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THE CITANDUY RIVER BASIN DEVELOPMENT PROJECT

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BANJAR PLAINS PROJECT FEASIBILITY REPORT

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SUBMITTED BY
PRC ENGINEERING CONSULTANTS, INC.
DENVER, COLORADO, U.S.A. BANJAR, INDONESIA

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BANJAR PLAINS PROJECT

FEASIBILITY REPORT

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GLOSSARY

Abbreviations and Terms

R.I.	Republic of Indonesia
U.S.A.I.D.	United States Agency for International Development
A.M.S.	United States Army Map Service
BAPPENAS	National Development Planning Board
BAPPEMKA	District Planning Board
BIMAS	Mass guidance for agricultural intensification with government credit at low interest
DGWRD	Directorate General Water Resources Development
INMAS	Same as BIMAS but without government credit.
BULOG	National agency for price control, stock and distribution of rice
DOLOG	Provincial Agency administering BULOG program
B.U.U.D.	Village Cooperative Unit
IRR	Internal Rate of Return
A.E.S.	Agricultural Extension Service
LPMA/DPMA	Institute of Hydraulic Engineering
Rough Rice	(Gabah) Threshed rice (with hull), unmilled at 14 percent moisture
SAWAH	Rice Field
Milled Rice	(Beras) Rice that is dehulled and polished

GLOSSARY

Abbreviations and Terms (Continued)

Wet Stalk Rice (or Padi)	Unthreshed rice, still in the panicle (head or ear), tied in a bundle, cut 15 to 20 cm below the panicle, not dried. (Conversion to rough rice = 59%) (Conversion to milled rice = 40%)
Dry Stalk Rice (or Padi)	Same as above but dried. (Conversion to rough rice = 77%) (Conversion to milled rice = 52%)
Kabupaten	District
Kecamatan	Sub-district
Desa	Village
Bupati	Chief of District
Kampung	Settlement

MEASUREMENT AND CONVERSION FACTORS

Length

1 meter	=	39.37 inches	=	3.2808 feet
2.54 centimeters	=	1 inch		
0.3048 meter	=	1 foot		
1,000 meters	=	1 kilometer	=	0.6214 statute mile
1.60935 kilometer	=	1 statute mile		

Area

1 Bata	=	14 square meters		
1 hectare	=	2.47 acres	=	10,000 square meters
1 square kilometer	=	100 hectares	=	247 acres

Volume

1 cubic meter	=	1,000 liters	=	1.308 cubic yards
1 cubic meter	=	0.0008107 acre feet	=	35.3144 cubic feet
1 liter	=	0.2642 gallon	=	0.03531 cubic foot
1,233.5 cubic meters	=	1.0 acre foot	=	325,851 gallons

Temperature

$^{o}C = 5/9(^{o}F-32)$ $^{o}F = 9/5\ ^{o}C+32$

Currency

1 Rupiah	=	100 sen	=	$0.0024 U.S. approx.
1 U.S. Dollar	=	415 rupiah	=	41,500 sen

Weight

1 kilogram	=	2.2046 pounds		
1 metric ton	=	1,000 kilograms	=	2,204.6 pounds
2,000 pounds	=	1 ton	=	907.18 kilograms
1 kwintal (kw)	=	100 kilograms	=	220.463 pounds
1 metric ton (t)	=	1,000 kilograms	=	2,204.63 pounds
1 liter (rice)	=	800 grams	=	1.764 pounds

METRIC SYSTEM ABBREVIATIONS

	Unit	Abbreviation or Symbol	Equivalent of Meter
Length:	millimeter	mm	0.001
	centimeter	cm	0.01
	meter	m	1.0
	kilometer	km	1,000.0
Area:	square centimeter	cm^2	0.0001 m^2
	square meter	m^2	1.0 m^2
	hectare	ha	10,000 m^2
	square kilometer	km^2	1,000,000 m^2
Volume:	cubic meter	m^3	1.0 m^3
	liter	l	1,000 cm^3 = 0.001 m^3
	million cubic meters	MCM	
Mass and Weight:	kilogram	kg	1,000 g
	metric ton	t	1,000 kg
Flowing Water:	liter per second	l/s or lit/sec	
	cubic meter per second	cms or m^3/s or m^3/sec	

3

Conversion Rates from Stalk Rice (Padi) to Rough Rice (Gabah) to Milled Rice (Beras)

Klasifikasi	Classification	Conversion Rates: Percent (%)									
1. Padi Basah di Desa	Wet stalk rice in the village	100	119	122	123	130	145	154	156	169	250
2. Padi Kering di Desa	Dry stalk rice in the village	84	100	103	104	109	122	130	132	143	208
3. Padi Kering Lumbung di Desa	Dry stalk rice stored in the village	82	97	100	101	106	119	127	128	139	204
4. Padi Kering Lumbung di Pabrik	Dry stalk rice stored at mill	81	96	99	100	105	118	125	127	137	200
5. Padi Kering Giling di Pabrik	Dry stalk rice ready for milling	77	92	94	95	100	111	119	120	130	192
6. Gabah Basah di Desa	Wet rough rice in the village	69	82	84	85	90	100	106	108	116	169
7. Gabah Kering di Desa	Dry rough rice in the village	65	77	79	80	84	94	100	101	110	161
8. Gabah Kering Lumbung di Desa	Dry rough rice stored in the village	64	76	78	79	83	93	99	100	109	159
9. Gabah Kering Giling di Pabrik*	Dry rough rice ready for milling*	59	70	72	73	77	86	91	92	100	147
10. Beras	Milled rice	40	48	49	50	52	59	62	63	68	100

Source: Petunjuk Pengelolaan Penggilingan Padi Perusahaan Pertanian Negara, Jakarta (1972)

Rice Mill Management Instructions Government Agricultural Enterprises, Jakarta

*Dried to 14% Moisture.

Chapter I

INTRODUCTION

General

The Banjar Plains Project is situated in the upper Citanduy River Basin. The Citanduy River Basin, which is over 4,460 square kilometers in areal extent, is situated in the provinces of West Java and Central Java in the southern region of the island of Java. Following the launching of the First Five Year Plan by the Republic of Indonesia in 1969, the Government classified the Citanduy River Basin as being in Group "A". This classification signified that the control and development of the Citanduy Basin was in the national interest. In pursuance of this, a Citanduy River Project organization was set up by a decree in April, 1969, which was charged with the work of flood protection and irrigation.

The terrain of the Citanduy River Basin is conducive to development of a number of irrigation systems of varying sizes. Some systems like the North Lakbok Irrigation System have been in existence for a long time. Many of the smaller systems are of the semi-technical or rural type. For details of existing irrigation systems reference should be made to the Master Plan Report.[1/*] The exploitation of the water resources of the basin on a planned basis is now under way. The various subprojects in the basin have now been identified and the Government is pursuing a program to

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1/ The Citanduy River Basin Development Project 'Master Plan', Engineering Consultants, Inc., Denver, Colorado, U.S.A., May, 1975.

* A bibliography is given at the end of this volume listing all the references used in this study.

carry out feasibility studies for many of these subprojects. The Banjar Plains Project is one such subsystem located just west of the Banjar town.

This report presents the studies carried out to evaluate the irrigation and water supply potential in Banjar Plains area and to determine the feasibility of the project. The result of these studies are presented in the subsequent chapters.

Authorization

The Banjar Plains Feasibility Report was prepared as part of the scope of work of the contract between the Directorate General of Water Resources Development of the Ministry of Public Works and Electric Power of the Republic of Indonesia and Engineering Consultants, Inc., (E.C.I.) of Denver, Colorado, U.S.A. This contract, No. Kab 9/2/14 signed on February 10, 1977, provided for Consultant Services for the Citanduy River Basin Development Project of which Banjar Plains forms a part. The work presented in this report has been carried out in accordance with the terms of this contract and is submitted in fulfillment of the requirements.

Purpose and Scope

The Citanduy River Basin Development Project is a continuation of the overall effort aimed at the development, utilization of the total land, water and human resources in the project area. This involves flood control, irrigation and drainage, rehabilitation of existing irrigation systems, construction of new irrigation systems, reclamation, land use and

management practices, erosion and sediment control, operation and maintenance, management of systems, thereby laying the groundwork for improved conditions in the project area. The Banjar Plains Project is a subproject in the Citanduy Basin for which this feasibility basin study has been carried out with the objective to formulate and review the technical, social and economic aspects of the project to a level of intensity compatible with the requirements of international lending agencies.

The specific objectives and scope of the feasibility study for the Banjar Plains Project have been outlined in the Terms of Reference of the Contract. The scope of the study includes but is not limited to the following:

1. Identify problems and needs of the area.

2. Conduct studies of alternative project layouts to determine the optimal utilization of the water and land resources within the project area.

3. Carry out surveys to obtain reliable data concerning existing field conditions.

4. Analyze water resources and water quality, to determine availability and suitability for irrigation and municipal needs.

5. Prepare an initial layout of the irrigation and drainage system.

6. Identify a management system necessary to achieve the projected pattern of utilization.

7. Consider the environmental impact of the proposed development and the social benefits occurring to the people.

8. Carry out an economic and financial analysis.

9. Recommend the most feasible development plan based on the needs in the project area, technical/economical feasibility and socio-environmental acceptability.

This study is based on data that was collected during previous phases of the Citanduy Basin study as well as data collected under the present phase of the study.

Previous Investigations

Work on the development of Citanduy Basin dates back many years. Most of the development efforts to date have been concentrated on either the lower Citanduy/Ciseel River system or the Segara Anakan and its environs. In the upper watershed areas, efforts to date have been confined to small irrigation projects, mostly of the rural type and such soil conservation measures as reforestation, the greening program and contour farming. The previous studies carried out for the Citanduy Basin are presented in a chronological order in the Master Plan Report[1/] by E.C.I. A list of previous reports is also available in the abovementioned report.

Investigation for development of the Banjar Plains Area for irrigation and supply of municipal raw water to the Banjar township was first carried out during 1972-73 by the Directorate of Irrigation. In the early stages of development the Directorate of Irrigation was keenly interested in developing small size projects which could yield quick returns. The Banjar Plains project study was taken up under this policy. A reconnaissance report on this study was submitted by P. T. Karpa[2/] in March, 1973, to the Directorate of Irrigation.

2/ Laporan Reconnaissance/Pra Rencana Proyek Irigasi Dataran Banjar Propinsi Jawa Barat by P. T. Karpa, Bandung, Indonesia, March, 1973.

The P. T. Karpa report proposed a diversion structure on the Citanduy River about 7.6 km upstream of the confluence of Citanduy River and Cimuntur River. The diversion weir was to be 40 m long and about 10 m high and was designed for a 100 year flood discharge of 758 m^3/s. The main canal was sized to carry 1,904 l/s to irrigate two rice crops per year over an area of 887 ha in the Banjar Plains. The total length of the main and secondary canals proposed was 28.3 km, while the length of drainage canals was estimated to be 27.5 km. The project was also to provide domestic raw water supply of 116 l/s and a flushing water supply of 510 l/s to the Banjar township. Economic analysis indicated that the benefit to cost ratio would be one at an interest rate of 3.7 percent. Geological investigation of the diversion work along with material test results are presented in a separate volume.[3/]

Subsequent to the setting up of a separate project organization for the Citanduy Basin under the Directorate of Rivers, further investigation of the Banjar Plains Irrigation System was transferred to the jurisdiction of the Citanduy Project Authority. Very little work has been carried out since then to evaluate the feasibility of the project as outlined in the report by P. T. Karpa.[2/]

In conducting a basinwide study for flood protection, E.C.I. in its report[4/] of November, 1973, identified a flood storage dam about 800 m downstream of the confluence of Citanduy and Cimuntur Rivers and about 8 km upstream of Banjar town. The project envisaged a dam 60 m high to provide a flood storage volume of 350×10^6 m^3 with a water surface area of 1,740 ha. In a

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3/ Laporan Penyelidikan Geologi Dan Mekanika Tanah Rentjana Bendungan Dataran Banjar, Djabar, August, 1971.

4/ 'Recommendation for First Priority Feasibility Studies', Engineering Consultants, Inc., Denver, Colorado, U.S.A., November, 1973.

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subsequent report[5/] E.C.I. examined the possibility of constructing a multipurpose reservoir at this site. This project, with a dam 50 m high and a full reservoir water surface area of 1,280 ha at a capacity of 280×10^6 m^3 was proposed to provide irrigation supplies to about 20,000 ha including the Banjar Plains area and a supply of raw water for municipal needs to Banjar town. The reservoir would, however, submerge 5.4 km of railroad and a substantial length of highway as well as 30 ha of an historical area. The project was estimated to cost $40.7 million in 1974. Because of the high cost of relocations involved, an alternate Banjar Dam Project was proposed 2.5 km upstream of the confluence of Citanduy and Cimuntur Rivers. This project would involve two dams, one on Citanduy River and the other on the Cimuntur River, and was proposed as a single purpose flood protection project. A geological and materials report[6/] on the Banjar Dam was prepared by LPMA in November, 1974.

Later studies indicated, that for flood protection in the basin, a levee system was more economical than providing flood storage reservoirs. Consequently, the Banjar Dam Project was dropped from further consideration. The present study will, thus, be the first major feasibility study for the Banjar Plains Area.

Project Area Description

The Citanduy Basin lies between approximately 7°00′ and 7°40′ south latitude and 108°10′ and 109°15′ east longitude. The

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5/ Master Plan, Appendix J, 'Dam and Levees', Engineering Consultants, Inc., Denver, Colorado, U.S.A., November, 1974.

6/ Laporan Penyuelidikan Geologi Teknik, pada rencana, Waduk Banjar, Jawa Barat, Lembaga Penyelidikan Masalah Air, Bandung, November, 1974.

basin is bounded on the east by the Serayu River basin; on the north by the Cimanuk River Basin; on the north and west by the Citarum River Basin, and on the south and west by the Indian Ocean, the Ciwilas River Basin, and several small river basins all discharging into the Indian Ocean. The area described above is shown on Figure I-1.

The Banjar Plains Project, which encompasses about 3,000 hectares (gross study area) near the town of Banjar is situated in the Upper Citanduy River Basin. Physically, the area is bordered by the Sawal Mountain in the north; Kembang, Bangkok and Pasir Tenjo Mountains in the south; Sawal Mountain and Cipalih River catchment on the west, and Sukajadi Mountain and swamp area around Bantardawa on the east. Geographically, the project area is located between south latitude $7^{o}10'$ and $7^{o}25'$, and between east longitude $108^{o}10'$ and $108^{o}33'$. The project area lies west of the Banjar township and is shown on Figure I-1.

Drainage Area

The headwaters of the Citanduy River originate on the north and west slopes of Volcano Sawal, which rises to an elevation of 1,760 m. The total upper drainage basin of Citanduy, which cover the north, west and south slopes of the mountain, is about 32,000 ha. The Cimuntur River, a principal tributary of the Citanduy River, collects the runoff from the north and east slopes. The upper reach of the Citanduy River has a total length of about 20 km to a point west of Tasikmalaya in which the riverbed drops some 1,370 m from its origin to an elevation of about 350 m. In this reach, the drainage pattern is of the incised type in residual soils formed from weathered Quarternary volcanic material and Tertiary basalt and andesites. Volcanic ash and debris are mixed with the soils. At higher elevations the soils are andosols and at lower elevations the soils are latosols.

Because of the relatively deep and steep channel bed, the annual rainfall of over 3,500 mm is safely carried away with little or no flood danger.

The middle course of the Citanduy River, which extends from west of Tasikmalaya to a point downstream of the confluence of the Citanduy and Cimuntur Rivers, flows through a narrow V-shaped valley with steep side slopes and depths varying from 50 to 100 m. This middle section, which terminates upstream of Banjar town, has a total length of about 60 km and drops 330 m in elevation. At the confluence of the Citanduy River and Cimuntur River, the riverbed elevation is about 26 m, while about 8 km downstream at the Banjar bridge the riverbed elevation drops to 15 m. In this region, certain reaches of the river meander in its own alluvium, in which case the average riverbed slope is flatter. The average bed slope in the middle reach is about six meters per kilometer of river length measured along the river channel.

The proposed diversion site for the Banjar Plains Project will be located on the Citanduy River about 8 km upstream of the confluence with Cimuntur River and is shown on Figure I-2. The extent of the drainage area is shown on Figure I-1. The major tributaries upstream of the diversion work are, Cikidang River with a drainage of 135 km^2 and Cicenang, Cibeureum and Cibuyut tributaries with a combined drainage area of 127 km^2. There are a number of other small tributaries. In many areas, the small tributary channels have been obliterated by agricultural practices. Normally, farmers transform small tributary channels into a series of cascading rice paddies. The slopes flanking the tributary are also terraced so that the basin becomes a terraced field with a small drainage channel alongside the paddies. Where the river has meandered, farmers have cultivated land up to the riverbanks. A detailed description of the Citanduy Basin is presented in E.C.I.'s Feasibility Report.[7/]

Service Area

The Banjar Plains Project has a gross study area of approximately 3,000 hectares with elevation varying from 100 m to 28 m above mean sea level. This area is located in Ciamis district and covers portions of Banjar, Cimaragas and Pamarican subdistricts. In all, five villages are located in the service area. The villages of Banjar and Balokang are fully within the service area, while parts of Situbatu, Binangun and Batulawang lie within the service area.

The proposed irrigaton service area has a gross area of 1,453 hectares. The cultivable lands are situated between elevation 50 m and 30 m. The irrigation service area lies between the Citanduy River and the ridge separating the Citanduy and Cikembang River drainages. On the western side, the service area is bounded by an undulating low line of hills. The eastern end of the service area is bounded by Sangkur mountains which extend all the way up to the Citanduy River. The northern edge is bounded by the Citanduy River. The service area is shown hatched on Figure I-2. The Banjar Plains Irrigation Service Area is approximately 7 km long and varies in width from 0.5 km to 4 km.

The service area is crossed by a railroad and a number of secondary roads. The Banjar town occupies most of the northeastern portion of the service area while the village of Balokang lies in the northwestern portion. There is a high density of settlement (kampung) inside the service area. Small rural irrigation systems serve part of the service area. These systems channelize the runoff from small drainages on the outlying

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7/ The Citanduy River Basin Development Project, 'Feasibility Report', Engineering Consultants, Inc., Denver, Colorado, U.S.A., March, 1975.

hills through ditches to provide irrigation water during the wet season. Most of the area being cultivated is in rice culture. Since the service area is surrounded by a low line of hill ranges on one side and by the Citanduy River on the other side, extension of the service area beyond the present boundaries shown on Figure I-2 will not be feasible.

Surveys

For purpose of this feasibility study, three sets of surveys were available along with aerial photographs. The aerial photographs series XXX-1 to 28 to a scale of 1:20,000 covers part of the Banjar Plains Project Area. However, considerable reach of the Citanduy River and the service area has cloud cover. Lack of ground control robs the aerial photographs of their value.

Of the three sets of ground surveys available, two were carried out by P. T. Karpa of Bandung for the Directorate of Irrigation and the third by Biro Tri Tunggal of Bandung for the Citanduy Project. The P. T. Karpa surveys were carried out in 1969 and 1972 while the B. T. Tunggal survey was undertaken in 1974-75.

The 1969 surveys consist of a set of 1:5,000 scale maps covering the entire Banjar Plains command and portion of the Citanduy right bank downstream of the diversion site where the main canal alignment is situated. A contour interval of one meter has been used in these maps. These maps also show the Citanduy riverbed elevations between the road bridge at Banjar town and to a location about one kilometer upstream of the diversion site.

The 1972 survey was confined to a strip of land along the canal alignment and have been drawn to a scale of 1:2,000. Also a 1:500 scale map of the diversion site has been prepared. The set

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of benchmark used for the 1972 surveys is indicated on the maps and some of the monuments have been located in the field. However, the benchmark system used for the 1969 system has not been recorded on the maps. A comparison of the two sets of maps indicated certain discrepancies in the riverbed level and in other locations.

The Biro Tri Tunggal survey of 1974-75 covers a larger area and is drawn to a scale of 1:5,000 with contours at 5 m intervals. The surveys do not cover the river channel portion and the contours stop at the riverbanks. The benchmark system used is not shown on the maps. A comparison of this survey with the previous surveys of P. T. Karpa indicate discrepancies which are difficult to reconcile. Hence, this survey was not used in the feasibility study except to verify certain features or draw information that was not available in P. T. Karpa surveys.

During the feasibility study, limited surveys were carried out to ascertain the accuracy of the P. T. Karpa maps. Various level circuits were run covering most of the service area. These surveys indicate certain inherent inaccuracies in the vertical control of the maps. Portions of the maps are substandard for a feasibility study. The inaccuracy of the maps will have some bearing on the reliability of the technical features of the project as presented in this report. Revised topographic surveys, when available, may necessitate relocation of the diversion works if the terrain in the headreaches of the gravity supply canal is bad. Also, this could affect to some extent the height of the diversion structure, the alignment of the distribution system and the area commanded. Thus, it is anticipated that during the design phase certain modifications will become necessary in the designs of the project features.

Previous E.C.I. Reports

A draft of the feasibility report on the Banjar Plains Project was submitted in August, 1977, to the Directorate of Rivers. An addendum to the report was prepared in October, 1977. This report recommended a project to irrigate 900 hectares and provide municipal raw water supply to the town of Banjar. Following a review of the report by the Directorate of Rivers and U.S. AID in the steering committee meeting held at Ciamis in November, 1977, an Executive Summary report was prepared and submitted in December, 1977.

The Executive Summary updated the draft study and also looked at the possibility of providing raw water for an industrial complex to be set up near Banjar. The project recommended in this report was to provide irrigation for 750 hectares of two rice crops and a Municipal and Industrial water supply of 1,000 l/s. This report was reviewed at a meeting on February 10, 1978, by the Directorate of Rivers and U.S. AID. It was decided to drop the industrial water supply demand from the project as the setting up of the industrial complex in the near future was not anticipated.

This final feasibility report is prepared for a project which will provide irrigation for over 785 hectares of two rice crops and a municipal water supply of 269 l/s. Various suggestions and comments made by both the Directorate of Rivers and U.S. AID have been incorporated in this report.

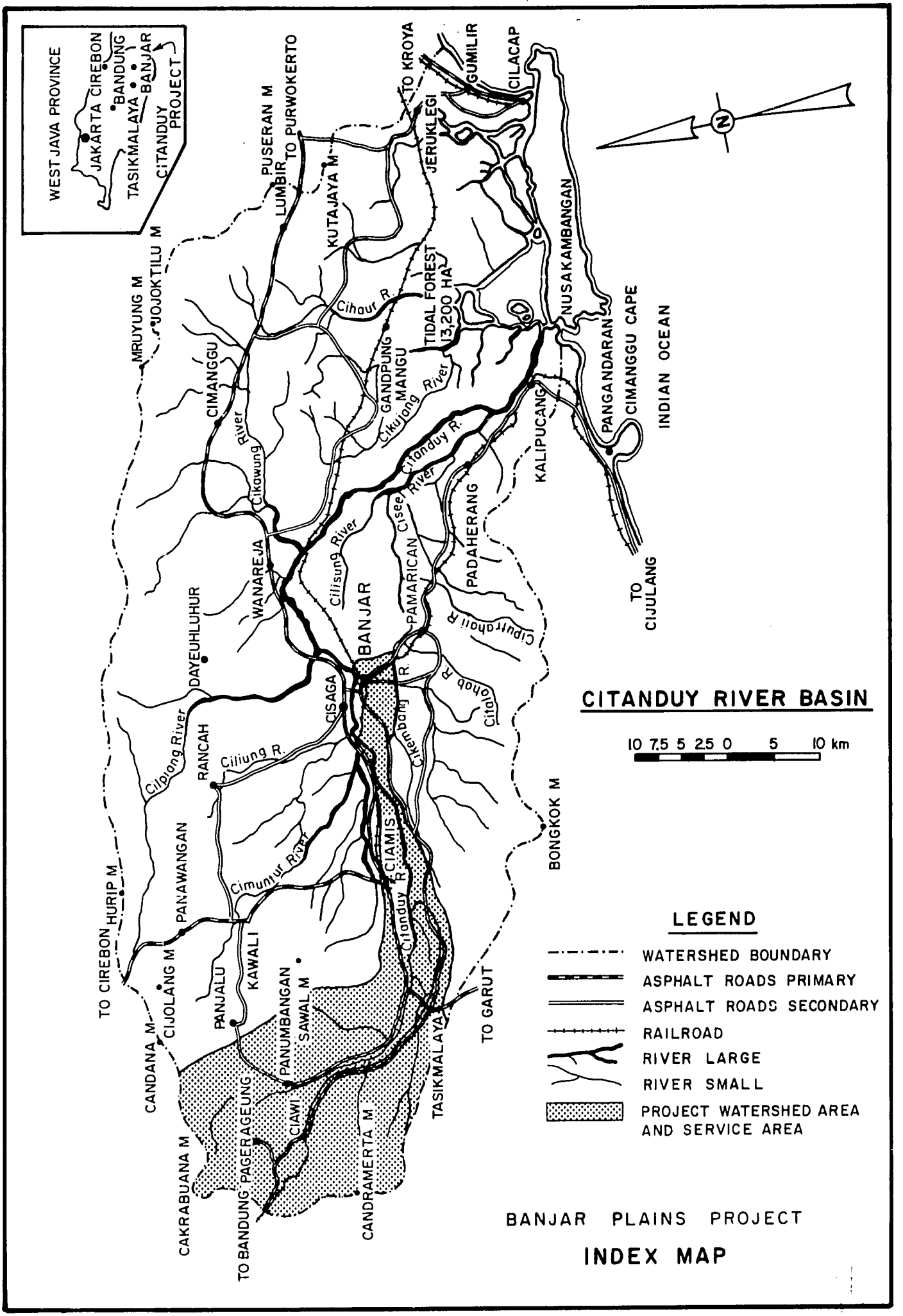
Acknowledgments

This report would not have been possible without the assistance and cooperation extended by the various organizations of the Governent of the Republic of Indonesia. The establishing of the Citanduy Project and the tremendous efforts and inputs to develop the Citanduy Basin Area would not have been possible without the vision and guidance of the Director General of Water Resources Development of the Ministry of Public Works and Electric Power of Republic of Indonesia.

The Consultant wishes to express his deep sense of appreciation to Ir. Y. Sudaryoko, Director of Rivers, and his staff for their keen interest and continuous guidance.

The preparation of this report was a team effort, jointly shared by the members of the Citanduy Project and the E.C.I. team. The willing efforts and the unfailing support in this study extended by the Citanduy Project team, led by Ir. Rachardjo Notosaputro, is graciously acknowledged.

Thanks are also due to U.S.A.I.D. personnel for their cooperation and valuable assistance in preparing this report. The Consultant also wishes to acknowledge the invaluable contribution made by Mr. Rachlan, Bappemka, Ciamis.


WEST JAVA PROVINCE
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ASPHALT ROADS PRIMARY
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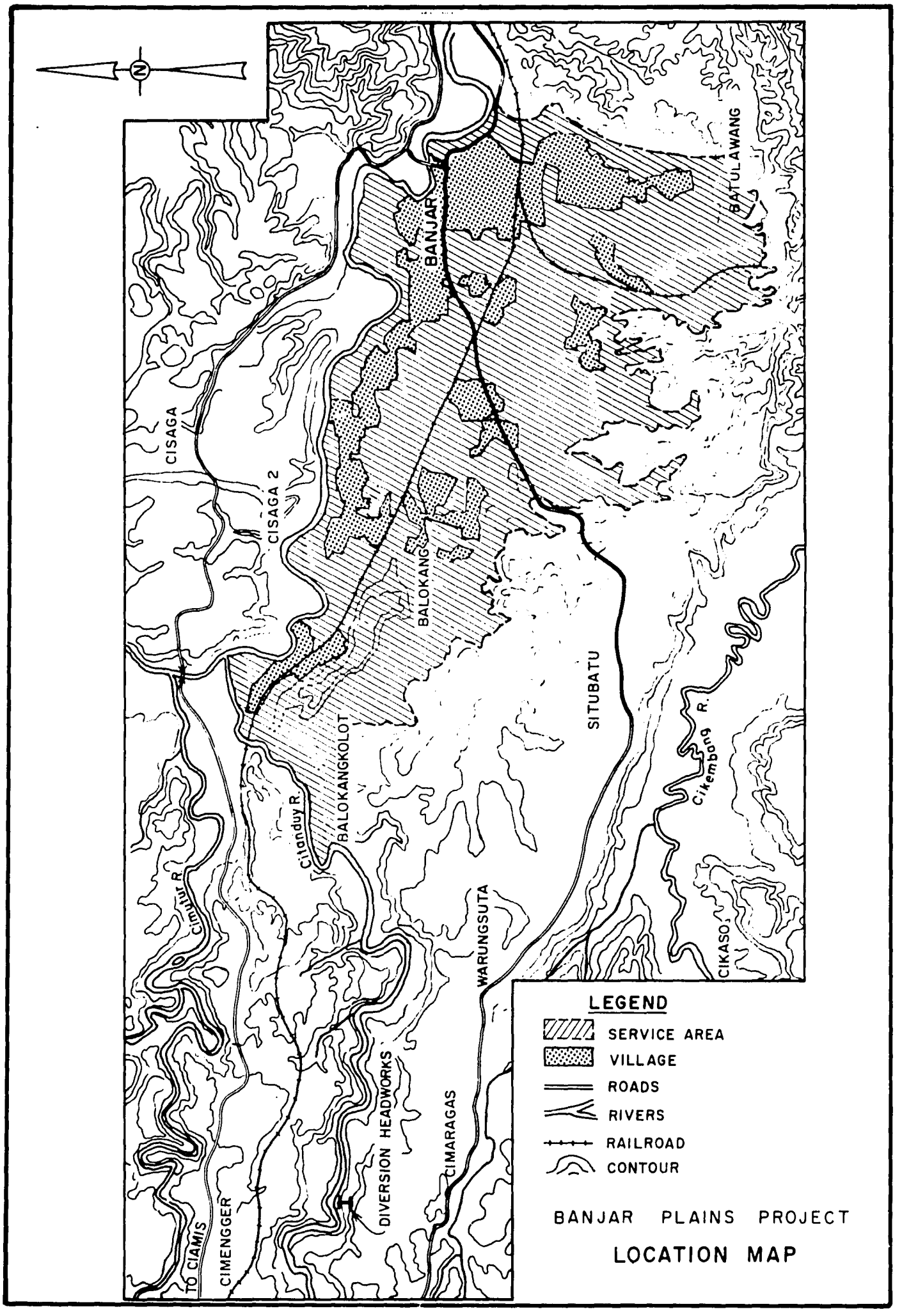
RAILROAD
RIVER LARGE
RIVER SMALL
PROJECT WATERSHED AREA AND SERVICE AREA
BANJAR PLAINS PROJECT
INDEX MAP



BANJAR PLAINS PROJECT

LOCATION MAP

Chapter II

HYDROLOGY

General

This chapter presents the climatological and hydrological data pertaining to the Banjar Plains Project. The available data have been analyzed to determine the availability of water. The detailed information on hydrology for the entire Citanduy Basin prepared during the prefeasibility phase of the Citanduy River Basin Development Project is available in a separate report[1/]

Previous hydrology studies for this project were carried out by P. T. Karpa for the Directorate of Irrigation and are presented in a Reconnaissance Report[2/] of March, 1973. The hydrological analysis was based on six rain gage stations in the drainage area with rainfall records extending from 1934 to 1941. The runoff was obtained by applying a runoff coefficient to the average monthly rainfall. No stream gage data were used to justify the runoff obtained. The peak discharges for floods with 10, 20, 50 and 100 years recurrance intervals were computed from rainfall using the Melchior method. A 100 year flood peak of 758 m^3/s was used in designing the diversion works.

1/ The Citanduy River Basin Development Project, 'Hydrology', Appendix B, Engineering Consultants, Inc., Denver, Colorado, U.S.A., November, 1974.

2/ Laporan Reconnaissance/Pre Rencana Proyek Irigasi Dataran Banjar, Propinsi Jawa Barat, P. T. Karpa, Bandung, March, 1973.

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Streamflow records are now available to develop the hydrological data needed for the feasibility study of the project. Rainfall data has been compiled for many additional locations surrounding the project area. In performing these hydrologic studies an attempt has been made to utilize and evaluate all existing data up to 1976. Runoff records for the gaging stations on the Citanduy River at Leuwitonjong and Cirahong in the command areas and the gaging station at Batununggal on the Cimuntur River have been updated on basis of new data. The records for the gaging station at Cirahong and at the Banjar gaging station, which was discontinued in 1973, were utilized for developing the monthly streamflow volume at the diversion site. Records of other stations were used as backup data.

Climate

Citanduy River Basin is influenced climatically by the tradewinds, the transit of the equatorial low pressure zones (doldrum belt) and by upwind orographic barriers. Pronounced wet and dry seasons, having relative uniformity in duration and time of occurrence, result from these combined influences. Intensity and severity of seasons vary with the proximity effects of large equatorial storms.

Banjar Plains Service Area, which is located at the terminus of a coastal plain, is affected by orography in the prevailing wind path. During the mid-July through mid-November dry period, when the doldrum belt lies to the north, the moisture of the southeast tradewinds has been depleted in overland transit and precipitation is limited to infrequent, scattered convective storm activities originating at high altitude. With the arrival of the doldrum belt in mid-November the convective storm activity progressively increases, reaching a maximum in the January-March

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period, then progressively decreases as the doldrum belt moves northward. With the passing of the doldrums, about mid-July, the tradewinds become the primary influence and the dry season resumes.

In the mountainous portion of the Citanduy River watershed above Banjar Plains Project, the dry season is shorter and less severe. The upwind orographic conditions are less effective and scattered convective storms are frequent. Convergent airflows downwind from mountain peaks produce local precipitation with regularity, and general light-intensity storms occur when temperatures drop below dewpoint.

To establish the varying conditions within the project area, climatological data were collected from the stations at Cilacap, Tasikmalaya and Bandung. Cilacap is located 64 km to the east of Banjar town at an elevation of 5 m above MSL, while Tasikmalaya is located 36 km to the west of Banjar town at an elevation of 360 m above MSL. Bandung City is at an elevation of over 550 m and is about 150 km northwest of Banjar. Banjar twon is at an elevation of 30 m above MSL. The data from Cilacap appeared to be the most reliable. The data from Tasikmalaya were quite sparse and contained some questionable information. Data from these two stations, Cilacap and Tasikmalaya, should represent conditions within the project area, which lies just north of the east-west line between the two stations. The data from Bandung represent conditions not encountered in the project area. Other data were available, but covered very short periods and were of very questionable reliability.

Temperature

The annual temperature range is very small and it would be extremely difficult to attempt to distinguish seasons by temperature. The constancy of temperature is due to the tropical

waters which surround Java. Mean monthly temperatures for Cilacap, Tasikmalaya and Bandung stations are shown in Table II-1. The temperature within the project area should follow closely an average of the temperatures recorded at Tasikmalaya and Cilacap stations.

Values for monthly average temperature have ranged from 32°C at Cilacap to 18°C at Tasikmalaya. The deviation of the mean monthly from the mean annual temperature is rarely more than 1°C and the difference between maximum and minimum is about 7°C in the Cilacap area and from 6°C to 11°C in the Tasikmalaya area.

Relative Humidity

Relative humidity is high and relatively constant throughout Indonesia, probably as a result of the warm tropical waters surrounding the islands. The average annual humidity in the project area is estimated to be 82 percent. The humidity in Bandung has ranged from 51 percent to 86 percent; in Tasikmalaya from 70 to 84 percent; and in Cilacap from 78 to 91 percent. The values of mean relative humidity are given in Table II-2. The method used to calculate most of these values is not known. As humidity varies considerably during the day, these values may only generally reflect the mean.

Sunshine

The percent of sunshine hours is shown in Table II-3 for the stations at Cilacap, Tasikmalaya and Bandung. The data within the project area are not complete nor, in the instance of Tasikmalaya, do they appear to be valid for a long-time average. In addition, the values do not appear to substantiate the temperature pattern in the project area.

Wind

The lower wind pattern does not correspond to the regional upper air pattern. Table II-4 shows the data at Cilacap and Tasikmalaya. The predominant wind direction is from the southeast quadrant for most of the year and varies from west to south to east during January through March. From the available data for Cilacap, it is observed that prevailing winds from the north, northwest, or northeast do not occur in any month. At Tasikmalaya, there are no months reported with winds from the west and only two months reported with winds from the north.

Wind velocities at Cilacap range from 4 to 10 knots. Highest mean wind velocities were reported normally during the month of July through September. Wind speeds at Cilacap most likely are higher than those experienced inland in the project area because of the off-and-on shore breezes.

Evaporation

There are no evaporation data available close or in the project area except from a station at the Pataruman Weir, which was established in January, 1974. Data from four stations in Western and Central Java are shown in Table II-5. These data are believed to be from average daily DeWild balance pan evaporation data. Lake evaporation data for Segara Anakan and Tasikmalaya region from 'Hydrology'[1/] appendix is also included in Table II-5. Losses due to evaporation required to compute transpiration is discussed in Chapter IV-Agriculture.

Rainfall

General

The network of rainfall stations in and close to the project area is quite dense. There are 46 stations within the Citanduy River Basin Development Project area which have at least five years of consecutive records, and perhaps twenty other stations adjacent to the basin, which were also considered. Some of the rainfall records are long-term going back as far as 1879. The locations of most of these station are shown on Figure II-1.

Adequate maintenance and replacement of equipment has not been carried out for many rainfall stations. As a result, many station records have been interrupted and even discontinued. Therefore, many stations required intensive analysis to make them usable for the hydrologic studies.

Twenty-seven stations were selected for long-term analysis based on their location and apparent reliability. The records at these stations were made continuous within their period of record and checked for consistency by a double-mass analysis. The data were then correlated and extended to cover the period 1915 through 1973. Rainfall data for the period 1974 through 1976 were collected for many of these stations and used in the hydrologic studies where necessary.

Annual and Monthly Rainfall

The Upper Citanduy basin is the drainage area of the Citanduy River above Banjar town. The annual mean rainfall over the Upper Citanduy Watershed is estimated to be 3,120 mm. This estimate of mean rainfall was made by the Thiessen and the isohyetal methods. The rainfall is greatest on the southeastern

side of Volcano Sawal. On the other side of the volcano, it appears that the rainfall decreases slightly to the edge of the basin.

The wettest year of record is 1968 with 5,220 mm of rainfall and the driest is 1918 with only 1,821 mm. The values of the basin-averaged monthly rainfall on the Upper Citanduy Watershed Area for the period of records is shown in Table II-6. January and December record the highest average monthly rainfall of 397 mm of rain. August is the driest month with 94 mm. Also shown in Table II-6 are the average monthly rainfall of five stations in the Banjar Plains watershed and service area. The areal distribution of mean annual rainfall is shown on Figure II-2.

Service Area

The rainfall pattern for the project service area is influenced by the topography surrounding the area. Heavy rainfall occurs to the southeast of the project around Cilacap. Proceeding to the northwest, a rain shadow is indicated in the Lower Citanduy/Ciseel Basin. Lower Citanduy/Ciseel Basin is the area downstream of the Pataruman weir. Rainfall then increases to the north due to orographic lifting over the hills forming the northern basin boundary. The Lower Citanduy/Ciseel River Basin, southeast of the Banjar Plains, under the effect of the rain shadow receives some of the lowest annual rainfall in the entire Citanduy Basin. The effect is felt as far inland as the Banjar area. The mean average annual rainfall over the service area varies from 2,523 mm at Banjar near the eastern project boundary to 3,089 mm at Manonjaya west of the project area. The average elevation of the service area is nearer the elevation at Banjar and the mean annual rainfall over the area is estimated as 2,700 mm.

Records for the Banjar rain gage show January to be the wettest month with 339 mm of rain and August as the driest with only 69 mm. The values of monthly rainfall for the Banjar rain gage are shown in Table II-6.

Streamflow

General

There are three organizations presently collecting data relating to stream runoff at 21 locations in the Citanduy River Basin. They are the Directorate of Penyelidikan Masalah Air (DPMA), the Provincial Public Works Department (P.U. Prop.) and the Citanduy Project Office (C.P.O.). The stream gaging stations relevant to the Banjar Plains Project study are the three gages on the Citanduy River at Leuwitonjong, Cirahong and Banjar, and the gage on Cimuntur River at Batununggul. The location of these gages are shown on Figure II-1.

The Leuwitonjong staff gage is located on the Citanduy River just upstream from the village of Tonjong which is about 2 km north of Tasikmalaya. The drainage area at this location is 485 km^2. The gage was established in February, 1970. Zero of the gage is reported to be at El. 248.5 m and the rating curve is established only in the low flow region. The flow records at this station were used only to verify and confirm the flow records at the downstream station of Cirahong and to evaluate the low flows.

The Cirahong gage is located on the Citanduy River at the Cirahong Village about 1.5 km northeast of Manonjaya. This gage is about 19.5 km upstream of the proposed Banjar Plains Diversion Headworks and has a drainage area of 627 km^2. This station was

established as a staff gage in November, 1969, and was converted to automatic gage in 1972. Zero of the gage is reported to be at El. 182.119 m. Discharge measurements are made by boat and from the highway bridge near the station. The recorded streamflow data for this station has been used in determining the monthly runoff for the Banjar Plains Project and in determining the low flows at the diversion site.

The Banjar stream gaging station is located on the Citanduy River at the Banjar road bridge. The site is about 8 km downstream of the confluence of the Citanduy and Cimuntur Rivers and about 16 km downstream of the proposed Banjar Plains Diversion Headworks. This gage was established in January, 1957, and was discontinued at the end of 1972. The zero of the gage is at El. 15.3. The drainage area for this gage is 1,314 km^2. The data from this gage has been used to develop the monthly runoff volume at the Banjar Plains diversion weir.

The Batununggul staff gaging station is located below the confluence of the Cimuntur and the Cilisung river and has a drainage area of 578 km^2. The gage is located less than a kilometer upstream of the Cimuntur confluence with Citanduy and hence, the gage readings are affected by the backwater. This station has been in operation from November, 1969. The zero of the gage is at El. 25.821 m. The records for the station have been used to verify the flows at the Citanduy and Cimuntur river confluence and flood elevations.

Discharge Rating Curve

The stream gage rating curve for the Cirahong gaging station is shown on Figure II-3. The curve is well defined by current meter measurements up to 100 m^3/s and has been extended to 500 m^3/s on basis of velocity - area studies and logarithmic plotting.

The rating curve for the Banjar gaging station is shown on Figure II-4. The curve is well defined by current meter measurements up to 140 m^3/s and has been extended to 350 m^3/s on basis of velocity-area studies. The recorded discharges beyond 600 m^3/s are in doubt for this station.

Streamflow Data

Mean daily flows for the Cirahong station for 1970 through 1974 were originally computed by the Direktorat Penyelidikan Masalah Air (DPMA). Use of these records has been limited since about thirty percent of the daily water level readings is missing. Compounding the problem the computer print-outs of the daily discharge tables in the COSSARR MODEL report[3/] erroneously listed periods of missing records as being zero flow. Monthly and annual averages reflect this error.

During this study a review of the published data based on gage readings for the period 1975 and 1976, indicated a good correlation between the mean daily gage height record for the gaging station at Leuwitonjong and the mean daily gage heights for the Cirahong station. The missing gage records at Cirahong gage in the period 1970 to 1974 were reconstructed and the gaps in the record filled in by use of this correlation. Daily flows for 1975 and 1976 were also computed so that there is now a continuous daily streamflow record for the period 1970 through 1976 for the Cirahong gage. Using the values of mean daily flows, mean monthly discharges at the Cirahong station have been calculated for the period of records. The daily streamflow data is presented in the Appendix Volume, Vol. III. The largest mean monthly flow was 89.8 m^3/s and occurred during 1976. The minimum mean monthly flow

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3/ 'Analisa Laboratorium Data-Data Hidrologi', Sungai Citanduy, COSSARR Model, Direktorat Penyelidikan Masalah Air, Bandung, June, 1975.

was recorded during September, 1972. The average annual runoff for the periods of record (1970-76) was 42.3 m^3/s. Monthly and annual runoff volume in millions of cubic meters is shown in Table II-7.

The monthly and annual runoff of Citanduy River at Banjar is shown in Table II-8. This has been taken from the 'Hydrology' Appendix[1/] mentioned earlier in this chapter. Since the gage has been discontinued from 1973, there are no further data available to update this table. It is seen that there are a few missing records in this period of 1966 through 1972. Comparison of Tables II-7 and II-8 indicate that the average annual runoff for the Cirahong gage is 1.63 million m^3/km^2 while for the downstream Banjar gage it is 1.90 million m^3/km^2. A major contributing factor for this difference in yields is believed to be due to the higher runoff from the 580 km^2 drainage area of Cimuntur River Basin. However, the possibility of inaccuracy in the Banjar gaging data cannot be ruled out, since the data at Banjar gage and the Pataruman gage (loacated 5 km downstream of Banjar gage) do not follow expected trends, i.e., increase and decrease together, nor are the differences constant.

Simulated Streamflow

During preparation of Appendix B, of the Citanduy River Basin Development Project, Hydrology report,[1/] correlation studies of rainfall and runoff were made for several locations in the Citanduy River Basin. From these studies, synthetic streamflows were developed by correlation of known river flows and precipitation records from rain gage stations in the area. Synthetic runoff values were obtained for the period 1950 to 1973 for the streamflow station at Banjar. Records for the station at Banjar were used from 1966 through 1973 and the flows for 1950 through 1968 were generated by the rainfall-runoff correlation. This data is shown in Table II-9 and was used to estimate the monthly runoff at the proposed Banjar Pataruman River dam site.

Project Runoff

Three sites have been identified for location of the Banjar Plains Diversion Headworks. Their location varies from 19.5 to 23 km downstream of the Cirahong gage and 4.5 to 8 km upstream of the confluence of Citanduy and Cimuntur Rivers near the village of Cimaragas. These sites are discussed latter as upper, middle and lower site. The drainage area at each respective location is 738, 746, and 750 km^2. Since the difference in drainage areas between the three sites is small, only one set of runoff was developed as the project runoff. This was for the diversion site with 738 km^2 drainage area.

Runoff values for 1950 through 1969 have been generated from the runoff data at Banjar gage presented in Table II-9. The monthly values at Banjar gage were first multiplied by the drainage area factor of 0.56 (738/1,314). Since the Cimuntur drainage has a higher yield as compared to the Citanduy drainage, the above values were reduced by the yield factor 0.89 (1.69/1.90) which is the ratio of average annual yields per square kilometer of the Cirahong and Banjar gages. Monthly runoff from 1970 through 1976 has been obtained by applying a drainage area factor of 1.18 (738/627) to the Cirahong stream gage data presented in Table II-7. The project monthly runoff for the period 1950 through 1976 is presented in Table II-10 along with total annual, average annual and average monthly values. The simulated long-term mean/annual runoff at the diversion site is 1,288.3 million m^3 giving a yield of 1.75 million m^3/km^2. The driest month is September with an average yield of 42.1 million m^3, while the wettest month is January with an average yield 167.5 million m^3. The minimum monthly flow is 5.2 million m^3 in September, 1972.

The 27 years of annual simulated runoff record is presented graphically in Figure II-5. It is seen that the years 1954, 1961-64, 1967 and 1972 were years of low yield. Out of 27 years, the annual runoff is less than the mean annual runoff for 56 percent of the period.

Low Flow Analysis

The water for irrigation and municipal needs of the Banjar Plains will be supplied by either a diversion weir or a pumping plant involving no water storage in either case. Hence, an estimate of the firm water supply in the river during low flow periods must be made to determine the adequacy of the supplies. The daily observed flow data available for this analysis is for a period from 1970 through 1976 at the Cirahong gage which is about 19.5 km upstream of the diversion site with about 85% of drainage area. This is the closest gaging station to the diversion site.

To determine water availability for irrigation from a diversion structure, normally a frequency analysis based on long-term daily flow or weekly flow records is necessary. In the present case, only seven years mean daily flow data is available, of which 1972 happens to be a dry year. This data was used to develop flow duration curves for each of the months in which runoff is low. The normal dry months are July through September.

The flow duration curves for the Cirahong gage for the months of July through October are presented in Figure II-6 to II-9. The curves indicate the magnitude of flow in m^3/s and the percent of time in that month that magnitude of flow was either equalled or exceeded. Thus, the flow in the month of July (Figure II-6) which equals or exceeds 5.0 m^3/s occurs for 75 percent of the time or, putting it in another way, the flow at 75 percent firmness is 5.0 m^3/s. The magnitude of flow at 90, 95 and 100 percent firmness is shown on Table II-11 for the four months. It is seen that the minimum flow of 1.2 m^3/s at 100 percent firmness occurs in the month of October.

The minimum flow at the diversion site during the dry year of 1972 was also estimated as follows. The flow-duration values at the diversion site were obtained by applying a drainage area factor of 1.18 (738/627) to the values at the Cirahong gage. These values at 90, 95 and 100 percent firmness are shown in

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Table II-11 for the four dry season months. The minimum flow of 1.4 m^3/s occurs in the month of October. At 95 percent firmness the flow at the diversion site is determined to be 1.7 m^3/s.

The driest season during the period of record was 1972 and the second driest was 1977. The minimum daily discharge for 1972 at the Cirahong station was 1.20 m^3/s, occurring on October 20-22. This corresponds with a minimum daily flow of 0.20 m^3/s, occurring October 16-22, 1972 at the gaging station at Leuwitonjong, 32.5 km upstream.

During periods of low flows, the Upper Citanduy is mostly spring fed. Assuming the principal source of inflow to the stream is from springs adjacent to the river, a second estimate of the minimum flow at the diversion can be made on basis of inflow per kilometer of river between the gaged points and the diversion headworks. During October, 1972, the inflow rate between Leuwitonjong and Cirahong gages was:

$$\frac{1.20\ m^3/s - 0.20\ m^3/s}{32.5\ km} = 0.30\ m^3/s/km$$

Using the above rate of inflow, the additional flow between Cirahong and the diversion site would be:

$$0.03\ m^3/s/km \times 19.5\ km = 0.58\ m^3/s$$

The resulting flow at the diversion weir would be:

$$1.20 + 0.58 = 1.78\ m^3/s$$

The average of the two methods gives a minimum discharge at the diversion site of 1.60 m^3/s for October, 1972, and is believed to be a conservative estimate of low flow for the site at 100 percent firmness.

Flow duration studies were also carried out at the Pataruman diversion structure on Citanduy River in order to evaluate that sufficient water is available for diversion at the Banjar diversion site without affecting the diversion requirements for the existing irrigation system of North Lakbok. The Pataruman

weir is 18 km downstream of the Banjar diversion site and has a drainage area of 1,330 km^2. For this analysis the COSSARR generated data of simulated daily streamflow downstream of the Pataruman weir was used. This data for the Period 1956 through 1974 was generated by DPMA,[3/] using the Corp of Engineers COSSARR model.

The DPMA COSSARR data of 1975 is not very reliable in the low flow period because the correlation of observed flow to generated flow was based on annual flow volumes. Hence, any frequency analysis of flow in the low flow range would give results that are biased. The present data was considered adequate to give information on the annual flow duration.

The mean annual flow duration curve based on eighteen years simulated mean daily flow is shown on Figure II-10. The lower end of the curve, especially below a flow range of 4 m^3/s, is considered to be not reliable. It is seen that at 90 percent firmness, a flow of about 10.7 m^3/s is available on an annual basis downstream of the Pataruman weir while at 95 percent firmness the flow is about 5.0 m^3/s. From observed data, the lowest flow recorded in the period during October 23-29, 1972, was 1.6 m^3/s. Thus, during the low flow period a diversion at the Banjar site of about 1.5 m^3/s or less should not affect present diversion demands in North Lakbok. More data is needed to improve this estimate.

Floods

General

Normally, there is not much damage due to floods in the Upper Citanduy Basin. Although runoff concentrates quickly in the steep mountain streams and travel rapidly as a flood wave in the

Citanduy Basin, 890 m^3/s, will not cause overbank spill to the Banjar Plains Project Area. However, intense rainfall over the service area may cause overbank flooding of the tributary streams crossing the area. Local flooding can be controlled by providing adequate drains.

The high water rating curve for the gaging station at Cirahong has not been defined by discharge measurements, therefore, annual peak flows have not been computed. The maximum mean daily flow recorded at the gage is 319 m^3/s, which occurred on September 23, 1973. Thus, it is not possible to do a flood analysis based on observed floods and rainfall intensities.

Project Floods

Project floods for a number of sub-basins in the Citanduy River Basin Development Project Area have been developed using unit hydrographs and storm rainfall. These are presented in 'Hydrology', Appendix B,[1/] mentioned earlier. The project floods are used as input in flood routing studies and as volume floods for river diversion during construction. A summary of project floods for 10, 25 and 50 year reoccurence intervals are shown in Table II-12 for the diversion site of the Banjar Plains Project, the adjoining Cimuntur Basin and at the old Banjar damsite just downstream of the confluence of the Citanduy and Cimuntur Rivers. The peak flows at the diversion site for the 10, 25 and 50 year floods are 827 m^3/s, 932 m^3/s and 1,080 m^3/s. The 100 year flood has a peak of 1,220 m^3/s and a flood volume of 80.8 million m^3/s.

The flood hydrographs for the Banjar Plains Project are shown in Figure II-11. Both the peak discharge and the volume of flow under each hydrograph is also shown on the same Figure.

A 1,000 year return period flood was earlier computed in Appendix B, 'Hydrology' Report.[1/] This was for the Banjar dam on Citanduy River at the alternate Banjar site. This site is about 2.5 km upstream of the confluence of Citanduy and Cimuntur Rivers and about 5.5 km downstream of the diversion site. This hydrograph has a peak discharge of 2,305 m^3/s and has a 60 hour volume of 152.6 million m^3, and is shown in Figure II-12. The time to peak from beginning of excess rainfall is about 17 hours.

The flood hydrograph was developed using a unit hydrograph and basin storm rainfall. The 1,000 year storm rainfall was computed to be 258 mm for a storm of 18 hours duration with the excess rainfall as 189 mm. Since the location of the alternate Banjar site is close to the proposed diversion site, the hydrograph in Figure II-12 can be considered to be the 1,000 year flood hydrograph for the Banjar Plains Project at the diversion site.

Design Flood

The 100-year flood is selected as the design flood for the design of Banjar Plains diversion structure on the Citanduy River. The flood hydrograph has a peak discharge of 1,220 m^3/s and a volume of 80.8 million m^3 and was determined using a unit hydrograph with the 100 year basin rainfall as 153 mm. The excess rainfall during the storm is 90 mm. The design flood hydrograph is shown on Figure II-11.

Sedimentation

Sediments are produced by rainfall impact, mass movement of residual soils, and by stream channel erosion in the headwater

areas of the Citanduy Basin. These sediments are transported by the river system to the alluvial plain. In the undeveloped system, some of the sediments were transported directly through to the mouth of the Citanduy River, but a significant portion of the material was temporarily stored on the flood plain with the flood waters; and some sediments were left as a permanent deposit on the flood plain.

The residual soils on Volcano Sawal and the hill areas, which together make up 85 percent of the Citanduy drainage basin, are being eroded by rainfall impact and by stream channel cutting. The sediment yields from these headwater areas are estimated to be approximately 15 million metric tons per year. That is an average of about 5 mm of soil removed from over the entire headwater area each year.

Landslides and other mass movements of soil and loose rock that reach an active watercourse are probably a significant source of sediment also, as the flowing water easily entrains material from the toes of such masses. The evaluation of landslide in the basin is very difficult because of the land preparacions carried out by farmers. As soon as a slide moves down, it is terraced and farming begins, frequently rice culture. The slides generally provide more gentle slopes for this purpose than the pre-existing hillside slopes. Locally, it sometimes appears that landslides have been encouraged.

Actually, the sediment yield in the Citanduy Basin varies greatly from one small watershed to another. For example, on the east side of Volcano Sawal, one stream is red with sediment and bars of silt are deposited along the banklines. In the neighboring stream, clear water is cascading down a riverbed covered with large boulders. In general, more sediments are obtained from the east side of the volcano than from the west side. This is the reason that the Cimuntur River which drains down the eastern slope of Volcano Sawal has greater sediment concentration as compared to Citanduy River which drains the south and western slopes of Volcano Sawal.

The volume of sediment transported by Citanduy is estimated to be large. Over half of the annual load is transported during perhaps 5 percent of the time when the large flow occurs. The Citanduy River has aggraded considerably for a distance of over 1.5 km upstream of its confluence with Cimuntur. Also, sand and gravel bars are visible at low flows at many bends along a 10 km distance upstream of the confluence.

There are no measurements for bedload transported in the upper reaches of the river. Previous studies have assumed 15 percent of the total load as bedload for the Citanduy Basin. In the reach where Banjar Plains diversion structure will be located, it is estimated that the bedload percentage would be about 20 percent.

A few suspended sediment discharge measurements are available at the gaging station at Cirahong from November, 1969 through January, 1974. Results of these measurements are presented in Table II-13. This data is for low to normal flows and does not give an idea of sediment concentration during floods.

Analyses of suspended sediment samples collected in the Citanduy River system show that suspended sediment is mostly silt. The river waters in the Citanduy Basin have a very turbid appearance. The Cimuntur River is more reddish in color even at low flow as compared to the Citanduy River, indicating the high rate of erosion even at low rainfall intensities.

Within the river channel system there is some active bankline erosion taking place. In the lower reaches, the erosion is in the form of slip-circle failures of a few meters of bankline length. Local reaches of some banklines have a scalloped appearance. There is no net river channel widening and very little channel migration because the slip-circle area fills in with sediments deposited by the river.

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There are no records of past and present rates of deposition on the alluvial plain. In local spots along the natural levee, there are silt deposits 8 cm thick that appear to have been deposited by a single flood.

For the Banjar Plains Project the suspended sediment in the silt ranges will be the prime consideration,as there is to be no storage involved. The problem is one of excluding the suspended sediment from the distribution system. Currently, there is little data available which can be used to accurately estimate the quantity of suspension that would be drawn into the distribution system.

TABLE II-1

Mean Monthly Temperature

Month	Temperature (Degrees Centigrade)			
	Cilacap 1/	Cilacap 2/	Tasikmalaya 3/	Bandung 4/
January	26.7	27.2	25.5	22.8
February	27.0	27.6	25.8	22.7
March	26.8	27.4	25.8	23.0
April	27.1	27.5	25.1	23.4
May	27.1	27.1	25.1	23.6
June	26.1	26.3	24.4	23.2
July	25.2	26.4	23.8	22.7
August	24.6	25.1	24.6	23.0
September	25.2	25.8	24.0	23.4
October	26.5	26.6	25.0	23.5
November	26.8	27.1	25.0	23.0
December	27.8	27.1	25.2	22.8
Average	26.4	26.8	24.9	23.1

1/ 1961-1972, as reported.

2/ 1961-1972, average of maximum and minimum readings.

3/ 1971-1973, average of maximum and minimum readings.

4/ 1952-1971, as reported.

TABLE II-2

Mean Monthly Relative Humidity

Month	Humidity (Percent)		
	Cilacap 1/	Tasikmalaya 2/	Bandung 3/
January	84.5	79	83
February	83.8	80	78
March	84.2	80	78
April	85.8	80	82
May	84.1	82	79
June	83.7	80	77
July	83.7	81	75
August	82.7	78	72
September	81.2	78	70
October	82.9	77	72
November	84.2	81	79
December	85.1	80	81
Average	84	80	77

1/ 1961-1972, as reported.

2/ 1971-1973, average of readings at 0700 and 1300 hours.

3/ 1952-1971, method for estimating mean not known.

TABLE II-3

Percent of Sunshine Hours

Month	Percent of Sunshine Hours		
	Cilacap 1/	Tasikmalaya 2/	Bandung 3/
January	46	40	53
February	59	39	54
March	51	54	57
April	53	59	60
May	60	38	65
June	59	47	70
July	49	54	69
August	66	56	71
September	69	39	70
October	54	40	63
November	42	43	55
December	39	34	57

1/ Partial records 1960, 1962-1965.

2/ Partial records 1960, 1971-1973.

3/ 1952-1971.

At Cilacap, 100% sunshine hours represents the period from 0800 to 1600 hours.

At Tasikmalaya, 100% sunshine hours represents the period from 0700 to 1600 hours.

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TABLE II-4

Wind Direction and Velocity

Month	Cilacap[1/]		Tasikmalaya[2/]	
	Direction	Velocity(Knots)	Direction	Velocity(Knots)
January	Variable	4.8	E	4.0
February	Variable	4.9	E	4.3
March	Variable	5.4	SE	4.0
April	E/SE	6.3	E	4.0
May	E/SE	7.7	E	4.0
June	E/SE	8.5	E	4.3
July	E/SE	9.4	E	4.6
August	E/SE	9.9	E	4.6
September	SE/E	10.3	E	5.0
October	SE/E	8.9	E	4.6
November	SE/E	7.1	S	4.3
December	E/SE	5.3	S	4.3
Average		7.4		4.3

1/ 1961-1972, anemometer 11 meters above ground surface.

2/ 1971-1973, anemometer approximately 5 meters above ground surface.

Note: Anemometer elevation not given in the records.

TABLE II-5

Monthly Evaporation

Month	Evaporation (mm)					
	Madiun 1/	Kening 2/	Pasuruan Exp.Sta. 3/	Ciregon 4/	Segara Anakan 5/	Tasikmalaya 5/
January	127	65	60	56	101	108
February	118	67	48	53	101	99
March	140	62	48	58	106	114
April	138	75	56	62	108	113
May	152	74	62	76	110	92
June	150	108	79	87	106	90
July	146	140	99	111	100	100
August	174	161	122	138	133	114
September	201	126	141	146	149	113
October	205	81	134	126	148	121
November	144	63	98	96	122	114
December	149	68	53	67	106	112
Totals	1,844	1,090	1,000	1,076	1,400	1,290

1/ 1958-1971 2/ 1967-1972 3/ 1966-1970 4/ 1936-1946

5/ Lake evaporation.

Note: Station evaporation believed to be from DeWild evaporimeters. Segara Anakan and Tasikmalaya values computed using Christiansen method and multiplied by a factor of 0.7.

TABLE II-6

Average Monthly Rainfall for the Upper Citanduy Basin and Selected Raingage Stations - (mm)

Month	Upper Citanduy Basin	Tarikolot Raingage No. 223 A	Ciamis Raingage No. 229 A	Manonjaya Raingage No. 231	Banjar Raingage No. 245	Pamarican Raingage No. 247 A
January	397	344	394	383	339	310
February	345	317	373	362	304	298
March	379	348	367	378	313	308
April	291	260	276	276	233	226
May	232	217	226	230	175	174
June	142	113	151	154	127	123
July	133	108	150	144	99	105
August	94	76	101	95	69	64
September	115	97	110	109	72	69
October	246	226	259	252	201	190
November	350	326	310	316	282	247
December	397	317	391	391	310	282
T O T A L	3,121	2,802	3,109	3,089	2,523	2,395

TABLE II-7

Observed Monthly and Annual Runoff of Citanduy River at Cirahong

(Million m^3)

Drainage Area = 627 km^2

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1970	157.2	110.6	204.6	185.1	128.6	98.2	68.8	23.1	28.0	44.7	105.8	145.4	1300.1
1971	136.6	113.7	158.6	133.0	117.8	67.9	30.0	18.9	65.1	137.1	202.4	192.0	1373.1
1972	182.7	100.5	112.5	82.2	114.6	17.8	11.0	7.9	4.4	4.7	44.6	107.9	790.6
1973	151.3	135.0	135.3	165.1	191.0	94.3	119.7	47.7	192.8	158.0	180.9	151.3	1722.4
1974	51.7	169.3	83.3	149.8	109.0	23.6	39.4	125.1	98.8	135.0	154.5	225.0	1364.5
1975	173.3	162.1	195.8	171.6	109.8	29.0	31.1	17.5	89.2	216.4	164.6	155.1	1515.5
1976	107.1	142.6	171.1	87.9	35.6	15.0	10.4	8.1	6.4	87.6	232.8	115.2	1019.8

TABLE II-8

Observed Monthly and Annual Runoff of Citanduy River at Banjar

(Million m^3)

Drainage Area = 1,314 km^2

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1966	399.8	396.4	401.0	303.3	246.4	155.5	58.9	50.9	101.1	249.1	238.5	388.4	2989.3
1967	294.6	312.1	308.0	254.0	109.8	46.7	53.6	20.9	20.3	—	52.4	434.8	—
1968	349.0	268.5	326.1	252.8	312.9	—	—	340.2	84.4	269.1	288.7	271.6	—
1969	302.2	277.9	260.5	156.7	126.9	298.3	59.2	22.6	31.6	83.1	224.1	227.4	2070.5
1970	208.4	190.6	284.5	248.5	207.0	170.0	147.3	78.6	83.7	107.0	198.3	265.2	2189.1
1971	281.0	203.6	280.8	190.1	191.9	155.4	123.2	124.9	176.1	254.4	366.7	452.2	2800.3
1972	474.1	295.6	233.5	191.9	249.6	84.9	65.2	61.9	—	—	79.0	—	—
1973	Discontinued.												
AVG.	329.9	277.8	299.2	228.2	206.4	151.8	84.6	100.0	82.8	192.5	206.8	339.9	2499.9

Note: 1966 and 1967 are based on original water levels and 1973 rating curve.

TABLE II-9

Monthly Runoff for the Citanduy River at Banjar

(Million m^3)

Drainage Area = 1,314 km^2

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1950	334.6	270.8	303.5	227.0	222.8	104.0	103.7	102.4	90.4	299.0	332.6	394.3	2785.1
1951	458.9	338.1	289.7	171.3	225.7	170.8	103.3	86.7	64.2	127.5	215.7	233.7	2395.6
1952	287.7	255.5	307.1	233.0	148.7	90.0	63.9	62.6	43.2	160.3	302.2	442.9	2397.1
1953	515.1	379.0	380.4	260.1	359.9	224.4	136.4	82.0	38.4	48.2	52.1	91.6	2567.6
1954	180.8	166.2	207.3	199.4	145.2	114.2	86.7	82.5	59.5	161.6	253.5	388.2	2045.1
1955	447.8	302.5	342.4	228.8	148.2	107.8	101.7	105.7	78.8	252.0	343.0	539.9	2998.6
1956	566.0	408.8	391.8	263.3	268.9	176.0	121.7	123.2	83.3	199.1	242.0	385.8	3229.8
1957	424.0	268.0	336.3	237.6	214.9	149.0	140.0	150.6	79.7	156.8	219.4	327.7	2704.0
1958	315.4	284.0	337.4	217.7	207.7	128.6	102.1	92.8	55.6	161.0	169.8	269.9	2342.0
1959	332.9	270.3	287.5	204.3	253.6	197.3	151.7	118.3	69.1	155.6	138.7	237.4	2416.7
1960	259.3	275.1	312.3	244.5	238.8	166.9	124.5	87.9	48.7	105.8	187.8	245.0	2296.6
1961	303.7	223.1	242.1	208.5	290.8	207.5	133.5	83.5	46.0	51.7	72.2	108.1	1970.7
1962	181.3	160.5	258.9	285.0	147.1	124.8	108.0	81.9	47.3	126.0	193.0	342.3	2056.1
1963	310.4	295.5	254.4	219.8	288.4	172.6	105.9	55.0	13.6	17.2	41.1	53.7	1927.6
1964	83.7	83.1	128.9	130.6	87.4	70.0	54.1	51.5	39.5	159.1	233.5	353.3	1474.7
1965	427.3	345.2	356.7	219.5	268.6	186.2	110.5	70.8	32.8	51.7	68.2	164.6	2302.1
1966	399.8	396.4	401.0	303.3	246.4	155.5	58.9	50.9	101.1	249.1	238.5	388.4	2989.3
1967	294.6	312.1	308.0	254.0	109.8	46.7	53.6	20.9	20.3	30.0	52.4	434.8	1937.2
1968	349.0	268.5	326.1	252.8	312.9	250.0	200.0	340.2	84.4	269.1	288.7	271.6	3213.3
1969	302.2	277.9	260.5	156.7	126.9	298.3	59.2	22.6	31.6	83.1	224.1	227.4	2070.5
1970	208.4	190.6	284.5	248.5	207.0	170.0	147.3	78.6	83.7	107.0	198.3	265.2	2189.1
1971	281.0	203.6	280.8	190.1	191.9	155.4	123.2	124.9	176.1	254.4	366.7	452.2	2800.3
1972	474.1	295.6	233.5	191.9	249.6	84.9	65.2	61.9	21.2	35.0	79.0	150.0	1941.9
1973	293.7	288.1	352.2	300.6	386.4	197.8	286.2	177.2	37.1	381.6	414.8	346.4	3342.1
AVG.	334.7	270.8	303.5	227.0	222.8	156.2	114.2	93.9	60.2	151.8	201.5	296.4	2433.0

TABLE II-10

Monthly Runoff at Banjar Plains Diversion Site

(Million m^3)

Drainage Area = 738 km^2

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1950	167.6	135.7	137.7	113.7	111.6	52.1	51.9	51.3	45.3	149.8	166.6	197.6	1380.9
1951	229.8	168.7	145.1	85.8	113.1	85.5	51.7	43.4	32.2	63.9	63.0	117.1	1199.3
1952	144.1	128.0	153.9	116.8	74.5	45.0	32.0	31.4	21.7	80.3	151.4	222.0	1201.1
1953	258.0	189.9	190.5	130.3	180.3	112.4	68.3	41.1	19.3	24.2	26.1	45.8	1286.2
1954	90.5	83.2	103.8	99.9	72.8	57.2	43.4	41.3	29.8	81.0	127.0	194.4	1024.3
1955	224.3	151.5	171.5	114.6	74.2	54.0	50.9	53.0	39.5	126.2	171.8	270.4	1501.9
1956	283.5	204.8	196.3	131.9	134.7	88.1	61.0	61.7	41.7	99.7	121.2	193.3	1617.9
1957	212.4	134.2	168.5	119.0	107.7	74.7	70.1	75.5	40.0	78.6	109.9	164.2	1354.8
1958	158.0	142.3	169.0	109.1	104.1	64.4	51.1	46.5	27.8	80.6	85.1	135.2	1173.2
1959	166.8	135.4	144.0	102.3	127.0	98.8	76.0	59.2	34.6	78.0	69.5	118.9	1210.5
1960	129.9	137.8	156.4	122.5	119.6	83.6	62.3	44.1	24.4	53.0	94.1	122.7	1150.4
1961	152.2	111.8	121.3	104.4	145.7	103.9	66.9	41.8	23.0	25.9	361.2	54.1	987.2
1962	90.8	80.4	129.7	142.8	73.7	62.5	54.1	41.0	23.7	63.2	96.7	171.5	1030.1
1963	155.5	148.1	177.5	110.1	144.5	86.4	53.1	27.6	6.8	8.7	20.6	26.9	965.8
1964	41.9	41.7	64.6	65.5	43.8	35.1	27.1	25.8	19.8	79.7	116.9	177.0	738.9
1965	214.1	172.9	178.7	110.0	134.6	93.3	55.4	35.5	16.4	25.9	34.2	82.4	1153.4
1966	200.2	198.5	200.9	151.9	123.4	77.9	29.1	25.5	50.7	124.8	119.5	194.5	1496.9
1967	147.6	156.4	154.3	127.3	55.0	23.4	26.9	10.4	10.2	15.0	26.2	217.8	970.5
1968	174.8	134.5	163.4	126.7	156.8	125.2	100.2	170.4	42.3	134.8	144.6	136.0	1609.7
1969	151.4	139.2	130.5	78.5	63.6	149.4	29.6	11.3	15.8	41.7	112.3	113.9	1037.2
1970	185.0	130.2	204.8	217.9	151.4	115.6	81.0	27.2	33.0	52.6	124.5	171.1	1530.3
1971	160.8	133.8	186.7	156.5	138.7	79.9	35.3	22.2	76.6	161.4	238.2	226.0	1616.1
1972	215.0	118.3	132.4	96.8	134.9	21.0	12.9	9.3	5.2	5.5	52.5	127.0	930.8
1973	178.1	158.9	159.3	194.3	224.8	111.0	140.9	56.1	226.9	186.0	212.9	178.1	2027.3
1974	60.9	199.3	98.0	176.3	128.3	27.8	46.4	147.2	116.3	158.9	181.9	264.8	1606.1
1975	204.0	190.8	230.5	202.0	129.2	34.1	36.6	20.6	105.0	254.7	193.7	182.6	1783.8
1976	126.1	167.8	201.4	130.5	41.9	17.7	12.2	9.5	7.5	103.1	274.0	135.6	1200.3
AVG.	167.5	144.2	159.5	126.3	15.2	73.3	52.8	45.6	42.1	87.3	117.4	157.1	1288.3

TABLE II-11

Flow Magnitude at Various Firmness Values

Month	Cirahong Gage Flow (m^3/s) Firmness			Diversion Site Flow (m^3/s) Firmness		
	90%	95%	100%	90%	95%	100%
July	3.8	3.0	2.6	4.5	3.5	3.1
August	2.5	2.3	2.0	2.9	2.7	2.4
September	1.8	1.6	1.4	2.1	1.9	1.7
October	1.5	1.4	1.2	1.8	1.7	1.4

TABLE II-12

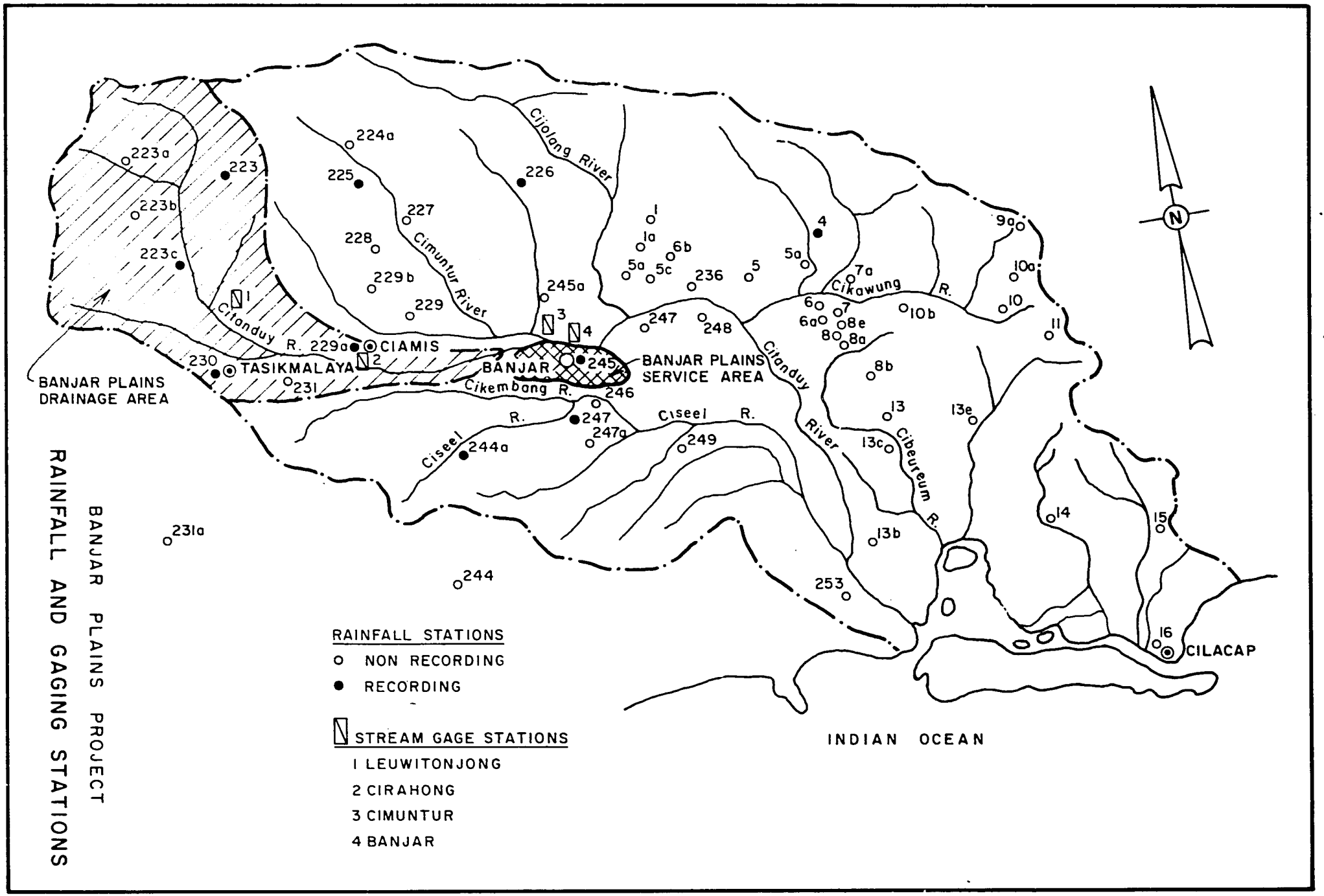
Summary of Project Floods

	Rainfall (mm)	Peak Discharge (m^3/s)	Volume Runoff (Million m^3)
Banjar Diversion Site (Upper Citanduy Basin):			
10-Year	105	827	54.2
25-Year	125	932	62.8
50-Year	139	1,080	71.0
Cimuntur Basin:			
10-Year	117	790	38.2
25-Year	138	970	48.2
50-Year	154	1,089	56.0
Citanduy and Cimuntur Basin above Banjar Damsite:			
10-Year	111	1,450	93.5
25-Year	130	1,750	115.6
50-Year	144	2,050	132.5

TABLE II-13

Suspended Sediment Measurements on Citanduy River at Cirahong Gage

Date	No. of Samples	Discharge (m^3/s)	Concentration (ppm)	Sediment (Tons/Day)
11-21-69	6	28.6	88	220
2-9-70	3	58.7	250	1,300
3-3-71	1	30.1	140	360
8-18-71	2	8.1	29	20
9-13-71	1	6.9	38	23
11-15-71	3	65.1	170	1,000
12-16-71	3	48.3	610	2,500
1-29-72	3	39.1	120	410
3-14-72	3	51.0	800	3,500
5-30-72	1	18.3	86	140
1-2-73		51.0		4,810
3-2-73		27.0		362
4-20-73		61.0		1,599
6-20-73	4	38.0	195	677
7-30-73	4	14.0	46	52
9-9-73	4	16.0	40	59
11-3-73	4	56.0	350	1,769
12-12-73	4	46.0	479	2,288
1-26-74	4	37.0	228	737

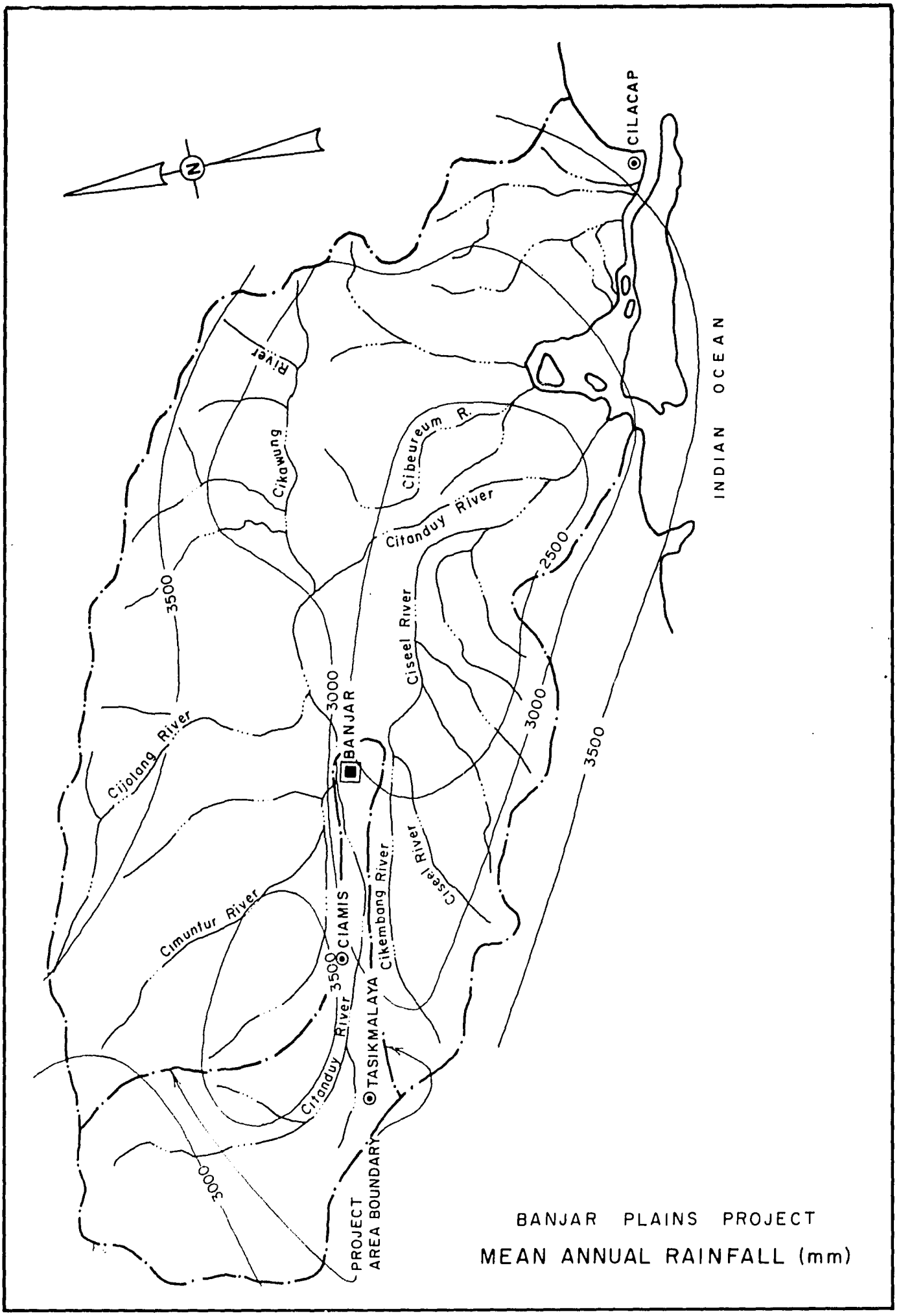


BANJAR PLAINS PROJECT

RAINFALL AND GAGING STATIONS

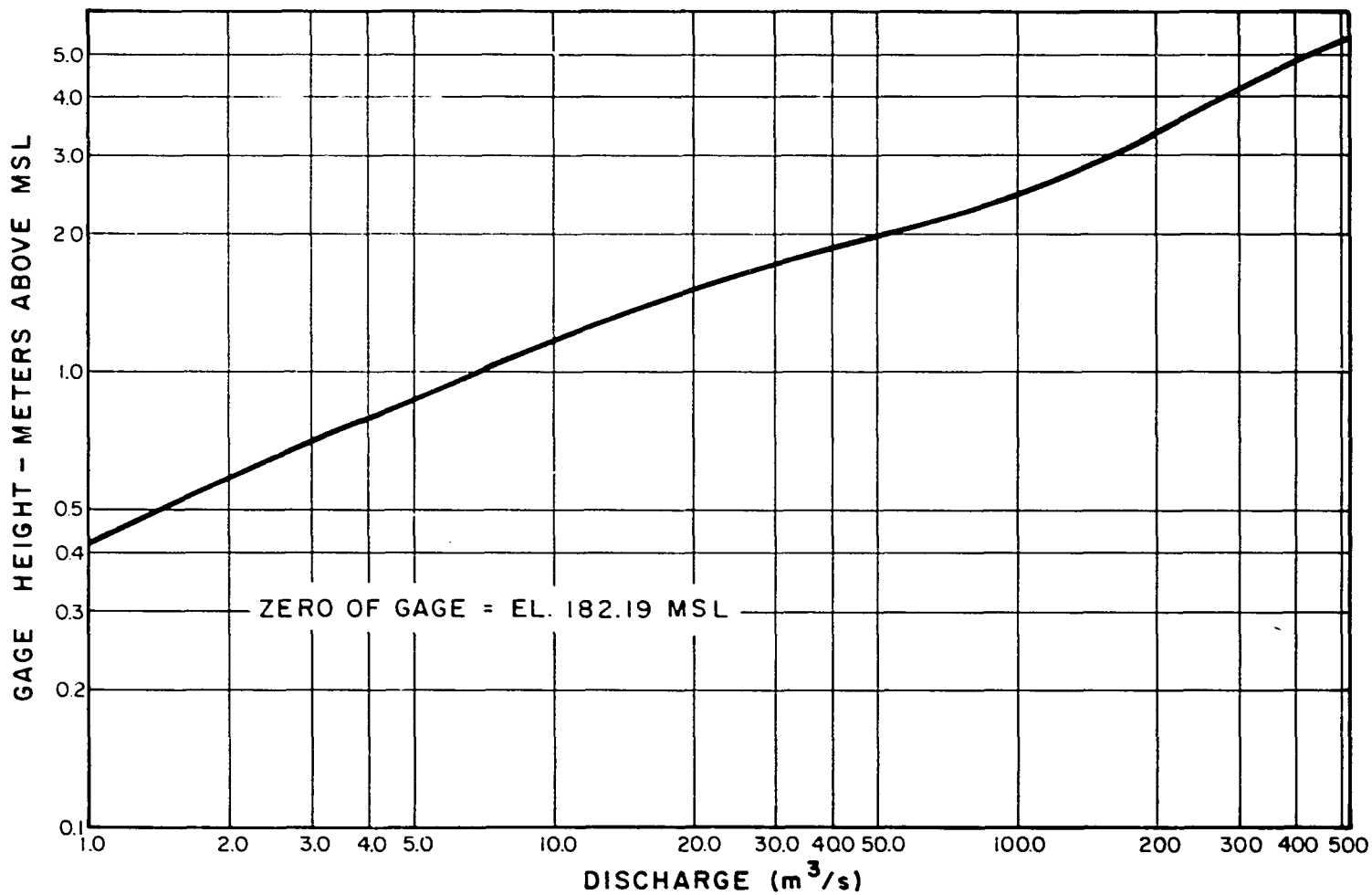
ENGINEERING CONSULTANTS, INC.

