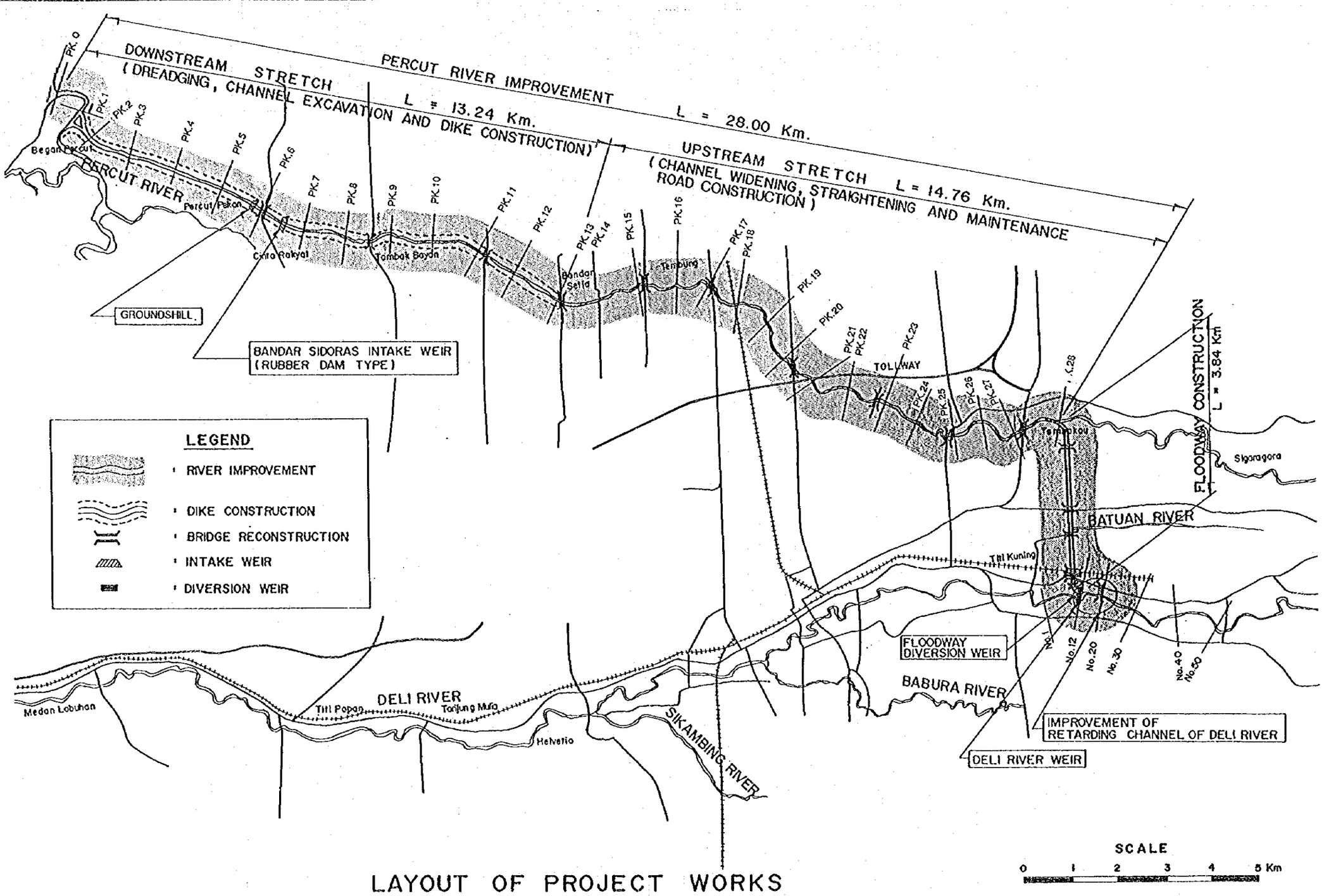
FIGURES

CHAPTER 4

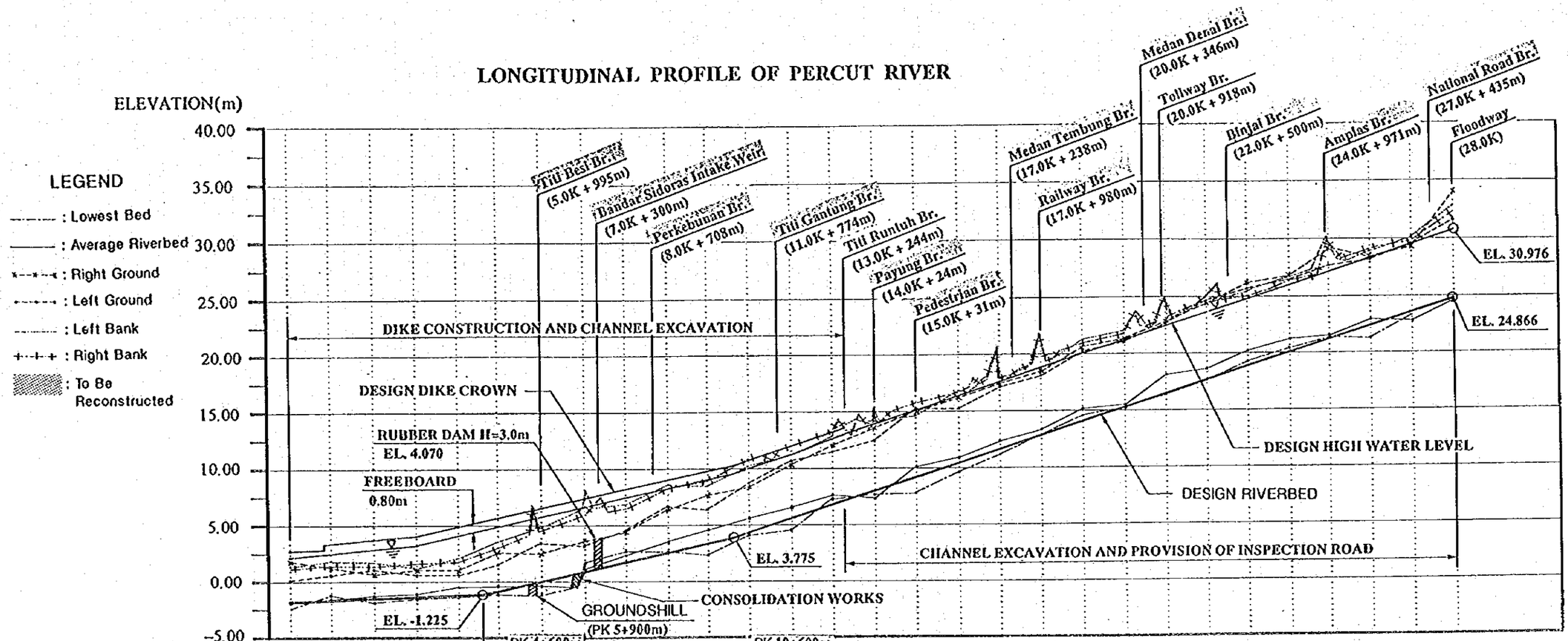
FORMULATION OF DEFINITIVE PLAN



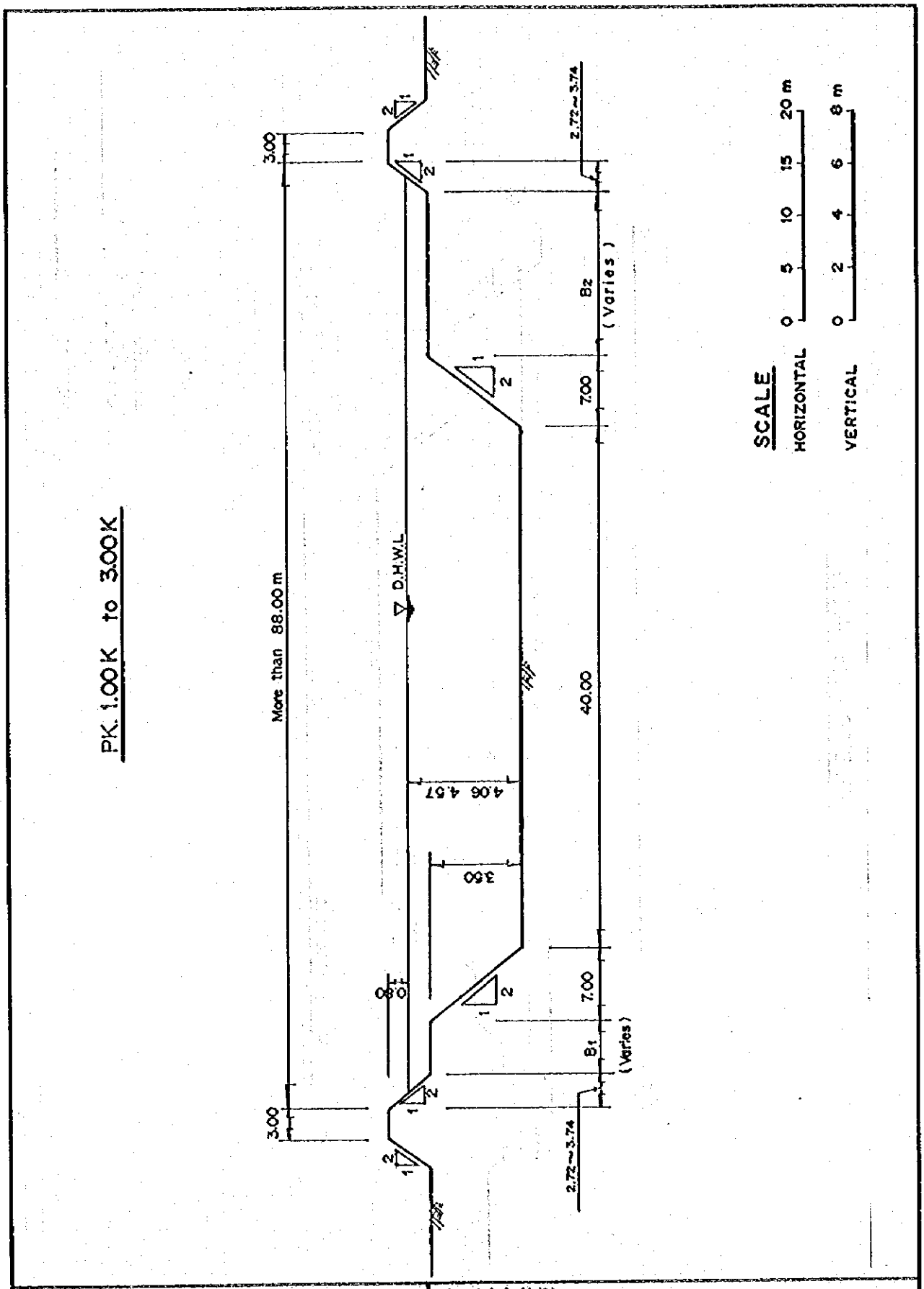
LAYOUT OF PROJECT WORKS

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.1.1 LAYOUT OF PROJECT WORKS

LONGITUDINAL PROFILE OF PERCUT RIVER



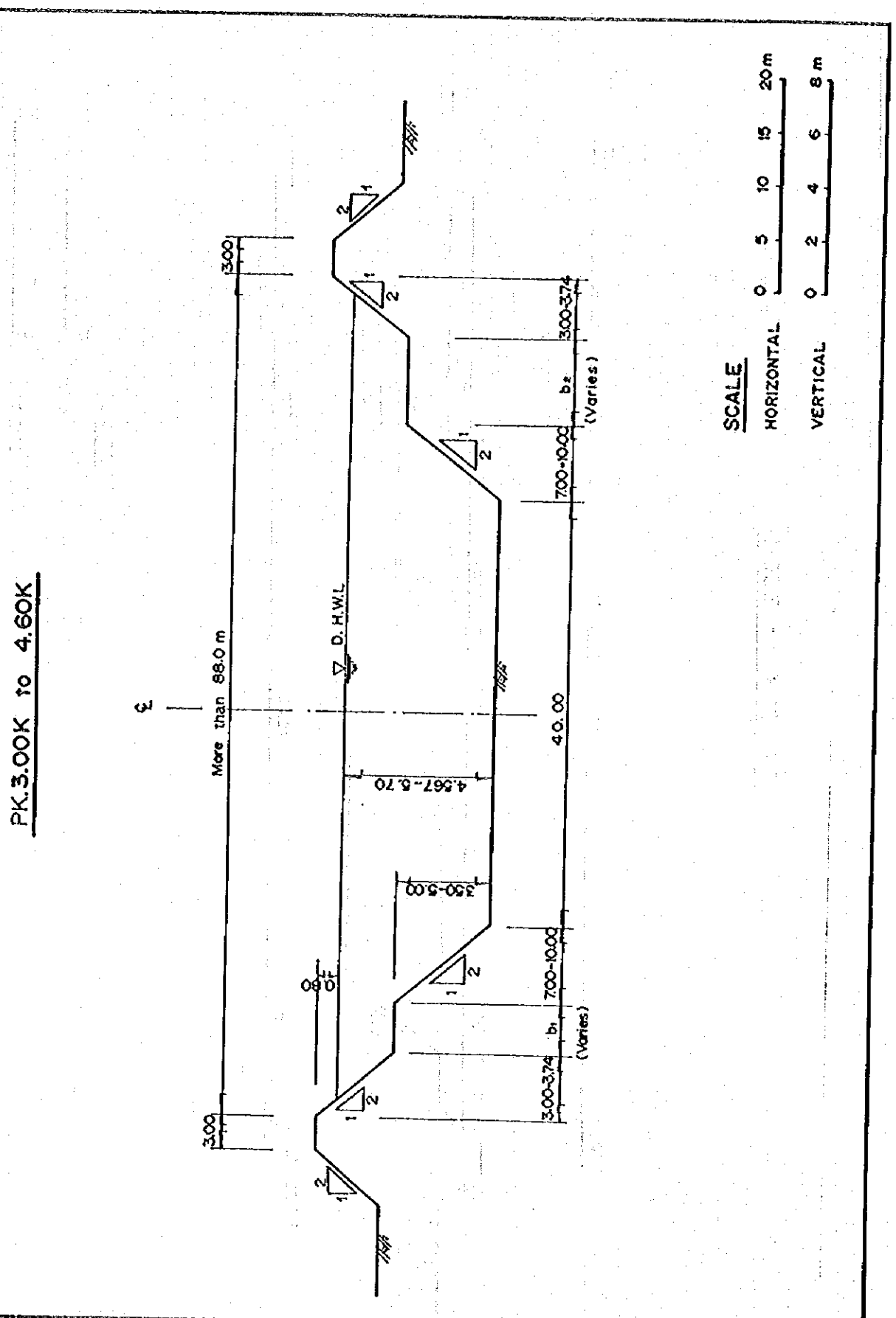
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.1 LONGITUDINAL PROFILE OF PERCUT RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



DETAILED DESIGN STUDY ON
MEDAN FLOOD CONTROL PROJECT

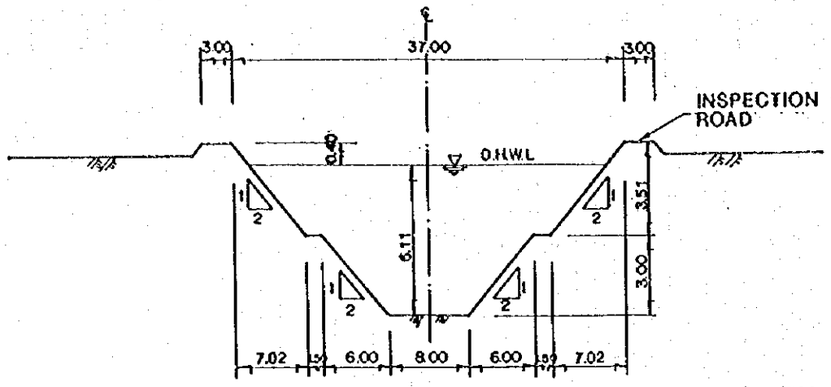
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.2 (1/3)
STANDARD CROSS SECTION OF PERCUT RIVER

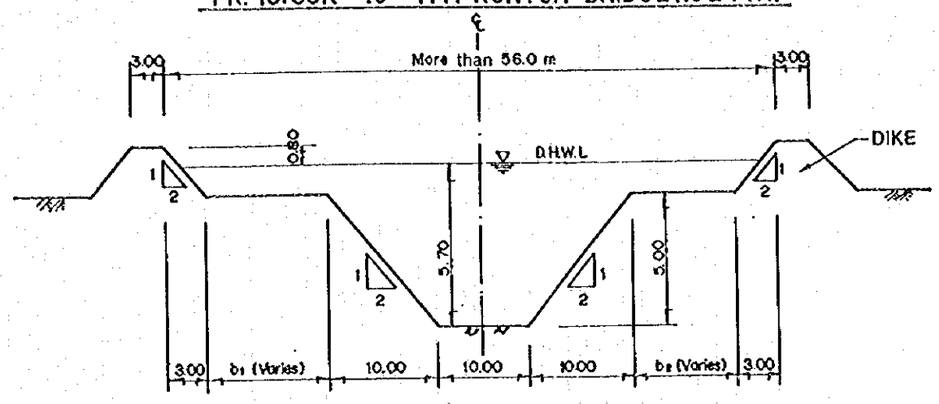


DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.2 (2/3) STANDARD CROSS SECTION OF PERCUT RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	

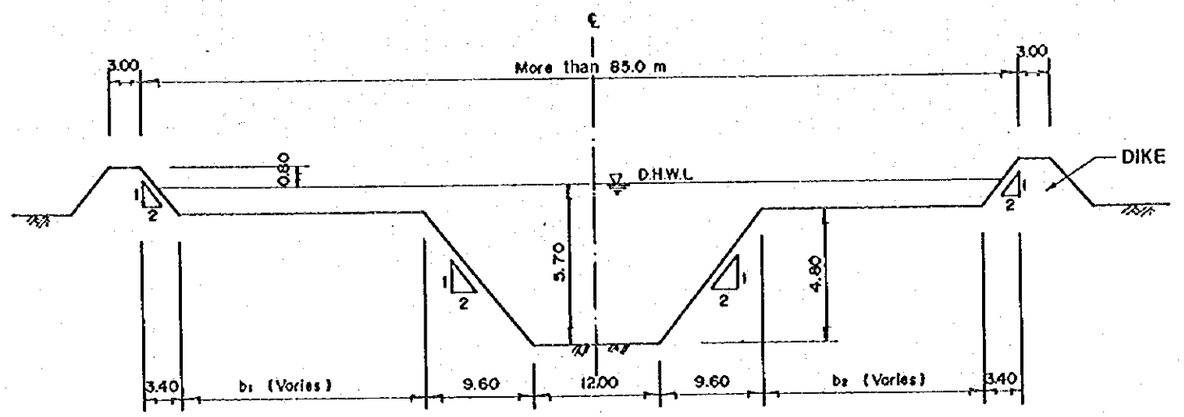
TITI RUNTUH BRIDGE (13.244K) to PK. 28.00K



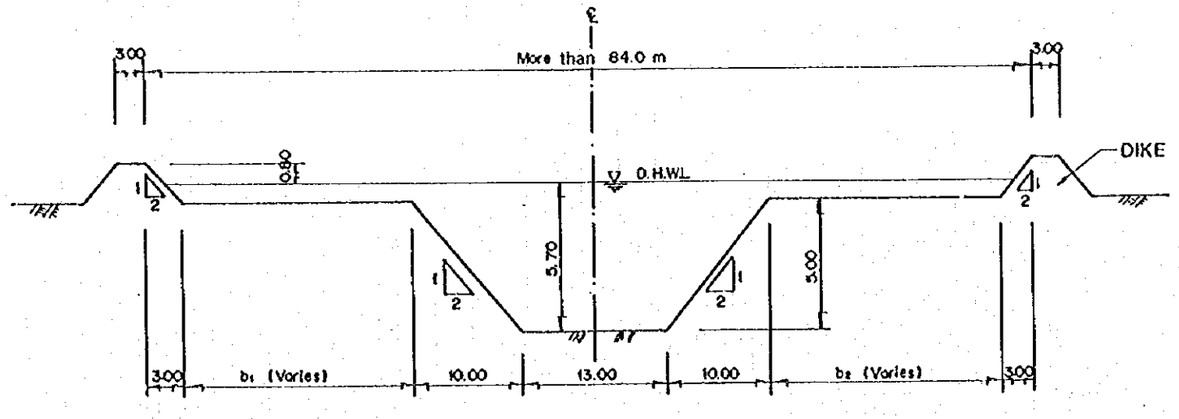
PK. 10.60K to TITI RUNTUH BRIDGE (13.244K)



PK. 7.20K to PK. 10.60K



PK. 4.60K to PK. 7.20K

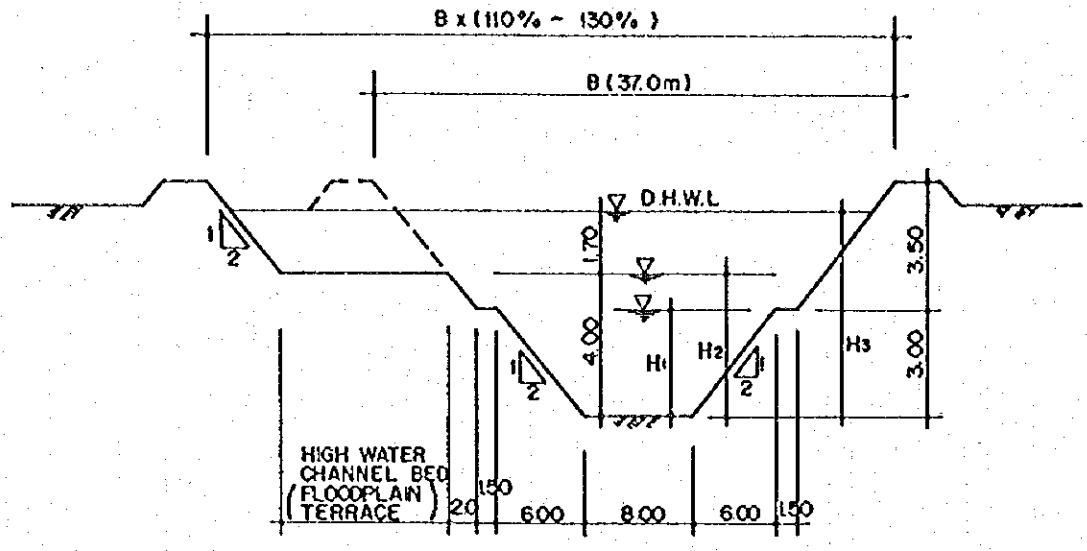


SCALE

HORIZONTAL 0 5 10 15 20 m

VERTICAL 0 2 4 6 8 m

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.2 (3/3) STANDARD CROSS SECTION OF PERCUT RIVER

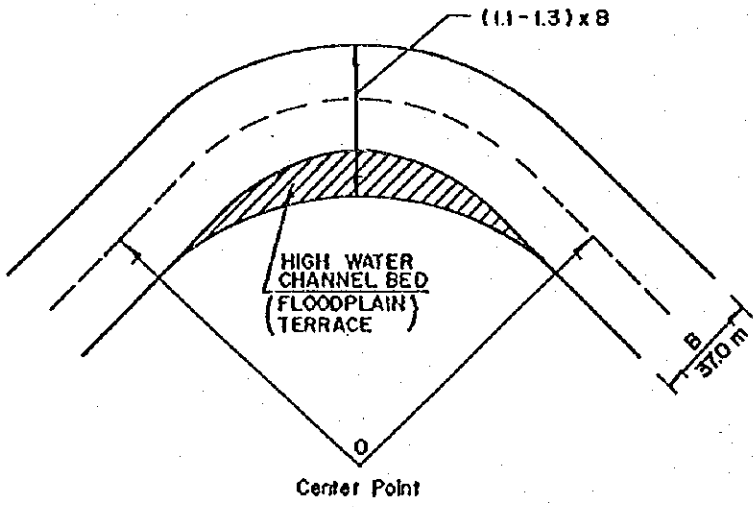


STANDARD CROSS SECTION AT BEND

RELATIONSHIP BETWEEN H,Q AND PROBABILITY

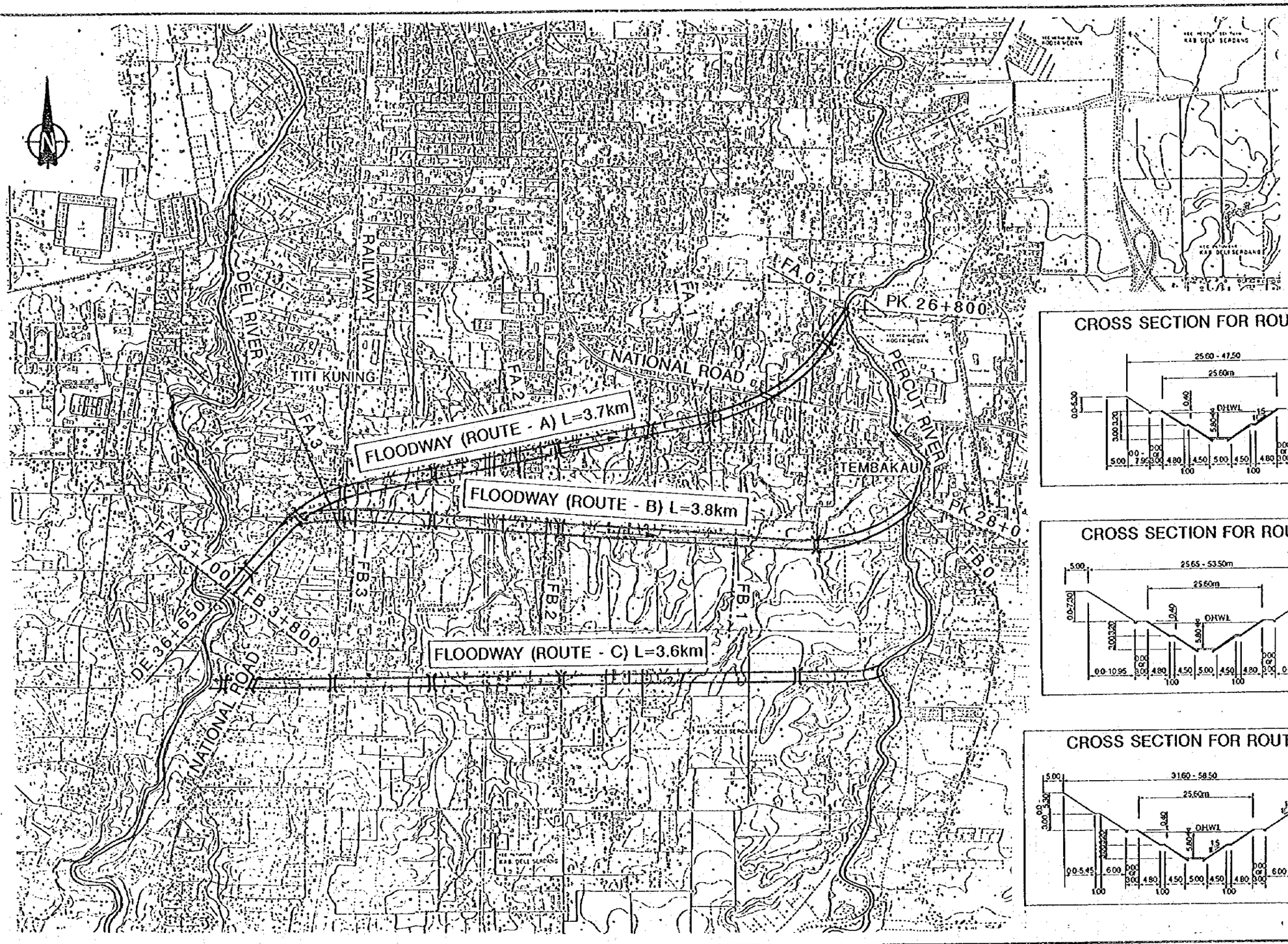
	H1	H2	H3
WATER DEPTH (m)	3.0	4.0	5.7
DISCHARGE (m^3/s)	69.5	123.9	274.8
PROBABILITY	10 TIMES/Y	2 TIMES/Y	15 YEAR※

