Republic of the Philippines

Feasibility Study for Manila-Bataan Coastal Road and Its Related Roads (C-5 & C-6) Project

FINAL REPORT

Vol. Ⅳ: Appendix

March, 1980

Japan International Cooperation Agency

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APPENDIXES FOR VOLUME I

APPENDIXES FOR VOLUME II

Appendix I-1

Table II-2-1 POPULATION AND EMPLOYMENT BY ZONE 1979, 1980, 1990 AND 2000

Unit: Persons

Zone No.	Total Population				Employed Persons by Residence			
	1979	1980	1990	2000	1979	1980	1990	2000
1 2 3 4	234,650	254,900	405,500	565,920	75,264	80,932	135,762	199,260
5	352,790	363,950	443,000	531,280	111,729	115,554	148,316	187,064
6	11,250	15,050	52,000	90,530	3,563	4,778	17,410	31,876
7	104,730	109,000	142,000	178,130	33,168	34,608	47,542	62,720
8	19,820	20,550	26,000	32,000	6,277	6,525	8,705	11,267
9	36,670	38,100	49,000	60,950	11,613	12,097	16,405	21,460
11	75,340	78,900	107,500	138,430	23,860	25,051	35,991	48,741
10 12 13	18,960	22,850	60,000	98,840	6,005	7,255	20,088	34,802
14 15	98,630	101,900	125,500	151,700	31,236	32,353	42,017	53,414
16 17	116,020	121,000	160,000	202,490	36,744	38,418	53,568	71,297
18	59,700	61,050	69,000	78,300	18,907	19,383	23,101	27,569
19	55,230	56,450	63,500	71,790	17,491	17,923	21,260	25,277
20	202,000	210,000	271,300	338,460	63,973	66,675	90,831	119,172
21	356,500	363,400	399,400	443,080	112,904	115,380	133,719	156,008
22	109,730	113,400	140,000	169,540	34,751	36,005	46,872	59,695
23	442,250	452,700	516,300	590,120	140,061	143,732	172,857	207,781
24	51,520	53,000	63,000	74,280	16,316	16,828	21,092	26,154
25	73,740	72,300	64,500	53,520	23,353	22,955	21,594	18,844
26	1,800	2,700	11,500	20,650	570	857	3,850	7,271
27	122,190	119,500	103,500	82,600	38,698	37,941	34,651	29,083
28	271,810	279,750	334,000	395,090	86,082	88,821	111,823	139,111
29	42,110	50,900	135,000	222,960	13,336	16,161	45,193	78,504
30	122,570	129,100	183,000	241,080	38,818	40,898	61,268	84,884
31	177,050	188,350	285,000	388,380	56,072	59,801	95,418	136,749
32	338,990	354,300	476,000	608,240	107,358	112,490	159,365	214,161
33	545,880	571,800	780,500	1,006,640	172,880	181,547	261,311	354,438
50	664,790	694,600	1,052,000	1,434,250	210,539	220,536	352,210	504,999
51	557,070	588,650	853,000	1,137,050	176,424	186,896	285,584	400,355
52	609,730	648,000	1,034,300	1,462,440	193,101	205,740	346,284	514,925
Project Area	5,877,590	6,136,150	8,405,300	10,864,930	1,861,433	1,948,228	2,814,094	3,285,540
34	32,740	33,760	43,980	52,560	10,369	10,719	14,724	18,506
35	46,850	48,310	64,940	75,210	14,837	15,338	21,072	26,481
36	127,480	130,950	166,010	193,500	40,373	41,586	55,580	68,131
37	95,360	97,810	122,280	139,570	30,201	31,055	40,939	49,142
38	49,320	51,720	75,700	105,540	15,620	16,421	25,344	37,160
39	326,240	333,460	405,670	455,290	103,320	105,874	135,818	160,308
40	98,810	100,280	115,000	122,330	31,293	31,839	38,502	43,072
41	45,330	46,070	53,430	57,370	14,356	14,627	17,888	20,200
42	73,970	79,470	134,450	208,440	23,426	25,232	45,014	73,392
43	587,460	602,150	749,010	867,130	186,049	191,183	250,769	305,316
44	241,670	246,510	294,890	331,660	76,537	78,267	98,729	116,777
45	273,770	285,970	407,960	555,450	86,703	90,795	136,585	195,574
46	30,520	32,550	52,810	79,770	9,666	10,335	17,681	28,087
47	175,730	185,040	278,110	391,650	55,654	58,750	93,111	137,900
48	345,200	358,200	488,220	609,260	109,325	113,729	163,456	214,520
49	7,647,670	7,802,140	9,346,830	10,677,180	2,422,017	2,477,179	3,129,319	3,759,435
53	5,903,630	6,026,540	7,255,680	8,377,250	1,869,650	1,913,426	2,429,202	2,935,546
54	722,070	750,210	1,031,620	1,311,260	228,650	238,192	345,356	482,821

Estimated by the study team, August 1979.

Continued

POPULATION AND EMPLOYMENT BY ZONE 1979, 1980,1990 AND 2000

(Cont'd.) Unit: Persons

Zone No.	EMPLOYED PERSONS BY WORKPLACE							
	Primary				Secondary			
	1979	1980	1990	2000	1979	1980	1990	2,000
1								
2	2,982	2,982	3,000	2,213	42,580	43,000	52,000	70,490
3								
4								
5	774	774	800	600	34,310	37,000	71,000	127,160
6	0	0	600	872	510	1,000	6,000	13,320
7	150	150	100	36	1,840	3,000	15,000	32,697
8	95	95	300	367	970	1,000	1,500	2,420
9	1,109	1,109	1,700	1,666	1,940	2,000	3,000	4,840
11	1,084	1,084	1,000	666	5,820	7,000	20,000	39,960
10								
12	372	372	1,000	1,183	3,470	4,000	10,000	19,380
13								
14	1,964	1,964	2,000	1,480	4,740	5,000	8,600	14,770
15								
16	11	11	0	0	12,310	13,000	22,400	38,510
17								
18	655	655	1,000	978	4,860	5,000	7,400	11,870
19	131	131	2,000	2,183	2,900	3,000	4,600	7,510
20	500	500	0	0	5,880	6,000	8,400	13,080
21	627	627	0	0	10,780	11,000	15,400	23,980
22	480	480	0	0	3,880	4,000	6,000	9,690
23	114	114	0	0	9,080	10,000	21,100	38,990
24	2,415	2,415	0	0	11,640	12,000	18,000	29,100
25	111	111	0	0	3,880	4,000	6,000	9,690
26	210	210	0	0	5,530	6,000	11,800	21,310
27	552	552	0	0	8,310	9,000	17,600	31,730
28	442	442	0	0	7,380	8,000	15,700	28,340
29	133	133	150	121	1,430	3,000	19,000	42,390
30	67	67	0	0	4,190	7,000	36,000	78,720
31	464	464	500	390	18,020	19,000	32,500	55,710
32	839	839	900	699	19,450	21,000	40,500	72,660
33	1,461	1,461	1,750	1,482	61,000	61,000	72,000	100,510
50	6,371	6,371	4,500	1,911	119,350	124,000	195,000	322,130
51	1,566	1,566	0	0	80,860	84,000	132,000	217,980
52	937	937	190	0	52,039	56,000	107,000	192,914
Pro-ject Area	26,616	26,616	21,490	17,473	539,129	569,000	975,500	1,672,254
34	3,191	3,191	5,000	6,810	900	1,000	2,000	3,000
35	1,993	1,993	3,500	5,010	1,500	2,000	7,000	12,000
36	12,852	12,852	18,000	23,150	5,000	5,000	5,000	5,000
37	10,029	10,029	12,000	15,970	3,300	4,000	11,000	18,000
38	1,538	1,538	2,500	3,460	1,800	2,000	4,000	6,000
39	11,047	11,047	13,000	14,950	4,400	5,000	11,600	17,000
40	6,838	6,838	8,000	9,160	2,400	3,000	9,000	15,000
41								
42	2,130	2,130	3,000	3,870	0	0	1,000	2,000
43	52,652	–	50,906	45,492	51,722	–	96,546	157,848
44	21,660	–	20,042	17,400	21,277	–	38,011	60,374
45	30,519	–	34,419	36,377	21,502	–	46,819	90,160
46	3,402	–	4,456	5,224	2,397	–	6,064	12,948
47	14,748	–	17,598	19,306	7,291	–	16,853	33,510
48	30,939	–	33,182	31,963	30,392	–	62,930	110,907
49	641,834	–	591,441	526,321	317,284	–	566,407	913,543
53	714,218	–	665,601	592,980	471,159	–	847,791	1,376,771
54	23,800	24,616	34,500	48,350	20,200	21,000	31,000	45,760

Estimated by the study team, August 1979.

POPULATION AND EMPLOYMENT BY ZONE 1979, 1980, 1990 AND 2000

(Cont'd)

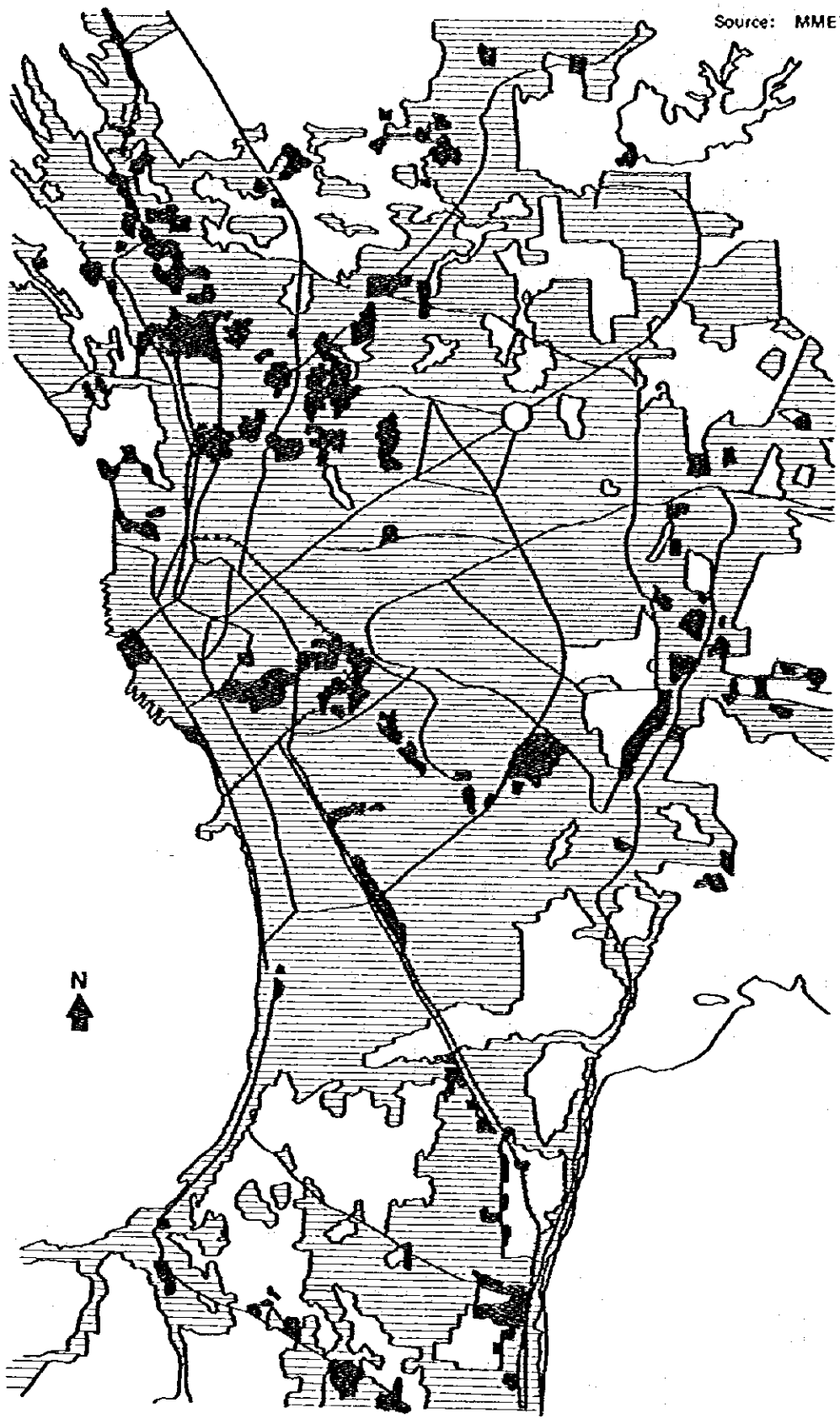
Unit: Persons

Zone No.	EMPLOYED PERSONS BY WORKPLACE							
	Tertiary				Total Employed by Workplace			
	1979	1980	1990	2000	1979	1980	1990	2000
1								
2	38,160	38,000	37,000	37,140	83,722	83,982	92,000	109,843
3								
4								
5	36,880	41,000	84,600	134,620	71,964	78,774	155,800	262,380
6	2,000	2,000	2,100	2,330	2,510	3,000	8,700	16,522
7	16,990	17,000	17,900	19,930	18,980	20,150	33,000	52,663
8	900	1,000	2,000	3,180	1,965	2,095	3,800	5,967
9	3,000	3,000	3,000	3,000	6,049	6,109	7,700	9,506
11	9,750	10,000	13,000	16,960	16,654	18,084	34,000	57,586
10								
12	2,900	3,000	4,000	5,180	6,742	7,372	15,000	25,743
13								
14	29,420	30,000	37,300	47,280	36,124	36,964	47,900	63,530
15								
16	14,430	15,000	18,700	23,740	26,751	28,011	41,100	62,250
17								
18	5,990	6,000	6,400	7,210	11,505	11,655	14,800	20,058
19	8,980	9,000	9,600	10,810	12,011	12,131	16,200	21,133
20	41,740	41,000	33,600	26,200	48,120	47,500	42,000	39,280
21	66,160	65,000	53,400	41,800	77,567	76,627	68,800	65,780
22	38,900	39,000	41,900	47,490	43,260	43,480	47,900	57,180
23	66,950	68,000	81,800	101,340	76,144	78,114	102,900	140,330
24	92,750	93,000	100,100	113,630	106,805	107,415	118,100	142,730
25	39,900	40,000	43,000	48,760	43,891	44,111	49,000	58,450
26	61,390	63,000	82,200	107,480	67,130	69,210	94,900	128,790
27	121,810	125,000	163,000	213,060	130,672	134,552	180,600	244,790
28	37,990	39,000	51,000	66,780	45,812	47,442	66,700	95,120
29	7,640	9,000	23,000	39,220	9,230	12,133	42,150	81,731
30	18,000	18,000	18,000	18,000	22,257	25,067	54,000	96,720
31	57,890	59,000	73,000	92,220	76,374	78,464	106,000	148,320
32	117,480	120,000	151,000	192,920	137,769	141,839	192,400	266,279
33	148,140	151,000	187,000	236,380	210,601	213,461	260,250	338,372
50	56,380	62,000	121,000	190,800	182,101	192,371	320,500	514,841
51	174,670	189,000	341,000	522,580	257,096	274,566	473,000	740,560
52	169,666	180,000	325,100	565,930	222,642	236,937	432,290	758,844
Project Area	1,486,996	1,536,000	2,124,100	2,937,080	2,052,741	2,131,616	3,121,090	4,626,807
34	3,900	4,000	5,000	6,000	7,991	8,191	12,000	15,810
35	4,300	5,000	12,000	19,000	7,793	8,993	22,500	36,010
36	11,600	12,000	16,000	20,000	29,452	29,852	39,000	48,150
37	16,700	17,000	20,000	23,000	30,029	31,029	44,000	56,970
38	6,400	6,000	2,000	2,000	9,738	9,538	8,500	11,460
39	15,700	16,000	19,000	22,000	31,147	32,047	43,000	53,950
40	12,800	13,000	15,000	17,000	22,038	22,838	32,000	41,160
41								
42	2,000	2,000	2,000	2,000	4,130	4,130	6,000	7,870
43	81,676	–	103,317	101,976	186,049	–	250,769	305,316
44	33,600	–	40,676	39,004	76,537	–	98,729	116,777
45	34,681	–	55,317	69,038	86,703	–	136,585	195,574
46	3,866	–	7,161	9,915	9,666	–	17,651	28,087
47	33,615	–	58,660	85,084	55,654	–	93,111	137,900
48	47,994	–	67,348	71,650	109,325	–	163,456	214,520
49	1,462,898	–	1,911,471	2,319,571	2,422,017	–	3,129,319	3,759,435
53	684,302	–	915,809	965,795	1,869,680	–	3,429,202	2,935,546
54	50,930	52,000	64,000	78,770	94,930	97,616	129,500	172,880

Estimated by the study team, August 1979.

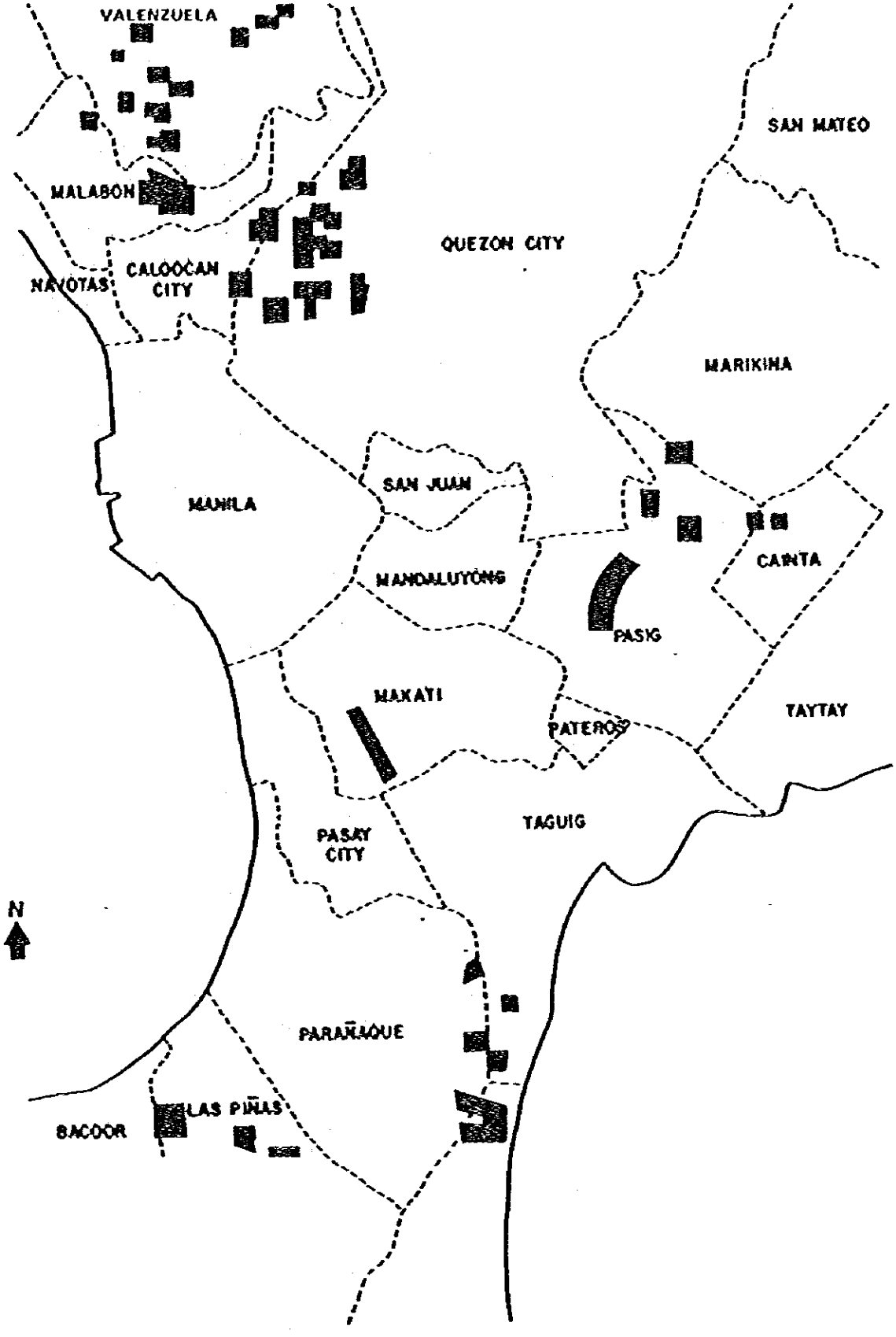
Appendix I-2
Fig. II-2-1 DISTRIBUTION OF INDUSTRIAL LAND USE

Source: MMETROPLAN



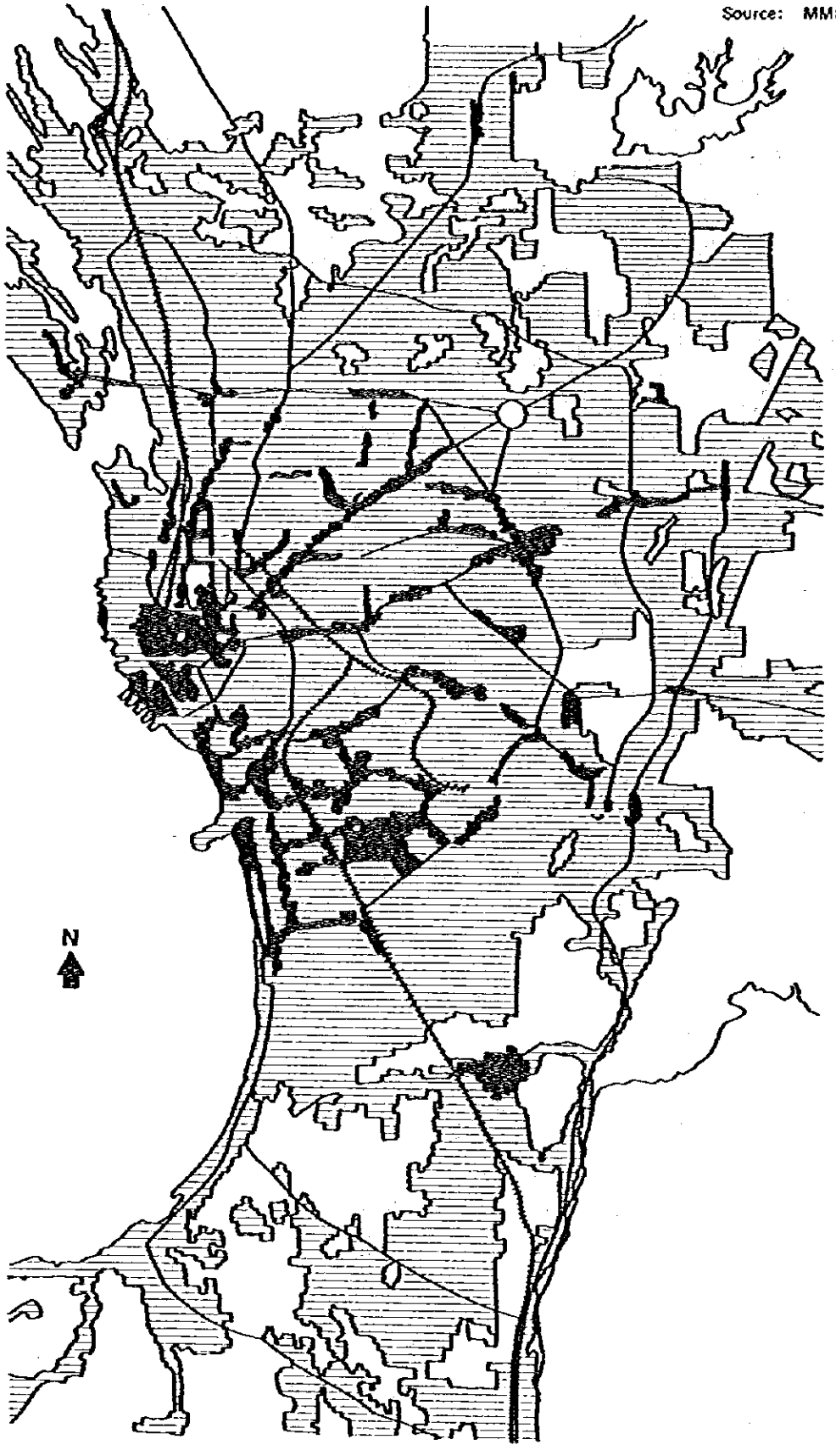
Appendix I-3
Fig. II-2-2 INDUSTRIAL DEVELOPMENT 1960-1975

Source: OPWTC PPDO

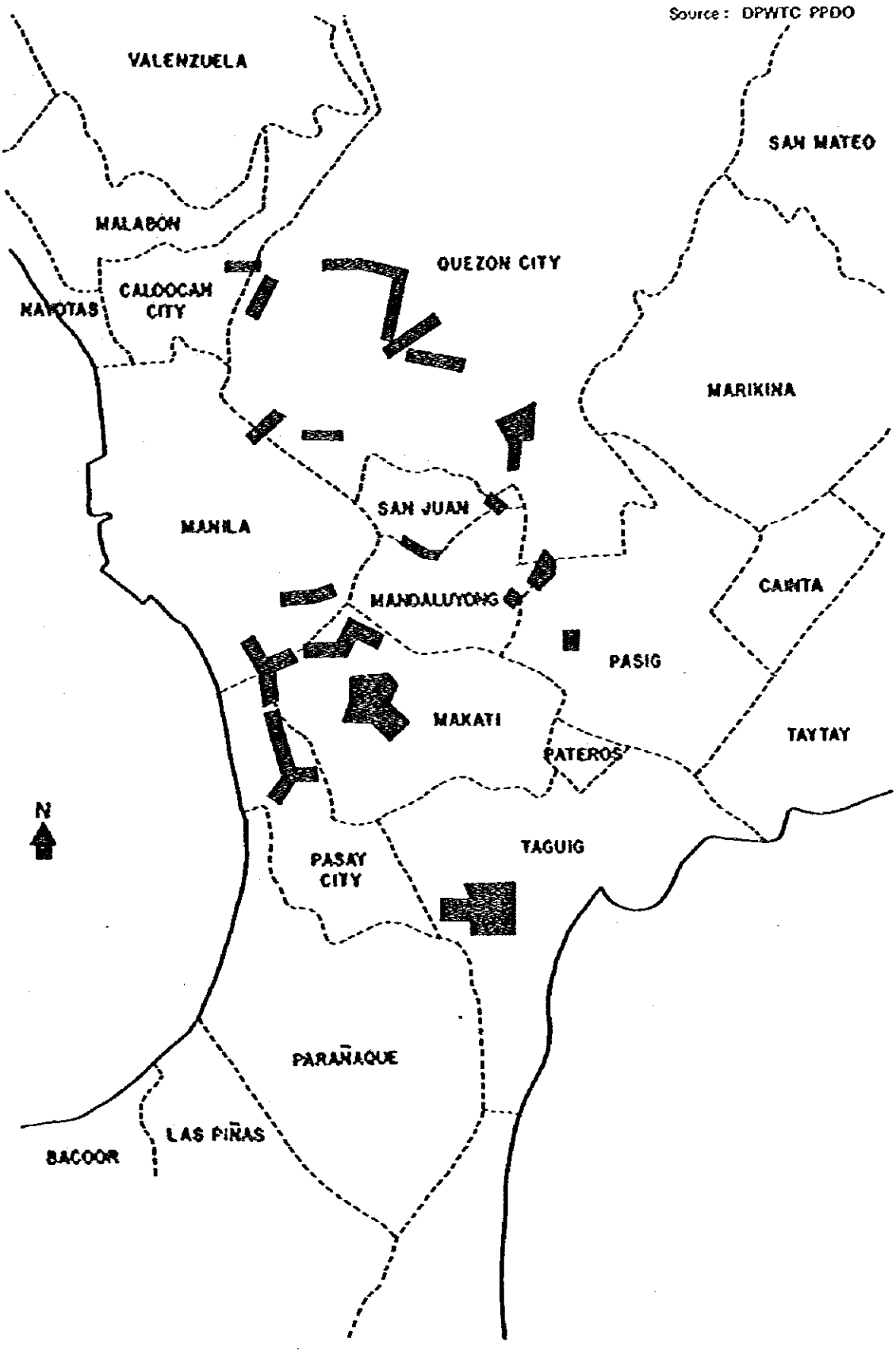


Appendix I-4
Fig. II-2-3 DISTRIBUTION OF COMMERCIAL LAND USE

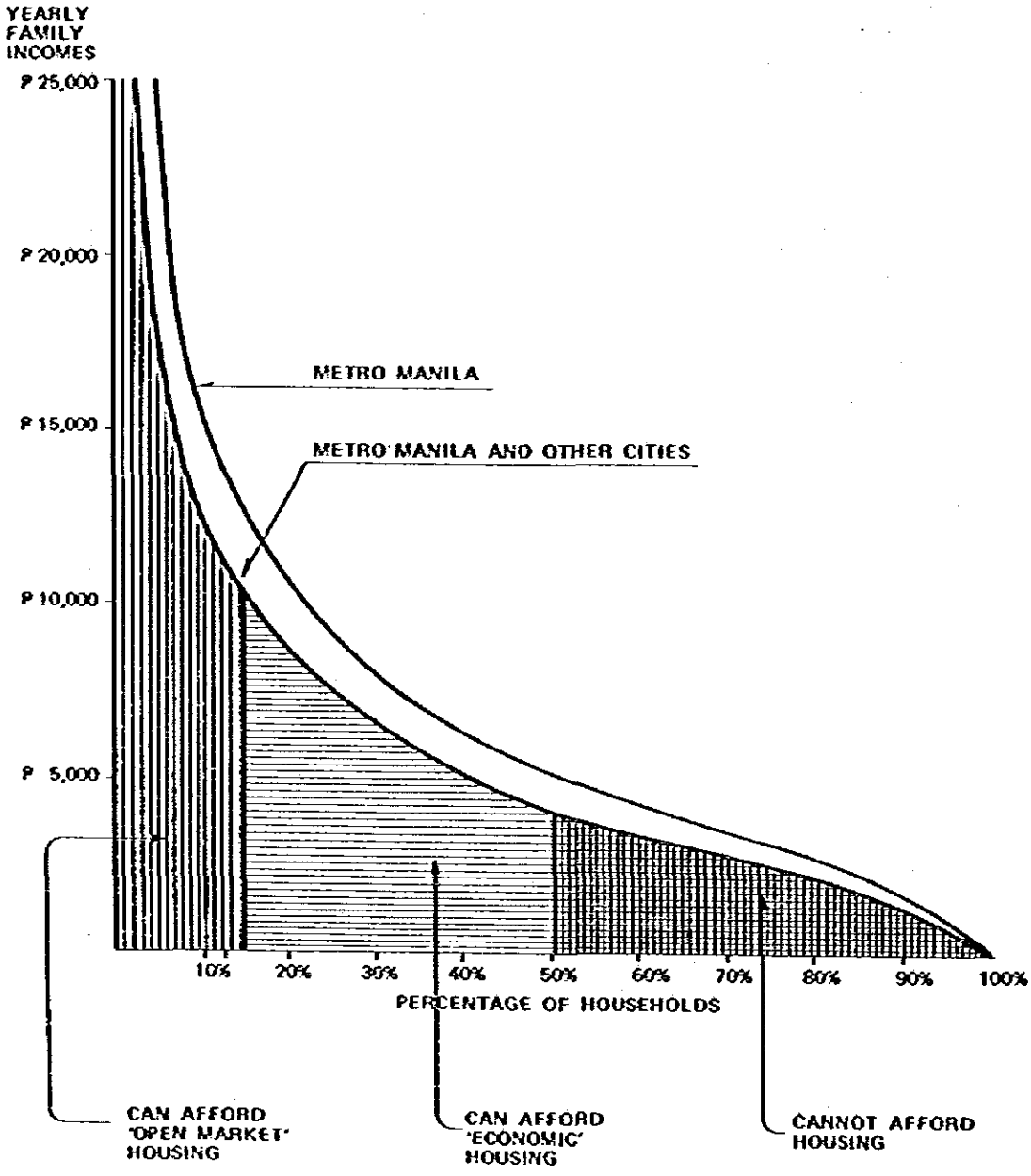
Source: MMETROPLAN



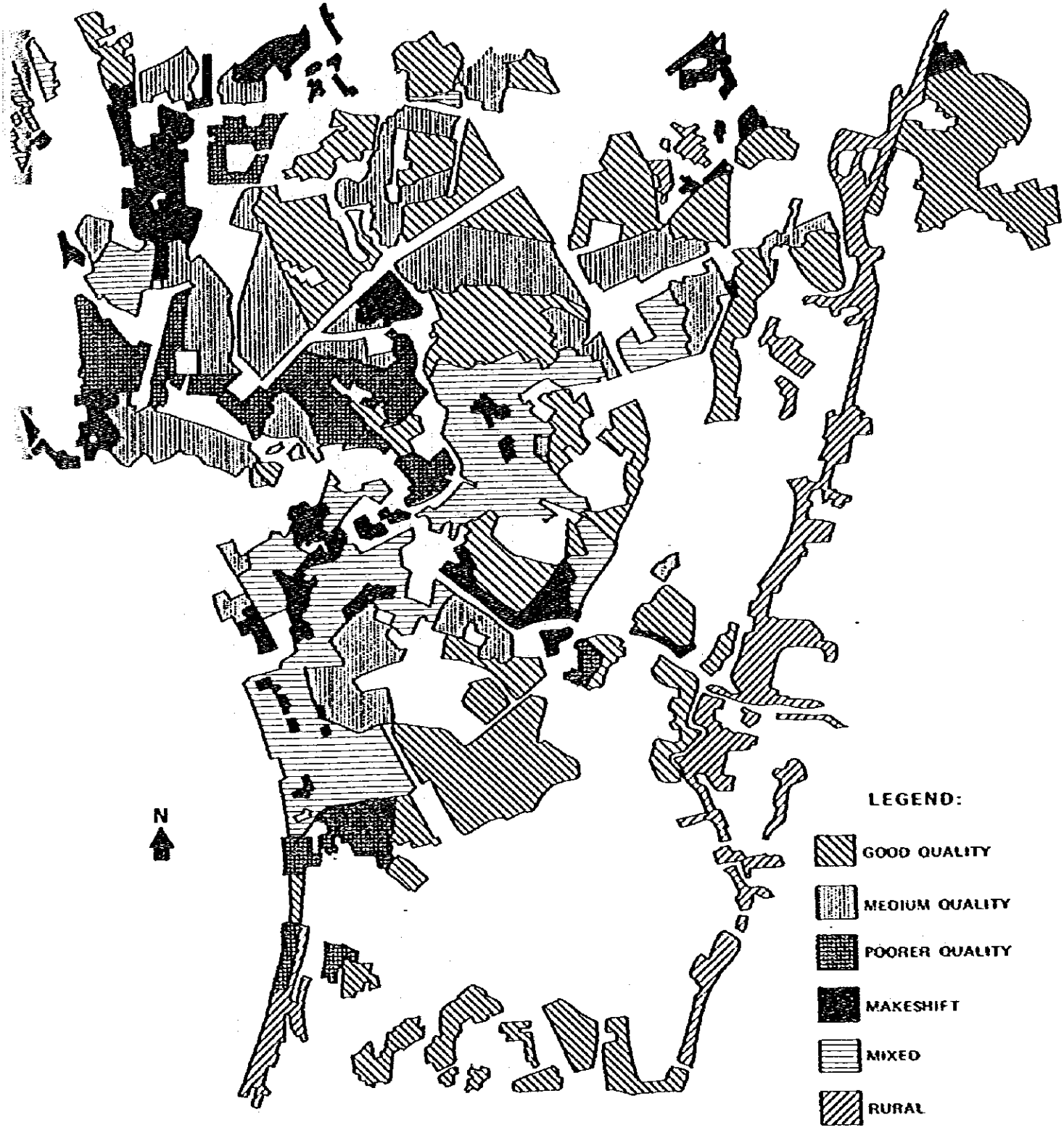
Appendix I-5
Fig. II-2-4 COMMERCIAL DEVELOPMENT 1960-1975