FIGURE II-1



BANJAR PLAINS PROJECT

MEAN ANNUAL RAINFALL (mm)



BANJAR PLAINS PROJECT

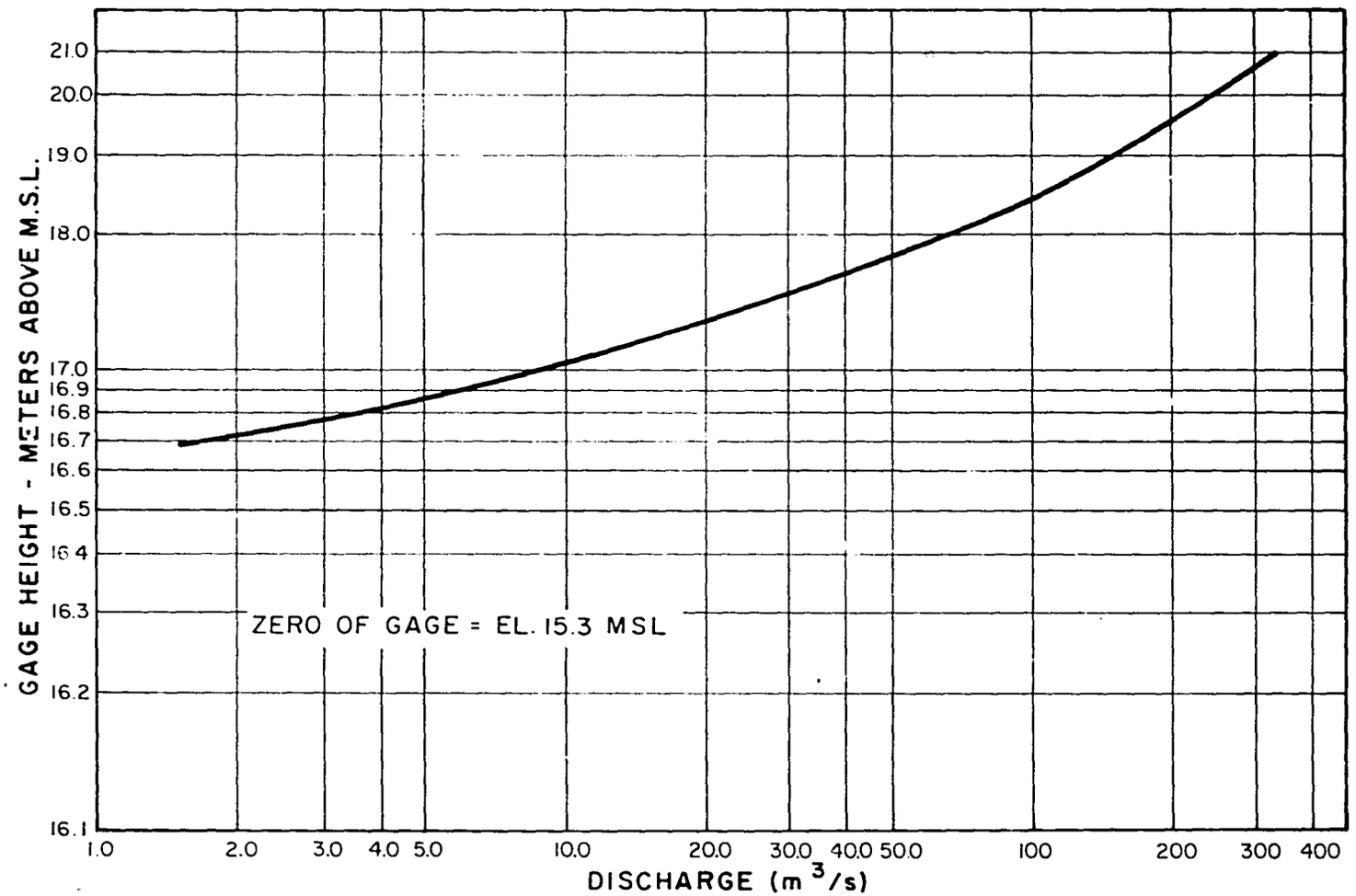
DISCHARGE RATING CURVE

CITANDUY RIVER AT CIRAHONG

FIGURE II-3

ENGINEERING CONSULTANTS, INC.

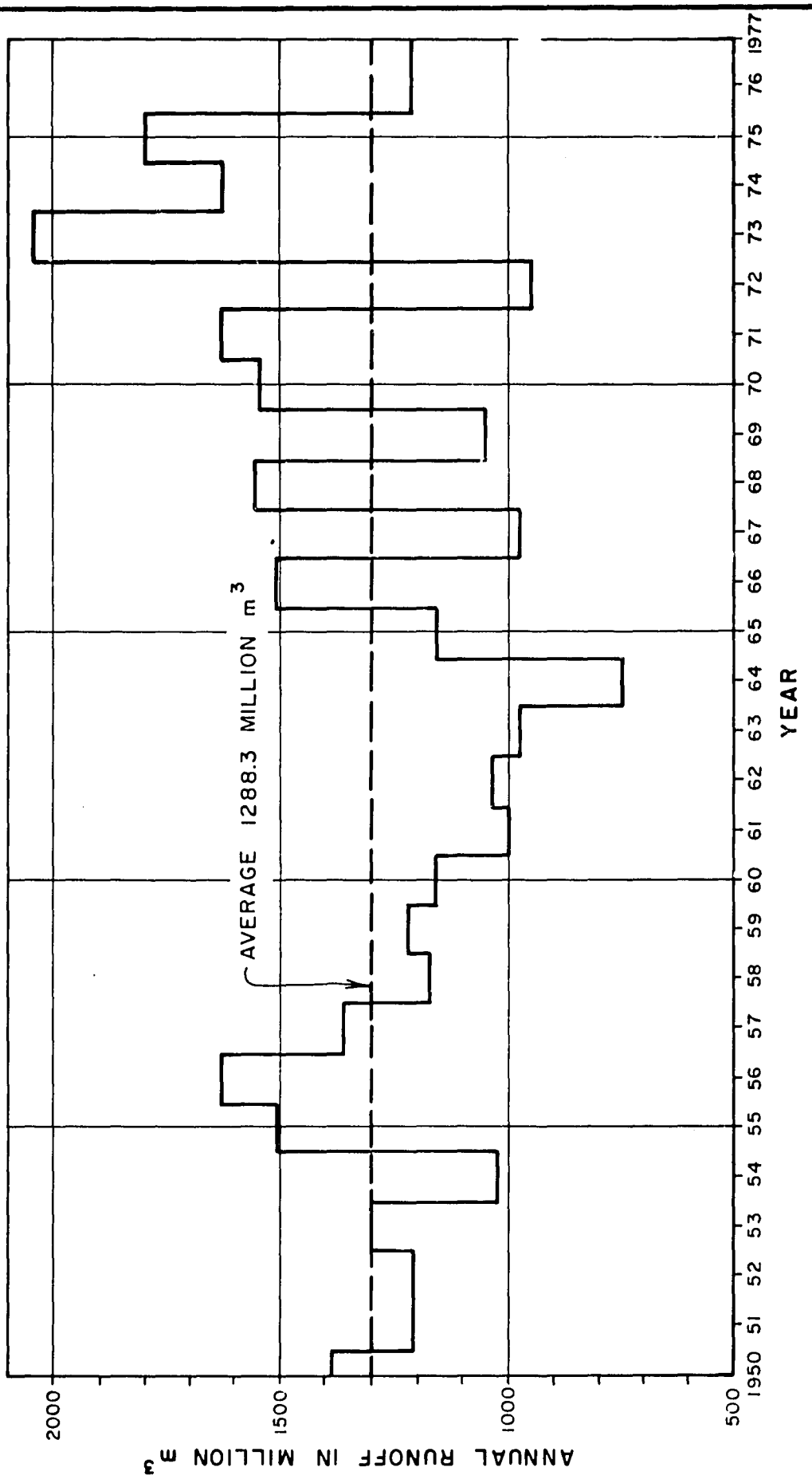
FIGURE II - 4



BANJAR PLAINS PROJECT

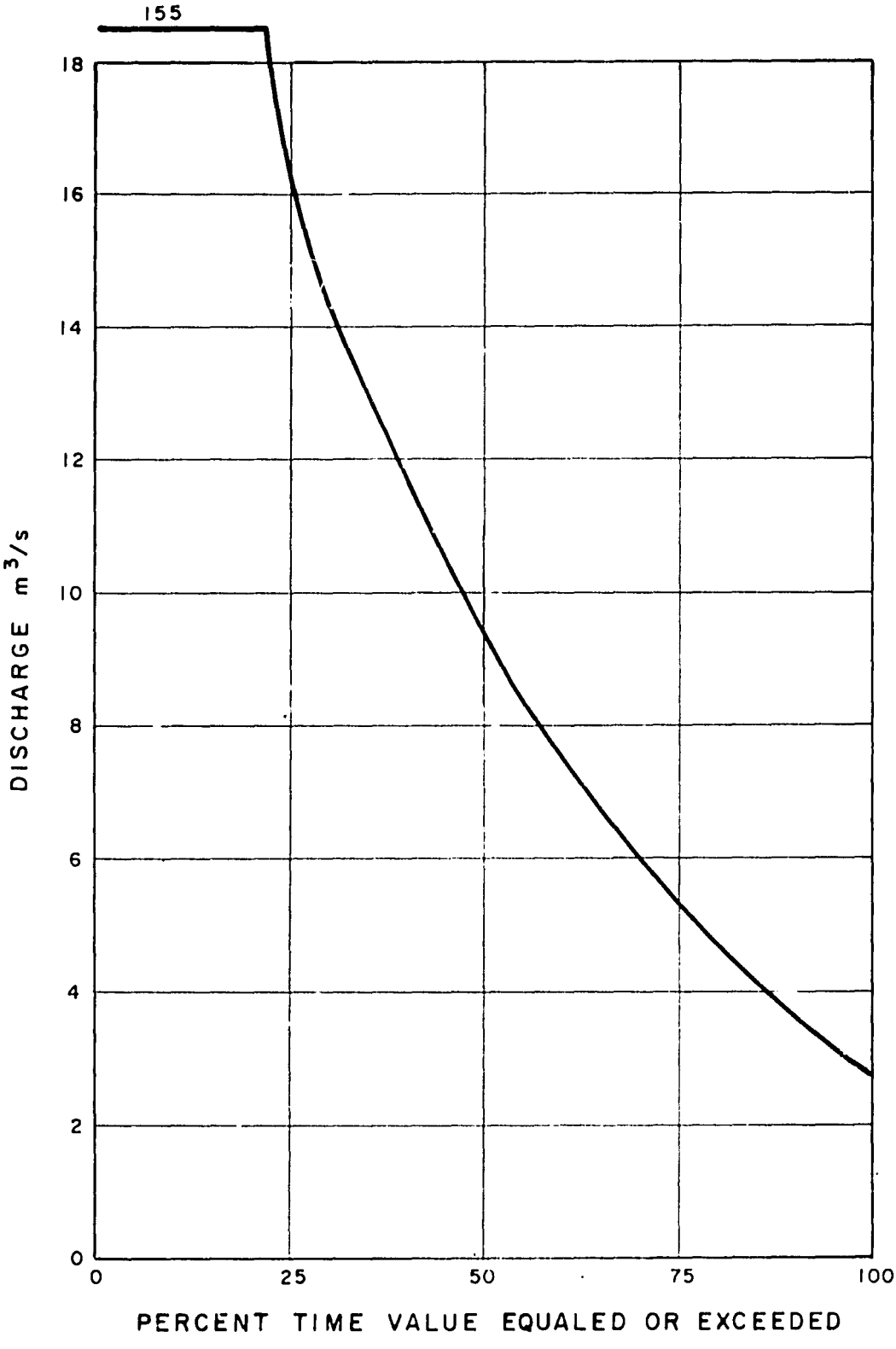
DISCHARGE RATING CURVE

CITANDUY RIVER AT BANJAR



BANJAR PLAINS PROJECT

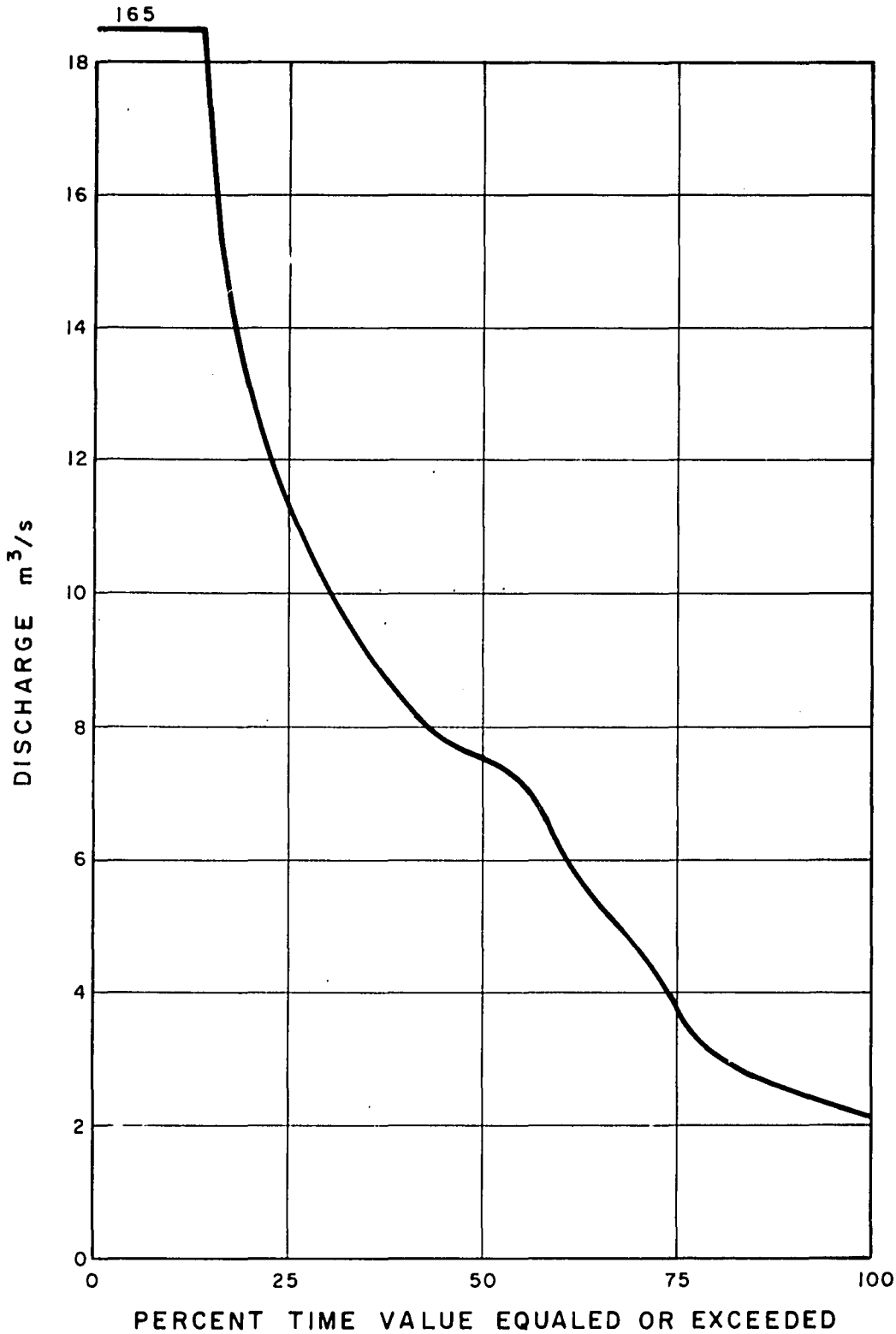
ANNUAL RUNOFF AT DIVERSION SITE



BANJAR PLAINS PROJECT

FLOW DURATION CURVE AT CIRAHONG GAGE

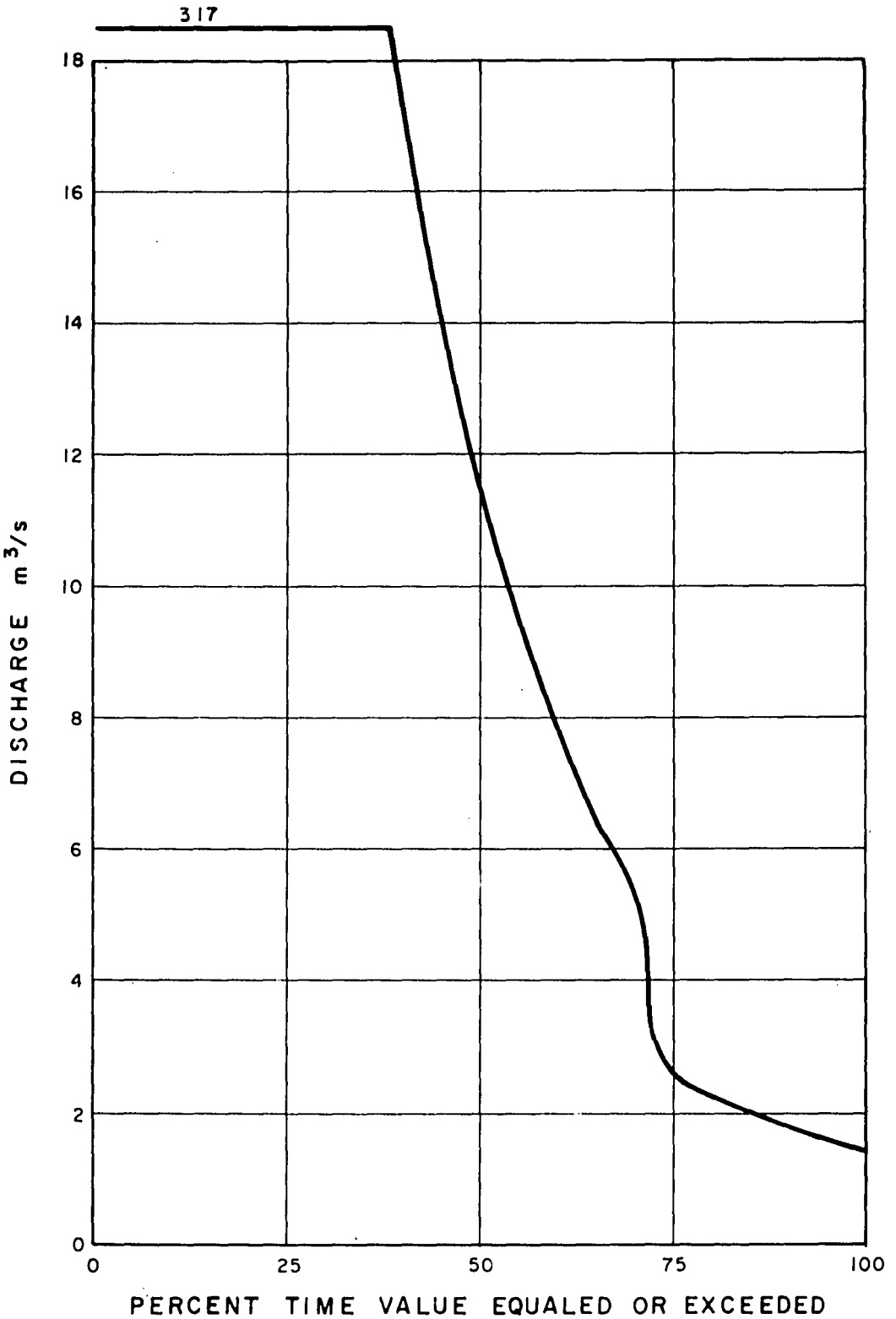
FROM DAILY STREAM FLOW DATA FOR JULY



BANJAR PLAINS PROJECT

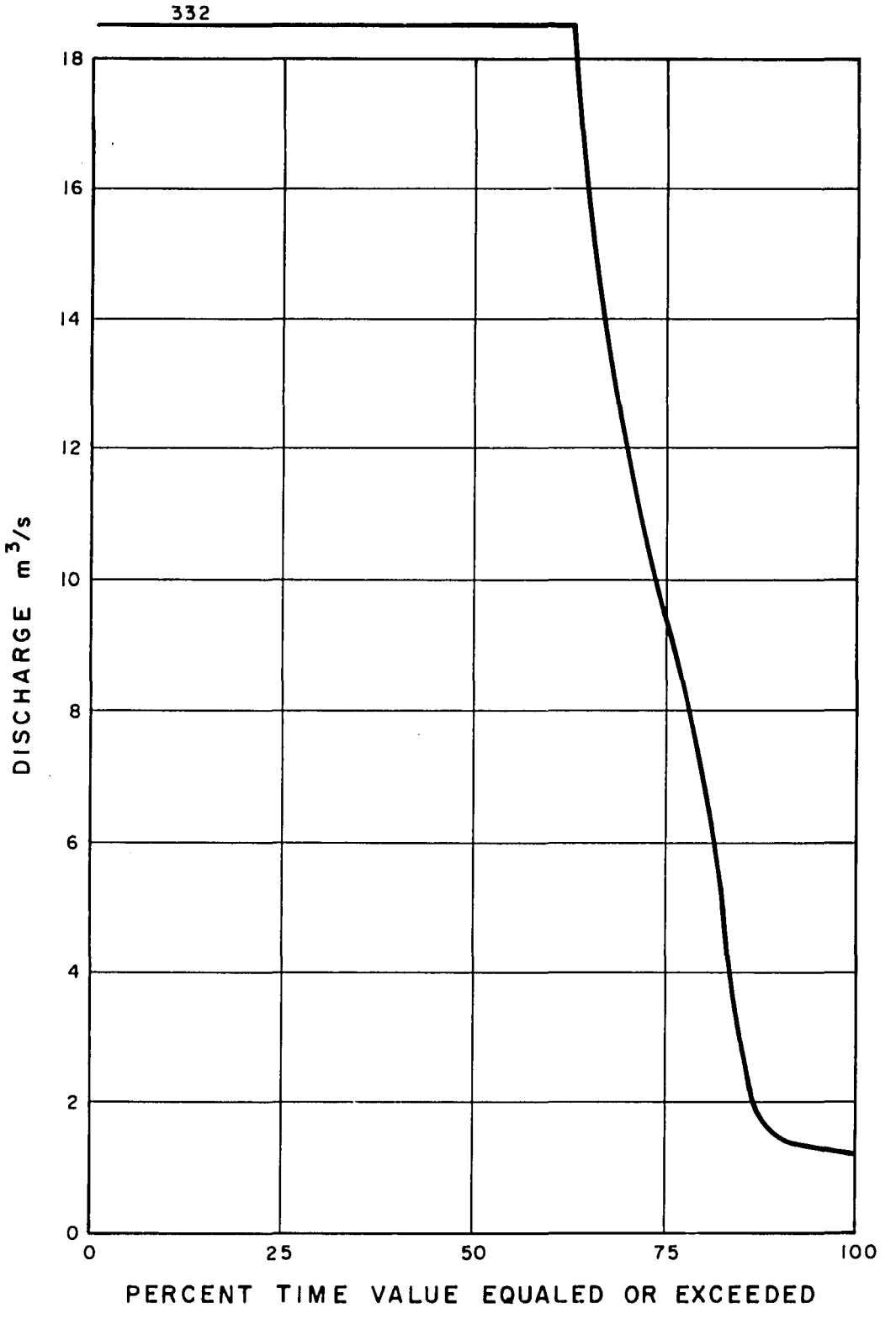
FLOW DURATION CURVE AT CIRAHONG GAGE

FROM DAILY STREAM FLOW DATA FOR AUGUST



BANJAR PLAINS PROJECT

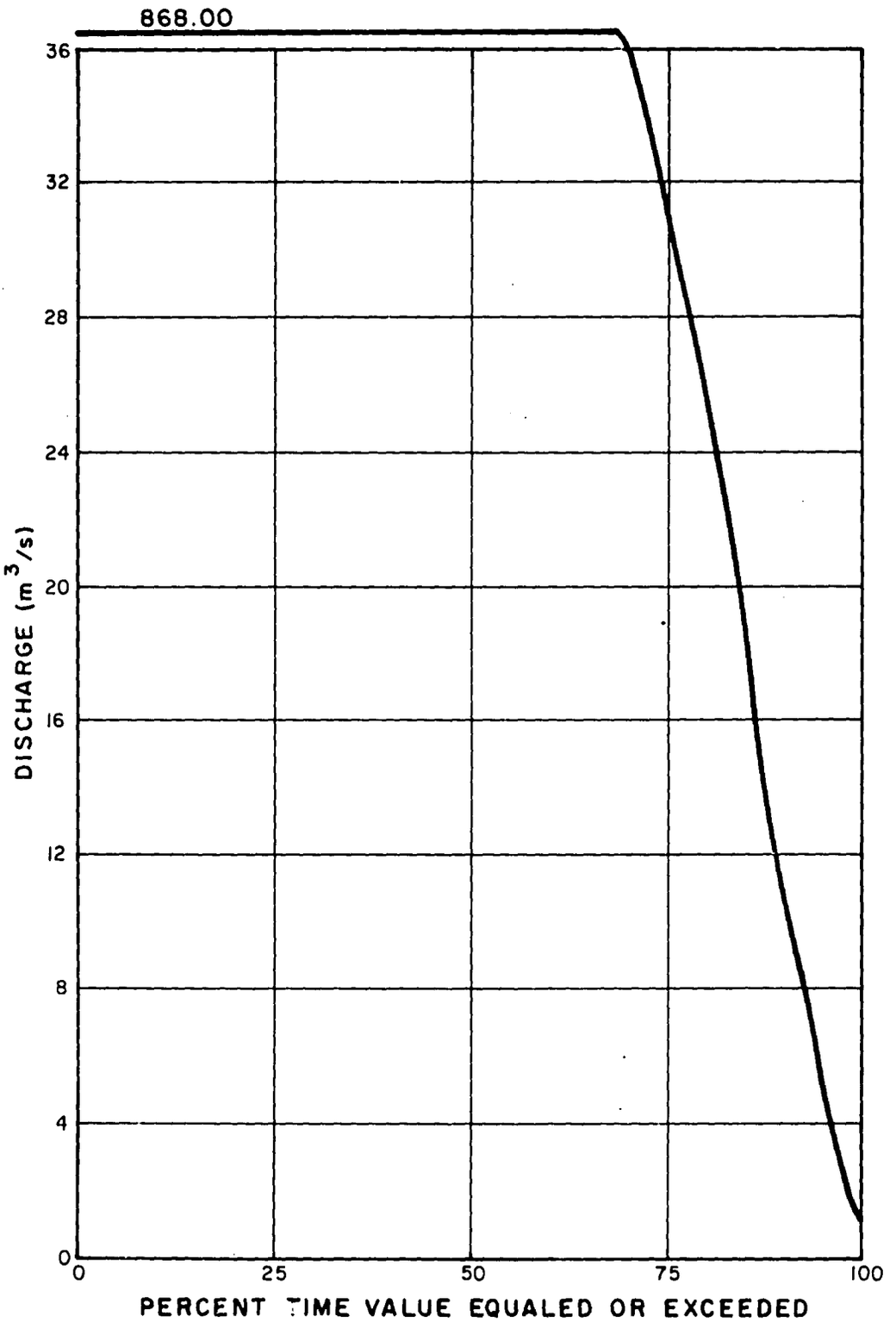
FLOW DURATION CURVE AT CIRAHONG GAGE
FROM DAILY STREAM FLOW DATA FOR SEPTEMBER



BANJAR PLAINS PROJECT

FLOW DURATION CURVE AT CIRAHONG GAGE

FROM DAILY STREAM FLOW DATA FOR OCTOBER



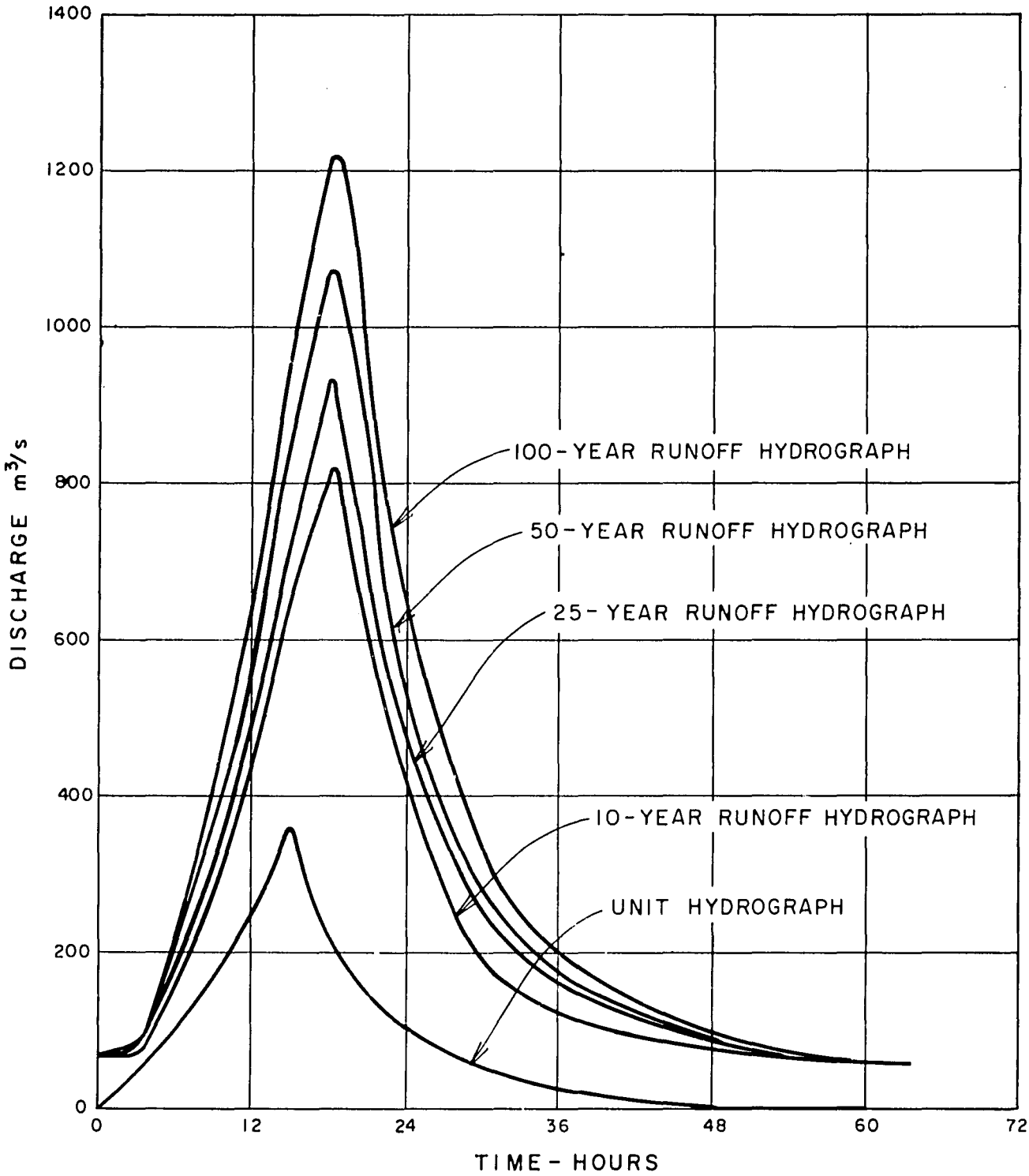
BANJAR PLAINS PROJECT

FLOW DURATION CURVE AT PATARUMAN WEIR

AFTER DIVERSION

FROM DAILY DATA FOR THE ENTIRE YEAR

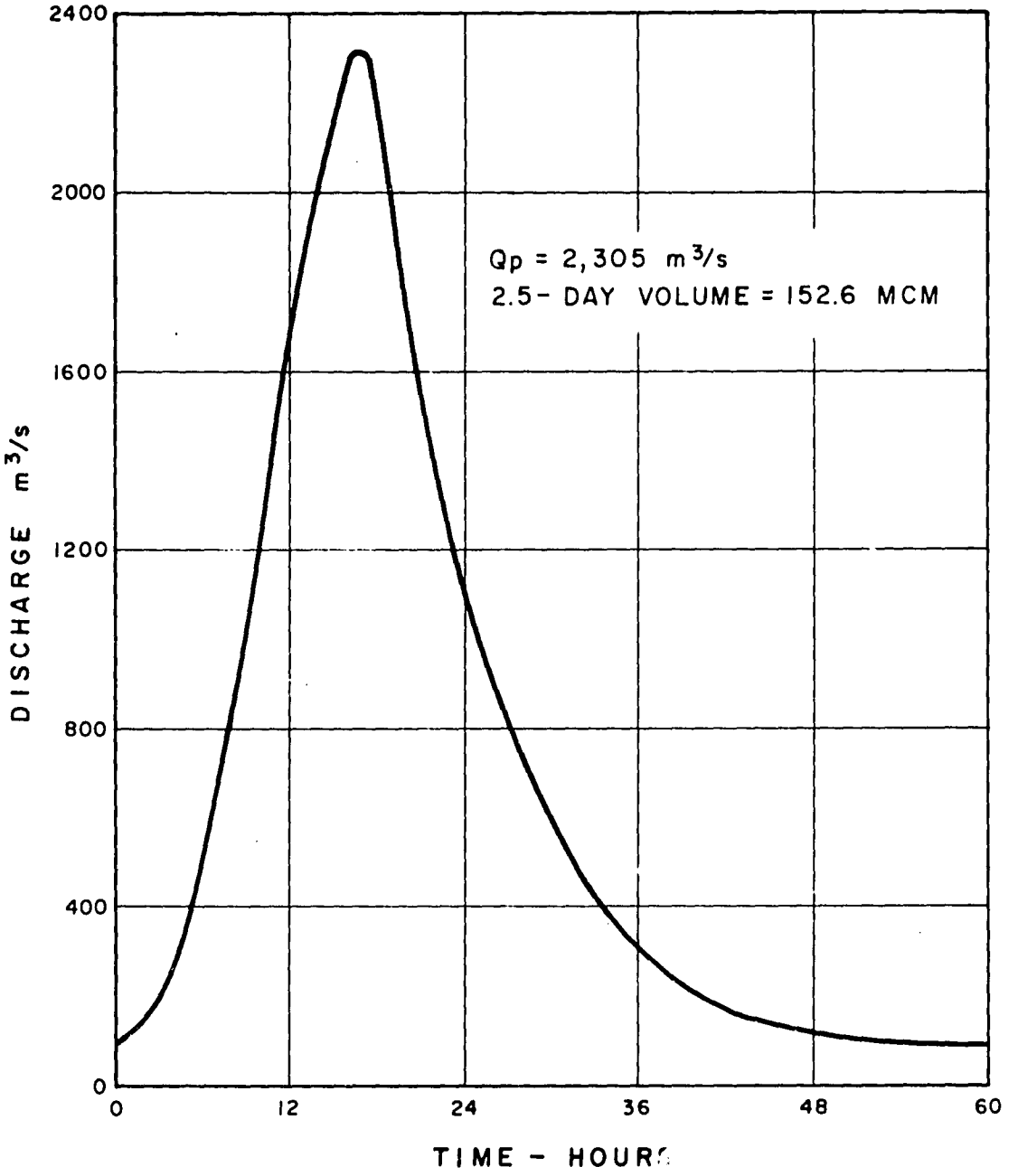
FLOOD	PEAKDISCHARGE m^3/s	VOLUME million m^3
10 YEAR	827	54.2
25 YEAR	932	62.8
50 YEAR	1080	71.0
100 YEAR	1220	80.8



BANJAR PLAINS PROJECT

FLOOD HYDROGRAPH

DIVERSION SITE



BANJAR PLAINS PROJECT

1000 YEAR FLOOD HYDROGRAPH

Chapter III

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

General

Historically, municipal water supply in the Banjar Plains area and the surrounding hamlets has always been from hand-dug wells and from the Citanduy River. The high rate of annual rainfall and the subsurface geology contribute to widespread occurrence of shallow groundwater and make it possible to use hand-dug shallow wells for domestic water supplies. Hand pumps are usually used to lift the water, but frequent use is made of a bucket and rope, in which case the well is not covered. Water from the Citanduy River is hand-carried.

The close proximity of the shallow wells to streams, fishponds and the river, which are highly polluted, give rise to possible pollution from human and animal wastes. The ponds, open sewers and waterways constitute the principal disposal system for sewage. Apparently, the problem is greater during the dry season when percolation from surface ponds contribute more to the groundwater in the wells. Also, during the dry months of July through October, there is an acute shortage of water and in drought years the only major source of water supply is from the Citanduy River for the people living in the Banjar Plains Area and the surrounding region.

Thus, the problem is both of availability and quality. Use of polluted water is a health hazard even if the water is boiled for drinking and cooking. Using the water for washing and bathing is also a health hazard. It is not customary among most of the local residents to boil their water.

In the Banjar region there is, at present, very little industrial activity which needs large quantities of raw water supply. All of the existing industries are of the small scale industry or cottage industry types. These are rice milling, brick and roof tile manufacturing, lumber processing, and cassava processing. The water supply demand for the small scale industries are currently met from either well water or water transported from the Citanduy River. The quantity of water required is small.

The economic prosperity of the region, coupled with the Republic of Indonesia's goal to increase potable supply of water in highly populated areas of Java, has brought out a critical need to identify projects for municipal supplies. To attract any industry to the region, an assurance of adequate industrial water supply is needed. Industrial water supply is herein defined as the water delivered to large and medium scale industries for process water, landscaping and incidental domestic use as well as public service water within an industrial zone. The Banjar Plains Project, which is essentially an irrigation project, can be planned to supply both the municipal and projected industrial needs of the area. The terms of reference stipulates that water resources analysis and water quality studies be carried out to determine the availability and suitability for projected municipal needs of the area. Hence, the presentation in this chapter is confined to projecting the municipal needs of the area and the water quality of the Citanduy River. Also, a possible demand for industrial water supply has been developed, based on available information. No effort has been made to draw up a water supply scheme for the area, which should be the subject matter of a separate study.

Present Water Supply

The city of Banjar has a water supply system which was installed in 1973 through a loan from World Health Organization. The system consists of a cistern at a spring source and a pipeline into town where residents can tap on at specified points. The original capacity of this system was 5 liters per second and serves a small percentage of Banjar population. A sand filter system has been provided at the source, and apart from this there is no other treatment provided. A recent inspection of the system indicated that there was little or no maintenance. This has resulted in blocking of the sand filter and deterioration of the supply system, which has drastically reduced the capacity.

Apart from this system, all other municipal needs are obtained from covered and open shallow wells or from the Citanduy River by hand. Most of the shallow wells were reported to go dry during the dry months. Water in most wells is available at a depth of 5 to 10 meters. The capital cost of these wells is about Rp. 100,000 each. During the dry season raw water from the Citanduy River is purchased from becaks and porters at an average cost of Rp. 1.25 per liter in Banjar and Rp. 1.75 per liter in suburban areas. Average daily consumption of this raw river water is 40 liters per capita and the average annual period of use is 75 days, resulting in an annual per capita expenditure of Rp. 3,750 in Banjar and Rp. 5,250 in suburban areas. During the 1977 dry period, questionable quality drinking water sold for as high as Rp. 6.25 per liter. Good to fair quality water was obtainable free of charge at a few community wells, small springs and community mosques.

In August, 1972, the Institute of Technology in Bandung, at the request of the Department of Public Works, conducted an investigation for a municipal water supply and distribution system for the town of Banjar. The system proposed by the Institute of Technology consisted of a groundwater supply from three wells, three elevated storage tanks, and a distribution system of 5, 8,

10 and 15 cm pipelines to serve the central sector of Banjar. The investigation was completed in 1972, but never was implemented.

The system of waste disposal in the towns and villages of the area consist of open sewers and gutters and fishponds. Where sewers exist, they are in clay pipes buried underground at the edge of the streets. The raw sewage is dumped into the nearest natural drainage without treatment. As would be expected, this means of waste disposal is a source of bad odor, insects and water pollution in the streams. In the dry season the problems are more acute because the supply of flushing water is reduced. Some of the houses in Banjar town have been provded with a septic tank system. However, the use of the septic tanks is not widespread. Currently, there are no plans to provide a modern sewer system and treat the sewage.

At present, the service area has little or no industry of significance. Discussion with the local officials of Ciamis revealed the possibility of development of an industrial sector in the future. The industries that were identified to be located near the Banjar township were a Rayon Fiber Textile Mill, a Non-Urea Fertilizer Factory, and a Carbon Active and Fiber Rubber Factory. A letter from the Chief of Planning Board, Ciamis is attached as an exhibit at the end of this chapter, in which the possibility of the above industries coming up in the region have been discussed. However, the present investigation indicates that, currently, there does not exist a strong commitment or a plan for the development of these industries by the Government of Indonesia. Hence, this study was limited to identifying a possible gross industrial sector demand without going into details.

Groundwater

The potential for groundwater development in the project service area appears to be poor. Shallow-dug wells in the clay soil of the project area have low yields and are dependent upon

peripheral seepage and surface wastes for recharge. Most of these wells fail during the dry season. A few dug wells adjacent to the Citanduy River extend below river level and apparently are recharged by the river. The terrain and geology of the area does not indicate the presence of a good water bearing aquifer.

Three small springs in the project service area were observed to yield slightly more than one-half liter per second while two rice fields, totalling about 4 hectares, were obviously supplied by subterranean spring flow during the 1977 dry season. Several small springs located near the periphery of the service area had similarly nominal yields. Numerous small springs were observed in the banks of the Citanduy River above the diversion site. All springs observed were in exposures of thin conglomerate layers. The source of water for these springs appears to be precipitation stored in overlying formations. These springs are submerged during high flows. Location of some of the springs are shown in Figure IV-2, Chapter IV-Agriculture.

Thus, a municipal and industrial supply cannot use either groundwater source or spring source in this area. The water supply needs to be obtained from a surface source such as the Citanduy River.

Municipal Water Requirement

The municipal needs for the service area has been developed based on a population projection and per capita consumption. Various classes of consumers were identified. The per capita consumption for domestic and flushing purposes was based on an urban system of Class B type for a population less than 100,000. The municipal needs are discussed in the following sections.

Service Area

The irrigation service area for the Banjar Plains Project was described in Chapter I-Introduction. The area was limited by the terrain and the command elevation. However, for purposes of Municipal Supplies, the service area is not the same as the irrigation service area. It was also recognized that this study cannot formulate the regional municipal supply needs, comprising of extensive urban and rural areas. Thus, the service area for the municipal needs was confined to a region which can be supplied by a gravity system below elevation 45 m above MSL. This elevation happens to be the elevation at which water supply will be available to the service area.

The service area selected for municipal supply consists of the entire township of Banjar, Balokang village and Jelat subvillage on the right bank of the Citanduy River. On the left bank of Citanduy River the service area will comprise the residual Banjar township areas, most of the Purwahardja village area comprised of Cipadung, Siluman, Parungsari and Randegan subvillage areas and a small portion of the Cisaga village area below elevation 40 m. This service area will cover approximately an area of 9 km in the east-west direction and 4 km in the north-south direction. A schematic diagram of the municipal service area is shown in Figure III-1. Facilities for the water supply system to cross the Citanduy River exist at the railroad bridge and the two road bridges in the area, and the Cimuntur River at the existing road bridge, thus avoiding expensive river crossing works.

Population

General

The population of Indonesia, according to a 1976 census[1/] was reported to be 134.7 million. The historical growth rate for the country was indicated to be 2.1 percent each year. The island of Java is the most densely settled area in the archipelago, constituting only 6.6 percent of the land area of the Indonesian nation, but having about 65 percent of the population. The reported population growth per annum for Java as a whole is 1.9 percent, while in regions of high density the growth varies between 2.2 to 2.5 percent. There is little reported migration of population within Java, except locally near towns.

The regional long-term population growth trends are not available. According to the Family Planning Coordination Board, the birth rate for Java is expected to fall as much as 50 percent by the year 2000 as a result of the widespread practice of family planning. It is expected that the population growth rate in Java will reduce to 1.6 percent by the year 2000.

The population of the Citanduy Basin was estimated to be 2.5 million in 1972. The density is about 600 persons per square kilometer. Within the Citanduy Basin density of population varies considerably. Heavier settlement, denoted by more frequent and larger villages, occurs along the highways that traverse the basin from west to east and from northwest to southeast along the right and left sides of the Citanduy Valley. Within the Citanduy Basin the density of subdistricts varies from 193 persons per square kilometer in the Dayeuhluhur subdistrict to 737 for the

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1/ World Population Data Sheet, 1976, The Population Reference Bureau, Inc.

Tasikmalaya subdistrict. The Banjar Plains Project service area for municipal water lies along main arterial highways and has a high density of population.

Service Area Population

A schematic diagram of the villages that will be served with municipal water in the service area is presented on Figure III-1. The entire service area is in the Ciamis district of West Java and parts of the service area lie in the subdistricts of Banjar, Cimaragas and Pamarican.

The population of each of the three subdistricts was collected for the period 1967 to 1976. This is presented in Table III-1. The growth rate was determined by plotting the historical population growth on a semi-logarithmic scale for the three subdistricts. This is shown on Figure III-2. The mean annual growth rate for the three subdistricts of Banjar, Pamarican and Cimaragas was found to be 2.4%, 2.2% and 2.06%, respectively. These growth percentages are close to the mean national growth rate and slightly lower than the average growth rate for Java. The Banjar subdistrict's historical growth shows sudden spurts of growth in the years 1970 and 1972, possibly due to the establishment of the Citanduy Project. Otherwise, the growth rate in all the three subdistricts do not indicate a strong emigration or immigration. Also, present inquiries do not indicate a possibility of increased growth in the near future. However, with the ongoing development efforts in Citanduy Project area there is a likelihood of a steady growth in the region's population.

The villages that are anticipated to receive municipal water supply benefits are:

On the right bank of Citanduy River:

1. The town of Banjar.
2. The village of Balokang.
3. The Jelat subvillage which is part of village Mulyasari. Pataruman is a part of Jelat subvillage.

On the left bank of Citanduy River:

1. The village of Purwahardja. This comprises the subvillages Cipadung, Siluman, Parungsari, Randegan I and II and Pasirleutik. Part of Parungsari subvillage is on the right bank of the river. Except for the Pasirleutik subvillage, the other subvillages can be served.
2. The village of Cisaga. This has nine subvillage areas. Only a small part of the village can be served because of elevation limitations.

The population statistics of these villages for the period 1972 to 1977 is presented in Table III-2. The population figures shown were collected from the village chiefs. Survey of houses in these areas was not carried out to determine the exact number of residential and commercial establishments that would be served. The population shown in Table III-2 is taken as the base population for which municipal water supply will be required. The 1976 population of the municipal water supply service area is 60,377.

Population Projection of Service Area

The base 1976 population that would benefit from municipal water supply is taken as 60,500. For purposes of determining the water supply demand for this area over the next two decades, it is necessary to project the population growth up to year 2000.

Historically, the growth rate in the three subdistricts varies between 2.04 to 2.2 percent. From the limited population

statistics available for Banjar and Balokang villages, the historical growth rate for Banjar township is twice that of Balokang village. This is because of local migration from the surrounding subvillages. The setting up of the Citanduy Project Office and expansion of its activity contributed in the spurt of population growth of Banjar. However, without the possibility of establishing an industrial sector, further growth in Banjar town might not take place at this rate. With the provision of municipal water supply and development in the region, there is the likelihood of an increased growth rate for the area. In the absence of a detailed sociological study or a plan for the development of the region, it was concluded to use a population rate of growth close to the historical subdistrict growth. For purposes of this study, a conservative growth rate of 2.1 percent has been adopted to develop population projection up to year 2000 and is shown on Figure III-3 and in Table III-3. This growth rate is believed to be slightly conservative and there is a possibility that this could increase with industrialization of the area, or be stabilized with a strong program of family planning.

Municipal Water Demand Projections

General

Municipal water use is computed in this study based on users such as domestic, small commercial users, and public. Domestic water is used in and around residences and varies with the standard of living, but is proportional to resident population. Small commercial use includes water used in small business or light commercial establishments by persons who are not residents of the area. This is normally for domestic and light manufacturing use and cannot be stated conveniently in terms of population. Public use of water is for street and sewer flushing, public gardens, fire fighting and for unmetered public institutions.

The consumption of water per capita varies over a wide range and is affected by various factors. In the United States the variation is from 200 to 2,000 liters per day per capita. In Indonesia, the water consumption is very low. For the city of Semarang in Central Java, historical records show that usage varied from 670 liters per day per connection in 1966, to 1,512 liters per day per connection in 1974. The average number of people served by each connection is seven. The unaccounted water ranged from 40% to 60%. Thus, the historical average actual consumption per capita increased from about 50 to 100 liters per day over an eight year period. For supply through public hydrant the historical data for Semarang indicates that about 360 persons are served by each hydrant and rate of consumption is about 10 liters per day per person.

For projecting the municipal needs the available historical statistics were limited to the population projection. Little information was available regarding GOI's projection for per capita consumption by class of consumers for an Urban Class B type town. The current practice of computing rural municipal needs by Director General of Water Resources in their planning work is to allow a continuous flow of one liter per second for a population of 1,000. This amounts to 86.4 liters per capita per day. This study was based on the general norm used by the World Health Organization in developing countries as well as information contained in Burns and McDonnell Report for 'Semarang Water Supply', 1976, and other sources.

Population Served

In developing the municipal demands, it is necessary to identify the percentage of the population that will be served. Normally, the number of people provided connection will increase over the years as the economy of the area improves as well as with availability of funds for expansion. Two types of connections have been identified for this purpose. They are,

1. Public hydrant, and
2. Residential.

Table III-4 gives the percentage of population served at five year intervals for the two types of connections. It is expected that by the year 2000 about 90% of the people in the area will be provided with municipal water supply.

Water Use

The municipal water requirements to be used in the Banjar Plains study was obtained by projecting the water use up to year 2000. This projection was based on the population projection in the service area and the percent of the population that will be served. For purposes of projecting the water use, various categories of consumption were identified. They are residential, public hydrant, public institution, city offices, commercial, and water required for sanitary and flushing purposes. The per capita or per connection consumption by user category is based on usage in developing countries and is considered to be adequate. For purposes of city office use, which is mostly fire fighting, public gardens, public bath, etc., the usage was estimated. A similar procedure was used for light commercial establishments.

The projected municipal demand is presented in Table III-5. This has been worked out at five-year intervals. The unaccounted water, which is defined as the difference between the quantity of water supplied to the system and the quantity of water metered in the system, is a loss to the system due to leakage from mains and service lines, or because of inaccurate meters, illegal service connections, false meter readings, system flushing and other similar uses. Records of usage in the Semarang water system over the last nine years indicate that unaccounted water ranged from 40 to 60 percent. This is considered exceptionally high when compared to the system losses of 10 to 20 percent in the United States. With a well planned system, it is believed the

system losses should be within 20 to 30%. Starting with a 30 percent loss, it is assumed that by the year 2000 this could be reduced to 20 percent by an efficient operation.

The average municipal demand by year 2000 will be 23,223 m^3/day or 269 liter/second. The total average per capita consumption will be 259 liters/day, which is considered to be a reasonable rate of consumption. The development of the demand and per capita consumption over the period 1980 to 2000 is graphically presented in Figure III-4. The per capita consumption will increase rapidly in the first two decades with the introduction of assured water supply, while in the subsequent decades the rate of increase should stabilize to a lower value.

For purposes of determining the design capacity of supply, the fluctuation in per capita consumption from day to day and throughout any one day are of great importance. The maximum daily, or the maximum 24-hour consumption varies from 1.25 to 1.75 times the average hourly consumption, while the fluctuation within the hour can be as large as 2 to 3 times. The storage tanks will normally provide for fluctuation within the hour. Hence, the design capacity of supply system should be able to meet the fluctuation in a day. For tl Banjar Plains Project the design capacity for municipal needs should be taken to be 1.5 times the requirement in the year 2000, which is 400 liters per second. However, for cost allocation and economic analysis, a municipal supply demand of 269 liter/second and has been taken.

The Directorate General of Water Resources Planning figure of one liter/second and for 1,000 persons will yield about 90 liters per second in the year 2000. It is believed that this figure is essentially for designing canal capacities when the canal water is used for municipal use by the rural population along the canal. It is of interest to compare the present projected demand of 270 liter/second and to the municipal water

demand used in the Directorate of Irrigation Reconnaissance Report.[2/] In this report, the municipal demand was estimated to be 626 liters/second. This is 57% more than the present estimated demand. Details of the demand were not given in this report.[2/] It is considered that the demand of 626 liters/second. is too high for a town of the type of Banjar.

Industrial Water Demand Projection

The industrial water demand is based on very little data. The basis for identifying an industrial sector was the data furnished by the Ciamis Planning Board (see Exhibit at the end of this chapter). According to this, three major industries were identified as possible to be set up near Banjar town. These were a Rp. 10 billion fiber/textile industry, a Rp. 2 billion non-urea fertilizer industry, and a Rp. 10 billion carbon active and fibered rubber industry. It is to be pointed out that these industries have not been included in the next Five-Year Plan nor were further details available from any other agency. Hence, the probability of the industrial sector coming up within the next 10 to 15 years is considered low. However, preliminary studies were carried out to determine the magnitude of water supply needed for these three industries.

The industrial complex will be located west of Banjar town in an area of about 180 hectares bounded by the Banjar-Ciamis railroad on the northeast side, the Banjar-Manonjaya road on the southeast side and by steep uplands on the remaining sides. This is shown in Figure III-5 with the land classification. This location will provide adequate access to a water supply system, either from an M and I treatment plant located within the

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2/ Laporan Reconnaissance/Pra Rencana Proyek Irigasi Dataran Banjar, Propinsi Jawa Barat, P. T. Karpa, Bandung, March, 1973.

industrial zone, or directly from the Banjar Plains Project main canal which will run through the industrial zone. The water supply demand for the planned industry is presented below based on Ciamis Planning Board's information.

Industry	Rayon Fiber Textile Mill	Non-Urea Fertilizer Factory	Carbon Active and Fibered Rubber Factory
Construction Cost in Billion Rupiahs	10+	2+	10+
Construction Date	1979 if Water Available	When Water Available	Dependent on Firm Water Supply
Local Employment	600	400	360
Raw Material Source	Not Stated	Local Phosphate and Limestone	Local Coconut Fiber & Rubber
Water Demand (l/s)	200 (Increase to 400 in 3-5 Years)	200	150
Total Water Demand	550 l/sec. to 750 l/sec. in 3-5 years.		

Thus, a total industrial water requirement of 750 liter/second. is anticipated, in case the industrial development takes place.

M & I Supply System

Although the scope of this report does not call for a study of the M & I distribution system, a reconnaissance level study was carried out to provide an approximate cost involved in the treatment, delivery and distribution of water. This does not include the cost of delivering water at the M & I intake. From the reconnaissance study the following conditions are apparent:

1. The treatment plant and primary storage reservoir will be located in the industrial zone as shown on Figure III-5.

2. Water for the municipal-industrial system should be obtained from the project main canal near the treatment plant.

3. The project drain system should be used to convey industrial return flow to Citanduy River. These effluents must be treated to acceptable quality by the industries concerned.

4. The capital costs of the municipal-industrial system are estimated to range between Rp. 9.0 billion and Rp. 22.6 billion, including the industrial water treatment requirements. These costs are not to be included in the costs of the Banjar Plains Project.

Separate reconnaissance level estimates of annual costs for a treatment and distribution system for municipal needs and for a combined municipal and industrial need were prepared. The annual cost for construction, operation, maintenance, and replacement for the two cases are as follows:

	In Million Rupiahs	
Annual Equivalent Costs	Municipal Water Only	Muncipal and Industrial Water
Construction Cost (Annual)	609	2,356
O, M & R Cost		
Operation and Administration	53	197
Maintenance and Equipment	56	220
Replacement: Annual	103	376
Interim	24	105
Treatment Chemicals and Supplies	51	204
Fuel	5	25
Sub-Total	292	1,127
Total Annual Cost	901	3,483

The above costs were estimated by present value analysis using an interest rate of 12% and a capitalization period of 50 years. Capitalization of industrial related costs reflect a three-year development period while municipal costs were prorated over a 20-year period of increasing water usage.

Water Quality

Water quality for the Banjar Plains Irrigation system is considered good to excellent for irrigation purposes and acceptable for municipal and industrial water supply. This is based on water quality tests on samples obtained at the Cirahong gage, Banjar town and Pataruman Weir all on Citanduy River. The total dissolved solids are very low as are the chlorides and sulphates. The percent sodium is a little high for a classification of excellent for irrigation, but for water with the indicated range of dissolved solids, percent sodium is not an especially good parameter. The sodium absorption ratio is low, indicating low sodium hazards, and as the total dissolved solids are low, the salt hazard is low. Samples from the Cirahong gage, the Banjar Bridge and the Pataruman Weir are compared with the standards[3/][4/] and are shown in Table III-6 and III-7.

Water from the Citanduy River, diverted as an irrigation supply can be used for domestic water supply with minor treatment, including filtration, chlorination and iron removal. Water quality samples were taken at the Cirahong gage in November, 1969, Banjar Bridge in September, 1972, and at the Pataruman Weir in

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3/ The Citanduy River Basin Development Project, 'Feasibility Report', Engineering Consultants, Inc., Denver, Colorado, U.S.A., March, 1975.

4/ Water Quality and Treatment, Handbook of Public Water Supplies, American Water Works Association, Third Edition, 1971.

September, 1972, December, 1973, and January, 1974. This covers some of the low flow months. The water quality testing was done by DPMA at the Hydro-Chemical Laboratory in Bandung. The Banjar and Pataruman sampling points are downstream from the Cimuntur River and samples from these sites were of poorer quality than for Cirahong, about 19.5 kilometers upstream from the project diversion site. The water quality at the Cirahong gage is rated good to excellent for irrigation and would require both clarification and chlorination for municipal use. The suitability of water for use as an industrial supply depends on the requirements of the particular industry. Very few problems are anticipated in the industrial uses projected.

A retesting program of water quality for a municipal water supply to supplement tests published in the above tables is recommended, but was not attempted because of the limited time factor in the preparation of this report. It is noted that the previous tests were conducted in the months of September, November, December and January, covering the dry season and the wet season. But neither test period would reflect changes in mineral and chemical constituents that would appear as a result of irrigation return flow waters bearing nitrates, nitrites, and ortho phosphates from dissolved fertilizers, normally applied twice a year.

Monthly tests to cover a complete one-year cycle should be undertaken to determine the needs of water treatment processes for a Banjar municipal water supply. Tests should also be carried out of the groundwater in case groundwater has to be developed as a supplement or as alternative to surface water supply.

TABLE III-1

Population Statistics of Sub-Districts

	Sub-District		
Year	Banjar	Cimaragas	Pamarican
1967	84,731	24,919	58,678
1968	85,762	25,463	58,939
1969	86,875	26,548	58,949
1970	94,636	27,921	67,244
1971	94,429	30,477	68,946
1972	97,569	28,206	68,970
1973	97,369	28,747	69,301
1974	96,764	28,791	69,840
1975	97,424	28,598	70,183
1976	100,009	29,839	72,695

TABLE III-2

Population Statistics of Service Area

Village Unit	Year					
	1972	1973	1974	1975	1976	1977
Banjar	27,047	28,330	29,613	29,575	32,142	32,287
Balokang	7,562	7,964	7,648	7,666	7,666	7,829
Jelat (Subvillage)	--	--	--	5,230	5,477	5,673
Purwahardja (Except Pasir Leutik)	--	--	--	10,153	11,392	11,358
Cisaga (Part in Service Area)	--	--	--	3,680	3,700	3,722

TABLE III-3

Population Projection of Service Area

Year	Population
1976	60,500
1977	61,770
1980	65,740
1985	72,940
1990	80,930
1995	89,790
2000	99,630

Note: Annual Growth Rate taken as 2.1 percent.

TABLE III-4

Population Served

Year	Population	Population Served (Percent)		
		Residential	Public Hydrant	Total
1977	61,770			
1980	65,740	35	20	55
1985	72,940	55	15	70
1990	80,930	65	10	75
1995	89,790	75	8	83
2000	99,630	85	5	90

TABLE III-5

Municipal Demand Projection

Item	Year 1980	1985	1990	1995	2000
1. Residential					
Population Served (%)	35	55	65	75	85
Population Served	23,000	40,100	52,600	67,300	84,700
Per Capita Use (l/d)	100	120	140	150	150
Quantity (m^3/d)	2,300	4,812	7,364	10,095	12,705
2. Public Hydrant					
Population Served (%)	20	15	10	8	5
Population Served	13,100	10,900	8,100	7,200	5,000
Per Capita Use (l/d)	12	14	16	18	20
Quantity (m^3/d)	157	153	130	130	100
3. Public Institution					
Number of Connections	20	25	30	35	35
Per Connection Use (l/d)	1,500	2,000	2,500	2,500	2,500
Quantity (m^3/d)	30	50	75	88	88
4. City Office					
Quantity (m^3/d)	300	450	600	750	750
5. Light Commercial					
Number of Establishments	10	20	25	30	30
Quantity (m^3/d)	100	240	375	450	450
6. Sanitation and Flushing					
Population Served (%)	55	70	75	83	90
Population Served	36,200	51,000	60,700	74,500	89,700
Per Capita Estim. (l/d)	30	35	40	45	50
Quantity (m^3/d)	1,086	1,785	2,428	3,353	4,485
Total (1 to 6) (m^3/d)	3,973	7,490	10,972	14,866	18,578
Unaccounted for Water (%)	30	25	25	20	20
Quantity (m^3/d)	1,702	2,497	3,657	3,717	4,645
Total Quantity (m^3/d)	5,675	9,987	14,629	18,583	23,223
(l/s)	66	116	169	215	269
Average Per Capita (l/d)	157	196	241	249	259

Peak daily water supply 1.25 to 1.75 times average daily consumption.

Maximum supply demand equals 400 liters per second.

