CHAPTER 3 INITIAL ENGINEERING STUDY

3.1 General

3.1.1 Purpose of Study

The initial engineering study for the reclamation has been conducted to identify the suitable development scale in terms of physical conditions, environmental situation and construction economy.

3.1.2 Location of the Reclamation Site

The proposed reclamation site is situated in the north-west of Manila. This proximity facilitates the absorption by the reclaimed area of development activities from the Manila Metropolitan Area. With the Navotas Fishery Port in between, the site is contiguous to the port of Manila, the most important port of the nation (See Fig. IV-3-1).

3.2 Physical Conditions of the Reclamation Site

3.2.1 Hydrography

The shallow water depth of Manila Bay is due to the continuous sediment discharged from several rivers of which the most significant to the site is the Meycawayan River.

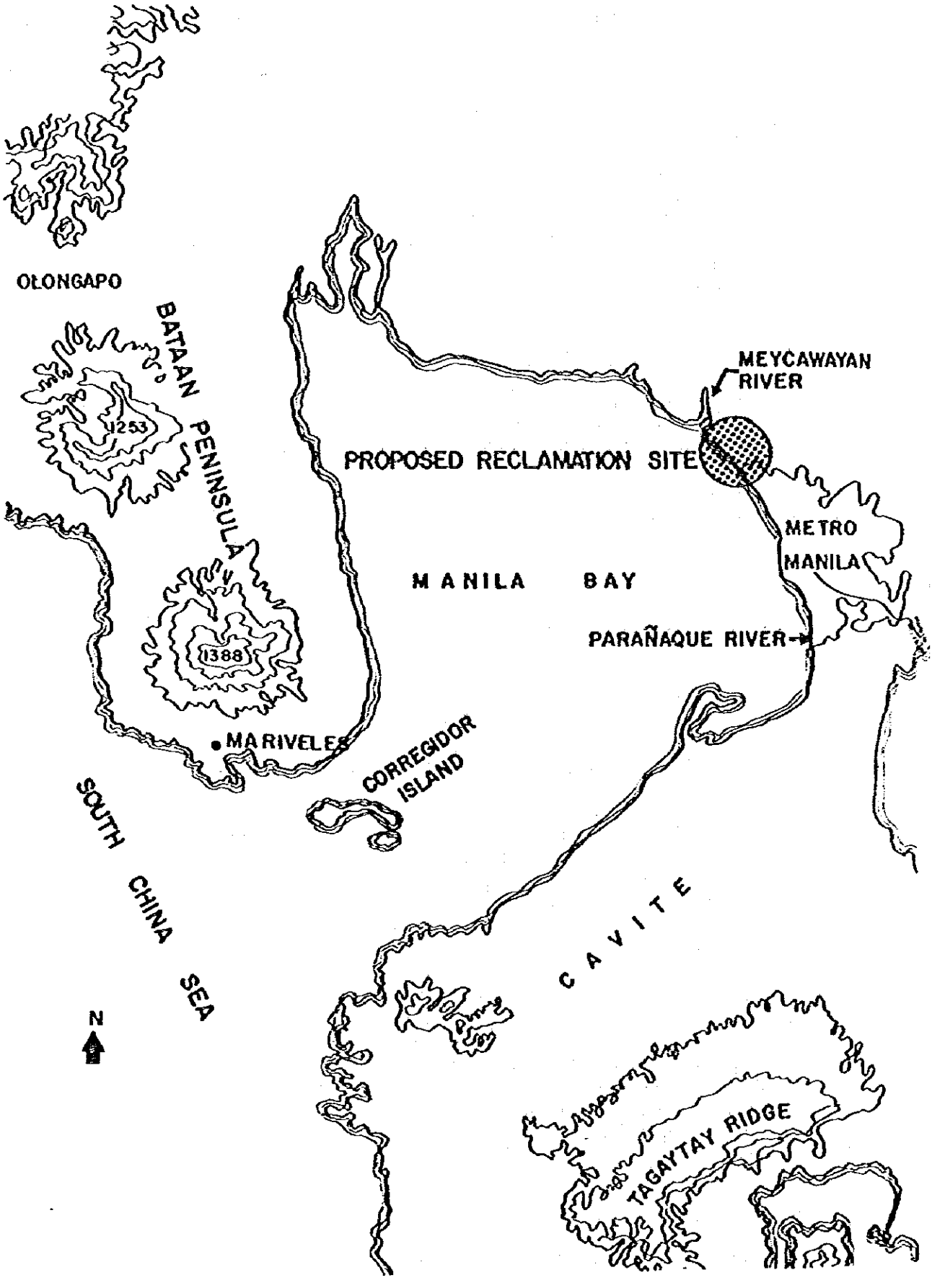
The general features of costal deposits of Manila Bay are primarily due to the characteristics of the bay current. The bay opens to the southwest facing the south China Sea and the eastward and northward currents are commonly observed in the vicinity of the proposed reclamation site.