※: IMMEDIATE PLAN



PLAN

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.3 CHANNEL FEATURES AT BEND IN PERCUT RIVER



CROSS SECTION FOR ROUTE-A

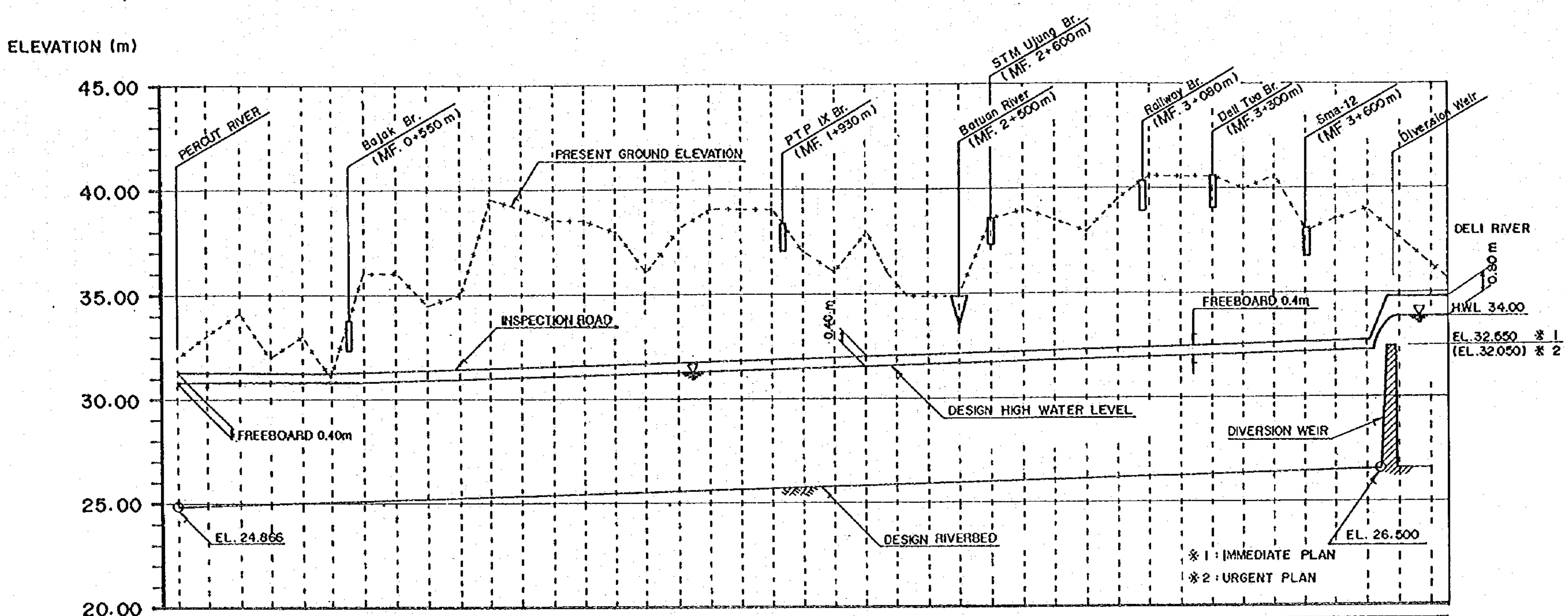
CROSS SECTION FOR ROUTE-B

CROSS SECTION FOR ROUTE-C

SCALE
0 200 400 600 800 m

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.4 ALTERNATIVES OF FLOODWAY ROUTE
JAPAN INTERNATIONAL COOPERATION AGENCY	

LONGITUDINAL PROFILE OF MEDAN FLOODWAY



DESIGN RIVERBED SLOPE: I = 2.350, L = 3.840 m

CROWN HEIGHT OF INSPECTION ROAD	31.376	31.376	31.376	31.376	31.376	31.379	31.421	31.464	31.506	31.549
DESIGN HIGH WATER LEVEL	30.976	30.976	30.976	30.976	30.976	30.976	30.976	30.976	31.006	31.049
DESIGN RIVERBED	24.866	24.909	24.951	24.994	25.036	25.079	25.121	25.164	25.206	25.249
EXISTING GROUND ELEVATION	32.000	33.000	34.000	32.000	33.000	31.000	36.000	36.000	34.500	35.000
DISTANCE FROM SECTION NO.0.0	0	100	200	300	400	500	600	700	800	900
SECTION NO(MF)	0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90

CROWN HEIGHT OF INSPECTION ROAD	31.592	31.634	31.677	31.719	31.762	31.804	31.847	31.889	31.932	31.975
DESIGN HIGH WATER LEVEL	31.092	31.134	31.177	31.219	31.262	31.304	31.347	31.389	31.432	31.475
DESIGN RIVERBED	25.292	25.334	25.377	25.419	25.462	25.504	25.547	25.589	25.632	25.675
EXISTING GROUND ELEVATION	39.500	39.000	38.500	38.500	38.000	36.000	38.000	39.000	39.000	39.000
DISTANCE FROM SECTION NO.0.0	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900
SECTION NO(MF)	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90

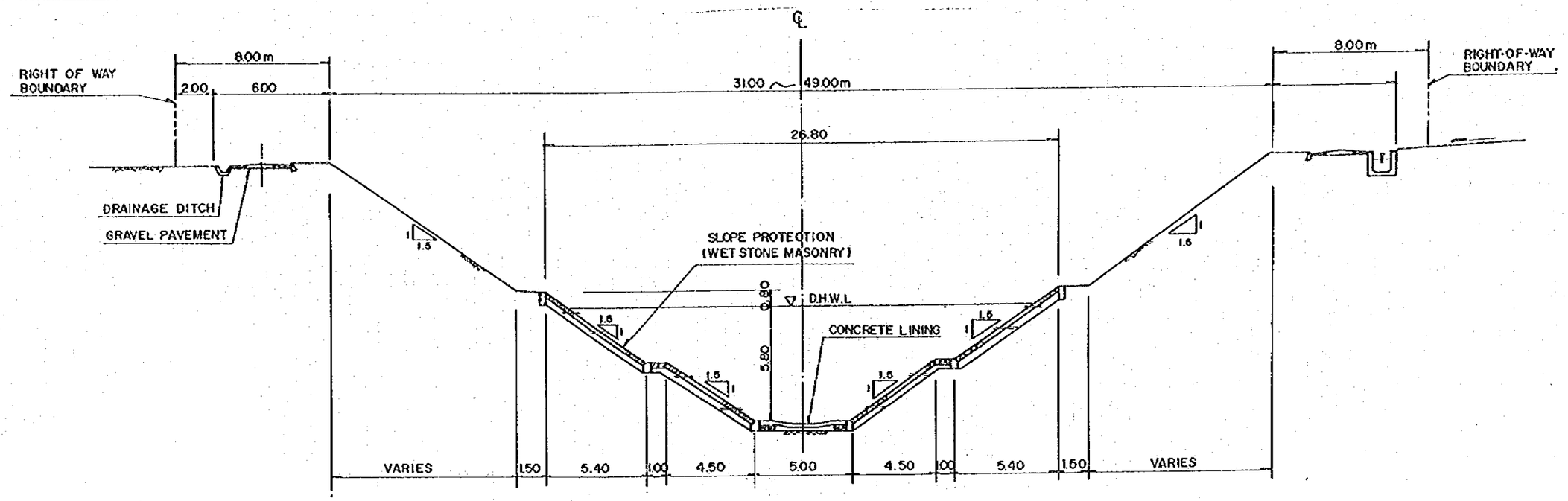
CROWN HEIGHT OF INSPECTION ROAD	32.017	32.060	32.102	32.145	32.187	32.230	32.272	32.315	32.357	32.400
DESIGN HIGH WATER LEVEL	31.517	31.560	31.602	31.645	31.687	31.730	31.772	31.815	31.857	31.900
DESIGN RIVERBED	25.717	25.760	25.802	25.845	25.887	25.930	25.972	26.015	26.057	26.100
EXISTING GROUND ELEVATION	37.000	36.000	38.000	35.000	34.500	35.000	38.500	39.000	38.500	38.000
DISTANCE FROM SECTION NO.0.0	2,000	2,100	2,200	2,300	2,400	2,500	2,600	2,700	2,800	2,900
SECTION NO(MF)	2.00	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90

CROWN HEIGHT OF INSPECTION ROAD	32.443	32.485	32.528	32.570	32.613	32.655	32.698	32.740	32.783	32.800
DESIGN HIGH WATER LEVEL	31.943	31.985	32.028	32.070	32.113	32.155	32.198	32.240	32.283	32.300
DESIGN RIVERBED	26.143	26.185	26.228	26.270	26.313	26.355	26.398	26.440	26.483	26.500
EXISTING GROUND ELEVATION	39.500	40.500	40.500	40.500	40.000	40.500	38.000	38.500	39.000	38.000
DISTANCE FROM SECTION NO.0.0	3,000	3,100	3,200	3,300	3,400	3,500	3,600	3,700	3,800	3,840
SECTION NO(MF)	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.84

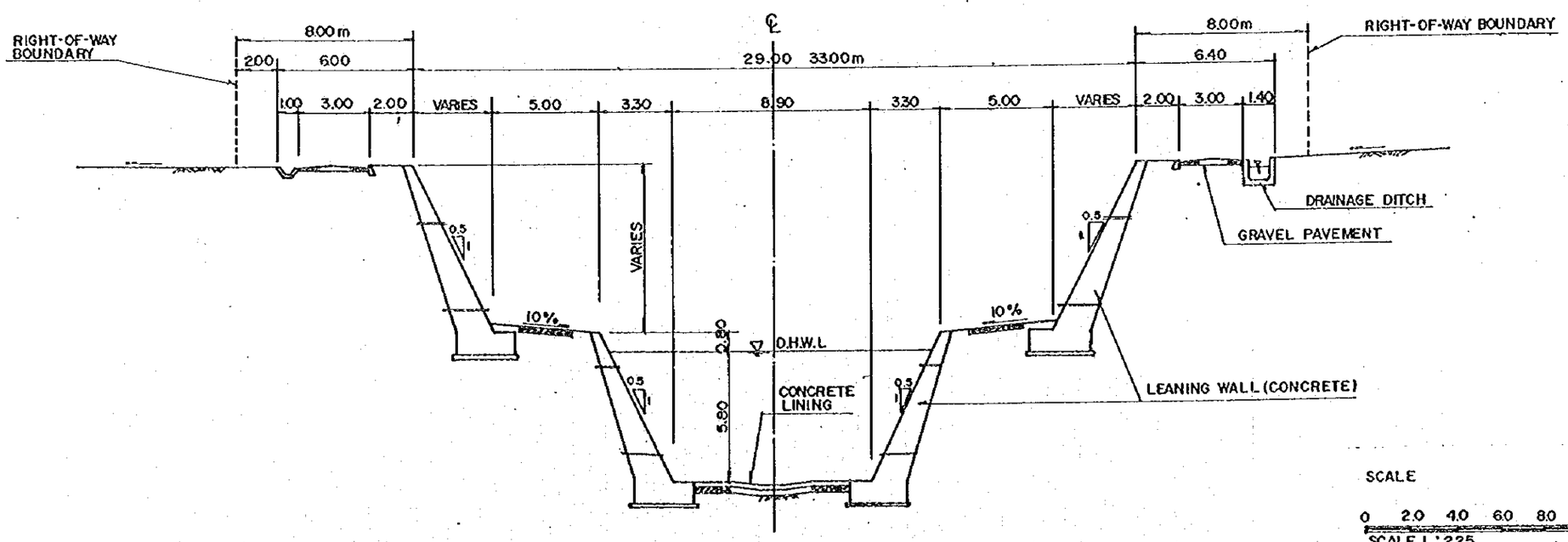
DETAILED DESIGN STUDY ON
MEDAN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.5
LONGITUDINAL PROFILE OF FLOODWAY



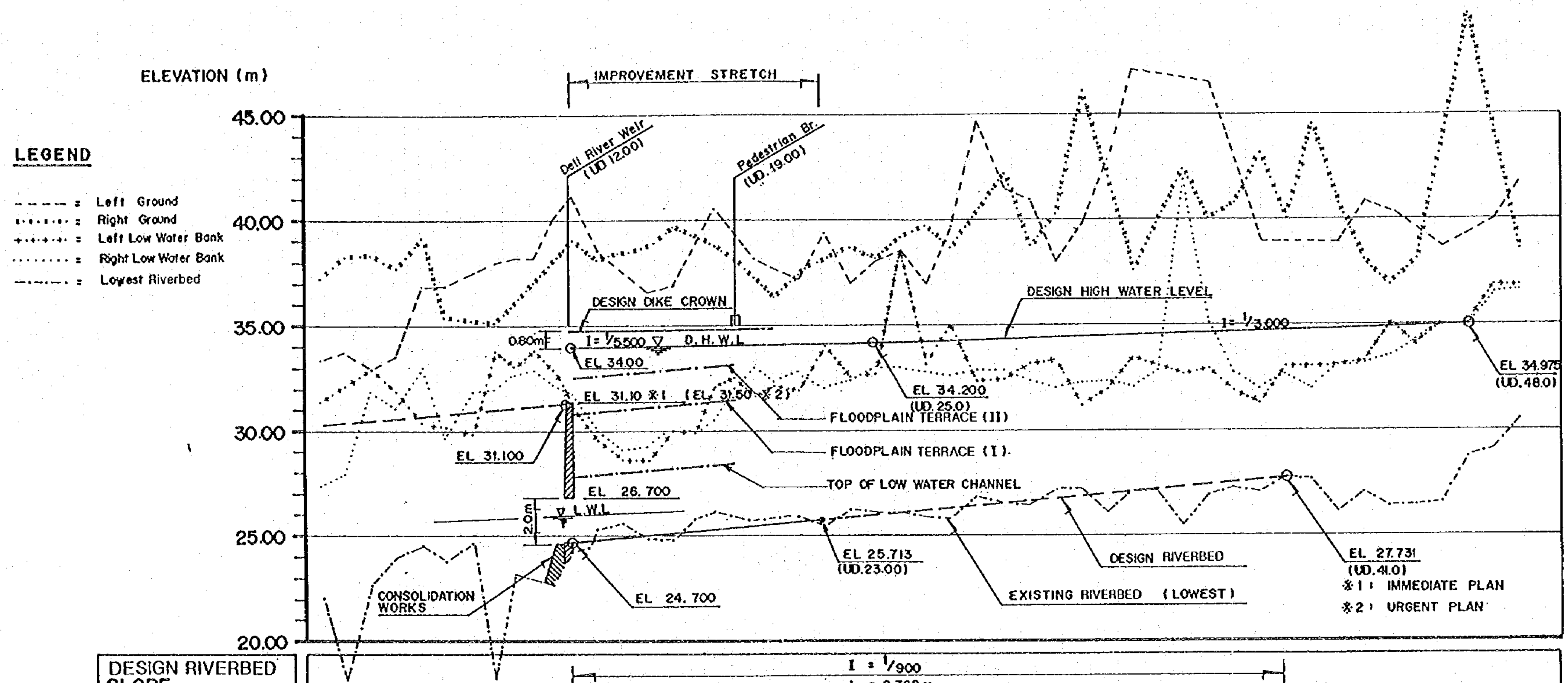
STANDARD CROSS SECTION OF FLOODWAY(CHANNEL TYPE-A)



STANDARD CROSS SECTION OF FLOODWAY(CHANNEL TYPE-B)

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.6 STANDARD CROSS SECTION OF FLOODWAY

LONGITUDINAL PROFILE OF RETARDING CHANNEL OF DELI RIVER



DESIGN RIVERBED SLOPE: I = 1/900, L = 2,728 m

SECTION NO (UD)	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
DISTANCE FROM STATION UDO	0	98	204	318	426	535	585	663	712	762
EXISTING RIVER BED (LOWEST)	22.370	18.150	22.660	24.070	24.590	23.870	24.660	18.023	23.150	22.860
DESIGN RIVERBED										
DESIGN HIGH WATER LEVEL										
DESIGN DIKE CROWN										

SECTION NO (UD)	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
DISTANCE FROM STATION UDO	810	860	1.054	1.152	1.256	1.308	1.356	1.406	1.456	1.510
EXISTING RIVER BED (LOWEST)	22.760	24.270	25.280	25.520	24.870	24.790	25.830	26.180	25.950	25.760
DESIGN RIVERBED		24.700	24.916	25.024	25.140	25.198	25.251	25.307	25.362	25.422
DESIGN HIGH WATER LEVEL		34.000	34.035	34.053	34.072	34.081	34.090	34.099	34.108	34.118
DESIGN DIKE CROWN		34.800	34.835	34.853	34.872	34.881	34.890	34.899	34.908	34.918

SECTION NO (UD)	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
DISTANCE FROM STATION UDO	1.560	1.678	1.772	1.872	1.962	2.060	2.160	2.262	2.368	2.468
EXISTING RIVER BED (LOWEST)	25.840	25.870	25.400	26.220	26.180	26.140	25.840	25.790	26.900	26.650
DESIGN RIVERBED	25.478	25.609	25.713	25.824	25.924	26.003	26.144	26.258	26.376	26.487
DESIGN HIGH WATER LEVEL	34.127	34.149	34.166	34.184	34.200	34.233	34.266	34.300	34.335	34.369
DESIGN DIKE CROWN	34.927									

SECTION NO (UD)	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00	40.00
DISTANCE FROM STATION UDO	2.578	2.676	2.772	2.874	2.966	3.066	3.166	3.266	3.364	3.458
EXISTING RIVER BED (LOWEST)	26.420	27.210	27.210	26.100	27.210	27.160	25.490	27.060	27.300	27.130
DESIGN RIVERBED	26.609	26.718	26.824	26.938	27.040	27.151	27.262	27.373	27.482	27.587
DESIGN HIGH WATER LEVEL	34.405	34.438	34.470	34.504	34.535	34.568	34.601	34.635	34.667	34.699
DESIGN DIKE CROWN										

SECTION NO (UD)	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00	50.00
DISTANCE FROM STATION UDO	3.588	3.688	3.788	3.888	3.988	4.088	4.188	4.288	4.388	4.488
EXISTING RIVER BED (LOWEST)	27.750	27.620	26.120	27.190	26.490	26.440	26.680	28.790	29.120	30.520
DESIGN RIVERBED	27.731									
DESIGN HIGH WATER LEVEL	34.742	34.775	34.809	34.842	34.875	34.909	34.942	34.975		
DESIGN DIKE CROWN										

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT

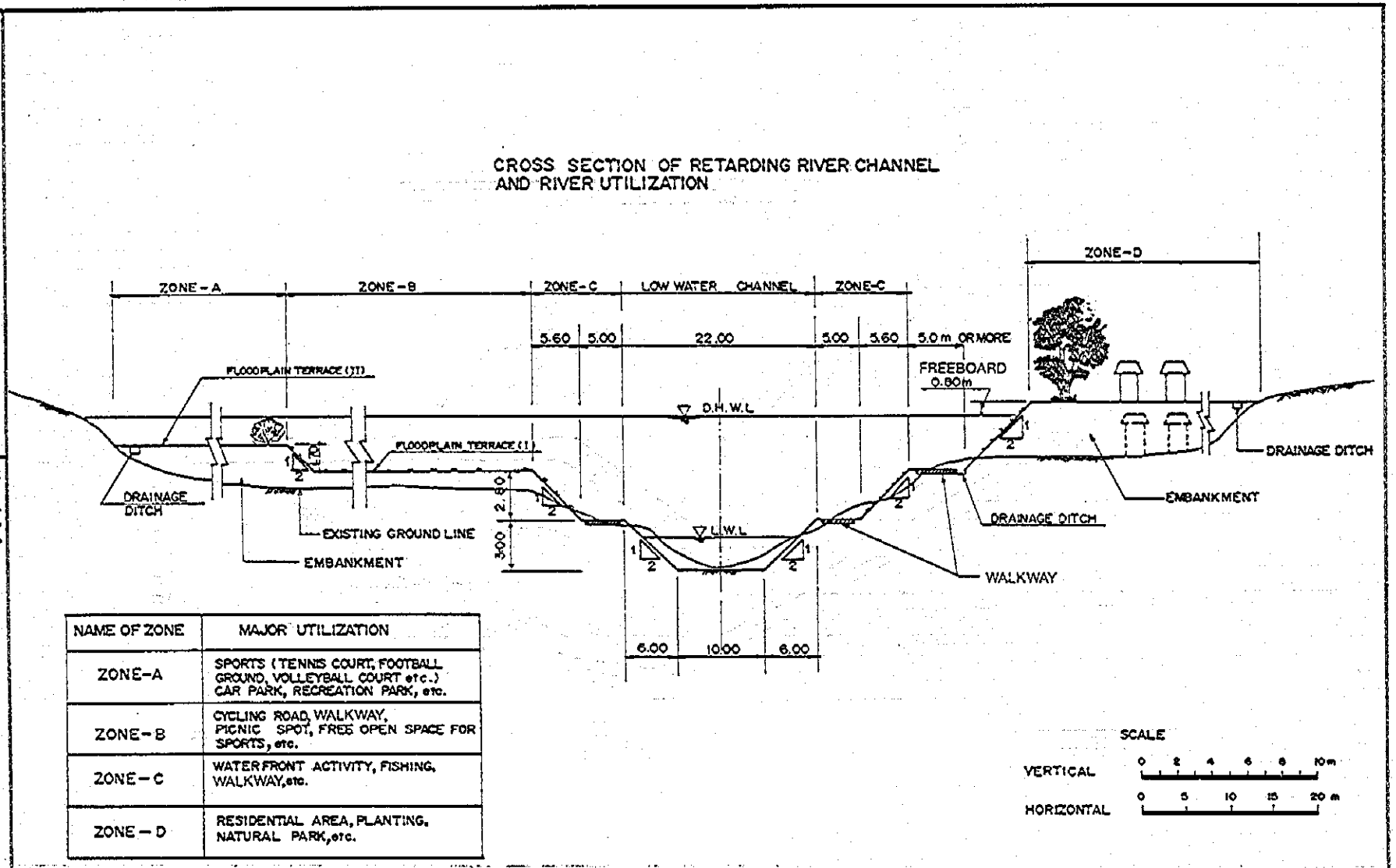
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.7
LONGITUDINAL PROFILE OF RETARDING CHANNEL OF DELI RIVER

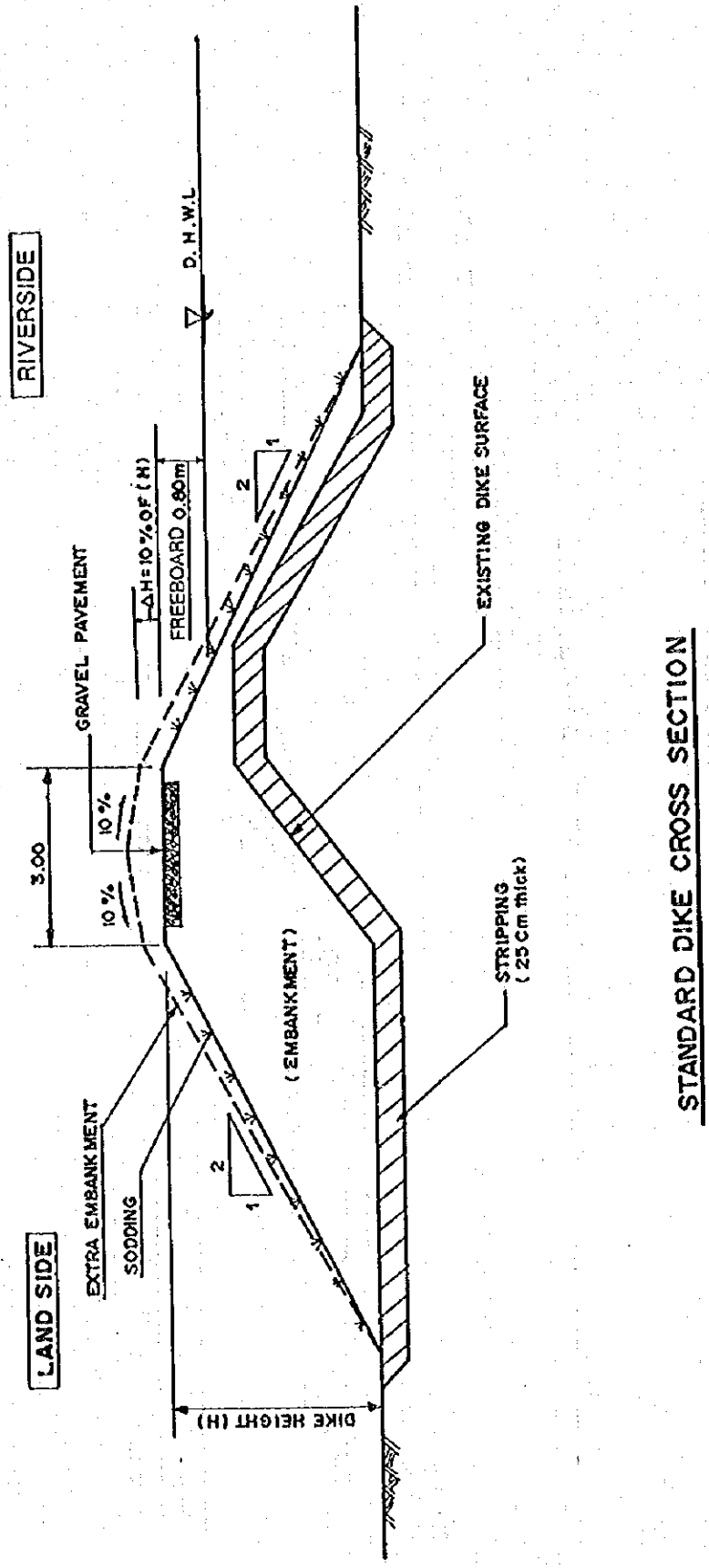
DETAILED DESIGN STUDY ON
MEDAN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

