REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

LOWER JENEBERANG RIVER FLOOD CONTROL PROJECT

MAIN REPORT

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OCTOBER 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of the Government of Indonesia, the Japanese Government decided to conduct a feasibility study on the Lower Jeneberang River Flood Control Project and entrusted the Japan International Cooperation Agency (J.I.C.A.) with the survey. The J.I.C.A. sent to Ujung Pandang City a survey team headed by Mr. Katsuhisa Abe from June 11 to October 30, 1979.

The team had close consultations with the officials concerned of the Government of Indonesia and conducted a field survey in the Jeneberang river basin including Ujung Pandang City from June 11 to October 30, 1979. After the team returned to Japan, further studies were made and the present report has been prepared.

I sincerely hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Indonesia for their close cooperation extended to the team.

October, 1980

Keisuke Arita
President
Japan International Cooperation Agency

S U M M A R Y

1. Introduction

This report presents the results of the feasibility study on the Lower Jeneberang River Flood Control Project.

2. History

Ujung Pandang city has always suffered from flood damge due to a poor drainage system and to the insufficient flow capacity of the Jeneberang river. Under this situation, the Government of the Republic of Indonesia requested the Government of Japan to formulate a flood control and drainage improvement project.

In response to the request, Japan International Cooperation Agency (JICA) dispatched a preliminary survey team to Indonesia in February 1979. The preliminary survey team has certified the necessity of flood control for the area.

3. Scope of Study

The scope of this study is as follows:

a. Formulation of an overall flood control and drainage improvement plan including the possibility of providing reservoirs

b. Formulation of an urgent flood control and drainage improvement plan

c. Preliminary design of urgent flood control and drainage improvement facilities.

4. Socio-economic Background

During a period of the Second Five-Year Development Plan (Pelita II) which commenced in the 1974/75 fiscal year, the average annual growth rate reached to about 6.9%.

The Third Five-Year Development Plan (Pelita III) was formulated in the 1979/80 fiscal year. The annual increased rate of GDP is expected to reach 6.5%. Per capita GDP is estimted to increase by about 24% during five years of the Pelita III.

In accordance with this policy, various development plans are proposed in Ujung Pandang city in order to establish a development center for the eastern Indonesia. The population of Ujung Pandang city which covers most part of the project area is estimated at 604,438 at the present time. According to the statistics, job seekers in South Sulawesi Province amount to 3% approximately. Those who work for 35 hours or less in a week account for about 45%.

5. Project Area

In the project area lie two rivers; namely, Jeneberang and Tallo. The Jeneberang river sometimes inflicts flood damage on the project area. The Tallo river has an insufficient flow capacity due to tidal backwater, though it serves as a drainage river. The drainage system consists of two drainage channels, neither of which have sufficient drainage capacity during a flood.

Under this situation, a regional development plan is now going on in the project area under the national policy. This development plan is divided into three stages, the first and second stages of which are to be completed in 1985 and 2000 respectively.

Climate conditions in the project area are dominated by the tropical monsoons. The annual mean rainfall is estimated at 4,000 mm and 2,800 mm in the mountainous area and low-lying land respectively. The climate is divided into two pronounced seasons; a rainy season and a dry season.

Jeneberang River

The Jeneberang river with a catchment area of 727 km^2 flows in the hilly land down to the Kampili weir and goes down in the low-lying land without a heavy meandering and pours into the Makassar Strait. The river-bed gradient is 1/1400 and 1/2100 in the upper and lower reaches of the Sungguminasa bridge respectively.

The river has partially dikes on the both sides. The bankful flow capacities in the upper and lower reaches of the Sungguminasa bridge are estimated at 600 m^3/s and 1,000 m^3/s respectively.

River-bed materials consist of gravels at Bili-Bili and Kampili and of fine sand at Sungguminasa.

The river provides 31,000 ha of agricultural land with irrigation water. However, it can irrigate only 3,500 ha of paddy field during the dry season.

During the flood in 1967, the right bank collapsed at 9.5 K (above the Sungguminasa bridge) and at 3.0 K. Overtopped water flowed into Ujung Pandang city and inflicted flood damage on the city.

Tallo River

The Tallo river, so-called tidal river, has a mean gradient of 1/10,000 at its lower reaches and its catchment area is 417.3 km^2. The tidal compartment extends more than 10 km from the estuary. The Tallo river, meandering down to the Makassar Strait, has partially low dikes, 0.5 m -1.0 m in height. The flow capacity of the river is so small as 50 m^3/s and 150 m^3/s in the upper and lower reaches of the Tallo bridge respectively.

Inner Basin

The water-shed boundary is the Jeneberang river in the south, the Tallo river in the north and Ujung Pandang old urban area in the west.

The inundation area is divided by the Panakkukang street into a city-side area and a mountain-side area. The lowest land elevations of the city-side area and the mountain-side area are about 1.5 m and 0.3 m above M.S.L. respectively.

The present drainage system in the area consists of the Pampang river, the Panampu and Sinrijala channels, and two sluices along the Jeneberang river. All of those channels have insufficient flow capacities to mitigate the flood damage.

The biggest observed inundation, which corresponds to 8-year return period, occured in January of 1976. The area was ponded for three days at the average inundation depth of 60 cm, or about 1.0 m at maximum. The inundation area is estimated at 35 km2 and the inundation damage at 450 million Rupiah.

6. The Project

6.1 Overall Flood Control

An overall flood control system consisting of flood control of the Jeneberang river and of improving the drainage system was formulated in sphere of the preliminaly stage. The flood control of the Jeneberang river comprises river improvement and dam construction plans.

Even after completion of the urgent flood control project, Ujung Pandang city is still vulnerable to flood damage. In the overall flood control, Jeneberang flood control should be implemented prior to drainage improvement. The drainage improvement should be conducted in accordance with regional development.

Jeneberang River Flood Control

The flood discharge of a 50-year return period, 3,700m^3/s, is employed as the design flood to the overall flood control of the Jeneberang river.

A discharge of 1,200 m^3/s out of 3,700 m^3/s is regulated by the Bili-Bili impounding reservoir and the rest, 2,500 m^3/s is confined in the river channel.

1) River Improvement

The proposed stretch to be improved in this plan extends approximately 20 km from the estuary to the Kampili weir.

The proposed longitudinal profiles are 1/1,270 in the upper reaches of the Sungguminasa bridge and 1/1,900 in its lower reaches.

Compound cross-section is employed for the plan. The cross-section has a low water channel with a flow capacity of 950 m^3/s, which corresponds to 1.5-year return period.

River widths of the upper and lower reaches of the Sungguminasa bridge are 265 m and 325 m respectively. The Sungguminasa bridge is to be extended in length to accord with the proposed new river width.

Riparian structures such as revetments, groynes and groundsills, are proposed in the plan to assure the stability and safety of the proposed river channel.

2) Dam and Reservoir

The proposed Bili-Bili dam site is located in the middle reaches of the Jeneberang river, about 31 km from the estuary. A rock-fill type with a height of 65 m is employed for the Bili-Bili site.

The reservoir of Bili-Bili has a total storage capacity of 320 x 10^6 m^3 and a total effective storage capacity of 262 x 10^6 m^3.

A capacity of 24 x 10^6 m^3 will be allotted for flood control. This volume will regulate 1,200 m^3/s out of 2,750 m^3/s at the dam site. The remaining capacity, 238 x 10^6 m^3, can be used for water utilization purposes.

By using the storage capacity of 238 x 10^6 m^3, it is possible to utilize a discharge of 21 m^3/s at Kampili site. The estimated power to be generated will be approximately 75,000 MWH per annum. A power station will be equipped with two generators with an output of 11,000 KW each.

A regulation pondage equipped with two gates will be constructed at 4 km down to the proposed Bili-Bili dam site to regulate the water volume.

<u>Drainage System Improvement</u>

The system without mechanical drainage cannot be applied to the overall plan, because the minimum elevation of the inundation area is lower than the outlet water stage of the channel.

The optimum pumping capacity is 30 m^3/s in the second development stage and 40 m^3/s in the third development stage. After the installation of a pumping station with the optimum pumping capacity, it is still unavoidable that many effects will be submerged during a flood.

The drainage channels are designed to meet the pumping capacity. The proposed drainage channels have a width ranging from 6 m to 20 m.

The structure of the proposed station can accommodate 8 pumps with a capacity of 5 m^3/s each. For the second development stage, 6 pumps will be installed.

The gates will be installed at Pannara and the Pampang bridge to prevent reverse flow from the Tallo river.

Effectiveness of the Overall Flood Control

The discharge of a 50-year return period flood will be perfectly controlled by the improved Jeneberang river channel and by the proposed reservoir.

Irrigation for 31,000 ha in the rainy season will become stable. The irrigable area in the dry season will increase to 19,000 ha from 3,500 ha, and also 2.5 crops will be possible in a year.

By using the discharge of irrigation water, the power that could be generated is estimated to be 22,000 KW and its generation is 75,000 MWH per annum.

The drainage system proposed in the overall plan will be effective as the project area is developed.

6.2 Urgent Flood Control

It takes a long time and costs a lot to realize the overall flood control. A flood control system is urgently needed for the project area. Based on the overall flood control, an urgent flood control plan has been formulated to mitigate the flood damage. The plan is composed of the Jeneberang river improvement and of drainage system improvement.

Jeneberang River Improvement

The design flood is 2,500 m^3/s at Kampili weir which corresponds to 10-year return period.

The natural buffer having a regulation capacity of $13x10^6$ m^3 is located in the upper reaches of the Sungguminasa bridge. The design discharge of 2,500 m^3/s will be regulated to 2,100 m^3/s at the Sungguminasa bridge site.

The proposed stretch extends about 9 km from the Sungguminasa bridge to the estuary. Design high-water stage should not exceed 2 m above the surrounding ground level. The proposed alignment is designed in accordance with the existing course to prevent a social problem derived from house evacuation and land acquisition. The river bed gradient is designed at 1/1,950. Although the river channel may have a sufficient flow capacity by means of raising embankment, only the low-water channel will be prepared to stabilize the channel against the low-water discharge.

Riparian structures such as revetment and groyne are proposed to assure the stability and safety of the proposed river channel.

Drainage System Improvement

From the technical viewpoint, a natural drainage system is employed for the urgent plan, taking into account the topographical condition of the project area.

The Panampu drainage channel will be improved and the Jongaya drainage channel is newly proposed in this project. The Sinrijala drainage channel is only shaped to provide an usual drainage.

The proposed Panampu channel with a drainage capacity of 30 m^3/s in a maximum is 4.9 km in length and 15.5 m in width. The proposed Jongaya drainage channel, having a drainage capacity of 30 m^3/s in maximum is 7.3 km in length and 17.5 m in width. Revetment is prepared in the proposed channels.

Bridges over the Panampu and Sinrijala channels are renewed. The road section which will cross the proposed Jongaya channel will be replaced by new bridges. A sluice gate is installed at 1.0 km of the Sinrijala channel to control the reverse flow from the mountain-side area to the city-side area during a flood.

Effectiveness of the Urgent Flood Control

After the completion of the urgent flood control, the Jeneberang river water will not flow into the project area in the flood below a 10-year return period and the rainfall in the inundation area will be immediately drained through the proposed channels. As a result, the inundation water stage in the city-side area lowers to 1.87 m in M.S.L. in the flood of a 5-year return period, and this means that the city-side area will be released from the damage caused by the flood below a 5-year return period.

7. Evaluation for the Urgent Flood Control

The construction work including the design work for the urgent flood control is planned to be carried out during the period from 1981 to 1985. The construction plan is formulated so that the flood control benefit is brought about from 1986 after the completion of the urgent plan.

The economic construction cost amounts to US$ 11.90 million in total.

Fund requirements for the construction amount to US$ 5,272,300 in foreign currency portion and US$ 12,385,000 in domestic currency portion, provided that the construction works are carried out on a contract basis. If the works are implemented on a force account basis, the fund requirements amounts to US$ 7,139,000 in foreign currency portion and US$ 12,385,000 in domestic currency portion.

In the case that all the constraction cost is estimated in local currency (the foreign engineering service is exceptional), the fund requirements amount to US$ 18,502,000 on the contract basis and to US$ 19,967,000 on the force account basis. The engineering service cost of US$ 1,884,000 is included in the above two cases.

The annual cost necessary for operation, maintenance and replacement of the facilities is estimated at US$0.055 million.

The flood control benefit is US$2.02 million per annum. The internal rate of return of the project is 13.2%.

The sensitivity analysis indicates that the project maintains a relatively high internal rate of return of about 12.1% for the case of 10% increase in the construction cost and about 12.2% for the case of the completion of the first stage regional development plan in 1990.

PRINCIPAL FEATURES OF THE PROJECT

I. Project Features

1.1 Overall Flood Control Project

River Improvement

Standard project flood	2,750 m^3/s at the proposed Bili-Bili dam
	3,700 m^3/s at Kampili weir and Sungguminasa bridge
Design flood	2,500 m^3/s at Kampili weir and Sugguminasa bridge
Stretch to be improved	20 km from the estuary to Kampili weir
Sungguminasa bridge	Expanded to 267 m
Groundsill	1 place at 30 m downstream of Sungguminasa bridge
Revetment	11.1 km long
Groyne	86 places, 4.3 km long in total
Sluice	15 places
Land acquisition	70 ha
House evacuation	220 houses

Bili-Bili Dam and Reservoir

Catchment area	384.4 km^2
Surface area	16.5 km^2
Dam height	65 m
Dam volume	8.0 x 10^6 m^3
Type of dam	Rockfill, central core type
Total effective storage capacity	262 x 10^6 m^3
Effective storage capacity for flood control	24 X 10^6 m^3, 1,200 m^3/s peak discharge cut

Effective storage capacity for water utilization	238×10^6 m^3
Utilizable water	21 m^3/s at the Kampili weir
Irrigable area	25,000 ha increase in total
Power station	2 units x 11,000 kW each with vertical shaft Kaplan turbines
Annual energy output	75,000 MWH
Regulation pondage	1.2×10^6 m^3 in regulation capacity
Sabo dam	3 places
Road relocation	15 km
Land acquisition	1,400 ha
House evacuation	550 houses

<u>Drainage System Improvement</u>

Pumping station	6 units x 5 m^3/s of pumping capacity at the second stage, 8 units x 5 m^3/s of capacity at the third stage
Drainage capacity	30 m^3/s at the second stage, 40 m^3/s at the third stage
Drainage channel	4.3 km long along the Pampang river at the second stage, 16.9 km long at the third stage.
Sluice	2 places at Pannara and at the proposed pumping station site
Land acquisition	30 ha in the second and the third stage area
House evacuation	20 houses in the second and the third stage area

1.2 Urgent Flood Control Project

<u>River Improvement</u>

Design flood	2,500 m^3/s at the Kampili weir, 2,100 m^3/s at the Sungguminasa bridge

Stretch to be improved	9 km down-stream of Sungguminasa bridge
Natural buffer	1 place, 13 x 10^6 m^3 of regulation capacity
Revetment	5.7 km long
Groyne	23 places, 1 km long in total
Sluice	3 places
Drainage ditch	2.8 km long
Land acquisition	5 ha
House evacuation	60 houses

Drainage System Improvement

Panampu channel	4.9 km long, 15.5 m wide in maximum, 30 m^3/s in drainage capacity
Jongaya channel	7.3 km long, 17.5 km wide in maximum, 30 m^3/s in drainage capacity
Sinrijala channel	Shaping of the channel, 2.3 km long
Sluice	1 place at Panakkukang road
Bridge	22 places
Land acquisition	15 ha
House evacuation	370 houses

II. Cost and Benefit of Urgent Flood Control Project

Rupiah and Yen are converted to US Dollar at the exchange rates of Rp. 625 = US$ 1 and ¥ 250 = US$ 1.

2.1 Economic Cost

Unit: x 10^3 US$

Item	Foreign Currency	Local Currency	Total
River Improvement	2,757	3,472	6,229
Drainage Improvement	1,606	4,067	5,673
Total	4.363	7,539	11,902

2.2 Fund Requirement

The fund requirements are estimated at the escalation rates of 7% for foreign currency and of 10% for local currency.

a) Estimation on a contract basis in both foreign and local currencies

Unit: $\times 10^3$ US$

Item	Foreign Currency	Local Currency	Total
River Improvement	3,679	5,905	9,584
Drainage Improvement	2,044	6,480	8,524
Total	5,723	12,385	18,108

b) Estimation on a contract basis all in local currency except for engineering services cost

Unit: $\times 10^3$ US$

Item	Foreign Curreny	Local Currency	Total
River Improvement	1,211	8,646	9,857
Drainage Improvement	673	7,972	8,645
Total	1,884	16,618	18,502

c) Estimation on a force account basis in both foreign and local currencies

Unit: $\times 10^3$ US$

Item	Foreign Curreny	Local Currency	Total
River Improvement	4,849	5,906	10,755
Drainage Improvement	2,290	6,479	8,769
Total	7,139	12,385	19,524

d) Estimation on a force account basis all in local currency except for engineering services cost

Unit: $\times 10^3$ US$

Item	Foreign Currency	Local Currency	Total
River Improvement	1,211	9,841	11,052
Drainage Improvement	673	8,242	8,915
Total	1,884	18,083	19,967

2.3 Benefit

Annual flood control benefit	US$2.02 million
Internal rate of return	13.2%

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GLOSSARY OF TERMS AND ABBREVIATIONS

1) Local Administrative Organizations
   Kab. = Kabupten = Regency
   Kec. = Kecamatan = Township
   Desa = Village

2) Other Local Terms
   Pelita I = First Five-Year Development Plan
   Pelita II = Second Five-Year Development Plan
   Pelita III = Third Five-Year Development Plan
   Sungai = River
   S. = Saluran = Channel
   Jl. = Jalan = Street

3) Length
   m = meter
   cm = centimeter
   km = kilometer
   K = kilometer point

4) Area, Volume and Weight
   m^2 = square meter
   ha = hectare = 10^4 m^2
   km^2 = square kilometer = 10^6 m^2
   ℓ = liter = 1,000 cm^3
   m^3 = cubic meter
   cm^2 = square centimeter
   kg = kilogram

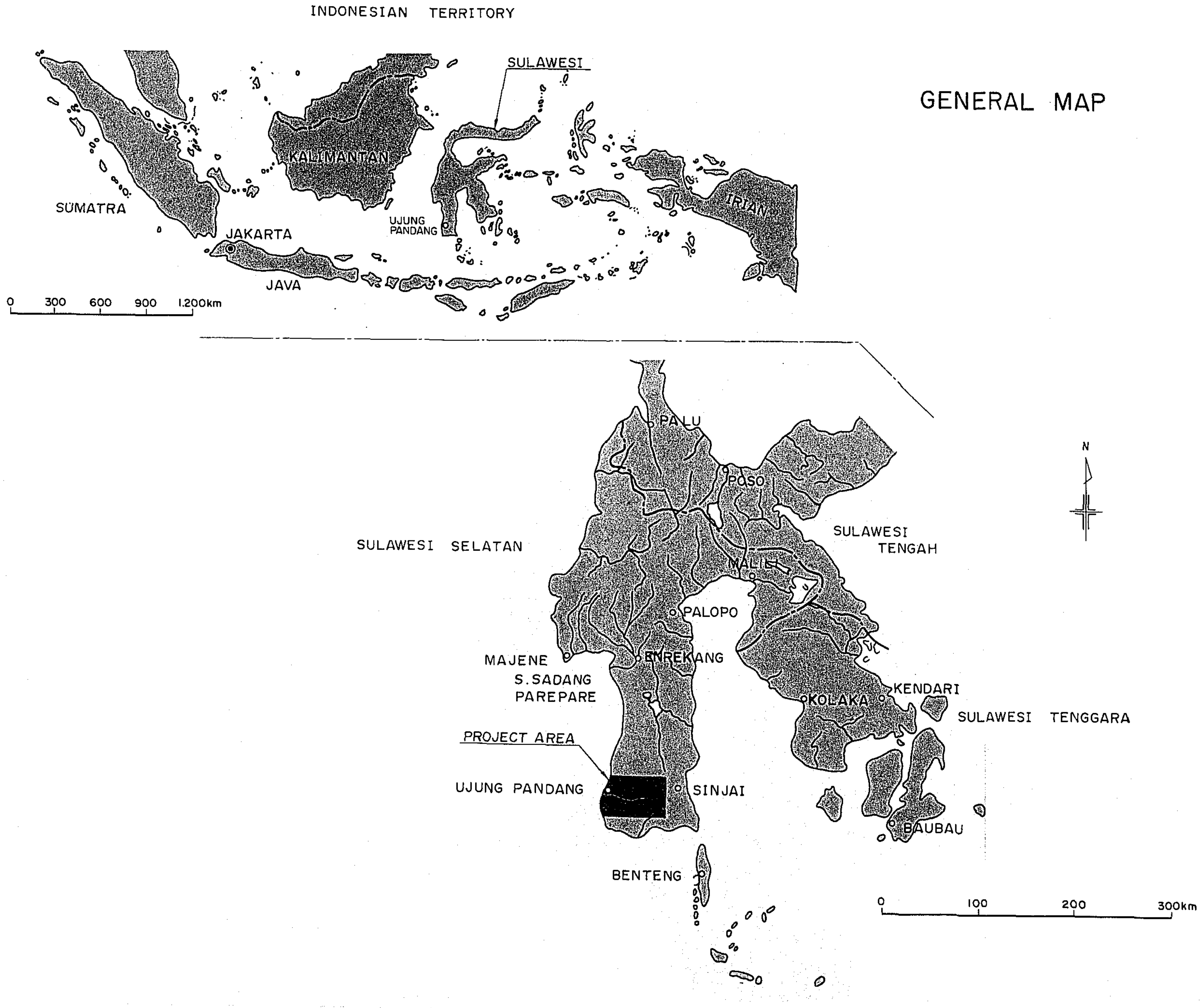
5) Derived Measures based on the Same Symbols
   m^3/s, m^3/sec = cubic meter per second
   t/ha, ton/ha = ton per hectare
   m^3/km^2 = cubic meter per square kilometer
   mm/day = millimeter per day
   $m^3/km^2/year$ = cubic meters per square kilometers per year

6) Electic Measures
   KW = kilowatt
   KWH = kilowatt-hour
   MWH = megawatt-hour

7) Currency
   US$ = United States Dollar
   RP = Indonesian Rupiah
   ¥ = Japanese Yen

8) Temperature, Height, etc.
   °C = degrees in Centigrate
   M.S.L. = above mean sea level
   DL = datum line
   EL. = elevation
   qc = resistance of cone penetration test
   PS = horse power

GENERAL MAP



INDONESIAN TERRITORY
SULAWESI
KALIMANTAN
SUMATRA
JAKARTA
UJUNG PANDANG
JAVA
IRIAN
0 300 600 900 1.200km
PALU
POSO
SULAWESI TENGAH
SULAWESI SELATAN
MALILI
PALOPO
MAJENE
ENREKANG
S.SADANG
PAREPARE
KOLAKA
KENDARI
SULAWESI TENGGARA
PROJECT AREA
UJUNG PANDANG
SINJAI
BAUBAU
BENTENG
N
0 100 200 300km

CHAPTER I INTRODUCTION

1.1 Project History

Ujung Pandang city has always suffered from flood damage due in part to a poor drainage system and in part to the insufficient flow capacity of the Jeneberang river. Regional development plans together with a drainage system improvement plan have been prepared under the guidance of the local government. However, the proposed drainage system improvement plan still leaves room for further improvement to reduce flood damage in the area.

Under this situation, International Engineering Consultants Association conducted a project identification. Based on its findings, the Government of the Republic of Indonesia requested the Government of Japan to formulate a flood control and drainage improvement project.

In response to the request, Japan International Cooperation Agency (JICA) dispatched a preliminary survey team to Indonesia for 18 days from February 22, 1979. They have certified the necessity of flood control for the area.

1.2 Scope of the Study

The scope of the study which was agreed upon by and between the Government of the Republic of Indonesia and the Government of Japan is as follows:

- Formulation of an overall flood control and drainage improvement plan including the possibility of providing reservoirs
- Formulation of an urgent flood control and drainage improvement plan
- Preliminary design of urgent flood control and drainage improvement facilities.

The results of the investigation and studies were presented in the report of the following two separate volumes:

1) Main Report

2) Supporting Report ; I. Hydrology, II. Geology, III. Sabo and Soil Conservation, IV. River Improvement, V. Dam and Reservoir, VI. Drainage System Improvement, VII. Construction Planning and VIII. Project Economy

The survey team, headed by Mr. Katsuhisa Abe and consisting of 11 experts recruited from CTI Engineering Co., Ltd., Japan, made investigation through JICA to conduct a feasibility study of the Lower Jeneberang River Flood Control

Project during the period from June to October, 1979. (Refer to Tabel 1-1). On their return, the survey team conducted a further detailed study in Japan during the period from November of 1979 to October of 1980.

CHAPTER II GENERAL BACKGROUND

2.1 Socio-Economic Background

The Republic of Indonesia is located in the tropical zone and has a territory of 2.03 million km^2 and a population of 137 million people.

In the 1960s, the annual growth rate of Gross Domestic Products (GDP) was only about 2%. However, during the period of the First Five-Year Development Plan (Pelita I) starting in the 1970/71 fiscal year, which was aimed at the reestablishment of the national economy, the national economy showed a rapid growth reaching 7% per annum.

During the period of the Second Five-Year Development Plan (Pelita II) which commenced in the 1974/75 fiscal year, the average annual growth rate reached about 6.9%; although agricultural production, emigration, education and sanitation had not been improved to a satisfactory degree.

Following the Pelita II, the Third Five-Year Development Plan (Pelita III) was formulated in the 1979/80 fiscal year for the purpose of 1) improvement of living standard, technology and welfare together with its equalization and 2) formulating a foundation for the subsequent development step. The annual increase rate of GDP is expected to reach 6.5% during this period.

Achievement of the Pelita III requires rapid development of all sectors; e.g., infrastructure, industry, agriculture, mining, energy, and so on. Table 2-1 presents the target composition of national production by economic sector.

The annual rate of increase of the population is estimated at 2.0% in the period of the Pelita III, while that of the Pelita II was about 2.3%. The present population of 137 million is forecast to reach 151 million at the end of the Pelita III. Per capita GDP is estimated to increase by about 24% during the five years of Pelita III.

In accordance with this policy, various development plans are proposed in Ujung Pandang city in order to establish a center for Eastern Indonesia.

2.2 Project Background

Two rivers lie in the project area; namely the Jeneberang and the Tallo having a catchment basin of 727 km^2 and 417 km^2 respectively. The elevation of the project area is extremely low. The lowest elevation is about 0.3 m above M.S.L. The Jeneberang river sometimes inflicts flood damage on the project area. The Pampang river, a tributary of the Tallo river, has an insufficient flow capacity due to a tidal back water though it serves as a drainage river. The drainage system consists of two drainage channels; Panampu and Sinrijala, both of which do not have sufficient drainage capacity during a flood. As a result, the project area suffers from flood damage annually due to a poor drainage system.

The Jeneberang river provides 31,000 ha of agricultural land with irrigation water. The water volume of the Jeneberang decreases so much in a dry season that only 10% of this agricultural land is irrigable.

The river is also utilized as a municipal water supply and industrial water supply to Ujung Pandang city. In the near future, Ujung Pandang city will be developed and enlarged in accordance with "Emergency Programme Assainering Kotamadya Ujung Pandang"/1 and "Regional Development Plan"/2. Accordingly, industrial water and electric power will be seriously in demand.

While the water shortage in a dry season is one problem, flood damage in a rainy season is another.

As the area urbanizes, flood damage will become such a major social problem that flood control and drainage improvement project will be immediately required to protect the human lives and properties in the project area.

/1 : This programme was prepared by BIEC International, Inc. in 1978 for the regional development, which consists of three development stages.

/2 : This plan was prepared by P.T. Timurama in 1975 for the first regional development.

CHAPTER III PROJECT AREA

3.1 Location

Sulawesi Island is administratively divided into four provinces; namely North Sulawesi, Central Sulawesi, South Sulawesi, and Southeast Sulawesi. The project area is located in the South Sulawesi Province and covers the Jeneberang river basin including Ujung Pandang city, the capital city of the South Sulawesi Province. (Refer to Fig. 3-1.)

Administratively speaking, the project area covers a part of Ujung Pandang city and parts of the Kabpaten Gowa and Malos as illustrated in Fig. 3-2.

3.2 Existing Development Plan

Several development plans are now going on in Ujung Pandang city under a national policy in order to meet the population increase and to improve the living environment.

Urban development plans are described in reports; "Regional Development Plan" and "Emergency Programme" prepared by P.T. Timurama and BIEC International Inc. respectively, and these cover 2,442 ha with a population of 114,750.

BIEC's development plan was divided into three stages as shown in Fig. 3-2. The First and Second Stages covering 386.7 ha and 970.2 ha are to be completed in 1985 and 2000 respectively. The Third Stage covers the rest. The Second and Third Stage areas have the land with an elevation of 0.68 m or less, 258 ha in total. This low land is schemed to be reclaimed up to 0.68m.

The development area is zoned into dwelling, public and industrial areas. The population density in the development area is ranked at 50, 75 and 100 persons per ha.

3.3 Population

The population of Ujung Pandang city which covers most of the project area is estimated at 604,438 with a population density of 5,300 persons/km^2 at the present time. Those living in the lowland, less than 2.5 m/1 above M.S.L., amount to about 110,000 persons.

The population at the time of completion of the First Development Stage is forecast to increase to about 700,000 in 1985 and 1,150,000 in 2000, according to the report on "Ujung Pandang Industrial Complex Project".

/1: The area lower than 2.5 m above M.S.L. is vulnerable to flood damage.

According to the statistics, though job seekers in South Sulawesi Province amount to only 3% approximately, those who work for 35 hours or less in a week account for about 45%.

3.4 Natural Resources

3.4.1 Topography

Jeneberang River Basin

The Jeneberang river rises in the Bawakaraeng Mountain, which has an elevation of 2,833 m above M.S.L., and the river flows to the west. Joining many tributaries and changing its directions to the south-west, it joins the Jenelata river at an distance of 30 km from the river mouth. After that, it passes through the southern part of Ujung Pandang city, and flows into the Makassar Strait. The total length of the river is about 75 km and the catchment area is 727 km^2 as shown in Fig. 3-1. The basin gradients in the upper and lower reaches of the Jenelata confluence are calculated to be about 1/65 and 1/800 respectively.

The natural vegetation of the mountainous area is sparse; however, Aran-Aran and a few tall trees do exist. In the top reaches lies a collapse which has produced the sediments to raise the riverbed level of the Jeneberang river. Below Bili-Bili an alluvial fan has developed on the right and left sides. On the right side of these lower reaches lie an urban area and agricultural land which is now under urbanization. On the left side extends fertile agricultural land.

Tallo River Basin

The Tallo river with a catchment area of 417.3 km^2 and a length of 66 km originates in Kallapolompo Mountain having an elevation of 885 m above M.S.L. The river flows through the northern part of Ujung Pandang city and continues into the Makassar Strait. Flood run-off concentrates in the mountainous upper reaches, and subsequently many places in the lower reaches are inundated, resulting in a swampy area.

Some of these areas in the lower reaches of the Tallo river are used for paddy fields and fish ponds.

Inner Basin

The flood affected area is sandwiched between the Jeneberang river and the Tallo river and currently is used mainly for agricultural purposes. The area adjacent to the old urban area of Ujung Pandang city has recently started to be urbanized. Most of the drainage area is located in the low land, 0.3 m above M.S.L. at its lowest. Fig. 3-3 shows the drainage area of 60.5 km^2, which includes Ujung Pandang city.

3.4.2 Climate

Climatic conditions in the project area are dominated by the tropical monsoons. The annual mean rainfall is estimated at 4,000 mm in the mountainous area and 2,800 mm at the low-lying area. The climate is divided into two pronounced seasons; a rainy season with 75% of the annual rainfall, from November to April, and a dry season, from May to October.

The monthly mean temperature is about 26°C, fluctuating slightly throughout the year, and the maximum and minimum daily temperatures are 30°C and 22°C.

The monthly mean relative humidity is about 85% in the rainy season and 70% in the dry season. The annual mean evaporation ranges from 1600 mm to 1800 mm, which is measured by a pan evaporimeter. The rate of sunshine per month is between 40% to 50% in the rainy season and is about 80% in the dry season.

3.4.3 Flood, Run-off and Sediment

Flood

According to the data collected at Kampili station, the first, second and third biggest floods of the Jeneberang river are recorded at 3,350 m^3/s in 1967, 2,120 m^3/s in 1977 and 1,440 m^3/s in 1974. Table 3-1 presents the probable discharge of the Jeneberang river.

The water stage of the Tallo river has been gauged in a tidal compartment since April of 1979. Flood discharge of the Tallo river cannot be clarified due to insufficiency of data.

Run-off

The water stage of the Jeneberang river has been gauged at Kampili and Bili-Bili. According to the data well-arranged in 1978, the annual mean run-off at Bili-Bili, with a catchment area of 384 km^2, is estimated at 30 m^3/s.

Based on the daily rainfall data well-collected at Malino, Bontobili and Sungguminasa, the annual run-off volume and the 355th largest discharge of the year at Bil-Bili and Kampili were estimated by means of the tank model method. The annual run-off volume in the droughtiest year of the decade is estimated at 796 x 10^6 m^3 (in 1976) and 1,099 x 10^6 m^3 (in 1958), and the 355th largest discharge of the year is recorded at 3.3 m^3/s at Bili-Bili in 1976 and 5.6 m^3/s at Kampili in 1958.

Sediment

Sediments are produced by collapse and terrace scarp erosion in the Lompobatang volcanic products distribution area located in the upper reaches of the Jeneberang and also by bank erosion in the middle reaches.

Sediments produced in the upper reaches in the past were deposited in the midddle reaches. This deposit and further sediment from the upper reaches were then transported to the lower reaches. At present there still remains a sediment deposit in the middle reaches, but serious sediment production in the upper reaches is not observed nowadays.

Sediments yield in the river basin is estimated at 1,500 $m^3/km^2/yr$ from the scale of collapse, which corresponds to that calculated from the volume of sediments deposited in the estuary and sea-bed in the past 78 years. Fig. 3-4 illustrates sediment deposition in the estuary.

3.4.4 Tidal Stage

The tidal stage in the Makassar Strait is recorded at the Makassar port gauging station. Based on the records well-arranged in 1976, 1977, and 1978, mean high and low water springs are calculated and a model tidal hydrograph is given in Fig. 3-5.

3.4.5 Geology and Soil Mechanics

Geology in the project area is classified into four groups: 1) Neogene Tertiary sedimentary rocks, 2) Dikes of Neogene Tertiary, 3) Lompobatang volcanic products of Quarternary and 4) alluvial deposites. These are shown in Fig. 3-6.

Neogene Tertiary sedimentary rocks distributed in the middle reaches consist mainly of relatively hard massive volcanic breccia and tuff. Soft siltstone and sandstone are intercalated therein.

Dikes intruding the Neogene Tertiary sedimentary rock exist in a width of several hundred meters and a length of several kilometers. The dikes consist of hard diabase and microdiorite and have a lot of cracks.

Lompobatang volcanic products distributed in the upper reaches consist of andesite lavas, tuff breccias and mud flows.

Alluvial deposites are distributed in the riverbed and in the plain lying in the lower reaches. In the river bed these deposites consist of sand and gravels, and in the plain area they form unconsolidated strata including sand and clay.

3.5 Present Conditions of Rivers

3.5.1 River Channel

Jeneberang River

The Jeneberang river flows through the hilly land down to the Kampili weir and continues through the flat-lying land without any heavy meandering and ultimately pours into the Makassar Strait. The stretch of 20 km from the estuary to the Kampili weir is presented in Fig. 3-7.

The riverbed gradient of the Jeneberang is 1/1,400 and 1/2,100 in the upper and lower reaches of Sungguminasa bridge respectively.

At present, the Jeneberang river splits at 4.4 K into right and left courses. Judging from the aerophotoes, before 1924 the river used to split into the right course in the north and the old Jeneberang course: the latter is now closed.

Embankment along the Jeneberang river, commenced in 1965, was completed along the stretch from 2.0 K to 9.0 K on the left and from 2.6 K to 10.9 K on the right. However there is no dike in the vicinity of 7.2 K on the left side and also none in the vicinity of 8.0 K on the right side. In addition, the dikes have insufficient safety because of inconsistencies of cross-sections and elevations.

The bankful flow capacities of the Jeneberang in the upper and lower reaches of Sungguminasa bridge are estimated at 600 m^3/s and 1,000 m^3/s respectively. Fig. 3-8 shows the flow capacity of each section along the Jeneberang river.

The section having the lowest flow capacity in the lower reaches of the Sungguminasa bridge is located near 8.0 K, where there is no dike, as shown in Fig. 3-9. However, the road lying 1 m above the ground level in the right side serves as a dike. The discharge that reaches as high as the surface of the road is at an estimated 1,800 m^3/s.

In the upper reaches of Sungguminasa bridge there exist a road on the right hand side and the Kampili irrigation channel on the left hand side, both of which are higher than the existing ground level. The area surrounded by the road and the channel serves as a natural buffer and regulates flood water (refer to Fig. 5-5). The discharge, if over 1,800 m^3/s, will overtop the road and flow into the Bili-Bili irrigation channel on the right hand side.

At present, riverbed materials consist of gravels at Bili-Bili and Kampili and fine sand at Sungguminasa. Judging from the riverbed materials and the present riverbed gradient, a serious sediment discharge has not occurred, though partially sedimented. Fig. 3-10 shows the 50% grain size of riverbed materials at each cross-section.

<u>Tallo River</u>

The Tallo river with a mean gradient of 1/10,000 is a so-called tidal river. The stretch under tidal influence extends more than 10.0 K from the estuary. The Tallo river, meandering down to the Makkasar Strait, is a natural river having no dikes except for the partial compartment near the estuary (refer to Fig. 3-11).

The flow capacity of the Tallo river is as small as 50 m^3/s at 18.0 K and 150 m^3/s at 9.0 K. The cross-sections of 9.0 K and 18.0 K are presented in Fig. 3-9.

3.5.2 Estuary of Jeneberang River

A sand-bar has developed at the Jeneberang estuary due to sediment discharge from the upper reaches. Long before this, a great deal of sediment passed down the old Jeneberang course, which is now closed, and was deposited in the Makkasar port. At present, the Jeneberang flows down through the left course without a serious sediment discharge.

The total sediment yield since 1900 is estimated at 60,000,000 m^3. This figure is arrived at by the difference between the results of the newly conducted survey and the chart prepared by the Ministry of Marine of the Netherlands in 1900 (refer to Fig. 3-4).

3.5.3 River Utilization

Jeneberang River

The Jeneberang river water is utilized for irrigation, municipal water, industry and for fish ponds at the estuary. At 3.6 K, people are ferried across the Jeneberang river. Fig. 3-7 shows the existing riparian facilities. Sand collection is briskly conducted in the lower reaches of Sungguminasa bridge mainly during the dry season by the local populace.

Tallo River

The Tallo river water is utilized as cooling water for the thermal power station and for fish ponds at the estuary. The Tallo river, being tidal, has a gentle gradient, and is used for boat transportation.

3.6 Present Conditions of the Drainage System

3.6.1 Inner Basin

The water-shed boundary of the inner basin is as follows; the Jeneberang river in the south, the Tallo river in the north and the Ujung Pandang old urban area in the west. The inner basin is divided by Jl. Panakkukang into a city-side area (15.1 km^2) and a mountain-side area (45.4 km^2).

The minimum land elevation is about 1.5 m in the city-side area and 0.3 m in the mountain-side area. At present, the inner basin suffers from floods almost every year.

3.6.2 Drainage System Conditions

Drainage system in the project area consists of the Pampang river, the Panampu and Sinrijala channels, and two sluices along the Jeneberang river (refer to Fig. 3-3).

The Panampu and Sinrijala serve as drainage channels for the area under urbanization. The Pampang river, a tributary of the Tallo river, is now utilized as a drainage chan nel.

The Panampu channel with a total length of 4 km flows down directly into the Makassar Strait. The Sinrijala channel has a total length of 2.5 km, and this joins the Pampang river and, flows into the Makassar Strait through the Tallo river. The Pampang river has a total length of about 20 km.

The Pampang river, the Panampu and Sinrijala channels have the flow capacity of 15 m^3/s, 4 m^3/s and 4 m^3/s respectively. None of them is satisfactory to mitigate the flood damage.

Two sluices existing on the right bank of the Jeneberang river (2.8 K to 6.5 K) were installed for the purpose of draining the inundation water along the bank of the Jeneberang river. However, the drainage ditches leading to those sluices are not well-maintained.

3.7 Flood Damage

The biggest observed inundation, which corresponds to an 8-year return period flood occured in January of 1976 and this inflicted a great deal of damage on the project area due to the poor drainage system. According to the rainfall data, rainfall lasted for 23 days from January 5 to 27, and the maximum daily rainfall was recorded at 300 mm on January 12. The total rainfall during that period amounted to 984 mm.

The most damaged areas during the flood were the old urban area along the Panampu channel and the city-side area along Jl. Veteran;in these areas the ponding stage reached 2.1 m. The area sandwiched by Jl. Veteran and Jl. Panakkukan was ponded for three days at the average ponding depth of 60 cm, to an maximum of about 1.0 m. A number of houses in the area were submerged to about floor level.

The inundation area in 1976 is estimated at 35 km^2 as shown in Fig. 3-12. The inundation damage is estimated at 450.0 million Rupiah.

An extensive flooding occured in 1967 and inflicted great damage to Ujung Pandang city. The levee breached at locations 3 K and 9.5 K on the right bank of the Jeneberang river. Due to insufficient record the flood damage cannot be estimated.

3.8 Socio-Economy

3.8.1 Land Use

At present, the area with an elevation of 2.5 m or less is 2,951 ha in total. This includes the urban area of about 880 ha, the swampy area of about 140 ha and the agricultural land of about 1,931 ha.

In the area lower than 2.5 m, 325 ha, 559.6 ha and 947.4 ha will be re-urbanized in the First, Second and Third Development Stages respectively. Table 3-2 demonstrates the transition of land use for each stage.

3.8.2 Transportation and Communication

Transportation system in the project area consists of air lines, sea traffic and road traffic. Garuda Indonesian Airways and Merpati Nusantara provide domestic air line services to Jakarta with 41 flights a week, Ambon with 16 flights a week, Surabaya with 35 flights a week and to some 20 other places on a less frequent basis.

Makassar port plays an important role for sea traffic and international trade. The port has three wharves to which 10,000-ton ships can be anchored. The total length of the wharves is 1,770 m and they have a water depth of 7 or 8 m.

Main roads in the project area are Jl. Gowa Jaya leading to Kabupatan Maros and Jl. Gowa Raya leading to Kabupatan Gowa. Both of these roads connect main cities with agricultural land.

The telecommunication system is provided for the main cities by the Ministry of Communication. In Ujung Pandang city, 6,569 telephones have been installed with a diffusion rate of one telephone per 16.6 houses.

3.8.3 Water Demand

Agriculture

The Jeneberang river provides 31,000 ha of agricultural land with irrigation water. Since the existing irrigation system depends on the natural flow of the river, it can irrigate only about 3,500 ha of paddy field during the dry season, and even during a rainy season the intake of water is unsteady.

Electric Power

The total power generation capacity of Ujung Pandang city is approximately 57,500 KW at present. The electric power demand is expected to reach 127 MW and 207 MW in 1985 and 1990 respectively. This is according to the report on Sadang Hydroelectric Power Development by JICA.

Municipal Water

There exist two municipal water supply systems in Ujung Pandang city. The old system supplies water to only 100,000 persons from the Jeneberang river. However, this system does not work in the dry season due to the low water stage of the Jeneberang.

In 1976, an open channel of 26 km in length was constructed to convey water from the Maros river, and this now supplies water to 30% of the population. The remainder still rely upon wells. It is obvious that the municipal water demand will increase as the development plan progresses.