In the case of Paranàque river which is located south of the Project site, major sediment does not form near its estuary because of the relatively strong velocity of the bay current.[1]

On the other hand, heavy deposits are found in the estuary area of the Meycawayan River and the sea is shallow for a good distance from the shore since the river experiences a weak velocity of the bay current because it is located in the inner part of Manila Bay.

1/ Source: The Journal of the Geological Society of the Philippines, Vol. XXIII.

Fig. IV-3-1 GENERAL PLAN OF MANILA BAY



3.2.2 Oceanography

The main tidal data are as follows:

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

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

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

No record of wave observations are available for the vicinity of the proposed reclamation site. However, in 1978, Salzgitter Consult GMBH estimated the waves with a probability of occurrence of once per year for each direction of attack using meteorological data. The results of the study made by Salzgitter are summarized as follows:[5/]

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

5/ Source: Master Plan Study, Port of Manila, 1978

No official records concerning current observations are available of Manila Bay; however, a short survey was made some years ago and reported current velocities of around 0.05 m/sec. Even under the most adverse conditions, e.g. superposition of tidal currents and wind generated currents, no effective disturbance to navigation is expected.

3.2.3 Meteorology

Information on air temperature, relative humidity, rainfall, and prevailing wind direction and mean wind speed are presented in Appendix I-85.

Three major wind systems have been identified:

- NE monsoon (September - February)
- SE trade winds (February - May)
- SW monsoon (June - September)

Between 1955 and 1973, for the months of June to December, a total of 83 tropical cyclones (or more than 4 per year) approached Manila within 180 nautical miles. 30% of these typhoons caused winds in Manila of 40 km/h (Beaufort 6) and higher; only 8% cause gales of 63 km/h (Beaufort 8) and higher.[6/]

The average mean annual rainfall observed in Meycawayan and Navotas River systems ranges from 1,800 mm to 2,200 mm. Since the area has a tropical heavy rainfall, the type of rainfall is characterized by heavy showers. In such showers the rate of precipitation may reach to about 400 mm in low land area and 600 mm in mountain area at maximum 24-hour rainfall of 25-year frequency.[7/]

3.2.4 Sub-surface Soils Conditions

Based on available data and information concerning subsurface soils conditions, the probable soil profiles and cross sections along the proposed routes were drawn and are shown in Appendix I-86. The Geological Map shown in Appendix I-88 shows the general boundary between alluvial lowland plains (deltas) and diluvial upland formation (Guadelupe Tuff).

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

The deltaic deposits are intensively developed at variable depths of 10 to 25 m and are composed of silty clay, sandy and fine sand.

6/ Source: Master Plan Study, Port of Manila, 1978.
7/ Source: Pampanga Delta-Candaba Swamp Development Project, 1977.

Deltaic deposits predominate, particularly in water-logged areas and fishponds. Representative soils properties of each layer are summarized as follows:

Epoch	Name of Layer	N-Value	Unconfined Compressive Strength (qu)	Moisture Content (%)	Index (IP)
Recent	Silty Clay	0 to 3	0.1 to 0.3 kg/cm^2	40 to 50	15 to 20
Ditto	Silty Sand	0 to 3	-	-	-
Recent/ Pleisto-cene	Alternating Silty Sand/ Sandy Silt/ Clay	5 to 30	-	-	-
Pleisto-cene	Tuff	20 to 50	10 to 20 kg/cm^2	-	-

The stratification of sub-surface soils at the area to be filled is estimate as follows:

- Alluvium loose silt and clay with thin sand layers (from seabed to approximately 10 meters below seabed);
- Deluvium silty sand, sandy silt and clay layers (approximately 10 meters to 25 meters below seabed); and
- Tertiary bedrock, tuff (approximately 20 to 30 meters below seabed.

3.3 Various Conditions Affecting the Scale of Reclamation Area

Before the establishment of the conceptual plan, studies and evaluations of various conditions inherent to the Site were carried out to identify the limit of the proposed reclamation area under the combined considerations of land use, physical situation and surroundings. The following description is an outline of the findings:

3.3.1 Land Use

The proposed reclaimed area may involve the following tentative land uses:

- Clean industrial area;
- Commodity distribution center;
- Garbage disposal area;
- Housing area; and
- Areas for the other urban services.

3.3.2 Physical Conditions

As described in Section 3.2 the hydrographical, oceanographical and meteorological condtions of the site are considered to be favorable not only for the reclamation, but also for the wharf facilities planned.

The subsurface soils condition at the site will necessitate consideration for the settlement of foundations and fill materials. Therefore survey of the subsurface soils and the study for the settlement of soft soils are indispensable.

3.3.3 Access to the Site

The land transport system in Metro Manila Area is considered to be road intensive, with rail commuter traffic servicing only a limited share of daily passenger trips.

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

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

It is expected that the construction of the two above mentioned R-10 projects will offer favorable land access to the reclamation site and provide ideal land transport conditions.

In view of the present situation of the Port of Manila, it is clear that the development of the Site will be beneficial not only for reclaimed area itself, but also for the Port which is needed an alternative supporting port to the South and North Harbors.