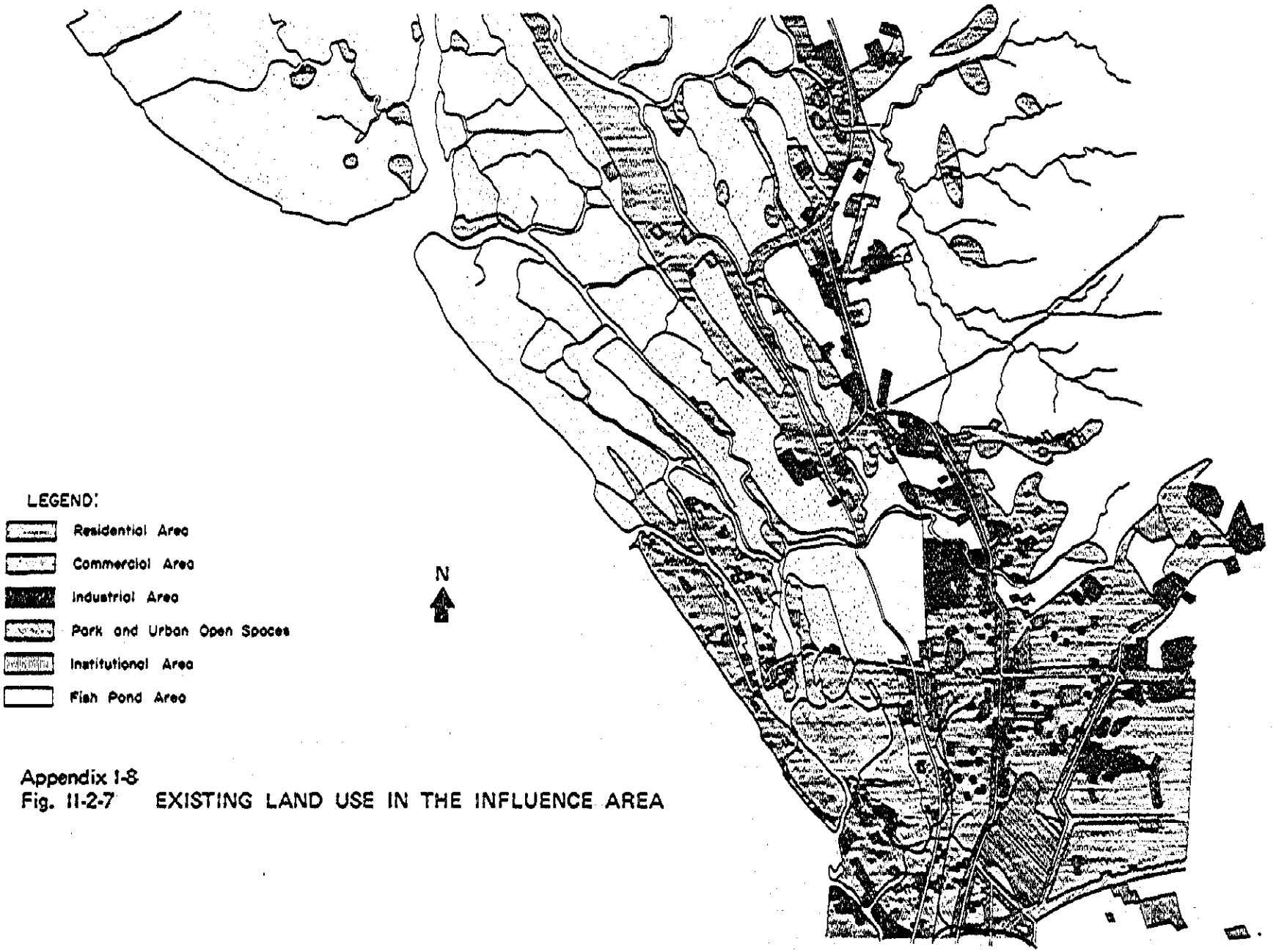


Appendix I-6
Fig. II-2-5 ABILITY TO AFFORD HOUSING BY FAMILY INCOME (1972)

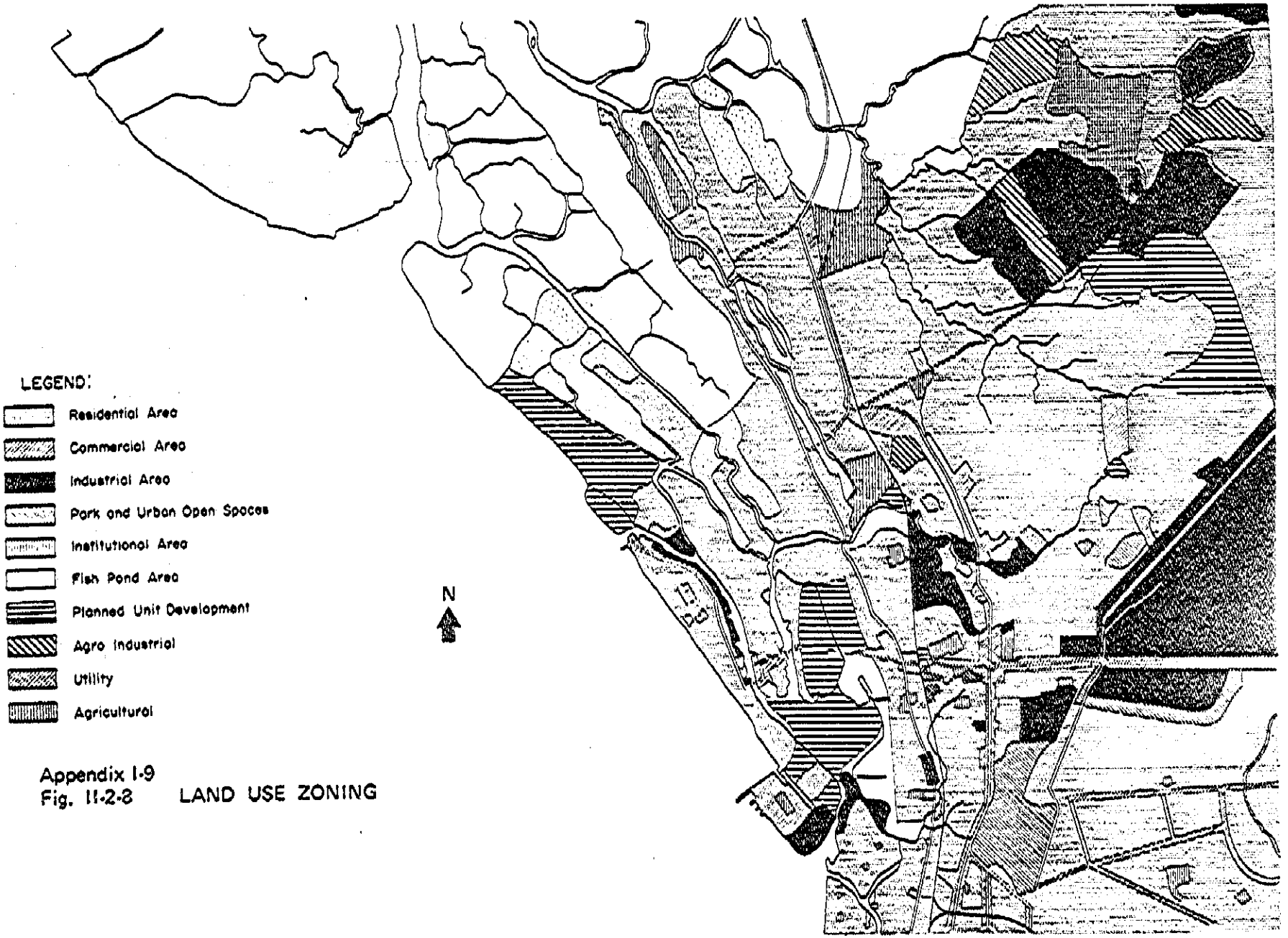


Appendix I-7
Fig. II-2-6 HOUSING QUALITY IN METRO MANILA





Appendix 1-8
Fig. II-2-7 EXISTING LAND USE IN THE INFLUENCE AREA

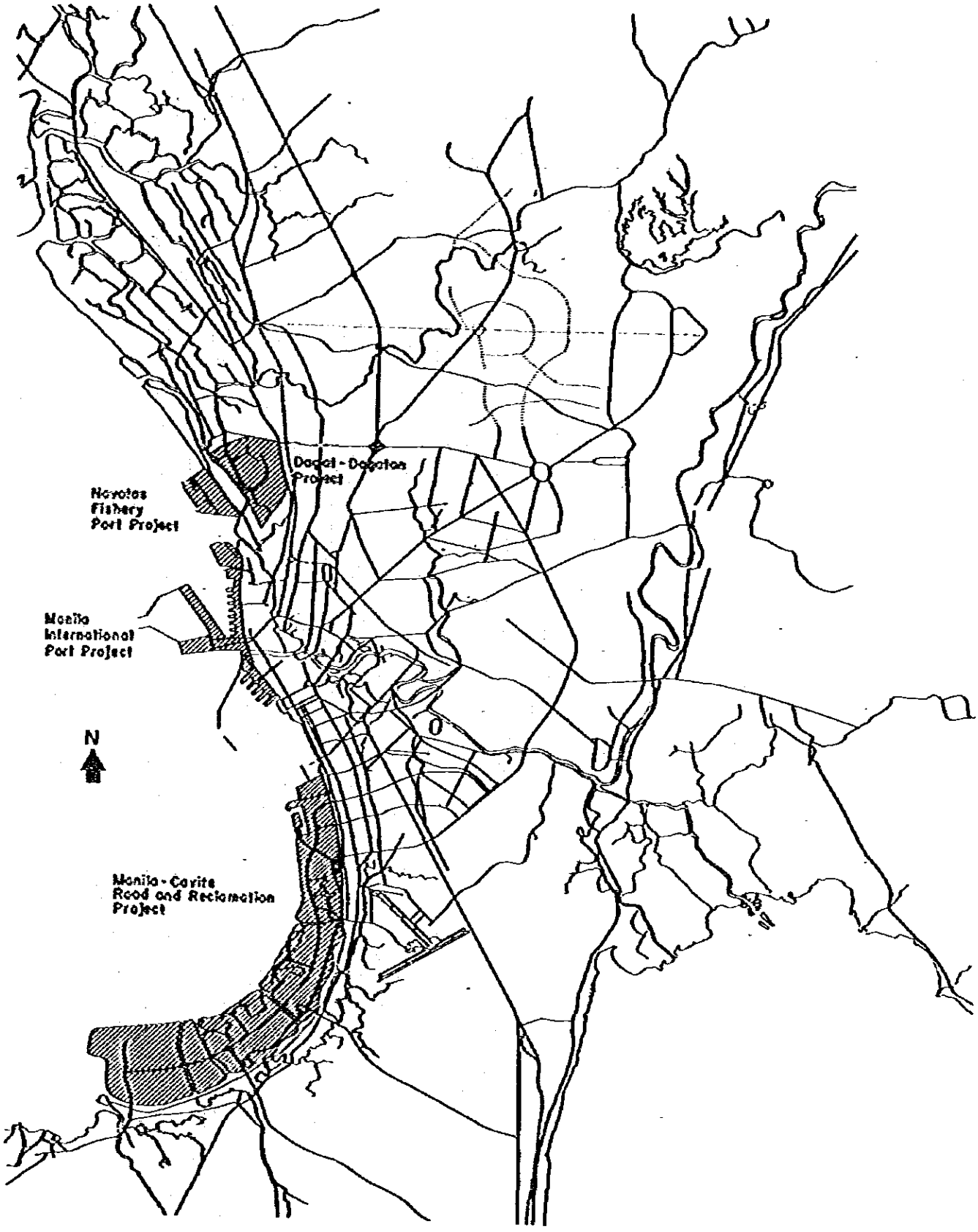


Appendix I-9
Fig. II-2-8 LAND USE ZONING

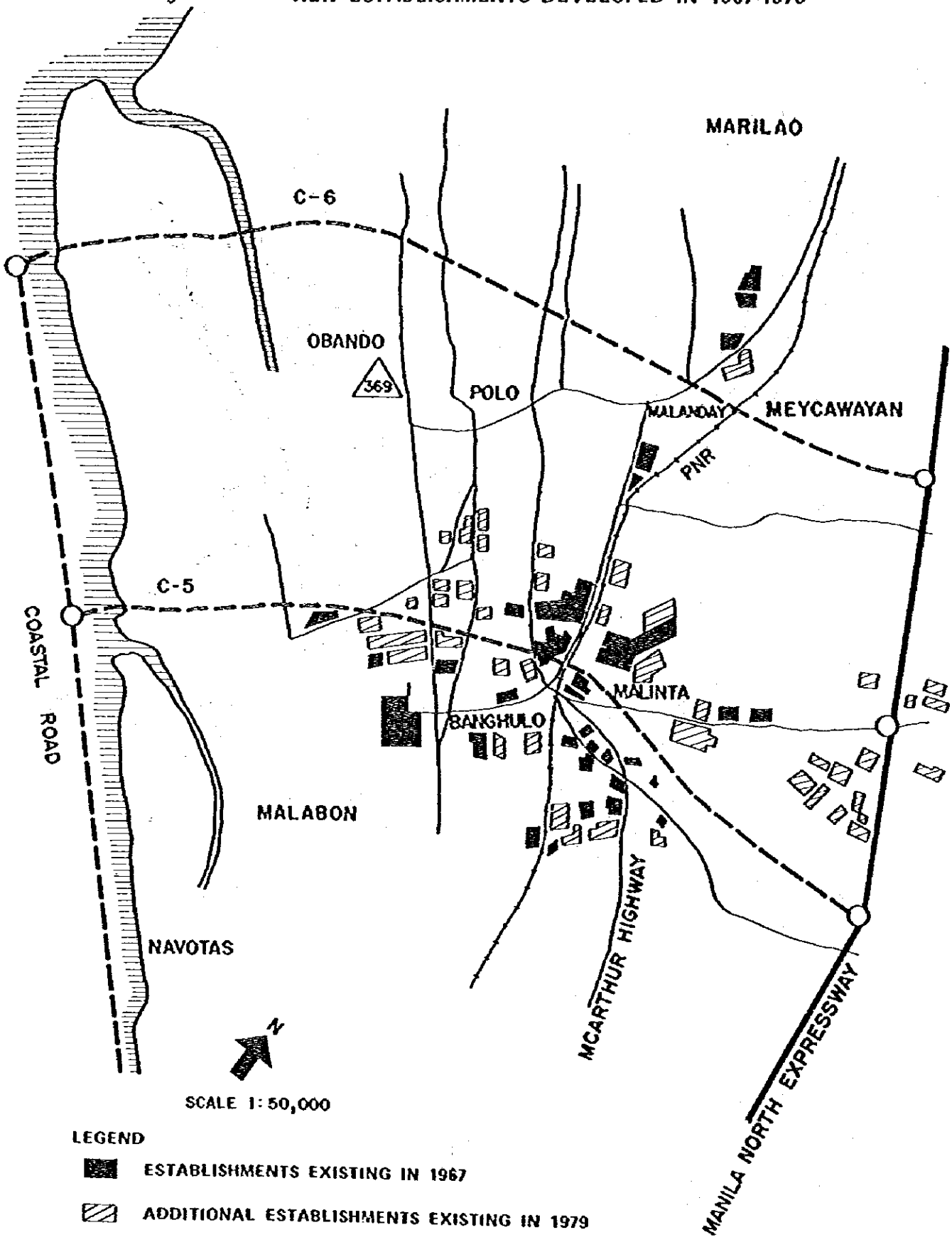
Appendix I-10
Table II-2-2 SUMMARY OF ZONING PLAN FOR METRO MANILA

Municipality	Residential	Open space/ Park	Agricultural	Institutional	Industrial	Commercial	Utilities	Reclamation Area	Agro-Industrial	Fish-ponds	Vacant/ Undeveloped	Total
Manila	14.0100	5.6100	9.3400	4.6700	3.2690	0.9340	0.4670					38.30000
San Juan	8.2056	0.4056		1.0816	0.3432	0.3640						10.4000
Mandaluyong	9.1000	7.4360		2.7040	5.4080	1.3520						26.0000
Pasay City	8.3400	0.2780		0.0695	1.0425	4.1700						13.9000
Caloocan City	12.7512	26.2384	7.9782	0.4587	1.7599	1.9466	0.1120	2.0852				53.3302
Valenzuela	15.9900	4.7000	14.1000	2.8200	2.3500	4.2300			0.9600	1.8800		47.0300
Malabon	11.4513	0.4674	0.7011	1.1685	1.8696	1.8696				5.8425		23.3700
Navotas	0.3370	1.1795	0.8425	0.6740	0.1011	0.1685	0.0067					3.3093
Quezon City	46.3360	3.3240		6.6480	7.9776	1.9944						66.2800
Pasig	9.1800	0.2295	12.9610	0.3105	3.5100	0.8100						27.0010
Marikina	6.7940	2.7176		3.3970	4.7555	2.0382					12.2674	31.9697
Pateros	0.8400		1.0450	0.8500								2.7350
Muntilupa	14.0100	14.0100	9.3400	4.6700	3.2690	0.9340	0.4670					46.7000
Makati	16.7216	2.9860		0.8958	0.2986	8.9580						29.8600
Paranaque	15.3200	4.6600	5.7450	0.1915	1.9150	1.1490	0.5745			5.7450		35.3000
Las Piñas	24.9240	12.4620	2.0770		1.2462					0.4154		41.1246
Taguig	2.2100	0.3700		0.2200	0.7400	0.9000				3.0000		7.4400
TOTAL	216.5207	87.0740	64.1298	30.8291	39.8552	31.8183	1.6272	2.0852	0.9600	16.8829	12.2674	502.4498

Appendix I-11
Fig. II-2-9 MAJOR DEVELOPMENT PROJECTS IN METRO MANILA

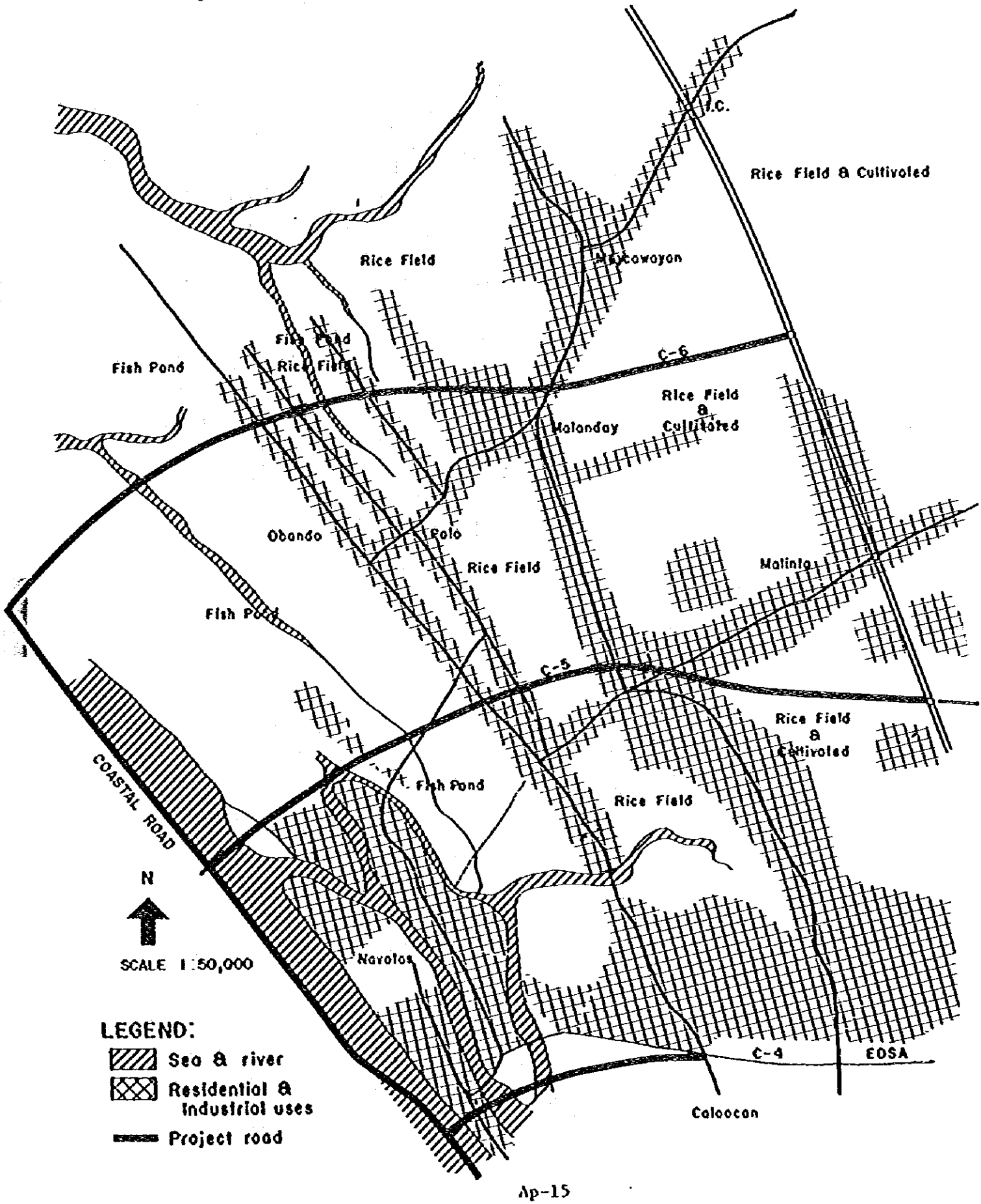


Appendix I-12
Fig. III-2-1 NEW ESTABLISHMENTS DEVELOPED IN 1967-1979



Appendix I-13

Fig. III-2-2 LAND UTILIZATION IN DIRECT INFLUENCE ZONE, 1979



Appendix I-14

Table III-3-1 TRAFFIC ON ROADS IN THE PROJECT AREA

Station No.	Road and Municipality	Year	Cars	Jeep-neys	Buses	Trucks	Total (AADT)	Ratio '78/76
	McArthur Highway [1]							
1	Km Valenzuela	'76	6,163	6,007	410	574	13,154	
	10	'78	7,291	6,461	16	1,142	15,910	1.21
2	Km Marilao	'76	4,869	3,722	258	2,938	11,787	
	28	'78	5,703	4,292	225	2,181	12,357	1.05
3	Km Malolos	'76	6,536	871	2,112	3,360	12,879	
	45	'78	4,295	1,675	878	2,707	9,555	0.74
4	Km Calumpit	'76	6,221	1,234	1,938	2,466	11,859	
	53	'78	9,611	2,780	1,970	4,736	19,093	1.60
5	Km San Fernando	'76	6,949	1,306	2,132	3,045	13,452	
	62	'78	5,254	3,713	5,466	4,472	18,891	1.40
6	Km Angeles	'76	4,168	1,853	1,468	2,062	9,551	
	96	'78	8,313	2,473	1,163	2,723	14,672	1.54
7	Km Angeles	'76	6,951	2,133	2,283	3,057	14,418	
	70	'78	10,006	2,379	2,742	5,073	20,205	1.40
	Bataan Highway [1]							
8	Km Guagua	'76	2,888	3,301	709	1,287	8,186	
	81	'78	4,921	2,701	1,160	1,362	10,144	1.24
9	Km Lubao	'76	2,057	877	686	1,089	4,709	
	95	'78	2,834	813	1,037	1,496	6,180	1.31
10	Km Dinalpihan	'76	1,043	647	441	729	2,854	
	109	'78	1,198	916	504	403	3,021	1.06
11	Km S. Benito	'76	1,194	266	790	686	2,936	
	110	'78	1,391	222	1,024	500	3,137	1.07
12	Km Orani	'76	1,161	1,007	410	574	3,154	
	118	'78	708	25	24	553	1,310	0.42
13	Km Balanga	'76	1,416	1,543	411	610	3,980	
	122	'78	960	776	419	358	2,573	0.88
14	Km Limay-Mari	'76	367	46	332	405	1,150	
	148	'78	848	223	428	323	1,822	1.58
15	Km Mariveles	'76	335	35	296	304	970	
	163	'78	693	116	314	286	1,409	1.45
	Manila North [2] Expressway							
16	Balintawak – Malinta	'78	–	–	–	–	34,600	–
17	Ma – Meycawayan	'78	–	–	–	–	28,700	–
18	My – Bucaue	'78	–	–	–	–	25,000	–
19	Bu – Bigaa	'78	–	–	–	–	21,400	–
20	Bi – St. Rita	'78	–	–	–	–	7,700	–
21	SR – Tibag	'78	–	–	–	–	6,900	–
22	Ti – S. Domingo							
	Malolos–Obando–Caloocan [1]							
23	Km 25 Obando	'78	–	–	–	–	4,900	–
24	Km 42 Malolos	'78	3,221	3,393	122	1,478	10,348	–
	Guiguito–Maasin–Palayan	'78	712	880	188	46	1,833	–
25	Km 46 Plaridel	'78	1,257	734	636	842	3,472	–

Source: 1) PPDO, MPH, August 1979.
2) Manila North Highway Adm. Office, CDCP, March 1979.

Appendix I-15
Table III-3-2 TRAFFIC COUNT RESULTS FOR 24-HOUR PERIOD [2]

Station	Direction [1] Types	Car, Jeep and Taxi	Pick-up & Vans	Jeepney	Bus	Truck – Medium	Truck – Large	Total
1	I	8954	2169	1442	1991	58	529	16543
	(%)	(54)	(13)	(9)	(12)	(9)	(3)	(100)
	II	9239	4005	808	2243	1799	870	18964
	(%)	(49)	(21)	(4)	(12)	(9)	(5)	(100)
	Total	18193	6174	2250	4234	3257	1399	35507
	(%)	(51)	(17)	(6)	(12)	(9)	(4)	(100)
2	I	1797	1060	1591	12	480	107	4947
	(%)	(36)	(21)	(30)	(0)	(10)	(2)	(100)
	II	1943	734	1239	18	354	56	4344
	(%)	(45)	(17)	(29)	(0)	(8)	(1)	(100)
	Total	3740	1794	2730	30	834	163	9291
	(%)	(40)	(19)	(29)	(0)	(9)	(2)	(100)
3	I	3606	801	5249	25	821	376	10878
	(%)	(33)	(7)	(48)	(0)	(8)	(3)	(100)
	II	3247	1060	5925	38	748	318	11336
	(%)	(29)	(9)	(52)	(0)	(7)	(3)	(100)
	Total	6853	1861	11174	63	1569	694	22214
	(%)	(31)	(8)	(50)	(0)	(7)	(3)	(100)
4	I	1183	457	1511	78	210	62	3504
	(%)	(34)	(13)	(43)	(2)	(6)	(2)	(100)
	II	1256	240	1318	37	202	73	3126
	(%)	(40)	(8)	(42)	(1)	(6)	(2)	(100)
	Total	2439	697	2829	115	412	135	6627
	(%)	(37)	(11)	(43)	(2)	(6)	(2)	(100)
5	I	391	61	272	7	44	2	777
	(%)	(50)	(8)	(35)	(1)	(6)	(0)	(100)
	II	388	105	292	0	21	1	807
	(%)	(48)	(13)	(36)	(0)	(3)	(0)	(100)
	Total	779	166	564	7	65	3	1584
	(%)	(49)	(10)	(36)	(0)	(3)	(0)	(100)
TOTAL	I	15931	4548	9965	2113	3013	1076	36646
	(%)	(44)	(12)	(27)	(6)	(8)	(3)	(100)
	II	16073	6144	9582	2336	3124	1318	38577
	(%)	(42)	(16)	(27)	(6)	(8)	(3)	(100)
	Total	32004	10692	19547	4449	6137	2394	75223
	(%)	(43)	(14)	(24)	(6)	(8)	(3)	(100)

Notes: 1) Direction II towards Manila and the direction I to San Fernando.
2) Percent share of a vehicle type is indicated in ( ).
3) A week day of mid-July 1979.

Appendix I-16
Table III-3-3 CHANGES OF DAILY TRAFFIC VOLUME, 1978

Daily Traffic Volume at the Control Station (KM 28) on Manila North Road[1)]

Date	Total Traffic Count, 24 hours	Daily Traffic Over the Average	Date	Total Traffic Count, 24 hours	Daily Traffic Over the Average
6- 5 Mon.	12,264	1.021	12- 4 Mon.	11,756	1.030
6- 6 Tue.	11,490	0.957	12- 5 Tue.	11,922	1.045
6- 7 Wed.	12,175	1.014	12- 6 Wed.	11,484	1.006
6- 8 Thu.	12,925	1.077	12- 7 Thu.	11,211	0.983
6- 9 Fri.	12,082	1.006	12- 8 Fri.	11,066	0.970
6-10 Sat.	12,189	1.015	12- 9 Sat.	11,288	0.989
6-11 Sun.	10,898	0.908	12-10 Sun.	11,145	0.977
Total	84,023	-	Total	79,872	-
Average	12,004	1.000	Average	11,140	1.000

Monthly Changes of ADT at the Control Station (KM 28) on Manila North Road[1)]

Month / Items	1	2	3	4	5	6	7	8	9	10	11	12	Aver-age
ADT	12,992	12,540	12,570	12,453	12,153	12,289	12,794	11,559	12,421	12,853	12,154	11,408	12,354
Monthly Factor	1.052	1.015	1.017	1.008	0.984	0.995	1.036	0.936	1.005	1.040	0.983	0.923	1.000
Seasonal Factor	0.990			1.005			1.010			1.002			

Source: PPDO of MPH

Note: 1) The station number 2002 of KM 28 on Manila North Road (the extension of McArthur Highway) is located in the direct influence zone, Marilao Bulacan.

Appendix I-17
Table III-3-4 SAMPLED NUMBER OF VEHICLES IN OD INTERVIEW

Station	1		2		3		4		5		Total		Total
Direction 1)	I	II	I	II	I	II	I	II	I	II	I	II	
Sampled Number of Vehicles = A	1,685	2,057	499	616	1,065	1,066	348	297	70	89	3,667	4,125	7,792
Traffic Volume 2) = B	16,543	18,964	4,947	4,344	10,878	11,336	3,504	3,126	777	807	36,646	38,577	75,223
A/B Ratio (%)	10.2	10.8	10.1	14.2	9.8	9.4	9.9	9.5	9.0	11.0	10.0	10.7	10.4

Notes: 1) Direction II is towards Manila and I towards San Fernando.
2) From Appendix I-14.

Appendix I-18
Table III-3-5 AVERAGE NUMBER OF PASSENGERS PER VEHICLE

Station	1		2		3		4		5		Total		Average pass/veh
Vehicle Type	Veh.	pass.	veh.	pass.	veh.	pass.	veh.	pass.	veh.	pass.	veh.	pass.	
Car	18,148	50,217	3,738	9,114	6,834	17,811	2,440	6,356	776	1,847	31,936	85,345	2.7
Jeepney	2,269	33,028	2,728	40,684	11,150	164,154	2,830	43,165	564	8,042	19,541	289,073	14.8
Bus-Medium	743	25,923	0	0	20	256	0	0	0	0	763	26,179	34.3
Bus-Large	3,545	165,489	0	0	33	287	114	2,499	0	0	3,692	168,275	45.6
Bus-Total	4,288	191,412	0	0	53	543	114	2,499	0	0	4,455	194,454	43.7

Appendix I-19
Table III-3-6 TRIP-PURPOSE DISTRIBUTION OF PASSENGER CARS [1]

Station	Direction [3]	To/from Home	Between Works/ Businesses	Others	Total
1	I	1,436	2,379	5,057	8,872
	II	3,092	2,125	3,964	9,181
2	I	339	387	1,063	1,789
	II	252	437	1,250	1,939
3	I	545	877	2,164	3,586
	II	775	618	1,831	3,224
4	I	307	312	552	1,171
	II	199	367	694	1,260
5	I	135	0	254	389
	II	46	99	242	387
Total [2]	I	2,762	3,955	9,090	15,807
		(17.5)	(25.0)	(57.5)	(100.0)
	II	4,364	3,646	7,981	15,991
		(27.3)	(22.8)	(49.9)	(100.0)
Total	(I + II)	7,126	7,601	17,071	31,798
		(22.4)	(23.9)	(53.7)	(100.0)

Notes: 1) Car, jeep and taxi.
2) Percent share is shown in ( ).
3) Direction II towards Manila and the direction I from Manila.

Appendix I-20, Table III-3-7 (A) FUEL USE IN SAMPLED NUMBER OF VEHICLES

Car Type / Fuel Type	Car		Pickup		Jeepney		Bus		Truck		Total 1)	
	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel
Station 1	16,716	1,268	5,435	726	583	1,669	373	3,901	664	3,981	24,857	15,168
2	3,502	198	1,575	218	486	2,242	0	0	224	784	5,787	3,442
3	6,544	280	1,668	211	2,728	8,266	21	32	515	1,768	17,034	5,019
4	2,361	70	562	94	546	2,200	26	65	133	430	3,628	2,859
5	725	51	183	0	204	360	0	0	14	57	1,126	468
Total 1)	29,840 (94.1)	1,867 (5.9)	9,243 (88.3)	1,249 (11.7)	4,547 (26.6)	12,537 (73.4)	420 (9.5)	3,998 (90.5)	1,550 (18.1)	7,020 (81.9)	52,432 (66.0)	26,956 (34.0)

Note: 1) No answers are not included.

Appendix I-20, Table III-3-7 (B) AVERAGE LOADING WEIGHT IN TONS

Type	Vehicle 1)	Weight (t)	Average Weight (t/veh.)	Loading Veh. Ratio (%)	Remarks
Truck, Medium	6,206	14,666.7	2.36	35.9	Load-capacity loss than 5 t
Truck, Large	2,019	7,134.5	3.53	31.9	More than 5 t
Trailer	433	1,595.9	3.69	34.7	More than 5 t
Total	8,658	23,397.1	2.70	34.9	

Note: 1) Empty trucks are included.

Appendix I-21, Table III-3-8 MAJOR COMMODITIES CARRIED

Commodity 1)		1 Milled Rice Palay	2 Sugar Cane	3 Log and Lumber	4 Food Products	5 Processed Foods	6 Fertilizers	7 Oil Products	8 Cement and Steels	9 Iron or and Minerals	Total 3)
veh.	M	175	69	96	211	395	14	128	894	283	2,265
	H	88	35	51	39	51	8	17	312	41	642
	TR	4	18	12	9	40	0	36	22	14	155
	Total	267	122	159	259	486	22	181	1,228	338	3,062
2)		(8.7)	(4.0)	(5.2)	(8.5)	(15.9)	(0.7)	(5.9)	(40.1)	(11.0)	(100.0)
Weight (t)											
	M	1,093.7	517.7	763.3	787.5	414.7	146.9	913.1	7,985.4	986.0	13,608.3
	H	915.8	388.1	419.9	235.7	452.4	72.4	83.9	4,212.0	342.1	7,122.3
	TR	7.0	153.0	240.0	88.2	398.7	0.0	222.0	347.0	140.0	1,595.9
	Total	2,016.5	1,058.8	1,423.2	1,111.4	1,265.8	219.3	1,219.0	12,544.4	1,468.1	22,326.5
2)		(9.0)	(4.7)	(6.4)	(5.0)	(5.7)	(1.0)	(5.5)	(56.1)	(6.6)	(100.0)
Average Weight (t/veh.)											
	M	6.2	7.5	8.0	3.7	3.6	10.5	7.1	8.9	3.5	6.5
	H	10.4	11.1	8.2	6.0	8.9	9.1	4.9	13.5	8.3	11.1
	TR	1.8	8.5	20.0	9.8	10.0	0	6.2	15.8	10.0	10.2
	Total	7.6	8.7	9.0	4.3	2.6	10.0	6.7	10.2	4.3	7.6

Notes: 1) M: medium trucks; H: Heavy trucks and TR: trailers
Empty vehicles are not included
2) ( ) indicates the percent composition.
3) Unindentified commodities are excluded.

Appendix I-22
Table III-3-9 TRIP-LENGTH DISTRIBUTION

Vehicle Type, Trip & Trip Ratio / Trip length (km)	Car/Pick-up		Truck	
	Trip	Ratio (%)	Trip	Ratio (%)
0.0 ∿ 10.00	4,320	10.12	549	6.47
11.00 ∿ 20.00	6,620	15.50	839	9.83
21.00 ∿ 30.00	6,517	15.27	842	9.87
31.00 ∿ 40.00	6,699	15.69	927	10.86
41.00 ∿ 50.00	4,516	10.58	727	8.51
51.00 ∿ 60.00	4,281	10.03	628	7.35
61.00 ∿ 80.00	3,603	8.44	1,184	13.88
81.00 ∿ 100.00	3,620	8.48	1,388	16.28
101.00 ∿ 120.00	2,154	5.05	1,056	12.37
121.00 ∿ 140.00	351	0.82	356	4.16
141.00 ∿ 160.00	13	0.03	35	0.41
Total 1/	42,694	100.00	8,531	100.00

Notes: 1/ Average trip distances are calculated at 42.6 km for small vehicles (car and pick-up) and 59.9 km for trucks (including trailer types).