3.8.4 Assets in the Project Area

The value of buildings and household effects in the area with an elevation of 2.5 m or less are estimated at 59,000 million Rupiah.

The present and future value of buildings and household effects in each development stage are summarized in Fig. 3-13.

CHAPTER IV FORMULATION OF OVERALL FLOOD CONTROL

4.1 General

An overall flood control system has been formulated in order to mitigate the flood damage in the project area after completion of the Second and Third Stages of regional development. The overall flood control plan consists of flood control of the Jeneberang river, of improving the drainage system and it also includes improvement to the Pampang river.

The flood control plan of the Jeneberang river is designed on a 50-year return period basis to protect the project area from floods. The methods of flood control are enumerated as follows: 1) impounding reservoir, 2) floodway, 3) river improvement and 4) retarding basin.

For regulation of the flood on a 50-year return period basis, it is topographically extremely difficult to excavate a floodway and to find out an area suitable for a retarding basin in the project area. Therefore, only an impounding reservoir and a river improvement scheme can be employed in the overall flood control plan. The optimum size of the impounding reservoir and of the river improvements is determined from the technical, economic and social viewpoints.

Improvement of the existing drainage system by means of both natural and mechanical drainage was studied from the economic viewpoint to determine the optimum level of the new drainage system.

In the economic viewpoint, it is recommended that a multi-purpose dam be constructed rather than one for the sole-purpose of flood control.

To meet the demand for agricultural water, municipal water and electric power in the lower reaches, the possibility of water resources development by constructing a multi-purpose dam was also studied.

4.2 Design Flood of the Jeneberang River

Flood discharge on a 50-year return period basis was employed for the formulation of an overall flood control plan, in due consideration of the improvement scales to other rivers in Indonesia (refer to "Hydrology" in the supporting report)

Standard project flood at the following places are tabulated below.

- Bili-Bili : 2,750 m^3/s
- Kampili : 3,700 m^3/s
- Sungguminasa : 3,700 m^3/s

Standard project flood of 3,700 m^3/s at Sungguminasa will be shared both by an impounding reservoir and by the improved Jeneberang river channel.

In the study on the optimum scale of the reservoir and of the river improvement, the cost /1 allocated to flood control capacity of a multi-purpose dam was studied for economic justification. The total costs of river improvement and of a dam construction are almost the same at any allocation as illustrated in Fig. 4-1.

On the other hand, to confine 2,500 m^3/s or more in the Jeneberang river, it will be required to evacuate a large number of houses and to acquire a great deal of river reservation area as shown in Fig. 4-2.

As a result, the overall flood control plan is formulated on the following conditions.

- Discharge controlled by Bili-Bili dam: 1,200 m^3/s
- Design discharge for river improvement: 2,500 m^3/s
- River improvement stretch: Estuary to Kampili weir/2

The flood hydrograph and flood distribution are shown in Fig. 4-3 and Fig. 4-4 respectively.

4.3 River Improvement

4.3.1 Design High-Water Level

It is advisable that the design high water level of the river channel is planned to be as low as possible to reduce damage potential. However, a completely-excavated channel requires much excavation and high construction cost. The design high-water level in the target stretch from the estuary to the Kampili weir should be at 2m or less above ground level (refer to Fig. 4-5).

4.3.2 Alignment

A new alignment is proposed in the stretch of 20 km from the estuary to the Kampili weir. Basically the present river course will be used since it has only slight meandering. It is proposed that the river width should be 265 m and 325 m in the upper and lower reaches of the Sungguminasa bridge respectively. At any bends in the river couse, however, the river width will be wider than the above-mentioned standard width in order to be able to accommodate safely the design flood.

/1 : The cost was calculated by the ratio of flood control capacity to the total effective capacity.

/2 : The upper channel of the Kampili weir has such a sufficient flow capacity that there is no need to facilitate river improvement.

Now considering the right and left courses which divert at 4.4 K; the left course, the main channel of the Jeneberang at present, will be improved, while the right one will be closed. Fig. 4-6 shows the proposed alignment.

4.3.3 Longitudinal Profile

The proposed longitudinal gradients in the upper and lower reaches of the Sungguminasa bridge are 1/1,270 and 1/1,900 respectively. The average excavation depth is about 80 cm and 60 cm in the upper and lower reaches of the Sungguminasa bridge respectively. Fig. 4-5 shows the proposed longitudinal profile.

4.3.4 Cross-Section

Compound cross-section is superior to single cross-section, though more costly, in the light of channel stability.

The standard cross-sections shown in Fig. 4-6 can confine 950 m^3/s (that is 1.5-year return period discharge)in the low-water channel and 2,500 m^3/s in the whole cross-sectional area.

4.3.5 Required Earthwork

The required earthwork, consisting of banking and excavating the channel and drainage ditches, is given in Table 4-1.

Since the riverbed materials are not appropriate for embankment, embankment materials will have to be conveyed from a borrow-pit.

Table 4-1 EARTHWORK VOLUME OF RIVER IMPROVEMENT

Unit:m^3

	Upper Reaches of Sungguminasa Bridge	Lower Reaches of Sungguminasa Bridge	Drainage Ditches	Total
Embankment	850,000	480,000	-	1,330,000
Excavation	2,900,000	1,600,000	150,000	4,650,000

It is proposed that the right course of the Jeneberang be used as a spoil bank, but still leaving a drainage ditch. The volume of excavation materials to be put into this right course channel is estimated at 1,200,000 m^3. The balance of the excavation materials (3,450,000 m^3) will be utilized for the reclamation of the lower land of the project area and along the Tallo river.

4.3.6 Riparian Structures

Bank Protection

A dike will be constructed on both banks along the proposed river courses.

It is proposed that the height of the dike be not greater than 3.2 m above the ground level, including a freeboard of 1.2 m. The proposed dikes should have a crest width of 3.0 m; this is so that vehicles can pass along it for river management. The side-slope gradients of river-side and land-side are to be 1:2 to assure the dike stability.

To protect the bank from erosion, revetment will be provided in the high-water and low-water channels in the vicinity of the bridge and at the concave side of the sharpest bends.

Wet masonry will be employed for revetment using cobbles and these can be easily obtained at the project site.

For the areas which will not be revetted, sodding will be provided to protect the slope surface of the bank from heavy rainfall and flow erosion.

Furthermore, a groyne will be provided at the concave side of the sharpest bends, as shown in Fig. 4-6. This will prevent erosion at the foot of the side-slope by accelerating sediment deposit. Wooden pile permeable groyne will be employed in the project.

Groundsill

A lot of sediment will be deposited in the Bili-Bili reservoir after the construction of the Bili-Bili dam. As a result, the proposed river bed might suffer from slightly increased erosion.

To assure the safety of the Sungguminasa bridge, groundsill is proposed to be installed at a point of 30 m downstream from the Sungguminasa bridge, and this will protect its foundation. The location of the groundsill is shown in Fig. 4-6.

Drainage Facilities

The existing sluices are installed at short intervals along certain parts of the dikes and these exert an unfavorable influence upon its stability. Also some of the existing drainage facilities along the Jeneberang river do not fulfill their intended function due to poor maintenance. The existing drainage facilities will therefore be systemized.

Sluices are proposed at intervals of 2 km on an average, and the main drainage ditches will be improved so as to drain the land-side water. Fig. 4-6 also illustrates the location of the proposed main drainage ditches and of the proposed sluices.

Sungguminasa Bridge

The channel near the Sungguminasa bridge has an insufficient cross-sectional area to accommodate the design flood. To increase its flow capacity, the river width will be broadened. The Sungguminasa bridge will be extended in length to cover the proposed new river width.

4.4 *Sabo and Soil Conservation*

4.4.1 General Condition

The concept of soil conservation is to prevent sediment transportation and to prevent the erosion of the riverbed, the collapse, the denuded land and the grassland. In general, afforestation and Sabo facilities are effective for soil conservation.

The field investigation and the aerophotographs of the Jeneberang river basin verified that grassland occupies about 7% of the project area, and that the area of collapse which is now producing sediments is less than 0.03%. A large scale of cliff formed by an ancient depression exists in the Lompobatang caldera wall, but at present it is not producing sediments. The location of the collapse and the cliff are illustrated in Fig. 4-7.

The cliff, consisting of hard rocks, is not anticipated to break down in the near future, though this is possible in the far future. Therefore, it is not considered necessary or economical to take any countermeasures against the cliff.

At present, sediments are produced mainly by the collapse in the upper reaches and by lateral erosion in the terrace and in the fan.

4.4.2 Sabo Dam

Sediment transport can be controlled by Sabo dams to a certain extent. A Sabo dam brings about riverbed rising in its upper reaches, and this has an additional advantage of helping to prevent a new occurrence of collapse.

It is recommended that a group of Sabo dams be installed to control sediment production and to reduce transportation into the project area (refer to Fig. 4-7).

The location of the Sabo dams is justifiable at the following situations: 1) in the lower reaches of an active collapse, 2) in a narrow valley, 3) in a place where it can prevent lateral erosion by sedimentation and 4) in a place to which the necessary construction materials can be conveyed without difficulty.

4.4.3 Soil Conservation

Areas in the grassland of the Jeneberang river basin appears stable and produces relatively little sediment.

Accordingly, a countermeasure is not required urgently from the viewpoint of soil conservation, but it is preferable that afforestation be conducted not only to provide forestry, but also to provide water retention and better natural scenery.

It is observed that trees are growing in the grassland, especially in and around the places where water congregates. Afforestation is realizable by selecting the species suitable for the site and by providing trenches which will increase the water content of the ground.

4.5 Dam and Reservoir

4.5.1 Selection of Dam Site

Three dam sites were nominated from the topographical and geological conditions along the Jeneberang river; namely Bili-Bili (31 km upstream from the estuary), Pasaratowoya (44 km upstream from the estuary) and Jonggoa (53 km upstream from the estuary).

The comparative study of the three dam sites was made from the technical, economic and social viewpoints.

The Bili-Bili dam site is to be employed in the project since it is superior to the other sites in three ways; 1) Effective storage capacity, 2) Effective storage capacity per dam cost and 3) Advantage of location for flood control.

4.5.2 Bili-Bili Dam

Topography and Geology

The Bili-Bili dam site is located in the middle reaches of the Jeneberang, and as shown in Fig. 4-8, it is 31 km from the estuary. Two small hills lie in the dam site, and these reduce the river width to about 200 m.

The dam site consists of Neogene Tertiary impermeable sedimentary rocks and of permeable dykes of Neogene Tertiary. Both of them have sufficient strength for fill dam foundations. The former can be utilized for impermeable materials and the latter for rock materials.

Reservoir

The reservoir of Bili-Bili, if developed to the maximum, will have a water stage of 100.0 m above M.S.L., a surface area of 16.5 km^2, a total storage capacity of 320 x 10^6 m^3 and a total effective storage capacity of 262 x $10^6 m^3$.

A capacity of 24 x $10^6 m^3$ will be allotted for flood control. This volume will regulate 1,200 m^3/s out of 2,750 m^3/s of the standard project flood at the dam site. The remaining capacity can be used for water utilization purposes. Fig. 4-9 shows the relation curve between the elevation and storage capacity.

Dam

A rock fill dam with a central core is suitable for the Bili-Bili site taking into account the topographical conditions of the site and the location of a quarry.

The Bili-Bili dam consists of a main dam linking two hills and also of two wing dams. The main dam will close the Jeneberang river, and the right wing dam will close the saddle through which Jl. Malino passes, while the left one will close the saddle along the water-shed of the Jenelata river (refer to Fig. 4-10).

A spillway will be installed on the hill located between the main dam and the right wing dam. The flood discharge for the dam will be designed at 4,200 m^3/s /1 at the dam site.

To improve the safety against a flood, an emergency spillway /2 will be constructed at the ridge between the main dam and the left wing dam.

Table 4-2 presents the principal features of the Bili-Bili dam.

4.5.3 Water Resources Development

Judging from the expected future water demand in the project area, the storage capacity thus developed can be utilized for irrigation, hydropower and as a municipal water supply.

Irrigation water in the lower reaches is seriously in demand, and furthermore demand for municipal water supply and for electric power will obviously increase. The storage between the normal water level and the low water level will be 238 million m^3, which may be allotted for irrigation, power generation and municipal water.

Irrigation and Municipal Water

It is possible to utilize a discharge of 21 m^3/s at Kampili throughout the year. This is estimated from the annual rainfall of the droughtiest year in the last ten annual recordings (refer to Table 4-3). If this discharge will be used for irrigation, 60% of 31,000 ha agricultural land, about 19,000 ha /3 will be irrigable for an additional 1.5 crop even in the dry season. Irrigation water can also be alloted for municipal water.

/1: This discharge is obtained from increasing the 200-year return period flood of 3,500 m^3/s by 20% in accordance with the design criteria determined by the Japan National Committee on Large Dams.

/2: This is to be installed at a lower elevation than the main crest in order to prevent the overflow caused by gate operation miss or an extraordinary flood.

/3: This is calculated on the assumption that the water requirement in depth is 8 mm/day, and farm waste and conveyance losses are 10% each of the water requirement.

Power Generation

Based on the average annual rainfall during the last decade, the annual energy output is estimated at 75,000 MWH. A power station will be equipped with two vertical shaft Kaplan turbines each having an output of 11,000 KW. The effective head varies from 16.5 m to 40.5 m. The maximum output of the turbine is estimated at 10,100 KW.

A regulation pondage will be required to regulate the daily water volume for irrigation. A fixed weir will be installed 4 km down from the dam to maintain the water volume of 1,200,000 m^3 which is required for water supply. The related hydraulic facilities are located as shown in Fig. 4-8.

4.6 Drainage System Improvement

4.6.1 Possible Drainage System

A drainage scheme usually includes natural drainage, mechanical drainage and use of a regulation pond.

However in this case, it is topographically impossible to provide a space for regulation pond. And even if a regulation pond could be provided, its effectiveness would be doubtful on the grounds that since the area is often subject to five days of continuous heavy rainfall, any regulation pond would at least be partially filled within first two or three days. In other words, the capacity of a regulation pond would be reduced well before the peak run-off occurs.

System that comprise only natural drainage channel is also topographically unavailable in the overall plan, because the minimum elevation of the inundation area is lower than the outlet water stage of the channel. Therefore, a mechanical drainage system can be considered.

4.6.2 Optimum Drainage System

A study was made for two optimum drainage systems, namely one for the area after completion of the second stage development and another for the area after completion of the third stage development.

However neither the second nor the third stages of regional development will be commenced until after completion of the urgent plan.

Therefore, these optimum drainage systems have been determined on the assumption that the drainage facilities proposed in this urgent plan have already been installed and are in operation.

Premise of Study

The study on the optimum drainage system is based on the following premises.

1) Drainage Condition

The inundation area is divided into two parts (the city-side and the mountain-side areas) by Jl. Panakkukang. The calculation model has two inundation areas.

The Sinrijala channel linking these two areas has the function of transporting the inundation water. If the inundation water depth in the inundation area exceeds 2.2 m, the inundation water overflows onto the Panakkukang road.

The drainage system should be designed to drain the inundation water, not the overtopped water from the Jeneberang. The drainage calculation has been based on the assumption that there is no overtopped water from the Jeneberang.

The inundation water would be drained by the Pampang river, and by the Sinrijala, Panampu and Jongaya channels. Fig. 4-11 illustrates the calculation model.

2) Run-off

The suggested development work in the inner basin is expected to change the run-off coefficients in this area.

As stated earlier most floods are caused by 5 days of continuous rainfall. The run-off after the second and third development stages has been estimated by using the rainfall intensity pattern as shown in Fig. 4-12, considering the change of run-off coefficients.

3) Outlet Water Stage

The inundation water is drained into the Makassar Strait and Pampang river. The outlet water stage of each drainage channel is shown in Fig. 4-11. The outlet water stage of the Pampang river cannot be estimated exactly because of insufficient hydraulic data of the Tallo river. Consequently the model tidal hydrograph had to be used to estimate their outlet water stages, and this takes into account the topographical gradient.

4) Pumping Station

The drainage system has been designed for the area under urbanization. As the regional development progresses, the present land elevation in the area is anticipated to vary considerably. In this study, therefore, the optimum pumping capacity has been determined on the assumption that a pumping station will be installed only at the Pampang bridge.

5) Cost Estimation

The cost required for the installation of pumps and for modification of the existing channels as well as the construction of the proposed channels is estimated.

The assumptions for the cost estimate of drainage system improvement are 1) that the side-slope gradient of any open channel is 1:1, and 2) that any excavation of the riverbed is limited to 2.0 m below M.S.L. In calculating the discharge capacity of a channel, it has been assumed that the coefficient of roughness is n = 0.025.

6) Benefit Estimation

The optimum pumping capacities for the second and third development stages were determined on the assumption that the facilities proposed in the urgent plan are already in operation and that second and sthird stages of regional development have been already completed. The optimum scale of the drainage facilities is evaluated from flood damage inflicted on buildings and on household effects. The effect of flood damage to agricultural land and to crops has been disregarded in this evaluation since it is considered to be almost negligible.

The project benefit is calculated as the difference between the damages done with and without the new drainage system.

Determiantion of System Scale

By changing the pumping capacities, the level of inundation water will be accordingly altered. The annual mean benefit in each case is presented in Table 4-4.

The cost required for the proposed pumping station and drainage channels have been estimated. The total construction cost in each case is presented in Table 4-4.

It has been concluded that the optimum pumping capacity should be 30 m^3/s in the second stage and 40 m^3/s in the third stage of regional development (refer to Fig. 4-13).

After the installation of a pumping station with the optimum pumping capacities stated above, it is highly likely that a lot of area will still be submerged during a flood, although the area will be reduced.

It is economically reasonable to invest several times as much as the annual expected damage reduction. Thus a pumping capacity of about 150 m^3/s could be economically justified for the third development stage, but this would not coincide with the optimum. Since the exact conditions then applying to the area (after completion of the regional development plan) are not known now, a further study will be required to determine the most suitable capacity, based on the more realistic development plan.

The drainage channels have been designed to meet each of the pumping capacities. It is important that the channel capacity and pumping capacity figures do coincide with each other. Short-cuts will be provided in the heavily meandering lower reaches of the Pampang river so as to increase its flow capacity and to lower its outlet water stage. The optimum drainage system is illustrated in Fig. 4-14.

4.6.3 Required Earthwork

The required earthwork consists of excavation and dredging of drainage channels. The volume is estimated as follows.

Table 4-5 EARTHWORK VOLUME OF DRAINAGE SYSTEM IMPROVEMENT

Development Stage	Volume
Second	240×10^3 m^3
Third (including Second)	660×10^3 m^3

A spoil bank can be prepared in the lowlands of the project area or along the Tallo river.

4.6.4 Drainage Facilities

Drainage Channel

The proposed drainage channel has a side-slope gradient of 1:1.0, a channel depth of 2.8 m to 3.9 m and a channel width ranging from 6.3 m to 20.5 m. Fig. 4-15 shows the longitudinal profiles and cross-sections of the drainage channels.

Along both crests of the channel banks, roads have been designed for channel management. One of them with a width of 3.0 m enables vehicles to pass along and the other with a width of 1.5 m is for pedestrians.

Pumping Station

As already mentioned, the required pumping capacity is calculated at 30 m^3/s and 40 m^3/s in the second and third development stages. The location of the station is shown in Fig. 4-16. The geology at the proposed pumping station site was found to consist of Alluvial deposites with a thickness of 20 m, under which Neogene Tertiary sedimentary rocks lie.

The Alluvial deposites consist of sand with qc of 40 kg/cm^2 and clay with qc of 10 kg/cm^2. The structure of the proposed station can accommodate 8 pumps with a capacity of 5 m^3/s each. For the second development stage, only 6 pumps need to be installed. (Refer to Fig. 4-16.)

Sluice

During a flood, the Tallo river water flows into the project area through the Pampang river and Pannara site, while usually water flows into the Tallo river. It is proposed, therefore, that two gates be built; one at Pampang bridge site and the other at the Pannara site, as shown in Fig. 4-14. These gates will prevent reverse flow from the Tallo river.

Road Raising

The boundary between the inner basin and the Tallo river basin is considered to be the road between Pannara and Sungguminasa. A 100 m stretch of this road is low lying (3.5 m above M.S.L.), and during a big flood, flood water is likely to overtop this low stretch and to flow into the inner basin.

Raising of this stretch is proposed as shown in Fig. 4-14.

4.7 Land Acquisition and House Evacuation

The land acquisition necessary for the implementation of the project is tabulated below:

- River improvement	:	70 ha
- Dam and reservoir	:	1,400 ha
- Drainage improvement including the Pampang river short-cut (in the second and third stage areas only)	:	30 ha

The number of houses to be evacuated is estimated at 790, the breakdown of which is presented below.

- River improvement	:	220 houses
- Dam and reservoir	:	550 houses
- Drainage improvement including Pampang river short-cut (in the second and third stage areas only)	:	20 houses

4.8 Construction Cost

The construction cost of the overall flood control plan (consisting of river improvement, drainage system improvement and use of a reservoir) is roughly calculated on a contract basis.

This approximate total construction cost is presented in Table 4-6 for reference.

Table 4-6 CONSTRUCTION COST OF OVERALL PLAN

(Unit: x 10^6 US$)

Works	Cost
Drainage	
1) Pumping station	
Second stage	19.2
Third stage (including second stage)	24.8
2) Channel	
Second stage	1.9
Third stage (including second stage)	5.1
River	47.7
Dam	
Dam	125.3
Hydropower Station	26.7

CHAPTER V FORMULATION OF URGENT FLOOD CONTROL

5.1 General

It will be costly in terms of both time and money to realize the overall flood control described in Chapter IV. However, a flood control system is urgently needed for the project area now under a rapid urbanization.

Based on the overall flood control, therefore, an urgent flood control plan has been formulated to mitigate the flood damage to some extent. This plan consists of making improvement to the Jeneberang river as well as to the drainage system.

The degree to which the Jeneberang river should be improved has been determined from the technical and social conditions. The optimum size of the drainage system, however, has been determined from the economic viewpoint, and the calculation for this is based on the assumption that there will be no overtopped water from the Jeneberang river.

The urgent flood control plan, consisting of drainage system improvement and river improvement, has been economically evaluated as a package project.

5.2 River Improvement

5.2.1 Design Flood and River Improvement Stretch

A comparative study was made so as to determine the degree of river improvement and over what length it should be conducted. Optimum scale of river improvement is as follows.

- River improvement scale : 10-year return period
- Design flood : 2,500 m^3/s at Kampili
  : 2,100 m^3/s at Sungguminasa bridge (Refer to Figs. 5-1 and 5-2.)
- River improvement stretch : Estuary to Sungguminasa bridge (9.0 km)

The following are the results of the comparative study.

1) The value of damage potential to property of all types in the lower reaches of the bridge is far greater than that in its upper reaches. (The primary purpose of flood control is to protect Ujung Pandang city located in the lower reaches.)

2) The earthwork volume that will be required to improve the river from the estuary to the Kampili weir will be extremely large in comparison with that from the estuary to the Sungguminasa bridge.

3) The difference in earthwork volume between the 5- and 10-year return periods for the stretch between the estuary and the bridge is not very significant.

4) The stretch between the Sungguminasa bridge and the Kampili weir has an additional function of acting as a natural buffer, and this is effective for extraordinary floods.

5.2.2 Design High-Water Stage

In order to reduce the damage potential to the immediate vicinity, the design high-water stage should not exceed 2 m above the surrounding ground level (refer to Fig. 5-3).

5.2.3 Alignment

The stretch that requires alignment extends for about 7 km from the Sungguminasa bridge to the lower end of the existing dike at 2.0 K.

Although inundation will occur in the lower reaches below 2.0 K by any flood over 800 m^3/s, new dikes are not proposed in this stretch since 1) the overtopped water does not flow into Ujung Pandang city and 2) the reaches have few assets.

Most of the stretch to be aligned has already been embanked and has only a little meandering. It is proposed that the present alignment be utilized wherever possible to prevent the social problem derived from house evacuation and land acquisition. This proposed alignment is shown in Fig. 5-4.

5.2.4 Longitudinal Profile

The proposed longitudinal gradient has been designed at 1/1,950 after taking into consideration 1) the flow capacity at each cross-section, 2) the function of the existing riparian structures and 3) the dredging and excavation volume. (Refer to Fig. 5-3.)

5.2.5 Cross-Section

Where the cross-section of the river channel has a sufficient flow capacity, it will not be altered. However, to stabilize the channel against the low-water discharge, only a low-water channel will be prepared for the urgent flood control in accordance with the standard cross-section proposed in the overall plan. In other words, only the riverbed will be excavated down to the proposed riverbed stage.

The Jeneberang river splits at 4.4 K into right and left courses. In the lower reaches of 4.4 K, only the left course can be regarded as the main one and only this will be improved. The right course will be allowed to remain as it is.

5.2.6 Natural Buffer

The bankful discharge between Sungguminasa and Kampili is estimated at 600 m^3/s. Under the existing conditions (refer to 3.5.1), therefore, any discharge over 600 m^3/s overflows the channel at various points. The inundation area between Sungguminasa and Kampili are proposed as a natural buffer.

Jl. Malino lying between the Bili-Bili irrigation channel and the river channel should be raised so that the 10-year return period flood of 2,500 m^3/s will not flow into the Bili-Bili irrigation channel. Accordingly, when this is done, the discharge from the inundation area above the Sungguminasa bridge will be maintained at 2,100 m^3/s at Sungguminasa.

This inundation area can accommodate 13.0×10^6 m^3. Fig. 5-5 shows the stretch, the longitudinal profile and the cross-section of the road to be raised as well as its location.

By raising the road, a negative benefit will occur during a big flood because the ponding water stage in this inundation area will be increased. On the other hand, however, by excavating the low-water channel in the lower reaches of the Sungguminasa bridge, a positive benefit will occur during small floods. These negative and positive benefits counterbalance each other. Therefore, the damage in this inundation area caused by the implementation of the project can be disregarded in the project evaluation.

5.2.7 Influence on the Lower Reaches

As seen above, the flood discharge in the Jeneberang river channel will increase from 1,800 m^3/s to 2,100 m^3/s after completion of the improvement work and this may exert an adverse influence upon the lower reaches of 2.0 K.

However, the riverbed will be excavated to maintain the channel stability. As a result, the water stage in the lower reaches will not increase and therefore, no harmful influence will be exerted onto the surrounding area (refer to Fig. 5-6 and Table 5-1).

Table 5-1 VARIATION OF WATER STAGE AT 2.0 K

	Discharge(m^3/s)	Water Level(M.S.L.m)
Left Jeneberang river		
Before Improvement	950	3.13
After Improvement	1,330	3.11
Right Jeneberang river		
Before Improvement	850	3.20
After Improvement	770	3.05

5.2.8 Required Earthwork

The volume of earthwork to be excavated from the river channel is estimated at 800,000 m^3. At present, sand is collected from the Jeneberang riverbed by the local populace for selling and this amounts to between 200,000 m^3/year and 300,000 m^3/year. Any sand excavated during the project construction period can therefore be sold in a similar way. The earthworks necessary to improve the Jeneberang river are summarized in Table 5-2.

Table 5-2 EARTHWORK VOLUME OF RIVER IMPROVEMENT

Works	Volume (m^3)
Embankment	95,500
Road Raising	16,000
River Channel Excavation	794,000
Drainage Ditch Excavation	12,000

5.2.9 Riparian Structures

Bank Protection

It is planned that in the urgent flood control plan the exisitng dikes in the lower reaches of the Sungguminasa bridge should be raised.

The proposed dikes should have a crest width of 3.0 m; this is so that vehicles can pass along them for river management. The side-slope gradients of river-side and land-side are to be 1:2 to assure dike stability.

The volume of materials required for the embankment and road raising is estimated at 111,500 m^3. Usually, dredged riverbed materials are used for embankments. However, in this case the riverbed materials of the Jeneberang consist of fine sand of uniform grain size, and this is not suitable for embankments because it is too permeable. Furthermore, because the sand is fine, it can not be satisfactorily compacted.

Accordingly, a borrow pit will be required to provide embankment materials. The hilly land located 2 km north-east of the Sungguminasa bridge is recommended for use as a borrow pit (refer to Fig. 5-5). The available volume is estimated at 120,000 m^3.

To protect the river bank from erosion, revetment will have to be provided in both the high-water and low-water channels on the bends. The length of river course where this is required is 5,700 m and the location is presented in Fig. 5-4.

Wet masonry will be employed for revetment using cobbles which can be easily obtained from the project site.

For the areas which will not be revetted, sodding will be provided to protect the slope surface of the bank from heavy rainfall and flow erosion.

Furthermore, groyne will be provided at the bends, as shown in Fig. 5-4. This will prevent erosion at the foot of the side-slope by accelerating sediment deposit. Wooden pile permeable groyne will be employed in the project.

This groyne will need to be installed at 23 places, each being approximately 30 m in length, 2.3 m in height and having interval of 45 m.

Drainage Facilities

Some of the existing sluices can be left intact, but all the others will have to be either renewed or removed because sluices installed at close proximity to one another adversely affects the safety and stability of the dikes.

5.3 Drainage System Improvement

5.3.1 Possible Drainage Systems

It is usually economically viable to set up a drainage system in any area that has a lot of assets. But in so doing any harmful side effects upon other areas must be avoided.

Usually, a drainage scheme includes natural drainage, mechanical drainage and use of a regulation pond.

Within the scope of this urgent flood control plan, however, it is not necessary to use a mechanical drainage system because the lowest ground elevation in the first development stage area is 1.5 m above M.S.L. and the high water springs is 0.56 m above M.S.L. Furthermore, it is economically unviable to provide space for a regulation pond. And even if a regulation pond could be provided, its effectiveness would be doubtful on the grounds that since the area is often subject to 5 days of continuous heavy rainfall, any regulation pond would at least be partially filled within first two or three days. In other words, the capacity of a regulation pond would be reduced well before the peak run-off occurs.

From the economic and technical viewpoints therefore, it is proposed that only a natural drainage system should be employed in the context of the urgent flood control discussed in this chapter.

During a large flood, the sole function of the Sinrijala channel is to transport water from the city-side area to the mountain-side area. Usually, however, its function is to provide a normal drainage facility. The cross-sectional shape of the channel has been designed to simply provide this normal drainage facility.

In this study on the application of natural drainage to the area for urgent flood control, it became evident not only that improvement to the Panampu channel would be necessary but also that excavation of the Jongaya channel would have to be undertaken. The three reasons for this are explained below.

1) If only the Panampu channel should be employed and improved, the size of the channel would have to be so large that it would cause such social problems as house evacuation and land aquisition.

2) To reduce this social inconvenience to an absolute minimum, a coverd channel leading to the sea through Ujung Pandang city may be considered. However, any such covered cahnnel would be costly to construct as well as hard to maintain.

3) The main Jongaya channel would be indispensable in draining the inundation water over the Jongaya area. The Panampu channel can not fulfill this function.

5.3.2 Optimum Scale of Drainage System

Premise of Study

The study on the optimum natural drainage system is based on the following premises.

1) Drainage Condition

The inundation area is divided into two parts (city-side area and mountain-side area) by Jl. Panakkukang. The calculation model has two inundation areas.

The Sinrijala channel linking these two areas has the function of transporting the inundation water. If the inundation water depth in the inundation area exceeds 2.2 m, the inundation water overflows onto the Panakkukang road.

The drainage system should be designed to drain the inundation water, not the overtopped water from the Jeneberang. The drainage calculation has been based on the assumption that there is no overtopped water from the Jeneberang.

The inundation water would be drained by the Pampang river, through the Sinrijala and by the Panampu and Jongaya channels. Fig. 5-7 illustrates the calculation model.

2) Run-Off

The suggested development work in the inner basin is expected to change the run-off coefficients in the area.

Most floods are caused by 5 days of continuous rainfall. The run-off after the first development stage has been estimated by using the rainfall intensity as shown in Fig. 4-12, considering the change of run-off coefficients.

3) Outlet Water Stage

The inundation water is drained into the Makassar Strait and into the Tallo and Pampang rivers. The outlet water stage of each drainage channel is shown in Fig. 5-7. The outlet water stages of the Tallo and Pampang rivers cannot be estimated exactly because of insufficient hydraulic data of the Tallo river. Consequently the tidal curve had to be used to estimate their outlet water stages, and this takes into account the topographical gradient.

4) Cost Estimation

The cost required for the modification of the existing channels and for the construction of the proposed channels is estimated on the following assumptions; 1) that the side-slope gradient of any open channel is 1:1, and 2) that any excavation of the riverbed be limited to 2.0 m below M.S.L.

In calculating the discharge capacity of a channel, it has been assumed that the coefficient of roughness is $n = 0.025$.

5) Benefit Estimation

The benefit is calculated as the difference between the damages done with and without the new drainage system.

These estimated damages are assumed to be inflicted on the buildings and household effects existing after completion of the first development stage.

The effect of flood damage to agricultural land and crops has been disregarded in this benefit evaluation since it is considered to be almost negligible.

<u>Optimum Drainage System</u>

A comparative study on the optimum scale of both the Panumpu and Jongaya channels was conducted to determine the most economical system (refer to Fig. 5-8). The optimum drainage system consists of the Panampu, Jongaya and Sinrijala channels and its essential features are tabulated below. The optimum drainage system is presented in Fig. 5-9.

Table 5-3 FEATURES OF THE PROPOSED DRAINAGE CHANNELS

	Panampu Channel	Jongaya Channel	Sinrijala Channel
Total Length	4.9 km	7.3 km*	2.3 km
Max. Width	15.5 m	17.5 m	9.0 m
Max. Depth	2.6 m	2.6 m	2.8 m
Profile	1/4,000	1/6,400	1/5,700
Max. Drainage Capacity	30 m^3/s	30 m^3/s	7 m^3/s
Work required	Improvement	New excavation	Shapping

Note * : This includes the length of the old Jeneberang course.

5.3.3 Required Earthwork

The earthwork required for the drainage system in the urgent plan consists of excavation, dredging, filling for channel banking and spoil. The volumes of these works are given below.

Table 5-4 EARTHWORK VOLUME OF DRAINAGE SYSTEM IMPROVEMENT

Earthworks	Volume (m^3)
Excavation	399,000
Dredging	139,000
Filling	30,000
Spoil	508,000

A spoil bank can be prepared in the old Jeneberang course and in the lowland near the Hassanudding University.

5.3.4 Drainage Facilities

Drainage Channel

The proposed drainage channels will have side-slope gradients of 1:1.0 and channel depths of 2.56 m. Since they will not be embanked, freeboard is not applicable. The channel widths vary in accordance with the required drainage capacity, while the channel depths are to be fixed.

Along both crests of the channel banks, roads have been designed for channel management. One of them with a width of 3.0 m enables vehicles to pass along and the other with a width of 1.5 m is for pedestrians.

Fig. 5-10 shows the longitudinal profile and cross-sections of the drainage channel.

Bridge

Since it will be necessary to widen the channels, the existing bridges crossing the Panampu and Sinrijala channels will have to be renewed. At the intersection of the proposed new Jongaya route and the existing road, a new bridge will have to be constructed.

The existing bridge at the intersection of the Sinrijala channel and Jl. Panakkukang should be replaced by the bridge with a sluice.

These structures are made of reinforced concrete and be of the simple beam type since not only all the materials are readily obtainable in the site but it will also be easy to construct.

In determining the height of the beam, 0.6 m was added to the high-water level for clearance. The length of the sluice should be 1.0 m over the width of the proposed channel. The widths of any new bridges should correspond to the existing road width.

Sluice

A sluice equipped with a gate should be installed at the intersection of the Sinrijala channel and the Panakkukang road. This will control the reverse flow from the mountain-side area to the city-side area during a flood. The cross-sectional area of this sluice should be the same as that of the channel immediate upstream.

5.4 Effectiveness of the Urgent Flood Control

As outlined, the urgent flood control plan consists of drainage and river improvements as a package project. The effectiveness of this plan in the inundation area has been carefully assessed. The study was based on the premise of study 2) and 3) described in Page 32 and 33 and on the following assumptions:

It is assumed that the river water of the Jeneberang will overflow during floods exceeding the below-mentioned return periods, and the breaking points are inferred to be the following.

1) After completion of the urgent flood control project

- Flood return period : 10 years
- Point to be broken : 9.6 K, 6.0 K

2) Under the existing conditions

- Flood return period : 2.4 years
- Point to be broken : 6.0 K
- Flood return period : 8 years
- Point to be broken : 9.6 K, 6.0 K

The calculation model in Fig. 5-11 is based on the above-mentioned assumptions. The study results are given in Table 5-5.

Table 5-5 INUNDATION WATER STAGE WITH AND WITHOUT PROJECT

Unit;(M.S.L.m)

Return Period	Without Project		With Project	
	Mountain-side	City-side	Mountain-side	City-side
2-year	1.45	2.03	1.30	1.54
5-year	1.68	2.53	1.50	1.87
10-year	2.11	2.71	1.64	2.01

The inundation water stage in the city-side area will decrease to 1.87 m in M.S.L. in the flood of 5-year return period, and this means that the city-side area will be released from the damage caused by the flood below 5-year return period.

5.5 Land Acquisition and House Evacuation

The land acquisition necessary for the implementation of the urgent plan is tabulated below.

- River improvement : 5 ha /1
- Drainage improvement : 15 ha

Total : 20 ha

The number of houses to be evacuated is estimated at 430. The breakdown is presented below.

- River improvement : 60 houses
- Drainage improvement : 370 houses

Total : 430 houses

5.6 Construction Materials

Tonasa cement and Fortune cement, both of which are produced in Indonesia, are procurable in Ujung Pandang city and are available in both quantity and quality.

Aggregates necessary for the construction consist of sand, gravels and cobbles. The sand can be dredged, and the gravels and cobbles can be obtained from the middle and upper reaches.

Log piles and sod obtainable in the project site are also adequate for the project. Steel required for bridges and steel sluice gates to be used in the project can be produced in Indonesia.

/1 : The river-side area between the existing dikes is not counted for the land to be aquired.

5.7 Construction Schedule

The urgent flood control project consists of two sectors; namely, the required improvements of the Jeneberang river and the drainage system. The construction period for both sectors is estimated to be five years from 1981 to 1985. This includes the preparatory work and the detailed engineering works.

River Improvement

The improvement work to the Jeneberang river must be con ducted during the dry season from April to October. Dredging, excavation and embankment works can then be carried out and must start at the lower reaches of the river and work up toward the upper reaches. In this way, no detrimental effects will be exerted upon the project area and especially upon Ujung Pandang city. The detailed work section and work order are illustrated in Fig. 5-12. The main work is distributed on an annual basis and in quantitative terms as set forth in Table 5-6 and Fig. 5-13.

Drainage System Improvement

The majority of drainage channel improvement work should also be carried out during the dry season from April to October. The exception is the dredging work required to convert the old Jeneberang river into a drainage channel. The dredger used in the main river course during the dry season can be oprerated to dredge this course during the wet season.

To create the maximum effectiveness, improvement work should be carried out to the channels in the following order; Panampu, Jongaya and Sinrijala. The work period for these is expected to be two years, two years and one year respectively. The order and sections are illustrated in Fig. 5-14. The main work is distributed on an annual basis and in quantitative terms as set forth in Table 5-7 and Fig. 5-15.

5.8 Construction Equipment

The equipments required for the project construction consist of bulldozers, back hoes, dump trucks, and so on. The capacity and necessary quantity of each equipment are summarized in Table 5-8.

CHAPTER VI ECONOMIC EVALUATION FOR URGENT FLOOD CONTROL

6.1 General

This chapter deals with the economic evaluation of the urgent flood control project. As seen, this plan consists of making improvements to the Jeneberang river and to the drainage system in the inner basin.

It is assumed that the estimated damages be inflicted on the buildings and household effects existing after completion of the first development stage.

The economic feasibility of the flood control project has been evaluated by means of calculating the internal rate of return. A sensitivity analysis has also been made with respect to variation in the economic cost and the completion time of the first stage development. A financial analysis has not been included in this study since no cash inflow is expected.

The socio-economic impacts of the project are briefly assessed in due consideration of the effects of the project on the required development.

Rupiah and Yen are converted to US Dollars at the exchange rate of Rp. 625 to US$ 1 and ¥ 250 to US$ 1. The project life for the economic evaluation is 50 years from 1981 to 2030.

6.2 Project Benefit

Project benefit is defined as the flood damage reduction due to implementation of the project. The annual benefit is given as the reduction in annual damages; and annual damages are obtained by multiplying the total damage potential by the probable flood rate.

Flood damage consists of direct damage, indirect damage and intangible damage. Direct damages are defined as the monetary expenditure required, or which would be required, to restore the flood damaged property to its pre-flood condition. Indirect damages include the net monetary cost of evacuation, relocation, lost wages, lost production, and lost sales. Intangible flood damages are defined as flood effects which connot be measured in monetary terms. In this study, only the direct damages to buildings and farm crops and the indirect damages are assessed and evaluated.

The mean annual flood damage is determined by summing up the potential direct damage (from floods of different frequencies) plus the potential indirect damage (estimated by applying an indirect damage rate).

By implementing the urgent flood control project, benefits are expected in the city-side and the mountain-side areas. Estimates of the total flood damage potential with and without the project are based on the conditions described in the supporting report.

The estimated annual damages to buildings and household effects and to farm crops in the project area are summarized in Table 6-1.

Table 6-1 *ANNUAL MEAN DAMAGE*
(1st Stage Development)

Unit: $\times 10^6$ US$

		Without Project	With Project
Buildings and Household Effects	Direct	1.998	0.250
	Indirect	0.300	0.038
Sub-total		2.298	0.288
Farm Crops	Direct	0.035	0.028
	Indirect	0.007	0.006
Sub-total		0.042	0.034
Total		2.340	0.322

The annual expected damage reduction is estimated at US$ 2.02 million, the breakdown of which is tabulated in Table 6-2.

6.3 Project Cost

6.3.1 Economic Construction Cost

The economic construction cost of improvements to rivers and the drainage systems is estimated at US$ 11.90 million equivalent, which consists of US$ 7.54 million equivalent of local currency and US$ 4.36 million of foreign currency. The breakdown and disbursement of the economic cost are presented in Tables 6-3 and 6-4.

6.3.2 Operation and Maintenance Cost

The annual cost necessary for operation and maintenance of the project is estimated at US$ 0.055 million as set out in Table 6-5.

6.4 Fund Requirement for Construction

Fund requirement for the project construction has been estimated in two different ways, that is, contract basis and force account basis, and is estimated at the escalation rate of 7% for foreign currency and of 10% for local currency.

Included in both these ways of estimating the fund requirement are the actual purchasing cost of machinery and of acquiring the land and also the expected cost escallation. With respect to the cost of construction machinery, only the depreciation cost has been counted in the estimate for the contract basis, while all the purchasing cost is reflected for the force account basis.

Fund requirements for the construction amount to US$ 5,272,300 in foreign currency portion and US$ 12,385,000 in domestic currency portion, provided that the construction works are carried out on a contract basis. If the works are implemented on a force account basis, the fund requirements amounts to US$ 7,139,000 in foreign currency portion and US$ 12,385,000 in domestic currency portion.

In the case that all the construction cost is estimated in local currency (the foreign engineering service is exceptional), the fund requirements amounts to US$ 18,502,000 on the contract basis and to US$ 19,967,000 on the force account basis. The engineering services cost of US$ 1,884,000 in foreign currency portion is included in the above two cases.

6.5 Evaluation

6.5.1 Internal Rate of Return

The internal rate of return has been calculated at 13.2% on the basis that the benefits and cost are as estimated in 6.2 and 6.3 above. This internal rate of return indicates the economic soundness of the project.

6.5.2 Sensitivity Analysis

Project sensitivity has been analyzed by considering the change in the economic construction cost and the completion time of the regional development.

The sensitivity analysis indicates that the project maintains a relatively high internal rate of return of about 12.1% if there should be a 10% increase in the construction cost. The analysis also indicates that the rate will still be remained at 12.2%, should the first stage of regional development be completed in 1990.

