Table 6.4-6(1/4) CONSTRUCTION COST OF PROPOSED SCHEMES

PASIG-MARIKINA RIVER IMPROVEMENT (100-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works							Construction Cost		
				Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
River Mouth/San Juan C.	Sta. 0+000/ 8+735	8,735	1150	2,334	0	40	3	0	1	20	646	60	706
San Juan C./Napindan C.	Sta. 8+735/18+495	9,760	500	300	0	60	10	0	0	15	212	45	257
Napindan C./M.C.G.S.	Sta.18+495/ 5+425	5,580	500	100	10	10	1	0	0	8	39	24	63
M.C.G.S. /Mangahan C.	Sta. 5+425/ 6+635	1,210	500	100	5	2	1	0	0	15	24	18	42
Mangahan C./Sta.7+425	Sta. 6+635/ 7+425	790	2900	50	5	2	2	0	0	10	26	12	38
M.C.G.S.			500	30	6	0	22	300	0	1	183	1	184
San Juan River	Sta. 0+000/10+653	10,653	900	1,820	0	175	43	0	4	50	580	177	757
	Sub-Total	36,728		4,734	26	289	82	300	5	119	1,710	337	2,047
Mangahan C./Nangka C.	Sta. 7+425/18+620	11,195	2900	2,493	555	109	46	0	0	950	497	334	831
Nangka C. /Rodorigez B.	Sta.18+620/27+200	8,580	2600	1,596	692	0	0	0	0	1,753	218	517	735
Marikina Dam (Qcut=600m3/s)			2100	40	0	0	120	0	0	2,500	675	125	800
	Sub-Total	19,775		4,129	1,246	109	166	0	0	5,203	1,390	976	2,366
	Total	56,503		8,863	1,272	398	248	300	5	5,322	3,100	1,313	4,413

Table 6.4-6(2/4) CONSTRUCTION COST OF PROPOSED SCHEMES

BAHO BULI MAHABA RIVER IMPROVEMENT (30-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works							Construction Cost		
				Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Mahaba River	Sta. 0+000/ 5+000	5,000	160	390	35	0	0	0	6	173	64	130	194
	Sta. 5+000/ 6+000	1,000	160	10	0	0	0	0	0	3	1	3	4
	Sub-Total	6,000		400	35	0	0	0	6	176	65	133	198
Baho River	Sta. 0+000/ 5+500	5,500	275	560	30	0	0	0	7	172	92	120	212
	Sta.A0+000/A2+000	2,000	230	190	3	0	0	0	3	52	29	16	45
	Sta.A2+000/A3+000	1,000	230	40	0	0	0	0	0	9	4	3	7
	Sub-Total	8,500		790	33	0	0	0	10	233	125	139	264
Buli River	Sta. 0+000/6A+200	3,100	270	240	36	0	0	0	4	81	67	71	138
	Sta.6A+200/8A+200	2,000	230	250	5	0	0	0	3	60	37	18	55
	Sta.8A+200/9A+830	1,630	230	170	13	0	0	0	1	61	32	18	51
	Sta.9A+830/10+480	650	230	70	6	0	0	0	1	26	12	31	43
	Sta.10+480/14+000	2,520	180	260	16	0	0	0	3	93	46	111	158
	Sta.14+000/15+000	1,000	180	60	0	0	0	0	1	16	18	19	36
	Sub-Total	10,900		1,050	76	0	0	0	13	337	212	269	480
Tributary-B	Sta. 0+000/ 5+000	5,000	95	340	11	0	0	0	3	118	57	35	92
	Sta. 5+000/ 6+000	1,000	95	20	2	0	0	0	2	12	5	3	9
	Sub-Total	6,000		360	13	0	0	0	5	130	62	39	101
Tributary-C	Sta. 0+000/ 4+000	4,000	50	140	3	0	0	0	3	49	25	43	67
	Sta. 4+000/ 5+000	1,000	50	150	0	0	0	0	0	5	1	2	3
	Sub-Total	5,000		290	3	0	0	0	3	54	26	45	71
Mangahan Diversion	Sta. 6+800/ 6+100	700	470	870	15	0	0	0	0	180	131	53	184
	Sta. 6+100/ 4+500	1,600	435	840	0	0	0	0	0	140	128	42	170
	Sta. 4+500/ 3+000	1,500	280	410	24	0	0	0	0	93	47	28	75
	Sub-Total	3,800		2,120	39	0	0	0	0	413	306	123	429
	Total	40,200		5,010	199	0	0	0	37	1,343	796	747	1,542

Table 6.4-6(3/4) CONSTRUCTION COST OF PROPOSED SCHEMES

MALABON-TULLAHAN RIVER IMPROVEMENT (30-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Malabon River	Sta. 0+000/ 2+835	2,835	500	970	112	68	0	0	3	64	122	77	199
	Sta. 2+835/ 4+377	1,542	480	170	55	20	0	0	0	33	37	40	77
	Sta. 4+377/ 5+427	1,050	450	70	82	10	0	0	3	13	40	16	56
	Sub-Total	5,427		1,210	250	98	0	0	6	110	199	133	332
Tullahan River	Sta. 0+000/ 4+800	4,800	420	400	141	0	0	0	0	80	163	96	259
	Sta. 4+800/18+000	13,200	290	20	0	0	0	0	0	19	23	23	46
	Sta.18+000/20+500	2,500	210	10	21	0	0	0	0	5	8	6	14
	Sta.20+500/21+500	1,000	210	10	0	0	0	0	0	1	3	1	4
	Sub-Total	21,500		440	163	0	0	0	0	105	197	126	323
	Total	26,927		1,650	413	98	0	0	6	215	397	259	655

SOUTH PARANAQUE LAS PINAS RIVER IMPROVEMENT (30-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Las Pinas River	Sta. 0+000/ 1+780	1,780	210	181	80	3	0	0	2	21	111	25	136
	Sta. 1+780/ 6+395	4,615	180	498	94	20	0	0	2	86	149	104	253
	Sta. 6+395/ 7+395	1,000	110	30	0	5	0	0	0	3	11	4	15
	Sub-Total	7,395		710	173	28	0	0	4	110	271	133	404
South Paranaque River	Sta. 0+000/ 0+560	560	520	76	10	3	0	0	0	4	21	5	26
	Sta.D0+000/D0+400	400	520	76	19	0	0	0	0	2	51	2	53
	Sta.D0+400/S0+000	400	350	91	14	0	0	0	0	9	10	11	21
	Sta.S0+000/S1+200	1,200	350	242	68	0	0	0	0	37	20	44	65
	Sta.S1+200/S2+600	1,400	300	272	31	0	0	0	0	46	32	55	88
	Sta.S2+600/S3+600	1,000	300	91	2	0	0	0	0	16	3	19	23
	Sub-Total	4,960		846	144	3	0	0	0	114	138	137	275
Dongalo River	Sta. 0+000/ 2+600	2,600	170	211	38	13	0	0	0	24	54	29	83
	Sta. 2+600/ 3+600	1,000	170	30	1	5	0	0	0	6	11	7	18
	Sub-Total	3,600		242	39	18	0	0	0	30	65	36	101
	Total	15,955		1,797	357	49	0	0	4	254	475	305	780

Table 6.4-6(4/4) CONSTRUCTION COST OF PROPOSED SCHEMES

DRAINAGE IMPROVEMENT

Drainage Area	Area	Required Works												Construction Cost		
		Pump Station		Gate		Channel Impvt.	Open Cha. Const.	Closed Cha. Const.	Ring Dike/ Lake Dike	Regulating Pond		Reconst. Bridge	Land Acq.	Civil Works	L.A./Compen.	Total
	(km2)	(site)	(m3/s)	(site)	(ton)	(m)	(m)	(m)	(m)	(site)	(1000m3)	(place)	(1000m2)	(mil.Peso)	(mil.Peso)	(mil.Peso)
Project Scale (5-Yr)																
Malabon-Navotas	24.9	8	62.1	16	405	5,100	5,600	800	22,000	0	0	11	106	1,108	43	1,151
East of Mangahan	8.8	4	27.0	4	84	1,100	7,300	0	1,800	2	51	2	62	211	38	249
West of Mangahan	38.1	5	129.3	10	342	34,100	11,000	1,450	8,900	4	642	26	237	1,910	166	2,076
Sub-Total	71.8	17	218.4	30	831	40,300	23,900	2,250	32,700	6	693	39	405	3,229	247	3,476
Project Scale (3-Yr)																
San Juan	12.7	9	31.0	13	103	1,300	0	12,300	3,400	0	0	8	6	960	2	962
Mandaluyong Pasig	15.9	3	14.5	3	40	2,500	0	8,800	0	0	0	5	8	713	8	721
Marikina	13.0	0	0.0	1	7	0	1,000	2,600	0	0	0	2	20	169	15	184
Paranaque Laspinas	15.4	2	12.5	8	175	4,800	650	0	0	0	0	3	36	559	14	573
Valenzuela	18.4	0	0.0	1	10	12,900	500	0	8,000	0	0	4	29	205	12	217
Sub-Total	75.4	14	58.0	26	335	21,500	2,150	23,700	11,400	0	0	22	99	2,606	51	2,657
Total	147.2	31	276.4	56	1,166	61,800	26,050	25,950	44,100	6	693	61	504	5,835	298	6,133

Table 6.4-7 SUMMARY OF ANNUAL OPERATION, MAINTENANCE AND REPLACEMENT COST

UNIT : MIL. PESO

RIVER IMPROVEMENT SCHEME	OPERATION, MAINTENANCE AND REPLACEMENT COST	PROJECT SCALE
1. PASIG RIVER	7.6	100-Yr
2. MARIKINA RIVER	3.2	100-Yr
3. BAHO BULI MAHABA RIVERS	2.1	30-Yr
4. MALABON TULLAHAN RIVERS	1.1	30-Yr
5. SOUTH PARANAQUE LAS PINAS RIVERS	1.5	30-Yr
TOTAL	15.5	

UNIT : MIL. PESO

DRAINAGE IMPROVEMENT SCHEME	OPERATION, MAINTENANCE AND REPLACEMENT COST	PROJECT SCALE
1. MALABON NAVOTAS	9.7	5-Yr
2. EAST OF MANGAHAN	3.1	5-Yr
3. WEST OF MANGAHAN	36.0	5-Yr
4. MALABON NAVOTAS (REMAINING)	1.7	5-Yr
5. SAN JUAN	7.5	3-Yr
6. MANDALUYONG PASIG	3.7	3-Yr
7. MARIKINA	3.4	3-Yr
8. PARANAQUE LAS PINAS	3.4	3-Yr
9. VALENZUELA	0.7	3-Yr
TOTAL	69.2	

Table 6.4-8(1/2). AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN
(under the land use condition of 2020)

UNIT: million peso

SUB-BASIN	TOTAL AREA* (km2)	HOUSE/BUILDING** TOTAL	HOUSE/BUILDING** PER km2	HOUSE/BUILDING*** TOTAL	HOUSE/BUILDING*** PER km2	INDUSTRIAL INDOOR MOVABLES TOTAL	INDUSTRIAL INDOOR MOVABLES PER km2
(MEYCAUAYAN)							
ME- 1	2.38	1,979.20	831.60	1,979.20	831.60	0.00	0.00
ME- 2	10.13	4,799.20	473.76	4,787.20	472.58	73.50	7.26
ME- 3	21.55	18,469.60	857.06	18,293.60	848.89	1,078.00	50.02
ME- 4	22.54	4,407.20	195.53	4,203.20	186.48	1,249.50	55.43
ME- 5	8.59	3,103.60	361.30	2,745.60	319.63	2,192.75	255.27
ME- 6	21.76	9,625.60	442.35	9,313.60	428.01	1,911.00	87.82
ME- 7	8.82	4,317.60	489.52	3,761.60	426.49	3,405.50	386.11
ME- 8	17.81	9,106.00	511.29	7,568.00	424.93	9,420.25	528.93
ME- 9	18.42	10,165.60	551.88	10,139.60	550.47	159.25	8.65
SUB-TOTAL	132.00	65,973.60	499.80	62,791.60	475.69	19,489.75	147.65
(MALABON-TULLAHAN)							
MT- 1	0.26	208.00	800.00	208.00	800.00	0.00	0.00
MT- 2	13.38	13,878.40	1,037.25	13,878.40	1,037.25	0.00	0.00
MT- 3	20.08	11,827.60	589.02	10,857.60	540.72	5,941.25	295.88
MT- 4	9.97	4,942.00	495.69	4,514.00	452.76	2,621.50	262.94
SUB-TOTAL	43.69	30,856.00	706.25	29,458.00	674.25	8,562.75	195.99
(PASIG/MARIKINA)							
PM- 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM- 2	13.46	7,361.20	546.89	7,291.20	541.69	428.75	31.85
PM- 3	47.26	38,426.00	813.08	37,752.00	798.82	4,128.25	87.35
PM- 4	6.18	4,578.00	740.78	4,182.00	676.70	2,425.50	392.48
PM- 5	11.33	7,639.60	674.28	7,059.60	623.09	3,552.50	313.55
PM- 6	8.74	4,086.80	467.60	3,690.80	422.29	2,425.50	277.52
PM- 7	4.58	3,088.80	674.41	2,916.80	636.86	1,053.50	230.02
SUB-TOTAL	91.55	65,180.40	711.97	62,892.40	686.97	14,014.00	153.07
(SAN JUAN)							
SJ- 1	23.27	19,578.40	841.36	19,536.40	839.55	257.25	11.06
SJ- 2	10.53	6,432.00	610.83	6,018.00	571.51	2,535.75	240.81
SJ- 3	2.18	1,128.00	517.43	942.00	432.11	1,139.25	522.59
SJ- 4	9.96	5,462.00	548.39	5,348.00	536.95	698.25	70.11
SJ- 5	8.24	4,164.80	505.44	3,480.80	422.43	4,189.50	508.43
SJ- 6	14.02	8,010.40	571.36	7,962.40	567.93	294.00	20.97
SJ- 7	3.55	2,644.00	744.79	2,644.00	744.79	0.00	0.00
SJ- 8	12.07	7,559.20	626.28	7,559.20	626.28	0.00	0.00
SJ- 9	6.53	4,367.20	668.79	4,255.20	651.64	686.00	105.05
SJ- 10	1.09	638.00	585.32	580.00	532.11	355.25	325.92
SUB-TOTAL	91.44	59,984.00	655.99	58,326.00	637.86	10,155.25	111.06
(BAHO/BULI)							
BB- 1	16.55	15,317.20	925.51	15,085.20	911.49	1,421.00	85.86
BB- 2	6.63	6,955.20	1,049.05	6,955.20	1,049.05	0.00	0.00
BB- 3	5.55	2,492.40	449.08	2,184.40	393.59	1,886.50	339.91
BB- 4	25.76	25,684.80	997.08	25,684.80	997.08	0.00	0.00
BB- 5	4.21	2,962.40	703.66	2,878.40	683.71	514.50	122.21
BB- 6	4.46	4,774.40	1,070.49	4,726.40	1,059.73	294.00	65.92
BB- 7	9.18	7,518.00	818.95	7,024.00	765.14	3,025.75	329.60
SUB-TOTAL	72.34	65,704.40	908.27	64,538.40	892.15	7,141.75	98.72
(SOUTH PARANAQUE/LAS PINAS)							
PL- 1	11.49	9,549.60	831.12	9,273.60	807.10	1,690.50	147.13
PL- 2	3.44	3,270.40	950.70	3,270.40	950.70	0.00	0.00
PL- 3	19.25	18,986.40	986.31	18,730.40	973.01	1,568.00	81.45
PL- 4	6.24	6,012.40	963.53	5,806.40	930.51	1,261.75	202.20
PL- 5	9.72	10,886.40	1,120.00	10,886.40	1,120.00	0.00	0.00
ZP- 1	6.77	3,203.20	473.15	3,203.20	473.15	0.00	0.00
ZP- 2	3.67	3,897.60	1,062.02	3,897.60	1,062.02	0.00	0.00
ZP- 3	4.76	1,097.60	230.59	1,097.60	230.59	0.00	0.00
SUB-TOTAL	65.34	56,903.60	870.88	56,165.60	859.59	4,520.25	69.18

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).
The location of subbasins is presented in Fig. 3.1-1.

Table 6.4-8(2/2). AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN
(under the land use condition of 2020)

UNIT: million peso

SUB-BASIN	TOTAL AREA* (km2)	HOUSE/BUILDING**		HOUSE/BUILDING***		INDUSTRIAL INDOOR MOVABLES	
		TOTAL	PER km2	TOTAL	PER km2	TOTAL	PER km2
(MALABON NAVOTAS)							
MA- 1	2.26	1,592.00	704.42	1,456.00	644.25	833.00	368.58
MA- 2	2.05	1,207.20	588.88	1,207.20	588.88	0.00	0.00
MA- 3	2.21	1,598.40	723.26	1,598.40	723.26	0.00	0.00
MA- 4	0.50	381.60	763.20	369.60	739.20	73.50	147.00
MA- 5	1.89	1,306.00	691.01	1,272.00	673.02	208.25	110.19
MA- 6	1.34	1,036.00	773.13	1,036.00	773.13	0.00	0.00
MA- 7	2.40	1,692.00	705.00	1,688.00	703.33	24.50	10.21
MA- 8	3.76	2,974.00	790.96	2,974.00	790.96	0.00	0.00
MA- 9	0.30	88.00	293.33	42.00	140.00	281.75	939.17
MA- 10	0.91	426.00	468.13	342.00	375.82	514.50	565.38
MA- 11	0.69	192.00	278.26	72.00	104.35	735.00	1,065.22
MA- 12	0.32	64.00	200.00	0.00	0.00	392.00	1,225.00
SUB-TOTAL	18.63	12,557.20	674.03	12,057.20	647.19	3,062.50	164.39
(MANILA AND SUBURBS, NORTH)							
NM- 1	16.79	7,968.00	474.57	7,790.00	463.97	1,090.25	64.93
NM- 2	0.36	104.00	288.89	54.00	150.00	306.25	850.69
NM- 3	9.06	4,556.00	502.87	4,344.00	479.47	1,298.50	143.32
NM- 4	0.69	278.00	402.90	210.00	304.35	416.50	603.62
NM- 5	1.68	414.00	246.43	126.00	75.00	1,764.00	1,050.00
SUB-TOTAL	28.58	13,320.00	466.06	12,524.00	438.21	4,875.50	170.59
(MANILA AND SUBURBS, SOUTH)							
SM- 1	5.99	4,843.20	808.55	4,811.20	803.21	196.00	32.72
SM- 2	7.06	3,180.00	450.42	2,846.00	403.12	2,045.75	289.77
SM- 3	1.41	98.00	69.50	0.00	0.00	600.25	425.71
SM- 4	3.88	1,412.00	363.92	1,344.00	346.39	416.50	107.35
SM- 5	24.80	11,301.60	455.71	10,999.60	443.53	1,849.75	74.59
SUB-TOTAL	43.14	20,834.80	482.96	20,000.80	463.63	5,108.25	118.41
(EAST OF MANGAHAN)							
EM- 1	1.67	1,816.00	1,087.43	1,816.00	1,087.43	0.00	0.00
EM- 2	2.42	812.80	335.87	682.80	282.15	796.25	329.03
EM- 3	2.72	914.80	336.32	884.80	325.29	183.75	67.56
EM- 4	1.95	958.80	491.69	958.80	491.69	0.00	0.00
SUB-TOTAL	8.76	4,502.40	513.97	4,342.40	495.71	980.00	111.87
(WEST OF MANGAHAN)							
WM- 1	9.12	5,140.00	563.60	4,764.00	522.37	2,303.00	252.52
WM- 2	5.14	3,669.60	713.93	3,505.60	682.02	1,004.50	195.43
WM- 3	6.83	5,494.00	804.39	5,170.00	756.95	1,984.50	290.56
WM- 4	14.28	9,710.80	680.03	9,642.80	675.27	416.50	29.17
WM- 5	2.77	3,102.40	1,120.00	3,102.40	1,120.00	0.00	0.00
SUB-TOTAL	38.14	27,116.80	710.98	26,184.80	686.54	5,708.50	149.67
(PARANAQUE LAS PINAS)							
PA- 1	8.82	2,254.00	255.56	2,254.00	255.56	0.00	0.00
PA- 2	2.41	1,690.80	701.58	1,690.80	701.58	0.00	0.00
PA- 3	1.55	1,087.60	701.68	1,087.60	701.68	0.00	0.00
PA- 4	2.65	2,412.80	910.49	2,412.80	910.49	0.00	0.00
SUB-TOTAL	15.43	7,445.20	482.51	7,445.20	482.51	0.00	0.00

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).
The location of subbasins is presented in Fig. 3.1-1.

TABLE 6.4-9 BREAKDOWN OF ANNUAL AVERAGE BENEFIT OF THE MASTER PLAN
(under the land use condition of 2020)

RIVER SYSTEM/ DRAINAGE AREA	PROJECT SCALE IN FLOOD RETURN PERIOD							
	100-YR	50-YR	30-YR	20-YR	10-YR	5-YR	3-YR	2-YR
1. River System								
Pasig Marikina	797 *	769	712	648	515	---	---	---
Baho Buli Mahaba	188	184	177 *	169	151	---	---	---
Malabon Tullahan	93	91	88 *	83	75	---	---	---
S.Paranaque Las Pinas	131	127	121 *	114	100	---	---	---
Sub-total	1,209	1,171	1,098	1,014	841	---	---	---
2. Drainage Area								
Manila	---	---	---	---	402	---	---	---
Malabon Navotas	---	---	---	---	444	409 *	358	286
East of Mangahan	---	---	---	---	73	70 *	61	52
West of Mangahan	---	---	---	---	679	675 *	666	653
San Juan	---	---	---	---	137	125	107 *	84
Mandaluyong Pasig	---	---	---	---	167	161	150 *	137
Marikina	---	---	---	---	46	46	45 *	43
Paranaque Las Pinas	---	---	---	---	101	100	99 *	96
Valenzuela	---	---	---	---	73	59	42 *	28
Sub-total	---	---	---	---	2,122	1,645	1,528	1,379

NOTE *: Annual average benefit of the Master Plan; 2,780 million peso in total.

Table 6.4-10 ANNUAL CASH FLOW OF THE MASTER PLAN

Unit : Million Peso

NO.	YEAR	ECONOMIC COST				ANNUAL AVERAGE BENEFIT	ANNUAL CASH FLOW
		CONSTRUC-TION	LAND ACQUISITION	OMR	TOTAL		
1	1991	379	117		495		(495)
2	1992	379	117		495		(495)
3	1993	379	117		495		(495)
4	1994	379	117		495		(495)
5	1995	379			379		(379)
6	1996	379		27	406	651	245
7	1997	379		27	406	651	245
8	1998	379		27	406	651	245
9	1999	379		27	406	651	245
10	2000	379		27	406	651	245
11	2001	308	223	54	584	1,302	718
12	2002	308	223	54	584	1,302	718
13	2003	308	223	54	584	1,302	718
14	2004	308	223	54	584	1,302	718
15	2005	308		54	362	1,302	941
16	2006	308		54	362	1,302	941
17	2007	308		54	362	1,302	941
18	2008	308		54	362	1,302	941
19	2009	308		54	362	1,302	941
20	2010	308		54	362	1,302	941
21	2011	258	418	77	753	2,057	1,304
22	2012	258	418	77	753	2,057	1,304
23	2013	258	418	77	753	2,057	1,304
24	2014	258	418	77	753	2,057	1,304
25	2015	258		77	335	2,057	1,722
26	2016	258		77	335	2,057	1,722
27	2017	258		77	335	2,057	1,722
28	2018	258		77	335	2,057	1,722
29	2019	258		77	335	2,057	1,722
30	2020	258		77	335	2,057	1,722
31	2021			85	85	2,778	2,694
32	2022			85	85	2,778	2,694
33	2023			85	85	2,778	2,694
34	2024			85	85	2,778	2,694
35	2025			85	85	2,778	2,694
36	2026			85	85	2,778	2,694
37	2027			85	85	2,778	2,694
38	2028			85	85	2,778	2,694
39	2029			85	85	2,778	2,694
40	2030			85	85	2,778	2,694
41	2031			85	85	2,778	2,694
42	2032			85	85	2,778	2,694
43	2033			85	85	2,778	2,694
44	2034			85	85	2,778	2,694
45	2035			85	85	2,778	2,694
46	2036			85	85	2,778	2,694
47	2037			85	85	2,778	2,694
48	2038			85	85	2,778	2,694
49	2039			85	85	2,778	2,694
50	2040			85	85	2,778	2,694
51	2041			85	85	2,778	2,694
52	2042			85	85	2,778	2,694
53	2043			85	85	2,778	2,694
54	2044			85	85	2,778	2,694
55	2045			85	85	2,778	2,694
56	2046			85	85	2,778	2,694
57	2047			85	85	2,778	2,694
58	2048			85	85	2,778	2,694
59	2049			85	85	2,778	2,694
60	2050			85	85	2,778	2,694
					IRR =	17.26%	
					B/C =	1.18	
					NPV =	537.50	

NOTE: Assumptions for the cost-benefit flow are
- Annual distribution of construction cost is equal in each phase;
- Land acquisition is made in the first four years in each phase;
- 50% of the first phase OMR cost and benefit accrues from the 6th year.

