

TABLES

CHAPTER 3
INVESTIGATION AND ANALYSIS

Table 3.1.1 (1/2) FINAL RESULT OF CONTROL POINTS

DATUM : WGS84
 PROJECTION : U.T.M
 ZONE : 49
 SEMI-MAJOR AXIS : 6,378,137.0000
 MENI-MINOR AXIS : 6,356,752.3143
 FLATTERING : 298.2572236
 SCALE FACTOR : 0.9996000
 LATITUDE OF ORIGIN : 0° 0' 0" 0000
 LONGITUDE OF ORIGIN : 111° 0' 0" 0000E

STATION	NORTHING	EASTING	LATITUDE	LONGITUDE	EVEVATION	REMARKS
N.0004	7° 4' 7.0809" S	110° 28' 55.8562" E	9,218,632.118	442,814.138		
N.1.0259 (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° 0' 19.0705" S	110° 26' 56.3074" E	9,225,629.835	439,138.413	7.980	
JP-11	7° 0' 18.8507" S	110° 25' 40.3323" E	9,225,633.799	436,807.342	14.416	
JP-12	7° 0' 22.1649" S	110° 24' 30.8753" E	9,225,529.384	434,676.387	86.673	
JP-13	7° 0' 44.3283" S	110° 22' 14.5173" E	9,224,843.319	430,487.408	60.949	

Table 3.1.1(2/2) FINAL RESULT OF CONTROL POINTS

STATION	NORTHING	EASTING	LATITUDE	LONGITUDE	EVEAVATION	REMARKS
JP-14	7° 1' 23.1271" S	110° 23' 19.3198" E	9,223,654.479	432,483.354	34.648	
JP-15	7° 1' 32.2396" S	110° 22' 16.3507" E	9,223,372.085	430,551.770	80.953	
JP-16	7° 1' 37.6491" S	110° 20' 54.4400" E	9,223,202.528	428,038.896	184.599	
JP-17	7° 3' 1.1278" S	110° 21' 33.5130" E	9,220,640.610	429,241.206	204.198	
JP-18	7° 3' 1.4915" S	110° 19' 36.6186" E	9,220,624.394	425,654.959	219.344	
JP-19	7° 3' 34.4587" S	110° 20' 54.294" E	9,219,613.256	426,540.306	218.583	
JP-20	7° 4' 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
















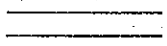

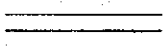

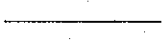

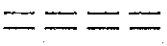

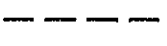

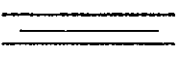



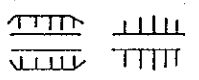

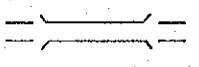

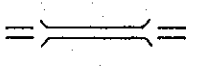
	Triangulation point		Market
	GPS point		Transformer house
	Bench Mark TTG		Bank
	Minor order levelling		Gas station
	Spot elevation		Telephon office
	Minor order BM		Government office
	House/Building		Hotel
	Factory		Main road
	Public hall		Road > 2m
	Public station		Road 1-2m
	Mosque		Road under construction
	Church		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
	Rail way		Farm/Cultivated
	Railway bridge		Sugar cane
	Station		Palm plantation
	Intersecting railway		Rubber plantation
	Water/Oil pipe		Teak plantation
	Water/Oil tank		Coffee plantation
	Automatic waterlevel gauge		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

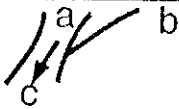




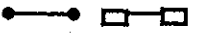

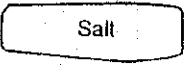
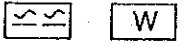
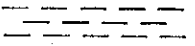

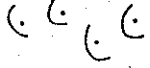
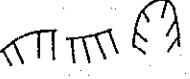
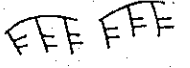
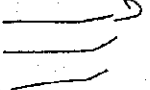

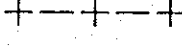
	River(a),rivulet(b) direction(c)	+·+·+·+	Kecamatan boundary
	Channel		
	Water fall		
	Small/large revetment		
	Small/large wair		
	Small/large watergate		
	Sand(a),shore line(b)		
	Saltarn		
	Fish pond/Pond,Lake		
	Swamp		
	Depresion		
	Rocs		
	Preclpice, Land slide		
	Cliff		
	Contour		
	Storages		
	Kabupaten boundary		

Table 3.3.1 HYDROLOGICAL STATIONS AND DATA COLLECTION

No.	Station	Organi- zation	Start Year	Year of Record													Additional Data									
				67	70	75	80	85	90	91	*	*	*	*	*	96										
(1) Daily Rainfall Data				by Feasibility Study in 1993																						
25	Kebonadem	PU,BMG	1951	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
33	Karangtengah	PU,BMG	1948	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
34	Ngareanak	PU,BMG	1951	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B
37	Boja	PU,BMG	1969	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	B
39	Limangan	PU,BMG	1951	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
41d	Bringinmangkang	BMG	1958	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
41e	BMG Semarang	BMG	1968	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
44	Mijen	PU,BMG	1958	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
59	Candi	BMG	1958	A	A	A	A	A	A	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	B
65c	Sumurjurang	PU,BMG	1952	B	B	A	A	B	A	B	A	A	A	A	A	B	A	A	A	A	B	B	A	A	A	A
68b	Klepu	BMG	1951	B	A	B	B	B	B	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A
97	Plamongan	PU,BMG	1958	B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
99	Banyumeneng	PU,BMG	1956	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
(2) Hourly Rainfall Data																										
41e	BMG Semarang	BMG	1959	(1959-1966=A)	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
5	Kaligading	IHE	1980		B	A	A	A	A	A	A	A	A	A	A	B	A	A	A	B	A	A	B	A	A	A
(3) Daily Discharge Data																										
	Panjang	IHE	1983																		A	A	A	A	A	
	Patemon	IHE	1992																					B	A	A
	Kalipancur	IHE	1992																					B	A	A
(4) Hourly Water Level Data																										
	Simongan Weir	PU	1987																					B	B	B
			1961																					C	C	C
																								C	C	C

Note : Symbol=A means complete data. Symbol=B means incomplete data. Symbol=C means intermittent data

Table 3.3.2 ANNUAL MAXIMUM RAINFALL FOR EACH DURATION AT BMG-SEMARANG STATION

Unit: mm

No.	Year	5-min.	10-min.	15-min.	30-min.	45-min.	60-min.	120-min.	3-hours	6-hours	12-hours	1-day
1	1959	20	25	30	50	53	53	55	55	55	55	75
2	1960	18	22	32	46	46	47	51	57	67	71	87
3	1961	21	26	28	40	43	44	50	66	87	116	124
4	1962	11	20	25	30	35	38	45	52	73	76	100
5	1963	22	24	25	38	40	40	44	62	70	118	120
6	1964	21	31	42	62	78	80	89	91	98	100	100
7	1965	11	15	18	28	38	40	41	44	91	125	166
8	1966	27	30	34	43	50	54	72	80	90	91	91
9	1976	17	20	32	43	59	75	107	107	135	183	206
10	1978	17	25	36	60	72	85	98	102	115	115	115
11	1979	15	24	29	37	50	56	99	114	126	126	126
12	1980	14	28	62	82	82	91	175	185	192	192	192
13	1981	20	40	50	65	70	80	113	120	204	228	253
14	1982	10	10	16	47	58	69	80	103	131	131	157
15	1983	18	36	54	73	83	93	93	96	96	96	96
16	1984	16	27	35	47	61	67	79	83	85	81	91
17	1985	15	25	35	55	71	96	149	149	149	247	253
18	1986	31	46	62	72	86	100	105	123	129	130	130
19	1987	27	32	37	60	85	88	93	93	96	138	138
20	1988	15	26	36	51	71	81	102	102	117	174	174
21	1989	16	26	30	44	55	80	100	100	108	142	142
22	1990	10	20	30	50	57	58	66	70	82	100	115
23	1991	10	20	30	40	48	49	70	71	125	132	132
24	1992	16	21	30	55	75	80	88	94	98	99	99
25	1993	22	30	40	75	84	92	108	110	130	182	238
26	1994	20	30	36	55	56	68	79	79	86	90	90
27	1995	15	22	35	60	67	79	100	100	100	100	124
28	1996	25	37	41	66	85	110	114	116	117	117	117

Table 3.3.3. PROBABLE RAINFALL FOR EACH DURATION AT BMG-SEMARANG STATION

Return Period T (year)	Gumbel Variable Y	Data N=28 (1959-1966, 1976-1996)												
		5-min. (mm)	10-min. (mm)	15-min. (mm)	30-min. (mm)	45-min. (mm)	60-min. (mm)	120-min. (mm)	3-hours (mm)	6-hours (mm)	12-hours (mm)	1-day (mm)		
2	0.36651	17.1	25.2	33.7	50.6	60.4	68.2	83.4	89.2	103.9	120.1	130.0		
3	0.90273	19.6	28.8	38.9	57.1	68.0	77.8	98.1	103.7	120.2	142.1	154.0		
5	1.49994	22.5	32.8	44.8	64.4	76.4	88.6	114.5	119.9	138.3	166.6	180.7		
8	2.01342	25.0	36.2	49.8	70.6	83.7	97.9	128.5	133.8	153.8	187.7	203.7		
10	2.25037	26.2	37.8	52.1	73.5	87.0	102.2	135.0	140.2	161.0	197.5	214.3		
20	2.97020	29.6	42.6	59.1	82.2	97.2	115.2	154.7	159.7	182.8	227.0	246.5		
25	3.19853	30.7	44.1	61.3	85.0	100.4	119.3	160.9	165.8	189.8	236.4	256.7		
30	3.38429	31.6	45.3	63.1	87.2	103.1	122.6	166.0	170.9	195.4	244.1	265.0		
40	3.67625	33.0	47.3	65.9	90.8	107.2	127.9	174.0	178.8	204.2	256.1	278.1		
50	3.90194	34.1	48.8	68.1	93.5	110.4	132.0	180.2	184.9	211.1	265.3	288.2		
60	4.08596	35.0	50.0	69.9	95.7	113.0	135.3	185.2	189.9	216.6	272.9	296.4		
80	4.37574	36.4	52.0	72.7	99.3	117.1	140.5	193.2	197.7	225.4	284.8	309.4		
100	4.60015	37.5	53.4	74.9	102.0	120.3	144.6	199.3	203.8	232.2	294.0	319.4		
150	5.00730	39.5	56.2	78.9	106.9	126.0	151.9	210.4	214.8	244.6	310.7	337.6		
200	5.29581	40.9	58.1	81.7	110.4	130.1	157.1	218.3	222.6	253.3	322.6	350.5		
1000	6.90723	48.6	68.8	97.4	130.0	152.9	186.2	262.4	266.2	302.2	388.8	422.6		
	Xo	15.28	22.80	30.16	46.16	55.23	61.53	73.42	79.25	92.81	105.01	113.64		
	1/a	4.83	6.66	9.73	12.14	14.13	18.05	27.36	27.07	30.31	41.08	44.73		

Note : X = Xo + Y*(1/a)

Return Period T (year)	Gumbel Variable Y	Data N=22 (1959-1966, 1976-1990)												
		5-min. (mm)	10-min. (mm)	15-min. (mm)	30-min. (mm)	45-min. (mm)	60-min. (mm)	120-min. (mm)	3-hours (mm)	6-hours (mm)	12-hours (mm)	1-day (mm)		
2	0.36651	16.7	24.7	33.3	48.4	54.5	64.7	80.0	87.6	103.8	121.2	132.0		
5	1.49994	21.6	31.8	43.8	60.5	66.8	82.4	109.6	116.7	136.2	164.4	177.6		
100	4.60015	34.9	51.3	72.5	93.6	100.5	130.6	190.2	196.2	226.2	280.8	297.6		

(2) by Feasibility Study in 1993

Table 3.3.4 RAINFALL INTENSITY FORMULA FOR SHORT DURATION

(T < 2 hours)

Return Period T (year)	Time (min.)	Probable Data (mm/hr)	by Formula (mm/hr)	Difference (%)	Rainfall Intensity Formula (R=mm/hr, T=min.)
2	5	204.6	195.0	-4.7	$R = 1567.1/(T+11.79)^{0.739}$
	10	151.4	160.9	6.3	
	15	134.9	138.1	2.4	
	30	101.2	99.4	-1.8	
	45	80.5	79.3	-1.5	
	60	68.2	66.7	-2.2	
	120	41.7	42.6	2.2	
5	5	270.2	261.2	-3.3	$R = 1271.9/(T+ 6.95)^{0.638}$
	10	196.7	209.0	6.3	
	15	179.0	177.2	-1.0	
	30	128.7	127.1	-1.2	
	45	101.9	102.3	0.4	
	60	88.6	87.0	-1.8	
	120	57.2	57.8	1.0	
10	5	313.8	305.6	-2.6	$R = 1230.2/(T+ 5.20)^{0.600}$
	10	226.7	240.6	6.1	
	15	208.2	202.9	-2.5	
	30	146.9	145.4	-1.0	
	45	116.1	117.6	1.3	
	60	102.2	100.5	-1.7	
	120	67.5	68.0	0.7	
20	5	355.4	348.2	-2.0	$R = 1241.4/(T+ 4.12)^{0.575}$
	10	255.5	270.8	6.0	
	15	236.2	227.5	-3.7	
	30	164.4	163.0	-0.9	
	45	129.6	132.2	2.0	
	60	115.2	113.4	-1.6	
	120	77.3	77.6	0.4	
25	5	368.8	361.9	-1.9	$R = 1245.5/(T+ 3.81)^{0.568}$
	10	264.7	280.4	5.9	
	15	245.2	235.3	-4.0	
	30	170.0	168.7	-0.8	
	45	133.9	136.9	2.2	
	60	119.3	117.6	-1.4	
	120	80.5	80.7	0.2	
50	5	409.6	403.9	-1.4	$R = 1273.4/(T+ 3.06)^{0.550}$
	10	292.7	309.7	5.8	
	15	272.5	259.1	-4.9	
	30	187.0	185.8	-0.6	
	45	147.2	151.2	2.7	
	60	132.0	130.2	-1.4	
	120	90.1	90.2	0.1	
100	5	450.0	445.5	-1.0	$R = 1318.3/(T+ 2.53)^{0.537}$
	10	320.6	338.8	5.7	
	15	299.7	282.9	-5.6	
	30	204.0	202.9	-0.5	
	45	160.3	165.5	3.2	
	60	144.6	142.8	-1.2	
	120	99.6	99.5	-0.1	

Table 3.3.5 RAINFALL INTENSITY FORMULA FOR LONG DURATION

(T > 1 hour)