6.6 Socio-Economic Impact

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

Increase of employment opportunity due to implementation of the project will be reflected on the regional economy. About 1,000 persons will have to be employed in the river and drainage improvement work during the construction period. Furthermore about 22 persons will be required permanently for operatrion and maintenance work.

Technical knowledge will also be transferred to the Indonesian staff through the construction work in various fields, and this will be useful in the realization of other flood control projects in the future.

The living environment will be greatly improved by implementation of the project. The enhanced economic activity through this improved living environment will also exert a beneficial influence on the socio-economy of the region.

CHAPTER VII CONCLUSION AND RECOMMENDATIONS

7.1 General

This study was undertaken with the joint objectives of 1) conducting a preliminary survey for determining an overall flood control plan (this includes the possiblity of reservoirs) and 2) making a feasibility study of the urgent flood control and drainage improvement plan for Ujung Pandang city.

It has been concluded that both the overall and the urgent flood control projects are required to protect the inhabitants and their belongings from flood damage and are necessary to spur the regional development. It has been also identified that the urgent flood control project be technically sound and economically feasible at the internal rate of return of 13.2%.

It is recommended, therefore, that both the overall and the urgent projects be forwarded to the next stage immediately.

7.2 Conclusion

7.2.1 Overall Flood Control

The overall flood control scheme has been planned for the design flood on a 50-year return period basis, and this is in line with the improvement scales of other important rivers in Indonesia. The standard project flood of 3,700 m^3/s at Kampili and 2,750 m^3/s at Bili-Bili corresponds to 50-year return period be controlled by the proposed river improvement and by building an impounding reservoir.

A dam at Bili-Bili, 31 km upstream from the estuary, has been planned to have the multi-purpose uses of flood control, water supply and power generation. A rock fill dam with an central core should be employed and its height is 65 m. This Bili-Bili dam should consist of a main dam linking two hills and of two wing dams. The total effective storage capactiy thus developed is estimated at 262.0 million m^3. Of this volume, 24.0 million m^3 has been allotted for flood control, while 238.0 m^3 has been allotted for water utilization.

The standard project flood of 2,750 m^3/s at the Bili-Bili proposed dam site will be controlled to 1,550 m^3/s (peak discharge cut of 1,200 m^3/s) by an impounding reservoir. The design flood for the river channel has been fixed at 2,500 m^3/s, which includes the run-off from the remaining basin in the lower reaches of the Bili-Bili dam.

It is proposed that the river improvement work be carried out over a stretch of 20 km, from the estuary to the Kampili weir. The work consists of excavation, dredging and embankment along the river course. Riparian structures such as revetment, groyne, groundsill, bridges, sluiceways and drainage ditches will also have to be provided.

The optimum drainage system consisting of pumps and drainage channels should be applied to the project area after completion of the second and third stages of regional development. The optimum pumping capacity has been determined to be 30 m^3/s in the second stage and 40 m^3/s in the third stage. However, it is virtually impossible to mitigate all inundation damage simply by building a pumping station and drainage channels. This is because the elevation of the area is very low.

The total length of the drainage channels that will need to be constructed is 4.3 km in the second stage of area development and 16.9 km in the third stage of area development. The drainage channels will have to be revetted.

At present, sediments are produced mainly by the collapse in the upper reaches and by the lateral erosion in the terrace and fan, though it is not serious. Three Sabo dams should therefore be installed in the upper reaches of the Jeneberang river to control sediment transport. Though the mountainous slope appears stable and produces little sedimen at the present time, it is recommended that afforestation be conducted to provide forestry and also to provide water retention and other environmental improvement.

The effectiveness brought about by the implementation of this proposed overall flood control project is as follows:

Flood Control

The discharge of a 50-year return period flood will be perfectly controlled by the improved Jeneberang river channel and by the proposed reservoir. After completion of the overall flood control project, the project area will not suffer from any damage caused by floods up to a 50-year return period.

Irrigation

The present agricultural land is estimated at 31,000 ha in the rainy season and 3,500 ha in the dry season.

After completion of the project, it is possible to utilize, for irrigation purposes, a discharge of 21 m^3/s at the Kampili weir. Irrigation for 31,000 ha in the rainy season will become stable. The irrigable area in the dry season will increase to 19,000 ha from 3,500 ha, and also 2.5 crops will be possible in a year. The irrigable area in the dry season will increase to 28,500 ha (19,000 ha x 1.5 crops). In other words, the agricultural land will increase by 25,000 ha.

The irrigation facilities such as the Kampili and Bili-Bili intakes and ditches have already been installed. Therefore, by simply securing an adequate water supply, the agricultural products from the area can be expected to increase drastically, almost as much as twice annually.

Power Generation

By using the discharge of irrigation water, the power that could be generated is estimated to be 22,000 KW and its generation is 75,000 MWH per annum. The former corresponds to about 40% of the present power demand of Ujung Pandang city. The proposed power station site is within 20 km of the existing three sub-centers.

Water Supply

The municipal and industrial water demand in the area will increase as regional development progresses. The proposed reservoir is expected to be helpful in supplying the water demand.

7.2.2 Urgent Flood Control

The proposed river improvement work has been planned for the design flood on a 10-year return period basis. This design flood of 2,100 m^3/s at the Sungguminasa bridge could be confined by the improved river channel.

The river channel improvement work will have to be carried out along a length of 9.0 km from the estuary to the Sungguminasa bridge. The work consists of excavation, dredging and embankment along the river course. Riparian structures such as revetment, groyne, sluiceways and drainage ditches will also have to be provided.

A natural buffer exists in the upper reaches of the Sungguminasa bridge. This will regulate a discharge of 2,500 m^3/s at the Kampili weir to 2,100 m^3/s at the Sungguminasa bridge.

The proposed drainage system consists of three main drainage channels; i.e., Panampu, Sinrijala and Jongaya channels. Under the plan, the total length of these three channels is about 14.5 km. The existing Panampu channel will be improved and its drainage capacity will be increased to 30.0 m^3/s. The existing Sinrijala channel will be only shaped for the usual everyday drainage. The Jongaya channel will be excavated in order to be able to drain the flood water through the old Jeneberang river. Its drainage capacity is to be 30.0 m^3/s. All these proposed drainage channels will be revetted except for the old river. A sluiceway and bridges will be also provided.

The urgent flood control work, including engineering services, is proposed in the plan to commence in 1981 and to be completed in 1985.

The economic construction cost of improvements to rivers and the drainage systems is estimated at US$ 11.90 million equivalent, which consists of US$ 7.54 million equivalent of local currency and US$ 4.36 million of foreign currency.

Fund requirements for the construction amount to US$ 5,272,300 in foreign currency portion and US$ 12,385,000 in domestic currency portion, provided that the construction works are carried out on a contract basis. If the works are implemented on a force account basis, the fund requirements amounts to US$ 7,139,000 in foreign currency portion and US$ 12,385,000 in domestic currency portion.

In the case that all the construction cost is estimated in local currency (the foreign engineering service is exceptional), the fund requirements amounts to US$ 18,502,000 on the contract basis and to US$ 19,967,000 on the force account basis. The engineering services cost of US$ 1,884,000 is included in the above two cases.

The annual cost necessary for operation, maintenance and replacement of the facilities is estimated at US$0.055 million.

After implementation of the urgent flood control project, the flood water of the Jeneberang river will not affects the project area, if its return period is less than 10 years. The proposed drainage channels will protect the project area from inundation damage, if its return period is less than 5 years. The annual flood control benefit proceeded by the project is estimated at US$ 2.02 million.

7.3 Recommendations

7.3.1 Overall Flood Control

1) Even after completion of the urgent flood control work of the Jeneberang river, Ujung Pandang city will still be faced with the prospect of damage due to floods of 10-year return period or more. On the other hands, development of water resources in the area will be indispensable in supporting the future water demand. This water demand will increase as the regional development of Ujung Pandang city progresses.

   It is recommended, therefore, that the feasibility study on the overall Jeneberang river flood control and water resources development be executed as soon as possible.

   Implementation of the drainage system improvement plan in the second and third development areas is not urgently required. This is because there exists no significant assets in the areas at present. The improvement of the drainage system should be gradually implemented as the area develops.

2) The river improvement work is designed on the 50-year return period basis over the stretch from the estuary to Kampili. To protect Ujung Pandang city from the floods

over 50-year return period, a buffer will be required along the river course. It is desired that a further study on the buffer be made in the next stage.

3) At present, areas in the grassland of the river basin appear stable and produce little sediment. A countermeasure is not required urgnetly from the viewpoint of soil conservation. However, it is important that soil conservation be provided to prevent the possible future increased sediment discharge. It is recommended that further survey and study be conducted in the next stage.

4) A pumping capacity of about 150 m^3/s could be economically justified for the area after completion of the third development stage. Rough estimation has verified that it is less costly to reclaim the low-lying area. However, both methods are considerably costly. Under this situtión, the future development of this area should be studied carefully.

5) Upon completion of the second and third development stages, the agricultural land which is now a part of the mountain-side area will be developed into an urban area. Then, irrigation water for the area will no longer be required.

   To prevent flood water from flowing into the mountain-side area through the Bili-Bili irrigasion channel, the Bili-Bili intake will have to be repaired to prevent leakage of flood water into the channel. And some facilities should be installed to drain the flood water in the channel back to the Jeneberang river somewhere upstream of the Sungguminasa bridge.

   Since adequate maps of this area are not readily avialable at present, further studies will be required in the next stage.

6) For the early implementation of the overall flood control plan and water resources development of the Jeneberang river, the following studies should be conducted for the feasibility level.

   - Cross levelling and longitudinal survey in the proposed structure sites and along irrigation channels.

   - Topographical maps with a scale of 1/5,000 covering the proposed dam site, hydro-power station site, regulation pondage and Sabo dam sites, and with a scale of 1/10,000 for the proposed reservoir, the existing irrigation areas and for the river course from Sungguminasa to the proposed dam sites.

   - Installation of several water gauge stations along the Jeneberang river and of several rainfall gauge stations at the upper reaches of the river.

- Measurement of discharge at each water gauge station, and of the sediment load of the Jeneberang river.

- The boring and seismic prospecting at the proposed dam site.

7.3.2 Urgent Flood Control

1) A flood control consisting of river improvement and drainage system improvement is urgently needed for the project area now under a rapid urbanization. The flood control plan should be implemented immediately to protect the area from flood damage and to spur the regional development.

2) The inundation area above the Sungguminasa bridge has not been examined in this study because of no detailed map. Since the regulation capacity of the inundation area is one of the most essential factors to determine the design flood for its lower river channel, more detailed surveying and further study should be carried out in the detailed engineering phase.

3) There are a number of houses required to be evacuated or moved for the implementation of the proposed river and drainage improvement, and it is likely to become a cause of social problem. The house evacuation should be carried out with an utmost care to comply with the applicable laws and regulations.

4) Not to hamper the early implementation of the urgent flood control plan, the following items should be conducted for the detailed engineering phase.

   - Cross leveling and longitudinal survey along the proposed stretch of the Jeneberang (50 m in interval) and along the proposed drainage channels (20 m in interval).

   - Topographical maps with a scale of 1/2,500 for the proposed Jeneberang river course, with a scale of 1/200 for the proposed drainage channel and for the proposed portion of raising road, with a scale of 1/50 covering the proposed structure sites and with a scale of 1/10,000 covering the inundation area above the Sungguminasa bridge.

   - The soil survey and test at the proposed borrow pit, the proposed structure sites, and dredging portion of the Jeneberang river and the drainage channel.

Table 1-1 MEMBER OF SURVEY TEAM, COUNTERPART AND ADVISORY COMMITTEE

Advisory Committee

Head	Mr. Takao Jinnouchi
River	Mr. Naohito Murata
Drainage	Mr. Tadahiko Nakao
Hydrology	Mr. Tsuneya Mochizuki
Coordinator	Mr. Katsuhiko Biyajima

Survey Team and Counterparts

Team Leader	Mr. Katsuhisa Abe	Mr. Soeratman Mr. Rusbini
Hydrologist	Mr. Yoshiharu Matsumoto	Mr. Suwarno Mr. Singkir
River Engineer	Mr. Hiroshi Kimura	Mr. Amar Mr. Syarifuddin Mr. Nur Alim
Drainage Engineer	Mr. Makoto Migita	Mr. Rasyid Mr. Siradjuddin
Geologist and Sabo Engineer	Mr. Shinichi Uda	Mr. Budiono Mr. Syamsul Mr. Hasbi
Hydraulic Structural Engineer	Mr. Yoshiyuki Tomioka	Mr. Supriya Mr. Didiek
Dam Engineer	Mr. Akio Yoshino	Mr. Edy Wahjono Mr. Islamuddin
Engineering Economist	Mr. Joji Ishii	Mr. Syafiudin Mr. Suwardy
Survey Engineer	Mr. Masao Iimori Mr. Kiyotaka Takahashi	Mr. Ramli M. Nur Mr. A. Halim Mr. Abd. Wahab Mr. Arifin Mr. Rasyid Mr. Abd. Rauf Mr. Amir
Liaison Officer	Mr. Kimio Shimomura	Mr. Ridwan Mr. Badjaras

Table 2-1 TARGET COMPOSITION OF NATIONAL PRODUCTION BY ECONOMIC SECTOR

	Fiscal Year 1978/1979	Annual Growth rate	Fiscal Year 1983/1984
Agriculture	31.4%	3.5%	27.2%
Mining	17.9%	4.0%	15.9%
Manufacturing	10.2%	11.0%	12.6%
Construction	4.9%	9.0%	5.5%
Transport	4.6%	10.0%	5.4%
Others	31.0%	8.1%	33.4%
Gross	100.0%	6.5%	100.0%

Table 3-1 PROBABLE DISCHARGE OF JENEBERANG RIVER

Unit: m^3/s

Return Period (Year)	Bili-Bili	Kampili Weir	Sungguminasa	
100	3,122 (8.1)	4,163 (6.7)	4,163 (6.2)	
50	2,748 (7.1)	3,664 (5.9)	3,664 (5.5)	
30	2,471 (6.4)	3,249 (5.3)	3,294 (4.9)	
20	2,249 (5.9)	2,998 (4.8)	2,998 (4.5)	
10	1,862 (4.8)	2,483 (4.0)	2,483 (3.7)	2,085 * (3.1)
5	1,461 (3.8)	1,948 (3.1)	1,948 (2.9)	1,670 * (2.5)
2	854 (2.2)	1,138 (1.8)	1,138 (1.7)	1,090 * (1.6)

* Discharge after regulation
() Specific discharge

Table 3-2 TRANSITION OF LAND USE

(ha)

Land Use \ Development Stage		Existing	1st Stage	2nd Stage	3rd Stage
City Side Area	Urban area	671.6	774.1	792.1	792.1
	Agricultural area	258.5	156.0	138.0	138.0
	No use	24.2	24.2	24.2	24.2
	Total	954.3	954.3	954.3	954.3
Mountain Side Area	Urban area	208.1	226.7	661.8	1,443.3
	Agricultural area	1,673.0	1,657.7	1,280.0	510.0
	No use	115.6	112.3	54.9	434.0
	Total	1,996.7	1,996.7	1,996.7	1,996.7
	Grand Total	2,951.0	2,951.0	2,951.0	2,951.0

Table 4-2 PRINCIPAL FEATURES OF THE BILI-BILI DAM

I T E M	FEATURES
DAM AND RESERVOIR	
Catchment Area	384.4 km^2
Type of Dam	Rockfill, Central Core
Crest Elevation	EL 105.00 m
Max. Height of Dam	65.0 m
Crest Length	1,670 m
Dam Volume	8.0 million m^3
Low Water Level (L.W.L.)	EL 74.00 m
Normal Water Level (N.W.L.)	EL 98.00 m
Surcharge Water Level (H.W.L.)	EL 100.00 m
Sediment Storage Capacity	58 million m^3
Effective Storage Capacity	238 million m^3
Flood Control Capacity	24 million m^3
SPILLWAY	
Type of Spillway	Overflow Weir-Chuteway
Gate	7 gates, 8.5 x 9.5 m
Design Discharge Capacity	4,200 m^3/s

Table 4-3 UTILIZABLE DISCHARGE AT KAMPILI

Y E A R	UTILIZABLE DISCHARGE
1953	23 m^3/s
1956	32
1957	20
1958	24
1959	27
1960	25
1975	24
1976	21
1977	24
1978	32

Table 4-4 BENEFIT AND COST ESTIMATE OF DRAINAGE SYSTEM

	Pump (m^3/s)	Benefit ($x10^9$Rp.)	Cost ($x10^9$Rp.) Pump	Cost ($x10^9$Rp.) Channel	Cost ($x10^9$Rp.) Total
Second Stage	P = 10	0.658	5.00	0.76	5.76
	P = 20	1.704	8.50	0.96	9.46
	P = 30	2.840	12.00	1.11	13.11
	P = 40	3.128	15.50	1.24	16.74
	P = 50	3.296	19.00	1.35	20.35
Third Stage	P = 10	3.475	5.00	1.81	6.81
	P = 20	6.917	8.50	2.27	10.77
	P = 30	10.563	12.00	2.76	14.76
	P = 40	14.390	15.50	2.96	18.46
	P = 70	17.795	26.00	3.98	29.98
	P =100	18.730	36.50	4.56	41.06
	P =160	23.069	57.50	5.46	62.96

Table 5-6 BREAKDOWN OF THE TOTAL WORK VOLUME
(URGENT RIVER IMPROVEMENT)

ITEM	UNIT	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	TOTAL
Dredging	m^3	39,600	79,200	72,600	72,600	264,000
Excavation						
Overland	m^3	39,800	79,500	73,000	72,700	265,000
Under Water	m^3	39,800	79,500	73,000	72,700	265,000
Embankment	m^3	16,600	26,500	24,600	27,800	95,500
Sodding	m^2	11,700	21,500	25,400	24,400	83,000
Revetment						
High-water	m	700	2,300	600	2,100	5,700
Low-water	m	-	1,300	2,600	1,800	5,700
Groyne	PC	-	-	23	-	23
Sluice (1.5x1.5m)	PC	-	-	-	2	2
Sluice (1.1x1.1m)	PC	-	1	-	-	1
Drainage Ditch	m^2	-	600	-	2,200	2,800
Land Acquisition	m^2	9,000	14,300	4,300	27,700	55,300
House Evacuation	PC	20	20	10	10	60
Road Raising	m	-	-	-	2,950	2,950

Table 5-7 BREAKDOWN OF THE TOTAL WORK VOLUME
(URGENT DRAINAGE SYSTEM IMPROVEMENT)

ITEM	UNIT	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	TOTAL
Excavation	m^3	119,200	134,000	116,000	30,000	399,200
Dredging	m^3	55,400	83,000	-	-	138,400
Filling	m^3	4,000	2,100	2,800	10,600	19,500
Backfill	m^3	2,600	2,800	2,800	2,300	10,500
Revetment	m^2	23,000	24,900	24,700	21,300	94,000
Bridge	PC	5	10	5	2	22
Sluice	PC	-	-	-	1	1
Land Acquisition	m^2	35,800	52,000	50,800	12,800	151,400
House Evacuation	PC	140	150	80	-	370

Table 5-8 CONSTRUCTION EQUIPMENT TO BE PURCHASED

Equipment	Capacity	Unit
Drainage System Improvement		
Bulldozer	11 ton	3
Back Hoe	0.6 m3	4
Dump Truck	8 ton	16
Pile Driver	2.5 ton Ram	1
Tamper	80 kg	1
River Improvement		
Dredger	520 ps	1
Anchor Barge	30 ps	1
Wheel Loader	1.2 m3	1
Wheel Loader	2.0 m3	2
Bulldozer	11 ton	1
Bulldozer	21 ton	3
Back Hoe	1.2 m3	2
Dump Truck	8 ton	31
Vibrating Roller	2.5 ton	1
Soil Compactor	90 kg	1
Tamper	80 kg	1
Road Roller	11-12 ton	1
Tire Roller	8-20 ton	1
Asphalt Engine Sprayer	200 ℓ	1
Asphalt Finisher	2.5 m class	1

Table 6-2 (1) ANNUAL EXPECTED DIRECT DAMAGE REDUCTION

BUILDING AND HOUSELHOLD EFFECTS IN THE FIRST DEVELOPMENT STAGE

1	2				3		4	5	6	7	8
Return Period (1/T)	Inundation Water Stage(M.S.L.m)				Flood Damage(10^6Rp)		Flood Damage Reduction (10^6Rp)	Average (10^6Rp)	Expected Value	5 x 6 (10^6Rp)	Total (10^6Rp)
	Without Project		With Project		Without Project	With Project					
	H_1	H2	H1	H2							
(1/1)	(1.30)	(1.89)	(1.12)	(1.27)	520	40	480				
								535	0.50	268	
1/2	1.45	2.03	1.30	1.54	690	100	590				
								655	0.084	55	
1/2.4	1.50	2.14	1.34	1.60	840	120	720				
								1,500	0.216	324	
1/5	1.68	2.53	1.50	1.87	2,700	420	2,280				
								4,460	0.100	446	
1/10	2.11	2.79	1.64	2.01	7,300	660	6,640				
											1,093.0

NOTE H_1 : Inundation water stage in the mountain-side area

H_2 : Inundation water stage in the city-side area

Table 6-2 (2) ANNUAL EXPECTED DIRECT DAMAGE REDUCTION

FARM CROPS IN THE FIRST DEVELOPMENT STAGE

1	2				3		4	5	6	7	8
Return Period (1/T)	Inundation Water Stage(M.S.L.m)				Flood Damage(10^6Rp)		Flood Damage Reduction (10^6Rp)	Average (10^6Rp)	Expected Value	5 x 6 (10^6Rp)	Total (10^6Rp)
	Without Project		With Project		Without Project	With Project					
	H_1	H_2	H_1	H_2							
(1/1)	(1.30)	(1.89)	(1.12)	(1.27)	20.1	17.3	3.8				
								3.60	0.50	1.800	
1/2	1.45	2.03	1.30	1.54	23.0	19.6	3.4				
								3.45	0.084	0.290	
1/2.4	1.50	2.14	1.34	1.60	23.7	20.2	3.5				
								4.50	0.216	0.972	
1/5	1.68	2.53	1.50	1.87	27.2	21.7	5.5				
								6.20	0.100	0.620	
1/10	2.11	2.79	1.64	2.01	31.4	24.5	6.9				
											3.682

NOTE H_1 : Inundation water stage in the mountain-side area

H_2 : Inundation water stage in the city-side area

Table 6-3 BREAKDOWN OF ECONOMIC COST

WORKS	UNIT	QUANTITY	COST ($x10^3$US$) F.C.	L.C.
1. RIVER IMPROVEMENT				
Main Works				
Dredgeing	m^3	264,000	225	233
Excavation	m^3	530,000	1,051	946
Embankment	m^3	95,500	202	199
Sodding	m^2	83,000	-	41
Revetment	m	5,700	-	1,155
Groyne	pc	23	-	53
Sluice	pc	3	1	31
Drainage Ditch	m	2,800	9	9
Road Raising	m	2,950	27	162
Sub-Total			1,515	2,829
Preparatory Work	LS		227	424
Land Acquisition and House Evacuation	LS		-	55
Total for 1			1,742	3,308
2. DRAINAGE CHANNEL				
Main Works				
Excavation	m^3	399,200	339	184
Foundation	m	23,290	-	207
Revetment	m^2	93,700	-	937
Backfill	m^3	10,500	-	2
Filling	m^3	19,500	6	4
Spoil	m^3	369,200	334	406
Dredging	m^3	138,400	195	227
Bridge	nos.	22	8	621
Sluice	nos.	1	1	64
Sub-Total			883	2,652
Preparatory Work	LS		132	398
Land Acquisition and House Evacuation	LS		-	824
Total for 2			1,015	3,874
Total for 1 and 2			2,757	7,182
3. Engineering	LS		1,606	357
Grand Total			4,363	7,539

Table 6-4 ANNUAL DISBURSEMENT OF ECONOMIC COST

UNIT: $x10^3$US$

	ITEM	TOTAL		1		2		3		4		5	
		F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
Jeneberang River Improvement	MAIN WORKS	1,515.0	2,829.0	-	-	226.8	253.9	441.1	744.4	403.3	864.6	443.8	966.1
	PREPARATORY WORK	75.8	141.4	-	-	11.3	12.7	22.1	37.2	20.2	43.2	22.2	48.3
	SURVEY & SOIL TEST	151.5	282.9	-	-	22.7	25.4	44.1	74.4	40.3	86.5	44.4	96.6
	LAND ACQUISITION	-	35.4	-	-	-	5.8	-	9.1	-	2.8	-	17.7
	HOUSE EVACUATION	-	19.2	-	-	-	6.4	-	6.4	-	3.2	-	3.2
	SUB-TOTAL	1,742.3	3,307.9	-	-	260.8	304.2	507.3	871.5	463.8	1,000.3	510.4	1,131.9
Drainage System Improvement	PANAMPU ROUTE	293.5	1,054.3	-	-	206.1	623.6	87.4	430.7	-	-	-	-
	JONGAYA ROUTE	543.4	1,233.1	-	-	77.9	90.7	264.4	522.3	201.0	620.1	-	-
	SINRIJALA ROUTE	45.4	365.3	-	-	-	-	-	-	-	-	45.4	365.3
	PREPARATORY WORK	44.1	132.7	-	-	14.2	35.7	17.6	47.7	10.1	31.0	2.3	18.3
	SURVEY & SOIL TEST	88.2	265.2	-	-	28.4	71.4	35.2	95.3	20.1	62.0	4.5	36.5
	LAND ACQUISITION	-	705.3	-	-	-	229.1	-	252.1	-	162.7	-	61.4
	HOUSE EVACUATION	-	118.4	-	-	-	44.8	-	48.0	-	25.6	-	-
	SUB-TOTAL	1,014.6	3,874.3	-	-	326.6	1,095.3	404.6	1,396.1	231.2	901.4	52.2	481.5
	ENGINEERING WORK	1,606.0	357.4	750.0	120.0	216.0	59.7	240.0	66.3	200.0	55.5	200.0	55.5
	TOTAL	4,362.9	7,539.2	750.0	120.0	803.4	1,459.2	1,151.9	2,333.9	895.0	1,957.2	762.6	1,668.9
	GRAND TOTAL	11,902.1		920.0		2,262.6		3,485.8		2,852.2		2,431.5	

NOTE: The maiantenance cost is not included in this table
Conversion rate; 250 YEN to 1 US$

Table 6-5 BREAKDOWN OF OPERATION AND MAINTENANCE COST

Unit: $x10^3$Rp.

Item	1983		1984		1985		1986 - 2030	
	Number	Amount	Number	Amount	Number	Amount	Number	Amount
Remuneration								
- Supervisor	1 person	1,080	1 person	1,080	1 person	1,080	1 person	1,080
- Staff	1 person	720	2 persons	1,440	4 persons	2,160	6 persons	4,320
- Driver	1 person	480	1 person	480	2 persons	960	2 persons	960
- Operator	1 person	1,080	1 person	1,080	1 person	1,080	1 perosn	1,080
- Labor	6 persons	1,620	8 persons	2,160	10 persons	2,700	12 persons	3,240
Machinery								
- Jeep	1 nos.	1,000	1 nos.	1,000	2 nos.	2,000	2 nos.	2,000
- Clamshell	1 nos.	9,000	1 nos.	9,000	1 nos.	9,000	1 nos.	9,000
- Mechinary Maintenance	L.S.	5,000	L.S.	5,000	L.S.	5,500	L.S.	5,500
Office running Cost	L.S.	4,000	L.S.	4,000	L.S.	4,000	L.S.	4,000
Miscellaneous	L.S.	2,370	L.S.	2,520	L.S.	2,850	L.S.	3,120
T o t a l		26,080		27,760		31,330		34,300

Fig. 3-1 LOCATION MAP

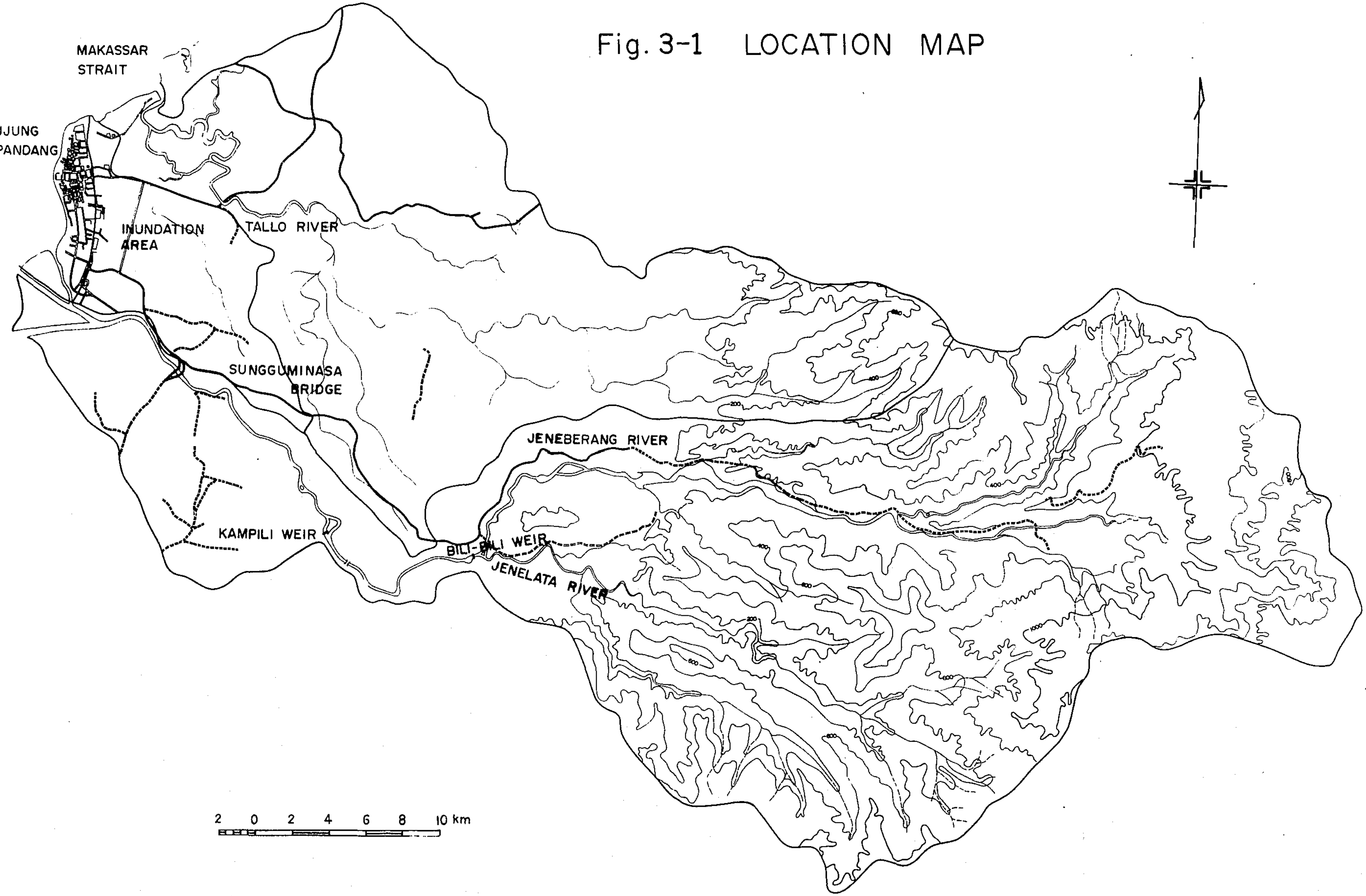


Fig. 3-2 PROJECT AREA AND DEVELOPMENT AREA

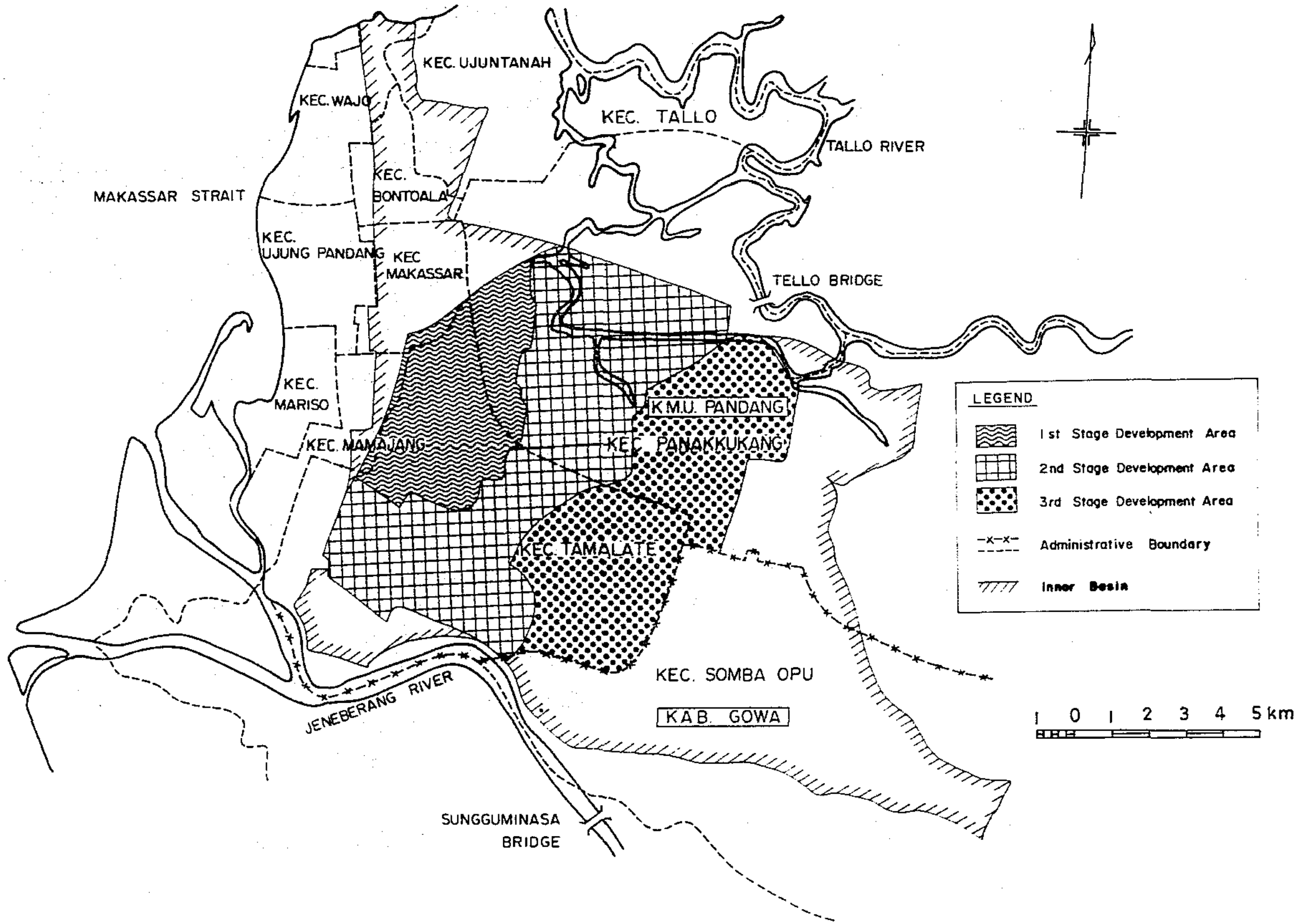


Fig. 3-3 PRESENT DRAINAGE AREA AND DRAINAGE CHANNELS

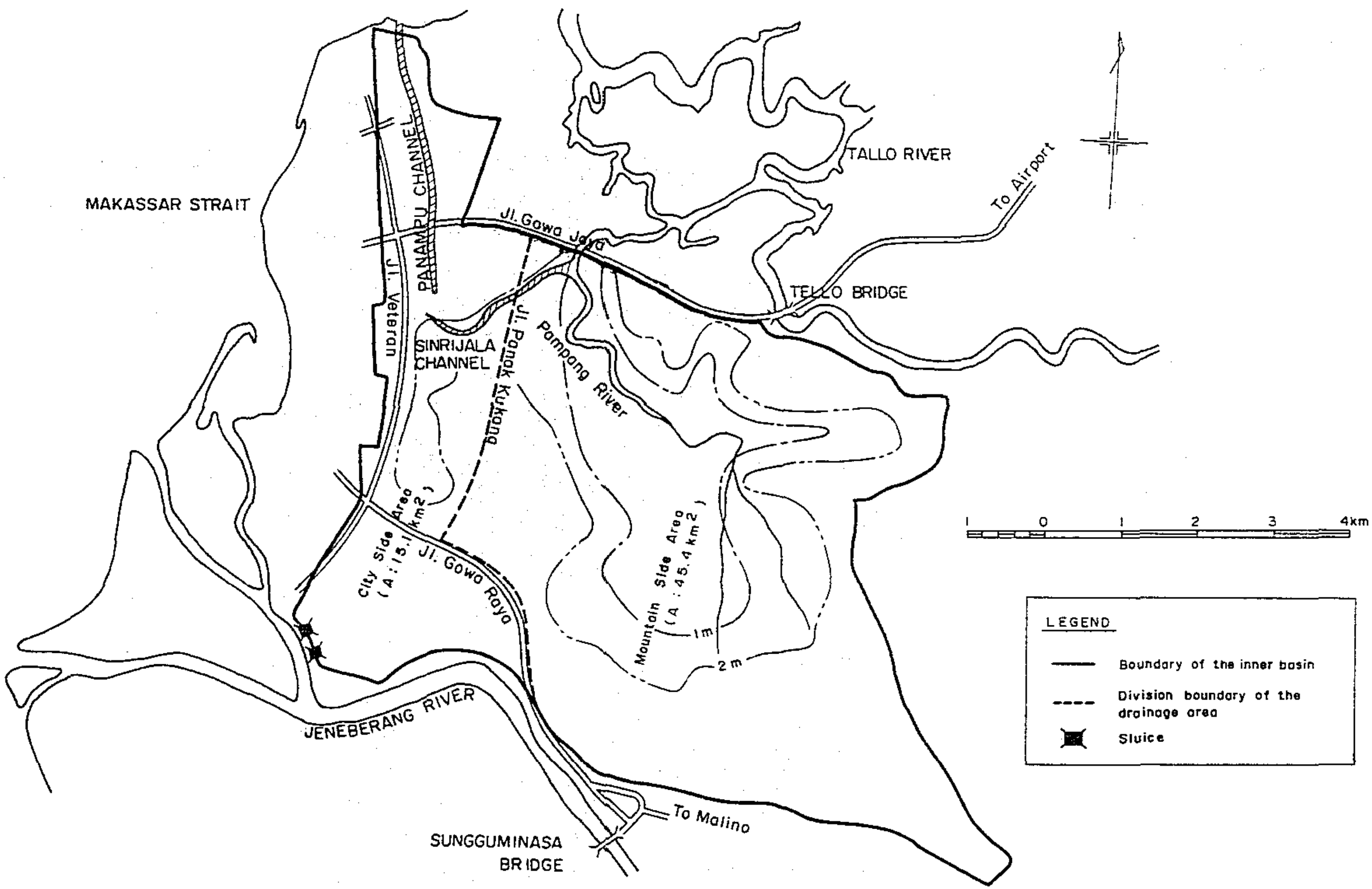


Fig. 3-4 TRANSITION OF ESTUARY SAND BAR

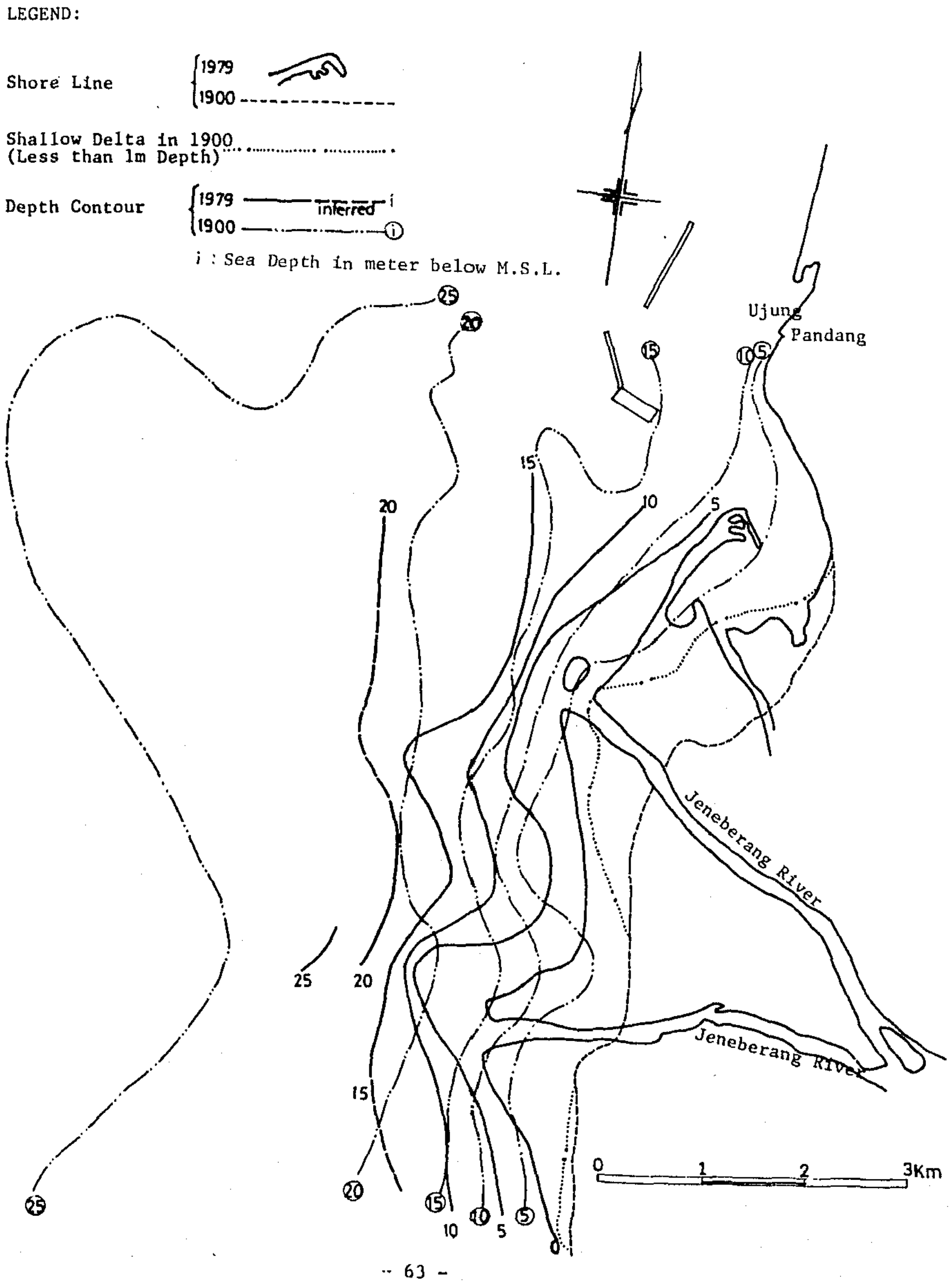
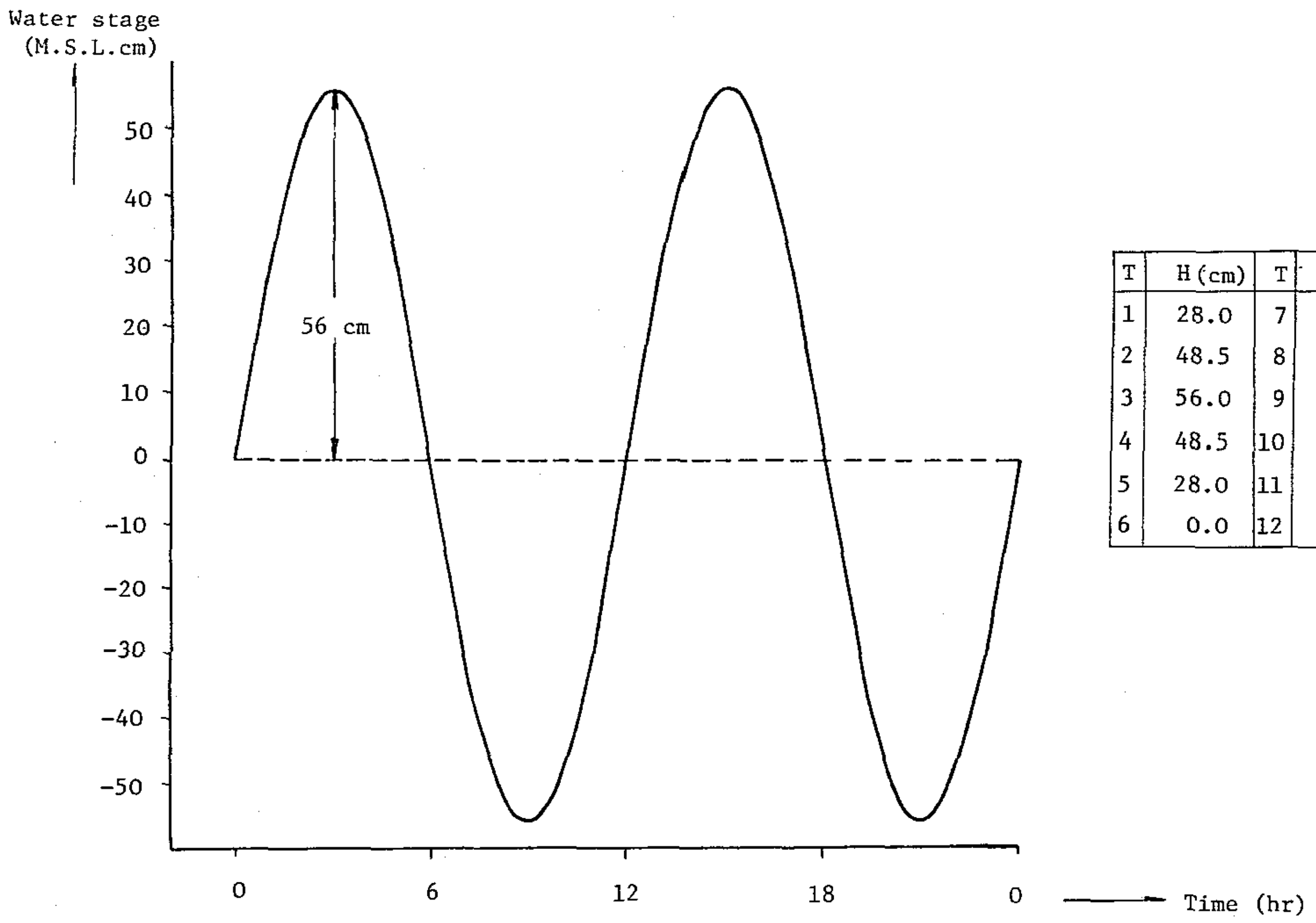