3.3.4 Meycawayan River and the Reclamation

To avoid the adverse effects of flooding which may occur by offshore reclamation, a hydrological study for Meycawayan River, especially a river course study, has been conducted. As a result of the hydrological study it was found that a minimum width of about 1,500 meters of waterway is required. The main hydrological components for Meycawayan River are as follows:

Watershed area	590 km^2 approx.
Time of concentration	6 hr.
Rainfall intensity	37 mm/hr (50-yr. frequency)
Run-off coefficient	0.6
Flood discharge	3,680 m^3/sec. (50-yr. frequency)
Length of waterway between reclamation blocks	3.5 km
Maximum backwater effect by the reclamation	15 cm
Anticipated head loss due to the bridge crossing the waterway	2 cm

If the reclamation is extended to the north of Meycawayan River, it would require a heavy investment cost for bridge construction needed to cross the waterway.

The construction cost for this bridge is estimated to be US $30 million (at 1979 prices) less contingencies and escalation allowance, and is based on the following bridge characteristics:

Total span	1,500 m
Width	2-2 lane (2 x 12.7 m)
Bridge Superstructure	Prestressed pretensioned concrete girder, 30 m long
Abutment	Inverted T-shape R.C. structure with cast-in-place R.C. pile foundations.
Pier	Cast-in-place pile bents

3.3.5 *Fisheries*

Due to the vital role of the fisheries in the regional economy, efforts must be made to preserve the existing fishing resources, even during the implementation of the reclamation and road projects.

It is known that any shortage of the supply of brackish water to the fishponds will adversely effect the satisfactory growth of milkfish.

Such effects (which are likely to occur with the reclamation extending to the north of Meycawayan River) can be eliminated by satisfactory waterway construction, and further, it is possible to simultaneously improve present brackish water supply situation in Meycawayan basin by providing the reclamation with well planned river course dredging upstream.

However, for the offshore reclamation north of the Meycawayan River, very carefull consideration will be necessary in order to maintain the fishpond and municipal fisheries as well as the estuary ecosystem during and after the construction of the reclaimed area.

3.3.6 Magnitude Costs of Unit Area of Reclaimed Land

Development of the conceptual plan for the reclaimed area must be done based on reclamation costs. Generally, reclamation cost is composed of the following:

- Filling cost (F-cost);
- Shore protection cost (S-cost);
- Soils improvement cost (I-cost); and
- Miscellaneous cost (M-cost).

Unit reclamation cost (total of F-, S-, I- and M-costs) will not be much influenced by the length along the shoreline, but mainly by the width from shoreline to the outer tip of the reclamation area (S-width).

Appendix I-89 shows the relation of S-width to sea depth and Appendix I-90 shows the effect of project width (S-width) and soil improvement ratio on the index of reclamation costs.

The following conditions are given for the calculation of the magnitude costs of unit reclamation area; these conditions do not preclude the establishment of more detailed conditions in the next stage of the study.

i) M-cost is omitted because of its proportion with the land area regardless of S-width.

ii) The assumed finished ground level is 3.0 M above M.L.L.W.

iii) The assumed bulkhead is the rock type with a slope of 1:2 sea-side, 1:1.2 land-side and 2 m top width.

iv) The soil improvement ratio by area is assumed zero for curve A, 30 percent for curve B and 50 percent for curve C.

v) The unit costs used in the comparison are as follows:

- Filling cost = P15 per cu.m.

- Rock mound cost = P200 per cu.m.

- Soil improvement cost

  Filling ground = P164 per square meter (by sand drain method).

  Bulkhead = P700 per square meter for the bottom area of rock (by sand composer method).

Table IV-3-1 shows the effect of project width (S-width) and soil improvement ratio on the index of reclamation costs.

Table IV-3-1 EFFECT OF PROJECT WIDTH AND SOIL IMPROVEMENT RATIO ON INDEX OF RECLAMATION COSTS

S-Width in meters	Soil improvement ratio 0%	30%	50%
250	1.000	1.000	1.000
500	0.951	0.966	0.916
1000	0.910	0.933	0.943
1500	0.999	0.999	0.999
2000	1.097	1.072	1.063
2500	1.198	1.150	1.133
3000	1.303	1.229	1.201
3500	1.408	1.309	1.272
4000	1.512	1.389	1.340

3.3.7 Conclusions

Based on the foregoing studies and evaluations, it is recommended that:

A. The limitation of the reclamation to the south bank of Meycawayan River should preserve the existing fishponds in Bulacan which is the major source of milkfish in the Manila Bay Region. Extensive reclamation immediately north of the river would block brackish water flowing freely from the Manila Bay into the fishponds, thereby hampering fish growth.

B. Reclamation as planned is recommended since reclamation further northward would reduce the outflow of Meycawayan River and cause disastrous flooding. A waterway with a width of about 1,500 meters must be provided to minimize such damming effect. The waterway would require a long bridge to span it and the substantial additional investment is not warranted at this stage.