Return Period T (year)	Time (min.)	Probable Data (mm/hr)	by Formula (mm/hr)	Difference (%)	Rainfall Intensity Formula (R=mm/hr, T=min.)
2	60	68.2	68.8	0.9	$R = 2417.0 / (T + 10.80)^{0.836}$
	120	41.7	41.2	-1.2	
	180	29.7	30.0	1.0	
	360	17.3	17.2	-0.6	
	720	10.0	9.8	-2.0	
	1440	5.4	5.5	1.9	
5	60	88.6	90.0	1.6	$R = 3245.6 / (T + 14.75)^{0.831}$
	120	57.2	55.1	-3.7	
	180	40.0	40.6	1.5	
	360	23.0	23.6	2.6	
	720	13.9	13.5	-2.9	
	1440	7.5	7.6	1.3	
10	60	102.2	104.2	2.0	$R = 3721.3 / (T + 15.67)^{0.826}$
	120	67.5	64.3	-4.7	
	180	46.7	47.5	1.7	
	360	26.8	27.7	3.4	
	720	16.5	15.9	-3.6	
	1440	8.9	9.1	2.2	
20	60	115.2	117.8	2.3	$R = 4202.2 / (T + 16.63)^{0.824}$
	120	77.3	73.1	-5.4	
	180	53.2	54.2	1.9	
	360	30.5	31.7	3.9	
	720	18.9	18.3	-3.2	
	1440	10.3	10.4	1.0	
25	60	119.3	122.0	2.3	$R = 4430.3 / (T + 17.47)^{0.826}$
	120	80.5	76.0	-5.6	
	180	55.3	56.3	1.8	
	360	31.6	33.0	4.4	
	720	19.7	19.0	-3.6	
	1440	10.7	10.8	0.9	
50	60	132.0	135.3	2.5	$R = 4923.2 / (T + 18.23)^{0.824}$
	120	90.1	84.6	-6.1	
	180	61.6	62.8	1.9	
	360	35.2	36.9	4.8	
	720	22.1	21.3	-3.6	
	1440	12.0	12.1	0.8	
100	60	144.6	148.3	2.6	$R = 5426.1 / (T + 19.02)^{0.824}$
	120	99.6	93.1	-6.5	
	180	67.9	69.3	2.1	
	360	38.7	40.8	5.4	
	720	24.5	23.5	-4.1	
	1440	13.3	13.4	0.8	
1000	60	186.2	191.6	2.9	$R = 7100.8 / (T + 20.89)^{0.822}$
	120	131.2	121.4	-7.5	
	180	88.7	90.7	2.3	
	360	50.4	53.6	6.3	
	720	32.4	31.0	-4.3	
	1440	17.6	17.7	0.6	

Table 3.3.6 HOURLY RAINFALL DATA IN ANNUAL MAXIMUM DAILY RAINFALL AT BMG-SEMARANG STATION

Year	Date	Total	8:00	9:00	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1:00	2:00	3:00	4:00	5:00	6:00	7:00
1987	Jan.27	138.0	0	0	0	0	4.2	45.8	29	9	7.4	2.2	3.3	2	8	9.5	4.5	9.5	3	0.6	0	0	0	0	0	0
1988	Dec.17	174.6	0	0	0	0	0	0	0	0	0	0	0	0	0	2.6	44.2	10.4	4.2	2.3	4.2	4.4	13.7	17	29.9	2.1
1989	Feb. 6	141.5	6.5	0	3	5.5	0.3	0.7	0	0.3	0.7	0	4.9	1.6	6.5	8	4.1	5	2.5	9.7	4	1	28	9	1.5	1.8
1990	Jan.22	115.0	0	0	0	0	0	0	0	0	0.2	4.2	9.6	4	1.7	14	3.5	15.5	10.5	8.5	8.5	4	0.5	10	3	2
1991	Dec.26	132.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	3.9	0.1	35.5	23	27	16.5	11.5	12	1.3	0.7
1992	Mar.11	98.8	0	0	0	0	0	0	0	0	0	0	0	40	47	7.3	3.2	0.3	1	0	0	0	0	0	0	0
1993	Jan.28	237.5	1.5	11	4	10.5	33	15	0.2	0	0.3	0	0	24.5	22	16	18	34	10	16	10.5	1	0.5	8	1.5	0
1994	Mar. 8	90.0	0	0	0	0	0	6	0	56	7	10.5	0	6	4.5	0	0	0	0	0	0	0	0	0	0	0
1995	Dec.12	124.0	1.2	1.3	7.5	1.5	0	4	0	0	0	0	0	2	12.5	51	10	2.5	0.5	0	0	0.5	5	3.5	4	17
1996	Apr.23	116.9	0	0	0	0	0	0	0	0	0	0.6	0	0	0.1	114.4	1.8	0	0	0	0	0	0	0	0	0

Unit : mm

Table 3.3.7 HOURLY RAINFALL RATIO IN ANNUAL MAXIMUM DAILY RAINFALL AND DESIGN STORM

Year	Date	Total	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	Peak	1	2	3	4	5	6	7	8	9	10	11	12
1987	Dec. 4	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.33	0.21	0.07	0.05	0.02	0.02	0.01	0.06	0.07	0.03	0.07	0.02	0.00
1988	Jan. 7	1.0	0.00	0.00	0.00	0.00	0.01	0.25	0.06	0.02	0.01	0.02	0.02	0.25	0.08	0.10	0.17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1989	Oct.15	1.0	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.05	0.06	0.06	0.29	0.04	0.02	0.07	0.03	0.01	0.20	0.06	0.01	0.01	0.05	0.00	0.02
1990	Jan.25	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.03	0.03	0.15	0.12	0.03	0.13	0.09	0.07	0.07	0.03	0.00	0.09	0.03	0.02	0.00
1991	Feb. 7	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.27	0.17	0.20	0.13	0.09	0.09	0.01	0.01	0.00	0.00	0.00	0.00	0.00
1992	Nov.22	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.48	0.07	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	Jan.29	1.0	0.14	0.06	0.00	0.00	0.00	0.00	0.10	0.09	0.07	0.08	0.14	0.04	0.07	0.04	0.00	0.00	0.00	0.03	0.01	0.00	0.01	0.05	0.02	0.04
1994	Mar. 5	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.62	0.08	0.12	0.07	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	May.10	1.0	0.06	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.10	0.41	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.03	0.14	0.01	0.01
1996	Apr. 2	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average(=Ai)		1.0	0.02	0.01	0.00	0.00	0.00	0.03	0.02	0.02	0.02	0.03	0.07	0.39	0.09	0.07	0.07	0.03	0.02	0.03	0.02	0.01	0.02	0.03	0.01	0.01
Return Period		Rd(mm)	Design Storm Rs (mm)																							
5-year		180.7	3.6	1.8	0.0	0.0	0.0	0.0	5.4	3.6	3.6	5.4	12.6	70.5	16.3	12.6	12.6	5.4	3.6	5.4	3.6	1.8	3.6	5.4	1.8	1.8
10-year		214.3	4.3	2.1	0.0	0.0	0.0	6.4	4.3	4.3	6.4	15.0	83.6	19.3	15.0	15.0	6.4	4.3	6.4	4.3	2.1	4.3	6.4	2.1	2.1	2.1
25-year		256.7	5.1	2.6	0.0	0.0	0.0	7.7	5.1	5.1	7.7	18.0	100.1	23.1	18.0	18.0	7.7	5.1	7.7	5.1	2.6	5.1	7.7	2.6	2.6	2.6
50-year		288.2	5.8	2.9	0.0	0.0	0.0	8.6	5.8	5.8	8.6	20.2	112.4	25.9	20.2	20.2	8.6	5.8	8.6	5.8	2.9	5.8	8.6	2.9	2.9	2.9
100-year		319.4	6.4	3.2	0.0	0.0	0.0	9.6	6.4	6.4	9.6	22.4	124.6	28.7	22.4	22.4	9.6	6.4	9.6	6.4	3.2	6.4	9.6	3.2	3.2	3.2

Note : (Hourly Rainfall in Design Storm)Rs = (Average Ratio)Ai * (Probable Rainfall in a day)Rd

TABLE 3.3-8 (1/2) DESIGN DISCHARGE OF SEMARANG RIVER

Name of Channel Section	Distance (m)	Accumulate Distance (m)	Drainage Area (km ²)	Accumulate Drainage Area (km ²)	Velocity (m/sec)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Run-off Coefficient	Peak Discharge (m ³ /sec)	Design Discharge (m ³ /sec)	Remarks
Option A											
A.1 Semarang River											
H-I (Sm-1)	895	895	0.219	0.219	1.50	25	138.7	0.650	4.39	5	
G-H (Sm-2)	1,367	2,262	0.875	1.094	1.51	40	108.3	0.599	15.77	16	
F-G (Sm-3)	1,024	3,286	0.508	1.602	1.26	54	92.1	0.615	20.16	21	
F'-F	0	3,286	2.935	4.537	1.47	73	77.0	0.615	41.77	42	Confluence of Sinpang Lima R.
E-F' (Sm-4)	1,027	4,313	0.975	5.512	1.47	85	70.4	0.593	45.15	46	
D-E (Sm-5)	1,061	5,374	0.354	5.866	1.47	97	65.1	0.609	45.68	46	
D'-D	0	5,374	0	5.866	0.87	97	65.1	0.609	39.68	40	Diversion to Baru River (6m ³ /s)
C-D (Sm-6)	638	6,012	0	5.866	0.72	112	58.4	0.609	34.36	40	
B-C (Sm-7)	1,150	7,162	0	5.866	0.75	137	50.1	0.609	27.80	40	
B''-B	0	7,162	4.252	10.118	0.75	137	50.1	0.626	58.56	59	Confluence of Asin River
B'-B''	280	7,442	0.58	10.698	0.75	144	48.5	0.628	60.39	61	Inflow from Bandatharjo West
A-B (Sm-8)	674	8,116	0.5	11.198	0.52	165	43.6	0.636	57.01	61	
A.2 Simpang Lima River											
O-P (SI-1)	1,457	1,457	2.051	2.051	0.70	50	96.0	0.545	23.86	24	
F'-O (SI-2)	996	2,453	0.884	2.935	0.70	73	76.8	0.545	24.50	25	Diversion to Kartini P. S. (6m ³ /s)
A.3 Asin River											
J-K (As-1)	2,400	2,400	2.038	2.038	0.60	82	72.1	0.650	21.23	22	
B'-J (As-2)	1,150	3,550	2.214	4.252	0.60	114	59.2	0.650	34.50	35	
A.4 Baru River											
M-D (Ba-1)		0	0	0	0.60				6.00	6	
L-M (Ba-2)		1.605	1.605	1.605	0.60			0.727			

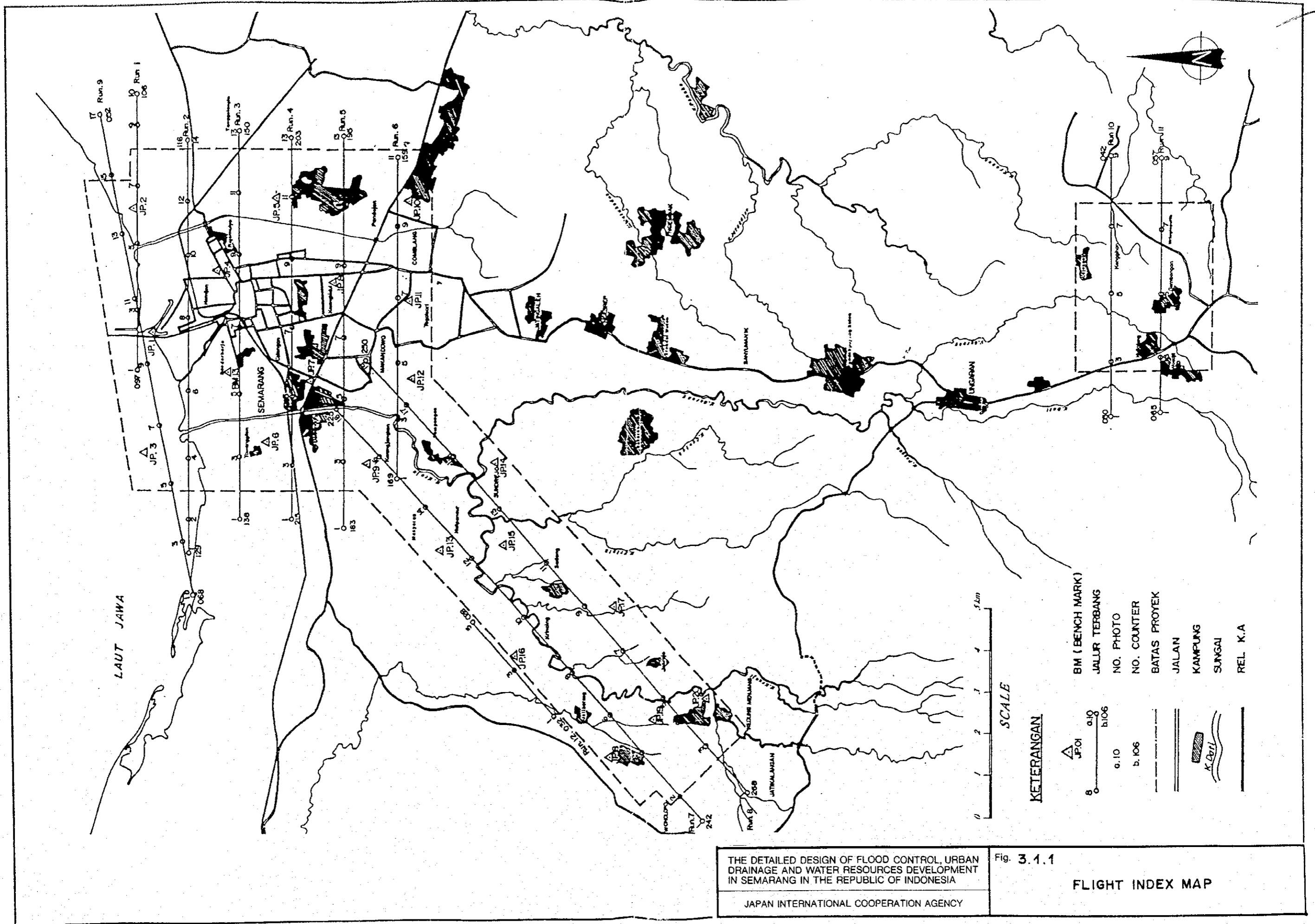
TABLE 3.3.9(2/2) DESIGN DISCHARGE OF SEMARANG RIVER

Name of Channel Section	Distance (m)	Accumulate Distance (m)	Drainage Area (km ²)	Accumulate Drainage Area (km ²)	Velocity (m/sec)	Time of Concentration (min)	Rainfall Intensity (mm/hr)	Run-off Coefficient	Peak Discharge (m ³ /sec)	Design Discharge (m ³ /sec)	Remarks
Option B											
B.1 Semarang River											
D - I (Sm - 1 to 5): Design discharges of sections H-I (Sm-1), G-H (Sm-2), F-G (Sm-3), E-F (Sm-4) and D-E (Sm-5) are the same as Option A											
C - D (Sm - 6)	638	6,012	0	5.866	0.70	112	58.2	0.609	45.68	46	No diversion to Baru River
B - C (Sm - 7)	1,150	7,162	0	5.866	0.70	139	49.6	0.609	45.68	46	
B' - B	0	7,162	4.252	10.118	0.60	137	50.1	0.626	64.56	65	Confluence of Asin River
B' - B"	280	7,442	0.580	10.698	0.60	145	48.1	0.628	66.81	67	Inflow from Bandarharjo West
A - B (Sm - 8)	674	8,116	0.500	11.198	0.60	164	43.9	0.636	63.44	67	
B.2 Simpang Lima River: Design discharges of sections, O-P (Si - 1) and F-O (Si - 2) are the same as Option A.											
B.3 Asin River: Design discharges of sections, J-K (As - 1) and B'-J (As - 2) are the same as Option A.											
B.4 Baru River: Design discharge is zero because of no diversion flow from Semarang River.											
Option C											
C.1 Semarang River											
D - I (Sm - 1 to 5): Design discharges of sections H-I (Sm-1), G-H (Sm-2), F-G (Sm-3), E-F (Sm-4) and D-E (Sm-5) are the same as Option A											
C - D (Sm - 6)	638	6,012	0	5.866	0.70	112	58.2	0.609	45.68	46	No diversion to Baru River
B - C (Sm - 7)	1,150	7,162	0	5.866	0.70	140	49.5	0.609	45.68	46	
B' - B	0	7,162	4.252	10.118	0.60	140	49.5	0.626	64.70	65	Confluence of Asin River
A - B (Sm - 8)	954	8,116	0.500	10.618	0.60	166	43.4	0.634	63.90	65	
C.2 Simpang Lima River: Design discharges of sections, O-P (Si - 1) and F-O (Si - 2) are the same as Option A.											
C.3 Asin River: Design discharges of sections, J-K (As - 1) and B'-J (As - 2) are the same as Option A.											
C.4 Baru River: Design discharge is zero because of no diversion flow from Semarang River.											