Fig. 3-5 MODEL TIDAL HYDROGRAPH



T	H (cm)	T	H (cm)
1	28.0	7	-28.0
2	48.5	8	-48.5
3	56.0	9	-56.0
4	48.5	10	-48.5
5	28.0	11	-28.0
6	0.0	12	0.0

Fig. 3-6 GEOLOGICAL MAP

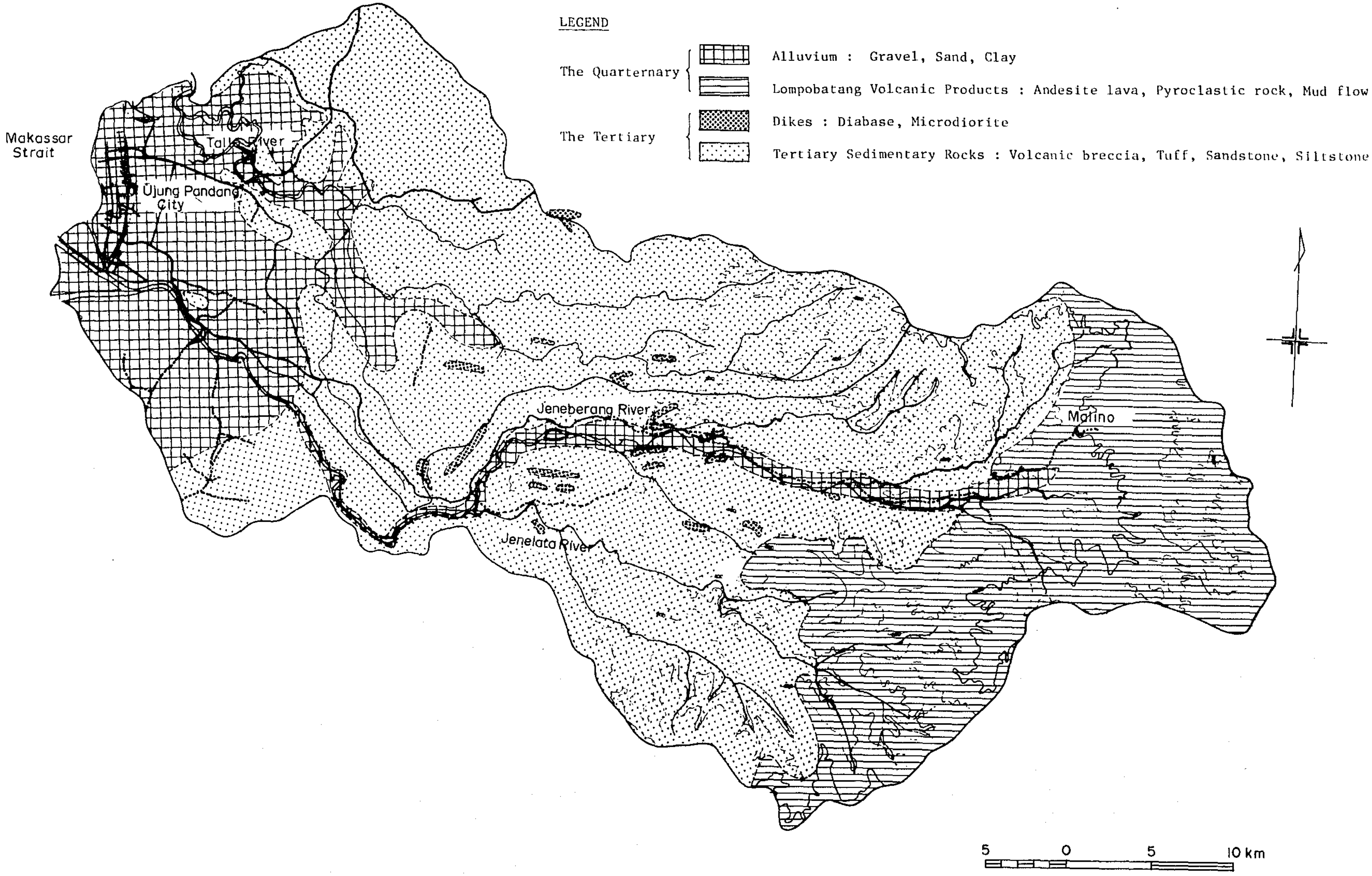


Fig. 3-7 GENERAL MAP OF JENEBERANG RIVER COURSE

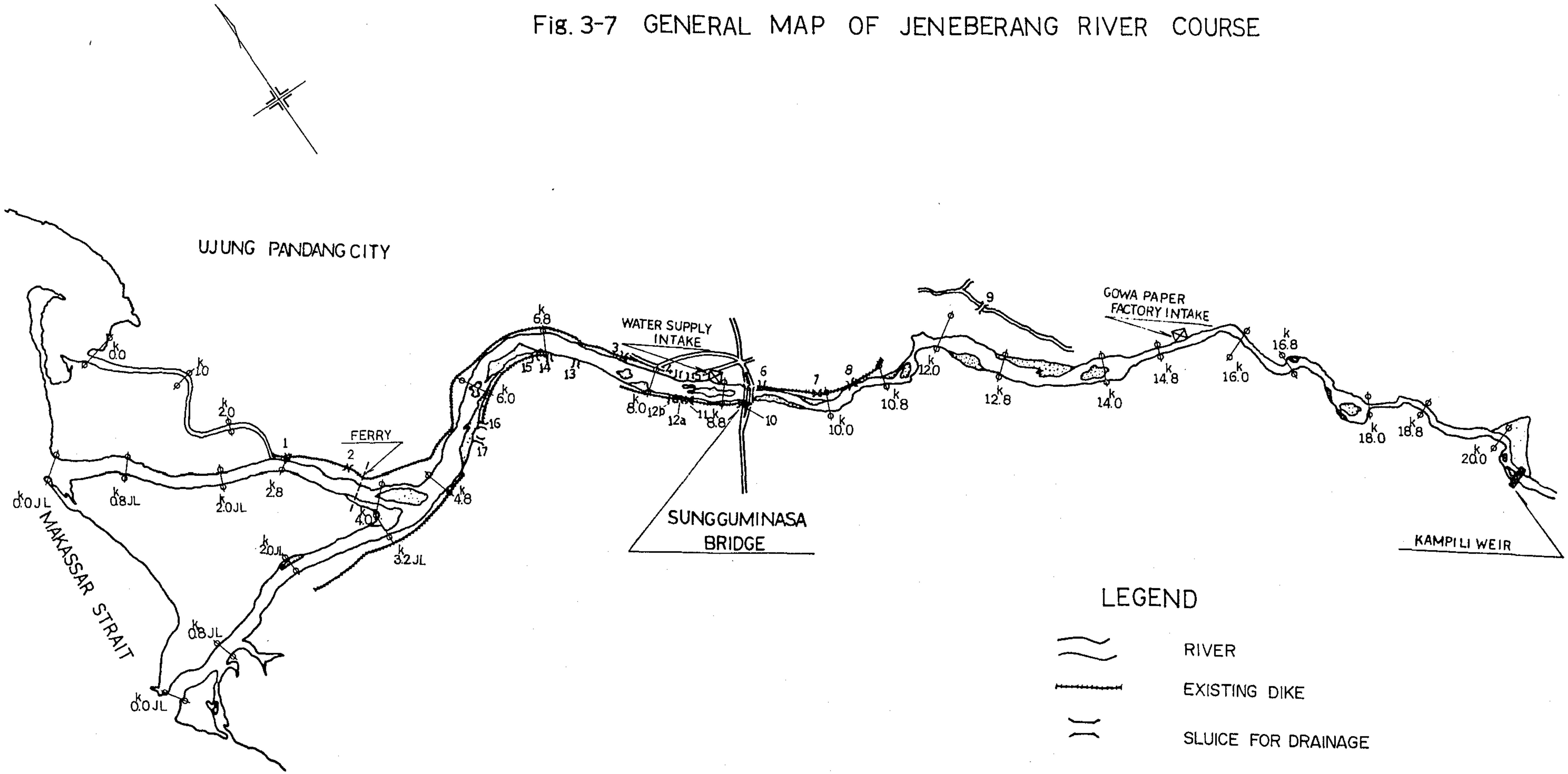


Fig. 3-8 PRESENT FLOW CAPACITY OF JENEBERANG RIVER

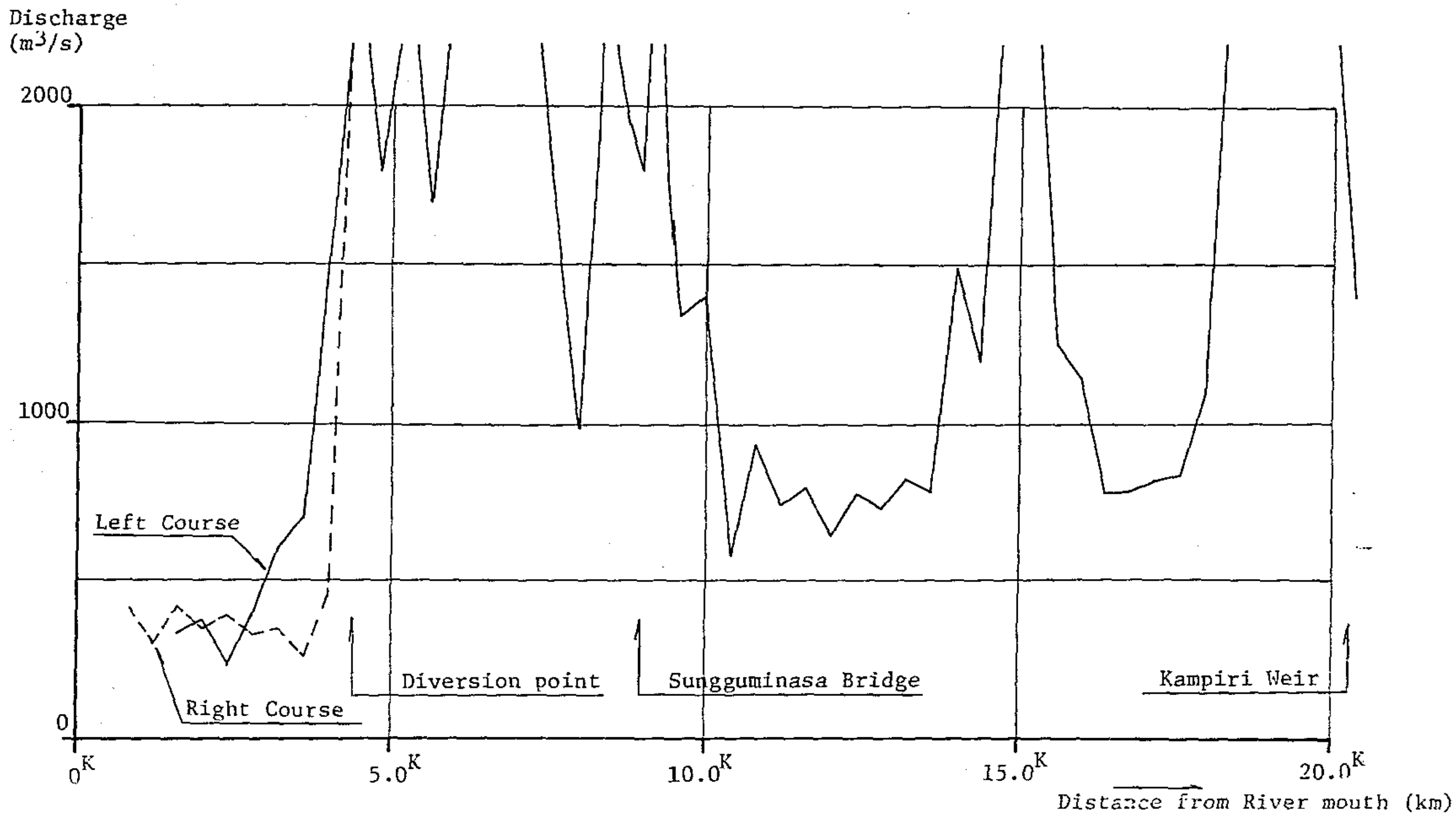


Fig. 3-9 CROSS-SECTION OF THE JENEBERANG AND TALLO RIVERS

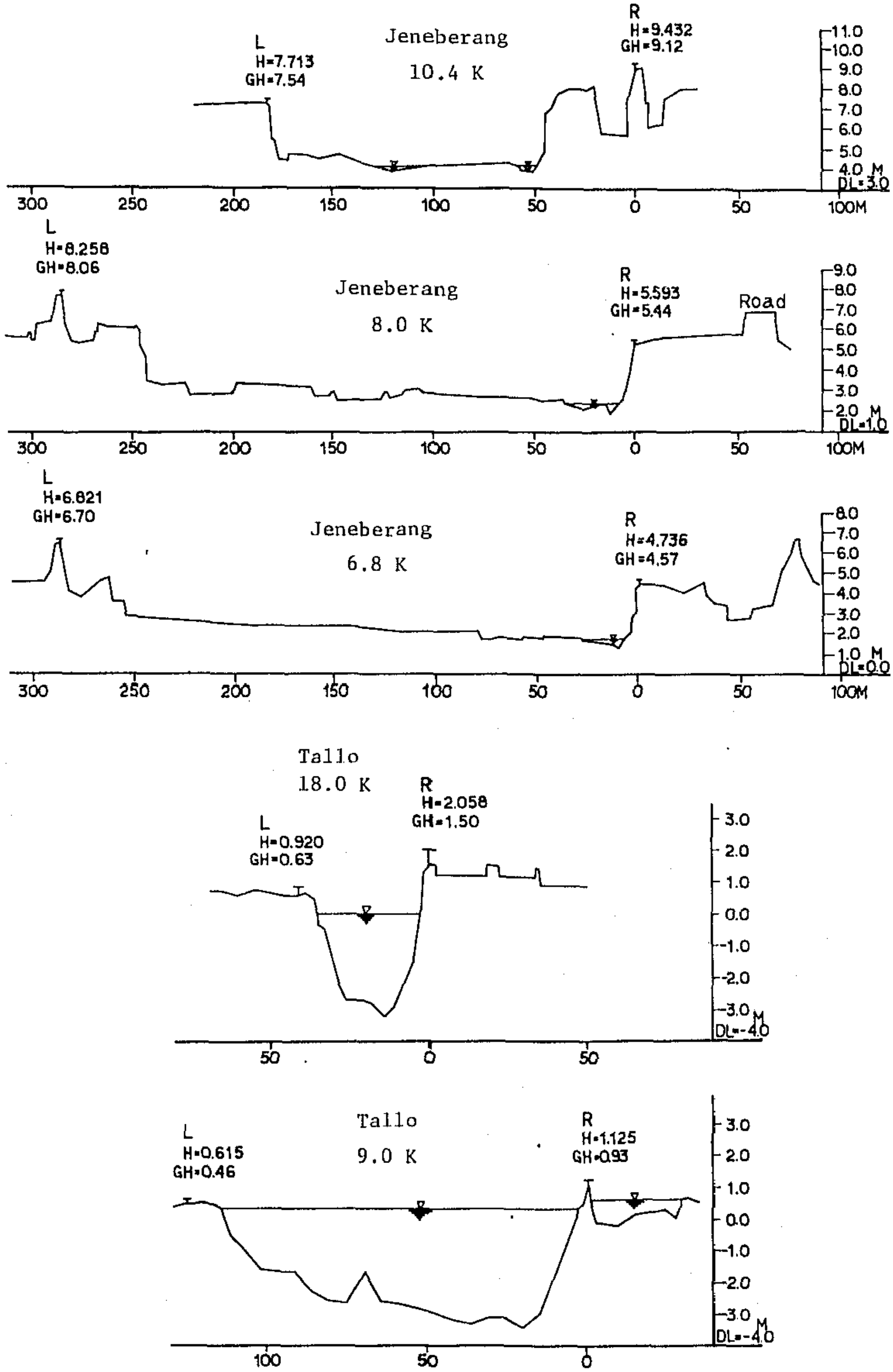
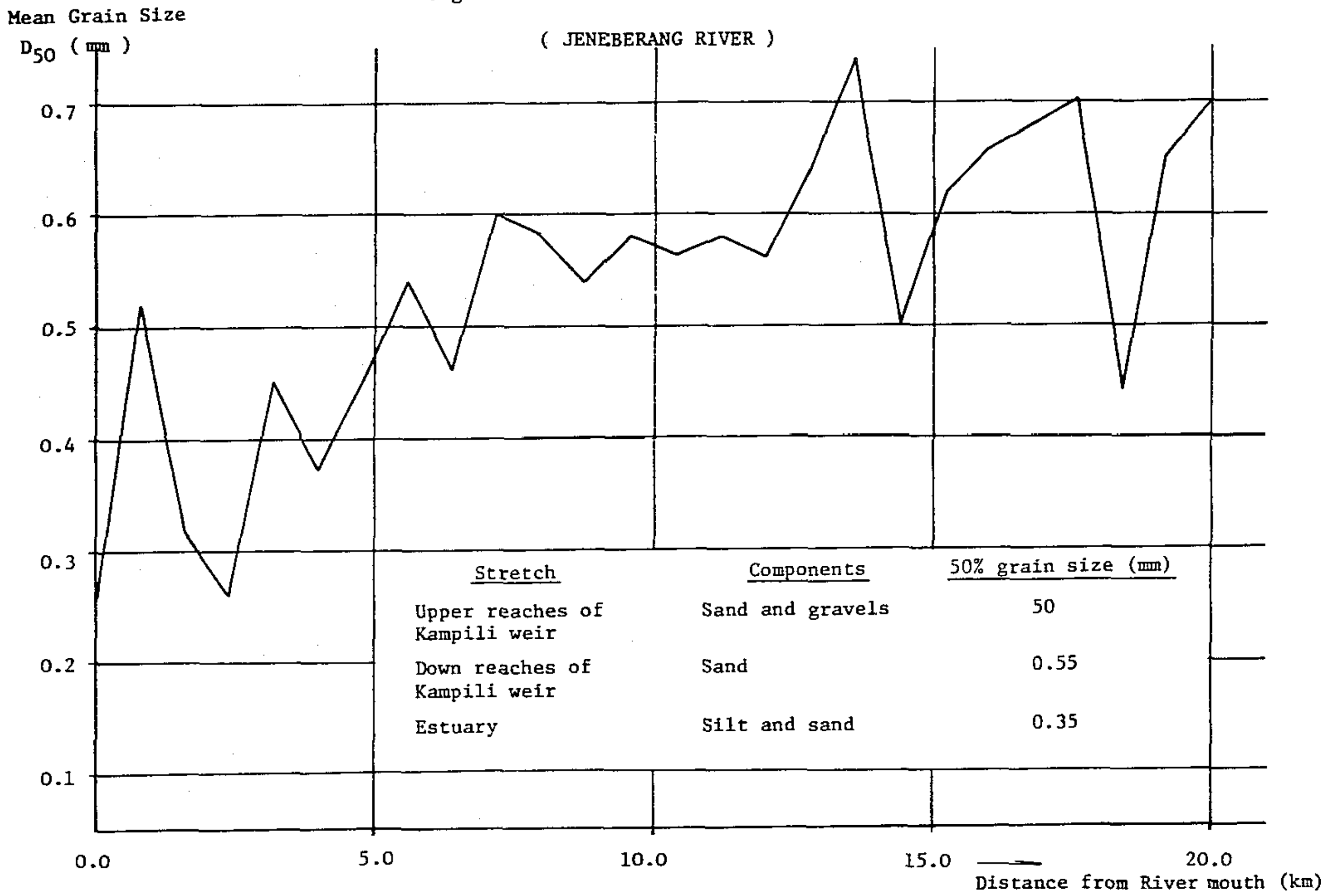


Fig. 3-10 MEAN GRAIN SIZE DISTRIBUTION

(JENEBERANG RIVER)



Stretch	Components	50% grain size (mm)
Upper reaches of Kampili weir	Sand and gravels	50
Down reaches of Kampili weir	Sand	0.55
Estuary	Silt and sand	0.35

Fig. 3-11 GENERAL MAP OF TALLO RIVER COURSE

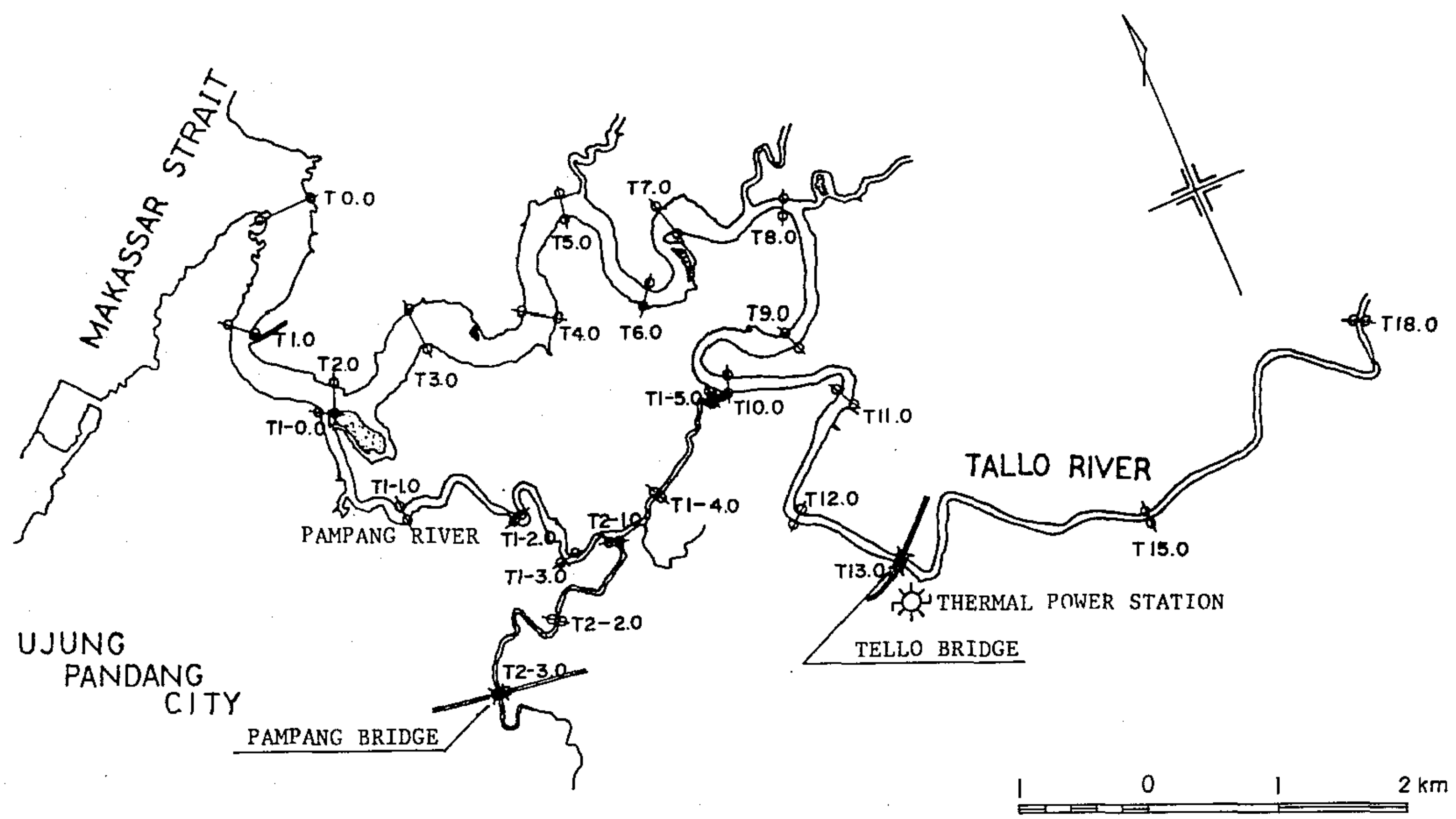


Fig. 3-12 INUNDATION MAP DURING THE FLOOD OF JAN. 1976

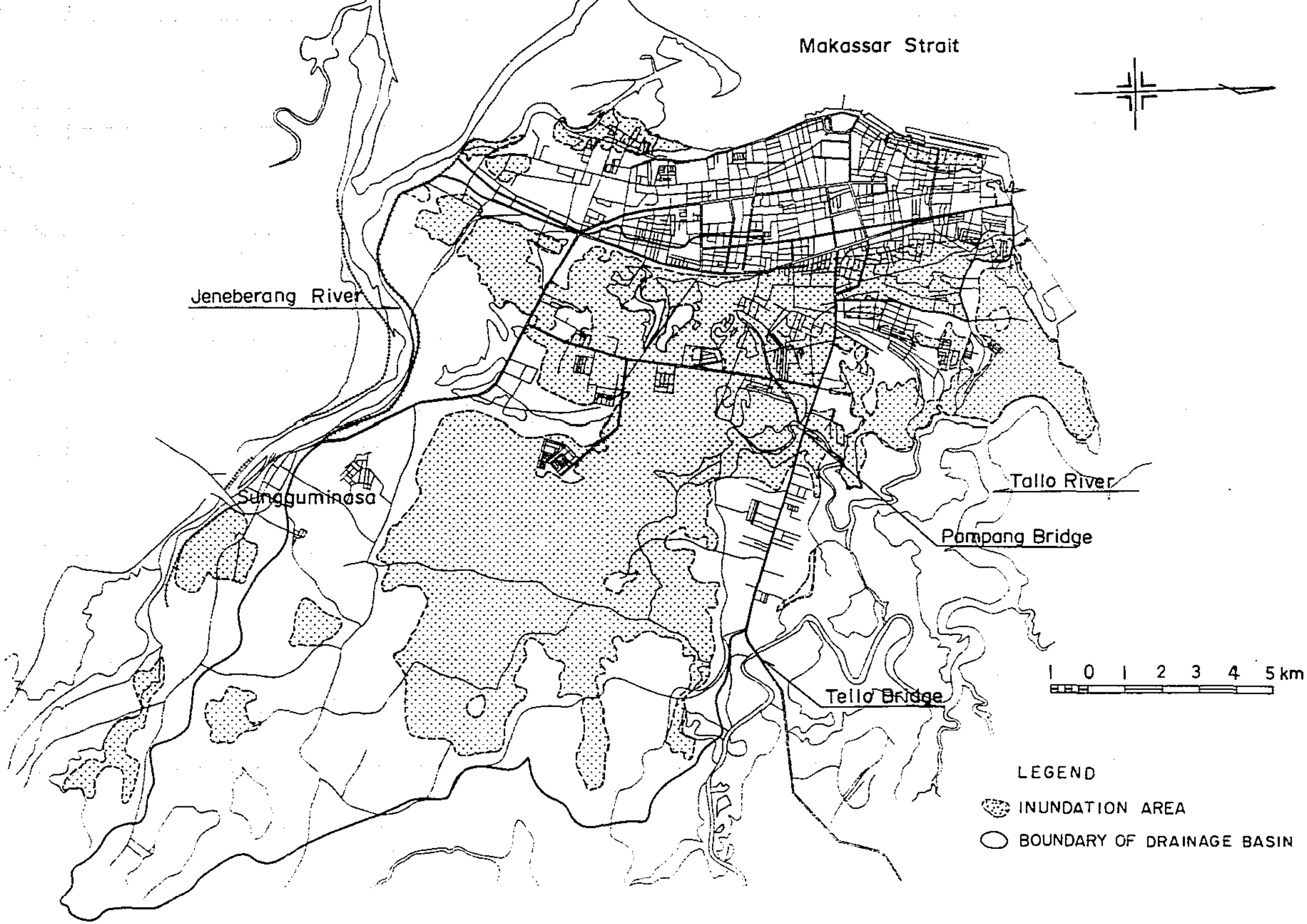
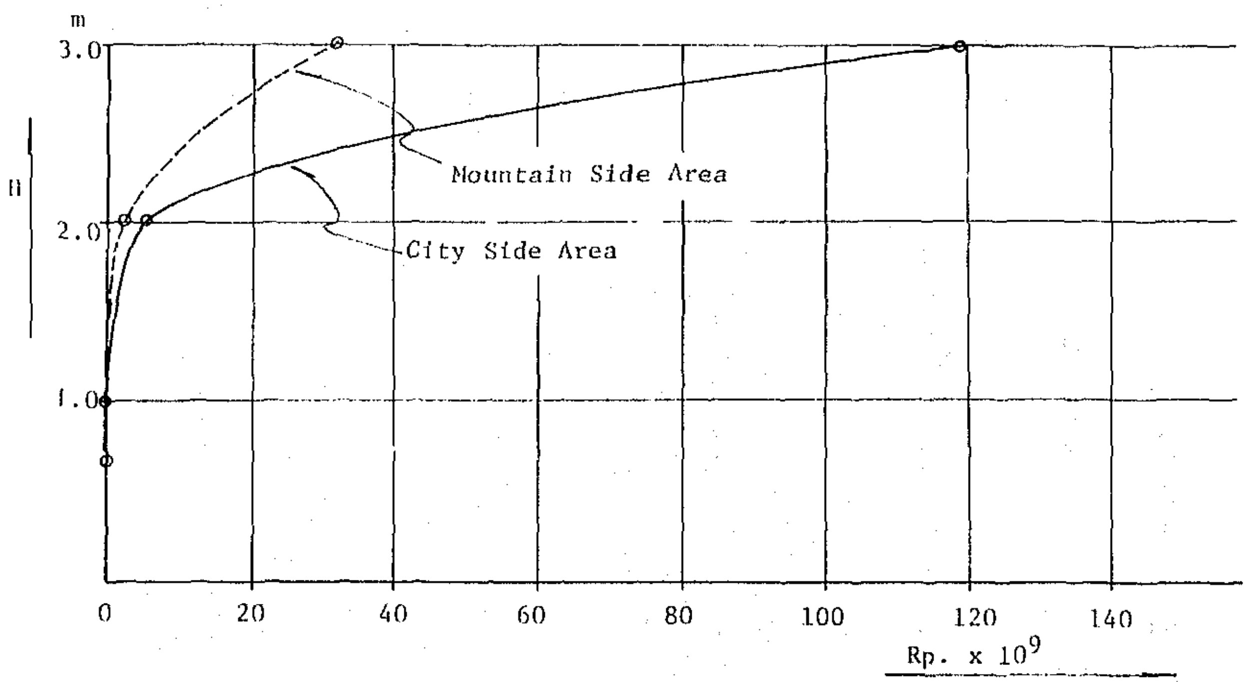


Fig. 3-13 (1) ASSETS - GROUND HEIGHT CURVE

Existing



1st Stage

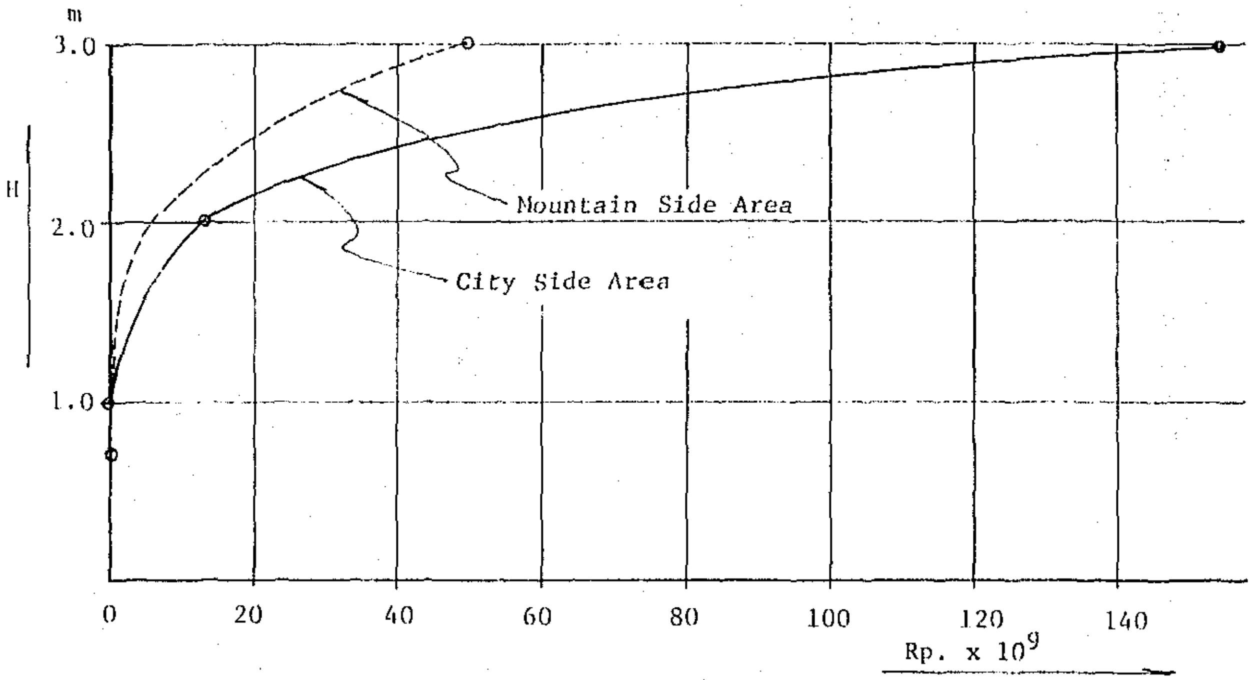
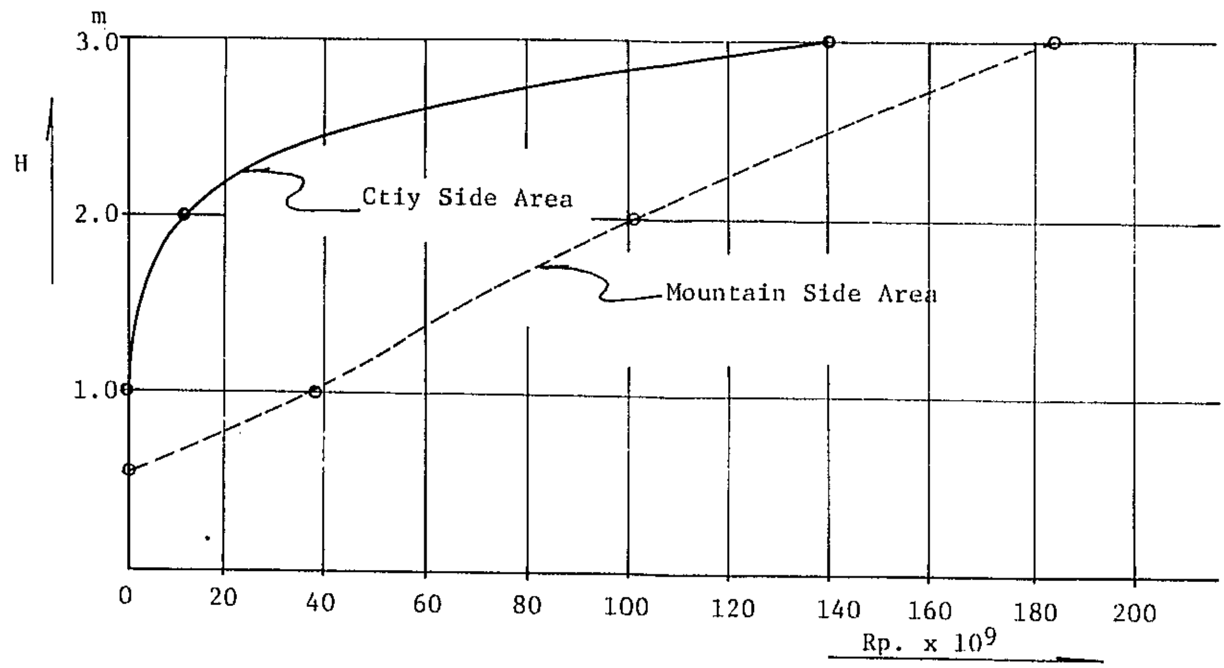


Fig. 3-13 (2) ASSETS - GROUND HEIGHT CURVE

2nd Stage



3rd Stage

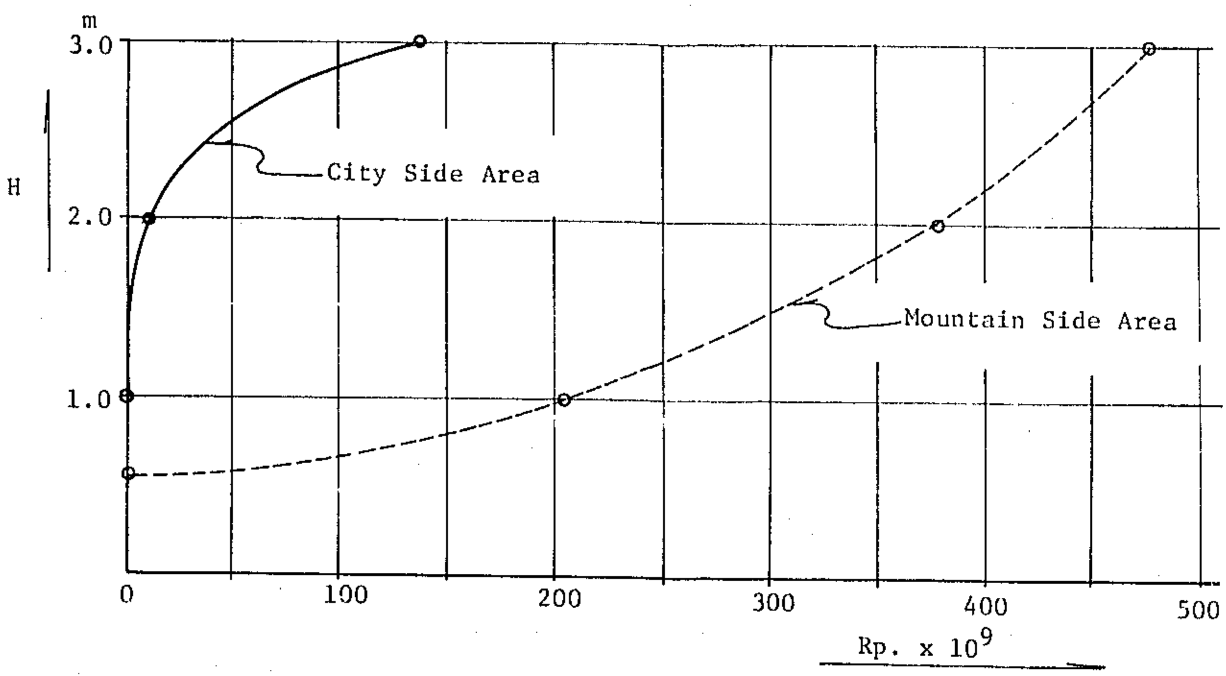
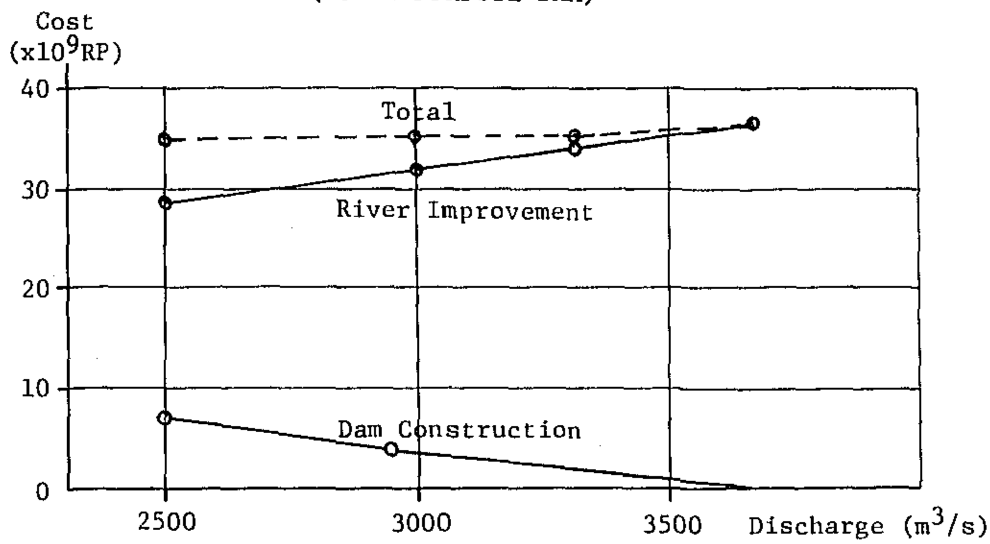


Fig.4-1 RELATION BETWEEN COST AND DISCHARGE
(MULTI-PURPOSE DAM)



Note: The cost allocated to flood control capacity of a multipurpose dam is counted for the dam construction cost.