Appendix I-23

Table III-3-10 ZONING FOR TRAFFIC STUDY

No.	Municipality	Barangay
1	Valenzuela South	Malinta, Karuhatan, Marulas, & Gen. T. de Leon
2	Valenzuela West	Arkong Bato, Pulo, Balangkas & Tagalag
3	Valenzuela Center	Malanday, Dalandanan, Pasolo & Caloong
4	Valenzuela East	Maysan, Lincunan, Canumay, Bignay and ugong
5	Caloocan Center	Calaanan, Grace Park, San Jose, Balintawak
6	Caloocan East	Kaybiga, Bagombong, De Paro, Tala and Camarin
7	Caloocan West	Maypayo, Sampalocan, Poblacion and Sangandaan
8	Obando East	Paliwas, Pagasa, Catanghalan & Panhulo
9	Obando West	S. Pascual, Hulo, Lawa, Paco and Tawiran
10	Meycawayan West	Ubihan, Liputan, Longos, Saluysoy and Malhacan
11	Meycawayan East	Liptong, Camalig, Pajo, Bahay pare
12	Marilao West	Boabangan Norte & Sur, Bo. Tabing iloz, Bo. Lias, Bo. Nagbalon
13	Marilao East	Bo. Sta. Rosa I & II, Loma de Gato, Prenza I & II
14	Malabon South	Ibaba, San Agustin, Tonsuya, Longos and Tañong
15	Malabon West	Dampalit, Hulong Duhat, Muzon, Baritan
16	Malabon Center	Maysilo, Panghulo, Tenejeros, Acacia & Tugatog
17	Malabon East	Potrero
18	Navotas South	Dagat Dagatan, East, West, Sipac, Bagunbayan
19	Navotas North	San Jose, Daang Hari, San Rogue, Tangos
20	Manila West	North Port District
21	Manila West	Divisoria Tondo
22	Manila North	Sta. Cruz District
23	Manila East	Sampaloc District
24	Manila West	Binondo & San Nicolas
25	Manila Center	Quiapo, San Miguel
26	Manila West	Intramuros
27	Manila South	Ermita & Malate
28	Manila East	Pandacan, Paco, & Sta. Ana
29	Quezon City North	Novaliches, Constitution Hills
30	Quezon City North	San Bartolome, Tandang Sora
31	Quezon City West	Sta. Mesa Hts. Santol, Balintawak San Jose, Del Monte, Galas
32	Quezon City Center	Kamuning, Bagobantay, Quadrangle
33	Quezon City East	New Manila, Cubao, Diliman, Murphy, Quirino
34	Bulacan South	Bulacan, Pinagbayanan, Pitpitan & Balubat
35	Bulacan Center	Bucaue, Lolomboy, Sta. Maria, Turo, Binang
36	Bulacan East	Sta. Maria, Pandi, Angat, Norzagaray
37	Bulacan Center	Malolos, Longos, Sta. Rita, Dakila
38	Bulacan Center	Guiguinto, Bohol, Balagtas, Panginay
39	Bulacan North	Plaridel, Pulilan, Baliwag, Bustos, S. Rafael
40	Bulacan West	Hagonoy, Paombong, San Isidro, Sta. Monica
41	Bulacan West	Calumpit, San Jose, Sta. Lucita, Iba
42	Bulacan East	Sapanga Palay, San Jose, Sto. Cristo
43	Pampanga East	Mexico Arayat, Sta. Arayat, Sta. Ana, Candaba
44	Pampanga South	Guagua, Lubao, Florida Blanca
45	Bataan	
46	Mariveles	
47	Olongapo	
48	Pampanga West	Porac, Angeles City, Mabalacat
49	Tarlac & Other Northern Province	
50	Pasig, Taytay and Antipolo	
51	Makati & Mandaluyong	
52	Parañague & Pasay	
53	Laguna & Other Southern Province	
54	Cavite	
55	Marikina, San Roque, San Mateo	
56	Reclaimed island No. 1, 2 and 3	
57	Reclaimed island No. 4	

Appendix I-24
Table III-4-1 COMMODITIES CARRIED BY TRUCKS

(1)	(2)		(3)	(4)	
Description	Traffic survey, July 1979 Commodity Item No. 1)	%	Sectoral growth ratio 1976 - 2000	(4) = (2)x(3)	
Agricultural	1,2,3	25.5	3.70	94.4	
Industries		43.5	12.50	596.5	
Mining	-	-	8.27	-	
Manufacturing	6,8	25.5	11.47	292.5	
Construction					
Electricity, gas, water	9	18.0	16.89	304.0	Weighted average growth rate p.a. 9.4%
Services		31.0	5.19	174.4	
Transport storage	7	7.4	8.09	59.9	
Commerce Services	4,5	23.6	4.85	114.5	
Total	-	100.0	6.78	865.3	

Note: 1) See Appendix I-21

Appendix I-25
Table III-4-2 TRANSFORMATION OF SECTORAL STRUCTURE, 1976-2000

Description	Percent Distribution among sectors			Annual Growth Rates (%)	Growth Ratio
	1978	1987	2000	1976 - 2000	1976 - 2000
Agriculture	30	24	17	5.6	3.70
Industries	30	37	52	11.1	12.50
Mining	2	2	2	9.2	8.27
Manufacturing	20	23	32	10.7	11.47
Construction	7	12	18	12.5	16.89
Electricity, gas, water	1				
Services	40	39	31	7.1	5.19
Transport storage	4	5	5	9.1	8.09
Commerce	21	34	36	6.8	4.85
Services	15				
Net Dom. Pro.	100%	100%	100%	8.3	6.78

Source: NEDA, Long-term Philippine Development Plan up to the year 2000.

Appendix I-26

Table III-4-3 NET DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN
CY 1976 - 1978

(In million pesos of 1972 prices)

Description	1969	1971	1973	1975	1976	1977	1978	78/69	p.a.%
Agriculture, fishery and forestry	(33) 13,765	14,416	(32) 15,745	16,943	(30) 17,752	18,590	(30) 19,445	1.41	3.9
Industrial Sectors	(25) 10,283	11,239	(27) 13,598	15,165	(30) 17,713	19,136	(30) 19,996	1.94	7.6
Mining	(2) 693	990	(2) 1,057	1,053	(2) 1,036	1,259	(2) 1,221	1.76	6.5
Manufacturing	(18) 7,620	8,311	(20) 10,144	10,662	(20) 11,877	12,797	(20) 13,361	1.75	6.4
Construction	(4) 1,739	1,651	(4) 2,084	3,076	(7) 4,325	4,583	(7) 4,888	2.81	10.8
Elect., gas & water	(1) 231	287	(1) 313	374	(1) 475	497	(1) 526	2.28	9.6
Service sector	(42) 17,169	18,627	(41) 20,571	22,817	(40) 23,913	25,232	(40) 26,351	1.53	4.8
Transport, storage	(4) 1,480	1,670	(4) 1,902	2,146	(4) 2,613	2,701	(4) 2,801	1.89	7.3
Commerce	(24) 9,744	10,332	(22) 11,211	12,309	(21) 12,617	13,462	(21) 14,013	1.44	4.1
Services	(14) 5,945	6,625	(15) 7,458	8,362	(15) 8,683	9,069	(15) 9,537	1.60	5.4
Net domestic product	(100) 41,217	44,282	(100) 49,914	54,925	(100) 59,378	62,958	(100) 65,792	1.60	5.4
Gross Domestic Product	48,779	53,526	60,931	68,392	72,962	77,484	82,093	1.68	5.9

Sources: 1) NEDA, Philippine Statistical Yearbook, 1978.
2) NEDA, Philippines Economic Indicators, June 1979, preliminary estimates.

Appendix I-27

Table III-4-4 GENERATED TRIPS FROM THE RECLAIMED AREAS[6]

Alt.	(1) Zone No.[2]	(2) Industrial Area	(3) Classified Area	(4) Average Trips/ha.	(5) No. of Trips	(6) Total Trips	(7) Residential[1] Area	(8) No. of Persons [Family]	(9) Job Opp. Outside, 10%	(10) Others[3]	(11) Total[4] (Private Vehicles)	(12) Total[5] (public)	(13) Grand Total
I	56	261	L. 87 S. 174	6 14	522 2,436	}2,958	(52)	15,600 [2,600]	650	520	88	J 39 B 12	2,958 (139)
	57	239	L. 80 S. 159	6 14	480 2,226	}2,706	-						2,706
II	56	179	L. 60 S. 119	6 14	360 166	}2,026	24 (52)	7,200 [1,200]	300	240	82	J 36 B 12	2,156 (139)
	57	98	L. 33 S. 65	6 14	198 910	}1,108	74	22,800 [3,800]	950	760	260	J116 B 34	1,518
III	56	240	L. 80 S. 160	6 14	480 2,240	}2,720	(52)	15,600 [2,600]	650	520	88	J 39 B 12	2,720 (139)
	57	140	L. 47 S. 93	6 14	282 1,302	}1,584	52	15,600 [2,600]	650	520	88	J 39 B 12	1,723

Notes:
1) Figures in ( ) are the area of Block which is used as the dumping site. Houses will be constructed after 1994.
2) Zone 56, which is composed of Blocks I, II and III, is to be completed in 1987. Zone 57 is Block IV which is to be completed several years later.
3) (10) = (8) × 0.2
4) (11) = {(9) + (10)} × 0.15 ÷ 2 — Residential Area
5) (12) = {(9) + (10)} × 0.50 ÷ 15, or 0.35 ÷ 35 — Residential Area
6) Due to the difficulty in estimating the number of employee at this stage of the study, vehicles used for commuting are not counted in the above table.

Appendix I-28
Table III-4-5 TRAFFIC GENERATION QUESTIONNAIRE

Date: '79 August _____ Interviewer: _____

Company Name	Type of Business	Address Phone No.

1. Area size of site (occupied area) _____ m^2

2. Area size floor space in total _____ m^2

3. Number of employees _____ pers

4. Do you have warehouses or stockyards in your Area? YES/NO

5. How many vehicles does your factory have?

   (1) Car _____ veh. (3) Pick-up & Van _____ veh.

   (2) Jeepney & Bus _____ veh. (4) Truck _____ veh.

6. How many private cars used by employees are parking within your area? _____ veh.

7. Type of commodity

   (1) Coming in

	Type of Comm.	Vehicle/day or week
1)	_____	_____ veh.
2)	_____	_____ veh.
3)	_____	_____ veh.
4) Others		_____ veh. (including empty)

   (2) Going out

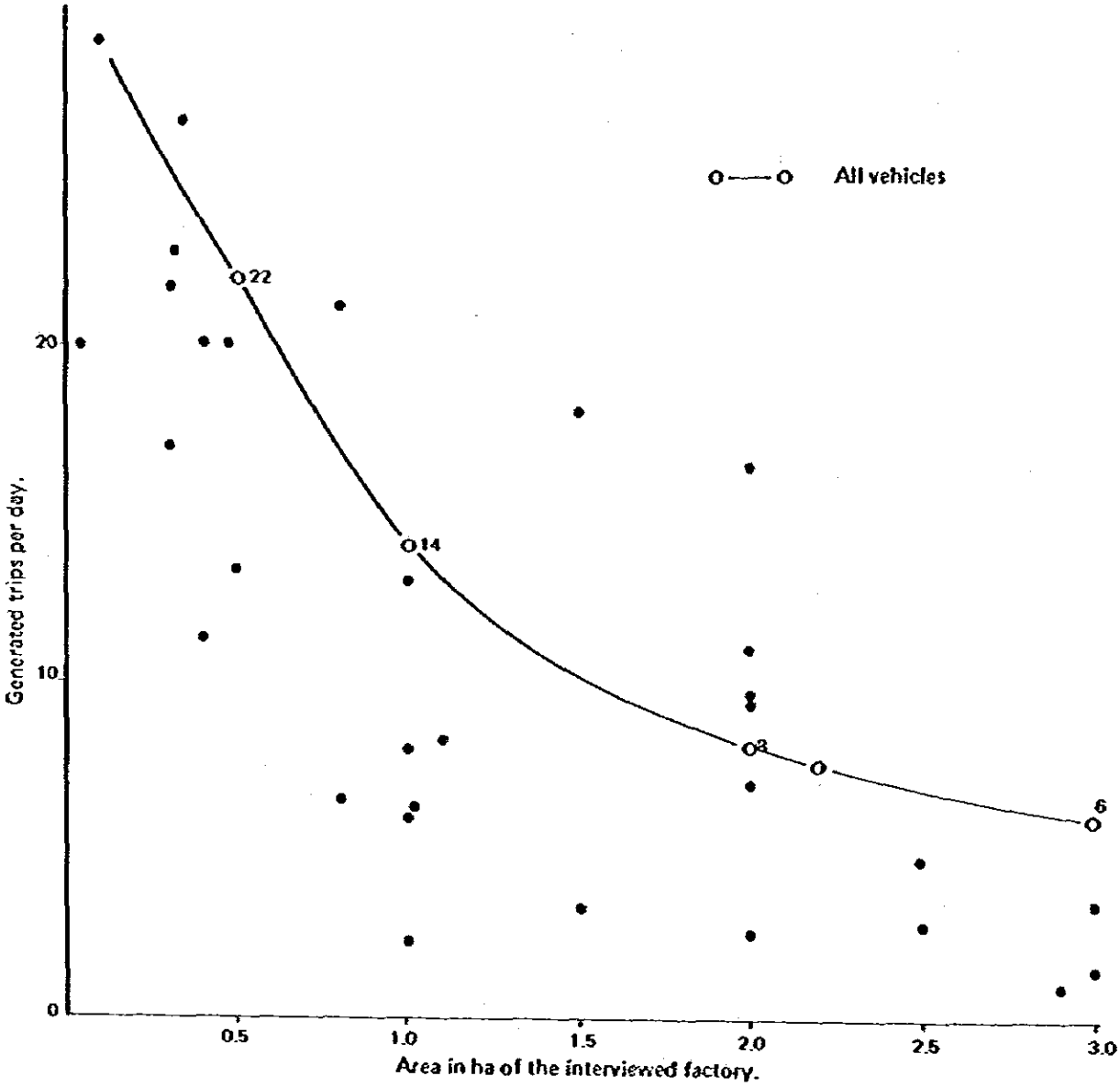
	Type of Comm.	Vehicle/day or week
1)	_____	_____ veh.
2)	_____	_____ veh.
3)	_____	_____ veh.
4)	_____	_____ veh.

8. How many vehicles come in your area per day in average? (vehicle/day)

   1) Passenger car _____ 3) Van, Pick-up _____

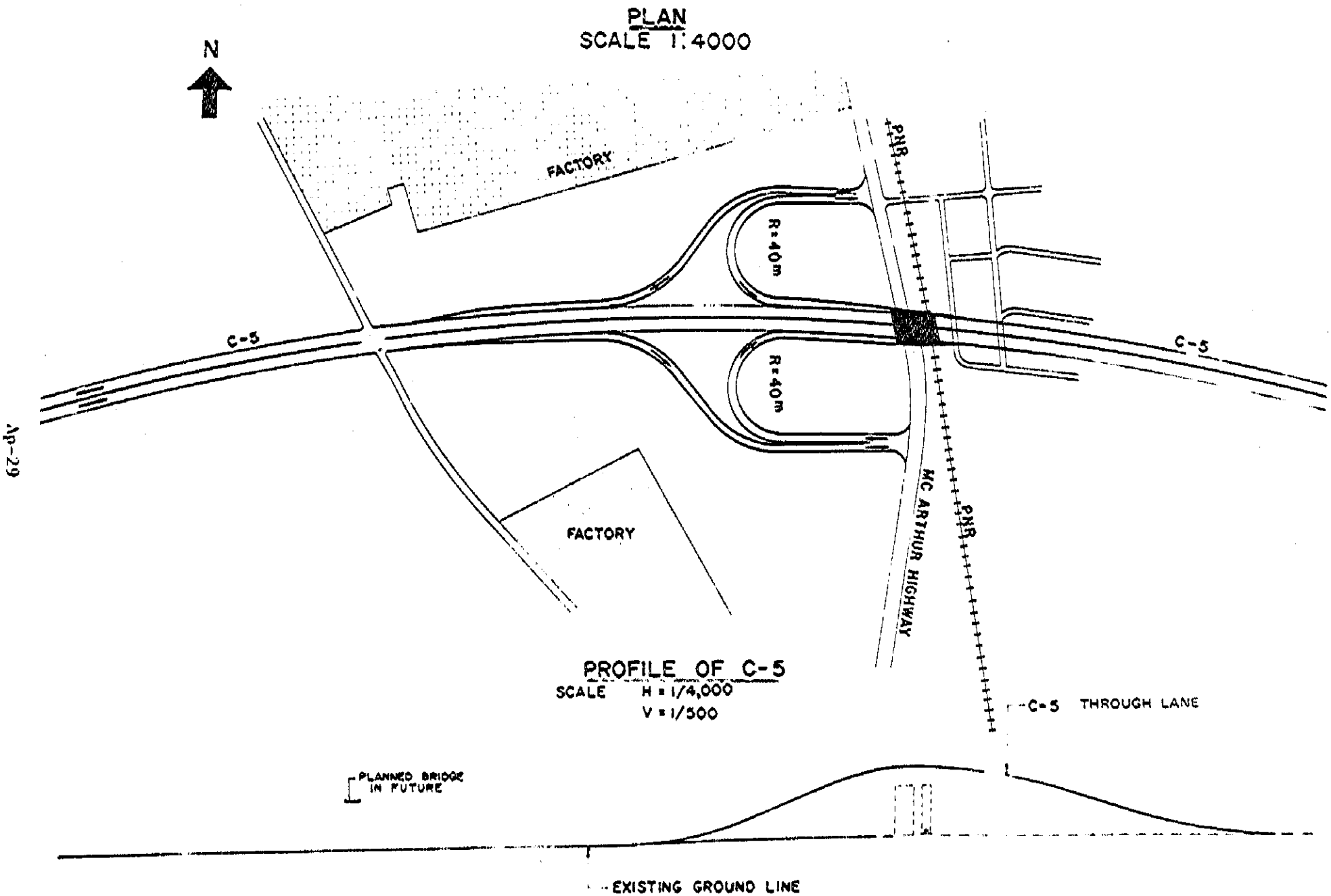
   2) Jeepney, Bus _____ 4) Truck _____

Appendix I-29
Fig. III-4-1 GENERATED TRIPS AND THE AREA OF FACTORY

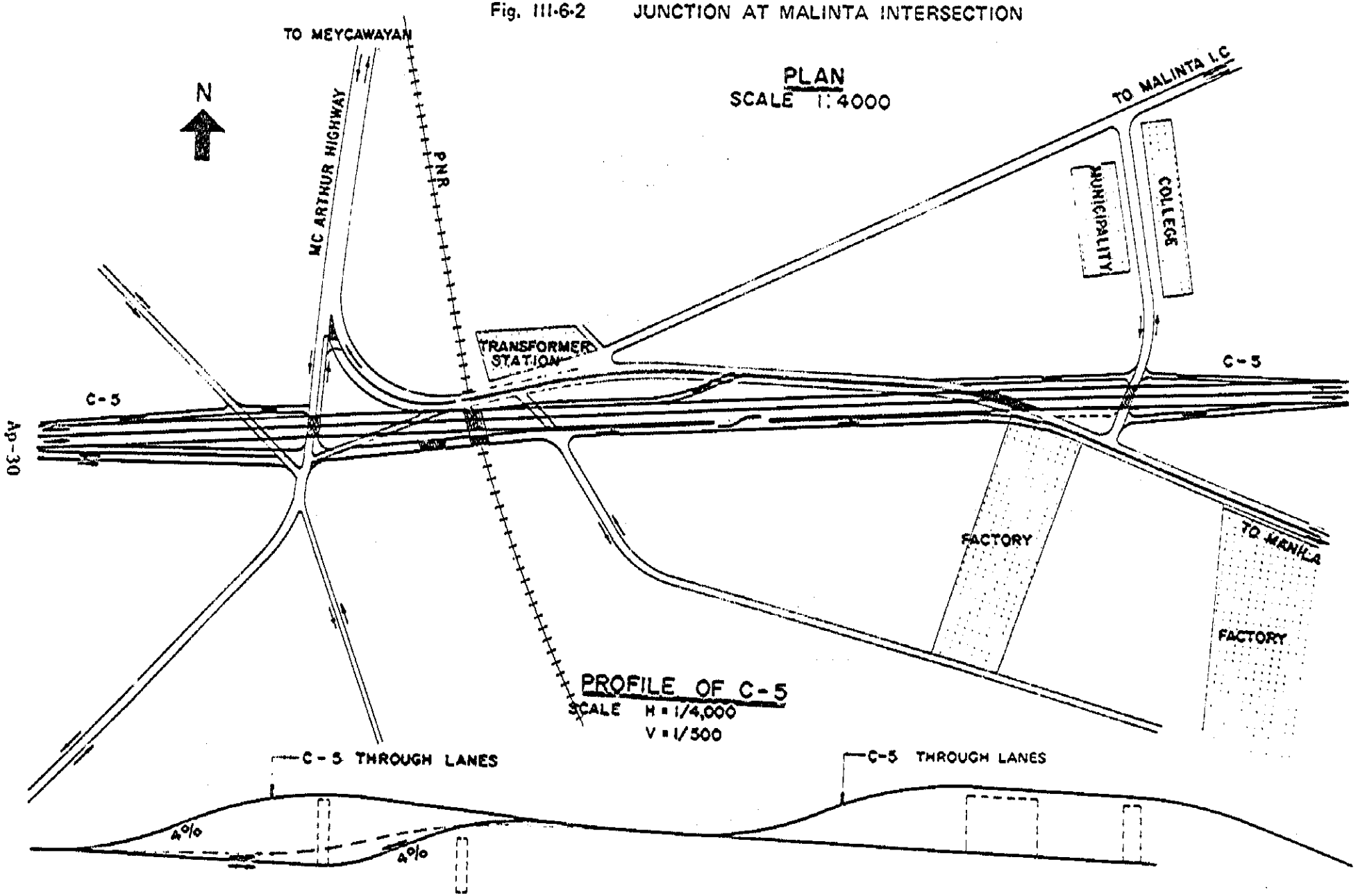


Appendix I-30
Fig. III-6-1

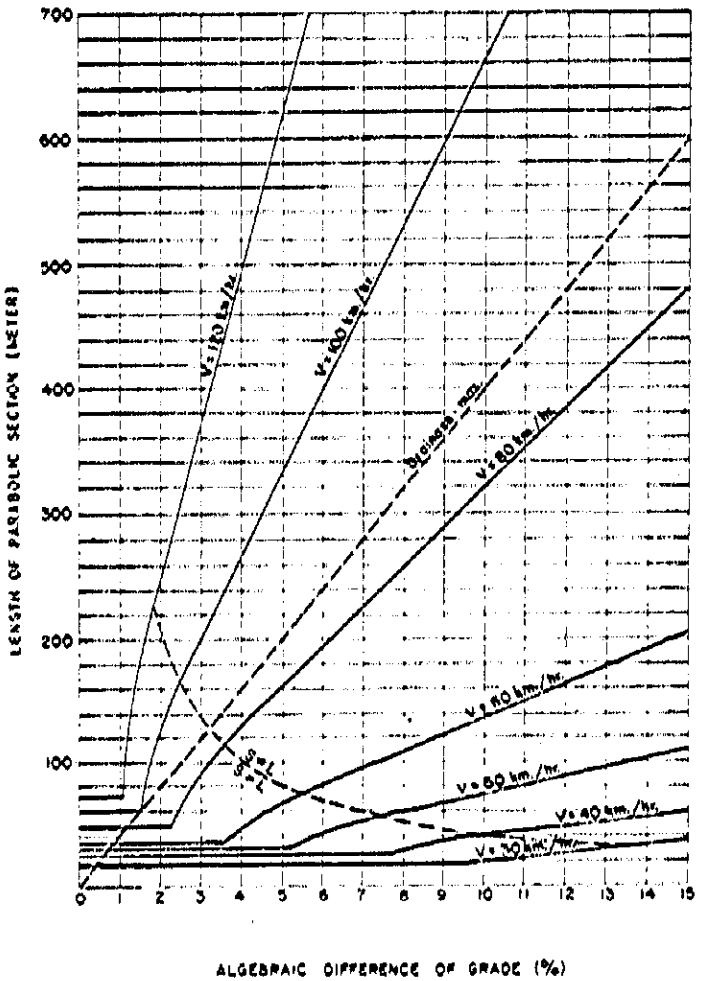
INTERCHANGE AT MCARTHUR HIGHWAY



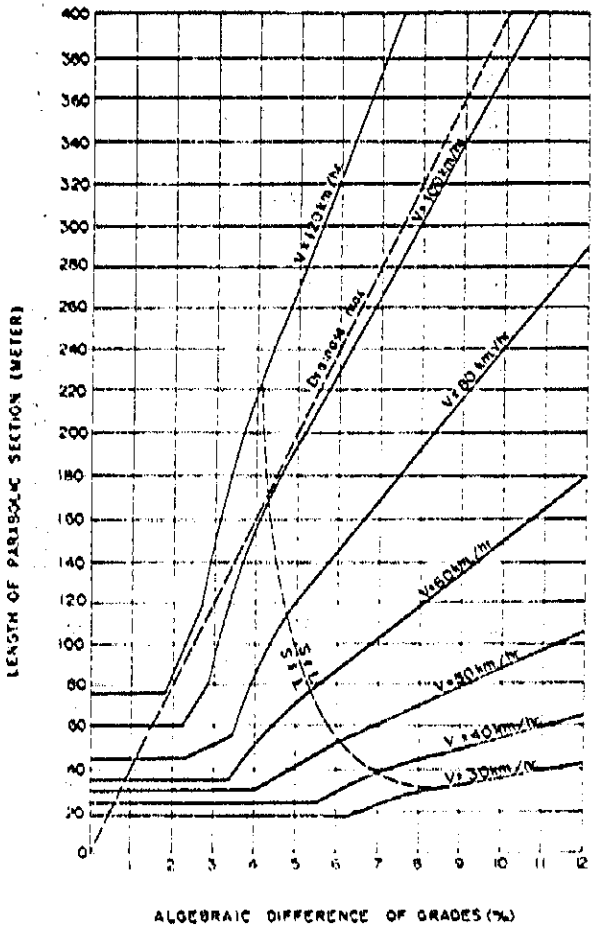
Appendix I-31
Fig. III-6-2 JUNCTION AT MALINTA INTERSECTION



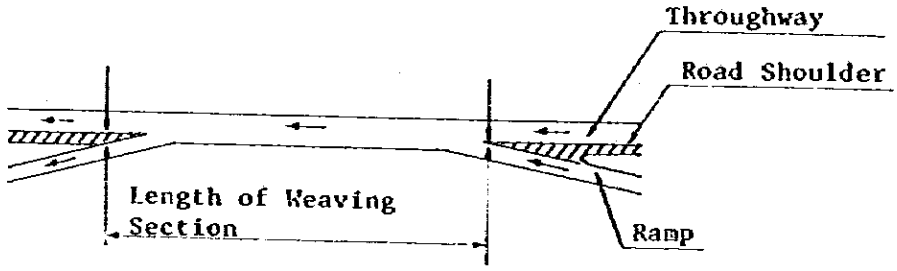
Appendix I-32
Fig. III-7-1 LENGTH OF VERTICAL CURVE (CRESTS)



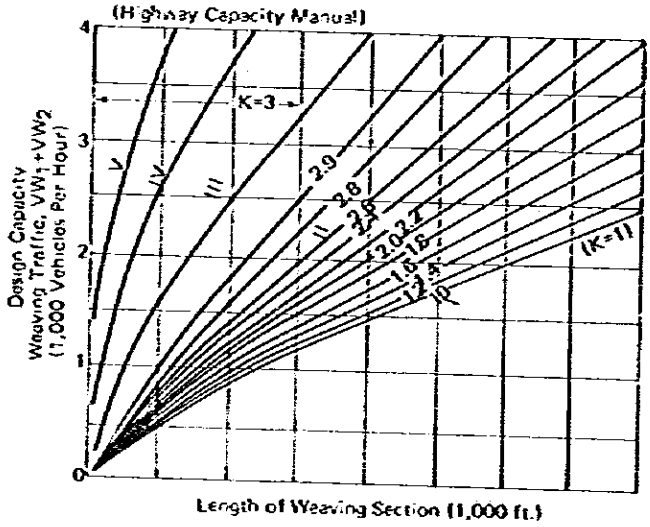
Appendix I-33
Fig. III-7-2 LENGTH OF VERTICAL CURVE (SAG)



Appendix I-34
Fig. III-7-3 LENGTH OF WEAVING SECTION



Appendix I-35
Fig. III-7-4 DESIGN CAPACITY OF WEAVING SECTION

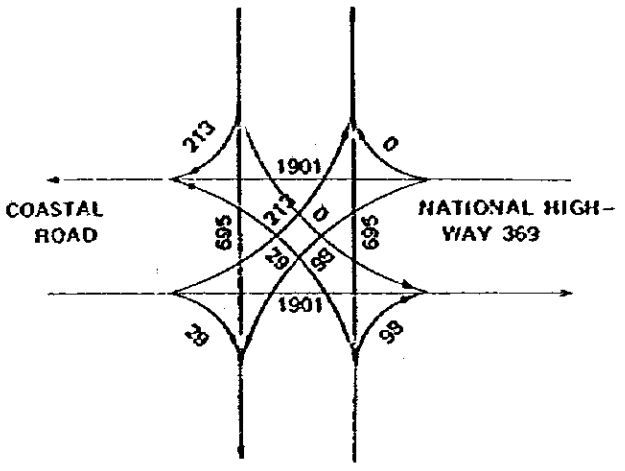


Appendix I-36

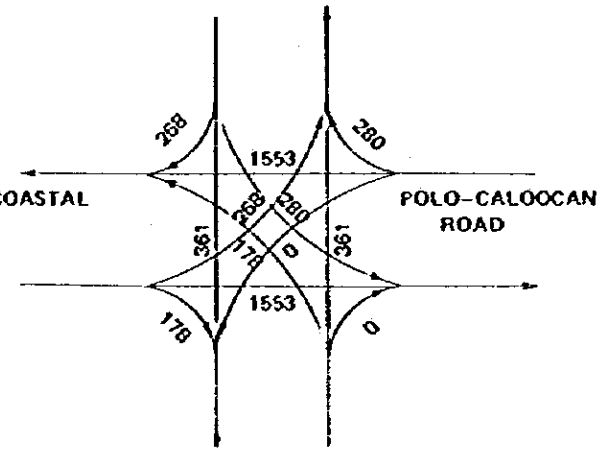
Fig. III-7-5 ESTIMATED TRAFFIC FLOWS AT INTERSECTION IN 1998

UNIT: VEHICLE/HR

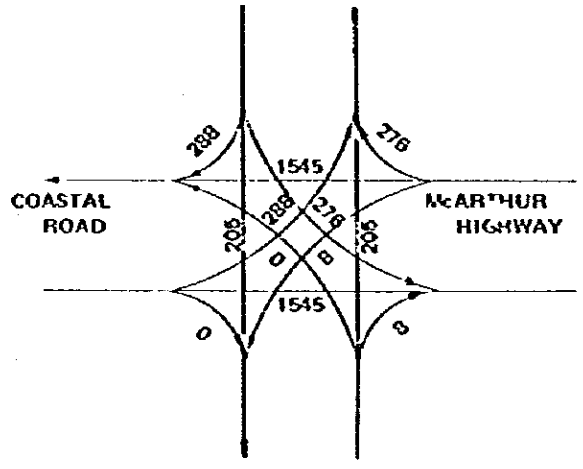
POLO-MALABON ROAD



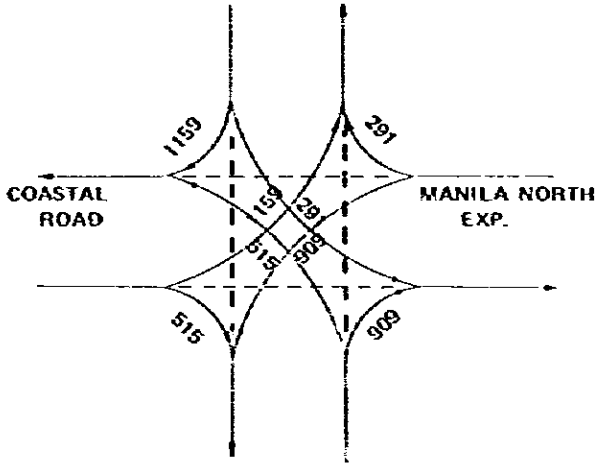
NATIONAL HIGHWAY 369



POLO-CALOOCAN ROAD



MCARTHUR HIGHWAY



----- GRADE SEPARATION

INTEGRATED CONGESTION RATIO AT INTERSECTIONS IN 1998

INTERSECTION	INTEGRATED CONGESTION RATIO	REMARKS
POLO-MALABON	0.81	
NATIONAL H.W.Y. 369	0.85	
POLO-CALOOCAN ROAD	0.87	
MCARTHUR HIGHWAY	0.90	

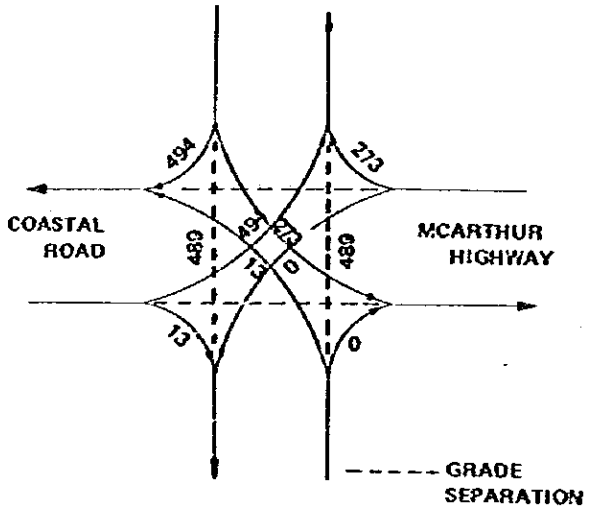
(Cont'd)

ESTIMATED TRAFFIC FLOWS AT INTERSECTION IN 1998

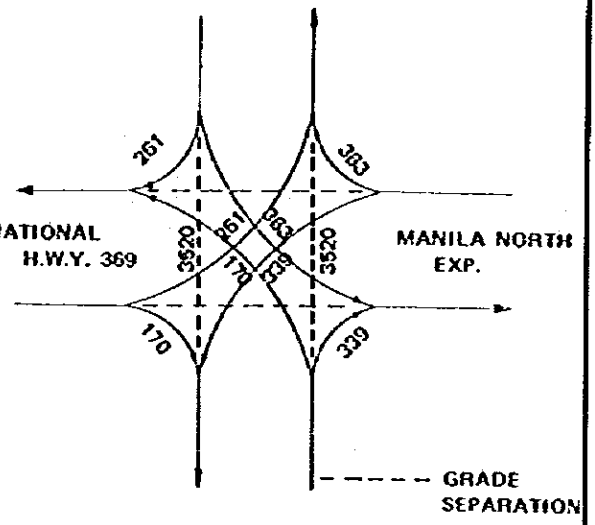
(C–6)

