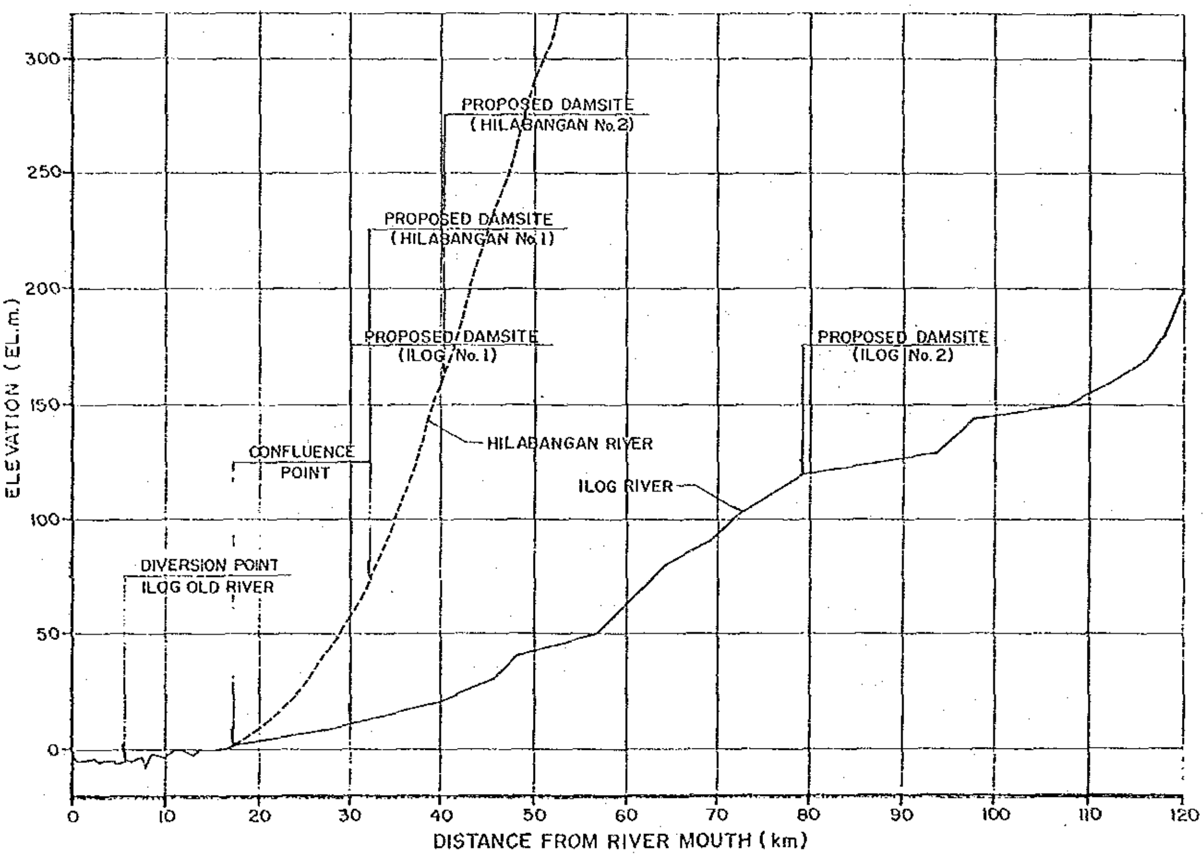
Table VI-3-2 COMPARISON OF ALTERNATIVE CASES OF RIVER IMPROVEMENT AND DIVERSION CHANNEL

Item	Unit	River Improvement		Diversion		
		Existing River (Case R1)	Shortcut (Case R2)	Binicuil (Case D1)	Old Ilog (Case D2)	Salong (Case D3)
Features						
Design Discharge						
Ilog River	m3/s	5,450.0	5,450.0	2,650.0	2,650.0	2,650.0
Diversion Channel	m3/s	-	5,450.0	2,800.0	2,800.0	2,800.0
Diversion Point		-	6.0k-15.0k	13.5k	6.0k	15.0k
Improved River Length						
Ilog River	km	20.0	11.0	20.0	20.0	20.0
Diversion Channel	km	-	6.0	11.0	6.5	11.0
Gradient						
Ilog River		1/5,000 -1/2,500	1/5,000 -1/2,500	1/5,000 -1/2,500	1/5,000 -1/2,500	1/5,000 -1/2,500
Diversion Channel		-	1/3,000	1/3,000	1/5,000	1/3,000
River Width						
Ilog River	m	160-300	160-300	80-140	80-140	80-140
Diversion Channel	m	-	230	140	150	140
Work Quantity						
Main Work						
Excavation	1000 m3	9,425.5	11,651.7	11,618.5	10,459.1	10,830.9
Embankment	1000 m3	966.7	1,444.1	1,575.5	1,393.7	1,686.9
Revetment	1000 m2	102.1	87.2	164.8	128.0	133.2
Bridge	m2	4,000.0	3,700.0	5,150.0	4,900.0	4,550.0
Sluice	unit	4.0	4.0	4.0	11.0	4.0
Drainage facility	unit	6.0	8.0	11.0	6.0	12.0
Diversion Weir	m	-	-	320.0	280.0	250.0
Compensation						
Land Acquisition	ha	222.6	307.5	277.5	205.1	256.7
House Evacuation	unit	354.0	211.0	404.0	311.0	246.0
Total Cost	mil.P.	1,187.0	1,363.7	1,547.5	1,322.4	1,401.2

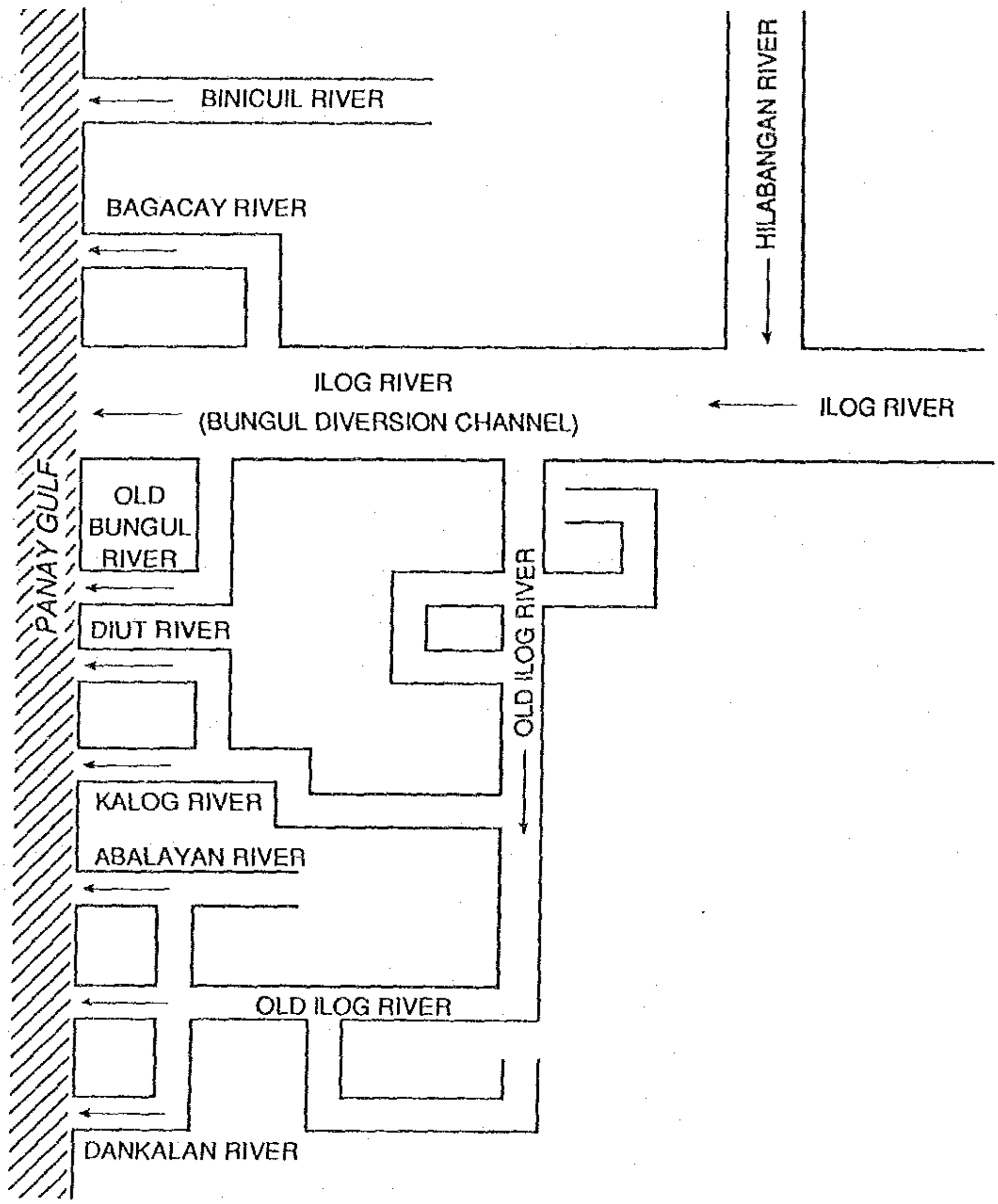
Table VI-3-3 BREAKDOWN OF RIVER IMPROVEMENT COST BY DESIGN DISCHARGE

Work Item	Feature	Unit Cost (P.)	Unit	5,450 M3/S Quantity	5,450 M3/S Total (mil.P.)	3,550 M3/S Quantity	3,550 M3/S Total (mil.P.)	2,800 M3/S Quantity	2,800 M3/S Total (mil.P.)	1,750 M3/S Quantity	1,750 M3/S Total (mil.P.)	900 M3/S Quantity	900 M3/S Total (mil.P.)
1. Construction Cost					843.4		672.8		493.4		376.8		323.7
(a) Preparatory Works (15% of (b))					110.0		87.8		64.4		49.1		42.2
(b) Main Construction Cost					733.4		585.1		429.1		327.6		281.5
Excavation													
	Common	60	m3	6,701,800	402.1	4,844,100	290.6	2,831,400	169.9	1,891,000	113.5	1,537,200	92.2
	Dredging	49	m3	2,723,700	133.5	2,134,700	104.6	1,551,300	76.0	822,600	40.3	448,800	22.0
Embankment		44	m3	966,700	42.5	966,700	42.5	966,700	42.5	966,700	42.5	966,700	42.5
Revetment		800	m2	102,100	81.7	102,100	81.7	102,100	81.7	102,100	81.7	102,100	81.7
Sodding		10	m2	530,200	5.3	530,200	5.3	530,200	5.3	530,200	5.3	530,200	5.3
Sluice													
	Type A	700,000	unit	3	2.1	3	2.1	3	2.1	3	2.1	3	2.1
	Type B	10,000,000	unit	1	10.0	1	10.0	1	10.0	1	10.0	1	10.0
Drainage Facility		500,000	unit	6	3.0	6	3.0	6	3.0	6	3.0	6	3.0
Bridge		13,300	m2	4,000	53.2	3,400	45.2	2,900	38.6	2,200	29.3	1,700	22.6
2. Administration Cost (5% of 1.)					42.2		33.6		24.7		18.8		16.2
3. Engineering Survices					134.9		107.7		79.0		60.3		51.8
Detailed Design (6% of 1.)					50.6		40.4		29.6		22.6		19.4
Supervision (10% of 1.)					84.3		67.3		49.3		37.7		32.4
4. Physical Contingency (10% of 1+2+3)					102.1		81.4		59.7		45.6		39.2
Sub Total (1+2+3+4)					1,122.6		895.6		656.8		501.5		430.8
5. Compensation					64.4		44.5		29.0		12.6		7.2
Land Acquisition													
	Fish Pond	230,000	ha	38	8.7	25	5.8	14	3.1	2	0.5	0	0.0
	Suger Cane	110,000	ha	178	19.6	131	14.4	88	9.7	35	3.9	24	2.6
	Residential Area	3,800,000	ha	6	21.9	4	14.8	3	9.8	1	4.9	1	2.8
House Evacuation		40,000	Unit	354	14.2	239	9.6	159	6.4	80	3.2	45	1.8
Grand Total					1,187.0		940.0		685.8		514.1		438.0

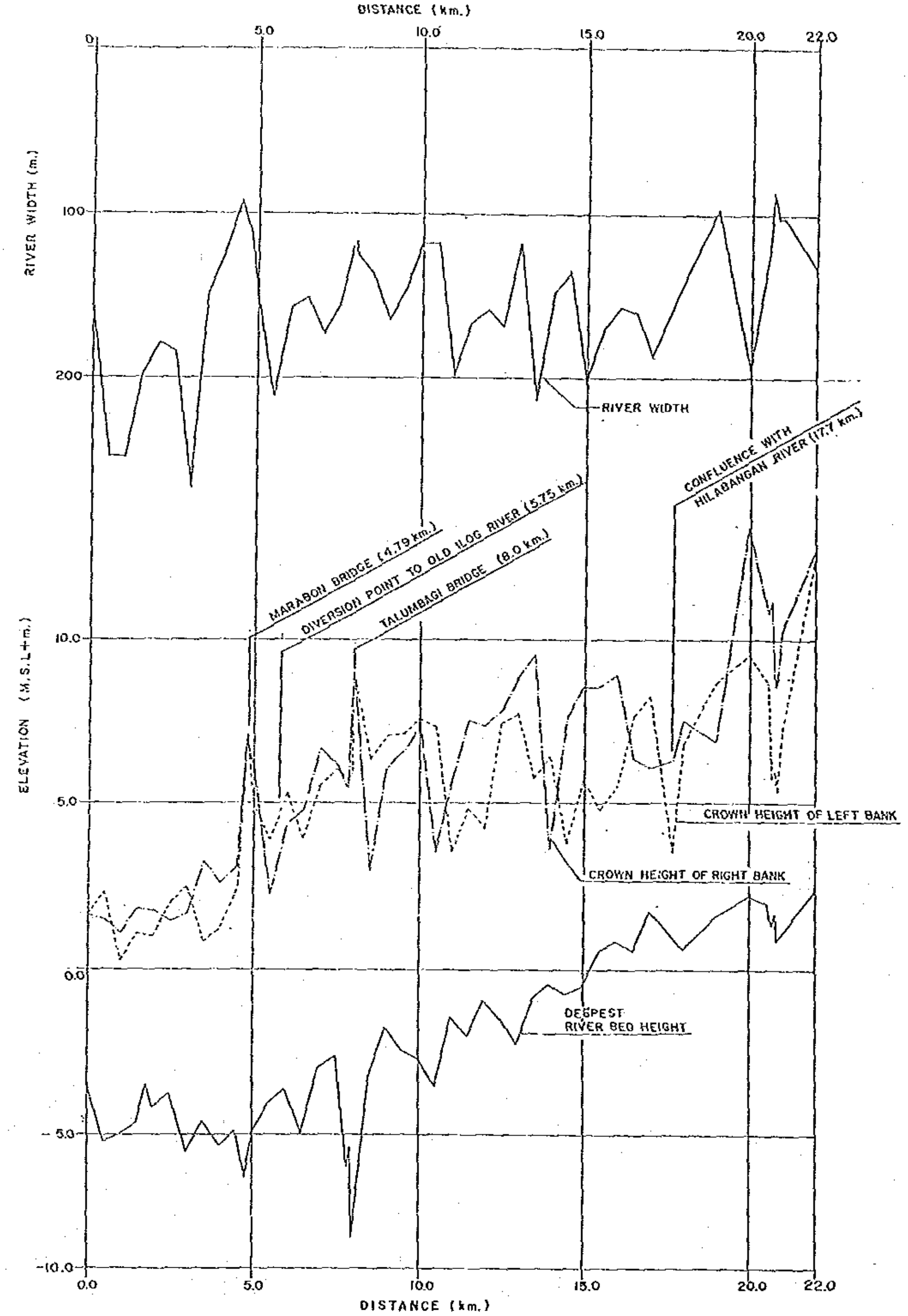
FIGURES



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-1 LONGITUDINAL PLOFILE OF ILOG RIVER AND HILABANGAN RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

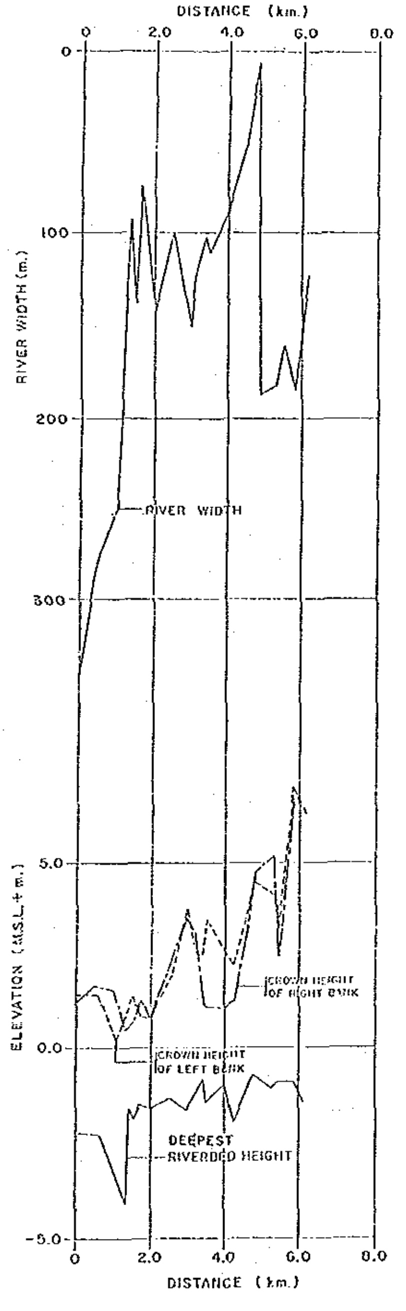


THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-2 RIVER SYSTEM IN LOWER REACHES
JAPAN INTERNATIONAL COOPERATION AGENCY	

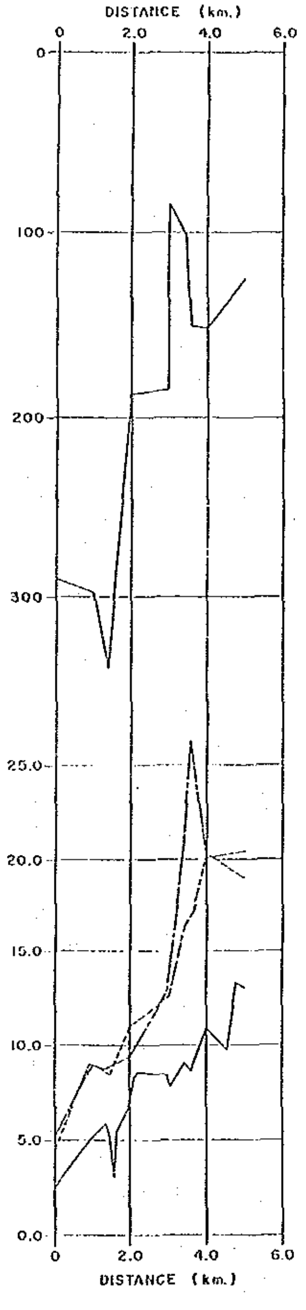


ILOG RIVER

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-3 (1/5) FEATURES OF ILOG RIVER, TRIBUTARY AND BRANCH RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

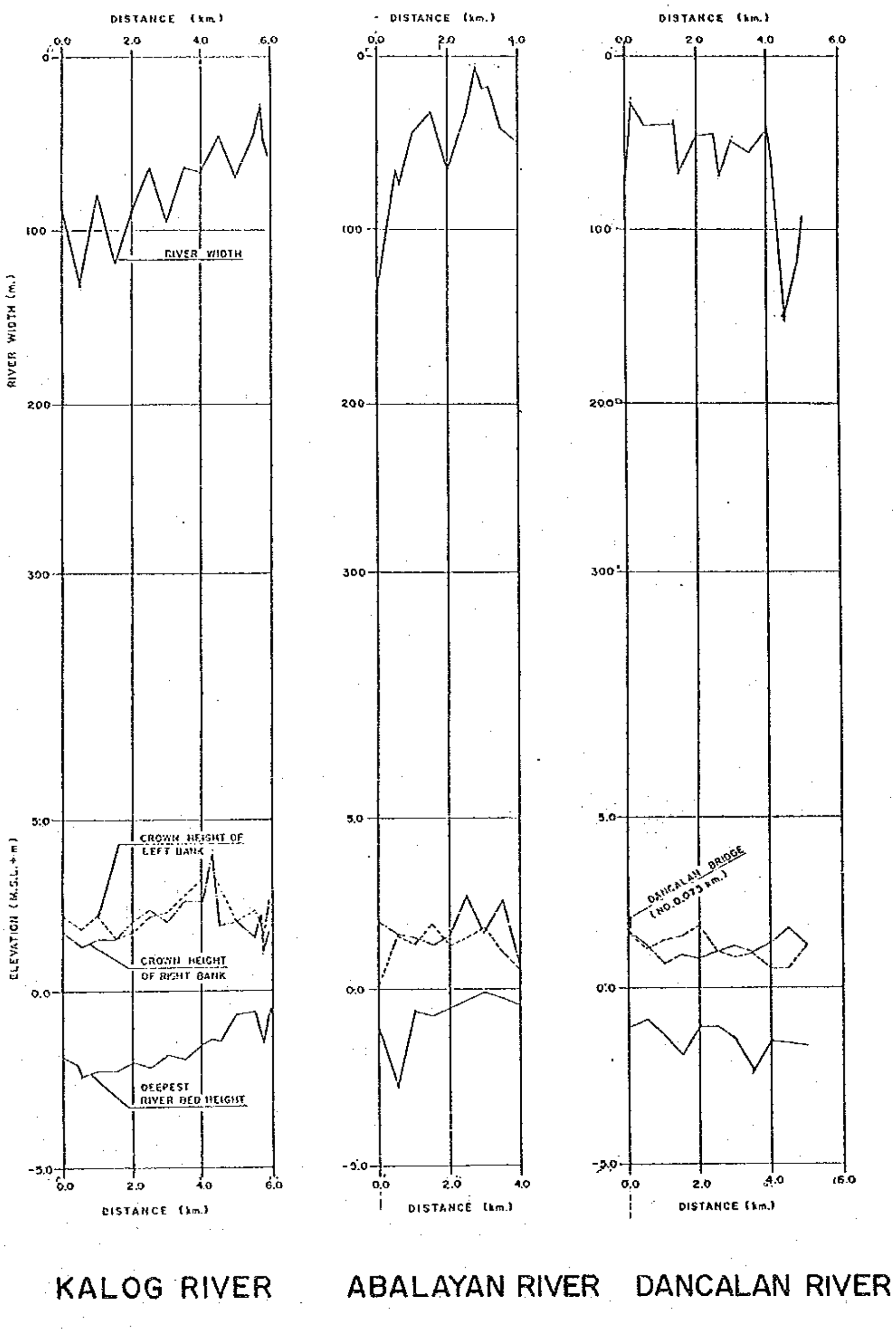


OLD ILOG RIVER

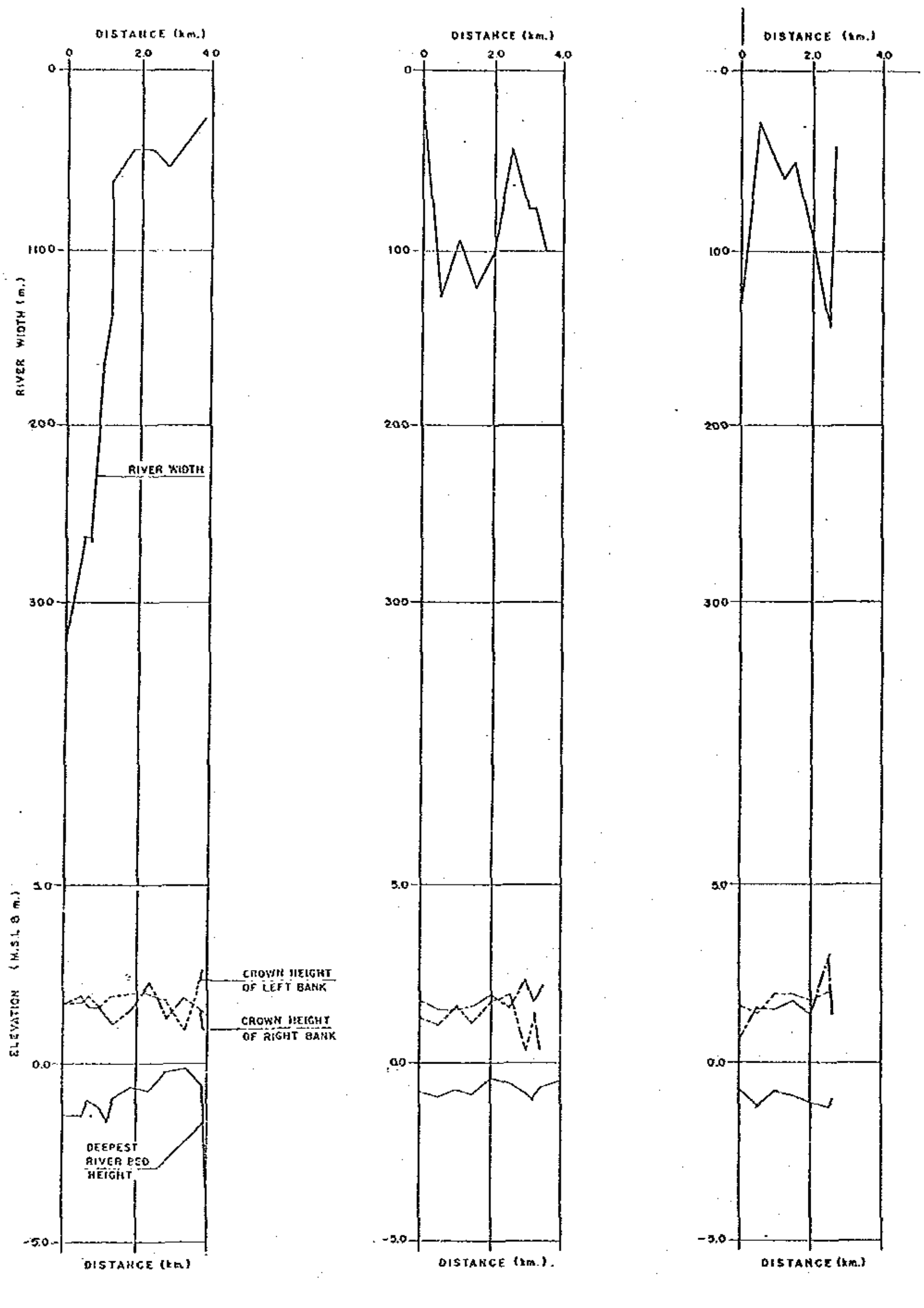


HILABANGAN RIVER

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-3 (2/5) FEATURES OF ILOG RIVER, TRIBUTARY AND BRANCH RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

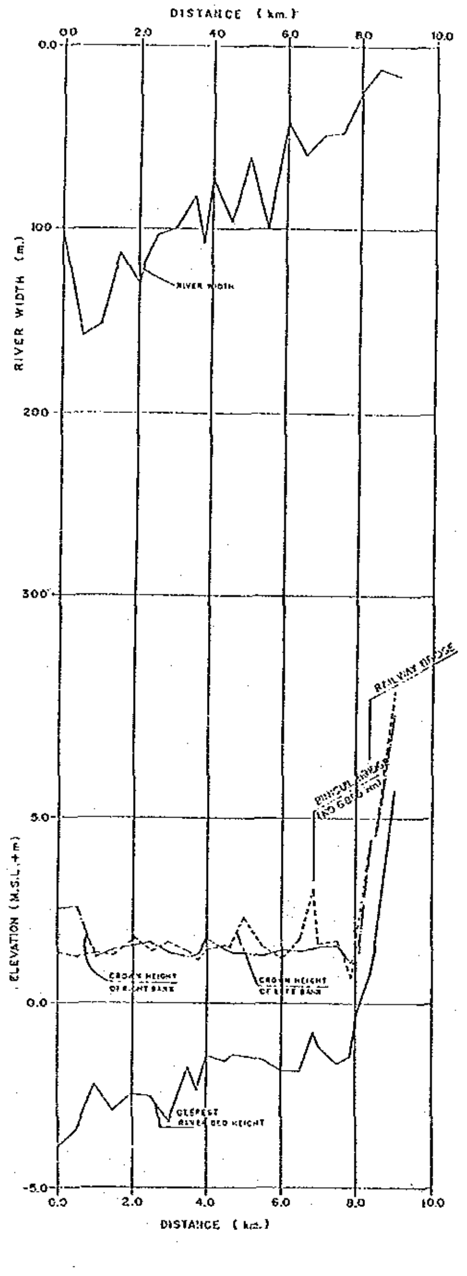


THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig. VI-1-3 (3/5) FEATURES OF ILOG RIVER, TRIBUTARY AND BRANCH RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



