The river improvement works can be divided into four work sections including the urgent works. It is technically and economically proposed that the river improvement works are implemented following the order mentioned below taking into account the significance of the area to be protected from the flooding.

1.	Urgent river improvement	:	1982-1987
2.	Improvement of the section from 2.0 k to the Sungguminasa bridge	:	1991
3.	Improvement of the section from the estuary to the diverted point, 4.4 k	:	1992-1995
4.	Improvement of the section in the upper reaches of the Sungguminasa bridge	:	1992-1995

The work section of the river improvement is presented in Fig. 6-2. Its constructin schedule is shown in Fig. 6-3.

Construction Machinery

The main construction machinery required for the river improvement work will be dredger, bulldozer, back hoe, wheel loader and dump truck.

The outline of the principal construction machinery is given in Table 6-3.

6.3.2 Cost Estimate

Construction Cost

The river improvement cost covers civil works, gates and equipment, land acquisition, engineering services and plus 15% physical contingencies. The total cost will be US$22.9 million, out of which US$10.8 million is of foreign currency and US$12.1 million of local currency. The breakdown of the construction cost is shown in Table 6-4.

Operation, Maintenance and Replacement Cost

The operation and maintenance cost will comprise the personnel cost, operational machinery and equipment, vehicles, administrative cost and miscellaneous. The annual operation and maintenance cost is estimated at US$ 0.09 million for the whole period of the project life. Replacement cost of the groyne in every 10 years and the sluice gate in every 25 years have been estimated at US$0.42 million and US$0.37 million, respectively.

6.4 WATER SUPPLY

6.4.1 Construction Schedule

Construction schedule has been so arranged as to see its completion by 1990, in view of putting all the related facilities in serviceable conditions simultaneously with the completion of Bili-Bili dam.

A period of 4 years from 1984 to 1987 has been assumed for a feasibility study and dedailed design, and the construction works will be undertaken during the remaining 3 years from 1988 to 1990.

The construction schedule is shown in Fig. 6-4.

6.4.2 Cost Estimate

Construction Cost

The construction cost comprises civil works, gates and equipment, land acquisition, engineering services and plus 15% contingencies. The construction cost totals to US$35.5 million, which is made up of the foreign currency portion amounting to US$28.8 million and the local currency portion of US$6.7 million. The construction cost is shown in Table 6-5.

Operation, Maintenance and Replacement Cost

The operation and maintenance cost comprises the personnel cost, operation machinery and equipment, vehicles, administrative cost and miscellaneous. US$0.09 million will be estimated for an annual operation and maintenance cost. Replacement cost of the regulating valve and the flow meter in each 25 years has been estimated at US$0.48 million.

6.5 IRRIGATION

6.5.1 Construction Schedule

Construction schedule is based on the assumption that 4 years (1983-1986) will be required for preparation works for commencing the construction works, and also that the improved irrigation facilities shall be ready for immediate use upon completion of Bili-Bili dam in 1990. Accordingly, the irrigation construction works would be started in 1987 and completed in 1990, so that the irrigation facilities could be used from 1991 onward. The construction schedule is shown in Fig. 6-4.

6.5.2 Cost Estimate

Construction Cost

Irrigation construction cost primarily comprises the direct construction cost, land acquisition cost, engineering cost and plus 15% physical contingencies. Construction cost

would be US$29.8 million, which might be broken down into the local currency portion of US$22.7 million and the foreign currency portion of US$7.1 million, as detailed in Table 6-6.

Operaton, Maintenance and Replacement Cost

The operation and maintenance cost comprises the personnel cost, operational machinary and equipment, vehicles, administrative cost and miscellaneous. The annual operation and maintenance cost is estimated at US$0.50 million. Replacement cost of the sluice gates in each 10 years amounts to US$0.12 million.

6.6 HYDRO POWER

6.6.1 Construction Schedule

The commencement of commercial operation of power generation is scheduled at the end of April 1991, simultaneously with the completion of the dam construction.

A construction work schedule of power station is formed taking time required for manufacture of power generating equipment, transportation to the project site and installation into consideration. The total time required for the above is estimated at 2 years. Based on this, the construction works are scheduled to be started from 1989. The commencement of the construction of transmission line will be started from June 1990 to be in time with the completion of installation of the power generating equipment at the proposed site.

The construction schedule is shown in Fig. 6-4.

6.6.2 Cost Estimate

Construction Cost

The construction cost for the hydro power station comprises civil works, generating equipment, transmission line, engineering cost and plus 15% physical contingencies.

The total cost will be US$25.4 million, out of which US$18.1 million is of foreign currency and US$7.3 million of local currency.

The breakdown of the construction cost is shown in Table 6-7.

Operation, Maintenance and Replacement Cost

The operation and maintenance cost will comprise the personnel cost, operational machinery and equipment, vehicles, administrative cost and miscellaneous. The annual operation and maintenance cost is estimated at US$0.17 million for the whole period of the project life. Replacement cost of the generating equipment after 35 years from the initial operation amounts to US$4.17 million.

CHAPTER VII - PROJECT EVALUATION

7.1 GENERAL

The project has been formulated primarily in order to mitigate flood damage. The secondary objectives are to secure municipal/industrial water, to intensify rice production and to increase the power generation capacity: These sectors should be regarded as a package by totalizing their effectiveness.

In this report, economic evaluation has been based on the total cost and benefit related to flood control, irrigation and hydro power sectors; in other words the cost and benefit concerning the municipal and industrial water supply are eliminated from the project cost and benefit. This is because the benefit of municipal and industrial water supply is still difficult to be quantified.

The economic viability of the project has been evaluated by means of calculating the Internal Rate of Return (IRR). Sensitivity analysis is also made on several assumtions.

Rupiah and Yen are converted to US Dollar at the exchange rate of Rp.625 to US$1.00 and ¥220 to US$1.00. The project life for the economic evaluation is fixed at 50 years from 1982, when the related engineering services are to start.

7.2 PROJECT COST

The total project cost is estimated at US$ 603.56 million, on the contract basis by using mid-1981 prices, of which US$ 298.01 million or 49% is foreign currency, and US$ 305.55 million or 51% is local currency. The quantity of works is estimated on the basis of the preliminary design which has been prepared during the study period. Unit prices and the costs of equipment required for the project implementation are in line with the recent bid prices for similar works. These prices and costs include about 10% of taxes and duties. Physical contingencies of 15% have been applied to all the works and equipment costs. Price contingencies are also taken into account at an annual escalation rate of 8% in 1982, 7.5% in 1983, 7% in 1984 and thereafter for foreign currency portion and 14% in 1982, 12% in 1983, 1984 and 1985, 10% in 1986 and thereafter for local currency portion. Compensation payments for house evacuation are in line with those of other Government-sponsered projects. The interest of bank loan during the construction period is computed at the annual rate of 3%. The project cost is classified by work item given as follows.

(x10^6 US$)

Work Item	Foreign currency	Local currency	Total
Dam and reservior	151.43	158.76	310.19
River improvement/1	38.77	66.18	104.95
Municipal/industrial water supply	56.91	14.79	71.70
Irrigation water supply	13.93	48.60	62.53
Power generatrion	36.97	17.22	54.19
T o t a l	298.01	305.55	603.56

Annual disbursements of the project cost and the base cost are presented in Tables 7-1 and 7-2, respectively.

7.3 ECONOMIC EVALUATION

7.3.1 Project Benefit

The benefit of this project will accrue from flood control sector, irrigation sector and also power generation sector. The benefit derived from the municipal and industrial water supply has not been quantified for such a reason as stated in 7.1. General.

Primary Benefit

Annual benefit derived from each sector which has been calculated in the monetary terms are summarized in next page. The process and assumptions for benefit calculation of each sector are described in Chapter IV of this report and in detailes in the Supporting Report.

NOTE /1 : Including costs for implementation of the Urgent Flood Control Plan

Sector		Annual benefit (x 10^6 US$)
Flood control	:	13.0
Irrigation	:	31.5
Power	:	3.9
Negative benefit/1	:	- 0.56
T o a l	:	47.84

Secondary Benefit

Secondary benefit, not only primary benefit, can be also expected from the project in the sectors such as recreation/tourism, and municipal/industrial water supply.

In and around the project area, the opportunities to enjoy recreation/tourism are limited to only a few places, although the project area has the capital city of South Sulawesi province (Ujung Pandang city) with a population of over 700,000. The Bili-Bili reservoir which is located only 31 km away after Ujung Pandang city and is quite accessible by Jl. Malino can provide a good opportunity for recreation/tourism.

As stated in 4.4.5, secondary benefits of municipal/industrial water supply are 1) to upgrade the living standard, 2) to improve the sanitary condition, 3) to reduce the frequency of disease and 4) to spur the commercial and industrial activities.

Indonesia is now importing about 2.0 million tons of rice annually, while the project area is enjoying surplus production of rice. After completion of the project, rice production will increase by 0.15 million tons, which will contribute to achievement of self-sufficiency of rice.

7.3.2 Economic Cost

Based on the preliminary designs, the economic construction cost was estimated in such a manner that the import duties, government subsidies and compensation cost should be excluded from the project cost, and that physical contingencies of 15% is added to the cost though no price contingency is considered. Estimation of costs required for equipment and engineering services, which are to be procured by international competitive bidding, is based on the international price levels. The local cost is estimated on the basis of researches on the prevailing prices for similar works which are now going on in and around the project area.

NOTE /1 : As negative benefit is counted a loss of production in the agricultural land to be submerged by the reservoir and to be acquired due to river improvement works. The negative benefit is subtracted from the annual benefit.

The construction cost will be required for construction of dam and its appurtenant facilities, the urgent flood control plan and overall river improvement works, irrigation system improvement works, municipal/industrial water supply system and power generation work. The total economic cost is estimated at US$ 276.43 million, which is composed of foreign currency portion of US$ 150.95 million and local currency portion of US$ 125.48 million equivalent. These costs are summarized below.

Work Item	Foreign currency	Local currency	Total
	($\times 10^6$ US$)		
Dam and reservoir	79.54	67.00	146.54
River improvement	17.35	21.81	39.16
Municipal/industrial water supply	28.78	6.68	35.46
Irrigation	7.20	22.71	29.91
Power	18.08	7.28	25.36
T o t a l	150.95	125.48	276.43

Allocation of Dam Construction Cost

To identify the equitable cost for each purpose, the economic dam construction cost has been allocated by "Separable Cost - Remaining Benefit Method". The result of cost allocation is as follows:

Purpose	Foreign currency	Local currency	Total
	($\times 10^6$ US$)		
Flood control	21.48	18.09	39.57
Municipal/industrial water supply	14.87	12.53	27.40
Irrigation	43.19	36.38	79.57
T o t a l	79.54	67.00	146.54

Cost Estimate by Sector

Based on the above allocation of the dam construction cost, the total project economic cost can be further classified by sector as follows:

(x10^6 US$)

Sector	Foreign currency	Local currency	Total
Flood control /1	38.83	39.90	78.73
Municipal/industrial water supply /2	43.65	19.21	62.86
Irrigation water supply /3	50.39	59.09	109.48
Power generation /4	18.08	7.28	25.36
T o t a l	150.95	125.48	276.43

Operation and Maintenance Cost

To assure the benefits throughout the project life, the related facilities should be successfully operated and safely maintained. The annual cost for operation and maintenance is estimated at US$ 0.92 million, which is composed of the following:

Work item	Annual cost (x10^3 US$)
Dam and reservoir	80
River and related structures	87
Municipal/induatrial water supply facilities	86
Irrigation facilities	500
Power generation	165
T o t a l	918

NOTE: Each purpose can be attained in combination of respective effectiveness of the dam and other relative works as discribed below:

/1 = Dam + Urgent Flood Control Plan + Overall River Improvement Plan
/2 = Dam + Pipeline
/3 = Dam + Irrigation Facilities
/4 = Generating Facilities + Transmission Line

Replacement Cost

Facilities related to the project are to be replaced periodically to attain their original purposes during the project life; the facilities to be replaced and their costs are summarized as below.

		($\times 10^6$ US$)
1) Dam and reservoir		
Gates (Durable period of 35 yrs.)	:	1.47
2) River and related facilities		
Groyne (Durable period of 10 yrs.)	:	0.42
Sluice (Durable period of 25 yrs.)	:	0.37
3) Municipal/industrial water supply		
Gates and valves (Durable period of 25 yrs.)	:	0.48
4) Irrigation		
Wooden bar, Gabion, Screen (Durable period of 10 yrs.)	:	0.12
5) Power Generation		
Generating equipment (Durable period of 35 yrs.)	:	4.17

7.3.3 Internal Rate of Return (IRR)

Evaluation of the project was made by means of calculating IRR on the basis of the estimated benefit and economic cost. The Internal Rate of Return of the Jeneberang River Flood Control Project (Phase II) is calculated at 14.8%, assuming a project life of 50 years. This rate shows economic viability of the Project.

The Internal Rate of Return has been further calculated for each sector based on the cost estimate by sector, which results in the following percentage.

Sector	IRR (%)
Flood Control	14.9
Irrigation	15.2
Power Generation	13.3
The Project	14.8

7.3.4 Sensitivity Analysis

Sensitivity analysis has been also made on the assumptions of 1) increase of construction cost, 2) decrease of annual benefit and 3) extension of construction period and build-up period for irrigation. The results are summarized below.

Case	Assumption	IRR (%)
I	Construction cost + 10%	13.7
II	Construction cost + 20%	12.8
III	Annual benefit - 10%	13.6
IV	Annual benefit - 20%	12.6
V	Construction period + 3 years	12.5
VI	Build-up period + 3 years	12.7

7.4 Socio-Economic Impacts

In addition to the benefits stipulated in the economic evaluation, favourable socio-economic impacts are created by the implementation of the project.

Employment Opportunity

Increase of employment opportunity by the project implementation will give a favourable impact on the regional economy. About 10,000 persons will be newly employed during the construction period and 200 persons will be required permanently for the operation and maintenance works.

Employment opportunity of the population who are serving for agriculture will be certainly increased due to intensive crop cultivation. Unemployment on farm is such a serious problem in the project area that increase of employment opportunity will help considerably to solve the problem.

Transfer of Knowledge

Technical knowledge will be also transferred to the Indonesian engineers through the detailed design and construction works in various engineering fields.

The Indonesian engineers are expected to make much of the technical knowledge to be transferred in order to formulate and implement for themselves other similar projects in the future.

Regional Economy and Social Stability

Living environment and sanitary in the project area will be surely improved due to less frequency of flooding, sufficient municipal water supply, more stable power distribution, and so on.

Increase of industrial water supply will provide an possibility for further industrial development.

In compliance with increment of rice yield, farm income in the project area will be hightened, which will enhance the economic activity in the region through its multiple effects on other sectors of the regional economy.

All of the above-mentioned project effects will thus contribute to socio-economic stability in the area.

CHAPTER VIII RECOMMENDATION

1. It has been identified that the project consisting of flood control, municipal and industrial water supply, irrigation, and power generation is technically feasible and economically viable, at the Internal Rate of Return (IRR) of 14.8%. It is, therefore, recommended that the each sector of the project be carried forward to the next stage with least lapse of time, in due consideration of an enhancement of the national economy, an advancement of the regional development and the promotion of the inhabitants' welfare. Especially, the commencement of construction of the proposed Bili-Bili dam which is the basical project for development and improvement of other related sectors is strongly recommended in the nearest future.

2. The flood control of the Jeneberang river with improvement scale of a 10-year return period was the subject-matter of the previous study and its results were incorporated into the "Urgent Flood Control Plan", whose detailed design work would be commenced from 1982.

The design flood of the river proposed under the above-said "urgent plan" is 2,100 m^3/s, while that proposed under the present plan is 2,300 m^3/s. Since the difference between the design floods, one under the "urgent plan" and the other under the present plan, is rather insignificant, and as it is both uneconomical and undesirable to make repetition or duplication of construction works likely to occure in up-grading the standards specified for the "urgent plan" to those proposed under the present plan, it is strongly recommended that the aforementioned discharge of 2,300 m^3/s be adopted as the design flood of the "urgent plan".

Final decision to this effect, however, will require a close co-ordination and adjustment among the authorities concerned.

3. The peak discharge and hydrograph of the flood generated from a basin is principally governed by the amount of rainfall, the hourly rainfall distribution and the local distribution of rainfall. The study on the design flood discharge covering the above mentioned items could not have been conducted satisfactorily due to a lack of supporting data.

In this connection, Bili-Bili and Jenelata water gauging stations which were established in 1976 and 1979, respectively, are now engaged in observation and will supply available data. By using such data, it is desirable that check-up of the design flood in this project would be carried out in the detailed design study stage.

The rain gauging station at Malino is the only one in and around the upper reaches of the Jeneberang river, while none is found in the Jenelata river basin. For the formulation of the future development of the basin, it is desirable that more rain gauging stations be established in its upper reaches. It is thereby recommended to establish at least two more stations in the Jeneberang river basin and two stations in the Jenelata river basin.

4. The low laying land of Ujung Pandang city has been proposed for spoil bank of the soil excavated from the Jeneberang riverbed through implementation of the river improvement works. Though the urbanization plan was formulated for the area in question and has been partially implemented, most part of the area still remains as paddy field and swamps.

Prior to implementation of the project, it will be required to carry out further study of the available space for the spoil bank in the area through a close co-ordination among the authorities concerned so that proper adjustment may be made between the implementation schedules, one is for the urbanization project and the other for the river improvement project.

5. At present, the river basin whose upper reaches is covered mostly by the grassland appears stable and produce little sediment. A countermeasure is not required urgently for soil conservation. However, it is important that soil conservation be provided to prevent the possible future sediment discharge. It is recommended that further survey and study be conducted in the next stage.

6. The scale of agricultural plan proposed under the present project is confined to the availability of irrigation water which can be developed by the proposed Bili-Bili dam. There still remains more land - 14,800 ha in total - which could be agriculturally developed through the means as described in the below:

- The area of 4,800 ha which could be made irrigable during dry season out of the existing Bili-Bili and Kampili irrigation area, but which is unable to be fed with irrigation water under the present project plan,
- The area of 5,000 ha, located on the eastern bank of the Kampili irrigation channel, and
- The area of 5,000 ha in the Pamukulu area.

In this connection, it is recommended that a further study on a comprehensive agricultural development including the water resources development in this area be conducted.

7. There are a number of houses which need to be evacuated or moved for implementation of the proposed project, thus causing some social problems. Utmost care should be taken in carrying out the house evacuation program in accordance with the applicable laws and regulations in force.

8. The following items should be conducted for the next engineering study stage to facilitate successful implementation of the project.

Necessary study for the detailed engineering (Dam construction and river improvement) is;

- Mapping with a scale of 1/500 covering the proposed dam site, with a scale of 1/2,500 for the proposed Jeneberang course and with a scale of 1/50 covering the proposed riparian structure sites,
- Cross levelling and longitudinal survey along the proposed dam axis and at the proposed main structure sites related to the dam construction and along the proposed Jeneberang river,
- Geological survey including boring and sesmic prospecting at the proposed dam site and at its main structure sites, and soil survey and test at the proposed borrow pit sites of the dam constuction and the river improvement, and
- Laboratory test for the embankment materials and concrete strength for dam construction and hydrolic model test for the proposed spillway.

Necessary study for the feasibility study (municipal and industrial water supply, irrigation improvement and power generation) is;

- Mapping with a scale of 1/10,000 covering the proposed irrigation area and along the proposed conveyance route for the municipal/industrial water,
- Cross levelling and longitudinal along the proposed irrigation channel and the proposed transmission line and along the proposed conveyance route for the municipal/industrial water, and
- Soil investigation covering the proposed irrigation area and water quality test of the Jeneberang river.

Table 2-1 SHARE OF GDP BY ECONOMIC SECTOR

Year : 1978

Sector	Indonesia	South Sulawesi
	%	%
Agriculture	30.7	54.9
Mining and Quarrying	17.6	0.4
Industry	9.9	3.6
Electricity,Gas & Water	0.5	0.5
Construction	5.7	1.0
Trade	15.7	16.6
Transportation & Communication	4.5	5.2
Banking	1.8	0.8
Services	10.6	0.9
Others	3.0	16.1
T o t a l	100.0	100.0

Table 2-2 SHIFT OF THE ECONOMIC STRUCTURE IN INDONESIA DURING THE PELITA III

Sector	1979 / 79	Average Growth Rate	1983 / 84
Agriculture	31.4 %	3.5 %	27.2 %
Mining & Quarrying	17.9	4.0	15.9
Industry	10.2	11.0	12.6
Construction	4.9	9.0	5.5
Transportation & Communication	4.6	10.0	5.4
Services	31.0	8.1	33.4
Total	100.0	6.5	100.0

Table 2-3 GROWTH OF GDP AND INVESTMENT IN SOUTH SULAWESI PROVINCE DURING PELITA III

	1979/80	1980/81	1981/82	1982/83	1983/84
Provincial GDP (mil. Rp.)	702,502	761,726	826,473	896,723	972,944
Investment (mil. Rp.)	147,925	171,392	196,991	222,285	248,601
a. Central Government	88,873	101,738	115,693	129,614	143,915
b. Provincial Government	11,864	13,779	15,887	17,983	20,161
c. Private Sector	47,188	55,875	65,401	74,688	84,525
Percentage of Investment(%)	22.1	22.5	23.8	24.8	25.6
Per capita GDP (Rp.)	120,400	128,107	136,585	145,336	154,755

Table 3-1 ECONOMIC ACTIVE POPULATION BY ECONOMIC SECTOR IN SOUTH SULAWESI (1976 AND 1979)

Economic Sector	1976		1979	
	Persons	%	Persons	%
Argiculture, Hunting, Forestry and Fishery	977,702	58.1	2,027,572	57.5
Mining and quarlying	1,450	0.1	1,524	0.1
Manufacturing	208,770	12.4	219,419	12.3
Electricity, Gas and Water	790	0.0	830	0.0
Construction	13,570	0.8	14,262	0.8
Trade, Hotels and Restaurants	193,224	11.5	203,080	11.3
Transport, Shortage and Communication	42,689	2.5	44,866	2.5
Financing, Insurance, Real estate and Business Services	6,246	0.4	6,565	0.4
Community, Social and Personal Services	181,178	10.8	190,419	10.6
Activities, Not adequately defined	158	0.0	166	0.0
Seeking Work	56,493	3.4	81,367	4.5
T o t a l	1,682,270	100.0	1,790,070	100.0

Table 3-2 MONTHLY RIVER DISCHARGE AT THE BILI-BILI & KAMPILI INTAKES

(Unit: m^3/sec)

	1975	1976	1977	1978	1979	1980
Jan.	54.07 87.73	94.82 153.85	112.57 182.65	67.54 109.59	98.67 160.09	85.65 138.14
Feb.	57.46 93.23	68.68 111.44	176.41 286.23	64.73 105.03	58.41 94.77	106.25 172.14
Mar.	51.20 83.07	68.79 111.61	60.02 97.38	35.34 57.34	61.18 99.27	73.56 119.95
Apr.	53.60 86.97	16.59 26.92	53.13 86.20	21.05 34.15	25.55 41.46	49.32 80.59
May	28.77 46.68	13.75 22.31	11.67 18.93	22.27 36.13	22.31 36.20	20.75 33.32
Jun.	10.76 17.46	2.89 4.69	20.33 32.99	16.09 26.11	10.72 17.39	5.33 8.18
Jul	4.66 7.56	2.75 4.46	2.72 4.41	27.54 44.68	2.67 4.33	2.57 11.60
Aug.	3.55 5.76	2.58 4.18	2.60 4.22	6.69 10.85	2.54 4.12	2.44 4.90
Sep.	2.58 4.19	2.33 3.78	2.40 3.89	4.34 7.04	2.38 3.86	2.29 3.80
Oct.	3.99 6.47	7.69 12.48	2.23 3.62	4.44 7.20	2.44 3.96	6.79 5.60
Nov.	41.77 67.77	17.48 28.36	17.05 27.66	20.57 33.38	7.07 11.47	21.53 28.10
Dec.	68.19 110.64	24.10 39.10	64.13 104.05	76.11 123.49	70.75 114.79	85.84 139.11
Dry Season Average	10.86 17.62	6.40 10.38	8.39 13.61	16.27 26.40	8.61 13.97	8.03 13.04

Note: Upper figures in the column - Bili-Bili
Lower figures in the column - Kampili

Table 3-3 IRRIGATION SYSTEM PREVAILING IN THE PROJECT AREA

	Gowa		Takalar		Ujung Pandang	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
D.P.U.P.S.S. technical	12,950	36.5	5,090	25.6	0	0.0
D.P.U.P.S.S. semi-tech.	7,450	21.0	1,920	9.6	0	0.0
Desa simple tech.	4,670	13.2	1,800	9.0	350	9.5
Desa non-tech.	10,410	29.2	11,100	55.8	3,330	90.5
T o t a l	35,480	100.0	19,910	100.0	3,680	100.0

Table 3-4 PLANTED AREA BY DIFFERENT PADDY VARIETIES IN THE PROJECT AREA

- 1980 -

(Unit: ha)

	Gowa		Takalar		South Sulawesi	
Varieties	Dry season	Wet season	Dry season	Wet season	Dry season	Wet season
Pl - 1	-	-	-	-	663.33	-
Pl - 2	-	-	-	-	5.00	-
PB - 5	-	4) 1,319.00	-	123.50	15,253.67	6,220.30
PB - 8	-	225.00	-	-	266.00	449.00
C4 - 63	-	559.00	3.50	4) 1,250.25	18,919.90	5) 8,760.55
Pelita	-	2,205.00	-	150.00	-	4,499.16
Adil	1) 756.95	307.00	-	-	1,296.95	1,301.52
Makmur	-	125.00	-	-	545.45	629.65
Cemar	-	21.00	-	-	-	168.00
Sub Total	756.95	4,761.00	3.50	1,532.75	36,950.30	22,078.18
PB - 20	-	98.00	-	-	2,379.34	1,340.95
PB - 26	64.69	209.00	4.00	78.50	5) 21,184.65	3,386.95
PB - 28	3.00	18.00	-	10.00	8,132.56	1,437.83
PB - 29	-	17.00	-	-	7,259.26	1,697.13
PB - 30	3) 216.13	212.00	5) 16.25	345.00	13,599.11	4,054.42
PB - 32	4) 174.00	5) 1,018.00	3) 56.65	5) 1,141.65	1) 56,998.47	3) 36,787.68
PB - 34	71.28	429.00	4) 55.65	2) 1,434.50	2,315.23	2,061.41
PB - 36	2.00	264.00	-	584.65	4) 26,330.87	4) 18,883.45
PB - 38	5) 112.83	641.00	2) 63.85	1,075.70	3,857.35	8,471.36
PB - 42	-	28.00	2.50	3) 1,373.50	2) 36,306.67	1) 57,088.63
Brantas	-	2) 1,697.00	-	423.96	2,786.81	4,384.14
Citarum	2) 301.60	1,594.00	1) 219.75	1) 1,678.30	3) 26,385.69	3) 35,337.02
Serayu	-	8.00	-	-	1,719.82	655.98
Asahan	62.38	55.00	-	5.00	2,527.44	6,903.61
Semeru	-	144.00	-	-	154.35	343.00
Cisadane	-	22.00	-	-	-	341.71
Ayung	-	-	-	-	-	118.32
Sub Total	1,007.91	6,454.00	418.50	8,150.76	211,936.86	183,296.58
U. Lama	906.18	5,198.00	26.00	151.00	18,629.27	14,223.18
Lokal	697.52	12,219.00	-	6,251.04	47,137.07	73,246.73
Galur	59.44	-	8.50	-	10,570.80	4,475.92
Total	3,428.00	28,632.00	456.50	16,085.55	325,224.20	297,320.59

Table 3-5 THE NUMBER OF FARM HOUSES IN KABUPATEN GOWA (1980)

(Unit: Nos.)

