The principal features of proposed structure are determined from the construction cost comparison study, as tabulated below:

Location of Bridge	Length (m)	Width (m)	No. of Spans	Type
Napindan channel	129.5	9.1	3	Post-tensioned composit I-beam
Mangahan floodway	248.0	9.1	6	-ditto-
Mangahan diversion	60.0	9.1	2	Reinforcing concrete
Lower Bicutan River	30.0	9.1	1	-ditto-

General drawings of two bridges at the Napindan channel and the Mangahan floodway are shown in Fig. 7.2-11.

Other than the abovementioned four bridges, reconstruction of two bridges in East of Mangahan and twenty-six bridges in West of Mangahan, most of their length are less than 10 m, will be required owing to improvement and construction works of rivers and drainage channels. Reinforcing concrete of superstructure and pile foundation of substructure are applied for these short span bridges.

7.2.7 Proposed Organizational Setup

In accordance with the proposed organizational setup of the master plan, as shown in Fig. 6.4-8, the design and construction will be executed by the DPWH-NCR or the PMO for Flood Control and Dredging Projects under DPWH. The DPWH-NCR will undertake the operation and maintenance (O&M) of the proposed project, excluding the one of the minor drainage laterals which is in charge of local government units such as MMC and city/municipality.

Design and Construction

To execute the design and construction work, the consulting engineers and a private company with high technical expertise will be hired or contracted, and the DPWH-NCR or the PMO mentioned above will undertake the supervision of this work.

The staffing of the required assistant such as draftsman, typist, driver, messenger, etc. would be decided at the stage of detail design of the proposed project. The details of required staffing and activity is described in Table 7.2-4.

Operation and Maintenance (O&M)

The proposed O&M Division of DPWH-NCR in the master plan will execute the operation of the related facilities for the proposed project, including the comprehensive management of maintenance work concerned and training of the related staff, for the purpose of the integrated and comprehensive operation of the related facilities.

The Engineering District Office of DPWH-NCR will undertake the practical and close maintenance activities for the proposed project under the management of the O&M Division mentioned above, including the O&M of pump stations and gates.

The details of main staffing and required activity is presented in Table 7.2-5. The staffing of the required assistant such as labourer, typist, driver, messenger, etc., will be decided at the stage of detail design of the proposed project.

7.2.8 Implementation Schedule and Construction Cost

The implementation schedule was prepared basically in accordance with that of the Master Plan; namely, the construction period of this priority project spans for four years. (Refer to Fig. 7.2-12.)

Construction cost consists of direct and indirect costs, the latter of which includes land acquisition, administration, engineering services, physical contingency and price contingency. Cost estimates are made at the price level of October 1988, divided into foreign and local currencies at the conversion rate of US$1.00 = ₱21.30 = ¥132. Physical contingency is estimated at 10% of the foreign and local currency costs, while price contingency is considered only for the local currency at the annual escalation rate of 6%.

The construction cost is estimated at 2,812 million pesos or 132.0 million U.S. dollars, consisting of 2,058 million pesos or

96.6 million U.S. dollars for the foreign currency portion and 754 million pesos or 35.4 million U.S. dollars for the local currency portion. Tables 7.2-6 and 7.2-7 show the breakdown of cost and the disbursement schedule.

7.2.9 Economic Evaluation

Inundation Water Level

To estimate the inundation damage reduction after completion of the proposed project, the inundation water levels in each of the subdrainage areas were estimated under the with- and the without-the-project situations as in the Master Plan. The estimation results are in Table 7.2-8.

Annual Average Benefit

The methodology and calculation conditions of the annual average benefit by the drainage improvement project in the East and West of Mangahan are, in principle, the same as those of the Master Plan as discussed in Subsection 6.4.6, except for the following.

For the calculation of the annual average benefit in the feasibility study, the present land use conditions (as of 1986) were employed as the basis for flood damage estimation under the with- and the without-the-project situations. In the Master Plan, however, the conditions at the year 2020 were employed, because this priority project is scheduled to be put into implementation within the coming decade.

Thus, the annual average benefit was calculated at 430 million pesos when drainage facilities are provided to cope with a flood of a 5-year return period (refer to Table 7.2-9).

Economic Viability and Project Justification

This priority 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 are based on the price level of October 1988, and the project life (for economic evaluation) is fixed until 2030 considering the durable life of the structure to be constructed for the project. The economic cost is estimated in the same concept as the Master Plan (see Subsection 6.4.7).

The calculation of IRR, B/C and NPV was based on the annual cash flow that was prepared from the economic cost and the annual average benefit in accordance with the implementation schedule or the annual disbursement schedule (refer to Table 7.2-10). A discount rate of 15% was applied for the calculation of B/C and NPV. The economic viability of the optimum plan was thus figured out as follows.

- IRR: 16.8%
- B/C: 1.11
- NPV: 194 million pesos

Sensitivity analysis has also been made in terms of IRR on the assumptions of increase of construction cost and decrease of annual benefit. The results are summarized below.

Construction cost + 5%:	16.0%
Construction cost + 10%:	15.2%
Annual benefit - 5%:	15.9%
Annual benefit - 10%:	14.9%

This priority project shows a high economic viability of 16.8% in IRR, and likewise, B/C and NPV also resulted in high values.

In the same concept as described in Sub-section 6.4.7 (Project Justification for the Master Plan), this project is also justified to be put into implementation in accordance to the proposed schedule.

7.2.10 Environmental and Socioeconomic Impacts

Environmental Impact

The major components of the proposed drainage improvement works are lakeshore dike and other works.Their environmental impacts are basically the same as described in the Master Plan.

Construction of the proposed lakeshore dike may decrease about 1.5% of the surface area of Laguna Lake. The water volume of this decreased area corresponds to only 0.8 cm up of the surface water level at EL 12.5 m. Thus, the effect of this impact is not considered significant. Moreover, the improvement of the Napindan River is planned to be implemented simultaneously, so rising of the lake water level could be reduced to a certain degree, though not calculated, earlier than the condition prior to the proposed project. Fish pens are seen in the lake, all of which are located below the elevation of 9.5 m. The lake dike to be constructed on the ground with an elevation of 11.5 m will give no adverse effects on them.

Socioeconomic Impact

In general, implementation of flood control and drainage projects could exert favorable influence not only on the project site but the whole nation as summarized below:

- Non-flooding situation and speedy/safe drainage of inundation water will surely improve the sanitary condition in the areas concerned with a result of less expenditure on medical care.
- Road network will be released from traffic interruption caused by floods. This will ensure the stabilization of people's economic activities and also circulation of commodities.
- A number of engineers, technicians, labor and so on will be required for the project implementation, so that employment opportunities may be increased at least during the construction period.

The north shore dike to be constructed in this project can be used as a maintenance road (10.7 km in length) connecting Bicutan and Taytay.

Besides the above-said favorable influence, it should be noted that this new road improves the transportation condition in Metro Manila and neighboring areas, not only for the project site. Also, the project can expect the augmentation of land value in a large area because of its location close to the center of Manila.

7.3 Drainage Improvement in Malabon-Navotas

7.3.1 Present Condition of Drainage Area

Topographical Features

As shown in Fig. 7.3-1, the objective subdrainage areas are divided by the Malabon-Tullahan River and several creeks. All of the subdrainage areas are located in the low-lying land with a slight variation in ground elevation. The lowest places of each subdrainage area range between EL 10.7 m and EL 11.0 m, which are lower than the mean spring high tide.

With regard to the road condition in the objective area, almost all of the roads have been constructed higher than the ground elevation of the surrounding area to ensure better transportation condition even in the flood season. Especially J. P. Rizal Road, a trunk road running from Caloocan to Obando, the elevation is so high that it serves as part of the ring dike.

River and Creek Utilization

The river and the creeks are utilized for the navigation of cargo boats, fishing boats, etc., and the volume of navigation is considerably brisk. Areas along the river and the creeks are utilized as harbors and shipyards, especially the area along the Navotas River.

Drainage Related Facilities

The existing drainage system is very poor in each subdrainage area, though some facilities such as ring dike, sluice gate, drainage channel, etc., were installed in some subdrainage areas (refer to Fig. 5.2-4).

A ring dike has been constructed on the river bank in almost all of the subdrainage areas with dimensions of approximately 12 m in height and 1.0 m in crest width. The existing height of the ring dike is not enough, considering the design high tide level and the freeboard.

The gate and sluice are located in the required place, but they have problems in watertightness. In order to use the existing gate and sluice, considerable improvement works are necessary to recover their required functions.

The drainage channel and lateral are under very poor conditions and there is no pumping station in the objective area.

7.3.2 Planning Conditions

Target Area

There are 14 subdrainage areas in Malabon-Navotas and the priority project is urgently required to be implemented for the mitigation of inundation damage (refer to Fig. 7.3-2). From the viewpoint of effective investment of limited funds up to the year 2000, the subdrainage areas which are now suffering from serious inundation damage should be selected as the priority project.

In this sense, the Dagat-Dagatan subdrainage area is excluded from this study because it has drainage facilities with the scale of a 5-year return period which is the same safety level as the proposed Master Plan. On the remaining 12 subdrainage areas, a study for selection of target area has been made considering the seriousness of the inundation damage in the subdrainage area. As the result, eight subdrainage areas, namely MA-1, MA-2, MA-3, MA-4, MA-5, MA-6, MA-9 and MA-11 were adopted as the target area for the feasibility study.

Watershed

Five of them are located at the north of Malabon, being divided by the Malabon-Tullahan River, and three are at the south of Malabon.

Improvement Scale

The consideration on improvement scale of the related facilities is the same as in Subsection 7.2.3.

Hydraulic Boundary

Tide levels in Manila Bay, according to past records, can be summarized as follows.

Tide Level	Elevation (m)
Design High Tide	11.8
Mean High Spring Tide	11.3
Mean Tide	10.5
Mean Low Spring Tide	10.0

Premise for Land Reclamation Height

According to the present land use conditions, there are some fishponds in the subdrainage areas located in the low-lying area and they are always inundated in the rainy season. However, these fishponds will be transformed to a residential area by 2020 under the existing land development plan. This process of urbanization will naturally involve reclamation to avoid flooding.

It is difficult to define the future land reclamation height at this moment. Since the topography of the subdrainage areas is strongly related to the cost estimate of the required facilities, the future reclamation height should be determined. On this sense, the height of the future raclaimed area has been assumed at EL 11.0 m, which is almost the lowest elevation of the existing urbanized area, under the consideration that the elevation of the newly reclaimed area will not be higher than that of the existing ones.

7.3.3 Study on Alternatives

Intergration of Subdrainage Area

The objective area is topographically divided into two areas, North of Malabon River and South of Malabon River, by the Malabon-Tullahan River.

To improve the drainage conditions, these are the following problems.

- Difficulty of Land Acquisition for Ring Dike; as a major facility of the drainage system, ring dike shall be constructed against seawater and/or river water. In consideration that the area along the river and creek is highly urbanized, it seems to be very difficult to acquire the right-of-way for the ring dike.
- Utilization of Creek as Drainage Channel; to drain stormwater, a main drainage channel has to be provided in each subdrainage area to convey stormwater to the gate and/or pumping station. For the construction of the main drainage channel, it is also very difficult to acquire the right-of-way for an open channel. In case of a closed drainage channel, construction work will be impractical considering the existing highly congested and populated area.

Therefore, in case that some of the subdrainage areas are integrated, the existing creek can be utilized as the main drainage channel. In this connection, adaptability of the integration of the subdrainage areas has been studied separately in the north and the south of the Malabon River.

(1) North of Malabon River

The North of Malabon River has five subdrainage areas divided by the river and/or creek.

Five (5) subdrainage areas are integrated into one whole drainage area by the ring dike as shown in Fig. 7.3-3 on the ground that (a) the construction cost is the lowest, (b) the existing river/creek closed by gate, and (c) the acquisition of right of way for the project works can be reduced, though it is anticipated to be inconvenient for navigation, at the time when the control gate is closed.

(2) South of Malabon River

The objective three subdrainage areas are located around the Dagat-Dagatan area.

Regarding the drainage system in Dagat-Dagatan, the drainage facilities are well equipped but the ring dike against the river water is deficient in height when the freeboard is considered, and it is not continuous. Therefore, the ring dike in the Dagat-Dagatan area has been included in this study.

Under such conditions, the study has been done and it has been justified that construction of ring dike for each of the subdrainage areas is recommendable as the optimum on the ground that it shows the lowest costs for construction and operation (refer to Table 7.3-1 for details). This optimum case is shown in Fig. 7.3-3.

Determination of Pump Capacity

Based on the optimum integration of subdrainage areas mentioned above, the pumping capacities at the years 2020 and 2000 were determined as follows.

Subdrainage Area	Pump Capacity Specific Discharge (m³/s/km²)	Total Discharge (m³/s)
<u>Land Use Conditions at 2020</u>		
North Bank of Malabon River:		
MA-1-A	2.7	3
MA-1-B, MA-2-A	2.4	4
MA-2-B, MA-3, MA-4, MA-5	3.6	22
South Bank of Malabon River:		
MA-6	4.5	6
MA-9	6.7	2
MA-11	6.8	4
<u>Land Use Conditions at 2000</u>		
North Bank of Malabon River:		
MA-1-A	1.8	2
MA-1-B, MA-2-A	1.8	3
MA-2-B, MA-3, MA-4, MA-5	3.3	20
South Bank of Malabon River:		
MA-6	3.0	4
MA-9	6.7	2
MA-11	5.8	4

As explained in the planning conditions for the East and West of Mangahan, the discharge at the year 2000 was used for the pumping equipment, while the discharge at the year 2020 was applied to the pumping station house.

7.3.4 Features of the Optimum Plan

The main components of the optimum plan are the construction of ring dike and drainage channels, improvement of existing drainage channels, and installation of pump stations and drainage gate. (Three pumping stations will be installed in the North of Malabon River, though all the subdrainage areas are integrated into one.) Their principal features are summarized as follows, and the locations of the structures are shown in Fig. 7.3-4.

Structure	Quantity	Dimension
(1) North of Malabon River		
Coastal Dike (with revetment)	5,700 m	EL 13.5 m, 2.5 m in height
River Dike (with revetment)	3,500 m	Raising of existing dike by 1 m in height
River Dike (without revetment)	6,700 m	-ditto-
Channel Improvement	600 m	10.0 m in width
Open Channel Construction	1,000 m	10.0 m in width
Pump Station	3 sites	25 cums in total*
Gate	7 sites	159 tons in total
Navigation Lock (Navotas River)	1 site	20 m in width, 180 m in length (see Fig. 7.3-9)
(2) South of Malabon River		
Coastal Dike (with revetment)	1,100 m	EL 13.5 m, 2.5 m in height
River Dike (with revetment)	3,600 m	Raising of existing dike by 1 m in height
Parapet Wall	8,500 m	Raising of existing wall by 1 m in height
Channel Improvement	700 m	20 m in width
Open Channel Construction	900 m	10 m in width
Closed Channel Construction	800 m	2.7 m in width x 3 units
Pump Station	3 sites	10 cums in total*
Gate	5 sites	55 tons in total

* Estimated under the land use condition of the year 2000.

7.3.5 Preliminary Design of Major Structures

Major structures in Malabon-Navotas were preliminarily designed on the basis of the least construction cost method.

Ring Dike

Ring dike in the north bank of the Malabon River consists of a coastal dike with a length of 5,700 m, Malabon River dike with a length of 3,600 m and a ring dike with a length of 6,700 m against high tide.

Coastal dike is provided along the seashore line of Navotas Island and its crest is set at EL 13.5 m, which is derived from hydraulic analysis and empirical DPWH standards. Malahon River dike is designed considering the Master Plan of the Malabon River and existing condition of river structures. Therefore, freeboard of Malabon River dike is determined by the design discharge of the river.

Coastal dike and Malabon River dike, providing their crest widths of 3 m, are made of borrowed earth material with a revetted slope of 1:2 at the waterside and a slope of 1:2 without revetment at the landside. As for the ring dike against high tide, which is drawn on the north drainage boundary, reinforcing work for existing tide dike is provided. The dike is designed to be earth dike with a slope of 1:2 at both sides and its crest with a 3.0 m wide is set at EL 12.5 m. (Refer to Fig. 7.3-5.)

In the south bank of the Malabon River, a river dike 3,600 m long along the Malabon River and a coastal dike 1,100 m long along the seashore line and the river course near estuary of the Malabon River are proposed, providing the same shapes as in the north bank of the Malabon River. Since there is inadequate open space for diking along the Navotas River and Estero de Marala, a parapet wall with 8,500 m of total length is provided at both sides of the water courses. Top elevation of the parapet wall is set at EL 13.5 m of the same level that the coastal dike is set. A shape of parapet wall is mostly the same as that of the landside backwater dike along the Napindan Channel. (Refer to Fig. 7.3-6.)

Drainage Channel

Design concept of drainage channel in Malabon-Navotas is basically the same as that in East and West of Mangahan. Principal features and design condition of proposed drainage channel are described in Table 7.3-2.

Pump Station

Most components of the pump station in malabon-Navotas are the same as in East and West of Mangahan. Submersible pumps are also applied. A general feature is illustrated in Fig. 7.3-7.

Sluice Gate

Proposed sluice gates in Malabon-Navotas are classified into four types as follows:

Type	Site
Open channel type/appurtenant to pump station	1
Box culvert type/appurtenant to pump station	4
Open channel type/independent	5
Box culvert type/independent	2

Basic design concept is the same in East and West of Mangahan. Main features and design condition are summarized in Table 7.3-3. Typical drawings are shown in Fig. 7.3-8.

Navotas Navigation Lock

A navigation lock is planned to be constructed at the estuary of the Navotas River near Tanza. This structure is designed assuming that one thousand dead weight ton class vessel can pass. Main features of the lock are as follows (refer to Fig. 7.3-9).

Lock chamber : 20 m wide and 120 m long

Gate chamber : 32 m wide and 30 m long (seaside)
32 m wide and 27 m long (river side)

Miter gate : 10.0 m (W) x 6.6 m (H) x 2 units (seaside)
10.0 m (W) x 6.0 m (H) x 2 units (river side)

Bascule bridge: 10.0 m (L) x 1.5 m (W) x 2 units

For the foundation works, reinforced concrete piles of 20 m long are provided to reach the stiff layer with adequate bearing capacity of N-value over 50, namely the Guadalupe Formation.

7.3.6 Proposed Organizational Setup

The DPWH-NCR or the PMO for Flood Control and Dredging Projects of DPWH may execute the supervision of the design and construction work. The DPWH-NCR will execute the O&M of the proposed project, excluding the one of the minor drainage laterals managed by local governments (refer to Fig. 6.4-8 and Subsection 7.2.7).

Design and Construction

The consulting engineers and a private company with high technical expertise will be contracted to execute the design and construction work, and the DPWH-NCR or the PMO mentioned above will execute the supervision of this work.

The main required staffing is the same as the one of the East and West Areas of Mangahan Floodway as shown in Section 7.2.7. The details of staffing and required acticity is explained in Table 7.2-4.

Operation and Maintenance (O&M)

The proposed O&M Division in the master plan will undertake the operation for the proposed projects, including the comprehensive management of related maintenance work, as explained in Section 7.2.7. The Engineering District Office of DPWH-NCR will undertake the practical and close maintenance activities for the proposed project, including the O&M of pump stations and flood gates, under the management of the O&M Division.

The details of main staffing and required activity is presented in Table 7.2-5 (refer to Section 7.2.7).

7.3.7 Implementation Schedule and Construction Cost

The implementation schedule was prepared basically in accordance with that of the Master Plan; namely, the construction period of this priority project spans for four years. (Refer to Fig. 7.3-10.)

On the same premises as presented in Subsection 7.2.8, the construction cost was estimated at 1,115 million pesos or 52.4 million U.S. dollars, consisting of 762 million pesos or 35.8 million U.S. dollars for the foreign currency portion and 353 million pesos or 16.6 million U.S. dollars for the local currency portion. Tables 7.3-4 and 7.3-5 show the breakdown of cost and the disbursement schedule.

7.3.8 Economic Evaluation

Inundation Water Level

To estimate the inundation damage reduction after completion of the proposed project, the inundation water levels in each of the subdrainage areas were estimated under the with- and the without-the-project situations as in the Master Plan. The estimation results are in Table 7.3-6.

Annual Average Benefit

The annual average benefit was calcaluted, in the same manner as discussed in Subsection 6.4.6, at 159 million pesos under the provision of drainage facilities designed to cope with flooding of a 5-year return period (refer to Table 7.3-7).

Economic Viability and Project Justification

This priority 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), in the same conditions as discussed in Subsection 7.2.9.

Based on the annual cash flow presented in Table 7.3-8, the economic viability was figured out as follows.

- IRR: 15.9%
- B/C: 1.05
- NPV: 38.9 million pesos

Sensitivity analysis has also been made in terms of IRR with the following results:

Construction cost + 5%:	15.1%
Construction cost + 10%:	14.4%
Annual benefit - 5%:	15.0%
Annual benefit - 10%:	14.2%

This project also shows a high viability of 15.9% in IRR. Likewise, B/C and NPV also resulted in high values. In the same concept as described in Sub-section 6.4.7 (Project Justification for the Master Plan), this project is also justified to be put into implementation in accordance to the proposed schedule.