C. The index of reclamation cost at S-width 1,000 meters is the minimum point. Therefore it can be said that the reclamation can be achieved very economically around this width (1,000 m) from the shore.

CHAPTER 4. ESTABLISHMENT OF CONCEPTUAL DEVELOPMENT PLAN

4.1 Alternative Development Concepts

4.1.1 General

Since there are various developmental approaches to solve the pressing problems in Metro Manila, the main aim of this chapter is to evaluate alternative development concepts for the Project. This includes determining of basic policies and objectives and also looking at the inland development sites vis-a-vis an offshore reclamation site. The examination and evaluation of the development scale, development pattern, general land utilization and transport system plan that would arise from urban activities and traffic movements, are also made.

One alternative concept is the "no development alternative" which means utilizing the existing industrial area and other sites without the Project. However, this alternative has already been judges as inadequate to solve the present and future problems in Metro Manila.

4.1.2 Project Policy

Generally, the policies for the development projects in Metro Manila are as follows:

- Maintenance of the Urban Environment;
- Contribution to the National Economy;
- Promotion of Urban Redevelopment;
- Promotion of New Urban Development; and
- Enhancement of Socio-Economic Impacts.

Furthermore, it is envisioned that a rapid economic transformation will take place in the future. Hence, the main project policy is to achieve the promotion of urban redevelopment and the contribution to the national economy.

4.1.3 Inland Development vs. Offshore Reclamation Development

There are two opposite concepts for regional development. These are the inland development and the offshore reclamation development.

Offshore reclamation development has the following major characteristics:

- Large-scale land development will be made within the 15km radius from CBD in Metropolitan Manila;
- The transport cost for inbound and/or outbound cargo traffic will be reduced in case of improving the wharf facilities provided in the development area;
- The investment cost of offshore reclamation development is more expensive than inland development.

The other concept, inland development tracts, have the following major characteristics:

- Large tracts of land are difficult to acquire within 15km radius, but possible to acquire within the 30 to 35km radius.
- Transport cost is high as compared to offshore reclamation development.
- Acquisition of vast inland areas will involve social and financial costs, and serious social problem as a large number of people will be affected.

Since the most important policy of the Government is to conserve energy while at the same time promoting the export-oriented industry, the offshore reclamation development is judged to be more suitable than the inland development.

4.1.4 Selection of Development Pattern

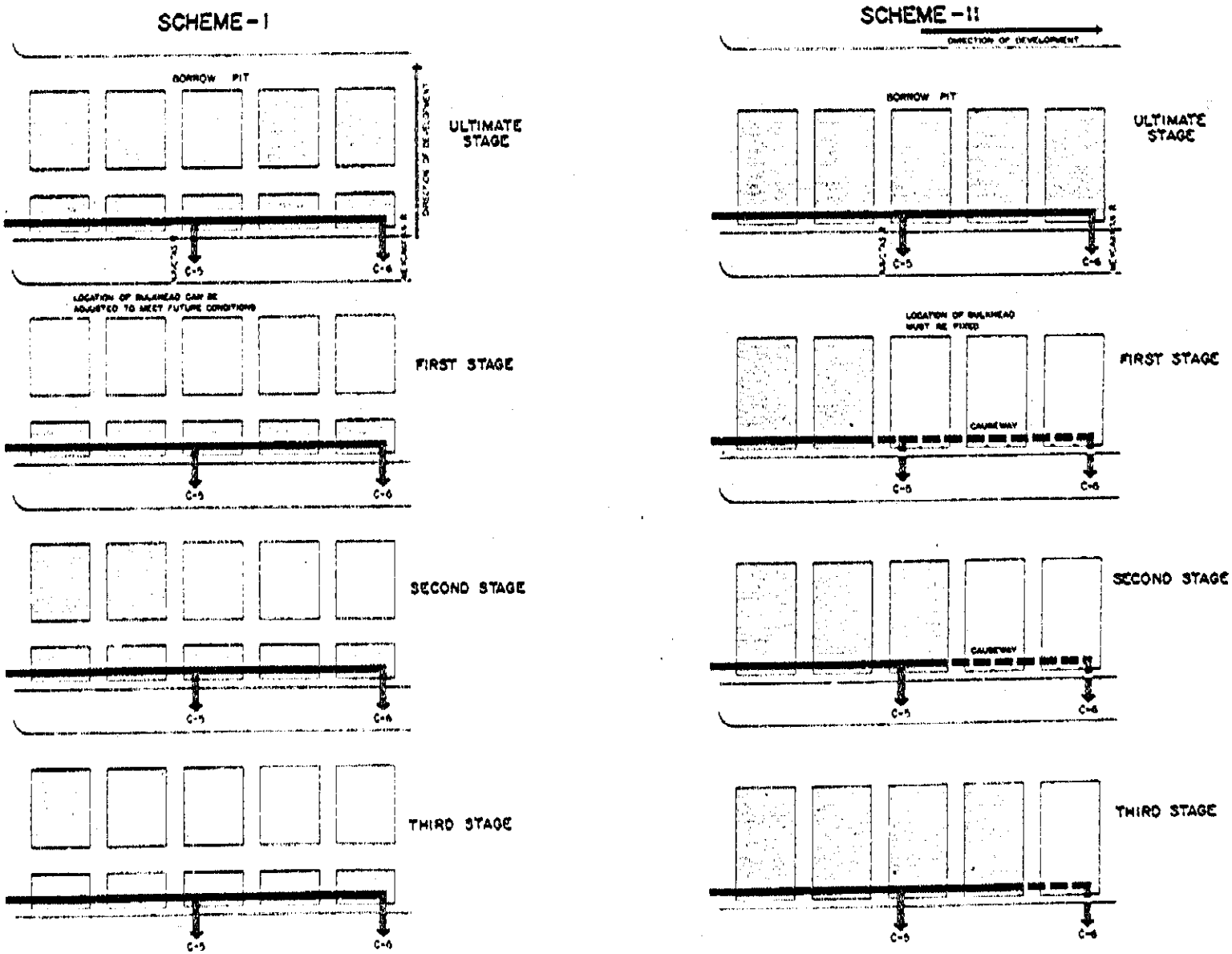
The planning of the development of reclamation area is mainly influenced by the demand, available physical conditions such as hydrography, oceanography, subsurface soils conditions and hydrology, interrelation with the development program for the basic infrastructures and other constraints. In view of these factors, two development alternatives shown in Fig. IV-4-1 were prepared for comparisons as follows:

A. Scheme - I

This plan bases on the concept that the initial stage of reclamation will proceed in the shallow water zone to minimize the initial investment cost. The direction of future development will be further offshore.

The dredging work conducted for the filling work will avoid the future reclaimed zone. After dredging, the borrow area between the initial reclaimed land and the future reclaimed area will become a calm mooring basin

Fig. IV-4-1 STAGE DEVELOPMENT OF RECLAMATION AREA



without additional dredging cost. If wharf facilities are required in the initial stage, a breakwater may be constructed at the edge of the future reclaimed land and later on this breakwater will serve as the bulkhead for the future reclamation work.

The followings are the advantages inherent to Scheme-I:

- better cash flow for the Project minimizing initial investment cost;
- timely provision of the required land for the Project roads; and
- flexibility for various land uses.

B. Scheme - II

This plan is based on the concept that the reclamation will proceed along the coastal line block by block with a predetermined fixed front line. This scheme has the advantage of shortening the peripheral length of the bulkhead. However, the following disadvantages are obvious.

- initial investment cost becomes quite large compared with Scheme I, since reclamation must be done in deep water;
- planning of the ultimate stage construction must be fixed at the nitial stage to determine the reclamation limit to offshore;
- land use of expensive reclaimed area provided with wharves for large ships will have more limited choice; and
- staged development of reclamation blocks does not match the staged construction of the Project roads.

Based on the advantages and disadvantages described above, it is recommended that the proposed reclamation be developed in accordance with Scheme-I.

4.1.5 Development Scale of the Reclaimed Area

The magnitude of land demand is extremely large and requires an equally enormous budget. The Team, therefore, undertook a thorough and careful study to determine the scale of development. The most important factors that were considered in determining the development scale of the project are as follows:

- magnitude of land demand;

- environmental constraints; and

- construction economy.

A. Magnitude of Land Demand

The magnitude of land demand can be seen in Table IV-4-1.

As described previously, in Sub-Section 2.2.2, in CHAPTER 2, the locating of industries in the proposed reclaimed area seems to be feasible. Therefore, the Team prepared the following additional data to check the industrial land requirement in Metro Manila more carefully.

Table IV-4-1

MAGNITUDE OF LAND DEMAND IN MMA

Land Use	Estimated Present Land Use, 1970	Projected Land Use, 1990	Balance
	(ha)	(ha)	(ha)
Industrial Area	2,000	4,000[1)]	2,000
Commercial Area	2,500	4,600	2,100
Housing Area	15,000	32,700	17,700

Note: 1) Low projection as shown in Table IV-2-3 in CHAPTER 2.

Appendix I-91 shows industrial land requirements in Metro Manila up to the year 2000 (low projection). According to this projection, in Metro Manila, an additional 2600 ha of industrial area will be required by the year 2000.

B. Environmental Constraints

From the environmental viewpoint, it is recommended that the proposed north limit of reclamation be at the extension of the south bank of Meycawayan River (See Sub-Section 3.3.7 in CHAPTER 3) with any further extension of the reclamation area reserved as a future project.

C. Construction Economy

1) Preferable North Limit of Reclamation

It is costly to provide the Meycawayan waterway with a crossing bridge in order to gain the additional

reclamation area beyond the Meycawayan estuary (See Sub-Section 3.3.7 in CHAPTER 3).

ii) Width of Reclaimed Land

A study on the width from shore to the tip of reclamation area (S-width) to the index of reclamation cost per unit area reveals that the reclamation can be achieved most economically at the S-width of 1,000 meters (See Sub-Section 3.3.7 in CHAPTER 3).