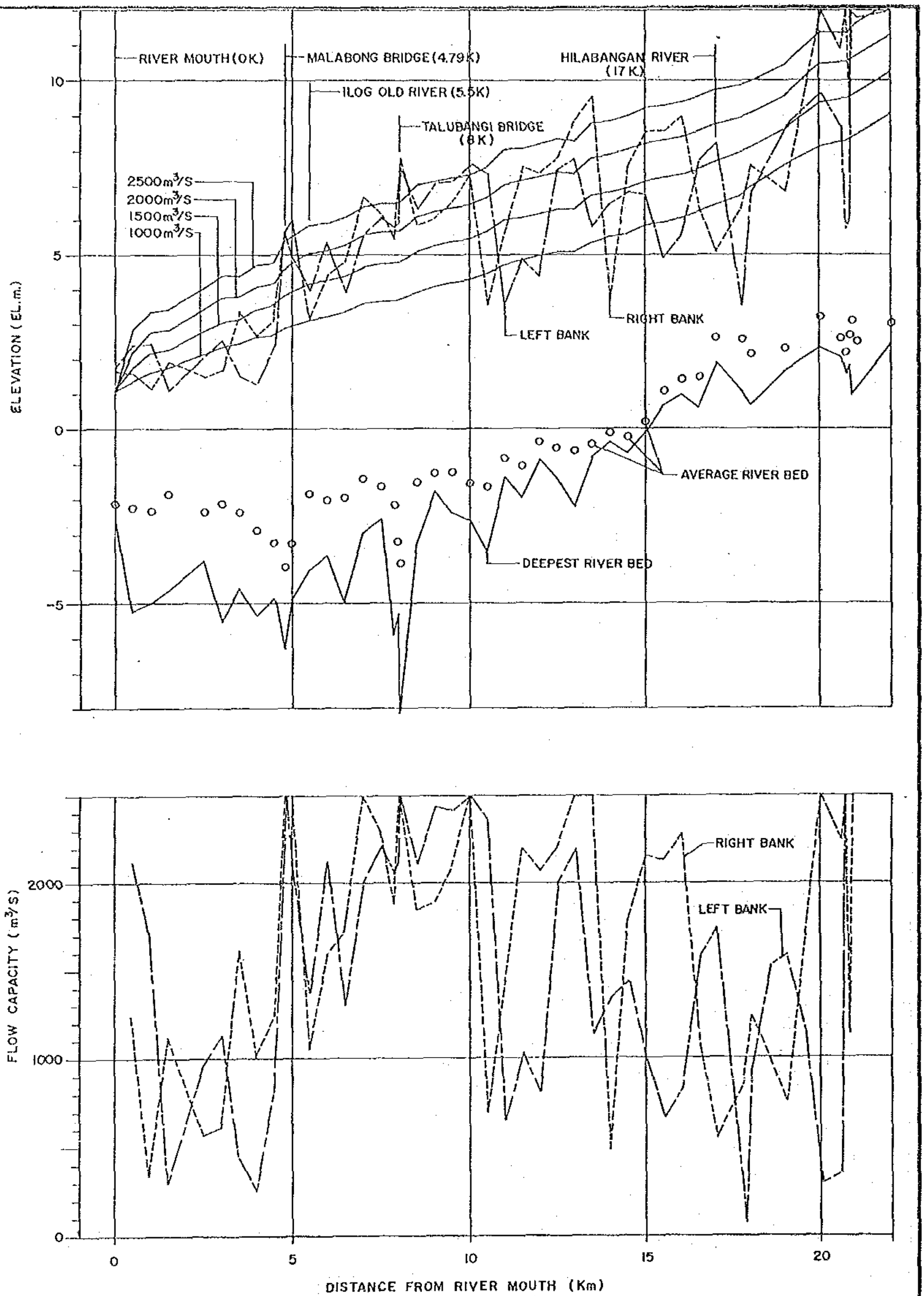
BAGACAY RIVER　　OLD BUNGUL RIVER　　DIUT RIVER

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-3 (4/5) FEATURES OF ILOG RIVER, TRIBUTARY AND BRANCH RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

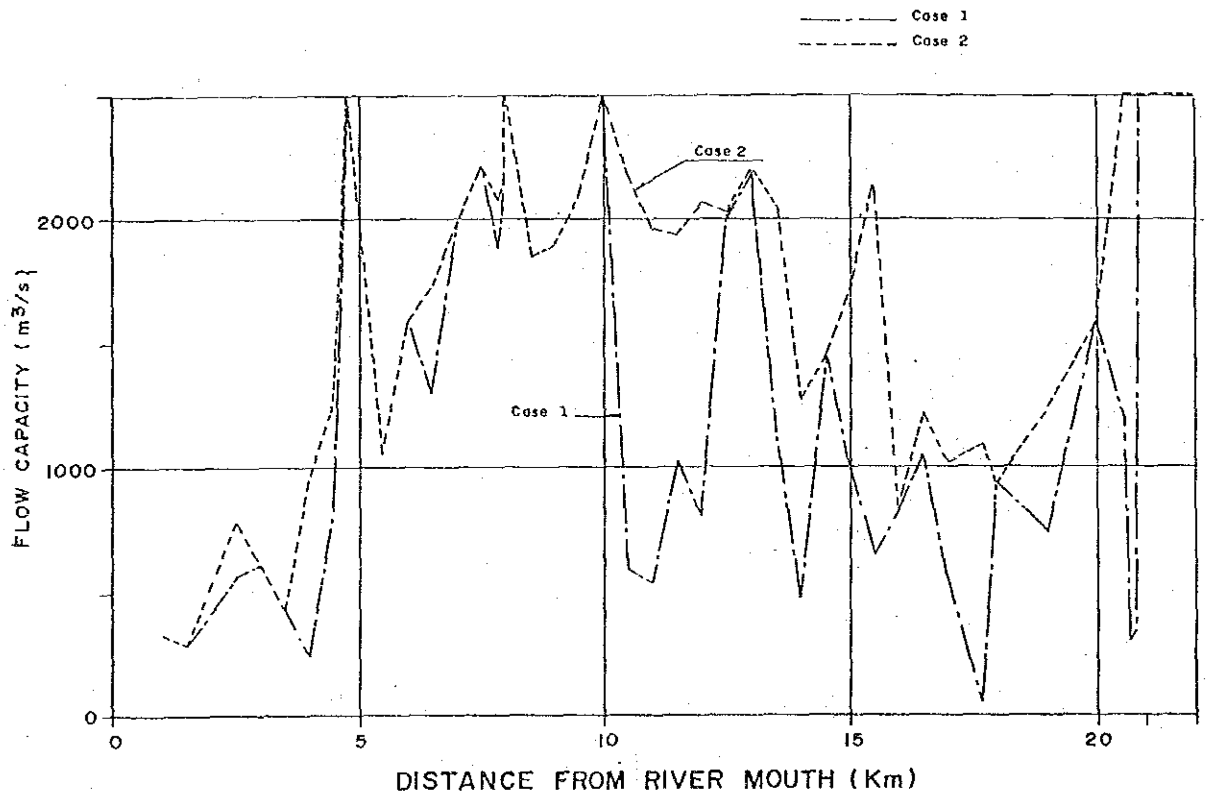


BINICUIL RIVER

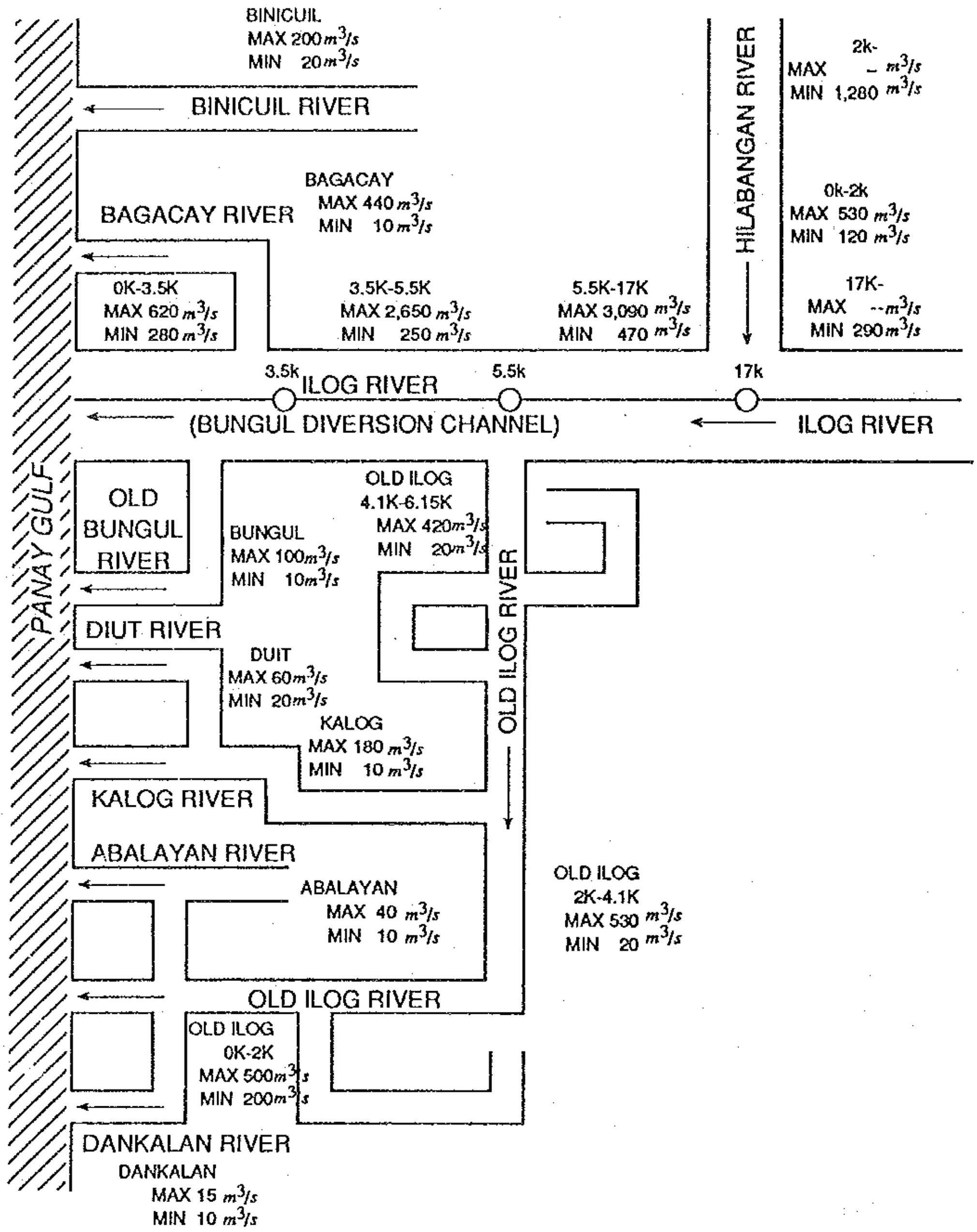
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-3 (5/5)	FEATURES OF ILOG RIVER, TRIBUTARY AND BRANCH RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY		



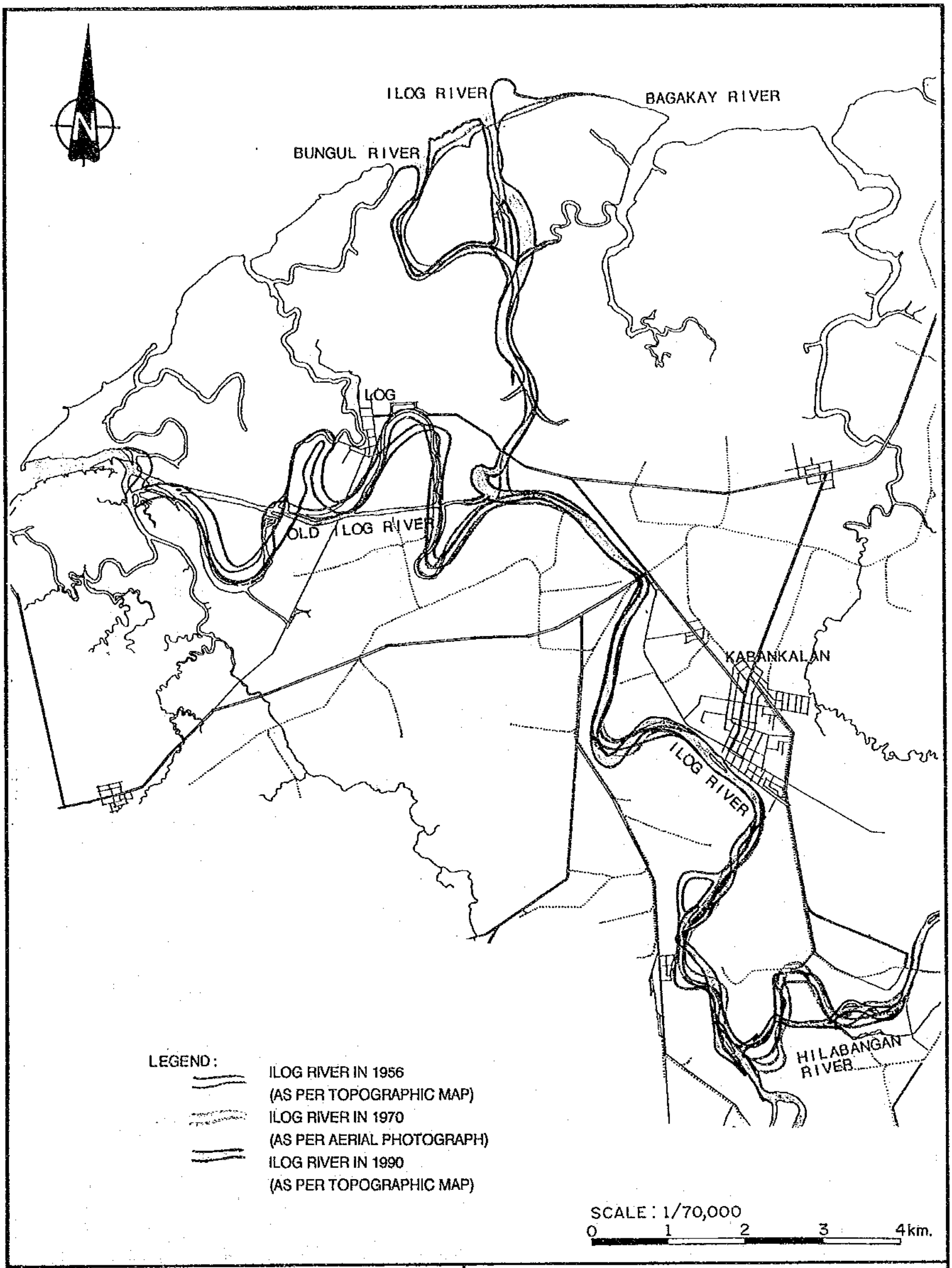
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-4 RESULTS OF NON-UNIFORM CALCULATION ALONG ILOG RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



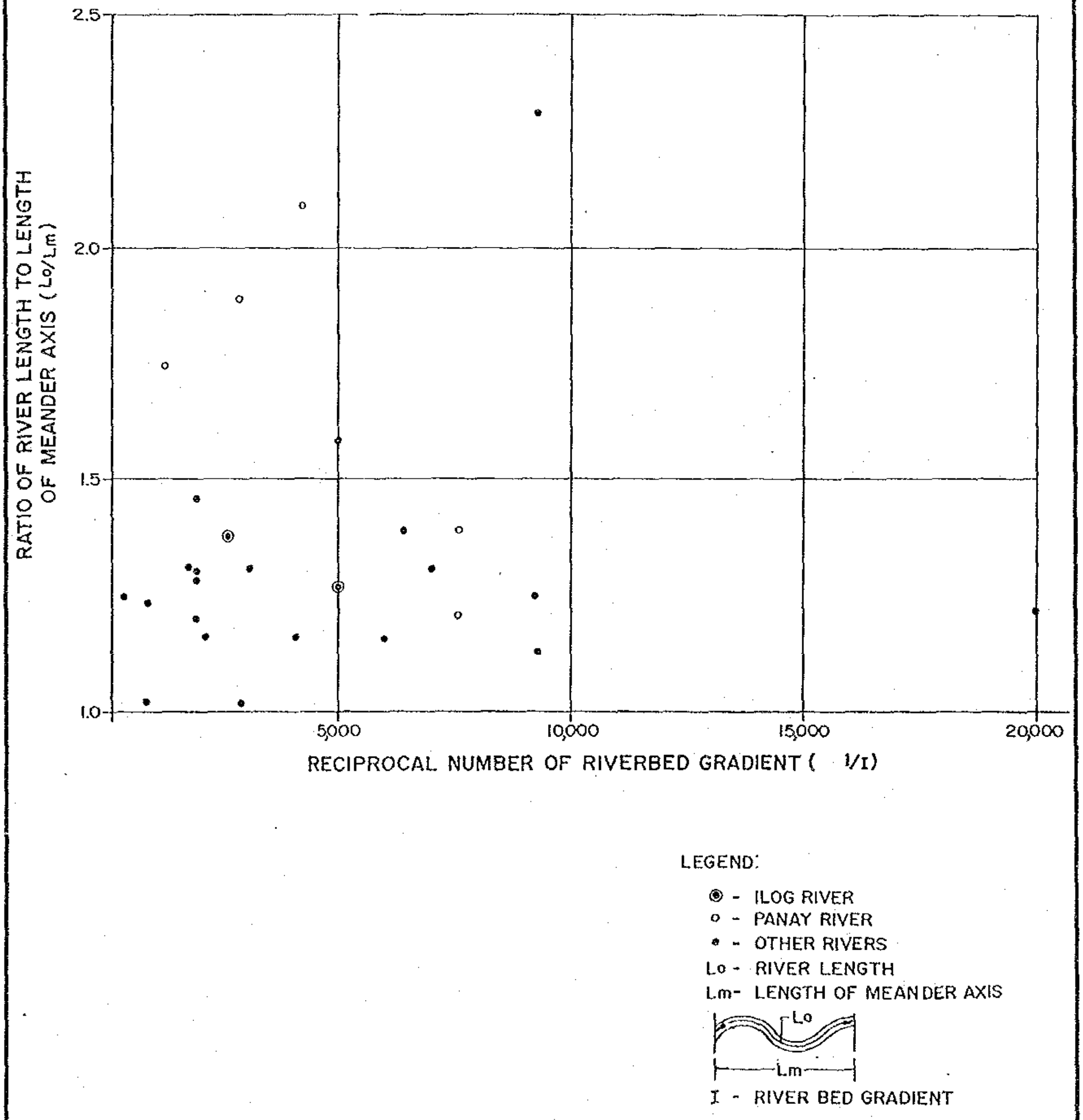
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-5 FLOW CAPACITY ALONG ILOG RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



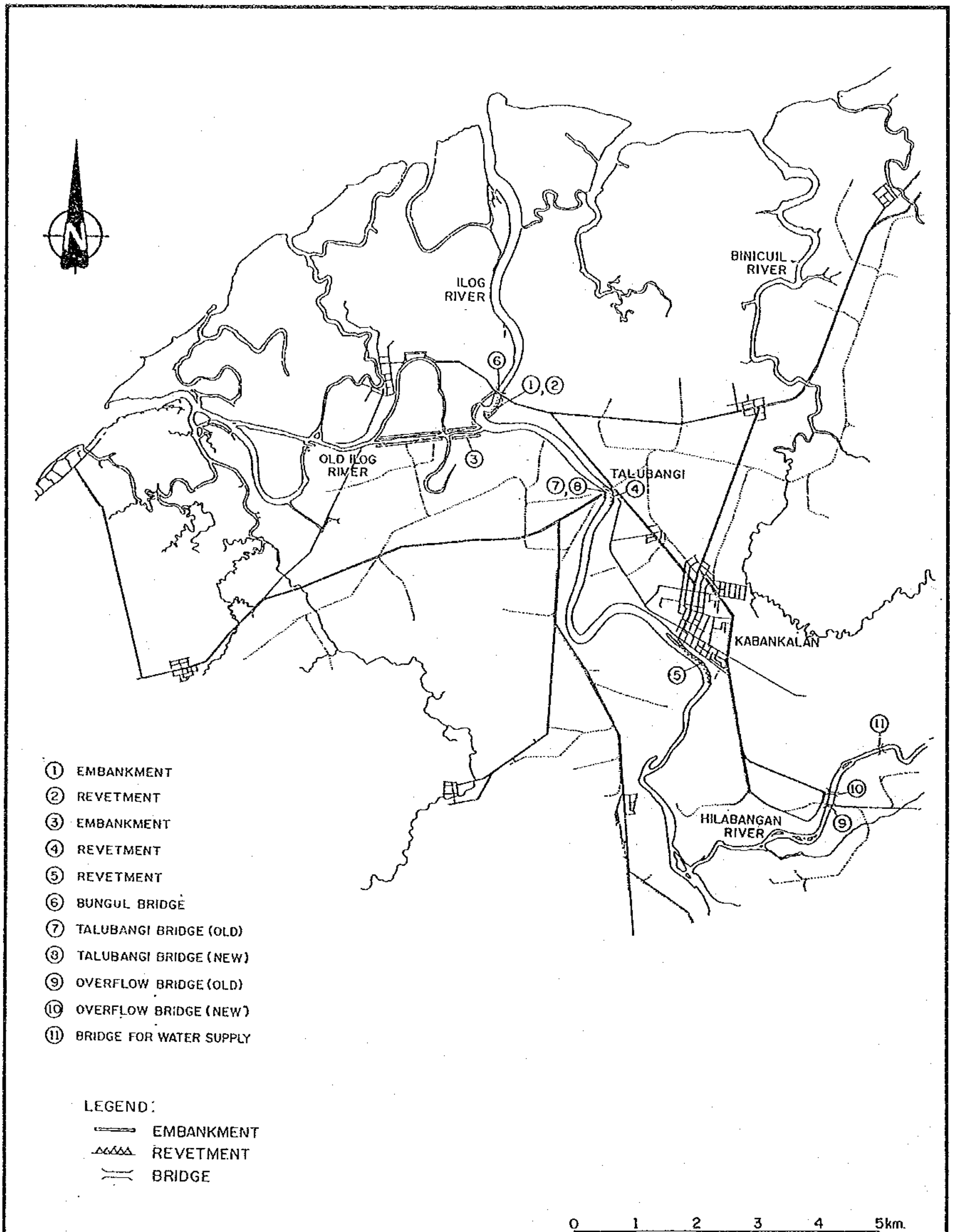
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-6 FLOW CAPACITY OF RELATED RIVERS
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-7 CHANGE OF RIVER COURSE
JAPAN INTERNATIONAL COOPERATION AGENCY	



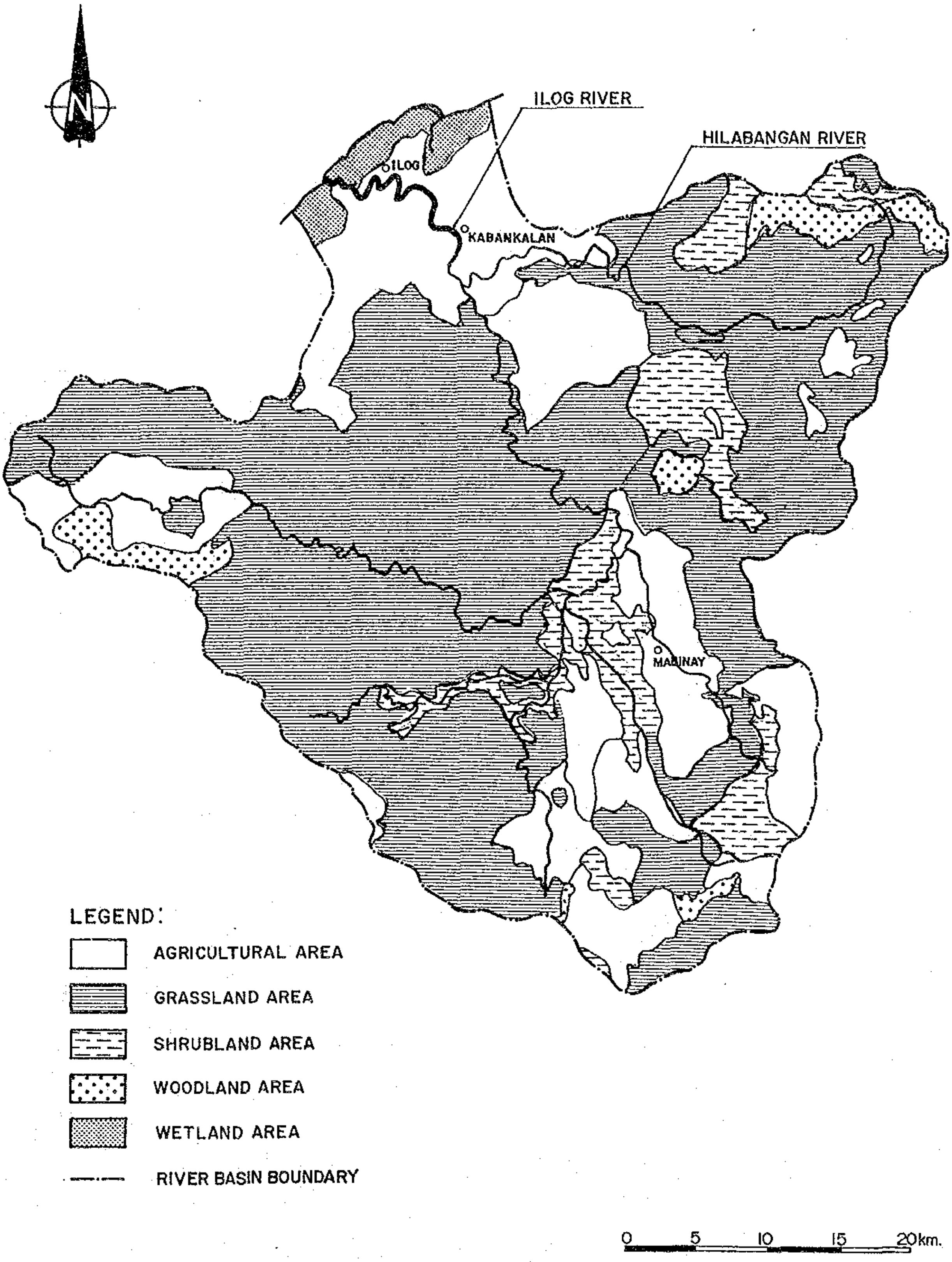
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-1-8 RATIO OF RIVER LENGTH TO LENGTH OF MEANDERS AXIS
JAPAN INTERNATIONAL COOPERATION AGENCY	