7.3.9 Environment and Socioeconomic Impacts

Environmental Impact

The major environmental problems which may be caused by the proposed ring dike in Malabon-Navotas are impairment of navigation and water quality deterioration as discussed in the Master Plan. The gates to be constructed in the ring dike are usually open for navigation, and even during flooding times, the proposed locks will enable ships to navigate. The water quality would not be deteriorated due to the related works because the water flow will not be prevented by usually openning the gates.

Socioeconomic Impact

The Malabon Navotas area is partially utilized as fishponds; it might be more appropriate to say that other land use is difficult due to the low-lying land. The project, in this context, may create an opportunity for land use diversification or changing to other uses such as residential area and agricultural land by checking the tidal water and draining storm water. This favorable influence can be expected in addition to those generally expected as discussed in Subsection 7.2.10.

7.4 Pasig-Marikina River

7.4.1 Target Stretch

The Pasig-Marikina River including its tributary, the San Juan River, was selected in the Master Plan study as one of the highest priority projects. However, the target stretch for the feasibility study is herein limited to the most significant portion of the river, i.e., Pasig River from the river mouth to the Napindan Junction and Lower Marikina River from the Napindan Junction to the effluent point of Mangahan Floodway, considering the flood control effect and the social significance that the river is passing through the core of Metro Manila.

7.4.2 Planning Condition

Target Completion Year

The year 2000 is set as the target completion year by which the project formulated in the Feasibility Study should be completed.

Runoff Discharge

The design discharge for the Feasibility Study was set on the basis of the runoff calculation results of the Master Plan study of which the discharge was obtained including Marikina Dam and Marikina Control Gate Structure (MCGS), setting the land use conditions at the year 2020.

Design Scale

The design scale is 30-year return period, since the Marikina Dam is not included in the feasibility study.

Diversion Discharge through Mangahan Floodway

The maximum diversion discharge through Mangahan Floodway is at 2,400 m^3/s, which has already been accepted.

Hydraulic Boundary Condition

To calculate the water stage of the river by non-uniform calculation, the Manila Bay tide level was set at the mean spring high tide of EL 11.30 m and the Laguna Lake stage at EL 12.50 m, with the Manning's roughness coefficient at 0.030 for the whole stretch of the river.

Criteria for River Improvement

- The alignment of the channel is planned in such a way that it will not exceed the existing alignment and follow it as much as possible.

- The design riverbed gradient is set not to change so steeply (variation of the bed gradient is to be within approximately 50 percent at the variation point), considering the existing profile.

- Single trapezoidal cross-section with a side slope of 1:1 is fundamentally applied, following the existing feature as much as possible.

- At the river mouth, the bed elevation is set to be connected to the seabed, which was obtained from the 1:10,000 topographic map.

7.4.3 Establishment of High Water Level

To confine the design discharge in the existing river channel, the water stage is generally obliged to be higher than the ground level due to the poor flow capacity of the channel. Once the design high water level is set higher than the ground level, a high levee will be required on both banks along the river course. This will present several inconveniences and it increases the damage potential. The most recommendable improvement is to confine the design discharge in the river channel with a water stage lower than the present ground level.

Since the target stretch is highly developed and densely populated, it is impractical to widen the river channel to confine the design discharge. Therefore, dredging of the bed is the only method to increase the flow capacity. However, this generally requires a huge amount of excavation volume and as a result, a big amount of construction cost.

Considering the above aspects, the adequacy of the design high water level was clarified as follows, setting the design high water level in almost equal elevation as the existing ground level. (Refer to Fig. 7.4-1.)

(a) Justification from River Utilization

There exist many factories on both banks of the Pasig River (refer to Fig. 7.4-2), and the banks are utilized as quay or wharf for the transportation of industrial materials and products. Thus, high dike construction with a higher design high water level on both banks will bring several problems and difficulties for the utilization of reparian facilities and could not be recommended from practical viewpoints.

(b) Justification from Riparian Structures

There exist many riparian structures such as bridges crossing the river, revetment and drainage facilities, i.e., pumping stations, flood gate and other small drainage sluices.

As for the bridges, only one bridge, the Pandacan Bridge, has no appropriate clearance for the design high water level and needs reconstruction (refer to Fig. 7.4-3). To avoid reconstruction of this bridge, the design high water level should be considerably lowered in height from the proposed one. This could not be recommended not only from the economical viewpoint due to the higher construction cost by excavation but also from the technical viewpoint because the stability of the river channel is difficult to maintain due to the lower bed height in the river mouth.

Concrete revetment is provided in almost all stretches of the Pasig River and Lower Marikina River. About 20% of the stretches are either destroyed or superanuated but others are still functional, though it is necessary to reconstruct them in the future. From this, making the design high water stage much lower than the existing ground level will result in higher construction cost because of the big volume of excavation.

The invert elevations of the drainage facilities such as pumping stations, flood gates and drainage channels are appropriately higher than the existing riverbed as shown in Fig. 7.4-3. All of the facilities are not affected by the design high water level.

From the above justifications, the design high water level has been determined as indicated in Fig. 7.4-1. By the adoption of this high water level, a river wall with an approximate height of 0.5 m to 1.0 m will be provided as a freeboard for almost all stretches, and this will not cause serious problems since a river wall exists already in the present condition.

In the lower reach, both banks are utilized as quays or wharves in many places, but the construction of wall with a lower height will not bring new social problems so seriously since a low wall already exists at present.

In the upper reaches, some portions require the construction of a river wall with a height of more than 1.0 m, but this will not present any problem since the river utilization facilities are not so densely distributed as in the lower reaches and hilly land is close to the riverbank. (Refer to Fig. 7.4-2 and Table 7.4-1.)

7.4.4 Confirmation of Necessity for MCGS

In the study for the Master Plan, the flood control plan was formulated by the combination of the channel improvement and the construction of the Marikina Control Gate Structure (MCGS). To clarify the necessity of the MCGS, more detailed study was conducted as below.

Study Case

The following three alternative cases were prepared for the comparative study, considering the existing condition of the river channel and riparian structures such as the Mangahan Floodway and the Napindan Hydraulic Control Structure (NHCS).

Alternative Case 1:	Natural Diversion through Mangahan Floodway (Without construction of MCGS and without allowing the flood diversion into the Napindan River)
Alternative Case 2:	Natural Diversion through Mangahan Floodway and Napindan River (Without construction of MCGS and with flood diversion into the Napindan River)
Alternative Case 3:	Diversion through Mangahan Floodway (With construction of MCGS and without diversion into the Napindan River)

Advantage of MCGS

The design discharge distribution for the above cases is indicated in Fig. 7.4-4.

The advantage of above plans could be judged by the least construction cost, since all of these plans were prepared under the same benefit.

According to the construction cost estimation results, the cost of Case 3 is far lower than the other cases. as shown in Table 7.4-2. Aside from the construction cost, Case 1 and Case 2 are deemed to be difficult to ensure the successful diversion without the control gate. Also, since the design discharge in the lower reach from San Juan confluence is bigger than the upper reach because of the runoff discharge from the San Juan River, the design bed was set at a low elevation, especially Case 1, and the maintenance of the riverbed is deemed difficult after completion.

From the above consideration, Case 3 was selected as the most viable improvement plan.

7.4.5 Proposed River Improvement Work

The most viable plan consists of the river channel improvement together with the construction of MCGS. The features of the plan are summarized as follows.

Design Discharge

The design discharge distributions with a 100-year return period are as follows. (Refer to Fig. 7.4-5.)

Stretch	Discharge
River Mouth to San Juan (No. 0+000 to No. 8+735)	1,150 m^3/s
San Juan to Napindan (No. 8+735 to No. 18+495)	500 m^3/s
Napindan to MCGS (No. 18+495 to No. 5+415)	500 m^3/s

Alignment

The alignment was set as shown in Fig. 7.4-6 by following the existing one without expanding the existing channel width. In the meandering portion in the upper reach of the San Juan River confluent, a short-cut plan was deleted based on the study results of the Framework Plan that the short-cut plan is not effective in the backwater reach for lowering the water stage of the river.

River embankment is to be provided for about 2 km in the upper stretches where the backwater by the MCGS is affected. Also, since the river mouth of the San Juan River is affected by the backwater of the Pasig River, about 3 km stretch will be improved.

Longitudinal Profile

The longitudinal profile was determined as follows in accordance with the planning conditions discussed in Subsection 7.4.2, as presented in Fig. 7.4-7.

Design Bed Gradient

Stretch	Existing Channel	Designed Channel
River Mouth to San Juan (No. 0+000 to No. 8+735)	1/33,000	1/29,000
San Juan to Napindan Junction (No. 8+735 to No. 18+495)	1/16,000	1/15,500
Napindan to MCGS (No. 18+425 to No. 5+425)	1/13,000	1/10,000

As for the channel bed stability of the above, it is very difficult to predict it since a large quantity of the Marikina floodwater is controlled by the Marikina Control Gate Structure and a big amount of discharge from the San Juan River will join the Pasig River. Therefore, the dynamic equilibrium of the bed is difficult to discuss. As a result, periodical maintenance work is, from the practical viewpoint, needed to be ensured after completion, though the designed bed is set at 5.00 m in the river mouth considering the smooth connection to the seas without changing much the existing profile.

Cross-Section

The cross-sectional feature was set with a trapezoidal type section with 1:1 side slope for all stretches, providing a concrete revetment and the river wall. At the river mouth, about 1.9 km stretch from No. 0+000 to No. 1+900 in which the revetment is not provided, trapesoidal section with 1:2 side slope was adopted.

Structural Features

The main work items and structural features of the proposed river improvement works are summarized as follows:

Work Item/Structure	Quantity	Description
Excavation (dredging)	2,884,000 m^3	Mainly in the lower stretch of the river
Revetment (concrete block)	114,000 m^2	5,000 m in total length
Parapet Wall (river wall)	17,000 m^3	Heightening of existing wall by 1.0 m
Bridge Reconstruction Pandacan Bridge	137.6 m in span length	PNR Truss Bridge
Marikina Control Gate Structure (MCGS)	Roller Gate 2 units x 17.5 m wide x 10.1 m high	Fixed & Movable Combined Type Weir

7.4.6 Preliminary Design of Major Structures

River improvement works of the Pasig-Marikina River comprises dredging, rehabilitation work for existing river wall, construction of Marikina Control Gate Structure (MCGS) and reconstruction of Pandacan Bridge (PNR).

Improved River Cross Section

Design cross section is set as a trapezoidal type with 1:1 side slope concrete revetment, parapet wall or river wall for all stretches in principle. As a result, the improvement pattern of each river stretch becomes as follows (refer to Fig. 7.4-8).

Stretch	Improvement Pattern
River mouth to San Juan (Sta. 0+000 to Sta. 8+735)	Dredging, raising of existing river wall or parapet wall and rehabilitation of bank protection. Design bed width 450 m - 75 m, trapezoidal section with 1:1 side slope.
San Juan to Napindan (Sta. 8+735 to Sta. 18+495)	Raising of existing river wall or parapet wall and rehabilitation of bank protection.
Napindan to MCGS (Sta. 18+495 to Sta. 5+425)	Principally no improvement and river wall or parapet wall for low elevation only.
MCGS to Mangahan Floodway (Sta. 5+425 to Sta. 6+375)	Dredging, providing new parapet wall or river wall and new bank protection. Design bed width 75 m, Trapezoidal section with 1:1 side slope.
Upstream of Mangahan Floodway (Sta. 6+375 to Sta. 7+425)	Dredging, providing new parapet wall or river wall and new bank protection. Design bed width 114 m, Trapezoidal section with 1:1 side slope.

Marikina Control Gate Structure

(1) Design Condition

Design discharge : 500 m^3/s (same as design discharge of the Lower Marikina River)

Design water level : EL 16.50 m (upstream side)
EL 14.20 m (downstream side)

Design river section:	Bed width	75.00 m
	Bank slope	1:1
	Bed elevation	EL 6.50 m

(2) Design of Gate

Japanese standard is applied in designing MCGS. The concept of the least construction cost is also applied. Design feature of MCGS is set as follows (refer to Fig. 5.2-2).

Gate span	:	2 nos. and 20.00 m each width including piers
Gate height	:	10.10 m
Gate type	:	Roller gate

Gate span of 20.00 m is the required minimum width of gate in Japanese standards. Two gates are required to make the safe operation of MCGS in case one gate becomes inoperable during flood flow of the Marikina River. Roller gate is commonly used in other weirs such as Napindan HCGS and Rosario weir. As for the foundation, direct foundation is adopted as the design river bed is composed of lapillic tuff which has adequate bearing capacity for gate structure.

In order to pass 500 m^3/s through MCGS, it is necessary to open the two gates of MCGS partially (3.0 m). If the two gates are fully opened and upstream and downstream water level of MCGS are fixed at the design water level, capacity of MCGS becomes about 1,550 m^3/s.

Reconstruction of Bridge

Design feature of the new Pandacan Bridge is as follows (refer to Fig. 7.4-9).

Length	:	137.60 m
Width of railway	:	5.40 m
Type	:	Steel plate girder

No. of spans : 3 spans (45.20 m each)

In the Philippine standard, type of superstructure of railway bridge must be steel bridge and its span must be 9.00 m - 30.00 m. But to make the obstruction rate by the piers of the flow area to be less than 4.0%, it is necessary to make the span length to be more than 45.20 m. So, this span length is adopted. From the economical comparison study, steel plate girder bridge is considered as suitable type for the superstructure.

7.4.7 Proposed Organizational Setup

The DPWH-NCR or the PMO for Flood Control and Dredging Projects of DPWH may undertake the supervision of the design and construction work. The DPWH-NCR will undertake the O&M of the proposed project, excluding the one of the minor drainage laterals managed by local governments (refer to Fig. 6.4-8 and Section 7.2.7).

Design and Construction

The consulting engineers and a private company with high technical expertise will be contracted to execute the design and construction work, and the DPWH-NCR or the PMO abovementioned will execute the supervision of this work.

The main required staffing is the same as the one of the East and West Areas of Mangahan Floodway as shown in Section 7.2.7. The details of staffing and required acticity is presented in Table 7.2-4.

Operation and Maintenance (O&M)

The proposed O&M Division in the master plan will undertake the operation of related facilities for the proposed projects, including the comprehensive management of related maintenance work, as shown in Section 7.2.7. The Engineering District Office of DPWH-NCR will undertake the practical and close maintenance activities for the proposed project, including the O&M of pump stations and flood gates, under the management of the O&M Division.

The details of main staffing and required activity is presented in Table 7.2-5 (refer to Section 7.2.7).

7.4.8 Implementation Schedule and Project Cost

The implementation schedule was prepared basically in accordance with that of the Master Plan; namely, the construction period of this priority project spans for five years. (Refer to Fig. 7.4-10.)

On the same premises as presented in Subsection 7.2.8, the construction cost was estimated at 1,401 million pesos or 65.8 million U.S. dollars, consisting of 927 million pesos or 43.5 million U.S. dollars for the foreign currency portion and 474 million pesos or 22.3 million U.S. dollars for the local currency portion (refer to Table 7.4-2). Table 7.4-3 shows the disbursement schedule.

7.4.9 Economic Evaluation

Annual Average Benefit

The annual average benefit was calculated, in the same manner as discussed in Subsection 6.4.7, at 198 million pesos under the provision of river improvement works designed to cope with floods of a 100-year return period (refer to Table 7.4-4).

Economic Viability and Project Justification

This priority 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), under the same conditions as discussed in Subsection 7.2.9. Based on the annual cash flow presented in Table 7.4-5, the economic viability was figured out as follows.

- IRR: 16.1%
- B/C: 1.07
- NPV: 56.5 million pesos

Sensitivity analysis has also been made in terms of IRR with the following results:

Construction cost + 5%:	15.3%
Construction cost + 10%:	14.6%
Annual benefit - 5%:	15.2%
Annual benefit - 10%:	14.4%

This project also shows a high viability of 16.1% in IRR. The social impacts expected by this project are so influencial to the whole nation as discussed in the following sub-section, that it is of great importance to forward its implementation from not only economic aspect but social viewpoint.

7.4.10 Environment and Socioeconomic Impacts

Environmental Impact

The major components of the proposed flood control works in the Pasig-Marikina River are the river improvement works such as excavation, revetment and parapet wall, and the Marikina Control Gate Structure (MCGS).

As already discussed in Subsection 6.4.7, no significant effects would be caused by the proposed works both in the river improvement and MCGS. Therefore, it is considered that the proposed schemes would be acceptable through the viewpoint of the environment.

Socioeconomic Impact

The lower reaches of the Pasig River is the very core of the nation as well as Metro Manila, and crucial offices/facilities which are influencial politically and economically to the whole nation are concentrated along its lower stream. In this situation, flood control and drainage in this area may give invaluable favorable impacts to the nationwide economic activities and people's living. Other favorable influence can also be expected as discussed in Sub-section 7.2.10.

CHAPTER 8. CONCLUSION AND RECOMMENDATIONS

1. The Framework Plan for the proposed Flood Control and Drainage Project in Metro Manila which consists of construction of the Parañaque Spillway with lake dike for the east and west areas of Mangahan Floodway, Marikina flood control dam and Marikina control gate structure, the improved works of river channel and installation of drainage facilities is formulated on the following project scale basis from the long term point of view.

(a) River improvement	:	100-year return period
(b) Drainage improvement	:	10-year return period

The Master Plan has been formulated within the frame of the Framework Plan, including all the above-said works except for the Parañaque Spillway. This plan is scheduled to be completed by the year 2020, and the project scales applied for the Master Plan are as follows:

(a) Flood control works	:	100-year return period for Pasig-Marikina
	:	30-year return period for the other rivers
(b) Drainage improvement works	:	5-year return period for the east and west areas of Mangahan and Malabon-Navotas
	:	3-year return period for the other areas
(c) Lake dike for east and west of Mangahan Floodway	:	40-year return period

It has been confirmed that the Master Plan is technically feasible, finanically affordable and economically viable.

2. Within the framework of the Master Plan, the Priority Project which narrows down the target areas/project to the east and west area of Mangahan Floodway, Malabon-Navotas area and Pasig River improvement works, is also formulated on the same project scale as that of the Master Plan, aiming at the early realization of the flood control and drainage for the most serious flood damaged areas. Studies so far made have shown that the Priority Project is technically feasible and economically viable. Through the realization of the project, enhancement of social welfare and stabilization of economic activities not only in the planning area but in the whole of the Philippines, together with the development of the Metro Manila area, is highly expected. Serious unfavorable effects on the environment is not expected by the project implementation.

   Therefore, it is strongly recommended that the project be forwarded to the next stage at the earliest possible opportunity.

3. Drainage improvement works in North and South Manila are not proposed in this study, though it is one of the most important areas. This is because drainage facilities are already provided with a certain degree of safety (against about a 5-year return period storm), and will be improved with foreign loan assistance. Moreover, dredging and declogging works in drainage channels will soon be put into implementation. After completion of these works, the drainage capacity in this area would be hightened to a satisfactory degree.

   In other words, however, there are so much needs for drainage improvement that it is essential to forward these works without losing any time.

4. There are a number of houses required to be evacuated or moved for the implementation of the proposed river and drainage improvement, and it is likely to become a cause of social problem. The house evacuation should be carried out with utmost care to comply with the applicable laws and regulations.

5. Large scale projects such as land development, building construction and highway construction will certainly increase runoff discharge in the areas concerned. It is one of the recommendable ideas to make it obligatory that flood and drainage control facilities be provided by the contractors or developers when such projects are put into implementation.

6. The flood control and drainage facilities should be maintained to assure their functions through daily maintenance works. Illegal actions such as dumping of garbage on river and drainage channels and construction of facilities in the riparian area resulting in the deterioration of flow capacity of the river and drainage channel should be discouraged through daily inspections.

7. The shore areas of the Laguna Lake suffered from considerable flood damage due to rising of the water level. (It reached EL 14.03 m in 1972 and EL 13.60 m in 1988.) In this study, countermeasures have been designed for only the north portion (east and west areas of Mangahan Floodway), so a further study is urgently required on flood control plans to lower the lake water level, including a detailed study on the Parañaque Spillway.

8. A ring dike is propoed for the Malobaon-Navotas Area to integrate the sub-drainage areas mainly judging from the economic aspects, but this study is based on the topographic maps with a scale of 1:10,000, which are not satisfactorily precise for this kind of study. When implementing the project, difficulties are also involved in acquiring land in this congested area, but the detailed research has not been done in this study. In this connection, it is recommended to collect more detailed information and to reexamine the plan prior to project implementation.

9. One of the most practical prestructural measures against floods is the publication of flood risk maps, which enable the residents to take some preparatory action such as land raising and construction of houses on stilts.

Detailed topographic maps and riparian surveying give fundamental information to prepare flood risk maps, but these are not yet well collected in the river basins of Malabon-Tullahan, Baho-Buli-Mahaba and Parañaque.

