## - A N N E X -

## PREVENTION OF LOCAL DISASTER IN THE AREA

### 1 THOUGHT OF SEDIMENT CONTROL

Besides environmental aspects aforementioned, sediment control will be discussed in this chapter. There exists the collapse area spreading 0.2 $km^2$ in the mountain regions in the upstream of the Jeneberang river which has produced tremendous amount of sediment in the past and has flown it down into the River.

At the present, the collapse area is supposed not to give ill-effects to the river, even if no sediment control facilities be built as described in the above chapter. It is, however, feared that the sediment discharge from the collapse area, if and when it occurs, may cause local disaster in the immediate downstream of the above-mentioned area. From this point of view, installation of appropriate sediment control facilities will be recommended to mitigate local disaster in the upstream area, though it is not to be included as a part of this project.

### 2 LOCATION AND FUNCTION OF SABO DAM

Three Sabo dams are recommended as the appropriate sediment control facilities and their locations are shown in Fig.1-23, in due consideration to the following conditions.

1) the active collapse areas in the lower reaches where sediments are currently produced

2) narrowness of the valley which helps saving the total dam volume (and, thereby, saving dam construction cost)

3) the place suitable for preventing lateral erosion of terrace and fan scrap through raising the riverbed and

4) the place which is situated in an easy reach of Sabo dam construction materials

The function of the Sabo dam is generally as follows.

1) to catch sediment discharge

2) to regulate sediment transportation, and

3) to prevent producing sediments.

The third function is atainable as Sabo dam will help raising the riverbed at its upper reaches by arresting outflowing sediments and the raised riverbed plays the role of counterweight to check fresh occurrence of collapse. Sabo dam will, therefore, be effectively installed in the very area where sediments are being produced.

# 3. PRELIMINARY STANDARD DESIGN, COST ESTIMATE AND CONSTRUCTION SCHEDULE OF SABO DAM

## 3.1 Preliminary Standard Design

The proposed Sabo dam will be desinged as the gravity structure of a floating type on their foundation consisting of thick sand and gravel. The size of the Sabo dam is given 15 m in height, 50 m in crest length and 2 m in crest width based on the field reconnaissance and the preliminary standard design of the Sabo dam is illustrated in Fig. 1-1(AN) as an example.

## 3.2 Cost Estimate

The construction cost of one dam is estimated at about 0.4 million dollars as indicated below and, therefore total construction cost of 1.2 million dollars will be required for the three proposed Sabo dam construction.

| Item | Quantity | Unit Price | Cost |
|---|---|---|---|
| a. Concrete Works | 2,800 $m^3$ | 120US$/$m^3$ | 336,000US$ |
| b. Excavation Works | 3,200 $m^3$ | 7US$/$m^3$ | 22,400US$ |
| c. Preparation Works & Others | L.S. | | 36,000US$ |
| Total | | | 394,000US$ |

## 3.3 Construction Schedule

As for the construction schedule, the period of three years is proposed for the entire completion of three proposed dams considering the following conditions:

1) One dry season from April to November is allotted to the construction period of one dam; the preparation works (1 month), the excavation works (2 months) and the concrete works (4 months).

2) The construction of three proposed dams will proceed consecutively for three years running from the upstream side to downstream side.

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

| Items | Bili-Bili (Jeneberang) | Pasaratowaya (Jeneberang) | Jonggoa (Jeneberang) | Pattalikang (Jenelata) |
|---|---|---|---|---|
| a. Catchment area ($Km^2$) | 384.4 | 319.2 | 242.0 | 226.3 |
| b. Surface area ($Km^2$) | 17.8 | 7.8 | 8.2 | 8.5 |
| c. Dam height (m) | 66.0 | 80.0 | 100.0 | 65.0 |
| d. Dam volume ($m^3$) | $6.3x10^6$ | $12.5x10^6$ | $19.1x10^6$ | $12.0x10^6$ |
| e. Reservoir capacity ($m^3$) | $362x10^6$ | $240x10^6$ | $280x10^6$ | $220x10^6$ |
| f. Effective storage capacity ($m^3$) | $304x10^6$ | $192x10^6$ | $243x10^6$ | $186x10^6$ |
| g. Construction cost ($) | $157x10^6$ | $288x10^6$ | $439x10^6$ | $276x10^6$ |
| h. Effective storage capacity per Dam volume (f/d) | 48.3 | 15.4 | 12.7 | 15.5 |
| i. Construction cost per Effective storage capacity ($/$m^3$) | 0.52 | 1.50 | 1.81 | 1.48 |
| j. Submerged houses (nos.) | 790 | 300 | 100 | 300 |
| k. Effective storage capacity per Annual run-off volume (1976)(%) | 38 | 29 | 49 | 40 |

Table 1-2 THE MAIN DAMS OF EXISTING AND PLANNING IN INDONESIA

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

Table 1-3 ALLOCATION OF RESERVOIR CAPACITY AND SPILLWAY COSTRUCTION COST

| | Discharge Facilities | | Water Utilization Capacity ($x10^6m^3$) | Flood Control Capacity ($x10^6m^3$) | Capacity for safety of dam body($x10^6m^3$) | Construction Cost ($x10^6$US$) |
|---|---|---|---|---|---|---|
| | Free flow Section | Gate Section | | | | |
| Type I | L = 130 m | | 224 | 63 | 45 | 22.9 |
| Type II | $L_1$ = 130 m | | 245 | 63 | 24 | 29.3 |
| | $L_2$ = 320 m | | | | | |
| Type III | L = 100 m | 6.5mx7.2mx2 | 230 | 46 | 56 | 23.5 |
| Type IV | $L_1$ = 100 m | 6.5mx7.2mx2 | 258 | 46 | 28 | 31.0 |
| | $L_2$ = 337 m | | | | | |
| Type V | L = 100 m | 6.5mx7.2mx2 | 237 | 46 | 13 | 26.7 |
| | | 7.3mx9.9mx4 | | | | |

Table 1-4 LAND ACQUISITION AND HOUSE EVACUATION

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

Table 1-5 SOURCE OF EMBANKMENT MATERIALS

(Unit ; x $10^3$ $m^3$)

| Material | Rock | Filter | Core | Randam | Waste & other use | Total |
|---|---|---|---|---|---|---|
| Required Embankment Volume | 3,790 | 800 | 1,060 | 630 | - | 6,280 |
| Available from | | | | | | |
| Diversion channels | - | - | - | 100 | 194 | 294 |
| Dam foundation | - | 100 | - | 40 | 750 | 890 |
| Spillway | 300 | - | 500 | 300 | 440 | 1,540 |
| Intake | 10 | - | - | 6 | 8 | 24 |
| Power plant | - | - | 10 | 5 | 15 | 45 |
| Pressure tunnel | - | - | 5 | - | 22 | 27 |
| Tailrace channel | 5 | - | - | - | 15 | 20 |
| Deficiency supplied from | | | | | | |
| Borrow pit | - | - | 545 | - | - | 545 |
| Rock quarry | 3,460 | - | - | 179 | - | 3,639 |
| River bed | - | 700 | - | - | - | 700 |

Table 1-6 SUMMARY OF MONTHLY RAINY DAY AT BILI-BILI

| RAINFALL (mm) | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 9.8 | 6.3 | 12.3 | 17.8 | 21.6 | 23.2 | 24.5 | 26.5 | 23.8 | 26.4 | 15.0 | 10.0 | 217.2 |
| 0.1 - 2.0 | 0.9 | 1.5 | 1.4 | 1.2 | 0.6 | 1.3 | 1.5 | 0.6 | 0.9 | 0.3 | 0.7 | 0.5 | 11.4 |
| 2.1 - 5.0 | 2.2 | 1.7 | 2.5 | 1.8 | 1.4 | 1.6 | 1.4 | 1.4 | 1.1 | 0.9 | 1.5 | 2.3 | 19.8 |
| 5.1 - 10.0 | 3.1 | 2.6 | 3.5 | 1.7 | 1.2 | 0.8 | 1.0 | 0.8 | 0.9 | 0.9 | 2.0 | 4.0 | 22.5 |
| 10.1 - 20.0 | 3.4 | 4.5 | 4.8 | 2.1 | 2.1 | 1.3 | 0.9 | 1.5 | 1.5 | 0.9 | 2.8 | 4.3 | 30.1 |
| 20.1 - 30.0 | 2.4 | 2.9 | 1.9 | 0.8 | 1.5 | 0.8 | 0.9 | 0 | 1.3 | 0.7 | 2.3 | 3.3 | 18.8 |
| 30.1 - 40.0 | 2.5 | 3.2 | 2.2 | 1.2 | 0.9 | 0.6 | 0 | 0 | 0.1 | 0.2 | 1.8 | 1.6 | 14.3 |
| 40.0 over | 6.7 | 5.3 | 2.4 | 3.4 | 1.7 | 0.4 | 0.8 | 0.2 | 0.4 | 0.7 | 3.9 | 5.0 | 30.9 |
| Total | 31.0 | 28.0 | 31.0 | 30.0 | 31.0 | 30.0 | 31.0 | 31.0 | 30.0 | 31.0 | 30.0 | 31.0 | 365 |
| Total Rainy day | 21.2 | 21.7 | 18.7 | 12.2 | 9.4 | 6.8 | 6.5 | 4.5 | 6.2 | 4.6 | 15.0 | 21.0 | 147.8 |

# Table 1-7 MONTHLY WORKABLE DAY FOR EACH WORK

MONTHLY WORKABLE DAY FOR CONCRETE WORK

| | JAN. | FEB. | MAR. | APR. | MAY. | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Calendar day | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | 365 |
| (2) Sunday | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 52 |
| (3) National holiday | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 0 | 2 | 0 | 2 | 12 |
| (4) (2) + (3) | 6 | 4 | 5 | 5 | 7 | 4 | 4 | 8 | 4 | 6 | 5 | 6 | 64 |
| (5) Rainy day | 12 | 13 | 16 | 5 | 4 | 2 | 2 | 0 | 1 | 2 | 8 | 11 | 76 |
| (6) (4) × (5)/(1) | 2 | 2 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 12 |
| (7) Repair day | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| (8) Workable day | 14 | 12 | 12 | 20 | 20 | 23 | 26 | 22 | 24 | 22 | 17 | 15 | 275 |

Workable days: 275 days/year 19 days/month

MONTHLY WORKABLE DAY FOR EMBANKMENT ROCK WORK

| | JAN. | FEB. | MAR. | APR. | MAY. | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Calendar day | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | 365 |
| (2) Sunday | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 52 |
| (3) National holiday | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 0 | 2 | 0 | 2 | 12 |
| (4) (2) + (3) | 6 | 4 | 5 | 5 | 7 | 4 | 4 | 8 | 4 | 6 | 5 | 6 | 64 |
| (5) Rainy day | 10 | 8 | 4 | 6 | 3 | 1 | 1 | 0 | 0 | 3 | 6 | 7 | 45 |
| (6) (4) × (5)/(1) | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 8 |
| (7) Repair day | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| (8) Workable day | 16 | 16 | 22 | 21 | 21 | 24 | 25 | 22 | 25 | 23 | 19 | 18 | 252 |

Workable days: 252 days/year 21 days/month

MONTHLY WORKABLE DAY FOR EMBANKMENT EARTH WORK

| | JAN. | FEB. | MAR. | APR. | MAY. | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Calendar day | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | 365 |
| (2) Sunday | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 52 |
| (3) National holiday | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 0 | 2 | 0 | 2 | 12 |
| (4) (2) + (3) | 6 | 4 | 5 | 5 | 7 | 4 | 4 | 8 | 4 | 6 | 5 | 6 | 64 |
| (5) Rainy day | 19 | 20 | 17 | 10 | 7 | 5 | 4 | 2 | 4 | 4 | 14 | 19 | 125 |
| (6) (4) × (5)/(1) | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 4 | 25 |
| (7) Repair day | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| (8) Workable day | 8* | 4 | 11 | 16 | 18 | 21 | 23 | 21 | 22 | 21 | 13 | 9 | 189 |

Workable days: JAN. to DEC. 189 days/year 16 days/month
APR. to OCT. 142 days/year 20 days/month

MONTHLY WORKABLE DAY FOR EXCAVATION WORK

| | JAN. | FEB. | MAR. | APR. | MAY. | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Calendar day | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | 365 |
| (2) Sunday | 4 | 4 | 5 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 52 |
| (3) National holiday | 2 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 0 | 2 | 0 | 2 | 12 |
| (4) (2) + (3) | 6 | 4 | 5 | 5 | 7 | 4 | 4 | 8 | 4 | 6 | 5 | 6 | 64 |
| (5) Rainy day | 7 | 5 | 2 | 3 | 2 | 0 | 1 | 0 | 0 | 1 | 4 | 5 | 30 |
| (6) (4) × (5)/(1) | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 |
| (7) Repair day | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| (8) Workable day | 18 | 19 | 23 | 22 | 21 | 25 | 25 | 27 | 23 | 23 | 21 | 19 | 263 |

Workable days: 263 days/year 22 days/month

Table 1-8 MAIN CONSTRUCTION MACHINERY FOR DAM

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

Table 1-9 CONSTRUCTION COST OF BILI-BILI DAM

| Work Item | Unit | Quantity | Total Amount ($x10^3$ US$) | Foreign Currencey ($x10^3$ US$) | Local Currency ($x10^3$ US$) |
|---|---|---|---|---|---|
| 1. Civil Works | | | | | |
| Excavation | $m^3$ | 890,000 | 5,266 | 2,609 | 2,657 |
| Embankment | $m^3$ | 6,280,000 | 42,205 | 28,771 | 23,434 |
| Spillway | L.S. | 1 | 32,140 | 16,586 | 15,554 |
| Foundation | L.S. | 1 | 9,000 | 5,940 | 3,060 |
| Intake | L.S. | 1 | 524 | 270 | 254 |
| Headrace channel | L.S. | 1 | 162 | 87 | 75 |
| Diversion | L.S. | 1 | 14,466 | 7,390 | 7,076 |
| Preparatory works | L.S. | 1 | 10,377 | 5,166 | 5,211 |
| Sub-total | - | - | 114,140 | 56,819 | 57,321 |
| 2. Gates & Equipment | L.S. | 1 | 2,638 | 2,239 | 399 |
| 3. Road Relocation | km | 19 | 2,500 | 250 | 2,250 |
| 4. Land Acquisition | ha | 780 | 5,360 | - | 5,360 |
| 5. House Evacuation | P.C. | 790 | 380 | - | 380 |
| 6. Relocation of Pumping St. | P.C. | 1 | 700 | 665 | 35 |
| 7. Engineering Service | L.S. | 1 | 10,990 | 9,190 | 1,800 |
| Sub-total (1-7) | - | - | 136,708 | 69,163 | 67,545 |
| 8. Physical Contingency | L.S. | 1 | 20,506 | 10,374 | 10,132 |
| Grand-total (1-8) | - | - | 157,214 | 79,537 | 77,677 |

Table 1-10 ANNUAL DISBURSEMENT SCHEDULE FOR DAM

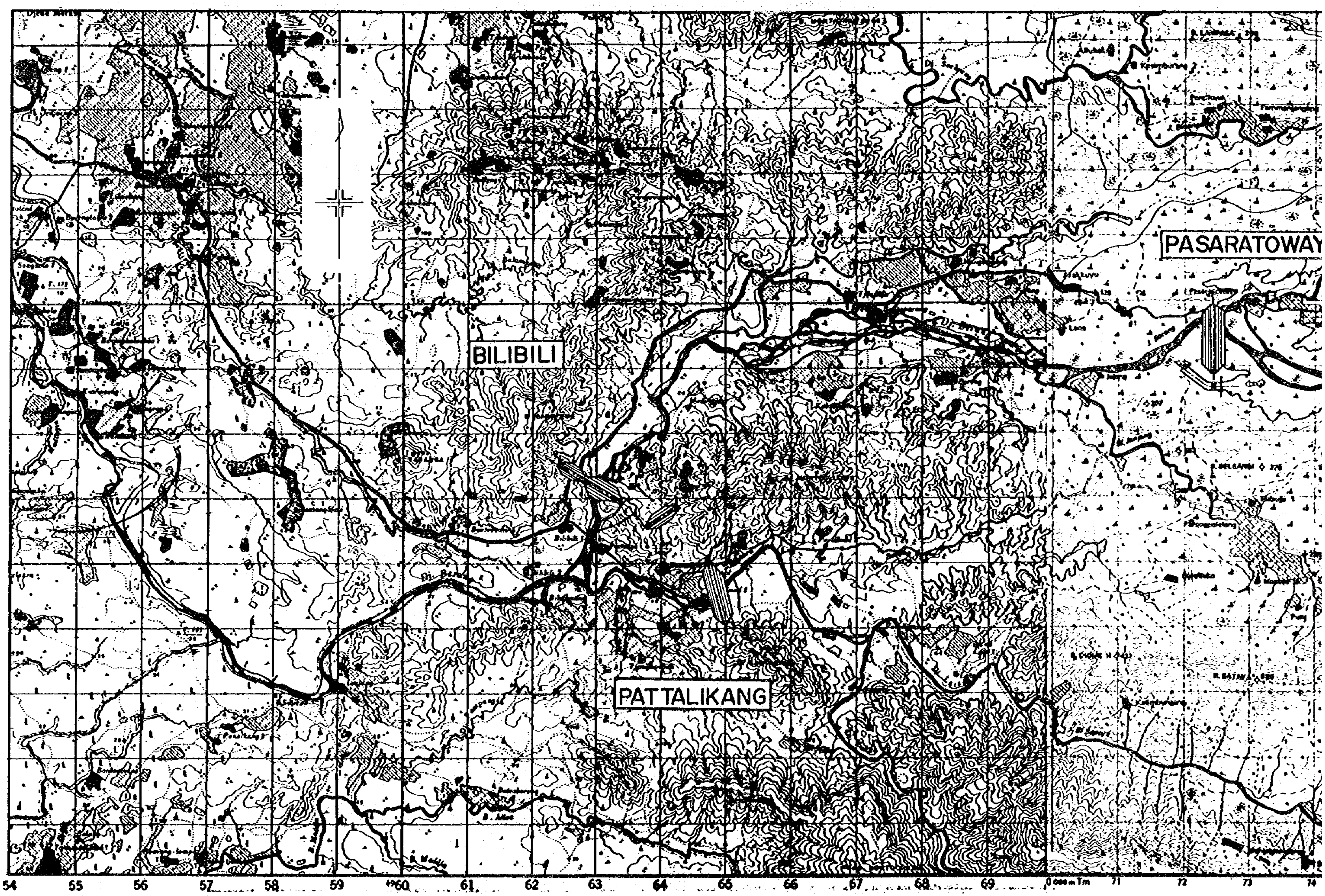
(Unit: x $10^3$ US$ )