Table 6.4-11 RESULT OF EIA FOR RIVER FLOOD CONTROL WORKS

Checklist Item	Pasig-Marikina River Improvement	Pasig-Marikina MCGS	Pasig-Marikina Marikina Dam	Malabon-Tullahan	Baho, Buli Mahaba	S. Parañaque -Las Piñas
A) Problems Due to Location						
1. Resettlement/Evacuation	0	0	-/A	-/B	-/B	-/B
2. Land value changes	+/A	+/A	+/A	+/A	+/A	+/A
3. Encroachment of precious ecology	0	0	0	0	0	0
4. Encroachment of historical/cultural values	0	0	0	0	0	0
5. Watershed erosion and silt runoff	0	0	+/A	0	0	0
6. Navigation	+/C	-/B	0	+/C	+/C	+/C
7. Effects on groundwater hydrology	0	0	±	0	0	0
8. Migrating valuable fish species	0	0	0	0	0	0
9. Inundation of land and mineral resources	0	0	-/C	0	0	0
B) Problems Related to Design						
1. Road erosion	+/A	0	0	+/A	+/A	+/A
2. Water right conflicts	0	0	0	0	0	0
3. Loss of community/ recreation areas	0	0	-/C	0	0	0
4. Intensification of traffic congestion	0	0	0	0	0	0
5. Aesthetics and landscape	+/A	+/B	+/A	+/A	+/A	+/A
6. Prevention of access	0	0	0	0	0	0
C) Problems in Construction Stage						
1. Soil erosion and silt runoff	-/C	-/B	-/B	-/C	-/C	-/C
2. Hazards to workers and nearby residents	0	0	0	0	0	0
3. Spread of communicable diseases	0	0	0	0	0	0
D) Problems in Operation Stage						
1. Water Quality	+/C	±	0	+/C	+/C	+/C
2. Eutrophication	0	0	0	0	0	0
3. Encroachment of precious ecology	0	0	0	0	0	0
4. Depreciation of fisheries	0	0	0	0	0	0
5. Vector disease hazards	0	0	0	0	0	0
6. Downstream erosion/ aggradation	0	0	0	0	0	0
7. Aesthetics and landscape	0	0	0	0	0	0

NOTE: (1) / : Left side is the expected effect, and right side is its significance

(2) 0 : No effect expected
+ : Positive effect expected
- : Negative effect expected
± : Neutral effect expected, i.e. there maybe a change but such change will be neither beneficial nor harmful

(3) A : Effect which has relatively high level of significance
B : Effect which has relatively medium level of significance
C : Effect which has relatively low level of significance

Table 6.4-12 RESULT OF EIA FOR DRAINAGE IMPROVEMENT WORKS

Checklist Item	Malabon-Nabotas	East and West Mangahan Lakeshore Dike	East and West Mangahan Other Works	San Juan	Mandaluyong -Pasig	Marikina	Parañaque -Las Piñas	Valenzuela
A) Problems Due to Location								
1. Resettlement/Evacuation	-/C	-/C	-/C	-/C	-/C	-/C	-/C	-/C
2. Land value changes	+/A	+/A	+/A	+/A	+/A	+/A	+/A	+/A
3. Encroachment of precious ecology	0	0	0	0	0	0	0	0
4. Encroachment of historical/cultural values	0	0	0	0	0	0	0	0
5. Watershed erosion and silt runoff	0	0	0	0	0	0	0	0
6. Navigation	-/C	-/C	+/C	+/C	+/C	+/C	+/C	+/C
7. Effects on groundwater hydrology	0	0	0	0	0	0	0	0
8. Migrating valuable fish species	0	0	0	0	0	0	0	0
9. Inundation of land and mineral resources	0	0	0	0	0	0	0	0
B) Problems Related to Design								
1. Road erosion	0	0	0	0	0	0	0	0
2. Water right conflicts	0	0	0	0	0	0	0	0
3. Loss of community/ recreation areas	0	0	0	0	0	0	0	0
4. Intensification of traffic congestion	0	0	0	0	0	0	0	0
5. Aesthetics and landscape	+/A	+/A	+/A	+/A	+/A	+/A	+/A	+/A
6. Prevention of access	0	-/B	0	0	0	0	0	0
C) Problems in Construction Stage								
1. Soil erosion and silt runoff	-/C	-/B	-/C	-/C	-/C	-/C	-/C	-/C
2. Hazards to workers and nearby residents	0	0	0	0	0	0	0	0
3. Spread of communicable diseases	0	0	0	0	0	0	0	0
D) Problems in Operation Stage								
1. Water Quality	-/C	±	±	+/C	+/C	+/C	+/C	+/C
2. Eutrophication	0	0	0	0	0	0	0	0
3. Encroachment of precious ecology	0	0	0	0	0	0	0	0
4. Depreciation of fisheries	0	0	0	0	0	0	0	0
5. Vector disease hazards	0	0	0	0	0	0	0	0
6. Downstream erosion/ aggradation	0	0	0	0	0	0	0	0
7. Aesthetics and landscape	+/C	0	+/C	+/C	+/C	+/C	+/C	+/C

NOTE: (1) / : Left side is the expected effect, and right side is its significance

(2) 0 : No effect expected
+ : Positive effect expected
- : Negative effect expected
± : Neutral effect expected, i.e., there maybe a change but such change will be neither beneficial nor harmful

(3) A : Effect which has relatively high level of significance
B : Effect which has relatively medium level of significance
C : Effect which has relatively low level of significance

TABLE 7.1-1 COST-BENEFIT RATIOS OF ALTERNATIVE CASES ON THE 1986-YEAR LAND USE CONDITIONS

RIVER SYSTEM	COST-BENEFIT RATIOS				
	100-YR	50-YR	30-YR	20-YR	10-YR
PASIG MARIKINA	0.84	0.88	0.88	0.86	0.82
BAHO BULI MAHABA	0.32	0.36	0.37	0.36	0.34
MALABON TULLAHAN	0.45	0.55	0.61	0.64	0.71
S.PARANAQUE LAS PINAS	0.63	0.69	0.73	0.74	0.76

DRAINAGE AREA	COST-BENEFIT RATIOS			
	10-YR	5-YR	3-YR	2-YR
MANILA	1.09	---	---	---
MALABON NAVOTAS	1.44	1.49	1.50	1.37
EAST OF MANGAHAN	1.01	1.08	1.11	1.07
WEST OF MANGAHAN	1.26	1.40	1.52	1.64
SAN JUAN	0.69	0.70	0.67	0.59
MANDALUYONG PASIG	0.79	0.82	0.84	0.96
MARIKINA	0.39	0.43	0.45	0.47
PARANAQUE LAS PINAS	0.68	0.76	0.86	0.96
VALENZUELA	0.81	0.82	0.71	0.50

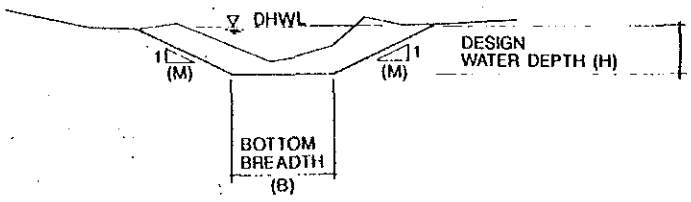
Table 7.2-1 OPTIMUM DIMENSIONS OF PUMPS AND REGULATION PONDS FOR EAST AND WEST OF MANGAHAN

Subdrainage Area	Objective Discharge* For Land Use at 2020		Optimum Dimensions of Pump and Regulation Pond							Dimensions of Pump For Land Use at 2000	
			Pump Station		Regulation Pond						
	Discharge (m^3/s)	Specific Discharge ($m^3/s/km^2$)	Design Capacity (m^3/s)	Specific Discharge ($m^3/s/km^2$)	High Water Level EL (m)	Bottom Height EL (m)	Water Depth (m)	Area (m^2)	Volume (m^3)	Design Capacity (m^3/s)	Specific Discharge ($m^3/s/km^2$)
EM-1	8.1	4.9	9	5.4	13.0	-	-	-	-	8	4.8
2	10.8	4.5	11	4.5	12.5	-	-	-	-	8	3.3
3	6.7	2.5	5	1.8	12.5	9.5	3.0	6,000	18,000	5	1.8
4	5.1	2.6	2	1.0	12.0	9.0	3.0	11,000	33,000	2	1.0
WM-1	45.3	5.0	46	5.0	12.0	-	-	-	-	32	3.5
2	26.3	5.1	12	2.3	12.0	9.0	3.0	46,000	138,000	7	1.4
3	35.2	5.2	20	2.9	12.0	9.0	3.0	61,000	183,000	14	2.0
4	66.1	4.6	45	3.2	12.0	9.0	3.0	86,000	258,000	31	2.2
5	12.4	4.5	6	2.2	12.0	9.0	3.0	21,000	63,000	4	1.4

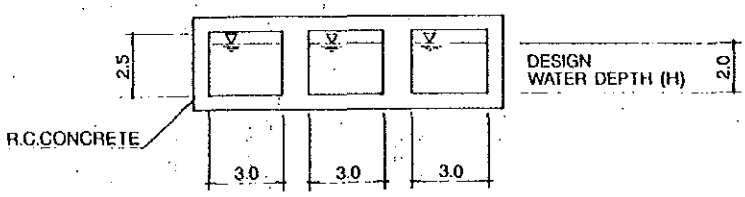
* Objective Discharge is the required pump capacity without the regulation pond.

Table 7.2-2(1/2) FEATURES OF PROPOSED DRAINAGE CHANNEL FOR EAST AND WEST OF MANGAHAN

Sub-D.Area	Drainage Area (ha)	Design Discharge (m3/s)	Channel Gradient (1/I)	Roghness Co-efficient	Length Const. (m)	Length Impvt. (m)	Bottom Breadth (B:m)	Design W.Depth (H:m)	Type	Side Slope (M)	Channel Code	Remarks
EM-1	83.0	15	5000	0.030	700		8.6	2.0	Trape.	2.0	b	
	83.6	13	5000	0.030	1,100		7.1	2.0		2.0	a	
S-total	166.6				1,800							
EM-2	74.3	11	5000	0.030	800		5.7	2.0	Trape.	2.0	b	
	39.9	18	5000	0.030	700		10.7	2.0	Trape.	2.0	a-3	
	39.7	14	5000	0.030	550		7.9	2.0	Trape.	2.0	a-2	
	87.8	10	5000	0.030	750		5.0	2.0	Trape.	2.0	a-1	
S-total	241.7				2,800							
EM-3	80.5	7	5000	0.030	700		2.8	2.0	Trape.	2.0	b	
	40.9	11	5000	0.030	900		5.7	2.0	Trape.	2.0	a-3	
	65.6	9	5000	0.030	500		4.3	2.0	Trape.	2.0	a-2	
	85.2	5	5000	0.030	600		1.3	2.0	Trape.	2.0	a-1	
S-total	272.2				2,700							
EM-4	53.5	17	5000	0.030		400	10.0	2.0	Trape.	2.0	a-3	
	45.8	13	5000	0.030		350	7.1	2.0	Trape.	2.0	a-2	
	95.7	9	5000	0.030		350	4.3	2.0	Trape.	2.0	a-1	
S-total	195.0					1,100						
Total	875.5				7,300	1,100						



TYPICAL CROSS SECTION OF TRAPEZOIDAL CHANNEL

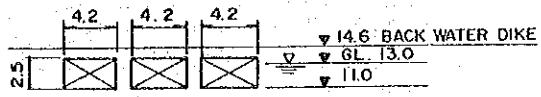
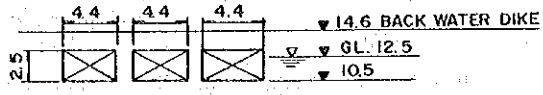
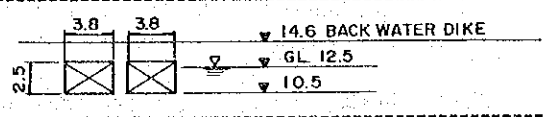
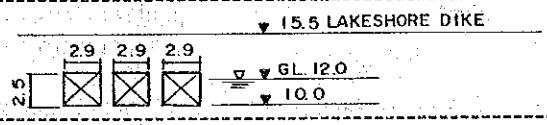
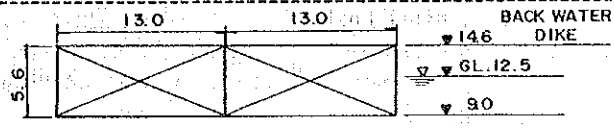
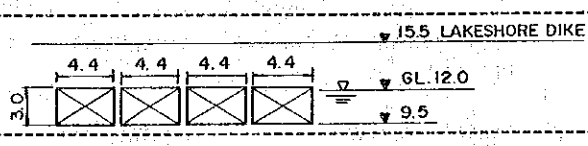
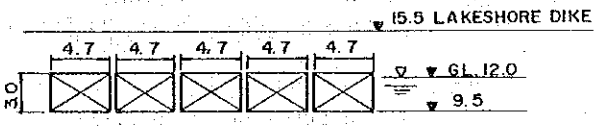
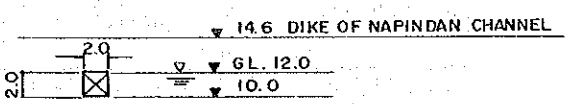
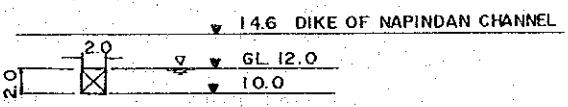
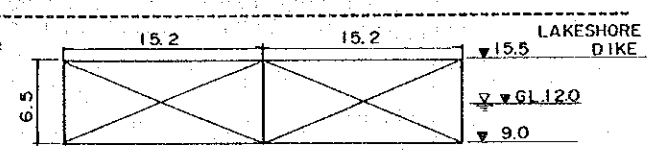
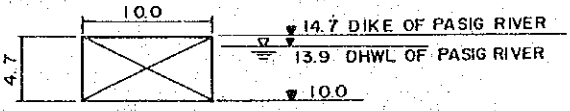
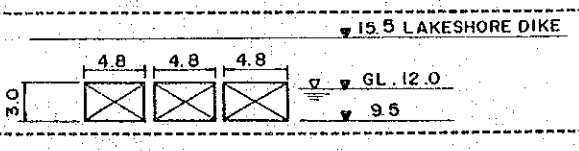


TYPICAL CROSS SECTION OF CLOSED CHANNEL
(THREE UNITS BOX CULVERT)

Table 7.2-2(2/2) FEATURES OF PROPOSED DRAINAGE CHANNEL FOR EAST AND WEST OF MANGAHAN

Sub-D.Area	Drainage Area (ha)	Design Discharge (m3/s)	Channel Gradient (1/I)	Roghness Co-efficient	Length Const. (m)	Length Impvt. (m)	Bottom Breadth (B:m)	Design W.Depth (H:m)	Type	Side Slope (M)	Channel Code	Remarks
WM-1	34.9	25	5000	0.030	600		15.5	2.0	Trape.	2.0	f-3	
	51.3	20	5000	0.030	450		12.0	2.0	Trape.	2.0	f-2	
	81.5	13	5000	0.030	450		7.1	2.0	Trape.	2.0	f-1	
	22.2	35	1500	0.030		600	16.0	1.7	Trape.	2.0	e	
	46.1	20	1500	0.030		800	10.0	1.6	Trape.	2.0	d-2	
	85.4	13	1500	0.030		600	10.0	1.2	Trape.	2.0	d-1	
	22.3	20	1500	0.030		450	17.0	1.2	Trape.	2.0	c-2	
	92.0	17	1500	0.030		500	14.0	1.2	Trape.	2.0	c-1	
	50.0	64	2000	0.030		800	13.0	2.9	Trape.	2.0	b-2	
	55.8	64	2000	0.030		850	20.0	2.3	Trape.	2.0	b-2	
	133.2	55	2000	0.030		900	23.0	2.0	Trape.	2.0	b-1	
	79.7	27	1500	0.030		1,000	12.0	1.7	Trape.	2.0	a-5	
	50.3	18	1500	0.030		700	21.0	1.0	Trape.	2.0	a-4	
	36.3	13	1500	0.030		250	15.0	1.0	Trape.	2.0	a-3	
	0.0	13	1500	0.030	250		15.0	1.0	Trape.	2.0	a-2	
	71.1	9	1500	0.030	500		10.0	1.0	Trape.	2.0	a-1	
S-total	912.1				2,250	7,450						
WM-2	56.0	21	5000	0.030	1,100		12.7	2.0	Trape.	2.0	d-3	
	51.9	16	5000	0.030	550		9.3	2.0	Trape.	2.0	d-2	
	99.5	11	5000	0.030	500		5.7	2.0	Trape.	2.0	d-1	
	55.8	8	5000	0.030		850	8.0	1.5	Trape.	2.0	c	
	89.0	27	5000	0.030		1,000	17.0	2.0	Trape.	2.0	b	Antipolo
	79.5	17	5000	0.030		1,000	10.0	2.0	Trape.	2.0	a-2	
	82.7	9	5000	0.030		900	7.0	1.7	Trape.	2.0	a-1	S.Baho
S-total	514.4				2,150	3,750						
WM-3	29.3	14	5000	0.030	600		7.9	2.0	Trape.	2.0	g-2	
	57.2	10	5000	0.030	400		5.0	2.0	Trape.	2.0	g-1	
	29.8	20	5000	0.030	550		12.0	2.0	Trape.	2.0	f-3	
	20.6	16	5000	0.030	550		9.3	2.0	Trape.	2.0	f-2	
	89.8	13	5000	0.030	400		7.1	2.0	Trape.	2.0	f-1	
	35.6	19	5000	0.030		550	11.3	2.0	Trape.	2.0	e-2	
	88.8	14	5000	0.030	600		7.9	2.0	Trape.	2.0	e-1	
	19.9	15	5000	0.030		800	8.6	2.0	Trape.	2.0	d-2	
	76.1	12	5000	0.030		300	6.4	2.0	Trape.	2.0	d-1	
	22.3	39	3000	0.030		550	20.0	2.0	Trape.	2.0	c	
	25.0	39	3000	0.030		800	16.0	2.2	Trape.	2.0	c	
	35.0	39	3000	0.030		1,000	16.0	2.4	Trape.	2.0	c	
	6.4	29	5000	0.030		300	20.0	1.9	Trape.	2.0	b	
	27.4	18	5000	0.030		300	10.7	2.0	Trape.	2.0	a-3	
	39.6	15	5000	0.030		1,000	8.6	2.0	Trape.	2.0	a-2	
	80.4	10	5000	0.030		750	5.0	2.0	Trape.	2.0	a-1	
S-total	683.2				3,100	6,350						
WM-4	38.8	13	5000	0.030		1,400	11.0	1.7	Trape.	2.0	o-2	Tipas
	20.0	13	5000	0.030		500	8.0	1.9	Trape.	2.0	o-2	Tipas
	67.4	7	5000	0.030		900	2.8	2.0	Trape.	2.0	o-1	Tipas
	92.2	17	5000	0.030	550		10.0	2.0	Trape.	2.0	n	
	62.1	11	5000	0.030	600		5.7	2.0	Trape.	2.0	m	
	42.7	25	5000	0.030		350	15.5	2.0	Trape.	2.0	l-2	
	97.1	18	5000	0.030		250	10.7	2.0	Trape.	2.0	l-1	
	128.4	21	5000	0.030		800	12.7	2.0	Trape.	2.0	k	Ususan
	41.2	42	2000	0.030		900	17.0	2.0	Trape.	2.0	j	Ususan
	47.9	30	500	0.030		500	2.0	2.5	Trape.	2.0	i-4	Ususan
	60.2	25	5000	0.030		1,350	15.5	2.0	Trape.	2.0	i-3	Ususan
	27.9	19	5000	0.030		200	11.3	2.0	Trape.	2.0	i-2	Ususan
	0.0	19	5000	0.015	250		9.0	2.0	B.Culvert	0.0	i-1	B=3.0m*3units
	55.6	19	5000	0.015	600		9.0	2.0	B.Culvert	0.0	h-2	B=3.0m*3units
	80.7	12	5000	0.015	600		6.0	2.0	B.Culvert	0.0	h-1	B=3.0m*2units
	12.4	17	5000	0.030		500	10.0	2.0	Trape.	2.0	g-2	
	102.1	16	5000	0.030		500	9.3	2.0	Trape.	2.0	g-1	
	19.3	14	5000	0.030	600		7.9	2.0	Trape.	2.0	f-2	
	73.5	12	5000	0.030	400		6.4	2.0	Trape.	2.0	f-1	
	67.7	91	5000	0.030		800	30.0	3.0	Trape.	2.0	e	Taguig
	12.3	83	5000	0.030		1,000	30.0	2.8	Trape.	2.0	d	Taguig
	24.2	67	5000	0.030		1,450	27.0	2.7	Trape.	2.0	c	Taguig
	12.2	29	5000	0.030		400	11.0	2.6	Trape.	2.0	b	Taguig
	64.5	21	5000	0.030		1,300	8.0	2.5	Trape.	2.0	a-5	Taguig
	31.1	16	5000	0.030		500	6.0	2.4	Trape.	2.0	a-4	Taguig
	45.6	13	5000	0.030		800	5.0	2.4	Trape.	2.0	a-3	Taguig
	49.3	9	5000	0.030		900	2.0	2.4	Trape.	2.0	a-2	Taguig
	51.2	5	5000	0.030		350	1.0	2.4	Trape.	2.0	a-1	Taguig
S-total	1,427.6				3,600	15,650						
WM-5	33.0	36	5000	0.030		350	15.0	2.5	Trape.	2.0	c	
	40.9	21	5000	0.030		550	12.7	2.0	Trape.	2.0	b-2	
	101.5	15	5000	0.030	550		8.6	2.0	Trape.	2.0	b-1	
	23.6	17	5000	0.030	400		10.0	2.0	Trape.	2.0	a-2	
	78.3	14	5000	0.030	400		7.9	2.0	Trape.	2.0	a-1	
S-total	277.3				1,350	900						
Total	3,814.6				12,450	34,100						

Table 7.2-3 FEATURES OF PROPOSED SLUICE GATE FOR EAST AND WEST OF MANGAHAN

DRAINAGE AREA	LOCATION	DESIGN DISCHARGE (M3/S)	TYPE	CROSS SECTION
EM-1	Buli River STA.0+000	25	Box culvert/Sluice appurtenant to Pump Station	
EM-2	Baho River STA.0+000	26	Box culvert/Sluice appurtenant to Pump Station	
EM-3	Mahaba River STA.0+000	15	Box culvert/Sluice appurtenant to Pump Station	
EM-4	Lakeshore Dike	17	Box culvert/Sluice appurtenant to Pump Station	
WM-1	Napindan R. Lower Buli R.	78	Open channel/Sluice appurtenant to Pump Station	
	Antipolo R. STA.0+800	*	Open channel/Sluice	
WM-2	Lakeshore Dike Anti Polo R. STA.3+100	44	Box culvert/Sluice appurtenant to Pump Station	
WM-3	Lakeshore Dike Labsan R. STA.1+800	58	Box culvert/Sluice appurtenant to Pump Station	
	Napindan C. STA.1+628	*	Box culvert/Sluice	
	Napindan C. STA.3+906	*	Box culvert/Sluice	
WM-4	Lakeshore Dike Taguig R. STA.7+970	91	Open channel/Sluice appurtenant to Pump Station	
	Tipas R. STA.2+010	*	Open channel/Sluice	
	Taguig R. STA.0+000	Navi.	Open channel/Sluice	
WM-5	Lakeshore Dike Bicutan R.	36	Box culvert/Sluice appurtenant to Pump Station	

NOTE: Design discharge of "*" presents that the gate size is determined from its maintenance function.