No	Name of Kecamatan	< 0.25 ha				0.25 - 0.50 ha				> 0.50 ha			
		Yeoman	Tenant	Yeoman and Tenant	Total 3+4+5	Yeoman	Tenant	Yeoman and Tenant	Total 7+8+9	Yeoman	Tenant	Yoeman and Tenant	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bontonompo	1,733	196	126	2,055	1,441	298	406	2,145	1,028	91	636	1,755
2	Bajeng	1,910	563	149	2,622	1,614	383	390	2,387	1,133	116	700	1,949
3	Tompobulu	813	70	45	928	2,123	212	521	2,861	6,749	293	2,331	9,373
4	Tinggimoncong	1,332	197	187	1,716	1,690	160	437	2,287	2,236	92	863	3,191
5	Parangloe	813	139	54	1,006	820	160	207	1,187	668	103	374	1,145
6	Bontamarunnu	306	309	51	666	825	539	340	1,704	908	392	707	2,007
7	Pallangga	2,164	219	127	2,510	1,735	229	578	2,532	810	106	1,002	1,918
8	Somba Opu	325	120	69	514	369	201	89	659	343	200	271	814
	Total	9,396	1,813	808	12,017	10,612	2,182	2,968	15,762	13,875	1,393	6,884	22,152

Source: Sensus penduduk 1980, penduduk Kabupaten Gowa 1980

Table 3-6 ECONOMIC ASPECTS OF FARM PRODUCTS

- RESULT OF FIELD SURVEY -

Index \ Commodity		Paddy Wet season	Paddy Dry season	Corn	Cassava	Green bean	Soy bean	Ground bean
Method of Cultivation (Traditional: New technic Bimas, Inmas, etc.)		traditional type	by animal	up land	up land	traditional type	traditional type	traditional
Gross Product								
Area planted	ha	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Products	ton/ha	2.500	2.000	0.670	7,000	0.290	1.410	0.800
Unit price	Rp/ton	71,500	71,500	35,000	10,000	125,000	70,000	125,000
(A) Gross products		178,750	143,000	23,450	70,000	36,500	98,700	96,000
Labor Force								
Family labors	day	10	24	30	70	20	10	95
Employed labors	day	160	33	10	-	-	30	37.5
(B) Total labors	day	170	57	40	70	20	40	132.5
Animals	day	-	10	-	-	-	-	-
Machines	day	-	-	-	-	-	-	-
Production Cost								
Cost of employed labor	Rp.	33,000	12,800	2,000	-	-	6,000	14,400
Cost of material	Rp.	30,900	29,400	2,850	10,400	3,500	9,500	7,500
Cost of depreciation	Rp.	-	-	-	-	-	-	-
Chargersand fees	Rp.	-	22,000	-	-	-	-	-
Tax	Rp.	-	-	-	-	-	-	-
(C) Production cost	Rp.	63,900	64,200	4,850	10,400	3,500	15,000	21,900
Income Profit								
(D) Family in income (A-C)	Rp.	114,850	78,800	18,600	59,600	32,750	83,200	74,100
(E) Cost of family labor	Rp.	2,000	16,000	6,000	13,000	4,000	2,000	15,000
(F) Farm profit (D-E)	Rp.	112,850	62,200	12,600	41,600	28,750	81,200	59,100
(G) Labor productivity (D:B)	Rp./day	676	1,091	465	851	1,638	2,080	559

Source : Agricultural Training Center in Gowa, 1978

Table 3-7 POWER DEMAND & CONSUMPTION AT WILAYAH VIII

Year	Installed Capacity (MW)	Peak Load (MW)	Generated Energy (10^3MWH)	Energy Sold (10^3 MWH)	Number of Consumer (nos.)
1975/1976	37.7	*	78.0	59.6	28,000
1976/1977	37.7	*	96.0	73.6	30,600
1977/1978	52.1	20.8	125.7	94.2	51,200
1978/1979	52.1	22.5	145.3	105.3	70,900
1979/1980	52.1	27.3	171.2	125.6	97,300

Source: PLN

Note : * No figure available

Table 3-8 NUMBER OF HOUSEHOLD ELECTRIFIED IN UJUNG PANDANG SYSTEM

(Unit: Nos.)

Description	1976	1977	1978	1979	1980
1. Number of Consumer	22,688	26,339	31,773	44,267	46,608
- Small consumer	4,772	4,085	3,629	2,747	2,590
- Household	14,959	19,109	24,871	38,139	40,631
- Commercial	2,957	3,145	3,273	3,381	3,387
2. Number of Household	233,310	238,697	241,109	248,342	254,550
3. Number of Household Electrified in Percentage	9.7%	11.0%	13.2%	17.8%	18.3%

Table 3-9 ASSETS DISTRIBUTION BY GROUND HEIGHT

Unit : x 10^9Rp.

GROUND HEIGHT	CITY SIDE AREA		MOUNTAIN SIDE AREA	
	VALUE	ACCUMULATION	VALUE	ACCUMULATION
0.5 - 1.0	-	-	2.0	2.0
1.0 - 1.5	8.4	8.4	3.4	5.4
1.5 - 2.0	42.5	50.9	14.4	19.8
2.0 - 2.5	190.5	241.4	71.7	91.5
2.5 - 3.0	137.9	379.3	15.9	107.4
3.0 - 3.5	50.9	430.2	9.7	117.1
3.5 - 4.0	18.5	448.7	-	-

Table 3-10 PADDY FIELD DISTRIBUTION BY GROUND HEIGHT

Unit : ha.

GROUND HEIGHT	CITY SIDE AREA		MOUNTAIN SIDE AREA	
	AREA	ACCUMULATION	AREA	ACCUMULATION
0.0 - 0.5	-	-	25.2	25.2
0.5 - 1.0	-	-	701.1	723.3
1.0 - 1.5	-	-	406.2	1,132.5
1.5 - 2.0	120.4	120.4	361.8	1,494.3
2.0 - 2.5	108.4	228.8	455.5	1,949.8
2.5 - 3.0	45.0	273.8	254.2	2,204.0
3.0 - 3.5	69.9	343.7	85.8	2,289.8
3.5 - 4.0	3.0	346.7	50.3	2,340.1

Table 3-11 ASSETS DISTRIBUTION BY GROUND HEIGHT IN THE FIRST STAGE URBANIZATION AREA

IN QUANTITATIVE TERMS

Unit : nos.

GROUND HEIGHT (m)		RESIDENCE			STORE	FACTORY	SCHOOL	OFFICE	MOSQUE	TOTAL	ACCUMULATION
		LARGE	MIDDLE	SMALL							
City-Side Area	1.5 - 2.0	162	196	63	2	0	3	0	0	426	426
	2.0 - 2.5	401	410	240	0	0	6	27	2	1,086	1,512
	2.5 - 3.0	21	18	0	0	0	0	1	0	40	1,552
Mountain-Side Area	1.5 - 2.0	0	0	0	0	0	0	0	0	0	0
	2.0 - 2.5	40	190	666	0	29	9	34	0	968	968
	2.5 - 3.0	21	36	114	0	0	0	0	2	173	1,141

IN MONETARY TERMS

Unit : million Rp.

GROUND HEIGHT (m)		RESIDENCE			STORE	FACTORY	SCHOOL	OFFICE	MOSQUE	TOTAL	ACCUMULATION
		LARGE	MIDDLE	SMALL							
City-Side Area	1.5 - 2.0	11,417.0	5,880.8	756.8	644.7	0.0	101.1	0.0	0.0	18,800.4	18,800.4
	2.0 - 2.5	28,260.6	12,301.7	2,882.9	0.0	0.0	523.1	6,849.6	322.3	51,140.2	69,940.6
	2.5 - 3.0	1,479.9	540.1	0.0	0.0	0.0	0.0	527.2	0.0	2,547.2	72,487.8
Mountain-Side Area	1.5 - 2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2.0 - 2.5	2,819.0	5,770.8	8,000.0	0.0	6,283.4	518.9	6,609.3	0.0	29,931.4	29,931.4
	2.5 - 3.0	1,479.9	1,080.1	1,369.4	0.0	0.0	0.0	0.0	0.0	3,929.4	33,860.8

Table 4-1 COMPARISON OF PRINCIPAL FEATURES OF DAM AND RESERVOIRS

Items		Bili-Bili (Jeneberang)	Pasaratowaya (Jeneberang)	Jonggoa (Jeneberang)	Pattalikang (Jenelata)
a. Catchment area	(Km^2)	384.4	319.2	242.0	226.3
b. Surface area	(Km^2)	17.8	7.8	8.2	8.5
c. Dam height	(m)	66.0	80.0	100.0	65.0
d. Dam volume	(m^3)	6.3×10^6	12.5×10^6	19.1×10^6	12.0×10^6
e. Reservoir capacity	(m^3)	362×10^6	240×10^6	280×10^6	220×10^6
f. Effective storage capacity	(m^3)	304×10^6	192×10^6	243×10^6	186×10^6
g. Construction cost	($)	157×10^6	288×10^6	439×10^6	276×10^6
h. Effective storage capacity per Dam volume	(f/d)	48.3	15.4	12.7	15.5
i. Construction cost per Effective storage capacity	($/$m^3$)	0.52	1.50	1.81	1.48
j. Submerger houses	(nos.)	790	300	100	300
k. Effective storage capacity per Annual run-off volume (1976)	(%)	38	29	49	40

Table 4-2 THE MAIN DAMS OF EXISTING & PLANNING IN INDONESIA

Name of dam	Island or Province	Catchment Area (km)	Design flod (m^3/s)	Specific discharge	Remarks (Rp.Years)
Jatiluhur	W. Java	4,500	8,000	1.78	1,000
Karangkastes	E. Java	2,050	4,200	2.05	1,000
Selorejo	E. Java	236	920	3.90	1,000
Nawangan	E. Java	2.7	40	14.98	500
Riamkanan	Kaliman	1,040	1,950	1.87	2,000
Lahor	E. Java	160	690	4.13	200 + 20%
Jatigede	W. Java	1,460	6,700 10,500	4.59 7.19	2,000 P.M.F
Sempor	C. Java	43	1,400	32.56	100+20%x20
Glepan	C. Java	796	4,500	5.65	10,000
Ngrambat	C. Java	607	3,900	6.43	10,000
Jaragung	C. Java	94	1,000	10.64	10,000
Jipang	E. Java	10,810	8,660	0.80	200+20%
Wonogiri	E. Java	1,350	6,250 9,600	4.63 7.11	200+20% P.M.F.
Bendo	E. Java	138	850	6.16	200+20%
Blega	Madura	118	1,010	8.56	P.M.F
Samira	Madura	78	810	10.38	P.M.F
Klampis	Madura	51	290	5.69	(1/2)P.M.F
Palasari	Bali	42.5	225	5.29	1,000
Umpu	Lampung	205	696	3.40	100
Parangjoho	P.B.S	2.8	310	14.22	500
Songputri	P.B.S	2.7	52	19.20	
Sangiran	P.B.S	21.0	290	13.80	
Pondok	P.B.S	33.0	370	11.21	
Condang	P.B.S	68.1	465	6.80	

TABLE 4-3 HYDROLOGICAL EFFECTIVENESS IN WATER STAGE

(Unit: H.S.L.m)

Return Period	Below Sunguminasa				Above Sungguminasa (12.0 K point)	
	City-Side Area		Mountain-Side Area			
	w/o	w	w/o	w	w/o	w
2 - year	2.03	1.27	1.45	1.30	9.4	8.1
2.4 - year	2.05	1.60	1.50	1.34	9.7	8.7
5 - year	2.61	1.78	2.04	1.42	9.9	9.2
10 - year	2.82	1.94	2.53	1.55	10.0	10.0
30 - year	2.86	2.01	2.82	1.77	10.0	10.4
50 - year	2.89	2.07	2.86	1.88	10.0	10.4

Table 4-4 FUTURE DEMAND OF MUNICIPAL AND INDUSTRIAL WATER

(Unit: m^3/day)

Distinguish	1985	1990	1995	2000
Houses	47,180	64,812	91,555	127,911
Public Facilities	1,887	2,991	4,578	6,396
Industry	23,400	29,100	31,100	33,100
Trading	8,580	9,610	10,770	12,070
Hotels	2,003	2,244	2,515	2,817
Sea Port	328	361	394	426
Office	4,804	5,816	7,043	8,527
Hospitals	674	890	1,168	1,523
Schools	3,002	5,609	9,684	15,228
Mosques	630	780	930	1,140
Sub-Total (m^3/day)	92,488	122,213	159,737	209,138
Loss	39,638	52,377	68,459	89,631
Total (m^3/day)	139,126	174,590	228,196	298,769
(l/sec)	1,526	2,021	2,641	3,458
Adjusted Volume (l/sec)	[1,500]	[2,000]	[2,700]	[3,500]

Table 4-5 INCOME OF CROP

Varieties	Yield (ton/ha)	Unit Price (Rp/ton)	Gross Products (Rp/ha)	Production Cost (Rp/ha)	Income (Rp/ha)
Paddy	2.5	71,500	178,750	64,000	114,750
Maize	0.7	35,000	24,500	4,850	19,650
Green bean	0.5	125,000	62,500	3,500	59,000
Cassava	7.0	10,000	70,000	10,400	59,600

Table 4-6 GROWTH PERIOD OF VARIETIES OF PADDY

(Unit: Number of Days)

Varieties of Paddy	Growth Period of Seedlings	After Transplanting		Total Growth Period
		Irrigation	Cultivatio	
1. C4 - 63	20 - 25	95	105	125 - 130
2. PB - 26	20 - 25	95	105	125 - 130
3. PB - 32	21 - 27	108 - 109	118 - 119	140 - 145
4. PB - 36	18 - 21	82 - 89	92 - 99	110 - 120
5. Citarum	20 - 25	95	105	125 - 130

Note 1 : Persuasion seed sowing : 7 - 10 days
Note 2 : Puddling : 10 - 14 days

Table 4-7 IDENTIFICATION OF BASIC YEAR FOR PLANNING

Benefitted Area: 19,200 ha

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Volume dependent on reservoir supply (x $10^6 m^3$)	—	—	—	—	—	241	190	69	178	198
Order of the "drought year"	7th	1st	9th	6th	10th	2nd	5th	8th	4th	3rd

Note: The order of the "drought year" was determined based on the rainfall amount during dry season at Hasanuddin.

Table 4-8 CALCULATION OF EVAPOTRANSPIRATION (Modified Penman Method)

(Unit: mm/day)

	Crop Consumptive use factor	1976		1977		1978		1979		1980	
		E	Er	E	Er	E	Er	E	Er	E	Er
Jan.	1.27	4.476	5.7	4.067	5.2	4.377	5.6	3.742	4.8	3.577	4.5
Feb.	1.15	4.357	5.0	4.015	4.6	4.443	5.1	3.763	4.3	3.477	4.0
Mar.	0.75	4.079	3.1	4.638	3.5	4.689	3.5	3.724	2.8	4.181	3.1
Apr.	*	5.136	*	5.000	*	5.079	*	4.312	*	4.116	*
May	0.92	4.625	4.3	4.753	4.4	4.302	4.0	3.963	3.6	4.049	3.7
Jun.	1.12	4.227	4.7	4.078	4.6	4.267	4.8	3.921	4.4	3.761	4.2
Jul.	1.27	4.792	6.1	4.929	6.3	4.134	5.3	3.851	4.9	4.179	5.3
Aug.	1.15	5.673	6.5	5.425	6.2	5.053	5.8	4.593	5.3	4.536	5.2
Sep.	0.75	6.308	4.7	6.372	4.8	5.228	3.9	4.955	3.7	5.238	3.9
Oct.	*	5.860	*	6.879	*	5.944	*	5.097	*	5.215	*
Nov.	0.92	5.084	4.7	5.918	5.4	5.181	4.8	4.986	4.6	4.925	4.5
Dec.	1.15	4.116	4.7	4.664	5.4	4.142	4.8	3.864	4.4	3.656	4.2

Table 4-9 DIVERSION REQUIREMENTS DURING DRY SEASON (1976)

	Unit	May	Jun.	Jul.	Aug.	Sep.
Unit Water Requirement	l sec/ha	1.433	1.212	1.463	1.527	1.238
Bili-Bili Intake (4,000 ha)	m^3/sec	*1) 0- 4.396	4.848	5.852	6.108	*2) 4.952-0
Kampili Intake (15,200 ha)	m^3/sec	*1) 0-16.706	18.422	22.238	23.210	*2) 18.818-0
Total (19,200 ha)	m^3/sec	*1) 0-21.102	23.270	28.090	29.318	*2) 23.770-0

* 1) : May 0% - 76.7% area
* 2) : Sep. 100% - 0% area

Table 4-10 ECONOMIC PRICE OF RICE (GABA)
- Import Substitution Price -

(Unit: Rp/ton)

1. International Market Price (F.O.B. Bangkok) /1 US$557	348,125
2. External Transportation Cost (Bangkok - Ujung Pandang)	8,125
3. Port Handling Charge and Storing Cost (including cost of sacks) /2	5,710
4. Selling Price of Rice at Ex-mill Gate	361,960
5. Milling Charge	- 6,000
6. Handling and Transportation Cost (Farm gate to mill)	- 2,700
7. Economic Farm Gate Price of Dry Stalk Paddy	353,260 [353,000]

Note: /1 : Source - Price prospects for Major Primary Commodities IBRD, 1980

Projected price to 1985 in 1980 constant US dollars.