Fig.4-2 DISCHARGE - LAND ACQUISITION AND
DISCHARGE - HOUSE EVACUATION CURVES
(River Improvement and Dam Construction)

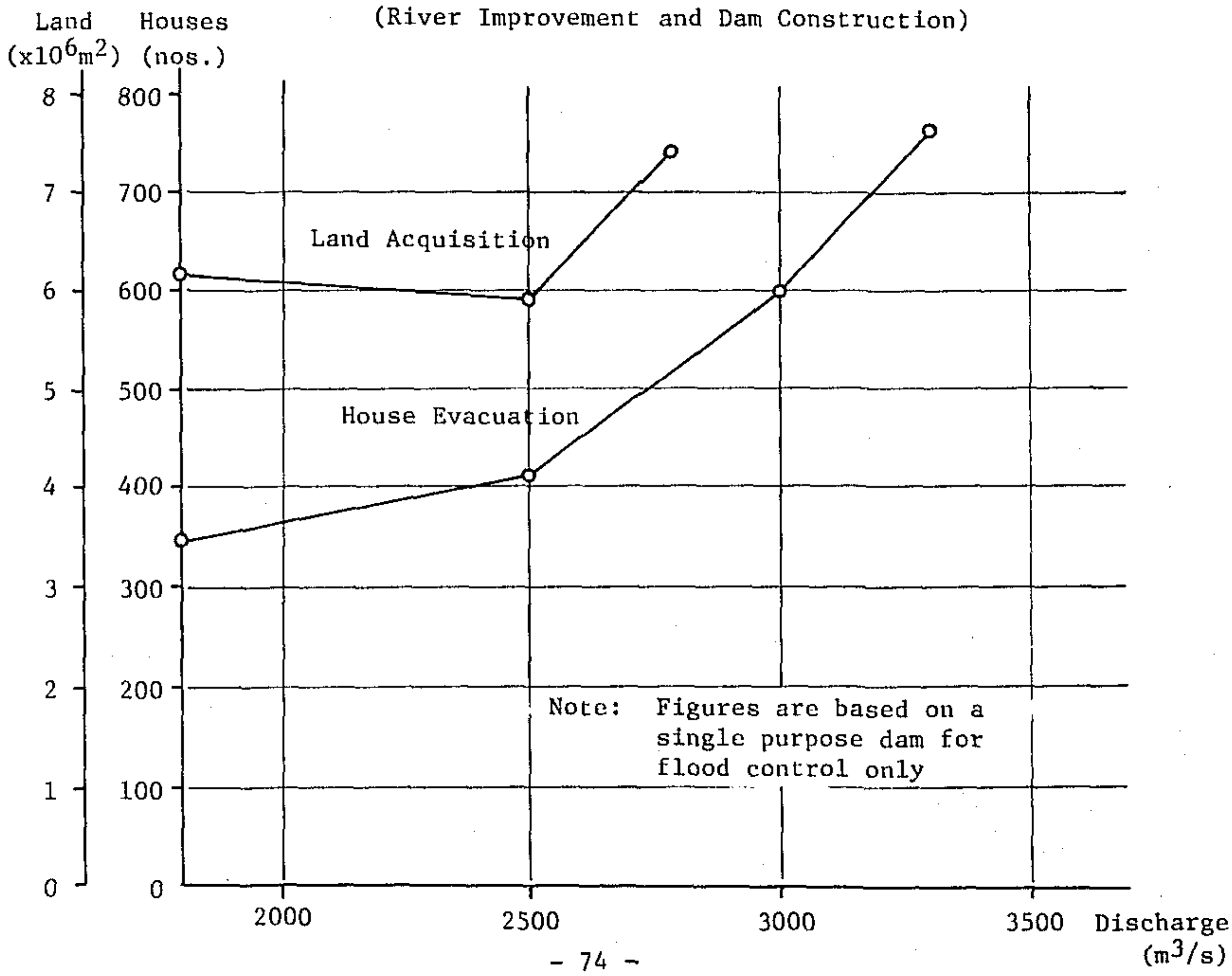


Fig. 4-3 FLOOD HYDROGRAPH

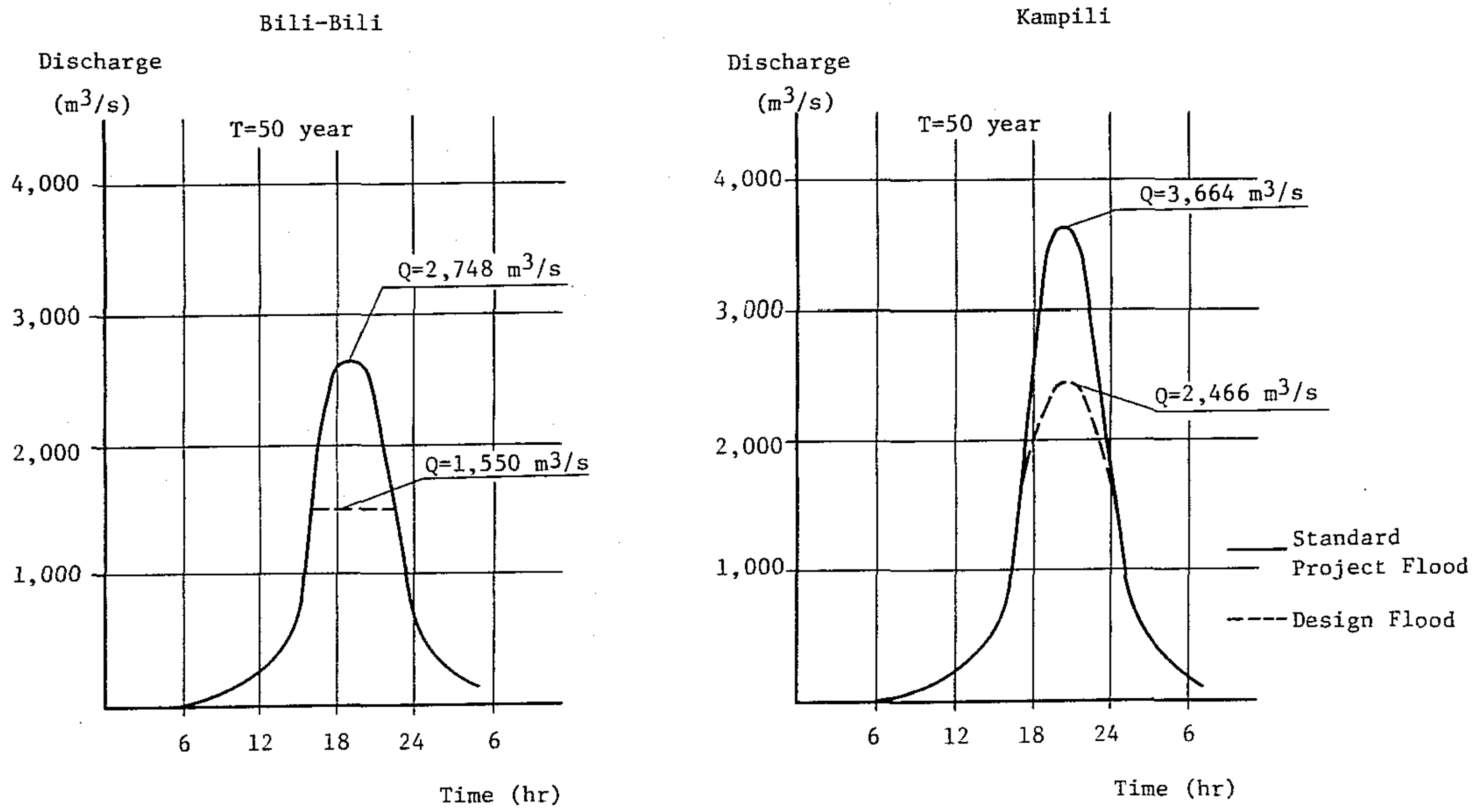
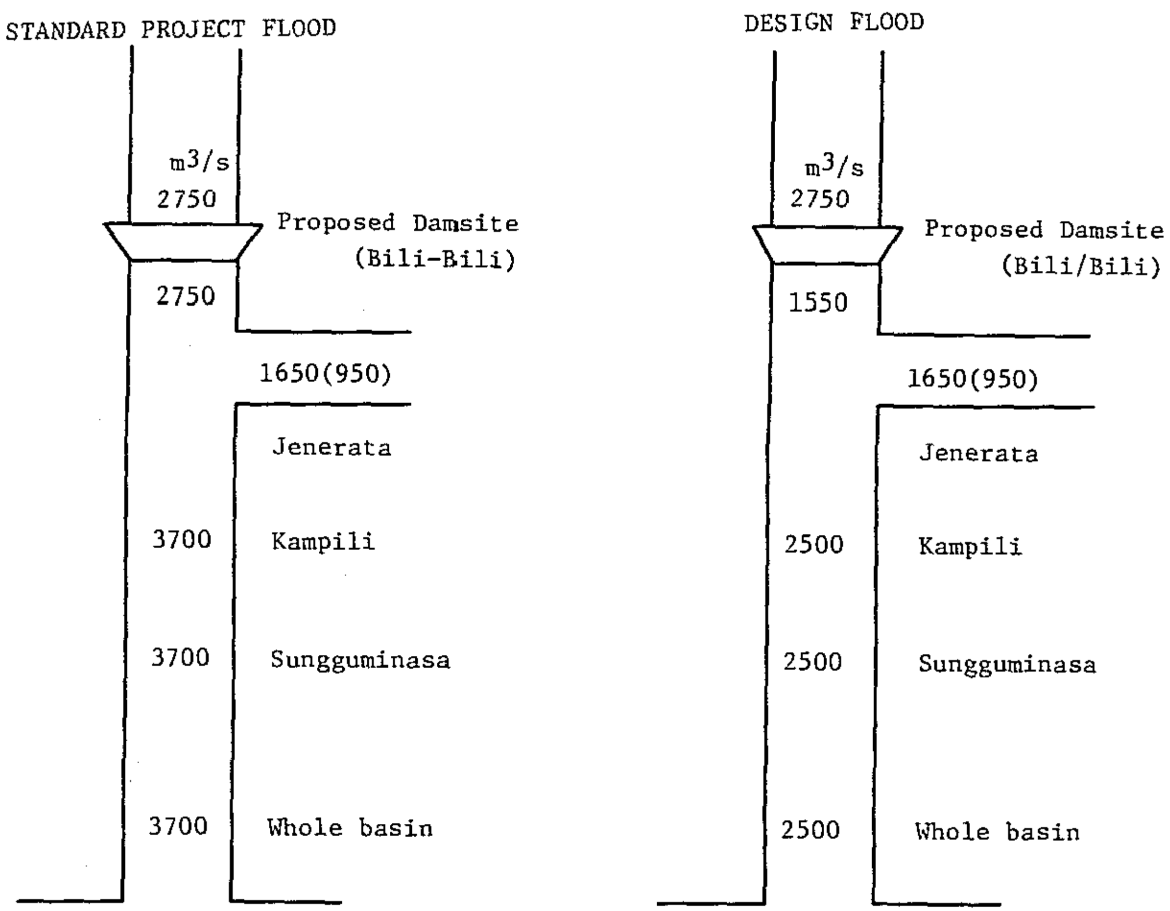


Fig. 4-4 FLOOD DISTRIBUTION

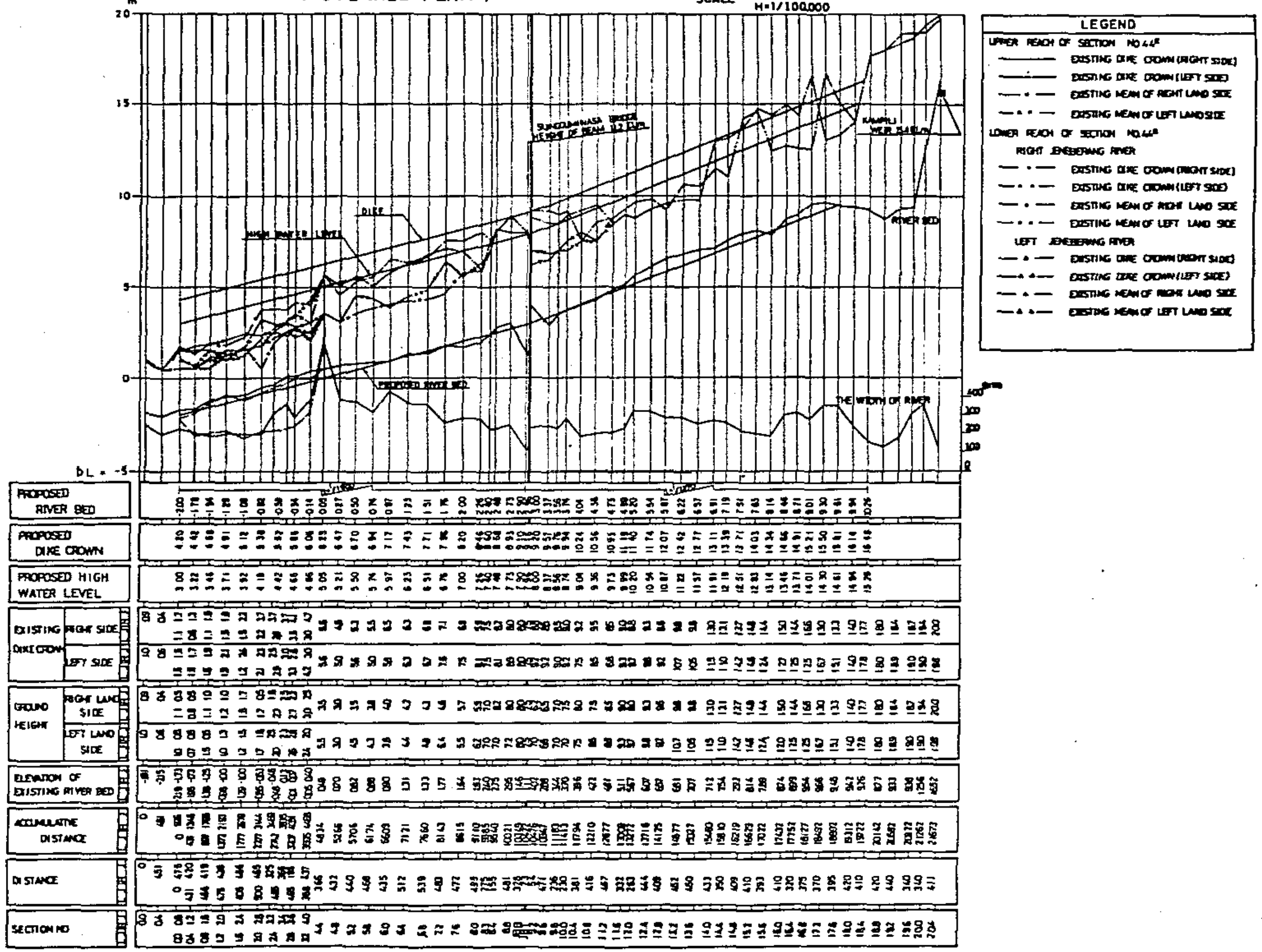


Note : Figures in parentheses represent discharge joining the main stream

Fig. 4-5 PROPOSED LONGITUDINAL PROFILE OF JENEBERANG RIVER

(OVERALL PLAN)

SCALE V= 1/200 H=1/100,000



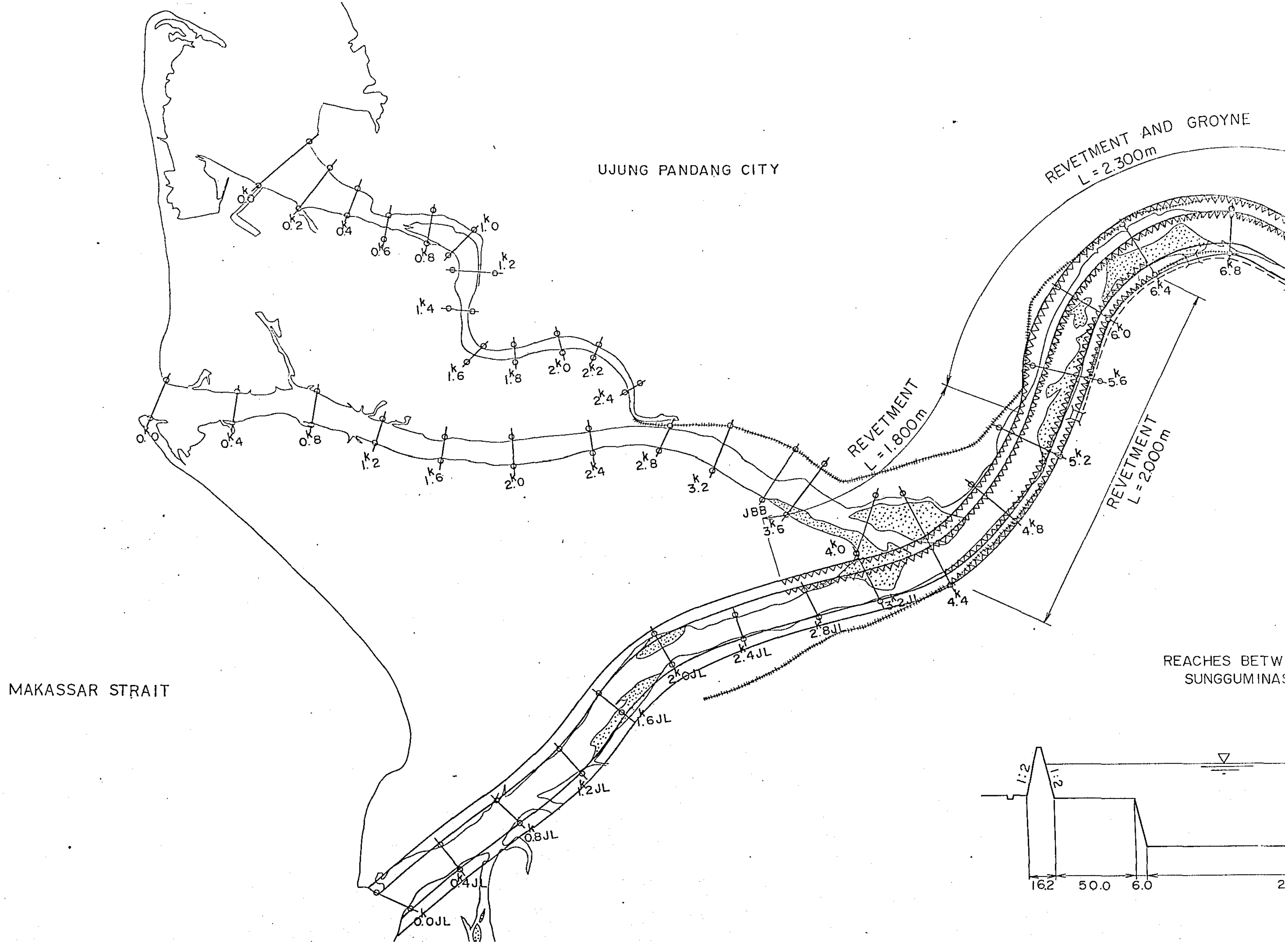
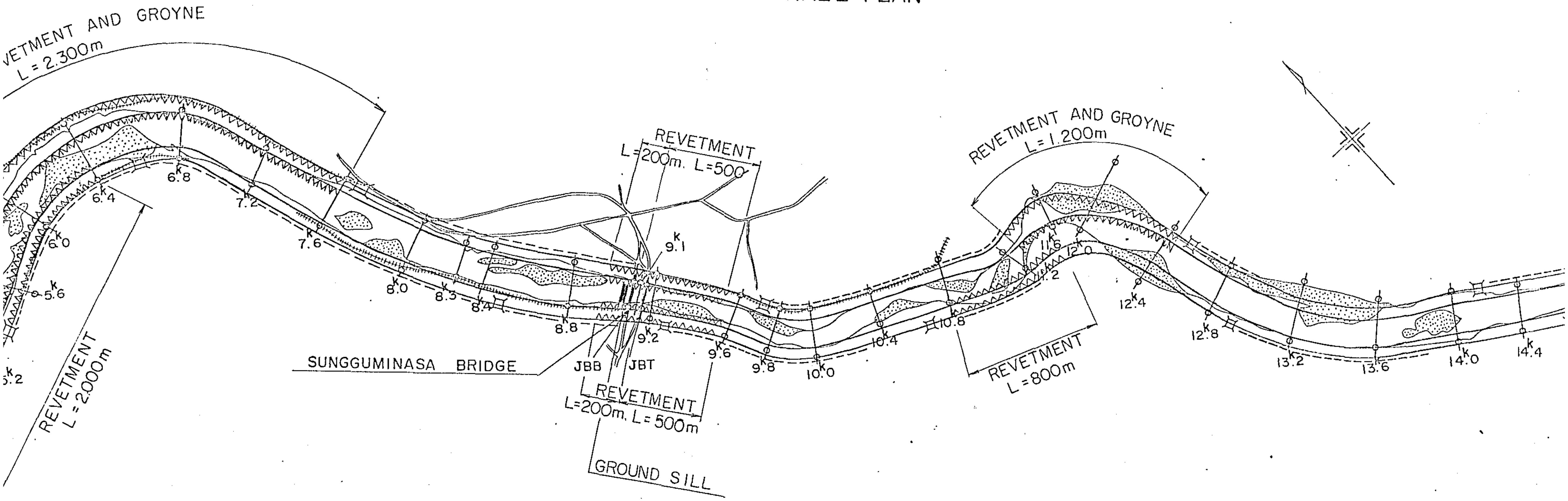
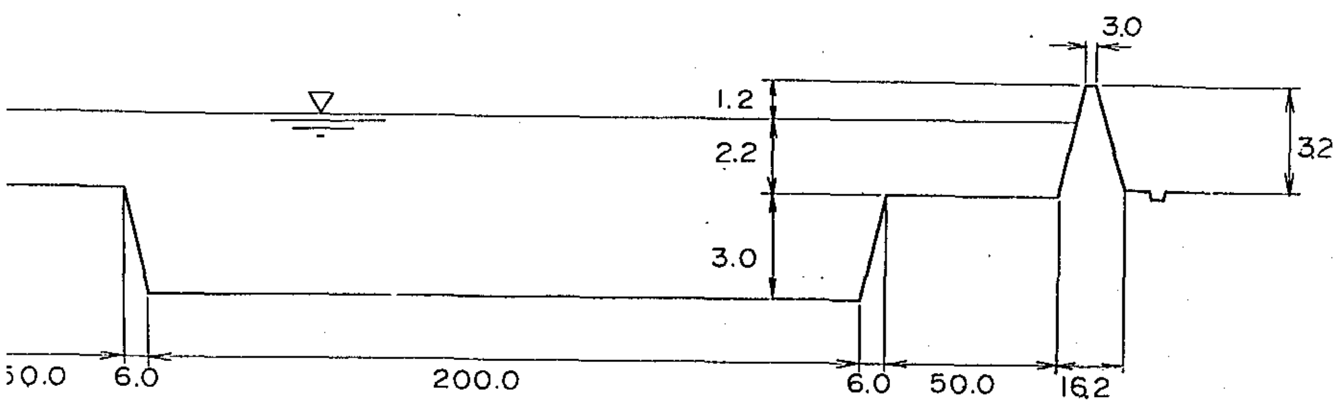

UJUNG PANDANG CITY
MAKASSAR STRAIT
REVETMENT AND GROYNE
L = 2.300m
REVETMENT
L = 1.800m
REVETMENT
L = 2.000m
JBB
REACHES BETW
SUNGGUMINAS
1:2
1:2
16.2
50.0
6.0

Fig. 4-6 PROPOSED ALIGNMENT FOR OVERALL PLAN

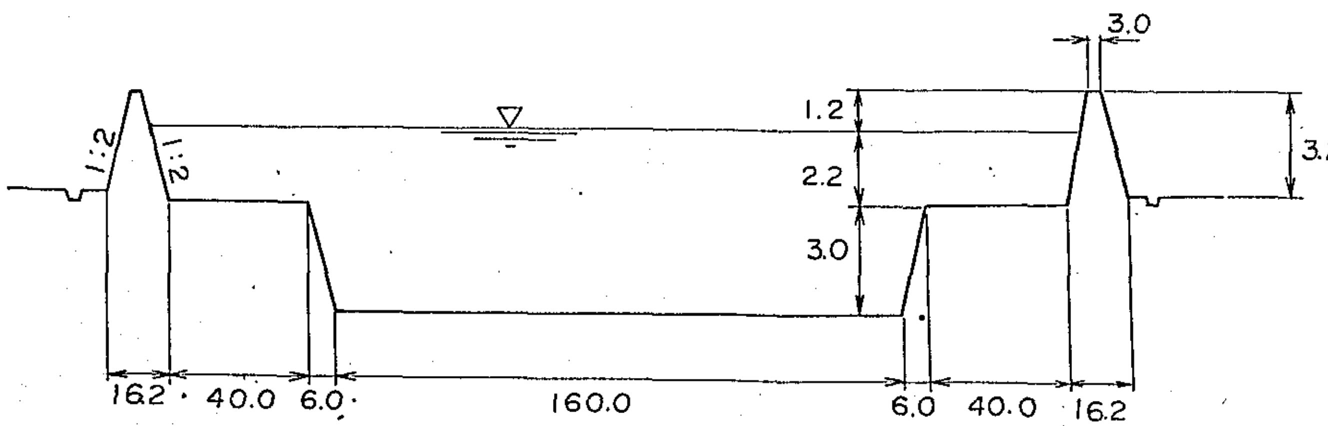


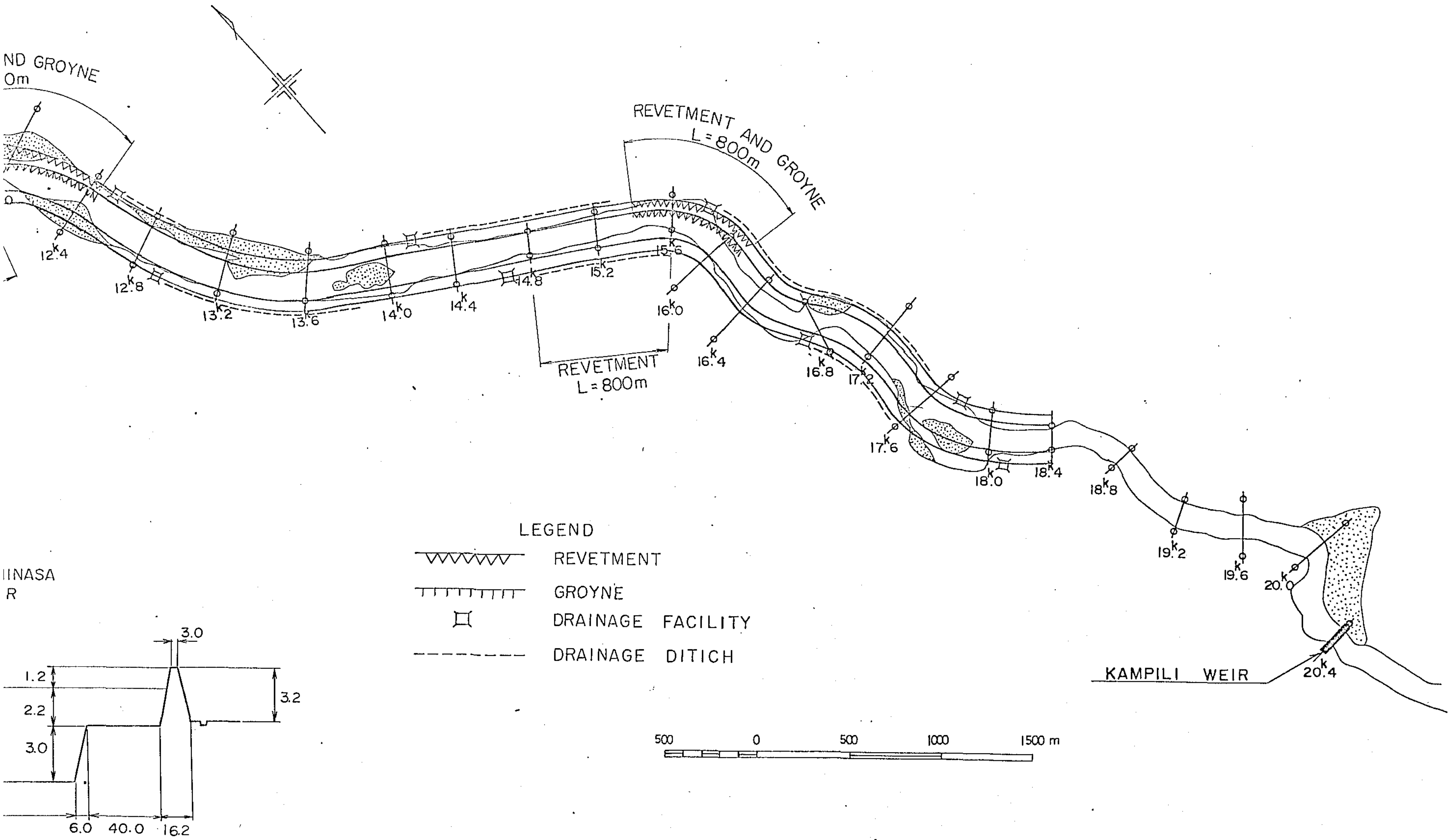
STANDARD CROSS - SECTION

REACHES BETWEEN ESTUARY AND SUNGGUMINASA BRIDGE



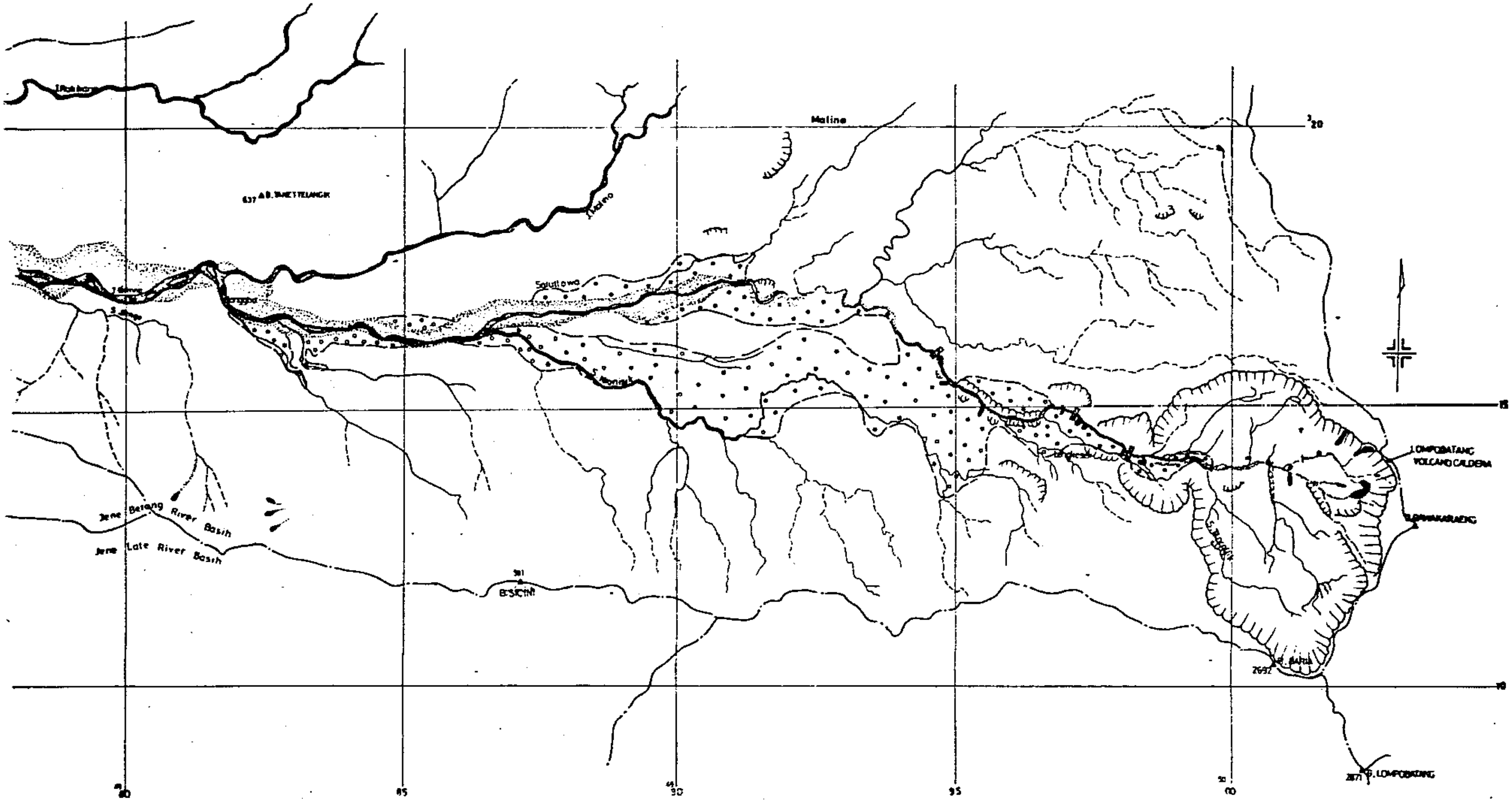
REACHES BETWEEN SUNGGUMINASA BRIDGE AND KAMPILI WEIR





ND GROYNE
0m
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
REVETMENT AND GROYNE
L = 800m
REVETMENT
L = 800m
KAMPILI WEIR
LEGEND
REVETMENT
GROYNE
DRAINAGE FACILITY
DRAINAGE DITICH
IINASA
R
3.0
1.2
2.2
3.0
3.2
6.0
40.0
16.2
500
0
500
1000
1500 m

Fig. 4-7 DISTRIBUTION OF COLLAPSES AND LOCATION OF THE PROPOSED SABO DAMS



Legend: Collapse, Sabo Dam, Cliff, River Bed Deposite, Terrace Fun.

Fig. 4-8 LOCATION OF BILI-BILI DAM AND HYDRAULIC FACILITIES

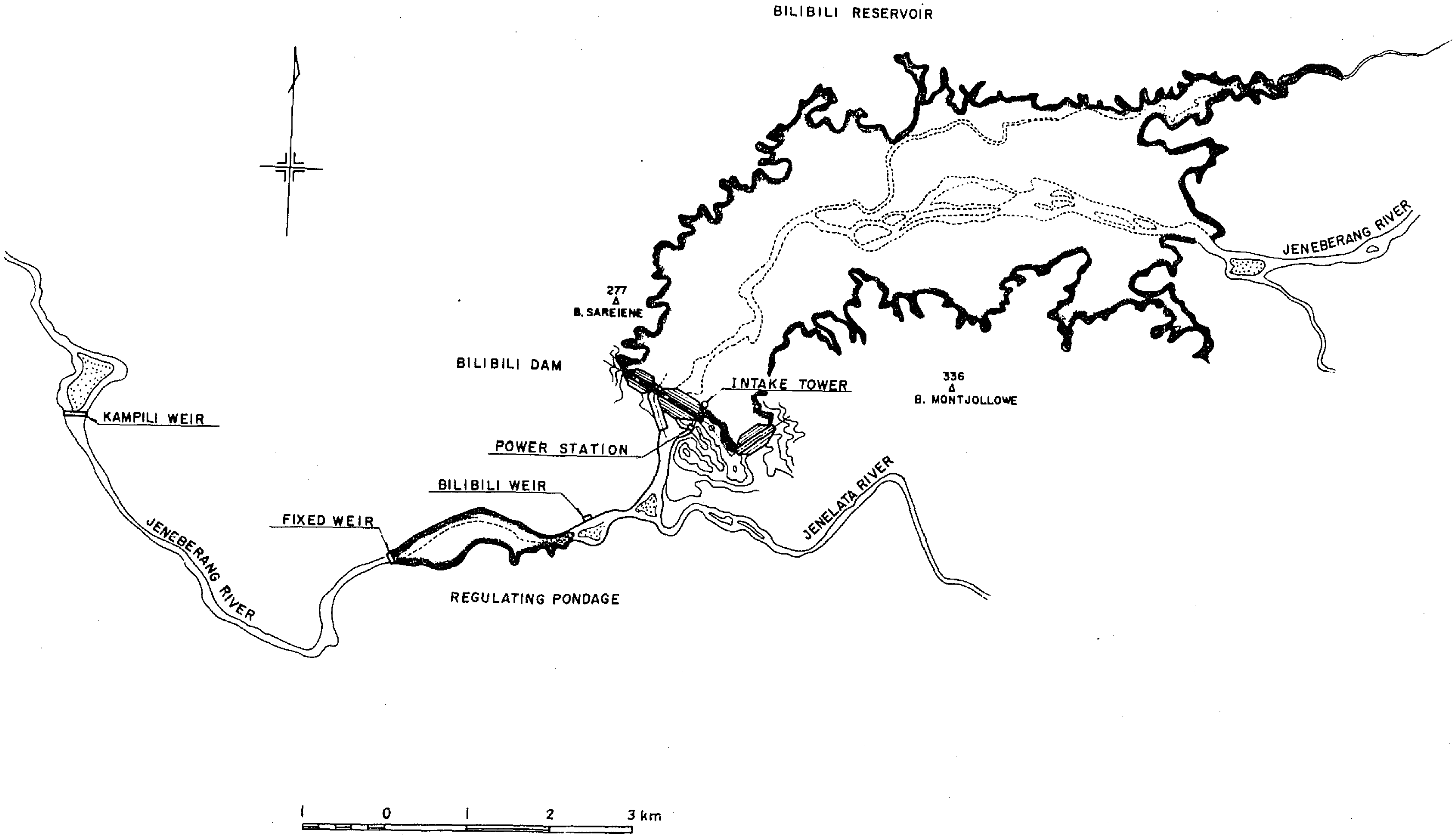
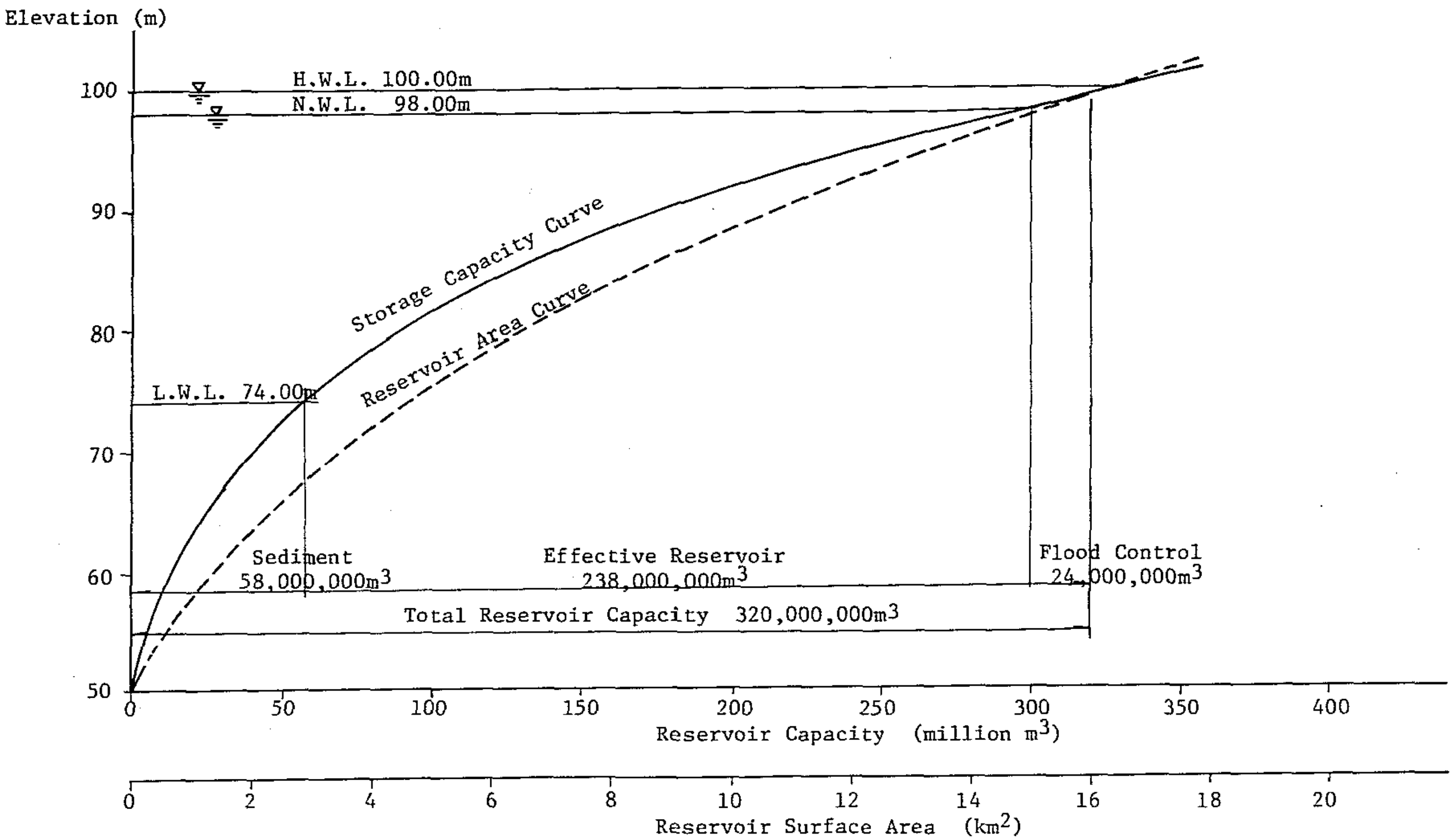
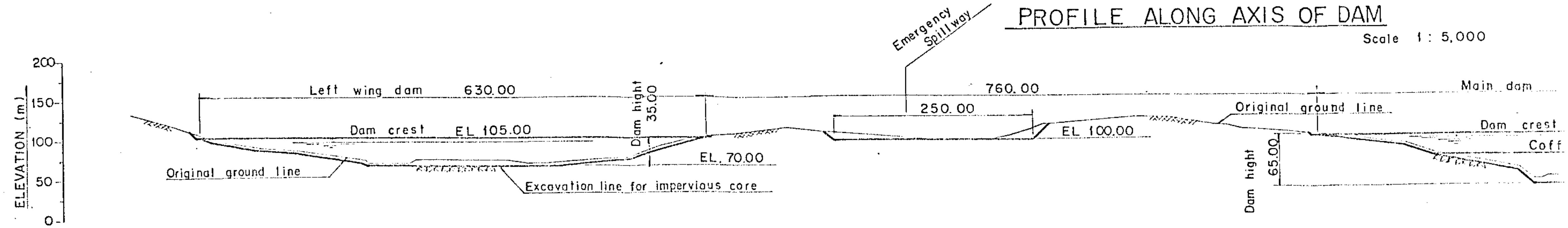


