Table 8-2-3 RESULTS OF THE WATER QUALITY SURVEY IN DRAINAGE CHANNEL

Sampling Site (Estero)	Date	W.Temp. (°C)	pH	EC (μΩ/cm)	Turb. (NTU)	SS (mg/ℓ)	DO (mg/ℓ)	BOD (mg/ℓ)	W.Flow (m^3/s)
St. 1 C. Recto	Feb.16	28.5	7.3	2205	28	-	0.0	68.0	0.18
(San Lazaro)	Sep.27	28.0	6.0	237	14	20.0	0.1	9.1	0.25
St. 2 C.M. Recto	Feb.16	26.0	7.2	305	23	-	0.0	86.0	0.12
(Magdalena)	Sep.27	27.8	6.6	248	10	7.0	0.1	9.6	0.24
St. 3 P. Casal Ext.	Feb.16	27.0	7.3	205	23	-	0.0	43.0	0.08
(San Miguel)	Sep.27	27.2	6.7	248	17	31.0	0.1	8.6	0.32
St. 4 Legarda	Feb.16	27.0	7.5	137	20	-	0.0	40.0	0.72
(Sampaloc)	Spe.27	28.0	7.5	248	11	20.0	0.1	9.6	1.20
St. 5 R. Magsaysay	Feb.16	27.0	7.3	152	22	-	0.0	116.0	0.25
(Valencia)	Sep.27	27.2	8.0	453	13	5.0	0.1	9.6	0.80
St. 6 P. Mendoza Guazon	Feb.16	27.0	7.3	168	28	-	0.0	96.0	0.60
(Cincordia)	Sep.27	27.8	6.7	291	14	13.0	0.1	12.0	0.84
St. 7 M. Roxas	Feb.16	27.0	7.3	210	39	-	0.0	40.0	0.18
(Santa Clara)	Sep.27	28.2	6.8	464	23	25.0	0.1	32.0	0.27
St. 8 Quirino (Paco)	Feb.16	27.0	7.2	8185	41	-	0.0	172.0	0.40
St. 9 South S. Highway	Feb.16	27.0	7.2	175	26	-	0.0	42.0	0.04
(Makati)	Sep.27	27.1	7.2	345	10	12.0	0.1	19.0	0.15
St. 10 Buendia	Feb.16	27.0	7.5	165	22	-	0.0	38.0	0.45
(T. de Gallina)	Sep.27	28.3	7.1	326	11	4.0	0.1	12.0	0.80
St. 11 EDSA	Feb.16	28.0	7.4	170	30	-	0.0	101.0	0.63
(T. de Gallina)	Sep.27	28.4	7.2	388	17	3.0	0.1	11.0	1.08
St. 12 Blumentritt	Feb.16	27.0	7.6	185	37	-	0.0	8.0	0.18
(Aglipay)	Sep.27	29.0	7.5	453	17	19.0	0.1	9.0	0.24
Mean	Feb.16	27.1	7.3	1022	28	-	0.0	70.8	0.32
	Sep.27	27.9	7.0	339	14	14.0	0.1	12.6	0.57
	Total	27.5	7.2	680	21	-	0.1	41.7	0.44

NOTE: Not analysed

Table 8-2-4 WATER QUALITY CONDTIONS OF LAGUNA LAKE

YEAR	W.TEMP. (C)	PH	TURB. (NTU)	DSS (mg/l)	DO (mg/l)	BOD (mg/l)	COD (mg/l)
LL-1. West Bay							
1982	30.0	8.4	18	1,387	8.4	-	-
1983	28.8	8.1	22	780	8.6	-	26.8
1984	29.0	8.1	24	508	7.7	-	31.2
1985	28.0	8.0	46	308	7.2	-	36.7
1986	27.4	8.2	34	609	8.1	3.5	42.0
1987	29.0	8.2	29	337	8.0	2.4	31.1
Mean	28.7	8.2	29	718	8.0	3.0	33.6
LL-2. EAST BAY							
1982	30.1	8.1	15	875	7.8	-	-
1983	30.3	8.2	21	797	8.8	-	27.3
1984	28.0	7.8	18	390	6.8	-	28.3
1985	28.0	7.9	32	246	7.5	-	25.9
1986	27.4	8.0	40	342	7.7	2.8	13.1
1987	28.5	7.8	28	316	7.4	2.2	24.6
Mean	28.7	8.0	25	530	7.7	2.5	23.8
LL-3. CENTRAL BAY							
1982	30.7	8.3	15	1,272	8.8	-	-
1983	30.8	8.1	22	812	8.8	-	-
1984	28.0	8.0	18	511	7.9	-	-
1985	28.0	8.0	37	311	7.4	-	-
1986	27.6	8.1	28	646	8.4	3.3	20.3
1987	28.2	8.0	26	349	7.8	2.8	24.1
Mean	28.9	8.1	24	710	8.2	3.1	22.2
LL-4. SOUTH BAY							
1982	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-
1986	27.6	8.0	35	402	8.0	2.4	17.2
1987	29.2	8.2	29	326	8.1	2.3	25.5
Mean	28.4	8.1	32	364	8.1	2.4	21.4

NOTE -: Not analysed.

Table 8-2-5 FISH PRODUCTION IN THE LAGUNA LAKE BY SPECIES, 1987
(In Metric Tons)

Species	Total	Aquaculture		Capture
		Fish Pens	Fish Cages	
FISH				
Milkfish	18,322	17,478	-	844
Tilapia	29,155	14,207	10,569	4,379
Carp	7,588	3,551	638	3,399
Ayungin	2,323	-	-	2,323
Goby	1,041	-	-	1,041
Sea Catfish	2,335	-	-	2,335
Mumel	2,117	-	-	2,117
Catfish	2,175	-	-	2,175
Anchovy Fry	6	-	-	6
Gouramy	400	-	-	400
Climbing Perch	119	-	-	119
Mullet	14	-	-	14
Eel	6	-	-	6
CRUSTACEANS				
Shrimp	7,991	-	-	7,991

Source: Fisheries Statistics Section, Bureau of Fisheries

Table 8-3-1 RESULT OF EIA FOR RIVER FLOOD CONTROL WORKS

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

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

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

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

Table 8-3-2 RESULT OF EIA FOR DRAINAGE IMPROVEMENT WORKS

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

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

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

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

Table 8-3-3(1/2) WATER QUALITY CONDITION IN MAJOR RIVERS (BOD)

River	Season	1982	1983	1984	1985	1986	1987	Mean
Marikina River (MK)								
MK-1 Montalban	Dry	1.1	2.0	1.4	1.7	-	1.9	1.6
	Rainy	1.4	1.4	1.8	2.6	3.6	2.7	2.3
	Average	1.2	1.8	1.7	2.3	3.6	2.3	2.2
MK-2 Rosario	Dry	7.7	16.3	35.0	50.0	-	45.0	30.8
	Rainy	3.1	27.0	12.0	7.0	12.5	16.1	13.0
	Average	10.2	19.8	10.1	21.0	13.0	22.0	16.0
MK-3 Vargas	Dry	5.0	16.5	37.0	60.0	-	39.0	31.5
	Rainy	22.8	24.0	13.1	7.0	20.0	20.4	17.9
	Average	15.7	19.0	19.1	25.0	20.0	28.4	21.2
Pasig River (PS)								
PS-1 Bambang	Dry	6.7	8.0	3.0	12.5	3.0	5.8	6.5
	Rainy	11.0	16.0	30.0	19.7	13.5	42.0	22.0
	Average	9.4	9.6	9.8	16.8	10.0	23.4	13.2
PS-2 Guadalupe	Dry	9.0	38.0	30.0	18.0	11.0	5.3	18.6
	Rainy	14.1	50.0	14.4	14.6	11.5	40.0	24.2
	Average	12.4	40.4	18.3	16.0	11.3	22.6	20.2
PS-3 Lambingan	Dry	7.3	33.0	100.0	18.0	10.0	7.3	29.3
	Rainy	12.3	50.0	15.4	13.7	12.0	42.8	24.4
	Average	10.5	36.4	36.6	14.8	11.3	25.0	22.4
PS-4 Jones	Dry	30.0	45.5	90.0	56.0	2.0	19.0	40.4
	Rainy	14.3	50.0	17.1	20.7	6.0	43.0	25.2
	Average	20.2	46.4	35.3	34.8	4.7	31.0	28.7
San Juan River (SJ)								
SJ-1 Congressional	Dry	14.8	36.3	n.a.	53.5	71.0	40.5	43.2
	Rainy	21.0	12.4	-	40.0	10.0	30.3	22.7
	Average	16.0	33.7	-	49.4	50.7	36.1	37.2
SJ-2 Dario Creek	Dry	56.8	34.3	n.a.	177.5	n.a.	174.0	110.7
	Rainy	82.7	41.0	-	23.3	38.0	81.5	53.3
	Average	66.5	37.6	-	85.0	38.0	121.1	69.6
SJ-3 Quezon Blvd.	Dry	68.8	49.3	n.a.	58.5	79.0	135.0	78.1
	Rainy	42.7	64.0	-	68.5	51.0	66.0	58.4
	Average	59.0	56.6	-	65.2	69.7	95.6	69.2
SJ-4 Sanchez	Dry	52.0	60.5	n.a.	650	91.0	65.3	66.8
	Rainy	68.0	48.3	-	55.0	18.0	45.5	47.0
	Average	58.9	54.4	-	58.3	66.7	54.0	58.5

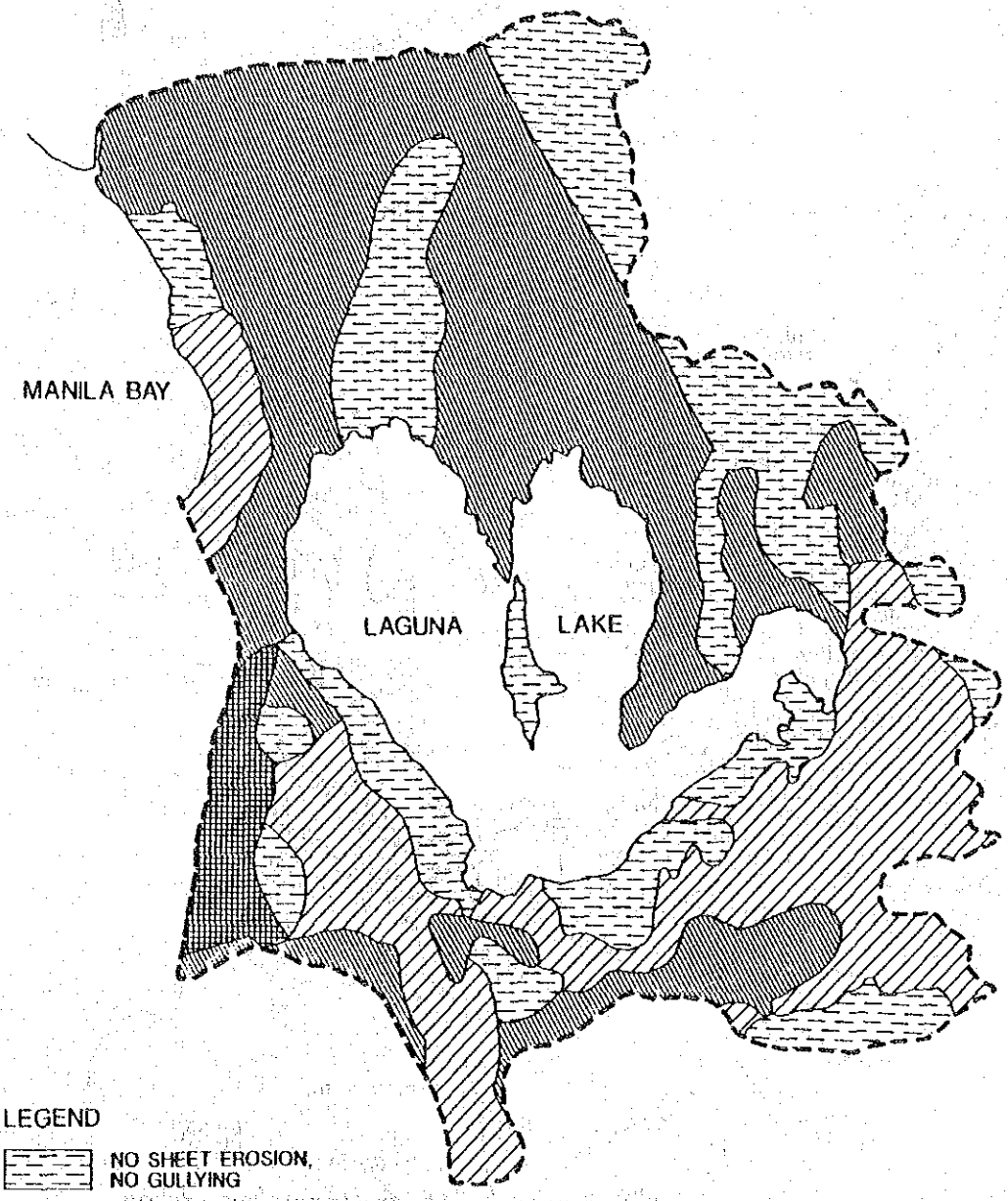
Table 8-3-3(2/2) WATER QUALITY CONDITION IN MAJOR RIVERS (BOD)

River		Season	1982	1983	1984	1985	1986	1987	Mean
Malabon-Tullahan (MT)									
MT-1	Gulod	Dry	20.0	22.9	n.a.	3.8	9.0	53.3	21.8
		Rainy	7.0	35.5	24.0	16.1	13.3	15.8	18.6
		Average	10.3	29.2	24.0	13.6	15.5	29.9	20.4
MT-2	North Expressway	Dry	82.0	75.5	n.a.	48.0	75.0	179.0	91.9
		Rainy	28.6	47.5	22.0	49.5	66.5	40.0	42.4
		Average	42.0	61.5	22.0	49.2	69.3	117.2	60.2
MT-3	MacArthur Highway	Dry	66.0	57.8	n.a.	48.0	44.0	174.0	78.0
		Rainy	106.7	54.0	90.0	48.5	44.7	86.2	71.7
		Average	96.5	55.9	90.0	48.4	44.5	130.1	77.6
MT-4	Gov. Pascual	Dry	74.0	54.3	n.a.	30.0	60.0	51.8	54.0
		Rainy	10.5	70.0	40.0	41.3	30.0	42.8	39.1
		Average	42.3	62.0	40.0	39.0	37.5	47.3	44.7
MT-5	Malabon	Dry	n.a.	24.7	n.a.	n.a.	50.0	-	37.4
		Rainy	25.1	28.0	30.0	28.7	22.3	-	26.8
		Average	25.1	26.3	30.0	28.7	29.0	-	27.8
Parañaque-Las Piñas River (PL)									
PL-1	Aurora Tramo	Dry	35.0	19.3	n.a.	69.3	42.0	63.4	45.8
		Rainy	54.0	30.8	-	38.7	29.7	47.6	40.2
		Average	46.0	25.9	n.a.	56.1	32.8	54.7	43.1
PL-2	MIA Road	Dry	25.0	23.0	n.a.	40.0	30.0	59.3	35.5
		Rainy	24.0	37.1	-	34.7	29.3	38.6	32.7
		Average	24.4	31.0	n.a.	37.7	29.5	47.8	34.1
PL-3	Parañaque Bridge	Dry	11.0	12.0	n.a.	23.9	40.0	13.6	20.1
		Rainy	10.0	6.9	-	23.0	4.9	11.0	11.2
		Average	10.4	9.0	n.a.	23.5	13.7	12.3	13.8
PL-4	Zapote Bridge	Dry	n.a.	17.5	-	23.7	n.a.	-	20.6
		Rainy	16.0	6.8	-	22.7	8.1	-	13.4
		Average	16.0	12.2	-	23.2	8.1	-	14.9

Note: n.a. Data not available.
- Water sampling not conducted.