TABLE III-6

WATER QUALITY STANDARDS

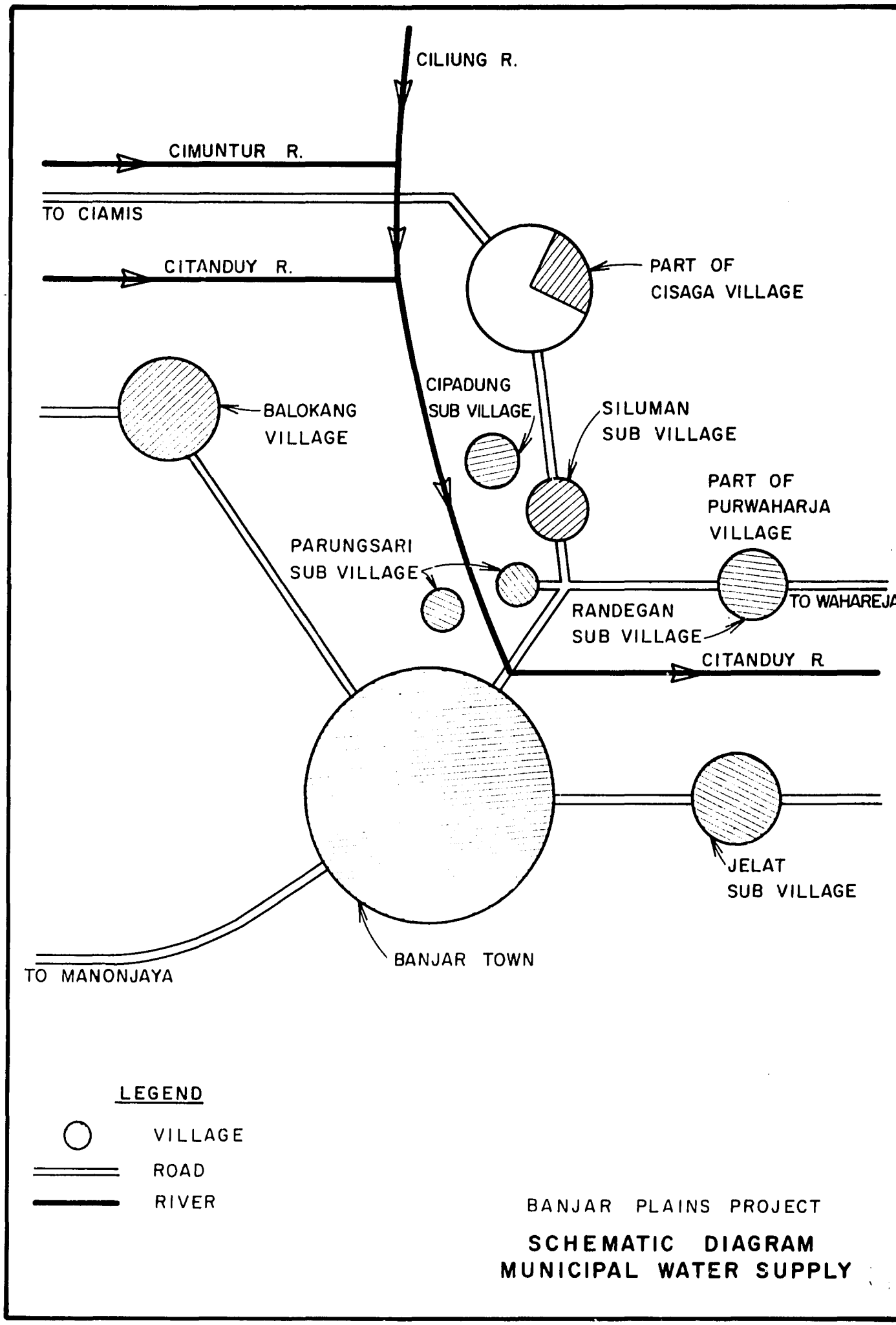
Class	Total Dissolved Solids (ppm)	Citanduy River	Percent* Sodium	Citanduy River	Chlorides Cl (ppm)	Citanduy River	Sulphates SO_4 (ppm)	Citanduy River
Excellent	0- 175	64 to 148	0-20	3.2 to 23.5	0-140	5.5 to 4.7	0-190	2.6 to 24.4
Good	176- 525		21-40		141-250		191-340	
Permissible	526-1400		41-60		251-430		341-580	
Doubtful	1401-2100		61-80		431-700		581-960	
Unsuitable	Above 2100		Above 80		Above 700		Above 960	

$$\text{*Percent Sodium} = \frac{Na \times 100}{Na + Ca + Mg + K}$$

Table III-7

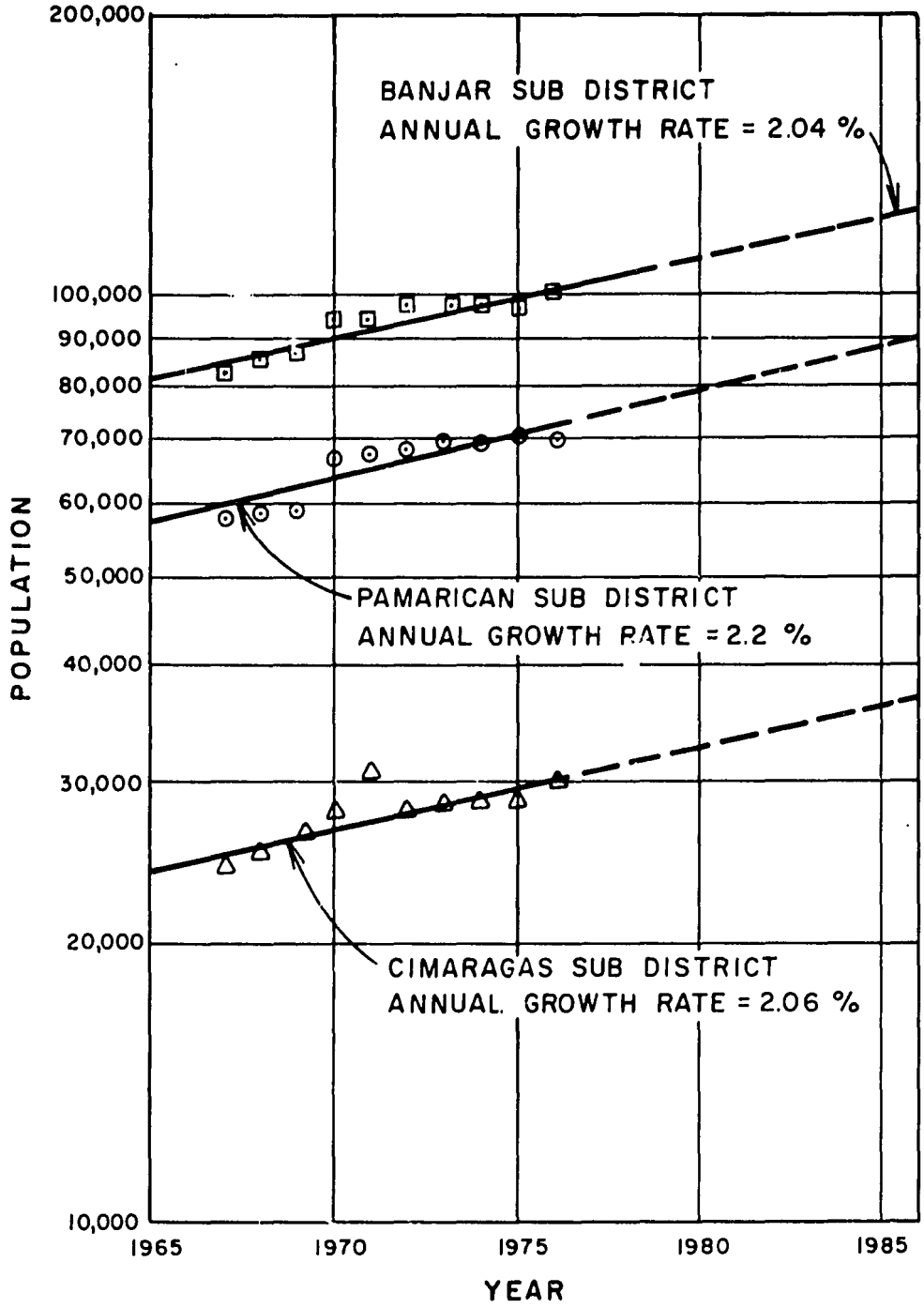
Citanduy River Water Quality Analysis

Sample Site	Date	Electric Conductivity micromho/cm	pH	Total Dissolved solids ppm	Soluble Ions (mg/l) SiO_2	Ca	Mg	Fe	Mn	CO_2 Agr	CO_2	CO_3	HCO_3	Cl	SO_4	PO_4	NH_4	NO_3	NO_2	K-	Na	% Na	SAR	Organic Matter mg/l $kMnO_4$	Hardness a_d	Turbidity SiO_2	Color Scale ptCo
Citanduy/ Cirahang	12-11-69	-	7.8	132.0	-	29.3	25.0	0.3	1	1	10.1	1	91.1	21.7	24.4					8.3	17.6	17.1	0.6				
Citanduy/ Banjar	16- 9-72	120	8.5	136	12.0	9.4	7.3	0.2	0.2	-	-	1.5	75.1	10.7	2.6	0.08	0.12	-	-	1.4	0.0	3.2	0.0	8.9	3.0	-	-
Citanduy/ Pataruman	16- 9-72	110	8.4	148	12.0	8.7	9.5	0.2	0.2	-	-	1.5	72.0	9.7	2.8	0.08	0.09	-	-	1.6	0.0	3.2	0.0	28.3	3.4	--	-
	13-12-73	176	7.6	135	11.5	25.0	7.5	5.0	0.0	3.4	4.0	-	60.4	5.5	10.0	0.52	0.02	0.03	0.0	1.9	13.5	23.5	0.6	11.0	5.3	73.0	87.0
	27- 1-74	73.0	7.5	64	10.0	6.8	5.0	7.5	0.0	4.0	4.4	-	39.0	7.8	11.0	0.002	0.12	0.01	0.02	1.2	3.5	16.1	0.2	21.2	2.1	98.0	140.0
World Health		Recommended Limit				75	50	.3	.1					200	200		0.5									5	5
Standard		Acceptable Limit				200	150	1.0	.5					600	400			45						200		25	50



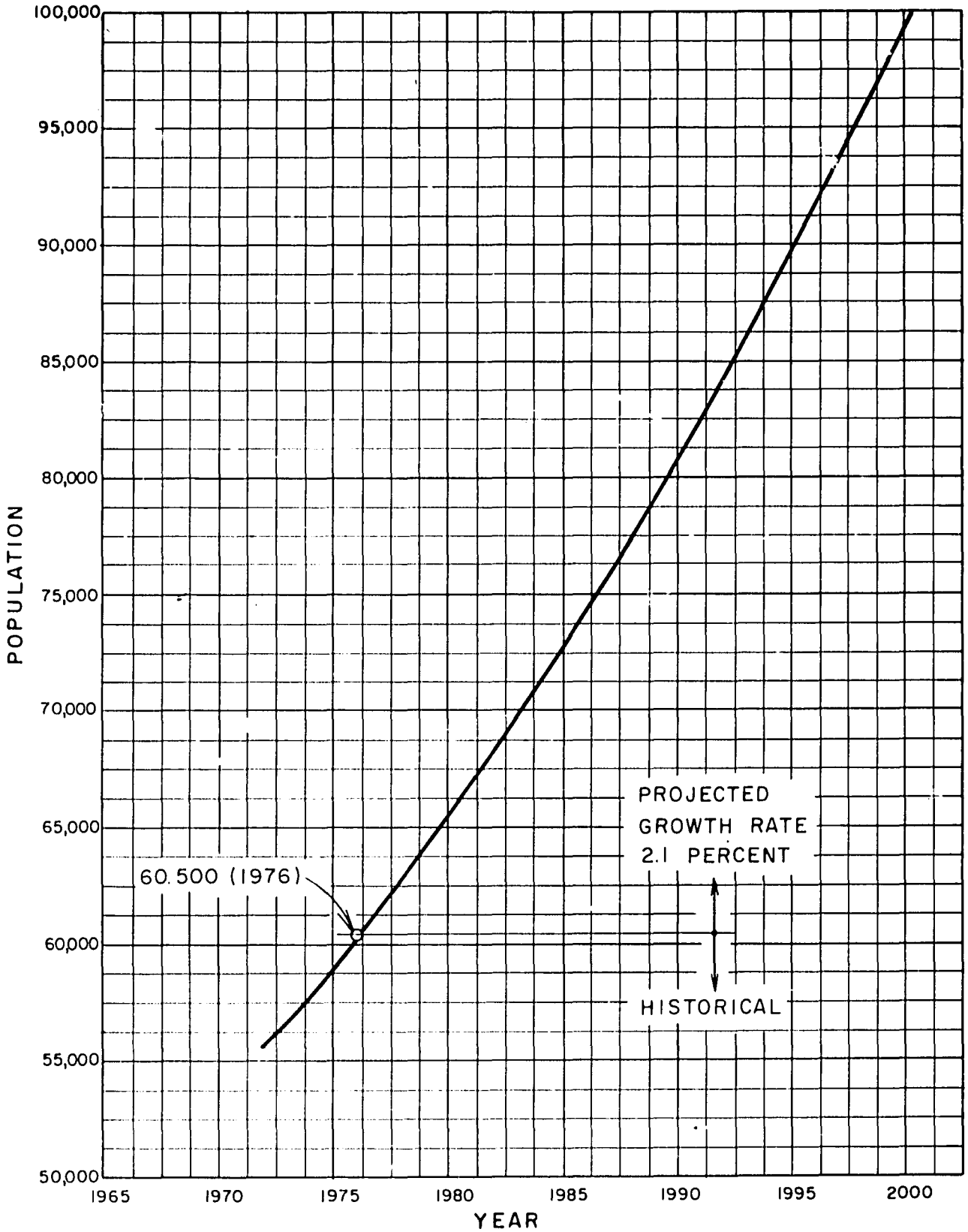
BANJAR PLAINS PROJECT

SCHEMATIC DIAGRAM
MUNICIPAL WATER SUPPLY



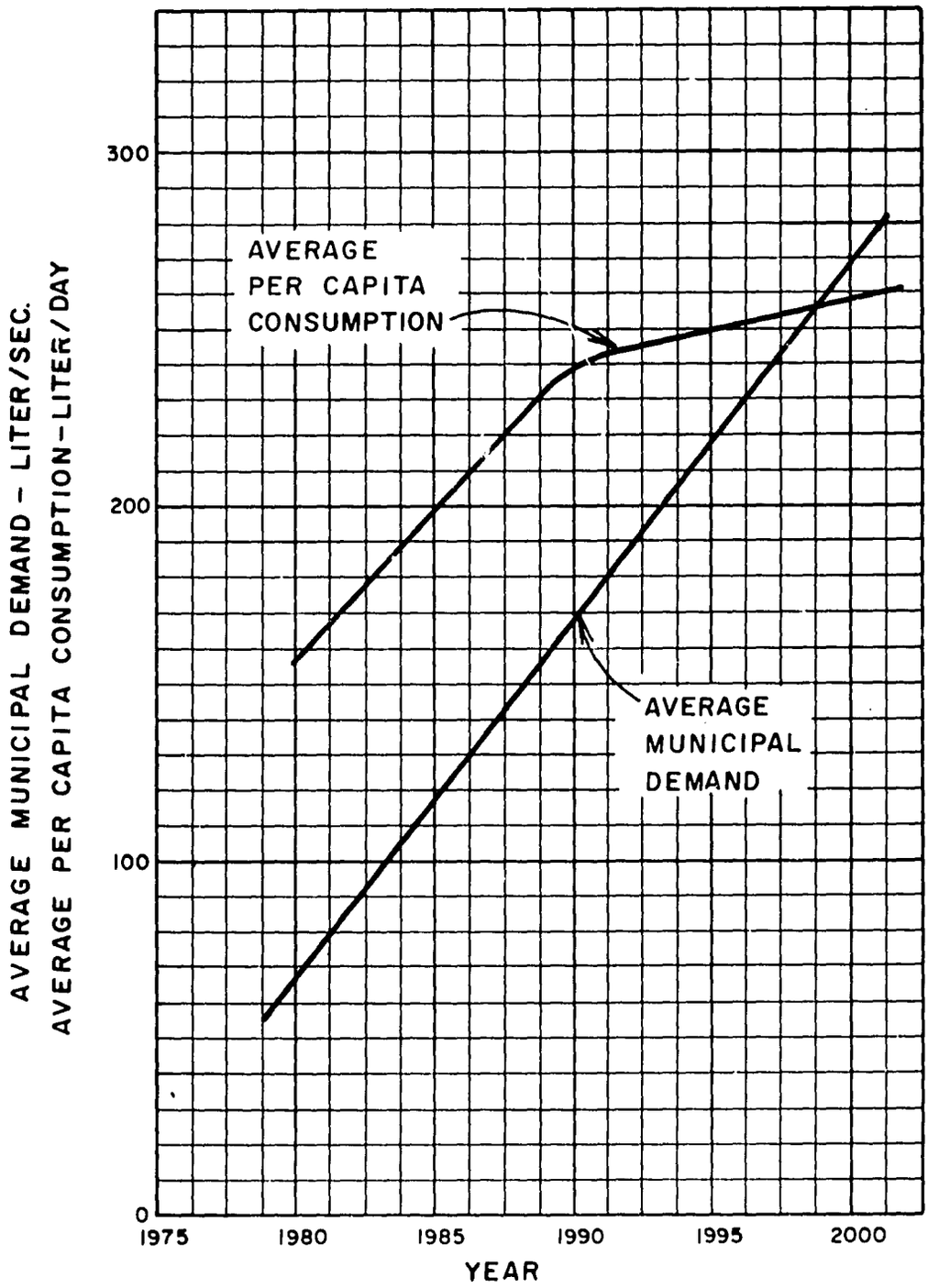
BANJAR PLAINS PROJECT

POPULATION GROWTH HISTORICAL AND PROJECTED



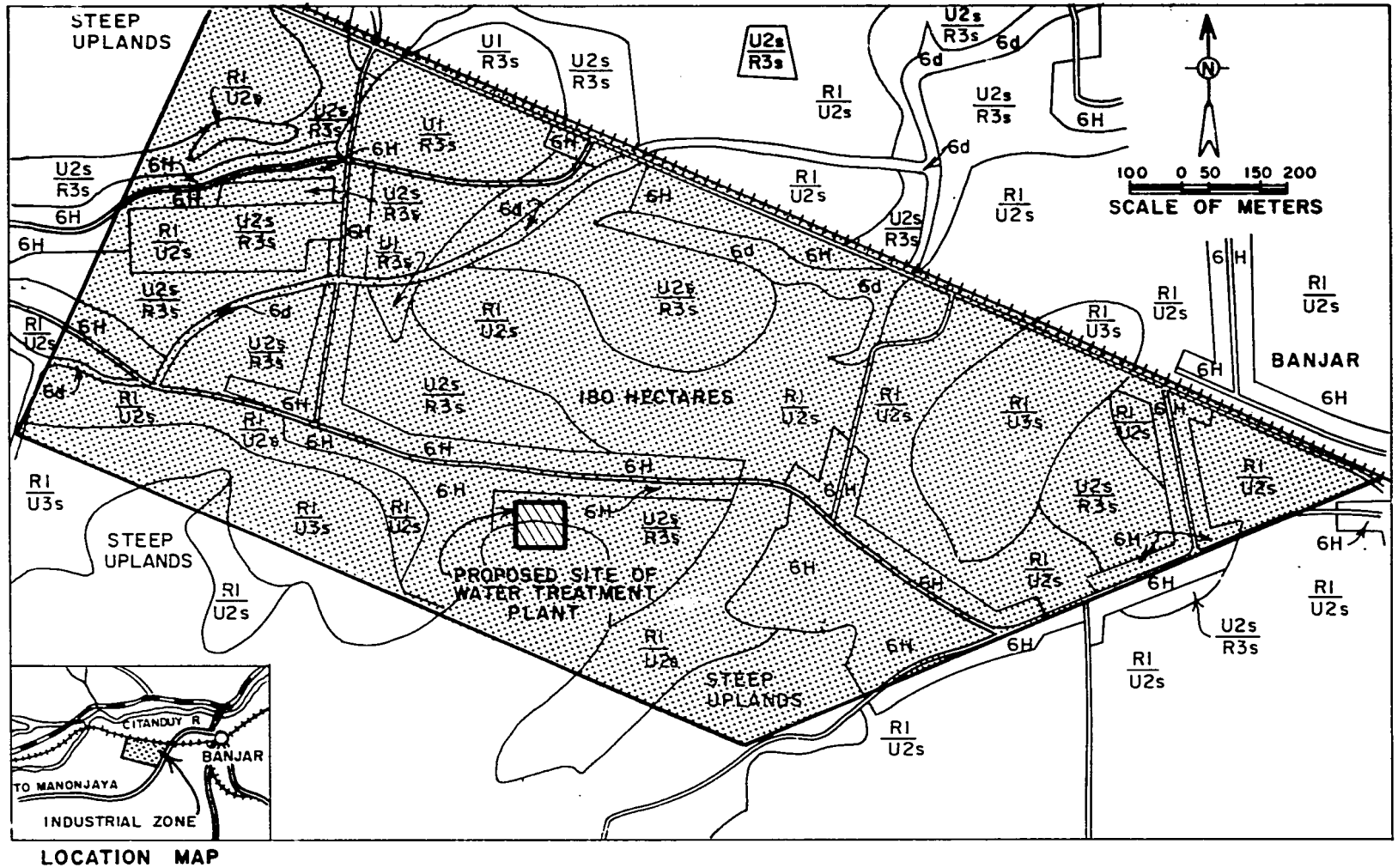
BANJAR PLAINS PROJECT

POPULATION PROJECTION
SERVICE AREA



BANJAR PLAINS PROJECT

MUNICIPAL DEMAND PROJECTION



LOCATION MAP

BANJAR PLAINS PROJECT

INDUSTRIAL ZONE

ENGINEERING CONSULTANTS, INC.

FIGURE III-5

Chapter IV

AGRICULTURE

General

The Banjar Plains Project has a gross study area of approximately 3,000 hectares which is made up of steep uplands and river floodplain. The project, as envisagad now, will serve the low, flat floodplain which has about 1,453 hectares of gross area. About 60 percent of this area is at present being cultivated, while the rest of the land is non-agricultural. Of the cultivated land, rice is grown on 605 hectares, while about 180 hectares of garden area is cultivated to coconut, cassava, sweet potato, cucumber and fruit trees. The balance of the gross study area of 1,547 (3,000-1,453) hectares is mostly made up of steep and rolling terrain with limited agricultural activity.

The present study concerns only the flat, floodplain area of 1,453 hectares, which is termed the service area. The rest of the gross study area does not lend itself to a gravity technical irrigation system, but is proposed to be brought into planning under the upper watershed study at a future date.

In the service area, current agricultural practice is to plant the first rice crop in the October-November period and harvest the same in February-March period. A second rice crop is planted on a limited area, depending on water availability, during March-April period and harvested during June-July period. The average dry rough rice (gabah) yield of the first crop is 2,885 kg/ha which is nearly 2.5 times that of the second crop. On areas where a second rice crop is not grown, an upland crop (Palawija crop) of corn, cassava, sweet potato, peanuts, soybeans and/or mungbeans is normally grown. Little or no area is cropped with two rice crops and an upland crop in a year.

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This chapter presents the current agricultural practice and land use in the service area, the soils and land classification, proposed cropping pattern and the irrigation requirements for the proposed cropping pattern.

Physiography

A general physical description of the project service area (see Fig. V-1) will show a small, flat plain bounded on the north by the Citanduy River, and on the south and east by a high mountain range. The plain is approximately 7 km in length with a width of 1/2 km (narrowest point) to 4 km (widest point). The main railroad line from Banjar to Bandung is located on the high, flat ridge of the plain which extends in an east-west direction. The city of Banjar is located at the eastern end of the plain.

The overall gradient of the plain is in a southeasterly direction, with local drainages extending north and south away from the railroad. One main drainage, beginning at the western end of the plain, flows easterly through the rice paddy area before turning north and emptying into the Citanduy River. Another main drainage, beginning south of Banjar, flows north along the project's eastern boundary and empties into the Citanduy River at the northeastern corner of Banjar.

The high hill range south and east of the plain consists of steep, undulating terrain devoted to mixed crops with isolated rice paddies located in small narrow drainages. Runoff (excess rainfall) flowing from these watersheds is used within the rice paddies where feasible.

Land Use

The cultivable lands within the Banjar Plains Service Area are either privately owned or operated on a cooperative basis. There is no government land or pastureland within this area.

Within the service area there are a few rural type irrigation systems which essentially collect the runoff and springflow occuring from the steep, rolling hills on the eastern edge of the service area. The collection is done through a contour channel which is then led into paddies, directly. This rainfall dependent system is very primitive and cannot supply assured flow during dry spells even in the rainy season. However, the system does provide some supplemental water which assures a higher rice yield over yields in areas without any irrigation. Also, part of the land that is supplied from this rural system is cropped to a second rice crop in years of average and above average rainfall. The actual area under this system could not be determined. It is estimated that around 350 hectares of rice paddies in the service area are served by the rural systems.

The present land use pattern in the study area is shown on Figure IV-1. The Figure shows location of areas planted to rice, but does not identify areas in the lowlands which are planted to upland crops during the dry season. As mentioned earlier, about 605 hectares of lowland area cultivated to rice is located in western and central part of the service area, while the 180 hectares of upland area is located near the settlements, along the river and on the steeper slopes forming the western boundary.

Most of the upland areas close to the settlement are planted to coconut and fruit trees, interplanted with cassava and vegetables. These lands have a good, deep alluvial soil. The uplands away from the settlement are cultivated to mixed crops.

Since the area of ricelands is limited, and Indonesia is critically short of rice, the use of paddies for production of a

second crop consisting of maize, soybean, sorghum and/or other field crops during the dry season is not foreseen. If irrigation water is available, most farmers will prefer to use their paddies for producing two crops of rice per year or, in some cases, two rice crops followed by a short season diversified crop utilizing residual soil moisture. Fish-sanitation ponds found in village areas usually go dry during the dry season. No farm land is used for the production of livestock.

Surface drainage for most of the service area is fair to good. A small area of about 30 hectares on the western boundary, close to Situbatu, is flooded during heavy rains. (See Fig. IV-2). Also, some lands along the river, which are in the low-lying areas, are flooded for short periods of time from rainfall and river flooding. Major flooding of any portion of the service area from the Citanduy River has not been reported.

Land Capability

Present use of the Banjar Plain lands does not fully utilize or maximize this resource, considering what would be possible with 'modern' agricultural technology. The deep alluvial soils are capable of higher crop production and yields than is presently the case. Much of this problem is due to the lack of irrigation water when required, and the resulting plant stresses, especially during the dry season. The non-use of recommended amounts of chemical fertilizer and recommended high-yield variety (HYV) seeds are additional reasons that these lands do not meet their potential. With the use of recommended inputs and technical irrigation, these lands are capable of doubling crop production, and exceptional farmers should do much better.

Much of the village soils inside the Kampung, have a clay loam texture that is ideal for the cultivation of vegetables. Irrigated family vegetable gardens can be developed close to the settlement if water supply is furnished. The agricultural

extension service will need to promote the idea of irrigated vegetables and other annual commercial crops. Additional use of village lands could be made in the production of livestock and poultry. This, too, would require an educational program promoted by the extension service.

Water Table

The water table in the service area ranges from two to four meters during the rainy season, but drops to a range of four to twelve meters during the dry season. Groundwater is listed as shallow for Banjar Plains Area, with no indications of salty water.

In the service area, four springs are situated which flow year round. These springs are an important source of water for rural irrigation and domestic use.

The Figure IV-2 shows the location of open wells where the water levels were measured and the location of springs.

Soils

The soils of Banjar Plain service area are a major natural resource that has not been fully exploited. These deep alluvial soils have not been cultivated to their utmost capability, particularly in increasing crop intensity and production. With supplemental water supply, all of the ricelands could be used for production of two rice crops. During the dry season, part of the area could support a third upland crop using residual moisture. Approximately 66 percent of the cultivable lands could be used for production of upland crops during the dry season if irrigation water can be provided. A field investigation of the entire

service area indicates that a technical irrigation system with tertiaries can be provided by a gravity and pumplift system.

The Banjar Plain soils have been greatly influenced by parent materials and historical flooding of the Citanduy River. Geological information tends to indicate that parent materials were volcanic debris consisting of breccia, tuff, sand and basalt. Sediments from the watershed slopes were carried by the Citanduy River as suspended loads and deposited as alluvial terraces and alluvial plains (fluvial). These fluvial soils, which developed as recent and subrecent alluvial materials, are found at a young stage of development with no diagnostic horizons formed for identification. These soils have a base saturation percentage of fair to good. Soil color is predominantly brown.

Field investigation of the Banjar Plain has shown a large area of fine-textured soils deposited over coarser materials consisting of fine broken rock, small gravel and some single grain sand bound together by clay particles. Deep deposits of fine-textured clays over coarser materials are found in river levees and river terraces. A large, wide, flat ridge of this soil is found parallel to the Citanduy River west of Banjar. The main east-west railroad line is located on this flat ridge. To the south of this ridge the area of ricelands consists of shallow, fine-textured clays over coarser materials of fine broken rock, small gravel and single grain sand bound together by clay. Because of the coarse materials in the lower profile, internal drainage does not tend to be a problem. However, yellow-orange rust color in the profile of ricelands does indicate the existence of a fluctuating water table. Some of the wells in the villages show a water table level of 3 to 4 m during the dry season.

Soil survey indicates the surface soils have a predominance Soil survey indicates the surface soils have a predominance of fine-textured clays, consisting of heavy clay (60+ percent clay), medium clay (49-59% clay), clay loam and some loam soil types. Sandy soil types were not found to be present, even on river

levees. Medium clay soils predominate with heavy clay soils nearly as important, followed by clay loam and a few isolated mounds of loam. Much of the large, flat ridge west of Banjar contains medium clay soil and rice is cultivated in open paddies, with mixed upland crops grown within the surrounding villages. Further west on the flat ridge the soil type changes to clay loam and some loam. Along the Citanduy River west of Banjar several large pockets of clay loam are found separated by medium clay. The large area of ricelands, south of the flat ridge, contain medium and heavy clays, with the heavy clay usually found in the natural low drainages. The general soil map of the Banjar Plains service area is shown on Figure IV-3.

Physical observation of these soils shows them to be a good medium for the development of increased crop production under improved irrigation. Under dry conditions, these soils show surface cracks of different widths and depths, depending on the percentage of clay. Heavy clays show cracks of 2 to 5 cm (width) and 15 to 20 cm (depth). Structurally, these soils extend from fine crumb in clay loam to angular blocky in dry heavy clay. Iron oxides found in these soils tend to bind together soil particles and establish the existing good structure. Soil erosion on Banjar Plains is not an important problem, since the clay soil have good cohesion due to the content of iron oxides. Rice paddies also act as a barrier against the movement of loose soils.

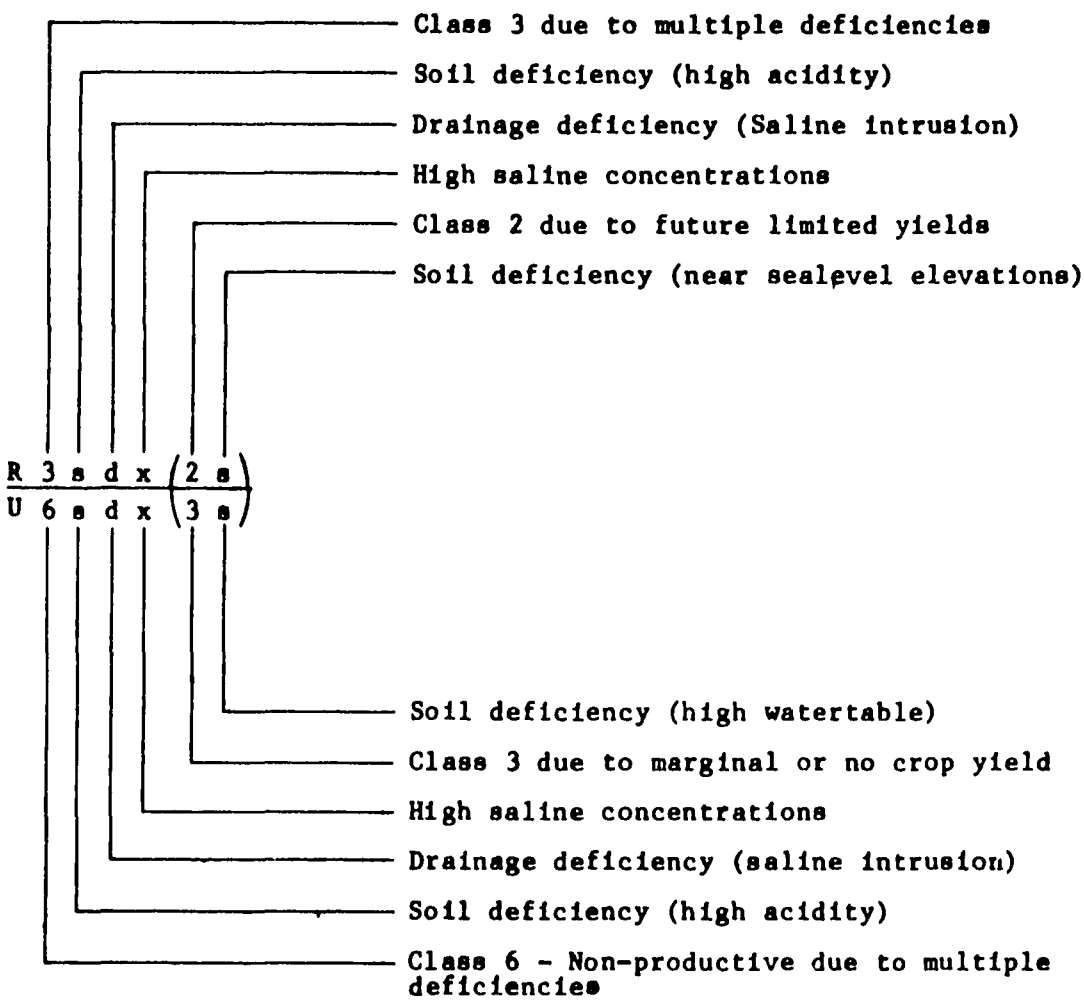
Land Classification

In conjunction with a soil survey, a classification of the land of Banjar Plains service area was made to determine suitability of lands for irrigated rice and upland crops. A field investigation was made to determine soil differences and physical features that would influence future planning and design of the irrigation system. Specifications, based on physical and chemical information, were used as a guide in classifying the lands into irrigable and non-irrigable areas. Finally, an inventory of these

areas was made to give an overall view of the soil resources available.

The land classification program features a dual-purpose system of examining each soil type for use in cultivating both rice and upland crops. Each area is given a symbol of R (riceland) and U (upland), shown as R/U or U/R, based on soil and crop science, and the judgement of the classifier. Each soil type is considered for cultivation of rice as a primary crop and cultivation of upland crops as a secondary crop. Soil and drainage deficiencies affecting crop production are taken into consideration when completing each land class symbol.

The following symbols were used in the classification of Banjar Plains lands.



100

This land class discloses the most marginal lands within the project area and corrective measures will improve these soils only to a limited land use. Due to the multiple deficiencies at almost sealevel elevation, the prospects of attaining high crop yields is questionable. The cultivation of upland crops will be almost impossible unless raised seedbeds (surjans) are used. Because of soil chemistry problems, a high watertable will need to be maintained at all times, limiting crop use to rice production, only. Shallow drainage ditches must be used to keep these soils from being overexposed to the air (oxidation). Because of these existing conditions, the land class for ricelands (R) has been put at 2 (to reflect less than class 1 conditions), while upland (U) has been raised from class 6 to 3 to reflect marginal improvements.

Non-Irrigable Lands

6 H - Town, village and other concentrated housing

6 d - Natural drainages

6 t - Steep slopes and high elevations

An inventory of the lands in the service area was made and the land classified under each of the above categories. The area, each category and its percentage are shown in Table IV-1. The land class is also shown on Figure IV-4 through Figure IV-11. The Figures cover the total gross study area of 3,000 hectares with land class limited to the service area of 1,453 hectares.

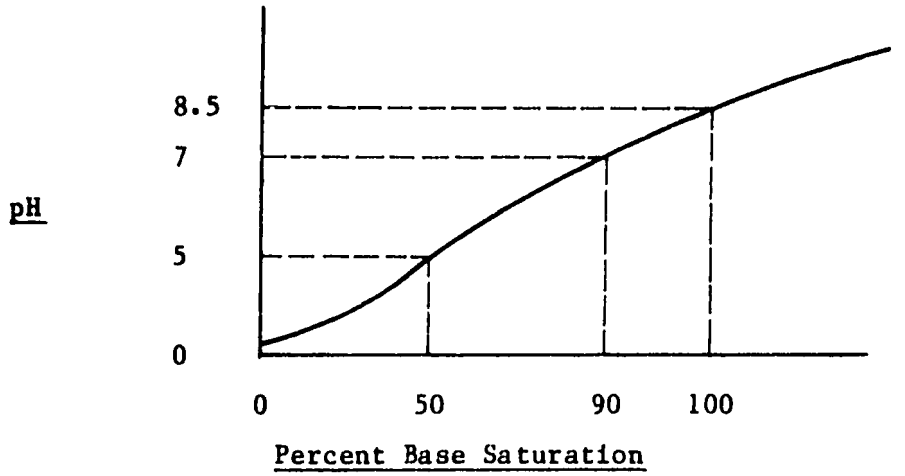
The advantages of the dual purpose land classification system is recognized when mapping alluvial soils that offer multiple use for a large variety of crops. This may offer an economic advantage when confronted by a small compact unit such as the Banjar Plain.

Although ricelands are not usually used for the cultivation of upland crops, a large area (407 ha) of Banjar Plain ricelands do adapt themselves to a dual use. Those lands with classification R1/U2s can be used for cultivation of upland crops when the irrigation water supply is limited. These medium clay soils can easily be adapted to cultivation of soybean, peanut, sorghum and sweet potatoes, crops that require less moisture than rice. The large area (224 ha) of land class U2s/R3s, located within villages, is adaptable to all crops.

Soil Fertility

Composite soil samples were collected at random from the service area in May, 1977. Ten borings were made for each sample. A total of twelve samples were collected at depths of 0-20 cm and 20-40 cm at six sites. Samples were sent to the Soil Research Institute in Bogor for chemical analysis. The results of the soil analyses is presented in Table IV-2.

The soil analyses data shows that the pH of these soils is moderately acid; some grain crops may respond to lime application when the soil pH is under 6.0. However, since the lower pH value is 5.4 and the percent base saturations are adequate in these soils no toxicity symptoms from Al, Fe and/or Mn in plants are expected. The base saturation expresses the ratio of Ca^{++}, Mg^{++}, K^{+}, Na^{+}, and NH_4^{+} with respect to the total cations in the soil exchange system. The realtionship of pH to Percent Base Saturation can be easily seen from the following graph.



The cation exchange capacity (CEC) of these soils is high. From the CEC it seems that the clays in the area are dominated by a 2:1 type of clay lattice. Since cracks in the surface are quite large during the dry season, it is probable that the clays are mainly montmorillonitic. Also, an increase in CEC with soil depth clearly shows that the clay increases in the B horizon, even when the Organic Matter (OM) is about 1% higher in the upper 0-20 cm of the soils sampled. It is usually safe to assume an increase of 2 me/100 g soil in CEC per each 1% increase in OM.

The salinity hazard is very low, although the values reported are deceiving, because they are not expressed in terms of Saturation Paste (Standard Procedure), but on a 1:5 soil:water ratio. Since these soils are approximately 60+ percent clay, the soil water holding capacity should be roughly 50% to 100% water for soil saturation. Therefore, if we multiply the electrical conductivity (EC) values by a factor of about 5, it will give a more realistic soil salinity value. The sodium hazard is low as shown by the calculated values of Exchangeable Sodium Percentage (ESP). These values range from 1.26 to 3.88, with the lower part of the soil profile sampled (20-40 cm) having greater ESP values, roughly double that in the surface (0-20 cm).

The percent organic matter (OM) estimates from the percent nitrogen (N) and percent carbon (C) is medium to low with values ranging from 4% to 1%. The upper part of the soil profile (0-20 cm) contains roughly 1% more OM than the lower part (20-40 cm).

The values of citrate soluble (P_2O_5) analysis ranged from 10 to 200 ppm and two soil locations showed considerably higher values than the rest of the samples (up to 20 fold difference). This could be due to sample contamination, since the trend to lower P_2O_5 in the 20-40 cm depth sampled, except for the two high P valued soils. Phosphate is not that mobile in acid soil, especially on a heavy-textured soil. Also, field observations revealed higher iron (Fe) content in the 20-40 cm depth, which could explain the trend to lower P_2O_5 values with depth, due to the formation of insoluble $FePO_4$ and $Fe_3(PO_4)_2$ compounds. Therefore, it is very improbable that values of 200 ppm available P_2O_5 could be found at 20-40 cm depth.

These soils under the proper fertilizer, tillage and water management should be very productive soils.

Crops and Cropping Patterns

Present cropping on Banjar Plain is devoted to the cultivation of rice, soybeans, peanuts, vegetables, cassava, sweet potatoes, fruit trees and coconuts, with limited cultivation of maize, sorghum, mungbeans and other assorted pulses. Rice is the primary crop produced during the rainy season, and a second crop of rice is produced if water is available during the early portion of the dry season. Low yields of most of the crops are due mainly to planting and management practices, non-use of production inputs and lack of irrigation water.

Present weighted average yields of some crops are shown in Table IV-3. This is based on yield data for the three subdistricts of Banjar, Ciamaragas and Pamarican in which the Banjar Plains service area lies. The wet season rice yield is 2,885 kg/ha of dry, rough rice (Gabah), while in the dry season it is only 1,089 kg/ha. The dry season yield is 38 percent of the wet season yield, and this is due to the paucity of water for the dry season crop, particularly the later part of it. Present rice

varieties grown in the service area during the wet season consist of local varieties on 50 percent of the area, IR variety on 40 percent of the area, and 10 percent of Pelita variety. The dry season rice crop is mostly limited to local varieties.

An analysis of Table IV-3 shows the cropping intensity for rice crops to be 1.04 for the three subdistricts on a whole. The cropping intensity of rice plus upland crop in the three years varied from 1.48 to 2.03 in the three subdistricts. Most of the second crop is made up of mixed upland crops. The predominant mixed crops are cassava and sweet potatoes. In the present condition, the cropping intensity for rice cannot be increased due to the fact that assured water supply is not available for the second crop. The small amount of land on which a second crop is grown is located in areas which have a rural irrigation system, such as the lands on the western portion of the Banjar Plains service area.

Future cultivation of crops (rice, upland, and garden) without the project has been estimated for the purpose of benefit computations. Conversion of the garden area of 100 ha to riceland area cannot be anticipated. For the second rice crop (dry season) of local varieties with longer growing season, water supply will remain to be a problem. It is estimated that approximately half of the rice land area can prove a rice crop during dry season, with the remainder of the 605 ha planted with an upland (Palasila) crop. This crop uses residual moisture and is far less sensitive to water stress as rice. Thus the resulting cropped area in future <u>without</u> project is estimated as follows:

	First Crop		Second Crop
rice	605 ha		300 ha
upland	--		305 ha
garden (one year)		180 ha	

Increasing the intensity of rice culture is particularly dependent upon the varieties of rice grown. The local variety is still a favorite with most farmers because of its taste and economic considerations. However, the 135 to 145 days of cropping period for producing local variety is a distinct disadvantage in getting two crops of rice within 7-8 months. Water shortage tends to be more critical if the two rice cropping period goes beyond eight months. Rice varieties IR28 and IR30 are superior to the local and Pelita varieties in this respect, as the two rice crops can be obtained within eight months. IR varieties should, in the future, become more popular because of their dwarf size, disease resistance, stiff straw, non-shattering grain characteristics and shorter growing season.

Future Cropping Patterns

The goals of a good cropping pattern are higher production, higher net farm income and better nutrition through the efficient use of all the resources available to the farmer. Furthermore, better distribution of labor and more frequent harvests are required by a good cropping pattern.

With the introduction of technical irrigation system, the farmer will generally prefer a rice-rice cropping pattern because it is the main food crop and the price of rice tends to be stable. The fact that nearly 15 percent of rice consumed in Java is imported is an additional factor in the nation's drive and the farmers' preference to grow rice. Also, dry rice is relatively easy to store in open space with less insect damage.

The growing of short season upland crops and vegetables beyond what is consumed locally is always difficult because of lack of infrastructural and marketing facilities and price fluctuation. The farmers resistance to growing these varieties beyond the local need is inherent and introduction of a cropping pattern with a higher intensity of upland crops must be supported

by providing inputs and a market. However, consideration should be given to the cultivation of irrigated vegetables and field crops in the upland areas. Soybeans, as the highest cash value crop, would be a good source of income. Soybeans, sorghum and maize are crops that Indonesia must support to fill livestock/poultry feed requirements. Processing of maize, peanuts and soybeans for production of oil is an important industry in Indonesia, and present crop production does not meet the country's requirements. Unfortunately, the local infrastructure for these crops does not meet the needs of increases in production. Table IV-3 shows crop yield figures for soybeans, peanuts and corn in recent years, which are low. It is not inconceivable to predict that these production figures could be doubled or even tripled when all management inputs are applied. During periods of low irrigation supply, the upland soils of land class U2/R3s and the land class R1/U2s could be used for cultivation of these crops in substitution for a limited second rice crop.

Increased rice production on Banjar Plain is associated with the problem of the farmers planting local varieties. A modern irrigation project requires that, in general, high-yielding varieties be used throughout the area, with planting of seedlings, maturity periods and harvesting dates kept to a prescribed schedule.

Several cropping rotations that can be adapted to the Banjar Plains Service Area are shown on Figure IV-12. Use of any one of these cropping rotations, or a combination of these, will depend on various factors. For the rice variety, the farmers will have to shift to high-yielding varieties (HYV), which are being extensively used in various parts of Java in irrigated areas. The traditional HYV variety of Pelita I/1, and the recently introduced HYV variety of IR-36 were chosen because of their shorter production period. Both varieties are similar with a 15 day average difference in the crop growing period. IR-36 yields slightly more than Pelita I/1 and has higher resistance to plant

insects and disease. These varieties now being recommended can change in the future with the introduction of still newer varieties.

The cropping rotation shown in Figure IV-12 assumes a 30 day staggering for all cropping operations. This would mean that all operations such as land preparation, transplanting or harvesting will have a 30 day staggering between the first farmer and the last farmer in the service area. This will not only stagger the peak demand of water, especially during land preparation, but will also reduce the size of the distributary system. For a run-of-the-river system, a staggering method of land preparation will reduce shortages, especially when the river flow is low.

The first cropping rotation shown on Figure IV-12 is for two HYV crops of Pelita I/1, a pattern frequently adopted when rainfall is plentiful or sufficient water is available for diversion. Land preparation begins about early September and continues for twenty days, followed by two days for transplanting. The nursery, plant in early September, would grow for a period of 20 to 22 days before seedlings are transplanted. The transplanted seedlings have a growth period of 105 days before reaching maturity. Harvesting would begin in mid-January and be completed by mid-February on all project land. The total growth period is about 125 to 127 days. Preparation for the second crop would begin immediately (beginning of February), and the harvesting completed by mid-July. The most critical period in terms of water shortage would be the land preparation period for the wet season crop, and crop water during June for the second crop.

The second cropping rotation is a modification of the first rotation that can be used when a water shortage is expected for the production of a second crop. A water shortage could be contemplated if rainfall during December, January and February (heaviest rainfall months) is below normal. A medium growing season rice variety (Pelita I/1) is used as the first crop, followed by a shorter growing season rice variety (IR-36). The

cultivation procedure for medium season crop (Pelita I/1) is the same as in the first cropping pattern; while the short season crop (IR-36) cultivation is initially the same, the crop growth period is shorter than first crop and harvesting begins by mid-May, and ending by mid-June. Total days for cultivating the short season crop (IR-36) is approximately 110-112 days. The cultivation of upland crops, after a second crop, is not possible because of a short cultivation period and possible shortage of irrigation water during the dry season. In the event a water shortage occurs in the month of September, then it might be necessary to switch from the medium season rice variety (Pelita I/1) to the short season (IR-36) variety. This would permit a 15 to 20 day delay in starting of the wet season crop without affecting the second crop. This cropping rotation is not shown on Figure IV-12.

A third cropping pattern combines one crop of medium season rice (Pelita I/1) followed by any one or a mixture of a variety of upland crops. This cropping pattern will be suitable for some of the upland areas classified as U2s/R3s, especially during years of below average rainfall. The medium season (Pelita I/1) crop is grown as the wet season crop in 125 to 127 days, followed by an upland crop. A long season upland crop, such as peanut and soybeans, will be grown immediately following harvesting of the rice crop if the soil is not heavily saturated due to rain. This will offer a poor medium for seedbed preparation and seed germination. A short season upland crop would be grown if a 20 to 30 days period is needed to prepare the seedbed and reduce saturation levels.

The last cropping rotation shown on Figure IV-12 is a higher intensity cropping suitable when sufficient water is available in the river during the dry period. It consists of two short duration rice crops (IR-36) followed by a short season upland crop. It is expected that this cropping pattern will be used by a small percentage of farmers whose areas lie close to the head reaches of the canal in years of above average rainfall.

Of the four cropping rotations indicated, irrigation requirement for the first and last crop rotation have been developed in the following paragraphs.

Irrigation Water Requirement

The climatic conditions which are of importance to irrigation requirement computation and cropping schedule planning are described in Chapter II, Hydrology. In the selection of rainfall data which are representative for the project area, an analysis has been made of rainfall data of three rainfall stations in the vicinity of Banjar Plains area. They are as follows:

Station Number	Rainfall Station	Approximate Elevation (Meters MSL)	Period of Record
245	Banjar and Pataruman	30	1971-1976
245a	Cisaga	85	1950-1973
247	Binangun (Gunung Putri)	20	1954-1976

The location of the rainfall stations are shown on Figure II-1. The Banjar/Pataruman station, which is about 3 kilometers downstream of the project area, probably represents the rainfall in Banjar Plains area reasonably well. The period of record, however, is too short to be used in irrigation requirement estimation. Of the two other rainfall stations which have more than 20 years of record, the Binangun/Gunung Putri station correlates the best with the Banjar station. The average monthly rainfall of Binangun is for 6 out of 12 months within 5 percent of the average monthly rainfall at Banjar/Pataruman. The average monthly rainfall at Binangun for the remaining months, generally in the light rain period, is slightly lower than at Banjar.

The rainfall at Binangun, therefore, has been selected as representative for the project service area. The use of these

data probably provides more conservative estimates of irrigation requirements. The 10 day rainfall for the period 1953 to 1976 for this station is presented in the Appendix volume. The average 10 day rainfall for this period is shown in Tables IV-4 and IV-5. The high rainfall during July second ten-day period is caused by above normal rainfall during the period 1954 to 1957. If these four years are not considered the magnitude drops from 122 mm to 44 mm, which is more reasonable.

The dry year ten-day period rainfall has also been worked out. In the 23 year period of rainfall data available, from 1954 to 1976, the dry years were 1961, 1965, 1966, 1972 and 1976. The ten-day rainfall for these years are shown in Tables IV-4 and IV-5.

The annual rainfall varies from 1,405 mm to 4,557 mm, with a mean value of approximately 2,560 mm. During the dry period (June through September) one out of three months has no rainfall. The average rainfall during the dry months amounts to about 650 mm. The mean dry year annual rainfall is about 1,746 mm which is 68 percent of the mean annual rainfall.

Based on the rainfall pattern at Binangun, three seasons can be distinguished using the following criteria:

Wet season with heavy rainfall:	Average monthly rainfall exceeds 200 mm.
Intermediate season with light rainfall:	Average monthly rainfall between 100 mm and 200 mm.
Dry season:	Average monthly rainfall is less than 100 mm or the majority of the months in that period have a rainfall of less than 100 mm.

The seasonal limits of 100 mm and 200 mm were selected for the following reasons; (a) 200 mm is equal to 6.7 mm/day, which

is normally quite adequate to grow wetland rice crop without irrigation; (b) with 100 mm (3.3 mm/day) or less, irrigation is needed for most upland crops; (c) rainfall between 100 mm (3.3 mm/day) and 200 mm (6.7 mm/day) wetland rice needs supplemental irrigation while upland crops can be grown without irrigation, particularly when following a rice crop with high residual soil moisture available.

The seasons defined according to the above criteria are:

Wet Season:	November to March
Intermediate Season (Light Rainfall):	April, May and October
Dry Season:	June to September

Water Requirement for Wetland Rice

The crop water requirement for wetland rice is defined as the sum of evapotranspiration and percolation during the crop growing season. During the land preparation and nursery, this will include, in addition, land soaking requirement.

Land Preparation

The amount of water required for land preparation is calculated using Wen's[1/] modified formula. With this formula the water requirement for a given area is constant during the whole land preparation. 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 was adopted in the p posed cropping calendar.

1/ Wen, Ligen; "Development of New Procedure for Determination of System Capacity of Transplanted Rice", Utah State University, Logan, Utah, 1970.

The amount of water required for soil saturation and puddling depends on the soil depth in the field and water losses due to evaporation and percolation. Based on recommended cropping pattern the land soaking requirement has been estimated for two different periods of the year. For crops transplanted in October and February/March, the land soaking requirement is estimated at 180 mm and 100 mm, respectively. These land soaking requirements are composed of an estimated soil saturation requirement of 130 mm and 50 mm, respectively, and 50 mm as submergence depth in the field. The land preparation requirement is calculated with Wen's formula as shown below.

$$Q = \frac{10AD_t}{E_c\left[1 - e^{-(D_t/D_s)n}\right]}$$

Where:

Q	=	Discharge in m^3/day.
A	=	Area in hectare.
D_t	=	Water requirement for transplanted rice -- is estimated at 6 and 7 mm/day, respectively, for the wet and dry season crop.
D_s	=	Water requirement for soaking and puddling the field, in meters, estimated at 180 mm and 100 mm, respectively.
E_c	=	Conveyance efficiency, assumed to be one.
n	=	Land preparation period in days.

With a land preparation time of 30 days, the total land preparation water requirement for the recommended cropping rotation are,

Transplanting -- October	285 mm
Transplanting -- February/March	216 mm

Crop Coefficient

Crop coefficient for submerged rice in humid regions of Asia have been published by FAO[2/] and have been used in determining the crop evapotranspiration in the project area, as no other data were available. The crop coefficients which have been used for both rice crop are:

First 50 days:	Kc = 1.1
Next 30 days:	Kc = 1.05
Last 25 days:	Kc = 0.95

The crop coefficient for upland crops are different from those for rice, and are normally lower. Based on data in the Southeast Asia region the magnitude of the crop coefficient for diversified crops are estimated to have a range from 0.65 to 1.05 over the growing period.

Crop Water Requirement

The potential evapotranspiration for the Banjar Plains Area has been calculated using the modified Penman method. Data on temperature, relative humidity, sunshine and wind velocity for the project area were derived from the data available for Tasikmalaya and Cilacap meteorological stations (see Chapter-II, Hydrology). The daily potential evapotranspiration on a monthly basis varies from 3.7 mm to 5.1 mm.

The calculated deep percolation loss is estimated to be 1 mm/day for computation of the crop water requirement.

The crop water requirement is defined as:

2/ FAO Publication "Crop Water Requirement", Publication No. 24, Revised in 1977.

$$CWR = K_c \, ET_p(t) + p(t)$$

Where: CWR = Crop water requirement in mm/period.

K_c = Crop coefficient.

ET_p = Crop evapotranspiration in mm/day.

t = Number of days.

p = Percolation in mm/day.

The CWR is shown in Tables IV-4 and IV-5 for two different cropping patterns. Table IV-4 is for two rice crops of high-yielding variety shown as number I cropping rotation on Figure IV-12, while Table IV-5 is for two short period HYV rice crop and a short season upland crop, identified as number IV cropping rotation on Figure IV-12. Irrigation is assumed to be shut off 10 days before harvest and the fields are drained. The crop water requirement is presented for a ten-day period with the 30-day staggering for all cropping operations.

Effective Rainfall

Effective rainfall is the net amount of rainfall which will be available to satisfy the crop water requirement at a specific time. There is an upper limit to the amount of water that plants can utilize, under any local climatic conditions. Rainfall generally diminishes the irrigation demand, but not all rainfall is effective in meeting the vegetative demand. Effective rainfall is also a function of the height of the bunds impounding water in the case of rice, the slope of field, the irrigation rotation schedule and infiltration rate.

The irrigation requirement for each ten-day period was worked out for one year duration. Since the Banjar Plains Project is a diversion project it is necessary to determine the irrigation requirement during the dry rainfall years, rather than for a normal year. Hence, the effective rainfall was computed based on

the average dry year ten-day rainfall instead of the mean annual ten-day rainfall. The magnitude of the effective rainfall is based on the following assumption:

a. Eighty percent of the dry year rainfall is considered to be the maximum amount that can be effective in any ten-day period, but cannot exceed the crop water requirement. This reduction allows for some immediate runoff to the drains.

b. The effective ten-day rainfall which is equal or less than the crop water requirement is counted as effective.

The magnitude of effective rainfall for the two crop rotations is shown in Tables IV-4 and IV-5. The average effective rainfall amounts to about 60 percent of the mean dry year rainfall.

Irrigation Diversion Requirement

The diversion requirement for the two crop rotations is shown in Tables IV-4 and IV-5. Since all cropping operations are staggered over a 30-day period, and the irrigation requirement is worked out for each 10-day period, the Tables have been prepared in three 10-day increments. The total irrigation requirement is the average depth of water required for the given period. In computing the irrigation requirement for the upland crop, the residual moisture has not been accounted for.

The irrigation requirement has been worked out based on 80 percent farm efficiency during land preparation and 50 percent during crop growth stage. These efficiencies are based on the Consultant's experience and data collected on many projects in Southeast Asian countries. The conveyance

efficiency, which reflects the losses in the distribution system, is taken to be 80%. Thus, the overall efficiency for land preparation will be 64%, and for the crop growth stage will be 40 percent. These efficiency values were recommended in the Consultant's report.[3/] The Directorate of Irrigation recommends using an overall efficiency of 65 percent. There are no data available on the efficiencies in any existing irrigation systems to substantiate such a high efficiency value. Also, the efficiencies for run-of-the-river projects, such as the Banjar Plains, will be considerably lower when compared to storage projects.

Tables IV-4 and IV-5 show the 10-day irrigation requirement in liters/second per hectare as well as for the total area of 785 ha. For the two rice crops, the maximum irrigation diversion requirement is expected to be about 1.22 m^3/sec during the land preparation time in September. The irrigation requirement during September and October will be large as compared to other months. In the event of zero rainfall during any 10-day period, the maximum irrigation diversion requirement will be 1.60 m^3/sec, which occurs in the month of October.

The cropping pattern with two rice crops and one short season upland crop has a maximum irrigation diversion requirement of 1.84 l/s/ha or 1.44 m^3/sec for the 785 ha, during land preparation in September . This cropping pattern has a large diversion demand during the months of July, September and October when the flow in the river will be at a minimum. It would not be possible to adopt this cropping pattern on all the 785 ha. It is envisaged that a small part of the area would grow the short season upland crop, while the two rice crops will be feasible over the entire 785 ha.

3/ "Operation and Maintenance Manual-Irrigation and Drainage", Engineering Consultants, Inc., Denver, Colorado U.S.A., November, 1976.

TABLE IV-1

Land Class Inventory

Symbol			Hectares	Percent of Area
Irrigable				
R1 / U3s	)		269	18.5
R1 / U2s	)	Present Riceland	407	28.0
R3d (1) / U3sd(3s)	)		29	2.0
U1 / R3s	)		21	1.5
U2s / R3s	)	Flat Upland	224	15.4
		Net Irrigable	950	65.4
Non-Irrigable				
6 H			401	27.6
6 d			60	4.1
6 t			42	2.9
		Total Non-Irrigable	503	34.6
Gross Area			1,453	100

TABLE IV-2

Soil Analysis Results[1/]

(Service Area)

Sample Number	Depth (cm)	pH H_2O Paste	pH K31	Base Saturation (%)	CEC	EC (1:5) mmhos/cm. (25°C)	OM* (%)	OM %C	OM %N	OM c/N	Citrate Soluble P_2O_5 (ppm)	Exchange Category me/100g Ca	Mg	Na	K	ESP**
185971	0-20	5.4	4.2	54	31.2	0.048	3	1.56	0.17	9	20	10.7	5.5	0.4	0.4	1.28
972	20-40	5.9	4.5	56	34.4	0.050	2	1.00	0.12	8	10	12.4	5.5	1.0	0.3	2.91
185973	0-20	5.7	4.4	62	34.7	0.057	2-3	1.43	0.13	11	20	13.7	6.9	0.5	0.4	1.44
974	20-40	6.0	4.7	70	37.7	0.033	2-4	1.09	0.18	6	10	17.5	7.9	0.8	0.2	2.12
185975	0-20	5.9	4.3	68	39.3	0.027	2	0.91	0.10	9	20	17.8	8.0	0.9	0.2	2.29
976	20-40	6.1	4.6	68	44.0	0.034	1-2	0.51	0.08	6	20	19.8	8.8	1.2	0.2	2.73
185977	0-20	5.6	4.3	60	42.5	0.071	4	2.2[illegible]	0.22	10	130	16.3	8.4	0.6	0.3	1.41
978	20-40	6.2	5.0	67	43.4	0.090	4	2.36	0.21	11	200	17.3	10.0	1.4	0.3	3.23
185979	0-20	5.7	4.1	58	37.5	0.025	2-3	1.39	0.13	10	20	14.2	6.7	0.6	0.4	1.60
980	20-40	6.6	5.2	74	36.1	0.037	1-2	0.51	0.08	6	10	16.9	7.7	1.4	0.5	3.88
185981	0-20	5.9	4.4	60	23.9	0.030	2-3	1.27	0.15	8	70	6.1	7.0	0.3	1.0	1.26
982	20-40	5.9	4.5	60	26.3	0.035	1.5-2	0.87	0.12	7	110	8.4	6.1	0.4	1.0	1.52

1/ Testing carried out be Soil Research Institute, Bogor, Order No. 3026/1977.

* Approximated values calculated from %N and %C.

** Calculated values from exchangeable Na and CEC.

TABLE IV-3

Weighted Average Yields for Various Crops[1/]

CROP	Total Hectares				Kilograms/Hectare			
	1974	1975	1976	Average	1974	1975	1976	Weighted Average
Rice (Wet Season)	14,960	14,228	11,709	13,632	4,681	5,079	4,923	4,889[2/]
Rice (Dry Season)	561	623	334	506	1,396	2,270	1,805	1,845[2/]
Corn	1,551	203	350	701	1,012	978	1,178	1,036
Cassava	8,276	6,145	3,212	5,878	7,141	6,667	7,326	7,013
Sweet Potato	3,713	2,129	1,030	2,111	3,433	3,843	3,837	3,637
Peanuts	1,870	340	529	913	840	1,071	1,137	926
Soybeans	--	292	216	254	--	866	737	811
Mungbean	35	--	8	22	600	--	700	619

1/ Source: Kecamatan Records and Agricultural Extension Service, Ciamis.

2/ Rice yield reported in wet stalk. To convert to dry rough rice (Gabah), multiply by 0.59.

TABLE IV-4

Diversion Requirement for Two Rice Crop

Period		ET_p	K_c	Units = mm per Ten Day Period: Mean Rainfall	Dry Year Rainfall	1 CWR	1 RE	1 IR	2 CWR	2 RE	2 IR	3 CWR	3 RE	3 IR	Σ IR	IR l/s/ha	Total IR l/s
Jan	1	44	0.95	80	130	52	52	0	52	52	0	56	56	0	0	0	0
	2	44	0	96	91	0	0	0	52	52	0	52	52	0	0	0	0
	3	48	0	113	72	0	0	0	0	0	0	57	57	0	0	0	0
Feb	1	51	0	96	78	72	62	16	0	0	0	0	0	0	5	0.06	48
	2	51	0	95	86	72	69	5	72	69	5	0	0	0	3	0.04	31
	3	41	0	56	42	72	34	59	72	34	59	72	34	59	59	0.68	534
Mar	1	47	1.1	[illegible]	60	62	48	35	72	48	38	72	48	38	37	0.43	337
	2	47	1.1	81	69	62	55	18	62	55	18	72	55	27	21	0.24	188
	3	52	1.1	89	74	68	59	23	68	59	23	68	59	23	23	0.27	222
Apr	1	43	1.1	64	69	57	55	5	57	55	5	57	55	5	5	0.06	48
	2	43	1.1	61	62	57	50	18	57	50	18	57	50	18	18	0.21	165
	3	43	1.05	63	43	55	34	53	57	34	58	57	34	58	56	0.65	510
May	1	38	1.05	77	93	50	50	0	50	50	0	52	52	0	0	0	0
	2	38	1.05	56	42	50	34	40	50	34	40	50	34	40	40	0.46	362
	3	42	0.95	47	38	51	30	53	55	30	63	55	30	63	60	0.69	542
Jun	1	38	0.95	29	13	46	10	90	46	10	90	50	10	100	93	1.08	848
	2	38		54	0				46	0	115	46	0	115	77	0.89	699
	3	38		50	4							46	3	108	36	0.42	336
Jul	1	37		73	0												
	2	37		122	0												
	3	41		64	0												
Aug	1	43		45	0												
	2	43		47	0												
	3	47		32	0												
Sep	1	50		36	0	95	0	148							49	0.57	448
	2	50		60	0	95	0	148	95	0	148				99	1.15	903
	3	50		39	11	95	9	134	95	9	134	95	9	134	134	1.55	1,217
Oct	1	47	1.1	73	29	62	23	98	95	23	113	95	23	113	108	1.25	981
	2	47	1.1	77	25	62	20	100	62	20	100	95	20	117	106	1.23	965
	3	52	1.1	74	37	68	30	95	68	30	95	68	30	95	95	1.10	864
Nov	1	45	1.1	107	42	60	34	65	60	34	65	60	34	65	65	0.75	589
	2	45	1.1	102	77	60	60	0	60	60	0	60	60	0	0	0	0
	3	45	1.05	79	59	58	47	28	60	47	33	60	47	33	31	0.36	283
Dec	1	43	1.05	89	60	55	48	18	55	48	18	57	48	23	20	0.23	180
	2	43	1.05	92	103	55	55	0	55	55	0	55	55	0	0	0	0
	3	47	0.95	85	94	56	56	0	61	61	0	61	61	0	0	0	0
Total				2,559	1,746		1,017			1,012			1,016		1,140		

Average Effective Rainfall = 1,015/1,746 = 58%

CWR = Crop water requirement

RE = Effective rainfall

IR = Irrigation requirement

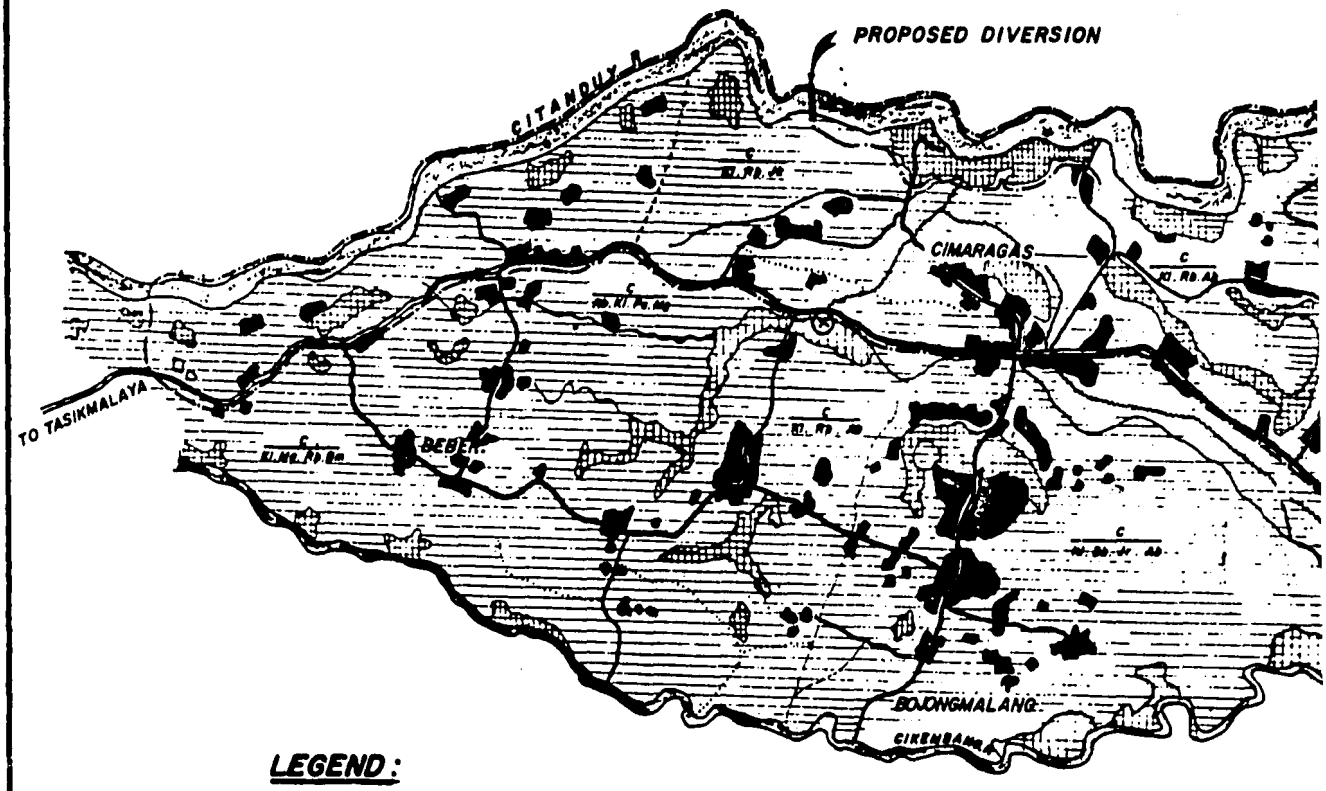
TABLE IV-5

Diversion Requirement for Two Rice and One Upland Crop

Period		ET_p	K_c	Mean Rainfall	Dry Year Rainfall	1 CWR	1 RE	1 IR	2 CWR	2 RE	2 IR	3 CWR	3 RE	3 IR	Σ IR mm	IR l/s/ha	Total IR l/s
				Units mm per Ten Day													
Jan	1	44	1.1	80	130	93	93	0	73	73	0	52	52	0	0	0	0
	2	44	1.1	96	91	76	73	5	93	73	31	73	73	0	12	0.14	110
	3	48	1.1	113	72	64	58	15	79	58	33	93	58	55	34	0.39	306
Feb	1	51	1.1	96	78	66	62	10	66	62	10	80	62	28	16	0.19	149
	2	51	1.1	95	86	66	66	0	66	66	0	66	66	0	0	0	0
	3	41	1.1	56	42	53	34	48	53	34	48	53	34	48	48	0.56	440
Mar	1	47	1.05	56	60	59	48	28	62	48	35	62	48	35	33	0.38	299
	2	47	1.05	81	69	59	55	10	59	55	10	62	55	18	13	0.15	118
	3	52	1.05	89	74	66	59	18	66	59	18	66	59	18	18	0.21	165
Apr	1	43	0.95	64	69	51	51	10	55	51	10	55	51	10	10	0.12	94
	2	43	0.95	61	62	25	25	0	51	50	3	55	50	13	5	0.06	48
	3	43		63	43				26	26	0	51	34	43	14	0.16	126
May	1	38		77	93							23	23	0	0	0	0
	2	38	0.65	56	42	25	25	0							0	0	0
	3	42	0.65	47	38	27	27	0	27	27	0				0	0	0
Jun	1	38	0.78	29	13	30	10	50	25	10	38	25	10	38	42	0.49	384
	2	38	0.92	54	0	35	0	88	30	0	75	25	0	63	75	0.87	683
	3	38	1.05	50	4	40	3	93	35	3	80	30	3	68	80	0.93	720
Jul	1	37	1.05	73	0	39	0	98	39	0	98	34	0	85	94	1.09	856
	2	37	1.05	122	0	39	0	98	39	0	98	39	0	98	98	1.13	882
	3	41	1.0	64	0	41	0	103	43	0	108	43	0	108	106	1.23	965
Aug	1	43	0.95	45	0	41	0	103	43	0	108	45	0	113	108	1.25	981
	2	43		47	0				41	0	103	43	0	108	70	0.81	636
	3	47		32	0							45	0	113	38	0.44	345
Sep	1	50		36	0	98	0	153							51	0.59	463
	2	50		60	0	98	0	153	98	0	153				102	1.18	927
	3	50	1.1	39	11	88	9	198	98	9	139	98	9	139	159	1.84	1,441
Oct	1	47	1.1	73	29	62	23	98	81	23	145	98	23	117	120	1.39	1,091
	2	47	1.1	77	25	62	20	105	62	20	105	81	20	153	121	1.40	1,099
	3	52	1.1	74	37	68	30	95	68	30	95	68	30	95	95	1.10	864
Nov	1	45	1.1	107	42	60	34	65	60	34	65	60	34	65	65	0.75	589
	2	45	1.05	102	77	57	57	0	60	60	0	60	60	0	0	0	0
	3	45	1.05	79	59	57	47	25	57	47	25	60	47	33	28	0.32	251
Dec	1	43	1.05	89	60	55	48	18	55	48	18	55	48	18	18	0.21	165
	2	43	0.95	92	103	51	51	0	55	55	0	55	55	0	0	0	0
	3	47	0.95	85	94	75	75	0	56	56	0	60	60	0	0	0	0
Total		1,598		2,559	1,746		1,083			1,057			1,064				

Average Effective Rainfall = 1,068/1,746 = 61%

CWR = Crop water requirement
RE = Effective rainfall
IR = Irrigation requirement

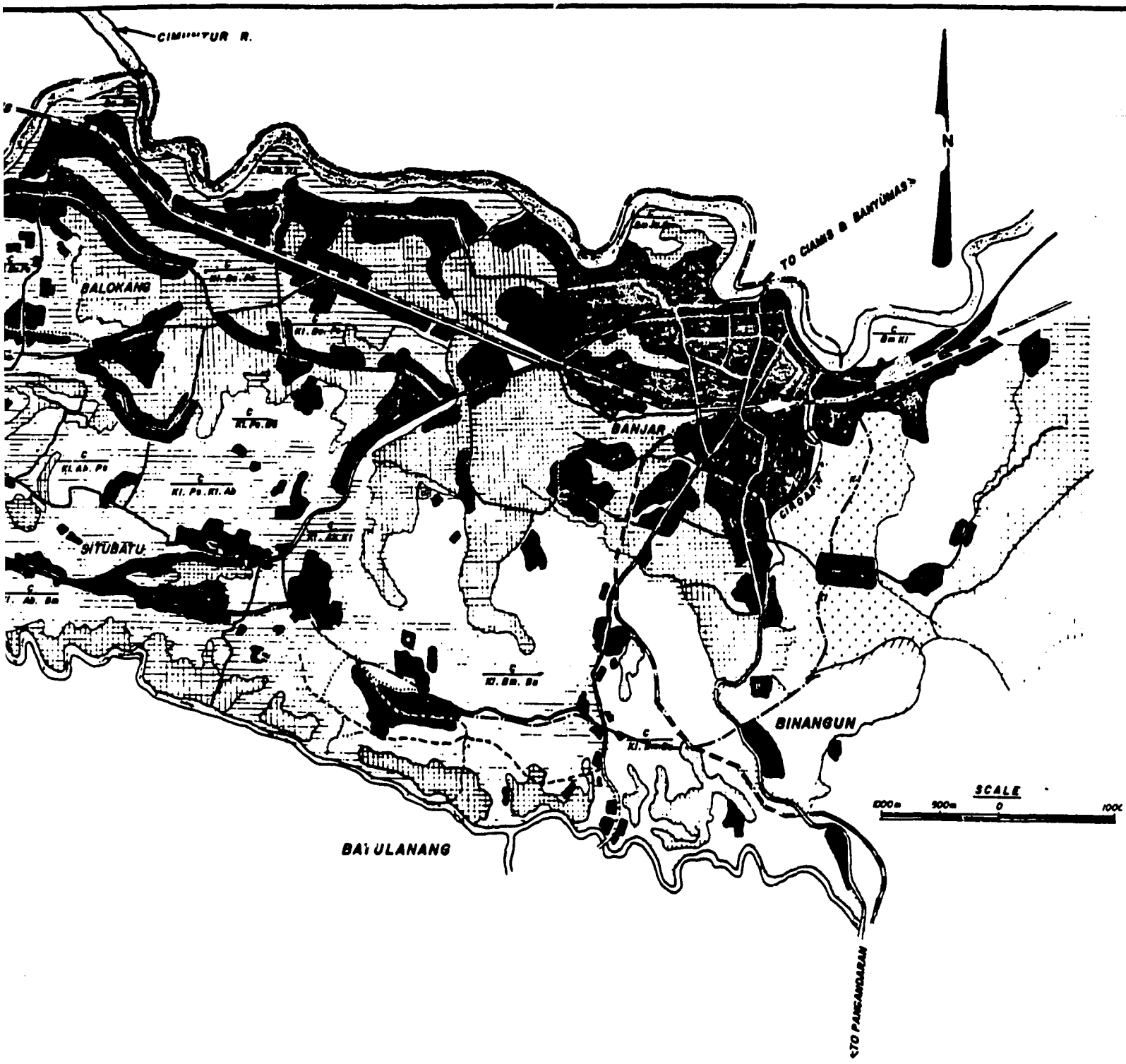


LEGEND :

	SETTLEMENT		RAIL ROAD
	RICE. FIELD		PRIMARY/SEC. ROAD
	UPLAND		VILLAGE ROAD
	PLANTATION		RIVER
	FOREST		BANJAR PLAIN SERVICE AREA BOUNDARY
	MIX GARDEN = C		

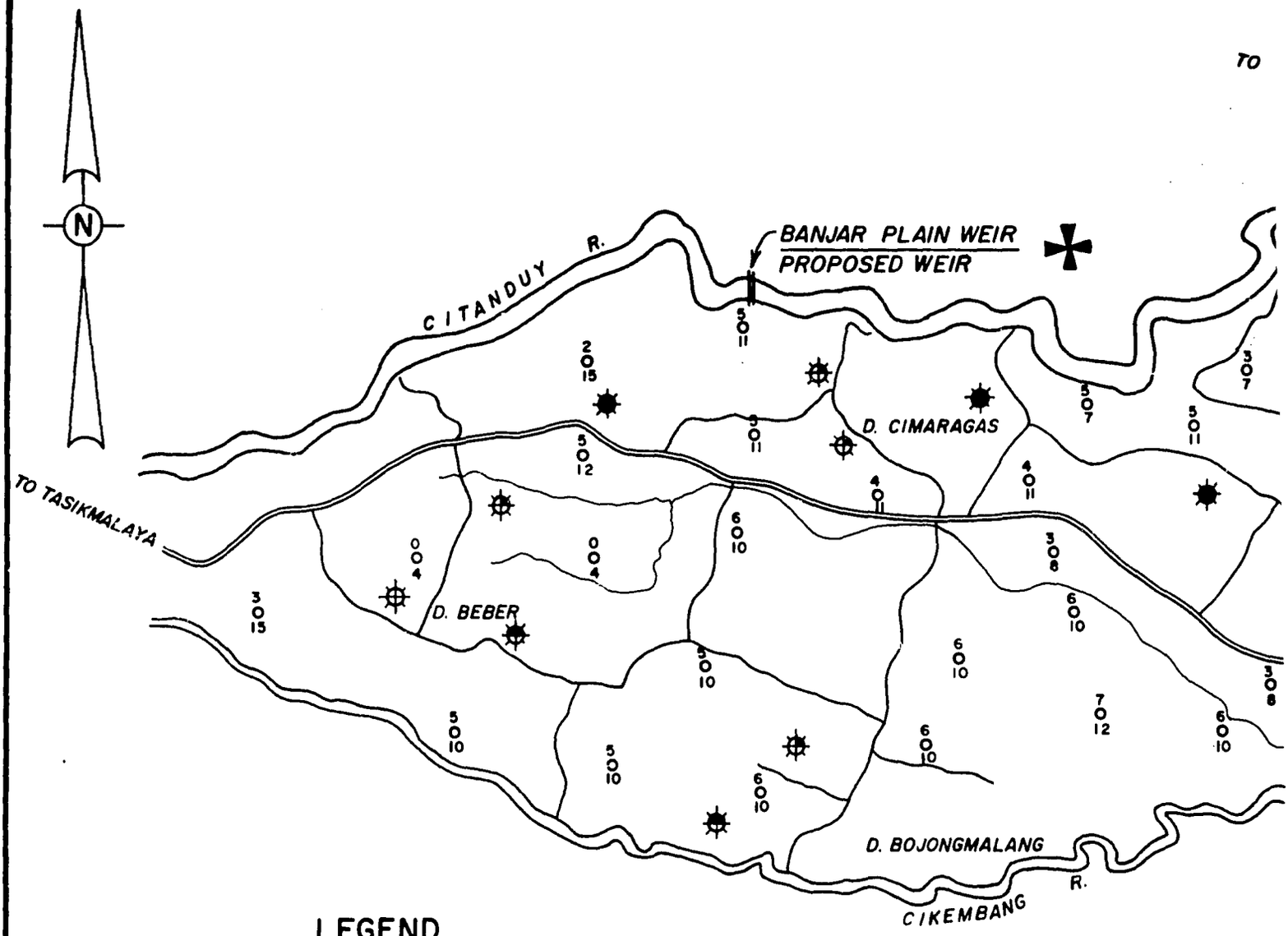
Kl = COCONUT
Ab = ALBIZZIA
Ps = BANANA
Jk = JENGKOL (POD TREE)
Dk = DUKU (FRUIT)
Bm = BAMBOO
Jb = JAMBU (FRUIT)
Mg = MANGGO
Bu = FRUITS
Jr = CITRUS

FIGURE IV -



BANJAR PLAINS PROJECT

LAND USE



LEGEND

PERKAMPUNGAN (SETTLEMENT)

DAERAM YANG TERGENANG DIMUSIM HUJAN LEBAT (INUNDATED DURING HEAVY RAIN)

JALAN K.A. (RAILROAD)

JALAN ASPAL (PRIMARY/SECONDARY ROAD)

JALAN TANAH/KAMPUNG (PASSABLE FOR CARS/EARTH ROAD)

SUNGAI (RIVER)

MATA AIR YANG MENGELUARKAN AIR DALAM SETAHUNNYA (SPRINGS WHICH PRODUCE WATER YEAR ROUND)

" 9 MONTHS

" 6 MONTHS

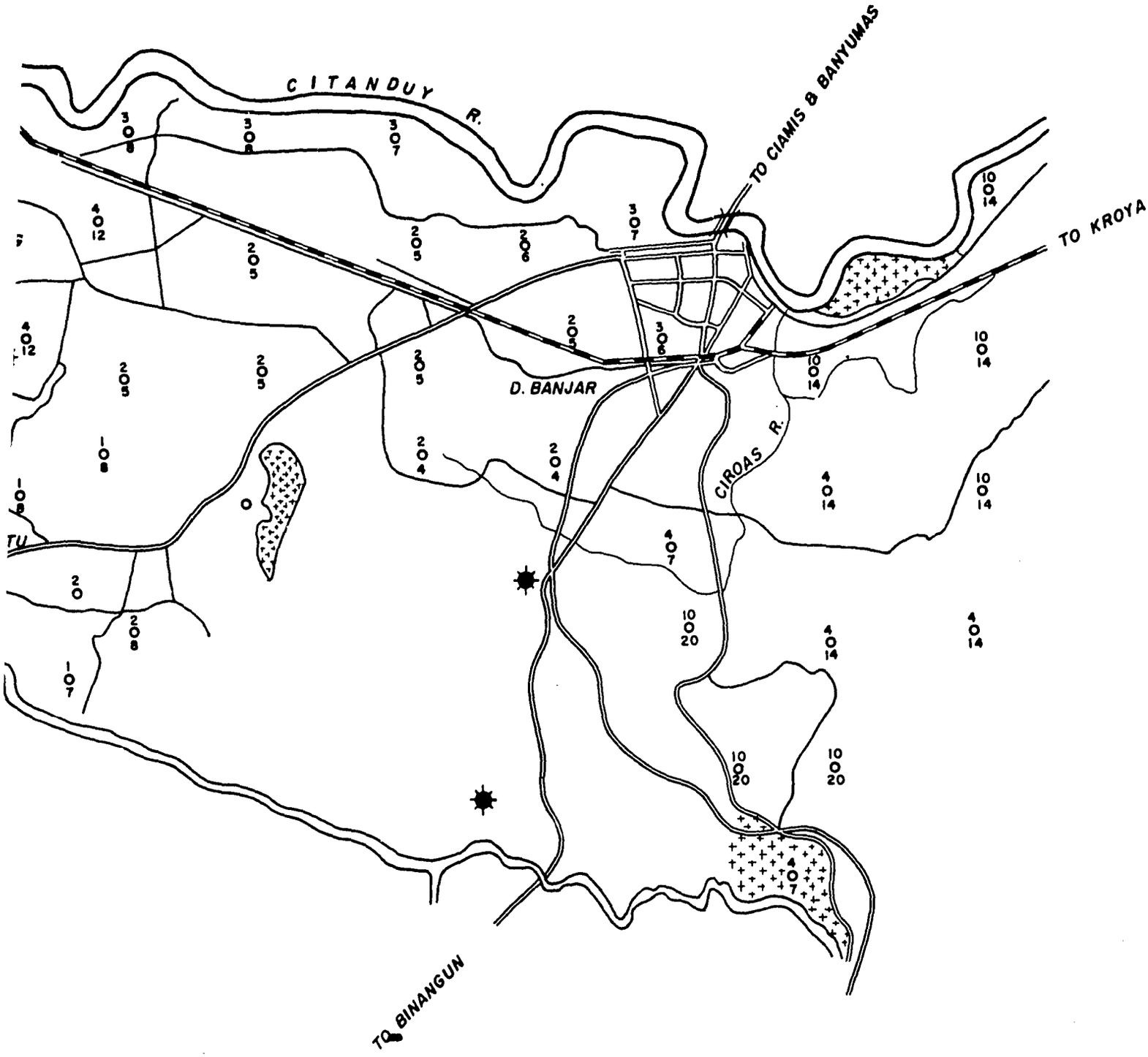
" 3 MONTHS

KEDALAMAN AIR SUMUR DARI PERMUKAAN TANAH (WELL WATER DEPTH FROM EARTH SURFACE)

5 m : MUSIM PENGHUJAN (RAINY SEASON)

8 m : MUSIM KEMARAU (DRY SEASON)

WEIR SITE



REPUBLIC OF INDONESIA

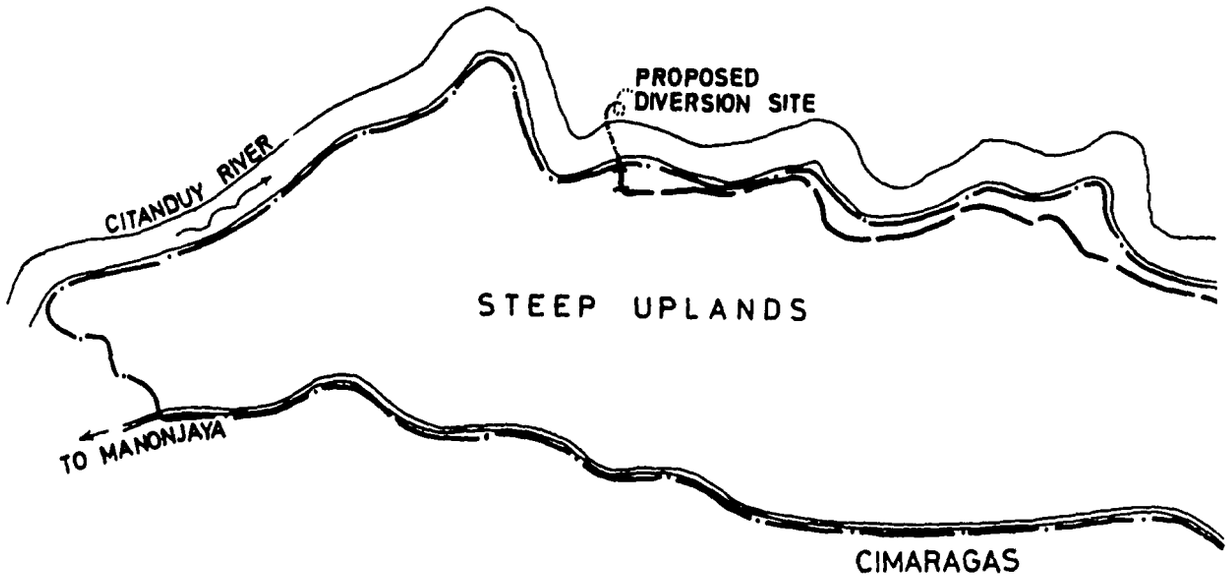
MINISTRY OF PUBLIC WORKS & ELECTRIC POWE
DIRECTORATE GENERAL OF WATER RESOURCES DEVELC
DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
SPRINGS AND OPEN WELLS