Fig. 4-9 RELATION CURVE BETWEEN ELEVATION AND STORAGE CAPACITY

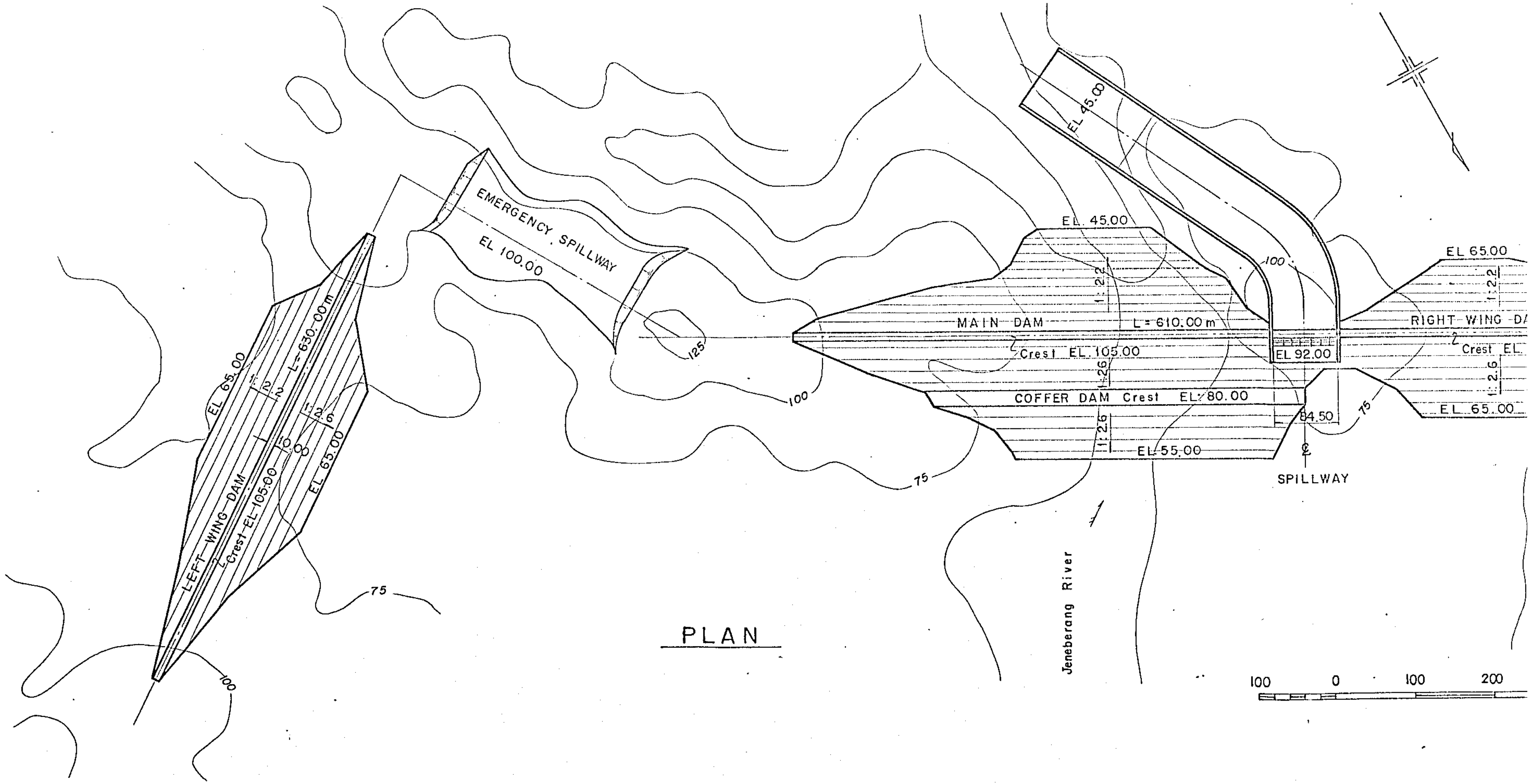


PROFILE ALONG AXIS OF DAM

Scale 1 : 5,000

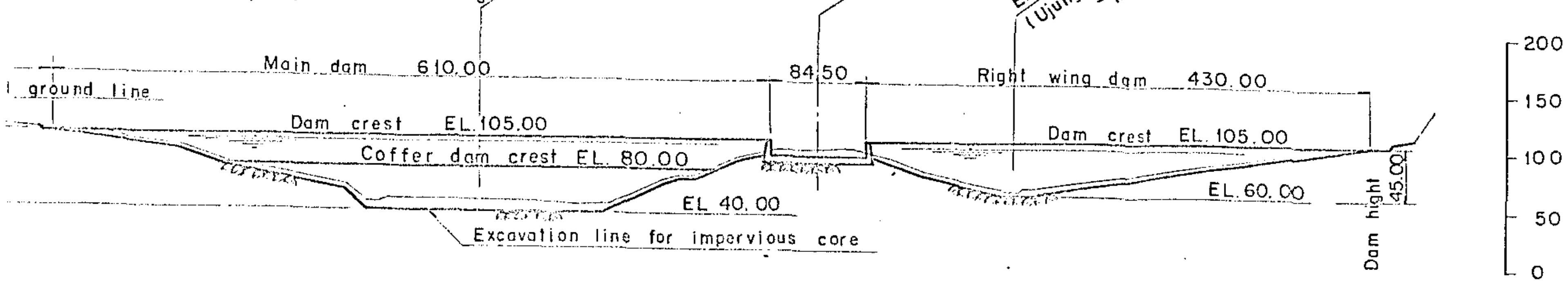


PLAN



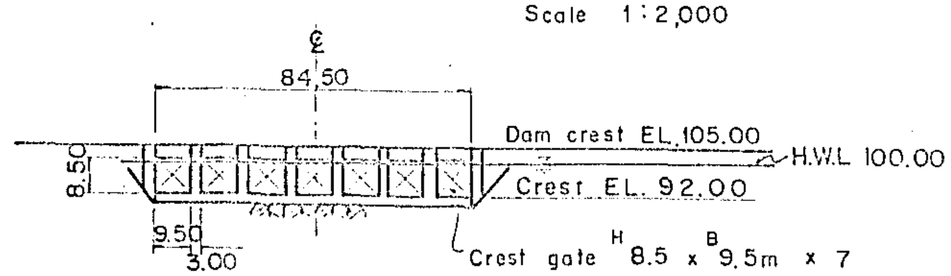
: OF DAM

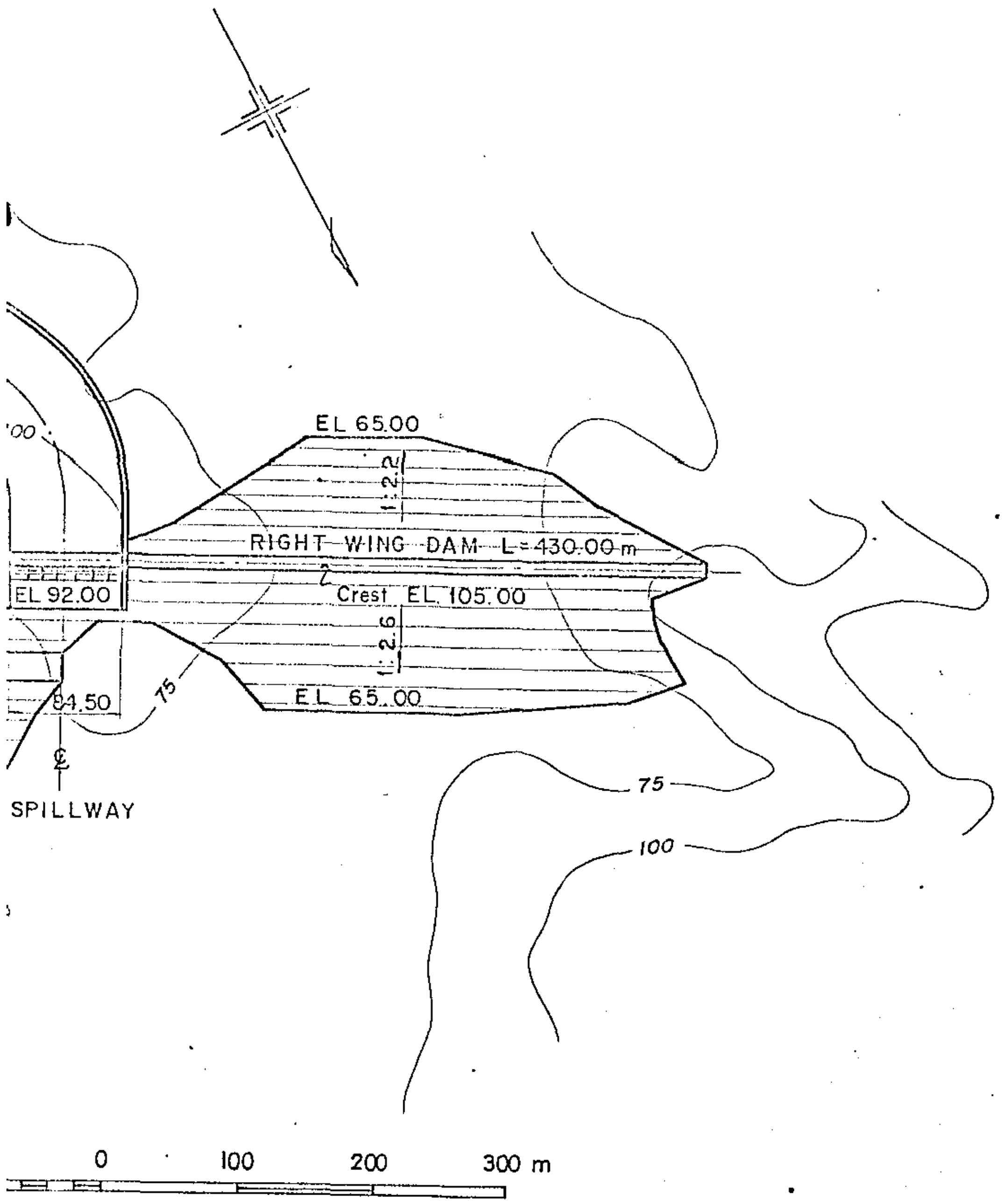
Scale 1 : 5,000



SPILLWAY CROSS SECTION

Scale 1 : 2,000





TYPICAL CROSS SECTION OF DAM

Scale 1 : 2,000

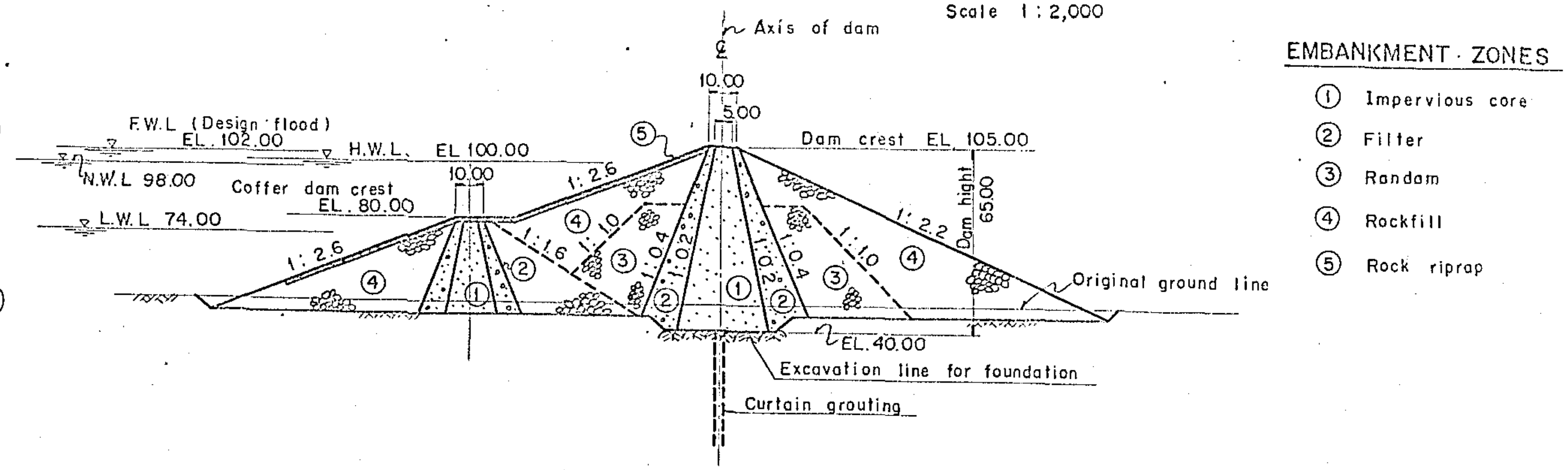
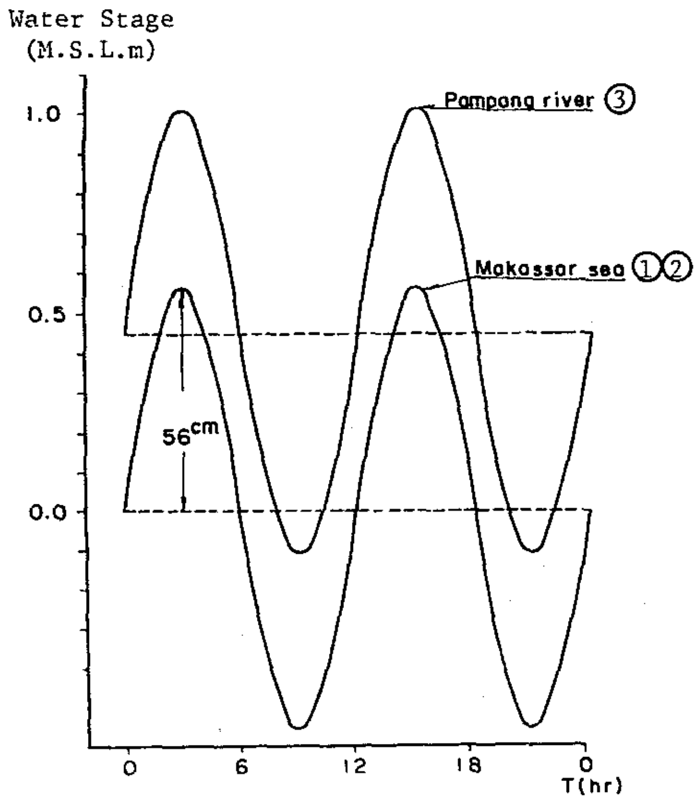


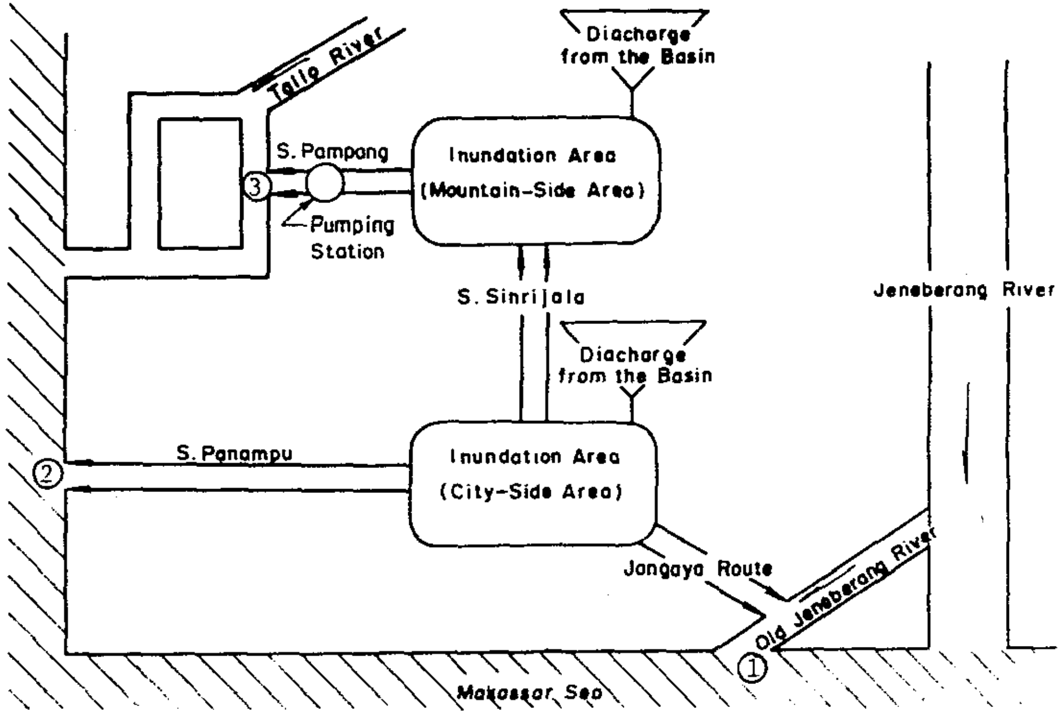
Fig. 4-10 GENERAL PLAN OF BILI - BILI DAM

Fig. 4-11 CALCULATION MODEL AND OUTLET WATER STAGE

OUTLET WATER STAGE



CALCULATION MODEL



Legend : ①,② and ③ Show the outlet points of drainage channels

Fig. 4-12 RAINFALL INTENSITY PATTERN

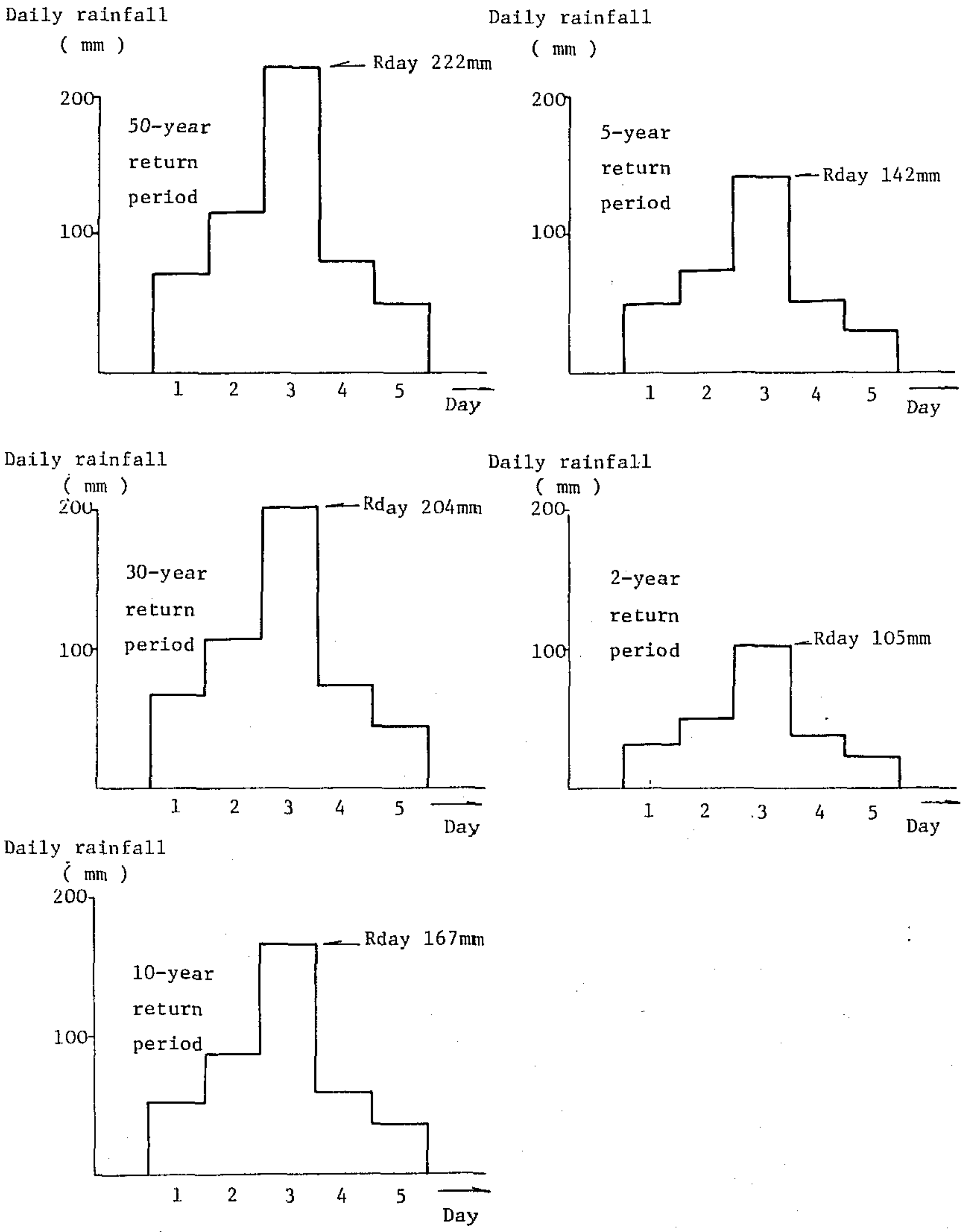
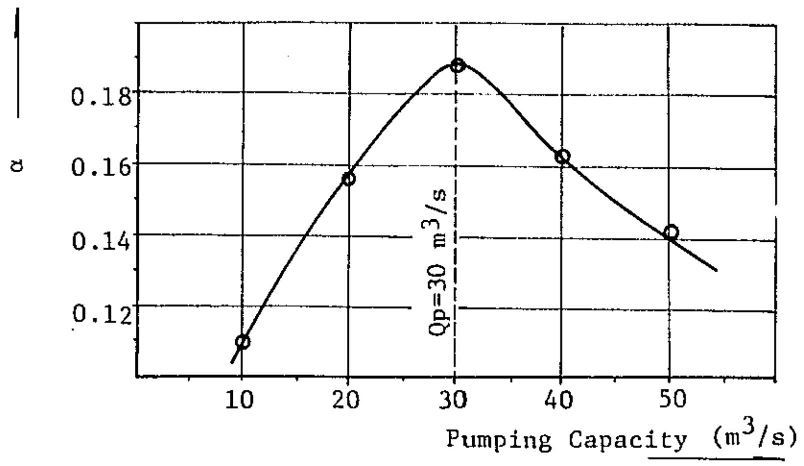
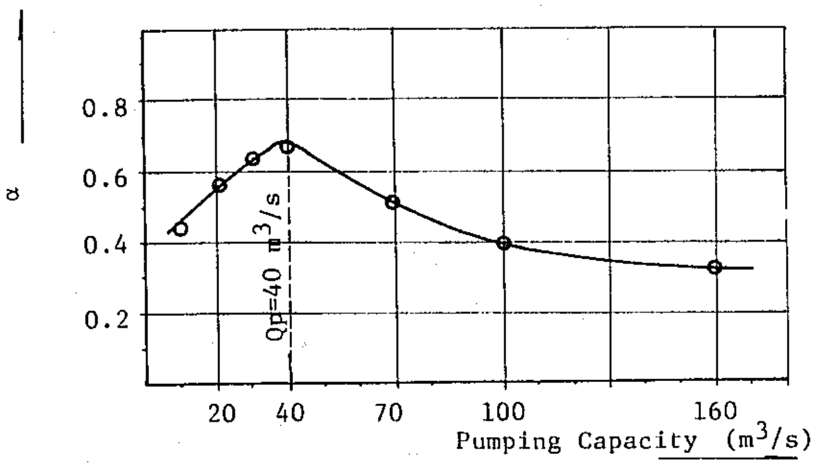


Fig. 4-13 OPTIMUM DRAINAGE SCALE FOR OVERALL PLAN
(After Completion of Urgent Flood Control)

After Completion of the Second Stage Development



After Completion of the Third Stage Development



NOTE : α = Annual Expected Damage Reduction/Construction Cost

Fig. 4-14 LOCATION OF OPTIMUM DRAINAGE SYSTEM FOR OVERALL PLAN

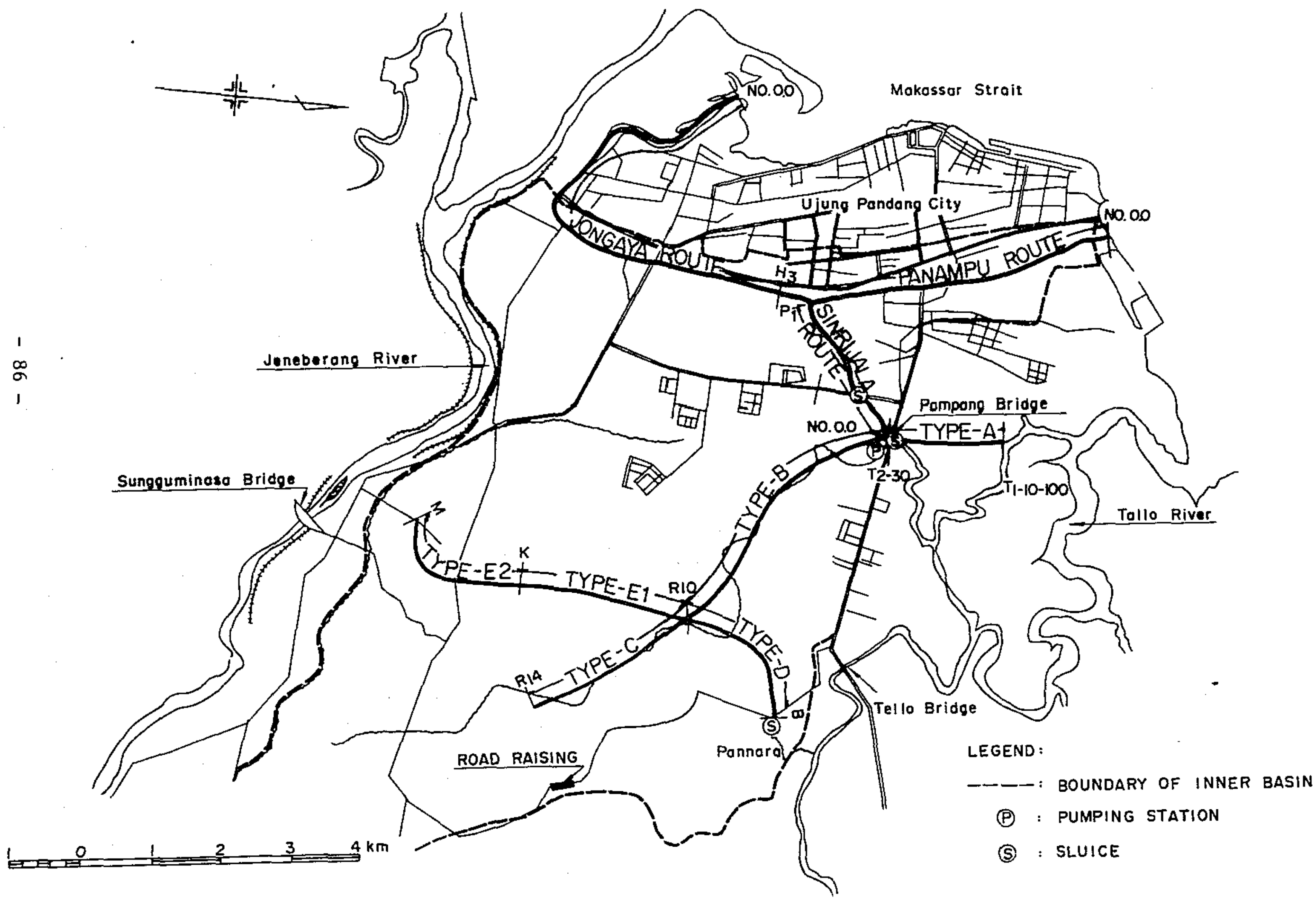


Fig. 4-15(1) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR OVERALL PLAN

NO. B - NO. R10 - NO. M

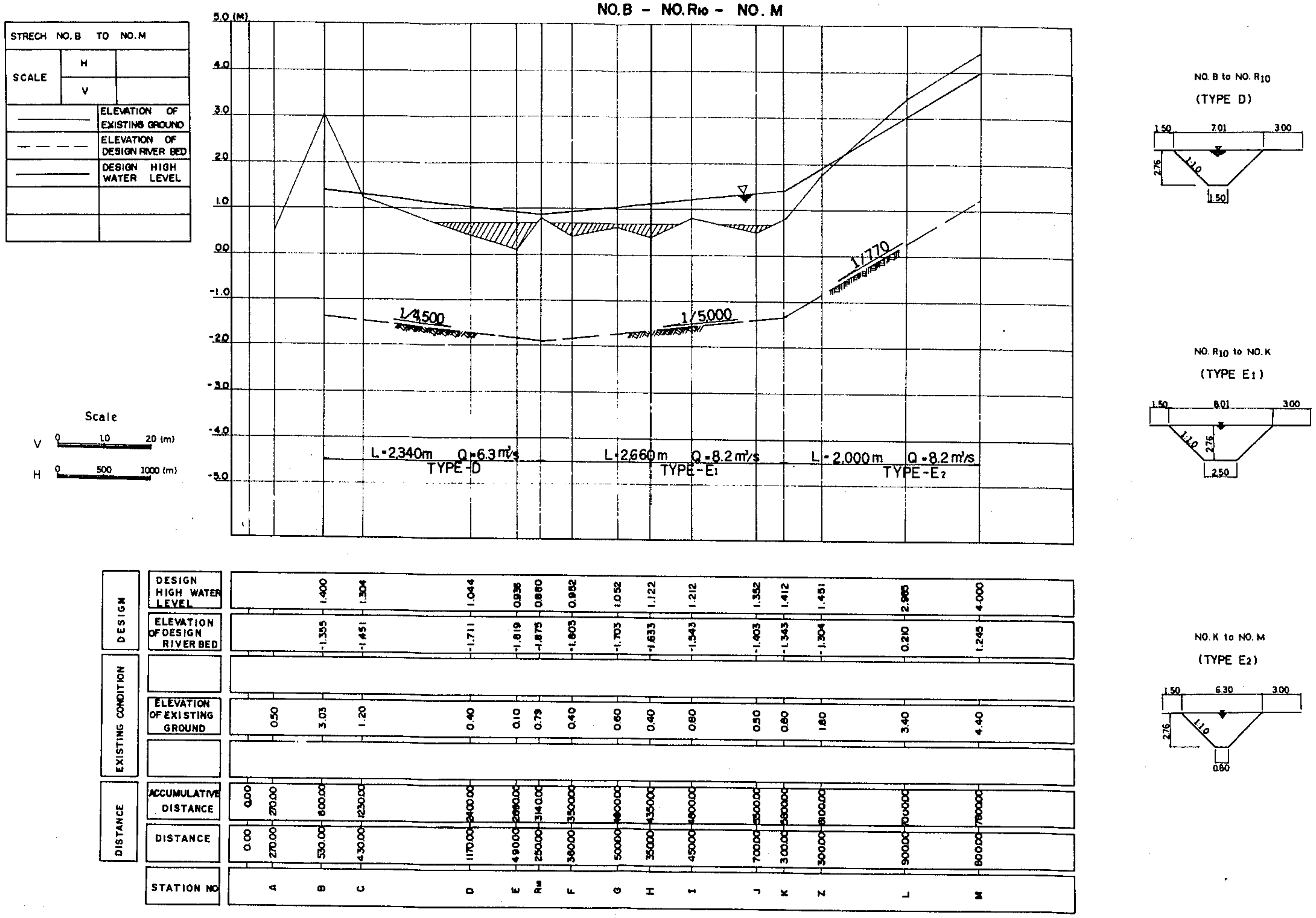
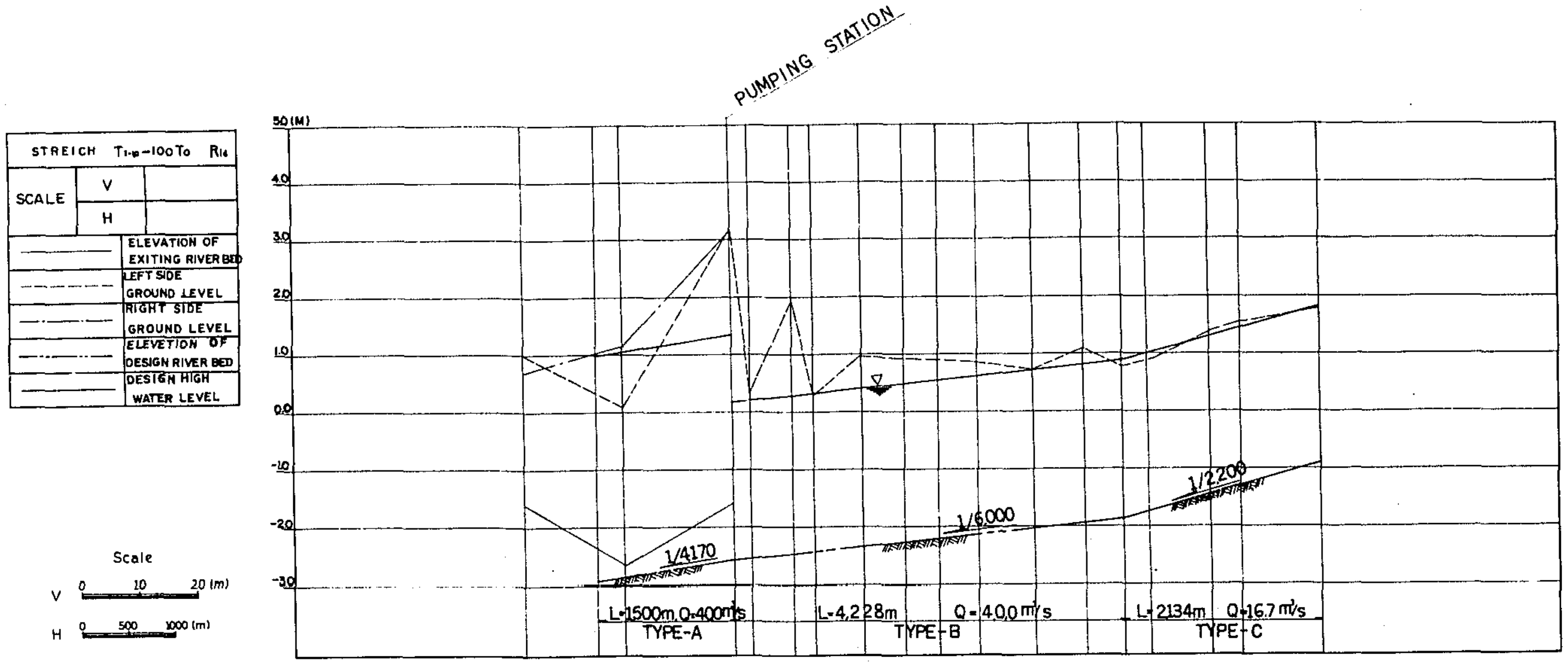
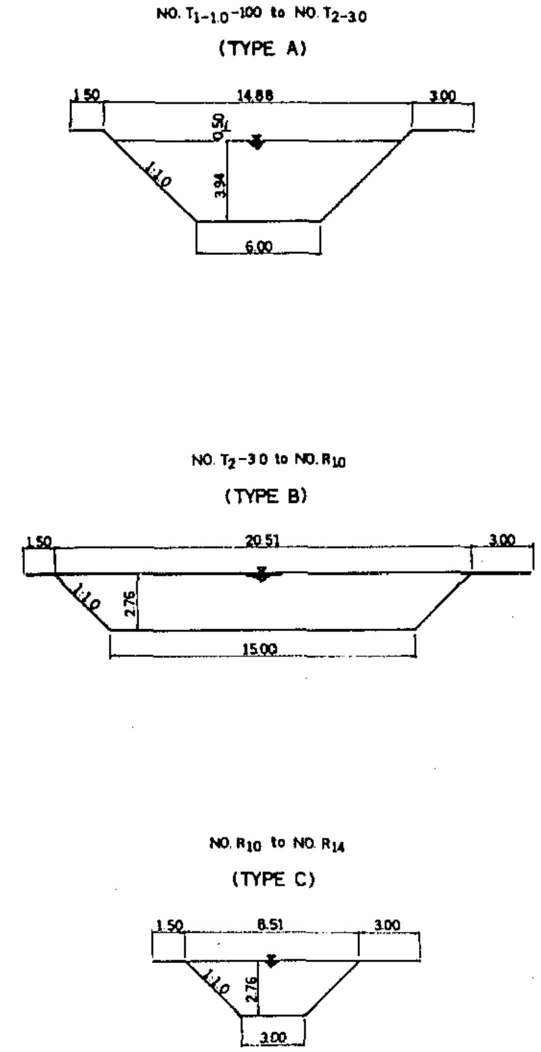


Fig.4-15(2) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR OVERALL PLAN
PAMPANG NO. T1.0-100 — NO. R14





STATION NO	DESIGN: HIGH WATER LEVEL	DESIGN: ELEVATION DESIGN RIVER BED	EXISTING CONDITION: RIGHT SIDE GROUND LEVEL	EXISTING CONDITION: LEFT SIDE GROUND LEVEL	EXISTING CONDITION: ELEVATION OF EXISTING RIVER BED	DISTANCE: ACCUMULATIVE DISTANCE	DISTANCE: DITANCE
T2-1.0			0.68	1.00	-1.61	0.00	0.00
T1-0-100	1.000	-2.940				764.00	764.00
T2-2.0	1.075	-2.865	1.12	0.08	-2.67	1076.00	312.00
T2-3.0	1.360 / 0.173	-2.580	3.18	3.20	1.58	2264.00	1180.00
R.1	0.207	-2.548		0.36		2454.00	190.00
R.2	0.283	-2.472		1.90		2914.00	460.00
R.3	0.324	-2.431		0.42		3156.00	242.00
R.4	0.411	-2.344		0.99		3682.00	526.00
R.5	0.482	-2.273		0.93		4109.00	427.00
R.6	0.543	-2.212		0.92		4473.00	364.00
R.7	0.620	-2.135		0.89		4936.00	463.00
R.8	0.721	-2.034		0.76		5541.00	605.00
R.9	0.810	-1.945		1.08		6083.00	542.00
R.10	0.880	-1.875		0.79		6492.00	409.00
R.11	1.035	-1.720		0.94		6823.00	331.00
R.12	1.321	-1.434		1.39		7463.00	640.00
R.13	1.463	-1.292		1.50		7774.00	311.00
R.14	1.850	-0.909		1.79		8626.00	852.00

Fig. 4-16 PUMPING STATION FOR OVERALL PLAN

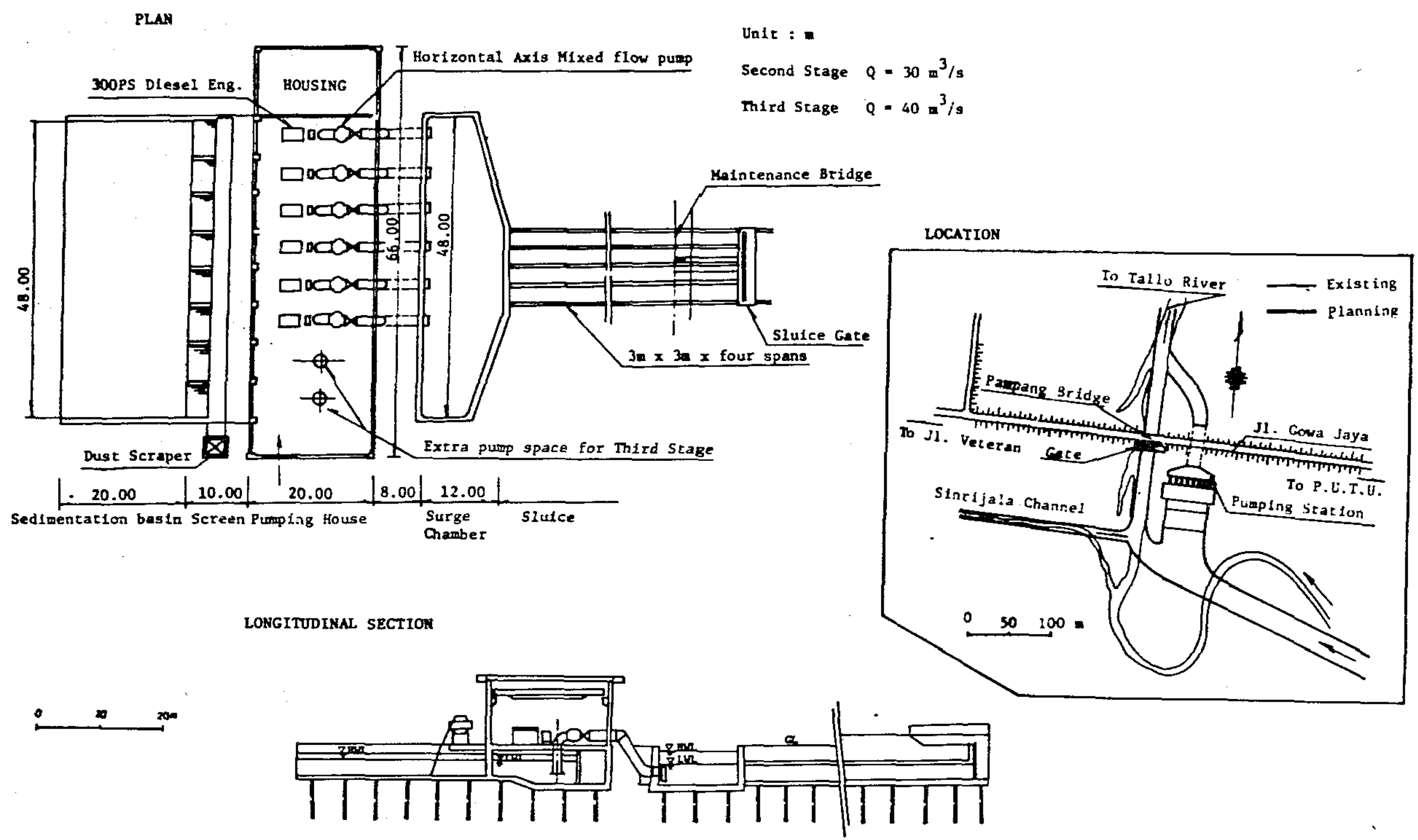
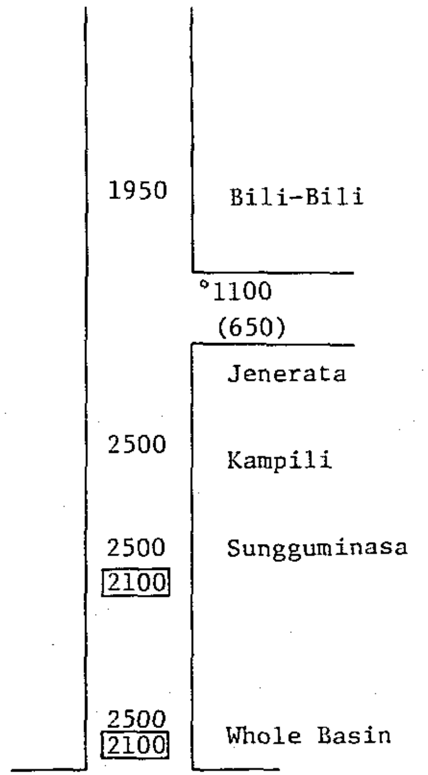


Fig. 5-1 DESIGN DISCHARGE OF JENEBERANG RIVER



▭ : Discharge after Regulation by Retarding Basin

( ): Discharge joing the Main Stream

Fig. 5-2 DESIGN FLOOD HYDROGRAPH

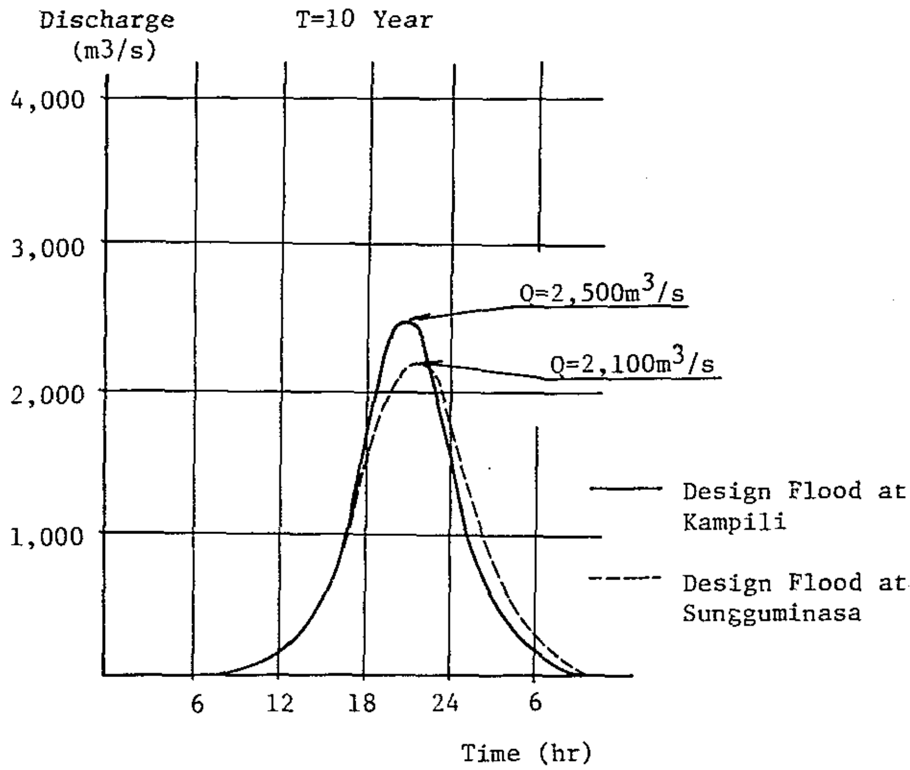


Fig. 5-3 PROPOSED LONGITUDINAL PROFILE OF JENEBERANG RIVER
(URGENT PLAN)