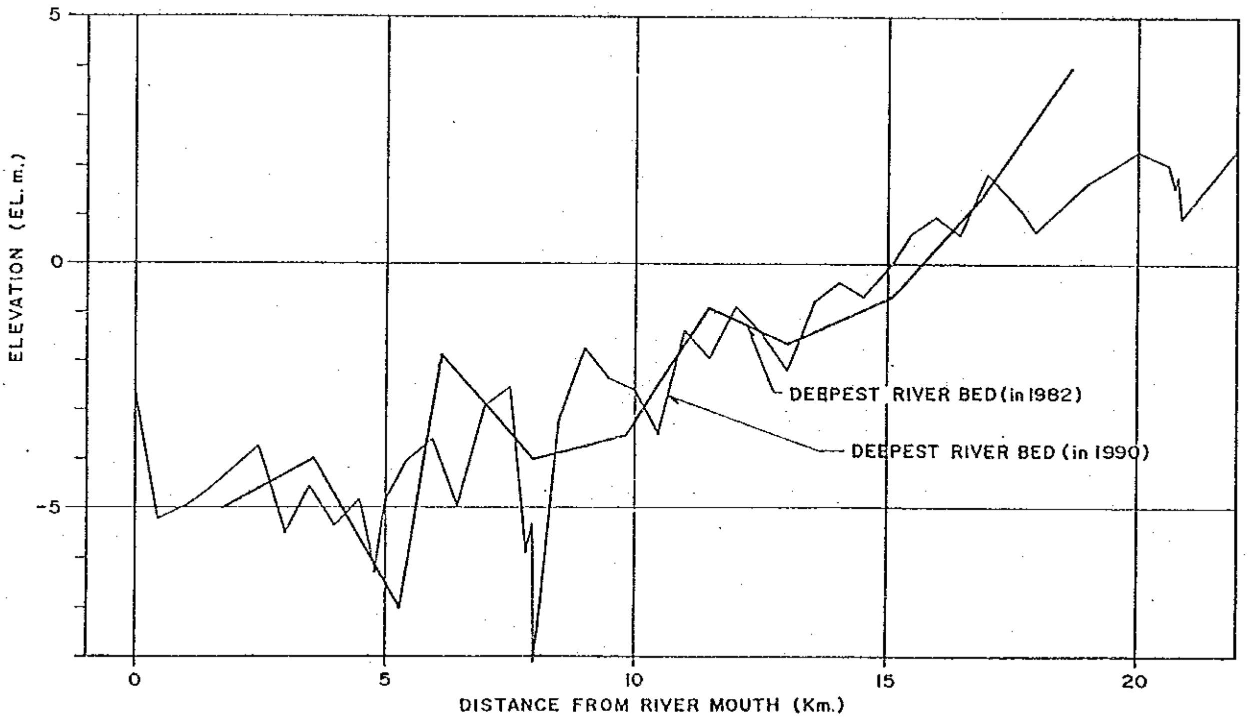
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

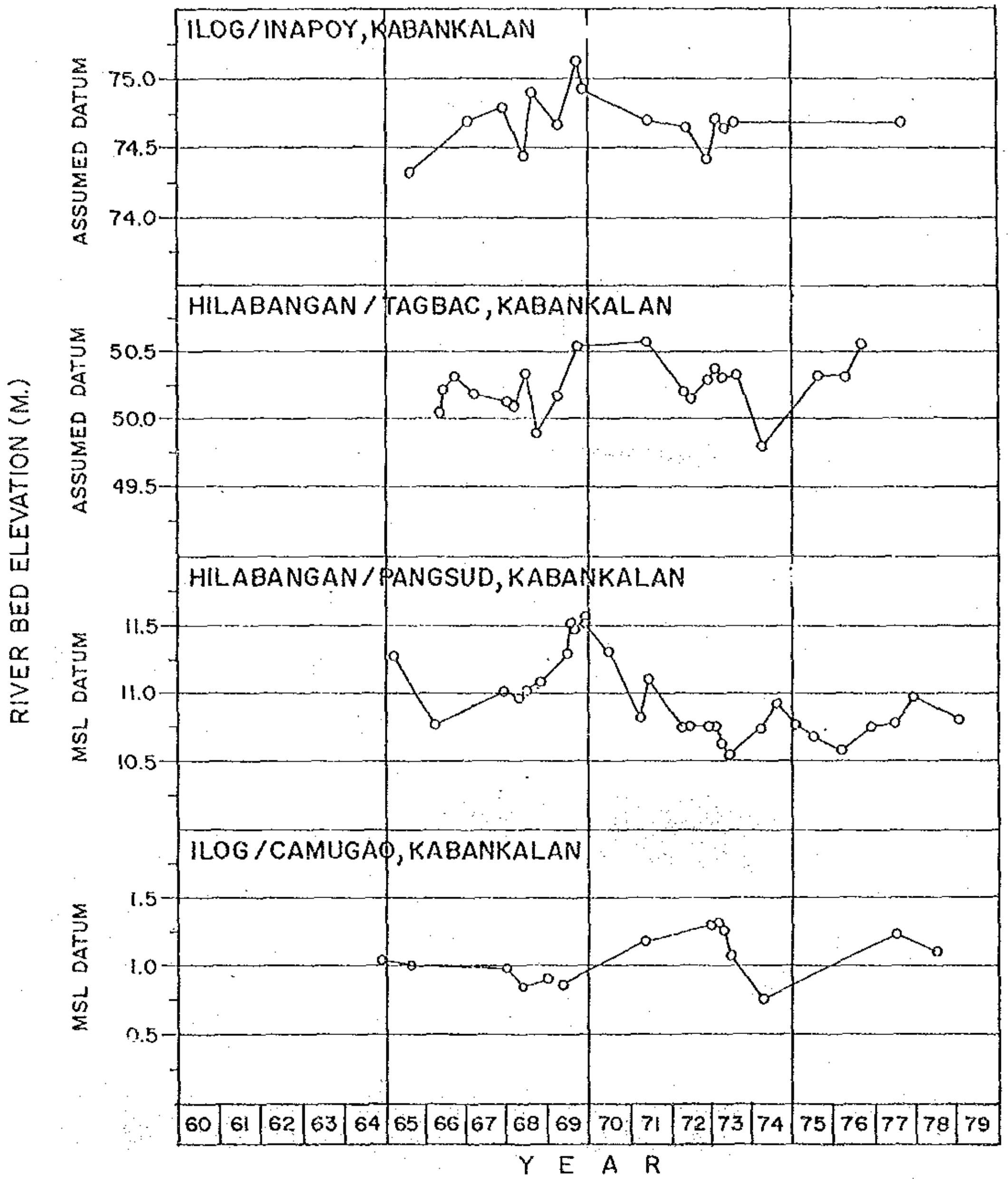
Fig.VI-1-9 LOCATION OF RIVER STRUCTURES



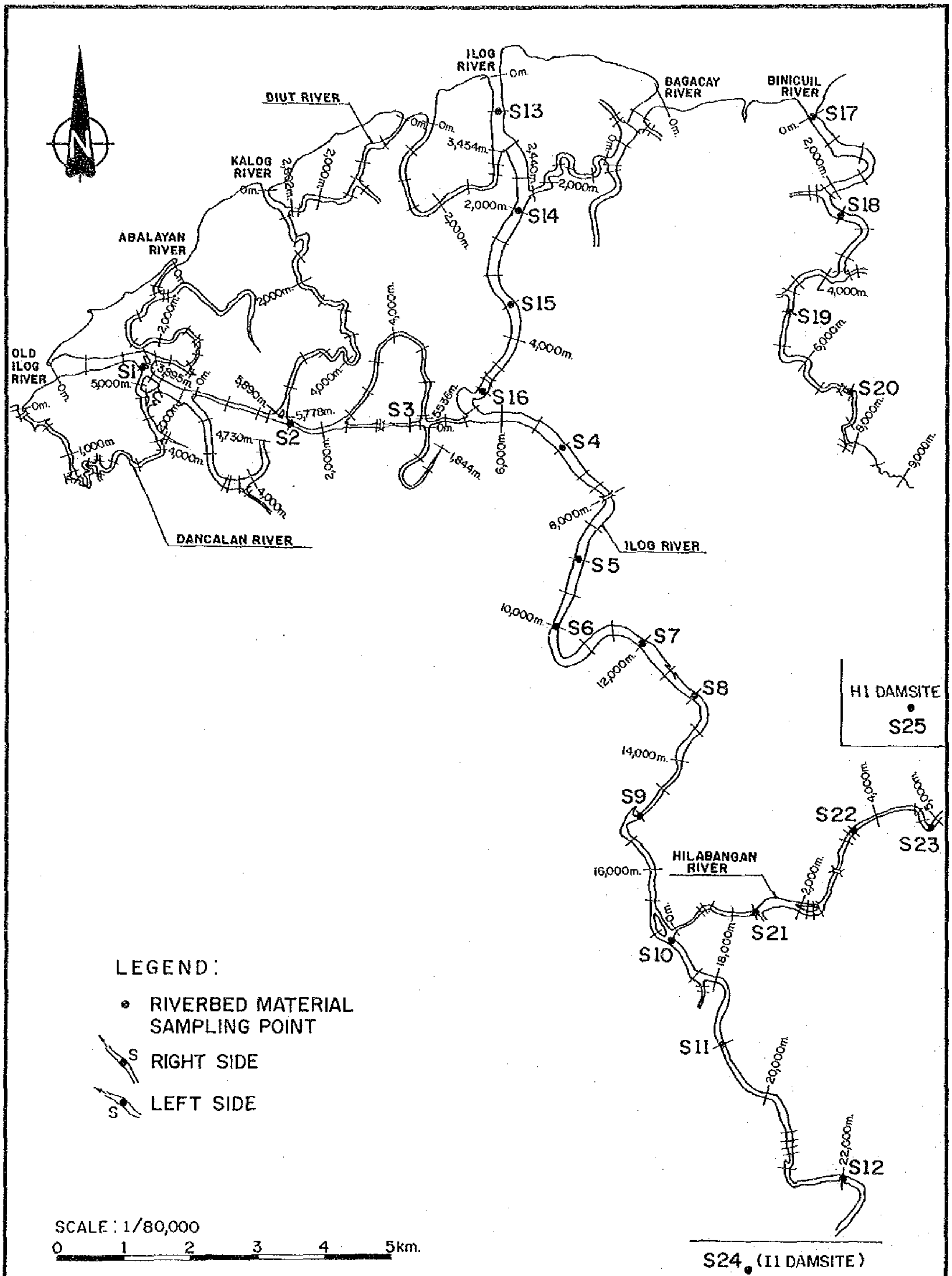
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-2-1 VEGETATION CONDITION
JAPAN INTERNATIONAL COOPERATION AGENCY	



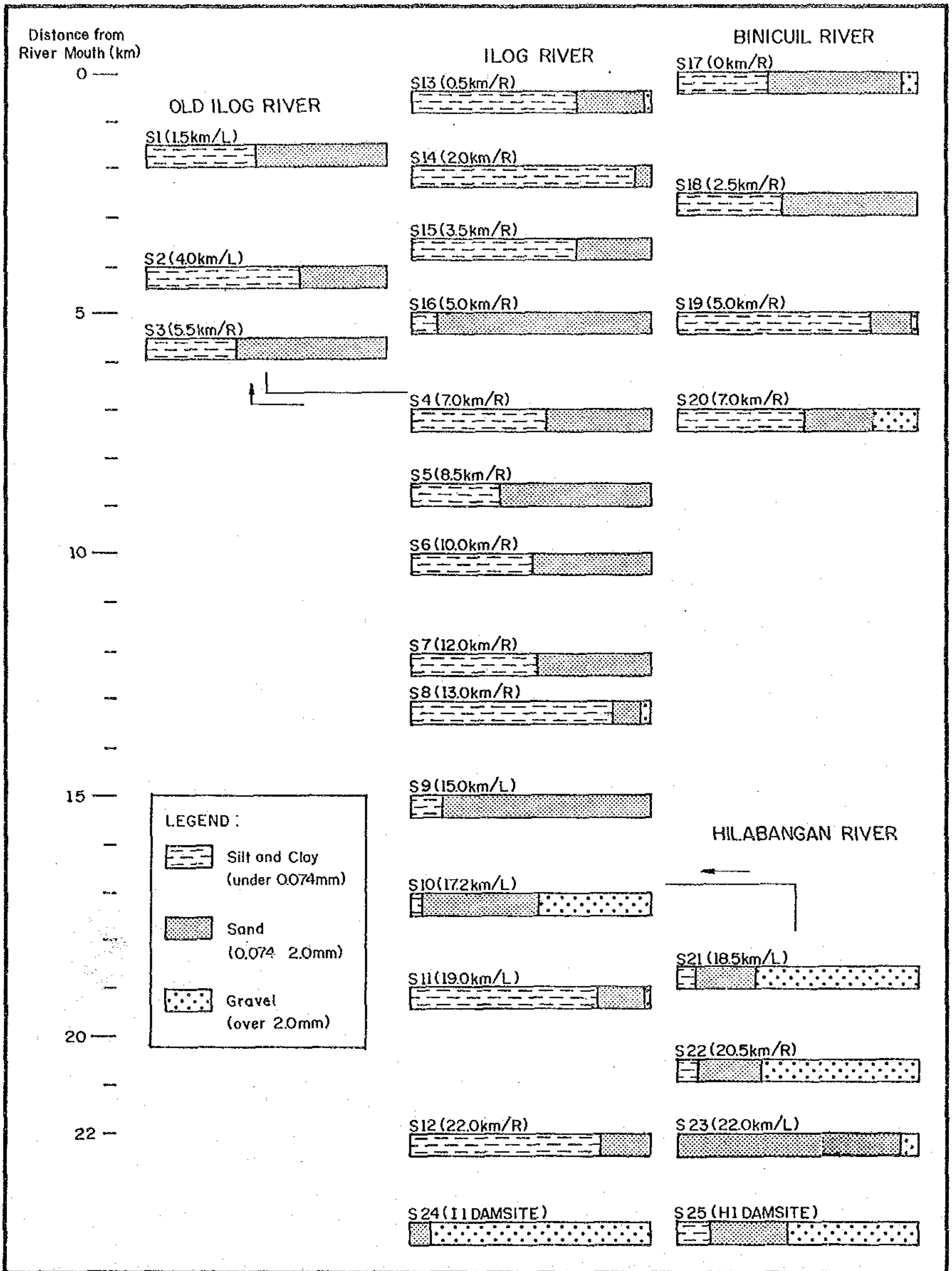
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-2-2 CHANGE OF RIVERBED ELEVATION
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-2-3 FLUCTUATION OF RIVERBED
JAPAN INTERNATIONAL COOPERATION AGENCY	



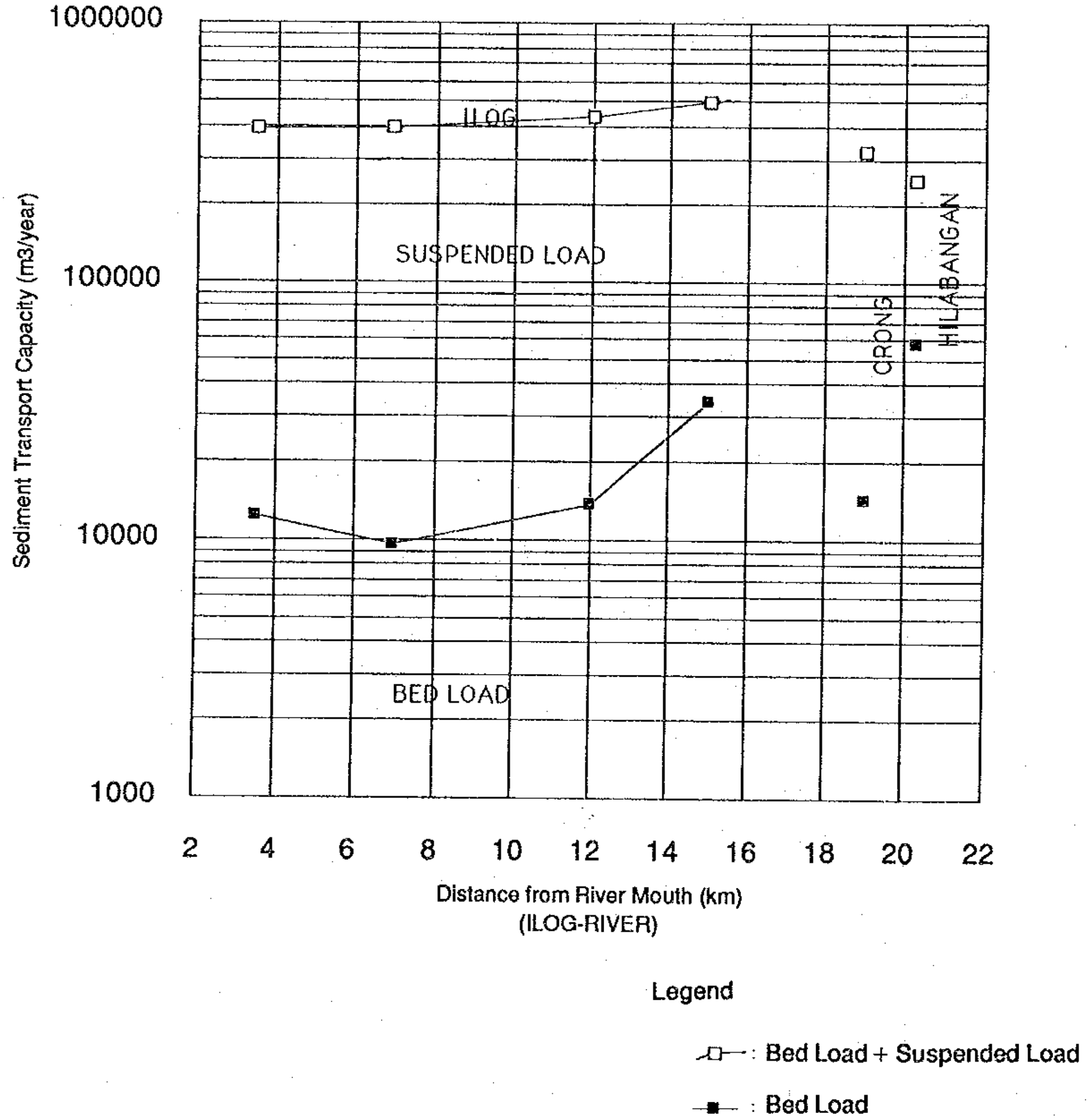
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-2-4 LOCATION MAP OF RIVERBED MATERIAL SAMPLING POINT
JAPAN INTERNATIONAL COOPERATION AGENCY	



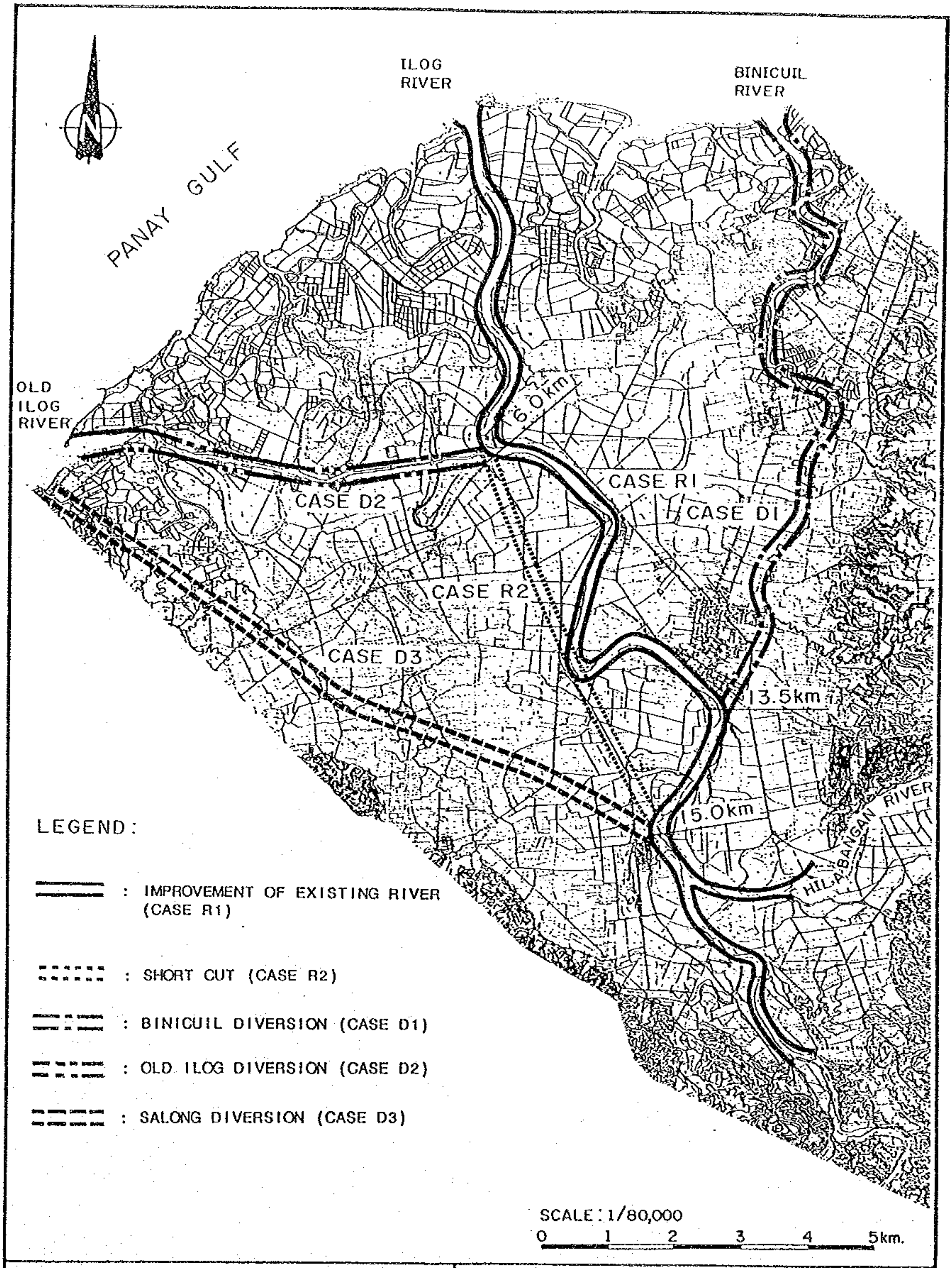
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

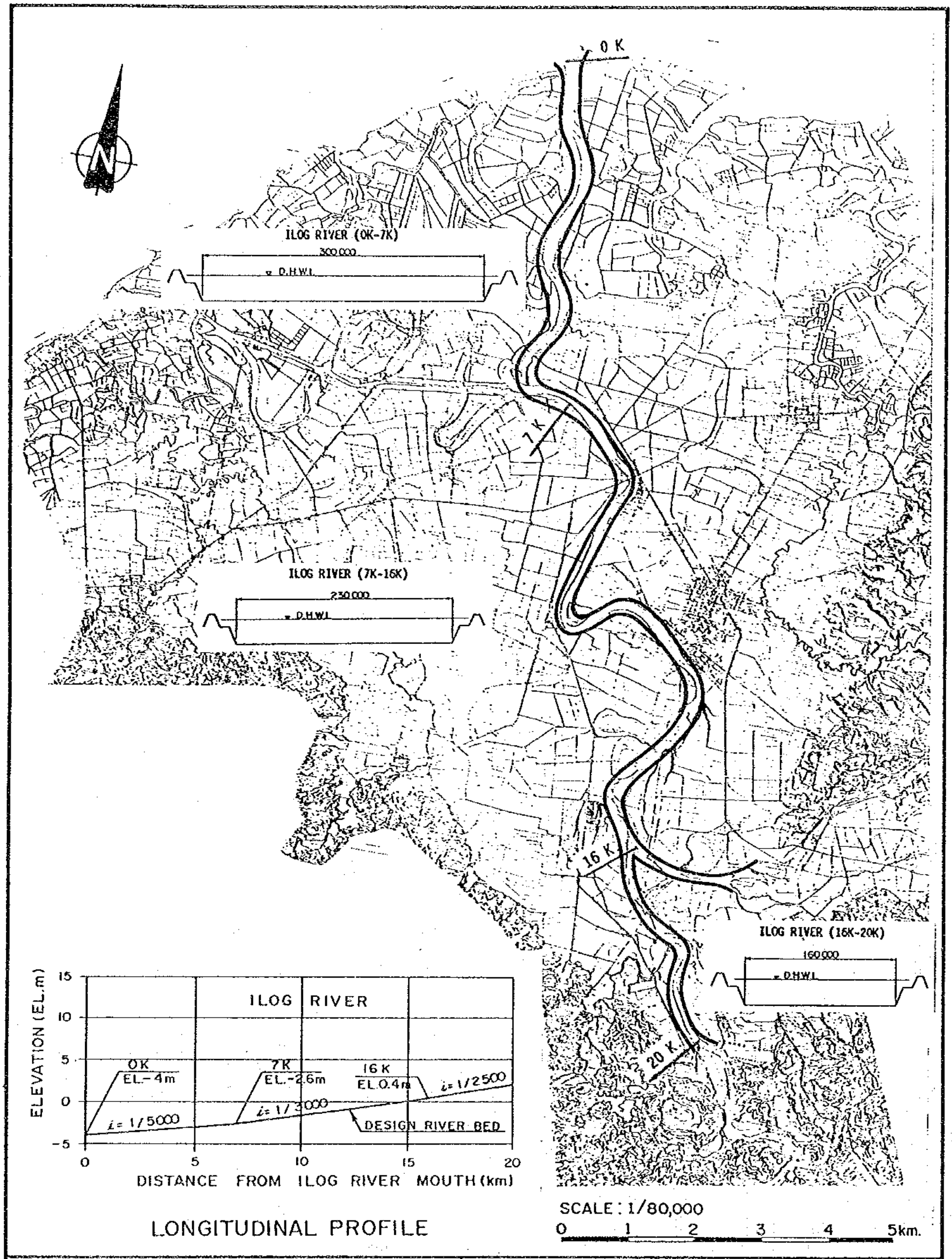
Fig.VI-2-5 GRAIN SIZE COMPOSITION OF RIVERBED MATERIAL



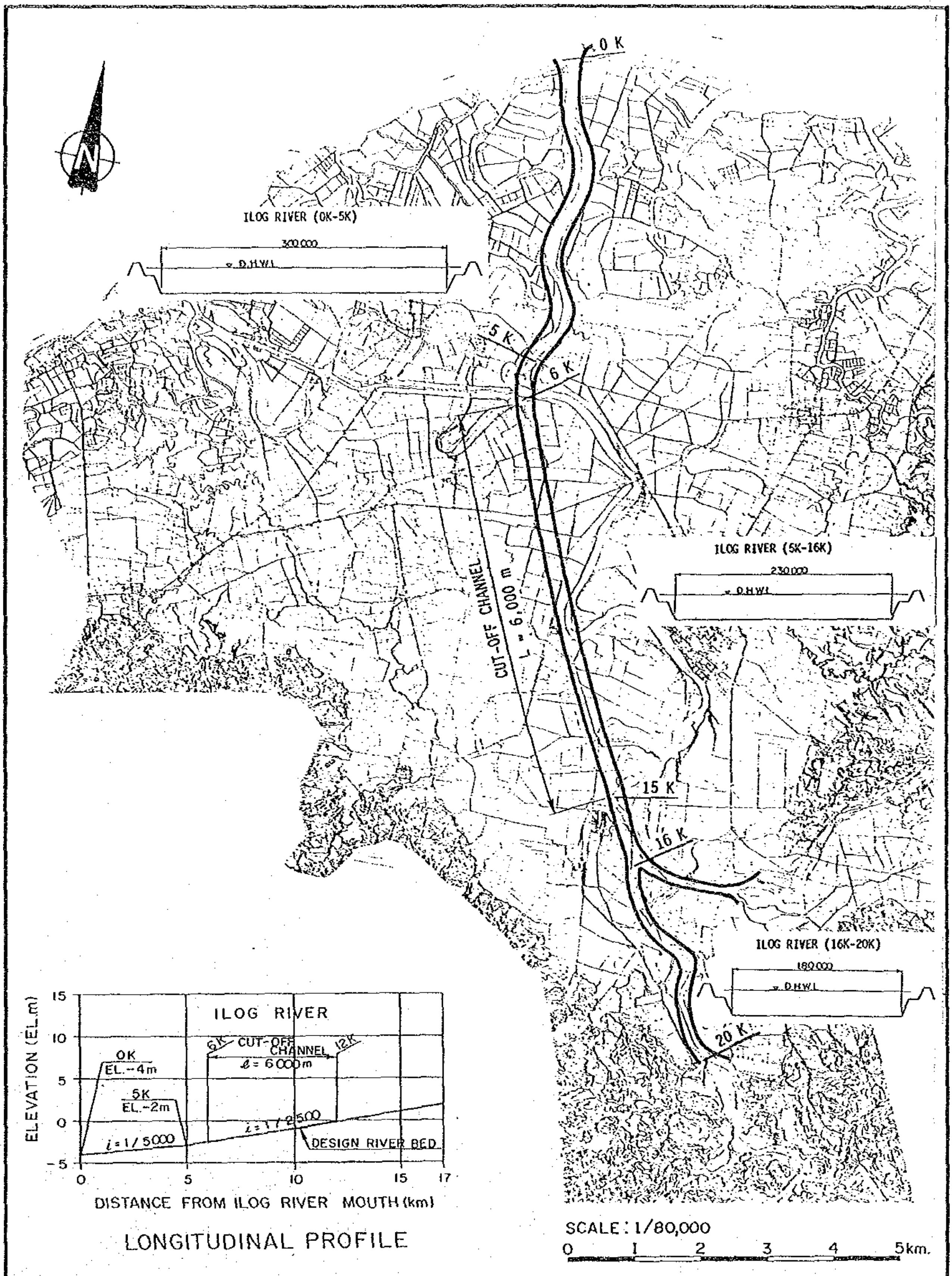
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-2-6 SEDIMENT TRANSPORTATION CAPACITY
JAPAN INTERNATIONAL COOPERATION AGENCY	



