Potential flood damages to traffic for 1988 and 2010 are assumed to be the same as habitual flood damages to traffic for 1988 and 2010.

The three (3) types of flood damages described above are added together, and the result is multiplied by 120% to arrive at the final amount of flood damages. 20% addition is to incorporate all unspecified/unquantified flood damages including damages to roads and bridges.

Total potential flood damages work out to Rp.135,208.5 million for 1988 and Rp.444,407.5 million for 2010. (Refer to Table B.33).

5.5 Average Annual Flood Damage

5.5.1 Direct Flood Damages to Property

Relationships between return period and inundation depths/durations were established on the assumption that there exists a convex curve relation between them as shown in Table B.34. (This assumption is based on such a relationship existing between return period and basin average daily rainfall.)

Relationships between inundation depths/durations and flood damage ratios for houses, shops and factories have already analysed. (Refer to Table B.18).

These two (2) sets of relationships are combined together. Furthermore, average depths/durations by inundation area for both the habitual and potential year (Table B.10 and B.12), unit value of the house, shop and factory for 1988 and 2010 (Table B.17) and the number of the three (3) types of property by inundation area for *1988 and 2010 (Table B.25 and B.26) are brought in and combined* together.

The resultant equations expressing the relationships between return period and direct flood damages to houses, shops and factories are converted into probability density functions. They are finally integrated by return period for the span of 1/2 to 43 years. (Refer to Fig. B.19 and Table B.35).

Going through these procedures, one gets average annual direct flood damages to the three (3) types of property for 1988 and 2010. (Refer to Table B.36 and B.37).

Taking into account the damages to other property, annual average direct flood damages to property add up to Rp.37,074.6 million for 1988 and Rp.126,136.1 million for 2010.

5.5.2 Income Losses due to Shop Closure

When inundation hits, shops, factories and other establishments are sometimes forced to stop operations for hours or days. During that period, they cannot engage in economic activities, resulting in income losses.

In arriving at average annual income losses due to shop closure, the same procedures as in the preceding Section are followed. Only a few equations and data employed are different. As the dependent variable of inundation depths/durations, the number of non-working days is used instead of flood damage ratio. Also, average daily gross profit per establishment is used in place of unit value of property.

Average annual income losses due to shop closure by inundation area for 1988 and 2010 are shown in Table B.38 and B.39. Taking into account the income losses for other establishments, average annual income losses due to shop closure sum up to Rp.917.7 million for 1988 and Rp.3,561.0 million for 2010.

5.5.3 Other Flood Damages

As mentioned already, it was found out as a result of the sampling questionnaire survey that there is no discernible difference in the traffic damages for the habitual flood year and those for the potential flood year. It means that average annual traffic damages are equal to traffic damages for the habitual or potential flood year.

Table B.40 and B.41 show average annual traffic damages by inundation area for both the habitual and potential flood years. The damages sum up to Rp.1,225.1 million for 1988 and Rp.4,452.6 million for 2010.

Making 20% allowances for the flood damages unaccounted for including damages to roads and bridges, average annual flood damages for the year 1988 and 2010 finally work out at Rp.47,061.0 million and Rp.160,979.7 million respectively. (Refer to Table B.42).

Table B.1 Catchment Area of Sub-basin

No.	River Name			Catchment Area (ha)		
				TOTAL	Inside DKI	Outside DKI
1	Angke			28,540	4,140	24,400
		1 - 1	Angke	26,900	2,500	24,400
		1 - 2	Kreo	790	790	-
		1 - 3	Daanmongot	850	850	-
2	Pesanggrahan & Grogol			15,970	6,330	9,640
		2 - 1	Pesanggrahan	2,210	2,210	-
		2 - 2	Grogol	13,760	4,120	9,640
3	Sekretaris			1,240	1,240	-
4	Krukut			10,530	7,330	3,200
		4 - 1	Krukut	7,420	4,220	3,200
		4 - 2	Mampang	3,110	3,110	-
5	Cideng			1,810	1,810	-
6	K. Bata			820	820	-
7	Ciliwung			31,850	3,610	28,240
8	Anak Ciliwung			560	560	-
9	Ciliwung Sahari			110	110	-
10	Sentiong			3,250	3,250	-
11	Cipinang			6,540	3,480	3,060
12	Sunter			11,330	8,490	2,840
13	Buaran			4,340	1,500	2,840
		13 - 1	Buaran	1,130	1,130	-
		13 - 2	Jati Kramat	3,210	370	2,840
14	Cakung (1)			5,600	1,600	4,000
15	Cakung (2)			3,040	3,040	-
16	Malang			1,440	1,440	-
17	Kali Baru Barat/Ps. Minggu			240	240	-
18	Mookervart			1,200	1,200	-
19	Maja			1,200	1,200	-
20	Camal			1,360	1,360	-
21	Angke Jelambar			1,500	1,500	-
22	Pakin			520	520	-
23	Duri			270	270	-
24	Belencong			4,330	4,330	-
25	Lagoa			710	710	-
26	Lagoa Buntu			480	480	-
27	BAY DRAINAGE AREA			4,589	4,589	-
TOTAL				143,369	65,149	78,220

Source : JICA

Table B.2 Observation Period of Daily Rainfall Data

No. of G/S	Name of Station	Available Period	Total Year
24 A	Teluk Naga	1963-67, 77, 83, 85	8
24 B	Kamal Muara	1972-73, 78-79, 81-86	10
26	Tanjung Priok	1959-60, 69-88	22
26 A	Cengkareng/Kapuk	1959-64, 68-88	27
26 C	Pasar Ikan	1952-60, 77	10
26 D	Cilincing/Marunda	1957-73, 81, 84, 86, 88	21
26 F	Jembatan Dua	1954-71, 81, 83	20
26 G	Kedoya	1979-83, 87-88	7
27	Jakarta-BMG	1942-88	47
27 A	Jatibaru	1950-62, 80	14
27 B	Kemayoran	1951-85	35
28 A	Manggarai-PJKA	1961-72, 83, 84	14
28 B	P.A. Manggarai	1976-79, 83	5
28 C	P.A. Setiabudi	1976-79, 81-86	10
28 D	Waduk Melati	1976-79, 81-86	10
28 E	P.A Karet	1954-79, 81-88	31
29 B	BPMD. Klender	1952-60, 69-70, 77-79, 80-85	20
29 C	P.A Pulogadung	1978-79, 83-87	7
29 D	Pulo Gebang	-	0
30	Tangerang	1947-54, 57-60, 72-76, 81-88	25
30 E	Lengkong	1947-66, 74-75, 77-85, 87	32
30 F	Tangerang-Geofisika	72-88	17
30 H	Peristengan	1948-76, 81-88	37
30 I	Pasarbaru-Tangerang	1975-79, 81-88	13
30 J	Curug	1961-88	28
31 A	Pondok Jagung	1948-66, 78-84	26
31 B	Kawaraci	1952-76, 77-83	32
32 A	Kebayoran Lama	1951-61, 71-76, 78-81	21
32 B	Kebayoran Baru	1949-58, 78-84	17
32 C	Pondok Betung	1976-88	13
32 D	Lebak Bulus	-	0
33 A	Ragunan	1927-1945, 1949-84	45
33 B	Jatipadang	1948-83	36
33 C	Halim Perdanakusuma	1946-88	43
33 D	Pondok Gede	1953-58, 64-70, 72-74, 81-82	18
34 A	Serpong	1951-69, 71-76, 77-88	37
35	Ciputat	1955-65, 67-69, 71-74, 81-83	21
35 A	Paweya	1948-56, 69-76, 77-78	19
35 D	Pondok Ranggun	1978-81	4
36	Depok	1930-41, 51-69, 72-88	48
36 B	Sawangan	1921-42, 52-57, 67-85	47
78	Cileungsi	1971-77	7
78 H	Kranji	1971-73, 77	4

Table B.3 Observation Period of Continuous Rainfall

No. of G/S	Name of Station	Available Period	Total Year
26	Tanjung Priok	1975 - 88	14
27	Jakarta - BMG	1958 - 62, 64 - 88	30
27 B	Kemayoran	1966, 68 - 69, 71 - 76, 78 - 84	16
30 F	Tangerang Geofisika	1971 - 76	6
32 C	Pondok Betung	1975 - 88	14
33 C	Halim Perdanakusuma	1957 - 58, 61 - 67, 74 - 88	24

Table B.4 Rainfall Intensity Duration Curve in Master Plan of 1973

(Unit : mm/hour)

Duration (Minutes)	Return Period			
	2 Year	5 Year	10 Year	25 Year
0	0	0	0	0
10	117	134	144	160
20	101	115	124	137
30	87	100	109	119
40	76	89	98	107
50	68	80	89	98
60	62	74	81	91
70	56	68	75	84
80	51	63	69	78
90	47	58	65	73
100	44	54	61	68
110	40	50	57	64
120	37	47	54	61
150	31	39	46	52
180	26	34	40	46

Source : Master Plan for Drainage and Flood Control of Jakarta, 1973

Table B.5 Annual Maximum Rainfall Data

(Unit : mm)

Year	Rainfall Duration (Minutes) 5	10	15	30	45	60	120	180
1959	15.6	29.6	48.5	67.9	77.6	86.3	99.2	100.2
1961	11.4	19.4	31.5	42.6	47.8	58.8	71.9	99.7
1962	9.9	18.2	25.3	50.5	70.0	85.0	88.0	91.8
1965	17.2	21.7	30.2	41.0	42.9	45.0	51.7	57.7
1966	11.3	18.8	26.7	39.2	45.0	48.0	49.5	52.9
1967	10.2	20.0	30.0	41.0	55.0	67.2	79.0	81.0
1968	10.0	20.0	28.2	40.4	50.0	52.2	58.0	61.3
1969	10.0	20.0	30.0	54.2	65.1	68.1	75.8	78.3
1971	8.0	14.6	24.0	36.2	39.6	41.3	58.7	65.2
1972	10.0	20.0	28.5	40.0	52.5	58.0	67.0	80.7
1973	11.4	21.0	32.0	46.5	56.2	66.0	75.2	76.3
1974	12.4	20.0	29.4	46.5	54.0	63.3	75.2	83.0
1975	12.3	19.2	20.3	39.0	56.2	65.0	66.1	67.3
1976	15.0	20.0	40.0	60.0	77.5	89.8	97.3	101.4
1977	10.0	20.0	30.0	52.3	70.0	78.0	123.0	139.5
1978	14.6	20.0	30.0	47.0	53.5	60.4	66.1	68.7
1979	15.2	25.1	34.8	70.4	89.9	114.7	158.5	177.3
1982	7.3	14.6	22.0	43.9	44.0	57.3	65.3	65.3
1983	8.0	15.0	21.0	42.0	65.0	83.1	88.2	90.7
1984	5.0	10.0	14.0	24.0	32.6	39.4	51.6	54.9
1985	6.1	12.0	15.3	30.5	45.0	60.0	107.0	114.8
1987	7.5	15.0	20.0	40.0	41.0	50.0	55.8	77.2
1988	12.5	20.0	25.0	40.0	54.5	64.5	64.5	64.5

Source : BMG

Table B.6 Result of Frequency Analysis by Iwai's Method

(Unit : mm)

Rainfall Duration	Return Period					
	1.5	2	5	10	20	25
5 min.	9.12	10.44	13.22	14.79	16.14	16.54
10 min.	16.67	18.43	21.94	23.82	25.41	25.87
15 min.	23.61	26.69	33.24	36.98	40.23	41.21
30 min.	39.58	43.83	53.21	58.74	63.67	65.17
45 min.	48.81	54.25	67.01	75.00	82.40	84.70
60 min.	56.29	63.14	78.36	87.41	95.51	97.98
120 min.	66.20	74.58	97.98	115.26	133.05	138.93
180 min.	71.78	80.98	106.72	125.79	145.43	151.94

Table B.7 Result of Frequency Analysis by Pearson Type III's Method

(Unit : mm)

Rainfall Duration	Return Period					
	1.5	2	5	10	20	25
5 min.	9.13	10.44	13.56	15.55	17.41	18.00
10 min.	16.68	18.43	22.39	24.79	26.97	27.64
15 min.	23.65	26.96	33.31	35.76	39.86	41.14
30 min.	39.60	43.83	53.45	59.30	63.60	65.23
45 min.	48.40	53.88	66.76	74.86	82.40	84.75
60 min.	55.76	62.42	78.58	89.08	97.50	100.21
120 min.	63.71	71.49	93.79	110.75	128.65	134.68
180 min.	68.91	77.31	101.94	121.04	141.48	148.41

Table B.8 Result of Frequency Analysis by Gumbel's Method

(Unit : mm)

Rainfall Duration	Return Period					
	1.5	2	5	10	20	25
5 min.	9.12	10.44	13.70	15.86	17.93	18.58
10 min.	16.57	18.28	22.49	25.28	27.95	28.80
15 min.	23.42	26.58	34.33	39.47	44.39	45.96
30 min.	38.99	43.44	54.40	61.66	68.62	70.83
45 min.	47.94	53.81	68.24	77.80	86.97	89.88
60 min.	55.28	62.68	80.89	92.95	104.51	108.18
120 min.	63.42	74.17	100.62	118.13	134.93	140.26
180 min.	68.48	80.54	110.20	129.84	148.68	154.65

Table B.9 Relationship between Rainfall Intensity and Duration

(Unit : mm/hour)

Rainfall Duration	Return Period					
	1.5	2	5	10	20	25
5 min.	109.58	125.29	162.77	186.62	208.94	215.94
10 min.	100.06	110.55	134.34	148.75	161.80	165.82
15 min.	94.60	107.84	133.24	143.04	159.44	164.56
30 min.	79.20	87.66	106.91	118.59	127.20	130.46
45 min.	64.53	71.83	89.01	99.81	109.86	113.00
60 min.	55.76	62.42	78.58	89.08	97.50	100.21
120 min.	31.86	35.75	46.89	55.37	64.32	67.34
180 min.	22.97	25.77	33.98	40.35	47.16	49.47

Table B.10(1) Survey Result for Habitual Flood Area

Flood Area No.	Flood Area (ha)	Depth of Inundation		Duration of Inundation	
		Max. (m)	Mean. (m)	Max. (hour)	Mean. (hour)
1	30.6	0.25	0.10	77	18
2	49.0	0.30	0.13	70	18
3	27.0	0.25	0.10	68	16
4	24.5	0.20	0.10	65	15
5	52.7	0.30	0.14	75	19
6	40.4	0.20	0.17	48	18
7	18.4	0.50	0.41	96	35
8	24.5	0.50	0.21	24	8
9	30.6	0.40	0.20	24	8
10	24.5	0.50	0.22	24	8
11	36.8	0.25	0.11	72	22
12	102.9	0.50	0.22	24	13
13	17.2	0.25	0.14	24	7
14	16.0	0.25	0.13	24	7
15	8.6	0.30	0.15	24	7
16	24.5	0.30	0.14	48	17
17	41.6	0.50	0.27	144	43
18	53.9	0.45	0.25	72	36
19	41.7	0.55	0.29	72	36
20	44.1	0.40	0.24	96	39
21	25.7	0.45	0.25	72	30
22	47.8	0.20	0.15	48	20
23	30.6	0.25	0.18	24	23
24	36.8	0.50	0.27	24	19
25	69.8	0.50	0.16	168	17
26	56.4	0.45	0.14	48	18
27	12.3	0.55	0.18	48	16
28	25.7	0.55	0.17	72	19
29	211.9	0.50	0.18	168	41
30	85.8	0.55	0.22	72	36
31	58.8	0.55	0.25	48	24
32	36.8	0.45	0.15	36	18
33	46.6	0.50	0.20	60	33
34	29.4	0.50	0.29	24	18
35	24.5	0.45	0.25	24	15
36	18.4	0.45	0.23	24	19
37	20.8	0.50	0.31	24	16
38	41.7	0.30	0.15	168	40
39	90.7	0.25	0.11	36	17
40	153.1	0.35	0.17	48	18
41	215.6	0.25	0.11	72	24
42	29.4	0.20	0.17	36	22
43	73.5	0.30	0.18	24	16
44	61.3	0.20	0.18	2	2
45	47.8	0.75	0.27	168	20

Table B.10(2) Survey Result for Habitual Flood Area

Flood Area No.	Flood Area (ha)	Depth of Inundation		Duration of Inundation	
		Max. (m)	Mean. (m)	Max. (hour)	Mean. (hour)
46	22.1	0.50	0.17	36	13
47	18.4	0.50	0.20	36	12
48	39.2	0.50	0.23	48	13
49	45.3	0.50	0.22	36	15
50	45.3	0.40	0.18	24	13
51	33.1	0.50	0.45	1	1
52	14.7	0.05	0.10	1	1
53	28.2	0.20	0.11	1	1
54	74.7	0.60	0.36	5	3
55	39.2	0.70	0.41	24	7
56	20.8	0.30	0.14	5	3
57	15.9	0.80	0.80	5	5
58	34.3	0.20	0.13	2	2
59	49.0	0.35	0.25	3	2
60	39.2	0.40	0.28	3	2
61	40.4	0.10	0.10	12	12
62	56.4	1.00	0.44	72	26
63	23.3	0.40	0.23	5	3
64	17.2	0.30	0.18	24	13
65	23.3	0.30	0.15	24	11
66	104.1	0.25	0.13	1	1
67	68.6	0.30	0.23	1	1
68	22.1	0.60	0.34	48	31
69	73.5	0.50	0.27	24	10
70	41.7	0.20	0.11	6	2
71	23.3	1.50	0.53	48	22
72	19.6	1.00	0.53	72	48
73	22.1	0.15	0.10	48	14
74	89.4	0.30	0.20	24	7
75	47.8	0.15	0.10	1	1
76	49.0	1.00	0.48	72	45
77	79.0	0.20	0.20	24	18
78	60.0	0.30	0.18	24	16
79	194.4	0.50	0.37	48	26
	3,835.3				

Source : JICA

Table B.11 Rainfall of 1977, 1979 and 1981 Floods

(Unit : mm)

Rainfall Gauging Station No	1977			1979			1981		
	Jan. 18	Jan. 19	Jan. 20	Jan. 17	Jan. 18	Jan. 19	Dec. 24	Dec. 25	Dec. 26
24A	-	-	-	-	-	-	-	-	-
24B	-	-	-	-	90	-	-	-	-
26	90	247	53	19	100	35	67	2	33
26A	4	123	56	4	114	61	-	-	-
26B	-	-	-	-	-	-	-	-	-
26C	-	-	-	-	-	-	175	48	59
26D	-	-	-	-	-	-	100	42	0
26F	-	-	-	-	134	-	106	31	0
26G	-	-	-	8	135	48	75	52	18
27	62	200	3	6	207	71	125	1	29
27A	-	-	-	-	-	-	-	-	-
27B	80	330	34	3	180	60	150	47	2
28C	53	197	29	9	201	80	124	22	15
28D	32	216	43	-	223	74	107	28	3
28E	17	194	9	10	200	63	132	36	0
29B	67	215	36	7	92	39	-	-	-
29C	-	-	-	-	158	28	-	-	-
29D	-	-	-	-	110	-	-	-	-
30	2	47	23	22	170	73	80	0	91
30D	-	-	-	-	-	-	-	-	-
30E	4	64	21	60	176	118	91	78	24
30F	62	24	58	-	181	-	-	-	-
30H	-	-	-	15	105	93	123	50	11
30I	-	-	-	-	154	-	87	67	2
30J	85	10	60	19	70	60	82	32	4
31A	-	-	-	-	190	85	91	65	19
31B	-	-	-	-	-	-	-	-	-
32A	-	-	-	-	144	-	-	-	-
32B	-	-	-	-	150	80	-	-	-
32C	39	61	58	13	70	82	171	54	4
32D	9	27	10	-	-	-	-	-	-
33A	54	97	63	29	106	34	132	85	62
33B	53	157	60	-	104	54	133	74	1
33C	103	250	51	11	60	33	119	28	0
33D	-	-	-	-	-	-	-	-	-
34	-	-	-	-	-	-	-	-	-
34A	51	16	45	88	45	0	134	48	0
35	-	-	-	45	27	103	133	34	0
35A	-	-	-	-	-	-	-	-	-
35D	-	-	-	-	50	28	225	59	13
36	-	-	-	12	61	23	186	80	20
36B	-	-	-	-	87	-	-	-	-
78	-	-	-	-	-	-	-	-	-
78H	-	-	-	-	-	-	-	-	-

Source : BMG

Table B.12 (1) Survey Result for Potential Flood Area

Flood Area No.	Flood Area (ha)	Depth of Inundation Max. (m)	Depth of Inundation Mean. (m)	Duration of Inundation Max. (hour)	Duration of Inundation Mean. (hour)
1	307.5	1.00	0.54	120	33
2	58.8	1.20	0.60	120	32
3	30.6	0.90	0.52	120	35
4	25.7	1.10	0.55	96	30
5	18.4	3.00	1.52	96	46
6	31.9	0.70	0.51	48	31
7	27.0	1.50	1.13	96	72
8	90.7	1.00	0.62	168	37
9	55.1	0.50	0.35	168	62
10	15.9	1.00	0.48	72	54
11	105.4	1.25	0.38	48	23
12	15.9	0.50	0.34	48	25
13	109.0	1.50	0.64	96	45
14	38.0	1.50	0.57	120	36
15	51.5	2.00	1.45	74	56
16	29.4	1.50	1.27	168	76
17	171.5	2.00	0.42	84	18
18	49.0	1.00	0.65	24	24
19	62.5	1.00	0.59	96	32
20	61.3	1.00	0.38	120	33
21	23.3	1.00	0.80	72	49
22	30.6	1.20	0.67	168	80
23	40.4	2.00	0.92	120	46
24	52.7	0.50	0.33	24	19
25	303.8	1.50	0.70	168	97
26	248.7	1.20	0.76	336	142
27	94.3	1.50	0.81	336	170
28	270.7	1.00	0.41	360	111
29	139.7	1.00	0.55	168	58
30	72.3	1.00	0.73	96	56
31	368.7	1.60	0.73	168	84
32	1379.4	1.00	0.60	176	100
33	69.8	2.50	0.70	216	97
34	30.6	3.00	1.25	360	175
35	25.7	3.00	1.25	360	170
36	24.5	2.50	1.13	336	155
37	23.3	2.50	1.10	336	163
38	47.8	2.00	0.57	360	102
39	94.3	2.00	0.64	360	105
40	182.5	2.00	0.51	336	97
41	79.6	1.50	0.47	168	116
42	138.4	1.00	0.45	240	83
43	41.7	1.25	0.55	336	216
44	1585.2	1.50	0.49	360	107
45	281.8	0.70	0.41	120	57
46	31.9	0.80	0.63	168	82

Table B.12 (2) Survey Result for Potential Flood Area

Flood Area No.	Flood Area (ha)	Depth of Inundation Max. (m)	Depth of Inundation Mean. (m)	Duration of Inundation Max. (hour)	Duration of Inundation Mean. (hour)
47	100.5	1.00	0.62	336	50
48	62.5	1.50	0.84	216	130
49	425.1	1.50	0.66	240	129
50	102.9	2.00	1.17	168	67
51	360.2	2.00	1.30	168	83
52	56.4	2.20	1.11	168	72
53	30.6	1.70	0.96	336	171
54	42.9	0.60	0.43	168	94
55	105.4	2.50	0.60	72	50
56	94.3	1.30	0.49	168	57
57	122.5	3.00	1.55	360	194
58	140.9	1.10	0.69	96	51
59	52.7	0.80	0.47	36	30
60	18.4	1.20	0.49	49	22
61	33.1	0.50	0.19	26	13
62	77.2	1.50	0.82	72	28
63	50.2	2.00	1.55	168	60
64	31.9	3.00	2.02	288	70
65	28.2	2.00	1.20	72	40
66	12.3	1.50	1.24	168	106
67	44.1	1.70	0.70	336	131
68	63.7	0.50	0.38	24	8
69	164.2	1.50	0.68	168	40
70	49.0	1.00	0.61	52	34
71	14.7	0.30	0.24	24	12
72	57.6	2.00	1.31	168	71
73	23.3	1.20	0.60	48	24
74	14.7	0.50	0.34	36	27
75	30.6	2.00	1.30	168	70
76	91.9	1.00	0.34	24	10
77	23.3	1.00	0.67	168	48
78	23.3	1.40	0.75	72	13
79	85.8	0.60	0.40	2	2
80	38.0	1.50	0.96	72	52
81	123.7	1.60	0.77	120	47
82	50.2	0.30	0.21	48	9
83	115.2	1.50	0.62	48	20
84	77.2	2.50	1.79	336	238
85	28.2	1.60	0.94	96	72
86	24.5	2.00	1.25	120	79
87	30.6	0.70	0.43	168	54
88	94.3	1.50	0.86	96	58
89	49.0	0.45	0.23	36	19
90	34.3	2.00	1.25	168	112
91	188.7	1.00	0.72	360	143
92	39.2	1.50	0.84	216	130
93	153.1	0.50	0.43	96	42
94	60.0	1.25	0.73	276	90
95	279.5	0.60	0.45	240	114
96	41.7	0.50	0.50	24	24
Total	11,098.6				

Source : JICA

Table B.13 Annual Maximum Basin Average Daily Rainfall

(Unit : mm)

Year	Annual Maximum Basin Average Daily Rainfall	Nos. of Gauging Station
1941	61.0	20
1942	70.2	18
1943	77.3	18
1948	55.8	15
1949	152.7	18
1950	65.6	19
1951	48.2	25
1952	54.6	27
1953	46.6	28
1954	47.1	27
1955	70.0	28
1956	66.5	27
1957	52.1	27
1958	49.6	23
1959	42.9	25
1960	58.1	25
1961	53.6	26
1962	56.1	23
1963	62.2	23
1964	39.8	19
1965	52.1	25
1966	39.4	17
1967	54.9	21
1968	71.1	25
1969	36.1	24
1970	79.3	25
1971	62.4	30
1972	45.4	29
1973	81.7	29
1974	56.0	28
1975	35.6	27
1976	71.2	26
1977	143.5	25
1978	54.6	26
1979	119.9	28
1980	58.9	26
1981	109.8	27
1982	45.8	27
1983	44.2	27
1984	68.1	27
1985	55.2	24
1987	77.1	25
1988	52.5	25

Source : JICA

Table B.14 Result of Frequency Analysis of Basin Average Daily Rainfall

(Unit : mm/hour)

Return Period (Year)	Computation Method			
	Iwai	Hazen	Peason Type II	Gumbel
1.01	35.2	32.5	39.0	18.6
1.5	52.7	47.9	50.2	49.9
2	60.2	55.5	56.7	59.9
5	81.6	78.4	77.1	84.7
10	97.8	97.1	93.8	101.0
20	114.7	117.8	112.4	116.7
25	120.4	125.0	118.9	121.7
30	125.1	131.1	124.3	125.8
40	132.6	141.0	133.3	132.1
45	135.8	145.3	137.2	134.7
50	138.6	149.1	140.6	137.1
60	143.6	156.0	146.8	141.1
70	147.9	161.9	152.2	144.5
80	151.6	167.2	157.0	147.4
90	155.0	172.0	161.3	150.0
100	158.0	176.4	165.3	152.3
200	178.7	207.2	193.2	167.5

Table B.15 Number of Samples by Area Number

Flood Area No.	No. of Samples House	Shop	Factory	Flood Area No.	No. of Samples House	Shop	Factory
1	31	3	-	48	10	3	-
2	7	1	-	49	19	17	-
3	6	1	-	50	13	5	-
4	6	1	-	51	26	9	-
5	5	-	-	52	8	3	-
6	5	-	-	53	8	-	-
7	5	-	-	54	5	1	-
8	18	11	24	55	25	10	-
9	9	1	-	56	24	2	-
10	4	3	-	57	15	2	10
11	10	-	-	58	10	-	-
12	5	-	10	59	5	-	-
13	26	12	-	60	7	-	10
14	15	-	-	61	6	-	-
15	10	-	-	62	7	-	-
16	6	8	-	63	10	8	-
17	24	-	-	64	5	-	-
18	4	-	-	65	5	-	-
19	10	-	-	66	5	1	-
20	14	-	-	67	15	-	-
21	9	-	-	68	10	1	-
22	6	-	-	69	20	1	-
23	6	-	-	70	4	2	-
24	4	-	-	71	5	1	-
25	17	-	36	72	10	3	-
26	20	9	-	73	6	5	-
27	15	13	-	74	4	-	-
28	17	3	11	75	6	4	-
29	14	4	-	76	15	-	-
30	9	2	-	77	5	1	-
31	41	1	-	78	13	-	-
32	33	1	-	79	4	1	-
33	10	1	-	80	6	-	-
34	5	1	-	81	20	-	-
35	5	1	-	82	9	4	-
36	5	1	-	83	21	1	-
37	5	1	-	84	11	-	10
38	5	1	-	85	5	-	-
39	11	2	-	86	4	-	-
40	14	3	-	87	5	-	-
41	10	-	-	88	5	-	-
42	13	2	-	89	6	-	-
43	10	4	-	90	8	-	-
44	20	5	-	91	10	1	-
45	13	1	-	92	3	-	9
46	5	-	-	93	15	3	-
47	15	9	-	94	18	9	-
				Total	1,033	204	120

Table B.16 Regression Analysis of Relationships between Inundation Depths/Durations and Flood Damage Ratios

Definition :

Y_i : Flood Damage Ratio to Property Value (%) X_{i1} : Inundation Depth (cm) X_{i2} : Inundation Duration (hr.)

i=1 : in the Habitual Flood Year i=2: in the Potential Flood Year i=3: in the Medium Flood Year (Theoretical)

$\overline{Y}_i$: Average Flood Damage Ratio to Property Value (%)

$\overline{X}_{i1}$: Average Inundation Depth (cm) ; $\overline{X}_{11} = 21$, $\overline{X}_{21} = 78$, $\overline{X}_{31} = 53$

$\overline{X}_{i2}$: Average Inundation Duration (hr.) ; $\overline{X}_{12} = 20$, $\overline{X}_{22} = 80$, $\overline{X}_{32} = 54$

P : Average Property Value per Unit (Rp.) $\overline{Z}_i$: Average Flood Damages per Unit ($= P\overline{Y}_i \div 100$) (Rp.)

Property	Regression Equation	$\overline{Y}_i$	$\overline{Z}_i$	Correlation Coefficient	T-Value
1. House	$Y_1 = 0.01694 + 0.00794X_{11} + 0.00091X_{12}$	$\overline{Y}_1 = 0.14935$	$\overline{Z}_1 = 19,432$	0.2477	5.7506
	$Y_2 = 0.87866 + 0.01474X_{21} + 0.00310X_{22}$	$\overline{Y}_2 = 2.27638$	$\overline{Z}_2 = 296,174$	0.1572	4.0114
	$Y_3 = 0.10504 + 0.01944X_{31} + 0.00390X_{32}$	$\overline{Y}_3 = 1.34596$	$\overline{Z}_3 = 175,119$	0.2486	8.6764
	P = 13,010,745				
2. Shop	$Y1 = -0.05324 + 0.00040X_{11} + 0.00261X_{12}$	$\overline{Y}_1 = 0.03382$	$\overline{Z}_1 = 14,457$	0.2263	1.8872
	$Y2 = 0.13332 + 0.01590X_{21} + 0.00651X_{22}$	$\overline{Y}_2 = 1.89432$	$\overline{Z}_2 = 809,694$	0.2100	2.2214
	$Y3 = -0.39743 + 0.01983X_{31} + 0.00793X_{32}$	$\overline{Y}_3 = 1.08178$	$\overline{Z}_3 = 462,388$	0.3380	4.7517
	P = 42,743,254				
3. Factory	$Y_1 = -0.02344 + 0.00350X_{11} + 0.00122X_{12}$	$\overline{Y}_1 = 0.07446$	$\overline{Z}_1 = 53,304$	0.4722	1.9436
	$Y_2 = 1.62334 + 0.01424X_{21} + 0.01749X_{22}$	$\overline{Y}_2 = 4.13326$	$\overline{Z}_2 = 2,958,716$	0.5564	2.8966
	$Y_3 = 0.51254 + 0.01598X_{31} + 0.01861X_{32}$	$\overline{Y}_3 = 2.36442$	$\overline{Z}_3 = 1,692,525$	0.6634	4.6116
	P = 71,583,109				

Source : JICA

Table B.17(1) Average Property Value and Flood Damages per Unit in 1988

1. Average Property Value per Unit

(Unit : Rp.)

	Item	House	Shop	Factory
1)	Building	9,859,421	27,969,634	26,594,580
2)	Household Possessions	3,151,324		
3)	Equipment & Machines		10,017,852	42,270,467
4)	Inventory		4,755,768	2,718,062
	Total	13,010,745	42,743,254	71,583,109

Note : Average number of household members per house worked out at 5.6, average number of workers per shop at 2.8, and average number of workers per factory at 8.5.

2. Average Flood Damages per Unit

(Unit : Rp.)