Source: Surveyed by NPCC, 1982-1987.

FIGURES



LEGEND

NO SHEET EROSION, NO GULLYING

SMALL EXTENT OF SHEET EROSION AND NO GULLYING . LESS THAN 1/4 OF ORIGINAL SURFACE SOIL ERODED.

MODERATE SHEET EROSION, 1/4 TO LESS THAN 1/2 OF ORIGINAL SURFACE SOIL ERODED

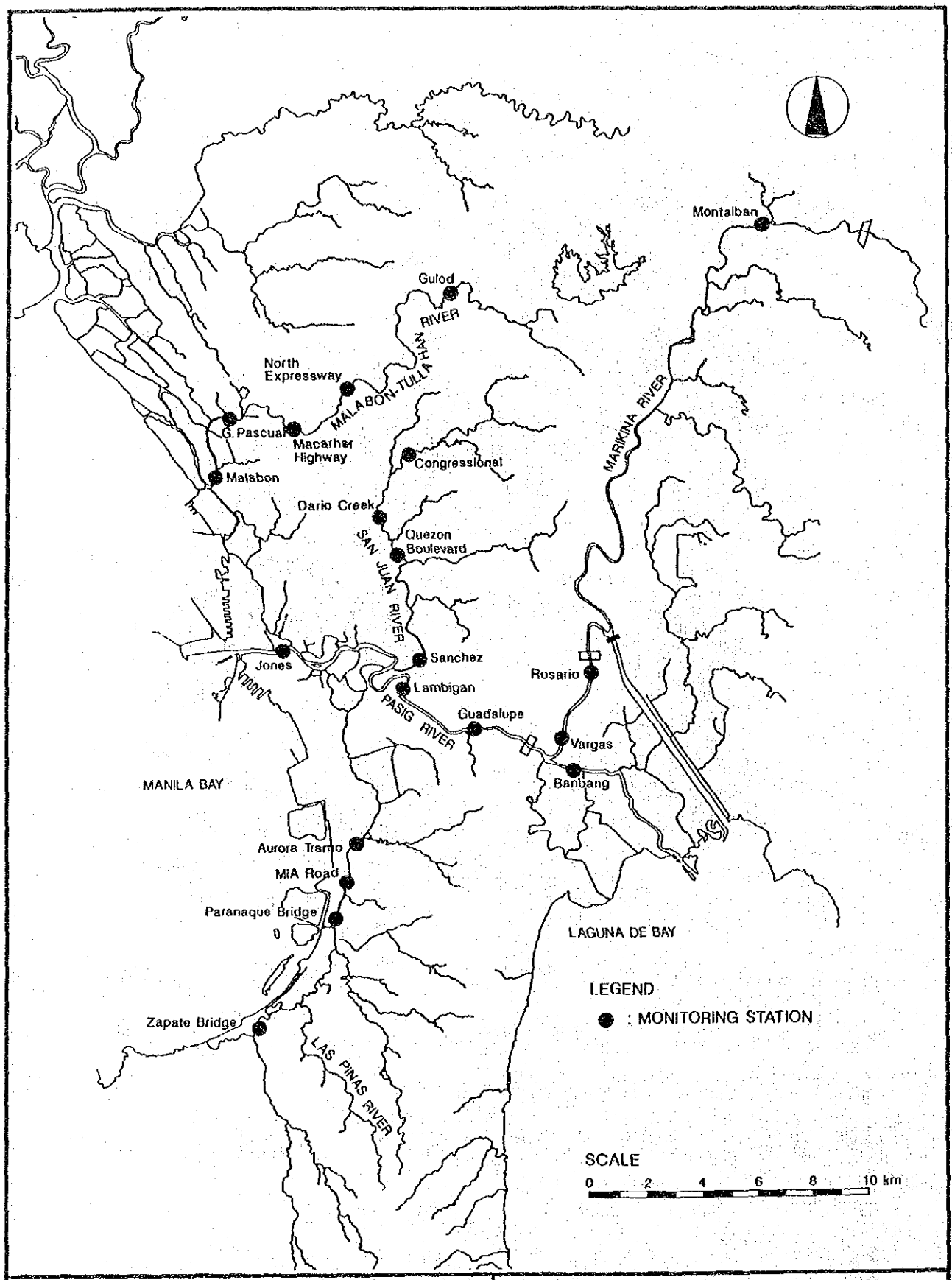
SERIOUS SHEET EROSION, 3/4 OR OVER 3/4 OF ORIGINAL SURFACE SOIL ERODED, OR ALL THE SURFACE SOIL AND LESS 1/4 OF THE SUBSOIL ERODED.

SCALE

0 5 10 15 20 km

Source: Framework Plan, Laguna Lake Basins, 1983, NWRC

THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES	SOIL EROSION MAP OF THE LAGUNA LAKE BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY	Fig.8-2-1