Table 7.2-4 STAFFING AND REQUIRED ACTIVITY FOR DESIGN AND CONSTRUCTION OF THE PROPOSED PROJECT

Position	Required Activity	Number of Staff
Project Manager	Management of all activities for the design and construction.	1
(Design and Construction Unit)		
Supervising Engineer	Supervision of all activities in the unit.	1
Senior Civil Engineer	Supervision of design and construction of rivers/channels, lakeshore dike, pump stations/gates and bridges.	4
Senior Mechanical/ Electrical Engineer	Supervision of the design and installment of machines, auxilliary equipment and accessories of the related facilities such as pump stations and flood gates.	2
Sub-total		7
(Administrative Unit)		
Senior Administrative Officer	Supervisor of all work in the unit.	1
Administrative Officer/Secretary	Administrative affairs, general clerical work, filing and accounting for the office.	1
Sub-total		2
Total		10

Table 7.2-5(1/2) STAFFING AND REQUIRED ACTIVITY FOR OPERATION AND MAINTENANCE OF THE PROPOSED PROJECT (PROPOSED O&M DIVISION OF DPWH-NCR)

Position	Required Activity	Number of Staff
Chief Supervising Engineer /1	Supervision of all activities for the operation and maintenance of the proposed project, including the maintenance activities in the Engineering District Office.	1
(Flood/Drainage Control Unit)		
Supervising Engineer	Supervision of all activities in this unit. Study of optimum operation method of MCGS, pump stations and gates in flood season. Formulation of the technical training program of operation and maintenance for all the staff concerned.	1
Senior Hydrologist/ Civil Engineer	Hydro-meteorological data collection and analysis and flood predicition.	1
Hydrologist/ Civil Engineer	Assistant of senior hydrologist.	1
Senior Civil Engineer	Preparation of programs for the rehabilitation and maintenance of river, channels and bridges, and buildings, etc. of pump stations, gates and MCGS.	1
Civil Engineer	Assistant of senior civil engineer.	1
Senior Mechanical/ Electrical Engineer	Preparation of programs for the rehabilitation and maintenance of machines and auxilliary equipment and accessories of the pump stations and gates.	1
Mechanical/Electrical Engineer	Assistant of mechanical/electrical engineer.	1
Senior Telecommunication Engineer	Preparation of programs for the rehabilitation and maintenance of telecommunication facilities. Supervision of usual and special maintenance activities for these facilities.	1
Telecommunication Engineer	Special inspection of telecommunication facilities installed in the O&M division, covering both external and internal inspections, including the change of parts. This is carried out monthly, annually, before the flood season, and in emergency situations when an abnormal condition has been detected during the usual inspections. Usual external inspection and operation of telecommunication facilities are carried out every day.	1
Sub-total		9
(Administrative Unit) Administrative Officer/Secretary	General clerical work and accounting for the office.	2
Total		12

/1: The staff of a private company and casual employees will be hired to perform the work of assistants such as labourer, typist, guard, driver, etc.

On the O&M of the Pasig-Marikina River, the dissemination of the control method of MCGS, pump stations, and gates, and flood forecasting, with the permission of Director of DPWH-NCR and top official of the flood control and drainage office in DPWH-NCR.

Table 7.2-5(2/2) STAFFING AND REQUIRED ACTIVITY FOR OPERATION AND MAINTENANCE OF THE PROPOSED PROJECT (ENGINEERING DISTRICT OFFICE DPWH-NCR)

Position	Required Activity	Number of Staff
(At the Site of Engineering District Office) /1		
Senior Civil Engineer	Supervision of all maintenance activities regarding the project in the district area.	1
Civil Engineer	Inspection of river, channel, such as the condition of silting, floating garbage, squatters, river wall, embankment. This is carred out weekly, before/after the flood season, and in emergency situations like a flood disaster.	2
Mechanical/Electrical Engineer	Special inspection of machines and auxiliary equipment and accessories of the pump stations and gates, including those of MCGS, covering both external and internal inspections, including the change of parts. This is carried out monthly, annually, before the flood season, and in emergency situations when an abnormal condition has been detected during the usual inspection.	1
Telecommunication Engineer	Special inspection of telecommunication facilities installed in pump stations and gates, covering both external and internal inspections, including the change of parts. This is carried out monthly, annually, before the flood season, and in emergency situations when an abnormal condition has been detected during the usual inspection.	1
Total		5
(At the Site of MCGS) /1		
Senior Mechanical/ Electrical Engineer	Supervision of all operation and maintenance activities of MCGS.	1
Mechanical/Electrical Engineer	Daily usual inspection of mechanial, electrical and telecommunication facilities and operation of gate.	2
Civil Engineer	Daily usual inspection of the structure and surrounding condition.	1
Total		4
(At the Site of Pump Station) /1		
Mechanical/Electrical Engineer	O&M activity of the pump station. Daily usual inspection of mechanical, electrical and telecommunication facilities, including surrounding condition.	2
(At the Site of Flood Gate) /1		
Mechanic/Electrician	Operation and maintenance activity of gate. Daily usual inspection of mechanical, electrical and telecommunication facilities, including surrounding condition.	1

/1: Casual employees will be contracted to execute the assistant work such as labourer, guard, driver, etc.

Table 7.2-6(1/2) COST BREAKDOWN OF THE OPTIMUM DRAINGE SYSTEM FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

1US$=132Yen=21.3Peso

Work Item	Feature	Unit	Quantity	Total (1000P)	Foreign Currency (1000P)	Local Currency (1000P)
1 Lakeshore Dike				587,652	499,105	88,547
Preparatory Works *1)		l/s	1	97,942	83,184	14,758
Earth dike w/ sheet pile	L=10,700m H=4m	cu.m	872,000	299,090	269,181	29,909
Sluice Gate		ton	240	110,880	90,922	19,958
Box culvert type	2.5m*2.9m*3no.	ton	20	9,240	7,577	1,663
Box culvert type	3.0m*4.4m*4no.	ton	40	18,480	15,154	3,326
Box culvert type	3.0m*4.7m*5no.	ton	50	23,100	18,942	4,158
Open channel type	6.5m*15.2m*2no.	ton	100	46,200	37,884	8,316
Box culvert type	3.0m*4.8m*3no.	ton	30	13,860	11,365	2,495
Maintenance bridge				79,740	55,818	23,922
Napindan channel	130m*9.1m	sq.m	1,170	23,400	16,380	7,020
Mangahan floodway	250m*9.1m	sq.m	2,250	45,000	31,500	13,500
Mangahan diversion	60m*9.1m	sq.m	540	7,560	5,292	2,268
Lower bicutan	30m*9.1m	sq.m	270	3,780	2,646	1,134
2 River Channel Works				163,396	136,865	26,531
Preparatory Works *1)		l/s	1	27,233	22,811	4,422
Napindan River				70,162	59,638	10,524
Dredging		cu.m	583,200	59,483	50,561	8,922
Parapet wall	L=2495m	cu.m	1,200	3,743	3,182	561
Embankment	L=2747m	cu.m	98,500	3,942	3,351	591
Revetment		sq.m	5,000	2,994	2,545	449
Buli River	L=1600m			8,520	6,090	2,430
Embankment		cu.m	14,700	840	714	126
Re-con bridge	2 bridges	sq.m	960	7,680	5,376	2,304
Baho River	L=1800m			587	499	88
Embankment		cu.m	14,700	587	499	88
Mahaba River	L=2400m			4,138	2,985	1,154
Embankment		cu.m	14,600	586	498	88
Re-con bridge	2 bridges	sq.m	444	3,552	2,486	1,066
Mangahan Diversion	L=3900m			50,828	43,204	7,624
Excavation		cu.m	723,900	49,327	41,928	7,399
Embankment		cu.m	37,500	1,501	1,276	225
Lower Bicutan River	L=800m			1,928	1,639	289
Dredging		cu.m	4,000	276	235	41
Embankment		cu.m	41,300	1,652	1,404	248

- CONTINUED -

Table 7.2-6(2/2) COST BREAKDOWN OF THE OPTIMUM DRAINGE SYSTEM FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

1US$=132Yen=21.3Peso

Work Item	Feature	Unit	Quantity	Total (1000P)	Foreign Currency (1000P)	Local Currency (1000P)
3 Drainage System				1,280,678	1,142,491	138,187
Preparatory Works *1)		l/s	1	213,446	190,415	23,031
Regulaton Pond	6sites	cu.m	693,000	95,600	78,392	17,208
Channel Works				219,100	178,545	40,555
Drainage channel impvt.	L=35200m	l/s	1	65,300	55,505	9,795
Const. of open channel	L=18300m	l/s	1	131,100	104,880	26,220
Const. of closed channel	L=1450m	l/s	1	22,700	18,160	4,540
Sluice Gate	9sites	ton	186	85,932	70,464	15,468
Box culvert type	2.5m*4.2m*3no.	ton	24	11,088	9,092	1,996
Box culvert type	2.5m*4.4m*3no.	ton	25	11,550	9,471	2,079
Box culvert type	2.5m*3.8m*2no.	ton	15	6,930	5,683	1,247
Open channel type	5.6m*13.m*2no.	ton	90	41,580	34,096	7,484
Open channel type	2.0m*2.0m	ton	3	1,386	1,137	249
Box culvert type	2.0m*2.0m	ton	3	1,386	1,137	249
Box culvert type	2.0m*2.0m	ton	3	1,386	1,137	249
Open channel type	2.0m*2.0m	ton	3	1,386	1,137	249
Open channel type	4.7m*10.m	ton	20	9,240	7,577	1,663
Pump Station	9sites	cu.ms	111	609,300	578,835	30,465
		cu.ms	8	44,800	42,560	2,240
		cu.ms	8	44,800	42,560	2,240
		cu.ms	5	28,000	26,600	1,400
		cu.ms	2	26,000	24,700	1,300
		cu.ms	32	150,400	142,880	7,520
		cu.ms	7	39,200	37,240	1,960
		cu.ms	14	78,400	74,480	3,920
		cu.ms	31	145,700	138,415	7,285
		cu.ms	4	52,000	49,400	2,600
Lateral		m	114,500	57,300	45,840	11,460
Sub-Total(1+2+3)				2,031,726	1,778,461	253,265
4 Administration *2)		l/s	1	101,586	0	101,586
5 Engineering Services		l/s	1	102,240	92,016	10,224
6 Physical Contingency *3)		l/s	1	223,555	187,048	36,508
7 Land Acquisition & Compensation		ha	91	185,434	0	185,434
Total(1+2+3+4+5+6+7)				2,644,542	2,057,524	587,017
8 Price Contingency *4)				167,013	0	167,013
9 Grand total				2,811,555	2,057,524	754,030

Notes:
1);20% of main civil works
2); 5% of main civil works(1+2+3)
3);10% of (1+2+3+4+5)
4); 0% for foreign currency and 6% for local currency

Table 7.2-7 DISBURSEMENT SCHEDULE FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

UNIT : THOUSAND US$

	WORK ITEM	TOTAL			1991		1992		1993		1994	
		TOTAL	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1.	PREPARATORY WORKS	15,898	13,916	1,982	4,976	900	8,940	1,081	0	0	0	0
2.	CONSTRUCTION WORKS	79,488	69,580	9,908	4,882	866	21,566	3,014	21,566	3,014	21,566	3,014
	2.1 LAKESHORE DIKE	22,991	19,527	3,464	4,882	866	4,882	866	4,882	866	4,882	866
	2.2 RIVER CHANNEL WORKS	6,392	5,355	1,037	0	0	1,785	346	1,785	346	1,785	346
	2.3 DRAINAGE SYSTEM	50,105	44,698	5,407	0	0	14,899	1,802	14,899	1,802	14,899	1,802
	TOTAL OF 1.+2.	95,386	83,496	11,890	9,858	1,766	30,506	4,095	21,566	3,014	21,566	3,014
3.	ADMINISTRATION	4,769	0	4,769	0	581	0	1,730	0	1,229	0	1,229
4.	ENGINEERING SERVICES	4,800	4,320	480	1,080	120	1,080	120	1,080	120	1,080	120
	TOTAL OF 1. TO 4.	104,955	87,816	17,139	10,938	2,467	31,586	5,945	22,646	4,363	22,646	4,363
5.	PHYSICAL CONTINGENCY (10% of the above total)	10,496	8,782	1,714	1,094	247	3,159	595	2,265	436	2,265	436
6.	LAND ACQUISISTION & COMPENSATION	8,706	0	8,706	0	4,353	0	4,353	0	0	0	0
	TOTAL OF 1. TO 6.	124,157	96,598	27,559	12,032	7,067	34,744	10,893	24,911	4,799	24,911	4,799
7.	PRICE CONTINGENCY (F.C.:0% L.C.:6%)	7,841	0	7,841	0	1,350	0	2,859	0	1,623	0	2,009
	GRAND TOTAL	131,997	96,598	35,400	12,032	8,417	34,744	13,752	24,911	6,423	24,911	6,808

NOTE : Figures may not add up to totals due to rounding.
Currency conversion rates are 1.00 US$ = 132 Yen = 21.30 Peso.

Table 7.2-8 INUNDATION WATER LEVEL WITH AND WITHOUT PROJECT
FOR EAST AND WEST OF MANGAHAN

Name of Sub-drainage Area	W/ or W/O Project	Maximum Inundation Water Level (E.L.m) 2-Yr. Return Period	3-Yr. Return Period	5-Yr. Return Period	10-Yr. Return Period	30-Yr. Return Period	50-Yr. Return Period	100-Yr. Return Period
EAST OF MANGAHAN								
EM-1	W/O	13.40	13.52	13.68	14.02	14.32	14.48	14.56
	W/	-	-	-	13.23	13.29	14.48	14.56
EM-2	W/O	12.78	13.00	13.12	13.39	13.65	13.86	14.08
	W/	-	-	-	12.73	12.79	13.86	14.08
EM-3	W/O	12.80	13.01	13.16	13.25	13.65	13.86	14.08
	W/	-	-	-	12.73	12.78	13.86	14.08
EM-4	W/O	12.40	12.57	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	12.26	12.38	13.86	14.08
WEST OF MANGAHAN								
WM-1	W/O	12.55	12.60	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	12.24	12.31	13.86	14.08
WM-2	W/O	12.15	12.50	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	11.79	12.00	13.86	14.08
WM-3	W/O	12.15	12.50	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	11.77	11.92	13.86	14.08
WM-4	W/O	12.35	12.50	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	12.00	12.08	13.86	14.08
WM-5	W/O	12.15	12.50	12.85	13.22	13.65	13.86	14.08
	W/	-	-	-	11.96	12.06	13.86	14.08

Table 7.2-9 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

Unit: million peso

FLOOD RETURN PERIOD	FLOOD DAMAGE W/O PROJECT	FLOOD DAMAGE W/ PROJECT	REDUCTION	AVERAGE	EXPECTATION	BENEFIT
				167.1	0.50000	83.6
2-yr.	334.2	0.0	334.2			
				424.3	0.16667	70.7
3-yr.	514.4	0.0	514.4			
				687.0	0.13333	91.6
5-yr.	859.5	0.0	859.5			
				959.3	0.10000	95.9
10-yr.	1,214.4	155.3	1,059.1			
				1,194.2	0.06667	79.6
30-yr.	1,528.4	199.2	1,329.2			
				664.6	0.01333	8.9
50-yr.	1,633.6	1,633.6	0.0			
				0.0	0.01000	0.0
100-yr.	1,734.1	1,734.1	0.0			
					TOTAL	430.3

Table 7.2-10 ANNUAL CASH FLOW FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

Unit : Million Peso

NO.	YEAR	ECONOMIC COST				ANNUAL AVERAGE BENEFIT	ANNUAL CASH FLOW
		CONSTRUC-TION	LAND ACQUISITION	OMR	TOTAL		
1	1991	282.7	92.7		375.4	0.0	(375.4)
2	1992	791.4	92.7		884.1	107.6	(776.5)
3	1993	569.5			569.5	215.1	(354.4)
4	1994	569.5			569.5	322.7	(246.8)
5	1995			39.1	39.1	430.3	391.2
6	1996			39.1	39.1	430.3	391.2
7	1997			39.1	39.1	430.3	391.2
8	1998			39.1	39.1	430.3	391.2
9	1999			39.1	39.1	430.3	391.2
10	2000			39.1	39.1	430.3	391.2
11	2001			39.1	39.1	430.3	391.2
12	2002			39.1	39.1	430.3	391.2
13	2003			39.1	39.1	430.3	391.2
14	2004			39.1	39.1	430.3	391.2
15	2005			39.1	39.1	430.3	391.2
16	2006			39.1	39.1	430.3	391.2
17	2007			39.1	39.1	430.3	391.2
18	2008			39.1	39.1	430.3	391.2
19	2009			39.1	39.1	430.3	391.2
20	2010			39.1	39.1	430.3	391.2
21	2011			39.1	39.1	430.3	391.2
22	2012			39.1	39.1	430.3	391.2
23	2013			39.1	39.1	430.3	391.2
24	2014			39.1	39.1	430.3	391.2
25	2015			39.1	39.1	430.3	391.2
26	2016			39.1	39.1	430.3	391.2
27	2017			39.1	39.1	430.3	391.2
28	2018			39.1	39.1	430.3	391.2
29	2019			39.1	39.1	430.3	391.2
30	2020			39.1	39.1	430.3	391.2
31	2021			39.1	39.1	430.3	391.2
32	2022			39.1	39.1	430.3	391.2
33	2023			39.1	39.1	430.3	391.2
34	2024			39.1	39.1	430.3	391.2
35	2025			39.1	39.1	430.3	391.2
36	2026			39.1	39.1	430.3	391.2
37	2027			39.1	39.1	430.3	391.2
38	2028			39.1	39.1	430.3	391.2
39	2029			39.1	39.1	430.3	391.2
40	2030			39.1	39.1	430.3	391.2

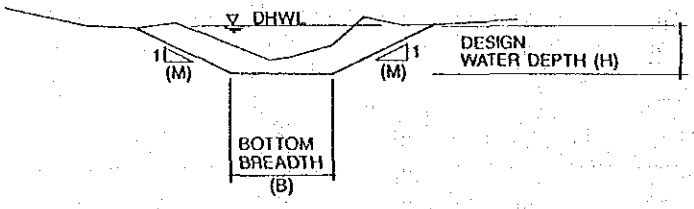
IRR	=	16.81%
B/C	=	1.11
NPV	=	193.58

Table 7.3-1 COST BREAKDOWN OF ALTERNATIVE CASES FOR DRAINAGE SYSTEM IN SOUTH OF MALABON RIVER

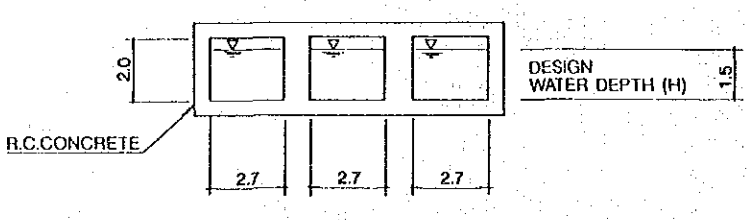
ITEM	UNIT	ALTERNATIVE CASE 1		ALTERNATIVE CASE 2		ALTERNATIVE CASE 3	
		QUANTITY	COST (MIL.PESO)	QUANTITY	COST (MIL.PESO)	QUANTITY	COST (MIL.PESO)
1 Main Civil Works			212		265		417
Dike	m	13,200	62	9,800	52	4,700	36
Embankment w/ Revetment	m	3,600	13	3,600	13	3,600	13
Embankment w/o Revetment	m	0	0	0	0	0	0
Parapet Wall	m	8,500	26	5,100	16	0	0
Coastal Dike	m	1,100	23	1,100	23	1,100	23
Drainage Channel Impvt.	m	2,400	6	1,600	2	1,600	2
Gate	site	5		5		4	
	ton	64	29	99	45	158	73
Pump Station	site	3		3		2	
	cu.ms	12	114	20	166	30	306
2 Preparatory Works & Others	l/s	1	124	1	155	1	243
3 Land Acquisition & Compensation	ha	9	63	8	42	7	29
Sub-Total(1+2+3)			398		462		689
4 Operation, Maintenance & Replacement Cost	l/s	1	24	1	34	1	62
Total			423		497		751

Table 7.3-2 FEATURES OF PROPOSED DRAINAGE CHANNEL FOR MALABON-NAVOTAS

Sub-D.Area	Drainage Area (ha)	Design Discharge (m3/s)	Channel Gradient (1/I)	Roghness Co-efficient	Length Const. (m)	Length Impvt. (m)	Bottom Breadth (B:m)	Design W.Depth (H:m)	Type	Side Slope (M)	Remarks
MA-1-A	53.0	13	1500	0.030		600	4.0	2.0	Trape.	2.0	Panghulo
	60.0	13	1500	0.030	1,000		4.0	2.0	Trape.	2.0	
S-total	113.0				1,000	600					
MA-6	64.0	25	2000	0.030		300	10.0	2.0	Trape.	2.0	Catmon
	70.0	25	2000	0.030		400	15.0	1.6	Trape.	2.0	Catmon
	34.0	7	5000	0.030	400		6.5	1.5	Trape.	2.0	
	34.0	7	5000	0.030	500		6.5	1.5	Trape.	2.0	
S-total	202.0				900	700					
MA-11	69.0	12	5000	0.015	800		8.1	1.5	B.Culvert	0.0	B=2.7m*3units
S-total	69.0				800						
Total	384.0				2,700	1,300					

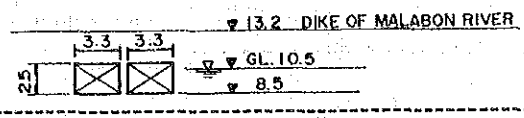
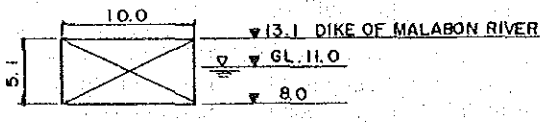
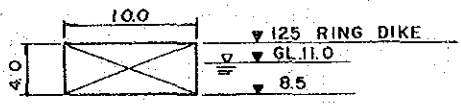
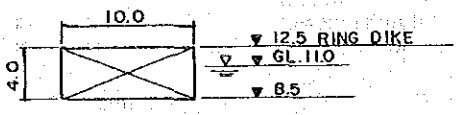
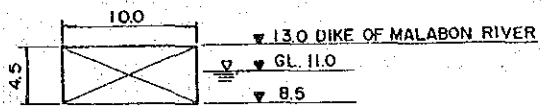
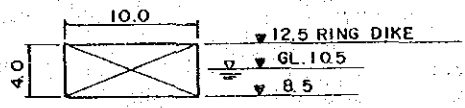
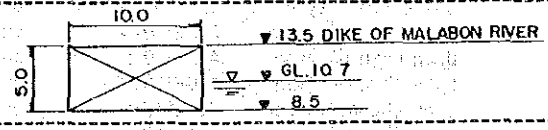
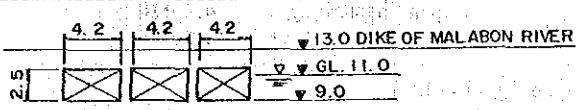
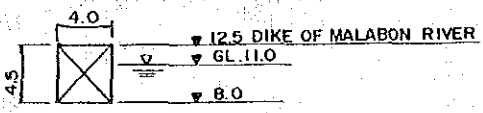
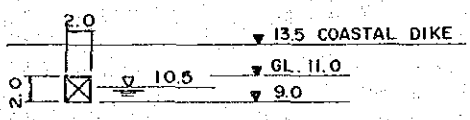
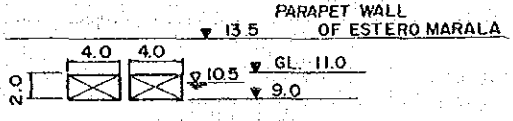
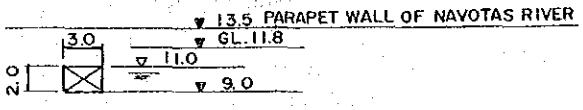


TYPICAL CROSS SECTION OF TRAPEZOIDAL CHANNEL



TYPICAL CROSS SECTION OF CLOSED CHANNEL
(THREE UNITS BOX CULVERT)

Table 7.3-3 FEATURES OF PROPOSED SLUICE GATE FOR MALABON-NAVOTAS

DRAINAGE AREA	LOCATION	DESIGN DISCHARGE (M3/S)	TYPE	CROSS SECTION
MA-1-A	Saltolan R. STA.0+000	13	Box culvert/Sluice appurtenant to Pump Station	
MA-1-B	Pinagkabalian STA.0+000	Navi.	*Open channel/Sluice* appurtenant to Pump Station	
	Pinagkabalian STA.2+200	Navi.	Open channel/Sluice	
MA-2-B	Dampalit R. STA.5+400	Navi.	Open channel/Sluice	
	Dampalit R. STA.0+000	Navi.	Open channel/Sluice	
MA-3	Dampalit R. STA.2+200	Navi.	Open channel/Sluice	
MA-5	Navotas R. STA.2+865	Navi.	Open channel/Sluice	
MA-6	Catmon Creek STA.0+000	25	Box culvert/Sluice appurtenant to Pump Station	
	Longos Creek STA.0+000	*	Box culvert/Sluice	
MA-9	Coastal Dike	2	Box culvert/Sluice appurtenant to Pump Station	
MA-11	Estero Marala STA.0+950	12	Box culvert/Sluice appurtenant to Pump Station	
	Dagat Dagatan Navotas R. STA.2+250	*	Box culvert/Sluice	

NOTE: Design discharge of "*" presents that the gate size is determined from its maintenance function.
Design discharge of "Navi." presents that the gate size is determined considering navigatin of vessels.