Though a flood risk map along the Pasig-Marikina River has been prepared in this study, it is required to collect such information and to publish flood risk maps for other rivers.

10. Basic data and information such as rainfall records, topographic maps and geological survey results on river channels and drainage areas which are required for analysis and studies are at present very limited in quantity and poor in quality. It is, therefore, necessary that such basic data be collected for use in further analysis and design works in the next stage.

TABLES

Table 1.1-1 MEMBERS OF THE ADVISORY COMMITTEE AND STUDY TEAM

Name and Position	Designation/Assignment
ADVISORY COMMITTEE	
Hidehiro Sadakane, MOC	Chairman
Yoichi Takeuchi, MOC	(Chairman until Dec. 1989)
Izumi Furukawa, MOC	Member
Katsuhide Yoshikawa, MOC	Member
Naoya Matsumoto, MOC	Member
Akira Mizobuchi, JICA	Coordinator
Tomiaki Ito, JICA	Coordinator
STUDY TEAM	
Katsuhisa Abe	Team Leader
Makoto Migita	Assistant Team Leader (Flood Control and Drainage Planner)
Susumu Heishi	Non-structural Measures Planner
Yuji Morioka	Urban Planner
Masahiro Asada	Hydrologist/Hydraulics and Water Quality Analyst
Kimihiko Kotoo	Geologist/Soil Mechanics Engineer
Katsuhiro Ikari	River Structures Planner
Takashi Furukawa	Structural Design Engineer
Atsuya Saisho	Construction Planner/Cost Estimator
Yuzuo Mizota	Operation and Maintenance Planner
Kimio Shimomura	Project Economist
Munemori Tada	Financial Expert
Youichi Iwai	Social and Environmental Impact Analyst
Toshiki Kuroiwa	Survey Expert

NOTE MOC : Ministry of Construction, Japan
JICA: Japan International Cooperation Agency

Table 2.1-1 TARGET OF GROSS NATIONAL PRODUCT AND PER CAPITA GNP

Item	Estimate 1986	Targets 1987	1988	1989	1990	1991	1992	Annual Average 1987-92
1. Gross National Product								
At constant 1972 prices (billion pesos)	89.4	95.3	101.9	108.6	116.2	124.3	132.7	113.2
Growth rate (%)	1.1	6.5	6.9	6.7	7.0	6.9	6.7	6.8
At current prices (billion pesos)	619.6	697.3	811.8	927.3	1,075.7	1,253.2	1,438.0	1,033.9
2. Inflation Rate (%)	2.0	5.2	8.7	7.0	8.3	8.9	7.4	7.6
3. Per Capita GNP								
At constant 1972 prices	1,597	1,661	1,734	1,808	1,891	1,977	2,064	1,856
Growth rate (%)	-1.3	4.0	4.4	4.3	4.6	4.5	4.4	4.4
At current prices	11,063	12,157	13,825	15,430	17,497	19,934	22,378	16,870

NOTE : Estimates and targets as of 5 November, 1986

SOURCE: NEDA and NCSO

Table 2.3-1 POPULATION IN THE NCR (1948-1980)

City/ Municipality	1948	1969	1970	1975	1980
NCR	1,569,128(100.0)	2,462,488(100.0)	3,966,695(100.0)	4,970,006(100.0)	5,925,884(100.0)
Manila City	983,906(62.7)	1,138,611(46.2)	1,330,778(33.5)	1,479,116(29.8)	1,630,485(27.5)
Caloocan City	58,208(3.7)	145,523(5.9)	274,453(6.9)	397,201(8.0)	467,816(7.9)
Pasay City	88,728(5.7)	132,673(5.4)	206,283(5.2)	254,999(5.1)	287,770(4.9)
Quezon City	107,977(6.9)	397,990(16.2)	754,452(19.0)	956,864(19.2)	1,165,865(19.7)
Pasig	35,407(2.3)	62,130(2.5)	156,492(3.9)	209,915(4.2)	268,570(4.5)
Las Pinas	9,280(0.6)	16,093(0.7)	45,732(1.2)	81,610(1.6)	135,514(2.3)
Makati	41,335(2.6)	114,540(4.7)	264,918(6.7)	334,448(6.7)	372,631(6.3)
Malabon	46,455(3.0)	76,438(3.1)	141,514(3.6)	174,878(3.5)	191,001(3.2)
Mandaluyong	26,309(1.7)	71,619(2.9)	149,407(3.8)	182,267(3.7)	205,366(3.5)
Marikina	23,353(1.5)	40,455(1.6)	113,400(2.9)	168,453(3.4)	211,613(3.6)
Muntinlupa	18,444(1.2)	21,893(0.9)	65,057(1.6)	94,563(1.9)	136,679(2.3)
Navotas	28,889(1.8)	49,262(2.0)	83,245(2.1)	97,098(2.0)	126,146(2.1)
Paranaque	28,884(1.8)	61,898(2.5)	97,214(2.5)	158,974(3.2)	208,552(3.5)
Pateros	8,380(0.5)	13,173(0.5)	25,468(0.6)	32,821(0.7)	40,288(0.7)
San Juan	31,493(2.0)	56,861(2.3)	104,559(2.6)	122,492(2.5)	130,088(2.2)
Taguig	15,340(1.0)	21,856(0.9)	55,257(1.4)	73,702(1.5)	134,137(2.3)
Valenzuela	16,740(1.1)	41,473(1.7)	98,456(2.5)	150,605(3.0)	212,363(3.6)

NOTE : Figures in parenthesis are percentage composition to the NCR total

SOURCE: NSO (1980 Census)

Table 2.3-2 LABOR FORCE PARTICIPATION RATE AND EMPLOYMENT STATUS IN THE PHILIPPINES AND NCR

Unit: Thousand in the number of persons

Year/Area	Labor Force Participation Rate (%)	Total Labor Force	Labor Force by Employment Status			
			Employed		Unemployed	
			Number	Percent	Number	Percent
Philippines						
1980	59.8	17,308	16,434	95.0	874	5.0
1981	61.7	18,423	17,452	94.7	970	5.3
1982	60.1	18,474	17,371	94.0	1,102	6.0
1983	64.1	20,310	19,212	94.6	1,099	5.4
1984	64.2	20,969	19,673	93.8	1,296	6.2
1985	63.4	21,318	19,801	92.9	1,517	7.1
1986	63.8	22,067	20,595	93.3	1,472	6.7
Average	62.4	19,838	18,648	94.0	1,190	6.0
NCR						
1980	53.3	2,058	1,843	89.6	215	10.4
1981	54.6	2,170	1,918	88.4	252	11.6
1982	55.7	2,280	1,980	86.8	300	13.2
1983	55.0	2,320	2,038	87.8	282	12.2
1984	60.0	2,647	2,172	82.0	475	18.0
1985	59.5	2,723	2,121	77.9	602	22.1
1986	53.6	2,539	2,049	80.7	490	19.3
Average	56.0	2,391	2,017	84.7	374	15.3

SOURCE: NCSO

Table 2.5-1 CLASSIFICATION OF TROPICAL DEPRESSIONS BY PAGASA

Classification	Wind Velocity
Tropical Depression	below 16.9 m/s
Tropical Storm	17.5 to 24.2 m/s
Severe Tropical Storm	24.4 to 32.5 m/s
Typhoon	more than 32.5 m/s

Table 2-4 GROSS NATIONAL AND REGIONAL DOMESTIC PRODUCTS (at constant 1972 prices)

Year	GDP Amount (mil. P)	GDP Growth (%)	GRDP (NCR) Amount (mil. P)	GRDP (NCR) Growth (%)	Contribution of NCR to GDP (%)
1980	92,706		29,294		31.6
		3.78		4.19	
1981	96,207		30,521		31.7
		2.90		3.24	
1982	98,999		31,511		31.8
		0.93		2.28	
1983	99,920		32,231		32.3
		-6.00		-9.23	
1984	93,927		29,256		31.2
		-4.39		-9.02	
1985	89,803		26,618		29.6
		1.08		0.05	
1986	90,770		26,631		29.3
Average	94,618	-0.28	29,437	-1.42	31.07

SOURCE: National Accounts Staff, NEDA

Table 2.7-2 NCR GROSS REGIONAL DOMESTIC PRODUCT BY SECTOR
(at constant 1972 prices)

Sector/ Subsector	1980		1986		Average, 1980-86		
	Amount (mil. P)	Growth (%)	Amount (mil. P)	Growth (%)	GRDP (mil. P)	Percent (%)	Growth Rate (%)
INDUSTRY	15.25	52.0	13.37	50.2	15.2	51.7	-2.0
Mining	-	-	-	-	-	-	-
Manufacturing	12.26	41.8	11.60	43.6	12.4	42.0	-0.8
Constructions	2.44	8.3	0.90	3.4	2.2	7.4	-12.8
Electricity, Gas and Water	0.55	1.9	0.87	3.3	0.7	2.4	7.9
SERVICES	14.04	48.0	13.26	49.8	14.2	48.3	-0.8
Transport, Communication and Storage	2.04	7.0	2.2	8.3	2.2	7.4	1.3
Trade	2.91	9.9	3.77	14.2	3.4	11.5	4.5
Finance and Housing	3.31	11.3	1.12	4.2	2.5	8.5	12.4
Other Services	5.79	19.8	6.17	23.2	6.2	20.9	1.2
TOTAL	29.29	100.0	26.63	100.0	29.4	100.0	-1.4

NOTE : Figures may not add up to totals due to rounding

SOURCE: National Account Staff, NEDA

Table 3.1-1(1/2) LAND USE CONDITION IN 1986

UNIT : km2

SUB-BASIN	TOTAL AREA	RESIDENTIAL/COMMERCIAL LOW D.	MID. D.	HIGH D.	INDUST-RIAL	FISH POND	FOREST	OPEN SPACE	AGRICUL-TURE
(MEYCAUAYAN)									
ME- 1	23.67	1.64	0.00	0.00	0.00	0.24	21.57	0.09	0.13
ME- 2	15.06	2.12	0.08	0.00	0.06	3.27	6.13	3.24	0.16
ME- 3	21.81	8.60	0.06	0.00	0.37	0.41	9.46	2.83	0.08
ME- 4	29.23	3.24	0.00	0.00	1.02	16.32	6.69	1.65	0.31
ME- 5	9.32	1.63	1.15	0.00	1.79	3.75	0.73	0.19	0.08
ME- 6	24.52	4.74	0.07	0.00	0.32	12.06	4.31	2.46	0.56
ME- 7	8.82	0.85	0.00	0.00	2.04	3.15	0.37	1.94	0.47
ME- 8	17.81	3.23	1.23	0.00	3.75	6.87	0.00	2.47	0.26
ME- 9	18.42	5.42	0.23	0.89	0.74	10.31	0.00	0.83	0.00
SUB-TOTAL	168.66	31.47	2.82	0.89	10.09	56.38	49.26	15.70	2.05
(MALABON-TULLAHAN)									
MT- 1	25.82	0.06	0.00	0.00	0.00	0.00	25.76	0.00	0.00
MT- 2	13.38	5.78	1.18	0.00	0.00	0.39	2.35	3.64	0.04
MT- 3	20.08	7.04	0.14	0.07	2.98	4.48	1.14	4.12	0.11
MT- 4	9.97	0.00	3.42	1.58	2.03	1.63	0.00	1.31	0.00
SUB-TOTAL	69.25	12.88	4.74	1.65	5.01	6.50	29.25	9.07	0.15
(PASIG/MARIKINA)									
PM- 1	277.66	0.00	0.00	0.00	0.00	0.00	277.66	0.00	0.00
PM- 2	97.53	1.24	0.00	0.00	0.00	7.12	86.11	2.31	0.75
PM- 3	137.01	6.26	1.12	0.31	0.96	9.32	99.64	12.49	6.91
PM- 4	6.18	2.86	0.27	0.26	1.28	0.31	0.00	0.57	0.63
PM- 5	11.33	6.35	0.53	0.00	2.27	0.00	0.00	2.18	0.00
PM- 6	8.74	1.52	1.49	0.82	1.34	0.00	0.00	3.57	0.00
PM- 7	4.58	0.00	1.41	0.81	0.87	0.07	0.00	1.42	0.00
SUB-TOTAL	543.03	18.23	4.82	2.20	6.72	16.82	463.41	22.54	8.29
(SAN JUAN)									
SJ- 1	23.27	12.27	0.11	0.83	0.00	1.36	1.43	7.03	0.24
SJ- 2	10.53	5.71	0.00	0.03	1.42	1.38	0.00	1.78	0.21
SJ- 3	2.18	0.79	0.61	0.38	0.28	0.00	0.00	0.12	0.00
SJ- 4	9.96	1.37	4.60	0.29	0.28	0.06	0.00	3.18	0.18
SJ- 5	8.24	0.06	2.35	1.87	2.82	0.00	0.00	1.14	0.00
SJ- 6	14.02	0.49	5.68	3.38	0.26	0.26	0.00	3.95	0.00
SJ- 7	3.55	0.00	2.72	0.06	0.14	0.00	0.00	0.63	0.00
SJ- 8	12.07	1.85	5.26	1.05	0.00	0.00	0.00	3.91	0.00
SJ- 9	6.53	0.34	1.75	2.44	0.37	0.06	0.00	1.57	0.00
SJ- 10	1.09	0.00	0.33	0.34	0.20	0.00	0.00	0.22	0.00
SUB-TOTAL	91.44	22.88	23.41	10.67	5.77	3.12	1.43	23.53	0.63
(BAHO/BULI)									
BB- 1	16.55	7.63	2.68	0.63	0.26	1.45	2.21	1.48	0.21
BB- 2	6.63	0.42	0.02	0.00	0.26	1.42	2.19	2.05	0.27
BB- 3	5.55	0.41	0.17	0.18	0.97	1.29	0.00	2.53	0.00
BB- 4	26.52	3.31	0.34	0.00	0.24	1.21	5.68	15.51	0.23
BB- 5	4.21	1.23	0.00	0.19	1.14	0.15	0.69	0.81	0.00
BB- 6	4.46	1.33	0.00	0.00	0.72	1.12	0.00	1.29	0.00
BB- 7	10.49	1.75	0.00	0.17	0.58	0.61	1.62	5.76	0.00
SUB-TOTAL	74.41	16.08	3.21	1.17	4.17	7.25	12.39	29.43	0.71
(SOUTH PARANAQUE/LAS PINAS)									
PL- 1	11.49	6.96	0.15	0.00	1.71	1.45	0.00	1.07	0.15
PL- 2	3.44	1.22	0.00	0.00	0.00	1.24	0.00	0.98	0.00
PL- 3	19.25	11.42	0.11	0.00	1.35	1.23	1.16	3.98	0.00
PL- 4	6.27	4.41	0.00	0.00	0.32	0.21	0.57	0.63	0.13
PL- 5	9.72	5.35	0.14	0.00	0.64	2.24	0.25	0.53	0.57
ZP- 1	36.79	1.56	0.00	0.00	0.00	3.21	30.72	1.16	0.14
ZP- 2	3.67	3.44	0.00	0.00	0.00	0.23	0.00	0.00	0.00
ZP- 3	4.76	0.98	0.00	0.00	0.00	3.78	0.00	0.00	0.00
SUB-TOTAL	95.39	35.34	0.40	0.00	4.02	13.59	32.70	8.35	0.99

NOTE : The location of subbasins is presented in Fig. 3.1-1.

Table 3.1-1(2/2) LAND USE CONDITION IN 1986

UNIT : km2

SUB-BASIN	TOTAL AREA	RESIDENTIAL/COMMERCIAL LOW D.	MID. D.	HIGH D.	INDUST-RIAL	FISH POND	FOREST	OPEN SPACE	AGRICUL-TURE
(MALABON NAVOTAS)									
MA- 1	2.26	0.38	0.00	0.00	0.34	1.54	0.00	0.00	0.00
MA- 2	2.05	0.13	0.79	0.00	0.00	1.13	0.00	0.00	0.00
MA- 3	2.21	0.00	1.23	0.62	0.03	0.04	0.00	0.21	0.08
MA- 4	0.50	0.04	0.22	0.00	0.00	0.03	0.00	0.21	0.00
MA- 5	1.89	0.00	1.09	0.00	0.67	0.00	0.00	0.06	0.07
MA- 6	1.34	0.00	0.00	0.71	0.00	0.61	0.00	0.02	0.00
MA- 7	2.40	0.00	0.50	0.75	0.35	0.50	0.00	0.30	0.00
MA- 8	3.76	0.00	0.32	1.25	0.00	0.19	0.00	2.00	0.00
MA- 9	0.30	0.00	0.18	0.00	0.07	0.00	0.00	0.05	0.00
MA- 10	0.91	0.00	0.35	0.11	0.21	0.00	0.00	0.24	0.00
MA- 11	0.69	0.00	0.21	0.00	0.42	0.00	0.00	0.06	0.00
MA- 12	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00
SUB-TOTAL	18.63	0.55	4.89	3.44	2.09	4.04	0.00	3.47	0.15
(MANILA AND SUBURBS, NORTH)									
NM- 1	16.79	0.00	2.20	9.69	1.06	0.00	0.00	3.73	0.11
NM- 2	0.36	0.00	0.00	0.24	0.08	0.00	0.00	0.04	0.00
NM- 3	9.06	0.00	2.07	5.46	0.56	0.00	0.00	0.97	0.00
NM- 4	0.69	0.00	0.00	0.31	0.38	0.00	0.00	0.00	0.00
NM- 5	1.68	0.00	0.00	1.06	0.14	0.00	0.00	0.48	0.00
SUB-TOTAL	28.58	0.00	4.27	16.76	2.22	0.00	0.00	5.22	0.11
(MANILA AND SUBURBS, SOUTH)									
SM- 1	5.99	3.06	0.44	1.66	0.13	0.00	0.00	0.70	0.00
SM- 2	7.06	0.00	0.12	3.97	1.93	0.00	0.00	1.04	0.00
SM- 3	1.41	0.00	0.06	0.00	0.26	0.00	0.00	1.09	0.00
SM- 4	3.88	0.00	1.46	0.45	0.20	0.00	0.00	1.77	0.00
SM- 5	24.80	3.88	5.07	4.03	1.27	0.04	0.11	10.40	0.00
SUB-TOTAL	43.14	6.94	7.15	10.11	3.79	0.04	0.11	15.00	0.00
(EAST OF MANGAHAN)									
EM- 1	1.67	1.20	0.06	0.00	0.23	0.16	0.00	0.02	0.00
EM- 2	2.42	0.33	0.09	0.02	0.62	1.09	0.00	0.27	0.00
EM- 3	2.72	0.36	0.00	0.35	0.00	2.00	0.00	0.01	0.00
EM- 4	1.95	0.13	0.00	0.15	0.03	1.23	0.00	0.41	0.00
SUB-TOTAL	8.76	2.02	0.15	0.52	0.88	4.48	0.00	0.71	0.00
(WEST OF MANGAHAN)									
WM- 1	9.12	2.74	1.51	0.00	0.31	3.34	0.00	1.22	0.00
WM- 2	5.14	0.51	0.00	0.00	0.00	1.99	0.00	2.64	0.00
WM- 3	6.83	2.82	0.00	0.00	0.64	1.33	0.00	1.81	0.23
WM- 4	14.28	3.44	0.24	0.00	0.44	5.03	0.71	4.41	0.01
WM- 5	2.77	1.22	0.00	0.00	0.00	1.53	0.02	0.00	0.00
SUB-TOTAL	38.14	10.73	1.75	0.00	1.39	13.22	0.73	10.08	0.24
(PARANAQUE LAS PINAS)									
PA- 1	8.82	0.04	1.22	1.43	0.11	0.53	0.00	5.49	0.00
PA- 2	2.43	0.51	0.17	0.15	0.09	1.51	0.00	0.00	0.00
PA- 3	1.53	0.32	0.11	0.09	0.05	0.96	0.00	0.00	0.00
PA- 4	2.65	1.32	0.22	0.00	0.00	0.86	0.00	0.00	0.25
SUB-TOTAL	15.43	2.19	1.72	1.67	0.25	3.86	0.00	5.49	0.25

NOTE : The location of subbasins is presented in Fig. 3.1-1.