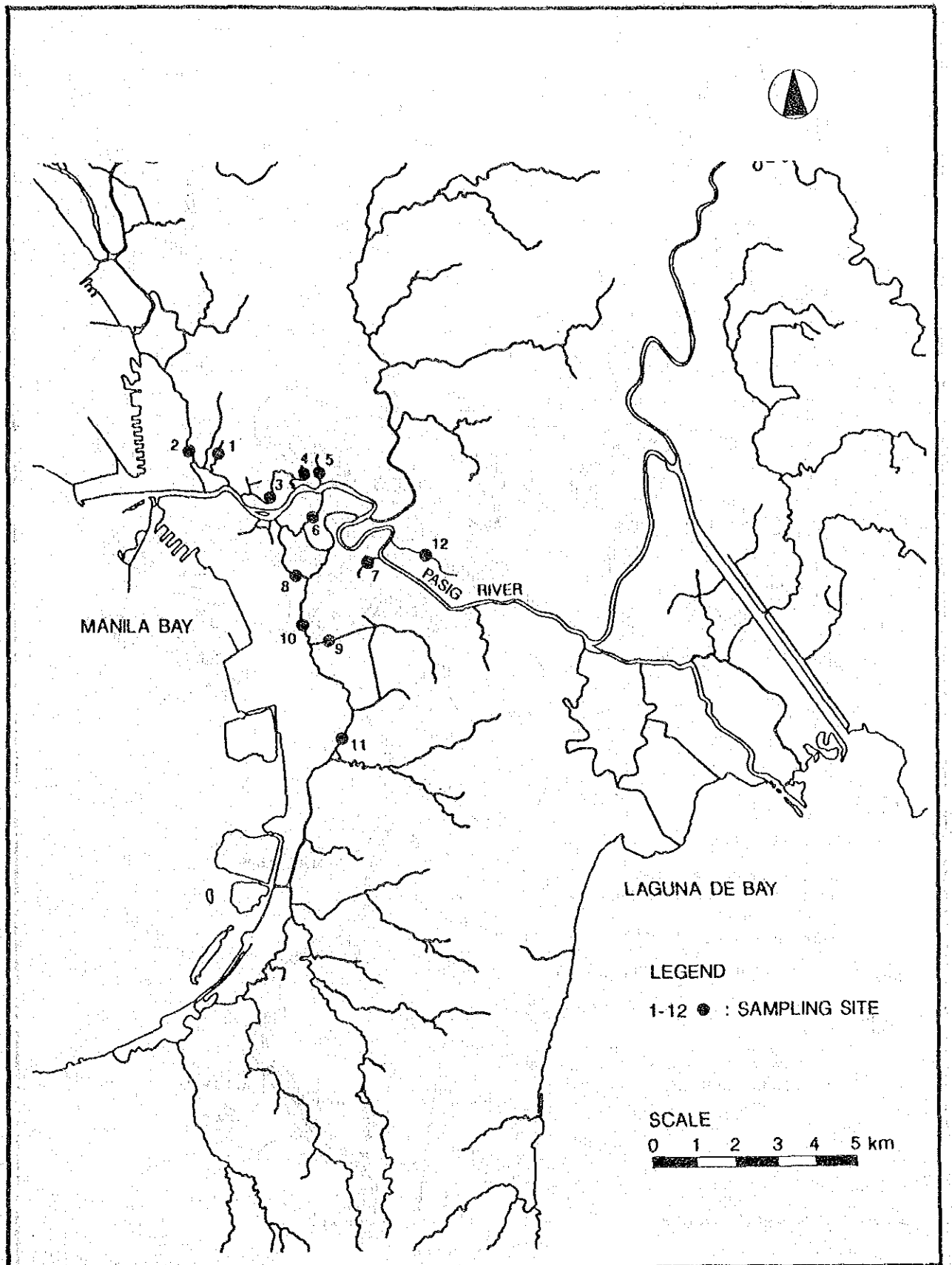


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

WATER QUALITY MONITORING STATION

Fig.8-2-2

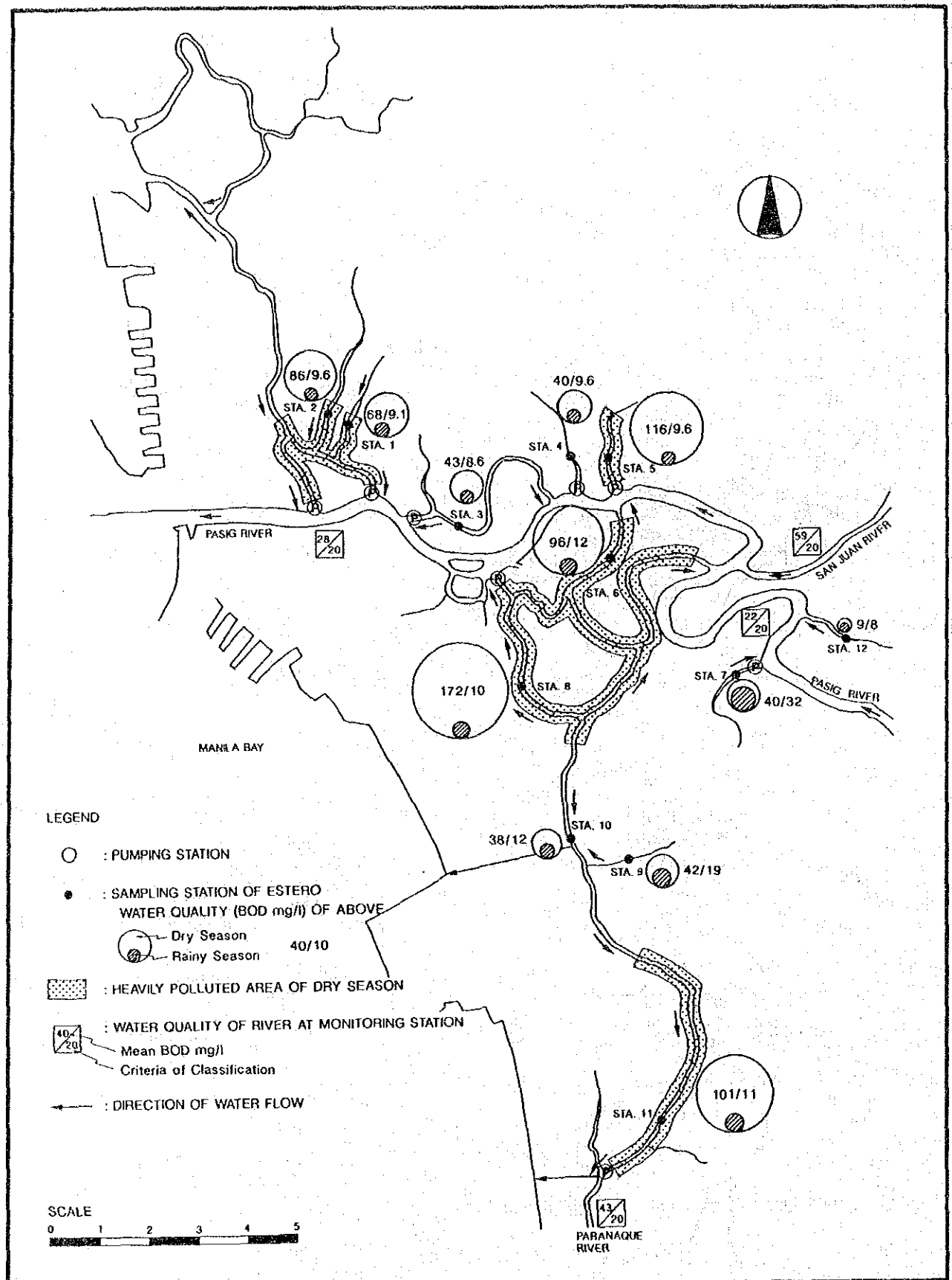


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

SAMPLING SITES

Fig.8-2-3

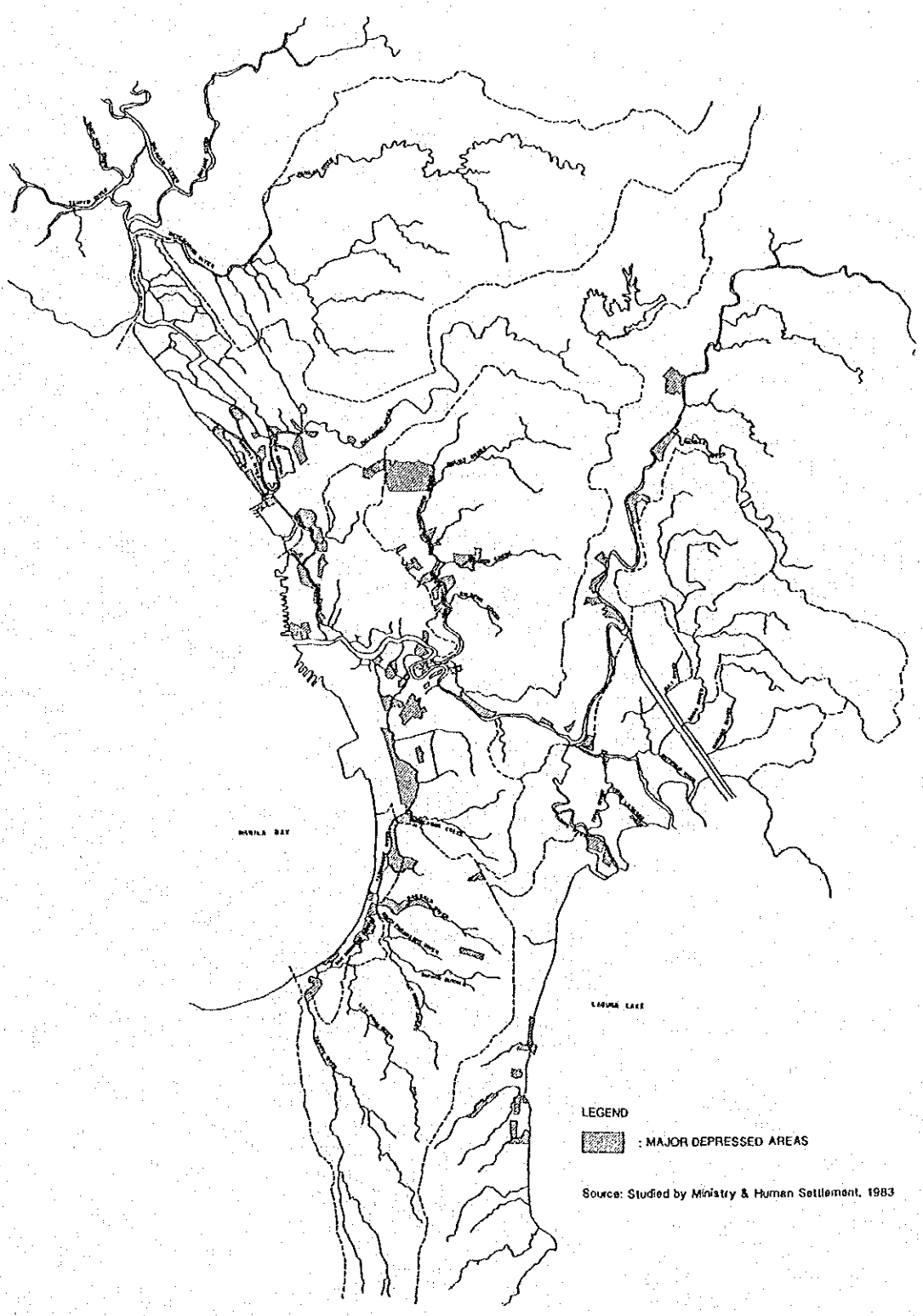


THE STUDY ON FLOOD CONTROL AND DRAINAGE PROJECT IN METRO MANILA, PHILIPPINES

JAPAN INTERNATIONAL COOPERATION AGENCY

WATER QUALITY CONDITION OF ESTERO

Fig.8-2-4



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

JAPAN INTERNATIONAL COOPERATION AGENCY

DISTRIBUTION OF MAJOR DEPRESSED AREAS

Fig.8-2-5

IX. FINANCIAL ANALYSIS

SUPPORTING REPORT

IX. FINANCIAL ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

1. PUBLIC FINANCE AND EXPENDITURE

The institutions or entities belonging to the public sector which are subject to public financing are the Office of the President of the Republic of the Philippines, the Office of the Vice President, the various agencies under the fiscal management of the national government (Department, but used to be called as Ministry), the local governments such as the province, city or municipality, and the government-owned or controlled corporations.

The forms of case management showing public finances and expenditures are prepared by the national government. Spending in the Philippines ranged from 13 to 17 percent during 1981-1986. Government spending as a share of the GDP is smaller on the average than in developing countries (20 to 25%) and industrial countries (around 30%). The portion of the combined expenditures of the national government and public corporations (net of equity and lending) to the GDP shows a steady share ranging from 23% to 28%, except for 18% in 1984 when the Philippines experienced harsh economic crisis.

As shown in Table 9-1-1, the ideal policy of balanced budget has not been applied to the financial management of public corporations in the Philippines. Budget deficit has been allowed to finance operational activities and investment requirements, but the government is sensitive to the deficit indicator by setting its allowable percentage of deficit to GDP since the argument of the said ratio eventually leads to the increase of domestic or external financial resources to make up for financial gap between revenue and expenditure.

Government spending can be classified in a variety of ways. The most important distinction in a budget is between current and capital transactions. The ratio of capital spending of the national government to the GDP was from 7% to 4% during 1981-1983. This range is a typical GDP share in middle income countries where the GNP per capita is from US$500 to US$1,500 according to the IBRD's classification.

The year 1984 was marked by recession where the real term of GDP sharply dropped compared to the previous year. The adverse effect of the unfavorable economy resulted in the scale-down of capital outlay

consisting of public investment on various kinds of development projects. The policy of cutting back on investment amount during economic recession is quite often adopted in other countries as well. However, the increase of operating expenditure covering personal and operation plus maintenance costs cannot be evaded since the country was confronted with rapid price escalation. The things that eased the financial conditions of the national government were the unexpected increase of tax revenue and the rescheduling of external debt (repayment) conducted in 1984.

The magnitude of fiscal finance by local governments consisting of four (4) cities and thirteen (13) municipalities in Metro Manila is negligibly small compared to that of the national government. Fiscal revenues by local governments are mostly derived from local taxes such as real property tax and the business tax. The Metro Manila Commission (MMC) was established in 1975 under the Office of the President and has been engaged in various coordination works of inter-agencies and development policy and plan formulation in the National Capital Region (NCR). The MMC has been empowered to carry out fiscal perrogatives including taxation, borrowing, and transfer payments from 15% of general funds in local governments in NCR.

External financing has been a controversial issue in the Philippines since the total outstanding external debt consisting of monetary and non-monetary capitals, reached about US$28 billion in 1986. The amount corresponds to almost five times the public expenditure of the national government. The national government under which various agencies implement many development projects is the principal borrower from foreign countries or lending institutions. The outstanding debt of the national government was recorded at around US$5.4 billion in 1986. On June 27, 1984, Presidential Decree No. 1934 amended the Foreign Borrowing Law and raised the foreign borrowing ceiling previously fixed at US$5.0 billion to US$10 billion. However, it is reminded that continuous borrowing will entail the lasting payment of principal and interest. It is noteworthy that the growing interest payment during the recent years reached US$962 million, corresponding to about a third of the outflow in services shown in the Balance of Payments in Table 9-1-2.

Under the circumstances specified above, the government put emphasis on borrowing from the Official Development Assistance (ODA) whose loan conditions are more concessionary than commercial loans. Outstanding debt on ODA reached about US$7.8 billion in 1986. As far as the ODA to the Philippines is concerned, it is clear that borrowing from foreign countries categorized as bilateral was increasing more than that from multinational sources, since loan conditions of bilaterial funds are considered to be more concessionary than multilateral sources.

As shown in Table 9-1-2, the balance of current account in the balance of payments gradually improved since 1983 mainly because the government implemented an effective import control. Nevertheless, the performance of export stagnated. As a result, debt service ratio increased and reached to about 18% in 1986. The said ratio of 18% is higher than the corresponding ratio of other ASEAN countries.

2. FINANCIAL CONDITIONS FOR FLOOD CONTROL AND DRAINAGE WORKS

2.1 Public Investment on Flood Control-Related Works

Public investment on infrastructural projects under the management of government agencies and public corporations come from the capital outlay. Table 9-2-1 shows the past performance of investment allocation into subsectors such as transportation, water resources, power, communication, social and other infrastructures. The magnitude of public investment on infrastructure to the Philippine economy can be demonstrated by using the investment-GNP ratio. Statistical results of the said ratios during six (6) years reveal that ratios in the early 1980's have been kept at around 4%, but dropped down to 1.8% in 1986. The government decision of scaling down capital outlays at the recession time eventually leads to the reduction of investment infrastructure.

Public investment on flood control and drainage is identified in the water resources sector. The amount of local plus foreign funds allocated to flood control and drainage projects was about 500 million pesos in 1986. The proportion of flood control investment out of the total infrastructure outlays ranged from 1% to 4% during 1981-1986. The recession experienced in 1984 tended to postpone investment on flood

control and drainage projects, resulting in the drastic scale-down of public investment on the flood control sector in 1984. The performance of utilization rate of capital was low. Low utilization rate mainly orgiinated in insufficient amount of local fund to be allocated to foreign-assisted projects. This problem eventually affected the proper disbursement of foreign capitals, resulting in the increase of undrawn foreign capital.

Table 9-2-2 shows the actual disbursement on infrastructure projects of sub-category and selected institutions related to flood control and drainage projects. The selected institutions are the Department of Public Works and Highways (DPWH); the Philippine Atmospheric, Geographical and Astronomical Services Administration (PAGASA); the Metro Manila Infrastructure Utilities and Engineering known as MMINUTE (Special Project Office under NCR Regional Office of DPWH); and the Metro Manila Commission (MMC).

DPWH is the principal agency conducting projects related to infrastructures. Flood control and drainage projects have been ranked in second position in terms of investment allocation in DPWH. The other works where DPWH is involved are highways, ports, water supply, school buildings, national buildings and others, of which the highway sector receives the biggest and massive share of investment. The major foreign-assisted flood control and drainage projects as of November 1987 are summarized in Table 9-2-3.

The functional status of MMINUTE appears to be in the independent category according to the subsector classification of DPWH's investment portfolio. The public works conducted by MMINUTE is urban infrastructure in Metro Manila. The kinds of public works are water supply, sanitation and drainage systems and streets. IBRD has been committed to minor drainage projects under MMINUTE since one of the bank's policies is to improve sanitation conditions in the Metro Manila region. The improvement of drainage systems at barangays in municipalities or cities has been the major work since drainage system improvement is expected to contribute to the upgrading of hygienic conditions as an intermediate measure up to the completion of the sewerage system.

MMC is a unique entity specializing in coordinating works of various issues in the National Capital Region. The major practical works conducted by the MMC are garbage collection and sanitation which are exclusively handled by the Environmental Sanitation Center (ESC) under the MMC. Almost half of the MMC budget is expended on garbage collection and sanitation improvement. There is the Waterways Operation Service Division under ESC. This division specializes in cleaning garbage inside watercourses, but its contribution to cleaning of open waterways is negligibly small. Of notable importance is the difficulty of access to squatter areas by garbage collectors and vehicles and the growing rental fee on collector vehicles paid by ESC to private lenders.

PAGASA is now conducting the flood forecasting and warning for Luzon such as the Pampanga River Flood Forecasting and Warning System; the Flood Forecasting and Warning System in Agno, Bicol and Cagayan River Basins; and the Flood Forecasting and Warning System for Dam Operations which include Angat, Magat and Pantabangan dams that are cooperatively handled by NCR and NIA, with DPWH as the monitoring station. Along the Pasig-Marikina River, a telemetering gauging network is proposed to be constructed for the effective flood control and operation of the system for Metro Manila Area. DPWH had already finished the detailed design of the system, including the warning system along the Mangahan Floodway under foreign financial assistance.

The prompt relocation of squatters along many waterways still entail political difficulty and social problems since the matter of squatters cannot be solved by a single solution. The IBRD has been assisting the so-called Metro Manila Urban Projects where many agencies are involved with the National Housing Authority as the leading institution. The projects consist of site development, slum improvement and training services for upgrading the skill of people in resettlement areas. DPWH was also involved in urban projects in the form of the Dagat-Dagatan projects. Nevertheless, it is regretable that these urban projects could not greatly contribute to the solution of squatter problems along waterways.

2.2 Expenditure on Flood Control and Drainage Projects in NCR

Operation and maintenance of flood control and drainage works have been neglected. In particular, the general fund authorized under the General Appropriations Act for operation and maintenance related to flood control and drainage in the NCR Regional Office of DPWH up to 1985 has not been disbursed, with the exception of the fund for operation and maintenance of pumping stations. Operating funds began to be outlayed in 1986, which is shown in Table 9-2-4. Operating expenditure in the NCR turns out to be about 40% of the total expenditure of DPWH in the flood control sector.

Maintenance activities of drainage works under the NCR Regional Office of DPWH are reflected in Table 9-2-5. The Maintenance Division had conducted an inventory survey of drainage facilities and it periodically studies the condition of siltation in waterways and drainage systems. Based on the information gathered, area selection or prioritization for dredging or declogging works was eventually determined. Table 9-2-5 shows the results of maintenance activities by district office and facility in 1987. As to district offices, more than half of the funds has been disbursed in North Manila Engineering District Office covering the northern part of Manila City. As far as drainage facility is concerned, open waterways (estero) received the biggest share.

The allocation percentage of capital investment into the NCR Regional Office fluctuates year by year and does not show any steady ratio. Investment amount consisting of foreign and local funds ranged from 50 to 95 million pesos during 1983-1986. Mangahan Floodway and the Napindan Hydraulic Control Gate Structure are the foreign-assisted projects. A substantial portion of local funds was disbursed on the construction of drainage laterals and diking in Navotas and Malabon area. Table 9-2-6 shows the detailed breakdown of capital investment by kind of works.

3. FINANCIAL PLANNING

The purpose of financial planning is the quantification of financial resources to be funded to flood control and drainage works in the National Capital Region for the period up to the year of 2020, being the target year of the Master Plan of the project. Financial resources are to be derived from three sources. The first is the source under fiscal operation of the national government which is to be allocated to DPWH, being the implementing agency of flood control and drainage works. The first source consists of domestic and external funds. The second is the fund from local governments in the NCR. The last source is a special fund, except for government financing.

As far as public fund from local governments including institutions like the MMC is concerned, spending has been scarcely allocated to flood control and drainage works in the past years. Though fiscal revenue of local governments is expected to grow, the prospect of a certain amount of investment for the said works would not be so promising. Even if such an allocation is put in practice, the fund would be very small. Consequently, financial planning focuses on the first and third sources; namely, financial resources from the national government and the special fund. Nevertheless, the introduction of the special fund is often a subject of controversy, and it takes time to put the special fund in practice. As a result, the analysis on the special fund is based in not quantitative, but conceptual approach. Quantitative analysis of financial availability is forecast at 1988 constant price.

3.1 Financial Availability of the National Government Budget

The GDP share of public investment on infrastructures (has ranged from 2% to 5% in the past) is an indication for setting the investment target on public works. If financial impacts of outstanding debt or budget deficit on the Philippine economy are also taken into account, investment forecast determined by the GDP share would not result in a reasonable figure which is explainable in the macro-economic context. The following studies were undertaken to estimate the amount of funds to be finally allocated to flood control and drainage works in Metro Manila. Financial impact of outstanding debt and budget deficit on the Philippine economy were examined in (1) and (5), respectively.

(1) Estimate on growth of the Philippine economy
(2) Forecast of Gross Domestic Product
(3) Forecast of the government's expenditure
(4) Forecast of fiscal revenue
(5) Quantitative analysis of budget deficit to be allowable
(6) Financial sources to make up for budget deficit
(7) Budget allocation to DPWH
(8) Regional allocation of DPWH's budget on flood control and drainage works in National Capital Region

Economic Growth

Economic growth based on potential aspect is illustrated in the following way. The model for forecasting economic growth is based on the well-known Harrod-Domer model of economic growth with the following equation.

$$(\dot{Y}/Y) = (I/Y) / (I/\dot{Y})$$

where:

Y: GDP
$\dot{Y}$: Growth of GDP
I: Investment

The left side of the equation indicates the rate of growth of GDP. The numerator of the right side is the propensity of investment, and the denominator is the marginal capital-output ratio. Based on the investment propensity and the marginal capital-output ratio where observation period is from 1971 to 1986, the following classification of period is presented. One is the period of stable economic growth during 1971-1982. The other is the longer period of unstable economic growth during 1971-1986 in which economic depression time from 1983 to 1986 is included.