UNIT: VEHICLE/HR

NATIONAL HIGHWAY 369



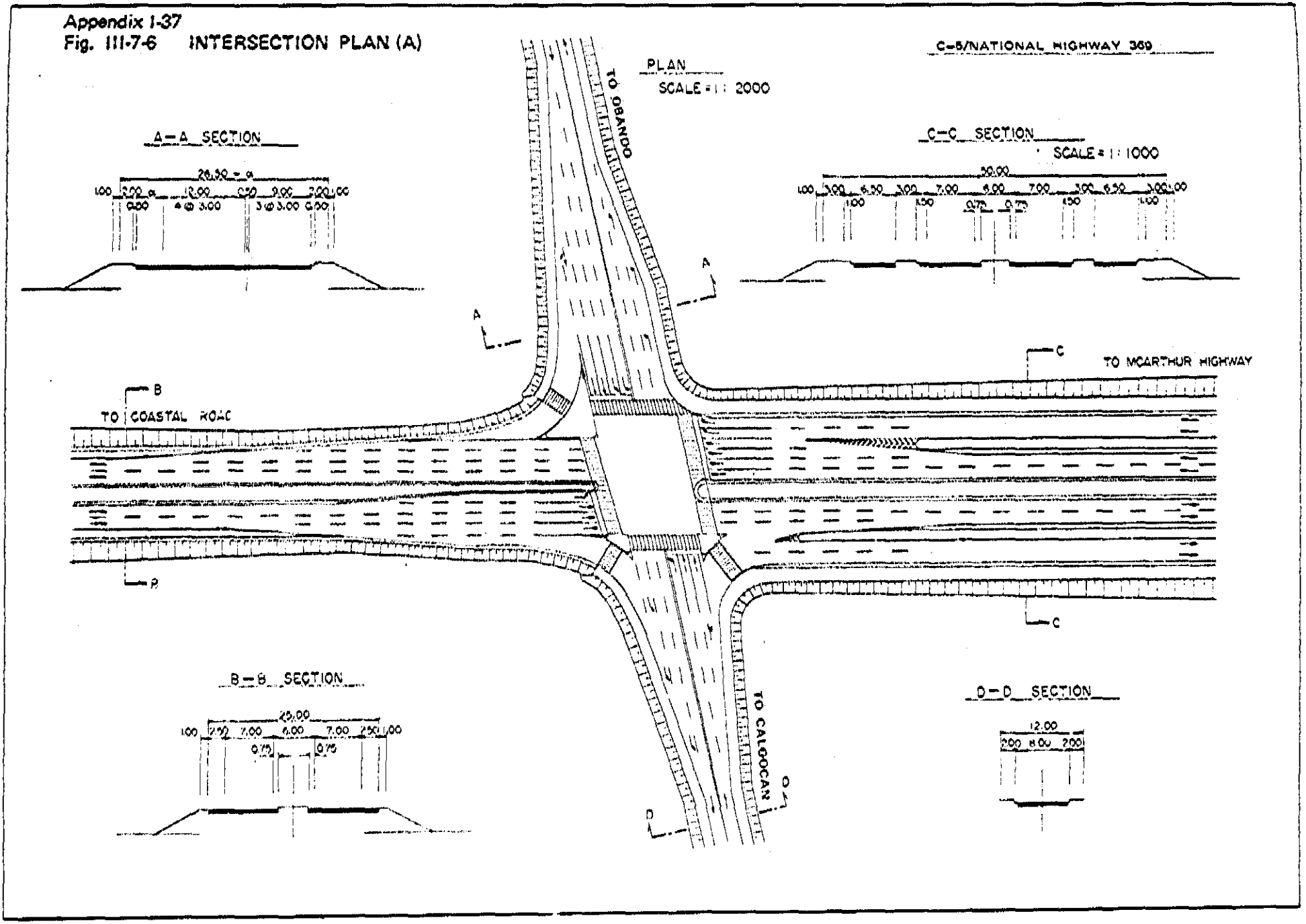
MCARTHUR HIGHWAY



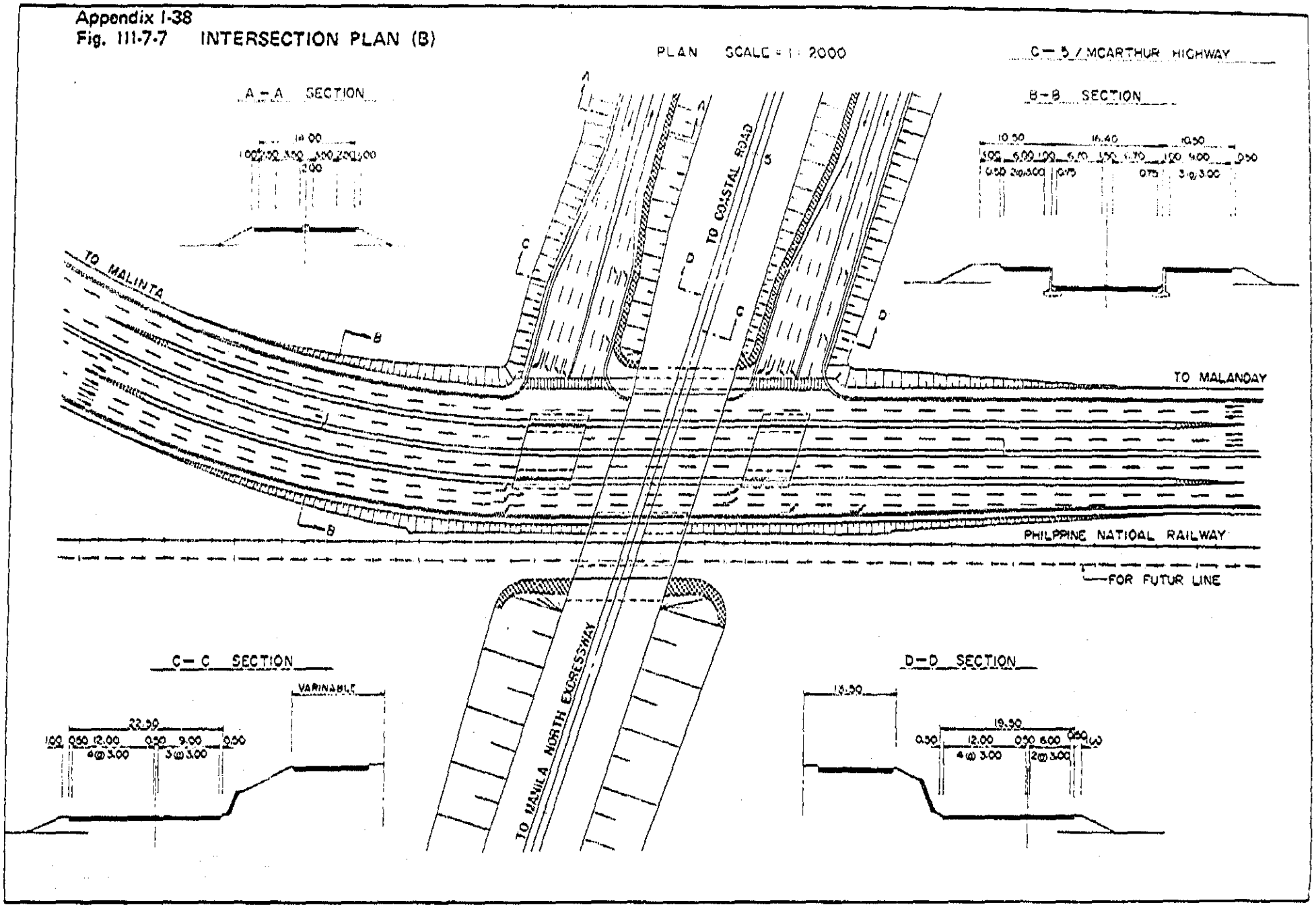
INTEGRATED CONGESTION RATIO AT INTERSECTIONS IN 1998

INTERSECTION	INTEGRATED CONGESTION RATIO	REMARKS
NATIONAL HIGHWAY 369	0.87	
MCARTHUR HIGHWAY	0.90	

Appendix 1-37
Fig. III-7-6 INTERSECTION PLAN (A)

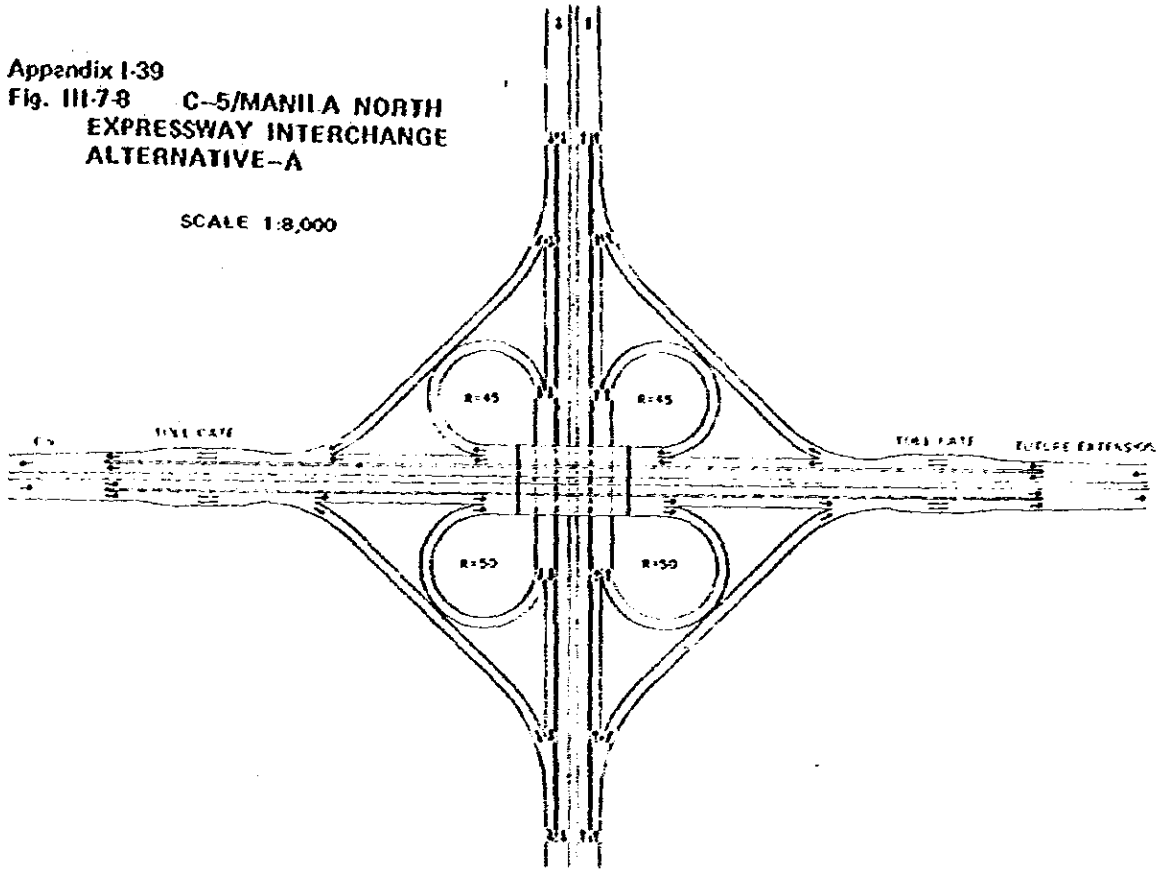


Appendix I-38
Fig. III-7-7 INTERSECTION PLAN (B)



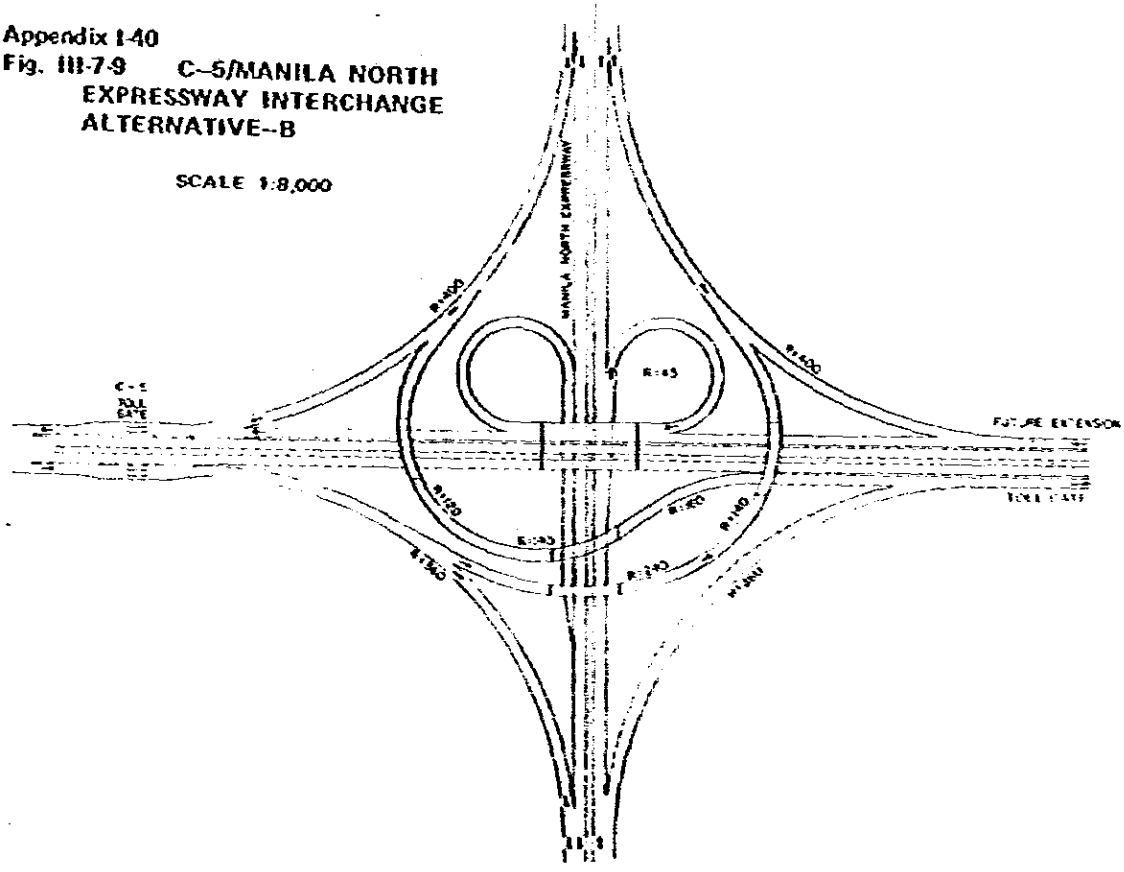
Appendix I-39
Fig. III-7-8 C-5/MANILA NORTH EXPRESSWAY INTERCHANGE ALTERNATIVE-A

SCALE 1:8,000

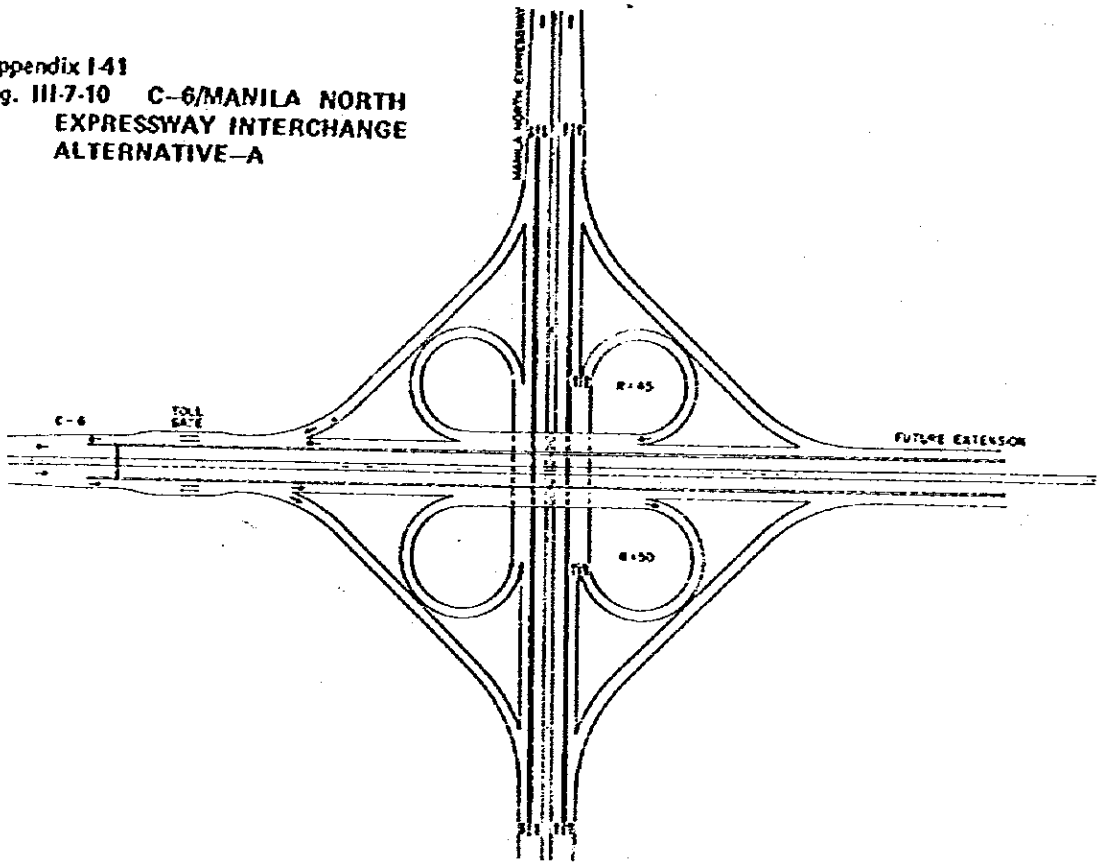


Appendix I-40
Fig. III-7-9 C-5/MANILA NORTH EXPRESSWAY INTERCHANGE ALTERNATIVE-B

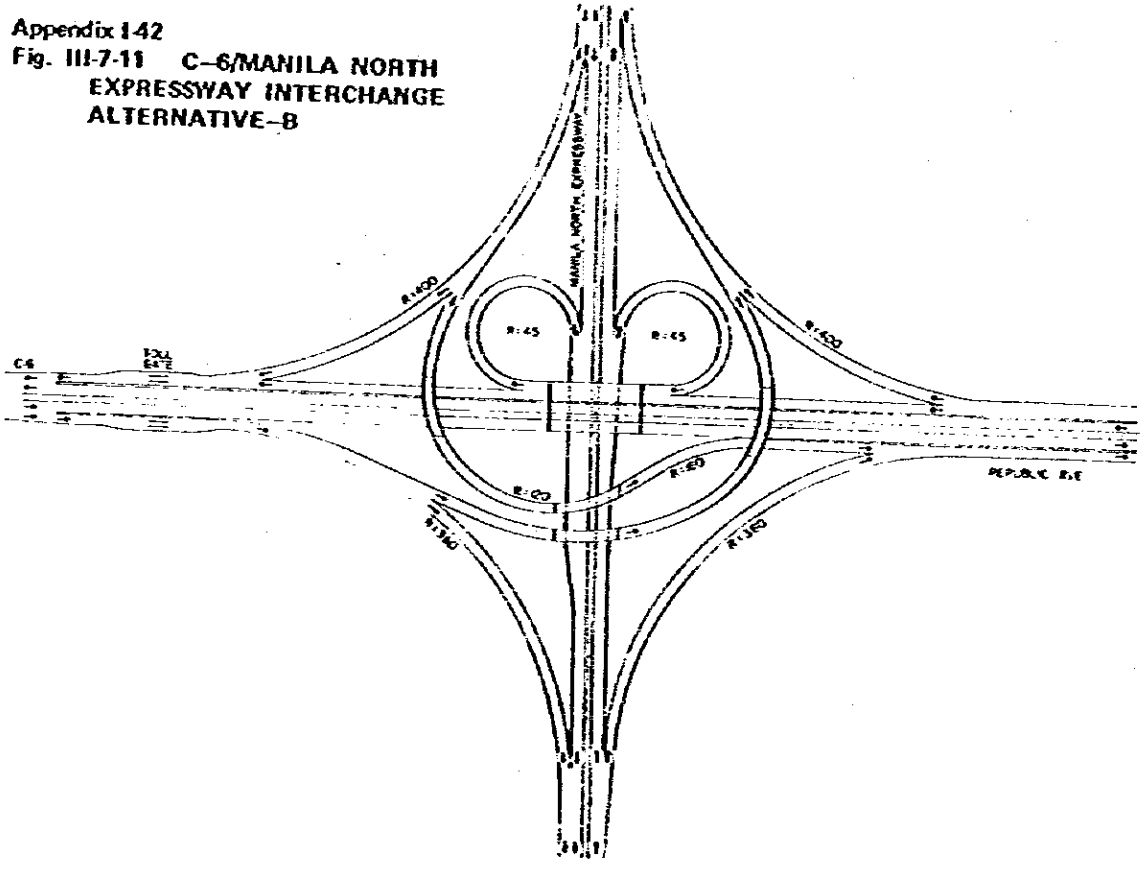
SCALE 1:8,000



Appendix I-41
Fig. III-7-10 C-6/MANILA NORTH EXPRESSWAY INTERCHANGE ALTERNATIVE-A

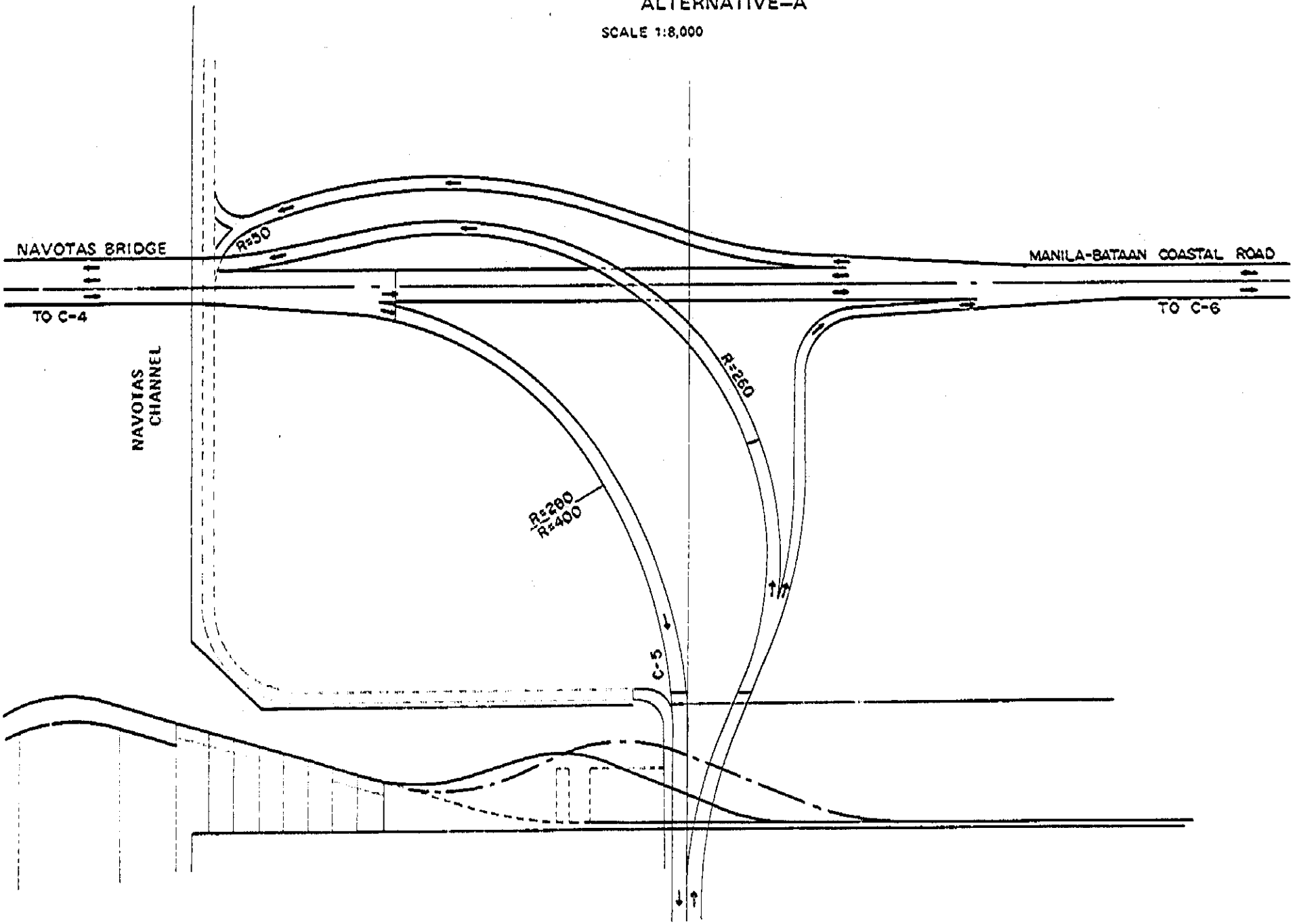


Appendix I-42
Fig. III-7-11 C-6/MANILA NORTH EXPRESSWAY INTERCHANGE ALTERNATIVE-B

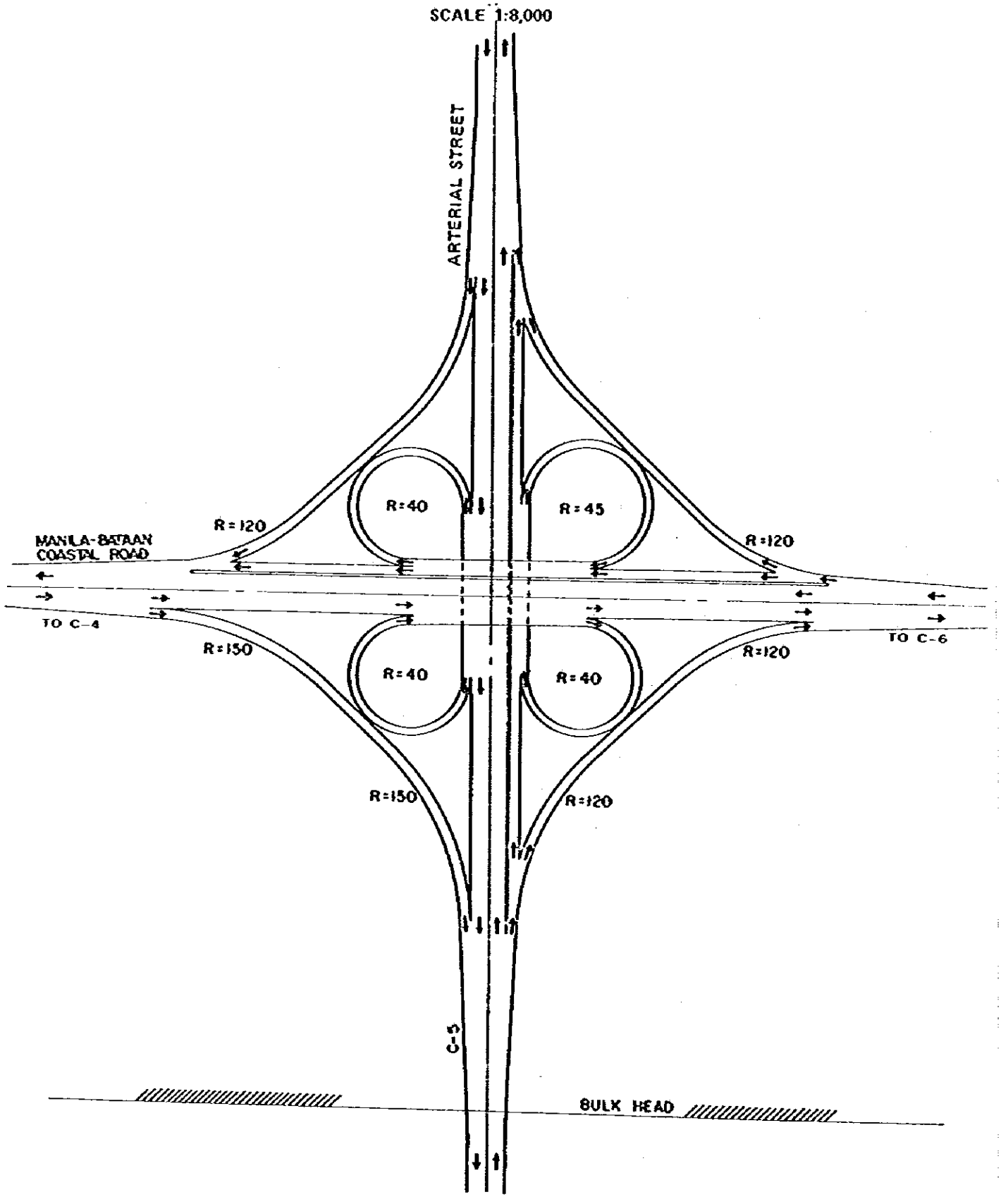


Appendix I-43
Fig. III-7-12 COASTAL ROAD/C-5 INTERCHANGE
ALTERNATIVE-A

SCALE 1:8,000

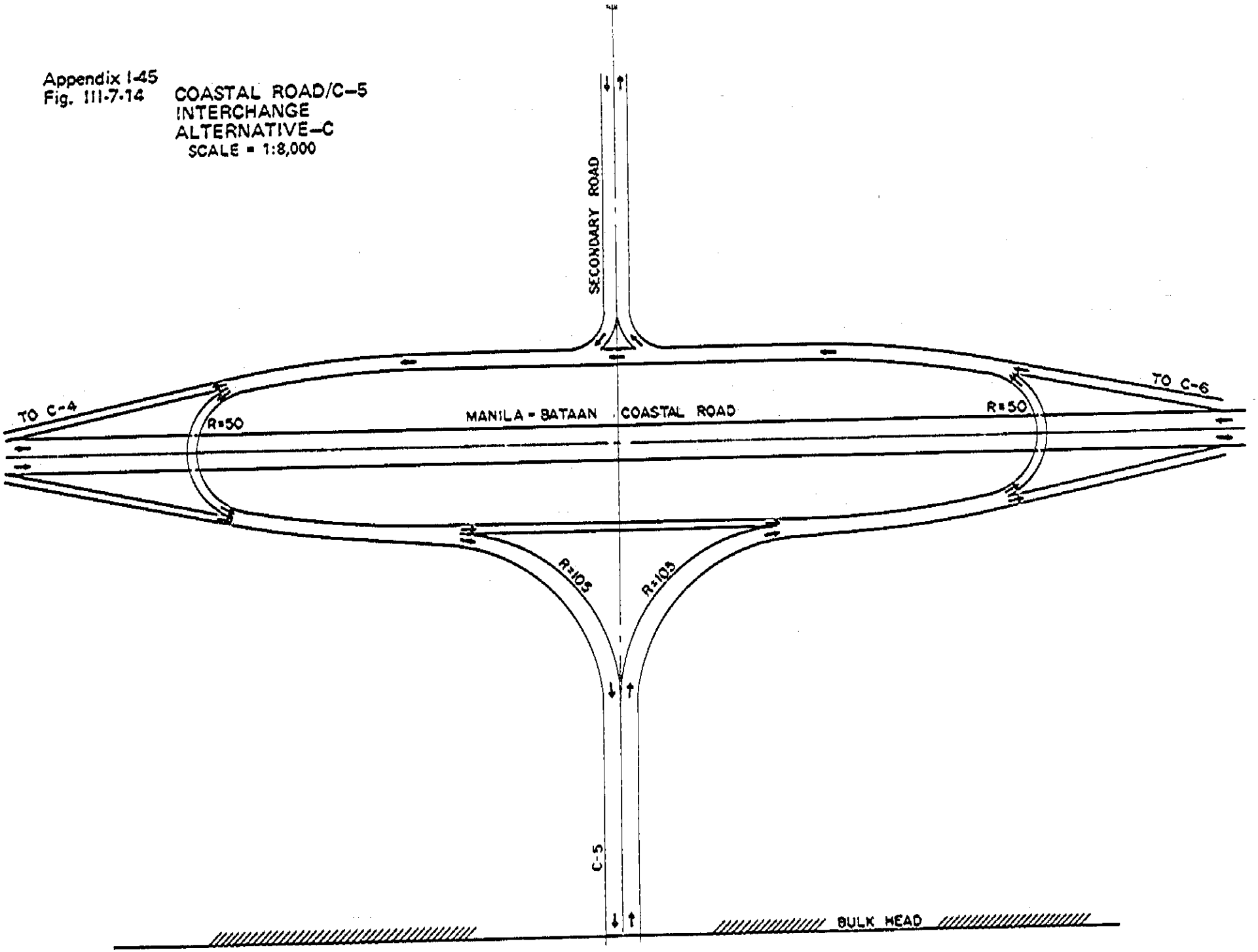


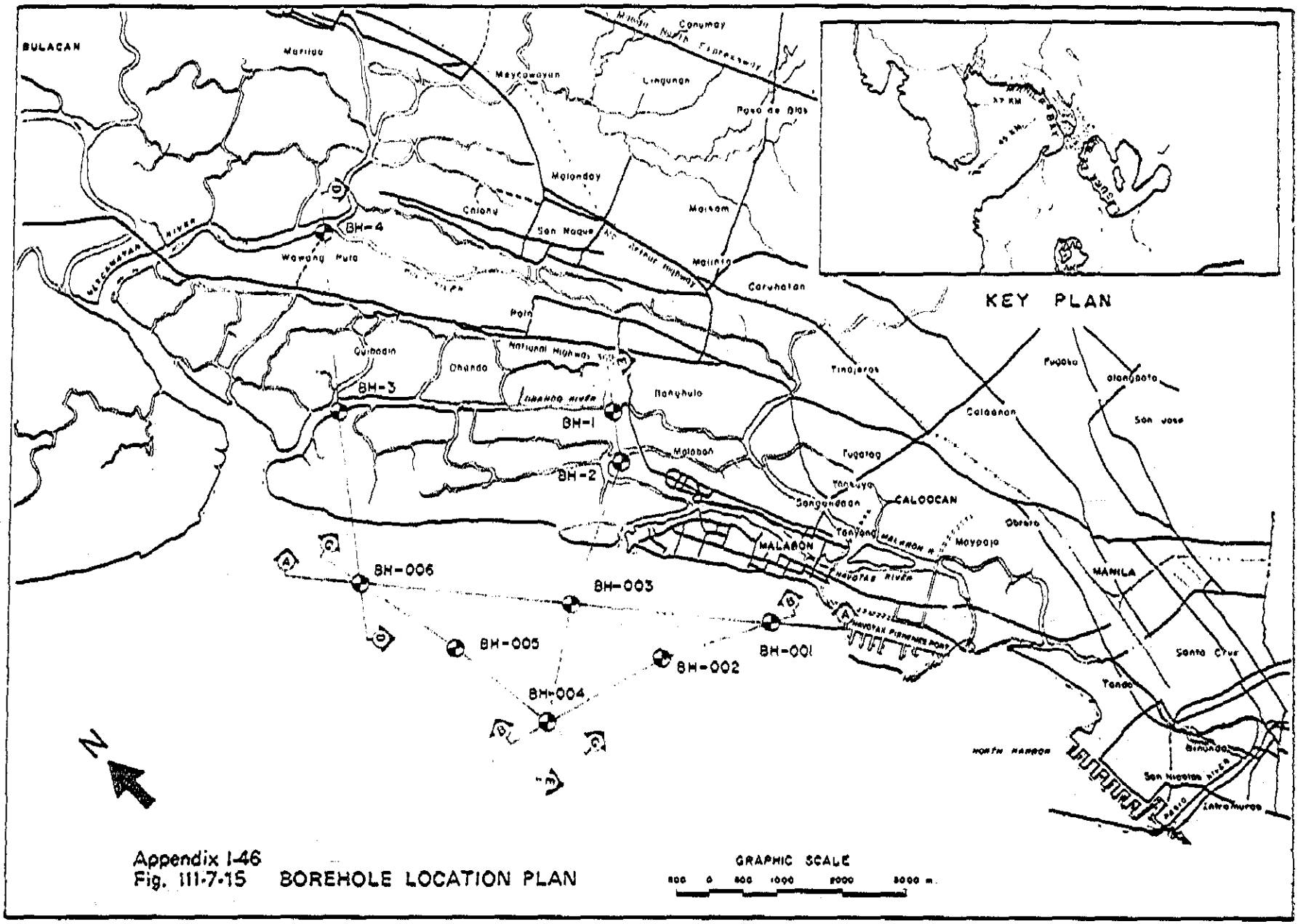
Appendix I-44
Fig. III-7-13 COASTAL ROAD/C-5 INTERCHANGE
ALTERNATIVE-B