Table 3.1-2(1/2) LAND USE CONDITION IN 2020

UNIT : km2

SUB-BASIN	TOTAL AREA	RESIDENTIAL/COMMERCIAL LOW D.	MID. D.	HIGH D.	INDUST-RIAL	FISH POND	FOREST	OPEN SPACE	AGRICUL-TURE
(MEYCAUAYAN)									
ME- 1	23.67	1.11	0.92	0.00	0.00	0.13	21.29	0.09	0.13
ME- 2	15.06	0.46	5.34	0.00	0.06	2.63	4.93	1.58	0.06
ME- 3	21.81	6.63	13.18	0.54	0.88	0.04	0.26	0.28	0.00
ME- 4	29.23	3.01	1.04	0.00	1.02	16.32	6.69	0.84	0.31
ME- 5	9.32	1.63	1.15	0.00	1.79	3.75	0.73	0.19	0.08
ME- 6	24.52	4.73	4.66	0.48	1.56	8.93	2.76	1.18	0.22
ME- 7	8.82	1.93	2.00	0.00	2.78	1.06	0.00	1.05	0.00
ME- 8	17.81	0.00	8.71	1.00	7.69	0.37	0.00	0.04	0.00
ME- 9	18.42	4.73	5.40	0.87	0.13	7.26	0.00	0.03	0.00
SUB-TOTAL	168.66	24.23	42.40	2.89	15.91	40.49	36.66	5.28	0.80
(MALABON-TULLAHAN)									
MT- 1	25.82	0.00	0.26	0.00	0.00	0.00	25.56	0.00	0.00
MT- 2	13.38	9.92	3.46	0.00	0.00	0.00	0.00	0.00	0.00
MT- 3	20.08	0.63	9.78	3.88	4.85	0.73	0.00	0.21	0.00
MT- 4	9.97	0.00	1.72	5.23	2.14	0.82	0.00	0.06	0.00
SUB-TOTAL	69.25	10.55	15.22	9.11	6.99	1.55	25.56	0.27	0.00
(PASIG/MARIKINA)									
PM- 1	277.66	0.00	0.00	0.00	0.00	0.00	277.66	0.00	0.00
PM- 2	97.53	6.36	0.00	0.28	0.35	5.08	84.07	1.27	0.12
PM- 3	137.01	32.40	1.35	0.64	3.37	3.93	89.75	3.22	2.35
PM- 4	6.18	3.00	0.93	0.13	1.98	0.00	0.00	0.00	0.14
PM- 5	11.33	5.43	0.21	1.35	2.90	0.00	0.00	1.44	0.00
PM- 6	8.74	1.79	2.01	0.13	1.98	0.00	0.00	2.83	0.00
PM- 7	4.58	0.79	2.00	0.72	0.86	0.00	0.00	0.21	0.00
SUB-TOTAL	543.03	49.77	6.50	3.25	11.44	9.01	451.48	8.97	2.61
(SAN JUAN)									
SJ- 1	23.27	11.47	7.68	0.91	0.21	0.00	0.00	3.00	0.00
SJ- 2	10.53	0.00	5.22	3.07	2.07	0.00	0.00	0.17	0.00
SJ- 3	2.18	0.05	0.95	0.21	0.93	0.00	0.00	0.04	0.00
SJ- 4	9.96	1.80	3.46	0.94	0.57	0.00	0.00	3.19	0.00
SJ- 5	8.24	0.69	2.32	1.42	3.42	0.00	0.00	0.39	0.00
SJ- 6	14.02	0.42	6.50	3.82	0.24	0.00	0.00	3.04	0.00
SJ- 7	3.55	1.55	0.16	1.30	0.00	0.00	0.00	0.54	0.00
SJ- 8	12.07	2.71	4.29	1.82	0.00	0.00	0.00	3.25	0.00
SJ- 9	6.53	0.86	3.26	1.14	0.56	0.00	0.00	0.71	0.00
SJ- 10	1.09	0.00	0.62	0.14	0.29	0.00	0.00	0.04	0.00
SUB-TOTAL	91.44	19.55	34.46	14.77	8.29	0.00	0.00	14.37	0.00
(BAHO/BULI)									
BB- 1	16.55	11.11	2.92	0.51	1.16	0.00	0.00	0.85	0.00
BB- 2	6.63	6.21	0.00	0.00	0.00	0.14	0.00	0.28	0.00
BB- 3	5.55	1.42	0.27	0.63	1.54	0.16	0.00	1.53	0.00
BB- 4	26.52	22.59	0.48	0.00	0.00	0.74	0.76	1.95	0.00
BB- 5	4.21	0.72	2.32	0.36	0.42	0.00	0.00	0.39	0.00
BB- 6	4.46	4.22	0.00	0.00	0.24	0.00	0.00	0.00	0.00
BB- 7	10.49	6.00	0.38	0.00	2.47	0.00	1.31	0.33	0.00
SUB-TOTAL	74.41	52.27	6.37	1.50	5.83	1.04	2.07	5.33	0.00
(SOUTH PARANAQUE/LAS PINAS)									
PL- 1	11.49	8.28	0.00	0.00	1.38	0.25	0.00	1.58	0.00
PL- 2	3.44	2.92	0.00	0.00	0.00	0.52	0.00	0.00	0.00
PL- 3	19.25	16.07	0.00	1.22	1.28	0.00	0.00	0.68	0.00
PL- 4	6.27	5.12	0.09	0.00	1.03	0.00	0.03	0.00	0.00
PL- 5	9.72	9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZP- 1	36.79	2.86	0.00	0.00	0.00	3.21	30.02	0.56	0.14
ZP- 2	3.67	3.48	0.00	0.00	0.00	0.19	0.00	0.00	0.00
ZP- 3	4.76	0.98	0.00	0.00	0.00	3.78	0.00	0.00	0.00
SUB-TOTAL	95.39	49.43	0.09	1.22	3.69	7.95	30.05	2.82	0.14

NOTE : The location of subbasins is presented in Fig. 3.1-1.

Table 3.1-2(2/2) LAND USE CONDITION IN 2020

UNIT : km2

SUB-BASIN	TOTAL AREA	RESIDENTIAL/COMMERCIAL LOW D.	MID. D.	HIGH D.	INDUST-RIAL	FISH POND	FOREST	OPEN SPACE	AGRICUL-TURE
(MALABON NAVOTAS)									
MA- 1	2.26	1.30	0.00	0.00	0.68	0.28	0.00	0.00	0.00
MA- 2	2.05	0.61	0.49	0.22	0.00	0.50	0.00	0.23	0.00
MA- 3	2.21	0.57	0.00	1.60	0.00	0.01	0.00	0.03	0.00
MA- 4	0.50	0.28	0.07	0.00	0.06	0.00	0.00	0.09	0.00
MA- 5	1.89	0.00	1.41	0.24	0.17	0.00	0.00	0.07	0.00
MA- 6	1.34	0.00	1.16	0.18	0.00	0.00	0.00	0.00	0.00
MA- 7	2.40	0.00	1.51	0.80	0.02	0.00	0.00	0.07	0.00
MA- 8	3.76	0.00	3.65	0.09	0.00	0.00	0.00	0.02	0.00
MA- 9	0.30	0.00	0.00	0.07	0.23	0.00	0.00	0.00	0.00
MA- 10	0.91	0.00	0.24	0.25	0.42	0.00	0.00	0.00	0.00
MA- 11	0.69	0.00	0.09	0.00	0.60	0.00	0.00	0.00	0.00
MA- 12	0.32	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00
SUB-TOTAL	18.63	2.76	8.62	3.45	2.50	0.79	0.00	0.51	0.00
(MANILA AND SUBURBS, NORTH)									
NM- 1	16.79	0.30	0.34	11.97	0.89	0.00	0.00	3.29	0.00
NM- 2	0.36	0.00	0.00	0.09	0.25	0.00	0.00	0.02	0.00
NM- 3	9.06	0.00	0.00	7.24	1.06	0.00	0.00	0.76	0.00
NM- 4	0.69	0.00	0.00	0.35	0.34	0.00	0.00	0.00	0.00
NM- 5	1.68	0.00	0.00	0.21	1.44	0.00	0.00	0.03	0.00
SUB-TOTAL	28.58	0.30	0.34	19.86	3.98	0.00	0.00	4.10	0.00
(MANILA AND SUBURBS, SOUTH)									
SM- 1	5.99	2.96	0.52	1.80	0.16	0.00	0.00	0.55	0.00
SM- 2	7.06	0.00	0.25	4.41	1.67	0.00	0.00	0.73	0.00
SM- 3	1.41	0.00	0.00	0.00	0.49	0.00	0.00	0.92	0.00
SM- 4	3.88	0.00	0.00	2.24	0.34	0.00	0.00	1.30	0.00
SM- 5	24.80	2.93	6.10	4.73	1.51	0.00	0.00	9.53	0.00
SUB-TOTAL	43.14	5.89	6.87	13.18	4.17	0.00	0.00	13.03	0.00
(EAST OF MANGAHAN)									
EM- 1	1.67	1.50	0.17	0.00	0.00	0.00	0.00	0.00	0.00
EM- 2	2.42	0.04	0.70	0.13	0.65	0.44	0.00	0.46	0.00
EM- 3	2.72	0.79	0.00	0.00	0.15	1.78	0.00	0.00	0.00
EM- 4	1.95	0.84	0.00	0.03	0.00	1.05	0.00	0.03	0.00
SUB-TOTAL	8.76	3.17	0.87	0.16	0.80	3.27	0.00	0.49	0.00
(WEST OF MANGAHAN)									
WM- 1	9.12	2.35	0.52	2.86	1.88	0.43	0.00	1.08	0.00
WM- 2	5.14	3.13	0.00	0.00	0.82	0.56	0.00	0.63	0.00
WM- 3	6.83	3.70	0.84	0.59	1.62	0.00	0.00	0.04	0.04
WM- 4	14.28	7.14	0.52	2.05	0.34	0.00	0.00	4.23	0.00
WM- 5	2.77	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUB-TOTAL	38.14	19.09	1.88	5.50	4.66	0.99	0.00	5.98	0.04
(PARANAQUE LAS PINAS)									
PA- 1	8.82	0.00	1.88	1.25	0.00	0.51	0.00	5.18	0.00
PA- 2	2.41	1.14	0.00	0.69	0.00	0.58	0.00	0.00	0.00
PA- 3	1.55	0.73	0.00	0.45	0.00	0.37	0.00	0.00	0.00
PA- 4	2.65	1.79	0.09	0.56	0.00	0.21	0.00	0.00	0.00
SUB-TOTAL	15.43	3.66	1.97	2.95	0.00	1.67	0.00	5.18	0.00

NOTE : The location of subbasins is presented in Fig. 3.1-1.

Table 3.3-1. GROUND WATER LEVEL AND LAND SUBSIDENCE

PERIOD	OBSERVATION YEAR	ALLUVIAL DEPOSIT GROUND LEVEL	ALLUVIAL DEPOSIT G.W. LEVEL	GUADALUPE FORMATION GROUND LEVEL	GUADALUPE FORMATION G.W. LEVEL
- 1950					
	1955		----------------		----------------
- 1960			DOWN		DOWN
	1967	DOWN	----------------		----------------
- 1970					
			UP		DOWN
	1979	---------------		----------------	
- 1980	1981	ALMOST UNCHANGED	----------------	UNCHANGED	----------------
	1988	---------------	UNCHANGED OR UP	----------------	UNCHANGED OR UP
- 1990					

Table 3.4-1 PROBABLE BASIN MEAN TWO-DAY RAINFALL IN RIVER BASINS

RIVER BASIN	PROBABLE TWO-DAY RAINFALL (mm) IN FLOOD RETURN PEIROD						
	100-YR	50-YR	30-YR	20-YR	10-YR	5-YR	2-YR
Malabon-Tullahan	700	620	570	520	430	360	240
Marikina (St.Nino)	660	600	540	510	440	370	270
San Juan	660	600	550	510	430	360	250
Pasig-Marikina *	660	600	540	510	440	370	270
Buli-Baho-Mahaba	670	580	500	470	400	320	210
South Paranaque-Las Pinas	770	660	570	520	420	320	200

NOTE *: Including the San Juan River Basin.

Table 3.4-2 ANNUAL MAXIMUM DISCHARGE AT STO. NINO

YEAR	DATE	H.MAX (m)	Q.MAX (m3/s)
1958	Sep. 10	14.78	507
1959	Nov. 19	-	2,072
1960	Aug. 14	18.06	1,562
1961	Sep. 22	16.82	1,161
1962	Jul. 20	17.10	1,261
1963	Jun. 28	16.19	931
1964	Jun. 30	17.45	1,367
1965	Jun. 24	15.48	702
1966	Nov. 21	19.40	2,036
1967	Jun. 08	18.20	1,609
1968	Aug. 29	16.68	1,107
1969	Sep. 01	17.45	1,350
1970	Sep. 02	20.48	2,464
1971	-	14.50	439
1972	Aug. 01	18.05	1,559
1973	Oct. 08	13.95	318
1974	Jul. 20	13.98	324
1975	Aug. 10	13.70	269
1976	May 22	16.90	1,192
1977	Nov. 14	19.44	2,051
1986	Sep. 01	20.92	2,650

NOTE: No records between 1978 and 1985.
The annual maximum discharge was calculated from the rating curve newly established by the study team.

Table 3.4-3 RUNOFF COEFFICIENT AND C-VALUE FOR DIFFERENT LAND USE

No.	Land Use: Code	Land Use: Classification	Runoff Coefficient f	C-Value c
1	Urban Area 1	Low Density Residential	0.50	90
2	Urban Area 2	Middle Density Residential	0.65	80
3	Urban Area 3	High Density Residential	0.80	70
4	Factory 1	Factories in Manila City and Pasig Riverine	0.65	80
5	Factory 2	Factories in Suburbs	0.50	120
6	Open Space	Park, Golf Course, Military Space, Airport, Graveyard and Race Course	0.35	170
7	Farmland 1	Paddy Field and Fishpond	0.10	1100
8	Farmland 2	Other Form of Farming Area	0.30	210
9	Mountainous Area	Tropical Forest, Grassland, Bush and Orchard in Steep Slope	0.80	290

Table 3.4-4(1/2) PROBABLE DISCHARGE IN SUBDRAINAGE AREAS UNDER THE LAND USE CONDITION OF 2020

NAME	CATCHMENT AREA (ha)	RUNOFF COEFFICIENT	PROBABLE DISCHARGE (m3/s) IN FLOOD RETURN PEIROD						
			100-YR	50-YR	30-YR	10-YR	5-YR	3-YR	2-YR
MANILA & SUBURBS									
(North)									
NM-1	1,679	0.70	324.7	299.9	285.9	249.1	223.1	200.3	179.7
NM-2	36	0.67	16.6	15.1	14.3	12.3	11.1	9.9	9.1
NM-3	906	0.74	221.6	204.0	194.2	168.9	151.5	135.9	122.4
NM-4	69	0.73	27.1	24.7	23.4	20.3	18.3	16.3	14.9
NM-5	168	0.66	52.8	48.2	45.8	39.6	35.7	31.9	29.1
(South)									
SM-1	599	0.59	114.8	105.7	100.6	87.5	78.5	70.4	63.4
SM-2	706	0.71	170.6	156.9	149.3	129.8	116.4	104.4	94.2
SM-3	141	0.45	34.3	31.2	29.6	25.6	23.1	20.6	18.8
SM-4	388	0.64	111.6	102.0	96.9	83.9	75.5	67.6	61.4
SM-5	2,480	0.55	323.7	300.0	286.2	249.8	223.4	200.8	179.5
MALABON-NAVOTAS									
MT-4-1	411	0.65	92.2	84.7	80.6	70.1	62.9	56.4	50.9
MT-4-2	218	0.65	50.3	46.2	44.0	38.2	34.3	30.7	27.7
MA-1	226	0.45	37.0	34.0	32.3	28.1	25.2	22.6	20.4
MA-2	205	0.45	30.6	28.2	26.8	23.3	20.9	18.8	16.9
MA-3	221	0.71	64.6	59.1	56.2	48.7	43.8	39.2	35.6
MA-4	50	0.49	13.8	12.6	11.9	10.3	9.3	8.3	7.6
MA-5	189	0.64	45.9	42.1	40.0	34.8	31.2	28.0	25.3
MA-6	134	0.67	36.6	33.5	31.9	27.6	24.8	22.3	20.2
MA-7	240	0.69	52.7	48.6	46.3	40.2	36.1	32.4	29.1
MA-8	376	0.65	88.6	81.3	77.4	67.2	60.3	54.1	48.9
MA-9	30	0.57	12.0	10.8	10.3	8.8	8.0	7.1	6.6
MA-10	91	0.62	25.6	23.4	22.2	19.2	17.3	15.5	14.1
MA-11	69	0.52	17.6	16.0	15.2	13.2	11.9	10.6	9.7
MA-12	32	0.50	11.2	10.1	9.6	8.3	7.5	6.7	6.1
EAST OF MANGAHAN									
EM-1	167	0.52	36.5	33.4	31.7	27.5	24.7	22.2	20.1
EM-2	242	0.46	36.9	33.9	32.3	28.1	25.2	22.6	20.4
EM-3	272	0.24	21.7	19.9	19.0	16.5	14.8	13.3	12.0
EM-4	195	0.29	23.8	21.8	20.7	17.9	16.1	14.4	13.1
WEST OF MANGAHAN									
WM-1	912	0.57	111.7	103.7	99.0	86.6	77.4	69.6	62.0
WM-2	514	0.44	63.8	58.9	56.2	48.9	43.8	39.4	35.3
WM-3	683	0.54	83.5	77.4	73.9	64.6	57.7	51.9	46.3
WM-4	1,428	0.50	131.9	122.1	115.9	101.1	90.1	81.2	71.9
WM-5	277	0.50	52.5	48.1	45.8	39.7	35.7	32.0	28.9

NOTE: Fig.3.4-3 shows the location of subdrainage areas.

Table 3.4-4(2/2) PROBABLE DISCHARGE IN SUBDRAINAGE AREAS UNDER THE LAND USE CONDITION OF 2020

NAME	CATCHMENT AREA (ha)	RUNOFF COEFFICIENT	PROBABLE DISCHARGE (m3/s) IN FLOOD RETURN PEIROD 100-YR	50-YR	30-YR	10-YR	5-YR	3-YR	2-YR
SAN JUAN									
SJ-5-1	283	0.59	57.2	52.6	50.1	43.5	39.1	35.0	31.6
SJ-5-2	31	0.59	9.0	8.2	7.8	6.7	6.0	5.4	4.9
SJ-7-1	256	0.59	70.9	64.7	61.5	53.2	47.9	42.9	39.0
SJ-7-2	92	0.59	28.3	25.7	24.4	21.1	19.0	17.0	15.5
SJ-8-1	87	0.56	22.1	20.2	19.2	16.6	14.9	13.4	12.2
SJ-8-2	59	0.56	14.5	13.2	12.6	10.9	9.8	8.8	8.0
SJ-9-1	94	0.61	23.6	21.6	20.5	17.8	16.0	14.3	13.0
SJ-9-2	187	0.61	40.5	37.2	35.4	30.7	27.6	24.8	22.3
SJ-9-3	62	0.61	18.1	16.5	15.7	13.6	12.2	11.0	10.0
SJ-10	109	0.62	27.8	25.5	24.2	21.0	18.9	16.9	15.3
MANDALUYONG-PASIG									
PM-5-1	929	0.52	91.8	83.7	79.4	68.7	61.8	55.3	50.5
PM-5-2	138	0.52	36.9	33.7	31.9	27.6	24.9	22.3	20.3
PM-7	458	0.61	109.8	100.7	95.7	83.1	74.6	66.9	60.6
MARIKINA									
PM-3-1	32	0.51	11.4	10.3	9.8	8.4	7.6	6.8	6.3
PM-3-2	42	0.51	11.5	10.4	9.9	8.6	7.7	6.9	6.3
PM-3-3	149	0.51	36.3	33.1	31.4	27.2	24.5	21.9	19.9
PM-3-4	193	0.51	37.3	34.3	32.6	28.3	25.4	22.8	20.6
PM-3-5	76	0.51	17.6	16.0	15.2	13.2	11.9	10.6	9.7
PM-3-6	125	0.51	28.9	26.4	25.1	21.7	19.5	17.5	15.9
PM-4-1	344	0.52	76.6	70.1	66.6	57.7	51.9	46.5	42.2
PM-4-2	207	0.52	43.7	40.0	38.0	33.0	29.6	26.6	24.1
PARANAQUE-LAS PINAS									
PA-1	882	0.46	125.0	115.2	109.8	95.5	85.6	76.8	69.1
PA-2	243	0.49	30.1	27.9	26.6	23.2	20.7	18.6	16.7
PA-3	153	0.49	44.0	39.9	37.9	32.7	29.5	26.4	24.1
PA-4	265	0.54	56.5	51.8	49.3	42.7	38.4	34.4	31.2
VALENZUELA									
ME-9	1,842	0.40	163.5	151.8	144.9	126.6	113.1	101.8	90.7

NOTE: Fig.3.4-3 shows the location of subdrainage areas.