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

DRAWN : DIR. TATA GUNA TANAH	SUBMITTED :
TRACED : ADE RUSTANDY	RECOMMENDED:
CHECKED:	APPROVED : J.F. FARM
DATE : APRIL 7, 1978	DRAWING NUMBER:

ENGINEERING CONSULTANTS INC



LEGEND

	RIVER
	PRIMARY ROAD
	RAILROAD
	BANJAR PLAIN BOUNDARY
	IRRIGATED/UPLAND BOUNDARY
HY. C	HEAVY CLAY (60%+CLAY)
MED. C	MEDIUM CLAY (49-59%CLAY)
CL	CLAY LOAM
L/CL	LOAM OVER CLAY LOAM
—xx—	VILLAGE BOUNDARY

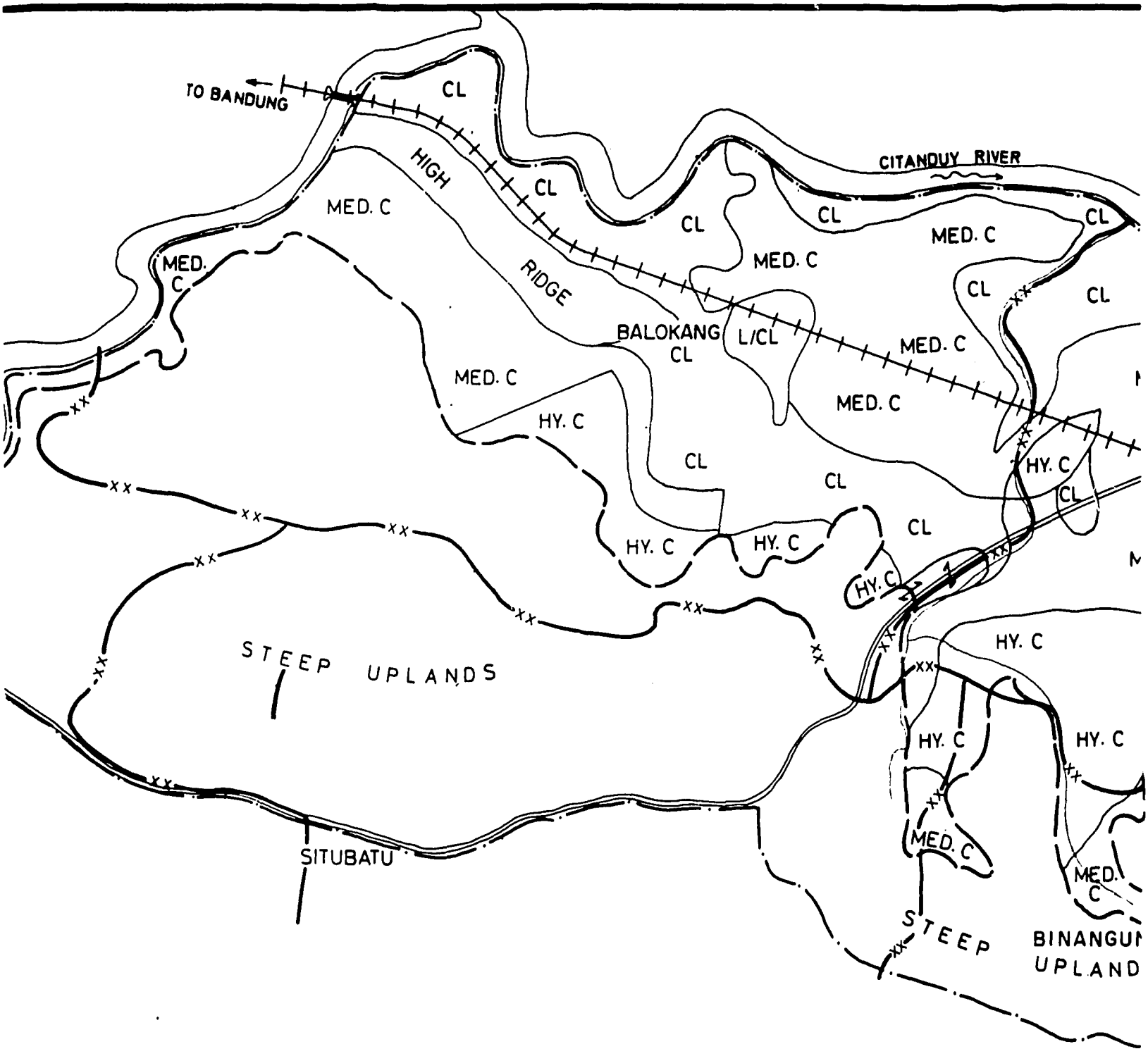
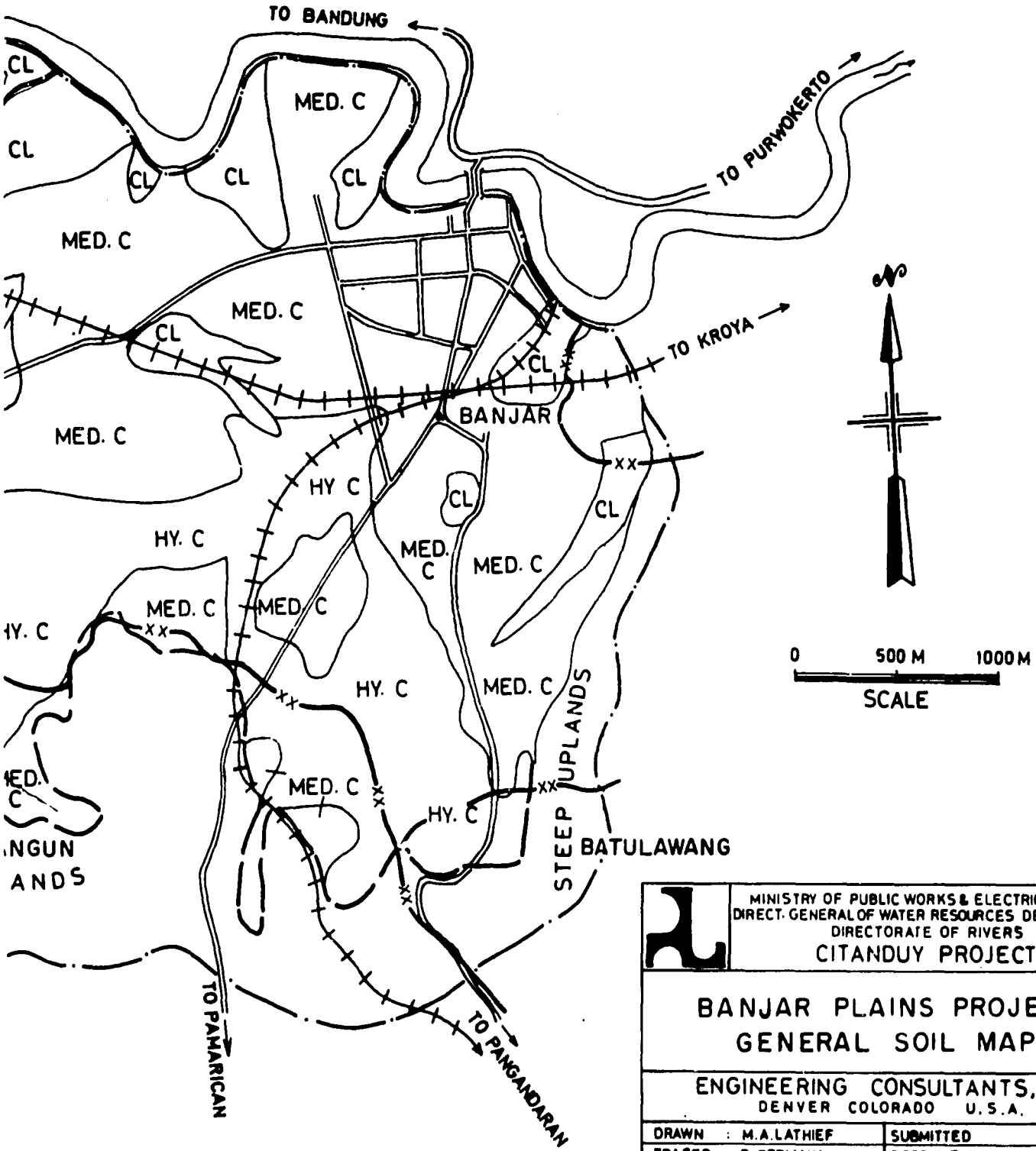

TO BANDUNG
CITANDUY RIVER
HIGH RIDGE
CL
MED. C
MED. C
BALOKANG
CL
L/CL
MED. C
MED. C
MED. C
CL
CL
CL
CL
CL
CL
CL
CL
HY. C
HY. C
HY. C
HY. C
HY. C
HY. C
HY. C
HY. C
HY. C
MED. C
MED. C
MED. C
STEEP UPLANDS
SITUBATU
STEEP
BINANGUI
UPLAND

FIGURE IV - 3



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

BANJAR PLAINS PROJECT
GENERAL SOIL MAP

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

DRAWN	: M.A.LATHIEF	SUBMITTED	: B.L. MILLER
TRACED	: D.PERMANA	RECOMMENDED	: B.L. MILLER
CHECKED	:	APPROVED	: F.E. FARMER
DATE	: SEPT. 2 - 1977	DRAWING NUMBER	:

FIGURE IV-5

FIGURE IV-6

V-7	
IV-8	FIGURE IV-10
IV-9	FIGURE IV-11

SYMBOLS:

R1 / U3s		(LT.GREEN)	HEAVY CLAY (60% + CLAY)
R1 / U2s		(BROWN)	MEDIUM CLAY (49-59% CLAY)
R3d(1) / U3sd(3s)		(LT.BLUE)	R1/U3s LAND WITH SURFACE DRAINAGE PROBLEM
U1 / R3s		(DK.GREEN)	LOAM OVER CLAY LOAM
U2s / R3s		(ORANGE)	CLAY LOAM SURFACE SOIL
6H		WHITE	CONCENTRATED HOUSING
6d		WHITE	NATURAL DRAINAGE
6t		WHITE	STEEP SLOPES AND HIGH ELEVATIONS

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CITANDUY PROJECT

BANJAR PLAINS PROJECT LAND CLASSIFICATION MAPS INDEX

ENGINEERING CONSULTANTS INC.
DENVER COLORADO U.S.A

DRAWN :	SUBMITTED :
TRACED :	RECOMMENDED : B.L. MILLER
CHECKED :	APPROVED : F.E. FARMER
DATE : SEPT 10 1979	DRAWING NUMBER :

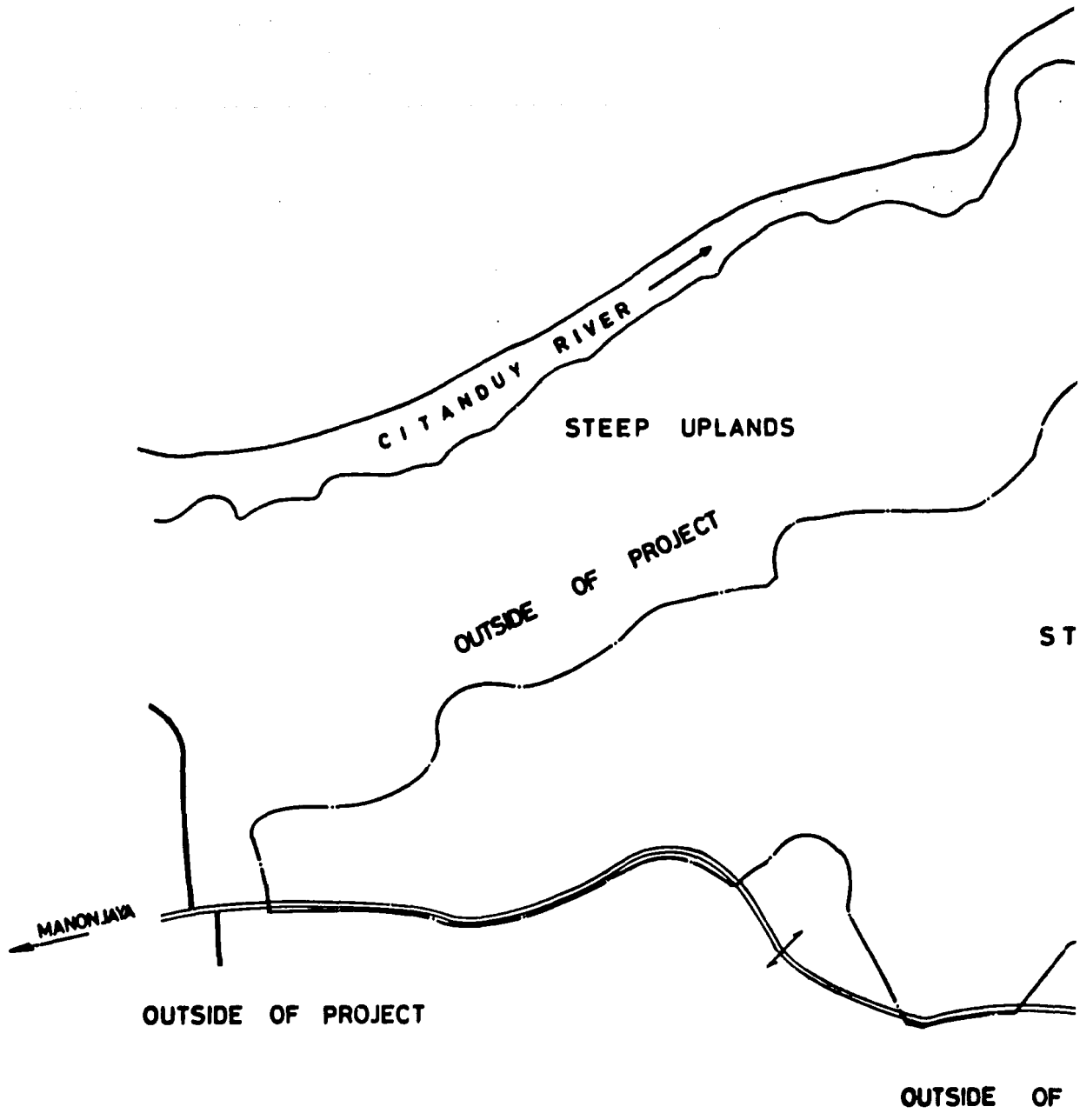
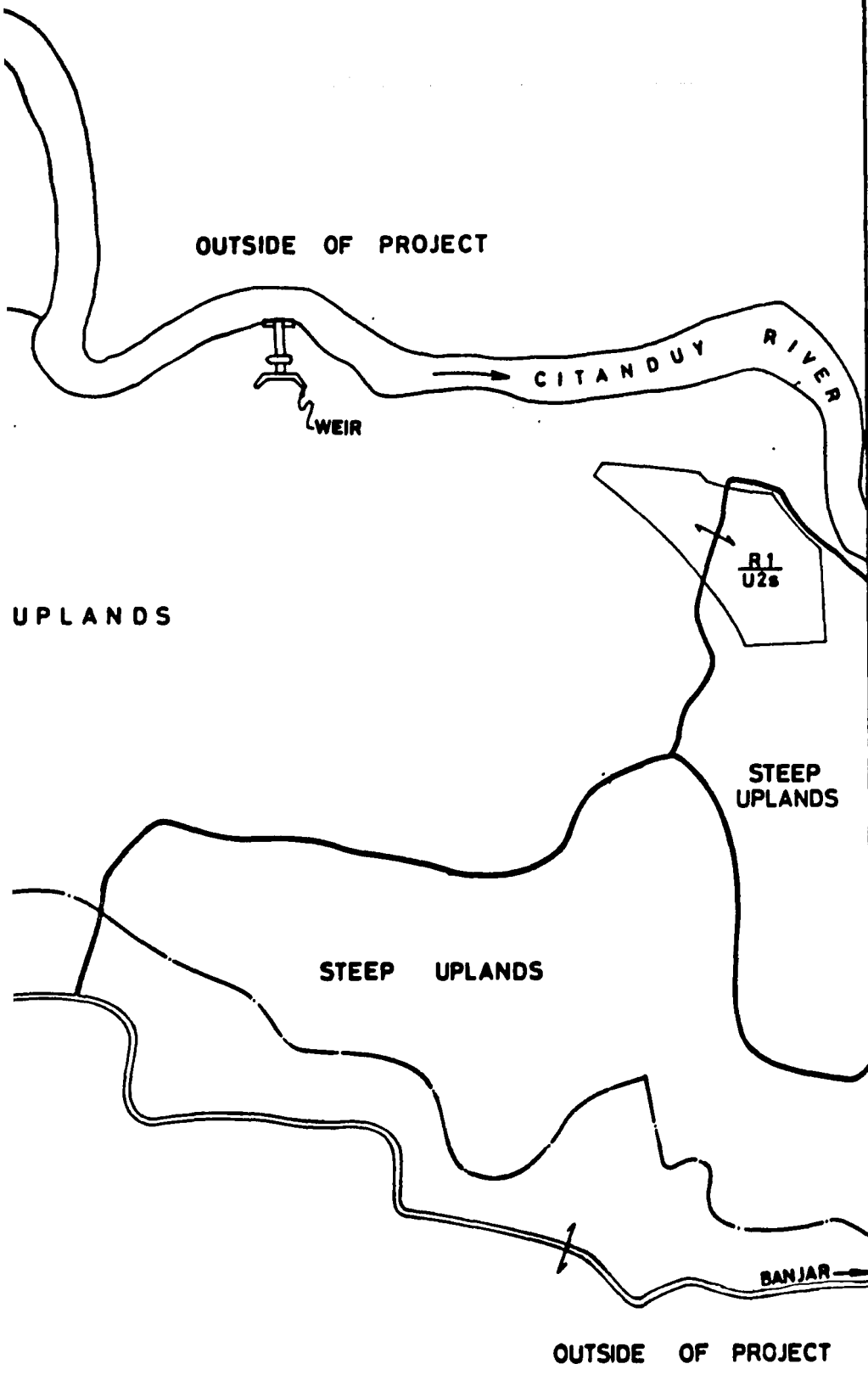
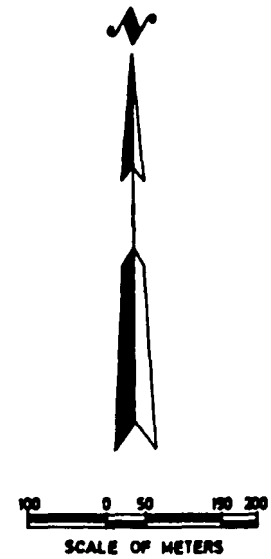

CITANDUY RIVER
STEEP UPLANDS
OUTSIDE OF PROJECT
ST
MANONJAYA
OUTSIDE OF PROJECT
OUTSIDE OF

FIGURE IV-5



MATCH TO FIGURE IV-6



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BANJAR PLAINS PROJECT
LAND CLASSIFICATION

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

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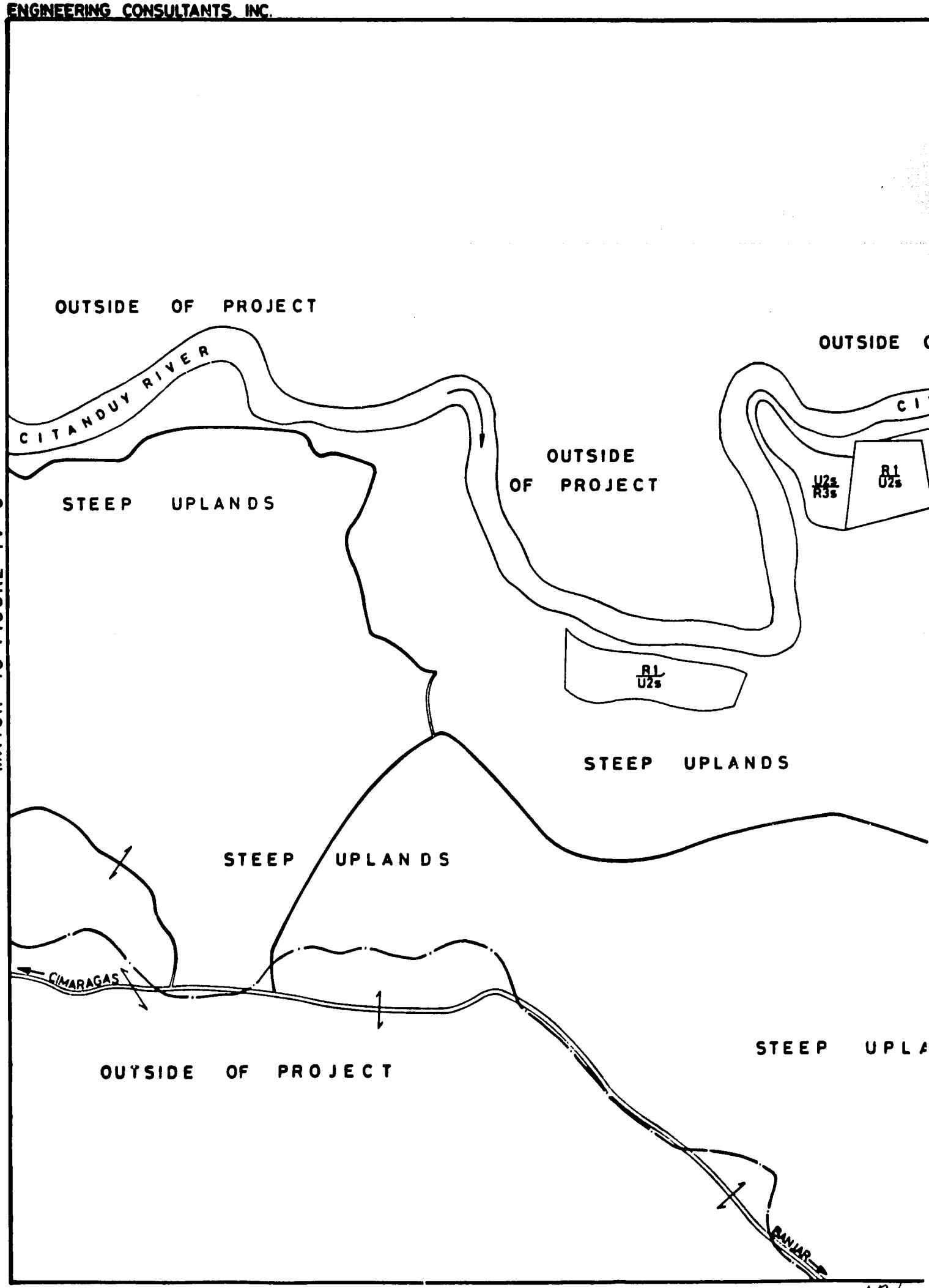
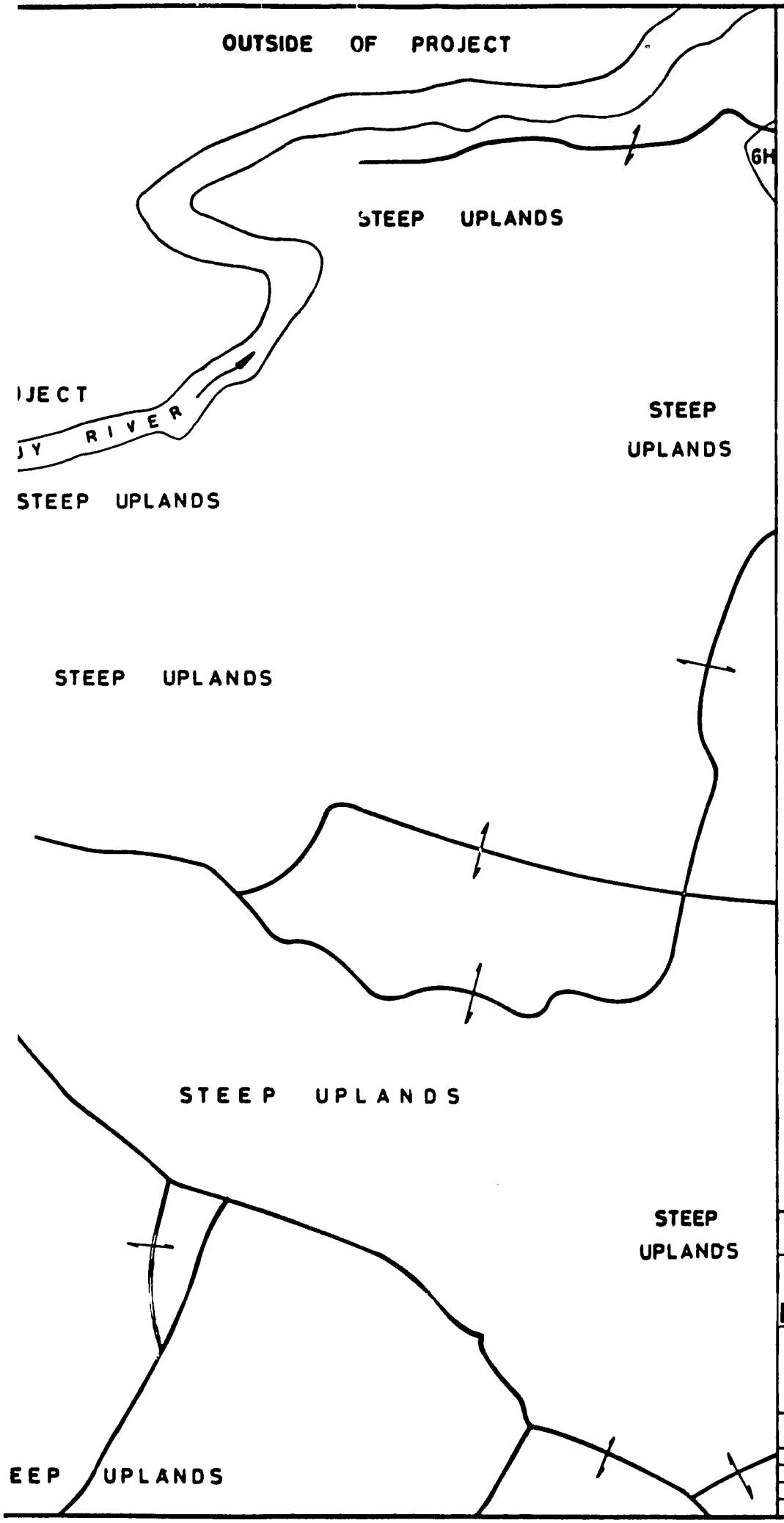
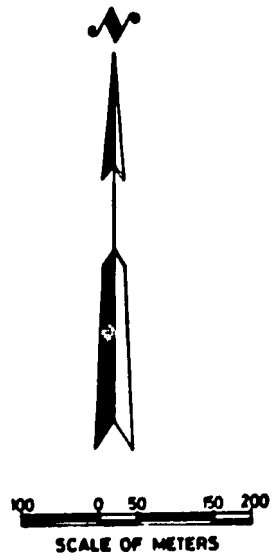
TRACED	DARSU	RECOMMENDED	B.L. MILLER
CHECKED		APPROVED	F. E. FARMER
DATE	SEPT, 8 1977	DRAWING No	



MATCH TO FIGURE IV-5

FIGURE IV - 6





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DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
LAND CLASSIFICATION

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

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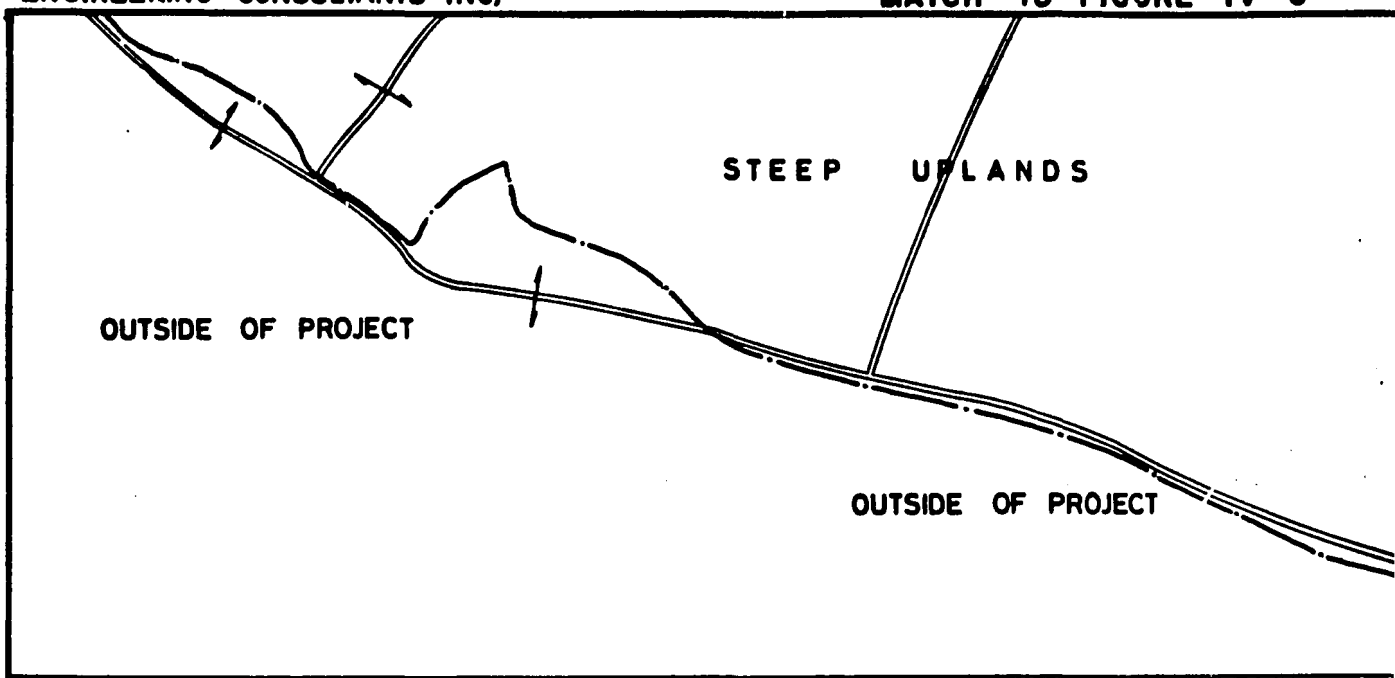
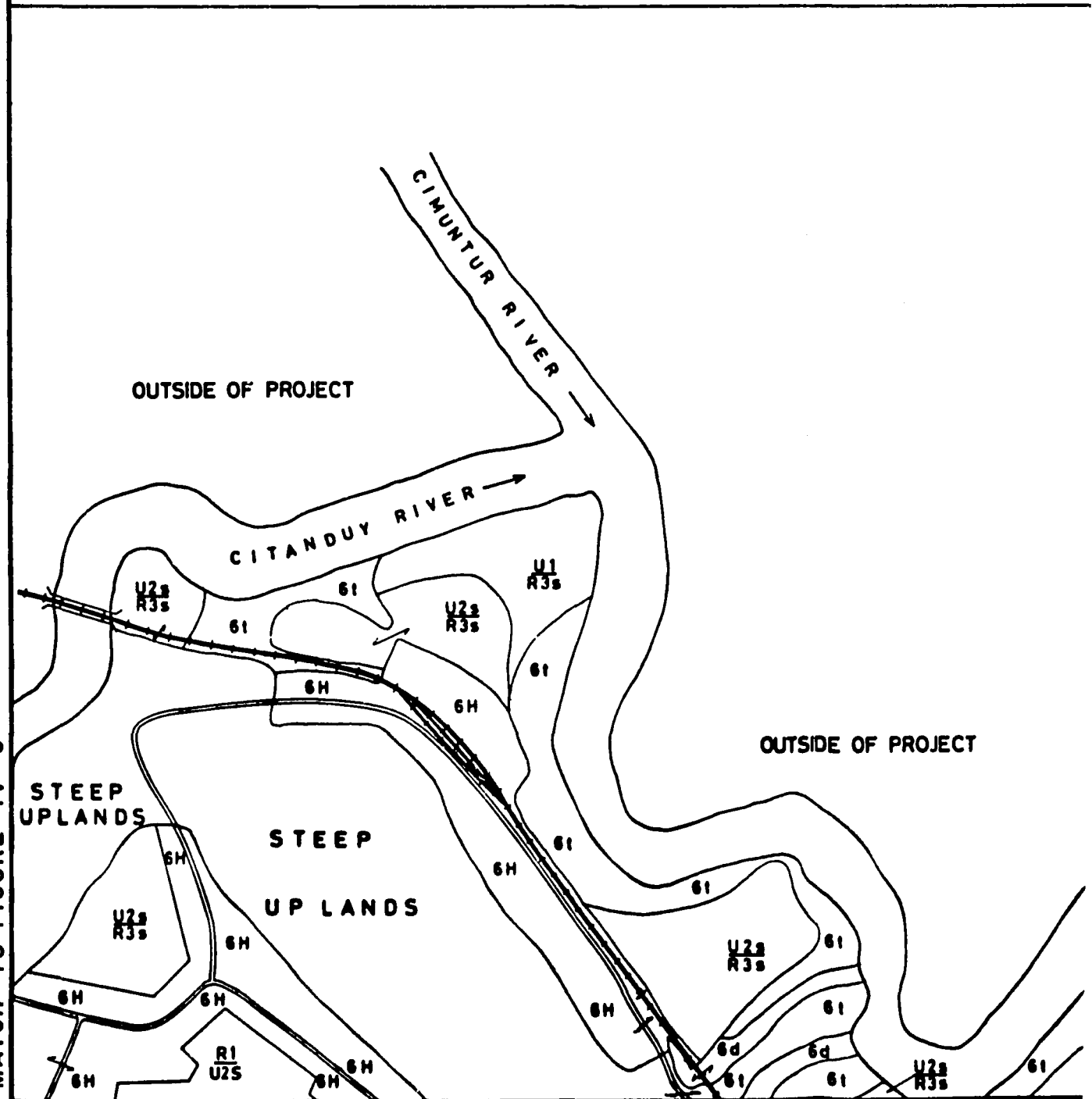
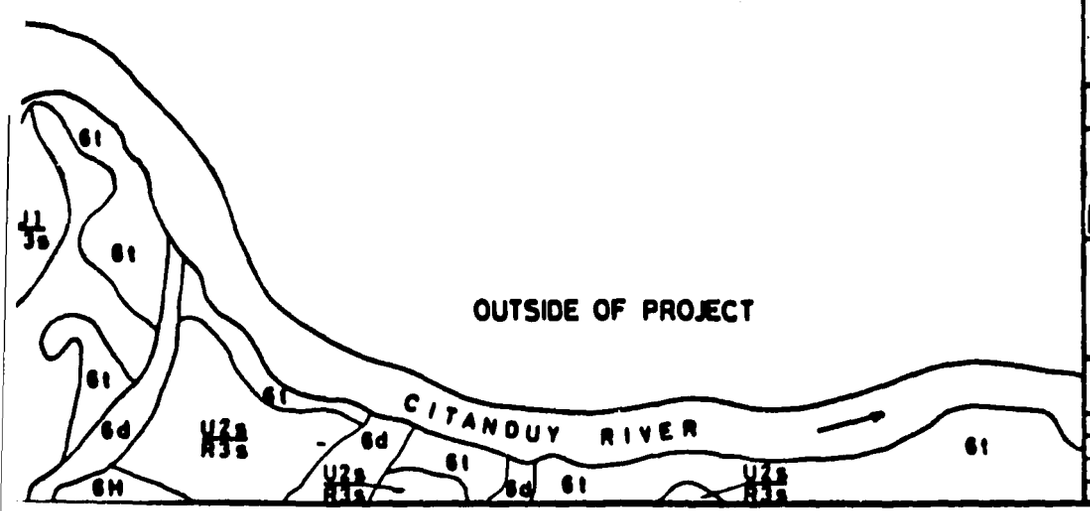
TRACED :	RECOMMENDED : B.L. MILLER
CHECKED :	APPROVED : F.E. FARMER
DATE :	DRAWING No :

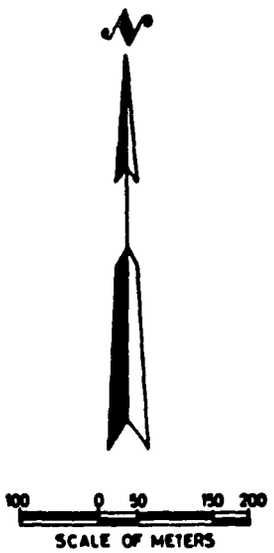
MATCH TO FIGURE IV-6





MATCH TO FIGURE IV-6





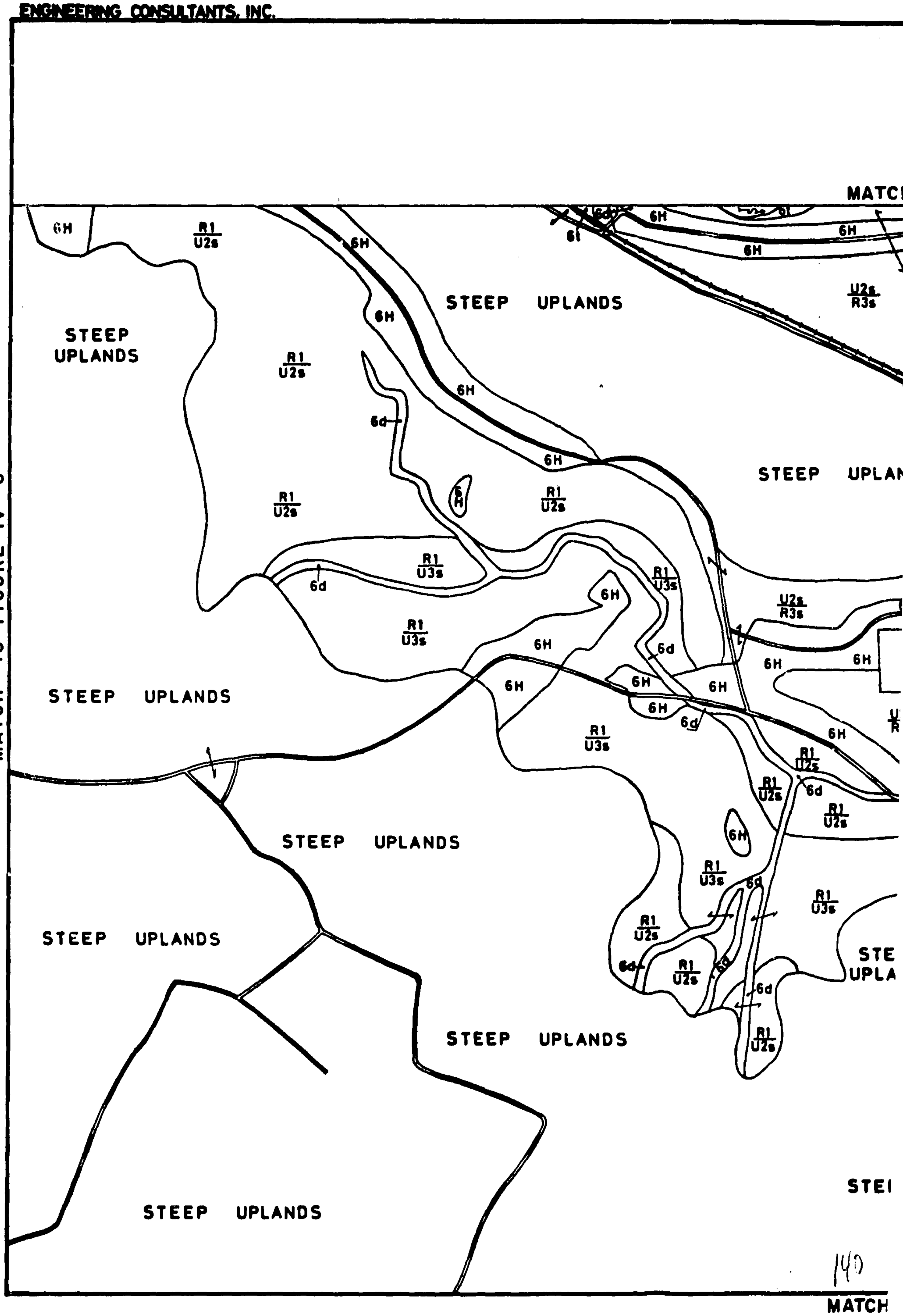
REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT LAND CLASSIFICATION

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

DRAWN		SUBMITTED	
TRACED	SALIM	RECOMMENDED	B.L. MILLI
CHECKED		APPROVED	F.E. FARM
DATE	SEPT 10, 1977	DRAWING NUMBER	


MATCH
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6H
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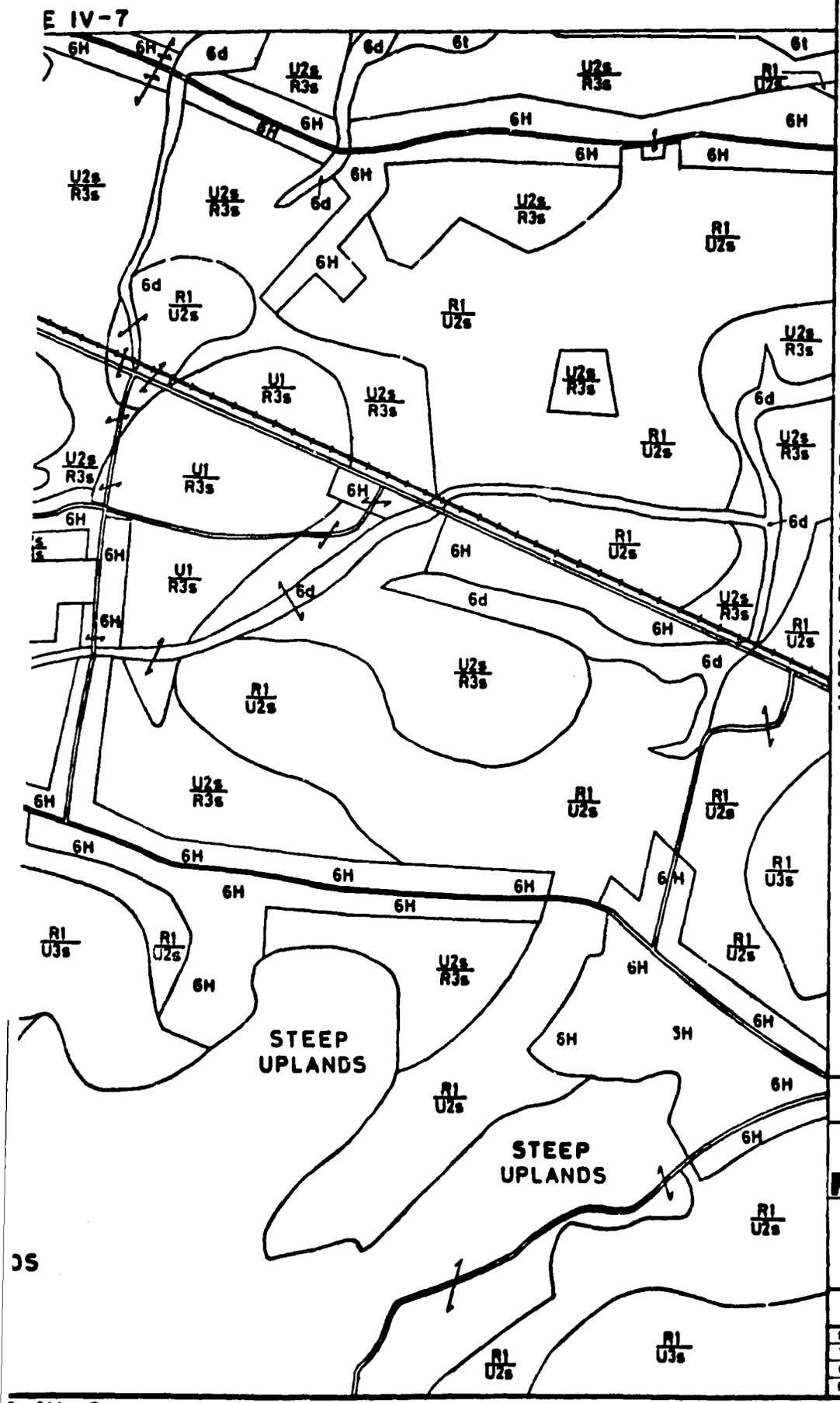

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DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT LAND CLASSIFICATION

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

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TRACED :	B. PERMANA	RECOMMENDED :	B.L. MILLER
CHECKED :		APPROVED :	F.E. FARMER
DATE :	SEPT. 8-1977	DRAWING No :	

MATCH TO FIGURE IV-6

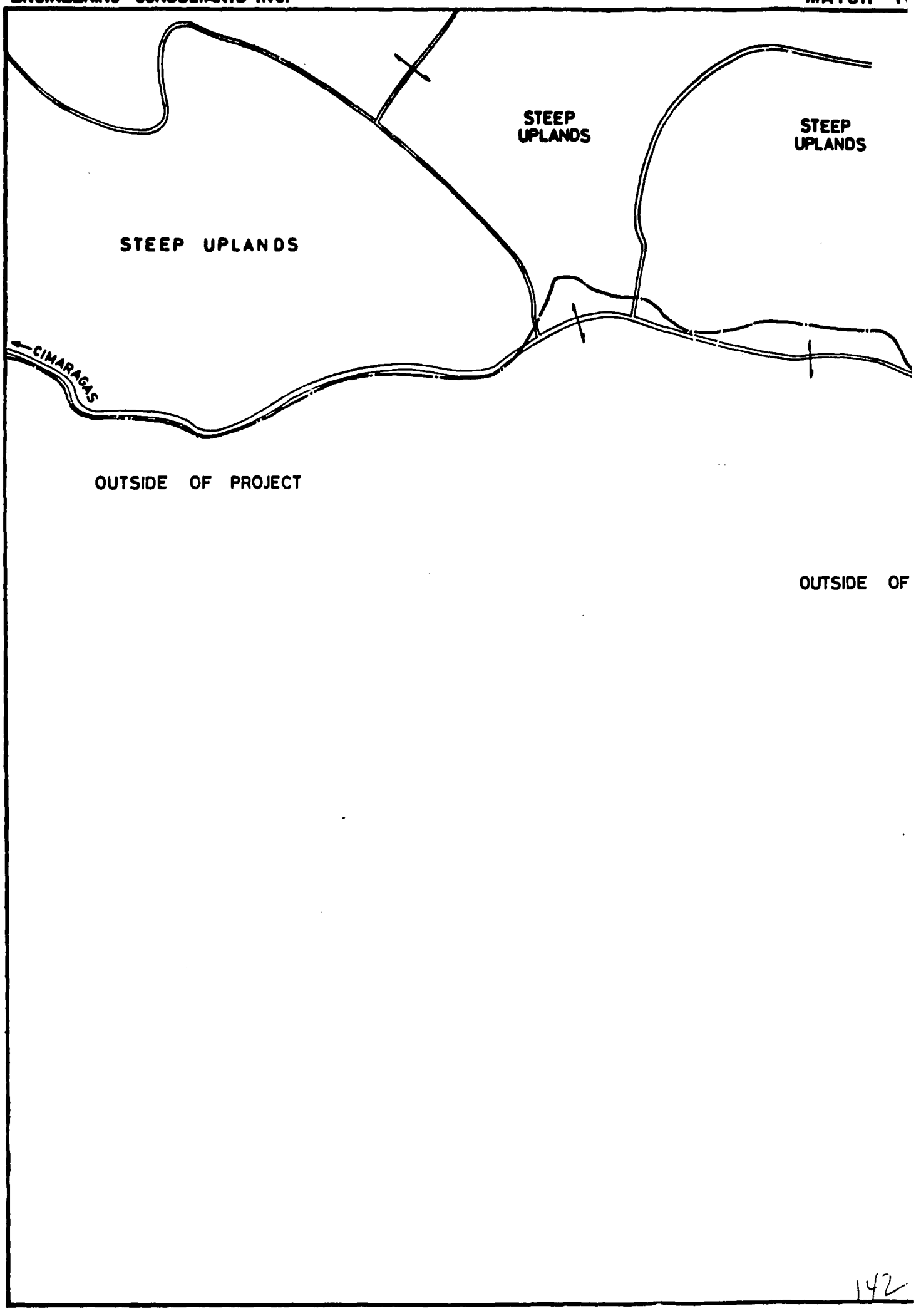
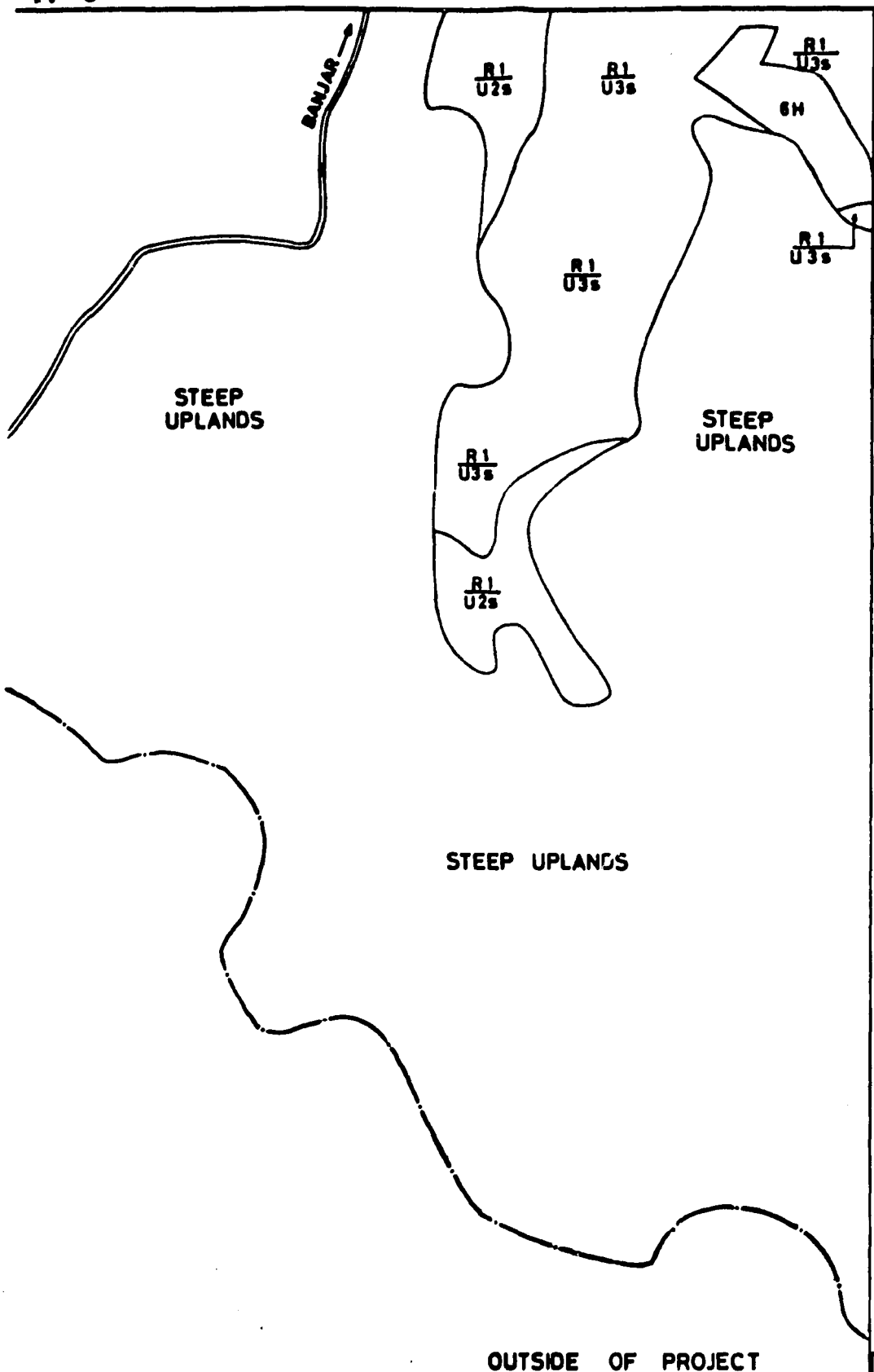


FIGURE IV-9



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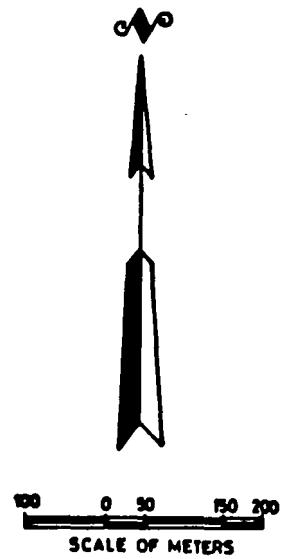

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CITANDUY PROJECT

BANJAR PLAINS PROJECT
LAND CLASSIFICATION

ENGINEERING CONSULTANTS, INC.
DENVER COLORADO USA

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CHECKED		APPROVED	P. E. FARMER
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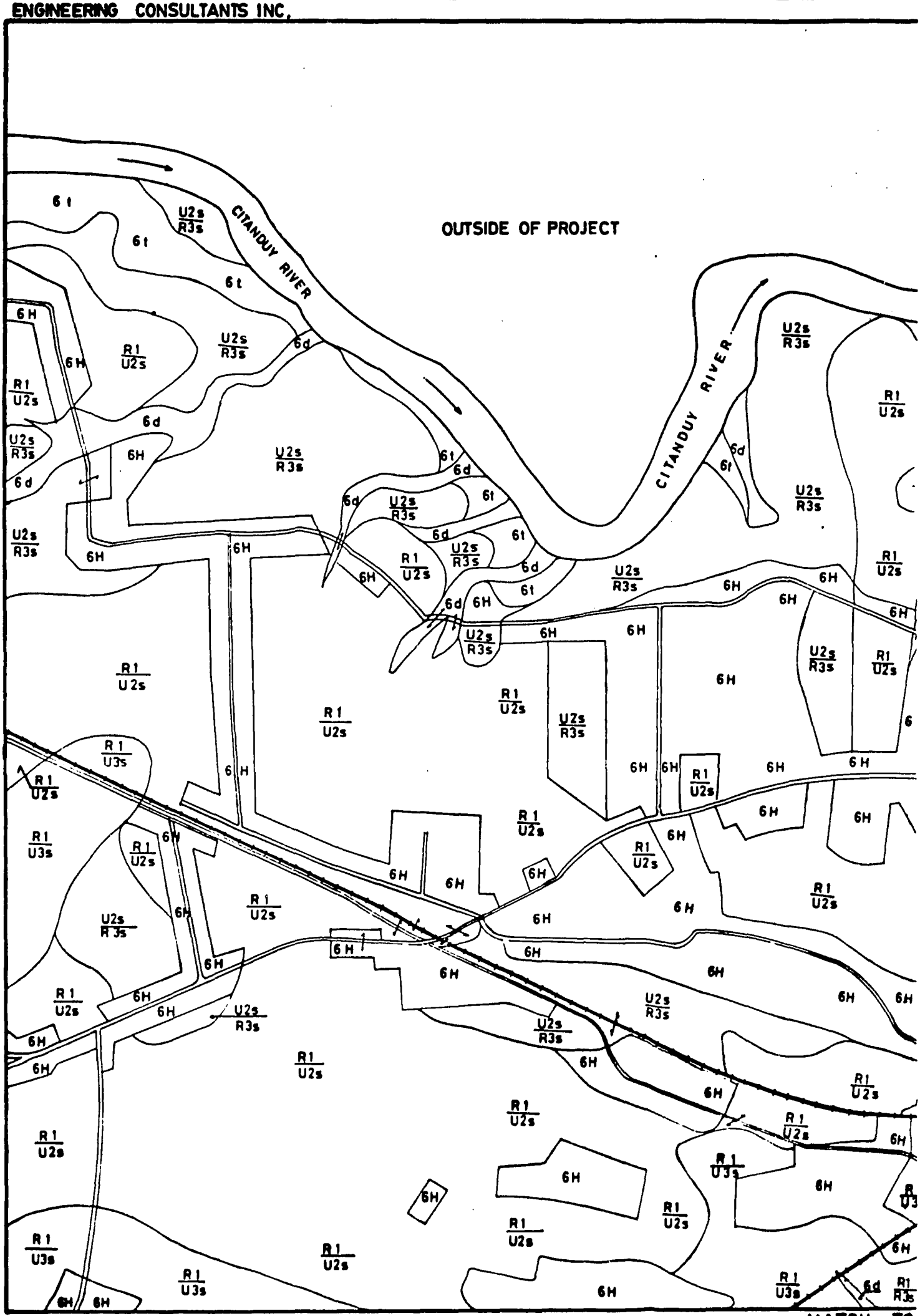
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CITANDUY RIVER
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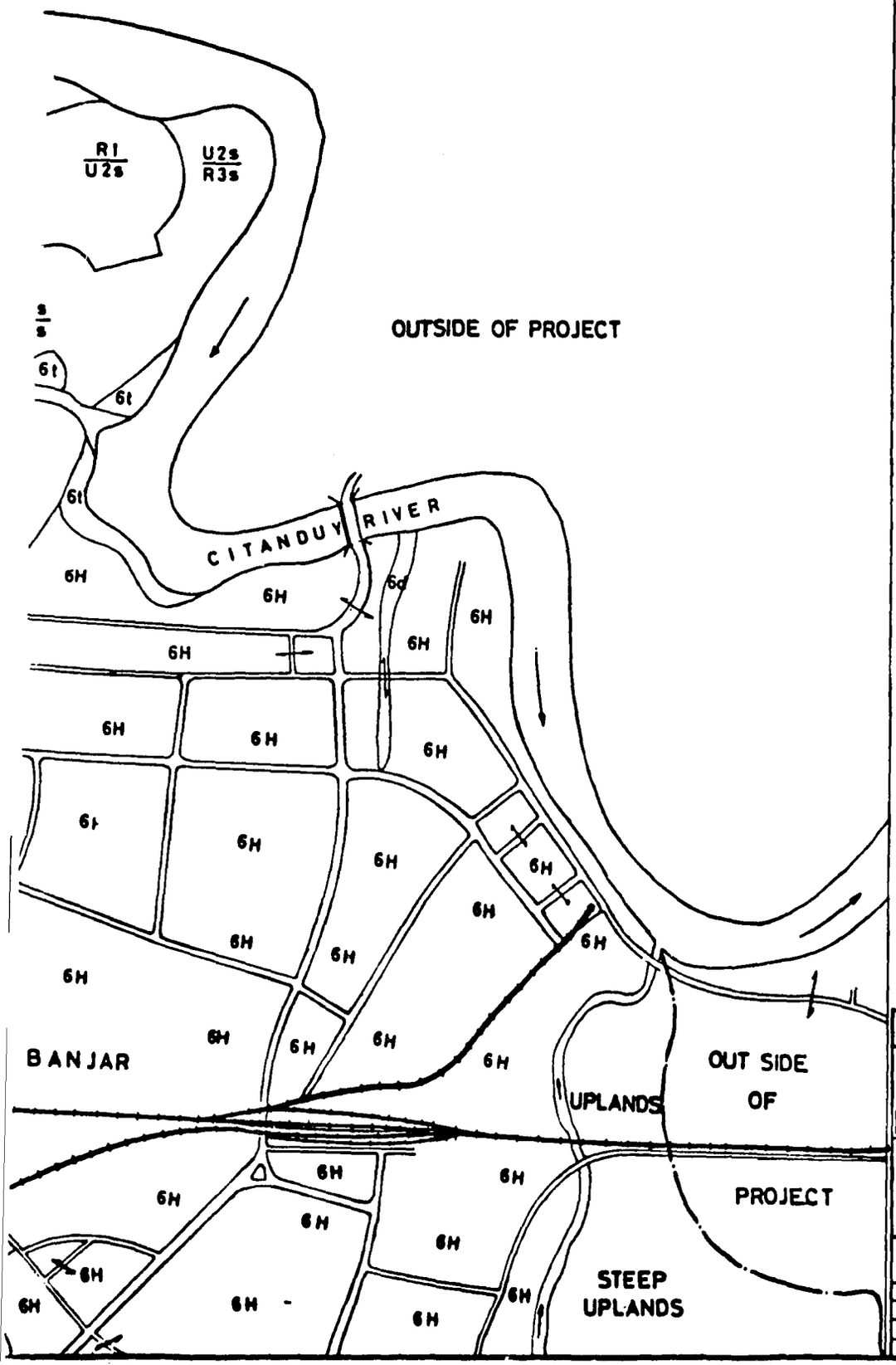
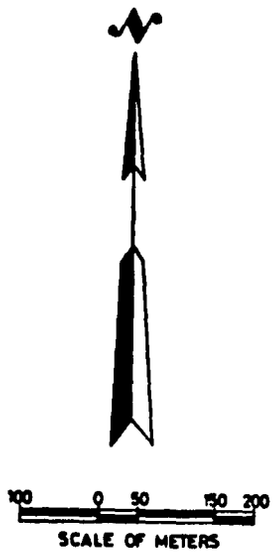
MATCH TO

FIGURE IV - 10





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DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
LAND CLASSIFICATION

ENGINEERING CONSULTANTS INC
DENVER COLORADO U S A

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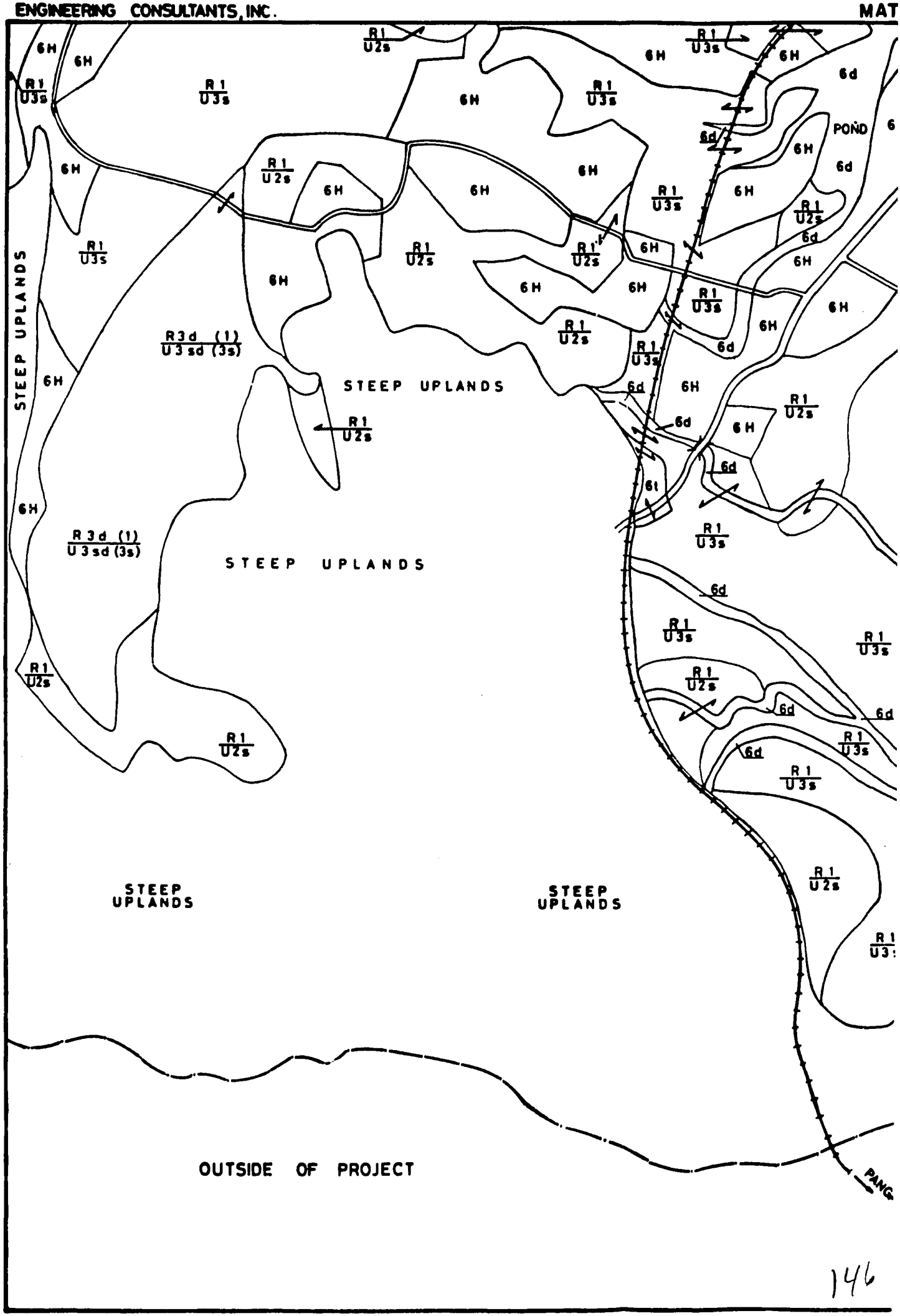
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6H
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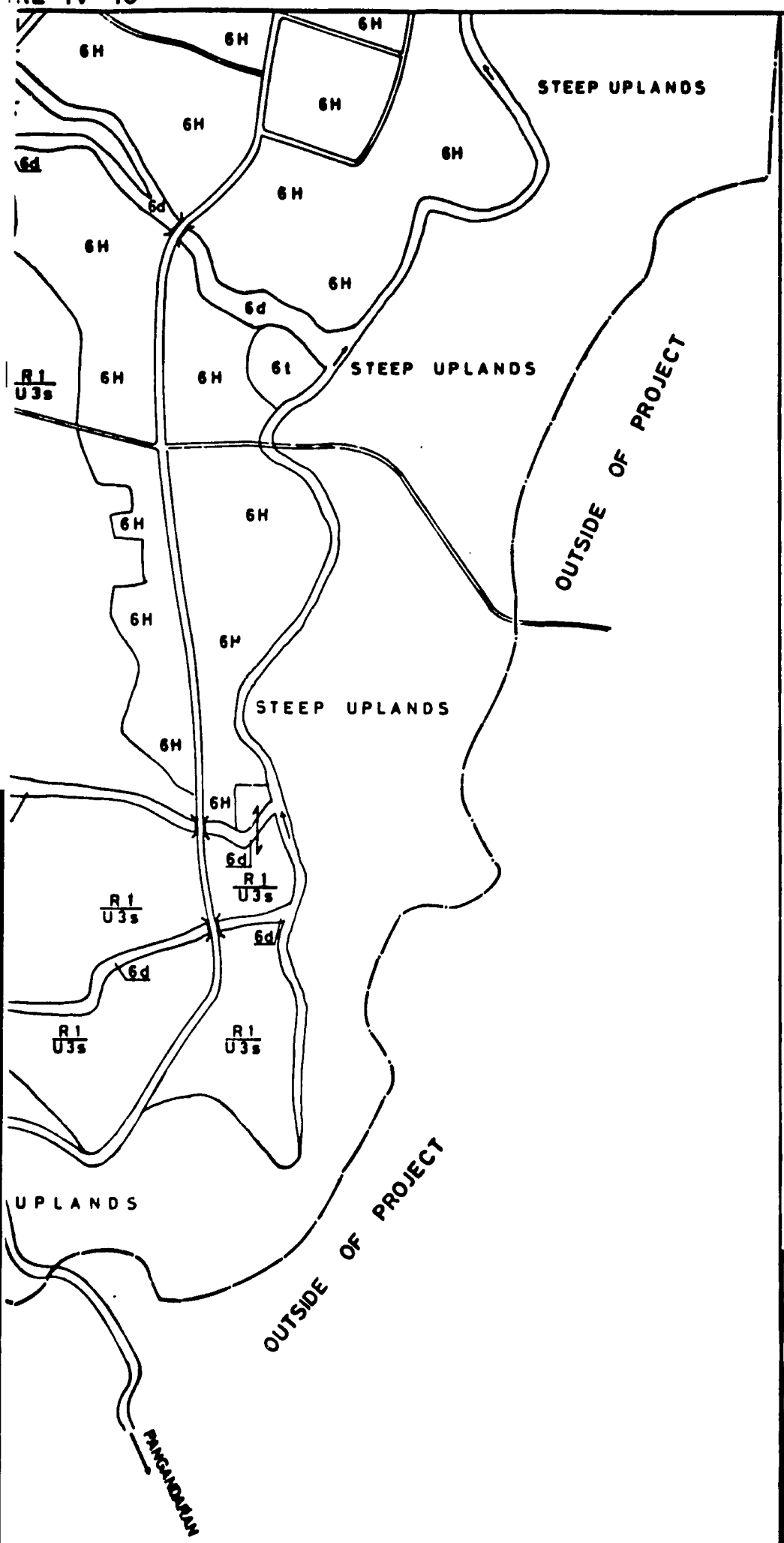

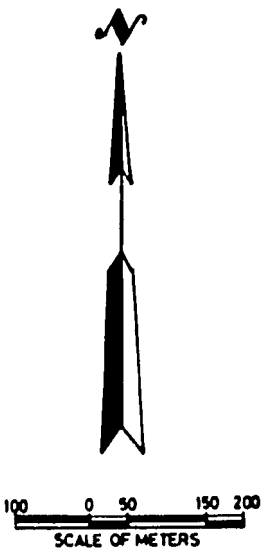

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LAND CLASSIFICATION

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

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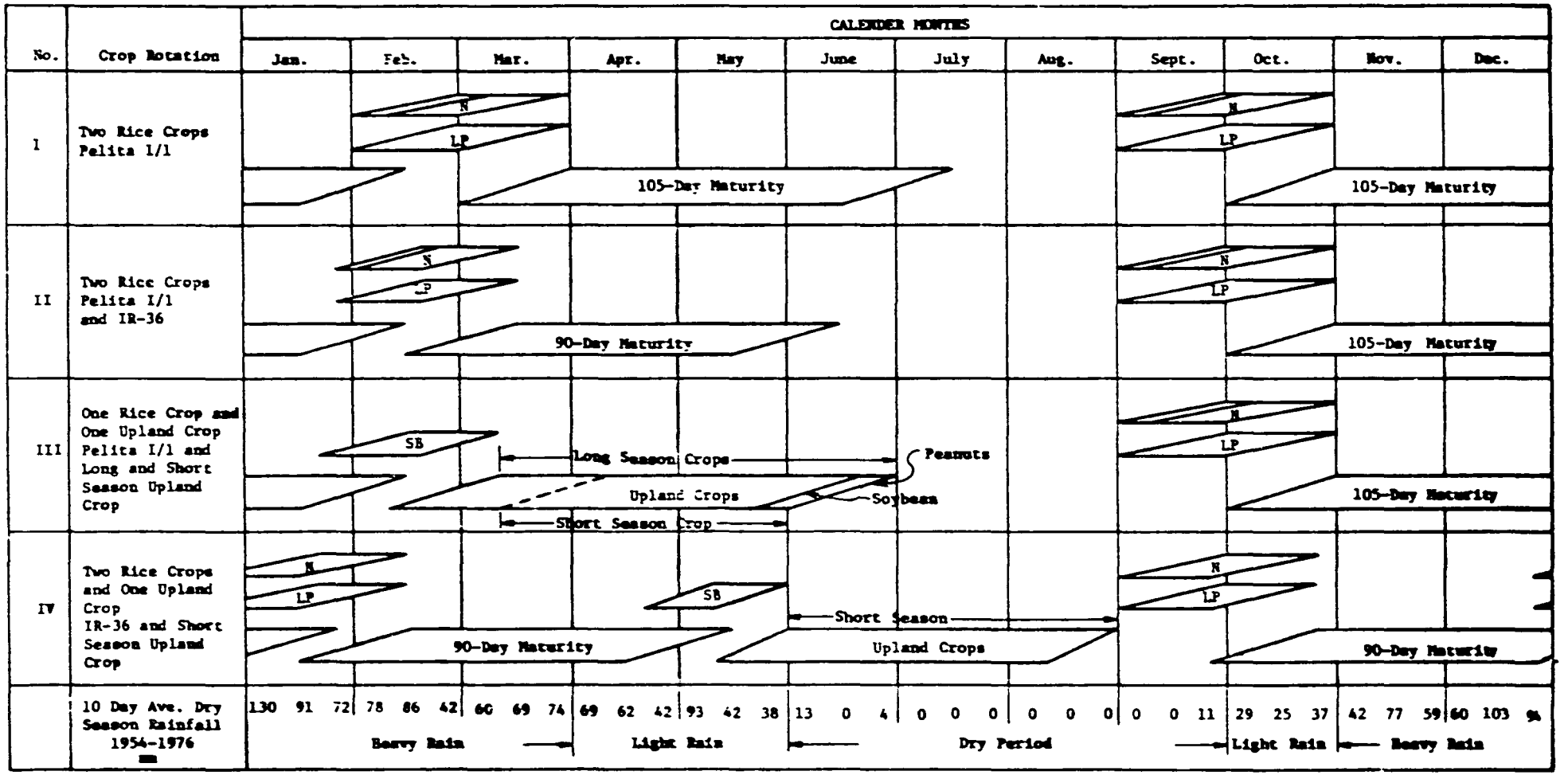
CHECKED		APPROVED	F.E. FARMER
DATE	SEPT 9 1977	DRAWING No	

FIGURE IV-12

Recommended Crop Rotation

N - Nursery
LP - Land Preparation
SB - Seed Bed Preparation



Chapter V

PROJECT PLANNING

General

The Banjar Plains Project area is located on the right bank of the Citanduy River upstream of the location where the river leaves its incised regime and enters the plain. The terrain is typical of the middle reaches of a river with fairly steep slopes and is not ideally suited for a major diversion work or storage reservoir. For a run-of-the-river project, under ideal conditions, the river should be in the plains where a low diversion structure will command a large area starting immediately downstream. For storage reservoir, sufficient capacity should be available with a reasonable dam height. For this, a fan-shaped valley is preferable to the incised type of valley the Citanduy River has in this reach.

This chapter describes the planning studies carried out in connection with the location and type of headworks, and discusses the water availability and the water demand that can be met.

Water Supply Demand

The Banjar Plains Project will provide irrigation water to some 785 ha of land and municipal raw water to Banjar town and surrounding areas. The irrigation service area has been described in Chapter I-Introduction, and the land use and current agricultural practices are presented in Chapter IV-Agriculture. The M & I demand was discussed in Chapter III-Municipal and Industrial Water Supply.

The municipal water supply in the year 2000 for the Banjar town and the surrounding hamlets is estimated to be 269 l/s. This is for a total population of about 99,600, of which it is estimated that 85 percent will be served. The municipal water demand is projected to increase from 66 l/s in year 1980 to 269 l/s in year 2000.

Development of an industrial sector near the town of Banjar was identified based on information supplied by the Ciamis Planning Board. The industrial water supply demand was estimated to be 750 l/s. However, as discussed in Chapter III, the development of the industrial sector could not be substantiated from the Government of Indonesia's Planning Board, Bapanas, or the Ministry of Industries. Further, the Directorate of Rivers is of the opinion that the Banjar Plains Project should not have the industrial water supply component since the probability of any major industries coming up in the next two decades is remote. Hence, the industrial sector water demand is not considered in the formulation of the project.

Without the industrial sector development, an area of 785 hectares can be irrigated by the Banjar Plains irrigation system. Chapter IV discussed the type of cropping patterns that can be adopted for the project. Also, mean 10-day irrigation diversion requirements were developed for two different cropping patterns; one for two rice crops in a year, and a second one for two rice crops and a short season upland crop in a year. The peak 10 day irrigation demand for the two different cropping patterns during the dry season of June through October was discussed in Chapter IV-Agriculture. Because of the sustained large irrigation requirements during June through October, a cropping pattern of two rice crops and an upland crop is not recommended for this project on the total area. A two rice crop pattern will not require a sustained demand during all the dry months except during the land preparation stages for the rice crop in September. During years when there is a delay in the start of the rainy season, the

land preparation for the September rice crop can be delayed by as much as a month without affecting the wet season crops.

During years of above average rainfall it will be possible to grow a short season upland crop on 245 ha of class U land. However, both the economic analysis and irrigation water demand discussion is limited to a cropping pattern of two rice crops in a year.

The maximum irrigation diversion demand, assuming 80% mean dry year rainfall as effective, will be 1.22 m^3/s. If there is a total lack of rainfall during any 10-day period, the irrigation diversion demand will increase to 1.60 m^3/s to irrigate 785 ha.

The total maximum diversion demand for irrigation and municipal water supply will be 1.49 m^3/s. If the rainfall fails during a peak irrigation demand period, then the total maximum diversion demand will be 1.87 m^3/s. In the event the industrial water supply demand develops, as discussed in Chapter III, the total maximum diversion demand will be 2.24 m^3/s.

Water Supply Availability

The historical monthly synthetic streamflow volume at the Banjar Diversion Site for the period 1950 to 1976 is presented in Table II-10. These were developed by establishing a relationship between known flows and the basin index precipitation using a refinement of antecedent coefficient technique. A review of the above table indicates that the monthly flows during September are the lowest. The average monthly flow for September is 42.1 million m^3, while the minimum flow is 5.2 million m^3 in the year 1972. The maximum monthly water requirement for irrigation and municipal water supply of 3.23 million m^3 occurs during the month of October. Thus, it is seen that with a storage project there should be sufficient water available to meet the demand during the driest period. Since the water supply is through a

diversion system without a storage reservoir, availability of water has to be verified based on the minimum flow in the river.

A flow duration analysis based on daily flow from 1970 through 1976 is presented in Chapter II. During the dry year of 1972, the minimum river flow was estimated to be 1.6 m^3/s in October. At 95 percent firmness, the magnitude of flow during September and October is estimated to be 1.9 m^3/s and 1.7 m^3/s, respectively. Since the maximum diversion demand will be 1.49 m^3/s in September, it is anticipated that sufficient flow in Citanduy River should be available at the diversion site.

