13.44	Parshall Flume	0.30 m width
0 + 100	12.30	11.08	12.05	12.45	1.70 m drop	
0 + 200	11.90	11.61	11.97	12.37		
0 + 400	11.40	10.96	11.82	11.72	0.50 m drop	
0 + 600	11.90	10.77	11.67	11.57		
0 + 800	11.69	10.57	11.51	11.41	FTO	
1 + 000	11.56	10.42	11.36	11.76	Pipe Syphon	Cross drain
1 + 200	11.72	10.27	11.21	11.11		
1 + 400	11.67	10.85	11.05	10.96		
1 + 500	11.50	10.77	10.97	11.37	Wasteway	To Kali Serang
A III-4						
0 + 000	24.69	24.44	24.98	25.38		
0 + 070	24.69	24.39	24.93	25.33	Culvert	
0 + 150	27.45	24.33	24.87	25.27	Culvert	
0 + 250	23.25	20.19	20.73	24.13	4.00 m drop	
0 + 350	19.69	19.90	20.52	20.92	Parshall Flume	0.30 m width
0 + 550	16.32	17.34	17.88	18.28	FTO with 2.50 m drop	A 16
0 + 750	14.19	14.20	14.74	15.14	3 m drop	
0 + 950	11.75	12.05	12.60	13.00	2.00 m drop	
1 + 150	10.95	11.91	12.45	12.85		
1 + 350	11.06	11.77	12.31	12.71		
1 + 450	11.53	11.63	12.17	12.57	FTO	To A 17
1 + 600	11.40	11.52	12.01	12.41		
1 + 800	11.41	11.38	11.87	12.27		

TABLE B-26

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Lateral A III-4; A III-5; A III-6 and A III-7 (Continued)

Canal Elevation Alignmnet and Structure Location

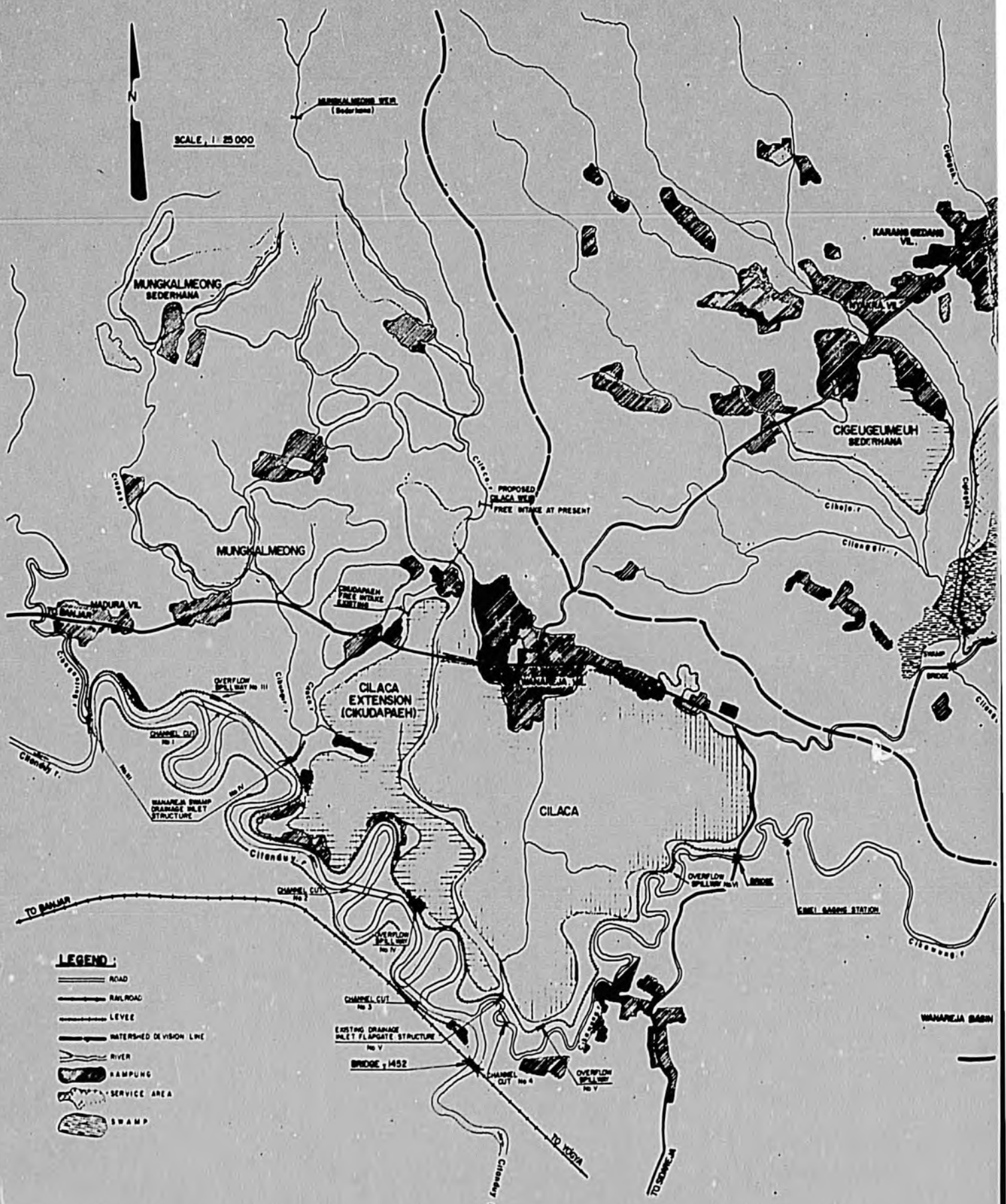
Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
A III-4						
2 + 000	11.38	11.24	11.73	12.13		
2 + 200	11.44	11.09	11.59	11.99		
2 + 250	11.42	11.05	11.55	11.95	FTO	A 18
2 + 400	11.30	10.94	11.50	11.90	Wateway	
A III-5						
0 + 000	25.49	24.63	25.06	25.49	Turnout	
0 + 050	25.00	24.59	25.02	25.42	Parshall Flume	0,30 m width
0 + 100	24.00	20.99	21.42	21.82	3.40 m drop	
0 + 200	22.31	20.90	21.33	21.73		
0 + 250	21.09	20.86	21.29	21.69	Farm Turnout	
A III-6						
0 + 000	26.48	20.90	21.30	21.70		
0 + 050	26.30	20.76	21.26	21.56	Parshall Flume	0.30 m width
0 + 100	23.90	20.83	21.05	21.45	3.00 m drop	
0 + 200	17.20	27.75	18.15	18.55	3.00 m drop	
0 + 300	17.00	16.68	17.08	17.48	1.00 m drop	
0 + 400	16.17	15.60	17.00	17.40	1.00 m drop	
0 + 500	16.15	15.53	16.93	17.37		
0 + 600	16.10	15.46	16.85	17.25		
0 + 700	14.05	13.87	14.27	14.67	2 FTO and 2.50 m drop	
0 + 800	13.87	13.81	13.19	13.59	FTO and 1.00 m drop	
0 + 850	13.29	12.71	13.11	13.51	Wasteway	To Cibeureum Village drain
A III-7						
0 + 000	26.58	17.00	17.37	17.77	FTO	
0 + 050	26.55	16.86	17.26	17.66	Parshall Flume	0.30 m width

TABLE B-27

HYDRAULIC DATA OF IRRIGATION CANAL
CILACA SYSTEM, WANAREJA PROJECT AREA

Canal Code: Tertiary A III-7; A III-8 and A III-9 Canal Elevation Alignment and Structure Location