The rate of GDP growth determined by the average of investment propensity and marginal capital-output ratio during stable period is calculated to be about 5%. The same growth rate under unstable economic condition results in about 4%.

The model for forecasting economic growth based on financial impact of outstanding debt on the Philippine economy is demonstrated in the following way. Additional variables are added to the equation to reflect the realistic situation of the Philippine economy into the Harrod-Domer model. One is the saving function where domestic saving is largely influenced by debt service. The other is inflow of foreign capitals.

$$S = So + s \cdot Y - q \cdot DS \quad \text{... Eq. 9-3-1}$$

where:

S : domestic saving
So: coefficient
s : marginal propensity of saving
DS: debt service

$$DS = D \cdot (r + 1/n) \quad \text{... Eq. 9-3-2}$$

where:

D: public and public-guaranteed debt outstanding
r: average interest rate
n: average repayment period

Inserting Eq. 9-3-2 into Eq. 9-3-1, the saving function is:

$$S = so + [s - q\ (r + 1/n)\ h] \cdot Y \quad \text{... Eq. 9-3-3}$$

where:

h: D/Y

Investment is identically equal to domestic saving plus foreign capital inflow.

$$I = S + F \quad \text{... Eq. 9-3-4}$$

where:

F: foreign capital inflow

Harrod-Domer model of economic growth is:

$$(\dot{Y}/Y) = (I/Y) / (\dot{I}/\dot{Y}) = i/K \qquad \text{... Eq. 9-3-5}$$

where:

i: rate of investment to GDP

k: marginal capital - output ratio

Inserting Eq. 9-3-3 plus Eq. 9-3-4 into Eq. 9-3-5, the Harrod-Domer equation is arranged for:

$$\begin{aligned}\dot{Y}/Y &= 1/K\,[(so + (s - q\,(r + 1/n)\,h \cdot Y + F)/Y] \\ &= 1/K\,[(so + s \cdot Y)/Y - q\,(r + 1/n)\,h + F/Y] \\ &= 1/K\,[S^* - q\,(r + 1/n)\,h + F/Y] \qquad \text{... Eq. 9-3-6}\end{aligned}$$

Coefficient of saving function (So, s, q) are calculated on the basis of the multiple regression analysis, and the other parameters like K, r, and n are derived from financial statistics. Observation period is 16 years from 1971 to 1986. The results are shown as follows: $S^* = 0.3$, $q = 2.95$, $r = 0.07$, $n = 15$, and $K = 5.9$, approximately.

Furthermore, the ratio of foreign capital inflow to GDP is assumed to be:

$$F/Y = f = h \cdot (g + 1/n) \qquad \text{... Eq. 9-3-7}$$

where:

h: the ratio of debt outstanding to GDP

g: economic growth

Inserting Eq. 9-3-7 into Eq. 9-3-6, the following equation is finally obtained:

$$g = 1/(K - h)\,[S^* - 1\,(qr - (1 - q)/n)] \qquad \text{... Eq. 9-3-8}$$

Given coefficients and parameters shown above, it is clear that h is an influential factor on economic growth. The rate of debt outstanding to GDP is 0.65 in 1986. Though the variation of h is uncertain for the target period, h is assumed to be approximately 0.5 on the average of the same period. Eventually economic growth (g) is estimated to be about 3% per annum.

Forecast of GDP

Economic growth is examined in cases without and with the condition of financial impact of debt on the economy. Accordingly, the rates of economic growth are 5%, 4% and 3%. GDP is forecast at the 1988 constant price, as shown in Table 9-3-1.

Forecast of the Government's Expenditure

Government spending is broadly classified into current and development expenditure. Current expenditure is assumed to increase in proportion to economic growth. Development expenditure is forecast by two methods. The first method starts with the GDP share of government expenditure. Subsequently, development expenditure is estimated by the difference between government and current expenditure. The second is the rate of development expenditure to gross investment.

The following are the conditions and assumptions to determine development expenditure by the respective rates of growth.

(1) 5% growth rate

(a) The average rate of government expenditure to GDP during the period of stable economic growth from 1971 to 1982.

(b) The average rate of investment to GDP, and the average rate of development expenditure to gross investment during the same period.

(2) 4% growth rate

(a) The average rate of government expenditure to GDP during the period of unstable economic growth from 1971 to 1986.

(b) The average rate of investment to GDP, and the average rate of development expenditure to gross investment during the same period.

(3) 3% growth rate

(a) The average rate of government expenditure to GDP during the period of unstable economic growth from 1971 to 1983.

(b) The average rate of investment to GDP, and the average rate of development expenditure to gross investment during the same period.

The study results of the governmental's expenditure are shown in Table 9-3-1.

Forecast of Fiscal Revenue

Fiscal revenue is broadly classified into tax and non-tax portion. The tax portion consists of income, international, and other categories. For a simple analysis, the tax portion is not taken individually by item, but as the aggregate. The forecast of tax revenue is based on the multiplication of tax elasticity with respective economic growth. Tax elasticity is defined as the rate of tax growth to economic growth based on historical data. The portion of non-tax is estimated by the proportion of non-tax to tax. The results are shown in Table 9-3-2.

Quantitative Analysis of Budget Deficit to be Allowable

The money supply (M1) has been the most influential factor to inflation. Since the portion of the deficit finance constitutes a large part of the increase of money supply in the past, deficit finance is expected to accelerate inflation in the Philippine economy. Consequently, provided that the rate of inflation to be acceptable is decided at 10% per annum, the increase rate of deficit finance should be kept within the same rate of 10%.

Deficit finance turned out to be about 31 billion pesos in 1986. Budget deficit to be allowed in 1988 is estimated at 37 billion pesos.

Deficit finance is demonstrated in Table 9-3-2 on the basis of fiscal revenue and the government expenditure. All cases of deficit finance shown in Table 9-3-2 are allowable because deficit finance in 1988 is less than 37 billion pesos. Furthermore, the size of deficit

finance would become smaller and smaller during 1990-2020. Since the patterns of government expenditure are two cases by the rate of economic growth, the maximum level of expenditure is selected by growth rate.

Financial Sources to Make Up for Deficit Finance

Finance sources for development are the domestic long-term bonds or loans and the external official development assistance. As shown in Table 9-3-2, the higher the rate of economic growth is, the more fiscal revenue increases. Nevertheless, the augment of fiscal revenue cannot be expected in case of low economic growth. Under such circumstances, domestic finance becomes the important source to make up for deficit. External funds required for deficit finance of the national government is a part of foreign capital inflow. If the inflow of foreign capital shown in Eq. 9-3-7 is continuously guaranteed, the Philippines would not be confronted with the shortage of external funds for deficit finance.

Budget Allocation to DPWH

(1) Development Expenditure

The institutional (DPWH) share of development on actual basis during 1981-1986 is shown in Table 9-3-3. Since the observation period was confined to the recent years including the economic depression time, the spending allocation to DPWH tends to be underestimated. The rate of investment allocation to DPWH was calculated at 15.5% on the average.

(2) Current Expenditure

Owing to the difficulty of data access to actual figures of current expenditure, the observation period was limited to only the four years from 1983 to 1986. Table 9-3-3 also shows the annual current expenditure on both obligation and actual bases.

Since the rate of allocation to DPWH has been constant within the range of 3%, the use of these rates for the forecast of DPWH's current spending would not result in biased output. The rate was determined at 2%, which corresponds to the ratio on actual basis in 1986.

Regional Allocation of DPWH's Budget on Flood Control and Drainage Works in National Capital Region

Regional allocation of DPWH's investment is based not on obligation expenditure but preferably actual spending. However, obligation basis is adopted for selecting the rate of investment allocation to flood control and drainage works in NCR, due to insufficient data on actual spending. The observation period on obligation basis is 9 years. Regional allocation of DPWH's investment to NCR is about 16% on the average. Sectoral allocation of investment in NCR to flood control and drainage works is about 25%.

The medium-term investment programme of DPWH revised in the early 1988 reveals that regional allocation of investment to NCR ranges from 10 to 16% during 1988-1992. Thus, a regional allocation of 16% is not necessarily an over-estimate of investment flow into NCR. The same programme also shows 25% of sectoral allocation to flood control and drainage works. Table 9-3-4 shows investment allocation of DPWH to flood control and drainage works in NCR.

The following are the conditions to estimate the expenditure for flood control and drainage works in NCR.

(1) Current spending of DPWH based on institutional allocation of 2% to the said agency.

(2) Spending for operation and maintenance is 65% of the current budget for DPWH.

(3) O&M for flood control and drainage works is 17% of the budget for operation and maintenance.

(4) O&M for flood control and drainage works in NCR is 50% of the budget for the said civil works.

Table 9-3-5 shows the expenditure on operation and maintenance for flood control and drainage works in the NCR. The results are summarized as follows:

Unit: billion peso

Growth Rate	Accumulative Amount (1990-2020)	
	Development Investment	Current Expenditure
5%	16.5	7.5
4%	14.1	6.1
3%	11.6	5.1

3.2 Other Fund Source

Surcharge Tax Concept

At present, sewerage charge is imposed on users in area where sewerage system is provided. Since the sewerage charge is fixed at 50 percent of the water tariff (excluding the maintenance service charge), it is apparent that the revenue amount under such level of sewerage charge is not large enough to cover operation and maintenance costs of the existing sewerage systems. Under such circumstances, MWSS which is in charge of water supply and sewerage imposes the so-called environmental surcharge on all users of water supply. The rate of this surcharge is 10% of water supply.

The reason why this surcharge was introduced is to prevent sanitary conditions from getting worse since drainage water discharged by all users of water supply worsens sanitary conditions. Since foul drainage puts a physical burden on the existing drainage systems, it is reasonable that revenue collected through the environmental surcharge be spent on the rehabilitation of drainage systems. Currently, minor drainage system is the target of this surcharge.

As shown in Table 9-3-6, per capita surcharge per month is calculated at about 2 pesos. Assuming that a family size is about 6 persons, the same surcharge per household per month is 12 pesos which is considered to be the manageable amount according to the capacity to pay in an ordinary household. Even if the rate of this surcharge becomes double, this order of payment would not seriously affect household expenditures.

Nevertheless, the accounting of environmental surcharge is currently under the management of MWSS. If the revenue collected by

this surcharge is proposed to be spent on the rehabilitation of drainage mains or laterals under the management of DPWH, the acknowledgement by MWSS would be absolutely necessary. Until sewerage are completely provided in the National Capital Region, the introduction of environmental surcharge into drainage systems under DPWH is the most realistic and implementable way of funding. The Corporate Planning Section of MWSS estimates that the revenue derived from this surcharge would reach to around 200 million pesos in 1990.

Funding from Real Property Tax

Since the beneficiaries of flood control projects are the residents of the NCR and the purpose of the said works is to protect their properties, real property tax would be justified as the possible source of funds to finance flood control and drainage works.

However, the capacity of the fiscal revenue of local governments in the NCR is so small that the possibility of allocating a part of the revenue to expenditures on flood control works is hardly expected. The use of real property tax as one of the fund sources must be discussed and acknowledged at the regional diet, since this tax is a major portion of the local tax. Hence, funding from the real property tax would be a controversial matter.

3.3 Overall Assessment

The prospect of economic growth in real terms for the long period of between 1990 and 2020 is entirely unknown and difficult to predict. Economic performance depends on activities sectors and policies or strategies of the government to be expected in the coming Philippine economy. The range of growth rates from 3% to 5% would be figures to be performable if the improvement of the Philippine economy is taken into account.

The growth rate of 3% is considered to be a realistic performance of the Philippine economy because the rate reflects the financial impact of the outstanding debt on the economy. However, the potential economic growth rate per annum for a long period ranges from 4% to 5%. This is already proven by past economic performances observed from 1971 to 1988.

Although the prospect for economic growth in real terms for a long period is difficult to predict, the rate of 4% or more would be the potential growth to be attained. This rate is the annual average growth of the economy in the period from 1971 to 1988 during which the Philippines experienced a high growth rate as well as stagnation of the economy. Since economic performance in the future is expected to repeat the cycle of high growth and stagnation, the rate of 4% or more is considered to be the obtainable economic growth.

TABLES

Table 9-1-1 HISTORICAL PERFORMANCE OF PUBLIC FINANCE AND EXPENDITURE

Unit: Million Peso

	1981	1982	1983	1984	1985	1986
(1) Gross Domestic Product (GDP)						
GDP at current price	305,274	340,585	384,095	540,466	609,459	626,717
GDP at 1972 price	96,207	98,999	99,920	93,927	89,803	90,770
Deflator (1972=100)	317	344	384	575	679	690
(2) National Government						
Revenue	35,933	38,206	45,632	56,861	68,961	79,245
Tax	31,423	33,800	39,848	50,118	61,253	65,491
Non-Tax	4,510	4,406	5,784	6,743	7,708	13,492
Expenditure	48,079	52,610	53,063	66,926	80,102	110,497
Operating	26,390	31,746	34,522	42,873	55,275	66,921
Capital Outlay	20,760	18,646	16,148	9,786	8,796	11,715
Net Lending	929	2,218	2,393	14,267	16,031	27,452
Deficit	-12,146	-14,405	-7,431	-10,065	-11,141	-31,252
Deficit/GDP (%)	4.0	4.2	1.9	1.9	1.8	5.0
Financing	12,146	14,405	7,431	10,065	11,141	31,252
External (net)	5,992	4,597	5,437	2,004	-340	3,580
Domestic (net)	6,154	9,808	1,994	8,061	11,481	27,672
Change in Cash	3,362	-1,281	2,638	8,207	1,771	3,369
(3) Public Corporations						
Revenue	31,265	34,466	41,348	25,816	56,310	38,738
Expenditure	43,528	45,606	57,390	37,010	64,192	44,306
Operating	29,547	32,265	39,290	24,103	51,885	38,425
Capital Outlay	13,981	13,341	18,100	12,907	12,307	5,881
Deficit	-12,263	-11,140	-16,042	-11,194	-7,882	-6,779
Deficit/GDP (%)	4.0	3.3	4.2	2.1	1.3	1.1
Financing	12,263	11,140	16,042	11,194	7,882	6,779
External (net)	6,983	6,820	11,293	5,786	-2,326	-5,261
Domestic (net)	5,280	4,320	4,748	5,408	10,208	12,040
(4) NCR Local Government						
Revenue						
Government	1,480	1,458	1,598	1,644	1,844	1,758
MMC	384	429	514	606	732	672
Expenditure						
Government	1,225	1,551	1,404	1,710	1,833	1,723
MMC	384	430	486	605	668	656

SOURCE: Statistic Yearbook 1987
Department of Finance, Bureau of Treasury
Department of Finance, Government Corporate Monitoring & Coordinating Committee
Metro Manila Commission (Expenditures of Local Government are estimates)