At present there are no major technical irrigation systems upstream of the Banjar site. There are, however, a number of rural and semi-technical irrigation systems called the Upper Citanduy Irrigation System which utilize the upper Citanduy flows. This system is comprised of ten small irrigation systems with a total cultivable area of about 5,600 ha. Upgrading these systems to a technical system, and proposing a higher cropping intensity, could reduce the flow at the Banjar diversion. However, the feasibility study for the Upper Citanduy Irrigation System should propose a cropping pattern that will assure the flow required at the Banjar Diversion site, in the event Banjar Plains Project has a higher priority.

The withdrawal of water for the Banjar Plains will not affect the present committed withdrawals at the Pataruman weir. This was verified by carrying out a flow duration analysis of flows just downstream of the Pataruman weir. This analysis, based on COSSARR data, indicated that the minimum flows just downstream of the Pataruman weir exceeds the diversion demand for Banjar Plains. An overall water balance study for the Citanduy Basin is underway to analyze the water potential of the basin. However, because of the small size of the Banjar Plains area, its upstream location, and the type of data available, the study will not provide answers to the water availability or

shortage to a degree better than has been brought out in the above analysis.

Headworks

Previous investigations, as discussed in Chapter I, have suggested construction of a storage dam on the Citanduy River upstream of its confluence with the Cimuntur River. A storage reservoir can provide supplemental irrigation during dry periods for the downstream areas of North Lokbok and Sidareja-Cihaur in addition to providing flood protection. This reservoir will not be able to command the entire area in the Banjar Plains. There are no good reservoir sites in the upstream reaches, so that the total Banjar Plains service area could be brought under command. Thus, the concept of a storage reservoir as a part of the Banjar Plains Project was negated because of the terrain, insufficient flood control benefit, excessive compensation, low reservoir capacities and a high sediment load. Studies to develop storages for downstream areas in Citanduy Basin, based on irrigation needs, will be carried out in other feasibility studies.

The next alternative is to divert the unregulated river flow either by a gravity diversion from a point upstream of the service area or by pumping from the river further downstream. The Inda Kaya[1/] report did identify a diversion weir for gravity diversion to the Banjar Plains Area. Provision of a pumping plant can be a viable alternative considering the size and compactness of the service area. However, the Directorate of Rivers is of the opinion that pumping should be limited to small heads and service areas off the laterals rather than use pumping plants to serve the

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1/ Laporan Reconnaissance/Pra Rencana Proyek Irigasi Dataran Banjar Propinsi Jawa Barat, by P. T. Karpa, Bandung, March, 1973.

entire system. The main reason for this is the current difficulties experienced in the O & M of pumping plants and possibility of shutdowns during a critical irrigation season, leading to partial crop failures.

Diversion Weir

The gravity diversion concept was first introduced in the Reconnaissance Report[1/] of the Directorate of Irrigation. To command the entire Banjar Plains Area by gravity, irrigation supplies have to be delivered at an elevation of 50 m above MSL. Riverbed elevation adjacent to the irrigation service area is about 25 m above MSL. Hence, any structure in this location has to be more than 25 m high for diversion of water. The riverbed is broad and contained by high banks in this reach. Backwater would submerge rice paddies and a number of Kampungs, or settlements. Thus, there are no suitable diversion sites in the immediate vicinity of the service area.

Extensive field reconnaissance was carried out in the upper reaches of the river to identify a suitable location for a diversion weir. The riverbed drop is fairly steep in the 10 to 12 km reach upstream of the service area, averaging a slope of 3 meters per kilometer. Suitable diversion sites are available in this reach upstream of the service area. The river reach 9 km above the confluence is in mountainous terrain and a diversion in this reach would need a tunnel to supply water to the main irrigation canal. Also, steep riverbanks of the narrow gorge would make supply canal construction difficult and excesssively costly.

An investigation of the river reach upstream of the service area was carried out to determine a suitable site for a diversion structure. Three sites, designated as upper, middle and lower sites were identified. The locations of these sites are shown on Figure V-1. The upper site is located approximately 8 km upstream

of the confluence and was originally investigated by the Directorate of Irrigation. The middle site is about 1.8 km downstream of the upper site, near the village of Panyingkiran. The lower site is about 3.5 km downstream of the upper site.

Lower Site

The lower site is located 3.5 km downstream of the upper site near the settlement of Kramat Sangaditia. The river at this location skirts a firm boulder covered ridge on the right bank. The river bed elevation is about 30 meters above mean sea level with a river channel width of 70 m. The river banks are about 3 to 4 meters high with a steep slope of 1 to 1. The right bank ridge, around which the river flows is about 250 m long and has an average slope of 1 in 20. The left abutment, which is the outer curve of the river, is steeper.

The diversion weir can be located on the right bank and construction of the weir, under sluices, canal regulator and desilting basin can be carried out under dry conditions while using the river channel for carrying the construction period flood. The site is topographically suitable for the weir construction. The aproach channel will be about 80 m long and will have an acute approach. The downstream channel, from the weir to the river will be only 50 m long with a drop of about 14 m from the weir crest to the river bed. Suitable energy dissipation structures would be required. A 21 m high embankment with a crest length of over 200 m will be required on the left bank to close the river channel.

At present very little geological information is available for this site. Although this site will reduce the gravity supply canal length by about 3.8 km when compared to the upper site, the pool created at flood stage will submerge settlements on the right bank and some rice land. Although the site is considered suitable, present surveys and data available do not indicate that

this site would be more economical as compared to the upper site. However, without further investigations, the economic feasibility of this site over the other sites can not be determined.

Middle Site

The river at this location has a series of rapids with rock outcrops. The riverbed elevation is about 35 meters above mean sea level and the bed drops over 2 m in a short length of about 400 m. The riverbed at this location is 75 m wide with 6 m high vertical banks. Beyond the vertical bank, the left bank of the river rises more rapidly than the right bank. Surface investigation of the site indicates that the diversion weir foundation in the river is good.

The diversion weir would have to be located in the river channel with short lengths of earthen dikes on either side. The height of the weir above riverbed level would be about 13 meters with undersluices and the canal head regulator being located on the right bank.

Since the weir would be constructed in the river channel, diversion of the flow during construction would be a major problem. The size of the diversion structure to be provided will be larger than a structure at the upper site. The main advantage of locating the diversion at this site will be the reduction in length of the main supply canal by about 2.5 km. Surface examination indicates the foundation conditions at this site appear to be somewhat more favorable as compared to the upper site. However, this can only be confirmed after a subsurface investigation. From the economic point of view, the increase in cost of the diversion structure at this location as compared to the upper site is estimated to exceed any saving in cost resulting from the 2.5 km reduction in the length of the main supply canal. Hence, the middle site was not considered for further investigation.

Upper Site

The upper site is located on a bend in the river. The riverbed is about 43 m above MSL, and has a width of 40 m. The left bank of the river rises steeply to an elevation of 60 m. The right bank above an elevation of 48 m has a gradually sloping berm, which is typical of the terrain at the convex bend of a meandering river. The material in this location is mostly river alluvium and conglomerates. The berm is about 120 m wide rising to El. 55 at the base of a steep slope.

The Directorate of Irrigation has carried out detailed survey of this site along with surface and subsurface investigations. The results of these investigations are presented in two reports.[1] & [2] The geology of the area is discussed in Chapter VI, Geology.

A diversion weir at this site can be constructed on the right bank while using the river channel to carry the construction period flows. The height of the diversion weir will be about 5 m above channel bed. A 200 m long dike will be required on the left bank to close the river channel. Height of the embankment in the river channel will be about 12 to 13 m. A layout of the weir structure and appurtenances is shown on Figures VII-1 and VII-2 in Chapter VII, Project Features.

Constructing the diversion structure at this location will result in a lower height of the weir and avoid expensive river diversion. However, the canal will have to be aligned in deep cut through the head reaches. Further investigations need to be carried out to determine if the cost of the head reaches of the canal, specifically between the upper and lower site, is more than the increase in cost for building the diversion structure at the

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[2] Laporan Penyelidikan Geologi Teknik, Pada Rencana, Waduk Banjar, Jawa Barat, Lembaga Penyelidikan Masalah Air, November, 1974.

lower site. Of the three sites, the upper site seems to be more promising at this stage of investigation and was selected for the location of the diversion weir. Feasibility level designs and estimates were prepared for this and are presented in Chapters VII and IX.

The diversion weir proposed at this site has a regulator with sill at about El. 46.5 and a canal full supply at El. 48.0. At this sill elevation, nearly 626 ha of land can be commanded in the service area. Some 159 ha is proposed to be irrigated by providing a relift pump. In order to be able to irrigate the entire area by gravity, the full supply elevation would have to be at 55.5 m. This would increase the height of the weir structure by about 8.0 m. Preliminary cost studies indicate that it is more economical to provide a relift pump to irrigate the 159 ha than to construct a diversion structure with sufficient height to irrigate the total service area by a gravity system. A feasibility level layout and design for the above diversion weir has been carried out and is presented in Chapter VII-Project Features.

Pumping Plant

In considering the alternatives to a gravity diversion structure, the feasibility of providing a pumping plant was also investigated. Pumping plants for irrigation exist in many areas of Java and new plants are being designed and constructed for projects in many areas of Java and Sumatra. Most of these pumping plants are equipped with diesel engines and irrigate from 600 to 16,000 hectares. Considering local availability of oil and the fact that necessary expertise for constructing and operating pumping plants exist, it is appropriate to consider a pumping plant alternative for the Banjar Plains Project.

The principal advantage of providing a pumping plant is that it can be located close to the service area, thus, avoiding over 7 km of supply canal which would be aligned parallel to the

Citanduy River, traversing steep terrain and requiring expensive cross-drainage works. Further, if the pumping plant can be designed as a well-type plant, without a weir to create a pool, the cost of such a plant will be less than a diversion weir. However, the O & M cost for a pumping plant will be higher.

Two sites were investigated; the Balokang pumping plant site and the Bridge 1406 pumping plant site. These sites are shown on Figure V-1. The Balokang pumping plant site is located about 800 m upstream of the 1406 railroad bridge near the village of Balokang. The other site is about 50 m upstream of the 1406 railroad bridge. The two sites have similar geological conditions. From a river morhpology point, the Bridge 1406 site appears to have a more stable bank condition because of the bridge and the steep gorge just upstream of the pumping plant site. A pumping plant at either site would be capable of irrigating the total service area except for about 12-15 ha, which is located on the right bank of the river upstream of the pumping plant site.

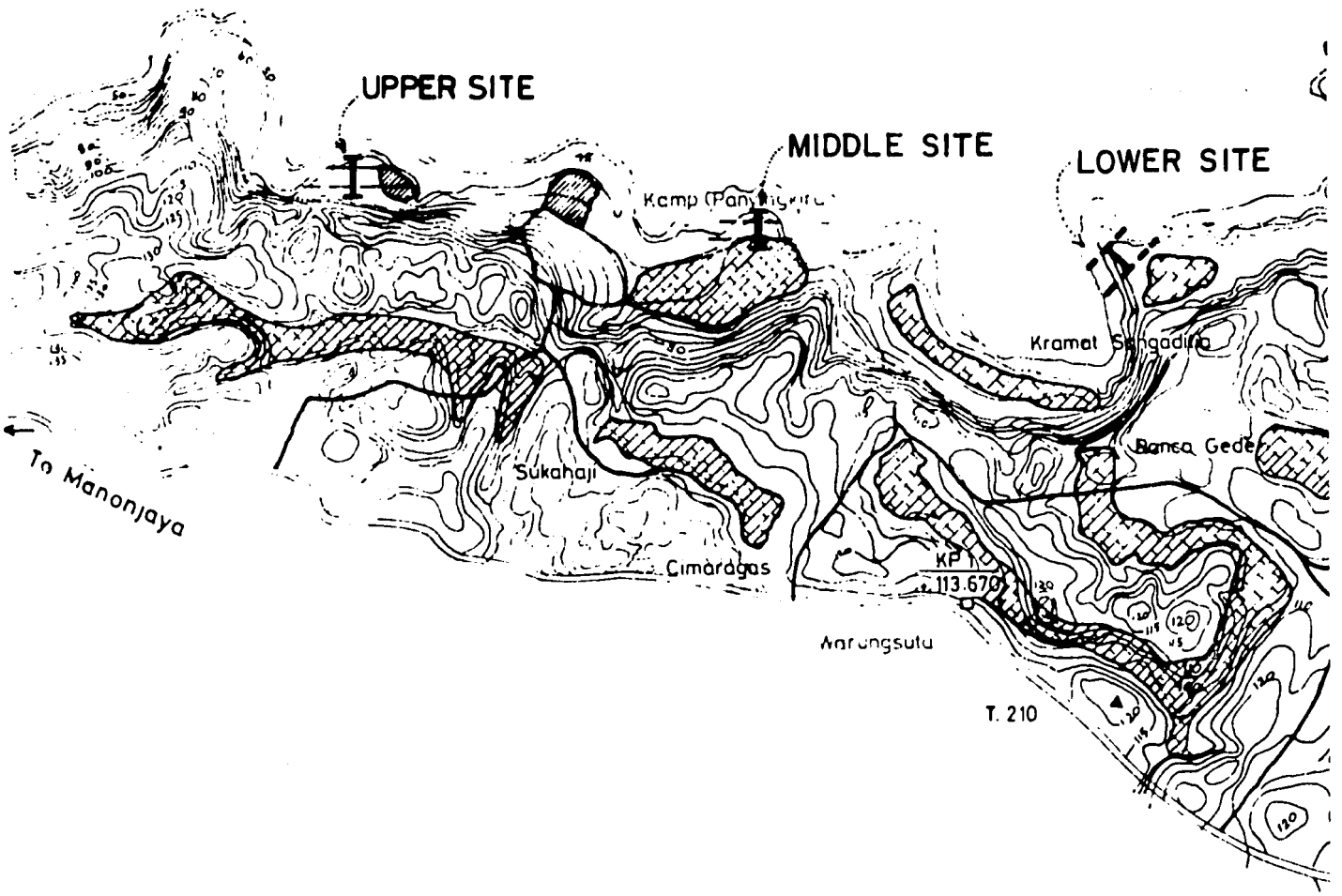
The pumping plant can be planned to deliver the water required for irrigation and municipal needs either at an elevation of 52.0, in which case an area of 775 ha can be commanded by a gravity delivery system, or it can be delivered at El. 45.0 to command 616 ha by a gravity system and provide a relift of about 6 m to irrigate the additional 159 ha. The former case involves not only pumping to a higher head for the total water required, but also the cost of the distribution system would be larger. In the latter case, a relift to irrigate 159 ha at the higher elevations will require a small distribution system.

The Balokang pumping plant site is considered suitable in case the water is to be lifted to El. 52.0 without relifting. The delivery side of the pumping plant will require a 500 m long pipe to the open channel gravity system. The desilting basin cannot be

located adjacent to the pumping plant, but would have to be located approximately 900 m away in cultivated fields, creating problems in using a gravity type flushing system.

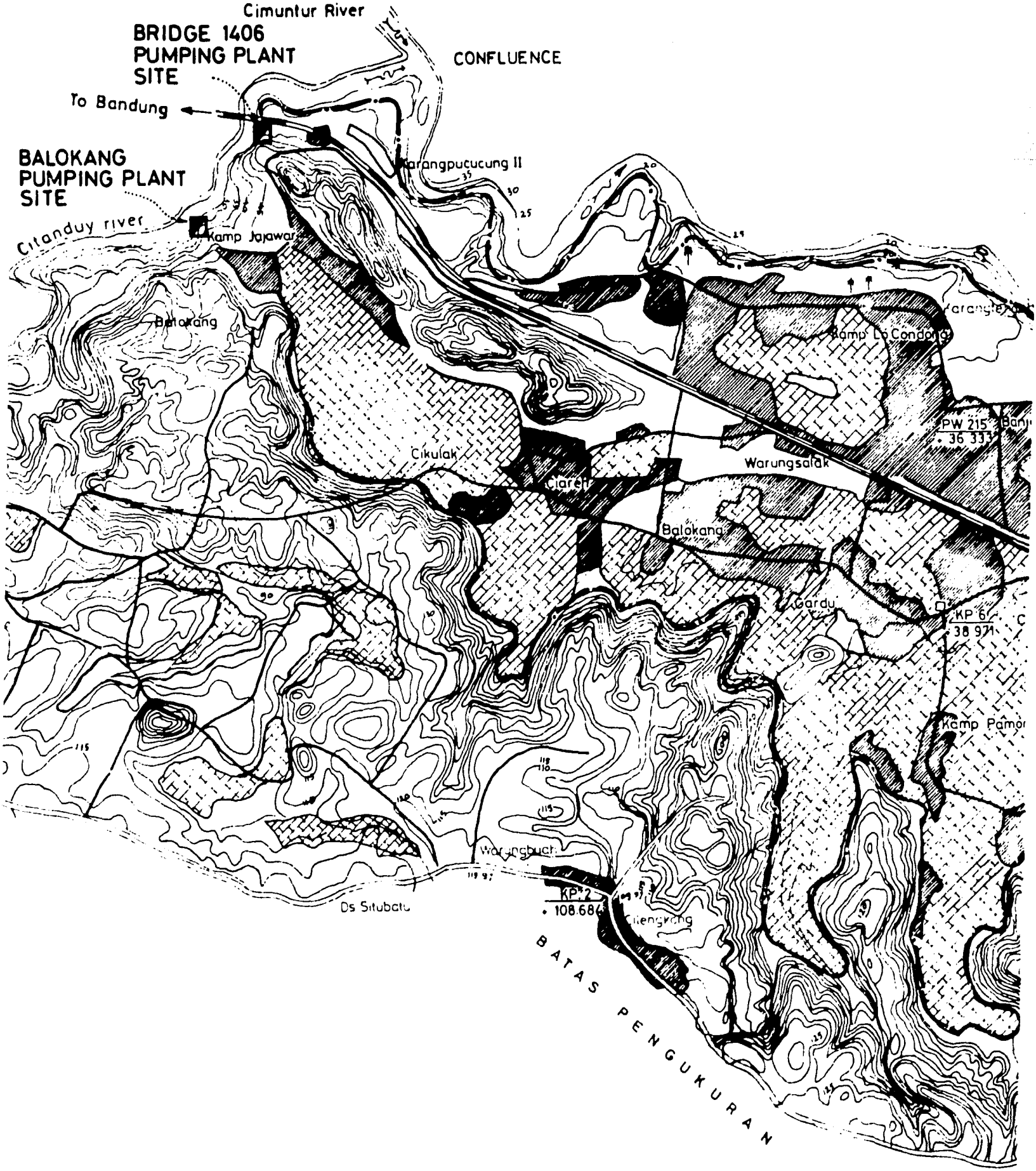
The bridge 1406 pumping plant site is well suited from considerations of an economical distribution system with first stage pumping to El. 45.0. There is sufficient space close to the pumping plant to provide for a desilting basin with a gravity flushing system. The proximity of the railroad and a rail yard to this site is a further advantage during construction and operation.

Distribution system considerations indicated that pumping first to El. 45.0 and relifting water to irrigate 159 ha would be more economical. This fact along with other advantages mentioned above makes the Bridge 1406 pumping plant site better suited. A feasibility level layout and design for this pumping plant site has been carried out and is presented in Chapter VII-Project Features.



LEGEND:

- DIVERSION SITE
- PUMPING PLANT SITE
- SERVICE AREA
- RICE
- SETTLEMENT


Cimuntur River
BRIDGE 1406
PUMPING PLANT
SITE
CONFLUENCE
To Bandung
BALOKANG
PUMPING PLANT
SITE
Karangpucucung II
Citanduy river
Kamp Jajawar
Balokang
Kamp Lo Condong
PW 215
36 333
Cikulak
Warungsalak
Ciareh
Balokang
Gardu
KP 6
38 971
Kamp Pamor
Warungbuah
KP 2
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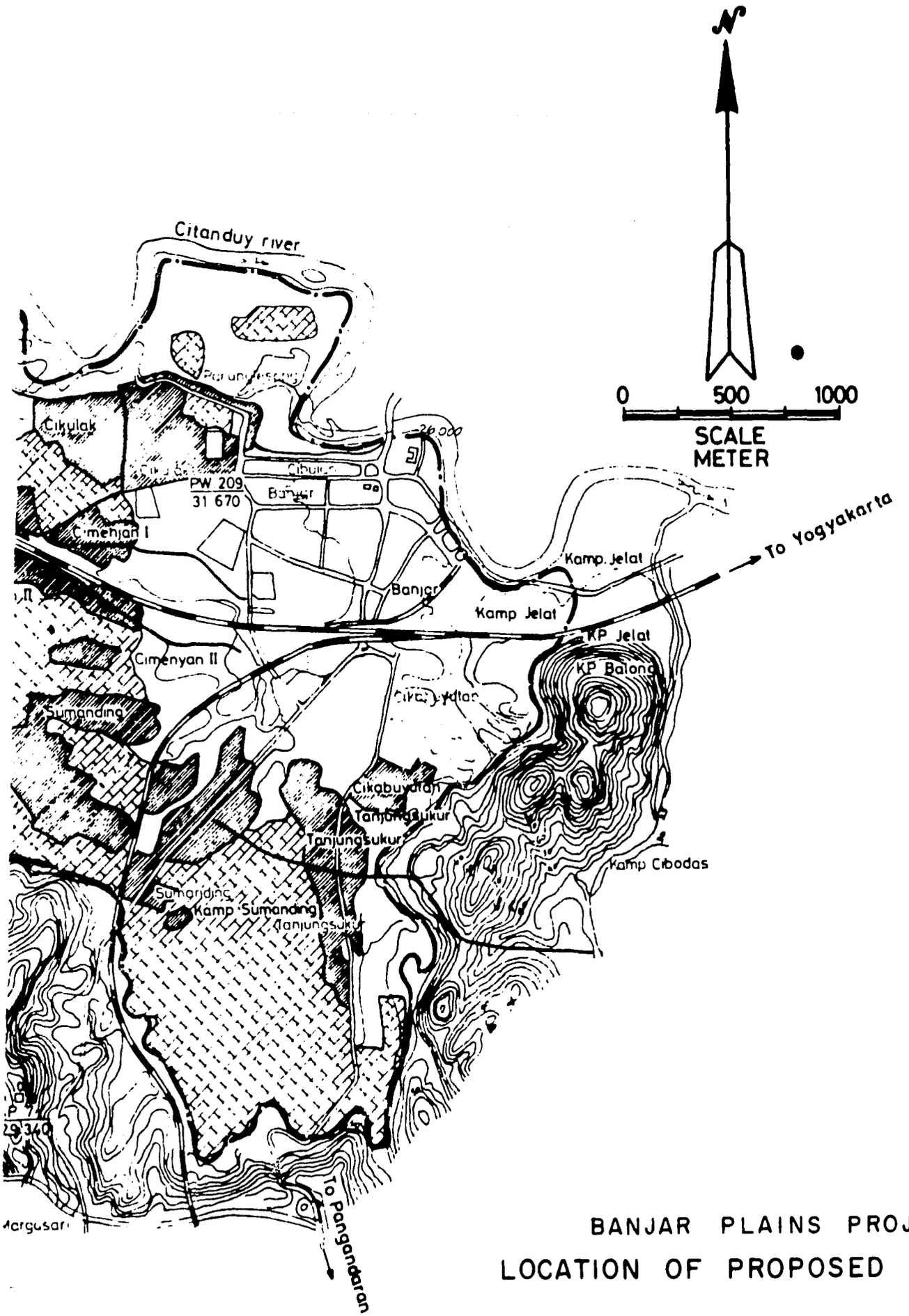

BANJAR PLAINS PROJECT

LOCATION OF PROPOSED PROJECTS

Chapter VI

GEOLOGY

General[1/]

The diversion weir for the Banjar Plains Area is located on the Citanduy River immediately downstream from the emergence of the Citanduy from the deep, incised canyon to the wider floodplain reach that is typical of the lower river valley. The riverbed slope changes from approximately 8 m/km in the canyon reach to approximately 0.2 m/km on the alluvial plain. Downstream from the canyon section, the river is underlain by progressively thicker deposits of alluvial material that were derived from the steeper reaches towards the headwaters. The alluvium is composed of erosion products from volcanic material and the soils weathered from volcanic rocks that have been reworked in transportation to the site of deposition. Typically, the alluvium consists of clays grading to silts and sands and often contains gravel and boulders of volcanic rock. The valley walls are of volcanic breccia intercalated with tuff that has formed a "plateau" above the river. The breccia is composed of angular to semi-angular particles of andesite and tuff with typical particle sizes between 3 and 10 cm, although a few may be as large as a meter or more in diameter. The volcanic breccia overlies a fine to coarse grained tuff that crops out in a few places in the area near the pump station site. The breccia overlies a conglomerate at the weir site.

1/ Most of the information presented herein is taken from geologic reports prepared by DPMA and the Direktorat Irigasi: "Laporan Penjelidikan Geologi Dan Mekanika Tanah Rentjana Bendungan Dataran Banjar, August, 1971.

Laporan Penyelidikan Geologi Teknik Pada Rencana Waduk Banjar, November, 1974.

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Upper Weir Site

There are three types of strata found in the area; alluvial materials which are mapped as either talus or river sediments, volcanic breccia, and conglomerate which is mapped as either weathered conglomerate or conglomerate. These are shown on the geologic map, Figure VI-1, and the profile map, Figure VI-2.

Alluvial Material

This is found as either talus, thought to be the product of slides and weathering, at the foot of the exposed volcanic breccia or as river deposits. Measured depth to groundwater in the river deposits ranged from 2.1 to 5.3 meters. $\underline{k}$ values were found to vary from 1.42 to 4.05×10^{-4} cm/sec. No bearing capacity or strength tests were made on the alluvial material.

Volcanic Breccia

This breccia forms a steep cuesta on the south side of the Citanduy River valley. It is composed of andesite rocks or tuff fragments, mostly a few centimeters in diameter, but with some up to 2 m, with silt and ash. The breccia occurs in layers or is intercalated with layers of tuff. It is compact and massive, but contains open joints that generally are at right angles to the bedding plane.

Conglomerate

Cropping out on the north side of the river valley and found beneath the alluvial deposits, the conglomerate is composed of rounded gravel to boulder size andesite, tuff and, occasionally, claystone. The upper part is badly

weathered and partially changed to clay containing boulders that are more resistant to weathering. In the unweathered layers there are grain size changes both laterally and vertically so that, occasionally, the conglomerate grades to tuffaceous sandstone or silty tuff. Packer test permeabilities in the weathered conglomerate ranged from 2.84×10^{-3} to 1.80×10^{-4} cm/sec, while the unweathered conglomerate permeability was on the order of 10^{-3} cm/sec.

This site does not seem to offer any extreme problems for the proposed structure although a more detailed subsurface exploration program is recommended during the design stage along with laboratory analysis of material. It appears that the foundation will consist of 10 meters or more of river sediments and some provision must be made to prevent differential settlement in a structure with the mass of the proposed weir. Suitable materials in adequate quantities for the embankment portions are available in the vicinity. The boulders in the alluvium may present some difficulty during the excavation of the channel.

Pumping Station Site

The geology of this site is similar to that discussed for the weir site although no conglomerate was found, and the river sediments overlying the tuff are much thicker (Figure VI-3). All foundation excavation will probably be in the alluvial sediments, although detailed investigations should be made at the design stage to establish the depth to bedrock and the character of the alluvium. Some difficulty with boulders may be anticipated during excavation. Groundwater will probably be encountered near the elevation of the water in the river. Any deep excavations in the alluvium will require shoring or gentle backslopes with benches and provisions for dewatering.

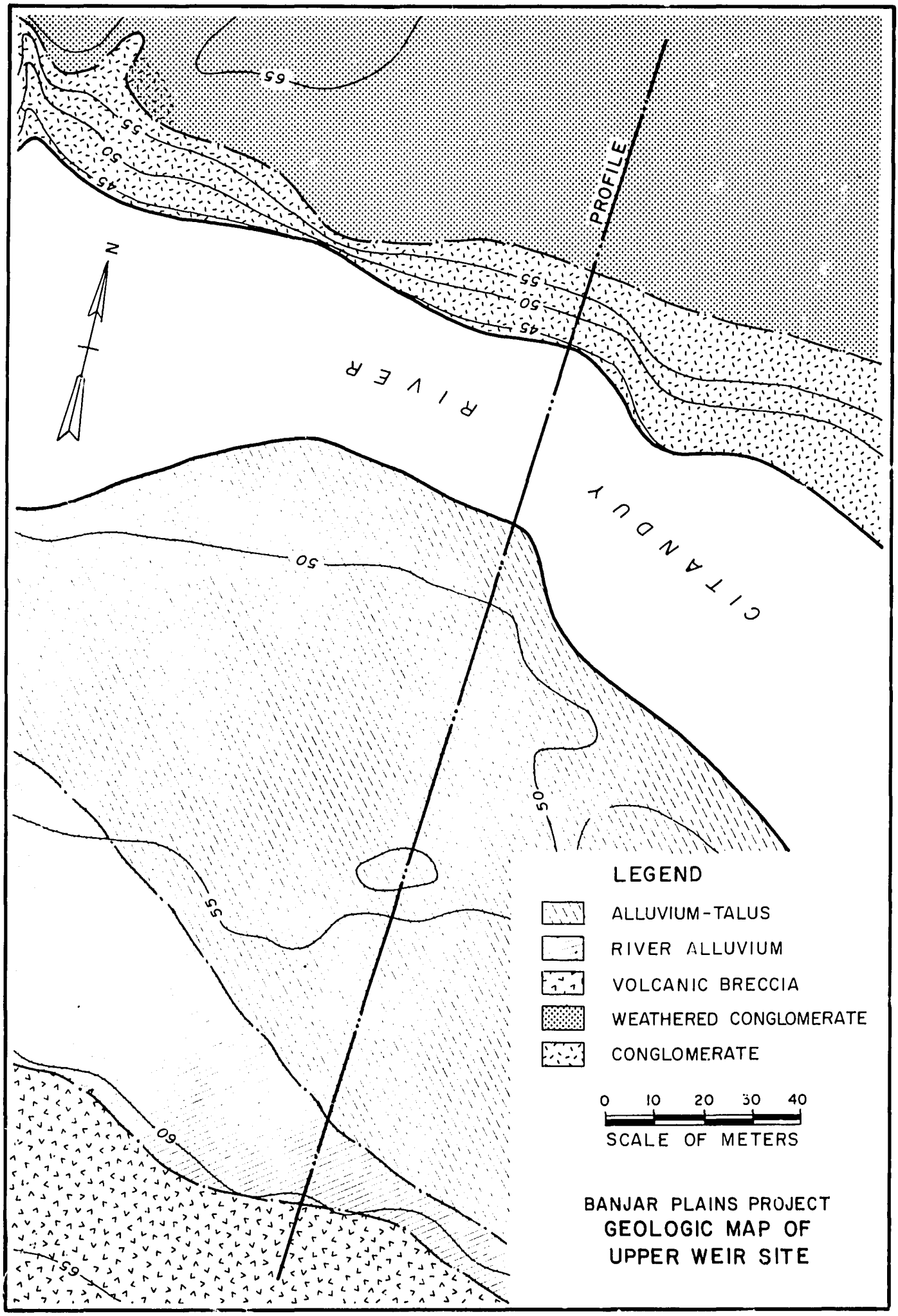
Gravity Supply Canal

At several locations on the south side of the Citanduy River between the weir site and the pump station site there is evidence of local landslide activity. Where the canal is to be excavated on very steep existing slopes there must be some provision in the design to prevent the development of slides. Wide bench excavation and gentle backslopes will probably be adequate to relieve excessive loading at those locations where the existing side slope is too steep to be stable. The presence of rock outcrops (breccia) along the proposed route indicates that some rock excavation may be required although a boring on the top of the breccia ridge southwest of the pump station site indicated a high degree of weathering, and unweathered breccia (bedrock) was reached at a depth of over 20 meters.

Seismicity

As stated in the "Design Criteria, Irrigation and Drainage",[2/] all major structures shall be designed to withstand the effects of a horizontal earthquake acceleration equivalent to 0.12 g. The earthquake force shall be applied in such a direction that it, in combination with other loadings, will produce the most severe stress condition in the structure.

2/ "Design Report - Irrigation and Drainage", Citanduy Project Engineering Consutlants, Inc., Denver, Colorado, U.S.A., November 1976


PROFILE
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RIVER
CITANDUY
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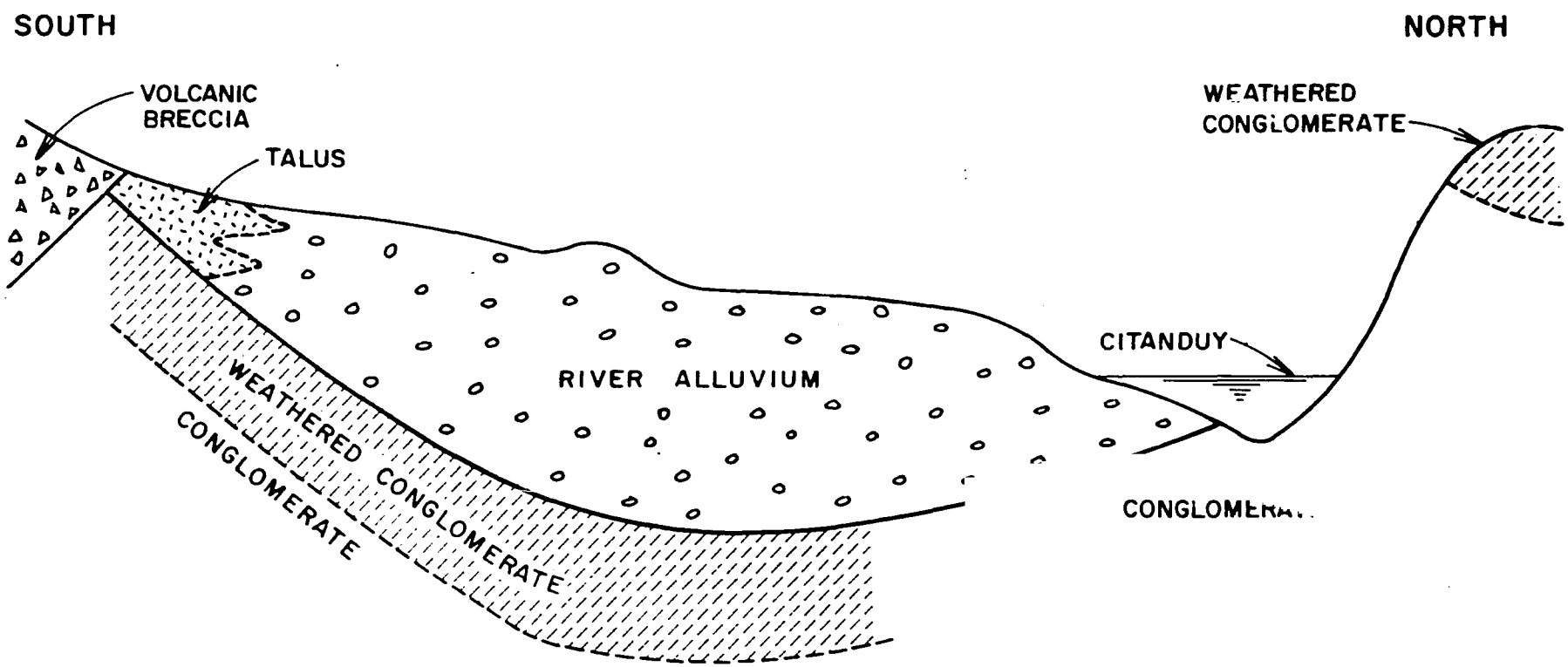
LEGEND
ALLUVIUM-TALUS
RIVER ALLUVIUM
VOLCANIC BRECCIA
WEATHERED CONGLOMERATE
CONGLOMERATE
0 10 20 30 40
SCALE OF METERS
BANJAR PLAINS PROJECT
GEOLOGIC MAP OF
UPPER WEIR SITE



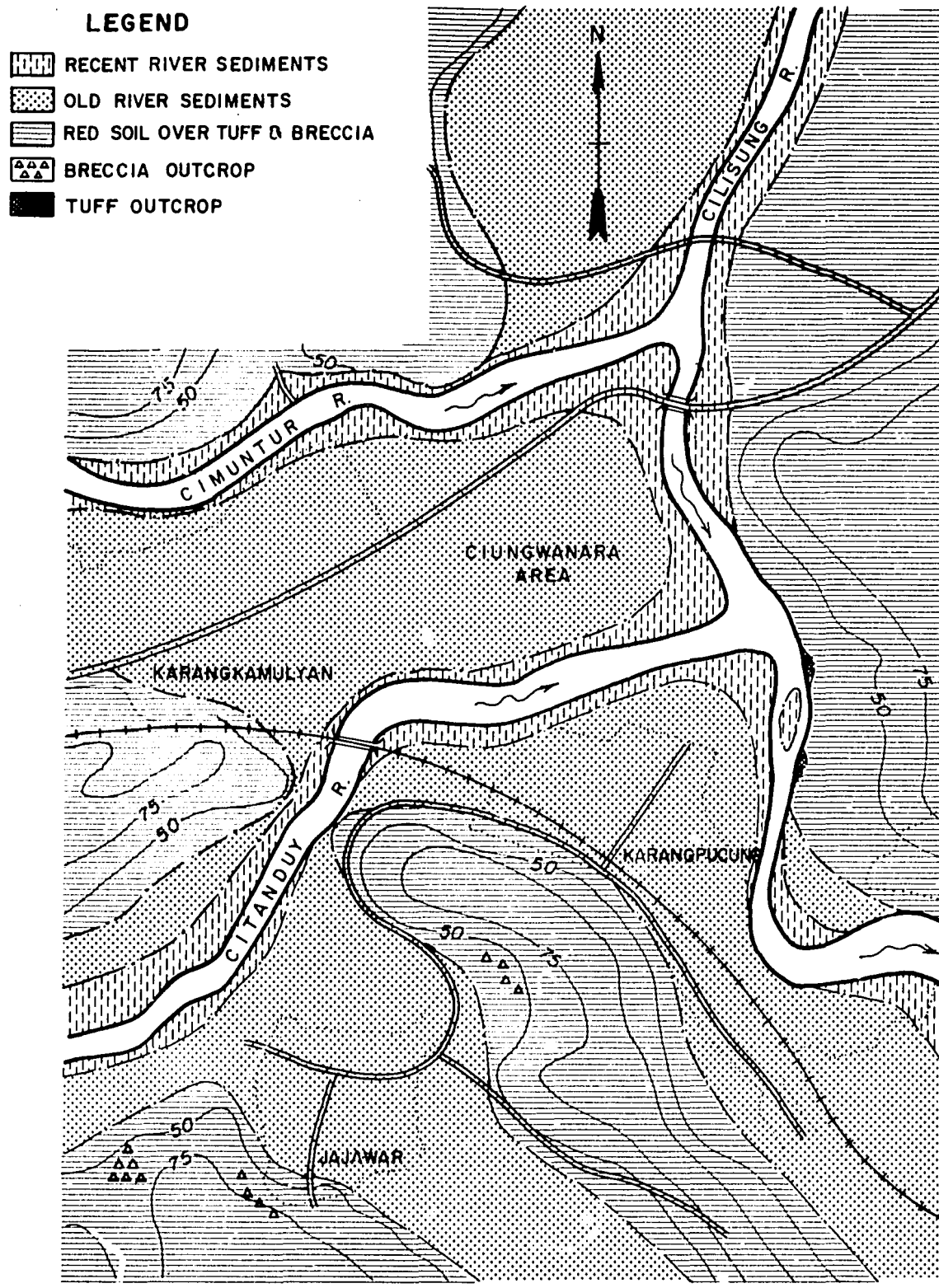
SCALE: HORIZONTAL = 1:1000
VERTICAL = 1:500

BANJAR PLAINS PROJECT

PROFILE AT UPPER WEIR SITE

ENGINEERING CONSULTANTS, INC.

FIGURE VI-2



BANJAR PLAINS PROJECT

GEOLOGIC MAP OF PUMP STATION AREA

Chapter VII

PROJECT FEATURES

General

The irrigation system for proposed Banjar Plains Project includes the project features for conveyance of water from the point of diversion to the area of water use. A gravity diversion system is presented as the most feasible alternative with a pumped diversion system as the alternate plan.

Both the gravity and pumped systems, as proposed, would incorporate desilting basins for sediment reduction and would require relift pumping for service to nearly 20 percent of the project irrigation area. Supply point for municipal raw water and the irrigation water distribution system are identical under either plan. Annual costs with the gravity diversion plan are significantly less than for the pumping plan due to lower operating and maintenance costs.

The gravity system appears to be more attractive than the pumping system from a national viewpoint when energy and fuel requirements are considered and would probably be preferable to a pumping plant when local environmental aspects are considered.

Conversely, the gravity system has certain features which are not attractive. The gravity supply canal route in its head reaches traverses areas of existing and potential landslides in combination with steep cross-slopes where bench flumes will be required for economical conveyance media. Landslides at any of these location would require aqueduct reconstruction resulting in periods of total service interruption. Conservative back benching was used in the design of the canal to decrease the landslide

potential.

Additional geologic and topographic data will be required to determine relative physical feasibility prior to selection of the project supply system.

Gravity System

The primary features of the gravity system are grouped as, (1) Diversion weir; (2) Desilting basin and gravity supply canal; (3) Main supply canal and distribution system, and (4) Highline pumping plant and distribution system. These proposed features, with appurtenant sub-features, would convey water of Citanduy River to the Main canal and Highline systems for delivery and distribution to the lands of Banjar Plains Project. The point of delivery for the municipal portions of the diverted water is assumed to be at the beginning of the Main canal supply system where topographic features are conducive to the construction of water treatment and diurnal storage facilities.

A short description of the primary features is presented in the following paragraphs. However, the Main canal and Highline canal distribution systems are discussed in Chapter VIII-Irrigation and Drainage.

Diversion Weir

The diversion weir, the primary feature of the gravity system, would be constructed across a bend of Citanduy River about 6.5 kilometers upstream from the project irrigated area. The weir, accounting for 55 percent of the gravity system cost, would be a composite stone masonry-reinforced concrete structure with reinforced concrete sluiceway and control gate structures. The regulator is designed to divert a minimum flow of 2.0 m^3/s at a

small head loss. Pressure actuated shutter gates are proposed for the weir crest to provide diversion head during low flow periods. Plan and section views of the proposed structure are shown on Figure VII-1 and VII-2, respectively. Elevations shown on the plan and section views require verification to coincide with the elevation of Benchmark KP-4, in the project water use area, upon which hydraulic computations were based. Prior to final design, the discrepancies in elevations must be resolved by further survey and mapping.

Construction of the weir and control works is proposed with the major portion of construction occurring in excavation prior to river diversion. Subsequent to completion of the masonry structure, the right bank would be breached to the river and the present river channel closed by construction of a dike, permitting the river to flow through the constructed section.

Desilting Basin

The desilting works for the gravity system would be located 800 meters downstream from the diversion weir gate. The proposed structure would be about 150 meters in length and contain 7 sediment storage bays, each 2.5 meters wide and 1.3 meters in depth. Plan and section views of the proposed structure are shown on Figure VII-3. The silt bays are sloped for direct single-bay flushing at super-critical velocity to facilitate rapid silt removal. Structure dimensions were based upon a design condition of 2.0 cubic meters per second flow with a sediment concentration of 1,000 ppm. A design cycling period of 13.5 days and a basin detention period of one hour were used to calculate basin dimensions. Sediment bay and water prism capacity requirements were 2,220 and 7,200 cubic meters. The main dimensions for the desilting basin are as follows:

Elevations:

Top of Structure	48.50 meters
Normal Water Surface	48.00 meters
Floor, Inlet to Sediment Bays	45.55 meters
Floor, Outlet of Sediment Bays	44.55 meters
Slope, Sediment Bays	0.008
Slope, Sediment Discharge Pipe	0.007
Floor Width	19.50 meters
Top Width	27.00 meters

Gravity Supply Canal

Gravity supply canal, the supply aqueduct for Banjar Plains Project, would convey water for 7.32 kilometers from the headworks to the Main supply canal and distribution system. The alignment is shown on Figure VII-4. Between the headworks and Highline pumping station, a distance of 6.78 kilometers, the capacity requirement averages 1,800 liters per second. Between Highline pumping station and the beginning of Main supply canal system, the capacity requirement average 1,600 liters per second. This design capacity will allow a duty factor of 1.7 liters per second per hectare.

The gravity supply canal, as proposed, would comprise the following waterway sections:

Earth Canal Sections	1.8 m^3/s	4,200 meters
Earth Canal Sections	1.6 m^3/s	410 meters
Masonry Lined Cuts	1.8 m^3/s	1,070 meters
Bench Flumes	1.8 m^3/s	1,140 meters
Bench Flumes	1.6 m^3/s	130 meters
Elevated Flumes	1.8 m^3/s	220 meters
Desilting Basin		150 meters
Total Length		7,320 meters

Earth Canal Sections

Earth canal sections of the gravity supply canal totals 4,610 meters in length, accounting for 63 percent of the total length. Earth canal sections were selected for minimum deposition and scour using Kennedy's relationship for trapezoidal sections:

$$Vs = Kd^{0.64}$$

Where: Vs = Canal velocity for maximum stability.

d = Canal water depth.

K = 0.55 for clay predominant materials of Citanduy River Basin.

Hydraulic parameters for the earth canal section of the gravity supply canal are:

Canal Capacity (m^3/s)	1.80	1.60
Total Length (km)	4.20	0.41
Base Width (meters)	2.50	2.25
Water Depth (meters)	0.91	0.88
Water Area (m^2)	3.517	3.142
Mean Velocity (m/s)	0.51	0.51
Wetted Perimeter (meters)	5.781	5.423
Hydraulic Radius (meters)	0.608	0.579
Mannings Roughness	0.030	0.031
Slope (meters/km)	0.46	0.52
Freeboard (meters)	0.50	0.50
Top Width (meters)	6.73	6.39
Side Slope	1.5H:1V	1.5H:1V

Earth canal sections were used for terrain having no more than 35 percent cross-slope. Approximately 50 percent of the earth canal traverses cross-slopes of 8 percent or greater. The typical (average earthwork) section for the 1.8 m^3/s sections with a cross-slope of 12 percent, requires 5.58 cubic meters of excavation and 4.50 cubic meters of compacted embankment per meter of canal, and has a right-of-way width of 18.2 meters. The

typical section of the 1.6 m^3/s section with a 16 percent cross-slope requires 17.8 meters for right-of-way. Unit excavation and embankment quantities are 5.27 and 2.66 cubic meters per meter, respectively. A typical section is shown in Figure VII-5.

Bench Flumes and Lined Cuts

Bench flumes and lined canal sections account for 2,340 meters, or 32 percent, of the length of the gravity supply canal. Bench flumes were used for crossing steep banks, generally having 80 to 100 percent cross-slopes. These are generally areas of active or potential landslides and require considerable back bench cutting to achieve structural stability. Lined canal sections were used in deep cuts where minimum excavation is a prerequisite. In the initial 800 meters of canal, between the headworks and desilting basin, the canal is lined to maintain high velocity for sediment conveyance. Bench flumes and lined canals will have 20 centimeter thick stone masonry lining throughout, with 1/4 horizontal to 1.0 vertical sideslopes and would have the same hydraulic properties. Hydraulic and physical data for these sections are presented in the following tabulation:

Capacity (m^3/s)	1.80	1.60
Length, Bench Flume (km)	1.14	0.13
Length, Lined Section (km)	1.07	--
Base Width (meters)	1.50	1.40
Water Depth (meters)	1.25	1.20
Freeboard (meters)	0.50	0.50
Water Area (m^2)	2.27	2.04
Water Perimeter (meters)	4.08	3.92
Hydraulic Radius (meters)	0.56	0.52
Mannings Roughness	0.018	0.018
Slope (m/km)	0.45	0.48

Elevated Flume Sections

Three elevated flume crossings, totalling 220 meters in length are proposed for the gravity supply canal. The superstructures for these crossings would be of reinforced concrete construction having the following hydraulic and physical dimensions:

Capacity	1.80 m^3/s
Base Width	1.80 meters
Water Depth	1.30 meters
Freeboard	0.50 meters
Water Area	2.34 m^2
Wetted Perimeter	4.40 meters
Hydraulic Radius	0.227 meters
Mannings Roughness	0.013
Slope	0.23 m/km
Structure Height	2.00 meters
Overall Width	2.20 meters
Wall and Floor Thickness	0.20 meters
Concrete	1.16 m^3/meter
Steel	102 kg/meter
Structure Weight	2,700 kg/meter
Gross Weight	5,040 kg/meter

Details of the largest of these crossings are shown on Figure VII-6. Substructure data for the other crossings are:

(1) Continuous stone masonry substructure with clear span of 4.0 meters; maximum substructure height, 1.25 meters.

(2) Ten each, 5 meter spans on 0.5 x 3.2 untapered concrete piers; maximum pier height, 3.25 meters.

Waterway Structures

Ancilliary structures of the gravity supply canal include irrigation turnouts, cross drainage culverts and road bridges. These account for approximately 3 percent of the total gravity supply system costs.

There are three nominally sized irrigation turnouts in the gravity supply canal reach, serving a total of 15 hectares of rice lands. Each turnout would have a stone masonry inlet channel with double stoplog slots, a removable circular orifice gate and a concrete pipe 4 meters in length extending through the canal bank. Checks in the canal will not be required for these turnouts. Turnout data are shown in the following tabulation:

Diversion Capacity, liters per second	20
Number of Turnouts	3
Hectares Served per Turnout	5
Diameter of Orifice Gate, centimeters	20
Diameter of Discharge Pipe, centimeters	30

A total of 39 cross drainage culverts, all within the earth canal sections, are proposed for the gravity supply canal. Inlets and outlets would have stone masonry headwalls extending one meter above the pipe at the inlet side and 20 centimeters above the outlet end of the pipe. Clearance between the canal bottom and the top of the pipe will normally be one meter. A design velocity of 2.0 meters per second was assumed for all culvert sizes, yielding the following relationship:

$$d = 0.8\ Q^{1/2}$$

Where: d = Pipe diameter

Q = Peak discharge in m^3/s

Peak discharge was estimated on the basis of a single ten-year frequency storm of one hour duration and 11 centimeters depth over the watershed, resulting in the following relationship:

$$Q = 2.4\ S^{0.38}\ A^{0.76}$$

Where: Q = Peak discharge, m^3/s

S = Lower semi-basin slope

A = Drainage area in square kilometers

Drainage culvert data are as follows:

Culvert Diameter (centimeters)	100	80	50
Capacity (m^3/s)	1.6	1.0	0.4
Number of Culverts	8	2	29
Length of Culvert (meters)	23	22	21

One single lane bridge is proposed for the gravity supply canal, located in the earth canal section. The proposed bridge would be 3.75 meters wide and have spans of 6.0 meters. The superstructure would be a reinforced concrete T-beam section on stone masonry piers.

The main canal and its distribution system are discussed in Chapter VIII - Irrigation and Drainage.

Highline Pumping Station

Highline pumping station, shown on Figure VII-7, would supply 275 liters per second to the Highline Canal System, discussed in Chapter VIII, for irrigation of 159 hectares of Banjar Plains Project lands. The Highline pumping station complex includes a trashrack and wasteway bay; a wasteway channel; the pumping station and the delivery pipe to Highline canal.

The trashrack and wasteway bay is the only control structure on gravity supply canal after the outlet gate of the desilting works, and is adaptable as a canal check by inserting rectangular control gates in the stoplog slots, either ahead of the trashrack

or after the pumping station intake, as desired. The diagonally constructed concrete weirs and center-mounted stoplogs of the wasteway bay provide a total crest length of 4.24 meters, and provide a maximum diversion capability of 2.0 cubic meters per second with a maximum head of 40 centimeters.

The wasteway channel would be stone masonry lined and would operate at super-critical velocity. Hydraulic parameters are:

Q	$= 2.0\ m^3/s$	W_p	$= 2.462\ m$	V	$= 4.42\ m/s$
b	$= 2.0\ m$	$AR^{2/3}$	$= 0.146\ m^{2/3}$	h_v	$= 1.0\ m$
d	$= 0.22\ m$	n	$= 0.018$	d_2	$= 1.22\ m$
A	$= 0.452\ m^2$	s	$= 0.061$	H	$= 1.6\ m$

The proposed Highline pumping station would be housed in a reinforced concrete structure adjacent to the wasteway and trashrack bay with a floor elevation of about 44.3 meters. The pump intake would extend into the trashrack forebay, eliminating the need for a forebay or intake well. Two direct coupled 12.5 horsepower pumps with a total head of 7.7 m, and driven by diesel engines are proposed. The pumps would be connected to steel intake and discharge manifolds. Attendant operation is provided.

The pump discharge line would be a buried steel pipe, 30 cm in diameter and about 65 meters long, terminating in a stone masonry outlet box and discharging into Highline canal.

Pumped System

The pumped system, alternative to the gravity system, would deliver water to Main canal and Highline canal systems and to the municipal supply point at locations identical to those of Gravity Supply System. However, the pumped system will eliminate the 7 km of the Gravity Supply Canal. The irrigation area that would be

served is essentially the same (760 ha as compared to 785 ha for the gravity plan) and the capital costs of the two supply systems are slightly different (1.59 billion Rupiahs for the pump plan compared to 1.70 billion for the gravity plan).

The primary features of the pumped system are: (1) Main pumping plant; (2) Desilting basin; (3) Relift pumping station, and (4) Link supply canal. The layout of the proposed features is shown on Figure VII-8.

Main Pumping Station

The main pumping station, the primary feature of the alternative pumping system, would be constructed on the right bank of Citanduy River about 50 meters upstream from railroad bridge 1406 and about 6.8 km west of Banjar railway station. The pumping plant, accounting for 53 percent of the alternative supply system cost, would be a reinforced concrete structure with appurtenant concrete and stone masonry river intake works. Three 70 cm deep-well pumps with 9 meter vertical columns are proposed. Each pump would have a design capacity of 0.60 m^3/s and would be direct driven by a 180 hp diesel engine. Plan and elevation views of the pumping plant are shown on Figure VII-9.

The pumps would be manifold coupled to a steel pipe discharge line, 100 cm in diameter and 35 meters long, terminating at a stone masonry canal headbox. A masonry lined feeder canal, 50 meters in length, would convey the pumping station discharge to a desilting basin.

Hydraulic data for the pumping station are summarized as follows:

Hydraulic Gradient at Outlet Box	El. 45.03 meters
Outlet Loss	0.12 meters
Discharge Line Loss	0.24 meters

Manifold Loss	0.28 meters
Manifold Intake Loss	0.08 meters
Hydraulic Gradient at Pump	El. 45.75 meters
Water Surface at Intake	El. 28.00 meters
Plant Operating Head	17.75 meters

Desilting Basin

The desilting works for the pumped system would be located within the right-of-way of the pumping station complex. The proposed structure would be 120 meters in length and contain five (5) bays, each 2 meters wide and 2.50 meters in depth. Plan and sectional views of the proposed desilting works are shown on Figure VII-10. The silt bay floor and separator walls would be sloped to provide super-critical velocity for single bay flushing. Structure dimensions were based upon a design condition flow of 1.8 cubic meters per second, having a sediment concentration of 1,000 parts per million. A design cycling period of 13.5 days and a basin detention period of 1 hour were used to calculate basin dimensions.

Sediment bay and water prism capacity requirements are 2,000 and 6,300 cubic meters, respectively. Physical data for the desilting basin are as follows:

Elevations:	
Top of Structure	45.50 meters
Normal Water Surface	45.00 meters
Floor, Inlet to Sediment Bays	38.90 meters
Floor, Outlet of Sediment Bays	38.00 meters
Slope of Sediment Bays	0.009
Slope of Silt Discharge Line	0.06
Floor Width	11.00 meters
Top Width	21.4 meters

Relift Pumping Station

Relift pumping station would supply 275 liters per second to Highline Supply canal through a Link canal for irrigation of 159 hectares of project lands served by Highline canal system.

The relift pumping station would be located within the right-of-way of the main pumping station-desilting basin complex. Water supply for the relift station would be diverted from the desilting basin through a reinforced concrete pipe, 50 cm in diameter and 5 meters long. The pump house would be a 2-story concrete structure, 3 by 4 meters in plan, with a basement floor elevation of 44.0 meters. A tile drain, 10 cm in diameter by 20 meters long would provide floor drainage. Two mixed flow pumps, powered by 12.5 hp diesel engines, would be connected to the intake and discharge pipes by steel manifolds. The plant operating head is 7.13 meters. The outlet pipe would be welded steel, 35 cm in diameter and 20 meters long, terminating in a 3 meter by 3 meter stone masonry outlet box. Hydraulic data for the relift station are summarized as follows:

Hydraulic Gradient at Outlet Box	El. 51.00 meters
Discharge Line Friction	0.23 meters
Outlet Loss	0.22 meters
Loss in Two LR30 Bends	0.07 meters
Manifold Loss	0.22 meters
Hydraulic Gradient of Pump Outlet	El. 51.74 meters
Hydraulic Gradient of Intake	El. 45.00 meters
Intake Line Friction	0.06 meters
Entrance Loss	0.11 meters
Manifold Loss	0.22 meters
Hydraulic Gradient of Pump Inlet	El. 44.61 meters
Plant Operating Head	7.13 meters

Link Supply Canal

The Link supply canal (See Fig. VII-8), 300 meters in length, would convey the discharge of Relift Pumping Plant to the Highline canal system, discussed in Chapter VIII. Two earth canal sections, totalling 220 meters in length, would be connected by a lined section 80 meters in length. The O & M roads for these sections would serve as a replacement for an existing public road in the proposed construction area. The earth canal sections would have uniformly distributed cross-slopes between 12 and 35 percent. The lined section would be in a cut through a ridge and the depth of cut above lining would vary, more or less uniformly, between 0.5 and 5.5 meters. Hydraulic data for these sections are as follows:

	Earth Section	Lined Section
Discharge (liters/sec)	275	275
Base (meters)	0.60	0.65
Depth (meters)	0.55	0.50
Freeboard (meters)	0.40	0.40
Side Slopes	1.50H to 1V	0.25H to 1V
Area (m^2)	0.58	0.39
Perimeter (meters)	2.23	1.68
Hydraulic Radius (meters)	0.262	0.230
Mannings Roughness	0.035	0.018
Slope (m/km)	0.77	0.54

Waterway structure of Link Supply Canal would be:

Two single-lane concrete bridges, 2.6 meters span, 40° skew, 1-50 cm distribution turnout, without check.

The details of the Main canal and its distribution system, along with the Highline canal and its distribution system, are presented in Chapter VIII.

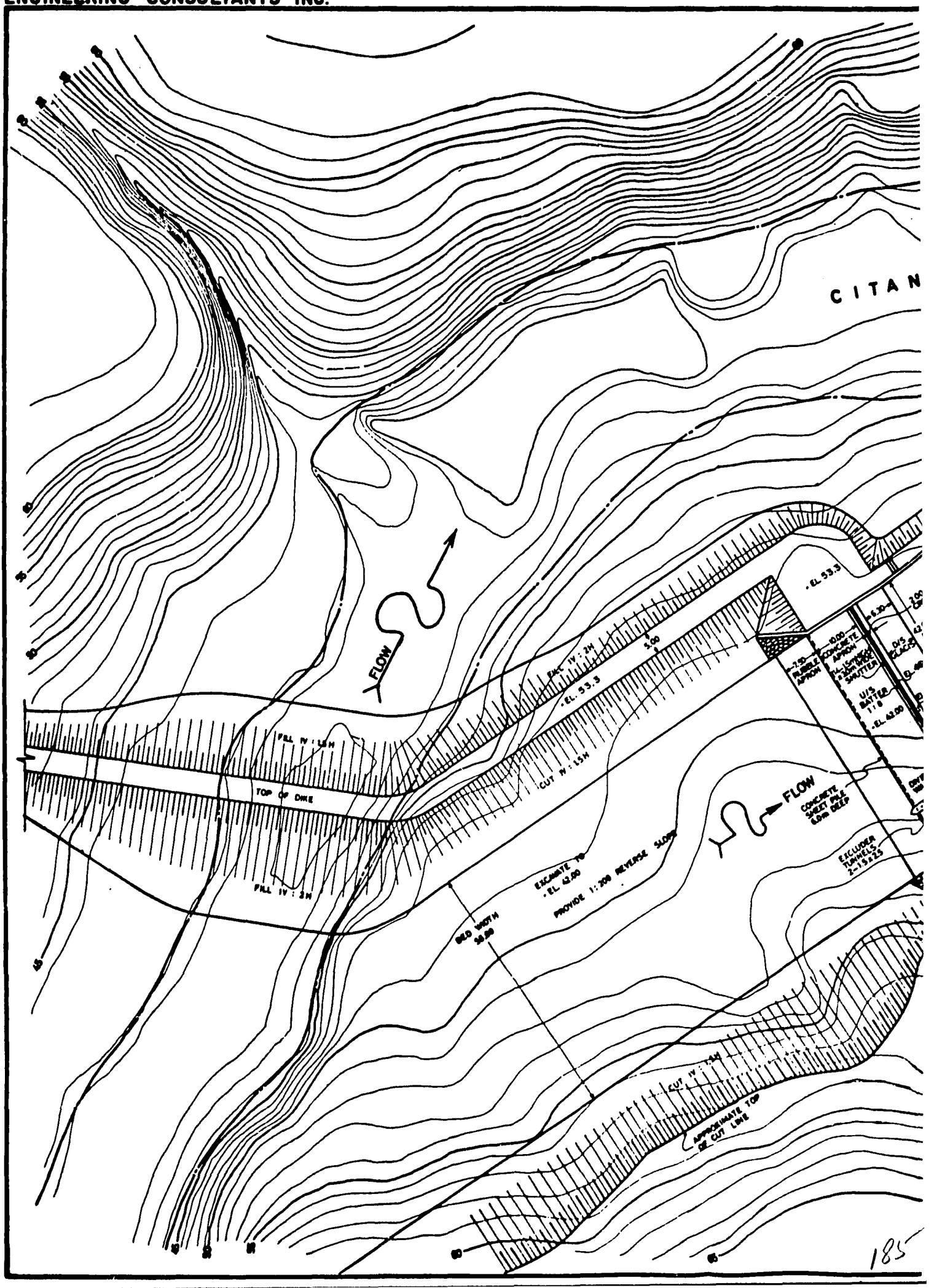
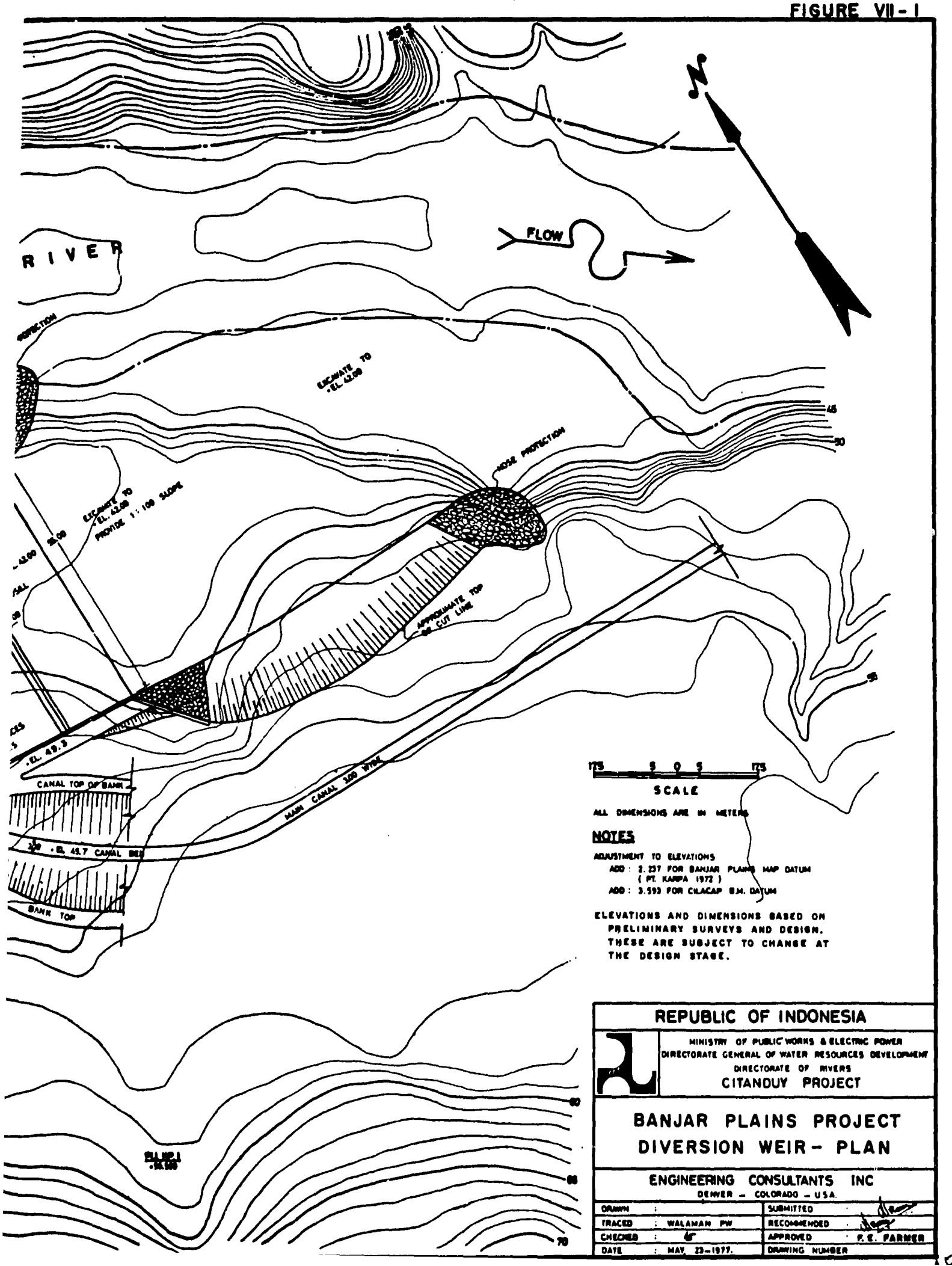
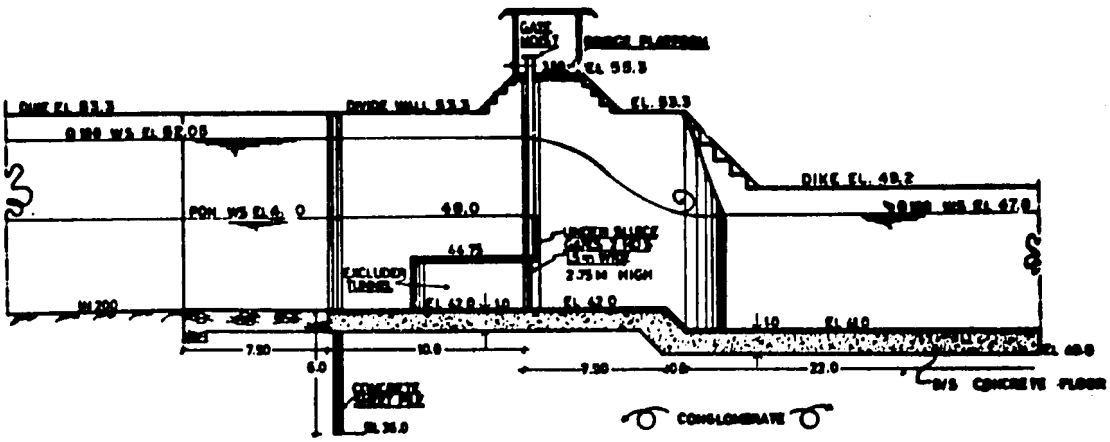
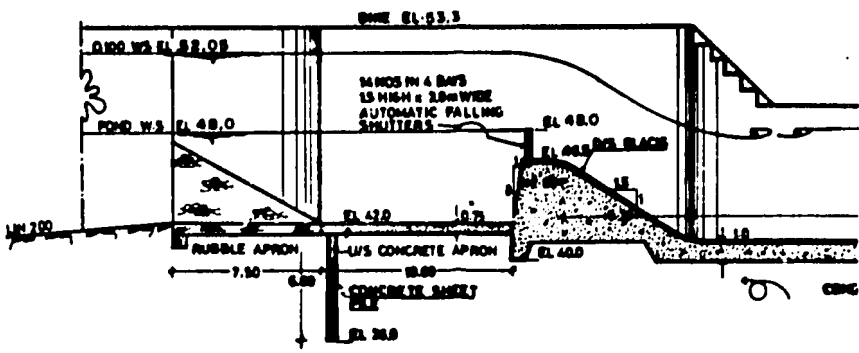

CITAN
FLOW
FILL IV : 1.5H
TOP OF DIKE
FILL IV : 2H
CUT IV : 1.5H
EL. 53.3
EXCAVATE TO
EL. 42.00
PROVIDE 1:200 REVERSE SLOPE
BED WIDTH
CUT IV : 1.5H
APPROXIMATE TOP
OF CUT LINE
FLOW
CONCRETE
SHEET PILE
EXCLUDER
TUNNELS
2-15x25
EL. 53.3
U/S
BATTER
1:8
EL. 42.00

FIGURE VII-1

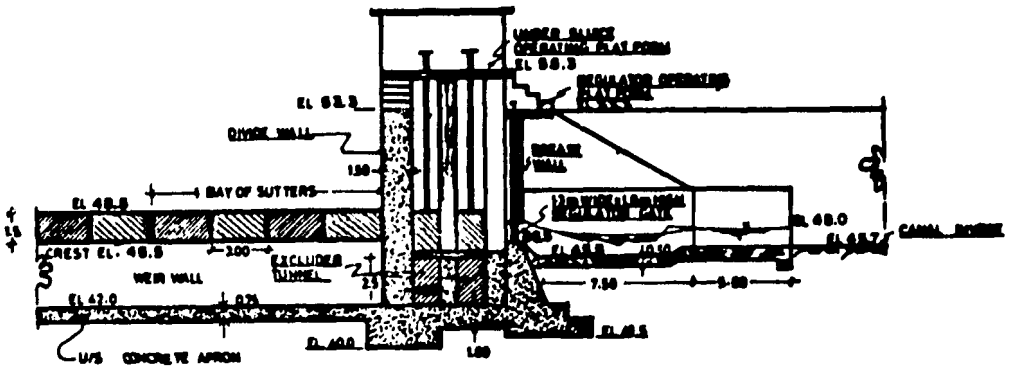

N
FLOW
RIVER
ELEVATE TO EL. 42.00
ELEVATE TO EL. 42.00 PROVIDE 1:100 SLOPE
NOSE PROTECTION
APPROXIMATE TOP OF CUT LINE
CANAL TOP OF BANK
EL. 45.7 CANAL BED
BANK TOP
MAIN CANAL 300 WIDE
EL. 49.3
45
50
55
60
65
70
175 5 0 5 175
SCALE
ALL DIMENSIONS ARE IN METERS
NOTES
ADJUSTMENT TO ELEVATIONS
ADD : 2.237 FOR BANJAR PLAINS MAP DATUM (PT. KARPA 1972)
ADD : 3.593 FOR CILACAP B.M. DATUM
ELEVATIONS AND DIMENSIONS BASED ON PRELIMINARY SURVEYS AND DESIGN. THESE ARE SUBJECT TO CHANGE AT THE DESIGN STAGE.
REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT
BANJAR PLAINS PROJECT
DIVERSION WEIR - PLAN
ENGINEERING CONSULTANTS INC
DENVER - COLORADO - USA
DRAWN :
TRACED : WALAMAN PW
CHECKED :
DATE : MAY 23-1977.
SUBMITTED
RECOMMENDED
APPROVED : F. E. FARMER
DRAWING NUMBER



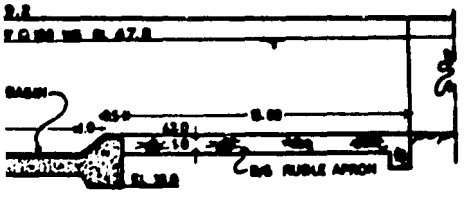
LONGITUDINAL SECTION
THROUGH UNDER SLUICES



CROSS-SECTION
THROUGH WEIR



LONGITUDINAL SECTION THROUGH REGULATOR



SCALE

ALL DIMENSIONS ARE IN METERS.

NOTES

ADJUSTMENT TO ELEVATIONS
ADD : 2.237 FOR BANJAR PLAINS MAP DATUM
(PT. KARPA 1972)
ADD : 3.593 FOR CILACAP B.M. DATUM

ELEVATIONS AND DIMENSIONS BASED ON PRELIMINARY SURVEYS AND DESIGN. THESE ARE SUBJECT TO CHANGE AT THE DESIGN STAGE.

REPUBLIC OF INDONESIA

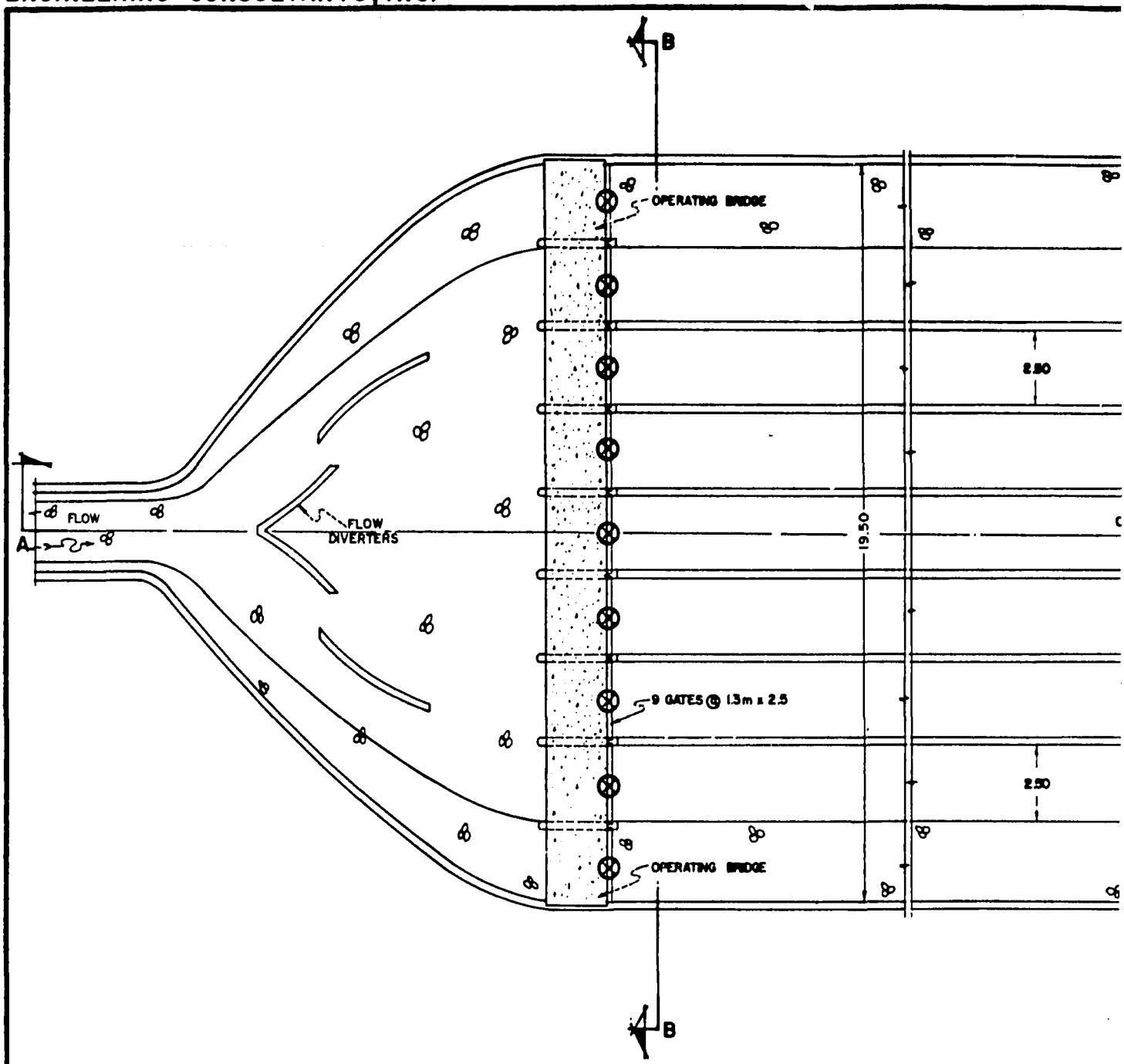
MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
DIVERSION WEIR - SECTIONS

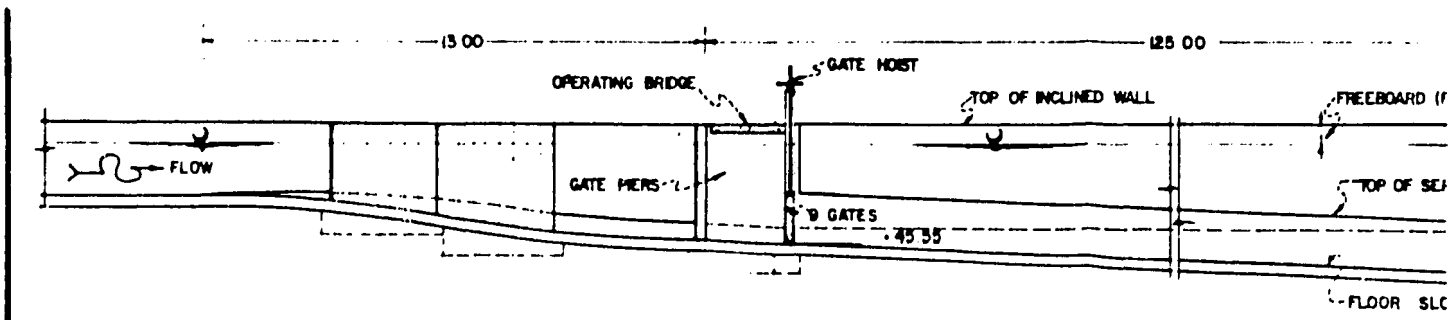
ENGINEERING CONSULTANTS INC.
DENVER — COLORADO — U.S.A

DRAWN	:	SUBMITTED	:
TRACED	:	RECOMMENDED	:
CHECKED	:	APPROVED	: P.E. FARMER

ENGINEERING CONSULTANTS, INC.