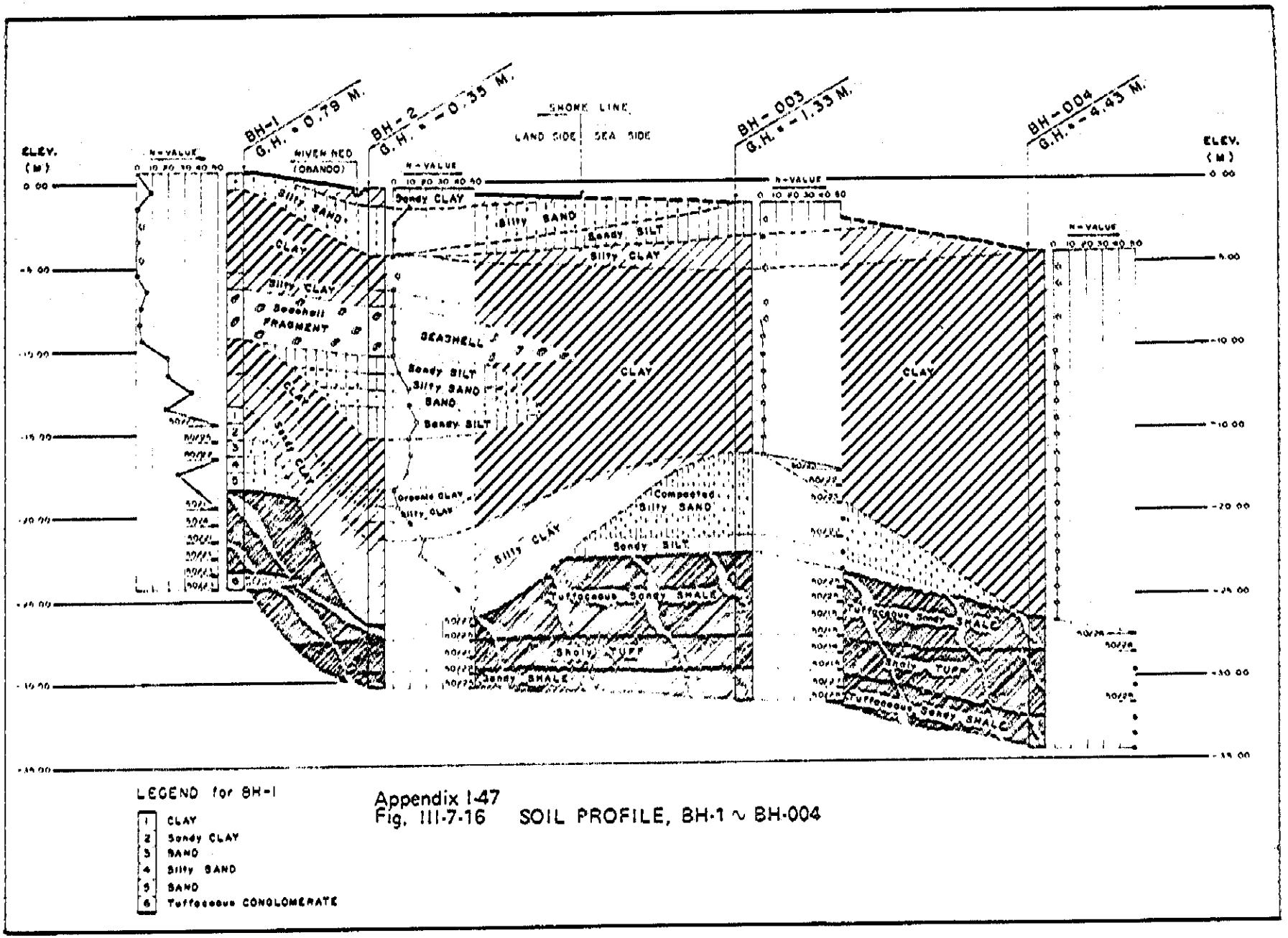
Appendix I-45
Fig. III-7-14

COASTAL ROAD/C-5
INTERCHANGE
ALTERNATIVE-C
SCALE = 1:8,000



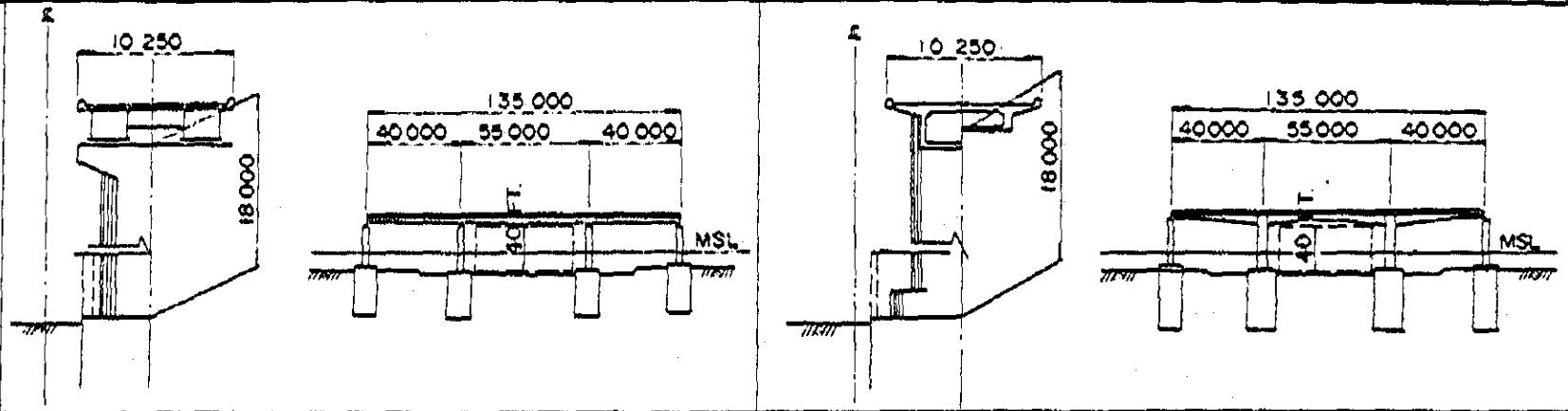


Appendix I-46
Fig. III-7-15 BOREHOLE LOCATION PLAN



Appendix I-47
Fig. III-7-16 SOIL PROFILE, BH-1 ~ BH-004

Appendix I-48
Fig. III-7-17 COMPARATIVE ANALYSIS OF BRIDGE TYPE CROSSING NAVOTAS WATERWAY

Descriptions	3- Span Continuous Steel Box Girder	3-Span Costinuous P.C Box Girder
TYPICAL CROSS SECTION AND SIDE VIEW		
APPROXIMATE MATERIALS QUANTITIES	**Superstructure** Steel Weight 240 t Concrete 340 m³ Reinforcement 75 t Form 1 700 m² Pavement 1 250 m² Handrail 270 m **Substructure** Concrete 720 m³ Reinforcement 72 t Form 950 m² Steel Pile 2690 m Steel Accessory 240 t	**Superstructure** Concrete 1 060 m³ Pc Rod 45 t Reinforcement 120 t Form 3 160 m² Pavement 1 250 m² Handrail 270 m **Substructure** Concrete 930 m³ Reinforcement 90 t Form 1 220 m Steel Pile 3900 m Steel Accessory 350 t
APPROXIMATE CONSTRUCTION COST	Superstructure ₱ 5,960,000 Substructure ₱ 10,580,000 Total ₱ 16,540,000	Superstructure ₱ 4,510,000 Substructure ₱ 14,680,000 Total ₱ 19,190,000
PRACTICABILITY OF ERECTION	Erection Easier Construction period : Short	Erection (Cantilever method) High level Construction period Long
MAINTENANCE	Painting cost is necessary	Maintenance cost is negligible but repair is difficult
CONCLUSION	Recommended	—

Appendix I-49

Table III-7-1(A) LIST OF BRIDGES TO BE CONSTRUCTED

Road	Bridge No.	Station	Brdige Length	Super Structure Type	Foundation Type	Crossing Object	Remarks
C-5	Br-1	STA .0+0	450 m (2x40m + 1x30m + 17X20m)	Steel Continuous Box P. C. Composite	Pile	Coastal Road	Interchange Br.
	2	STA. 0+510	280 m (14 x 20m)	P.C. Composite	Pile	Canal	Canal Br.
	3	STA. 0+988	22.3m (1 x 22.3m)	P.C. Composite	Pile		River Br.
	4	STA. 1+934	64.5 m (3 x 21.5m)	P.C. Composite	Pile		River Br.
	5	STA. 2+230	18 m (1 x 18m)	R.C. Hollow Slab	Pile		River Br.
	6	STA. 2+260	42 m (2 x 21m)	P.C. Composite	Pile		Over Br.
	7	STA. 2+824	43.2 m (2x21.6m)	P.C. Composite	Pile		River Br.
	8	STA. 3+160	46 m (2 x 23m)	P.C. Composite	Pile		Over Br.
	9	STA. 3+670	41 m (2 x 20.5m)	P.C. Composite	Pile	Natl. Highway 369	Over Br.
	10	STA. 4+70	40 m (2 x 20m)	P.C. Composite	Pile		Over Br.
	11	STA. 4+276	60.3 m (3 x 20.1m)	P.C. Composite	Pile		River Br.
	12	STA. 4+660	52.3 m (25.0m + 27.3m)	P.C. Composite	Pile		Over Br.
	13	STA. 5+110	57.3 m (41.3m + 16.0m)	Steel Composite P.C. Composite	Spread	Mc-Arthur Hwy.	Interchange Br.
	14	STA. 5+818	23.2 m (1 x 23.2m)	P.C. Composite	Spread		Throughway Br.
	15	STA. 9+50	69.6 m (4 x 17.4m)	P.C. Composite	Spread	North Expressway	Interchange Br.
C-6	Br-1	STA. 0+546	280 m (14 x 20m)	P.C. Compsoite	Pile	Canal	Canal Br.
	2	STA. 1+822	30.9 m (1 x 30.9m)	P.C. Composite	Pile		River Br.
	3	STA. 2+420	142.1 m (7 x 20.3m)	P.C. Composite	Pile		River Br.
	4	STA. 3+711	14.3 m (1 x 14.3m)	R.C. Hollow Slab	Pile		River Br.
	5	STA. 3+850	23.5 m (1 x 23.5m)	P.C. Composite	Pile	Natl. Highway 369	Interchange Br.
	6	STA. 4+297	14.7 m (1 x 14.7m)	P.C. Composite	Pile		Throughway Br.
	7	STA. 4+580	138.6 m (7 x 19.8m)	P.C. Composite	Pile		River Br.
	8	STA. 4+925	14.1 m (1 x 14.1m)	P.C. Composite	Pile		Throughway Br.
	9	STA. 5+270	26.5 m (1x26.5m)	P.C. Composite	Pile		River Br.
	10	STA. 5+600	13.2 m (1 x 13.2m)	P.C. Composite	Pile	Natl. Highway 369	Throughway Br.
	11	STA. 6+78	32.1 m (1 x 32.1m)	P.C. Composite	Pile		River Br.
	12	STA. 6+260	13.6m (1 x 13.6m)	P.C. Composite	Pile		Throughway Br.
	13	STA. 6+682	40.0 m (2 x 20m)	P.C. Composite	Pile		River Br.
	14	STA. 6+826	37.7 m (1 x 37.7m)	Steel Composite	Spread	Mc-Arthur Hwy.	Interchange Br.
	15	STA. 7+376	16.0 m (1 x 16.0m)	P.C. Composite	Spread	P.N. Railway	Throughway Br.
	16	STA. 7+568	16.2 m (1 x 16.2m)	P.C. Composite	Spread		Throughway Br.
	17	STA. 7+878	89.2 m (3 x 22.3m)	P.C. Composite	Spread		River Br.
	18	STA. 8+492	25.5 m (1 x 25.5m)	P.C. Composite	Spread		River Br.
	19	STA. 9+492	69.6 m (4 x 17.4m)	P.C. Composite	Spread	North Expressway	Interchange Br.
Coastal Road	1	STA. 1+526	40 m (2 x 20m)	P.C. Composite	Pile		Over Br.
	2	STA. 3+172	495 m (40m+55m+40m+18x20m)	P.C. Composite Steel 3 span box	Pile Steel-piled-well	Navotas Wareway	Canal Br.
	3	STA. 5+445	120 m (6 x 20m)	P.C. Composite	Pile	Canal	Canal Br.

Appendix I-49

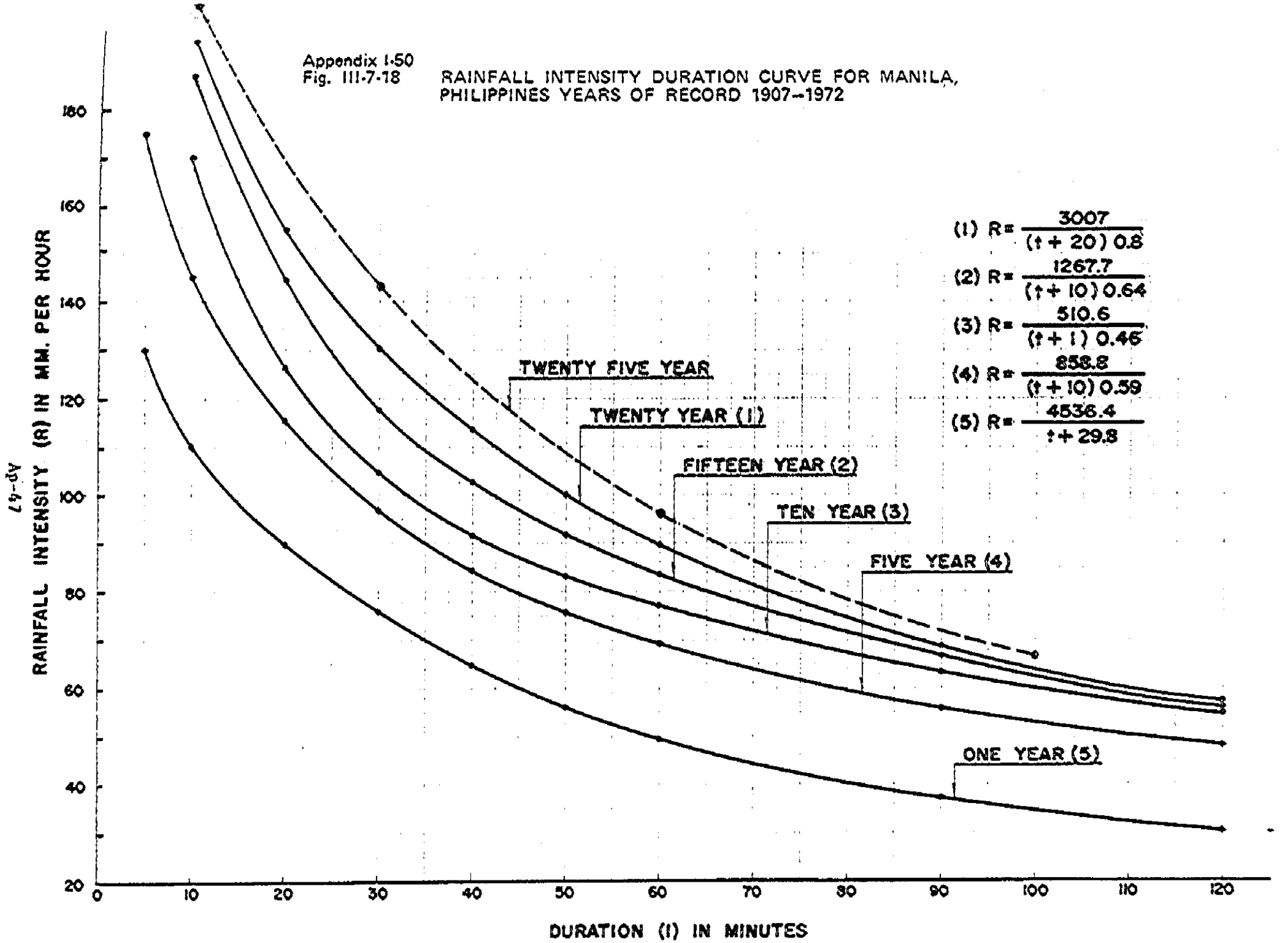
Table III-7-1(B) LIST OF CULVERTS TO BE CONSTRUCTED

Road	Culverts Number	Road Station	Width (m)	Depth (m)	Invert EL. (m)		Remarks
	C1	5+790	2.0	2.0	To meet existing G.L.		Storm drainage only
	C2	6+300	4.0	4.0	"	"	"
	C3	7+190	"	"	"	"	"
	C4	8+035	"	"	"	"	"
	C5	8+530	"	"	"	"	"
C-5	C6	9+720	2.0	2.0	9.0	(-1.47)	Storm drainage and brackish water supply
	C7	1+090	"	"	"	"	"
	C8	1+290	"	"	"	"	"
	C9	1+460	"	"	"	"	"
	C10	1+700	"	"	"	"	"
	C11	3+300	"	"	"	"	"
	C12	3+400	"	"	"	"	"
	C13	3+800	"	"	10.0	(-0.47)	Storm drainage only
	C14	4+000	"	"	"	"	"
	C15	0+815	2.0	2.0	9.0	(-1.47)	Storm drainage and brackish water supply
	C16	0+960	"	"	"	"	"
	C17	1+195	"	"	"	"	"
	C18	1+475	"	"	"	"	"
	C19	1+730	"	"	"	"	"
C-6	C20	2+050	"	"	"	"	"
	C21	2+190	"	"	"	"	"
	C22	2+705	"	"	"	"	"
	C23	2+850	"	"	"	"	"
	C24	2+955	"	"	"	"	"
	C25	3+070	"	"	"	"	"
	C26	3+325	"	"	"	"	"
	C27	3+540	"	"	"	"	"
	C28	4+750	"	"	"	"	"

Note: Figures in ( ) designate Invert Els. based on M.S.L datum.

Appendix I-50
Fig. III-7-18

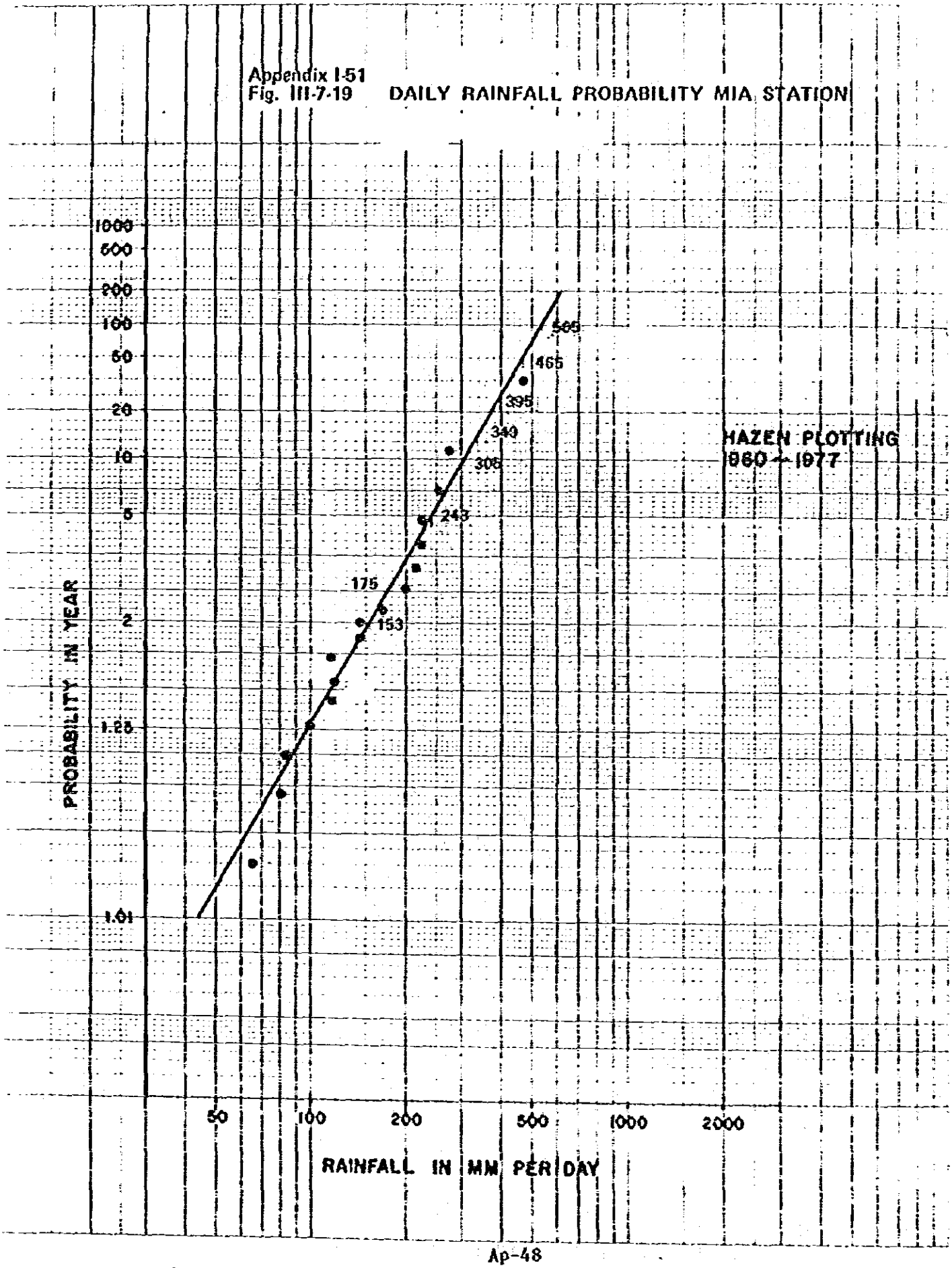
RAINFALL INTENSITY DURATION CURVE FOR MANILA, PHILIPPINES YEARS OF RECORD 1907–1972



AP-67

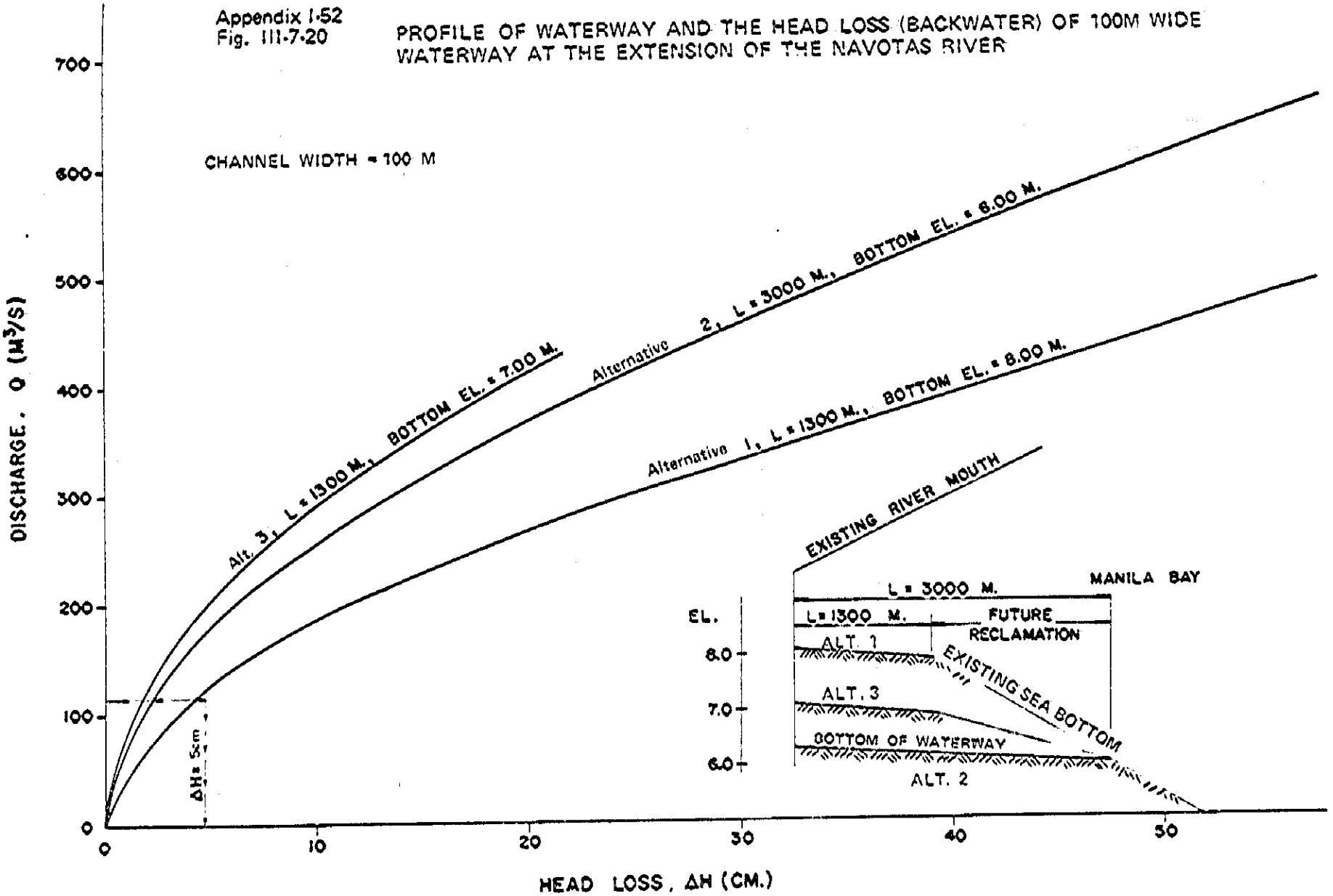
Appendix I-51
Fig. III-7-19

DAILY RAINFALL PROBABILITY MIA STATION

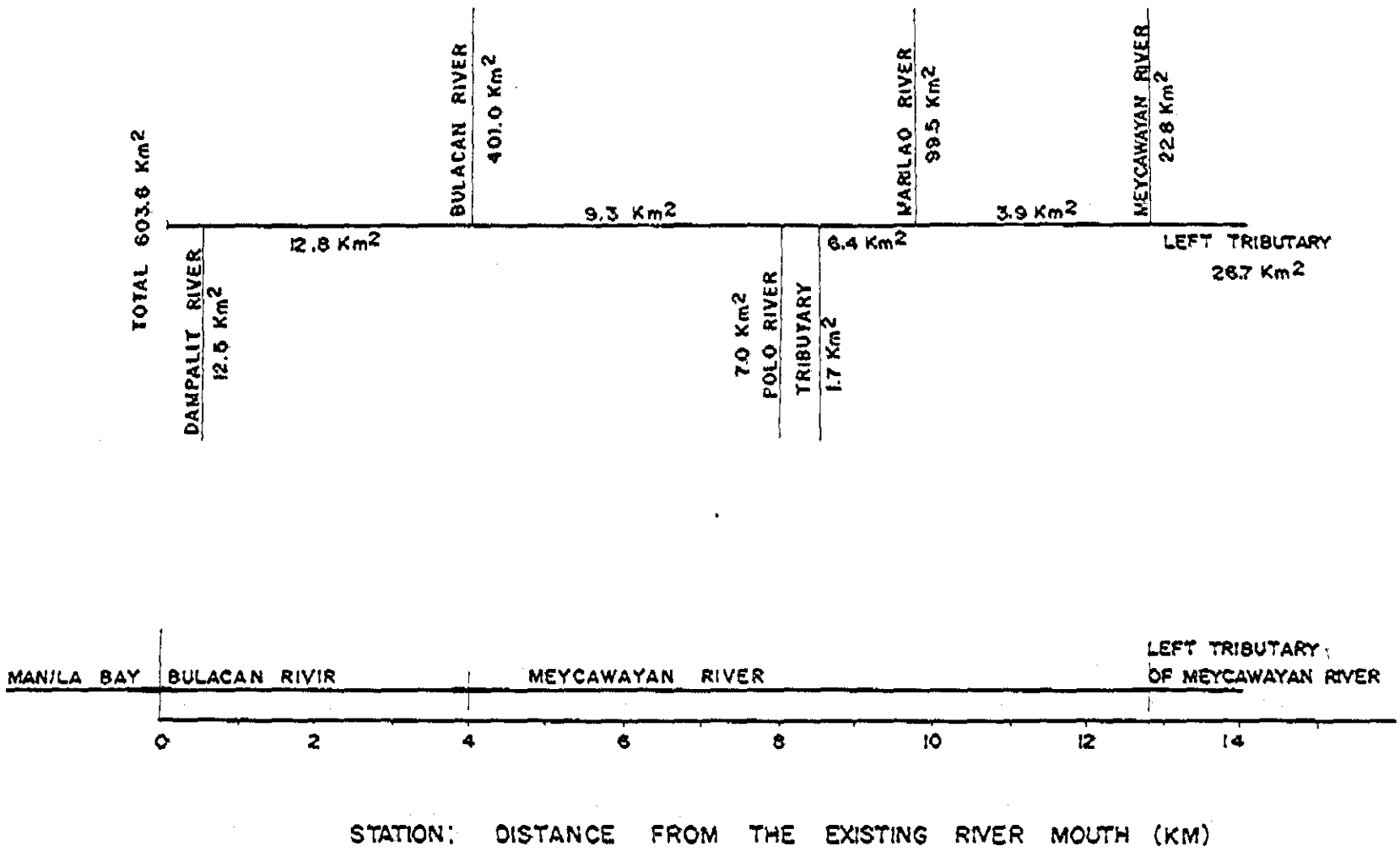


Appendix I-52
Fig. III-7-20

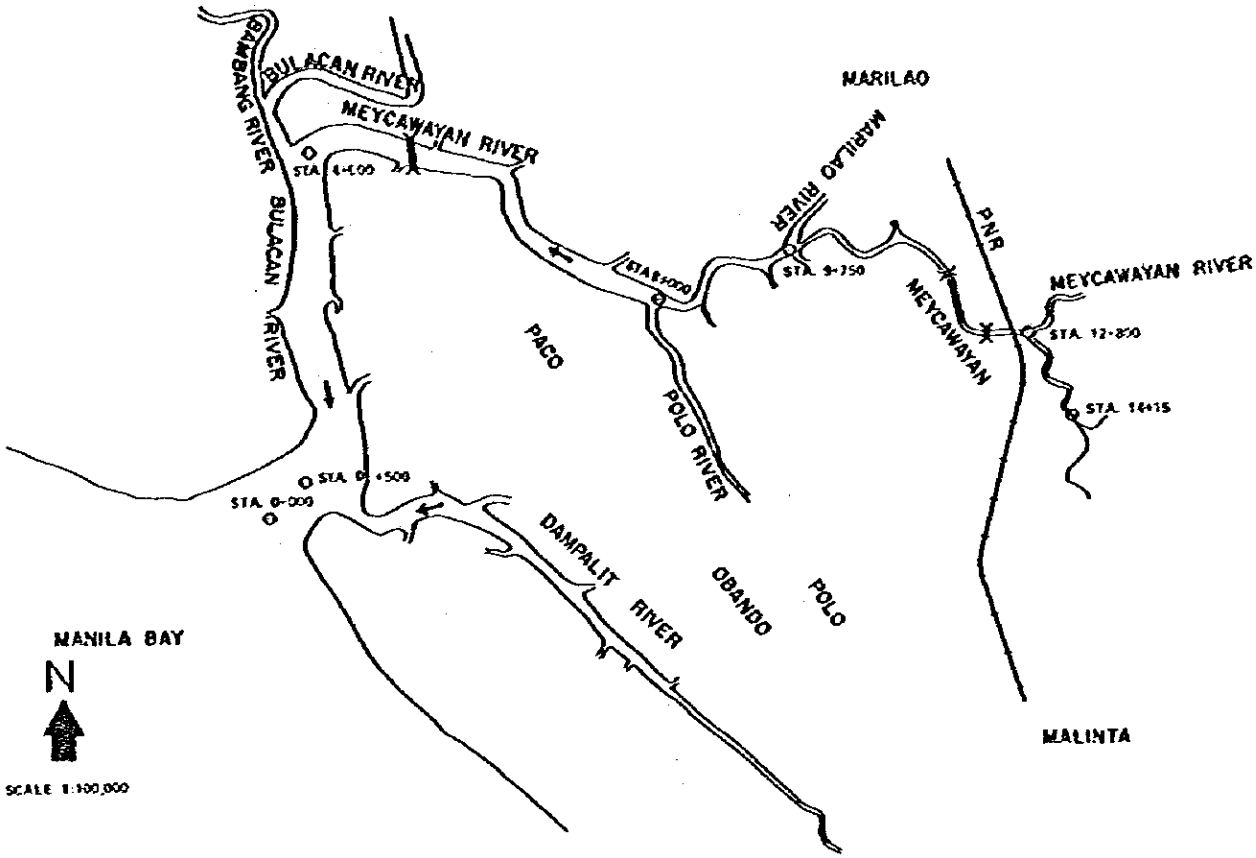
PROFILE OF WATERWAY AND THE HEAD LOSS (BACKWATER) OF 100M WIDE WATERWAY AT THE EXTENSION OF THE NAVOTAS RIVER

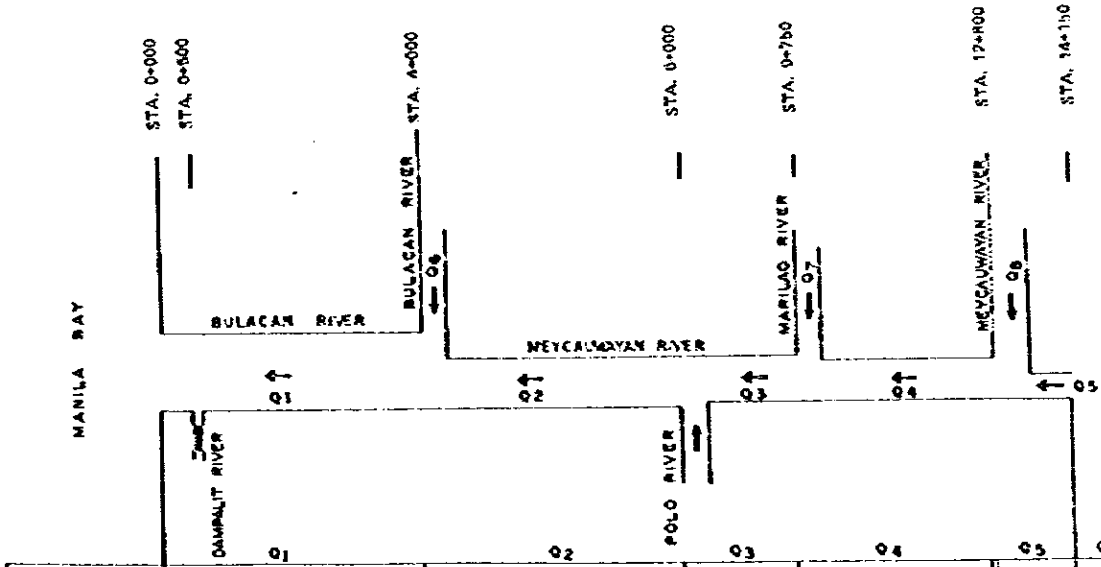


Appendix I-53
Fig. III-7-21 DRAINAGE AREAS OF MEYCAWAYAN RIVER SYSTEM



Appendix I-54
Fig. III-7-22 PLAN AND DISCHARGES OF MEYCAWAYAN RIVER

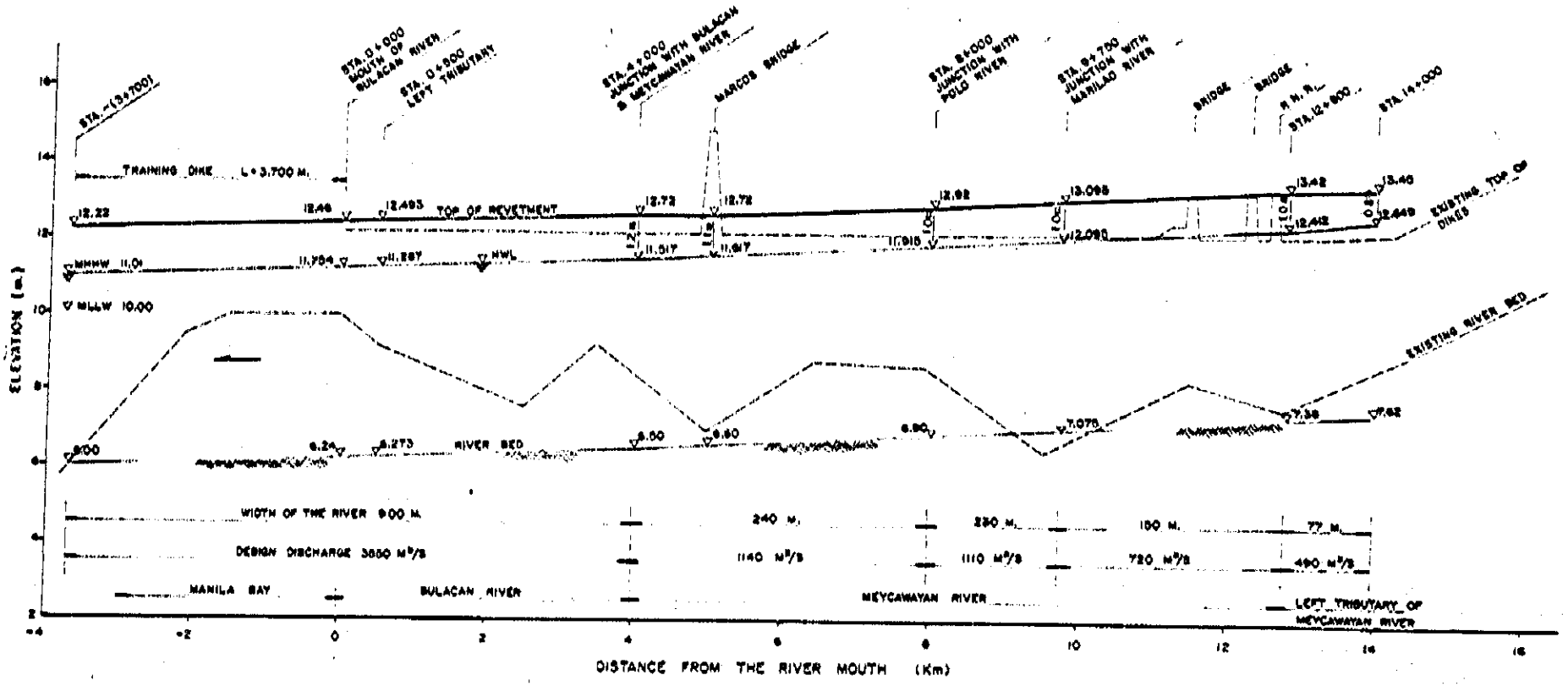




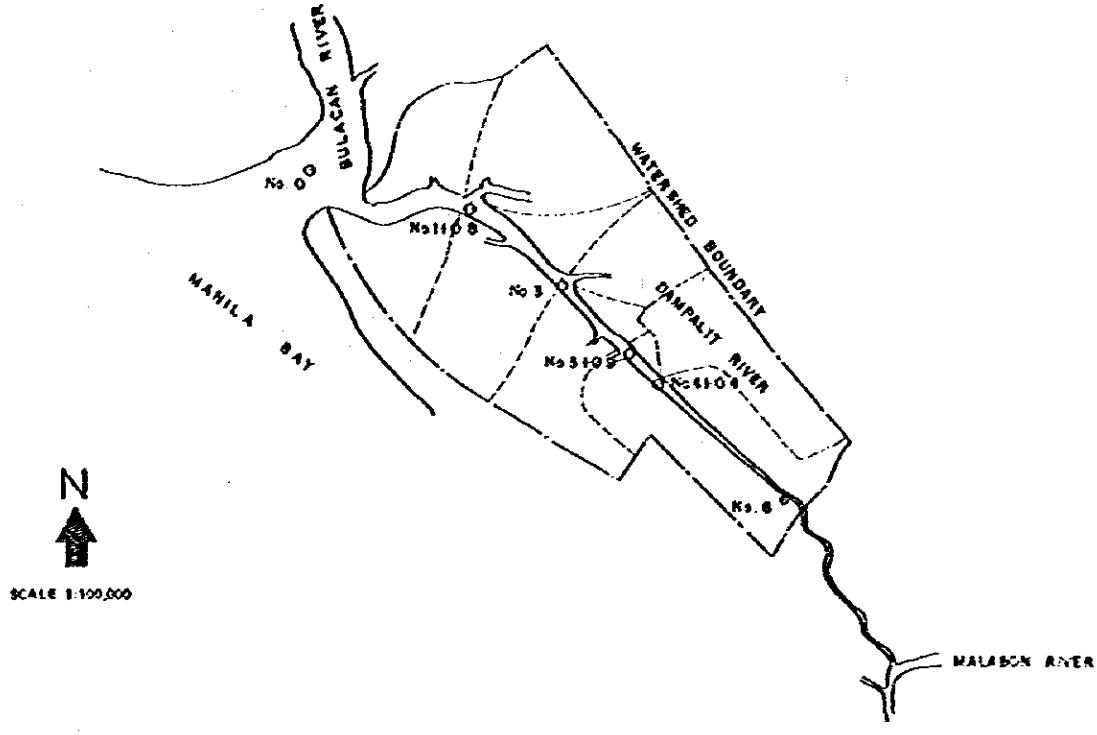
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
100 YEAR	4050	1320	1280	820	560	2840	830	360
50 YEAR ※	3550	1140	1110	720	490	2480	730	330
25 - YEAR	3020	970	940	590	400	200	620	270