Table 3.4-5 PROBABLE DISCHARGE IN THE PRIORITY DRAINAGE AREAS UNDER THE LAND USE CONDITION OF 1986

NAME	CATCHMENT AREA (ha)	RUNOFF COEFFICIENT	PROBABLE DISCHARGE (m3/s) IN FLOOD RETURN PEIROD 100-YR	50-YR	30-YR	10-YR	5-YR	3-YR	2-YR
MALABON-NAVOTAS									
MT-4-1	411	0.51	72.34	66.46	63.24	55.00	49.35	44.25	39.94
MT-4-2	218	0.51	39.47	36.25	34.52	29.97	26.91	24.09	21.73
MA-1	226	0.23	18.9	17.4	16.5	14.4	12.9	11.6	10.4
MA-2	205	0.34	23.1	21.3	20.3	17.6	15.8	14.2	12.8
MA-3	221	0.64	58.2	53.3	50.7	43.9	39.5	35.4	32.1
MA-4	50	0.48	13.6	12.3	11.7	10.1	9.1	8.1	7.4
MA-5	189	0.57	40.9	37.5	35.7	31.0	27.8	24.9	22.5
MA-6	134	0.47	25.7	23.5	22.4	19.4	17.4	15.6	14.2
MA-7	240	0.52	39.7	36.6	34.9	30.3	27.2	24.4	22.0
MA-8	376	0.51	69.5	63.8	60.7	52.7	47.3	42.4	38.4
MA-9	30	0.57	12.0	10.8	10.3	8.8	8.0	7.1	6.6
MA-10	91	0.55	22.7	20.7	19.7	17.0	15.3	13.7	12.5
MA-11	69	0.52	17.6	16.0	15.2	13.2	11.9	10.6	9.7
MA-12	32	0.35	7.8	7.1	6.7	5.8	5.2	4.7	4.3
EAST OF MANGAHAN									
EM-1	167	0.47	33.0	30.2	28.7	24.9	22.4	20.0	18.2
EM-2	242	0.31	24.9	22.9	21.8	18.9	17.0	15.2	13.7
EM-3	272	0.24	21.7	19.9	19.0	16.5	14.8	13.3	12.0
EM-4	195	0.24	19.7	18.0	17.1	14.8	13.3	12.0	10.8
WEST OF MANGAHAN									
WM-1	912	0.36	70.5	65.5	62.6	54.7	48.9	44.0	39.1
WM-2	514	0.27	39.2	36.2	34.5	30.0	26.9	24.2	21.7
WM-3	683	0.38	58.7	54.5	52.0	45.4	40.6	36.5	32.6
WM-4	1,428	0.33	87.0	80.6	76.5	66.1	58.3	52.1	45.9
WM-5	277	0.28	29.4	26.9	25.6	22.2	20.0	17.9	16.2

NOTE: Fig.3.4-3 shows the location of subdrainage areas.

Table 3.4-6 ANNUAL MAXIMUM LAKE STAGE

ORDER	OCCURRENCE YEAR	OCCURRENCE MONTH	LAKE WATER STAGE (EL.m)
1.	1972	August	14.03
2.	1978	October	13.58
3.	1986	October	13.34
4.	1960	October	13.17
5.	1952	October	13.08
6.	1967	November	12.87
7.	1976	May	12.77
8.	1962	September	12.77
9.	1956	September	12.76
10.	1984	October	12.67
11.	1948	September	12.54
12.	1970	December	12.53
13.	1980	November	12.43
14.	1974	November	12.40
15.	1946	October	12.36
16.	1947	December	12.36
17.	1961	November	12.29
18.	1953	December	12.28
19.	1963	September	12.24
20.	1985	October	12.20
21.	1966	December	12.16
22.	1951	December	12.15
23.	1973	December	12.08
24.	1982	September	12.08
25.	1971	September	12.05
26.	1977	September	12.03
27.	1950	October	11.98
28.	1979	August	11.95
29.	1983	October	11.94
30.	1958	October	11.92
31.	1981	November	11.90
32.	1957	October	11.87
33.	1965	September	11.76
34.	1949	November	11.72
35.	1955	December	11.71
36.	1975	January	11.69
37.	1968	October	11.67
38.	1954	November	11.54
39.	1987	December	11.51
40.	1959	November	11.49
41.	1969	September	11.27

Table 3.5-1(1/2) DRAINAGE DISTRICTS, DRAINAGE METHODS AND MAJOR DRAINAGE CHANNELS

Drainage District	Area (ha)	Drainage Method	Pump Capacity (m^3/s)	Major Drainage Channel	
				Estero/Drain	Drainage Main/Outfall
MANILA AND SUBURBS					
(NORTH)					
1. Sunog Apog	802	Gravity drainage through Estero de Sunog Apog and Estero de Vitas to Manila Bay.	-	Sunog Apog (2.97/25.0)	Blumentritt (2.97/2.57)* Kanlaon-Ply Margal (0.65/2.00)
2. Vitas	573	Gravity drainage through Estero de Vitas and Estero dela Reina to Manila Bay. A pumping station will be constructed.	-	Vitas (1.84/52.6) Reina (1.31/15.8)	Solis-Tecson (1.48/2.20)* South Antipolo (1.42/4.40) Tayuman (1.61/2.40)
3. Balut	36	Gravity flow to Manila Bay. A pumping station will be constructed.	-	-	-
4. Northeast Pasig	72	Gravity drainage to Pasig River.	-	-	-
5. Valencia P.S.	277	Pump drainage to Pasig River.	10.5	Valencia (0.85/11.2)	Visayas (0.67/2.05)*
6. Aviles-Sampaloc P.S.	345	-do-	14.1	Sampaloc (0.65/15.6) San Miguel (1.18/9.0)	Washington-Ply Margal (0.36/2.40) Economia (0.59/2.20)* Lepanto-Josefina (1.16/4.22) Lepanto-Gov. Forbes (1.06/3.60)**
7. Quiapo P.S.	212	-do-	9.5	Quiapo (0.96/25.6) San Miguel (1.32/18.7)	Severino Reyes (0.54/3.20)
8. Binondo P.S.	304	-do-	11.4	Reina (1.55/23.1) Binondo (0.90/22.3)	Zurbaran (0.71/2.15)*
9. Northwest Pasig	69	Gravity drainage to Pasig River.	-	-	-
10. North Manila Bay	168	Gravity drainage to Manila Bay.	-	-	Pacheco (1.11/4.28) Lakandula (0.88/3.84)
Sub-Total	2,858		45.5		
(SOUTH)					
1. Makati Slope	307	Gravity drainage to Pasig River.	-	-	Zorbal Orbit (1.17/5.00)
2. Makati P.S.	142	Pump drainage to Pasig River.	7.0	-	Makati Headrace No. 1 (0.41/2.60) Makati Headrace No. 2 (0.63/5.00)
3. Sta. Clara P.S.	150	-do-	5.3	Sta. Clara (1.34/6.2)	-
4. San Andres	339	Pump drainage to Pasig River. A pumping station will be constructed.	-	Pandacan (2.43/11.3) Tripa de Gallina (2.00/12.7)	Vito Cruz (1.32/2.05) Estrada (0.59/2.94)

Note: Figures in parenthesis indicate Length (km)/Width (m).
* indicates drainage main/outfall with 2 bays
** indicates drainage main/outfall with 3 bays

Table 3.5-1(2/2) DRAINAGE DISTRICTS, DRAINAGE METHODS AND MAJOR DRAINAGE CHANNELS

Drainage District	Area (ha)	Drainage Method	Pump Capacity (m^3/s)	Major Drainage Channel	
				Estero/Drain	Drainage Main/Outfall
5. Pandacan P.S.	104	Pump drainage to Pasig River.	4.4	Pandacan (1.78/18.1)	-
6. Paco P.S.	178	-do-	7.6	Paco (1.60/20.4)	-
7. Balete	85	Gravity drainage to Manila Bay.	-	-	-
8. Southwest Pasig	141	Gravity drainage to Pasig River.	-	-	-
9. South Manila Bay	388	Gravity drainage to Manila Bay.	-	-	Padre Faura (1.16/3.20) Remedios (1.34/4.40)
10. Libertad P.S.	755	Pump drainage to Manila Bay.	48.0	Tripa de Gallina (2.40/12.3)	Buendia Roxas (1.96/4.60)** Libertad (1.80/4.70) EDSA (1.73/4.30)*
11. Tripa de Gallina P.S.	1,725	-do-	56.0	Tripa de Gallina (2.39/26.6)	-
Sub-Total	4,314		128.3		
Total	7,172		173.8		
MALABON-NAVOTAS					
(DAGAT-DAGATAN)					
1. Spine	164	Gravity drainage through Spine Drain to Bangkulasi River.	-	Spine (2.0/5.0)	-
2. Saluysoy	97	Gravity drainage through Saluysoy Drain to Bangkulasi River.	-	Saluysoy (1.7/4.5)	-
3. Maypajo	115	Gravity drainage through Northern and Southern drains to Estero North Sunog Apog.	-	Northern (1.1/4.0) Southern (0.8/3.0)	-
4. Kapitbahayan	91	Gravity drainage through laterals to Bangkulasi River and Manila Bay.	-	-	-

Note: Figures in parentheses indicate Length (km)/Width (m).
* indicates drainage main/outfall with 2 bays
** indicates drainage main/outfall with 3 bays

Table 3.6-1. COMPARISON OF PUMP CAPACITY, FLOW CAPACITY, 10-YEAR AND 5-YEAR RETURN PERIOD FLOOD IN MANILA AND SUBURBS

Drainage District	Existing Pump Capacity (m^3/s)	Pump Capacity for 10-Year Return Period Flood (m^3/s)	Pump Capacity for 5-Year Return Period Flood (m^3/s)	Drainage Channel	Flow Capacity (m^3/s)	10-Year Return Period Flood (m^3/s)	5-Year Return Period Flood (m^3/s)
North Manila and Suburbs							
Sunog Apog	-	-	-	Estero de Vitas	*	161	144
				Estero de Sunog Apog	56	108	97
				Estero de Maypajo	35	91	73
				Blumentritt Interceptor	20	37	32
Vitas	(31.8)	31.8	25.2	Estero de Vitas	50	67	60
				Estero dela Reina	20	29	26
Balut	(2.0)	2.0	1.4				
Northeast Pasig	-	5.5	4.4				
Valencia P.S.	10.5	18.0	14.4	Estero de Valencia	30	59	53
				Visayas Main	18	19	17
Aviles-Sampaloc P.S.	14.1	18.3	14.6	Estero de Sampaloc	40	48	43
				Lepanto-Gov. Forbes Main	50	48	43
				Economia Main	10	21	19
				Lepanto-Josefina Main	20	35	32
				Estero de San Miguel	5	19	17
Quiapo P.S.	9.5	11.2	9.0	Estero de Quiapo	40	37	33
				Estero de San Miguel	20	18	16
				Severino Reyes Main	7	15	13
Binondo P.S.	11.4	17.2	13.7	Estero de Binondo	40	50	45
				Estero dela Reina	5	49	44
Northwest Pasig	-	-	-	-	-	-	-
North Manila Bay	-	-	-	Pacheco Main	8	13	12
				Lakandula Main	10	9	8
South Manila and Suburbs							
Makati Slope	-	-	-	Zobel Orbit Outfall	40	40	36
Makati P.S.	7.0	7.0	5.6	Pond	-	25	22
				Makati Headrace No. 1	13	13	10
				Makati Headrace No. 2	17	16	13
Sta. Clara P.S.	5.3	9.6	8.0	Estero de Sta. Clara	5	32	29
San Andres	(17.4)	17.4	13.6	Estero de Pandacan	3	58	51
				Estero Tripa de Gallina	5	26	23
Pandacan P.S.	4.4	7.1	5.7	Estero de Pandacan	15	26	24
Paco P.S.	7.6	9.7	7.9	Estero de Paco	50	36	32
				Estero de Paco/1	20	28	25
Baleta	-	5.3	4.4				
Southwest Pasig	-	-	-	-	-	-	-
South Manila Bay	-	-	-	Padre Faura Main	20	19	17
				Remedios Main	17	17	16
Libertad P.S.	48.0	54.2	43.8	Pond	-	122	110
				Buendia-Roxas Outfall	50	50	45
				Libertad Outfall	8	8	7
				EDSA	25	25	23
				Estero Tripa de Gallina/2	10	45	41
				Zobel-Roxas Main	18	19	17
Tripa de Gallina P.S.	56.0	58.8	46.6	Tripa de Gallina/3	100	132	117
				-do- /4	60	49	43
				-do- /5	20	65	59

Note: Figures in parentheses indicate the planned pump capacity in the project assisted by the Government of Japan.

* Bank of channel is lower than the Design Tide Level (EL 11.80 m).
/1 Upper reaches of Estero dela Concordia
/2 The reaches between Zobel-Roxas Main and Buendia-Roxas Outfall
/3 The reaches between the pumping station and Dilain Creek
/4 The reaches between Dilain Creek and EDSA
/5 Upper reach from EDSA

Table 3.7-1 PARAMETERS OF WATER QUALITY CRITERIA

Quality Parameter	Fresh Surface Water					
Class	AA	A	B	C	D	E
Color, Units		75	50	50		
Temperature °C		30	30	3(e)	3(e)	
Transparency			(c)	(c)	(c)	
Dissolved Oxygen		5	5	5	3	2
5-day BOD at 20°C		10	15	20		
Total Dissolved Solids				1,000	1,000	
Total Solids	(a)	(a)		2,000	2,000	
pH	(a)	6.5-8.5	6.5-8.5	6.5-8.5	6.0-8.5	5.0-9.0
Coliform, MPN/100 mℓ	50	5,000	1,000	5,000		
Phenolic substances	(a)	(a)	0.002	0.02		

Remarks: 1. (a) National standars for Drinking Water in the Philippines.
(b) Shall not be present in concentration to cause deleterious or abnormal biotic growth.
(c) Secchi Disk shall be visible at a minimum depth of one (1) meter.
(d) Recommended maximum concentration for irrigating citrus is 0.075 mg/ℓ.
(e) Rise in temperature.

2. All values are maximum permissible except for Dissolved Oxygen which is minimum permissible.

3. All units in mg/ℓ except those indicated.

4. Water usage and classification of fresh surface water:

Classifications	Best usage
- Class AA	For source of public water supply. This class is intended primarily for water having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the National Standards for Drinking Water (NSDW) of the Philippines.
- Class A	For source of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the NSDW.
- Class B	For primary contact recreation.
- Class C	For the propagation and growth of fish and other aquatic resources.
- Class D	For agriculture, irrigation, livestock watering and industrial cooling and processing.
- Class E	For navigational use.

Source : Rules & Regulations of the National Pollution Control Commission (1978), Section 69, Table 1 - NPCC Water Quality Criteria (1978)

Table 3.9-1. 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
- 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
- 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	880	950	1,150	1,400	1,700	2,070	2,520	3,070
Flood Control	220	240	290	350	430	520	630	770
- 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

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

Table 4.1-1 PLANNING CRITERIA FOR FRAMEWORK PLAN, MASTER PLAN AND PRIORITY RPOJECT

Planning Criteria	Framework Plan	Master Plan	Priority Project
Target Completion Year	Not specified, but far future.	Year 2020	Year 2000
Coverage Area	Metro Manila Area, Cainta and Taytay.	In principle, same as Framework Plan.	Areas with top priority.
Land Use Condition	As of 2020.	As of 2020.	As of the present.
Design Return Period	River: 100-yr. Drainage: 10-yr.	To be set up river by river based on financial condition.	To be set up for the selected areas in consideration of economic viability
Financial Aspects	No consideration on financial aspect.	Within the limitation of funds available until the target completion year.	Within the limitation financial sources obtainable until the target completion year.

Table 5.3-1(1/4) CONSTRUCTION COST OF FRAMEWORK PLAN

PASIG-MARIKINA RIVER IMPROVEMENT (100-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
River Mouth/San Juan C.	Sta. 0+000/ 8+735	8,735	1150	2,334	0	40	3	0	1	20	646	60	706
San Juan C./Napindan C.	Sta. 8+735/18+495	9,760	500	300	0	60	10	0	0	15	212	45	257
Napindan C./M.C.G.S.	Sta.18+495/ 5+425	5,580	500	100	10	10	1	0	0	8	39	24	63
M.C.G.S. /Mangahan C.	Sta. 5+425/ 6+635	1,210	500	100	0	2	1	0	0	15	24	18	42
Mangahan C./Sta.7+425	Sta. 6+635/ 7+425	790	2900	50	5	2	2	0	0	10	26	12	38
M.C.G.S.			500	30	6	0	22	300	0	1	183	1	184
San Juan River	Sta. 0+000/10+653	10,653	900	1,820	0	175	43	0	4	50	580	177	757
	Sub-Total	36,728		4,734	21	289	82	300	5	119	1,710	337	2,047
Sta.7+425 /Nangka C.	Sta. 7+425/18+620	11,195	2900	2,493	555	109	46	0	0	950	497	334	831
Nangka C. /Rodorigez B.	Sta.18+620/27+200	8,580	2600	1,596	692	0	0	0	0	1,753	218	517	735
Marikina Dam (Qcut=600m3/s)			2100	40	0	0	120	0	0	2,500	675	125	800
	Sub-Total	19,775		4,129	1,246	109	166	0	0	5,203	1,390	976	2,366
	Total	56,503		8,863	1,267	398	248	300	5	5,322	3,100	1,313	4,413
Paranaque Spillway(C. Bottom Width : 60m)		9,000		7,600	45	30	50	590	5	580	3,476	524	4,000
	G.Total	56,503		16,463	1,312	428	298	890	10	5,902	6,576	1,837	8,413

Table 5.3-1(2/4) CONSTRUCTION COST OF FRAMEWORK PLAN

BAHO BULI MAHABA RIVER IMPROVEMENT (100-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Mahaba River	Sta. 0+000/ 5+000	5,000	190	475	43	0	0	0	6	210	78	159	237
	Sta. 5+000/ 6+000	1,000	190	12	0	0	0	0	0	3	1	3	4
	Sub-Total	6,000		487	43	0	0	0	6	213	79	162	241
Baho River	Sta. 0+000/ 5+500	5,500	335	682	37	0	0	0	7	209	112	146	258
	Sta.A0+000/A2+000	2,000	280	231	4	0	0	0	3	63	35	19	54
	Sta.A2+000/A3+000	1,000	280	49	0	0	0	0	0	10	5	3	8
	Sub-Total	8,500		962	41	0	0	0	10	282	152	168	320
Buli River	Sta. 0+000/6A+200	3,100	330	292	44	0	0	0	4	98	82	86	168
	Sta.6A+200/8A+200	2,000	280	304	6	0	0	0	3	73	45	22	67
	Sta.8A+200/9A+830	1,630	280	207	16	0	0	0	1	74	40	22	62
	Sta.9A+830/10+480	650	280	85	7	0	0	0	1	32	14	38	52
	Sta.10+480/14+000	2,520	200	317	20	0	0	0	3	113	57	135	192
	Sta.14+000/15+000	1,000	200	73	0	0	0	0	1	19	21	23	44
	Sub-Total	10,900		1,278	93	0	0	0	13	409	259	326	585
Tributary-B	Sta. 0+000/ 5+000	5,000	110	414	13	0	0	0	3	144	70	43	113
	Sta. 5+000/ 6+000	1,000	110	24	2	0	0	0	2	14	7	4	11
	Sub-Total	6,000		438	15	0	0	0	5	158	77	47	124
Tributary-C	Sta. 0+000/ 4+000	4,000	80	170	4	0	0	0	3	60	30	52	82
	Sta. 4+000/ 5+000	1,000	80	183	0	0	0	0	0	5	2	2	4
	Sub-Total	5,000		353	4	0	0	0	3	65	32	54	86
Mangahan Diversion	Sta. 6+800/ 6+100	700	570	1,059	18	0	0	0	0	219	159	65	224
	Sta. 6+100/ 4+500	1,600	520	1,023	0	0	0	0	0	170	156	51	207
	Sta. 4+500/ 3+000	1,500	340	499	29	0	0	0	0	114	56	34	90
	Sub-Total	3,800		2,581	47	0	0	0	0	503	371	150	521
	Total	40,200		6,100	242	0	0	0	37	1,630	970	907	1,877

Table 5.3-1(3/4) CONSTRUCTION COST OF FRAMEWORK PLAN

MALABON-TULLAHAN RIVER IMPROVEMENT (100-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Malabon River	Sta. 0+000/ 2+835	2,835	570	1,132	140	68	0	0	3	75	156	90	246
	Sta. 2+835/ 4+377	1,542	550	198	59	20	0	0	0	42	36	50	87
	Sta. 4+377/ 5+427	1,050	520	77	91	11	0	0	3	15	94	18	112
	Sub-Total	5,427		1,407	289	99	0	0	6	132	287	158	445
Tullahan River	Sta. 0+000/ 4+800	4,800	480	452	160	0	0	0	0	87	280	104	384
	Sta. 4+800/18+000	13,200	330	23	0	0	0	0	0	26	47	31	78
	Sta.18+000/20+500	2,500	240	11	24	0	0	0	0	7	16	8	24
	Sta.20+500/21+500	1,000	240	11	0	0	0	0	0	2	5	2	7
	Sub-Total	21,500		497	184	0	0	0	0	122	347	146	493
	Total	26,927		1,904	473	99	0	0	6	254	634	305	938

SOUTH PARANAQUE LAS PINAS RIVER IMPROVEMENT (100-Yr)