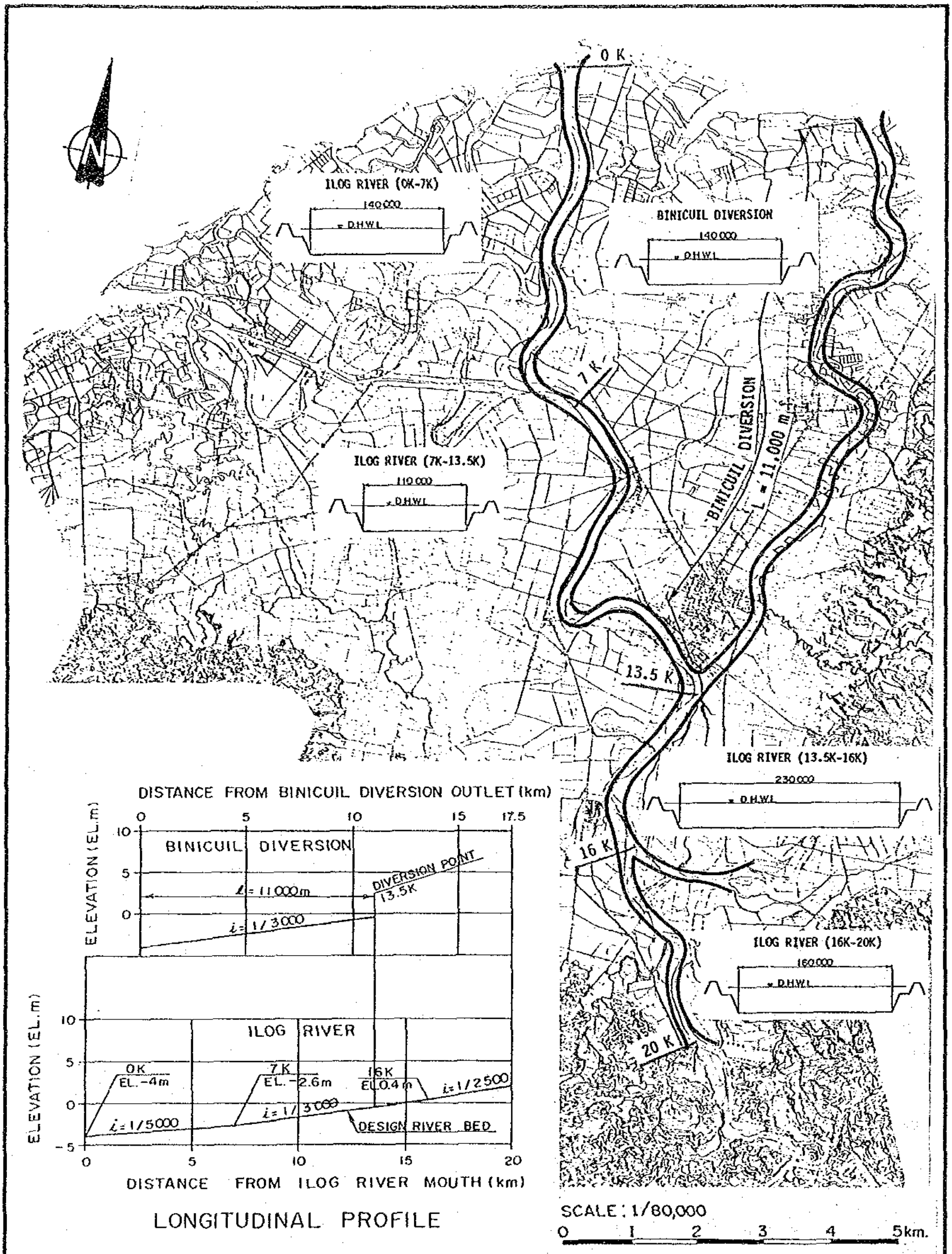
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-1 ALTERNATIVE CASES OF RIVER IMPROVEMENT AND DIVERSION PLANS
JAPAN INTERNATIONAL COOPERATION AGENCY	



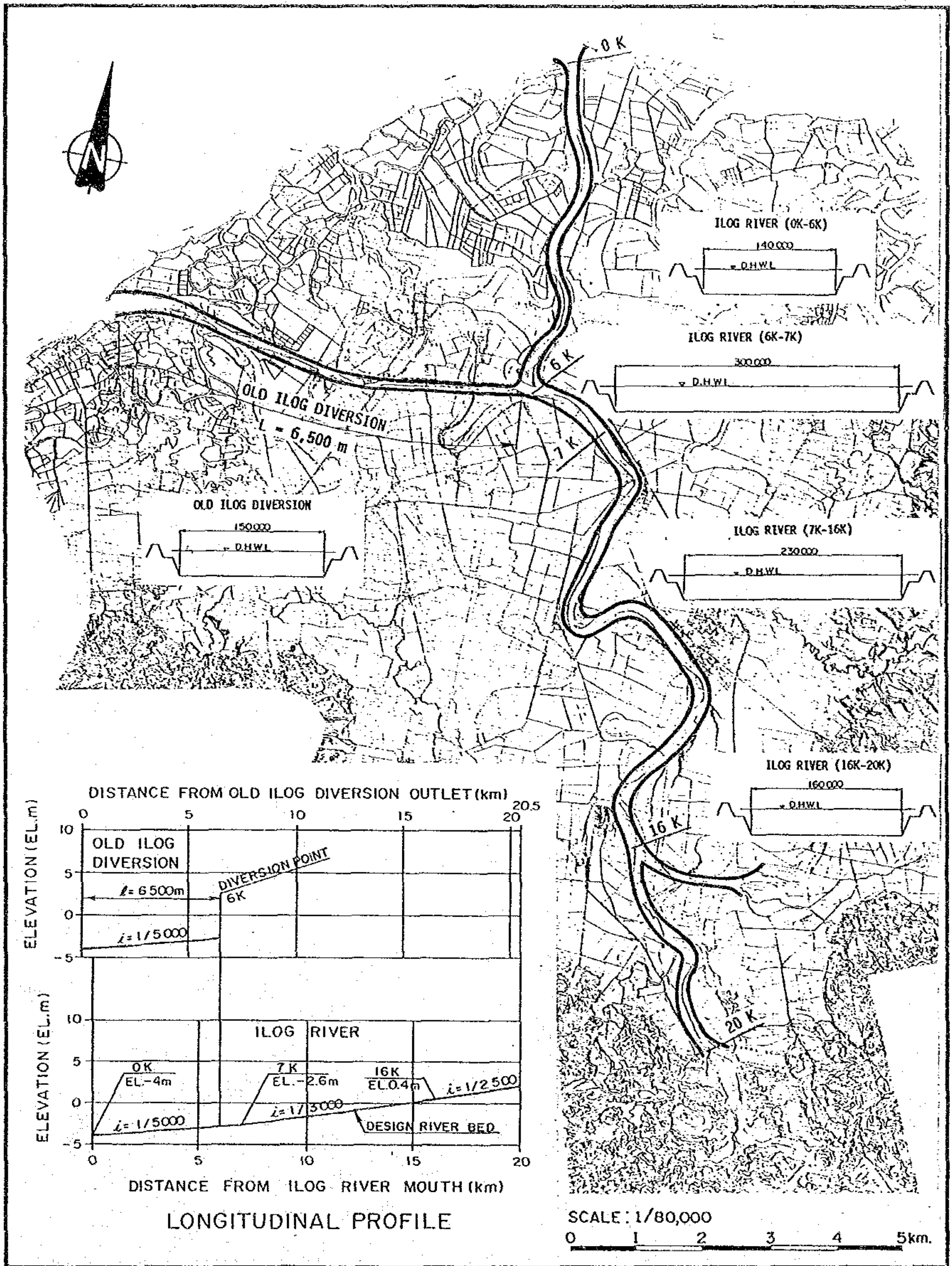
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-2 FEATURES OF ALTERNATIVE CASE (CASE R1)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.VI-3-3 FEATURES OF ALTERNATIVE CASE (CASE R2)



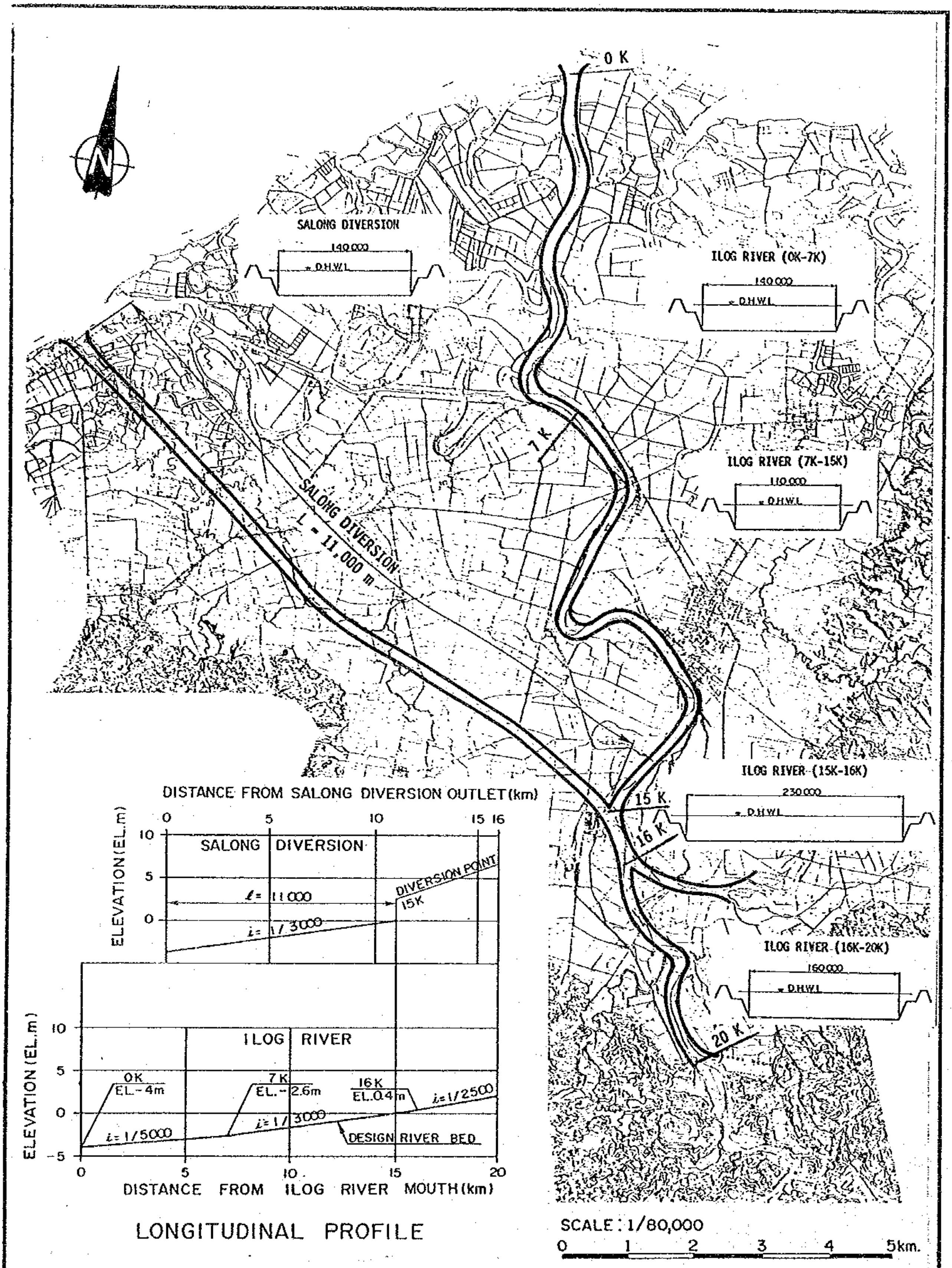
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-4 FEATURES OF ALTERNATIVE CASE (CASE D1)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

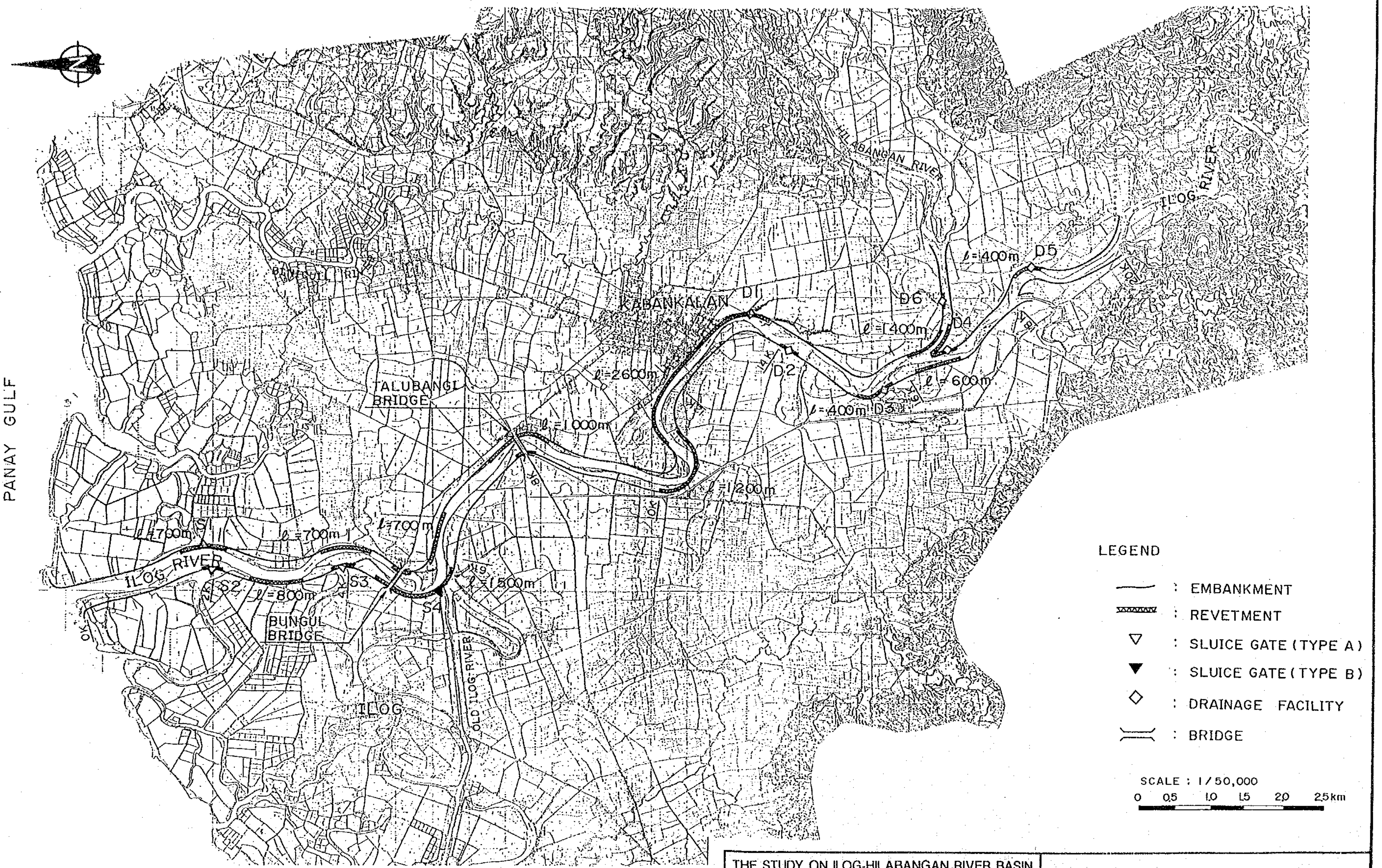
Fig.VI-3-5 FEATURES OF ALTERNATIVE CASE (CASE D2)



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

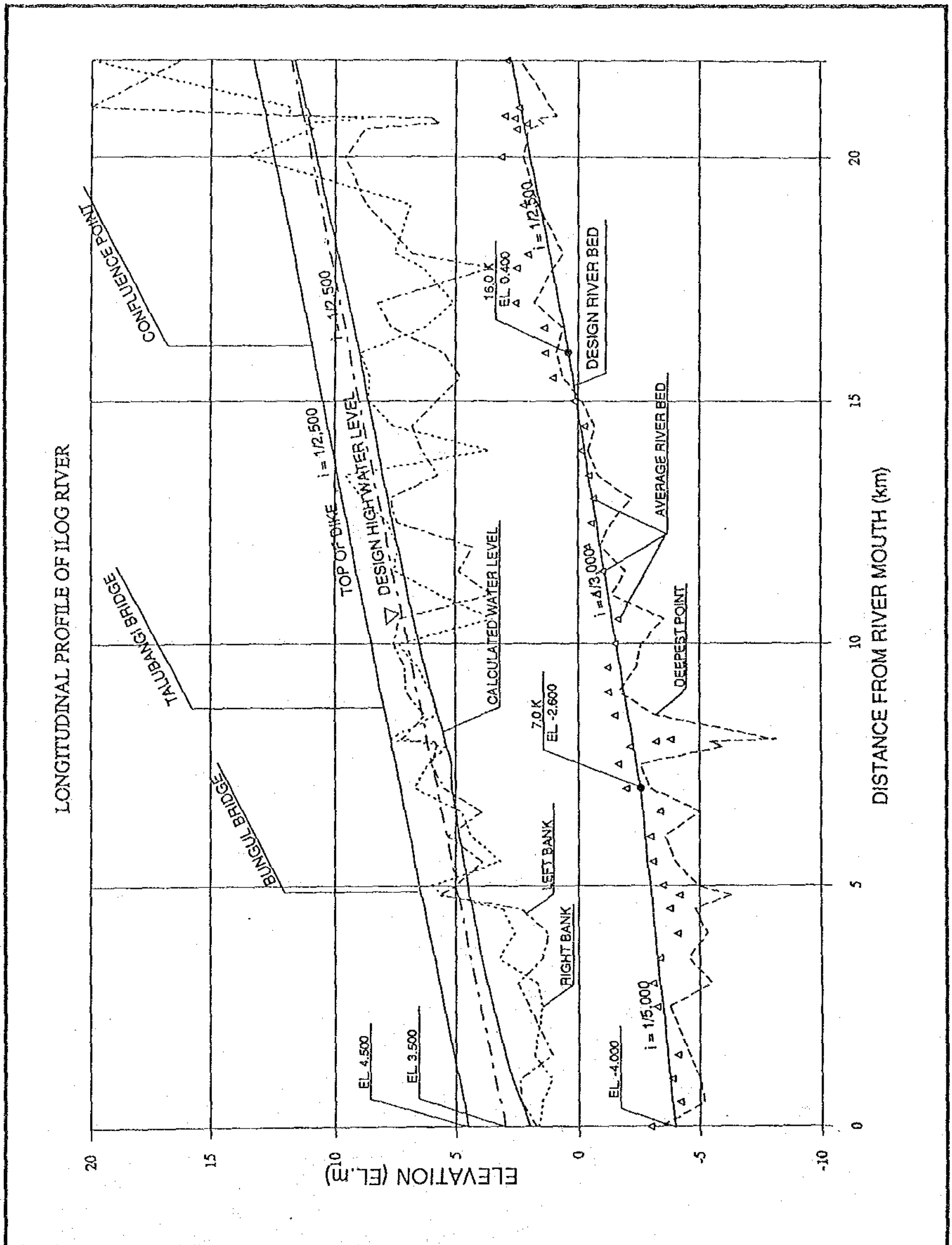
Fig.VI-3-6 FEATURES OF ALTERNATIVE CASE (CASE D3)



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

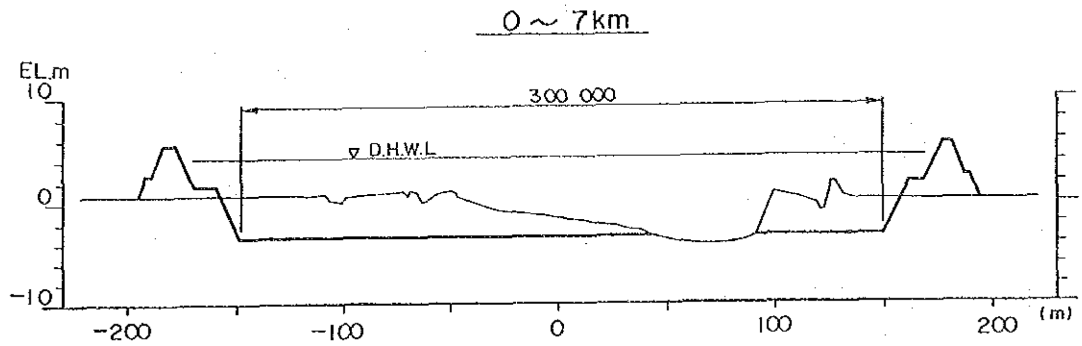
JAPAN INTERNATIONAL COOPERATION AGENCY

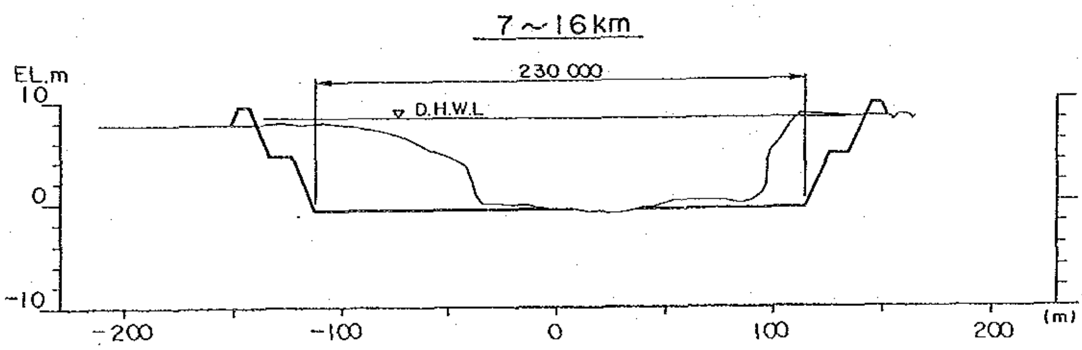
Fig.VI-3-7 PROPOSED ALIGNMENT OF RIVER IMPROVEMENT PLAN

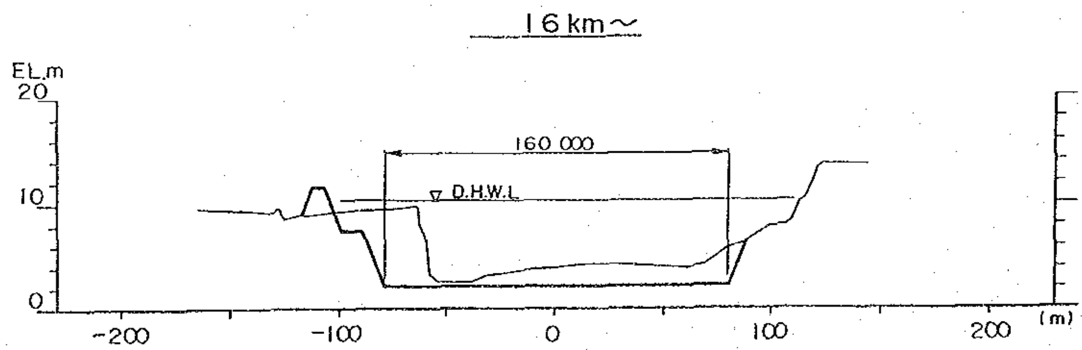


THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-8 DESIGN LONGITUDINAL PROFILE OF ILOG RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

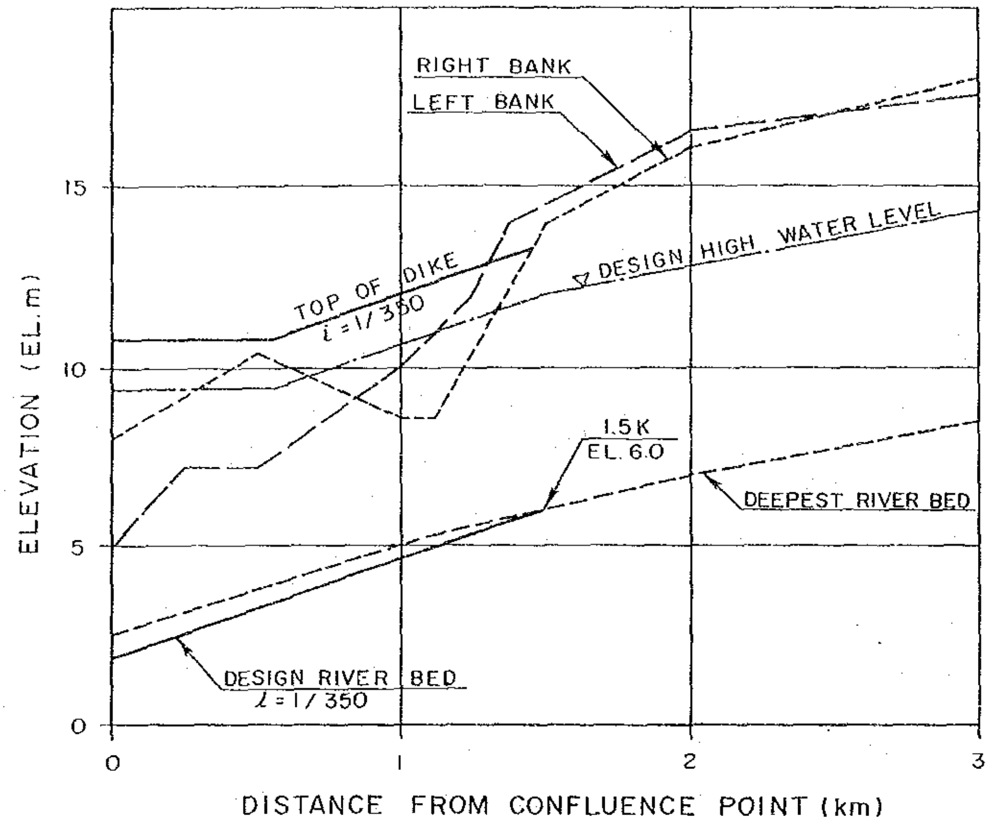
ILOG RIVER



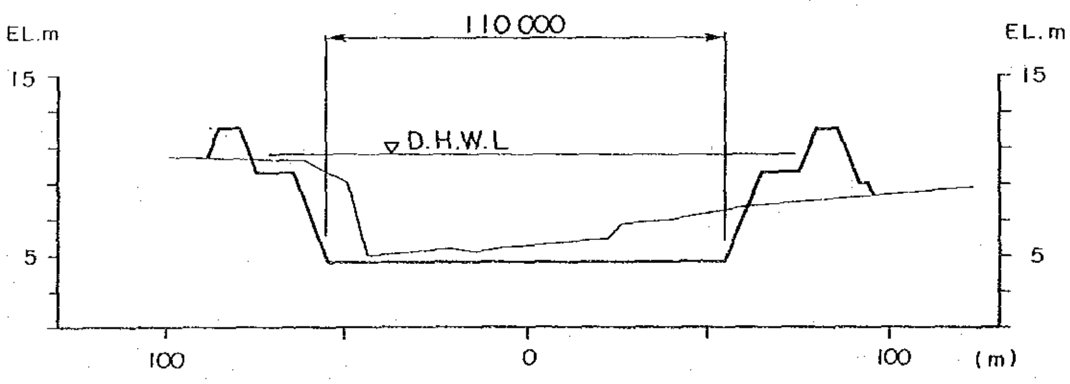




THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-9 DESIGN CROSS SECTION OF ILOG RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