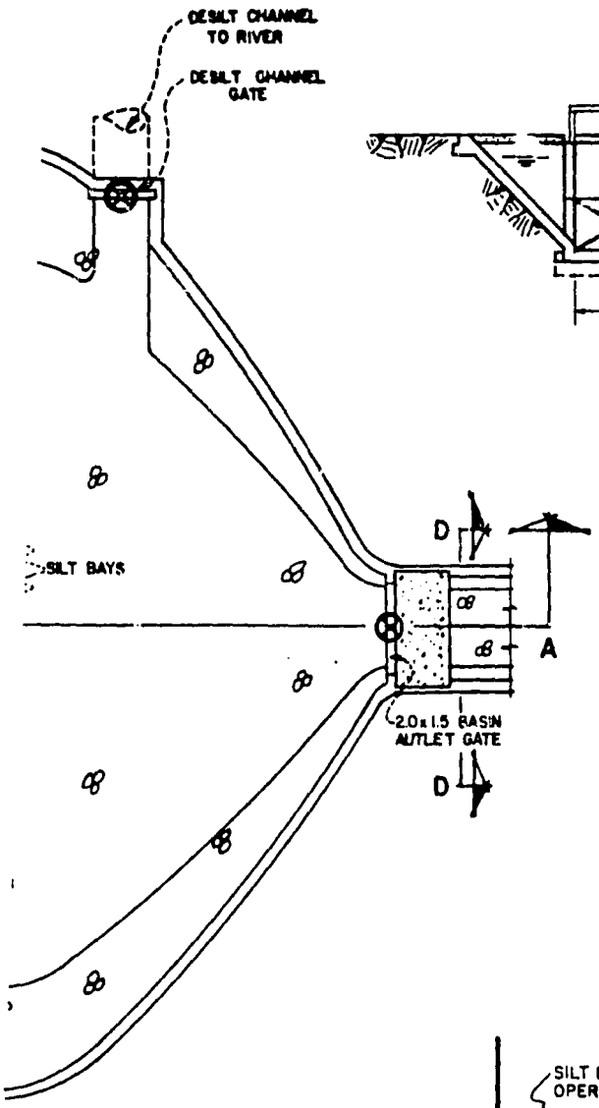


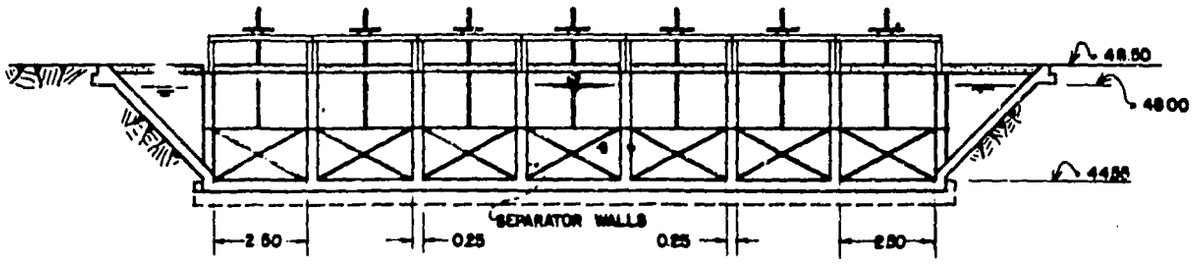
PLAN



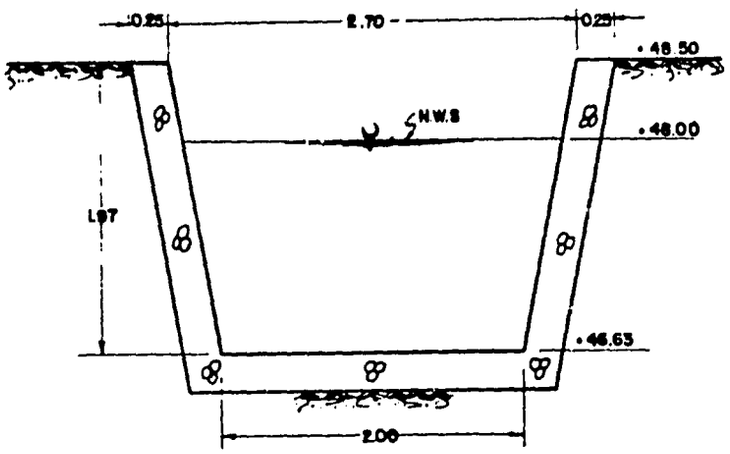
SECTION A-A

FIGURE VII - 3

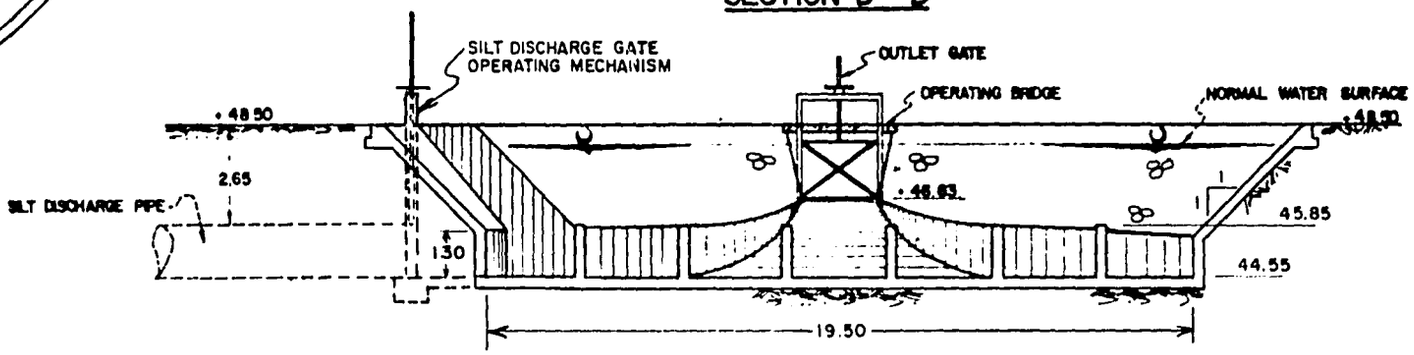




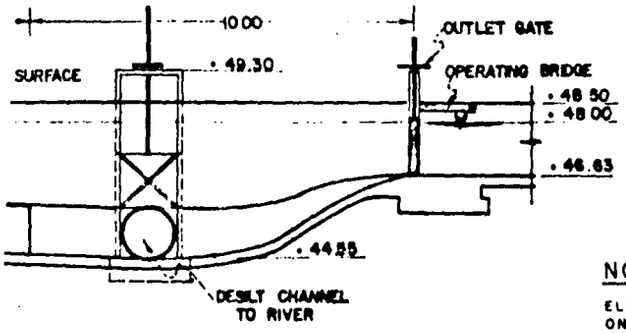
SECTION B-B



SECTION D-D



SECTION C-C



NOTES

ELEVATIONS AND DIMENSIONS BASED ON PRELIMINARY SURVEYS AND DESIGN. THESE ARE SUBJECT TO CHANGE AT THE DESIGN STAGE.

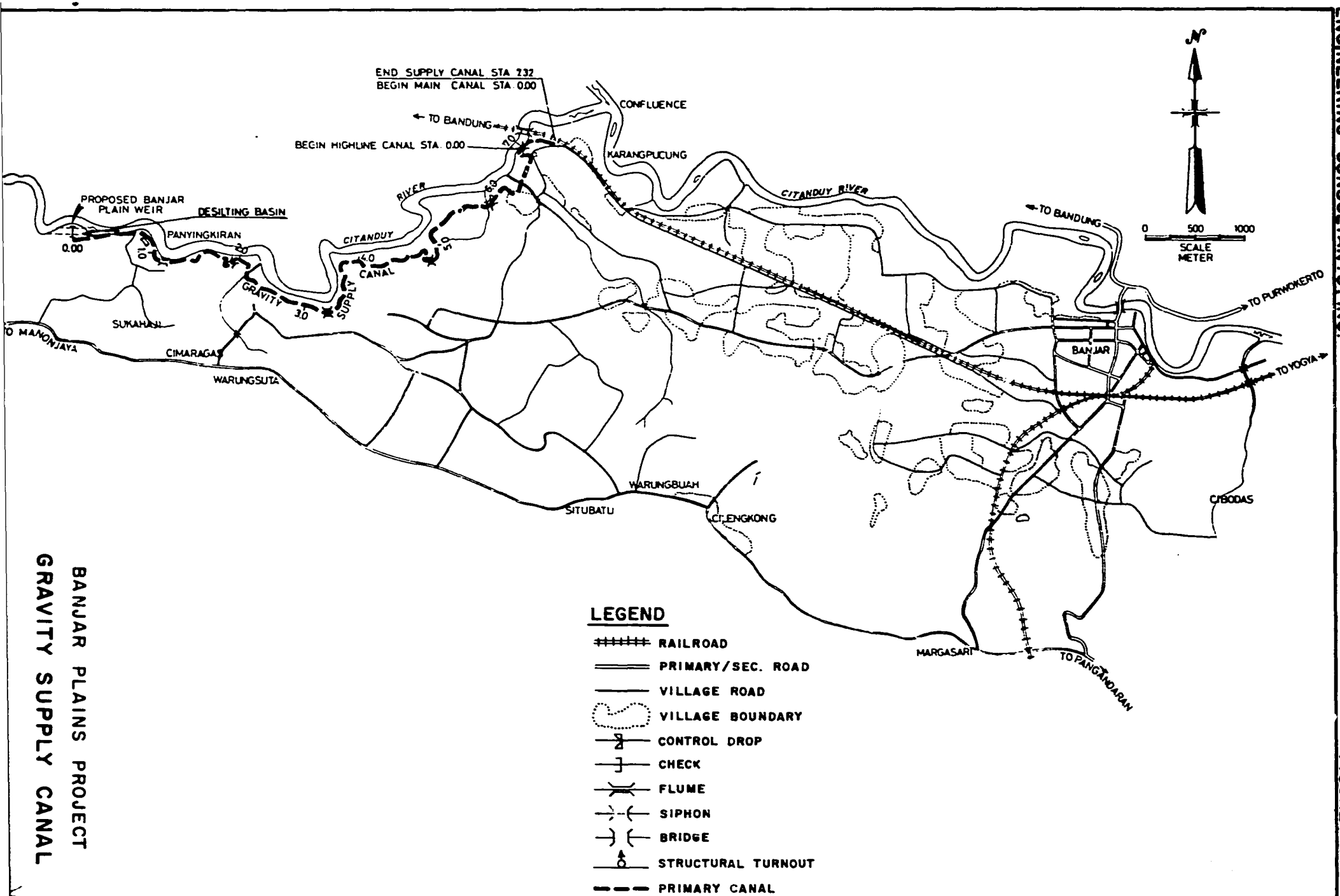
REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT
DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
GRAVITY SYSTEM
DESILTING BASIN

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

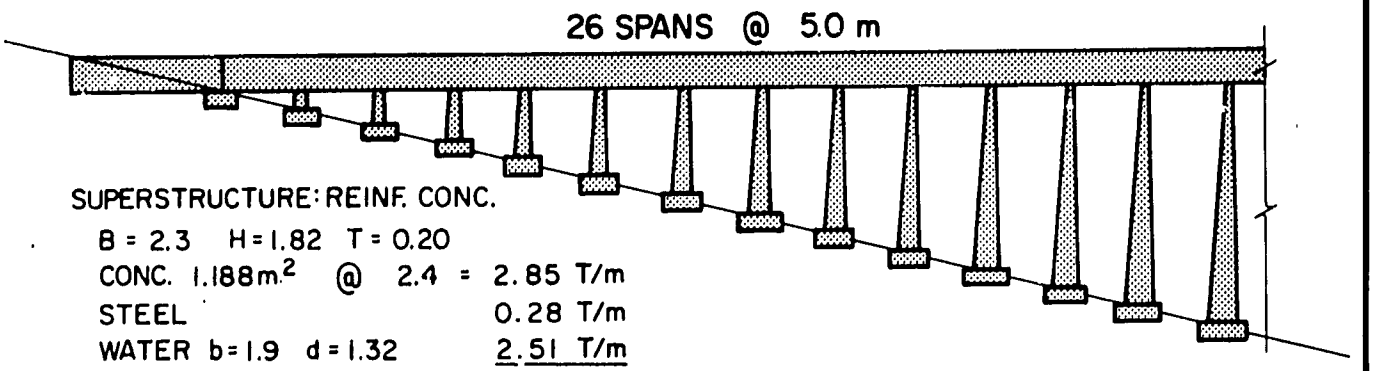
DRAWN	DASIRAN	SUBMITTED	E.A. POLASKY
TRACED	ADE RUSTANDY	RECOMMENDED	
CHECKED	E.A. POLASKY	APPROVED	F.E. FARMER
DATE	JULY 26 1977	DRAWING NUMBER	



BANJAR PLAINS PROJECT

GRAVITY SUPPLY CANAL

FIGURE VII - 4



SUPERSTRUCTURE: REINF. CONC.

B = 2.3 H = 1.82 T = 0.20

CONC. 1.188 m^2 @ 2.4 =	2.85 T/m	
STEEL	0.28 T/m	
WATER b = 1.9 d = 1.32	2.51 T/m	
	5.64 T/m	28.2 T/PIER

F & B SLOPE = 0.25 SIDE 0.01667

AREA = 1.15 + 0.576 h

VOLUME = 1.15H + 0.288 H^2

24 PIERS : $\Sigma H = 192$ m

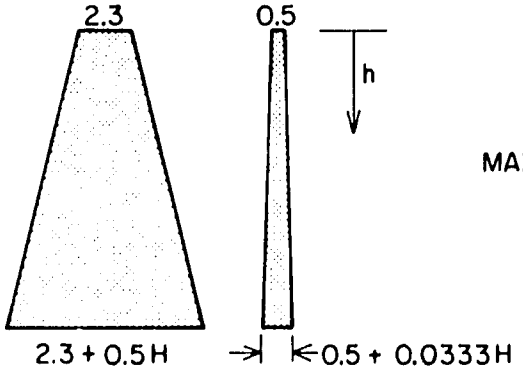
$\Sigma H^2 = 1984\ m^2$

QUANTITIES :

REINFORCED CONCRETE, SUPERSTRUCTURE	154 m^3
REINFORCED CONCRETE, FOOTING	180 m^3
STONE MASONRY, PIERS	792 m^3
EXCAVATION FOR FOOTINGS	220 m^3
REINFORCING STEEL	52.9 T
CLEARING ROW	1300 m^2

PIERS : STONE MASONRY

TOP : 2.3m x 0.5m



MAXIMUM BEARING : H = 15

SUPERSTRUCTURE	28.2	T
PIER 2.4 T/m^3	196.9	T
FOOTING 2.64 T/m^3	28.5	T
	253.6	T
FOOTING AREA	21.6	m^2
BEARING	11.7	T/m^2

FOOTINGS : PIER BASE + 0.5m ENDS & SIDES, T = 0.5 m

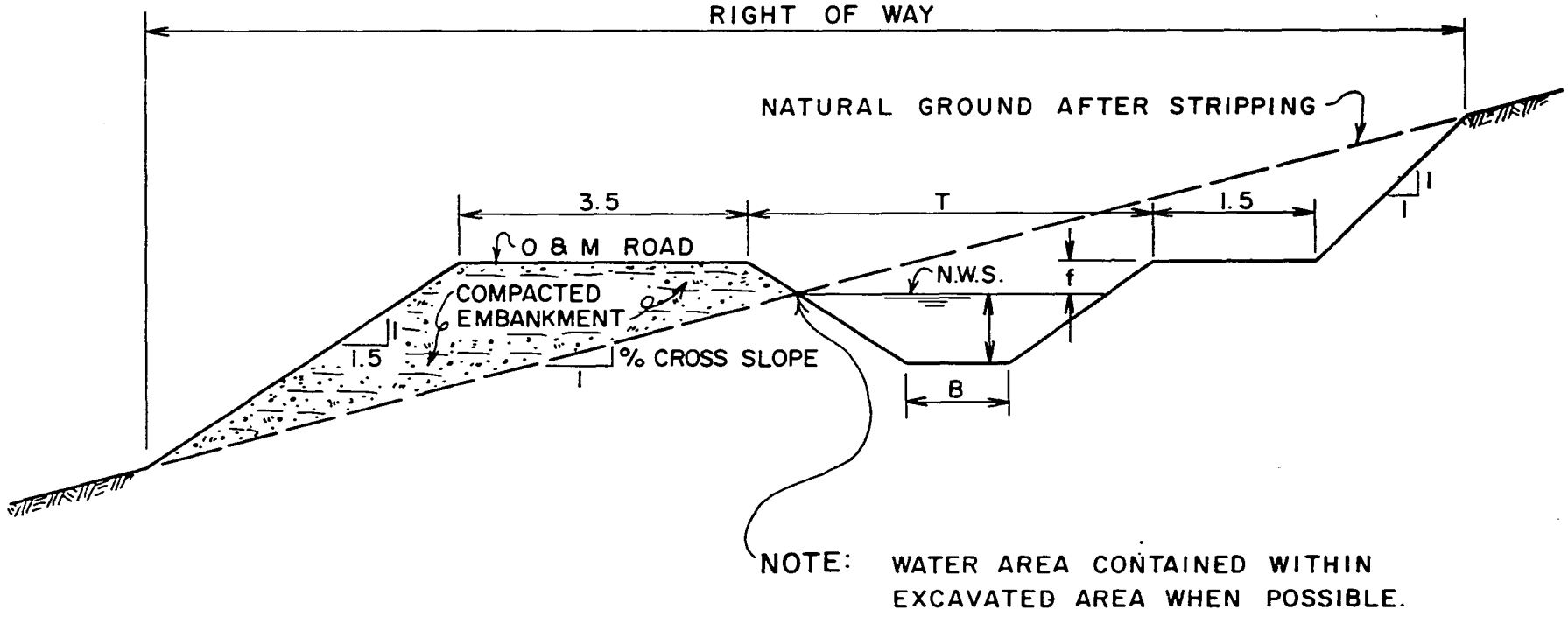
AREA = 4.95 + 1.11 H VOLUME = 2.475 + 0.555H

26 FOOTINGS: ΣH = 208 m

BANJAR PLAINS PROJECT

GRAVITY SUPPLY CANAL

ELEVATED FLUME STA. 4.80 TO STA. 4.93



NOTE: WATER AREA CONTAINED WITHIN EXCAVATED AREA WHEN POSSIBLE.

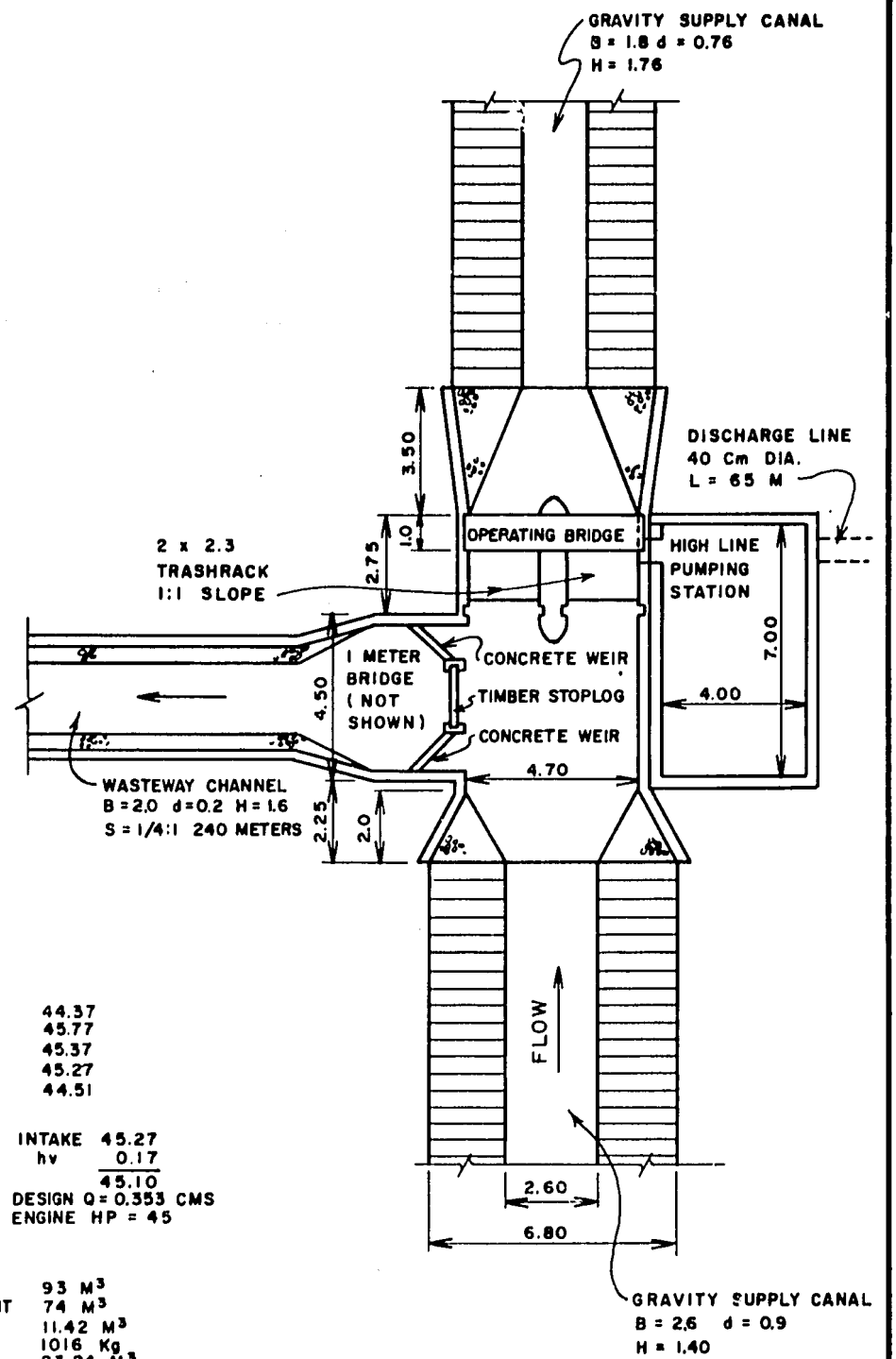
BANJAR PLAINS PROJECT

GRAVITY SUPPLY CANAL

TYPICAL EARTH CANAL SECTION

ENGINEERING CONSULTANTS, INC.

FIGURE VII-5



ELEVATIONS

FLOOR OF STRUCTURE	44.37
TOP OF WALLS	45.77
CREST OF W.W. WEIRS	45.37
WATER SURFACE	45.27
OUTLET TRANSITION	44.51

PUMP STATION

DELIVERY EL.	50.69	INTAKE	45.27
HF-hv	2.11	hv	0.17
	52.80		45.10

TOTAL HEAD = 7.70. DESIGN Q = 0.353 CMS
HYDRAULIC HP = 36.3 ENGINE HP = 45
2 UNITS OF 22.5 HP

TRASHRACK & WASTEWAY BAY

EXCAVATION	93 M^3
COMPACTED EMBANKMENT	74 M^3
REINFORCE CONCRETE	11.42 M^3
REINFORCE STEEL	1016 Kg
UNREINF. CONC.	23.24 M^3
STONE MASONRY	10.54 M^3
TIMBER STOPLOGS	0.774 M^3

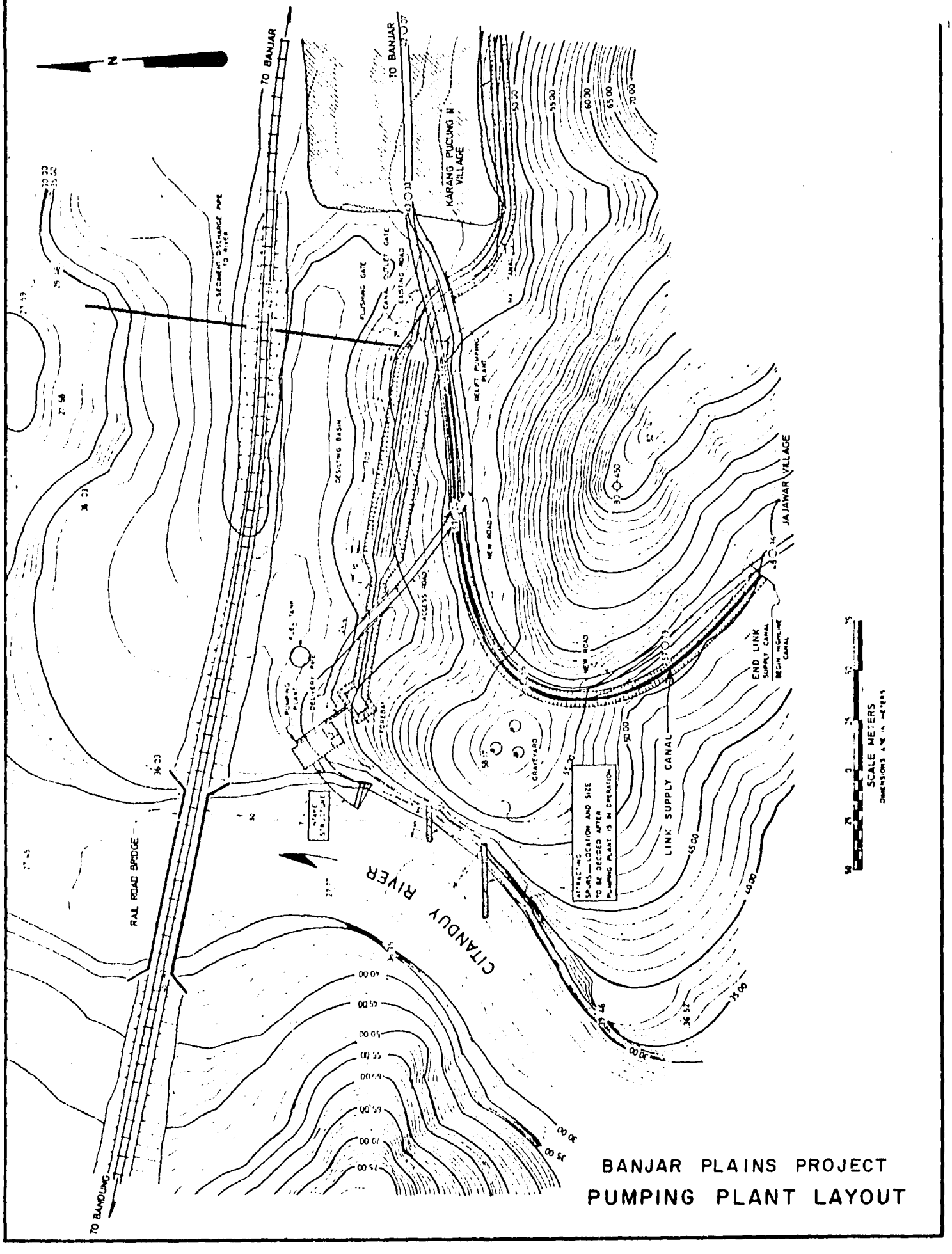
WASTEWAY CHANNEL 240 M

EXCAVATION	518 M^3
BACKFILL	415 M^3
STONE MASONRY	237.5 M^3

PUMP STATION

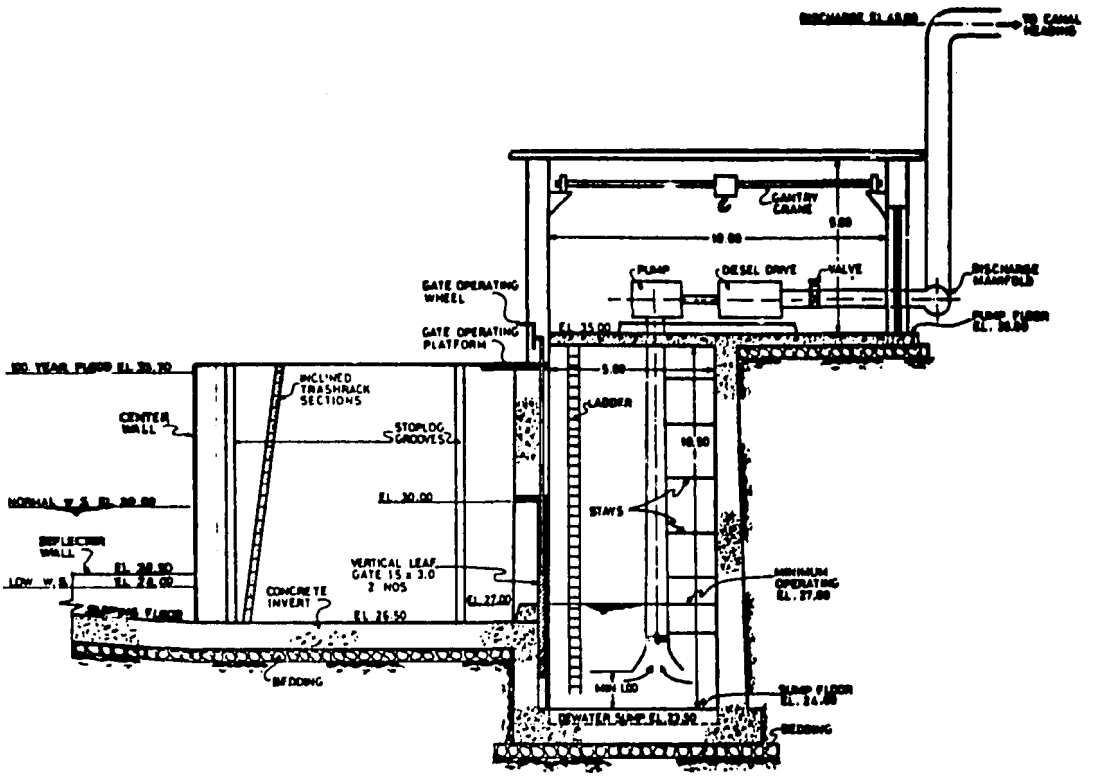
EXCAVATION	52 M^3
REINFORCE CONCRETE	40.52 M^3
STEEL	36.06 Kg
STONE MASONRY	28.32 M^3
DELIVERY PIPE	65 M
EXCAVATION	79 M^3
BACKFILL	65 M^3
STONE MASONRY	6.25 M^3
TOTAL ROW	1915 M^3

BANJAR PLAINS PROJECT
HIGHLINE PUMP STATION



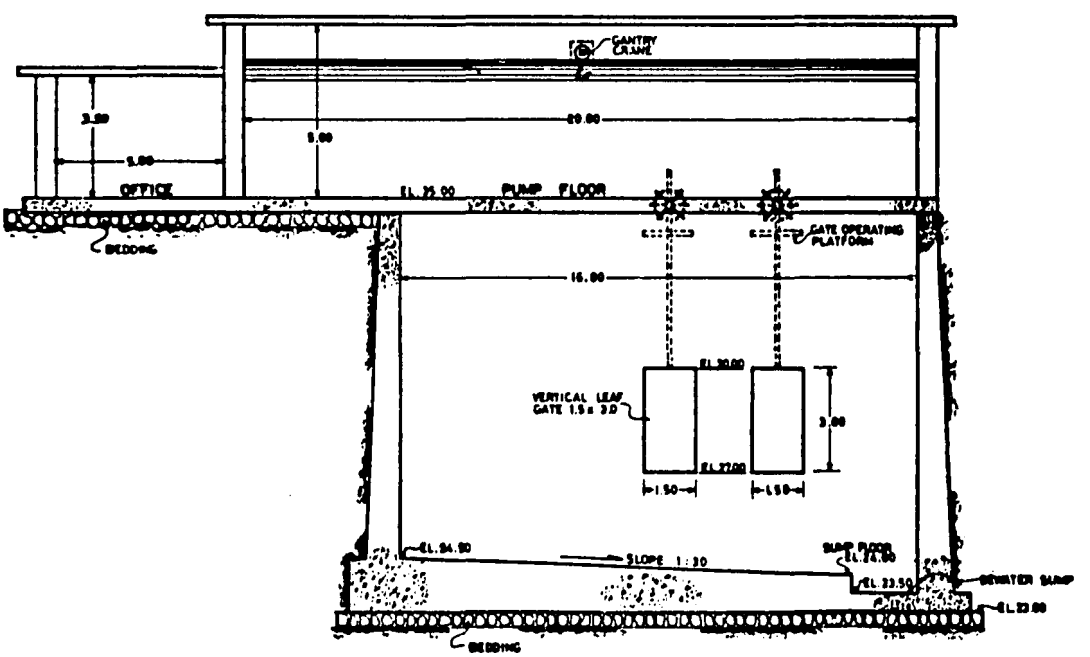
BANJAR PLAINS PROJECT
PUMPING PLANT LAYOUT

ENGINEERING CONSULTANTS, INC.



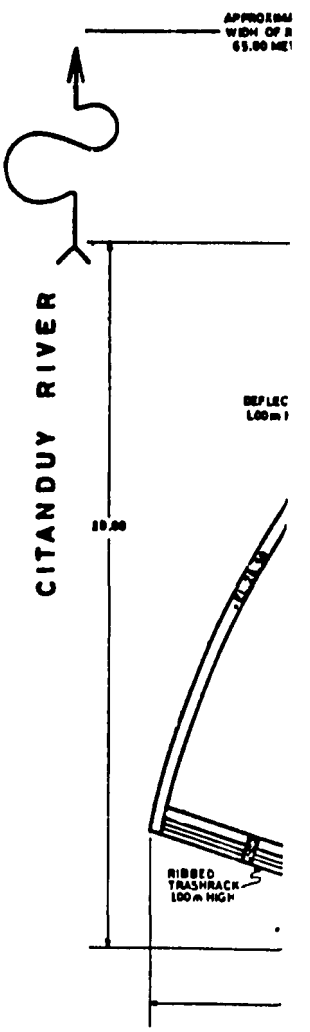
SECTION ALONG A–A

SCALE 1:100



SECTION ALONG B–B

SCALE 1:100



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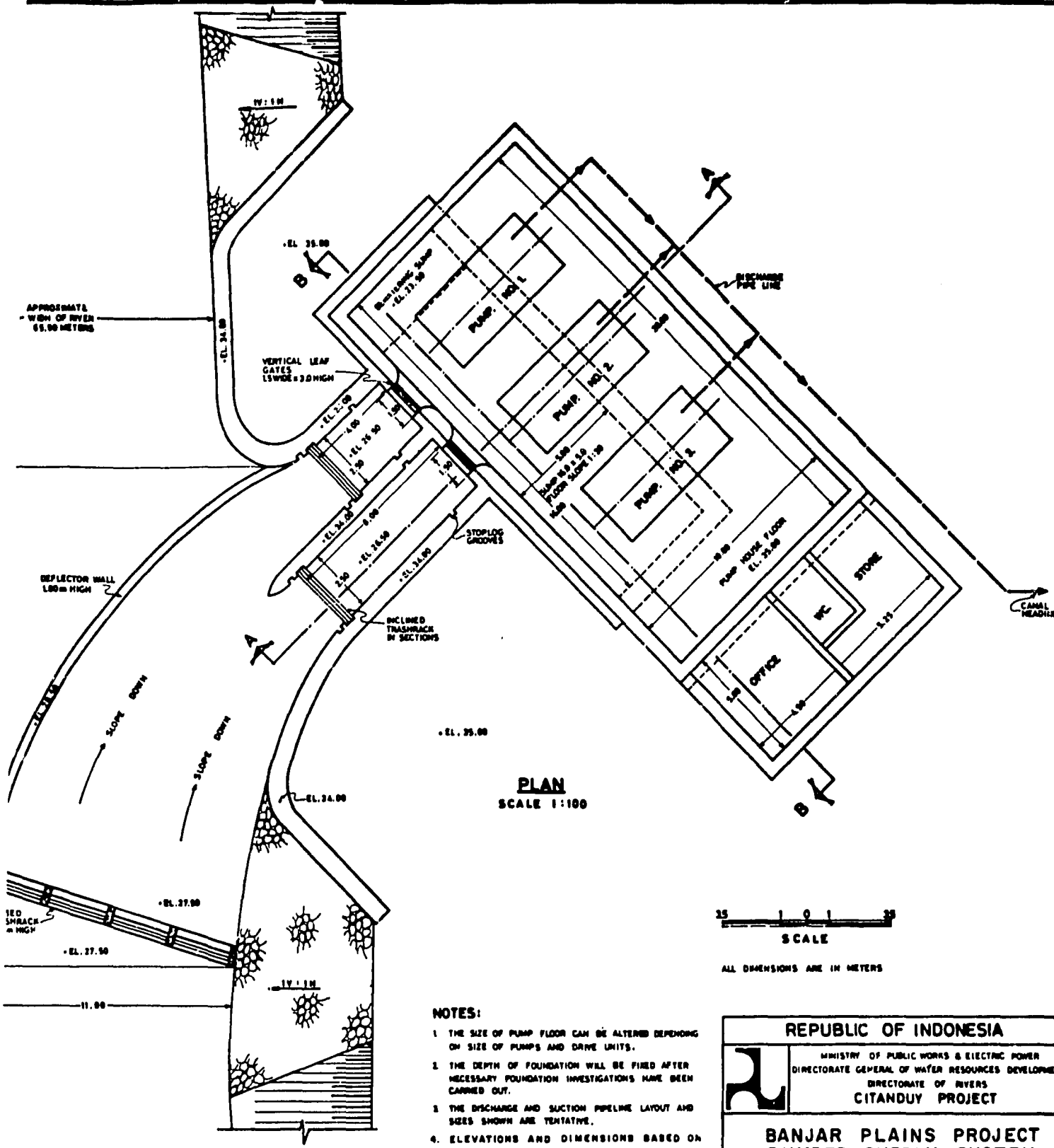

PLAN
SCALE 1:100

NOTES:

1. THE SIZE OF PUMP FLOOR CAN BE ALTERED DEPENDING ON SIZE OF PUMPS AND DRIVE UNITS.
2. THE DEPTH OF FOUNDATION WILL BE FIXED AFTER NECESSARY FOUNDATION INVESTIGATIONS HAVE BEEN CARRIED OUT.
3. THE DISCHARGE AND SUCTION PIPELINE LAYOUT AND SIZES SHOWN ARE TENTATIVE.
4. ELEVATIONS AND DIMENSIONS BASED ON PRELIMINARY SURVEYS AND DESIGN. THESE ARE SUBJECT TO CHANGE AT THE DESIGN STAGE.

REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS & ELECTRIC POWER
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DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
PUMPED SUPPLY SYSTEM
PUMPING PLANT

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

DRAWN	:	SUBMITTED	:
TRACED	: WALAMAN PW	RECOMMENDED	:
CHECKED	:	APPROVED	: F. E. FARMER
DATE	: MAY, 28—1977.	DRAWING NUMBER	

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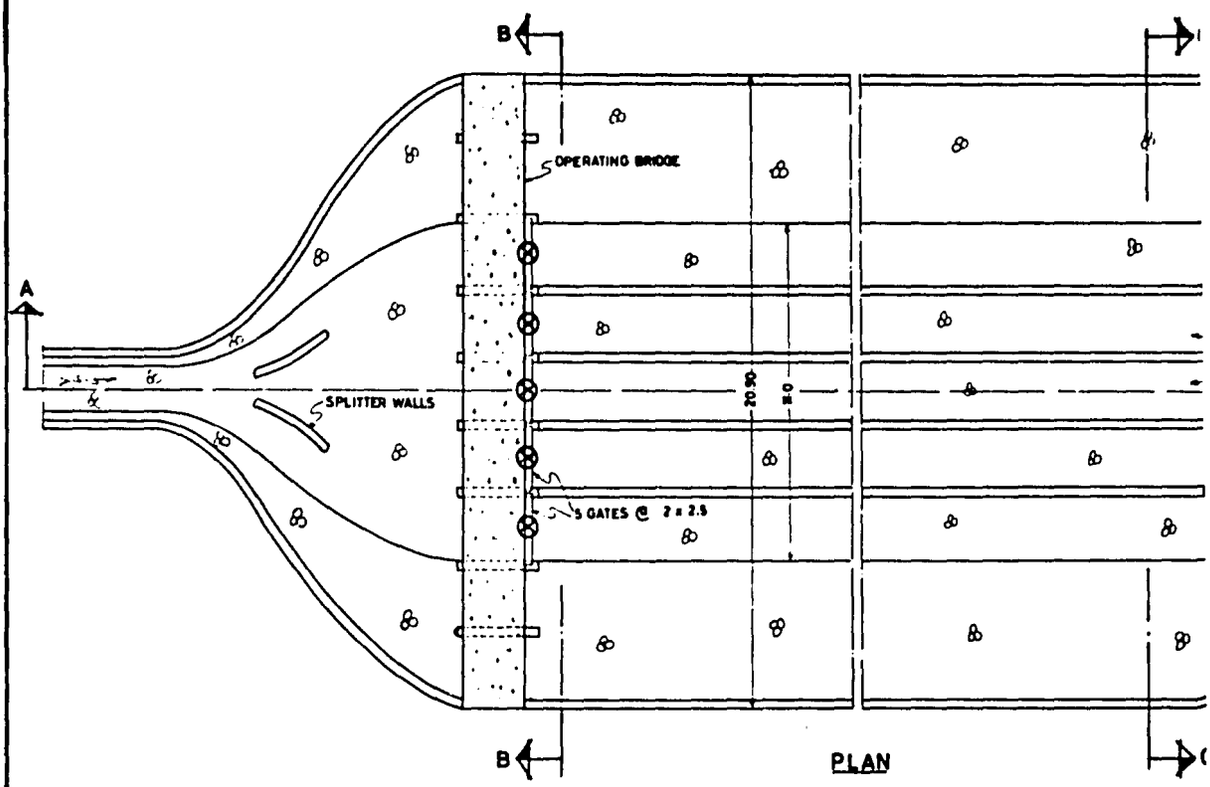
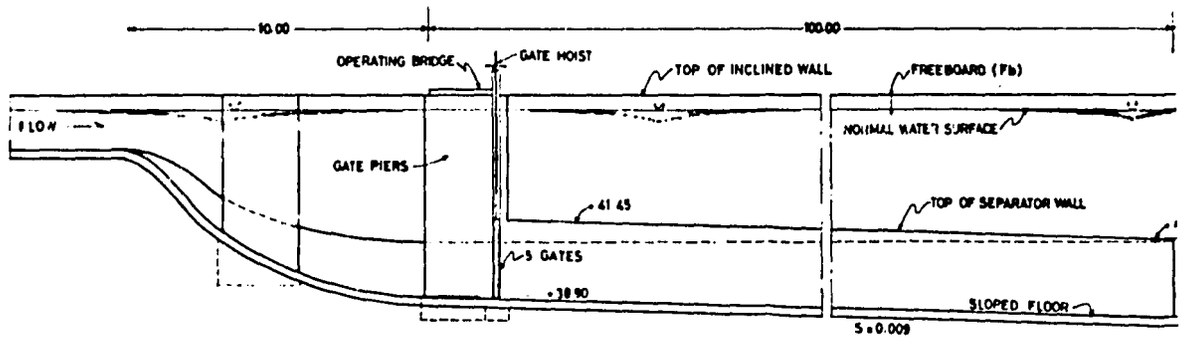
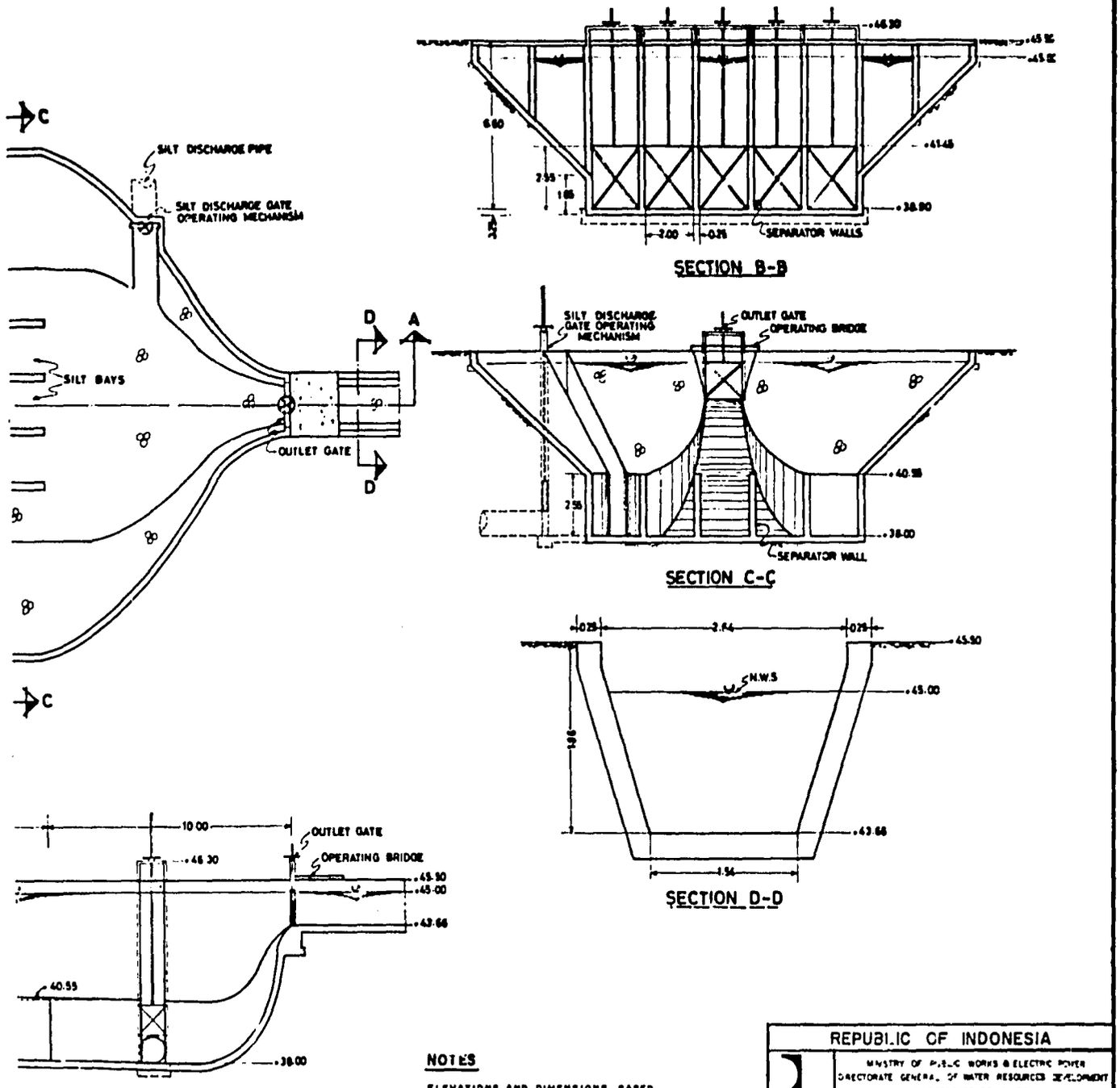


PLAN



SECTION A-A

FIGURE VII-10



NOTES

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DIRECTORATE OF RIVERS
CITANDUY PROJECT

BANJAR PLAINS PROJECT
PUMPED SYSTEM
DESILTING BASIN

ENGINEERING CONSULTANTS, INC
DENVER COLORADO, USA

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TRACED		RECOMMENDED	
CHECKED	A. POLASKY	APPROVED	P.E. FARMER
DATE	JULY 11 1977	DRAWING NUMBER	

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Chapter VIII

IRRIGATION AND DRAINAGE

Irrigation

The Banjar Plains Project will irrigate 785 ha of land suitable for lowland rice cultivation. About 350 ha is presently irrigated from rural systems. Irrigation water is derived from springs and creeks in the adjacent hills. Many of the canals used in these small rural irrigation systems are dual purpose and serve both irrigation and drainage. Except for road crossings, no other structures exists. In the design of the technical irrigation system, these existing canals have been incorporated, where possible for irrigation or drainage purposes.

This feasibility proposal divides the proposed irrigation area into two portions served by a main canal and a highline canal system. The command areas for main and highline canals are 626 and 159 ha, respectively. The gravity supply canal would serve about 15 ha directly.

Main Canal System

The main canal system service area of 626 ha is comprised of about 494 ha of riceland and about 132 ha presently planted to upland crops. The latter lands are mainly located along the Citanduy River. The highest lands which can be irrigated by the main canal have an elevation of about 43 m above mean sea level.

Irrigation water to the lands below elevation 43 m is supplied by the main canal and its distributaries. The main canal

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is 14.75 km long and traverses terrain with cross-slopes of up to 100%, averaging about 20%. Design capacities range from 1,500 l/s at the beginning of the canal to 50 l/s near the tail end. The design capacity of the canal are based on a water duty rate of 1.65 l/s/ha at the farm turnouts increased by the seepage losses in each reach. The main canal contains 6 lateral turnouts and 40 turnouts for smaller irrigation units. The schematic layout of the main canal irrigation system is shown on Figure VIII-1, and the main canal features are given in Table VIII-1.

The proposed main canal is composed of the following waterway sections.

Earth Canal Section	12.50 km
Cut Rock Section	0.10 km
Elevated Lined Section	0.53 km
Bench Flume Section	1.25 km
Elevated Flume Section	0.02 km
Railroad Siphon	0.08 km
Total Main Canal Length	14.75 km

The earth canal section of the main canal accounts for about 85% of the total length. The sections were selected for non-scouring and non-silting velocities using Kennedy's formula for trapezoidal sections, as discussed in Chapter VII. A service road with a width of 3.5 m is provided along the main canal to facilitate the operation and maintenance. The earth canal quantities have been determined based on a balanced cut and fill cross-section; fill comprises 85% of the cut to compensate for compaction and waste. Approximately 70% of the earth canal sections traverse terrain with 15% to 40% cross-slopes.

The seepage losses in the earth canals have been computed using the Moritz formula.

$$S = C\sqrt{\frac{Q}{V}}$$

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Where:	S	=	Loss in l/s per km length of canal.
	Q	=	Discharge in m^3/s.
	V	=	Mean velocity in m/s.
	C	=	4.7 for clay and clayey loam soils.

The rock cut sections are excavated 3 to 4 m into tuff and have 0.25 horizontal to 1 vertical sideslopes.

Elevated lined sections were used where the main canal traverses some of the low lying rice areas. The elevated sections are 2.0 to 2.5 m above ground surface and have a total length of 530 m. The design capacity ranges from 720 down to 120 l/s. The stone masonry lining is 20 cm thick with a 1/4 to 1 sideslope. The embankment top width is 1.0 m with a 1.5 horizontal to 1 vertical sideslope.

Bench flumes were used in terrain with a 40% to 100% cross-slope. Generally, these areas may be subject to landslides and require considerable back cutting.

The elevated flume at main canal station 1.14 has a design capacity of 1,500 l/s. The rectangular concrete structure cross-section measures 2.8 x 3.8 m and has a length of 20 m. The substructures consist of 4 untapered concrete piers with 5-meter spacing and a maximum pier height of 3.5 m.

The structures in the main canal consist of turnouts, check structures, wasteways, bridges, drain inlets and cross-drainage reinforced concrete pipe culverts. Table VIII-1 shows the number and design capacities of these structures.

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

Turnouts

A total of 43 turnouts have been proposed in the main canal with capacities ranging from 20 to 300 liters/sec. The turnouts have reinforced concrete wing walls and stone masonry inlet floors. The turnouts are provided with orifice gates of the circular type for discharge of 20 to 100 l/s, and with a rectangular type for discharges greater than 100 l/s. In addition, timber stoplog facilities have been provided to be used during repair or replacement of the orifice gates.

Checks

In order to maintain the required design water surface elevation in the main canal, 17 checks have been proposed. The gate mount, weir and bridge would be of reinforced concrete and the remaining part of the structure would be constructed from stone masonry. The checks would have double stoplog provisions to facilitate repair and replacement of the control gates. For canals with bottom widths greater than 1.0 m, double bay check structures are used in the design.

Wasteways

Wasteways are provided downstream of drain inlets in the main canal and at certain locations to facilitate maintenance of the canal. The wasteway structure will be similar to the check structure in design, but will have only timber stoplog provisions.

Cross-Drainage

To convey the storm runoff from the surrounding hills under the main canal, 59 cross-drainage culverts are provided, ranging from single barrel pipes 0.5 m in diameter to triple barrel 1 m diameter pipes. The hydraulic design of these culverts is discussed in Chapter VII.

Bridges

Two single-lane and three double-lane bridges are proposed for the main canal. The single-lane bridges would be 3.75 m wide and the double-lane bridges would have a width of 7.0 m. The bridge spans range from 3.62 to 6.9 m. The superstructure would be reinforced concrete T-beam section on stone masonry piers.

Main Canal Laterals

The main canal lateral system includes 6 laterals and one sublateral, with a total length of 9.29 km. The pertinent features of the main canal laterals are given in Table VIII-2. The design capacities range from 10 l/s to 312 l/s. The two main laterals are M2.45L and M8.80L, which have command areas of 182 and 110 ha, respectively. Except for a 10 m long elevated flume, all lateral canals consist of earth canal sections. The design water level of the laterals is assumed at 30 cm above ground surface.

Farm Distribution System

The farm distribution system, or the tertiary system, includes the main farm ditches, farm ditches and farm drains. The main farm ditches are supplied by farm irrigation canals which

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distribute irrigation water through a division box into the main farm ditch. The total length of main farm ditch is 34.25 km. The area served by a farm irrigation canal is normally up to 50 ha. The main farm ditch will convey water to 5 ha plots. From the main farm ditch, water is conveyed to each field by a farm ditch. The number of division boxes is based on the assumption that paddy-to-paddy irrigation in Banjar Plains Project should not exceed 150 m in distance.

The farm turnouts are sized based on land preparation requirement. Land preparation staggered over three ten-day periods (30 days) results in a maximum irrigation requirement at farm turnout of 1.65 l/s/ha. The farm distribution system capacity is designed for this duty factor.

Highline Canal System

The highline canal system will irrigate about 159 ha of land presently under cultivation. These lands are situated below the 49 m elevation. The highline canal, with a total length of 3.76 km, has a design capacity ranging from 100 to 275 l/s. The canal, as envisaged, is composed of the following waterway sections:

Earth Section	3.21 km
Elevated Lined Section	0.30 km
Bench Flume Section	0.16 km
Elevated Flume Section	0.09 km
TOTAL Highline Canal Length	3.76 km

The highline canal system layout is shown on Figure VIII-1, and the features are presented in Table VIII-3. The earth sections of the highline canal have cross-slopes up to 50% and the 160 m of bench flume has a 75% cross-slope. The elevated lined section from Station 0.56 to Station 0.90 is from 0.0 to 3.0 m above ground surface. The two elevated flume sections have

rectangular concrete canal cross-sections of 0.90 m x 0.80 m, and design capacities of 120 l/s. The substructure consists of 8 tapered and 10 untapered concrete piers with a spacing of 5 m and a maximum pier height of 3.0 and 5.0 m, respectively.

The highline canal lateral has a length of 1.72 km. The lateral H0.56L has a command area of 42 ha. The features of lateral H0.56L are tabulated in Table VIII-4. The highline canal system is also provided with a tertiary system. The total length of the main farm ditch for the highline system is 3.42 km.

Drainage

The Banjar Plains Project Area drains into the Citanduy and Ciraos Rivers. The latter is a tributary of the Citanduy River. The drainage in the project area is, for most part, reasonably good and no flooding is reported in the area, except for an area of about 50 ha west-southwest of kampung Pamangkolan. During heavy rains the rapid runoff of the adjacent steep hills cause flooding in this particular area. No data are available on frequency, depth and duration of the flooding. In some portions of the project area the water depth in the rice paddies after heavy rainfall remains too high for optimum growing conditions. The existing drains in the project area require improvements and new drains need to be added in order to dispose of the storm runoff and irrigation return flow.

Drainage Flow

A design drainage flow intensity for paddy fields and small hilly catchments has been developed and used in determining the drainage canal capacities. The peak discharge of the small hilly catchments to be used in this feasibility report was estimated on the basis of a single storm of one-hour duration and 11 cm depth

over a theoretical watershed, resulting in the relation:

$$Q = 2.4\ S^{0.38}\ A^{0.76}$$

Where: Q = Peak discharge in m^3/s.

S = Lower semi-basin slope in m/m.

A = Catchment area in km^2.

For paddy fields where a maximum flood storage of 48 hours was allowed, the drainage flow intensity for a 10-year design flood was computed at 6 l/s per hectare. The drainage capacity was based on the above criteria and was taken from the design report.[1/]

Drainage Layout and Features

The layout of the proposed primary and secondary drainage system is presented in Figure VIII-2. Aside from the Ciraos River, the primary drainage system consists of 4 drains with a total length of about 16.5 km, and capacities ranging from 1 m^3/s to 11 m^3/s. The secondary drains have a total length of about 21.5 km and drain capacities vary from 0.5 m^3/s to 2.0 m^3/s. About 60% of the designed drains are existing and have to be improved in order to cope with the design flows. The runoff from the hills surrounding the lowland rice is conveyed under main and highline canals and laterals by cross-drainage culverts, and collected in proposed drainage canals at the toe of the hill slopes.

The capacities of the drainage canals were determined using Manning's formula. The maximum velocities are governed by the maximum tractive force for non-scouring velocities. For maximum

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1/ "Design Report-Drainage and Irrigation", Citanduy Project, Engineering Consultants, Inc., Denver, Colorado, U.S.A., November, 1976.

tractive force for non-scouring velocities. For the clayey soils in the project area, a maximum tractive force of 1.25 kg/m^2 was adopted. The following relationship for tractive force was used:

$$\tau = \gamma RS$$

Where: τ = Tractive force in kg/m^2.

γ = Unit weight of water; 1,000 kg/m^3.

R = Hydraulic radius in m.

S = Canal slope.

The minimum design velocity in the drainage canals shall be not less than 0.5 m/s. The drainage canals would be constructed below the average natural ground surface.

The structures for the proposed drainage system include drops, culverts, drain inlets, and sideslope and bed protection. The number and design capacities are tabulated and shown in Table VIII-5. The drops and drain inlets were designed in stone masonry. The drainage system consists of 26 road culverts of which 4 were designed as double barrel box culverts. The remaining 22 culverts have been designed with reinforced concrete pipes. Riprap and gravel blankets were used in the design estimate for the 1,260 m of armored section.

TABLE VIII-1
(Continued)

Main Canal Features

REACH	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8
STATION	0.00-2.45	2.45-6.34	6.34-7.90	7.90-8.80	8.80-11.50	11.50-12.47	12.47-14.06	14.06-14.75
Turnout								
Q = 20 l/s	1	8			2	2	1	3
50 l/s	3	5	7		2	3	2	
100 l/s		2						
200 l/s				1				
300 l/s	1							
Check	2	4	2	1	3	1	2	2
Q (l/s)	1,150	800	566	400	220	180	135	100
Wasteway	1	1	2		2	1	1	1
Q (l/s)	1,150	800	566		220	180	135	100
RCP Culvert								
Ø 0.5 m	8	11	6		6	3	6	4
Ø 1.0 m	1	3	3		2	1	2	
2-Ø 1.0 m		1			1			
3-Ø 1.0 m		1						
Bridge								
Single Lane	1	1						
Span (m)	6.90	5.92						
Double Lane		1					1	1
Span (m)		5.92					3.90	3.62
Drain Inlet	1	1						
FREE-FLOW								
Siphon (RR)							1	
Length (m)							80	

TABLE VIII-1

Main Canal Features

REACH	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8
STATION	0.00-2.45	2.45-6.34	6.34-7.90	7.90-8.80	8.80-11.50	11.50-12.47	12.47-14.06	14.06-14.75
Length (m)	2,450	3,890	1,560	900	2,700	970	1,590 1/	690
Earth Section								
B (m)	2.40	2.00	1.25	1.00	0.80	0.60	0.50	0.40
Q (l/s)	1,500	1,200-875	566-400	400-390	220-180	180-135	135-100	100-50
L (m)	2,350	3,830	1,280	130	2,560	560	1,370	1,740
X-Slope (%)	6-30	0-40	20-35	20	0-30	15-35	5-30	0-35
Rock Cut Section								
B (m)	2.80			1.00				
Q (l/s)	1,500			395				
L (m)	80			20				
Elevated Lined Section								
B (m)		1.7	1.00		0.60	0.60	0.50	
Q (l/s)		800	461		180	175	120	
L (m)		60	220		60	50	140	
Bench Flume Section								
B (m)			1.00	1.00	0.60	0.60		
Q (l/s)			417	395	182	1[illegible]		
L (m)			60	750	80	360		
X-Slope (%)			60	65-75	50	40-100		
Elevated Flume Section								
B (m)	3.8							
Q (l/s)	1,500							
L (m)	20							

1/ Reach M-7 includes 80 meters of Railroad Siphon.

TABLE VIII-3

Highline Canal Features

Reach	H-1	H-2	H-3	H-4
Station	0.00-0.56	0.56-0.90	0.90-3.10	3.10-3.76
Length (m)	560	340	2,200	660
Earth Section				
B (m)	0.70		0.40	0.40
Q (l/s)	195		100	75
L (m)	400		2,200	610
X-Slope (%)	0-30		0-50	15-35
Elevated Lined Section				
B (m)		0.50		
Q (l/s)		135		
L (m)		340		
Bench Flume Section				
B (m)	0.50			
Q (l/s)	195			
L (m)	160			
X-Slope (%)	75			
Elevated Flume Section				
B (m)				0.40
Q (l/s)				65
L (m)				50
Turnout				
Q = 20 l/s			4	2
Q = 50 l/s	1	1	1	1
Q = 100 l/s	1	1		
Check	1	1	3	1
Q (l/s)	195	135	100	75
Check - Drop				
Q (l/s)				
Drop				
Q (l/s)				
Wasteway		1	1	1
Q (l/s)		135	100	100
RCP Culvert				
Ø 0.50 m	3		6	2
Ø 1.00 m			3	
Two-Lane Bridge			1	
Span (m)			4.12	

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TABLE VIII-2

Main Canal Lateral

Lateral		Earth Canal				Turnout				Division Box			
Name	Reach	Length (km)	Q (l/s)	Check	Drop		Q (l/s)	Flume X-ing	Rail-road Siphon	1-Way	2-Way	Rail-road Siphon	End Check and Wasteway
M0.5L	1	0.20	38		3	1	18					1	
	2	0.12	25	1		2	25		1				1
M1.65L	1	0.08	32		1	2	10		1			1	
	2	0.15	25	1	4	1	10		1				
	3	0.11	18	1		2	10						
	4	0.19	10	2	1	2	10						1
M2.45L	1	0.20	312		2	1	87		1			1	
	2	0.45	254	1	1	1	90						
	3	0.63	207	1	1	1	63	1					
	4	0.72	179	1		1	25	1					
	5	0.42	158	1	1	1	48		1				
	6	0.22	138	1		1	18						
	7	0.28	133	1	1	1	63						
	8	0.42	104	1		1	25		1				
	9	0.08	94	1		1	94						1
M2.45L	1	0.18	87			1	18						
/0.2L	2	0.42	76	1	2	2	76		1				1
M4.39L	1	0.01	50	ELEVATED FLUME									
	2	0.03	50			1	28		1				
	3	0.14	32	1		1	18						
	4	0.22	25	1		1	18						1
M6.24L	1	0.22	94		2	1	18						
	2	0.33	87	1		1	18						
	3	0.02	79	1		1	38		1				
	4	0.15	58	1		1	38						
	5	0.78	32	3		3	32						1
M8.80L	1	0.32	195			1	25						
	2	0.02	172	1		2	25		1				
	3	0.52	164	2		2	58		1				
	4	0.14	132	1		1	43						
	5	0.36	116	1		2	43	1	1				
	6	0.44	98	2		2	43	1	1			1	
	7	0.72	87	2	2	2	58						1
Total	Lat.	9.29	10-312	31	21	44	10-94	8	13			4	7

TABLE VIII-5

Drainage System

Design Capacity (m^3/s)	Existing Drains (km)	Proposed Drains (km)	Drop	Culvert	Drain Inlet	Sideslope and Bed Protection (m)
0.5	4.90	6.15	21	15	11	
1.0	3.60	3.75	3	3	4	
2.0	1.20	2.50	6		4	
3.0	2.70	2.80	6	4		
4.0	0.50	0.30			2	
5.0	2.00					840
6.0	0.85					
7.0	1.80			3		420
9.0	0.45			1		
11.0	1.10					
13.0	3.40					
Total	22.50	15.50	36	26	21	1,260

TABLE VIII-4

Highline Canal Lateral

Lateral		Earth Canal				Turnout		Road-way	Division Box		End Check and	Cross Drainage
Name	Reach	Length (km)	Q (l/s)	Check	Drop		Q (l/s)	Siphon	1-Way	2-Way	Wasteway	Culvert
HO.56L	1	0.08	100			1	38	1				
	2	0.66	87	1		1	32					1
	3	0.61	71	1		1	32	1				2
	4	0.37	53	1		1	53				1	2
Total	Lat.	1.72	17-100	5		7	17-53	2			2	10

Chapter IX

PROJECT COSTS

General

The past few years have seen construction costs undergo major adjustments throughout the world. This abrupt and continuing rise in costs was triggered principally by the dramatic increase in the price of crude oil since 1973. Construction cost estimates have always been subject to inflationary and other pressures, but the degree of accuracy which was common in the past may not be attainable in the future.

The magnitude of project features, the need to adhere to an economic and practical construction schedule, and the restraints imposed by the technical engineering and construction specifications involved all influence and, indeed, dictate the choice of the construction technology to be used on the various project features. This, in turn, will have a direct bearing on the relative proportions of labor, material, and equipment costs as well as the distribution of foreign and domestic currency components.

The size and magnitude of the features of the Banjar Plains Project are ideally suited for execution by labor intensive methods. Further, a major portion of the work can be handled by local contractors with either equipment available within the country or supplementing it with imports.

The foreign currency requirement will be mainly for pumping plant equipment, diversion wier shutters, regulator gates, major construction equipment, spare parts for equipment, structural steel and reinforcing steel, engineering services for a consultant for construction supervision, along with office and other equipment not available in Indonesia. The main elements that will be financed in domestic currency will be construction equipment

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available in country, fuel, oil and lubricant, inland transportation, fabrication of structural steel, cement, lumber and other construction material, salaries and wages of laborers and Indonesian staff employed on the project.

The cost estimate has been prepared for the two schemes discussed in Chapter VII. They are, (1) Gravity System, and (2) Pumped System. The operation and maintenance costs for the two schemes have also been estimated.

Project Estimate

Cost items for each feature were considered separately and their costs determined. Most costs were determined by first computing the quantity from preliminary designs and then applying the unit price for that item. Some of the items for which quantity estimates could not be made were costed on a lump-sum basis. The identification of the items and quantity evaluation was carried out to a feasibility level.

Both the Gravity System and the Pumped System were divided into eleven (11) separate components for estimate purposes. Of these components, the following seven (7) components are common between the two systems:

Main Canal - Reach M-1 to M-8
Main Canal - Laterals
Main Canal - Tertiary System
Highline Canal - Reach H-1 to H-4
Highline Canal - Laterals
Highline Canal - Tertiary System
Drainage System

The Main canal and Highline canal systems were divided into reaches (sub-systems) on the basis of hydraulic size to facilitate

cost and quantity computation. The detailed estimate for these and the Drainage system are included in the Appendix volume. In forming the estimate for these items, several alternatives for waterways, waterway structures, etc., were compared on the basis of relative cost. Many alternative alignment and apportionment of service area between the Main and Highline canals were compared.

The other components of the Gravity system are, (1) Diversion Weir, (2) Desilting Basin, (3) Gravity Supply Canal, and (4) Highline Pumping Plant. The detailed estimate for these items is presented in Table IX-3. The alternative Pumped system components are, (1) Main Pumping Plant, (2) Desilting Basin, (3) Relift Pumping Plant, and (4) Link Supply Canal. The detailed estimate for these items is presented in Table IX-5. The above estimates are based on feasibility level designs discussed in Chapter VII-Project Features.

Quantities

Quantities for unit price items were generally obtained by direct computation of the amounts of work or material involved in construction. Earthwork quantities for structures were computed by superimposing the structure over topographic maps. Tables of earthwork quantities and right-of-way requirements were prepared for canals and other waterways using size and cross-slopes as variables. Separate tables were prepared for supply aqueducts (water prism below natural ground level), for delivery canals in balanced cut and fill, and for distribution waterways where the water surface is above cropland.

Concrete, masonry, steel, timber and similar quantities were calculated from standard design drawings and from feasibility designs of features for this Project Report.

Control, orifice and check gates were designed for the features involved and their assembled weights calculated from

material quantities used while gate valve weights were obtained from manufacturers catalogs. Pipe quantities were determined from feasibility design drawings for structures and from tables of quantities for culverts, turnouts, etc.

Unit Prices

Unit prices for work and material quantities were computed at 1976 price levels. Many prices were obtained from successful bid data for similar cost items over recent years. Some prices were obtained for material costs and work estimate records of Citanduy Project, adjusted for contractors profit. Per-item costs for items such as pumps, engines and weir shutter gates were obtained from manufacturers and suppliers recent quotations.

Earthwork prices were obatined from the Citanduy Project Office and are based on 1976 Project material costs and work estimates. Adjustments were made for estimated labor requirements such as preparing pipe beds, trimming for structures and other hand labor, to obtain structural excavation prices.

Concrete prices were obtained from successful bid data. The bids generally included reinforcement costs which were separated out for this feasibility estimate. Basic concrete cost, including contractor profit and overhead, was obtained for items such as mass concrete, floors and footings. This was found to average Rp. 23,200 per m^3, adjusted to 1976 price base. Concrete in superstructures was found to average Rp. 83,250 per m^3 (exclusive of reinforcement); the difference representing forming, scaffolding, and false work costs. Steel reinforcement (smooth roll, local) was estimated to cost Rp. 280/kg in place, using the Project material and work estimates data. Unit prices used in this feasibility estimate, with some variations for special conditions, are presented in Table IX-1. The unit prices for certain items are shown to vary depending on site conditions, lead, etc.

Lump-Sum Items

Lump-sum items are generally estimated from previous bid items or from estimates of equipment, materials, fuel and labor over a specified duration. The field facilities item for Banjar Plains weir was taken from costs of office building, godowns, mandi's, utilities and similar facilities for previous weir construction in the Citanduy Basin. Dewatering was estimated from equipment, fuel and labor costs over the construction period. Diversion of flow for culverts and drainage structures were estimated to be 10,000 Rupiahs per structure, all labor cost. Lump-sum detour and traffic maintenance costs are engineering judgement estimates. The lump-sum electrical/mechanical accessories costs for the Pumping Plant alternative were based on similar plants. This item was scaled down for the Highline Pump Station estimate.

Cost Base

The estimates, prepared for both the Gravity system and the Pumped system, were based on the 1976 cost, as the unit prices were either available or developed to that base. The estimates were then updated to reflect the 1977 costs by using a general cost escalation factor based on inflation. These factors are different for domestic and foreign components. An inflation rate of 20 percent was applied to all domestic items, while 7 percent was used for foreign items.

It was estimated that for main items, such as pumping plants, the foreign currency cost component would be 35 percent while for all other items, such as diversion weir, desilting basin, canals and canal structures the foreign currency cost would be 18 percent. The escalation factors used are 1.1545 and 1.1766 for the 35 percent and 18 percent foreign component items, respectively.

Contingencies

A contingency factor of 15 percent was applied to the calculated costs of Banjar Plains features. This factor is required to allow for unforeseen developments such as design changes, unit cost increases, minor inflation and changed conditions. It also is required to compensate for minor cost items not detailed at the feasibility level, oversight and computational errors, and data reliability. Discrepancies in topographic data that were not reconciled at the time of preparation of this Report mandates that an allowance be made to compensate for adverse data.

Engineering and Administration

Engineering services consist of final design construction drawings, specifications, construction field investigations, and surveying and mapping for final design. Administration services consist of supervision and inspection of construction, procurement of required construction goods and services, and general supervision and coordination of all forces involved in constructing the project. An allowance of 15 percent over the total cost of the project, including the 15 percent contingencies, is deemed adequate to cover the costs for the above mentioned items.

Cost Summary

Cost estimate abstracts for the Gravity System and the Pumped System are presented in Tables IX-2 and IX-4, respectively. The detailed estimate for the two systems are presented in Tables IX-3 and IX-5. As mentioned earlier, the escalation factors were first applied to the estimated costs for each of the major items, depending on the foreign component, to bring the cost to 1977 base. Over this cost, first a 15 percent Contingency was

applied, followed by a 15 percent Engineering and Administration cost.

The total cost of the Gravity system is Rp. 1,700,504,000, while that of the Pumped system is Rp. 1,575,522,000.

Operation, Maintenance and Replacement

Operation, Maintenance and Replacement costs for the project is dependent on the scheme selected. A detailed scheme for the operation and maintenance phase of the project is presented in the Appendix volume. The scheme has been formed with the assumption that the Banjar Plains Project will be under an administration control similar to the other irrigation systems in the Citanduy Basin.

Operation and Maintenance is a vital part of water management for the Banjar Plains Irrigation system to achieve the crop production identified in this report. The success of this proposed project will vary directly with the success achieved in the O & M of this irrigaton system. Project Citanduy will be able to offer support to the Banjar Plains irrigation system only if budget funds are provided to accomplish a specific O & M work plan each year. Operation and Maintenance efficiency will improve each year to the extent that Administrative Management evaluates actual costs of operating experience in comparison with work and results actually accomplished.

The Banjar Plains Project is a run-of-the-river project with a "flow through" irrigation system. The "flow through" irrigation practice provides several advantages to O & M phases of the system. After the desilting basin removes a major portion of the suspended silts, the irrigation canals provide a domestic raw water supply to nearby villages enroute to the farmers' fields. Once the system is put in operation, a constant flow of water

through the supply canal is maintained resulting in a constant water level at the tertiary headgates during the growing season of the rice crop. However, maintenance of the canals and distributary system to carry the design flows forms the single-most important factor in any O & M scheme.

Costs

The annual costs of Banjar Plains Irrigation system was estimated based on a 50-year economic life of the major civil structures in accordance with current practice for similar irrigation projects in Indonesia. This economic life is being used for the current rehabilitation works for irrigation systems in the Citanduy Basin.

The annual O, M & R costs are estimated as a combination of the following:

1. Operation Costs

These costs include staff positions at current labor costs, plus fuel and lubrication, plus communication and administrative costs, and are approximately 1% to 2% of the estimated cost for the Gravity and Pumped systems.

2. Maintenance Costs

Routine maintenance, inspection and administrative costs are included in this item, and they vary from 1% to 10% of the estimated cost, depending on the item. The percentages used for various items is shown in Table IX-6.

3. Replacement Costs

Moving parts subject to scour, wear, abrasion, erosion, cavitation or corrosion require periodic overhaul and

replacement. The costs required for replacement costs for the Gravity system and the Pumped system for 5, 10, and 25-year replacement periods were taken from the cost estimates. The useful life, in years, for various components is shown in Table IX-6.

The annual operation cost, maintenance cost and replacement cost for 5, 10, and 25-year replacement periods for the Gravity system and Pumped system is presented in Tables IX-7 and IX-8, by subheads. The details of these cost are given in the Appendix volume. It is seen that the annual operation and maintenance cost for the Gravity system amounts to Rp. 57,851,000 and Rp. 81,694,000 for the Pumped system. The 5, 10, and 25-year replacement cost for the Pumped system is greater than the Gravity system as seen from Tables IX-7 and IX-8.

O, M & R Cost Comparison

An O, M & R cost comparison was made between the Gravity system and the Pumped system to determine the total present worth of the O, M & R costs to be expended over the period of analysis. For this, the 5, 10 and 25-year replacement costs were first converted to an annual cost at an interest rate of 12 percent, assuming the life of the project to be 50 years. The replacement costs that occur on the fiftieth year are not considered as the project life is 50 years. The annual O, M & R cost for the Gravity system is Rp. 72,627,000 and for the Pumped system it is Rp. 133,655,000. This is shown in Table IX-9. Thus, the Pumped system will cost about Rp. 61,028,000 each year more to operate than to the Gravity system.

The present worth of the O, M & R cost over the 50 years was computed from the annual costs, assuming the interest rate to be 12%. This is also shown in Table IX-9. It is seen that the present worth of the O, M & R costs is Rp. 603,131,000 for the

Gravity system as compared to Rp. 1,109,938,000 for the Pumped system, which is an increase of Rp. 506,807,000 for the Pumped system.

O & M Coordination

It is vital that an understanding of the continuous O & M responsibility for the Banjar Plains Irrigation system be reached and agreed upon before the design of the project is completed. O & M considerations should be reviewed during the design.

A commitment to provide an O & M budget annually to the Irrigation Service should be secured from the Province of West Java before construction is started to insure crop production levels stated in the project benefits. Continuous, responsible O & M will make future rehabilitation unnecessary for the Banjar Plains Irrigation System.

Project Selection

A total cost comparison of the Gravity System and the Pumped System was carried out to determine the most economical Project. This is based on the capital cost of the project, the interest during construction and the present worth of the O, M & R costs. The capital cost of the two projects is given in Table IX-2 and IX-4, and the present worth of the O, M & R in Table IX-9. The interest during construction is computed on a three-year construction basis with capital outlays of 25%, 45% and 30% during the first, second and third year of construction, respectively. The interest rate is taken as 12%.

The cost comparison of the two systems is shown in Table IX-10. It is seen that the Pumped System costs Rp. 3,082,207,000 as compared to Rp. 2,731,661,000 for the Gravity system. Thus, the total cost of the Pumped System is Rp. 350,366,000 more than the

Gravity System.

In addition to the increased costs, a Pumped System is not favored over a Gravity System by the Director General of Water Resources, Republic of Indonesia, because of inherent operational and maintenance difficulties, and lack of skilled manpower. Hence, from both cost and operational points of view, the Gravity System is recommended for the Banjar Plains Project over the Pumped System.

Construction Schedule

The major project features of the Gravity System are physically and geographically separated from each other. This will permit scheduling the construction of each feature as simultaneous operations, to a large extent.

Construction of the diversion weir, desilting basin, gravity supply canal, main canal system, highline pumping plant, highline canal system, and the drainage system is proposed to be carried out in a three-year construction period following award of contract. The recommended capital outlay for the three years will be 25%, 45% and 30%. At the 1977 level of estimate, the capital required for the three years will be:

First Year	Rp. 425,126,000
Second Year	Rp. 765,227,000
Third Year	Rp. 510,151,000

During the first year it is proposed to complete the foundation works for the diversion weir, desilting basin, along with earthwork for the canals. Procurement of construction materials, ordering for major structural items such as regulator gates, weir shutters and pumping plant will be included in the first year. In the second year, a major portion of the diversion

weir including all concreting, and a large portion of the masonry work will be carried out. The concreting work on the desilting basin will be undertaken. It is expected to complete at least 40% of the cross-drainage works on the canal system along with a major portion of the earthwork for the canal. Work on the highline pumping plant will be started. Half of the work on the drainage system will be completed. The last year of construction will include erection of gates and shutters on the weir; diverting river into the weir section; construction of dike; completion of desilting basin; installation of highline canal pumps; completion of all civil work on the canal and drainage systems. It is proposed that irrigation water will be supplied to the service area during the fourth year of the project.

Municipal Water Supply System Cost

A reconnaissance level study of a municipal water supply system was prepared to provide an evaluation of treatment, delivery and distribution cost. This system would be able to deliver 269 l/s at full development with provision for overhead storage to meet the peak daily demand.