/2 : Handling charge at harbor 30 Rp/ton
Storing chasrge 7 Rp/ton/day x 240 days
Cost of sacks 4000 Rp/ton

Table 4-11 IRRIGATION BENEFITS

Description	W/O Project	W/Project	Increment
1. Planted Area (ha)			
-wet season paddy field	24,000	24,000	0
-dry season paddy field	2,400	19,200	16,800
2. Unit Yield (ton/ha)			
-wet season rice	2.62	3.12	0.50
-dry season rice	2.24	3.12	0.88
3. Project Price of Paddy (Rp/ton)			
-rice (Gaba)	353,000	353,000	0
4. Unit Production Cost (Rp/ha)			
-wet season rice	180,000	190,000	10,000
-dry season rice	190,000	200,000	10,000
5. Gross Production Value (1x2x3) ($x10^6$ Rp)	24,095	47,579	23,484
-wet season rice	22,197	26,433	4,236
-dry season rice	1,898	21,146	19,248
6. Total Production Cost (1 x 4) ($x10^6$ Rp)	4,776	8,400	3,624
-wet season rice	4,320	4,560	240
-dry season rice	456	3,840	3,384
7. Net Production Value (5 - 6) ($x10^6$ Rp)	19,319	39,179	19,860
-wet season rice	17,877	21,873	3,996
-dry season rice	1,442	17,306	15,864
8. Crop Damage Due to Water Shortage ($x10^6$ Rp)	0.0	282	282
-wet season rice	0.0	109	109
-dry season rice	0.0	173	173
9. Adjusted Net Production Value (7 - 8) ($x10^6$ Rp)	19,319	38,897	19,578
-wet season rice	17,877	21,764	3,887
-Dry season rice	1,442	17,133	15,691

Table 4-12 RELATION BETWEEN IRR AND MAXIMUM AVAILABLE DISCHARGE

Maximum available discharge m^3/s	Maximum output KW	Annual generated energy MWH	Construction cost x 10^6 US$	Unit construction cost per kWH (sending end) US$/KWH	Internal Rate of Return %
22	7,700	54,610	17,651	0.323	13.2
32	11,200	69,600	22,052	0.317	13.3
42	14,900	80,580	25,851	0.321	12.9
62	22,200	94,570	31,122	0.329	12.5

Table 4-13 GENERATED ENERGY AT BILI-BILI HYDRO POWER STATION

(Unit: MWH)

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1976	8,333	7,795	8,333	4,836	4,074	6,751	7,581	6,561	2,336	557	422	723	58,301
1977	7,883	7,526	8,333	7,800	3,604	5,775	8,307	7,490	2,967	3,853	1,618	5,889	71,041
1978	8,277	7,526	8,333	5,539	4,036	4,730	6,873	7,077	2,953	7,911	6,449	6,521	76,225
1979	8,333	7,526	8,333	6,717	6,110	3,991	7,432	6,959	2,689	4,583	2,085	5,792	70,549
1980	8,269	7,795	8,333	8,064	5,214	6,891	7,339	6,349	2,485	2,483	1,312	7,309	71,843

Table 5-1 LAND ACQUISITION AND HOUSE EVACUATION

Classification	Amount
1. Land	
Cultivated land	
Paddy Field	660 ha
Field	120 ha
Forest	350 ha
Bamboo	305 ha
Residential Area	156 ha
2. Houses	790 nos
3. Relocation of Road	19 km
4. Relocation of Pumping Station	1 place

Table 6-1 MAIN CONSTRUCTION MACHINERY FOR DAM

No.	Machinery	Capacity	Unit
1	Bulldozer	32 ton	12
2	Bulldozer w/Ripper	32 ton	12
3	Bulldozer	21 ton	20
4	Dump truck	20 ton	30
5	Dump truck	8 ton	54
6	Dozer shovel	2.0 m^3	7
7	Wheel loader	3.1 m^3	11
8	Backhoe	Hyd. 1.2 m^3	5
9	Ordinary truck	3.0 ton	15
10	Truck crane	Hyd. 50 ton	2
11	Truck mixer	3.0 m^3	6
12	Concrete pump car	40 m^3/hr.	2
13	Tractor and Trailer	30 ton	1
14	Water tanker	8 kl.	3
15	Fuel tanker	8 kl.	5
16	Vibration roller	15 ton	5
17	Tamping roller	13.5 ton	4
18	Road roller	10 ton	4
19	Soil compactor	22 ton	4
20	Motor grader	3.7 m	5
21	Boring machine	max. 150 m	20
22	Grout mixer and pump	200 l.	20
23	Crawler drill	3 in.	8
24	Rock breaker	4 in.	10
25	Log drill w/sinker	1.5 in.	30
26	Pick hammer		30
27	Portable air compressor	17 m^3/min.	20
28	Concrete mixer	0.5 m^3	6
29	Concrete bucket	0.8 m^3	3
30	Concrete vibrator	flexible 130 ø	5
31	Concrete vibrator	flexible 40 ø	10
32	Concrete vibrator	moul type	5
33	Vibrator roller	5 ton	5
34	Rammer	80 kg	15
35	Air tamper		30
36	Centrifugal pump	8 in.	5
37	Turbine pump	3 m^3/min.	5
38	Submergible pump	8 in.	5
39	Submergible pump	4 in.	5
40	Submergible pump	2 in.	7
41	Sand pump	1 m^3/min.	6
42	Diesel generator	500 kW	2
43	Screening plant	125 t/hr.	1
44	Concrete plant	1 m^3 x 2	1

Table 6-2 CONSTRUCTION COST OF BILI-BILI DAM

Work Item	Unit	Quantity	Total Amount ($\times 10^3$ US$)	Foreign Currencey ($\times 10^3$ US$)	Local Currency ($\times 10^3$ US$)
1. Civil Works					
Excavation	m^3	890,000	5,266	2,609	2,657
Embankment	m^3	6,280,000	42,205	28,771	23,434
Spillway	L.S.	1	32,140	16,586	15,554
Foundation	L.S.	1	9,000	5,940	3,060
Intake	L.S.	1	524	270	254
Headrace channel	L.S.	1	162	87	75
Diversion	L.S.	1	14,466	7,390	7,076
Preparatory works	L.S.	1	10,377	5,166	5,211
Sub-total	-	-	114,140	56,819	57,321
2. Gates & Equipment	L.S.	1	2,638	2,239	399
3. Road Relocation	km	19	2,500	250	2,250
4. Land Acquisition	ha	780	5,360	-	5,360
5. House Evacuation	P.C.	790	380	-	380
6. Relocation of Pumping St.	P.C.	1	700	665	35
7. Engineering Service	L.S.	1	10,990	9,190	1,800
Sub-total (1-7)	-	-	136,708	69,163	67,545
8. Physical Contingency	L.S.	1	20,506	10,374	10,132
Grand-total (1-8)	-	-	157,214	79,537	77,677

Table 6-3 MAIN CONSTRUCTION MACHINERY FOR RIVER IMPROVEMENT

No.	Machinery	Capacity	Unit
1	Dredger	800 PS	1
2	Anchor Barge	35 PS	1
3	Wheel Loader	2.1 m^3	3
4	Wheel Loader	1.2 m^3	4
5	Back Hoe	1.2 m^3	4
6	Back Hoe	0.7 m^3	4
7	Asphalt Engine Sprayer	200 l	1
8	Asphalt Finisher	2.4 - 3.6 m	1
9	Road Roller	10/12 ton	1
10	Tire Roller	8/20 ton	1
11	Vibration Roller	25 ton	5
12	Soil Compactor	90 kg	10
13	Tamper	80 kg	10
14	Bull Dozer	21 ton	8
15	Bull Dozer	11 ton	4
16	Dump Truck	8 ton	90

Table 6-4 CONSTRUCTION COST OF RIVER IMPROVEMENT

Work Item	Unit	Quantity	Total Amount ($x10^3$ US$)	Foreign Currency ($x10^3$ US$)	Local Currency ($x10^3$ US$)
1. Civil Works					
Dredging	m^3	816,000	2,685	1,371	1,314
Excavation	m^3	1,320,000	6,559	3,443	3,116
Embankment	m^3	270,000	1,565	761	804
Filling	m^3	360,000	1,043	507	536
Sodding	m^2	347,000	441	-	441
Revetment	m	5,400	732	-	732
Groyne	P.C.	54	123	-	123
Sluice	P.C.	2	44	2	42
Drainage ditch	m	1,200	69	34	35
Groundsill	P.C.	2	405	19	386
Diversion channel of S. Garassi	m^3	80,000	352	176	176
Preparatory works	L.S.	1	1,402	631	771
Sub-total	-	-	15,420	6,944	8,476
2. Gates	P.C.	2	42	-	42
3. Land Acquisition	ha	43	1,376	-	1,376
4. House Evacuation	P.C.	85	204	-	204
5. Engineering Service	L.S.	1	2,885	2,488	397
Sub-total (1 - 5)	-	-	19,927	9,432	10,495
6. Physical Contingency	L.S.	1	2,990	1,415	1,575
Grand-total (1 - 6)	-	-	22,917	10,847	12,070

Table 6-5 CONSTRUCTION COST OF WATER SUPPLY

Work Item	Total Amount ($x10^3$ US$)	Foreign Currency ($x10^3$ US$)	Local Currency ($x10^3$ US$)
1. Civil Works			
Gate-controlled division works	197	36	161
Sand basin & regulating basin	238	70	168
Pipeline & appurtenant structures	8,981	4,535	4,446
Preparatory works	942	464	478
Sub-total	10,358	5,105	5,253
2. Gates & Equipment			
Gates	42	-	42
Ductile cast-iron pipe	17,151	17,151	-
Valves	44	44	-
Sub-total	17,237	17,195	42
3. Land Acquisition	11	-	11
4. Compensation	80	-	80
5. Engineering Service	3,153	2,727	426
Sub-total (1 - 5)	30,839	25,027	5,812
6. Physical Contingency	4,626	3,754	872
Grand-total (1 - 6)	35,465	28,781	6,684

Table 6-6 CONSTRUCTION COST OF IRRIGATION

Work Item	Total Amount ($x10^3$ US$)	Foreign Currencey ($x10^3$ US$)	Local Currency ($x10^3$ US$)
1. Main Works			
Work I (S.C. & R.F.)	5,400	778	4,622
Work II (S.C. & R.F.)	5,400	778	4,622
Work III	5,833	984	4,849
S.C. & R.F.	5,400	778	4,622
Kampili main channel	433	206	227
Work IV	6,214	1,018	5,196
S.C. & R.F.	5,400	778	4,622
Bili-Bili connecting channel	648	161	487
Bili-Bili existing channel	166	79	87
Sub-total	22,847	3,558	19,289
2. Engineering Service	3,100	2,640	460
Sub-total (1-2)	25,947	6,198	19,749
3. Physical Contingency	3,892	930	2,962
Grand-total (1-3)	29,839	7,128	22,711

Note: S.C. & R.F. = Secondary Channel and Relevant Facilities

Table 6-7 CONSTRUCTION COST OF HYDRO POWER

Work Item	Total Amount ($x10^3$ US$)	Foreign Currencey ($x10^3$ US$)	Local Currency ($x10^3$ US$)
1. Civil Works			
Intake	491	270	221
Headrace tunnel	152	87	65
Penstock	525	254	271
Power house	6,156	3,426	2,730
Tailrace channel	1,021	524	497
Preparatory works	835	456	379
Sub-total	9,180	5,017	4,163
2. Gates & Penstock	1,392	1,182	210
3. Generating Equipment	5,955	5,590	365
4. Transmission line & Sub-station	3,640	2,320	1,320
5. Engineering Service	1,885	1,613	272
Sub-total (1-5)	22,052	15,722	6,330
6. Physical Contingency	3,308	2,358	950
Grand-total (1-6)	25,360	18,080	7,280

Table 7-1 ANNUAL DISBURSEMENT OF THE PROJECT COST

(Unit : x10^6 US$)

WORK ITEM	F.C.	L.C.	TOTAL	1982		1983		1984		1985		1986		1987	
				F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
D A M	151.43	158.76	310.19	-	-	2.83	0.85	1.51	0.28	0.23	2.02	18.68	20.40	20.27	26.05
RIVER IMPROVEMENT	38.77	66.18	104.95	1.22	0.19	0.30	0.04	1.71	3.52	2.82	6.97	2.61	7.25	2.63	7.44
MUNICIPAL & INDUSTRIAL WATER SUPPLY	56.91	14.79	71.70	-	-	-	-	-	-	-	-	1.63	0.27	0.87	0.17
IRRIGATION	13.93	48.60	62.53	-	-	-	-	-	-	1.19	0.24	0.04	-	2.17	9.99
HYDRO-POWER	36.97	17.22	54.19	-	-	-	-	-	-	-	-	-	-	1.28	0.25
T O T A L	298.01	305.55	603.56	1.22	0.19	3.13	0.89	3.22	3.80	4.24	9.23	22.96	27.92	27.22	43.90

(CONTINUED)

WORK ITEM	1988		1989		1990		1991		1992		1993		1994		1995	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
D A M	28.15	36.38	34.03	44.14	27.93	28.64	3.74	-	3.75	-	3.75	-	3.75	-	2.81	-
RIVER IMPROVEMENT	1.59	0.24	0.80	0.11	0.53	0.02	3.92	3.90	4.95	7.39	5.37	7.73	5.96	9.88	4.36	11.50
MUNICIPAL & INDUSTRIAL WATER SUPPLY	13.90	4.42	20.30	5.82	13.38	4.11	1.43	-	1.44	-	1.44	-	1.44	-	1.08	-
IRRIGATION	2.37	10.99	3.07	12.58	3.43	14.80	0.35	-	0.35	-	0.35	-	0.35	-	0.26	-
HYDRO-POWER	0.04	-	6.18	5.69	24.95	11.28	0.95	-	0.95	-	0.95	-	0.95	-	0.72	-
T O T A L	46.05	52.03	64.38	68.34	70.22	58.85	10.39	3.90	11.44	7.39	11.86	7.73	12.45	9.88	9.23	11.50

Table 7-2 ANNUAL DISBURSEMENT OF THE BASE COST

(Unit : $x10^6$ US$)

WORK ITEM	F.C.	L.C.	TOTAL	1982		1983		1984		1985		1986		1987	
				F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
D A M	69.16	67.55	136.71	-	-	2.17	0.61	1.02	0.18	0.07	1.16	11.59	10.55	11.44	12.24
RIVER IMPROVEMENT	16.56	24.21	40.77	0.99	0.16	0.20	0.03	1.19	2.26	1.83	4.00	1.52	3.75	1.39	3.50
MUNICIPAL & INDUSTRIAL WATER SUPPLY	25.03	5.81	30.84	-	-	-	-	-	-	-	-	1.02	0.14	0.48	0.08
IRRIGATION	6.20	19.75	25.95	-	-	-	-	-	-	0.79	0.14	-	-	1.23	4.72
HYDRO-POWER	15.72	6.33	22.05	-	-	-	-	-	-	-	-	-	-	0.80	0.13
T O T A L	132.67	123.65	256.32	0.99	0.16	2.37	0.64	2.21	2.44	2.69	5.30	14.13	14.44	15.34	20.67

(CONTINUED)

WORK ITEM	1988		1989		1990		1991		1992		1993		1994		1995	
	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
D A M	14.68	15.55	16.30	17.15	11.89	10.11	-	-	-	-	-	-	-	-	-	-
RIVER IMPROVEMENT	0.70	0.10	0.23	0.04	0.08	0.01	1.58	1.25	1.86	2.16	1.85	2.05	1.90	2.38	1.24	2.52
MUNICIPAL & INDUSTRIAL WATER SUPPLY	7.55	1.88	10.11	2.26	5.87	1.45	-	-	-	-	-	-	-	-	-	-
IRRIGATION	1.23	4.72	1.46	4.91	1.49	5.26	-	-	-	-	-	-	-	-	-	-
HYDRO-POWER	-	-	3.13	2.21	11.79	3.99	-	-	-	-	-	-	-	-	-	-
T O T A L	24.16	22.25	31.23	26.57	31.12	20.82	1.58	1.25	1.86	2.16	1.85	2.05	1.90	2.38	1.24	2.52