Property	Flood		Year
	Habitual	Potential	Medium(Theoretical)
1) House			
(1) Building	14,550	198,514	118,043
(2) Household Possessions	4,882	97,660	57,076
Total	19,432	296,174	175,119
2) Shop			
(1) Building	7,560	421,177	240,535
(2) Equipment & Machines	2,069	74,409	42,752
(3) Inventory	4,828	314,108	179,101
Total	14,457	809,694	462,388
3) Factory			
(1) Building	49,107	847,156	494,468
(2) Equipment & Machines	893	790,688	448,423
(3) Inventory	3,304	1,320,872	749,634
Total	53,304	2,958,716	1,692,525

Source : JICA

Table B.17(2) Average Property Value per Unit in 2010

(Unit : Rp.)

	Item	House	Shop	Factory
1)	Building	24,501,667	69,507,393	66,090,244
2)	Household Possessions	7,831,362		
3)	Equipment & Machines		24,895,384	105,046,422
4)	Inventory		11,818,569	6,754,661
	Total	32,333,029	106,221,346	177,891,327

Note : The above figures were calculated by multiplying the corresponding figures for 1988 by 2.485102, which is the estimated growth rate of per capita GDP 1988 to 2010.

Source : JICA

Table B.18 Relationships between Inundation Depths/Durations and Flood Damage Ratios

Definition :

Y : Flood Damage Ratio (%)
X_1 : Inundation Depth (cm)
X_2 : Inundation Duration (hr.)

	Property	Equation
1.	House	$Y = -0.617707 + 0.02902333X_1 + 0.00787833X_2$
2.	Shop	$Y = -0.628531 + 0.02109201X_1 + 0.01097092X_2$
3.	Factory	$Y = -1.345342 + 0.03343442X_1 + 0.03588397X_2$

Source : JICA

Table B.19 Regression Analysis of Relationships between Inundation Depths/Durations and Non-Working (Non-Operating) Days

Definition :

- Y_i : Non-Working Days due to Floods (days) X_{i1} : Inundation Depth (cm) X_{i2} : Inundation Duration (hr.)
- i=1 : in the Habitual Flood Year i=2: in the Potential Flood Year i=3: in the Medium Flood Year (Theoretical)
- $\overline{Y}_i$: Average Non-Working Days due to Floods (days)
- $\overline{X}_{i1}$: Average Inundation Depth (cm) ; $\overline{X}_{11} = 21$, $\overline{X}_{21} = 78$, $\overline{X}_{31} = 53$
- $\overline{X}_{i2}$: Average Inundation Duration (hr.) ; $\overline{X}_{12} = 20$, $\overline{X}_{22} = 80$, $\overline{X}_{32} = 54$
- P : Average Income per Day per Unit (Rp.) $\overline{Z}_i$: Average Income Losses per Unit $(=P\overline{Y}_i)$ (Rp.)

Property	Regression Equation	$\overline{Y}_i$	$\overline{Z}_i$	Correlation Coefficient	T-Value
1. House	$Y_1 = 0.0183 + 0.00310X_{11} + 0.00622X_{12}$	$\overline{Y}_1 = 0.2078$		0.2806	8.1127
	$Y_2 = 1.1766 + 0.00205X_{21} + 0.01484X_{22}$	$\overline{Y}_2 = 2.5237$		0.4862	17.5262
	$Y_3 = 0.4036 + 0.00491X_{31} + 0.01578X_{32}$	$\overline{Y}_3 = 1.5160$		0.5400	26.9468
2. Shop	$Y1 = 0.0864 + 0.00000X_{11} + 0.01630X_{12}$	$\overline{Y}_1 = 0.4124$	$\overline{Z}_1 = 11{,}537$	0.2792	3.2250
	$Y2 = -0.2102 + 0.00776X_{21} + 0.03628X_{22}$	$\overline{Y}_2 = 3.2975$	$\overline{Z}_2 = 92{,}251$	0.7592	16.4546
	$Y3 = -0.2895 + 0.00773X_{31} + 0.03565X_{32}$	$\overline{Y}_3 = 2.0453$	$\overline{Z}_3 = 57{,}219$	0.7593	20.7738
	P = 27,976				
3. Factory	$Y_1 = -0.0407 + 0.05005X_{11} + 0.00216X_{12}$	$\overline{Y}_1 = 1.0536$	$\overline{Z}_1 = 114{,}304$	0.2252	1.9574
	$Y_2 = -0.5709 + 0.03859X_{21} + 0.02604X_{22}$	$\overline{Y}_2 = 4.5223$	$\overline{Z}_2 = 490{,}620$	0.6647	9.2879
	$Y_3 = -0.1494 + 0.02913X_{31} + 0.02992X_{32}$	$\overline{Y}_3 = 3.0102$	$\overline{Z}_3 = 326{,}574$	0.6997	11.1679
	P = 108,4489				

Source : JICA

Table B.20 Average Daily Gross Profit per Shop and Factory in 1988

(Unit : Rp.)

	Item	Shop	Factory
1.	Average Monthly Sales per Establishment	2,571,306	9,765,000
2.	Average Gross Profit Ratio	32.64%	33.33%
3.	Average Monthly Gross Profit per Establishment (1. x 2 ÷ 100)	839,274	3,254,675
4.	Average Daily Gross Profit per Establishment (3. ÷ 30)	27,976	108,489

Note : Average number of workers per shop and factory are 2.8 and 8.5 respectively.

Source : JICA

Table B.21 Regression Analysis of Relationships between Inundation Depths/Durations and Non-Working (Non-Operating) Days

Definition :

- Y : Non-Working Days due to Floods (days)
- X_1 : Inundation Depth (cm)
- X_2 : Inundation Duration (hr.)

	Property	Equation
1.	House	$Y = -0.591789 + 0.01381111X_1 + 0.02547778X_2$
2.	Shop	$Y = -0.562888 + 0.00679400X_1 + 0.04163070X_2$
3.	Factory	$Y = -0.162458 + 0.02991222X_1 + 0.02939506X_2$

Source : JICA

Table B.22 Formula for Estimation of Flood Damages to Traffic

1. Estimation of Time Cost

$$TC(i,v) = (KM_f(v)/SP_f(v) - KM_n(v)/SP_n(v)) * TI * NP(v) * LP * HW * NV(i,v)$$

where

TC (i,v)	:	Time cost by inundation area by vehicle
$KM_f(v)$	:	Operating kilo-meters per day during inundation by vehicle
$SP_f(v)$	:	Operating speed per hour during inundation by vehicle
$KM_n(v)$	:	Operting kilo-meters per day in normal time by vehicle
$SP_n(v)$	:	Operating speed per hour in normal time by vehicle
TI	:	No. of inundated days in flood season in which traffic impediment is prevalent
NP(v)	:	Average No. of passangers by vehicle
LP	:	Labor participation rate
HW	:	Hourly wages/salaries
NV(i,v)	:	No. of vehicles on road by inundation area by vehicle

2. Estimation of Incremental Vehicle Operating Cost

$$IVOC(i,v) = (KM_f(v) * VOC_f(v) - KM_n(v) * VOC_n(v))$$

where

IVOC(iv)	:	Incremental vehicle operating cost by inundation area by vehicle
$VOC_f(v)$	:	Vehicle operating cost per km during inundation by vehicle
$VOC_n(v)$	:	Vehicle operating cost per km in normal time by vehicle

Source : JICA

Table B.23 Basic Figures for Estimation of Flood Damages to Traffic

Item	Unit	Passenger Car	Bus	Truck	Motor Cycle
Operating km per day in normal time	km	77	125	153	46
Operating speed per hr in normal time	km/hr	51	55	57	48
Operating km per day during inundation	km	69	113	138	41
Operating speed per hr during inundation	km/hr	21	28	29	24
No. of inundated days in which traffic impediment is prevalent	days	1	1	1	1
Average No. of passengers	persons	3	10	2	1
Vehicle operating cost per km in normal time	Rp.	91	223	254	31
Vehicle operating cost per km during inundation	Rp.	118	290	330	40

Labor participation rate : 0.4117
Average hourly wages/salaries : Rp. 113,000/(30 days x 8 hrs) = Rp. 471

Source : JICA & Statistik Indonesia

Table B.24 Flood Damages to Traffic per Vehicle

(Unit : Rp.)

Item	Passenger Car	Bus	Truck	Motor Cycle
Time Cost	1,033	3,418	331	146
Incremental Vehicle Operating Cost	1,135	4,895	6,678	214
Total	2,168	8,313	7,009	360

Source : JICA

Table B.25 Number of Property by Type by Inundation Area in 1988

(Unit : Rp.)

Inundation Area	Property House	Shop	Factory	Inundation Area	Property House	Shop	Factory
1	29,223	1,251	19	49	17,647	142	23
2	6,022	35	16	50	7,830	81	1
3	2,950	66	2	51	14,966	120	92
4	1,107	168	3	52	2,944	75	5
5	867	27	1	53	1,364	7	0
6	1,330	65	2	54	2,164	3	56
7	108	2	0	55	9,275	405	3
8	3,619	117	3	56	10,366	236	74
9	5,227	154	8	57	2,019	66	2
10	395	77	1	58	3,395	58	1
11	6,009	241	9	59	491	15	0
12	645	12	1	60	186	5	0
13	11,719	93	10	61	258	6	0
14	1,949	92	3	62	2,277	29	4
15	2,699	73	2	63	3,730	40	1
16	1,986	32	2	64	2,860	25	1
17	10,805	103	2	65	1,617	24	0
18	3,540	14	0	66	515	8	0
19	1,810	37	1	67	1,274	11	1
20	5,727	115	2	68	4,933	0	1,574
21	855	4	0	69	6,130	52	65
22	2,050	41	2	70	2,094	14	3
23	1,964	72	0	71	389	3	2
24	398	6	1	72	3,174	15	1
25	1,783	12	27	73	1,383	2	0
26	3,237	110	25	74	497	2	0
27	3,334	51	179	75	450	1	0
28	11,893	187	198	76	1,699	94	0
29	5,425	987	6	77	1,145	11	0
30	711	22	5	78	579	28	0
31	19,650	550	41	79	1,400	102	0
32	38,896	657	65	80	1,889	7	0
33	3,823	8	16	81	2,265	19	1
34	1,698	28	0	82	4,676	46	5
35	1,423	23	0	83	8,460	25	23
36	661	25	0	84	2,984	58	0
37	1,298	21	0	85	1,040	24	3
38	316	0	0	86	1,323	23	2
39	1,370	27	1	87	2,395	64	1
40	4,251	97	1	88	2,197	15	1
41	3,393	0	7	89	243	2	1
42	10,693	105	1	90	1,204	24	0
43	2,188	26	0	91	1,891	6	96
44	11,749	0	14	92	579	5	4
45	2,243	18	6	93	2,284	19	16
46	488	4	4	94	631	2	3
47	892	0	2	95	2,112	14	10
48	1,010	5	6	96	492	4	2
				Total	381,145	7,897	2,771

Source : JICA

Table B.26 Number of Property by Type by Inundation Area in 2010

(Unit : Rp.)

Inundation Area	Property			Inundation Area	Property		
	House	Shop	Factory		House	Shop	Factory
1	31,130	1,823	30	49	20,123	207	36
2	6,362	51	25	50	8,425	118	1
3	3,095	97	2	51	18,860	175	145
4	1,258	245	5	52	3,275	109	7
5	975	40	2	53	1,544	11	0
6	1,555	95	3	54	2,415	5	89
7	474	2	0	55	9,858	590	5
8	4,775	170	4	56	10,914	344	118
9	5,535	225	13	57	5,133	97	3
10	489	112	2	58	6,475	84	2
11	6,667	351	14	59	1,618	22	0
12	1,028	17	1	60	609	8	0
13	11,951	135	16	61	1,086	9	0
14	2,089	134	5	62	4,235	43	6
15	2,864	107	4	63	4,406	58	1
16	2,257	47	3	64	3,287	36	1
17	11,733	150	3	65	1,994	35	1
18	3,824	20	1	66	680	12	0
19	2,170	54	1	67	1,809	16	1
20	6,537	167	3	68	5,777	0	2,490
21	1,085	6	0	69	7,692	76	103
22	2,436	59	3	70	2,607	20	4
23	2,382	104	0	71	554	5	3
24	689	9	2	72	3,909	21	2
25	4,143	18	43	73	1,693	3	0
26	4,656	160	39	74	684	3	1
27	3,895	74	283	75	856	2	0
28	13,442	273	314	76	2,386	137	0
29	6,214	1,438	9	77	1,444	17	0
30	1,063	32	8	78	891	41	0
31	21,486	801	64	79	2,550	149	1
32	53,925	957	104	80	2,384	11	0
33	4,837	11	26	81	5,384	28	1
34	2,147	41	1	82	5,470	67	8
35	1,800	34	1	83	10,493	36	36
36	994	36	0	84	4,438	85	0
37	1,642	31	0	85	1,568	35	5
38	714	0	0	86	1,786	33	3
39	2,199	39	2	87	2,977	94	2
40	6,284	141	2	88	2,818	22	2
41	4,548	0	11	89	677	2	2
42	12,672	153	2	90	1,842	34	1
43	2,752	38	1	91	4,576	9	153
44	23,376	0	22	92	902	7	6
45	4,389	26	9	93	3,541	46	36
46	742	5	6	94	1,123	3	4
47	1,713	0	3	95	3,979	112	36
48	1,461	7	9	96	873	15	11
				Total	487,074	11,627	4,428

Source : JICA

Table B.27 Estimation of the Number and Ratio of Other Specified Property in the Inundation Area

I. The Year 1988

1. Total Number of Other Specified Property

Hotel	Restaurant	Hospital	Office	School	Religious Facilities	Total
180	1,258	1,533	5,178	5,355	8,244	21,746

2. Estimation of the Number of Other Specified Property in the Inundation Areas

21,746 x 23.49% (population ratio) = 2,206 .... (1)

3. Estimation of the Number of Hotels, Restaurants and Hospitals in the Inundation Areas

(180 + 1,256 + 1,533) x 23.94% = 711 .... (2)

4. Ratio of (1) and (2) to 10,598 (Number of Shops / Factories in the Inundation Areas)

5,206 ÷ 10,598 = 49.12%
711 ÷ 10.598 = 6.71%

II. The Year 2010

1. Total Number of Other Specified Property

21,746 x 1.456861 (estimated growth rate of population 1988 to 2010)
= 31,681

2. Estimation of the Number of Other Specified Property in the Inundation Areas

31,681 x 20.89% (population ratio) = 6,618 .... (1)

3. Estimation of the Number of Hotels, Restaurants and Hospitals in the Inundation Areas

(180 + 1,256 + 1,533) x 1.456861 x 20.89% = 904 .... (2)

4. Ratios of (1) and (2) to 15,791 (Number of Shops / Factories in the Inundation Areas)

6,618 ÷ 15,791 = 41.91%
904 ÷ 15,791 = 5.72%

Note : School = Primary, Junior General High & High School;
Religious Facilities = Mosque, Church & Temple

Source : JICA

Table B.28 Estimated No. of Vehicles on Road by Inundation Area in 1988

Inundation Area No.	Passanger Car	Bus	Truck	Motor Cycle	Total	Inundation Area No.	Passanger Car	Bus	Truck	Motor Cycle	Total
1	2,328	791	1,004	4,469	8,591	49	3,333	1,132	1,437	6,397	12,299
2	436	148	188	836	1,607	50	1,708	580	737	3,279	6,304
3	142	48	61	272	524	51	1,658	563	715	3,183	6,119
4	127	43	55	245	470	52	507	172	219	973	1,871
5	119	40	51	228	439	53	199	68	86	382	735
6	212	72	92	407	783	54	62	21	27	118	228
7	115	39	49	220	423	55	1,235	419	532	2,370	4,557
8	380	129	164	729	1,402	56	633	215	273	1,215	2,337
9	1,941	659	837	3,726	7,163	57	379	129	163	727	1,398
10	64	22	28	123	236	58	341	116	147	654	1,257
11	417	142	180	801	1,540	59	70	24	30	135	259
12	62	21	27	118	227	60	98	33	42	187	360
13	1,777	604	766	3,410	6,557	61	199	68	86	382	734
14	321	109	138	616	1,184	62	154	52	66	295	568
15	293	100	126	563	1,082	63	425	144	183	816	1,569
16	395	134	170	758	1,458	64	322	109	139	618	1,188
17	3,266	1,110	1,408	6,269	12,054	65	248	84	107	477	916
18	652	221	281	1,251	2,405	66	76	26	33	146	280
19	1,627	553	702	3,124	6,006	67	316	107	136	607	1,166
20	279	95	120	536	1,030	68	194	66	84	373	717
21	185	63	80	356	685	69	830	282	358	1,593	3,062
22	563	191	243	1,081	2,078	70	110	37	47	211	405
23	335	114	145	644	1,238	71	45	15	19	86	165
24	56	19	24	107	206	72	210	71	91	403	775
25	188	64	81	360	693	73	58	20	25	112	215
26	212	72	92	408	784	74	69	23	30	132	254
27	162	55	70	311	598	75	183	62	79	352	677
28	541	184	233	1,038	1,995	76	228	77	98	437	840
29	210	71	91	404	776	77	135	46	58	260	499
30	84	28	36	161	309	78	342	116	147	656	1,262
31	3,405	1,157	1,468	6,535	12,565	79	245	83	106	471	905
32	3,196	1,086	1,378	6,134	11,794	80	240	82	104	461	887
33	257	87	111	493	948	81	307	104	132	590	1,134
34	107	36	46	205	395	82	328	112	142	630	1,212
35	90	30	39	172	331	83	760	258	328	1,459	2,805
36	47	16	20	90	173	84	5,778	1,963	2,491	11,090	21,321
37	82	28	35	157	302	85	1,511	513	651	2,900	5,575
38	106	36	46	204	393	86	1,657	563	714	3,180	6,113
39	175	59	75	336	646	87	168	57	72	323	620
40	13,325	4,527	5,745	25,577	49,174	88	336	114	145	644	1,239
41	179	61	77	343	659	89	63	21	27	121	233
42	485	165	209	932	1,791	90	2,576	875	1,111	4,945	9,507
43	111	38	48	213	409	91	573	195	247	1,100	2,114
44	1,348	458	581	2,588	4,976	92	37	13	16	71	137
45	292	99	126	560	1,076	93	139	48	60	268	515
46	24	8	10	46	89	94	58	20	25	112	215
47	99	34	43	190	364	95	282	96	122	541	1,042
48	95	32	41	183	351	96	31	11	13	60	116
						Total	70,369	23,907	30,337	135,070	259,684

Source : Statistik Indonesia & JICA

Table B.29 Estimated No. of Vehicles on Road by Inundation Area in 2010

Inundation Area No.	Passanger Car	Bus	Truck	Motor Cycle	Total	Inundation Area No.	Passanger Car	Bus	Truck	Motor Cycle	Total
1	6,921	3,328	3,698	14,062	28,010	49	9,908	4,765	5,294	20,131	40,097
2	1,295	623	692	2,631	5,241	50	5,079	2,442	2,714	10,319	20,554
3	422	203	225	857	1,707	51	4,929	2,371	2,634	10,016	19,949
4	379	182	202	770	1,533	52	1,507	725	805	3,062	6,099
5	354	170	189	719	1,431	53	592	285	316	1,202	2,395
6	631	303	337	1,282	2,554	54	183	88	98	373	742
7	341	164	182	692	1,378	55	3,671	1,765	1,961	7,459	14,856
8	1,129	543	603	2,295	4,570	56	1,882	905	1,006	3,825	7,618
9	5,771	2,775	3,083	11,725	23,354	57	1,126	541	602	2,288	4,556
10	190	92	102	387	770	58	1,012	487	541	2,057	4,097
11	1,241	597	663	2,521	5,021	59	209	100	111	424	844
12	183	88	98	372	741	60	290	139	155	589	1,174
13	5,282	2,540	2,822	10,732	21,377	61	591	284	316	1,202	2,394
14	954	459	510	1,938	3,859	62	457	220	244	929	1,851
15	872	419	466	1,771	3,528	63	1,264	608	675	2,568	5,115
16	1,174	565	627	2,386	4,753	64	957	460	511	1,944	3,873
17	9,710	4,670	5,188	19,730	39,298	65	738	355	394	1,500	2,988
18	1,938	932	1,035	3,937	7,841	66	226	109	121	459	913
19	4,838	2,327	2,585	9,830	19,580	67	940	452	502	1,909	3,803
20	830	399	443	1,686	3,358	68	577	278	308	1,173	2,337
21	551	265	295	1,120	2,232	69	2,467	1,186	1,318	5,013	9,984
22	1,674	805	895	3,402	6,776	70	326	157	174	663	1,320
23	997	480	533	2,027	4,036	71	133	64	71	271	539
24	166	80	89	338	673	72	624	300	334	1,269	2,527
25	558	268	298	1,134	2,259	73	173	83	93	352	702
26	632	304	337	1,283	2,556	74	205	99	109	416	829
27	482	232	257	978	1,949	75	545	262	291	1,108	2,207
28	1,607	773	859	3,266	6,504	76	677	325	362	1,375	2,738
29	625	301	334	1,270	2,529	77	402	193	215	817	1,627
30	249	120	133	506	1,008	78	1,017	489	543	2,066	4,115
31	10,122	4,868	5,408	20,566	40,964	79	729	351	390	1,482	2,952
32	9,501	4,569	5,076	19,305	38,452	80	714	344	382	1,452	2,892
33	764	367	408	1,551	3,090	81	913	439	488	1,855	3,696
34	318	153	170	646	1,287	82	976	469	522	1,984	3,951
35	266	128	142	541	1,078	83	2,260	1,087	1,207	4,591	9,145
36	139	67	74	283	563	84	17,176	8,260	9,177	35,899	69,511
37	243	117	130	494	984	85	4,491	2,160	2,400	9,126	18,177
38	316	152	169	643	1,280	86	4,925	2,368	2,631	10,006	19,931
39	520	250	278	1,057	2,105	87	500	240	267	1,015	2,022
40	39,615	19,051	21,165	80,490	160,321	88	998	480	533	2,028	4,039
41	531	255	284	1,079	2,149	89	188	90	100	381	759
42	1,443	694	771	2,932	5,839	90	7,659	3,683	4,092	15,562	30,997
43	330	159	176	670	1,335	91	1,703	819	910	3,460	6,893
44	4,009	1,928	2,142	8,145	16,224	92	111	53	59	225	447
45	867	417	463	1,761	3,508	93	417	200	222	844	1,682
46	72	35	38	146	290	94	174	83	93	353	702
47	294	141	157	597	1,188	95	839	404	448	1,704	3,395
48	283	136	151	574	1,144	96	93	44	50	190	378
						Total	209,203	100,605	111,772	425,060	846,641

Source : Statistik Indonesia & JICA

Table B.30 Regression Analysis of Relationships between per Capita GDP and No. of Vehicles in D.K.I Jakarta

Vehicles	Regression Equation	Correlation Coefficient	T-Value
Passenger Car	$y = -153{,}987 + 0.2617134x$	0.9683	10.9638
Bus	$y = -178{,}383 + 0.1445833x$	0.9155	6.4366
Truck	$y = -142{,}216 + 0.1535120x$	0.9843	15.7684
Motor Cycle	$y = -343{,}573 + 0.5466566x$	0.9825	14.8991
Total	$y = -818{,}161 + 1.1064653x$	0.9760	12.6725

Where x : per Capita GDP (Rp. at 1990 prices)
y : No. of registered vehicles

SOURCE : JICA

Table B.31 Registered Vehicles and per Capita GDP in D.K.I Jakarta

(Unit : No.)

Item	1987	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	2010
Per Capita GDP (Rp.)	1,245,500	1,362,100	1,443,720	1,637,700	1,668,440	1,796,700	1,861,360	1,865,600	1,885,740	1,938,740	2,016,050	5,010,080
Passenger Car	190,566	202,781	222,345	247,066	275,139	299,164	321,837	340,177	356,188	376,907	397,159	1,180,718
Bus	17,132	21,655	29,350	38,478	48,603	61,285	81,047	99,078	111,147	123,740	134,928	567,804
Truck	58,449	64,713	77,781	95,858	112,498	128,859	140,562	149,781	154,498	159,344	171,223	630,832
Motor Cycle	369,428	403,668	428,144	495,312	570,972	628,414	669,906	697,572	713,063	720,024	762,324	2,398,992
Total	635,575	692,817	757,620	876,714	1,007,212	1,117,722	1,213,352	1,286,608	1,334,896	1,380,015	1,465,634	4,778,346

Note : Per Capita GDP is at 1990 prices.
Sources : Statistik Indonesia & JICA

Table B.32 Estimated Habitual Flood Damages

(Unit : Rp.)

Damages Item	Amount of Damages 1988	2010
1. Direct Damages to Property		
House	8,952,970,700	30,641,736,800
Shop	340,775,500	1,246,462,000
Factory	278,187,800	1,104,703,400
Others	304,034,800	985,373,400
Total	9,875,968,800	33,978,275,600
2. Indirect Damages		
1) Income Losses		
Shop	118,078,400	431,898,100
Factory	290,934,100	1,155,319,800
Others	27,444,700	90,788,900
Sub-Total	436,457,200	1,678,006,800
2) Traffic Damages		
Time Cost	368,335,100	1,318,060,800
Incremental VOC	856,787,700	3,134,574,000
Sub-Total	1,225,122,800	4,452,634,800
Total	1,661,580,000	6,130,641,600
3. Other Damages		
Total	2,307,509,800	8,021,783,400
Grand Total	13,845,058,600	48,130,700,600

Source : JICA

Table B.33 Estimated Potential Flood Damages

(Unit : Rp.)

Damages Item	Amount of Damages 1988	2010
1. Direct Damages to Property		
House	96,690,762,300	312,208,613,300
Shop	4,806,695,500	17,581,559,100
Factory	4,096,714,100	16,268,339,200
Others	4,373,354,800	14,186,492,400
Total	109,967,526,700	360,245,004,000
2. Indirect Damages		
1) Income Losses		
Shop	558,661,600	2,043,428,300
Factory	829,308,200	3,293,241,100
Others	93,132,800	305,257,500
Sub-Total	1,481,102,600	5,641,926,900
2) Traffic Damages		
Time Cost	368,335,100	1,318,060,800
Incremental VOC	856,787,700	3,134,574,000
Sub-Total	1,225,122,800	4,452,634,800
Total	2,706,225,400	10,094,561,700
3. Other Damages		
Total	22,534,750,400	74,067,913,100
Grand Total	135,208,502,500	444,407,478,800

Source : JICA

Table B.34 Relationships between Return Period and Inundation Depths/Durations

$$DEP(i,x) = 0.8444 * DEP(i,1/2) + 0.1556 * DEP(i,43) + 0.2245 * (DEP(i,43) - DEP(i,1/2)) * LOG(x)$$

$$DUR(i,x) = 0.8444 * DUR(i,1/2) + 0.1556 * DUR(i,43) + 0.2245 * (DUR(i,43) - DUR(i,1/2)) * LOG(x)$$

where

DEP(i,x) : Average Inundation Depth (cm) in Inundation Area No. i for the x Year Return Period

DEP(i,1/2) : Average Inundation Depth (cm) in Inundation Area No. i for the Habitual Flood Year (= 1/2 Year Return Period)

DEP(i,43) : Average Inundation Depth (cm) in Inundation Area No. i for the Potential Flood Year (= 43 Year Return Period)

x : x Year Return Period

DUR(i,x) : Average Inundation Duration (hr.) in Inundation Area No. i for the x Year Return Period

DUR(i,1/2) : Average Inundation Duration (hr.) in Inundation Area No. i for the Habitual Flood Year (= 1/2 Year Return period)

DUR(i,43) : Average Inundation Duration (hr.) in Inundation Area No. i for the Potential Flood Year (= 43 Year Return Period)

Note : Dep(i,1/2), DEP(i,43), DUR(i,1/2), DUR(i,43) in the "without" case are calculated based on the questionnaire survey.

Source : JICA

Table B.35 Methodology for Estimation of Average Annual Flood Damages (Direct Damages to Property)

1. $fdr(p,i,x) = a_0(p)+b_1(p)*DEP(i,x)+b_2(p)* DUR(i,x)$ .... Formula 1

where

$fdr(p,i,x)$: Flood Damage Ratio for Property Type p (p = House, Shop or Factory) in Inundation Area No. i for x Year Return Period

$a_0(p), b_1(p), b_2(p)$: Constants for Property Type p

$DEP(i,x), DUR(i,x)$: Refer to Table B.5.20.