Station	(+ msl) Ground Surface Elv.	Design of Bed Elv.	Design of Water Surface Elv.	Design of Top Bank Elv.	Structures	Remarks
A III-7						
0 + 200	17.20	16.83	17.14	17.54	Parshall Flume	0.30 m width
0 + 325	17.20	16.36	16.67	17.07	FTO	
0 + 400	14.00	13.08	13.98	14.38	3.00 m drop	
0 + 600	13.50	12.91	13.31	13.75	0.50 m drop	
0 + 800	13.07	12.75	13.15	13.55		
0 + 950	13.13	12.63	12.03	13.43	FTO	
1 + 200	12.10	11.42	11.82	13.22		
1 + 375	11.50	11.78	11.58	11.98	Wasteway	To Cikawung River
A III-8						
0 + 000	13.12	12.93	13.32	13.72	Turnout	
0 + 050	13.10	12.89	13.28	13.68	Parshall Flume	0.30 m width
0 + 200	12.50	12.77	12.41	12.81		
0 + 400	12.70	11.88	12.25	12.65		
0 + 600	12.80	11.70	12.09	12.49		
0 + 800	12.50	11.54	11.92	12.32	Farm Turnout	
1 + 000	12.40	11.21	11.60	12.00		
1 + 100	12.60	11.05	11.44	11.84	Wasteway	To Cikawung River
A III-9						
0 + 000	15.44	15.20	15.64	16.04	Turnout	
0 + 050	15.44	15.03	15.47	15.87	Parshall Flume	0.30 m width
0 + 200	14.10	13.96	14.40	14.25	1.35 m drop	
0 + 400	13.76	13.81	14.25	14.10		
0 + 475	13.70	13.75	14.19	14.04	FTO	
0 + 600	14.55	13.66	14.10	13.95		
0 + 800	14.23	13.50	13.94	13.79	FTO	
0 + 925	17.20	13.19	13.63	13.69	FTO	
0 + 975	17.10	13.17	13.61	13.67	Wasteway	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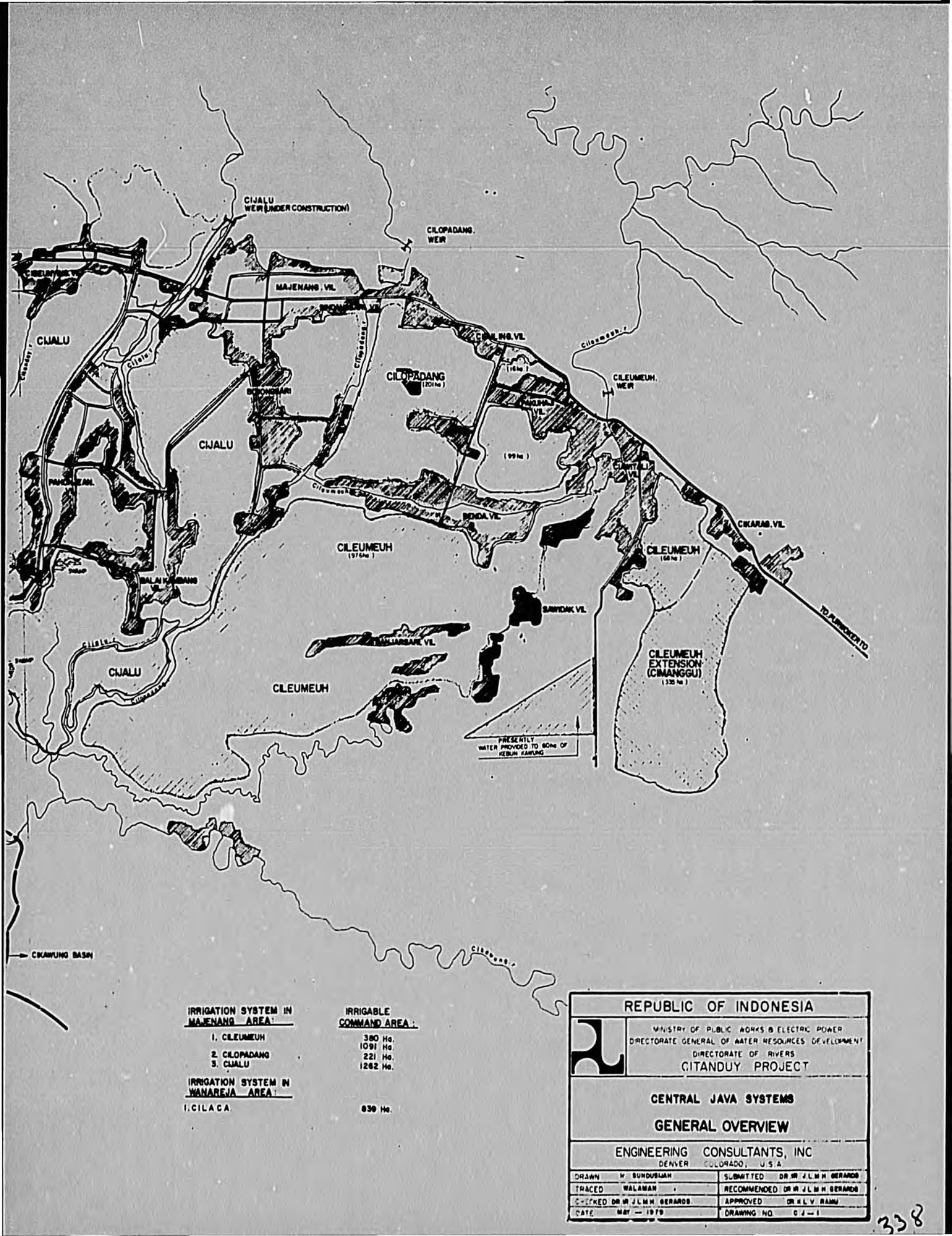
SCALE, 1 : 25 000
MUNGKALMEONG WEIR
(Sedurkana)
MUNGKALMEONG
SEDERHANA
KARANG GEDANG VIL.
CIGEUGEUMEUH
SEDERHANA
PROPOSED
CILACA WEIR
FREE INTAKE AT PRESENT
MUNGKALMEONG
CIKUDAPAEH
FREE INTAKE
EXISTING
MADURA VIL.
TO BANJAR
OVERFLOW
SPILLWAY No III
CILACA
EXTENSION
(CIKUDAPAEH)
CHANNEL CUT
No I
WANAREJA SWAMP
DRAINAGE INLET
STRUCTURE
No II
CILACA
CHANNEL CUT
No 2
TO BANJAR
OVERFLOW
SPILLWAY
No IV
OVERFLOW
SPILLWAY No VI
BRIDGE
KIMEL BARRIS STATION
SWAMP
BRIDGE
WANAREJA BASIN
CHANNEL CUT
No 3
EXISTING DRAINAGE
INLET FLAPGATE STRUCTURE
No V
BRIDGE, 1452
CHANNEL
CUT No 4
OVERFLOW
SPILLWAY
No V
TO YOGYA
TO SOMPEJA
LEGEND :
ROAD
RAILROAD
LEVEE
WATERSHED DEVISION LINE
RIVER
KAMPUNG
SERVICE AREA
SWAMP



IRRIGATION SYSTEM IN MAJENANG AREA:	IRRIGABLE COMMAND AREA:
1. CILEUMEUH	380 Ha.
2. CILOPADANG	1091 Ha.
3. CIJALU	221 Ha.
	1262 Ha.
IRRIGATION SYSTEM IN WANAREJA AREA:	
1. CILACA	830 Ha.

REPUBLIC OF INDONESIA

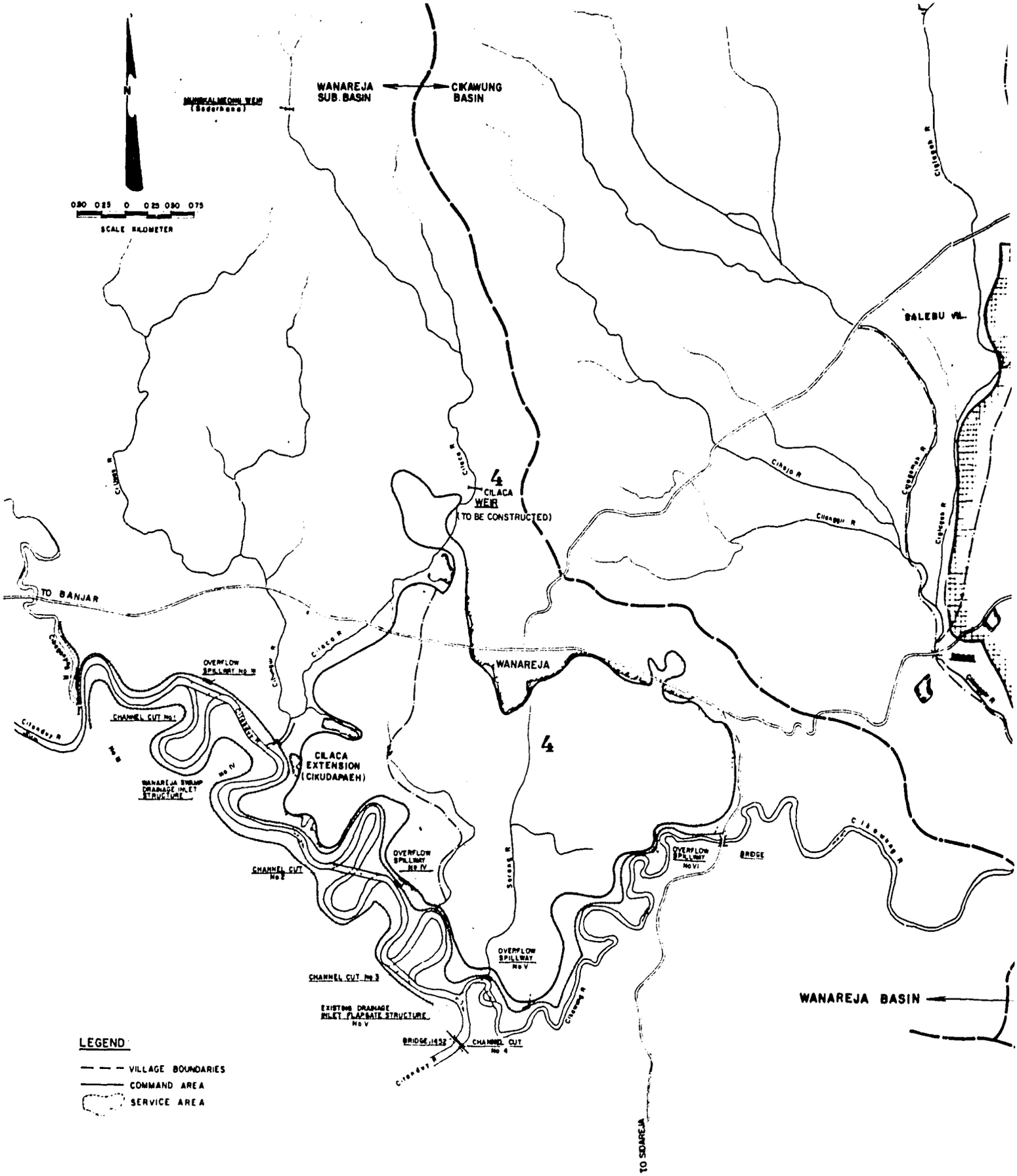
MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