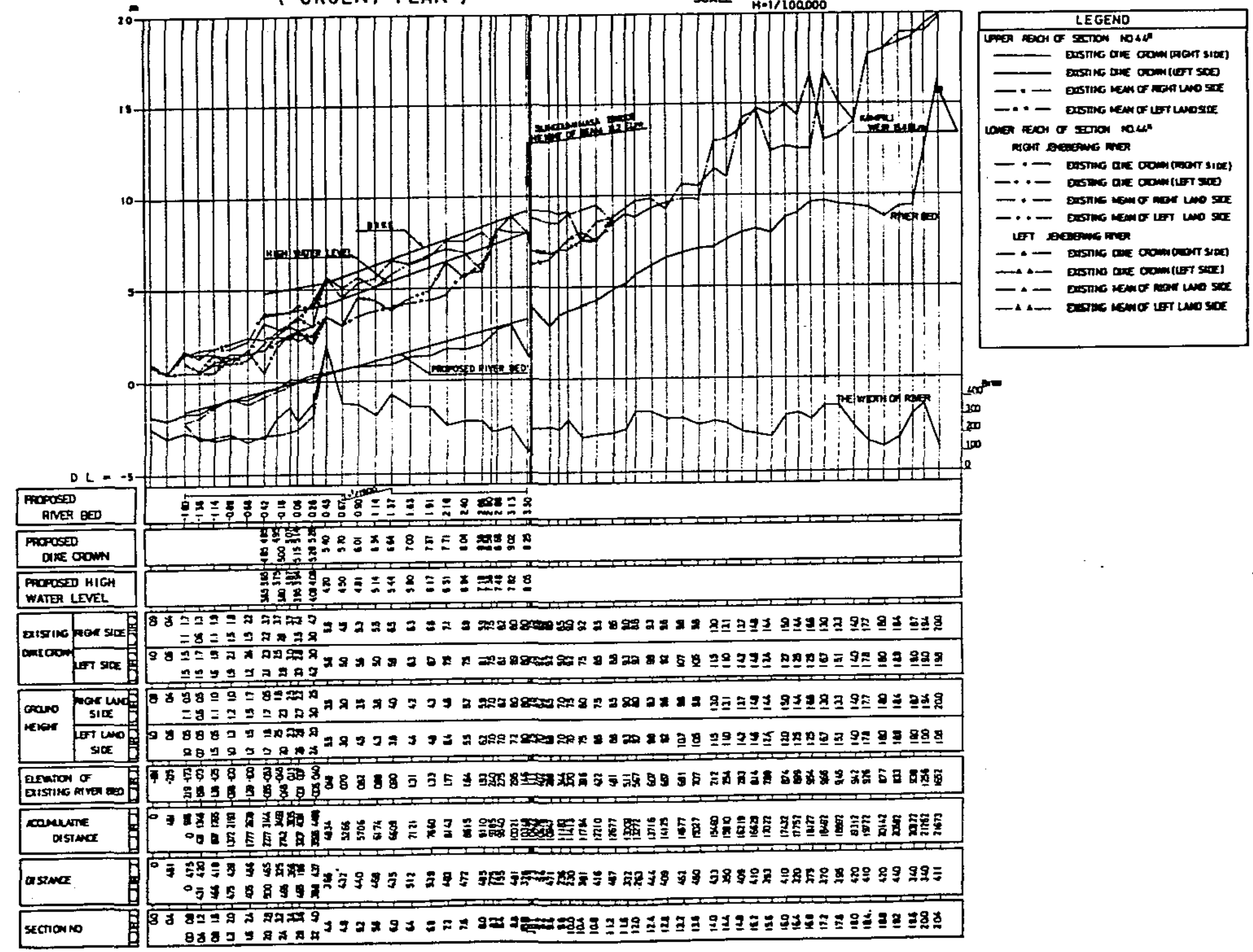


Fig. 5-4 PROPOSED ALIGNMENT FOR URGENT PLAN

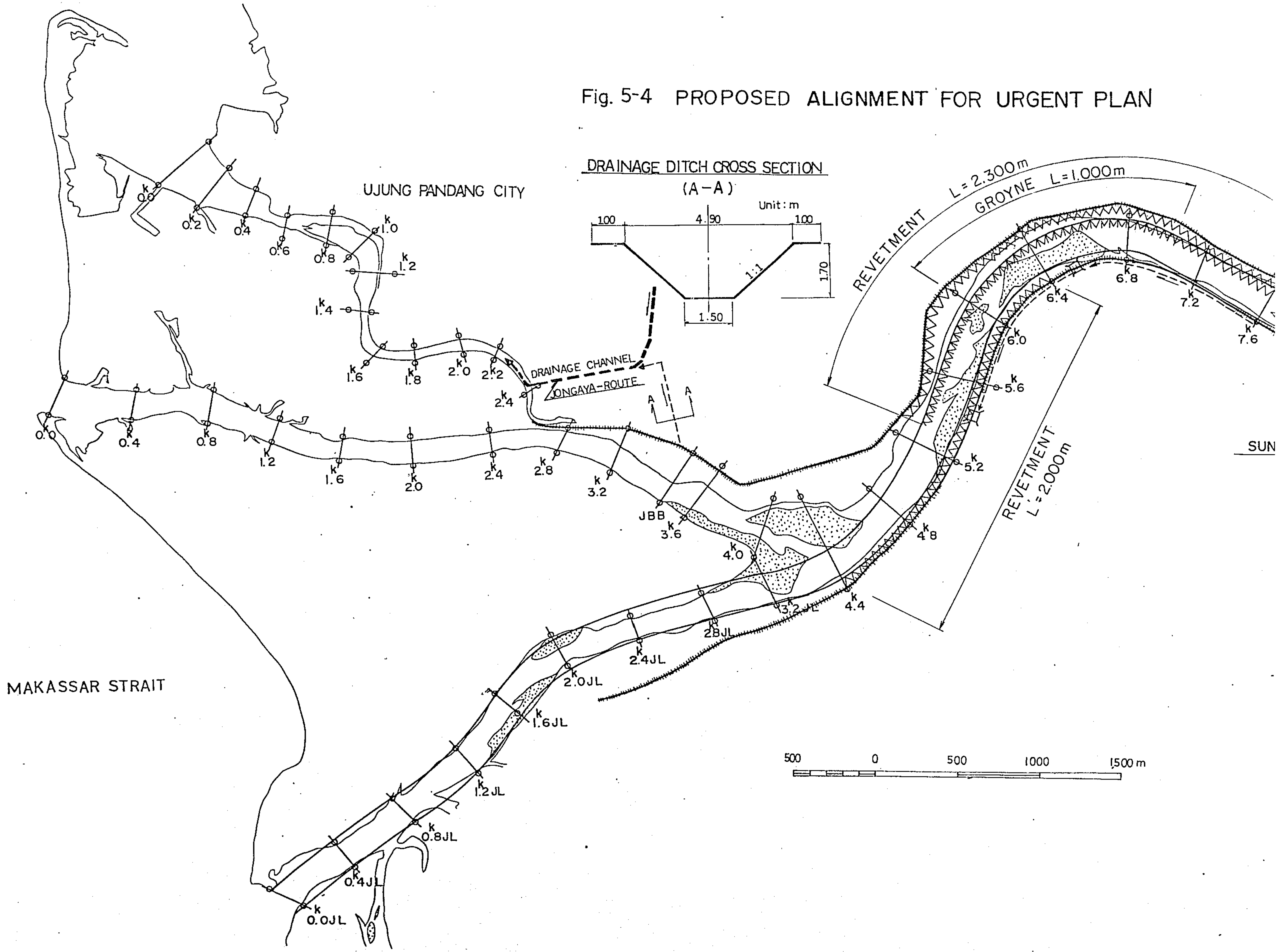


Fig. 5-4 PROPOSED ALIGNMENT FOR URGENT PLAN

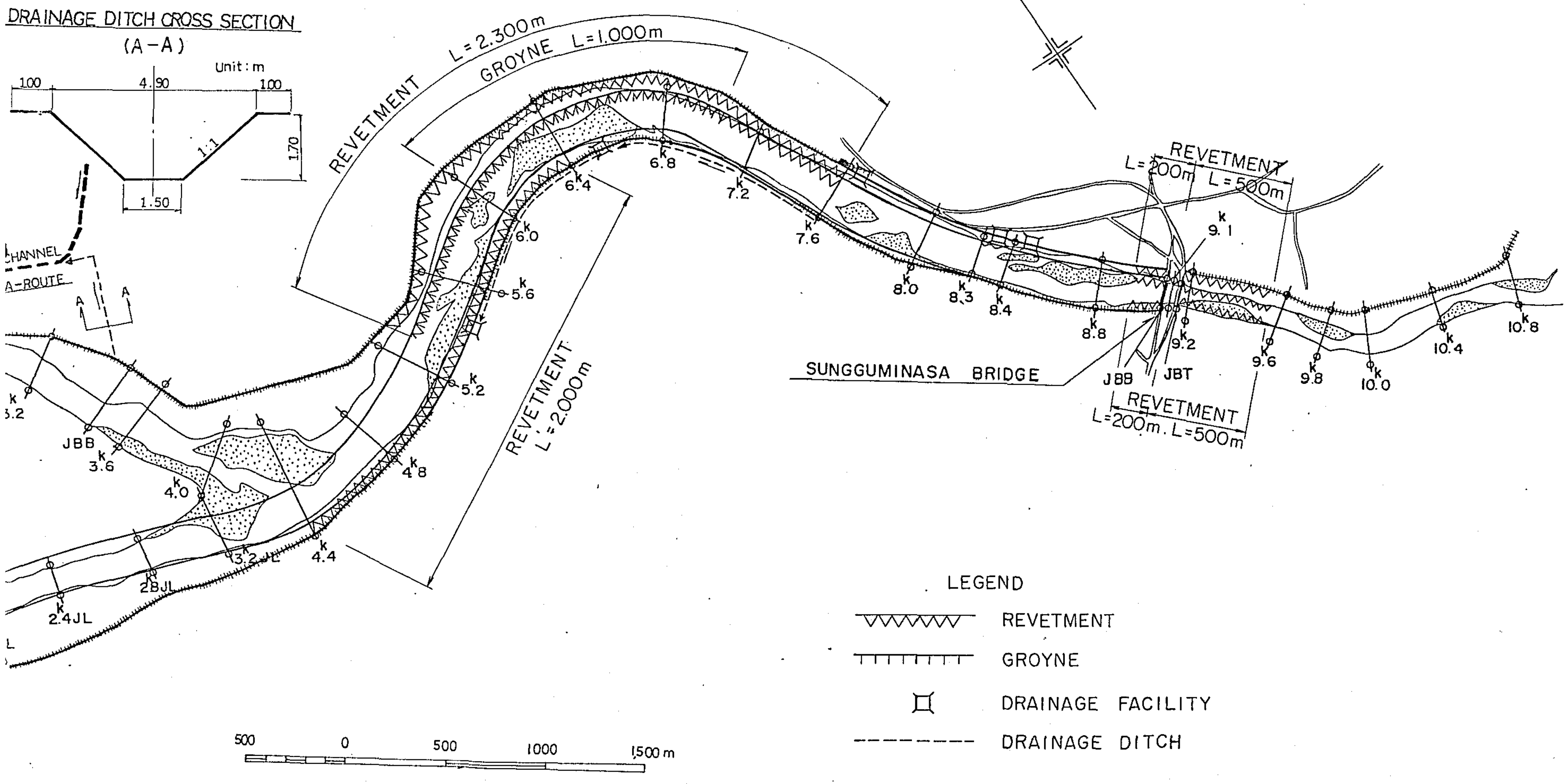
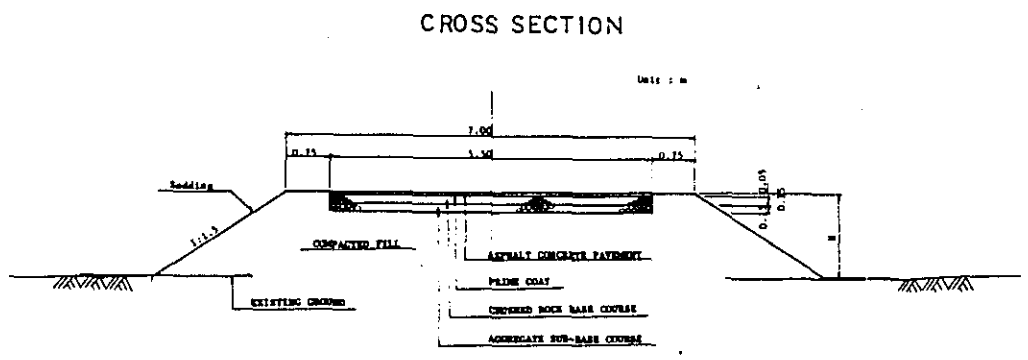
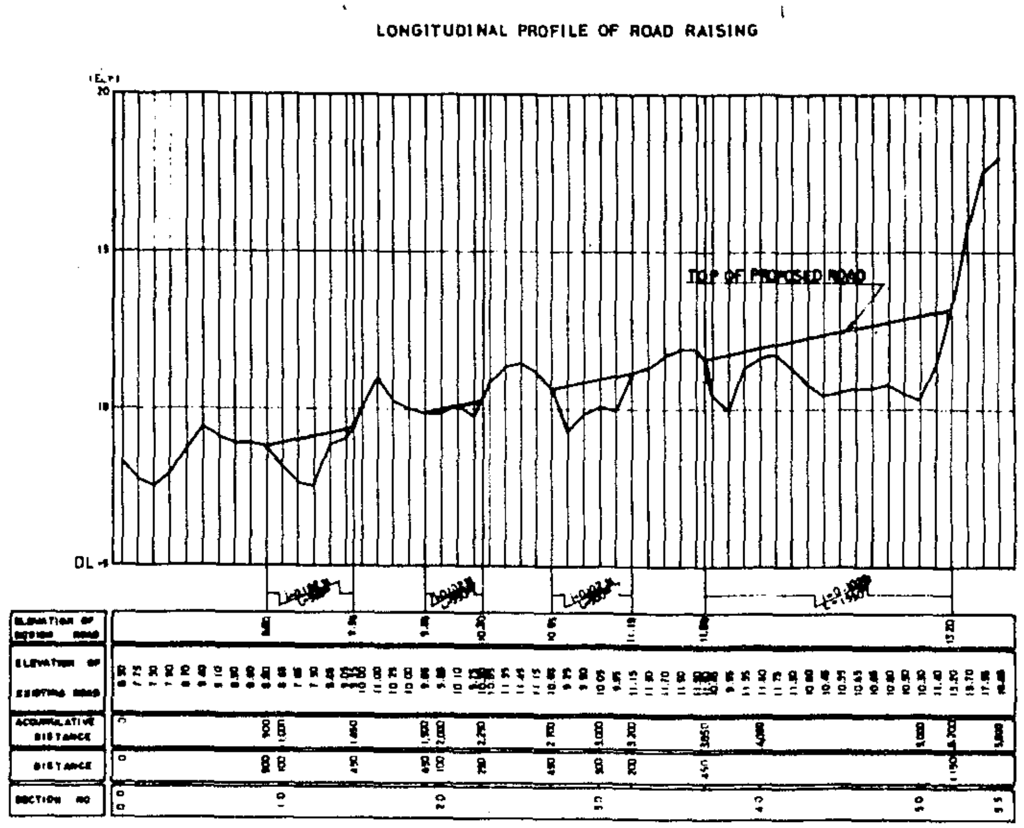


Fig. 5-5 ROAD RAISING SECTION





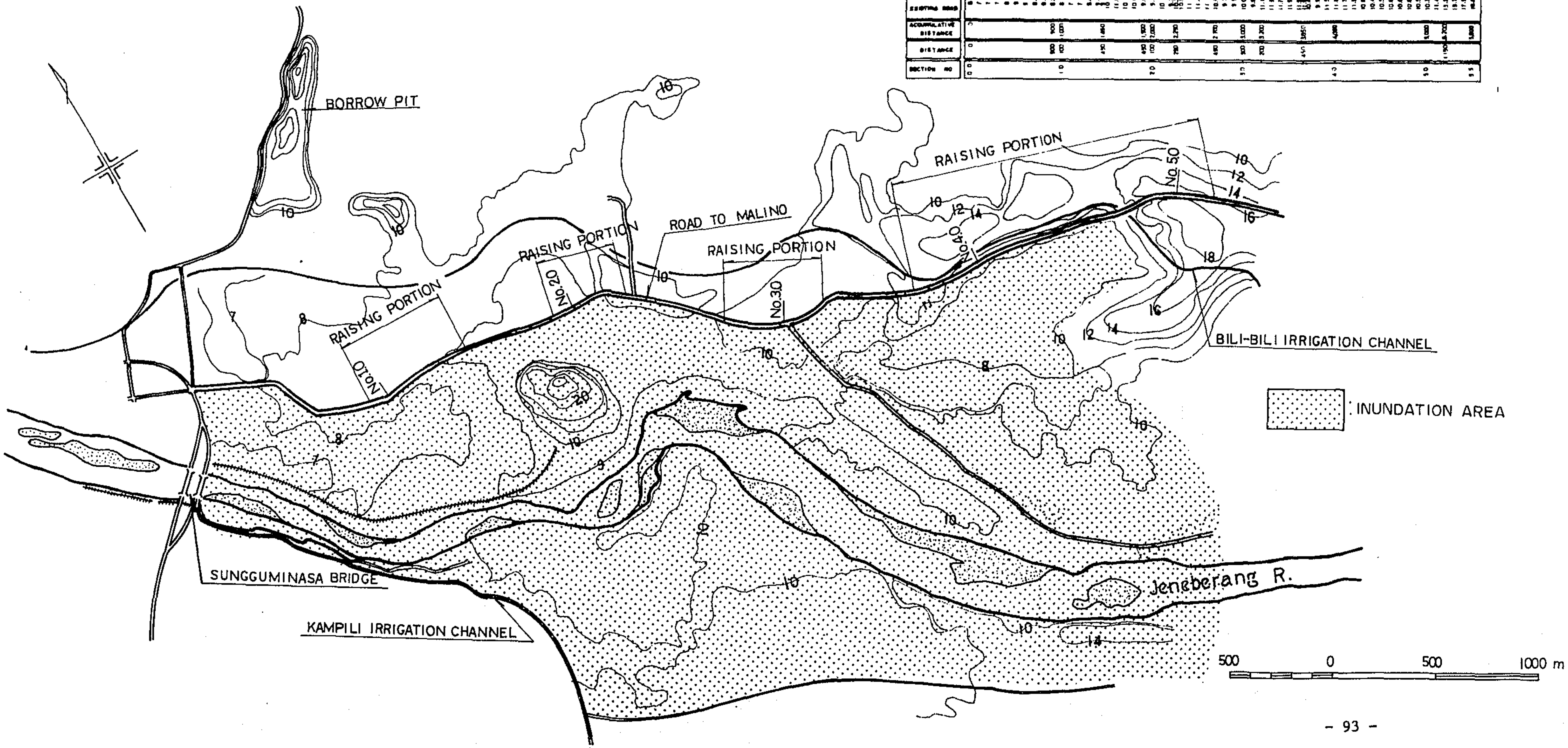
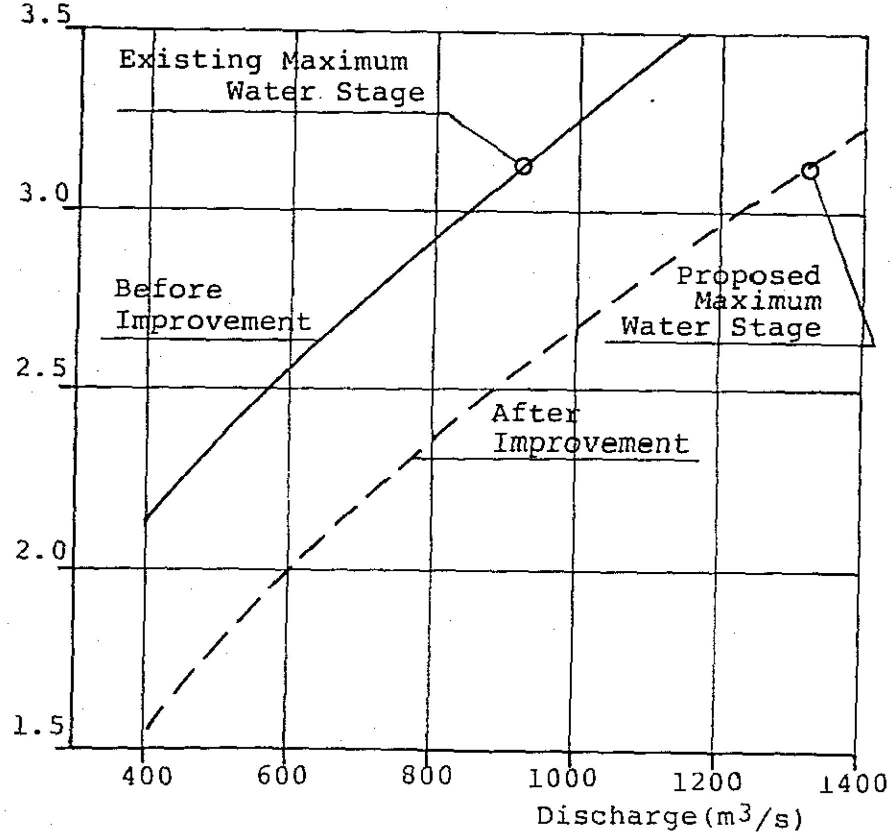
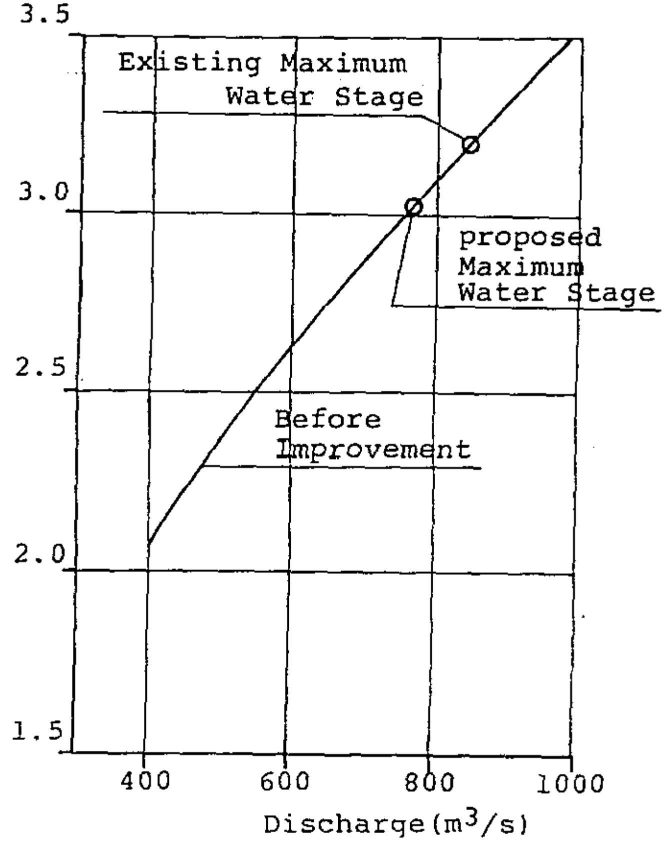


Fig. 5-6 RATING CURVE AFTER RIVER IMPROVEMENT
(SECTION NO. 2.0K)



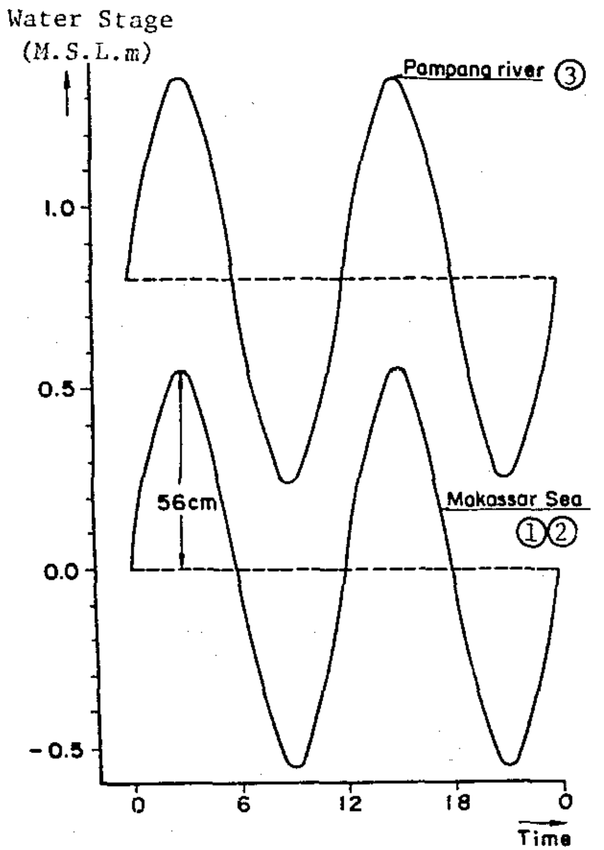


	Discharge(m^3/s)	Water Stage(M.S.L.m)
Before Improvement	950	3.13
After Improvement	1,330	3.11

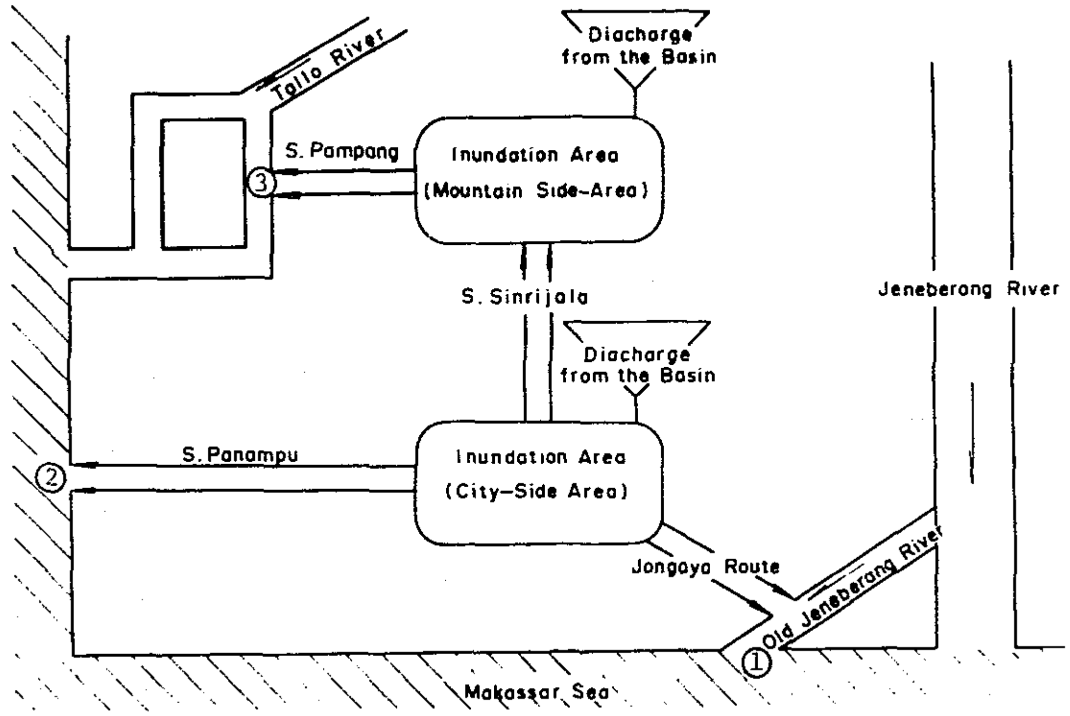
	Discharge(m^3/s)	Water Stage(M.S.L.m)
Before Improvwment	850	3.20
After Improvement	770	3.05

Fig. 5-7 CALCULATION MODEL AND OUTLET WATER STAGE

OUTLET WATER STAGE

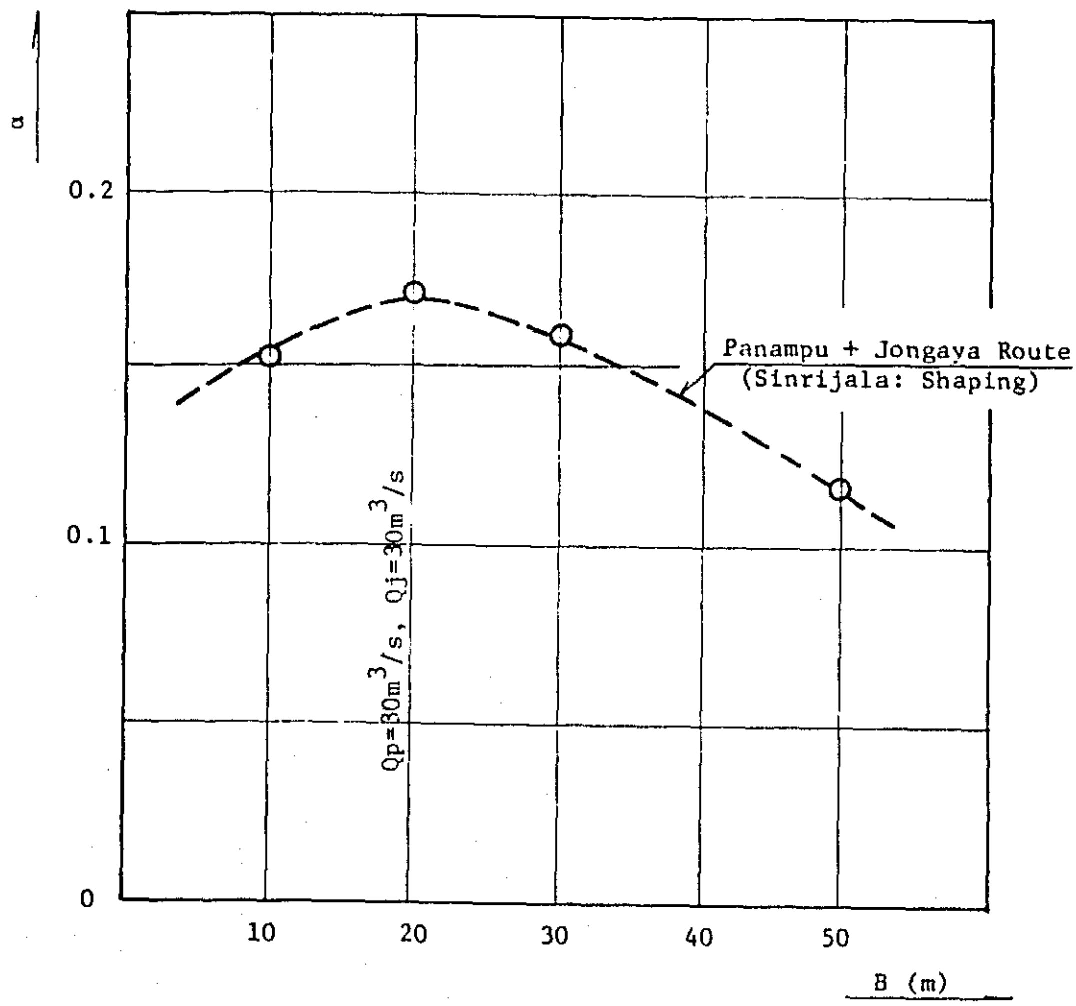


CALCUALTION MODEL



Legend : ①, ② and ③ Show the outlet points of drainage channels.

Fig. 5-8 OPTIMUM SCALE OF TWO DRAINAGE CHANNELS



α: Annual Expected Damage Reduction/Construction Cost

B: Bottom Width of Channel

Qp: Discharge of Panampu Channel

Qj: Discharge of Jongaya Route Channel

Fig.5-9 LOCATION OF OPTIMUM DRAINAGE SYSTEM FOR URGENT PLAN

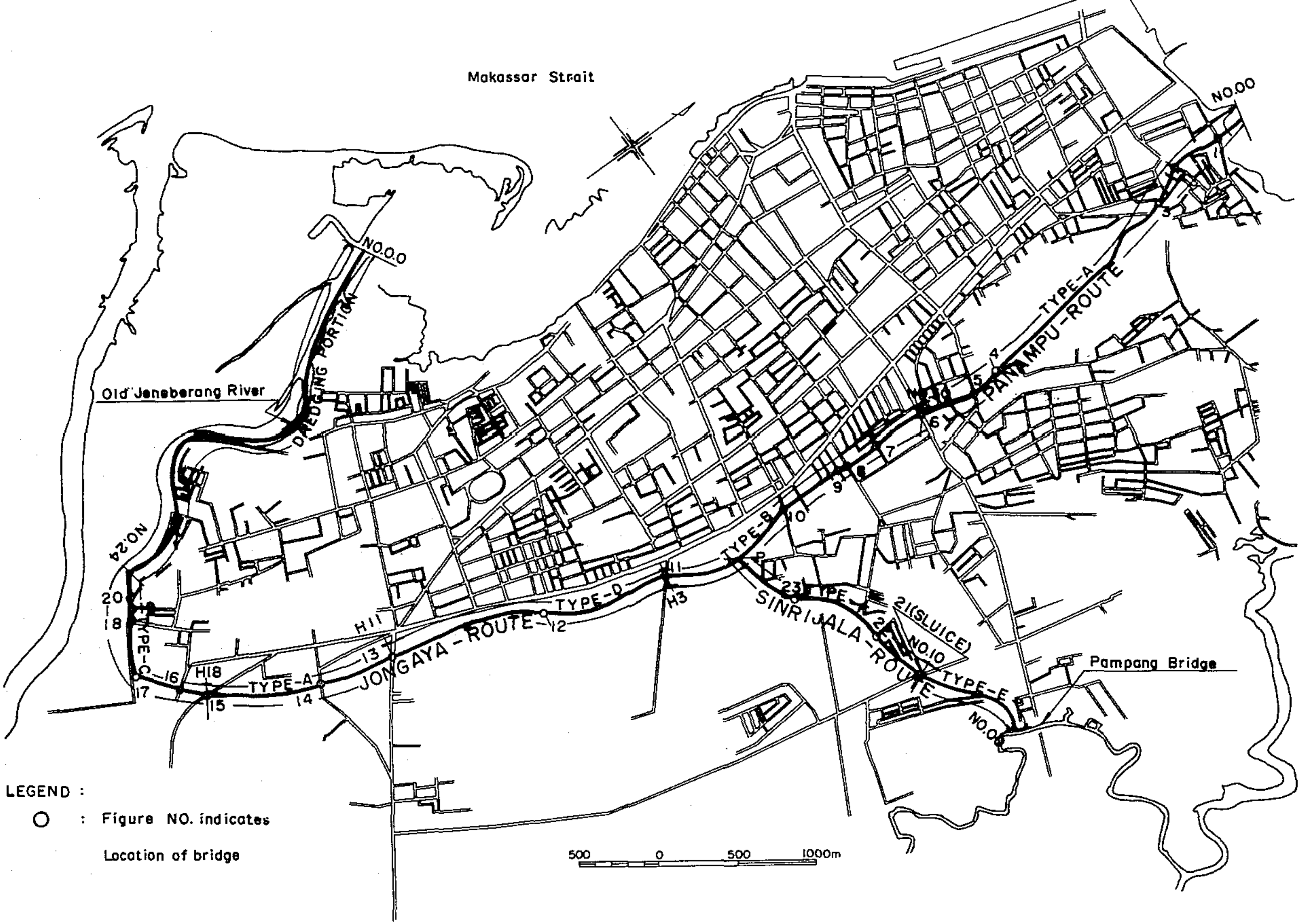
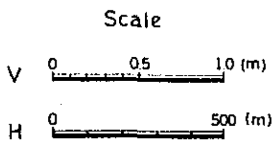
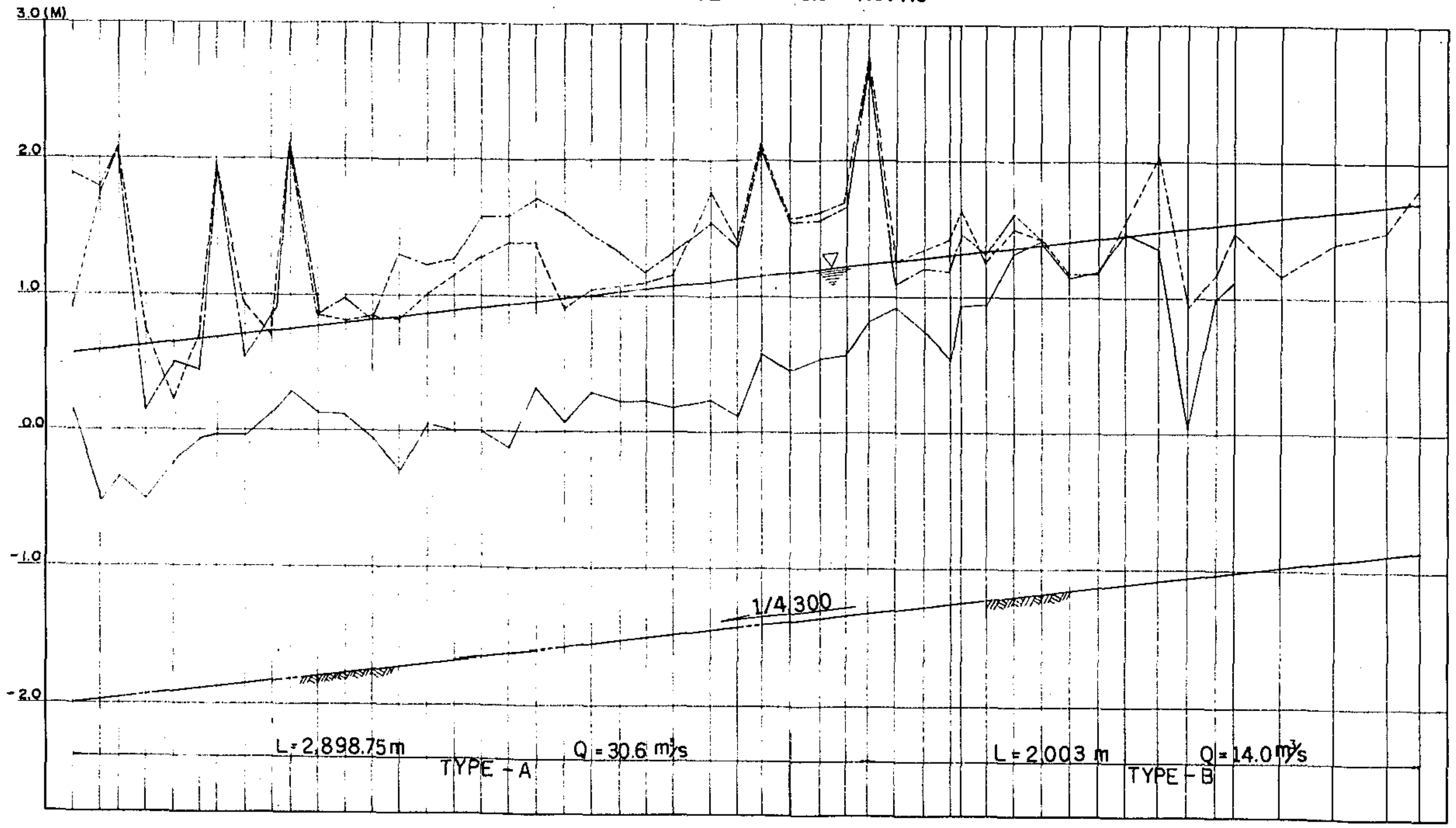


Fig. 5-10(1) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR URGENT PLAN

PANAMPU ROUTE NO. 0.0 – NO. H3

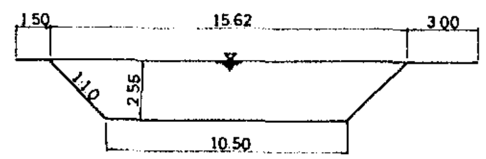
STRETCH NO.0.0 TO NO. H3	
SCALE V	
SCALE H	
········	ELEVATION OF EXISTING RIVER BED
- - - - -	LEFT SIDE GROUND LEVEL
—·—·—	RIGHT SIDE GROUND LEVEL
—··—··—	ELEVATION OF DESIGN RIVER BED
———	DESIGN HIGH WATER LEVEL





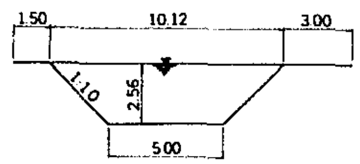
NO.0 to NO.3.0

(TYPE A)



NO.3.0 to NO.H3

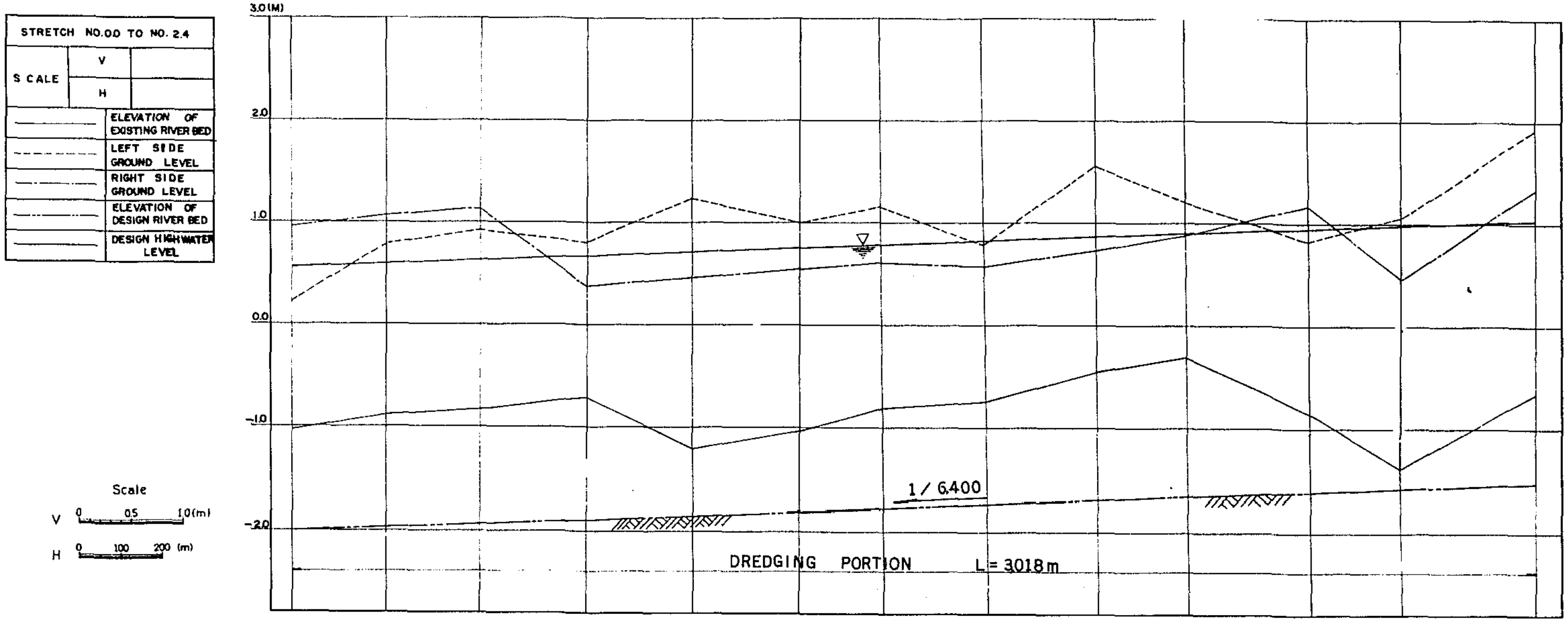
(TYPE B)