2. $VL(p,i,y) = v1(p,y) * NO(p,i,y)$ .... Formula 2

where

$VL(p,y)$: Value of Property Type p in Inundation Area No. i in the Year y

$vl(p,y)$: Unit Value of Property Type p in the Year y

$NO(p,i,y)$: No. of Property Type p in Inundation Area No. i in the Year y

3. $FD(p,i,x,y) = fdr(p,i,x) * VL(p,i,y)$ .... Formula 3

$TFD(x,y) = \sum_p \sum_i FD(p,i,x,y) = A(y) + B(y) * LOG(x)$ .... Formula 4

where

$FD(p,i,x,y)$: Flood Damages to Property Type p in Inundation Area No. i for x Year Return Period in the Year y

$TFD(x,y)$: Flood Damages to Property for x Year Return Period in the Year y

$A(y), B(y)$: Constants for the Year y

4. $AFD(y) = \int_{1/2}^{43} TFD(x,y)/x^2 dx = \int_{1/2}^{43} (A(y) + B(y) * LOG(x))/x^2 dx$

$= \left[(-A(y)/x) - B(y) * (LOG(x) + 1)/x\right]_{1/2}^{43}$

.... Formula 5

where

$AFD(y)$: Average Annual Flood Damages to Property in the Year y

Table B.36 Estimated Average Annual Flood Damages (Direct Damages to property) by Inundation Area in 1988 - "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	1,258,091,000	No. 49	30,663,330
2	339,655,000	50	440,483,100
3	68,089,520	51	1,289,866,000
4	26,672,970	52	753,536,800
5	92,543,950	53	93,122,610
6	91,854,200	54	0
7	38,954,190	55	863,646,600
8	347,617,100	56	1,105,030,000
9	130,483,200	57	376,958,700
10	0	58	347,651,900
11	384,500,600	59	100,882,100
12	0	60	0
13	0	61	0
14	0	62	468,175,500
15	267,598,200	63	1,396,064,000
16	153,698,700	64	813,770,500
17	0	65	881,691,700
18	0	66	44,538,440
19	0	67	11,279,120
20	52,314,130	68	0
21	0	69	795,996,100
22	197,161,300	70	63,989,400
23	13,842,520	71	0
24	0	72	1,221,574,000
25	453,771,300	73	120,025,500
26	88,281,920	74	16,526,500
27	1,386,769,000	75	83,108,930
28	1,292,377,000	76	0
29	1,084,136,000	77	0
30	0	78	0
31	2,481,633,000	79	59,151,950
32	6,034,926,000	80	509,093,700
33	0	81	365,009,600
34	557,743,500	82	0
35	422,021,500	83	0
36	184,071,700	84	716,818,600
37	398,466,200	85	412,838,000
38	40,805,330	86	644,266,800
39	115,625,600	87	33,069,350
40	416,318,100	88	345,399,300
41	0	89	0
42	0	90	560,601,200
43	50,326,510	91	67,703,450
44	814,032,700	92	19,249,970
45	0	93	155,885,000
46	59,694,180	94	83,704,950
47	83,537,530	95	842,768,000
48	148,719,800	96	0

Note : Property = Houses, Shops and Factories
Source : JICA

Table B.37 Estimated Average Annual Flood Damages (Direct Damages to property) by Inundation Area in 2010 - "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	3,386,136,000	No. 49	90,795,000
2	899,571,400	50	1,181,241,000
3	177,570,300	51	4,068,939,000
4	75,306,320	52	2,128,663,000
5	261,919,200	53	263,077,300
6	271,909,000	54	0
7	415,635,700	55	2,340,739,000
8	1,145,408,000	56	2,994,456,000
9	353,711,800	57	2,295,920,000
10	0	58	1,635,428,000
11	1,073,840,000	59	832,853,000
12	0	60	0
13	0	61	0
14	0	62	2,151,039,000
15	715,530,000	63	4,121,286,000
16	436,927,700	64	2,336,606,000
17	0	65	2,718,057,000
18	0	66	146,613,200
19	0	67	39,850,690
20	148,404,100	68	0
21	0	69	2,502,066,000
22	589,347,300	70	197,978,600
23	41,707,260	71	0
24	0	72	3,748,315,000
25	2,484,679,000	73	365,232,900
26	319,266,500	74	56,580,460
27	4,613,680,000	75	391,881,200
28	3,929,318,000	76	0
29	3,328,900,000	77	0
30	0	78	0
31	6,927,222,000	79	267,798,400
32	20,870,630,000	80	1,589,389,000
33	0	81	2,141,294,000
34	1,764,464,000	82	0
35	1,335,007,000	83	0
36	685,872,500	84	2,646,747,000
37	1,260,427,000	85	1,545,892,000
38	228,254,600	86	2,173,453,000
39	459,153,600	87	102,187,400
40	1,528,755,000	88	1,103,500,000
41	0	89	0
42	0	90	2,127,699,000
43	159,007,900	91	333,585,200
44	4,009,410,000	92	74,611,060
45	0	93	609,819,000
46	225,783,900	94	368,071,400
47	397,778,100	95	4,742,304,000
48	536,945,300	96	0

Note : Property = Houses, Shops and Factories

Source : JICA

Table B.38 Estimated Average Annual Flood Damages (Income Losses due to Shop Closure) by Inundation Area in 1988
- "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	37,455,690	No. 49	10,551,230
2	4,847,427	50	1,002,645
3	1,802,799	51	25,669,370
4	3,745,333	52	6,357,472
5	327,701	53	486,421
6	2,155,713	54	8,472,600
7	139,746	55	11,461,220
8	2,160,390	56	29,441,630
9	9,141,170	57	5,757,872
10	112,557	58	1,909,773
11	5,191,909	59	97,972
12	22,766	60	11,834
13	1,172,389	61	0
14	264,712	62	1,358,972
15	1,170,094	63	1,843,891
16	979,870	64	963,521
17	95,552	65	1,032,155
18	33,556	66	340,420
19	67,234	67	555,207
20	834,638	68	162,577,800
21	0	69	16,861,960
22	2,601,233	70	714,049
23	39,011	71	23,734
24	43,661	72	1,645,917
25	15,337,710	73	62,868
26	11,258,860	74	105,138
27	113,670,200	75	72,594
28	84,475,290	76	8,029
29	45,590,050	77	0
30	781,221	78	0
31	42,841,570	79	61,723
32	83,335,620	80	567,901
33	3,307,270	81	706,062
34	3,196,152	82	357,883
35	2,452,887	83	1,729,045
36	2,456,743	84	5,955,829
37	2,217,239	85	3,561,450
38	122,576	86	3,933,037
39	1,954,748	87	1,987,952
40	6,071,873	88	667,022
41	1,249,958	89	86,926
42	1,522,044	90	3,305,088
43	2,200,944	91	24,862,630
44	4,798,363	92	1,190,739
45	545,066	93	4,551,000
46	1,552,441	94	1,010,507
47	560,459	95	7,772,000
48	2,275,823	96	160,000

Note : Establishments Concerned : Shops and Factories
Source : JICA

Table B.39 Estimated Average Annual Flood Damages (Income Losses due to Shop Closure) by Inundation Area in 2010 - "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	136,988,200	No. 49	39,852,130
2	18,789,500	50	3,665,158
3	6,631,707	51	100,261,700
4	13,781,520	52	23,669,510
5	1,258,977	53	1,772,636
6	7,953,791	54	33,322,260
7	505,943	55	41,752,260
8	8,036,849	56	113,427,900
9	33,778,910	57	21,067,030
10	442,933	58	7,001,299
11	19,425,730	59	373,886
12	89,589	60	46,571
13	4,613,584	61	0
14	1,041,697	62	5,299,668
15	4,422,888	63	6,811,079
16	3,689,883	64	3,566,424
17	376,017	65	3,827,691
18	132,051	66	1,257,537
19	264,580	67	2,054,434
20	3,107,818	68	639,776,000
21	0	69	66,267,520
22	9,618,400	70	2,745,740
23	153,517	71	93,399
24	171,814	72	6,137,901
25	59,969,610	73	247,397
26	42,763,230	74	403,478
27	445,261,800	75	272,867
28	328,284,000	76	31,595
29	165,710,400	77	0
30	3,059,498	78	0
31	159,524,700	79	242,891
32	310,637,200	80	2,074,926
33	12,960,270	81	2,630,918
34	11,649,350	82	1,408,343
35	8,941,305	83	6,804,140
36	8,924,463	84	21,609,360
37	8,083,356	85	13,502,950
38	482,362	86	14,621,470
39	7,186,140	87	7,273,706
40	22,119,360	88	2,513,062
41	4,918,834	89	342,072
42	5,556,045	90	12,043,030
43	8,015,851	91	97,751,260
44	18,882,520	92	4,627,261
45	2,144,579	93	24,749,000
46	6,039,752	94	3,942,533
47	2,205,519	95	97,604,000
48	8,882,997	96	2,124,000

Note : Establishments Concerned : Shops and Factories
Source : JICA

Table B.40 Estimated Average Annual Flood Damages (Traffic Damages) by Inundation Area in 1988 - "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	40,531,110	No. 49	58,022,000
2	7,583,464	50	29,742,760
3	2,470,410	51	28,867,260
4	2,219,007	52	8,825,090
5	2,071,073	53	3,465,620
6	3,695,268	54	1,073,953
7	1,994,559	55	21,497,420
8	6,613,618	56	11,023,400
9	33,794,490	57	6,593,136
10	1,114,279	58	5,928,283
11	7,265,099	59	1,221,887
12	1,071,830	60	1,698,161
13	30,933,450	61	3,463,817
14	5,584,661	62	2,677,772
15	5,105,308	63	7,402,102
16	6,877,650	64	5,603,762
17	56,865,380	65	4,323,403
18	11,346,550	66	1,321,853
19	28,333,360	67	5,502,629
20	4,859,318	68	3,381,360
21	3,229,499	69	14,447,430
22	9,805,656	70	1,910,193
23	5,840,946	71	780,314
24	974,198	72	3,656,852
25	3,268,976	73	1,015,374
26	3,698,664	74	1,199,707
27	2,819,869	75	3,193,100
28	9,412,051	76	3,962,377
29	3,660,036	77	2,355,056
30	1,459,175	78	5,954,390
31	59,277,210	79	4,271,297
32	55,641,260	80	4,184,171
33	4,471,231	81	5,347,797
34	1,861,801	82	5,717,207
35	1,560,627	83	13,233,500
36	814,485	84	100,585,900
37	1,423,730	85	26,302,620
38	1,852,887	86	28,840,730
39	3,046,121	87	2,925,566
40	231,991,300	88	5,844,129
41	3,109,582	89	1,098,361
42	8,449,951	90	44,853,340
43	1,931,417	91	9,973,753
44	23,476,380	92	647,343
45	5,076,443	93	2,433,000
46	420,242	94	1,016,491
47	1,719,386	95	4,913,000
48	1,655,500	96	548,000

Source : JICA

Table B.41 Estimated Average Annual Flood Damages (Traffic Damages) by Inundation Area in 2010 - "Without Project" Case

(Unit : Rp.)

Inundation Area	Flood Damages	Inundation Area	Flood Damages
No. 1	147,307,600	No. 49	210,877,100
2	27,561,590	50	108,098,100
3	8,978,537	51	104,916,100
4	8,064,832	52	32,074,200
5	7,527,176	53	12,595,560
6	13,430,200	54	3,903,209
7	7,249,091	55	78,130,910
8	24,036,750	56	40,063,820
9	122,823,800	57	23,962,310
10	4,049,772	58	21,545,940
11	26,404,510	59	4,440,864
12	3,895,495	60	6,171,853
13	112,425,500	61	12,589,010
14	20,297,070	62	9,732,181
15	18,554,890	63	26,902,440
16	24,996,350	64	20,366,500
17	206,673,400	65	15,713,110
18	41,238,250	66	4,804,186
19	102,975,700	67	19,998,930
20	17,660,860	68	12,289,320
21	11,737,400	69	52,508,190
22	35,638,000	70	6,942,466
23	21,228,520	71	2,835,998
24	3,540,658	72	13,290,580
25	11,880,870	73	3,690,307
26	13,442,550	74	4,360,255
27	10,248,620	75	11,605,100
28	34,207,470	76	14,400,990
29	13,302,150	77	8,559,290
30	5,303,273	78	21,640,830
31	215,439,000	79	15,523,740
32	202,224,400	80	15,207,090
33	16,250,390	81	19,436,210
34	6,766,590	82	20,778,800
35	5,671,995	83	48,096,250
36	2,960,191	84	365,572,500
37	5,174,451	85	95,595,080
38	6,734,193	86	104,819,700
39	11,070,920	87	10,632,770
40	843,156,800	88	21,240,090
41	11,301,560	89	3,991,918
42	30,710,780	90	163,016,400
43	7,019,606	91	36,248,930
44	85,323,320	92	2,352,725
45	18,449,990	93	8,841,000
46	1,527,343	94	3,694,366
47	6,248,992	95	17,856,000
48	6,016,804	96	1,990,000

Source : JICA

Table B.42 Summary of Estimated Average Annual Flood Damages - "Without Project" Case

(Unit : Rp.)

Item	1988	2010
1. Direct Damages to Property		
1) House	32,924,186,000	110,409,076,000
2) Shop	1,491,725,000	5,784,115,000
3) Factory	1,291,569,000	5,298,272,000
4) Other Specified Property 1/	1,367,153,000	4,644,628,000
Sub-Total	37,074,633,000	126,136,091,000
2. Indirect Damages		
1) Income Losses due to Shop Closure		
(1) Shop	291,591,000	1,080,776,000
(2) Factory	568,440,000	2,287,572,000
(3) Other Specified Property 2/	57,707,000	192,669,000
Sub-Total	917,738,000	3,561,017,000
2) Traffic Damages		
(1) Time Cost	368,335,000	1,318,060,000
(2) Incremental VOC	856,789,000	3,134,571,000
Sub-Total	1,225,124,000	4,452,631,000
Total (1.+2.)	39,217,495,000	134,149,739,000
3. Damages to Other Unspecified Property Including Infrastructure		
(1.+2.+3.) x 20 %	7,843,499,000	26,829,948,000
Grand Total (1.+2.+3.)	47,060,994,000	160,979,687,000

Note : 1/: Hotel, Restaurant, Hospital, Office, School, (Primary, Junior General Hight & High) and Religious Facilities (Mosque, Church & Temple)

2/: Hotel, Restaurant and Hospital

Damages to other specified property were estimated based on the ratios between the number of shops/factories and that of other specified property.

Source : JICA

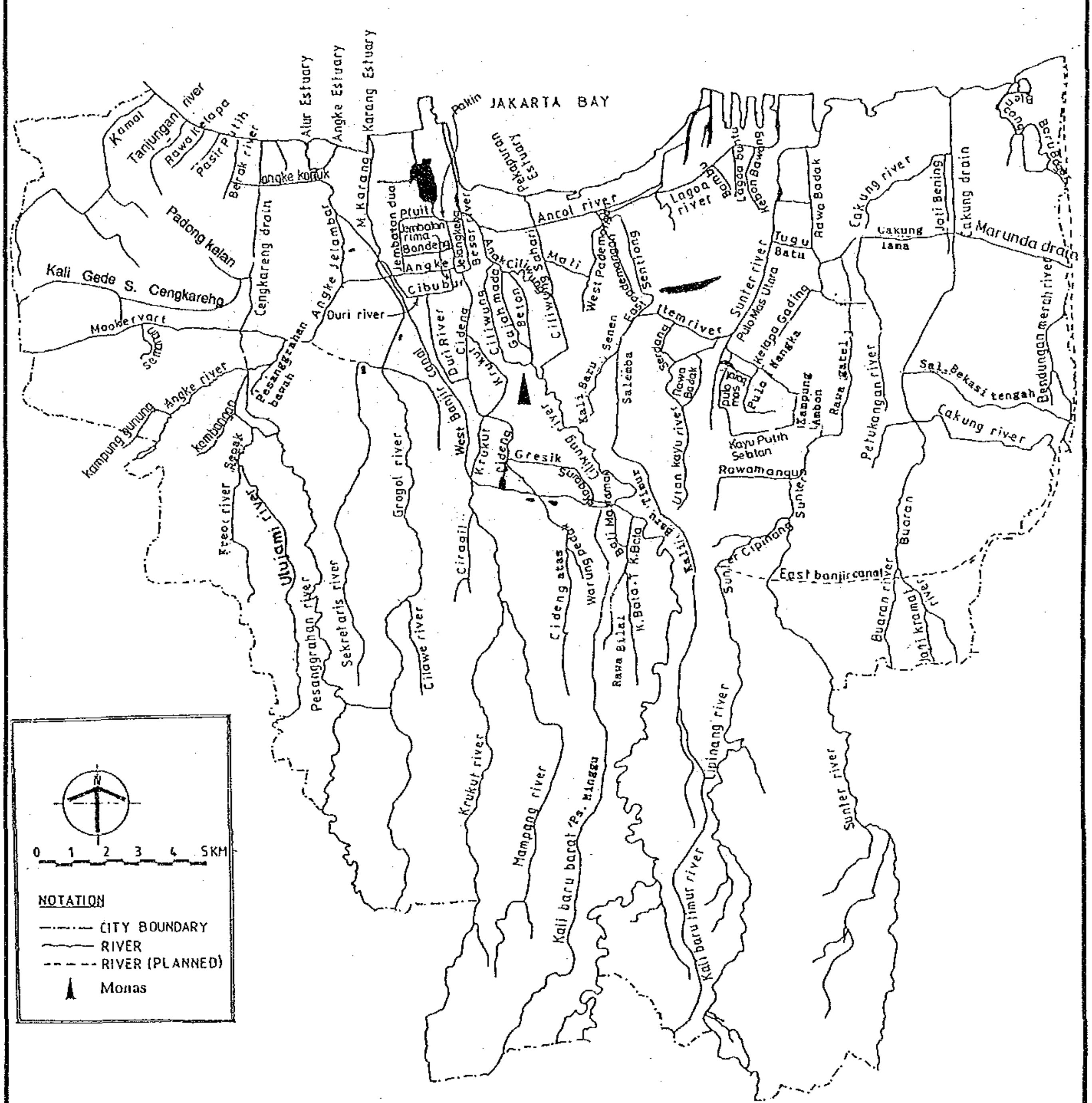
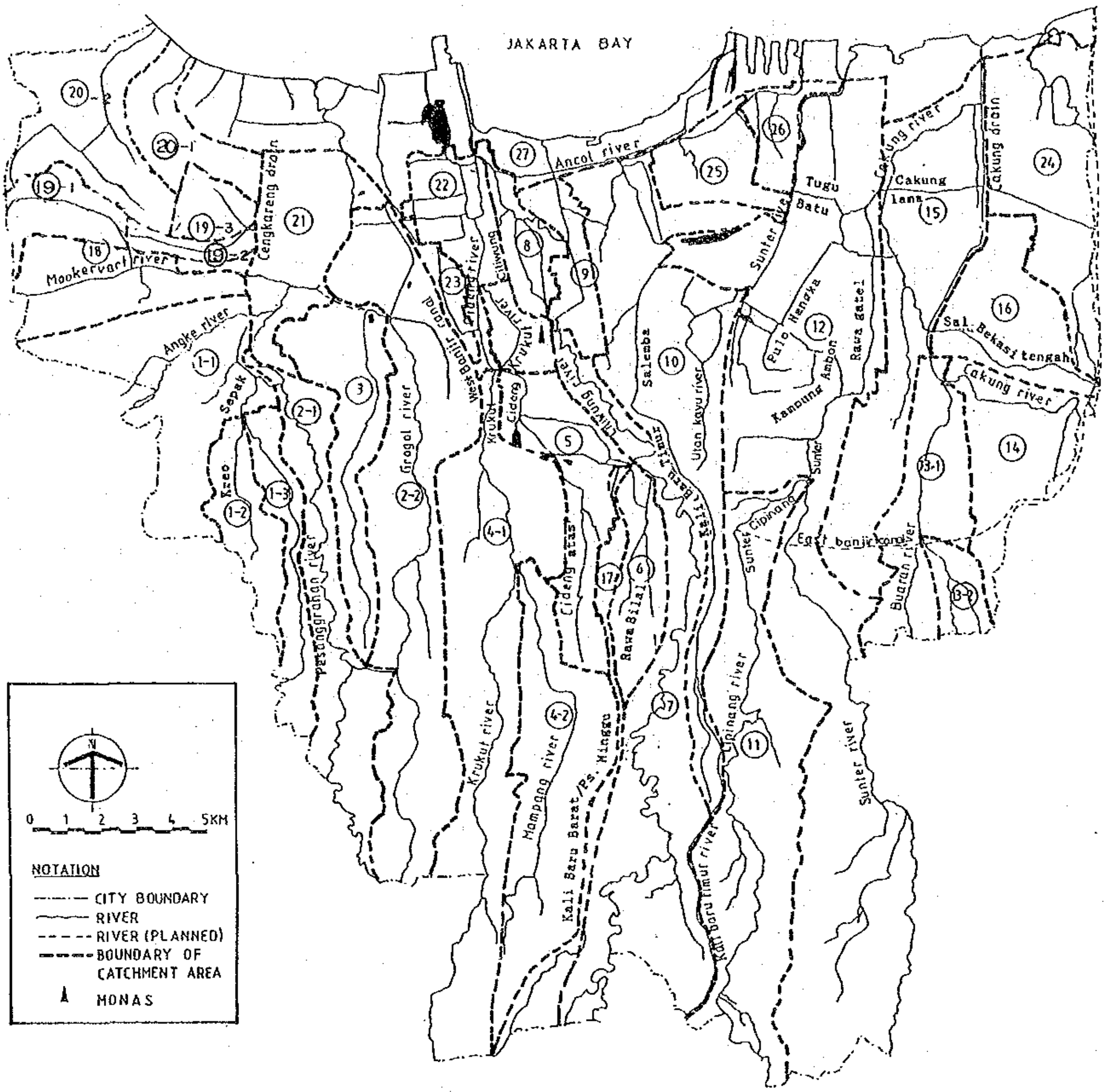


FIG. B.1 EXISTING RIVER AND CHANNEL NETWORK

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Catchment Area of Sub Basin Inside of Jakarta (km2)

No.	Nama.	Catchment.	No.	Nama.	Catchment.
1 -1	Angke	25.0	13 - 1	Buaran	11.3
1 -2	Sepak	7.9	13 - 2	Jati Kramat	3.7
1 -3	Daan Mogot	8.5	14	Cakung (1)	16.0
2 -1	Pesanggrahan	22.1	15	Cakung (2)	30.4
2 -2	Grogol	41.2	16	Malang	14.4
3	Sekretaris	12.4	17	Kali Baru Barat	2.4
4 -1	Krukut	42.2	18	Mookervart	7.1
4 -2	Mampang	31.1	19 - 1	Kali Gede / Kali Bor	5.6
5	Cideng	18.1	19 - 2	B.Cengkareng	3.3
6	K. Bala	8.2	19 - 3	Pedongkelan	5.2
7	Ciliwung	36.1	20 - 1	Tanjungang	7.8
8	Anak Ciliwung	5.6	20 - 2	Kamal	16.4
9	Ciliwung Sahari	1.1	21	Angke Jelambar	15.0
10	Sentiong	32.5	22	Pakin	5.2
11	Cipinang	34.8	23	Duri	2.7
12	Sunter	84.9	24	Belencong	43.3
			25	Lagoa	7.1
			26	Lagoa Buntu	4.8
			27	BAY DRAINAGE AREA	45.9

Total 651.5 km^2

FIG. B.2 BASIN MAP OF STUDY AREA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

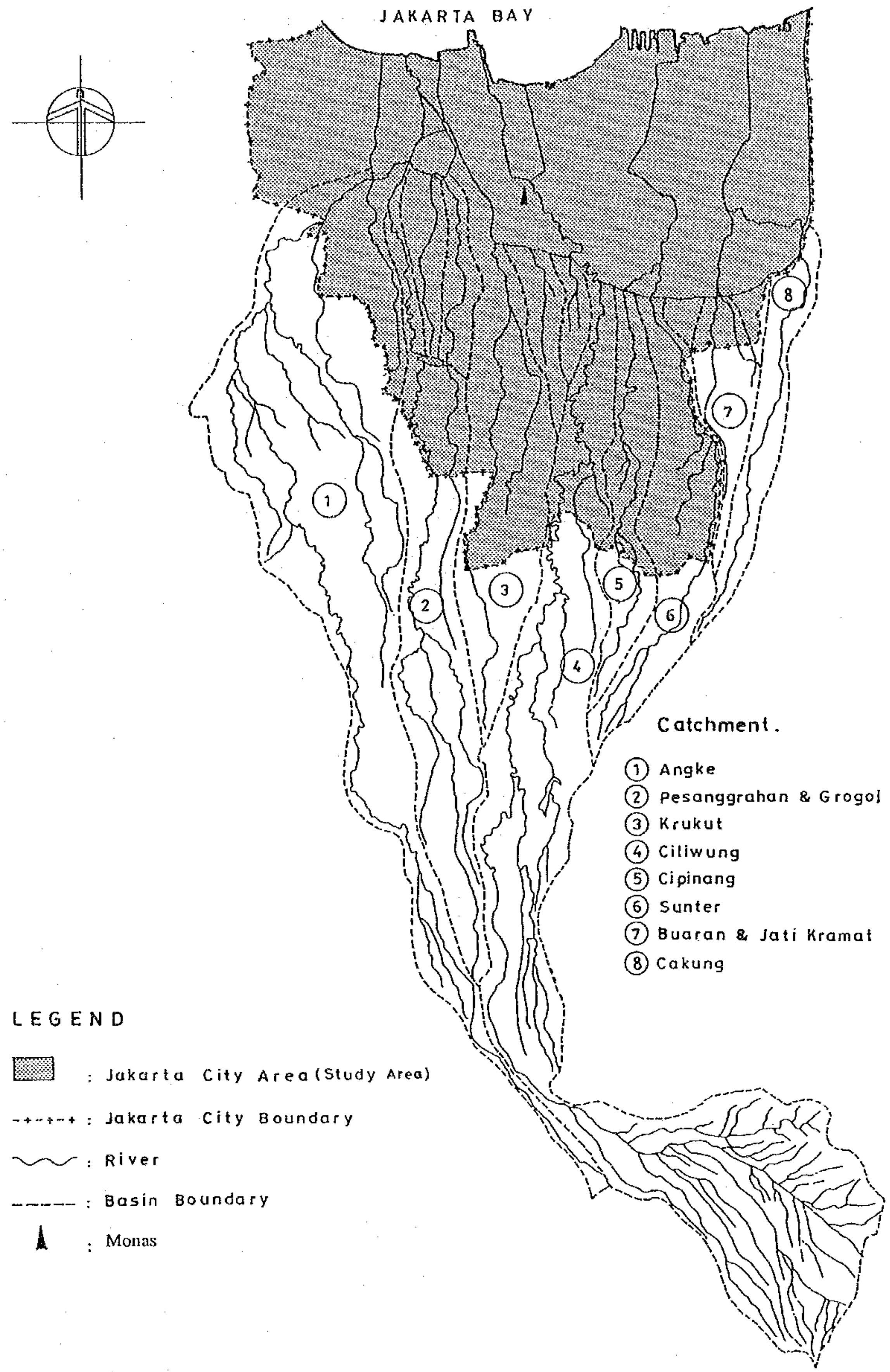


FIG. B.3 TOTAL BASIN MAP

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

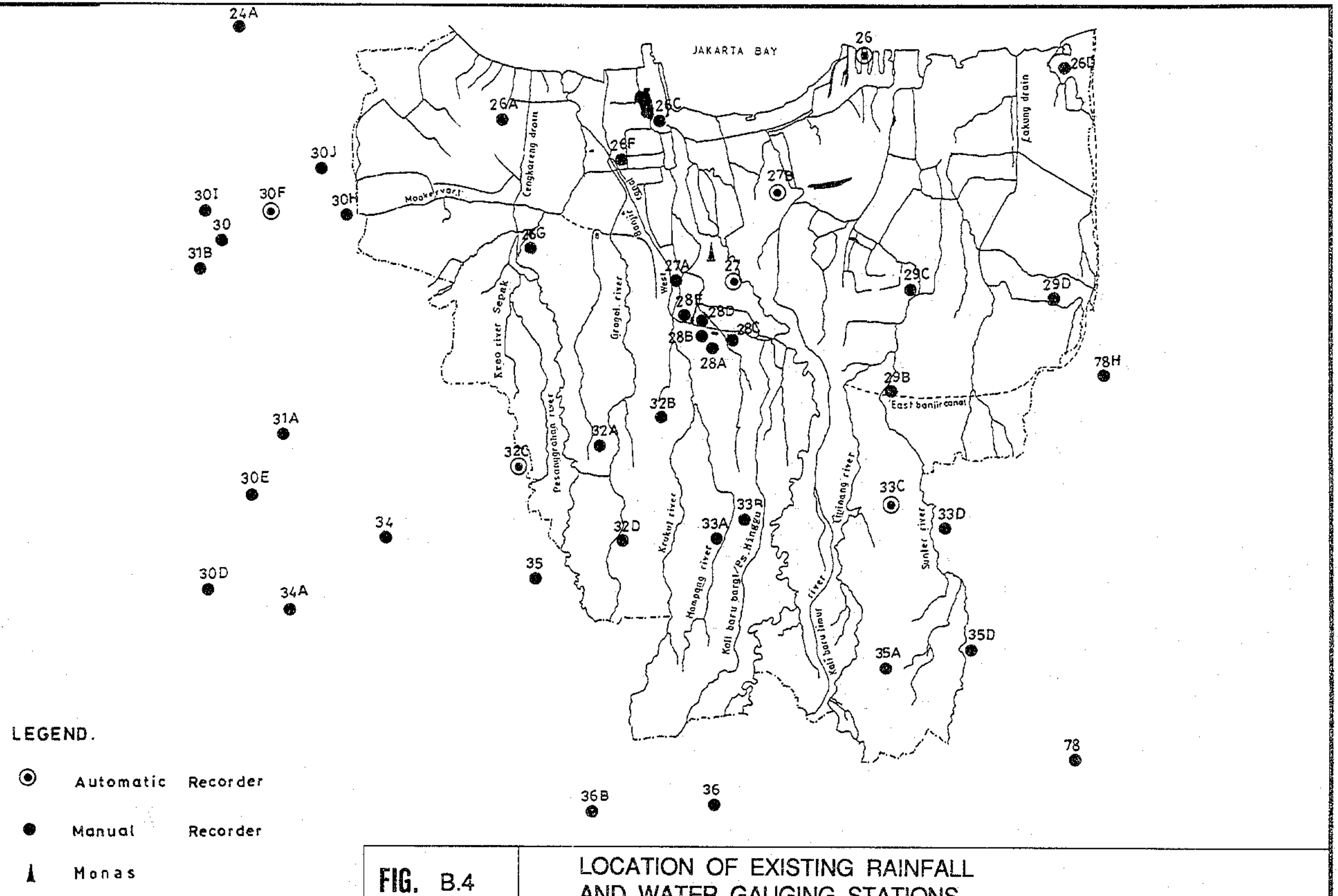


FIG. B.4 LOCATION OF EXISTING RAINFALL AND WATER GAUGING STATIONS

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

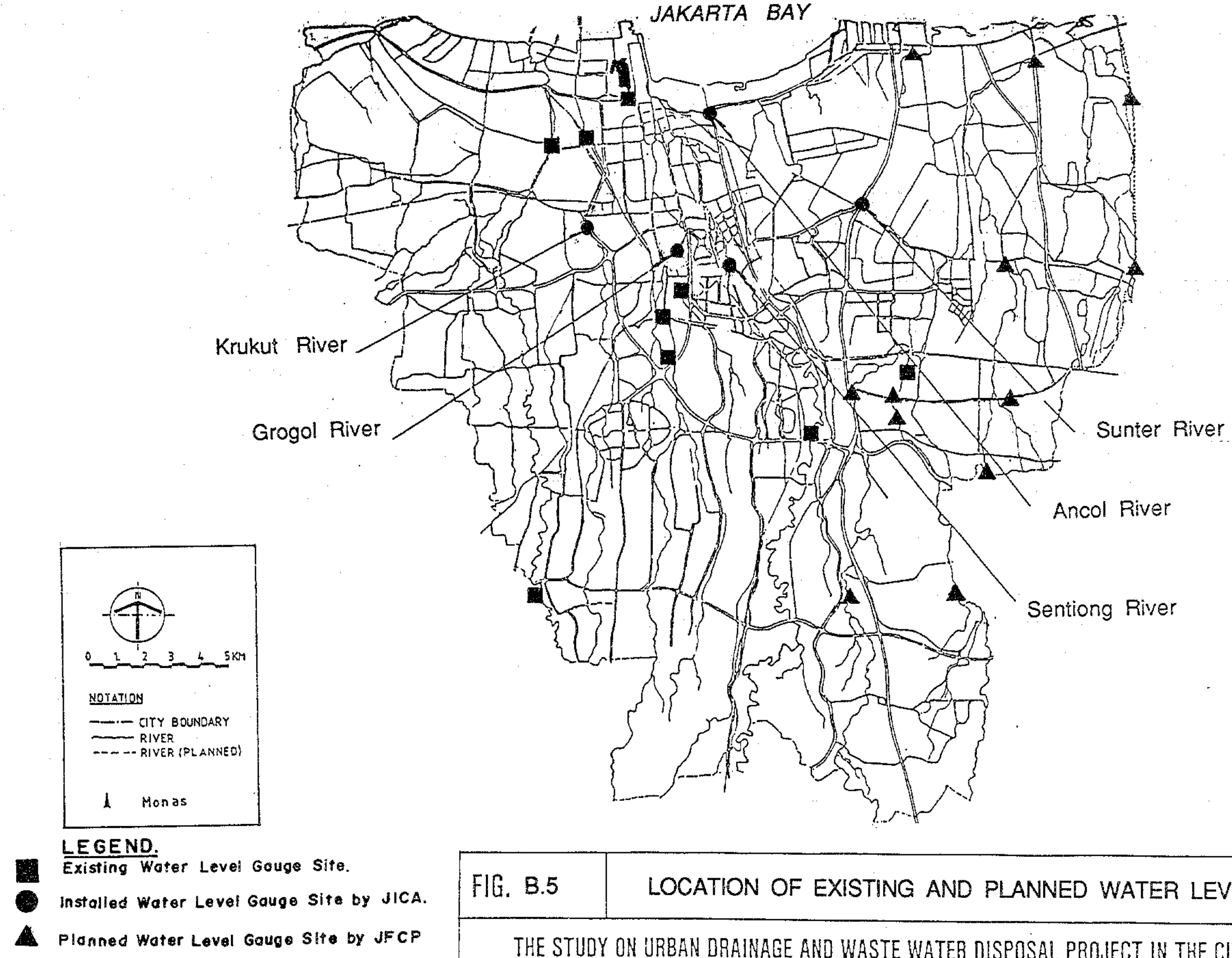


FIG. B.5 LOCATION OF EXISTING AND PLANNED WATER LEVEL GAUGE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

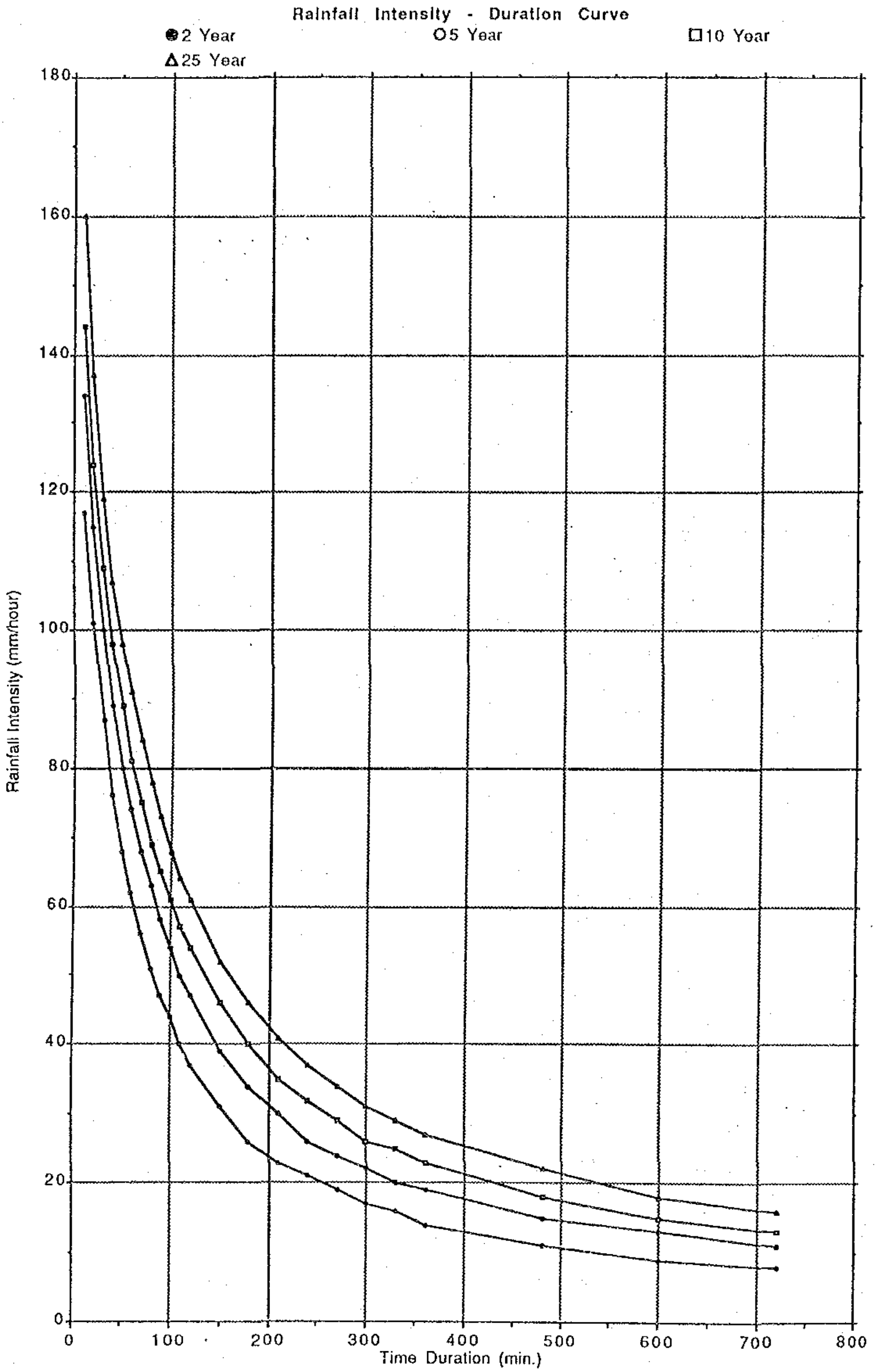
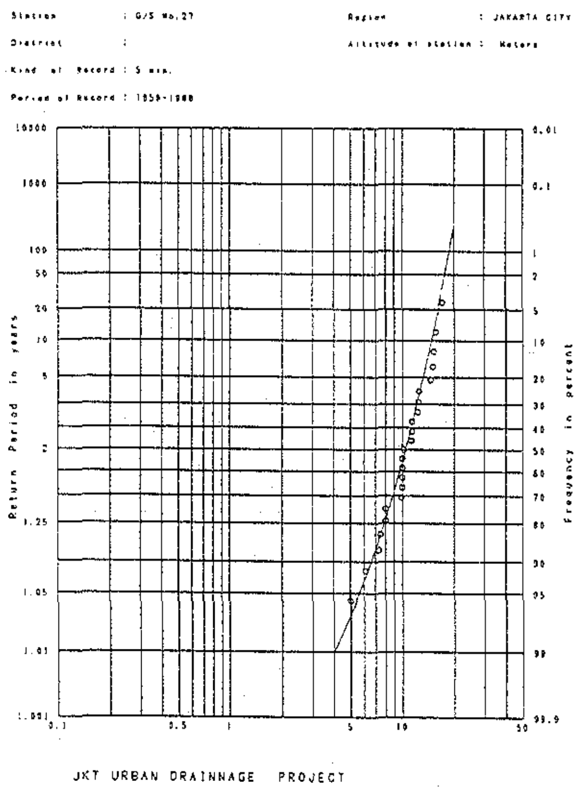
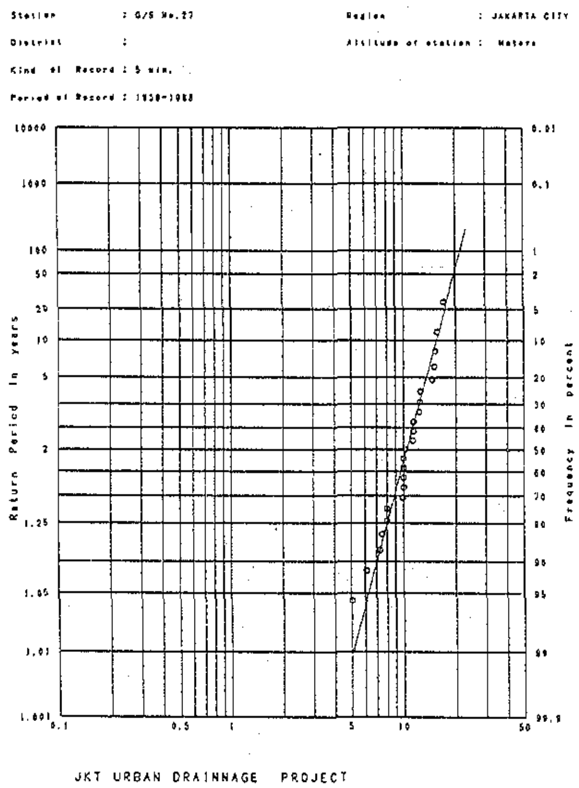