| Work Item | Total | | 1983 | | 1984 | | 1985 | | 1986 | | 1987 | | 1988 | | 1989 | | 1990 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. | F.C. | L.C. |
| 1. Civil Works | | | | | | | | | | | | | | | | | | |
| Excavation | 2,609 | 2,657 | - | - | - | - | - | - | 503 | 517 | 2,106 | 2,140 | - | - | - | - | | |
| Embankment | 18,771 | 23,434 | - | - | - | - | - | - | - | - | 3,964 | 4,845 | 4,545 | 5,706 | 5,135 | 6,446 | 5,127 | 6,437 |
| Spillway | 16,586 | 15,554 | - | - | - | - | - | - | - | - | 1,309 | 1,421 | 5,781 | 5,656 | 7,717 | 7,119 | 1,779 | 1,358 |
| Foundation | 5,940 | 3,060 | - | - | - | - | - | - | 2,277 | 1,173 | 1,930 | 994 | 1,733 | 892 | - | - | - | - |
| Intake | 270 | 254 | | | | | | | - | - | 90 | 122 | 180 | 133 | - | - | - | - |
| Headrace channel | 87 | 75 | - | - | - | - | - | - | - | - | 14 | 18 | 65 | 47 | 8 | 10 | - | - |
| Diversion | 7,390 | 7,076 | - | - | - | - | - | - | 6,049 | 6,140 | - | - | - | - | - | - | 1,341 | 936 |
| Preparatory works | 5,166 | 5,211 | - | - | - | - | - | - | 883 | 783 | 931 | 940 | 1,216 | 1,239 | 1,310 | 1,375 | 826 | 874 |
| Sub-total | 56,819 | 57,321 | - | - | - | - | - | - | 9,712 | 8,613 | 10,240 | 10,340 | 13,379 | 13,633 | 14,407 | 15,120 | 9,081 | 9,615 |
| 2. Gates and Steel Pipe | 2,239 | 399 | - | - | - | - | - | - | - | - | - | - | - | - | 701 | 123 | 1,538 | 276 |
| 3. Road Relocation | 250 | 2,250 | - | - | - | - | - | - | 63 | 563 | 63 | 563 | 62 | 562 | 62 | 562 | - | - |
| 4. Land Acquisition | - | 5,360 | - | - | - | - | - | 1,072 | - | 1,072 | - | 1,072 | - | 1,072 | - | 1,072 | - | - |
| 5. House Evacuation | - | 380 | - | - | - | - | - | 76 | - | 76 | - | 76 | - | 76 | - | 76 | - | - |
| 6. Relocation of Pumping St. | 665 | 35 | - | - | - | - | - | - | 665 | 35 | - | - | - | - | - | - | - | - |
| 7. Engineering Service | 9,190 | 1,800 | 2,165 | 610 | 1,023 | 175 | 68 | 12 | 1,148 | 194 | 1,137 | 192 | 1,239 | 209 | 1,137 | 194 | 1,273 | 214 |
| Sub-total (1-7) | 69,163 | 67,545 | 2,165 | 610 | 1,023 | 175 | 68 | 1,160 | 11,588 | 10,553 | 11,440 | 12,243 | 14,680 | 15,552 | 16,307 | 17,147 | 11,892 | 10,105 |
| 8. Physical Contingency | 10,374 | 10,132 | 325 | 92 | 153 | 26 | 10 | 174 | 1,738 | 1,583 | 1,716 | 1,836 | 2,203 | 2,333 | 2,446 | 2,572 | 1,783 | 1,516 |
| Grand-total (1-8) | 79,537 | 77,677 | 2,490 | 702 | 1,176 | 201 | 78 | 1,334 | 13,326 | 12,136 | 13,156 | 14,079 | 16,883 | 17,885 | 18,753 | 19,719 | 13,675 | 11,621 |

Table 1-11 AGE BRACKET DISTRIBUTION OF INHABITANT IN DAM SUBMERSION AREA

| Age | Male (%) | Female (%) | Total (%) |
|---|---|---|---|
| 0 ∿ 4 | 7.6 | 7.0 | 14.6 |
| 5 ∿ 9 | 8.4 | 8.2 | 16.6 |
| 10 ∿ 14 | 7.0 | 5.2 | 12.2 |
| 15 ∿ 19 | 3.9 | 5.0 | 8.9 |
| 20 ∿ 24 | 3.3 | 4.4 | 7.7 |
| 25 ∿ 29 | 4.5 | 5.2 | 9.7 |
| 30 ∿ 34 | 3.0 | 3.3 | 6.3 |
| 35 ∿ 39 | 3.6 | 3.5 | 7.1 |
| 40 ∿ 44 | 2.6 | 2.4 | 5.0 |
| 45 ∿ 49 | 2.0 | 2.1 | 4.1 |
| 50 ∿ 54 | 1.4 | 1.3 | 2.7 |
| 55 ∿ 59 | 0.7 | 0.7 | 1.4 |
| 60 ∿ 64 | 0.6 | 0.9 | 1.5 |
| 65 ∿ 69 | 0.5 | 0.6 | 1.1 |
| Over 70 | 0.6 | 0.5 | 1.1 |
| Grand Total | 49.7 | 50.3 | 100.0 |

Source: SENSUS PENDUDUK KABUPATEN GOWA 1980


PASARATOWAY
BILIBILI
PATTALIKANG
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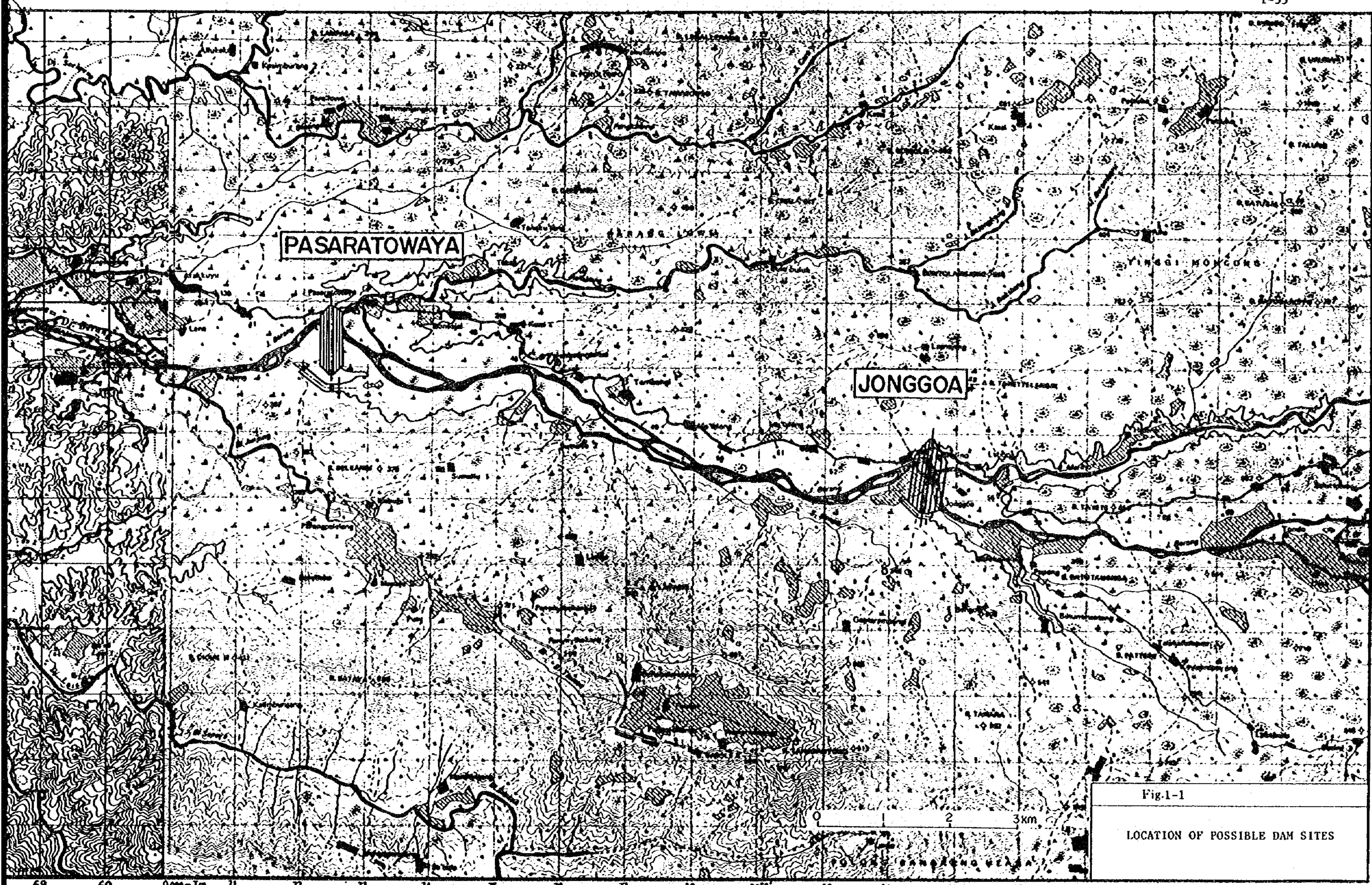
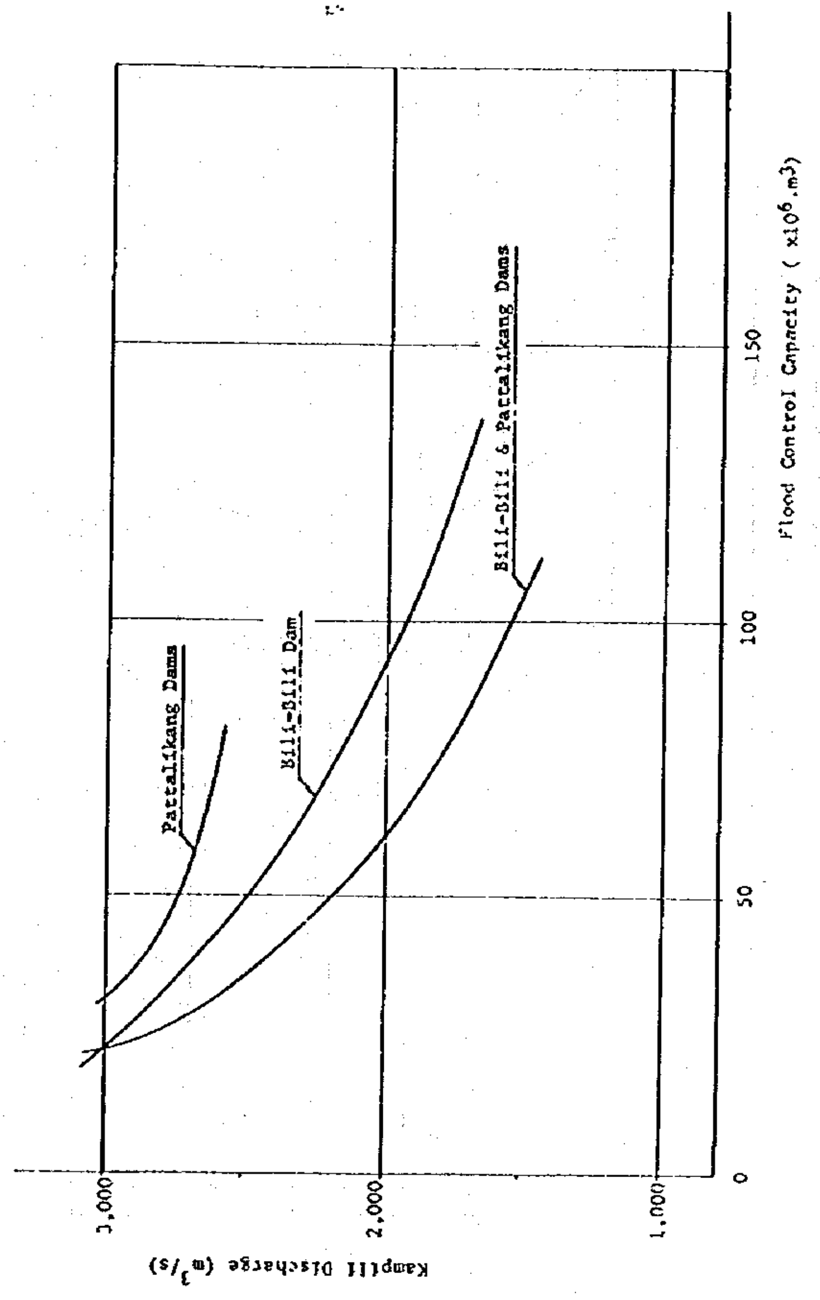



Fig.1-1

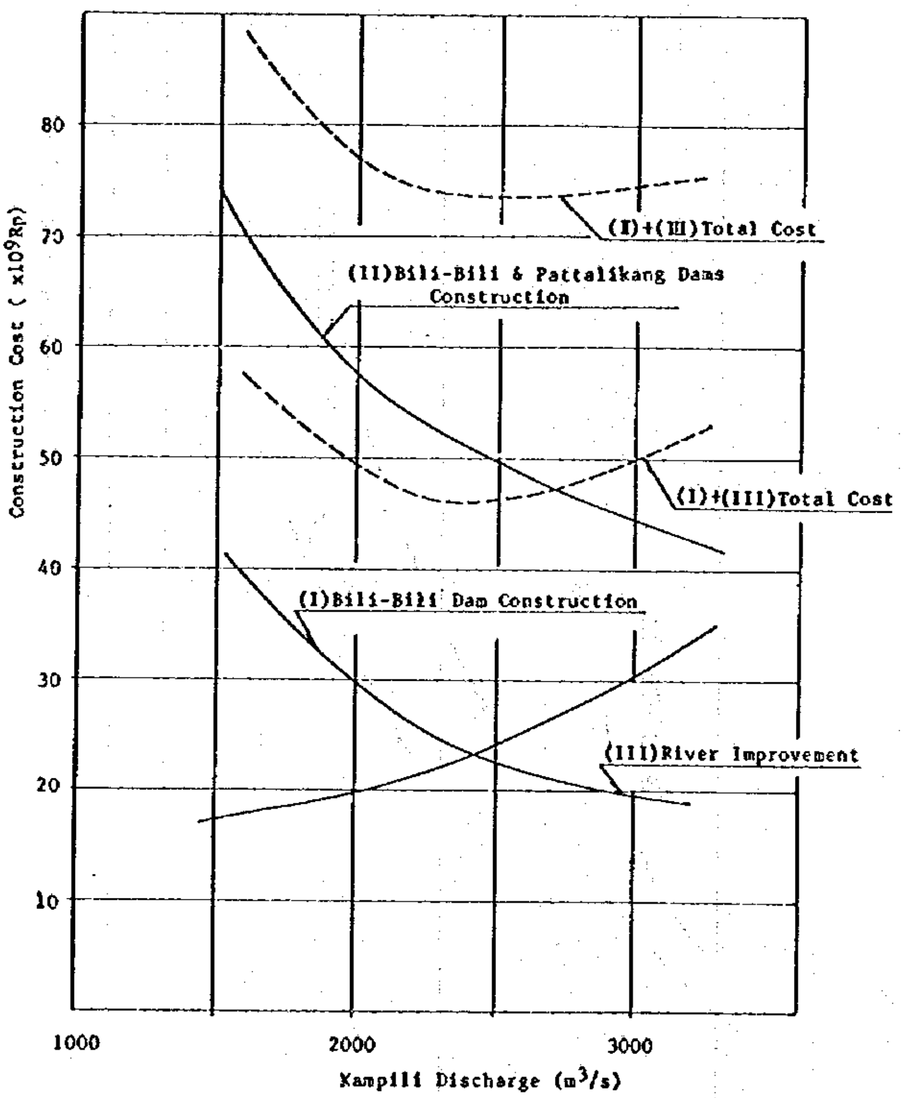
LOCATION OF POSSIBLE DAM SITES




Note: The flood control capacity corresponds to the reservor volume necessary for the diffinit limitation of the outfrow.