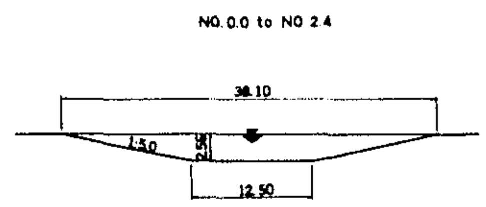


SECTION NO.	DESIGN: HIGH WATER LEVEL	DESIGN: ELEVATION OF DESIGN RIVER BED	EXISTING CONDITION: RIGHT SIDE GROUND LEVEL	EXISTING CONDITION: LEFT SIDE GROUND LEVEL	EXISTING CONDITION: ELEVATION OF EXISTING RIVER BED	DISTANCE: ACCUMULATIVE DISTANCE	DISTANCE: DISTANCE
0.0	0.560	-2.000	1.89	0.89	0.14	0.00	0.00
0.1	0.583	-1.977	1.79	1.73	-0.53	99.10	99.10
0.2	0.599	-1.961	2.09	2.08	-0.34	167.25	68.15
0.3	0.622	-1.938	0.16	0.41	0.51	267.25	100.00
0.4	0.645	-1.915	0.52	0.23	-0.22	367.25	100.00
0.5	0.669	-1.891	0.45	0.70	-0.07	467.25	100.00
0.6	0.683	-1.877	1.99	1.98	-0.03	530.65	63.40
0.7	0.707	-1.853	0.54	0.95	0.04	630.65	100.00
0.8	0.730	-1.830	0.87	0.69	0.14	730.65	100.00
0.9	0.745	-1.815	2.11	2.16	0.29	796.75	66.10
1.0	0.769	-1.791	0.85	0.85	0.13	896.75	100.00
1.1	0.792	-1.768	0.98	0.81	0.12	996.75	100.00
1.2	0.815	-1.745	0.81	0.84	-0.06	1096.75	100.00
1.3	0.838	-1.722	1.31	0.81	-0.29	1196.75	100.00
1.4	0.862	-1.698	1.23	0.99	0.05	1296.75	100.00
1.5	0.885	-1.675	1.27	1.14	0.00	1396.75	100.00
1.6	0.908	-1.652	1.58	1.28	0.00	1496.75	100.00
1.7	0.931	-1.629	1.59	1.38	-0.12	1596.75	100.00
1.8	0.955	-1.605	1.72	1.39	0.33	1696.75	100.00
1.9	0.978	-1.582	1.61	0.89	0.06	1796.75	100.00
2.0	1.001	-1.559	1.46	1.03	0.29	1896.75	100.00
2.1	1.024	-1.536	1.34	1.06	0.23	1996.75	100.00
2.2	1.048	-1.512	1.17	1.09	0.23	2096.75	100.00
2.3	1.071	-1.489	1.32	1.15	0.18	2196.75	100.00
2.4	1.102	-1.458	1.56	1.78	0.24	2328.75	132.00
2.5	1.125	-1.435	1.38	1.34	0.11	2428.75	100.00
2.6	1.146	-1.414	2.13	2.13	0.58	2518.75	90.00
2.7	1.169	-1.391	1.54	1.56	0.45	2618.75	100.00
2.8	1.192	-1.368	1.56	1.61	0.55	2718.75	100.00
2.9	1.216	-1.344	1.66	1.68	0.57	2818.75	100.00
3.0	1.234	-1.326	2.73	2.75	0.82	2898.75	80.00
3.1	1.257	-1.303	1.10	1.27	0.92	2998.75	100.00
3.2	1.281	-1.279	1.22	1.36	0.76	3098.75	100.00
3.3	1.304	-1.256	1.19	1.43	0.55	3198.75	100.00
3.4	1.311	-1.249	1.49	1.70	0.93	3229.75	31.00
3.5	1.334	-1.226	1.32	1.26	0.95	3329.75	100.00
3.6	1.358	-1.202	1.62	1.50	1.32	3429.75	100.00
3.7	1.381	-1.179	–	1.43	1.41	3529.75	100.00
3.8	1.404	-1.156	–	1.18	1.15	3629.75	100.00
3.9	1.427	-1.133	–	1.19	1.19	3729.75	100.00
4.0	1.451	-1.109	–	1.62	1.47	3829.75	100.00
4.1	1.479	-1.081	–	2.05	1.36	3952.25	122.50
4.2	1.502	-1.058	–	0.95	0.02	4052.25	100.00
4.3	1.526	-1.034	–	1.18	0.99	4152.25	100.00
4.4	1.542	-1.018	–	1.47	1.12	4222.25	70.00
P.I.	1.580	-0.980	–	1.16	–	4382.25	160.00
H.1	1.626	-0.934	–	1.40	–	4582.25	200.00
H.2	1.672	-0.888	–	1.48	–	4782.25	200.00
H.3	1.700	-0.860	–	1.81	–	4901.75	119.50

Fig. 5-10 (2) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR URGENT PLAN

JONGAYA ROUTE NO. 0.0 - NO. 2.4 (1/2)





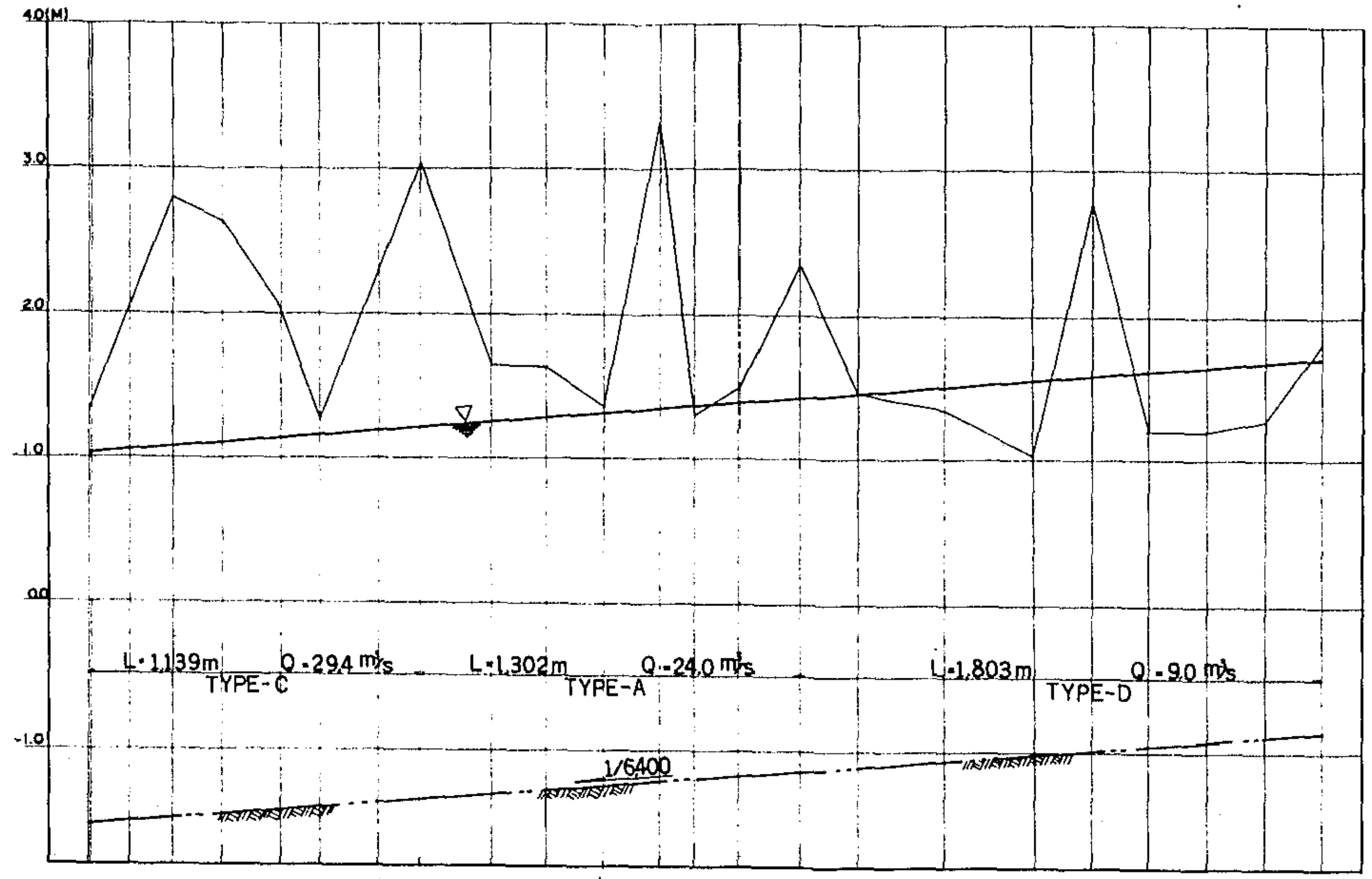
DESIGN	DESIGN HIGH WATER LEVEL	0.560	0.595	0.631	0.672	0.712	0.752	0.784	0.823	0.865	0.899	0.945	0.981	1.036
DESIGN	ELEVATION OF DESIGN RIVER BED	-2.000	-1.965	-1.929	-1.888	-1.848	-1.808	-1.776	-1.737	-1.695	-1.661	-1.615	-1.579	-1.523
EXISTING CONDITION	RIGHT SIDE GROUND LEVEL	0.95	1.06	1.14	0.38	0.45	0.55	0.61	0.57	0.73	0.88	1.17	0.46	1.33
EXISTING CONDITION	LEFT SIDE GROUND LEVEL	0.22	0.79	0.92	0.80	1.23	1.00	1.16	0.78	1.55	1.21	0.84	1.06	1.91
EXISTING CONDITION	ELEVATION OF EXISTING RIVER BED	1.03	0.90	0.83	0.71	-1.21	-1.03	-0.81	-0.74	-0.45	-0.30	-0.84	-1.38	-0.86
DISTANCE	ACCUMULATIVE DISTANCE	0.00	226.00	456.00	718.00	974.00	1231.00	1431.00	1682.00	1952.00	2171.00	2465.00	2693.00	3018.00
DISTANCE	DISTANCE	0.00	226.00	230.00	262.00	256.00	257.00	200.00	251.00	270.00	219.00	294.00	228.00	325.00
	SECTION NO.	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4

Fig. 5-10(3) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR URGENT PLAN

JONGAYA ROUTE NO. 2.4 - NO. H3 (2/2)

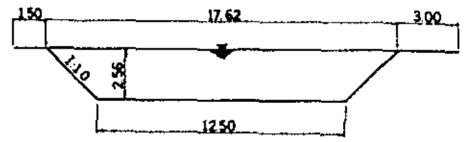
STRETCH NO. 2.4 TO NO. H3	
SCALE V	
SCALE H	
————	ELEVATION OF EXISTING GROUND
—·—·—	ELEVATION OF DESIGN RIVER BED
————	DESIGN HIGH WATER LEVEL

Scale
V 0 0.5 1.0 (m)
H 0 500 (m)

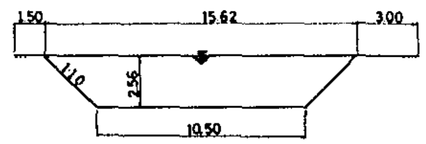


SECTION NO.	DESIGN: DESIGN HIGH WATER LEVEL	DESIGN: ELEVATION OF DESIGN RIVER BED	EXISTING CONDITION: ELEVATION OF EXISTING GROUND	DISTANCE: ACCUMULATIVE DISTANCE	DISTANCE: DISTANCE
24	1.037	-1.523	1.33	3018.00	328.00
H.21.4	1.038	-1.522	1.38	3025.50	7.50
H.21.3	1.056	-1.501	2.08	3159.50	134.00
H.21.2	1.082	-1.478	2.81	3306.50	147.00
H.21.1	1.108	-1.451	2.64	3480.50	174.00
H.21	1.140	-1.420	2.05	3680.50	200.00
H.20	1.161	-1.399	1.26	3813.50	133.00
H.19	1.192	-1.368	2.32	4013.50	200.00
H.18	1.215	-1.345	3.03	4157.00	143.50
H.17	1.253	-1.307	1.63	4402.00	245.00
H.16	1.283	-1.277	1.61	4592.00	190.00
H.15	1.314	-1.246	1.35	4792.00	200.00
H.14	1.345	-1.215	3.28	4992.00	200.00
H.13	1.363	-1.197	1.29	5104.00	112.00
H.12	1.387	1.173	1.49	5259.00	155.00
H.11	1.418	-1.142	2.35	5459.00	200.00
H.10	1.451	1.109	1.46	5669.00	210.00
H.9	1.498	1.062	1.34	5969.00	300.00
H.8	1.545	-1.015	1.02	6269.00	300.00
H.7	1.576	-0.984	2.81	6469.00	200.00
H.6	1.606	-0.954	1.20	6662.00	193.00
H.5	1.638	-0.923	1.20	6862.00	200.00
H.4	1.669	-0.891	1.27	7062.00	200.00
H.3	1.700	-0.860	1.81	7262.00	200.00

NO. 2.4 to NO. H18
(TYPE C)



NO. H18 to NO. H11
(TYPE A)



NO. H11 to NO. H3
(TYPE D)

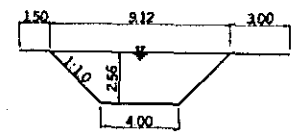
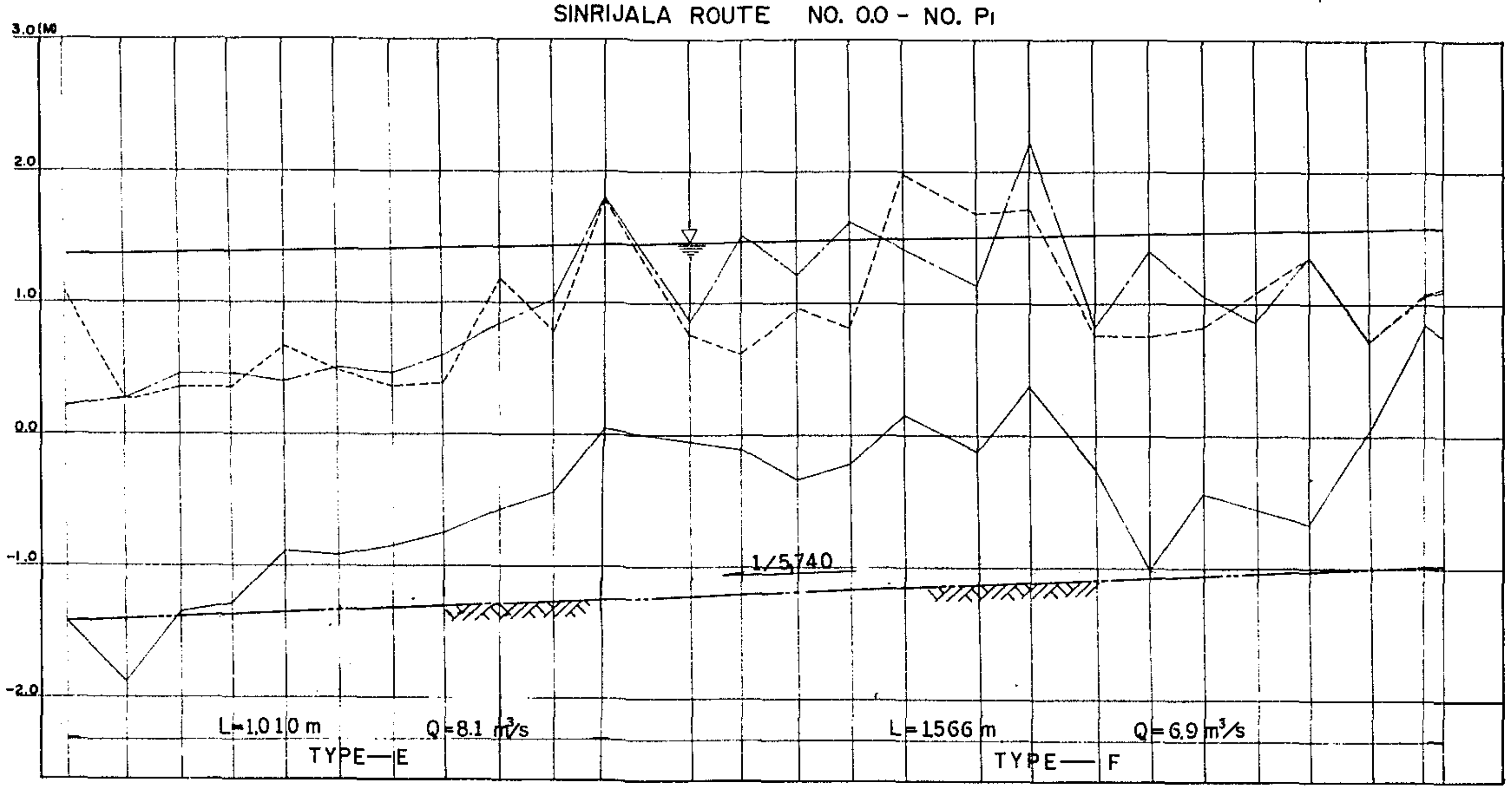


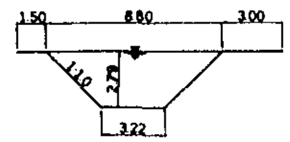
Fig 5-10(4) LONGITUDINAL PROFILE OF DRAINAGE CHANNEL FOR URGENT PLAN
SINRIJALA ROUTE NO. 0.0 - NO. P1

STRETCH NO.0.0 TO P1	
SCALE V	
SCALE H	
————	ELEVATION OF EXISTING RIVER BED
– – – –	LEFT SIDE GROUND LEVEL
–·–·–·	RIGHT SIDE GROUND LEVEL
–··–··–	ELEVATION OF DESIGN RIVER BED
————	DESIGN HIGH WATER LEVEL

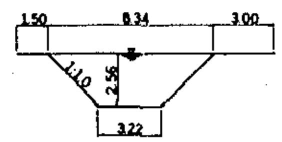
Scale
V 0 0.5 1.0 (m)
H 0 100 200 (m)



NO.0.0 to NO.1.0
(TYPE E)



NO.1.0 to NO. P1
(TYPE F)



		0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
DESIGN	HIGH WATER LEVEL	1.360	1.369	1.378	1.386	1.395	1.404	1.412	1.421	1.429	1.438	1.446	1.460	1.468
DESIGN	ELEVATION OF DESIGN RIVER BED	-1.429	-1.410	-1.392	-1.375	-1.358	-1.340	-1.323	-1.306	-1.288	-1.271	-1.250	-1.225	-1.208
EXISTING CONDITION	RIGHT SIDE GROUND LEVEL	1.06	0.26	0.36	0.36	0.67	0.49	0.37	0.39	1.19	0.79	1.79	0.76	0.62
EXISTING CONDITION	LEFT SIDE GROUND LEVEL	0.22	0.27	0.46	0.46	0.40	0.51	0.47	0.61	0.84	1.02	1.80	0.86	1.51
EXISTING CONDITION	ELEVATION OF EXISTING RIVER BED	-1.42	-1.87	-1.34	-1.28	-0.88	-0.91	-0.84	-0.73	-0.56	-0.43	0.05	-0.05	-0.10
DISTANCE	ACCUMULATIVE DISTANCE	0.00	110.00	210.00	310.00	410.00	510.00	610.00	710.00	810.00	910.00	1010.00	1168.00	1268.00
DISTANCE	DISTANCE	0.00	110.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	158.00	100.00
	SECTION NO.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2

		1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	P
DESIGN	HIGH WATER LEVEL	1.477	1.485	1.494	1.505	1.514	1.524	1.533	1.542	1.550	1.559	1.568	1.577	1.580
DESIGN	ELEVATION OF DESIGN RIVER BED	-1.191	-1.173	-1.156	-1.131	-1.113	-1.094	-1.076	-1.057	-1.041	-1.024	-1.004	-0.986	-0.988
EXISTING CONDITION	RIGHT SIDE GROUND LEVEL	0.97	0.82	1.98	1.68	1.72	0.77	0.76	0.82	1.09	1.35	0.71	1.08	
EXISTING CONDITION	LEFT SIDE GROUND LEVEL	1.21	1.62	1.41	1.14	2.22	0.82	1.40	1.06	0.86	1.35	0.71	1.06	
EXISTING CONDITION	ELEVATION OF EXISTING RIVER BED	-0.33	-0.21	0.16	-0.12	0.38	-0.24	-1.00	-0.42	-0.55	-0.66	0.06	0.85	
DISTANCE	ACCUMULATIVE DISTANCE	1368.00	1468.00	1568.00	1702.00	1802.00	1926.00	2026.00	2126.00	2226.00	2326.00	2441.00	2541.00	2576.00
DISTANCE	DISTANCE	100.00	100.00	100.00	134.00	100.00	124.00	100.00	100.00	100.00	100.00	115.00	100.00	35.00
	SECTION NO.	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	P

Fig. 5-11 CALCULATION MODEL

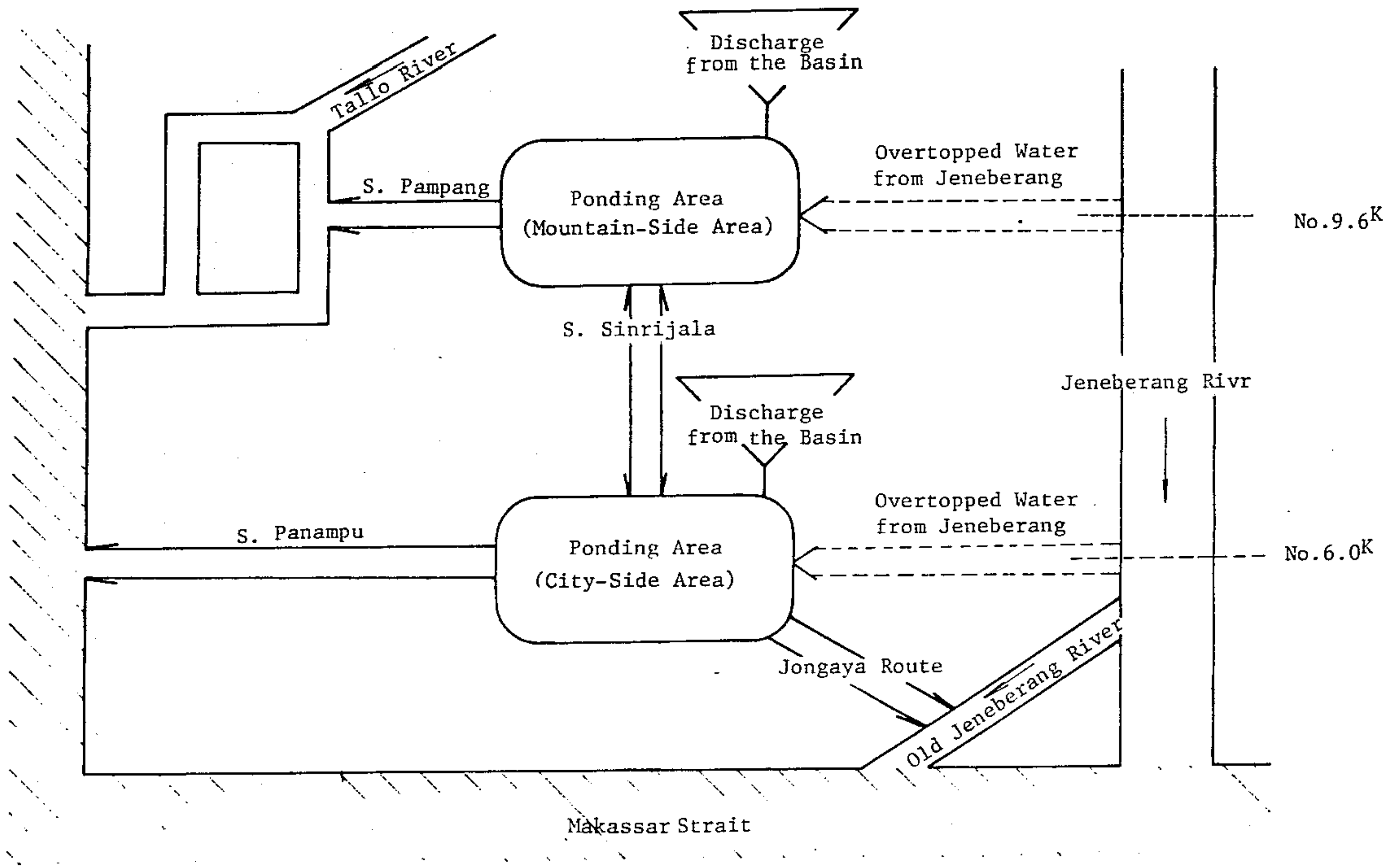


Fig. 5-12 RIVER IMPROVEMENT WORK SECTION

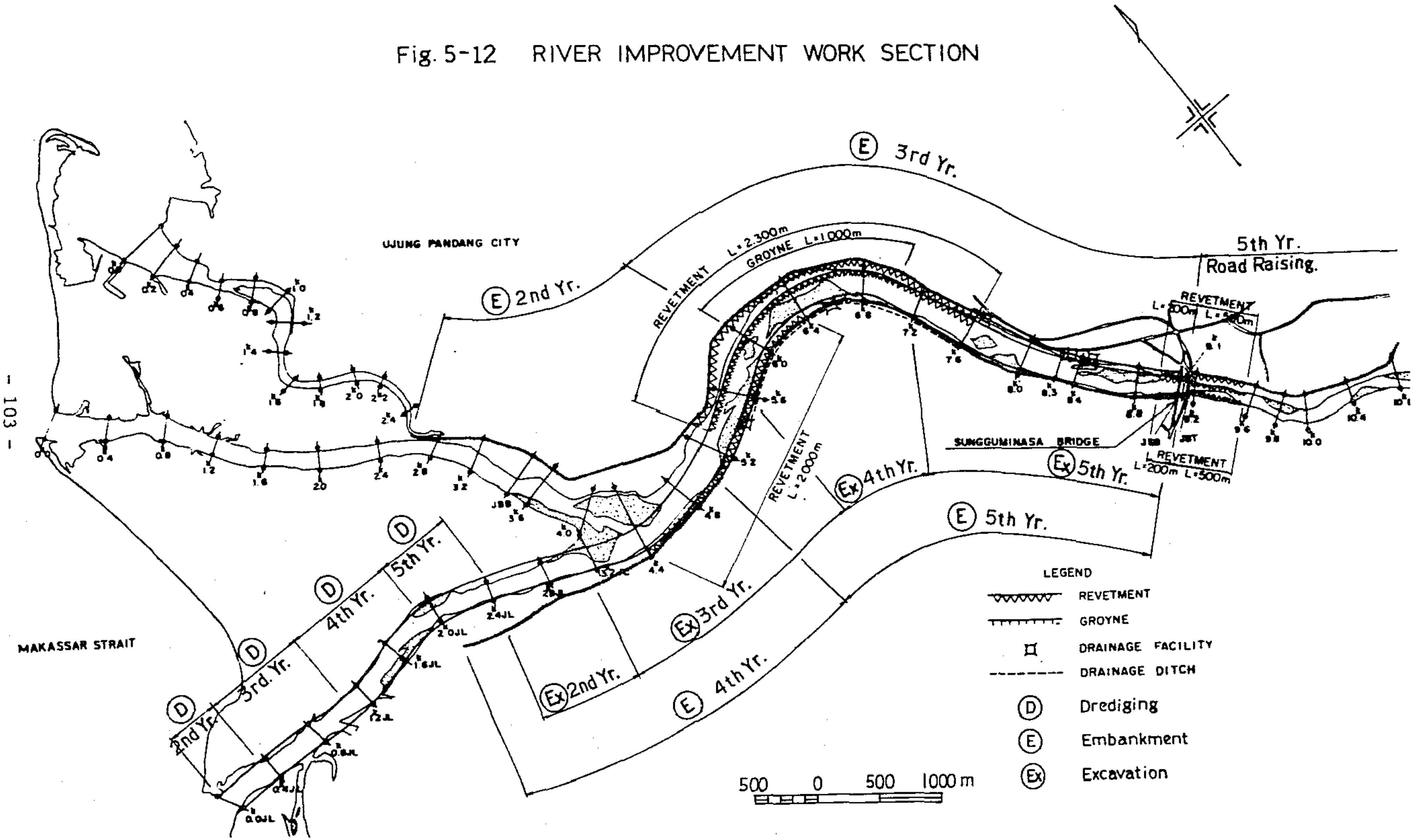
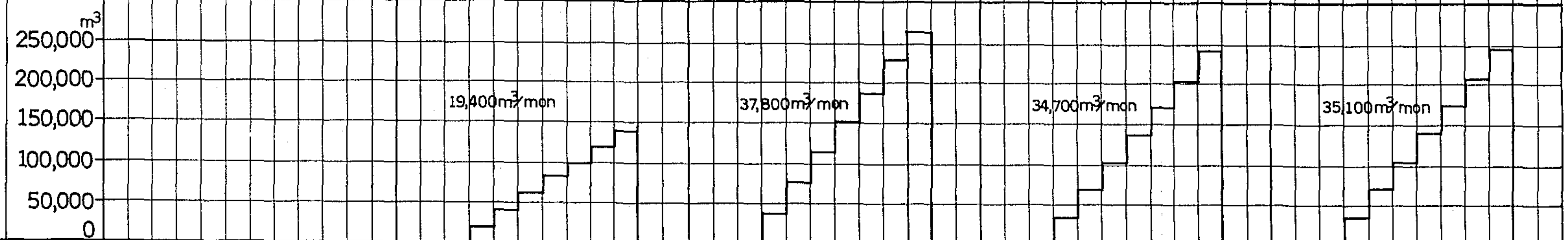


Fig. 5-13 CONSTRUCTION SCHEDULE (RIVER IMPROVEMENT)

WORK		VOLUME	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.
PREPARATION		(LUMP SUM)	(M–A)	(M–A)			
DETAILED ENGINEERING			(A–D)	(J–O)	(A–O)	(A–O)	(A–O)
EARTH WORK	DREDGING	264,000 m³		39,600	79,200	72,600	72,600
	LAND EXCAVATION	265,000 m³		39,800	79,500	73,000	72,700
	UNDERWATER EXCAVATION	265,000 m³		39,800	79,500	73,000	72,700
	EMBANKMENT	95,500 m³		16,600	26,500	24,600	27,800
SODDING		83,000 m²		11,700	21,500	25,400	24,400
REVETMENT	HIGH WATER	5,700 m		700	2,300	600	2,100
	LOW WATER				1,300	2,600	1,800
GROYNE		23 PCS				23	
SLUICE		3 PCS			1		2
ROAD RAISING		2,950 m					2,950

EARTH WORK PROGRESS



MACHINERY / LABOR			1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.
MACHINERY	DREDGER	520 PS		1	1	1	1
	WHEEL LOADER	2.0 m³		1	2	2	2
	WHEEL LOADER	1.2 m³		1	1	1	1
	BACK HOE	1.2 m³		1	2	2	2
	BULL DOZER	21 ton		2	3	3	3
	BULL DOZER	11 ton		1	1	1	1
	DUMP TRUCK	8 ton		18	31	31	31
	VIBRATING ROLLER	2.5 ton		1	1	1	1
LABOR Man-Day	EARTH WORK	OPERATION		26	42	42	42
		MAINTENANCE		3	5	5	5
		MISC		20	25	20	20
	REVETMENT GROYNE	MASON		15	130	160	150
		MISC		30	250	300	300
	TOTAL			94	452	527	517

Fig. 5-14 DRAINAGE CHANNEL WORK SECTION

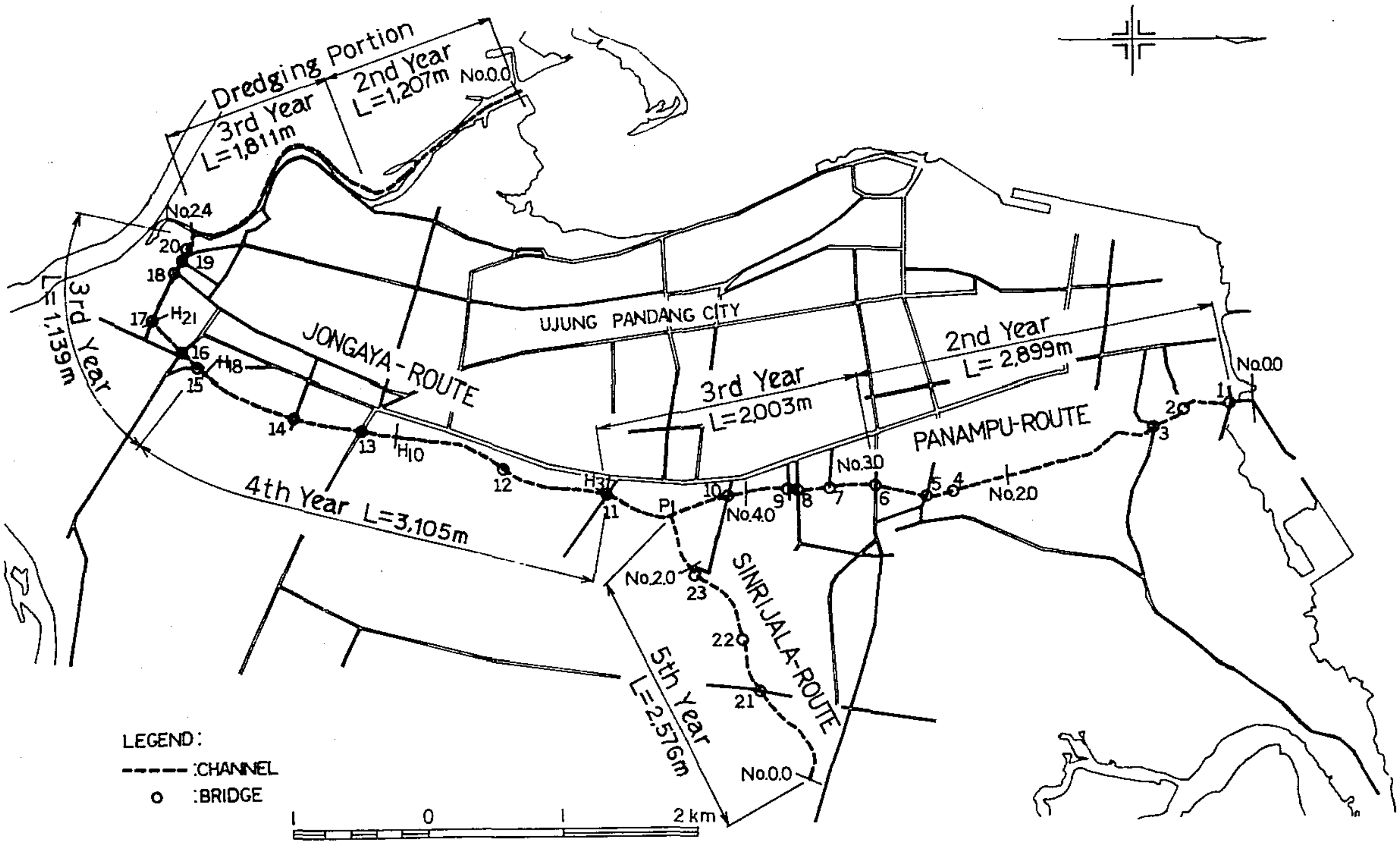
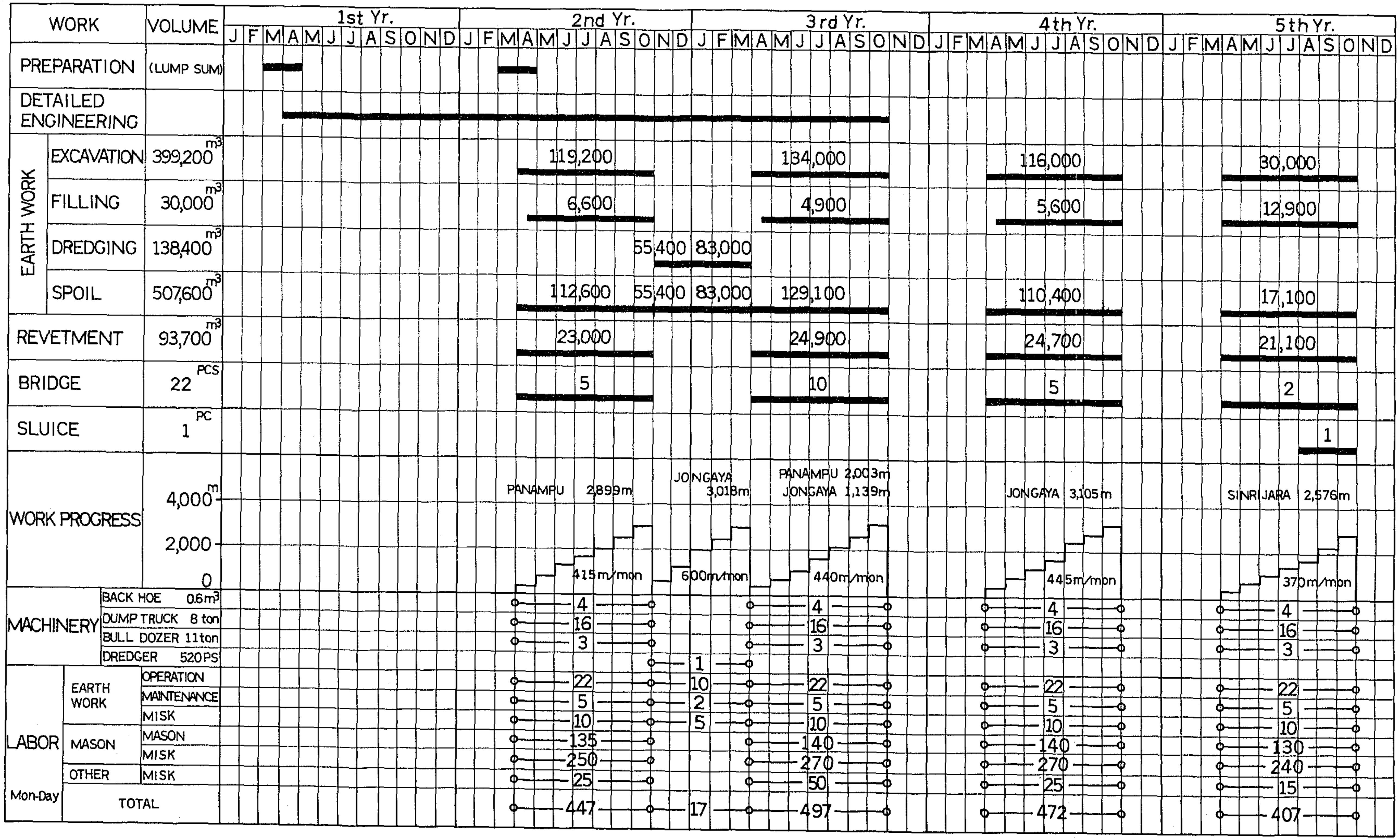


Fig. 5-15 CONSTRUCTION SCHEDULE (DRAINAGE IMPROVEMENT)



APPENDIX

MINUTES OF MEETING

I. Meeting on July 3, 1979

The Japanese Survey Team (JICA) and the Directorate of Planning and Programming of the Directorate General of Water Resources Development, Ministry of Public Works, the Government of the Republic of Indonesia, exchanged their views concerning the Inception Report for Feasibility Study of Lower Janeberang River Flood Control Project prepared by the Japanese Survey Team.

Following items were agreed upon by and between the both parties.

1. With regard to the cross-sectional survey of Tallo river described in 3.1.1.b. of the Inception Report, the sentence of "in a same condition of (a)" was eliminated, and the Japanese Survey Team will conduct the necessary number of cross-sectional survey.

2. With regard to the improvement of drainage system, the study will be conducted on main drainage channels, and the old urban area of Ujung Pandang City will not be included in the Project area.

3. With regard to the geology and soil mechanics in 3.1.4. of the Inception Report, there might be available result of boring test in the project area. Therefore should the result be available, boring and its test will not be conducted.

4. Japanese Survey Team will study the amount of sediment discharge and the degraded area to be controlled, and likewise will introduce erosion control. In this connection, the geology and sabo engineer will cover the engineering field of erosion control and soil conservation to the extent mentioned above.

5. Japanese Survey Team will make efforts to indicate necessity for comprehensive water resources development including flood control of the Jeneberang river by the end of October.

MINUTES OF MEETING

II. Meeting on September 25, 1979

A meeting between the Directorate of Planning & Programming and the Japanese Survey Team was held in the Department of Public Works (DPU) on 25 September 1979.

The following was agreed upon by and between both parties.

1. Definition of the future conditions in the objective area:

   i) Urgent drainage system will be studied, based on the conditions at the time of completion of the First Stage (1985) proposed in the Regional Development Plan.

   ii) Overall drainage system will be studied, based on the conditions at the time of completion of the Second and Third Stage respectively proposed in the same plan.

2. Proposal of river improvement scale:

   i) Jeneberang river improvement scale for the urgent flood control will be determined after studying three alternative plans ; 5-, 7- and 10-year return periods.

   ii) The scale for the overall flood control was determined at 50-year return period.

3. Cancellation of the boring test and its soil test:

Judging that the existing geological data prepared by the Directorate Geology give enough information for this feasibility study, the proposed boring test and its soil test were cancelled.

MINUTES OF MEETING

III. Meeting on October 27, 1979

A meeting between the Directorate of Planning & Programming and the Japanese Survey Team was held on October 27, 1979. The Progress and Study Reports submitted October 20, 1979 were explained and discussed. It was agreed that the Survey Team will conduct more detailed study in Japan, based on the criteria and findings described in the Study Report.

In addition, the following were discussed and agreed upon by and between both parties.

1. Jeneborang River Improvement

a) Natural retarding basin

To increase the regulation capacity of natural retarding basin in the upper reaches of Sungguminasa bridge, it is considerably effective to raise the road surrounding that basin. The effectivity will be studied, considering the social problems caused thereby.

b) Intermediate improvement scale

The scale of urgent and overall flood control was agreed to be 10-year and 50-year return period respectively. Judging from the characteristics of the existing river channel, the maximum scale of flood control by means of river improvement is about 10-year return period. To control a flood of more than 10-year return period, possibility of a reservoir will be studied. However, from the economical viewpoint, the reservoir to control a flood of intermediate return period can not be recommended.

2. Drainage System

a) Urban development plan

Following the basic concepts of the existing development plan prepared by BIEC International, Co., the study will be conducted. In connection with this plan, the lower parts in the development area will be filled with soil 12 cm above the mean high water springs (+68 cm above M.S.L.).

b) Bili-Bili irrigation channel

The lower area of the Bili-Bili irrigation is being urbanized. Bili-Bili irrigation channel is not utilized in a dry season. A great deal of discharge flows down through this channel into the inner basin in a rainy season. However, in the event that the gates will be operated properly, the flood water will not inflict a big damage to the inner basin.

Countermeasures against the possible damage caused by gate mis-operation will be studied and recommended.

MINUTES OF MEETING

IV. Meeting on February 8, 1980

The Japanese Survey Team (JICA) and Ministry of Public Works, the Government of Republic of Indonesia, exchanged their views concerning the feasibility study result of interim report of Lower Jeneberang River Flood Control Project prepared by the Japanese Survey Team.

Appreciation of the study result and following items were agreed upon by and between the both parties.

1) Japanese Survey Team will amend the followings in draft final report.

   i) To make clear in the report that the overall study is in sphere of preliminary stage.

   ii) To insert the minutes of meeting during the study.

   iii) To insert the back-data concerning the determination of design flood for urgent and overall flood control plan.

   iv) To add the indication of north direction in the plan maps.

2) With regard to draft final report, the Government of Republic of Indonesia will provide Japanese Survey Team with its comments within 30 days after discussion of interim report, if any Japanese Survey Team will submit 30 copies to the Government of Republic of Indonesia within 3 months after receipt of the comments. Discussion of draft final report will be held in Indonesia after submittal of draft final report.

MINUTES OF MEETING

V. Meeting on July 16, 1980

A meeting between the Directorate of Planning & Programming and the Japanese Survey Team was held on July 16, 1980 in Jakarta. Japanese Survey Team explained the draft final report. Both parties exchanged their views on the mattersd mentioned below.

1). Retarding Basin
   - Opinion of the people
   - Resettlement program
   - Cost of house evacuation

2). Proposed drainage channel in relation with the Cipta Karya's Plan

3). Hydrological Matters

4). Irrigable area by the overall plan

Japanese Survey Team wil prepare some additional expalanations in the final report to make the study result clear.

Appreciation of the study report was agreed upon by and between both parties.

With regardrd to the final report, the Directorate of Planning & Programming will provide Japanese Survey Team with its comments within 30 days after submission of the draft final report.

Japanese Survey Team will submit 50 copies to the Government of the Republic of Indonesia within 2 months after reciept of the comments on the draft final report.