Considering above-mentioned factors, the most suitable area for the development can be said approximately 800 ha (8,000 m x 1,000 m = 800 ha).

4.1.6 Major Land Utilization

The alternatives for the utilization of the reclaimed land are the following:

Theme - 1 = industrial uses

Theme - 2 = commercial and tourist uses

Theme - 3 = residential and institutional uses

Theme - 4 = uses for urban redevelopment of depressed and stagnated areas of Metro Manila.

The factors considered in evaluating these were as follows:

- Historical trend of land uses in the adjacent areas;
- Future land demand; and
- Lot selling prices.

The historical trends of land use in the adjacent areas are industrial and medium and low class residential areas. Therefore, Theme-2 is not suitable as land for commercial and tourist uses in the proposed reclaimed area.

As mentioned in Sub-Section 3.3.6 CHAPTER 3, development cost of reclaimed land is comparatively high. Therefore, it would not be feasible to utilize these lands as exclusively for residential and institutional areas (Theme-3).

In case of industrial uses, it is generally said that higher lot selling prices could be expected compared with the residential and institutional uses. From this point of view it would be possible to locate industrial zone for the reclaimed land (Theme-1).

4.1.7 Suitable Types of Industry

In line with the national policy and strategy, it is very important to have manufacturing, labor-intensive and export oriented industries. The market-oriented industry is also suitable in the generated reclaimed area, since the site is located near Manila which is the biggest market in the Philippines.

In addition, no polluting industries should be located in the site considering existing regional environmental policies.

Table IV-4-2 shows the selection factors for suitable types of industry in the proposed reclaimed area.

4.1.8 Transport System

The following alternative transport systems can be considered in the Project area:

Alternative Plan - 1 : Highway System

Alternative Plan - 2 : Highway system plus marine transport system

In industrial countries, many of the reclamation projects have water transport facilities because expensive land transport costs can be eliminated entirely or reduced to a great extent.

This reclamation, therefore should utilize not only highway system but also marine transport system as much as possible.

4.2 Development Policy and Objectives of the Reclaimed Area

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

- to promote urban renewal in order to serve as a catalyst and a complement to transform Metro Manila into a "City of Man";
- to contribute to the national economy by facilitating industrial growth; i.e. export-oriented and labor intensive industries; and
- to promote the conservation of human and natural resources.

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

i) to develop industrial park town where parks and sport fields are adequately distributed in the development area.

ii) to provide a large industrial estate with modernized industrial facilities.

Table IV-4-2 MANUFACTURING INDUSTRY TO BE LOCATED IN THE RECLAMATION PROJECT

Selection Factors / Industry	End Use			Factor Intensity		Capital Productivity		Import Substitution & Export Orientation		Environmental Aspect		Suitable Industry To Be Located In The Reclamation Project
	Consumer Goods	Intermediate Goods	Durable & Capital Goods	Capital Intensive	Labor Intensive	High Capital Output Ratio	Low Capital Output Ratio	Domestic Market Oriented	With Export Potential	Polluting Industry	Non-Polluting Industry	
Apparel	x				x		x		x		x	x
Beverages	x				x		x	x			x	x
Chemicals		x		x		x		x		x		
Food Processing	x			x			x		x		x	x
Furniture	x				x		x		x		x	x
Leather Products	x				x	x			x	x		
Machinery			x		x		x	x			x	x
Electrical Machinery			x		x	x			x		x	x
Metal Products		x			x	x		x			x	x
Metals, Basic		x		x		x		x		x		
Non-Metallic Mineral Products		x		x		x			x	x		
Petroleum		x		x		x		x		x		
Printing & Publishing	x				x		x	x			x	x
Pulp & Paper		x		x		x			x	x		
Rubber Products		x		x			x		x		x	x
Textiles	x				x	x			x		x	x
Tobacco	x				x		x	x			x	x
Transport Equipment			x		x	x		x			x	x
Wood Products		x			x		x		x		x	x
Miscellaneous	x				x	x			x		x	x

Source: The Philippines -- Priorities and Prospects for Development World Bank Country Report

iii) to provide urban utilities within the area as well as for the northern part of Metro Manila.

iv) to provide variety of residential living environment.

v) to provide an efficient transport system towards the Manila Bataan Coastal Corridor.

vi) to provide additional storage areas for Metro Manila. The development proposes to offer the necessary additional facilities for smooth living and industrial operations.

4.3 General Guideline of Land Use Planning

The following guidelines were adopted in the establishment of land use planning in the proposed reclaimed area:

4.3.1 Residential Area (Housing)

- Housing for low income class will be made available to serve as relocation sites in line with the urban renewal programs for slum and squatter areas;

- Housing for medium income class will also be provided mainly for the employees to be attached to the developed area;

- Population density will be as shown below:

  Medium class housing 250 persons/ha

  Low class housing 400 persons/ha

It is assumed that the above population densities include a number of workers employed in the reclaimed area. Neighborhood centers in the areas will provide the people with daily services and will enhance the development of the neighborhood into a self-contained unit that will form a part of a large community.