River	Stretch	Length (M)	Design Discharge (m3/s)	Required Works: Exca. (1000m3)	Embank. (1000m3)	Revet. (1000m2)	Concrete (1000m3)	Gate (ton)	Re.Bridge (place)	Land Acq. (1000m2)	Construction Cost: Civil Works (mil.Peso)	L.A./Compen. (mil.Peso)	Total (mil.Peso)
Las Pinas River	Sta. 0+000/ 1+780	1,780	250	227	100	3	0	0	2	32	132	38	171
	Sta. 1+780/ 6+395	4,615	220	624	118	25	0	0	2	135	151	162	313
	Sta. 6+395/ 7+395	1,000	130	38	0	7	0	0	0	4	15	5	20
	Sub-Total	7,395		889	218	35	0	0	4	171	298	205	503
South Paranaque River	Sta. 0+000/ 0+560	560	630	95	12	4	0	0	0	5	26	6	32
	Sta.D0+000/D0+400	400	630	95	24	0	0	0	0	2	64	2	67
	Sta.D0+400/S0+000	400	430	113	18	0	0	0	0	11	14	13	27
	Sta.S0+000/S1+200	1,200	430	302	86	0	0	0	0	46	45	37	82
	Sta.S1+200/S2+600	1,400	370	340	39	0	0	0	0	72	53	58	110
	Sta.S2+600/S3+600	1,000	370	113	3	0	0	0	0	20	13	16	29
	Sub-Total	4,960		1,060	183	4	0	0	0	156	214	132	346
Dongalo River	Sta. 0+000/ 2+600	2,600	200	265	48	16	0	0	0	30	80	24	104
	Sta. 2+600/ 3+600	1,000	200	38	2	7	0	0	0	8	16	6	23
	Sub-Total	3,600		302	50	23	0	0	0	38	97	30	127
	Total	15,955		2,251	451	62	0	0	4	365	609	368	977

Table 5.3-1(4/4) CONSTRUCTION COST OF FRAMEWORK PLAN

DRAINAGE IMPROVEMENT(10-Yr)

Drainage Area	Area	Required Works												Construction Cost		
		Pump Station		Gate		Channel Impvt.	Open Cha. Const.	Closed Cha. Const.	Ring Dike/ Lake Dike	Regulation Pond		Reconst. Bridge	Land Acq.	Civil Works	L.A./Compen.	Total
	(km2)	(site)	(m3/s)	(site)	(ton)	(m)	(m)	(m)	(m)	(site)	(1000m3)	(place)	(1000m2)	(mil.Peso)	(mil.Peso)	(mil.Peso)
North Manila & Suburbs	28.6	3	15.5	1	15	7,950	0	5,750	0	0	0	1	6	1,496	17	1,513
South Manila & Suburbs	43.1	1	5.3	2	25	7,750	0	0	0	0	0	3	3	909	9	918
Sub-Total	71.7	4	20.8	3	40	15,700	0	5,750	0	0	0	4	9	2,405	26	2,431
Malabon-Navotas	24.9	8	76.1	16	420	5,100	5,600	800	22,000	0	0	11	119	1,246	48	1,294
East of Mangahan	8.8	4	31.1	4	90	1,100	7,300	0	1,800	2	60	2	57	251	35	286
West of Mangahan	38.1	5	147.6	10	350	34,100	11,000	1,450	8,900	4	776	26	372	2,066	260	2,327
Sub-Total	71.8	17	254.8	30	860	40,300	23,900	2,250	32,700	6	836	39	548	3,563	344	3,906
San Juan	12.7	9	52.7	13	128	1,300	0	12,300	3,400	0	0	8	7	1,197	2	1,199
Mandaluyong Pasig	15.9	3	23.0	3	47	2,500	0	8,800	0	0	0	5	9	847	9	856
Marikina	13.0	0	0.0	1	10	0	1,000	2,600	0	0	0	2	23	179	9	188
Paranaque Laspinas	15.4	2	19.8	8	195	4,800	650	0	0	0	0	3	47	723	18	741
Valenzuela	18.4	3	10.9	1	15	12,900	500	0	8,000	0	0	4	38	318	15	333
Sub-Total	75.4	17	106.4	26	396	21,500	2,150	23,700	11,400	0	0	22	124	3,263	54	3,317
Total	218.9	38	382.0	59	1,296	77,500	26,050	31,700	44,100	6	836	65	681	9,231	424	9,655

Table 6.3-1(1/3) FLOODING WATER STAGE OF RIVERS

Name of Station	Station No.	Inundation Water Stage (El.m) 100-yr.	50-yr.	30-yr	20-yr.	10-yr.	5-yr.	2-yr.
Pasig-Marikina River								
(Pasig River)								
P-1	1+900	11.73	11.69	11.65	11.64	11.60	11.55	11.49
P-2	2+980	12.24	12.16	12.07	12.06	11.97	11.86	11.71
P-3	3+935	12.47	12.38	12.27	12.25	12.14	12.01	11.83
P-4	4+695	12.58	12.47	12.36	12.34	12.22	12.08	11.88
P-5	5+605	12.85	12.73	12.60	12.58	12.44	12.28	12.04
P-6	6+480	13.08	12.95	12.81	12.78	12.63	12.45	12.18
P-7	7+295	13.32	13.18	13.02	12.99	12.82	12.61	12.31
P-8	8+095	13.37	13.23	13.08	13.05	12.88	12.67	12.37
P-9	9+695	13.85	13.69	13.51	13.47	13.28	13.02	12.65
P-10	10+745	13.92	13.77	13.59	13.51	13.36	13.09	12.70
P-11	11+495	14.02	13.86	13.68	13.64	13.45	13.17	12.76
P-12	12+315	13.14	13.99	13.81	13.77	13.58	13.28	12.84
P-13	13+295	14.30	14.15	13.97	13.93	13.73	13.41	12.94
P-14	14+290	14.38	14.23	14.06	14.01	13.82	13.49	13.01
P-15	15+295	14.62	14.48	14.31	14.26	14.07	13.71	13.18
P-16	16+315	14.84	14.70	14.53	14.48	14.29	13.91	13.34
P-17	17+185	14.99	14.85	14.67	14.62	14.43	14.03	13.44
P-18	18+165	15.10	14.96	14.79	14.73	14.54	14.13	13.52
P-19	18+495	15.17	15.03	14.85	14.80	14.60	14.19	13.56
(Marikina River)								
M-1	0+980	15.23	15.09	14.92	14.86	14.67	14.25	13.61
M-2	1+780	15.27	15.13	14.96	14.90	14.70	14.28	13.64
M-3	2+710	15.34	15.20	15.02	14.96	14.76	14.33	13.68
M-4	3+700	15.41	15.26	15.09	15.02	14.82	14.38	13.72
M-5	4+660	15.52	15.36	15.18	15.12	14.90	14.46	13.79
M-6	5+595	15.71	15.55	15.35	15.28	15.05	14.61	13.92
M-7	6+635	15.21	16.03	15.83	15.75	15.49	15.03	14.32
M-8	7+615	18.09	17.82	17.52	17.41	17.03	16.43	15.58
M-9	8+575	18.93	18.65	18.34	18.22	17.83	17.19	16.29
M-10	9+465	19.43	19.15	18.83	18.72	18.31	17.66	16.74
M-11	10+410	19.69	19.42	19.11	19.00	18.61	17.98	17.09
M-12	11+175	20.10	19.83	19.52	19.41	19.02	18.38	17.46
M-13	12+125	20.90	20.60	20.27	20.15	19.73	19.04	18.06
M-14	13+120	21.32	21.01	20.66	20.54	20.07	19.39	18.43
M-15	14+120	21.67	21.34	20.98	20.84	20.33	19.65	18.68
M-16	15+120	22.86	22.45	22.02	21.86	21.22	20.47	19.43
M-17	16+120	23.31	22.86	22.39	22.21	21.52	20.76	19.70
M-18	17+120	23.44	23.00	22.54	22.38	21.72	21.00	20.08
M-19	18+120	23.76	23.33	22.89	22.73	22.10	21.46	20.68
M-20	19+220	23.95	23.53	23.08	22.93	22.30	21.67	20.90
M-21	19+850	24.00	23.58	23.14	22.98	22.36	21.74	20.97
M-22	20+600	24.17	23.77	23.37	22.21	22.68	22.16	21.60
M-23	21+400	24.78	24.46	24.15	24.01	23.52	23.09	22.77
M-24	22+150	25.44	25.18	24.93	24.79	24.22	23.72	23.36
M-25	23+080	26.11	25.86	25.62	25.48	25.09	24.74	24.39

Table 6.3-1(2/3) FLOODING WATER STAGE OF RIVERS

Name of Station	Station No.	Inundation Water Stage (El.m) 100-yr.	50-yr.	30-yr	20-yr.	10-yr.	5-yr.	2-yr.
(Marikina River, Cont'd)								
M-26	24+910	27.00	26.75	26.49	26.33	25.96	25.55	25.12
M-27	25+910	27.52	27.25	26.97	26.81	26.42	25.99	25.51
M-28	26+780	27.87	27.59	27.31	27.13	26.74	26.28	25.78
M-29	27+200	27.85	27.58	27.30	27.13	26.75	26.31	25.81
(Inundation Area: East Side Lowland of Mangahan)								
E-1	0+000	13.35	13.15	12.95	12.88	---	---	---
E-2	0+900	15.12	14.65	14.16	13.99	---	---	---
E-3	1+800	16.24	15.90	15.57	15.45	---	---	---
E-4	2+500	16.96	16.66	16.38	16.29	---	---	---
E-5	3+300	17.11	16.77	16.44	16.34	---	---	---
E-6	4+250	17.21	16.85	16.51	16.40	---	---	---
E-7	5+100	17.36	16.99	16.62	16.50	---	---	---
E-8	6+100	17.85	17.55	17.26	17.17	---	---	---
E-9	7+300	18.82	18.56	18.30	18.22	---	---	---
E-10	8+300	19.58	19.32	19.03	18.90	---	---	---
E-11	9+300	20.25	19.99	19.72	19.60	---	---	---
E-12	10+200	20.83	20.54	20.12	20.09	---	---	---
(Inundation Area: West Side Lowland of Mangahan)								
W-1	0+000	12.57	12.54	12.52	12.51	---	---	---
W-2	1+000	12.77	12.66	12.58	12.56	---	---	---
W-3	2+000	13.32	13.18	13.04	13.00	---	---	---
W-4	3+000	13.94	13.75	13.56	13.49	---	---	---
W-5	4+000	14.08	13.87	13.64	13.57	---	---	---
W-6	5+000	14.59	14.44	14.26	14.20	---	---	---
W-7	5+800	15.27	15.13	14.96	14.90	---	---	---
(San Juan River)								
S-1	0+000	13.60	13.45	13.30	13.25	13.10	12.85	12.50
S-2	1+000	14.18	14.02	13.90	13.81	13.61	13.37	13.02
S-3	2+000	14.56	14.40	14.29	14.19	13.96	13.74	13.40
S-4	2+975	15.31	15.16	15.09	14.96	14.71	14.52	14.20
S-5	4+130	16.32	16.15	16.10	15.94	15.64	15.44	15.09
S-6	5+130	16.79	16.63	16.57	16.41	16.12	15.93	15.59
S-7	6+000	17.25	17.10	17.04	16.89	16.62	16.44	16.12
S-8	7+000	18.06	17.91	17.85	17.70	17.43	17.25	16.93
S-9	7+690	18.61	18.45	18.39	18.23	17.96	17.78	17.50

Table 6.3-1(3/3) FLOODING WATER STAGE OF RIVERS

Name of Station	Station No.	Inundation Water Stage (El.m) 100-yr.	50-yr.	30-yr	20-yr.	10-yr.	5-yr.	2-yr.
Buli-Baho-Mahaba River								
(Buli River)								
Bu-1	1+000	15.30	15.10	14.80	14.45	14.20	14.10	14.00
Bu-2	2+000	16.75	16.68	16.62	16.61	16.58	16.53	16.46
(Baho River)								
Ba-1	3+000	16.10	15.80	15.60	15.40	15.30	15.10	15.00
Ba-2	4+000	17.42	17.34	17.27	17.25	17.19	17.11	17.02
Ba-3	5+000	19.42	19.20	19.01	18.94	18.79	18.54	18.22
Ba-4	6+000	17.70	17.57	17.44	17.38	17.27	17.06	16.63
Ba-5	7+000	18.56	18.43	18.32	18.27	18.20	17.99	17.51
Ba-6	8+000	19.75	19.57	19.40	19.34	19.24	18.91	18.09
Ba-7	9+000	17.00	17.00	17.00	17.00	17.00	17.00	17.00
(Mahaba River)								
Ma-1	3+000	16.90	16.70	16.50	16.20	16.10	15.90	15.70
Ma-2	4+000	19.19	19.05	18.96	18.93	18.83	18.71	18.59
Ma-3	5+000	21.68	21.56	21.46	21.43	21.39	21.34	21.26
Pond-1		19.36	19.33	19.32	19.31	19.30	19.27	19.20
Pond-2		14.42	14.30	14.20	14.16	14.05	13.93	13.78
Malabon-Tullahan River								
(Tullahan River)								
T-1	1+000	12.95	12.75	12.66	12.53	12.32	12.18	11.97
T-2	2+000	13.64	13.48	13.40	13.28	13.11	12.92	12.62
T-3	3+000	14.91	14.62	14.49	14.29	13.95	13.70	13.24
T-4	4+000	15.60	15.40	15.20	15.10	14.80	14.60	14.10
T-5	5+000	17.20	17.10	17.00	16.80	16.50	16.30	15.80
Pond-3		12.97	12.83	12.76	12.67	12.52	12.38	11.93
South Paranaque-Las Pinas River								
(Dongaro River)								
D-1								
D-2	2+000	13.55	13.34	13.27	13.21	13.12	13.01	12.84
D-3	3+000	15.96	15.75	15.62	15.53	15.39	15.23	15.03
(South Paranaque River)								
S-1	3+200	14.50	14.40	14.20	14.10	14.00	13.80	13.60
(Las Pinas River)								
L-1								
L-2	5+000	17.04	16.91	16.81	16.74	16.59	16.41	16.22
L-3	6+000	18.81	18.60	18.52	18.44	18.33	18.24	18.14
Pond-4		12.19	12.06	11.95	11.91	11.85	11.78	11.69

Table 6.3-2(1/5) INLAND INUNDATION WATER STAGE

Pond Name	Scale of Facilities	2-Yr Rainfall		3-Yr Rainfall		5-Yr Rainfall		10-Yr Rainfall		30-Yr Rainfall		50-Yr Rainfall		100-Yr Rainfall	
		Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)
MANILA AND SUBURBS (NORTH MANILA)															
NM-1	Existing	12.50	2.15	12.56	2.79	12.63	3.68	12.72	4.83	12.93	7.46	13.03	8.03	13.14	8.27
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.33	1.26	12.36	1.34	12.38	1.39
NM-2	Existing	11.97	0.20	11.99	0.20	12.01	0.21	12.05	0.21	12.14	0.22	12.19	0.23	12.28	0.24
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	11.97	0.20	11.97	0.20	11.97	0.20
NM-3	Existing	12.20	1.39	12.28	1.78	12.38	2.34	12.51	2.98	12.69	3.89	12.80	4.44	12.94	5.14
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.17	1.25	12.18	1.26	12.19	1.35
NM-4	Existing	12.30	0.13	12.38	0.16	12.47	0.20	12.53	0.24	12.67	0.34	12.76	0.41	12.87	0.49
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	11.98	0.01	11.99	0.01	11.99	0.01
NM-5	Existing	12.54	0.58	12.56	0.60	12.59	0.64	12.64	0.71	12.77	0.88	12.86	1.00	12.96	1.14
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.49	0.51	12.50	0.52	12.51	0.53
MANILA AND SUBURBS (SOUTH MANILA)															
SM-1	Existing	12.39	0.76	12.47	0.90	12.52	0.99	12.61	1.16	12.83	1.57	12.98	1.81	13.13	1.86
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.25	0.51	12.29	0.59	12.39	0.76
SM-2	Existing	12.03	1.10	12.06	1.32	12.10	1.64	12.19	2.26	12.41	3.75	12.49	4.33	12.57	4.76
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.05	1.29	12.08	1.46	12.12	1.78
SM-3	Existing	12.06	0.12	12.08	0.15	12.10	0.18	12.15	0.24	12.24	0.37	12.32	0.47	12.45	0.64
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	11.97	0.01	11.97	0.01	11.97	0.02
SM-4	Existing	12.07	0.73	12.09	0.85	12.12	1.00	12.19	1.31	12.35	2.03	12.46	2.56	12.52	2.73
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	11.96	0.25	11.97	0.28	11.98	0.31
SM-5	Existing	12.20	1.61	12.31	2.09	12.45	2.66	12.53	3.41	12.72	5.09	12.86	6.39	13.03	7.52
	2-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5-Yr	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10-Yr	-	-	-	-	-	-	-	-	12.35	2.24	12.44	2.66	12.51	3.22
MALABON-NAVOTAS															
MT-4-1	Existing	12.51	0.76	12.59	0.82	12.71	0.92	12.92	1.08	13.27	1.36	13.46	1.51	13.63	1.54
	2-Yr	-	-	12.20	0.48	12.24	0.51	12.27	0.54	12.31	0.58	12.32	0.60	12.36	0.63
	3-Yr	-	-	-	-	12.20	0.48	12.24	0.52	12.28	0.55	12.30	0.57	12.33	0.60
	5-Yr	-	-	-	-	-	-	12.20	0.48	12.25	0.53	12.27	0.55	12.29	0.57
	10-Yr	-	-	-	-	-	-	-	-	12.22	0.50	12.23	0.51	12.27	0.54
MT-4-2	Existing	12.59	0.33	12.66	0.37	12.77	0.42	13.01	0.52	13.41	0.70	13.56	0.75	13.72	0.80
	2-Yr	-	-	12.10	0.10	12.11	0.10	12.15	0.12	12.23	0.16	12.25	0.18	12.31	0.21
	3-Yr	-	-	-	-	12.10	0.10	12.12	0.11	12.17	0.14	12.20	0.15	12.26	0.18
	5-Yr	-	-	-	-	-	-	12.10	0.10	12.14	0.12	12.15	0.13	12.21	0.15
	10-Yr	-	-	-	-	-	-	-	-	12.11	0.11	12.12	0.11	12.15	0.13