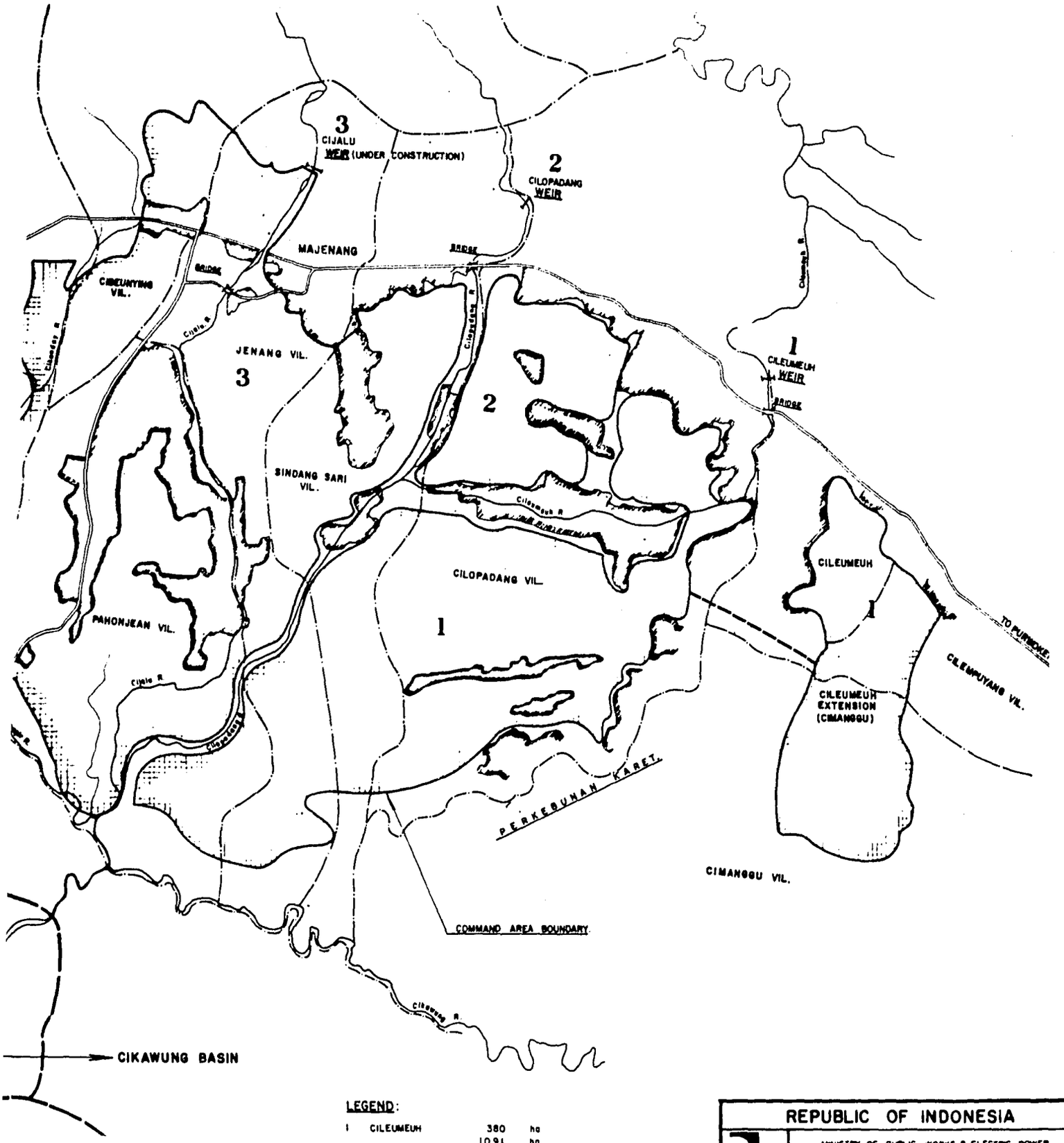
CENTRAL JAVA SYSTEMS

GENERAL OVERVIEW

ENGINEERING CONSULTANTS, INC
DENVER COLORADO, U.S.A.

DRAWN	H. SUNDUSWAN	SUBMITTED	DR. IR. J.L.M.H. GERARDS
TRACED	WALAMAN	RECOMMENDED	DR. IR. J.L.M.H. GERARDS
CHECKED	DR. IR. J.L.M.H. GERARDS	APPROVED	DR. K.L.V. RAMU
DATE	MAY — 1979	DRAWING NO.	C J — 1


N
WANAREJA SUB. BASIN
CIKAWUNG BASIN
SCALE KILOMETER
BALEBU VIL.
CILACA WEIR
(TO BE CONSTRUCTED)
TO BANJAR
WANAREJA
OVERFLOW SPILLWAY No III
CHANNEL CUT No 1
CILACA EXTENSION (CIKUDAPAEH)
WANAREJA SWAMP DRAINAGE INLET STRUCTURE
OVERFLOW SPILLWAY No IV
CHANNEL CUT No 2
OVERFLOW SPILLWAY No V
CHANNEL CUT No 3
EXISTING DRAINAGE INLET FLAPGATE STRUCTURE No V
BRIDGE 1932
CHANNEL CUT No 4
OVERFLOW SPILLWAY No VI
BRIDGE
TO SIDAREJA
WANAREJA BASIN
LEGEND
VILLAGE BOUNDARIES
COMMAND AREA
SERVICE AREA



LEGEND:

1	CILEUMEUH	380	ha
		1091	ha
2.	CILOPADANG	221	ha
3.	CIJALU	1262	ha
4.	CILACA	839	ha.

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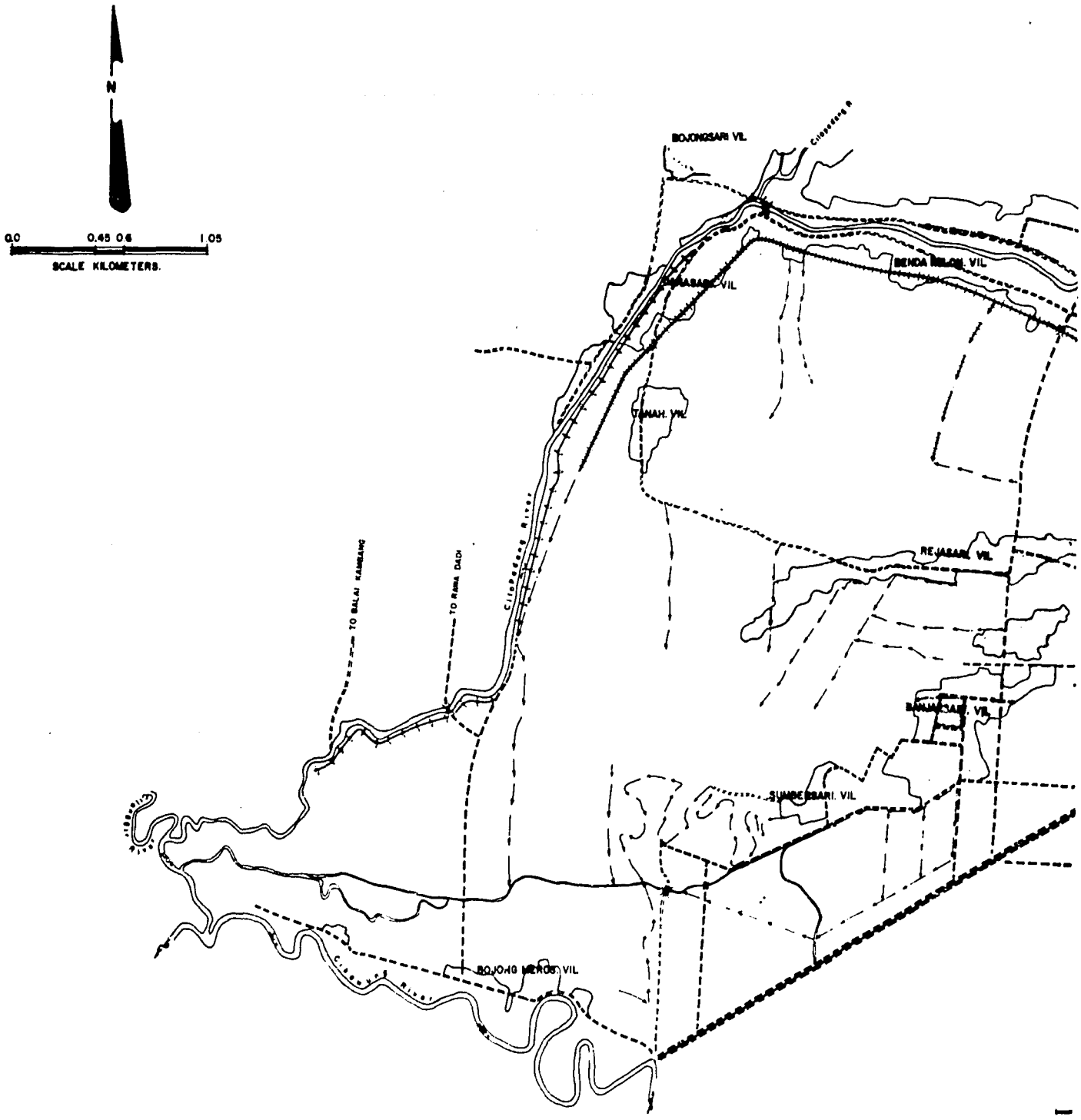
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

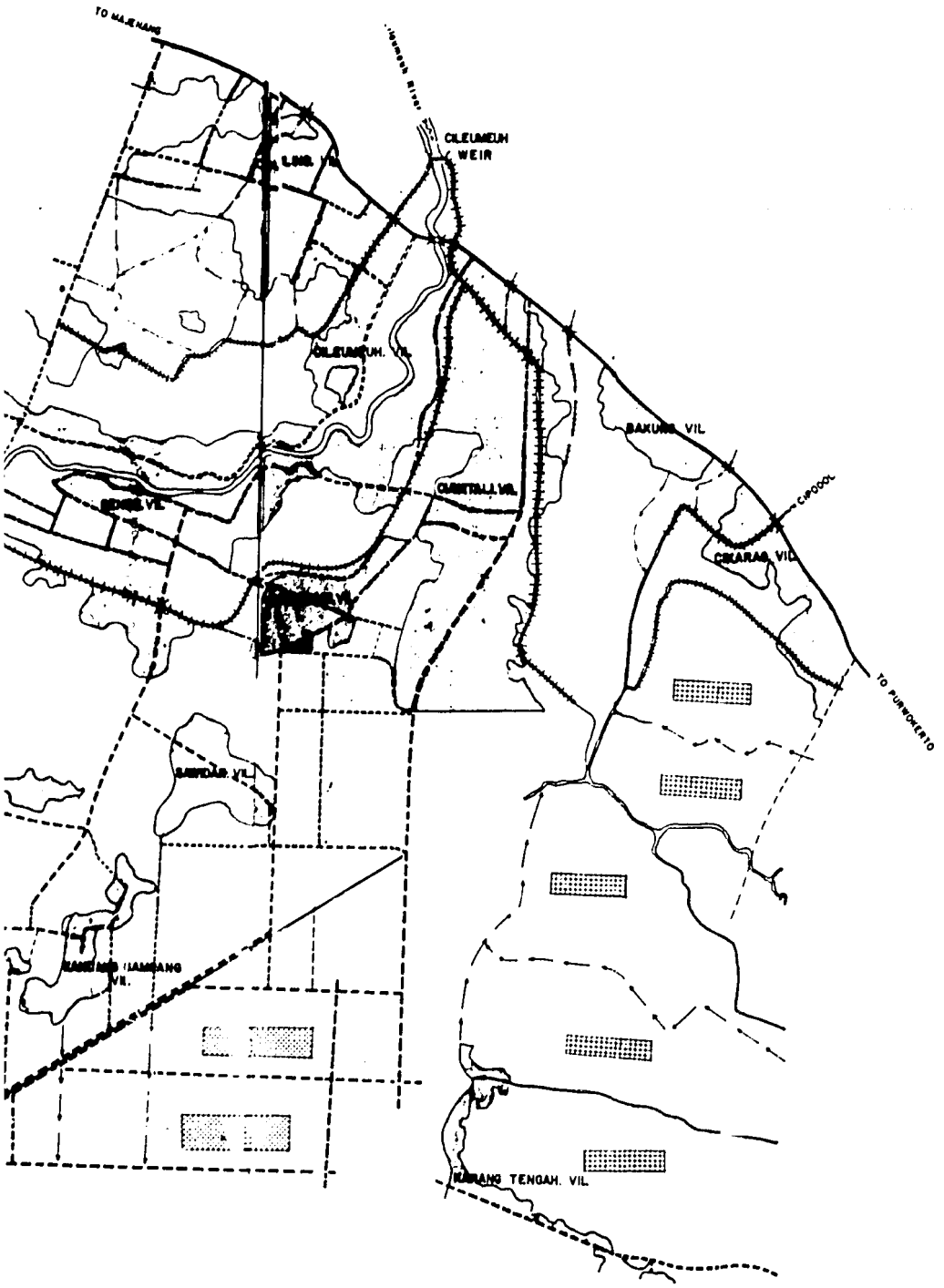
CENTRAL JAVA SYSTEM

POLITICAL & COMMAND AREA BOUNDARIES

ENGINEERING CONSULTANTS, INC
DENVER COLORADO, U.S.A.