FIG. B.6	RAINFALL INTENSITY DURATION CURVE OF 1973 MASTER PLAN

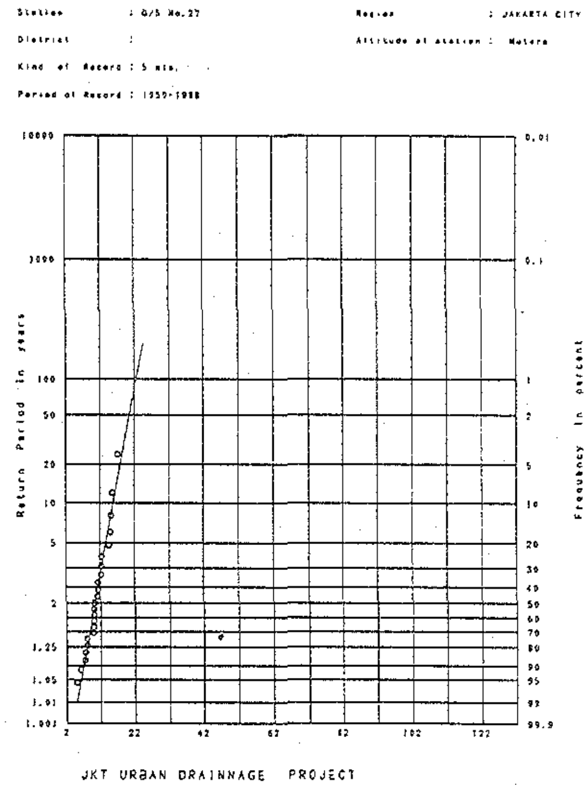
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (5 min.)



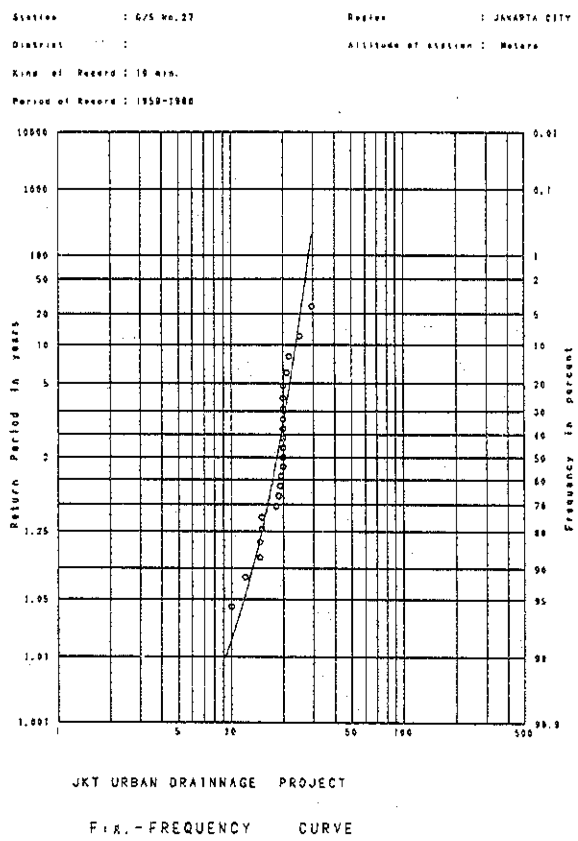
Pearson Type III (5 min.)



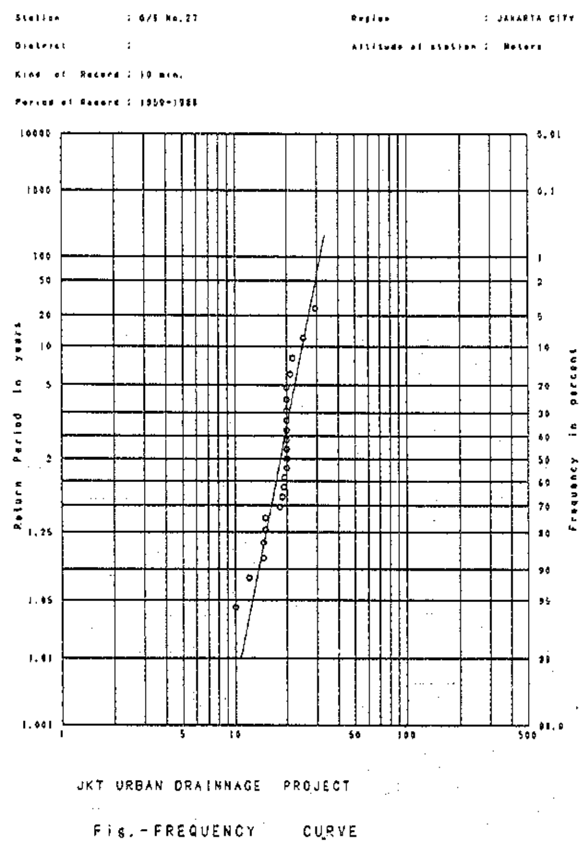
Gumbel (5 min.)

FIG. B.7(1)	RESULT OF FREQUENCY ANALYSIS (5 MIN.)

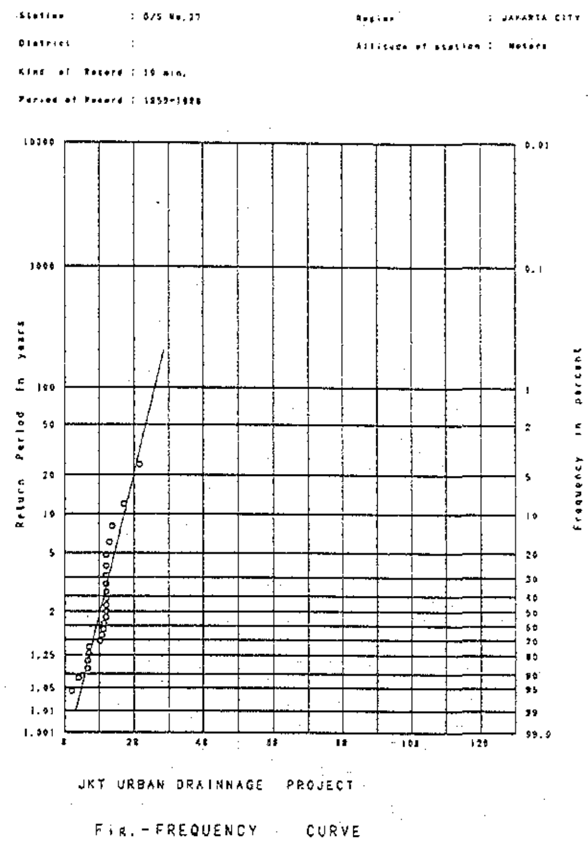
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (10 min.)



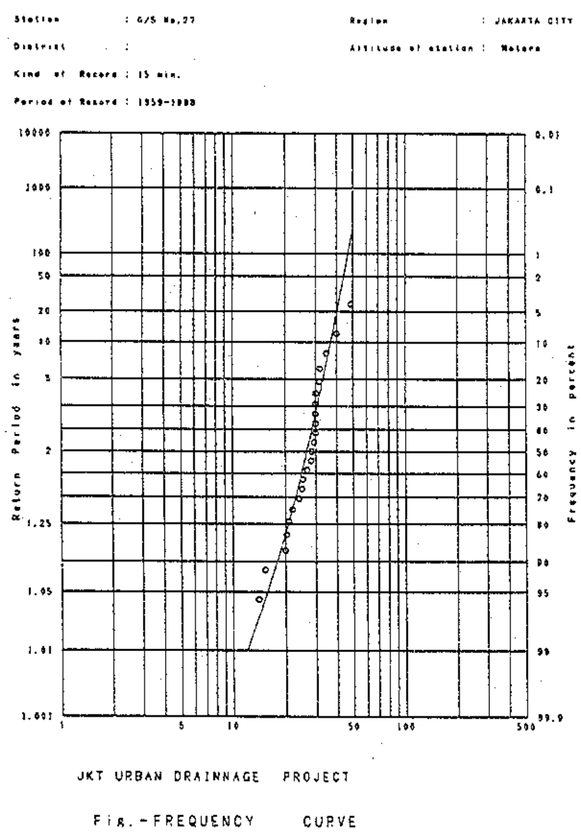
Pearson Type III (10 min.)



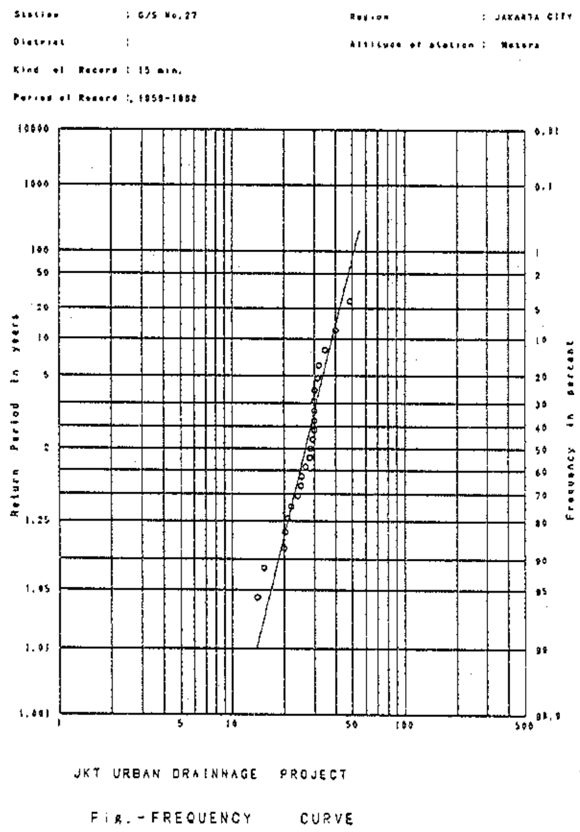
Gumbel (10 min.)

FIG. B.7(2) RESULT OF FREQUENCY ANALYSIS (10 MIN.)

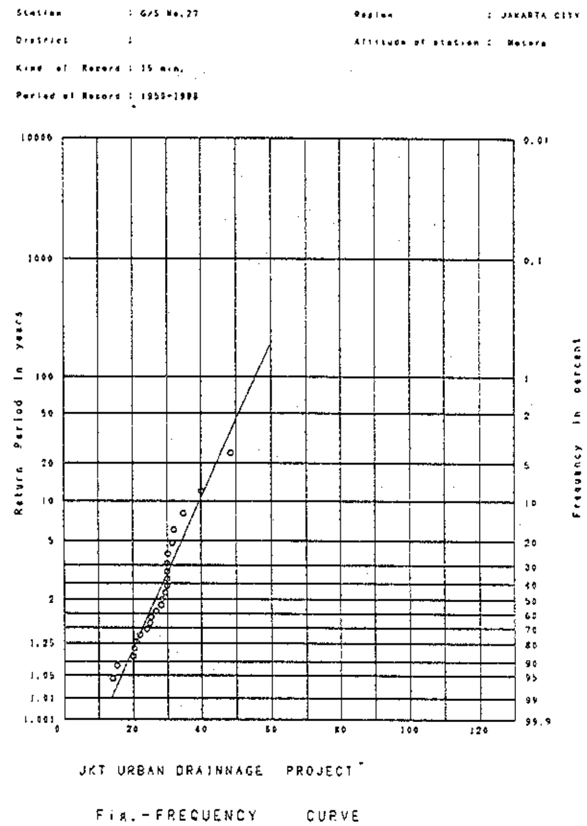
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (15 min.)



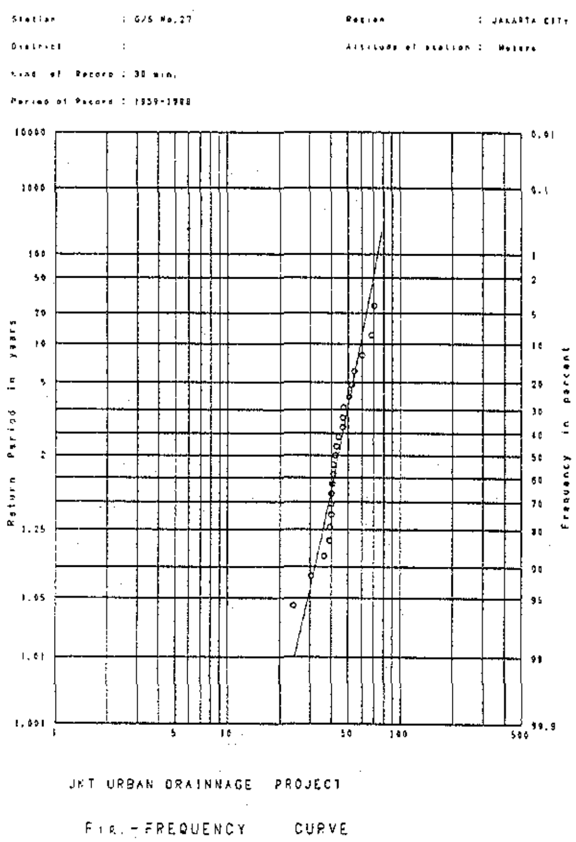
Pearson Type III (15 min.)



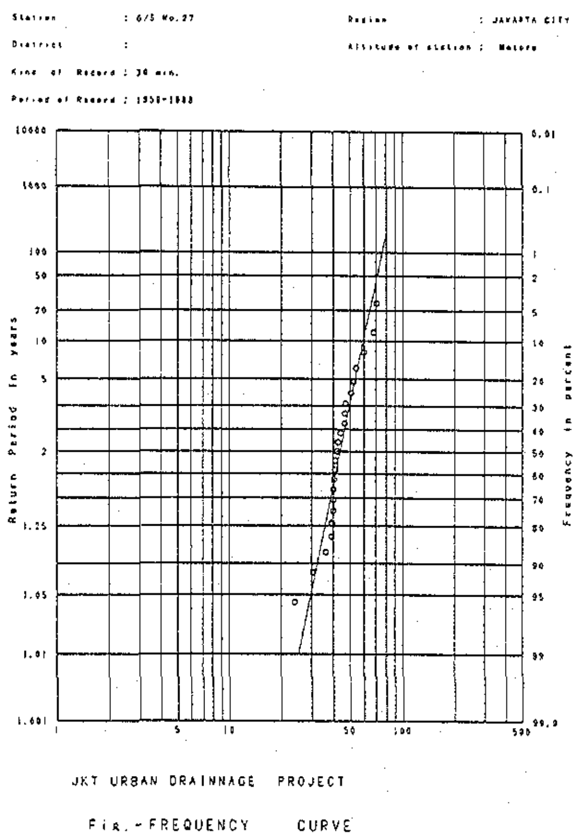
Gumbel (15 min.)

FIG. B.7(3) RESULT OF FREQUENCY ANALYSIS (15 MIN.)

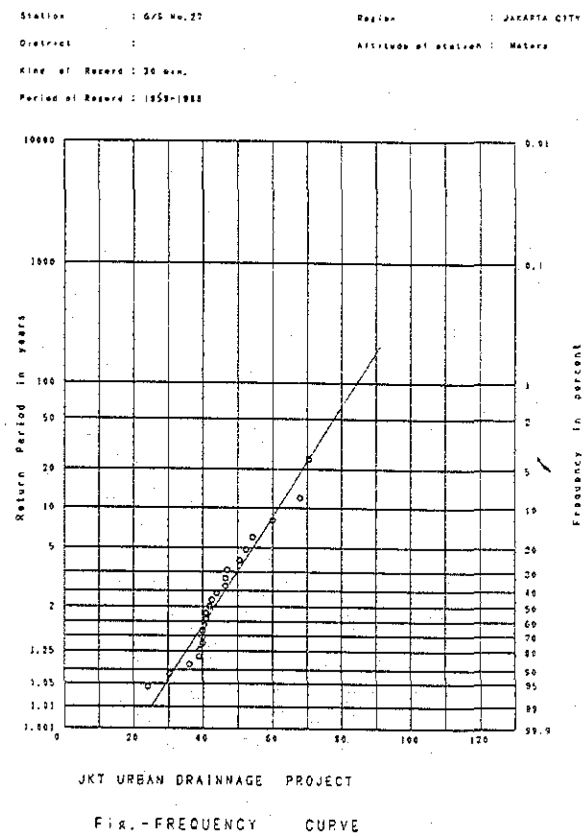
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (30 min.)



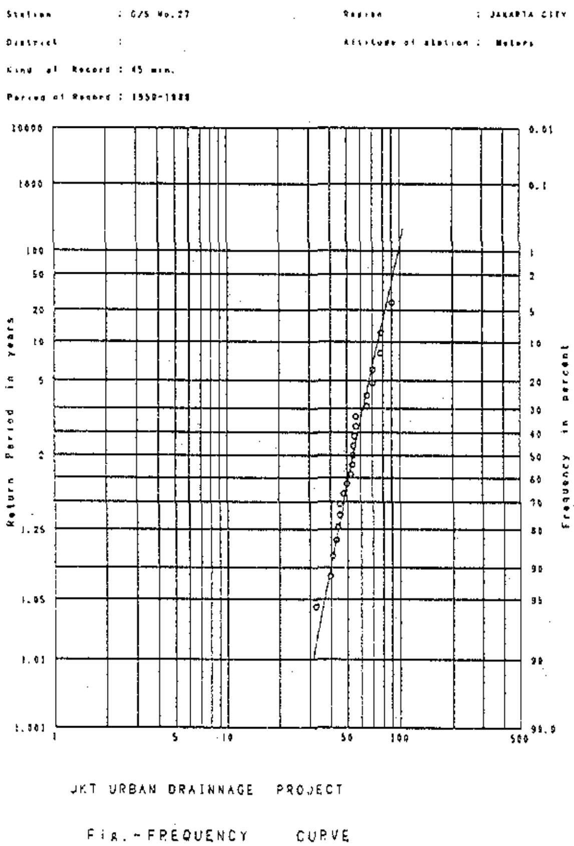
Pearson Type III (30 min.)



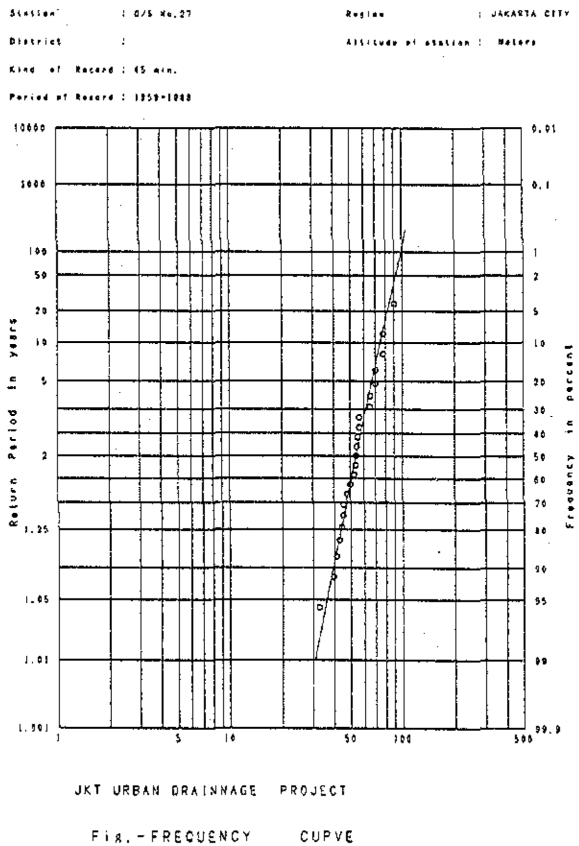
Gumbel (30 min.)

FIG. B.7(4) RESULT OF FREQUENCY ANALYSIS (30 MIN.)

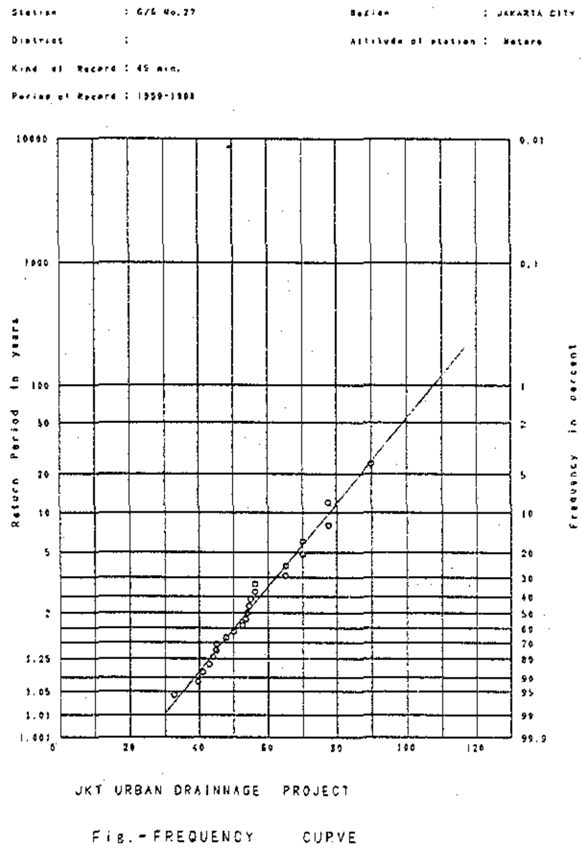
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (45 min.)



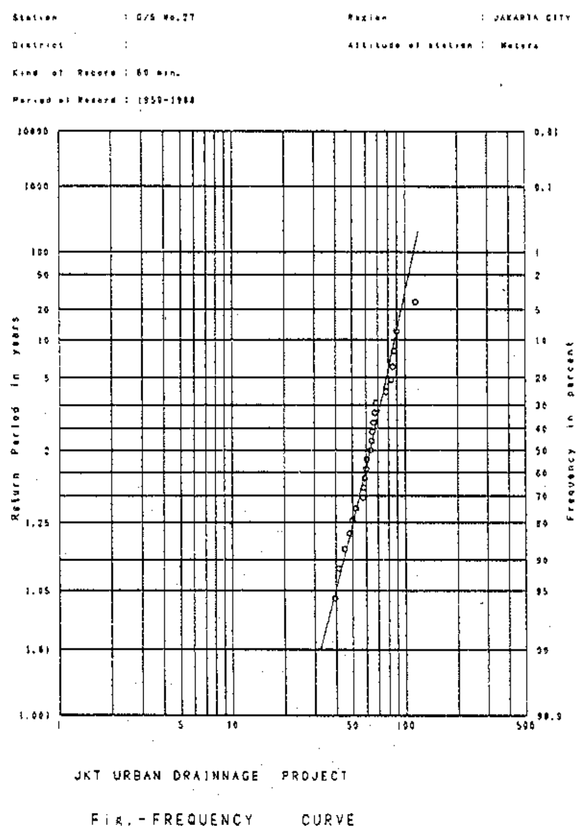
Pearson Type III (45 min.)



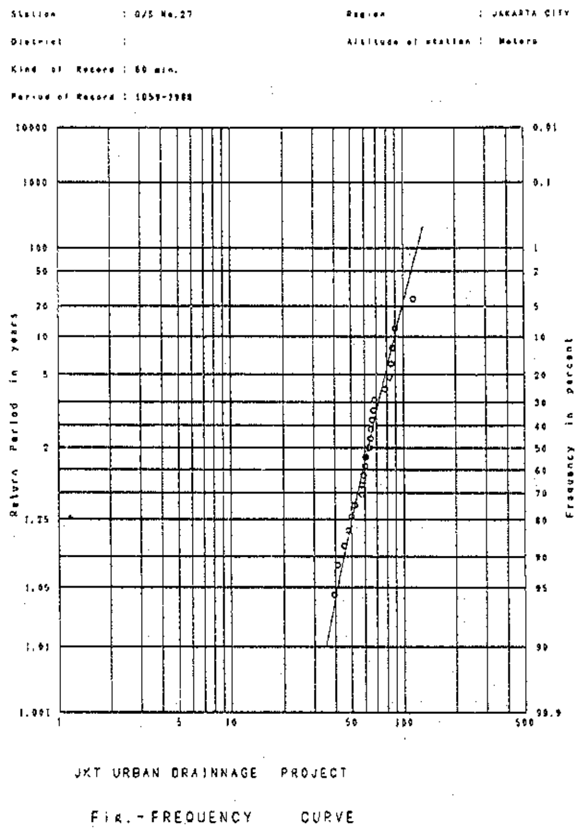
Gumbel (45 min.)

FIG. B.7(5) RESULT OF FREQUENCY ANALYSIS (45 MIN.)

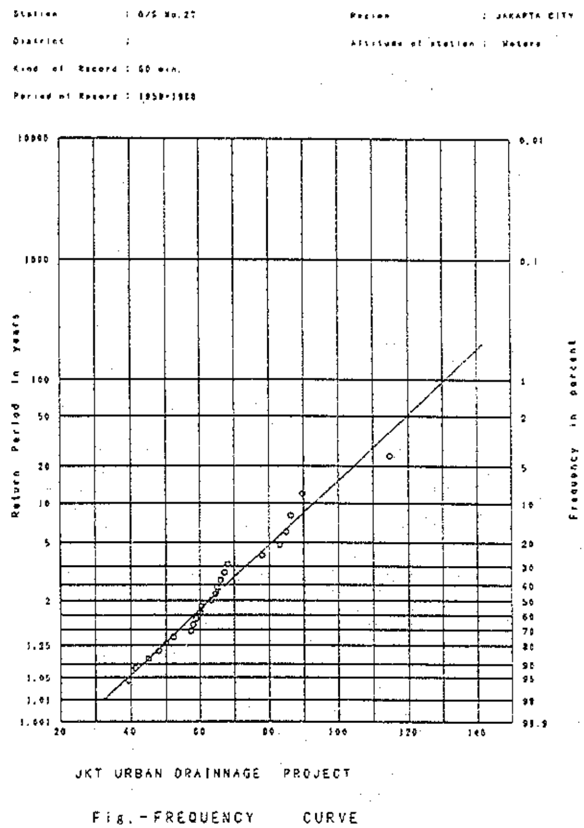
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (60 min.)



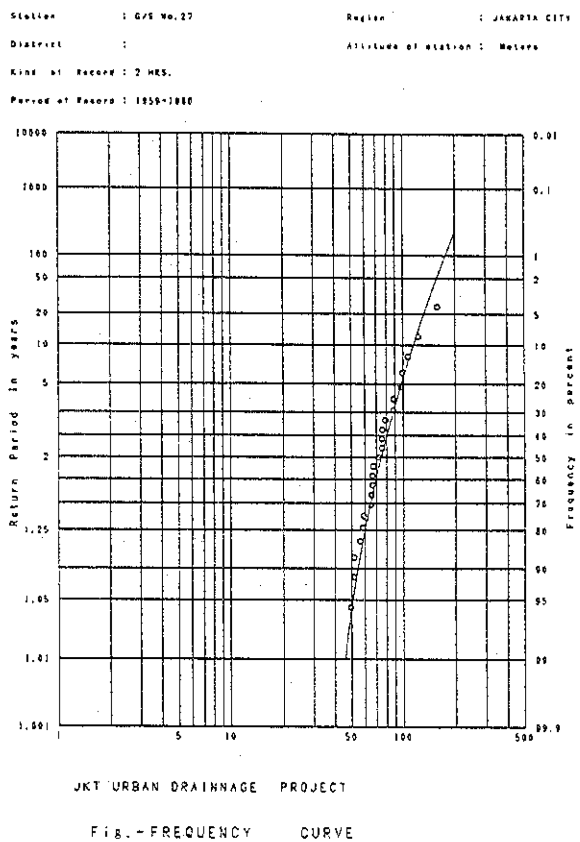
Pearson Type III (60 min.)



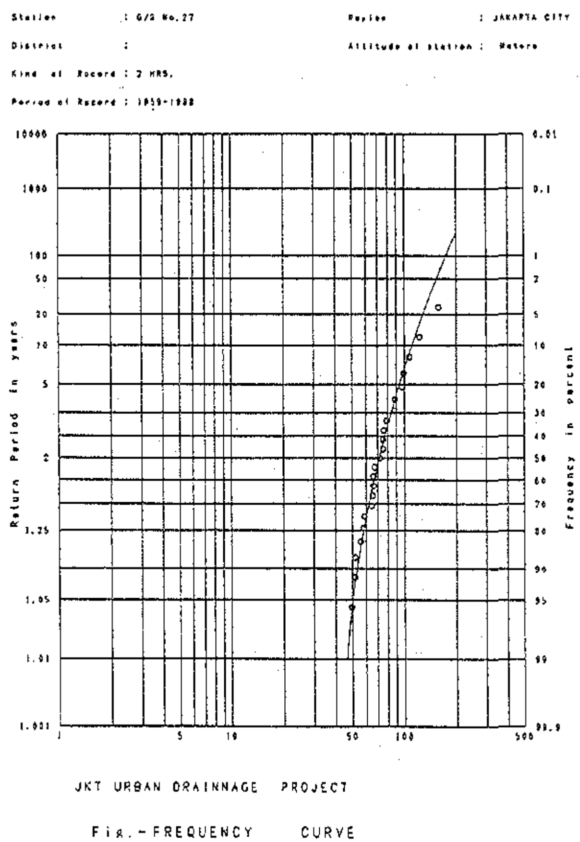
Gumbel (60 min.)