4.3.2 Activity (Town) Center

- The activity center will consist of the community centers and the institutional centers;

- The community center will provide social and commercial facilities that will cater to the needs of a neighborhood;

- The institutional areas will include the development field office, technical college center, civic and medical center; and

- Population density in these areas is assumed at 340 persons/ha.

4.3.3 Industrial Area

- The manufacturing industrial area will consist of steel processing factories, shipbuilding and repair factories, wood industries, machinery factories and other light industrial factories;

- The factories will be allocated to fully function with each other; and

- Population density in these areas is assumed at 75 persons/ha.

4.3.4 Storage and Terminal Area

- The storage and terminal area will include POL and L.P.G. storage, commodities distribution center with marine port and warehouses;

- The area will service the people in Metro Manila and will enhance its development into a self-contained unit; and

- Population density in these areas is assumed at 100 persons/ha.

4.3.5 Parks

- The development of reclaimed area will provide substantial open space amounting to at about 20 percent of total reclaimed area, and

- There will be a predominantly green environment since buildings/factories will be located among trees.

4.3.6 Utility Area

- The utility systems provided in the area will include water supply and distrubiton, sewage collection and treatment, drainage system and power; and

- Utility systems will be located where they can serve the maximum area at the lowest cost.

4.3.7 Transport System

- Pedestrian traffic will be separated from vehicle traffic through the use of the pedestrian foot paths;

- Smooth traffic flow will be made possible through the separation of through traffic from local traffic;

- Adequate and efficient marine transport system will be provided; and

- The Coastal Road will be treated as an internal facility of the road system in the developed area.

- Marine transport system can be developed whenever it becomes necessary. The port facilities can be constructed on the reclamation area by using some part of the industrial zone. The shipway in dredged as shown in Appendix I-127.

CHAPTER 5. PRELIMINARY MASTER PLAN OF RECLAIMED AREA

5.1 Alternative Master Plans

Following the before-mentioned guidelines, three alternative master plans were considered as follows:

Table IV-5-1 LAND USE CHARACTERISTICS OF EACH ALTERNATIVE MASTER PLAN

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

Note: For a detailed outline of the land allocation to industries and commodities distribution center, see also Appendix I-92 and Appendix I-93.

The detailed land use allocation for each alternative is outlined in tables IV-5-1 thru IV-5-4, Appendixes I-92 thru I-94 and illustrated in Master Plan (Land Use Plan) in volume III.

The general features of the matter plans are more fully described in the following section 5.2.

Table IV-5-2 LAND USE ALLOCATION (Alternative-I)

Block	Name	Area (ha.)
Block - I	Residential	52
	Town Center	10
165 ha.	Park	69
	Sports	15
	Utility	5
	Road	14
Block - II	Wood Industry	101
185 ha.	Shipbuilding	60
	Road	24
Block - III	Oil Storage	20
	Distribution Center	15
215 ha.	Light Industry	110
	Park	20
	Utility	10
	Road	40
Block - IV	Steel Industry, Construction	96
	Steel Industry, Machinery	115
325 ha.	Light Industry	30
	Park	37
	Utility	5
	Road	42
Total		890

Table IV-5-3 LAND USE ALLOCATION (Alternative-II)

Block	Name	Area (ha.)
Block - I	Residential	52
	Town Center	10
165 ha.	Park	69
	Sports	15
	Utility	5
	Road	14
Block - II	Wood Industry	51
185 ha.	Ship Industry	30
	Light Industry	55
	Park	25
	Road	24
Block - III	Oil Storage	10
	Distribution Center	10
215 ha.	Steel Industry, Machinery	46
	Residential	24
	Town Center	5
	Park	59
	Sports	13
	Utility	8
	Road	40
Block - IV	Steel Industry, Construction	48
	Light Industry	53
325 ha.	Residential	74
	Town Center	15
	Park	57
	Sports	12
	Utility	14
	Road	52
Total		890

Table IV-5-4 LAND USE ALLOCATION (Alternative-III)

Block	Name	Area (ha.)
Block - I	Residential	52
	Town Center	10
165 ha.	Park	69
	Sports	15
	Utility	5
	Road	14
Block - II	Wood Industry	76
185 ha.	Ship Industry	45
	Light Industry	40
	Road	24
Block - III	Oil Storage	15
	Distribution Center	13
215 ha.	Steel Industry, Machinery	66
	Light Industry	36
	Park	37
	Utility	8
	Road	40
Block - IV	Steel Industry, Construction	72
	Steel Industry, Machinery	15
325 ha.	Light Industry	44
	Residential	52
	Town Center	12
	Park	49
	Sports	15
	Utility	14
	Road	52
Total		890

5.2 General Features of Alternative Master Plans

5.2.1 Residential Area

The objectives of residential development in the reclaimed areas are:

- to provide houses for workers in the reclaimed area, and
- to complement the housing program in Metro Manila.