DRAWN	Ir DANIEL A SOMA	SUBMITTED	DR IR J.L.M.H. GERARDS
TRACED	TASWA H	RECOMMENDED	DR IR J L M H GERARDS
CHECKED	DR IR J L M H GERARDS	APPROVED	DR IR L V RAMU
DATE	JUNE — 1979	DRAWING NO	C J — 8


N
0.0
0.45 0.6
1.05
SCALE KILOMETERS.
BOJONGSARI VIL.
BENDA BILOR VIL
TANAH VIL
REJASARI VIL
SUMBERSARI VIL
TO BALAI KAMBANG
TO RAWA DADI
Citarum River
BOJONG MEKOR VIL



LEGEND

- SINGLE LANE ASPHALT ROADS
- SINGLE LANE ROADS
- FOOT PATHS
- BRIDGE
- EXISTING CANALS
- EXISTING DRAIN
- CULVERT
- VILLAGE
- LEVEE
- SERVICE AREA
- PLANTATION

REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
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DIRECTORATE OF RIVERS
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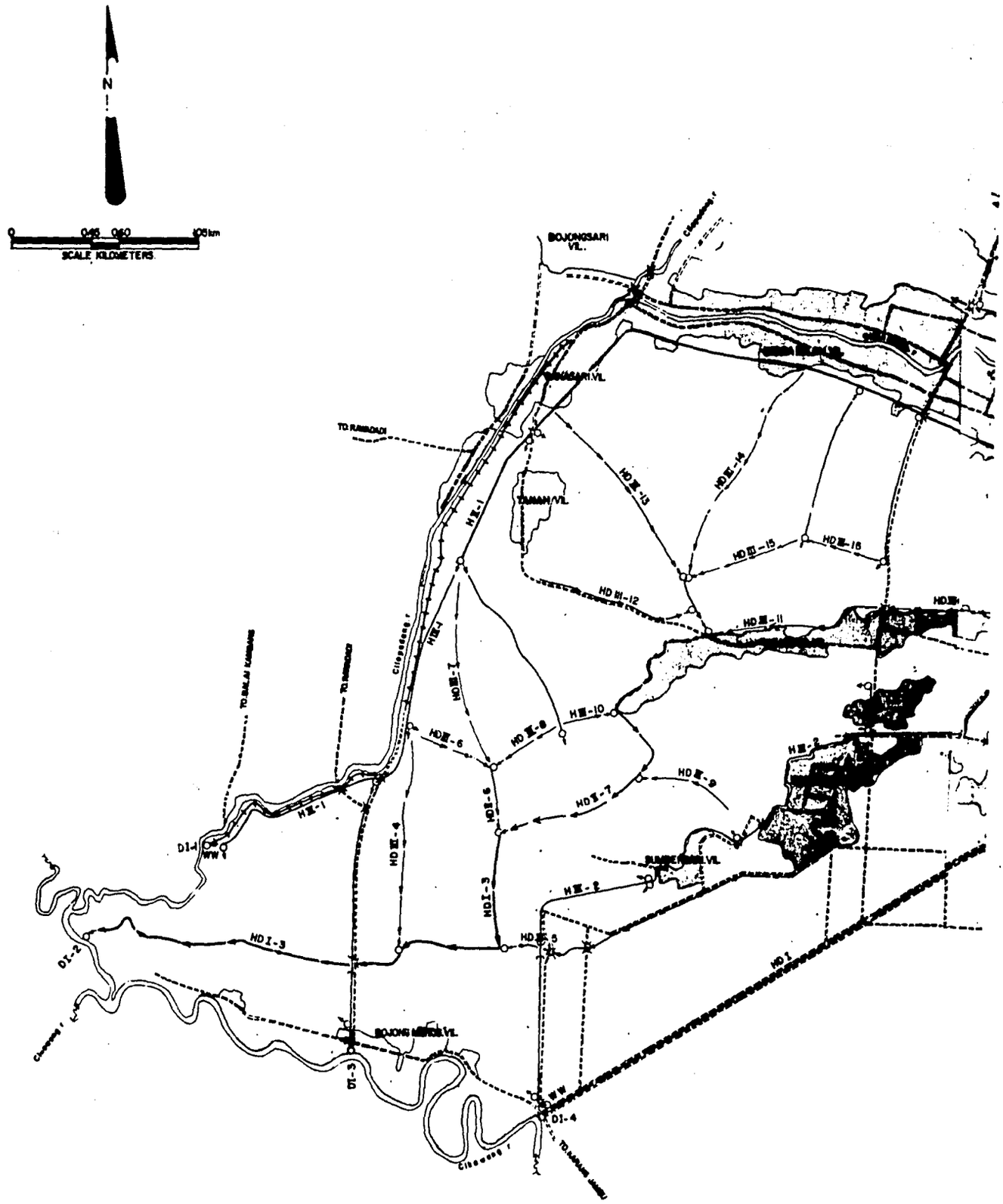
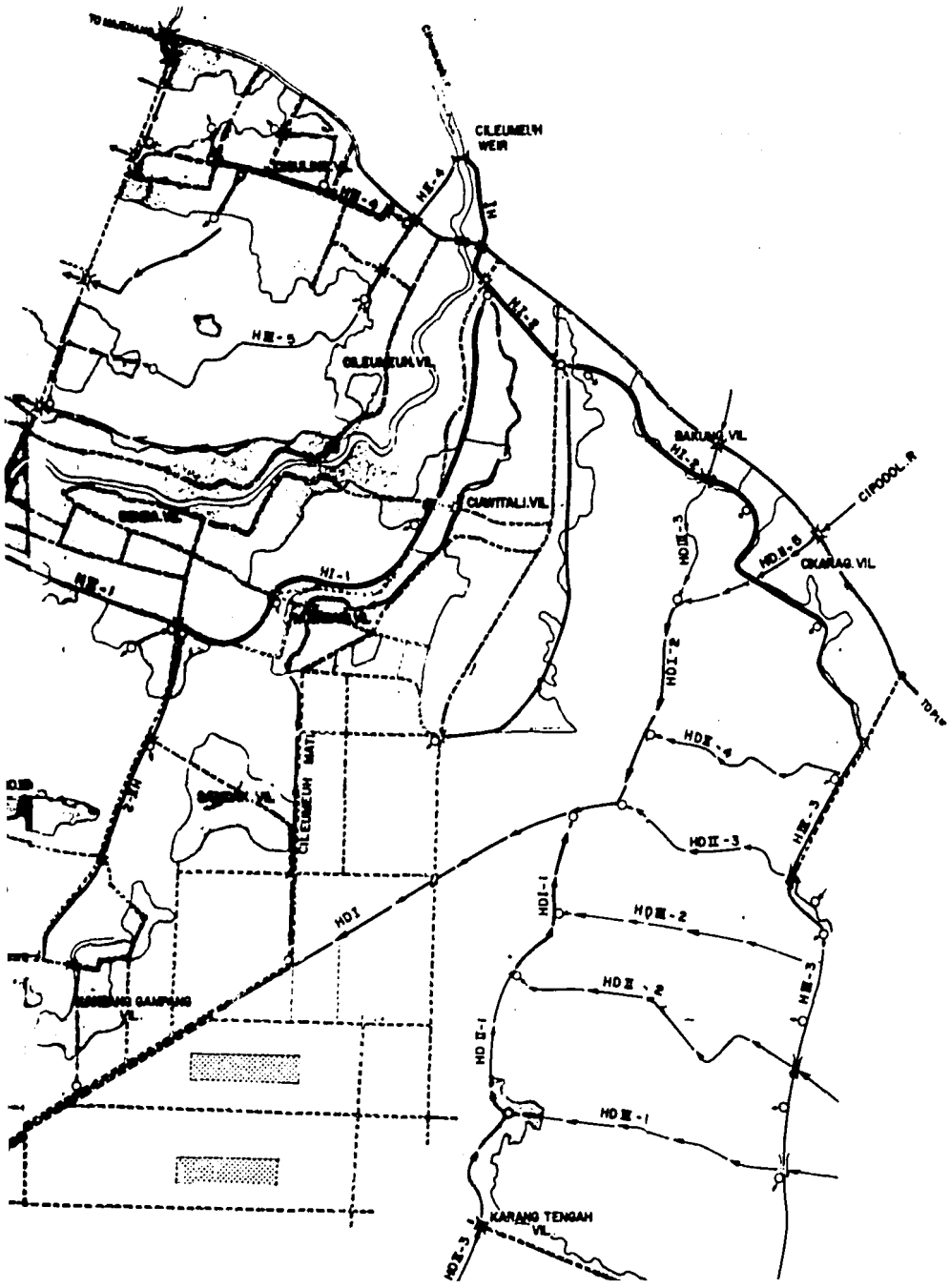
CILEUMEUH IRRIGATION AND DRAINAGE SYSTEM
INDEX MAP
EXISTING FACILITIES

ENGINEERING CONSULTANTS, INC
DENVER COLORADO, U.S.A.

DRAWN	W. Daniel A. Gama	SUBMITTED	DR.IR.J.L.M.H. Gerardo
TRACED	Jorge	RECOMMENDED	DR.IR. J.L.M.H. Gerardo
CHECKED	DR.IR.J.L.M.H. Gerardo	APPROVED	DR. K.L.V. Radha
DATE	May —1979	DRAWING NO.	C.d—3

242


N
SCALE KILOMETERS
BOJONGSARI VIL.
TAMAN VIL.
TO RANDAUDI
HD I-3
DI-1
DI-2
DI-3
DI-4
WW



LEGEND.