FIG. B.7(6) RESULT OF FREQUENCY ANALYSIS (60 MIN.)

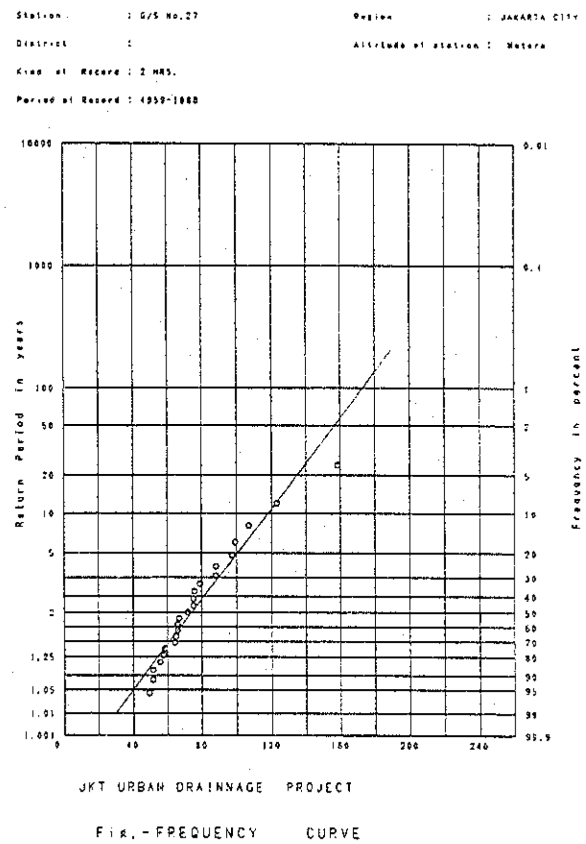
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (120 min.)



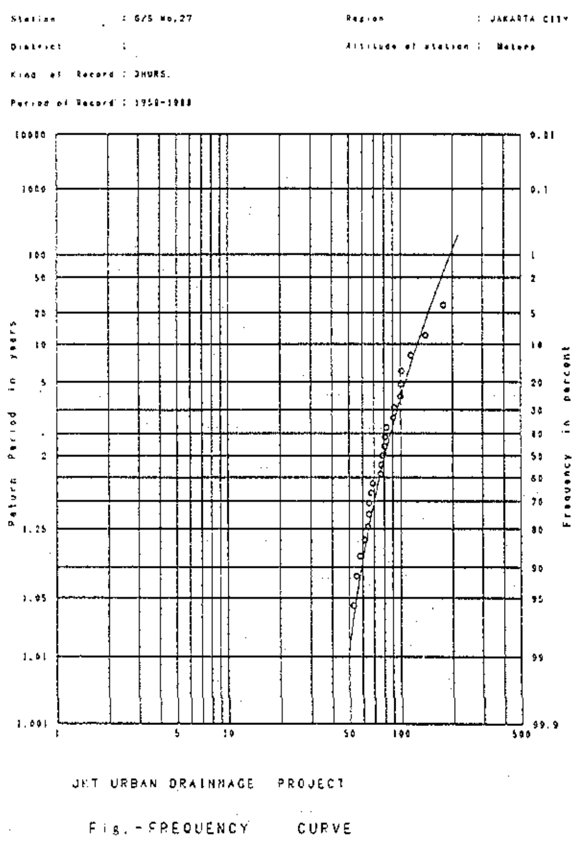
Pearson Type III (120 min.)



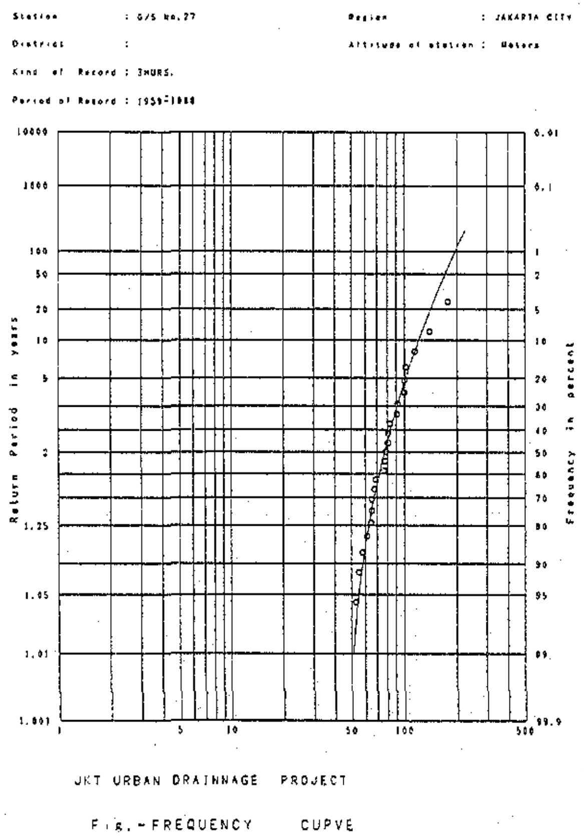
Gumbel (120 min.)

FIG. B.7(7) RESULT OF FREQUENCY ANALYSIS (120 MIN.)

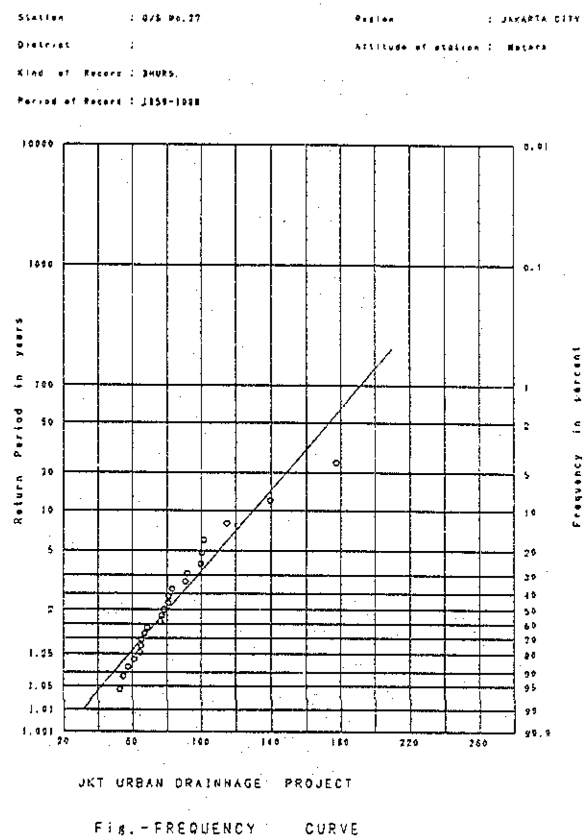
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Iwai (180 min.)



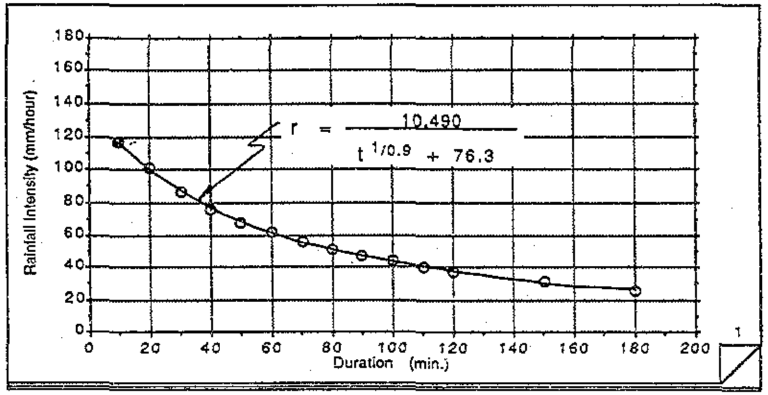
Pearson Type III (180 min.)



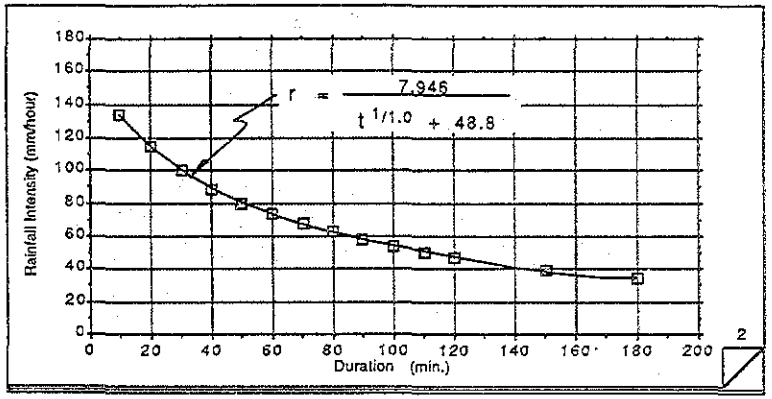
Gumbel (180 min.)

FIG. B.7(8) RESULT OF FREQUENCY ANALYSIS (180 MIN.)

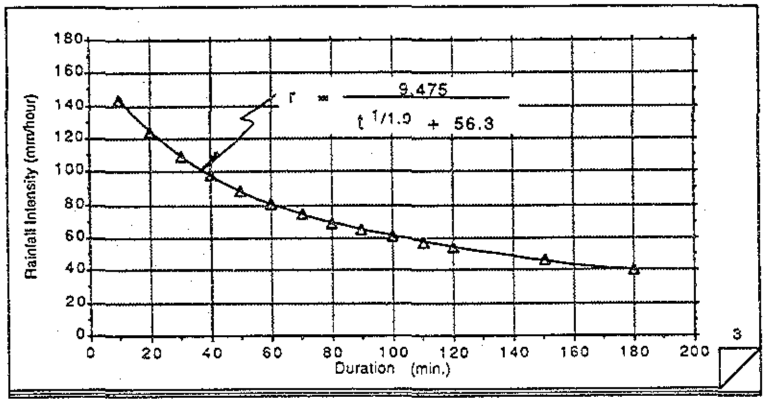
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



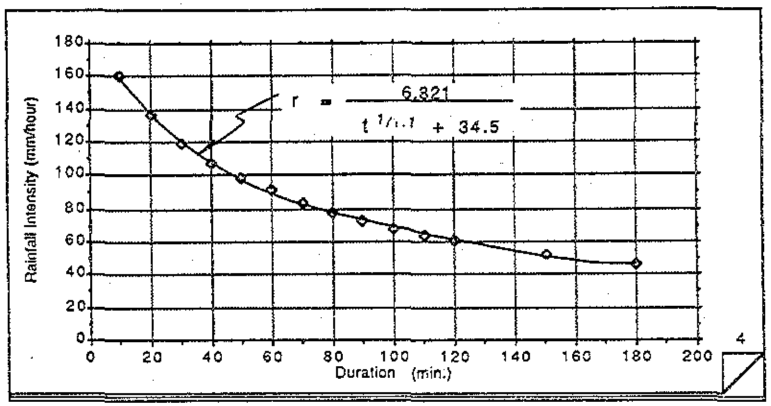
2 Year Return Period



5 Year Return Period



10 Year Return Period



25 Year Return Period

FIG. B.8	COMPARISON OF RAINFALL INTENSITY-DURATION CURVE AND EQUATION
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA	

JICA A.D 1991

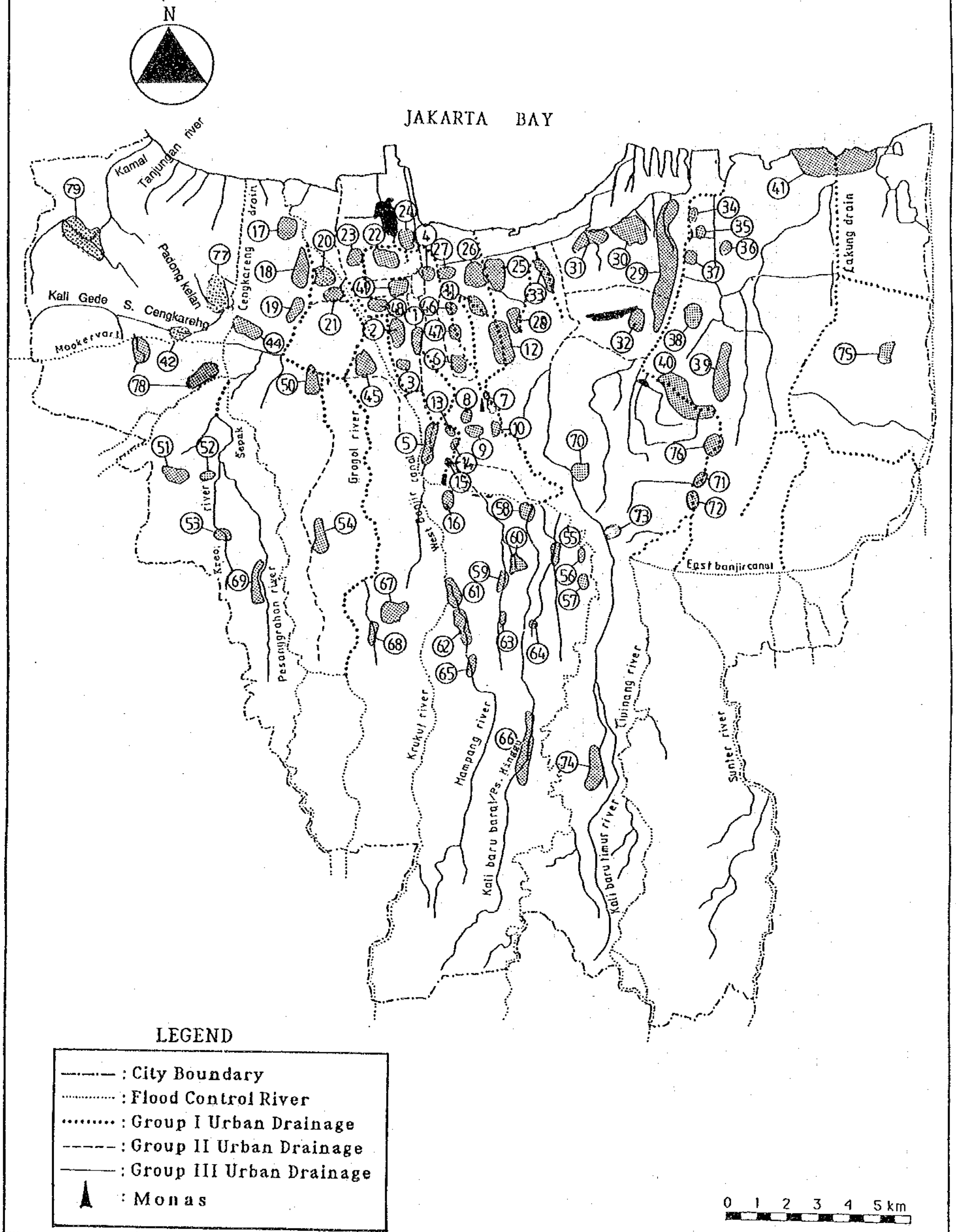


FIG. B.9 LOCATION OF HABITUAL FLOOD AREA

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

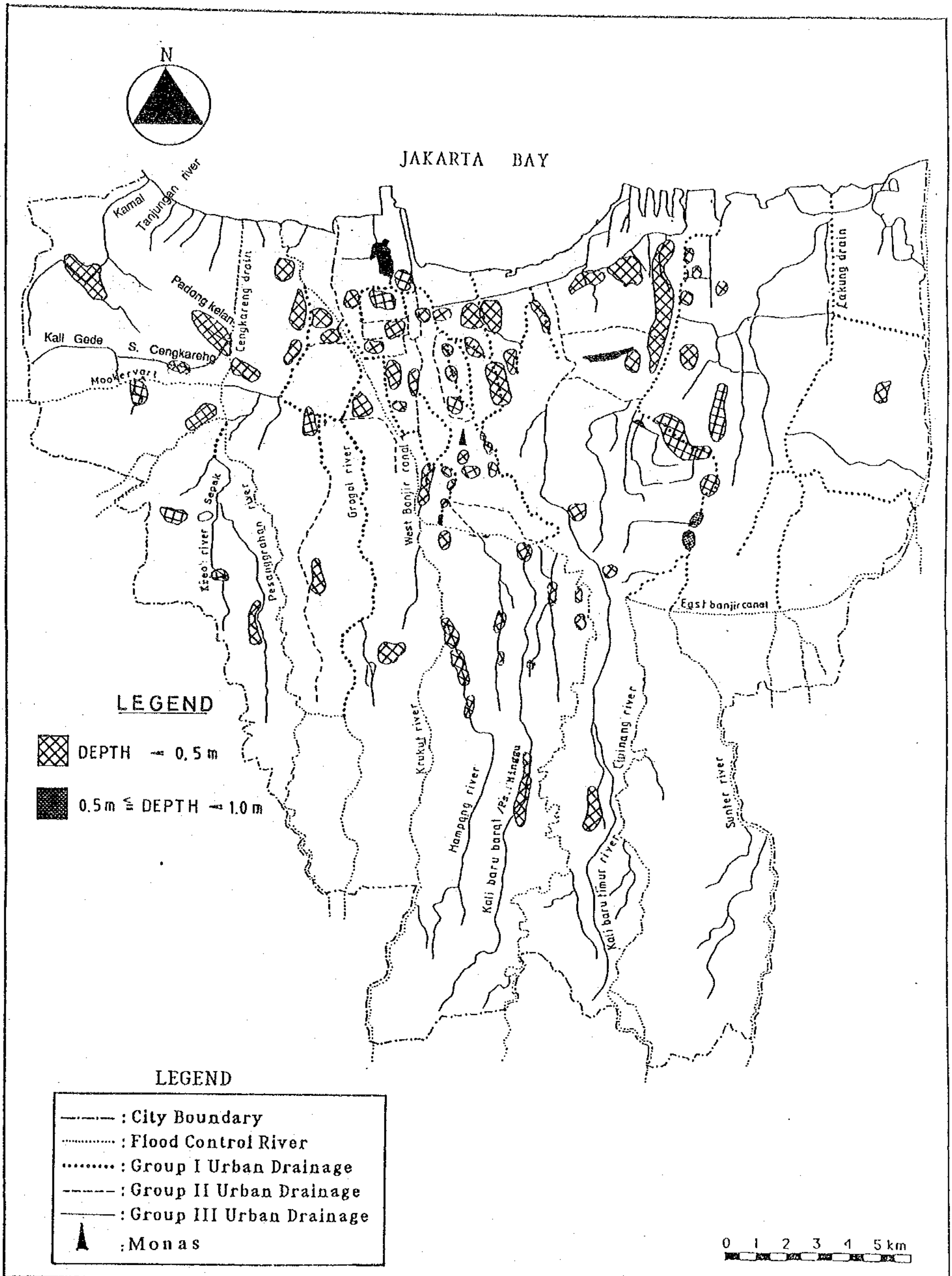


FIG. B.10 DISTRIBUTION OF HABITUAL FLOOD DEPTH

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

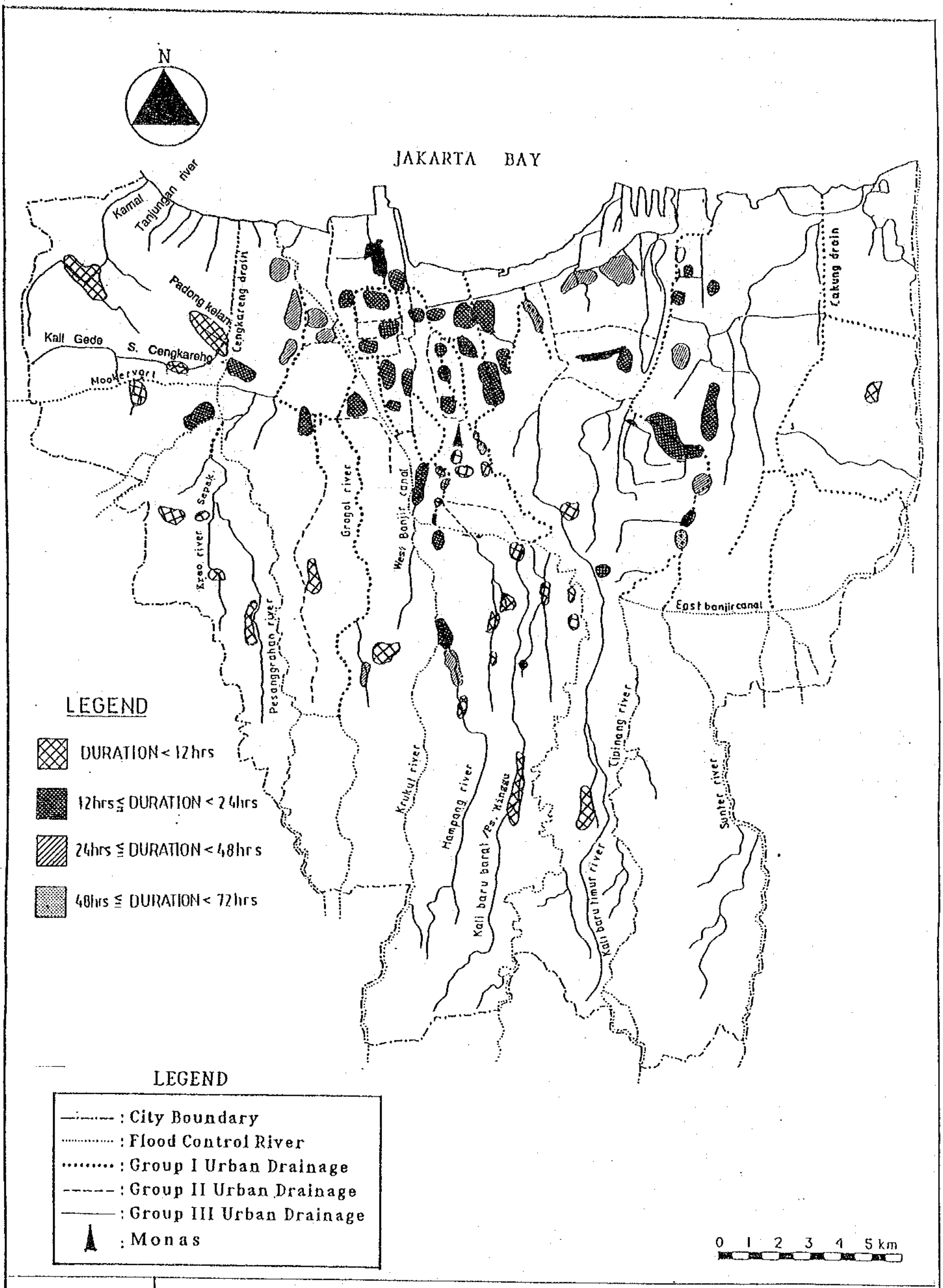
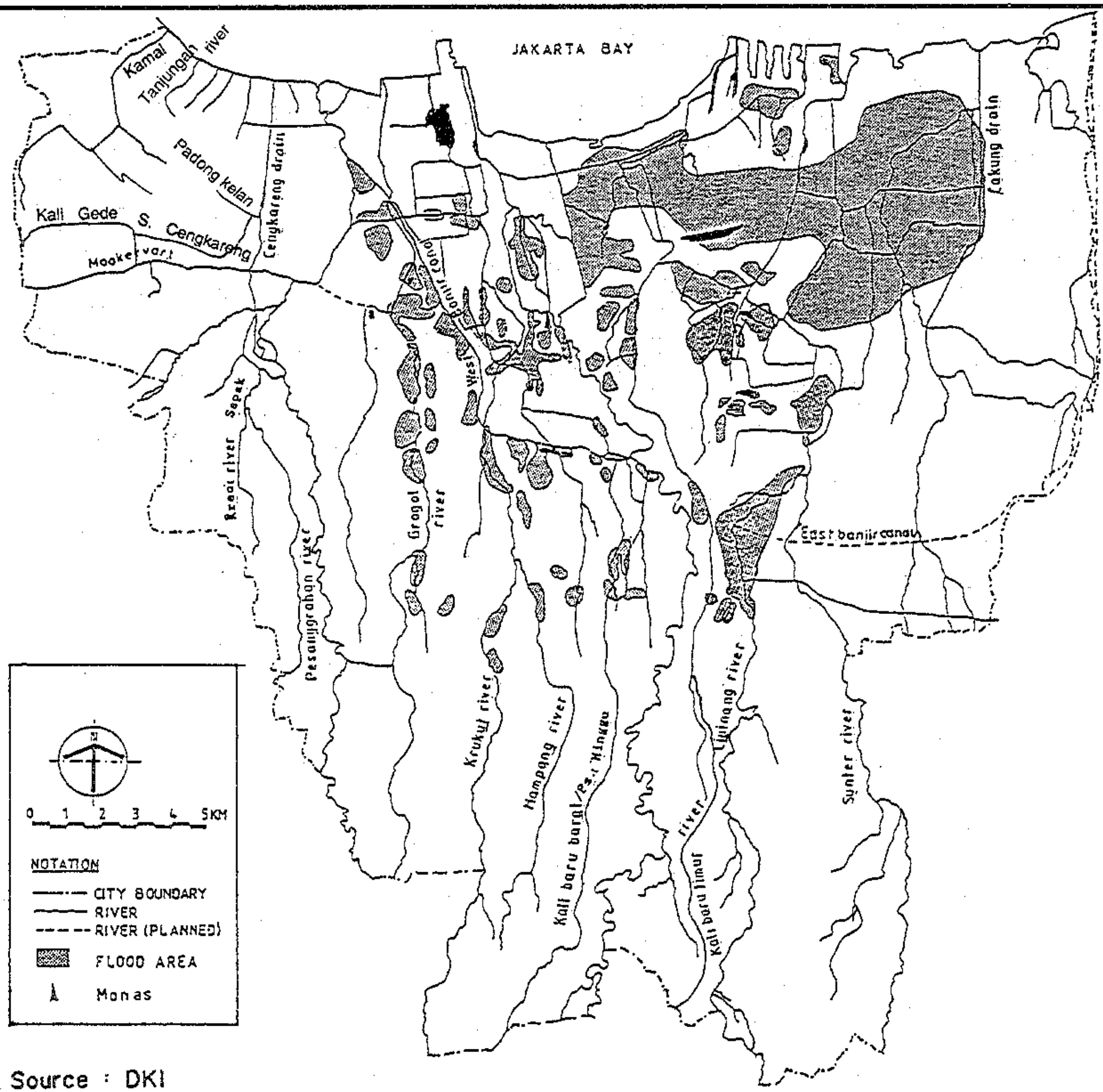


FIG. B.11 DISTRIBUTION OF HABITUAL FLOOD DURATION

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

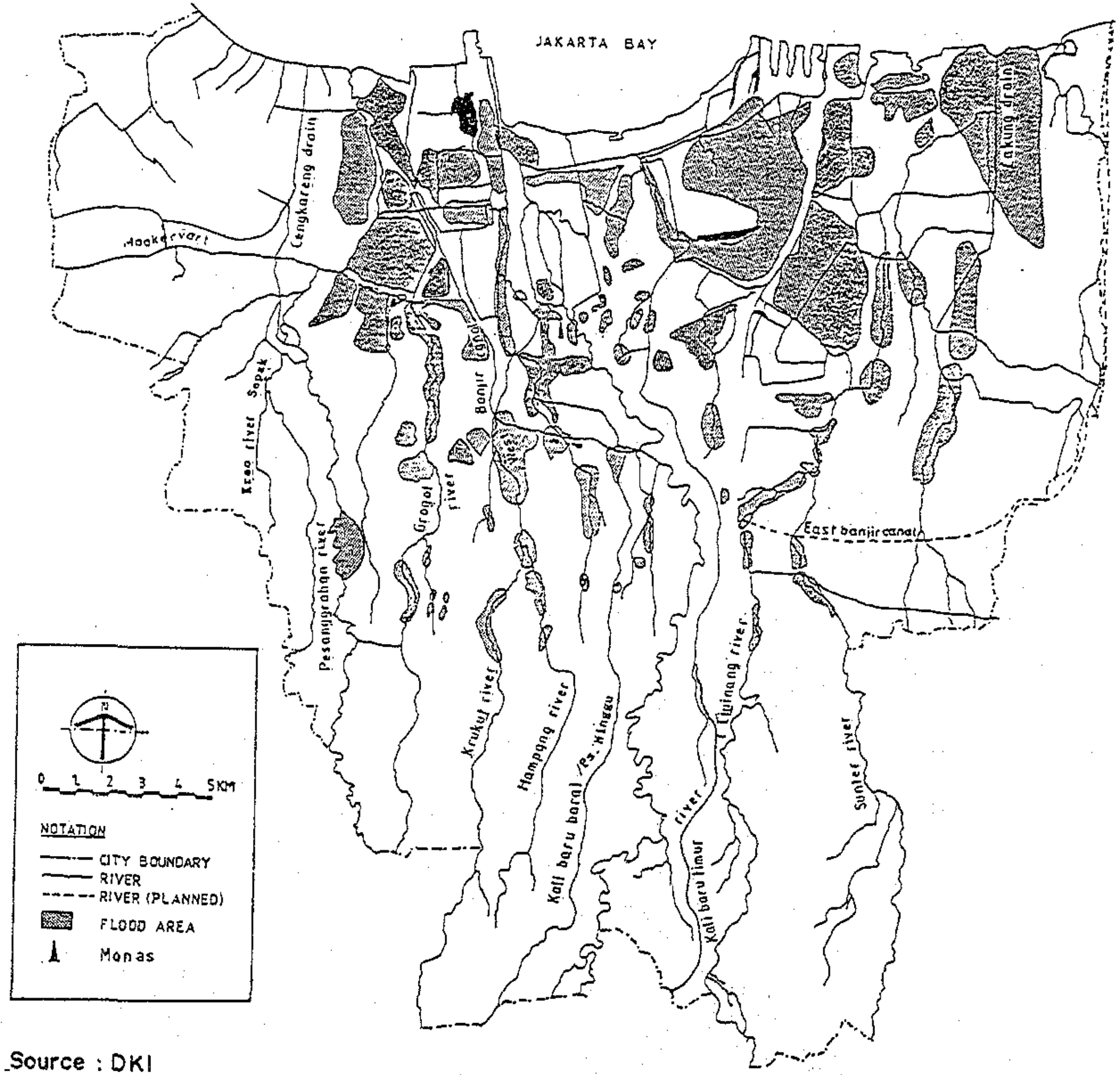
JICA A.D 1991



Source : DKI

FIG. B.12 FLOOD AREA OF JANUARY 19/20 IN 1977

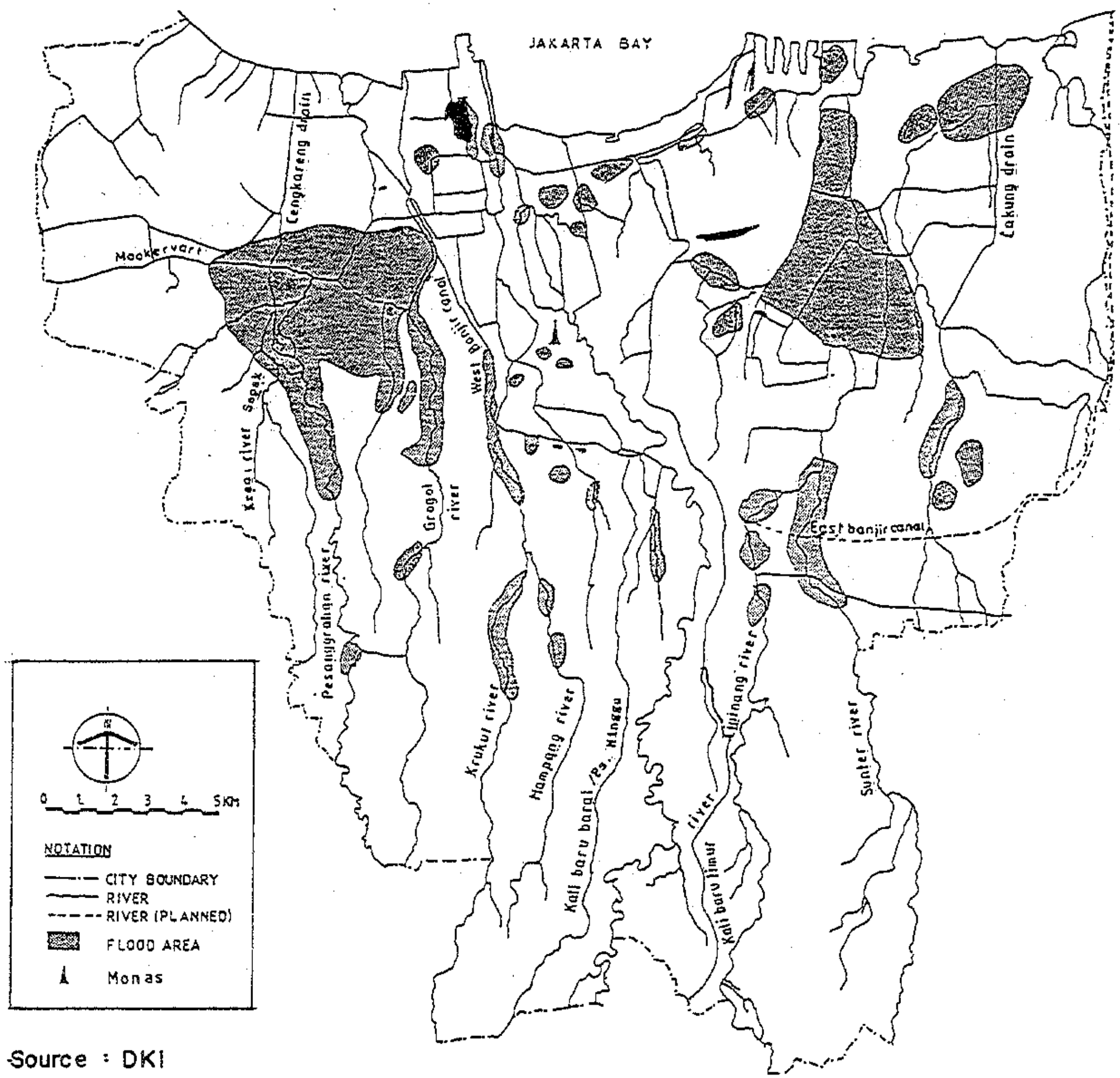
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Source : DKI