Table 7.3-4(1/2) COST BREAKDOWN OF THE OPTIMUM DRAINAGE SYSTEM FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROJECT

1US$=132Yen=21.3Peso

Work Item	Feature	Unit	Quantity	Total (1000P)	Foreign Currency (1000P)	Local Currency (1000P)
1 North of Malabon River				340,714	296,995	43,719
Preparatory Works *1)		l/s	1	56,786	49,499	7,286
Ring Dike		m	15,900	27,918	23,730	4,188
Coastal Dike(w/ revetment)	EL.13.5m/H=2.5m	m	5,700			
River Dike(w/ revetment)	Raising H=1m	m	3,500			
Ring Dike(w/o revetment)	Raising H=1m	m	6,700			
Embankment		cu.m	184,500	7,380	6,273	1,107
Revetment		sq.m	34,200	20,538	17,457	3,081
Channel Works			1,600	7,952		
Drainage channel impvt.		m	600	852	724	128
Const. of open channel		m	1,000	7,100	5,680	1,420
Lateral		m	31,200	15,600	12,480	3,120
Pump	3sites	cu.ms	25	159,000	151,050	7,950
		cu.ms	2	26,000	24,700	1,300
		cu.ms	3	39,000	37,050	1,950
		cu.ms	20	94,000	89,300	4,700
Sluice Gate	7sites	ton	159	73,458	60,236	13,222
Box culvert type	2.5m*3.3m*2no.	ton	14	6,468	5,304	1,164
Open channel type	5.1m*10.m	ton	30	13,860	11,365	2,495
Open channel type	4.0m*10.m	ton	20	9,240	7,577	1,663
Open channel type	4.0m*10.m	ton	20	9,240	7,577	1,663
Open channel type	4.5m*10.m	ton	25	11,550	9,471	2,079
Open channel type	4.0m*10.m	ton	20	9,240	7,577	1,663
Open channel type	5.0m*10.m	ton	30	13,860	11,365	2,495
2 Navigation Lock				98,650	83,374	15,276
Preparatory Works *1)		l/s	1	16,442	13,896	2,546
Excavation		cu.m	9,000	495	421	74
Backfill		cu.m	250,000	10,000	8,500	1,500
Riprap		sq.m	900	90	77	14
RC-pile		m	3,950	1,185	1,007	178
Revetment		sq.m	3,800	2,280	1,938	342
Mass concrete		cu.m	340	510	434	77
Reinforced concrete		cu.m	9,800	39,200	33,320	5,880
Steel sheet pile		sq.m	1,000	3,500	3,325	175
Gate		ton	180	24,948	20,457	4,491

- CONTINUED -

Table 7.3-4(2/2) COST BREAKDOWN OF THE OPTIMUM DRAINAGE SYSTEM FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROJECT

1US$=132Yen=21.3Peso

Work Item	Feature	Unit	Quantity	Total (1000P)	Foreign Currency (1000P)	Local Currency (1000P)
3 South of Malabon River				283,950	235,916	48,034
Preparatory Works *1)		l/s	1	47,325	39,319	8,006
Ring Dike		m	13,200	61,506	49,900	11,606
Coastal Dike(w/ revetment)	EL.13.5m/H=2.5m	m	1,100			
River Dike(w/ revetment)	Raising H=1m	m	3,600			
Parapet Wall,reinforced conc.		m	8,500			
Embankment		cu.m	133,200	5,328	4,529	799
Revetment		sq.m	14,300	8,578	7,291	
Reinforced concrete		cu.m	11,900	47,600	38,080	1,287
Channel Works		m	2,400	16,759		
Drainage channel impvt.		m	700	1,274	1,083	191
Const. of open channel		m	900	5,085	4,068	1,017
Const. of closed channel		m	800	10,400	8,320	2,080
Lateral		m	5,900	2,950	2,360	590
Pump	3sites	cu.ms	10	130,000	123,500	6,500
		cu.ms	4	52,000	49,400	2,600
		cu.ms	2	26,000	24,700	1,300
		cu.ms	4	52,000	49,400	2,600
Sluice Gate	5sites	ton	55	25,410	20,836	4,574
Box culvert type	2.5m*4.2m*3no.	ton	24	11,088	9,092	
Box culvert type	4.5m*4.0m	ton	12	5,544	4,546	
Box culvert type	2.0m*2.0m	ton	3	1,386	1,137	
Box culvert type	2.0m*4.0m*2no.	ton	12	5,544	4,546	
Box culvert type	2.0m*3.0m	ton	4	1,848	1,515	
Sub-Total(1+2+3)				723,313	616,285	107,029
4 Administration *2)		l/s	1	36,166	0	36,166
5 Engineering Services		l/s	1	85,200	76,680	8,520
6 Physical Contingency *3)		l/s	1	84,468	69,296	15,171
7 Land Acquisition & Compensation		ha	28	109,200	0	109,200
Total(1+2+3+4+5+6+7)				1,038,347	762,261	276,086
8 Price Contingency *4)				76,936	0	76,936
9 Grand Total				1,115,282	762,261	353,021

Notes:
1);20% of main civil works
2); 5% of main civil works(1+2+3)
3);10% of (1+2+3+4+5)
4); 0% for foreign currency and 6% for local currency

Table 7.3-5 DISBURSEMENT SCHEDULE FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROJECT

UNIT : THOUSAND US$

	WORK ITEM	TOTAL			1991		1992		1993		1994	
		TOTAL	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1.	PREPARATORY WORKS	5,660	4,822	838	930	137	3,196	598	697	103	0	0
2.	CONSTRUCTION WORKS	28,298	24,111	4,187	2,905	428	7,069	1,253	7,069	1,253	7,069	1,253
	2.1 NORTH OF MALABON RIVER	13,330	11,619	1,711	2,905	428	2,905	428	2,905	428	2,905	428
	2.2 NAVIGATION LOCK	3,859	3,262	597	0	0	1,087	199	1,087	199	1,087	199
	2.3 SOUTH OF MALABON RIVER	11,109	9,230	1,879	0	0	3,077	626	3,077	626	3,077	626
	TOTAL OF 1.+2.	33,958	28,933	5,025	3,834	565	10,264	1,851	7,766	1,356	7,069	1,253
3.	ADMINISTRATION	1,698	0	1,698	0	220	0	606	0	456	0	416
4.	ENGINEERING SERVICES	4,000	3,600	400	900	100	900	100	900	100	900	100
	TOTAL OF 1. TO 4.	39,656	32,533	7,123	4,734	885	11,164	2,557	8,666	1,912	7,969	1,769
5.	PHYSICAL CONTINGENCY (10% of the above total)	3,966	3,253	712	473	88	1,116	256	867	191	797	177
6.	LAND ACQUISISTION & COMPENSATION	5,127	0	5,127	0	2,564	0	2,564	0	0	0	0
	TOTAL OF 1. TO 6.	48,748	35,786	12,962	5,208	3,537	12,281	5,376	9,532	2,103	8,766	1,946
7.	PRICE CONTINGENCY (F.C.:0% L.C.:6%)	3,612	0	3,612	0	676	0	1,411	0	711	0	814
	GRAND TOTAL	52,360	35,787	16,574	5,208	4,212	12,281	6,787	9,532	2,814	8,766	2,761

NOTE : Figures may not add up to totals due to rounding.
Currency conversion rates are 1.00 US$ = 132 Yen = 21.30 Peso.

Table 7.3-6 INUNDATION WATER LEVEL WITH AND WITHOUT PROJECT FOR MALABON - NAVOTAS

Name of Sub-drainage Area	W/ or W/O Project	Maximum Inundation Water Level (E.L.m) 2-Yr. Return Period	3-Yr. Return Period	5-Yr. Return Period	10-Yr. Return Period	30-Yr. Return Period	50-Yr. Return Period	100-Yr. Return Period
MA-1	W/O	10.77	10.82	10.88	10.98	11.05	11.07	11.11
	W/	-	-	-	10.74	10.84	10.90	10.97
MA-2	W/O	10.73	10.77	10.83	10.92	11.03	11.07	11.11
	W/	-	-	-	10.77	10.87	10.92	10.99
MA-3	W/O	11.04	11.08	11.13	11.21	11.33	11.39	11.47
	W/	-	-	-	10.82	10.91	10.97	11.03
MA-4	W/O	11.05	11.08	11.12	11.19	11.28	11.34	11.41
	W/	-	-	-	10.82	10.91	10.97	11.03
MA-5	W/O	11.14	11.20	11.28	11.41	11.56	11.63	11.71
	W/	-	-	-	10.82	10.91	10.97	11.03
MA-6	W/O	10.99	11.02	11.05	11.11	11.23	11.25	11.31
	W/	-	-	-	10.92	10.98	11.02	11.05
MA-9	W/O	11.29	11.32	11.37	11.45	11.56	11.60	11.67
	W/	-	-	-	11.21	11.23	11.24	11.26
MA-11	W/O	11.11	11.17	11.24	11.37	11.53	11.59	11.66
	W/	-	-	-	10.92	10.95	10.97	11.00

Table 7.3-7 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROJECT

Unit: million peso

FLOOD RETURN PERIOD	FLOOD DAMAGE W/O PROJECT	FLOOD DAMAGE W/ PROJECT	REDUCTION	AVERAGE	EXPECTATION	BENEFIT
				99.2	0.50000	49.6
2-yr.	198.4	0.0	198.4			
				209.7	0.16667	35.0
3-yr.	221.1	0.0	221.1			
				235.3	0.13333	31.4
5-yr.	249.5	0.0	249.5			
				224.4	0.10000	22.4
10-yr.	283.8	84.5	199.3			
				219.8	0.06667	14.7
30-yr.	371.3	131.0	240.3			
				235.5	0.01333	3.1
50-yr.	391.0	160.4	230.6			
				236.1	0.01000	2.4
100-yr.	428.8	187.3	241.5			
					TOTAL	158.5

Table 7.3-8 ANNUAL CASH FLOW FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROEJCT

Unit : Million Peso

NO.	YEAR	ECONOMIC COST				ANNUAL AVERAGE BENEFIT	ANNUAL CASH FLOW
		CONSTRUC-TION	LAND ACQUISITION	OMR	TOTAL		
1	1991	118.5	54.6		173.1		(173)
2	1992	289.3	54.6		343.9	39.6	(304)
3	1993	223.1			223.1	79.3	(144)
4	1994	205.3			205.3	118.9	(86)
5	1995			9.7	9.7	158.5	149
6	1996			9.7	9.7	158.5	149
7	1997			9.7	9.7	158.5	149
8	1998			9.7	9.7	158.5	149
9	1999			9.7	9.7	158.5	149
10	2000			9.7	9.7	158.5	149
11	2001			9.7	9.7	158.5	149
12	2002			9.7	9.7	158.5	149
13	2003			9.7	9.7	158.5	149
14	2004			9.7	9.7	158.5	149
15	2005			9.7	9.7	158.5	149
16	2006			9.7	9.7	158.5	149
17	2007			9.7	9.7	158.5	149
18	2008			9.7	9.7	158.5	149
19	2009			9.7	9.7	158.5	149
20	2010			9.7	9.7	158.5	149
21	2011			9.7	9.7	158.5	149
22	2012			9.7	9.7	158.5	149
23	2013			9.7	9.7	158.5	149
24	2014			9.7	9.7	158.5	149
25	2015			9.7	9.7	158.5	149
26	2016			9.7	9.7	158.5	149
27	2017			9.7	9.7	158.5	149
28	2018			9.7	9.7	158.5	149
29	2019			9.7	9.7	158.5	149
30	2020			9.7	9.7	158.5	149
31	2021			9.7	9.7	158.5	149
32	2022			9.7	9.7	158.5	149
33	2023			9.7	9.7	158.5	149
34	2024			9.7	9.7	158.5	149
35	2025			9.7	9.7	158.5	149
36	2026			9.7	9.7	158.5	149
37	2027			9.7	9.7	158.5	149
38	2028			9.7	9.7	158.5	149
39	2029			9.7	9.7	158.5	149
40	2030			9.7	9.7	158.5	149
					IRR =	15.90%	
					B/C =	1.05	
					NPV =	38.87	

Table 7.4-1(1/3) CONDITION OF LAND SIDE AREA UTILIZATION AND TOPOGRAPHY
(AT THE LOW BANK ELEVATION SECTIONS)

Station No.		Existing Elevation		Designed Elevation			Condition of Land Side	
		(1) Bank (m)	(2) Ground (m)	(3) H.W.L. (m)	(4) Wall (m)	(5) 4-1 (m)	Utilization	Topography
No. 5+005	R	10.90	11.20	12.07	13.07	2.17	Office compound (Min. of Budget)	Flat land
	L	11.50	11.50	12.07	13.07	1.57	Factory compound	Flat land
No. 5+195	R	11.50	11.80	12.08	13.08	1.58	Hospital compound	Flat land
	L	12.20	12.50		13.08	0.88	Factory compound	Flat land
No. 5+395	R	11.70	12.10	12.09	13.09	1.39	Hospital compound	Flat land
	L	12.10	12.20		13.09	0.99	Factory compound	Flat land
No. 5+605	R	12.30	11.90	12.28	13.28	0.98	Malacanang Palace	Flat land
	L	12.10	12.30	12.28	13.28	1.18	Sante Banez Flood Gate	Flat land
No. 6+195	R	11.90	11.80	12.46	13.46	1.56	Malacanang Palace	Flat land
	L	12.70	12.30	12.46	13.46	0.76	Malacanang Park (Open space)	Flat land
No. 6+360	R	11.90	11.90	12.50	13.50	1.60	Malacanang Adm. Office	Flat land
	L	12.90	12.50	12.50	13.50	0.60	Malacanang Park (Open space)	Flat land
No. 6+480	R	11.50	11.50	12.54	13.54	2.04	Aviles Pump. Station (Residential area)	Flood land
	L	12.00	12.10	12.54	13.54	1.54	Malacanang Park (Open space)	Flood land
No. 6+650	R	13.00	11.40	12.58	13.58	0.58	Factory compound	Flat land
	L	13.00	13.80	12.58	13.58	0.58	Malacanang Park (Open space)	Flat land
No. 6+790	R	13.20	13.90	12.63	13.63	0.43	Factory compound	Flat land
	L	12.20	12.40	12.63	13.63	1.43	Office compound (City Engineer's Offic	Flat land
No. 6+895	R	12.90	13.70	12.67	13.67	0.77	Factory compound	Flat land
	L	12.60	12.60	12.67	13.67	1.07	Office compound (Open space)	Flat land
No. 7+095	R	12.50	12.90	12.72	13.72	1.22	- Unknown -	Flat land
	L	12.50	12.40	12.72	13.72	1.22	Factory compound (PNOC)	Flat land
No. 7+295	R	12.30	13.00	12.76	13.76	1.46	- Unknown -	Flat land
	L	12.70	12.50	12.76	13.76	1.06	Factory compound	Flat land
No. 7+470	R	13.00	13.80	12.83	13.83	0.83	PUP compound	Flat land
	L	12.40	12.40	12.83	13.83	1.43	Factory (Philippine Shell) compound	Flat land

Table 7.4-1(2/3) CONDITION OF LAND SIDE AREA UTILIZATION AND TOPOGRAPHY
(AT THE LOW BANK ELEVATION SECTIONS)

Station No.		Existing Elevation (1) Bank (m)	(2) Ground (m)	Designed Elevation (3) H.W.L. (m)	(4) Wall (m)	(5) 4-1 (m)	Condition of Land Side Utilization	Topography
No. 7+615	R	12.60	13.20	12.90	13.90	1.30	PUP compound	Flat land
	L	11.70	11.80	12.90	13.90	2.20	Factory (Philippine Shell) compound	Flat land
No. 7+845	R	12.20	13.00	12.97	13.97	1.77	Petron Terminal	Flat land
	L	13.00	12.40	12.97	13.97	0.97	Factory compound	Flat land
No. 8+910	R	12.10	12.70	13.21	14.21	2.11	Housing area	Hilly land
	L	13.20	13.20	13.21	14.21	1.01	Petron Terminal	Flat land
No. 9+075	R	12.00	12.70	13.23	14.23	2.23	Housing area	Flat land
	L	13.20	13.40	13.23	14.23	1.03	Petron Terminal	Flat land
No. 9+225	R	12.00	12.70	13.24	14.24	2.24	Housing area	Flat land
	L	13.00	13.40	13.24	14.24	1.24	Factory compound	Flat land
No. 9+475	R	12.40	13.00	13.25	14.25	1.85	Factory compound	Flat land
	L	12.60	13.40	13.25	14.25	1.65	Factory compound	Flat land
No. 9+695	R	13.20	12.50	13.27	14.27	1.07	Factory compound (Marcere Steel)	Flat land
	L	13.40	13.30	13.27	14.27	0.87	Housing area	Flat land
No. 10+495	R	13.80	13.80	13.33	14.33	0.53	Housing area	Flat land
	L	12.90	12.30	13.33	14.33	2.03	Market area (Sta Ana Market)	Flat land
No. 10+745	R	12.80	13.80	13.35	14.35	1.55	Housing area	Flat land
	L	11.80	11.80	13.35	14.35	2.55	Housing area	Flat land
No. 10+965	R	13.00	13.30	13.36	14.46	1.46	Factory compound (Phimco Industry)	Flat land
	L	13.90	13.90	13.36	14.46	0.56	Housing area	Flat land
No. 11+165	R	11.60	12.30	13.38	14.38	2.78	High school compound	Flat land
	L	12.90	12.90	13.38	14.38	1.48	Housing area	Flat land
No. 15+095	R	14.20	14.30	13.66	14.66	0.46	Factory compound	Hilly land
	L	13.10	13.70	13.66	14.66	1.56	Factory compound (Colgate)	Hilly land
No. 15+295	R	14.20	14.20	13.67	14.67	0.47	Congested housing area	Hilly land
	L	13.10	13.90	13.67	14.67	1.57	Congested housing area	Hilly land

Table 7.4-1(3/3) CONDITION OF LAND SIDE AREA UTILIZATION AND TOPOGRAPHY
(AT THE LOW BANK ELEVATION SECTIONS)

Station No.		Existing Elevation (1) Bank (m)	(2) Ground (m)	Designed Elevation (3) H.W.L. (m)	(4) Wall (m)	(5) 4-1 (m)	Condition of Land Side Utilization	Topography
No. 15+495	R	14.40	15.10	13.68	14.68	0.28	Congested housing area	Hilly land
	L	12.30	13.70	13.68	14.68	2.38	Factory compound	Hilly land
No. 0+590	R	12.70	12.70	13.94	14.94	2.24	Factory compound	Hilly land
	L	12.90	13.40	13.94	14.94	2.04	Congested housing area	Flat land
No. 0+780	R	13.10	13.10	13.95	14.95	1.85	Open space	Hilly land
	L	13.20	13.10	13.95	14.95	1.75	Office compound (Pasig Manpower)	Flat land
No. 0+980	R	12.10	12.30	13.96	14.95	2.85	Factory compound	Hilly land
	L	13.20	13.10	13.96	14.95	1.75	Housing area	Flat land
No. 1+180	R	12.50	12.50	13.97	14.97	2.47	Housing area	Hilly land
	L	15.70	15.60	13.97	14.97	-	Housing area	Flat land
No. 2+145	R	15.80	15.70	14.02	15.02	-	Factory compound	Hilly land
	L	12.30	12.50	14.02	15.02	2.72	Factory compound	Flat land
No. 2+320	R	15.00	15.30	14.03	15.03	0.03	Open space	Hilly land
	L	13.40	13.40	14.03	15.03	1.63	Factory compound	Flat land
No. 2+510	R	13.00	13.00	14.04	15.04	2.04	Factory compound	Hilly land
	L	14.10	14.10	14.04	15.04	0.94	Housing area	Flat land
No. 2+710	R	14.70	14.80	14.05	15.05	0.35	Housing area	Hilly land
	L	15.40	15.40	14.05	15.05	-	Housing area	Flat land
No. 2+910	R	12.70	13.20	14.07	15.07	2.37	Housing area	Hilly land
	L	14.30	14.40	14.07	15.07	0.77	Housing area	Flat land
No. 3+100	R	13.00	13.10	14.08	15.08	2.08	Housing area	Hilly land
	L	15.00	15.00	14.08	15.08	0.08	Housing area	Flat land
No. 4+080	R	14.00	14.20	14.13	13.13	-	Open space	Hilly land
	L	12.40	12.30	14.13	13.13	0.73	Housing area	Flat land
No. 4+280	R	16.50	13.50	14.14	15.14	-	Housing area	Hilly land
	L	16.50	12.70	14.14	15.14	-	Housing area	Flat land
No. 4+470	R	12.00	12.00	14.15	15.15	3.15	Factory compound	Hilly land
	L	16.10	16.20	14.15	15.15	-	Factory compound	Flat land

Table 7.4-2 COST BREAKDOWN OF THE OPTIMUM PLAN FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

1US$=132Yen=21.3Peso

Work Item	Feature	Unit	Quantity	Total (1000P)	Foreign Currency (1000P)	Local Currency (1000P)
1 River Improvement				718,313	611,645	106,668
River Mouth/San Juan C.	L=8735m			494,093	418,307	75,786
Preparatory Works		l/s	1	117,679	99,629	18,050
Excavation		cu.m	2,334,000	305,754	259,891	45,863
Parapet wall/River wall		cu.m	3,000	9,000	7,650	1,350
Revetment		sq.m	40,000	24,000	20,400	3,600
Steel sheet		sq.m	5,000	17,500	16,625	875
Reconst. Pandacan bridge	L=140m	sq.m	840	20,160	14,112	6,048
San Juan C./Napindan C.	L=9760m			159,750	137,259	22,491
Preparatory Works		l/s	1	45,750	39,309	6,441
Excavation		cu.m	300,000	37,500	31,875	5,625
Parapet wall/River wall		cu.m	10,000	30,000	25,500	4,500
Revetment		sq.m	60,000	36,000	30,600	5,400
Steel sheet		sq.m	3,000	10,500	9,975	525
Napindan C./M.C.G.S.	L=5580m			28,170	24,385	3,785
Preparatory Works		l/s	1	5,770	4,995	775
Excavation		cu.m	100,000	9,500	8,075	1,425
Embankment		cu.m	10,000	400	340	60
Parapet wall/River wall		cu.m	1,000	3,000	2,550	450
Revetment		sq.m	10,000	6,000	5,100	900
Steel sheet		sq.m	1,000	3,500	3,325	175
M.C.G.S. /Mangahan C.	L=1210m			17,520	15,312	2,208
Preparatory Works		l/s	1	2,920	2,552	368
Excavation		cu.m	100,000	6,900	5,865	1,035
Parapet wall/River wall		cu.m	1,000	3,000	2,550	450
Revetment		sq.m	2,000	1,200	1,020	180
Steel sheet		sq.m	1,000	3,500	3,325	175
Mangahan C./STA.7+425	L=790m			18,780	16,383	2,397
Preparatory Works		l/s	1	3,130	2,731	400
Excavation		cu.m	50,000	4,750	4,038	713
Embankment		cu.m	5,000	200	170	30
Parapet wall/River wall		cu.m	2,000	6,000	5,100	900
Revetment		sq.m	2,000	1,200	1,020	180
Steel sheet		sq.m	1,000	3,500	3,325	175
2 Marikina Control Gate Structure				138,600	116,147	22,453
Preparatory Works		l/s	1	23,100	19,358	3,742
Excavation		cu.m	30,000	7,000	5,950	1,050
Embankment		cu.m	6,000	300	255	45
Concrete		cu.m	22,000	62,000	52,700	9,300
Gate (10.1m*17.5m*2no.)		ton	300	46,200	37,884	8,316
Sub-Total(1+2)				856,913	727,792	129,121
3 Administration *1)		l/s	1	42,846	0	42,846
4 Engineering Services		l/s	1	127,800	115,020	12,780
5 Physical Cotingency *2)		l/s	1	102,756	84,281	18,475
6 Land Acquisition & Compensation		ha	7	160,000	0	160,000
Total(1+2+3+4+5+6)				1,290,315	927,093	363,222
7 Price Cotingency *3)				110,675	0	110,675
8 Grand Total				1,400,990	927,093	473,896

Notes;
1); 5% of main civil works(1+2)
2);10% of (1+2+3+4)
3); 0% for foreign currecy and 6% for local currency

Table 7.4-3. DISBURSEMENT SCHEDULE FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

UNIT : THOUSAND US$

WORK ITEM	TOTAL			1991		1992		1993		1994		1995	
	TOTAL	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. PREPARATORY WORKS	9,310	7,913	1,397	3,041	548	2,339	424	2,300	390	234	36	0	0
2. RIVER IMPROVEMENT WORKS	30,919	26,256	4,663	620	91	8,010	1,431	7,390	1,340	5,118	901	5,118	901
2.1 LOWER MARIKINA R. IMPVT.(M.C.G.S/STA.7+425)	1,421	1,240	181	620	91	620	91	0	0	0	0	0	0
2.2 CONST. OF MARIKINA CONTROL GATE STRUCTURE	5,422	4,544	878	0	0	2,272	439	2,272	439	0	0	0	0
2.3 PASIG R. IMPVT.(RIVER MOUTH/M.C.G.S.)	24,076	20,472	3,604	0	0	5,118	901	5,118	901	5,118	901	5,118	901
TOTAL OF 1.+2.	40,229	34,169	6,060	3,661	638	10,349	1,854	9,690	1,730	5,352	937	5,118	901
3. ADMINISTRATION	2,011	0	2,011	0	215	0	610	0	571	0	314	0	301
4. ENGINEERING SERVICES	6,000	5,400	600	1,080	120	1,080	120	1,080	120	1,080	120	1,080	120
TOTAL OF 1. TO 4.	48,240	39,569	8,671	4,741	973	11,429	2,584	10,770	2,421	6,432	1,371	6,198	1,322
5. PHYSICAL CONTINGENCY (10% of the above total)	4,824	3,957	867	474	97	1,143	258	1,077	242	643	137	620	132
6. LAND ACQUISISTION & COMPENSATION	7,512	0	7,512	0	2,504	0	2,504	0	2,504	0	0	0	0
TOTAL OF 1. TO 6.	60,576	43,526	17,051	5,215	3,574	12,571	5,347	11,846	5,167	7,075	1,509	6,818	1,454
7. PRICE CONTINGENCY (F.C.:0% L.C.:6%)	5,197	0	5,197	0	683	0	1,403	0	1,748	0	631	0	732
GRAND TOTAL	65,774	43,526	22,248	5,215	4,257	12,571	6,750	11,846	6,915	7,075	2,140	6,818	2,186

NOTE : Figures may not add up to totals due to rounding.
Currency conversion rates are 1.00 US$ = 132 Yen = 21.30 Peso.