- SINGLE LANE ASPHALT ROADS.
- SINGLE LANE ROADS.
- FOOT PATHS.
- BRIDGE.
- CULVERT
- PRIMARY CANALS.
- SECONDARY CANALS.
- TERTIARY CANALS.
- TURNOUT.
- DRAIN INLET.
- MAIN DRAIN.
- SECONDARY DRAIN.
- TERTIARY DRAIN.
- FLUME.
- SIPHON.
- VILLAGE.
- LEVEE.
- PLANTATION.

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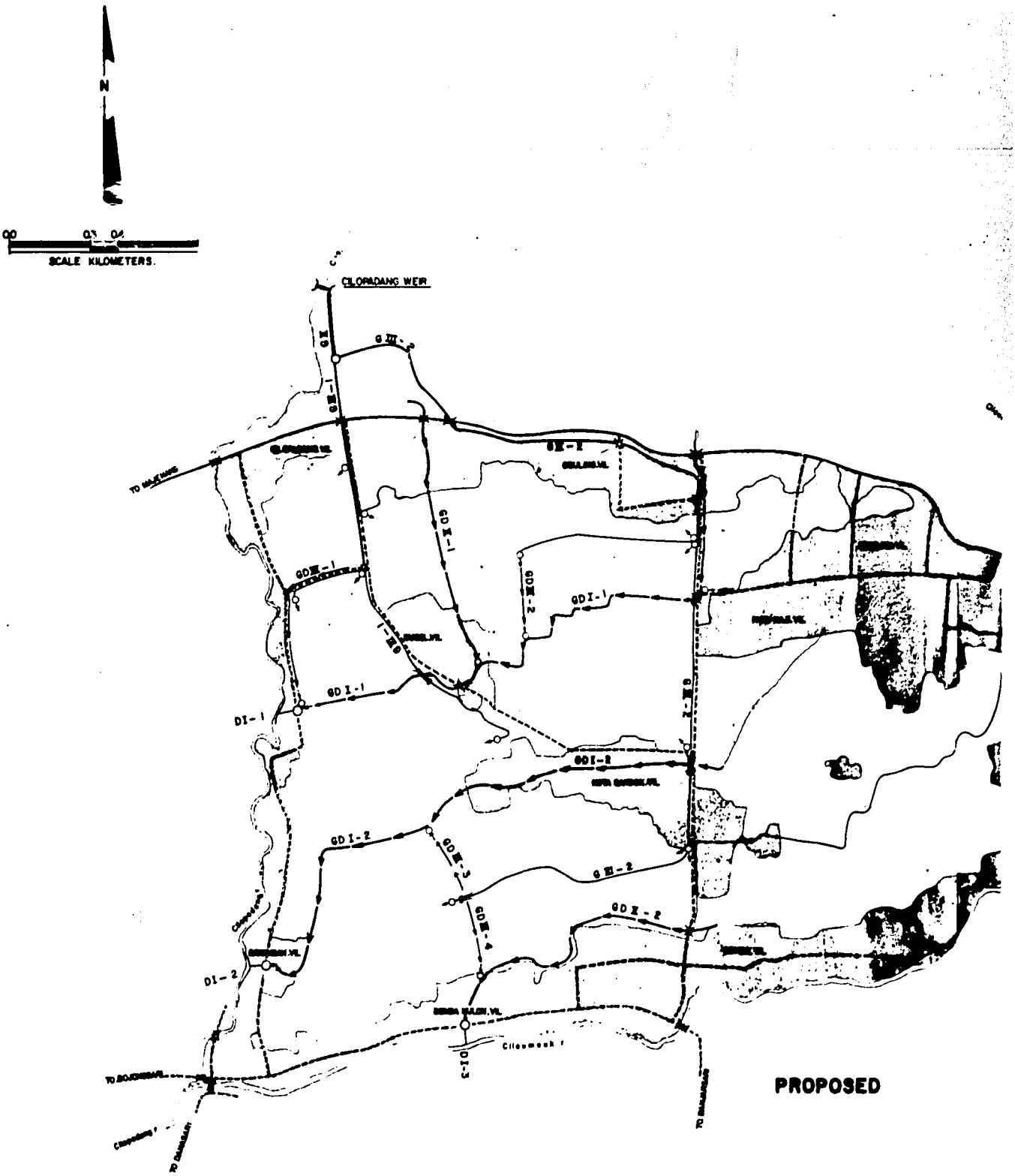
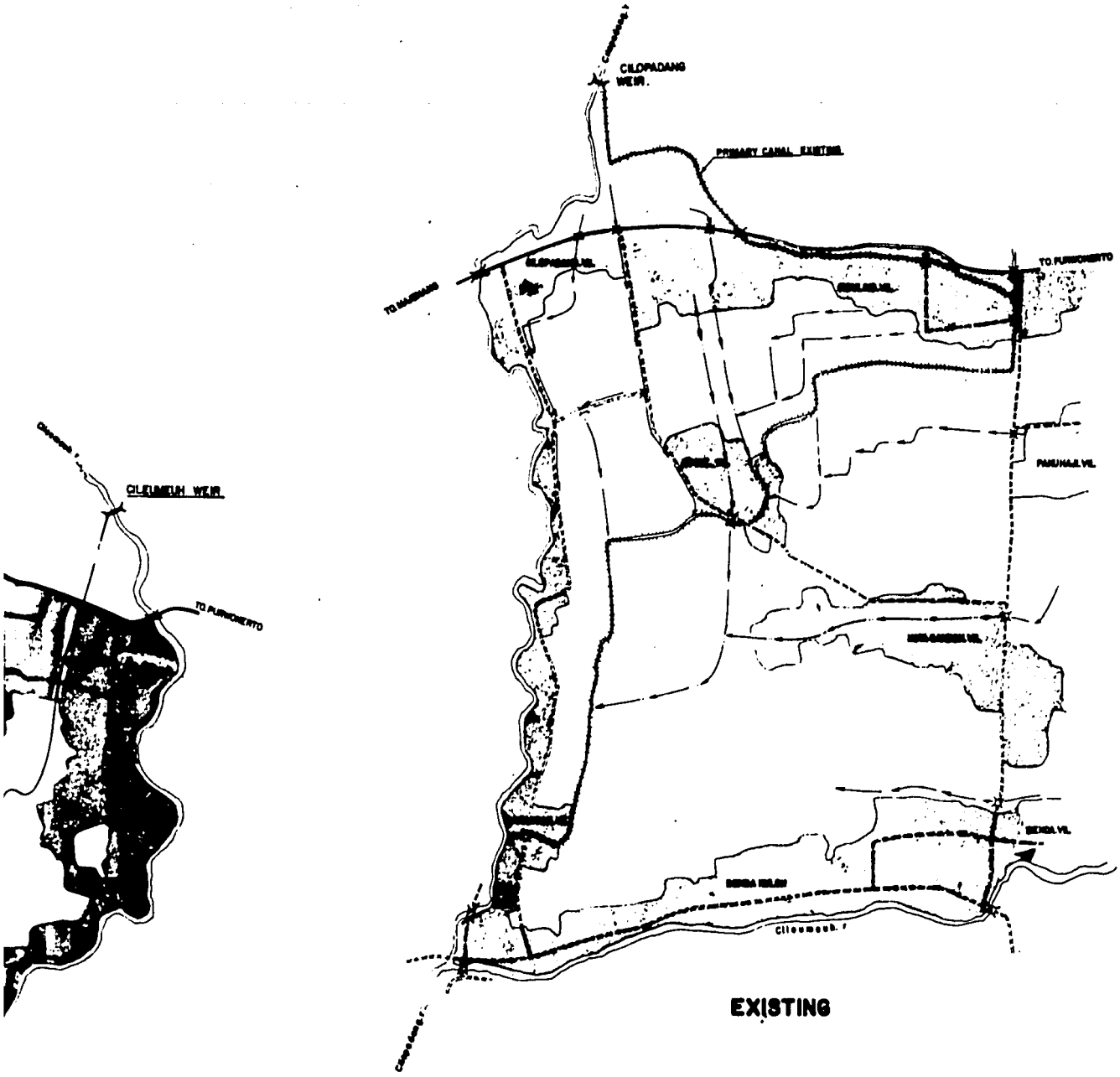
PROPOSED FACILITIES

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO, U.S.A.

DRAWN Ir DANIEL A. SOMA	SUBMITTED : DRIR. J.L.M.H. GERARDS.
TRACED : D.A.R.S.U.	RECOMMENDED DR.IR. J.L.M.H. GERARDS.
CHECKED DR.IR.J.L.M.H. GERARDS.	APPROVED DR. K.L.V. RAMU
DATE MAY — 1979	DRAWING NO. : C.J— 4


N
SCALE KILOMETERS.
CILORADANG WEIR
GD I-1
GD I-2
GD II-1
GD II-2
GD III-1
GD III-2
GD III-3
GD III-4
GD IV-1
GD IV-2
DI-1
DI-2
PROPOSED



EXISTING

LEGEND.

- SINGLE LANE ASPHALT ROADS.
- SINGLE LANE ROADS.
- FOOT PATHS.
- BRIDGE.
- CULVERT.
- PRIMARY CANALS.
- SECONDARY CANALS.
- TERTIARY CANALS.
- TURNOUT.
- DRAIN INLET / FLAP GATE.
- EXISTING CANALS.
- EXISTING DRAIN.
- MAIN DRAIN.
- SECONDARY DRAIN.
- TERTIARY DRAIN.
- FLUME.
- VILLAGE.
- SIPHONS.

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PROPOSED & EXISTING FACILITIES

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO, U.S.A.