※ DESIGN FLOOD DISCHARGE

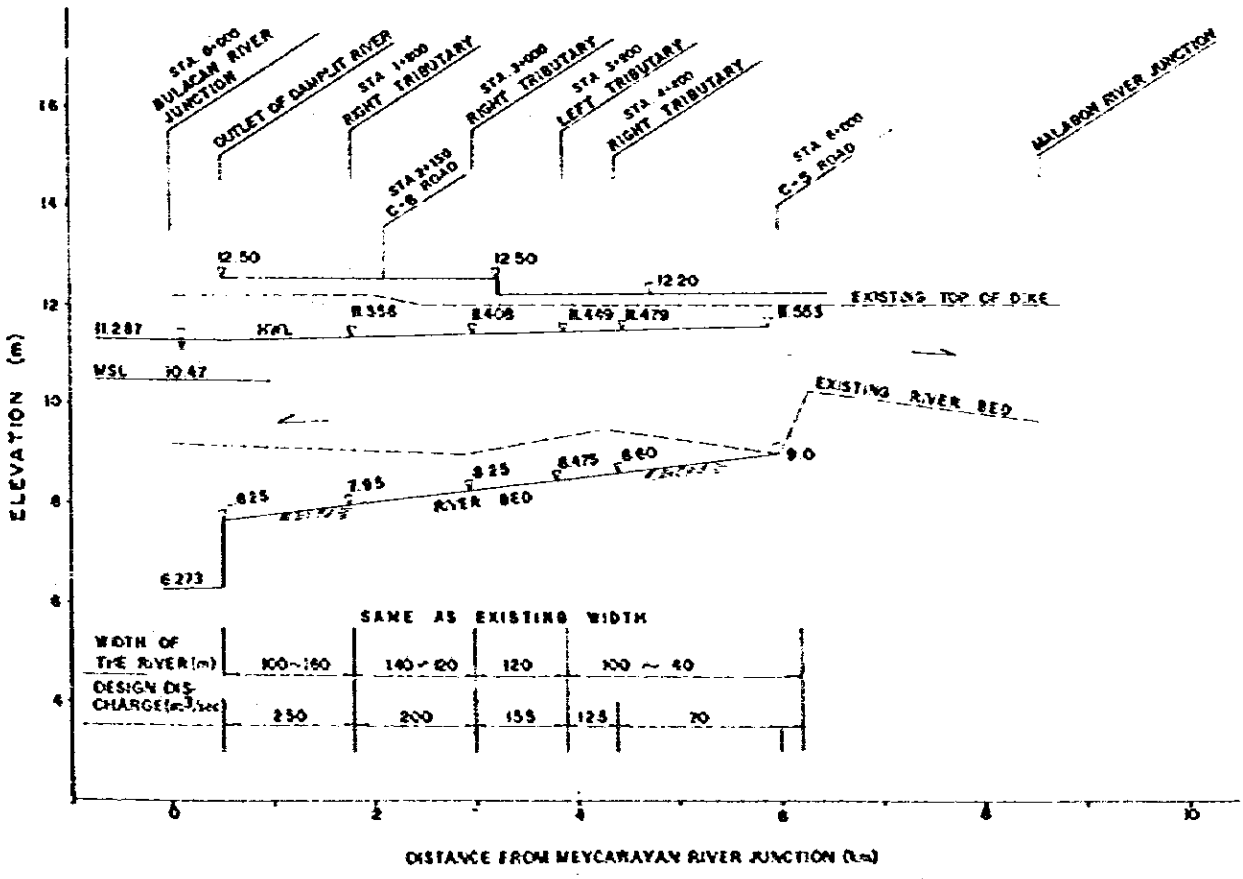
Appendix I-55
Fig. III-7-23 LONGITUDINAL PROFILE ALONG THE BULACAN–MEYCAWAYAN RIVER



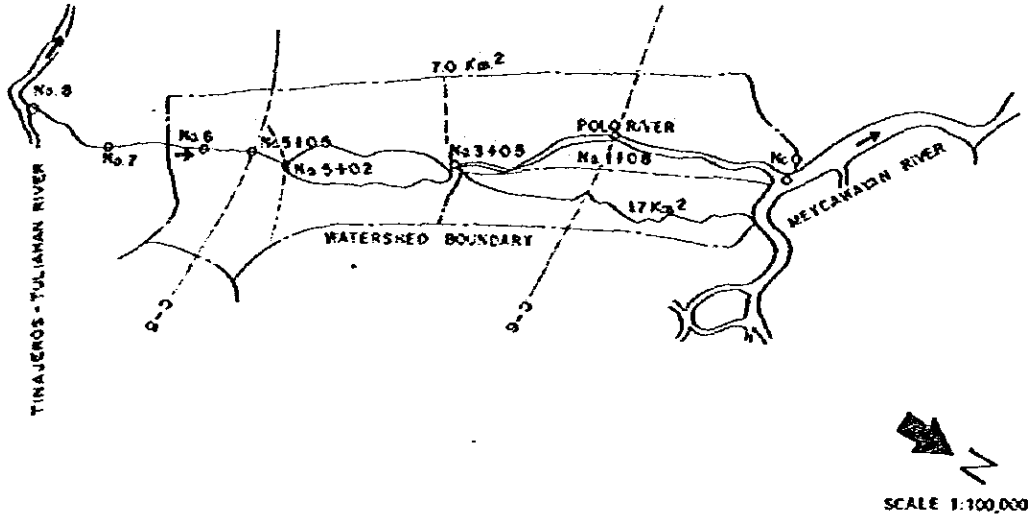
Appendix I-56
Fig. III-7-24 PLAN AND PROFILE OF DAMPALIT RIVER



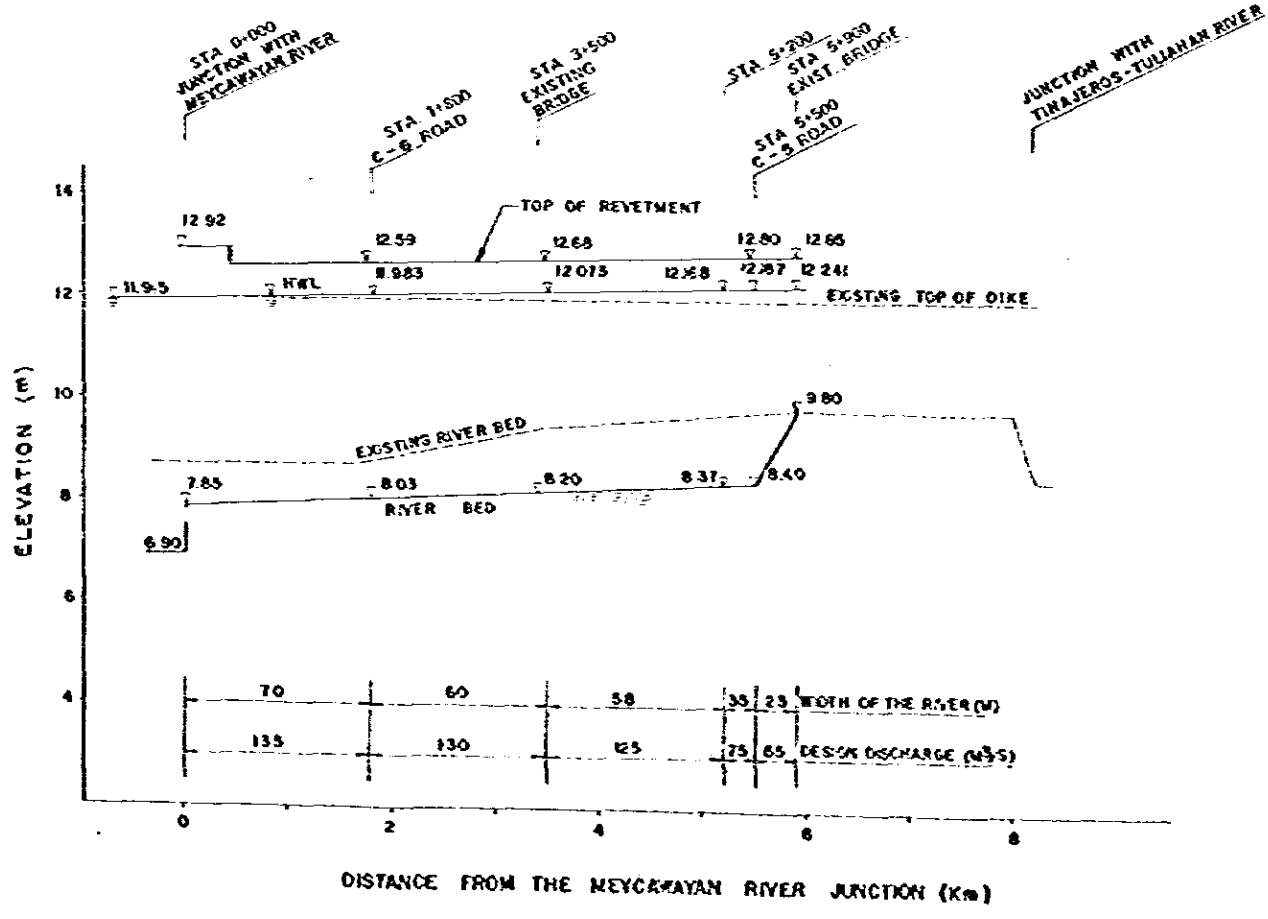
LONGITUDINAL PROFILE ALONG THE DAMPALIT RIVER



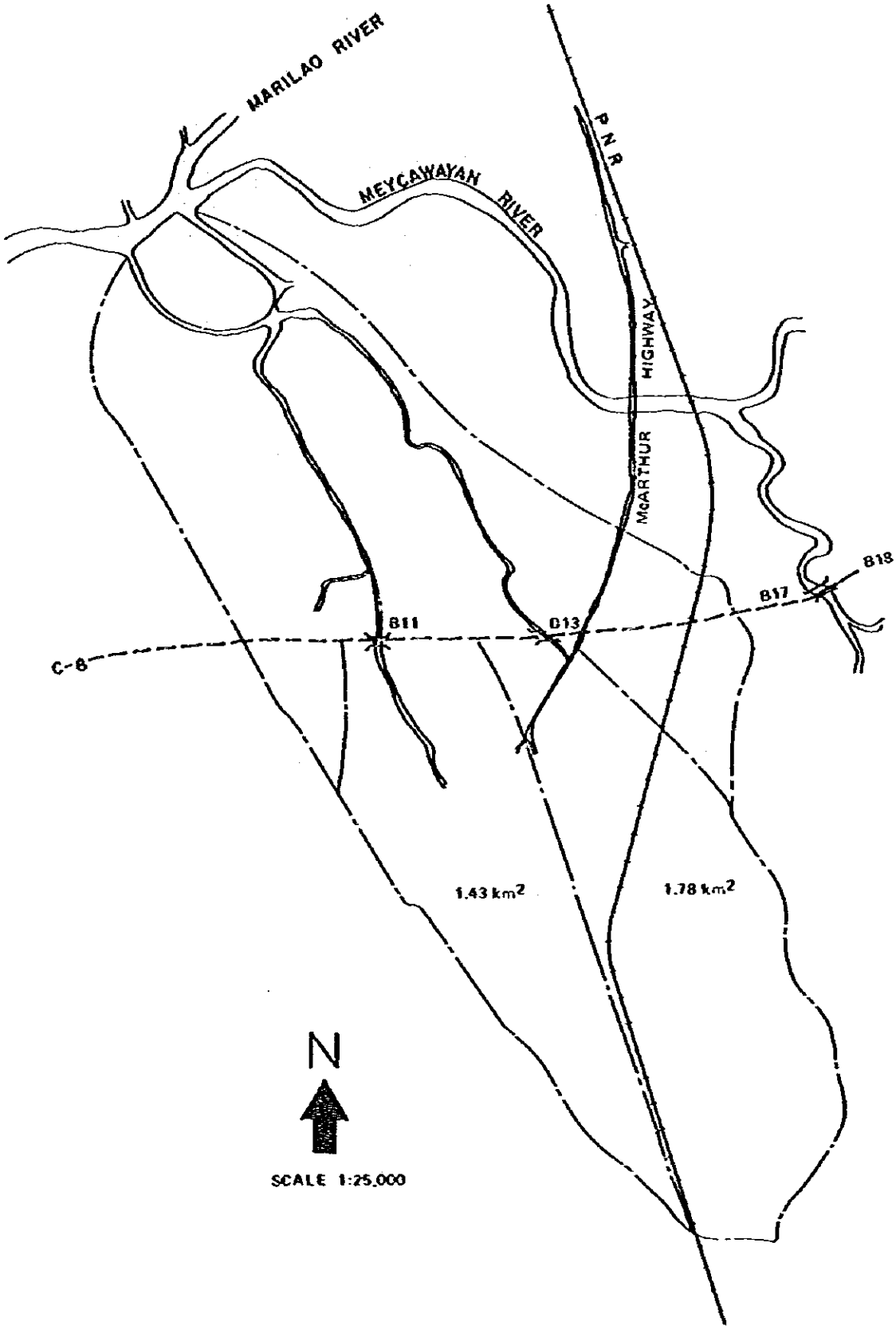
Appendix I-57
Fig. III-7-25 PLAN AND PROFILE OF POLO RIVER



LONGITUDINAL PROFILE ALONG THE POLO RIVER



Appendix I-58
Fig. III-7-26 PLAN OF THE TRIBUTARIES OF MEYCAWAYAN RIVER



Appendix I-59 ENVIRONMENTAL STUDIES

CHAPTER 1. INTRODUCTION

Pursuant to the Philippine Environmental Policy (P.D. 1151), the Manila-Bataan Coastal Road and Its Related Roads Project have the necessity of considering the environmental aspects of its development plans. This feasibility study, therefore, includes environmental studies with particular reference to the implementation of the Project.

The studies have been conducted according to the guidelines set by the National Environmental Protection Council (NEPC) and include the following:

- Project Summary;
- Description of the Environment of the Project Area;
- Relation of the Project to National Development Plan and Land/ Resource Use Policies;
- Description of Environmental Impacts of the Project and Mitigation of Adverse Effects; and
- Summary of Irreversible Commitments of Resources.

CHAPTER 2. PROJECT SUMMARY

2.1 Phasing and Staging of the Project and Construction Component

The project studied was divided into Phase I and Phase II and further subdivided inot Stages as shown in Table 59-1 according to the priority established by the Study.

Table 59-1 PHASES AND STAGES OF DEVELOPMENT

Phase	Stage	Construction Component
I	I	Construction of the Coastal Road and C-5
		Development ofReclamation Blocks I-III
		Construction of Street Network and Utilities in Reclamation Block I
		Construction of the grade separation structures and overlay for the Coastal Road and C-5
	II	Construction of the extension of the Coastal Road upto Reclamation Block IV
		Development of Reclamation Block IV.
		Construction of C-6
		Development of Reclamation Blocks V-VII
		Construction of the extension of the Coastal Road to Bataan (Phase II of Manila-Bataan Coastal Road)

2.2 Description of the Project Roads

A. Salient Features of the Project Roads

See Sub-Section 6.1.2 of Part III in Volume I.

B. Function of the Project Roads

See Sub-Section 6.1.3 of Part III in Volume I.

C. Design Standards

See Section 7.3 of Part III in Volume I.

D. Typical Cross-Section of the Project Roads

The elements of cross-section component applicable to the Project Roads were described in Sub-Section 7.3.1 of Part III in Volume I. The Figs. III-7-3 thru III-7-8 in Volume I present typical cross-sections of the Project Roads.

E. Design of Interchange

See Sub-Section 7.5.3 of Part III in Volume I.

F. Comparative Analysis of Bridge Type

See Sub-Section 7.7.4 of Part III in Volume I.

2.3 Description of the Development of the Reclamation Area

A. Location and Land Form of the Reclaimed Area

The proposed reclamation site is situated in the northwest of Manila. This proximity facilitates the absorption by the reclaimed area of development activities from the Manila Metropolitan Area. With the Navotas Fishery Port intervening, the site is contiguous to the port of Manila, the most important port of the nation.

The northern limit of reclamation area is the south bank of the Meycawayan River and any further northward expansion is reserved as a future project.

The adopted land form of the Reclaimed Area is shown in Appendix I-109.

B. Land Demand Analysis and Case Study of Land Use to be Located in the Reclaimed Area

See Chapter 2 of Part IV in Volume I.

C. Various Conditions Affecting the Scale of Reclamation Area

See Section 3.3 of Part IV in Volume I.

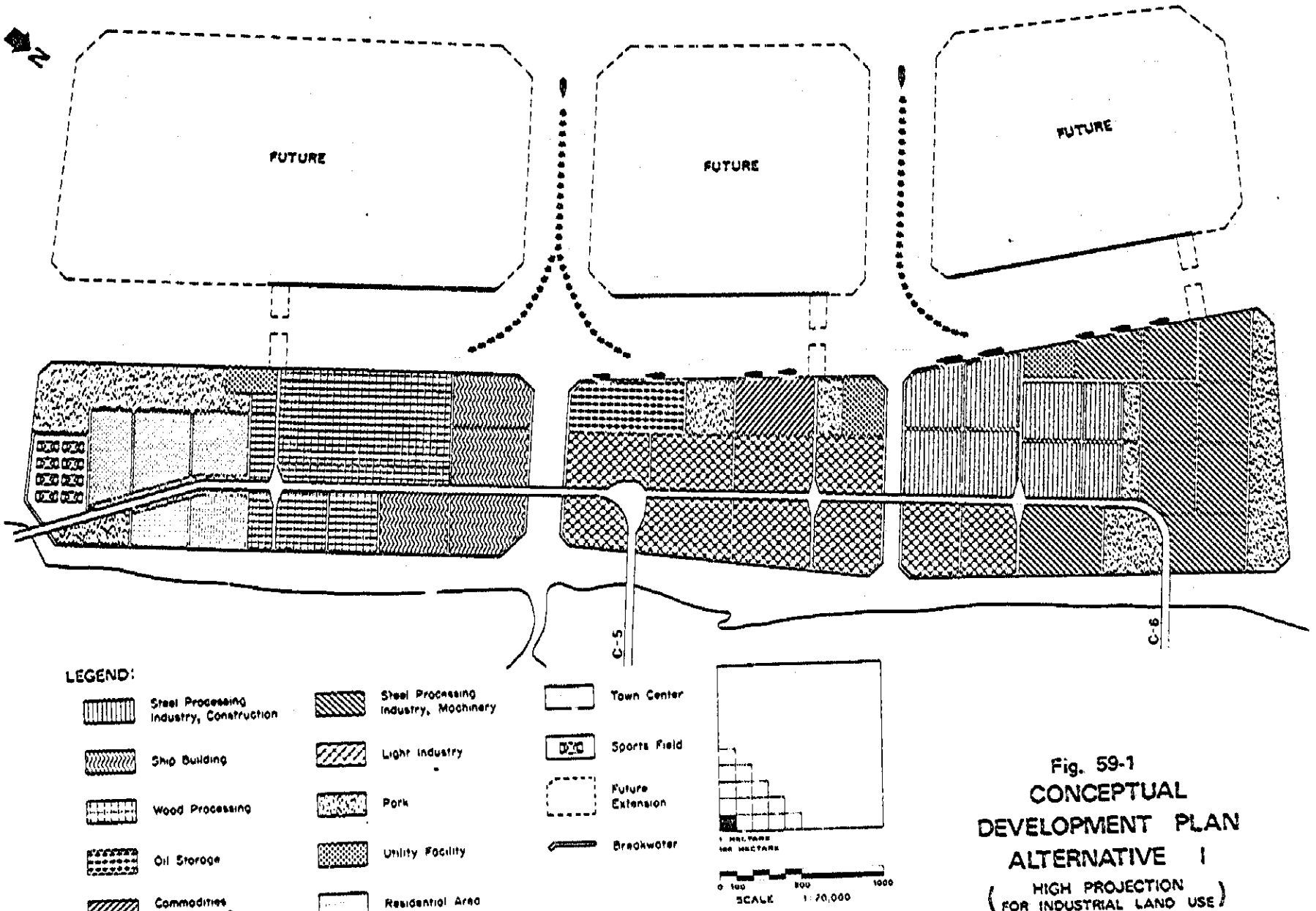


Fig. 59-1
CONCEPTUAL DEVELOPMENT PLAN ALTERNATIVE I
(HIGH PROJECTION FOR INDUSTRIAL LAND USE)

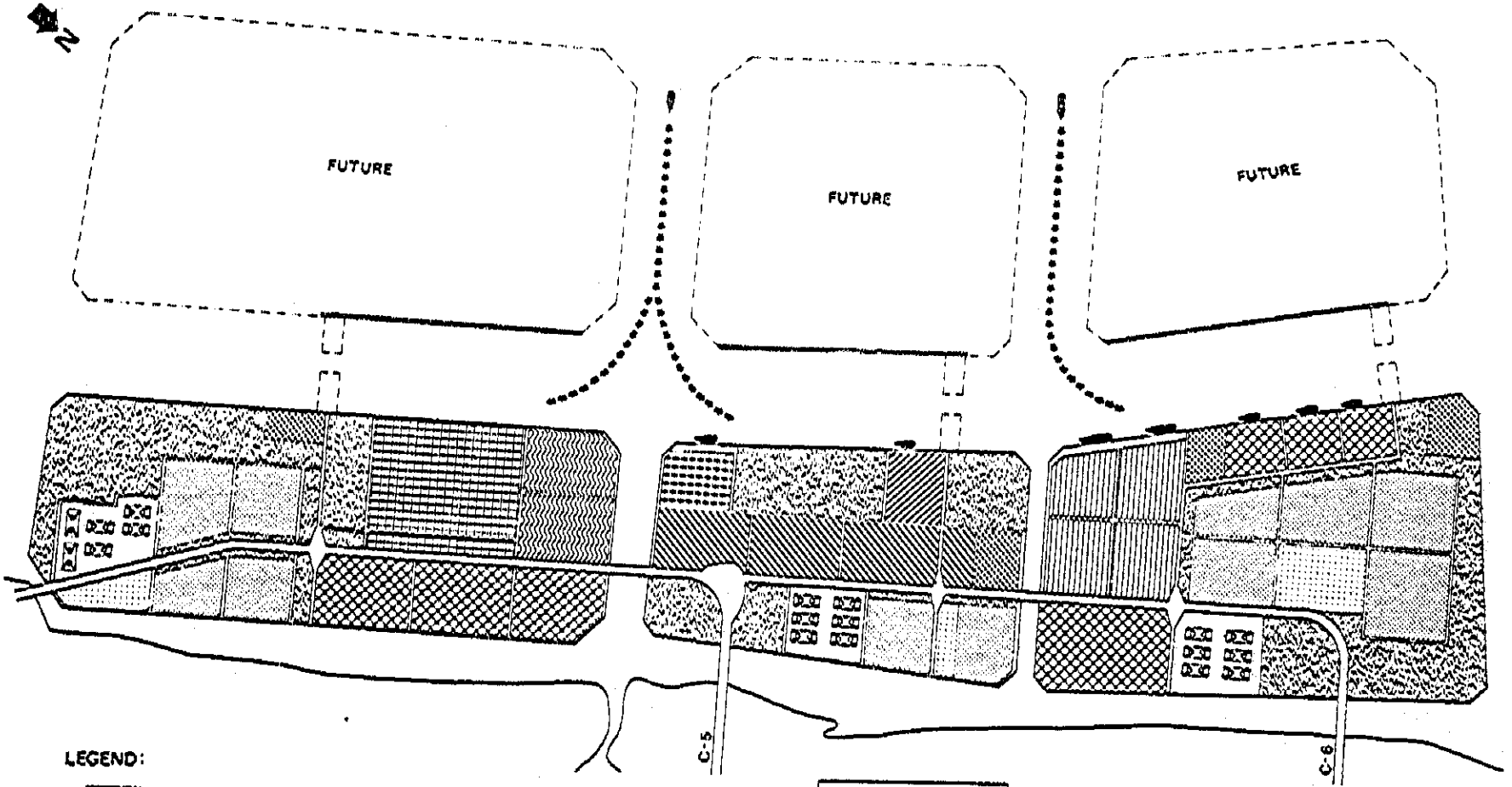


Fig. 59-2
CONCEPTUAL DEVELOPMENT PLAN ALTERNATIVE II
(LOW PROJECTION FOR INDUSTRIAL LAND USE)

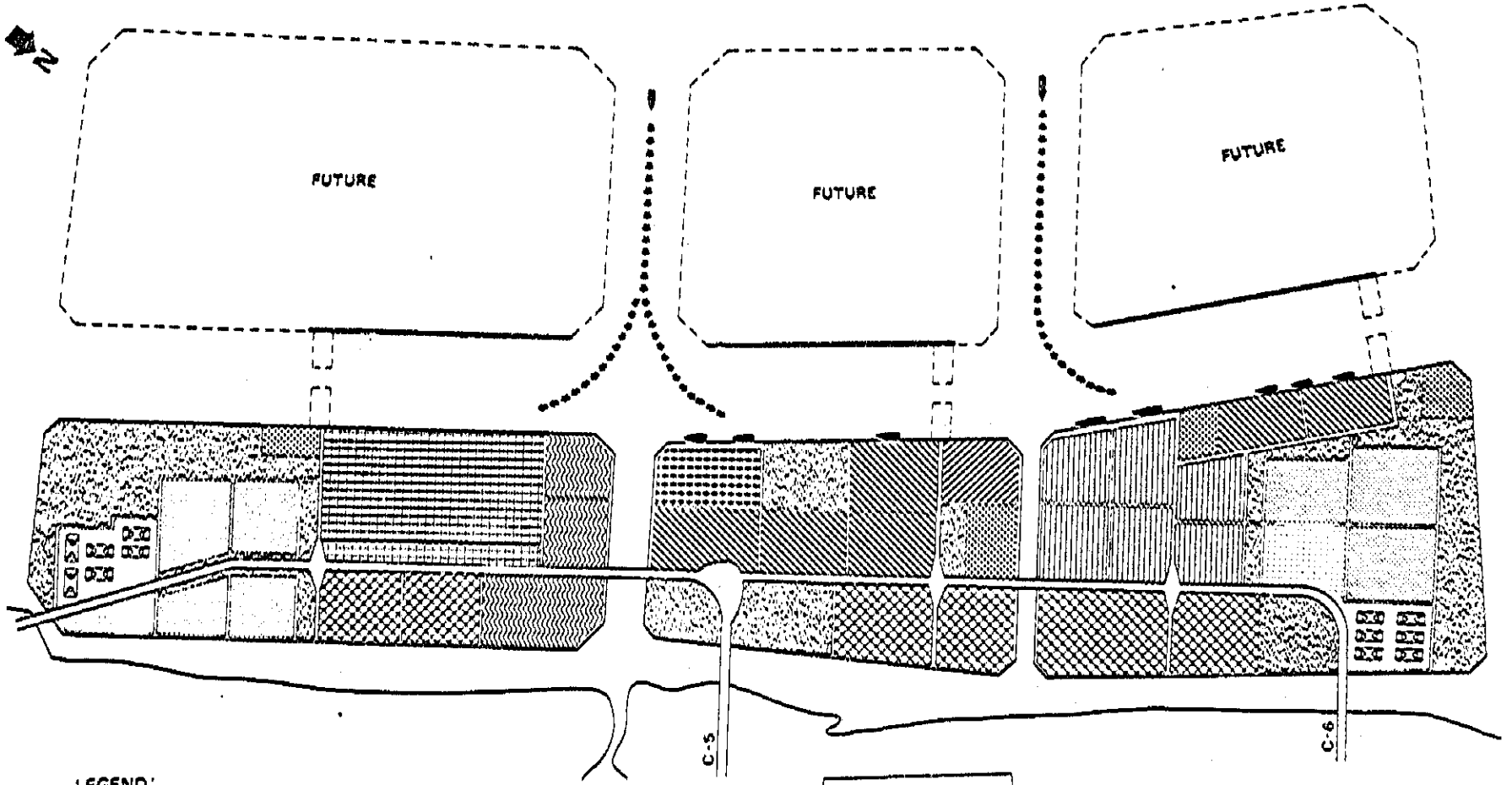


Fig. 59-3
CONCEPTUAL DEVELOPMENT PLAN ALTERNATIVE III
(MEDIUM PROJECTION FOR INDUSTRIAL LAND USE)

D. Land Use of Proposed Reclaimed Area

The land uses considered for the reclamation area follow the national policy for development which stresses the importance of manufacturing, labor-intensive and export-oriented industries. In addition, market-oriented industry were considered as also suitable for the reclaimed area since the site is located near Manila which is the biggest market in the Philippines.

Another consideration in determining the land uses in the area was to avoid polluting types of industries in view of the existing regional environmental policies.

Table IV-4-2 of Part IV in Volume I shows the selection of types of industry found to be suitable for the proposed reclaimed area.

Three alternative development plans were evaluated as presented in Figs. 59-1 thru 59-3.

Each alternative has different pattern land use characteristics as shown in Table 59-2.

Table 59-2 LAND USE CHARACTERISTICS OF EACH ALTERNATIVE

Alter-native	Level of Land Allocation by Category of Land Use				
	Industries & Commodity Distribution Center	Park	Residential Area	Town Center	Utility Area
I	High	Low	Low	Low	Low
II	Low	High	High	High	High
III	Medium	Medium	Medium	Medium	Medium

E. Dredging and Filling

See Section 6.5 of Part IV in Volume I.

F. Bulkhead and Breakwater Structure

See Section 6.7 of Part IV in Volume I.

CHAPTER 3. DESCRIPTION OF THE ENVIRONMENT OF THE PROJECT AREA

3.1 General

In addition to the road construction, the development of the reclaimed area also forms an important integral part of the Project. Consequently, the Project Area includes two types of environments: land and sea (bay) environments. Since natural, as well as man-made ecosystems will therefore experience the impact of the Project, impacts will be assessed for the following productive natural and man-made ecosystems (See Figs. 59-4 and 59-5).

i) Natural Ecosystems

- Estuary ecosystems of Navotas and Meycawayan Rivers;
- Mudflat ecosystems along bay coasts of municipalities of Navotas and Obando; and
- Marine ecosysten of the Manila Bay.

ii) Man-Made Ecosystems

- Urban ecosystems in the municipalities includes in the direct influence zones (i.e., residential, institutional commercial/ industrial, parks and open spaces); and
- Agro-ecocystems, such as bangus fishponds and rice fields.

The following sub-sections briefly describe mainly the physical and biological environment of the influence area. Where dedcriptions overlap with aspects already mentioned in detail in the other parts of this Report, the relevent sections are indicated of the purpose of cross-reference.

3.2 Physical Environment

A. Geography

Metro Manila is located in the central western part of Luzon Island, bordered by the Manila Bay on the west, tidal flats heavily-developed into fishponds on the northwest, the Central Plain of Luzon to the north, the foothills of the Sierra Madre Mountain Range to the northeast and east, Laguna de Bay to the southeast, and by a narrow neck of flatlands on the south.

B. Topography

The topography of Metro Manila is largely divided into the hilly area and the lowland area. The hilly area, with altitudes ranging from 13 to 20 m above Mean Sea Level, is indented by erosion valleys draining westward to the bay and eastward to the Marikina River.