Table 6.3-2(2/5) INLAND INUNDATION WATER STAGE

Pond Name	Scale of Facilities	2-Yr Rainfall		3-Yr Rainfall		5-Yr Rainfall		10-Yr Rainfall		30-Yr Rainfall		50-Yr Rainfall		100-Yr Rainfall	
		Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)
MALABON-NAVOTAS															
MA-1	Existing	10.98	0.47	11.03	0.58	11.07	0.73	11.14	0.96	11.25	1.33	11.31	1.53	11.39	1.79
	2-Yr	-	-	10.73	0.37	10.78	0.39	10.89	0.44	11.03	0.59	11.07	0.72	11.11	0.85
	3-Yr	-	-	-	-	10.73	0.37	10.80	0.40	10.95	0.46	11.02	0.55	11.06	0.68
	5-Yr	-	-	-	-	-	-	10.74	0.38	10.83	0.41	10.91	0.44	11.01	0.51
	10-Yr	-	-	-	-	-	-	-	-	10.75	0.38	10.79	0.40	10.86	0.42
MA-2	Existing	10.79	0.64	10.85	0.67	10.93	0.71	11.03	0.81	11.12	1.05	11.17	1.19	11.24	1.36
	2-Yr	-	-	10.78	0.63	10.83	0.66	10.93	0.71	11.05	0.87	11.09	0.98	11.14	1.11
	3-Yr	-	-	-	-	10.78	0.63	10.84	0.66	10.98	0.73	11.04	0.84	11.09	0.98
	5-Yr	-	-	-	-	-	-	10.79	0.64	10.88	0.68	10.95	0.72	11.03	0.82
	10-Yr	-	-	-	-	-	-	-	-	10.81	0.65	10.84	0.66	10.92	0.70
MA-3	Existing	11.06	1.36	11.11	1.43	11.16	1.51	11.25	1.64	11.38	1.83	11.45	1.93	11.53	2.01
	2-Yr	-	-	10.83	0.55	10.88	0.77	10.97	1.15	11.07	1.38	11.12	1.45	11.18	1.54
	3-Yr	-	-	-	-	10.83	0.55	10.89	0.81	11.01	1.29	11.05	1.35	11.11	1.43
	5-Yr	-	-	-	-	-	-	10.84	0.60	10.93	0.98	10.99	1.24	11.04	1.34
	10-Yr	-	-	-	-	-	-	-	-	10.86	0.68	10.89	0.81	10.96	1.11
MA-4	Existing	11.06	0.19	11.09	0.21	11.13	0.23	11.19	0.27	11.29	0.33	11.35	0.36	11.42	0.40
	2-Yr	-	-	10.83	0.07	10.88	0.09	10.97	0.14	11.07	0.20	11.12	0.23	11.18	0.26
	3-Yr	-	-	-	-	10.83	0.07	10.89	0.10	11.01	0.16	11.05	0.18	11.11	0.22
	5-Yr	-	-	-	-	-	-	10.84	0.07	10.93	0.12	10.99	0.15	11.04	0.18
	10-Yr	-	-	-	-	-	-	-	-	10.86	0.08	10.89	0.10	10.96	0.13
MA-5	Existing	11.17	0.72	11.24	0.74	11.33	0.76	11.48	0.79	11.62	1.02	11.70	1.16	11.79	1.34
	2-Yr	-	-	10.83	0.10	10.88	0.28	10.97	0.59	11.07	0.70	11.12	0.71	11.18	0.73
	3-Yr	-	-	-	-	10.83	0.10	10.89	0.31	11.01	0.69	11.05	0.70	11.11	0.71
	5-Yr	-	-	-	-	-	-	10.84	0.14	10.93	0.45	10.99	0.66	11.04	0.70
	10-Yr	-	-	-	-	-	-	-	-	10.86	0.21	10.89	0.31	10.96	0.55
MA-6	Existing	11.04	0.75	11.08	0.78	11.13	0.83	11.22	0.91	11.35	1.04	11.43	1.10	11.52	1.18
	2-Yr	-	-	10.92	0.51	10.94	0.57	10.98	0.67	11.05	0.76	11.09	0.79	11.14	0.84
	3-Yr	-	-	-	-	10.92	0.51	10.94	0.58	11.00	0.71	11.03	0.74	11.08	0.78
	5-Yr	-	-	-	-	-	-	10.92	0.52	10.96	0.62	10.99	0.68	11.02	0.73
	10-Yr	-	-	-	-	-	-	-	-	10.93	0.54	10.94	0.57	10.97	0.64
MA-7	Existing	11.40	0.80	11.50	0.90	11.59	0.91	11.76	0.92	12.02	0.93	12.16	0.93	12.33	0.94
	2-Yr	-	-	11.23	0.62	11.27	0.66	11.35	0.75	11.49	0.90	11.55	0.91	11.61	0.91
	3-Yr	-	-	-	-	11.23	0.62	11.28	0.67	11.40	0.80	11.47	0.87	11.54	0.91
	5-Yr	-	-	-	-	-	-	11.24	0.63	11.31	0.71	11.36	0.76	11.45	0.85
	10-Yr	-	-	-	-	-	-	-	-	11.25	0.64	11.28	0.67	11.34	0.73
MA-8	Existing	13.10	0.75	13.12	0.86	13.16	1.01	13.22	1.30	13.38	2.01	13.49	2.51	13.57	2.58
	2-Yr	-	-	13.00	0.30	13.01	0.32	13.01	0.36	13.03	0.42	13.03	0.45	13.05	0.50
	3-Yr	-	-	-	-	13.00	0.30	13.01	0.33	13.02	0.38	13.02	0.40	13.04	0.45
	5-Yr	-	-	-	-	-	-	13.00	0.30	13.01	0.34	13.02	0.36	13.02	0.40
	10-Yr	-	-	-	-	-	-	-	-	13.00	0.31	13.01	0.32	13.01	0.36
MA-9	Existing	11.29	0.12	11.32	0.17	11.37	0.17	11.45	0.21	11.56	0.24	11.60	0.24	11.67	0.25
	2-Yr	-	-	11.21	0.09	11.22	0.09	11.24	0.10	11.29	0.13	11.32	0.14	11.36	0.16
	3-Yr	-	-	-	-	11.21	0.09	11.23	0.09	11.26	0.11	11.28	0.12	11.32	0.14
	5-Yr	-	-	-	-	-	-	11.21	0.09	11.23	0.10	11.25	0.10	11.27	0.12
	10-Yr	-	-	-	-	-	-	-	-	11.21	0.08	11.22	0.09	11.23	0.09
MA-10	Existing	12.21	0.13	12.26	0.17	12.32	0.21	12.45	0.29	12.57	0.40	12.62	0.47	12.70	0.56
	2-Yr	-	-	12.00	0.00	12.01	0.01	12.02	0.02	12.05	0.03	12.06	0.04	12.08	0.05
	3-Yr	-	-	-	-	12.00	0.00	12.01	0.01	12.04	0.02	12.05	0.03	12.07	0.04
	5-Yr	-	-	-	-	-	-	12.00	0.00	12.02	0.01	12.03	0.02	12.05	0.03
	10-Yr	-	-	-	-	-	-	-	-	12.01	0.00	12.01	0.01	12.03	0.02
MA-11	Existing	11.11	0.23	11.17	0.24	11.24	0.25	11.37	0.28	11.53	0.32	11.59	0.37	11.66	0.42
	2-Yr	-	-	10.92	0.15	10.94	0.17	10.97	0.19	11.02	0.21	11.05	0.22	11.10	0.23
	3-Yr	-	-	-	-	10.92	0.15	10.94	0.17	10.99	0.20	11.01	0.21	11.04	0.22
	5-Yr	-	-	-	-	-	-	10.92	0.15	10.95	0.18	10.96	0.19	11.00	0.21
	10-Yr	-	-	-	-	-	-	-	-	10.93	0.16	10.94	0.17	10.96	0.18
MA-12	Existing	13.05	0.05	13.13	0.06	13.25	0.07	13.46	0.08	13.63	0.10	13.72	0.11	13.83	0.12
	2-Yr	-	-	12.50	0.00	12.51	0.00	12.53	0.00	12.57	0.01	12.59	0.01	12.62	0.01
	3-Yr	-	-	-	-	12.50	0.00	12.52	0.00	12.55	0.00	12.56	0.01	12.60	0.01
	5-Yr	-	-	-	-	-	-	12.50	0.00	12.53	0.00	12.54	0.00	12.57	0.01
	10-Yr	-	-	-	-	-	-	-	-	12.51	0.00	12.52	0.00	12.54	0.00

Table 6.3-2(3/5) INLAND INUNDATION WATER STAGE

Pond Name	Scale of Facil-ities	2-Yr Rainfall Max. Water Level (EL. m)	2-Yr Rainfall Max. Flooded Area (km²)	3-Yr Rainfall Max. Water Level (EL. m)	3-Yr Rainfall Max. Flooded Area (km²)	5-Yr Rainfall Max. Water Level (EL. m)	5-Yr Rainfall Max. Flooded Area (km²)	10-Yr Rainfall Max. Water Level (EL. m)	10-Yr Rainfall Max. Flooded Area (km²)	30-Yr Rainfall Max. Water Level (EL. m)	30-Yr Rainfall Max. Flooded Area (km²)	50-Yr Rainfall Max. Water Level (EL. m)	50-Yr Rainfall Max. Flooded Area (km²)	100-Yr Rainfall Max. Water Level (EL. m)	100-Yr Rainfall Max. Flooded Area (km²)
EAST OF MANGAHAN															
EM-1	Existing	13.45	0.20	13.58	0.23	13.75	0.29	14.10	0.38	14.44	0.41	14.54	0.43	14.61	0.44
	2-Yr	-	-	13.00	0.13	13.07	0.15	13.33	0.19	13.44	0.20	14.54	0.43	14.61	0.44
	3-Yr	-	-	-	-	13.05	0.15	13.28	0.19	13.35	0.20	14.54	0.43	14.61	0.44
	5-Yr	-	-	-	-	-	-	13.24	0.19	13.29	0.19	14.54	0.43	14.61	0.44
	10-Yr	-	-	-	-	-	-	-	-	13.25	0.19	14.54	0.43	14.61	0.44
EM-2	Existing	12.94	0.24	13.14	0.39	13.32	0.59	13.53	0.81	13.79	1.09	13.89	1.12	14.08	1.24
	2-Yr	-	-	12.73	0.23	12.77	0.23	12.82	0.23	12.92	0.24	13.89	1.12	14.08	1.24
	3-Yr	-	-	-	-	12.73	0.23	12.77	0.23	12.84	0.23	13.89	1.12	14.08	1.24
	5-Yr	-	-	-	-	-	-	12.74	0.23	12.79	0.23	13.89	1.12	14.08	1.24
	10-Yr	-	-	-	-	-	-	-	-	12.75	0.23	13.89	1.12	14.08	1.24
EM-3	Existing	12.80	0.24	13.01	0.40	13.16	0.63	13.25	0.77	13.65	1.32	13.86	1.56	14.08	1.80
	2-Yr	-	-	12.73	0.19	12.76	0.21	12.82	0.25	12.95	0.34	13.86	1.56	14.08	1.80
	3-Yr	-	-	-	-	12.73	0.19	12.77	0.22	12.86	0.28	13.86	1.56	14.08	1.80
	5-Yr	-	-	-	-	-	-	12.73	0.19	12.80	0.24	13.86	1.56	14.08	1.80
	10-Yr	-	-	-	-	-	-	-	-	12.75	0.20	13.86	1.56	14.08	1.80
EM-4	Existing	12.45	0.29	12.63	0.41	12.85	0.58	13.22	0.75	13.65	0.86	13.86	0.92	14.08	1.01
	2-Yr	-	-	12.25	0.19	12.33	0.23	12.49	0.31	12.63	0.41	13.86	0.92	14.08	1.01
	3-Yr	-	-	-	-	12.25	0.19	12.35	0.24	12.54	0.34	13.86	0.92	14.08	1.01
	5-Yr	-	-	-	-	-	-	12.27	0.20	12.43	0.28	13.86	0.92	14.08	1.01
	10-Yr	-	-	-	-	-	-	-	-	12.31	0.22	13.86	0.92	14.08	1.01
WEST OF MANGAHAN															
WM-1	Existing	12.58	1.73	12.65	2.10	12.85	3.16	13.22	4.73	13.65	5.84	13.86	6.02	14.08	6.30
	2-Yr	-	-	12.24	0.95	12.29	1.01	12.36	1.11	12.48	1.27	13.86	6.02	14.08	6.30
	3-Yr	-	-	-	-	12.24	0.95	12.30	1.03	12.40	1.16	13.86	6.02	14.08	6.30
	5-Yr	-	-	-	-	-	-	12.25	0.96	12.34	1.08	13.86	6.02	14.08	6.30
	10-Yr	-	-	-	-	-	-	-	-	12.27	0.99	13.86	6.02	14.08	6.30
WM-2	Existing	12.15	1.11	12.50	2.64	12.85	3.68	13.22	4.32	13.65	4.69	13.86	4.87	14.08	5.01
	2-Yr	-	-	11.77	0.33	11.85	0.38	12.00	0.46	12.08	0.81	13.86	4.87	14.08	5.01
	3-Yr	-	-	-	-	11.77	0.33	11.88	0.39	12.03	0.59	13.86	4.87	14.08	5.01
	5-Yr	-	-	-	-	-	-	11.80	0.35	12.01	0.50	13.86	4.87	14.08	5.01
	10-Yr	-	-	-	-	-	-	-	-	11.87	0.39	13.86	4.87	14.08	5.01
WM-3	Existing	12.17	1.54	12.50	2.96	12.85	4.51	13.22	5.28	13.65	5.54	13.66	5.70	14.08	5.87
	2-Yr	-	-	11.76	0.60	11.83	0.66	11.95	0.77	12.06	1.07	13.86	5.70	14.08	5.87
	3-Yr	-	-	-	-	11.76	0.60	11.87	0.70	12.02	0.90	13.86	5.70	14.08	5.87
	5-Yr	-	-	-	-	-	-	11.79	0.63	11.97	0.78	13.86	5.70	14.08	5.87
	10-Yr	-	-	-	-	-	-	-	-	11.84	0.67	13.86	5.70	14.08	5.87
WM-4	Existing	12.54	2.59	12.63	3.00	12.85	3.85	13.22	5.19	13.65	6.24	13.86	6.43	14.08	6.67
	2-Yr	-	-	12.00	0.91	12.05	0.97	12.12	1.04	12.26	1.70	13.86	6.43	14.08	6.67
	3-Yr	-	-	-	-	12.00	0.91	12.07	0.99	12.18	1.46	13.86	6.43	14.08	6.67
	5-Yr	-	-	-	-	-	-	12.01	0.94	12.11	1.24	13.86	6.43	14.08	6.67
	10-Yr	-	-	-	-	-	-	-	-	12.05	1.06	13.86	6.43	14.08	6.67
WM-5	Existing	12.18	0.68	12.50	0.89	12.85	1.35	13.22	1.69	13.65	1.94	13.86	2.04	14.08	2.14
	2-Yr	-	-	11.94	0.54	11.99	0.56	12.07	0.61	12.21	0.70	13.86	2.04	14.08	2.14
	3-Yr	-	-	-	-	11.94	0.54	12.01	0.57	12.11	0.63	13.86	2.04	14.08	2.14
	5-Yr	-	-	-	-	-	-	11.95	0.54	12.04	0.59	13.86	2.04	14.08	2.14
	10-Yr	-	-	-	-	-	-	-	-	11.98	0.55	13.86	2.04	14.08	2.14
SAN JUAN															
SJ-5-1	Existing	16.19	0.26	16.47	0.27	16.68	0.31	17.03	0.36	17.60	0.45	17.91	0.50	18.29	0.56
	2-Yr	-	-	15.64	0.24	15.66	0.24	15.68	0.24	15.72	0.24	15.75	0.24	15.78	0.24
	3-Yr	-	-	-	-	15.66	0.24	15.67	0.24	15.71	0.24	15.73	0.24	15.76	0.24
	5-Yr	-	-	-	-	-	-	15.67	0.24	15.70	0.24	15.72	0.24	15.74	0.24
	10-Yr	-	-	-	-	-	-	-	-	15.69	0.24	15.71	0.24	15.72	0.24
SJ-5-2	Existing	15.80	0.06	15.93	0.06	16.09	0.06	16.36	0.07	16.59	0.08	16.69	0.09	16.81	0.10
	2-Yr	-	-	15.57	0.05	15.58	0.05	15.59	0.05	15.61	0.05	15.62	0.05	15.64	0.05
	3-Yr	-	-	-	-	15.58	0.05	15.59	0.05	15.61	0.05	15.62	0.05	15.64	0.05
	5-Yr	-	-	-	-	-	-	15.59	0.05	15.61	0.05	15.61	0.05	15.63	0.05
	10-Yr	-	-	-	-	-	-	-	-	15.60	0.05	15.61	0.05	15.63	0.05
SJ-7-1	Existing	14.01	0.33	14.21	0.37	14.46	0.42	14.64	0.48	14.93	0.58	15.09	0.63	15.29	0.70
	2-Yr	-	-	13.71	0.27	13.76	0.28	13.82	0.29	13.90	0.31	13.93	0.31	13.98	0.32
	3-Yr	-	-	-	-	13.71	0.27	13.77	0.28	13.85	0.30	13.89	0.31	13.94	0.32
	5-Yr	-	-	-	-	-	-	13.72	0.27	13.80	0.29	13.83	0.29	13.89	0.31
	10-Yr	-	-	-	-	-	-	-	-	13.73	0.27	13.76	0.28	13.81	0.29

Table 6.3-2(4/5) INLAND INUNDATION WATER STAGE

Pond Name	Scale of Facil-ities	2-Yr Rainfall Max. Water Level (EL. m)	2-Yr Rainfall Max. Flooded Area (km²)	3-Yr Rainfall Max. Water Level (EL. m)	3-Yr Rainfall Max. Flooded Area (km²)	5-Yr Rainfall Max. Water Level (EL. m)	5-Yr Rainfall Max. Flooded Area (km²)	10-Yr Rainfall Max. Water Level (EL. m)	10-Yr Rainfall Max. Flooded Area (km²)	30-Yr Rainfall Max. Water Level (EL. m)	30-Yr Rainfall Max. Flooded Area (km²)	50-Yr Rainfall Max. Water Level (EL. m)	50-Yr Rainfall Max. Flooded Area (km²)	100-Yr Rainfall Max. Water Level (EL. m)	100-Yr Rainfall Max. Flooded Area (km²)
SAN JUAN															
SJ-7-2	Existing	14.25	0.09	14.50	0.10	14.67	0.11	14.97	0.13	15.45	0.16	15.71	0.18	16.04	0.20
	2-Yr	-	-	13.72	0.07	13.78	0.07	13.86	0.08	13.97	0.08	14.02	0.08	14.08	0.08
	3-Yr	-	-	-	-	13.71	0.07	13.77	0.07	13.88	0.08	13.92	0.08	13.99	0.08
	5-Yr	-	-	-	-	-	-	13.72	0.07	13.80	0.07	13.84	0.08	13.90	0.08
	10-Yr	-	-	-	-	-	-	-	-	13.73	0.07	13.76	0.07	13.81	0.07
SJ-8-1	Existing	14.19	0.09	14.45	0.10	14.64	0.11	14.93	0.12	15.41	0.14	15.68	0.16	16.02	0.17
	2-Yr	-	-	13.70	0.06	13.76	0.06	13.82	0.07	13.91	0.07	13.94	0.07	13.99	0.08
	3-Yr	-	-	-	-	13.71	0.06	13.76	0.07	13.85	0.07	13.88	0.07	13.94	0.07
	5-Yr	-	-	-	-	-	-	13.72	0.06	13.79	0.07	13.82	0.07	13.88	0.07
	10-Yr	-	-	-	-	-	-	-	-	13.73	0.06	13.75	0.06	13.81	0.07
SJ-8-2	Existing	14.13	0.06	14.38	0.07	14.59	0.07	14.87	0.08	15.35	0.10	15.61	0.10	15.94	0.11
	2-Yr	-	-	13.70	0.05	13.75	0.05	13.81	0.05	13.90	0.05	13.93	0.05	13.97	0.06
	3-Yr	-	-	-	-	13.71	0.05	13.76	0.05	13.85	0.05	13.88	0.05	13.93	0.05
	5-Yr	-	-	-	-	-	-	13.71	0.05	13.78	0.05	13.81	0.05	13.87	0.05
	10-Yr	-	-	-	-	-	-	-	-	13.73	0.05	13.75	0.05	13.80	0.05
SJ-9-1	Existing	12.77	0.13	12.89	0.18	13.03	0.24	13.28	0.34	13.55	0.44	13.64	0.45	13.75	0.47
	2-Yr	-	-	12.62	0.07	12.63	0.07	12.65	0.08	12.67	0.09	12.67	0.09	12.69	0.09
	3-Yr	-	-	-	-	12.63	0.07	12.65	0.08	12.67	0.09	12.67	0.09	12.68	0.09
	5-Yr	-	-	-	-	-	-	12.65	0.08	12.67	0.09	12.67	0.09	12.68	0.09
	10-Yr	-	-	-	-	-	-	-	-	12.66	0.09	12.67	0.09	12.68	0.09
SJ-9-2	Existing	12.98	0.26	13.18	0.31	13.43	0.39	13.66	0.43	14.02	0.48	14.21	0.51	14.45	0.55
	2-Yr	-	-	12.68	0.16	12.70	0.17	12.72	0.18	12.74	0.18	12.75	0.19	12.77	0.19
	3-Yr	-	-	-	-	12.69	0.17	12.71	0.17	12.73	0.18	12.74	0.19	12.76	0.19
	5-Yr	-	-	-	-	-	-	12.68	0.17	12.71	0.18	12.72	0.18	12.74	0.19
	10-Yr	-	-	-	-	-	-	-	-	12.70	0.17	12.71	0.18	12.73	0.18
SJ-9-3	Existing	13.00	0.08	13.20	0.11	13.46	0.14	13.67	0.15	14.01	0.17	14.19	0.18	14.42	0.19
	2-Yr	-	-	12.68	0.05	12.69	0.05	12.71	0.05	12.74	0.05	12.75	0.05	12.77	0.06
	3-Yr	-	-	-	-	12.68	0.05	12.70	0.05	12.72	0.05	12.73	0.05	12.75	0.05
	5-Yr	-	-	-	-	-	-	12.68	0.05	12.71	0.05	12.72	0.05	12.73	0.05
	10-Yr	-	-	-	-	-	-	-	-	12.70	0.05	12.70	0.05	12.72	0.05
SJ-10	Existing	12.89	0.26	12.99	0.31	13.07	0.37	13.20	0.47	13.41	0.62	13.50	0.66	13.60	0.67
	2-Yr	-	-	12.68	0.17	12.70	0.18	12.72	0.19	12.75	0.20	12.77	0.20	12.78	0.21
	3-Yr	-	-	-	-	12.68	0.17	12.71	0.18	12.74	0.19	12.75	0.20	12.77	0.21
	5-Yr	-	-	-	-	-	-	12.69	0.17	12.73	0.19	12.74	0.19	12.76	0.20
	10-Yr	-	-	-	-	-	-	-	-	12.70	0.17	12.71	0.18	12.73	0.19
MANDALUYONG-PASIG															
PM-5-1	Existing	16.94	0.67	17.13	0.80	17.38	0.98	17.77	1.26	18.44	1.73	18.61	1.85	18.81	1.99
	2-Yr	-	-	16.46	0.33	16.47	0.34	16.49	0.35	16.52	0.37	16.54	0.38	16.57	0.40
	3-Yr	-	-	-	-	16.46	0.33	16.48	0.34	16.50	0.36	16.52	0.37	16.54	0.39
	5-Yr	-	-	-	-	-	-	16.46	0.33	16.48	0.35	16.49	0.35	16.52	0.37
	10-Yr	-	-	-	-	-	-	-	-	16.47	0.34	16.48	0.34	16.49	0.35
PM-5-2	Existing	14.72	0.12	14.82	0.14	14.95	0.17	15.16	0.22	15.52	0.30	15.72	0.35	15.96	0.41
	2-Yr	-	-	14.46	0.06	14.47	0.06	14.47	0.06	14.49	0.07	14.49	0.07	14.51	0.07
	3-Yr	-	-	-	-	14.46	0.06	14.47	0.06	14.48	0.06	14.48	0.07	14.50	0.07
	5-Yr	-	-	-	-	-	-	14.46	0.06	14.47	0.06	14.48	0.06	14.49	0.07
	10-Yr	-	-	-	-	-	-	-	-	14.46	0.06	14.47	0.06	14.48	0.06
PM-7	Existing	13.46	1.46	13.53	1.49	13.62	1.52	13.77	1.58	14.01	1.68	14.13	1.73	14.30	1.79
	2-Yr	-	-	13.20	0.70	13.26	0.87	13.36	1.17	13.49	1.47	13.52	1.48	13.55	1.49
	3-Yr	-	-	-	-	13.20	0.70	13.27	0.91	13.42	1.34	13.48	1.47	13.52	1.48
	5-Yr	-	-	-	-	-	-	13.21	0.73	13.31	1.02	13.38	1.21	13.47	1.46
	10-Yr	-	-	-	-	-	-	-	-	13.23	0.79	13.27	0.90	13.35	1.13
MARIKINA															
PM-3-1	Existing	22.89	0.01	22.97	0.01	23.07	0.01	23.25	0.02	23.67	0.03	23.98	0.04	24.50	0.05
	2-Yr	-	-	22.50	0.00	22.51	0.00	22.53	0.00	22.57	0.00	22.59	0.00	22.63	0.00
	3-Yr	-	-	-	-	22.50	0.00	22.52	0.00	22.55	0.00	22.57	0.00	22.60	0.00
	5-Yr	-	-	-	-	-	-	22.50	0.00	22.53	0.00	22.54	0.00	22.57	0.00
	10-Yr	-	-	-	-	-	-	-	-	22.51	0.00	22.52	0.00	22.54	0.00
PM-3-2	Existing	22.71	0.01	22.75	0.01	22.81	0.02	22.91	0.02	23.16	0.04	23.34	0.05	23.65	0.06
	2-Yr	-	-	22.50	0.00	22.51	0.00	22.52	0.00	22.54	0.00	22.55	0.00	22.57	0.00
	3-Yr	-	-	-	-	22.50	0.00	22.51	0.00	22.53	0.00	22.54	0.00	22.55	0.00
	5-Yr	-	-	-	-	-	-	22.50	0.00	22.51	0.00	22.52	0.00	22.54	0.00
	10-Yr	-	-	-	-	-	-	-	-	22.51	0.00	22.51	0.00	22.52	0.00

Table 6.3-2(5/5) INLAND INUNDATION WATER STAGE

Pond Name	Scale of Facil-ities	2-Yr Rainfall		3-Yr Rainfall		5-Yr Rainfall		10-Yr Rainfall		30-Yr Rainfall		50-Yr Rainfall		100-Yr Rainfall	
		Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)	Max. Water Level (EL. m)	Max. Flooded Area (km^2)
MARIKINA															
PM-3-3	Existing	21.51	0.04	21.73	0.05	22.01	0.06	22.51	0.08	22.77	0.11	22.97	0.13	23.31	0.16
	2-Yr	-	-	20.51	0.00	20.55	0.00	20.62	0.00	20.75	0.01	20.81	0.01	20.92	0.02
	3-Yr	-	-	-	-	20.52	0.00	20.56	0.00	20.68	0.01	20.73	0.01	20.83	0.01
	5-Yr	-	-	-	-	-	-	20.52	0.00	20.59	0.00	20.64	0.01	20.73	0.01
	10-Yr	-	-	-	-	-	-	-	-	20.53	0.00	20.56	0.00	20.64	0.01
PM-3-4	Existing	19.94	0.10	20.04	0.12	20.16	0.15	20.40	0.21	20.62	0.25	20.73	0.27	20.91	0.31
	2-Yr	-	-	19.51	0.00	19.53	0.01	19.56	0.01	19.63	0.03	19.66	0.04	19.71	0.05
	3-Yr	-	-	-	-	19.51	0.00	19.53	0.01	19.59	0.02	19.61	0.03	19.66	0.04
	5-Yr	-	-	-	-	-	-	19.51	0.00	19.55	0.01	19.57	0.02	19.61	0.03
	10-Yr	-	-	-	-	-	-	-	-	19.52	0.00	19.53	0.01	19.56	0.01
PM-3-5	Existing	20.74	0.03	20.77	0.04	20.81	0.04	20.89	0.05	21.05	0.07	21.15	0.08	21.38	0.11
	2-Yr	-	-	20.72	0.03	20.73	0.03	20.74	0.03	20.76	0.03	20.77	0.03	20.78	0.04
	3-Yr	-	-	-	-	20.73	0.03	20.74	0.03	20.75	0.03	20.76	0.03	20.77	0.04
	5-Yr	-	-	-	-	-	-	20.74	0.03	20.74	0.03	20.74	0.03	20.76	0.03
	10-Yr	-	-	-	-	-	-	-	-	20.73	0.03	20.74	0.03	20.75	0.03
PM-3-6	Existing	20.62	0.03	20.64	0.04	20.68	0.05	20.74	0.07	20.87	0.11	20.98	0.14	21.15	0.19
	2-Yr	-	-	20.50	0.00	20.51	0.00	20.52	0.00	20.53	0.01	20.54	0.01	20.55	0.02
	3-Yr	-	-	-	-	20.50	0.00	20.51	0.00	20.52	0.01	20.53	0.01	20.54	0.01
	5-Yr	-	-	-	-	-	-	20.50	0.00	20.51	0.00	20.52	0.01	20.53	0.01
	10-Yr	-	-	-	-	-	-	-	-	20.50	0.00	20.51	0.00	20.52	0.00
FM-4-1	Existing	18.21	0.18	18.26	0.23	18.32	0.28	18.44	0.39	18.57	0.53	18.63	0.61	18.74	0.76
	2-Yr	-	-	18.00	0.00	18.01	0.01	18.03	0.03	18.06	0.05	18.07	0.06	18.09	0.08
	3-Yr	-	-	-	-	18.00	0.00	18.01	0.01	18.04	0.04	18.05	0.04	18.07	0.06
	5-Yr	-	-	-	-	-	-	18.01	0.01	18.02	0.02	18.03	0.03	18.05	0.04
	10-Yr	-	-	-	-	-	-	-	-	18.00	0.00	18.01	0.01	18.03	0.03
PM-4-2	Existing	18.26	0.11	18.32	0.14	18.39	0.17	18.51	0.23	18.57	0.29	18.62	0.34	18.70	0.42
	2-Yr	-	-	18.00	0.00	18.01	0.00	18.03	0.01	18.07	0.03	18.08	0.03	18.11	0.05
	3-Yr	-	-	-	-	18.00	0.00	18.02	0.01	18.05	0.02	18.06	0.03	18.09	0.04
	5-Yr	-	-	-	-	-	-	18.00	0.00	18.02	0.01	18.02	0.03	18.06	0.03
	10-Yr	-	-	-	-	-	-	-	-	18.01	0.00	18.02	0.01	18.03	0.01
PARAÑAQUE-LAS PIÑAS															
PA-1	Existing	12.86	2.80	13.00	3.31	13.14	3.50	13.42	3.89	13.69	3.99	13.79	4.02	13.91	4.05
	2-Yr	-	-	12.17	0.55	12.20	0.58	12.23	0.62	12.28	0.69	12.31	0.73	12.37	0.80
	3-Yr	-	-	-	-	12.18	0.56	12.20	0.59	12.25	0.65	12.27	0.68	12.32	0.73
	5-Yr	-	-	-	-	-	-	12.18	0.57	12.22	0.61	12.23	0.63	12.27	0.67
	10-Yr	-	-	-	-	-	-	-	-	12.19	0.57	12.20	0.59	12.21	0.61
PA-2	Existing	12.02	0.59	12.05	0.69	12.09	0.84	12.17	1.14	12.30	1.63	12.37	1.90	12.46	2.25
	2-Yr	-	-	11.96	0.35	11.97	0.37	11.97	0.39	11.98	0.41	11.98	0.42	11.99	0.44
	3-Yr	-	-	-	-	11.96	0.35	11.97	0.38	11.98	0.40	11.98	0.41	11.98	0.42
	5-Yr	-	-	-	-	-	-	11.96	0.35	11.97	0.39	11.97	0.39	11.98	0.41
	10-Yr	-	-	-	-	-	-	-	-	11.97	0.36	11.97	0.38	11.97	0.39
PA-3	Existing	12.13	0.30	12.20	0.42	12.29	0.58	12.44	0.83	12.54	0.98	12.59	1.04	12.65	1.13
	2-Yr	-	-	11.96	0.00	11.96	0.01	11.97	0.01	11.98	0.03	11.98	0.04	11.99	0.05
	3-Yr.	-	-	-	-	11.96	0.00	11.96	0.01	11.97	0.02	11.98	0.03	11.98	0.04
	5-Yr	-	-	-	-	-	-	11.96	0.00	11.97	0.01	11.97	0.02	11.98	0.03
	10-Yr	-	-	-	-	-	-	-	-	11.96	0.00	11.96	0.00	11.96	0.01
PA-4	Existing	12.06	0.62	12.11	0.74	12.18	0.94	12.30	1.26	12.49	1.68	12.55	1.69	12.63	1.70
	2-Yr	-	-	11.97	0.38	11.99	0.42	12.02	0.50	12.06	0.61	12.07	0.63	12.08	0.66
	3-Yr	-	-	-	-	11.97	0.38	11.99	0.43	12.03	0.53	12.06	0.60	12.07	0.63
	5-Yr	-	-	-	-	-	-	11.98	0.39	12.01	0.47	12.03	0.52	12.06	0.60
	10-Yr	-	-	-	-	-	-	-	-	11.99	0.41	12.00	0.45	12.02	0.50
VALENZUELA															
ME-9	Existing	12.11	2.95	12.16	3.52	12.23	4.27	12.37	5.66	12.51	7.58	12.55	8.48	12.61	9.65
	2-Yr	-	-	12.13	3.22	12.19	3.85	12.25	4.43	12.32	5.16	12.35	5.47	12.39	5.87
	3-Yr	-	-	-	-	12.19	3.85	12.25	4.43	12.32	5.16	12.35	5.47	12.39	5.87
	5-Yr	-	-	-	-	-	-	12.23	4.18	12.30	4.95	12.33	5.26	12.37	5.70
	10-Yr	-	-	-	-	-	-	-	-	12.27	4.60	12.30	4.95	12.34	5.39

TABLE 6.3-3 BENEFIT/COST RATIOS OF ALTERNATIVE CASES ON THE 2020-YEAR LAND USE CONDITIONS

RIVER SYSTEM	BENEFIT/COST RATIOS				
	100-YR	50-YR	30-YR	20-YR	10-YR
PASIG MARIKINA	1.32	1.38	1.38	1.35	1.28
BULI BAHO MAHABA	0.73	0.82	0.84	0.83	0.78
MALABON TULLAHAN	0.73	0.88	0.98	1.04	1.14
S.PARANAQUE LAS PINAS	0.98	1.07	1.13	1.16	1.19

DRAINAGE AREA	BENEFIT/COST RATIOS			
	10-YR	5-YR	3-YR	2-YR
MANILA	1.17	---	---	---
MALABON NAVOTAS	2.40	2.49	2.50	2.29
EAST OF MANGAHAN	1.77	1.89	1.94	1.88
WEST OF MANGAHAN	1.97	2.19	2.38	2.57
SAN JUAN	0.81	0.83	0.79	0.69
MANDALUYONG PASIG	1.36	1.42	1.45	1.65
MARIKINA	1.40	1.52	1.61	1.69
PARANAQUE LAS PINAS	0.97	1.08	1.23	1.37
VALENZUELA	1.59	1.61	1.39	0.98

Table 6.4-1 PROJECT SCALES AND INVESTMENT COST

RIVER SYSTEM / DRAINAGE AREA	CASE 1		CASE 2		CASE 3		CASE 4		CASE 5		CASE 6	
	PROJECT SCALE	INVEST. (MIL.P)	PROJECT SCALE	INVEST. (MIL.P)	PROJECT SCALE	INVEST. (MIL.P)	PROJECT SCALE	INVEST. (MIL.P)	PROJECT SCALE	INVEST. (MIL.P)	PROJECT SCALE	INVEST. (MIL.P)
1. PASIG-MARIKINA RIVER	100-Yr.	4,413	100-Yr.	4,413	30-Yr.	3,774	30-Yr.	3,774	100-Yr.	4,413	30-Yr.	3,774
2. BAHO BULI MAHABA RIVERS	50-Yr.	1,652	30-Yr.	1,542	30-Yr.	1,542	20-Yr.	1,494	---		---	
3. MALABON-TULLAHAN RIVER	50-Yr.	759	30-Yr.	655	30-Yr.	655	20-Yr.	589	---		---	
4. S. PARANAQUE L. PINAS RIVERS	50-Yr.	869	30-Yr.	780	30-Yr.	780	20-Yr.	715	---		---	
SUB-TOTAL		7,693		7,390		6,751		6,572		4,413		3,774
1. MANILA	10-Yr.	2,431	---		---		---		10-Yr.	2,431	---	
2. MALABON NAVOTAS	10-Yr.	1,294	5-Yr.	1,151	5-Yr.	1,151	3-Yr.	1,004	10-Yr.	1,294	5-Yr.	1,151
3. EAST OF MANGAHAN	10-Yr.	286	5-Yr.	249	5-Yr.	249	3-Yr.	218	10-Yr.	286	5-Yr.	249
4. WEST OF MANGAHAN	10-Yr.	2,327	5-Yr.	2,076	5-Yr.	2,076	3-Yr.	1,893	10-Yr.	2,327	5-Yr.	2,076
5. SAN JUAN	5-Yr.	1,066	3-Yr.	962	3-Yr.	962	2-Yr.	867	---		---	
6. MANDALUYONG PASIG	5-Yr.	790	3-Yr.	721	3-Yr.	721	2-Yr.	579	---		---	
7. MARIKINA	5-Yr.	200	3-Yr.	184	3-Yr.	184	2-Yr.	168	---		---	
8. PARANAQUE LASPINAS	5-Yr.	658	3-Yr.	573	3-Yr.	573	2-Yr.	504	---		---	
9. VALENZUELA	5-Yr.	265	3-Yr.	217	3-Yr.	217	2-Yr.	211	---		---	
SUB-TOTAL		9,316		6,133		6,133		5,443		6,338		3,476
TOTAL INVESTMENT		17,009		13,523		12,884		12,015		10,751		7,250

Table 6.4-2 COMPOSITION OF PROPOSED COMMITTEE

	Composition	Present Related Responsibility	Position in Committee	Proposed Responsibility for the Committee
1.	Secretary of DPWH	Supervision of all flood control projects nationwide.	Chairman	Management, presiding and coordinating for the committee.
2.	Director-General of NEDA	Allocation of funds for flood control and drainage projects nationwide.	Member	Coordination on the fund allocation of the proposed projects and other projects.
3.	Governor of MMC	Supervision of all public service activities in Metro Manila.	-ditto-	Coordination of the proposed projects and other public affairs in Metro Manila.
4.	Undersecretary for Planning, DPWH	Supervision of the Planning Service, the Bureau of Design, and the Bureua of Research and Standards, DPWH.	-ditto-	Coordination of the proposed projects and other plans administered by DPWH.
5.	General Manager of LLDA	Identification of development programs of Laguna Lake and adjoining areas.	-ditto-	Coordination of the proposed projects and other programs in Laguna Lake and adjoining areas.
6.	President of Metro Manila Mayor's League	Supervision of public service activities in respective cities or municipalities.	-ditto-	Coordination of the proposed projects and other public affairs in the cities and municipalities concerned.

Table 6.4-3 COMPOSITION OF PROPOSED TECHNICAL WORKING GROUP (TWG)

	Composition	Present Related Responsibility	Position in Committee	Proposed Responsibility for TWG
1.	Undersecretary for Planning, DPWH	Supervision of the Planning Service, the Bureau of Design, and the Bureau of Research and Standards, DPWH.	Chairman	Management, presiding and coordination for TWG.
2.	Regional Director of DPWH-NCR	Management of DPWH-NCR and supervision of all flood control projects in Metro Manila.	Member	Coordination of the proposed projects and other programs administered by DPWH-NCR and other related regional programs under DPWH.
3.	Project Director of PMO, DPWH	Implementation of major flood control and drainage projects in Metro Manila.	-ditto-	Coordination of the proposed projects and other related programs under PMOs under DPWH.
4.	Representative of NEDA	Allocation of funds for flood control and drainage projects.	-ditto-	Coordination on the fund allocation of the proposed projects and other programs.
5.	Representative OF LLDA	Identification of development progams of Laguna Lake and adjoining areas.	-ditto-	Coordination of the proposed projects and other programs in Laguna Lake and adjoining areas.
6.	Representative of PAGASA	Meteorological information services and flood forecasting activities.	-ditto-	Coordination and cooperation on flood forecasting.
7.	Representative of OCD	Information center on flood defense and flood disaster.	-ditto-	Cooperation on flood forecasting and flood defense.
8.	Representative of MMC	Cleaning of waterways to facilitate drainage, and minor drainage programs as a part of road maintenace projects.	-ditto-	Coordination of the proposed projects and other public affairs in Metro Manila.
9.	President of Metro Manila Mayor's League*	Supervision of public service activities in respective cities or municipalities.	-ditto-	Coordination of the proposed projects and other public affairs in the cities and municipalities concerned.

* On call, case to case basis.

Table 6.4-4 RESPONSIBILITY OF PROPOSED IMPLEMENTING AGENCIES

Items	D P W H		Local /3
	NCR	PMOs	Governments
I. Planning and Design	0	0	
II. Construction	0	0	
III. Operation /1	0		
IV. Maintenance /1			
1. River	0		
2. Drainage Facilities			
(a) Estereo	0		
(b) Drainage Main/Outfall	0		
(c) Drainage Lateral /2			
- Major	0		
- Minor			0
(d) Street Gutter /2			
- Major	0		
- Minor			0

[Note]

/1: Operation and Maintenance of pumping stations, floodgates, etc., are included.

/2: Drainage laterals and street gutters are classified into two: major facilities and minor facilities. Major facilities are those connected to national level structures and/or national roads and minor facilities are those connected to local government level structures and/or secondary/tertiary roads.

/3: Local governments mean MMC and city/municipality.

0: This mark shows the execution of each item of responsibility.

Table 6.4-5 WORK UNIT COST

Item	Unit	(A) Total	(A) F.C.	(A) L.C.	(B) Total	(B) F.C.	(B) L.C.	(C) Total	(C) F.C.	(C) L.C.	Remarks
1 Main Civil Works											
Excavation	cu.m										
Excavation,common	cu.m	50	43	7	30	26	4	30	26	4	
Excavation,pump dredger	cu.m	170	145	25	140	119	21	50	43	7	
Excavation,clamshell	cu.m	200	170	30	160	136	24	70	60	10	
Backfill	cu.m	30	26	4	30	26	4	30	26	4	
Embankment	cu.m	40	34	6	40	34	6	40	34	6	
Rip-rap	sq.m	100	50	50	100	50	50	100	50	50	
Revetment,rubble concrete	sq.m	600	450	150	600	450	150	600	450	150	
Mass concrete	cu.m	1,500	1,125	375	1,500	1,125	375	1,500	1,125	375	
Parapet wall,R.C.	cu.m	3,000	2,100	900	3,000	2,100	900	3,000	2,100	900	
River wall,rubble concrete	cu.m	1,200	660	540	1,200	660	540	1,200	660	540	
River wall,reinforced con.	cu.m	4,000	2,800	1,200	4,000	2,800	1,200	4,000	2,800	1,200	
River wall,steel sheet pile	sq.m	3,500	3,325	175	3,500	3,325	175	3,500	3,325	175	
Bridge(inc.demolition)	sq.m	8,000	6,000	2,000	8,000	6,000	2,000	8,000	6,000	2,000	
Sub total											
Preparatory works & mis. *1)											1);20-80% of sub-total
Total											
2 E/S & admi. *2)											2);20% of main civil works
3 Contingency *3)											3);10% of (1+2)
4 Land acquisition											
Congested area 1 *4)	sq.m	3,000			3,000			3,000			4);Manila,Quezon,Makati & Pasay city aeras
Congested area 2 *5)	sq.m	1,200			1,200			1,200			5);except above-mentioned 4)areas
Open space *6)	sq.m	300			300			300			6);other than residence area

Notes:
* Unit costs(A) are applied in the congested areas along the Pasig R.& Esteros.
* Unit costs(C) are applied in the areas of the vicinities of river mouths and with available spaces for spoil banks.
* Unit costs(B) are applied for areas other than the above-mentioned areas where unit costs (A)or(C) applied.
* Preparatory works & mis. costs are varied in accordance with revetment works & water depth.
  - 80% : water depth of 5m<H
  - 50% : water depth of 3m<H<5m
  - 30% : water depth of H<3m
  - 20% : others