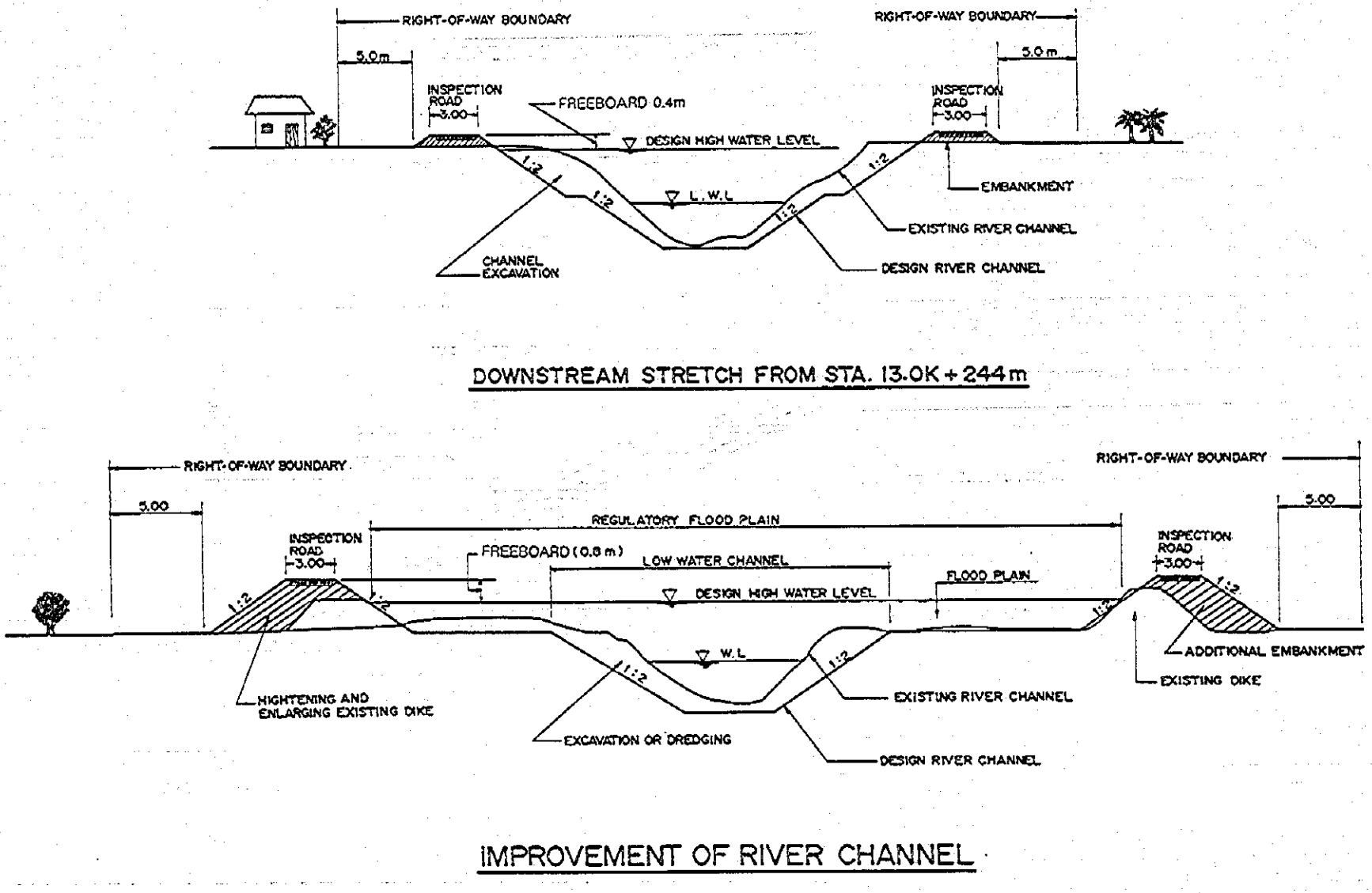
Fig. 4.2.8
TYPICAL CROSS SECTION OF RETARDING CHANNEL OF DELIRIVER AND CHANNEL UTILIZATION



NAME OF ZONE	MAJOR UTILIZATION
ZONE-A	SPORTS (TENNIS COURT, FOOTBALL GROUND, VOLLEYBALL COURT etc.) CAR PARK, RECREATION PARK, etc.
ZONE-B	CYCLING ROAD, WALKWAY, PICNIC SPOT, FREE OPEN SPACE FOR SPORTS, etc.
ZONE-C	WATER FRONT ACTIVITY, FISHING, WALKWAY, etc.
ZONE-D	RESIDENTIAL AREA, PLANTING, NATURAL PARK, etc.



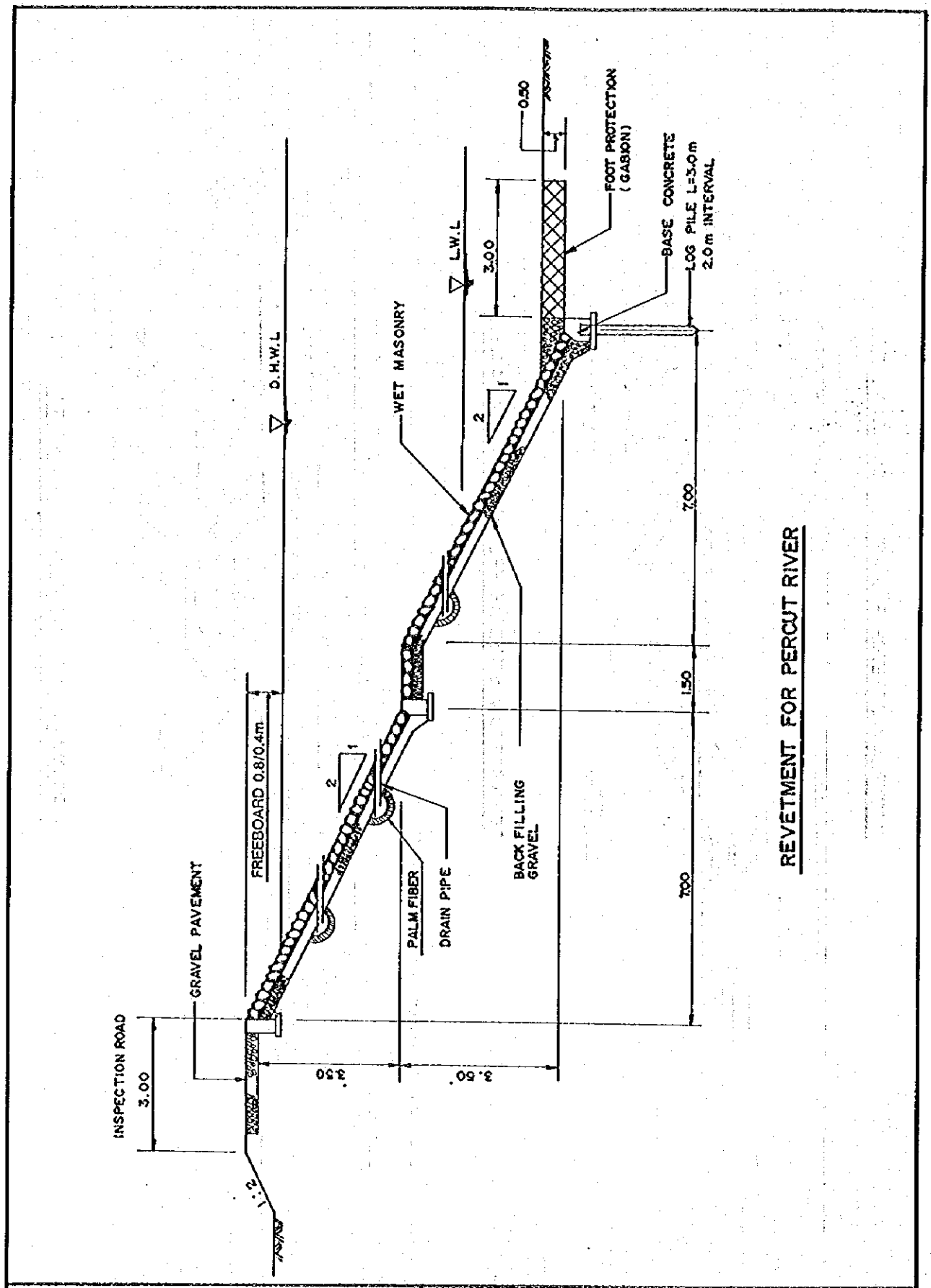
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.9 CROSS SECTION OF PROPOSED DIKE
JAPAN INTERNATIONAL COOPERATION AGENCY	



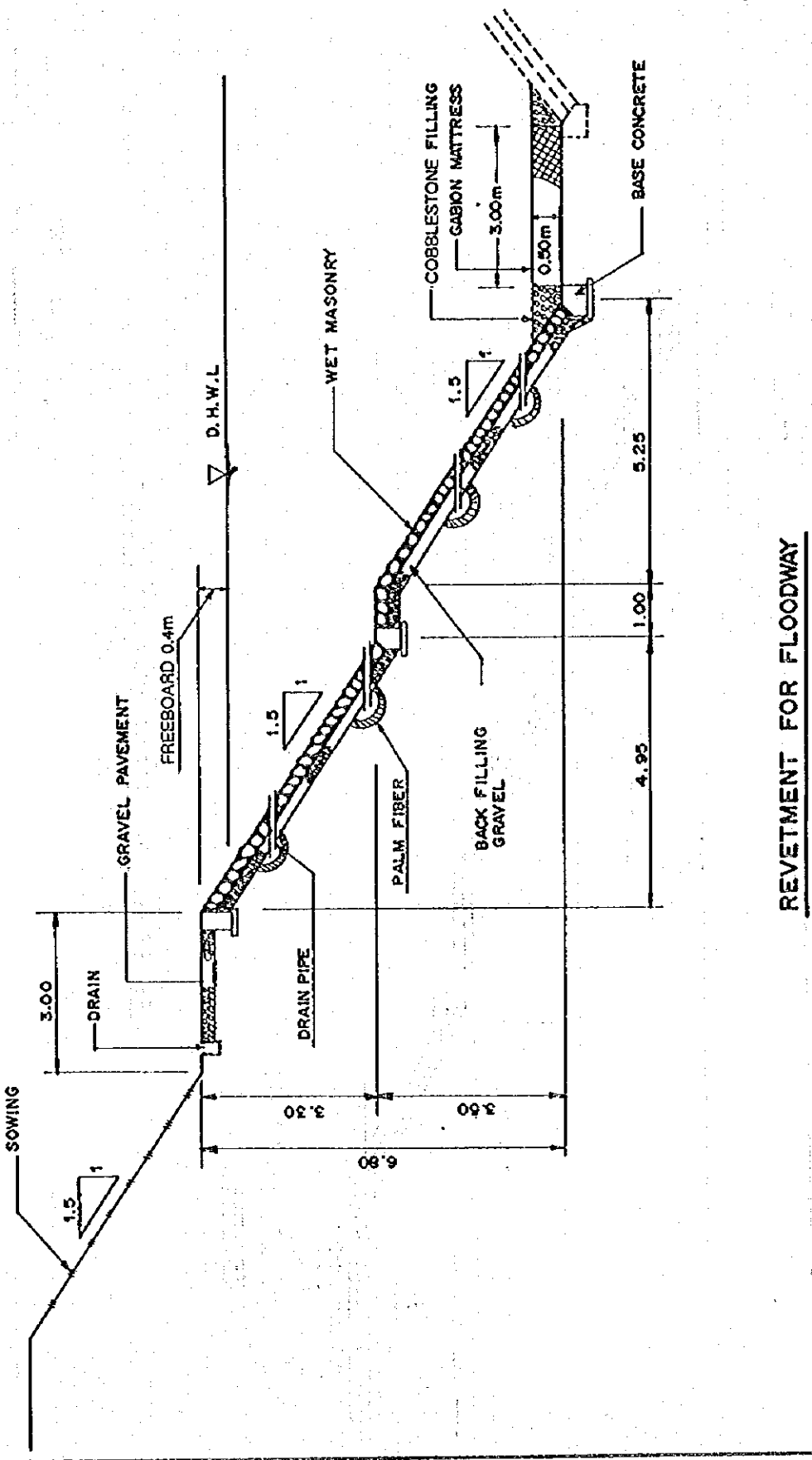
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

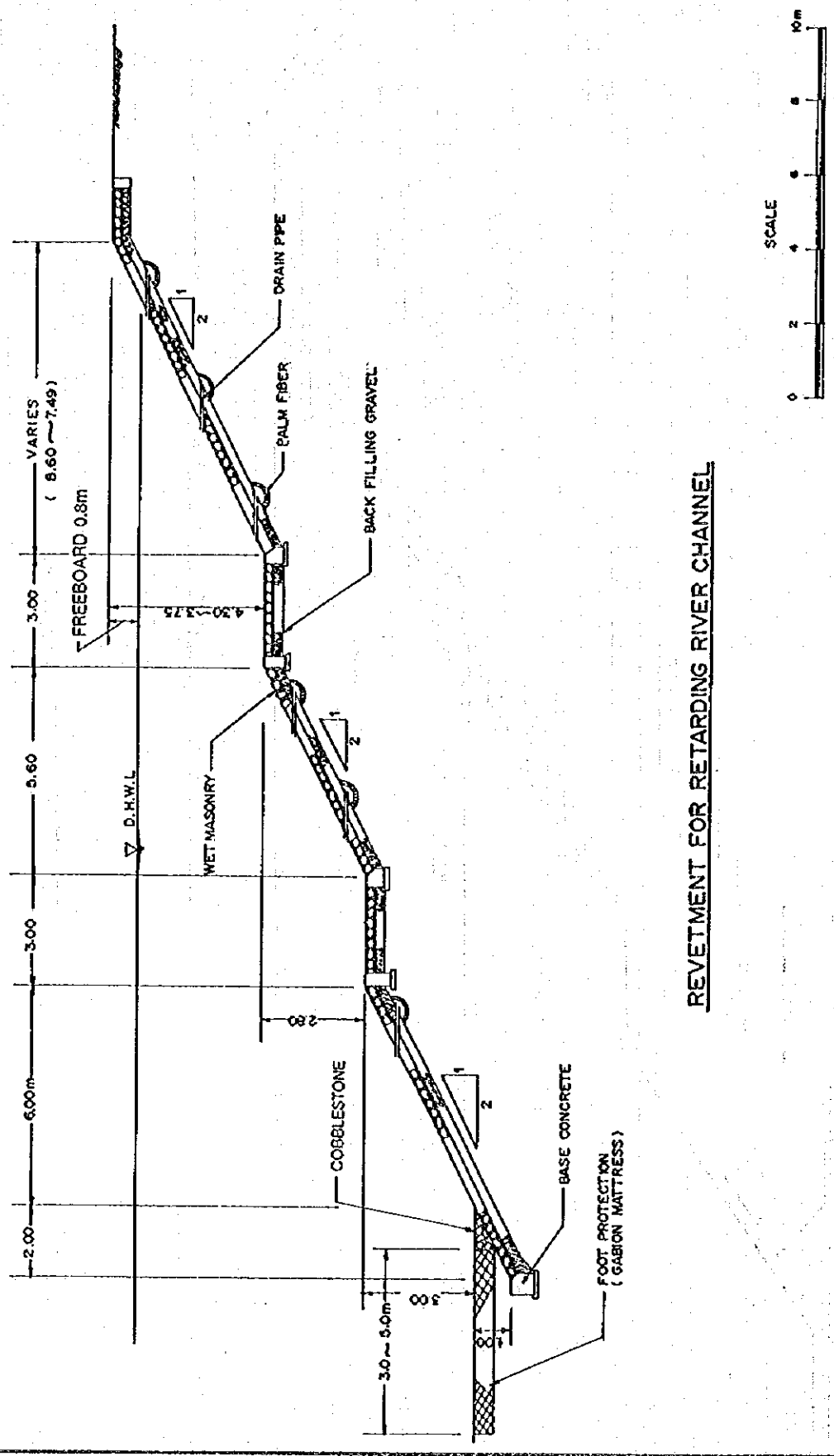
Fig. 4.2.10 DIKE IMPROVEMENT OF PERCUT RIVER



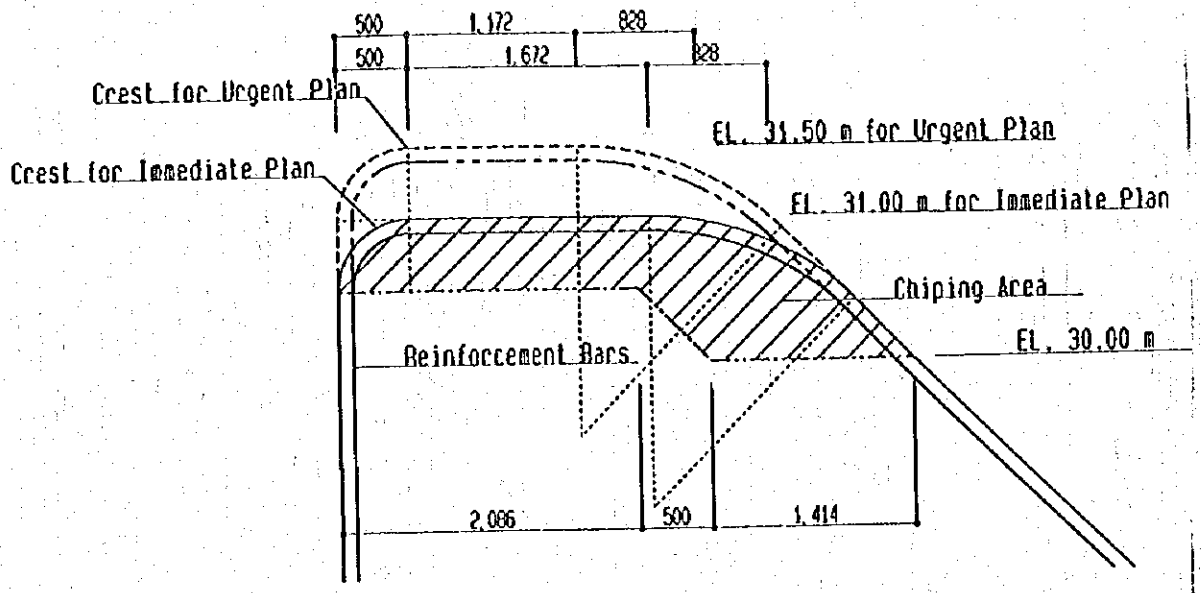
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.11 REVETMENT FOR PERCUT RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



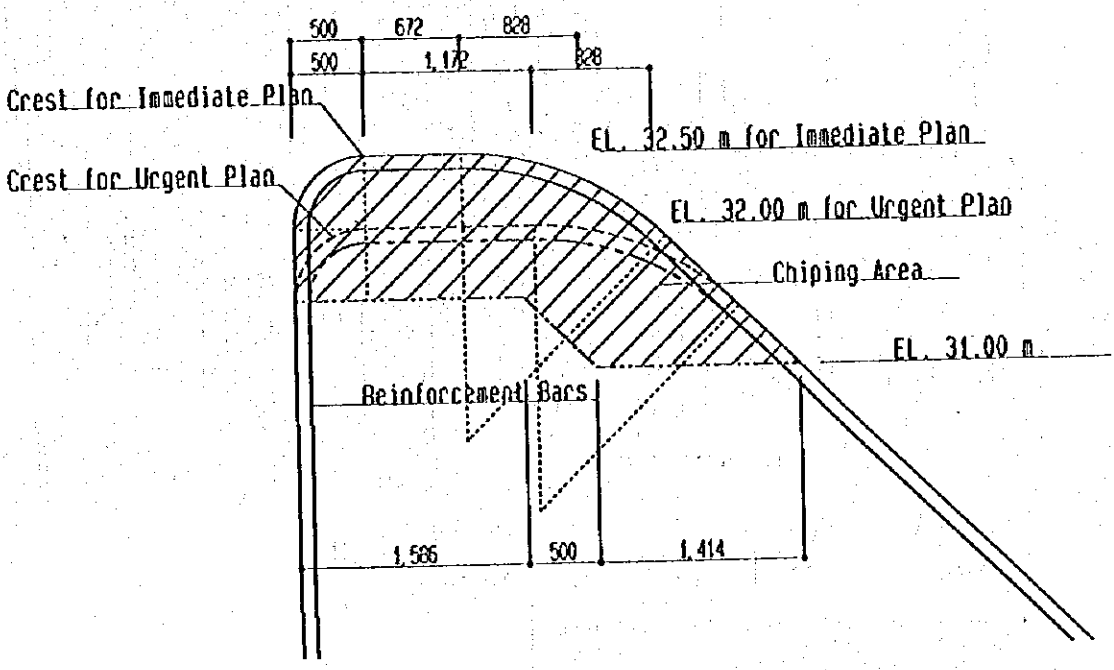
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.12 REVETMENT FOR MEDAN FLOODWAY
JAPAN INTERNATIONAL COOPERATION AGENCY	



DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.13 REVETMENT FOR RETARDING CHANNEL OF DELI RIVER

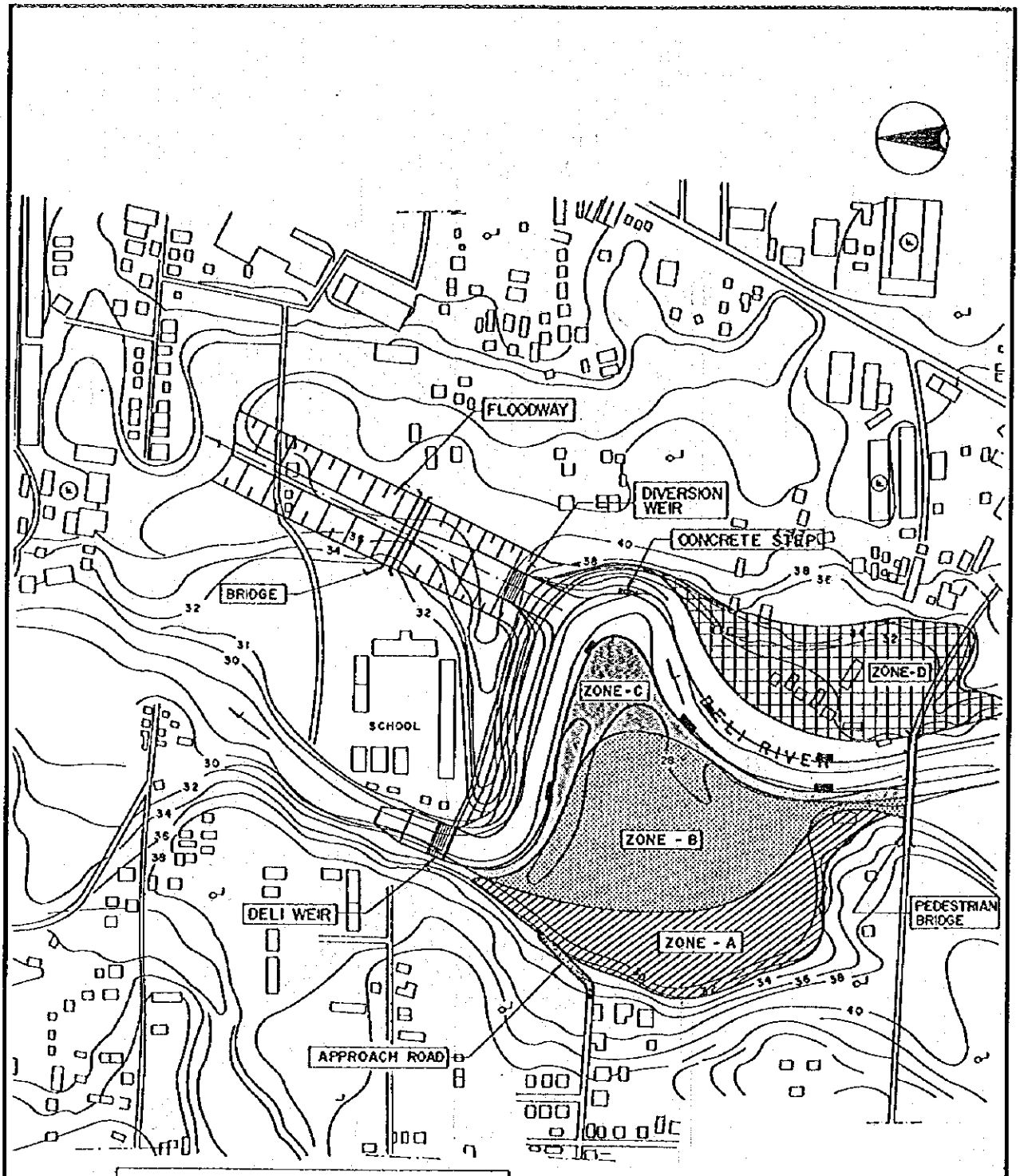


Deli River Weir



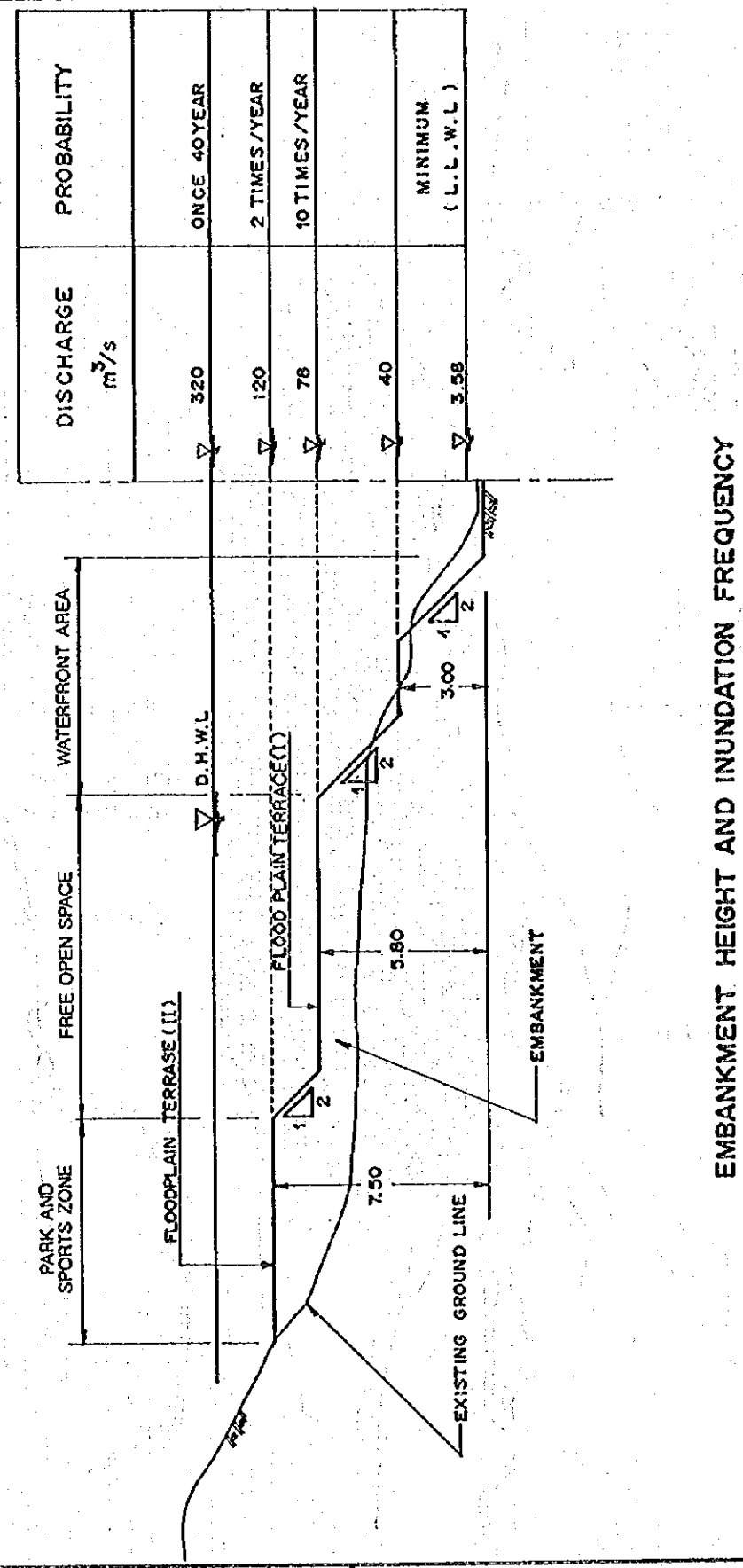
Floodway Weir

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.14 MODIFICATION METHOD OF CREST OF DIVERSION WEIRS



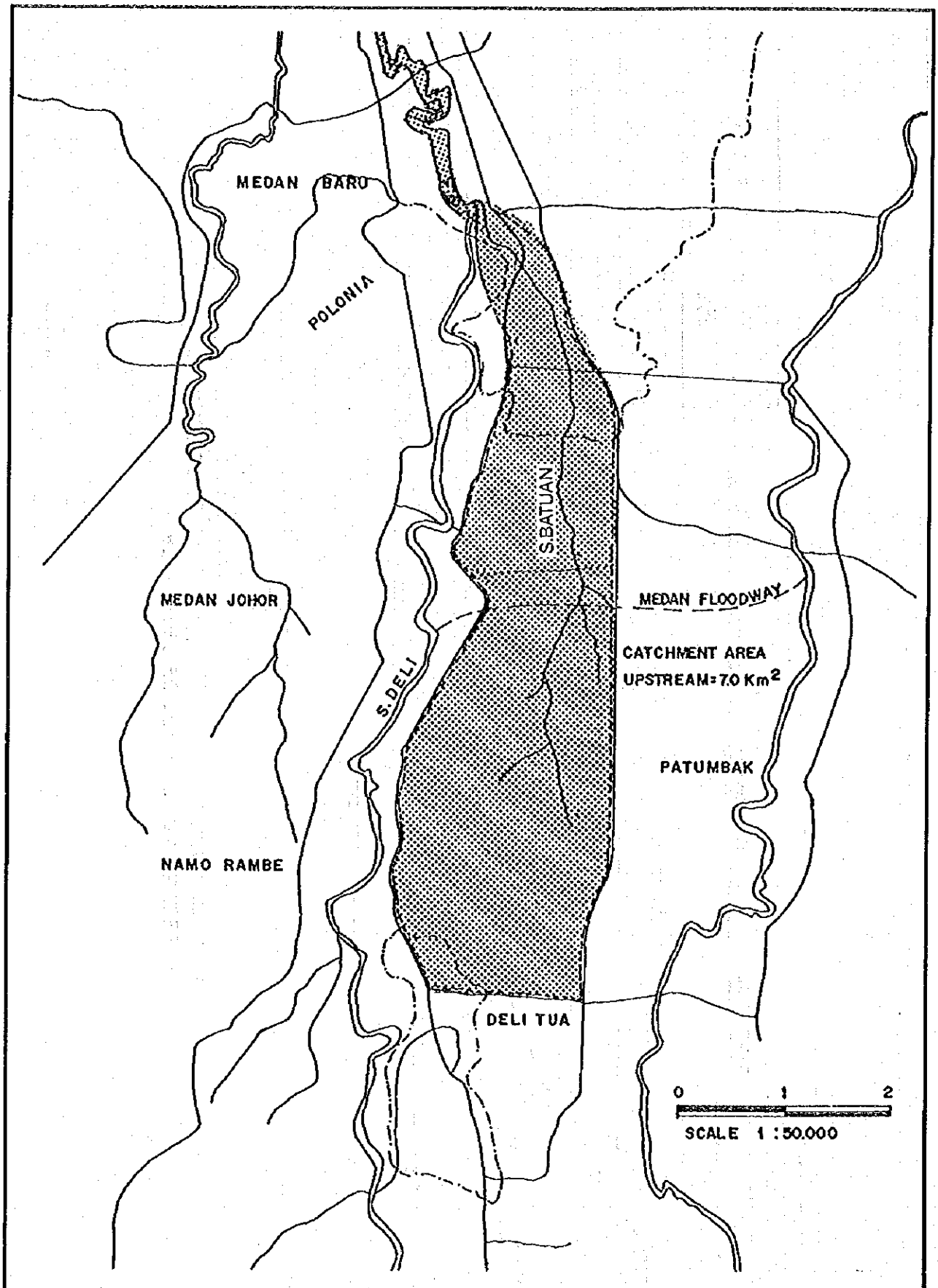
LAND USE ZONING OF RETARDING CHANNEL OF DELI RIVER

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.15 LAND USE ZONING IN RETARDING CHANNEL OF DELI RIVER



EMBANKMENT HEIGHT AND INUNDATION FREQUENCY IN RETARDING CHANNEL OF DELI RIVER

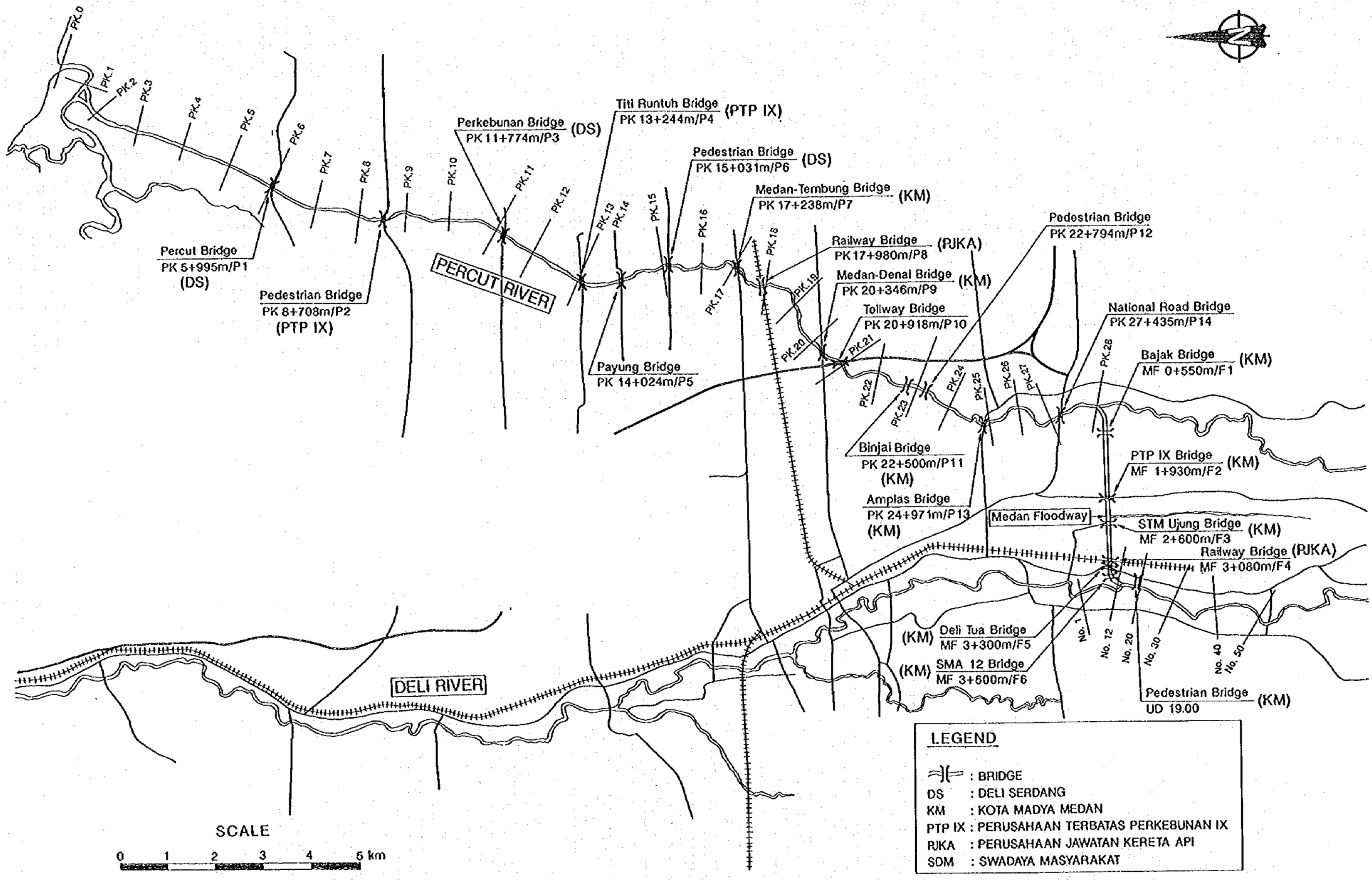
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 4.2.16 EMBANKMENT HEIGHT AND INUNDATION IN RETARDING CHANNEL OF DELI RIVER



DETAILED DESIGN STUDY ON
MEDAN FLOOD CONTROL PROJECT

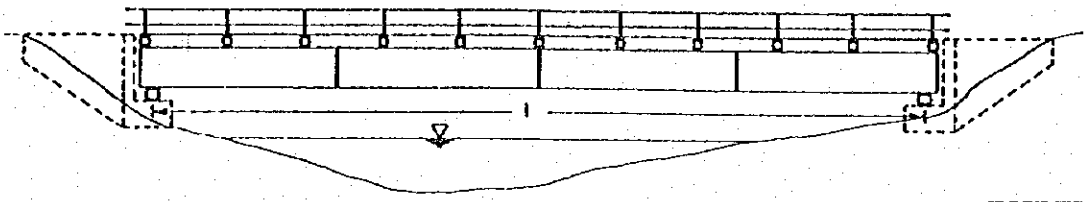
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.2.17
BATUAN RIVER BASIN

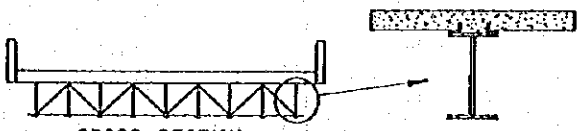


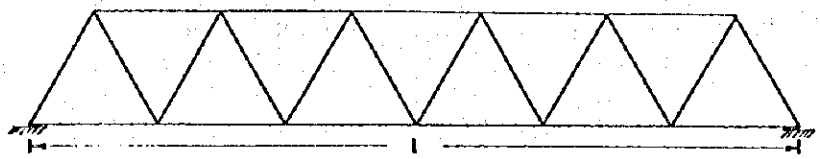
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.18 LAYOUT OF BRIDGE LOCATION
JAPAN INTERNATIONAL COOPERATION AGENCY	

a. STEEL BRIDGE

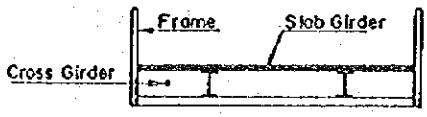


a.1. PLATE GIRDER

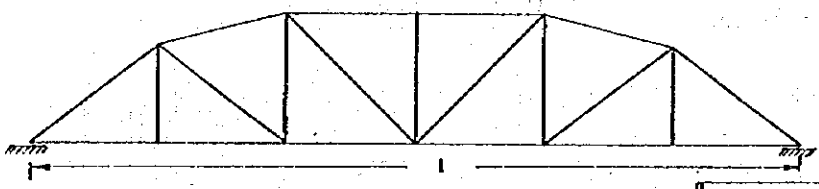




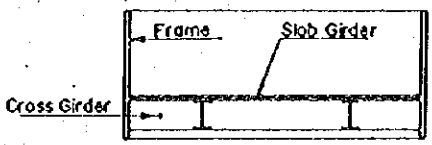
a.2. WARREN TRUSS



CROSS SECTION



a.3. PRATT TRUSS



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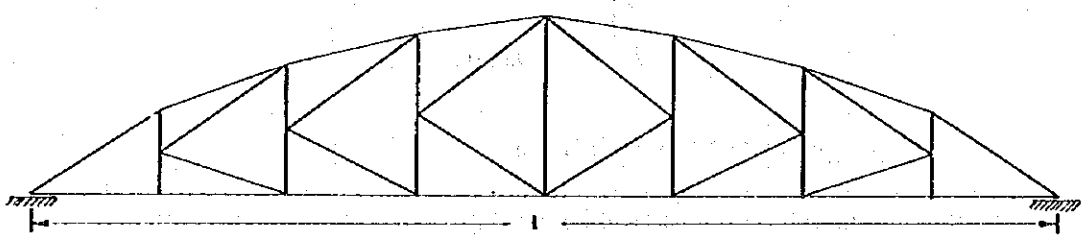
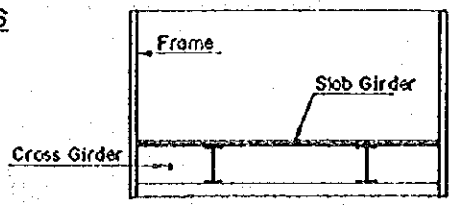


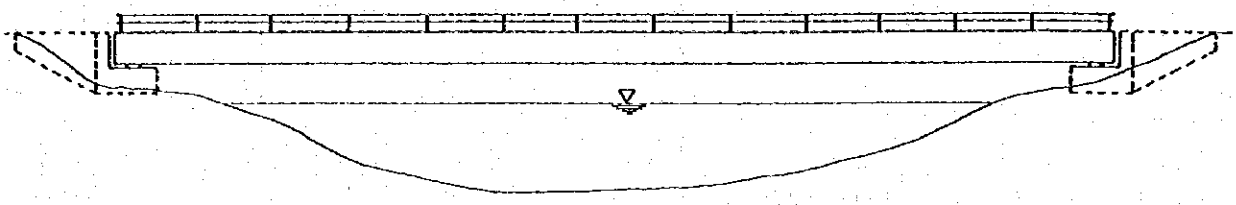
a.4. K - TRUSS

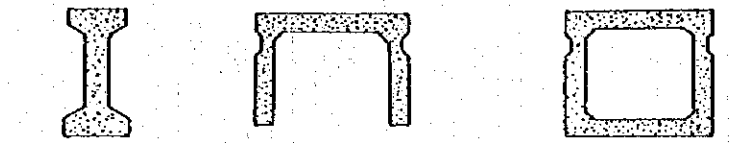


CROSS SECTION

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.19 (1/2) CROSS SECTION OF EACH BRIDGE TYPE
JAPAN INTERNATIONAL COOPERATION AGENCY	

b. PRESTRESSED BRIDGE

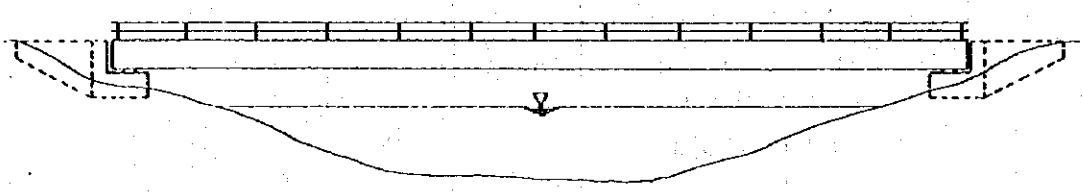


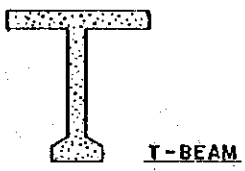


(a). I GIRDER (b). CHANNEL GIRDER (c). BOX GIRDER

c. REINFORCED CONCRETE BRIDGE

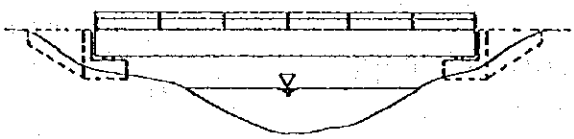
c.1. T. BEAM





T-BEAM

c.2. SLAB CONCRETE BRIDGE

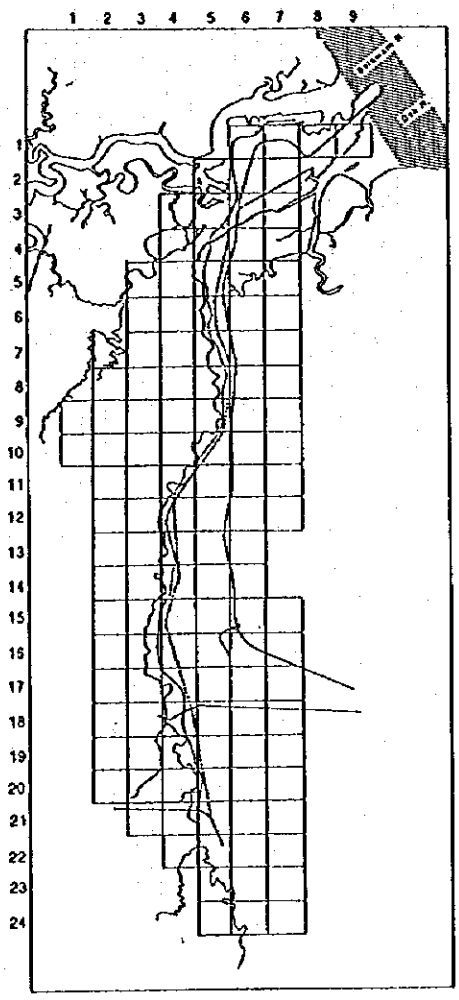


(a) (b)

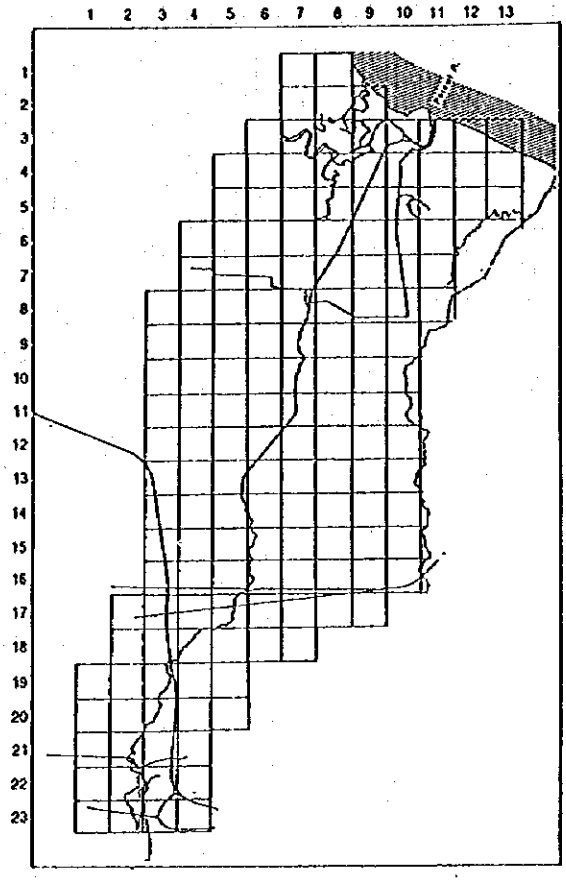
SLAB

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 4.2.19 (2/2) CROSS SECTION OF EACH BRIDGE TYPE
JAPAN INTERNATIONAL COOPERATION AGENCY	

DELI RIVER



PERCUT RIVER



DETAILED DESIGN STUDY ON
MEDAN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 4.3.1
MESH-MAP OVER DELI AND PERCUT RIVER BASINS

CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS

CHAPTER 5. ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 Environmental Impact Study

5.1.1 Review on Previous Study

The Environmental Impact Study (ANDAL) was carried out in August 1991 as part of the B-P Study by JICA. However, the study results have to be reviewed in accordance with the new Government Regulation No. 51 of 1993 regarding environmental impact assessment, and official approval of the Central Committee on Environment (KOMPUS) is required prior to project implementation. The ANDAL should provide analytical information on what environmental impact could be brought by the project to the river and its surrounding areas, and its main purposes are summarized as follows:

(1) To assist decision-makers in selecting the alternatives of the plan or scheme from the environmental aspect;

(2) To integrate environmental considerations in the detail design of the project; and

(3) To serve as a guide to environmental management and monitoring.

Taking account of the above, the review study on the ANDAL was conducted as proposed in the Terms of Reference (KA-ANDAL). The review shows that physical aspects such as climate, geology, topography, soil and land use remain the same as before, but the analysis of water quality of both Deli and Percut rivers is deemed to be necessary in the present study stage for subsequent management and monitoring works. In addition, the water table of shallow wells existing along the proposed floodway has to be measured and observed, because it may lower due to the construction of Medan Floodway and bring adverse effects on the resulting rural living environment.

A biological approach is also considered as an important factor in the environmental study. The previous ANDAL covered studies on fauna and flora in three river basins such as Deli, Percut and Padang, and confirmed that there are rare species of wild animals, birds and fishes in the Lau Simeme dam site upstream of Percut River. However, this site is not considered to be a project-affected area since the project area is defined to be downstream of Titi Kuning and Tembakau where neither endangered species nor protected animals have been reported to exist. The dominant plants in the project area are bananas, coconuts, palm trees and cacao, but these are cultivated for domestic consumption or commercial purposes. In general, therefore, no significant biological impact is anticipated with the Project; hence, the items studied were

limited to life forms such as plankton, benthos, necton and aquatic plants, all of which may be affected by discharge and water quality.

Social aspects were of great concern in this review study, because it is no longer practical for all data and information collected in the feasibility study to represent the actual conditions of the project area. The social environment has certainly changed due to urbanization and regional development, and it will serve as an indicator to determine the socio-economic impact on the community. Aware of the fact that people's perception and willingness to participate in the project are essential to successful project implementation, interview survey was carried out in concerned villages. The survey included farm economy, land ownership, public health, education and so on. It was conducted in such a way that 100 families were selected at random from eight villages to answer the questionnaire.

5.1.2 Environmental Impact Statement

Water Quality Test

According to the decree of the North Sumatra Provincial Government regarding the classification of water standard which was enacted on May 19, 1992, there are four groups defined as A, B, C and D. With regard to the water test and analysis for both the Deli and Percut rivers, Group B is considered eligible according to the following description.

Group A	Drinkable water without treatment.
Group B	Water which needs to be treated for drinking and other domestic use.
Group C	Water which can be used for fishery and livestock.
Group D	Water which can be used for agriculture, industry and power generation.

Water samples were taken from 11 locations, six in Deli River and five in Percut River as indicated in Fig. 5.1.1. Test items were 45 in total including physical, chemical and microbiological analysis. According to the test results shown in Table 5.1.1, toxic substances were not detected in the river water. However, the results show that these two rivers are polluted particularly in the downstream as they run with wastewater discharged from a number of drain canals. It seems that almost all of the rivers running through the urban area are facing the same environmental problems.

The water quality test results are summarized as follows:

(1) Chemical Substances

In the classification of water quality, Group B has no standard values for color and turbidity, but the former is applicable to Group A, because the values range from 10 to

15 being within the maximum value of 15 TCU, and the latter is showing values over the maximum unit determined as Group A.

The contents of iron (Fe) and magnesium (Mg) show higher than the standard values in some locations at the lower reaches of the rivers. Hence, attention should be paid to the downstream from the confluence with the Sikambing for Deli River and also the downstream from the railway bridge for Percut River.

The increase of chemical substances undoubtedly results from wastes being produced by human activities in the urban area. The standard of hydrogen ion concentration pH ranges from 5 to 9. In the upstream the water is alkaline showing pH 8.5 to 8.8, while in the downstream it is 6.6, slightly acidic or nearly neutral.