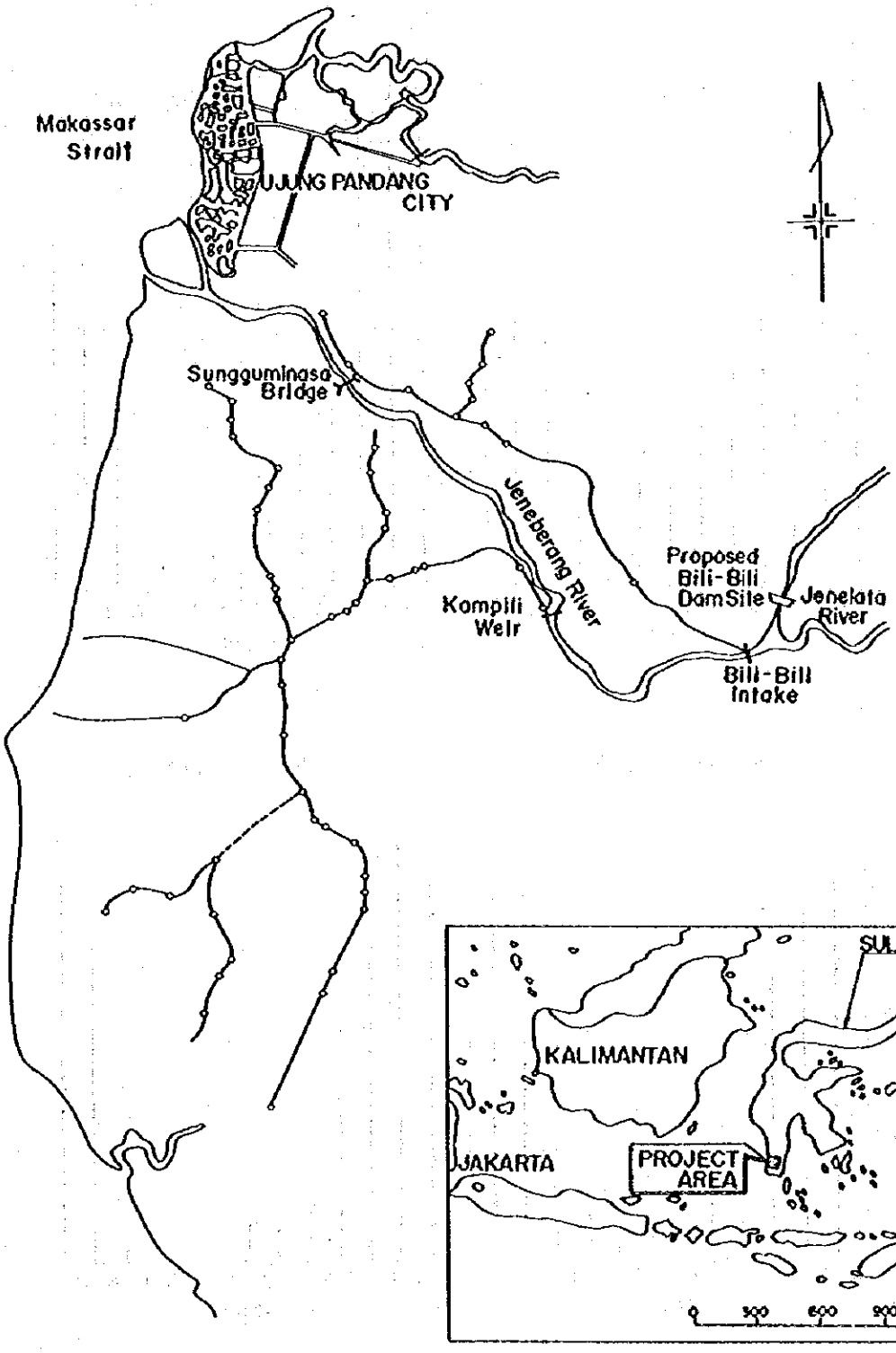


Fig. 3-1

PROJECT AREA

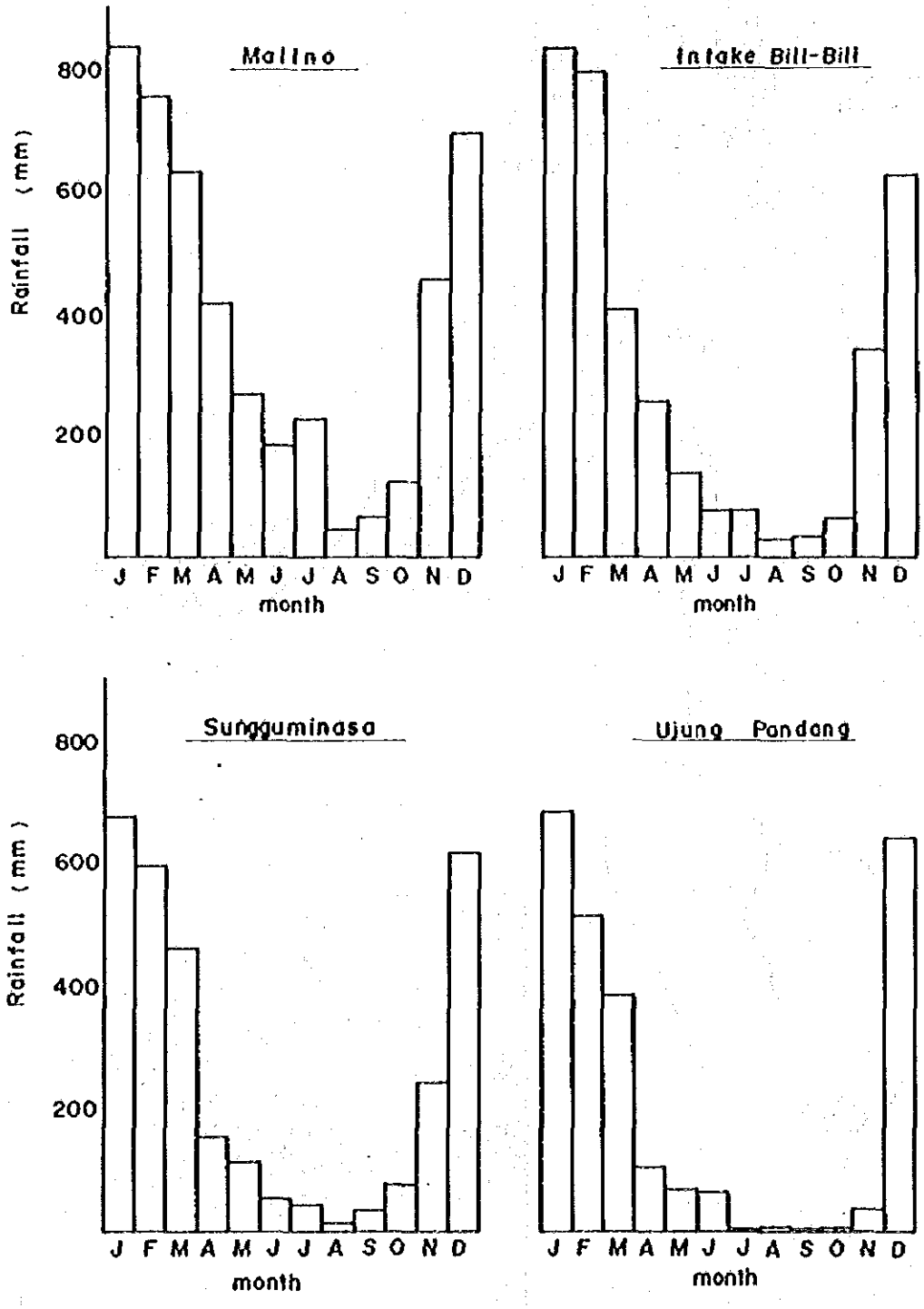


Fig. 3-2

MONTHLY RAINFALL RECORD

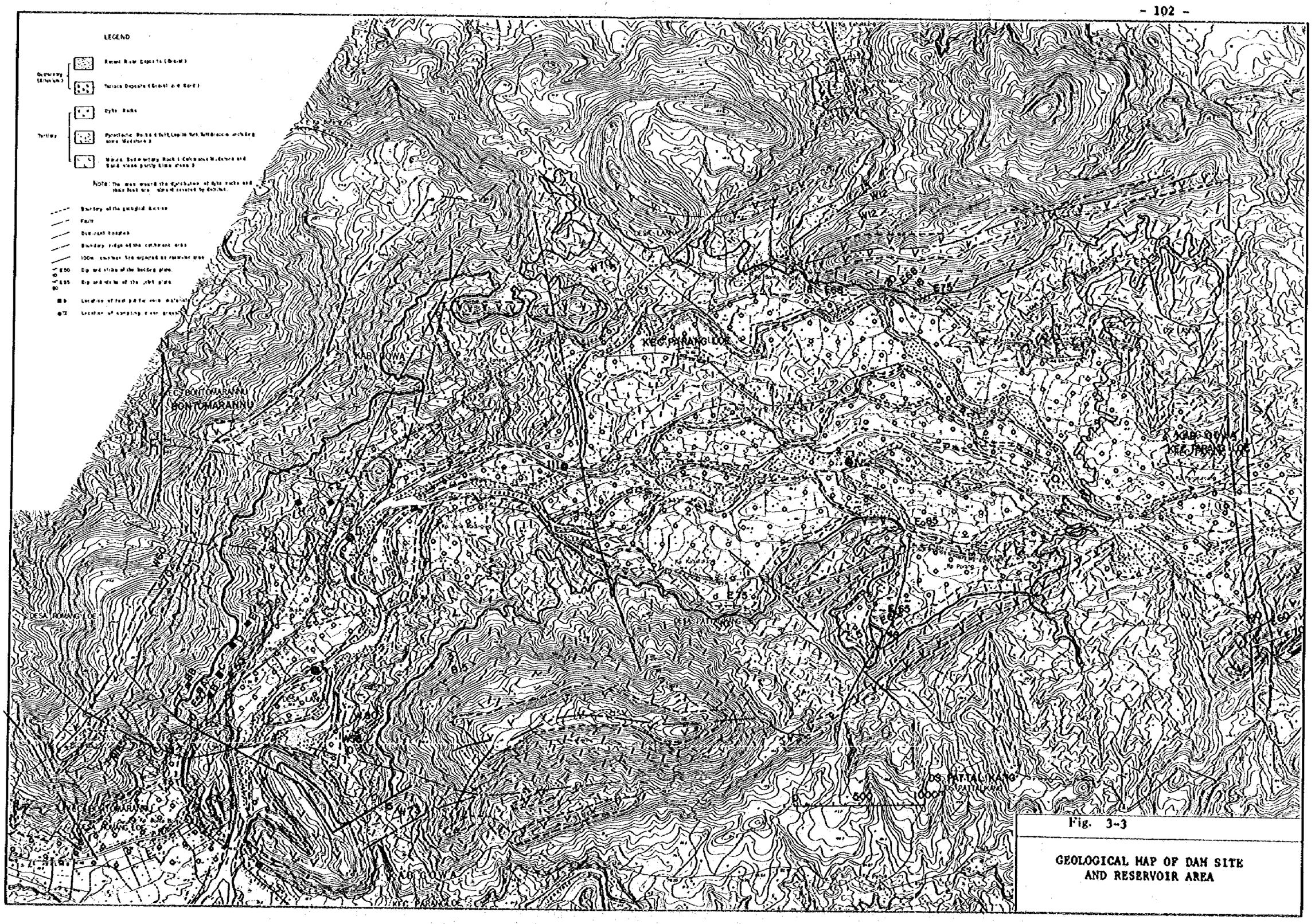


Fig. 3-3

GEOLOGICAL MAP OF DAM SITE AND RESERVOIR AREA

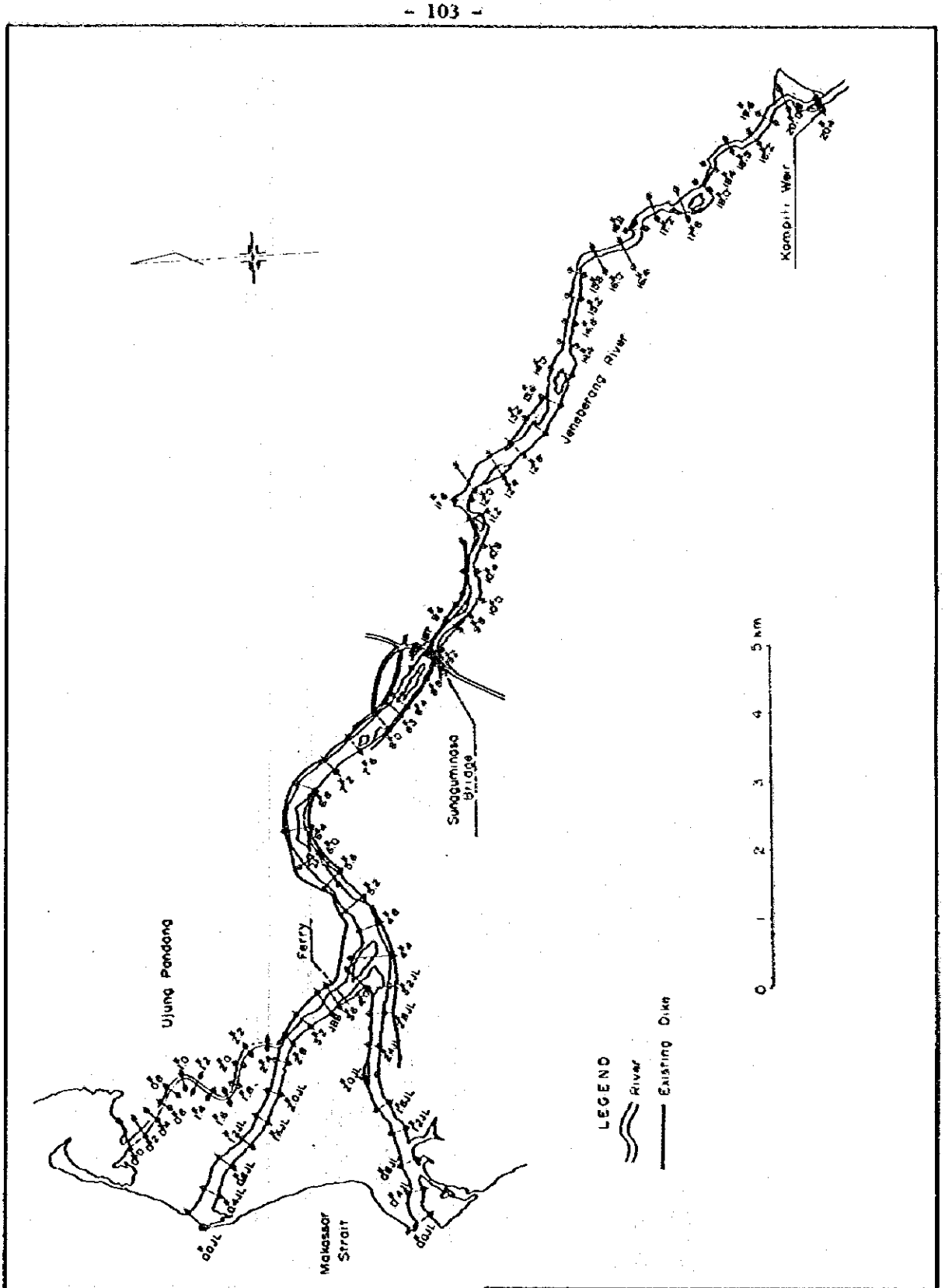


Fig. 3-4

GENERAL MAP OF THE JENEBERANG RIVER COURSE

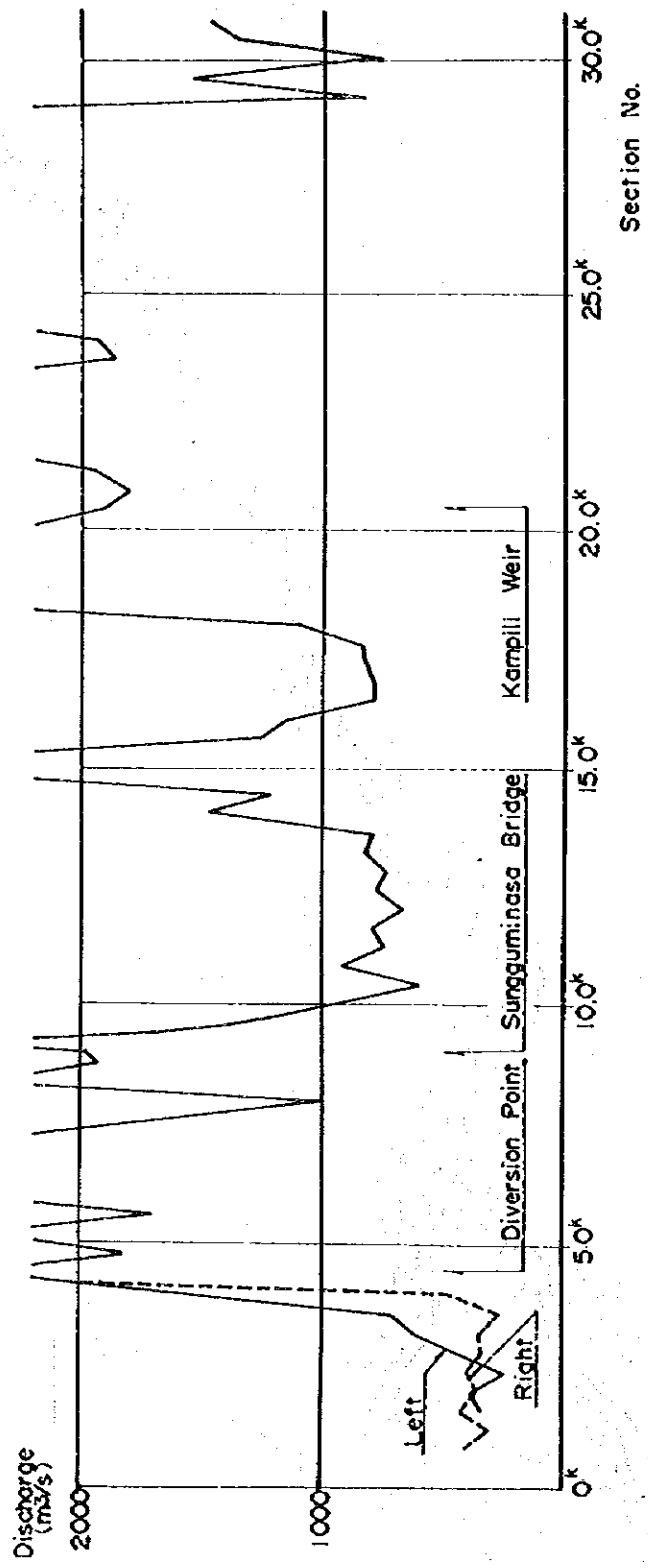
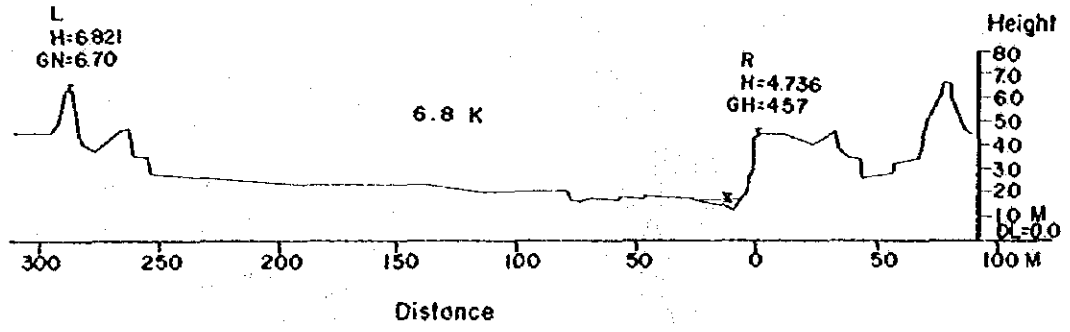
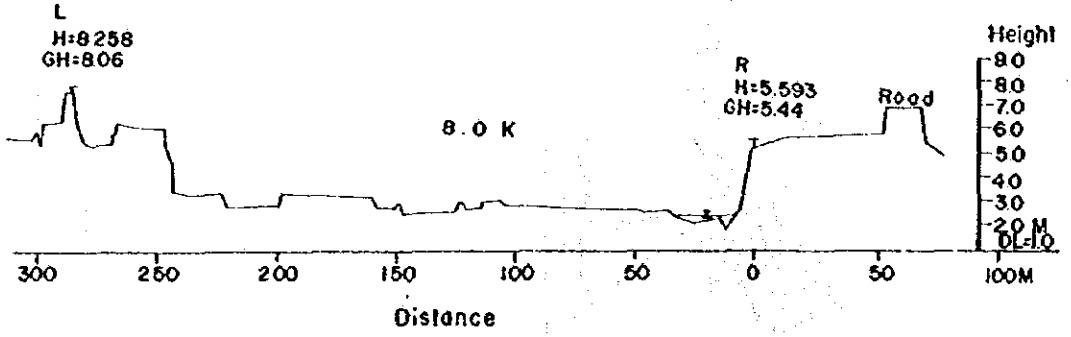