Table 9-1-2 BALANCE OF PAYMENT AND EXTERNAL FINANCING

Unit: Million US$

	1981	1982	1983	1984	1985	1986
(1) Balance of Payment						
Current Transaction						
Trade Balance	-2,224	-2,646	-2,482	-679	-482	-202
Export	5,722	5,021	5,005	5,391	4,629	4,842
Import	7,946	7,667	7,487	6,070	5,111	5,044
Services	-309	-1,040	-740	-855	26	783
Inflow	2,896	2,983	3,217	2,619	3,288	3,791
Outflow	3,205	4,023	3,867	3,474	3,262	3,008
of which : Interest	529	548	657	780	831	962
Transfer	472	486	472	236	379	441
Inflow	485	498	483	237	388	445
Outlfow	13	12	11	1	9	4
Balance	-2,061	-3,200	-2,750	-1,298	-77	1,022
(2) External Financing						
a. National Government						
Debt Outstanding	3,370	3,794	4,476	4,690	5,249	5,362
Borrowing	851	631	692	304	199	479
Principal Repayment	93	93	202	184	217	304
b. Public Corporations						
Debt Outstanding	4,383	4,923	5,937	7,209	5,947	5,561
Borrowing		2,991	2,564	629	1,617	886
Principal Repayment		2,192	1,548	282	1,742	1,144
c. Total Debt Outstanding	20,817	24,226	24,050	24,571	26,184	28,172
Public & Public-guaranteed	7,677	8,929	10,509	11,612	3,561	19,827
ODA	3,493	3,916	4,909	5,627	6,882	7,834
Multilateral	2,006	2,300	2,987	3,320	3,504	3,636
Bilateral	1,487	1,616	1,922	2,307	3,378	4,198
Private	4,184	5,013	5,670	5,985	6,679	11,993
Private Non-guaranteed	2,761	3,229	3,125	2,711	2,998	1,794
Short Term	9,421	11,235	9,404	9,492	8,573	5,378
Use of IMF	958	833	942	756	1,052	1,173
d. Debt Service	868	1,091	1,298	1,115	1,257	1,581
Debt Service Ratio (%)	10.1	13.6	16.0	13.9	15.8	18.3

SOURCE: World Debt Tables, IBRD
Central Bank of the Philippines

Table 9-2-1 PUBLIC INVESTMENT IN INFRASTRUCTURE

Unit: Million Peso

Sector	1981				1982				1983			
	CDC	D	U (%)	P (%)	CDC	D	U (%)	P (%)	CDC	D	U (%)	P (%)
(1) Transportation	4,135	2,977	72	22	5,504	4,385	80	27	4,518	3,424	76	21
(2) Water Resource	4,222	3,130	74	23	5,845	3,577	61	23	4,471	2,698	60	16
(Flood Control)/1	(506)	(320)	(63)	(2)	(703)	(429)	(61)	(3)	(458)	(242)	(53)	(1)
(3) Power	7,412	6,842	92	50	7,207	7,207	100	45	9,932	9,932	100	60
(4) Communication	94	26	28	1	149	105	70	1	318	144	45	1
(5) Social Infrastructure	667	471	71	3	1,113	532	48	3	751	166	22	1
(6) Other Infrastructure	172	135	78	1	216	65	30	1	187	122	65	1
(7) Total	16,702	13,581	81	100	20,034	15,872	79	100	20,635	16,486	81	100
(8) GDP		305,274				340,585				384,095		
(9) Ratio of (7)/(8)		4.4				4.7				4.3		

Unit: Million Peso

Sector	1984				1985				1986			
	CDC	D	U (%)	P (%)	CDC	D	U (%)	P (%)	CDC	D	U (%)	P (%)
(1) Transportation	3,754	3,210	86	22	2,778	2,285	81	16	-	3,025	-	27
(2) Water Resource	3,154	2,538	80	18	-	3,338	-	23	3,211	2,626	82	23
(Flood Control)/1	(251)	(105)	(42)	(1)	(-)	(563)	(-)	(4)	(715)	(504)	(70)	(4)
(3) Power	8,107	8,107	100	56	7,811	7,811	100	55	5,126	5,126	100	46
(4) Communication	74	29	39	1	173	44	25	1	118	16	14	0
(5) Social Infrastructure	415	325	78	2	-	586	-	4	601	412	69	3
(6) Other Infrastructure	167	160	96	1	-	66	-	1	-	39	-	1
(7) Total	15,671	14,369	92	100	-	14,104	-	100	-	11,244	-	100
(8) GDP		540,466				609,459				626,717		
(9) Ratio of (7)/(8)		2.7				2.3				1.8		

NOTE : CDC : Cash Disbursement Ceiling
D : Actual Disbursement
U : Utilization Rate = D/CDC
P : Percentage of Actual Disbursements by Sector
/1 : Included in "Water Resources"

SOURCE: NEDA Year-End Report to the President 1981, 1982, 1983, 1986
Philippine Development Report 1985

Table 9-2-2 PUBLIC INVESTMENT ON INFRASTRUCTURE
BY SELECTED INSTITUTION

Unit: Million Peso

Sector/ Sub-Sector	Agency	Year					
		1981	1982	1983	1984	1985	1986
Infrastructure							
Transportation							
Highway	DPWH	2,108	3,364	2,967	1,846	2,159	2,837
Port	DPWH	-	80	157	72	100	188
Water Resource							
Water Supply	MWSS	628	695	878	1,197	1,013	506
Sewerage	MWSS	60	195	278	295	279	105
Water Supply	DPWH	79	133	176	143	31	40
Flood Control	SPWH	320	429	242	105	563	504
of which : NCR		-	-	59	63	51	95
Communication							
FFWS	PAGASA	2.9	4.6	-	37.5	149.4	27.9
Social Infrastructure							
School Building	DPWH	-	386	0	148	152	13
National Building	DPWH	-	5	77	126	185	120
Hospital	DPWH	-	28	0	0	249	227
Other Infrastructure							
Urban Infra	MMINUTE	-	11	53	67	66	38
Specific	DPWH	-	14	0	0	0	0
Other Infra	DPWH	-	2	1	2	192	294
Others							
Environment							
Garbage	MMC	-	-	210	266	300	452

NOTE: DPWH : Department of Public Works and Highways
MWSS : Metropolitan Waterworks and Sewerage System
PAGASA : Phil. Atmospheric, Geographical and Astronomical Services Adm.
MMINUTE : Metro Manila Infrastructure Utilities & Engineering
NCR : National Capital Region
MMC : Metro Manila Commission
"Specific" means site development projects called Dagat-Dagatan which was one of the schemes of the IBRD-assisted Metro Manila Urban Project.

Table 9-2-3 MAJOR FOREIGN-ASSISTED FLOOD CONTROL AND DRAINAGE PROJECTS

	Project Name	Region	Foreign Fund	Remarks
(1)	Mangahan Floodway	NCR	OECF	Out of the nine (9) project components of the Mangahan Floodway, seven (7) are covered by OECF such as the Rosario Wier, bridge, concrete-lined channel, etc. The remaining two (2) being mostly dredging work is financed by local funds.
(2)	Lower Agusan	Butuan City	OECF	Loan is presently under negotiation.
(3)	Dagat-Dagatan River Bank Improvement	NCR	KFW	Bank Improvement of rivers in, Navotas, Metro development. Out of six (6) project components, four (4) are covered by KFW Fund of the Federal Republic of Germany (West Germany), of which bank improvement in the Malabon and Bangkulasi rivers were completed.
(4)	PREMIUMED	VIII	IBRD	Drainage improvement projects for municipal development. PREMIUMED means Program for Essential Municipal Infrastructure Utilities Maintenance and Engineering Development. IBRD committed eleven (11) projects so far of which seven (7) projects are still on-going. Those projects are mostly implemented in municipalities in Mindanao.
(5)	BRBDP	IV	ADB	BRBDP means Bicol River Basin Development Project. ADB committed forty-seven (47) projects of which twenty-two (22) are still on-going.
(6)	MMDSR	NCR	ECF	MMDSR means Metro Manila Drainage Rehabilitation Projects which aim at rehabilitating the existing pumping stations. MMDSR started in January 1985 and is expected to be completed in 1989.

Table 9-2-4 OPERATING EXPENDITURES OF FLOOD CONTROL SECTOR

Unit: Million Peso

Item	1983	1984	1985	1986
(1) Operating Expenditure by National Government	34,522	42,873	55,275	66,921
(2) Operating Expenditure by DPW	135	1,012	183	1,301
Policy	25	27	30	80
Operation	34	699	96	845
Flood Control	0	4	10	146
NCR	0	0	0	62
Pumping Station	0	2	10	12
Others	34	695	86	699
Administration	76	286	57	376

SOURCE: Accounting Section (DPWH)
Financial Controller (NCR)

Table 9-2-5 MAINTENANCE ACTIVITY OF DRAINAGE WORKS IN NCR (1987)

Unit: Million Peso

District Office/ Item	Open Waterways	Drainage Mains	Drainage Laterals	Maintenance	Total
(1) North Manila	17.9	5.5	1.0	-	24.4
(2) South Manila	2.3	0.9	0.8	-	4.0
(3) Quezon City	0	0.1	0.8	-	0.9
(4) 1st Metro Manila	1.0	0	0.7	-	1.7
(5) 2nd Metro Manila	5.1	2.5	0.7	-	8.3
(6) Napindan HCS	-	-	-	1.7	1.7
(7) MANAVA	-	-	-	1.5	1.5
(8) Regional Maintenace	-	-	-	0.9	0.9
TOTAL	26.3	9.0	4.0	4.1	43.4

SOURCE: Maintenance Division (NCR)

Table 9-2-6 CAPITAL INVESTMENT ON FLOOD CONTROL IN NCR

Unit: Million Peso

	Kind of Work	1983	1984	1985	1986
(1)	Bank Improvement	2,382,409	6,764,951	0	13,564,256
(2)	Construction of Drainage Main	9,439,940	2,409,993	0	3,394,896
(3)	Construction of Drainage Lateral	15,078,909	11,740,024	8,332,326	6,081,522
(4)	Construction of Pumping Station & Floodgates	10,725,000	12,632,704	0	2,768,890
(5)	Diking	0	12,072,430	15,117,958	3,307,231
(6)	Tide Control Gate	0	1,223,060	8,183,257	19,189,584
(7)	Dredging	2,918,600	1,740,151	95,000	211,410
(8)	Declogging of Drainage Main	94,216	0	0	0
(9)	Declogging of Drainage Lateral	758,517	677,252	0	0
(10)	Others (ROW, etc.)	5,016,835	0	413,003	8,372,930
(11)	Operation of Pumping Station	0	0	1,319,564	0
(12)	Mangahan Floodway	3,987,482	975,581	0	0
(13)	Napindan HCS	9,096,781	0	0	0
(14)	Supplemental Program	0	12,624,385	17,370,395/1	38,119,668
	TOTAL	59,498,659	82,860,531	50,831,503	95,010,407

NOTE /1: Project listing not available

SOURCE : Annual Report (NCR)
Financial Division (NCR)

Table 9-3-1 FORECAST OF GOVERNMENT EXPENDITURE BY ECONOMIC GROWTH

Unit: Million Peso

Item	1988	1990	1995	2000	2005	2010	2015	2020
- 5% Growth Rate								
GDP	814,990	898,530	1,146,780	1,463,610	1,867,980	2,384,070	3,042,740	3,883,390
1.1 G.E.	120,620	132,980	169,720	216,610	276,460	352,840	450,330	574,740
Current	86,650	95,530	121,920	155,600	198,590	253,460	323,490	412,860
Development	33,970	37,450	47,800	61,010	77,870	99,380	126,840	161,880
1.2 G.E.	116,320	128,240	163,660	208,880	266,580	340,240	434,250	554,220
Current	86,650	95,530	121,920	155,600	198,590	253,460	323,490	412,860
Development	29,670	32,710	41,740	53,280	67,990	86,780	110,760	141,360
- 4% Growth Rate								
GDP	807,200	873,070	1,062,220	1,292,350	1,572,340	1,912,990	2,327,440	2,831,690
1.1 G.E.	121,080	130,960	159,330	193,850	235,850	286,950	349,120	424,750
Current	85,860	92,870	112,990	137,470	167,250	203,490	247,580	301,220
Development	35,220	38,090	46,340	56,380	68,600	83,460	101,540	123,530
1.2 G.E.	121,130	131,020	159,410	193,950	235,960	287,090	349,290	424,960
Current	85,860	92,870	112,990	137,470	167,250	203,490	247,580	301,220
Development	35,270	38,150	46,420	56,480	68,710	83,600	101,710	123,740
- 3% Growth Rate								
GDP	799,440	848,130	983,220	1,139,820	1,321,360	1,531,820	1,775,800	2,058,640
1.1 G.E.	119,920	127,220	147,480	170,980	198,200	229,770	266,370	308,800
Current	85,000	90,180	104,540	121,190	140,490	162,870	188,810	218,880
Development	34,920	37,040	42,940	49,790	57,710	66,900	77,560	89,920
1.2 G.E.	119,940	127,240	147,510	171,000	198,230	229,810	266,410	308,840
Current	85,000	90,180	104,540	121,190	140,490	162,870	188,810	218,880
Development	34,940	37,060	42,970	49,810	57,740	66,940	77,600	89,960

NOTE: The assumptions for estimating government expenditure are:

1.1 The ratio of government expenditure to GDP = 0.148 for 5% growth rate and 0.150 for 4% and 3% growth rates

1.2 Investment prosperity = 0.26, the ratio of development expenditure to gross investment = 0.14 for 5% growth rate and 0.23 and 0.19, respectively, for 4% and 3% growth rates

Table 9-3-2 FORECAST OF FISCAL REVENUE AND BUDGET DEFICIT

Unit: Million Peso

Growth Rate/ Item	1988	1990	1995	2000	2005	2010	2015	2020
- 5% Growth Rate								
GDP	814,990	898,530	1,146,780	1,463,610	1,867,980	2,384,070	3,042,740	3,883,390
Tax	80,890	92,010	126,950	175,160	241,680	333,460	460,100	634,830
Non-tax	11,320	12,880	17,770	24,520	33,840	46,680	64,410	88,880
Tax + Non-tax	92,210	104,890	144,720	199,680	275,520	380,140	524,510	723,710
Deficit								
	(3.5)	(3.1)	(2.1)	(1.2)	(0.05)			
1.1	-28,410	-28,090	-25,000	-16,930	-940	27,300	74,180	148,970
	(2.9)	(2.6)	(1.7)	(0.6)				
1.2	-24,110	-23,350	-18,940	-9,200	8,940	39,900	90,260	169,490
- 4% Growth Rate								
GDP	807,200	873,070	1,062,220	1,292,350	1,572,340	1,912,990	2,327,440	2,831,690
Tax	80,140	88,890	115,190	149,270	193,430	250,660	324,820	420,920
Non-tax	11,220	12,440	16,130	20,900	27,080	35,090	45,470	58,930
Tax + Non-tax	91,360	101,330	131,320	170,170	220,510	285,750	370,290	479,850
Deficit								
	(3.7)	(3.4)	(2.6)	(1.8)	(1.0)	(0.06)		
1.1	-29,720	-29,630	-28,010	-23,680	-15,340	-1,200	21,170	55,100
	(3.7)	(3.4)	(2.6)	(1.8)	(1.0)	(0.07)		
1.2	-29,770	-29,690	-28,090	-23,780	-15,450	-1,340	21,000	54,890
- 3% Growth Rate								
GDP	799,440	848,130	983,220	1,139,820	1,321,360	1,531,820	1,775,800	2,058,640
Tax	79,400	85,860	104,410	126,970	154,400	187,760	228,330	277,660
Non-tax	11,120	12,020	14,620	17,780	21,620	26,290	31,970	38,870
Tax + Non-tax	90,520	97,880	119,030	144,750	176,020	214,050	260,300	316,530
Deficit								
	(3.7)	(3.5)	(2.9)	(2.3)	(1.7)	(1.0)	(0.3)	(0.4)
1.1	-29,400	-29,340	-28,450	-26,230	-22,180	-15,720	-6,070	-7,730
	(3.7)	(3.5)	(2.9)	(2.3)	(1.7)	(1.0)	(0.3)	(0.4)
1.2	-29,420	-29,360	-28,480	-26,250	-22,210	-15,760	-6,110	-7,690

NOTE: The assumptions and conditions for estimating fiscal revenue and budget are:

(1) Increase rate of tax portion = The rate of economic growth X income elasticity of tax $(\dot{t}/t)(\dot{y}/y)$. The elasticity = 1.33.