(2) Chemical Indicator of Pollution

Despite of the fact that BOD and COD are significant indicators of water pollution, standard values are not determined as criteria of water quality, so that recommendable values are presumably set to be less than 20 mg/l for both BOD and COD. In the downstream from the confluence with Babura River, BOD shows high values such as 34, 48 and 38 mg/l representing high contents of organic substances in Deli River running through the urban districts. Consequently, dissolved oxygen (DO) does not reach the standard value of 6 mg/l. The same tendency can be seen in the test results for the contents of dissolved solids and suspended solids indicating high values in the lower reaches of the river.

The water quality of Deli River has been analyzed under MUDP and PROKASIH, and values of BOD, COD and DO are graphically shown in Figs. 5.1.2 and 5.1.3 as compared with test results by the Study Team. On Percut River, BOD and COD represent favorable values at the junction with the proposed floodway indicating 14 mg/l and 20 mg/l, respectively.

However, these values increase to 28 mg/l and 40 mg/l in the downstream showing that the water quality has degraded due to the intrusion of pollutants from housing areas. Fig. 5.1.4 shows variations of BOD, COD and DO on Percut River in proportion to the distance from the estuary. Judging from the test, Percut River is less polluted than Deli River in terms of organic contents.

(3) Toxic Substances

Toxic substances such as arsenic, cyanide, cadmium, barium, chrome hexavalent and so on were not detected from both the Deli and Percut rivers.

(4) Bacteria

Only faecal coliform has been detected from water samples for the test on coliform bacteria in the laboratory of P.T. Sucofindo, so that total coliform could be represented by the number of faecal coliform. The upstream water of the two rivers contains 240 in 100 ml of water which is less than the standard value of 2,000, but the number of coliforms detected from the downstream water is 2.4×10^5, a tremendous increase of bacteria which represents a remarkable hygienic deterioration.

Two locations are pointed out in this regard: the confluence with the Sikambing and that with Bandar Sidoras. The lower reaches of these two locations are critical in terms of sanitation. The river is part of life especially for low income families, because river water is used for bathing, washing clothes and sanitary purposes as well, but it should be noted that these daily activities are closely related to the increase of coliform.

Sediment Composition

Two samples of sediment were taken from the riverbed of Percut River: one under the railway bridge at Tembung and the other one under the national road bridge at Amplas. The test results show that the mud contains 4.6 mg/l of lead (Pb) indicating an unexpectedly high level. In addition, copper (Cu) and chromium (Cr) were detected from the samples. Since these substances were not found in the river water, they may have been discharged with the wastewater from factories and accumulated on the riverbed because river flow is impeded by the Bandar Sidoras Intake Weir preventing the sediment from being flushed away. The results of sample analysis are tabulated below.

Item No.	Parameter	Unit	Location 1	Location 2
1	Arsenic (As)	mg/l	0.000	0.000
2	Beryllium (Be)	mg/l	0.000	0.000
3	Copper (Cu)	mg/l	2.668	3.531
4	Chromium (Cr)	mg/l	0.020	0.101
5	Mercury (Hg)	mg/l	0.000	0.000
6	Lead (Pb)	mg/l	4.556	4.641
7	Stannum (Sa)	mg/l	0.000	0.000
8	Cadmium (Cd)	mg/l	0.010	0.000
9	Barium (Ba)	mg/l	0.000	0.000

(Note) Location 1 is under the railway bridge at Tembung; Location 2 is under the national road bridge at Amplas.

Shallow Well

Water table is considered as an indicator to measure the impact on groundwater due to the construction of the floodway. The measurement of water table was carried out on June 29, 1995 for shallow wells which are currently being used by the residents.

Fig. 5.1.5 shows the location of 14 sample wells selected along the proposed floodway. The western part of this district has been developed as business and residential areas, but no sufficient services are provided by the PDAM.

Therefore, shallow wells predominate in this area as a source of potable water. They reach the water table at 1 to 5 m below the ground surface, and depth is 2 to 5 m depending on the location.

However, the water level may fluctuate according to the season. Monitoring will be required to observe the groundwater level during and after the construction, and an appropriate measure should be taken to assure the safety of drinking water to the residents quantitatively and qualitatively.

Biological Component

(1) Plankton

Sampling locations are the same as those for water test, and the test was carried out in the laboratory of North Sumatra University to analyze species and density of plankton. In the upstream of Deli River, 6 to 11 species were confirmed as a test result with the density of between 70,000 and 130,000 per liter of water, while in the downstream it shows 4 to 9 species with the density of 50,000 to 90,000. On the other hand, 10 species were found in the upstream of Percut River and 7 to 9 species were confirmed in the downstream.

The density of respective locations is 140,000 and 70,000 to 120,000 individuals per liter of sample water. Taking a look at the diversity index, it fluctuates from 1.02 in the upstream to 0.58 in the downstream of Deli River representing the degradation of water quality due to the increase of BOD. Meanwhile, the index shows minor changes in Percut River from 0.93 to 0.81. As a general concept, the result also shows that the more species can be found in less polluted water.

(2) Benthos

Samples were taken from the mud soil of the riverbed at the same location as plankton. The study result shows species, number of individuals per square meter and diversity index (Shannon Weaver). The number of species was confirmed to be 7 in each river, among which Amnicola is predominant. It also represents high density in the upstream indicating 141 to 313 individuals/m^2 for Deli River and 537 individuals/m^2 for Percut River. As far as Deli River is concerned, only one kind of Benthos was detected in the middle and downstream, and its diversity index is null. It means that there is no favorable environment for the Benthos to survive there except for Amnicola.

(3) Necton

Study was conducted through the interview with local people and field observation, and as a result, 8 species of fishes have been confirmed in Deli River and 12 in Percut River. These are neither endangered species nor protected ones. The size of fishes in Percut River is slightly bigger than those found in Deli River. The most popular one in this area is called "Ikan Sapu-Sapu," and it is, however, not edible.

(4) Aquatic Plant

Three species of aquatic weeds have been confirmed in the field observation. Those are Eichornia Crassipes (water hyacinth), Hydrilla Verticillata and Spirogyra. H. Verticillata is the most dominant species in both rivers. E. Crassipes can be seen at the proposed diversion weir site on Deli River. The mangrove trees growing at the estuary of Percut River are playing an important role in terms of natural ecosystem. They stretch only on the left bank occupying about 60 ha of area. Mangrove no longer exists on the right bank and fish industry has been developed in turn with the great loss of such valuable resources for environmental preservation.

Social Aspects

(1) Project Area

The project area comprises part of Medan urban area and Deli Serdang consisting of five kecamatans or sub-districts: Medan Johor, Medan Amplas, Medan Denai, Medan Tembung and Percut Sei Tuan. The number of villages involved, called kelurahan, is supposed to be 25 altogether, as shown below.

Proposed Channel	Medan/Deli-Serdang	Kecamatan	Kelurahan
Percut River	Medan City	M. Amplas	Timbang Deli, Amplas, Harjusari I, Sitirejo II, Sitirejo III
	Medan City	M. Denai	Binjai, Denai, T.S. Mandala II, T.S. Mandala III, Medan Tenggara
	Medan City	M. Tembung	Tembung
	Deli Serdang	P. Sei Tuan	Bandar Khalifah, Bandar Setia, Saentis, Cinta Rakyat, Cinta Damai, Percut, Laut Dendang, Sampali, Pematang Lalang
Floodway	Medan City	M. Johor	Titi Kuning, Sukamaju
	Medan City	M. Amplas	Harjosari II
	Deli Serdang	Patumbak	Patumbak Kp. Marindal Satu

Source: City Planning Office (Tata Kota)

Fig. 5.1.6 shows the sub-districts covered by the social impact study. According to the topographic map at 1/1,000 prepared in October 1995 covering the whole target area, the total area to be required for the land expropriation is estimated at 213 ha including public properties. Above all, the river improvement works of Percut River need to acquire about 136 ha of land which accounts for 64% of the total required area. Although the occupancy rate of residential area is more or less 9% as a whole, it turns up to 25% for the floodway area and 26% for the upstream of Percut River.

Table 5.1.2 shows details on the basis of identified land use. The number of project-affected houses/buildings will amount to 936 including public facilities such as schools, mosques, factories, etc., out of which 902 units are privately owned. However, the number of project-affected families is estimated at 1,584. It can be noted that most of the housing units are located in the residential area for the floodway, while 70% of houses are in wetlands downstream of Percut River.

This contrast may be induced by the difference of socio-economic conditions between these two areas. Houses in the floodway area are generally neat and stable with 113 m^2 of average floor space, while those in Percut River are built in the riverside for low income people with 58 m^2 of floor space. The number of project-affected houses and floor spaces are listed in Tables 5.1.3 and 5.1.4.

(2) Land Ownership

The study report shows that a family holds land of 0.095 ha on average for the proposed floodway, while it is 0.24 ha along Percut River. The difference in the average lot size is mainly due to the difference of land category. The floodway area is located in the urban planning zone where the land is being developed for housing construction and become a highly populous area especially in the western part. On the other hand, the land along Percut River is in rural area developed for agricultural use. It can be developed more as suburban villages to supply farm products to the city.

It is reported that only 23.6% of all residents have officially registered their own land with certificates issued by the Proyek Nasional Agraria (PRONA: National Agrarian Project) under the National Land Agency (BPN). This can be described as 71% for the floodway area and 16% for Percut River. The percentage of registered land is extremely low in the rural area of the Percut mainly because of the domination of settlements for low income people around the area. These people are keeping a traditional way of life without paying attention to land registration. Despite of these facts, land compensation can be paid to each project-affected family regardless of whether or not the land is duly registered.

(3) Economy

Survey data show that there is a big gap in annual income per capita between the two areas. Since the floodway area is greatly influenced by and even incorporated with the urban economy of Medan, people are engaged in various works such as commercial business, industry, public services, skilled and unskilled labors, and the average income per capita is estimated at Rp. 670,000 annually. The area along Percut River, on the other hand, can be categorized as a zone of rural economy which is based on small scale monoculture. People are dedicating themselves to the task of farming, fishery and simple labor in plantations. Rice is the main crop in this area with successful achievement of double-cropping a year under irrigation system. Annual earnings per capita will amount to Rp. 420,000.

(4) Public Health and Education

Sanitary environment is a basic issue to discuss public health. According to the interview survey, liquid waste is discharged into open ditches at the rate of 77%, and drain pipes for the remaining 23%. It pours into the river at the extreme end.

With regard to the solid waste, 55% of domestic waste and refuse produced in the area is thrown into rubbish boxes, whereas 45% is dumped into the river or drain channels. Since garbage collecting service is provided in the proposed floodway area by the public sanitary enterprise, solid waste management rate is relatively high. On the contrary, this service is not rendered in the area along the Percut River except for some sub-districts in the upstream, so that the waste is disorderly dumped into the flow channel producing stench.

The public water supply system PDAM is less developed in the project area covering about 20%. The water demand of residents in the floodway area is covered by the service of the PDAM and groundwater, while people in the area along Percut River are depending on shallow wells and river water which may cause water-related diseases. The study report indicates that about 20% of all respondents often suffer disease inflicted by water, and skin diseases are predominant in the Study Area.

School attendance rate is high indicating about 85% of all school age children in the area. In the floodway area, this figure goes up to more than 90%. This may be based on the nationwide promotion for children's education. For those who go to college or university, it shows only 1.34% as a whole. Educational facility and school staff are considered sufficient to a certain extent. One elementary school exists at the rate of 401 children in the study area, which is slightly less than that of Medan City.

(5) People's Perception

The interview survey conducted in the project area indicates that no one is opposed to the project and, basically, 100% of all respondents agree to the implementation of the project for the following reasons:

(1) To enhance village development by mitigating flood damage	36.0%
(2) To improve the living environment	22.5%
(3) To expect compensation for land and house	21.3%
(4) To create job opportunities	20.2%

Meanwhile, some people feel anxiety about the project, because they are not aware of how much their lives will be affected by negative impacts such as disturbance and inconvenience during and after construction. People in the Percut area are worried about the deterioration of river water. Nevertheless, it can be noted that all respondents take a positive attitude to the project and are desirous of participating in

project related works. This trend may be based on the people's potential demand for flood control and also apprehension for its approach.

5.2 Environmental Impact Assessment

5.2.1 Environmental Management Plan

Based on the impact study, the environmental management plan was formulated with a view of preventing and mitigating negative impacts as well as enhancing positive strategic impacts. The following issues were discussed as basic approach to the establishment of a proper management plan. All fundamental issues on environmental management are summarized in Table 5.2.1.

Social Approach

(1) Land Acquisition

Land issue is supposed to be the most significant social impact on the community in the pre-construction stage. In principle, land acquisition depends on direct negotiations with project-affected people, and it should be concluded by mutual agreement before the construction work starts. If some conflict arises therefrom, the project might be suspended and scratched in the worst case.

However, continuous effort is expected all the time to keep dialogue with the people. At the request of the Project Office, a land acquisition committee has been created under the direction of the Mayor or Bupati to take up legal procedures on land compensation. An inventory survey has also been conducted by the Badan Pertanahaan Nasional (BPN: National Land Agency) to provide information on the number of affected families, parcels and evaluation of their compensation values, and all these works have to be properly managed by the Project Office. Since no resettlement plan has been taken into account, people have no choice except cash-based negotiation.

(2) Management of Expropriated Land

After land expropriation, the Project Office should pay more attention to the encroachment of people into public land. This matter has to be watched carefully from time to time even after the construction, and any illegal action should be strictly prohibited especially on the use of land or building of a house in the restricted area.

The Project Office is required to take immediate action in collaboration with other agencies concerned for the demolition of houses existing in the expropriated land and the relocation of public facilities as well. This might be very important in the land acquisition process to show that ownership of the land has changed to the government.

(3) Mitigation of Public Inconvenience

It is also necessary to take measures during the construction period for the prevention of noise, dust and traffic congestion, and special care needs to be taken in thickly populated areas in the mobilization of heavy equipment and its operation. The noise problem can be minimized in an effort to control daily operating hours of equipment. Sprinkling water is also required during construction as a means of dust prevention. It is, however, more difficult to control traffic since a number of dump trucks will be mobilized and moved around the construction site to transport soil materials. In this sense a dumping site for surplus soil should be properly selected at the nearest location possible from the construction site, otherwise the project may worsen the present traffic conditions. The volume of soil produced by the floodway construction is estimated to be as much as 1.3 million m^3. This volume has to be carried away from the site in such a manner that no disturbance arises therefrom in the current traffic. This issue shall have to be discussed further along with the location of dumping site and work schedule.

Technical Approach

(1) Quality of River Water

Although toxic substances were not detected in the river water, the values of BOD and COD reflect the high contents of organic matter. This is mainly because of the wastes discharged from the factories and settlements. Since there is no specific standard for these parameters, there is no proper way to control the quality for the moment. Under these circumstances, more efforts should be made so as not to worsen the quality in every possible way, and should lead to gradual improvement in the long run. To achieve this objective the following matters have to be taken into consideration:

(a) Revision of water standards including BOD, COD, organic matter, suspended solids and so on.

(b) Control of liquid waste from factories and improvement of drainage system.

(c) Periodical collection of garbage and refuse dumped in the channel in close cooperation with the Perusahaan Daerah Kebersihan (Public Sanitary Enterprise).

(d) Technical assistance and collaboration of PROKASIH (Clean River Project) in monitoring work.

(e) Promotion of clean river campaign and sanitary guidance to the community in association with the villagers' organization called Lembaga Ketahanan Masyarakat Desa (LKMD).

In the construction stage, turbidity may increase due to the earth moving work and, as a result, more sediment is anticipated in the downstream. Thus, the quality is temporarily degraded but may not affect the river environment as a whole. Since water quality test was conducted in the ANDAL study, a monitoring survey is absolutely necessary during and after the construction to watch carefully the degree of pollution.

(2) Aquatic Biology

A large number of mangrove trees in the coastal area have already vanished in proportion to the development of the fishing industry. Mangrove trees are found only on the left bank at the river mouth of Percut River, so that the dike should not be constructed in this part of the area in order that the trees can grow and survive in a condition of natural ecology. The same attention needs to be drawn to the fishing industry to restrict fishpond construction.

The increase of sediment may give a negative impact on benthos during the construction period since they are small aquatic plants and animals living at the bottom of the river. It seems that this is not serious because the river will recover its function shortly after construction is completed. The management of aquatic weeds is also an important task as a maintenance work, because growth of these plants may reduce the flow capacity of the channel. This can be done easily by cutting the weeds and cleaning the channel free from any obstruction.

(3) Groundwater

The issue on groundwater is limited only to the floodway area, and no influence is anticipated in the area of Percut River. The groundwater level will fluctuate from time to time whether it is rainy season or not.

It is still too early to judge if the groundwater is significantly affected by the construction of floodway. If the answer is positive, it must be clear how much impact

there is. Care should be taken anyhow not to create any water shortage problem in this area. Therefore, monitoring is absolutely necessary to make a constant observation of the water level in selected shallow wells.

According to the interview survey, the PDAM serves more than 50% of the residents in the floodway area, and services will increase year by year. From the optimistic point of view, the groundwater will no longer be used as a source of domestic water in the future, and the public water supply system could replace it.

(4) Others

The Percut River is designed with increased flow capacity because flood discharge will be partly diverted from Deli River. The water level may also increase and bank overflow will consequently inundate the surrounding area. Therefore, dikes have to be constructed on both sides of the river to protect the area from flooding.

However, the swampy area existing on the left bank near the river mouth is an exceptional case from the ecological reason as described in item (2). On the other hand, it will be necessary to build a dike on the right bank for the protection of fishponds.

In view of the fact that toxic substances are found in the sediment, more information is required to estimate its volume. Proper measures shall be taken, as the case may be, to treat them separately from other sediments. Mud with high contents of toxic matters such as lead and copper should not be used as embankment material. It is advisable to dispose them by mixing with concrete as a preventive measure against leakage.

5.2.2 Environmental Monitoring Plan

Significant Parameters for Monitoring

Based on the present environmental conditions any significant change shall be carefully observed and marked to determine the project impact regardless of whether it is positive or negative. This monitoring work has to be performed periodically for a certain period of time depending on the subject parameter.

The impact source varies according to the project stage. In the pre-construction stage, for example, the significant impact source is land expropriation; in the construction stage on the other hand, it is certainly represented by civil works such as embankment, dredging, excavation, mobilization of equipment and material, and so on. In the post-construction stage

there is no specific impact source, but it can be determined based on all natural and social environmental effects resulting from the construction of flood control facilities.

There are a number of parameters to be monitored in each stage. Most of them were described as significant items for the management plan and are also considered inevitable for the subsequent monitoring work in terms of environmental assessment. In this regard the parameters tabulated below shall be carefully surveyed.

Project Stage	Parameter
(1) Pre-Construction Stage	(a) Any issue arising from land expropriation
(2) Construction Stage	(a) Noise level, dust content level, traffic congestion (b) River water quality (c) Sedimentation (volume and treatment of soil mixed with toxic substances) (d) Groundwater level along the floodway (e) Irrigation water for the paddy field at Bandar Sidoras (f) Aquatic biology (plant and biota)
(3) Post- Construction Stage	(a) Illegal use of expropriated land (b) River water quality (c) Sedimentation by erosion (d) Groundwater level along the floodway (e) Solid waste and refuse in the riverbank (f) Project effect and evaluation

Monitoring Method

Basically, there are four methods to collect relevant data and information: (1) field observation, (2) interview survey, (3) field measurement, and (4) sample analysis. The monitoring method is decided in accordance with the subject matter.

Field observations and interview are the most basic ways to conduct a monitoring survey. These methods are mainly employed to approach the social aspects such as progress of land compensation, people's willingness to participate in the project and any other socio-economic changes.

The field measurement method is often applied using proper equipment and material, and the output can be quickly provided by such direct measurement at site. This method can be used for the survey of noise level, dust pollution, groundwater level and so on, but frequent measurement is required to make the data more reliable because the value of these parameters may change according to the time and season.

On the other hand, the sample analysis method is used for such parameters as water quality and detection of toxic contents in the sediment. Samples are taken periodically from the selected

location and analyzed in an eligible laboratory to trace test results from the environmental point of view. These results may help alleviate adverse effects in the long run.

In principle it is advisable that the monitoring location remain unchanged. Noise and dust level study can be conducted only in dense populated areas, i.e., the western part of the floodway and upstream of Percut River represented by Titi Kuning, Binjai, Mandala and Tembung. Sampling locations for the study of river water quality and groundwater level should be the same as those selected in the ANDAL study. The number of sample locations is 11 and 14, respectively.

During the construction period sedimentation also needs to be monitored near the estuary, because sediment may sometimes interrupt the navigation of fishing boats at ebb tide. For the toxic matters found in the sediment, it is recommendable to take a few more samples from each river for further detailed examination prior to construction.

Monitoring duration and frequency have been discussed to achieve an effective study. Since these two matters can be decided on the basis of impact source and characteristic of each parameter, the minimum required period and time shall be carefully determined to provide reliable information. Based on the deliberation and discussion, the required duration and frequency for each parameter are set as follows:

Parameter	Duration	Frequency
Land Expropriation	As long as problem unsettled	Every 6 months
Noise, Dust, Traffic	Construction period	Every 3 months
River Water Quality	Construction period + min. 2 years	Every 3 months
Sediment	Construction period	Every 6 months
Groundwater	Construction period + min. 1 year	Every 6 months
Irrigation Water	Construction period + min. 1 year	Every 6 months
Aquatic Biology	Construction Period + min. 1 year	Every 6 months
Illegal Land Use	Construction period + min. 2 years	Every 3 months
Solid Waste and Refuse	After construction, min. 2 years	Every 3 months
Project Effect	After construction, no limit defined	Once a year

Relevant Institutions

Apart from the DPUP North Sumatra or project owner, several government agencies or institutions will be involved in environmental monitoring implementation or its supervision. The project owner is expected to take the initiative as an implementing agency for this purpose, but since the local government is more concerned with social matters, all information on community and sub-district may be available from BAPPEDA TK. II of Medan and Deli Serdang, except for the land issue which is managed by the Land Acquisition Committee.

Generally, the Ministry of State for Environment deals in the environmental impact management as a supervisor, however, its operational agency, called Badan Pengendalian Dampak Lingkungan (BAPEDAL), has not been created yet in North Sumatra. Under these circumstances, all environmental issues are discussed in the Regional Committee, called Komisi Daerah (KOMDA), under the direction of the chief of BAPPEDA TK. I.

The monitoring for river water quality can be undertaken as part of PROKASIH which is promoted under the auspices of the Bureau of Population and Environment, North Sumatra Provincial Government. Fundamental issues on the monitoring plan are compiled and summarized in Table 5.2.2.

5.3 Social Impact Study

5.3.1 Inventory Survey

Administratively, the project area is under Medan City and Deli Serdang District, encompassing four sub-districts (kecamatans) of Medan City and two sub-districts of Deli Serdang District. The construction works of Medan Floodway could affect two villages of Medan Johor Sub-District, one village in Medan Amplas and two villages in Patumbak, and the Percut River improvement works could affect 11 villages of three sub-districts in Medan City and 9 villages of Percut Sei Tuan Sub-District. Their areas, population and number of households are presented in Table 5.3.1.

Existing Land and Resources Use

Areas of the respective land uses were measured along Percut River, Upper Deli River and the Floodway, as presented in Table 5.3.2.

(1) Agriculture

Land use for agricultural activities in the project area can be classified into three categories; namely, (1) cropland for annual crops consisting of paddy field and other food crops (corn, peanut, etc.); (2) plantation land for cocoa, sugarcane and tobacco; and (3) mixed garden of coconut, banana, rambutan, duku, etc. Total area of plantations affected by the project is estimated at 13.25 ha and paddy field is at 7.19 ha.

(2) Fishery and Aquaculture

Land use for fishery (fishpond) is found only in Harjosari II Village with a total area of 1.31 ha. Aquaculture (shrimp ponds) is found in the river mouth area (Bagan Percut). The total area of shrimp ponds to be affected by the project is estimated at 0.59 ha.

(3) Industrial Establishments

Industrial establishments spread over Amplas, Tembung and Bandar Khalifah (along Percut River) and Titi Kuning (along the proposed floodway). The total area of industrial land to be affected by the project is estimated at 17.48 ha.

(4) Residential Area

The residential areas to be affected by the project spread along the proposed floodway and Percut River, especially rather densely in the villages of Titi Kuning, Sukamaju, Harjosari, Binjai, Menteng, Tegal Sari, Denai, Kenangan Tembung, Bandar Setia and Percut. The total area of residential land is estimated at 35.55 ha, consisting of 3.75 ha along the proposed floodway and 31.80 ha along Percut River.

Buildings, Structures and Facilities

The number of buildings and structures to be affected were counted along Percut River, Upper Deli River and the Floodway, as presented in Table 5.3.3.

(1) Houses

The number of houses to be affected by the project is counted at 902 units consisting of 768 units along Percut River, 125 units along the floodway, and 9 units in the retarding channel upstream of Deli River Weir.

(2) Schools

The number of public schools is three, which are located along the proposed river improvement area. Moslem schools are four; three are located along Percut River and one in the floodway.

(3) Mosques and Churches

The mosque which will be affected by the project is 10 units consisting of eight units in the Percut River improvement section, one unit in the floodway and one unit in the retarding channel. The churches to be affected by the project are found in Kenangan Village (Perumnas Mandala) with the total of three units.

(4) Cemeteries

The cemeteries to be affected by the project spread over the villages of Binjai, Tegal Sari, Denai, Kenangan and Percut. The total number of cemeteries is nine places; eight of them are Moslem cemeteries and one, Christian cemetery.

Infrastructure

(1) Roads and Bridges

Totally, there are 22 road networks to be affected by the implementation of the project. Among them, 15 road networks are located in the area of Percut River improvement works and 7 road networks in the floodway. The detailed data on name of road network, type of pavement and relative structures are presented in Table 5.3.4.

The bridges to be affected by the project are 15 units; namely, 14 units along Percut River and one unit upstream of the proposed Deli River Weir. Among the 15 bridges, road bridges are 12, railway bridge is one and pedestrian bridges are two units. Furthermore, new bridges across eight sections of the floodway are required to be constructed to preserve the existing traffic and transportation which will be interfered by the construction of floodway. Most of the existing bridges will be reconstructed except the national road bridge and the railway bridge which will be provided together with riverbed and slope protection works.