Table 7.4-4 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

Unit : million peso

FLOOD RETURN PERIOD	FLOOD DAMAGE W/O PRJOJECT	FLOOD DAMAGE W/ PRJOJECT	REDUCTION	AVERAGE	EXPECTATION	BENEFIT
				56.0	0.50000	28.0
2-yr.	112.0	0.0	112.0			
				219.1	0.30000	65.7
5-yr.	326.2	0.0	326.2			
				420.1	0.10000	42.0
10-yr.	513.9	0.0	513.9			
				757.2	0.05000	37.9
20-yr.	1,000.5	0.0	1,000.5			
				1,027.1	0.01667	17.1
30-yr.	1,053.7	0.0	1,053.7			
				526.8	0.01333	7.0
50-yr.	1,261.9	1,261.9	0.0			
				0.0	0.01000	0.0
100-yr.	1,440.6	1,440.6	0.0			
					TOTAL	197.7

Table 7.4-5 ANNUAL CASH FLOW FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

Unit : Million Peso

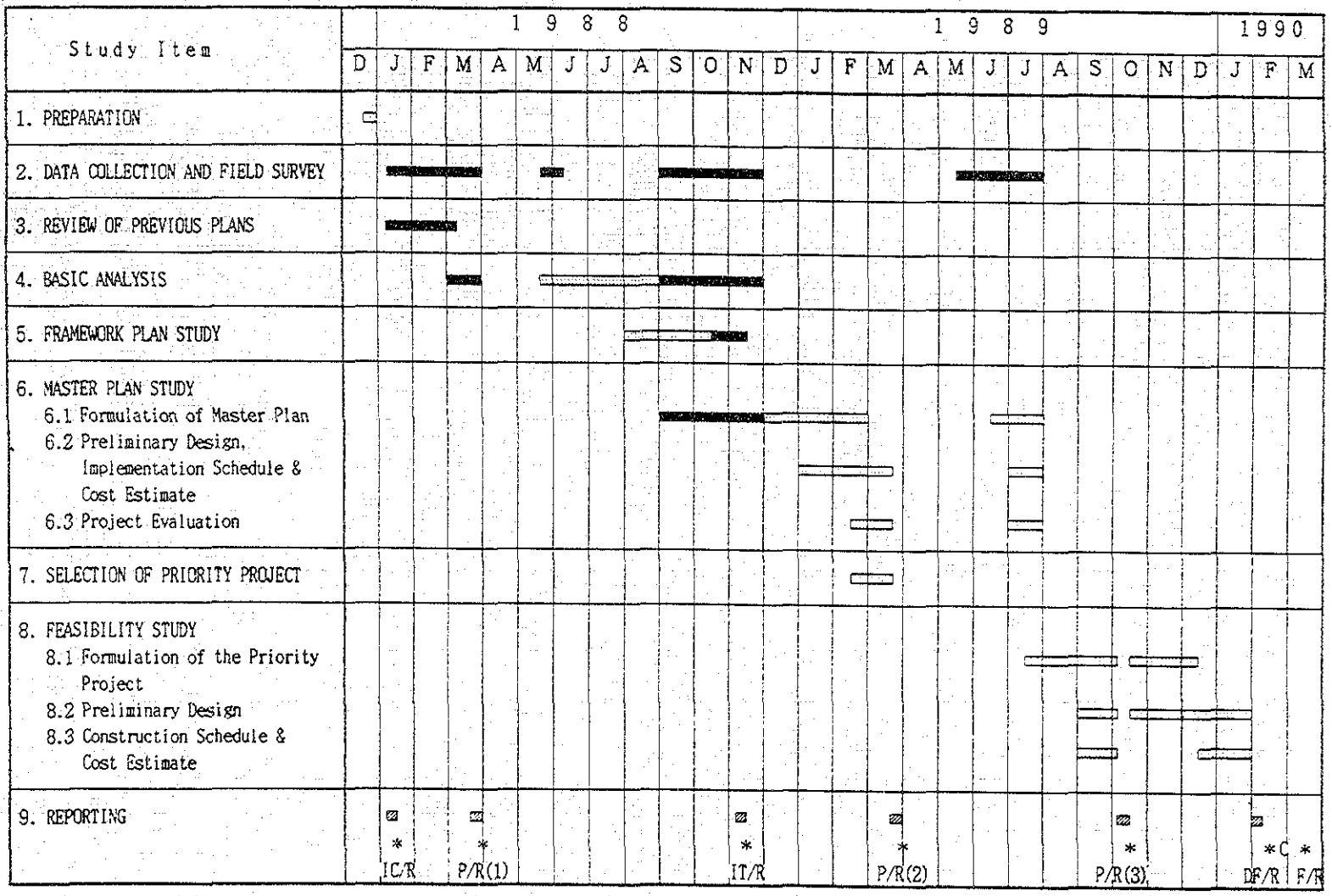
NO.	YEAR	ECONOMIC COST				ANNUAL AVERAGE BENEFIT	ANNUAL CASH FLOW
		CONSTRUC-TION	LAND ACQUISITION	OMR	TOTAL		
1	1991	120.5	53.3		173.8		(173.8)
2	1992	295.5	53.3		348.8	39.5	(309.3)
3	1993	278.2	53.3		331.5	79.1	(252.4)
4	1994	164.5			164.5	118.6	(45.9)
5	1995	158.6			158.6	158.2	(0.4)
6	1996			5.0	5.0	197.7	192.7
7	1997			5.0	5.0	197.7	192.7
8	1998			5.0	5.0	197.7	192.7
9	1999			5.0	5.0	197.7	192.7
10	2000			5.0	5.0	197.7	192.7
11	2001			5.0	5.0	197.7	192.7
12	2002			5.0	5.0	197.7	192.7
13	2003			5.0	5.0	197.7	192.7
14	2004			5.0	5.0	197.7	192.7
15	2005			5.0	5.0	197.7	192.7
16	2006			5.0	5.0	197.7	192.7
17	2007			5.0	5.0	197.7	192.7
18	2008			5.0	5.0	197.7	192.7
19	2009			5.0	5.0	197.7	192.7
20	2010			5.0	5.0	197.7	192.7
21	2011			5.0	5.0	197.7	192.7
22	2012			5.0	5.0	197.7	192.7
23	2013			5.0	5.0	197.7	192.7
24	2014			5.0	5.0	197.7	192.7
25	2015			5.0	5.0	197.7	192.7
26	2016			5.0	5.0	197.7	192.7
27	2017			5.0	5.0	197.7	192.7
28	2018			5.0	5.0	197.7	192.7
29	2019			5.0	5.0	197.7	192.7
30	2020			5.0	5.0	197.7	192.7
31	2021			5.0	5.0	197.7	192.7
32	2022			5.0	5.0	197.7	192.7
33	2023			5.0	5.0	197.7	192.7
34	2024			5.0	5.0	197.7	192.7
35	2025			5.0	5.0	197.7	192.7
36	2026			5.0	5.0	197.7	192.7
37	2027			5.0	5.0	197.7	192.7
38	2028			5.0	5.0	197.7	192.7
39	2029			5.0	5.0	197.7	192.7
40	2030			5.0	5.0	197.7	192.7
					IRR =	16.07%	
					B/C =	1.07	
					NPV =	56.54	

FIGURES

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

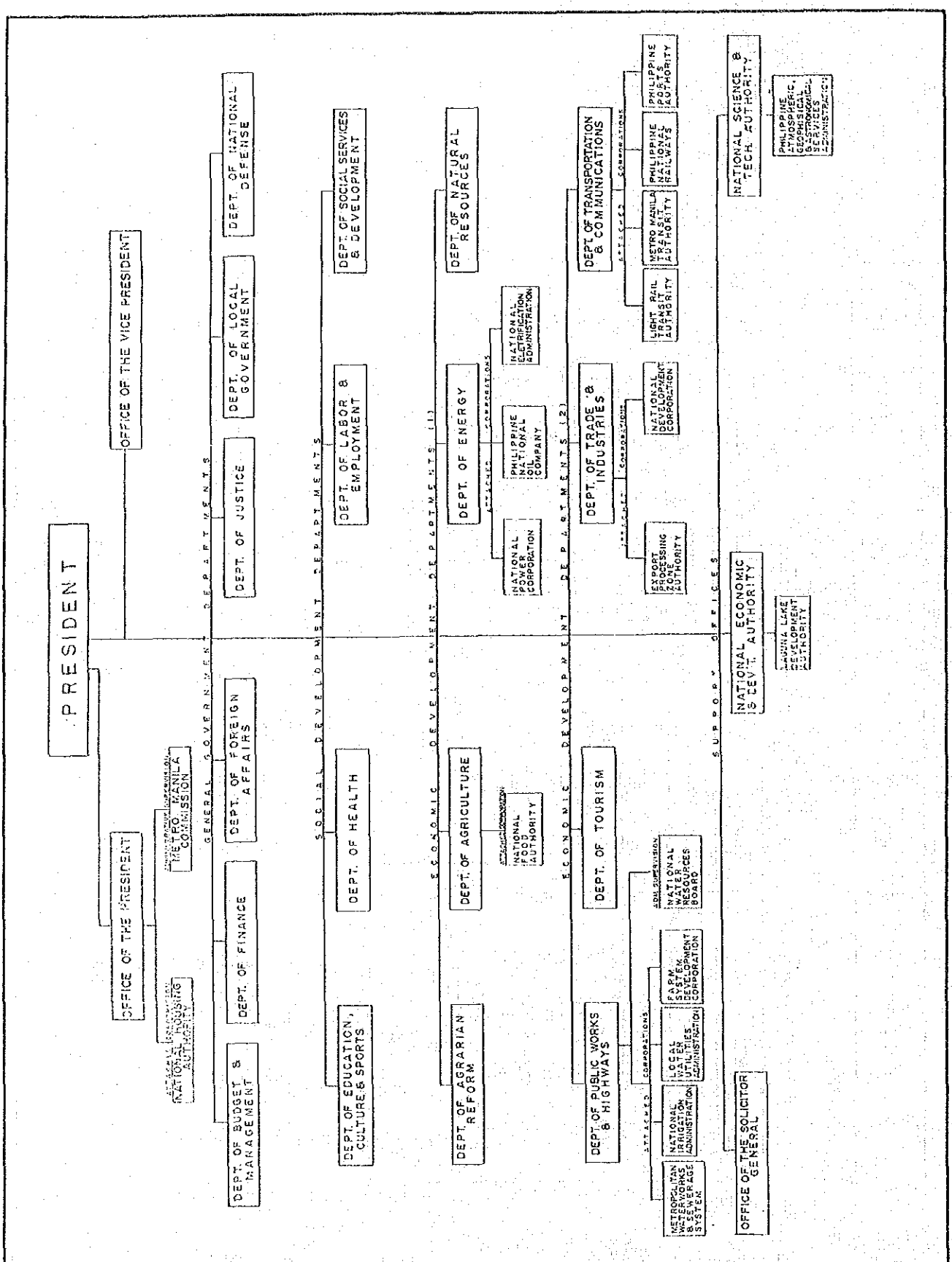
STUDY SCHEDULE



LEGEND

▬▬	: STUDY IN THE PROJECT SITE	IC/R	: INCEPTION REPORT	P/R(3)	: PROGRESS REPORT (3)
▭	: STUDY IN JAPAN	P/R(1)	: PROGRESS REPORT (1)	DF/R	: DRAFT FINAL REPORT
▨	: EXPLANATORY MEETING ON REPORT	IT/R	: INTERIM REPORT	F/R	: FINAL REPORT
*	: REPORT SUBMITTAL	P/R(2)	: PROGRESS REPORT (2)	C	: COMMENT

Fig.1.1-1

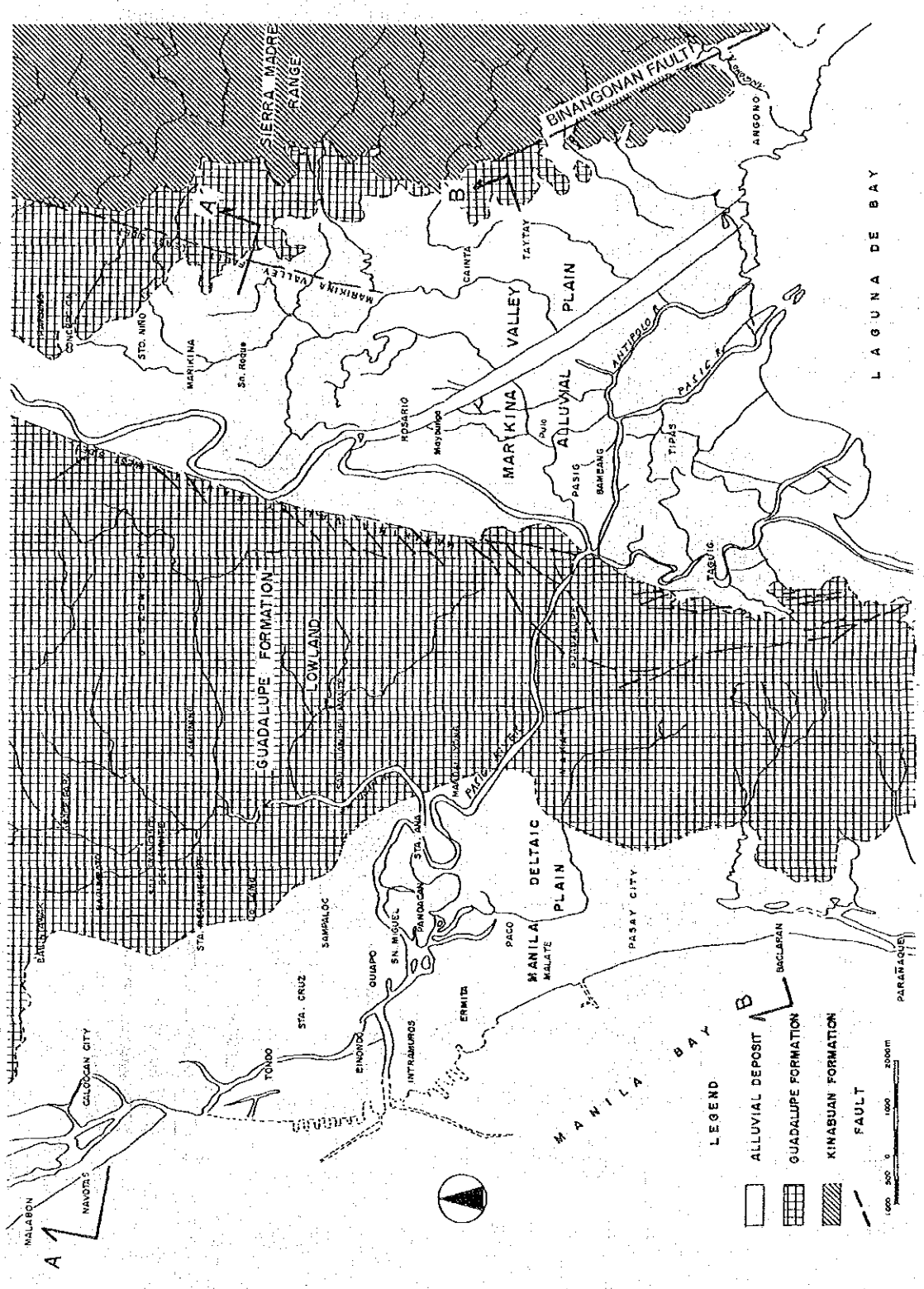


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

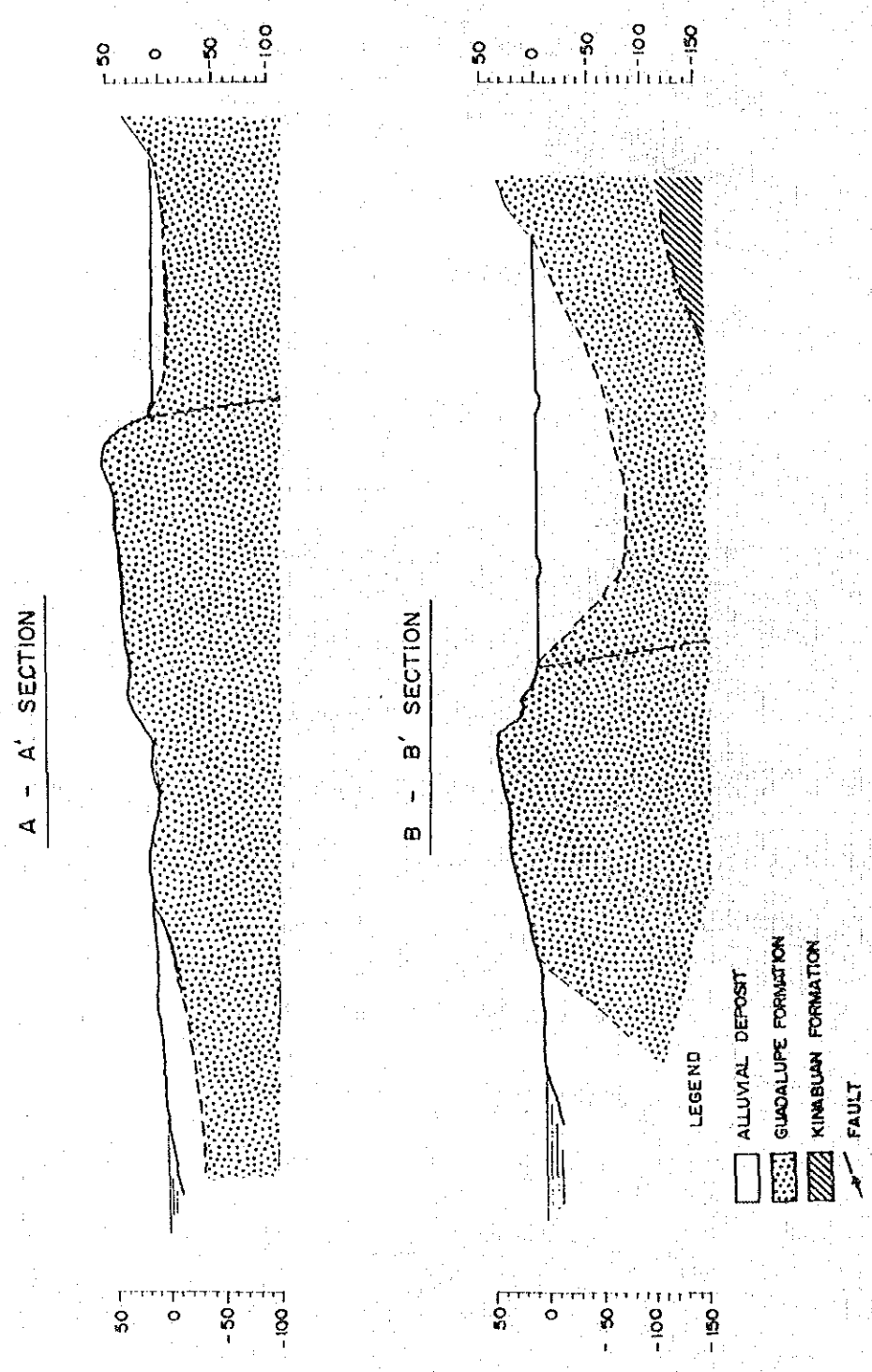
JAPAN INTERNATIONAL COOPERATION AGENCY

ORGANIZATIONAL CHART OF THE GOVERNMENT

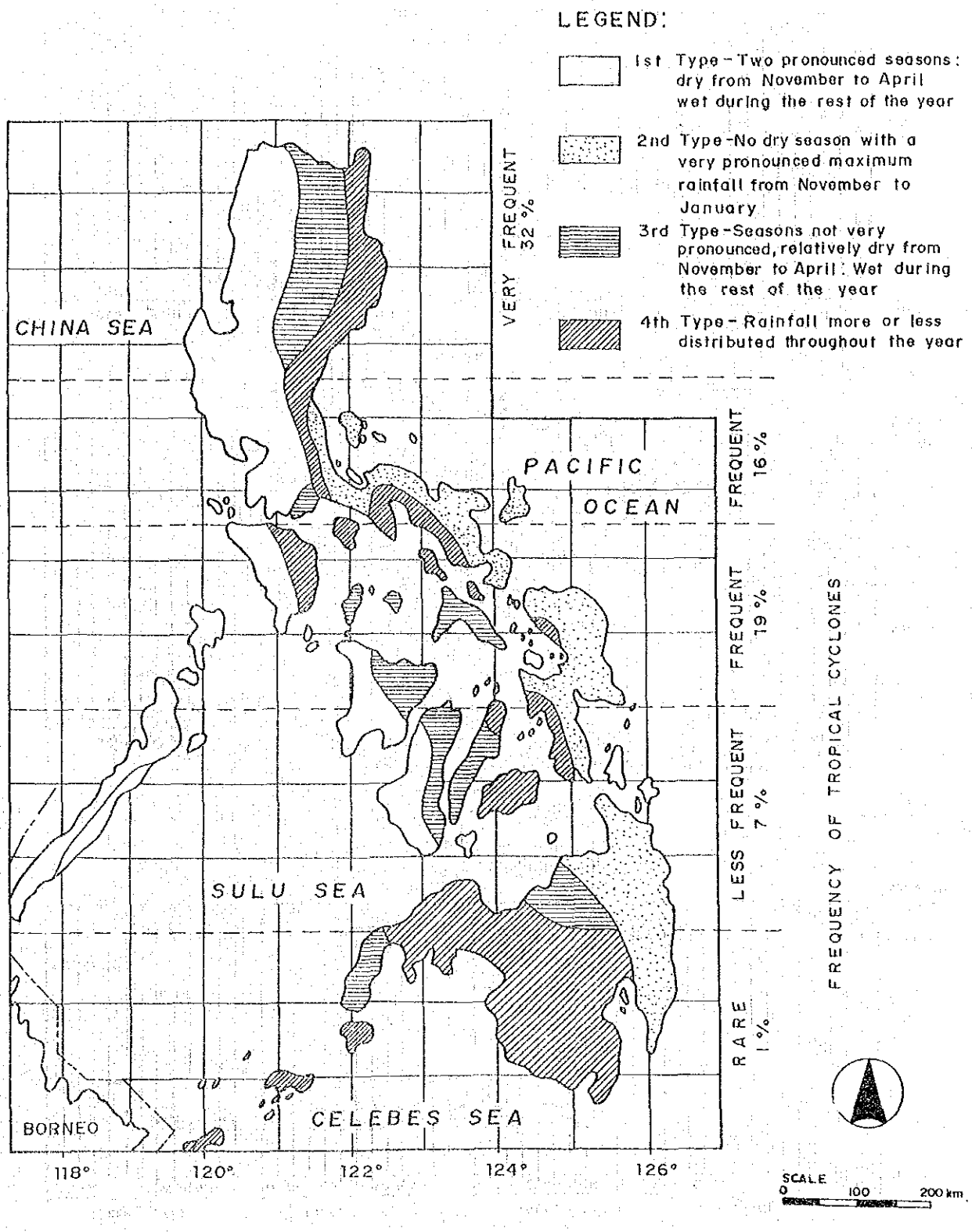
Fig.2.2-1



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES	GEOLOGICAL MAP OF THE STUDY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.2.4-1



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES	GEOLOGICAL SECTION OF THE STUDY AREA
JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.2.4-2

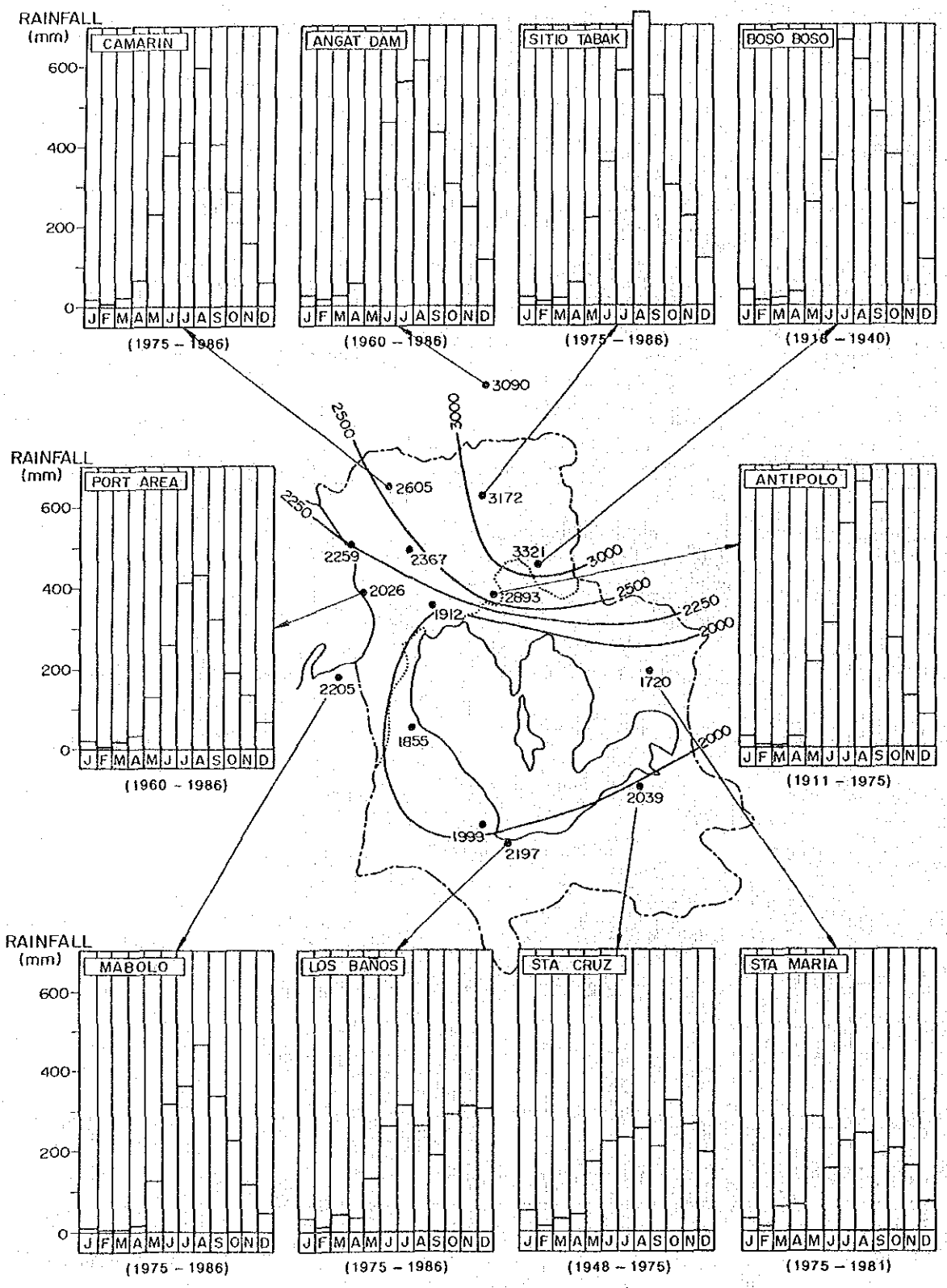


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

RAINFALL CLIMATIC REGIONS IN THE PHILIPPINES

Fig.2.5-1

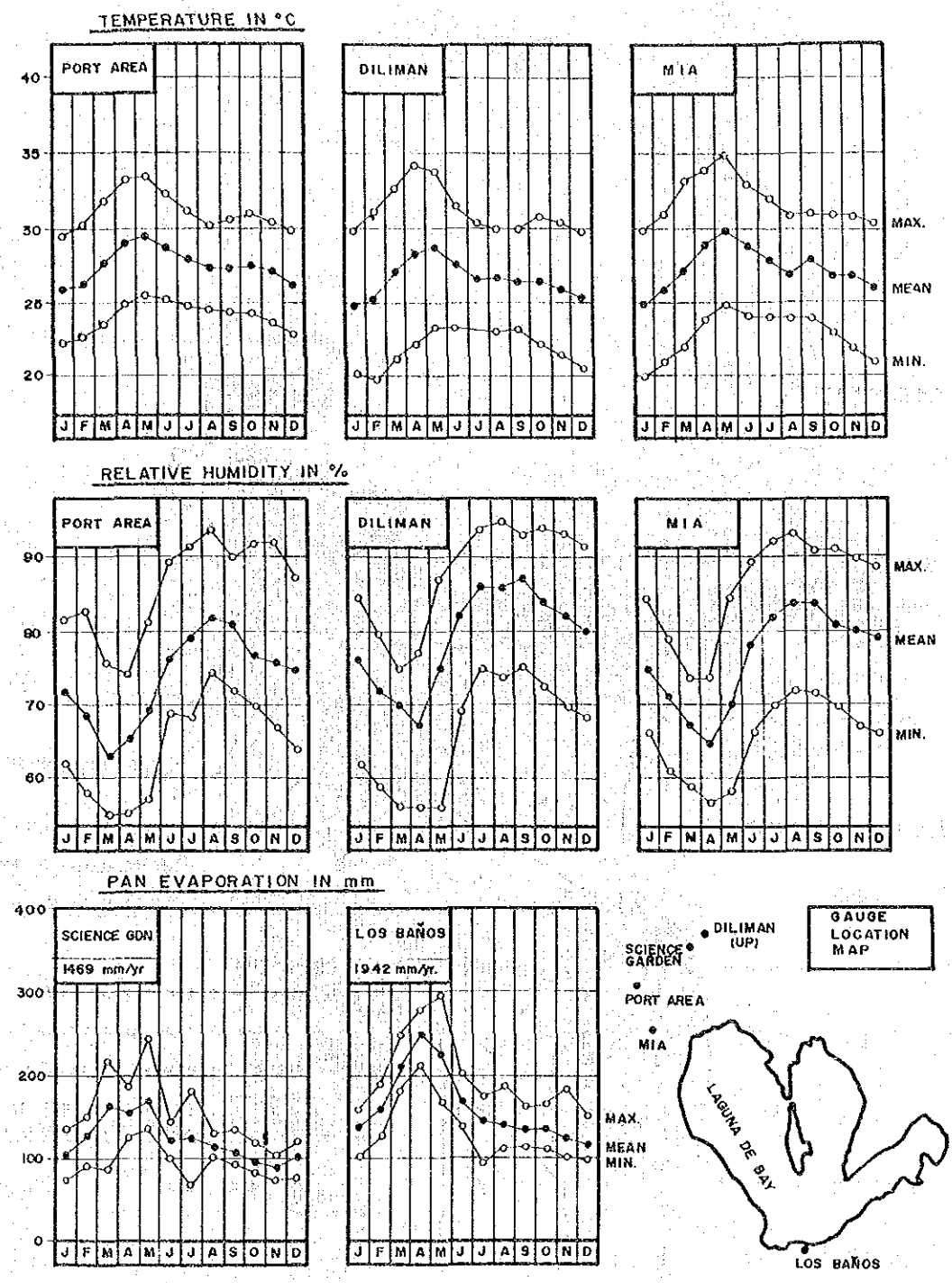


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

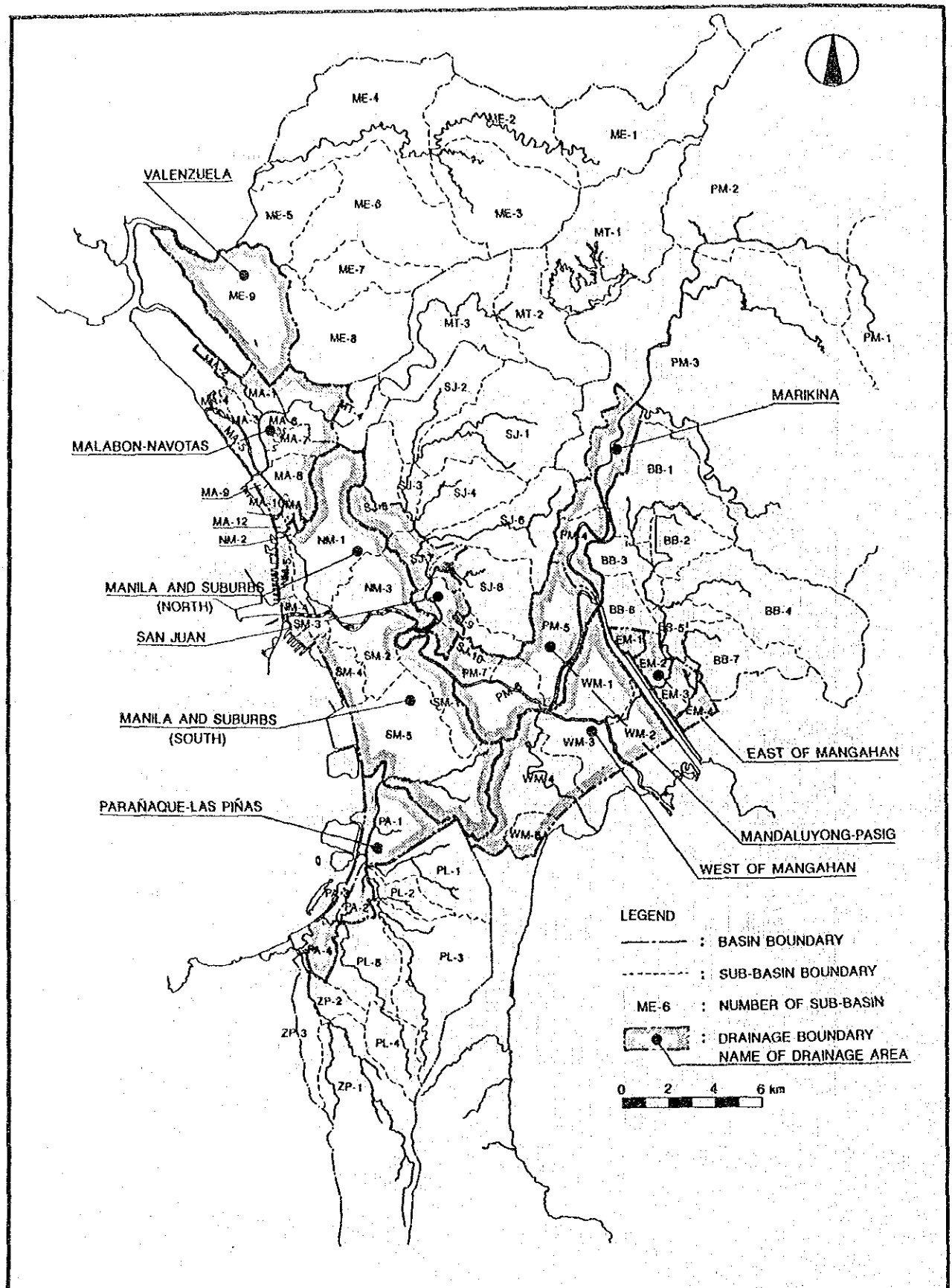
JAPAN INTERNATIONAL COOPERATION AGENCY

ANNUAL RAINFALL ISOHYETAL MAP AND MONTHLY RAINFALL DISTRIBUTION AT SELECTED GAUGES

Fig.2.5-2



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES JAPAN INTERNATIONAL COOPERATION AGENCY	MONTHLY VARIATION OF TEMPERATURE RELATIVE HUMIDITY AND PAN EVAPORATION Fig.2.5-3

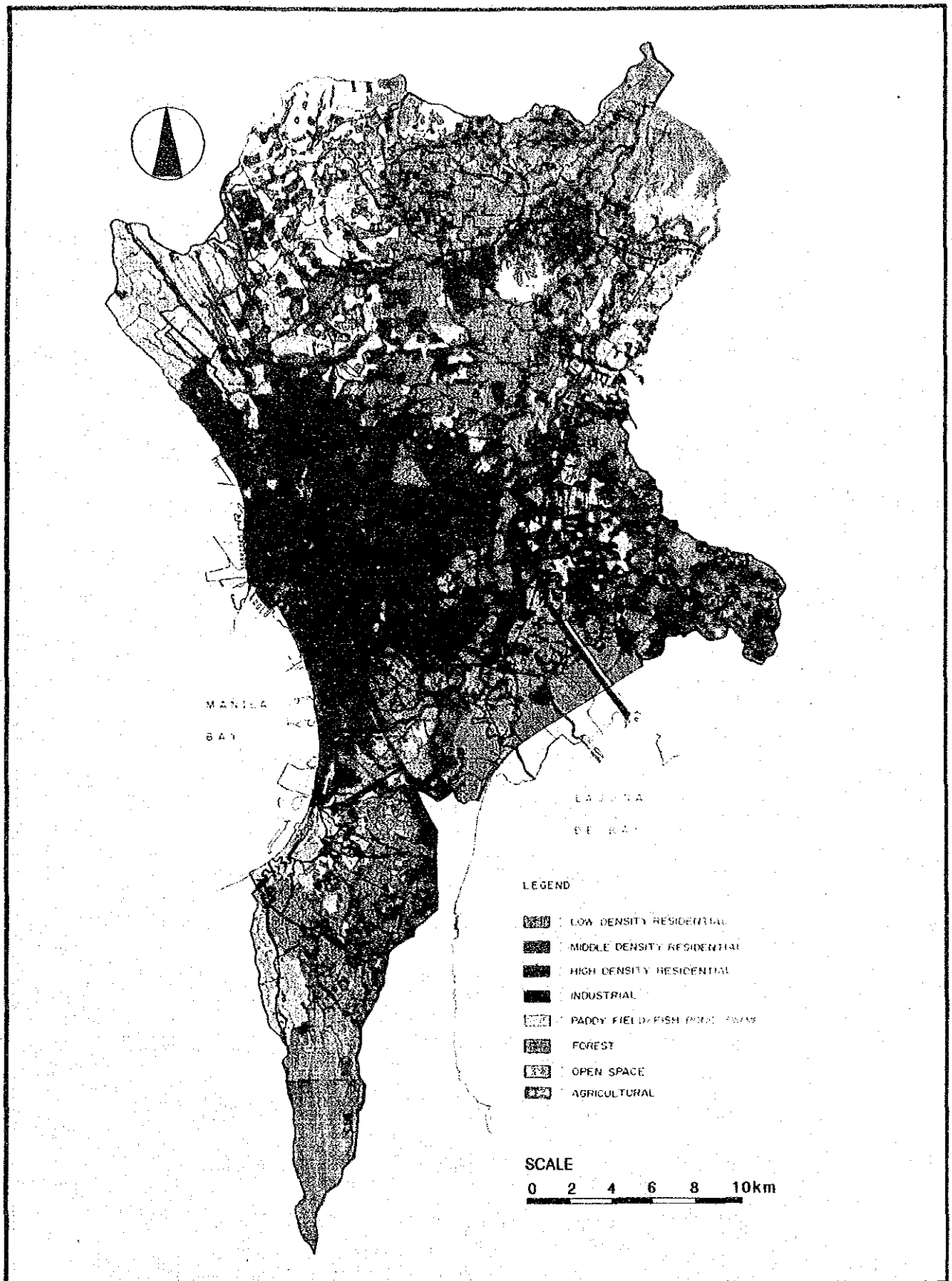


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

DRAINAGE AREAS IN THE STUDY AREA

Fig.3.1-1

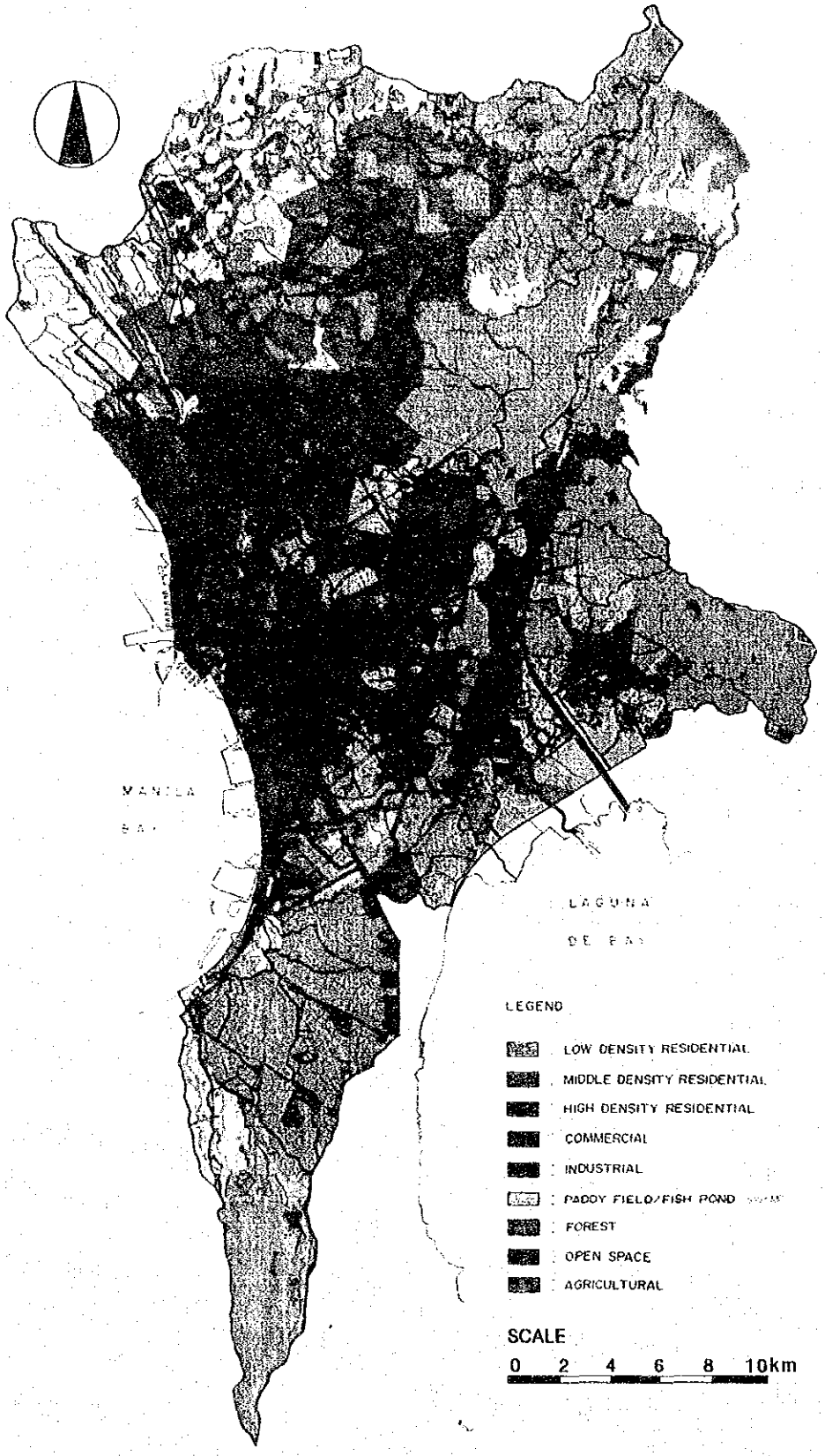


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

LAND USE MAP IN 1986

Fig.3.1-2

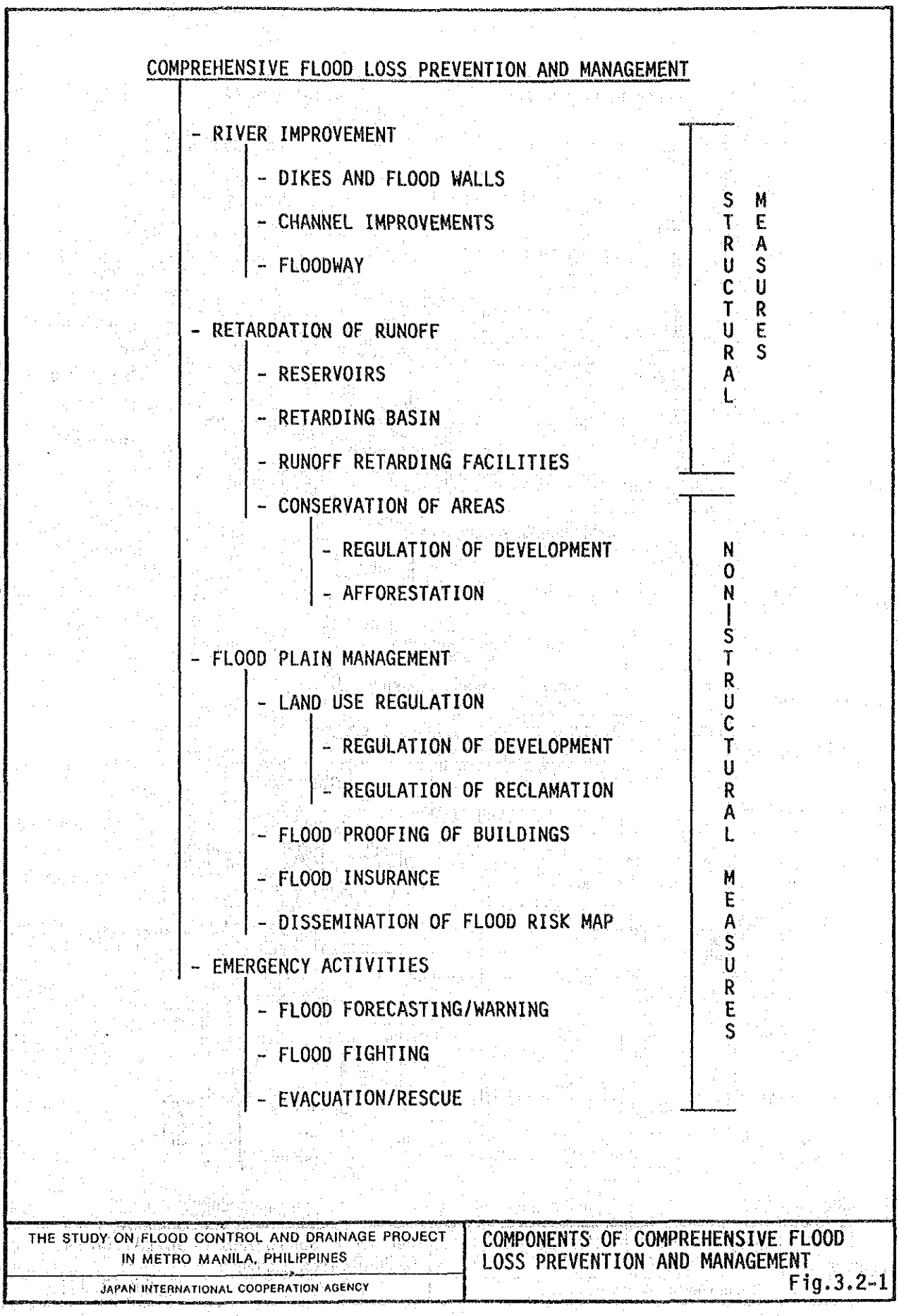


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

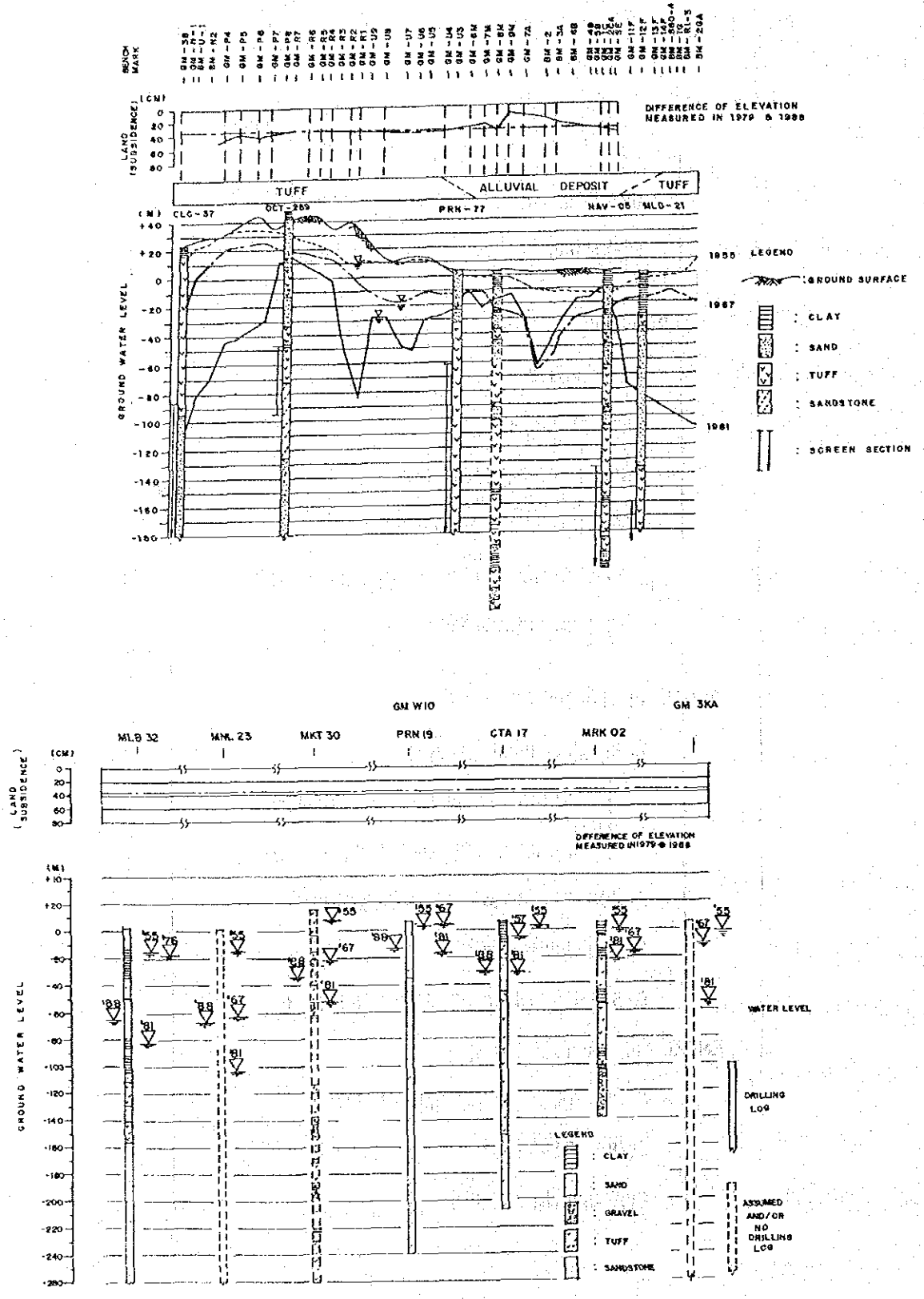
JAPAN INTERNATIONAL COOPERATION AGENCY

LAND USE MAP IN 2020

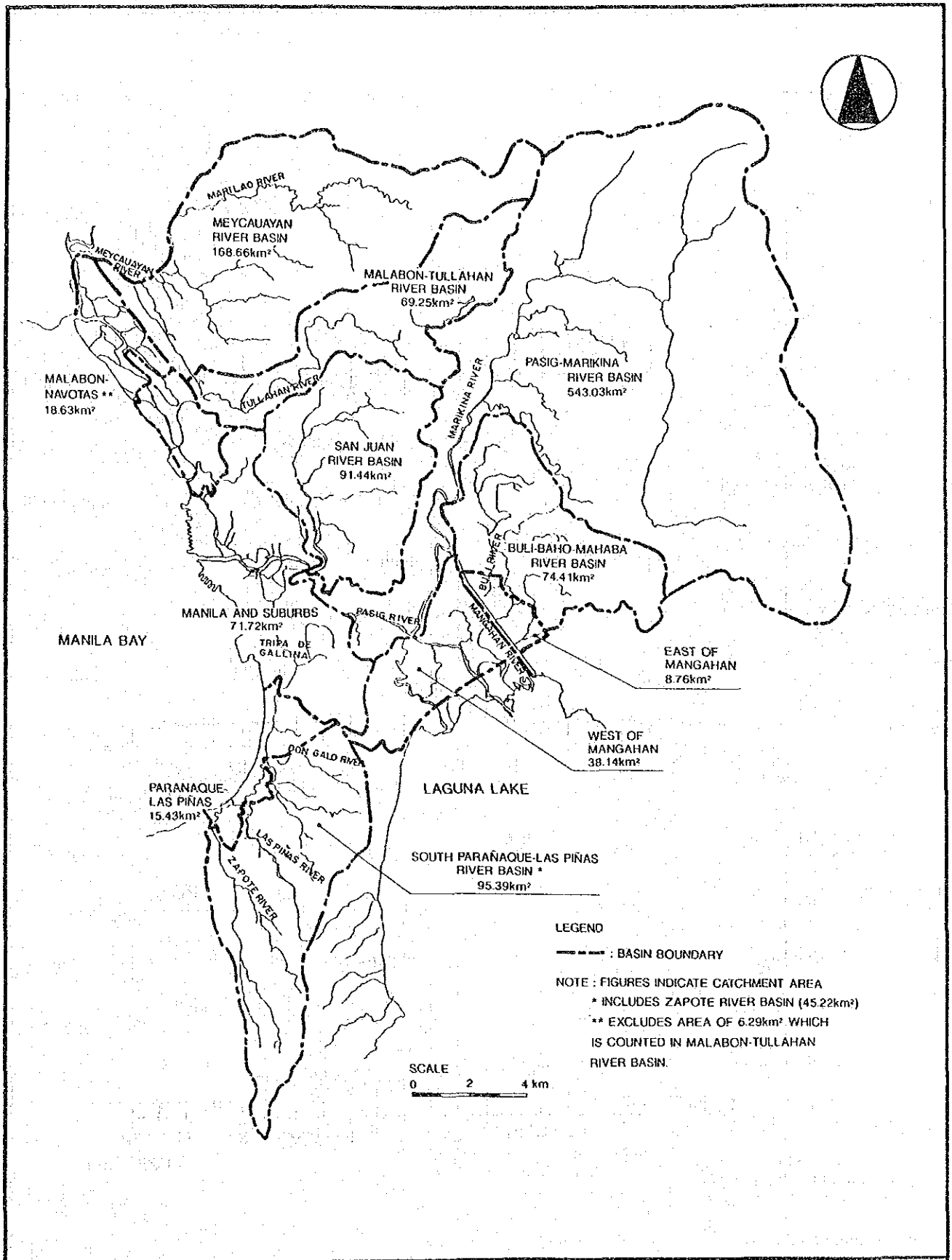
Fig.3.1-3



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES JAPAN INTERNATIONAL COOPERATION AGENCY	COMPONENTS OF COMPREHENSIVE FLOOD LOSS PREVENTION AND MANAGEMENT Fig.3.2-1



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES	SURVEY RESULTS AND FLUCTUATION OF GROUNDWATER LEVEL
JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.3.3-1

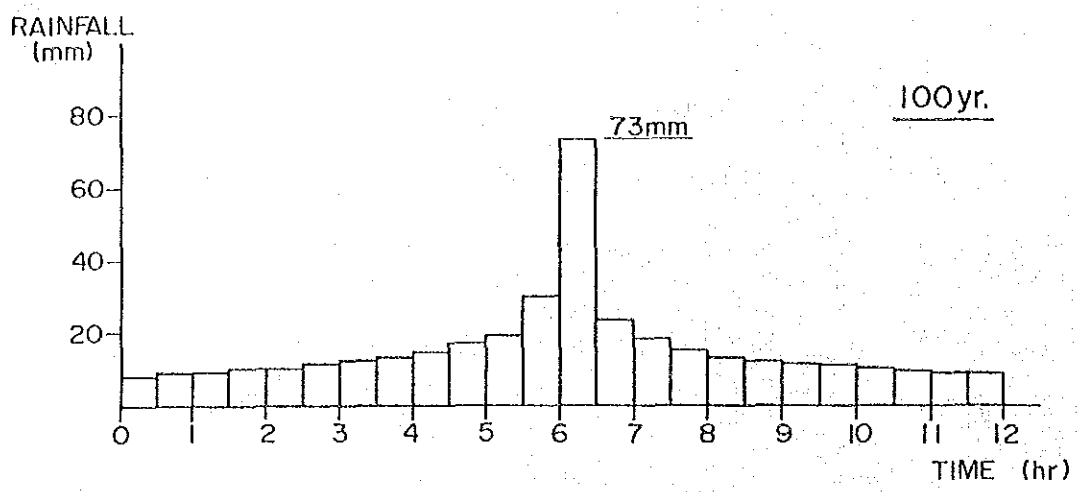


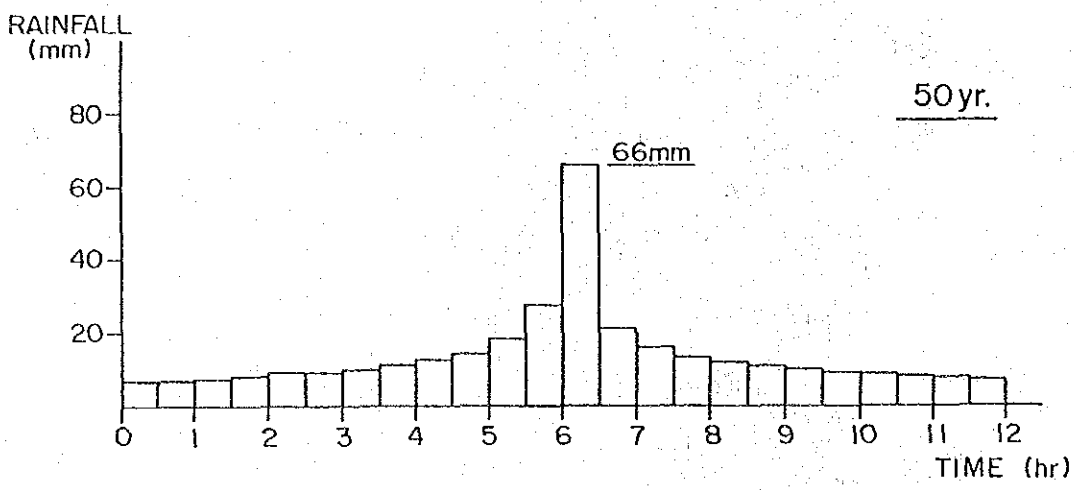
THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

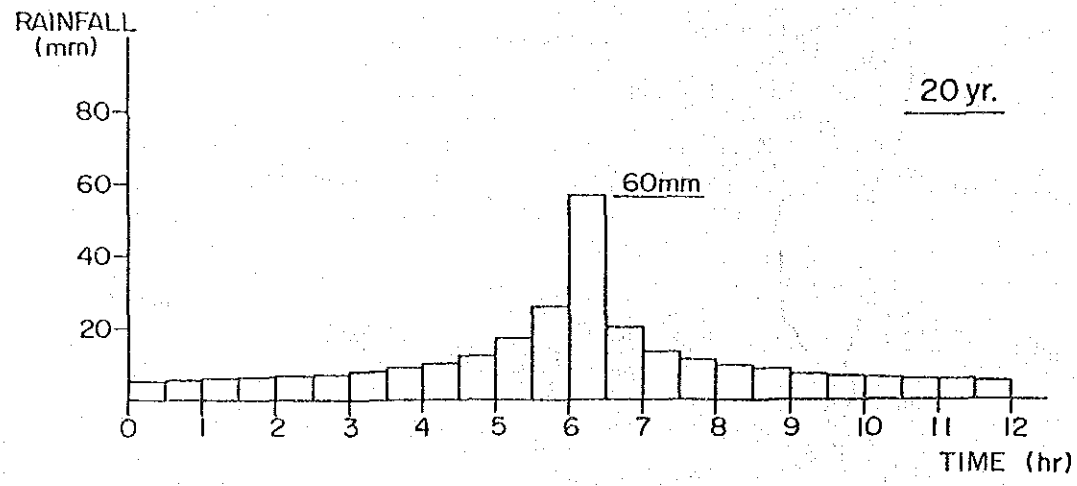
JAPAN INTERNATIONAL COOPERATION AGENCY

WATERSHED IN THE STUDY AREA

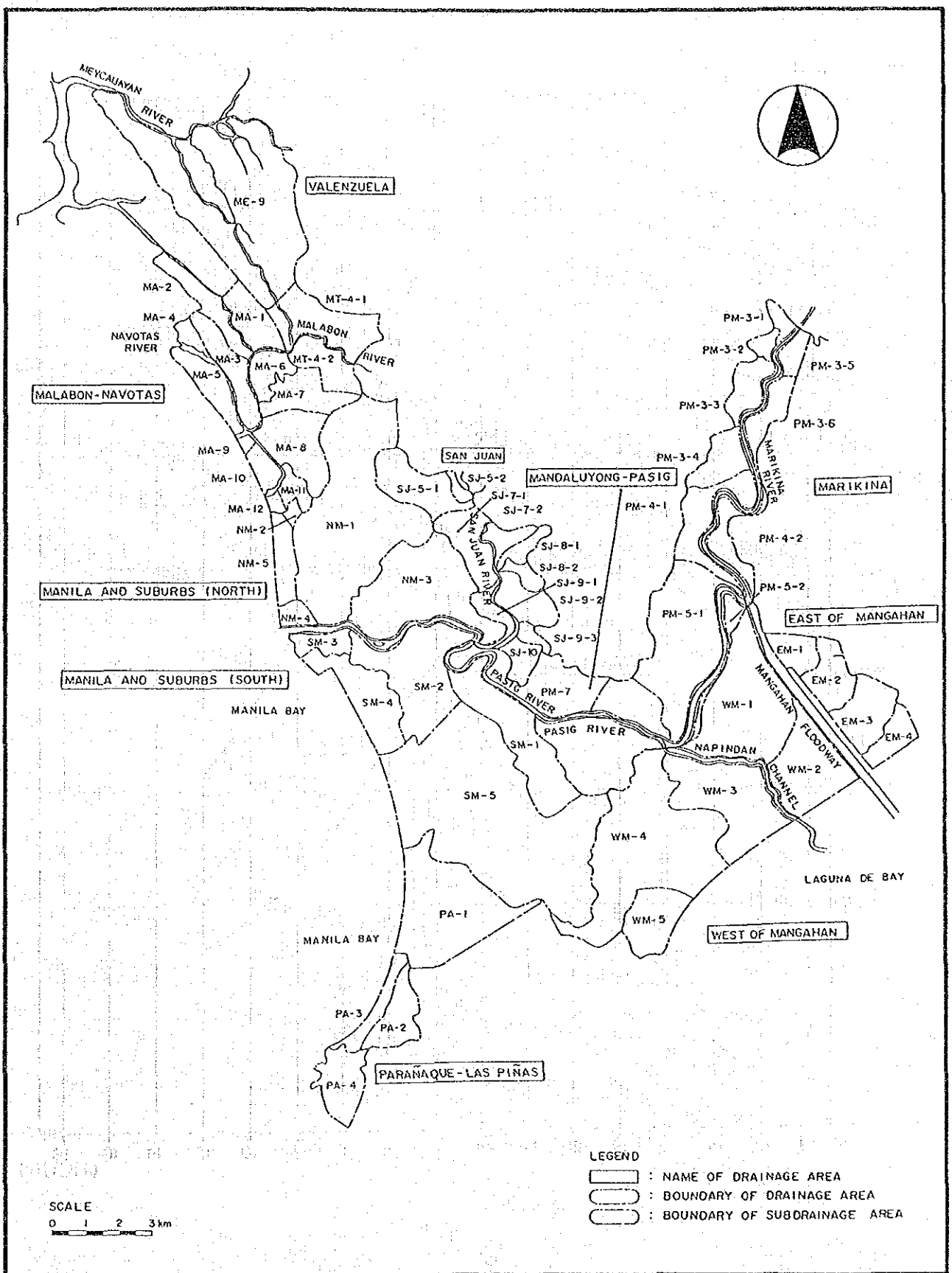
Fig.3.4-1







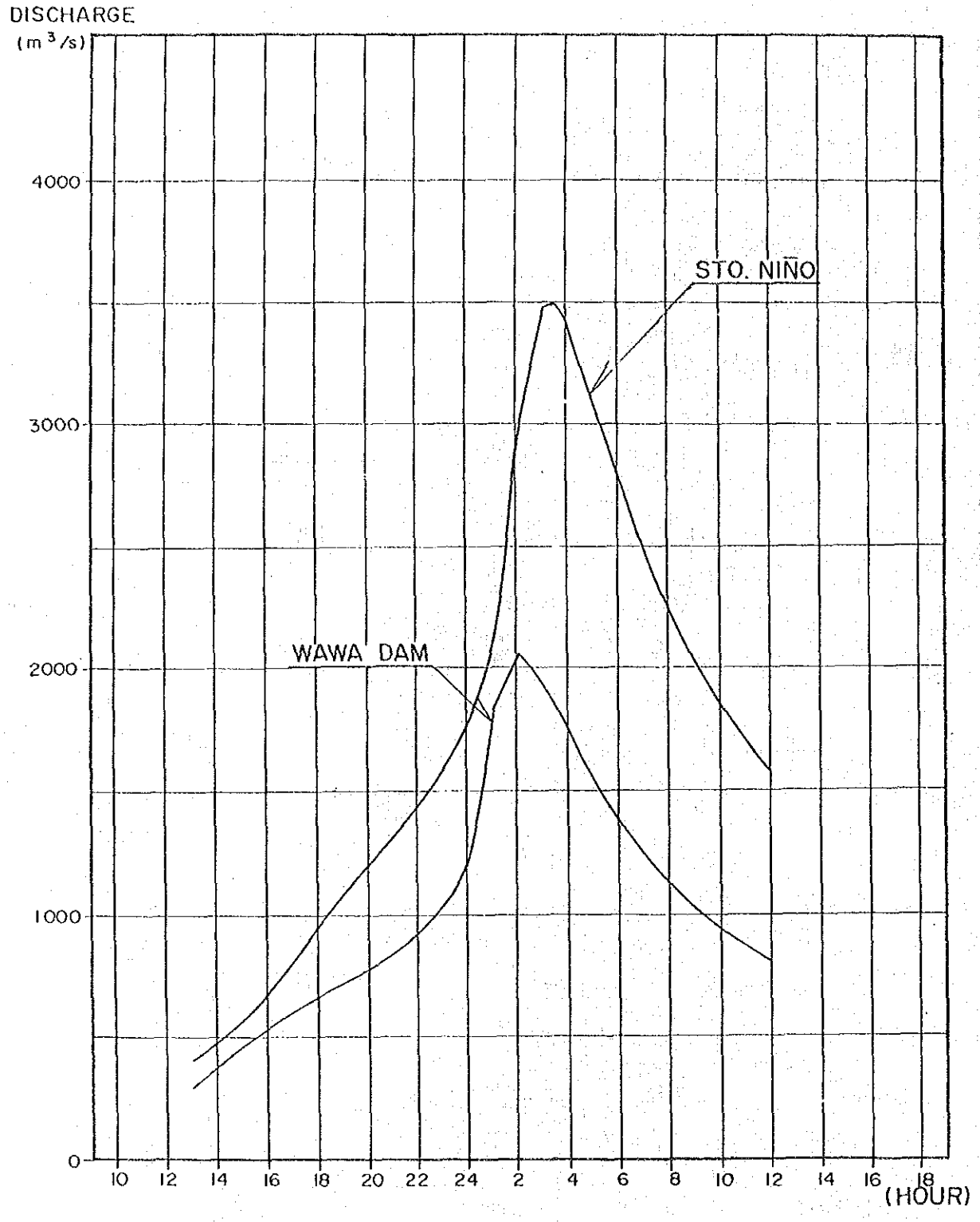
THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES JAPAN INTERNATIONAL COOPERATION AGENCY	DESIGN HYETOGRAPH AT PORT AREA GUAGE Fig.3.4-2



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

SUBDRAINAGE AREAS IN THE STUDY AREA
Fig.3.4-3



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

MARIKINA RIVER 100-YEAR FLOOD HYDROGRAPH BY STORAGE FUNCTION MODEL

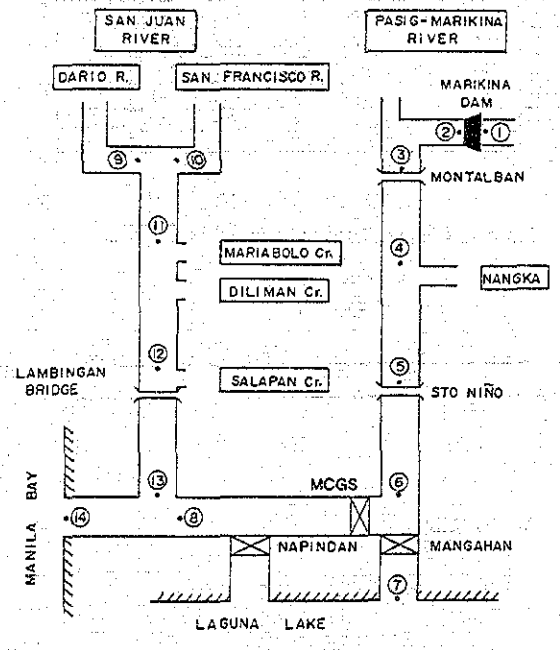
Fig.3.4-4

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

PROBABLE DISCHARGE IN RIVER BASINS UNDER THE LAND USE CONDITION OF 2020

Fig.3.4-5(1/3)



PASIG-MARIKINA RIVER BASIN
(INCL. SAN JUAN RIVER BASIN)

W/O MARIKINA DAM & W/O MCGS

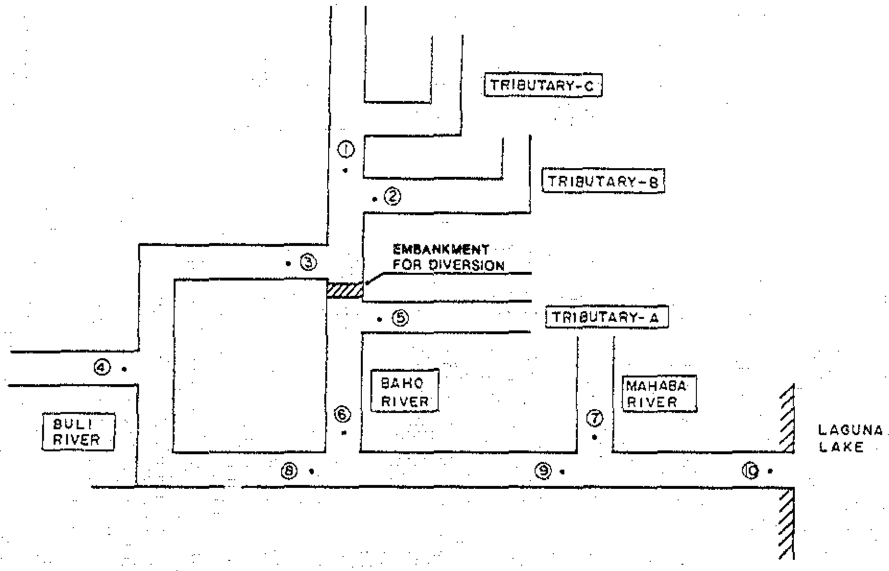
UNIT : m^3/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	2000	1800	1700	1600	1400	1200	1000
②	2000	1800	1700	1600	1400	1200	1000
③	2700	2450	2250	2100	1900	1600	1300
④	3050	2800	2550	2400	2100	1750	1400
⑤	3500	3200	2900	2800	2400	2050	1600
⑥	3500	3200	2900	2800	2400	2050	1600
⑦	2250	2000	1850	1750	1450	1200	900
⑧	1200	1100	1000	950	850	750	600
⑨	250	230	230	220	210	200	190
⑩	390	380	370	350	330	320	310
⑪	630	600	600	570	540	520	490
⑫	820	790	780	750	700	670	610
⑬	900	860	850	810	740	700	630
⑭	1500	1350	1200	1150	1000	900	750

W/ MARIKINA DAM & W/ MCGS

UNIT : m^3/s

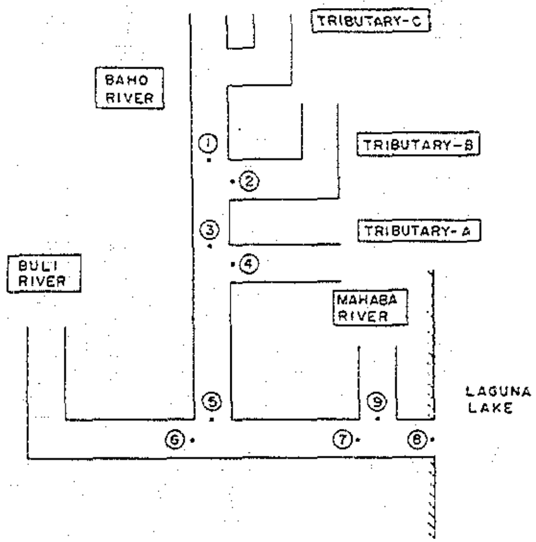
Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	2000	1800	1700	1600	1400	1200	1000
②	1500	1400	1300	1250	1200	1000	900
③	2050	1900	1800	1700	1550	1300	1200
④	2600	2400	2200	2100	1900	1600	1400
⑤	2900	2700	2500	2400	2100	1800	1550
⑥	2900	2700	2500	2400	2100	1800	1550
⑦	2400	2000	2200	1900	1600	1300	1050
⑧	500	290	100	80	65	50	30
⑨	250	230	230	220	210	200	190
⑩	390	380	370	350	330	320	310
⑪	630	600	600	570	540	520	490
⑫	820	790	780	750	700	670	610
⑬	900	860	850	810	740	700	630
⑭	950	860	800	750	660	570	420