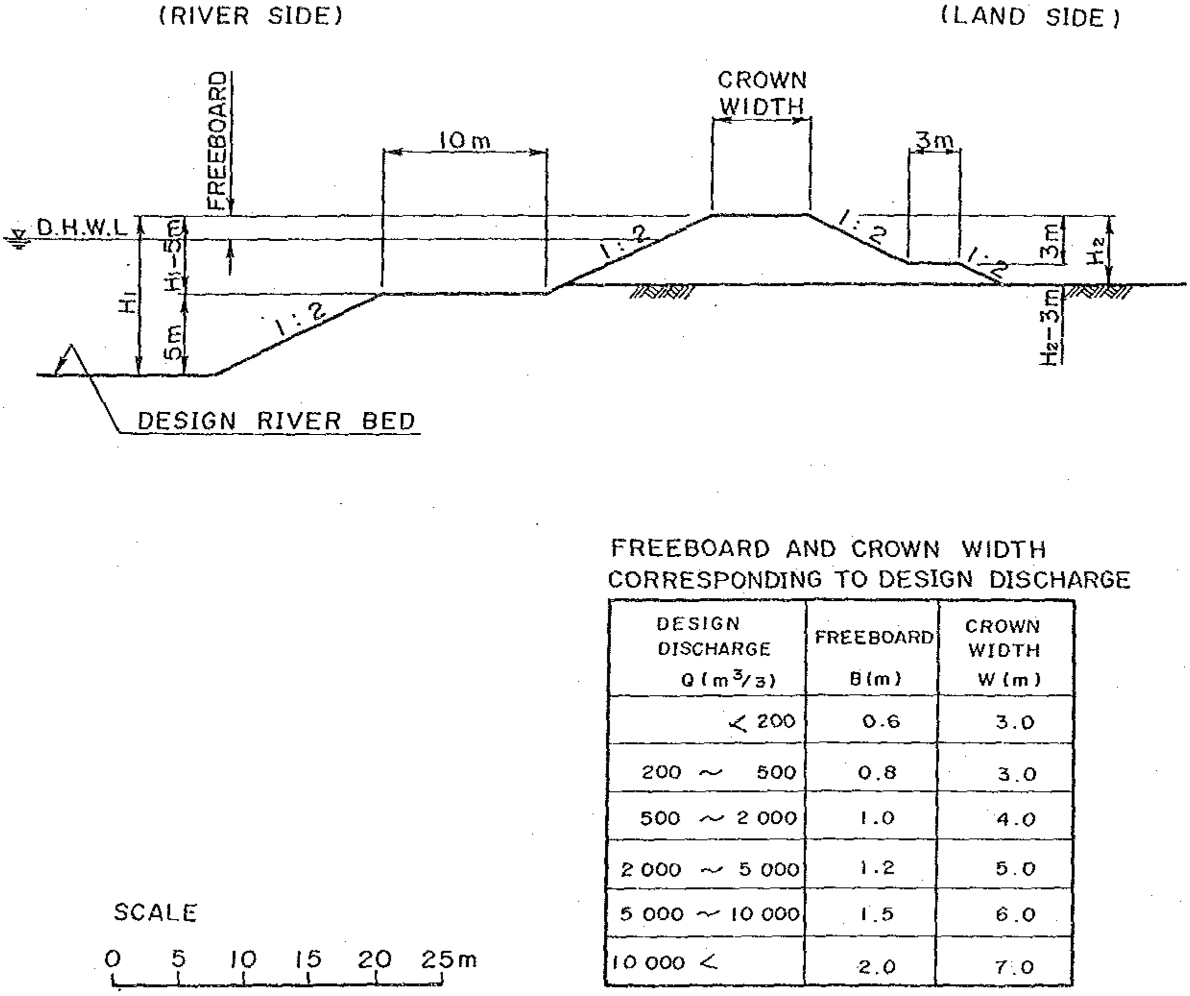


LONGITUDINAL PROFILE



DESIGN CROSS SECTION

THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-3-10 DESIGN LONGITUDINAL PROFILE AND DESIGN CROSS SECTION OF HILABANGAN RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



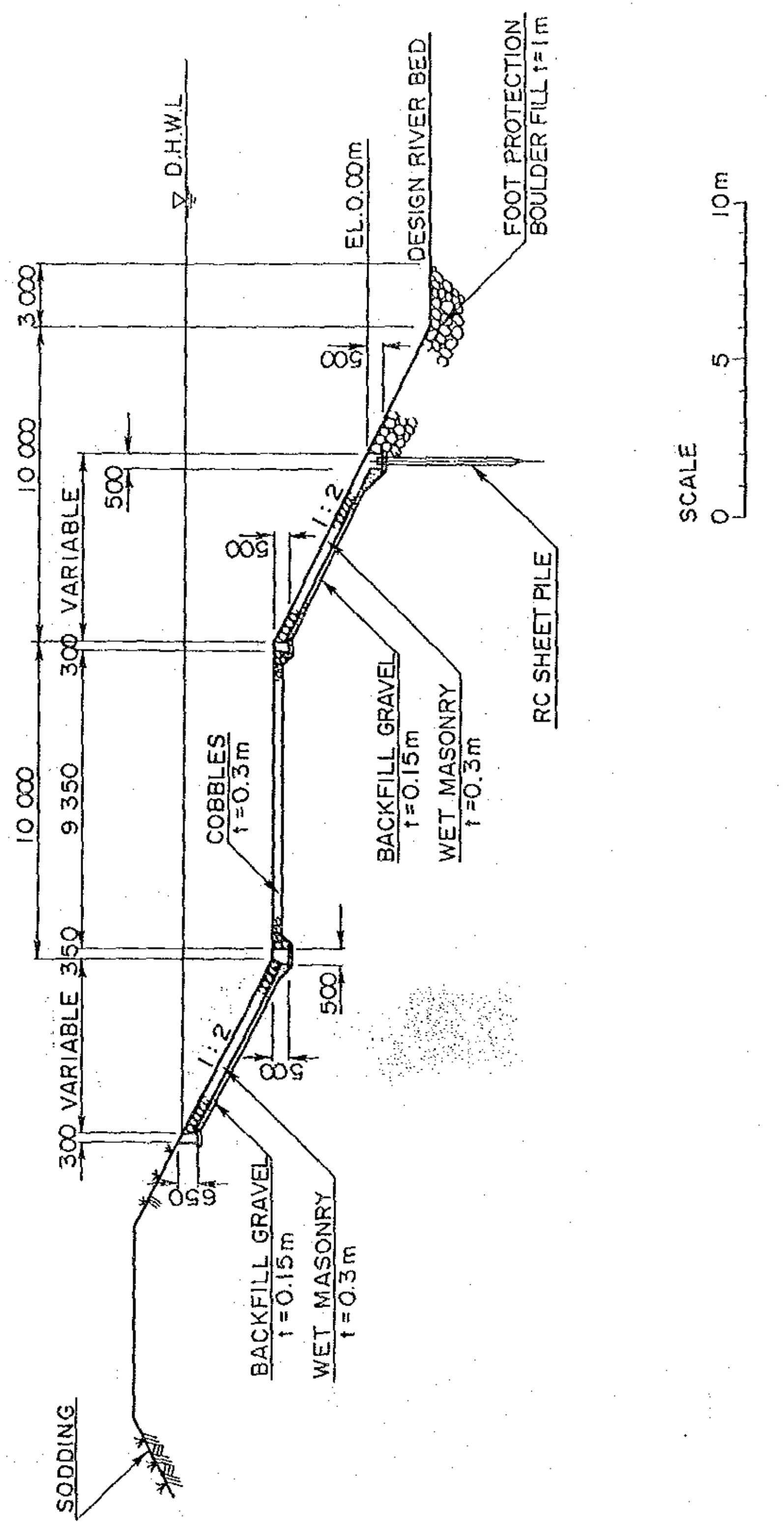
FREEBOARD AND CROWN WIDTH
CORRESPONDING TO DESIGN DISCHARGE

DESIGN DISCHARGE Q (m³/s)	FREEBOARD B (m)	CROWN WIDTH W (m)
< 200	0.6	3.0
200 ~ 500	0.8	3.0
500 ~ 2 000	1.0	4.0
2 000 ~ 5 000	1.2	5.0
5 000 ~ 10 000	1.5	6.0
10 000 <	2.0	7.0

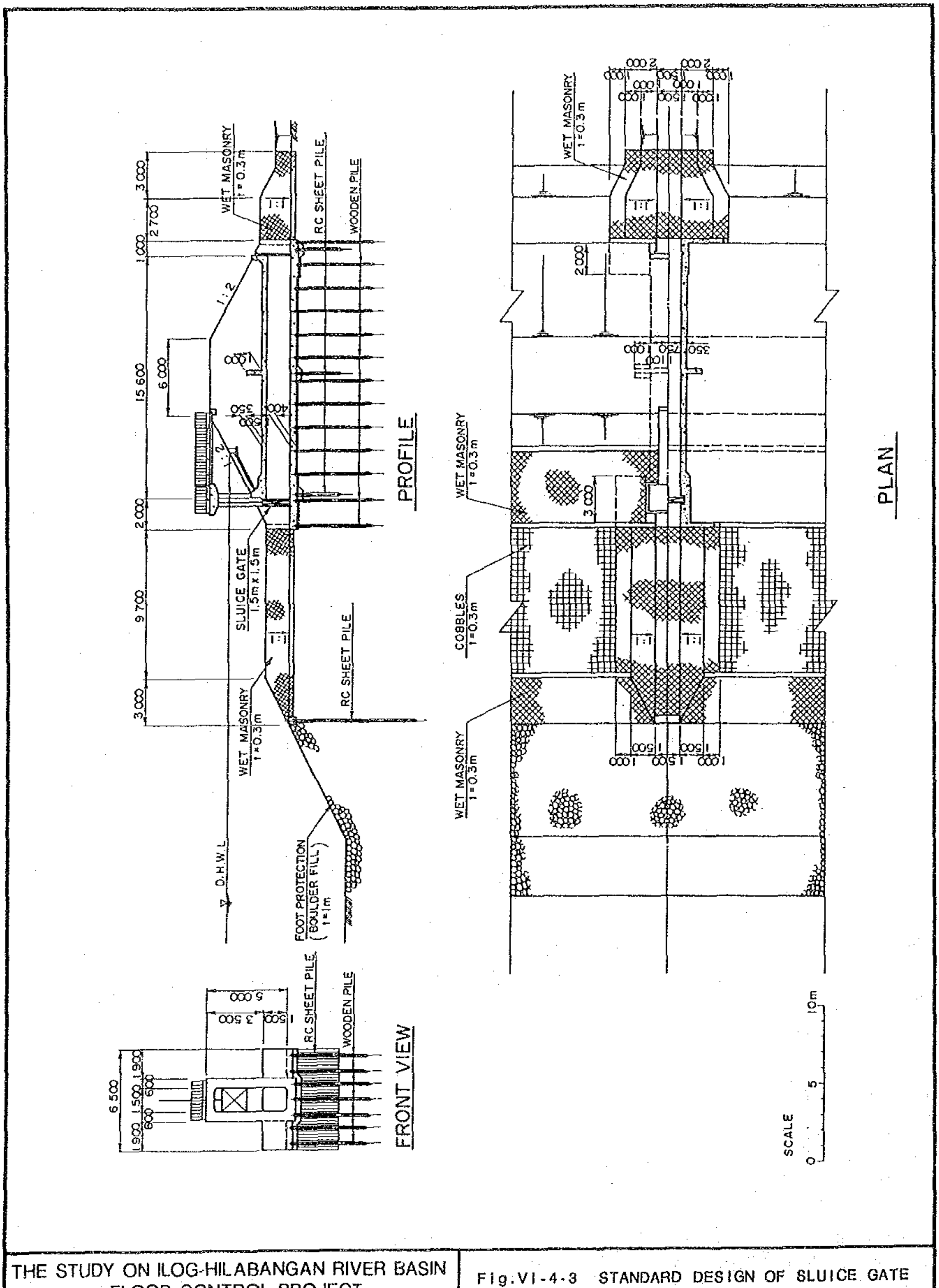
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

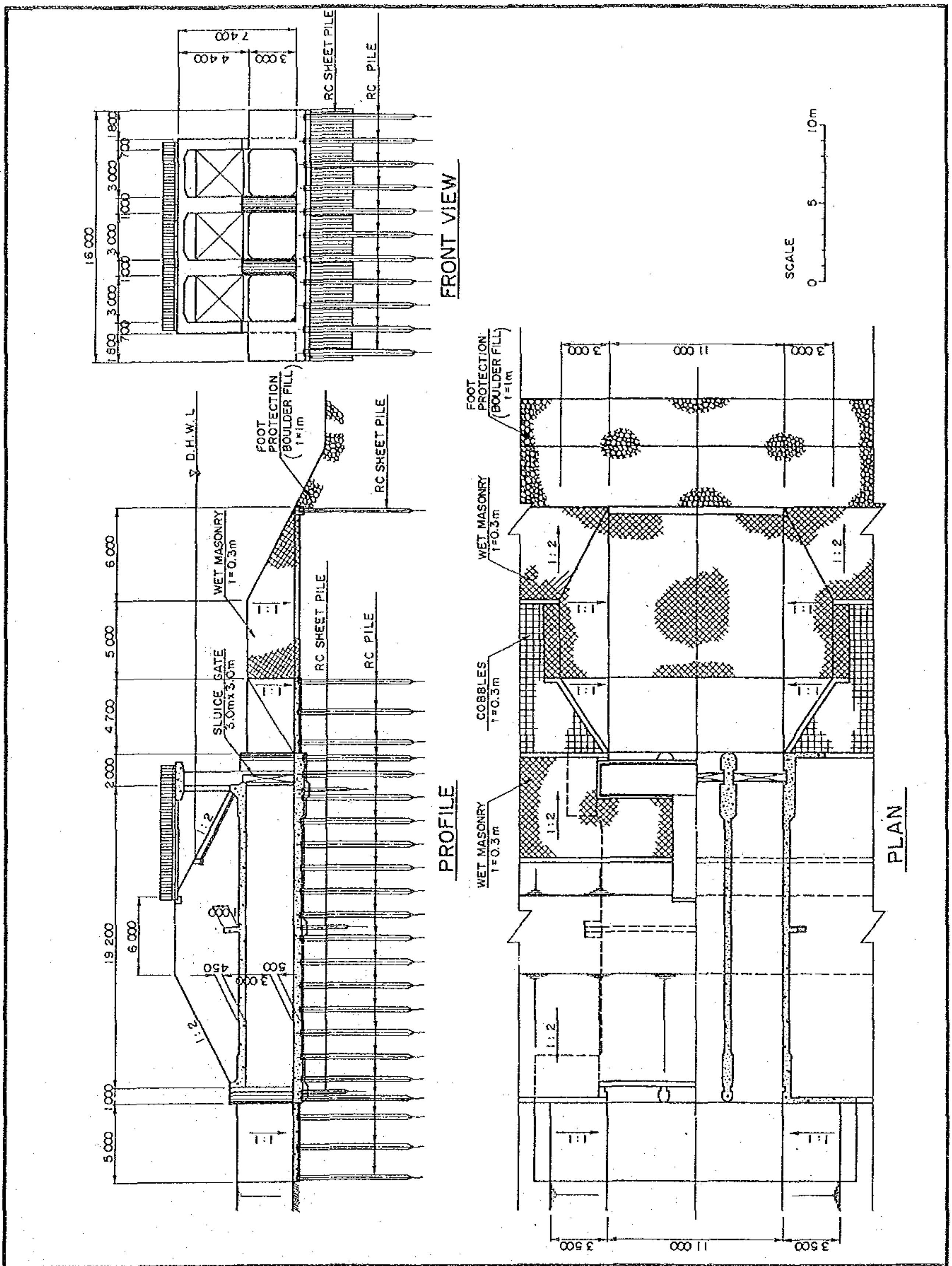
Fig.VI-4-1 STANDARD DESIGN SECTION OF RIVER DIKE



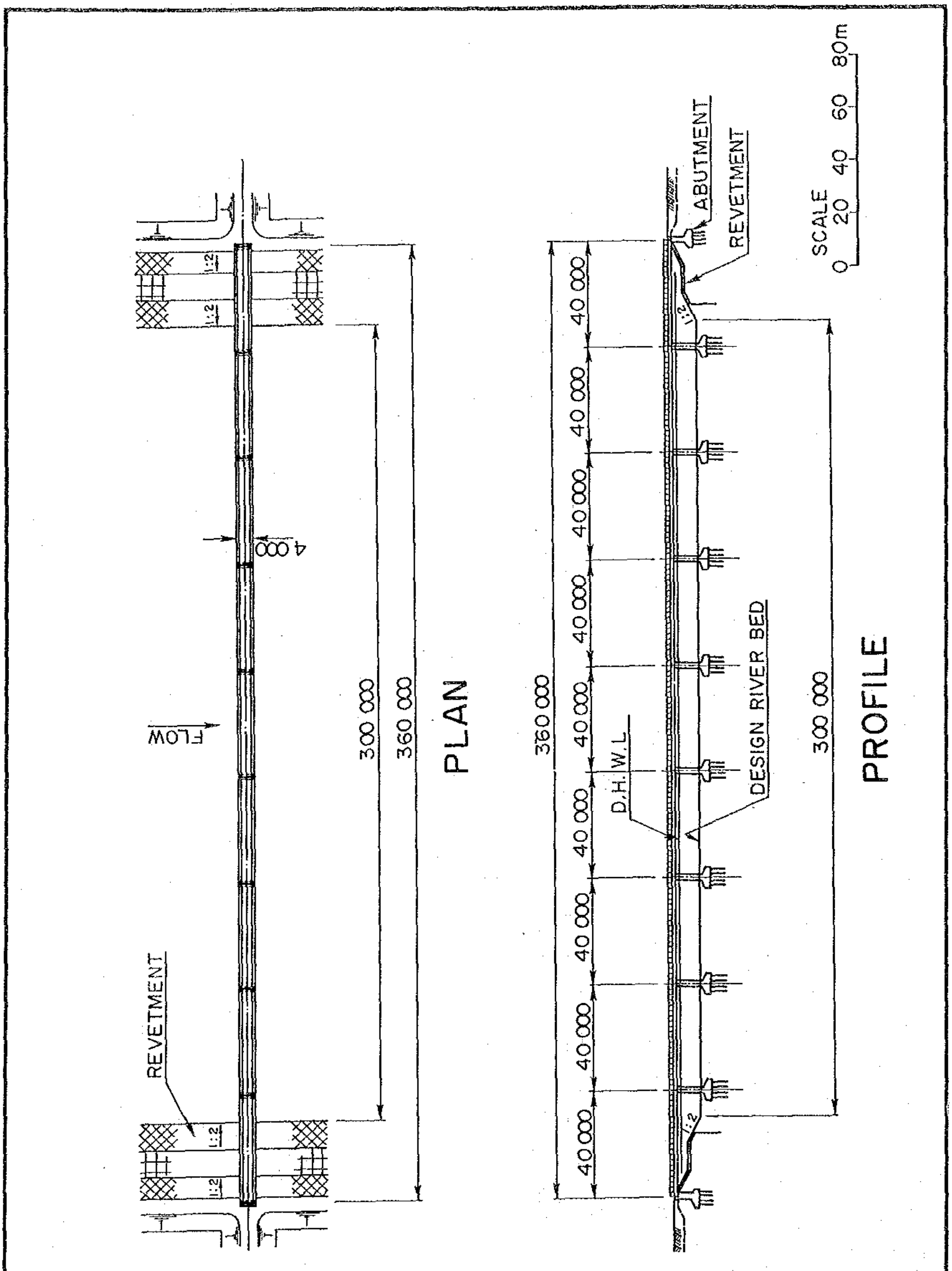
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-4-2 STANDARD DESIGN SECTION OF REVETMENT
JAPAN INTERNATIONAL COOPERATION AGENCY	



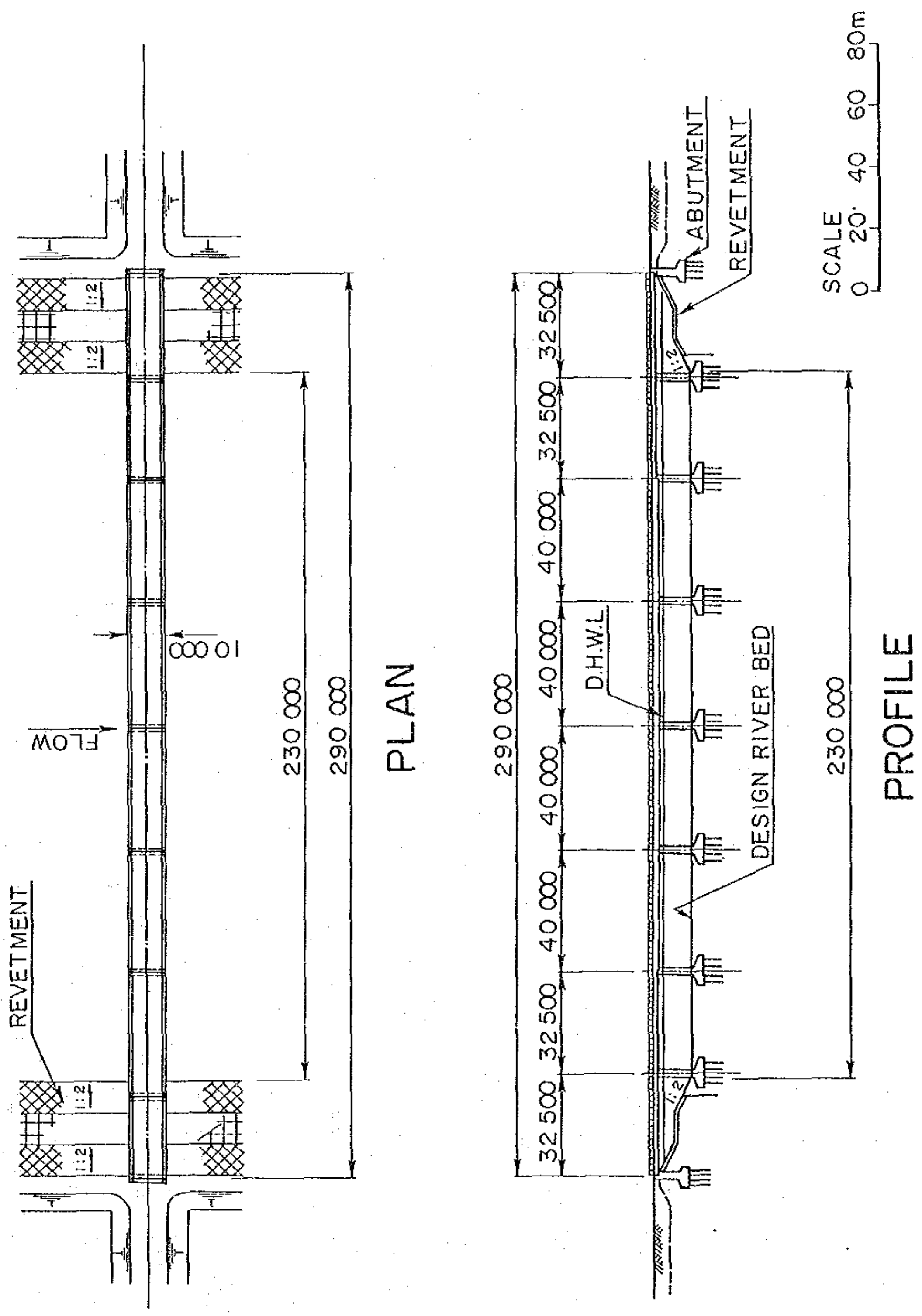
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-4-3 STANDARD DESIGN OF SLUICE GATE (TYPE A)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-4-4 STANDARD DESIGN OF SLUICE GATE (TYPE B)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-4-5 STANDARD DESIGN OF BUNGUL BRIDGE
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VI-4-6 STANDARD DESIGN OF TALUBANGI BRIDGE
JAPAN INTERNATIONAL COOPERATION AGENCY	

VII. DAM PLANNING

STUDY

ON

ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

SUPPORTING REPORT VII. DAM PLANNING

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1. STUDY ON DAM SITES

1.1 Previous Studies

In 1966, the United States Bureau of Reclamation (USBR) conducted the study on the Ilog-Hilabangan River Basin for water resources development such as irrigation, and hydroelectric power generation integrated with the regulation of the rivers for flood control. The location, approximate catchment area and potential height of dam for each site are tabulated as follows:

Dam	Location N. Lat.	Location E. Long.	Catchment Area (km^2)	Potential Height (m)
Ilog No. 1	9°52'	122°51'	1,389	100
Ilog No. 2	9°46'	122°51'	264	70
Hilabangan No. 1	9°58'	122°55'	371	90
Hilabangan No. 2	9°56'	122°57'	324	240

The above four (4) dam and reservoir sites having favorable topography were identified on the maps with a scale of 1:50,000. Two (2) of these sites, Ilog No. 1 and Ilog No. 2, were inspected on the ground by a team of engineers and geologists.

In 1979, the National Water Resources Council (NWRC) carried out the study of the framework plan on the Ilog-Hilabangan River Basin. Multipurpose development plans on the above-mentioned four (4) dam and reservoir sites were also proposed. The capacity of each reservoir and their high water level (elevation) are listed as follows:

Dam	Capacity (MCM)	HWL (m)
Ilog No. 1	3,000	100
Ilog No. 2	260	140
Hilabangan No. 1	14	120
Hilabangan No. 2	820	320

1.2 Screening of Dam Sites

Preliminary Selection of Dam Sites

Dam sites in the river basin were examined through the topographical maps (1:250,000, 1:50,000 and 1:10,000), geological maps (1:1,000,000 and 1:250,000), aerial photographs and previous studies. Various conceivable dam sites for the project were selected in view of the relatively favorable topographic condition for dam construction and reasonable storage capacity to be obtained thereat.

Following the selection of the conceivable dam sites in the river basin, screening of these dam sites was made, aiming to exclude those for which the detailed evaluation is considered unnecessary. The screening of dam sites was made on the following basis:

(1) Flood Control Effect

It is desirable that dam sites are located close to the objective area to assure a more flood regulation effect by the dam.

(2) Water Resources Development

It is desirable that the dam sites can assure a sufficient storage capacity to meet the water resources requirement in the basin.

(3) Geological Condition

In the basin where a high dam may not be practical because of widespread limestone, it is necessary to examine the possibility of low dams with a bigger storage capacity.

Finally, five possible dam sites were preliminarily selected as follows (refer to Fig. VII-1-1):

(1) I1 Site (Ilog No. 1) upper
(2) I1 Site (Ilog No. 1) lower
(3) I2 Site (Ilog No. 2)
(4) H1 Site (Hilabangan No. 1)
(5) H2 Site (Hilabangan No. 2)

The storage capacity curve of each site was worked out based on the topographic map of 1:10,000 and shown in Fig. VII-1-2.

Screening of the Selected Dam Sites

Geological surface survey was carried out at five (5) possible dam sites selected by the first screening, Ilog No.1 lower (I1 lower), Ilog No.1 upper (I1 upper), Ilog No.2 (I2), Hilabangan No.1 (H1) and Hilabangan No.2 (H2) in order to comprehend the outline of the geological conditions of each dam site. (Refer to Fig. VII-1-3.)

The following geological conditions were found based on the survey results. The Ilog No.1 lower, Ilog No.1 upper, and Hilabangan No.1 dam sites are underlain by volcanic clastic rocks composed of tuff breccia interbedded with sandstone, siltstone and tuff. Meanwhile, Ilog No.2 and Hilabangan No.2 dam sites are underlain by hard, porous limestone. Since dam sites on limestone zone generally cause leakage problems, it is not recommendable to propose dams at the Ilog No.2 and Hilabangan No.2 dam sites, and thus, these were eliminated for the further study.

2. SELECTION OF THE OPTIMUM DAM SITES

2.1 Geological Condition

In addition to the geological surface survey of dam sites, exploratory core drilling and geological surface survey were carried out for the selected three dam sites/reservoirs, except for drilling at Ilog No.1 lower which is considered unnecessary because of its low dam height. Their geological conditions were observed as follows.

2.1.1 Dam Site

Ilog No.1 Upper and Lower Dam Site

The bed rock of the Ilog No.1 upper dam site is largely composed of tuff breccia and tuff. The permeability of the bed rock including unconsolidated portion is relatiely low; less than 7 Lugeon. The right and left sides of the dam site are moderately weathered to a depth of 7 m from the ground surface. The unconfined compressive strength of samples taken from the drilling core ranges from 76.5 to 323.7 kg/cm^2. This figure verified that the strength of volcanic clastic rocks is relatively low, and the bed rocks are classified as "Low" and "Very Low" strength class.