(2) Drainage

In accordance with the survey in the D/D Study, 37 drainage outlets are identified to be draining inland water into Percut River. For the floodway, 8 channels are found to be either drainage channels or roadside ditches crossing the floodway, while one channel is serving the paddy field on the other side.

All drainage outlets towards Percut River will be reconstructed in the course of the Percut River improvement works, and seven new drainage outlets will be constructed. The irrigation channel will be replaced by a pipe over the floodway to keep supplying irrigation water.

(3) Water Supply

The inventory survey on water supply system clarified that there are five water transmission pipes lain across the floodway and six pipes on Percut River. All pipes will be re-installed with a water pipe bridge for pipes with a diameter of more than

600 mm, or at the side of new bridges. The water transmission system and its main pipes to be affected by the project are illustrated in Fig. 5.3.1 and Table 5.3.5.

(4) Electrical Installation

The survey on electrical installation shows that there are 39 electrical poles, one unit of transformer and one unit of distribution box along the floodway, and 18 electrical poles in the area of Percut River improvement works, as presented in Table 5.3.6.

(5) Telephone Installation

The number and location of telephone posts were surveyed in the project affected area. There are totally 29 posts identified in the area, i.e., Titi Kuning, Sukamaju and Marindal Village, and details are shown in Table 5.3.7.

Development Plan

The development plans which were identified in the project area are as follows:

(1) Development of residential area in Jl. SMA 12, Titi Kuning with 12 units of houses.

(2) Development of residential area in Tembung Village (left bank of Percut River) with the total development area of 2 ha. Development will be undertaken by a private company.

5.3.2 Prediction and Evaluation

Social impacts will possibly accrue during the pre-construction, construction and post construction stages of project implementation. The impacts predicted in each stage are presented below as summarized in Table 5.3.8.

Pre-Construction Stage

Social conflicts may arise due to land acquisition, especially when the rate of compensation is not acceptable to the local people. The impacts can be categorized into four; namely, disturbance to land use (agricultural land, fishery, aquaculture, residential area, industrial area), disturbance to houses/buildings, disturbance to public facilities (schools, mosques/churches, cemetery, etc.), and disturbance to plants.

The total area required for the Project is estimated to be 223 ha consisting of housing site of 26.54 ha. mixed garden of 28.67 ha, shrub/swamp/idle land of 60.66 ha, dry land of 58.25 ha, paddy field of 8.77 ha, fishpond of 6.97 ha, plantation of 23.94 ha, industrial area of 2.52 ha, infrastructure of 4.40 ha, public facilities of 0.58 ha, and others of 1.7 ha.

The number of houses to be affected by the Project is around 950 units consisting of permanent houses of 408 units, semi-permanent houses of 215 units and temporary houses of 326 units. It is predicted that public apprehension may arise especially in Percut Village when house evacuation is inconsistent with the resettlement plan and the rate of house compensation is not sufficient to pay a new location. The impact of land acquisition is considered as an important negative impact, because there are many aspects and facilities that could be affected. If no agreement is reached beforehand, social unrest will continue in the construction and the post construction stages. In short, public unrest may appear under the conditions mentioned below.

(1) When there is no agreement on the rate of compensation between the government and the local people;

(2) When house evacuation is inconsistent with the resettlement plan and the rate of compensation is not sufficient to pay for a new site or land;

(3) When the remaining land or house is not feasible to support people's livelihood in the future.

The number of mosques, churches, schools, moslem schools and cemeteries affected by the project are 10, 3, 3, 4 and 9 units, respectively. Public apprehension will occur if there are not special approaches to acquire all of these facilities.

Construction Stage

(1) Traffic Congestion and Disturbance to People's Mobility

Equipment and material mobilization, earth excavation for the floodway, dredging of Percut River, diking in Percut River and construction of supporting facilities are predicted to result in traffic congestion, especially along Jl. Medan-Delitua, Jl. Sisingamangaraja-Ampas, Jl. Seksama Ujung, Jl. Pasar Merah Ujung, Jl. Panglima Denai and Jl. Medan-Tembung which have the traffic volume of 13,090, 6,950, 25,000, 13,990, 10,180, 18,180 and 19,400, respectively. Generally, the traffic load in these road networks consists of essential commodities, manufactured products, building materials, foods, miscellaneous goods and agricultural products. The result of the traffic survey in the project area is presented in Table 5.3.9.

On the other hand, people's mobility will also be affected by the project in some locations; namely, Jl. Tapian Nauli, Jl. SMA 12, Gg. Amal, Gg. Salak. Gg. Kelapa Kuning (Titi Kuning Village), Jl. Suka Cerdas (Sukamaju Village), Jl. Tuba 3, Jl. Tanggul Kanan (Denai Village), Jl. Tanggul Kanan, Jl. Benteng (Bandar Khalifah

Village), Jl. Perhubungan, Jl. Terusan, Jl. Bandar Setia-Tambak Bayan, Jl. Kebun Coklat PTP IX (Bandar Setia Village), Jl. Cinta Damai, Jl. Todak and Jl. Bagan Percut (Percut Village).

Traffic congestion may arise especially on the busy road (6 segments) and people's mobility may be affected in 16 locations. Therefore, these impacts are considered as important negative impacts, although they will occur only in the construction stage.

(2) Disturbance to the Use of Percut River Water

The results of investigation show that 44.1% of the total population live along Percut River and use river water for bathing and washing. Disturbance of river water quality during the excavation of Percut River is therefore considered as an important negative impact of the project.

(3) Lowering of Water Level for Public Wells

Earth diking for the floodway and dredging of Percut River may result in the lowering of water level for public wells. The lowering of groundwater level may occur along the proposed floodway and this will be a serious problem because about 33% of the people in the proposed floodway still depend on the groundwater as a source of domestic water. However, this impact can be considered as insignificant because the lowering of groundwater level is only around 0.5 to 1 m, while the depth of shallow wells in the project site is 5.5 to 7.0 m and the water level is 2 to 5 m from the ground surface.

(4) Disturbance to Irrigation

In Percut River, there is an intake weir for irrigation at Bandar Sidoras. The total area of the paddy field being irrigated is about 3,400 ha and planting seasons start in December to January and June to July. Increase of sedimentation and turbidity in Percut River due to the excavation works is predicted to create a higher turbidity in the paddy fields irrigated by the Bandar Sidoras Intake Weir, and this impact is considered as an important negative impact of the project.

(5) Disturbance to Development Plans in the Area

Land acquisition will affect the development plans in the project site, i.e., the residential plan in Jl. SMA 12, Titi Kuning and the shopping complex plan in Tembung with the area of 5 ha and 2 ha, respectively. This impact is considered as a not important negative impact because the total area of the development plan is relatively small.

(6) Disturbance to the Use of Infrastructures

Earth diking for the proposed floodway, as well as dredging and diking of the Percut River is predicted to disturb the infrastructures, i.e., electrical installations, water supply pipes, telephone lines and sewerage channel. Therefore, the daily activities of people such as lighting, bathing, cooking, communication and liquid waste handling will be disturbed.

Disturbance to electrical installations will occur in some villages such as Titi Kuning, Sukamaju, Harjosari, Denai, Menteng and Binjai with the affected people totaling 212 households. Disturbance to the water supply system will affect some villages, namely Titi Kuning, Sukamaju, Harjosari II, Denai, Menteng, Binjai and Tembung. During the construction period, 6 villages will be affected by the disturbance of telephone installations, i.e., Titi Kuning, Sukamaju, Marindal, Denai, Menteng and Tembung.

On the other hand, the disturbance to drainage system will arise in almost all villages in the project area. Generally, the service area of the drainage system consists of residential areas (such as Tegalsari Mandala and Kenanga) and agricultural areas (such as those in Cinta Rakyat and Pematang Lalang).

Disturbance to daily activities of people due to the disburbance to infrastructures is considered as an important negative impact. The impacts will occur in many communities and villages in the project area.

(7) Disturbance to Industrial Activities

Land clearing will affect industrial activities in some locations, i.e., Titi Kuning and Bandar Khalifah. The industries to be affected by the project are the glass and paper industries in Titi Kuning, the sawmill in Bandar Khalifah, and the Chinese cake industry in Laut Dendang Village.

Disturbance to industrial activities in the construction stage is considered as a not important negative impact, because the total number of industries to be affected by the project is relatively small and the commodities produced are not essential for the people.

Post Construction Stage

Illegal utilization of land may occur along the Percut riverbank and the area bordering on the floodway in the post construction stage. The land may be used for residential, agricultural,

commercial and other activities. This illegal utilization may be due to the high growth of population and the limited land in the urban area.

The illegal utilization of land along the Percut riverbank and the area bordering on the floodway during the post construction stage is considered as an important negative impact, because the impacts will occur in the long period and they may increase other impacts such as pollution of river water, land use conflicts among people, and so on.

5.3.3 Impact Management Plan

As described in the preceding Subsection 5.3.2, several important as well as not important negative impacts will arise during the three stages of project implementation. A management plan for the social impacts is therefore necessary, as presented in Table 5.3.10.

In the framework of social impact management, the Project Office conducted extension meetings in the villages to be affected from March 8 to March 27, 1996. The results of these meetings show that more than 85% of the total number of project affected people or all of those who attended the meetings agree to the implementation of the project.

TABLES

CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS

Table 5.1.1 (1/2) RESULTS OF WATER QUALITY TEST

No.	Parameter	Water Quality Standard (B)	Sampling Site on Deli					
			1	2	3	4	5	6
1	Colour	- PtCo	10	15	15	10	10	10
2	Turbidity	- NTU	25	43	30	22	20	20
3	Water Temperature	Normal (°C)	28.6	28.9	29.5	29.4	28.8	29.3
4	Air Temperature	-	30.4	30.2	31.2	31.0	31.4	33.7
5	pH	5 ~ 9	7.22	7.08	6.88	6.77	8.80	8.52
6	Ammonium [NH4]	- mg/l	0.1	0.1	0.1	0.1	0.1	0.1
7	Calcium [Ca]	- mg/l	14.4	15.2	15.2	12.0	13.6	10.4
8	Copper [Cu]	1 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
9	Iron [Fe]	5 mg/l	2.442	5.654	7.324	4.321	3.019	2.683
10	Manganese [Mn]	0.5 mg/l	0.261	0.266	1.317	0.207	0.114	0.055
11	Magnesium [Mg]	- mg/l	6.4	4.9	19.0	5.4	4.9	5.4
12	Z i n c [Zn]	5 mg/l	0.011	0.043	0.049	0.024	0.079	0.007
13	Chloride [Cl]	600 mg/l	50	14	14	12	26	22
14	Fluoride [F]	1.5 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
15	Nitrate [NO3]	10 mg/l	0.2	0.4	0.2	0.6	0.2	0.2
16	Nitrite [NO2]	1.0 mg/l	0.5	1.2	0.2	0.2	0.0	0.0
17	Phosphate [PO4]	- mg/l	0.3	0.0	0.0	0.6	0.3	0.0
18	Sulfate [SO4]	400 mg/l	11	10	8.2	9.1	13	14
19	Barium [Ba]	1.0 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
20	Cadmium [Cd]	0.01 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
21	Cyanide [Cn]	0.1 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
22	Chrom Hexavalent [Cr+6]	0.05 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
23	L e a d [Pb]	0.1 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
24	Mercury [Hg]	0.001 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
25	Selenium [Se]	0.01 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
26	BOD [5 days 20 C]	- mg/l	24	38	48	34	26	23
27	COD [by K2Cr207]	- mg/l	40	60	80	60	40	40
28	Organic Matter [KMn04]	- mg/l	21	13	28	20	17	14
29	Anion Surfactan as ABS	0.5 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
30	Dissolved Solid	1,000 mg/l	70	50	60	40	40	40
31	Dissolved Oxygen	* 6 mg/l	1.8	2.6	1.8	2.4	3.5	3.5
32	Residue on Evaporation	- mg/l	0.0	0.0	0.0	0.0	0.0	0.0
33	Suspended Solid	- mg/l	6.7	4.9	6.0	3.8	3.8	3.8
34	Oil and Grease	- mg/l	0.0	0.0	0.0	0.0	0.0	0.0
35	Phenolic Compound	0.002 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
36	Sulfide	0.1 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
37	M.O Alkalinity [CaCO3]	- mg/l	70	60	65	50	40	20
38	P.P Alkalinity [CaCO3]	- mg/l	0.0	0.0	0.0	0.0	0.0	0.0
39	Total Alkalinity [CaCO3]	- mg/l	70	60	65	50	40	20
40	Total Hardness [CaCO3]	- mg/l	62	58	116	52	54	48
41	Total P	- mg/l	0.1	0.0	0.0	0.2	0.1	0.0
42	Arsen [As]	0.05 mg/l	0.0	0.0	0.0	0.0	0.0	0.0
43	Chromium [Cr]	- mg/l	0.0	0.0	0.0	0.0	0.0	0.0
44	Faecal Coliform	2,000/100 ml	2.4×10^5	2.4×10^3	2.4×10^5	2.4×10^2	2.4×10^2	2.4×10^2
45	Total Coliform	10,000/100 ml	2.4×10^5	2.4×10^3	2.4×10^5	2.4×10^2	2.4×10^2	2.4×10^2

* For surface water more than 6 mg/l suggested

Table 5.1.1(2/2) RESULTS OF WATER QUALITY TEST

No.	Parameter	Water Quality Standard (B)	Sampling Site on Percut				
			7	8	9	10	11
1	Colour	- PtCo	15	15	15	15	10
2	Turbidity	- NTU	32	40	38	40	22
3	Water Temperature	Normal (^{0}C)	28.4	27.2	29.7	29.8	28.6
4	Air Temperature	-	30.8	32.0	27.5	31.5	34.6
5	pH	5 ~ 9	6.64	6.60	8.57	8.58	8.53
6	Ammonium [NH4]	- mg/l	0.1	0.1	0.1	0.1	0.1
7	Calcium [Ca]	- mg/l	16.8	14.4	13.6	34.4	17.6
8	Copper [Cu]	1 mg/l	0.0	0.0	0.0	0.0	0.0
9	Iron [Fe]	5 mg/l	3.076	3.989	4.556	3.967	1.766
10	Manganese [Mn]	0.5 mg/l	0.062	0.113	0.120	0.565	0.000
11	Magnesium [Mg]	- mg/l	11.0	4.4	4.4	4.9	1.0
12	Z i n c [Zn]	5 mg/l	0.026	0.065	0.046	0.030	0.000
13	Chloride [Cl]	600 mg/l	175	13	14	31	12
14	Fluoride [F]	1.5 mg/l	0.0	0.0	0.0	0.0	0.0
15	Nitrate [NO3]	10 mg/l	0.8	1.6	1.3	1.0	0.2
16	Nitrite [NO2]	1.0 mg/l	0.4	0.6	0.4	0.4	0.0
17	Phosphate [PO4]	- mg/l	0.3	0.6	0.9	0.4	0.3
18	Sulfate [SO4]	400 mg/l	18	10	9.4	10	8.8
19	Barium [Ba]	1.0 mg/l	0.0	0.0	0.0	0.0	0.0
20	Cadmium [Cd]	0.01 mg/l	0.0	0.0	0.0	0.0	0.0
21	Cyanide [Cn]	0.1 mg/l	0.0	0.0	0.0	0.0	0.0
22	Chrom Hexavalent [Cr+6]	0.05 mg/l	0.0	0.0	0.0	0.0	0.0
23	L e a d [Pb]	0.1 mg/l	0.0	0.0	0.0	0.0	0.0
24	Mercury [Hg]	0.001 mg/l	0.0	0.0	0.0	0.0	0.0
25	Selenium [Se]	0.01 mg/l	0.0	0.0	0.0	0.0	0.0
26	BOD [5 days 20 C]	- mg/l	26	15	28	26	14
27	COD [by K2Cr207]	- mg/l	40	20	40	40	20
28	Organic Matter [KMn04]	- mg/l	69	7.8	17	19	11
29	Anion Surfactan as ABS	0.5 mg/l	0.0	0.0	0.0	0.0	0.0
30	Dissolved Solid	1,000 mg/l	120	40	40	40	40
31	Dissolved Oxygen	* 6 mg/l	2.8	3.1	2.5	2.3	4.7
32	Residue on Evaporation	- mg/l	0.0	0.0	0.0	0.0	0.0
33	Suspended Solid	- mg/l	13.8	3.7	3.9	3.4	3.1
34	Oil and Grease	- mg/l	0.0	0.0	0.0	0.0	0.0
35	Phenolic Compound	0.002 mg/l	0.0	0.0	0.0	0.0	0.0
36	Sulfide	0.1 mg/l	0.0	0.0	0.0	0.0	0.0
37	M.O Alkalinity [CaCO3]	- mg/l	75	55	55	55	60
38	P.P Alkalinity [CaCO3]	- mg/l	0.0	0.0	0.0	0.0	0.0
39	Total Alkalinity [CaCO3]	- mg/l	75	55	55	55	60
40	Total Hardness [CaCO3]	- mg/l	88	54	52	106	48
41	Total P	- mg/l	0.1	0.2	0.3	0.2	0.1
42	Arsen [As]	0.05 mg/l	0.0	0.0	0.0	0.0	0.0
43	Chromium [Cr]	- mg/l	0.0	0.0	0.0	0.0	0.0
44	Faecal Coliform	2,000/100 ml	2.4×10^5	2.4×10^5	2.4×10^2	2.4×10^2	2.4×10^2
45	Total Coliform	10,000/100 ml	2.4×10^5	2.4×10^5	2.4×10^2	2.4×10^2	2.4×10^2

* For surface water more than 6 mg/l suggested

Table 5.1.2 REQUIRED AREA FOR LAND EXPROPRIATION

(Unit : m^2)

Claasification	Floodway	Percut I (Downstream)	Percut II (Upstream)	Upper Deli	Total
Residential Area	32,310	7,720	109,100	46,270	195,400
Dryland/Wasteland	37,770	278,140	67,700	52,860	436,470
Cultivated Land	5,755	335,400	82,150	23,043	446,348
Paddy Field	12,405	67,700	0	0	80,105
Plantation/Woods	94,348	81,700	159,800	0	335,848
Wetland	9,020	283,500	69,670	0	362,190
Factory	3,725	0	12,180	730	16,635
Cemetery	160	0	12,800	0	12,960
Total	195,493	1,054,160	513,400	122,903	1,885,956

Table 5.1.3 NUMBER OF PROJECT-AFFECTED HOUSES AND FACILITIES

Item	Floodway	Percut I (Downstream)	Percut II (Upstream)	Upper Deli	Total
House	171	377	396	26	970
- Type A	105	276	150	24	555
- Type B	33	14	112	1	160
- Type C	33	21	109	1	164
School	2	0	2	1	5
Mosque	0	2	2	1	5
Factory	1	0	3	3	7
Cemetery	1	0	1	0	2
Church	0	0	1	0	1
Total	175	379	405	31	990

Table 5.1.4 FLOOR SPACE OF PROJECT-AFFECTED HOUSES AND FACILITIES

Item	Floodway	Percut I (Downstream)	Percut II (Upstream)	Upper Deli	Total
House	16,492	17,042	22,945	4,112	60,591
- Type A	11,922	16,006	10,355	3,912	42,195
- Type B	3,565	879	9,088	182	13,714
- Type C	1,005	157	3,502	18	4,682
School	600	0	34	960	1,594
Mosque	221	117	204	158	700
Factory	0	0	2,025	760	2,785
Church	0	0	304	0	304
Total	17,313	17,159	25,512	5,990	65,974

Note : house is classified into the following tree types in accordance with floor space directly affected by the Project.
Type A = Full floor space
Type B = More than 50%
Type C = Less than 50%

Table 5.2.1 ENVIRONMENTAL MANAGEMENT PLAN FOR MEDAN FLOOD CONTROL PROJECT

Impact Managed	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency Concerned
(Pre-Construction)					
-Social unrest	-Land acquisition -House evacuation	-Compensation -Public protest/ demonstration & project disturb	-Negotiation -Resettlement plan -Presidential decree No. 55/1993	All project affected villages	-Land acquisition committee -Project office -DGWRD -Cipta Karya
(Construction Stage)					
-Noise	Operation of heavy equipment	Noise level : 60 dBA	-Control of number or speed of vehicles/ equipment -Working hour -Equipment operators	Housing area	Project office
-Air pollution and traffic congestion	-Mobilization of equipment -Earth works	-Quality standard KLH decree No. 02/ MENLH/I/1988 -Traffic congestion frequency/duration	-Covering materials with sheet -Watering road -Selection of spoil site	Villages close to the project site Bridge construction site	Project office
-Water quality of the river	All civil works relating to the project	Water quality standard according to Gov. regulation No.20/1990	-Dredging work from downstream -Effort to minimize spilt soil into the river -Protective net at downstream direction	Percut River Weir and bridge construction sites	-Project office -Government of North Sumatra Province
-Sedimentation	Dredging in the Percut river	Soil suspended level 100 to 250 mg/l	Sediment dredging at the river mouth	River mouth at Percut village	Project office
-Groundwater level	Construction of floodway	-Depth of groundwater -Public complaint about decline of groundwater level	-Compensation for affected wells -Extension of water supply service by PDAM	Titi Kuning, Suka Maju, Harjo Sari	Project office
-Disturbance for irrigation and fishpond	Dredging in the Percut river	-Unit water requirement for paddy : 1.1 l/sec/ha -Soil suspended level 100 to 250 mg/l -Standard water quality	-Control of turbidity level -Dredging of main irrigation canal in case of high sedimentation	Saentis, Cinta Rakyat, Cinta Damai and Percut villages	-Project office -PU branch office Deli Serdang
-Mud pollution by toxic materials	River dredging work	Contents of Cu, Cr, Pb and Cd in mud Sediment	-No use of such materials for embankment -Proper method of disposal in dumping site	Harjo Sari, Sitirejo, Denai, Medan Tembung, Medan Tenggara, Sidorejo	-Project office -Government of North Sumatra Province
-Disturbance for the use of river water	River dredging work	Public perception, reaction of people to bathing/washing	-Effort to minimize degradation of water quality -Advising people of filtering water	All villages existing along Percut River	Project office
-Aquatic biology	-Weir construction -Percut river improvement work	-Diversity index of plankton and benthos -Mangrove trees	-Effort to minimize degradation of water quality -Release of Benthos from dredged material -Preservation of natural ecology	-Percut river and river mouth -Submergible area by the weir	Project office
(Post-Construction)					
-Illegal use of land on river and floodway borders	-Land acquisition -Dependence on river water	-No. of squatters -Illegal land use	-Effort to gain public comprehension -Control of illegal land use	Villages along Percut River and Floodway	Project office
-Sedimentation and aquatic weed development	Erosion in upstream the rives	-Soil suspended level 100 mg/l -Massive growth of weed	-Dredging Sediment -Weed control	Submergible area by the weir Percut River, Floodway	Project office
-Groundwater level	Construction of floodway	-Depth of grundwater -Public complaint about decline of groundwater level	-Compensation for affected wells -Extension of water supply service by PDAM	Titi Kuning, Suka Maju, Harjo Sari	Project office
-Solid waste and refuse	People's conception of river channel	-Amount of waste -Riverine landscape	-Establishing waste collecting system -Educating people	All project affected villages	-Project office -Municipality/Deli Serdang Regency -Public Sanitary Corp.

