

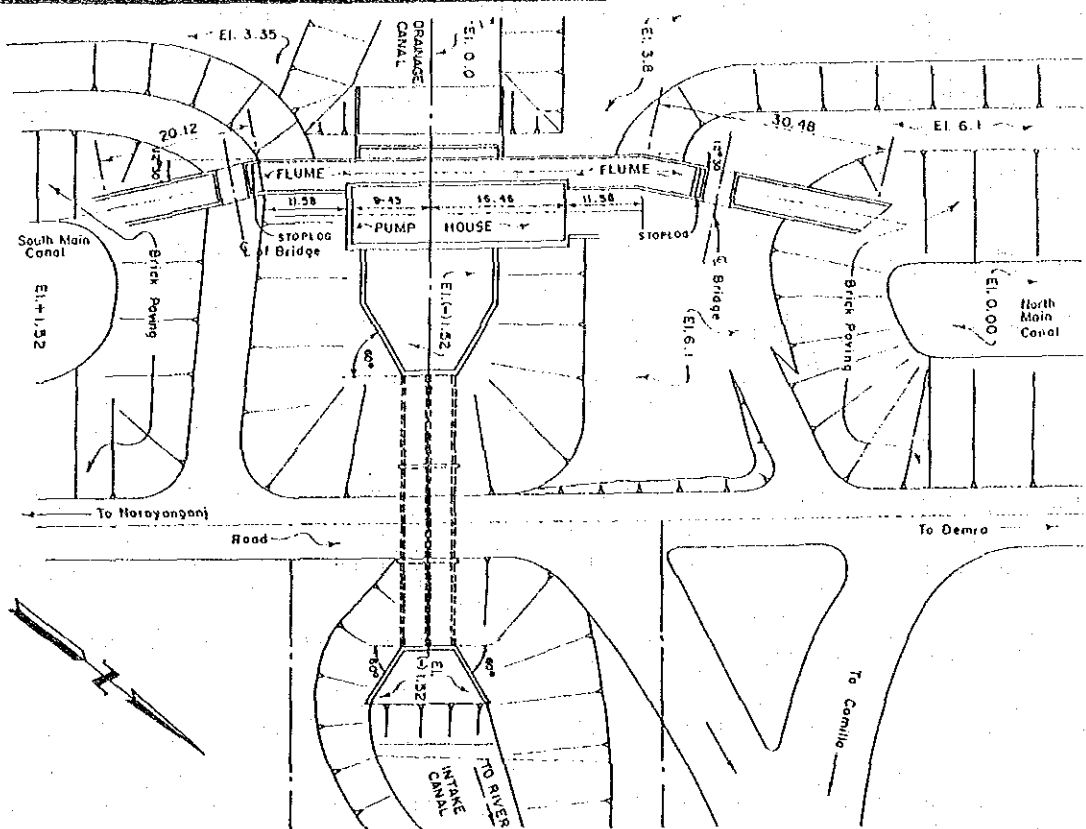
FIG. H.5

PLAN VIEW

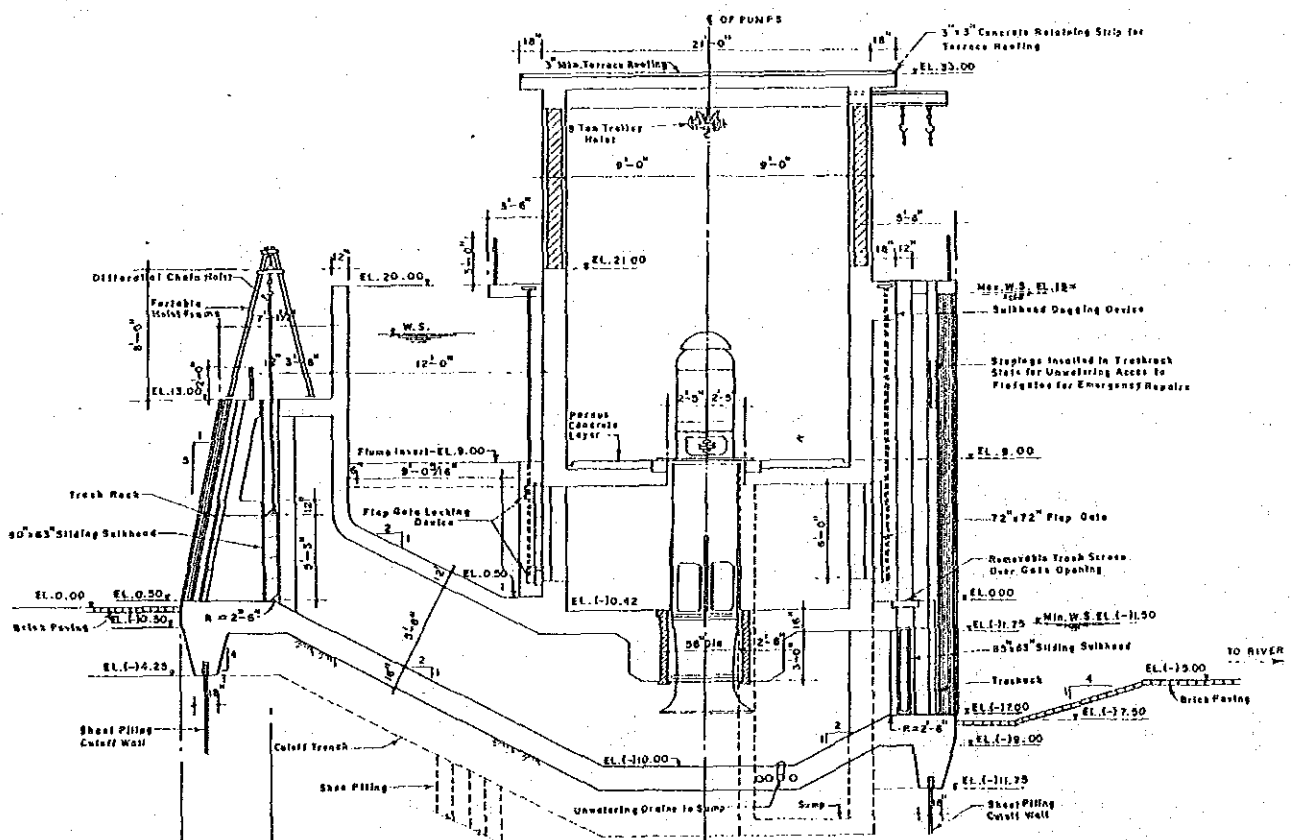
EXISTING NARINDA PUMPING STATION

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH





KEY PLAN FOR PUMPING PLANT



PUMP HOUSE-SECTION

FIG. H.6

EXISTING DEMRA PUMPING STATION

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



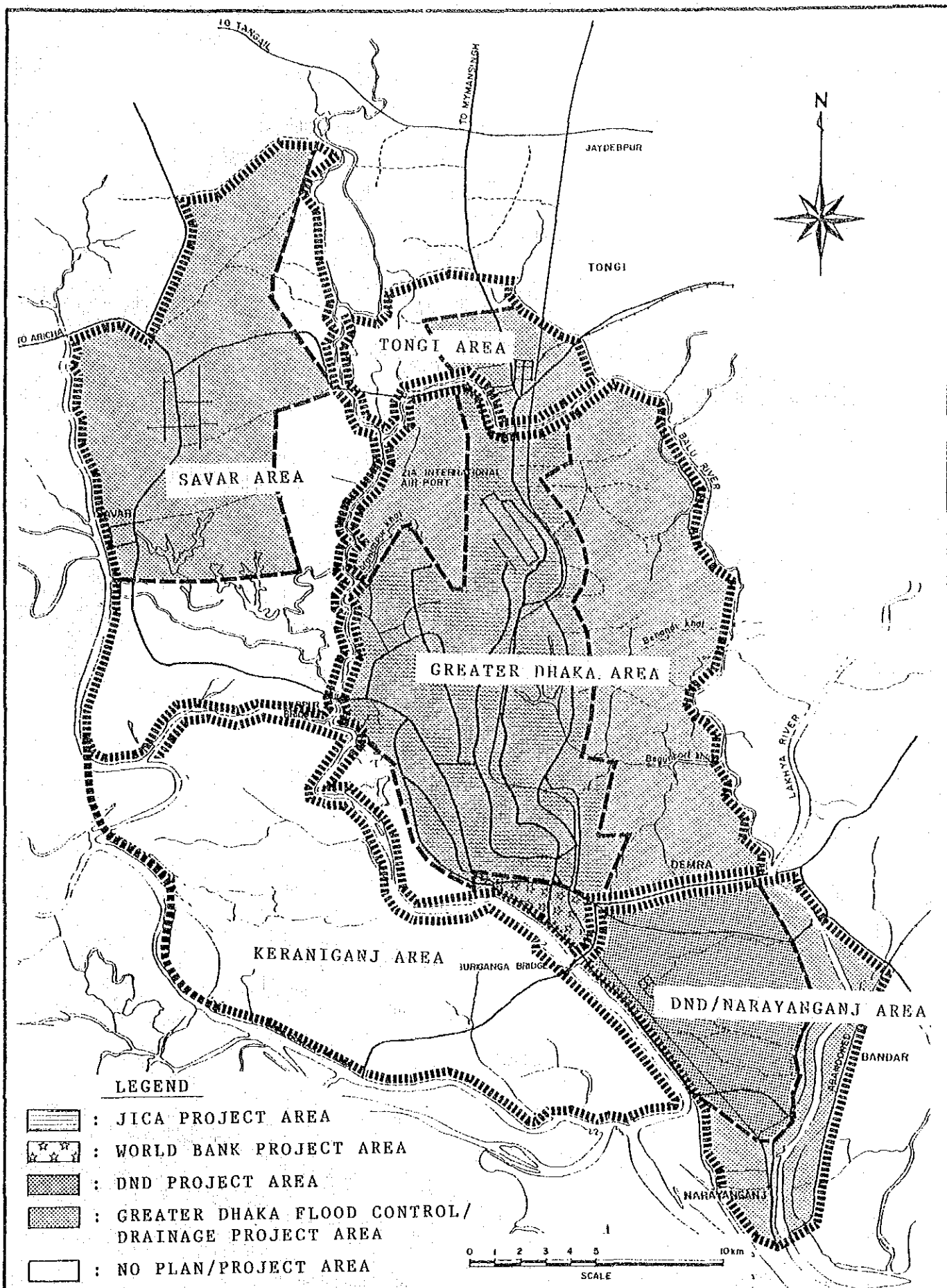
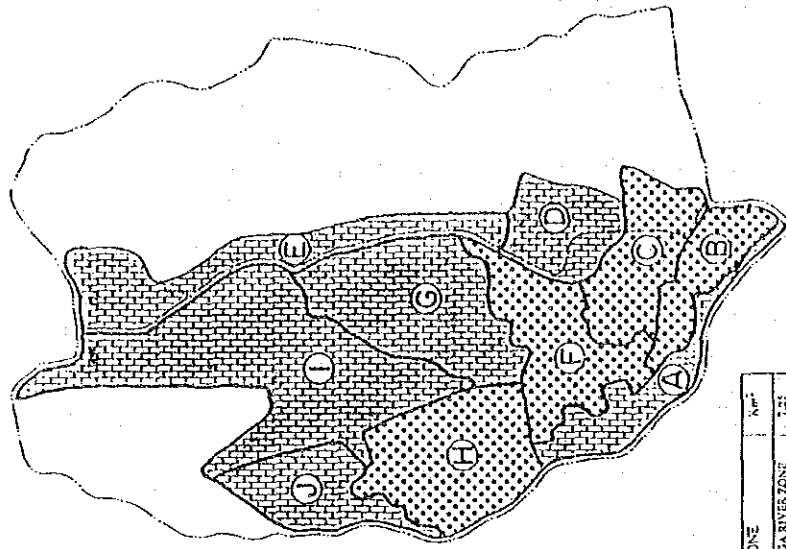
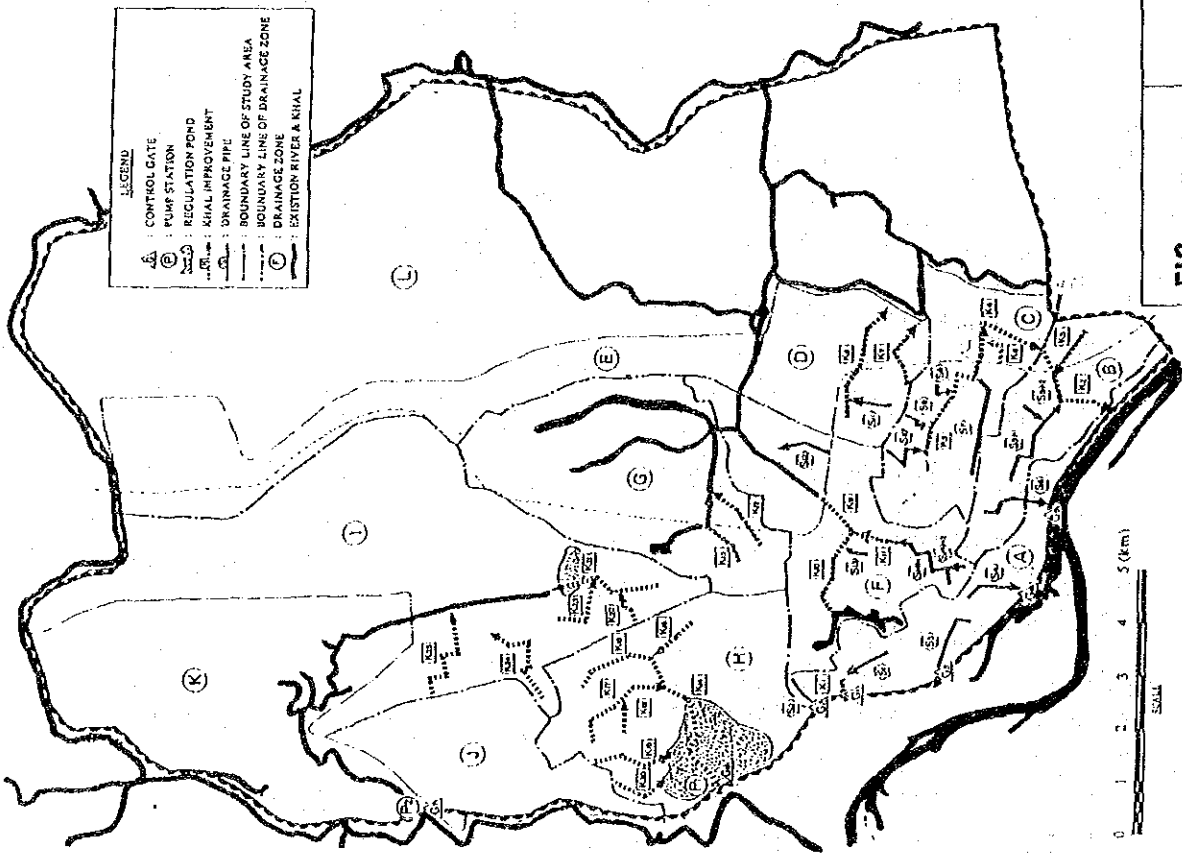


FIG. H.7

LOCATION OF EXISTING DRAINAGE PLAN AND PROJECT

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



DRAINAGE ZONE	Area (km ²)
A. DURGAंगा RIVER ZONE	7.25
B. DIDDAI KHAL ZONE	7.24
C. SECUNDA GICIA KHAL ZONE	10.62
D. BASIAD ZONE	7.46
E. NORTH EAST EDGE ZONE	13.93
F. BEGUNARI KHAL ZONE	13.77
G. GULSIAM BANAZONE	13.24
H. KALLYANPUR ZONE	11.67
I. NORTH ZONE	31.42
J. TURAG RIVER BANK ZONE	7.65
TOTAL DRAINAGE AREA	134.81

FIG. H.8

PROPOSED FACILITIES AND THEIR PHASED PROGRAM BY JICA STUDY

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



PROPOSED PHASED PROGRAM
Unit : Million Tk at 1989 price

ZONE	WORKS	PHASE	REMARKS
A	(1) Drainage Pipe	L=3.80km	127.5 S1.S-S3.S4
	(2) Khal Improvement	L=0.30km	6.3 K1
	(3) Sluice Gate	n=1place	62.5
	(4) Land Acquisition	A=1.10ha	4.8
B	(1) Drainage Pipe	L=4.33km	295.2 S5.S6
	(2) Khal Improvement		K2.K3
	(3) Pump Station	n=1place	
	(4) Sluice Gate		6.0
	(5) Land Acquisition		
C	(1) Drainage Pipe	L=4.81	206.2 S7.S8.S9.S10
	(2) Khal Improvement	L=1.00km	17.5 I-K4.K5.II-K6
	(3) Land Acquisition	A=2.60ha	80.8 I-A=1.3ha 4.8
D	(1) Drainage Pipe	L=0.70km	29.5 S11
	(2) Khal Improvement	L=1.45km	80.9 K7.K8
	(3) Land Acquisition	A=1.20ha	19.2
E	(1) Drainage Pipe	L=3.41km	117.0 S12.S13.S14
	(2) Land Acquisition		K9.K10.K11
G	(1) Khal Improvement	L=2.90km	4.0 K12.K13
	(2) Land Acquisition	A=1.20ha	19.2
H	(1) Khal Improvement	L=7.50km	240.1 I-N1-I-N14
	(2) Pump Station	L=10.0m ³ /s	206.3 K15.K16.K17
	(3) Sluice Gate	n=1place	50.9
	(4) Land Acquisition	A=5.30ha	68.0 I-A=3.10ha 46.4
I	(1) Khal Improvement	L=6.95km	244.1 K18.K19.K20
	(2) Pump Station	I=2.5m ³ /s	171.1 K21.K22
	(3) Sluice Gate	n=1place	15.1
	(4) Land Acquisition	A=3.1ha	37.2
J	Sub-Total	1035.0	1949.4
	Contingency and Engineering	336.4	357.3
TOTAL		1371.0 Million Tk	2306.7 Million Tk 4478.7 M.Tk

Note : Proposed works with (*) in the B-Zone are included in the World Bank Project.

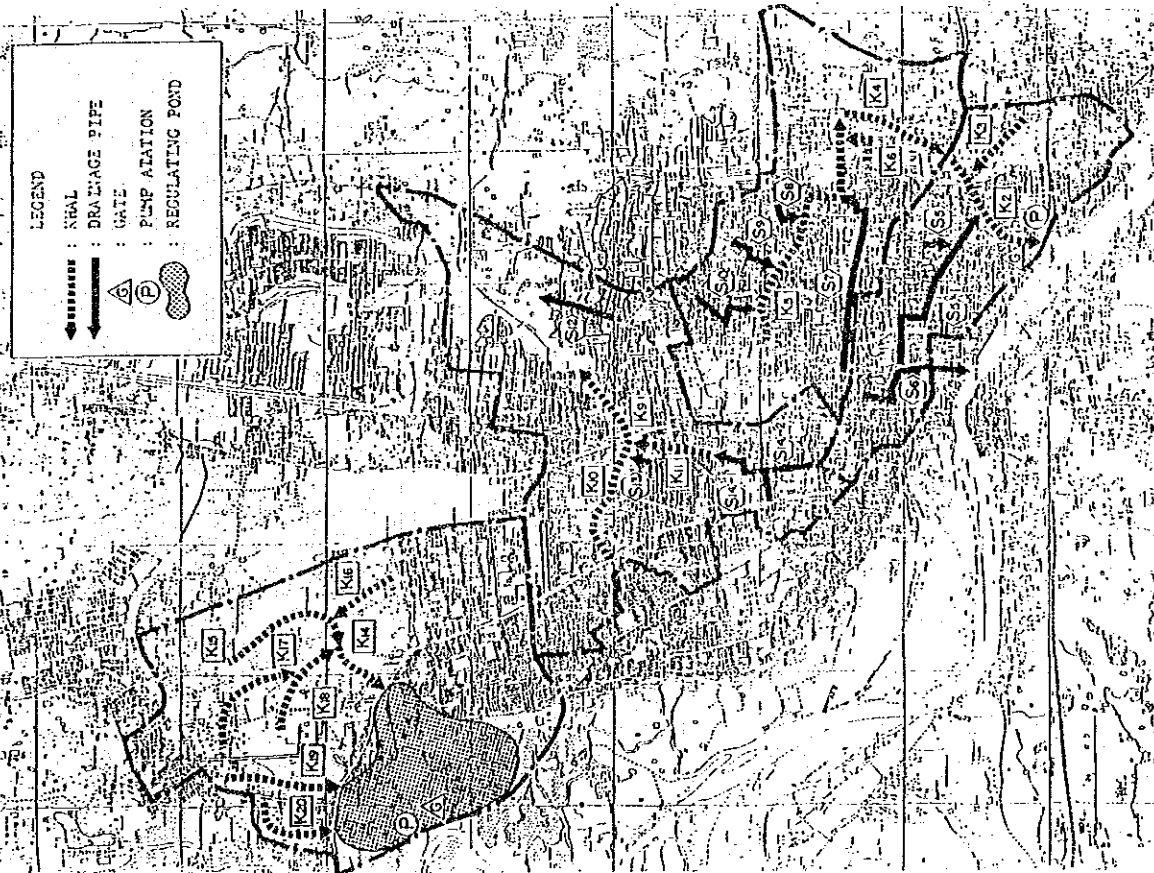


FIG. H.9

URGENT PROJECT PROPOSED BY JICA STUDY

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



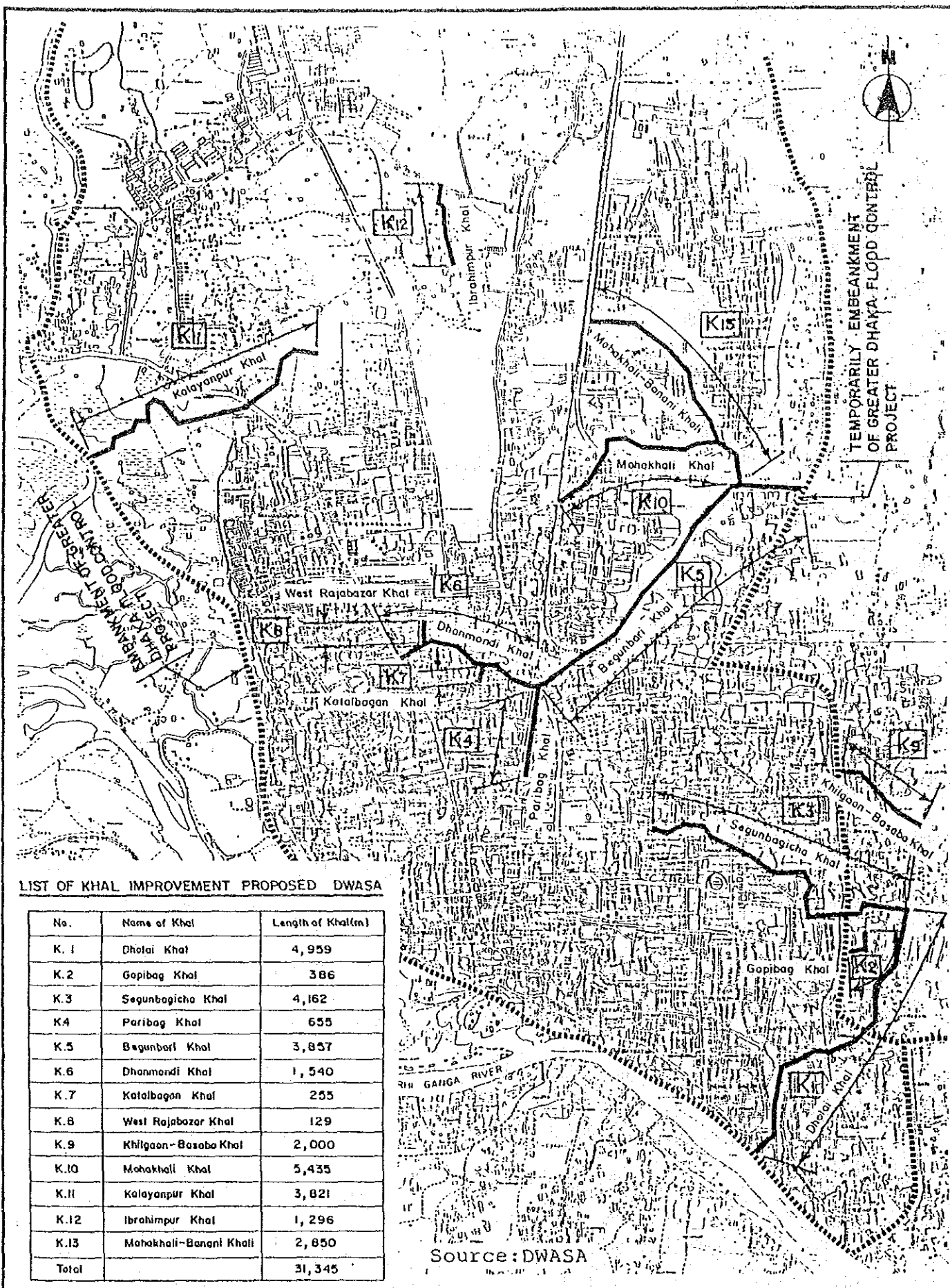
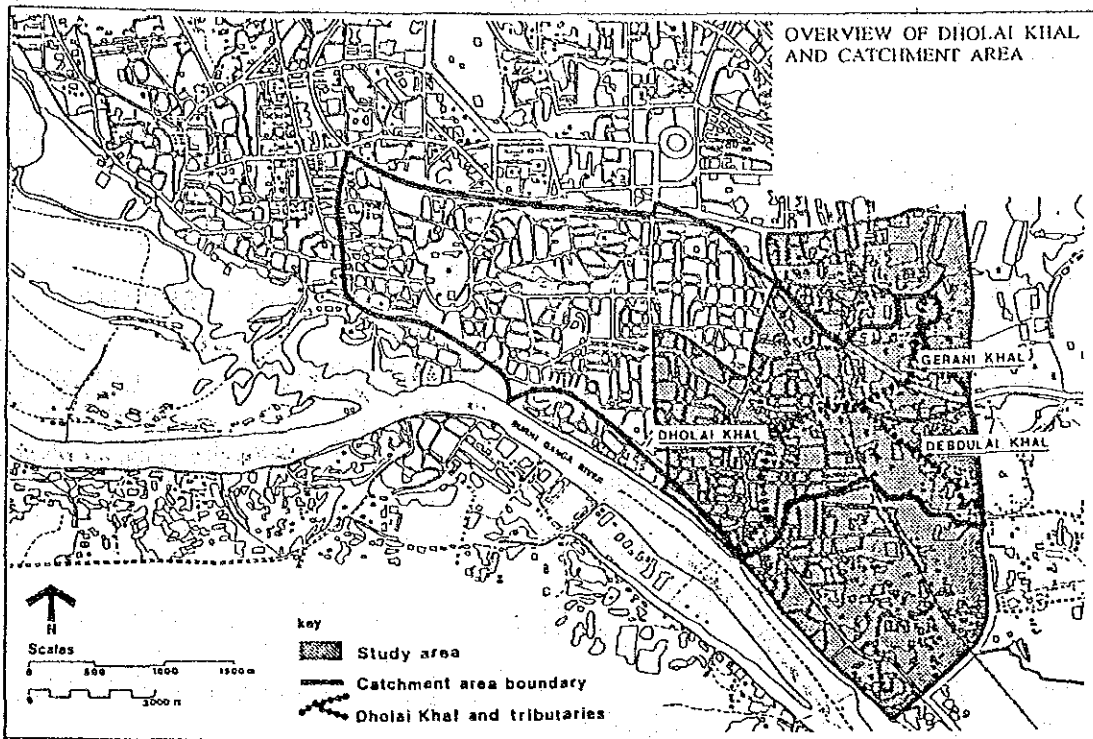


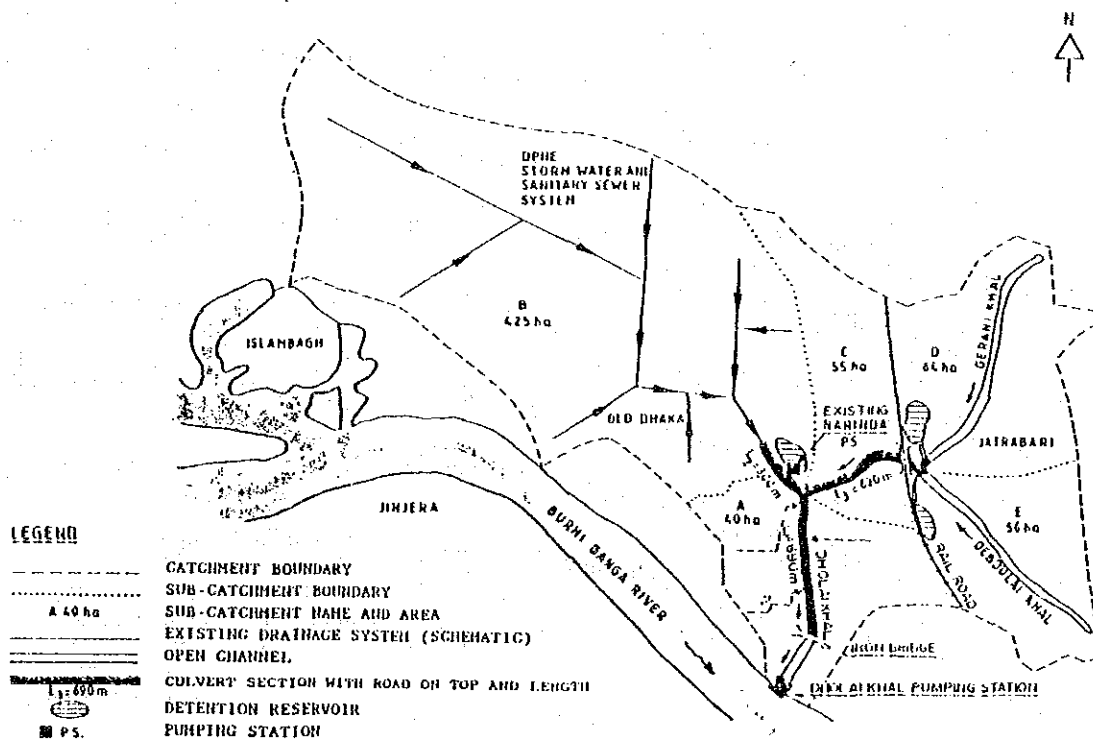
FIG. H.10

URGENT KHAL CLEANING PROJECT BY DWASA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



STUDY AREA AND CATCHMENT AREA OF DHOLAI KHAL



Source : Final Report on Dholai Khal Rehabilitation and Area Development Study by B.K.H. B.V. in October 1986

FIG. H.11

PROPOSED DRAINAGE SYSTEM OF DHOLAI KHAL
REHABILITATION AND AREA DEVELOPMENT PROJECT

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

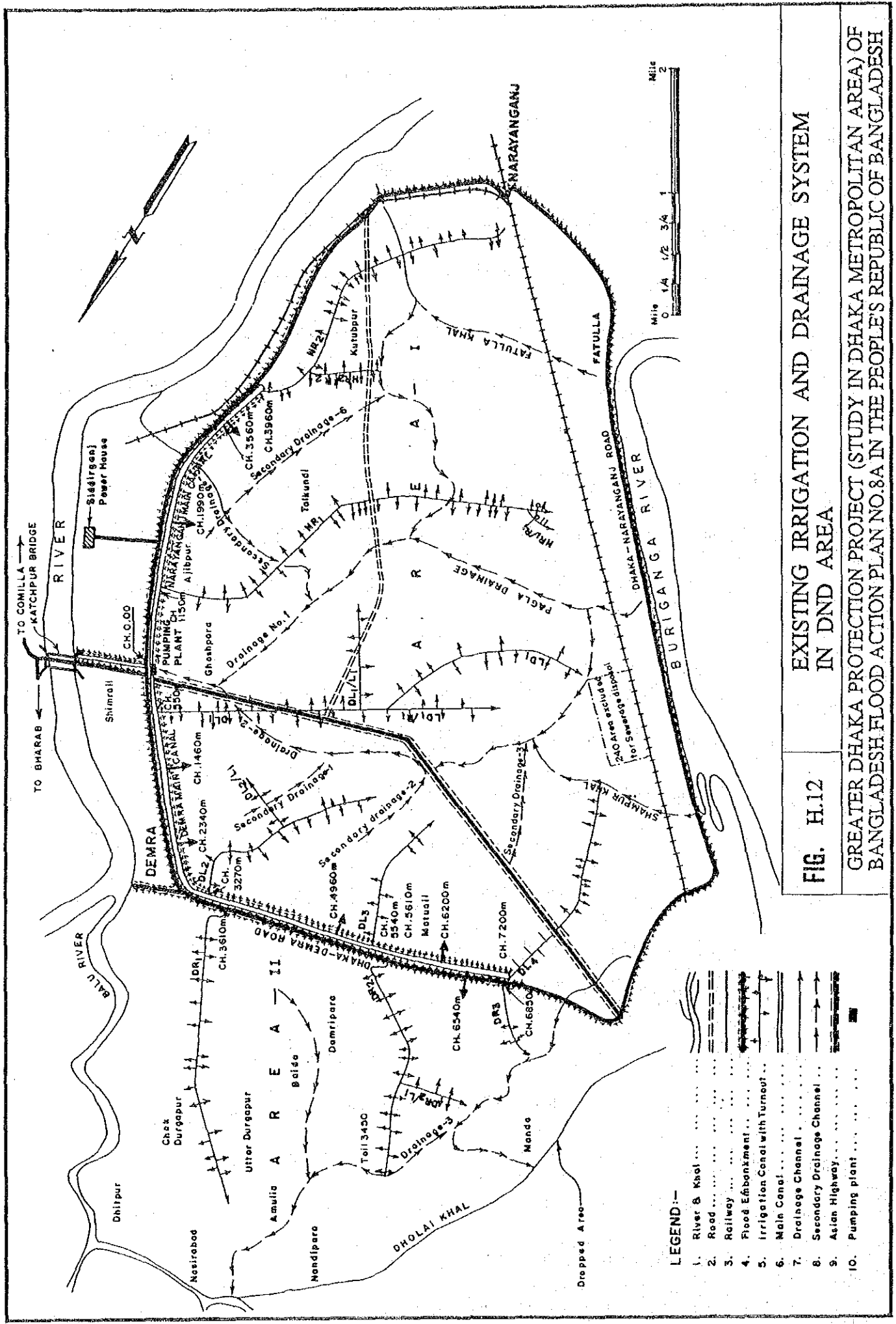


FIG. H.12 EXISTING IRRIGATION AND DRAINAGE SYSTEM IN DND AREA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

- LEGEND:-**
- 1. River & Khal
 - 2. Road
 - 3. Railway
 - 4. Flood Embankment
 - 5. Irrigation Canal with Turnout
 - 6. Main Canal
 - 7. Drainage Channel
 - 8. Secondary Drainage Channel
 - 9. Asian Highway
 - 10. Pumping plant



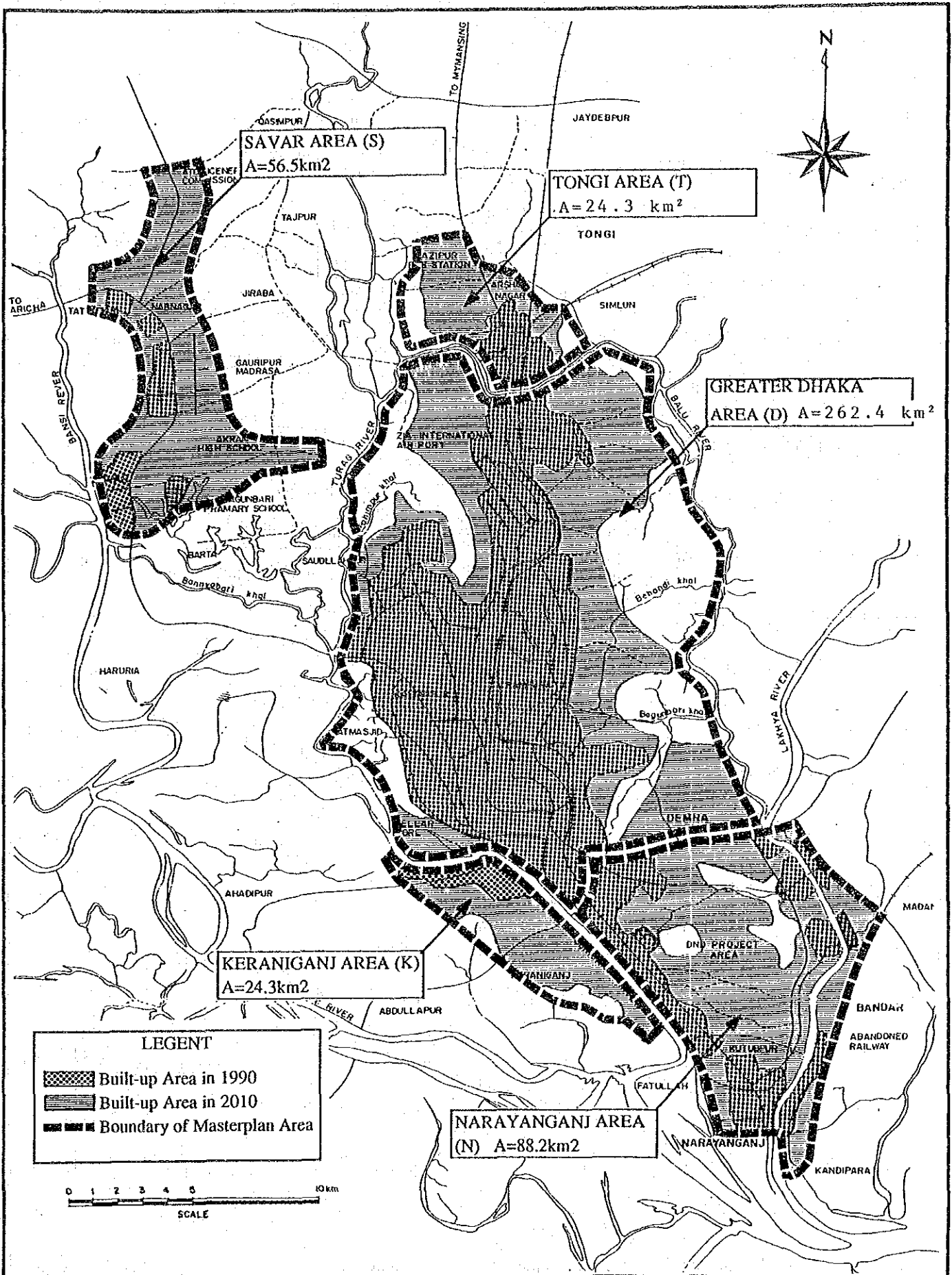
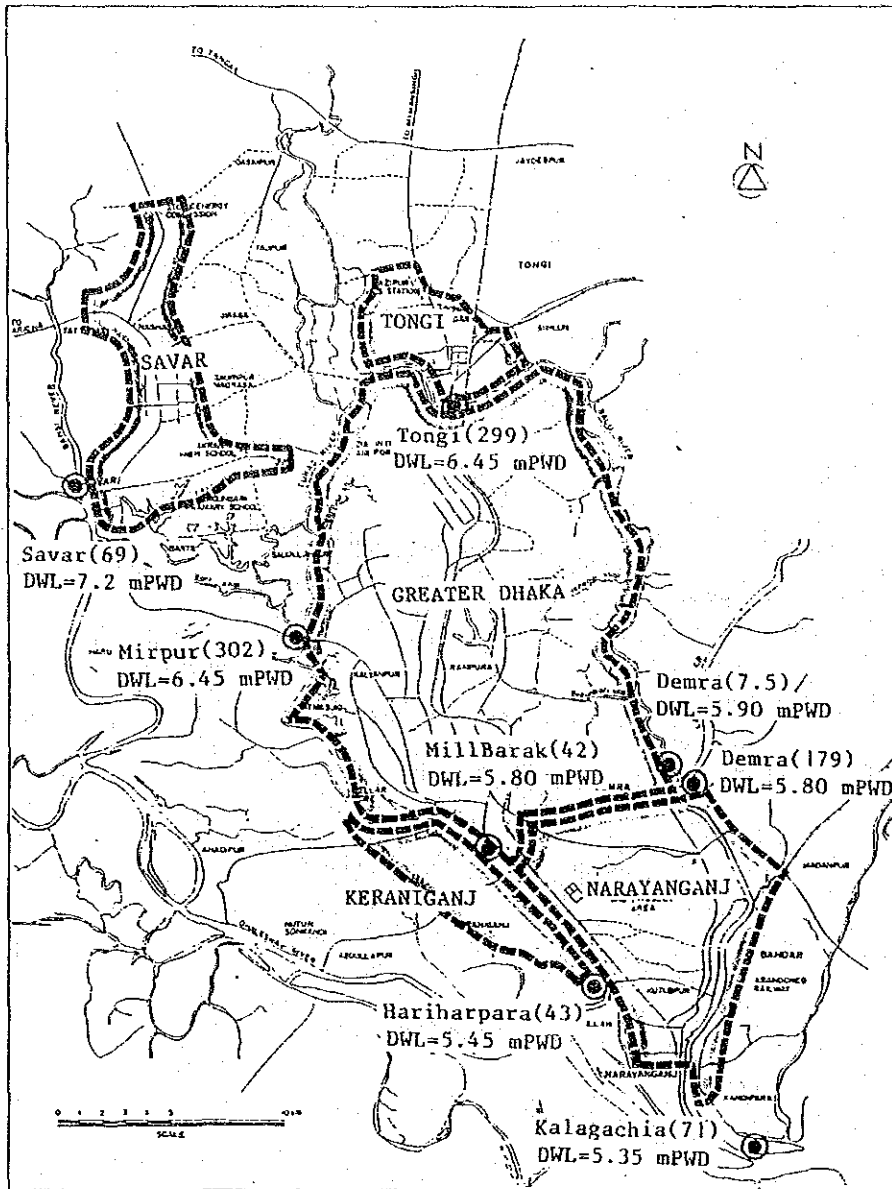


FIG. H.13

LOCATION OF MASTER PLAN AREA
OF STORM WATER DRAINAGE

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF
BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



Design Flood Water Levels of Stormwater Drainage

(1) Greater Dhaka Area

- Buriganga River Left Bank Zone : 5.80 to 6.45 m PWD
- Turag River Left Bank Zone : 6.45 m PWD
- Balu River Right Bank Zone : 5.90 to 6.45 m PWD

(2) Tongi Area

- Tongi East and West Zone : 6.45 m PWD

(3) Narayanganj Area

- DND Project, Narayanganj East and West Zone : 5.45 to 5.80 m PWD

(4) Keraniganj Area

: 5.45 to 5.80 m PWD

(5) Savar Area

: 7.20 m PWD

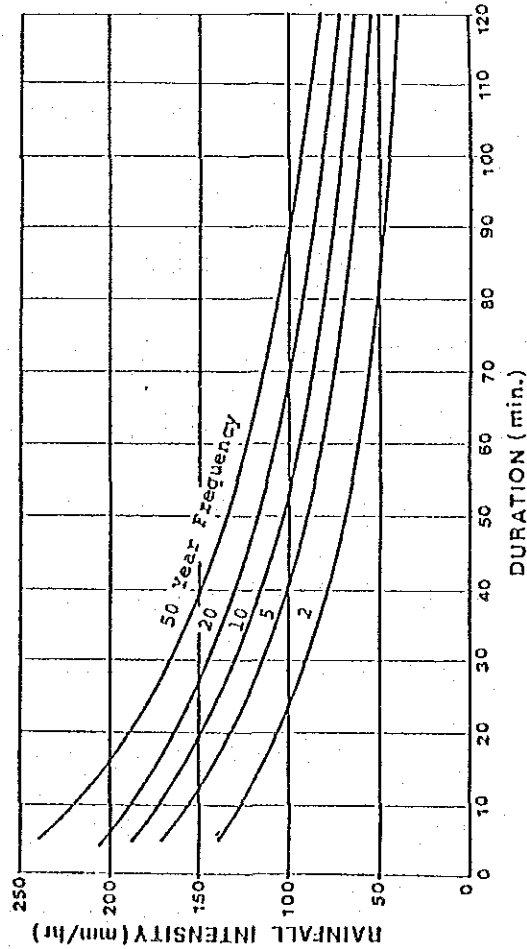
FIG. H.14

DESIGN FLOOD WATER LEVELS
IN MASTER PLAN AREA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF
BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

RAINFALL INTENSITY-DURATION FORMULA

RETURN PERIOD	EQUATION	RAINFALL INTENSITY			
		15	30	60	120
2	$\frac{5689}{1+44}$	113.4	90.4	84.3	40.8
3	$\frac{7874}{1+27}$	123.8	99.7	71.7	49.0
5	$\frac{9005}{1+20}$	139.3	112.8	81.9	53.0
10	$\frac{10390}{1+13}$	157.2	129.8	94.6	61.8
20	$\frac{12311}{1+9}$	175.9	140.8	107.0	70.3
50	$\frac{14415}{1+7}$	200.2	165.7	123.2	81.4



HOURLY DISTRIBUTION

hr	%	R ₁ mm	R ₂ mm
1	9	17.4	4.8
2	15	29.3	8.0
3	44	82.8	23.2
4	15	30.6	8.5
5	9	18.0	5.0
6	7	14.9	3.5
TOTAL	100	192.0	53.0

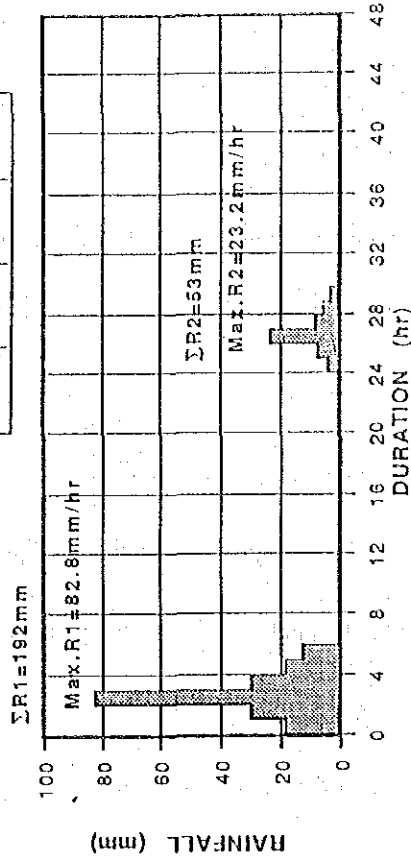


FIG. H.15

DESIGN RAINFALL

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



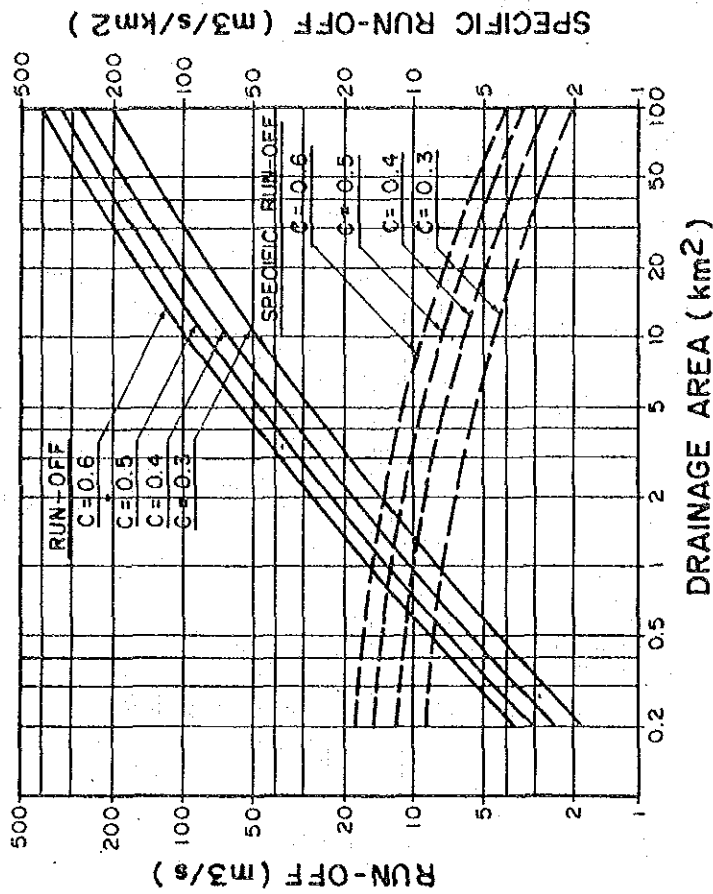
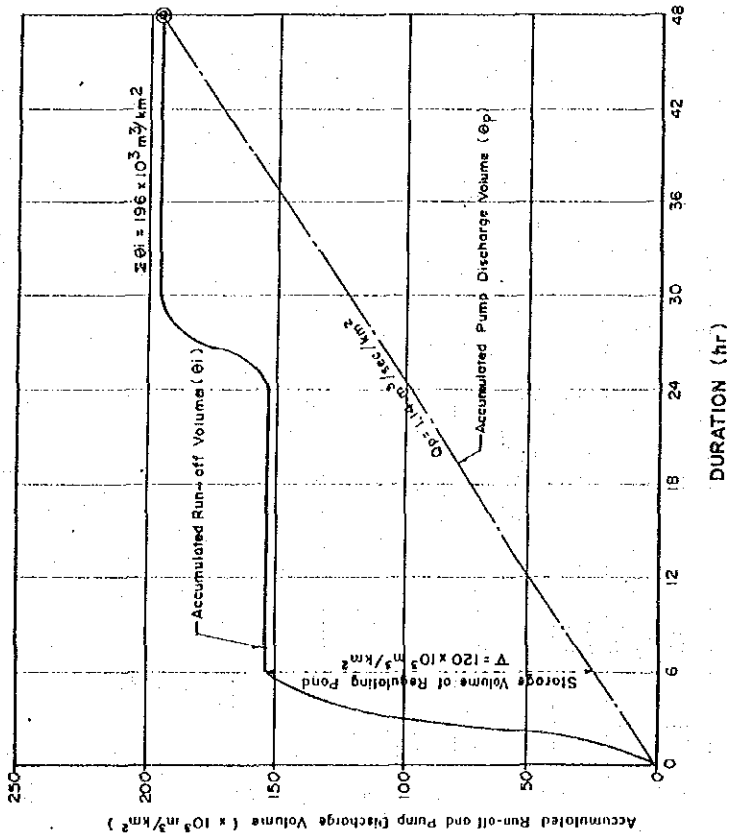
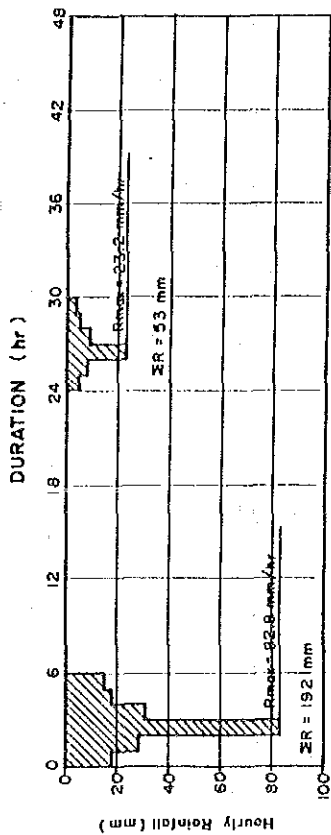


FIG. H.16

SPECIFIC REQUIREMENTS OF PUMP AND REGULATING POND, AND SPECIFIC PEAK OFF AND DRAINAGE AREA CURVES

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

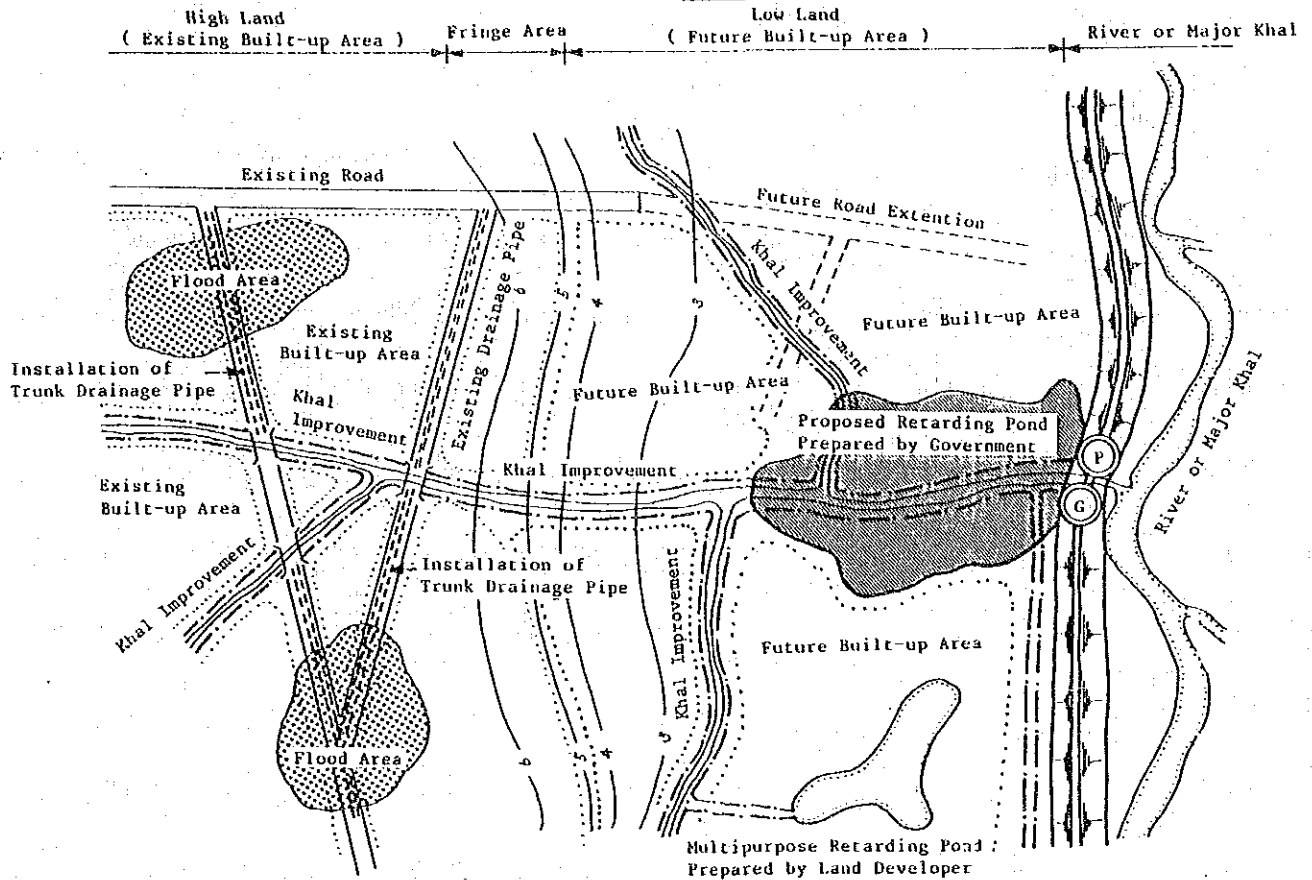


Measures in Existing Built-up Area

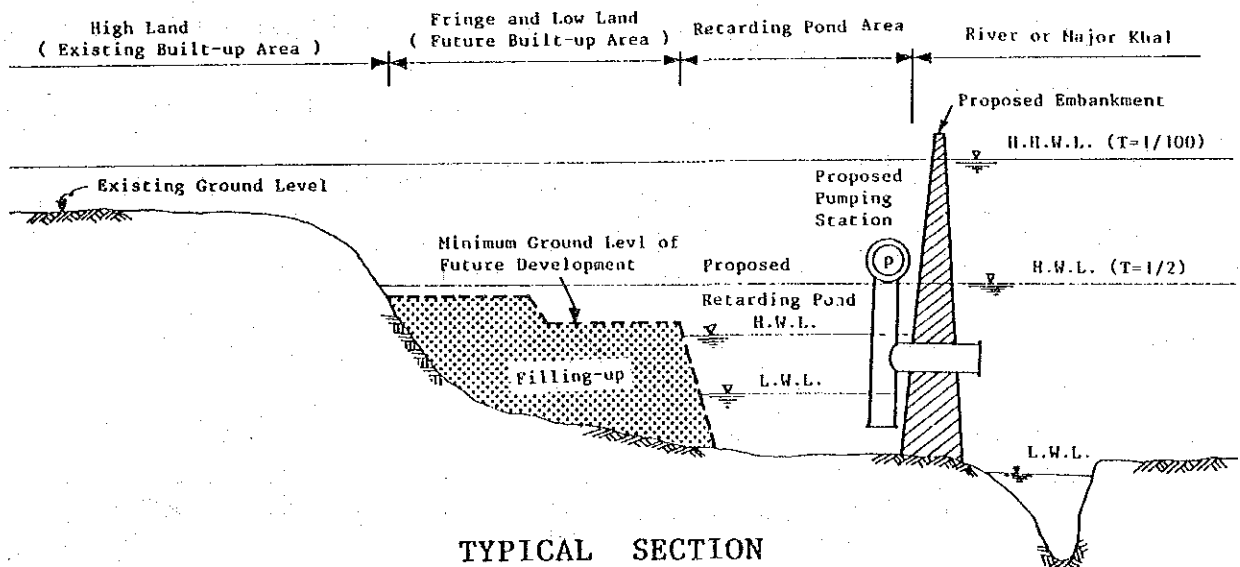
- Structural Measures**
- All of the required pumping station with sluice gate
 - Khal improvement and installation of trunk drainage pipe

Measures in Future Built-up Area

- Structural Measures**
- All of the required pumping station with sluice gate
 - Trunk khal Improvement
- Non-structural Measures**
- Recommendation of minimum ground elevation by filling up in future development areas
 - Land use regulation for the proposed pump regulating pond and trunk khal areas



P L A N

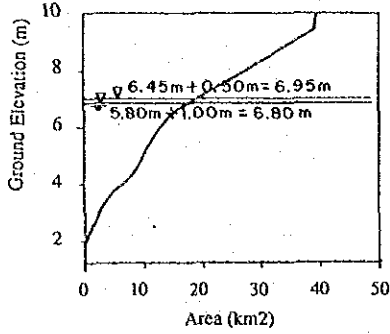


TYPICAL SECTION

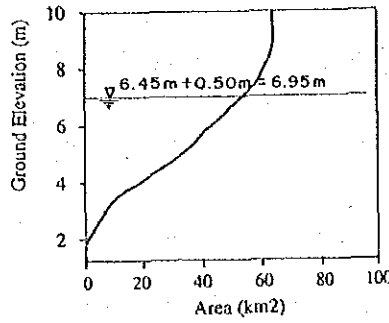
FIG. H.17 SCOPE OF STRUCTURAL AND NON-STRUCTURAL MEASURES

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

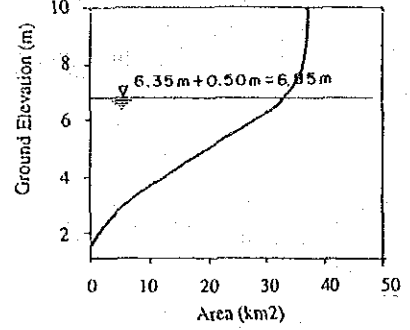
Buriganga River Left Bank Zone



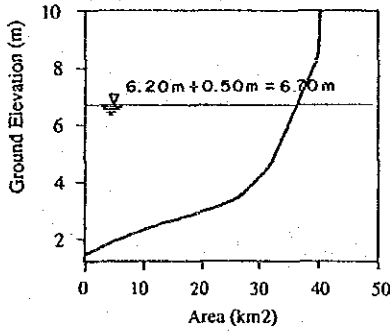
Turag River Left Bank Zone



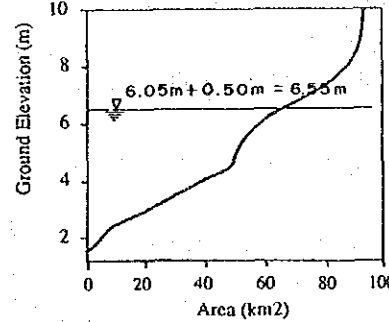
Balu River Right Bank Zone Northern Area



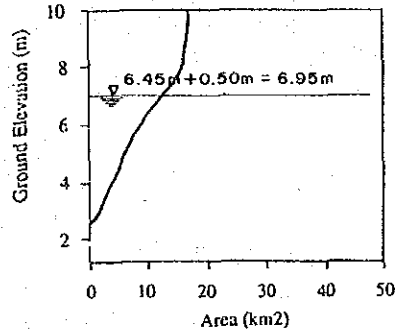
Balu River Right Bank Zone Central Area



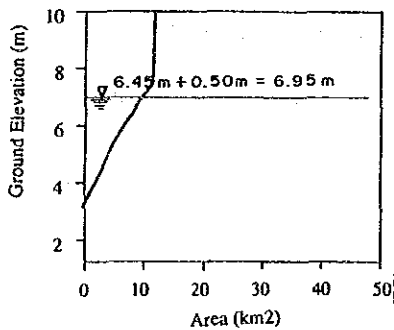
Balu River Right Bank Zone Southern Area



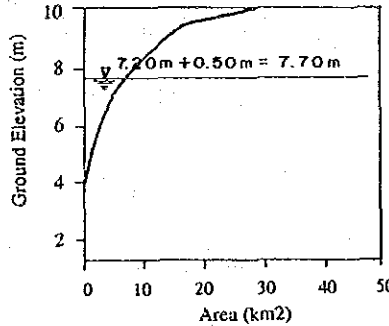
Tongi West Zone



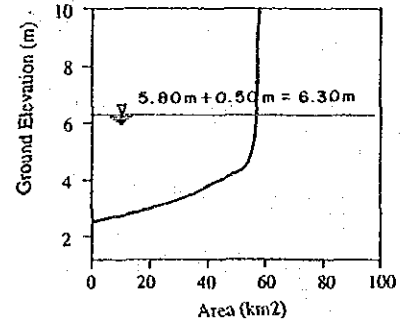
Tongi East Zone



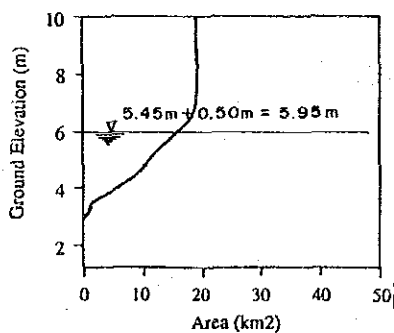
Savar



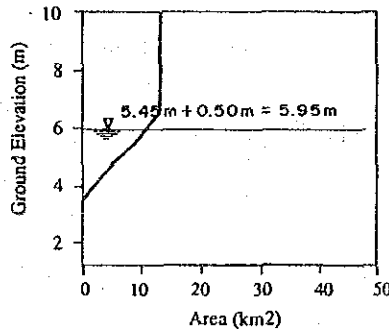
DND Project Zone



Narayanganj West Zone



Narayanganj East Zone



Keraniganj

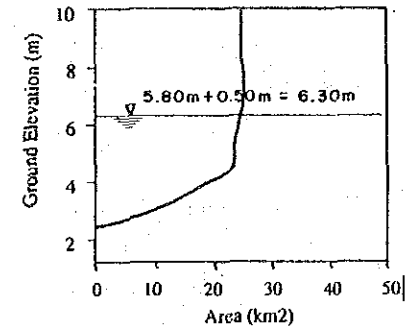
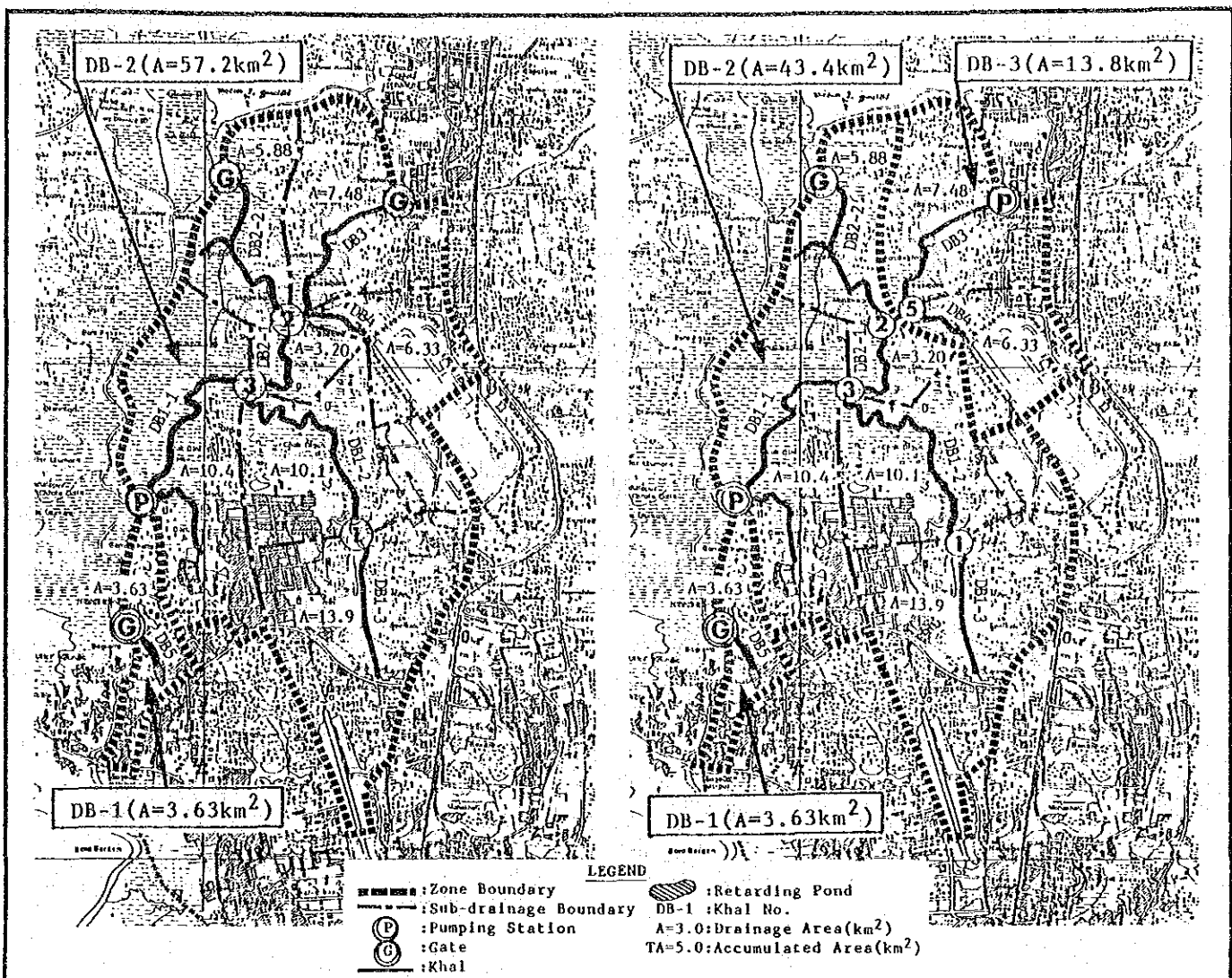


FIG. H.18

GROUND ELEVATION AND AREA CURVE BY DRAINAGE ZONE

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



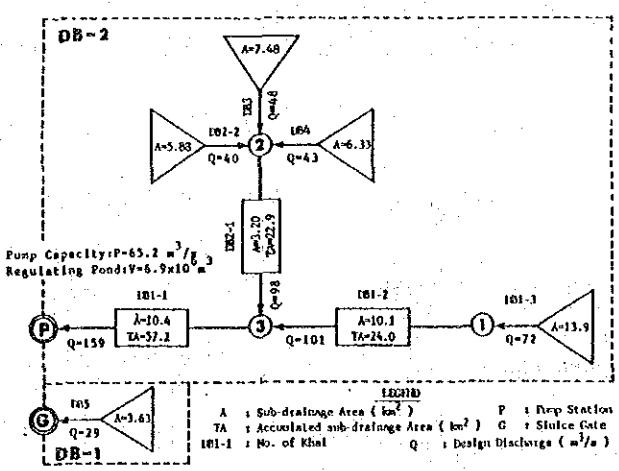


LEGEND

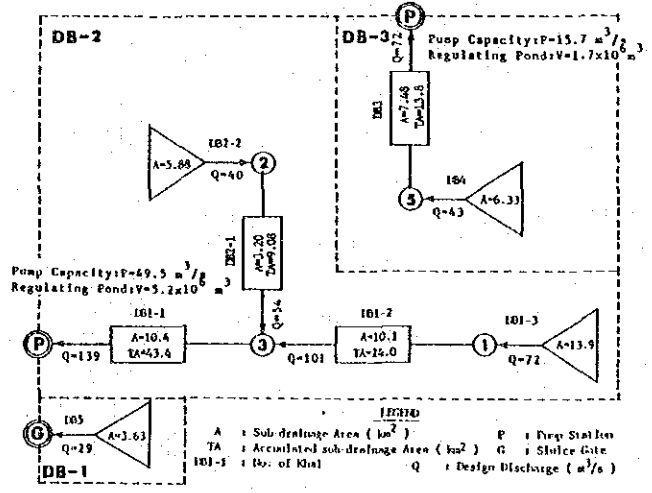
- : Zone Boundary
- : Sub-drainage Boundary
- : Pumping Station
- : Gate
- : Khal
- : Retarding Pond
- DB-1 : Khal No.
- A=3.0: Drainage Area (km²)
- TA=5.0: Accumulated Area (km²)

Drainage Plan

Drainage Plan



Drainage Model



Drainage Model

Alternative I

Alternative II

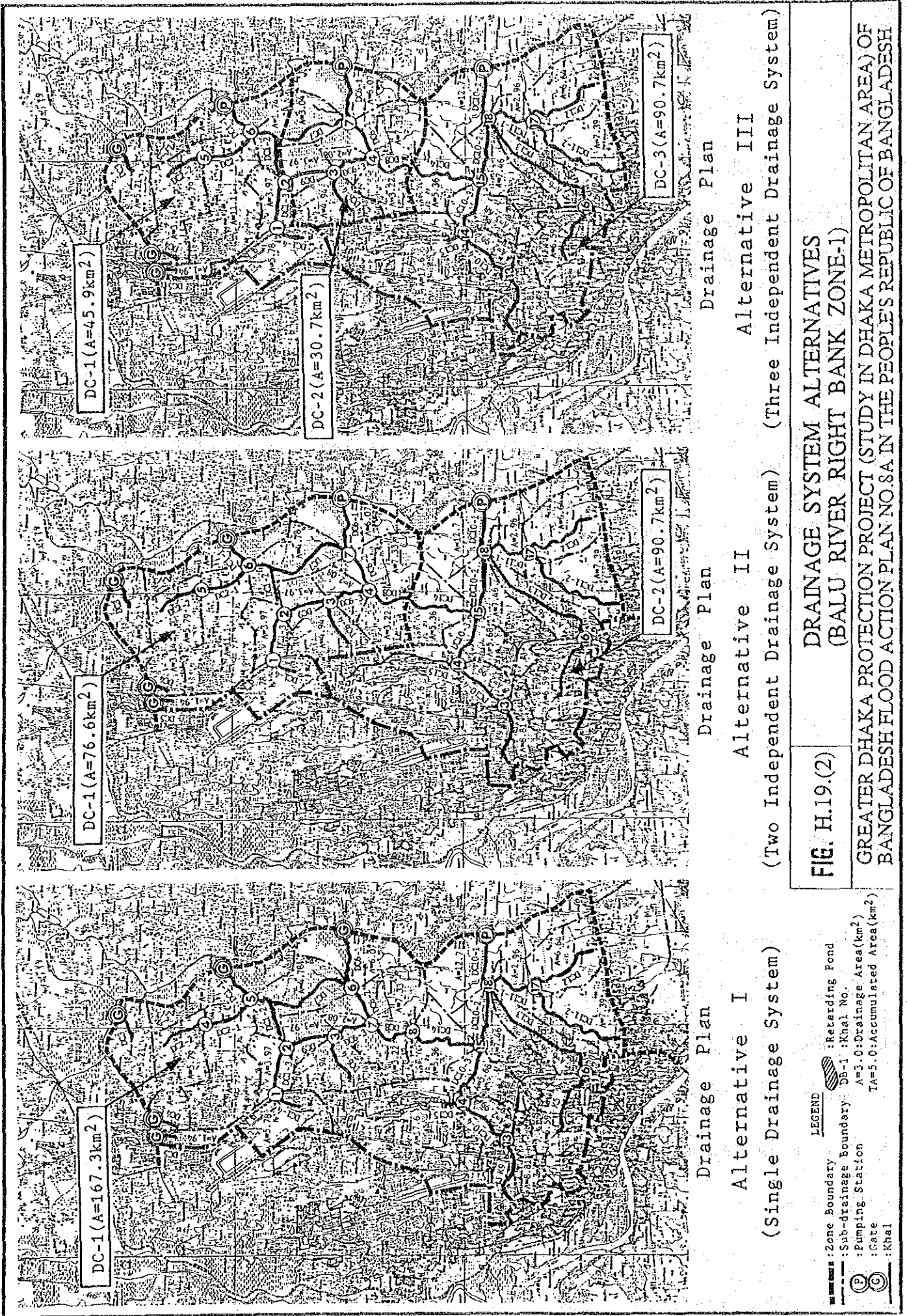
(Two Independent Drainage System)

(Three Independent Drainage System)

FIG. H.19.(1) DRAINAGE SYSTEM ALTERNATIVES (TURAG RIVER LEFT BANK ZONE)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH





Drainage Plan

Alternative I
(Single Drainage System)

Drainage Plan

Alternative II
(Two Independent Drainage System)

Drainage Plan

Alternative III
(Three Independent Drainage System)

LEGEND

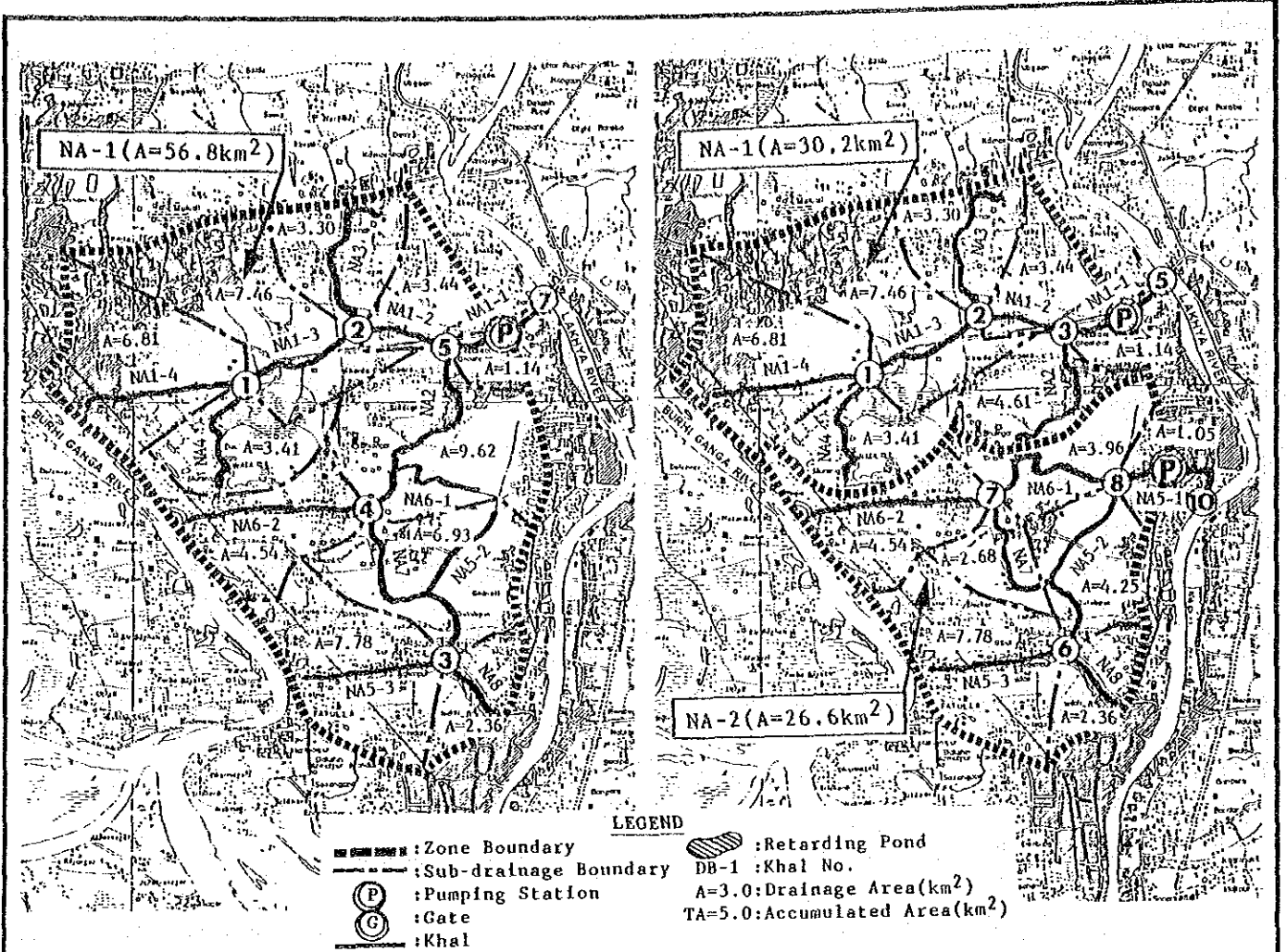
- : Zone Boundary
- : Sub-drainage Boundary
- : Retarding Pond
- : Pumping Station
- : Gate
- : Khal
- : DB-1 :Khal No.
- : A=3.0:Drainage Area(km²)
- : TA=5.0:Accumulated Area(km²)

FIG. H.19.(2)

**DRAINAGE SYSTEM ALTERNATIVES
(BALU RIVER RIGHT BANK ZONE-1)**

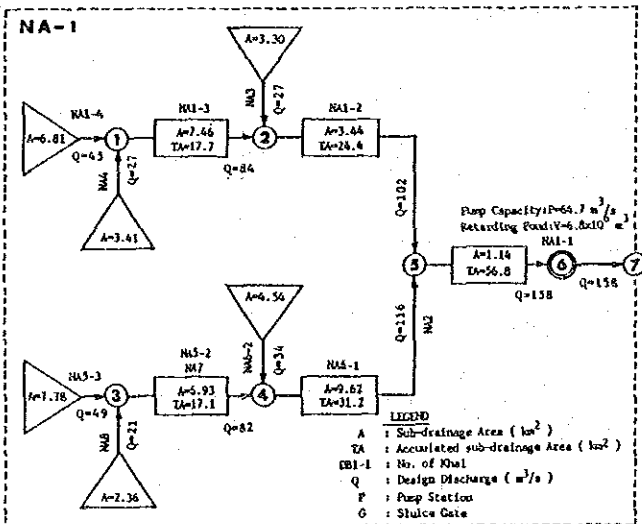
GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH





Drainage Plan

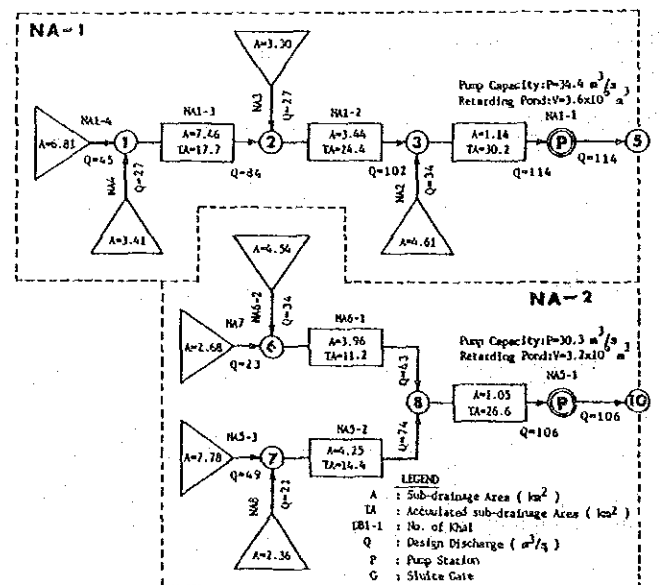
Drainage Plan



Drainage Model

Alternative I

(Single Drainage System)



Drainage Model

Alternative II

(Two Independent Drainage System)

FIG. H.19.(4)

**DRAINAGE SYSTEM ALTERNATIVES
(DND PROJECT ZONE)**

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

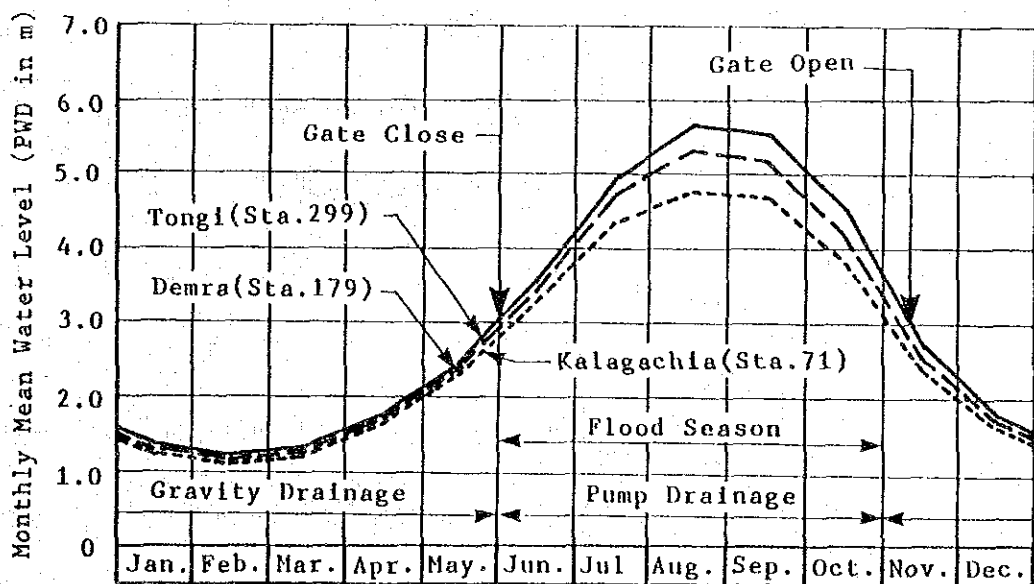
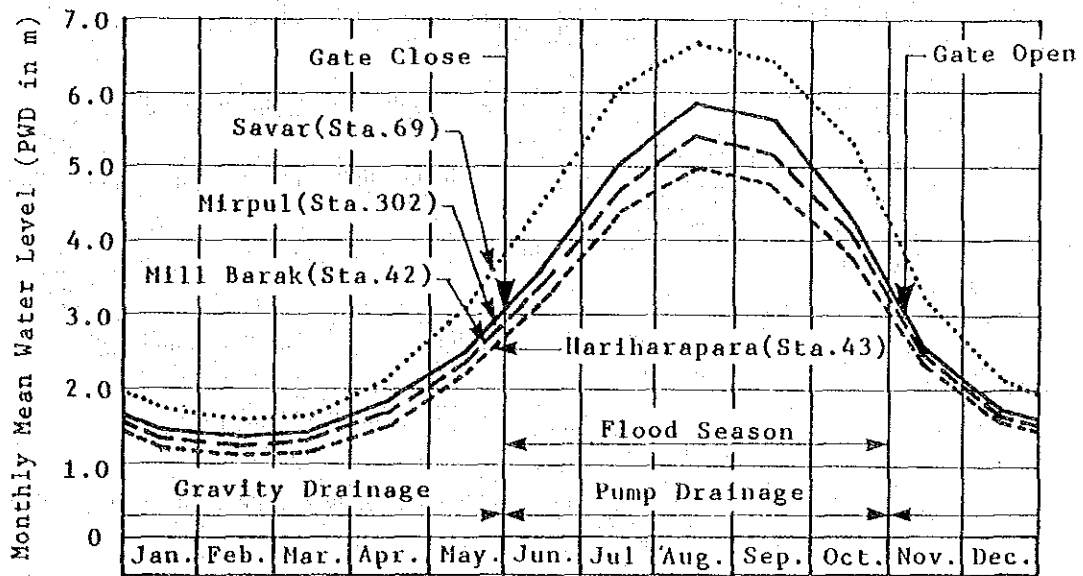
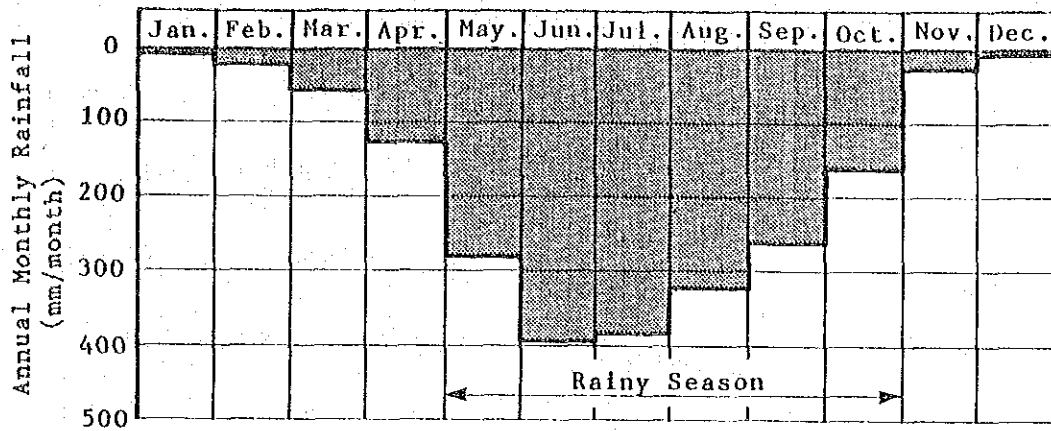


FIG. H.20

SEASONAL VARIATION OF RAINFALL AND FLOOD WATER LEVEL IN DHAKA METROPOLITAN AREA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

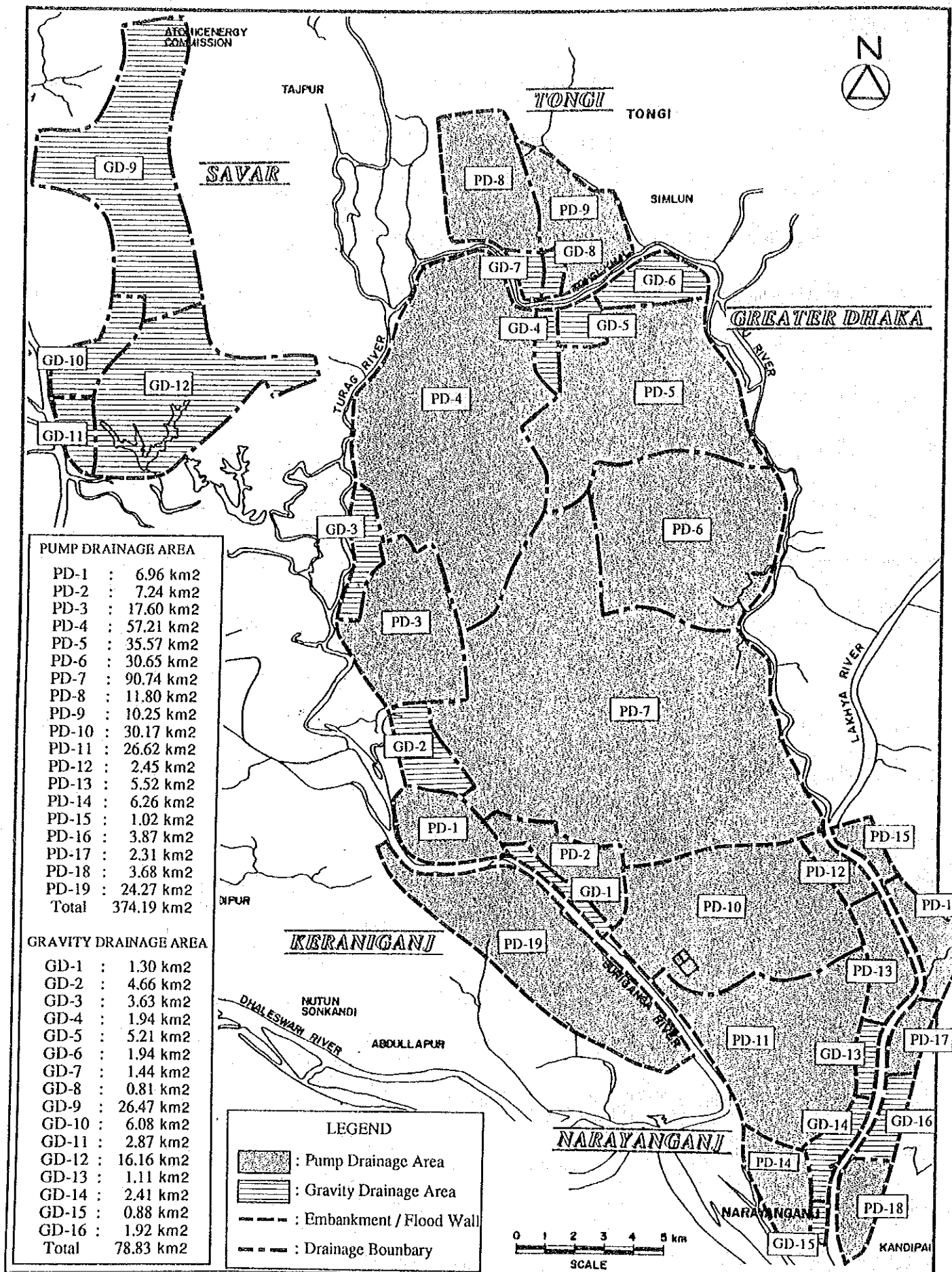
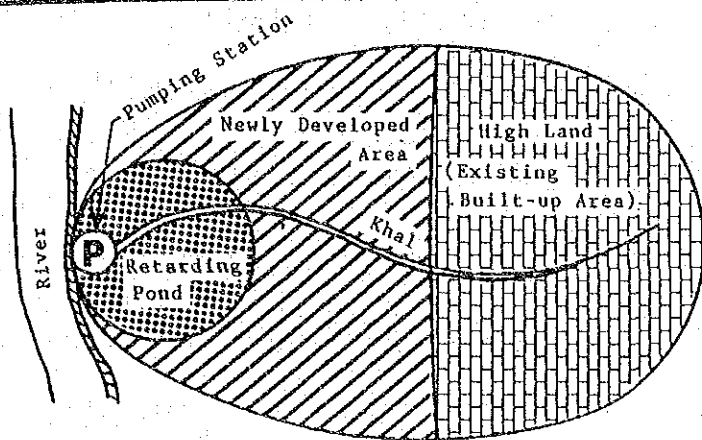


FIG. H.21

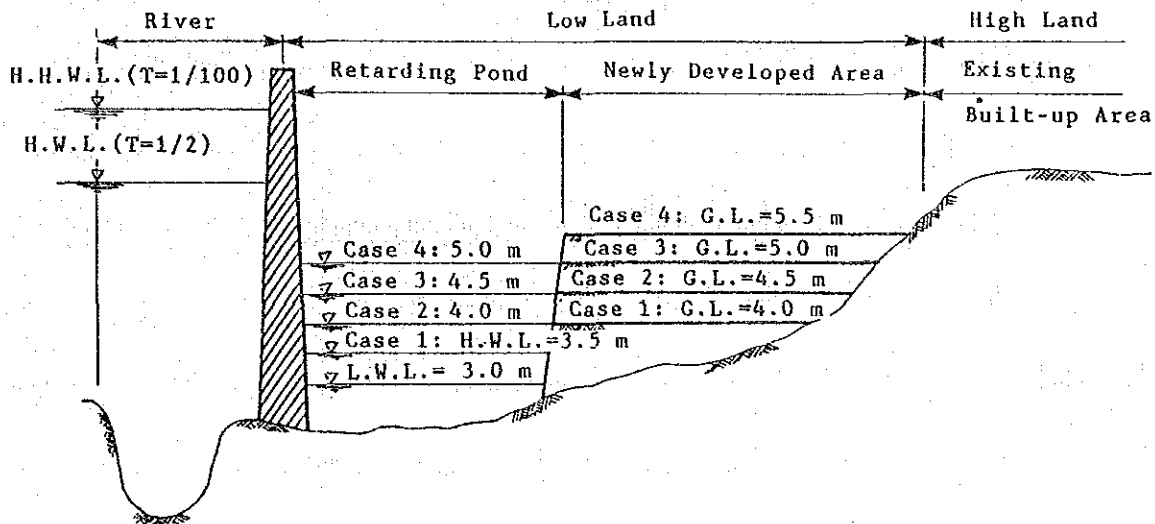
ZONING OF GRAVITY AND PUMP DRAINAGE AREA

GREATHER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

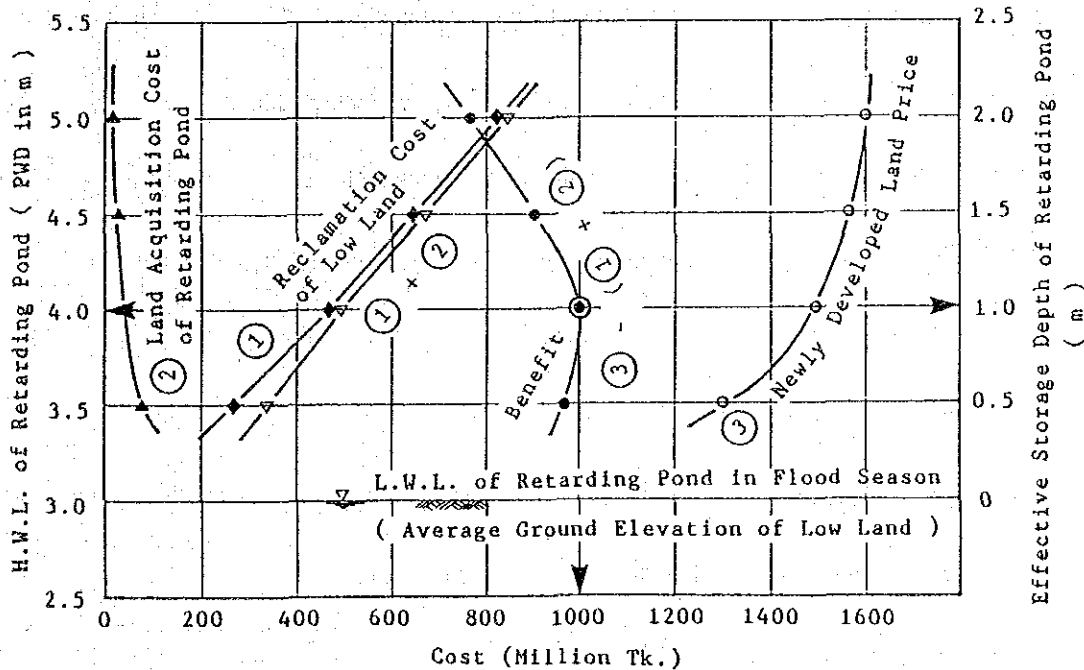


- Main Features of Case Study**
- * Case Study Area: $A=100$ ha (1.0 km²)
 - * Required Pump Capacity: $P=1.14$ m³/s
 - * Required Storage Volume of Retarding Pond: $V=120,000$ m³
 - * L.W.L. of Retarding Pond: $H=3.0$ m PWD
 - * Variation of H.W.L. of Retarding Pond: $H= 3.5$ to 5.0 m PWD

Key Map of Case Study Area



Standard Section Of Case Study Area



H.W.L. Of Retarding Pond - Cost, Benefit Curves

FIG. H.22

CASE STUDY FOR DESIGN HIGH WATER LEVEL OF RETARDING POND

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



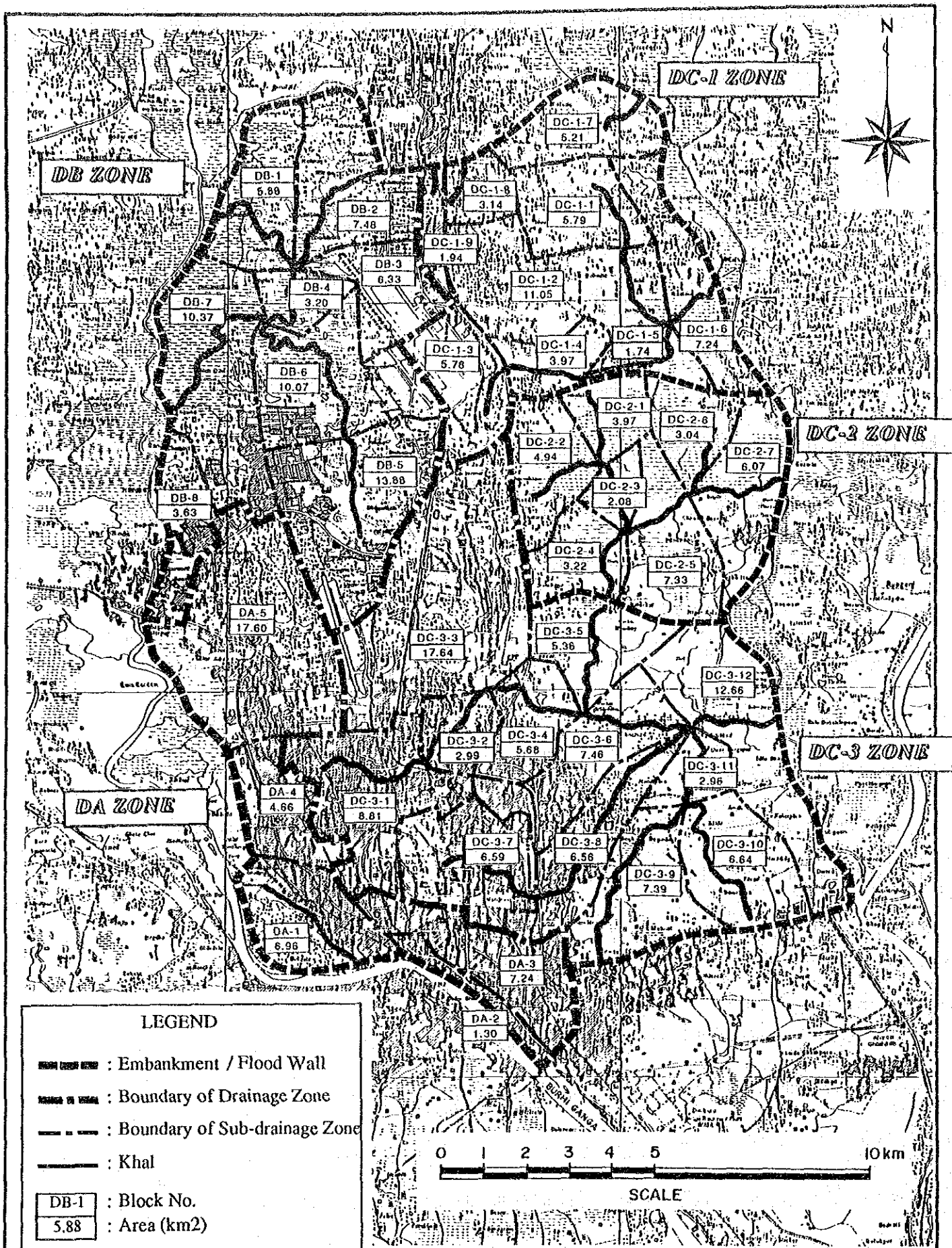


FIG. H.23.(1)

**SUB-DIVIDED DRAINAGE AREA
(GREATER DHAKA)**

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

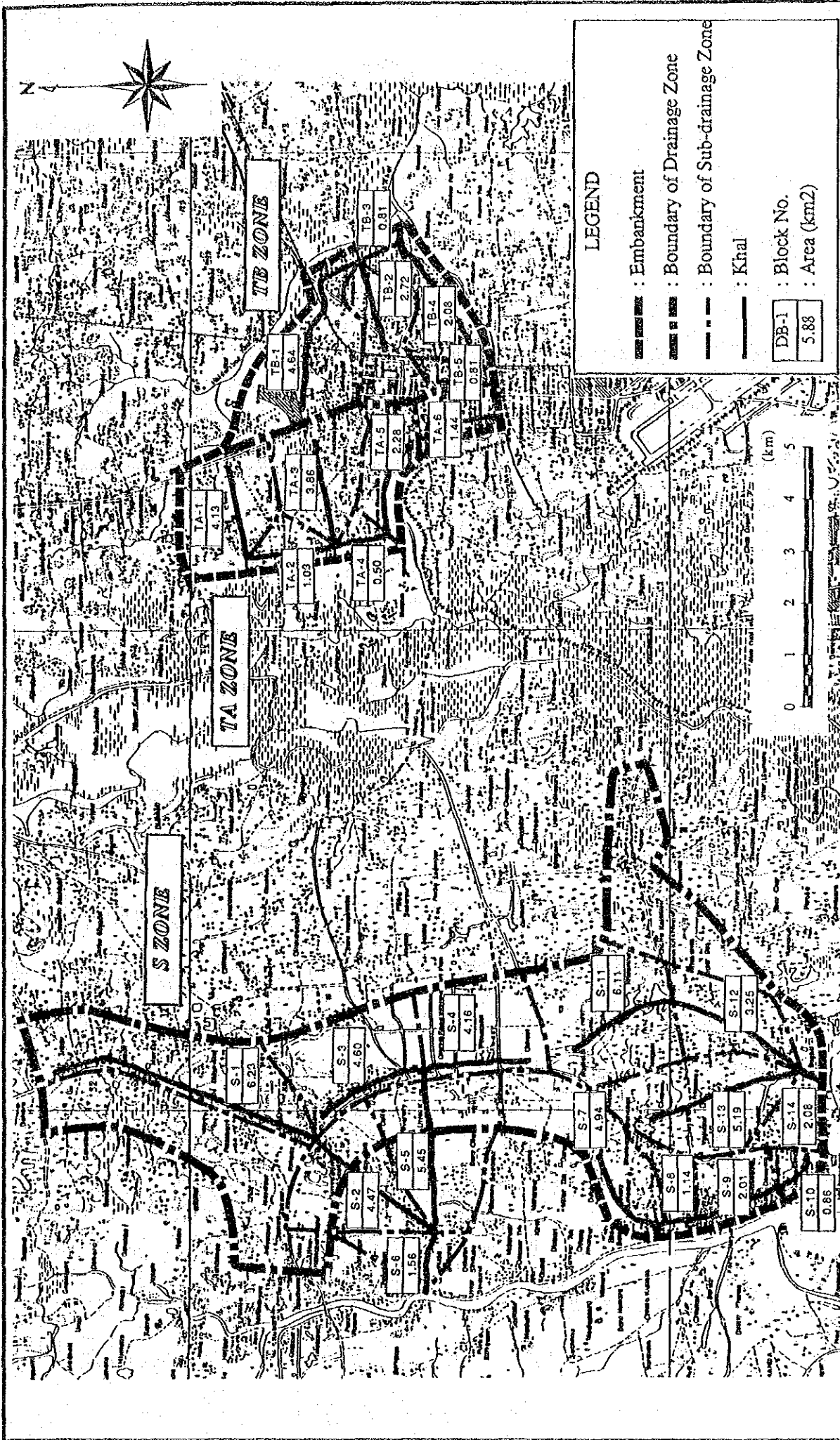


FIG. H.23.(2) SUB-DIVIDED DRAINAGE AREA (TONGI AND SAVAR)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



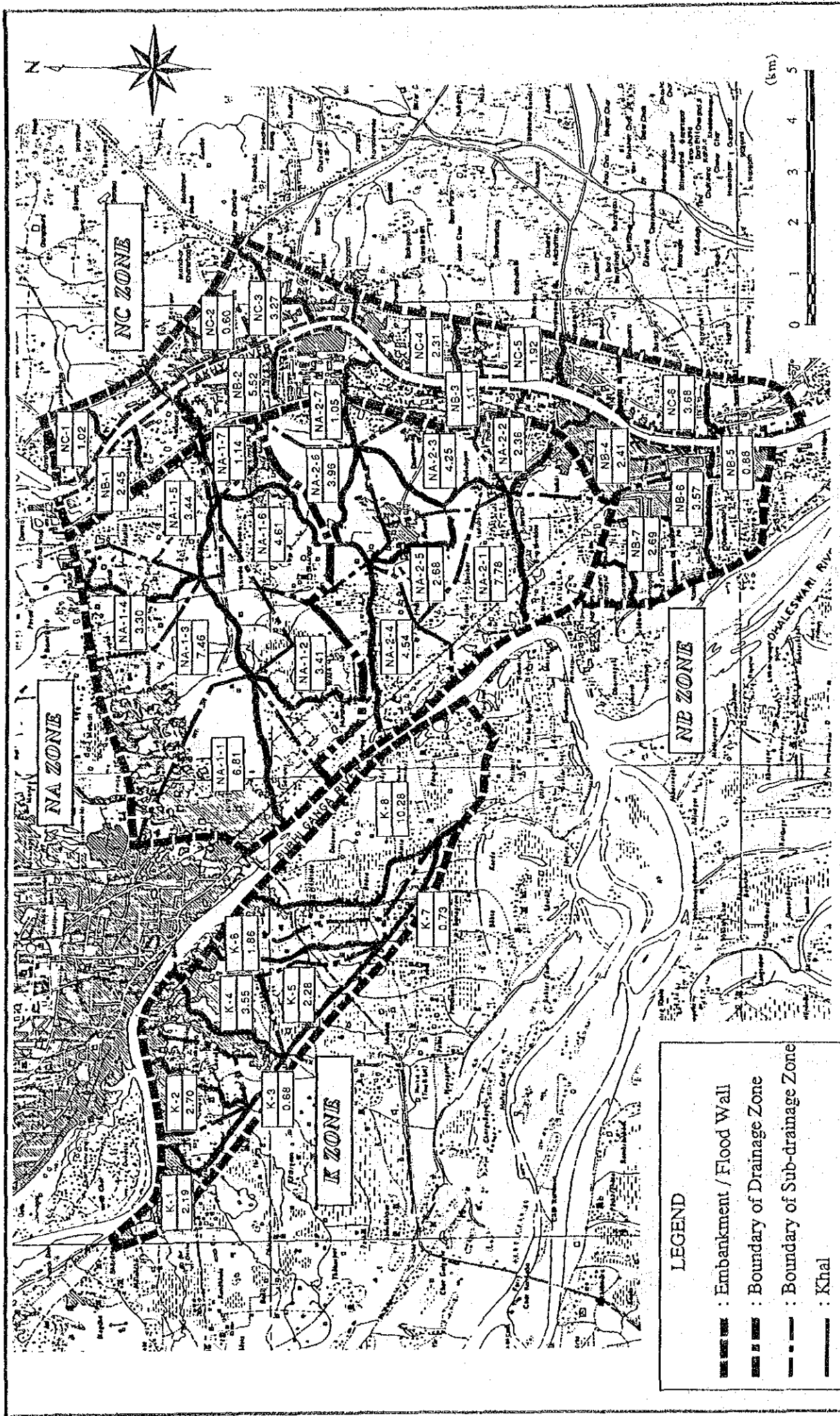


FIG. H.23.(3)
SUB-DIVIDED DRAINAGE AREA
(NARAYANGANJ AND KERANIGANJ)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8.A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



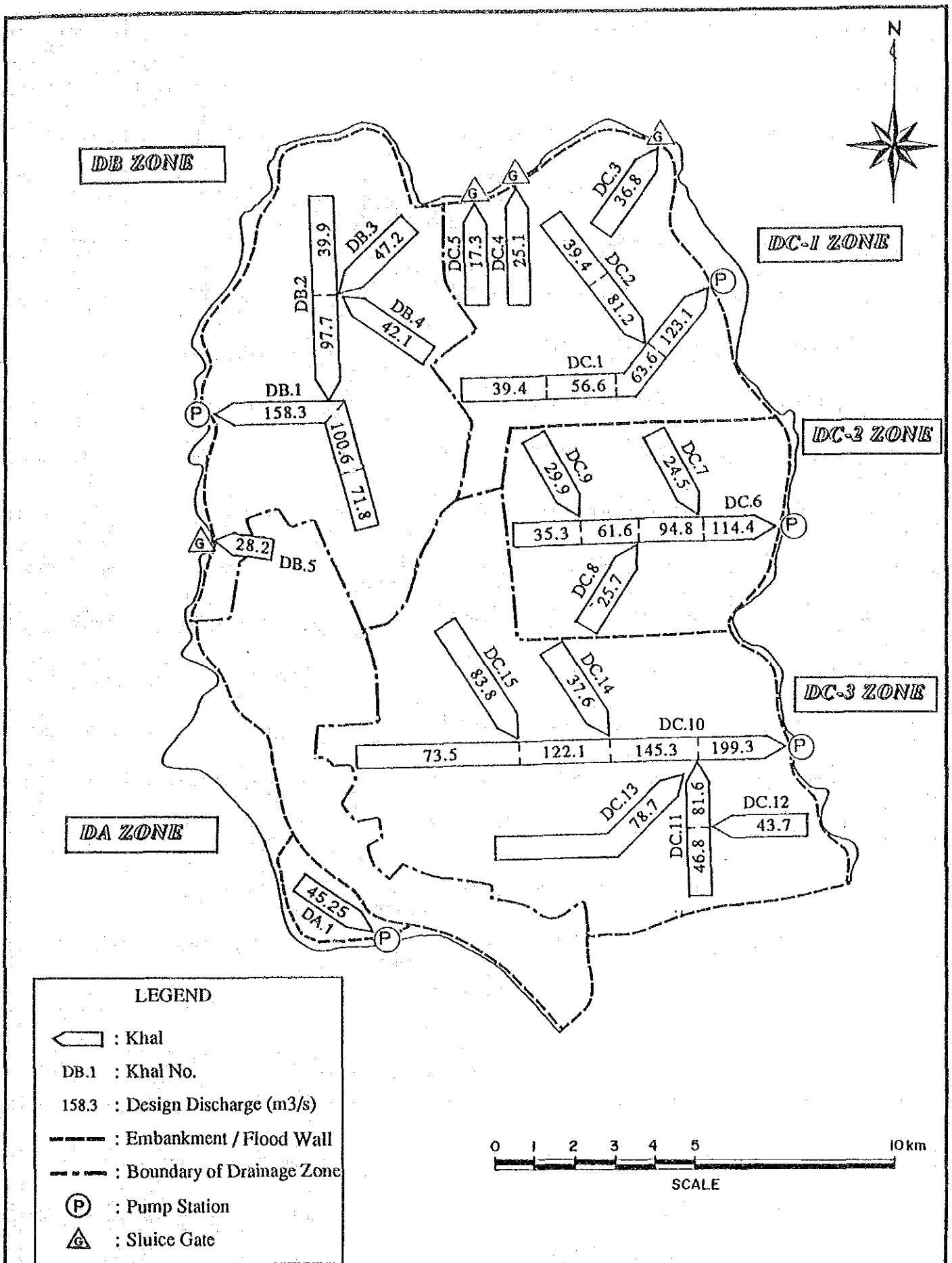
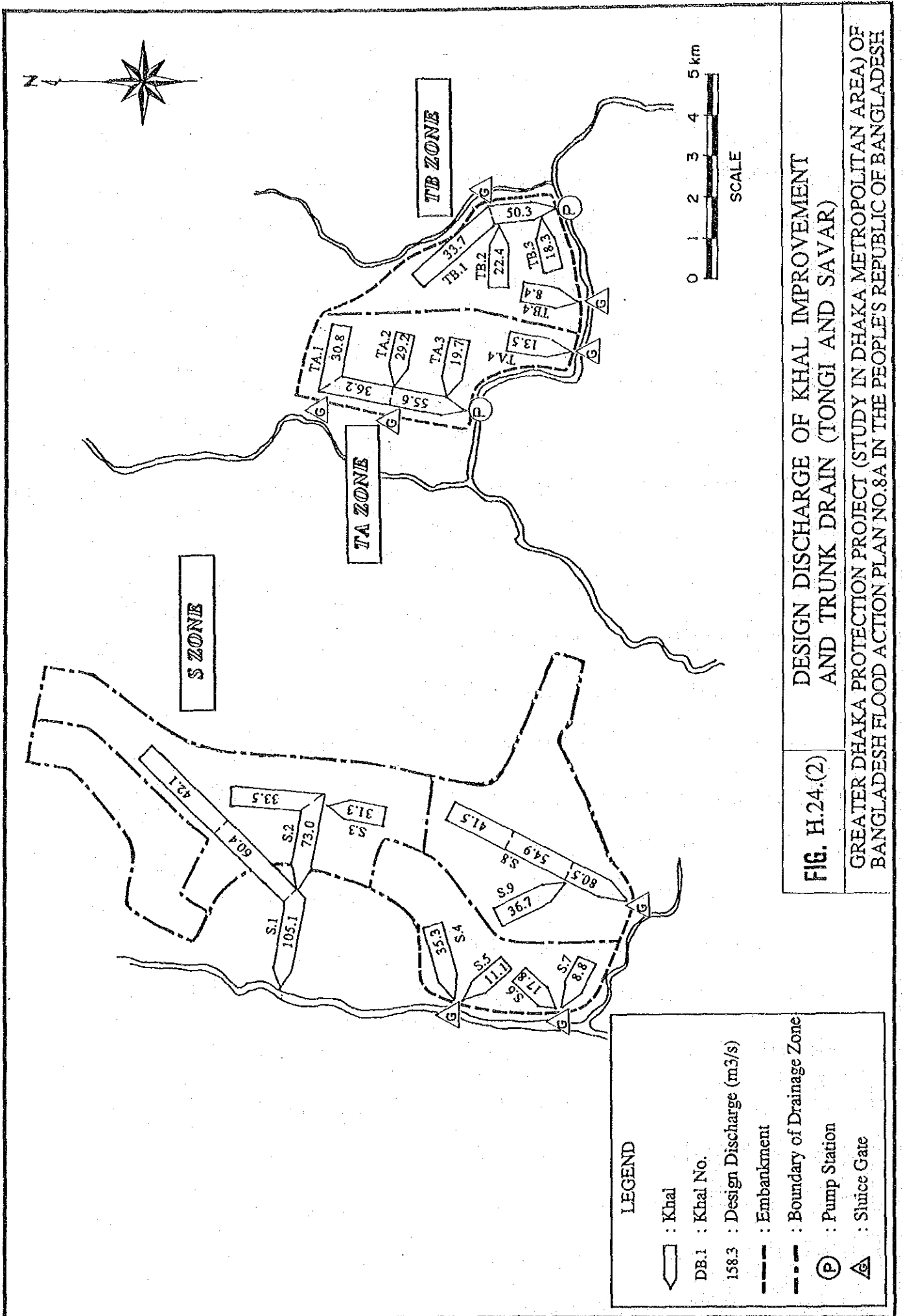
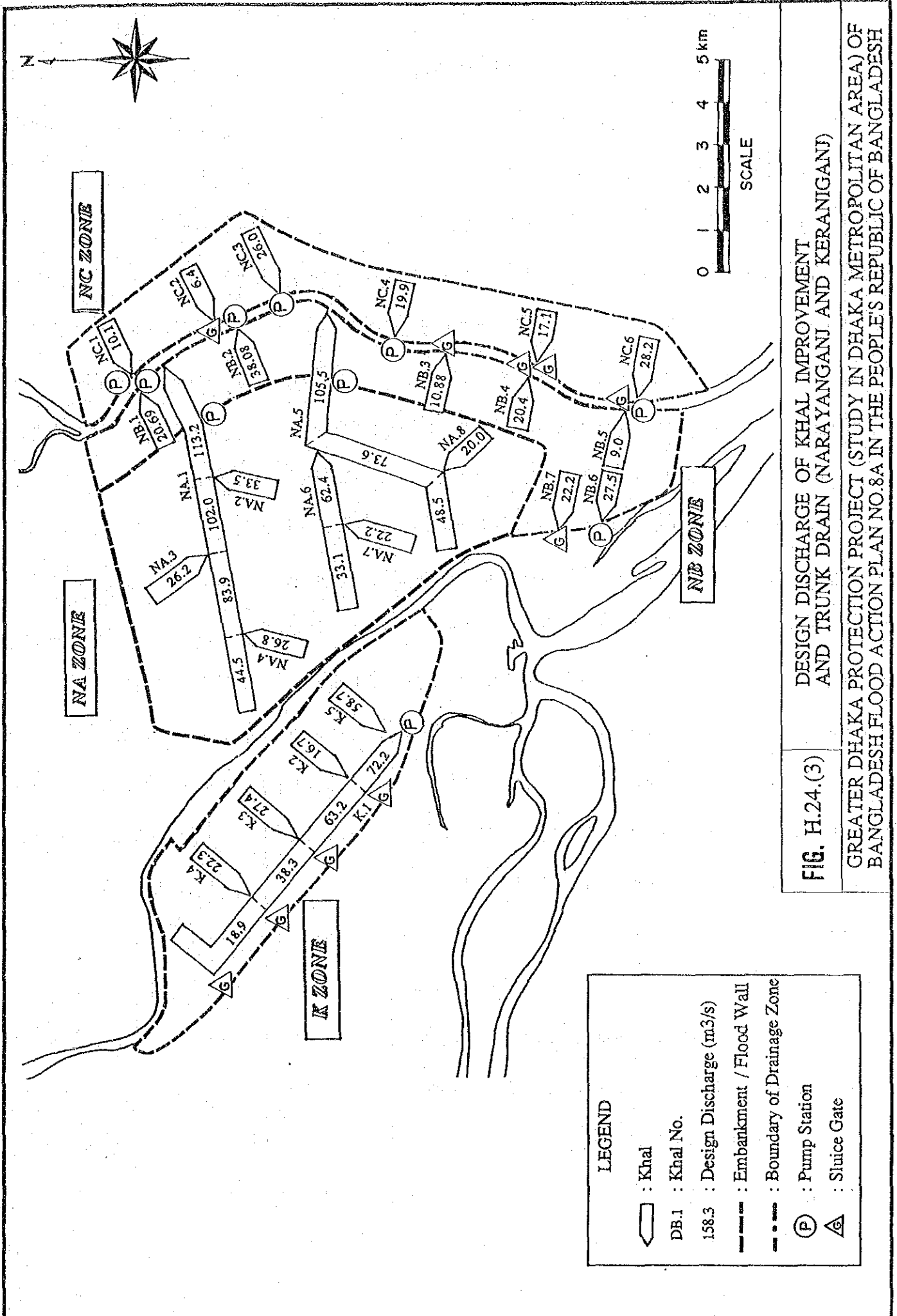


FIG. H.24.(1)

DESIGN DISCHARGE OF KHAL IMPROVEMENT AND TRUNK DRAIN (GREATER DHAKA)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH





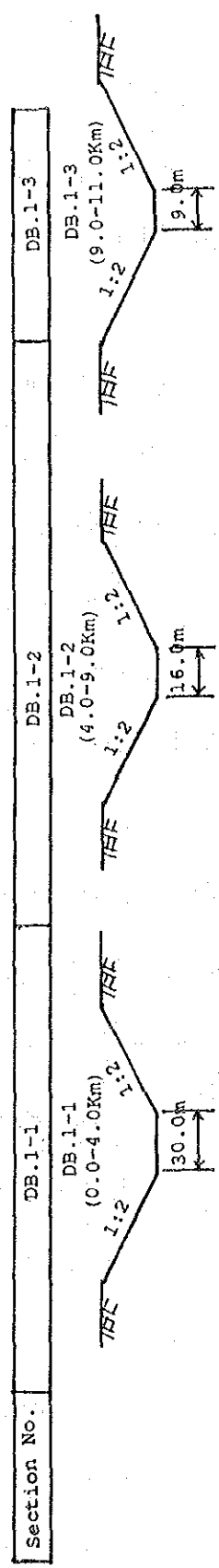
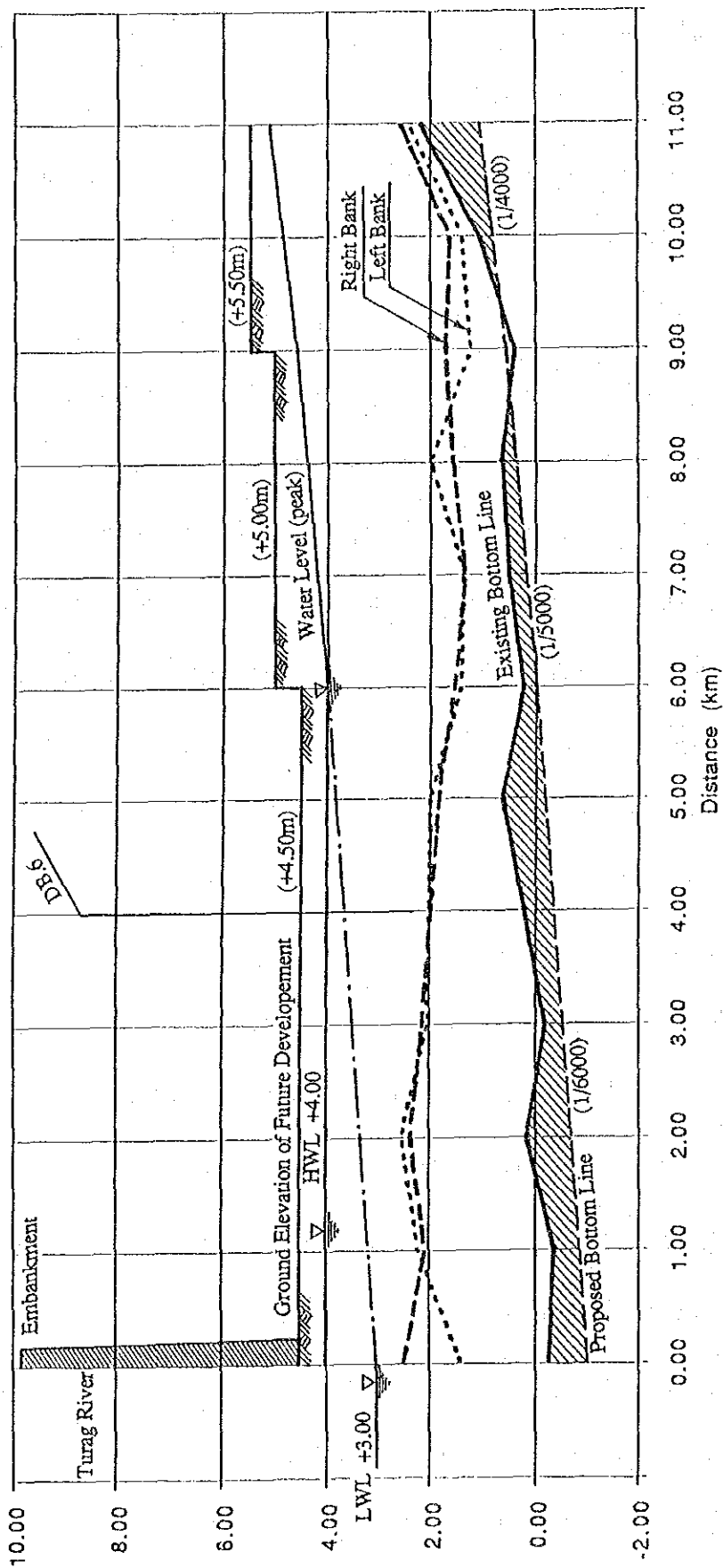
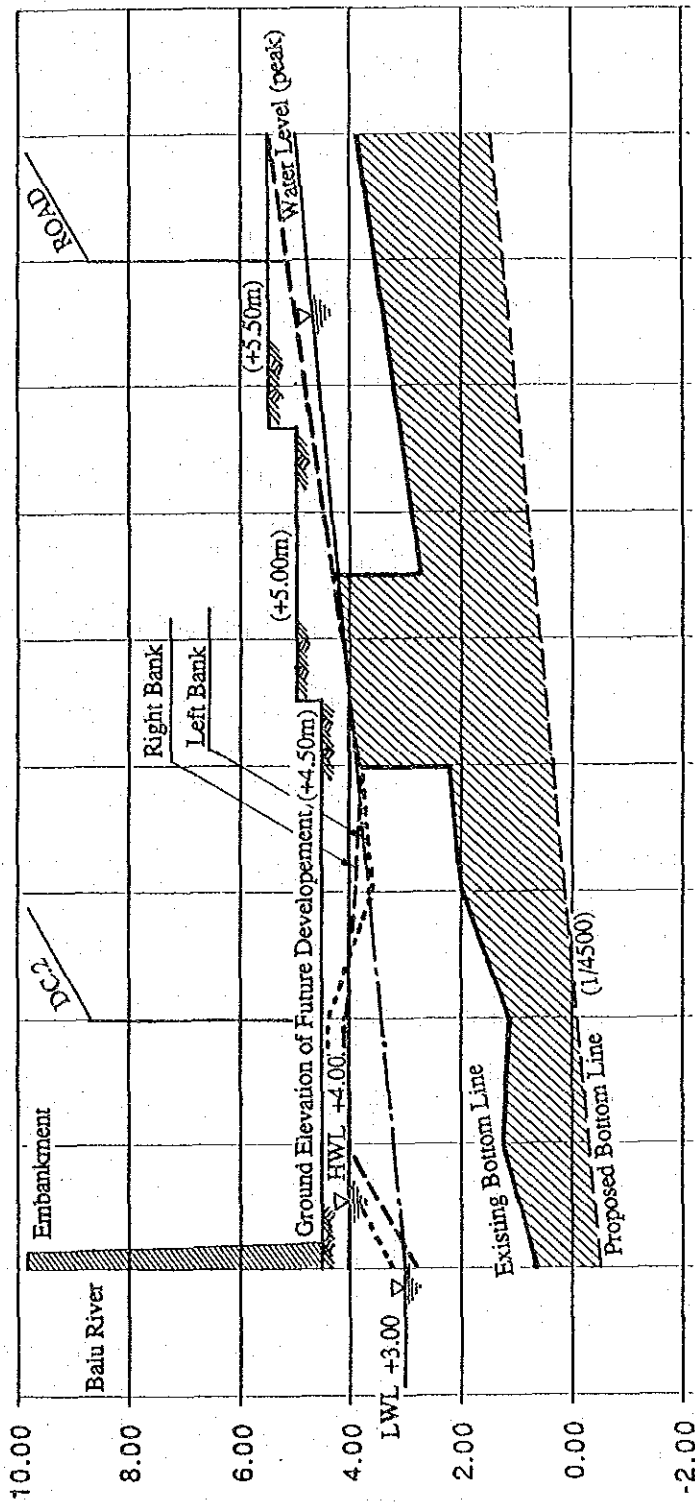


FIG. H.25.(1) PROPOSED LONGITUDINAL AND CROSS SECTIONS
(DB.1 : IBRAHIMPUR KHAL)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH





0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00
Distance (km)

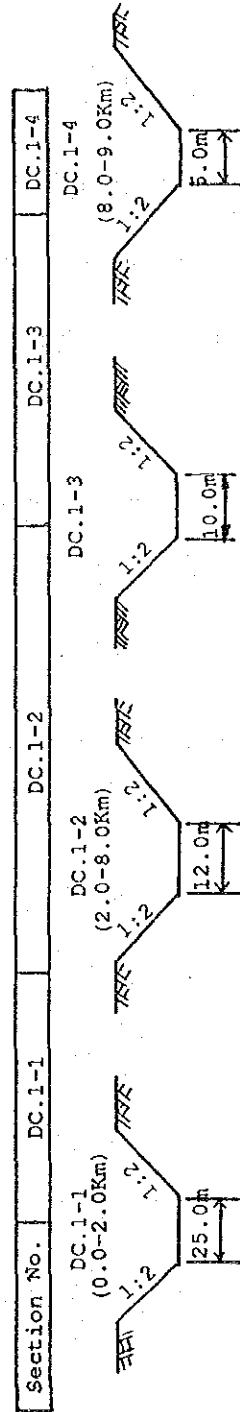


FIG. H.25.(2) PROPOSED LONGITUDINAL AND CROSS SECTIONS (DC.1)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



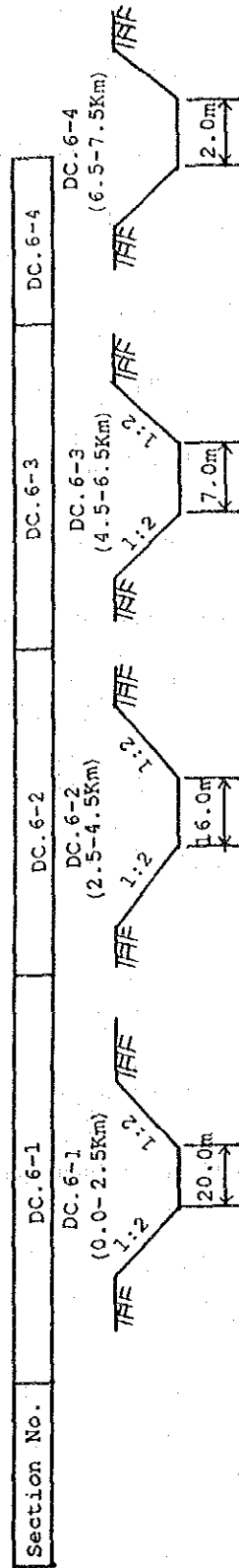
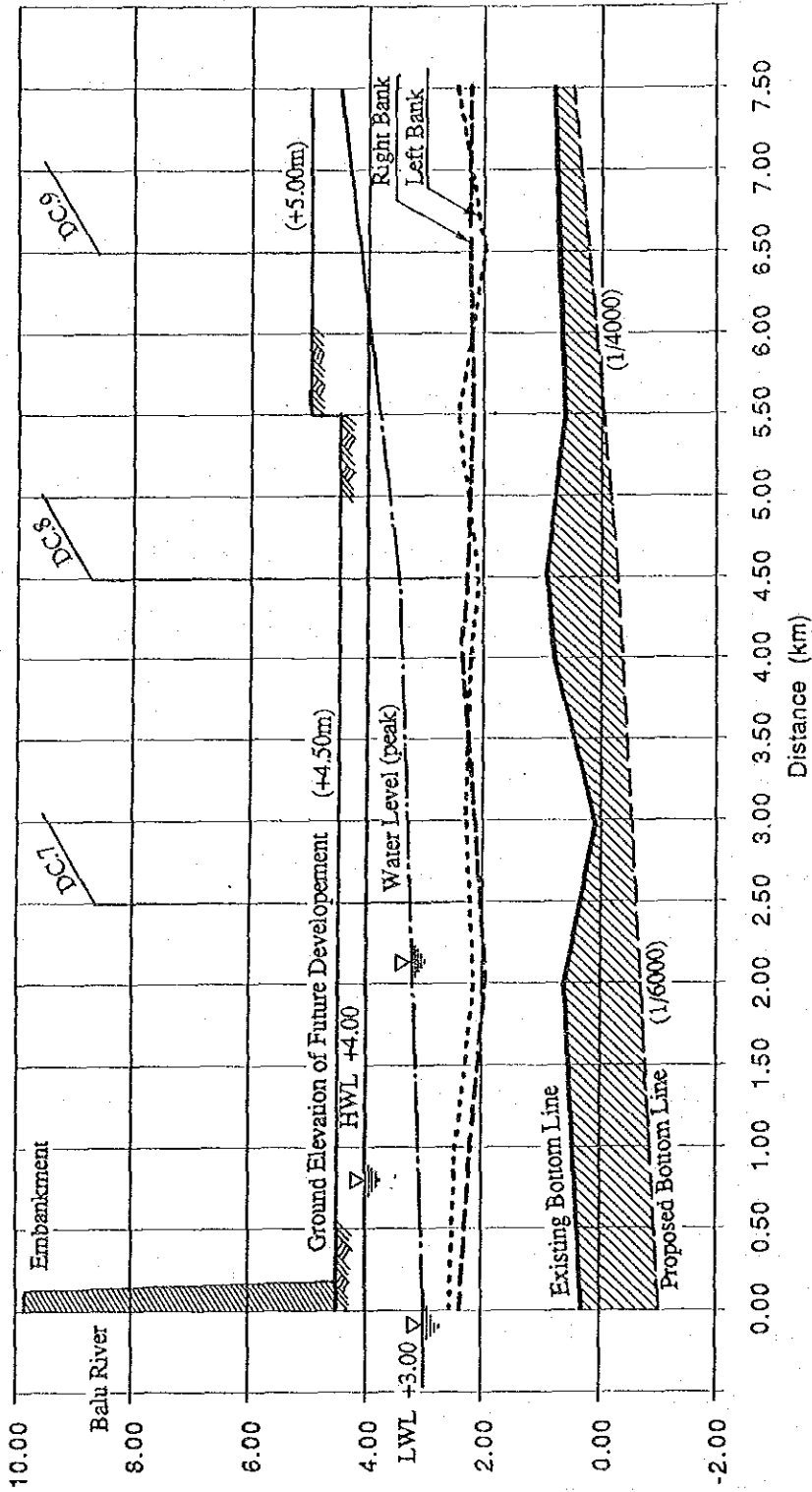


FIG. H.25.(3) PROPOSED LONGITUDINAL AND CROSS SECTIONS
(DC.6 : BEHANALI KHAL)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF
BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

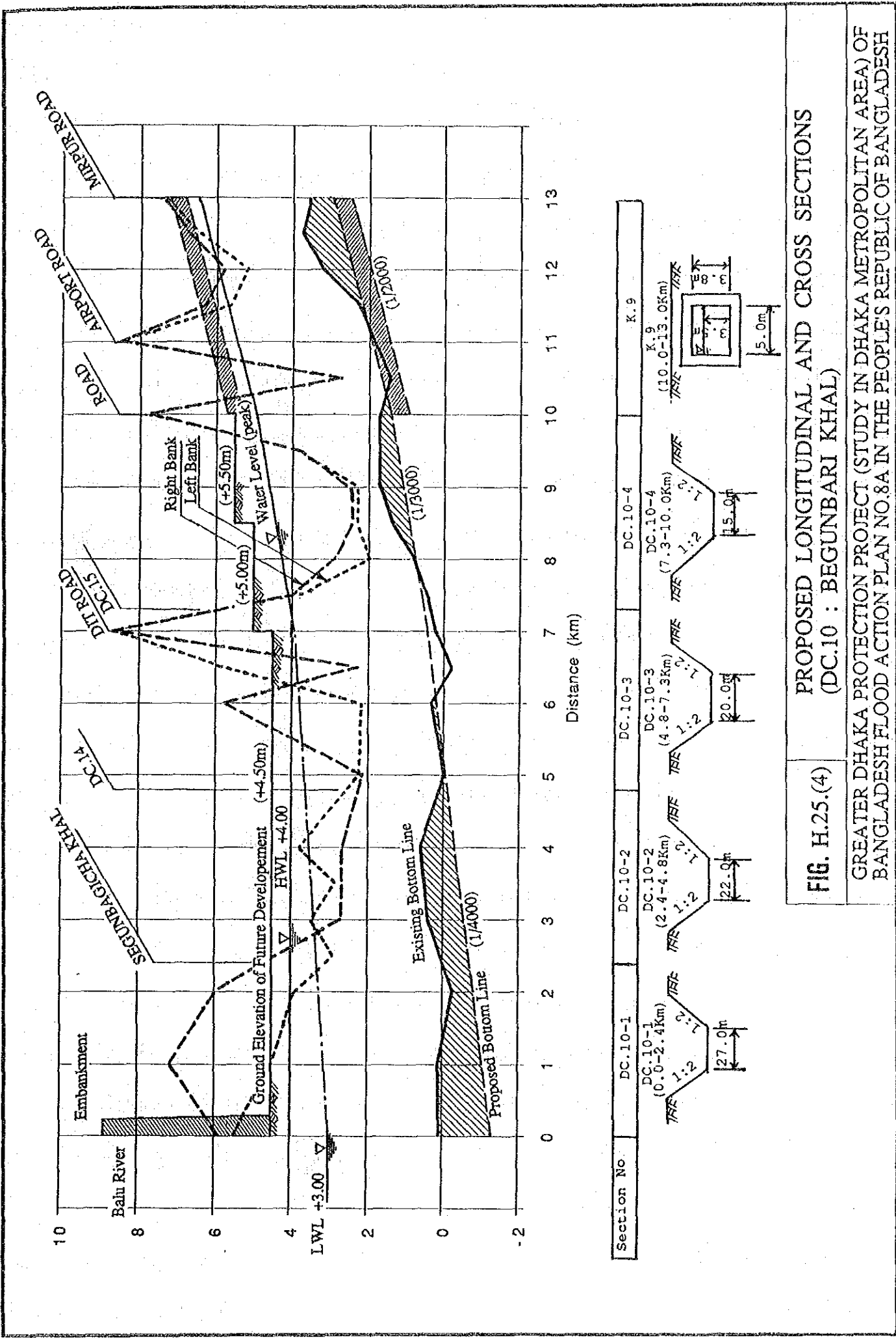
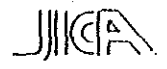


FIG. H.25.(4) PROPOSED LONGITUDINAL AND CROSS SECTIONS (DC.10 : BEGUNBARI KHAL)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



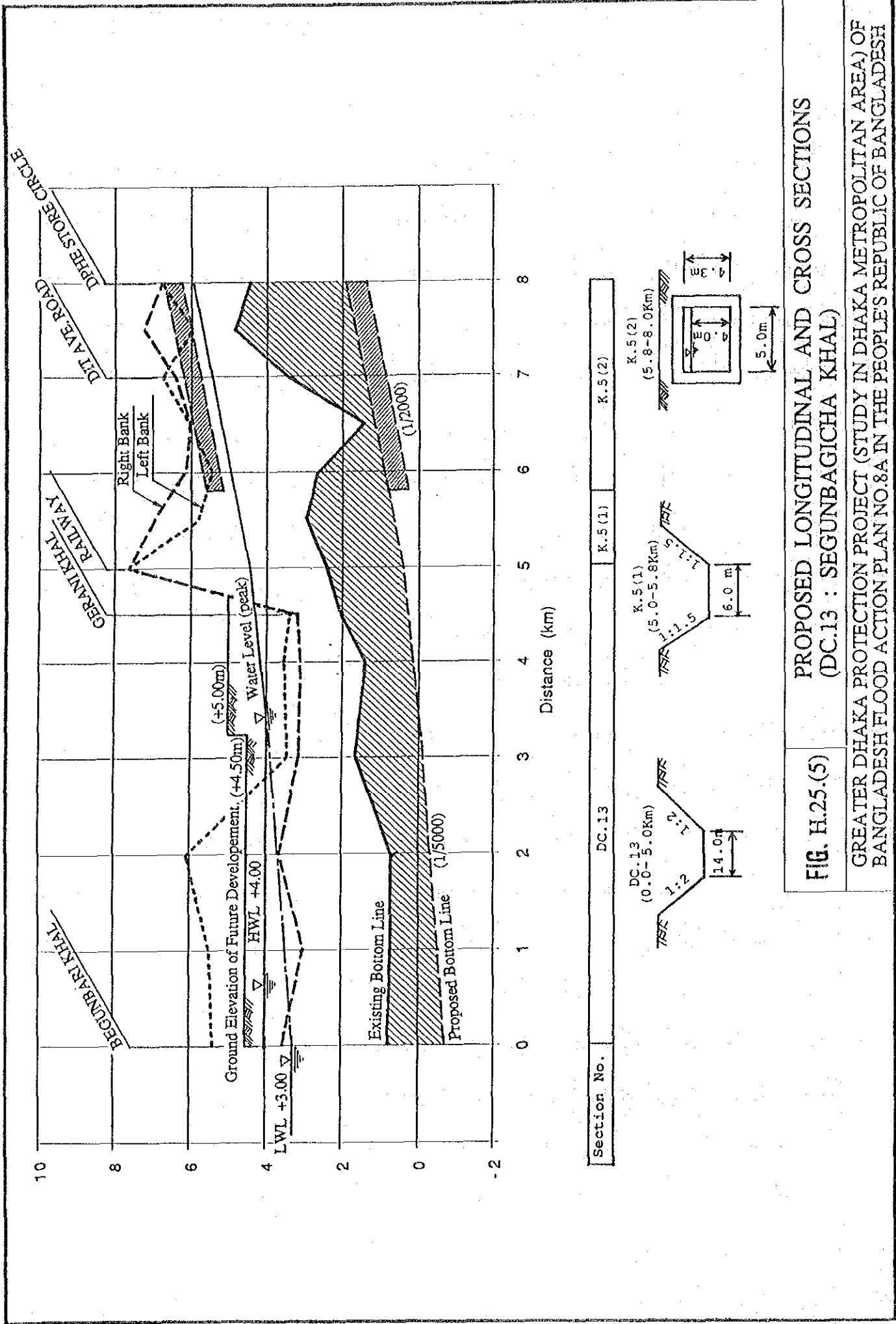


FIG. H.25.(5) PROPOSED LONGITUDINAL AND CROSS SECTIONS
(DC.13 : SEGUNBAGICHA KHAL)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



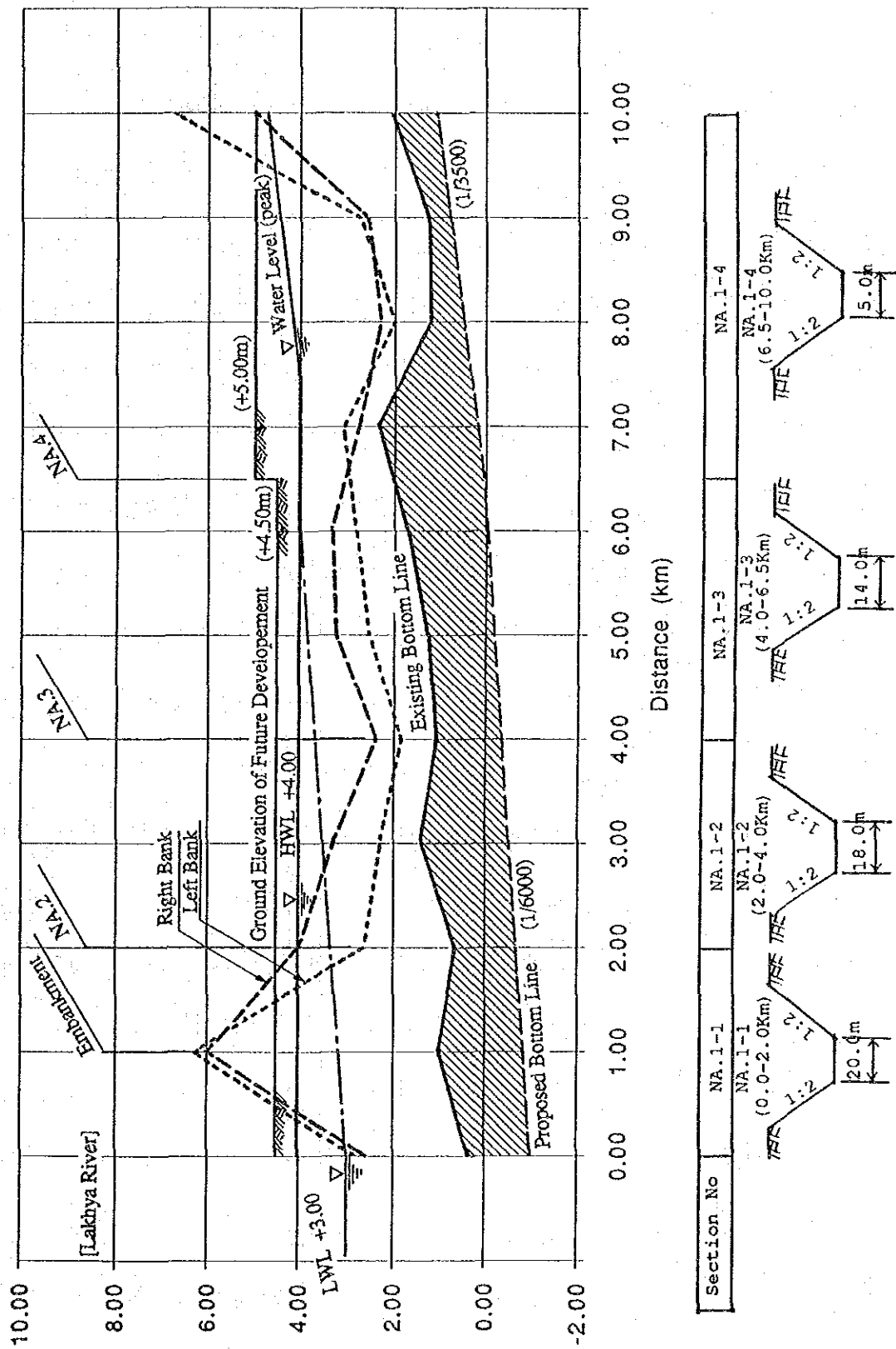


FIG. H.25.(6) PROPOSED LONGITUDINAL AND CROSS SECTIONS (NA.1)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



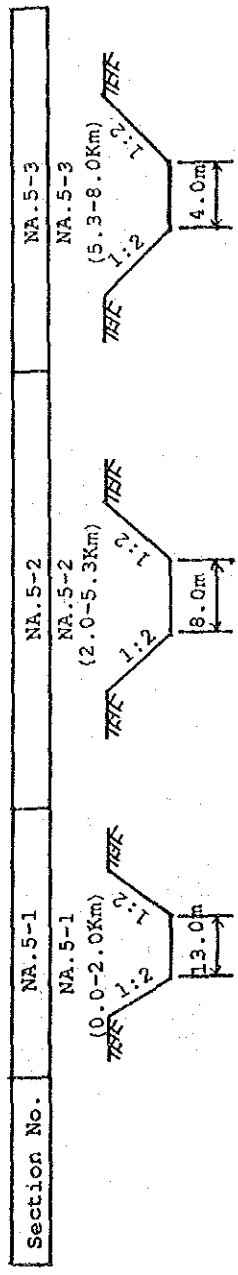
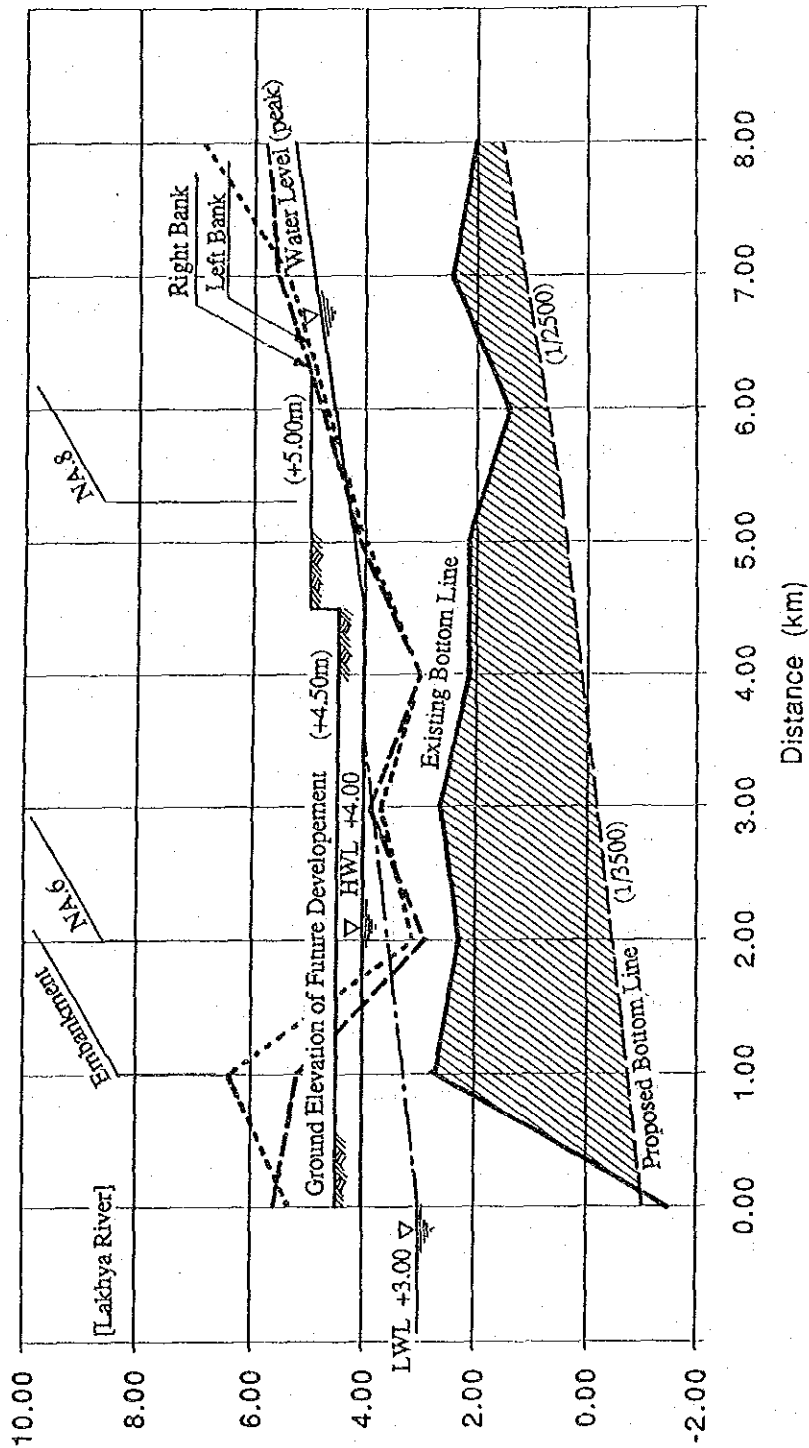
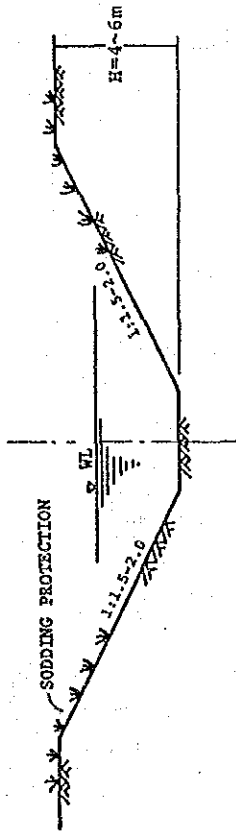


FIG. H.25.(7) PROPOSED LONGITUDINAL AND CROSS SECTIONS (NA.5)

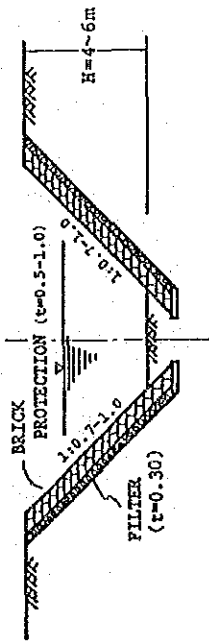
GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



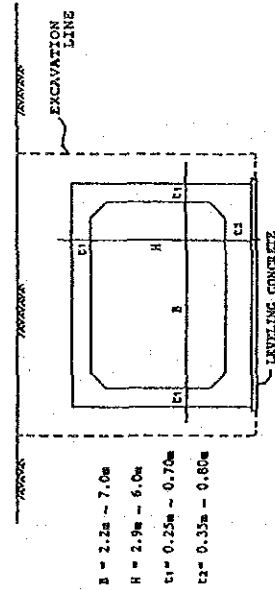
TYPE - 1 : TRAPEZOIDAL TYPE (1) - SODDING PROTECTION



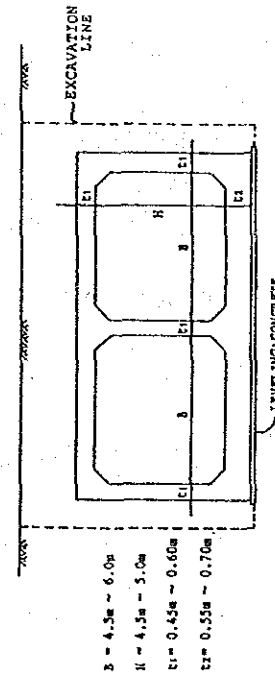
TYPE - 2 : TRAPEZOIDAL TYPE (2) - BRICK PROTECTION



TYPE - 1 SINGLE BOX CULVERT



TYPE - 2 DOUBLE BOX CULVERT



TYPE - 3 : CONCRETE PANEL WALL TYPE (1) - WITH BRACING BEAM

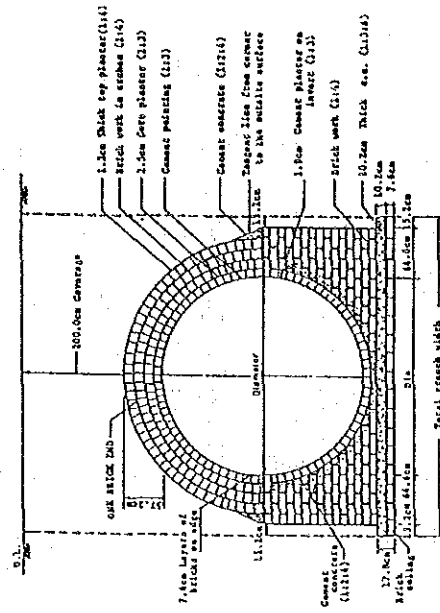
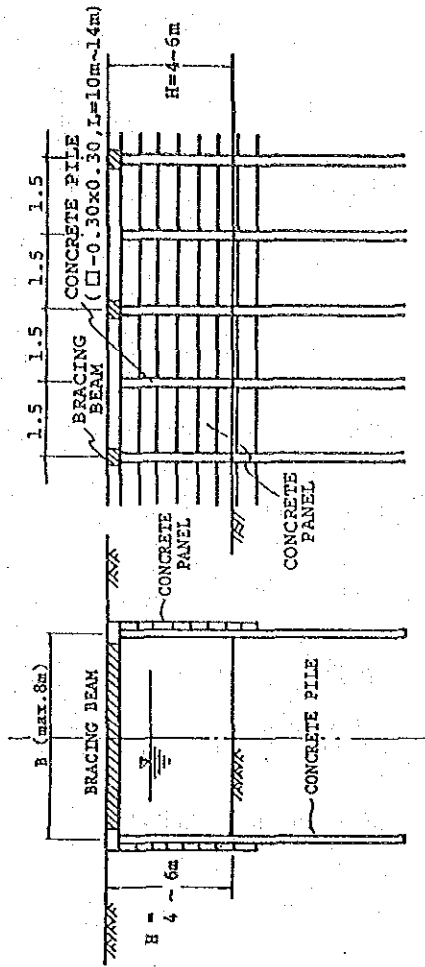


FIG. H.26

TYPICAL DESIGN OF IMPROVEMENT OF KHAL AND TRUNK DRAIN

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

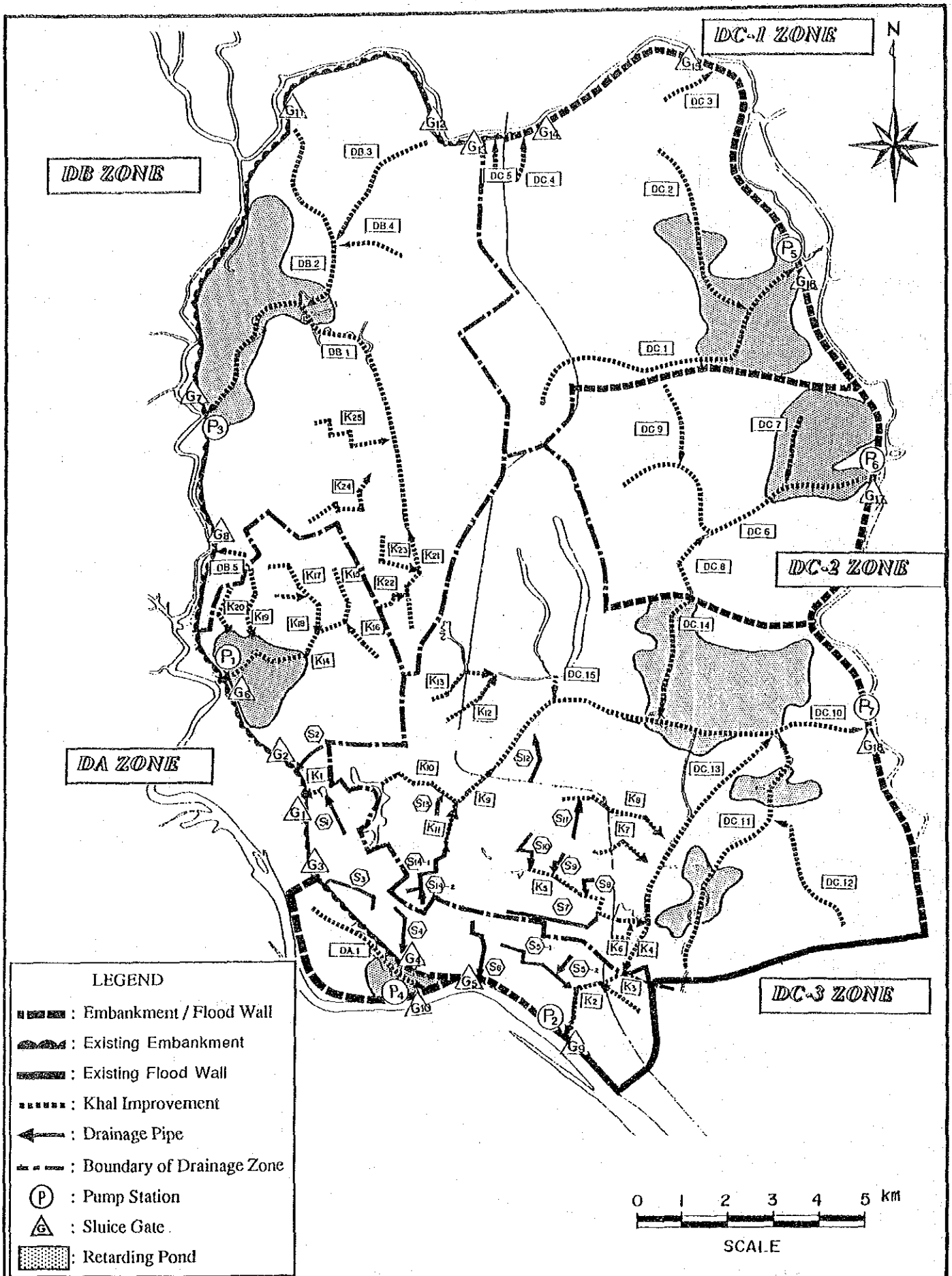


FIG. H.27 (1)

PROPOSED FACILITIES (GREATER DHAKA)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

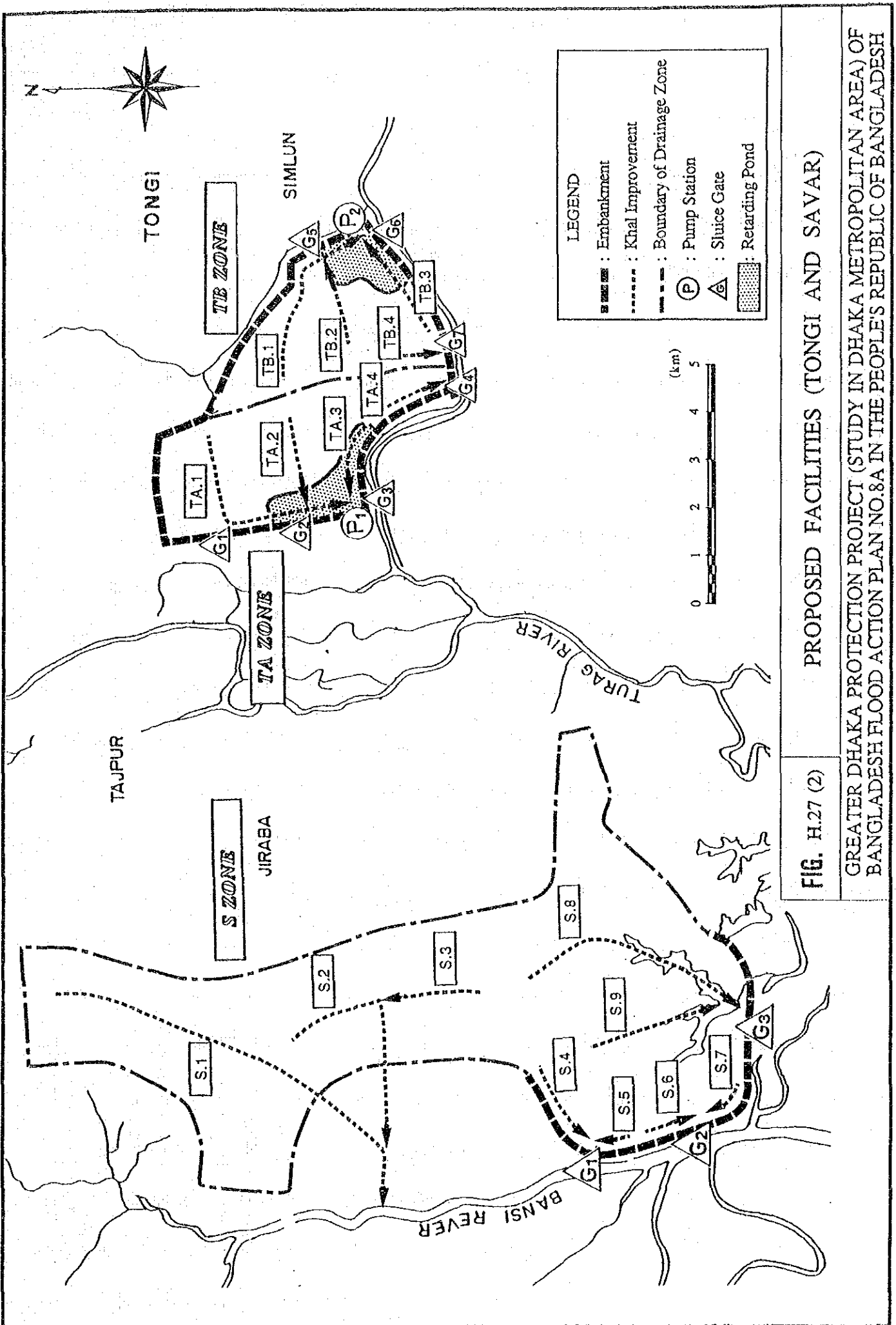


FIG. H.27 (2)

PROPOSED FACILITIES (TONGI AND SAVAR)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8.A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

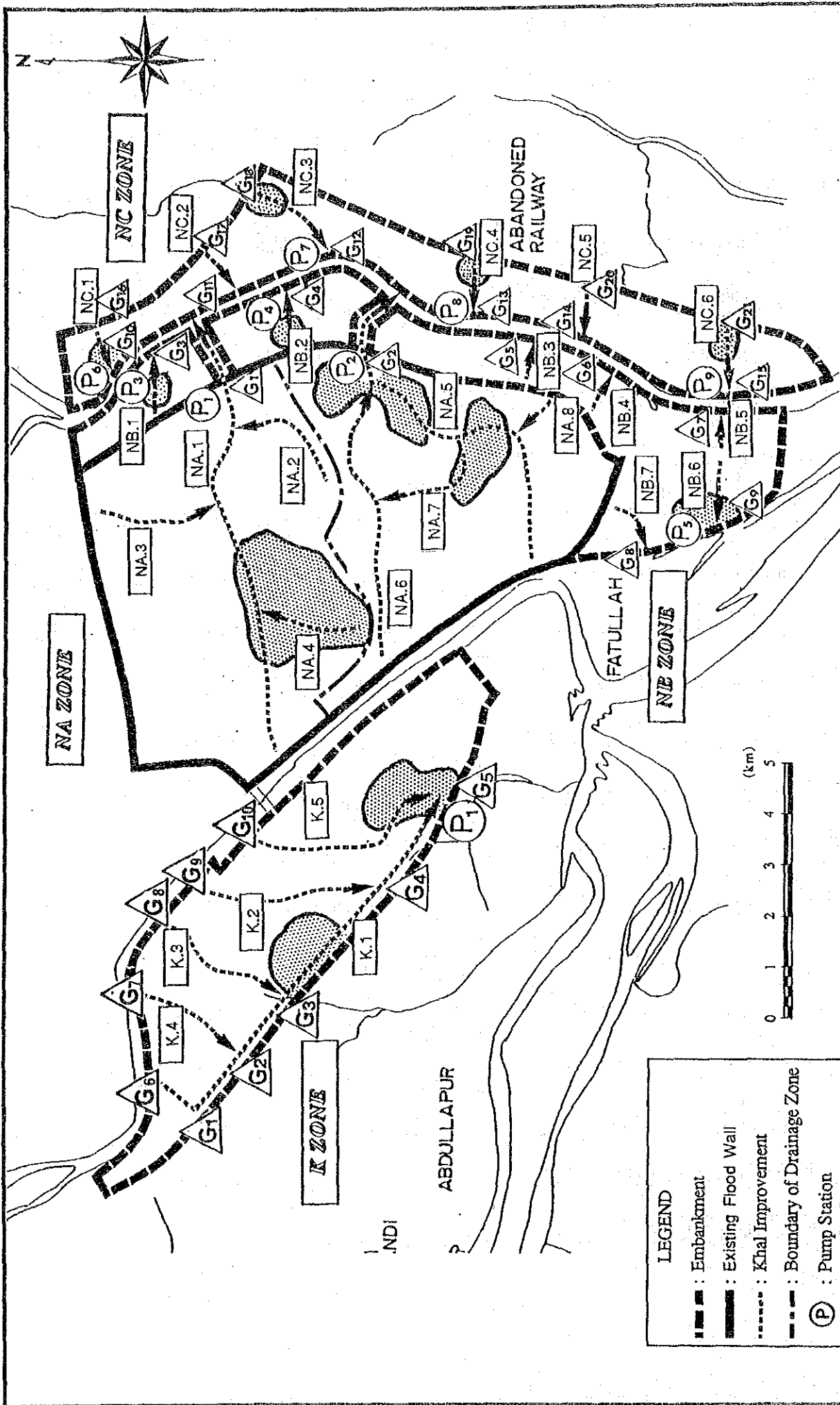


FIG. H.27 (3) PROPOSED FACILITIES (NARAYANGANJ AND KERANIGANJ)

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

LEGEND

- : Embankment
- : Existing Flood Wall
- : Khal Improvement
- - - : Boundary of Drainage Zone
- (P) : Pump Station
- (G) : Sluice Gate
- [] : Retarding Pond