Fig. 59-4 SCHEMATIC DIAGRAM: MAJOR ECOSYSTEMS IN NAVOTAS, MALABON AND MEYCAWANYAN ESTUARIES

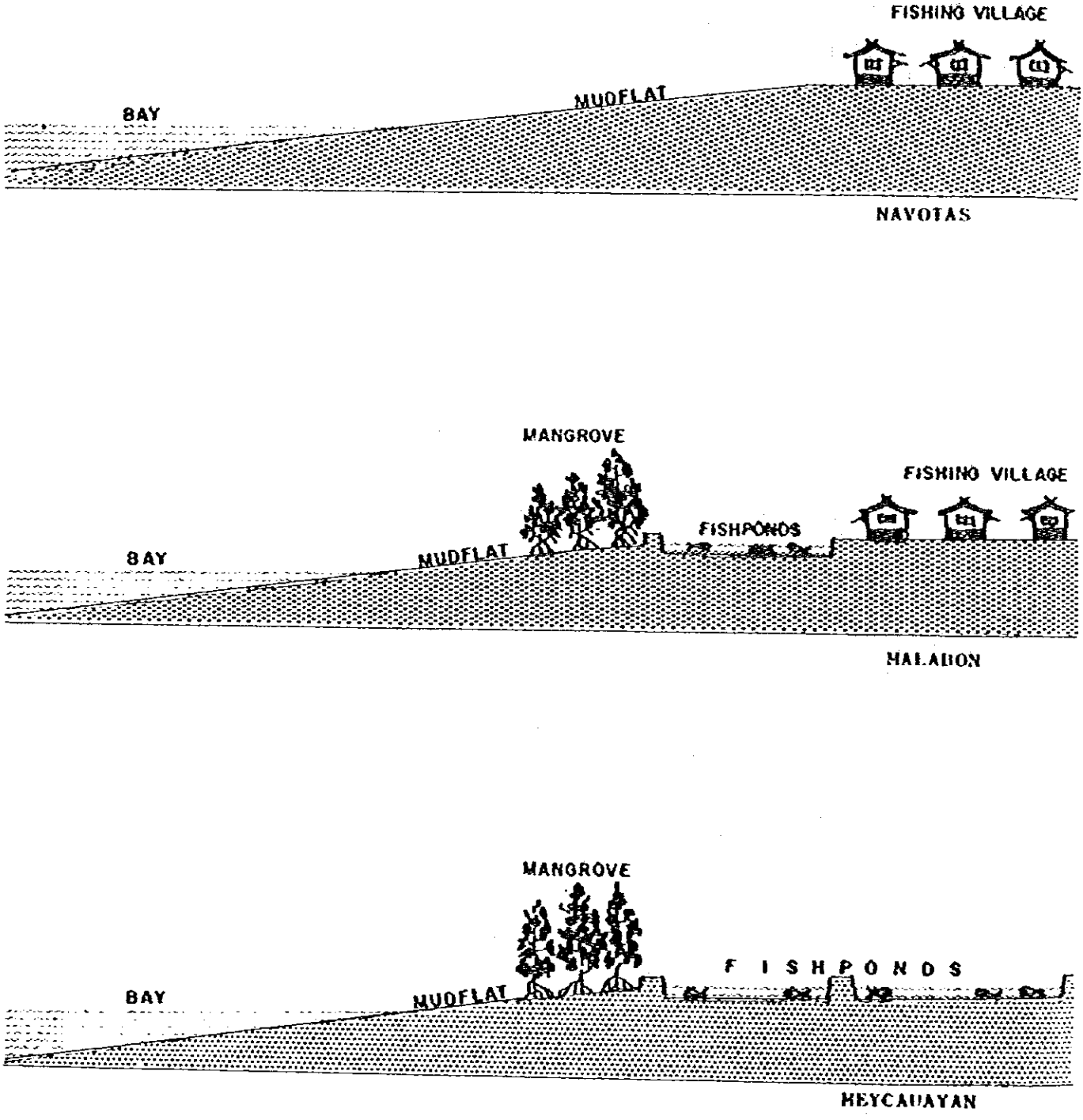
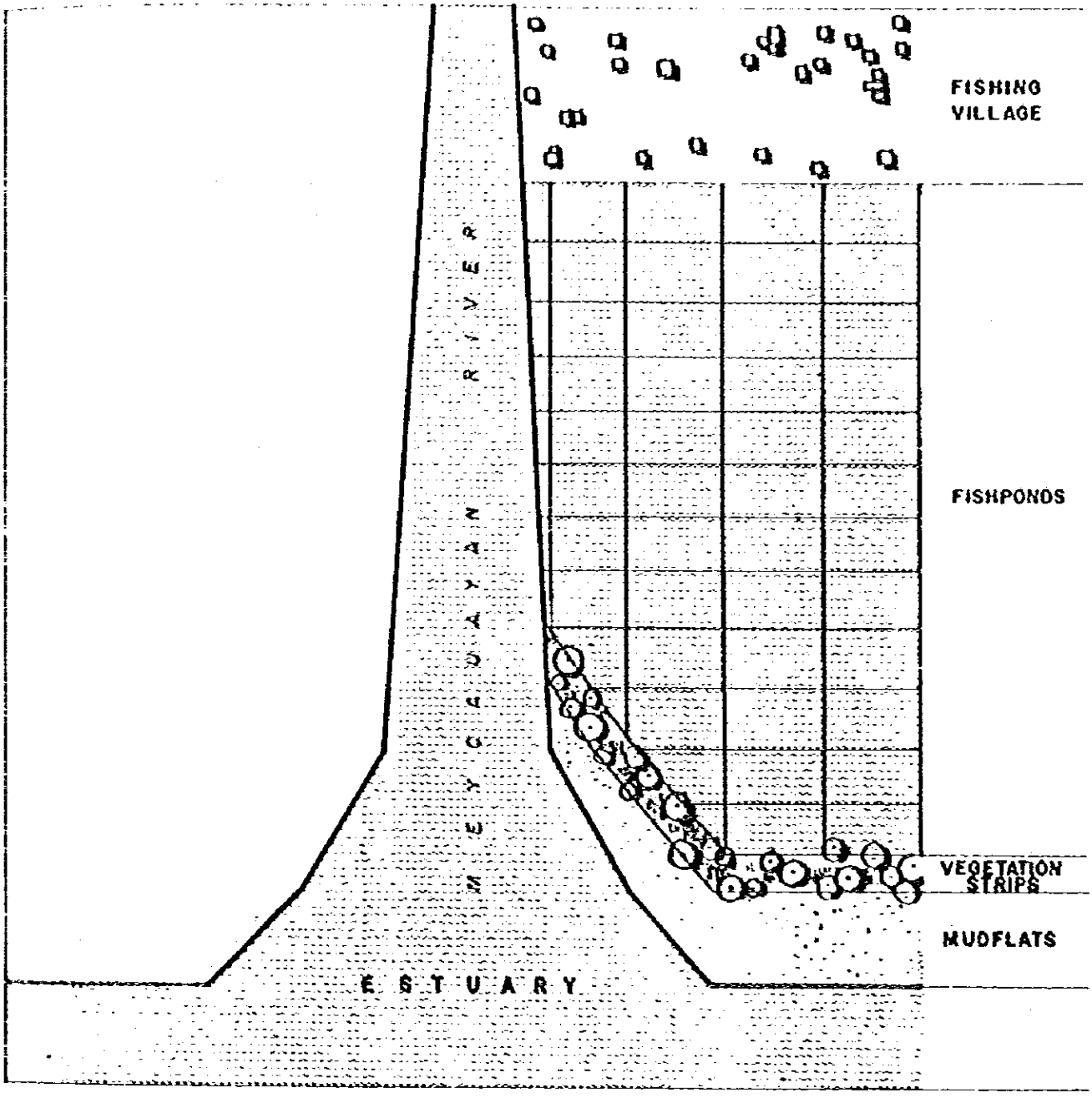


Fig. 59-5 SCHEMATIC DIAGRAM: MEYCAWAYAN ESTUARY



The lowland area, which is 1.5 to 2.5 m above Mean Sea Level, is the principal delta area of the Pasig River which drains Laguna de Bay, and meanders through the city in an east-west direction.

The Project Roads are located for the most part on the shallow offshore area and lowlands spread out in the deltas of Navotas and Meycawayan Rivers. The proposed reclamation site is a shallow offshore area with depths of 0.00 to 3.5 m below Mean Lower Low Water.

C. Geological and Soils Conditions

The geological map shows the general boundary between alluvial lowland plains (deltas) and diluvial upland formation (Guadalupe Tuff).

This tuff formation declines gradually westward to Manila Bay. Several valleys were eroded and filled with deltaic sediments (alluvial deposits) by major streams, i.e., Meycawayan and Navotas Rivers and their tributaries.

The deltaic deposits are intensively developed at variable depths of 10 to 25 m and are composed of clay, silty clay, silty sand, sandy silt, sand and seashells. They predominate particularly in water-saturated areas and fishponds.

For further details refer as follows:

Descriptions	Part	Chapter	Section/ Sub-Section
Probable soils profiles along the Project Roads	IV	3	3.2.4
Geological and sub-surface soils conditions of the reclamation site	IV	6	6.3

D. Climate

Climatological data include temperature, humidity, wind, cyclone and rainfall. These data have been observed by the Philippine Atmospheric, Geophysical Astronomical Scientific Administration (PAGASA). Generally, the Project Area has a Type-I climate which is characterized by two pronounced seasons: dry season from November to April and wet season for the rest of the year (See Fig. 59-6).

i) Temperature

The temperature regime in the Project Area is rather uniform throughout the year. It has an annual average of 27.6°C, ±0.5°C deviation. The data shown in Table 59-3 were observed by PAGASA over a 20-year period (1951-1970).

The hottest months are April (29.1°C) and May (29.6°C). The coldest months are January (25.9°C) and December (26.3°C).

Fig. 59-6 TYPES OF CLIMATE IN LUZON

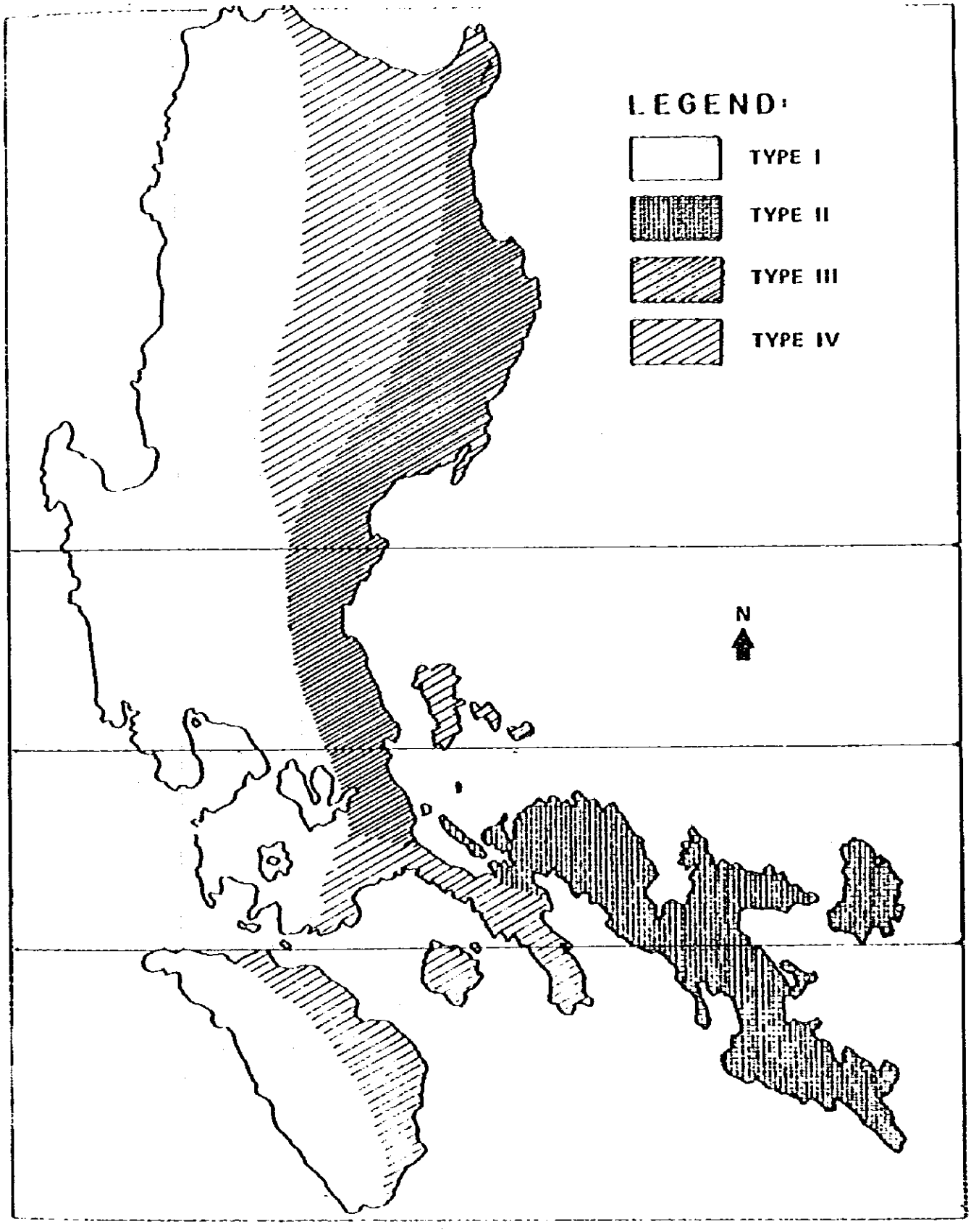


Table 59-3 CLIMATIC VARIATIONS IN THE PROJECT AREA

	MONTH	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	ANNUAL MEAN	STATISTICAL PERIOD AND PLACE
(1)	Normal Mean Temperature (C°)	25.9	26.4	27.7	29.1	29.6	28.7	28.0	27.5	27.5	27.8	27.2	26.3	27.6	1951-70 Manila
	S.D.	.67	.63	.49	.44	.54	.63	.41	.48	.46	.33	.43	.52	.5	
(2)	Normal Mean Relative Humidity (%)	76	72	70	67	74	82	86	86	87	84	82	80	77	1960-70 Science Garden, Quezon City
(3)	Mean Prevailing Wind Direction/ Average Wind Veolcity (Knots)	NE/5	SE/5	SE/6	SE/5	SE/6	SW/8	SW/8	SW/9	SW/8	NE/5	NE/5	NE/5	NE/6	1951-70 Manila
(4)	Normal Rainfall (mm)	16.4	16.6	11.2	20.4	184.3	394.1	444.3	448.1	424.0	130.0	138.4	47.1	189.6	1951-70 Diliman, Quezon City
	S.D.	14.27	10.64	18.91	26.39	189.75	285.89	229.62	163.06	113.04	80.82	110.04	44.50	107.2	
(5)	Normal No. of Rainy Days	4.0	3.0	3.0	3.0	8.0	16.0	20.0	22.0	22.0	15.0	12.0	9.0	11.4	1951-70 Manila
	S.D.	2.35	1.98	2.05	2.0	4.44	4.31	3.77	3.8	3.38	4.39	4.07	5.04	3.5	

Source : Philippine Weather Bureau Publications

The highest temperatures occur between 1 and 3 PM, the lowest temperatures occur between 5 and 7 AM.

ii) Humidity

The Project Area has high relative humidity from June to December (80-87%) and low relative humidity from January to May (70-76%). The mean annual relative humidity is 77% (See Table 59-3).

The diurnal behavior of relative humidity is characterized by high values at night and early mornings, and low values during the day and early evenings. However, variations from this general pattern occur during rainfall in the day and early evening, when relative humidity values are high.

iii) Winds

Table 59-3 shows the prevailing winds in the Project Area as follows:

SE winds -- from February to March, at 5 to 6 knots;
SW winds -- from June to September at 8 to 9 knots; and
NE winds -- from October to January, at 5 to 6 knots.

This data was observed by PAGASA over a 20-year period (1951-1970).

iv) Cyclones

A cyclone is a circular or nearly circular area of low atmospheric pressure in which the winds blow counter-clockwise in the Northern Hemisphere. Tropical cyclones are also known as typhoons or hurricanes. They are relatively small, very violent storms in tropical latitudes. Tropical cyclones are classified by PAGASA according to the maximum winds above their centers:

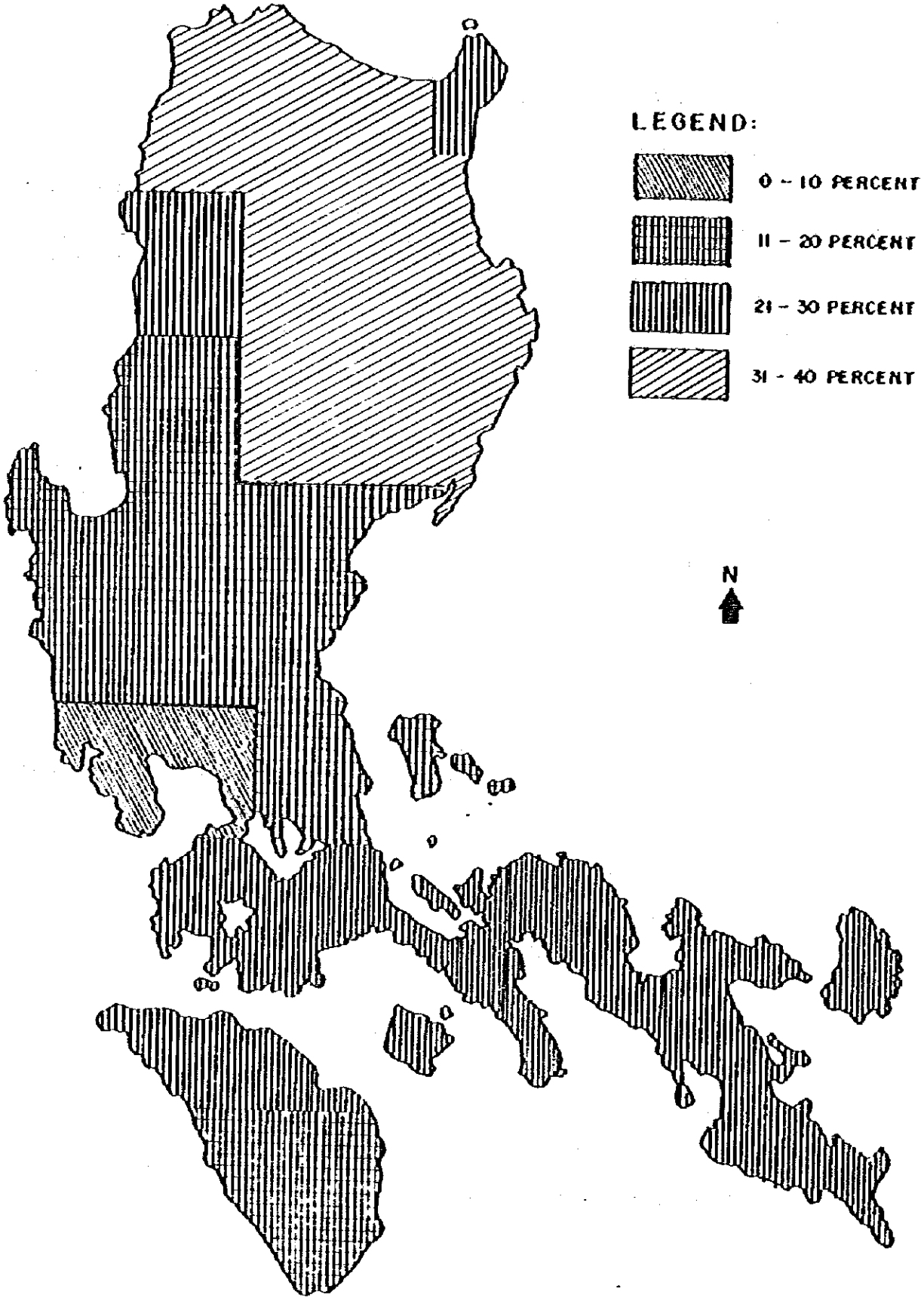
Classification	Wind Speed (km/hr)
Tropical depressions	up to 61
Tropical storms	63 - 87
Severe tropical storms	88 - 117
Typhoons	above 118

The Project Area has the lowest frequency of tropical cyclone passage in Luzon: 0-10% (See Fig. 59-7).

v) Rainfall

PAGASA classifies four types of rainfall according to the characteristics of rainfall distribution in a locality during different times of the year.

Fig. 59-7 MEAN PERCENTAGE PREQUENCIES OF TROPICAL CYCLON PASSAGE IN LUZON



The Project Area falls under Type-D, since rain is not evenly distributed, with as many as 6 dry months. (See Fig. 59-8).

Rainy months are from July to October. These months have 394 to 424 mm of rainfall, and from 15-22 rainy days per month. (See Table 59-3). Dry months are from January to April. These months have 16 to 21 mm of rainfall, and from 3-4 rainy days per month.

E. Oceanography

The main tidal data is as follows:

Descriptions	Values in meter
Mean tidal range (MHW-MLW)	0.75
Diurnal tidal range (MHHW-MLLW)	1.01
Mean higher high water (MHHW)	+ 1.01 above MLLW
Mean high water (MHW)	+ 0.86 above MLLW
Mean sea level (MSL)	+ 0.47 above MLLW
Mean low water (MLW)	+ 0.10 above MLLW
Mean lower low water (MLLW)	0.00 above MLLW

Highest observed tide -- 1.77 above MLLW (July 23, 1911)
Lowest observed tide --- 0.67 below MLLW (February 3, 1912)

The greatest tidal range occurs usually in June and December while the smallest range occurs in March and September.

No record of wave observations are available for the vicinity of the proposed reclamation site.

In 1978, Salzgitter Consult GMBH [1] estimated the waves with a probability of occurrence or excedence of once per year for each direction of attack using meteorological data.

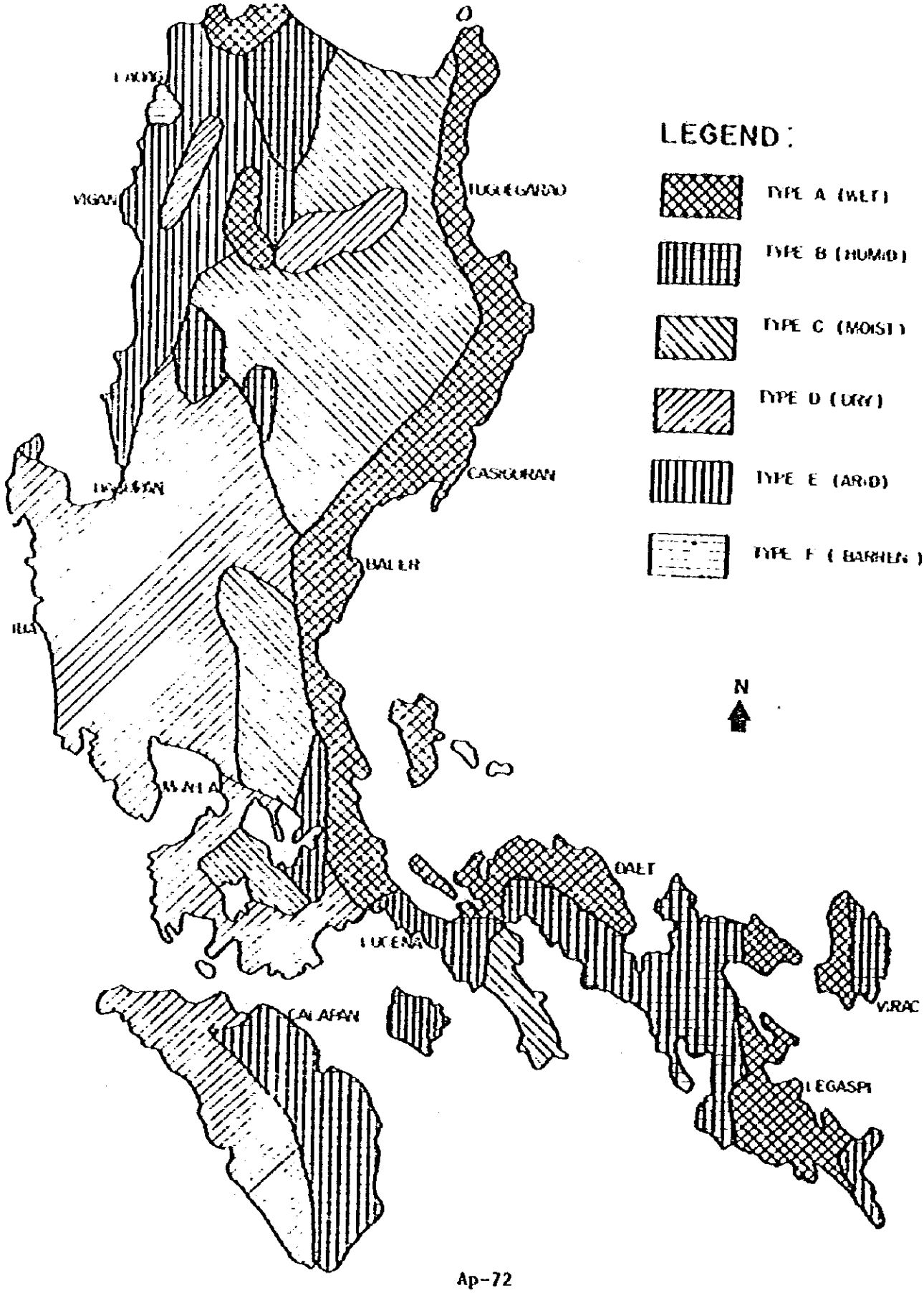
The results of the study made by the said consultant are summarized as follows:

Direction of Attach	Wave Height (m)	Design Wave Period (sec)	Wave Length (m)
NW	0.7	5.0	37
WNW	1.1	6.5	55
W	1.5	5.5	47
WSW	1.7	6.0	56
SW	1.3	5.0	39

No official records concerning current observations are available of Manila Bay. A short survey was made some years

[1] Source: Master Plan Study, Port of Manila, 1978.

Fig. 59-8 RAINFALL TYPES IN LUZON



ago and found a current velocity of around 0.05 m/sec.[2/] Even under the most adverse conditions, e.g. superimposition of tidal currents and wind generated currents, no significant disturbance to navigation is expected.

F. Hydrology

i) Daily Rainfall

The relationship between 24-hour rain and return period based on the records of Norzagaray and MIA observation stations are shown in Table 59-4:

Table 59-4 DAILY RAINFALL DATA

Unit: mm

Return Period (Year)	Norzagaray	MIA
2	261	153
5	356	243
10	514	305
15	455	340
25	505	395
50	570	465
100	640	535

Source : The report "Pampanga Delta/Candaba Swamp Area Development Project, Surface Water Studies, P 19".

ii) Description of River Systems

The river systems related to the Projects are Navotas and Meycawayan Rivers systems.

(a) Navotas River System

The main stream of the Navotas River originates from the La Mesa Creek and flows toward the west and finally into the Manila Bay. The Novaliches Reservoirs (La Mesa Dam) is located in the upstream portion of the Tullahan River (La Mesa Creek).

This reservoir has been used to supply water to the Manila area. Although the water level is low under ordinary weather condition, it reaches the crest of the spillway when the upstream basin experiences heavy rainfall. In this case, the water in the reservoir goes to Manila except for the overflow from the spillway. The middle stream area has been developed mainly for residential and industrial purposes.

2/ Source: Master Plan Study, Port of Manila, 1978.

The slope of the river is relatively steep except in the lower downstream portion. The width of the basin is narrow compared with its length. Flood waters of the Tullahan River are drained mostly by the Marala and Navotas Rivers; the future construction of the Navotas Cut-Off Channel will also help drain the flood waters.

The drainage network of Navotas River system is partially connected with the Bulacan River system through the rivers and channels.

The main features of the Navotas River system are as follows:

Drainage area (including La Mesa Dam watershed)	= 88 Km^2
Main stream length	= 35 Km
Time of concentration	= 320 min
Run-Off Coefficient	= 0.6

The peak discharge of the Navotas River is estimated to be 710 cubic meters per second for a 50-year period.

(b) Meycawayan River System

Meycawayan River system consists of the following rivers and tributaries:

Name of River	Drainage Area (km^2)
Bulacan/Bambang	166.2
Bocaue	234.8
Marilao	99.5
Meycawayan	22.8
Polo	7.0
Dampalit	12.5
Other tributaries	60.8
Total	603.6

The main hydrollgical components of the Meycawayan River system are as follows:

Drainage area	= 603.6 km^2
Main stream length	= 51 km
Time of concentration	= 420 min
Run-off coefficient	= 0.6
Estimated peak discharge for 50-year frequency	= 3,260 $m^3/sec.$

(c) Flood

The area between the McArthur Highway and the Manila Bay is low and flat consisting mainly of fishponds, rice fields and towns located along the roads. About 12 kilometers from the mouth of Meycawayan River to the Philippine National Railways, the inland area is low and the terrain is almost flat. This area has been flooded frequently and overflowing of the fishpond dikes is a yearly occurrence. The discharge capacity of the Meycawayan River is quite small compared with its large catchment area and the amount of rainfall for following reasons:

- River width is limited by artificial fishpond dikes;
- The presence of fishpond traps in the river and its mouth affect siltation which raises the flood level; and
- A large head loss is due to shallow portion (sand bar) around the river mouth.

Floods in the towns along the existing roads (Polo, Obando, etc.) are considered to be affected by backwater from the Meycawayan River. C-5 and C-6 Roads are planned to traverse this low and flat area.

(d) Sedimentation

The river system in the basin carries eroded materials with their water flow. As the cohesive soils (silt or clay) meets seawater, flocculation occurs. Shoals or sand flats have therefore been formed.

At present, there has been no study of the sedimentation rate of the Navotas and Meycawayan Rivers system. Only short discussions is presented below:

Sedimentation in the Planned Navotas Waterway (between Reclamation Blocks)

The sediment discharge in the Navotas River is small for the following reasons:

- Since the sediment load from the upstream La Mesa Dam basin will be deposited in the reservoir, the volume of fine soil particles which overflows from the spillway during large floods will be negligible; and

- Once the Navotas Cut-Off Chennel is provided, the greater part of sediment discharge will flow through it.

Meycawayan River Mouth

To avoid the possibility of flooding which may occur at the offshore reclamation, the extent of planned reclamation was limited to the South bank of the Meycawayan River.

The shallow portion of the Meycawayan River mouth may be dredged to obtain soils needed for the reclamation. Since the sediment discharge transported by the Meycawayan River will be big, even if the shallow portion is dredged once, it will continue to be silted year by year. Therefore, the dredging will decrease the flood damage in the upstream area in short term, until the dredged portion becomes silted again. Soils transported by the Meycawayan River will be deposited around the river mouth in the long term and the extent of siltation will be similar to the present condition.

G. Water Quality

Estuarine (or marine) water quality is expressed in terms of the following physical and chemical parameters. Physical parameters include temperature (°C), pH (units), dissolved oxygen (mg/l), turbidity (mg/l), and color (units). Chemical parameters include, at least, nitrate (mg/l), phosphate (mg/l), sulfate (mg/l), manganese (mg/l) and chromium (mg/l).

i) Significance

The above-mentioned water quality parameters are important for the following biological reasons:

Temperature and pH slow or hasten the biological activities of water organisms. Temperature also affects the dissolved oxygen in water; high temperatures (above 30°C) enable dissolved oxygen to escape, especially at surface levels.

Dissolved oxygen (DO) molecules in water keep the organisms which use oxygen for respiration aline, Waters low in DO (less than 3.0 mg/l) support little or no life at all. DO molecules in water are also used in the decomposition of both organic and inorganic wastes. Waters low in DO are overloaded with organic and inorganic wastes.

Turbidity and color affect the photosynthetic activity of planktons, the microscopic nutrient producers in water. These planktons float and photosynthesize only as far as light penetrates the water body. Thus, if the water is

highly turbid, photosynthetic activity of planktons is low and plankton feeders such as shrimps, crabs, young fishes, etc., would not have much to eat. Waters with high turbidity and color readings support little or no life at all.

Nitrate, phosphate and sulfate are fertilizer ingredients. High concentrations of these compounds in a water body mean that these compounds have been washed off from cultivated areas wherein fertilizers have been applied. High levels of nitrate, phosphate and sulfate in a water body result in excessive algae (lumot) growths. When these dense mats of algae die, they use up DO in water in the process of decomposition which causes oxygen depletion. Waters with high levels of these compounds support little or no life at all.

Manganese and chromium are heavy metals which come from industrial and municipal wastes. High levels of these heavy metals are lethal to water organisms.

ii) Determination of Water Quality

Determination of water quality requires adequate sampling during the wet and the dry seasons. Where tide levels fluctuate, as in estuaries and marine shallow waters, sampling should take times of high and low tides into consideration. Hence, water sampling and analysis at the Project Site were not for water quality determination, but rather to "spot check" the water to know whether the general water quality levels.

The Team stresses that water quality check results shown in Tables 59-5 to 59-7 are tentative, and are subject to change when additional data indicate that they are inadequate.

Table 59-5 WATER QUALITY:
OFFSHORE NEAR THE NAVOTAS FISHERY PORT

Station # 1

Place: Navotas, Metro manila
Date : 10-27-79
Tide : Ebb

PARAMETERS		POINTS		
		A	B	C
PHYSICAL	Temperature, °C	31	30	29
	pH, units	8	8	8
	DO, mg/l	3.75	5.0	7.75
	Turbidity, mg/l	110	3.0	0
	Color, Units	10	10	5
CHEMICAL	A. Cations			
	B. Anions			
	Nitrate, mg/l	52.8	38.60	28.60
	Phosphate, mg/l	0.6	0.35	0.4
	Sulfate, mg/l	150	150	155
	C. Heavy Metals			
	Manganese, mg/l	0	0	0
	Crromium, mg/l	0	0	0

TIME	0930	0940	1000
Water Level	0.25 m	2.50 m	3.00 m
Distance from Mouth of River	0.25 km	0.50 km	1.50 km

Table 59-6 WATER QUALITY:
ESTUARY OF THE NAVOTAS RIVER

Section # 2

Place: Tanza, Malabon, Metro Manila
Date : 10-27-79

PARAMETERS		POINTS A	POINTS B	POINTS C
PHYSICAL	Temperature, °C	31	30	31
	pH, Units	7.6	7.5	7.6
	DO, mg/l	0	0	0
	Turbidity, mg/l	6	10	10
	Color, units	10	30	30
CHEMICAL	A. Cations			
	B. Anions			
	Nitrate, mg/l	48.4	37.4	35.2
	Phosphate, mg/l	1.0	0.4	0.5
	Sulfate, mg/l	180	180	180
	C. Heavy Metals			
	Manganese, mg/l	0.7	trace	0.4
	Chromium, mg/l	0	0	0

TIME	1135	1145	1200
Water Level	1.50 m	1.00 m	1.00 m
Distance from Mouth of River	0.25 km	0.50 km	1.50 km

Table 59-7 WATER QUALITY:
ESTUARY OF THE MEYCAWAYAN RIVER

Station # 3

Place: Meycawayan, Bulacan
Date : 10-27-79

PARAMETERS		POINTS		
		A	B	C
PHYSICAL	Temperature, °C	31	32	31
	pH, Units	7.6	7.8	8.5
	DO, mg/l	4.25	5.25	9.00
	Turbidity, mg/l	10	5	5
	Color, units	20	20	10
CHEMICAL	A. Cations			
	B. Anions			
	Nitrate, mg/l	28.60	35.2	41.8
	Phosphate, mg/l	1.0	0.6	0.4
	Sulfate, mg/l	180	170	180
	C. Heavy Metals			
	Manganese, mg/l	0	0	0
	Chromium, mg/l	0	0	0

TIME	1500	1510	1520
Water Level	2.00 m	1.50 m	1.50 m
Distance from Mouth of River	0.25 km	0.50 km	1.50 km

iii) Stations

A reclamation project entails waste discharges which will affect the following water bodies: (1) estuaries of nearby rivers and (2) marine shallow waters of the bay. The Study must consider that waste discharges (during project implementation and after project completion) do not just go into a water system, but rather into a living water ecosystem. Thus, project elements were selected so as to develop an area with minimal damage to the existing environment.

To study the water quality, stations were established on the offshore of the Navotas Fishery Port and the estuaries of Navotas and Meycawayan Rivers. (See Fig. 59-9). For each station, 3 sampling points were considered: 0.25; 0.5 and 1.5 km from the shoreline or the mouth of each river. A total of 9 sampling points were selected for the Project Site.

iv) Results of Water Analysis

(a) Offshore near the Navotas Fishery Port (Station #1)

It was only at Point A where turbidity (110 units) and phosphate (0.6 mg/l) marked high levels. The most probable causes of trubidity at the station were: (1) silt deposition coming from nearby areas; (2) mixed industrial effluents from various industrial plants located in the vicinity; and (3) domestic sewage. There were no traces of heavy metals (manganese and chromium) at this station.