Water for the municipal system would be obtained from the project main canal, Reach M-2, at or near the treatment plant. The treatment plant and the primary storage reservoir will be located just west of the Banjar-Manonjaya road after it crosses the Banjar-Bandung railroad. The location is shown on Figure III-5, in Chapter III-Municipal and Industrial Water Supply.

The estimate of the annual cost for the municipal water supply system which includes construction, operation, maintenance and replacement is presented below.

Annual Equivalent Costs	Million Rupiahs
Construction Cost	609
O,M & R Cost:	
Operation and Administration	53
Maintenance and Equipment	56
Replacement:	
Annual	103
Interim	24
Treatment Chemicals and Supplies	51
Fuel	5
Total Annual Cost	901

The above costs were estimated by present value analysis using an interest rate of 12% and an amortization period of 50 years. Municipal costs were prorated over a 20-year period of increasing water usage. The above discussed costs will not be considered in the economic analysis of the Banjar Plains Project. It is to be emphasized that a separate study is required to develop detailed plan for the municipal water supply system and estimate its cost.

TABLE IX-1

Unit Prices
(1976)

Cost Item	Unit	Price (Rupiahs)
Excavation	m^3	465
Excavation, Structural	m^3	650*
Compacted Embankment	m^3	650
Excavation, Rock, Tuff	m^3	1,080
Excavation, Structural,Rock	m^3	1,900*
Overhaul	km/m^3	1,000
Concrete, Superstructure	m^3	83,250
Concrete, Columns and Wall	m^3	53,200*
Concrete, Half-Formed, Finished	m^3	35,000
Concrete Slab, Bulk, Footing	m^3	23,200
Stone Masonry, Double Face	m^3	23,700*
Stone Masonry, Single Face	m^3	15,800
Steel Reinforcement	kg	280
Riprap and Gravel Armor	m^3	3,220
Road Paving, Bituminous	m^2	1,750
Road Surfacing, Stone	m^2	480
Control Gates, Steel Fabricated	kg	800
Measuring Tubes, Water Stage	Pair	160
Gate Valves, Cast, Machined	kg	1,670
Timber in Gates	m^3	350,000
Timber Stoplogs, Footbridge	m^3	140,000
Concrete Culvert Pipe, 100 cm	m	34,900*
Concrete Culvert Pipe, 80 cm	m	27,900*
Concrete Culvert Pipe, 50 cm	m	17,450*
Steel Pipe, Welded	kg	750
Steel Pipe, Manifolds	kg	900
Tile, Concrete or Clay, 10 cm	m	1,470
Bridge Rails, Steel, 5 cm	m	1,750
Clearing and Stripping	m^2	50
Right-of-Way	ha	166,000

* Varies.

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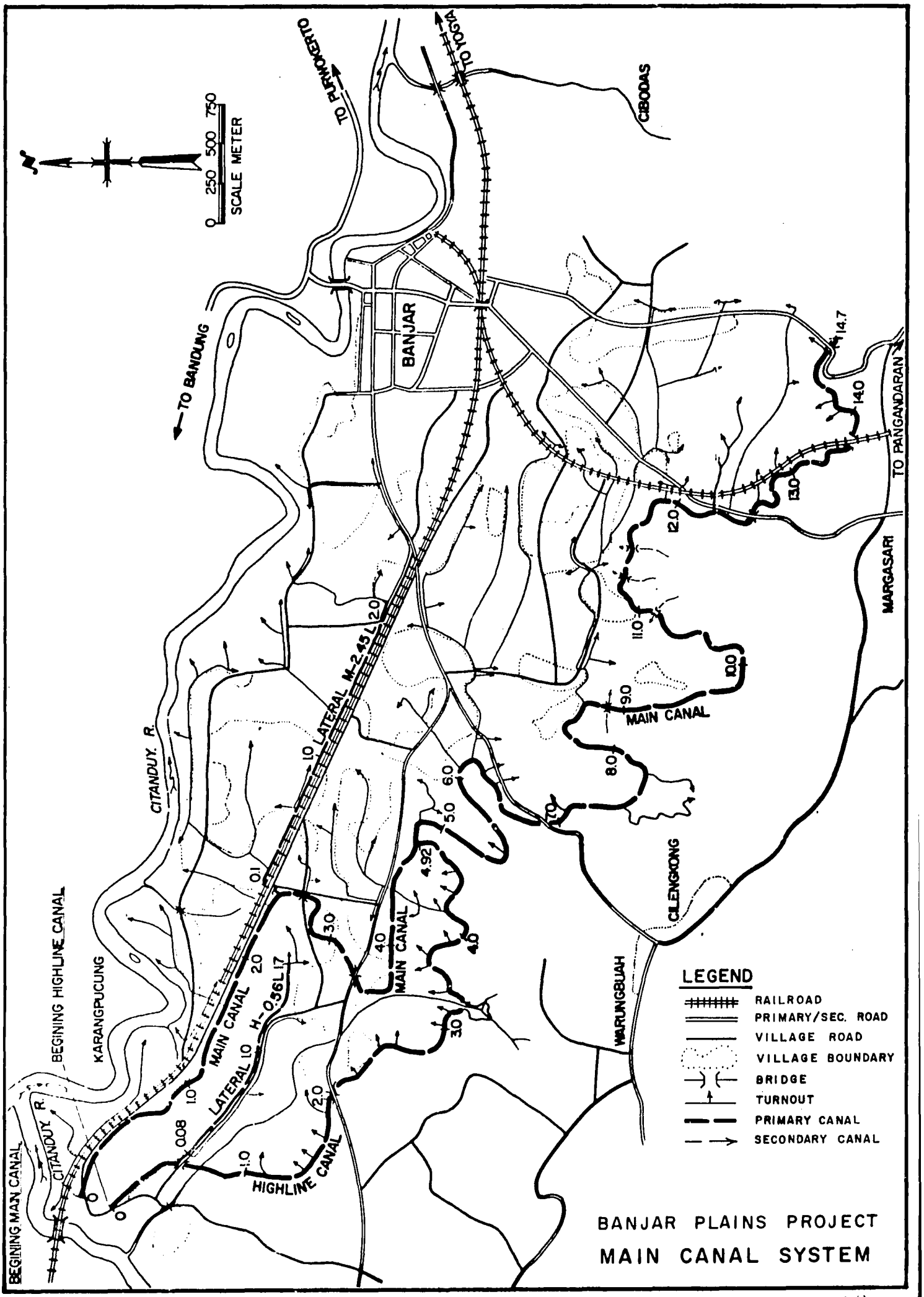
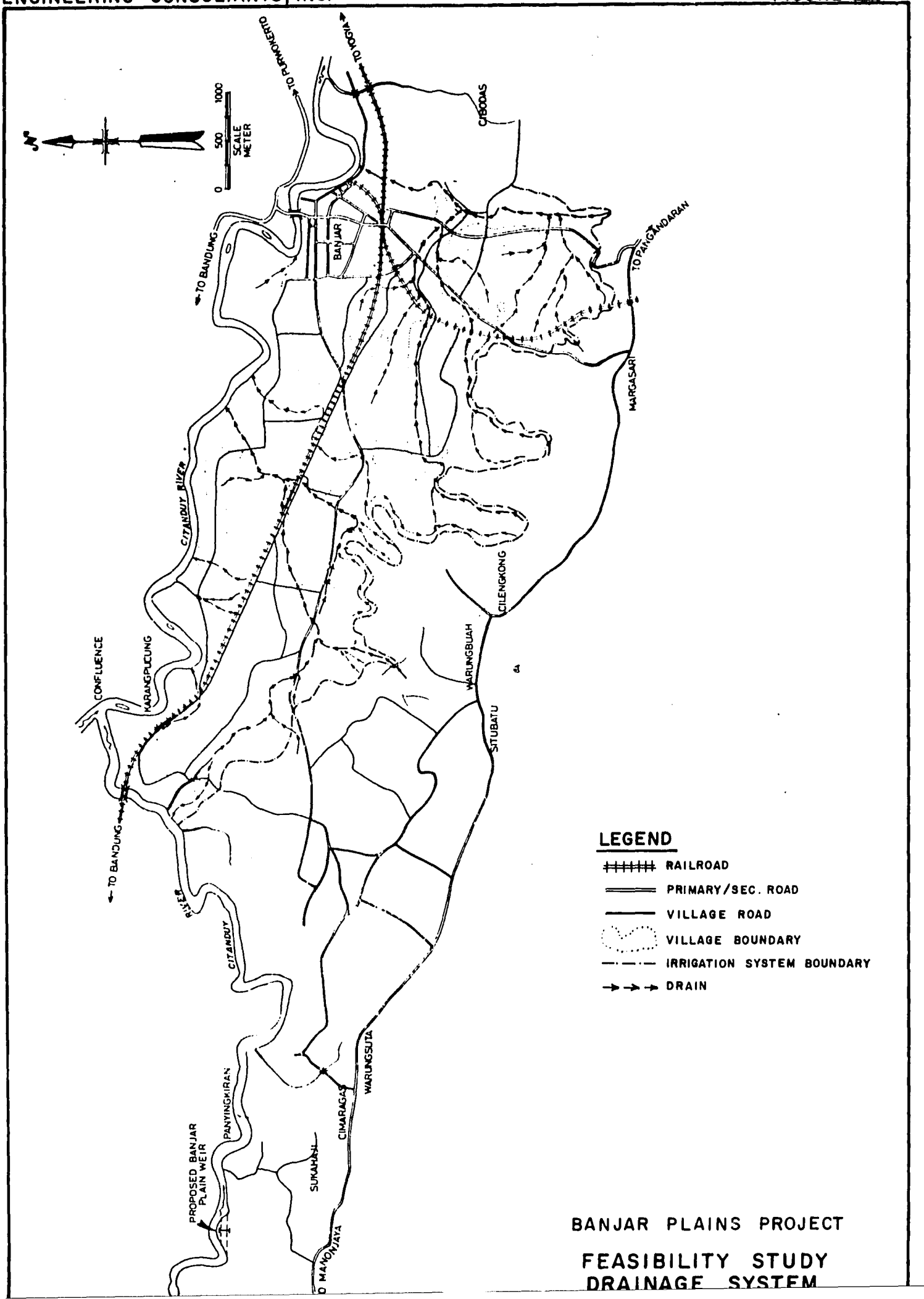
TABLE IX-2

Cost Estimate

GRAVITY SYSTEM				
Item No.	Item	Cost 1976 (Million Rp.)	Inflation Factor for 1977	Cost 1977 (Million Rp.)
1.	Diversion Weir	385.228	1.1766	453.259
2.	Desilting Works	83.115	1.1766	97.793
3.	Highline Pumping Plant	16.593	1.1545	19.157
4.	Gravity Supply Canal	219.222	1.1766	257.937
5.	Main Canal, Reach M-1 to M-8	185.161	1.1766	217.860
6.	Main Canal-Laterals	33.675	1.1766	39.622
7.	Main Canal-Tertiary System	59.589	1.1766	70.112
8.	Highline Canal, Reach H-1 to H-4	33.362	1.1766	39.254
9.	Highline Canal-Laterals	6.393	1.1766	7.522
10.	Highline Canal-Tertiary System	6.729	1.1766	7.917
11.	Drainage System	64.076	1.1766	75.392
	Sub-Total			1,285.825
Contingencies (15%±)				192.874
	Field Cost			1,478.699
Engineering and Administration (15%±)				221.805
	Total Cost (Million Rupiahs)			1,700.504
	Total Cost Million U.S. Dollars ($1.00=Rp.415.00)			4.097

Note: The costs presented in the following tables are based upon questionable topographic maps. Revisions may be necessary when surveys are completed.


BANJAR PLAINS PROJECT
MAIN CANAL SYSTEM
LEGEND
RAILROAD
PRIMARY/SEC. ROAD
VILLAGE ROAD
VILLAGE BOUNDARY
BRIDGE
TURNOUT
PRIMARY CANAL
SECONDARY CANAL
SCALE METER
0 250 500 750
TO BANDUNG
TO PURWOKERTO
TO TOGA
TO PANGANDARAN
BANJAR
CIBODAS
MARGASARI
CILENGKONG
WARUNGBUAH
MAIN CANAL
LATERAL M-2.45 L
LATERAL 1.0 H-0.56 L 1.7
HIGHLINE CANAL
BEGINING HIGHLINE CANAL
BEGINING MAIN CANAL
KARANGPUCUNG
CITANDUY R.



BANJAR PLAINS PROJECT

FEASIBILITY STUDY
DRAINAGE SYSTEM

TABLE IX-3

Cost Estimate (Detail)

Gravity System		Diversion Weir			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
1.	Excavation	167,000	m^3	465	77.655
2.	Compacted Embankment	26,500	m^3	650	17.225
3.	Reinforced Concrete-Superstructure	435	m^3	83,250	36.214
4.	Concrete, Finished-Weir and Apron	1,300	m^3	35,000	45.500
5.	Concrete, Bulk-Weir and Apron	1,160	m^3	23,200	26.912
6.	Steel Reinforcement	53,060	kg	280	14.857
7.	Stone Masonry	2,500	m^3	15,800	39.500
8.	Riprap	800	m^3	3,220	2.576
9.	Weir Shutters	Lump Sum		72,625,000	72.625
10.	Sluiceway Gate Frames and Hoists, One Each	1,600	kg	800	1.280
11.	Regulator Gate Frames and Hoist, One Each	200	kg	800	0.160
12.	Timber in Gates and Stoplogs	1.72	m^3	176,000	0.303
13.	Clearing and Stripping	40,000	m^2	50	2.000
14.	Dewatering	Lump Sum		41,200,000	41.200
15.	ROW	6	ha	166,000	0.966
16.	Field Facilities	Lump Sum		6,225,000	6.225
	Total Cost of Diversion Weir				385.228

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System			Desilting Works		
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
1.	Excavation	8,285	m^3	465	3.852
2.	Compacted Embankment	1,150	m^3	650	0.748
3.	Reinforced Concrete	396.8	m^3	83,250	33.036
4.	Steel Reinforcement	25,120	kg	280	7.034
5.	Unreinforced Concrete	644	m^3	23,200	14.937
6.	Stone Masonry	338	m^3	15,800	5.338
7.	Flushing Gate Frames, Guides and Sills	6,826	kg	750	5.120
8.	Flushing Gate Pedestals, Stems and Wheels	1,657	kg	900	1.492
9.	Canal Outlet Gate Frames, Guides and Sills	728	kg	750	0.546
10.	Canal Outlet Gate Pedestals, Stems and Wheels	184	kg	900	0.165
11.	Timber in Gates	4.95	m^3	350,000	1.732
12.	Silt Outlet Gate, 100 cm.	376	kg	1,670	0.627
13.	Silt Outlet Pipe, 1 m Dia. x 25 m, Concrete	19	m	15,700	0.296
14.	Timber in Stoplogs	10.6	m^3	140,000	1.488
15.	Clearing and Stripping	6,000	m^2	50	0.300
16.	ROW	1.08	ha	166,000	0.179
17.	Field Facilities	Lump Sum		6,225,000	6.225
	Total of Desilting Works				83.115

TABLE IX-3
(Continued)
Cost Estimate (Detail)

Gravity System		Highline Pumping Plant			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
1.	Excavation	629	m^3	465	0.292
2.	Compacted Backfill and Embankment	469	m^3	650	0.305
3.	Reinforced Concrete	19.92	m^3	83,250	1.658
4.	Steel Reinforcement	1,773	kg	280	0.496
5.	Unreinforced Concrete	19.69	m^3	23,200	0.457
6.	Stone Masonry	239.52	m^3	15,800	3.784
7.	Timber Stoplogs	0.66	m^3	140,000	0.092
8.	Engines and Pumps	Lump Sum		Lump Sum	8.440
9.	Mechanical and Electrical	Lump Sum		Lump Sum	0.960
10.	Clearing and Striping	1,624	m^2	50	0.081
11.	ROW	0.16	ha	166,000	0.026
	Total of Highline Pumping Plant				16.593

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System		Gravity Supply Canal-Waterways			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Earth Canal Section: 4.61 kilometers					
1.	Excavation	25,267	m^3	465	11.749
2.	Compacted Embankment	18,700	m^3	650	12.155
3.	Clearing and Stripping	84,000	m^2	50	4.200
4.	ROW	8.4	ha	166,000	1.394
	Sub-Total Earth Canal	. . . . .			29.498
Lined Canal and Bench Flumes: 2.34 kilometers					
1.	Excavation, Common	162,912	m^3	465	75.754
2.	Structural Excavation	9,714	m^3	650	6.314
3.	Stone Masonry	2,275	m^3	15,800	35.950
4.	Clearing and Stripping	42,700	m^2	50	2.135
5.	ROW	4.27	ha	166,000	0.709
	Sub-Total Lined Canal	. . . . .			128.471
Elevated Flume Crossings: 0.22 kilometers					
1.	Structural Excavation	215	m^3	650	0.140
2.	Reinforced Concrete	223.3	m^3	83,250	18.587
3.	Steel Reinforcement	49,605	kg	280	13.890
4.	Unreinforced Concrete	233	m^3	23,200	5.406
5.	Stone Masonry	896	m^3	15,800	14.157
6.	Clearing and Stripping	1,960	m^2	50	0.098
7.	ROW	0.245	ha	166,000	0.041
	Sub-Total Elevated Flume	. . . . .			52.318
	Total of Gravity Supply Canal-Waterways	. . . . .			202.679

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System		Gravity Supply Canal-Structures			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Turnouts					
1.	Excavation, Canal Bank	7.3	m^3	650	0.005
2.	Compacted Backfill	4.7	m^3	650	0.003
3.	Stone Masonry	5.6	m^3	15,800	0.088
4.	Gate Frames, Slides and Guides	159	kg	750	0.119
5.	Stem, Wheel and Miscellaneous Metalwork	35	kg	900	0.033
6.	Timber in Gate Frame	0.05	m^3	350,000	0.017
7.	Timber Stoplogs and Operating Bridge	0.28	m^3	140,000	0.039
	Sub-Total Turnouts				0.305
Culverts					
1.	Excavation of Pipe Trench	361	m^3	1,000	0.361
2.	Compacted Backfill	171	m^3	650	0.111
3.	Stone Masonry Headwalls and Outlets	47.2	m^3	15,800	0.746
4.	100 cm Dia. RC Pipe	122	m	34,900	4.265
5.	80 cm Dia. RC Pipe	29	m	27,900	0.804
6.	50 cm Dia. RC Pipe	403	m	17,450	7.039
7.	Diversion of Drainage	19	ea.	10,000	0.189
	Sub-Total Culverts				13.515
Bridges					
1.	Excavation, Structural	7	m^3	1,000	0.007
2.	Backfill	4.7	m^3	650	0.003
3.	Reinforced Concrete Superstructure	6.80	m^3	83,250	0.566
4.	Steel Reinforcement	604	kg	280	0.169
5.	Stone Masonry Piers	7.83	m^3	15,800	0.124
6.	Masonry Railings	2.36	m^3	23,200	0.055
	Sub-Total Bridges				0.924

TABLE IX-3
(Continued)
Cost Estimate (Detail)

Gravity System		Gravity Supply Canal-Structures			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Parshall Flumes					
1.	Excavation, Structural	2	m^3	1,000	0.002
2.	Compacted Backfill	2	m^3	650	0.001
3.	Concrete	10.58	m^3	83,250	0.881
4.	Steel Reinforcement	910	kg	280	0.225
5.	Recorder	2	ea	332,000	0.660
	Sub-Total Parshall Flumes				1.799
	Sub-Total Gravity Supply Canal-Structures				16.543
	Total of Gravity Supply Canal				219.222

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Item No.	Gravity System — Main Canal Item	Cost (Millions Rupiahs)
Reach M-1: Sta. 0.00 to Sta. 2.45		
1.	Earth Canals	12.865
2.	Elevated Flumes, B=1.9, d=1.40, Q=1.16, L=20 meters	3.321
3.	Rock Cut, Unlined 4 m deep includes: Road (1-lane) L=80 meters	3.651
4.	Turnouts, 1-300, 3-50, 1-20	1.061
5.	Checks, 2 each, Q=1,150, B=200	1.530
6.	Wasteway, Sta. 2.20	0.623
7.	Culverts, 1-1.0, 8-0.50	3.713
8.	Bridges, 1-single lane, 6.9 m span	2.195
9.	Parshall Flume	0.858
	Sub-Total Reach M-1	29.817
Reach M-2: Sta. 2.45 to Sta. 6.34		
1.	Earth Canals	16.079
2.	Elevated Flume, B=1.25, Q=0.72, L=60 meters	3.640
3.	Turnouts, 8-20, 5-50, 2-100	2.223
4.	Checks, 4 Nos., Q=800	2.636
5.	Wasteway and Drain Inlet, Sta. 5.65	0.561
6.	Culverts, One-3x1.0, One-2x1.0, Three-1.0, Eleven-0.5	9.589
7.	Bridges, 1-Single Lane, 2-Double Lane	10.833
8.	Parshall Flume	0.858
	Sub-Total Reach M-2	46.419
Reach M-3: Sta. 6.34 to Sta. 7.90		
1.	Earth Canals	5.286
2.	Elevated Flume, B=1.0, Q=0.461, L=220 meters	9.082

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System	Main Canal	
Item No.	Item	Cost (Millions Rupiahs)
Reach M-3: Sta. 6.34 to Sta. 7.90 (Continued)		
3.	Bench Flume, B=1.0, Q=0.417, L=60 meters	1.571
4.	Turnouts, 7-50	1.188
5.	Checks, 2 Nos.	0.964
6.	Wasteways, 2 Nos.	0.596
7.	Culverts, 3-1.0, 6-0.50	4.271
	Sub-Total Reach M-3	22.958
Reach M-4: Sta. 7.90 to Sta. 8.80		
1.	Earth Canals	0.381
2.	Bench Flumes, B=1.0, Q=395	25.309
3.	Rock Cut, Unlined	0.410
4.	Turnout, Lateral M8.80L	0.431
5.	Checks	0.383
	Sub-Total Reach M-4	26.914
Reach M-5: Sta. 8.80 to Sta. 11.50		
1.	Earth Canals	7.015
2.	Bench Flume, B=0.6, Q=182, L=80 meters	1.089
3.	Elevated Flume, B=0.60, L=60 meters	2.024
4.	Turnouts, 2-20, 2-50	0.610
5.	Checks, 3 Nos.	0.856
6.	Wasteways, 2 Nos.	0.398
7.	Culverts, 1-1.0 Dbl, 2-1.0, 6-0.50	4.468
	Sub-Total Reach M-5	16.460

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TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System	Main Canal	
Item No.	Item	Cost (Millions Rupiahs)
Reach M-6: Sta. 11.50 to Sta. 12.47		
1.	Earth Canals	1.615
2.	Bench Flumes, B=0.6, Q=165, L=360 meters	16.590
3.	Elevated Flume, B=0.6, L= 50 meters	1.749
4.	Turnouts, 2-20, 3-50	0.780
5.	Checks	0.246
6.	Wasteway	0.170
7.	Culverts, 1-1.0, 3-0.5	1.559
	Sub-Total Reach M-6	22.709
Reach M-7: Sta. 12.47 to 14.06		
1.	Earth Canals	2.951
2.	Elevated Flume, B=0.5, Q=120, L=160 meters	4.589
3.	Free Flow Siphon-Railroad Crossing, L= 80 meters	1.985
4.	Turnouts, 1-20, 2-50	0.476
5.	Checks, 2 Nos.	0.423
6.	Wasteways	0.156
7.	Culverts, 2-1.0, 6-0.50	2.952
8.	Bridges, 1-2 Lane	2.064
	Sub-Total Reach M-7	15.596
Reach M-8: Sta. 14.06 to Sta. 14.75		
1.	Earth Canals	1.652
2.	Turnouts, 3-50	0.514
3.	Checks, 2 Nos.	0.363
4.	Wasteway	0.133
5.	Culverts, 6-50	1.626
	Sub-Total Reach M-8	4.288
	Total of Main Canal (Reach M-1 to M-8)	185.161

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TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System	Main Canal-Laterals	
Item No.	Item	Cost (Millions Rupiahs)
1.	Earth Canal, 9.29 km	10.573
2.	Checks w/Drop, 9 Nos.	2.518
3.	Checks w/o Drop, 22 Nos.	4.519
4.	Drops, 12 Nos.	1.702
5.	Turnouts, 45 Nos.	6.533
6.	End Checks and Waste-ways, 7 Nos.	0.161
7.	Railroad Siphon, 4 Nos.	2.505
8.	Road Siphons, 13 Nos.	2.503
9.	Flumes, 4 Nos.	2.661
	Total of Main Canal-Laterals	33.675

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TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System		Main Canal-Tertiary System
Item No.	Item	Cost (Millions Rupiahs)
1.	Earth Canals, 34.25 km	30.297
2.	Drops	16.006
3.	Division Boxes	4.907
4.	End Checks and Wasteways, 62 Nos.	0.907
5.	Railroad Siphons, 10 Nos.	5.168
6.	Road Siphons, 16 Nos.	1.408
7.	Flumes	0.896
	Total of Main Canal-Tertiary System	59.589

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System	Highline Canal	
Item No.	Item	Cost (Millions Rupiahs)
Reach H-1: Sta. 0.00 to Sta. 0.56		
1.	Earth Canal	0.529
2.	Bench Flume	5.101
3.	Turnouts	0.287
4.	Check	0.252
5.	Culverts, 3-0.50	0.917
	Sub-Total Reach H-1	7.086
Reach H-2: Sta. 0.56 to Sta. 0.90		
1.	Elevated Flume	10.341
2.	Turnouts	0.201
3.	Check and Wasteway Drop	0.434
	Sub-Total Reach H-2	10.976
Reach H-3: Sta. 0.90 to Sta. 3.10		
1.	Earth Canal	3.239
2.	Turnouts	0.687
3.	Checks	0.570
4.	Wasteway	0.131
5.	Culverts	3.812
6.	Bridges	2.143
	Sub-Total Reach H-3	10.582
Reach H-4: Sta. 3.10 to Sta. 3.76		
1.	Earth Canal	1.144
2.	Elevated Flume	2.440
3.	Turnouts	0.305
4.	Checks	0.164
5.	Culverts	0.545
6.	Wasteway	0.120
	Sub-Total Reach H-4	4.718
	Total of Highline Canal (Reach H-1 to H-4)	33.362

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System	Highline Canal-Laterals	
Item No.	Item	Cost (Millions Rupiahs)
1.	Earth Canal, 2.66 km	2.119
2.	Checks	0.661
3.	Turnouts	0.436
4.	End Checks and Waste-way	0.017
5.	Cross Drainage Cul-vert	2.952
6.	Road Siphon	0.208
	Total of Highline Canal-Laterals	6.393

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System		Highline Canal-Tertiary System
Item No.	Item	Cost (Millions Rupiahs)
1.	Earth Canal, 7.23 km	2.996
2.	Drops	2.770
3.	Division Boxes	0.664
4.	End Checks and Waste-ways	0.194
5.	Road Siphons	0.105
	Total of Highline Canal-Tertiary System	6.729

TABLE IX-3
(Continued)

Cost Estimate (Detail)

Gravity System		Drainage System
Item No.	Item	Cost (Millions Rupiahs)
1.	Earth Canal, Waterways	37.420
2.	Road Culverts, RCP	3.660
3.	Road Culverts, Box	5.802
4.	Drops	8.999
5.	Side Slope and Bed Protection	7.760
6.	Drain Inlets	0.435
	Total of Drainage System	64.076

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TABLE IX-4

Cost Estimate

Pumped System				
Item No.	Item	Cost 1976 (Million Rp.)	Inflation Factor for 1977	Cost 1977 (Million Rp.)
1.	Main Pumping Plant	543.201	1.1545	627.126
2.	Desilting Works	73.075	1.1766	85.980
3.	Relift Pumping Plant	13.120	1.1545	15.147
4.	Link Supply Canal	4.580	1.1766	5.389
5.	Main Canal, Reach M-1 to M-8	185.161	1.1766	217.860
6.	Main Canal-Laterals	33.675	1.1766	39.622
7.	Main Canal-Tertiary System	59.589	1.1766	70.112
8.	Highline Canal-Reach H-1 to H-4	33.362	1.1766	39.254
9.	Highline Canal-Laterals	6.393	1.1766	7.522
10.	Highline Canal-Tertiary System	6.729	1.1766	7.917
11.	Drainage System	64.076	1.1766	75.392
	Sub-Total			1,191.321
Contingencies (15%±)				178.698
	Field Cost			1,370.019
Engineering and Administration (15%±)				205.503
	Total Cost (Million Rupiahs)			1,575.522
	Total Cost Million U.S. Dollars ($1.00=Rp. 415.00)			3.796

TABLE IX-5

Cost Estimate (Detail)

Pumped System				Pumping Plants	
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Main Pumping Plant: Q=1.82 m^3/s					
1.	Excavation	2,580	m^3	465	1.200
2.	Backfill	1,755	m^3	650	1.142
3.	Concrete	977	m^3	83,250	81.353
4.	Steel Reinforcement	86,975	kg	280	24.353
5.	Engines and Pumps	3	ea	127,500	382.500
6.	Extra Pump Column	9	m	300,000	2.700
7.	Mechanical, Electrical, Fuel Storage, Etc.	Lump Sum	--	43,725	43.725
8.	Discharge Manifold	1,620	kg	900	1.458
9.	Pump Valves, 0.50 m Dia.	3	ea	945,000	2.835
10.	Discharge Pipe, 1.0 m x 35 m x 0.003	2,580	kg	750	1.935
	Sub-Total Main Pumping Plant				543.201
Relift Pumping Plant: Q=0.28 m^3/s					
1.	Excavation, Pipe Trench and Structural	200	m^3	650	0.130
2.	Compacted Backfill	132	m^3	650	0.086
3.	Concrete	14.36	m^3	83,250	1.196
4.	Steel Reinforcement	1,278	kg	280	0.357
5.	Stone Masonry	9.05	m^3	15,800	0.143
6.	Concrete Pipe, 50 cm-1.0	5	m	16,020	0.080
7.	Concrete Tile, 10 cm-1.0	20	m	1,470	0.029
8.	Steel Pipe, 50 cm x 0.002	20	m	19,700	0.394
9.	Engines and Pumps	2	ea	4,797,400	9.595
10.	Mechanical, Electrical, Fuel Storage, Etc.	Lump Sum			1.110
	Sub-Total Relift Pumping Plant				13.120
	Total of Pumping Stations				556.321

TABLE IX-5
(Continued)

Cost Estimate (Detail)

Pumped System				Desilting Works	
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Desilting Works					
1.	Excavation	9,962	m^3	465	4.633
2.	Compacted Embankment	1,256	m^3	650	0.817
3.	Reinforced Concrete	351	m^3	83,250	29.237
4.	Steel Reinforcement	31,250	kg	280	8.752
5.	Unreinforced Concrete	285	m^3	23,200	6.620
6.	Stone Masonry	505	m^3	15,800	7.976
7.	Flushing Gate Frames, Guides, Sills and Headers	6,443	kg	750	4.832
8.	Flushing Gate Stems, Pedestals and Levers, Miscellaneous Metal	1,053	kg	900	0.948
9.	Canal Outlet Gate Frame, Guide, Sill and Header	570	kg	750	0.428
10.	Canal Outlet Gate Pedestal, Stem, Wheel and Misc. Metal	210	kg	900	0.190
11.	Treated Timber in Gates	5.35	m^3	350,000	1.875
12.	Silt Outlet Gate, 1 m Dia.	490	kg	1,670	0.818
13.	Silt Outlet Pipe, 1 m Dia. x 175 meters	175	m	15,700	2.748
14.	Timber in Stoplogs	12.1	m^3	140,000	1.696
15.	Clearing and Stripping (includes Pump Stations)	8,750	m^2	50	0.438
16.	ROW	2.8	ha	166,000	0.465
17.	Road Relocation	312	m	1,930	0.602
	Total of Desilting Works				73.075

TABLE IX-5
(Continued)

Cost Estimate (Detail)

Pumped System		Link Supply Canal-Waterways			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Earth Canal Section					
1.	Excavation	783	m^3	465	0.364
2.	Compacted Embankment	392	m^3	650	0.255
3.	Roadway Surfacing	770	m^2	485	0.343
4.	Clearing and Stripping	4,000	m^2	50	0.220
5.	ROW	0.55	ha	166,000	0.091
	Sub-Total Earth Canal Section				1.273
Lined Canal Section: L=80 m					
1.	Excavation, Common	2,590	m^3	465	1.204
2.	Excavation, Structural	162	m^3	650	0.106
3.	Stone Masonry Lining	52.95	m^3	15,800	0.836
4.	Roadway Surfacing	280	m^2	485	0.136
5.	Clearing and Stripping	1,600	m^2	50	0.080
6.	ROW	0.16	ha	166,000	0.027
	Sub-Total Lined Canal Section				2.389
	Total of Link Supply Canal-Waterways				3.662

TABLE IX-5
(Continued)

Cost Estimate (Detail)

Pumped System		Link Supply Canal-Structures			
Item No.	Item	Quantity	Unit	Unit Price (Rupiahs)	Cost (Millions Rupiahs)
Concrete Bridges Span					
1.	Excavation, Structural	6.93	m^3	650	0.005
2.	Compacted Backfill	4.62	m^3	650	0.003
3.	Reinforced Concrete Superstructure	6.77	m^3	83,250	0.563
4.	Steel Reinforcement	602	kg	280	0.169
5.	Stone Masonry Piers	7.80	m^3	15,800	0.123
6.	Stone Masonry Railings	2.37	m^3	23,200	0.055
	Sub-Total Link Supply Canal-Structures				0.918
	Total of Link Supply Canal-Waterways and Structures				4.580

TABLE IX-6

Estimated Annual Maintenance Costs

Item	Useful Life (Years)	Annual Maintenance Expense Percent of Construction Cost "As Built"
Primary Canals, Unlined	50	3
Primary Canals, Lined	50	2
Diversion Works	50	1
Desilting Works	50	1
Pipelines	25	1
Structures, Major	50	4
Structures, Minor	10	2
Pumping Station:		
Building	50	1
Elec. & Mech.	25	1 + 2*
Engines & Pumps	10	2 + 3*
Stationary Parts	10	2 + 3*
Rotating Parts	5	2 + 3*
Gates	10	2 + 3*
Stoplogs	5	5
Culverts	50	2
Bridges	50	1
Field Facilities, Bldg.	25	2
Drainage Waterways	50	5
Drain Inlets	5	10
Riprap	5	2

* Additional Costs due to difficulty and time factor of spare parts delivery through shipping distances and Customs.

TABLE IX-7

O, M & R Estimated Cost - Gravity System

Item	Cost-1977*	Unit: Million Rupiahs				
		Annual		Replacement Cost		
		Operation	Maintenance	5-Years	10-Years	25-Years
Gravity Supply						
Diversion Weir	599.435		15.461	4.012	115.730	9.683
Desilting Basin	129.331		3.106	2.318	15.061	10.142
Gravity Supply Canal	341.122		6.836	0.059	0.271	--
Highline Pump Plant	25.335		0.894	4.083	9.189	1.494
Sub-Total	1,095.223	12.354	26.297	10.472	140.251	21.319
Distribution						
Main Canal	433.243		10.835	10.837	17.590	0.541
Highline Canal	72.331		1.788	1.436	2.236	--
Sub-Total	505.574	2.236	12.623	12.273	19.826	0.541
Drainage						
Drainage System	99.706	0.329	4.012	12.707	--	--
TOTAL	1,700.503	14.919	42.932	35.452	160.077	21.860

*The 1977 Cost of each feature includes the Contingencies, as well as Engineering and Administrative Costs.

TABLE IX-8

O, M & R Estimated Cost - Pumped System

Item	Cost-1977*	Annual Operation	Annual Maintenance	Replacement Cost 5-Years	Replacement Cost 10-Years	Replacement Cost 25-Years
	Unit: Million Rupiahs					
Pumped Supply						
Main Pumping Plant	829.374		33.261	151.701	353.981	80.388
Desilting Works	113.709		1.766	2.586	13.877	4.191
Relift Pumping Plant	20.032		0.820	4.399	10.252	1.697
Link Supply Canal	7.127		0.173	--	--	--
Sub-Total	970.242	26.474	36.020	158.686	378.110	86.276
Distribution						
Main Canal	433.243		10.835	10.837	17.590	0.541
Highline Canal	72.331		1.788	1.436	2.236	--
Sub-Total	505.574	2.236	12.623	12.273	19.826	0.541
Drainage						
Drainage System	99.706	0.329	4.012	12.707	--	--
TOTAL	1,575.522	29.039	52.655	183.666	397.936	86.817

*The 1977 Cost of each feature includes the Contingencies, as well as Engineering and Administration Costs.

TABLE IX-9

O, M & R Estimated Annual Cost

Item	Unit: Million Rupiahs			
	Gravity System		Pumped System	
	Estimated Cost	Annual Cost	Estimated Cost	Annual Cost
Operation/Year	14.919	14.919	29.039	29.039
Maintenance/Year	42.932	42.932	52.655	52.655
Replacement: 5-Years*	35.452	5.566	183.666	28.835
Replacement: 10-Years*	160.077	9.055	397.936	22.511
Replacement: 25-Years*	21.860	0.155	86.817	0.615
Total Annual Cost		72.627		133.655
Present Worth of O, M & R* . .		603.131		1,109.938

*Interest Rate = 12%

TABLE IX-10

Total Cost of Gravity and Pumped System

	Unit: Million Rupiahs	
	Gravity System	Pumped System
Capital Cost of Project	1,700.504	1,575.522
Interest During Construction[1/, 2/]	428.026	396.567
Present Worth of O, M & R Costs[2/]	603.131	1,109.938
Total Cost	2,731.661	3,082.027

1/ Based on Three-Year Construction period with a capital outlay of 25%, 45% and 30% for the three years.

2/ Interest rate = 12%.

Chapter X

PROJECT BENEFITS

General

The national objective is the development and optimum utilization of land, water and human resources. There is a desperate need to improve productivity in agriculture and to enhance the welfare of the rural farm population. The project benefit will, to a large extent, be available to this sector.

The Banjar Plains Project, as formulated, has two direct benefits. They are: (1) Irrigation of 785 ha of land in the Banjar Plains Area, and (2) Provision of municipal water to the Banjar region. Although an industrial water demand was identified as a future possibility, the project, as envisaged now, does not include this component.

Apart from the above two direct benefits, the project will provide a number of indirect benefits such as an increase in employment, improved health, setting up of small-scale industries, etc. These are discussed in Chapter XII-Social Beneficiaries. This chapter identifies the annual benefit due to irrigation and municipal supply, which is used in the economic analysis.

Irrigation Benefit

Rice is the chief staple diet and is the main crop grown in the project area. The primary goal of Indonesia's five-year plan is to achieve self-sufficiency in rice. Currrently, over 15 percent of the rice consumed is imported into the country. The 1977 shortfall in rice production in Indonesia is estimated at 2.6 million tons, with production reported to be 15.9 million tons. Data collected from the Ciamis sub-district indicates that the consumption of rice in the Banjar sub-district, in 1976, far exceeded the production. The shortfall was about 23 percent. Thus, there is a compelling reason for increasing the rice production.

In the benefit studies, rice has been chosen as the most suitable and profitable food crop for the project area. Lands are highly suitable for rice and all farmers are experienced in rice production.

The present agricultural practice, and the future crop pattern for the Banjar Plains Area were discussed in Chapter IV-Agriculture. The project will provide irrigation water to 785 ha of land to grow two rice crops each year. Though the possibility of growing an additional short season upland crop on a part of this area exists, the benefits from this crop have not been taken into account.

Rice Yield

The basis for determining the irrigation benefit involves comparison of the expected future situation without and with the project. This comparison is made on the net farm income for the two situations. The farm budgets with and without the project require development of projected yields as well as crop and fertilizer prices. These are discussed in the following pages.

To develop the economic benefits derived from the project for the irrigation component, rice yield studies were carried out to identify average yields with and without the proposed scheme.

Present Yield

The present rice yields were obtained separately for wet and dry seasons in the project area. The data for three sub-districts (Kecamatan) for the years 1974, 1975, and 1976 were collected from Agricultural Extension Service records as well as from the Kecamatan records. The three Kecamatans are Banjar, Cimaragas and Pamarican. The yield data available at the village level were reviewed. The data are presented in Table X-1. The yields indicated in this Table are in wet stalk rice in the village (Padi Basah di Desa). It is seen from Table X-1 that only 4.3% of the rice cropped area is under rice during both the wet and dry season. Most of the dry season rice is grown in the villages of Balokang, Banjar and Binangun where small rural irrigation systems provide some water for the second crop. The rural irrigation systems in this area collect the delayed runoff through collection ditches skirting the hills and supplying the fields. The amount of water available in the ditch is dependent on the rainfall and is very limited. The shortage of water for the dry season crop is reflected in the low yields, as seen from Table X-1. The dry season average yield for the three years varies from 30 to 45 percent of the wet season average yield.

From the yield data, the weighted average yield for the wet and dry season, both in wet stalk rice and dry rough rice (Gabah), have been computed and are shown in Table X-2. The weighted average gabah yield for wet and dry season are 2,885 kg/ha and 1088 kg/ha, respectively. These yields have been taken as the baseline yields in Banjar Plains Service Area.

The Banjar Plain Service Area covers five villages. These are Banjar, Balokang, Situbatu, Binangun and Batulawang. Of these, the service area covers fully the village of Banjar and Balokang. The area irrigated in each village is shown on Table X-3.

The BIMAS and INMAS programs are currently available in the service area. From the data available from Kriya Bank, the enrollment for BIMAS program for the 1976/77 wet season was nearly 100% in the villages of Banjar, Balokang and Batulawang, while for the 1977/78 wet season it is only 20% as of February, 1978. During the dry season about 33% of area was covered by BIMAS in these villages. While the acceptance of BIMAS and INMAS packages as a program seem to be widespread, its implementation in terms of application of proper quantities of fertilizers and pesticides, use of HYV's, improved agricultural practices, water and land management are considered to be at a low to medium level. A survey at the village level indicated that local varieties are grown on 50% of the area with 40% of IR variety and 10% pelita variety making up the rest during the wet season. During the dry season, only local varieties are grown. The present level of on-farm management in the area is also low. Lack of drainage in parts of the service area and occasional flooding due to rain in the low-lying areas of the project are contributary causes in lowering of yields during the wet season. Currently, there appears to be no constraints on improving farm management with an active extension service program, except lack of dependable irrigation water supply.

Future Without Project

Based on the survey of the cultivable land in the service area, the land use pattern and the land classification, it was determined that without the industrial complex, the 605 ha of R class land can be cultivated with

rice and upland crops in a year, and 180 ha of U class land with one garden crop in one year. As presented in Chapter IV - Agriculture, the resulting cropped area in the future without project was determined as;

Crop	First Crop	Second Crop
rice	605 ha	300 ha
upland	--	305 ha
garden (one year)	180 ha	

Thus, a maximum rice cropping intensity of 1.77 was expected to be achieved in the service area of 785 ha in the future without the project.

An estimate of average yield in the future without the project has to be based on factors such as the historical yield trends; increasing use of HYV's; better agricultural practices; improved on-farm management; proper application of fertilizer, insecticides and rodent control measures; and availability of credit facilities as well as storage and marketing facilities. The main constraint in improving yield will be availability of irrigation water.

The yield projections for without project condition was made separately for each of the crops on the 605 ha and for the garden crop on the 180 ha. It was assumed that the present gradual trend in increased yields will be maintained.

With an increase in the use of HYV's, and with better agricultural practices and input as can be applied to rural irrigation system and rainfed areas, the wet season yield for the area under the rural irrigation system is estimated to increase from the present average yield of 2,885 kg/ha to 3,600 kg/ha, an increase of 25 percent. The dry season yield for this area is estimated to increase from the present average yield of 1,088 kg/ha to 1,300 kg/ha, an increase of 20 percent.

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The low yield in the dry season, mentioned above, is primarily due to the lack of moisture at the transplanting/growth stage of the crop. Even with complete acceptance in practice of the BIMAS/INMAS, it is believed that this factor (shortage of water) will negate the beneficial aspects of all other inputs and, hence, will not increase the dry season yields more than the projected 26 percent.

It is possible that a variety of upland crops can be grown on part of the area during the dry season. Without the project it is estimated that rice will be grown over 300 ha during the dry season and an upland crop over the balance of 305 ha. For economic analysis soybean has been taken as the representative upland crop with a yield of 950 kg/ha.

On the land where only one garden crop per year is grown, the estimated future yield is taken to be 1,000 kg/ha of kopra, because of coconut being the predominant crop. Conversion of these garden crop lands to ricelands is not anticipated without the project. Most of this land is U class land.

Future With Project

The Banjar Plains Area, with a technical irrigation/drainage system, and with prevention of occasional flooding by rain, will enjoy the opportunity to fully exploit its potential to maximize crop production. It is expected that with assured irrigation water supplies, greater confidence will be generated in the minds of the farmers, and they will invest in the proper and necessary inputs to ensure the higher yields that are possible with the new HYV varieties.

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The cultivable land in the service area, like most of the land in Java, can grow rice the year around provided there is sufficient water available from rainfall or irrigation. With the advent of the new HYV's, with a relatively short season, the possibility of producing two crops per year with limited water supply has become a reality. If there is water available all year, three crops per year are possible.

The Banjar Plains Project, which is a diversion project, has to depend on the river flow. It has been estimated, from the pattern of river flow and its magnitude, that the irrigation demands for two rice crops on an area of 785 ha can be met. In many years, sufficient water will be available to grow a third upland (Palawija) crop on part of the area. Although a cropping pattern of two rice crops and one upland crop has been identified as a possibility in the future, for purposes of economic analysis, the irrigation benefits have been taken to occur from two rice crops a year on the entire 785 ha. This would mean that the cropping intensity for rice will increase from 1.77 without the project to 2.0 with the project, a modest increase.

To derive the irrigation benefits, rice yield projections were made to a point in time when the project is fully completed. This would mean that the structural and non-structural features of the agro-system must be completed before the projected yields are realized. This point in time would either coincide with the completion of the physical facilities, or within a short period thereafter, when the non-structural features are fully functional. Further growth in yield during the life of the project that normally occurs due to social and technological development is not considered in computing the irrigation benefits.

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The projected rice yields are shown graphically on Figure X-1. During the wet season the average yield per crop is estimated to be 4,500 kg/ha with the project, as compared to a without project yield of 3,600 kg/ha.

With the provision of assured irrigation supplies, the dry season average yield per crop is estimated to quadruple from the without project yield of 1,300 kg/ha, to an average of 5,500 kg/ha. This yield projection, although seemingly excessive, is a realistic yield, considering that the wet season average yield now is around 3,000 kg/ha. The main factors that contribute to this increase in the dry season are:

1. Availability of irrigation water where there was a near total lack of moisture.

2. Favorable conditions that are normally associated with dry season irrigation.

3. Suitability of soil for rice cultivation.

4. Better drainage conditions.

It is conceivable that this increase in yield will be in stages for the dry season rice crop. It is to be pointed out that the yield figures discussed above are in gabah, which is dry rough rice ready for milling, with 14% moisture.

The yield projection made with the project in place is based on various factors which include both structural and non-structural items. These are:

1. Availability of irrigation water for two rice crops at 95% firmness. Hydrologic analysis has shown that this is available.

2. Provision of an efficient distribution system, including tertiaries for plots of 20 ha. Provision in the cost estimate has been made for such a tertiary system.

Experience in irrigation systems with and without tertiaries indicate that this is one of the single most important factors in increasing the average yields. Increases of over 20-25 percent in average yield have been obtained by providing the tertiary system.

A tertiary system may make the difference between a good and a bad crop, especially in years when flow is below normal in the river.

3. Adequate drainage system: Provision has been made in the estimate for a drainage system. The drainage system is designed to accommodate a 10-year frequency flood. With the provision of such drainage, water-logging and rain-flooding during the wet season on parts of the lowland are eliminated. During the dry season this permits a more efficient water use. Also, the build-up of soluble salts in the soil is minimized. All these factors will greatly improve the yield as compared to an irrigation system without proper drainage.

4. A comprehensive water management program: For optimizing yields, efficient water management is necessary. This would require scheduling of water deliveries to each 0.5 ha on a rotational basis. A scheduling based on a 30-day staggering of crops over the entire area has been identified. The road communication system available in the Banjar Plains service area is adequate for the ditch rider, the Ulu Ulu's and Ili Ili's, to perform their duties of water scheduling.

Provision has been made in the cost estimate for water measurement structures in the distribution system and proportional flow dividers in the tertiary system to improve water management. In the absence of a technical irrigation system, there is normally little or no water management.

5. A land management program: Provision of technical irrigation permits better land management which allows an increased cropping intensity, converts upland areas to rice culture, and increase yields on these lands.

6. Expanding the activities of the Agricultural Extension Service and implementing irrigated agricultural practices: The present Extension Service activities in the area are confined mostly to administering the BIMAS and INMAS programs and data collection, with agricultural practices limited to those of rainfed agriculture. Use of HYV's is currently limited to 50% of the wet season crop. Without the project, there is very little scope to improve these activities. With the project, it is assumed that these services and practices will be strengthened. With the training of PPL's in Pilot Demonstration Areas now underway, and expanding their cadre in the North Lakbok irrigation area, a sufficient number of trained PPL's should be available to implement the irrigated agricultural practice in the Banjar service area by 1985.

7. A sound O & M system: An extremely important consideration to obtain the projected yield and sustain it, is the provision of funds for an adequate O & M system. Many of the existing irrigation systems have not shown increases in yields partly due to the lack of O & M funding. The Banjar Plains cost estimate provides for adequate O & M.

8. Credit facilities: The improvement in yields is intimately related to the credit facility available to the farmer. An adequate supply of seeds, fertilizers, insecticides, farm implements and spraying facilities should be provided. The present BIMAS packet needs to be revised so that adequate long-term credit facilities are available to the farmer. The local government and the Agricultural Extension Service should take the responsibility of providing the needed inputs in sufficient quantity and at the time needed.

9. It has been recognized that in any effort to increase yields, encouragement of the farmer plays an important role. This encouragement must provide for identifying the leading farmers; setting up crop yield contests and providing cash bonus for the best farmers; setting up of pilot field plots in the service area and, organizing study tours of farmers to field experiment stations. Education of the farmer in improved agricultural techniques by the Extension Service personnel should be carried out by holding village group discussions.

10. Service area: The compactness of the Banjar Plains service area is an asset. Much of the infrastructure needed for implementation of some of the functions identified above exists at the present time. The area has a fairly good system of roads with the center of gravity of the area being less than 6 km from the town of Banjar. Adequate marketing and milling facilities can be made available in Banjar to handle the increase in yields with little investment.

With the above commitments firmly established, it is visualized that the projected yield of 4,500 kg/ha during the wet season, and 5,500 kg/ha during the dry season can be met. These are considered to be very reasonable and highly probable yields which can be achieved in the Banjar Plains area. The time at which these yields can be realized is largely dependent on the establishment of the infrastructure and the programs discussed above. Many of these are available in the area, but will need strengthening and modification. Since the service area is small, it is considered that the predicted yields can be obtained within two years after completion of the project.

In arriving at the projected yield, data from irrigated areas in the Citanduy region and from LPPP, Bogor, were collected. These yields are presented below to substantiate the projected yields.

The Feasibility Report[1/] on Citanduy River Basin Development, presents rice yield data for irrigated lowland under BIMAS program in the district of Ciamis, Cilacap and Tasikmalaya for the period 1971 to 1974. This is presented in Table X-4. The weighted average yield of rough rice for both wet and dry seasons ranges between 4,211 and 4,495 kg/ha. This data, from BIMAS program, represents rice that is irrigated, planted with HYV's using fertilizers and pesticides, and produced with technical supervision of progressive farmers. With the introduction of the tertiary system and further intensification of agricultural inputs, these average yield levels can reach the range of 4,500 to 5,500 kg/ha by 1985.

1/ "Feasibility Report", Citanduy River Basin Development Project, Engineering Consultants, Inc., Denver, Colorado, U.S.A., March, 1975.

A recent study by the Central Research Institute (LPPP) at Bogor, 1976, reported yield results for Pelita I/1 variety for two crops with irrigation. For conditions of the farmers cropping pattern and farmers cropping pattern without constraints, the average wet and dry season yields reported were 6,315 kg/ha and 6,000 kg/ha, respectively, of dry rough rice. The studies being carried out at Indramayu in West Java by LPPP are not experiment station test plot results, but they do have a high level of technical supervision. The 1976 crop was partially affected by insect problems and this reduced the yield. It is conceivable that the best farmers in the Banjar Plains area can achieve yields of over 6,000 kg/ha by 1984-1986. The average yield for the region is expected to be in the range of 75% to 80% of the Indramayu trials, which is about 5,000 kg/ha.

The above yield projections are based on a variety of inputs and on the capabilities of farmers in the region. To achieve the projected paddy yields used to determine benefits for the economic analysis, definite efforts by the concerned agencies are needed, and these must be pooled together in a systematic manner. The building of the project work is only a part of the development effort which also includes many other vital factors. It is therefore imperative that the works be maintained and operated properly; that on-farm development be carried out under a systematic land and water management program; and that agricultural extension services including technical guidance be made available to the farmers, to introduce advanced agricultural techniques, and that credit facilities and other operations and elements for increasing crop yield be provided under a well-defined and effective program. Failure to implement any of the above listed programs will not only retard the projected irrigated agricultural development, but will also adversely affect the economic viability of the project.

Crop and Fertilizer Prices

Rice is an important commodity widely traded in international markets. There is currently a short supply of rice in Indonesia, necessitating import from international markets. Should there ultimately be an abundance of this commodity it will find a ready export market. From an economic point of view, the rice price should be valued at its import substitution value rather than from the local price. This is because the prices prevailing in the local marketplace are influenced by government regulation and subsidy.

The rice price is developed using the I.B.R.D. (International Bank for Reconstruction and Development) projection for 1985, in 1977 constant U.S. Dollars. The price quoted is f.o.b. Bangkok and is for 20 to 25 percent broken milled rice. This price is $270 per metric ton, and has been used to develop the farm-gate economic price. Table X-5 shows the farm-gate economic price for rice which is $183 per metric ton (gabah) or Rp. 75,945. This price has been used in all the farm budgets.

The cropping calendar in future without project in dry season identified an area of 305 ha to be planted to an upland crop and a garden crop over the 180 ha presently under coconut, cossave, maire, etc. A soybean crop is considered here to represent the income from an upland (Palawiju) crop. The economic farming price is developed in Table X-6 for this crop. Table X-7 presents the economic price for kopra, which is felt to reflect the income which can be generated from the 180 ha of garden crop.

Some fertilizers, especially phosphate, is normally imported into the country but it is reported that Indonesia will achieve self sufficiency in nitrogen fertilizers in the near future. The current prices of fertilizers in Indonesia do have an element of subsidy. Hence, farm-gate prices for fertilizer were also developed based on international prices as projected for 1985 at 1977 constant U.S. Dollars by I.B.R.D., f.o.b. U.S. Gulf ports.

Table X-8 shows the farm-gate economic price for Urea and T.S.P. fertilizers which is Rp. 100 and Rp. 92 per kilogram, respectively.

The price for insecticide, rodenticide, seeds and spraying cost were based on local market surveys, and are considered reasonable.

Labor Input

The labor inputs used in the farm budgets are based on local farming practices. There is a total absence of mechanization of field work at present. The amount of labor required for different yield levels are modified according to whether a particular field operation is fixed or variable. To a considerable extent, the labor requirements are relatively inelastic.

Labor requirement for land preparation, which will include use of buffalo power, is considered to be the same in all the farm budgets. It is estimated that the land preparation for rice, which is spread over 25 days, will require 15 buffalo-days, which include the driver, 20 man-days, and 40-women days for each hectare of land. The cost of hiring a buffalo and driver is Rp. 900/day, while wages for men and women laborers is taken to be Rp. 250 and Rp. 150, respectively. The total cost of land preparation per hectare amounts to about Rp. 1,000 per day for the 25 days.

Harvesting is, at present, done by hand with the ani-ani knife and threshing by hand labor. However, the trend in rice production technology in the country is towards the use of sickle harvesting and machine thrashing. Since the magnitude of labor for harvesting will depend on the yield, the labor requirement per hectare of harvesting was converted to a percentage of the crop value. It was estimated that the harvesting cost would be about 10 percent of the crop value.

Farm Budget

Farm budgets were prepared for without and with project conditions. The budgets prepared are for a farm size of one hectare and for one crop. The one hectare size is simply a unit of area used for determining the net irrigation benefit and is not to be considered as a recommended size of farm. Farm sizes in the project area vary; the median size in the different village varies from 0.53 to 0.74 ha. In preparing the farm budget and arriving at the net farm income, family labor has not been considered as an expense.

Four farm budgets have been prepared for the future condition without project. The 605 ha of present ricelands will produce in the wet season a rice crop with an average estimated yield of 3,600 kg/ha of dry rough rice. In the dry season this area will be cropped with a rice crop over 300 ha, with an estimated yield of 1,300 kg/ha. Over the remaining 305 ha an upland crop (soybean) can be grown, for which a yield of 950 kg/ha is estimated. On the 180 ha of garden area, for which kopra yield is considered representative, an average yield of 1,000 kg/ha has been taken for the farm budget. These four farm budgets for the above cases are represented in Table X-9 through X-12.

The farm budgets allow expenses for rice storage and interest on operating capital at 5%, in addition to the various other expenses discussed. The quantity of fertilizer and insecticide for the crops are based on the recommended levels of production inputs in the BIMAS package. The inputs may have to be modified from place to place according to soil fertility requirements.

With the project, the total service area of 785 ha will be cropped to two rice crops with the projected average yield at 5,000 kg/ha per crop. The farm budget for this case is presented in Table X-13. The projected farm income is estimated to be Rp. 263,072 per crop per hectare.

Annual Irrigation Benefit

The annual irrigation benefit is defined as the difference between the projected net benefit with the project and without the project. This is shown in Table X-16 The total farm income without the project is expected to be Rp. 143.312 million while with the project this will be Rp. 413.023 million. Thus, the annual irrigation benefit will be Rp. 269.711 million which is used in the project economic analysis.

Municipal Water Supply Benefit

The municipal water supply benefit is the second major benefit that will be derived from the Banjar Plains Project. The present condition and the projected municipal demand are discussed in detail in Chapter III. It is estimated that the municipal demand will increase from 106 l/s in 1984 to 269 l/s in year 2000. Without the project, the municipal demands can only be met by construction of an alternative project.

The benefits from supplying municipal water to the city of Banjar were computed in conformance with the common practice of taking the benefits to be equal to the cost of the least expensive alternative water supply system for the needed amount of water. The least expensive alternative which would be needed in the absence of the Banjar Plains Project was taken to be a municipal pumping plant located on the Citanduy River near Banjar. This pumping plant would pump raw water into a desilting basin and canal which would supply raw water by gravity to the treatment plant. The water supply benefits will be equal to the costs of construction, operation and maintenance of this alternative water supply system since these costs will not be incurred if the Banjar Plains Project is constructed. The annual benefits were computed using an interest rate of 12% per year.

It was assumed that the municipal pumping plant and the desilting basin and canal would be built initially to their full capacity of 269 liters per second. The required initial municipal capacity has been estimated to be an average flow of 106 liters per second, the estimated 1984 demand. The total annual cost, including capital repayment, operation and maintenance cost for the alternative pumping plant and the appurtenant structures are shown in Table X-15. The uniform annual repayment costs, excluding fuel costs for a 50-year project life, and 12% interest rate works out to Rp. 74,350,000.

The municipal water supply benefit is presented in Table X-16. The benefit has to be tied to the municipal demand pattern discussed in Chapter III. The annual fuel cost has been computed based on the flow required for municipal supply. The total annual cost, which will be the project municipal benefit, has been developed for different years. The unit cost of water which is initially Rp. 23.32/m^3 in 1984, drops to Rp. 9.83/m^3 in 2001, as the demand on the system increases.

It is anticipated that with the building of the project the municipal demand would increase at a more rapid pace than projected if the necessary capital for municipal distribution system is made available.

TABLE X-1

Rice Yields for Three Kecamatan in the Banjar Plains Service Area

Crop	Total Area in Rice (ha)			Wet Stalk Rice Yield in kg/ha		
	1974	1975	1976	1974	1975	1976
Padi Sawah (Wet Season)	14,960	14,228	11,709	4,681	5,079	4,923
Padi Gogo (Dry Season)	561	623	334	1,396	2,270	1,805

Source: Kecamatan Records.

TABLE X-2

Weighted Average Yield for the Three Kecamatan in Banjar Plains Service Area

Crop	Computation	Weighted Average Yield in kg/ha	
		Wet Stalk Rice	Dry Rough Rice (Gabah)
Padi Sawah (Wet)	$\frac{(14960x4681)+(14228x5079)+(11709x4923)}{(14960+14228+11709)}$	4,889	2,885
Padi Gogo (Dry)	$\frac{(561x1396)+(623x2270)+(334x1805)}{(561+623+334)}$	1,845	1,088

1. Conversion factor of 0.59 is used to convert wet stalk rice to Gabah (dry rough rice ready for milling with 14% moisture).

TABLE X-3

Area Irrigated in the Five Villages

	Village	Area in Hectares
1.	Banjar	420
2.	Balokang	198
3.	Situbatu	36
4.	Binangun	99
5.	Batulawang	32
	Total	785

TABLE X-4[1/]

Yield[2/] of Irrigated Lowland Rice With BIMAS Program in Three Districts of the Citanduy Basin (1971-1973)

	Unit: kg/ha				
	Season - Wet (W) and Dry (D)				
Districts	71-(D)	71/72-(W)	72-(D)	72/73-(W)	73-(D)
Ciamis:					
Harvested (ha)	6,987	10,048	6,912	16,267	9,936
Yield (kg/ha)	4,350	4,574	4,428	5,059	4,658
Cilacap:					
Harvested (ha)	1,653	2,794	1,142	4,692	2,610
Yield (kg/ha)	3,919	3,365	3,431	3,570	3,209
Tasikmalaya:					
Harvested (ha)	5,833	7,610	--	8,529	2,951
Yield (kg/ha)	4,127	4,343	--	3,927	4,004
Weighted Average Yield (kg/ha)	4,211	4,323	4,287	4,495	4,289

Source: Agricultural Extension Service, Ciamis, Cilacap and Tasikmalaya. (Revised 10/11/74 to include additional Cilacap data.)

1/ From The Citanduy River Basin Development Project, "Feasibility Report", Engineering Consultants, Inc., Denver, Colorado, U.S.A., March, 1975.

2/ Rough rice at 14% moisture; kilogram/hectare.

TABLE X-5

Rice Price Structure, 1977, Indonesia
(Per Metric Ton)

International Price, f.o.b. Export Point[1/]	$ 270
Fee on Freight and Insurance	20
Imported Price	290
Port Handling Prices	10
Transportation to Selling Center	3
Less Transportation from Mill	- 5
Price Export - Mill	298
Conversion to Gabah (x .63)	188
Less Milling Costs[2/] and Transportation from Farm	- 5
Farm-Gate Economic Price, Dollars/1,000 kg	$ 183. (Gabah)
Farm-Gate Economic Price, Rupiahs/1,000 kg	Rp. 75,945.

1/ Rice f.o.b. Bangkok, 1985 I.B.R.D. projection in 1977 Constant Dollars for 25-30% broken milled rice.

2/ Rice milling by products equals milling cost.

1 $ = Rp 415

TABLE X-6

Soybean Price Structure, Indonesia (per Metric ton)

	Soybeans
International price, f.o.b. export point 1/	$ 281
Ocean freight and insurance	27
Imported price	$ 308
Port handling charges	10
Transport to selling center	3
Less transport from mill	5
Price ex-mill	$ 316
Less milling cost	-6
Less transport farm to mill	-2
Farm gate economic price	$ 308
Rupiah per ton	127,820

1/ Soybean f.o.b. Gulf port U.S.A., 1985 IBRD projection at 1977 constant dollars.

$ 1.00 = Rp 415

TABLE X-7

Kopra Price Structure, Indonesia
(Per metric ton)

International Price c.i.f. export point 1/	$ 397.5
Less insurance & freight differential 4%	-15.9
Imported price	381.6
Port Handling Charges	10.0
Transport to oil mill	3.0
Farm Gate Economic Price	
Rp. per ton	Rp. 163,759

1/ C.I.F. Europe from Philippines, 1985 IBRD projection at 1977 constant dollar.

$ 1.00 = Rp 415

TABLE X-8

Fertilizer Price Structure, 1977, Indonesia
(Per Metric Ton)

	Urea	T.S.P.
International Price, f.o.b. U.S. Gulf ports[1/]	$ 185	$ 165
Ocean Freight and Insurance	36	36
Imported Price	221	201
Port Handling Charges	6	6
Transportation to Distribution Center	5	5
Handling at Distribution Center	6	6
Transportation to Farm	4	4
Farm-Gate Economic Price Dollars/1,000 kg	$ 242	$ 222
Farm-Gate Economic Price Rupiahs/1,000 kg	Rp. 100,430	Rp.92,130

1/ Price f.o.b. U.S. Gulf Ports, 1985 I.B.R.D. projection in 1977 Constant Dollars.

$ 1.00 = Rp 415

TABLE X-9

Farm Budget, Future Without the Project, 3.6 t/ha Yield Wet Season Rice Crop

	Quantity	Cost/Unit (Rupiahs)	Total Cost (Rupiahs)
Receipt			
Rice	3.6 t	75,945	273,402
Expenses			
Land Preparation	25 days	1,000	25,000
Urea	260 kg	100	25,000
T.S.P.	60 kg	92	5,520
Insecticide	3 liter	1,230	3,690
Rodenticide	0.2 liter	2,300	460
Seed	25 kg	150	3,750
Spraying Cost	L.S.		1,000
Harvesting Cost	10% of Crop Value		27,340
Rice Storage	3.6 t	2,000	7,200
Interest on Operating Capital Rp. 39,420 (5%) for One Year			1,971
Total Expense			Rp.$100,931
Net Farm Income per Crop			Rp. 172,471
			$ 415.59

Note: Family labor has not been expensed in arriving at net farm income.

$ 1.00 = Rp 415

TABLE X-10

Farm Budget, Future Without the Project, 1.3 t/ha Yield Dry Season Rice Crop

	Quantity	Cost/Unit (Rupiahs)	Total Cost (Rupiahs)
Receipt			
Rice	1.3 t	75,945	98,729
Expenses			
Land Preparation	25 days	1,000	25,000
Urea	115 kg	100	11,500
T.S.P.	35 kg	92	3,220
Insecticide	2 liter	1,230	2,460
Rodenticide	0.2 liter	2,300	460
Seed	25 kg	150	3,750
Spraying Cost	L.S.		1,000
Harvesting Cost	10% of Crop Value		9,873
Rice Storage	1.3 t	2,000	2,600
Interest on Operating Capital Rp. 22,390 (5%) for One Year			1,120
Total Expense			60,983
Net Farm Income per Crop			Rp. 37,746
			$ 90.95

Note: Family labor has not been expensed in arriving at net farm income.

$ 1.00 = Rp 415

TABLE X-11

Farm Budget, Future Without the Project 950 kg/ha yield
Dry Season Soybean Crop

	Quantity	Cost/Unit (Rupiahs)	Total Cost (Rupiahs)
Receipt			
Soybean	0.950 t	127,820	121,429
Expenses			
Labor			
Man Plowing	20 days	375	7,500
Other	106 days	340	36,040
Woman other	65 days	300	19,500
Material			
Seed	30 kg	200	6,000
Fertilizer - TSP	40 kg	92	3,680
Insecticide	4 l	900	3,600
			76,320
Contingencies			
10% of all Expenses		Rp.	7,632
Total Expenses		Rp.	83,952
Net Farm Income per crop/ha		Rp.	37,477

Note: Family labor has not been expensed in arriving at net farm income.

$ 1.00 = Rp. 415

TABLE X-12

Farm Budget, Future Without the Project 1000 kg/ha yield

Annual Kopra Crop

	Quantity	Cost/Unit (Rupiahs)	Total Cost (Rupiahs)
Receipt			
Kopra	1.0 t	163,759	163,759
Expenses			
The annual expenses will include replanting, cost of seedling, insecticide, weed clearance, harvesting, hulking & drying of coconut, storing			
Assumed as 45% of crop value			73,692
Net Farm Income per Crop per ha			Rp. 90,067
			$ 217.03

Note: The 1972 Kopra average yield according to Data Statistik Perkebunan was 710 kg/ha. for Indonesia. The data between 1954 to 1972 does not show any increase.
A 40% increase in yield is assumed for w/o project situation with improved agricultural practices.

$ 1.00 = Rp. 415

TABLE X-13

Farm Budget, Future With the Project, 5.0 t/ha Yield

	Quantity	Cost/Unit (Rupiahs)	Total Cost (Rupiahs)
Receipt			
Rice	5.0 t	75,945	379,725
Expenses			
Land Preparation	25 days	1,000	25,000
Urea	258 kg	100	25,800
T.S.P.	75 kg	92	6,900
Insecticide	3 liter	1,230	3,690
Rodenticide	0.2 liter	2,300	460
Seed	25 kg	150	3,750
Spraying Cost	L.S.		1,000
Harvesting Cost	10% of Crop Value		37,973
Rice Storage	5 t	2,000	10,000
Interest on Operating Capital Rp. 41,600 @ (5%) for One Year			2,080
Total Expense			116,653
Net Farm Income per Crop			Rp. 263,072
			$ 636.32

Note: Family labor has not been expensed in arriving at net farm income.

$ 1.00 = Rp 415

TABLE X-14

Projected Annual Irrigation Benefits

	Irrigated Area (ha)	Net Farm Income/ha/Crop (Rupiahs)	Total Income (Millions Rupiahs)
Future With Project			
Two Crops/Year, 5 t/ha	785	263,072	413.023
Future Without Project			
First Crop			
rice, 3.6 t/ha	605	172,471	104.345
Second Crop			
rice, 1.3 t/ha	300	37,740	11.324
upland, 0.95 t/ha	305	37,477	11.431
Garden Crop, 1.0 t/ha	180	90,067	16.212
Total Without Project			143.312
Net Annual Irrigation Benefit			269.711

TABLE X-15

Alternative Municipal Water Supply Cost
(Pumping Plant)

Year of Construction	Construction Cost (Million Rupiahs)	Interest Period (Years)	Interest During Construction @ 12% (Million Rupiahs)	Construction Cost Including I.D.C.(Million Rupiahs)
1981	69.97	2.5	23.07	93.04
1982	125.94	1.5	23.58	149.52
1983	83.96	0.5	5.04	89.00
Total	279.87		51.69	331.50

Present Worth at the end of construction of all costs, excluding fuel cost, computed for 50-year project life and 12% interest rate.

Item		Million Rupiahs
Construction Cost plus I.D.C.		331.56
Annual O & M excluding Fuel Cost		173.93
Replacement Cost:	5-Years	59.71
	10-Years	51.04
	25-Years	1.18
Total		617.42
Uniform Annual Repayment Costs, excluding fuel cost, in Million Rupiahs equals: 617.42 x 0.120417		Rp. 74.35

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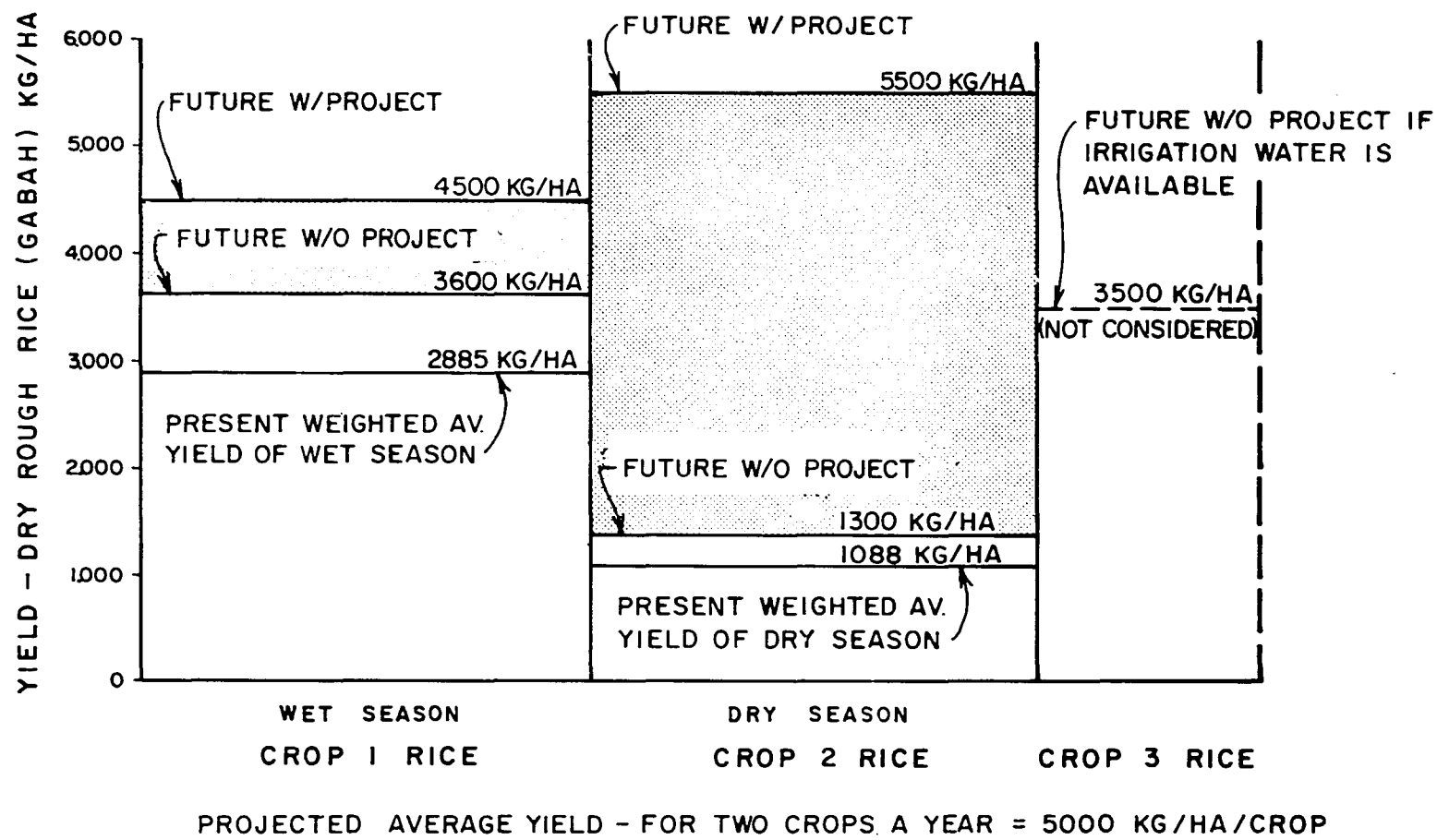
TABLE X-16

Municipal Water Supply Benefit

Year	Annual Cost (Million Rupiahs)	Annual Fuel Cost (Million Rupiahs)	Total Annual* Cost (Million Rupiahs)	Annual Municipal Demand		Unit Cost Rp/m^3
				l/s	Million m^3	
1984	74.35	3.60	77.95	106	3.343	23.32
1985	74.35	3.96	78.31	116	3.658	21.41
1986-90	74.35	5.15	79.50	143	4.510	17.63
1991-95	74.35	6.91	81.26	192	6.055	13.42
1996-2000	74.35	8.71	83.06	242	7.632	10.88
2001-2033	74.35	9.00	83.35	269	8.483	9.83

* This column will represent the municipal benefit for the project.



PROJECTED AVERAGE YIELD - FOR TWO CROPS A YEAR = 5000 KG/HA/CROP

BANJAR PLAINS PROJECT

RICE YIELDS

FIGURE X-1

Chapter XI

ECONOMIC AND FINANCIAL ANALYSIS

General

The economic and financial aspects of providing an assured water supply in the Banjar Plains Area for irrigation and municipal purposes are analyzed in this chapter. The project selected for this analysis is the Gravity System discussed in the previous chapters, because of its lower total cost, including O, M & R, in comparison to the total cost of the Pumped System.

The project, as proposed, is based on an economically sound plan for maximum development and utilization of the natural resources of the service area. Exhaustive examinations were made of the various alternatives before selecting the present scheme which combines full utilization of the land and water resources with realization of maximum economic benefits.

The primary objective of the project is to improve living standards of the people by stabilizing and increasing agricultural production in the service area. Other objectives are to improve supplies of water for domestic and municipal use, and enhance sanitary conditions in the streams by providing year-round flushing water. Drainage benefits are combined with agricultural benefits from rehabilitation and enhanced water supply. Indirect benefits will be of significant magnitude and value, but are not included in the analysis.

The Gravity System will divert 2,000 liters per second through a desilting basin and a 7.32 km long gravity supply canal. An area of 15 ha will be irrigated in this reach. The gravity supply canal feeds the main canal system for an irrigation area of 626 ha producing two rice crops per year. A highline pumping

plant on the mainline canal, and a highline canal system will supply irrigation water to 159 ha to irrigate two rice crops. Provision has been made to supply a municipal water demand of 269 liters per second from the main canal.

The irrigation service area lies mostly in the villages of Banjar and Balokang, while a portion of the villages Situbatu, Binangun and Batulawang are also covered. The municipal service area covers a larger population, mostly in the villages of Banjar, Balokang and the surrounding area. The service area consists mainly of subsistance farms, which are small in areal extent. The per capita income in the area is low. Infrastructural, demographic and agricultural data, as well as the socio-economic conditions prevailing in the service area, is presented in Chapter XII-Social Beneficiaries.

Economic Analysis

The economic justification for the Banjar Plains Project is presented in terms of internal rate of return (IRR), benefit to cost ratios and net benefits. Project construction costs, the operation, maintenance and replacement (O, M & R) costs and the benefits utilized in the economic analysis have been presented in Chapter IX and Chapter X.

Economic studies were 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, custom duties, and social welfare outlays are disregarded.

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 and operation of the project.

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

The determination of who receives the benefits and who incurs the costs is immaterial to the economic analysis. So long as all benefits and all costs occur within the national economy and are internalized in the economic study, it is of no consequence, in the national economic viewpoint, to whom the benefits accrue. However, it is of considerable interest, from the national social viewpoint, whether the benefits are distributed among the lower income groups of society. The socio-economic and indirect benefits were studied in order to ascertain the degree of social equity that would result from the Project. These studies are presented in Chapter XII-Social Beneficiaries.

Stemming from the increase in farm income that will materialize will be increases in the food supply; employment in farm and non-farm economic sectors; increased taxes (and increased public services); improved transportation; enhanced public health and general welfare for local communities.