DRAWN	ir. SUNDUHJAH	SUBMITTED	[illegible]
TRACED	DARSU	RECOMMENDED	[illegible]
	[illegible] JERARDS	[illegible]	[illegible] RADIO
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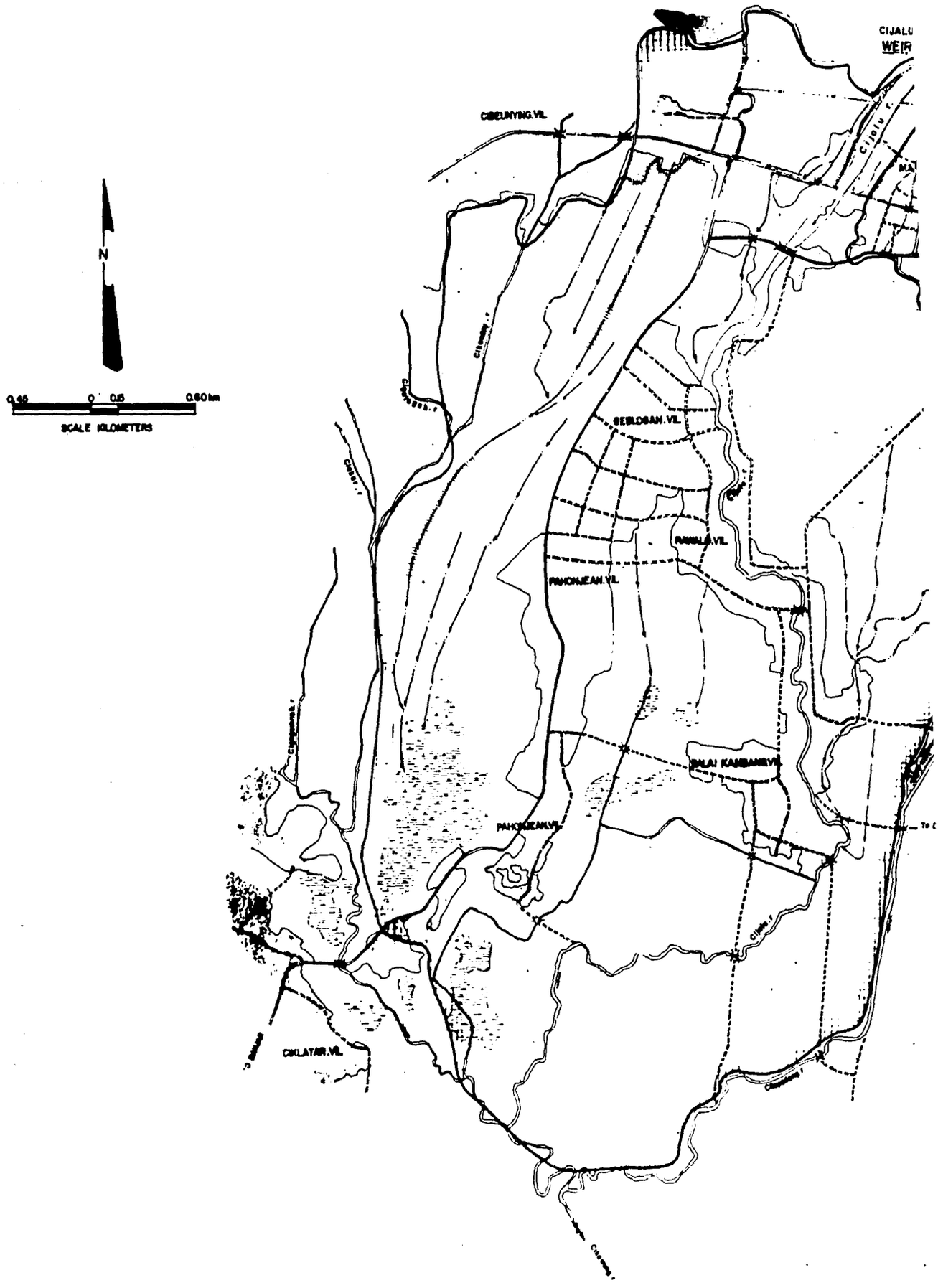
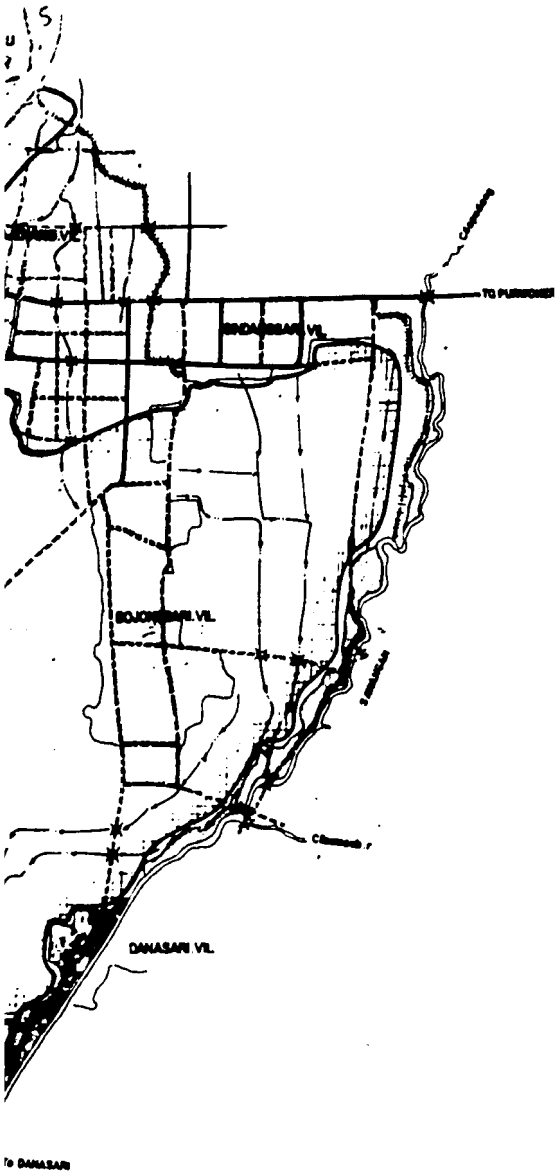

CIJALU
WEIR
CIBEUNYING.VIL
N
0.45
0
0.15
0.60 km
SCALE KILOMETERS
GEBLOGAN.VIL
RAWALO.VIL
PAHONJEAN.VIL
BALAI KAMBANG.VIL
PAHONJEAN.VIL
CIKLATAR.VIL



LEGEND

- SINGLE LANE ASPHALT ROADS.
- SINGLE LANE ROADS
- FOOT PATHS
- BRIDGE.
- CULVERT
- PRIMARY CANALS.
- EXISTING DRAINS
- LEVEE
- VILLAGE.
- SWAMP
- SERVICE AREA

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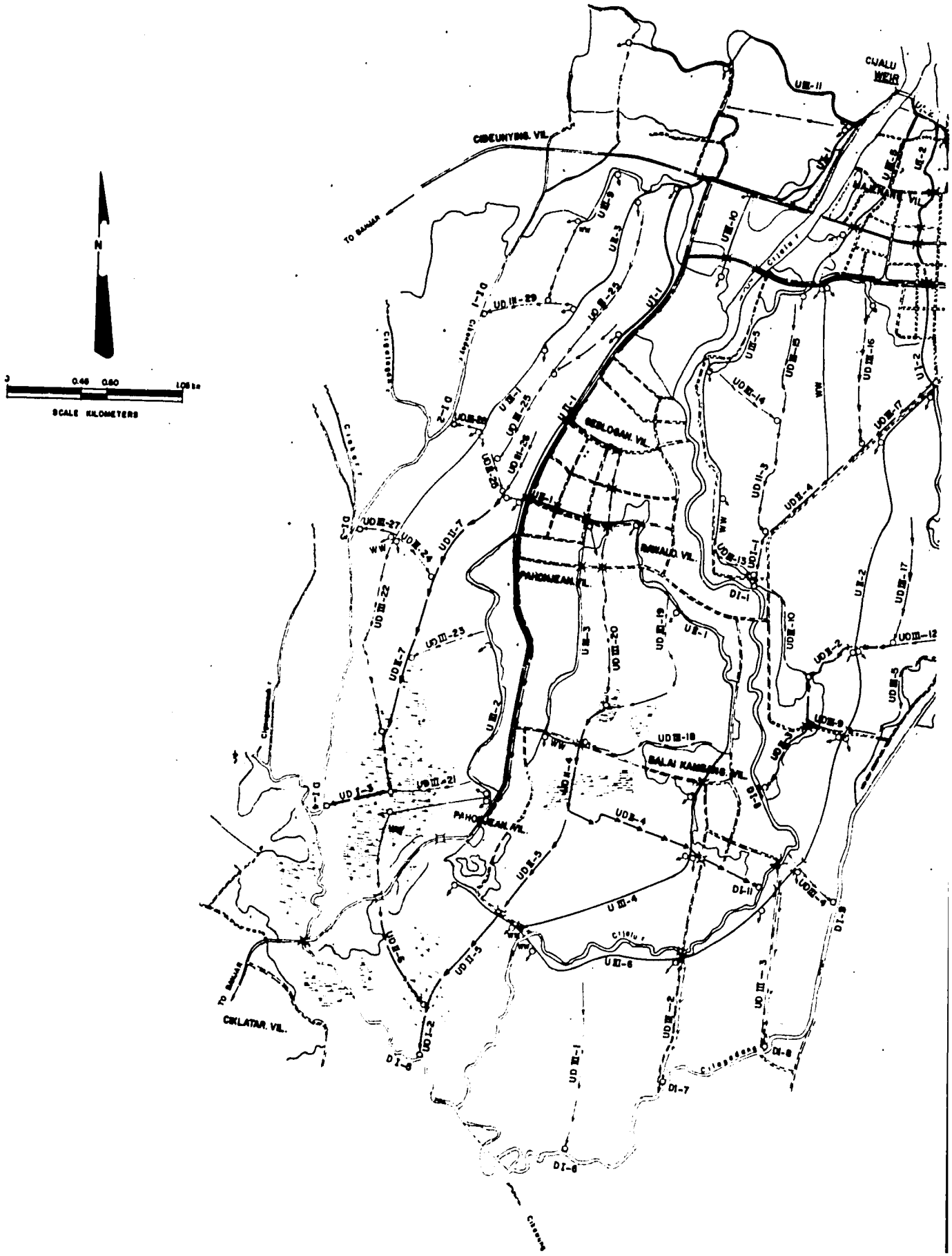
EXISTING FACILITIES

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO, U.S.A.