(2) Estimate of non-tax = tax portion X 0.14. 0.14 is the average rate of non-tax on the historical basis. Nevertheless, grant and Economic Support Fund are not inclusive in this estimation.

(3) Budget deficit is equal to fiscal revenue minus expenditure. Parenthesis indicates the rate of budget deficit to GDP.

Table 9-3-3 INSTITUTIONAL (DPWH) SHARE OF DEVELOPMENT AND CURRENT EXPENDITURE IN THE PAST

Development Expenditure

Unit: Million Peso

Item	1981	1982	1983	1984	1985	1986
(1) Allocation to DPWH	2,507	4,452	3,673	3,585	3,679	4,261
(2) Development Spending	21,689	20,864	18,541	24,053	24,527	39,167
(3) Ratio of (1)/(2) (%)	11.6	21.3	19.8	14.9	14.5	10.9

Current Expenditure

Unit: Million Peso

Growth Rate/Item	1983		1984		1985		1986	
	O.	A.	O.	A.	O.	A.	O.	A.
(1) Allocation to DPWH	1,408	135	1,160	1,012	1,548	183	1,869	1,301
(2) Current Expenditure	41,065	34,522	42,816	42,873	56,192	55,275	61,943	66,921
(3) Ratio of (1)/(2) (%)	3.4	0.4	2.7	2.4	2.8	0.3	3.0	1.9

NOTE: O. : Obligation basis A. : Actual basis

Table 9-3-4 FORECAST OF DEVELOPMENT EXPENDITURE FOR FLOOD CONTROL AND DRAINAGE WORKS IN NCR

Unit: Million Peso

Growth Rate/ Item	1988	1990	1995	2000	2005	2010	2015	2020
A. 5% Growth Rate								
Development Expenditure	33,970	37,450	47,800	61,010	77,870	99,380	126,840	161,880
DPWH	5,270	5,800	7,410	9,460	12,070	15,400	19,660	25,090
DPWH, NCR	840	930	1,190	1,510	1,930	2,460	3,150	4,010
Flood Control	210	230	300	380	480	620	790	1,000
B. 4% Growth Rate								
Development Expenditure	35,270	38,150	46,420	56,480	68,710	83,600	101,710	123,740
DPWH	5,470	5,910	7,200	8,750	10,650	12,960	15,770	19,180
DPWH, NCR	875	945	1,150	1,400	1,700	2,070	2,520	3,070
Flood Control	220	240	290	350	425	520	630	770
C. 3% Growth Rate								
Development Expenditure	34,940	37,060	42,970	49,810	57,740	66,940	77,600	89,960
DPWH	5,420	5,740	6,660	7,720	8,950	10,380	12,030	13,940
DPWH, NCR	870	920	1,070	1,240	1,430	1,660	1,920	2,230
Flood Control	220	230	270	310	360	420	480	560

NOTE: (1) DPWH : The rate of allocating development expnediture to DPWH (15.5%)
(2) DPWH, NCR : Regional allocation of DPWH's budget to NCR (16%)
(3) Flood Control : Sectoral allocation of DPWH's budget in NCR to flood control and drainage works (25%)

Table 9-3-5 FORECAST OF CURRENT EXPENDITURE FOR FLOOD CONTROL AND DRAINAGE WORKS IN NCR

Unit: Million Peso

Growth Rate/ Item	1988	1990	1995	2000	2005	2010	2015	2020
A. 5% Growth Rate								
Current Expenditure	86,650	95,530	121,920	155,600	198,590	253,460	323,490	412,860
DPWH	1,730	1,910	2,440	3,110	3,970	5,070	6,470	8,260
Operation	1,120	1,240	1,590	2,020	2,580	3,300	4,210	5,370
Flood Control	190	210	270	340	440	560	720	910
Flood Control (NCR)	100	110	140	170	220	280	360	460
B. 4% Growth Rate								
Current Expenditure	85,860	92,870	112,990	137,470	167,250	203,490	247,580	301,220
DPWH	1,720	1,860	2,260	2,750	3,350	4,070	4,950	6,020
Operation	1,120	1,210	1,470	1,790	2,180	2,650	3,220	3,910
Flood Control	190	210	250	300	370	450	550	660
Flood Control (NCR)	100	110	130	150	190	230	270	330
C. 3% Growth Rate								
Current Expenditure	85,000	90,180	104,540	121,190	140,490	162,870	188,810	218,880
DPWH	1,700	1,800	2,090	2,420	2,810	3,260	3,780	4,380
Operation	1,100	1,170	1,360	1,570	1,830	2,120	2,460	2,850
Flood Control	190	200	230	270	310	360	420	480
Flood Control (NCR)	100	100	120	140	160	180	210	240

NOTE: (1) DPWH : The rate of allocating current expenditure to DPWH (2%)
(2) Operation : The share of operation and maintenance (65%)
(3) Flood Control : Sectoral allocation of operation and maintenance to flood control (17%)
(4) Flood Control (NCR) : Regional allocation of expenditure for flood control and drainage works to NCR (50%). Spending for operation and maintenance cost of pumping station is also included.

Table 9-3-6 PER CAPITA CHARGE OF WATER SUPPLY, SEWERAGE SERVICES, AND ENVIRONMENT

Item	1985	1986	1987	1988	1989	1990
Population in NCR (thousand)	7,706	7,929	8,159	8,396	8,641	8,892
Population of water supply (thousand)	3,275	3,797	4,185	4,508	4,959	5,486
Population of sewerage service (thousand)	624	658	644	663	699	729
Household of water supply (thousand)	438	501	534	583	645	713
Water Supply (million ton)	303	311	331	352	382	416
Water Production (million ton)	787	904	863	782	764	771
Household of sewerage (thousand)	74	77	76	76	80	83
Water tariff (peso/ton)	3.11	3.99	4.08	4.29	4.67	4.91
Water revenue (million peso)	942	1,241	1,351	1,510	1,785	2,044
Sewerage revenue (million peso)	98	128	134	120	140	154
Environmental charge (million peso)	72	105	135	151	178	204
Per capita water charge (peso)	30	27	27	28	30	31
Per capita sewerage charge (peso)	13	16	17	15	17	18
Per capita environmental charge (peso)	2	2	3	3	3	3

SOURCE: MWSS (Corporate Planning Section)

X. ECONOMIC EVALUATION

SUPPORTING REPORT

X. ECONOMIC EVALUATION

TABLE OF CONTENTS

LIST OF TABLES

1. GENERAL

The study considers three kinds of flood control and drainage plans; Framework Plan, Master Plan and Priority Projects. The Priority Projects are proposed for the lower stream of the Pasig-Marikina River, east and west areas of the Mangahan Floodway and Malabon-Navotas areas. Economic viabilities of the Master Plan and the Proprity Projects were assessed on the basis of the years 2020 and 1986 land use conditions, respectively.

2. ANNUAL AVERAGE BENEFIT

Flood control benefit is generally defined as the reduction of potential flood damage attributed to the designed works. The reduction is obtained as the difference between the estimated flood damage under the with- and the without-the-project situations.

A study on annual average benefit to accrue by implementing the project has been carried out in the following order:

(1) Estimate of unit property value
(2) Identification of the relation between water level and damage
(3) Calculation of potential flood damage
(4) Estimate of annual average benefit

2.1 Estimate of Unit Property Value

The value of properties including immovables and indoor movables in each sub-basin was determined to estimate their flood damage in accordance with the land use categories as follows.

- Residential/Commercial (further classified into high, middle and low density)
- Industrial
- Agricultural
- Fishpond
- Forest
- Open Space

Of these categories, forest may be excluded from the flooding areas when calculating a unit property per area. Property values in the categories of agriculture, fishpond and open space are not taken into account for the following reasons:

- Urbanization in the following areas has advanced so much that agricultural lands remain to a negligible small degree;
- Fishponds are seen in the coastal area; however, its area to be protected from flooding is small in absolute terms and its flood damage is so little compared with other land use categories such as residential/commercial and industrial; and
- Open space is considered to be non-productive.

Housing and Movables Value

Residential/commercial is classified into three combinations in relation to density and quality, namely, Low Density/High Quality, Middle Density/Middle Quality and High Density/Low Quality, while industrial belongs to Middle Density/Low Quality, judging from their building-to-land ratio and construction materials.

The unit value per area is estimated by the following formula:

$$Av = Cc \times Dr \times Br$$

where,

Av : Average value per area (peso/m^2)
Cc : Construction cost of a new house (peso/m^2)
Dr : Depreciation ratio (%)
Br : Building-to-Land ratio (%)

Construction costs of new houses were researched by interviewing a real estate agent in Manila City. Depreciation ratios were estimated from the "1980 Census of Population and Housing, Special Report No. 5, NCSO" as shown in Table 10-2-1. The building-to-land ratios were obtained by measuring house floor areas and the total land on 1:2,000 scale maps. The averaged unit values per area for each combination are summarized in the following table.

Combination		Construction Cost (Peso/m^2)	Depreciation Ratio (%)	B-to-L Ratio (%)	Averaged Value (Peso/m^2)
Density	Quality				
(Residential/Commercial)					
Low	High	4,500	62	40	1,120
Middle	Middle	3,500	45	50	790
High	Low	2,500	40	60	600
(Industrial)					
Middle	Low	2,500	40	50	500

The value of movables in the residential/commercial category was not separately estimated in this study because it is considered to be in proportion to the immovables and the potential damage can be calculated by multiplying damage rates by the value of immovables as described further in the succeeding section. Movables belonging to the industrial category, including stocks and equipment, are evaluated at ₱1,230/m^2 on an average at the 1986 price according to the answers to the questionnaires. Based on the unit value per area of each category, the average unit value of properties was estimated for each sub-basin under the land use conditions in 2020 and 1986, as tabulated in Tables 10-2-2 and 10-2-3.

2.2 Identification of the Relation Between Water Level and Damage

Flood damage is basically calculated by the following formula; [unit property value] x [inundated area] x [damage rate], and the damage rates vary according to the inundation depth. Hence, the relation between height and area should firstly be identified.

The relation between height and area is arrived at from the 2-m contour maps with the scale of 1:10,000 prepared with the assistance of JICA in 1986. It was also based on the information and data collected in the study area and the contour maps with a scale of 1:10,000 prepared by BCGS in 1986. The relation between the height and property value was obtained by multiplying the above-said unit property value with the area.

Supplemental contour lines were drawn in the landside drainage areas to prepare a more accurate relationship. In the river water flooding areas, this relationship was obtained at about 1.0 kilometer intervals.

In the study conducted with the assistance of IBRD in 1983, a large-scale research on the flood damage in 1982 was carried out in the questionnaire manner, covering about 20,000 households. Based on the raw data of this research, direct damage rates were analyzed for the following inundation depth classifications, which were determined from the distribution of data.

Inundation Depth	Damage Rates	
	Houses	Indoor Movables
0-25 cm	0.043	0.038
26-50 cm	0.046	0.044
Above 50 cm	0.054	0.070

Note: All the damage rates are against the value of houses.

The direct damage rates of industrial indoor movables are likewise analyzed with results of 0.025, 0.053 and 0.180 against the value of indoor movables for the same classification of inundation depth. Indirect damage such as loss of income and loss of sales accounts for about 40% of the direct damage.

To identify the relation between water level and flood damage, flood damages at several water levels were calculated by the following formula:

$$D = \sum_{i=1}^{n} (HV_i \cdot R_1 + HV_i \cdot R_2 + IV_i \cdot R_3)$$

where,

D : Flood damage

HV : Value of houses/buildings

IV : Value of industrial indoor movables
R_1 : Damage rate of houses
R_2 : Damage rate of residential/commercial indoor movables
R_3 : Damage rate of industrial indoor movables
n : Number of drainage areas or sectioned river water flooding areas.

2.3 Calculation of Potential Flood Damage

Inundation and flooding water levels calculated for several probable rainfalls or discharges were applied to the relation between the water level and flood damage discussed above. In the east and west of Mangahan areas, several probable water levels of the Laguna Lake were likewise applied to the same relation to estimate the flood damage thereat under the existing condition, because they are more dominant than the inundation water levels by rainfall. The potential flood damages were estimated for each river system and drainage area as shown in Table 10-2-4.

The following considerations were given to the calculation of potential flood damage under the 2020-year land use conditions.

- Since it is hardly expected that houses/buildings will be constructed in very low-lying (at present) areas such as fishponds and swamps without any flood protection works, the future properties are assumed to exist on grounds higher than the habitually flooded areas.
- The riverside areas unused at present are in most cases habitually suffering from flooding. In the same concept as above, the future properties in these areas are assumed to exist away from the river channel.

2.4 Estimate of Annual Average Benefit

Based on the estimated damages for each probable rainfall or discharge, the annual average damage was calculated by the following formula.

$$B = \sum_{i=1}^{n} 1/2 \, [D(Q_{i-1}) + D(Q_i)] \cdot [P(Q_{i-1}) - P(Q_i)]$$

where,

B : Annual average benefit

$D(Q_{i-1})$, $D(Q_i)$: Flood damage caused by the floods with Q_{i-1} and Q_i discharges, respectively.

$P(Q_{i-1})$, $P(Q_i)$: Probabilities of occurrence of Q_{i-1} and Q_i discharges, respectively.

n : Number of floods applied

The annual average benefit, defined as the reduction of probable damage under the with- and the without-the-project situations, was thus estimated for the proposed plans as follows:

(1) Master Plan : 2.78 billion pesos
(see Table 10-2-5)

(2) Priority Project

(Drainage Improvement)
- East and West Mangahan : 430.3 million pesos
- Malabon Navotas (Stage I): 158.5 million pesos

(River Improvement)
- Pasig-Marikina downstream of Mangahan Floodway : 197.7 million pesos

The calculation of annual average benefits for the priority projects are presented in Tables 10-2-6 to 10-2-8.