FIG. B.13 FLOOD AREA OF JANUARY 18/19 IN 1979

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Source : DKI

FIG. B.14	FLOOD AREA OF DECEMBER 24/25 IN 1981

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

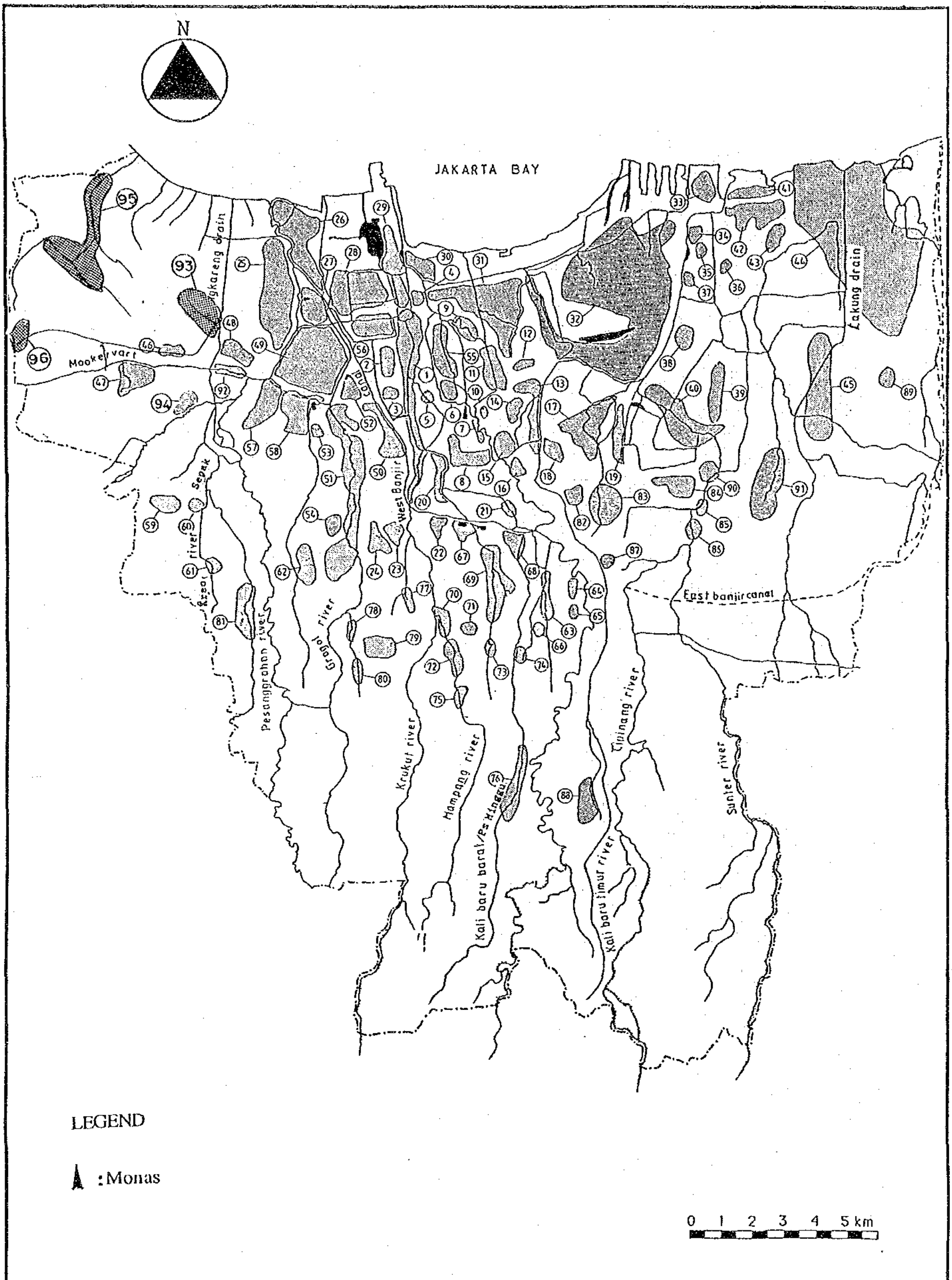


FIG. B.15 LOCATION OF POTENTIAL FLOOD AREA (40-YEAR FREQUENCY)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

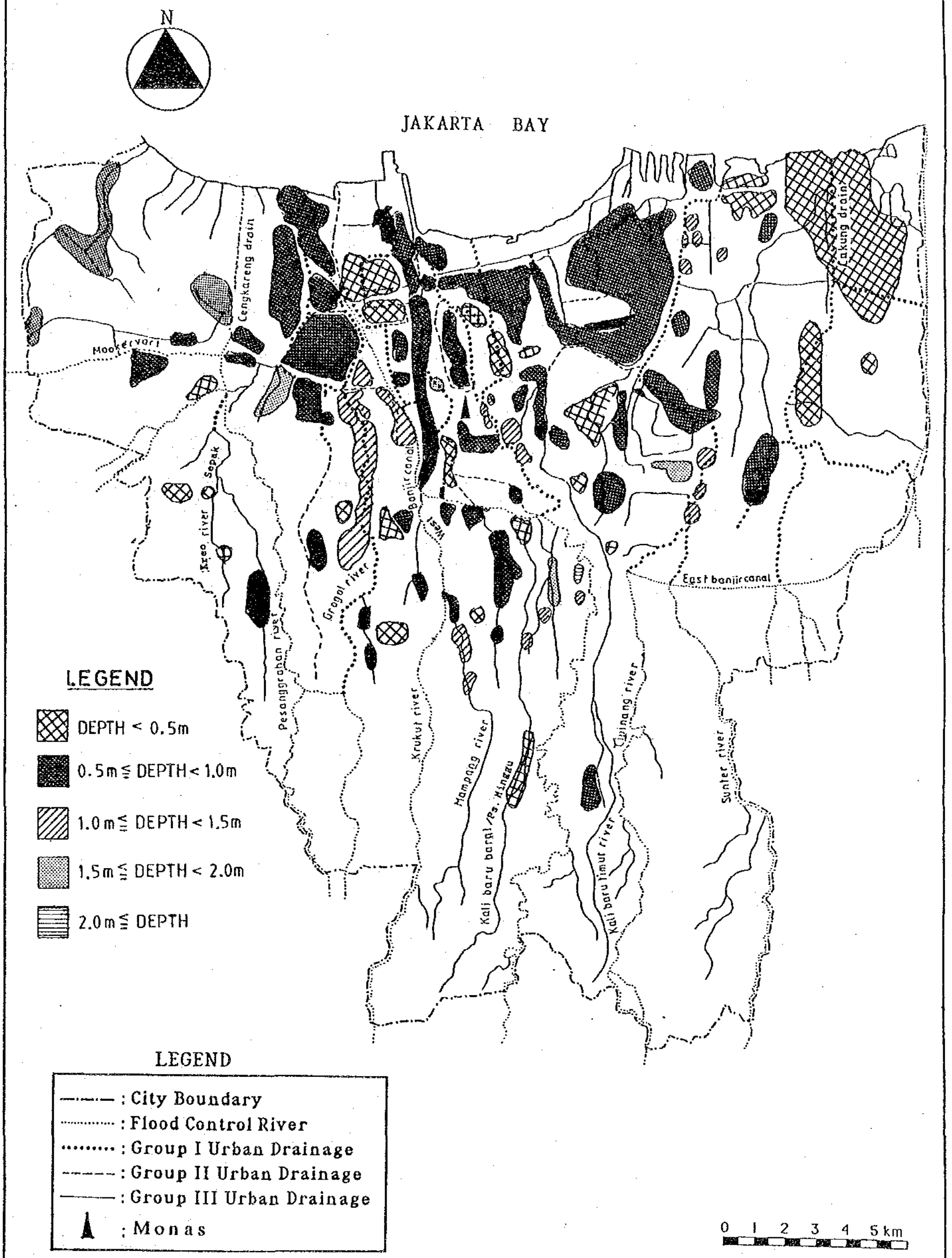


FIG. B.16 DISTRIBUTION OF POTENTIAL FLOOD DEPTH

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

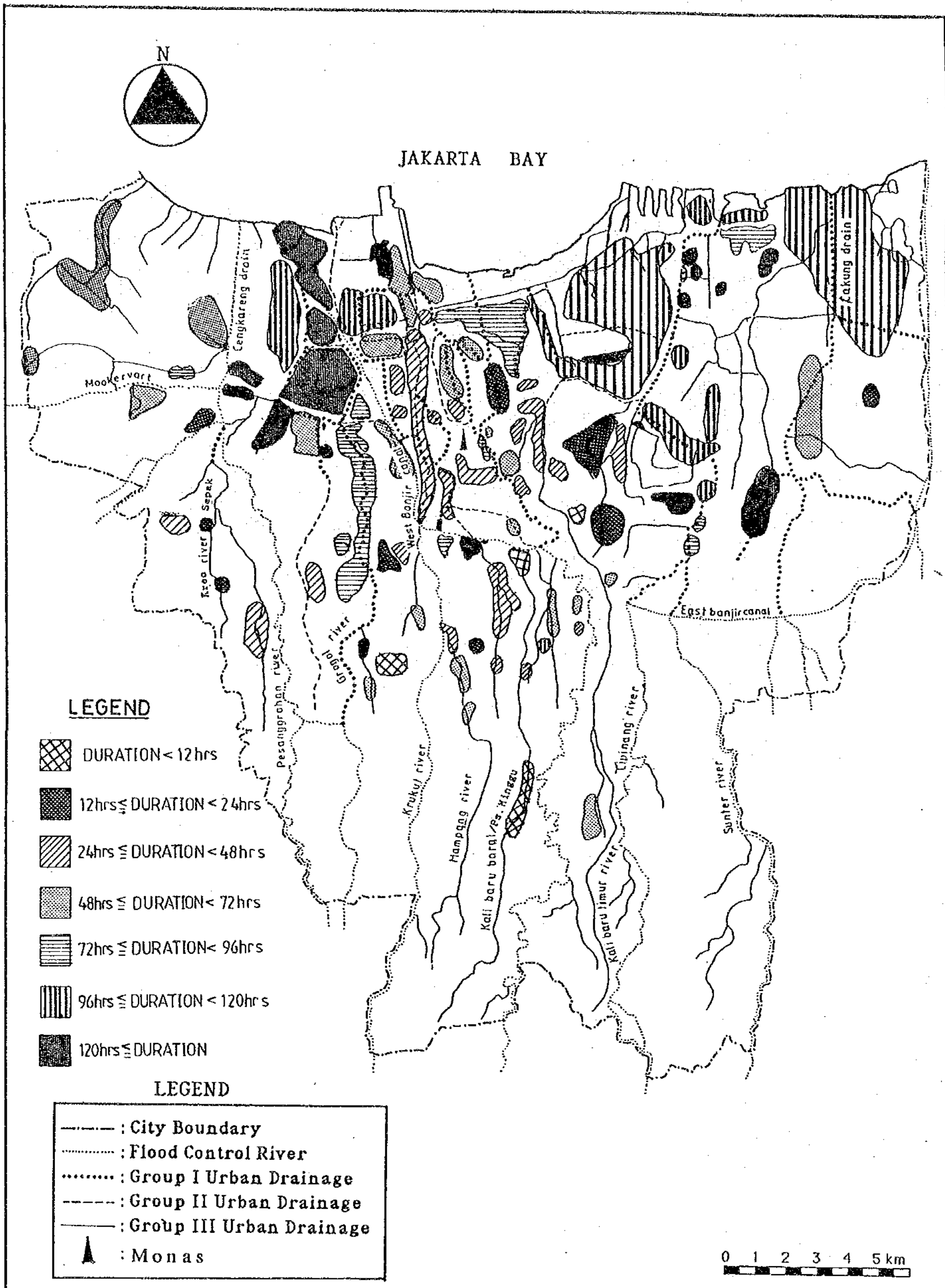


FIG. B.17 DISTRIBUTION OF POTENTIAL FLOOD DURATION

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

Station : BASIN AVERAGE

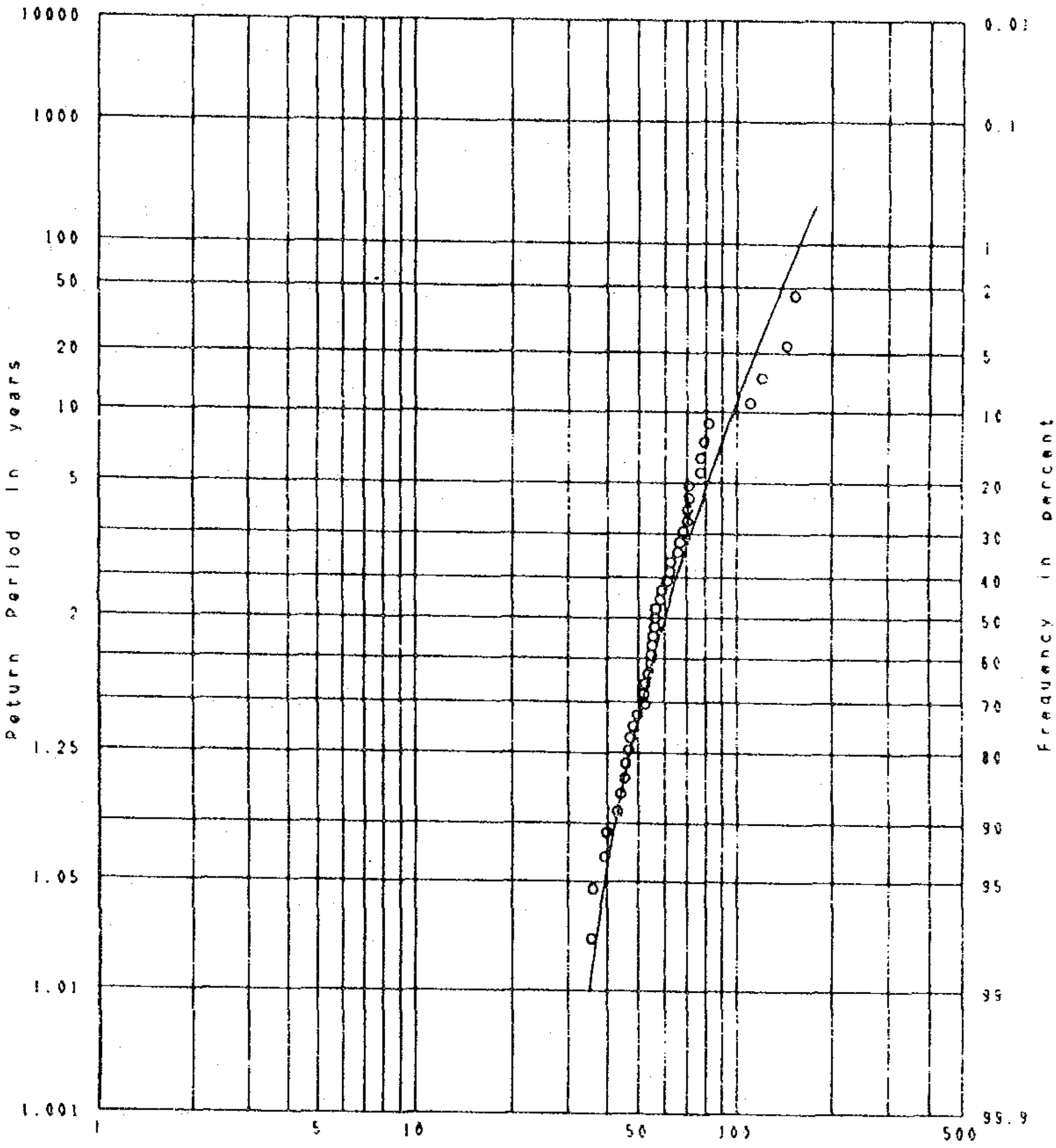
Region : JAKARTA CITY

District :

Altitude of station : Meters

Kind of Record : DAILY RAINFALL

Period of Record : 1935-1988



JKT URBAN DRAINAGE PROJECT

FIG. B.18(1) FREQUENCY CURVE OF BASIN AVERAGE DAILY RAINFALL (IWAI)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Station : BASIN AVERAGE

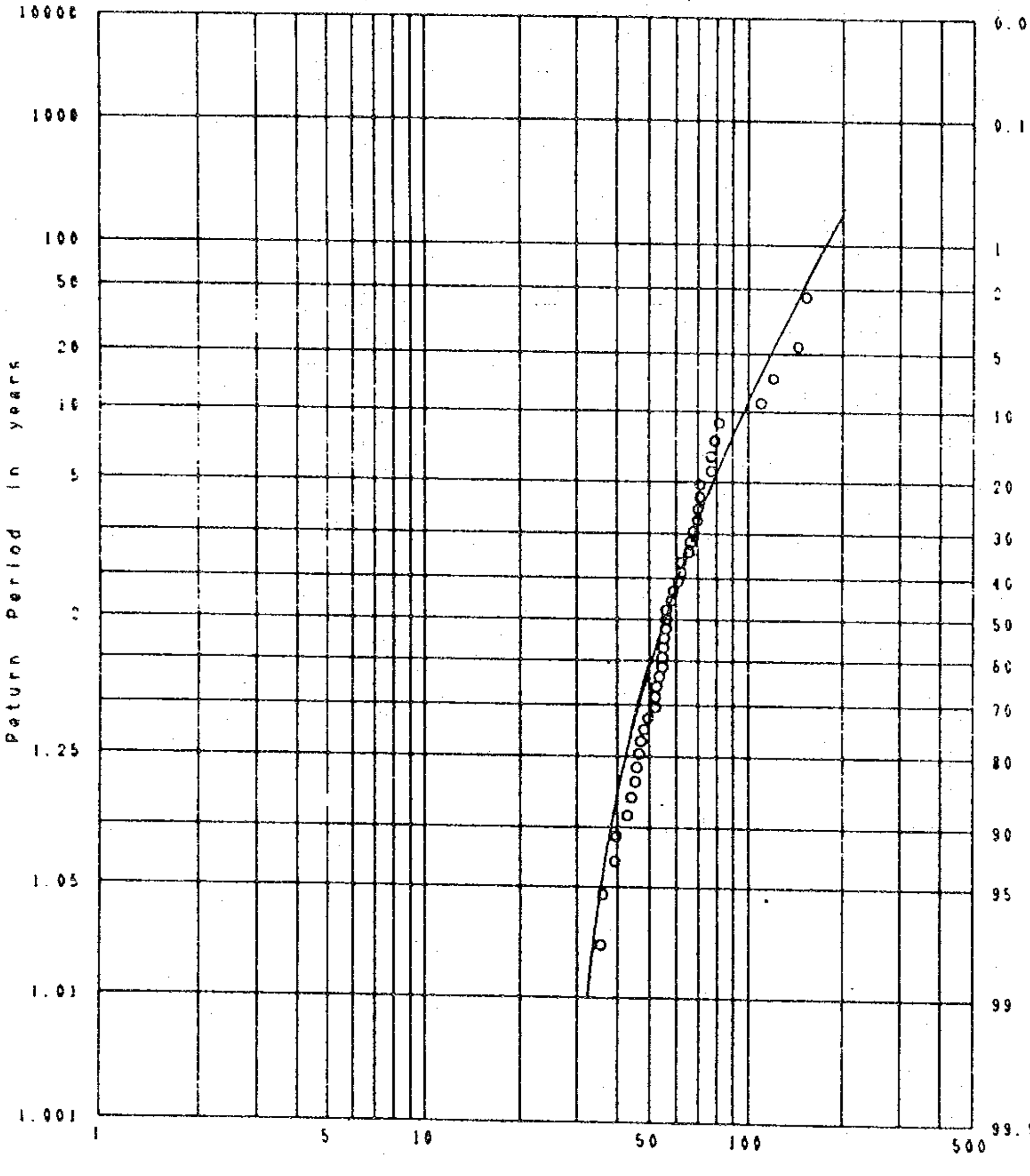
Region : JAKARTA CITY

District :

Altitude of station : Meters

Kind of Record : DAILY RAINFALL

Period of Record : 1935-1988

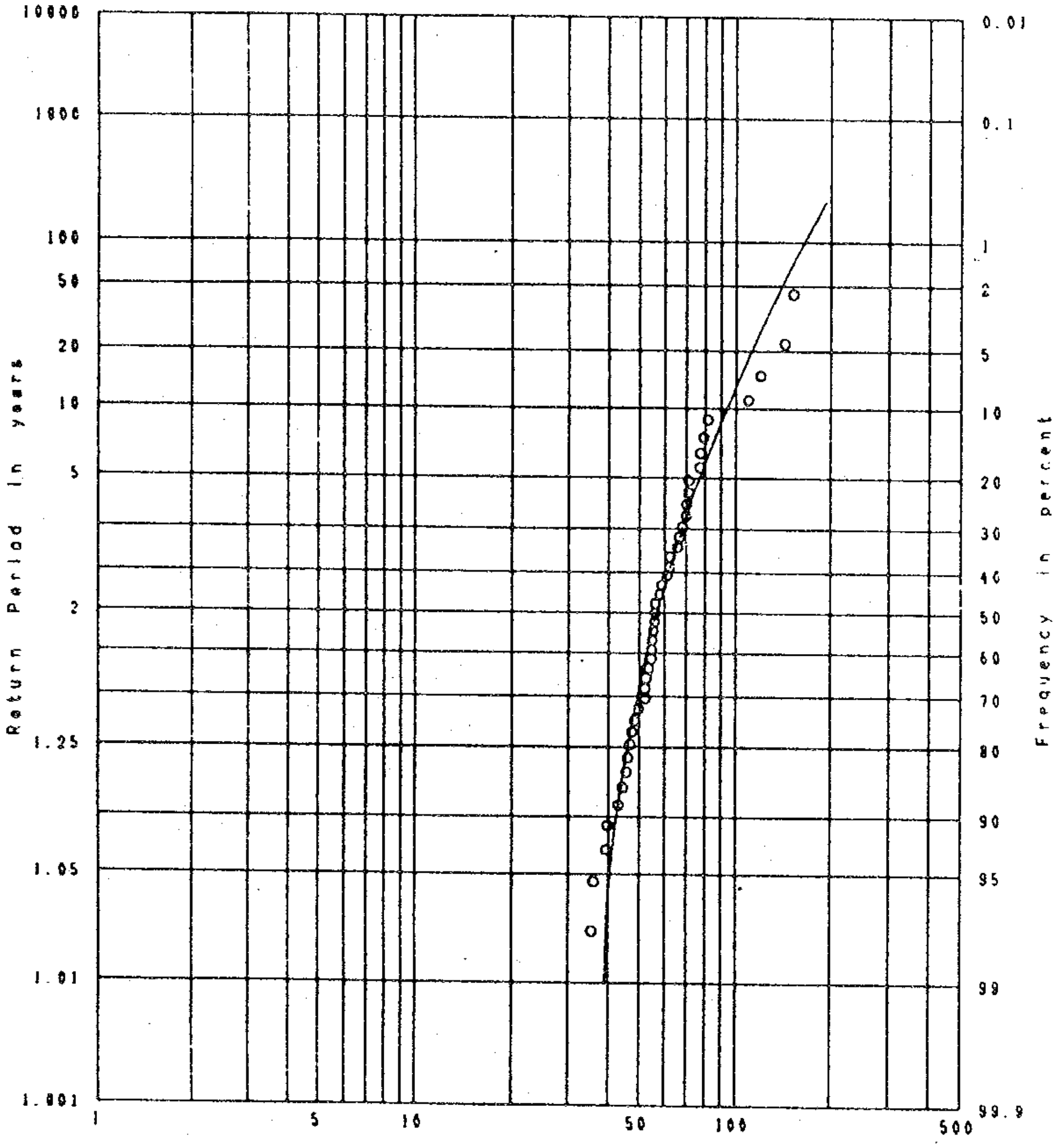


JKT URBAN DRAINAGE PROJECT

FIG. B.18(2)	FREQUENCY CURVE OF BASIN AVERAGE DAILY RAINFALL (HAZEN)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Station : BASIN AVERAGE
Region : JAKARTA CITY
District :
Altitude of station : Meters
Kind of Record : DAILY RAINFALL
Period of Record : 1935-1988



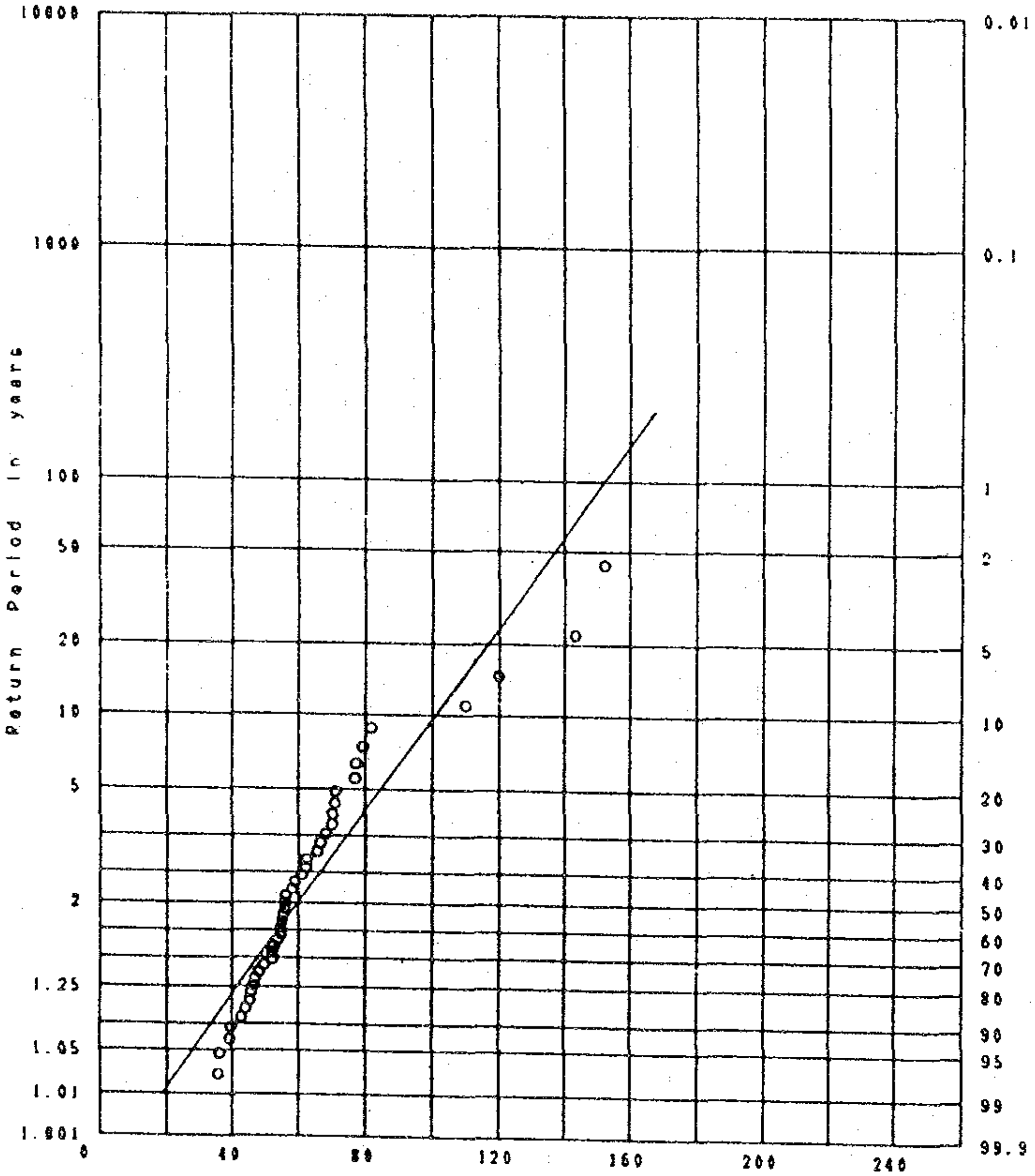
JKT URBAN DRAINAGE PROJECT

FIG. B.18(3)	FREQUENCY CURVE OF BASIN AVERAGE DAILY RAINFALL (PEARSON TYPE III)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

Station : BASIN AVERAGE
District :
Kind of Record : DAILY RAINFALL
Period of Record : 1935-1988

Region : JAKARTA CITY
Altitude of station : Meters



JKT URBAN DRAINAGE PROJECT

FIG. B.18(4) FREQUENCY CURVE OF BASIN AVERAGE DAILY RAINFALL (GUMBEL)

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

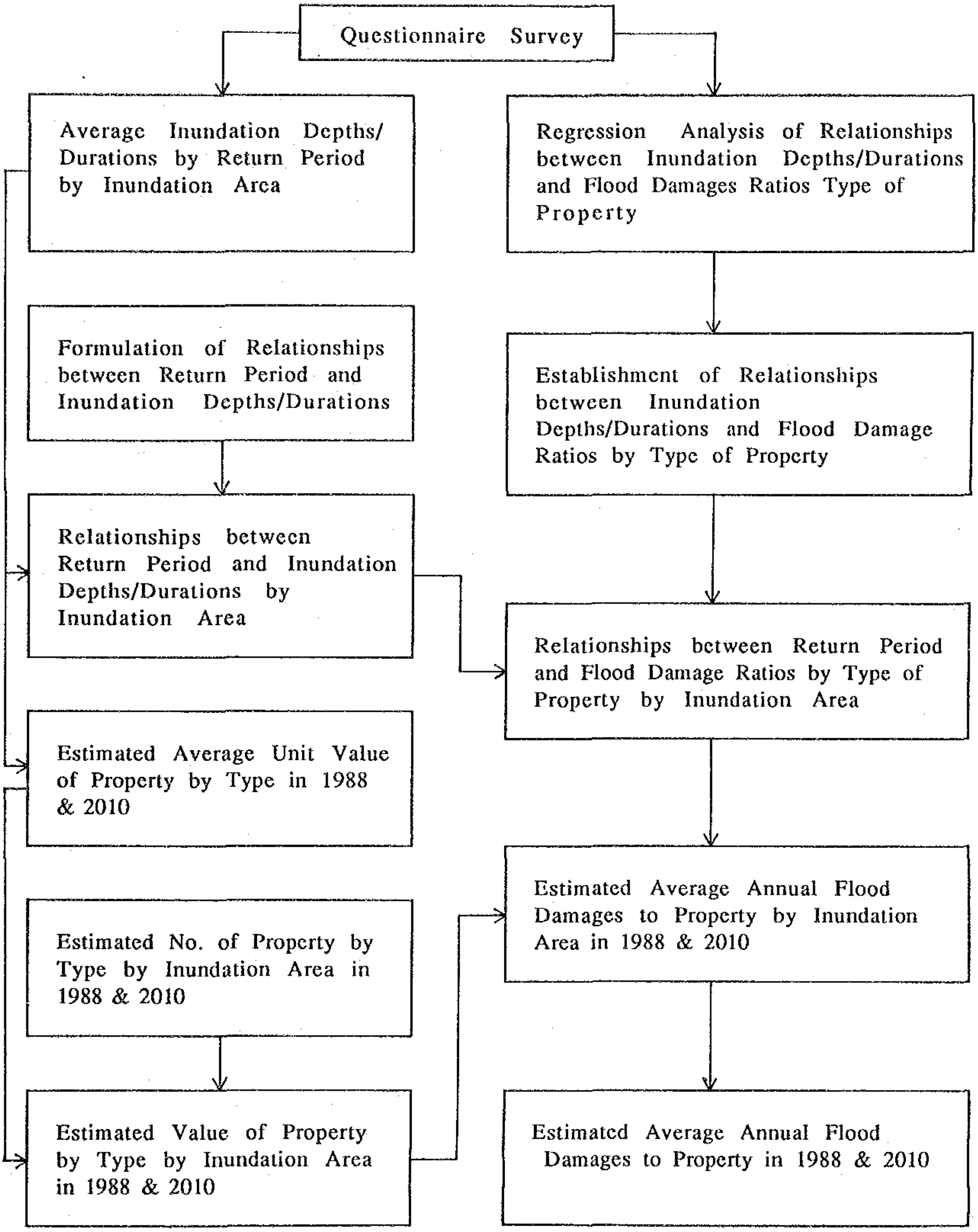


FIG. B.19 FLOW CHART FOR ESTIMATION OF AVERAGE ANNUAL FLOOD DAMAGES (DIRECT DAMAGES TO PROPERTY) IN 1988 & 2010 - "WITHOUT" CASE

APPENDIX C

ENVIRONMENTAL CONDITIONS

APPENDIX C ENVIRONMENTAL CONDITIONS

1. River Water Quality

1.1 Available Data

(1) P4L Observation

P4L has observed river water quality at 42 stations in the Study Area since 1979. The stations distribute over the whole Study Area comparatively uniformly as shown in Fig.C.1. The observed water quality parameters are as follows.