Fig. 3-5

PRESENT FLOW CAPACITY OF JENEBERANG RIVER





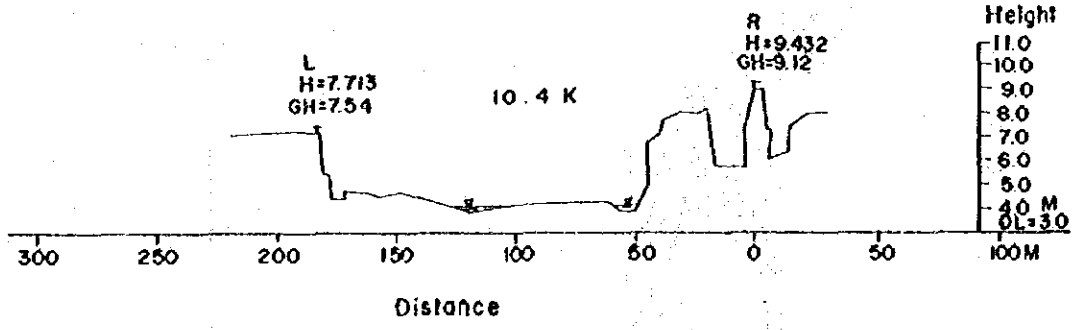


Fig. 3-6

CROSS-SECTION OF THE JENEBERANG RIVER

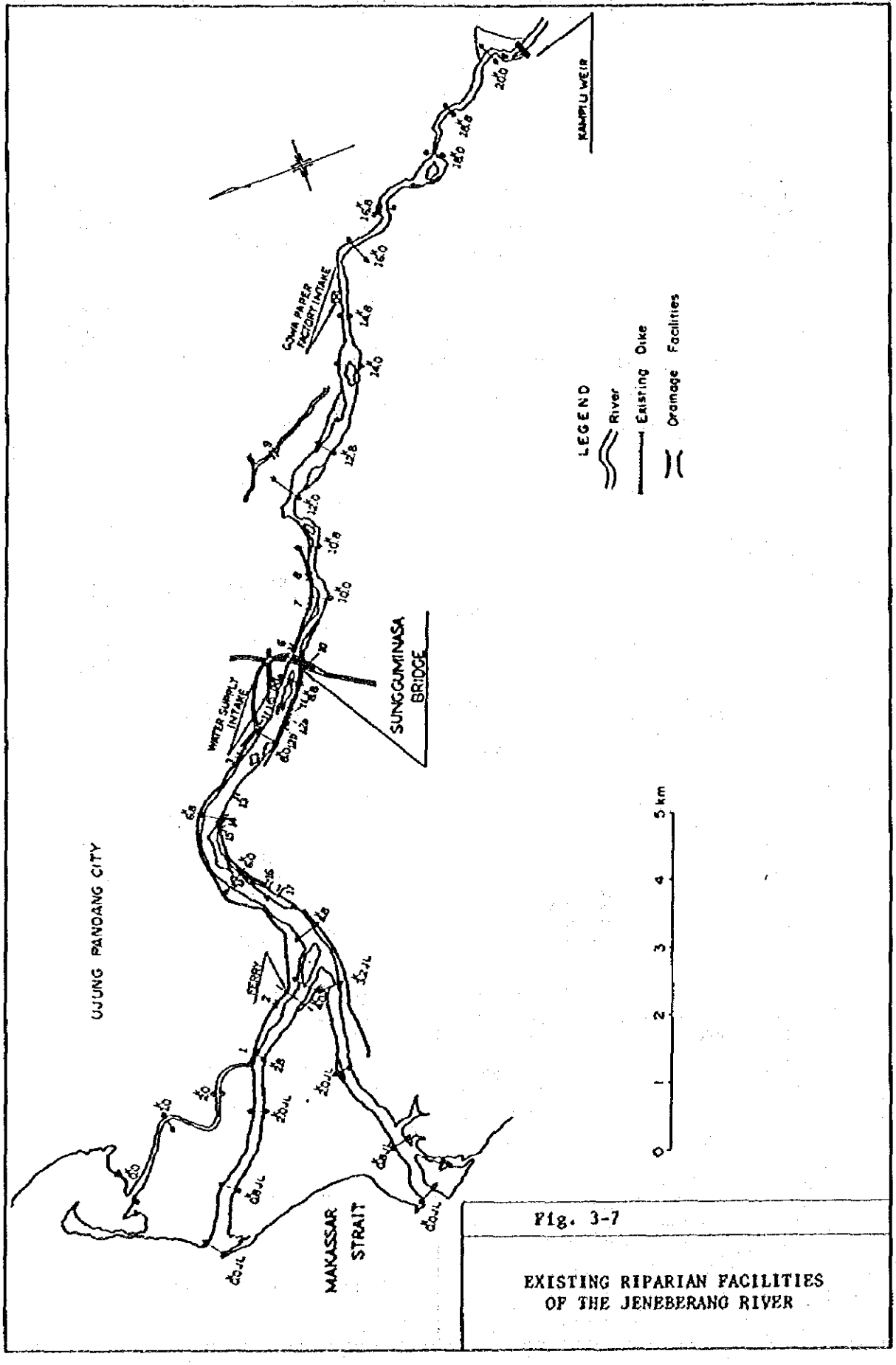


Fig. 3-7

EXISTING RIPARIAN FACILITIES
OF THE JENEBERANG RIVER

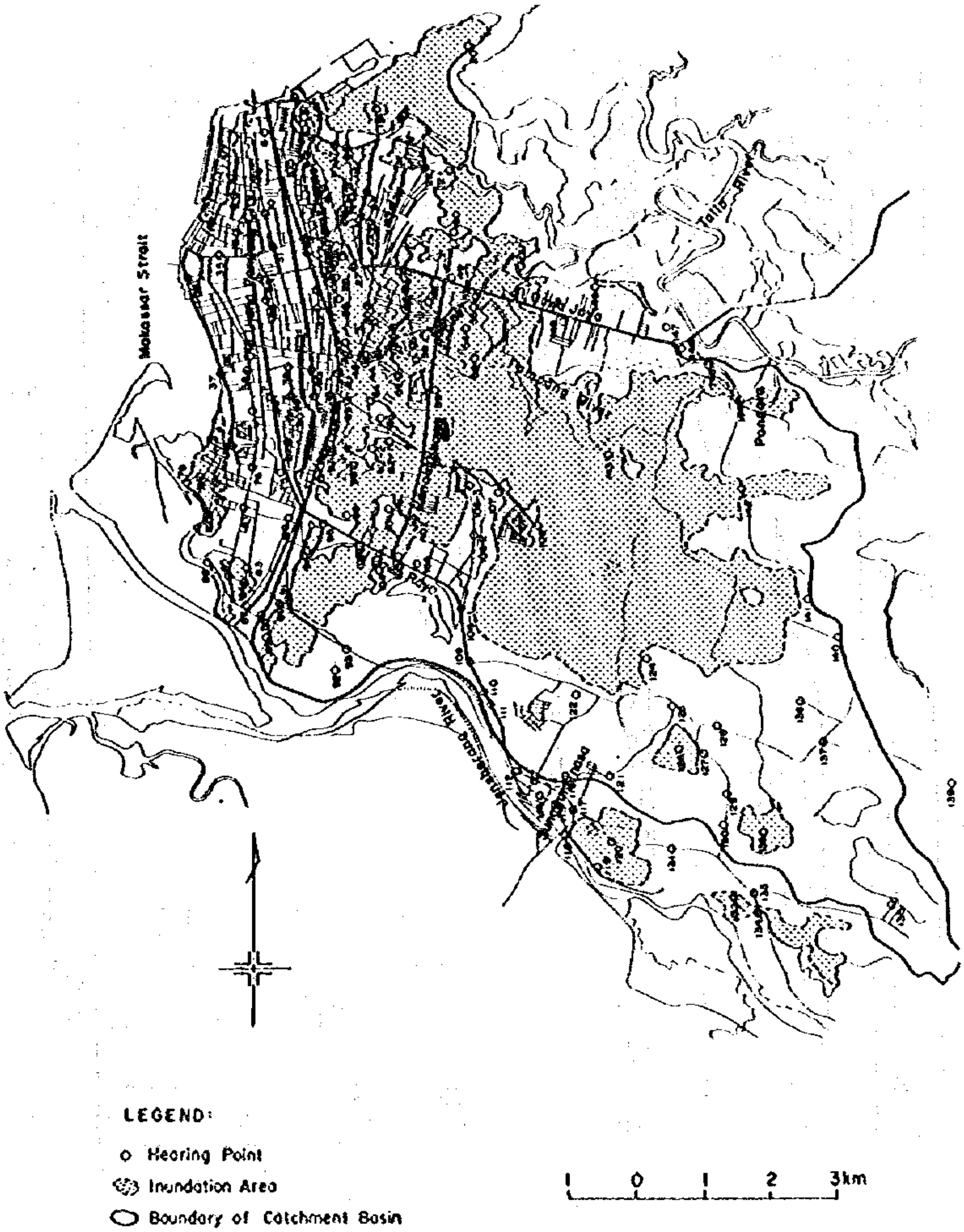


Fig. 3-8

INUNDATION MAP OF THE FLOOD OF JAN, 1976

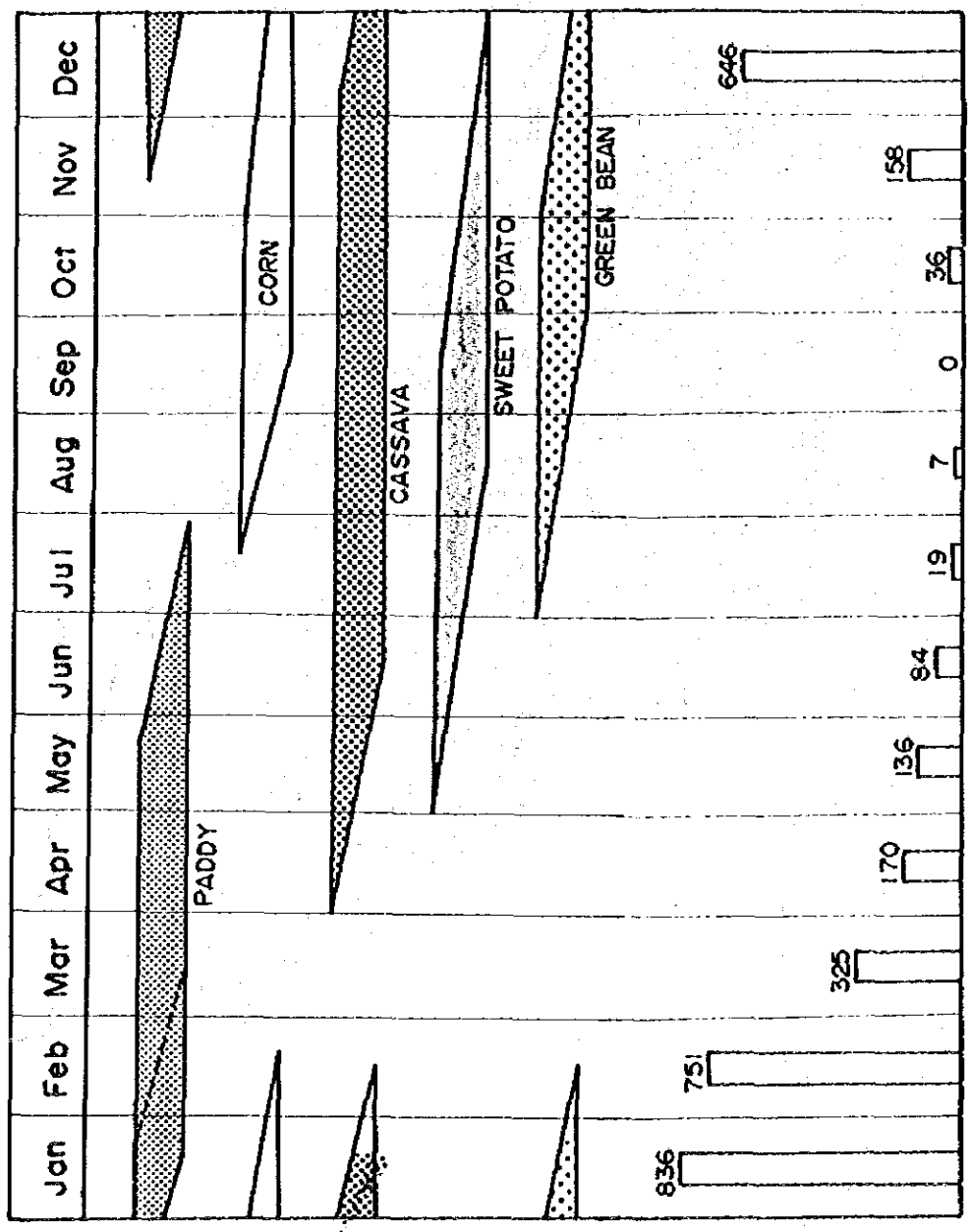


Fig. 3-9

PRESENT CROPPING & RAIN FALL PATTERN IN PROJECT AREA

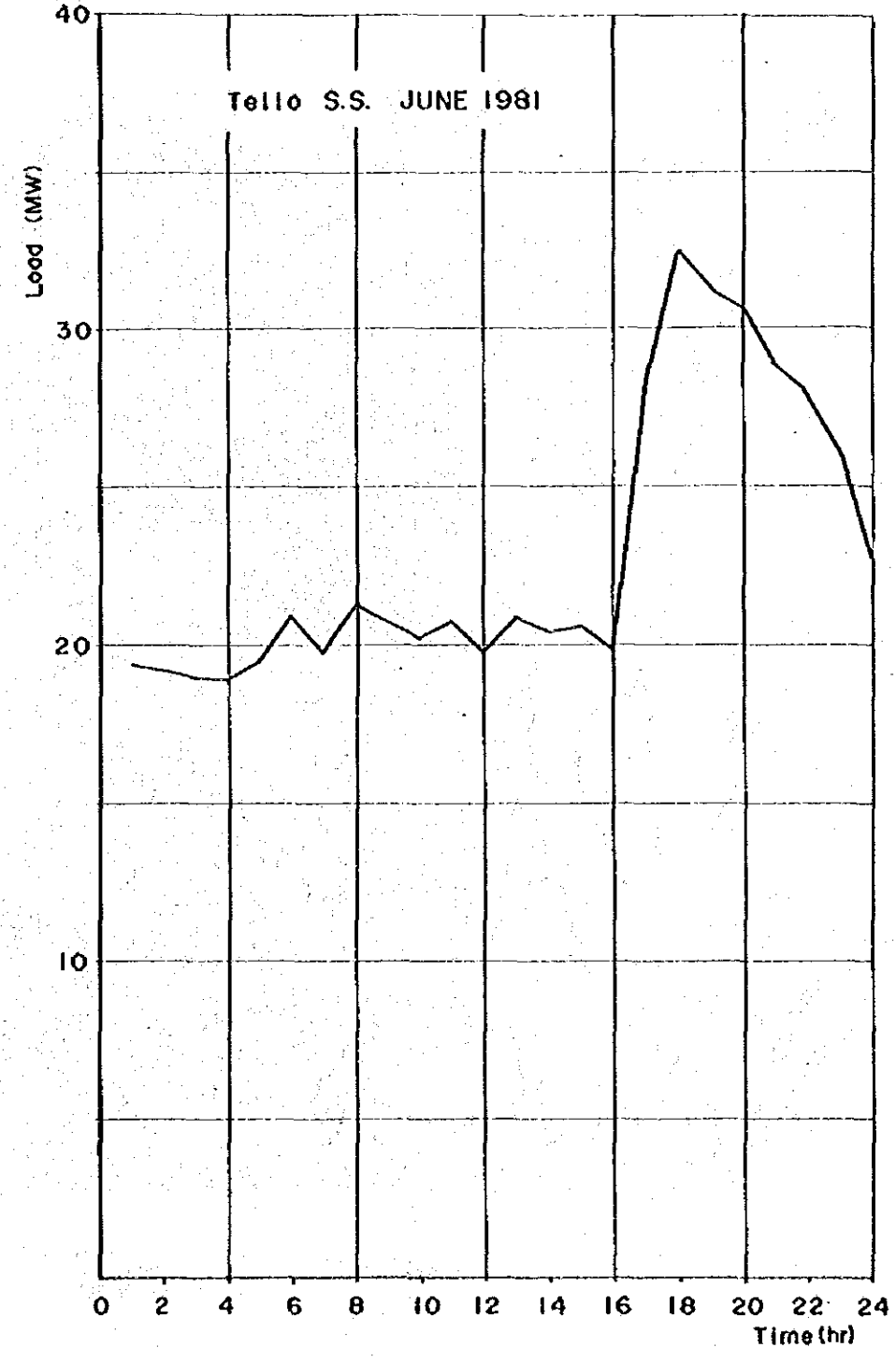


Fig. 3-10

DAILY LOAD CURVE

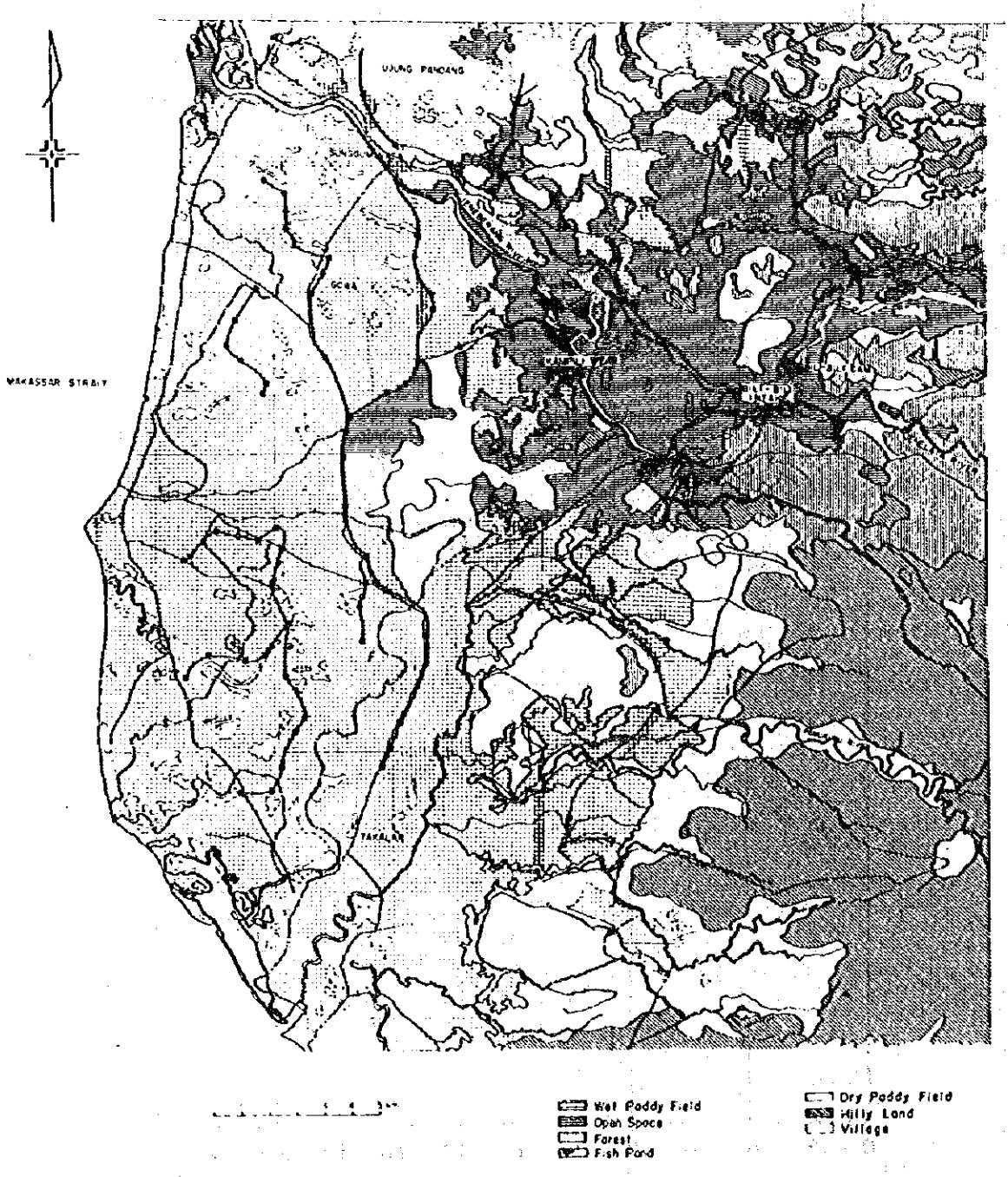


Fig. 3-11

LAND USE MAP

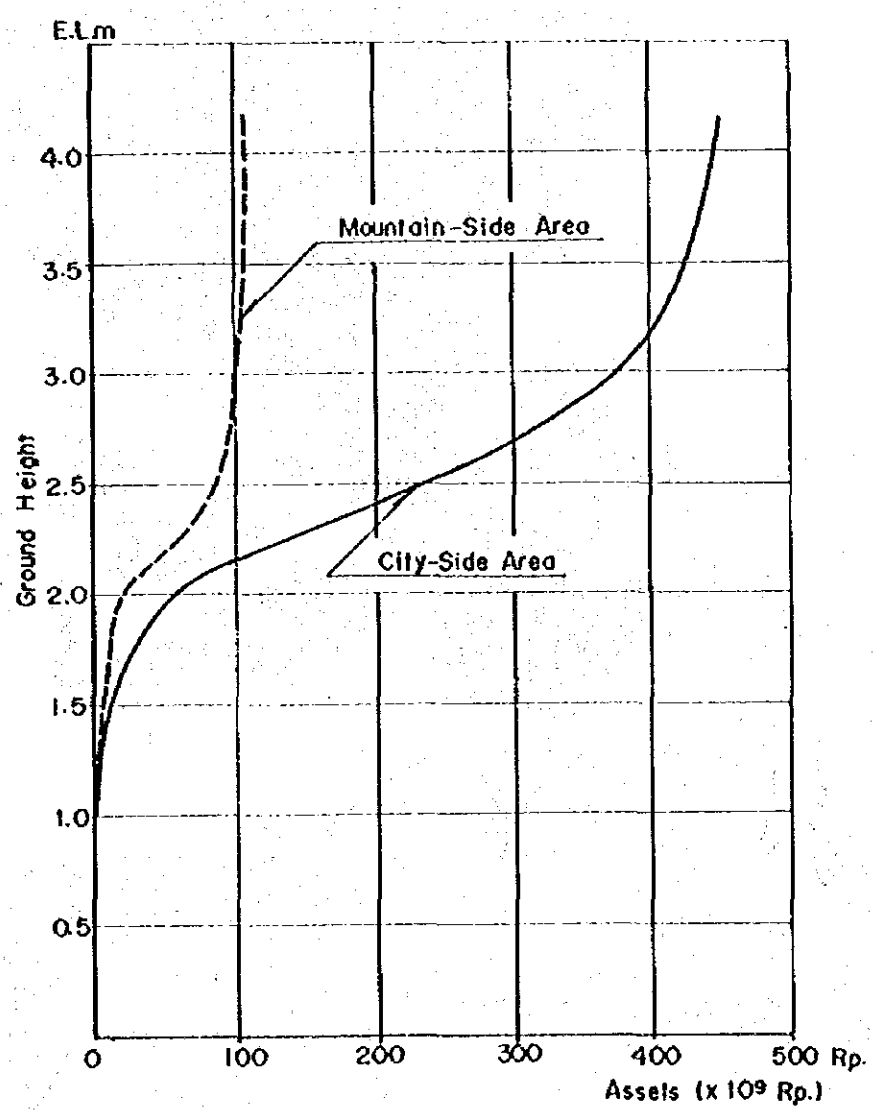


Fig. 3-12

RELATION CURVE BETWEEN GROUND HEIGHT AND THE EXISTING ASSETS

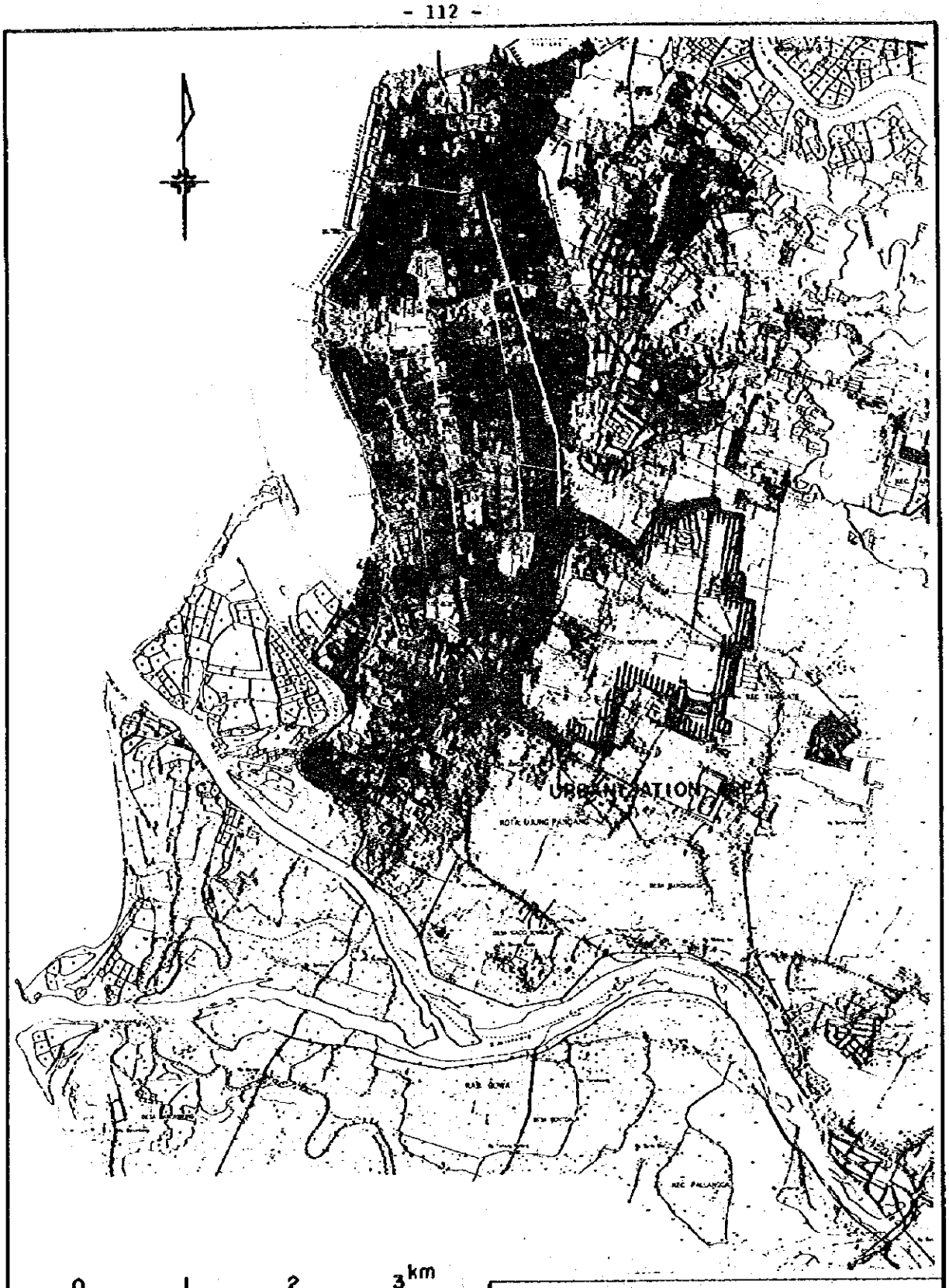


Fig. 3-13

LOCATION OF THE FIRST STAGE URBANIZATION AREA

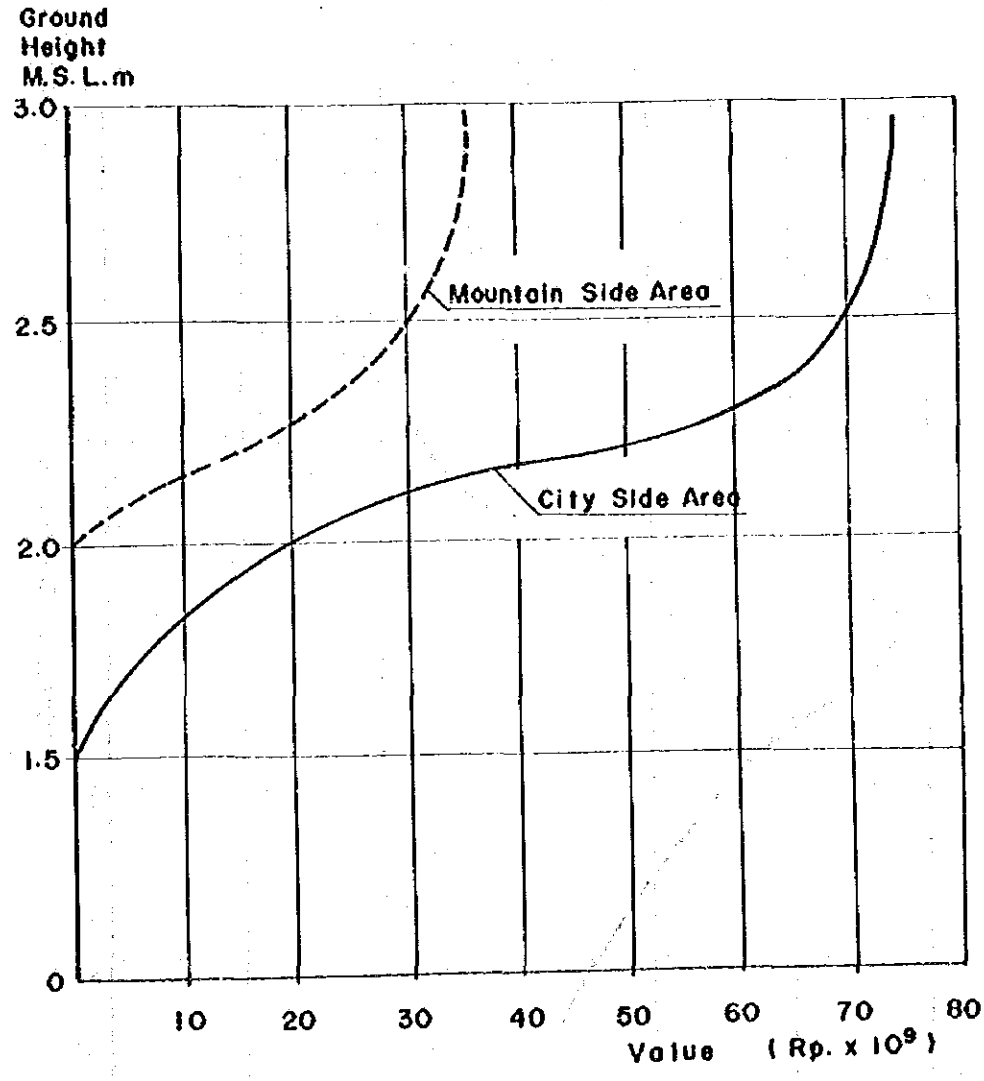


Fig. 3-14

RELATION CURVE BETWEEN
GROUND HEIGHT AND ASSETS
IN THE FIRST STAGE URBANIZATION AREA

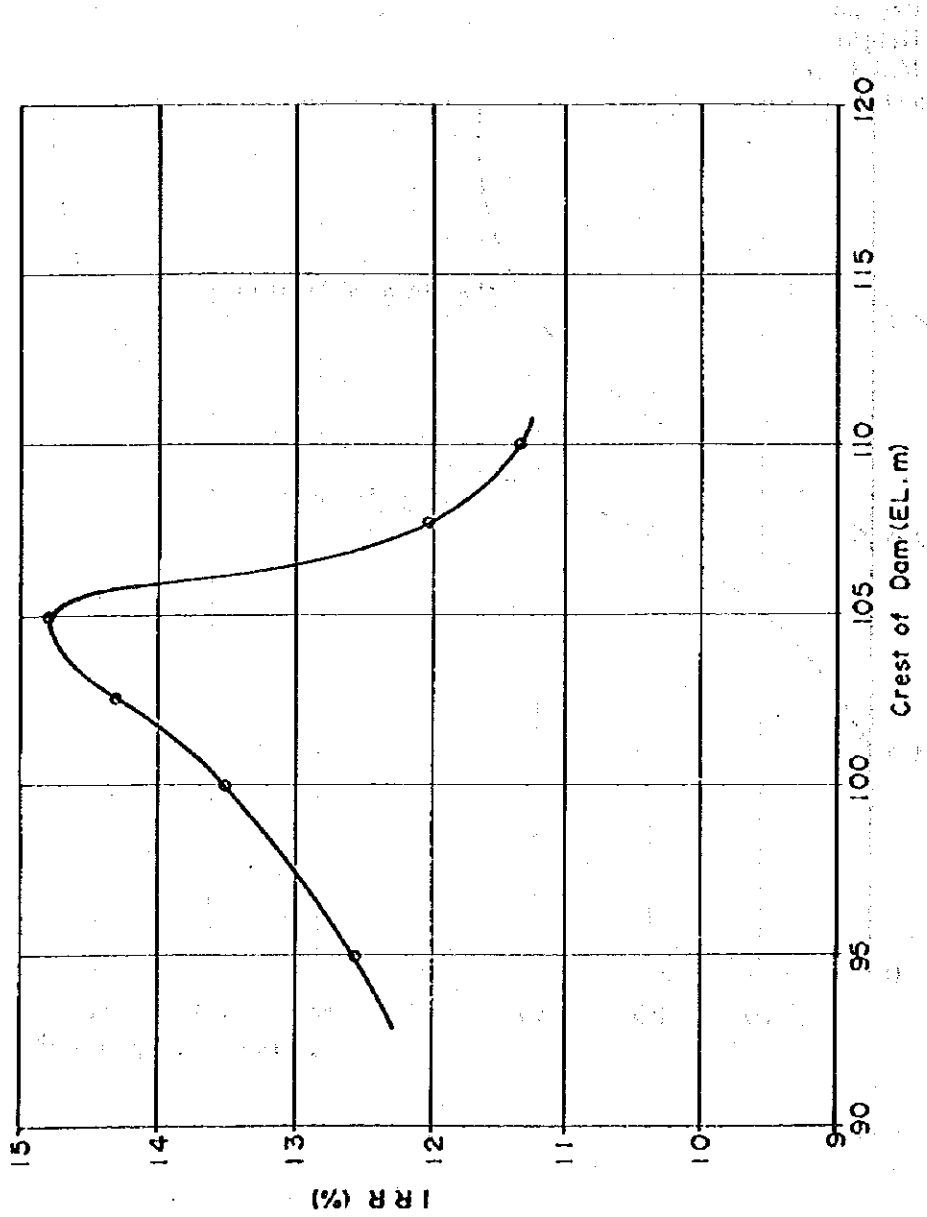
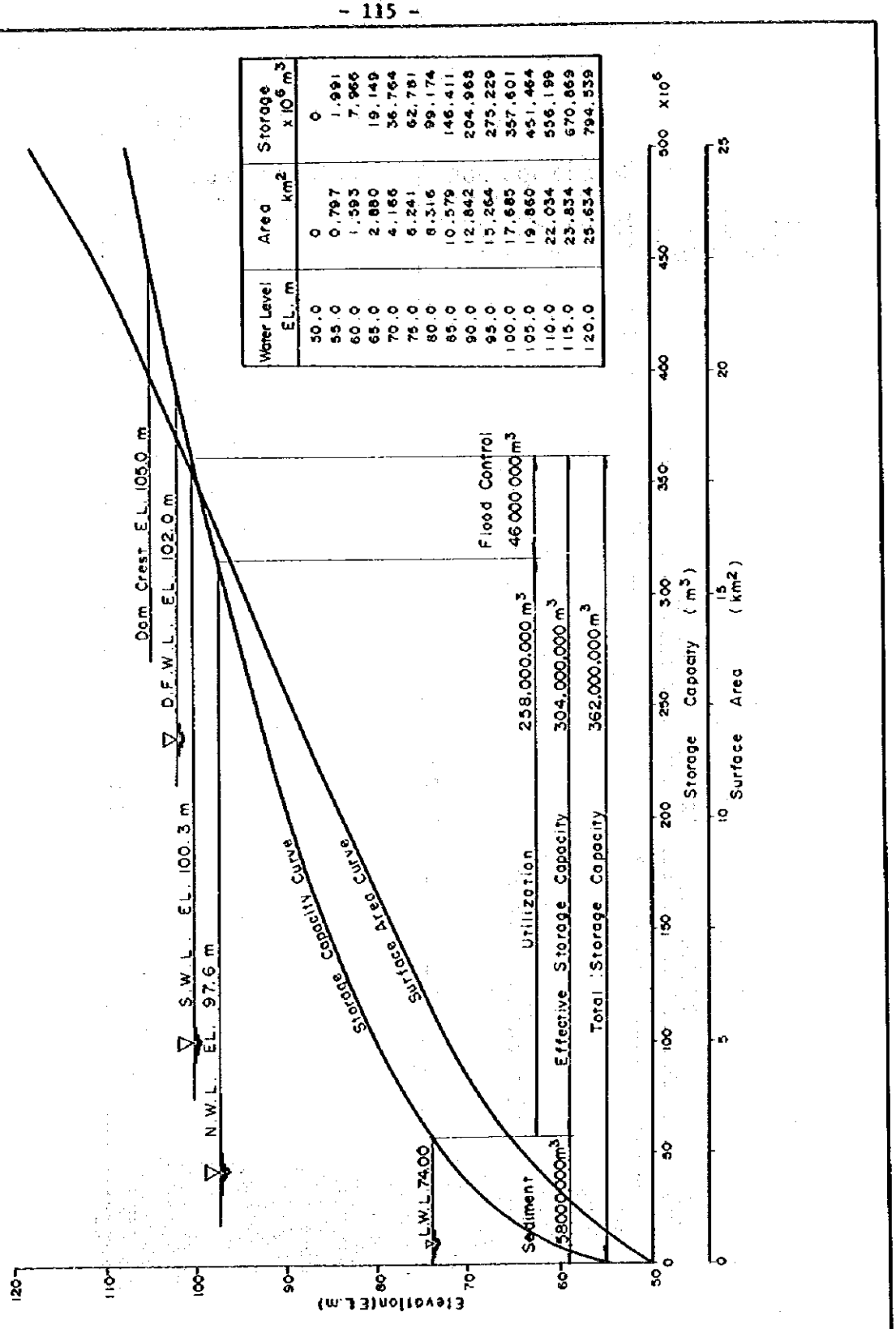