DRAWN Ir DANIEL A SOMA	SUBMITTED DR.IR J.L.M.H. GERARDS
TRACED Teuku Hardyono	RECOMMENDED [illegible]
CHECKED DR.IR J.L.M.H. GERARDS	APPROVED [illegible]
DATE MAY — 1979	DRAWING NO. C J — 8


N
0.40
0.80
1.06 km
SCALE KILOMETERS
CIJALU WEIR
CIBEUNYING. VIL.
TO BANDUNG
CIBLOGAN. VIL.
BANDUNG. VIL.
PANCUMEAN. VIL.
SALAI KAMBING. VIL.
CIKLATAR. VIL.
UD III-11
UD III-29
UD III-25
UD III-26
UD III-27
UD III-24
UD III-22
UD III-23
UD III-21
UD III-18
UD III-19
UD III-20
UD III-14
UD III-15
UD III-16
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UD III-12
UD III-13
UD III-10
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UD III-6
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UD III-3
UD III-2
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UD II-7
UD II-4
UD II-3
UD II-2
UD I-3
UD I-2
DI-1
DI-2
DI-3
DI-4
DI-5
DI-6
DI-7
DI-8
DI-9
DI-11
UI-1
UI-2
UE-1
UE-2
UE-3
UE-5
UE-10
UD II-5
UD II-6
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UD II-8
UD II-9
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UD II-15
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UD II-17
UD II-18
UD II-19
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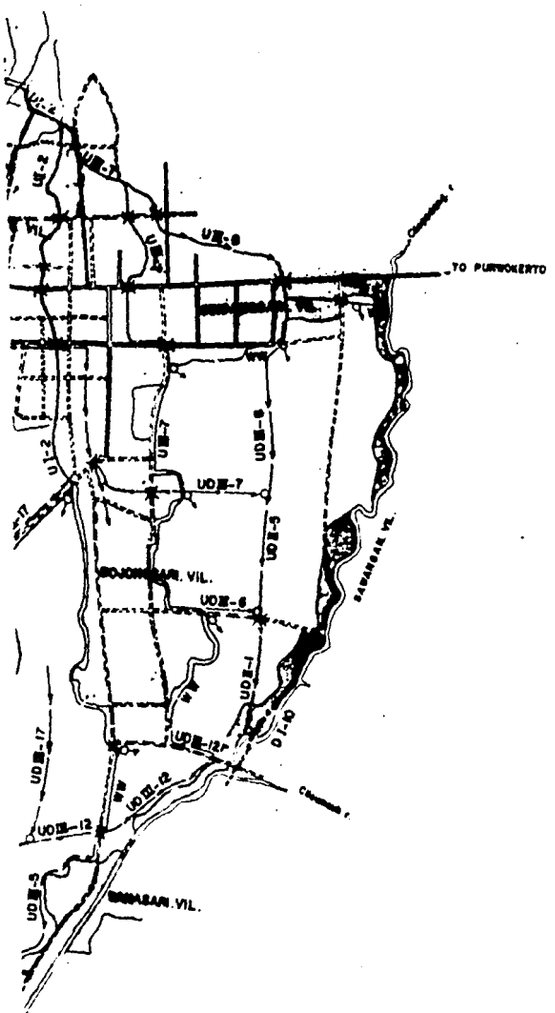
UD II-25
UD II-26
UD II-27
UD II-28
UD II-29
WW



LEGEND.

- SINGLE LANE ASPHALT ROADS
- SINGLE LANE ROADS
- FOOT PATHS
- BRIDGE
- CULVERT
- PRIMARY CANALS
- SECONDARY CANALS
- TERTIARY CANALS
- TURNOUT
- DRAIN INLET
- EXISTING CANALS
- EXISTING DRAIN
- MAIN DRAIN
- SECONDARI DRAIN
- TERTIARY DRAIN
- FLUME
- VILLAGE
- SIPHON
- SWAMP

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PROPOSED FACILITIES

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO, U.S.A.

DRAWN N DANIEL A SOMA	SUBMITTED DR IR J.L.M.H. GERARDS
TRACED TASWA HERDIYATNA	RECOMMENDED DR IR J L M.H. GERARDS
CHECKED DR IR J.L.M.H. GERARDS	APPROVED DR R.L.V RAMU
DATE JL — 1979	

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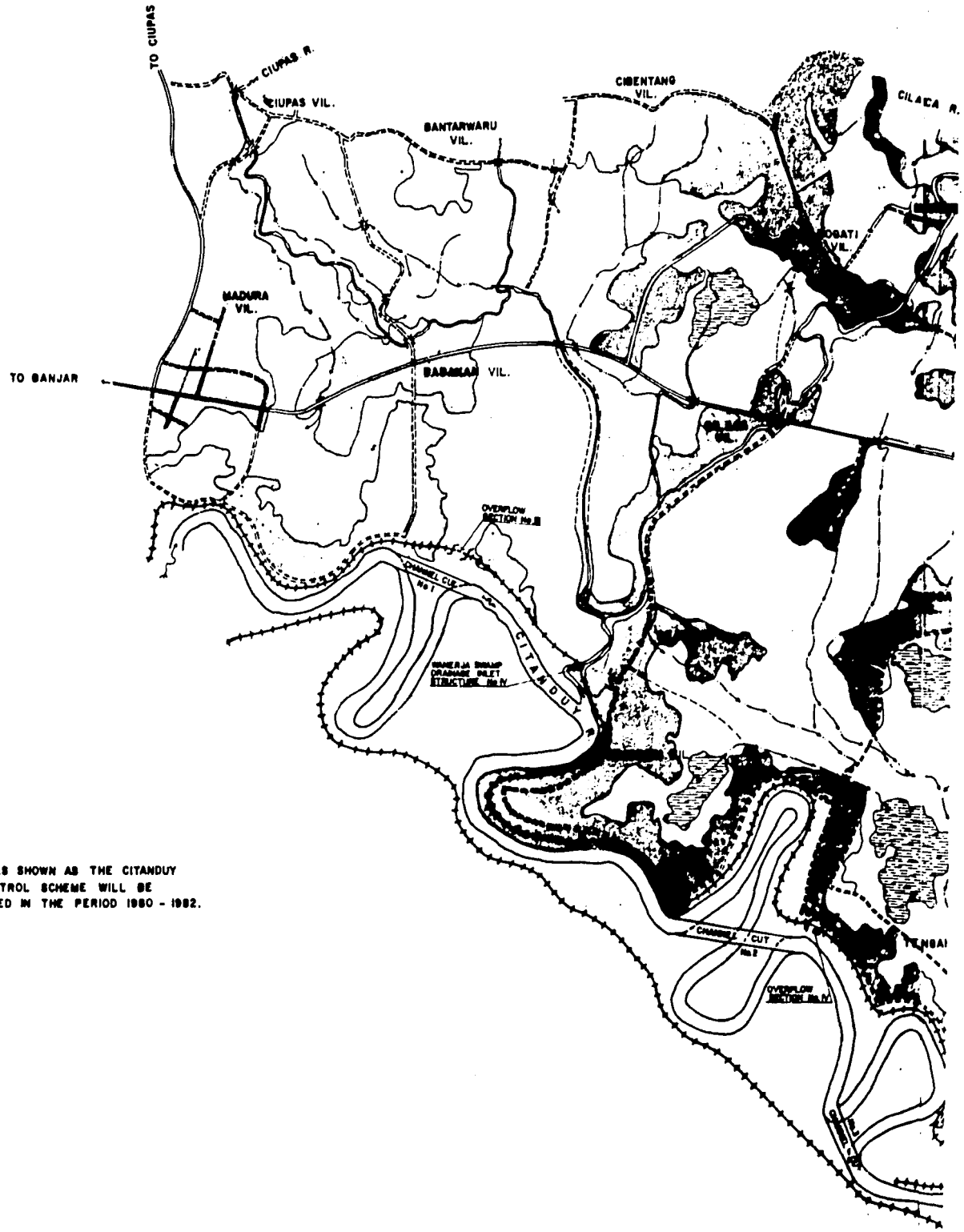
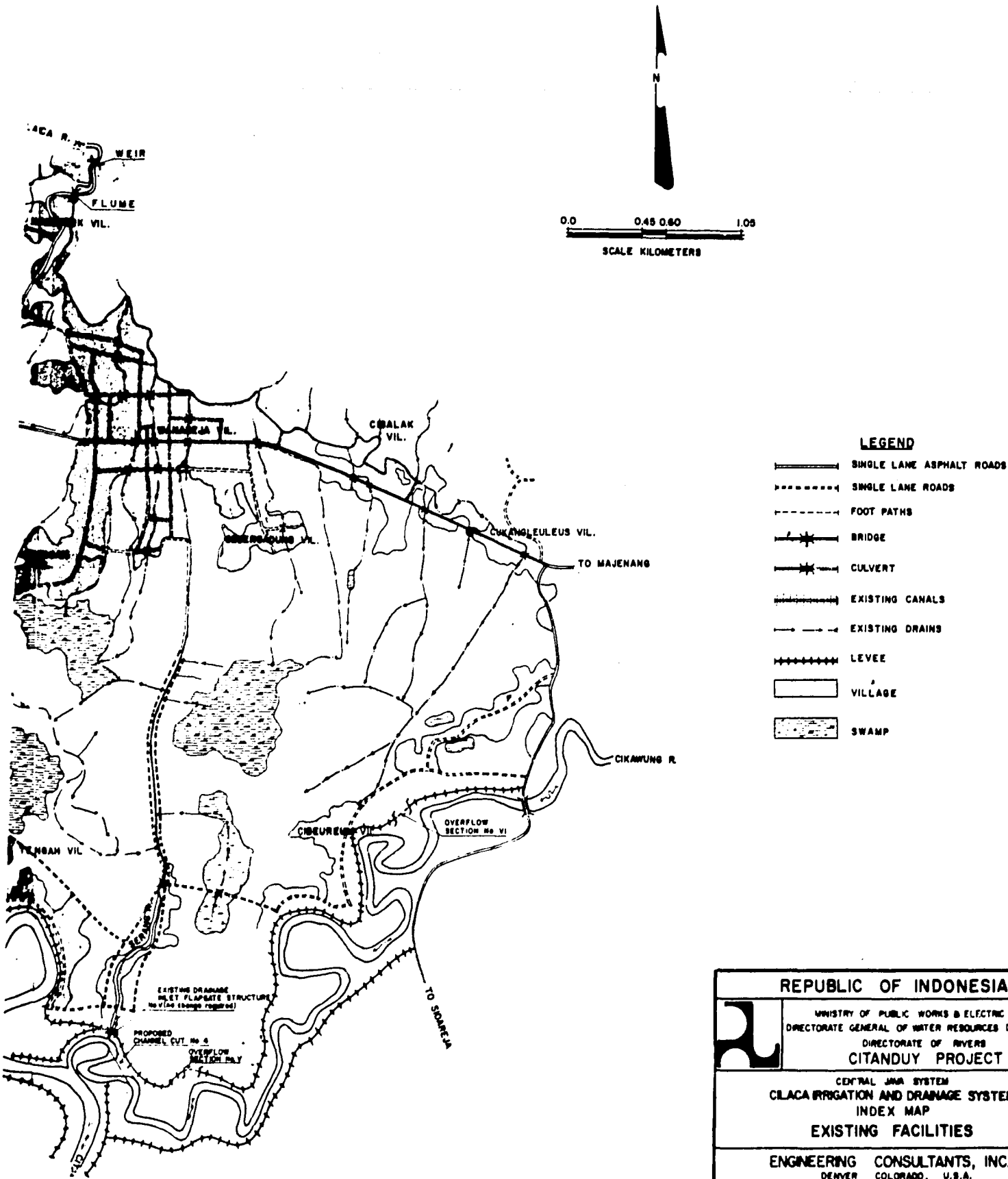


NOTE

THE DETAILS SHOWN AS THE CITANDUY FLOOD CONTROL SCHEME WILL BE IMPLEMENTED IN THE PERIOD 1980 - 1982.



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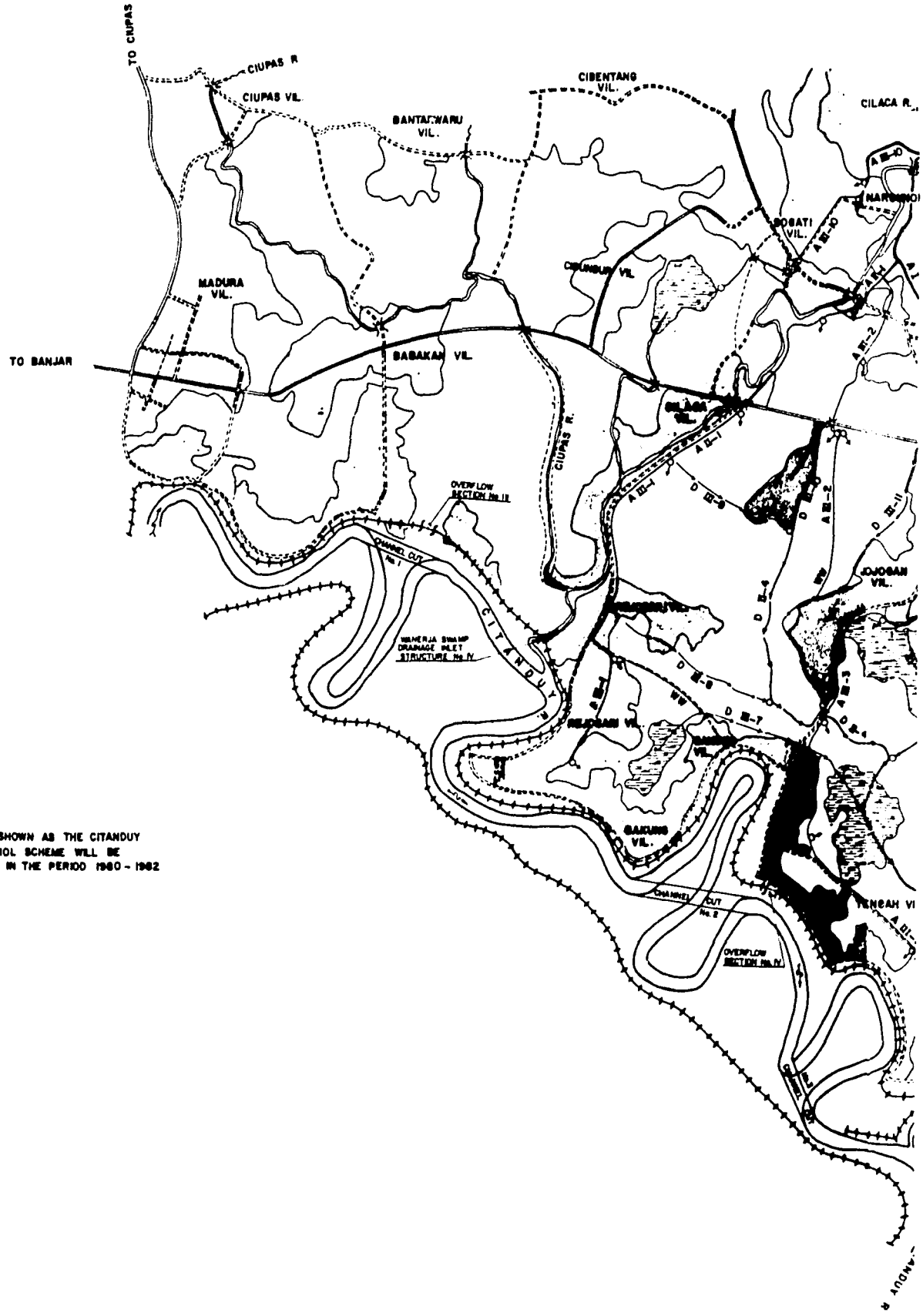
EXISTING FACILITIES

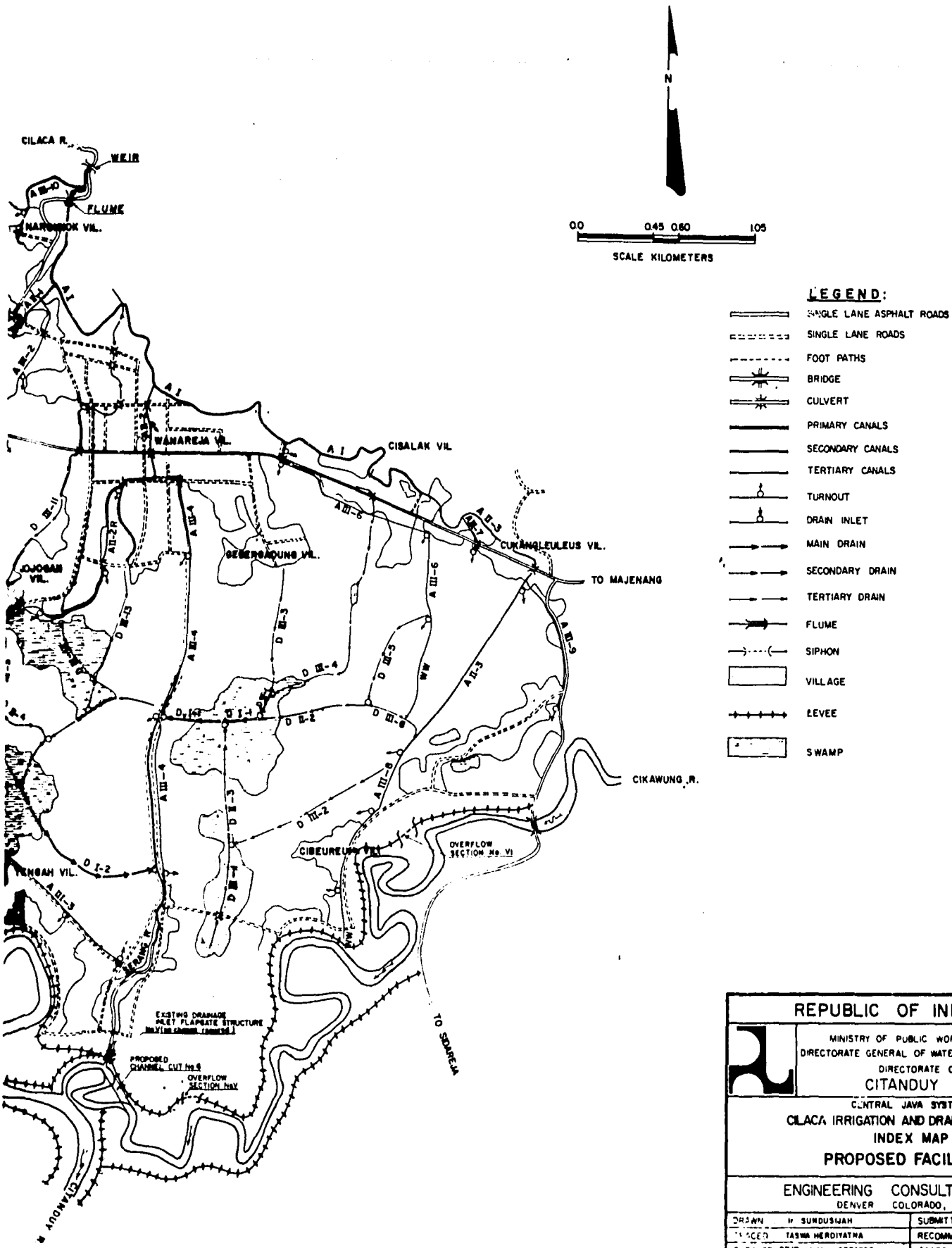
ENGINEERING CONSULTANTS, INC.
DENVER COLORADO, U.S.A.

DRAWN	Ir. SUNDUSUAH	SUBMITTED	DR.IR. J.L.M.H. GERARDS
TRACED	TASWA HERDIYATNA	RECOMMENDED	DR.IR. J.L.M.H. GERARDS
CHECKED	DR.IR. J.L.M.H. GERARDS	APPROVED	DR. IR. L.V. RAMU
DATE	JUNE - 1979	DRAWING NO.	C.J — 8



NOTE:

THE DETAILS SHOWN AS THE CITANDUY FLOOD CONTROL SCHEME WILL BE IMPLEMENTED IN THE PERIOD 1980 - 1982



REPUBLIC OF INDONESIA	
MINISTRY OF PUBLIC WORKS & ELECTRIC POWER DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT DIRECTORATE OF RIVERS CITANDUY PROJECT	
CENTRAL JAVA SYSTEM CILACA IRRIGATION AND DRAINAGE SYSTEM INDEX MAP PROPOSED FACILITIES	
ENGINEERING CONSULTANTS, INC. DENVER COLORADO, U.S.A.	
DRAWN W. SUNDUSIJAH	SUBMITTED DR. IR. J. L. M. H. GERARDS
TRACED TASWA HERDIYATNA	RECOMMENDED DR. IR. J. L. M. H. GERARDS
CHECKED DR. IR. J. L. M. H. GERARDS	APPROVED DR. K. L. V. RAMU
DATE JUNE — 1979	DRAWING NO. C.J — 8