The Ilog No.1 lower dam site has almost the same geological conditions as the Ilog No.1 upper dam site.

Hilabangan No.1 Dam Site

The geological features of the Hilabangan No.1 dam site are similar to those of the Ilog No.1 dam sites, but the permeability of uncosolidated to moderately consolidated part of the left side shows a high value of over 100 Lugeon. The unconsolidated alluvium deposits composed of sand and gravel overlay the bed rock of river bed with a thickness of 14 m approximately.

The unconfined compressive strength ranges from 85.4 to 165.9 kg/cm^2. Thus, the bed rocks of the Hilabangan No.1 dam site are classified as "Low" to "Very Low" strength class. The results of exploratory core drilling is compiled in Volume III Data Book.

2.1.2 Reservoir Area

Ilog No.1 Upper and Lower Dam Sites

The bedrocks of the Ilog No.1 upper and Ilog No.1 lower reservoir areas are composed of volcanic clastic rocks and limestone. The lithological components of clastic rocks are similar to the Ilog No.1 upper dam site. The limestone is soft to moderately hard, highly porous coralline or marly rock. In the eastern part of the reservoirs, the limestone body extends from the south (upper reaches) to the north (lower reaches). The upper course of the Ilog River is flanked by the limestone area. Several sinkholes and caves are commonly observed in the limestone zone of the reservoir area. The limestone area as shown in Fig. VII-2-1 is deemed to be distributed higher than EL.25 m of the riverbed. Leakage of impounded water through the limestone may be expected and cause problems in view of the distribution of limestone.

No remarkable land slide area can be found in the reservoir area of these two dam sites.

Hilabangan No.1 Dam Site

The bedrock of Hilabangan No.1 reservoir is mainly composed of volcanic clastic rocks which are similar to those of the Hilabangan No.1 dam site; however, limestone is partially found. The limestone area as shown in Fig. VII-2-2 is deemed to be distributed higher than EL.150 m of the riverbed, approximately up to the Hilabangan No.2 dam site. The limestone is crystalline to sandy, containing a few marly limestone lenses. The crystalline to sandy limestone is generally harder than that spreading at the Ilog No.1 lower and Ilog No.1 upper reservoir areas; however, solution cavities may be formed, judging from the existence of sinkholes in the area.

No remarkable landslide area can be found in the reservoir area of this dam site.

2.2 Possibility of Dam Construction

The possibility of dam construction was studied in due consideration of the geological data aforementioned and topographical conditions at each site.

Ilog No. 1

(1) Upper Dam Site

Approximately 80 meters of dam height is possible judging from the following conditions of the dam site.

(a) There is no particular problem in the dam foundation from the geological point of view.

(b) The topography of the dam site and the reservoir area allows the dam up to that height.

However, leakage may cause many problems because the porous limestone zone is widely distributed in the reservoir area. The limestone zone is deemed to be distributed higher than EL.25 m. The proposed dam site is located at about EL.10 m of the riverbed. In case the high water level of the reservoir is higher than EL.15 m (total storage capacity: 15 MCM), therefore, special provision has to be made to protect the water leakage and accompanying effects to the surroundings.

(2) Lower Dam Site

Judging from the topographical condition and geological survey, approximately 35 m of dam height is possible. However, as in the case of the upper site, when the high water level of the reservoir exceeds EL.25 m (total storage capacity: 77 MCM), leakage countermeasures are required. The lower site has an advantage over the upper site because of its larger storage capacity.

Hilabangan No. 1

Leakage is expected through the porous limestone zone widely distributed in the reservoir area. The limestone zone is deemed to be distributed above EL.150 m, approximately up to the Hilabangan No.2 dam site. The riverbed elevation of the Hilabangan No.1 dam site is around 70 m, and therefore, a dam higher than 80 m (total storage capacity: 56 MCM) requires a provision for leakage and its accompanying effects to the surroundings.

2.3 Comparative Study of the Dam Sites

As noticed in the preceding section 2.2, the geological condition of the reservoir area of three dam sites possibly has water leakage problem. Therefore, these dam sites are not expected to provide enough storage capacity to be used as a multi-purpose dam, while dam is one of the applicable measure for flood control.

In this connection, a comparative study was conducted to select the optimum dam site for flood control purpose which is used for further comparative study with the other applicable measure, river improvement, discussed in the sectoral report of Flood Control.

Basic Condition for Comparison

(1) Dam Type

Rockfill type dam is applied for three dam sites judging from the following conditions:

(a) The foundation rock composed of volcanic clastic rocks s classified as "Low" to "Very Low" strength class according to the results of the unconfined compressive tests. Under such condition of the foundation, a concrete dam of considerable size will be technically inappropriate to be constructed due to insufficient strength against sliding, and will not also be economically justifiable. Fill type dam, in general, exerts its load from the dam on the broader area of foundation than that for concrete dam, and therefore, it is less subject to the foundation strength.

(b) Unconsolidated portion exists irregularly in the foundation rock. Therefore, such condition of the foundation is not suitable for a concrete dam.

(c) From the topographic point of view, a spillway can be located on thebank of the dam site where a gentle ridge extends.

(d) Embankment materials are available in the vicinity of the dam site.

(2) Design Flood Discharge

The spillway is designed to pass the design flood discharge, which is calculated at 1.2 times the peak discharge with a 200-year return period as shown below.

Dam Site	Design Flood Discharge (m^3/s)
Ilog No.1 Lower	6,000
Ilog No.1 Upper	5,700
Hilabangan No.1	3,400

(3) Dam Slope

Dam body slopes are assumed to be 1:3.0 for the upper side and 1:2.5 for the lower side.

(4) Protection Work for Water Leakage

As stated in the preceding section, the Ilog No.1 upper and lower reservoir areas at approximately above EL.25 m cover the very porous limestone zone which is likely to cause leakage problems to the surrounding areas. As the protection work for water leakage, concrete channels above EL.25 m along the river course in the reservoir are provided. As for the Hilabangan No.1 dam site, such works are provided for the river channel above EL.150 m.

(5) Provision of Storage Capacity for Sedimentation

The required sedimentation capacity is estimated in the following condition:

(1) The sediment volume is based on the accumulated volume for 50 years employed for several dams constructed in this country.

(2) Specific sediment volume of 650 $m^3/km^2/year$ is adopted with reference to the observed data at Dahile in the Ilog River.

Consequently, the required sedimentation capacity is estimated as follows:

Dam Site	Catchment Area (km2)	Design Sediment Volume (MCM)
Ilog No.1 Lower	1,430	46
Ilog No.1 Upper	1,365	44
Hilabangan No.1	368	12

In case of the Ilog No.1 upper and lower dam sites, a sediment control dam is considered in its upper reaches to lighten the rquired sediment capacity, since it is large compared with the required flood control capacity. This has an economic advantage over the case of providing sediment storage capacity at the dam sites without sediment control dam.

Therefore, a sediment control dam with a height of 30 m at the upper reaches of the Ilog No.1 lower dam site is proposed. The sediment storage capacity is about 37 MCM, though the sediment imbalance of 9 MCM and 7 MCM, coming from the remaining area sandwiched by the sediment control dam and the dam sites is detained in the Ilog No.1 lower and upper dam sites, respectively. The sediment control dam is of a concrete gravity type equiped with apron.

2.4 Selection of the Optimum Dam Site

To identify the most suitable dam site among the three dam sites, rough cost comparisons by effective storage capacity and regulation effect were made as shown in Tables VII-2-1 and VII-2-2, and Figs. VII-2-3 and VII-2-4, respectively. Judging from the figures, Ilog No. 1 lower dam site has an economical advantage over the other dam sites, while the number of house evacuation is not much different among the sites. Ilog No. 1 lower dam site is then proposed as one of the applicable measures for further alternative study for flood control. For further comparative study, relation between the regulation effect and construction cost of Ilog No.1 lower dam was examined as shown in Fig. VII-2-5.

2.5 Conceptural Plan of Ilog No.1 Lower Dam Site

To clarify the features of the Ilog No.1 lower dam, a conceptural plan is set forth in Fig. VII-2-6.

TABLES

Table VII-2-1 COMPARISON OF ALTERNATIVE CASES OF DAM AND RESERVOIR

Item	Unit	Damsite									
		Ilog No.1 Upper Site			Ilog No.1 Lower Site					Hilabangan	
Catchment Area	km2	1,365			1,430					368	
High Water Level	EL. m	30	35	40	20	25	30	35	40	130	150
Storage Capacity	MCM	40	65	107	40	77	130	194	270	26	56
Effective Capacity	MCM	33	58	100	31	68	121	185	261	14	44
Sediment Volume	MCM	7	7	7	9	9	9	9	9	12	12
Dam Height	m	33.60	38.60	43.60	29.00	34.00	39.00	44.00	49.00	81.00	101.00
Dam Volume	MCM	0.60	0.70	0.84	0.55	0.82	1.12	1.80	2.32	2.35	4.30
Construction Cost *1	mil.P.	4,050	9,930	18,760	1,590	1,810	4,480	10,850	20,000	2,390	4,020
Dam	mil.P.	380	440	530	350	520	710	1,130	1,460	1,480	2,700
Spillway	mil.P.	750	770	800	740	790	850	1,000	1,110	910	1,320
Leakage Protection *2	mil.P.	2,420	8,220	16,930			2,420	8,220	16,930		
Sediment Control Dam *3	mil.P.	500	500	500	500	500	500	500	500		
House Evacuation	unit	195	225	265	85	150	220	255	300	10	15

Note *1 : Construction cost does not include compensation cost which is negligibly small compared with the total cost.
*2 : Concrete facing over the limestone zone up to the High Water Level.
*3 : Concrete gravity dam with a height of 30 m above the riverbed.

Table VII-2-2 REGULATED PEAK DISCHARGE FOR 100-YEAR RETURN PERIOD FLOOD BY FLOOD CONTROL CAPACITY

(1) Ilog NO.1 Lower Dam

Item	Unit	Flood Control Capacity (MCM)					
		10	15	35	67	107	149
High Water Level of Reservoir	EL.m	15.4	16.5	20.4	24.7	28.6	32.0
Regulated Peak Discharge at Reference Point	m3/s	5,230	4,890	3,820	2,790	2,270	2,080
Discharge Cut by Dam at Reference Point	m3/s	220	560	1,630	2,660	3,180	3,370

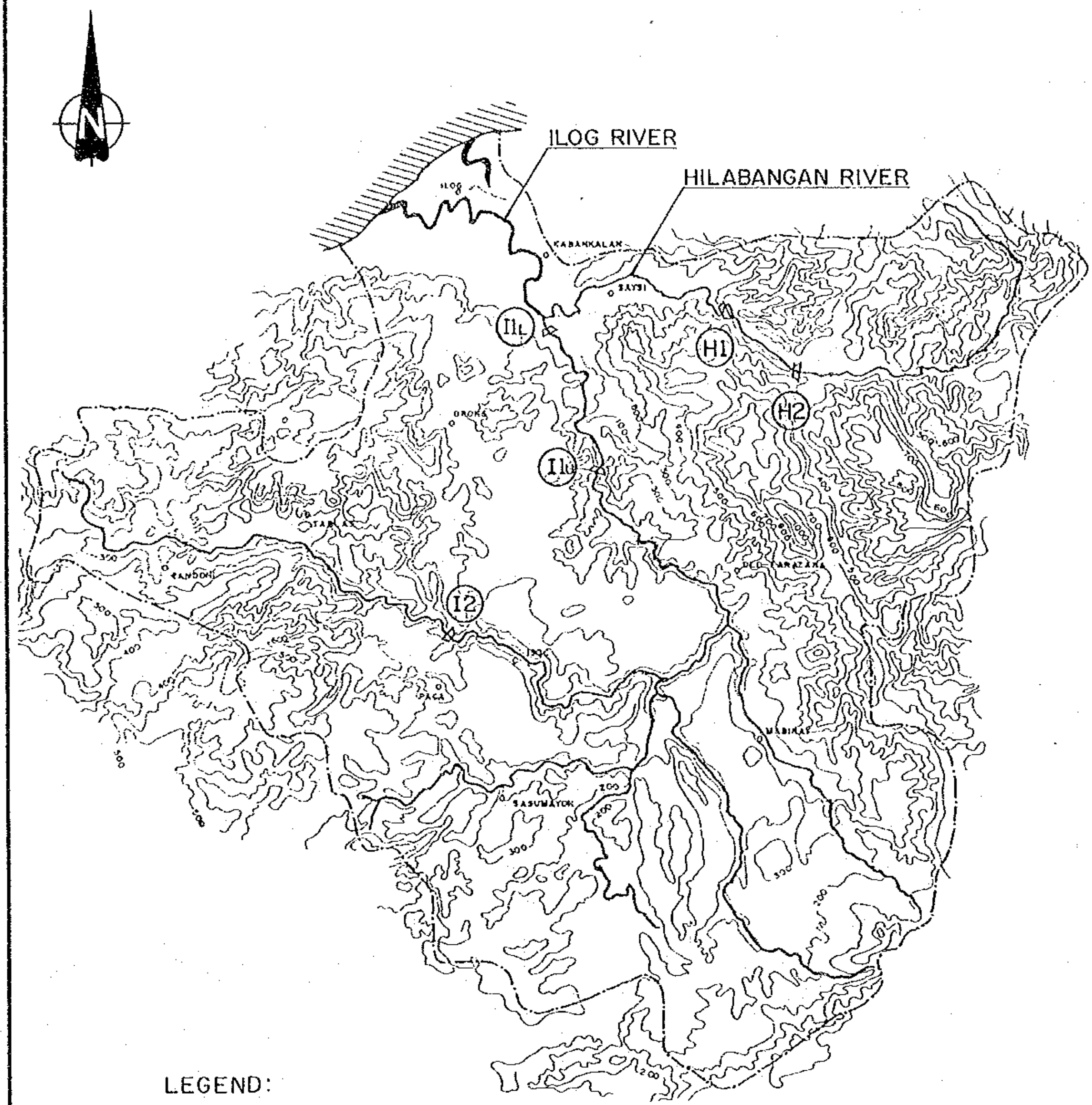
(2) Ilog NO.1 Upper Dam

Item	Unit	Flood Control Capacity (MCM)				
		30	47	80	117	167
High Water Level of Reservoir	EL.m	27.0	31.0	36.0	41.0	46.0
Regulated Peak Discharge at Reference Point	m3/s	4,260	3,500	2,700	2,400	2,170
Discharge Cut by Dam at Reference Point	m3/s	1,190	1,950	2,750	3,050	3,280

(3) Hilabangan NO.1 Dam

Item	Unit	Flood Control Capacity (MCM)			
		9	18	28	40
High Water Level of Reservoir	EL.m	125.9	133.4	140.0	147.6
Regulated Peak Discharge at Reference Point	m3/s	5,270	4,900	4,640	4,500
Discharge Cut by Dam at Reference Point	m3/s	180	550	810	950

FIGURES



LEGEND:

(H1) HILABANGAN No. I DAM SITE

(H2) HILABANGAN No.2 DAM SITE

(I1U) ILOG No. I DAM SITE (UPPER SITE)

(I1L) ILOG No. I DAM SITE (LOWER SITE)

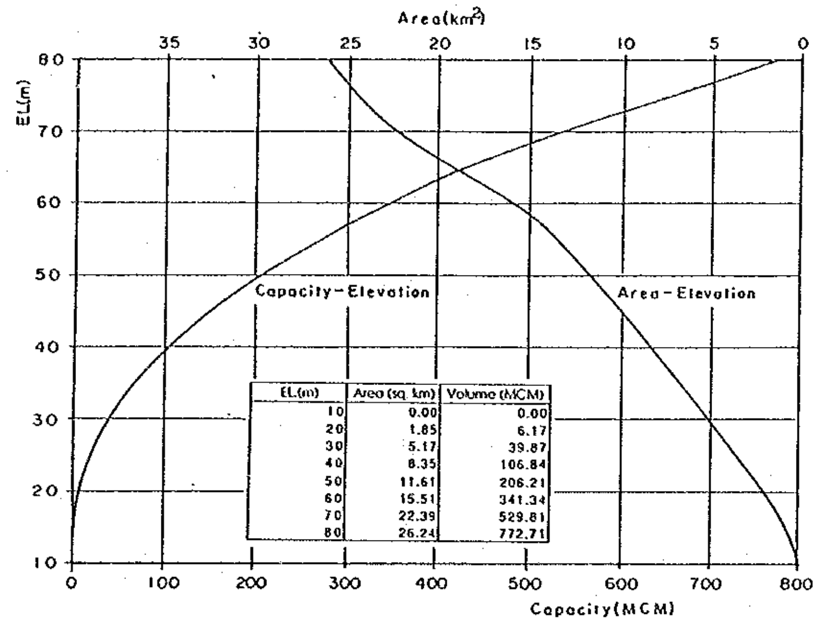
(I2) ILOG No. 2 DAM SITE

SCALE : 1/400,000

0 5 10 15 20 25 30km

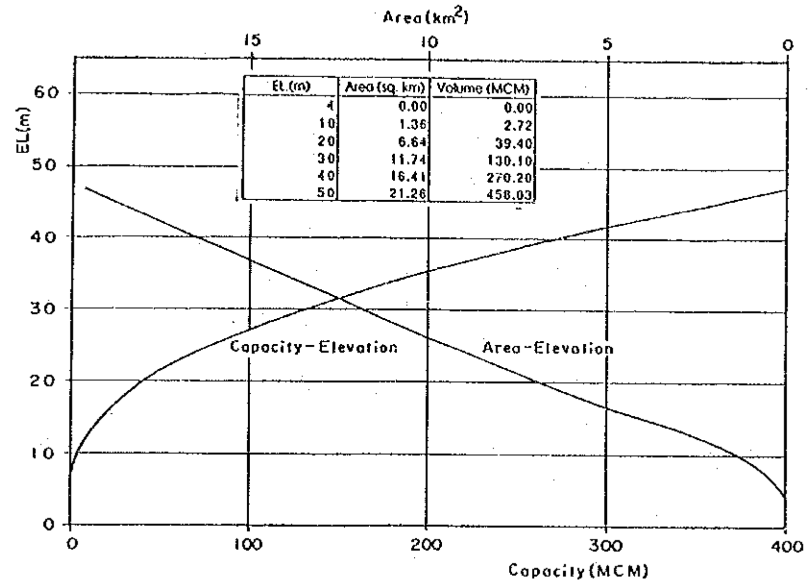
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-1-1 LOCATION OF POSSIBLE DAM SITES
JAPAN INTERNATIONAL COOPERATION AGENCY	

ILOG RIVER



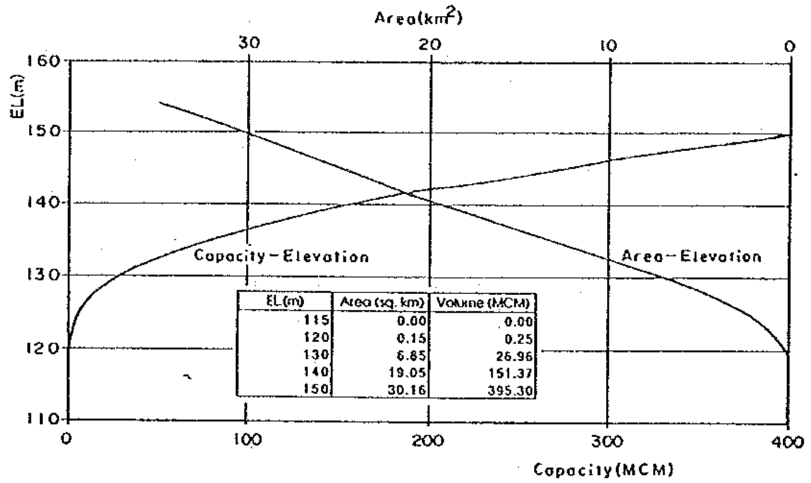
EL(m)	Area (sq. km)	Volume (MCM)
10	0.00	0.00
20	1.85	6.17
30	5.17	39.87
40	8.35	106.84
50	11.61	206.21
60	15.51	341.34
70	22.39	529.81
80	26.24	772.71

Ilog No.1 Upper



EL(m)	Area (sq. km)	Volume (MCM)
4	0.00	0.00
10	1.36	2.72
20	6.64	39.40
30	11.74	130.10
40	16.41	270.20
50	21.26	458.03

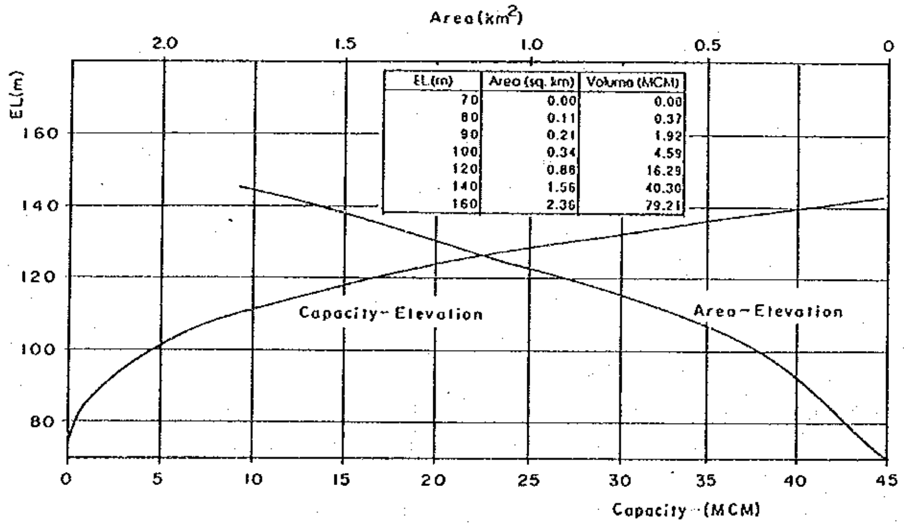
Ilog No.1 Lower



EL(m)	Area (sq. km)	Volume (MCM)
115	0.00	0.00
120	0.15	0.25
130	6.85	26.96
140	19.05	151.37
150	30.16	395.30

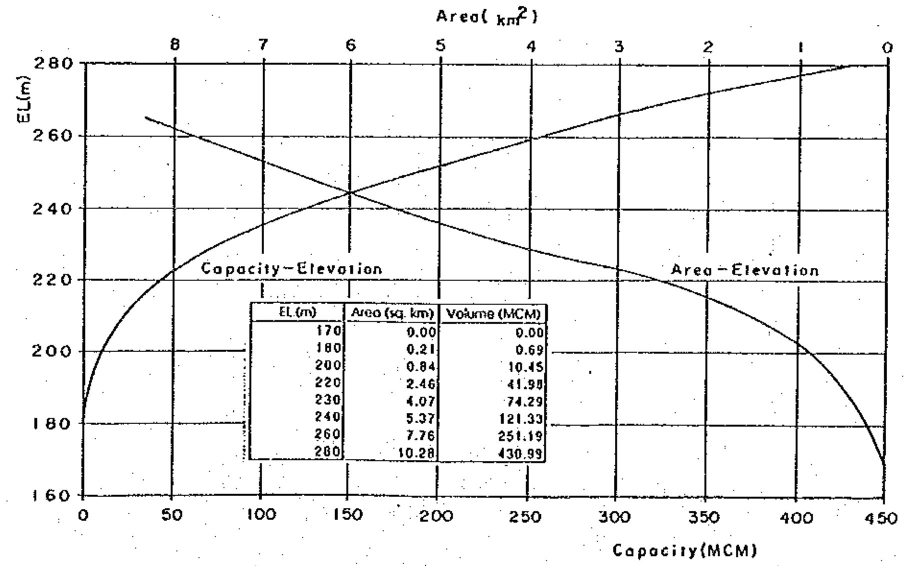
Ilog No.2

HILABANGAN RIVER



EL(m)	Area (sq. km)	Volume (MCM)
70	0.00	0.00
80	0.11	0.37
90	0.21	1.92
100	0.34	4.59
120	0.86	16.29
140	1.56	40.30
160	2.36	79.21

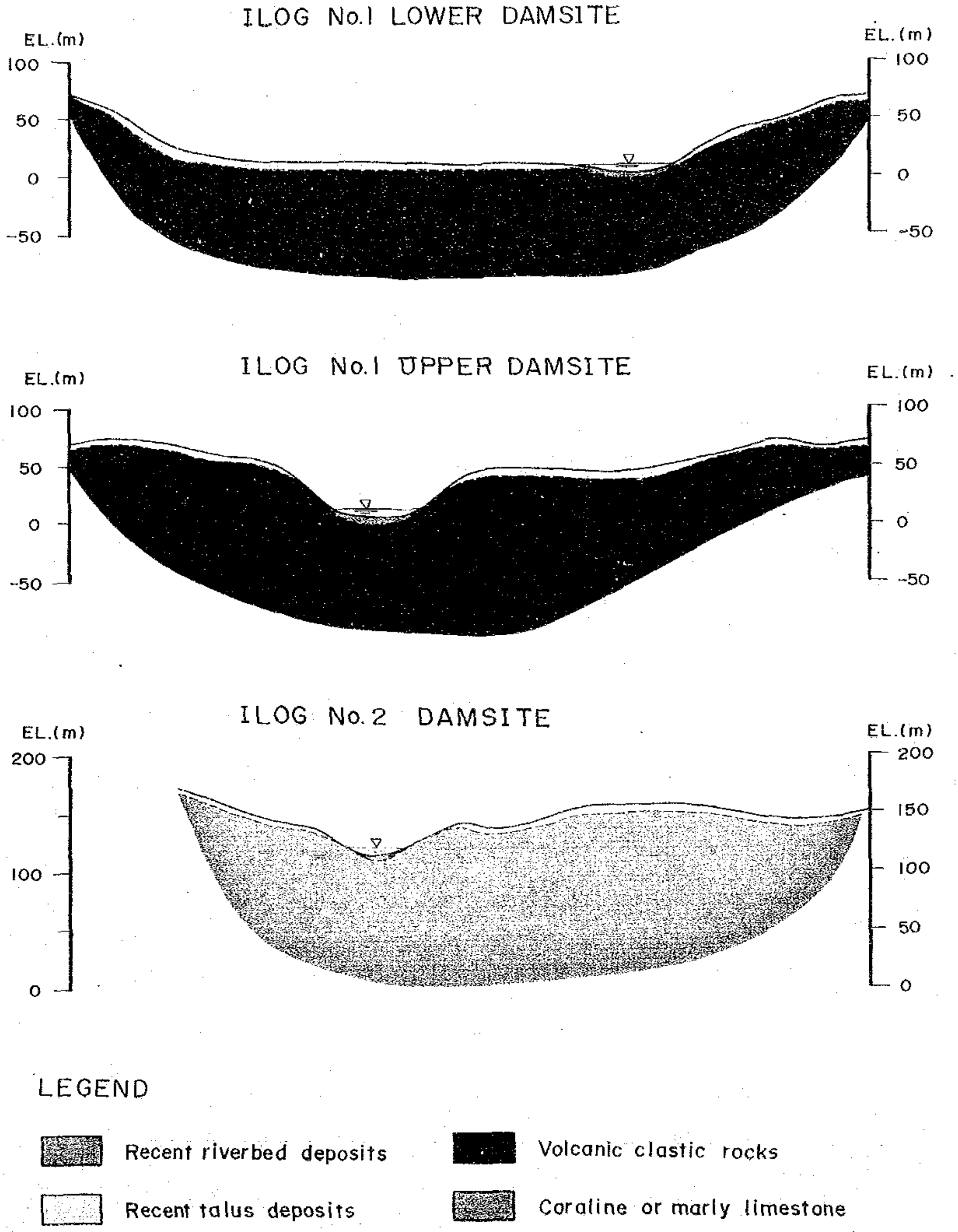
Hilabangan No. I



EL(m)	Area (sq. km)	Volume (MCM)
170	0.00	0.00
180	0.21	0.69
200	0.84	10.45
220	2.46	41.98
230	4.07	74.29
240	5.37	121.33
260	7.76	251.19
280	10.28	430.99