Note: Two (2) areas of 0.25 km² each (250 m in width, 1.0 km in length), which are newly reclaimed by the private developer and situated along both banks of the downstream of Semarang River are considered to include in the catchment area of Semarang River

FIGURES

CHAPTER 3 INVESTIGATION AND ANALYSIS

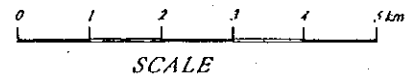
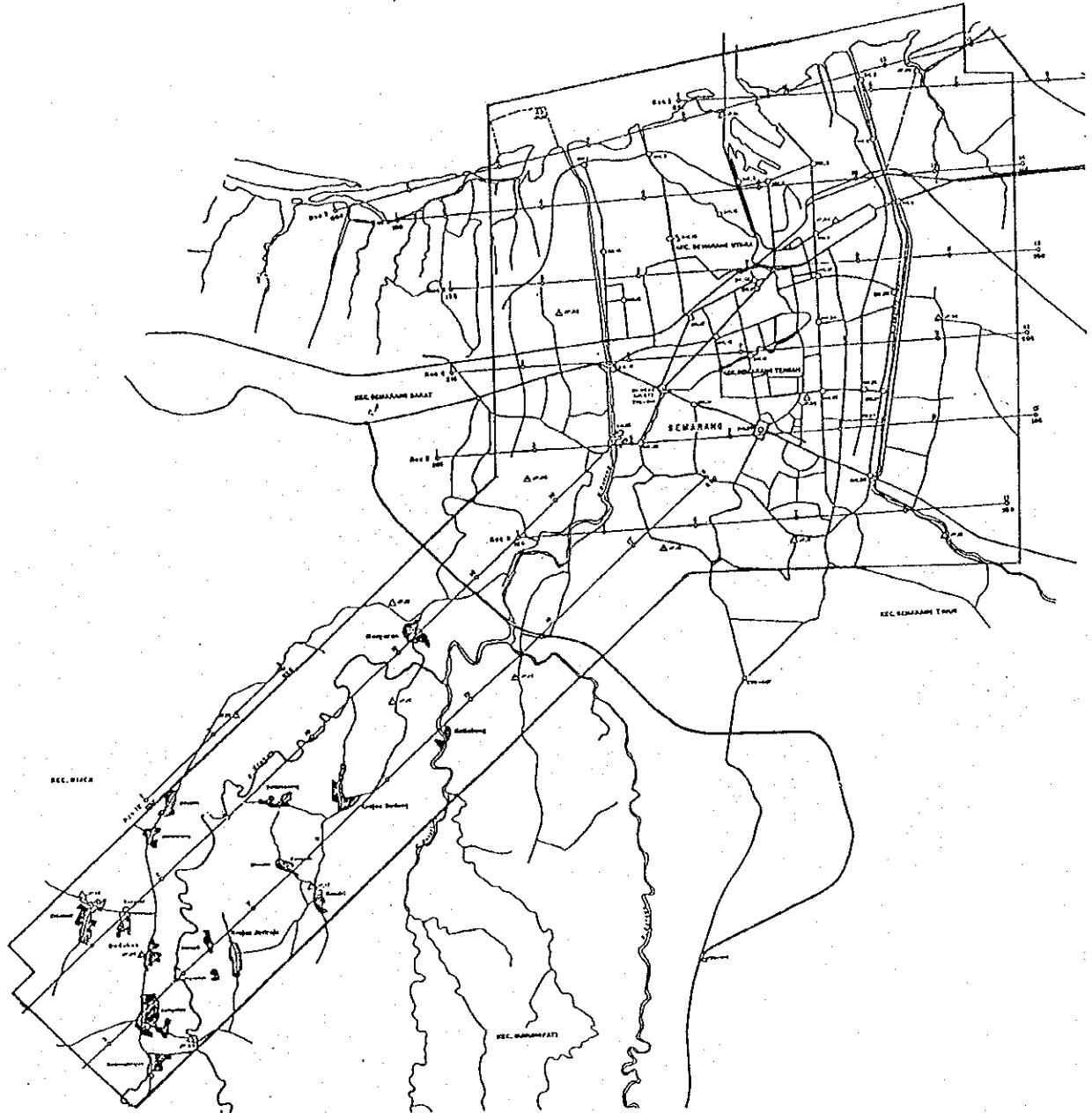


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA
 JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.1
 FLIGHT INDEX MAP



LAUF JAWA

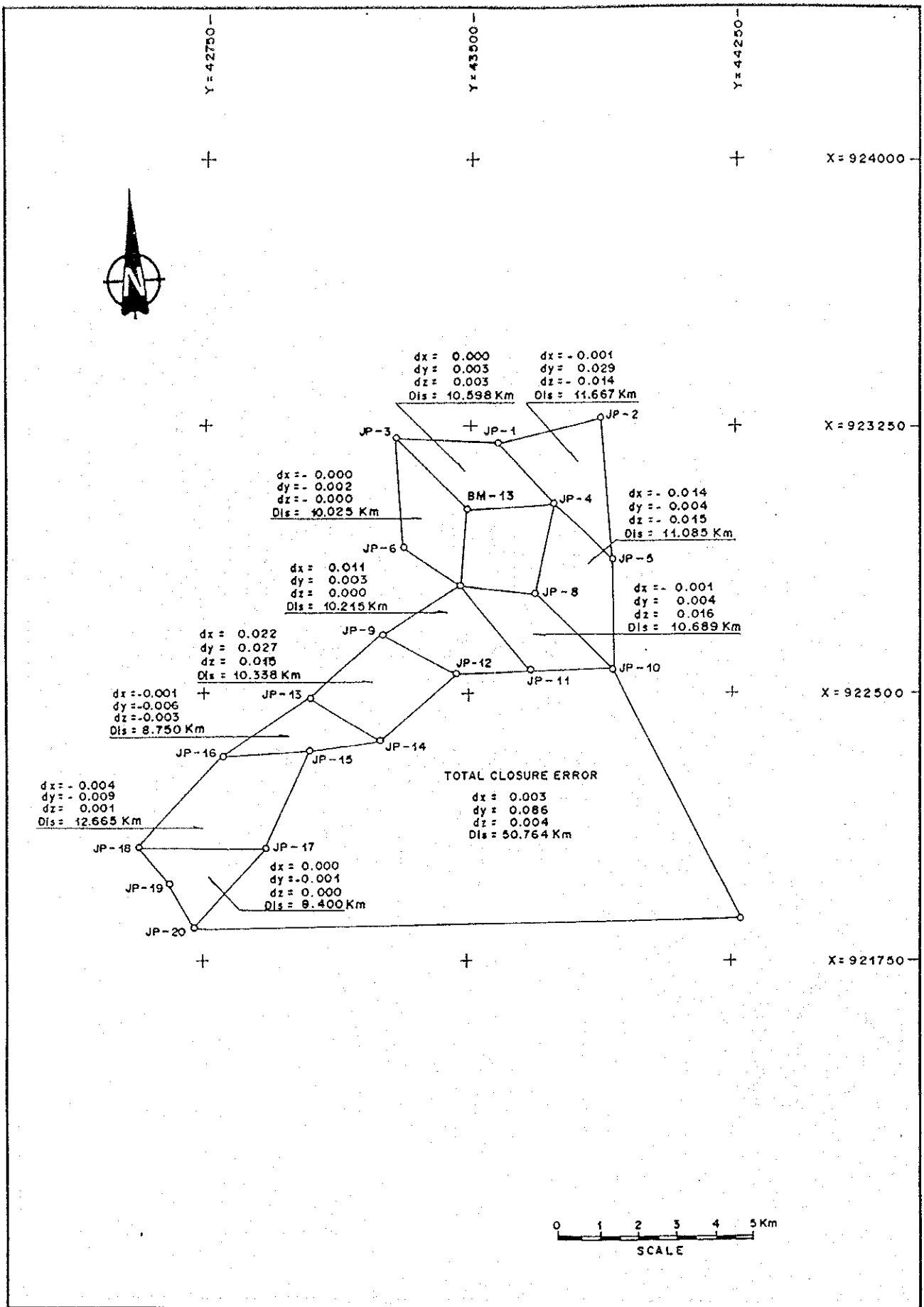


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

Fig. 3.1.2

UNCONTROLLED MOSAIC AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

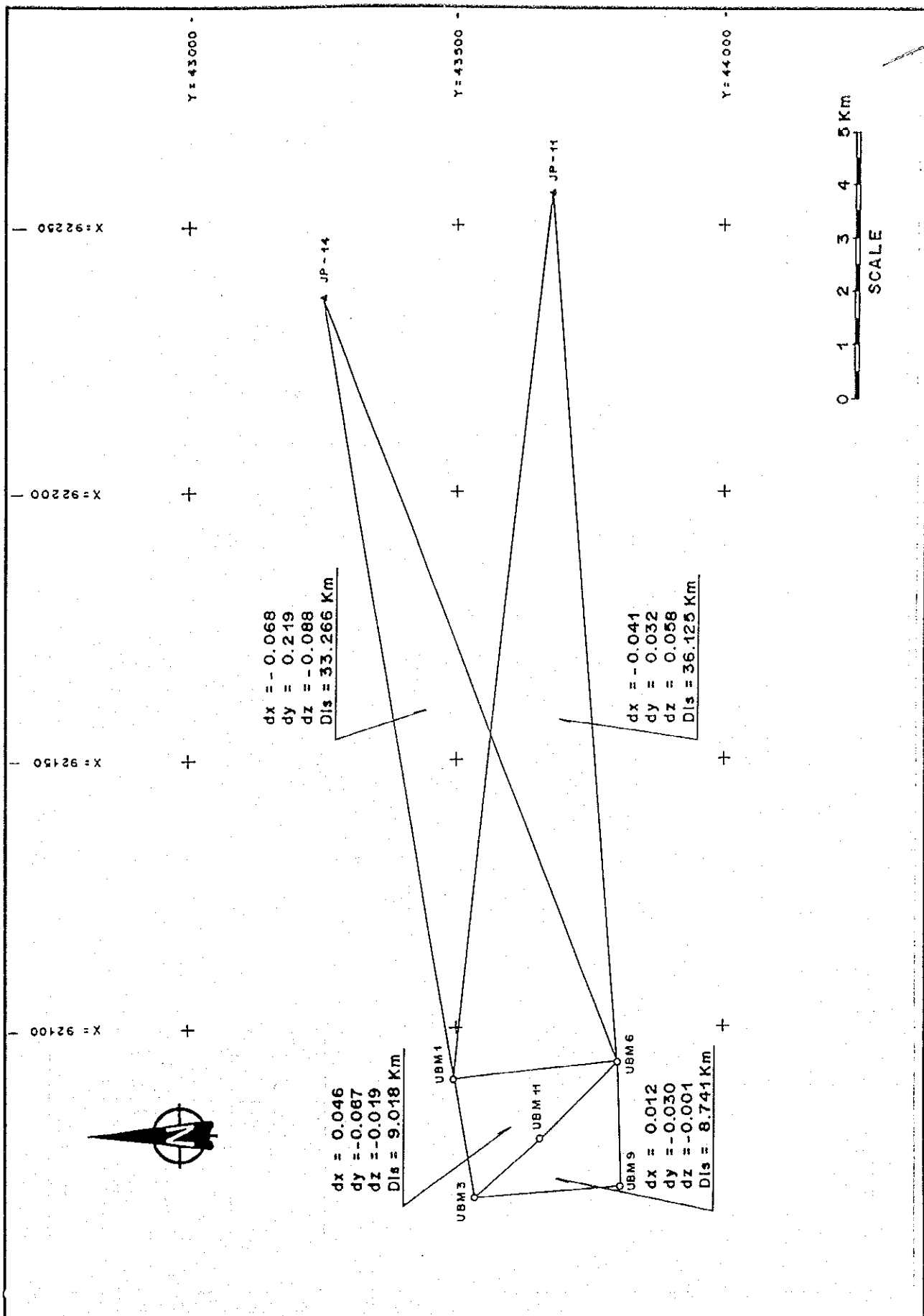


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.3

GPS QUALITY CONTROL (SEMARANG AREA)

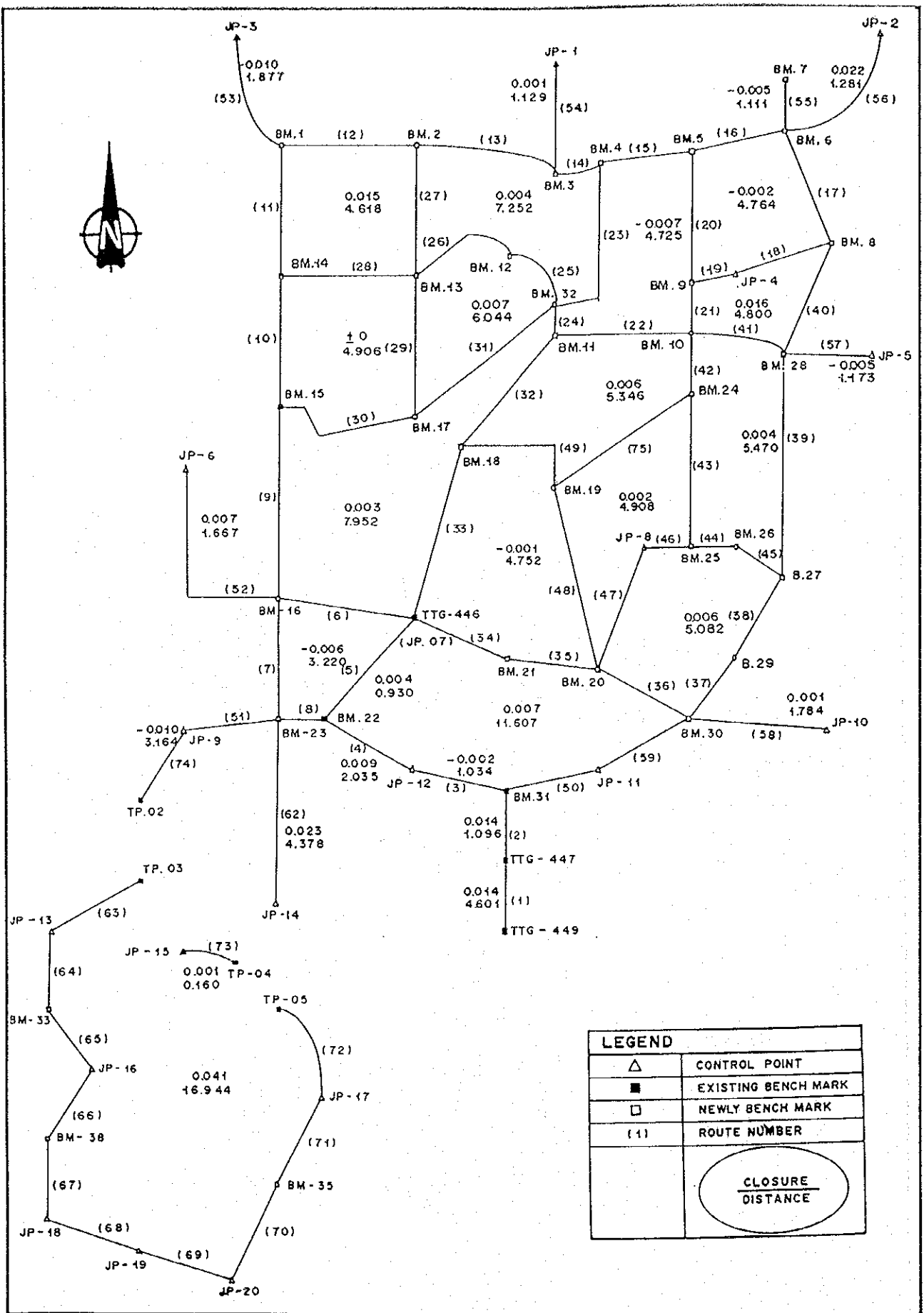


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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Fig. 3.1.4

GPS QUALITY CONTROL (UNGARAN AREA)

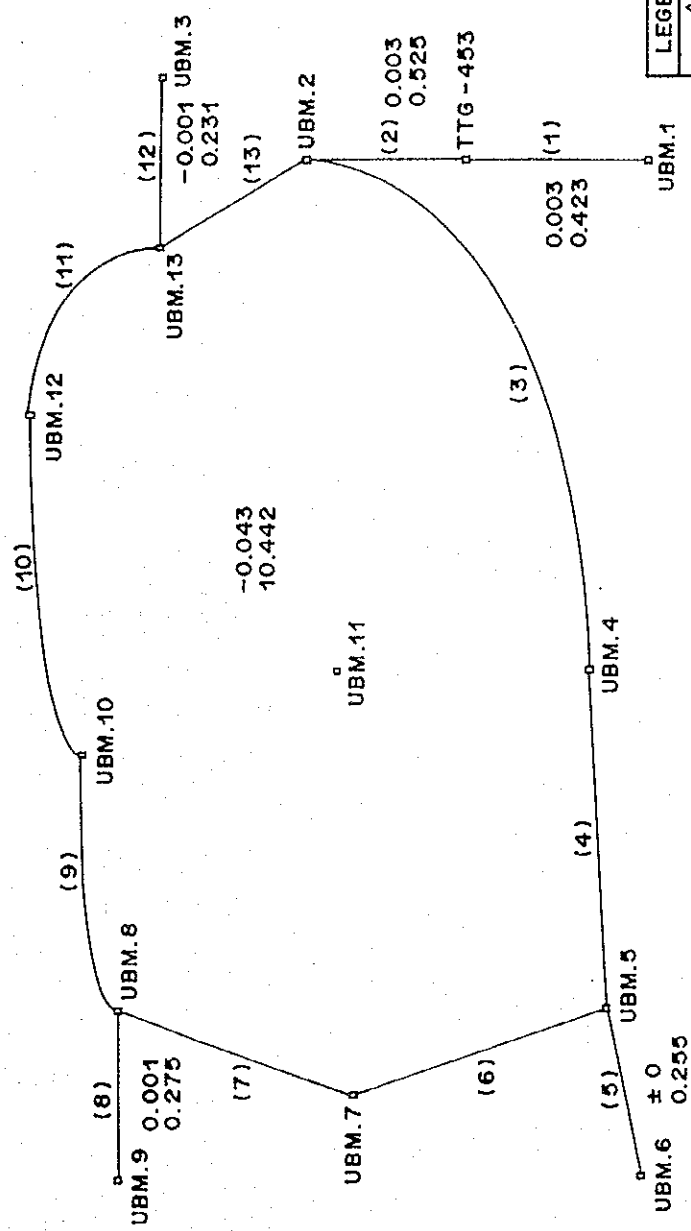


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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Fig. 3.1.5

LEVELING QUALITY CONTROL (SEMARANG AREA)



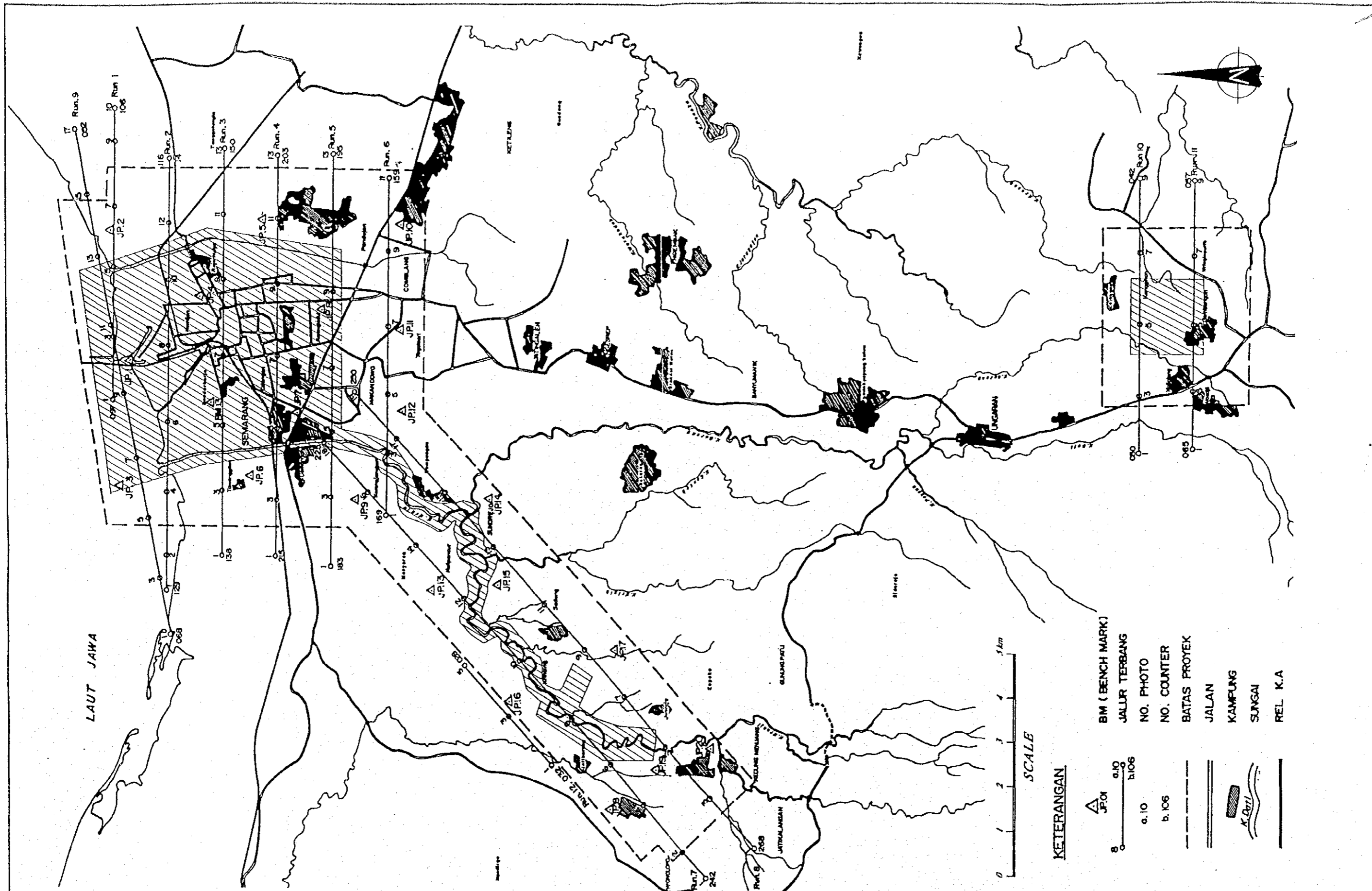
LEGEND	CONTROL POINT
△	EXISTING BENCH MARK
□	NEWLY BENCH MARK
(1)	ROUTE NUMBER
CLOSURE DISTANCE	

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

JAPAN INTERNATIONAL COOPERATION AGENCY

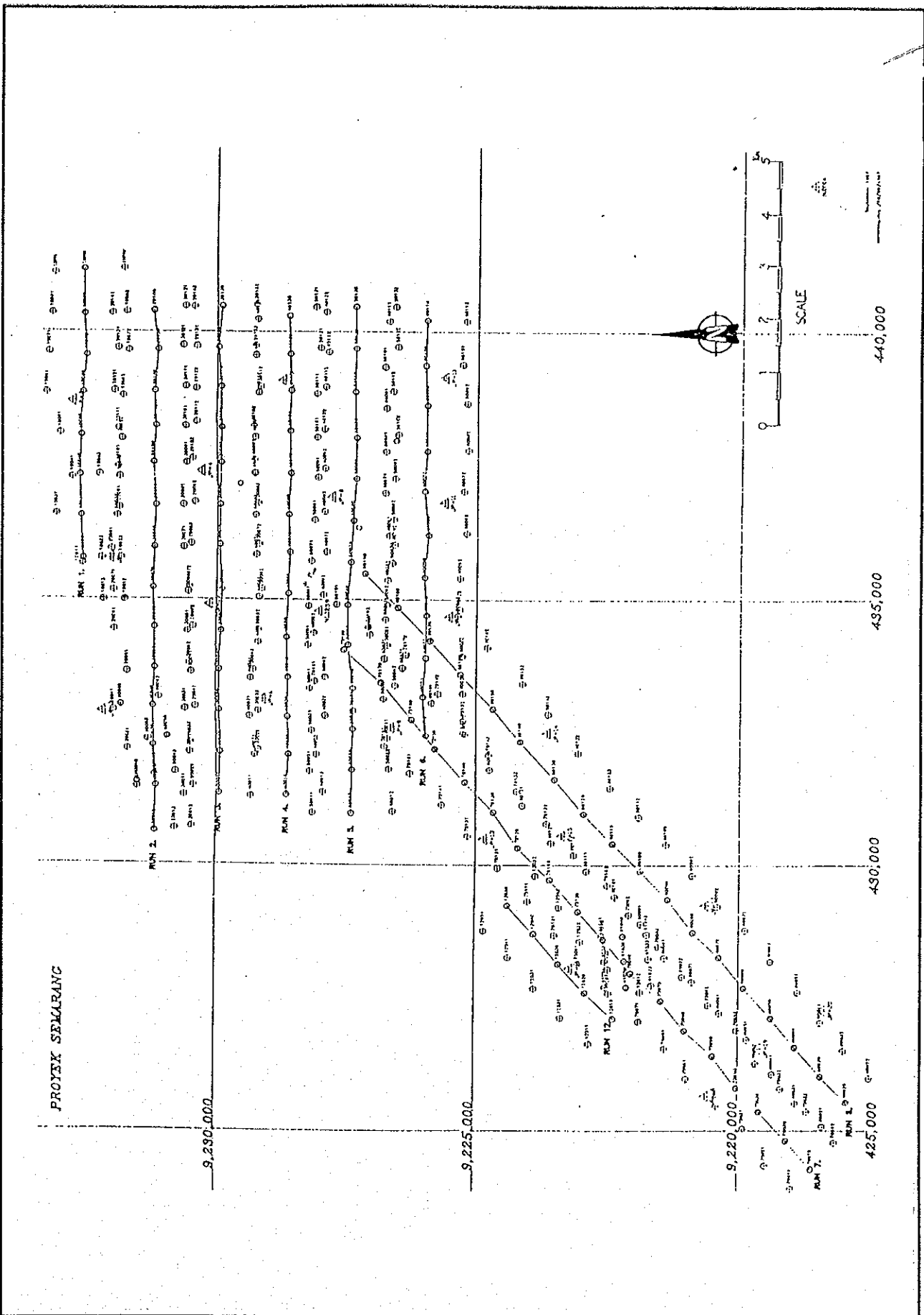
Fig. 3.1.6

LEVELING QUALITY CONTROL (UNGARAN AREA)



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

Fig. 3.1.7
 FIELD VERIFICATION

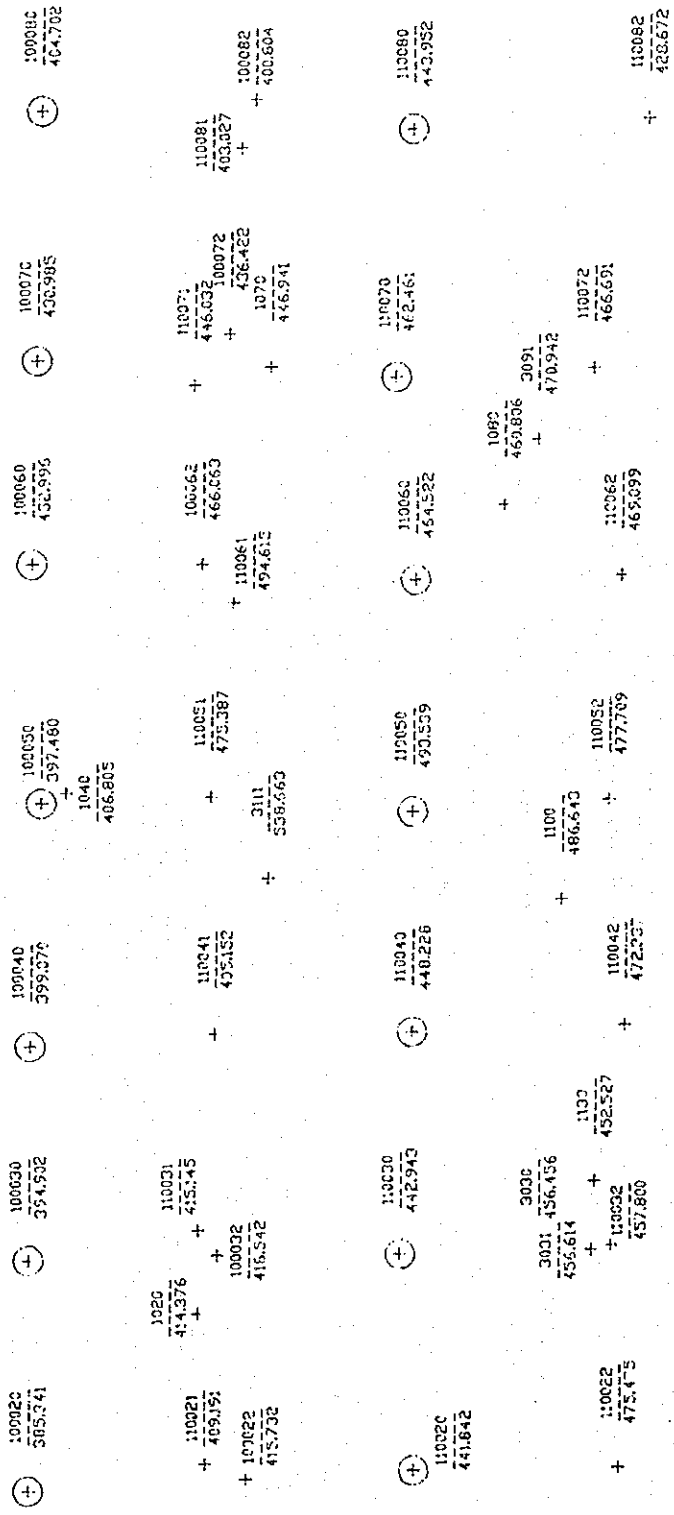


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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Fig. 3.1.8

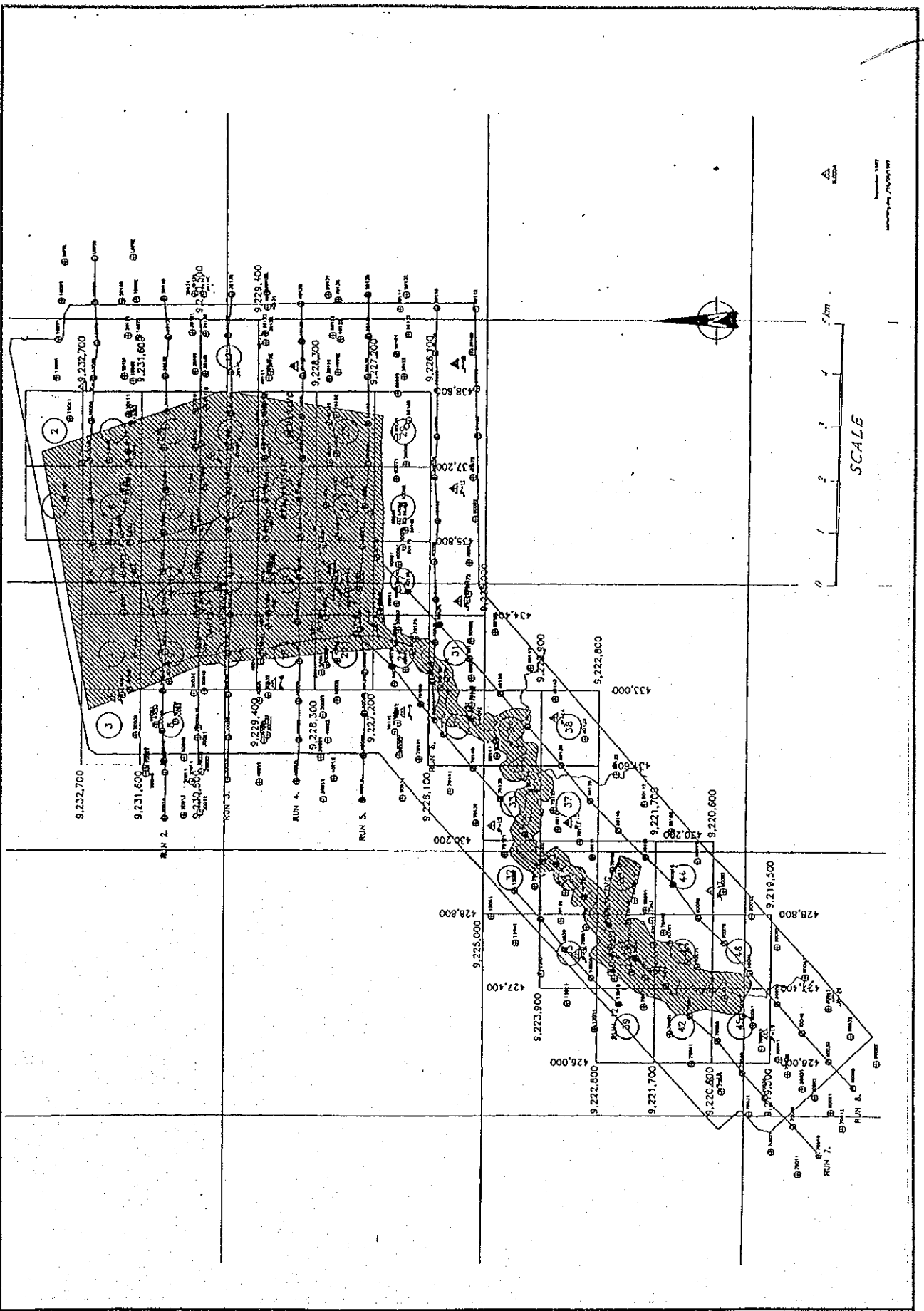
AERIAL TRIANGULATION (SEMARANG AREA)



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)

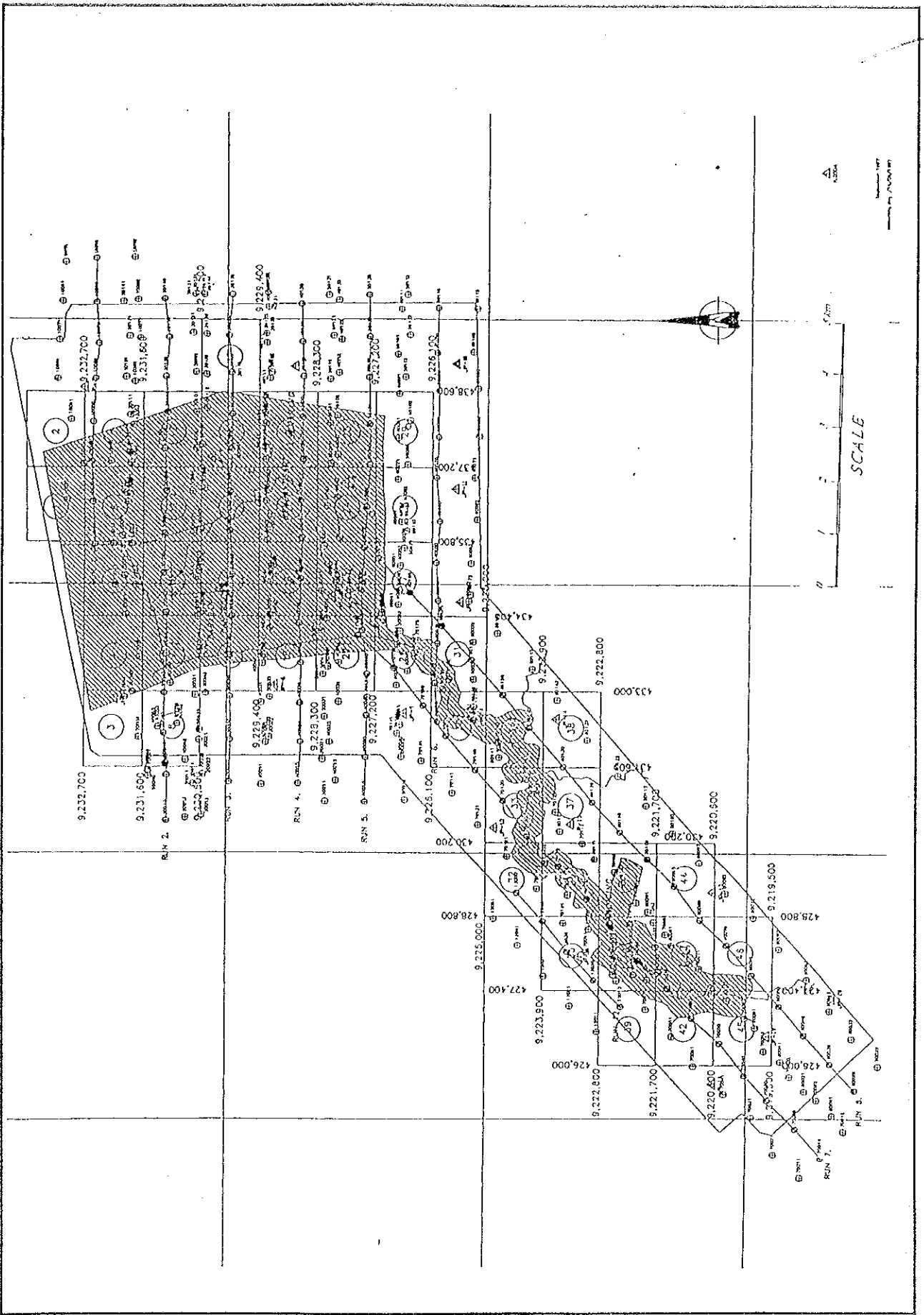


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

Fig. 3.1.10

SHEET INDEX

JAPAN INTERNATIONAL COOPERATION AGENCY

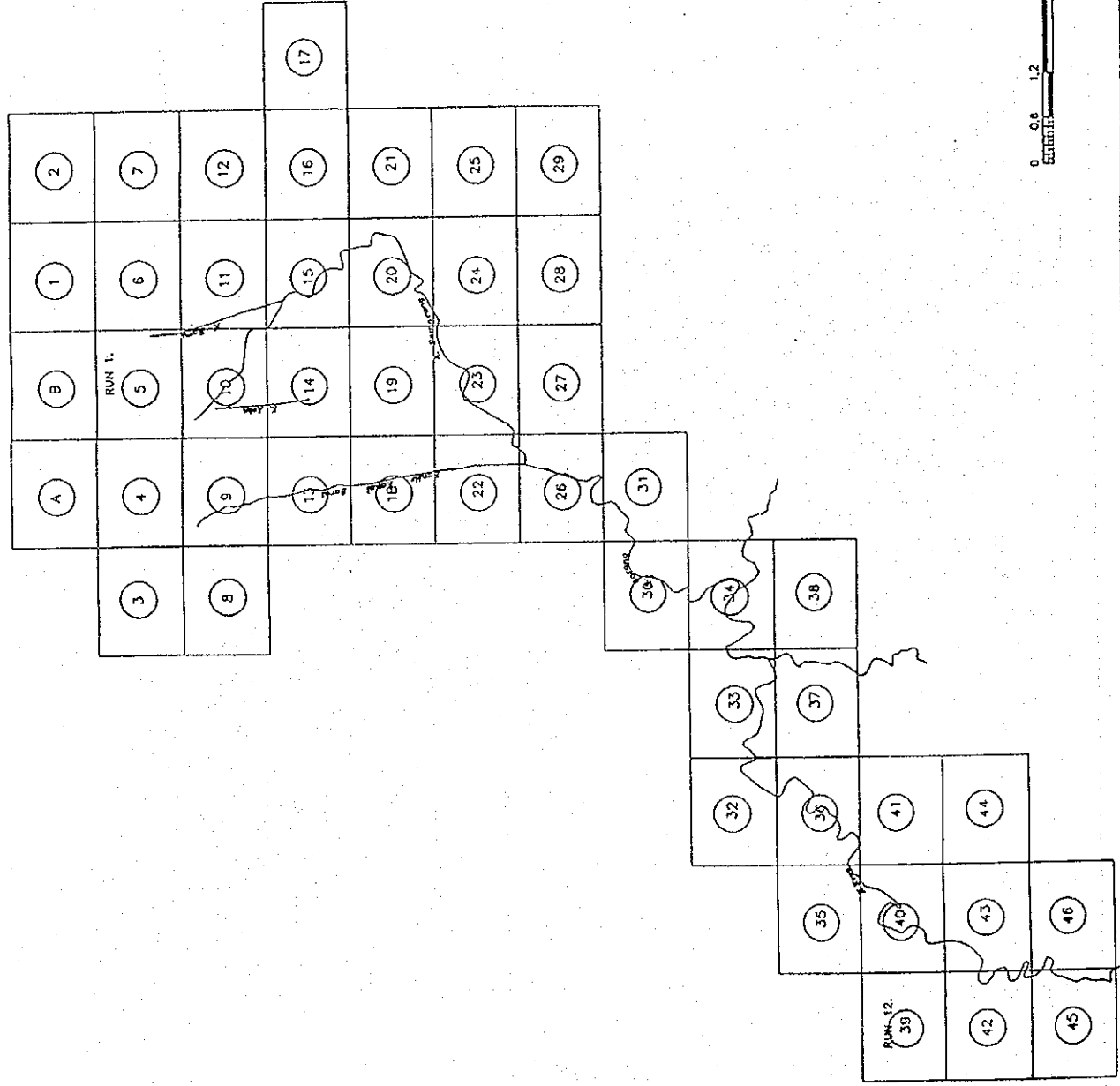


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.10

SHEET INDEX

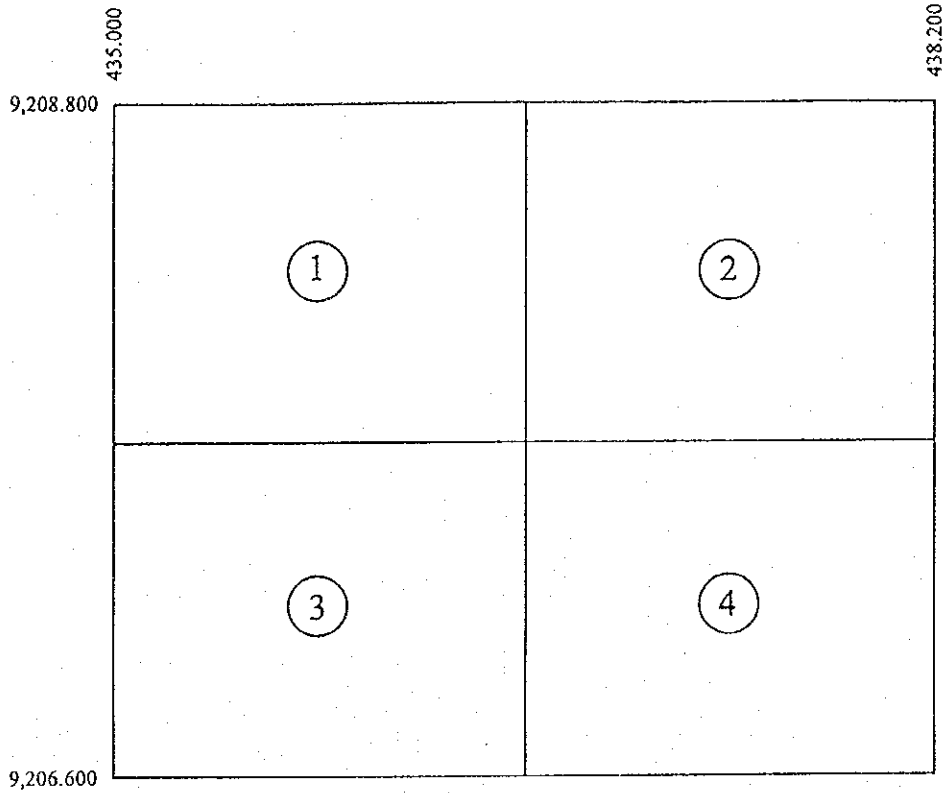


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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Fig. 3.1.11

SHEET INDEX SCALE 1:2,000 (SEMARANG AREA)

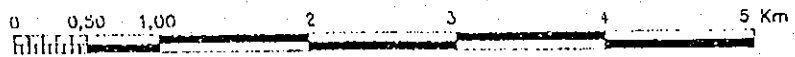
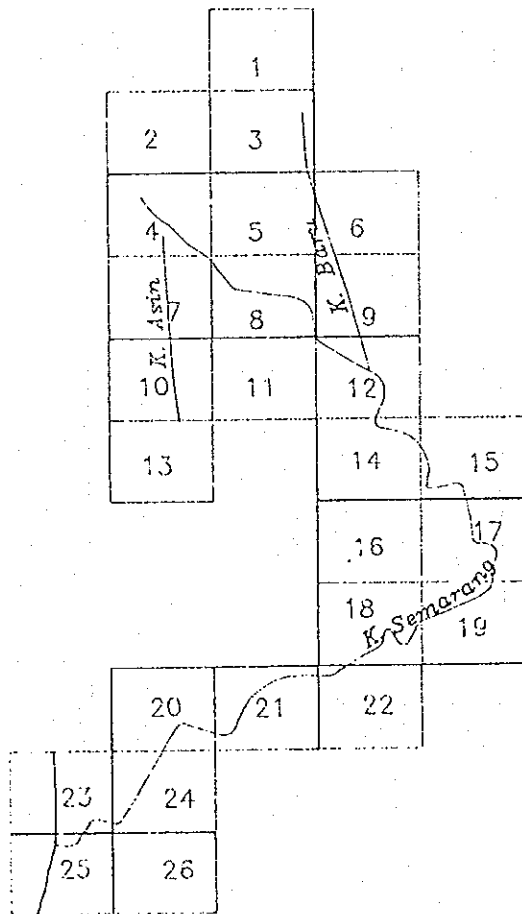


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN
DRAINAGE AND WATER RESOURCES DEVELOPMENT
IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 3.1.12

SHEET INDEX SCALE 1:2,000 (UNGARAN AREA)

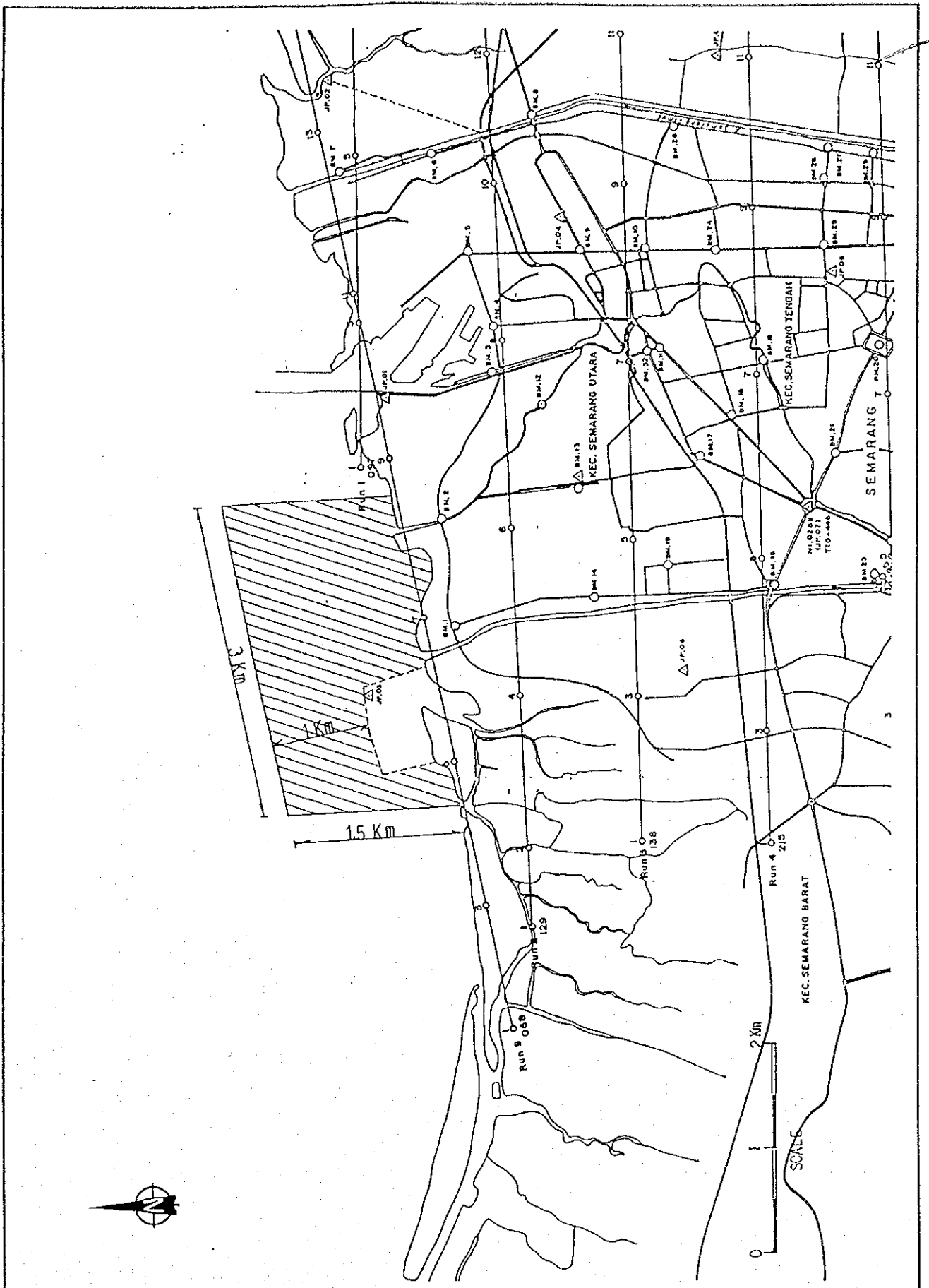


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

Fig. 3.1.13

SHEET INDEX SCALE 1:1,000

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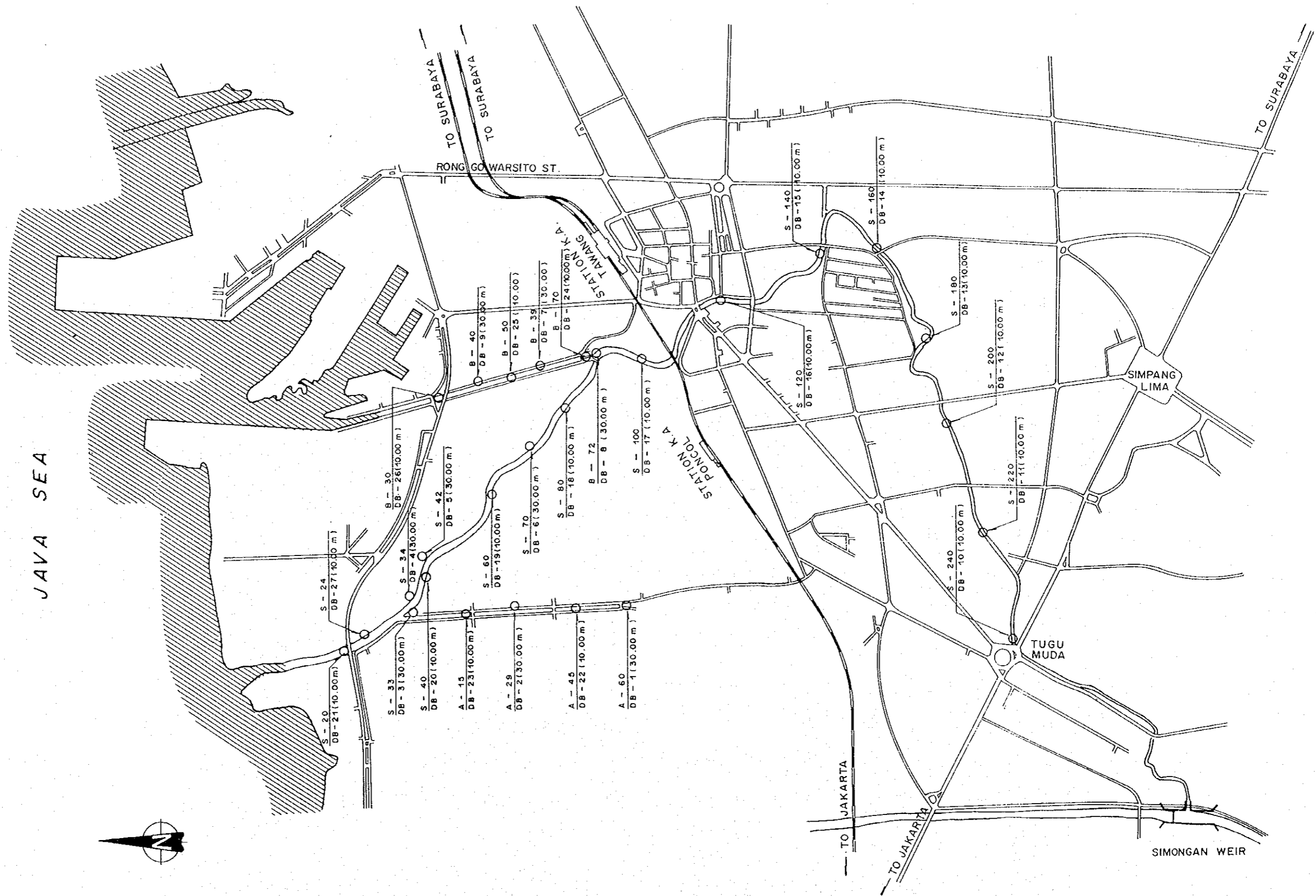
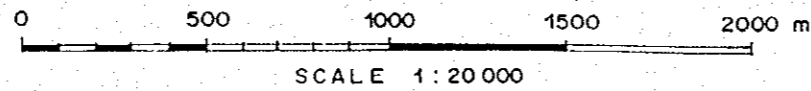
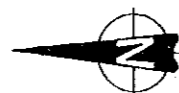


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

Fig. 3.1.14
SOUNDING SURVEY AREA

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JAVA SEA



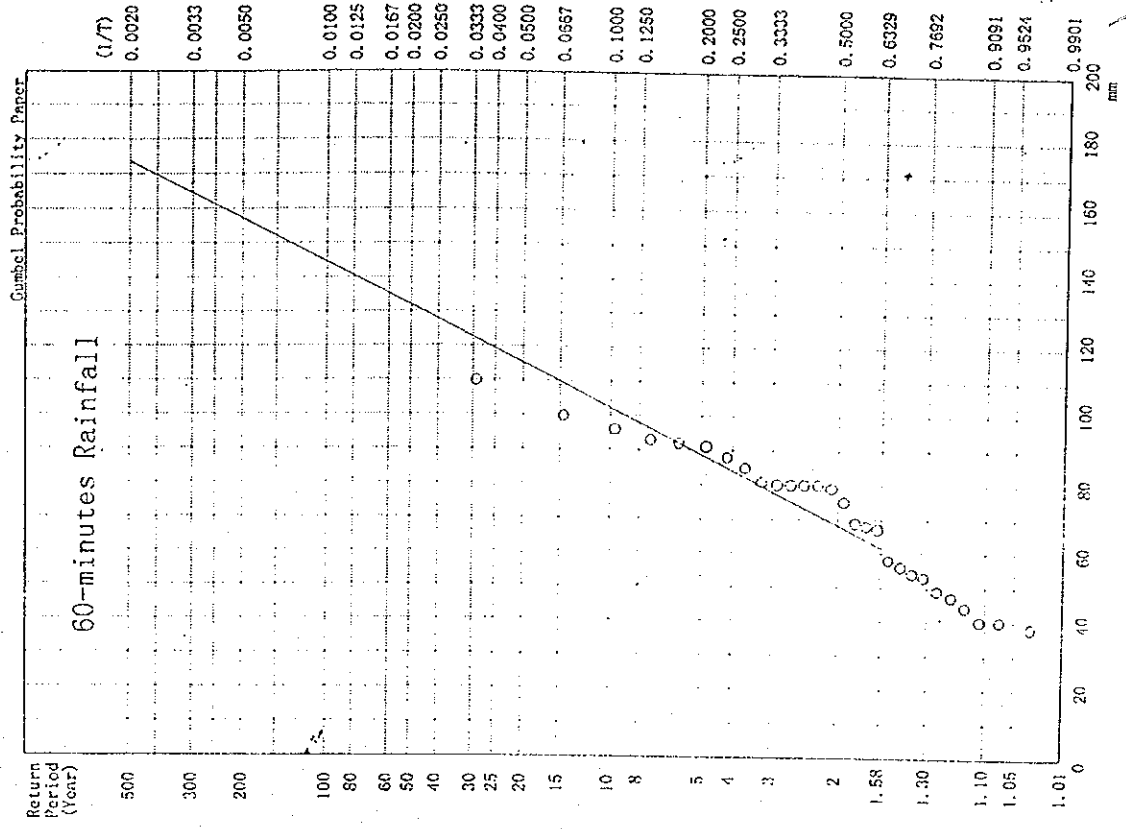
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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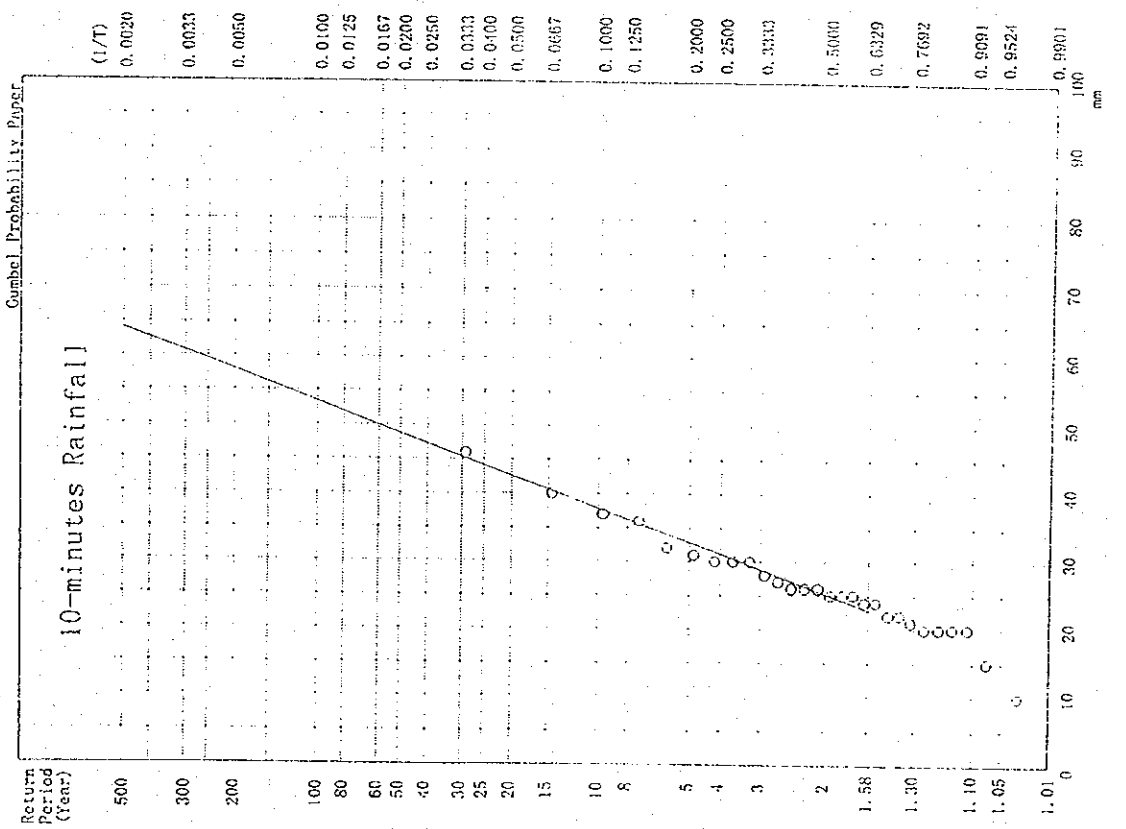
Fig. 3.2.1

LOCATION MAP OF BORINGS

Annual Maximum 60 Minutes Rainfall (mm) at BMG Station



Annual Maximum 10 Minutes Rainfall (mm) at BMG Station

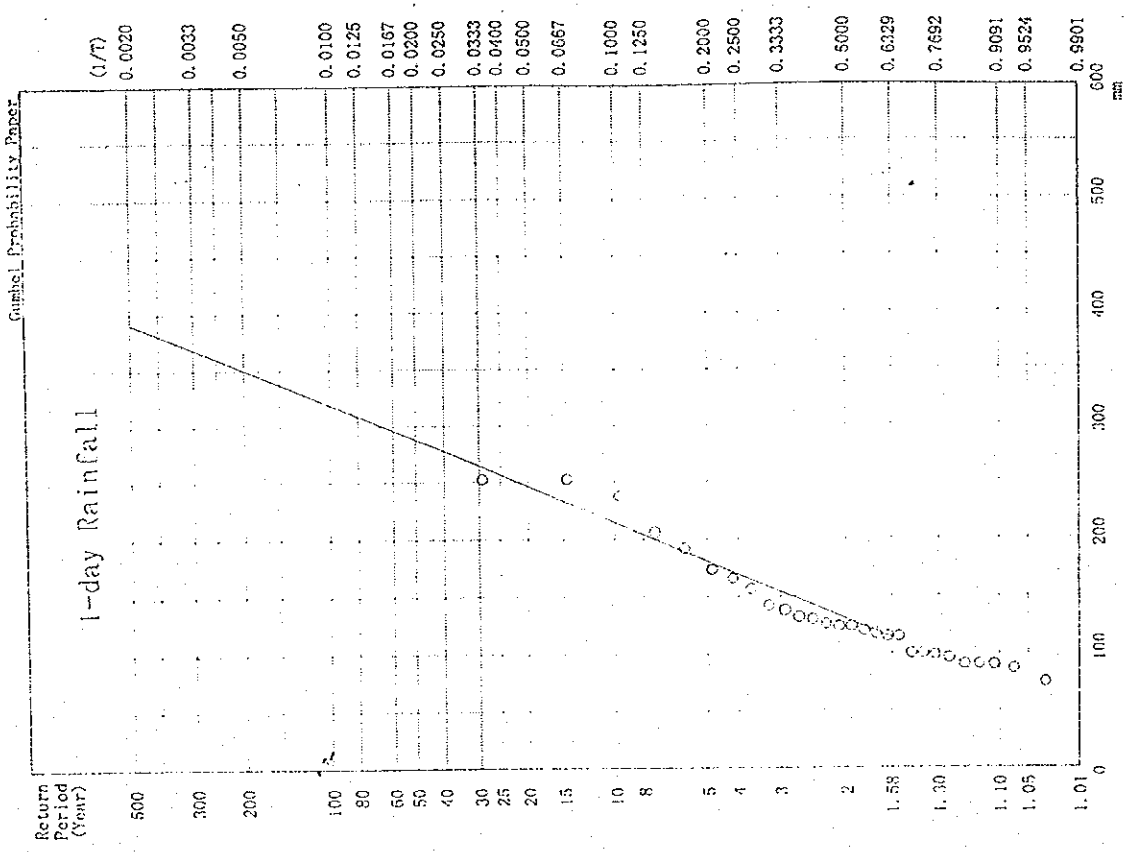


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

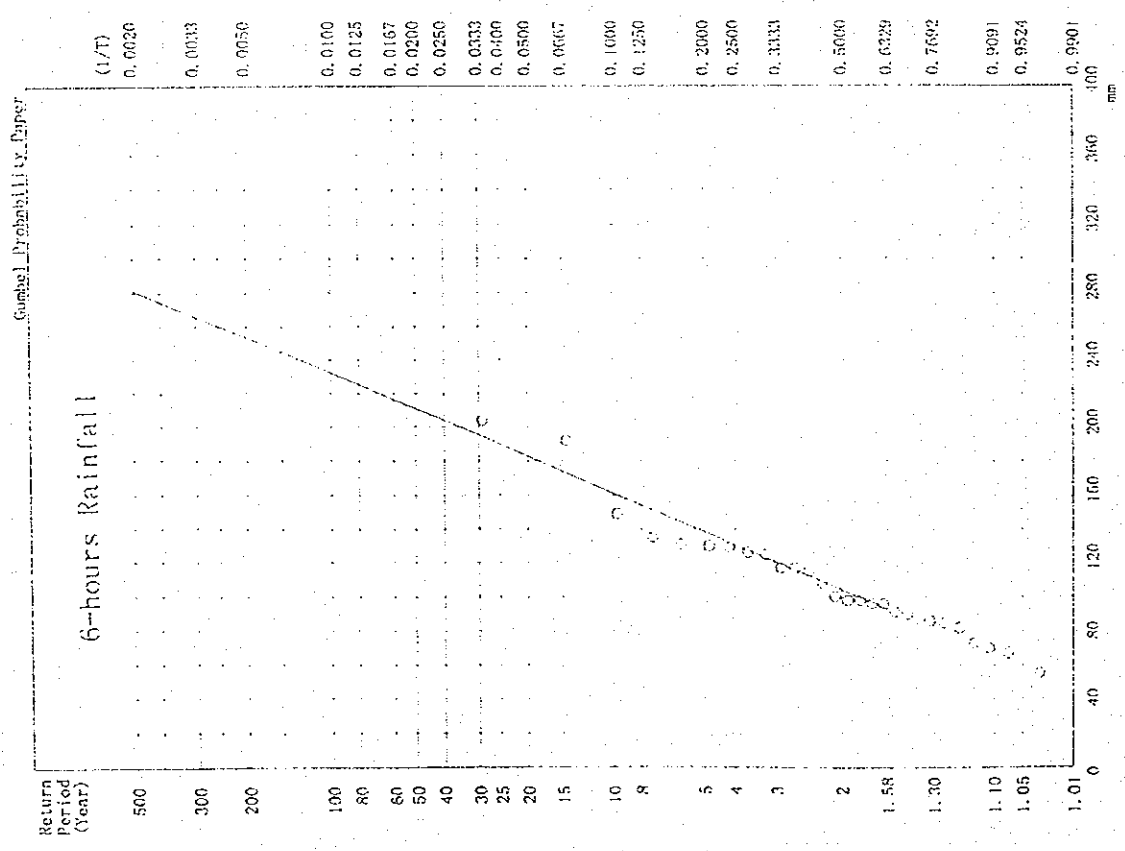
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Fig. 3.3.1 PROBABLE RAINFALL IN 10 AND 60 MINUTES

Annual Maximum 1 Day Rainfall (mm) at BNG Station



Annual Maximum 6 hours Rainfall (mm) at BNG Station



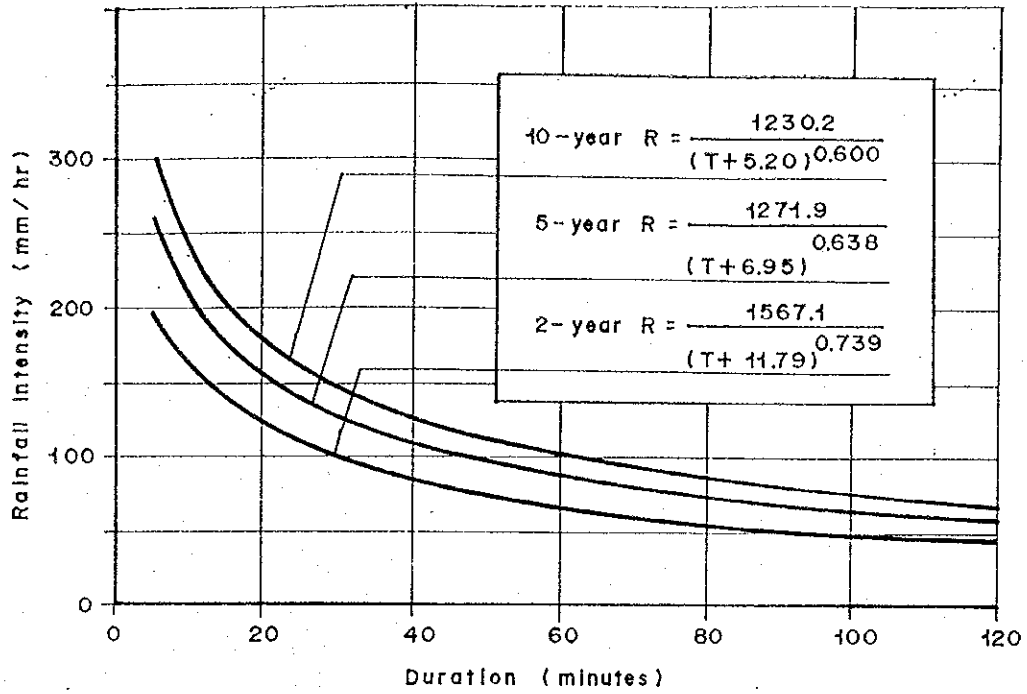
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

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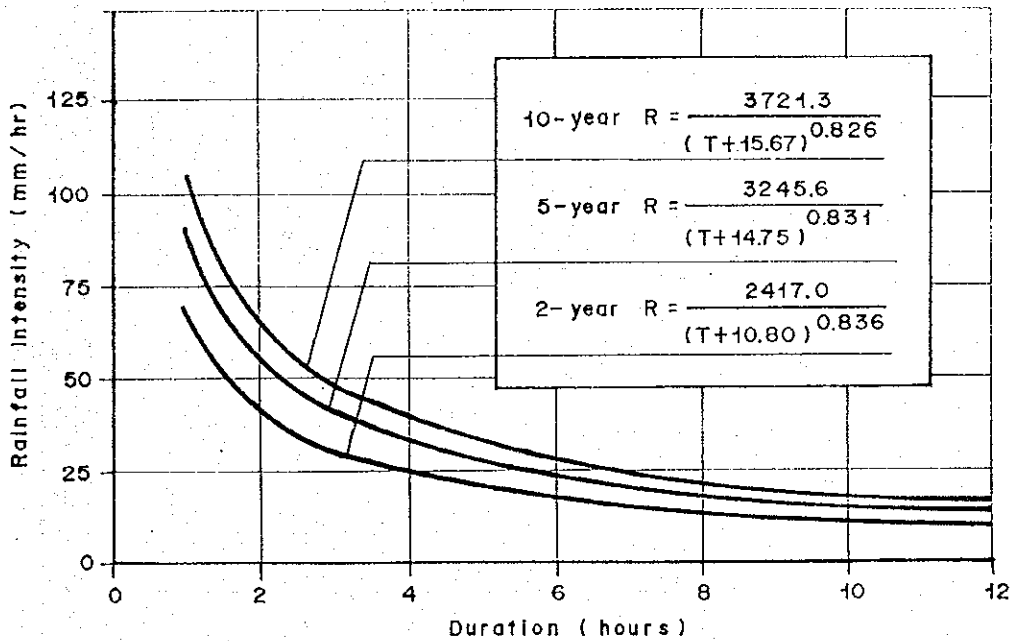
Fig. 3.3.2

PROBABLE RAINFALL IN 6 HOURS AND 1 DAY

Short Duration (T < 2 hours)



Long Duration (T > 1 hour)



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

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Fig. 3.3.3

RAINFALL INTENSITY CURVE

Jakarta Harbour
(TTG)

above MSL

Semarang Harbour
(BPP M2)

above MSL

above LWL

BPP M2 (Top of Bench Mark)

Revised HHWL

Revised HWL

MSL (Mean Sea Level)

Revised MSL

8PP M1 (Top of Bench Mark)

HHWL (Highest High Water Level)

HWL (High Water Level)

Revised LWL

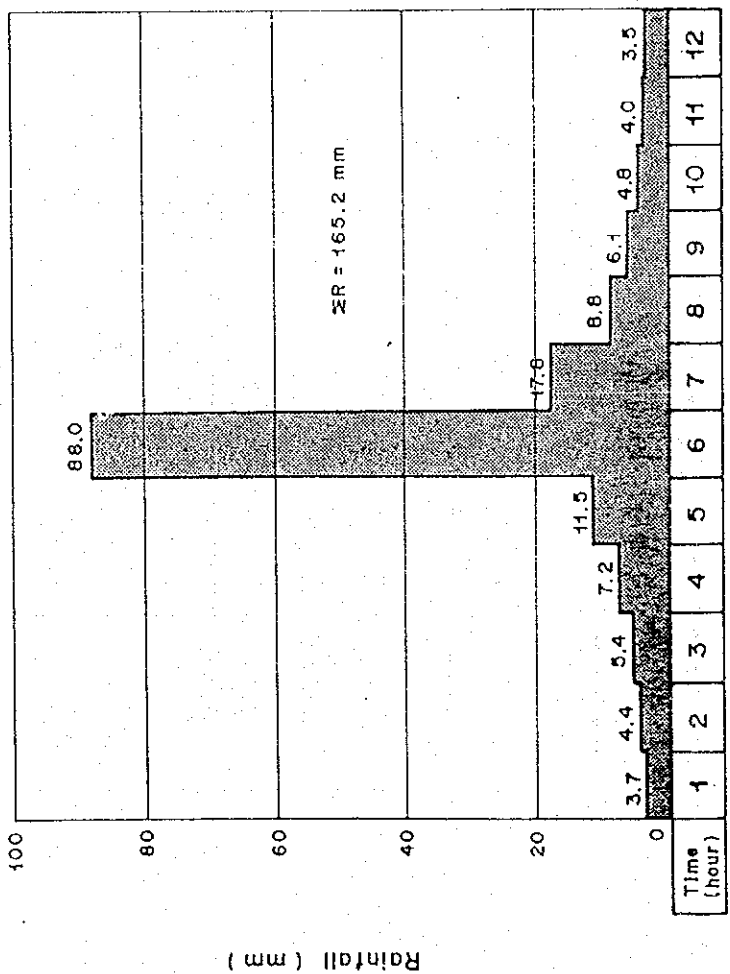
Revised LLWL

MSL (Mean Sea Level)

LWL (Low Water Level)

LLWL (Lowest Low Water Level)

LWL (Low Water Spring)

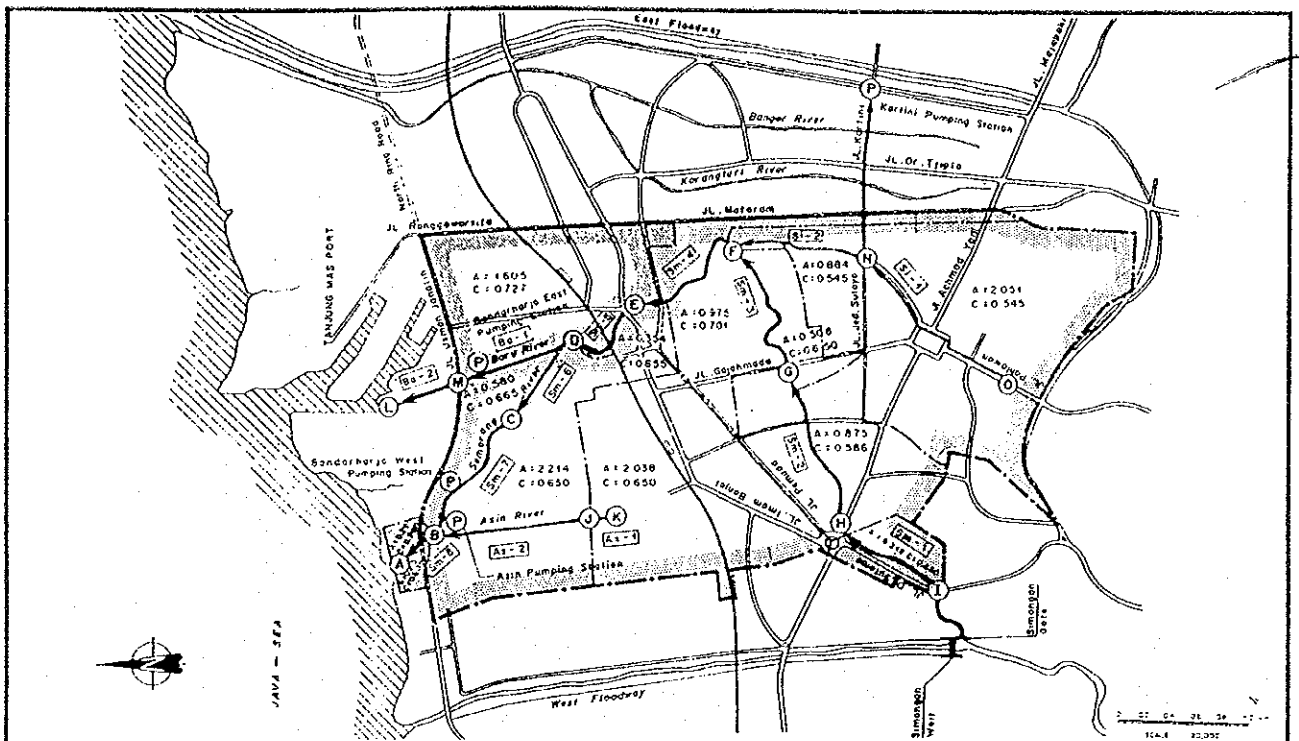


TIDAL LEVEL OF SEMARANG HARBOR

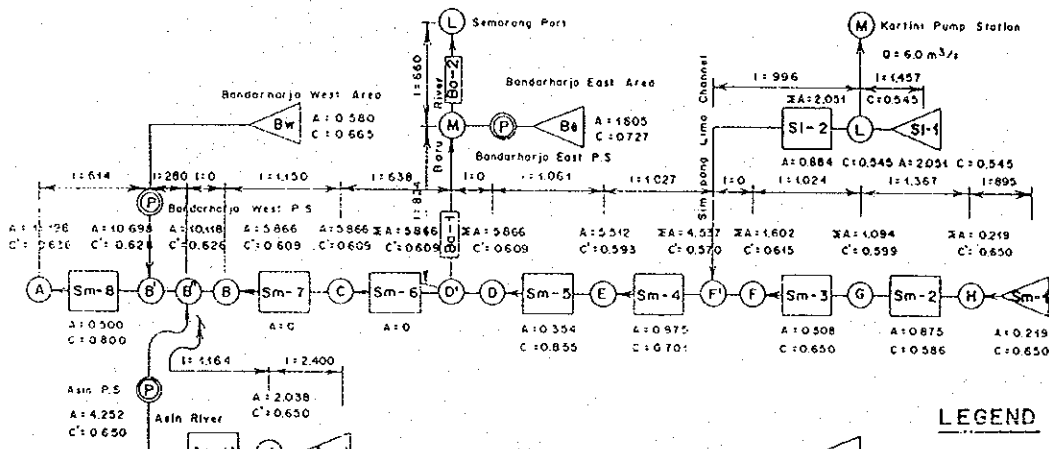
DESIGN RAINFALL FOR PUMP DRAINAGE

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA
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Fig. 3.3.4
DESIGN RAINFALL FOR PUMP DRAINAGE AND TIDAL LEVEL AT SEMARANG HARBOR



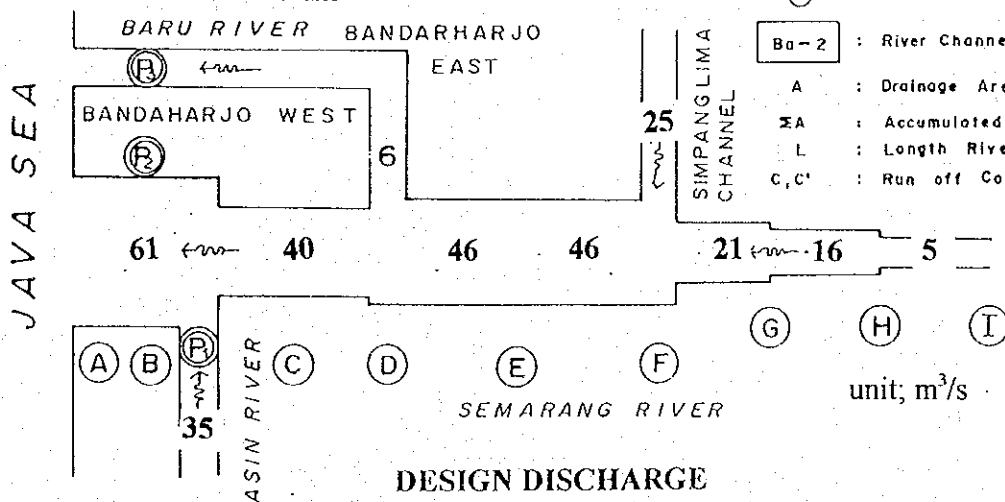
DRAINAGE SYSTEM



RUN-OFF MODEL

LEGEND

- Be-1 : Sub-drainage Area
- (A) : Calculation Point
- Ba-2 : River Channel
- A : Drainage Area (Km²)
- ΣA : Accumulated Drainage Area (Km²)
- L : Length River Channel (m)
- C, C' : Run off Coefficient



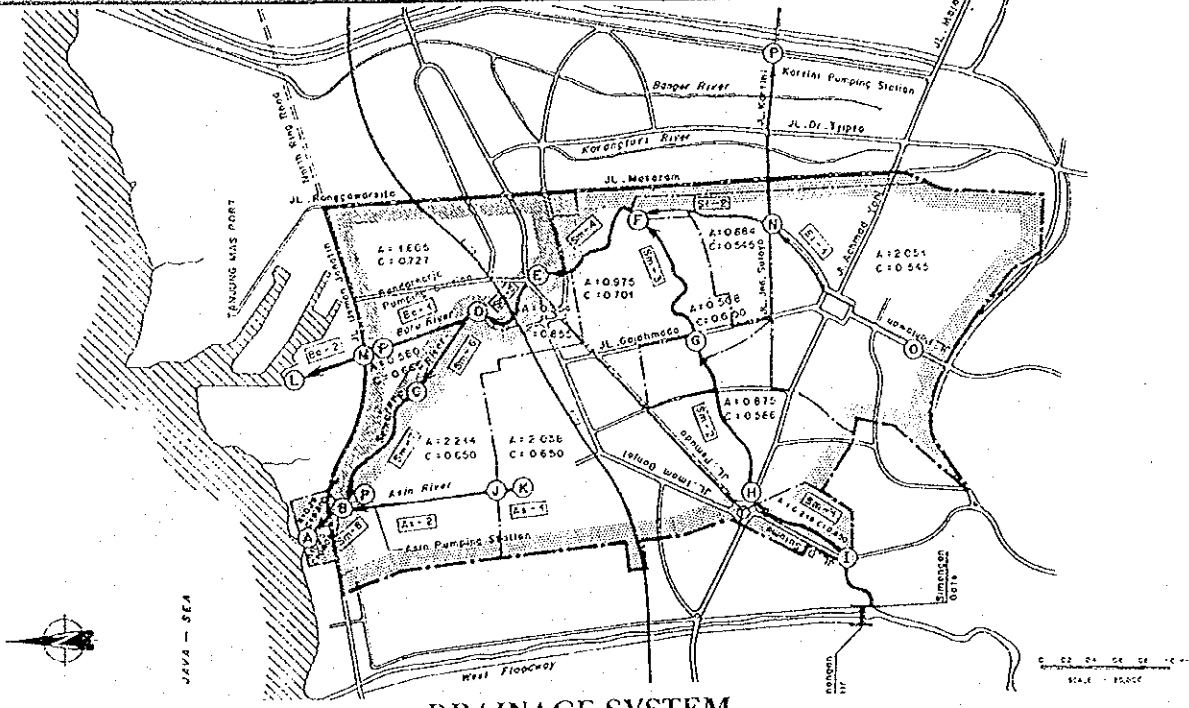
DESIGN DISCHARGE

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

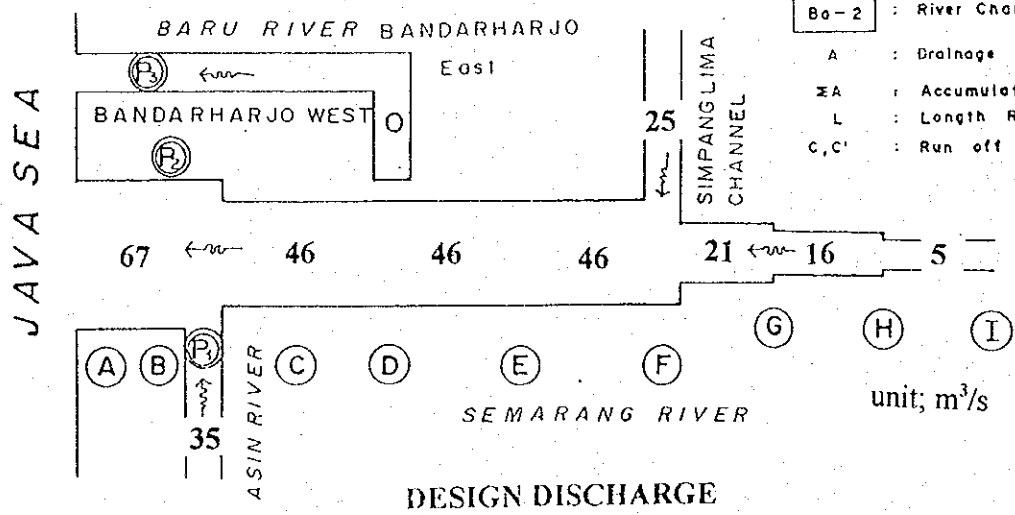
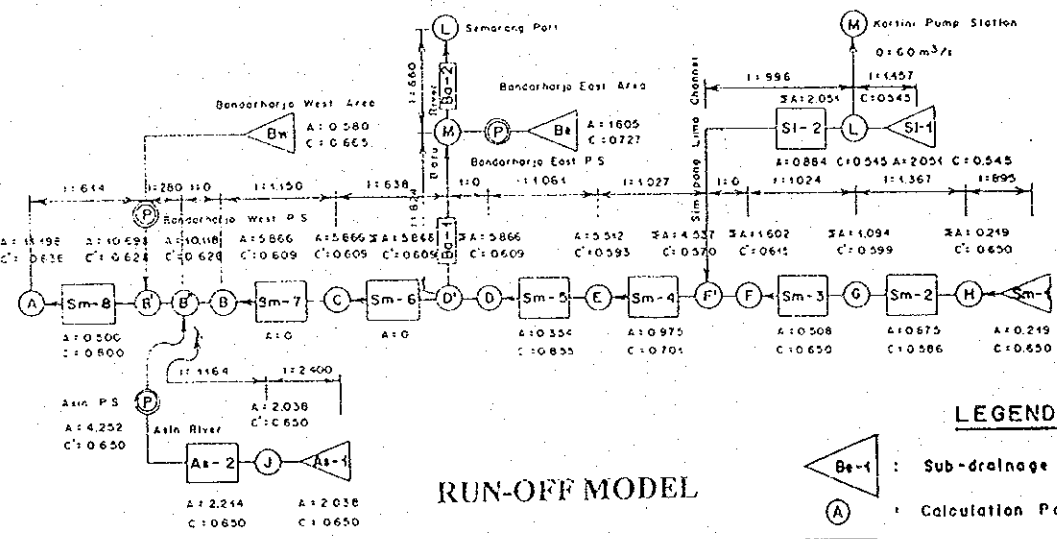
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Fig. 3.3.5 (1/3) -

DESIGN DISCHARGE OF SEMARANG RIVER SYSTEM (OPTION : A)



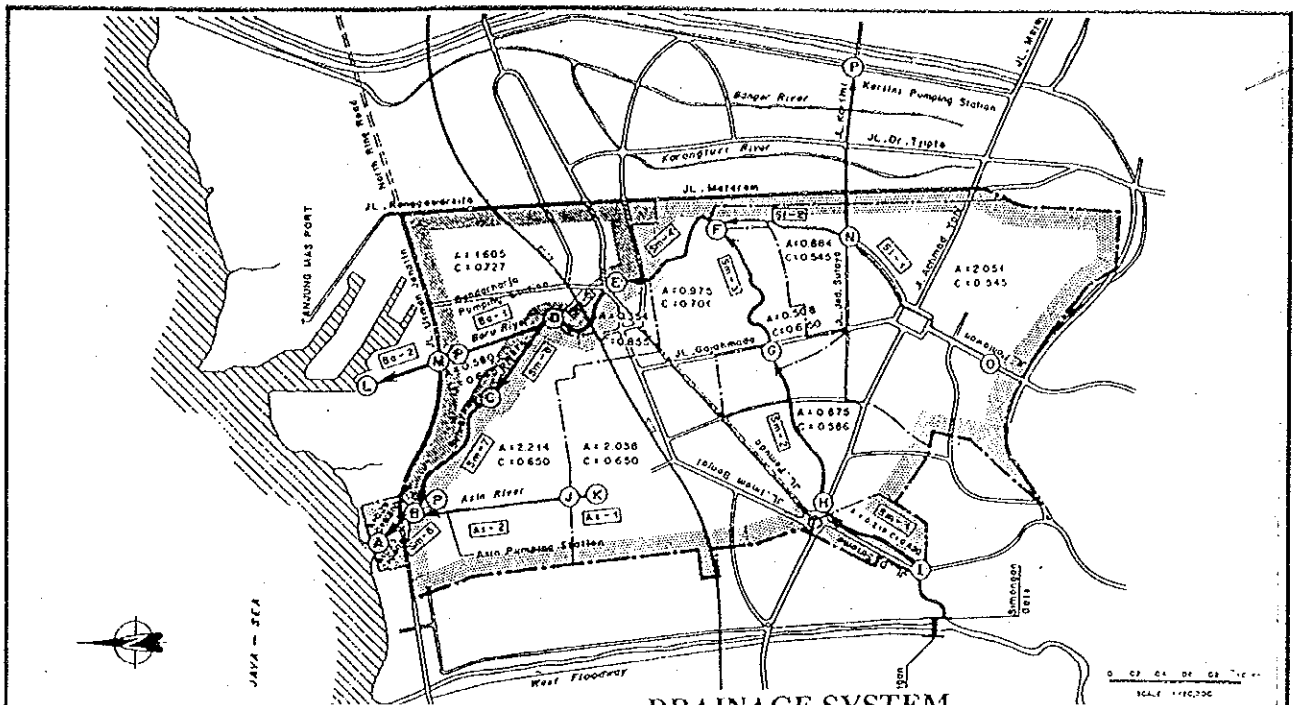
DRAINAGE SYSTEM



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

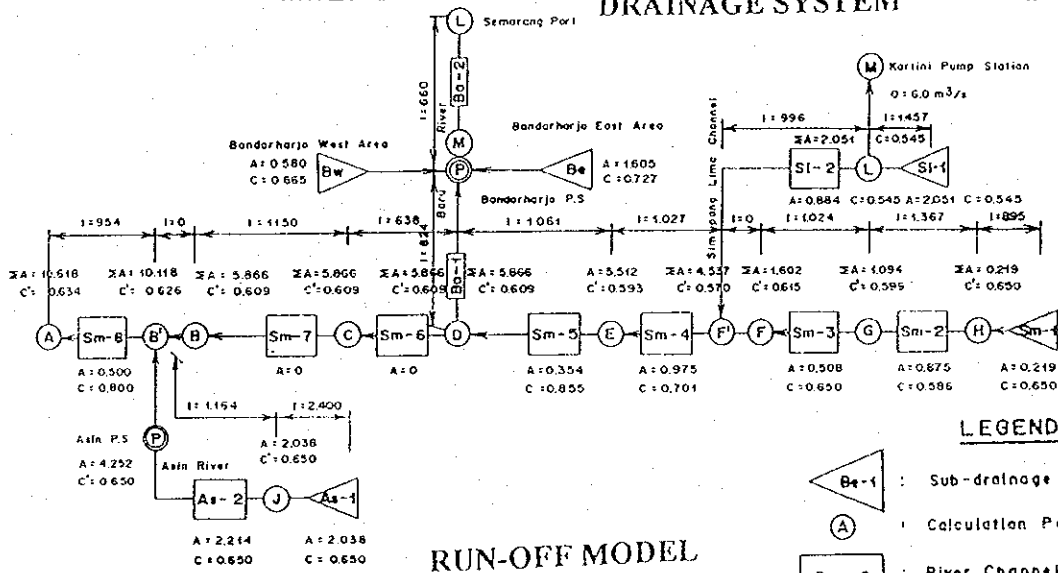
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Fig. 3.3.5 (2/3)
DESIGN DISCHARGE OF SEMARANG RIVER SYSTEM (OPTION : B)



SCALE 1:10000

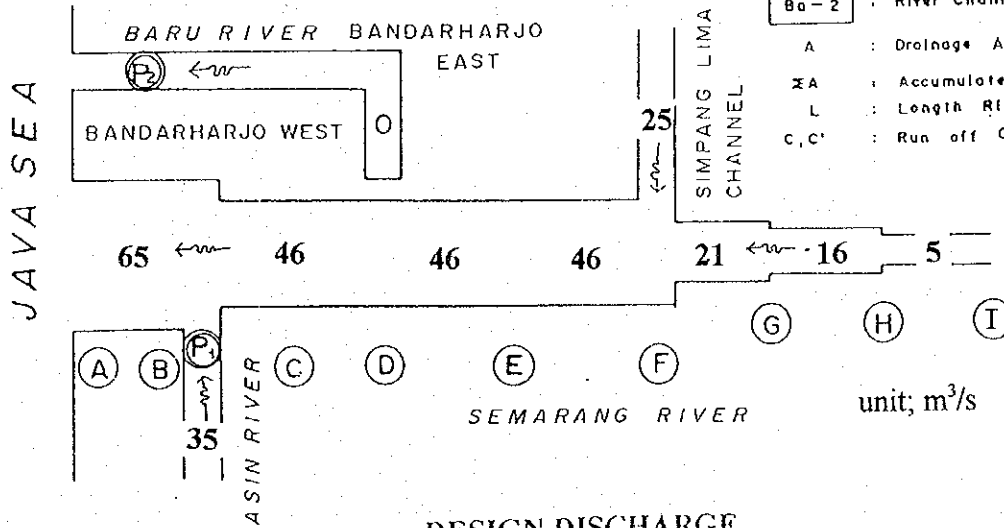
DRAINAGE SYSTEM



LEGEND

- Bw-1 : Sub-drainage Area
- A : Calculation Point
- Ba-2 : River Channel
- A : Drainage Area (Km²)
- ΣA : Accumulated Drainage Area (Km²)
- L : Length River Channel (m)
- C, C' : Run off Coefficient

RUN-OFF MODEL



DESIGN DISCHARGE

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

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Fig. 3.3.5 (3/3)

DESIGN DISCHARGE OF SEMARANG RIVER SYSTEM (OPTION : C)