Fig. 1-2

RELATION BETWEEN FLOOD CONTROL CAPACITY OF DAM AND DISCHARGE AT KAMPILI




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

Fig. 1-3

RELATION BETWEEN COST AND DISCHARGE AT KAMPILI

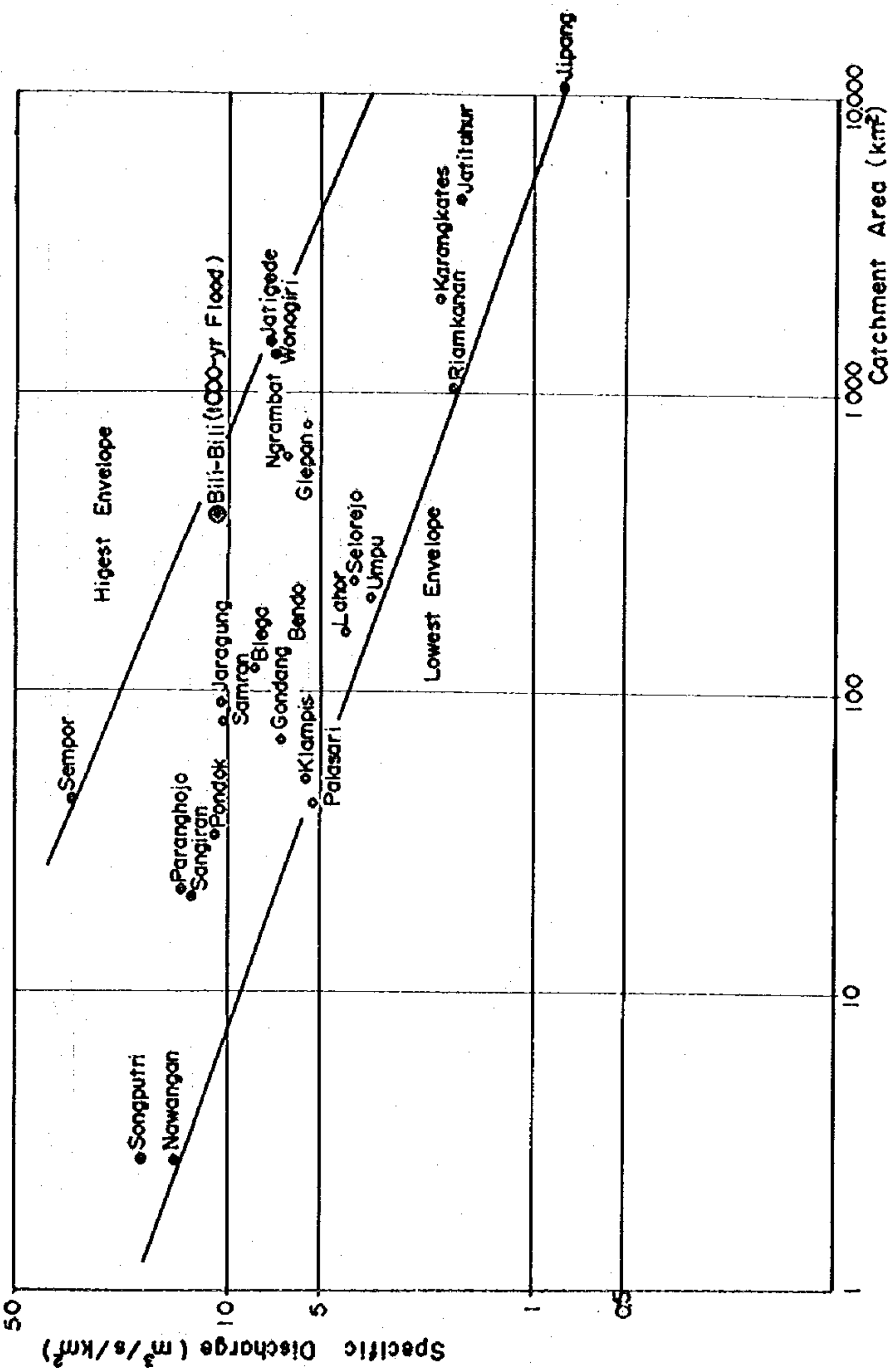



Fig. 1-4

RELATION CURVE BETWEEN CATCHMENT AREA & SPECIFIC DISCHARGE

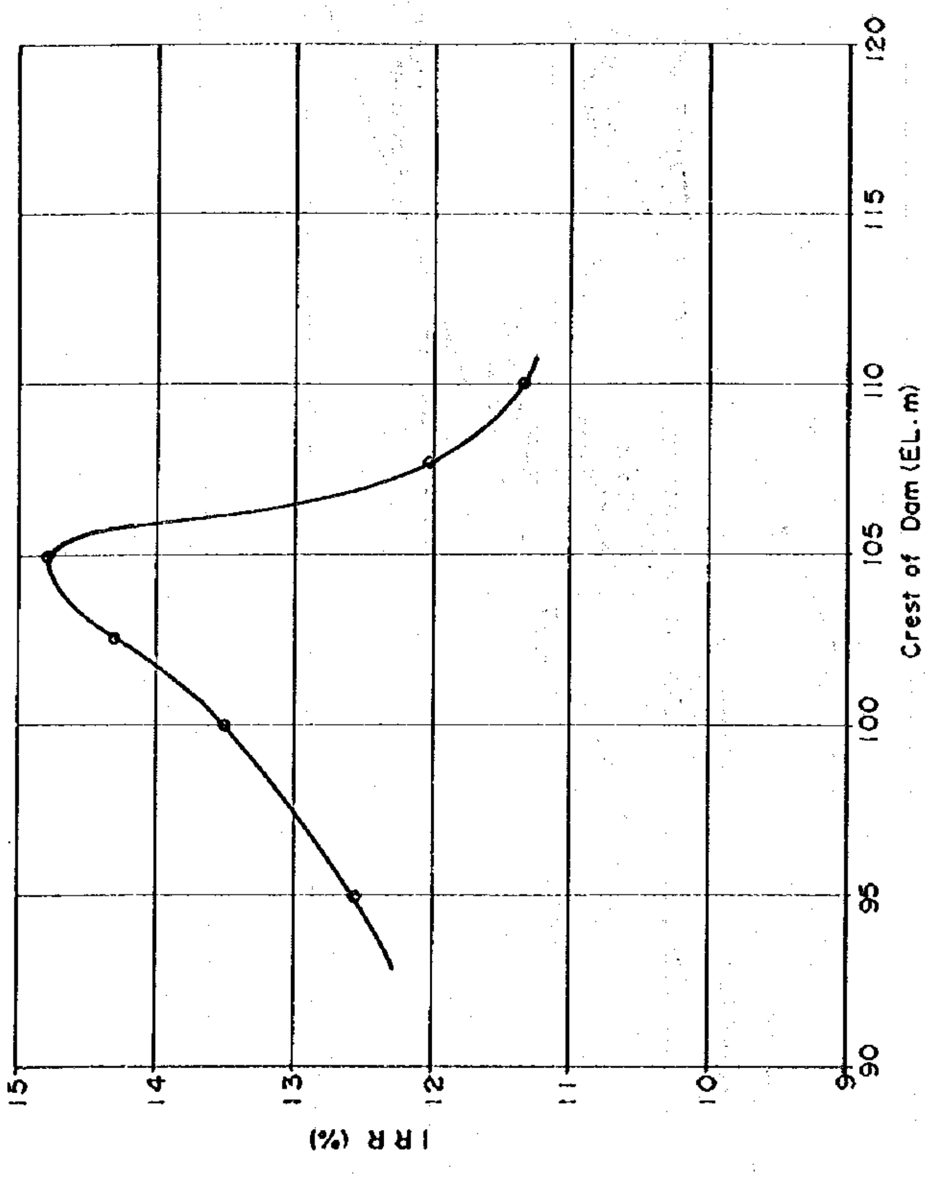



Fig. 1-5

RELATION BETWEEN IRR AND DAM HEIGHT

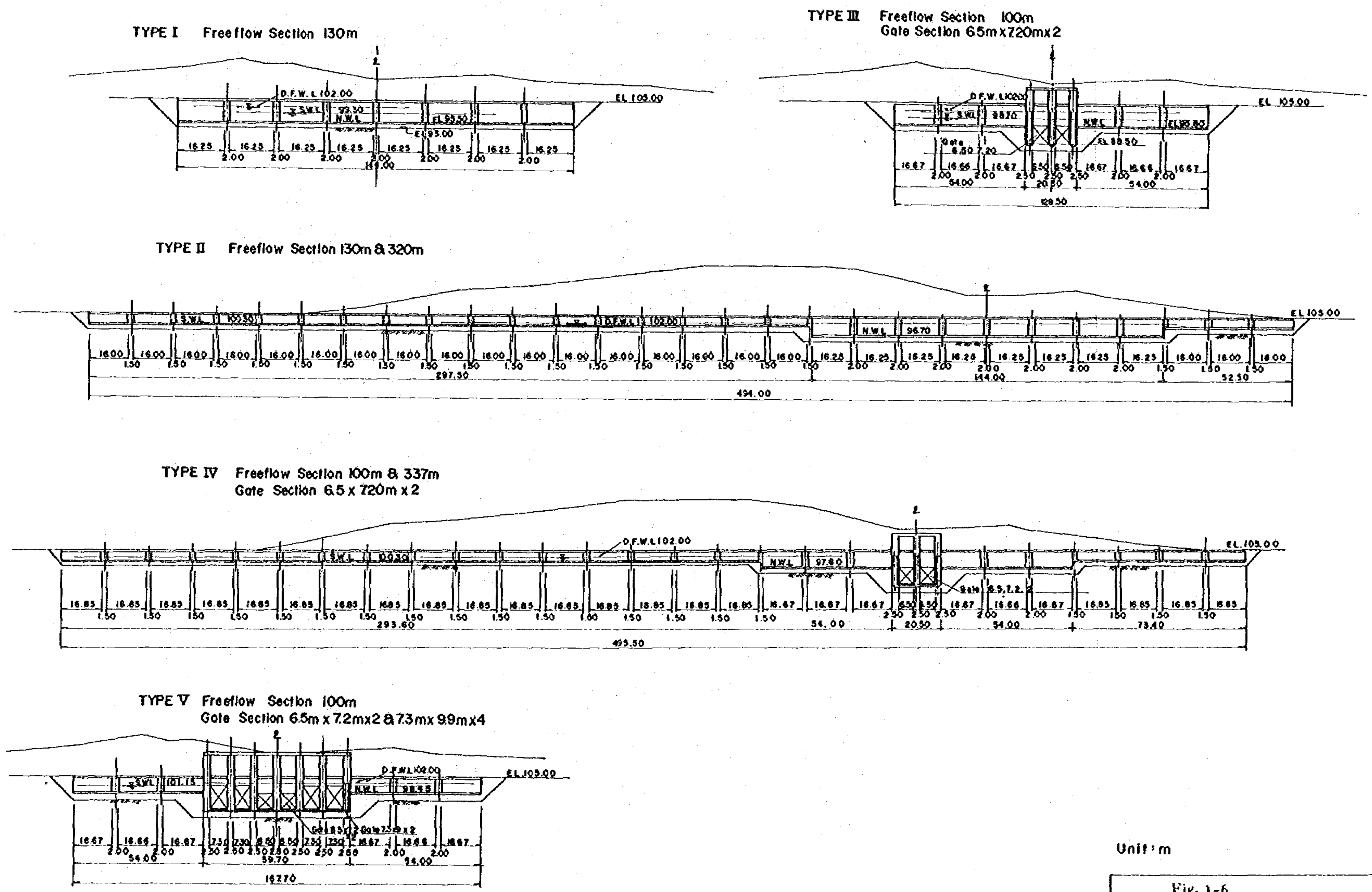
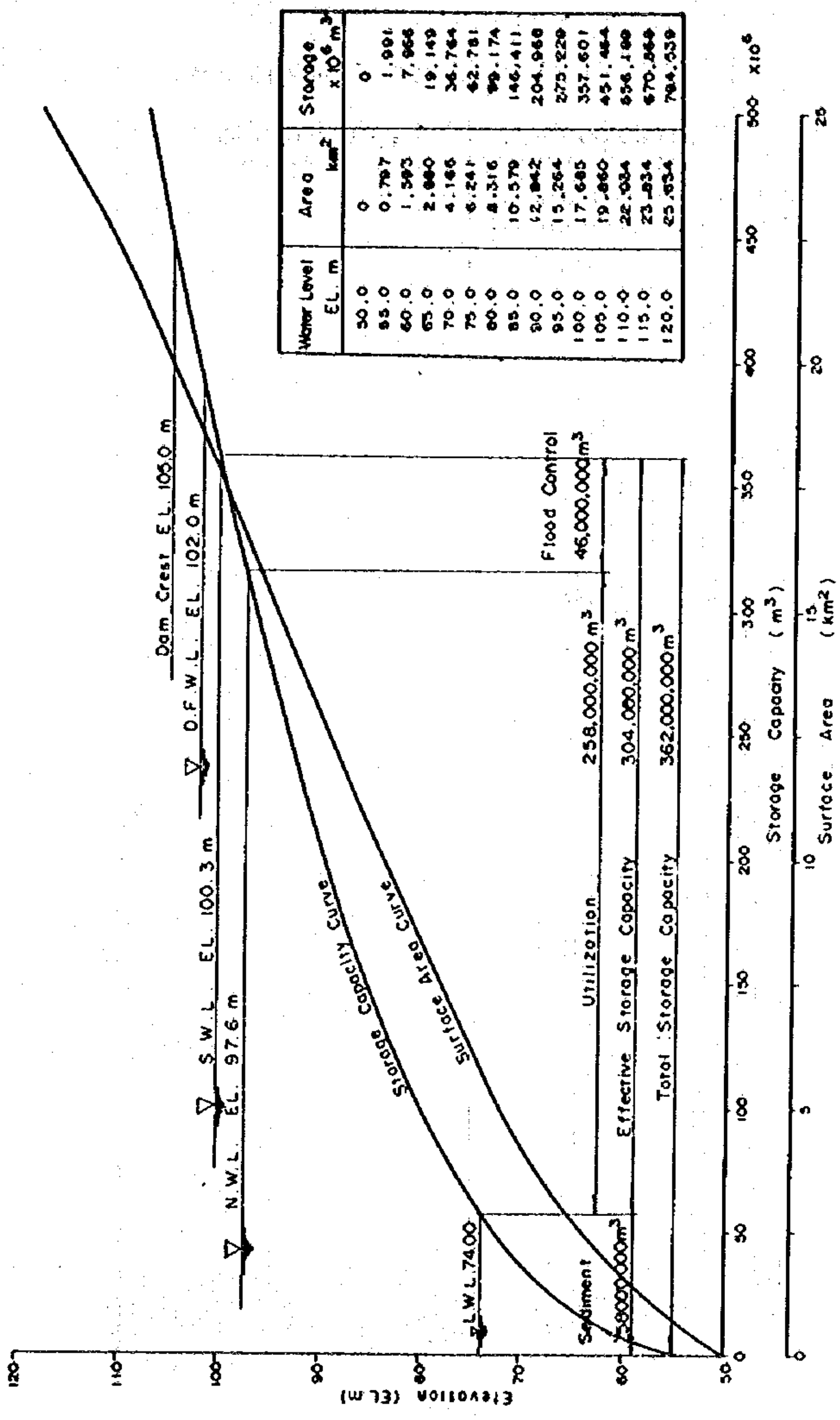



Fig. 1-6

ALTERNATIVE PLAN OF SPILLWAY TYPE




| Water Level EL. m | Area km² | Storage x 10⁶ m³ |
|---|---|---|
| 50.0 | 0 | 0 |
| 55.0 | 0.787 | 1.991 |
| 60.0 | 1.593 | 7.966 |
| 65.0 | 2.880 | 19.149 |
| 70.0 | 4.166 | 36.764 |
| 75.0 | 6.241 | 62.781 |
| 80.0 | 8.316 | 99.174 |
| 85.0 | 10.579 | 146.411 |
| 90.0 | 12.842 | 204.968 |
| 95.0 | 15.264 | 275.229 |
| 100.0 | 17.685 | 357.601 |
| 105.0 | 19.860 | 451.464 |
| 110.0 | 22.034 | 556.188 |
| 115.0 | 23.934 | 670.869 |
| 120.0 | 25.834 | 784.539 |