- pH, Cl^-, SS, SO_4^{2-}, COD, BOD, NH_4-N, Organic ($KMnO_4$), Methylene Blue, Phenol, Fe, Cu, Pb, Cd, Cr, Coliform Group, Fecal Coliform

Average water quality in dry and rainy seasons during the recent five (5) years (1983/1984-1987/1988) was calculated for the 42 stations with respect to BOD, COD, NH_4-N and Fecal Coliform. The results of the calculation are shown in Fig.C.2(1)-Fig.C.2(4).

(2) JICA Observation

The JICA Study Team conducted a river water quality observation at 52 stations of the Study Area during the dry season of 1989 (October 16-19, 1989). The observation stations were selected to supplement the P4L data, focussing on the urbanized areas in the inside of the West and East Banjir Canals, as shown in Fig.C.3. The observed water quality parameters are as follows.

- Water Temperature, Color, SS, pH, DO, BOD, COD, Cl^-, NH_4-N, NO_2-N, NO_3-N, PO_4-P, Cd, Cr, Hg and Fecal Coliform.

The results are shown in Fig.C.4(1)-Fig.C.4(14).

1.2 Yearly and Seasonal Change

The P4L data have shown no significant yearly change in water quality of the Study Area during the period of the past five (5) years (1983/84-1987/88). The yearly variation of BOD at the representative 10 stations are shown in Fig.C.5(1) - Fig.C.5(2).

According to the P4L data, BOD in dry season regionally distributes from approximately 15 mg/l (10-20 mg/l) in the southern edges to approximately 150 mg/l (100-180 mg/l) in the northern urban areas. While in rainy season, BOD in the northern urban areas lowers down to approximately 60 mg/l (50-70 mg/l) due to the increased dilution effects of river flow in rainy season (Refer to Fig.C.2(1)).

The water quality alleviation in rainy season is large in the highly polluted rivers, while small in the less polluted rivers. Correlation between BOD in dry season and BOD in rainy season for P4L observation is shown in Fig. C.6. The alleviation rate in rainy season is summarized below.

BOD in Dry Season (mg/l)	Alleviation Rate (Rainy/Dry) (%)
< 30	100
30-100	60
100-150	40
> 150	20

1.3 Regional Distribution of Dry Season Water Quality

The JICA Study Team data observed in the dry season of 1989 were incorporated into the P4L data observed in the dry seasons of the recent five (5) years (1983/84-1987/88) to establish a more detailed regional distribution of water quality in dry season. This incorporation of the data of the different sources is considered reasonable from the following facts that:

- Water quality analysis of both data was made by the P4L laboratory;
- *No significant yearly change has been recognized in the* recent five (5) years.

The regional distributions of BOD, COD, NH_4-N and Fecal Coliform are established based on their respective incorporated data as shown in Fig.C.7(1)-Fig.C.7(4).

(1) BOD

The regional variation of BOD in the Study Area is wide with the range of 10 mg/l to 255 mg/l. The maximum value is observed in the Ancol River, while the minimum in the uppermost of the Ciliwung River.

High BOD is observed in the river reaches:

- downstream of Grogol, middle and lower reaches of Cideng, Kali Bata, Ancol, Sentiong, Kali Barat Timur, Cipinang, tributaries of Sunter, Lagoa and downstream of Cakung.

BOD concentration exceeds 100 mg/l at about 50% of the observation stations in the above-mentioned rivers. Most of the above rivers are affected mainly by domestic and commercial wastewater. However, the major pollution source of the Kali Baru Timur, Cipinang and Cakung Rivers is *industrial wastes.*

The lower Ciliwung and lower Sunter main stream mark low BOD concentration of 10-40 mg/l due to the dilution effect of the Tarum Barat Canal. The West Banjir Canal is still less polluted with BOD concentration of 10-30 mg/l. The southern and western edge areas are also still less polluted. The BOD is in the range of 10-30 mg/l.

(2) COD

COD of the Study Area is in the range of 20-595 mg/l. The regional distribution pattern is the same as BOD.

(3) NH_4-N

NH_4-N ranges from 0.2 mg/l to 46.3 mg/l.
The regional distribution pattern is the same as BOD.

(4) Fecal Coliform

Fecal coliform of more than 10^6 (MPN/100 ml) is observed at almost all observation stations. This means that all the river waters of the Study Area are affected by human wastes to a great extent.

1.4 Classification of River Stretches by Water Quality

The existing water pollution of the rivers and channels in the Study Area is classified into four (4) classes in terms of BOD as shown below.

Class		BOD (mg/l)	Pollution Condition
I	:	0 - 30	Slight
II	:	30 - 60	Significant
III	:	60 - 90	Heavy
IV	:	90 -	Very Heavy

Herein, BOD of 30 mg/l is the upper limit for maintaining of aquatic biota in the Environment Standards of Indonesia.

Classification of the river stretches was made based on the water quality data observed by P4L and the JICA Study Team at 94 points and is shown in Fig. C.8.

2. River Water Use

2.1 Macro View

The rivers and canals in the Study Area are mostly used for only drainage of storm water and domestic wastewater. Beneficial uses such as water supply, irrigation and fishery are limited to some rivers and canals. In some particular rivers and canals, industrial wastewater is discharged.

Fig.C.9 shows a classification of the rivers and canals by existing water use.

(1) Water Supply Use

Water for potable use is drawn from the following five(5) rivers and canals at 10 locations (Refer to Fig.C.9).

- Angke River, Krukut River, Ciliwung River & Banjir Canal, Sunter River and Tarum Barat Canal.

The total intake volume is 10,485 l/s of which 5,905 l/s is drawn from the Ciliwung River and Banjir Canal, and 4,075 l/s from the Sunter River.

The detailed existing water supply use of the rivers and canals is shown in Table C.1.

(2) Irrigation and Fishery

The agricultural land use and production of the Study Area has rapidly decreased due to the sprawling urban developments in recent years. The agricultural area decreased from 21,407 ha in 1981 to 10,452 ha in 1987, resulting in production decrease from 89,582 ton to 56,214 ton in the same period.

The change of the agricultural area and production of the Study Area in the recent years (1981-1987) are shown in Table C.2.
However, the following rivers and canals are still used for irrigation (Refer to Fig.C.9).

- Baru River, Maja River, Mookervat River, Angke River, Buaran River, Malang River and Cakung River.

Fishing activities are also recognized in the above rivers and canals.

(3) Industrial Wastewater

Industrial wastewater is discharged into some particular rivers and canals including:

- Kali Baru Timur River, Cipinang River, Sunter River, Petukangan River and Cakung River (Refer to Fig.C.9).

2.2 Field Survey

A question on the existing use of the nearby rivers/canals was asked to the respondents as a part of the sampling survey on the people's needs for on-site sanitation and sewerage facilities.

Ten (10) houses for every Kelurahan were sampled, and the total number of houses visited by surveyors came to 2560. Therefore, the information on the use of rivers/canals can be obtained by river/canal and by Kelurahan. However, surveyors did not always select the houses located in the vicinities of waters because the major purposes of the survey lied elsewhere.

As a result of the processing of answers, the existing use of 15 major rivers/canals was clarified as shown in Fig. C.10. Those inland waters are Ancol, Angke, Banjir Canal, Kali Baru Timur, Cakung, Cideng, Ciliwung, Cipinang, Mookervart, Grogol, Krukut, Malang, Mampang, Sentiong and Sunter. In Fig. C.10, the percentage for a particular river water use expresses the ratio of respondents who answered in the affirmative regarding the said river water use.

Looking over and comparing the 15 graphs in Fig. C.10, one striking fact emerges: the most prevalent use of rivers is "sewerage". This use, combined with "irrigation" and "washing" forms the three major uses. Other uses are industrial water/wastewater, transport, bathing, recreation (swimming, fishing, etc.), fishing ground, dumping ground, etc.

Individual river wise, Ciliwung, Malang and Banjir Canal have the most varied water use including the three (3) major uses. Krukut and Sunter are used for sewerage, irrigation, industry and transport. Cakung and Grogol are utilized for the three (3) major purposes. Cideng and Kali Baru Timur are used for sewerage, irrigation and transport. People use Cipinang for sewerage, irrigation and industry. Mampang and Sentiong are used for sewerage and irrigation. Mookervart has the uses of sewerage and washing. Ancol is used for sewerage and industry.

Rivers having a variety of water uses tend to be below 100% in the use for "sewerage". Such rivers are Ciliwung, Malang, Angke, Krukut, Sunter, Grogol and Kali Baru Timur. They flow partly in the outskirts of Jakarta. On the contrary, those having a fewer number of water uses are mostly 100% in the use for "sewerage". They are Ancol, Mookervart, Mampang, Sentiong, Cipinang, Cideng and Cakung. Banjir Canal has a multi-faceted water use and at the same time the use for "sewerage" is 100%. Excluding Banjir Canal, it can be said that rivers having a variety of water uses are still alive on one hand and those having fewer water uses are more polluted on the other.

The longer rivers of Angke, Kali Baru Timur, Ciliwung and Sunter were cut into two to three parts based on Wilayah boundaries, and the water use for each part in a river was mutually compared.

The results are shown in Fig. C.10(5) to C.10(7). They show that as a river flows from the south to the north, the number of water use tends to decrease, whereas percentage of the use for "sewerage" rises from less than 100 to the full one hundred.

Table C.3 shows the existing uses of near-by rivers/canals by Kecamatan. According to it, 87.1% of people regard the water courses of the Study Area as "sewerage". Likewise, 26.6%, 9.7%, 5.0%, 4.9% and 4.0% of people observe that they are used for irrigation, washing, industry, transport and bathing, respectively.

Wilayah wise, the use for "sewerage" is higher in Jakarta Timur, Utara and Pusat. Likewise, the use for irrigation is marked in Jakarta Selatan, washing is witnessed more in Jakarta Barat and Selatan, industrial use is more pronounced in Jakarta Utara and Timur, the use for transport and bathing is the highest in Jakarta Selatan.

In terms of Kecamatan, the use for "sewerage" is 100% in Gambir, Sawah Besar and Koja. The use of irrigation is higher than 50% in Tanjung Priok and Mampang Prapatan. Washing is more widely practised in Cengkareng, Tebet, Tanah Abang and Cakung. Industrial use is concentrated in Kramat Jati, Pulo Gadung, Penjaringan and Koja. The use for transport is higher in Pasar Minggu, Tambora, Kemayoran and Tanah Abang. The use for bathing is observed more in Tebet, Cengkareng and Gambir.

Although water courses of the study area are used for various purposes, the level or intensity of positive uses is very low due to their highly unsanitary conditions.

3. Sea Water and Sediment Quality

3.1 Sea Water Quality

P4L started the water quality measurement for the Bay of Jakarta at 26 stations in 1987/1988. The locations of the monitoring stations are shown in Fig. C.11. The observed water quality parameters are as follows.

- pH, Conductivity, Salinity, DO, NH_4-N, NO_3-N, PO_4-P, Cu, Pb, Cd, Cr, Ni, Zn, Hg

The observed minimum, maximum and average values of the above mentioned water quality parameters during 1987/1988 is shown below.

		<u>Minimum - Maximum</u>	<u>Average</u>
NH_4-N (mg/l)	:	0.04 - 0.43	0.18
NO_3-N (mg/l)	:	N.D. - 1.02	0.14
PO_4-P (mg/l)	:	N.D. - 0.137	0.018
Conductivity (mhos/cm)	:	49.3 - 55.8	52.6
Salinity	:	30.7 - 35.2	33.1
pH	:	8.0 - 8.4	8.1
DO (mg/l)	:	6.3 - 8.6	7.5
Cu (g/l)	:	N.D. - 50	5
Pb (g/l)	:	N.D. - 65	26
Cd (g/l)	:	N.D. - 25	N.D.
Cr (g/l)	:	N.D. - 90	46
Ni (g/l)	:	N.D. - 105	34
Zn (g/l)	:	55 - 280	110
Hg (g/l)	:	0.15 - 0.58	0.31

Note: N.D. : not detectable

Average water quality of NH_4 -N and PO_4-P during 1987/1988 at each sampling station is shown in Fig. C.12.

The NH_4-N and PO_4-P concentrations at Tanjungpriok Port area are, respectively, 0.43 mg/l and 0.137 mg/l, as average. These values are rather high which indicate significant pollution due to wastewater of domestic origin. Apart form this area, the water quality of all other areas are rather uniform with no significant regional variation.

The JICA Study Team made a sea water quality observation at 20 stations in the Bay of Jakarta on December 5-6, 1989. The location of the sampling sites are shown in Fig. C.13. The observed water quality parameters are :

- Water Temperature, Color, Transparency, Electric Conductivity, pH, DO, COD, Cl^-, NH_4-N, NO_3-N, K-N, T-P, Cd, Cr, Cu, Hg,Pb

The sampling was made from the surface layer and mid water depth layer at each station. The water quality analysis was made by the laboratory of P3O.

The observed minimum, maximum and average values of above water quality parameters are shown below.

		Minimum - Maximum	Average
Conductivity (mhos/cm)	:	52.2 - 58.5	54.8
pH	:	7.7 - 8.4	8.2
DO (mg/l)	:	4.2 - 7.8	5.2
Cl^- (o/oo)	:	17.2 - 21.1	18.6
COD (mg/l)	:	58 - 204	124
NH_4- N (mg/l)	:	0.009 - 0.048	0.029
NO_2- N (mg/l)	:	0 - 0.006	0.001
NO_3- N (mg/l)	:	0.003 - 0.046	0.016
K - N (mg/l)	:	0.066 - 0.122	0.081
PO_4-P (mg/l)	:	0.017 - 0.115	0.039
Hg (g/l)	:	0.5 - 3.8	1.5
Pb (g/l)	:	N.D. - 4.2	N.D.
Cd (g/l)	:	N.D. - 1.0	N.D.
Cu (g/l)	:	2 - 61	25
Cr (g/l)	:	1.6 - 7.6	4.8

The water quality of NH_4-N and PO_4-P at the surface layer and mid water depth layer of each station are shown in Fig. C.14.

No significant regional variation in water quality was observed.

Among the above analized water quality values, the COD value was judged incorrect. The JICA Study Team conducted a sampling survey again on February 6-7, 1990. The sampling was made from the surface layer and mid water depth layer at the 20 stations shown in Fig. C.13. The observed water quality parameters are :

- PH, CL^-, COD, D-COD, NH_4- N, Fecal Coliform

The water quality analysis was made by the laboratory of P30.
The observed minimum, maximum and average values of the above water quality parameters are shown below.

	Minimum-Maximum	Average
Cl^- (o/oo)	8.6 - 21.8	17.0
COD (mg/l)	18 - 81	28
D-COD (mg/l)	18 - 80	25
NH_4- N (mg/l)	0.010 - 0.518	0.137
Fecal Coliform (MPN/100 CC)	4 - $150X10^2$	2,530

Note : D-COD : dissolved COD

The water quality of COD, D-COD, NH4-N and Fecal Coliform at the surface layer and mid water depth layer of each station are shown in Fig. C.15(1) and Fig. C.15(2).

COD in the Bay of Jakarta ranges from 18 mg/l to 81 mg/l with an average of 28 mg/l.

As evident from the above table and figures;
- COD of the Bay is mostly composed of dissolved one.
- The Bay, especially, the coastal area is largely affected by human waste.

3.2 Sea Sediment Quality

P4L conducted sea sediment quality observation at 26 stations in the Bay of Jakarta since 1987 along with the sea water quality observation. The sampling locations of sea sediment are the same as sea water sampling. The observed sediment quality parameters are:

		Minimum - Maximum	Average
Cu (mg/kg)	:	6.8 - 81.5	18.5
Pb (mg/kg)	:	9.5 - 30.5	18.3
Cd (mg/kg)	:	N.D	N.D.
Cr (mg/kg)	:	4.7 - 22.1	11.7
Ni (mg/kg)	:	5.6 - 12.8	10.3
Zn (mg/kg)	:	40 - 129	70
Hg (mg/kg)	:	0.29 - 4.10	1.27

Average sediment quality of Cu, Pb, Cr and Hg during 1987/1988 at each station are shown in Fig. C.16(1) and Fig. C.16(2).

The concentration of heavy metals, Cu (81.5 mg/kg), Pb (30.5 mg/kg), Cr (22.1 mg/kg) and Hg (4.10 mg/kg) are high close to the estuaries of Camal River and Cengkareng Drain. At Tanjungpriok Port, the concentration of Cu (35.6 mg/kg) is high.

The JICA Study Team made a sea sediment quality measurement at 10 locations during December 5-6, 1989 along with sea water quality observation. The sampling locations are shown in Fig.C.13. The observed sediment quality parameters are;

- I-L, Cd, Cr, Cu, Hg,Pb

The observed minimum, maximum and average values of above mentioned sediment quality parameters are given below.

		Minimum - Maximum	Average
I-L (%)	:	7.0 - 23.2	11.8
Cd (mg/kg)	:	1.82 - 2.92	2.34
Cr (mg/kg)	:	17.1 - 27.4	21.4
Cu (mg/kg)	:	13.2 - 53.9	29.2
Hg (mg/kg)	:	0.18 - 1.63	0.62
Pb (mg/kg)	:	84.4 - 139.5	105.7

The sediment quality of I-L, Cr, Hg and Pb at each station is shown in Fig. C.17(1) and Fig.17(2).

The I-L observed in the sediment is rather high on average (about 12 %). This indicates progressing of organic pollution. Especially close to the estuaries of Camal River and Cengkareng Drain, the I-L observed was very high (about 23 %).

Concerning heavy metals, in general, the concentration of Hg and Pb are rather high in all the observed stations. Especially at Tanjungpriok Port (St.8), the observed values are very high, with Hg of 1.63 mg/kg and Pb of 176 mg/kg.

4. Current of Jakarta Bay

4.1 Available Data

Current of the Jakarta Bay was measured 10 times by float tracking at 5 stations by NIHON SUIDO CONSULTANT in the dry season of 1975 (September 29, 1975 - October 14, 1975). The observation locations are shown in Fig. C.18. The observed currents are shown in Fig.C.19(1)-Fig.C.19(3).

PUSAT PENELITIAN DAN PENGEMBANGAN OSEANOLOGI (P3O) has also made 24-hours consecutive observation of current at the seven (7) fixed points since 1975. The location of the observation stations are shown in Fig.C.18, along with the location of the NIHON SUIDO CONSULTANT observation. The observation period for each station is shown below.

Observation Station	Observation Period
St. 1	13-14 July, 1986
	9-10 February, 1987
St. 2	28-29 August, 1983
	30-31 August, 1983
St. 3	14-15 October, 1983
	15-16 October, 1983
St. 4	13-14 April, 1985
	16-17 April, 1985
St. 5	8-9 September, 1985

St. 6	19-20 April, 1985
	4-5 September, 1985
St. 7	5-6 July, 1975
	27-28 October, 1982
	21-22 April, 1983
	28-29 January, 1987
	26-27 February, 1988

Hourly variations of the observed tidal current at each station are shown in Fig. C.20(1)-Fig. C.20(3).

4.2 Current Characteristics of Jakarta Bay

Marine current is generally a complicated one which consists of constant current and tidal current with various cycles.

Harmonic analysis was applied for the 24-hour consecutively observed current data at seven (7) points of the Jakarta Bay by P30 in order to identify the characteristics of the current in the Jakarta Bay. The analysis was made by using the following harmonic constants of the tide at Tanjung Priok.

	H	K
M2	5 cm	1^0
S2	5 cm	300^0
K1	25 cm	145^0
O1	13 cm	133^0

The results of the harmonic analysis are shown in Table C.4 and Fig. C.21.

As evident from the above table and figures, constant current is prevailing in the Bay of Jakarta.

The constant currents obtained in the above harmonic analysis are compared to average daily currents observed in the past as shown in Fig. C.22. The analized and observed currents well coincide with each other during both east and west monsoon seasons. The analized constant current is considered to be correct.

From the above discussions, the following major characteristics of the current are identified.

- Constant current is prevailing and is considered to be reprentative of the Jakarta Bay.

- There are two (2) typical patterns of constant current in the Jakarta Bay : east monsoon and west monsoon patterns.

- The average velocity of typical current in the Jakarta Bay is estimated at 13 cm/sec both during east monsoon (Apr. - Oct.) and west monsoon (Nov. - Mar.).

5. Groundwater Table and Quality

5.1 Groundwater Table

The latest groundwater table maps in dry and rainy seasons of the Study Area were prepared by Directorate General of Geology and Mineral, Ministry of Mining and Energy during the period of August, 1988 and February, 1989. The maps are shown in Fig. C.23(1) and Fig.C.23(2).

The JICA Study Team conducted a sampling survey of groundwater level at 60 wells in October, 1989. The location of the observed wells are shown in Fig. C.24.

The observed groundwater levels are plotted on the dry season map of the Directorate General of Geology and Mineral with a good coincidence between both data as shown in Fig. C.25.

5.2 Groundwater Quality

(1) Available Data

Pusat Penelitian and Pengembangan, Perkotaan and Lingkungan (P4L) DKI Jakarta observed groundwater quality of the wells existing in 21 Kelurahan of the Study Area in August, 1984 (dry season) and December, 1984 (rainy season). The major observed water quality parameters are:

- Organic Matter, NH_4-N, Hg

The observed water quality is shown in Table C.5(1) and Table C.5(2).

The JICA Study Team conducted groundwater quality observations for 30 shallow wells distributed over the whole Study Area in October, 1989 (dry season). The location of the observation well was selected to supplement the existing observation wells of P4L. The location of the observed wells are also shown in Fig. C.24. The major observed water quality parameters are;

- SS, PH, DO, BOD, COD, Cl^-, NH_4-N, NO_3-N, NO_2-N
  T-P, Cd, Cr, Hg, Fecal Coliform

(2) Saline Water Intrusion

According to the information from Directorate of Geology and Environment, the groundwater in the northern low-lying areas of the Study Area (approximately 30 % of the total Study Area) are affected by sea water intrusion. The affected areas by sea water with Cl^- content of higher than 500 mg/l are delineated as shown in Fig. C.26.

The JICA survey measured Cl^- content of higher than 200 mg/l in six (6) wells and of higher than 100 mg/l in 10 wells among the total observation wells of 30. The observed location and Cl^- content are also shown in Fig. C.26.

(3) Organic Pollution

The shallow well waters of the Study Area are largely affected by organic pollution.

The P4L survey measured NH_4-N in all the objective Kelurahans in both dry and rainy seasons. The maximum observed values in dry and rainy seasons are 12.92 mg/l and 5.45 mg/l respectively {Refer to Table C.5(1) and C.5(2)}.

The JICA survey observed NH_4 - N in 21 wells and Fecal Coliform in 28 wells among the 30 observation wells. The observed maximum NH_4 - N and Fecal Coliform are 10.74 mg/l and 4.6×10^5 (MPN/100 ml) respectively. The survey also measured a high content of COD in all the observation wells (Refer to Table C.6).

The regional distribution of NH_4 - N observed by P4L are shown in Fig. C.27(1) and Fig. C.27(2). The regional distribution of NH_4 - N, Fecal Coliform and COD observed by the JICA Study Team are shown in Fig. C.28, Fig. C.29 and Fig. C.30.

The organic pollution of the wells observed by the JICA Study Team was integrally evaluated by giving evaluation index from 0 to 4 with respect to water quality parameters COD, NH_4 and Fecal Coliform as shown in Table C.7. The regional distribution of the integrated pollution indexes are shown in Fig. C.31.

The correlation between well water depth (height between well water level and ground surface) and integrated pollution index is shown in Fig. C.32. The pollution index becomes larger in inverse proportion to well water depth.

(4) Heavy Metal Pollution

The P4L survey measured Hg content of higher than 0.001 mg/l (drinking water standard) in almost all the observation wells in dry season (Refer to Table C.5(1) and C.5(2). The regional distribution of the heavy metal pollution is shown in Fig. C.33. However, in the rainy season, heavy metal contamination of detrimental level was not observed except in one (1) Kelurahan.

The JICA survey also observed Hg contamination exceeding 0.001 mg/l in four (4) wells located in the southern edge of the Study Area (Refer to Table C.6).

6. Waterborne Disease

6.1 Statistic Records in the Past

Many people suffer from waterborne disease in the Study Area. Major waterborne diseases that affect the inhabitants of the Study Area are:

- Diarrhea, Cholera, Dysentery, Typhoid, Para Typhoid, Tape Worms, Nematode Worms and Mycosis

According to the records of the Department of Public Health, approximately 200,000 people have suffered from the above diseases every year on an average during the recent five (5) years (1984 - 1988). Among such diseases, diarrhea accounts for the largest number of 177,506, followed by dysentery of 15,131, mycosis of 8,425 and nematode worms of 7,169 as shown below.

Yearly Average Number of Patient

Diarrhea	177,506
Cholera	2,146
Dysentery	15,131
Typhoid	2,220
Para Typhoid	813
Tape worms	729
Nematode Worms	7,169
Mycosis	8,425
Total	214,138

The yearly variations of the number of patients by kind of disease during the recent five (5) years (1984-1988) are shown in Table C.8.

Number of patients suffered from waterborne disease is still on a high level. No significant change is recognized during the recent five (5) years.

Average annual number of patients during the recent five (5) years (1984 - 1988) by Kecamatan by type of disease are shown in Table C.9. Average annual number of patients per 100 thousand persons ranges from 185 in Kec. Senen to 6,438 in Kec. Koja with an average of 2,433. Its regional distribution is shown in Fig. C.34. The Kecamatans in the north coastal region are affected by waterborne disease at high rates.

6.2 Field Survey

Questions on the existing status of the hygiene and health in the Study Area were prepared in the sampling questionnaire survey. They were intended to obtain information on contraction rates for major diseases and infant mortality rates for the last three (3) years on Kelurahan basis.

Diseases listed in the questions were malaria, gastro-interitis, cholera, tuberculosis, D.H.F., typhoid, dysentery, diphtheria, measles, hepatitis A, hepatitis B and skin diseases. They can be classified as water-borne diseases.

The number of samples on household basis was 10 for each Kelurahan, adding up to 2,560 for the whole Study Area.

According to the results of the survey, the average contraction rate for the last three (3) years of the above 12 diseases across the Study Area is 56.5 cases per 1,000 population. It is the cumulative rate for the three (3) years.

Disease wise, gastro-enteritis with the highest share of 45.8% was contracted by 25.9 persons per 1,000 population. Other diseases with comparatively high contraction rates are skin diseases (9.3), dysentery (6.2), typhoid (3.9), DHF (3.2), malaria (2.1) and diphtheria (2.0).

Wilayah wise, Jakarta Utara has the highest disease contraction rate of 87.0 cases per 1,000 population, closely followed by 76.4 for Pusat. Other Wilayahs have the similar rates of 40's.

Kecamatan having the highest disease contraction rate is Tanah Abang with 155.9 cases per 1,000 population. Other Kecamatans with the rate of more than 100 are Penjaringan and Pulo Gadung.
Kecamatans with the rates falling between 80 and 100 are Mampang Prapatan, Cempaka Putih, Sawah Besar, Koja, Cilincing and Taman Sari. Kebon Jeruk has the lowest disease contraction rate of 14.5 cases per 1,000 population. Other Kecamatans with the rate of less than 20 are Cilandak and Pasar Rebo. Kecamatans with the rates falling between 20 and 30 are Menteng, Grogol Petamburan and Senen. (Refer to Table C.10(1) - Table C.10(2) and Fig. C.35).

According to the results of the survey, causes of infant mortality were fever, small pox, typhoid, malaria, cholera, diptheria, dysentery, tuberculosis, beri-beri, etc. Ages of infants who died range from one day to seven years. Infant mortalities are most prevalent among Low Income Class families.

It was found out that the combined infant mortality rate for the last three (3) years in the Study Area was 16.3 cases per 1,000 infants.

Wilayah wise, Jakarta Selatan has the highest mortality rate of 25.7 cases per 1,00 infants, closely followed by 25.0 for Utara. The third and the fourth are 13.4 for Timur and 13.1 for Barat respectively. Pusat has the lowest rate of 4.4.

Kecamatan having the highest mortality rate is Penjaringan with 46.8 cases per 1,000 infants. Other Kecamatans with the rate of not less than 40 are Pasar Minggu, Grogol Petamburan and Cilandak.
Kecamatans where no mortality cases were reported are Gambir, Sawah Besar, Kemayoran, Senen, Menteng, Tanjung Priok,

Cengkareng., Tambora and Matraman. (Refer to Table C.11 and Fig. C.36).

It is noticed that there are some differences in disease contraction rates by disease and by area between statistical data collected at Department of Public Health, D.K.I Jakarta and the data from the sampling questionnaire survey, although the average rate across the Study Area is similar.

However, it is not advisable to take one at the expense of the other. The JICA Study Team takes the position that the difference in figures is due to the difference in sources and the two data are equally useful and valid.

7. Water Quality Standards

Water quality standards for both environmental waters and wastewater effluents are to be determined by the Level I Regional Governments including DKI Jakarta, considering natural and socio-economic characteristics of their regions. To promote this task, the National Government are to establish guidelines for the water quality standards. These guidelines provide minimum requirements so that Regional Governments can set forth more stringent standards. By the time a Regional Government establishes its own standards, the national guidelines may be used as reference.

In DKI Jakarta, some standards have been established already. Relevant water quality standards applicable for the management of water quality in DKI Jakarta are presented below.

7.1 Environmental Water Quality Standards

(1) River Water

Environmental water quality standards for rivers in DKI Jakarta are stipulated by the Governor's Decree No. 1608, 1988. River courses within the DKI Jakarta are classified into four (4) groups, i.e. A, B, C and D depending on the intended use of river water as shown below.

Group A	:	drinking water source
Group B	:	fishery
Group C	:	agriculture
Group D	:	other than A, B and C, and suitable to support aquatic biota

Class designation of river sections in DKI Jakarta in accordance with above grouping is shown in Fig.C.37.

Table C.12 shows the water quality standard values for each class of rivers.

(2) Marine Water

Marine areas in and around the Jakarta Bay are used for various purposes including fishery, recreation and industry. DKI Jakarta are now investigating actual situations of marine water use in these areas in order to designate specific zones to specific purposes and then to establish appropriate water quality standards for each category of marine water use. For the time being, the guideline provided by the Decree of State Minister for Population and Environment No. KEP-02/MENKLH/I/1988 is the sole basis to evaluate the water quality of the Jakarta Bay area. It is shown in Table C.13.

7.2 Effluent Water Quality Standards

The Governor's Decree No.1608 also provides the effluent water quality standards for industry as shown in Table C.14. The standards are applied collectively to all industries.

Currently, the Office of State Minister for Population and Environment (OSMPE) is developing industrial wastewater standards for fourteen (14) industries and sewage treatment at large hotels. When established, they will become new guidelines for the Regional Authorities to establish their own standards. Kinds of industry considered are as follows:

1. Caustic soda
2. Electro plating
   - 2a : Copper
   - 2b : Nickel
   - 2c : Chromium
   - 2d : Zinc
3. Leather tanning
4. Oil refining
5. Palm oil
6. Pulp and paper
7. Rubber (Latex concentrate or Dry rubber)
8. Sugar cane
9. Tapioca starch
10. Textile
11. Urea fertilizer
12. Alcohol distillery (ethanol)
13. Mono sodium glutamate
14. Plywood
15. Hotels (3,4 and 5 stars)

Among those listed above, the industries existing in DKI Jakarta are 2,3,10 and 15. The currently proposed effluent water quality standards by OSMPE for these industries are shown in Tables C.15 through C.19. These standards are considered to be achievable using

Best Practicable Technology (BPT), and are minimum requirements for existing industries.