Fig. 4-1

RELATION BETWEEN IRR AND DAM HEIGHT



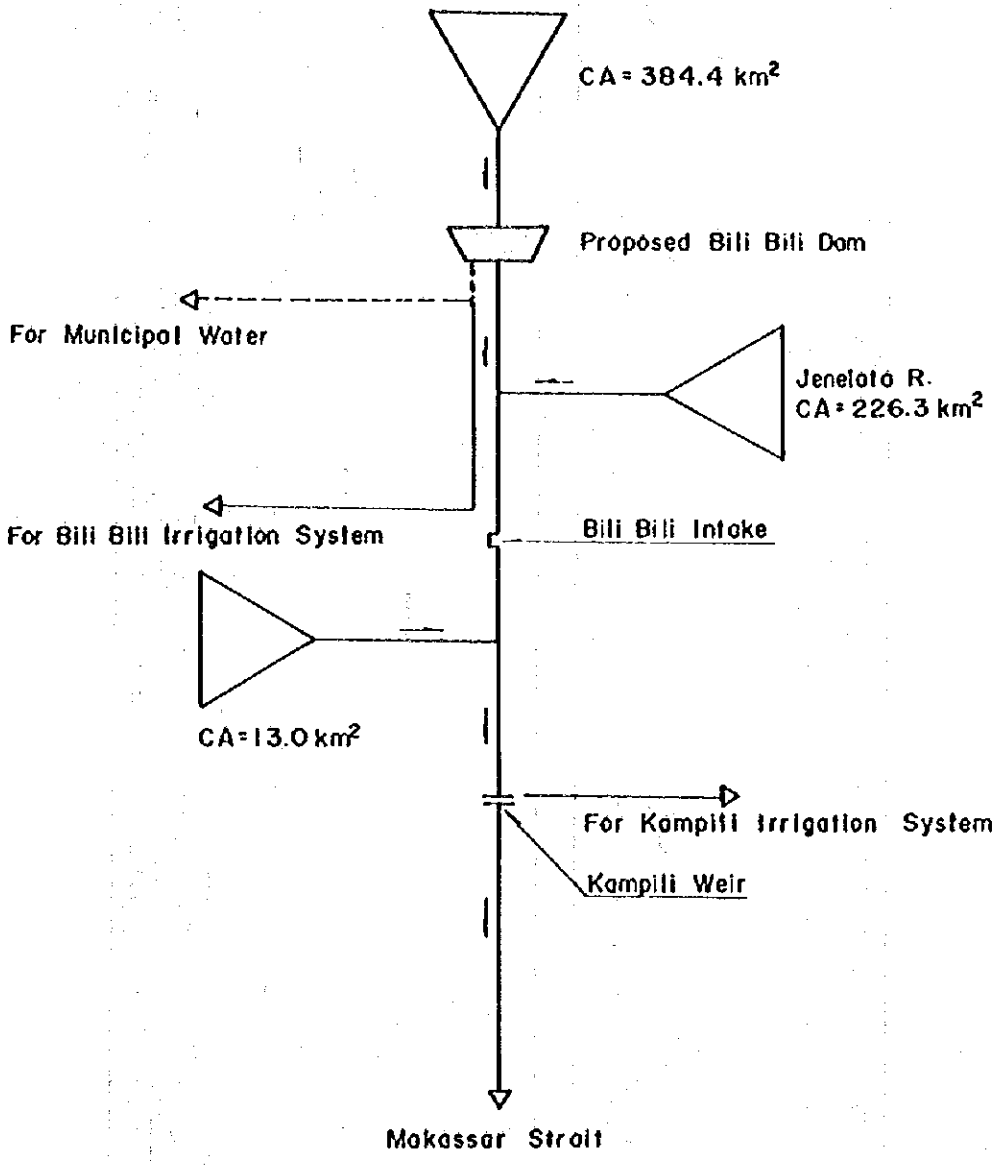
Water Level E.L. m	Area km²	Storage x 10⁶ m³
50.0	0	0
55.0	0.797	1.991
60.0	1.593	7.966
65.0	2.880	19.149
70.0	4.166	36.764
75.0	6.241	62.781
80.0	8.316	99.174
85.0	10.579	146.411
90.0	12.842	204.968
95.0	15.264	275.229
100.0	17.685	357.601
105.0	19.860	451.464
110.0	22.034	556.199
115.0	23.834	670.869
120.0	25.634	794.539

Fig. 4-2

RELATION CURVE BETWEEN ELEVATION AND STORAGE CAPACITY

Fig. 4-3

ALLOCATION OF RESERVOIR STORAGE



LEGEND

CA= : Catchment Area

: Irrigation Channel

: Pipeline

Fig. 4-4

SCHEMATIC DIAGRAM OF
WATER UTILIZATION SYSTEM

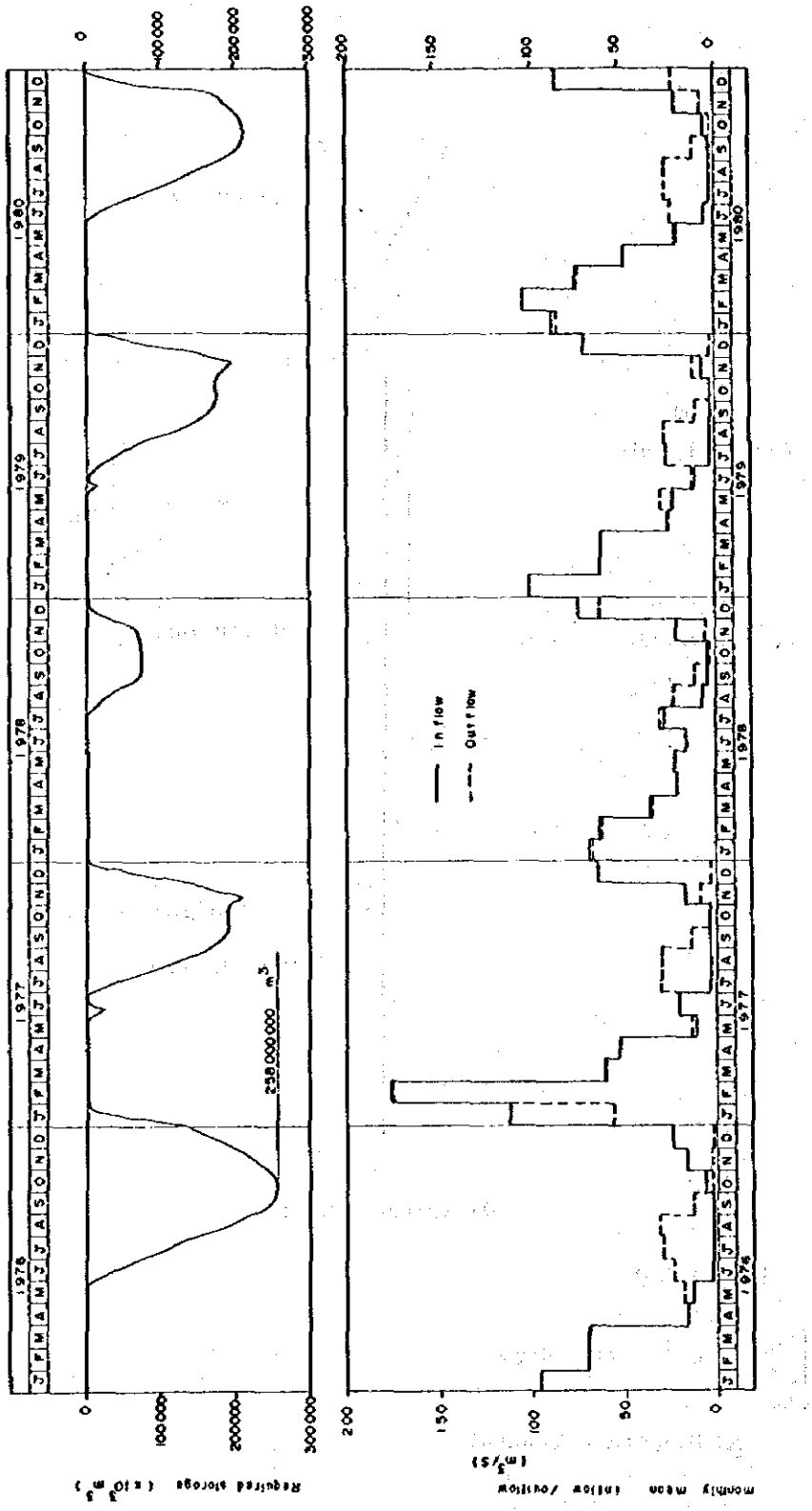


Fig. 4-5

VARIATION OF REQUIRED STORAGE

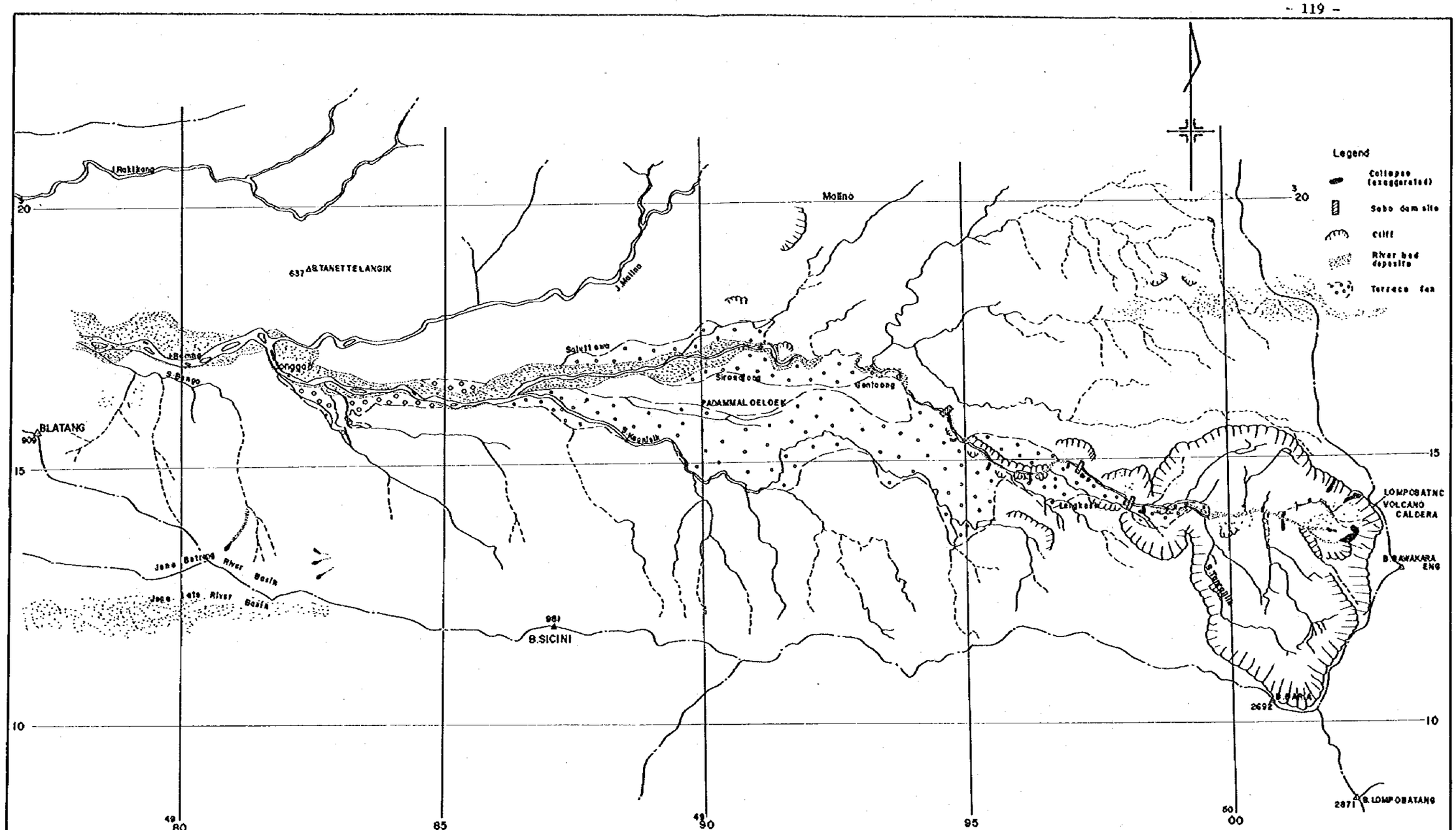


Fig. 4-6

DISTRIBUTION OF COLLAPSES AND LOCATION OF PROPOSED SABO DAMS

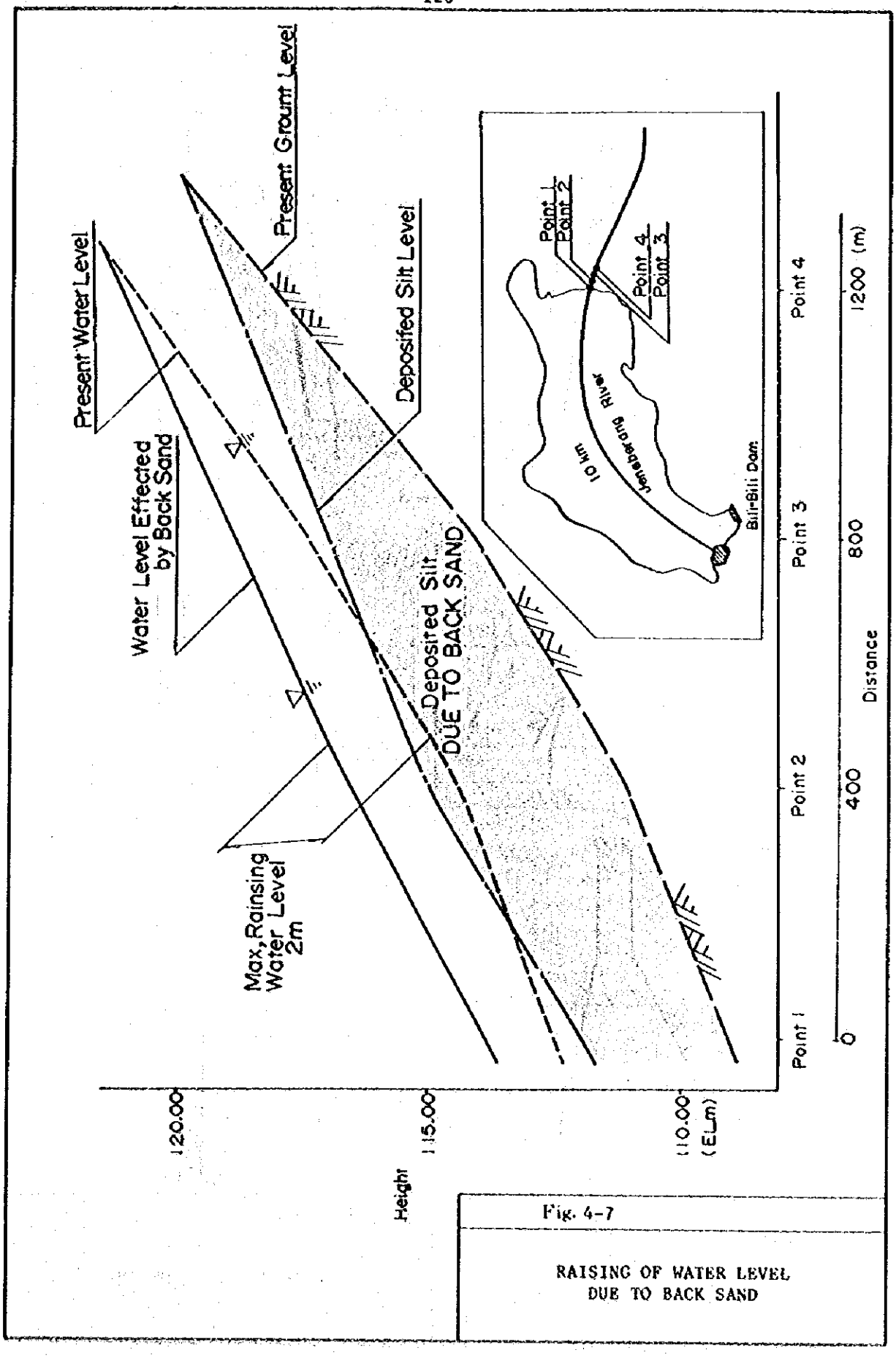
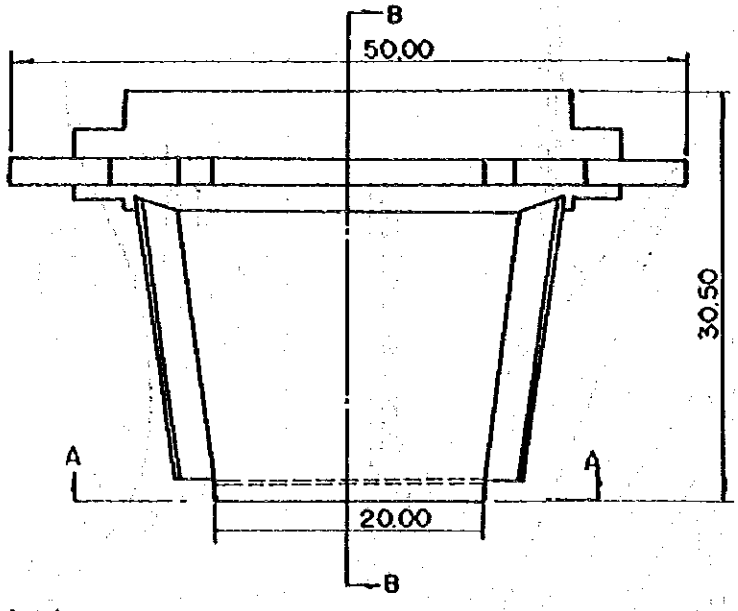
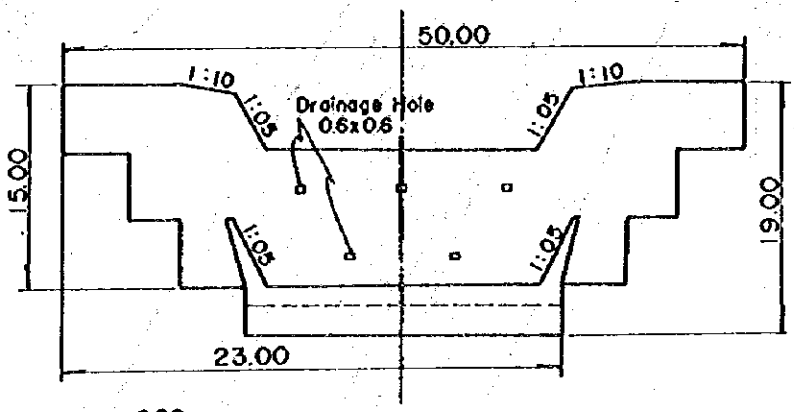


Fig. 4-7

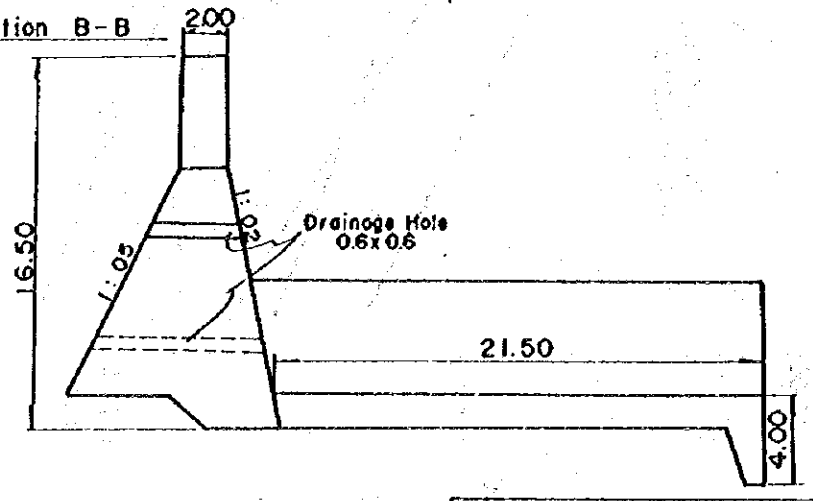
RAISING OF WATER LEVEL DUE TO BACK SAND



Section A–A



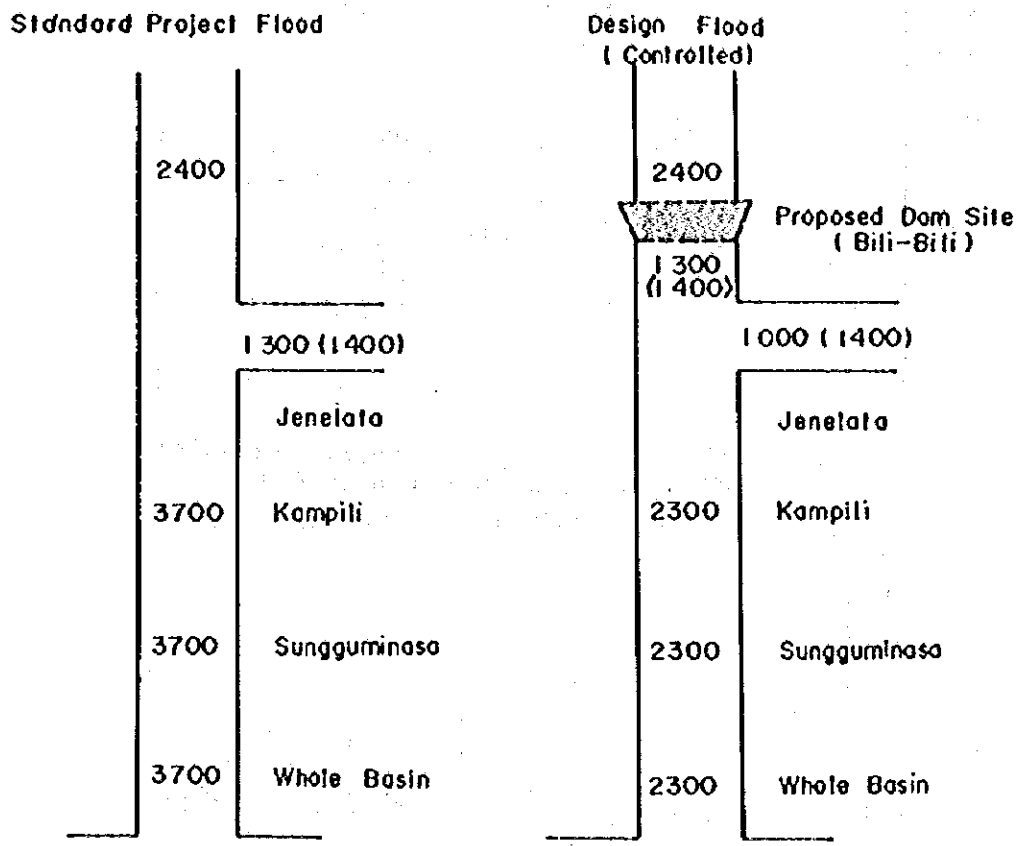
Section B-B



Unit : m

Fig. 4-8

GENERAL PLAN OF SABO DAM



NOTE: Figures show discharge to join the main stream.

( ) shows the peak discharge at Jenelata.

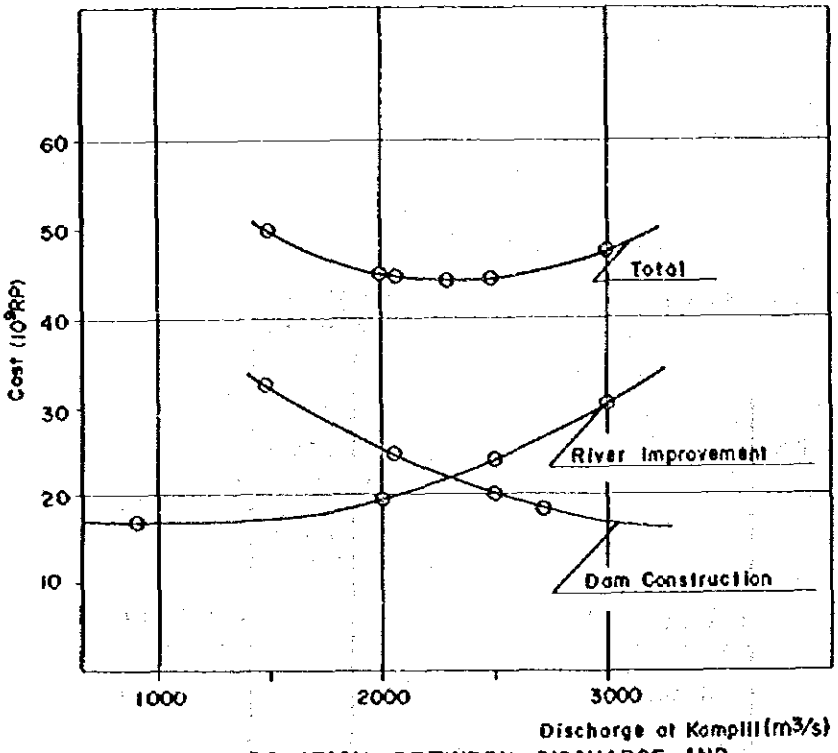
( ) shows the peak discharge after dam control.