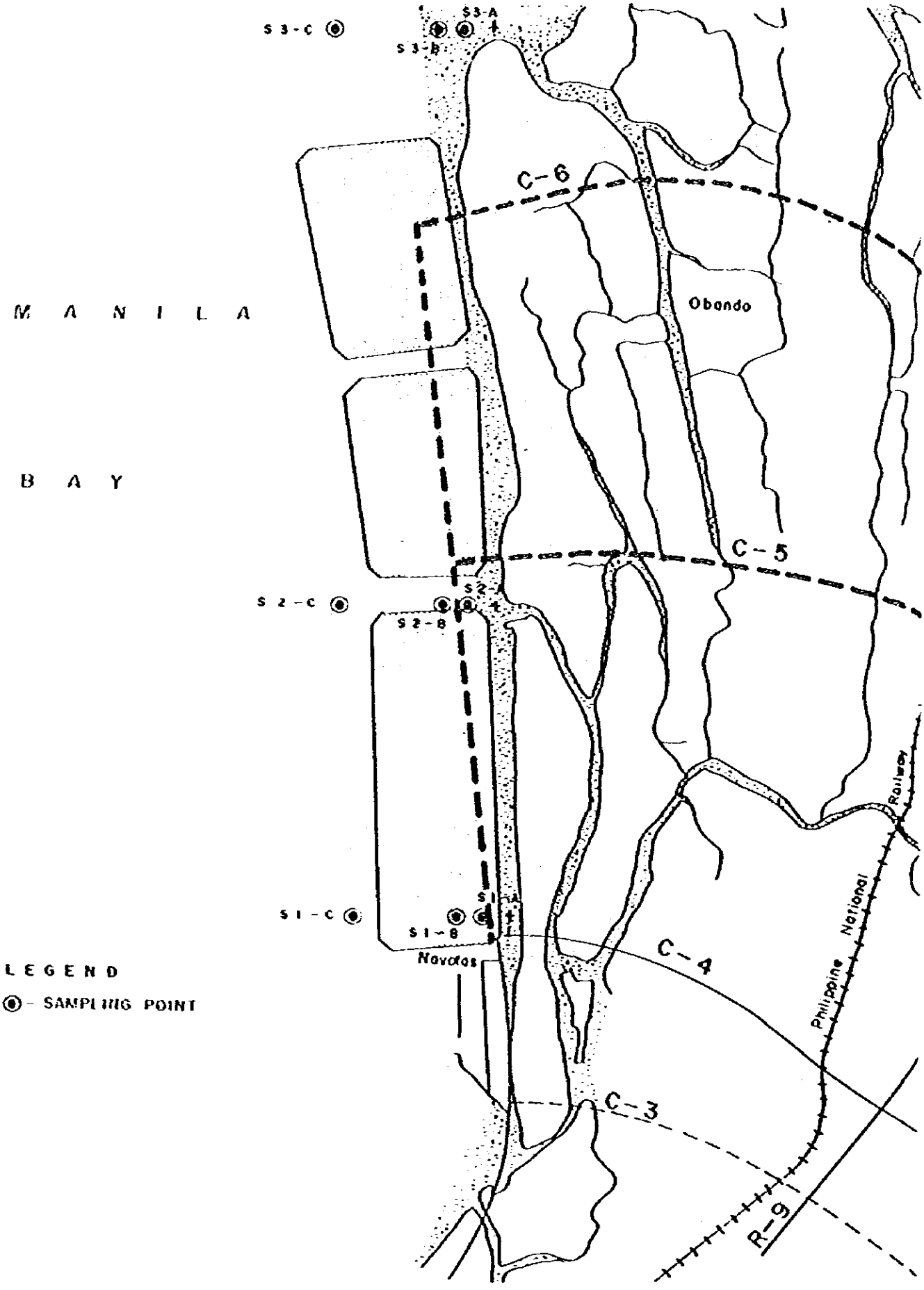
(b) Estuary of the Navotas River (Station #2)

During the survey, dissolved oxygen at Points A, B and C were at 0.0 level at 31°C. This could only mean an excessive organic waste load discharged upstream, from industrial and municipal sources. At point A, the phosphate level indicated 1.0 mg/l. This could only be caused by industrial and municipal waste discharges. Traces of manganese, a heavy metal, were detected (0.7 mg/l at Point A and 0.4 mg/l at Point C) from this estuary.

(c) Estuary of the Meycawayan River (Station #3)

During the survey, the phosphate levels indicated high values at Points A (1.0 mg/l) and B (0.6 mg/l). These phosphate levels could be due to fertilizer run-offs from cultivated fields and fishponds. There were no traces of heavy metals, manganese or chromium, in this estuary.

Fig. 59-9 WATER QUALITY STATIONS



3.3 Biological Environment

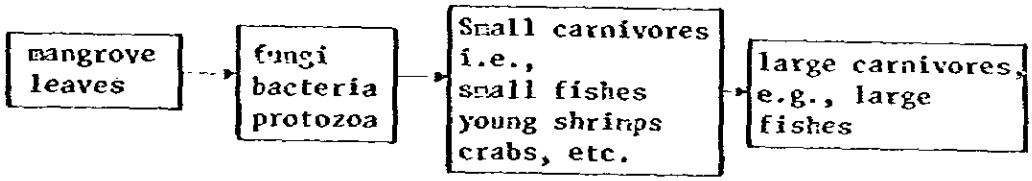
A. Vegetation

Water quality stations (See Fig. 59-9) also serve as observation points for the characteristic vegetation of the Project Site.

No bayshore vegetation exists around Station 1 (Navotas, Metro Manila). The fishing village has encroached on the upper part part of the bayshore mudflat (See the diagram in Fig. 59-4).

Mangrove vegetation borders the estuarine and fishpond areas in Stations 2 and 3. However, they do not exist in their natural, virgin condition since only traces of the natural stands of mangrove forest vegetation which existed before the area was developed into fishponds still remain (See the diagrams in Fig. 59-4).

The remaining mangrove vegetation strips are nonetheless ecologically important. They act as windbreakers, sheltering fishponds from the bay coast. They protect the bay coast from soil erosion, as their roots trap drifting sands. They are shelter belts for bird life and pollinating insects. Their leaf detritus contributes to the food input into the estuarine ecosystem as follows:



The dominant mangrove plants in the Project Site are Rhizophora sp. (Bakawan), Avicennia sp. (Apiapi) and Prosopis vidaliana (Aroma; Aromang Dagat). These will be destroyed if the proposed reclamation is planned without a waterway between the existing shore-line and the new reclamation area. This loss will cause loss of mudflat habitats, which will also result in a loss of mangrove plants and wildlife associated with it. A brief description of the dominant types of mangrove plants is as follows:

1) Rhizophora sp. (Bakawan)

Bakawan is a tree which is especially adapted to salty, muddy and tidal mudflats (see Fig. 59-10). It grows from 4 to 8 meters high. Its specialized roots, growing out from the tree trunk, arch repeatedly. These broadly placed anchoring roots enable the tree to resist the sweep of the sea.

Bakawan flowers most of the year. Its seeds germinate while still attached to the parent tree. Seedlings which are about 1/3 meters in length drop off from the branches of the parent tree, float, then take root in the mudflat. Local inhabitants mainly use Bakawan for fuel.

Fig. 59-10 RHIZOPHORA (BAKAWAN)

Habitat Fruiting branch

ii) Avicennia sp. (Apiapi)

Apiapi is a tree or shrub which is especially adopted to airless, water-saturated mudflats. It grows to a height of 8 meters. Its specialized roots grow upwards, stricking out like beds of nails during low tides.

Like Bakawan, Apiapi seeds also germinate while still attached to the parent tree. If a seedling is mature enough to live by itself, it drops off, floats, then takes root in the mudflat. Local inhabitants also also use Apiapi branches for fuel.

iii) Prosopis vidaliana (Aroma; Aromang Dagat)

Aroma is a shrub or a small tree 2 to 6 meters tall. It has spiny branches, twice pinnately compound leaves and yellowish flowers. This plant forms thickets along sandy seashores. Local inhabitants also uses Aroma branches for fuel.

Vegetation along polluted rivers which run through urban areas occur in patches, consisting mainly of grasses such as Talahib (Saccharum spontaneum), Kogon (Imperata cylindrica) Guinea grass (Panicum maximum) and other hardy annual herbs and shrubs. The only plant species living in the polluted waters is the water hyacinth (Eichornia crassipes).

Wild terestrial plant life in urban areas is limited to hardy grasses growing on vacant lots. Cultivated plant species are found in gardens and parks.

B. Wildlife

Birds are the most conspicuous wildlife in the Project Site. They nest, feed and rear their young among the mangroves. Table 59-8 shows the main bird species: Pluvialis dominica (Matang Baka) and Elanus caeruleus (Black-winged Kite).

Black-winged Kites belong to the Occipitridae (Hawk) family, commonly known as birds of prey. Their usual food is mice, birds, lizards, fishes and small mammals. Ecologically, they are important in checking the population of the organisms which they eat.

Predominant shoreland birds are Rhipidura javanica Malaysian Fantail), Rallus striatus (Slaty-breasted Rail), Xenus Cinereus (Wood Sandpiper), and Ereunetes ruficallis (Little Sint).

Table 59-8 WILDLIFE: MALABON-MEYCAWAYAN COASTAL AREA

Species	Presence in Ecological Subsystem	
	Estuary	Shoreland
1. Birds		
Charadriidae (Plover)		
Pluviales dominica (Pacific Golden Plover/Matang baka)	x	x
Muscicapridae		
Rhipidura javanica (Malaysian fantail)		x
Occipitridae (Hawk)		
Elanus caeruleus (Black-winged Kite)	x	
Rallidae (Rails)		
Rallus striatus (Slaty-breasted rail)	x	x
Scolopacidae		
Xenus cinereus (Wood sandpiper)		x
Actitis hypoleucos (Common Sandpiper)		x
Ereunetes ruficallis (Little Sint)		x
2. Reptiles		
Testudinata		
Chelonia japonica (Turtle/pagong)	x	

The only reptile associated with the Project Site belongs to the species Chelonia japonica (Pagong).

There are no endangered wildlife species associated with the Project Area.

C. Fish and Shellfish in Manila Bay

The Manila Bay is one of the 47 fishing grounds in the Philippines. It is rich in fish, shellfish and ranks 5th among the country's rich fishing grounds.

In 1976, the Bureau of Fisheries and Aquatic Resources (BFAR) recorded a harvest of 22,607,220 kilograms of fish and shellfish from the Bay. Harvest statistics were compiled from fish landings in Manila Bay at Hagonoy (Bulacan province) and Navotas (Rizal province) (See Table 59-9).

Fish species offshore spend some time in their lives feeding along nutrient-rich coastal areas and estuaries. Commercial species of shrimp live and spawn as adults offshore, but their larvae feed and grow in estuaries. Estuaries and coastal areas, therefore, serve as "nursery grounds" for fish and shellfish in a marine ecosystem. It is for this reason that these areas should be preserved.

Fish species in the Bay include shad, perch, bream, snapper, eel, mullet, garfish, sardines, anchovies, tuna, mackerel, and hairtail. Shellfish harvests include crab, shrimp and squid.

D. Fishpond Culture

Fishponds in the area were developed out of mangroves. That development, according to fishery experts, is best suited to the area, as it best preserves the ecology of the estuaries and the coastal areas of the Manila Bay. Fishponds within the direct influence zone occupy approximately 2,600 hectares.

The estimated fishpond production is 2,730 tons of fish a year.

Approximately 90% of all fishponds in the area products milkfish (Chanos chanos). The rest produces tilapia (Tilapia mossambica) and catfish (Clarias batrachus and C. macrocephalus).

i) Milkfish Culture

The production cycle of milkfish proceeds in the following stages: fry stage, fingerling stage, and marketable size stage.

Milkfish fry (about 0.8 gram) are acclimatized before they are released into nursery ponds. They are first

Table 59-9 FISH AND SHELLFISH HARVEST IN MANILA BAY (1976)

Fish Species		Quantity (kg)
1. Gizzard Shad		2,080
2. Perches, Breams, Snappers, Eels, etc.		13,372,690
Lizard Fish	639,930	
Threadfin Bream	5,118,270	
Groupers	3,318,620	
Snappers	529,650	
Slipmouth	3,739,180	
Moonfish	15,120	
Croakers	11,920	
3. Scads, Mullets, Garfish, etc.		1,328,970
Round Scad	368,720	
Crevalles	6,420	
Cavalla	510,600	
Mullet	76,340	
Silver Bar	17,600	
Flying Fish	4,520	
Black Pomfret	344,770	
4. Sardines and Anchovies		882,440
Anchovies	544,250	
Sardines	338,190	
5. Tuna		39,510
Eastern Little Tuna	38,950	
Swordfish	560	
6. Mackerels and Hairtails		4,071,410
Chub Mackerel	4,044,890	
Hairtail, Cutlass	26,520	
7. Miscellaneous Marine Fishes		114,990
8. Blue Crabs		900
9. White Shrimps		2,262,560
10. Squids		531,670
TOTAL		22,607,220

Source: 1976 Fisheries Statistics by the Bureau of Fisheries and Aquatic Resources (BFAR).

stocked in a small pond, where water salinity is from 20 to 251 ppt. For several days, the fry are fed with chick or duck egg yolk at the rate of 20 egg yolks per 5,000 fry per day.

Nursery ponds in the Project Area are located mainly in Obando, Bulacan. Two other places (Valenzuela and Bulacan) which raise milkfish fry are outside of the Project Area.

Milkfish fingerling (about 3 to 5 inches long) are raised to marketable size in rearing ponds.

ii) Factors Affecting Fishpond Production

Tide, salinity and water quality are the primary factors which affect fishpond production. Wide and abrupt changes on these factors would adversely affect the fishpond industry. Minimal changes on these factors would allow development along the coast of the Manila Bay without affecting the fishpond industry.

Tide

Fishponds in the area depend mainly on water brought in and drained by tidal fluctuation. Present fishpond harvests indicate the fact that the tidal characteristic in the area are conductive to fishpond culture. If the Project would cause a very narrow tidal range (i.e., tidal range with 1 or 2 meters annual absolute range and normal daily range of less than 2 meters), then there would be an unfavorable situation for water control and management of the fishponds (See Fig. 59-11).

Salinity

Generally, coastal fish farms in the area are more productive than those located upstream:

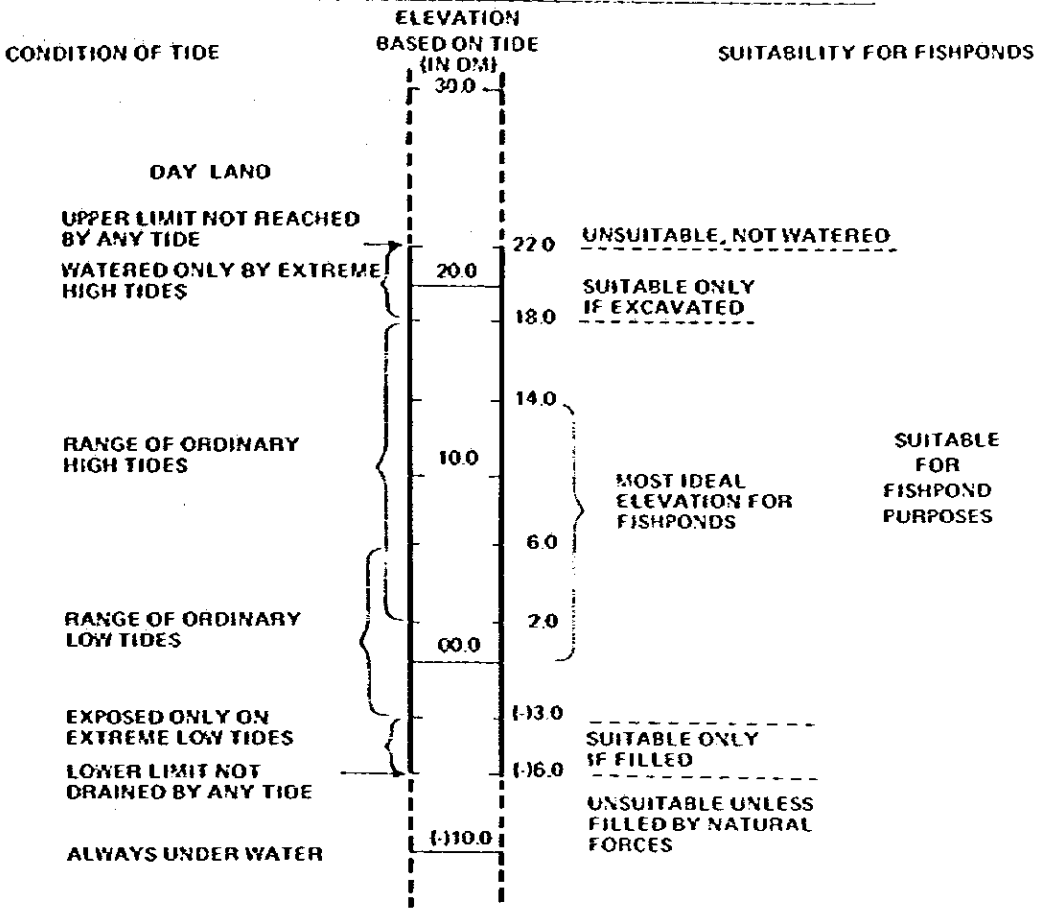
	yield/hectare
Average coastal production	1.05 tons/year
Average upstream production	0.75 tons/year

There is higher fish production along coastal areas because fish food is salinity dependent. Salinity of 0.025 ppt and above is conductive to optimum growth and reproduction of the following fish foods:

- Microbenthic algae (lab-lab) - benthic micro organisms consisting primarily of filamentous blue-green algae and diatoms;

- Filamentous green algae (lumot) - filamentous grass green algae; and

Fig. 59-11 TIDE CONDITIONS SUITABLE FOR FISHPONDS



Source: Dr. Herminio R. Rabanal, "Mangroves and their Utilization for Aquaculture," The Philippine Journal of Fisheries (Quezon City: Bureau of Fisheries and Aquatic Resources, Vol. 14, #2), p. 202.

- Free-floating planktons - micro organisms suspended in water.

Minor salinity changes may be brought about by the Project. Though wide ranges of salinity are tolerable for fish foods (algae and planktons) and for cultivable fish species, such salinity changes should not be too wide and abrupt to enable the organisms to adapt to changing conditions.

Water Quality

Estuarine waters in the Project Area were checked for water quality. (See Paragraph 3.2. G for the results of water analysis). In the past, about 200 hectares of fishponds have been abandoned in Malabon and Navotas (Metro Manila) because the water quality was degraded by effluents from small industries, domestic sewage and siltation.

3.4 Socio-Economic Environment of the Project Area and Direct Influence Zone

Descriptions of the existing socio-economic environment of the project area and direct influence zone of the Project Roads are given in Parts II and III of Volume I in respective sections and subsections mentioned below:

Description	Part	Chapter	Section/ Sub-Section
Project Area :			
Population and employed persons	II	2	2.1
Problems associated with population growth	II	2	2.1.2
Economic activities	II	2	2.2
Land use	II	2	2.3
Development projects along the coastal area	II	2	2.4
Tansport situation	II	2	2.5
Direct Influence Zone :			
Population	III	2	2.2
Development of new establishments	III	2	2.3
Present land utilization	III	2	2.4
Future prospect of the direct influence zone	III	2	2.5

CHAPTER 4. RELATIONSHIP OF THE PROJECT TO NATIONAL DEVELOPMENT PLANS AND LAND RESOURCE USE POLICIES

4.1 National Development Goals [1]

The goals of the country for the next decade are embodied in the Five-Year Development Plan. Briefly stated these goals are as follows:

- Promotion of social development and social justice;
- Attainment of self-sufficiency in food and greater self-reliance in energy;
- Attainment of high and sustained economic growth;
- Maintenance of acceptable prices and improvement in local financing efforts and balance of payments;
- Regional and rural development;
- Human settlements development and proper environmental management; and
- Maintenance of peace and order.

4.2 Strategy for Development [1]

The Five-Year Development Plan also states a two-pronged strategy for development; namely, i) Balanced Growth Strategy, and ii) Human Resource Development. The balanced growth strategy calls for, among other things, the following:

- Pursuit of industrial development to complement agricultural development;
- More efficient and competitive service sector to support rural growth;
- Production of more processed goods for domestic and export markets; and
- Rationalization of energy demand.

The human resource development seeks, among other things, the expansion of health, nutrition and housing services for the poor and the provision of more productive and better-income earning opportunities for the people.

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[1] Resume of the Five-Year Development Plan, 1978-1982. (Including the Ten-Year Development Plan, 1978-1987)

4.3 Economic Targets [4]

The Philippines will pursue higher and sustained economic growth in the next ten years. Within that period the GNP is projected to grow at a rate of 8 percent per annum, based on increased production in various economic sectors, notably the agricultural and industrial sectors. The agricultural sector will have to step-up food production and the modernization of farm management and technology while the industrial sector will focus on cottage, small and medium scale industries, industrial estates and large scale industrial plants.

Industry will grow at a much faster rate than agriculture. Although exports will comprise a substantial portion of both agricultural and industrial products, an increasing proportion of the exports will be made up of manufactured goods of the industrial sectors.

4.4 Regional Development Policies for Metropolitan Manila Area (MMA) [5]

In the pursuit of the above-stated goals and targets, the development of the MMA is built around several development policies:

- In land use allocation, inefficient concentrations are to be decentralized and inefficient dispersions are to be integrated;
- Employment oppourunities are to be dispersed to selected alternative growth centers;
- Support services and facilities are to be provided for and/or improved in the new projects and are also to be strengthened in the existing centers; and
- In transportation and communication, the objective is to improve accessibility between and among vital development centers.

4.5 Policy and Objectives of the Development of Project Roads and Reclaimed Area

The proposed Project will follow the above mentioned policy thrusts of the Government and the policy for the development projects in Metro Manila which are basically as follows:

- Consistency of Urban Environment;
- Contribution to National Economy;

4/ Resume of the Five-Year Development Plan, 1978-1982 (Including the Ten-Year Development Plan, 1978-1987)

5/ Extracted from "1978 Budget and General Appropriations Ordinance", Metro Manila Commission.

MMA comprises Manila, Caloocan City, Pasay City, Quezon City, Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinglupa, Navotas, Parañaque, Pasig, Pateros, San Juan, Taguig and Valenzuela.

- Promotion of Urban Redevelopment;

- Promotion of New Urban Development; and

- Enhancement of Socio-Economic Impacts.

On the other hand, it is envisioned that a rapid economic transformation will take place in the future. Hence, the main project policy should be to promote urban redevelopment and to contribute to the national economy. Environmental protection in the existing urban areas is also to be done simultaneously.

CHAPTER 5 DESCRIPTION OF ENVIRONMENTAL IMPACTS OF THE PROJECT AND MITIGATION OF ADVERSE EFFECTS

5.1 General

Environmental impacts were evaluated for the three types of environments described in previous sections: namely, physical, biological and socio-economic. In addition to the favorable impacts on production, storage, transportation and the basic human living environment mentioned below, adverse impacts and proposals for their mitigation were examined for the ecosystems affected by the Project on land and in the water and air.

The following components were used as the basis for this analysis.

Project Roads

- Coastal Road;
- C-5 Road; and
- C-6 Road.

Reclaimed Area

- Approximately 890 hectares.

Affected Areas

- Direct influence zone of the Project;
- MMA; and
- Corridor of the Project Roads.

Time Period for Consideration of Environmental Impact

- During construction; and
- After construction.

The preliminary qualitative analysis of the reasonably foreseeable effects of the Project Roads and the development of the Reclaimed Area on the above environmental indicators was carried out.

The results of this preliminary analysis show that a high degree of favorable effects will be brought about as follows:

- Transport mobility and accessibility;
- Realization of land use potentiality;
- Increase in land value;

- Urban renewal;

- Improved community cohesion;

- Creation of employment opportunities;

- Creation of new storage and disposal area;

- Better population distribution;

- Increased agricultural industrial production;

- Reduction in prices of commodities; and

- Alleviation of transport and port congestion.

These foreseeable main effects are discussed in detail in the Sections which follow:

5.2 Inland Road Construction (C-5 & C-6) and Probable Environmental Impacts

A. General

Descriptions of the existing environmental conditions are given in previous sections of this Part. Alternative schemes, alignments, locations, structures and solutions have already been discussed and analysed in respective sections mentioned below:

Description	Part	Chapter	Section/ Sub-section
Proposed road network alternatives	III	5	5.1
Study of alternative routes	III	6	6.2.1
Study of interchanges	III	7	7.5.3
Preferable types of structures (bridges)	III	7	7.7.3

A "no project' alternative would involve using the existing road networks which are clearly inadequate for the present and future development projects in the area. The funds for the Project Roads could be used for other priority infrastructure and development projects planned in the Philippines, but the resulting traffic congestion throughout MMA and the inefficient use and unrealized benefits of the development project far outweigh the costs to be incurred.

B. Favorable Environmental Impacts

Project elements producing a large magnitude of favorable effects are discussed in detail as follows:

i) Transport Mobility and Accessibility

The Circumferential Roads, C-5 and C-6, are not completely established at present. But the Project Roads (the Coastal Roads, C-5 and C-6) will make crossing and by-passing central Manila possible and greatly enhance and strengthen the function of the road network system in the MMA.

Moreover, establishment of the Project Roads will improve traffic service within their surrounding area, and reduce traffic congestion within direct influence zone. Accordingly, transport mobility and accessibility of the corridor along the Project Roads will be improved because of reduction of travel and traffic cost.

ii) Realization of Land Use Potentiality

Land use potentiality in the direct influence zone, especially the Coastal Road and C-5, will be greatly enhanced. The corridor of the Project Roads will be highly developed for industrial and housing land uses.

iii) Increase of Land Value in Direct Influence Zone

The improvement in accessibility will reasonably induce enhancement in land use potentiality and cause an increase in development demand due to favorable location, conditions, and thus the increase in land value in the surrounding area of the Project Roads.

iv) Better Community Cohesion

The growth of new community will be promoted by investors and inhabitants in the direct influence zone and the establishment of better communities will improve the comfort of the area.

C. Summary of Adverse Effects and their Mitigation

Project elements reducing environmental quality are summarized below;

Adverse Effect	Mitigation
1. Temporary air and water pollution during construction.	Nuisance and inconvenience during construction should be significantly reduced by introduction of proper construction management and supervision and adoption of proper construction equipment and methods.
2. Population displacement	The displaced families will be sufficiently compensated and/or resettled to proper areas. The squatter families affected by the Project Roads will be afforded better opportunities and improved quality of life in the resettlement projects of the Government. The relocation of these squatters will be undertaken with close coordination with the NHA and other Government agencies.
3. The embankment along C-5 and C-6 will slightly change existing drainage pattern and affect fishpond culture in surrounding area.	Sufficient investigation of biological, ecological and salinity conditions should be carried out to prepare the acceptable construction that will minimize adverse effects. Careful measures should also be provided against hydrological problems in the Navotas and Meycawayan Rivers Systems.
4. Loss of fishpond area	The fishpond area acquired for the right-of-way will be sufficiently compensated. Since transportation (between fishpond and consumer market) is one of the main components of fishing industry, the provision of adequate nodal points (i.e. from boat to truck) should be considered during the detailed engineering stage.

5.3 Offshore Coastal Road Construction and Reclamation Work

A. General

The Coastal Road is a part of the strategic transportation frame for the coastal area of Metro Manila together with Roxas Boulevard, R-10 and the future extension of the Coastal Road to Bataan.

The offshore route on the proposed reclaimed area is selected as the route for the Coastal Road in view of the following:

- The route will not cause serious social problems and will not affect any existing community;

- Enhancement of the value of the reclaimed area;

- Less construction, land acquisition and compensation cost; and

- Comparatively easy construction.

For further descriptions of the development of the reclaimed area, see next section.

B. Favorable Environmental Impacts

Project elements producing a large magnitude of favorable effects are discussed in detail below.

i) Transport Mobility and Accessibility

As mentioned before (See Paragraph 5.2.B in this Chapter) the Coastal Road, together with the C-5 and C-6, will greatly enhance and strengthen the function of the road network system in the MMA.

The plan to construct the Radial Road R-10 are already finalized and the tendering for certain parts of the road started in early 1978. That project covers not only the main trunk road between C.M. Recto Avenue and Spine Road at Navotas, but also the connecting stretches for the peripheral roads of C-2 and C-3.

The project of extending R-10 further up to C-4 is also under way and now the Government is proceeding with the final engineering stage.

It is expected that the construction of the Coastal Road will offer direct access to the reclaimed area and offer favorable access also to the hinterland and provide far improved land transport conditions to the direct influence zone.

ii) Creation of New Land

Proposed reclamation will provide about 890 hectares of land which can be utilized for promoting urban redevelopment which will contribute to the national economy.

iii) Realization of Land Use Potentiality

See Sub-Paragraph 5.2.B, ii) in this Chapter.

iv) Increase of Land Value in Direct Influence Zone

See Sub-Paragraph 5.2.B, iii) in this Chapter.

v) Better Community Cohesion

See Sub-Paragraph 5.2.B, iv) in this Chapter.

vi) Increase in the Value of Fishes

For fishery products, the Coastal Road will provide a shorter route to the market of Manila. When the fishing industry is supported by an effective means of transport the economic returns to the industry are immense, since transportation costs and the freshness of fishes are important components of fish marketing.

C. Summary of Adverse Effects and their Mitigation

Project elements reducing environmental quality summarized below:

Adverse Effect	Mitigation
1. Temporary water turbidity.	Spillways will be provided to minimize silting in the surrounding area during the construction. For further descriptions, see Paragraph 6.5.3 C in Part IV.
2. Loss of bottom dwelling area for sea organisms.	Sea beds will be stirred by the dredger, thereby changing the water quality temporarily in the surrounding area. The environmental effect of dredging is influenced by the characteristics of soils, oceanographic conditions, hydrographical conditions, type of dredger to be used and the size of borrow pit (area) planned. Therefore by adopting proper dredger and proper construction management (i.e. concentrated dredging at good soil areas) the adverse effect will be significantly reduced.
3. Loss of Fishing grounds.	Offshore areas occupied by the reclamation will be sufficiently compensated. To facilitate the fishery and fish carrier boats, the provision of approach ramps or nodal point areas will be planned at sufficient locations, since these facilities will mitigate fisherman's losses by increasing accessibility to consumer market.

5.4 Development of Reclamation Area

A. General

The following policies have been adopted for the development of reclaimed area:

- To promote urban renewal in order to serve as a catalyst and a complement to transform Metro Manila into a "City of Man";
- At the same time, to contribute to the national economy by promoting export-oriented and labor intensive industries; and
- To promote the conservation of human and natural resources.

In line with the above policy statement, the objectives of the reclamation development are as follows:

- To develop as industrial park town where parks and sport fields are adequately distributed in the development area;
- To provide a wide industrial estate with modernized industrial facilities;
- To provide urban utilities within the area as well as the northern part of Metro Manila;
- To encourage residential living environment variety;
- To provide an efficient transport system towards the Manila-Bataan Coastal Corridor; and
- To expand the stock and storage areas for Metro Manila. The development proposes to offer the necessary facilities for smooth living and industrial operations.

The most important factors that were considered in determining the development scale of the project are as follows:

- Magnitude of land demand;
- Environmental constraints; and
- Construction economy.

From the environmental viewpoint, it was decided that the proposed north limit of reclamation would be at the extension of the south bank of Meycawayan River. Thus adverse effects such as probable flood in the Meycawayan River basin, loss of mudflat areas and narrower tidal range for water control of fishponds were eliminated.

A study on the length from shore to the tip of reclamation area vs. the index of reclamation cost per unit area revealed that the reclamation can be achieved most economically at the distance offshore of 1,000 meters.

Considering above mentioned factors for the development scale, the most suitable area of the development of about 890 hectare was determined.

For further descriptions about located land use, see Paragraph 2.3.3, C in this Chapter.

B. Favorable Environmental Impacts

Project elements producing a large magnitude of favorable effects are discussed as follows:

i) Establishment of Labor-Intensive and Export-Oriented Industries

In line with national policies and strategies, export-oriented, labor-intensive and non-polluting manufacturing industries have been located in the reclaimed area. Land demand, economic and financial analysis upholds the allocations of reclaimed land primarily for industrial uses, with some patches for solid waste disposal, residential, and other land uses.

ii) Promote Urban Renewal

The reclaimed land will be utilized for attainment of the socio-economic goals of the government whose present thrust is concerned with housing, traffic decongestion, economic disposal, provision of basic infrastructures, and in general, the enhancement of the quality of life. The project will offer various opportunities for providing solutions to pressing urban problems such as the solid waste disposal problem and the need for warehousing and P.O.L. (Petroleum Oil Lubricant) storage space in the area.

iii) Generation of Employment Opportunities

The proposed reclaimed area will absorb about 35,000 workers when the area is developed by high priority projected industrial land uses.

iv) Establishment of P.O.L. Storage Area

The present storage capacity of petroleum in Metro Manila is good only for five days. Increasing its capacity is difficult since there is an acute shortage of space for the expansion of the tank farm area.

The P.O.L. complex, which is located along the Pasig River, had been reconstructed and the activities expanded in order to meet the demands of the continuous growth of the Metropolitan's economy. But recently, dense residential houses have encroached on the complex area thereby making expansion difficult.

Under such circumstances, there is a need for future development sites for P.O.L. storage facilities.

Generally, the basic requirements for P.O.L. complex sites are the following:

- As a safety precautionary measure, the location should be separated from the urban area. The chance of catastrophic disasters would be greatly aggrevated with the presence of P.O.L. facilities in an urban area;

- For the convenience of supply and distribution of oil, the location must have good accessibility to both water and land transportation;

- To prevent an accidental outflow of oil, enough space is required to provide oil protection dikes or walls.

In view of the foregoing situation, it is believed that the location of P.O.L. storage area in the proposed reclaimed area will offer great advantageous impact to the Metropolis.

v) Establishment of Solid Waste Disposal Area

Presently, Metro Manila has eleven dump sites, the biggest of which is located in Tondo. However, this site is causing pollution problems to the surrounding urban and sea areas.

The proposed reclamation area provides the space for solid waste from Manila City for about 10 years using the sanitary layer method.

C. Summary of Adverse Effects and Their Mitigation

Project elements reducing environmental quality are summarized as follows:

Adverse Effect	Mitigation
1. Temporary air and water pollution during construction.	See Paragraph 5.2.C
2. Probable water and air pollution	Only light industires will be established, with provision for sewerage treatment plant. The locationing of each type of industry has been determined by considering labor intensive (low energy consumption); therefore, air contamination will be small.

5.5 Development of Water Transport

A. General

The port facilities at the reclaimed area should consider the development plan for the Port of Manila to avoid competition and to be complementary with it.

The proposed reclaimed area considers the possibility of the following development of port facilities:

- Wharf for P.O.L. unloading; and

Major refinery factories of crude oil are located in Bataan and Batangas. At present, some of the petroleum products refined in Bataan are shipped to Pandacan Tankages by small barges, and those in Batangas are transported to Pandacan Tankages by a pipeline of 8 inch diameter. Therefore, it is imperative that the petroleum products refined in Bataan and Batangas will be transported to the P.O.L. storage area in the reclaimed area.

B. Summary of Adverse Effects and Their Mitigation

Project elements reducing environmental quality are summarized below:

Adverse Effect	Mitigation
1. There will be navigation related pollution from tank cleaning and accidental oil spills.	This can be minimized if the P.O.L. storage area is properly designed, equipped and operated.

5.6 Summary of Environmental Impacts

A summary of the probable environmental impact is shown in Table 59-10.

Table 59-10 PROPOSED PROJECT ELEMENTS AND PROBABLE ENVIRONMENTAL IMPACTS

Proposed Project Elements	Probable Environmental Impacts	
	Favorable Impacts	Adverse Impacts
Inland Road Construction (C-5 and C-6)	1) Increase of transport mobility and accessibility 2) Realization of land use potentiality 3) Increase of land value in direct influence zone 4) Better community cohesion 5) Better population distribution	1) Temporary air and water pollution during construction 2) Population displacement 3) The embankment along C-5 and C-6 will slightly change existing drainage pattern and affect biological and ecological conditions of a limited surrounding area 4) Loss of some fishpond area
Offshore Coastal Road Construction and Reclamation work	1) Increase of Transportation mobility and accessibility 2) Creation of new land (890 ha. approx.) 3) Realization of land use potentiality 4) Increase of land value in direct influence zone 5) Better community cohesion 6) Better population distibution 7) Increase of value of fishes produced in the direct influence zone	1) Temporary water turbidity 2) Loss of bottom dwelling area for sea organisms 3) Loss of some fishponds
Development of Reclamation Area	1) Establishment of labor-intensive and export oriented industries 2) Promotion of urban renewal	1) Temporary air and water pollution during construction

Cont'd

Proposed Project Elements	Probable Environmental Impacts	
	Favorable Impacts	Advarse Impacts
Development of Reclamation Area (cont'd)	3) Generation of employment opportunities 4) Future Petroleum, Oil and Lubricant (P.O.L.) storage area can be separated from the urban area 5) Provision of solid waste disposal area will provide clear and sanitary environment	2) Probable water pollution, if waste waters from industries are not properly handled
Water Transport Development (P.O.L. tankers)	1) Better utilization of the port facilities of the North Harbor due to decongestion	1) Probable navigation-related pollution if wash from tankers is not properly handled

CHAPTER 6. SUMMARY OF IRREVERSIBLE COMMITMENTS OF RESOURCES

The irreversible commitments of resources are summarized as follows:

Irreversible Commitment	Effect
Inland Road Construction (C-5 and C-6)	
a. Increase of transport mobility and accessibility in the direct influence zone.	a. Positive
b. Increase of land use potentiality and land use value in the direct influence zone.	b. Positive
c. Loss of fishpond area.	c. Negative
Offshore Coastal Construction and Reclamation Work	
a. Increase of transport mobility and accessibility in the direct influence zone.	a. Positive
b. Increase of land use potentiality and land use value in the direct influence area.	b. Positive
c. Employment opportunity.	c. Positive
d. Loss of fishing ground.	d. Negative
e. Loss of botton dwelling area for sea organisms.	e. Negative
Development of Reclamation Area	
a. Establishment of labor-intensive and export-oriented industries.	a. Positive
b. Promote urban renewal.	b. Positive
c. Establishment of P.O.L. storage area.	c. Positive
d. Establishment of solid waste disposal area.	d. Positive
e. Probable water and air pollution.	e. Negative
Development of Water Transport	
a. Decrease of congestion in the Port of Manila.	a. Positive
b. Probable navigation-related pollution at P.O.L. teroinal.	b. Negative