Hilabangan No. 2

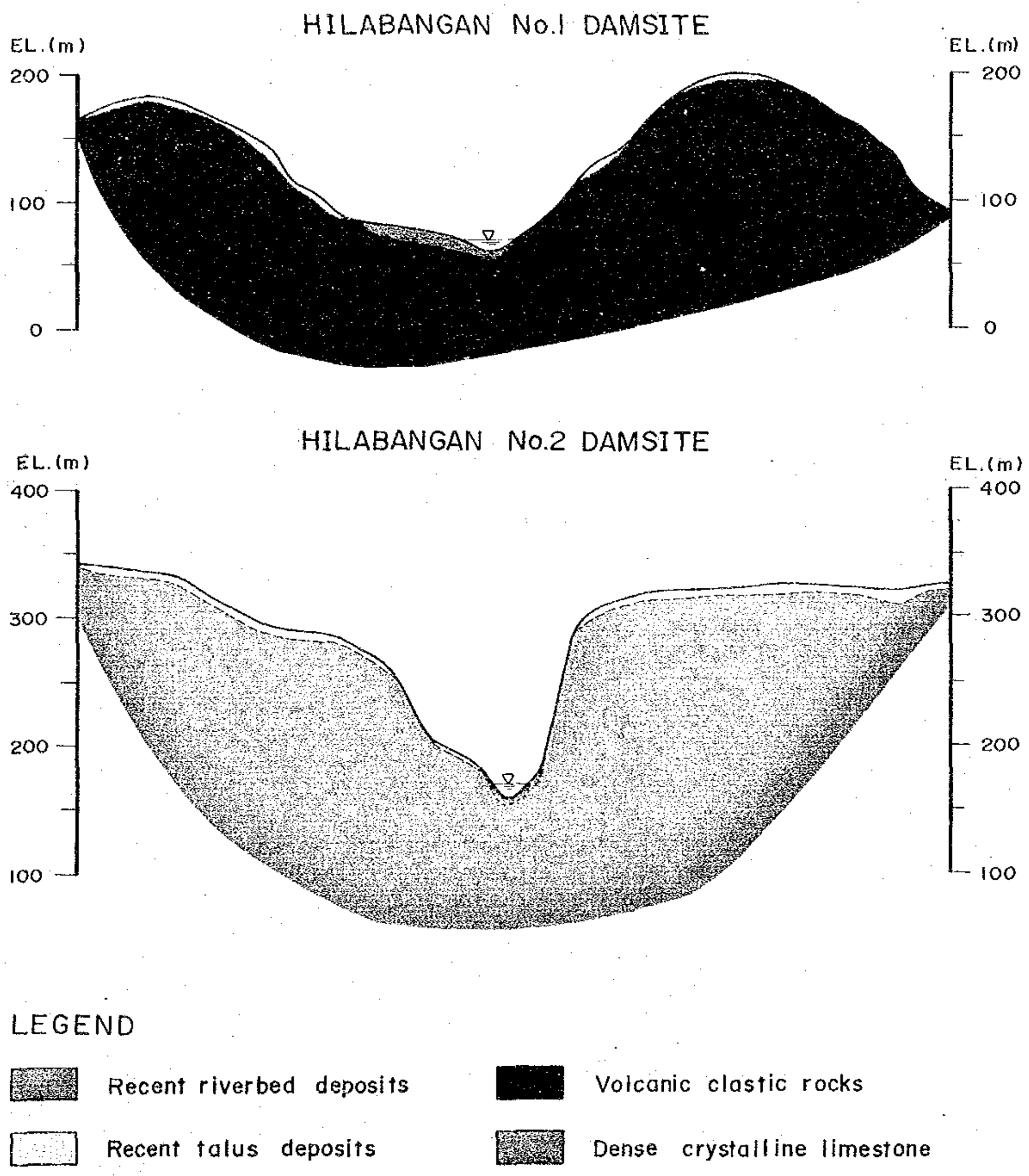
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-1-2 STORAGE CAPACITY-AREA CURVE
JAPAN INTERNATIONAL COOPERATION AGENCY	



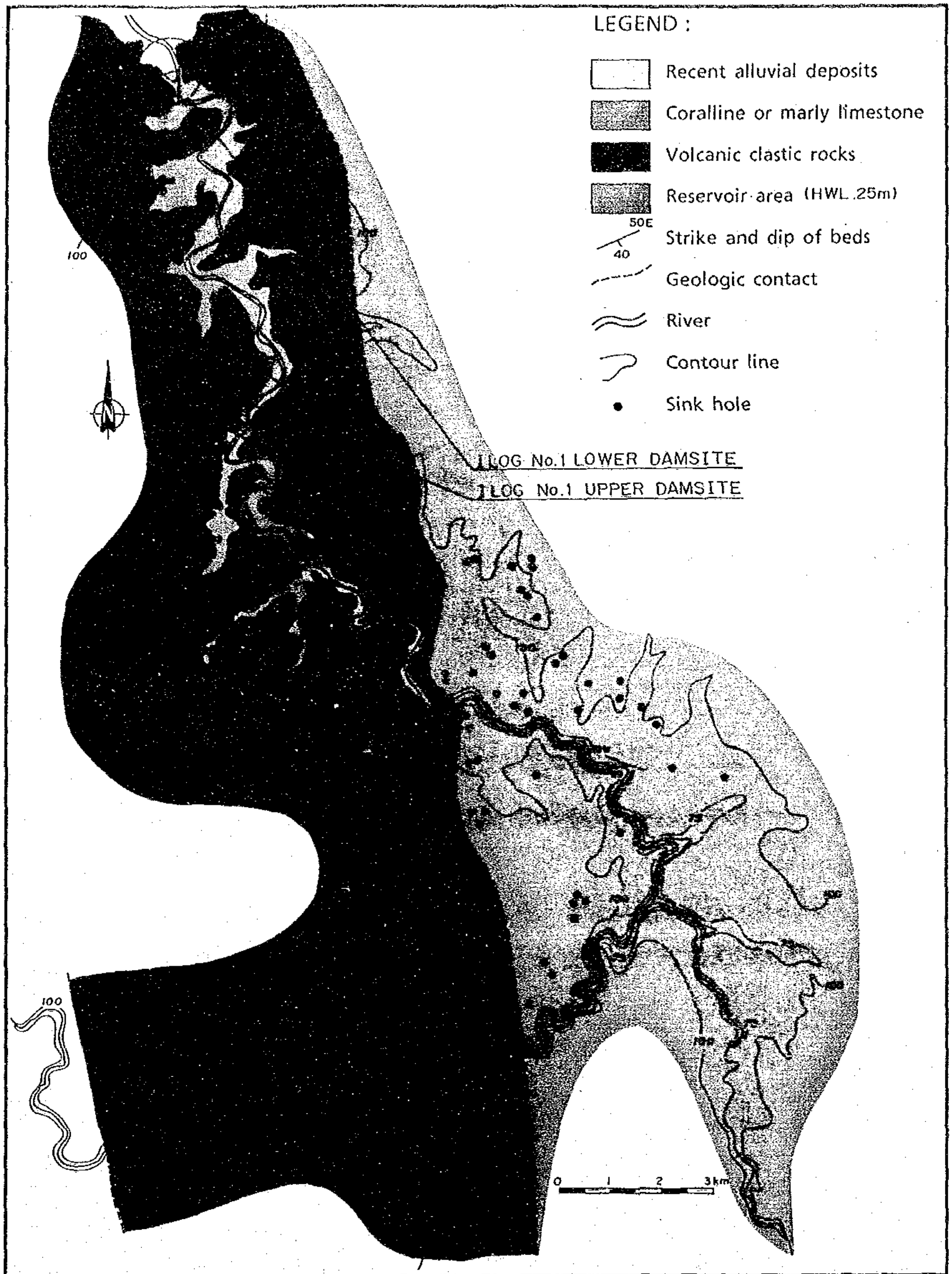
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

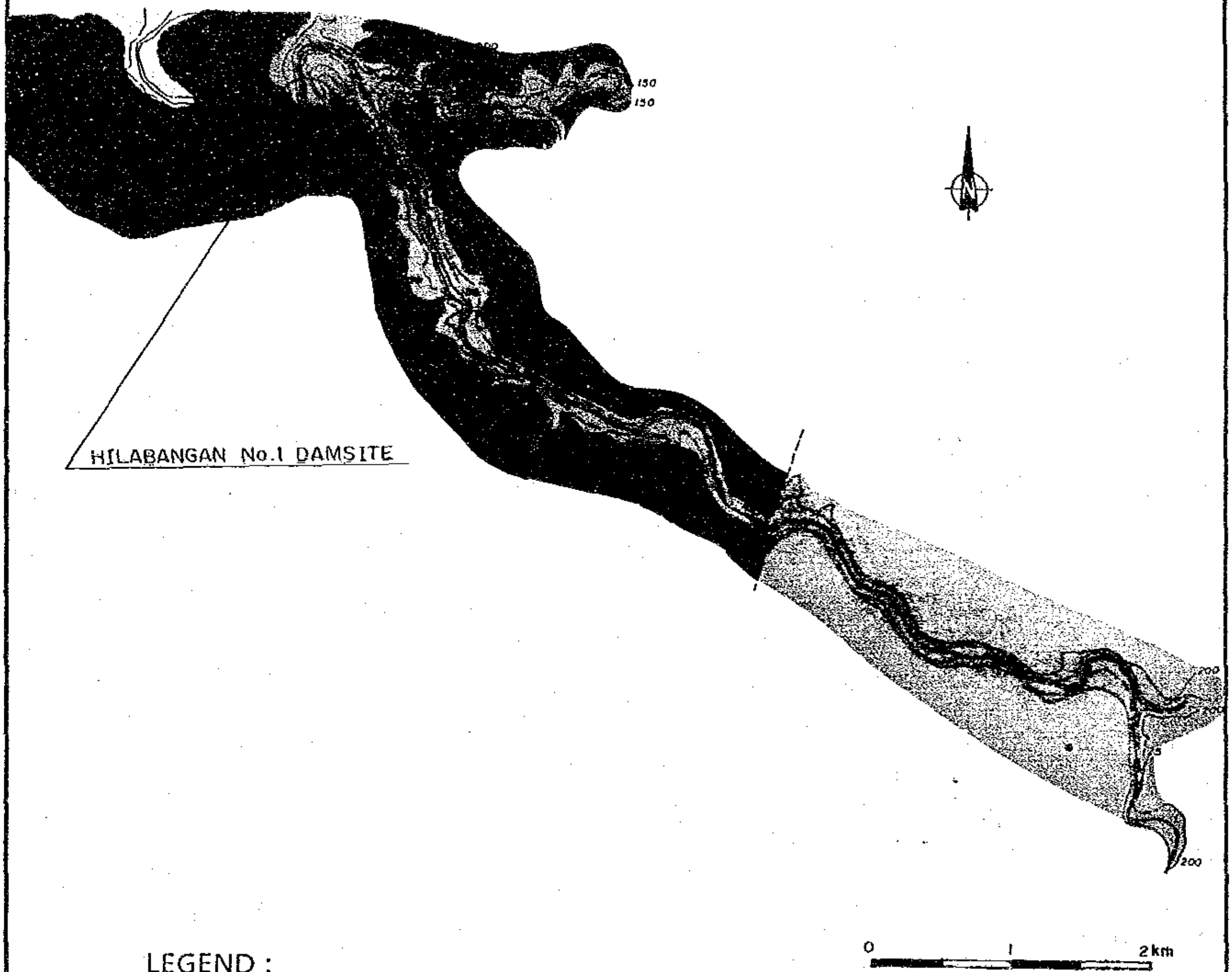
Fig.VII-1-3 GEOLOGIC SECTION OF DAM SITE (1/2)



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-1-3 GEOLOGIC SECTION OF DAM SITE (2/2)
JAPAN INTERNATIONAL COOPERATION AGENCY	



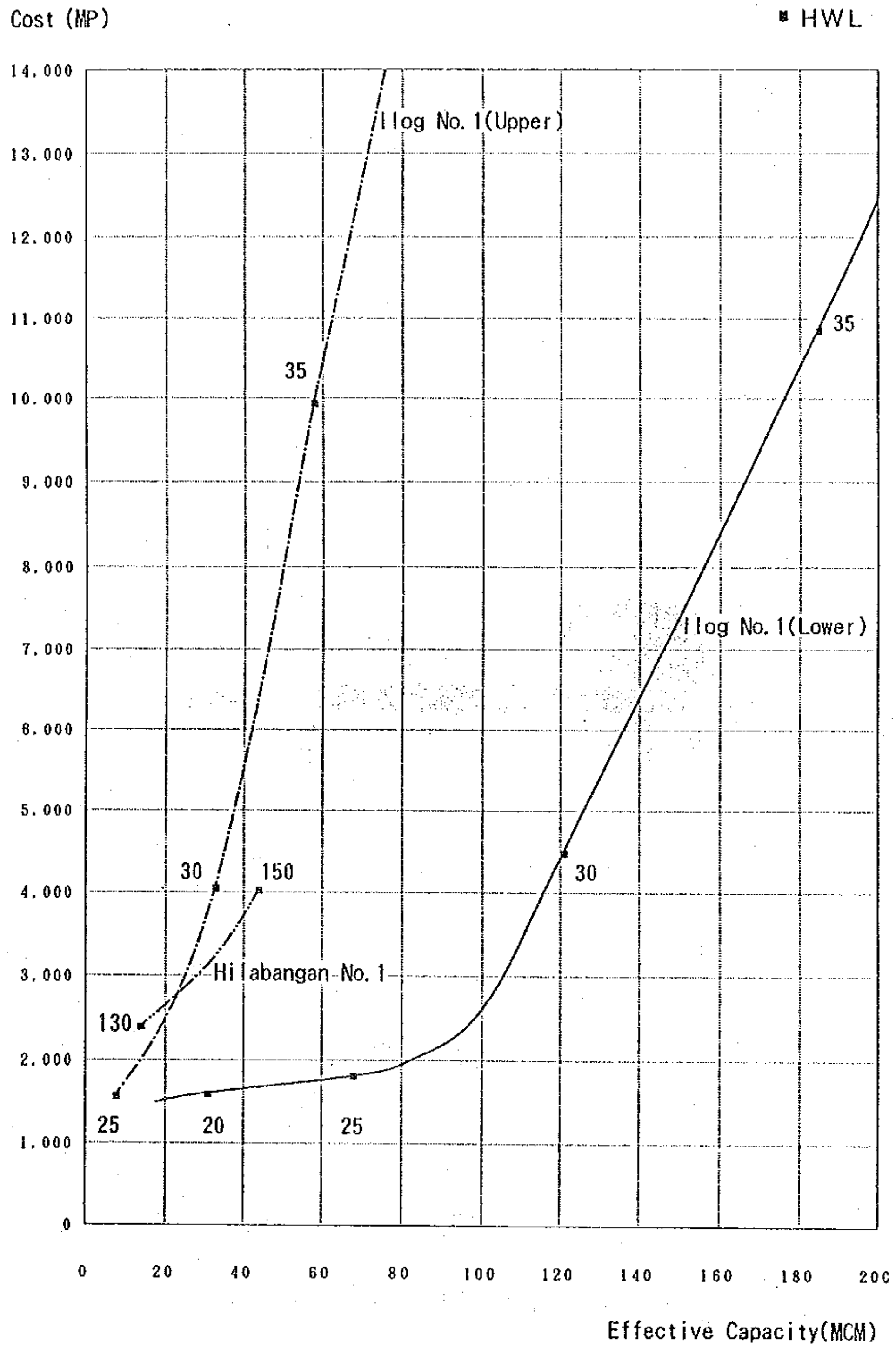
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-1 GEOLOGIC MAP OF ILOG NO.1 UPPER AND LOWER DAM SITES
JAPAN INTERNATIONAL COOPERATION AGENCY	



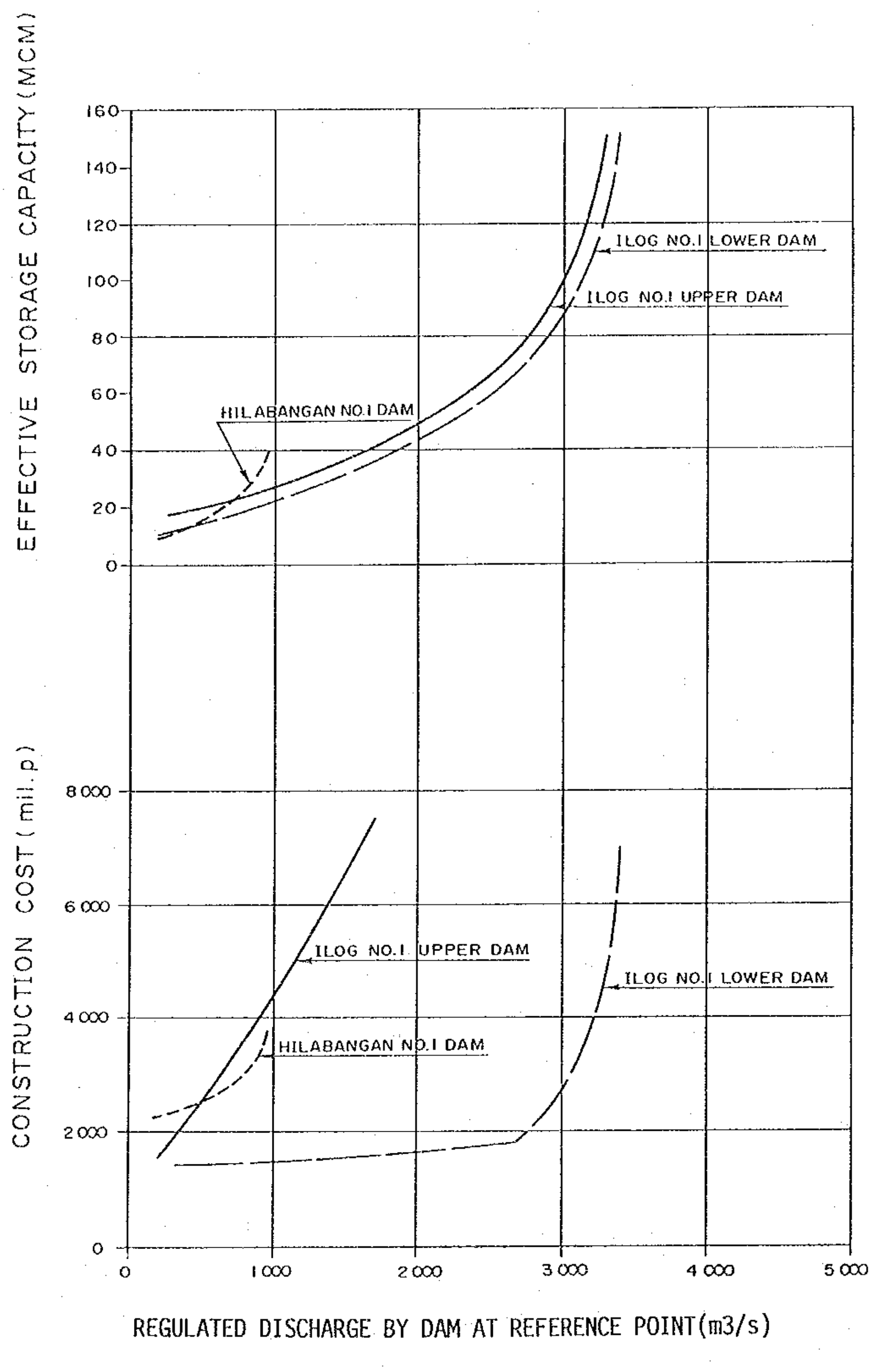
LEGEND :

- Recent alluvial deposits
- Dense crystalline limestone
- Volcanic clastic rocks
- Reservoir area (HWL. 150m)
- 50E / 40 — Strike and dip of beds
- Geologic contact
- River
- Contour line
- Sink hole

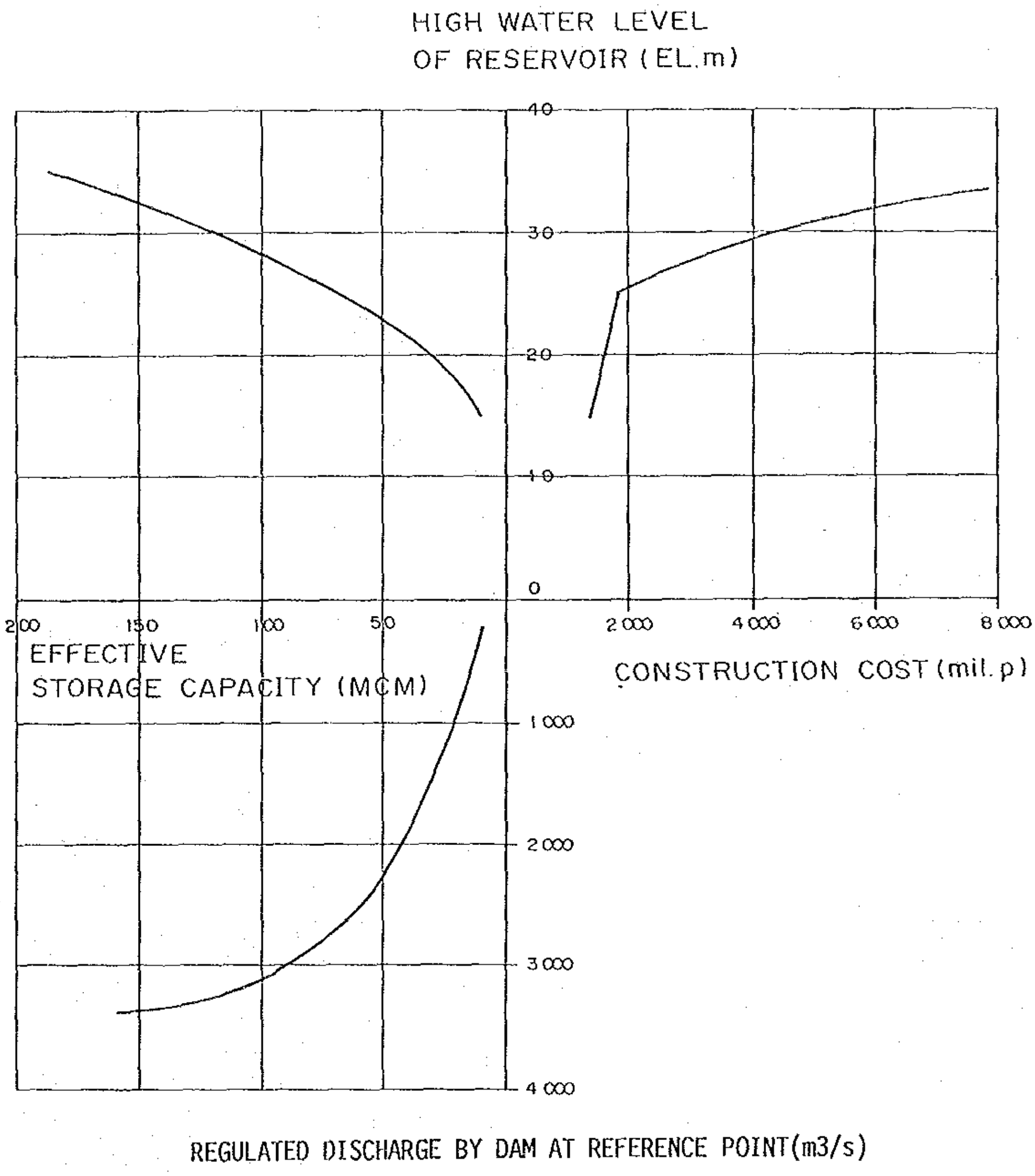
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-2 GEOLOGIC MAP OF HILABANGAN NO. 1 DAM SITE
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-3 COST-EFFECTIVE CAPACITY CURVE
JAPAN INTERNATIONAL COOPERATION AGENCY	

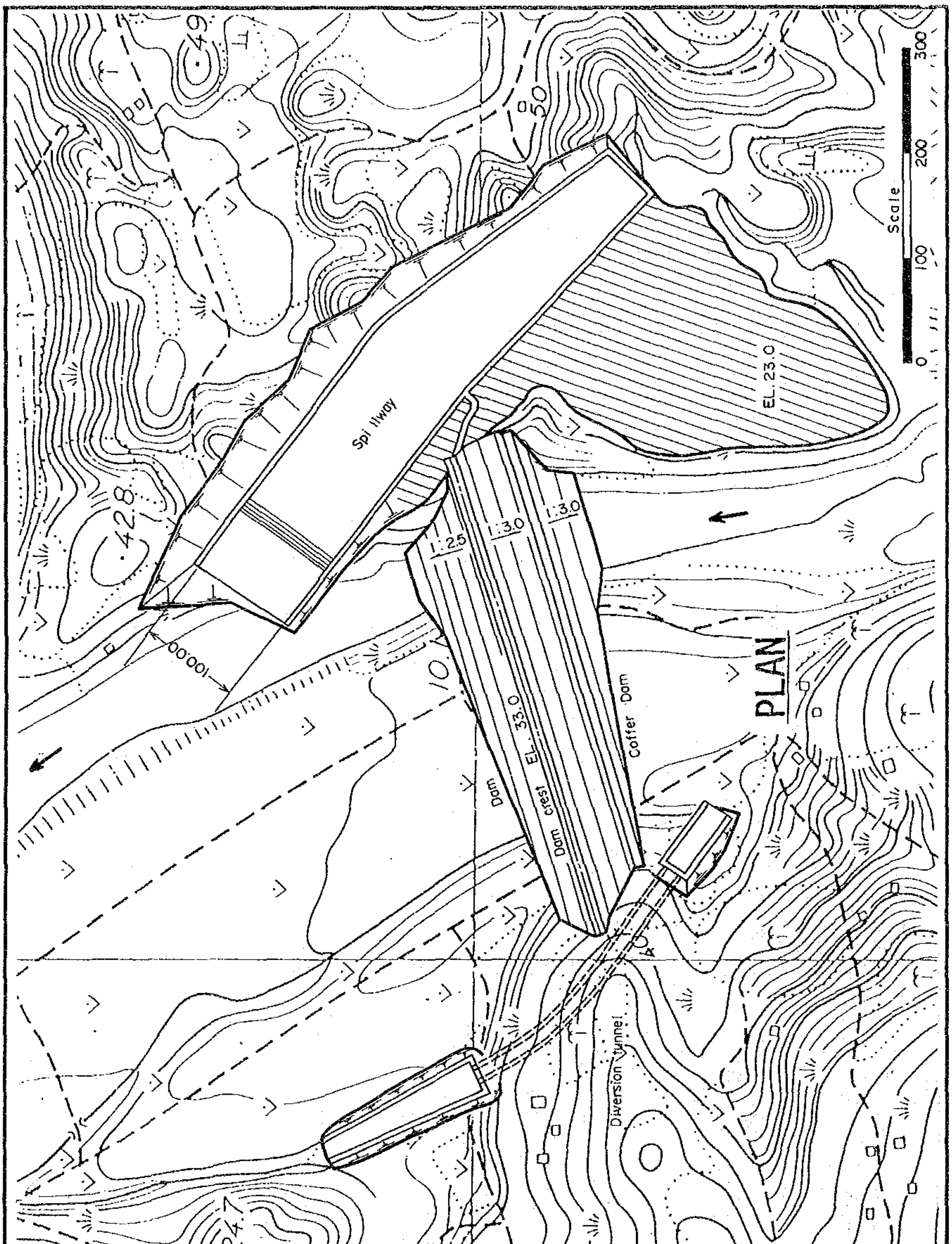


THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-4 EFFECTIVE STORAGE CAPACITY AND CONSTRUCTION COST VERSUS REGULATION EFFECT
JAPAN INTERNATIONAL COOPERATION AGENCY	