Unit : m^3/s

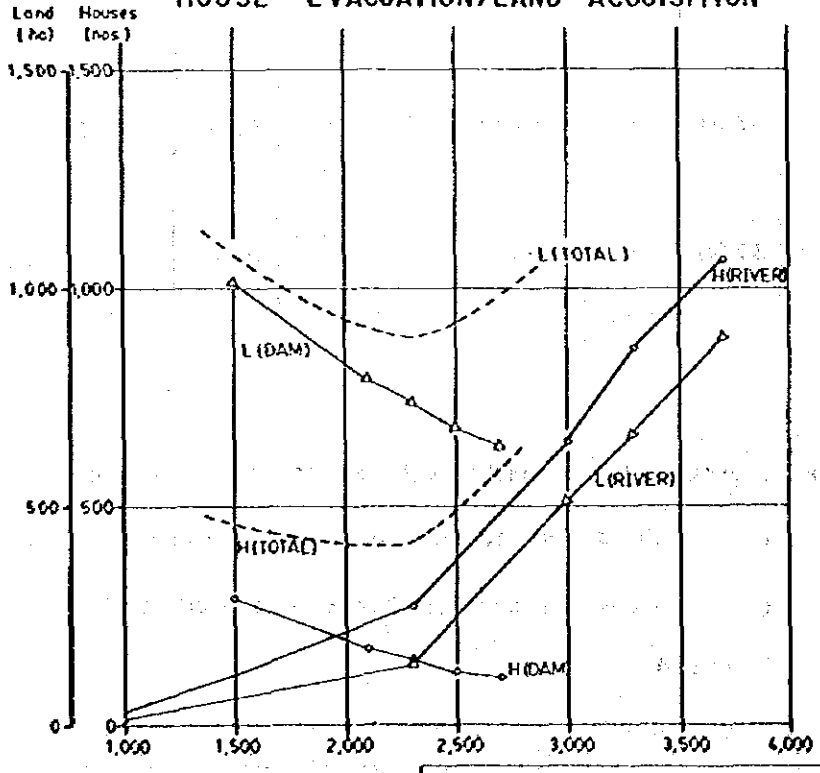
Fig. 4-9

STANDARD PROJECT AND DESIGN FLOOD
(50-YEAR RETURN PERIOD)

RELATION BETWEEN COST AND DISCHARGE AT KAMPILI



RELATION BETWEEN DISCHARGE AND HOUSE EVACUATION/LAND ACQUISITION



LEGEND
H : House Evacuation
L : Land Acquisition

Fig. 4-10

OPTIMUM SHARE OF DESIGN FLOOD BETWEEN DAM AND RIVER

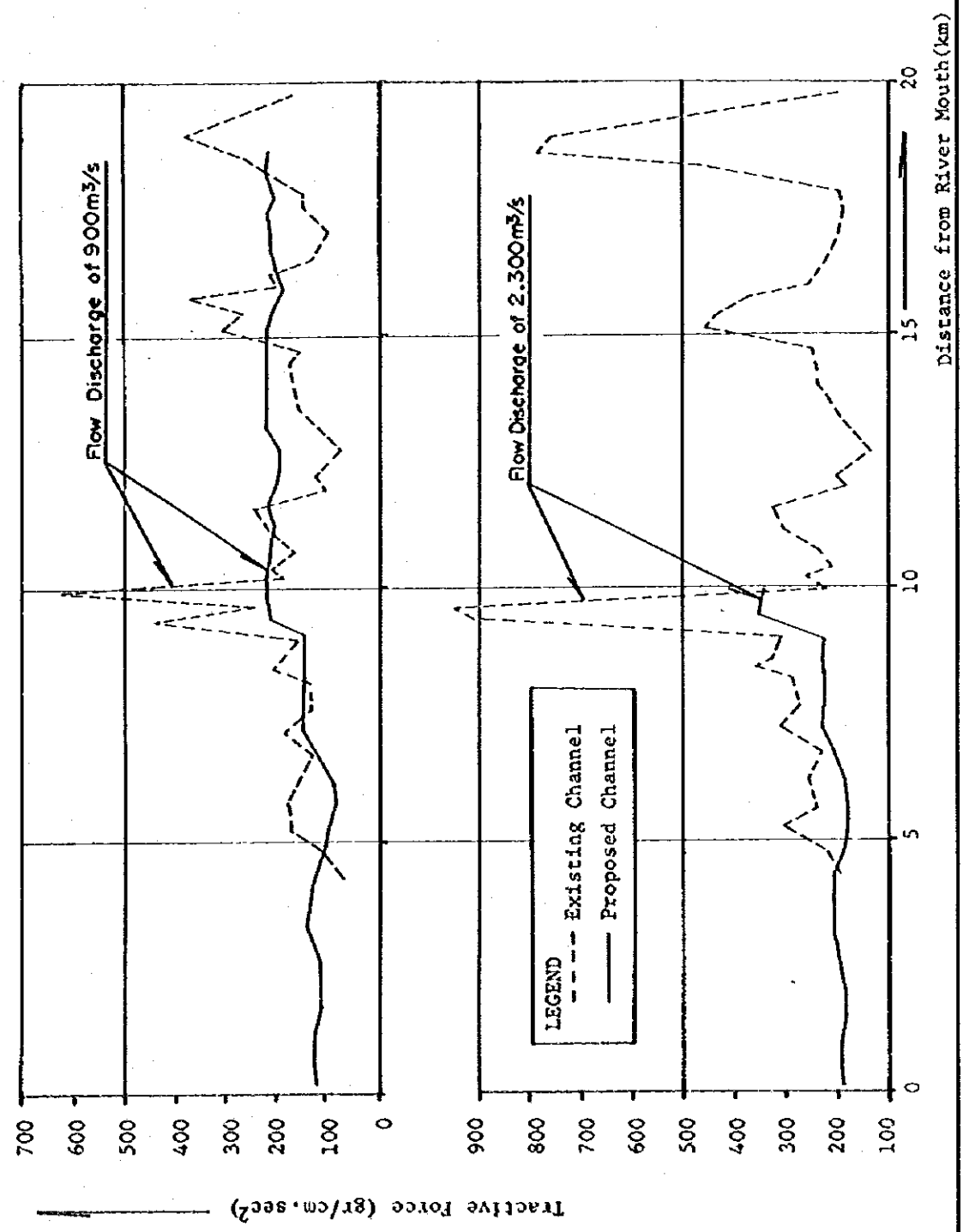


Fig. 4-11

COMPARISON OF TRACTIVE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL

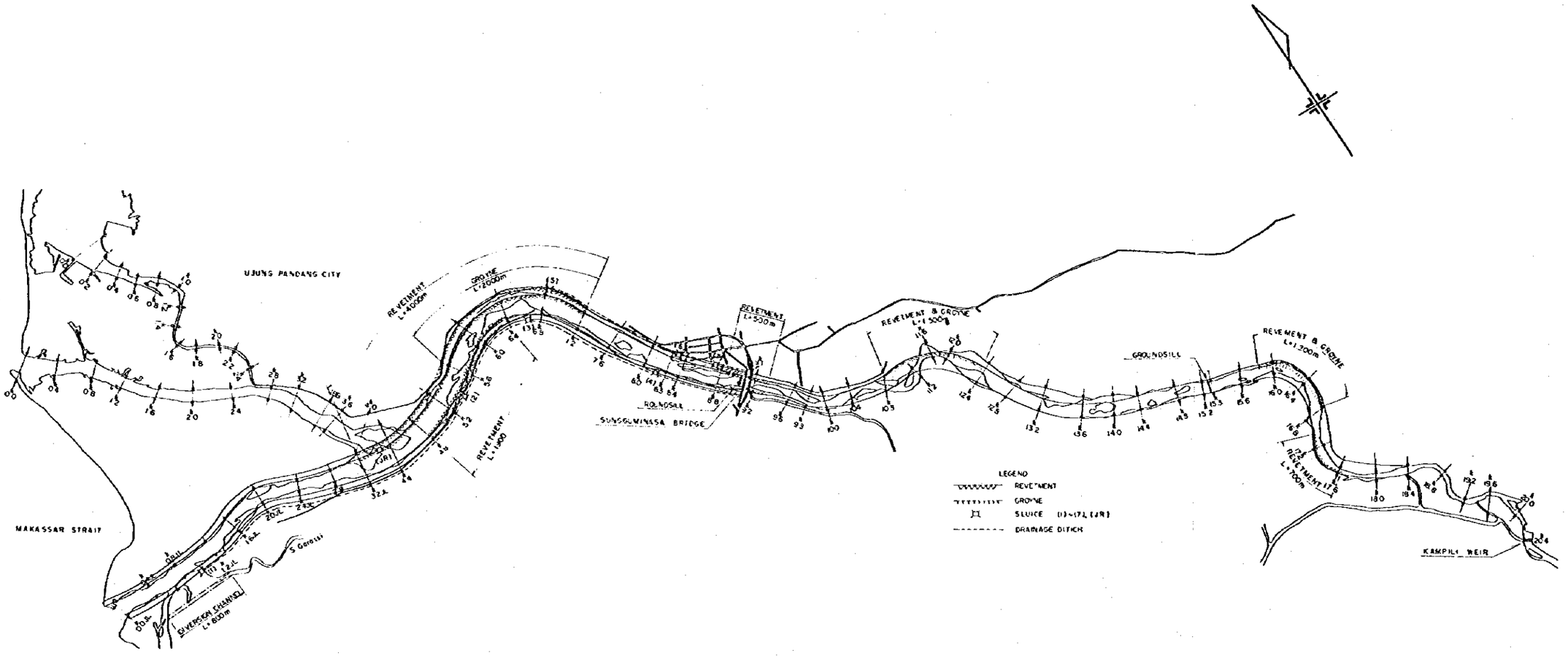


Fig. 4-12

PROPOSED ALIGMENT OF
THE JENEBERANG RIVER

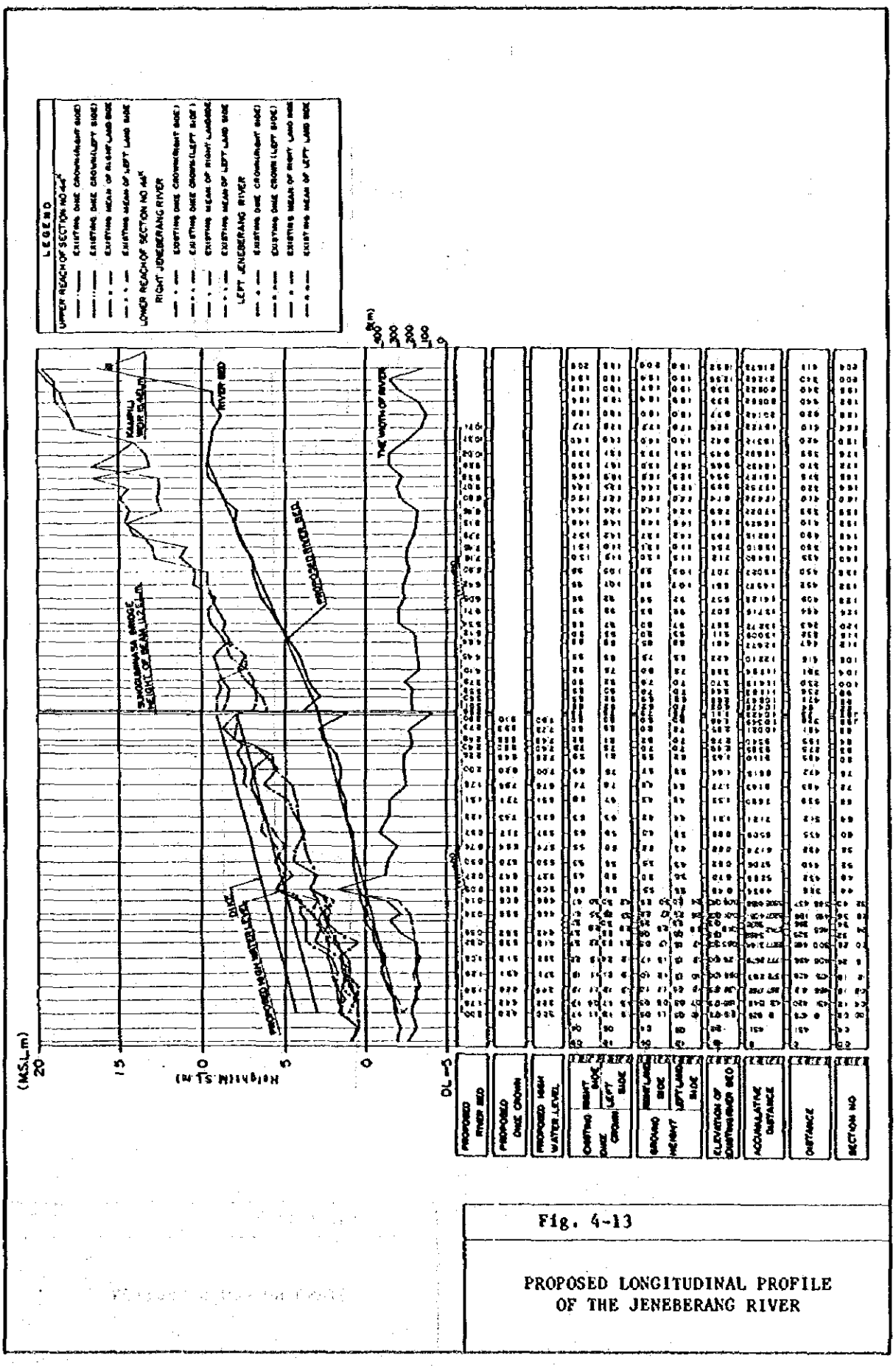


Fig. 4-13

PROPOSED LONGITUDINAL PROFILE
OF THE JENEBERANG RIVER

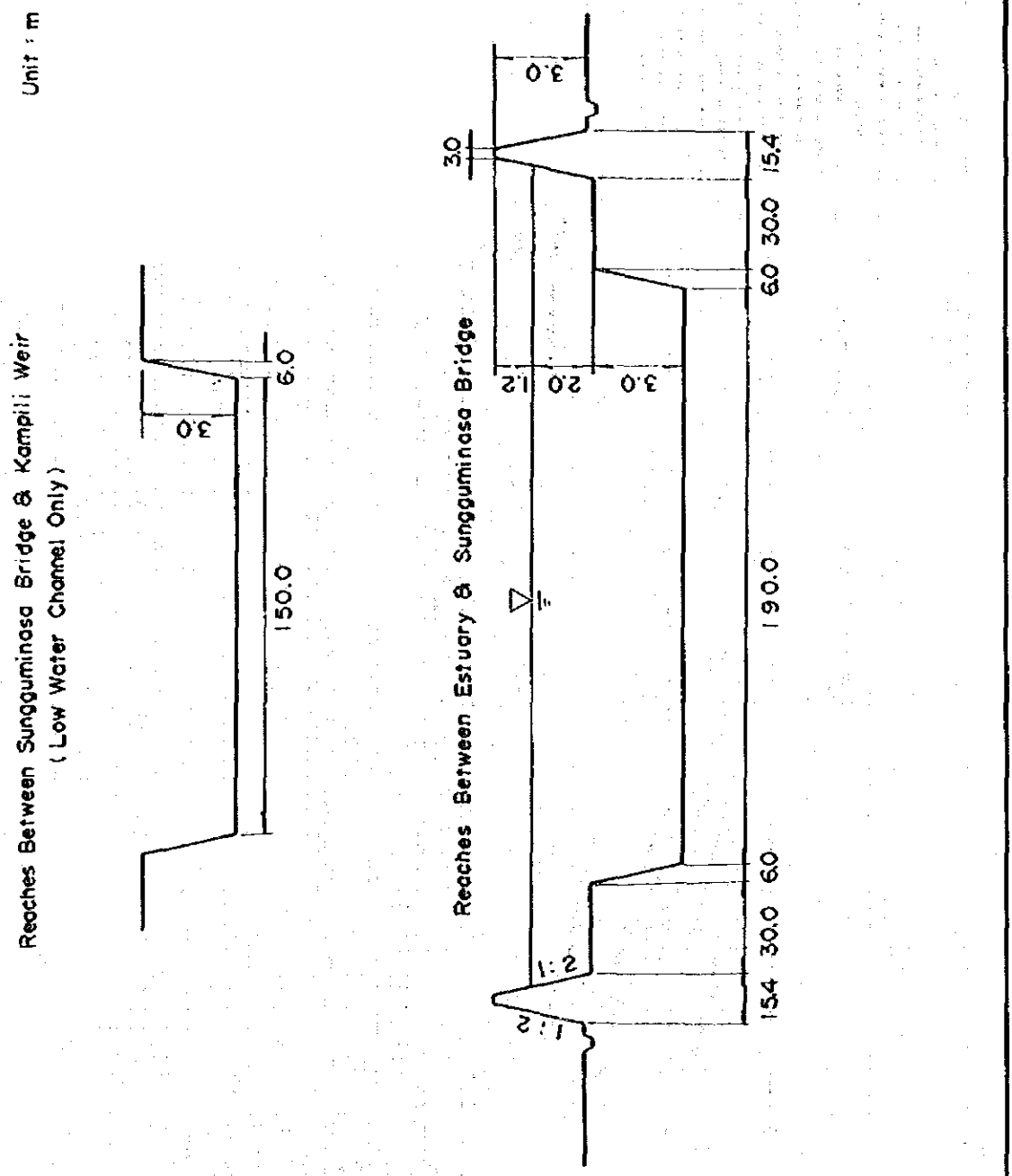
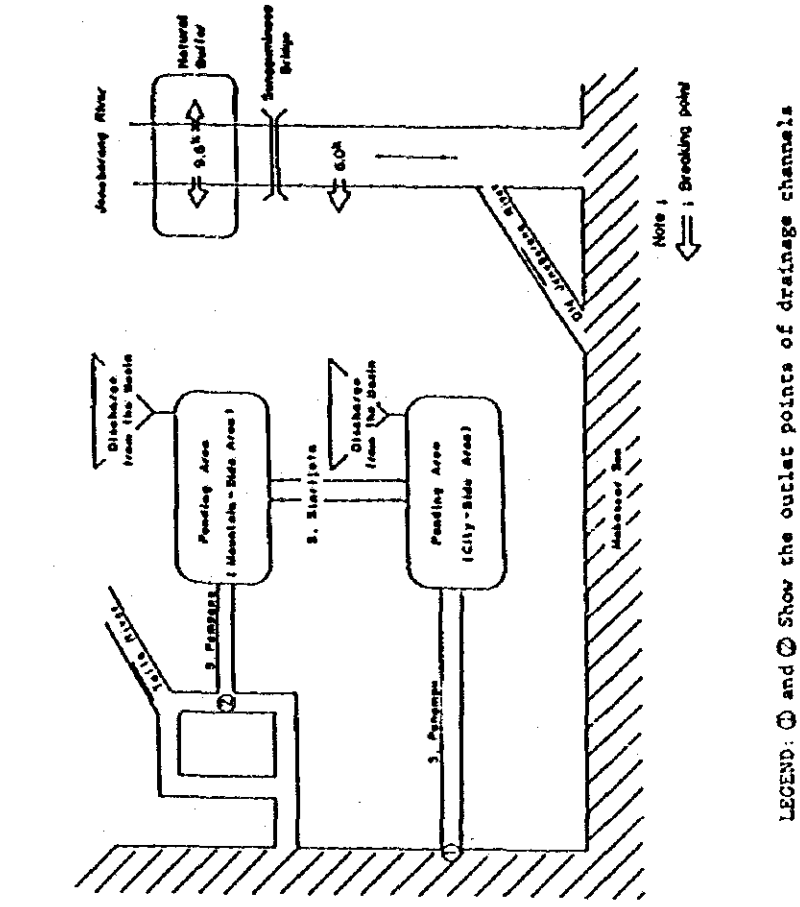


Fig. 4-14

STANDARD CROSS-SECTION



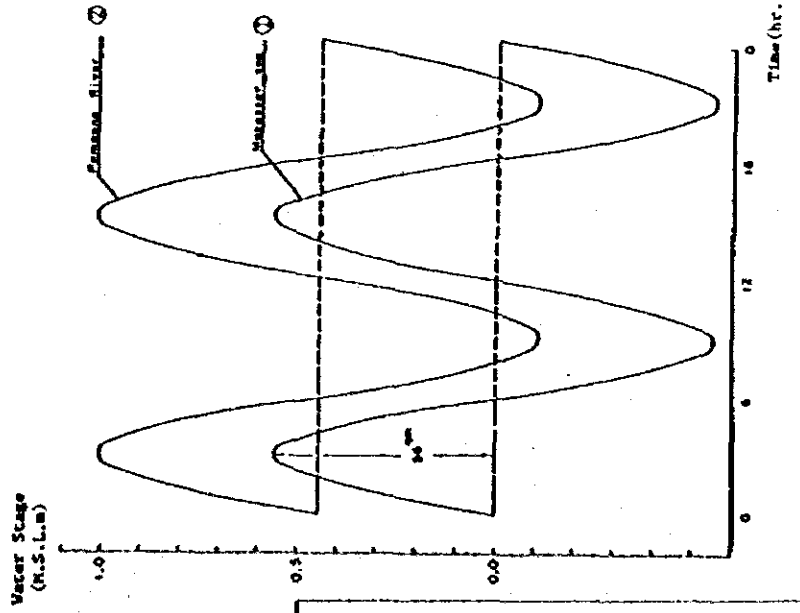


Fig. 4-15

CALCULATION MODEL AND
OUTLET WATER STAGE
(PRESENT SITUATION)