BULI-BAHO-MAHABA RIVER BASIN
W/ SHORT CUT

UNIT : m³/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	280	250	230	225	210	190	170
②	110	100	95	90	85	80	70
③	280	250	230	225	210	190	170
④	80	75	70	65	60	55	50
⑤	280	250	230	225	210	190	170
⑥	335	300	275	270	250	230	190
⑦	190	170	160	150	140	130	120
⑧	330	295	270	260	245	210	180
⑨	495	450	410	395	365	320	260
⑩	530	475	430	415	380	330	260



BULI-BAHO-MAHABA RIVER BASIN
W/O SHORT CUT

UNIT : m³/s

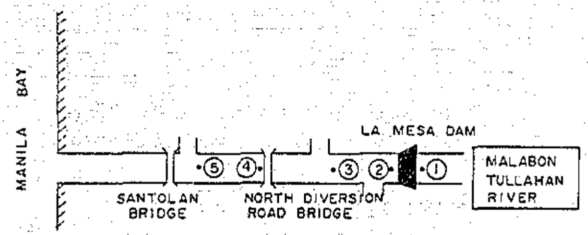
Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	280	250	230	225	210	190	170
②	110	100	95	90	85	80	70
③	280	250	230	225	210	190	170
④	280	250	230	225	210	190	170
⑤	520	470	430	420	390	350	290
⑥	120	110	100	95	90	85	80
⑦	530	480	440	420	390	350	290
⑧	570	510	470	450	410	360	290
⑨	190	170	160	150	140	130	120

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT
IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

PROBABLE DISCHARGE IN RIVER BASINS
UNDER THE LAND USE CONDITION OF 2020

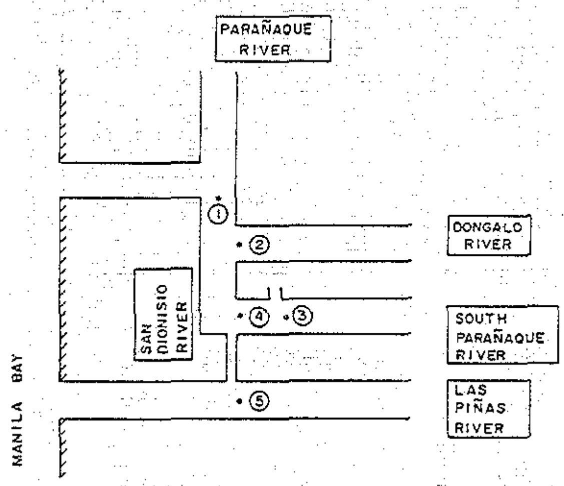
Fig.3.4-5(2/3)



MALABON-TULLAHAN RIVER BASIN

UNIT : m³/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	400	370	365	340	310	290	250
②	240	220	210	200	180	160	140
③	330	300	290	270	240	220	190
④	480	430	420	390	340	300	240
⑤	520	470	450	420	360	320	250



SOUTH PARAÑAQUE-LAS PIÑAS RIVER BASIN

UNIT : m³/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	630	560	520	490	440	380	320
②	200	180	170	160	140	120	100
③	370	330	300	290	260	220	190
④	430	380	350	330	300	260	220
⑤	220	200	180	170	160	140	120

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

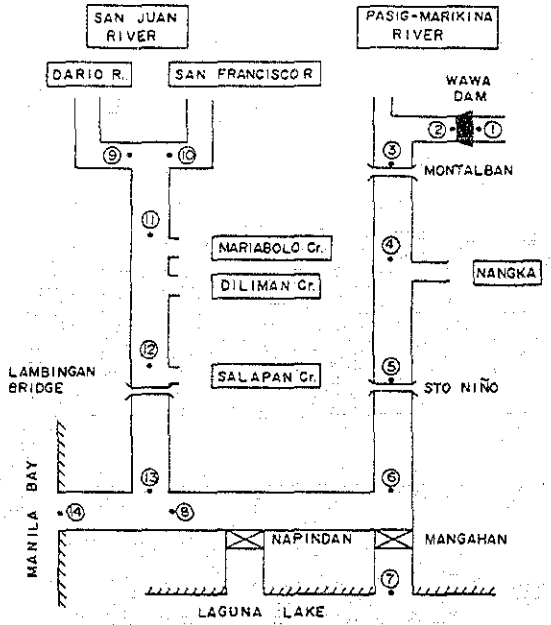
JAPAN INTERNATIONAL COOPERATION AGENCY

PROBABLE DISCHARGE IN RIVER BASINS UNDER THE LAND USE CONDITION OF 2020

Fig.3.4-5(3/3)

PROBABLE DISCHARGE IN RIVER BASINS UNDER THE LAND USE CONDITIONS OF 1986

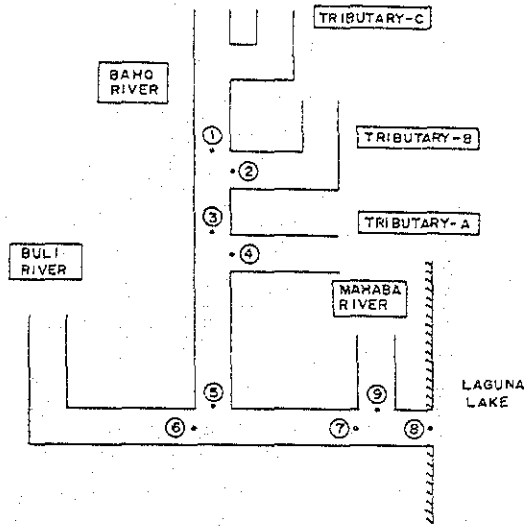
Fig.3.4-6(1/2)



PASIG-MARIKINA RIVER BASIN (INCL. SAN JUAN RIVER BASIN)

UNIT : m^3/s

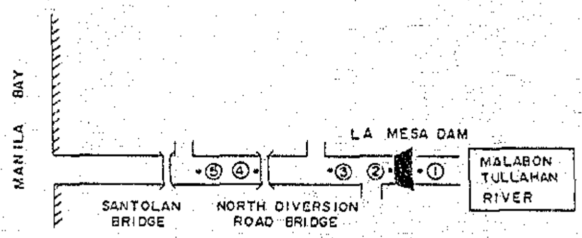
Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	2000	1800	1700	1600	1400	1200	1000
②	2000	1800	1700	1600	1400	1200	1000
③	2700	2450	2250	2100	1900	1600	1300
④	3050	2800	2550	2400	2100	1750	1400
⑤	3500	3200	2900	2700	2400	2050	1600
⑥	3500	3200	2900	2800	2400	2050	1600
⑦	2250	2000	1850	1750	1450	1200	900
⑧	1200	1100	1000	950	850	750	550
⑨	140	130	125	120	115	110	105
⑩	290	280	270	260	250	240	220
⑪	420	400	395	380	360	340	320
⑫	700	670	660	630	580	560	510
⑬	790	750	740	700	650	600	540
⑭	1450	1300	1200	1150	1000	850	650



BULI-BAHO-MAHABA RIVER BASIN

UNIT : m^3/s

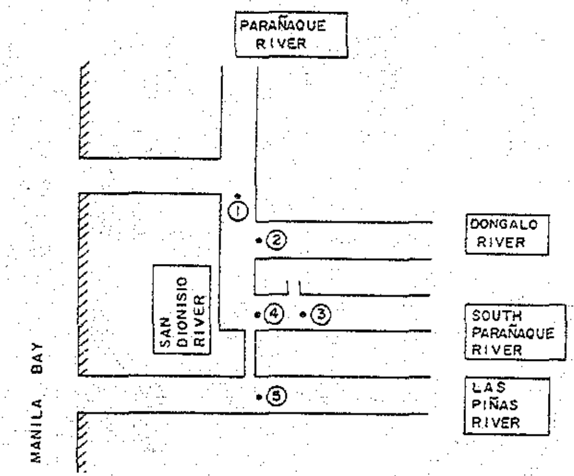
Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	260	230	210	205	200	180	160
②	70	65	60	60	55	50	45
③	240	220	200	190	180	160	140
④	210	190	170	165	160	140	120
⑤	430	390	350	340	310	280	230
⑥	80	75	70	65	65	60	50
⑦	450	400	360	350	320	280	230
⑧	480	430	390	370	340	290	230
⑨	150	130	120	115	110	100	90



MALABON-TULLAHAN RIVER BASIN

UNIT : m³/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	395	365	355	335	300	285	245
②	235	215	205	195	170	155	135
③	315	290	280	260	230	210	170
④	390	350	340	310	270	240	185
⑤	420	380	360	335	285	250	195

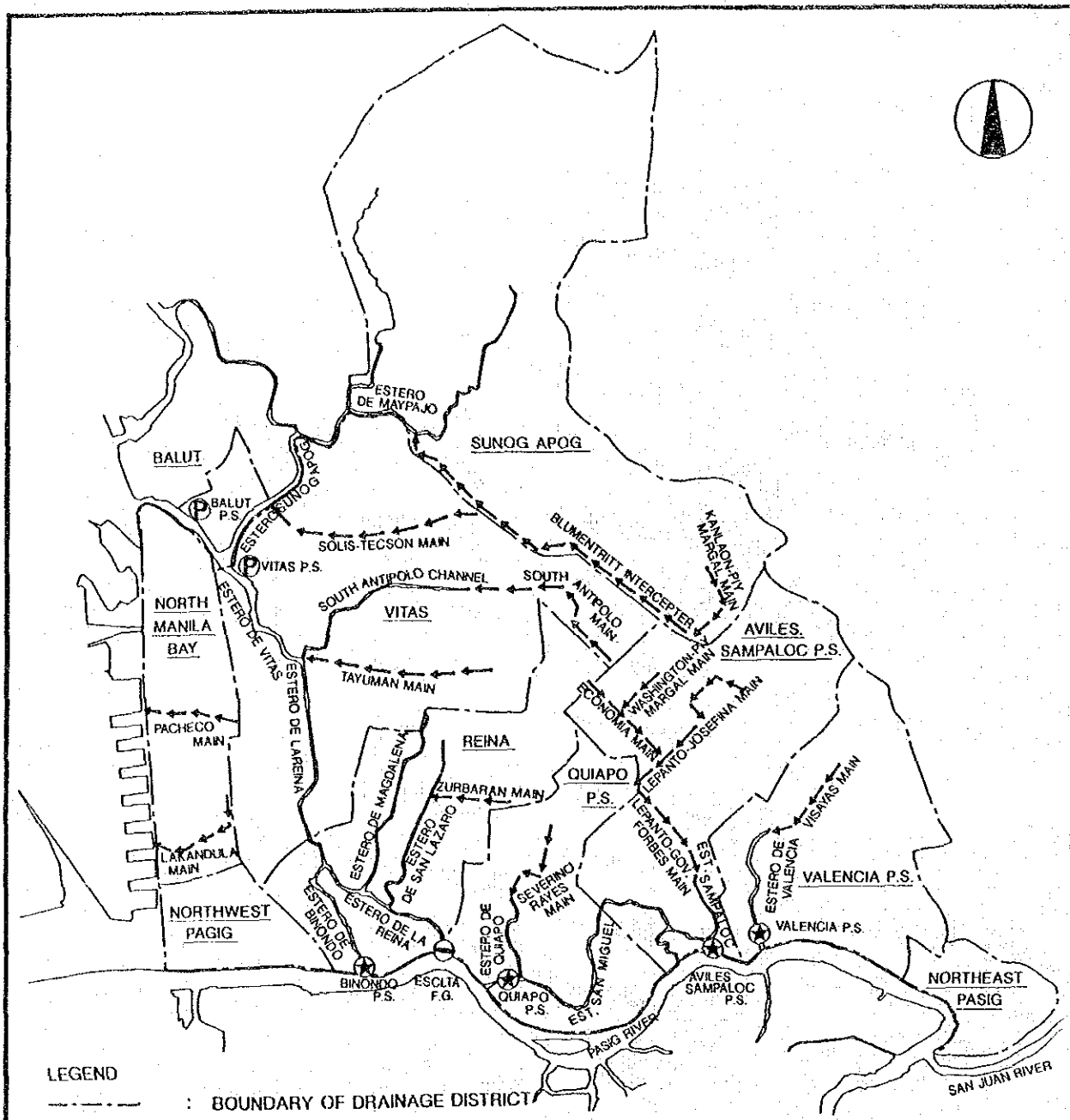


SOUTH PARAÑAQUE-LAS PIÑAS RIVER BASIN

UNIT : m³/s

Point No.	RETURN PERIOD						
	100	50	30	20	10	5	2
①	510	460	420	400	350	310	260
②	180	160	150	140	130	110	100
③	300	260	240	230	210	180	150
④	330	300	280	260	230	200	170
⑤	180	160	150	140	130	110	90

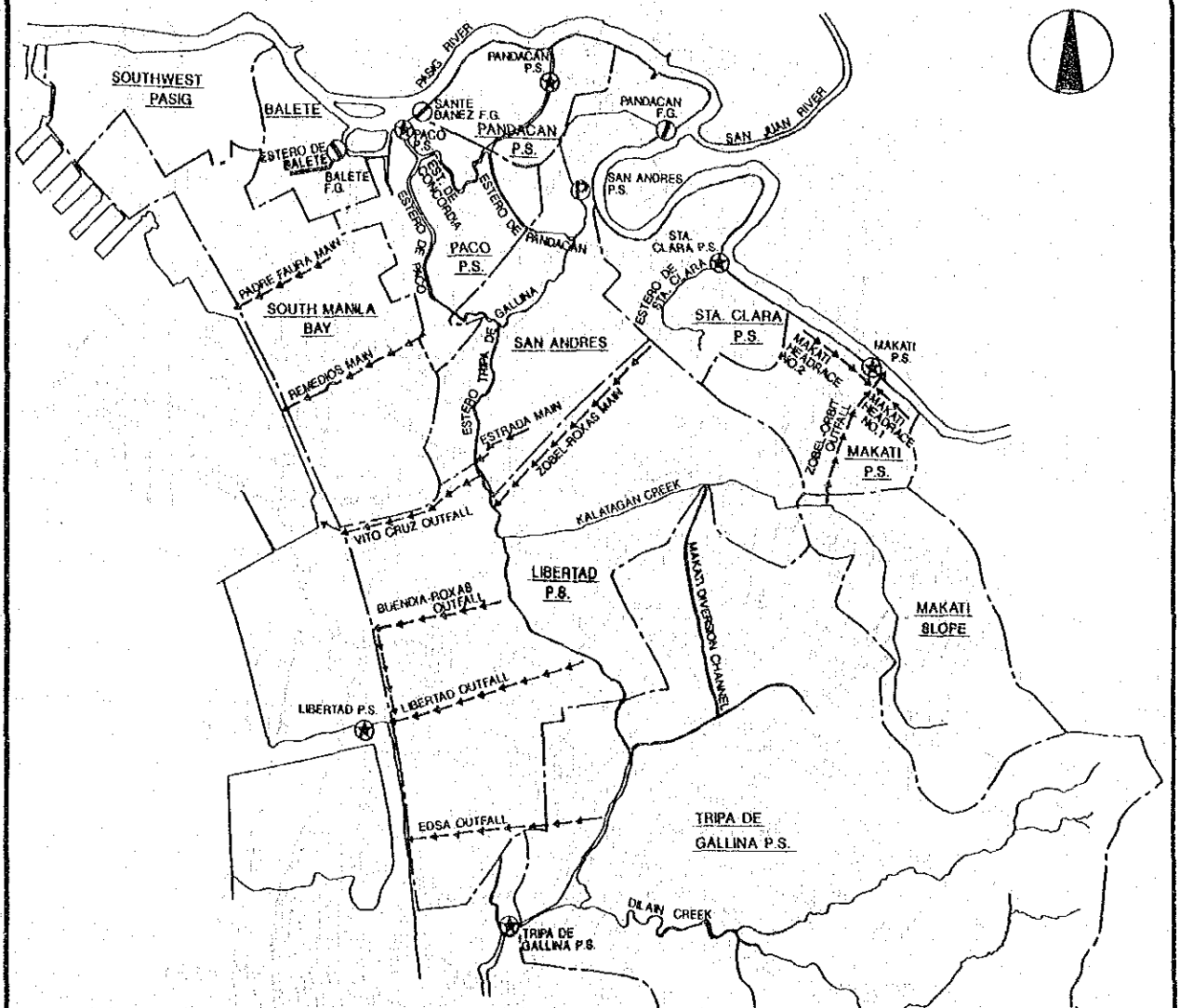
PROBABLE DISCHARGE IN RIVER BASINS
UNDER THE LAND USE CONDITIONS OF 1986
Fig.3.4-6(2/2)



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

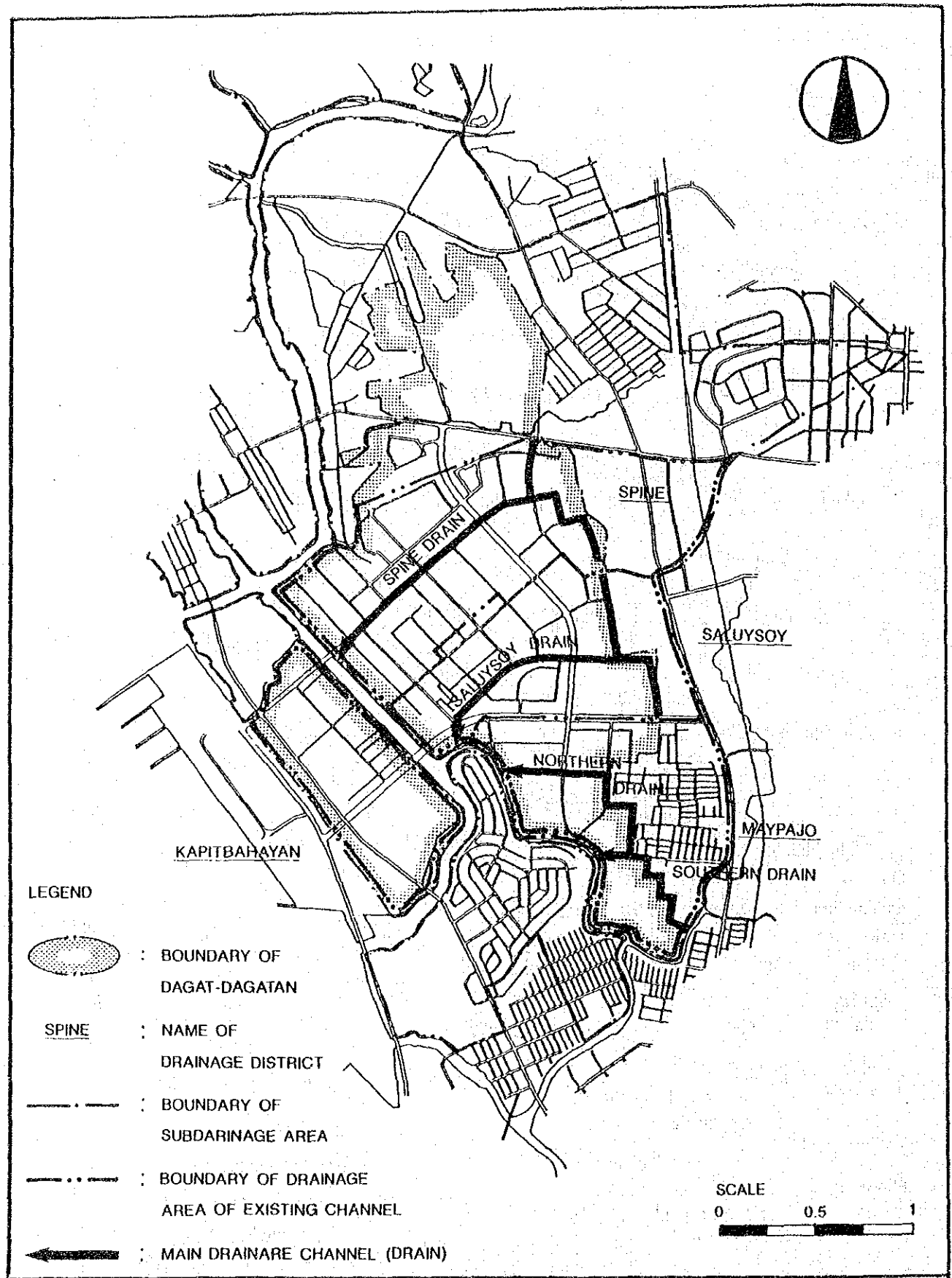
DRAINAGE SYSTEM IN MANILA AND SUBURBS
Fig.3.5-1(1/2)



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

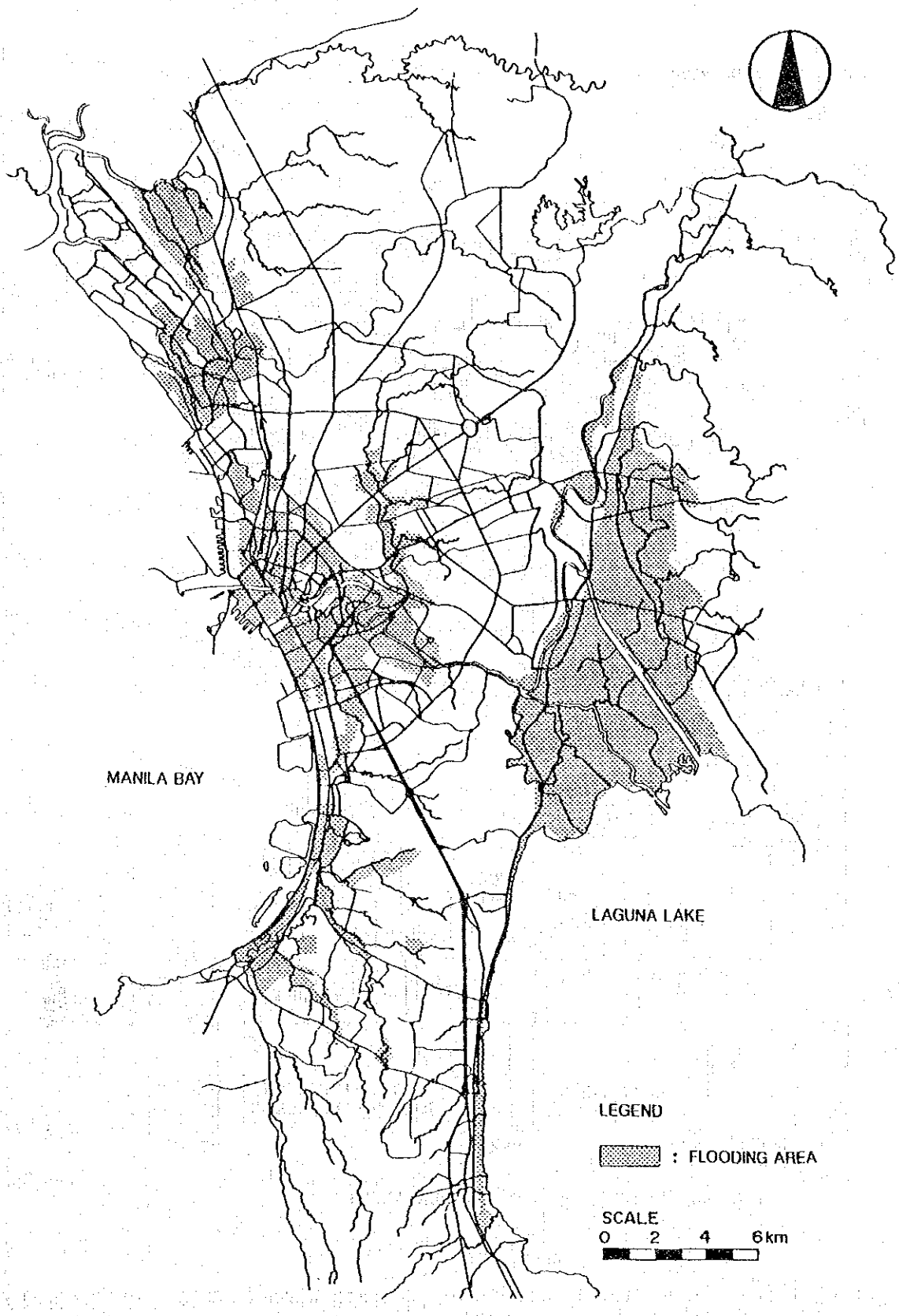
DRAINAGE SYSTEM IN MANILA AND SUBURBS
Fig.3.5-1(2/2)



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

DRAINAGE SYSTEM IN DAGAT-DAGATAN
Fig.3.5-2



THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

FLOODING AREA IN 1986

Fig.3.8-1