Fig. 1-7

RELATION CURVE BETWEEN ELEVATION AND STORAGE CAPACITY

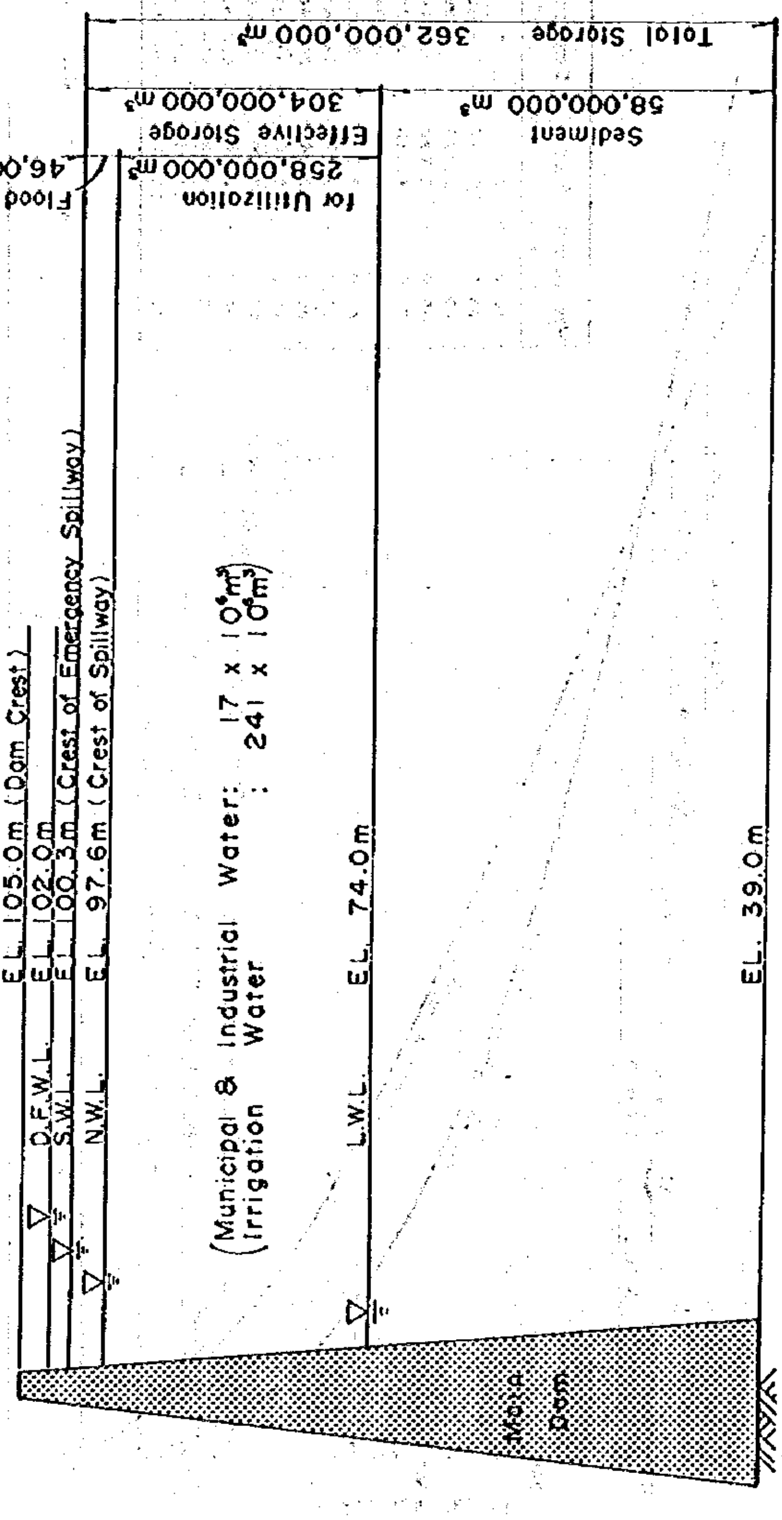



Fig. 1-8

ALLOCATION OF RESERVOIR STORAGE

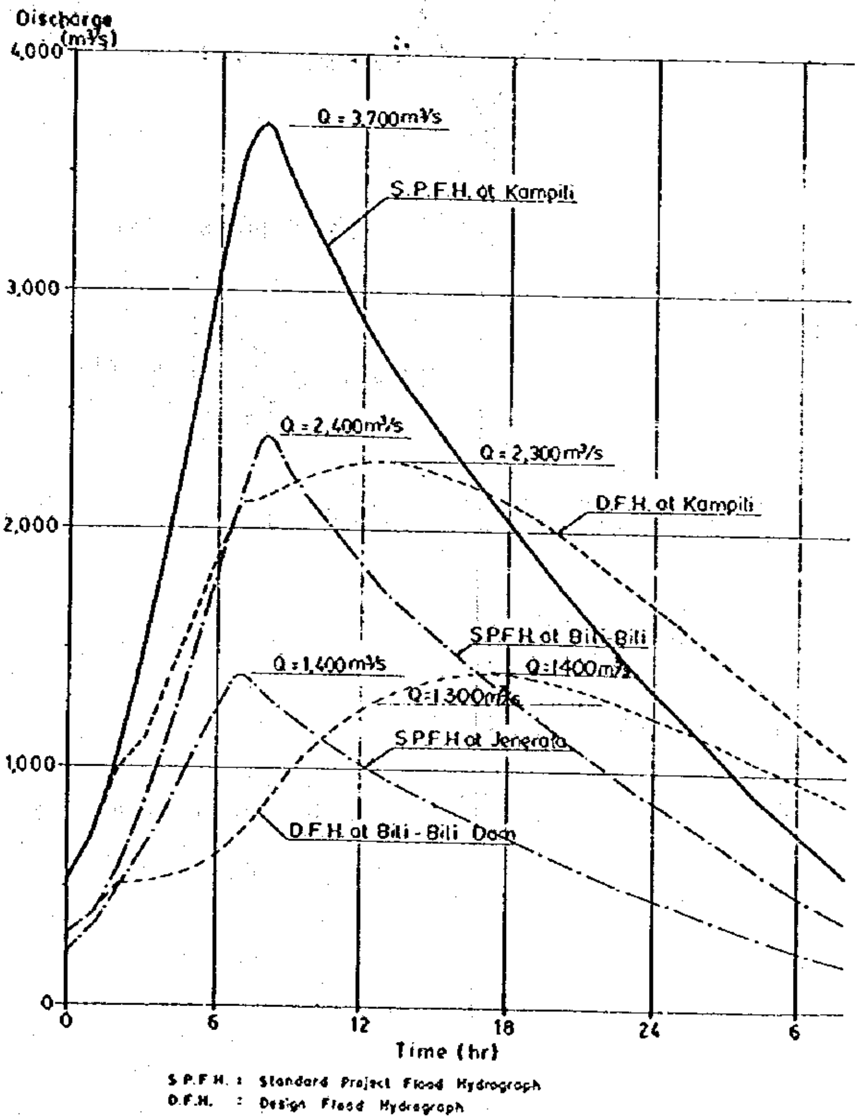



Fig. 1-9

STANDARD PROJECT
AND DESIGN FLOOD HYDROGRAPH

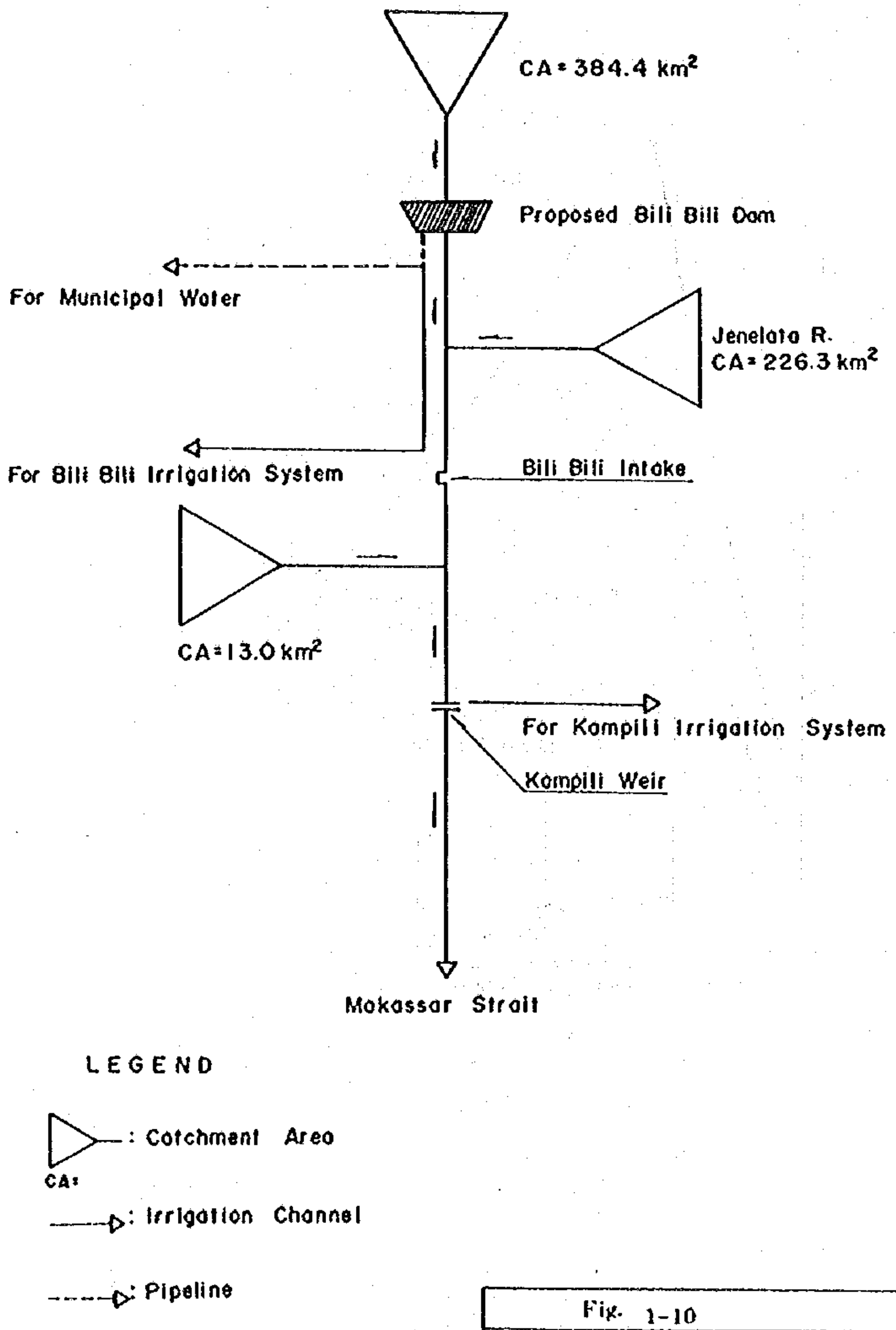



Fig. 1-10

SCHEMATIC DIAGRAM OF
WATER UTILIZATION SYSTEM

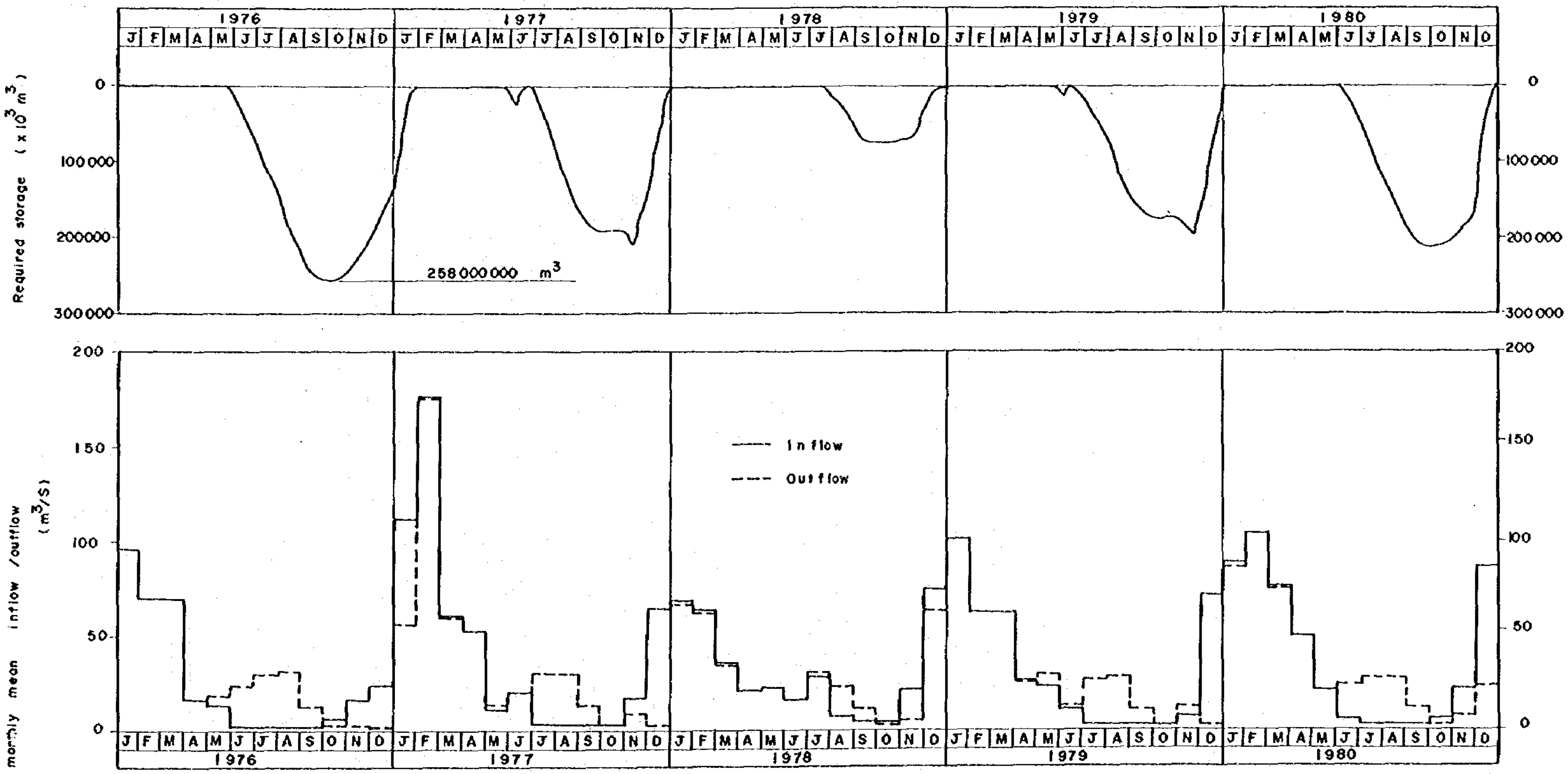



Fig. 1-11

VARIATION OF REQUIRED STORAGE

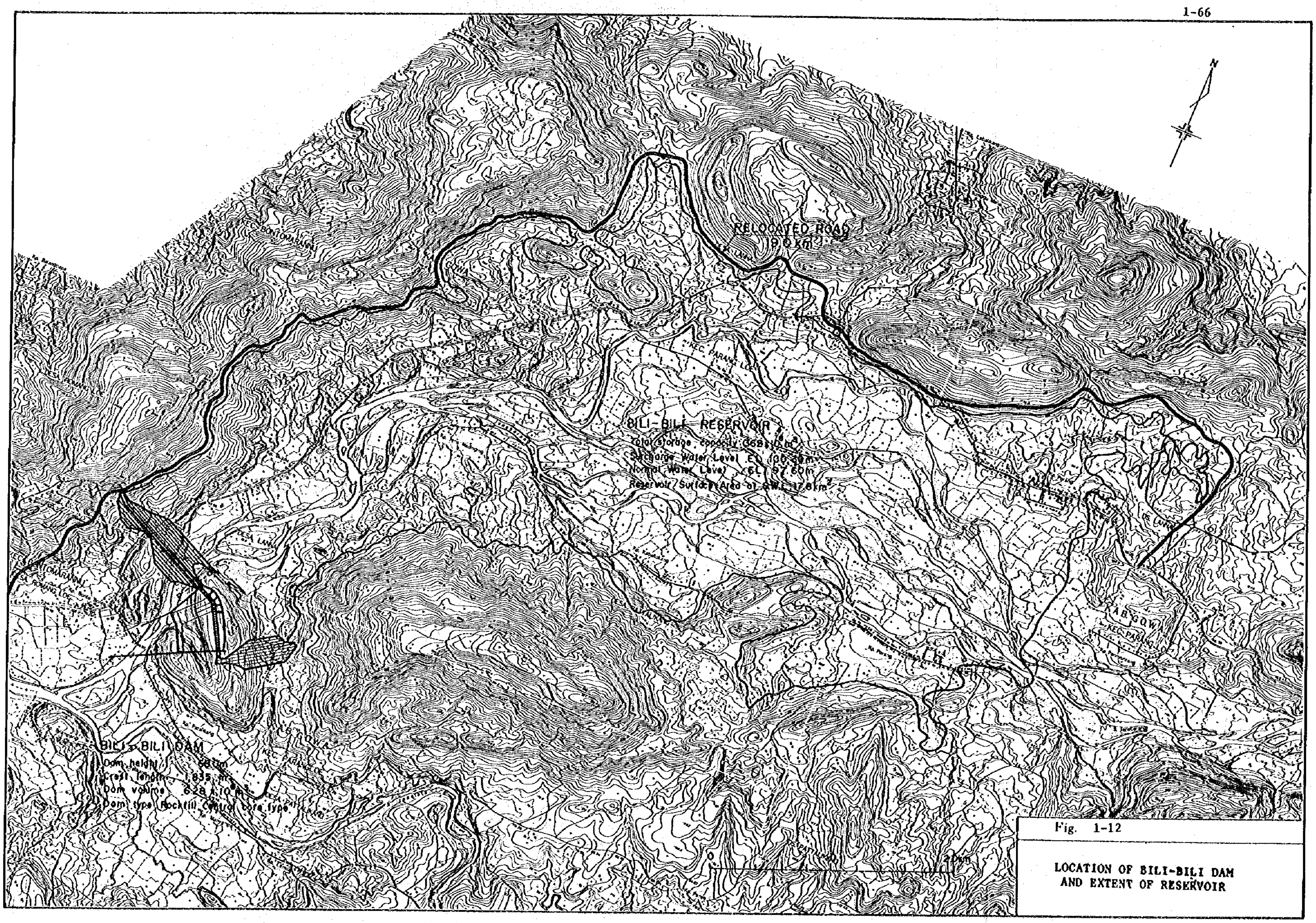
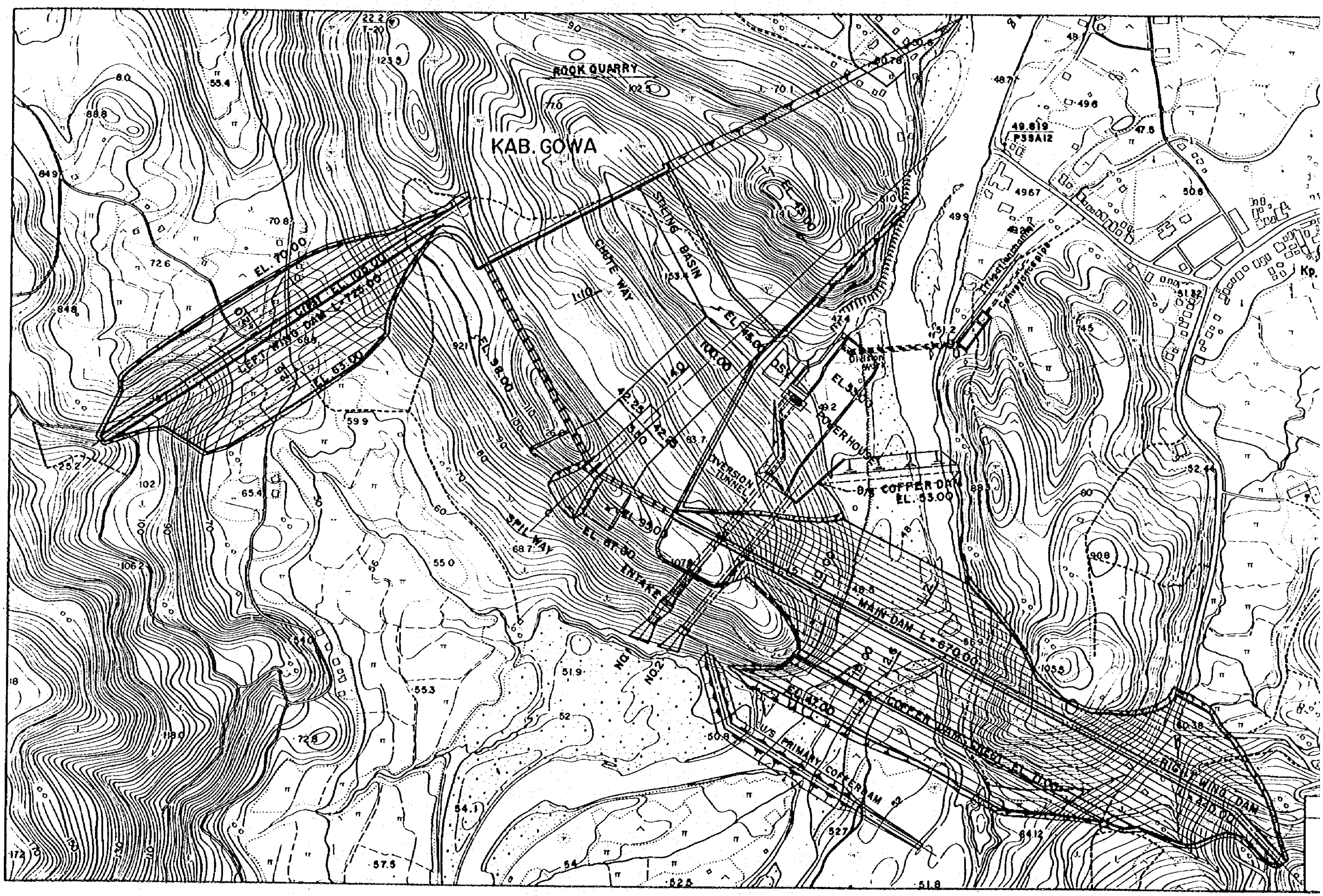



Fig. 1-12

**LOCATION OF BILI-BILI DAM AND EXTENT OF RESERVOIR**



KAB. GOWA
ROCK QUARRY
EL. 70.00
LEFT WING DAM L. 725.00
CREST EL. 100.00
EL. 63.00
CHUTE WAY
STILLING BASIN
EL. 45.00
EL. 98.00
SPILLWAY
INTAKE
DIVERSION TUNNEL
POWER HOUSE
D/S COFFER DAM EL. 53.00
MAIN DAM L. 670.00
U/S PRIMARY COFFERDAM
RIGHT WING DAM
EL. 95.00
EL. 87.00
EL. 42.00

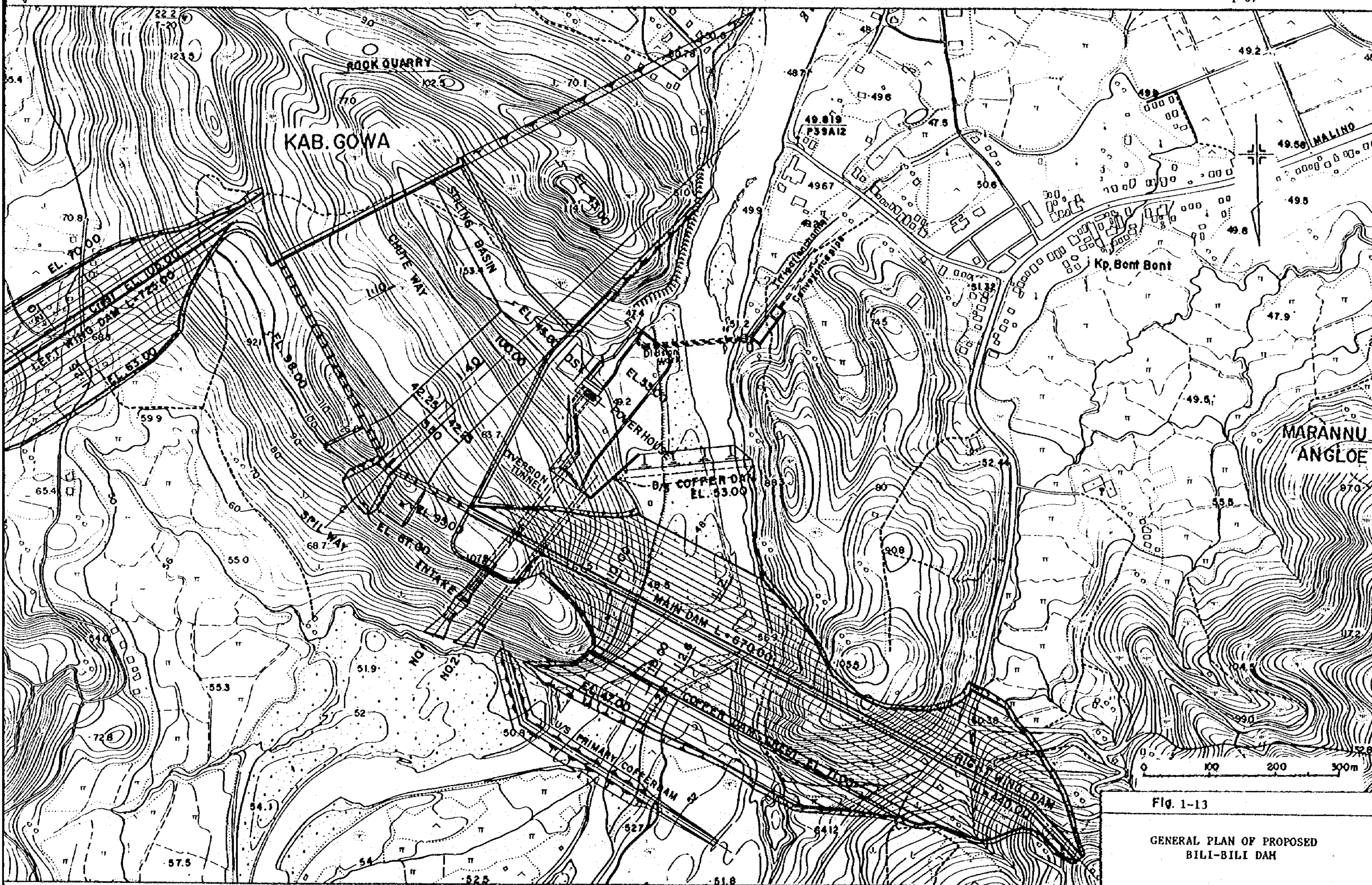
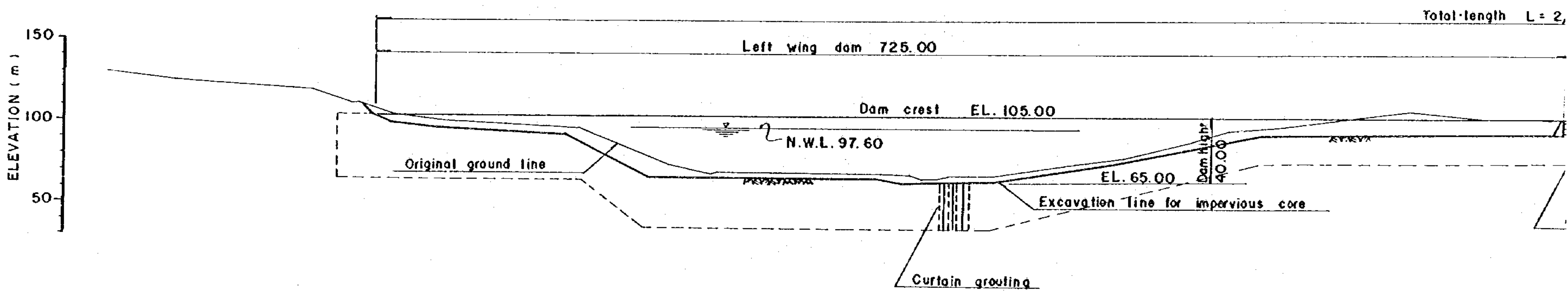
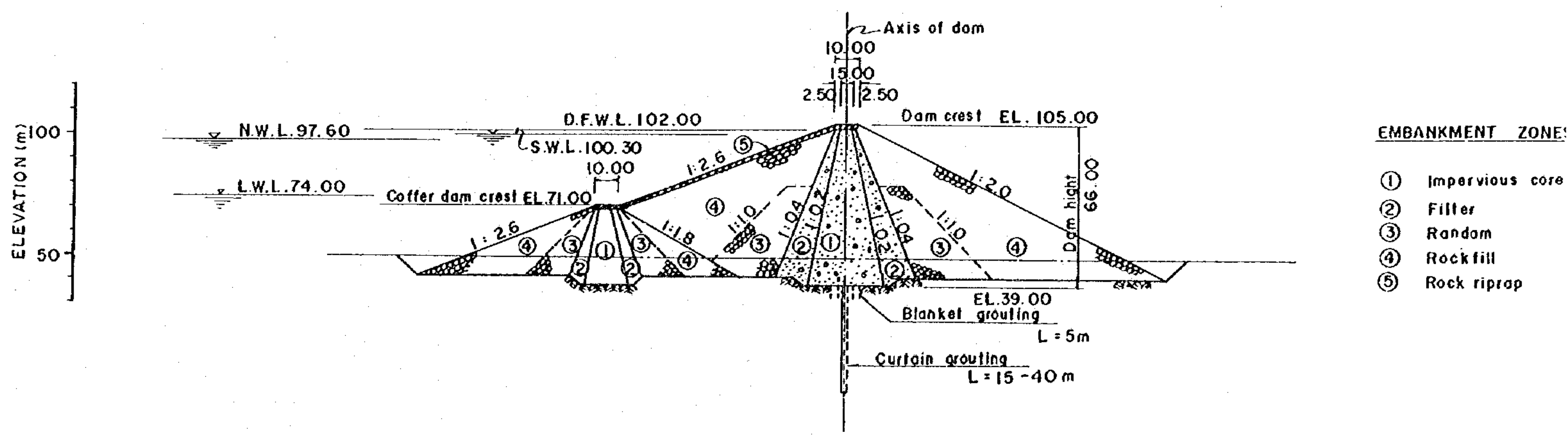



Fig. 1-13

GENERAL PLAN OF PROPOSED BILI-BILI DAM



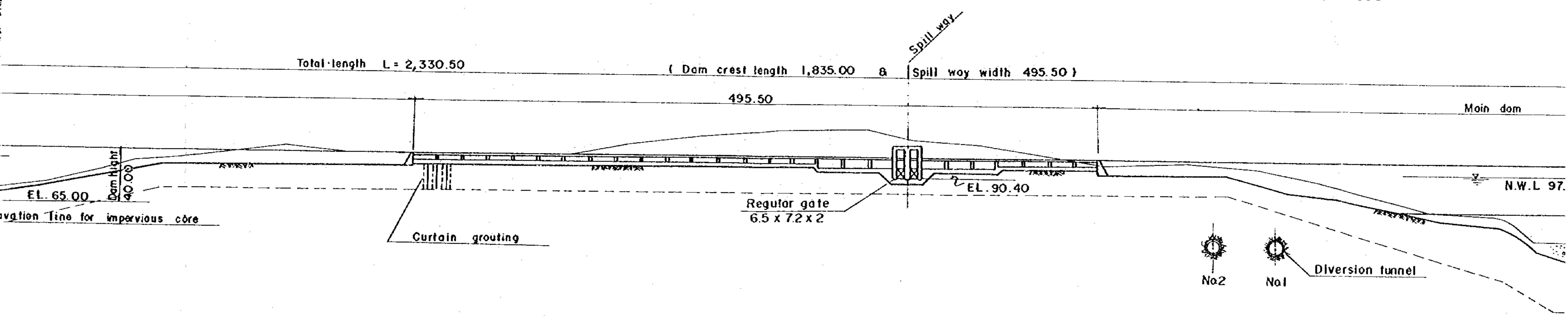



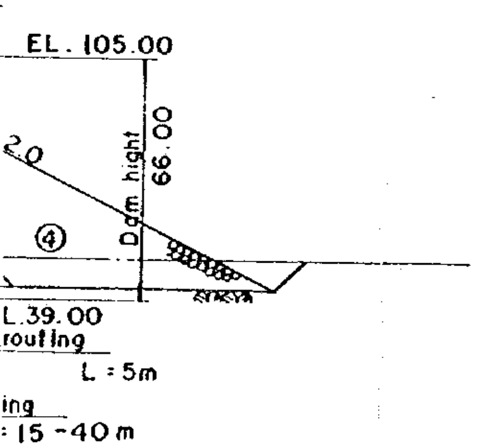

## TYPICAL CROSS SECTION OF DAM

Scale = 1: 2.000

## PROFILE ALONG AXIS OF DAM

Scale = 1: 2.500



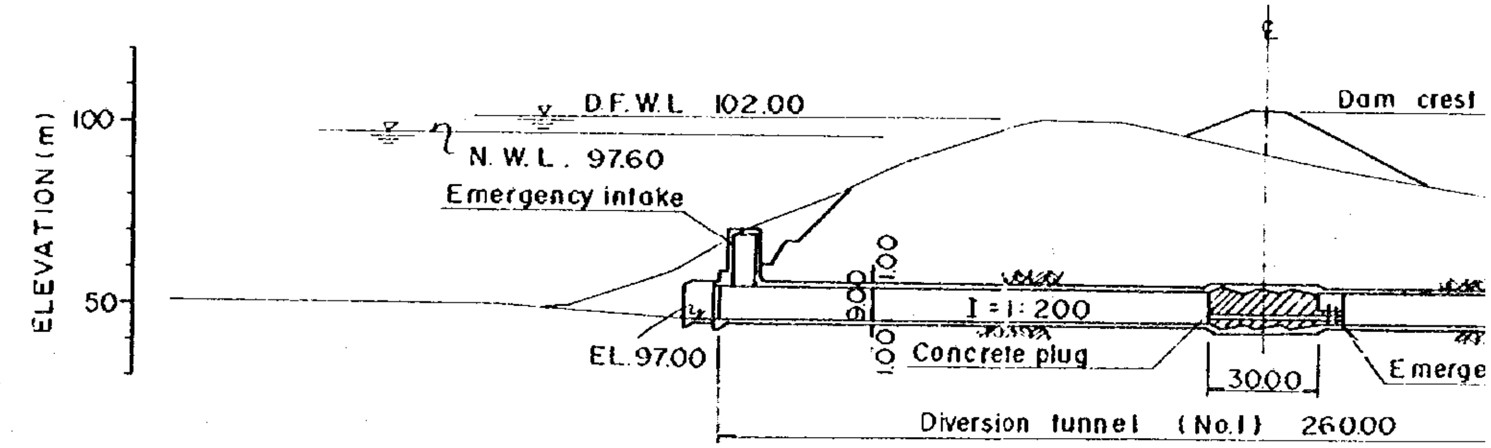




ON OF DAM

Scale = 1: 2.000

EMBANKMENT ZONES

① Impervious core
② Filter
③ Random
④ Rockfill
⑤ Rock riprap

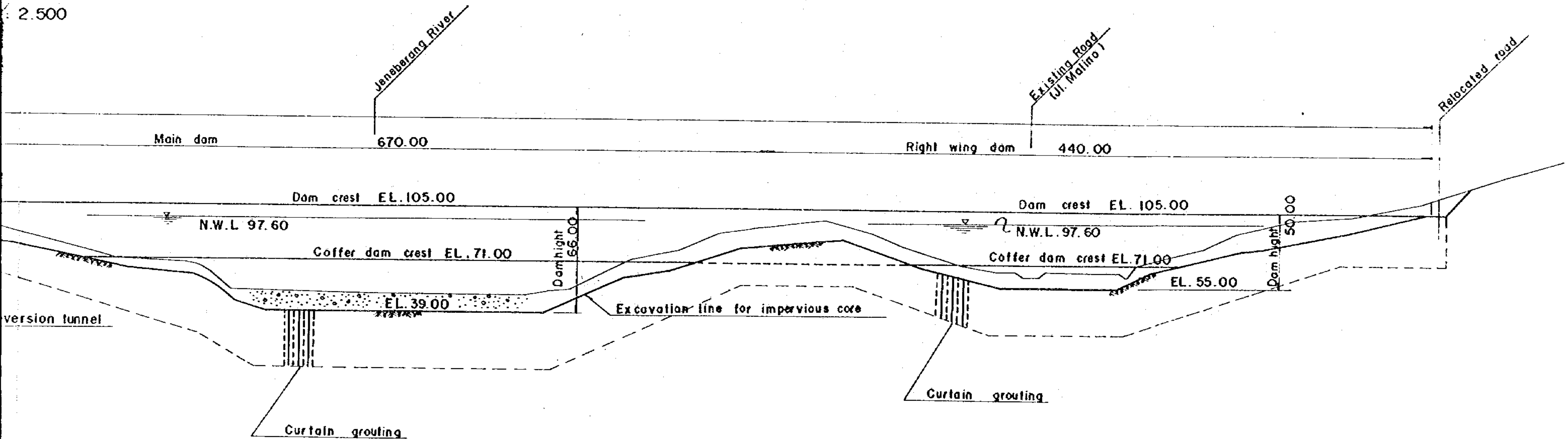


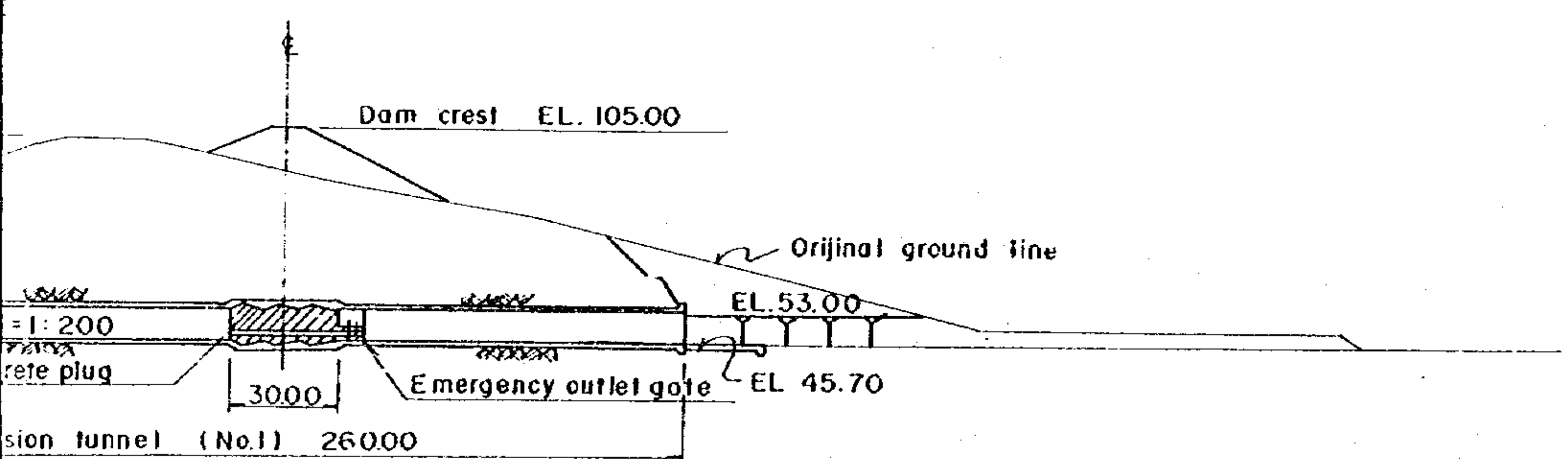

## PROFILE OF DIVERSION TUN

Scale = 1:

DAM

: 2.500




OF DIVERSION TUNNEL

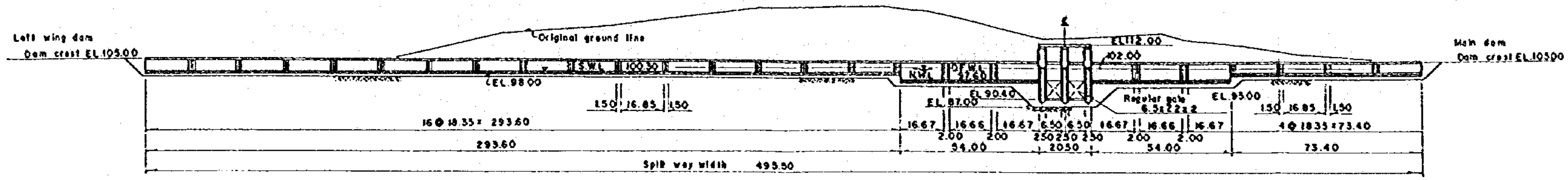
Scale = 1: 2,000

Unit: m

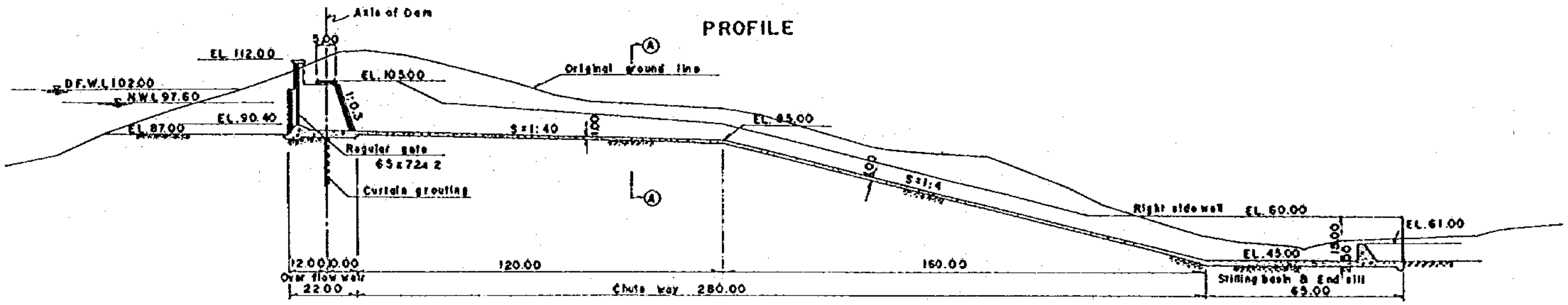
Fig. 1-14

DAM AND DIVERSION PROFILE AND CROSS SECTIONS

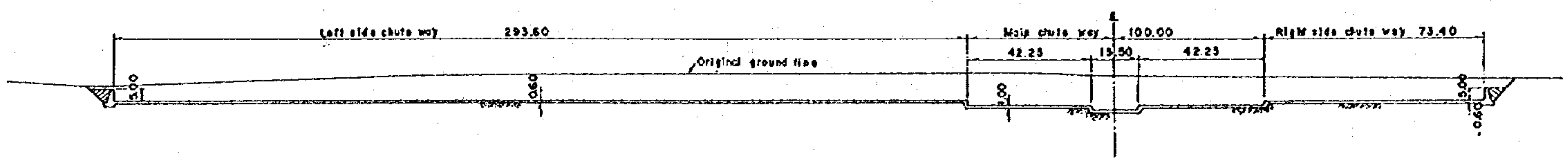
OVERFLOW WEIR - FRONT VIEW




PROFILE




CHUTE WAY-CROSS SECTION Ⓐ-Ⓐ

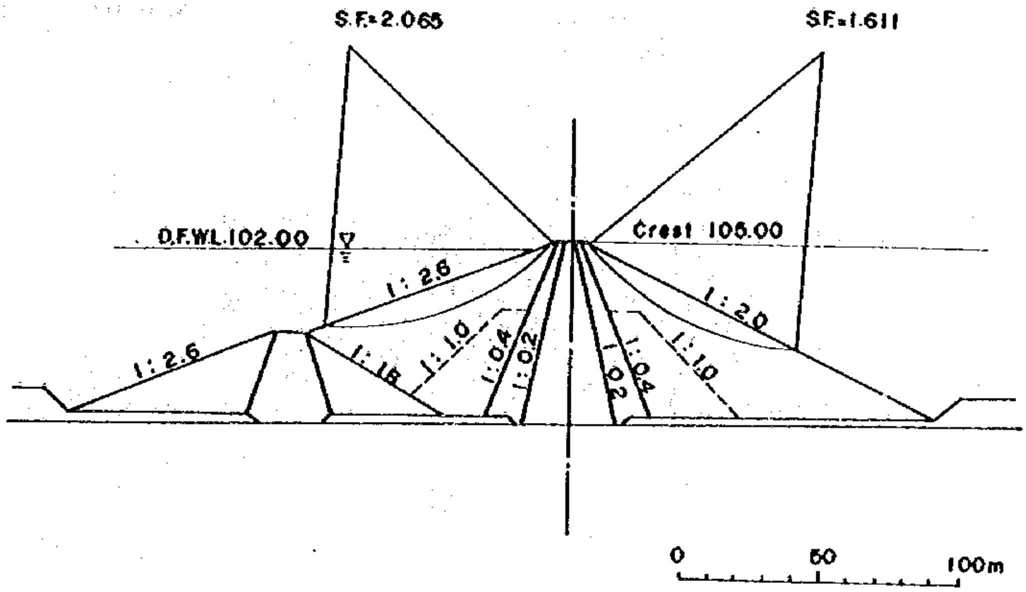



Unit: m

Fig. 1-15

SPILLWAY PROFILE & SECTIONS

Without Earthquake

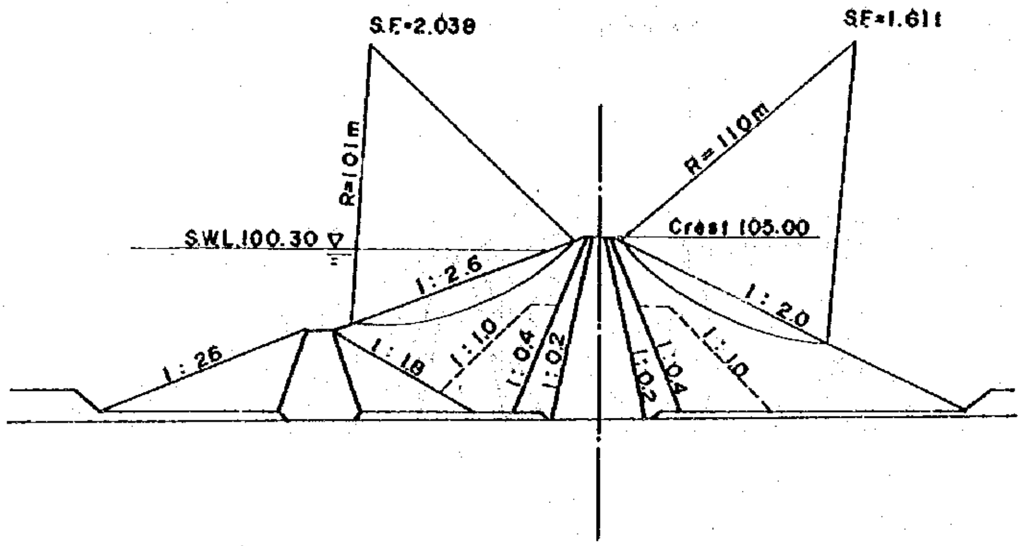



| Condition | Softy Facter | |
|---|---|---|
| | Up Stream Slope | Down Stream Slope |
| D. F. W. L. | 2.065 | 1.611 |
| S. W. L. | 2.038 | 1.611 |
| S. W. L. Ek=005 | 1.609 | 1.384 |
| N. W. L. | 1.979 | 1.617 |
| N. W. L. Ek=0.10 | 1.288 | 1.222 |

Fig. 1-16

STABILITY ANALYSIS OF DAM (1)
( IN THE CASE OF D.F.W.L.)

Without Earthquake




With Earthquake (Ea = 0.05)

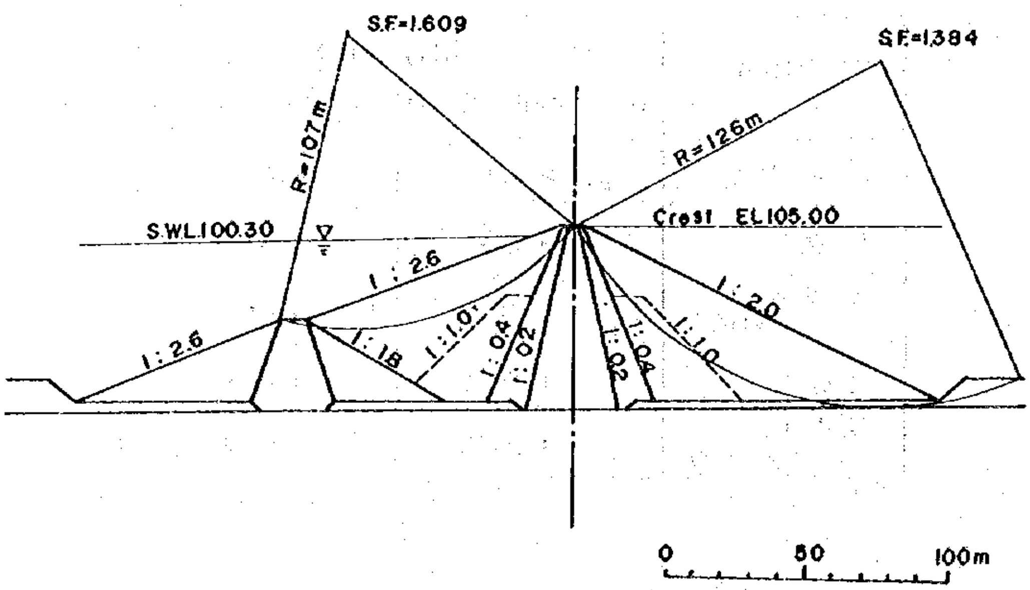
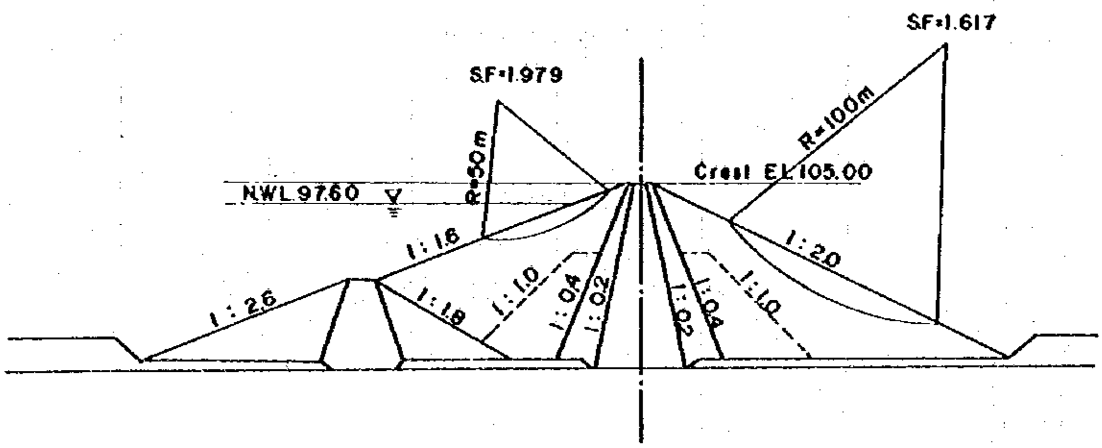



Fig. 1-16

STABILITY ANALYSIS OF DAM (2)
( IN THE CASE OF S.W.L.)

Without Earthquake




With Earthquake (Ek=0.10)

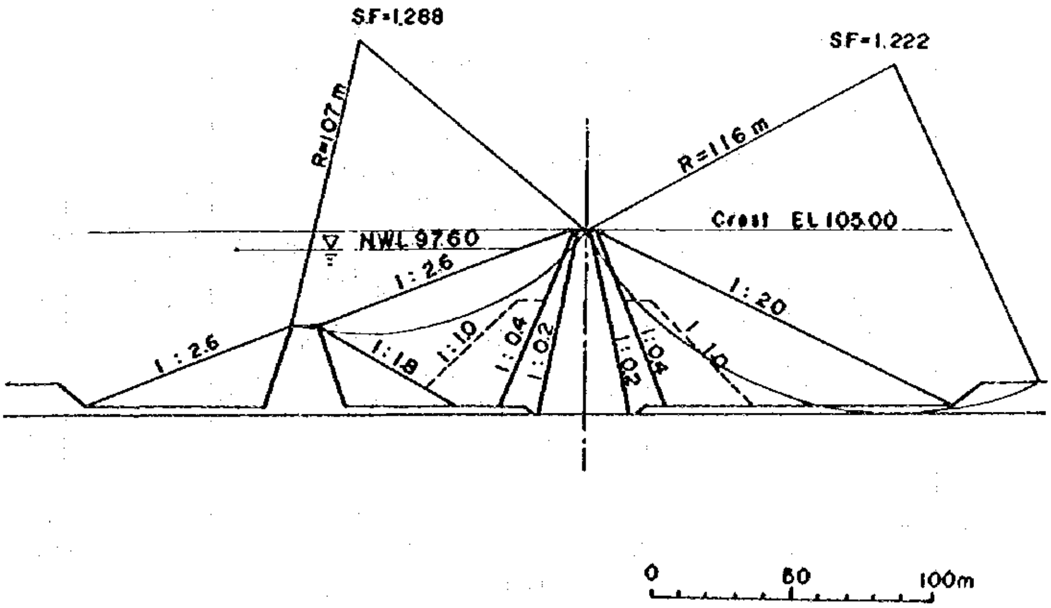
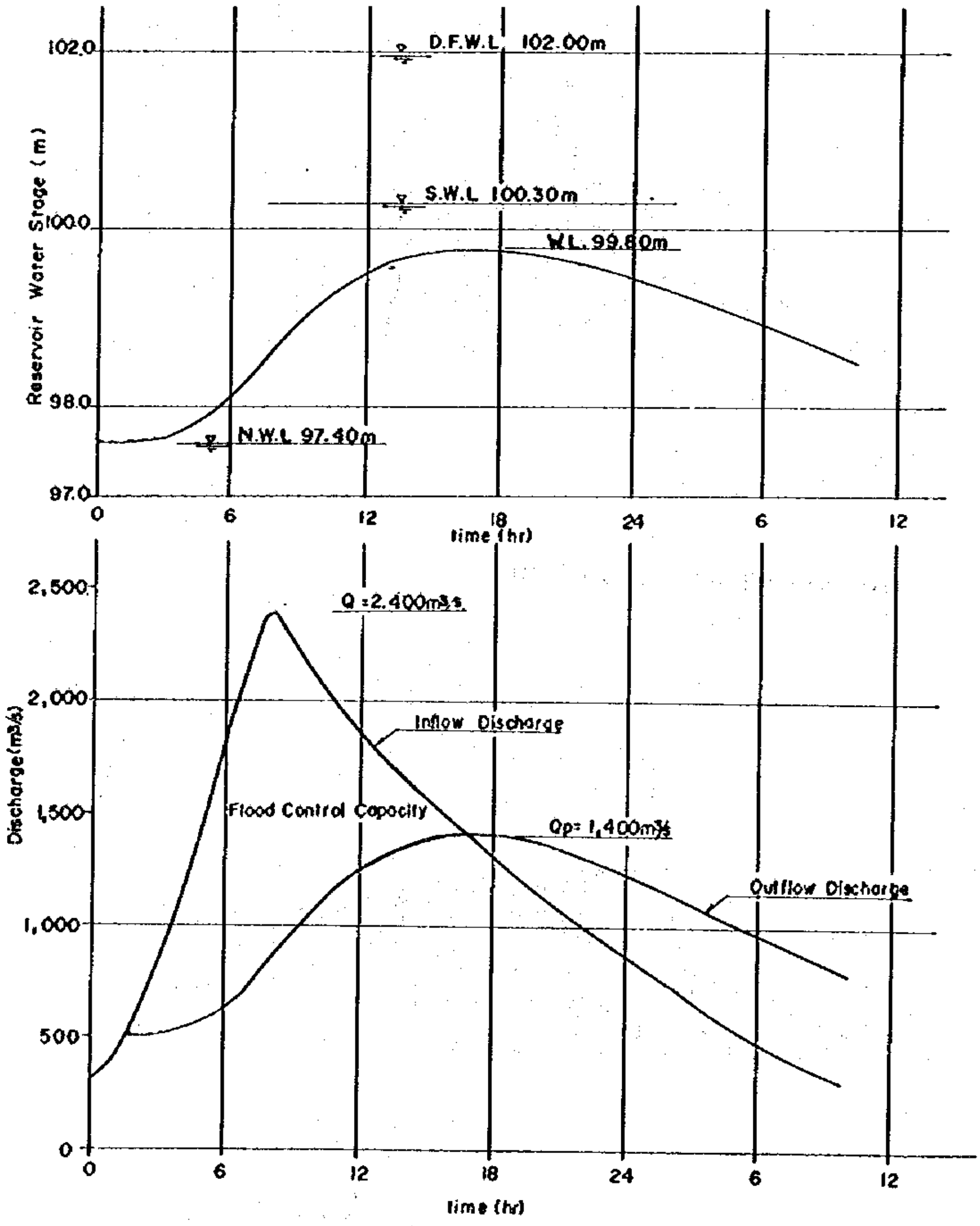



Fig. 1-16

STABILITY ANALYSIS OF DAM (3)
( IN THE CASE OF N.W.L.)




Note: S.WL.100.30m is adopted to provide 20% additonal surcharge Capacity.
-Inflow and Outflow at Bili Bili Dam 50-Year Return Period

Fig. 1-17

FLOOD HYDROGRAPH
AND
WATER LEVEL OF RESERVOIR

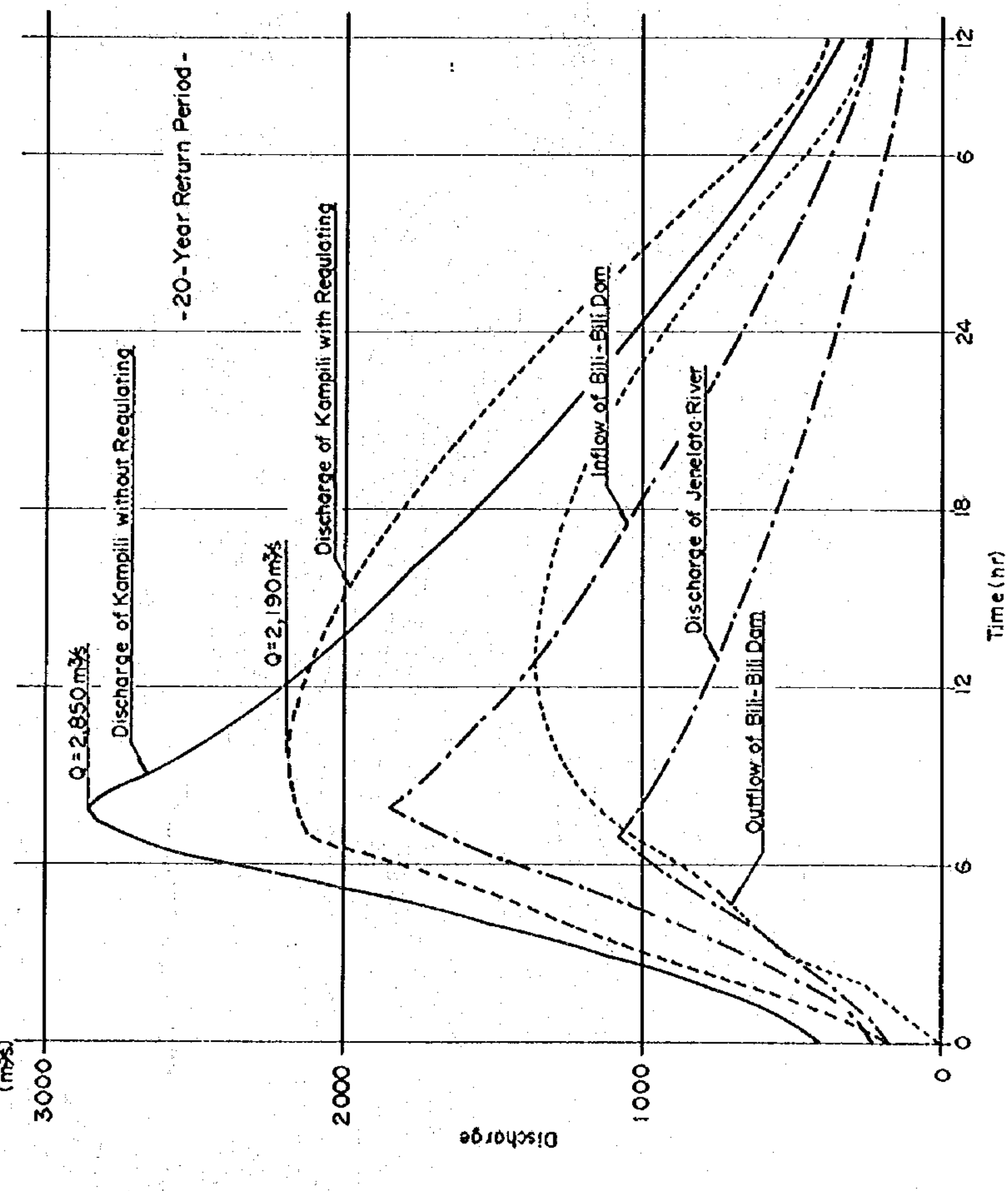



Fig. 1-18

DISCHARGE AT KAMPILI POINT
REGULATED BY COFFER DAM

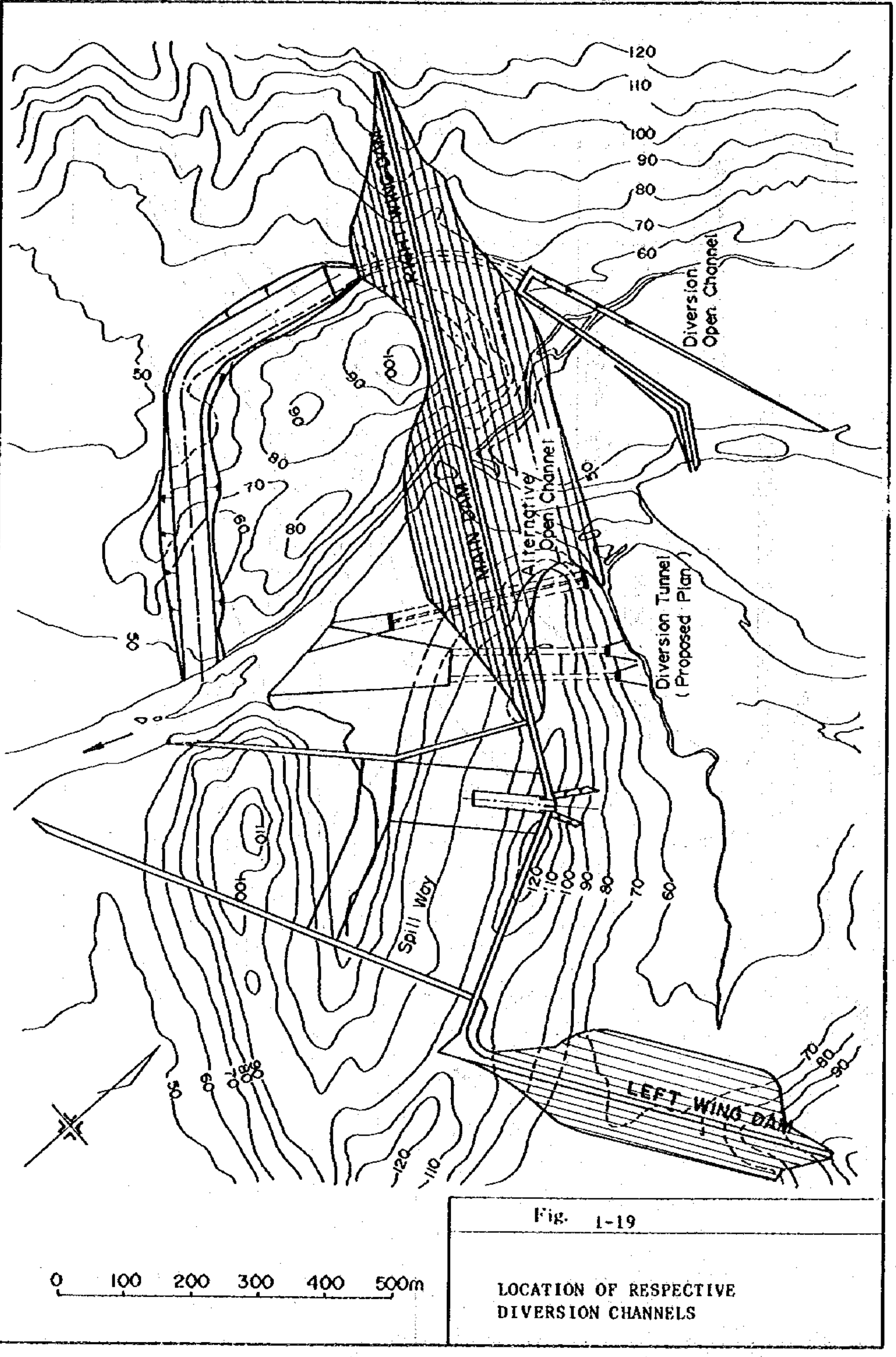



Fig. 1-19

LOCATION OF RESPECTIVE DIVERSION CHANNELS

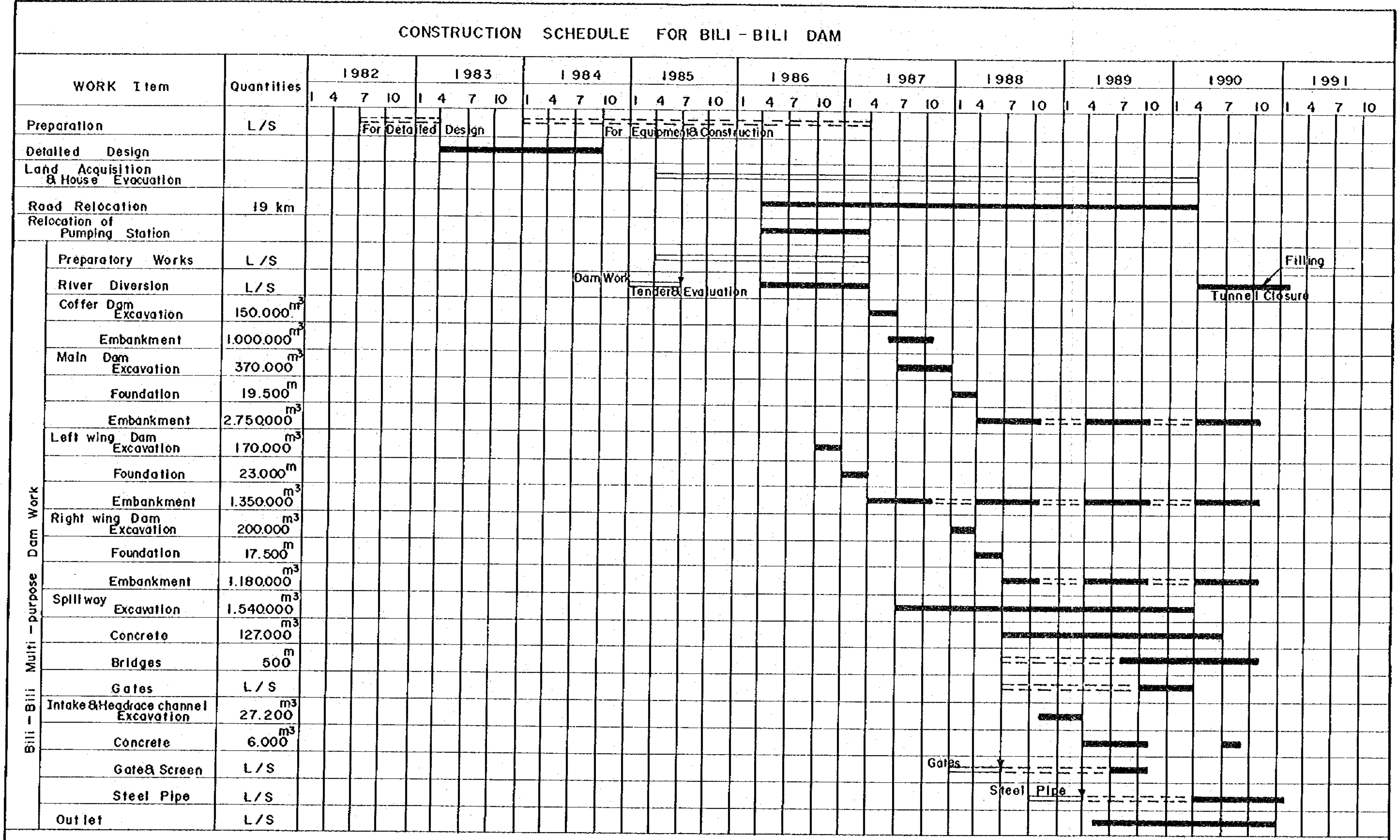



Fig. 1-20

CONSTRUCTION SCHEDULE
FOR BILI-BILI DAM

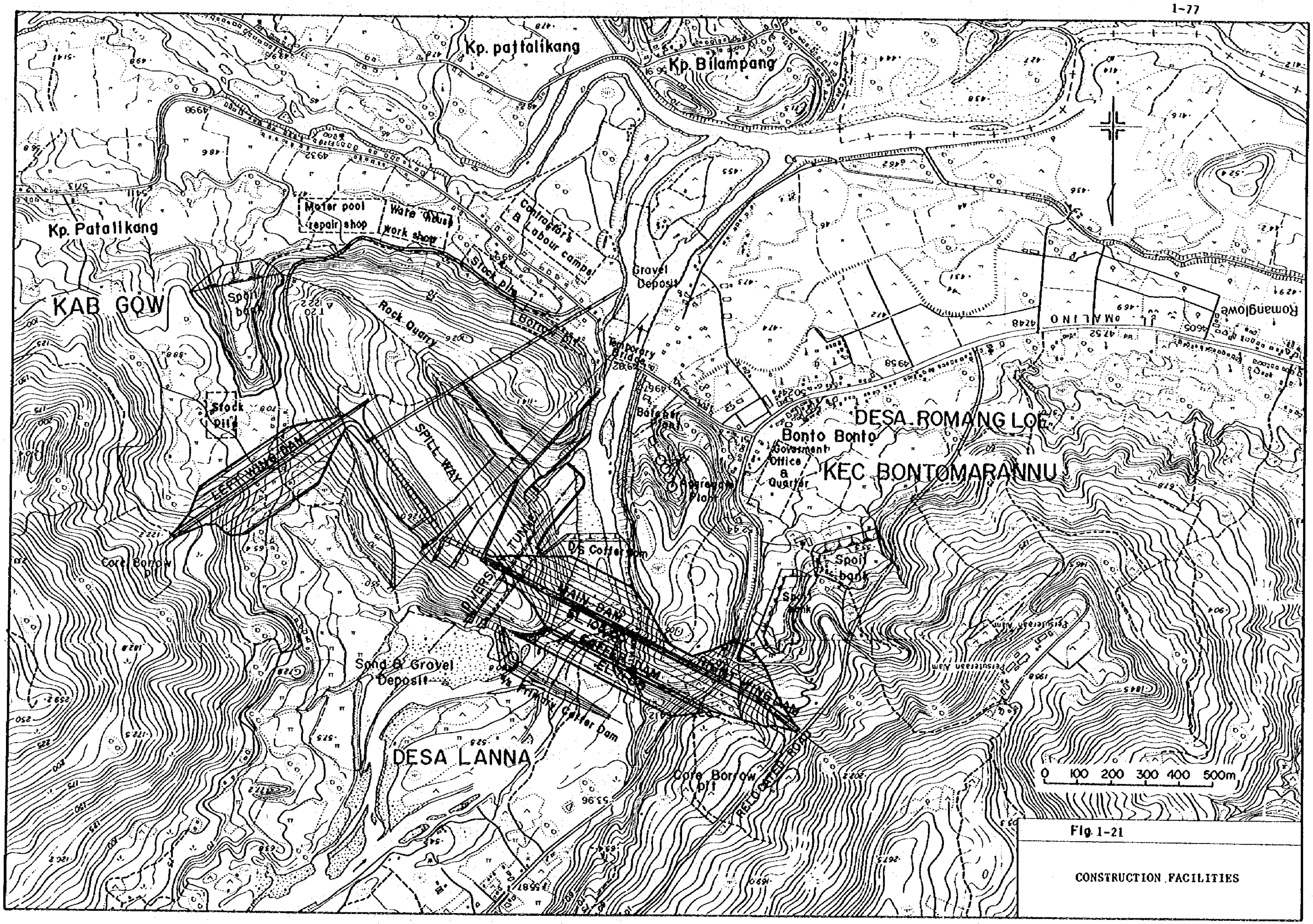
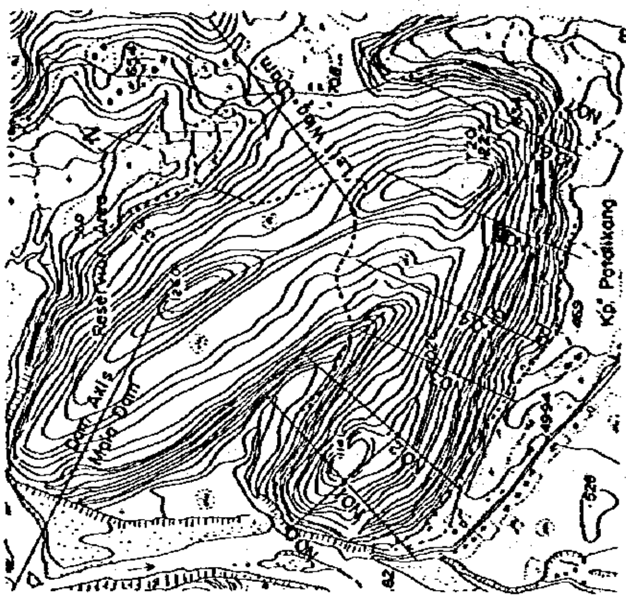



Fig. 1-21

CONSTRUCTION FACILITIES




Possible Quantity of Construction Materials.

| Geology | Dike rocks | Tuffous rocks | Calcareous sedimentary rocks |
|---|---|---|---|
| Appro quantity | 8,000,000 m³ | 850,000 m³ | 750,000 m³ |
| Construction materials | Rock materials | Core materials | — |

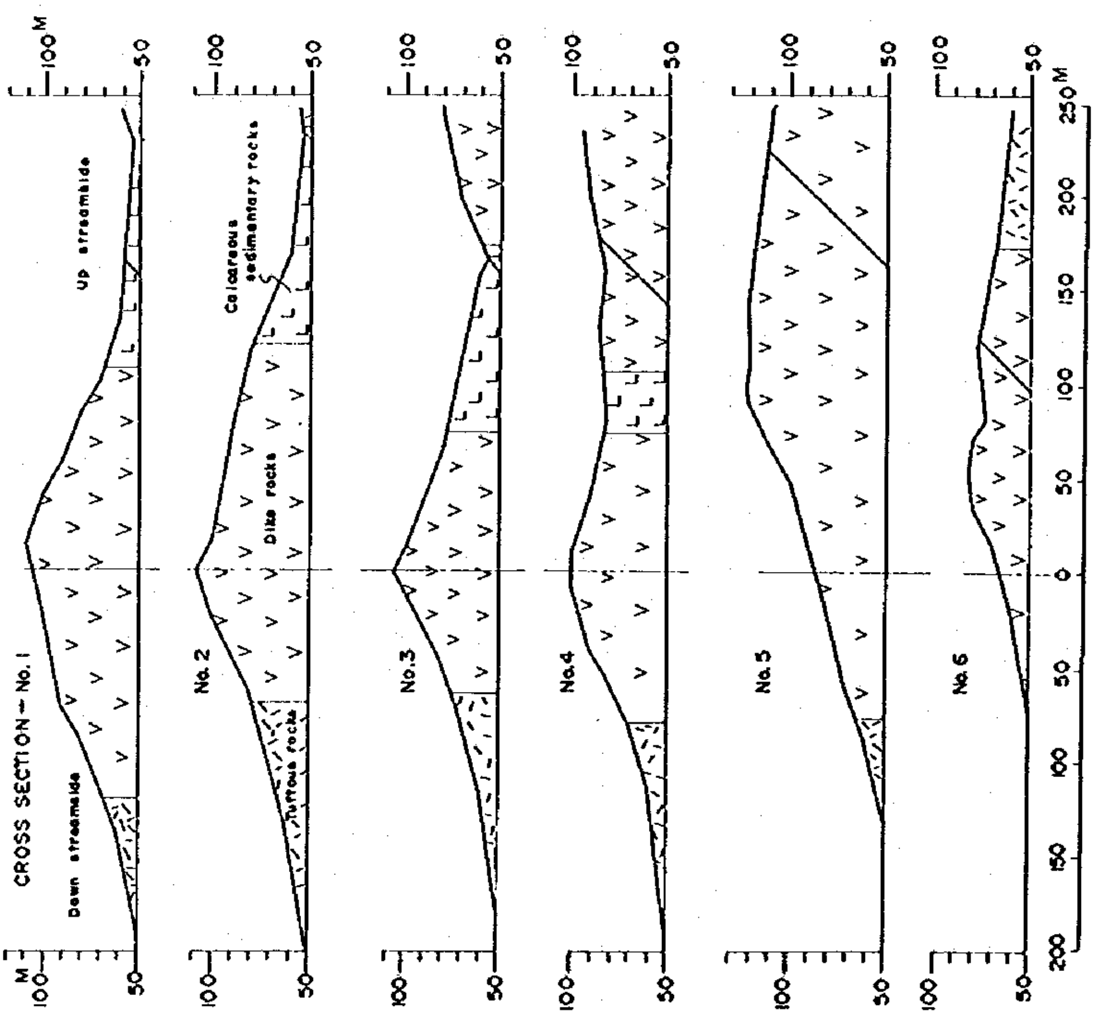



Fig.1-22

AVAILABILITY OF EMBANKMENT MATERIALS

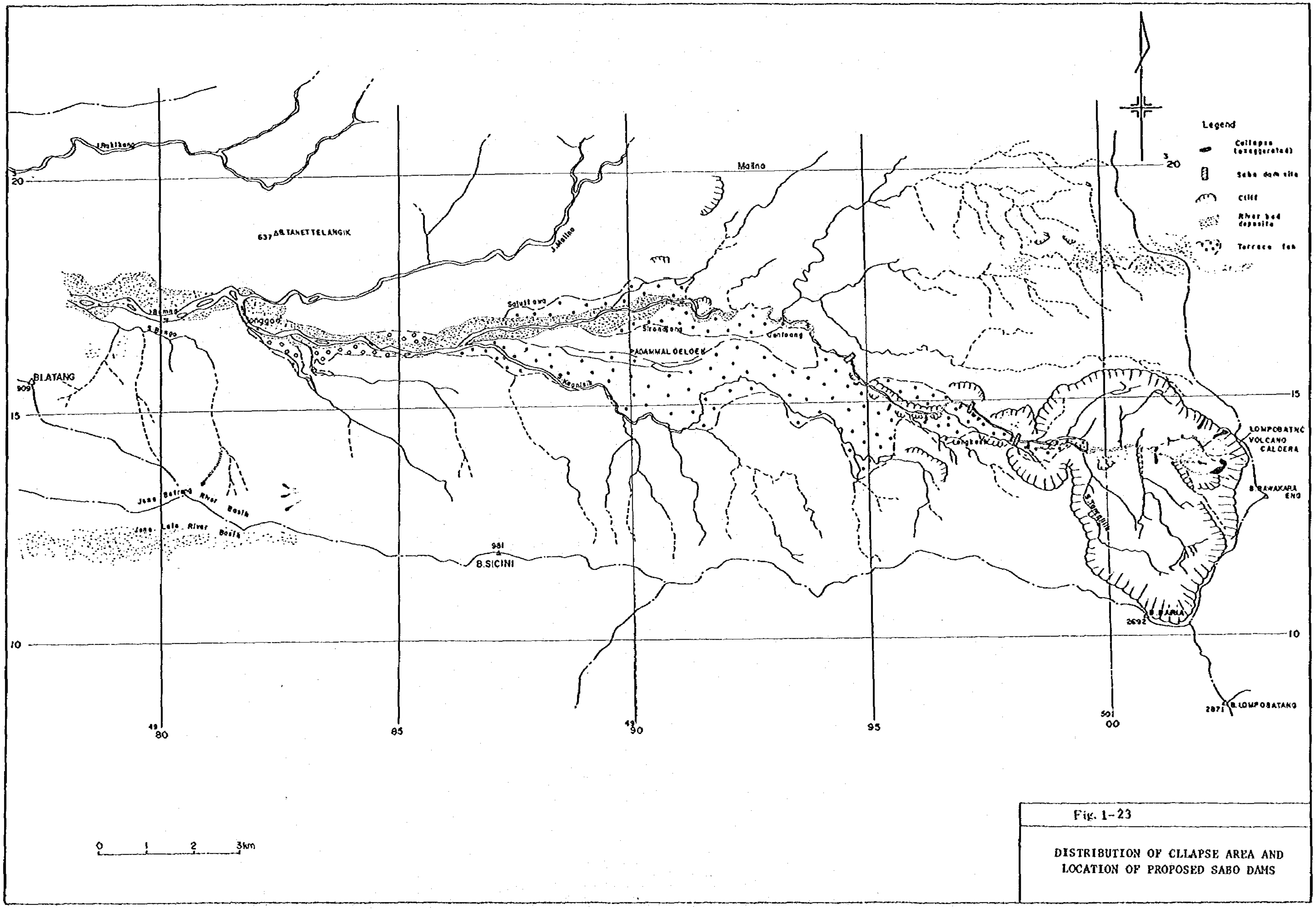



Fig. 1-23

DISTRIBUTION OF CLLAPSE AREA AND LOCATION OF PROPOSED SABO DAMS

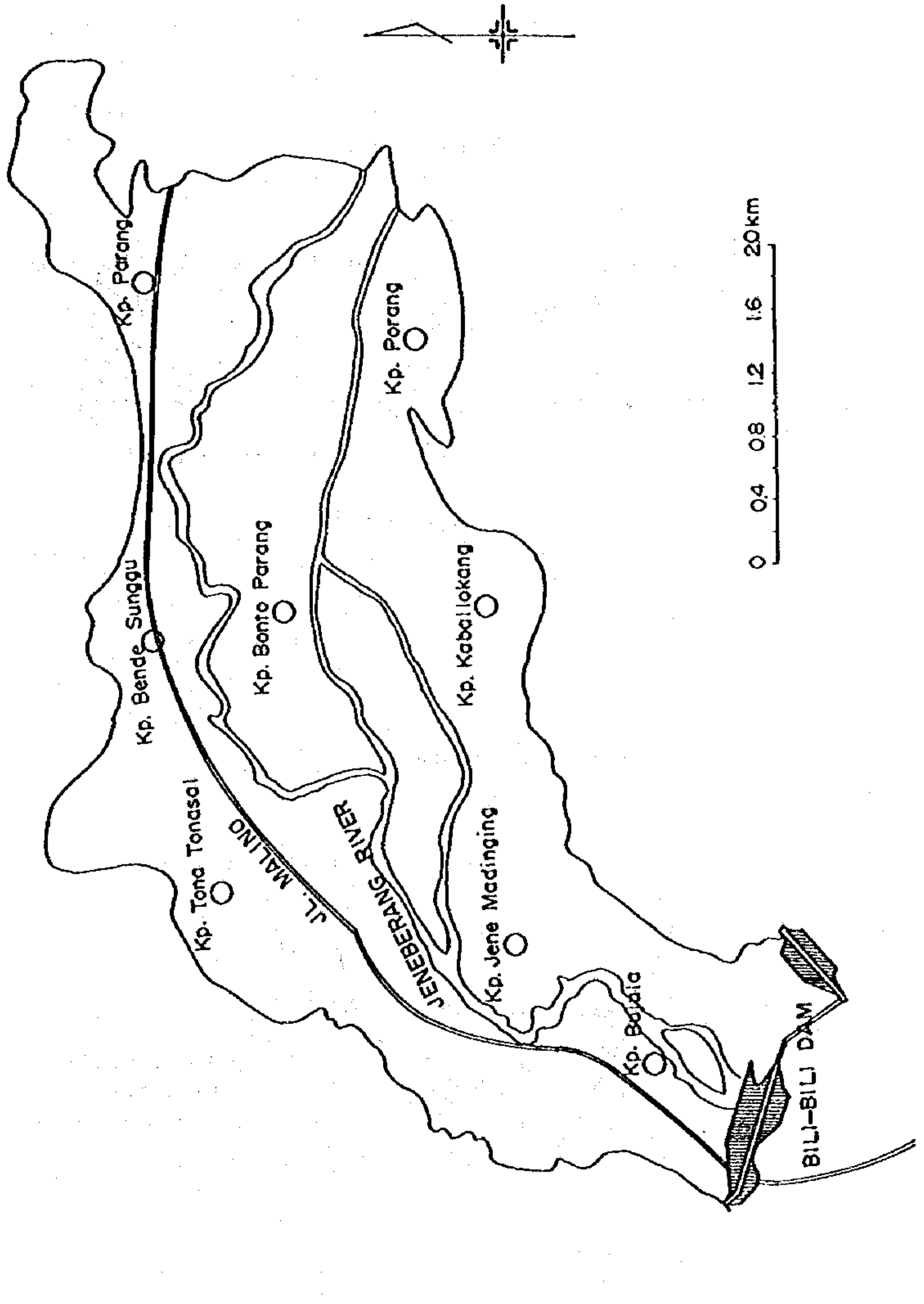
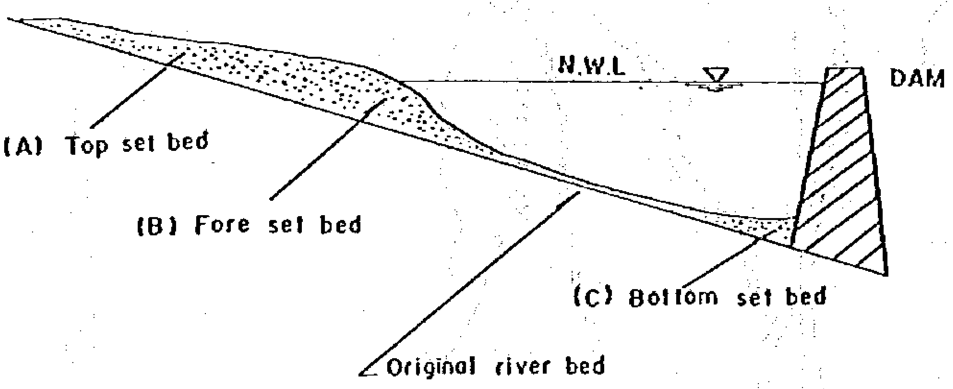



Fig. 1-24

VILLAGES IN DAM-SUBMERGED AREA

Profile




Cross – Section

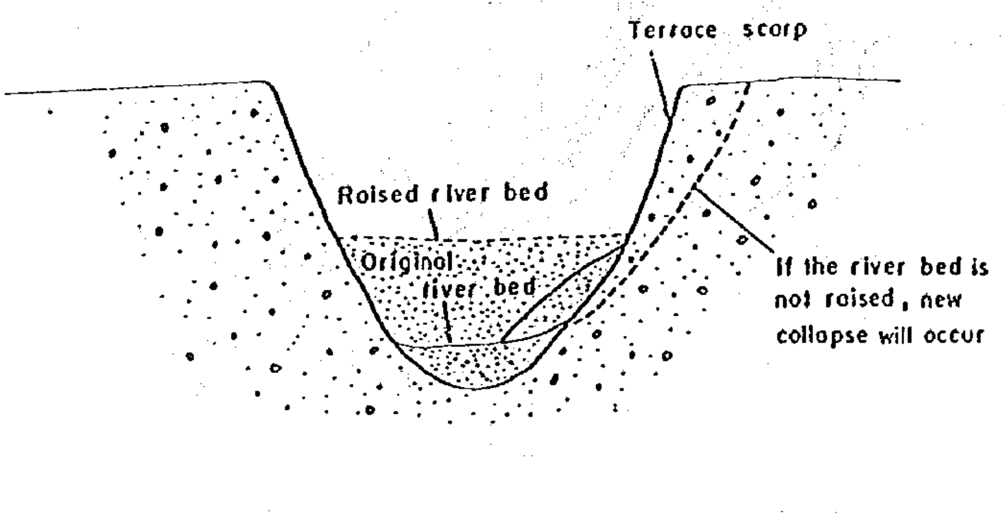



Fig.1-25

CONCEPTUAL DIAGRAM SHOWING DISTRIBUTION OF SEDIMENTS DIPOSITION AT UPSTREAM OF DAM

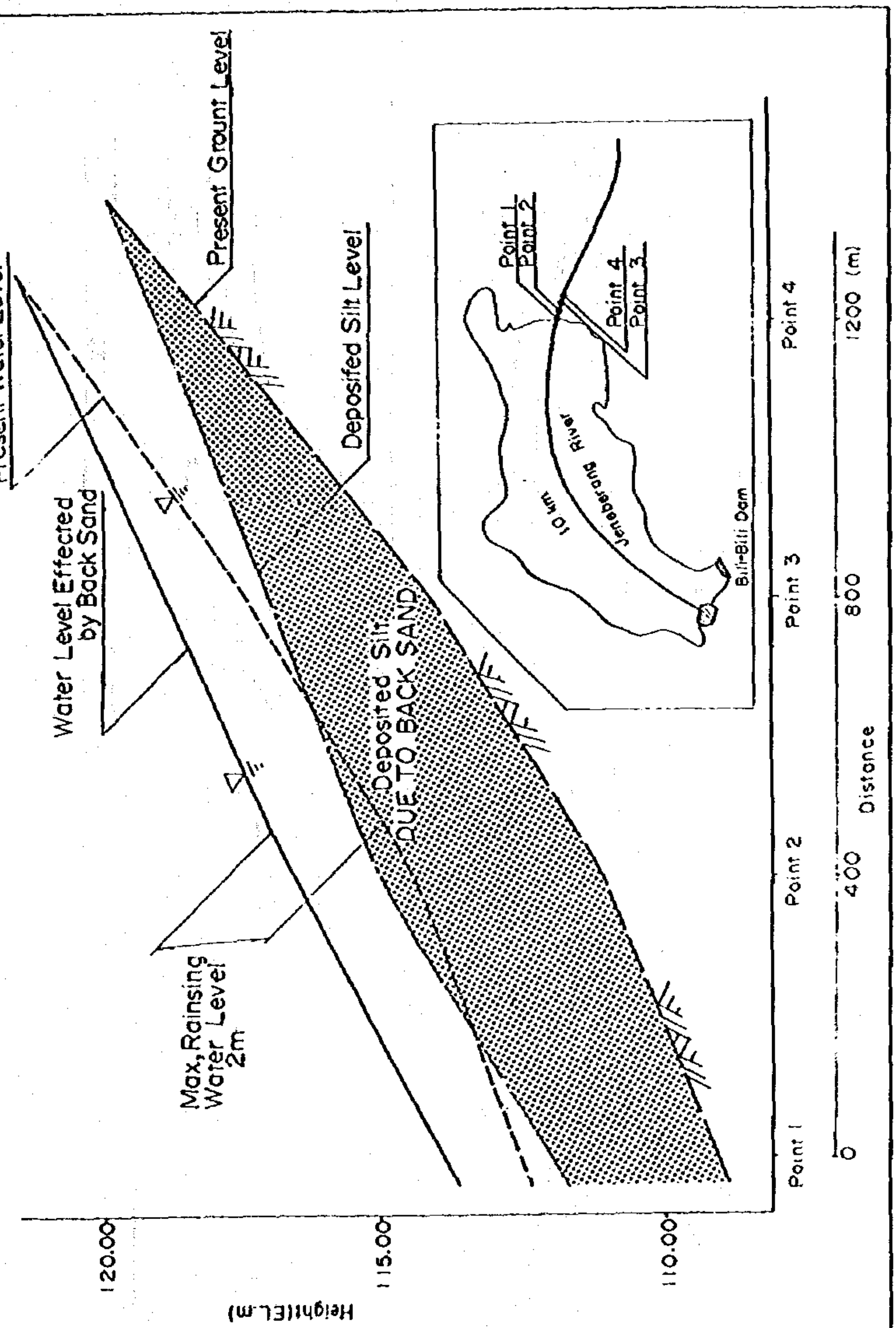
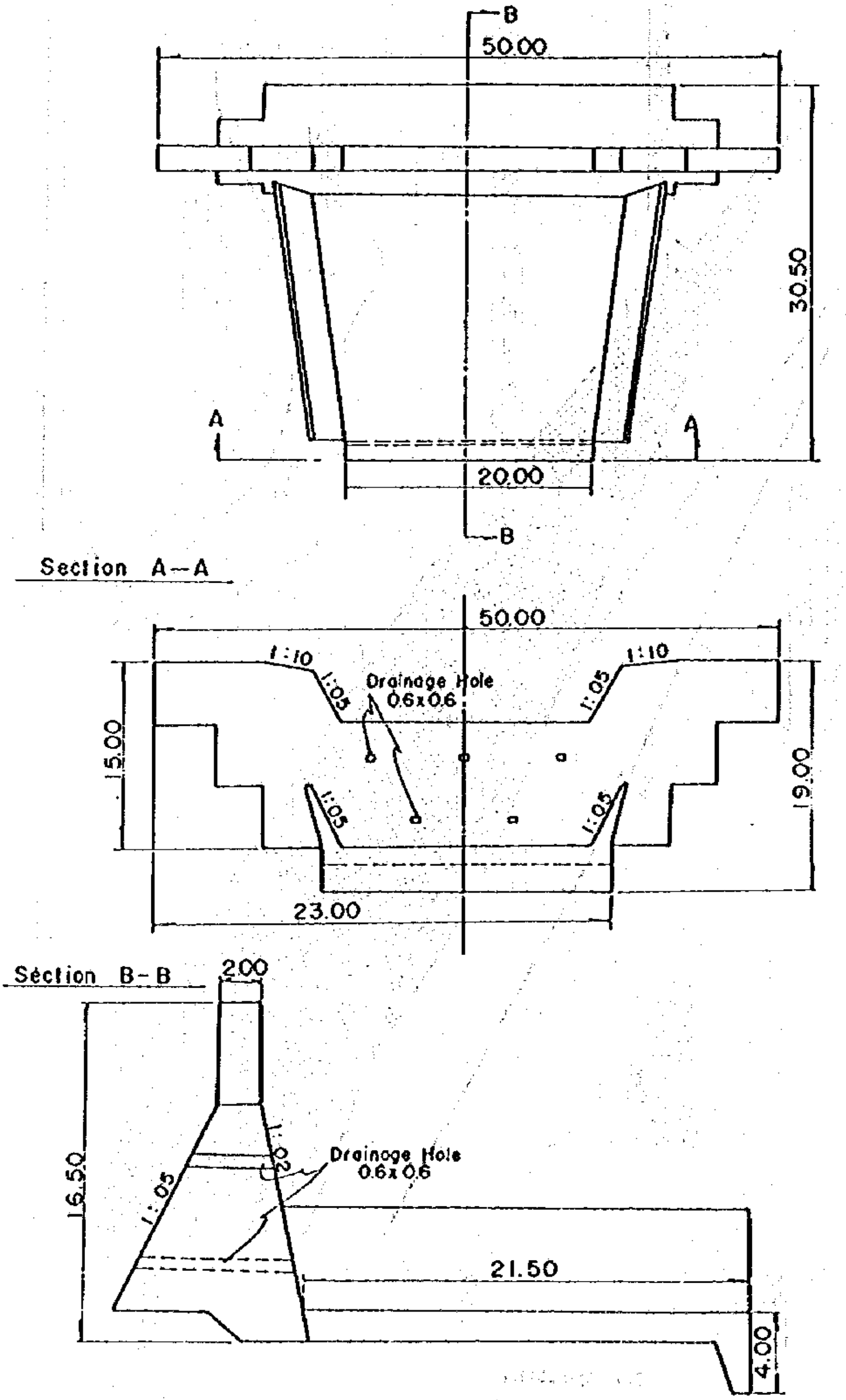



Fig. 1-26

RAISING OF WATER LEVEL
DUE TO BACK SAND




Unit : m

Fig. 1-1(AN)

GENERAL PLAN OF SABO DAM

# 2. RIVER IMPROVEMENT

# CONTENTS OF RIVER IMPROVEMENT

# LIST OF TABLES

## LIST OF FIGURES

## 1. GENERAL

Prior to the present project, a feasibility study on the so-called "Lower Jeneberang Flood Control Project" whose improvement scale is a 10-year return period had been performed by JICA in the period from June, 1979 to October, 1980.

The above-mentioned study is particularly for the "Urgent Flood Control Project", purpose of which is to produce an immediate relief of flood damage suffered by Ujung Pandang City. However, even after the completion of the project mentioned above, the basin areas including Ujung Pandang City, will still be exposed to the menace of damage caused by big floods.

Taking the above-mentioned situations into consideration, the present project is for a futher feasibility study on the overfall flood control project to upgrade the safety and on the water resources development project for a steady water supply by the construction of the proposed dam at Bili-Bili on the Jeneberang river.

As for the above-mentioned flood control scheme, the design scale is based on a flood of 50-year return period and the discharge is controlled by the proposed dam and river improvements. The ratio of the optimum flood control shares between the two may have to be determined taking technical, economic and social conditions fully into consideration.

## 2. PRESENT CONDITION

### 2.1 River Basin

The Jeneberang river, with a catchment basin of 727 $km^2$ and a length of 75 km., originates in the Bawakaraeng Mountain. In its upper reaches, the river runs down through a feather-shaped mountanious region with poor natural vegetation except a few tall trees and Aran-Aran ; the rainfall pattern and the topographic features in this part of the river are combinedly responsible for concentration of flood run-off along the same river. In its top reaches, there remains a collapse whose scar being kept unhealed for unknown period of time had produced sediments which had mostly caused to raise the riverbed level of the Jeneberang. The riverbed rising has also been due to terrace scarp erosion in its upper reaches and bank erosion in its middle reaches. After passing Bili-Bili, the river enter its low reaches which is spreading an alluvial fan on both the right and the left banks of the river. On its right bank, the city of Ujung Pandang came to shape itself which does not cease swaying its urbanizing influences on, and quickly robbing the rural nature of, the agricultural land which is spreading around it; the left bank consists of an extension of a fertile agricultural land.