Table 5.2.2 ENVIRONMENTAL MONITORING PLAN FOR MEDAN FLOOD CONTROL PROJECT

Monitoring Item	Monitoring Method	Location	Monitoring Frequency	Duration	Monitoring Agency Concerned
(Pre-Construction)					
-Land issue and social unrest	Interview and field confirmation	All project affected villages	Once every 6 months	As long as problems exist	-Land acquisition committee -Project office -DGWRD -Cipta Karya
(Construction Stage)					
-Noise	Measured by noise level meter	Dense populated area	Once every 3 months	Construction period	Project office
-Dust and traffic congestion	Field observation	-Villages close to project site -Bridge construction site	Once every 3 months	Construction period	Project office
-Water quality of the river	Test and analysis of sample waters in laboratory	11 locations selected in ANDAL study	Once every 3 months	Construction period	-Project office -Government of North Sumatra Province
-Sedimentation	Field observation	River mouth at Percut village	Once every 6 months	Construction period	Project office
-Groundwater level	Field observation and measurement	14 locations selected in ANDAL study	Once every 6 months	Construction period	Project office
-Disturbance for irrigation and fishpond	-Field observation -Sample water analysis in laboratory	Saentis, Cinta Rakyat, Cinta Damai and Percut villages	Once every 6 months	Construction period + min. 1 year	-Project office -PU Branch office Deli Serdang
-Mud pollution by toxic materials	Mud sample analysis in laboratory	Harjo Sari, Sitirejo, Denai, Medan Tembung Medan Tenggara, Sidorejo	Once every 6 months	Construction period	-Project office -Government of North Sumatra Province
-Disturbance for the use of river water	Field observation and interview	All villages existing along the Deli and Percut	Once every 6 months	Construction period + min. 1 year	Project office
-Aquatic biology	-Field observation and interview -Sample analysis	-Percut river and river mouth -Submergible area by the weir	Once every 6 months	Construction period	Project office
(Post-Construction)					
-Illegal use of land on river and floodway borders	Field observation	Along the Percut river and floodway border	Once every 3 months	Min. 2 years	Project office
-Sedimentation and aquatic weed development	Field observation and measurement	Along the Percut, Deli and floodway	Once every 6 months	Min. 1 years	Project office
-Groundwater level	Observation and measurement	14 sites selected in ANDAL study	Once every 6 months	Min. 1 years	Project office
-Solid waste and refuse	Field observation	Along the Percut, Deli and floodway	Once every 3 months	Min. 2 years	-Project office -Municipality/Deli Serdang Regency -Public Sanitary Corp.
-Water quality of the river	Sample analysis in laboratory	11 sites selected in ANDAL study	Once every 6 months	Min. 2 years	-Project office -Government of North Sumatra Province
-Project effect and evaluation	Observation and analysis	Whole project area	Once a year	No limit defined	Project office

Table 5.3.1 VILLAGES IN THE PROJECT AREA

Project Works	District	Sub-District	Village	Area	Population	Households	
						Existing	Affected
Percut River Improvement	Medan City	Medan Amplas	M-1 Harjosari I	4.16	20,968	3,777	92
			M-2 Sitirejo II	0.43	7,101	1,460	25
			M-3 Sitirejo III	0.40	8,380	1,528	30
			M-4 Timbang Deli	2.83	8,880	1,703	15
			M-5 Amplas	0.80	7,977	1,447	40
		Medan Denai	M-6 Binjai	4.14	24,927	4,278	200
			M-7 T.S. Mandala II	0.87	11,928	2,159	59
			M-8 T.S. Mandala III	1.03	16,976	2,896	28
			M-9 Medan Tenggara	2.07	4,017	872	90
			M-10 Denai	1.27	5,485	894	60
		Medan Tembung	M-11 Tembung	0.60	6,898	1,235	51
	Deli Serdang	Percut Sei Tuan	D-1 Bandar Khalipah	7.25	12,180	2,160	60
			D-2 Bandar Setia	3.61	6,000	1,053	60
			D-3 Laut Dendang	1.70	5,515	1,083	13
			D-4 Saentis	24.00	9,015	1,577	49
			D-5 Sampali	23.02	13,587	2,693	5
			D-6 Pematang Lalang	10.00	1,467	275	8
			D-7 Cinta Damai	11.76	4,537	859	150
			D-8 Cinta Rakyat	1.53	7,340	1,456	50
			D-9 Percut	10.63	6,736	1,634	334
Sub-Total				112.10	189,914	35,039	1,419
Medan Floodway	Medan City	Medan Johor	M-12 Titi Kuning	1.20	9,386	2,470	60
			M-13 Suka Maju	1.10	5,396	1,395	51
		Medan Amplas	M-14 Harjosari II	4.59	17,631	3,242	30
	Deli Serdang	Patumbak	D-10 Patumbak Kp.	6.15	6253	1218	4
			D-11 Marindal Satu	8.10	9,389	1,858	20
Sub-Total				21.14	48,055	10,183	165
Total				133.24	237,969	45,222	1,584

Table 5.3.2 LAND USE IN THE PROJECT AREA

ITEM	Upper Deli River		Medan Floodway		Percut River		Total	
	Area (m^2)	%	Area (m^2)	%	Area (m^2)	%	Area (m^2)	%
1. House Site / Residential	4,112	3.25	16,492	5.69	39,987	2.69	60,591	3.19
2. Mixed Garden	42,158	33.34	15,818	5.46	76,833	5.17	134,809	7.09
3. Fish Pond					69,671	4.69	69,671	3.66
4. Shrub / Bush / Idle Land	52,860	41.81	37,770	13.03	345,833	23.28	436,463	22.95
5. Paddy Field			12,405	4.28	67,702	4.56	80,107	4.21
6. Cultivated Land	23,043	18.22	5,755	1.98	417,549	28.10	446,347	23.47
7. Plantation			94,348	32.54	179,184	12.06	273,532	14.38
a. Cocoa			94,348	32.54	79,603	5.36	173,951	9.15
b. Sugar cane					39,069	2.63	39,069	2.05
c. Tobacco					5,550	0.37	5,550	0.29
d. Others					54,962	3.70	54,962	2.89
8. Factory	730	0.58	3,725	1.28	12,180	0.82	16,635	0.87
9. Infrastructures / Facilities	1,210	0.96	4,560	1.57	38,282	2.58	44,052	2.32
a. Road	1,210	0.96	4,560	1.57	17,967	1.21	23,737	1.25
b. Sewerage					6,492	0.44	6,492	0.34
c. Jetty					78	0.01	78	0.00
d. Railway					83	0.01	83	0.00
e. Vehicle station					13,641	0.92	13,641	0.72
f. Plantation road								
g. Weir area								
h. Dam (waduk)					21	0.00	21	0.00
10. Social Facilities								
a. Mosque	158				1,649	0.11	1,807	0.09
b. Church					1,277	0.09	1,277	0.07
c. Health service					1,067	0.07	1,067	0.06
d. School	960				1,814	0.12	2,774	0.15
e. Moslem school								
f. Others								
11. Commercial								
a. Shop								
b. Traditional market								
c. Super market								
d. Restaurant					33	0.00	33	0.00
12. Recreation								
a. Park								
b. Fishing park								
c. Others								
13. Office								
14. Cemetery :								
a. Family / Private					50	0.00	50	0.00
b. Public			160	0.06	12,777	0.86	12,937	0.68
15. Swampy Area								
16. Mixed Use :								
a. Commercial-residential								
b. Commercial-office								
c. Commercial-service					248	0.02	248	0.01
d. Others					593	0.04	593	0.03
17. Others					1,563	0.11	1,563	0.08
TOTAL	126,441	100.00	289,941	100.00	1,485,758	100.00	1,902,140	100.00

Table 5.3.3 BUILDING AND STRUCTURE IN THE PROJECT AREA

Building Structure	Percut River		Floodway	Retarding Channel		Total
	Right	Left		Right	Left	
1. House	524	244	125	9	---	902
2. Mosque	6	2	1	1	---	10
3. Church	3	---	---	---	---	3
4. School	2	1	---	---	---	3
5. Moslem School	1	2	---	1	---	4
6. Factory	1	2	1	1	---	5
7. Moslem Cemetary	4	3	1	---	---	8
8. Christian Cemetary	---	1	---	---	---	1

Source : Field Survey for Social Impact Study

Table 5.3.4 ACCESS AND ROAD IN THE PROJECT AREA

No.	Name of Road	Pavement	Link	Related Structure
1	Jl. Tapian Nauli	Earth	Titi Kuning - Pkl. Mansyur	Bridge (w = 1m, l = 3 m)
2	Jl. SMA 12	Paved	SMA 12 - Titi Kuning	-
3	G. Amal	Paved	-	-
4	G. Salak	Paved	Titi Kuning - Surya Residency	-
5	G. Klp. Kuning	Paved	Titi Kuning - Suk Maju	-
6	Jl. Suka Cerdas	Paved	Suka Maju - Titi Kuning	Culvert (w = 4 m)
7	Jl. Marindal	Paved	Marindal - Cit Center - Denai	-
8	Jl. Seksama Ujung	Paved	City Centre - Amplas/Menteng	Permanent Bridge
9	Jl. Menteng Raya	Paved (h*)	City Centre - Menteng Residency	Permanent Bridge
10	Jl. Tuba-3	Gravel	Denai Sub Village 13 - Jl. Denai	Culvert (w = 3 m)
11	Jl. Denai	Paved (h*)	City Centre - Medan Tengara	Permanent Bridge
12	Jl. Tanggul Kanan	Earth	Jl. Denai - Moslem Cemetery	-
13	Jl. Perumnas Mandala - Tembung	Earth	Mandala Residential - Tembung	-
14	Jl. Letda Sujono	Paved (h*)	City Centre - Tembung	Permanent Bridge
15	Jl. Bandar Khalifah	Earth	Bandar Khalifah - Tembung	Temporary Bridge (w = 1 m)
16	Jl. Benteng	Earth	Bandar Khalifah - Lau Dendang	Semi Permanent Bridge (w = 1.2 m)
17	Jl. Perhubungan	Gravel	Bandar Setia - Lau Dendang	Permanent Bridge (w = 4 m)
18	Jl. Terusan	Earth	Bandar Setia - Sampali	Permanent Bridge (w = 4 m)
19	Jl. Bandar Setia - Tambak Bayan	Earth	Bandar Setia - Tambak Bayan	Semi Permanent Bridge (w = 1 m)
20	Jl. PTP IX	Gravel	Cinta Rakyat - Bandar Setia	Semi Permanent Bridge (w = 5 m)
21	Jl. Cinta Damai	Gravel	Percut - Cinta Dantai	Permanent Bridge
22	Jl. Bagan Percut	Paved	Percut - Bagan Percut	Drainage Channel

Table 5.3.5 WATER PIPE AND WELL IN THE PROJECT AREA

No.	Location	Installation	Dia.(inch) of Pipe	Service Area	Well	
					Number	Depth (m)
1	Jl. SMA 12, Titi Kuning	Underground	5	1-sub village and SMA 12	15	7
2	Gg. Amat, Titi Kuning	Uunderground	5	1-sub village (Titi Kuning)	5	6
3	Gg. Salak, Titi Kuning	Uunderground	5	1-sub village (Titi Kuning)	6	6
4	Gg. Kelapa Kuning, Titi Kuning	Uunderground	3	1-sub village (Titi Kuning)	15	5.5
5	Jl. Suka Cerdas - Sukamaju	Uunderground	3	1-sub village (Sukamaju)	8	6
6	Jl. Marindal	Uunderground	5	1-sub village (Harjosari II)	3	6
7	Jl. Panglima Denai, Denai Bridge	Uunderground	5	1-sub village (Denai)	-	-
8	Jl. Menteng Raya, Menteng Bridge	Down stream	10	1-sub village (Denai)	-	-
9	Jl. M.Nawi Harahap	Seksama Bridge	10	Binjai and Menteng Village	-	-
10	Jl. Garu I Ujung, Medan Denai	Uunderground	30	Menteng, Denai and Amplas	-	-
11	Jl. Sisingamangaraja	Amplas Bridge	20	Amplas - Tj. Morawa	-	-

Table 5.3.6 ELECTRICAL INSTALLATION AFFECTED BY THE PROJECT

No	Location	Quantity	Number and Size of String	Voltage	Service Area
1	Jl. SMA 12	2 Poles	4 x 35 mm	TR	1 Sub-village(Titi Kuning)
2	G. Amat	4 Poles	4 x 35 mm	TR	1 Sub-village(Titi Kuning)
3	G. Salak	1 Pole	3 x 70 mm	TM	1 Sub-village(Titi Kuning)
		2 Poles	4 x 35 mm	TR	
4	G. Kelapa Kuning	4 Poles	3 x 70 mm	TM	1 Sub-village(Titi Kuning)
		4 Poles	4 x 35 mm	TR	
5	Jl. Suka Cerdas	5 Poles	3 x 70 mm	TM	1 Sub-village(Sukamaju)
		7 Poles	4 x 35 mm	TR	
		1 Transformer			
		1 Panel Box			
6	Jl. Sumber Utama	10 Poles	4 x 35 mm	TR	1 Sub-village(Harjosari II)
7	Jl. Denai (Denai Bridge)	1 Pole	3 x 70 mm	TM/TR	1 Sub-village(Denai)
			2 x 35 mm		
8	Jl. Menteng Ray	1 Pole	3 x 70 mm	TM/TR	1 Sub-village(Menteng)
	(Menteng Raya Bridge)		2 x 35 mm		
9	Gg. Ria	1 Pole	2 x 35 mm	TR	5 HH
10	Gg. Raja Aceh	2 Poles	2 x 35 mm	TR	9 HH
11	Jl. Selamat Ujung	2 Poles	2 x 35 mm	TR	11 HH
12	Jl. Garu III Ujung	1 Pole	2 x 35 mm	TR	27 HH danSempuma Residential Quarters

(Note): TR = Low Voltage
TM = Medium Voltage
HH = Household

Table 5.3.7 TELEPHONE LINE IN THE PROJECT AREA

No.	Location	No. of Post	Route	Service Area
1	Jl. SMA 12	2 poles	T. Kuning - SMA 12	SMA 12 (Titi Kuning)
2	Gg. Amal	2 poles	Jl. Deli Tua - Gg. Amal	1 Sub Village (T. Kuning)
3	Gg. Salak	2 poles	Jl. Deli Tua - Surya Residency	1 Sub Village (T. Kuning)
4	Jl. Sukamaju	11 poles	Sukamaju - City Centre	1 Sub Village (Sukamaju)
5	Jl. Sumber Utama	9 poles	Marindal - City Centre	1 Sub Village (Marindal)
6	Jl. Denai	2 poles	Denai - City Centre	Denai/Jl. Menteng Village
7	Jl. Letda. Suyono (Tembung Bridge)	1 pipe	Tembung - City Centre	Tembung Village

Source: Field Survey for Social Impact Study

Table 5.3.8 MATRIX OF SOCIAL IMPACT PREDICTION AND EVALUATION

Project Activity / Component / Social Impact	Pre-Construction	Construction							Post Construction	
	Land Acquisition	Equipment and Material Mobilization	Land Clearing	Excavation for Floodway	Weir Construction	Percut River Excavation	Percut River Embankment	River Structure Construction	Operation	Maintenance
1. Social Conflict/Social Unrest	INI									
2. Traffic Congestion		INI		INI		INI	INI	INI		
3. Disturbance to Utilization of Percut River Water						INI INI				
4. Declining of Water Stage in Wells				SNI		SNI				
5. Disturbance to Irrigation										
6. Declining of Agricultural Yield										
7. Disturbance to Development Plans in the Project Area	SNI									
8. Disturbance to Use of Infrastructures				INI		INI	INI			
9. Disturbnce to the Industrial Activities			SNI			SNI				
10. Illegal Utilization of Riparian Area along Percut River and Floodway									INI	

INI : Important Negative Impact
SNI : Slight Negative Impact

Table 5.3.9 TRAFFIC VOLUME IN THE PROJECT AREA

Link	Walker	Motor Cycle	Car, Jeep and Wagon	Pickup and Mini-Bus	Microtruck Pickup	Bus	2 Beam Truck	3 Beam Truck Trailer	Manual Vehicle	Total
Titi Kuning - Jl. Brigjen Katamso	83	4,203	3,173	4,236	1,026	2	12	0	356	13,091
Jl. Suka Cerdas - Jl. Besar Deli Tua	435	304	4	7	8	0	0	0	236	994
STM Ujung - Jl. Baru	319	870	321	26	53	0	11	0	628	2,237
Marindal - Jl. SM. Raja	104	2,935	647	486	327	1	82	13	2,364	6,959
Seksama - Sp. Amplas	1,031	4,322	2,168	3,654	414	101	168	1	2,127	13,986
Pasar Merah - Amplas	528	3,233	1,682	2,562	240	24	85	10	1,813	10,177
City Center - Denai Ujung Bridge	543	6,783	1,225	3,599	558	22	135	8	5,284	18,157
Jl. Pasar - Jl. Perhubungan	165	281	0	0	13	0	0	0	485	944
Bandar Setia - Titi Payung	30	473	19	2	12	0	19	2	762	1,319
Bandar Setia - Titi Runtuh Bridge	23	438	11	3	27	0	43	2	442	993
Bandar Setia - Tampak Bayan	33	250	0	0	0	0	0	0	470	753
Bandar Setia - Pasar 4	93	217	0	0	0	0	0	0	266	576
Jl. Percut - Jl. Cinta Damai	351	972	0	374	64	1	10	0	801	2,573
Ds. Todak/Kebun Sayur - Jl. Bagan Percut	120	243	21	0	48	0	22	0	291	745
Jl. Percut - Ds. Todak	-	-	-	-	-	-	-	-	-	-
Cinta Rakyat - Jl. Bagan Percut	48	380	77	145	46	0	16	0	437	1,149
Total	3,906	25,904	9,348	15,094	2,836	151	603	36	16,762	74,653

Table 5.3.10 (1/2) Matrix for Social Impact Management Plan

Item No.	Type of Social Impact to be Managed	The Objective of Management	Management Efforts	Location of Social Impact Management	Institutional Coordination System
(1)	(2)	(3)	(4)	(5)	(6)
I	PRE-CONSTRUCTION				
1	Social conflict and social unrest	To prevent social apprehension and social conflict between the project initiator and the people.	1. Extension to the people affected by the project, namely 165 households in proposed floodway and 1,400 households in Pecut riverbank (see Appendix 7.1)	All villages affected by the project	Project-LPC-People affected
			2. To provide land acquisition according according to negotiation between project and landowners (Presidential Decree No. 55/1993)	All villages affected by the project	Project-LPC-People affected
			3. To provide building compensation according to the estimation of Public Works Services	All villages affected by the project	Project-LPC-People affected
			4. To provide building compensation according to the estimation of Agricultural Services	All villages affected by the project	Project-LPC-People affected
			5. To provide building compensation for land and building remnant which are not feasible to support people living	All villages affected by the project	Project-LPC or appraiser team-People affected
			6. To prepare resettlement area for the people when the rate of house compensation is not sufficient to pay a new residence (see Appendix 7.2)	Percut Village	Project-LPC-Regional Government
			7. To relocate people's houses which are crossed by river normalization (see Appendix 7.2)	Tegalsari Mandala III, Tegalsari Mandala II and Denai Village	Project-LPC-Regional Government
			8. To carry out special approach to Moslem religious leaders, priests, land donation official ("nazir") and foundation leader to support acquisition for social facilities	Titi Kuning, Siti Rejo III, Timbang Deli, Binjai, Menteng, Tegalsari Mandala II, Tegalsari Mandala III, Kenangan, Denai, Bandar Khalipah, Tembung, Cinta Damai, Percut	Project-LPC-Key Person
			9. To be responsible for all administration costs of land certificate change related to this project	All villages affected by the project	Project-BPN
			10. To provide a chance for people who have no land certificate to take the statement letter from Kepala Desa known by Camat	All villages affected by the project	Project-BPN-Kepala Desa-Camat
II	CONSTRUCTION STAGE				
1	Traffic Congestion and Disturbance to People Mobility	To prevent traffic congestion on busy roads and to reduce disturbance to people mobility	1. To construct temporary bridges In locations where traffic is chronically heavy and where there are many mobility disturbances. The temporary bridges will be utilized up to the construction of the permanent bridges and new roads are finished.	At bridge locations such as Jl. Seksama Ujung, Pasar Merah Ujung, Jl. Panglima Denai, Jl. Taplan Nauli, Jl. SMA 12, Gang Amal, Gg. Salak, Gg. Kelapa Kuning, Jl. Suka Cerdas, Jl. Tuba 3, Jl. Tanggul Kanan Denai, Jl. Tanggul Kanan Bandar Khalipah, Jl. Benteng, Jl. Pemubungan, Jl. Terusan, Jl. Bandar Setia-Tambak Bayan, Jl. Kebun Coklat PTP IX, Jl. Cinta Damai, Jl. Todak, Jl. Bagan Percut	Project-PU Bina Marga
2	Disturbance to the use of Percut River Water	To prevent social unrest due to disturbance of Percut river water which is needed for bathing and washing	1. Percut river dredging should be started from the downstream	All villages along Percut river improvement	Project
			2. Dredging equipment should be operated from the edges of the river	All villages along Percut river improvement	Project
			3. Dredging system should be conducted according to the river flow	All villages along Percut river improvement	Project
			4. To extend to local people the use of healthy methods of water utilization and to advise water treatment by simple filtration.	All villages along Percut river improvement	Project-Public Health Services
			5. To provide public facilities for water supply such as public pump wells	All villages along Percut river improvement	Project-PU Cipta Karya
3	Decline of ground water level of public wells	To reduce ground water level decline in public wells	1. To extend water supply network to areas affected by the project	Especially in all villages along the proposed floodway (Titi Kuning, Sukamaju, Harjosari II, Marindal I, Patumbak Kampung)	Project-PDAM (Water Supply Enterprise)
			2. To build public facilities for water supply such as public pump wells	Especially in all villages along the proposed floodway (Titi Kuning, Sukamaju, Harjosari II, Marindal I, Patumbak Kampung)	Project-PU Cipta Karya
			3. To suggest digging of wells to local residents in case of significant decline of ground water level and to provide compensation for digging.	Especially in all villages along the proposed floodway (Titi Kuning, Sukamaju, Harjosari II, Marindal I, Patumbak Kampung)	Project

Table 5.3.10 (2/2) Matrix for Social Impact Management Plan

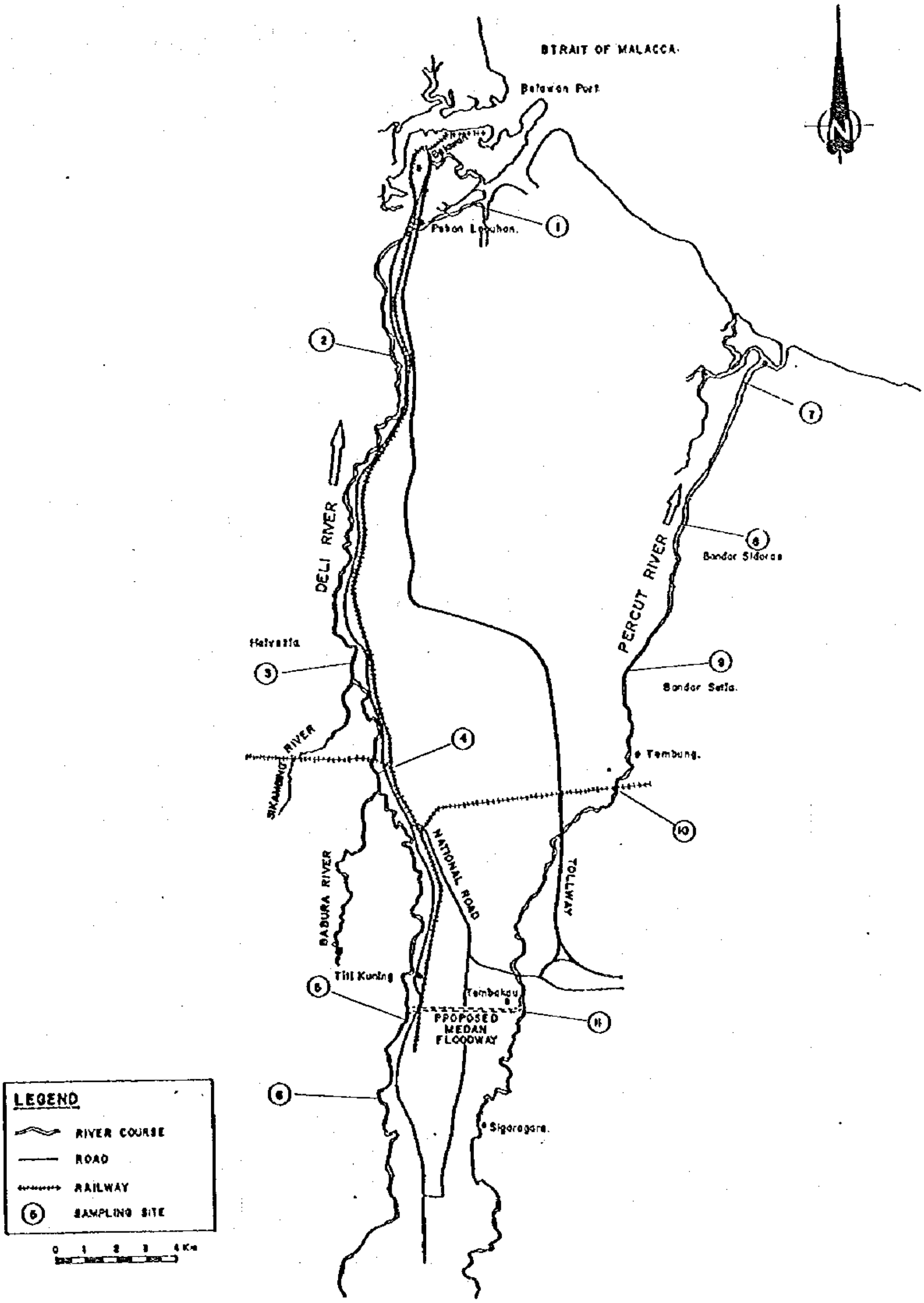
Item No.	Type of Social Impact to be Managed	The Objective of Management	Management Efforts	Location of Social Impact Management	Institutional Coordination System
(1)	(2)	(3)	(4)	(5)	(6)
4	Disturbance to Irrigation	To prevent social apprehension due to water discharge reduction and water quality of irrigation water for paddy fields.	1. To maintain the turbidity level of the Percut river water as low as possible by efforts such as: a. Starting dredging work from downstream b. Operating dredging equipment from the edges of river	Cinta Rakyat, Cinta Damai, Sampali, Pematang Lalang and Percut Village	Project-PU Irrigasi
			2. To close the Bandar Sidoras intake gate during the dredging period in the area	Bandar Sidoras Intake	Project-PU Irrigasi
			3. River dredging in the Bandar Sidoras weir area should be conducted in March-July and September-October when the requirement of irrigation water in the paddy fields is relatively low.	Cinta Rakyat, Cinta Damai, Sampali, Pematang Lalang and Percut Village	Project-PU Irrigasi
5	Decline of Agricultural Yield	To reduce declining of agricultural production	1. Land clearing should be conducted after harvest time	All villages in the project area	Project
			2. To provide seedlings of fruit or plantation crops to the affected people (around 5 seedlings per household)	All villages in the project area	Project-Agricultural Services-Plantation Services
			3. Reforestation for embankments of inundation area, proposed floodway and Percut River using mixed fruit trees (duku, rambutan, mangga, etc.) or plantation crops (coconut, cocoa, etc.)	All villages in the project area	Project-Agricultural Services-Plantation Services
6	Disturbance of Development Plan in the Area	To reduce and to prevent conflict between the project plan and the other plans	1. To inform the development company or the people the objective of the Medan Flood Control Project	Titi Kuning and Tembung Village	Project
			2. To provide land and building compensation if the plan is implemented	Titi Kuning and Tembung Village	Project
7	Disturbance of Infrastructure Use	To reduce disturbance on the use of infrastructures	1. To extend information to related institutions regarding the objectives of Medan Flood Control Project	All villages where there are infrastructures affected	Project-PLN-PDAM-Telkom-PU-Kanwil Perhubungan
			2. To suggest to related institutions the submission of report on disturbance intensity and budget proposal for the project	All villages where there are infrastructures affected	Project-Related Institution
			3. To provide compensation for installations affected by the project	All villages where there are infrastructures affected	Project-Related Institution
			4. To provide a chance for related institutions to relocate and arrange their installations before land clearing works	All villages where there are infrastructures affected	Project-Related Institution
			5. To flow out all sewerages and drainage channels to the floodway and Percut River supported by sluice gate	All villages affected by the project	Project-PU Irrigasi
8	Disturbance to Industrial Activities	To reduce disturbance to industrial activities	1. To inform the company the objectives of the Medan Flood Control Project	Titi Kuning, Bandar Khalipah and Laut Dendang Village	Project
			2. To provide compensation for land, buildings and installations	Titi Kuning, Bandar Khalipah and Laut Dendang Village	Project-LPU
			3. To provide a chance for industrial companies to relocate their installations up to normal activities	Kimsari Paper Industry in Titi Kuning and sawmill in Bandar Khalipah	Project
			4. To provide a chance for industrial companies to get a new location up to normal activities	Trass Industry in Titi Kuning and Chinese cake industry in Laut Dendang	Project
III	POST CONSTRUCTION STAGE				
1	Illegal utilization of land along Percut River and Floodway Border	To prevent illegal utilization of land along Percut River, floodway borders and inundation area	1. Extension program for people regarding river conservation	Villages along Percut River, proposed floodway and inundation area	Project-PU Irrigasi
			2. To put up signs informing that land is forbidden for use		
			3. To control and maintain the riverbank continuously		

Note : LPC = Land Provision Committee
BPN = National Land Board
PLN = Electricity Enterprise
PDAM = Water Supply Enterprise
Telkom = Telecommunication Enterprise
Kanwil Perhubungan = Representative Office for Transportation
PU Irrigasi = Irrigation-PU

FIGURES

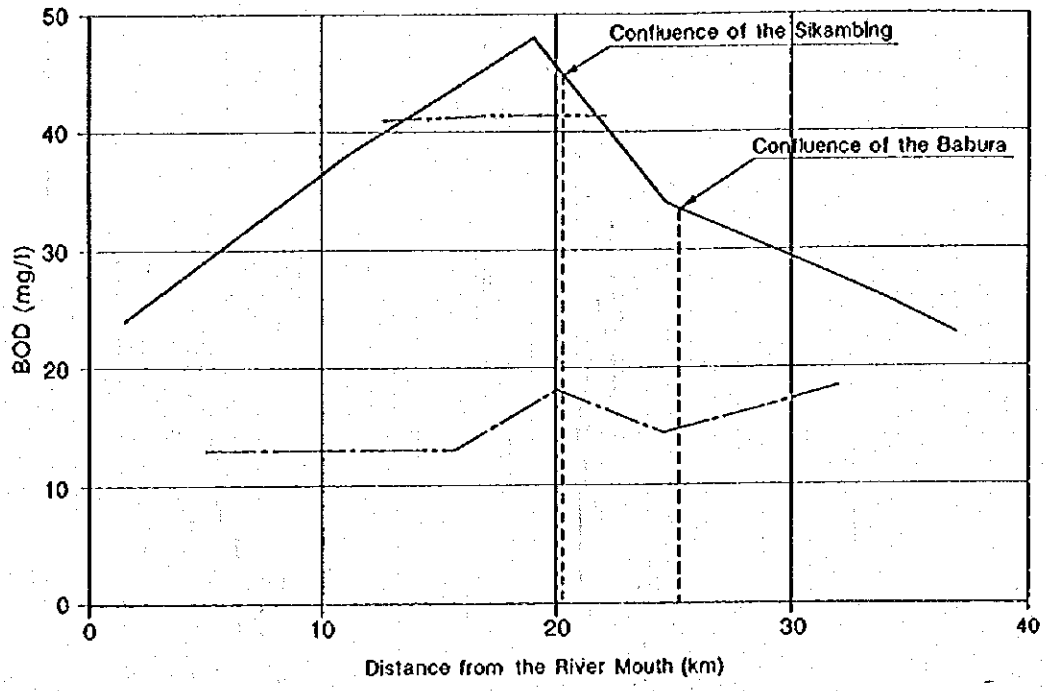
CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS



DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 5.1.1 WATER SAMPLING SITES
JAPAN INTERNATIONAL COOPERATION AGENCY	

BOD VALUES



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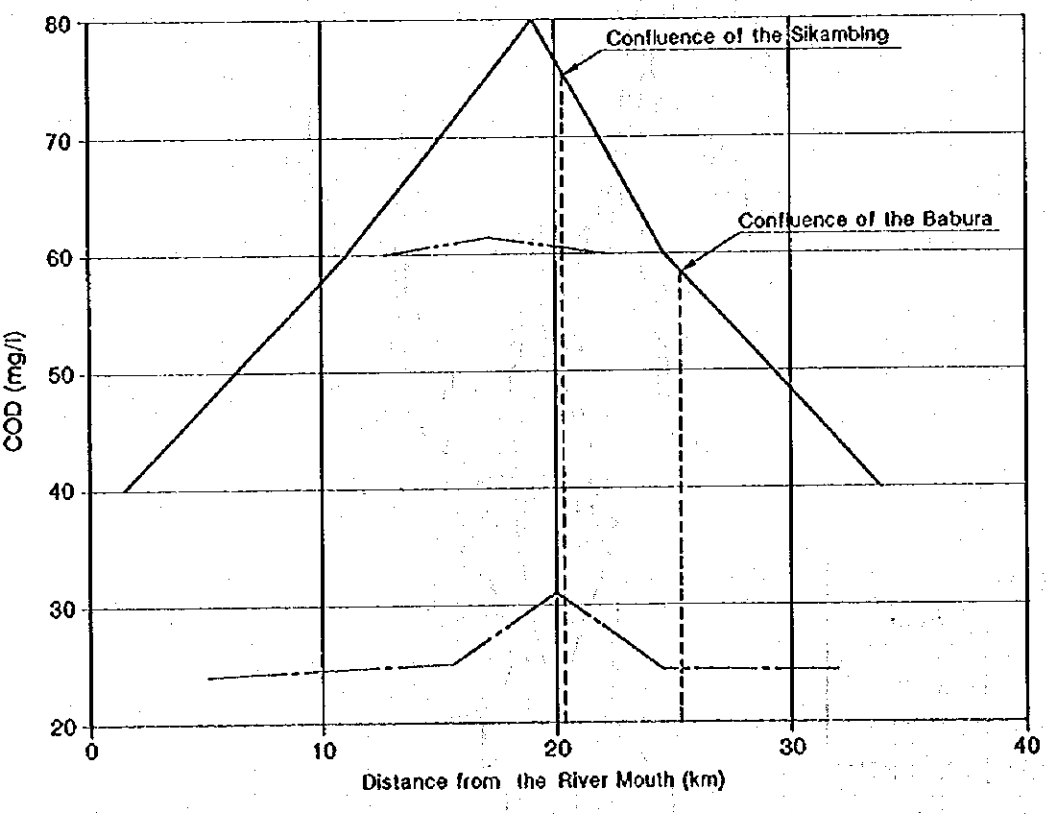
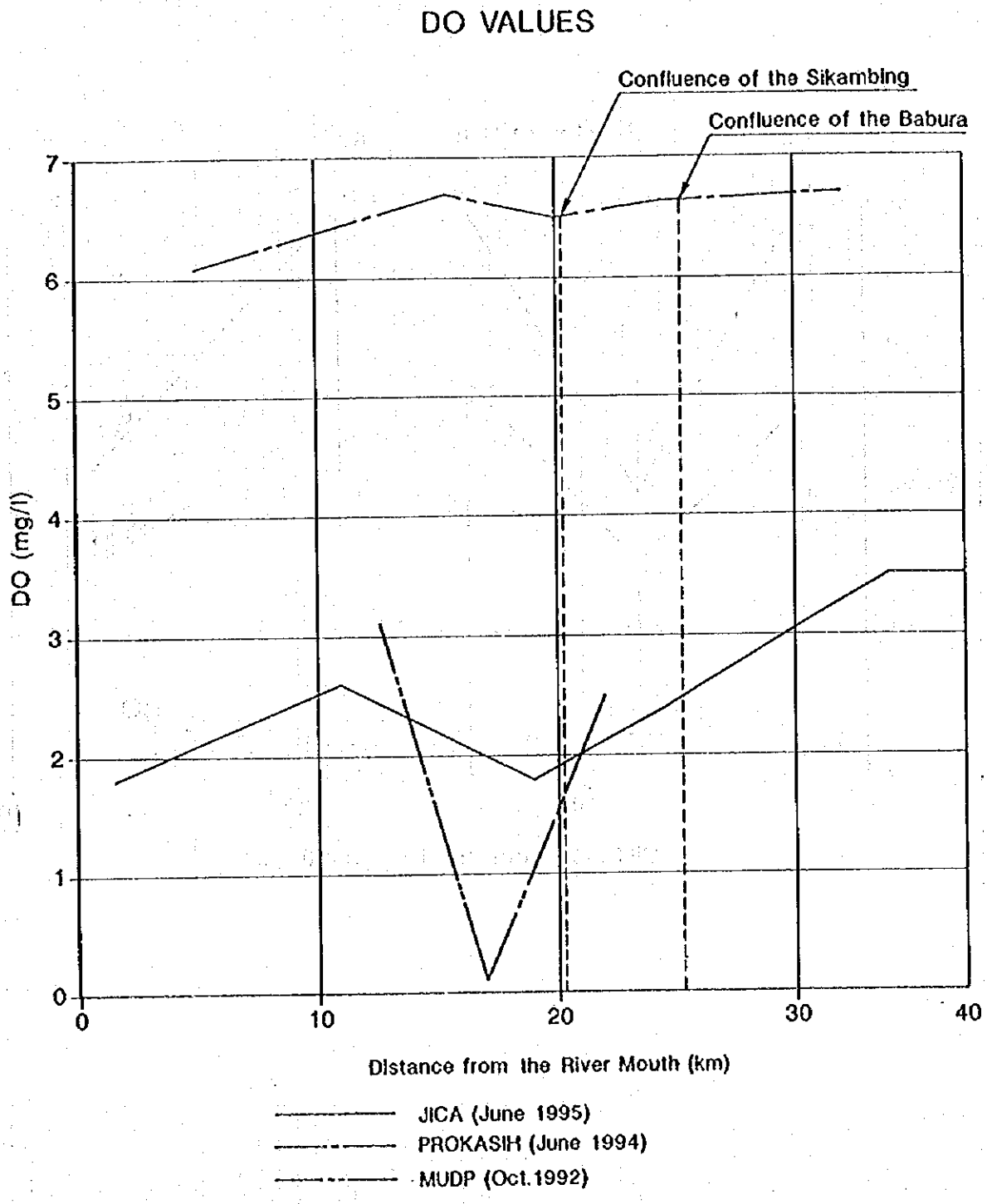


——— JICA (June 1995) —·—·— PROKASIH (June 1994) ····· MUDP (Oct.1992)

DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 5.1.2 BOD AND COD OF DELI RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



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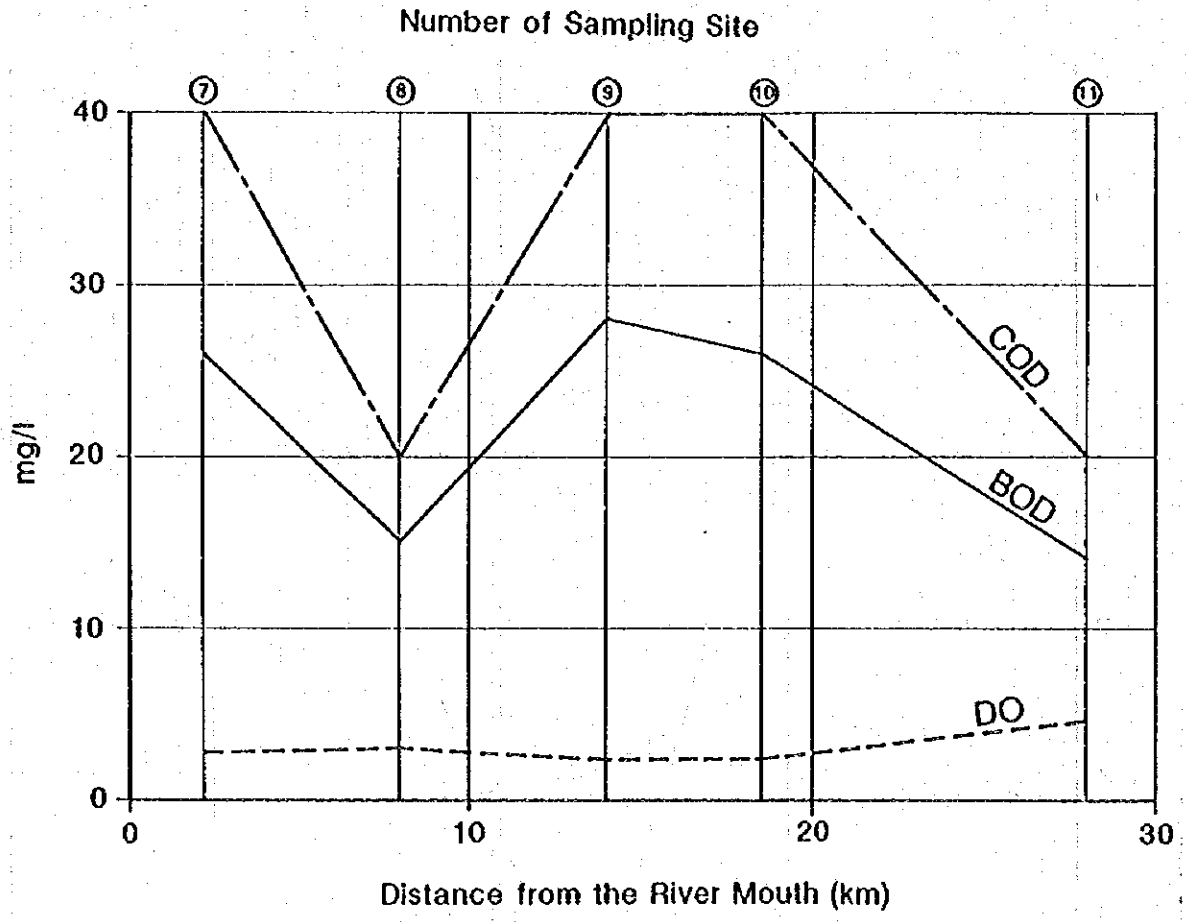
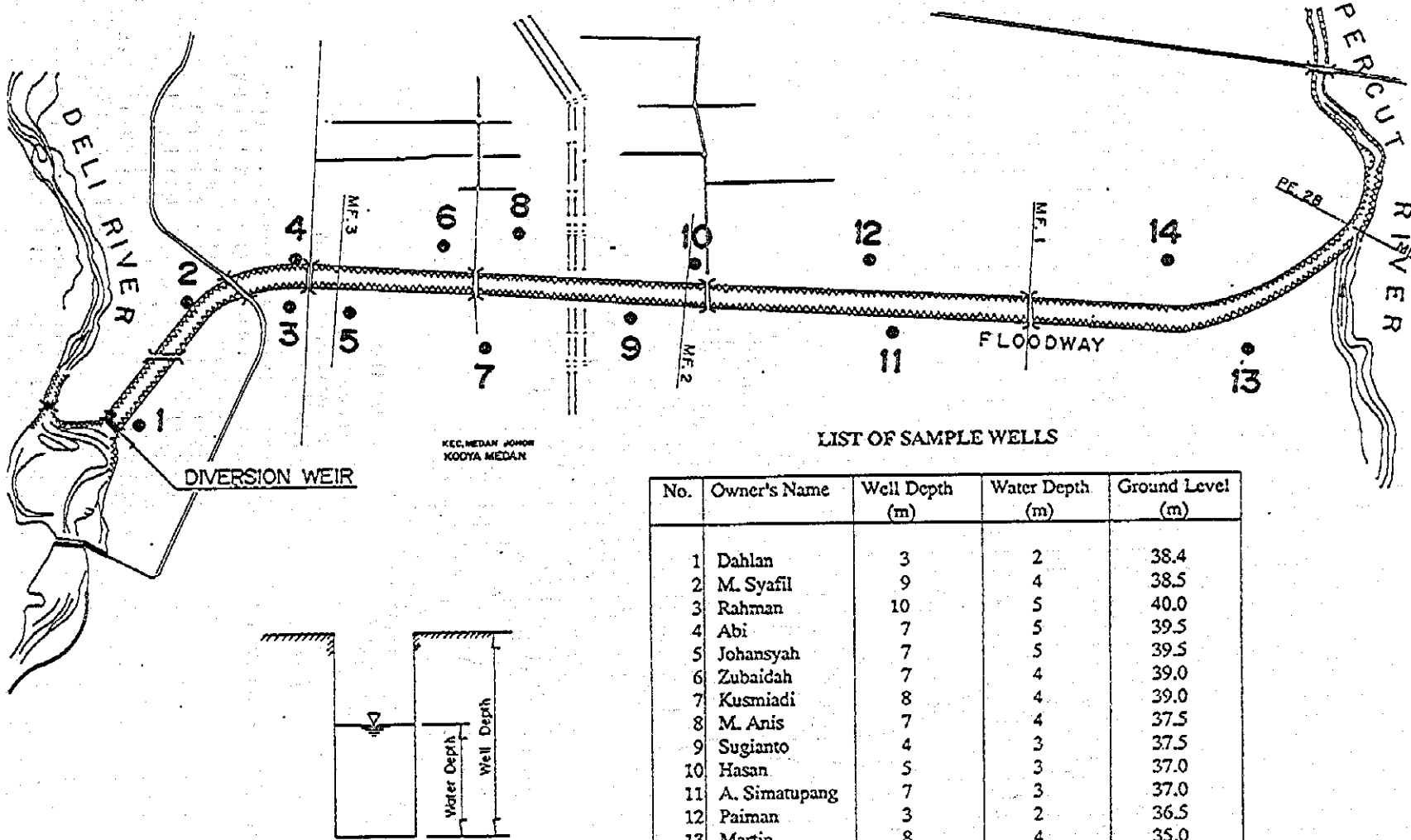
JAPAN INTERNATIONAL COOPERATION AGENCY	



DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 5.1.4 BOD, COD AND DO OF PERCUT RIVER
JAPAN INTERNATIONAL COOPERATION AGENCY	



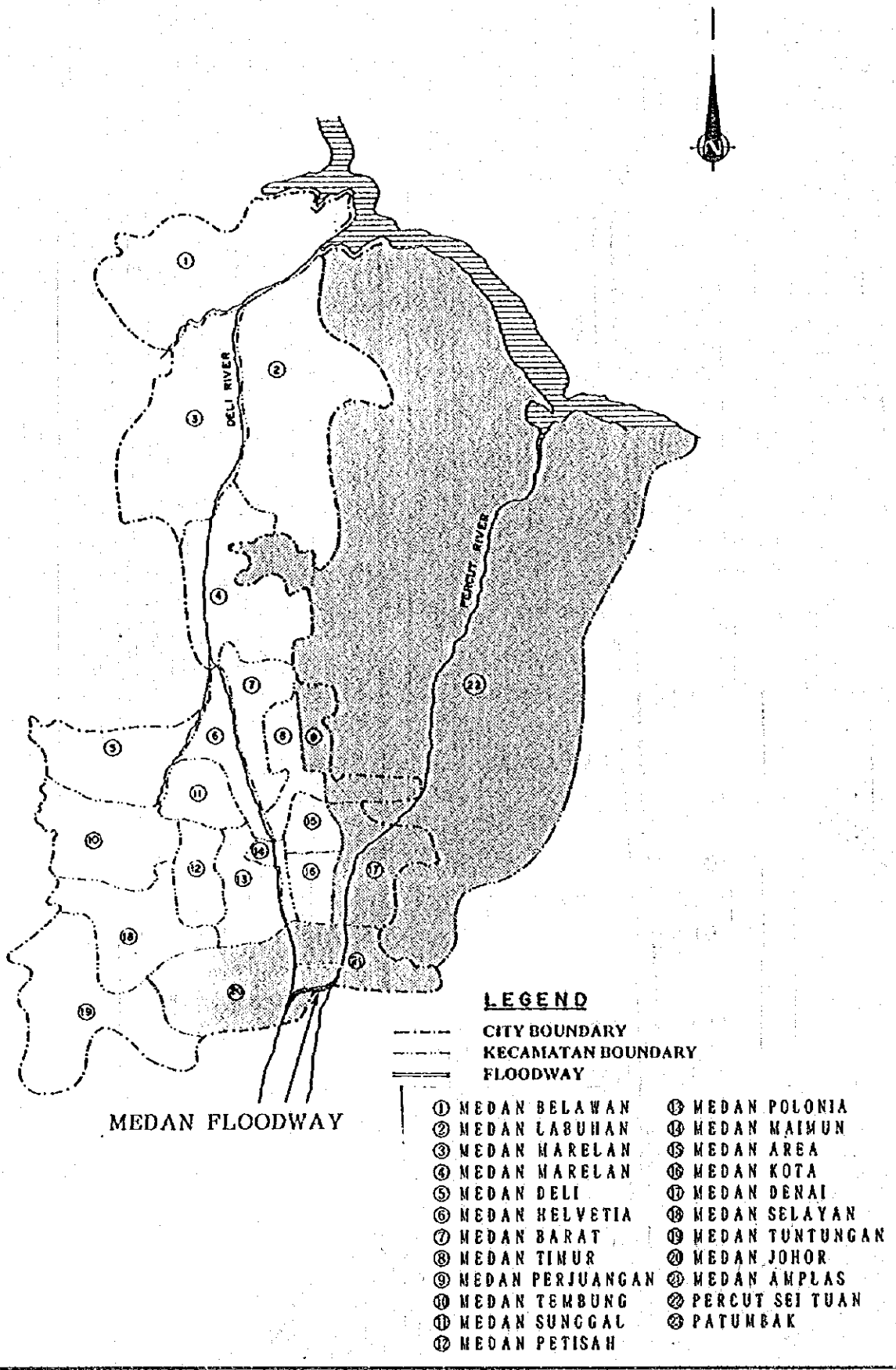
LIST OF SAMPLE WELLS

No.	Owner's Name	Well Depth (m)	Water Depth (m)	Ground Level (m)
1	Dahlan	3	2	38.4
2	M. Syafil	9	4	38.5
3	Rahman	10	5	40.0
4	Abi	7	5	39.5
5	Johansyah	7	5	39.5
6	Zubaidah	7	4	39.0
7	Kusmiadi	8	4	39.0
8	M. Anis	7	4	37.5
9	Sugianto	4	3	37.5
10	Hasan	5	3	37.0
11	A. Simatupang	7	3	37.0
12	Paiman	3	2	36.5
13	Martin	8	4	35.0
14	Zainal	8	4	35.0

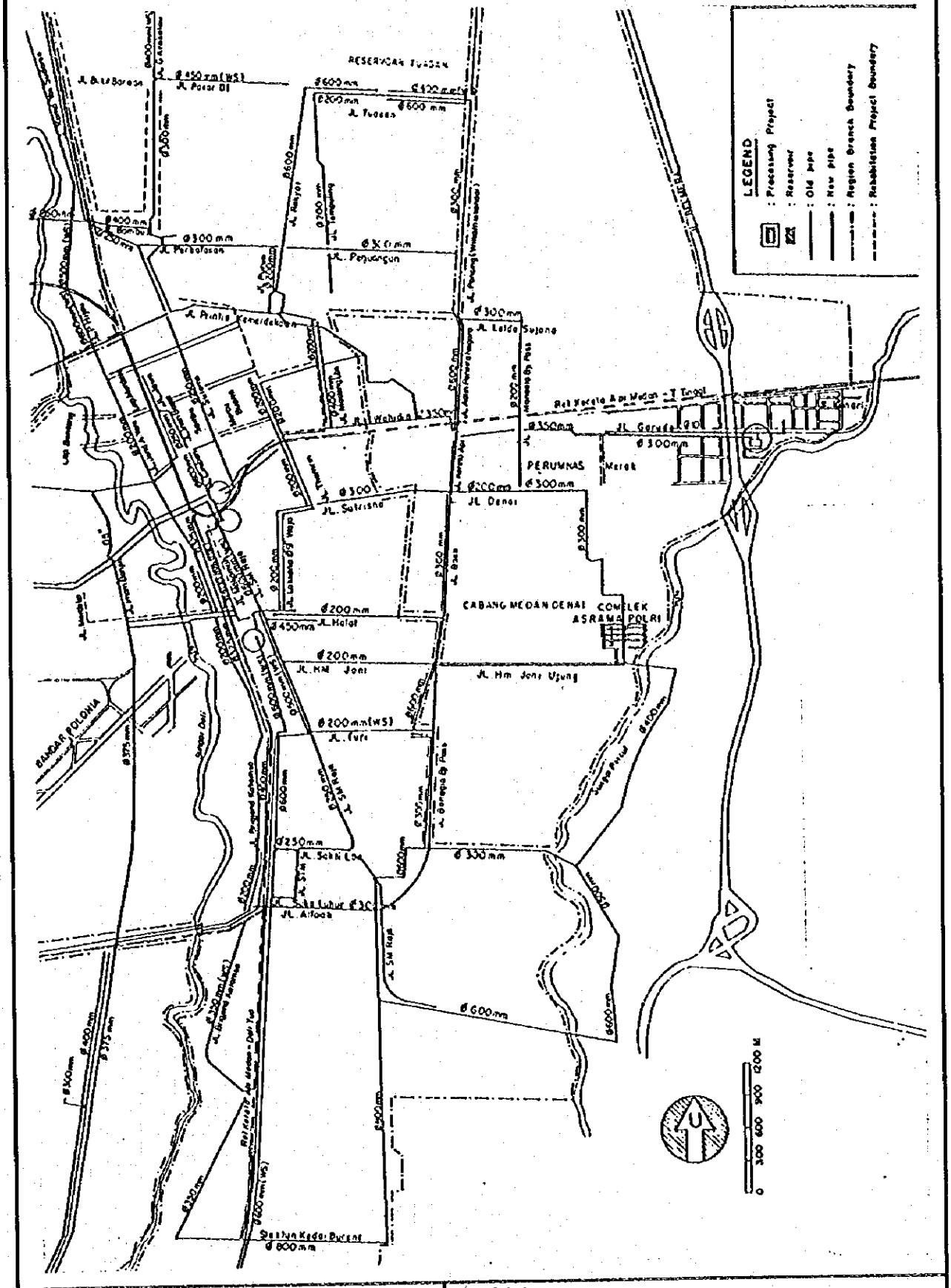
DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.1.5 LOCATION OF SAMPLING WELLS



DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT	Fig. 5.1.6 CONCRNED SUB-DISTRICTS FOR SOCIAL STUDY
JAPAN INTERNATIONAL COOPERATION AGENCY	



DETAILED DESIGN STUDY ON MEDAN FLOOD CONTROL PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 5.3.1 WATER MAIN PIPELINE NETWORK IN THE PROJECT AREA