3. ECONOMIC PROJECT COST

The economic costs of the project are nominal figures that duly reflect the true economic value of goods and services involved. These costs were used only for the economic evaluation of the project.

Transfer items such as taxes and duties imposed on construction materials and equipment, including government subsidy and contractor's profit, were excluded from the elements of financial cost. A value added tax (VAT) equivalent to 10% of gross receipts is collected according to the taxation system in the Philippines. It is therefore assumed that at least 10% of the financial construction cost is involved as the transfer items.

Land has to be acquired for project implementation, and its economic value is considered to correspond to the productivity foregone by the project, which is reflected by the price. Price contingency is also excluded from the financial cost for the calculation of economic cost. The economic cost of the Master Plan and the Priority Project were thus estimated as follows:

(1) Master Plan

The economic cost of the Master Plan is estimated at 13,523 million pesos in total, consisting of 7,390 million pesos for river systems and 6,133 million pesos for drainage system.

(2) Priority Project:

The Priority Project includes three components; two for drainage improvement and one for river improvement. The total economic costs were separately estimated as follows:

(Drainage Improvement)
- East and West Mangahan : 2,399 million pesos
- Malabon Navotas (Stage I): 945 million pesos

(River Improvement)
- Pasig-Marikina downstream of Mangahan Floodway : 1,177 million pesos

4. PROJECT EVALUATION

4.1 Economic Viability of the Project

The Project has been evaluated from the economic viewpoint by figuring out the economic viability in terms of internal rate of return (IRR), benefit-cost ratio (B/C), and net present value (NPV). All the monetary calculations were based on the price level of October 1988, and the project life (for economic evaluation) was fixed until 2050 for the Master Plan and 2030 for the Priority Project, considering the durable life of the last structure to be constructed for the project.

The calculation of IRR, B/C and NPV was based on the annual cash flow that was prepared from the above-said economic cost and the annual average benefit in accordance with the implementation schedule or annual disbursement schedule (refer to Tables 10-4-1 to 10-4-4). A discount rate of 15% was applied for the calculation of B/C and NPV. The economic viability of the Master Plan was thus figured out as follows.

- IRR : 17.3%
- B/C : 1.18
- NPV : 538 million pesos

The economic viability of Priority Project was likewise evaluated on the basis of the annual cash flows presented in Table 11-4-2. The results are summaried as follows:

	IRR	B/C	NPV
(Drainage Improvement)			
- East and West Mangahan :	16.7%	1.11	193.6 million pesos
- Malabon Navotas (Stage I):	15.9%	1.05	38.9 million pesos
(River Improvement)			
- Pasig-Marikina downstream of Mangahan Floodway :	16.1%	1.07	56.5 million pesos

high values of 16.7% and 15.9% in IRR, respectively, together with high values of B/C and NPV. In the same concept as described above, these works are also justified to be put into implementation in accordance to the proposed schedule.

River improvement works for the Pasig-Marikina downstream of Mangahan Floodway also shows a high viability of 16.1% in IRR. The social impacts expected from this project are essential to the whole nation as discussed in the preceding subsection, so that it is of great importance to promote its implementation from not only the economic aspect but the social viewpoint.

TABLES

Table 10-2-1 AVERAGE DEPRECIATION RATIO OF HOUSING UNIT

Class/Period (1)	Dwelling Unit (2)	Distribution (3)	Depreciation* (4)	(3)x(4)
1. High Quality				
1941 or earlier	4,939	2.40%	10.00%	0.24%
1942 - 1950	7,420	3.61%	10.75%	0.39%
1951 - 1960	26,694	12.98%	26.88%	3.49%
1961 - 1970	44,757	21.76%	49.38%	10.74%
1971 - 1975	35,906	17.45%	66.25%	11.56%
1976 - 1980	36,313	17.65%	77.50%	13.68%
1981 - 1988	49,700	24.16%	92.13%	22.26%
Sub-total	205,729	100.00%	---	62.36%
2. Meddle Quality				
1941 or earlier	27,122	4.96%	10.00%	0.50%
1942 - 1950	35,015	6.41%	10.00%	0.64%
1951 - 1960	88,768	16.24%	10.90%	1.77%
1961 - 1970	150,382	27.52%	32.50%	8.94%
1971 - 1975	77,713	14.22%	55.00%	7.82%
1976 - 1980	68,061	12.45%	70.00%	8.72%
1981 - 1988	99,401	18.19%	89.50%	16.28%
Sub-total	546,462	100.00%	---	44.67%
3. Low Quality				
1941 or earlier	25,922	4.30%	10.00%	0.43%
1942 - 1950	39,599	6.57%	10.00%	0.66%
1951 - 1960	72,482	12.03%	10.00%	1.20%
1961 - 1970	117,281	19.47%	11.35%	2.21%
1971 - 1975	84,752	14.07%	32.50%	4.57%
1976 - 1980	119,048	19.76%	55.00%	10.87%
1981 - 1988	143,254	23.78%	84.25%	20.04%
Sub-total	602,338	100.00%	---	39.98%

NOTE * : Durable life are 40, 30 and 20 years for the high, middle and low quality, respectively, and the salvage value is 10% for all.

SOURCE : 1980 Census of Pupulation and Housing, Special Report No.5, NCSO

Table 10-2-2(1/2) AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN UNDER THE LAND USE CONDITION OF 2020

UNIT: million peso

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

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).

Table 10-2-2(2/2) AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN UNDER THE LAND USE CONDITION OF 2020

UNIT: million peso

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

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).

Table 10-2-3(1/2) AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN UNDER THE LAND USE CONDITION OF 1986

UNIT: million peso

SUB-BASIN	TOTAL AREA* (km2)	HOUSE/BUILDING** TOTAL	HOUSE/BUILDING** PER km2	HOUSE/BUILDING*** TOTAL	HOUSE/BUILDING*** PER km2	INDUSTRIAL INDOOR MOVABLES TOTAL	INDUSTRIAL INDOOR MOVABLES PER km2
(MEYCAUAYAN)							
ME- 1	2.38	1,836.80	874.67	1,836.80	874.67	0.00	0.00
ME- 2	10.13	2,450.40	274.40	2,438.40	273.06	73.50	8.23
ME- 3	21.55	9,754.00	789.80	9,680.00	783.81	453.25	36.70
ME- 4	22.54	3,832.80	170.04	3,628.80	160.99	1,249.50	55.43
ME- 5	8.59	3,103.60	361.30	2,745.60	319.63	2,192.75	255.27
ME- 6	21.76	5,428.80	268.62	5,364.80	265.45	392.00	19.40
ME- 7	8.82	1,360.00	160.95	952.00	112.66	2,499.00	295.74
ME- 8	17.81	5,351.60	300.48	4,601.60	258.37	4,593.75	257.93
ME- 9	18.42	6,936.40	376.57	6,788.40	368.53	906.50	49.21
SUB-TOTAL	132.00	40,054.40	303.44	38,036.40	288.15	12,360.25	93.64
(MALABON-TULLAHAN)							
MT- 1	0.26	67.20	1,120.00	67.20	1,120.00	0.00	0.00
MT- 2	13.38	7,417.60	672.49	7,417.60	672.49	0.00	0.00
MT- 3	20.08	8,634.80	455.90	8,038.80	424.44	3,650.50	192.74
MT- 4	9.97	4,090.00	410.23	3,684.00	369.51	2,486.75	249.42
SUB-TOTAL	43.69	20,209.60	462.57	19,207.60	439.63	6,137.25	140.47
(PASIG/MARIKINA)							
PM- 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM- 2	13.46	1,388.80	121.61	1,388.80	121.61	0.00	0.00
PM- 3	47.26	8,285.20	221.71	8,093.20	216.57	1,176.00	31.47
PM- 4	6.18	3,831.20	619.94	3,575.20	578.51	1,568.00	253.72
PM- 5	11.33	7,990.00	705.21	7,536.00	665.14	2,780.75	245.43
PM- 6	8.74	3,654.40	418.12	3,386.40	387.46	1,641.50	187.81
PM- 7	4.58	1,788.00	390.39	1,614.00	352.40	1,065.75	232.70
SUB-TOTAL	91.55	26,937.60	294.24	25,593.60	279.56	8,232.00	89.92
(SAN JUAN)							
SJ- 1	23.27	14,328.40	656.06	14,328.40	656.06	0.00	0.00
SJ- 2	10.53	6,697.20	636.01	6,413.20	609.04	1,739.50	165.19
SJ- 3	2.18	1,656.80	760.00	1,600.80	734.31	343.00	157.34
SJ- 4	9.96	5,444.40	546.63	5,388.40	541.00	343.00	34.44
SJ- 5	8.24	3,633.20	440.92	3,069.20	372.48	3,454.50	419.24
SJ- 6	14.02	7,172.80	511.61	7,120.80	507.90	318.50	22.72
SJ- 7	3.55	2,240.00	630.99	2,212.00	623.10	171.50	48.31
SJ- 8	12.07	6,910.00	572.49	6,910.00	572.49	0.00	0.00
SJ- 9	6.53	3,318.80	508.24	3,244.80	496.91	453.25	69.41
SJ- 10	1.09	508.00	466.06	468.00	429.36	245.00	224.77
SUB-TOTAL	91.44	51,909.60	567.69	50,755.60	555.07	7,068.25	77.30
(BAHO/BULI)							
BB- 1	16.55	11,119.60	775.43	11,067.60	771.80	318.50	22.21
BB- 2	6.63	538.40	121.26	486.40	109.55	318.50	71.73
BB- 3	5.55	897.20	161.66	703.20	126.70	1,188.25	214.10
BB- 4	25.76	4,027.20	193.24	3,979.20	190.94	294.00	14.11
BB- 5	4.21	1,719.60	488.52	1,491.60	423.75	1,396.50	396.73
BB- 6	4.46	1,633.60	366.28	1,489.60	333.99	882.00	197.76
BB- 7	9.18	2,178.00	245.55	2,062.00	232.47	710.50	80.10
SUB-TOTAL	72.34	22,113.60	305.69	21,279.60	294.16	5,108.25	70.61
(SOUTH PARANAQUE/LAS PINAS)							
PL- 1	11.49	8,257.20	718.64	7,915.20	688.88	2,094.75	182.31
PL- 2	3.44	1,366.40	397.21	1,366.40	397.21	0.00	0.00
PL- 3	19.25	13,148.40	726.83	12,878.40	711.91	1,653.75	91.42
PL- 4	6.24	5,003.20	877.75	4,939.20	866.53	392.00	68.77
PL- 5	9.72	6,232.00	658.08	6,104.00	644.56	784.00	82.79
ZP- 1	6.77	1,747.20	287.84	1,747.20	287.84	0.00	0.00
ZP- 2	3.67	3,852.80	1,049.81	3,852.80	1,049.81	0.00	0.00
ZP- 3	4.76	1,097.60	230.59	1,097.60	230.59	0.00	0.00
SUB-TOTAL	65.34	40,704.80	622.97	39,900.80	610.66	4,924.50	75.37

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).

Table 10-2-3(2/2) AVERAGE UNIT VALUE OF PROPERTY IN EACH SUBBASIN UNDER THE LAND USE CONDITION OF 1986

UNIT: million peso

SUB-BASIN	TOTAL AREA* (km2)	HOUSE/BUILDING** TOTAL	HOUSE/BUILDING** PER km2	HOUSE/BUILDING*** TOTAL	HOUSE/BUILDING*** PER km2	INDUSTRIAL INDOOR MOVABLES TOTAL	INDUSTRIAL INDOOR MOVABLES PER km2
(MALABON NAVOTAS)							
MA- 1	2.26	493.60	218.41	425.60	188.32	416.50	184.29
MA- 2	2.05	777.60	379.32	777.60	379.32	0.00	0.00
MA- 3	2.21	1,362.00	616.29	1,356.00	613.57	36.75	16.63
MA- 4	0.50	220.80	441.60	220.80	441.60	0.00	0.00
MA- 5	1.89	1,006.00	532.28	872.00	461.38	820.75	434.26
MA- 6	1.34	426.00	317.91	426.00	317.91	0.00	0.00
MA- 7	2.40	920.00	383.33	850.00	354.17	428.75	178.65
MA- 8	3.76	1,006.00	267.55	1,006.00	267.55	0.00	0.00
MA- 9	0.30	158.00	526.67	144.00	480.00	85.75	285.83
MA- 10	0.91	388.00	426.37	346.00	380.22	257.25	282.69
MA- 11	0.69	252.00	365.22	168.00	243.48	514.50	745.65
MA- 12	0.32	0.00	0.00	0.00	0.00	0.00	0.00
SUB-TOTAL	18.63	7,010.00	376.27	6,592.00	353.84	2,560.25	137.43
(MANILA AND SUBURBS, NORTH)							
NM- 1	16.79	7,786.00	463.73	7,574.00	451.10	1,298.50	77.34
NM- 2	0.36	160.00	444.44	144.00	400.00	98.00	272.22
NM- 3	9.06	5,044.00	556.73	4,932.00	544.37	686.00	75.72
NM- 4	0.69	262.00	379.71	186.00	269.57	465.50	674.64
NM- 5	1.68	662.00	396.41	636.00	380.84	159.25	95.36
SUB-TOTAL	28.58	13,914.00	486.84	13,472.00	471.38	2,707.25	94.73
(MANILA AND SUBURBS, SOUTH)							
SM- 1	5.99	4,801.20	801.54	4,775.20	797.20	159.25	26.59
SM- 2	7.06	2,864.00	405.67	2,478.00	350.99	2,364.25	334.88
SM- 3	1.41	100.00	70.92	48.00	34.04	318.50	225.89
SM- 4	3.88	1,478.00	380.93	1,438.00	370.62	245.00	63.14
SM- 5	24.80	11,073.60	448.51	10,819.60	438.22	1,555.75	63.01
SUB-TOTAL	43.14	20,316.80	470.95	19,558.80	453.38	4,642.75	107.62
(EAST OF MANGAHAN)							
EM- 1	1.67	1,438.00	861.08	1,392.00	833.53	281.75	168.71
EM- 2	2.42	577.60	238.68	453.60	187.44	759.50	313.84
EM- 3	2.72	613.20	225.44	613.20	225.44	0.00	0.00
EM- 4	1.95	241.60	123.90	235.60	120.82	36.75	18.85
SUB-TOTAL	8.76	2,870.40	327.67	2,694.40	307.58	1,078.00	123.06
(WEST OF MANGAHAN)							
WM- 1	9.12	4,338.80	475.75	4,276.80	468.95	379.75	41.64
WM- 2	5.14	571.20	111.13	571.20	111.13	0.00	0.00
WM- 3	6.83	3,286.40	481.17	3,158.40	462.43	784.00	114.79
WM- 4	14.28	4,132.80	304.55	4,044.80	298.07	539.00	39.72
WM- 5	2.77	1,366.40	496.87	1,366.40	496.87	0.00	0.00
SUB-TOTAL	38.14	13,695.60	359.09	13,417.60	351.80	1,702.75	44.64
(PARANAQUE LAS PINAS)							
PA- 1	8.82	1,900.80	215.51	1,878.80	213.02	134.75	15.28
PA- 2	2.41	815.20	335.47	797.20	328.07	110.25	45.37
PA- 3	1.55	510.40	333.59	500.40	327.06	61.25	40.03
PA- 4	2.65	1,654.40	624.30	1,654.40	624.30	0.00	0.00
SUB-TOTAL	15.43	4,880.80	316.32	4,830.80	313.08	306.25	19.85

NOTE *: Excluding the area of forest.
**: For the calculation of damage on immovables (res./com. and industrial).
***: For the calculation of damage on movables (residential/commercial).