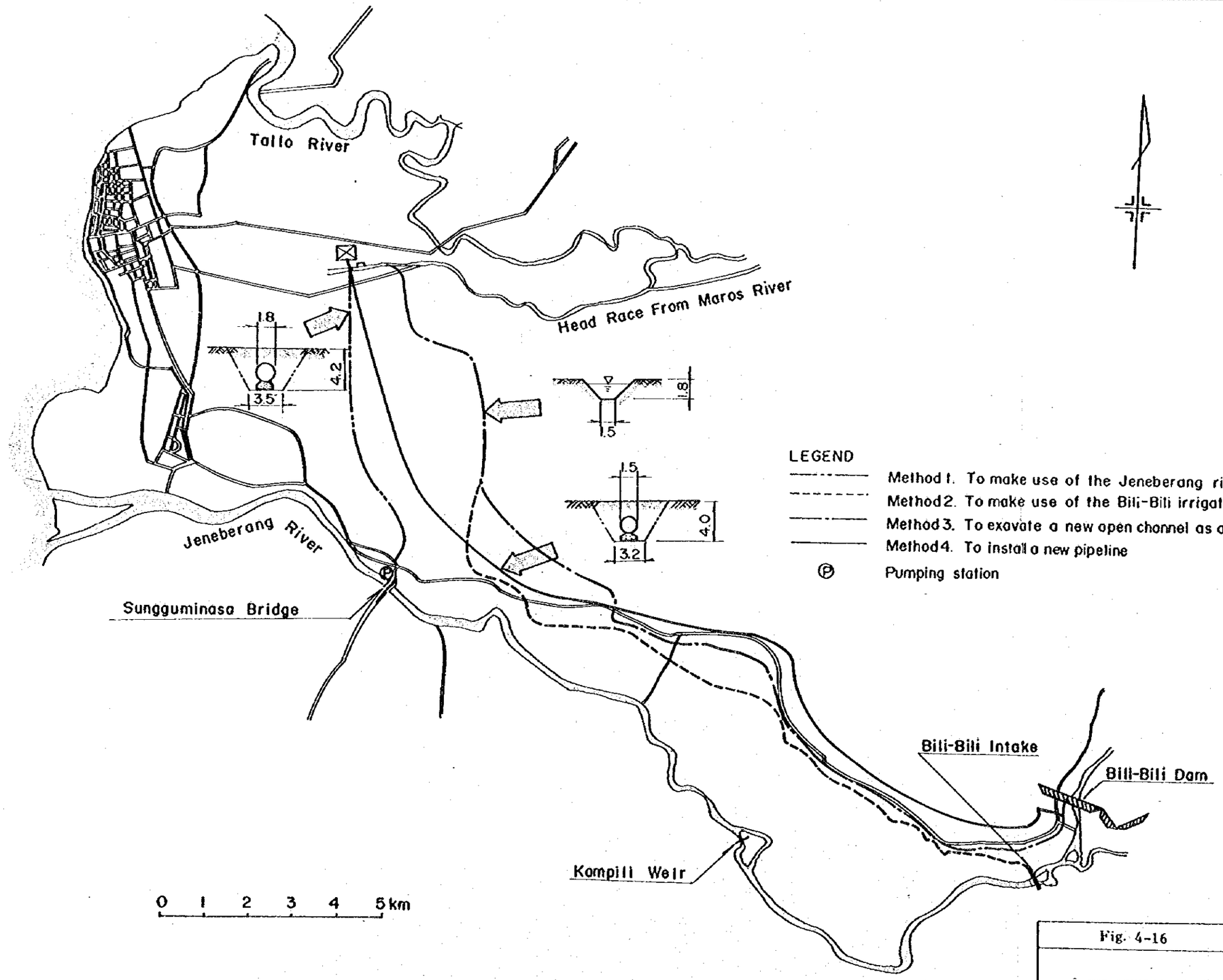


Fig. 4-16

THE MUNICIPAL AND INDUSTRIAL WATER HEADRACE ROUTE

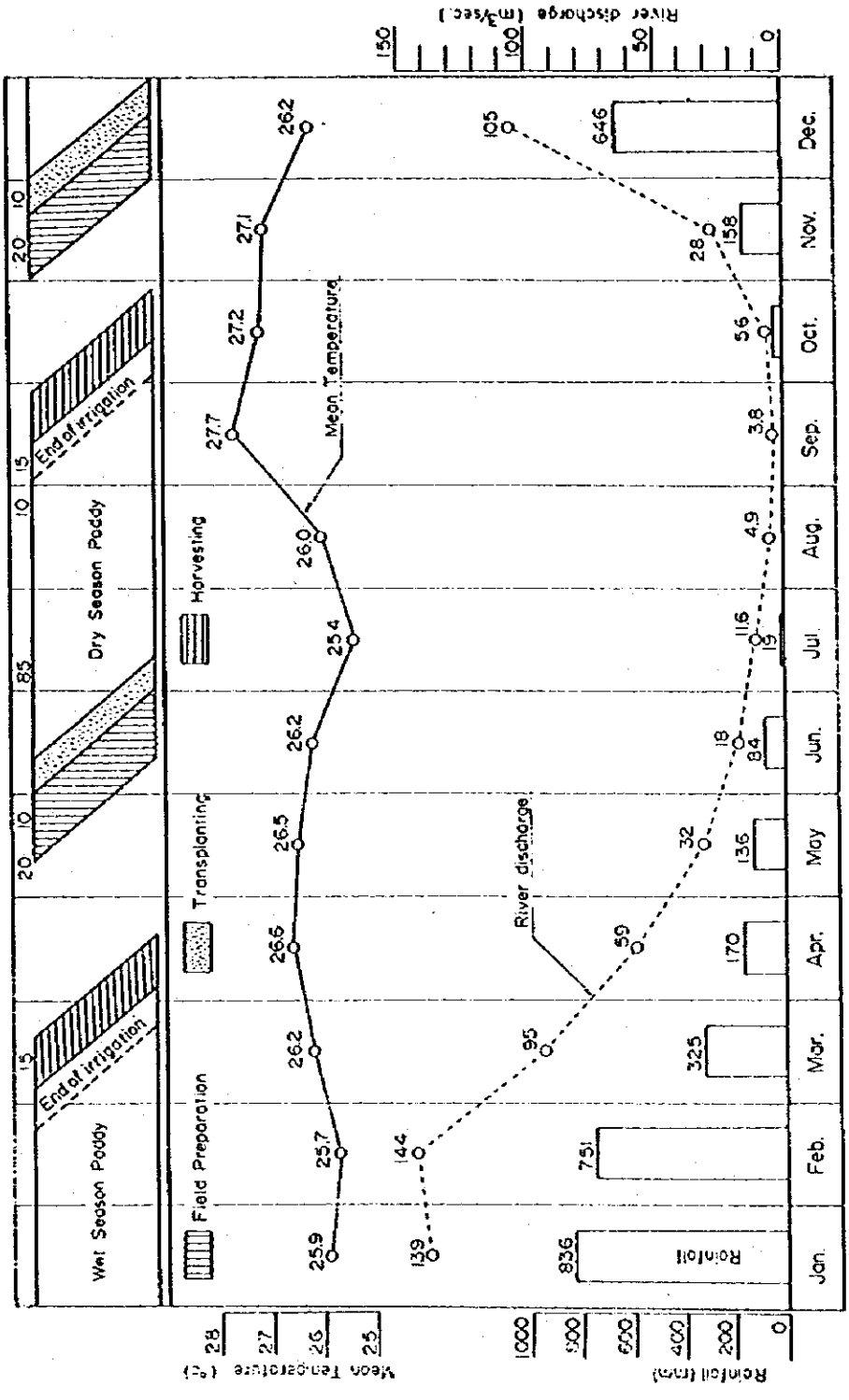


Fig. 4-17

PROPOSED CROPPING PATTERN

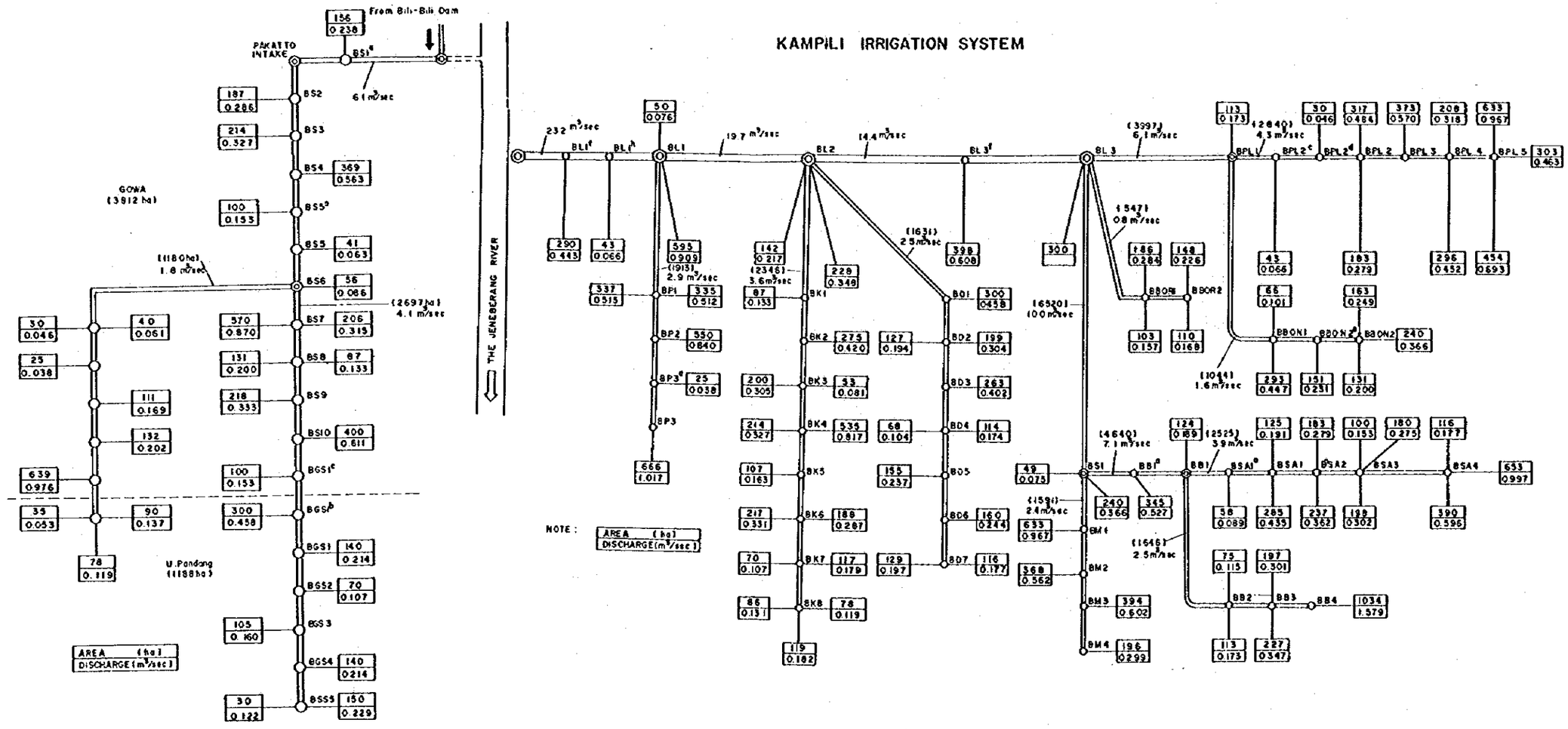


Fig. 4-18

DIAGRAM OF DISTRIBUTION SYSTEM
(BILI-BILI AND KAMPILI)

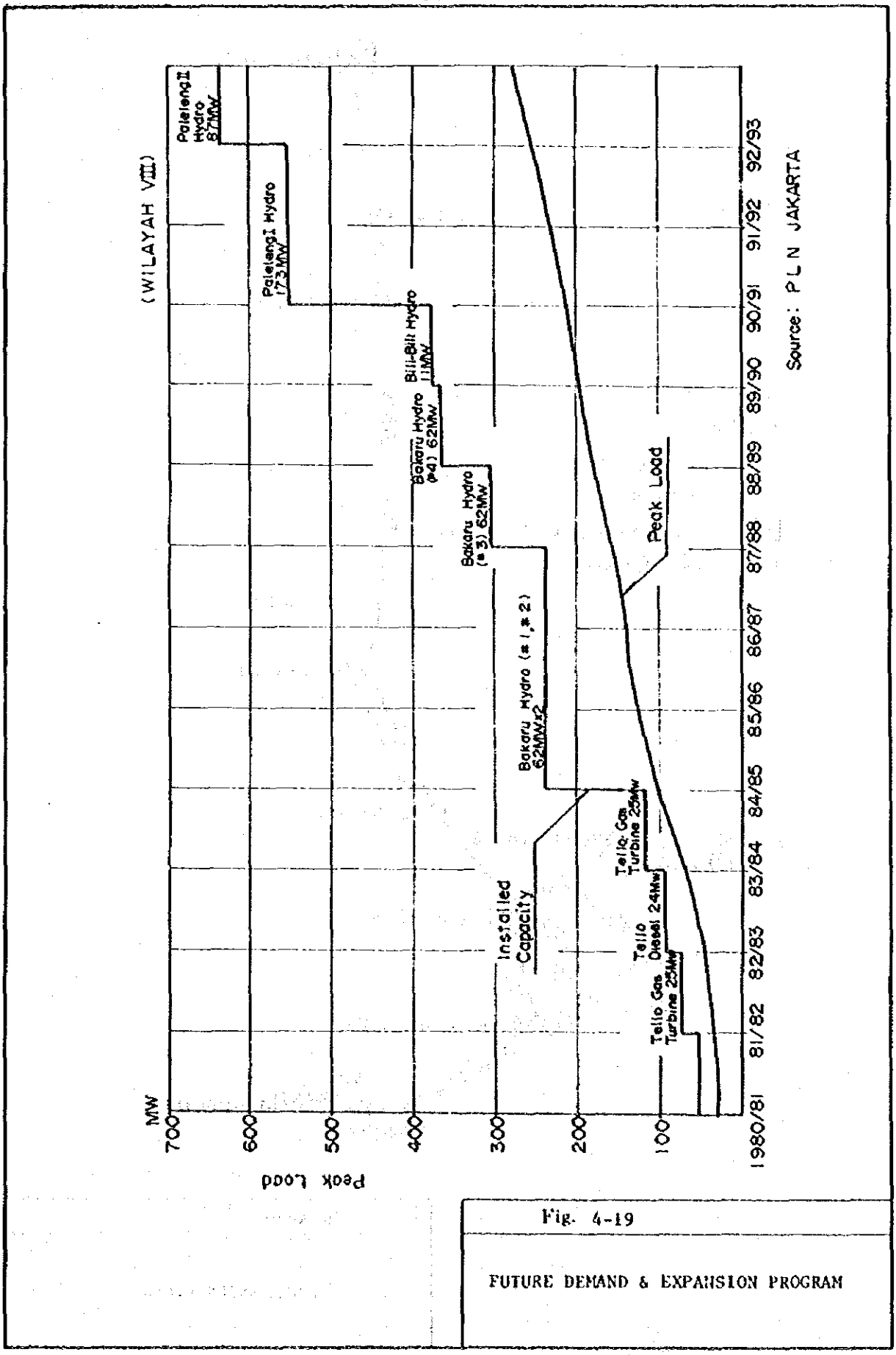


Fig. 4-19

FUTURE DEMAND & EXPANSION PROGRAM

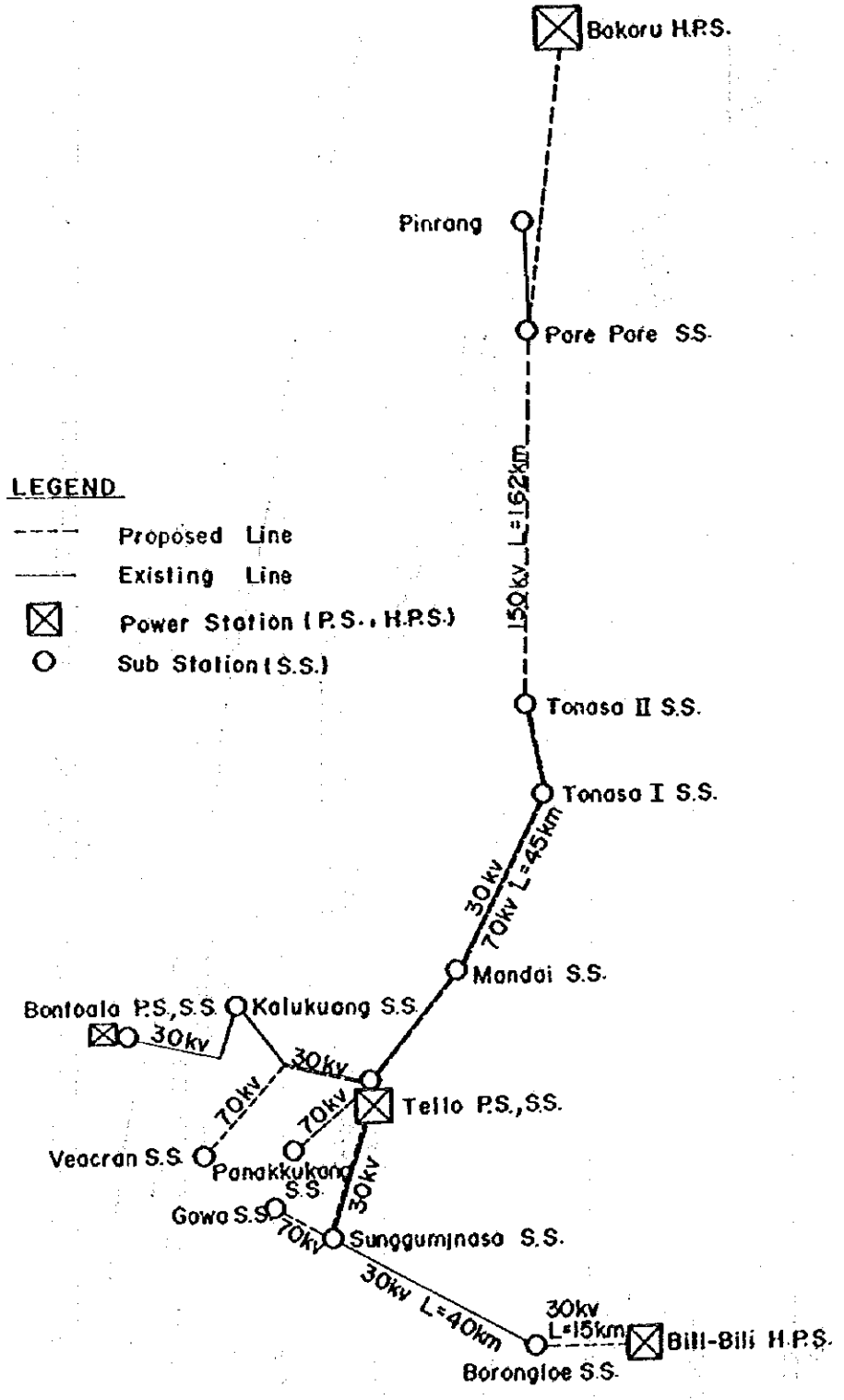


Fig. 4-20

TRANSMISSION LINES

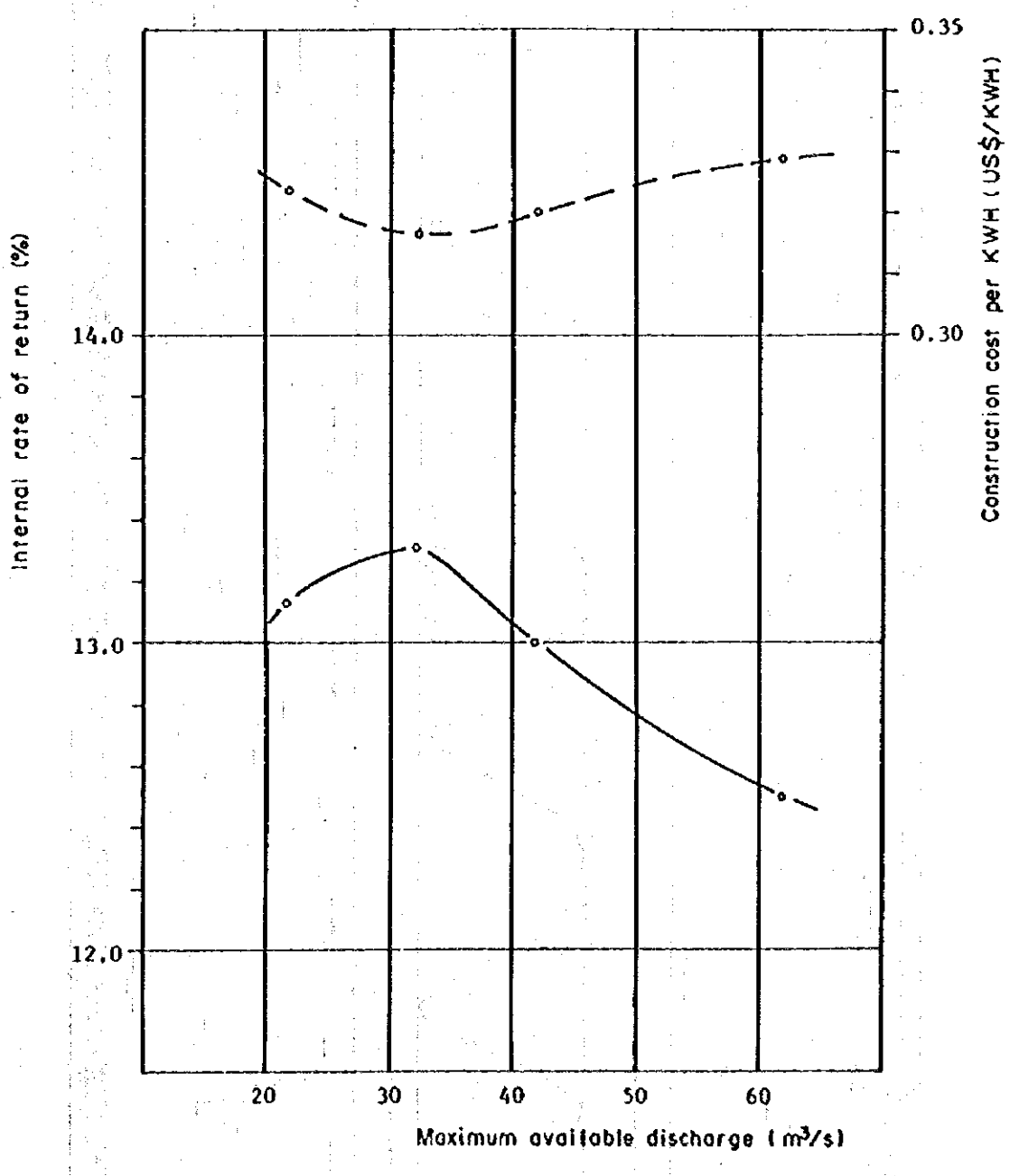


Fig. 4-21

RELATION BETWEEN IRR AND MAXIMUM AVAILABLE DISCHARGE

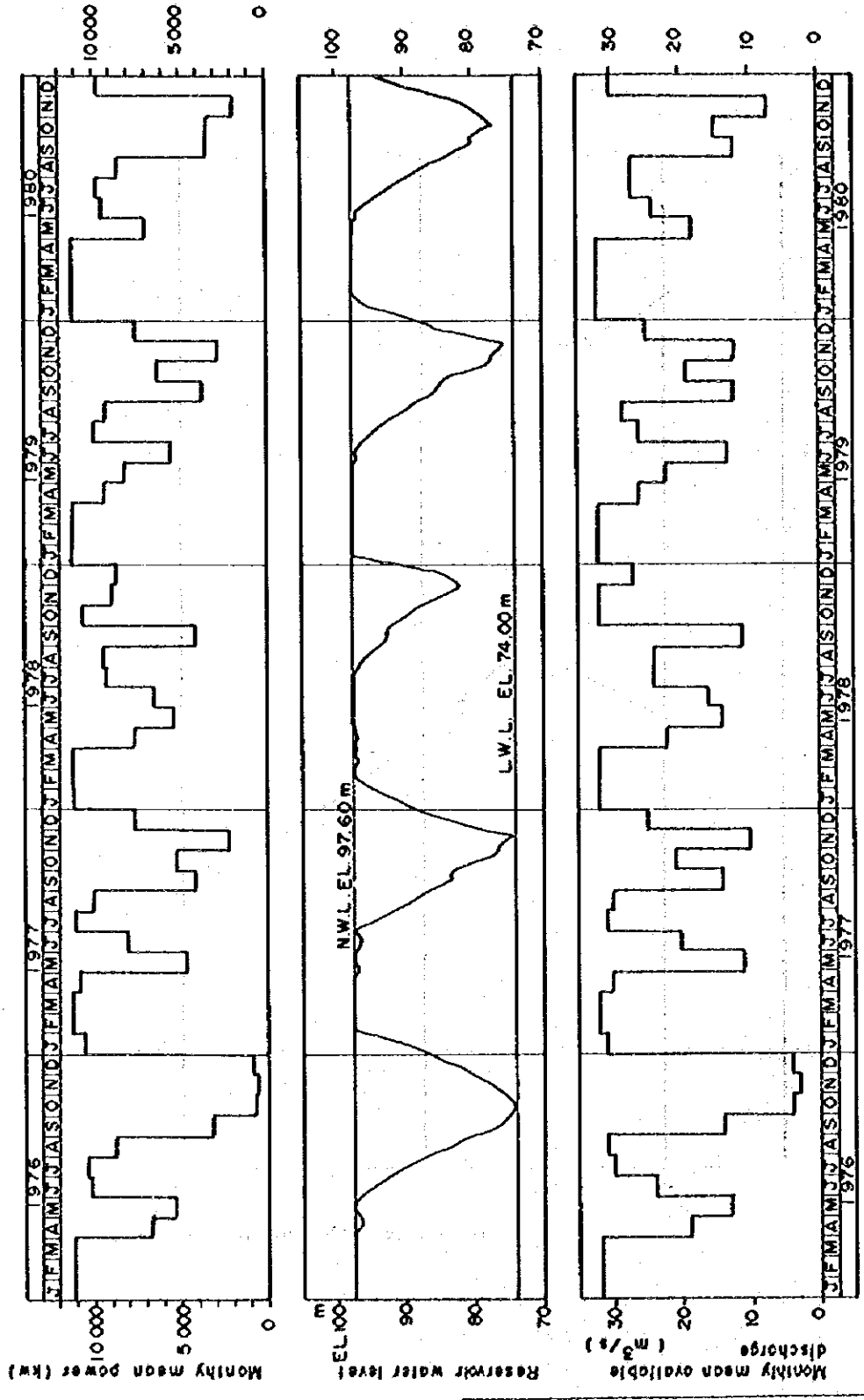


Fig. 4-22

OPERATION DIAGRAM OF HYDRO POWER