Project Costs

The recommended project (Gravity System) has been estimated to cost Rp. 1,700,504,000 to construct at the 1977 price level. The details of the estimate are presented in Chapter IX. Considering the project size, it was recommended that the project be constructed in three years with a capital outlay of 25%, 45% and 30% in the first, second and third years of construction, respectively.

The O, M & R cost for the Gravity System was also estimated, based on a project service life of 50 years. Apart from the annual costs of operation and maintenance, replacement costs of certain items at 5, 10, and 25 years intervals were identified. A project cost stream for the 53 years, which includes 3 years of construction and 50 years of project life, is given in Table XI-1. The cost stream shown does not include the interest during construction. For the internal rate of return analysis, the interest during construction does not have to be calculated separately, inasmuch as it is automatically figured in the discounting process.

The conversion of land presently under garden crop to rice (180 ha) is proposed to be carried out in three years beginning from the first year of project operation. A land development cost of Rp 100,000 per hectare has been included as capital cost to convert the 180 ha to rice land. This amount to Rp 6.0 million per year for the three years.

Project Benefits

The two main benefits from the project which are considered in the economic analysis are benefits from providing irrigation water for two rice crops annually on 785 ha of land and providing a municipal raw water supply. The magnitude of benefits are presented in Chapter X-Project Benefits.

The net annual irrigation benefit with an average crop yield of 5,000 kg/ha of dry rough rice was estimated to be Rp. 269,711,000. This is the net benefit derived from irrigating two rice crops annually on 785 ha. The net benefits at other crop yields will vary and are given in Table XI-2.

The annual municipal water supply benefit is related to the population growth and the projected demand pattern. Hence, the benefit stream will depend on the calendar year when the project is completed or when the municipal hookup is ready. The municipal benefit stream is given in Table X-13, Project Benefit Chapter.

The project benefit stream is shown in Table XI-2. A three year build-up will occur in the development of irrigation. With a three year construction period for the project, as mentioned above, the full irrigation benefit will occur on the seventh year from the start of construction on the project. The municpal benefit is assumed to commence two years after the project is constructed.

Economic Evaluation

The project was analyzed to determine the internal rate of return and the benefit-cost ratio. The internal rate of return (IRR) calculation is the discount (interest) rate at which the benefit-to-cost ratio is one-to-one, and is the means of ascertaining the rate of interest return on the investment. For the benefit-cost analysis, an interest rate of twelve percent was assumed. It is believed that this rate probably represents the minimum acceptable rate of return on investments of this type in Indonesia.

It is assumed that the project construction will start in 1981, and be completed in three years. The project will be operational in 1984.

The internal rate of return for the above benefit pattern is found to be 12.0 percent. This can be interpreted as meaning that the benefits to the country from the invested capital would be 12.0 percent. Table XI-3 summarizes the calculation. At the twelve percent interest rate, the benefit-cost ratio for the project is one to one.

The economic analysis is based on 1977 prices for both costs and benefits and an exchange rate of $1.00 = Rp.415. The analysis does not attempt to account for the effect of inflation on the estimated cost of construction and the benefits over the 50-year period of analysis. The usual practice for evaluation of engineering projects is to carry out the anlysis with price and cost levels at a given point in time, which normally assumes the current price level without consideration for inflation. With past rates of inflation having fluctuated between wide limits, it would be virtually impossible to predict a rate of inflation over a future period of 50 years with any confidence. Further, on a long-term basis, if the same inflation rate were to be applied to both benefits and costs, the effects on benefits would obviously be more than the effect on costs, including those associated with operation, maintenance and replacement. As such, applying any inflation rate to cost and benefit amounts would tend to increase both the internal rate of return and the benefit-to-cost ratio.

Should a delay in commencement of construction occur, the economics of the project would not be significantly changed unless there would be a change in the scope of the work. The benefits and costs in the analysis would remain in the same relationship and the economic justification would be independent of the project implementation schedule. However, the capital requirement for construction would depend on the calendar years of construction as it is likely to be affected by inflation during the intervening years.

Highline System - Incremental Analysis

An incremental analysis was carried out to determine if the highline canal pumping plant and the distribution system is economically justifiable. This system irrigates 159 ha of land located at elevations above 45.0. Without the project it is estimated that of this 159 ha about 55 ha would be double cropped with rice, about 56 ha would be cropped with an upland crop each

year, while the remaining 48 ha would produce one garden crop per year.

The capital cost of the highline canal pumping plant, highline canal system and the separable costs included in the diversion weir, desilting basin and gravity supply canal is estimated at Rp. 231,282,000. The annual O, M & R cost is estimated to be Rp. 13,890,000. The annual benefit from irrigation for the highline component amounts to Rp. 56,015,000.

The incremental internal rate of return for the Highline pumping plant and its distribution system works out to 11.8% which is very close to the IRR of the total project. The incremental B/C ratio at 12% interest will be slightly less than 1.0.

Sensitivity Analysis

The economic justification of the project is further analysed by a series of sensitivity analyses. These analyses provide an understanding of the project economics as a result of variations in the basic economic assumptions.

The economic analysis is based on many assumptions necessary to estimate the project costs and future benefits. These assumptions include costs of construction and O & M, projected crop yields with and without the project, values of future crops, and need and value of a domestic and municipal water supply.

To take benefits for domestic and municipal water supply there must exist an actual need for such services. In the case of the domestic and municipal water supply, the need is obvious. The question is only how high a priority the domestic water supply should have in the national development program. This is a policy question which can only be answered by the proper authority in the Government.

As the basic economic assumptions for the feasibility study are subject to change, either due to the fundamental uncertainties connected with all future projections, or due to government policies, sensitivity analyses have been made for the most important variables to show the effect on project economics of such changes.

The internal rates of return for specific cases are presented in Table XI-4. Based on the present study and considering the capabilities of the various departments of the Government of Indonesia in the execution and development of the project, a level of probability has been identified in Table XI-4 for each case.

Financial Analysis

The financial analysis portion of the report presents the cost allocation of the project between the two purposes of irrigation and municipal, as well as identifying the capital requirement.

Cost Allocation

Cost allocation in multiple purpose water resource projects involves the division of the cost of the project among the purposes served. Cost allocations are necessary to arrive at equitable shares of cost for reimbursement by project beneficiaries.

The costs allocated to a project purpose are not the costs to consider when deciding whether that purpose should be included in the plan. Instead, the relationship between benefits and costs of possible variations in purpose, size, or means of development is tested by an incremental analysis to determine their advantages and disadvantages.

The need for a cost allocation arises only when a plan includes joint costs of structure which produce several kinds of service. This is the case of the Banjar Plains Project. Assignment of costs for reimbursement by beneficiaries can be made using the results of the costs allocations presented herein. Also, any purpoca served by the project which might, according to national law or policy, be construed as non-reimburseable, can be assigned an equitable share of the cost. The basic data necessary for cost allocation is contained in Chapter IX.

The proposed Banjar Plains Project serves the two functions of irrigation and municipal raw water supply. To determine an equitable distribution of cost between irrigation and municipal water supply functions, the "Separable Costs-Remaining Benefits" method of allocation was used. The cost allocation was based on total project cost as expressed in 1977 prices, and consisting of total capital cost and capitalized O & M costs. An interest rate of 12 percent was used in the computation.

The separable cost-remaining benefits method limits the allocation to any function to the justifiable expenditure, which is the lesser of either the benefits or the cost of securing the same benefits through the most economical alternative means. After determining the justifiable expenditure, the separable costs are subtracted from the total justifiable expenditure to obtain the remaining justifiable expenditure, which is then used as the basis for allocating the remaining joint costs, which are the total joint costs less the total separable costs. The separable cost is the amount that will be saved if a particular function is eliminated from the multipurpose project. The total cost allocated to a function is the separable cost for that purpose plus the allocated portion of the remaining joint costs.

The amount of the cost included in the multiple purpose project to serve only a given function (separable cost) is identified by subtracting the cost of the project without that function from the cost of the multiple purpose project, including all

functions. By this process, the cost traceable to the inclusion of a specific function (separable cost) can be identified. Under this approach, the entire project is no longer a joint facility. Various parts of it may become "separable costs" associated with specific functions. The "joint" cost under the separable cost-remaining benefits procedure, thus, becomes the cost that remains after identifying and subtracting the separable cost for each function.

It should be noted that the "separable cost" used in the separable cost-remaining benefits allocation procedure are not necessarily associated with any particular physical facility. The terms refer only to "costs added" and "costs remaining".

The results of the allocation, based upon the separable costs-remaining benefits procedure, are presented in Table XI-5. The resulting allocation percentages which will be applicable to the total project cost, including O, M & R, at the time of the project completion are as follows:

For Irrigation Component - 79.5%
For Municipal Raw Water Supply Component - 20.5%

The repayment analysis, or water rate determination, can then be made based on these allocations.

Capital Requirements

In proposing the capital budgeting layout it is necessary to estimate a schedule of domestic and foreign capital requirements, adjusted to account for rates of inflation. As mentioned earlier, the effect of inflation does not bear adversely upon the economic viability of the project as long as the rate of inflation affects both costs and benefits in a similar manner. However, inflation does materially alter the capital budget of the financial entities and needs to be recognized.

The capital requirements are worked out for a specific construction schedule and the calendar year construction will begin. The construction on the Banjar Plains Project is proposed to be started in the year 1981. This will provide about two years in which arrangement for finance, construction drawings, specifications, construction planning, tenders, etc., can be completed. The project will be constructed in a three-year period and be operational in 1984. The percentage of capital cost required will be 25% in the first year, 45% in the second year and 30% in the third year.

Based on the above mentioned construction schedule, the foreign and domestic capital requirements have been worked out and adjusted for future inflation rates. The future foreign and domestic inflation rates were developed based on research by international agencies, and the Consultant's own investigation and judgment. These are shown below with the corresponding cost index factors based on 1977 prices applicable in Indonesia.

Estimated Percent Inflation Rate			Cost Index (apply to 1977 cost)	
Years	Domestic	Foreign	Domestic	Foreign
1977 - 1978	15	7.5	115.0	107.5
1978 - 1979	12	7.0	128.8	115.0
1979 - 1980	12	7.0	144.3	123.1
1980 - 1981	12	7.0	161.6	131.7
1981 - 1982	10	7.0	177.7	140.9
1982 - 1983	10	7.0	195.5	150.8

The foreign exchange component is estimated to be 35% of the total cost for the highline canal pumping plant, and 18% for all other items. The overall foreign exchange component works out to 18.25 percent.

Based on the above inflation rates, foreign exchange component and the proposed construction schedule, the total project cost, excluding interest charges, is estimated to increase from Rp. 1,700,504,000 at 1977 prices to Rp. 2,927,931,000 at the time of construction. This represents a cost increase of 72 percent due to inflation. The construction cost schedule expressed in 1977 Rupiah values and in variable Rupiah values adjusted for inflation is shown in Table XI-8. It is to be indicated that the escalated cost is for the identified construction schedule. Any change in the proposed schedule will change the variable Rupiah value.

TABLE XI-1

Project Cost Stream - Gravity System

(Million Rupiahs)

Year	Cost	Remarks	Year	Cost	Remarks
1	425.126	Construction Cost	28	115.163	O, M & R
2	765.227	Construction Cost	29	57.851	O & M
3	510.151	Construction Cost	30	57.851	O & M
4	63.851	O & M and Land Development			
5	63.851	O & M " " "	31	57.851	O & M
			32	57.851	O & M
6	63.851	O & M " " "	33	253.380	O, M & R
7	57.851	O & M	34	57.851	O & M
8	93.303	O, M & R	35	57.851	O & M
9	57.851	O & M			
10	57.851	O & M	36	57.851	O & M
			37	57.851	O & M
11	57.851	O & M	38	93.303	O, M & R
12	57.851	O & M	39	57.851	O & M
13	253.380	O, M & R	40	57.851	O & M
14	57.851	O & M			
15	57.851	O & M	41	57.851	O & M
			42	57.851	O & M
16	57.851	O & M	43	253.380	O, M & R
17	57.851	O & M	44	57.851	O & M
18	93.303	O, M & R	45	57.851	O & M
19	57.851	O & M			
20	57.851	O & M	46	57.851	O & M
			47	57.851	O & M
21	57.851	O & M	48	93.303	O, M & R
22	57.851	O & M	49	57.851	O & M
23	253.380	O, M & R	50	57.851	O & M
24	57.851	O & M			
25	57.851	O & M	51	57.851	O & M
			52	57.851	O & M
26	57.851	O & M	53	57.851	O & M
27	57.851	O & M			

O, M & R for Years 8, 18, 38 and 48 includes 5-year replacement costs.

O, M & R for Years 13, 23, 33 and 43 includes 5- and 10-year replacement costs.

O, M & R for Year 28 includes 5- and 25-year replacement costs.

Land Development Costs for conversion of 180 ha. of garden to ricelands included in year 4, 5 and 6.

TABLE XI-2

Annual Project Benefit Stream

(5.0 t/ha crop yield)

Year from start of Construc.	IRRIGATION: Rice Area brought under Irrigation (Ha)	Garden Area Converted to Rice (Ha)	Total Area Under Irr. (Ha)	Benefit Million Rp.	Mun. Million Rp.	Total Million Rp.	Remarks
1-3	0	0	0	0	0	0	Construction
4	300	0	300	94.818	0	94.818	Partial Irr. Benefit
5	455	60	515	169.972	0	169.972	Partial Irr. Benefit
6	605	120	725	243.546	81.260	324.806	Partial Irr. & full Mun. Benefit
7	605	180	785	269.711	81.260	350.971	Full Irr. & Mun. Benefit
8-10	605	180	785	269.711	81.260	350.971	"
11-15	605	180	785	269.711	83.060	352.771	"
16-53	605	180	785	269.711	83.350	353.061	"

TABLE XI-3

BANJAR PLAINS PROJECT

INTERNAL RATE OF RETURN ANALYSIS
(Million Rupiahs)

Interest Rate (%)	Present Worth Total Benefit	Present Worth Total Cost	Present Worth Net Benefit	Equivalent Uniform Annual Net Benefit	Benefit Cost Ratio
		Millions of Rupiahs			
0	17,173.653	5,592.290	11,581.363	218.516	3.071
1	13,038.392	4,654.924	8,383.468	204.553	2.801
2	10,116.537	3,980.304	6,136.233	188.836	2.542
3	8,012.317	3,484.499	4,527.818	171.671	2.299
4	6,467.781	3,112.307	3,355.473	153.409	2.078
5	5,312.561	2,826.948	2,485.614	134.405	1.879
6	4,432.601	2,603.583	1,829.017	114.982	1.702
7	3,750.468	2,425.215	1,325.253	95.412	1.546
8	3,212.849	2,280.045	932.805	75.909	1.409
9	2,782.506	2,159.771	622.735	56.634	1.288
10	2,433.051	2,058.469	374.582	37.699	1.182
11	2,145.514	1,971.851	173.663	19.179	1.088
12	1,906.063	1,896.770	9.294	1.118	1.005
13	1,704.470	1,830.884	-126.414	-16.459	0.931
14	1,533.067	1,772.430	-239.363	-33.543	0.865
15	1,386.030	1,720.057	-334.027	-50.134	0.806
16	1,258.879	1,672.724	-413.845	-66.241	0.753

Internal Rate of Return = 12.06 Percent

Notes: The Benefits are assumed to occur at the middle of the year.
The Costs are assumed to occur at the middle of the year.

TABLE XI-4

Sensitivity Analysis

Sr. No.	Case	At 12% Interest: Present Worth of Net Benefit (Million Rp.)	B/C Ratio	Internal Rate of Return	Probability[1/]
1a.	3-yr. Construction; 3-yr. Development lag for Irrigation, 2-yr. Delay in Municipal Benefit. Yield 5,500 kg/ha/crop	297.239	1.16	13.94	High
b.	Same as 1a. with Yield 5,000 kg/ha/crop	9.294	1.00	12.06	Very High
c.	Same as 1a. with Yield 4,500 kg/ha/crop	negative	.85	10.03	High
d.	Same as 1a. with Yield 4,000 kg/ha/crop	negative		7.83	Very Low
2.	3-yr. Construction; No lag in Irrigation and Municipal Benefit. Yield 5,000 kg/ha/crop	311.836	1.16	14.38	Low
3.	4-yr. Construction; 3-yr. Development lag for Irrigation, 2-yr. Delay in Municipal Benefit. Yield 5,000 kg/ha/crop	negative	.97	11.61	High

TABLE XI-4

(Continued)

Sensitivity Analysis

Sr. No.	Case	At 12% Interest: Present Worth of Net Benefit (Million Rp.)	B/C Ratio	Internal Rate of Return	Probability[1/]
4.	Same as 1b. with Rice Price Reduced 10 percent	negative	.86	10.19	Low
b.	Same as 1b. with Rice Price Increased 10 percent	274.876	1.14	13.80	High
c.	Same as 1b. with Rice Price Increased 20 percent	541.193	1.28	15.45	Low
5.	Same as 7a. with Yield 5,000 kg/ha/crop	negative	.80	9.27	High

1/ A probability ranking of Very Low, Low, High and Very High has been used to assist in the project economic evaluation.

TABLE XI-5

Cost Allocation

(Million Rupiahs)

No.	Item	Municipal	Irrigation	Totals
1.	Cost to be Allocated			1,886[1/]
	a. Capital Cost			(1,408)
	b. Capitalized O, M & R			(478)
2.	Capitalized Benefits	404[2/]	1,502	1,906
3.	Alternative Costs	404	1,849[3/]	2,253
4.	Justifiable Expenditure	404	1,502	1,906
5.	Separable Costs	37	1,482	1,519[4/]
	a. Capital Cost	(31)	(1,107)	(1,138)
	b. Capitalized O, M & R	(6)	(375)	(381)
6.	Remaining Justifiable Expenditure	367	20	387[5/]
7.	Percent Distribution	95	5	100.0
8.	Remaining Joint Costs	349	18	367[6/]
9.	Total Allocated Costs	386	1,500	1,886
	a. Capital Cost			(1,408)
	b. Capitalized O, M & R	(54)	(424)	(478)
10.	Allocation Percentages	20.5	79.5	100.0
11.	B/C Ratio	1.04	1.00	1.01[7/]

Note: Interest rate - 12 percent.
All prices are 1977.

1/ Present Worth of Project Cost plus O, M & R.

2/ Present Worth of Alternative Pumping Plant Cost plus O, M & R.

3/ Present Worth of Single-Purpose Irrigation Project Cost plus O, M&R

4/ Total Cost-Alternative Cost for Other Purposes.

5/ No. 4-5.

6/ No. 1-5.

7/ Ratio of No. 2 and 9.

TABLE XI-6

Construction Cost Schedule

(Millions of Rupiahs)

At Constant 1977 Price				Escalated Costs			
Year	Domestic	Foreign	Total	Year	Domestic	Foreign	Total
1	347.527	77.599	425.126	1981	561.604	102.198	663.802
2	625.548	139.679	765.227	1982	1,111.599	196.808	1,308.407
3	417.032	93.119	510.151	1983	815.298	140.424	955.720
Total	1,390.107	310.397	1,700.504		2,488.501	439.430	2,927.931

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Chapter XII

SOCIAL BENEFICIARIES

The Banjar Plains Project has two main components of benefits. The project will provide irrigation benefits to 785 ha of rice land in five villages and municipal raw water supply benefit to a population of over 60,000 mainly in five villages. The beneficiaries of these two components differ to some extent. However, majority of irrigation beneficiaries are part of the municipal beneficiaries. An industrial raw water supply component has been identified as a possible future development. This has not been included as part of the recommended project.

The irrigation service area covers the villages of Banjar and Balokang and partly the villages of Binangun, Situbatu and Batulawang. Of these three villages, the area irrigated in Binangun is 28 percent of the present rice area while in the other two villages it is very small. The area of land irrigated in the five villages is shown in Table X-3, Chapter X-Project Benefit. Almost all the landowners, cultivators and agricultural labor directly benefited by the project live in the villages of Banjar and Balokang. Hence, the irrigation beneficiary discussions will be limited to the people in these two villages.

The municipal raw water supply is intended to cover the village of Banjar, Balokang and extends to some of the subvillages on both banks of the Citanduy River roughly between the confluence of Citanduy and Cimuntur Rivers and Pataruman. The service area covered is approximately 36 square kilometers with a population of about 61,770 in 1977. Thus, the municipal raw water beneficiaries while overlapping the irrigation beneficiaries, extend to a larger

population.

The social beneficiary discussion to follow, is presented in terms of the service area and population group directly or indirectly benefited by the project.

Demography

With over 135 million people, Indonesia is the fifth most populous nation in the world. The average density of 51 persons per square kilometer is deceptively low in as much as 65 percent of the population live on only 6.6 percent of the nation's land surface on Java and Madura. The population of Western Java in 1961 was 11.4 million, 18 percent of the total population; by 1971 the population had risen to 21.8 million, a density of 440 people per square kilometer. The population in 1976-77 within the irrigation service area is estimated to be about 41,000 out of a total population of 59,709 for the five villages of which the service area is a part. The population of the municipal water service area is about 61,770.

The service area includes the town of Banjar and Balokang with a population density of 3120 and 780 per square kilometer respectively and lie wholly in the service area. Since only part of the remaining three villages lie in the service area, discussing the average population density of the service area is not proper.

Table XII-1 presents available population statistics for the five villages for the years 1966-1976. The growth rate for West Java for the years 1971 to 1976 was 2.1 percent. The growth rates in the five villages are significantly different. Between 1969 and 1971 the population in Banjar jumped over 150 percent from 10,001 to 25,761. This period corresponds with the beginning of the Citanduy Project, a multipurpose project in this general area. Since that time, the growth rate in Banjar has been

above the average for West Java but is believed to be temporary in nature. The low growth rates in three of the four remaining villages indicates the amount of emigration from those villages, presumably to Banjar. Based on the growth rates developed as shown in Table XII-1 the total population in the five villages has been projected to the year 2005, which is shown in Table XII-2, assuming a decline in the growth rate in Banjar to the West Java growth rate.

Since the project area covers all of Balokang and almost all of Banjar and small portions of the other three villages, the population of the project area is assumed to be slightly greater than the sum of the populations of Balokang and Banjar and most discussions will focus on those two villages. However, demographic statistics are presented for all the five villages.

A breakdown of population by age groups is presented in Table XII-3. The percentage of the 55 and older age groups in each village is an indication of migration to Banjar by those seeking off-farm employment, i.e., the 15-54 age group.

Economically Active Group

For purposes of discussion of the potential labor force the age group 15-54 is taken to be the economically active portion of the population. Table XII-4 presents the population of the five villages into three general groups, pre-school and school age 0-14, economically active age 15-54, and generally non-working or pensioned, 55 and older. The table also presents the number and percentage of people employed either continuously or intermittently in each village. Only in Situbatu is the number of employed less than the 15-54 age group.

If the economically active group is adjusted for the 0-14 age group and those enrolled in school through senior high, the labor force under 55 years of age in Banjar is 15,621 (49 percent of the population) and in Balokang is 3,525 (46 percent of the population). This indicates that almost everyone under the age of 55 who wants a job is employed either partly or fully, but the figures undoubtedly overlooks a great deal of underemployment. After the 1971 Census the Central Bureau of Statistics estimated the labor force of West Java at 46.32 percent of the population, 10 years of age and over. Of that group 14.5 percent were seeking work (6.7 percent of the population). It would appear that the employment situation in the project area is slightly superior to that in the Province. There is probably a great deal of disguised unemployment in these figures. It is generally felt that agricultural labor is only employed 30 percent of the time, but the remaining time does not represent idleness. The Village Chief of Balokang reported that when not working in agriculture 60 percent of the agricultural labor sought employment elsewhere.

Village records for labor distribution of the population 1975-1976 are shown in Table XII-5. Twenty percent of the total population in Banjar (42 percent of those employed) is active in agriculture. In Balokang 50 percent of the population is active in agriculture (83 percent of those employed). These figures do not include occasional work and the contribution of children. If the percentage of the economically active part of the population remains the same for the next 28 years, the labor force will grow as shown in Table XII-6.

Project Labor Potential

The project will aid in providing additional employment in two ways. Directly, because of the additional acreage coming under rice cultivation, the project will require sufficient yearly labor to farm 180 ha of rice in wet season and 485 ha in dry season. Indirectly, through better distribution of water and

increasing applications of fertilizer, yields will be larger requiring additional manpower at harvest time on the 785 ha. Table XII-7 shows the without-project and with-project scenario.

The direct increase in labor requirement will be for the 31,440 in the dry season and 14,040 in the wet season, which is a direct increase of 45,480 man-days per year. The indirect, if the assumed increases in production are maintained, will be about 215,380 man-days. Thus, the additional labor required will be 260,860 man-days per year. A total of 16,625 Buffalo days is also anticipated.

In addition to the increase on labor requirements directly attributed to agriculture there may be an increase in non-agricultural labor. These will be indirect, generated due to provision of a proposal for municipal raw water in the project and a possible industrial water supply.

The proposal to develop an industrial component will create demand for labor. Although development of the industrial complex is still uncertain, the labor potential has been worked out to identify the demand. The industries and the projected labor force and ancillary labor force required are shown in Table XII-8. If two of the three industries are located in Banjar, total labor requirements might reach 6,700 new permanent and part time jobs. This does not take into account the tertiary job benefits within the economy as a whole.

Income and Cost of Living

Figure XII-1 presents the income received by the agricultural and non-agricultural sectors since 1968 in Ciamis District. The increase in non-agricultural income has been dramatic. The income received by the non-agricultural sector is all the more expressive when one considers that there are five agricultural laborers to one non-agricultural laborer. However the stability

of per capita agricultural income indicates both an absolute and a relative decline in the economic position of farmers. Figure XII-1 also clearly indicates that per capita agricultural income in Ciamis District (approximately US $40) is far below the A.I.D. poverty benchmark of $190 adjusted by the I.B.R.D. Agricultural incomes in the Banjar Plains Project Area can be assumed to be below the Ciamis District average.

The major expenditures as percentage of income are shown in Figure XII-2. Over the past eight years the percentage spent on education and housing has doubled, savings have been reduced, and the percentage spent on food has dropped. The percentage of the consumer rupiah spent in other categories has remained fairly constant. The increase in housing costs would reflect not only increase in costs of materials but also increases in labor wage rates. The decrease in the percentage of the consumer rupiah spent on food is a reflects the general increase in income levels, but does not include the value of agricultural products consumed at home.

Land Tenure

The land use pattern in the five villages is shown in Table XII-9. It is noted that 83 percent of the land in the project is found in Banjar and Balokang villages, 13 percent in Binangun village and only 4 percent in Situbatu and Batulawang villages. The change in land use has been discussed previously.

Table XII-10 shows the breakdown of land holdings in the five villages as taken from village records. In Banjar the median lowland is in the 0.5-1.0 ha range; the median dryland is less than 0.51 ha. In Balokang both the median lowland size and the median dryland size are in the 0.5 ha range. Calculating a weighted average for size of land holdings in Banjar and Balokang gives the following:

	Lowland	Dryland
Banjar	0.74	0.75
Balokang	0.53	0.61
Binangun	0.99	1.35

Except for Banjar and Binangun dryland, these weighted averages are close to the median values. The general correspondence of the mean and median give a good estimate for the size of rice land owned.

Share cropping is prevalent in all these villages. Share cropping operates on a 50-50 basis of the net proceeds excluding taxes and the share cropper's labor input. All other inputs are deducted. The capital is usually supplied by the land owner. The percentage of families who sharecrop is about 23 percent in Banjar village and about 66 percent in Balokang village of the total families involved in agriculture. The total number of families involved in agriculture is estimated to be 2589 in the Banjar Plains Service Area.

The number of agricultural families that rent land is considerably smaller. In Banjar village about 20 percent of the families involved in agriculture rent land while in Balokang village it is only 3 percent. Land rents vary with the class of land. The class of land referred to herein is used in the village records and is based on the crop yield magnitude. Class I land is the highest yielding land, while Class V is the lowest yielding land. Class I land rents for Rp.150 per bata (712 bata = 1 hectare) or Rp.106,800 per hectare in Balokang. This would be a thirty to forty-year payout on the present purchase price of Class I land. At this rate, rental for Class II land would be about Rp.65,000 per hectare or about 60 percent of the Class I rental. Land is only rented when the land owner is in need of cash.

The families that own land and cultivate in Banjar village form the major percentage of the families involved in agricultural operation (about 51 percent). In Balokang village this percentage is only 31 percent.

The lands to be upgraded from garden to paddy are exclusively in Banjar and Balokang villages along the lower, riverside edge of the project area. Once year-round water is supplied to these 180 hectares its class value will change to Class I land. This will increase the value of this land, for sale or for rent, by at least 50 percent. Also the Class II to Class IV rice lands in the 605 ha portion will be upgraded to Class I with the provision of technical irrigation. This will increase the value of this land for sale or rent by at least 30 percent.

Cropping Pattern and Farm Income

The cropping pattern and various agricultural inputs to each crop are discussed in Chapter IV and X. The net farm income with and without the project is summarized in Table X-14.

At the assumed yields the project will produce an additional 5,300 tons of dry rough rice per year. The additional net income will be Rp.413 million.

The additional production will probably be used locally. In 1976 there was a deficit of 5,497 tons of rice in Banjar Subdistrict. Table XII-11 shows 1976 production and consumption statistics for Banjar and two other subdistricts in which the project area lies or borders and statistics for the district of Ciamis. While there is a surplus of 24,000 tons in the district, the Banjar subdistrict shows a deficit of 5,500 tons. It is obvious that an increase of 5,300 tons will help offset the yearly deficit in the area.

The assumed per capita consumption is 250 kg drystalk padi per capita per year. This approximates 350 grams of rice a day per person. Based on this, Table XII-12 shows rice demand in the affected villages over the next 30 years. If the population increase follows the projections in Table XII-2, rice demand within the area will greatly exceed production by 1985, even with the project. Of course, the projections serve only as a general guide for planning and they will need to be modified over time to reflect continuing changes. Nonetheless, they already indicate that additional rice production in the area will be needed merely to meet additional local demand.

Marketing and Processing

In the project area the present flow of rice through the market depends on the type of rice grown. If the farmer grows mixed varieties, i.e., a local variety and a high-yield variety, then he would tend to keep the local variety for his own consumption and sell the high-yielding variety. This is based on the Javanese preference for the taste of the local variety and its better storage characteristics. If high-yield varieties are grown, they are often threshed in or near the field hence they are marketed as dry-rough rice. Local varieties would be most often marketed as dry-stalk padi. The farmer can sell in the market, to a middleman, or take his rice to a mill where often he will find a broker to buy his rough rice. Rice can also be sold through the KUD but the price offered is lower than the price in the market.

It is reported that Banjar Subdistrict contains 16 mills. One mill is operated by the KUD; it has a 7 ton per day capacity. The 15 private mills are reported to have an average capacity of three to four tons per day. They reportedly enjoy a reputation for doing quality work. Seven mills are located in Balokang, eight are in Banjar, and one is in Langensari outside of the project area. The distribution is such that a farmer in the project area would have little difficulty getting his crop to a

mill for processing or for sale. Milling prices are Rp.3 per kilogram at the KUD mill and up to Rp.10 per kilogram at the private mills.

Storage facilities appear adequate with one 20 m x 10 m x 6 m storage facility in each of the 48 KUDs in Ciamis District. Banjar Subdistrict has two KUD storage facilities in addition to the large BULOG storage facility. There is no information on the total number of private facilities but storage is thought to be adequate.

Municipal Water

The project in addition to providing irrigation water for 785 hectares will also supply municipal raw water. The plan is to deliver 269 liters per second to a point in the system convenient for treatment and distribution to Banjar. People living around the supply canal and distributory system would also benefit from this water supply. The population benefiting from the supply of domestic water is not the same population benefiting from irrigation water.

The projected supply of municipal water and the background data supporting the plan are discussed in Chapter III-Municipal and Industrial Water Supply. In summary, most domestic water comes from hand-dug wells or the river. During the dry season the ground water supplies diminish and shortages develop and reliance increases on river water as a source of supply. During these periods the Banjar town dwellers purchase water from becak drivers or porters. People in Banjar are forced to purchase water since the municipal system installed in 1973 (exploiting a supply of water from a spring), is limited to a small percentage of the population. Furthermore, the lack of maintenance has further reduced its service.

In the dry season untreated water sells for Rp.1.25 to Rp.1.75 a liter. Average annual cost varies from Rp.3750 to Rp.5250 per person.

As discussed in Chapter III, the District Planning Office hopes to attract additional industry to locate in the Banjar area. One of the requisites for industrial development is the uninterrupted supply of good quality water. The three industries presently considered are a rayon fiber textile mill, a non-urea fertilizer factory and an activated carbon-fibered rubber factory. These would require about 700 liters of water per second at full development. Provision of M & I water by the Project should facilitate the location of new industry in the Banjar area.

Transportation

At the start of Pelita II (the second five-year plan) road systems throughout the Ciamis district were improved. The District Planning Office (BAPPEMKA) cites this as one of the factors in the dramatic improvement in non-agricultural income in the middle 70's. At the present time macadam and asphalt roads in and around Banjar are in desparate need of repair. All road building energies in the area are presently focused on the new Bandung to Cilacap highway. Table XII-13 summarizes the type of roads in the Banjar Plains service area.

Often overlooked in the general benefit picture, access roads ancillary to a project increase the means of transportation and communication. Present indications are that about 30 kilometers of new roads and six kilometers of replacement roads will be constructed along the main canal and major laterals. The roads will be gravel surfaced. This phase of the project will increase or improve the transportation net in the area by over 50 percent.

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Public Health Facilities

Data on public health facilities available to the public in 1976 for the three sub-districts of Banjar, Pamarican and Cimaragas are shown in Table XII-14. Although a small part of the Pamarican sub-district is included in the Banjar Plains Area, this sub-district is adjacent to the service area and the health facilities would be available to some of the population. Among the most frequent illnesses reported were influenza, bronchitis, gastroenteritis and tuberculosis. Over 26,000 patients were treated in the clinics during 1976. With the provision of treated water it is believed that the number of persons affected by water-borne diseases would be reduced, if not completely eradicated.

Educational Facilities

In 1975, there were 59 schools (including religious schools) in the two villages of Banjar and Balokang. The statistical details are shown in Table XII-15. In all, about 9,110 students attended various schools in 1975, manned by 306 teachers. This gives a teacher-to-student ratio of 1 to 30.

Banjar is the only village with both junior and senior high schools. School attendance in the project area is primarily concentrated at the elementary school level (grades 1 to 6) since this level constituted 67 percent (not including religious schools) of the total school attendance. The level of literacy in 1975 in the five villages was about 23 percent.

Summary

The foregoing discussion has sought to present those facets of the cultural environment where assumptions of benefits received by and through the project are more tangible and substantiated quantitatively. Although the surface area covers all or parts of

five villages only three villages really benefit, Banjar, Balokang, and Binangun and of these three the population and general infrastructure of the project area is confined to Banjar and Balokang.

Economically Active - Summary and Benefits

Banjar is essentially urban in character with that segment of the population working in the agricultural sector commuting the few kilometers to the fields. Balokang is rural with 83 percent of the labor force active in agriculture.

Present statistics indicate full employment of the economically active age groups. One has to assume that there is much disguised unemployment and underemployment. It is known that farm laborers are actively engaged in agricultural pursuits about 30 percent of the time. When not on the farm, becak driver, common laborer, and industrial employment are some of the jobs sought after seeding and before harvest.

Projected population increases are significant. By the time the project is scheduled to be fully operational, 1985, the population of Banjar and Balokang will have increased by 18 percent; the prospective labor force in Banjar will have increased by 20 percent and the labor force of Balokang will have increased by 6 percent. Offsetting this excess labor capacity will be additional man-days of agricultural labor required owing to construction of the project. Direct and indirect additional man-days of labor amount to 260,860 man days per year. If an agricultural labor year is assumed to be 110 days, i.e., 30 percent of 365, then by time the project is fully operational there will be a demand for 2,370 additional laborers, or four-fifths of the projected increase in labor force. At an average man-and-woman daily labor rate of Rp.325, the additional man days would amount to Rp. 85 million each year. In the past five years the agricultural day rate has increased about Rp.150. If this

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trend continues, the additional money brought into the economy by the agricultural labor section would double, although certainly much of the increase will disappear because of inflation.

The construction of the project itself will require an average of about 600 laborers and 50 skilled laborers over a three-year period, 1981-1984. This will bring in about Rp.180 million each year during the construction.

The municipal water treatment plant and distribution system will require construction labor. No estimates of costs or labor requirements have been made but the benefits must be considered.

The possible development of an industrial sector in the future if raw water is made available, will generate an additional 6,700 permanent and part-time jobs as indicated before. This amounts to 92 percent of the projected 1985 excess labor force. It is estimated that about 1.3 million man days per year will be added which will amount to Rp.1.3 billion per year in wages.

Culturally the people in West Java have established the home as the number one priority item in their list of personal possessions. This would mean that heads of households drawn to Banjar or new heads of households raised in Banjar will require housing. The quality of housing required will increase as more money becomes available through permanent employment. This will generate a home construction boom. The value to the economy and the labor requirements are not estimated but the benefits must be considered.

Land Tenure - Summary and Benefits

Rice is the primary food crop and production is consumed locally. Farms are small and the agricultural economy borders on the subsistance level. The improved water supply will bring all land affected to the Class I level as soon as the water is in the

canal. It is estimated that project land which is not Class I at present is the 180 hectares of the "U" class land and about 40 percent of the 605 hectares of the "R" class land. The project will raise the classification of this land to Class I and increase its value from an average of Rp.2,136,000 per hectare to Rp.4,272,000 per hectare. This immediate increase in asssets would accrue to the landowners themselves. Based on an average land holding of 0.64 hectare the increase in assets of each landowner would be Rp.1.37 million or a total of about Rp.900 million for the service area.

Individuals knowing of the project may seek to speculate on the increase in land value. Additionally, the increased land value and rental costs may further increase the growing disparity between land owners and landless laborers.

Cropping Pattern and Farm Income - Summary and Benefits

The principal lowland crop is rice and it is grown whenever sufficient water is available. This project will provide irrigation water to 785 hectares of rice land. The discussions and economic benefits have focused on increased yields offered by two rice crops and the effect of the project on Palawija crops have been ignored.

The future with the project will net Rp.413 million annually as opposed to a without project net of Rp.143.3 million. The increase in net proceeds with the project amounts to Rp.269.7 million per year. Based on the farm size assumed above, i.e., 0.64 hectares, there would be 1226 owner cultivator and about 1096 cultivator families sharing the increase in net receipts from rice or about Rp.116,000 yearly increase to each cultivator or tenant-owner family.

With an increase in soil moisture levels at the start of the dry season and some water available for irrigation in the dry season, there exists the possibility of growing a Palawija crop on at least 25 percent of the area. Benefit values for such a crop have not been identified as the economic analysis was based on two rice crops a year.

Marketing and Processing - Summary and Benefits

The present marketing and processing facilities appear to be sufficient to handle the increase in rice production. The 16 rice mills in Banjar Subdistrict have a combined capacity of about 60 tons of rice per day. Should additional capacity be required, it is believed that the phasing-in of the hectarage affected by the project over a three-year period will allow the usual market forces to adjust to the increased supply.

The additional rice production with the project will amount to 5,300 tons. At an average milling price of Rp.7 per kilogram, it is estimated that the millers in the local area will receive an additional income of Rp.37 million.

Storage should be no problem. Present storage at the farm, in KUD and private storage facilities, and the daily demand of about 14 tons of rice will not be stressed by additional production.

Municipal - Summary and Benefits

The project will provide 269 liters per second of raw water for municipal uses in the town of Banjar and surrounding areas. Present conditions require the populaton to purchase water during the dry season. Yearly costs per person average Rp.4500. Projected over the approximately 35,000 people to be affected, the amount of savings will be Rp.157.5 million per year.

The municipal water supply will have a beneficial effect on the health of the people in the area. By and large the population of the project area enjoy conditions healthier than other areas of West Java.

However, gastro-intestinal problems do occur including Chidera, which is listed under this general headings in health standards . They are particularly prevalent in the dry season as the ground water supply diminishes and the effluent from toilets and drains may get into wells and water courses undiluted. The improved health of the population because of additional water in the dry season is an unquantifiable benefit as is the greater efficiency of laborers whose health is improved.

Transportation - Summary and Benefits

Table XII-13 summarizes the number of kilometers of roads in the five villages of the project area. The inclusion in the project of 25 kilometers of road along canals and laterals should aid communication allowing the rural population to reach potential markets for their agricultural products and any home industry products. Also rural people will have greater access to Banjar for shopping and acquiring products cheaper through the larger urban stores.

As previously mentioned, the District Planning Office cites increased communication and ease of movement brought about by the new roads constructed through Pelita II as an important factor in the rapid growth of non-agricultural income in the middle 1970's. Of the Rp.60,000 per capita increase in annual non-farm wages realized in the period 1972-1976, it is not possible to quantify the part attributed to new roads. Common sense tells us an improved transportation net is vital to a progressive economy.

Conclusions

Table XII-16 summarizes the benefit discussed herein. Quantifiable irrigation and water supply benefits amount to over Rp.549.2 million per year after the project is completed; short term benefits over a three-year construction schedule amount to Rp.378 million per year. The long-term benefits include direct increases to the agriculture sector through increases in rice yields. These are discussed in depth in another section of the report.

Unquantified benefits also accrue to the project. In Table XII-16 no estimates were made on the construction and operation of the municipal water plant or on the potential for a housing construction boom. The probable error in making an estimate with no available information is too great. Suffice to let them remain as unquantified at this time. Another benefit in this same category is the costs of importing rice into the rice deficient districts e.g. Banjar. Subsequent surveys, if necessary can pinpoint the amount of rice imported and its transportation cost.

Improved health, greater work efficiency, the value of increased transportation facilities are unquantifiable, but have been discussed. Other items, not discussed, because of the difficulty in assigning benefits is the general literacy of the population.

For example, if it is true that financial considerations affect school attendance, then an increase in family income brought about by greater opportunity will increase the chances of youngsters to obtain an education. This is seen through the increase in expenditures for education shown in Figure XII-2 since 1973. Further, the more students in the 10-20 year old age group, the fewer the number seeking employment.

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Other items not discussed but just as certainty benefits are the increased profits to fertilizer, pesticide and seed dealers, wholesalers and manufacturers brought about by an increase of these items. The tertiary, or ripple effect, of introducing additional industry into the area has not been discussed at length. The director of BAPPEMKA in his letter to the project manager mentioned a 15 to 1 multiplier effect and the possibility of 20,000 additional jobs. An attempt to quantify these "benefits" and add them to the benefit list would not be appropriate without more study.

The increased payroll in agricultural labor will amount to Rp.85 million per year. Added to the labor benefits are an increase in the assets Rp.900 million for about 1,226 farmers and the savings in purchasing water of Rp.157.5 million per year for about 35,000 urban and rural residents of the Banjar service area.

It can be seen from the above discussion that most of the benefit from this project goes to the agricultural sector, whose average annual income per capita is 20 percent of the non-agricultural sector.

TABLE XII-1

Population of Villages in Which Project is Located (1966-1976)

Village	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Growth Rate Percent	Households 1975-1976 persons per household
1. Banjar	6872	7393	8550	10001	17253	25764	27047	28330	29613	29575	32142	4.5*	5845 / 5.5
2. Balokang	7157	7266	7258	7359	7491	7489	7562	7964	7648	7666	7666	0.7	1912 / 4.0
3. Binangun	5214	5224	5247	5302	5348	5395	5590	5762	5632	5669	5669	0.8	1667 / 3.4
4. Situbatu	4455	4513	4543	4539	4605	4685	4712	4765	4825	4942	4942	1.2	1431 / 3.4
5. Batulawang	4565	4586	4636	4707	4867	5527	5687	5617	5707	8272	9290	2.8**	1654 / 5.0

* Calculated since 1971

** Calculated 1966 - 1974

Source: Ciamis District Records. Adjustments made in 1971 and 1976 are based on the Population Census and Election Census respectively.

TABLE XII-2

Population Projections Through Year 2005 for Villages in which the Project is Located

Village	Rate %	1976	1985	1995	2005
Banjar	2.1*	32,142	38,753	47,705	58,725
Balokang	0.7	7,666	8,163	8,753	9,385
Binangun	0.8	5,669	6,090	6,596	7,143
Situbatu	1.2	4,942	5,502	6,199	6,985
Batulawang	2.8	9,290	11,911	15,699	20,693

* Rate based on average for West Java, 1967-1971

TABLE XII-3

Village Population By Age Group & Sex

Village	Age & Sex Group												Total
	0 - 4		5 - 14		15 - 24		25 - 54		55 & over		Total		
	M	F	M	F	M	F	M	F	M	F	M	F	
Banjar[1/]	2426	2675	4139	4553	2745	3129	4122	4578	1591	2184	15,023	17,119	32,142
Balokang[2/]	514	547	479	580	431	451	1322	1310	1013	1019	3,759	3,907	7,666
Binangun[2/]	196	179	778	764	597	701	762	767	434	491	2,767	2,902	5,669
Situbatu[2/]	320	320	447	464	622	616	567	567	518	506	2,474	2,473	4,947
Batulawang[2/]	738	786	425	502	548	697	1417	1572	763	824	3,891	4,381	8,272

1/ From village data for 1976/77

2/ From village data for 1975/76

TABLE XII-4

Population by Age Group

Age	Banjar No.	Banjar % Pop.	Balokang No.	Balokang % Pop.	Binangun No.	Binangun % Pop.	Situbatu No.	Situbatu % Pop.	Batulawang No.	Batulawang % Pop.
0 - 14	13,793	43	2,120	28	1,917	34	1,551	31	2,451	30
15 - 54	14,574	45	3,514	46	2,827	50	2,372	48	4,234	51
55 & over	3,775	12	2,032	27	925	16	1,024	21	1,587	19
Employed	14,915	46	3,867	50	3,104	55	1,452	29	4,721	57

Source: Village Records

TABLE XII-5

Labor Distribution (1975-1976)

Village	Farmers	Salesman	Business	Livestock Breeder & Fisherman	Labor		Employer Army Services	Total
					Farm	Industry		
Banjar	1869	1506	1489	-	4444	2907	2700	14,915
Bolokang	2139	129	11	-	1256	41	291	3,867
Binangun	1309	15	7	55	1480	141	97	3,104
Situbatu	823	21	4	-	452	-	152	1,452
Batulawang	3381	129	8	195	525	411	72	4,721

Source: Sub-District Records

TABLE XII-6

Projected Labor Force to 2005 - Banjar and Balokang

Desa	% Labor of Pop.	Labor Force 1985	Labor Force 1995	Labor Force 2005
Banjar *	46	17,826	21,944	26,013
Employed 1976				14,915
Increase in Labor Potential				12,098
Balokang **	50	4,082	4,376	4,692
Employed 1976				3,867
Increase in Labor Potential				825

* Based on population growth rate of 2.1% (W. Java)

** Based on population growth rate of 0.7%

TABLE XII-7

Requirements Without- and With-Project

Yearly Labor	Without Project				With Project	Additional
	Rice	Upland	Garden	Total	Total	Labor Reqd.
Number Ha farmed	605+300	305	180	1,390	(785 x 2)=1570	
Mandays labor/ha	118	60	80		255*	
Total man-days	106,790	18,300	14,400	139,490	400,350	260,860
Buffalo labor/ha	25	0	0		25	
Total Buffalo-days	22,625	0	0	22,625	39,250	16,625

*Estimated increase in harvest labor based on an average yield of 5 T/ha (Gabah) and converting 10 percent-of-crop harvest charge provided in the farm budget to addition man-days required.

TABLE XII-8

Possible Industries in Banjar Showing Labor Requirements and Potential Ancillary Labor Requirements

Industry	Approximate Construction Cost (million) U.S. $	New Jobs in Plant	Labor to Supply Raw Mat'l	Potential Ancillary Labor
Textile/fibers	$ 25	600	NA	1300
Non Urea Fertilizer	$ 5	400	1300	700
Activated Carbon Fibered Rubber	$ 25	360	5600	NA
Total	$ 55	1360	6900	2000

Source: BAPPEAKA, Ciamis

NA: Not Available

TABLE XII 9

Land Use Pattern - 1977

Village	Total Land (ha)	Ricefield (ha)	Mixed Garden Plantation Upland, Fallow (ha)	Settlement (ha)	Fishpond	Road, River and Stream	Others	Land in Project
Banjar	1029.1	311.9	389.6	259.2	12.6	49.5	6.3	420
Balokang	980.1	202.1	470.4	133.8	6.3	44.2	123.3	198
Binangun	1365.9	365.4	871.3	80.6	7.7	31.9	9.0	99
Situbatu	745.6	99.7	620.0	12.3	-	5.6	8.0	36
Batulawang	1968.6	105.7	1188.0	139.5	57.8	28.0	449.5	32

Source: Village Records

TABLE XII-10

Land Holdings - 1975
(Hectares)

Village	0 - 0.5 ha		0.5 - 1.0 ha		1.0 - 3 ha		3 - 5 ha		> 5 ha	
	Lowland	Dryland	Lowland	Dryland	Lowland	Dryland	Lowland	Dryland	Lowland	Dryland
Banjar	108	118	113	65	16	21	2	2	5	5
Balokang	341	491	210	286	31	94	-	1	-	1
Binangun	447	631	486	261	245	313	64	88	1	7
Situbatu	421	1160	50	230	5	105	-	7	-	-
Batulawang	382	984	76	483	8	328	-	36	-	-

Source: Village Records

TABLE XII-11

Production and Consumption of Rice (1976) for Ciamis District and Selected Subdistricts

Location	Production (ton)			Population	Consumption			Surplus (Deficit)
	Sawah	Gogo	Total		Consume	Seed	Total	
Subdistrict								
Banjar	18,870	0	18,870	96,815	24,206	164	24,368	(5,497)
Cimaragas	10,000	34	10,041	28,810	7,203	72	7,275	2,766
Pamarican	16,088	687	16,776	69,492	17,373	228	17,601	(826)
District								
Ciamis	349,342	5,744	355,085	1,304,951	326,238	4,500	330,738	24,347

Source: District Records

TABLE XII-12

Projected Rice Demand Based on 250 Kilograms/Person/Year for Five Villages in Project Area

Desa	Demand in Tons Per Year			
	1976	1985	1995	2005
Banjar	8,036	9,688	11,926	14,681
Balokang	1,917	2,041	2,188	2,346
Binangun	1,417	1,522	1,649	1,786
Situbatu	1,236	1,376	1,550	1,746
Batulawang	2,068	2,978	3,925	5,133
Banjar Subdistrict				
Demand:	24,206	27,155	29,965	31,355
Production	18,870			

TABLE XII-13

Kilometers of Roads by Type
Banjar Plains Service Area, 1977

Village	Asphalt*	Gravel	Macadam*	Earth
Banjar	14	9	6	1
Balokang	4	10	1	8
Binangun	12	0	0	14
Situbatu	4	2	4	7
Total	34	21	11	30

*For purposes of this distinction, asphalt roads are prepared with a base of stone, then layers of asphalt & sand are applied. Macadam roads are road surfaces covered by a gravel-asphalt mix; durability is poor.

TABLE XII-14

Medical Facilities in the Area - 1976

Sub-District	Type of Medical Facility				
	Public Health Center or Clinic (No.)	Mother and Child Clinic (No.)	Family Planning Clinic (No.)	Drug Stores (No.)	Ambulance (No.)
Banjar	1 1/	5	4	5	1
Pamarican	1 2/	2	1	-	-
Cimaragas	1 2/	1	1	-	-
T o t a l	3	8	6	5	1

Source: BAPPEMKA, Ciamis, 1977.

1/ 60 Beds.

2/ Without Beds.

TABLE XII-15

Educational Facilities

Village	Schools	Rooms	Students by Type of School				Total	Teachers
			Elementary	Junior High	Senior High	Religious		
Banjar	47	178	4,715	1,600	1,330	219	7,823	254
Balokang	12	48	1,016	32	—	179	1,287	52

Source: Village Records.

TABLE XII-16

Summary of Benefits

Event	Segment of Population Benefited	Benefit	Subsegment	Number Affected	Annual Man-Days	Man-Day Rate (Days) (Rp)	Annual Benefit (Rp.Million)
Irrigation Water Supply	Economically Active	Job Availability	Agriculture Labor	2,370	260,860	325	85
			Project Construction[1/]				
			Skilled	50	45,000	1,200	54.0
			Unskilled	600	540,000	600	324.0
			Industrial[2/]	6,700	1,300,000	1,000	1,300.0
			Municipal Water Plant		No Estimates Made		
			House Construction		No Estimates Made		
	Land Owner	Increase in Value of Land	Owner of other[3/] than Class I land whose land will be made Class I by provision of year-round water	1,226 Farmers			900.0
	Cultivator	Increase in Crops	Tenants/Owners and Renters	2,322 Cultivators	Net Increase of Rp. 116,000/Farmer per year on Rice		269.7
Increase in Production	Millers	Increase in Workload		Rp. 7 x 5,300,000 kg			37.0

TABLE XII-16
(Continued)

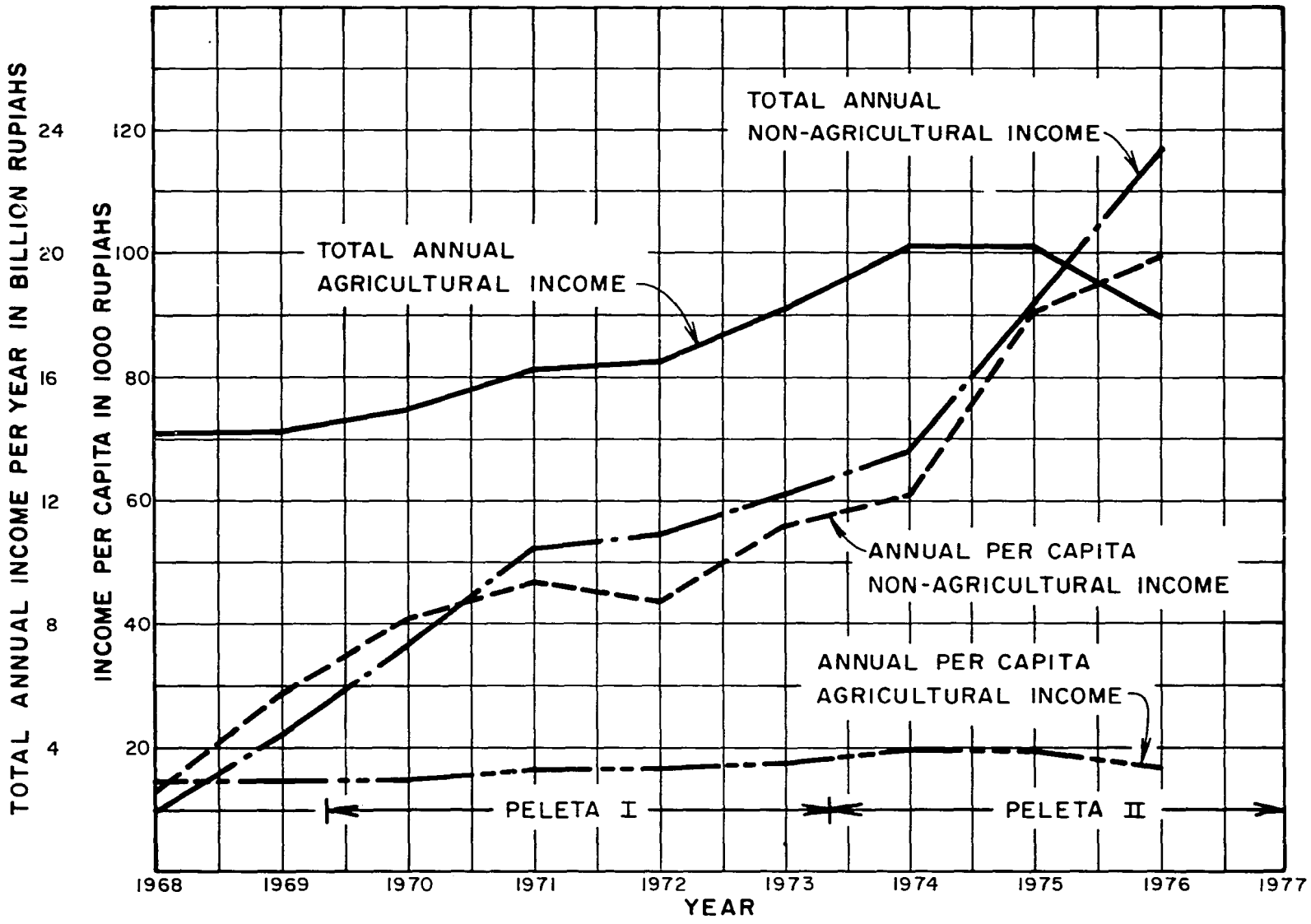
Summary of Benefits

Event	Segment of Population Benefited	Benefit	Subsegment	Number Affected	Annual Man-Days	Man-Day Rate (Day) (Rp)	Annual Benefit (Rp.Million)
Provision of Municipal Water	Population of Banjar & those along Canal	Lower Dry Season Water Costs		Approx. 35,000 People @ Rp.	4,500		157.5
		Improved Health			No Estimates Made		
		Greater work efficiency because of improved health & general well being			No Estimates Made		
Roads Along Canals and Major Laterals	Rural Population	Increase in transportation net will allow greater access to shops and stores of Banjar, aiding general market economy. Also, allow ease of transporting home industry products to potential market.			No Estimates Made		

1/ Benefits to run for the estimated three-year construction period.

2/ This component is not in the recommended project, but is possible development in the future.

3/ One time benefit.

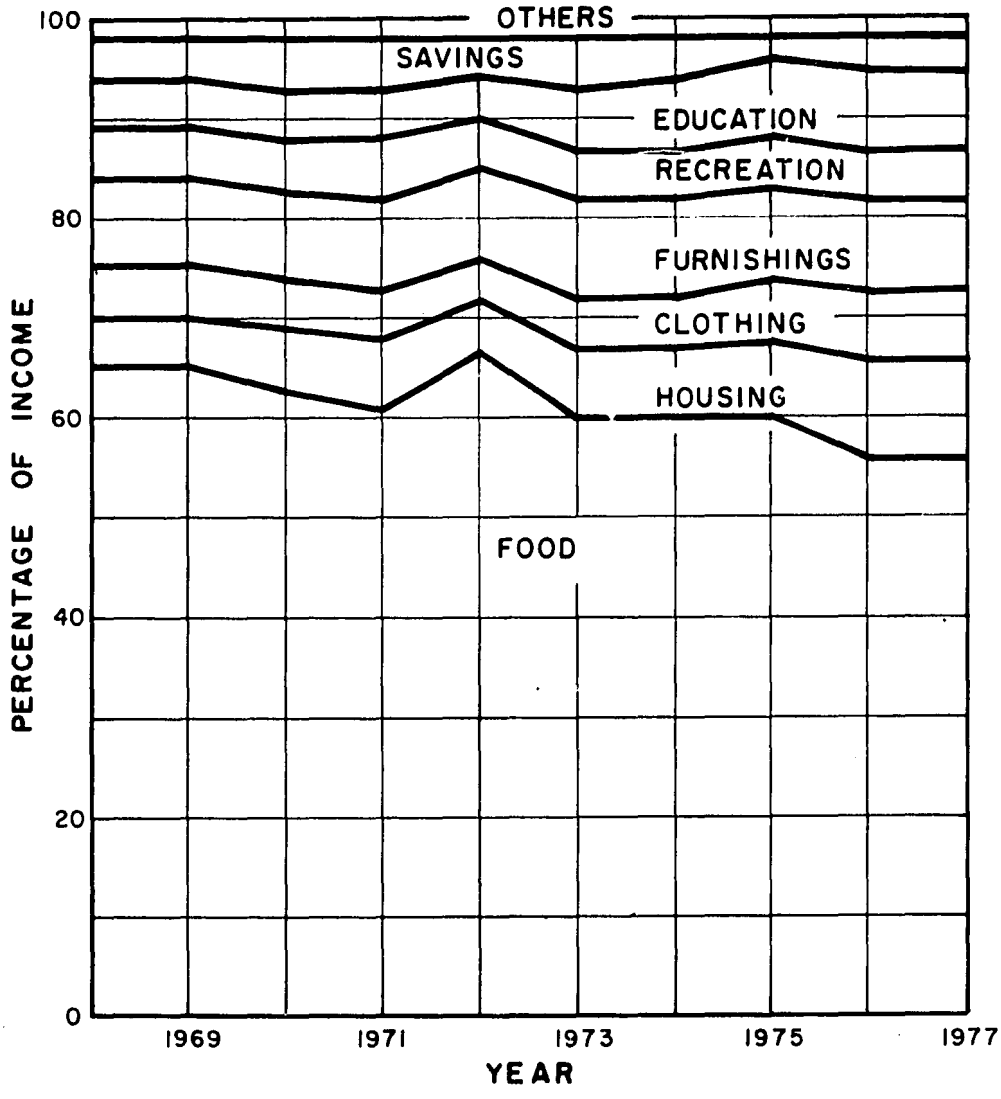


BANJAR PLAINS PROJECT

AGRICULTURAL & NON-AGRICULTURAL INCOME 1968 - 1977

CIAMIS DISTRICT

FIGURE XII - 1



BANJAR PLAINS PROJECT

MAJOR EXPENDITURES AS PERCENTAGE OF INCOME 1969 - 1977

CIAMIS DISTRICT

Chapter XIII

ENVIRONMENTAL ASPECTS

General

Irrigation of Banjar Plains Area will improve food production on lands already under rainfed cultivation and partly under a rainfed rural irrigation system. Increased food production means principally increased rice production from a more intensive farming pattern, changing from a single rice crop to a double rice crop per year and increasing yields on double rice crop areas as discussed in Chapter X-Project Benefits.

The proposed irrigation system is considered as a supplemental water supply to extend and improve irrigation efficiency over the existing rainfed system to the extent that water is available in the Citanduy River. The proposed system, if constructed, would improve the quality of life for the residents of the Banjar Plains Area through increased income from improved food production, including fish production.

The project will also provide assured domestic and municipal water supply to the Banjar region. This will improve the sanitation and public health aspects in the region.

The Banjar Plains Area has a gross area of approximately 3,000 ha, with approximately 30%, or 900 ha, between 50 and 28 m in elevation, with about 600 ha of this area usually planted to rice at the beginning of the rainy season, in October and November. A new irrigation and water supply project will improve and enhance the quality of life and social benefits in this area of the Citanduy Basin. The following environmental considerations

of Historical, Ecological, Fish and Wildlife, and Human Factors in the Environment is presented as an evaluation of the problems and needs that would be influenced by the anticipated improvements.

Historical

As far as is known at the time of this writing, there are no known archaeological sites within the areas to be occupied by the physical facilities of the proposed Banjar Plains Project. A survey of the area and conferences with the Village Chief of Balokang, indicate that there are no visible problems or conflicts with historical or sacred sites in the neighborhood.

Nearby is the Ciung Wanara Historical Reservation; however, it would not be affected by the project construction or operation. Design and preconstruction activities may find other sites related to this 900 year old memorial. Consideration should be given to retaining an official in the Department of Archaeology who would be able to assist in the identification and preservation of such artifacts, if required.

Traditionally, there are many small cemetaries among the surrounding villages that may be threatened unknowingly by new construction excavations. A more complete survey should be conducted during the design and preconstruction phases of the proposed work to avoid disturbance of these holy places.

Ecology

The ecological systems in the Banjar Plains area have been profoundly altered by overpopulation and intensive farming of the lands available for cultivation. An attempt is made to identify two major problems and needs of the area that may evolve through the impact of additional supplemental irrigation water supply.

Planning for the future in anticipation of these potential changes is considered absolutely essential, and the planning for land use controls should begin concurrently with the design and preconstruction phases of this project. The two important land use considerations which should be recognized in the planning of the Project are:

1) Planning should be considered that would insure the stability of the Banjar Plains area as a 'greenbelt', protected from expansion of the City of Banjar into the adjacent agricultural lands. Unregulated city expansion would cause a land use change from a village farming community to a municipal city, and would frustrate the purposes of the proposed constant supplemental irrigation and drainage system. The irrigation project will make land in the Banjar Plains more valuable for farming. This will tend to divert municipal development to other surrounding areas and keep Banjar Plains more open.

If the decision is made to construct this irrigation and drainage system, and funds are invested for this purpose, then the investment must be protected by proper planning to insure the protection and preservation of the Banjar Plains area as an open-space 'greenbelt' area for at least a 50-year period. This period of operation is necessary to justify the investment in the project. Since increased food production has been identified as a national goal; we recommend legal preservation of the Banjar Plains area as a 'greenbelt' open-space area set aside for irrigated farming.

2) The second problem and a need of the Banjar Plains Area that will also require concurrent planning in anticipation of a land use change that will occur with the importation of a supplemental water supply is the change in the land use pattern of the adjacent steep hillside lands presently used as catchment areas for the Banjar Plains Area rice paddy-lands. The existing rainfed irrigation system is an

outstanding use of existing resources. The surrounding steep hillside land forms several independent catchment areas to supply rain waters to irrigate adjacent rice paddylands. Also, the upper rice paddylands drain and provide additional catchment areas for lower rice paddylands. After an alternate irrigation system is constructed and made operational, one can anticipate a "short-stopping" of the diversion of rainfall/runoff waters now utilized from these hillside catchment areas to develop "new land" for irrigation of these same steep hillside lands. This event would constitute a major change in land use. These steep hillside lands are now apparently well-covered with coconut and banana plantings, with adequate ground cover so that erosion of the steep hillsides is not considered to be severe.

However, with the rice paddlylands on the valley floor supplied from the proposed alternate, constant irrigation system, it would be easily possible to construct irrigation check structures in the hillside gullies and build new tertiary irrigation ditches to serve newly terraced hillside slopes of the forest lands of existing banana and coconut trees. Thus, there could be a major change in the ecology of the area from forest use to terraced rice paddy and upland crop use. This land use change would cause increased erosion, intensified to the detriment of the adjacent valley floor rice paddylands. The new erosion sedimentation would also be expected to fill up the newly constructed drainage system and, eventually carry the increased sediment load back into the Citanduy River. The process is evident throughout Java, and may be inevitable, regardless of whether the project is built; however, it is important to state that this problem of erosion from the steep hillside lands does not exist in the Banjar Plains Area. From observations of other steep hillside farming practices in the Citanduy River Basin, one can conclude that this erosion will occur if these changes are permitted.

It is considered extremely important that the proper watershed conservation and management practices, through proper planning and land use regulation, be implemented and enforced before erosion becomes a major problem. Recommended conservation and watershed management practices have been identified and published in ECI's report.[1/] The Land Capability Classifications discussed in that report supplement and complement the critical land use and soil classifications discussed in detail in Chapter IV of this report. The change of land use from "tropical forest" to intensive crop production use requires the most careful planning of soil, water and plant conservation practices.

Fish and Wildlife

At the present time, there is little evidence of game fish or other wildlife. Game fish simply cannot exist in the silty waters of the majr streams and rivers of the Citanduy River Basin. After construction of the project, water from the Citanduy River will pass through a desilting basin that will encourage an increase of fishponds in the area by providing a water supply necessary for an increase in those food chain organisms which require clear water and are essential for fish life. The increased amount of clear water may also encourage the return of other wildlife to the area.

1/ Panawangan Pilot Watershed Conservation and Development Project", Final Design Report, Engineering Consultants, Inc., Denver, Colorado, U.S.A., October, 1976.

Human Factors in the Environment

People of the Banjar Plains area are the primary concern in the evaluation of environmental impact. Pressures and problems of population growth and public health are discussed in some detail in this report. A supplemental, alternate irrigation and municipal water supply from the proposed Banjar Plains Project will provide positive benefits to the people of the area. These benefits are considered and listed as follows.

1) Increased food production.

2) An increase in personal income of people in the area will promote economic stability in all the commercial and infrastructural activities which relate to the agricultural base.

3) Improved public health, through an improved municipal raw water supply.

One needs to identify the needs of the area by reference to the following factors:

1) The need to control soil erosion through concerned watershed conservation and management practices, as discussed in the previous paragraph.

2) The need for a potable municipal water supply, including water and sewage treatment plants. A low quality municipal water supply has a debilitating effect upon public health. Untreated sewage is the source of such diseases as cholera, gastro-enterities, dysentery and typhoid fever. The danger of epidemics becomes more critical during the dry season when streamflow is reduced or becomes nonexistant.

3) The need of "greenbelt" and open-space areas will also influence the way that people will respond to this protection of economic and human resources of the Banjar Plains Area.

Conclusions

To the extent that water is available to divert from the Citanduy River, the quality of life for the people of the Banjar Plains area will be enhanced through improved food production, increased personal income, and improved public health. Environmental and ecological damage is considered to be minimal.

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EXHIBIT

Ciamis, November, 1977

TO: Mr. Jack Earl Farmer/ECI
FROM: Rachlan/Bappemka, Ciamis
SUBJECT: Comment of the Feasibility Report-Banjar Plains Project

I. INTRODUCTION

1. This written comment on the Feasibility Report of the Banjar Plains Project is to meet the request of Ir. Sudaryoko, Chairman of the Steering Committee Meeting held in Ciamis on November 2 to 4, 1977.

2. The purpose of the comment is to render some information thought to be relevant to the Feasibility Report of the Banjar Plains Project, particularly concerning the intangible benefit of the proposed project.

II. GENERAL

1. According to the regional and local long-term prospective development plans, the town of Banjar is projected to the biggest central place, transit-trade center and growth center in the Banjar/Cilacap region - the whole Citanduy Basin.

2. The project is based on the gravity and functions of the town of Banjar today and in the immediate future.

a. The Gravity Theory

1. The town of Banjar is the converging point of:

1.1 Roads To and From:

a. The two rapidly developing harbors and industrial zones (Cirebon and Cilacap).

b. Bandung and Purwokerto.

c. The origin towns of tourists (Jakarta, Bandung, Cirebon, Cilacap, Yogyakarta, Surabaya) and the tourists' destination town (Pangandaran, which is one of the three tourist resorts that will be nationally developed in Java and Madura).

NOTE: The number of tourists coming to Pangandaran increases by 22.5% annually.

The number of tourists coming to Pangandaran from January to October, 1977:

Foreign	1,260	
Domestic		190,788
TOTAL		192,048

Vehicles:

Buses/Trucks	2,400
Taxis	6,339
Private Cars	4,290
Motorcylces	7,310

1.2 Railway Lines:

a. Main Line: Jakarta-Banjar-Surabaya

b. Feeder Line: Banjar-Cijulang

Cirebon, Bandung, Purwokerto and Cilacap are in effective distance by car (±120 to 150 km from Banjar).

Jakarta, Yogyakarta, Surabaya are in effective distance by train. Tourists from Jakarta, Yogyakarta, Surabaya coming by car to Pangandaran are usually travelling with packaged tour.

2. The town of Banjar has no competing towns in between Cirebon, Bandung, Purwokerto and Cilacap as far as the concentration of people are concerned. By the exception of Tasikmalaya which main funtion is a central place in the extreme western part of the Citanduy River Basin.

b. The Function of the Town of Banjar in the Regional Development

1. The hinterland of Banjar produced agricultural and extractive products of various kinds. Since the amount of the products exceeds the local need, much of it is becoming more and more good of trade. Banjar is the central place for the hinterland products.

2. Being located in the converging point of the main and collector roads, main and feeder railway lines, having a profitable access to bigger towns within

effective distance, Banjar is turning rapidly into a terminal center for transportation. Banjar is becoming a big transit-trade center in the Citanduy River Basin.

3. Having been a central place and transit-trade center, Banjar could be easily and cheaply developed into the growth center of the whole Citanduy River Basin by providing:

a. Good and adequate inter-regional roads connecting bigger towns which are now being built by the Department of Public Works and Electric Power (DPWEP (Cilacap-Banjar-Bandung and Banjar-Pangandaran for Class II roads).

b. More technical and vocational schools now seriously under consideration by the Department of Education and Culture.

c. Better electric power lines through the changing of 30 kV into 150 kV lines now having been done in the town of Ciamis and soon be followed by Banjar.

d. Automatic telephone system in Banjar now in the process of implementation.

e. Better railroad transportation through the upgrading of the tracks, locomotives and carriages now being considered by the Department of Transportation and Communication.

f. Enough land for the industrial activities decided by the Directorate General of Cipta Karya/DPWEP. The only development factor lacking to turn the town of Banjar into a strong growth center is water for industrial usage, drinking water and flushing water for the town.

4. Because the town of Banjar has no rival towns in the whole Citanduy River Basin and, therefore, automatically:

a. Is independent of smaller towns lying between Banjar and Cilacap, Cirebon, Bandung, Purwokerto, Pangandaran.

b. Has direct transitiveness to bigger towns within effective distance by roads or railroads and, hence, subordinate only to those towns.

Banjar will grow into a central place of the whole Citanduy region, the transit-trade center and at the same time a growth center. These three functions in one town will quickly

broaden the economic threshold demand and demand range, and these, in turn, will propel the town of Banjar into a place of strong position in the regional economic development. The economic position and the future of Banjar has been recognized by the planners in West Java and, hence, this town has been projected as nodal Class II in the medium/prospective development plan of West Java and projected as nodal Class I in the medium-term prospective plan of the district of Ciamis.

III. THE BANJAR PLAINS PROJECT

The Banjar Plains Project is an integral part of the comprehensive Citanduy River Basin Development Project. The goal of the project is to promote the economic and social life of the people within and outside the project area, directly and indirectly, through the project's spread and multiplying effects.

Therefore, I think it very important to consider the tangible and intangible benefits of the project. The tangible benefits have been stated in the Feasibility Report and I think it proper for me to concentrate my comment on the intangible benefits, particularly those concerning:

1. The consistency of the project

2. The desirability of the project

3. The intangible benefits of the project

4. The feasibility of the project which is actually the summing up of the consistency, the desirability and the benefits of the project.

ad. 1. The Banjar Plains Project is consistent with the National Economic Policy that states that the national economy should step-by-step move out from agricultural to non-agricultural up to the point of equilibrium of both has been fully achieved. The Banjar Plains Project is also consistent with the Regional Long-Term Prospective Plan that determines the town of Banjar to be the central place, transit-trade center and growth center in the Citanduy River Basin. The industries proposed to be located in the town of Banjar are:

1. The Fiber Industries/Textile

It has been calculated that the factory's construction cost will amount to U.S. $25,000,000. The industry will create 600 new permanent jobs in the factory for the local people. The spread and multiplying effect of the factory will create 1,300 partial and permanent new jobs.

2. The Non-Urea Fertilizer Industry (TSP, NPK, DAP)

The factory's construction cost is calculated to the amount of U.S. $5,000,000. This industry will create 400 new permanent jobs in the factory and 1,300 partial and permanent new jobs in the supply of raw material for the industry. The spread and multiplying effects of the factory will create 700 new jobs.

3. The Carbon Active and Fibered Rubber Industry

The factory's construction cost is to amount to U.S. $25,000,000. It will create 360 new permanent jobs in the factory and 5,600 new partial and permanent jobs in the supply of half-finished goods for the industry. The raw material for the carbon active and fibered rubber is, for the biggest part, waste product of coconut which is now still considered as of uneconomic value. The calculation shows that the people of Ciamis will receive U.S. $10,000,000 annually for the raw material and half-finished goods.

4. The Banjar Drinking Water Purification Plant

The three functions of the town of Banjar as the cenral place, transit-trade center and growth center of the Citanduy River Basin will turn the town into a big people concentration. The bigger the concentration the bigger the need for water supply, both for drinking and flushing water. The drinking water purification plant in Banjar will cost at least U.S. $7,500,000. The new permanent jobs created will be 100. The flushing water and healthy drinking water will decrease expenses spent on the curation of diseases and man-days lost from illness.

ad. 2. The Desirability of the Banjar Plains Project

Considered from the intangible benefits, the constrution cost of the Banjar Plains Project is actually an initial investment and stimulant to the other kinds of economic activities, particularly industries that ensure the increase of the regional and personal income, the creation of permanent and partial jobs in the urban and rural areas.

Jobs in the Citanduy River Basin today and in the future do not have only economic value but, perhaps more important, they create a sense of self-importance, good psychological impact on the people's motivation to participate in the development for mutual interest. The will to create something good for other fellow people does not only establish their sense

of responsibility, their sense of participation and belonging, but it is the most important investment for the continuation of the self-propelling growth, both materially and spiritually. Logically, the longer the process of reaching the finished goods, the more expensive the spread and multiplying effects of the industrial activities.

Based on this argumentation, the Banjar Plains Project is highly desirable economically and socially, by both the administration and the people in the influence area of the town of Banjar, and also by the National Government.

ad. 3. The Intangible Benefits of the Banjar Plains Project

The tangible benefit of the Banjar Plains Project in the form of the benefit-cost ratio of 1.06 to 1 has been stated in the Feasibility Report based on the assumption that the cost of the project is about U.S. $4,000,000. Compared with the initial construction cost of the 4 (four) industries that amount to U.S. 62,000,000, the input of the Banjar Plains Project of U.S. $4,000,000 is clearly of high benefit. In addition to it, the new permanent jobs in the 4 (four) factories of 1,460 and the new permanent and partial jobs closely associated with the supply of raw material and half-finished goods of 8,900 show us clearly of the intangible benefit of the project. It is not an overestimate that the spread and multiplying effect of the industries will create also not less than 20,000 new jobs. But it should be borne in mind that those industries depend entirely on the realization of the Banjar Plains Project, because without water from the project those industries are not feasible.

Other indirect benefits are the decrease of expenses spent on the curation of diseases closely associated with water and man-days lost from illness. The promotion of the will of the people to take an active part in the development as insurance for the continuation of the self-propelling growth materially and spiritually, the feeling of security for the people's economic and social life, mutual welfare and broadening of job opportunity of various kinds in the influence area of the town of Banjar are other important intangible benefits of the project.

ad. 4. The Feasibility of the Banjar Plains Project

The feasibility of the project as far as the location, the technology and the tangible benefits are concerned, has been declared by ECI. The intangible benefits, in my point of veiw, are the summing up of the several aspects mentioned in my comment on:

1. The consistency of the project considered from:

a. The National Economic Policy;

b. The Regional and Local medium-term prospective plan.

2. The desirability of the project considered from:

a. The increase of new permanent and partial jobs very badly needed today and in the future both for material and spiritual satisfaction in the urban and rural areas within and outside the Citanduy River Basin.

b. The increase of the regional and personal income coupled with a better distribution of wealth.

3. The intangible benefits of the project considered from:

a. The fact that the project is the real trigger to the founding of industries and social facilities that will cost at least 15 (fifteen) times as much as the cost of the Banjar Plains Project itself.

b. The fact that the project will be the starting point for the realization of better economic and social life within the Citanduy River Basin, and to some extent, in some areas surrounding the river basin.

/S/
RACHLAN
BAPPEMKA CIAMIS