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FAP-21/22

REPORT

ON

**TOPOGRAPHIC AND HYDROGRAPHIC
SURVEY IN JAMUNA RIVER**

(25)

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FAP 21

A-39



A-60

July 1992

HYDROLAND SURVEY LTD.

165/1, Mirpur Road (1st Floor),
Dhaka

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ON
TOPOGRAPHIC AND HYDROGRAPHIC
SURVEY IN JAMUNA RIVER

FAP 21

MAY-23/11



July 1992

HYDROLAND SURVEY LTD.

165/1, Mirpur Road (1st Floor),
Dhaka



HYDROLAND SURVEY LTD

July 26, 1992

Dr. H Brühl
Project Director
Bank Protection and River Training Pilot Project
FAP 21/22
House No. 4, Road No. 125
Gulshan 1,
Dhaka 1212

Subject : Report on topographic and hydrographic survey of
Jamuna River.

Dear Sir,

We have pleasure in enclosing herewith a "Report on Topographic and Hydrographic Survey of Jamuna River" based on survey and data collection works conducted by us under FAP 21.

Assuring you of our best of services at all times,

Thanking you,

Yours faithfully,

A K M S Khan
Managing Director

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1. SUMMARY

1.1 INTRODUCTION

1.2 Background :

A consortium of Rhein- Ruhr Ingenieur (Germany), Compagnie Nationale Du Rhone (France), Prof. Dr. Lackner & partners (Germany), Delft Hydraulics (Netherlands), was appointed by FPCO/BWDB for providing consultancy services for the Projects- Bank Protection and AFPM Pilot Project.

The consortium, desires to obtain topographical, bathymetric data and other pertinent information for setting up and/ or calibrating physical models and for the preparation of alternative designs within the framework of the bank protection Pilot Project FAP- 21 for the Jamuna River.

In order to perform the topographical and bathymetric survey in Jamuna River, HYDROLAND SURVEY LTD offered their services and was considered technically qualified and competent for such work. An agreement was signed in this connection on the second day of April, 1992.

1.3 Location

Location of topographical and bathymetric survey areas was :

<u>Location</u>	<u>River</u>	<u>Axis length</u> <u>(km)</u>
- Kamarjani (Manas Regulator)	Jamuna	5
- Bahadurabad	"	12
- Chandanbaisa	"	10

Location of three test areas in Jamuna river are shown in Index map (Fig. 1)

2. SCOPE OF WORK

2.1 Control Point :

2.1.1 Placement of 50 (fifty) reinforced concrete pillars in sheltered and safe locations at three test area, which will be used as on-shore control points to allow for later follow-up surveys of selected Cross-section.



2.1.2 Number of pillars placed at each survey sites :

- Kamarjani
(North of Manas Regulator) : 10
- Bahadurabad : 20
- Chandanbaisa : 20

2.1.3 Pillars having dimension 15 cm x 15 cm x 90 cm marked with respective numbers. A brass rod anchored at the top of the pillars.

2.2 Connection to Co-ordinate and Height System :

2.2.1 Engineers dealt with the connection of the test areas to grid co-ordinate system (BTM).

2.2.2 Connection of the test areas with known control points in the close surrounding of the survey area by second order closed traverse survey. Location of control points to be identified by the Engineer. Co-ordinates of at least two control points at each test areas to be provided by the Engineer. Height connection to be referred to PWD datum.

2.2.3 Height connection of existing Bench Marks in the vicinity of the survey areas by double levelling. Values of B.M. to be provided by the Engineers. Accepted maximum misclosure for levelling will be $\pm 10 \sqrt{k}$ (mm), where k is the length of the circuit in km.

2.3 Cross- Sections :

2.3.1 Cross- section surveys for total test area of approx. 27km x 3 km at three test sites. Length of Cross-section is estimated at approx. 1.5 km on land and 1.5 km in the water. Total numbers of cross-section will be 135 and total length may approx. be 405 km.

2.3.2 Cross- section will be 200 meter apart. Bathymetric sections should be in line with the on-shore sections Short cross-sections of about 100 meter length (50m on land and 50m in the water) to be taken in zones of significant changes of the river bank/embankment topography.

- 2.3.3 Width of on-shore area (bank and/or chars) is estimated at 1.5 km, however the length of profiles on land will cover the embankment. Height to be taken at 50 meter apart and distances may be widened, if the topography is homogeneous. Topographic survey shall include boundries of built-up areas and other significant topographic characteristics, if exists within the survey area.
- 2.3.4 Bathymetric survey to be performed from boat. Cross-section to be taken by means of echo-sounder (installed on a boat) and will be in line with those performed on-shore. Positioning can be done by conventional or electronic means with an accuracy of \pm 5 meter.
- 2.3.5 Temporary gauges to be placed at distances of about 2 km and connected to PWD datum by levelling. During the bathymetric surveys the river water level to be recorded for proper connection of the soundings to PWD datum.
- 2.3.6 Connection of landside profiles with waterside profiles to be made properly in view of elevation and location. One identical point in both the echo sounding profile and the topographic profile has to be pegged out and included in both surveys.
- 2.4 Calculations and Drawings :
- 2.4.1 Contractor will perform all necessary calculations, evaluations and drawings in accordance with the professional standards.
- 2.4.2 Each test site topographic maps on the Scale 1:5000 with contour lines in the on-shore and off-shore area have to be produced by the Contractor.
- 2.4.3 Maps have to show sounding figures in regular intervals according to standard. Contour line distances should be in general 0.25m in flat areas and may be 0.5 m to 1.0 m in steeper areas like river side and road embankments.
- 2.4.4 Maps have to show grid-crosses at 10 cm intervals on BTM grid system and respective co-ordinate figures in the margins of the plans.
- 2.4.5 Cross-section drawing have to be delivered of all measured profiles on the following scales :
- | | | |
|------------------|---|---------|
| horizontal Scale | - | 1: 2000 |
| vertical Scale | - | 1: 100 |
- 2.4.6 All drawings have to be delivered in original (transparent medium).

3. PERIOD OF EXECUTION OF WORKS

Field measurements of topographic and hydrographic survey at three test areas in Jamuna River were taken in hand from April 10, 1992 as per Time Schedule (Annexure-A). Data processing for the preparation of all relevant maps, plans, profiles, etc. were carried out in the office.

4. WORKS PERFORMED

4.1 Control Points :

50 (fifty) reinforced concrete pillars were placed in sheltered and safe locations (position/location selected by the Engineers) in three test area as reference Control Points in order to carry out follow-up surveys of selected cross-sections later.

Number of pillars erected at each test area were as follows :

Kamarjani (North of Manas Regulator)	: 10 nos.
Bahadurabad	: 20 nos.
Chandanbaisa	: 20 nos.

Pillars having dimension of 15 cm x 15 cm x 90 cm with brass rod anchored at the top were erected. Numbering of pillars at the three test areas have been given in the following order :

- Kamarjani (North of Manas Regulator)	: FAP 21.01 to FAP 21.10
- Bahadurabad	: FAP 21.11 to FAP 21.30
- Chandanbaisa	: FAP 21.31 to FAP 21.50

Location of the Control Points at three test sites may be seen in figures 2,3 & 4.

4.2 Connection to Co-ordinate (BTM) and Height (PWD) System :

The co-ordinates of the newly established shore control points in the Test areas have been determined through second order close traverse. The BTM co-ordinates of the reference point/points of the traverse were provided by the Engineers. The elevations/heights of the control points were determined by connecting them to the Bench Marks whose elevations were supplied by the Engineers.

4.3 Cross- Sections :

Cross- section surveys at the three test area were carried out at about 200 meter apart. Length of cross-sections were estimated at approximately 3 km (1.5 km on land and 1.5 km in water).

Number of cross- sections at each test areas and their lengths shown in Figures 2,3 & 4 are as follows :

Test Areas -----	No. of X -Section -----	Cross- Section length in km -----
Kamarjani (North of Manas Regulator)	26	79.68
Bahadurabad	61	191.05
Chandanbaisa	52	163.35
	-----	-----
Total :	139	434.08

4.3.1 On-shore area :

Heights along on-shore cross-section are taken generally at 50 meters apart and this distances were densified or widened depending on the topography of the area.

Topographic surveys were carried out at the test areas to include boundaries of built-up area, embankment, road, market, school and other significant topographic characteristics.

4.3.2 Off-shore area :

Bathymetric cross-sections were taken by shallow draught mechanised boat using echo-sounder fitted onboard and position fixing was done by conventional means i.e by sextant angles.

During bathymetric surveys the river water level was recorded from temporary gauges established at each test area for proper connection of the soundings to PWD datum.



5. METHODOLOGY USED

5.1 Cross- Sections :

The bathymetric cross-section and on-shore cross-sections were taken along the same transit lines. The landside profiles and the water side profiles were connected properly with respect to their elevations and locations i.e. one identical point in both the echo-sounding profile and topographic profile was pegged out and included in both surveys.

5.2 Levelling :

Levelling was done over the chars falling in line of the cross-section. On-shore levelling was also done from water line of high bank and over the high banks as well as covering the desired distances.

5.3 Soundings :

Soundings were taken continuously by echo-sounder and tracking of the survey boat along the bathymetric cross-section lines was controlled by taking two simultaneous sextant angles (with three control points ashore) and plotting them on the chart.

5.4 Traversing :

The newly established pillars at three test areas were traversed with EDM with theodolite to obtain local traverse net-work. Co-ordinates of these pillars have been provided in BTM grid system and the height are referred to PWD Datum.

5.5 Reduction of Depths and Heights :

Soundings (depths) taken along the bathymetric cross-sections (including levelling over chars) and also the spot levels (heights) taken along the on-shore cross-sections were reduced to PWD datum level.

5.6 Bench Marks used :

The heights of newly established pillars and cross-section surveys were determined with reference to the bench marks located at each test sites. Location/description of bench marks may be seen at Annexures-B,C&D.

5.7 Water level Gauges :

Temporary gauges were placed at about 2 km apart at each test area and half hourly water levels were recorded during the soundings.

These gauges were levelled and connected with the Bench Marks located within the test areas.

6. MANPOWER ENGAGED :

Manpower engaged in the field measurements as well as for data processing and preparation of plans, profiles etc. in the office were as follows :

6.1 For Field Works :

- Team Leader & Hydrographer	:	2
- Hydrographer	:	2
- Asstt. Hydrographer	:	8
- Sr. Surveyor	:	1
- Surveyor	:	5
- Recorder	:	6
- Staffman	:	12
- Gauge Reader	:	2
- Cook	:	3
- Umbrella man	:	6
- Leadsman	:	6

6.2 For Office Works :

- Hydrographer	:	4
- Asstt. Hydrographer	:	9
- Draftsman	:	6

7. EQUIPMENT AND VESSELS USED :

Equipment and vessels used for conducting the topographic and hydrographic surveys in Jamuna river were as under :

7.1 Equipment :

- EDM (fitted with theodolite)	:	1
- Sextant	:	6
- Echo Sounder	:	2
- Level Instrument	:	6
- Station Pointer	:	2
- Diagonal Scale	:	2
- Measuring Chain	:	2
- Measuring Tape	:	2
- Echo test Disc	:	2
- Plane Table	:	3
- Misc.		as required

7.2 Vessels :

- Survey and Accommodation Launch	:	2
- Mechanised Craft	:	3

8. MAPS, PROFILES, CO-ORDINATES, ETC. FURNISHED :

8.1 Topographic Maps :

Topographic maps for each test site at Kamarjani (Manas Regulator), Bahadurabad and Chandanbaisa were prepared on the Scale 1: 5000 with 0.25 meter contour lines in the on-shore and off-shore area. Significant topographic characteristics, such as embankment, market, school, roads etc. located in on-shore areas have also been shown on the maps.

The maps have been drawn on BTM grid system, showing grid- crosses at 10 cm interval and co-ordinate figures in the margins of the plans.

Number of maps provided for the three areas in A1 size are as under:

		map
Kamarjani (Manas Regulator)	...	: 3
Bahadurabad	...	: 6
Chandanbaisa	...	: 5

8.2 Cross- Section Profiles :

Total number of cross-sections for the three test areas were 139. Profiles for each cross-section (on-shore plus off-shore, both being on the transit) were drawn on horizontal scale 1: 2000 and vertical scale 1: 100.

Number of cross sections and profiles drawn in A1 size and supplied for each test area are as follows :

	Cross-Sections -----	Profiles -----
Kamarjani (Manas Regulator)	26	26
Bahadurabad	61	61
Chandanbaisa	52	52

8.3 Co-ordinates (BTM) and Height of control points :

50 control points established at the three test sites are as under :

Kamarjani (North of Manas Regulator)	:	10
Bahadurabad	:	20
Chandanbaisa	:	20

Total :		50

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Co-ordinates of each control points have been determined on BTM grid System and heights are referred to PWD datum. Co-ordinates and heights of control points of the above mentioned test areas are given in Annexure-E, F & G

8.4 Water level data :

Temporary gauges were established at the test sites and the water levels were recorded at regular interval during the period of bathymetric cross-section survey for reduction of soundings.

Gauge readings/ water level data collected at the three test areas in connection with the above mentioned works are furnished in Annexure- H, I & J.



TIME SCHEDULE FOR
TOPOGRAPHIC AND HYDROGRAPHIC SURVEY
OF JAMUNA RIVER

Location of Survey area	Particulars	April 1992				May 1992				June 1992	
		1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week
Chandanbaisa	1. Mobilisation										
	2. Erection of Pillars										
	3. Height Connection & Traversing										
	4. Cross-Section Survey										
	5. Drafting										
Manas (Regulator) (Kamarjani area)	1. Mobilisation										
	2. Erection of Pillars										
	3. Height Connection & Traversing										
	4. Cross-Section Survey										
	5. Drafting										
Bahadurabad	1. Mobilisation										
	2. Erection of Pillars										
	3. Height Connection & Traversing										
	4. Cross-Section Survey										
	5. Drafting										

Annexure - B

Description of Bench Marks
at
Kamarjani Test Area
(North of Manas Regulator)

<u>Description</u>	<u>Value of B.M. (PWD)</u>
a. FMBM NO.- 7603 : The Pillar is situated near Chirakuti ferry ghat in the village of Foliar ghop. It is east of Dakatia F.P. school and on the bank of the river Jamuna.	20.596 meters
b. FMBM NO.- 7604 : The pillar is situated near Council Bazar in the village of Giddhari. It is in front of the house of Moulavi Abdul Hamid and about 20m west from the embankment.	22.627 meters

Description of Bench Marks
at
Bahadurabad test area

<u>Description</u>	<u>Value of B.M. (PWD)</u>
a. <u>G.P.S NO.- 764</u> : The pillar is situated infront of Kulkandi Union Parishad office under Islampur Upazila. The pillar is selected south-east corner of the compound of the Union Parishad of Kulkandi.	20.305 meters
b. <u>FMBM NO.- 5244</u> : The pillar is situated just infront of the Bahadurabad ghat Railway Tinshed Mashjid. It is 5m west of the Kacha road. It is in between two train lines. It is about 200m east from the river Jamuna. There is an embankment between the pillar and the river Jamuna.	19.853 meters

Description of Bench Marks
at
Chandanbaisa test area

<u>Description</u>	<u>Value of B.M. (PWD)</u>
a. <u>G.P.S NO.- 750</u> : The pillar is situated south-east corner of the Godown and north-east of the quarter. It is about 50m west from the pond. An embankment has gone by the west and south of the pillar.	16.3827 meters
b. <u>FMBM NO - 7214</u> : The pillar is situated on the embankment and infront of the house of Md. Amirul Paramanik at Nanderpara. It is about 750m east of Kurnibari Madrasha and about 1km south of Dorgatola High School	16.2588 meters

Annexure - E

BTM Co-ordinates and Heights (PWD) of control points :

Test area	Control points	Co-ordinates		Heights(m)
		Easting(m)	Northing(m)	
Kamarjani (North of Manas Regu- lator)	FAP 21.01	462,674.650	805,806.030	23.619
	FAP 21.02	462,291.215	805,502.927	21.604
	FAP 21.03	462,521.844	805,178.591	21.966
	FAP 21.04	461,935.767	804,621.216	20.663
	FAP 21.05	462,144.114	803,710.167	23.279
	FAP 21.06	462,007.929	803,055.468	24.129
	FAP 21.07	462,253.071	802,776.406	24.185
	FAP 21.08	462,514.264	802,097.946	24.166
	FAP 21.09	462,653.396	801,496.161	24.628
	FAP 21.10	462,784.850	801,354.440	23.802

Annexure - F

BTM Co-ordinates and Heights (PWD) of control points :

Test area	Control points	Co-ordinates		Heights(m)
		Easting (m)	Northing(m)	
Bahadurabad	FAP 21.11	470,606.090	780,117.040	20.055
	FAP 21.12	470,286.578	779,429.526	20.853
	FAP 21.13	470,222.819	778,514.199	19.056
	FAP 21.15	470,624.508	776,053.663	18.898
	FAP 21.16	470,830.151	775,448.040	18.266
	FAP 21.17	470,534.646	774,261.157	18.760
	FAP 21.18	469,359.430	771,929.788	18.549
	FAP 21.19	469,090.246	770,741.104	19.557
	FAP 21.20	469,436.733	768,672.922	18.439
	FAP 21.21	469,780.200	768,424.280	20.368
	FAP 21.22	469,584.847	770,588.744	19.294
	FAP 21.23	470,308.696	771,294.102	19.511
	FAP 21.24	471,457.127	774,064.672	20.101
	FAP 21.25	471,319.707	775,238.021	19.228
	FAP 21.26	471,333.414	776,393.749	21.047
	FAP 21.27	471,234.400	777,494.019	19.923
	FAP 21.28	471,025.654	778,115.343	20.139
	FAP 21.29	470,634.315	779,024.610	20.763
	FAP 21.30	470,724.305	779,929.735	21.909

Annexure - G

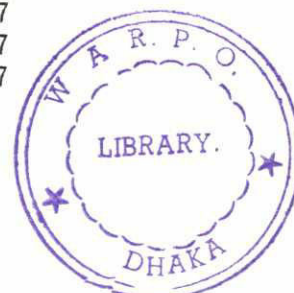
BTM Co-ordinates and Heights (PWD) of control points :

Test area	Control points	Co-ordinates		Heights(m)
		Easting (m)	Norththing(m)	
Chandanbaisa	FAP 21.31	460,193.677	746,857.190	18.319
	FAP 21.32	460,168.936	746,305.285	16.537
	FAP 21.33	460,416.808	745,868.358	19.738
	FAP 21.34	460,781.750	745,733.160	17.761
	FAP 21.35	460,620.192	745,180.259	15.877
	FAP 21.36	460,869.210	744,796.977	17.164
	FAP 21.37	460,965.542	744,205.470	18.860
	FAP 21.38	461,061.797	743,771.989	16.823
	FAP 21.39	460,897.334	743,354.301	15.866
	FAP 21.40	461,102.241	742,972.195	16.367
	FAP 21.41	461,450.006	742,652.283	16.340
	FAP 21.42	461,613.479	741,863.781	18.902
	FAP 21.43	462,147.485	741,035.822	18.818
	FAP 21.44	462,449.491	740,537.003	16.097
	FAP 21.45	462,238.120	739,917.552	16.225
	FAP 21.46	462,647.292	739,519.641	17.341
	FAP 21.47	462,600.292	738,999.641	15.222
	FAP 21.48	462,670.639	738,791.339	15.819
	FAP 21.49	462,448.554	738,416.280	15.995
	FAP 21.50	462,860.420	737,803.920	16.524

Annexure - H

Water level data
at
Kamarjani (North of Manas Regulator) test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
15.04.92	16 00	16.492
	16 30	16.492
	17 00	16.492
	17 30	16.492
	18 00	16.492
	18 30	16.492
16.04.92	06 00	16.497
	06 30	16.497
	07 00	16.497
	07 30	16.497
	08 00	16.497
	08 30	16.497
	09 00	16.497
	09 30	16.497
	10 00	16.497
	10 30	16.497
	11 00	16.497
	11 30	16.497
	12 00	16.497
	12 30	16.497
	13 00	16.497
	13 30	16.497
	14 00	16.497
	14 30	16.497
	15 00	16.497
	15 30	16.497
	16 00	16.497
	16 30	16.497
	17 00	16.497
	17 30	16.497
	18 00	16.497
	18 30	16.497
17.04.92	06 00	16.497
	06 30	16.497
	07 00	16.497
	07 30	16.497



Annexure - H

Water level data
at
Kamarjani (North of Manas Regulator) test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
17.04.92	08 00	16.492
	08 30	16.497
	09 00	16.497
	09 30	16.497
	10 00	16.497
	10 30	16.497
	11 00	16.497
	11 30	16.497
	12 00	16.497
	12 30	16.497
	13 00	16.497
	13 30	16.497
	14 00	16.497
	14 30	16.497
	15 00	16.497
	15 30	16.497
	16 00	16.497
	16 30	16.497
	17 00	16.497
	17 30	16.497
	18 00	16.497
	18 30	16.497
18.04.92	06 00	16.539
	06 30	16.539
	07 00	16.542
	07 30	16.542
	08 00	16.547
	08 30	16.547
	09 00	16.547
	09 30	16.547
	10 00	16.552
	10 30	16.552
	11 00	16.552
	11 30	16.552
	12 00	16.557
	12 30	16.557

Annexure - H

Water level data
at
Kamarjani (North of Manas Regulator) test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
18.04.92	13 00	16.557
	13 30	16.557
	14 00	16.562
	14 30	16.562
	15 00	16.562
	15 30	16.562
	16 00	16.562
	16 30	16.562
	17 00	16.567
	17 30	16.567
	18 00	16.572
	18 30	16.572
	19 00	16.577
19.04.92	06 00	16.752
	06 30	16.752
	07 00	16.757
	07 30	16.757
	08 00	16.757
	08 30	16.757
	09 00	16.762
	09 30	16.762
	10 00	16.762
	10 30	16.767
	11 00	16.767
	11 30	16.767
	12 00	16.772
	12 30	16.772
	13 00	16.777
	13 30	16.787
	14 00	16.797
	14 30	16.802
	15 00	16.807
	15 30	16.812
	16 00	16.827
	16 30	16.832
	17 00	16.842
	17 30	16.852
	18 00	16.857
	18 30	16.867
	19 00	16.877

Annexure - H

Water level data
at
Kamarjani (North of Manas Regulator) test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
20.04.92	06 00	17.127
	06 30	17.127
	07 00	17.130
	07 30	17.132
	08 00	17.135
	08 30	17.137
	09 00	17.137
	09 30	17.139
	10 00	17.142
	10 30	17.144
	11 00	17.147
	11 30	17.152
	12 00	17.157
	12 30	17.162
	13 00	17.167
	13 30	17.172
	14 00	17.177
	14 30	17.182
	15 00	17.187
	15 30	17.192
	16 00	17.197
	16 30	17.207
	17 00	17.217
	17 30	17.227
	18 00	17.237
	18 30	17.247
	19 00	17.257

Water level data
at
Bahadurabad test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
25.04.92	09 00	15.941
	09 30	15.941
	10 00	15.936
	10 30	15.936
	11 00	15.931
	11 30	15.931
	12 00	15.926
	12 30	15.926
	13 00	15.921
	13 30	15.916
	14 00	15.911
	14 30	15.911
	15 00	15.906
	15 30	15.901
	16 00	15.901
	16 30	15.896
	17 00	15.891
	17 30	15.891
	18 00	15.886
	18 30	15.886
26.04.92	07 00	15.826
	07 30	15.826
	08 00	15.826
	08 30	15.831
	09 00	15.831
	09 30	15.831
	10 00	15.816
	10 30	15.816
	11 00	15.816
	11 30	15.811
	12 00	15.811
	12 30	15.811
	13 00	15.811
	13 30	15.806
	14 00	15.806
	14 30	15.801
	15 00	15.801
	15 30	15.801
	16 00	15.796
	16 30	15.796
	17 00	15.791
	17 30	15.791

Annexure - I

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
26.04.92	18 00	15.786
	18 30	15.786
	19 00	15.786
27.04.92	07 00	15.711
	07 30	15.706
	08 00	15.706
	08 30	15.706
	09 00	15.701
	09 30	15.701
	10 00	15.701
	10 30	15.696
	11 00	15.696
	11 30	15.696
	12 00	15.691
	12 30	15.691
	13 00	15.691
	13 30	15.691
	14 00	15.686
	14 30	15.686
	15 00	15.686
	15 30	15.686
	16 00	15.681
	16 30	15.681
	17 00	15.681
	17 30	15.676
	18 00	15.676
	18 30	15.676
07.05.92	06 00	15.147
	06 30	15.147
	07 00	15.147
	07 30	15.147
	08 00	15.142
	08 30	15.142
	09 00	15.142
	09 30	15.142
	10 00	15.142
	10 30	15.137
	11 00	15.137
	11 30	15.137
	12 00	15.137
	12 30	15.137
	13 00	15.137
	13 30	15.132
	14 00	15.132
	14 30	15.132
	15 00	15.132

27

Annexure - I

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
07.05.92	15 30	15.132
	16 00	15.127
	16 30	15.127
	17 00	15.127
	17 30	15.127
	18 00	15.127
	18 30	15.127
08.05.92	06 00	15.137
	06 30	15.137
	07 00	15.137
	07 30	15.137
	08 00	15.137
	08 30	15.137
	09 00	15.137
	09 30	15.137
	10 00	15.137
	10 30	15.137
	11 00	15.137
	11 30	15.137
	12 00	15.137
	12 30	15.137
	13 00	15.137
	13 30	15.137
	14 00	15.137
	14 30	15.137
	15 00	15.137
	15 30	15.137
	16 00	15.137
	16 30	15.137
	17 00	15.137
	17 30	15.137
	18 00	15.137
	18 30	15.137
09.05.92	06 00	15.127
	06 30	15.127
	07 00	15.127
	07 30	15.127
	08 00	15.127
	08 30	15.127
	09 00	15.127
	09 30	15.127
	10 00	15.127
	10 30	15.127
	11 00	15.127
	11 30	15.127

Annexure - I

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
09.05.92	12 00	15.127
	12 30	15.127
	13 00	15.127
	13 30	15.132
	14 00	15.132
	14 30	15.132
	15 00	15.132
	15 30	15.132
	16 00	15.132
	16 30	15.137
	17 00	15.137
	17 30	15.137
	18 00	15.137
	18 30	15.137
15.05.92	06 30	15.162
	07 00	15.162
	07 30	15.167
	08 00	15.167
	08 30	15.167
	09 00	15.172
	09 30	15.172
	10 00	15.172
	10 30	15.177
	11 00	15.177
	11 30	15.177
	12 00	15.182
	12 30	15.182
	13 00	15.182
	13 30	15.182
	14 00	15.182
	14 30	15.182
	15 00	15.187
	15 30	15.187
	16 00	15.187
	16 30	15.187
	17 00	15.187
	17 30	15.192
	18 00	15.192
	18 30	15.192
	19 00	15.192
	19 30	15.192
16.05.92	06 30	15.202
	07 00	15.202
	07 30	15.202
	08 00	15.197

Annexure - I

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
16.05.92	08 30	15.197
	09 00	15.192
	09 30	15.192
	10 00	15.192
	10 30	15.187
	11 00	15.187
	11 30	15.182
	12 00	15.182
	12 30	15.177
	13 00	15.177
	13 30	15.177
	14 00	15.172
	14 30	15.172
	15 00	15.172
	15 30	15.167
	16 00	15.167
	16 30	15.162
	17 00	15.162
	17 30	15.161
	18 00	15.161
	18 30	15.161
	19 00	15.161
	19 30	15.161
17.05.92	06 30	15.171
	07 00	15.171
	07 30	15.171
	08 00	15.171
	08 30	15.171
	09 00	15.171
	09 30	15.176
	10 00	15.176
	10 30	15.181
	11 00	15.181
	11 30	15.181
	12 00	15.181
	12 30	15.186
	13 00	15.186
	13 30	15.186
	14 00	15.191
	14 30	15.191
	15 00	15.191
	15 30	15.196
	16 00	15.196
	16 30	15.196
	17 00	15.201

Annexure - I

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
17.05.92	17 30	15.206
	18 00	15.211
	18 30	15.211
	19 00	15.216
	19 30	15.216
18.05.92	06 30	14.998
	07 00	14.998
	07 30	14.998
	08 00	14.998
	08 30	14.998
	09 00	14.998
	09 30	14.993
	10 00	14.993
	10 30	14.993
	11 00	14.993
	11 30	14.993
	12 00	14.993
	12 30	14.988
	13 00	14.988
	13 30	14.988
	14 00	14.988
	14 30	14.988
	15 00	14.983
	15 30	14.983
	16 00	14.983
	17 00	14.983
	17 30	14.978
	18 00	14.978
	18 30	14.978

Water level data
at
Chandanbaisa test area

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
19.04.92	06 00	11.535
	06 30	11.537
	07 00	11.539
	07 30	11.541
	08 00	11.450
	08 30	11.542
	09 00	11.544
	09 30	11.546
	10 00	11.548
	10 30	11.550
	11 00	11.552
	11 30	11.555
	12 00	11.558
	12 30	11.561
	13 00	11.564
	13 30	11.567
	14 00	11.570
	14 30	11.574
	15 00	11.577
	15 30	11.580
20.04.92	16 00	11.583
	16 30	11.586
	17 00	11.590
	17 30	11.594
	18 00	11.596
	18 30	11.598
	06 00	11.760
	06 30	11.765
	07 00	11.770
	07 30	11.775
	08 00	11.780
	08 30	11.785
	09 00	11.790
	09 30	11.798
	10 00	11.808
	10 30	11.818
	11 00	11.828
	11 30	11.839
	12 00	11.850

Annexure - J

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
20.04.92	12 30	11.860
	13 00	11.870
	13 30	11.880
	14 00	11.890
	14 30	11.900
	15 00	11.910
	15 30	11.915
	16 00	11.920
	16 30	11.925
	17 00	11.930
	17 30	11.935
	18 00	11.940
	18 30	11.945
21.04.92	06 00	12.379
	06 30	12.384
	07 00	12.389
	07 30	12.394
	08 00	12.399
	08 30	12.404
	09 00	12.409
	09 30	12.414
	10 00	12.419
	10 30	12.424
	11 00	12.429
	11 30	12.439
	12 00	12.449
	12 30	12.459
	13 00	12.469
	13 30	12.479
	14 00	12.479
	14 30	12.484
	15 00	12.489
	15 30	12.494
	16 00	12.499
	16 30	12.504
	17 00	12.509
	17 30	12.514
	18 00	12.519
	18 30	12.529

62

Annexure - J

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
22.04.92	06 00	12.684
	06 30	12.694
	07 00	12.704
	07 30	12.714
	08 00	12.724
	08 30	12.734
	09 00	12.739
	09 30	12.744
	10 00	12.759
	10 30	12.764
	11 00	12.769
	11 30	12.774
	12 00	12.779
	12 30	12.784
	13 00	12.789
	13 30	12.794
	14 00	12.799
	14 30	12.804
	15 00	12.809
	15 30	12.814
	16 00	12.819
	16 30	12.824
	17 00	12.829
	17 30	12.834
	18 00	12.839
	18 30	12.844
23.04.92	06 00	12.998
	06 30	12.999
	07 00	13.000
	07 30	13.001
	08 00	13.002
	08 30	13.003
	09 00	13.004
	09 30	13.005
	10 00	13.006
	10 30	13.007
	11 00	13.008
	11 30	13.008
	12 00	13.008
	12 30	13.008
	13 00	13.008
	13 30	13.008

97

Annexure - J

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
23.04.92	14 00	13.008
	14 30	13.008
	15 00	13.008
	15 30	13.008
	16 00	13.008
	16 30	13.008
	17 00	13.008
	17 30	13.008
	18 00	13.008
	18 30	13.008
24.04.92	06 00	13.139
	06 30	13.138
	07 00	13.137
	07 30	13.136
	08 00	13.134
	08 30	13.133
	09 00	13.131
	09 30	13.129
	10 00	13.127
	10 30	13.125
	11 00	13.124
	11 30	13.122
	12 00	13.119
	12 30	13.115
	13 00	13.112
	13 30	13.110
	14 00	13.108
	14 30	13.106
	15 00	13.103
	15 30	13.101
	16 00	13.098
	16 30	13.095
	17 00	13.090
	17 30	13.087
	18 00	13.085
	18 30	13.080
25.04.92	06 00	13.018
	06 30	13.016
	07 00	13.013
	07 30	13.011
	08 00	13.009

69

Annexure - J

<u>Date</u>	<u>Time (Hours)</u>	<u>Reduced level (PWD)</u> <u>(In meters)</u>
25.04.92	08 30	13.007
	09 00	13.005
	09 30	13.001
	10 00	13.998
	10 30	12.995
	11 00	12.992
	11 30	12.990
	12 00	12.988
	12 30	12.986
	13 00	12.983
	13 30	12.980
	14 00	12.977
	14 30	12.974
	15 00	12.972
	15 30	12.970
	16 00	12.968
	16 30	12.966
	17 00	12.964
	17 30	12.962
	18 00	12.960
	18 30	12.957
27.04.92	06 00	12.569
	06 30	12.564
	07 00	12.559
	07 30	12.554
	08 00	12.551
	08 30	12.549
	09 00	12.547
	09 30	12.545
	10 00	12.544
	10 30	12.542
	11 00	12.540
	11 30	12.538
	12 00	12.536
	12 30	12.534
	13 00	12.532
	13 30	12.530
	14 00	12.528
	14 30	12.526
	15 00	12.524
	15 30	12.522
	16 00	12.520
	16 30	12.518
	17 00	12.516
	17 30	12.514
	18 00	12.512
	18 30	12.510



64

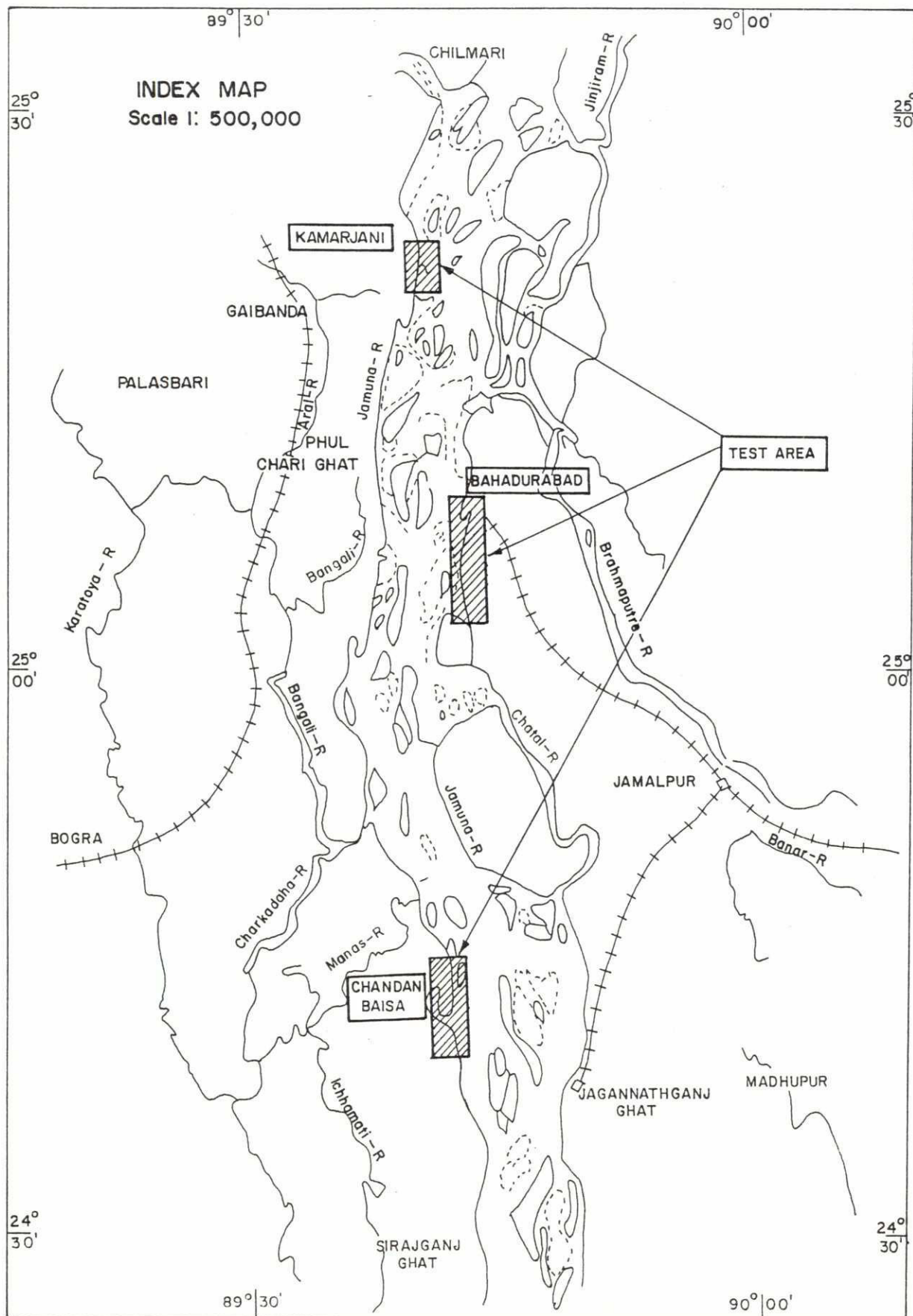
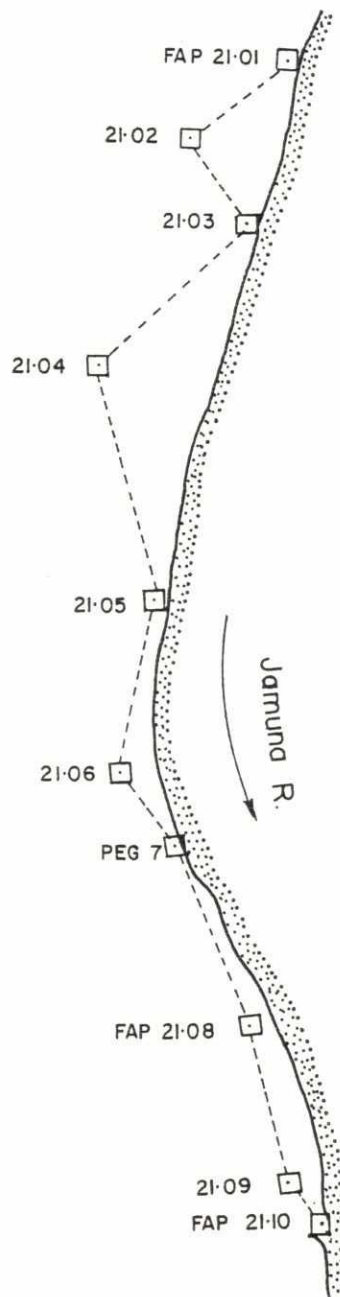


Fig. 1

LOCATION MAP OF
CONTROL POINTS
AT
KAMARJANI
(Manas Regulator)



(Not to Scale)

Distances in Meters

FAP 21-01	-	FAP 21-02	: 488.78
21-02	-	21-03	: 397.98
21-03	-	21-04	: 808.81
21-04	-	21-05	: 943.58
21-05	-	21-06	: 668.71
21-06	-	21-07	: 356.20
21-07	-	21-08	: 736.87
21-08	-	21-09	: 617.67
21-09	-	21-10	: 193.31

Fig. 2

LOCATION MAP OF
CONTROL POINTS
AT
BAHADURABAD



(Not to Scale)

Distances in Meters

FAP 21-11	-	FAP 21-12	750.0
21-12	-	21-13	917.54
21-13	-	21-15	2487.5
21-15	-	21-16	639.60
21-16	-	21-17	1230.0
21-17	-	21-18	2600.0
21-18	-	21-19	1230.0
21-19	-	21-20	2042.5
21-20	-	21-21	424.07
21-21	-	21-22	2175.0
21-22	-	21-23	1010.73
21-23	-	21-24	2999.18
21-24	-	21-25	1195.0
21-25	-	21-26	1185.0
21-26	-	21-27	1047.5
21-27	-	21-28	655.43
21-28	-	21-29	1000.0
21-29	-	21-30	900.0
21-30	-	21-11	221.45

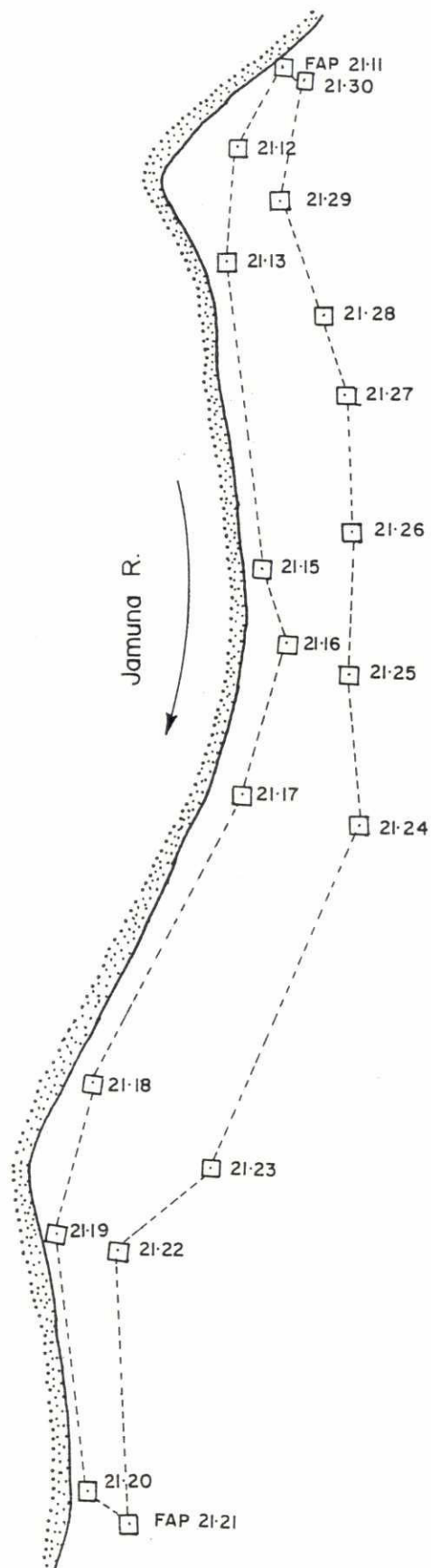


Fig. 3

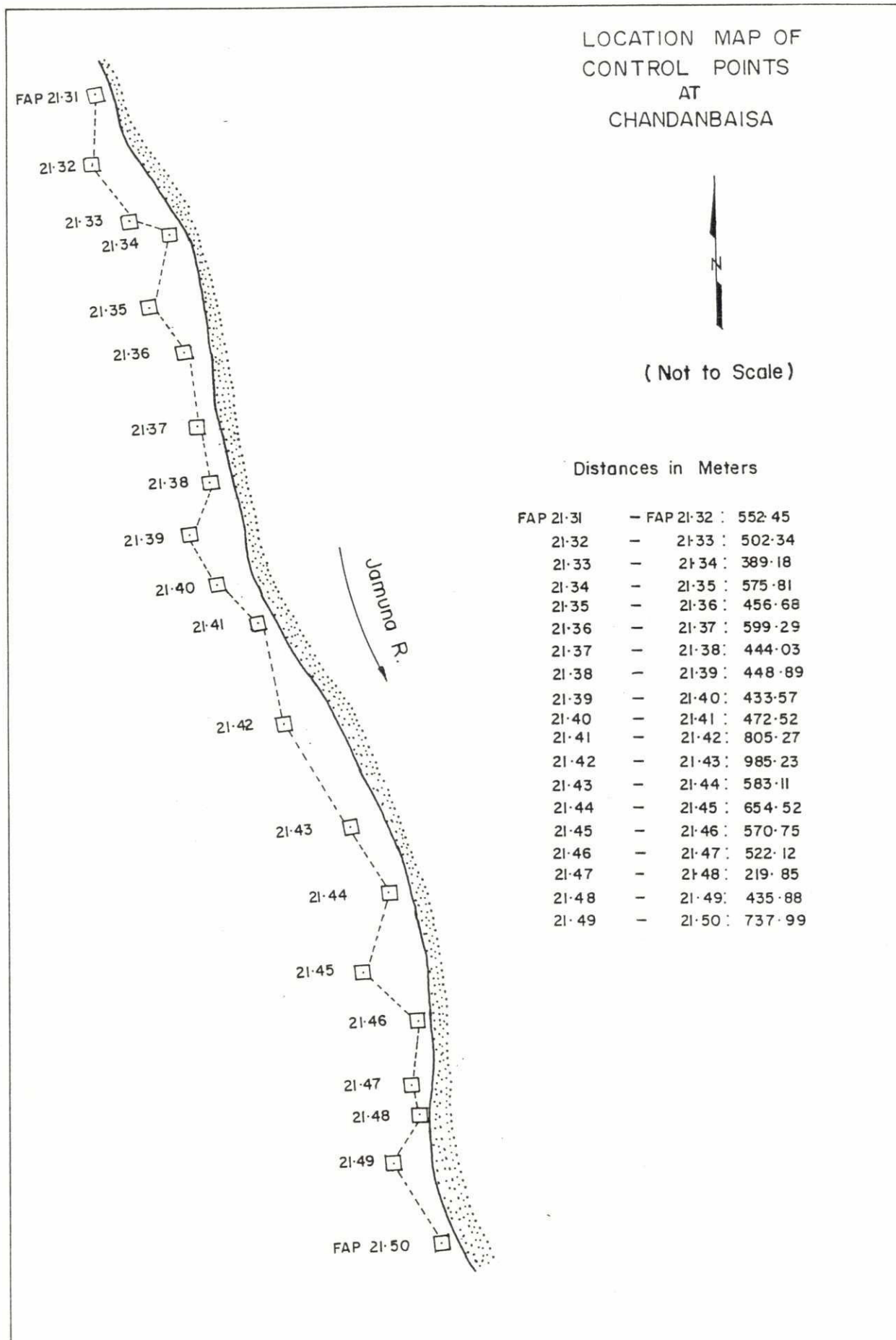


Fig. 4

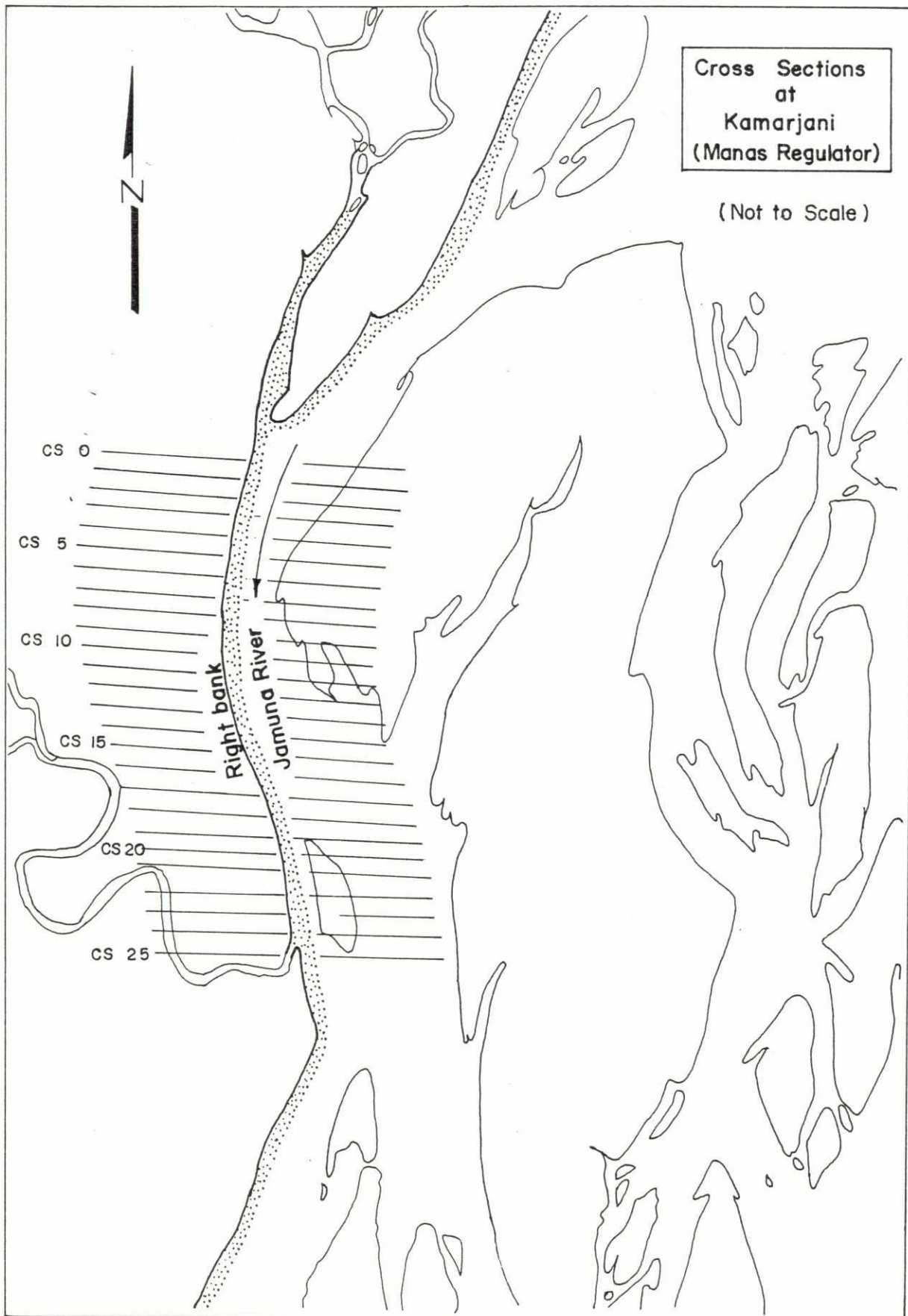


Fig.5

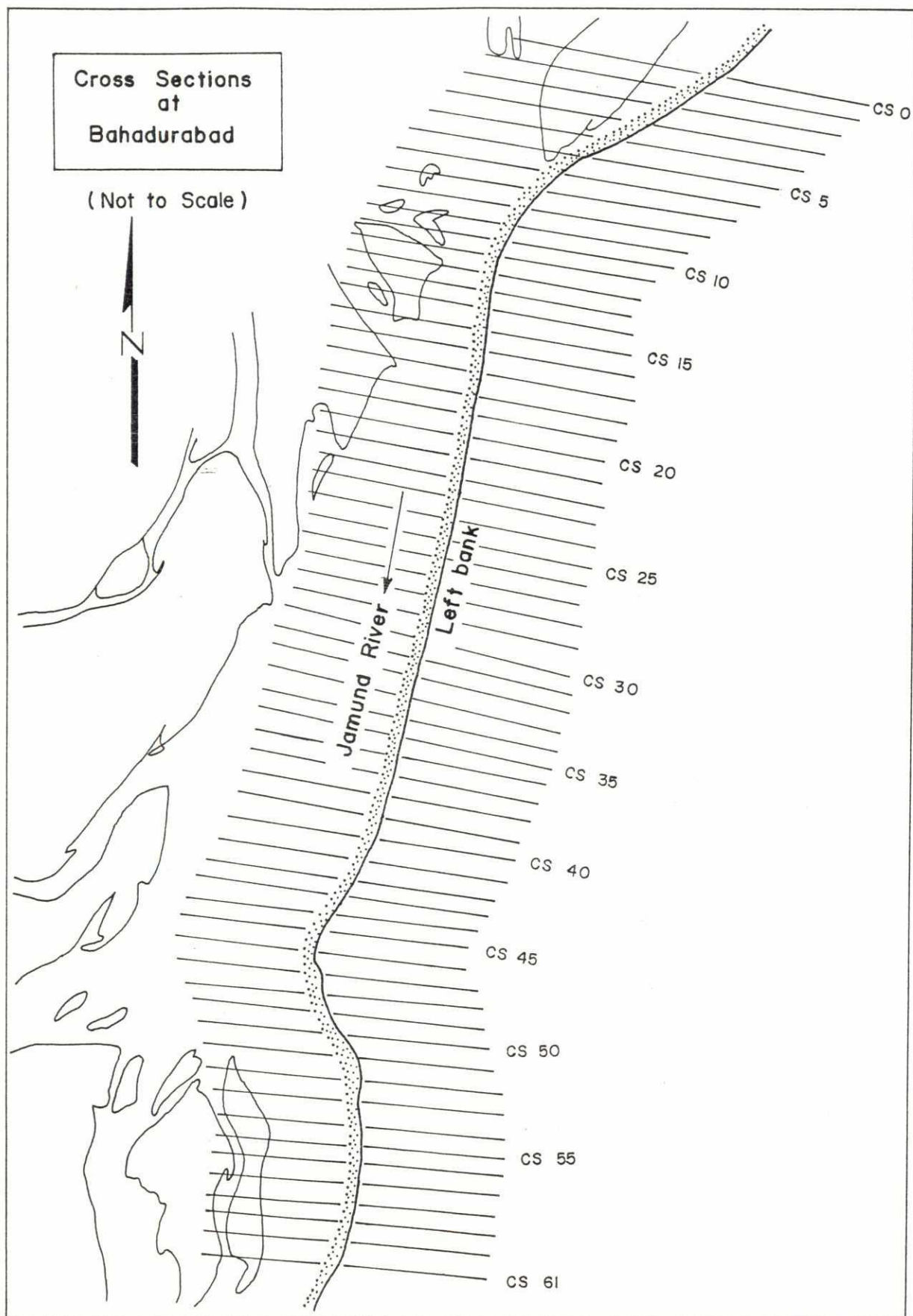


Fig. 6

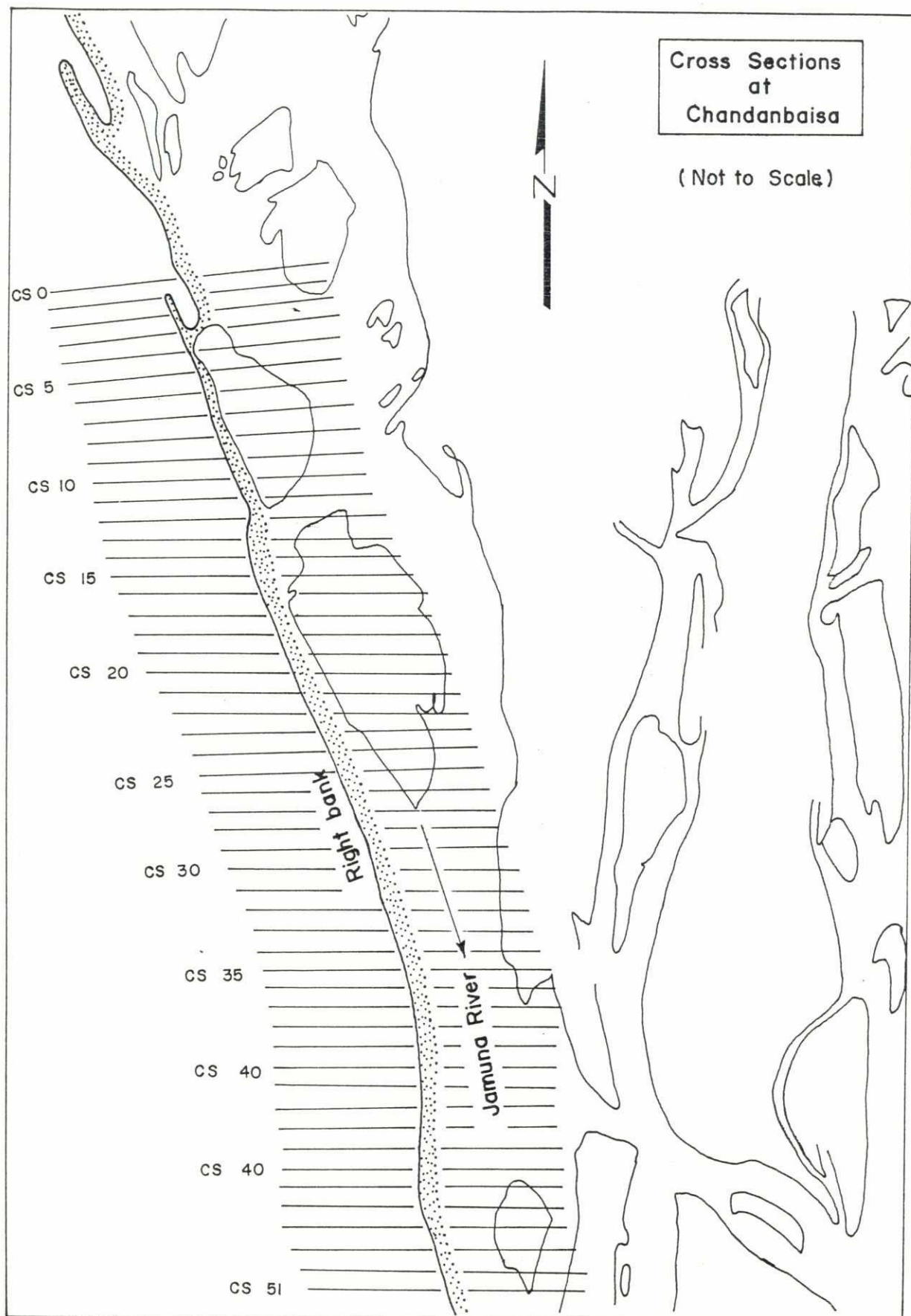
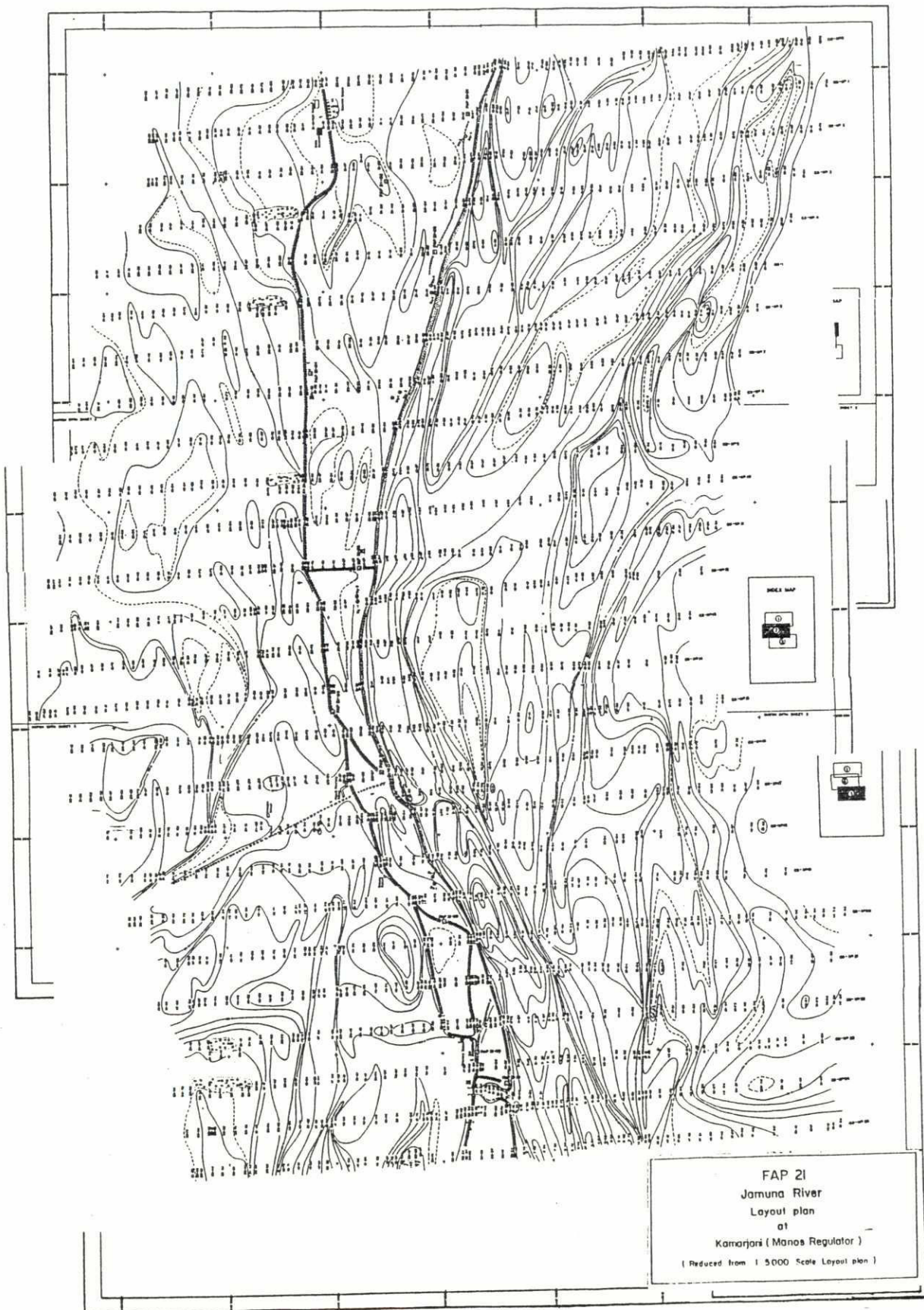


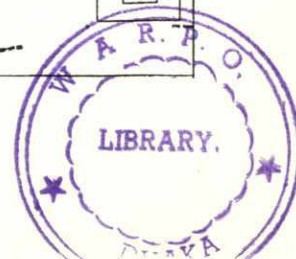
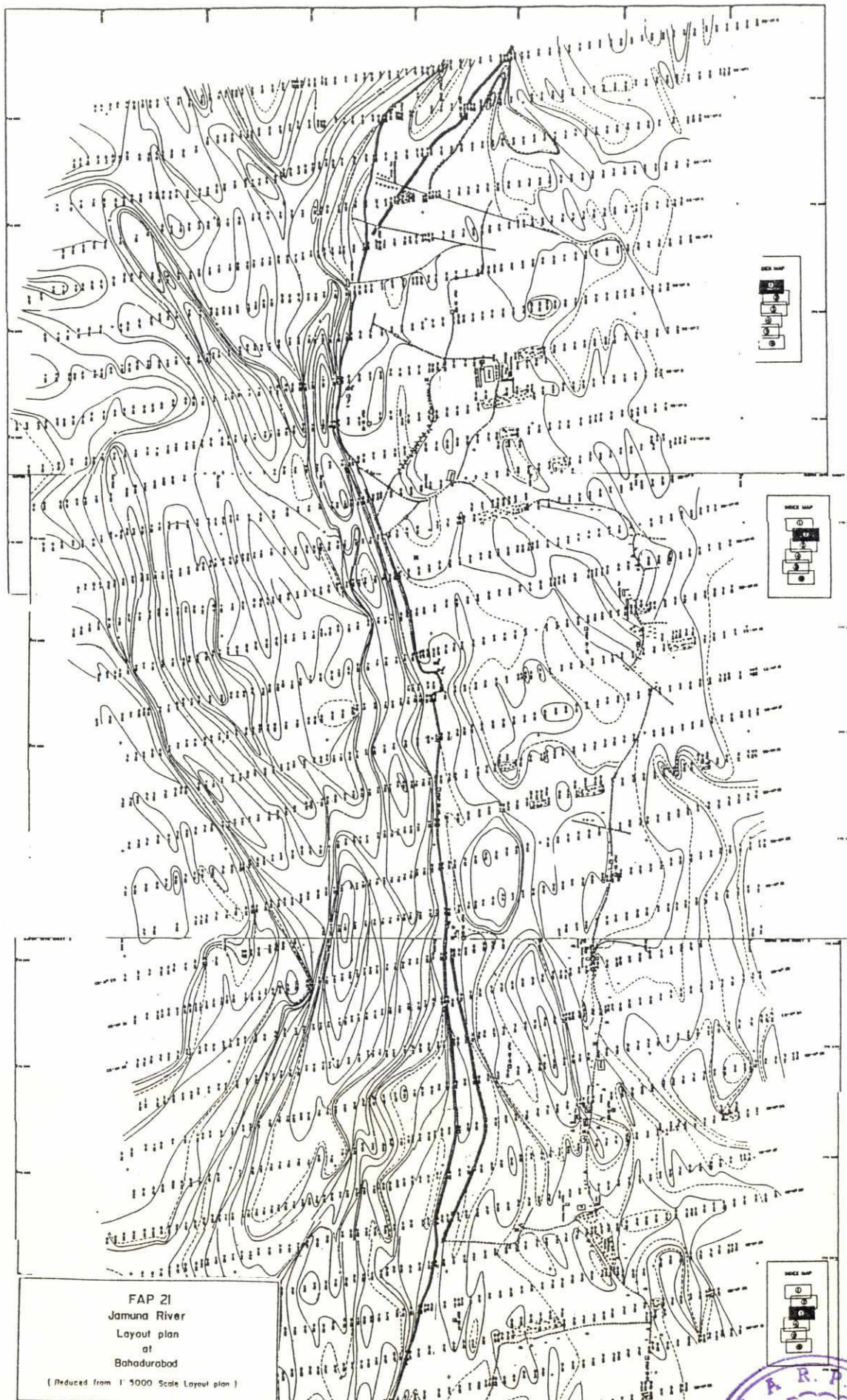
Fig. 7

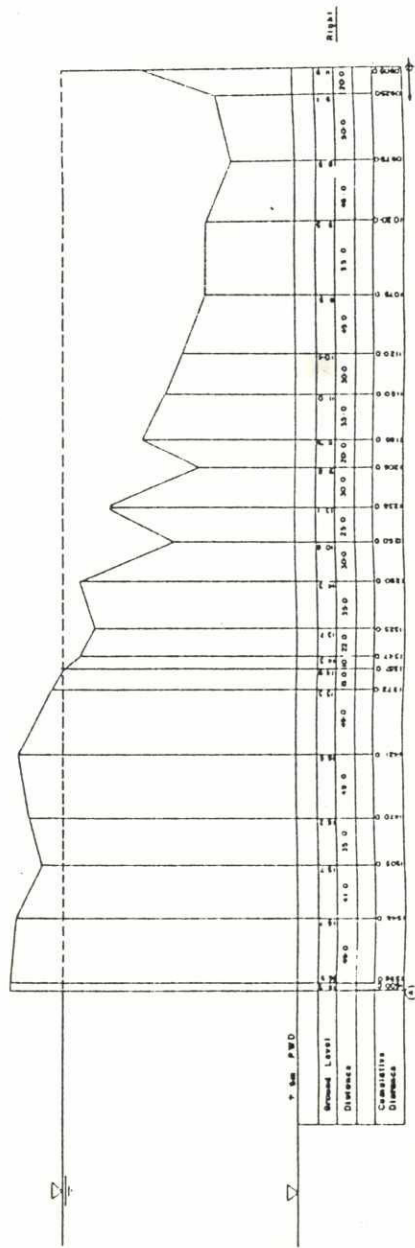
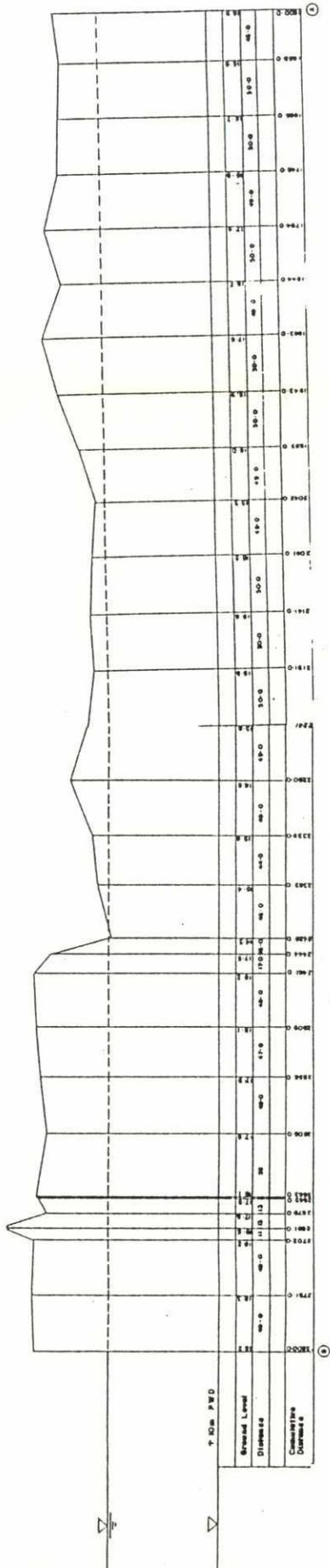
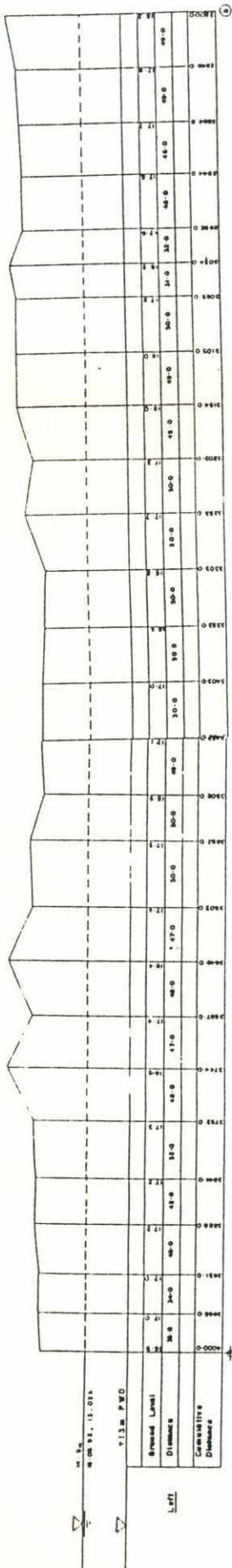
Specimen Copies:

- * Lay out Plan
- * Cross Section Profile







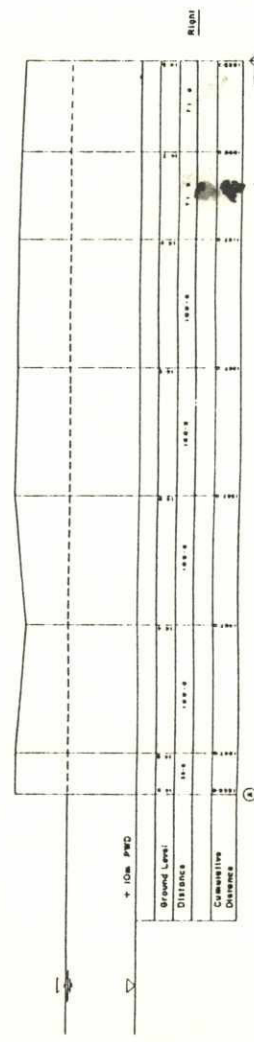
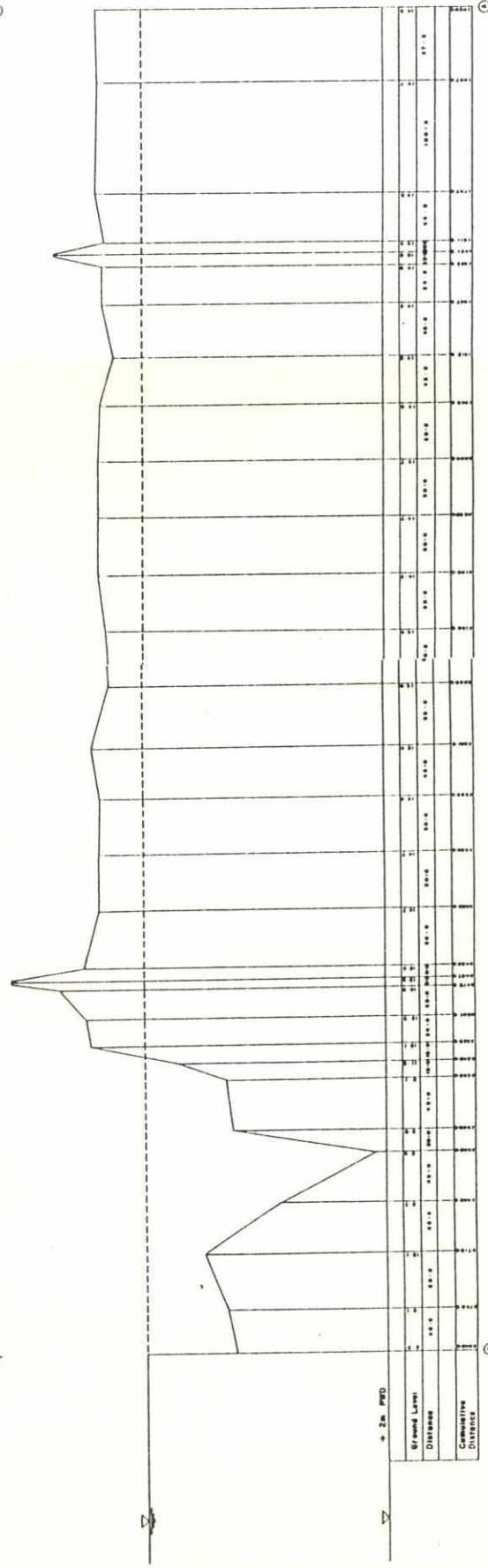


FAP 21
Jamuna River
Cross Section profile

at

Bahadurabad

(Reduced from Scale Hor. 1" 2000 Ver 1 100)

[illegible]

(Reduced from Scale Hor. 1:2000 Ver. 1:100)