The values specified as "N.T.B.E. Loading" in these Tables represent the "never to be exceeded loading," and they apply to any one sample analized at any time. As can be noted, these standards are based on loading per unit product.

Table C.1 Existing Water Supply Use

Water Source	Location of Intake		Intake Volume (l/s)	Name of Treatment Plant
	No.	Name of Kelurahan		
Angke River	1	Kembangan Timur	50	Cengkareng
		Kedaung Kaliangke	5	Pesing
		Cilandak	450	Cilandak
Krukut River				
Cliwung River				
& Banjir Canal	4	Balekambang	100	Condet
	5	Pejaten Timur	5	Pejaten
	6	Karet Tengsin	5,600	Pejompongan
	7	Pluit	200	Muara Karang
Sunter River	8	Jatinegara Kaum	4,000	Pulo Gadung
	9	Sunter Jaya	50	Sunter
Malang River	10	Cakung Barat	25	Cakung
Total			10,485	

Note : For location of intake, refer to Fig. C.9

Source : PDAM

Table C.2 Agricultural Area and Production in Jakarta

Year	Paddy		Meize and Cassava		Petatoes		Peanut and Vegetables		Total	
	Area (Ha)	Production (ton)	Area (Ha)	Production (ton)	Area (Ha)	Production (ton)	Area (Ha)	Production (ton)	Area (Ha)	Production (ton)
1981	19,105	70,387	702	6,204	489	3,542	1,111	9,449	21,407	89,582
1982	14,895	59,300	698	6,065	222	1,497	2,253	9,223	18,068	76,085
1983	9,498	37,476	488	3,842	120	665	2,016	10,415	12,122	52,398
1984	10,640	45,923	333	3,757	80	426	1,218	5,862	12,271	55,968
1985	10,630	47,998	312	3,931	45	277	1,474	10,926	12,461	63,132
1986	9,756	51,125	263	2,877	30	168	1,083	7,736	11,132	61,906
1987	9,255	47,656	226	2,160	15	57	956	6,341	10,452	56,214

Source : Jakarta in figures 1988

Table C.3 (1) Uses of Nearby Rivers/Canals by Kecamatan in 1989

(Unit : Rp.)

CODE NUMBER	NAME OF KECAMATAN	Transport	Washing	Bathing	Drinking	Irrigation	Industry	Recreation	Fishing Ground	Sewerage	Dumping Ground	No Use	Other
1100	GAMBIR	0.0	12.5	12.5	0.0	25.0	6.3	0.0	0.0	100.0	0.0	0.0	6.3
1200	SAWAH BESAR	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	100.0	0.0	0.0	0.0
1300	KEMAYORAN	14.3	3.6	0.0	0.0	3.6	3.6	0.0	3.6	85.7	0.0	0.0	7.1
1400	SENEN	0.0	9.1	0.0	0.0	30.3	3.0	6.1	0.0	93.9	0.0	0.0	3.0
1500	CEMPAKA PUTIH	0.0	0.0	0.0	0.0	38.1	0.0	0.0	0.0	95.2	0.0	0.0	4.8
1600	MENTENG	0.0	0.0	0.0	0.0	28.6	0.0	0.0	0.0	76.2	0.0	4.8	4.8
1700	TANAH ABANG	12.5	25.0	8.4	0.0	28.1	15.6	0.0	3.1	96.9	0.0	0.0	31.3
1000	JAKARTA PUSAT	4.8	8.4	3.0	0.0	23.5	4.8	1.2	1.2	92.2	0.0	0.6	9.6
2200	PENJARINGAN	9.5	9.5	9.5	0.0	9.5	23.8	4.8	2.4	92.9	4.8	0.0	21.4
2300	TANJUNG PRIOK	0.0	0.0	0.0	0.0	78.9	0.0	0.0	0.0	81.6	0.0	0.0	5.3
2400	KOJA	0.0	0.0	0.0	0.0	9.1	18.2	0.0	0.0	100.0	0.0	0.0	33.3
2500	CILINCING	10.0	7.5	2.5	0.0	10.0	0.0	0.0	0.0	97.5	5.0	0.0	37.5
2000	JAKARTA UTARA	5.2	4.6	3.3	0.0	16.8	10.5	1.3	0.7	92.8	2.6	0.0	24.2
3100	CENGKARENG	0.0	51.3	12.8	0.0	41.0	2.6	0.0	2.6	64.1	2.6	5.1	23.1
3200	GROGOL PETAMBURAN	3.8	3.8	0.0	0.0	7.7	0.0	0.0	0.0	88.5	0.0	7.7	8.3
3300	TAMAN SARI	0.0	0.0	0.0	2.8	8.3	0.0	0.0	0.0	91.7	2.8	2.8	3.8
3400	TAMBORA	15.7	15.7	5.9	0.0	19.6	3.9	0.0	2.0	88.2	0.0	3.9	5.9
3500	KEBON JERUK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	75.0	16.7	0.0	0.0
3000	JAKARTA BARAT	5.5	17.7	4.9	0.6	18.9	0.0	0.0	2.4	82.3	2.4	4.3	9.8
4100	TEBET	10.8	40.5	29.7	0.0	29.7	1.8	24.3	0.0	70.3	0.0	5.4	8.1
4200	SETIA BUDI	0.0	0.0	0.0	0.0	38.9	0.0	0.0	0.0	77.8	0.0	11.1	0.0
4300	MAMPANG PRAPATAN	3.7	0.0	0.0	0.0	51.9	11.1	3.7	0.0	88.9	3.7	3.7	3.7
4400	PASAR MINGGU	18.8	15.6	0.0	0.0	37.5	0.0	6.3	9.4	65.6	0.0	12.5	12.5
4500	KEBAYORAN BARU	2.9	2.9	2.9	0.0	34.3	0.0	0.0	0.0	91.4	0.0	2.9	5.7
4600	KEBAYORAN LAMA	0.0	8.3	8.3	0.0	8.3	0.0	0.0	0.0	91.7	0.0	0.0	8.3
4700	CILANDAK	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0	66.7	0.0	16.7	3.3
4000	JAKARTA SELATAN	7.2	13.2	7.8	0.0	35.3	1.2	7.2	1.8	79.0	0.6	6.6	7.8

Table C.3 (2) Uses of Nearby Rivers/Canals by Kecamatan in 1989

(Unit : Rp.)

CODE NUMBER	NAME OF KECAMATAN	Transport	Washing	Bathing	Drinking	Irrigation	Industry	Recreation	Fishing Ground	Sewerage	Dumping Ground	No Use	Other
5100	MATRAMAN	4.0	0.0	0.0	0.0	44.0	0.0	0.0	0.0	96.0	0.0	0.0	0.0
5200	PULO GADUNG	0.0	0.0	0.0	0.0	33.3	24.2	0.0	0.0	97.0	6.1	0.0	39.4
5300	JATINEGARA	3.2	0.0	0.0	1.6	30.6	0.0	0.0	0.0	98.4	1.6	0.0	22.6
5400	KRAMAT JATI	0.0	3.7	0.0	0.0	7.4	25.9	3.7	3.7	96.3	0.0	0.0	25.9
5500	PASAR REBO	0.0	0.0	0.0	0.0	36.4	0.0	0.0	0.0	81.8	9.1	9.1	0.0
5600	CAKUNG	4.0	20.0	4.0	0.0	4.0	4.0	4.0	0.0	72.0	0.0	0.0	4.0
5000	JAKARTA TIMUR	2.2	3.3	0.5	0.5	26.2	8.7	1.1	0.5	92.9	2.2	0.5	19.1
10000	JAKARTA	4.9	9.7	4.0	0.2	26.6	5.0	2.4	1.4	87.1	1.5	2.8	13.4

NOTE: A percentage means the ratio of respondents who answered in the affirmative regarding a particular use of nearby rivers/canals

Industry = Industrial water /wastewater, Recreation = Swimming, Fishing, etc.

Source : JICA

Table C.4 Results of Harmonic Analysis

St. No.	Date	Axis	Tidal Current						Constant Current	
			M1 *1)		M2 *2)		M4 *3)			
			Θ (°)	V (cm/s)	Θ (°)	V (cm/s)	Θ (°)	V (cm/s)	Θ (°)	V (cm/s)
1	13 - 14 July 1986	L *4)	339	14.5	312	19.4	81	3.0	323	23.5
		S *5)	69	3.7	42	2.0	171	0.0		
		S/L		0.25		0.10		0.01		
	9 - 10 February 1987	L	323	23.0	340	7.0	329	4.6	335	26.8
		S	53	0.8	70	1.6	59	0.6		
		S/L		0.03		0.22		0.12		
2	28 - 29 August 1983	L	51	8.7	53	6.3	339	2.2	262	8.8
		S	141	2.1	143	4.0	69	0.7		
		S/L		0.24		0.64		0.35		
	30 - 31 August 1983	L	71	15.4	47	9.7	33	3.1	242	22.2
		S	161	3.2	137	2.1	123	0.7		
		S/L		0.21		0.22		0.24		
3	14 - 15 October 1983	L	68	4.5	271	16.0	274	6.8	204	10.7
		S	158	0.2	1	0.7	4	1.7		
		S/L		0.04		0.05		0.25		
	15 - 16 October 1983	L	46	8.5	81	12.1	43	3.3	256	14.4
		S	136	0.3	171	0.5	133	2.5		
		S/L		0.04		0.04		0.75		
4	13 - 14 April 1985	L	2	17.4	358	7.9	42	3.2	186	26.0
		S	92	0.0	88	2.6	132	0.6		
		S/L		0.00		0.33		0.18		
	16 - 17 April 1985	L	343	16.1	326	13.6	68	8.4	31	14.0
		S	73	4.9	56	6.3	158	5.7		
		S/L		0.31						
5	8 - 9 September 1984	L	355	18.7	320	11.6	44	3.2	356	21.3
		S	85	6.7	50	5.7	134	0.9		
		S/L		0.36		0.49		0.29		
6	19 - 20 April 1985	L	341	8.2	325	9.1	352	5.7	72	25.8
		S	71	3.2	55	1.6	82	2.0		
		S/L		0.40		0.18		0.35		
	4 - 5 September 1985	L	288	24.9	278	18.0	18	5.9	319	2.3
		S	18	1.8	8	6.6	108	0.5		
		S/L		0.07		0.36		0.08		
7	5 - 6 July 1975	L	16	7.2	7.8	2.9	17	2.0	265	4.0
		S	286	0.0	348	1.3	287	0.7		
		S/L		0.00		0.45		0.35		
	27 - 28 October 1982	L	35	6.9	282	2.5	76	2.8	250	11.8
		S	305	3.0	12	1.5	346	0.9		
		S/L		0.43		0.6		0.32		
	21 - 22 April 1983	L	64	3.2	31	3.0	89	1.4	13	3.2
		S	334	0.1	301	0.3	259	0.5		
		S/L		0.03						
	28 - 29 January 1987	L	271	31.1	75	16.1	278	4.6	129	11.0
		S	1	3.3	165	5.4	8	0.3		
		S/L		0.11		0.34		0.07		
	26 - 27 February 1988	L	348	10.6	343	9.0	9	3.3	67	8.6
		S	78	6.7	73	1.8	279	0.1		
		S/L		0.63		0.2		0.03		

*1) M1 : diurnal tidal current
*2) M2 : semi - diurnal tidal current
*3) M4 : quarter - diurnal tidal current
*4) L : the apse line
*5) S : the minor axis

Table C.5(1) Observed Groundwater Quality by P4L (Aug. 1984)

KELURAHAN	Organic Matter (mg/l)	NH4-N (mg/l)	Hg (mg/l)
PULO GEBANG	3.68	0.232	0.0032
LUBANG BUAYA	2.70	0.112	0.0012
CEGER	2.50	0.052	0.0015
CIRACAS	2.76	0.154	0.0022
PEKAYON	1.77	0.048	0.0021
MAKASAR	2.88	0.162	0.0012
DURI KOSAMBI	4.64	0.434	0.0031
PEGADUNGAN	12.86	1.488	0.0088
JOGLO	1.92	0.242	0.0034
SEMANAN	7.00	0.422	0.0020
RAWA BUAYA	6.44	0.282	0.0007
SUKABUMI-UDIK	7.20	0.478	0.0022
LEBAK BULUS	3.06	0.074	0.0023
JAGAKARSA	2.12	0.090	0.0017
TANJUNG BARAT	2.06	0.038	0.0028
KARET KUNINGAN	2.22	0.386	0.0030
GROGOL UTARA	2.48	0.072	0.0023
CIPETE UTARA	2.40	0.308	0.0022
KEBUN KACANG	5.86	4.350	0.0017
CIKINI	15.44	12.920	0.0016
KEBON MELATI	3.80	0.488	0.0060

Source : "Groundwater 1984-1985" P4L

Table C.5(2) Observed Groundwater Quality by P4L (Dec. 1984)

KELURAHAN	Organic Matter (mg/l)	NH4-N (mg/l)	Hg (mg/l)
PULO GEBANG	2.164	0.018	0.0006
LUBANG BUAYA	2.832	0.032	-
CEGER	2.058	0.060	-
CIRACAS	1.466	0.048	0.0002
PEKAYON	1.774	0.048	-
MAKASAR	1.892	0.047	-
DURI KOSAMBI	4.874	0.260	0.0005
PEGADUNGAN	7.124	0.386	-
JOGLO	1.714	0.032	0.0008
SEMANAN	2.970	0.152	0.0002
RAWA BUAYA	5.454	0.552	-
SUKABUMI-UDIK	2.366	0.656	0.0001
LEBAK BULUS	1.828	0.051	0.0001
JAGAKARSA	1.524	0.110	0.0001
TANJUNG BARAT	1.968	0.124	0.0003
KARET KUNINGAN	3.292	0.357	0.0022
GROGOL UTARA	3.330	0.328	0.0002
CIPETE UTARA	3.194	0.045	-
KEBUN KACANG	4.15	5.451	0.0004
CIKINI	9.07	3.364	-
KEBON MELATI	2.99	0.523	-

Source : "Groundwater 1984-1985" P4L

Table C.6 (1) Observed Groundwater Quality by JICA (Oct.1989)

Sampling Point	K-1	K-2	K-3	K-4	K-5	K-6	K-7	K-8	K-9	K-10	K-11	K-12	K-13	K-14	K-15
Date	25.10.89	25.10.89	26.10.89	26.10.89	27.10.89	27.10.89	24.10.89	27.10.89	27.10.89	27.10.89	26.10.89	27.10.89	24.10.89	26.10.89	24.10.89
Time	10:30	10:10	9:57	10:20	10:30	9:20	12:05	9:50	10:00	13:20	10:45	11:30	11:55	9:50	10:00
Weather	Fine	Cloudy	Fine	Fine	Cloudy	Rain	Fine	Fine	Fine	Cloudy	Cloudy	Cloudy	Fine	Cloudy	Fine
Well depth (m)	12.5	7.75	2.85	12.9	8.00	31	4.75	(Pump)	(Pump)	3.35	12.15	8.50	5.10	7.95	1.80
Well diameter (m)	0.65	0.72	0.79	0.85	0.90	0.6	1.20	(Pump)	(Pump)	0.57	0.70	0.85	0.77	0.70	0.75
Air temperature (C)	30	29	31	30	29	27	34	30	30	32	31	28	33	32	32
Water temperature (C)	28.0	27.0	27.2	27.0	28.0	29.4	29.0	28.0	29.0	29.0	29.0	28.0	27.8	28.5	28.5
Color (pt-Co)	30.0	7.0	25.0	30.0	30.0	5.0	10.0	20.0	15.0	50.0	75.0	20.0	18.0	35.0	25.0
SS (mg/l)	37.0	40.0	18.0	40.0	37.0	20.0	45.0	20.0	10.0	20.0	40.0	30.0	10.0	30.0	70.0
pH	5.89	5.20	5.61	6.96	5.95	7.07	6.70	7.42	7.61	7.55	6.50	5.33	7.09	7.20	6.80
DO (mg/l)	4.0	4.2	2.1	5.3	3.6	6.4	2.5	4.0	2.5	2.5	2.15	2.1	3.6	1.8	4.0
BOD5 (mg/l)	10.30	6.3	8.0	12.0	10.5	8.5	11.6	6.4	6.4	6.0	3.1	2.4	1.20	4.0	5.10
CODcr (mg/l)	25.87	16.46	18.03	42.34	29.01	14.73	22.48	16.29	15.50	16.28	10.85	7.75	3.88	9.30	11.63
Cl (mg/l)	5.0	45.0	15.0	40.0	75.0	25.0	27.5	55.0	380.0	115.0	70.0	20.0	120.0	135.0	50.0
NH4-N (mg/l)	*	0.05	1.69	0.06	*	*	1.50	*	*	1.66	0.03	*	0.25	1.72	0.17
NO3-N (mg/l)	5.42	4.96	6.36	4.3	1.81	4.27	5.43	6.54	0.11	4.45	6.55	7.26	0.53	2.36	6.10
NO2-N (mg/l)	0.005	0.004	0.012	0.013	0.030	0.003	0.175	0.033	*	0.149	0.022	0.007	0.014	0.045	0.006
T-P (mg/l)	0.003	0.003	0.047	0.170	0.505	0.194	0.019	3.075	0.210	0.613	0.059	0.008	0.228	0.017	0.010
Cd (mg/l)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cr (mg/l)	*	*	*	*	*	0.05	*	*	*	*	*	*	*	*	0.05
Hg (mg/l)	0.0026	0.0012	0.0021	0.0033	*	*	*	*	*	*	*	*	*	*	*
F. Coli (N/100 cc)	2.4x10(2)	2.3x10(2)	2.3x10(2)	7.0x10(3)	7.5x10(3)	3	4.6x10(5)	3	5	4.6x10(2)	1.5x10(2)	4.3x10(2)	1.5x10(2)	1.5x10(3)	4.3x10(2)

Note : * Not detectable

Table C.6 (2) Observed Groundwater Quality by JICA (Oct.1989)

(Continued)

	K-16	K-17	K-18	K-19	K-20	K-21	K-22	K-23	K-24	K-25	K-26	K-27	K-28	K-29	K-30
Date	26.10.89	26.10.89	23.10.89	27.10.89	25.10.89	26.10.89	26.10.89	25.10.89	26.10.89	25.10.89	27.10.89	23.10.89	23.10.89	23.10.89	27.10.89
Time	13:45	13:00	11:00	11:20	11:45	10:35	12:05	12:15	11:05	13:00	10:25	12:30	12:30	11:30	9:20
Weather	Fine	Fine	Fine	Cloudy	Cloudy	Cloudy	Fine	Cloudy	Cloudy	Fine	Cloudy	Fine	Fine	Fine	Cloudy
Well depth (m)	1.70	0.30	0.35	(Pump)	(Pump)	0.78	1.75	8.20	8.25	(Pump)	8.60	14.90	13.40	6.40	2.87
Well diameter (m)	0.65	0.50	0.65	(Pump)	(Pump)	0.65	0.54	1.00	0.65	(Pump)	0.65	0.70	0.80	0.75	0.75
Air temperature (C)	33	33	34	30	30	32	35	31	32	30	31	33	33	32	29
Water temperature (C)	29.0	29.0	29.0	28.5	29.0	30.0	29.0	29.0	27.8	29.0	26.8	29.0	28.0	28.0	30.0
Color (pt-Co)	32.0	39.0	43.0	150.0	71.0	55.0	71.0	98.0	190.0	34.0	30.0	32.0	47.0	19.0	30.0
SS (mg/l)	65.0	70.0	60.0	70.0	50.0	120.0	120.0	60.0	220.0	30.0	40.0	32.0	47.0	30.0	30.0
pH	7.15	6.80	7.45	7.09	7.50	7.82	7.30	7.39	7.39	6.28	6.20	6.75	6.70	6.96	7.14
DO (mg/l)	1.3	2.8	0.85	4.5	6.0	2.3	1.9	2.0	3.3	2.10	2.65	1.70	2.40	4.45	3.55
BOD5 (mg/l)	15.0	6.30	25.10	26.20	3.20	62.0	6.0	5.0	3.0	4.0	20.60	17.0	7.40	7.0	7.5
CODcr (mg/l)	29.46	14.73	50.39	54.34	6.20	175.19	21.71	16.30	7.75	9.30	48.06	34.88	13.18	26.36	22.48
Cl (mg/l)	40.0	190.0	850.0	900.0	2.5	4150.0	1050.0	287.5	32.5	25.0	15.0	2.5	97.5	25.0	72.5
NH4-N (mg/l)	5.60	1.13	10.74	0.22	0.12	3.32	1.62	0.12	0.09	0.27	*	0.17	0.23	0.16	*
NO3-N (mg/l)	0.54	0.34	0.50	2.26	0.31	0.36	1.64	3.87	6.81	8.05	3.33	0.86	7.86	1.64	6.9
NO2-N (mg/l)	0.022	0.017	0.021	0.009	0.009	0.024	0.028	0.009	0.036	0.032	0.005	0.003	0.010	0.006	0.009
T-P (mg/l)	0.337	0.949	0.780	0.031	0.197	0.045	0.02	0.234	0.052	0.051	0.011	0.006	0.015	0.11	0.029
Cd (mg/l)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Cr (mg/l)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Hg (mg/l)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
F. Coli (N/100 cc)	4.6x10(3)	4.3 NO3	4.6x10(5)	3	3	2.4x10(4)	2.3x10(4)	2.4x10(2)	2.3x10(3)	2.3x10	2.4x10(2)	0	0	4.3x10(2)	2.4x10(2)

Note : * Not detectable

Table C.7 Integrated Pollution Index

No.	CODcr mg/l	CODcr Pollution Index	NH4-N mg/l	NH4-N Pollution Index	F. Coli N/100ml	F. Coli Pollution Index	Integrated Pollution Index
K-1	25.9	3	-	0	2.4x10	3	6
K-2	16.5	2	0.05	1	2.3x10	3	6
K-3	18.0	2	1.69	4	2.3x10	3	9
K-4	42.3	4	0.06	1	7.0x10	4	9
K-5	29.0	3	-	0	7.5x10	4	7
K-6	14.7	2	-	0	3	1	3
K-7	22.5	3	1.50	4	4.6x10	4	11
K-8	16.3	2	-	0	3	1	3
K-9	15.5	2	-	0	5	1	3
K-10	16.3	2	1.66	4	4.6x10	3	9
K-11	10.9	2	0.03	1	1.5x10	3	6
K-12	7.8	1	-	0	4.3x10	3	4
K-13	3.9	1	0.25	3	1.5x10	3	7
K-14	9.3	1	1.72	4	1.5x10	4	9
K-15	11.6	2	0.17	2	4.3x10	3	7
K-16	29.5	3	5.60	4	4.6x10	4	11
K-17	14.7	2	1.13	4	4.3x10	4	10
K-18	50.4	4	10.74	4	4.6x10	4	12
K-19	54.3	4	0.22	3	3	1	8
K-20	6.2	1	0.12	2	3	1	4
K-21	175.2	4	3.32	4	2.4x10	4	12
K-22	21.7	3	1.62	4	2.3x10	4	11
K-23	16.3	2	0.12	2	2.4x10	3	7
K-24	7.8	1	0.09	1	2.3x10	4	6
K-25	9.3	1	0.27	3	2.3x10	2	6
K-26	48.1	4	-	0	2.4x10	3	7
K-27	34.9	4	0.17	2	-	0	6
K-28	13.2	2	0.23	3	-	0	5
K-29	26.4	3	0.16	2	4.3x10	3	8
K-30	22.6	3	-	0	2.3x10	3	6

CODcr	Pollution Index	NH4-N (mg/l)	Pollution Index	F.Coli (N/100 ml)	Pollution Index
0	0	0	0	0	0
0.1-10.0	1	0.01-0.10	1	x1	1
10.1-20.0	2	0.11-0.20	2	x10	2
20.0-30.0	3	0.21-0.30	3	x 10	3
30.1 -	4	0.31-	4	x 10	4

Table C.8 Number of Patients by Kind of Disease

(Unit : Patients per year)

Year / Descase	1984	1985	1986	1987	1988	Average
Diarrhea	140,133	183,539	252,484	167,554	143,819	177,506
Cholera	2,923	3,720	3,388	519	178	2,146
Dysentery	34,087	16,364	10,833	8,242	6,127	15,131
Typhoid	3,072	2,913	2,443	1,324	1,348	2,220
Para Typhoid	-	476	639	1,210	1,740	813
Tape Worms	1,912	764	583	256	132	729
Nematode Worms	10,082	9,525	5,315	4,682	6,239	7,169
Mycosis	-	9,673	11,771	12,621	8,061	8,425
Total	192,209	226,974	287,456	196,408	167,644	214,138

Source : Department of Public Health

Table C.9 Average Annual Number of Patients by Kecamatan (1984 - 1988)

Unit : Patients per Year

Kind of Desease / Kecamatan	Diarrea	Cholela	Dysentery	Typhoid	Para Typhoid	Tape Worms	Nematode Worms	Mycosis	Total (5years)	Annual Average	per 10 Population	Population 1988
JAKARTA UTARA												
- Pulau Seribu	2186	26	270	14	11	22	223	50	2802	560	3978	14087
- Penjaringan	63016	1285	5136	345	5	56	1293	1738	72874	14575	4307	338407
- Tanjung Priok	43770	408	3178	708	638	164	3160	3807	55833	11167	3462	322586
- Koja	111925	658	2500	1068	156	94	1462	2283	120146	24029	6438	373221
- Cilincing	32610	362	2631	249	29	195	1773	2588	40437	8087	3728	216957
Sub-total	253507	2739	13715	2384	839	531	7911	10466	292092	58418	4617	1265258
JAKARTA TIMUR												
- Matraman	20615	0	1081	98	0	171	629	878	23472	4694	2006	234021
- Pulo Gadung	15639	119	628	309	81	91	859	1317	19043	3809	1176	323820
- Jatinegara	65107	451	5247	212	379	844	1787	1817	75844	15169	2372	639534
- Kramat Jati	32501	784	935	418	138	45	765	917	36503	7301	1884	387497
- Pasar Rebo	16211	16	4899	519	156	386	1952	2096	26235	5247	1502	349364
- Cakung	15281	4	1549	68	240	44	233	498	17917	3583	1715	209003
Sub-total	165354	1374	14339	1624	994	1581	6225	7523	199014	39803	1857	2143239
JAKARTA SELATAN												
- Tebet	18874	307	2225	198	172	8	431	804	23019	4604	1405	327620
- Setia Budi	9951	218	499	35	371	109	83	425	11691	2338	889	262959
- Mampang Prapatan	21068	564	3368	173	141	14	1292	550	27170	5434	1886	288092
- Pasar Minggu	34329	610	1326	268	77	59	802	5069	42540	8508	2356	361193
- Kebayoran Baru	16135	242	2156	574	32	55	1447	2041	22582	4536	1915	236852
- Kebayoran Lama	39041	283	3642	132	374	51	1843	5812	51178	10236	2321	440943
- Cilandak	14332	15	1332	672	81	28	863	868	18191	3638	2213	164396
Sub-total	153730	2239	14548	2052	1248	324	6761	15569	196471	39294	1887	2082055
JAKARTA BARAT												
- Cengkareng	57994	812	4351	532	164	128	1358	1942	67281	13456	3739	359917
- Grogol Petamburan	101984	484	10926	626	23	757	2790	2368	119958	23992	4378	547966
- Taman Sari	26460	1113	1024	1360	107	0	160	13	30237	6047	2983	202754
- Tambora	19745	537	6621	656	275	76	6518	1169	35597	7119	2017	353004
- Kebon Jeruk	41127	718	3533	1094	352	87	1916	1170	49997	9999	3100	322582
Sub-total	247310	3664	26455	4268	921	1048	12742	6662	303070	60614	3393	1786223
JAKARTA PUSAT												
- Gambir	7038	59	1204	69	15	16	192	756	9349	1870	1130	165448
- Sawah Besar	4328	3	1279	61	2	0	791	1	6465	1293	652	198411
- Kemayoran	17396	270	1310	198	14	79	327	318	19912	3982	1373	289994
- Senen	1585	0	8	8	0	0	3	0	1604	321	185	173868
- Cempaka Putih	15776	228	791	186	9	21	757	247	18015	3603	1431	251728
- Menteng	3923	138	795	65	9	35	43	28	5036	1007	658	153034
- Tanah Abang	17582	14	1209	185	14	12	91	556	19663	3933	1352	290845
Sub-total	67628	712	6596	772	63	163	2204	1906	80044	16009	1051	1523328
DKI JAKARTA	887529	10728	75653	11100	4065	3647	35843	42126	1070691	214138	2433	8800103
Annual Average	177506	2146	15131	2220	813	729	7169	8425	214138			

Table C.10 (1) Number of Those Who Contracted Major Diseases in the Last Three Years by Kecamatan

(Unit : No. of Cases per 1,000 Population)

CODE NUMBER	NAME OF KECAMATAN	Malaria	Gastro-enteritis	Cholera	Tubercu-losis	DHF	Typhoid	Dysentery	Diph-theria	Measles	Hepatitis A	Hepatitis B	Skin Diseases	Total
1100	GAMBIR	3.0	53.6	0.0	0.0	8.9	3.0	3.0	0.0	0.0	0.0	3.0	0.0	74.5
1200	SAWAH BESAR	10.7	46.6	0.0	0.0	7.1	14.3	7.1	0.0	0.0	0.0	0.0	3.6	89.2
1300	KEMAYORAN	2.2	26.8	0.0	0.0	4.5	2.2	17.9	0.0	0.0	0.0	0.0	2.2	55.8
1400	SENEN	0.0	17.6	0.0	0.0	0.0	2.9	5.9	0.0	0.0	0.0	0.9	0.0	29.3
1500	CEMPAKA PUTIH	2.6	45.9	7.7	0.0	7.7	0.0	10.2	0.0	0.0	0.0	0.0	15.3	89.4
1600	MENTENG	0.0	7.1	0.0	0.0	7.1	0.0	3.6	0.0	7.1	0.0	0.0	0.0	24.9
1700	TANAH ABANG	0.1	57.8	0.0	0.0	2.5	2.5	7.5	32.7	0.0	0.0	0.0	42.8	155.9
1000	JAKARTA PUSAT	4.0	37.2	1.2	0.0	5.3	3.2	8.5	5.3	0.8	0.0	0.8	10.1	76.4
2200	PENJARINGAN	2.2	62.4	0.0	2.2	8.6	6.5	2.2	6.5	6.5	0.0	0.0	34.4	131.5
2300	TANJUNG PRIOK	5.1	10.2	0.0	2.6	0.0	0.0	2.6	0.0	2.6	0.0	0.0	10.2	33.3
2400	KOJA	0.0	51.3	0.0	0.0	2.1	22.6	0.0	0.0	2.1	0.0	0.0	10.3	88.4
2500	CILINCING	5.1	17.9	0.0	10.2	0.0	2.6	45.9	0.0	2.6	2.6	0.0	0.0	86.9
2000	JAKARTA UTARA	2.9	37.4	0.0	3.5	2.9	8.6	11.5	1.7	3.5	0.6	0.0	14.4	87.0
3100	CENGKARENG	0.0	43.4	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	9.7	54.7
3200	GROGOL PETAMBURAN	1.6	12.8	0.0	0.0	0.0	0.6	0.0	4.8	0.6	0.0	0.0	4.8	27.2
3300	TAMAN SARI	2.2	59.5	0.0	0.0	11.0	2.2	6.6	0.0	0.0	0.0	0.0	4.4	85.9
3400	TAMBORA	1.6	21.1	4.9	0.0	8.1	1.6	4.9	0.0	1.6	1.6	0.0	0.0	45.5
3500	KEBON JERUK	0.0	3.2	0.0	0.0	0.0	1.6	1.6	0.0	1.6	0.0	0.0	6.5	14.5
3000	JAKARTA BARAT	1.0	26.2	1.0	0.0	3.7	1.4	2.4	1.0	1.0	0.3	0.0	5.1	43.1
4100	TEBET	0.0	24.5	0.0	0.0	2.4	4.9	7.3	0.0	0.0	0.0	0.0	2.4	41.5
4200	SETIA BUDI	0.0	13.2	0.0	0.0	2.2	2.2	0.0	0.0	2.2	2.2	2.2	15.4	39.6
4300	MAMPANG PRAPATAN	8.2	39.3	1.6	0.0	4.9	1.6	19.7	0.0	1.6	1.6	3.3	14.7	96.5
4400	PASAR MINGGU	2.9	24.3	0.0	0.0	5.7	1.4	7.1	0.0	1.4	0.0	0.0	10.0	52.8
4500	KEBAYORAN BARU	0.0	16.1	5.4	0.0	0.0	5.4	1.8	0.0	3.6	0.0	0.0	7.1	39.4
4600	KEBAYORAN LAMA	1.6	11.4	1.6	0.0	3.2	0.0	0.0	0.0	1.6	0.0	0.0	11.4	30.8
4700	CILANDAK	7.4	3.7	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
4000	JAKARTA SELATAN	2.8	20.5	1.4	0.0	3.3	2.2	5.8	0.0	1.7	0.6	0.8	9.7	48.8