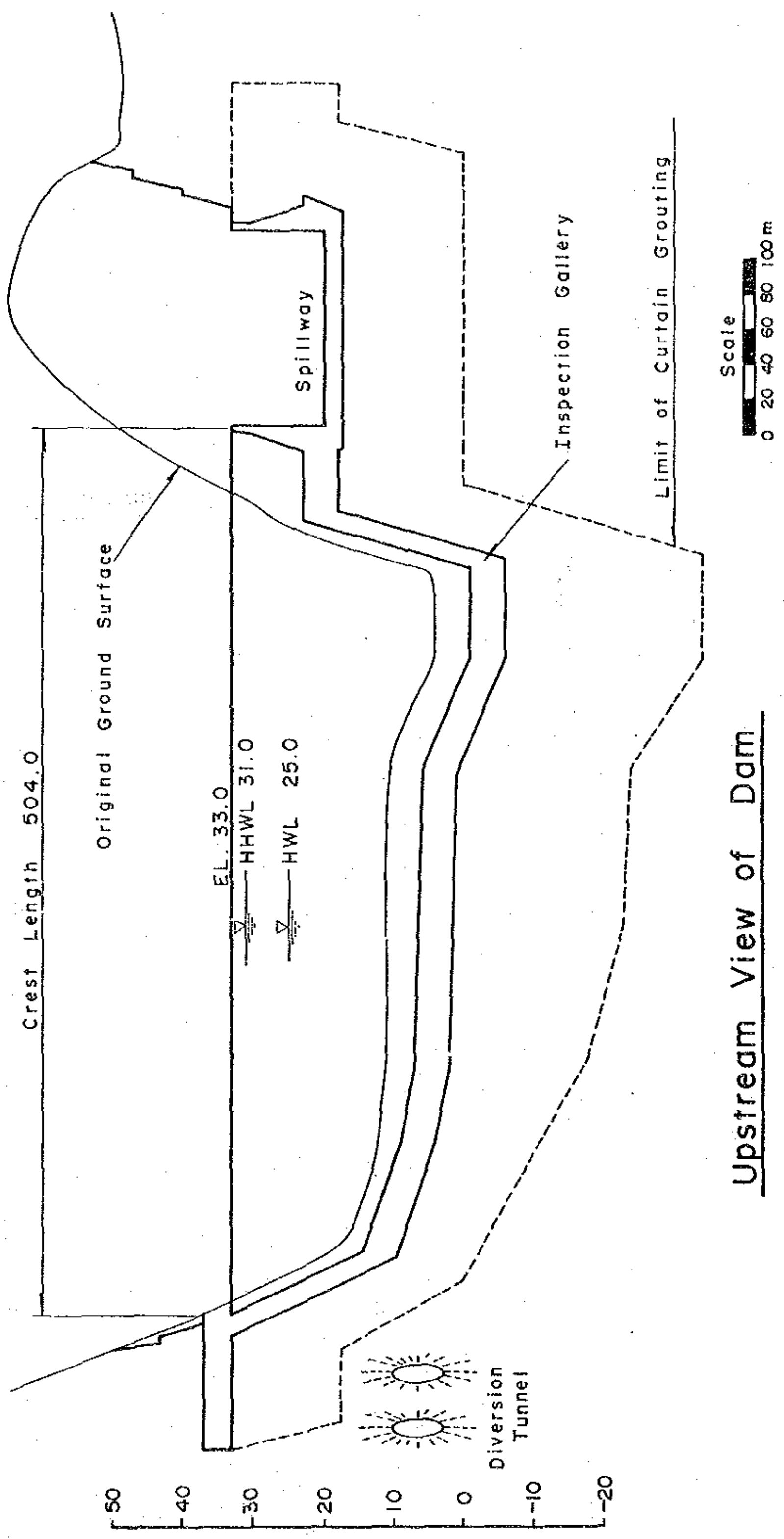


ILOG NO.1 LOWER DAM

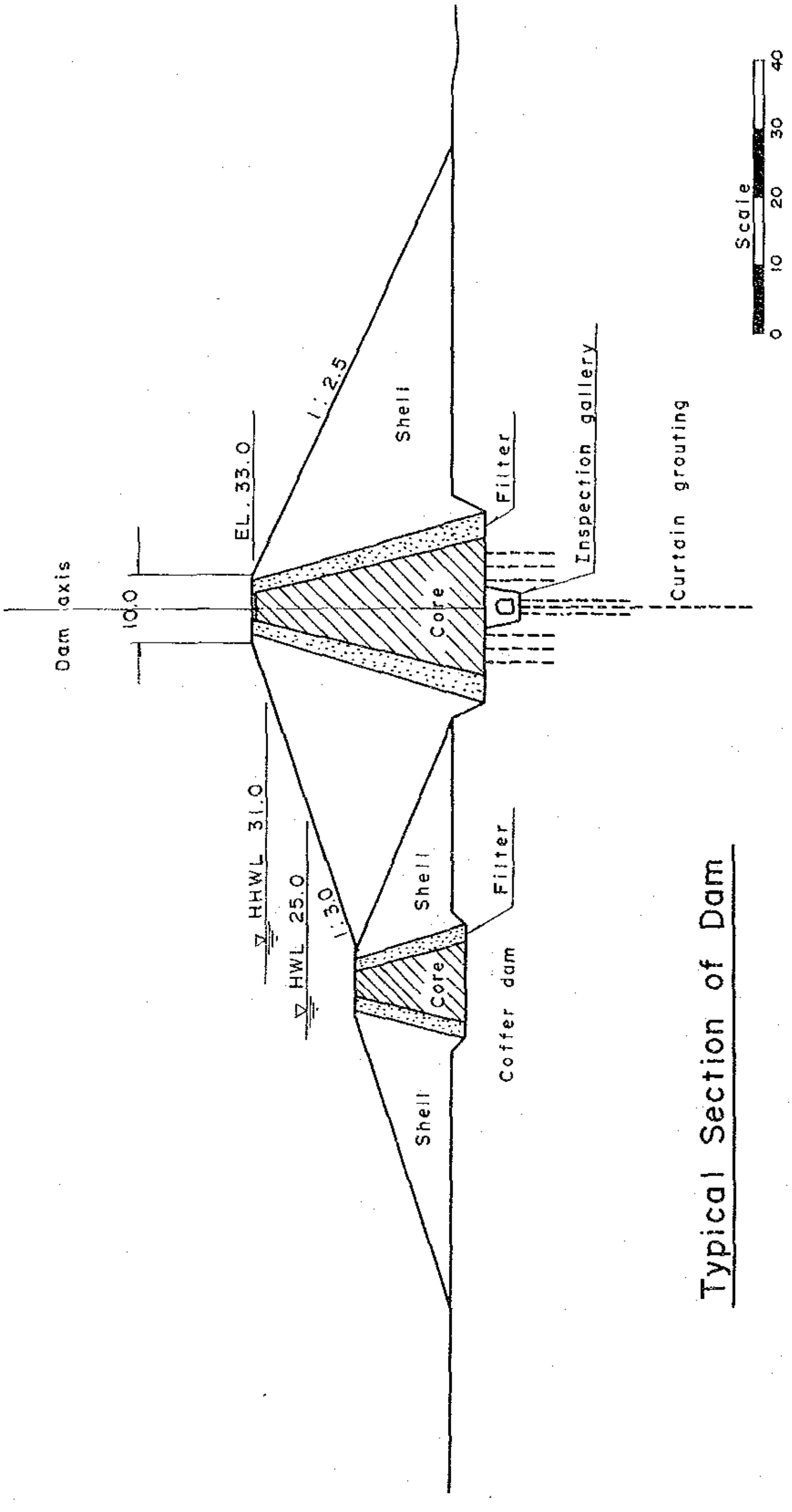
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.VII-2-5 RELATION BETWEEN REGULATION EFFECT AND DAM COST



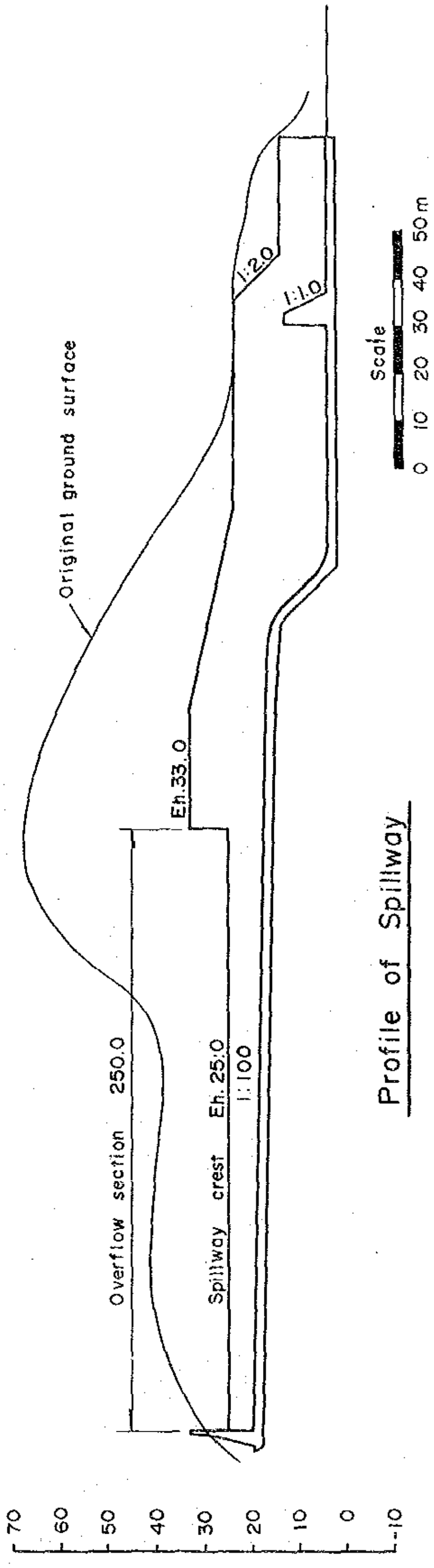
THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-6 (1/4) FEATURES OF ILOG NO.1 LOWER DAM
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-6 (2/4) FEATURES OF ILOG NO.1 LOWER DAM
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-6 (3/4) FEATURES OF ILOG NO. 1 LOWER DAM
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VII-2-6 (4/4) FEATURES OF ILOG NO.1 LOWER DAM
JAPAN INTERNATIONAL COOPERATION AGENCY	

VIII. CONSTRUCTION PLANNING AND COST ESTIMATE

STUDY
ON
ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT

SUPPORTING REPORT VIII. CONSTRUCTION PLANNING AND COST ESTIMATE

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1. INTRODUCTION

The works required for Ilog-Hilabangan River Basin Flood Control Project consist mainly of earth works such as dredging, excavation and embankment for river improvement.

The implementation schedule for the Master Plan was assumed to span a long period of 30 years from 1991 to 2020 including a feasibility study stage. Since the Master Plan is to be formulated on the condition that an Urgent Project be included therein in its early stage, scale-wise phasing implementation schedule is studied.

The construction planning described in this report was prepared on the basis of the design of structures in consideration of results of investigations on the capability of contractors in the Philippines such as technical level, prevailing construction methods and so on. Construction materials and equipment will be procured in the Philippines.

The construction cost of the master Plan is estimated at 1,224 million pesos at the price level of November 1990 and the conversion rates of currencies are US$1.00=¥130=P28.00 (₱1.00=¥4.64). This cost consists of main construction cost, engineering services and administration cost, physical contingency and compensation cost excluding price contingency.

2. CONSTRUCTION PLANNING

2.1 Implementation Schedule

In general, a master plan of this kind of infrastructure project requires a huge amount of money and a very long period to be implemented. Therefore, in preparing an implementation schedule of a master plan which consists of some components, depending on the land use, flooding nature, applied flood control measures, etc., consideration is given to the priority of each component, i.e., components with high priority are put into implementation in the earlier phases, prior to the others. In this master plan, however, it may be difficult to identify the clearly divided components due to the land-use and flooding conditions in the flood-prone area, and the Master Plan is to be formulated on the condition that an Urgent Project be included therein in its early stage. A phased implementation according to safety degree is, therefore, proposed on the following premises:

Phase I : A project with a scale smaller than the desgined one is completed as a first step before the target year. (Urgent Project)

Phase II : The Phase I project is up-graded until the target year to achieve the design scale.

Considering the flood control scales in other river basins in the Philippines, flood control works for a 25-year return period flood will be completed in the first phase as the Urgent Project, and subsequently it is upgraded to the design scale of a 100-year return period until the target year 2020. The economic aspect of the Urgent Project can also be justified as discussed in detail in the sectoral report of Economic Evaluation.

To prepare the implementation schedule which spans from 1991 to 2020, the following assumptions were set up:

(1) A feasibility study will be terminated within 1991, though this study was eliminated from the objectives of this study.

(2) It will take two years for loan application for detailed design, which is required in most cases of the previous loan procedures.

(3) Two years will be required for the detailed design works judging from the work quantity.

(4) As well as the case of detailed design, two years are necessary for loan application for construction.

(5) For the selection of contractor including pre-qualification stage, two years are ncessary.

(6) In the construction period for 20 years, 11 years will be allocated to the Phase I Project and 9 years to the Phase II Project so as to attain an equal annual cost disbursement for construction.

The implementation schedule is presented in Fig. VIII-2-1.

2.2 Outline of Work

Major work quantities for the master plan of the Ilog-Hilabangan River Basin are as follows:

Work Item	Unit	Quantity Phase I	Phase II
Excavation	1,000 m^3	2,831	3,870
Dredging	1,000 m^3	1,551	1,172
Embankment*	1,000 m^3	967	0
Revetment	1,000 m^3	102	51
Sluice	unit	4	0
Bridge	m^2	4,150	0

* Excavated material can be used.

2.3 Workable Days

Since construction will be much influenced by rainfall and flooding, the workable days were estimated based on the past rainfall records, the regulations applied in the Philippines and the criteria as follows:

(1) No works are done on the national and local holidays; and
(2) The works to be suspended due to rainfall are estimated from the following table

Rainfall Amount (mm)	Suspended Day Embankment	Excavation & Conrete Works
0 - 5	0	0
5 - 30	1	0.5
30 - 50	2	1
50 - 100	3	1.5
Over 100	4	2

However, river improvement works should be carried out only in the dry season because they consist mostly of earthwork such as excavation and embankment which cannot be expected to have good results under the rain; besides, it is a risky job to undertake such works under the threat of flooding.

Based on the rainfall data at Kabankalan (1980-1989), the annual workable days except rainy season is worked out as 110 days for embankment works and 145 days for excavation and concrete works. The execution works are planned for the condition that the work are generally on a single 8 hour-shift basis.

Month	Workable Days Embankment	Excavation & Concrete Works
Jan.	18	24
Feb.	20	24
Mar.	19	26
Apr.	16	25
May	0	0
Jun.	0	0
Jul.	0	0
Aug.	0	0
Sep.	0	0
Oct.	0	0
Nov.	0	0
Dec.	16	23
Total	110	145

2.4 Standard Construction Method for Main Works

Excavation Works

Excavation for river improvement works consists of river channel excavation for widening and deepening of channels. Excavated materials which are suitable in quality and available in quantity are to be used for dike embankment.

Unsuitable materials or materials in excess of the required embankment are to be dumped in the spoil bank area. The transportation distance of excavated materials is assumed at 1,000 m in average.

Excavation works are planned to be carried out by a combination of the following major equipment:

Bulldozer 11 ton class	:	6 units
Bulldozer 21 ton class	:	3 units
Backhoe, 0.66 m^3	:	6 units
Dump truck, 15 ton	:	18 units

Embankment Works

Embankment for river improvement works is the construction of new dikes. This works include the works of excavation and loading in river channel, hauling to the embankment site, material moisture content control, striping of surface soil of dike foundation, and spreading and compacting of embankment materials. Embankment work is planned to be carried out by a combination of the following major equipment:

Bulldozer, 11 ton class	:	2 units
Bulldozer, 15 ton class	:	1 unit
Tire roller, 8 ton	:	1 unit
Water wagon, 2,000 ltr. class	:	1 unit

Dredging Works

The dredging work section is assumed to cover a stretch from the river mouth up to 6 km on the Ilog River, considering the tidal section. The work is to be performed by a cutter suction dredger of 800 Hp class. The dredged materials are conveyed from the dredger to the spoil bank through a floating pipe and shore pipe. The floating pipeline is to be installed between the dredger and the fixed shore pipe. The floating pipeline is to be installed between the dredger and the fixed shore pipe, and the shorepipe is to be installed along the river bank to the spoil bank. The spoil bank may be used as residential land of farm land after completion of the dredging works. The spoil bank area to be sufficiently compacted using bulldozers.

Dredger operation is executed in two shifts per day with an hourly production rate assumed at 140 cu.m/hr. The dredging works per group are planned to be carried out by a combination of following major equipment:

Dredger 800 HP	:	1	unit
Tugboat 30 PS	:	1	unit
Bulldozer 11 ton	:	3	unit

The major items of equipment required for this project are as follows.

Equipment	Unit	Activity
Excavation		
- Bulldozer, 11 ton	6	dozing
- Bulldozer, 21 ton	3	dozing
- Backhoe, 0.66 m^3	6	loading
- Dump truck, 15 ton	18	hauling
Embankment		
- Bulldozer, 11 ton	2	dozing
- Bulldozer, 15 ton	1	dozing
- Tire roller, 8 ton	1	compacting
- Water wagon, 2000 l	1	moisture control

Equipment	Unit	Activity
Dredging		
- Dredger, 800 HP	1	dredging
- Tugboat, 30 PS	1	moving
- Bulldozer, 11 ton	3	dozing
Revetment		
- Wheel loader, 2.1 m^3	1	loading
- Dump truck, 11 ton	3	hauling
- Truck crane, 5 ton	1	installation
- Truck mixer, 5 ton	1	hauling
Sluice		
- Bulldozer, 11 ton	1	dozing
- Backhoe, 1.2 m^3	1	loading
- Dump truck, 11 ton	1	hauling
- Truck crane, 20 ton	1	installation
- Truck mixer, 3 m^3	2	hauling
- Concrete pump, 30 m^3/hr	1	pouring concrete

Using these equipment, the construction works consisting of excavation, dredging, embankment, revetment, etc., will be conducted in parallel in dry season and is expected to terminate within the construciton period of 20 years.

3. COST ESTIMATE

3.1 Conditions for Cost Estimate

Project cost was estimated at the price level of November 1990 and the currency conversion rates of US$1.00 = ₱28.00 = ¥130 under the following conditions.

(1) Main Construction Cost

Main construction cost consists of the cost of preparatory works and main works. The cost of preparatory works is assumed to be 15% of the cost of main works. The cost of main works is estimated by multiplying the unit cost with the corresponding work quantity.

The unit cost of each work item consists of direct cost and indirect cost. The direct cost in unit cost consists of the cost of construction materials, labor and equipment.

(2) Engineering Services and Administration Cost

Engineering services herein estimated is to cover the detailed design and construction supervision. The total engineering cost is 16% of the main construction works.

The engineering cost is allocated at 6% for the detailed design and 10% for construction supervision. (These rates are the maximum percentage of the NEDA's guideline.) The administration cost for the government is computed at 5% of the main construction cost.

(3) Project Contingency

Project contingency consists of physical contingency and price escalation contingency. Physical contingency is estimated at 10%, however, the price escalation is not considered here because the study stage is in the master plan.

(4) Compensation Cost

To obtain the compensation cost, the interview survey at Ilog and Kabankalan Municipality offices, DPWH 3rd engineering office, etc. was conducted. The following land acquisition and house evacuation costs are adopted on the basis of the prevailing cost for land, buildings and other private properties.

(a) Land Acquisition
- Residential Area : 3,800,000 pesos/ha
- Sugarcane Field : 110,000 pesos/ha
- Fishpond : 230,000 pesos/ha

(b) House Evacuation
- Building : 40,000 pesos/unit

3.2 Project Cost

Unit Cost

The unit cost of each work item for river improvement is estimated on the basis of information collected at the job site as presented in Table VIII-3-1, according to the foregoing criteria, standard design of riparian structures and preliminary construction plan.

Labor wages and unit prices of major construction materials adopted here are as shown in Tables VIII-3-2 and VIII-3-3, respectively.

Project Cost

The total project cost for the master plan is estimated at 1,252 million pesos with the following components. The breakdown is in Table VIII-3-4.

Item	Cost (in million ₱)
1. Construction	893
2. Administration	45
3. Engineering Services	143
4. Physical Contingency	108
5. Compensation	64
Total	1,253

3.3 Operation, Maintenance and Replacement Cost

Operation and Maintenance Cost

Operation and maintenance cost is required annually after completion of the project in order to keep the full designed function. This cost is estimated at 4.6 million pesos, assuming the required volume for each work as presented in Table VIII-3-5.

Replacement

Some of the facilities, especially mechanical equipment, have shorter useful lives than the civil works and require replacement within a certain period. Water gates are applicable for this item, however, their useful life is considered to be 30-year which accords to the project service life. Therefore, the replacement cost of water gates is not counted here.

TABLES

Table VIII-3-1 UNIT COST

Unit : Peso

No.	Item of Work	Unit	Direct Cost	Indirect Cost	Unit Cost
1.	Excavation				
1.1	Common	m3	48.00	11.97	60.00
1.2	Dredging	m3	39.00	9.83	49.00
2.	Embankment	m3	35.00	9.07	44.00
3.	Revetment				
3.1	Sodding	m2	8.00	1.85	10.00
3.2	Top Concrete 1	m3	1,480.00	266.84	1,747.00
3.3	Wet Masonry	m2	187.00	34.35	221.00
3.4	Base Concrete	m3	1,480.00	266.84	1,747.00
3.5	Boulders	m2	49.00	9.33	58.00
3.6	Top Concrete 2	m3	2,250.00	403.61	2,654.00
3.7	Sheet Pile				
	- Concrete	m2	1,324.00	276.61	1,601.00
	- Steel	m2	4,393.00	775.01	5,168.00
3.8	Riprap	m2	50.00	9.59	60.00
4.	Sluice and Drainage Facility				
4.1	Gate				
	- Sluice Gate	m2	128,000.00	25,785.00	153,785.00
	- Flap Gate	m2	111,000.00	23,680.00	134,680.00
4.2	Culvert (Concrete)	m3	3,011.00	537.91	3,549.00
5.	Bridge	m2	11,084.00	2,184.70	13,269.00

Table VIII-3-2 LABOR RATES

DESCREPTION	UNIT	PRICE (Peso)
1. Foreman	md	120.00
2. Common Labor	md	60.00
3. Operator	md	100.00
4. Assistant Operator	md	70.00
5. Mechanic	md	100.00
6. Assistant Mechanic	md	70.00
7. Welder	md	90.00
8. Electrician	md	100.00
9. Driver	md	70.00
10. Skilled Labor	md	80.00
11. Dredger Master	md	140.00
12. Dredging Crew	md	100.00

Table VIII-3-3 MATERIAL PRICE

DESCREPTION		UNIT	PRICE (Peso)
1. Cement	Normal Portland	ton	2,200.00
2. Reinforcement Bar		ton	15,000.00
3. Fuel	Diesel	ltr.	6.50
4. Gasoline	Premium	ltr.	9.50
5. Gear Oil		ltr.	35.00
6. Grease		gal.	70.00
7. Bitumen		ton	9,500.00
8. Timber	Support	bf.	13.00
	Plank	bf.	18.00
9. Plywood	(1/4"*4'*8')	sheet	170.00
10. Wire		kg	20.00
11. Nail		kg	25.00
12. Concrete Aggregate	Fine	m3	130.00
	Coarse	m3	140.00
13. Crusher-run		m3	110.00
14. Asphalt Mixture		ton	800.00

Table VIII-3-4 BREAKDOWN OF PROJECT COST

Work Item	Feature	Unit	Unit Cost (Peso)	Quantity	Total * (mil.P.)	Remarks
1. Construction Cost					892.65	
a. Phase 1					512.57	
(a) Preparatory Works					66.86	15% of (b)
(b) Main Construction Cost					445.71	
Excavation	Common	m3	60	2,831,400	169.88	
	Dredging	m3	49	1,551,300	76.01	
Embankment		m3	44	966,700	42.53	
Revetment		m2	800	102,100	81.68	
Sodding		m2	10	530,200	5.30	
Sluice	Type A	unit	700,000	3	2.10	
	Type B	unit	10,000,000	1	10.00	
Drainage Facility		unit	500,000	6	3.00	
Bridge		m2	13,300	4,150	55.20	
b. Phase 2					380.09	
(a) Preparatory Works					49.58	15% of (b)
(b) Main Construction Cost					330.51	
Excavation	Common	m3	60	3,870,400	232.22	
	Dredging	m3	49	1,172,400	57.45	
Embankment		m3	44	0	0.00	
Revetment		m2	800	51,050	40.84	
Sodding		m2	10	0	0.00	
Sluice	Type A	unit	700,000	0.0	0.00	
	Type B	unit	10,000,000	0.0	0.00	
Drainage Facility		unit	500,000	0.0	0.00	
Bridge		m2	13,300	0.0	0.00	
2. Administration Cost					44.63	5% of 1.
3. Engineering Services					142.82	
Detailed Design					53.56	6% of 1.
Supervision					89.27	10% of 1.
4. Physical Contingency					108.01	10% of 1+2+3
Sub Total (1+2+3+4)					1,188.12	
5. Compensation					64.41	
Land Acquisition	Fishpond	ha	230,000	37.7	8.67	
	Sugercane	ha	110,000	177.6	19.54	
	Residential Area	ha	3,800,000	5.8	22.04	
House Evacuation		unit	40,000	354.0	14.16	
Grand Total					1,252.53	

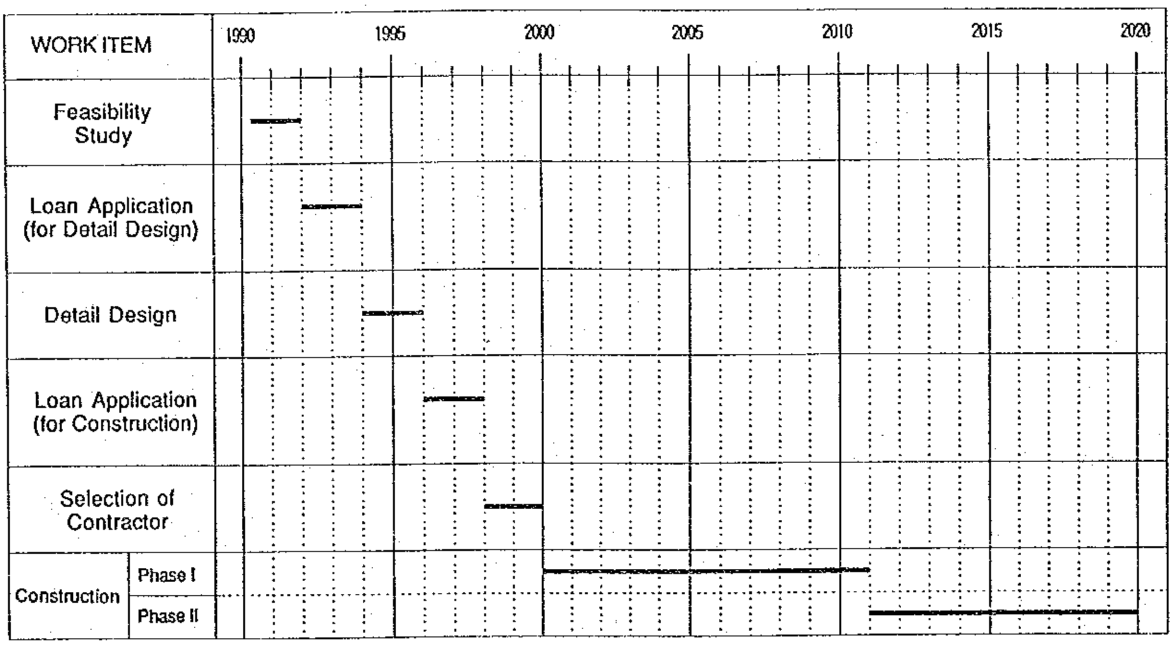
Note *: Figures may not add up to totals due to rounding.
**: Excavated material is employed for embankment material.

Table VIII-3-5 BREAKDOWN OF OPERATION AND MAINTENANCE COST

Work Item		Unit	Unit Cost (Peso)	Quantity	Total * (mil.P.)	Remarks **
1. Construction Cost					4.4	
(a) Preparatory Works (15% of (b))					0.6	
(b) Main Construction Cost					3.8	
Excavation	Common	m3	60	33,500	2.0	0.5 %
	Dredging	m3	49	27,200	1.3	1.0 %
Embankment		m3	44	2,400	0.1	0.25%
Revetment		m2	800	500	0.4	0.5 %
Sodding		m2	10	0	0.0	
Sluice	Type A	unit	700,000	0	0.0	
	Type B	unit	10,000,000	0	0.0	
Drainage Facility		unit	500,000	0	0.0	
Bridge		m2	13,300	0	0.0	
2. Administration Cost (5% of 1.)					0.2	
Grand Total					4.6	

Note * : Figures may not add up to totals due to rounding
** : Proportion of construction works.

FIGURES



THE STUDY ON ILOG-HILABANGAN RIVER BASIN FLOOD CONTROL PROJECT	Fig.VIII-2-1 IMPLEMENTATION SCHEDULE
JAPAN INTERNATIONAL COOPERATION AGENCY	