TABLE 10-2-4 POTENTIAL FLOOD DAMAGE BY FLOOD RETURN PERIOD

River System/ Drainage Area	Damage in Flood Return Period							
	100-YR	50-YR	30-YR	20-YR	10-YR	5-YR	3-YR	2-YR
(under the land use condition of 2020)								
1. River System								
Pasig Marikina	5,557	4,927	4,251	3,993	1,806	1,284	---	819
Buli Baho Mahaba	699	624	553	526	478	376	---	267
Malabon Tullahan	380	313	283	245	198	183	---	160
S.Paranaque Las Pinas	689	553	467	418	346	286	---	112
Sub-total	7,325	6,418	5,555	5,182	2,829	2,129	---	1,357
2. Drainage Area								
Manila	2,635	2,203	1,801	---	1,086	807	606	450
Malabon Navotas	1,809	1,643	1,459	---	1,119	917	802	707
East of Mangahan	564	494	436	---	305	226	156	105
West of Mangahan	3,604	3,416	3,221	---	2,493	1,620	809	418
San Juan	511	465	425	---	336	291	248	237
Mandaluyong Pasig	696	647	607	---	438	335	272	224
Marikina	486	452	386	---	268	195	152	116
Paranaque Las Pinas	494	443	402	---	287	196	148	101
Valenzuela	525	425	358	---	252	157	109	75
Sub-total	11,324	10,187	9,093	---	6,584	4,744	3,301	2,433
(under the land use condition of 1986)								
1. River System								
Pasig + lower Marikina	1,486	1,302	1,087	1,032	530	337	---	116
2. Drainage Area								
Malabon Navotas	624	569	540	---	413	363	322	289
East & West of Mangahan	2,152	2,027	1,897	---	1,507	1,067	638	415
Sub-total	2,776	2,596	2,437	---	1,920	1,430	960	704

TABLE 10-2-5 BREAKDOWN OF ANNUAL AVERAGE BENEFIT OF THE MASTER PLAN
(under the land use condition of 2020)

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

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

Table 10-2-6 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

Unit: million peso

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

Table 10-2-7 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROJECT

Unit: million peso

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

Table 10-2-8 CALCULATION OF ANNUAL AVERAGE BENEFIT FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

Unit : million peso

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

Table 10-4-1 ANNUAL CASH FLOW OF THE MASTER PLAN

Unit : million peso

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

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

Table 10-4-2 ANNUAL CASH FLOW FOR EAST AND WEST OF MANGAHAN DRAINAGE IMPROVEMENT PROJECT

Unit : million peso

No.	Year	Economic Cost				Annual Average Benefit	Annual Cash Flow
		Construction	Land Acquisition	OMR	Total		
1	1991	282.7	92.7		375.4	0.0	(375.4)
2	1992	791.4	92.7		884.1	107.6	(776.5)
3	1993	569.5			569.5	215.1	(354.4)
4	1994	569.5			569.5	322.7	(246.8)
5	1995			39.1	39.1	430.3	391.2
6	1996			39.1	39.1	430.3	391.2
7	1997			39.1	39.1	430.3	391.2
8	1998			39.1	39.1	430.3	391.2
9	1999			39.1	39.1	430.3	391.2
10	2000			39.1	39.1	430.3	391.2
11	2001			39.1	39.1	430.3	391.2
12	2002			39.1	39.1	430.3	391.2
13	2003			39.1	39.1	430.3	391.2
14	2004			39.1	39.1	430.3	391.2
15	2005			39.1	39.1	430.3	391.2
16	2006			39.1	39.1	430.3	391.2
17	2007			39.1	39.1	430.3	391.2
18	2008			39.1	39.1	430.3	391.2
19	2009			39.1	39.1	430.3	391.2
20	2010			39.1	39.1	430.3	391.2
21	2011			39.1	39.1	430.3	391.2
22	2012			39.1	39.1	430.3	391.2
23	2013			39.1	39.1	430.3	391.2
24	2014			39.1	39.1	430.3	391.2
25	2015			39.1	39.1	430.3	391.2
26	2016			39.1	39.1	430.3	391.2
27	2017			39.1	39.1	430.3	391.2
28	2018			39.1	39.1	430.3	391.2
29	2019			39.1	39.1	430.3	391.2
30	2020			39.1	39.1	430.3	391.2
31	2021			39.1	39.1	430.3	391.2
32	2022			39.1	39.1	430.3	391.2
33	2023			39.1	39.1	430.3	391.2
34	2024			39.1	39.1	430.3	391.2
35	2025			39.1	39.1	430.3	391.2
36	2026			39.1	39.1	430.3	391.2
37	2027			39.1	39.1	430.3	391.2
38	2028			39.1	39.1	430.3	391.2
39	2029			39.1	39.1	430.3	391.2
40	2030			39.1	39.1	430.3	391.2
					IRR =	16.81%	
					B/C =	1.11	
					NPV =	193.58	

Table 10-4-3 ANNUAL CASH FLOW FOR MALABON-NAVOTAS DRAINAGE IMPROVEMENT PROEJCT

Unit : million peso

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

Table 10-4-4 ANNUAL CASH FLOW FOR PASIG-MARIKINA RIVER IMPROVEMENT PROJECT

Unit : million peso

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

XI. NON-STRUCTURAL MEASURES

SUPPORTING REPORT

XI. NON-STRUCTURAL MEASURES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. GENERAL

This supporting report deals with the non-structural measures, which are essential to the mitigation of flood damage, particularly, in the urbanized and urbanizing areas.

Section 2 explains the mechanism of increase of the flood flow which is inevitably brought about by urbanization. Explained in Section 3 are the various non-structural measures which have been effectively applied for flood damage mitigation in other countries.

Some non-structural measures have been adopted in Metro Manila. These are described in Section 4. In Section 5, out of the various non-structural measures, the applicable ones were selected in consideration of the present practice in the Philippines. Section 6 describes the proposed non-structural measures which are highly expected to mitigate the flood damage in Metro Manila.

2. CAUSE OF INCREMENTAL FLOOD DAMAGE DUE TO URBANIZATION

One of the adverse effects of urbanization and development is the increase of flood damage induced by the following causes.

Increase of Runoff Coefficient

Before urbanization, a certain amount of flood runoff discharge is retained by infiltration into the ground, and is stored in natural retarding areas such as paddy fields, agricultural land and other open spaces. Therefore, flood runoff is minimized.

After urbanization, however, the permeable area decreases, so that rainfall in the impermeable areas such as residential area and paved roads is quickly discharged. Also, the reclamation of natural retarding area for residential purposes causes the loss of the inherent storage function. These result in the increase of runoff coefficient.

Shortage of Runoff Concentration Time

In accordance with urbanization, drainage system and sewerage works are installed for the convenience of the inhabitants. However, these systems shorten the runoff concentration time and cause the rapid rising of water level in the river and in the inland area.

Increase of Damage Potential in Flood-Prone Areas

The increase of flood damage potential because of concentration of population and property are produced due to the urbanization of flood-prone areas.

3. OUTLINE OF NON-STRUCTURAL MEASURES

To decrease flood damage in river basins, structural flood control measures such as the improvement of river channels and construction of dam, diversion channel and retarding basin have been conventionally employed. The structural measures are the principal ones to mitigate flood damage, but their completion requires a considerable time and enormous funds. Under the circumstances, the non-structural measures shown in Fig. 11-3-1 are being applied in many countries in addition to the conventional structural measures. The non-structural measures are explained hereinafter.

Retardation of Runoff

Among the measures for retardation of runoff, only the conservation of areas is classified as a non-structural measure. In the upper part of a watershed, certain types of vegetation are effective in controlling the rate of surface water runoff by the infiltration of rainfall into the soil. Urban development, especially in small river basins, causes the increment of peak flood flow as explained before and thus increases the magnitude and frequency of flooding downstream. Vegetation can be preserved by land use regulation to prevent damage to the lower reaches.

Flood Plain Management

(1) Land Use Regulation

Land use regulation is implemented in flood plains aiming to ensure that the established inhabitants do not suffer new flood damage and to ensure that the new developments themselves do not receive flood damage. In general, the flood plain is classified into zones such as prohibitive, restrictive and warning zones, and in each zone, land use is controlled by specifying suitable land use.

(2) Land Reclamation

Land reclamation is a measure to reduce the flood damage potential by elevating land over the inundation water level. In case there exist urbanized areas in the neighboring places, the new land reclamation increases the flood damage potential in the neighboring areas due to the destruction of the storage capacity. Therefore, when the effects are foreseen, land reclamation should be prohibited.

(3) Flood-Proofing of Buildings

The flood damage potential can also be reduced by the flood-proofing of buildings. These are the construction of high-floor houses, construction of walls of buildings with impervious materials, and closure of low-level windows and other openings.

(4) Flood Insurance

The flood insurance does not reduce the flood damage potential, but enables individual property owners to spread a certain but potentially large loss uniformly over a long period of time by paying premiums.

(5) Dissemination of the Flood Risk Map

In case of the new urban and industrial development, often developers know little of the local flooding conditions. The dissemination of the flood risk map help them to avoid new investment which might be destructed by flood and moreover to avoid the poor location of buildings which might worsen the flooding conditions in wide areas.

The new residents also gain the benefits from the flood risk map. They will be prepared for the floods with the establishment of evacuation procedures and evacuation areas.

Emergency Activities

(1) Flood Forecasting/Warning

Flood warning services is undertaken to give timely warnings to the people concerned and to the organizations for flood fighting and evacuating people.

(2) Flood Fighting

Flood fighting consists of the operation of existing flood control/drainage facilities during the flood period; the cleaning, the repair and strengthening of the existing flood control/drainage facilities; and the building of emergency works such as levees and dikes.

(3) Evacuation/Rescue

With early flood warning, people can evacuate and move personal properties and mobile equipment from the danger area to the place of safety.

Mentioned above is the explanation on the non-structural measures. In addition to these measures, there are noteworthy measures that can compensate for the natural storage/infiltration function of a watershed which will be lost by new urbanization. These are the rainfall retention facilities which are classified as structural measures but are explained hereunder in consideration of their function.

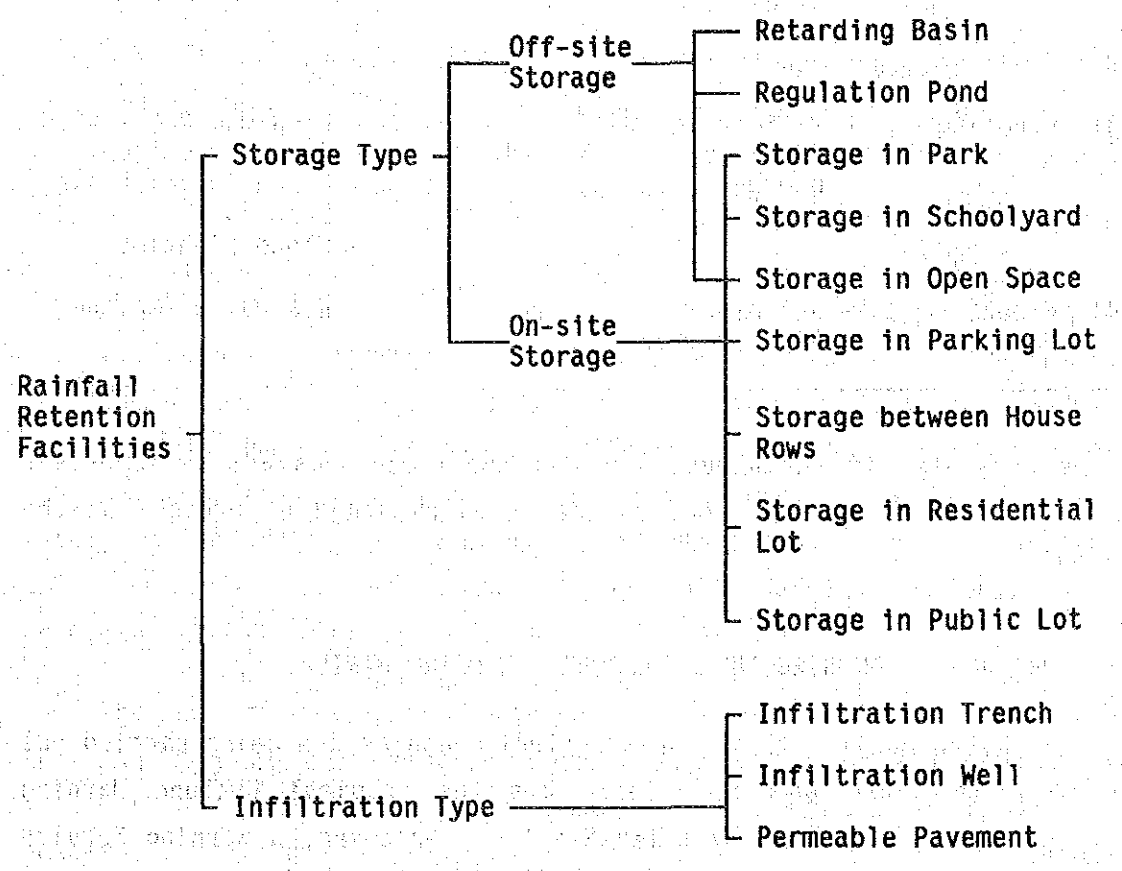
Rainfall retention facilities can be grouped into storage and infilitration types; the storage type can be divided into on-site and off-site, depending on location. Infiltration type include mainly on-site facilities.

Off-site storage facilities collect and store stormwater runoff at the end of a stream or other places (for example, a retarding basin or a flood regulation pond). Since these facilities can contain a large

volume of runoff, they are highly effective in regulating floods and, from a technical point of view, they ensure design reliability and safety. They are considered the primary runoff retention facilities.

On-site facilities store stormwater at the place of rainfall. These storage sites include parks and school grounds, as listed below.

Infiltration facilities are used in areas with high permeability, and a technical study to promote more infiltration is now underway.



The example, off-site and on-site storage facilities are shown in Figs. 11-3-2 and 11-3-3. The example of infiltration facilities is indicated in Fig. 11-3-4.

These non-structural measures are classified into the following categories in accordance with the process to flood damages: