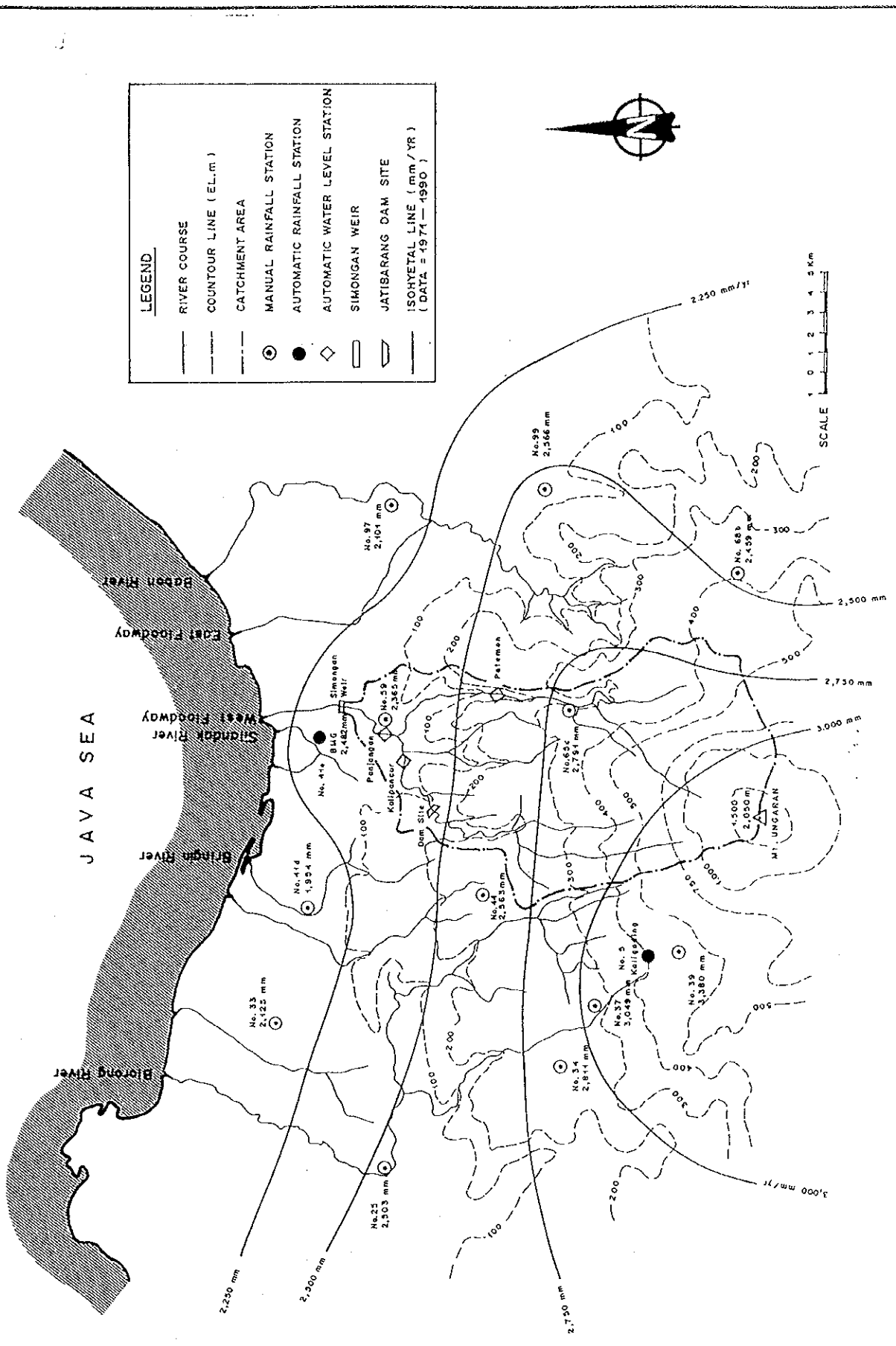
FIGURES

CHAPTER 2

PRESENT CONDITION OF THE STUDY AREA

LIST OF FIGURES

Chapter 2



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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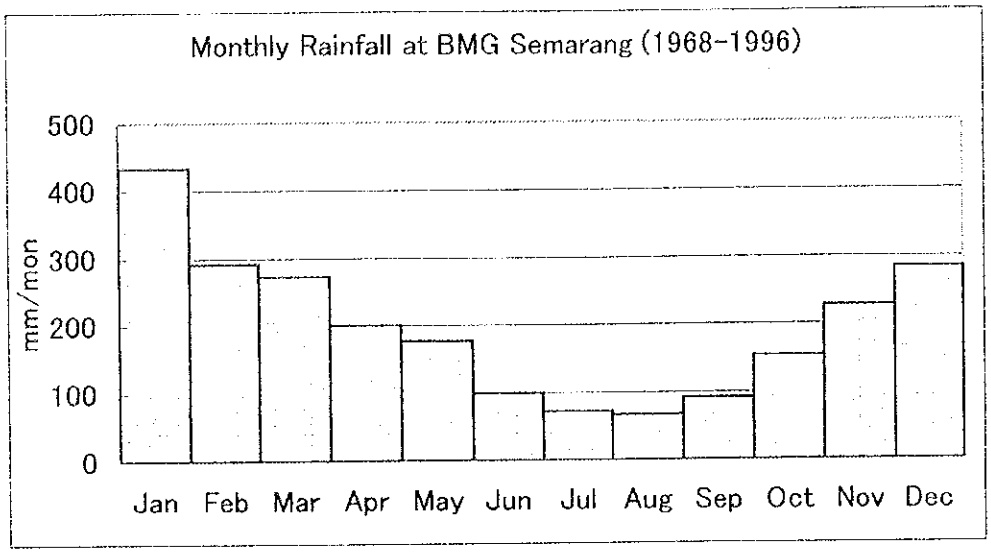
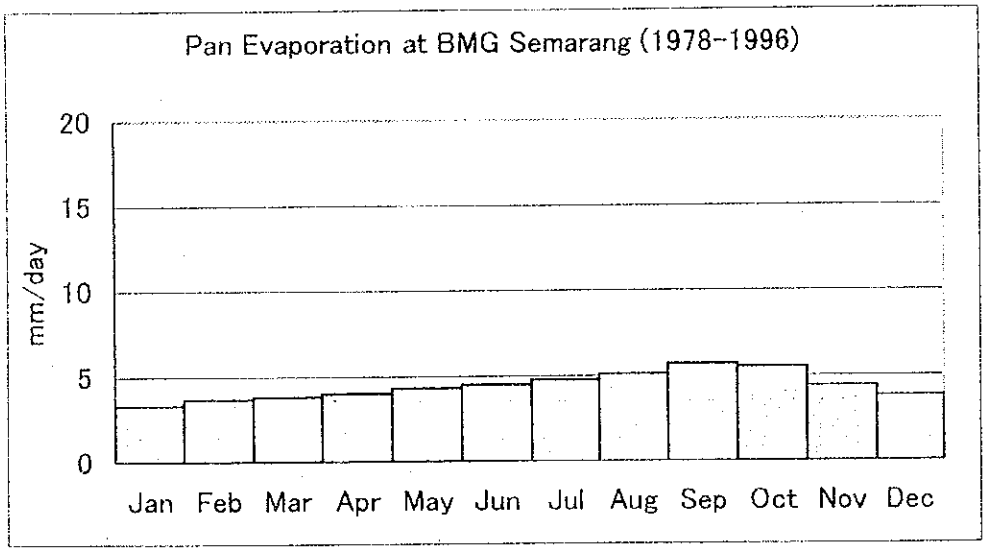
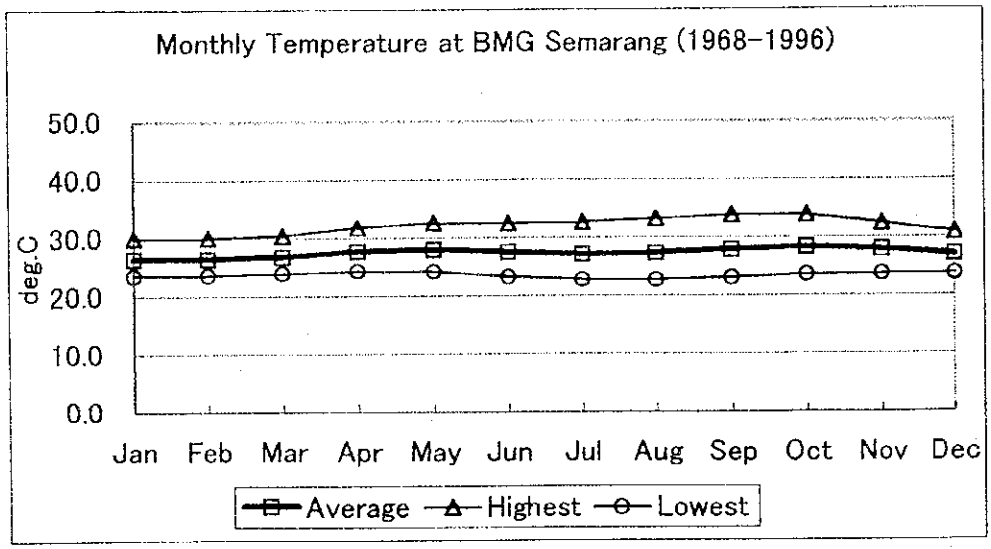
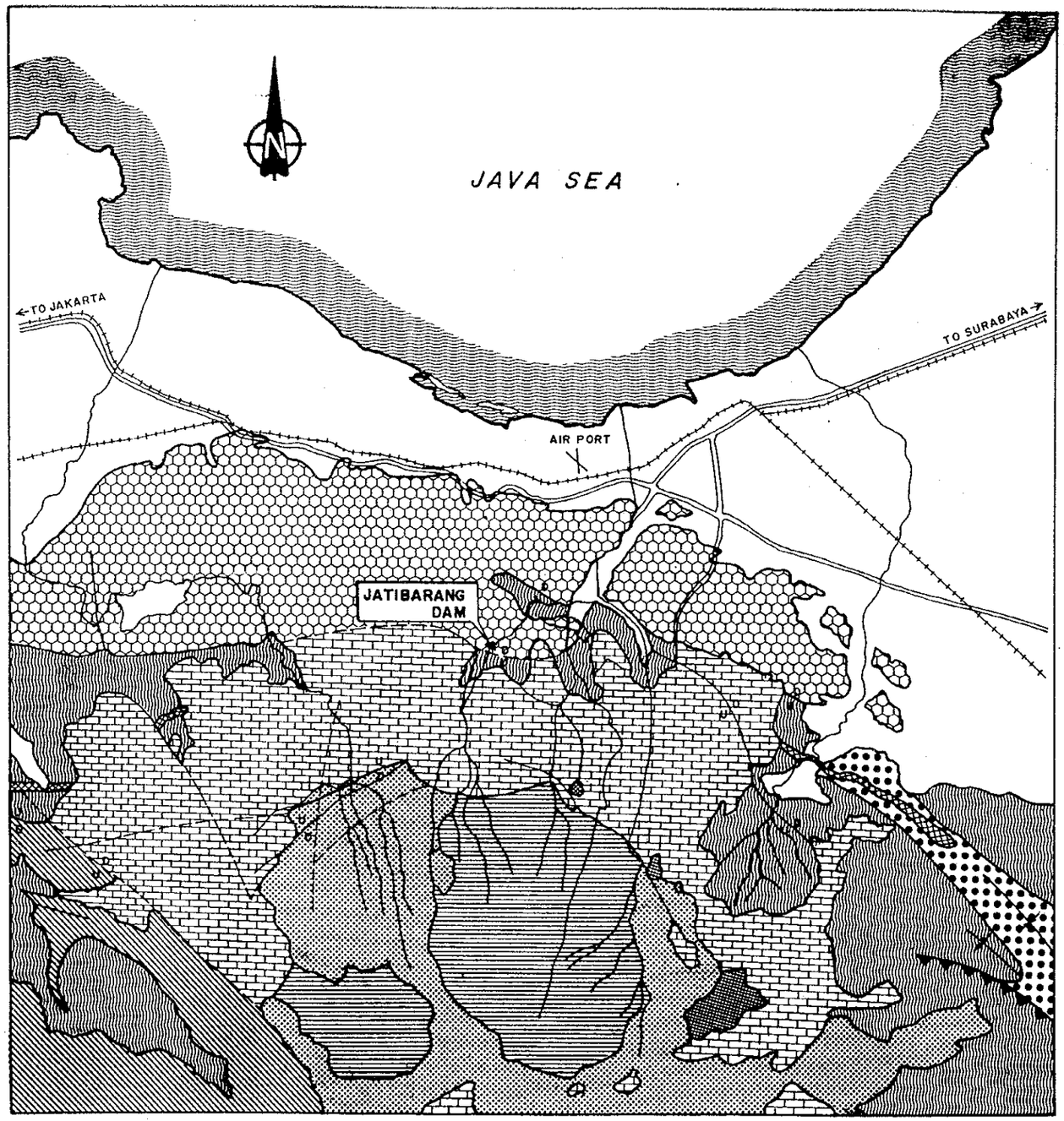
Fig. 2.1.1
LOCATION OF OBSERVATORIES AND ISOHYETAL LINE





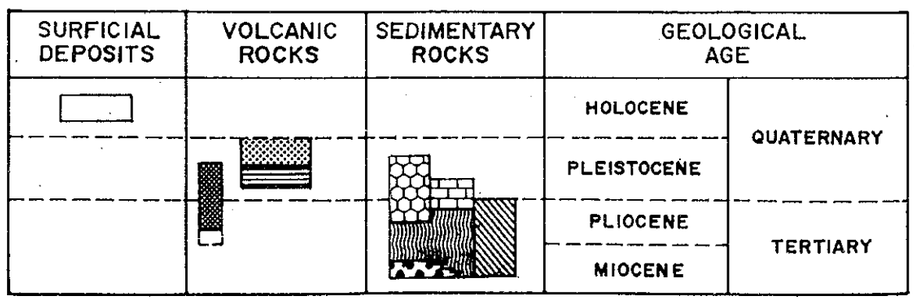


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 2.1.2 CLIMATIC CHARACTERISTICS IN STUDY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	



LEGEND :

- ALLUVIUM : COASTAL PLAIN; CLAY AND SAND, STREAM DEPOSITS; SAND, SILT, GRAVEL AND BOULDER
- MIDDLE G. UNGARAN LAHAR AND VOLCANIC ROCK : AUGITE - OLIVINE BASALT FLOWS
- LAVA FLOW OF G. UNGARAN : AUGITE - HORNBLENDE ANDESITE
- NOTOPURO FORMATION : VOLCANIC BRECCIA, LAVA FLOWS, TUFF, TUFFACEOUS SANDSTONE AND CLAYSTONE
- DAMAR FORMATION : TUFFACEOUS SANDSTONE, CONGLOMERATE, VOLCANIC BRECCIA AND TUFF
- KALIBIUK FORMATION : CLAYSTONE, MARL, SANDSTONE, CONGLOMERATE, VOLCANIC BRECCIA AND TUFF
- BANYAK MEMBER : ALTERNATION OF TUFFACEOUS, SANDSTONE, CALCAREOUS SILTSTONE, SANDSTONE AND PEBBLY SANDSTONE
- PENYATAN FORMATION : SANDSTONE, BRECCIA, TUFF, CLAYSTONE AND LAVA FLOW
- LIMESTONE
- INTRUSIVE ROCKS : AUGITE - HORNBLENDE ANDESITE AND AUGITE - OLIVINE ANDESITE
- NORMAL FAULT : U = UP, D = DOWN
- REVERSE FAULT
- FOLD AXIS
- INFERRED FAULT



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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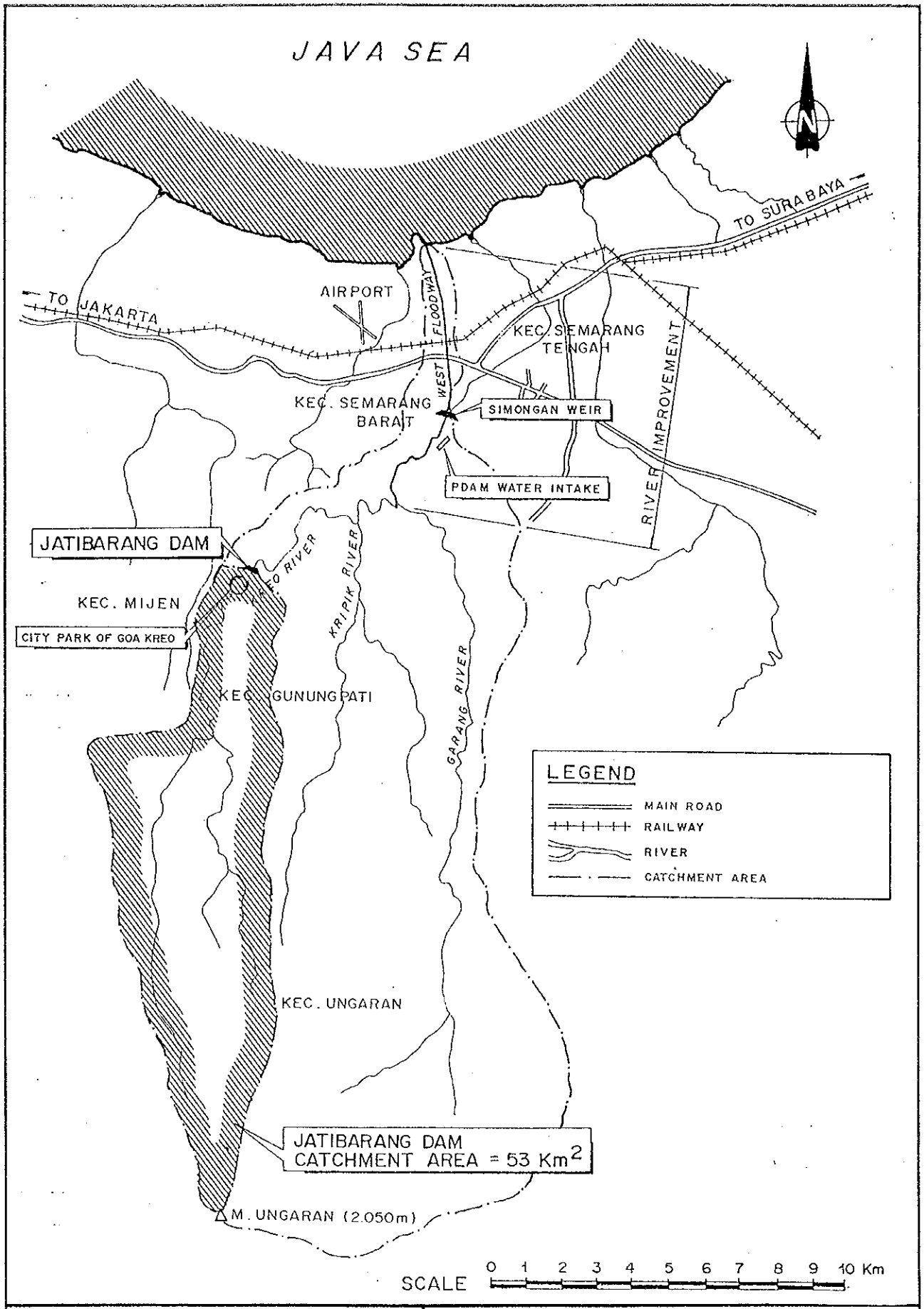
Fig. 2.1.3
REGIONAL GEOLOGICAL MAP AROUND THE STUDY AREA



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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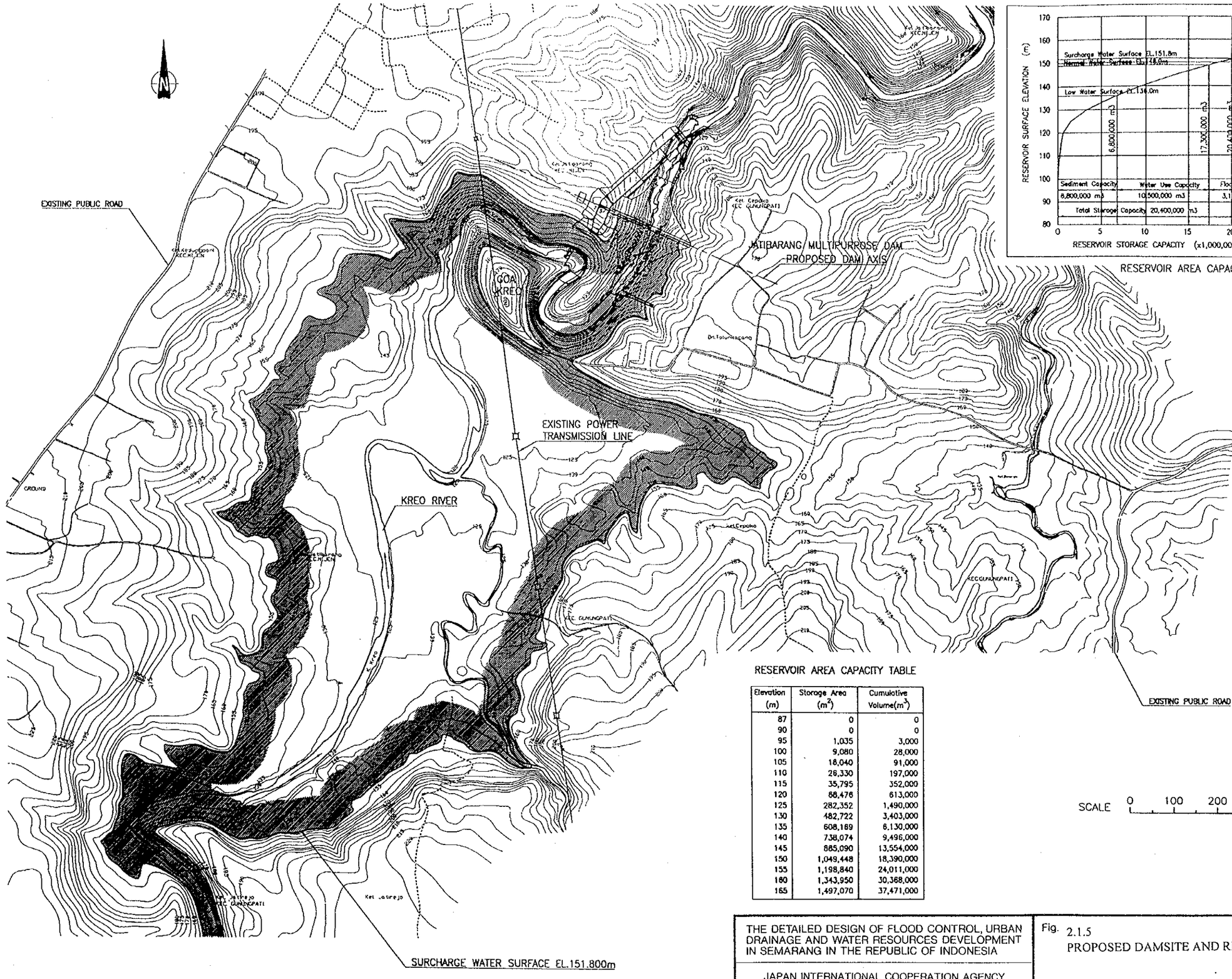
Fig. 2.1.4
EXISTING GARANG RIVER SYSTEM AND LOCATION OF JATIBARANG MULTIPURPOSE DAM



RESERVOIR AREA CAPACITY CURVE

RESERVOIR AREA CAPACITY TABLE

Elevation (m)	Storage Area (m^2)	Cumulative Volume(m^3)
87	0	0
90	0	0
95	1,035	3,000
100	9,080	28,000
105	18,040	91,000
110	26,330	197,000
115	35,795	352,000
120	88,476	613,000
125	282,352	1,490,000
130	482,722	3,403,000
135	608,189	6,130,000
140	738,074	9,496,000
145	885,090	13,554,000
150	1,049,448	18,390,000
155	1,198,840	24,011,000
160	1,343,950	30,368,000
165	1,497,070	37,471,000

SCALE 0 100 200 300 400m

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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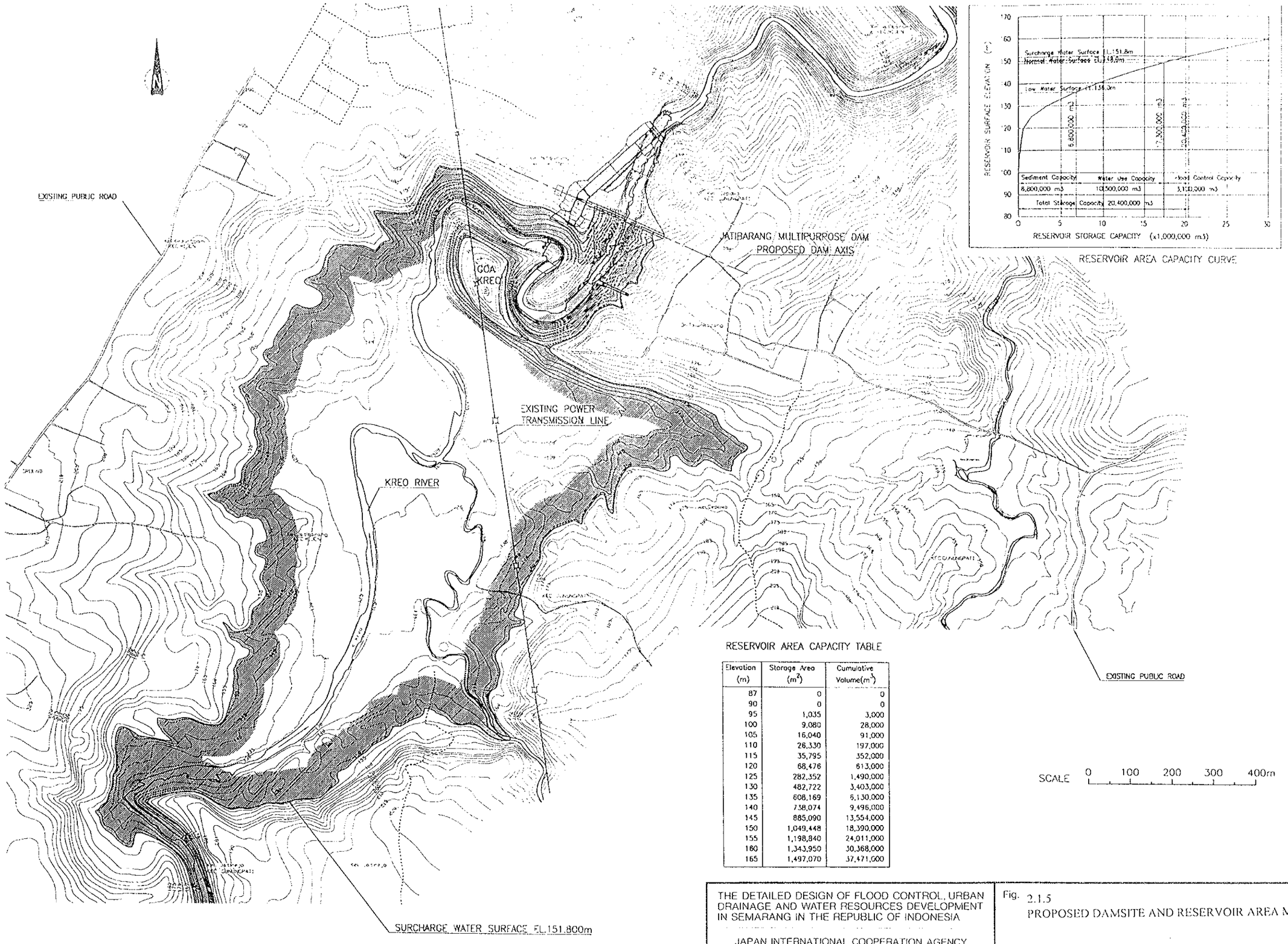
Fig. 2.1.5
PROPOSED DAMSITE AND RESERVOIR AREA MAP



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THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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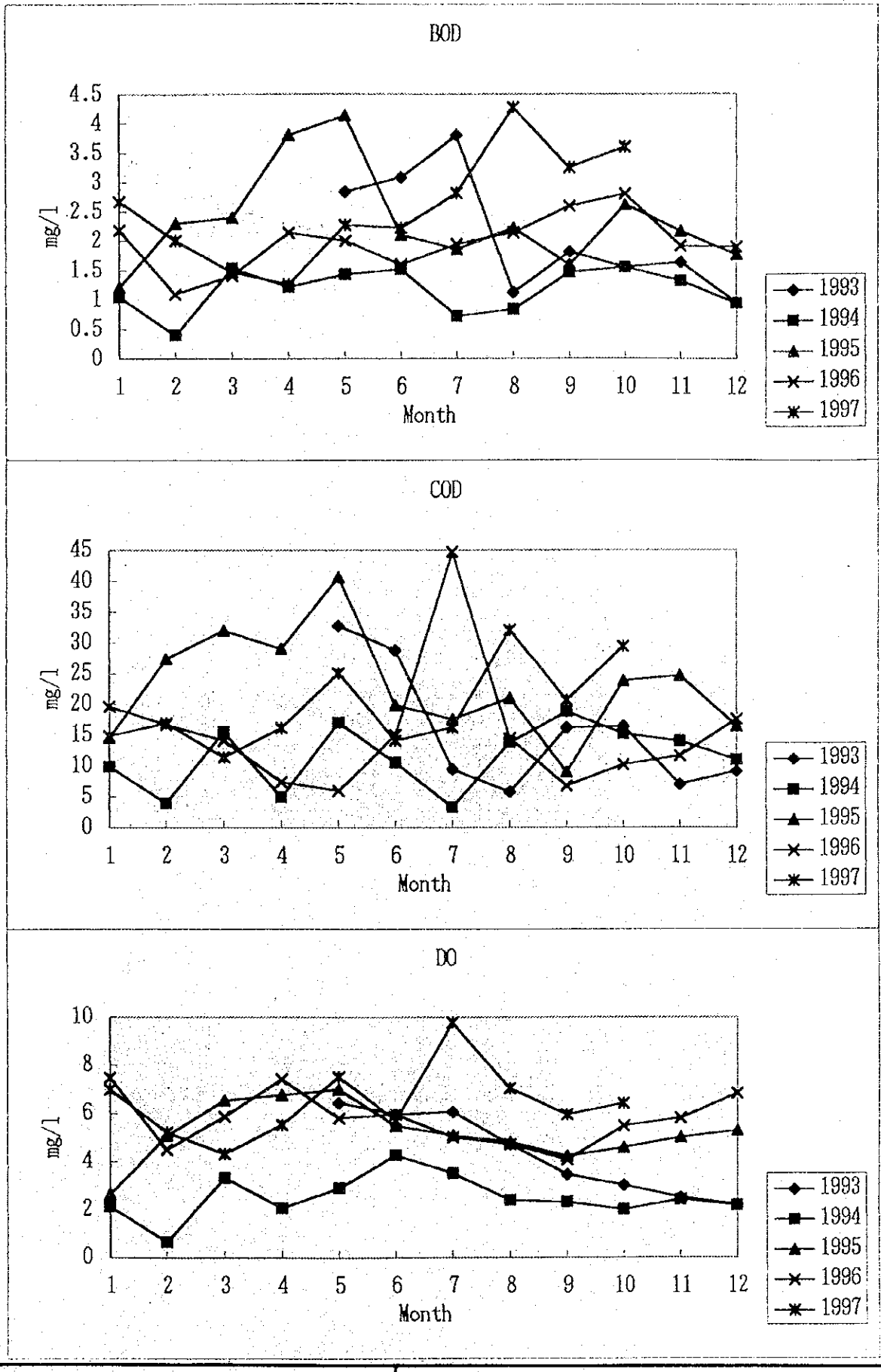
Fig. 2.1.5
PROPOSED DAMSITE AND RESERVOIR AREA MAP



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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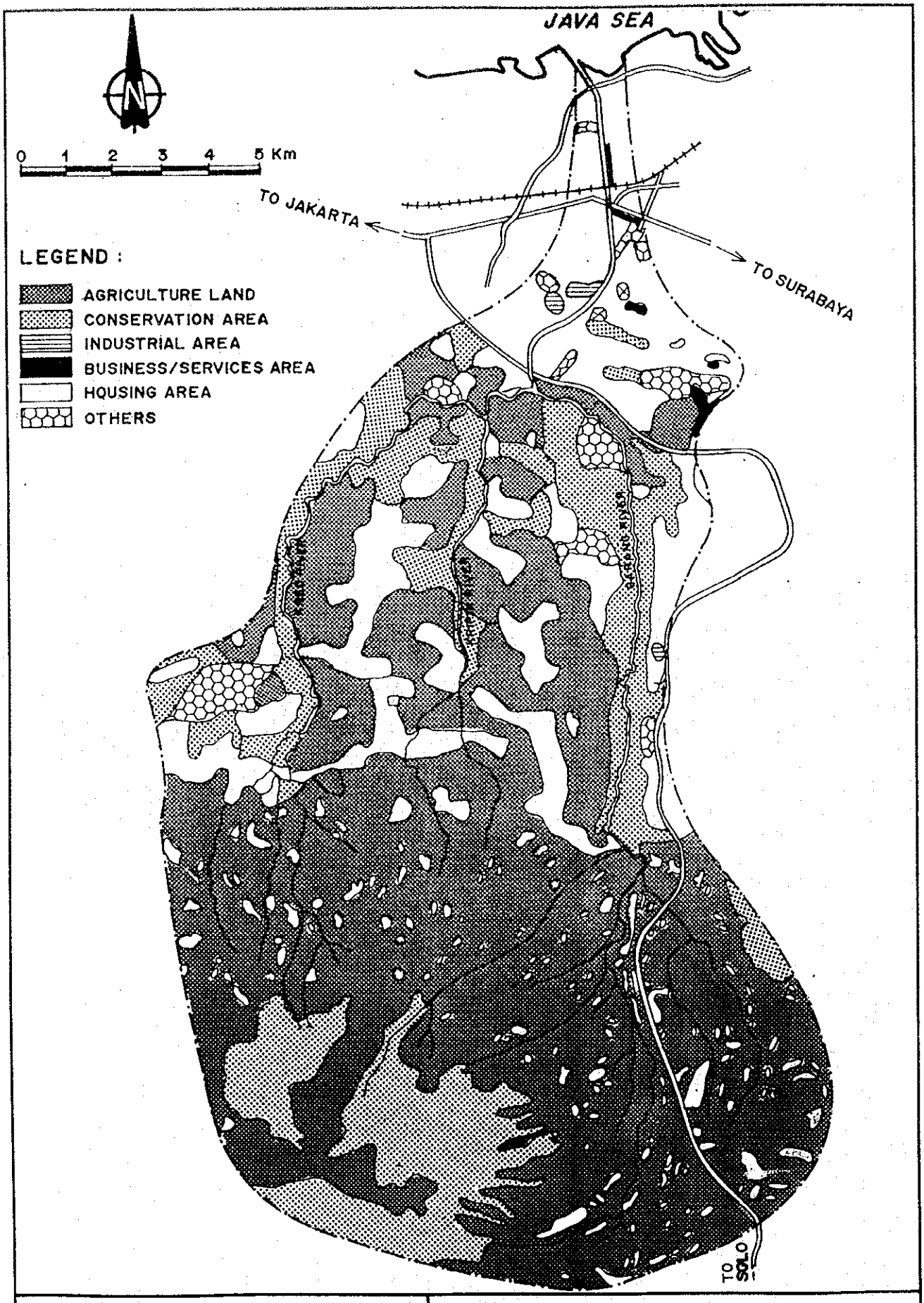
Fig. 2.1.6
WATER ANALYSIS RECORD BY PDAM (1993-1997)



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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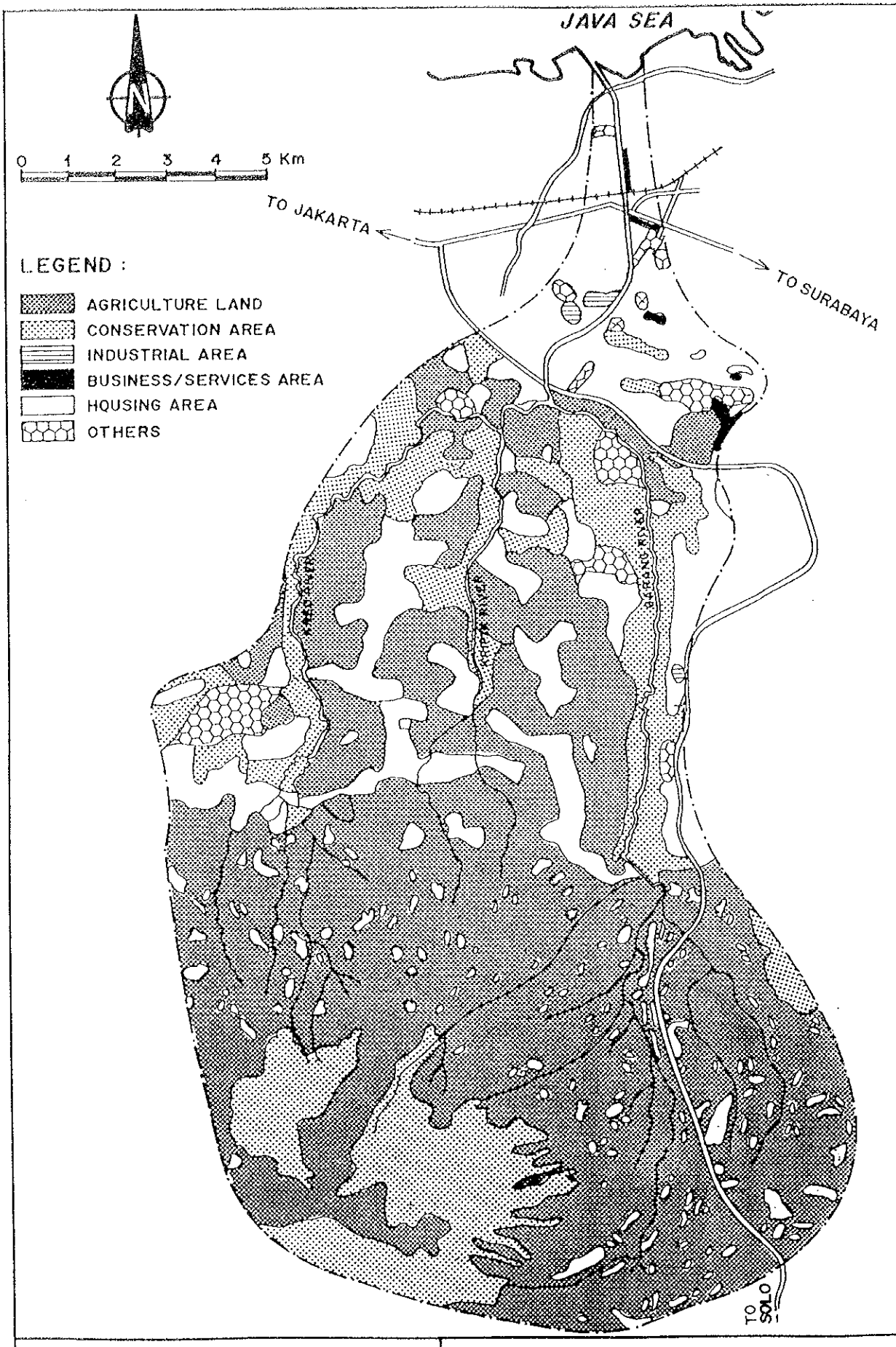
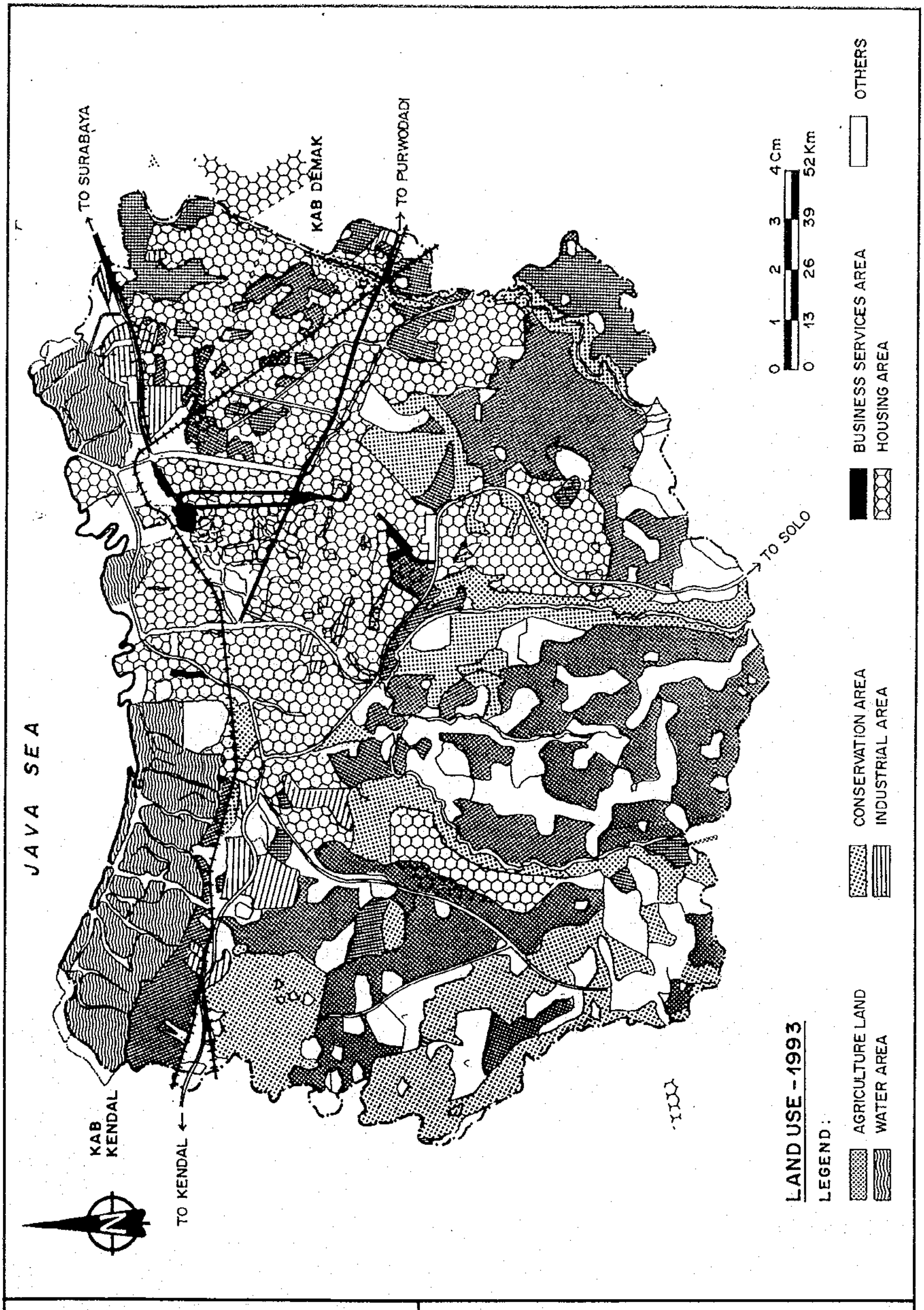
Fig. 2.1.7
LAND USE MAP OF GARANG RIVER BASIN
(1992-1995)



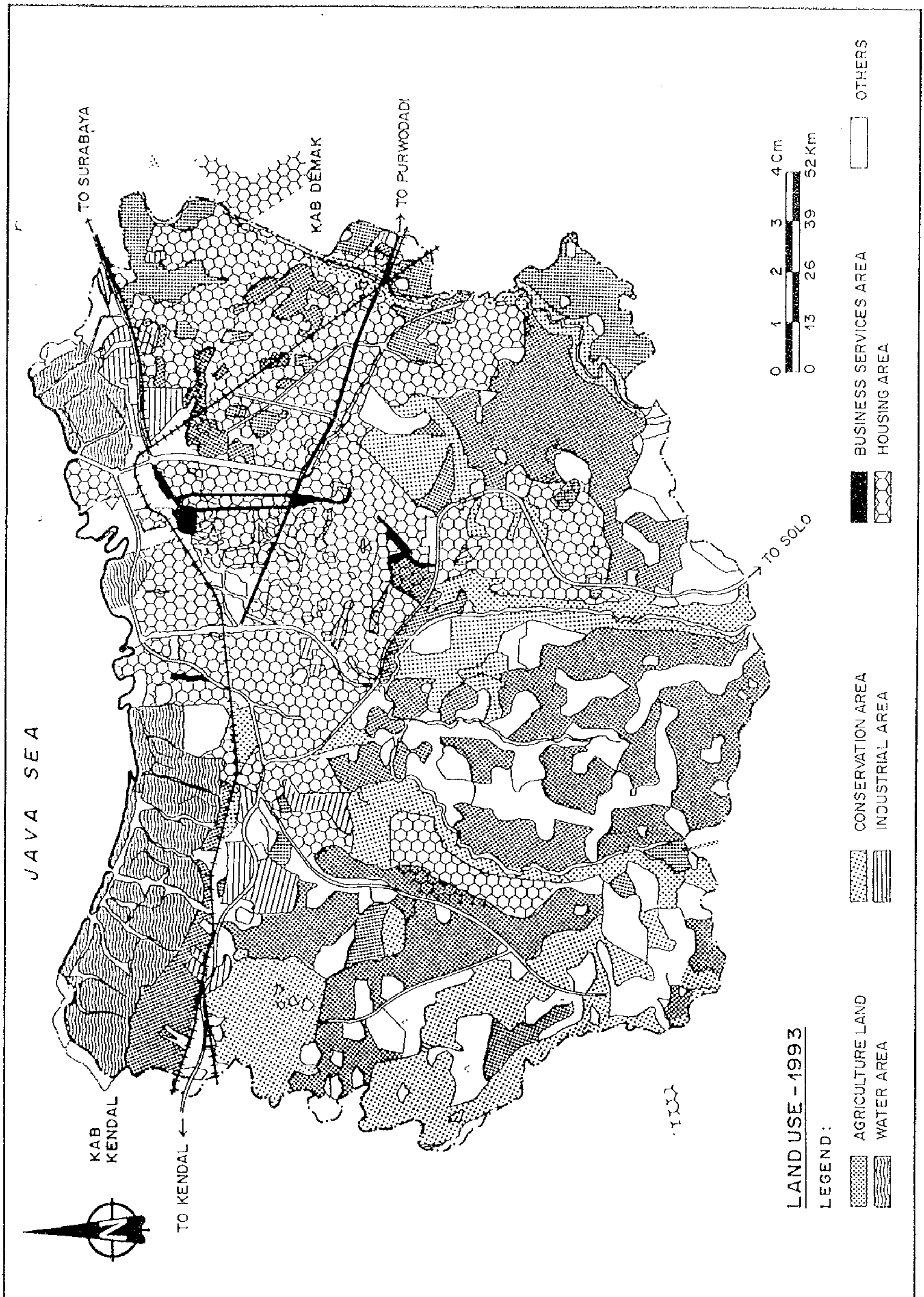
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

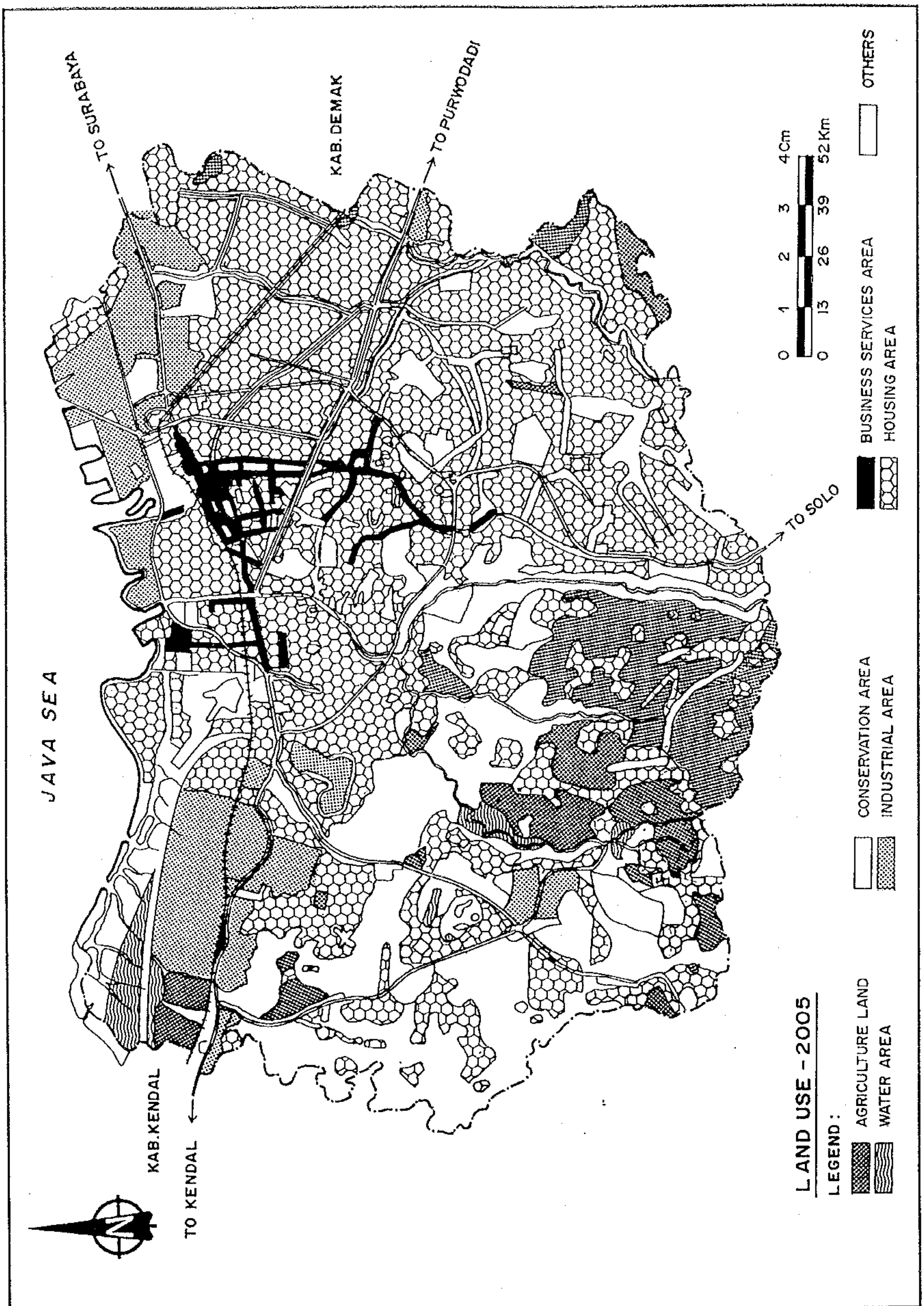
Fig. 2.1.7
LAND USE MAP OF GARANG RIVER BASIN
(1992-1995)



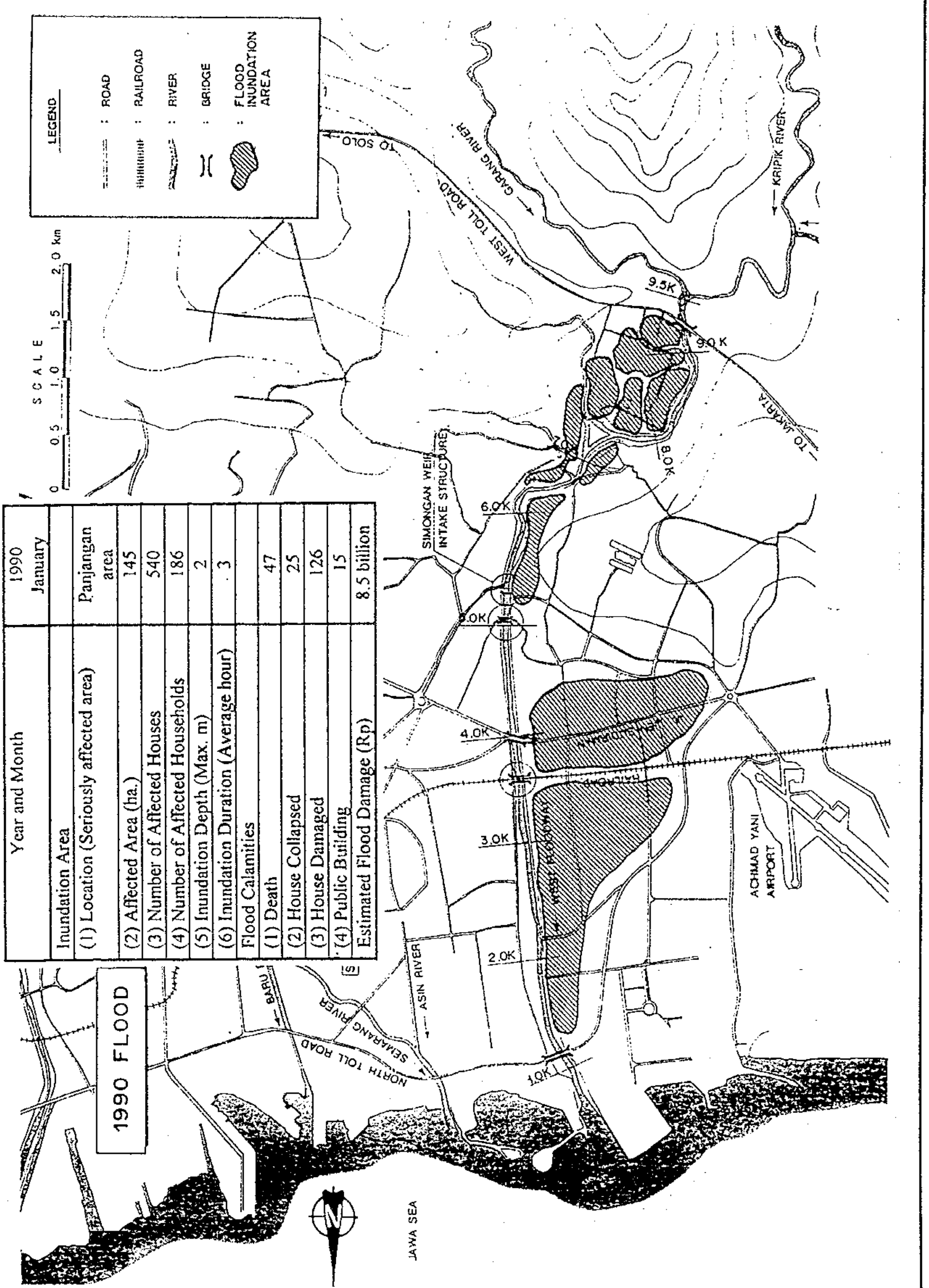
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 2.1.8 (1/2) LAND USE MAP OF SEMARANG CITY
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 2.1.8 (1/2) LAND USE MAP OF SEMARANG CITY



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 2.1.8 (2/2) LAND USE MAP OF SEMARANG CITY
JAPAN INTERNATIONAL COOPERATION AGENCY	



Year and Month	1990 January
Inundation Area	
(1) Location (Seriously affected area)	Panjangan area
(2) Affected Area (ha.)	145
(3) Number of Affected Houses	540
(4) Number of Affected Households	186
(5) Inundation Depth (Max. m)	2
(6) Inundation Duration (Average hour)	3
Flood Calamities	
(1) Death	47
(2) House Collapsed	25
(3) House Damaged	126
(4) Public Building	15
Estimated Flood Damage (Rp)	8.5 billion

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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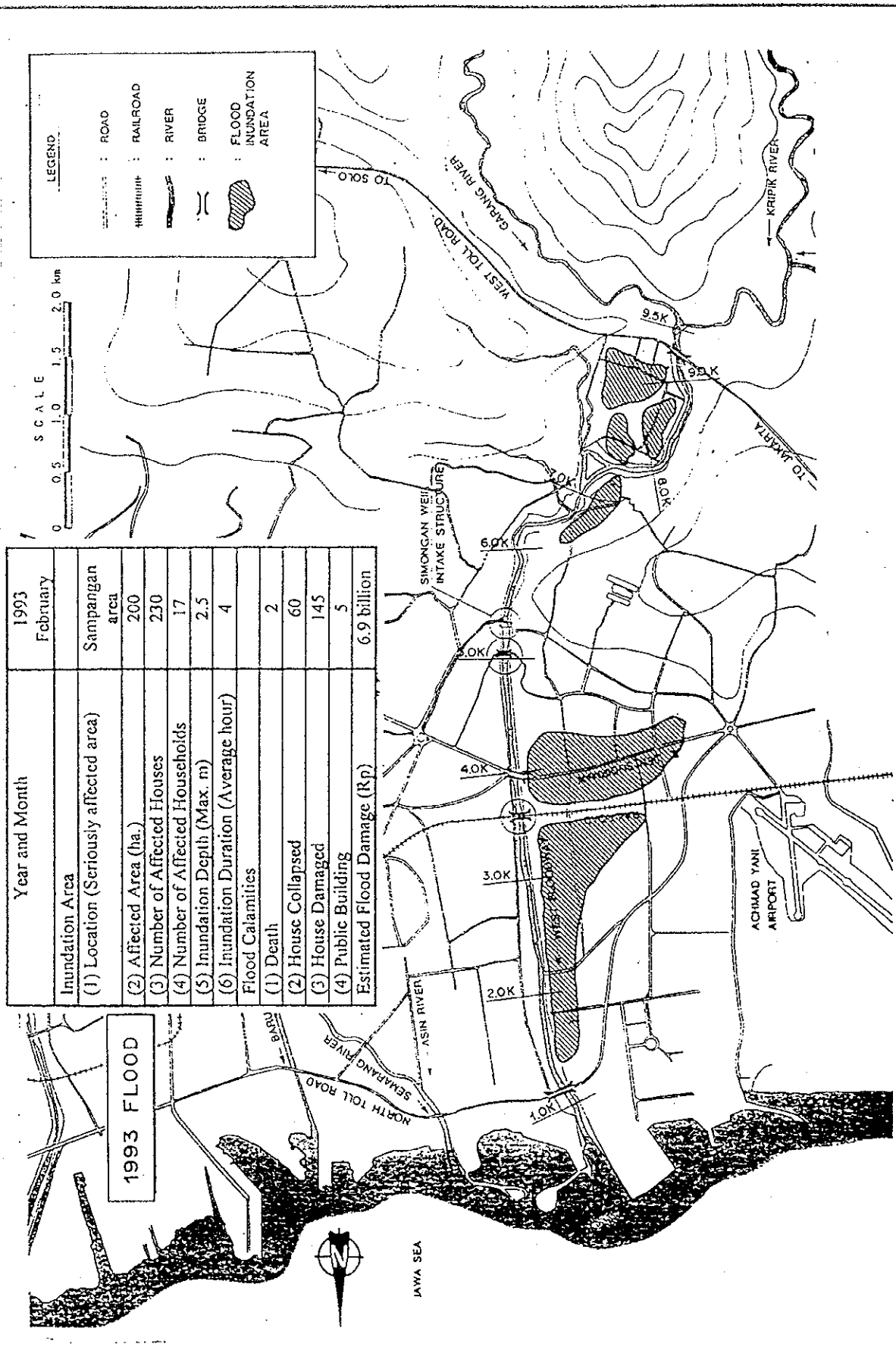
Fig. 2.2.1 (1/2)
FLOOD INUNDATION MAP



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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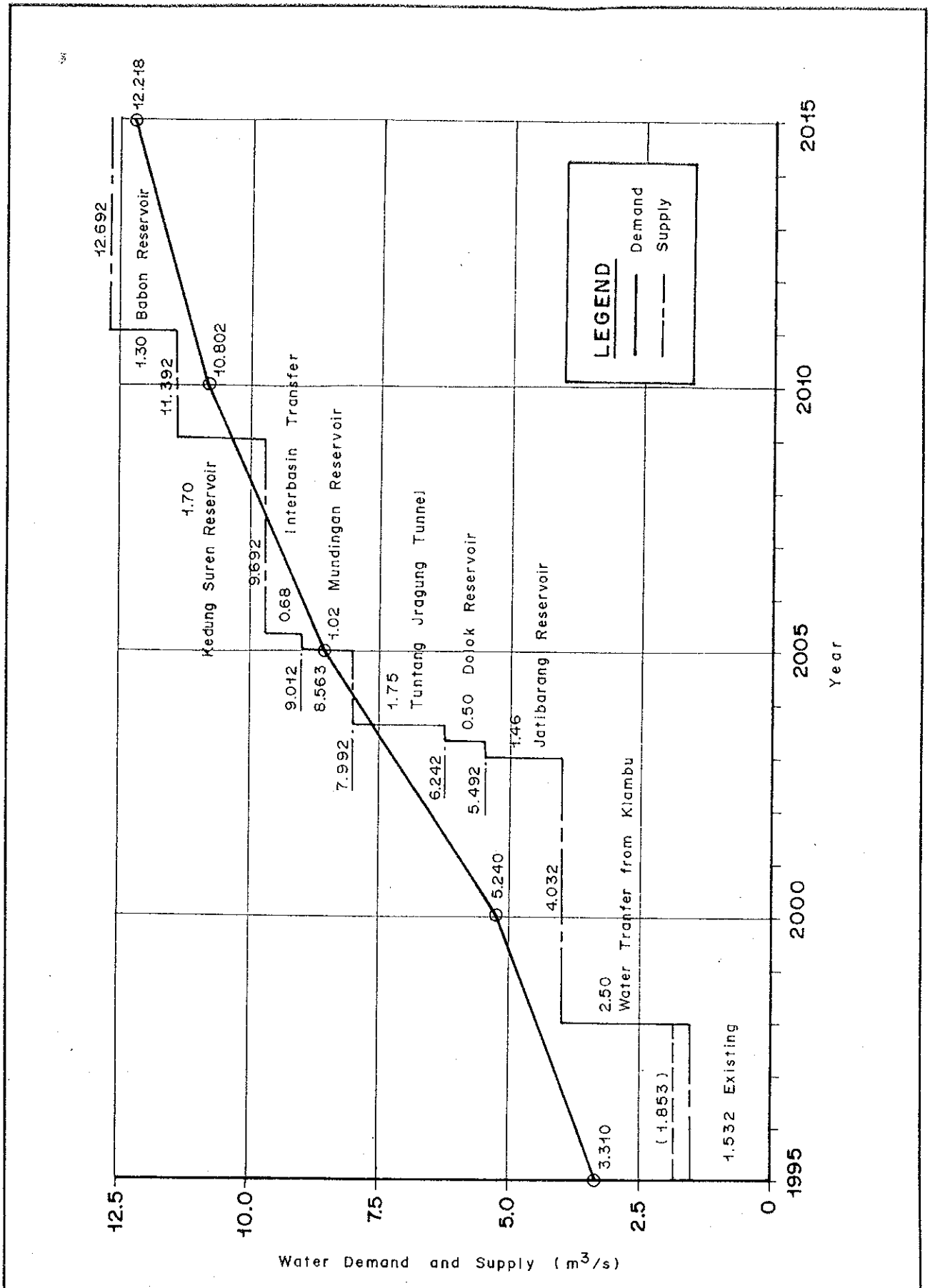
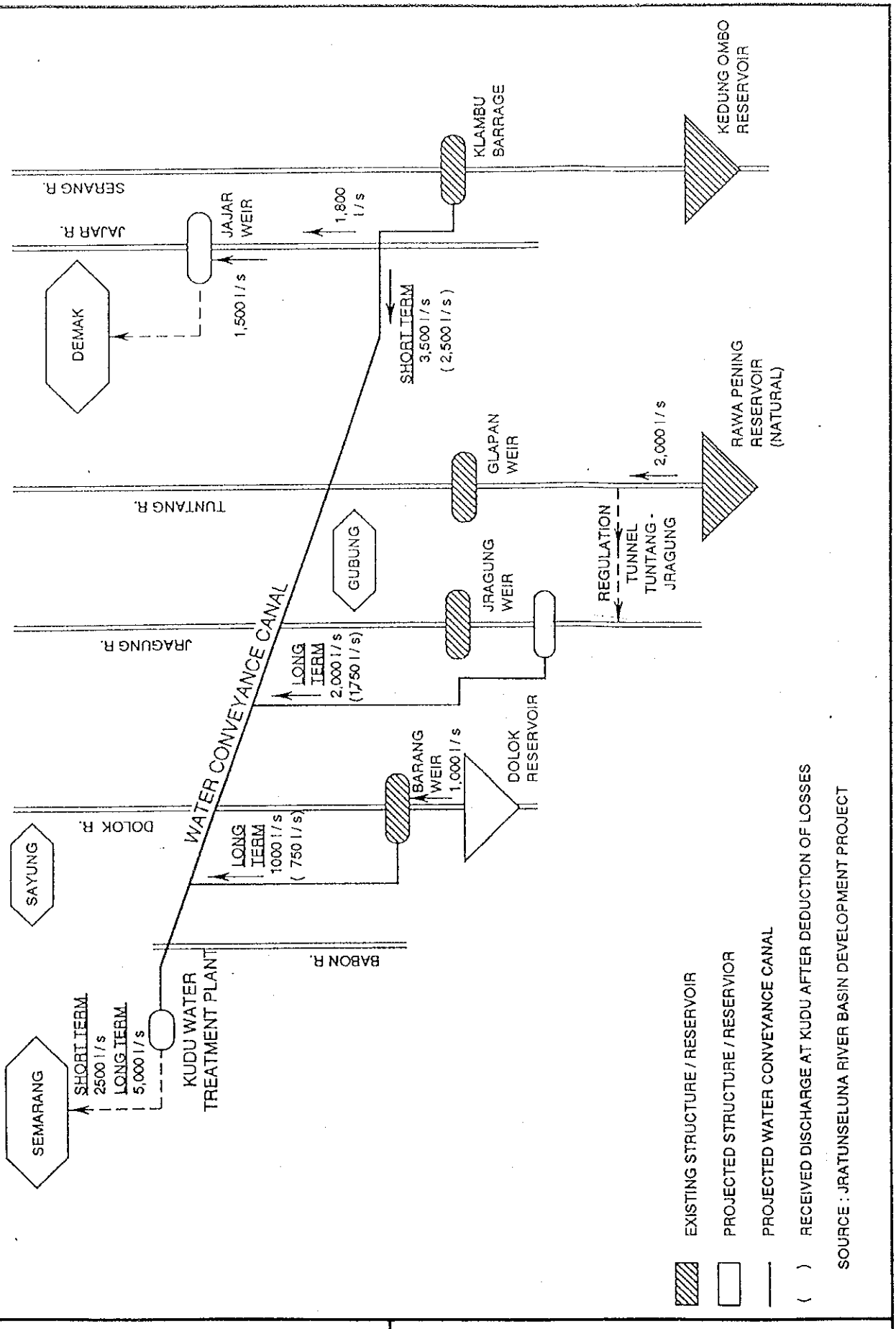
Fig. 2.2.1 (2/2)
FLOOD INUNDATION MAP



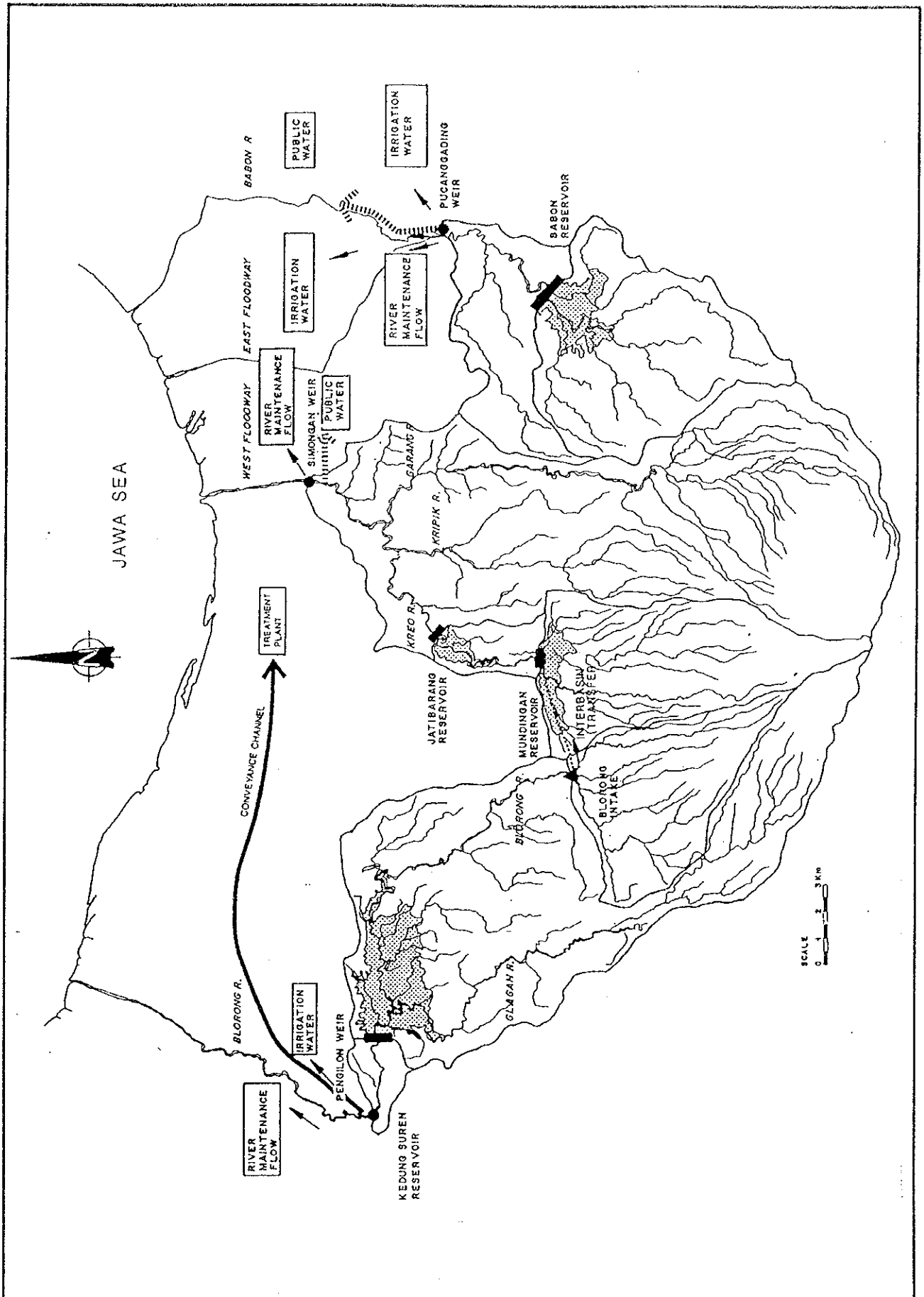
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 2.3.1 PUBLIC WATER SUPPLY PROGRAM FOR SEMARANG CITY
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 2.3.2
SCHEMATIC DIAGRAM OF WATER SUPPLY PLAN FOR DEMAK AND EASTERN SEMARANG AREAS



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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Fig. 2.3.3

LOCATION OF PROPOSED RESERVOIR BY JICA MASTER PLAN

CHAPTER 3

MAPPING AND SURVEY

CHAPTER 3 MAPPING AND SURVEY

3.1 Aerial Photography and Mapping

(1) Aerial Photography

Aerial photography at a scale of 1:8,000 and covering approximately 64 line kilometer in total was started after obtaining permission from the Central Survey and Mapping ABRI (PUSSURTA ABRI).

The results of the aerial photography are as follows:

Total No. of Films	1 Roll
Total Flight Runs	12 Runs
Total Exposures	156 Photos
Overlap and Side Lap	55% and 35%

The aerial photographs were taken by using Semarang Airport as a base, and processing of film and printing of aerial photos were done in Jakarta. The aerial photos were developed for mapping after checking navigation routes. The extent of the aerial photograph and navigation routes are shown in Fig. 3.1.1.

(2) Uncontrolled Mosaic

Using aerial photographs that are newly taken at a scale 1:8,000 in 1997, uncontrolled mosaic photo at a scale of 1:10,000 was established for the area of 35 km^2 in total. The uncontrolled mosaic area is shown in Fig. 3.1.2.

(3) Photo Control Point Survey

Photo control point survey was conducted by Global Positioning System (GPS), and spirit leveling started from the photo control points and bench marks (BMs) for the above-mentioned photogrammetry and the existing national control points and Tanda Tinggi Geodesi (TTGs). (refer to Fig. 3.1.1)

(a) Control Point Survey

The control point survey by GPS was executed to determine the X and Y coordinates of a minimum two (2) existing control points to be used for the photogrammetric mapping, cross section survey, longitudinal profile and

topographic survey. Final results of all photo control points by GPS are shown in Table 3.1.1.

(b) Datum Coordinates

The Indonesian Government changed the surveying datum in 1997 from the Indonesian Datum 1974 (ID74) ellipsoid to the World Geodetic System in 1984 (WGS 84).

Two (2) existing GPS stations having the new Indonesian Datum, namely N1.0259 and N.0004, which were established by Badan Koodinasi Survey Dan Pemetaan National (Bakosurtanal) in 1994, were chosen and applied as the X and Y geographical coordinates datum for this study by the JICA Study Team.

(c) GPS Observation

At least four (4) satellites were simultaneously observed for one hour for all the control points. In general, the base line lengths were planned between two (2) to five (5) km.

(d) Post-processing

The post-processing was done using GPS survey software to obtain the best independent baseline solutions for all the GPS sessions. With the existing two stations (N1.0259, N.0004) fixed as the planimetric control on the modified WGS ellipsoid and the same stations serving as the vertical control for mean sea level height, the whole GPS network was constrained and adjusted by the GPS surveying software.

(e) Accuracy of GPS Survey

Accuracy of trigonometric closures for coordinates and height were checked to be less than 10 PPM (10/1,000,000) between the control points (refer to Figs. 3.1.3 and 3.1.4).

(4) Leveling

Minor order leveling was executed to obtain the heights of control points necessary for the topographic survey, cross section survey and longitudinal profile survey.

Leveling survey was conducted by means of closed loops and double runs, and

temporary bench marks were established at every 2 km interval on the leveling routes. In addition, temporary bench marks were established at 49 points in Semarang City. And a total distance of the leveling survey was approximately 105 km.

The leveling works are described below:

(a) Datum Height

Government bench marks obtained from the Mean Sea Level of Indonesia as established by Bakosurtanal are applied for the leveling survey.

(b) Checking of Government Bench Marks

Before starting leveling survey, heights of three government bench marks namely TTG 446, TTG 449 and TTG 449 were checked by the local contractor.

Leveling Loops	Distance	Misclosure
TTG 449 to TTG 447	4.601 km	14 mm
TTG 447 to TTG 446	5.095 km	-201 mm

From the above, it was judged by the JICA Study Team that TTG 446 shall be ignored because TTG 446 had ground subsidence about 20 cm from 1983.

The JICA Study Team decided to use TTG 447 as the bench mark for topographic survey, river cross section survey and longitudinal profile survey in this project.

(c) Accuracy of Leveling

As show in Figs. 3.1.5 and 3.1.6, any misclosure of leveling does not exceed $20\sqrt{S}$ between bench marks and/or control points (S: a single distance between bench marks in kilometer). Standard division was 3.80 mm/km.

(5) Field Verification

Using two (2) times enlarged aerial photographs, the keys for interpretation required for plotting and cartography was done by verifying them in the field. The work quantity was 35 km^2 for mapping with the scale of 1:2,000 and 1 km^2 for mapping with the scale of 1:1,000. The area of field verification is shown in Fig. 3.1.7.

(6) Aerial Triangulation

The implication and purpose of Aerial Triangulation work are to obtain the coordinates (X, Y, Z) of the aerial photo points necessary for the orientation process of each stereo model on the plotting instrument for the purpose of topographic map on the scale of 1:2,000 and 1:1,000 applying coordinates (X, Y, Z) of ground control points resulting from field measurement (GPS and leveling) (refer to Figs. 3.1.8 and 3.1.9).

(a) Aerial Triangulation and Block Adjustment

The sequence of works to be carried out is as follows:

(i) Quantity

119 models of aerial triangulation work was carried out, and the quantity of models for each flight run was as follows:

Run Number	Number of Photo	Number of Model
Run 1 (Semarang Area)	10 PCs	9 Models
Run 2 (Semarang Area)	14 PCs	13 Models
Run 3 (Semarang Area)	13 PCs	12 Models
Run 4 (Semarang Area)	13 PCs	12 Models
Run 5 (Semarang Area)	13 PCs	12 Models
Run 6 (Semarang Area)	11 PCs	10 Models
Run 7 (Semarang Area)	18 PCs	17 Models
Run 8 (Semarang Area)	19 PCs	16 Models
Run 9 (Semarang Area)	17 PCs	6 Models
Run 11 (Semarang Area)	9 PCs	6 Models
Run 12 (Semarang Area)	9 PCs	6 Models
Total	146 PCs	119 Models

(ii) Data Collection

All necessary data such as flight index, control point coordinate and calibration of the aerial photographic camera were collected.

(iii) Planning

Preparation of aerial triangulation was carried out as follows:

Selection of the Aerial Photos

Total sheets of aerial photos for Ungaran Area : 12 models

Total sheets of the aerial photos for Semarang Area : 107 models.

Control Point Selection

Total control points were 22, consisting of 5 horizontal and 17 vertical control points for aerial triangulation processing at Ungaran area.

Total control points of 74, consisting of 21 horizontal and 53 vertical control points for aerial triangulation processing at Semarang area.

(iv) Preparation

The preparation stages were carried out as follows:

Point selection and numbering

Pass points and tie points were selected within the triple overlap area with the circle notation on the index model.

Numbering system for aerial triangulation

Ex. Model number : 8011*1*

Where:

8011 : first two digits show the number of flight run as shown and last two digits show the number of aero photographs.

1 : tie point number

The horizontal and vertical control points were annotated on the index models as a square, and vertical control points were annotated as triangle. The point selection and numbering were carried out on the 1:2,000 and 1: 1,000 scale of aerial photographs by using mirror stereoscope.

(v) Point Transfer

The selected and control points on the diapositive film were marked and then transferred to adjacent diapositive film by using Wild PUG-4 instrument. This process was carried out until the last photo.

(vi) Index Model

The index model on 1:50,000 scale, where all point numbers were plotted showing the relationship between each point, was produced.

(vii) Measurement of Coordinates

Photo coordinates were observed and measured by using an analytical stereoplotter Leica SD-2000. All points including fiducial marks were measured.

(viii) Adjustment

The final step of the aerial triangulation is the block adjustment using PATM-GPS software.

(ix) Result

Block adjustment of Ungaran Area

Sigma Naught in the model system is as below.

Sigma naught for horizontal block = 21.064 micron
Sigma naught for vertical block = 14.773 micron

Weight root mean square values and check value of residual of Photogrammetric observations.

Model Points	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.090	11.216	47.586
OBS z	0.063	7.888	23.664
Projection center	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.120	14.975	65.532
OBS z	0.094	11.750	73.658

Block adjustment of Semarang Area

Sigma Naught in the model system, is as below.

Sigma naught for horizontal block = 18.890 micron
Sigma naught for vertical block = 20.353 micron

Weight root mean square values and check value of residual of Photogrammetric observations.

Model Points	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.094	12.118	51.411
OBS z	0.080	10.273	30.820

Projection center	RMS. (meter) Terrain system	RMS. (micron) Model system	CHV VXY/Z Model system
OBS X/Y	0.254	32.718	138.809
OBS z	0.130	13.292	39.875

(x) Equipment

The equipment used in Aerial Triangulation is as follows:

Stereoscope	2 units
Point transfer Wild PUG-4	1unit
Analytical Stereoplotter Leica SD-2000	1 unit
Computer	1 unit
PATM-GPS Software	1 unit

(7) Plotting and Editing

The implication and purpose of stereo plotting and editing work are drawing details and contour lines using aerial photo diapositives, which are placed on the plate holders of the stereo plotter instrument (refer to Figs. 3.1.10 to 3.1.13).

The sequences of the plotting and editing works are as follows:

(a) Data collection

All the following necessary data were collected and prepared for stereo plotting.

- Model index of aerial triangulation
- Print out of aerial triangulation adjustment
- Vertical control points and description on two (2) times enlarged aerial photographs
- Field identification on two(2) times enlarged aerial photographs

(b) Planning

Preparation of stereo plotting was carried out as follows:

(i) Control sheets

Total control sheets of the stereo plotting topographic map are:

- 48 sheets for 1:2,000 scale of Semarang topographic map (including 4 sheets of sounding survey result);
- 4 sheets for 1:2,000 scale of Ungaran topographic map; and
- 26 sheets for 1:1,000 scale of channel topographic map

(ii) Models

Total models of stereo plotting are:

- 52 models for 1:2,000 scale of Semarang topographic map
- 4 models for 1:2,000 scale of Ungaran topographic map
- 12 models for 1:1,000 scale of channel topographic map

(c) Preparation of Control Sheets

Control sheets were produced by block adjustment result of aerial triangulation on polyester base material.

(d) Plotting

Plotting manuscript at the scale of 1:2,000 and 1:1,000 were produced from aerial photos at the scale of 1:8,000 by using second order precision plotter.

The sequences of the stereo plotting works are as follows:

- Inner Orientation;
- Relative Orientation;
- Absolute Orientation; and
- Plotting of details, spot height, vegetation boundary and contour lines.

Contour intervals for intermediate contour line are 1 m both maps with the scale of 1:2,000, and 1:1,000.

Editing works was carried out on the plotting manuscript by compiling result of field identification, such as symbol annotation etc.

(e) Result

The final manuscript was used for the fair drawing work and the number of sheets plotting manuscript are as below.

- 48 sheets plotting manuscript at scale of 1:2,000 for Semarang area (including 4 sheets of sounding survey result)
- 4 sheets plotting manuscript at scale of 1:2,000 for Ugarang area
- 26 sheets plotting manuscript at scale of 1:1,000 for channel area

(f) Equipment

The equipment used for plotting and editing are:

Computer	2 units
Roland Plotter	1 unit
Stereo Plotter, Wild A-8	2 units
Plotter Wild AG-1	1 unit
Stereo Plotter, Leica SD-2000	1 unit
Drafting Table	3 units

(8) Fair Drawing

The implication and purpose of fair drawing work are drawing details using symbols and contour lines with tracing method from the plotting manuscript and other additional data and information.

The sequence of the fair drawing were carried out as follows:

(a) Data Collection

All necessary data were collected and prepared for fair drawing such as:

- Plotting manuscript
- Vertical control points and description on two (2) times enlarged aerial photographs
- Field identification results on two (2) times enlarged aerial photographs

(b) Planning

Preparation for fair drawing were carried out as follows:

(i) Drawing sheets

Total sheets of fair drawing are 78 sheets, consisting of 48 sheets of

Semarang map (including 4 sheets of sounding survey result) and 4 sheets of Ungaran map at the scale of 1:2,000; 26 sheets of map at scale of 1:1,000.

(ii) Legend and Symbol

Legend and symbols used for the map are shown in Table 3.1.2.

(c) Preparation

The preparations were carried out as follows:

(i) Drawing sheets

Drawing sheets were made using computer PC on polyester base. The sheet's size is A1 (60 cm ~ 85 cm). Numbering system is as follows:

Sheet number 45-*12*

Where:

45 = Total sheets

12 = Sheet number

(d) Fair drawing

Fair drawing was carried out with tracing method using drafting pen and black ink from plotting manuscript at scale of 1:2,000 and 1:1,000.

Fair drawing works are as follows:

- Drawing details
- Spot heights and contour lines
- Symbols and annotations, on the map symbols must be matched to legend
- Vegetation boundary

Contour interval for intermediate contour lies are 1 m for map at scale of 1:2,000 and 1 m for map at scale of 1:1,000.

(e) Results

The results of the fair drawing are:

- 48 sheets of topographic map at scale of 1:2,000 for Semarang area,
- 4 sheets of topographic map at scale of 1:2,000 for Ugarang area,
- 26 sheets of topographic map at scale of 1:1,000 for Channel area,
- 48 sheets duplicate at scale of 1:2,000 for Semarang area,
- 4 sheets duplicate at scale of 1:2,000 for Ugarang area, and
- 26 sheets duplicate at scale of 1:1,000 for channel area.

The equipment used for the fair drawing works are:

- Computer : 2 units
- Roland plotter : 1 unit
- Drafting table : 9 units
- Drafting tools : 9 units

3.2 Ground Survey

(1) River Longitudinal Profile and Cross-Section Survey

(a) Installation of Kilometer Post

Prior to the commencement of the river longitudinal profile survey, kilometer posts of wooden pegs were installed on the right and left banks of West Floodway/Garang river. When the location of a kilometer post is very close to such structures as bridges, water intake and water pipes, kilometer posts were shifted to the center line of these structures. The position of a kilometer post was decided by traverse method in the field.

(b) Longitudinal Profile Survey

The river longitudinal profile survey (the profile survey) by direct leveling was executed to obtain heights of kilometer posts for the river cross section survey and to prepare longitudinal profile sections. Leveling routes were formed by closed loops and double-runs. A total distance of the leveling survey covering West Floodway, Garang, Semarang, Asin and Baru rivers was 41 km.

The datum height was applied for the longitudinal profile survey including

river cross section survey and auxiliary leveling. The heights of TTGs bench marks are applied to the kilometer posts by direct leveling.

All results of heights of kilometer posts by the profile survey, the deepest height of the river cross section survey, names of bridge and others were edited by Auto CAD system.. The longitudinal profile sections at a horizontal scale of 1:2,000, 1:1,000 and vertical scale of 1:100 were prepared on the draft plotting paper sheets using the longitudinal profile data.

(c) River Cross Section Survey

Heights and distance of slope changing points, roads, channels, etc. along the cross section lines were measured by using a Total Station System, levels and Electric Distance Meter (EDM).

Water levels and depths of the rivers were measured using a survey rod, and the distance of these measured simultaneously. The bridges, irrigation intakes and water pipes of all rivers were also measured. A total number of cross sections surveyed are approximately 814.

(d) Checking of Longitudinal Profile

(i) The check results of differences in height closure between the kilometer posts did not exceed $20\sqrt{S}$ (S: length of single run in kilometer) as specified in the Technical Specifications.

(ii) Checking of River Cross Sections

At the same kilometer posts checked above, river cross section lines were measured. The check results of height of these cross section line points did not exceed ±50 mm and distance errors between the cross section line points are less than 1/300 as specified in the Technical Specifications. Longitudinal profile and cross-section were surveyed along West Floodway/Garang River, Jatibarang damsite and its reservoir area, and two (2) tributary channels along Garang River.

West Floodway and Garang River

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	9.598 km	5	H=1/2,000 V=1/100	Sheet Size: A1
Cross-Section Survey	204 sections	104	H=1/200 V=1/100	Sheet Size: A1

Jatibarang Damsite and Reservoir Area

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	6.049 km	3	H=1/2,000 V=1/100	Sheet Size: A1
Cross-Section Survey	42 sections	42	H=1/200 V=1/100	Sheet Size: A1

Cengkek River (tributary of Garang River)

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	0.499 km	1	H=1/1,000 V=1/100	Sheet Size: A1
Cross-Section Survey	15 sections	8	H=1/200 V=1/100	Sheet Size: A1

Kalito River (tributary of Garang River)

Work Item	Volume	Drawing		Remarks
		No. of Sheets	Scale	
Longitudinal Profile	0.498 km	1	H=1/1,000 V=1/100	Sheet Size: A1
Cross-Section Survey	12 sections	6	H=1/200 V=1/100	Sheet Size: A1

3.3 Topographic Survey

Topographic survey was carried out for Jatibarang damsite, Simongan Weir, Asin Pumping Station, West and East Bandarharjo Pumping Station, West and East Bandarharjo Drainage area, a bridge across Semarang River and a water gate at Baru River.

The work quantities carried out are as follows:

(a) Scale 1:200

Simongan Weir	9.0 ha
Asin Pumping Station	9.0 ha
West Bandarharjo Pumping Station	6.0 ha
East Bandarharjo Pumping Station	3.0 ha
Bridge (Semarang River)	0.5 ha
Water gate (Baru River)	1.0 ha

(b) Scale 1:500

Jatibarang Damsite	15.0 ha
West Bandarharjo Drainage Area	2.8 ha
East Bandarharjo Drainage Area	3.2 ha

(c) Scale 1:1,000

Jatibarang Damsite	15.0 ha

3.4 Sounding Survey

(1) Location and Quantity

The location of the area for the sounding survey is shown in Fig. 3.4.1. The work quantities are 3 km^2, consisting of 16 survey lines and 1 km per line.

(2) Setting of Base Survey Line

Base survey line was established along the coastline for 3 km eastward from the mouth of West Floodway by GPS, traversing and spirit leveling. All control monuments were set at 200 m interval along the base survey line.

Misclosure of leveling does not exceed $20\sqrt{S}$ between bench mark and control points (S: a single distance in kilometer between control points).

(3) Measuring Interval of Survey Line

From the control point, water depth of each line 1 km offshore were measured at 30 m interval. Water surface was also measured.

(4) Equipment

Echo sounder and survey rod for water depth measurement, GPS and Total Station

Surveying System for positioning were used.

(5) Chart Drawing

Charts were interpolated in the 1:2,000 scale topographic map.

TABLES

CHAPTER 3

MAPPING AND SURVEY

LIST OF TABLES

Chapter 3

Table 3.1.1 RESULT OF CONTROL POINTS

DATUM : WGS84
PROJECTION : U.T.M
ZONE : 49
SEMI-MAJOR AXIS : 6,378,137.0000
MENI-MINOR AXIS : 6,356,752.4143
FLATTERING : 298.2572236
SCALE FACTOR : 0.9996000
LATITUDE OF ORIGIN : 000° 0′ 0″ 0000
LONGITUDE OF ORIGIN : 111° 0′ 0″ 0000E

STATION	NORTHING	EASTING	LATITUDE	LONGITUDE	ELEVATION	REMARKS
N.004	7° 04′ 7.0809″ S	110° 28′ 55.8562″ E	9,218,632.118	442,814.138		
N1.0259 (JP-7)	6° 59′ 1.5641″ S	110° 24′ 34.2824″ E	9,228,004.682	434,777.817	4.362	
JP – 1	6° 56′ 51.3269″ S	110° 25′ 6.6671″ E	9,232,005.355	435,766.570	0.922	
JP – 2	6° 56′ 28.9296″ S	110° 26′ 41.9642″ E	9,232,696.655	438,690.025	1.015	
JP – 3	6° 56′ 47.2163″ S	110° 23′ 32.0770″ E	9,232,127.943	432,863.829	0.926	
JP – 4	6° 57′ 46.8455″ S	110° 25′ 59.3975″ E	9,230,302.408	437,386.684	0.744	
JP – 5	6° 58′ 38.3085″ S	110° 26′ 54.6029″ E	9,228,724.049	439,082.490	2.999	
JP – 6	6° 58′ 26.1345″ S	110° 23′ 40.1529″ E	9,229,090.579	433,115.536	0.986	
JP – 8	6° 59′ 9.3077″ S	110° 25′ 43.6724″ E	9,227,769.509	436,907.230	2.864	
JP – 9	6° 59′ 46.0844″ S	110° 23′ 22.6932″ E	9,226,634.706	432,582.979	33.702	
JP – 10	7° 00′ 19.0705″ S	110° 26′ 56.3074″ E	9,225,629.835	439,138.413	7.980	
JP – 11	7° 00′ 18.8507″ S	110° 25′ 40.3323″ E	9,225,633.799	436,807.342	14.416	
JP – 12	7° 00′ 22.1649″ S	110° 24′ 30.8753″ E	9,225,529.384	434,676.387	86.673	
JP – 13	7° 00′ 44.3283″ S	110° 22′ 14.3173″ E	9,224,843.319	430,487.408	60.949	
JP – 14	7° 01′ 23.1271″ S	110° 23′ 19.3198″ E	9,223,654.479	432,483.354	34.648	
JP – 15	7° 01′ 32.2396″ S	110° 22′ 16.3507″ E	9,223,372.085	430,551.770	80.953	
JP – 16	7° 01′ 37.6491″ S	110° 20′ 54.4400″ E	9,223,202.528	428,038.896	184.599	
JP – 17	7° 03′ 1.1278″ S	110° 21′ 33.5130″ E	9,220,640.610	429,241.206	204.198	
JP – 18	7° 03′ 1.4915″ S	110° 19′ 36.6186″ E	9,220,624.394	425,654.959	219.344	
JP – 19	7° 03′ 34.4587″ S	110° 20′ 5.4294″ E	9,219,613.256	426,540.306	218.583	
JP – 20	7° 04′ 15.2827″ S	110° 20′ 28.5683″ E	9,218,360.582	427,251.956	212.435	
BM – 13	6° 57′ 52.1123″ S	110° 24′ 38.5192″ E	9,230,137.634	434,905.154	0.349	

Table 3.1.2 (1 / 3) Map Symbols

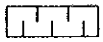
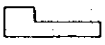
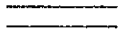
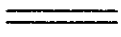
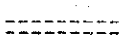
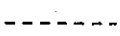
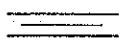
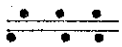
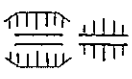
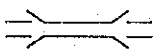
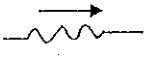
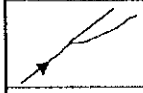
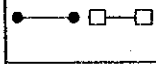
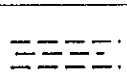
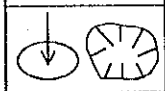
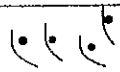
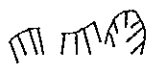
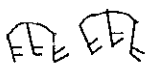
	Triangulation Point		Market
	GPS Point		Transformer house
	Bench Mark TTG		Bank
	Minor Order leveling		Gas station
	Spot elevation		Telephone office
	Minor order BM		Government office
	House/Building		Hotel
	Factory		Main road
	Public hall		Road >2m
	Public station		Road 1-2m
	Mosque		Road under construction
	Churc		Footpath
	Temple		Median strips
	Hospital		Road and strips
	Fire Station		Cutting and embankment
	Post Office		Iron and concrete bridge
	School		Wooden bridge

Table 3.1.2 (2 / 3) Map Symbols

	Foot bridge bamboo bridge		Cultivation land boundary
	Culvert		Rice field
	Railway	V	Farm/cultivated
	Railway bridge		Sugar cane
st	Station		Palm plantation
	Intersecting railway		Rubber plantation
Water/oil	Water/Oil Pipe	a	Teak plantation
Water/oil	Water/Oil Tank		Coffee plantation
G	Automatic waterlevel gauge	Co	Cacao plantation
	Electricity power		Orchard
	Wall hedge/fence		Other plantation
	Monument		Bush
	Moslem graves		Grass field
	Christian cemetery		Trees/Forest
	Chinese graves		Dead trees
	Buddha graves		Bore land
	Vegetation boundary		Bamboo copse

Table 3.1.2 (3 / 3) Map Symbols

	River(a), rivulet(b), direction(c)	+·-+·-+·-+	Kecamatan boundary
	Channel		
	Water fall		
	Small/large revetment		
	Small/large weir		
	Small/large watergate		
	Sand(a), shore line(b)		
	Saltarn		
	Fishpond/Pond, Lake		
	Swamp		
	Depression		
	Rocks		
	Precipice, Land slide		
	Cliff		
	Contour		
	Storages		
+-+-+	Kabupaten boundary		

FIGURES

CHAPTER 3

MAPPING AND SURVEY

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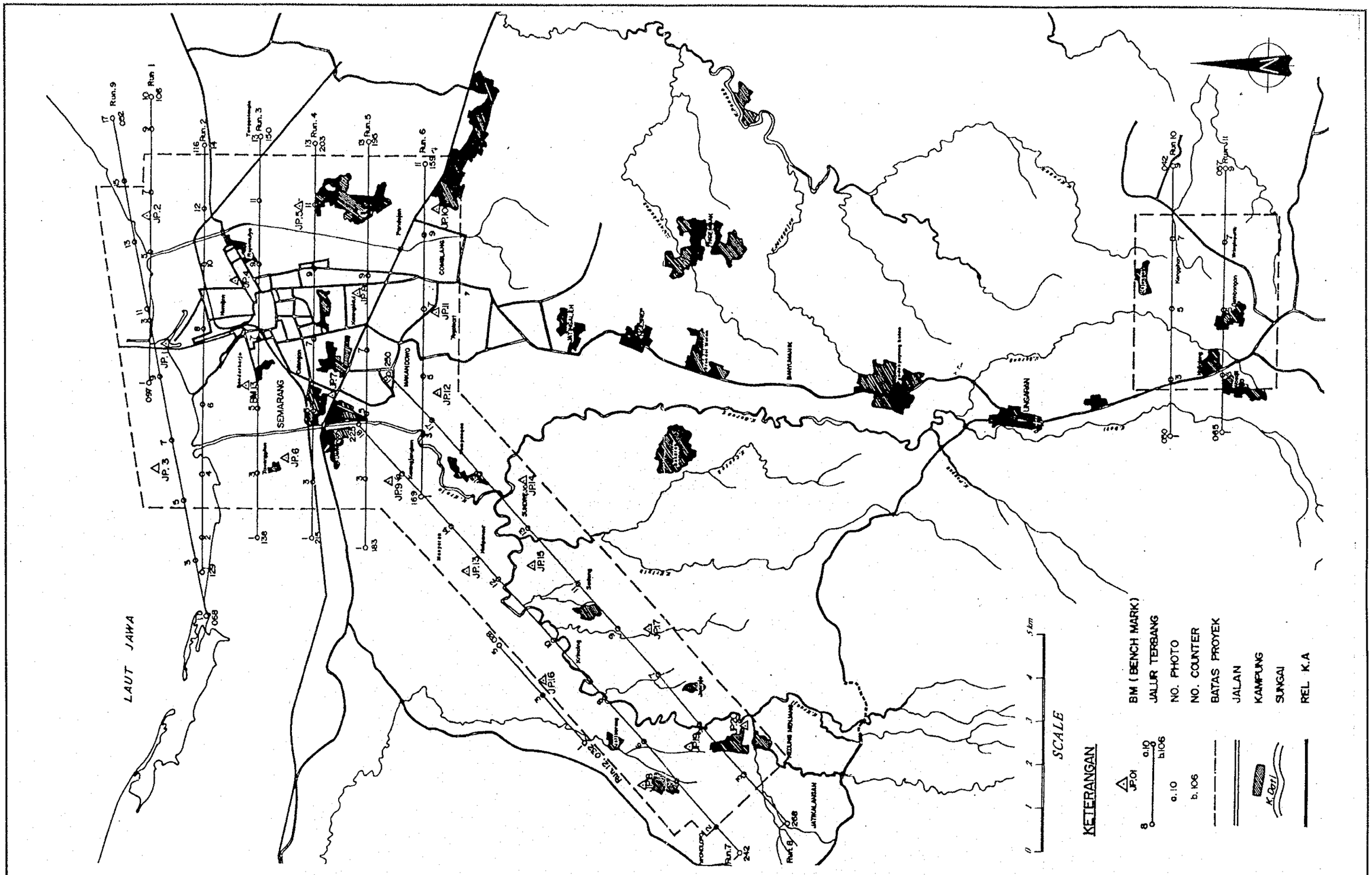


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.1 FLIGHT INDEX MAP
JAPAN INTERNATIONAL COOPERATION AGENCY	

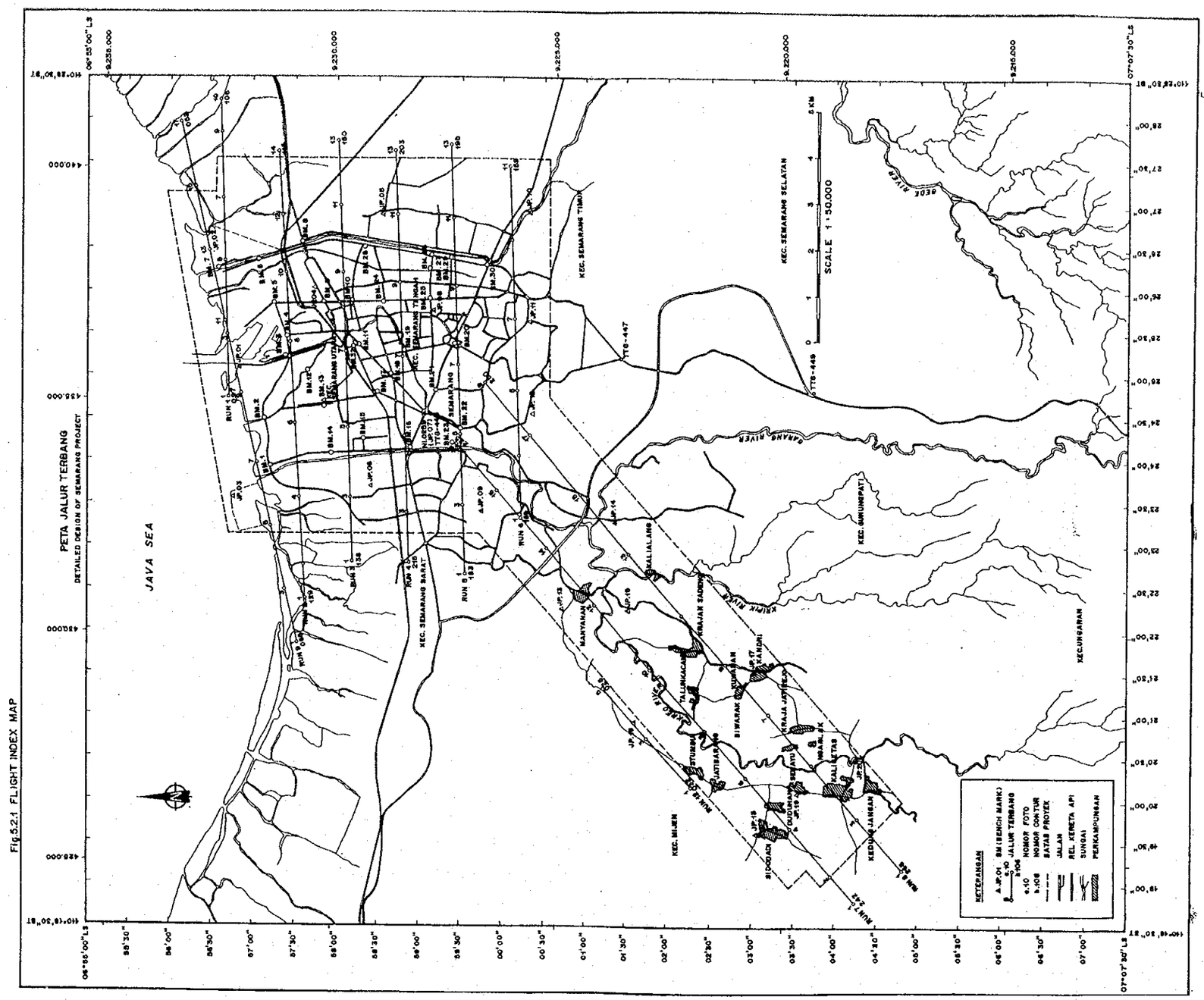
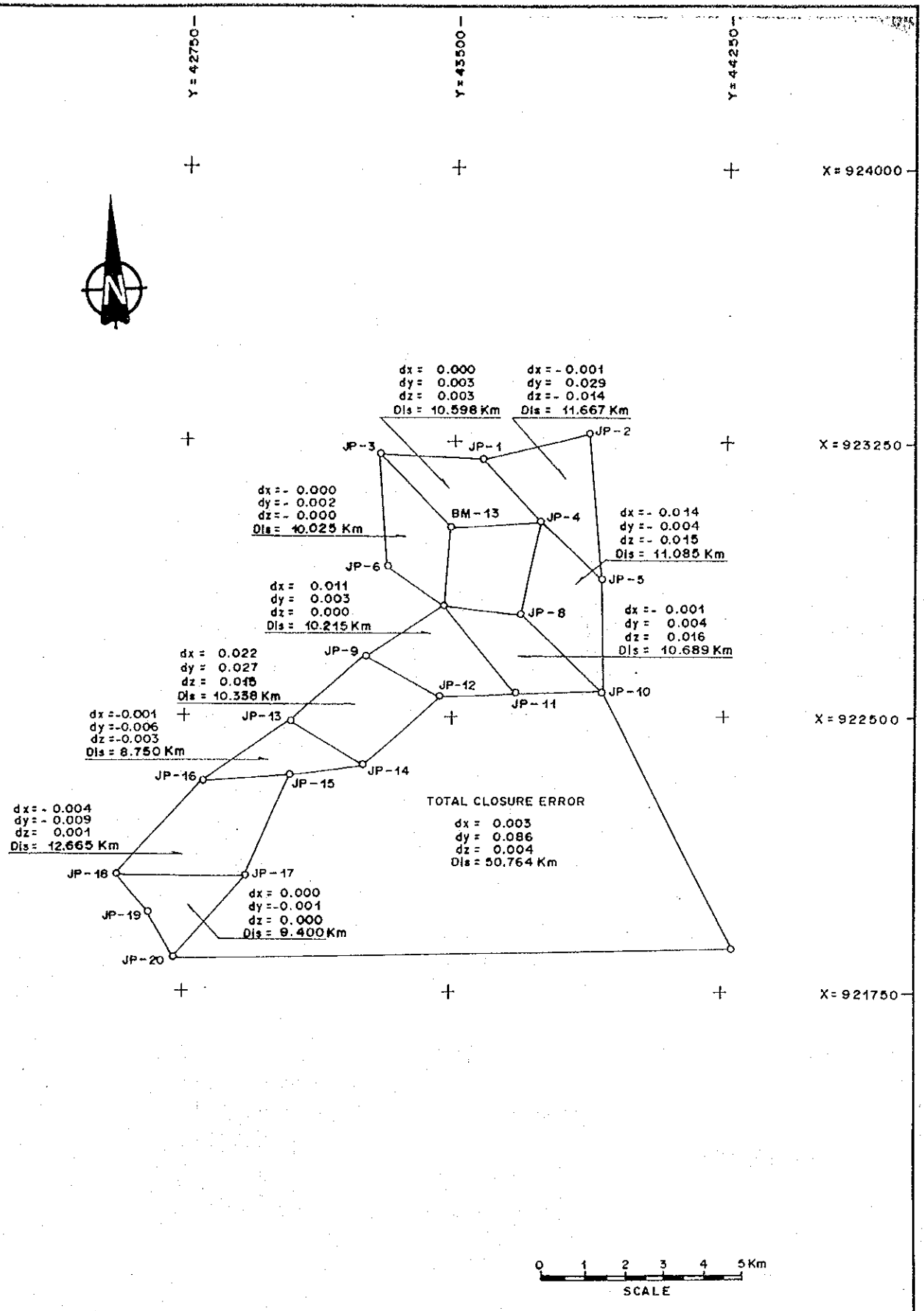
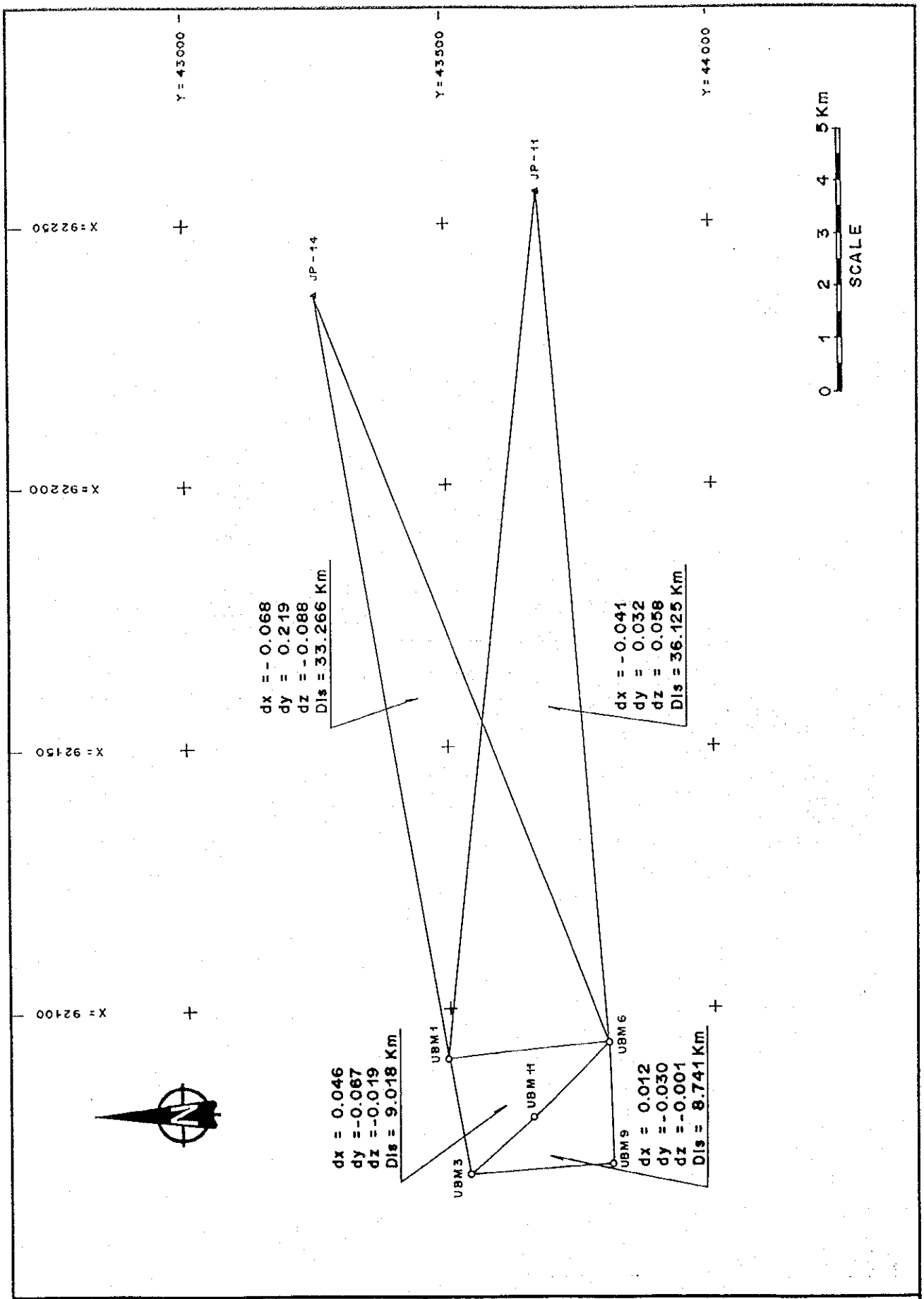


Fig.5.2.1 FLIGHT INDEX MAP

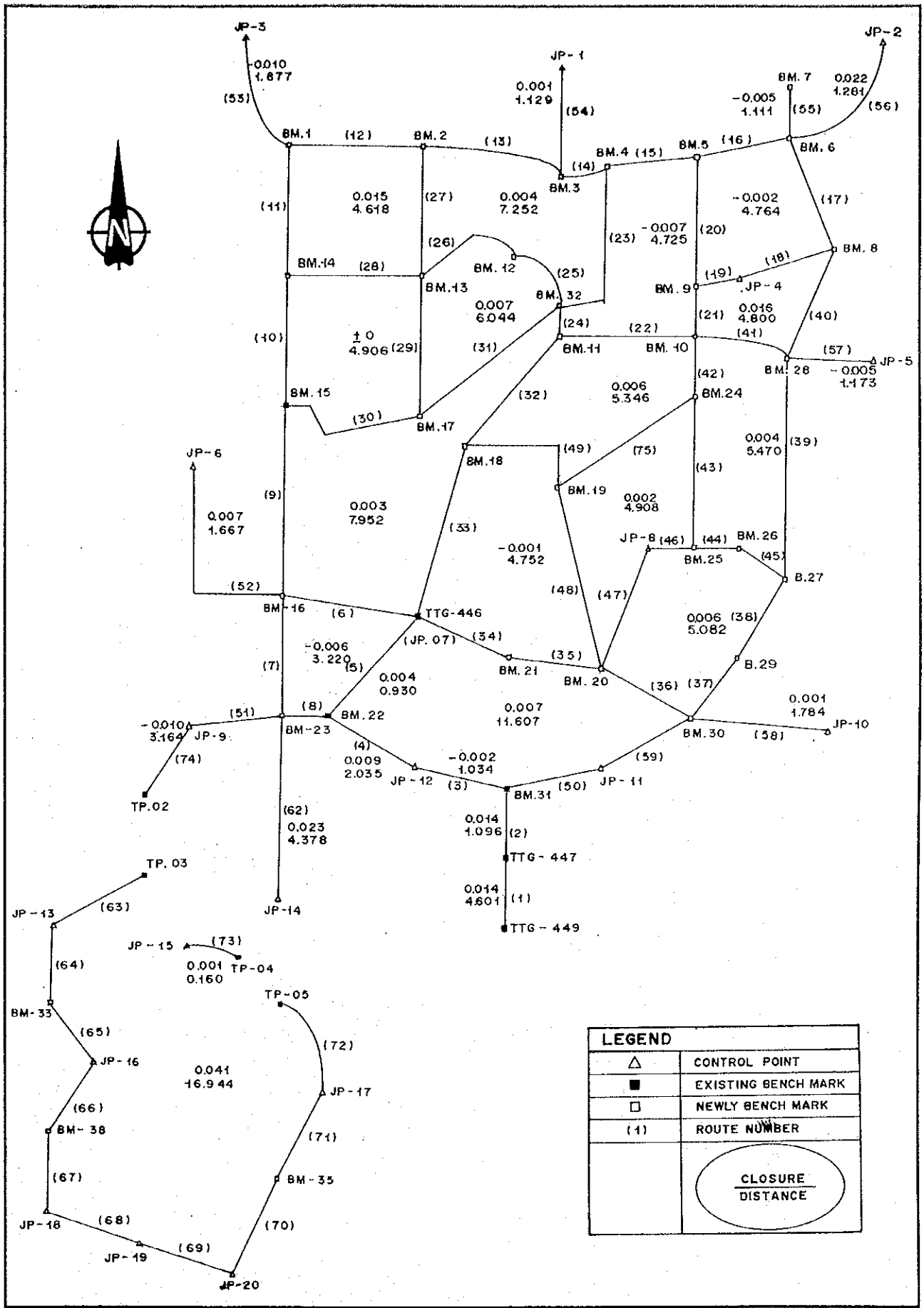
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.2 UNCONTROLLED MOSAIC AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	



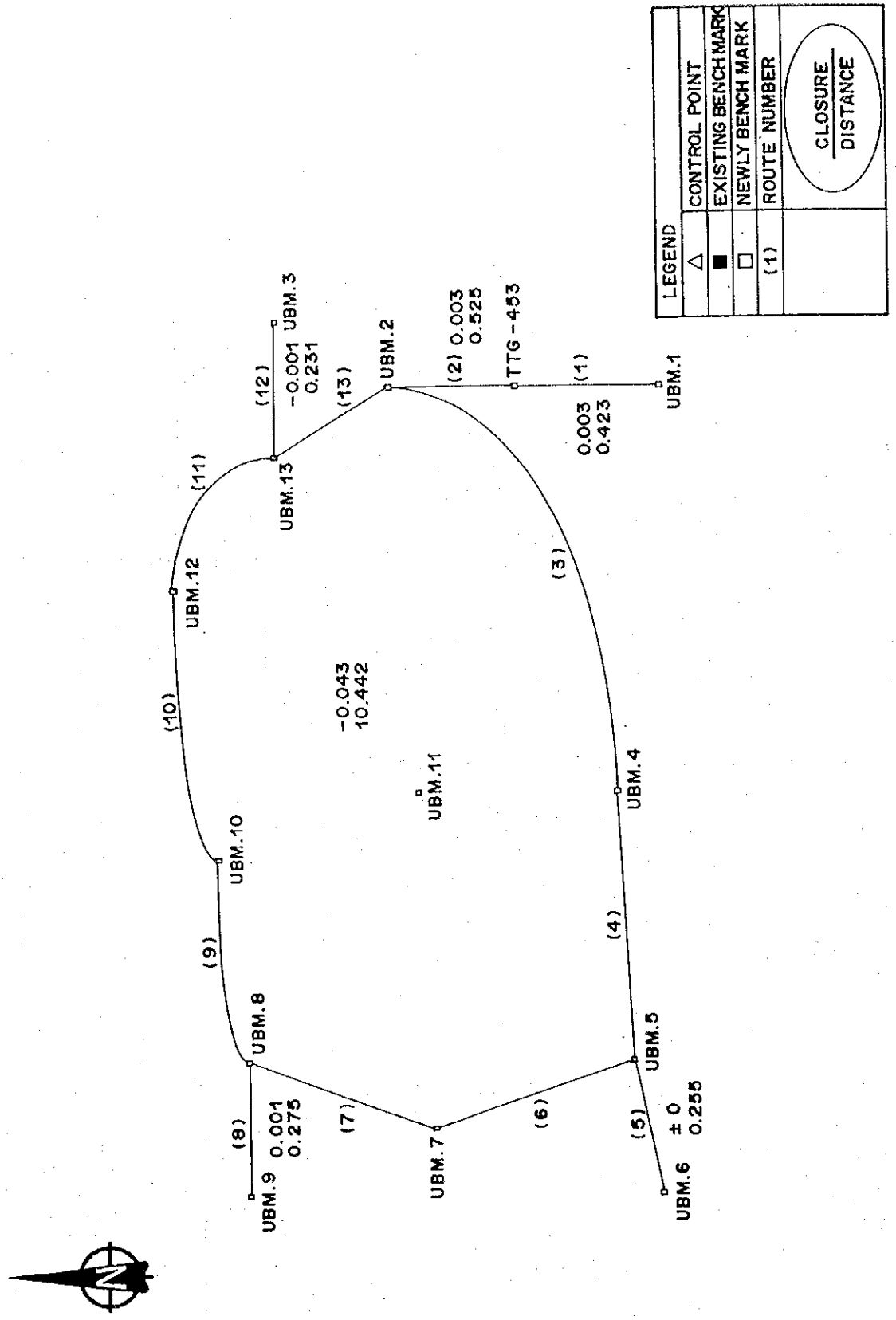
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.3 GPS QUALITY CONTROL (SEMARANG AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



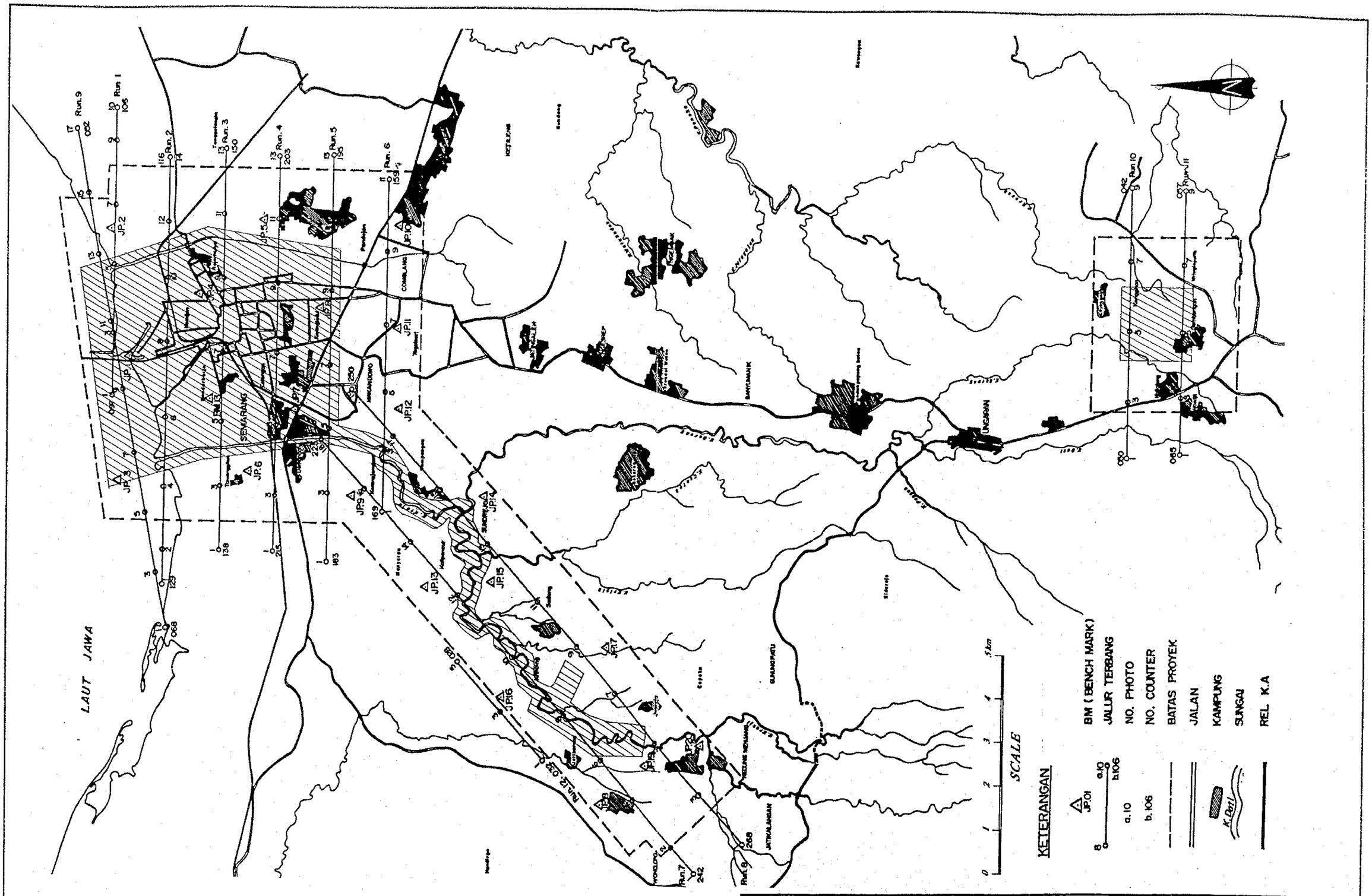
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.4 GPS QUALITY CONTROL (UNGARAN AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.5 LEVELING QUALITY CONTROL (SEMARANG AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.6 LEVELING QUALITY CONTROL (UNGARAN AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.7 FIELD VERIFICATION
JAPAN INTERNATIONAL COOPERATION AGENCY	

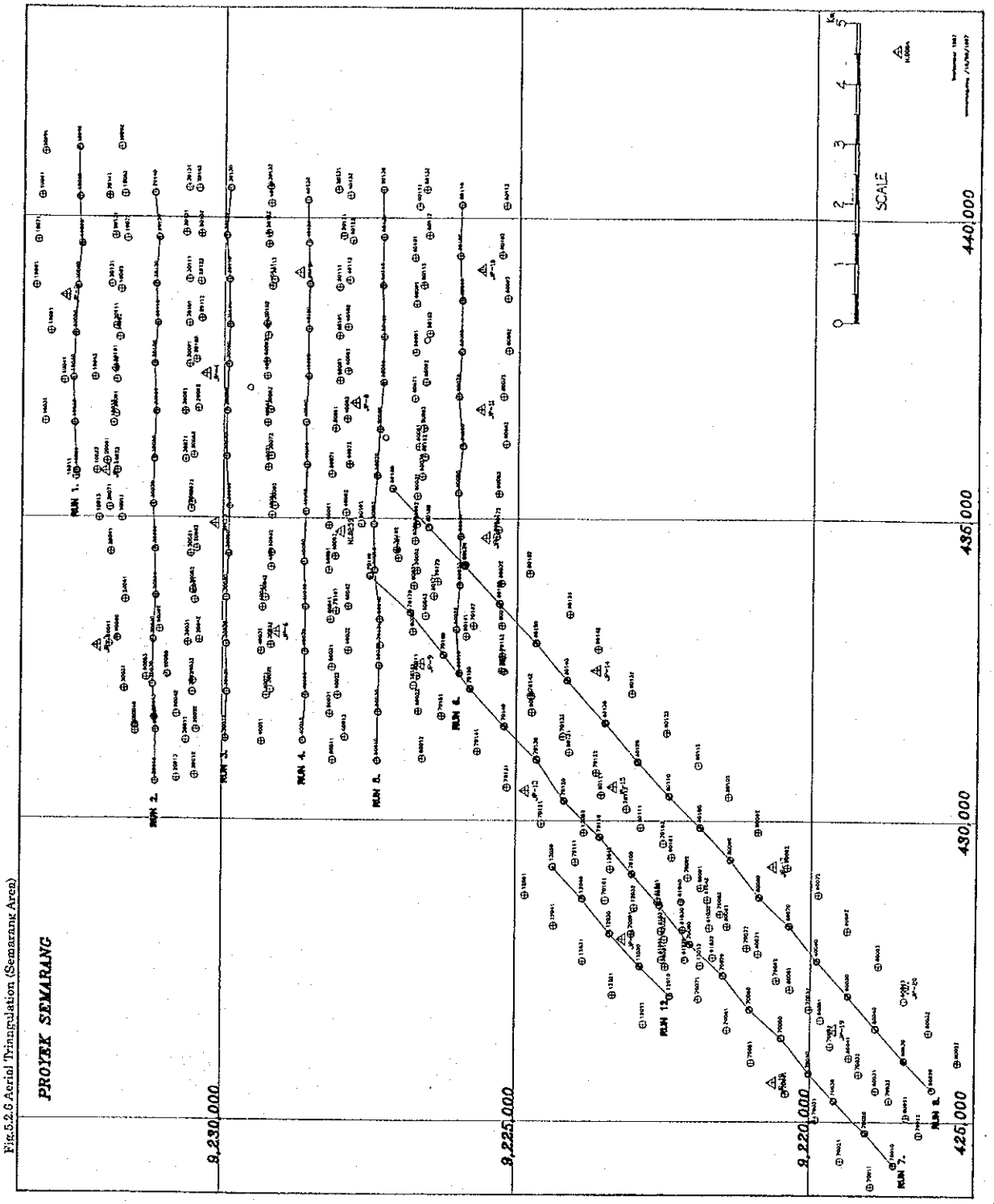
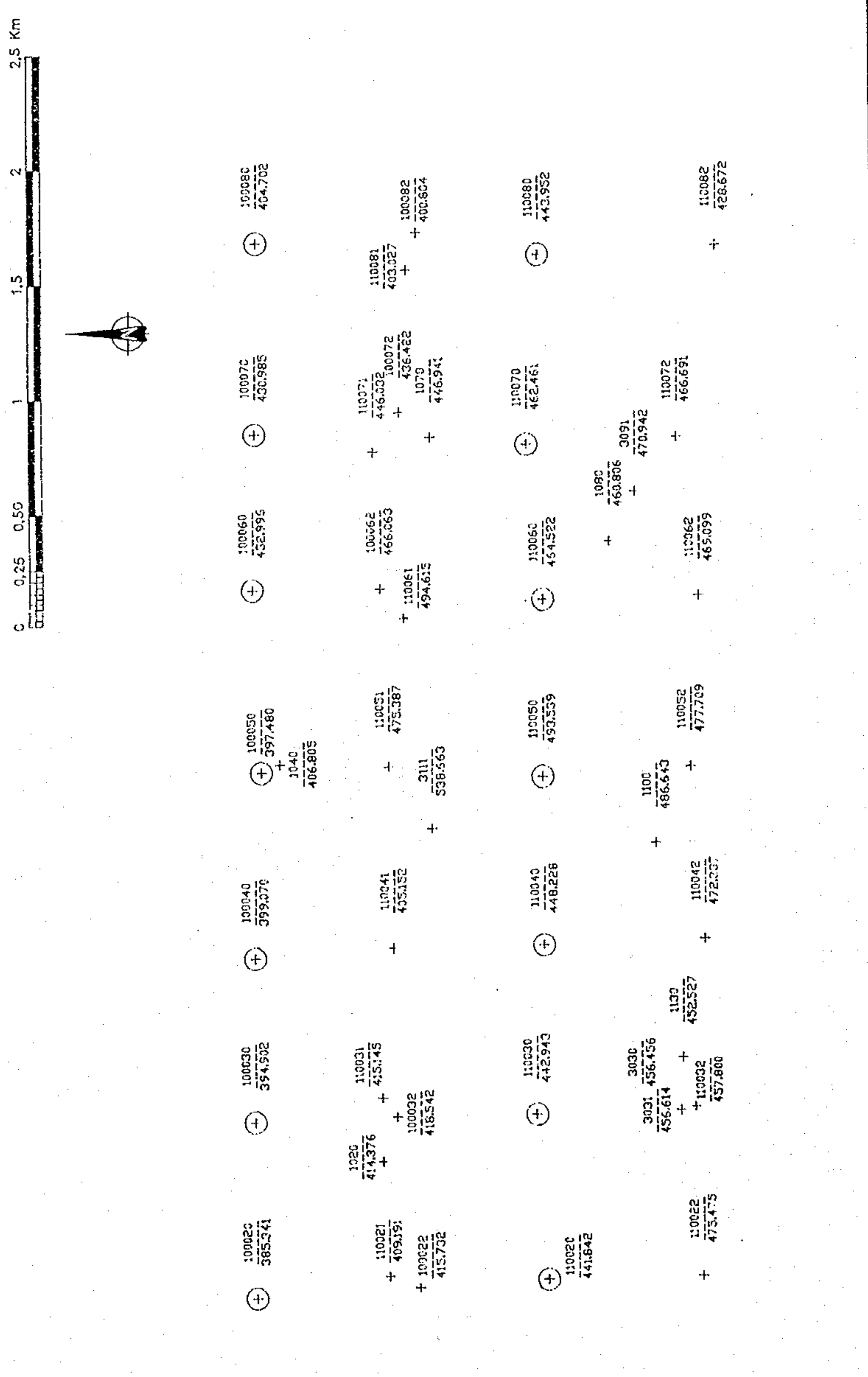


Fig.5.2.6 Aerial Triangulation (Semarang Area)

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.8 AERIAL TRIANGULATION (SEMARANG AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



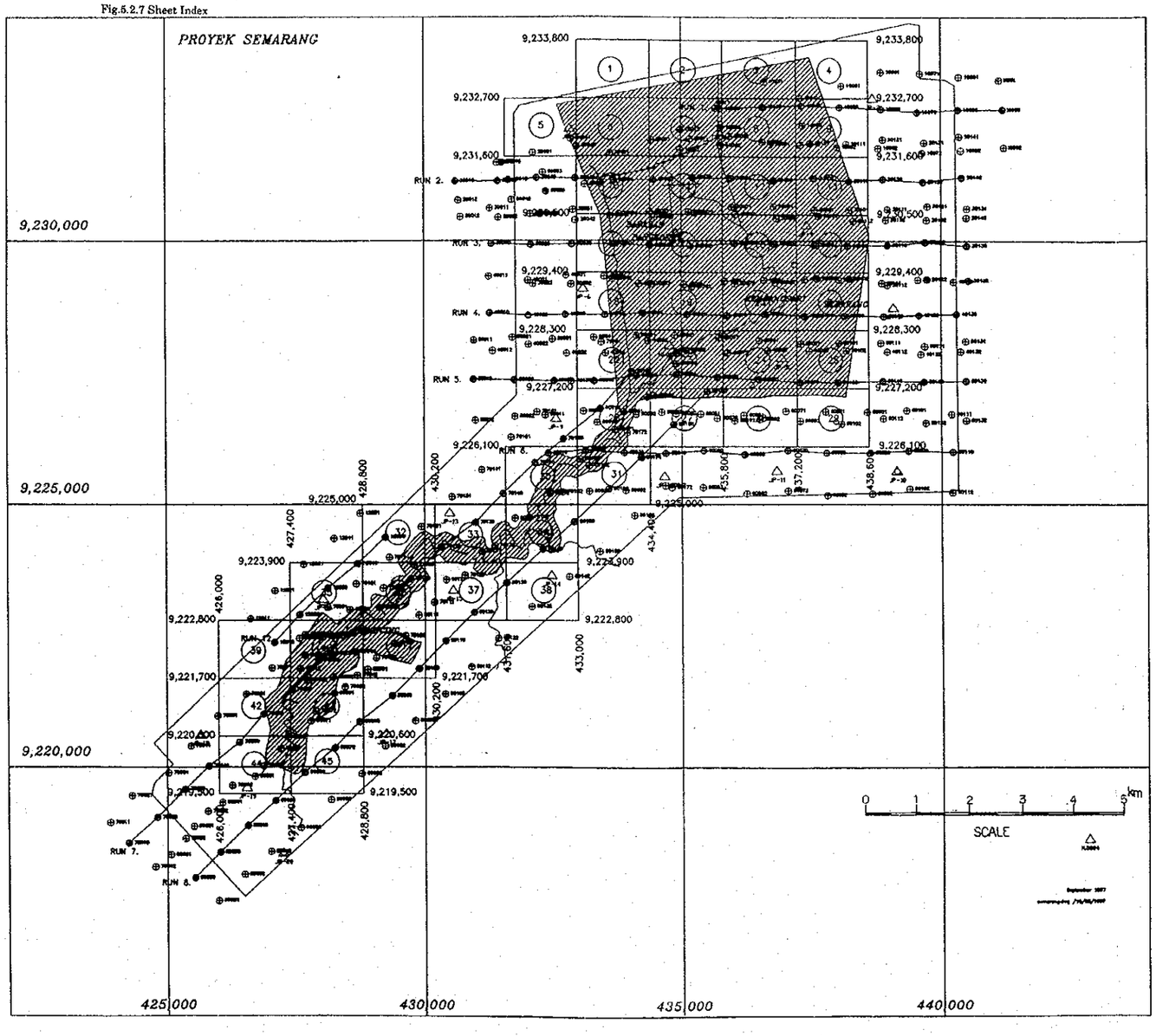
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.9

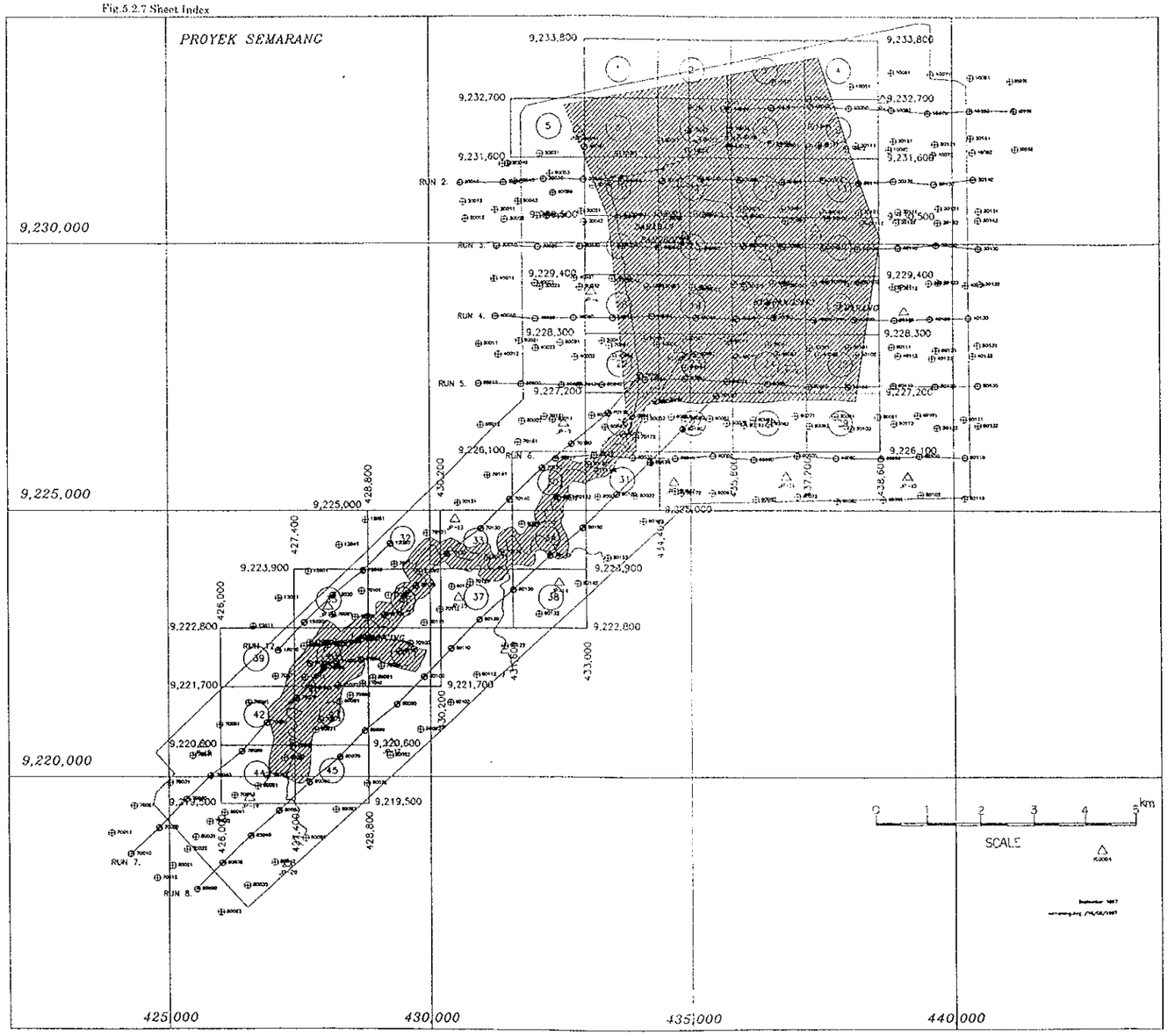
AERIAL TRIANGULATION (UNGARAN AREA)

Fig.5.2.7 Sheet Index

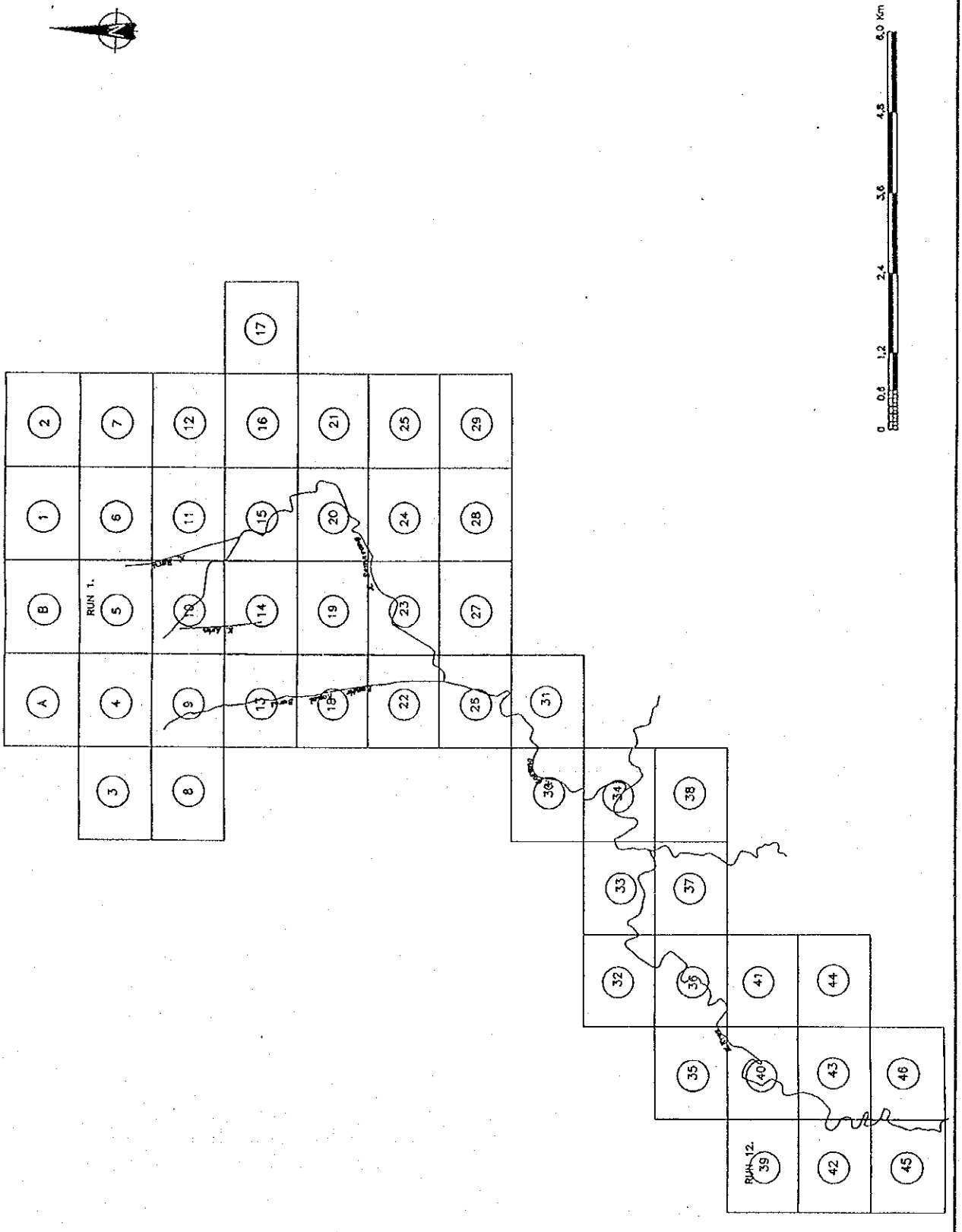


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.10 SHEET INDEX
JAPAN INTERNATIONAL COOPERATION AGENCY	

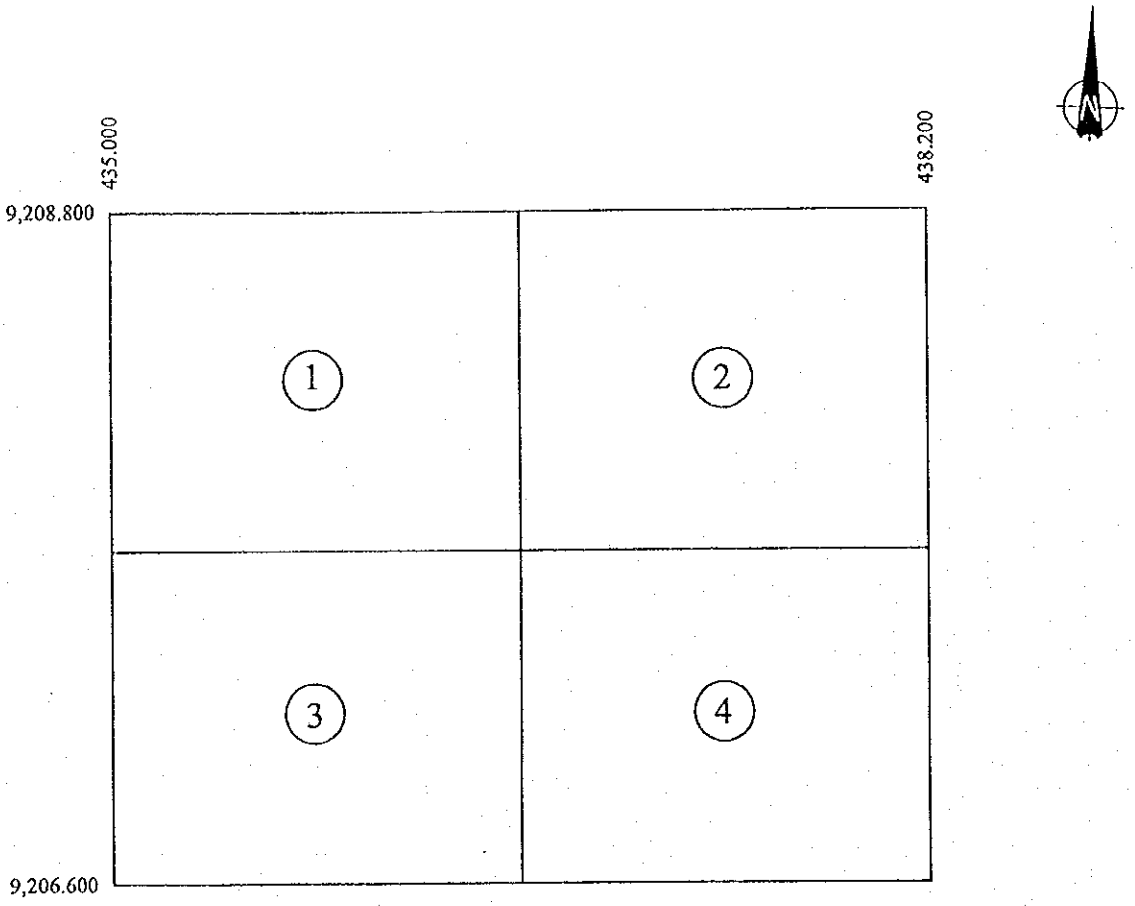
Fig.5.2.7 Sheet Index

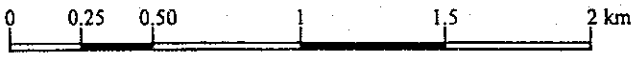


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.10 SHEET INDEX
JAPAN INTERNATIONAL COOPERATION AGENCY	



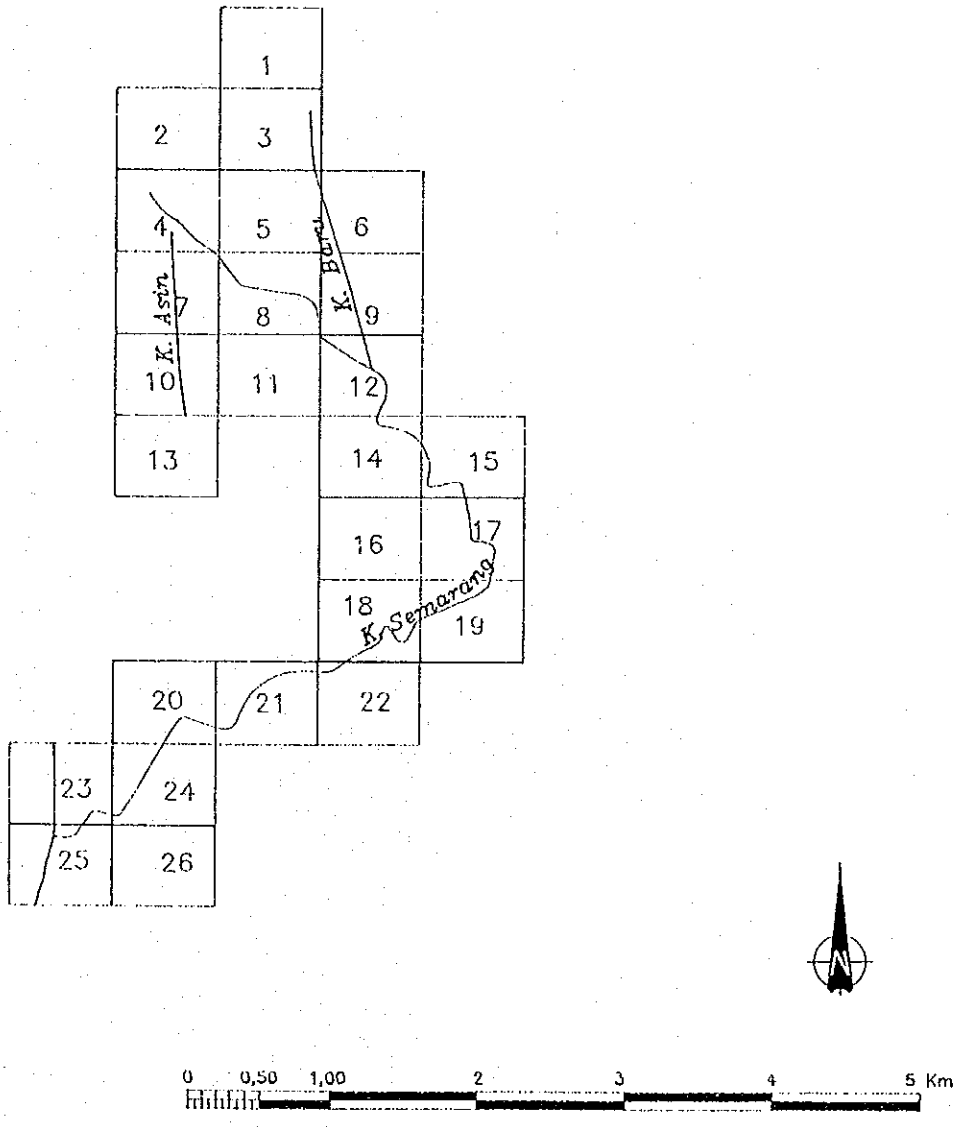
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.11 SHEET INDEX (SEMARANG AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



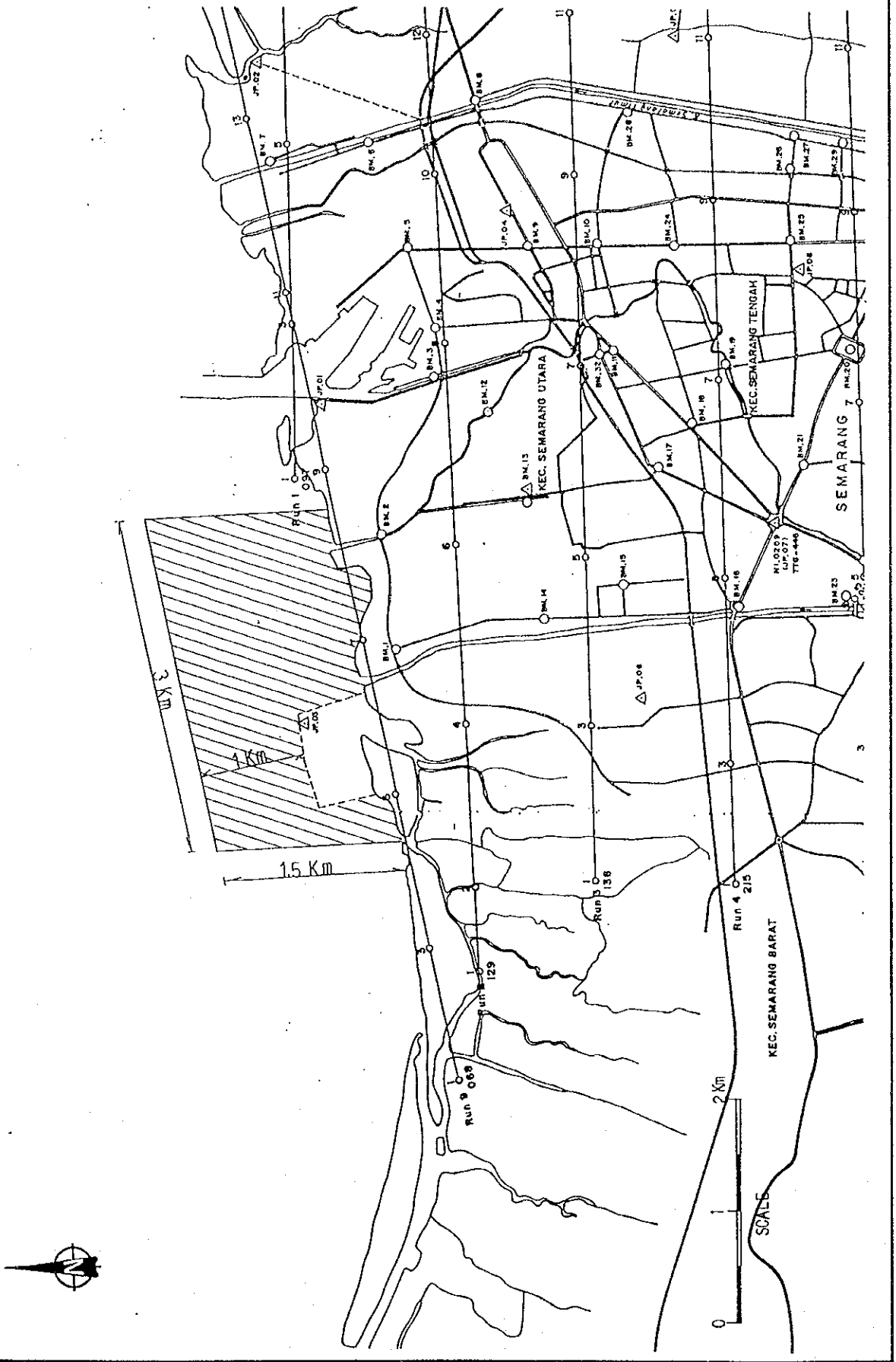


SCALE

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.12 SHEET INDEX (UNGARAN AREA)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.1.13 SHEET INDEX (URBAN DRAINAGE)
JAPAN INTERNATIONAL COOPERATION AGENCY	



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 3.4.1 SOUNDING SURVEY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	