The main consideration in this planning is to provide a better quality of environment. The location of these areas, therefore, are designated as follows based on the various levels of land allocation shown in Table IV-5-1, and as illustrated in Master Plan (Land Use Plan) in Volume III.

Alternative I (low allocation) - Residential area development is concentrated in Block I

Alternative II (high allocation) - These areas are developed in Blocks I, III and IV.

Alternative III (medium allocation) - These areas are developed in Blocks I and IV

In the residential areas, two classes of housing facilities will be provided, namely:

- Low income class; 1/3 of total residential area;
- Medium income class; 2/3 of total residential area.

The following will be also constructed:

- Multi-story apartments; and
- Single dwelling units.

Typical Layout of Residential Area

Appendix I-95 illustrates a typical residential area. In this plan, it is envisioned that the purpose of development will be geared toward community self-sufficiency.

Since the neighborhood is the basic center of social organization, for the community the neighborhood center is planned to provide the services required for daily activities.

Population

The planned population in the residential areas are as follows:

- Population Density

  Low income class - 400 residents/ha
  Medium income class - 250 residents/ha

These assumed figures are based on the Dagat-Dagatan Project.

- Total population

  Alternative I - - - - - - - - - - 15,600

  Alternative II - - - - - - - - - - 45,000

  Alternative III - - - - - - - - - 31,200

5.2.2 Community Center and Institutional Area

The community center will be integrated into several neighborhoods and with various facilities.

At the same time, institutional facilities will be located near the community center.

The community center will consist of commercial and social facilities and the institutional facilities will involve field office development, medical center and schools.

These areas, therefore, would be located in the center and easily accessible to and from each block.

- Alternative I (low allocation) - - - - - - - - Block I
- Alternative II (high allocation) - - - - - - - - Block I, III and IV
- Alternative III (medium allocation) - - - - - - - - Block I and IV

The planned population for the community center and institutional area is as follows:

- Alternative I - - - - - - - - 3,400
- Alternative II - - - - - - - - 10,200
- Alternative III - - - - - - - - 7,480

5.2.3 Industrial Area

The objectives of industrial development for the reclaimed land are as follows:

- to provide a wide variation of choice of location between the depressed area in the inner core of Metro Manila and the reclaimed land;

- to create employment opportunities and to utilize manpower resources within the Metro Manila Area;

- to provide a wide variety of transport modes so that maximum benefits, especially savings in terms of energy derived from freight movements will be derived; and

- to contribute to the national economy through the location of oriented and/or labor-intensive industries

The industrial area will consist of a steel processing complex, machinery factory comple, shipbuilding and repair complex, wood industry complex and other light industries.

Considering the efficiency of freight movements for these industries and the inter-relationship of their inputs and outputs, the following allocation plans are presented.

Alternative I
(high allocation)

Block II: Wood and Shipbuilding Industry

III: Light Industry and Petroleum Storage

IV: Steel Processing Industry (Construction & Machinery) and Light Industry

Alternative II
(low allocation)

Block II: Wood, Shipbuilding, and Light Industry

III: Petroleum Storage and Steel Processing Industry (Machinery)

IV: Steel Processing (Construction) and Light Industry

Alternative III
(medium allocation)

Block II: Wood, Shipbuilding, and Light Industry

III: Petrolian Storage and Steel Processing Industry (Machinery)

IV: Steel Processing Industry (Construction & Machinery) and Light Industry

Typical Layout of Processing Factory

Appendix I-96 illustrates the typical layout for a processing factory. In this plan, the following considerations were made:

- to organize a community unit with one factory as heirarchy of service levels each individual factory the daily service facilities within it;
- to increase labor-productivity;
- to develop the allocation of input-output storage for the convenience of the community movements; and
- to prepare a green environment for a better quality of life.

Workers

The workers in the industrial area were computed based on the worker density per hectare for individual factories as follows:

	Worker density/ha
Steel processing factory	50
Machinery factory	50
Shipbuilding and repairing	70
Wood industry	60
Other light industry	70

Total Number of Workers

Alternative I	29,610 workers
Alternative II	16,900 "
Alternative III	23,000 "

5.2.4 Storage and Commodities Distribution Center Area

The objectives for the storage and terminal areas in the reclaimed land are as follows:

- to provide adequate storage and terminal areas in order to reduce congestion in the depressed areas in Metro Manila;
- to optimize an adequate storage program of commodities for inhabitants and factories in Metro Manila;
- to maximize the benefits to be derived from accessibility of marine and road transport and proximity to markets; and
- to optimize the commodity flow and to minimize retail prices.

The major important factors considered in the land allocation are as follows:

- supply of commodities;
- transport network, highway and marine transport;
- proximity of collecting and distributing points; and
- avoiding adverse impact to the surrounding areas.

Considering these factors, the allocation plan is as follows:

Alternative	Petroleum Storage (ha)	Commodities Distribution Center (ha)
Alternative I (high allocation)	20	15
Alternative II (low allocation)	10	10
Alternative III (medium allocation)	15	13

Typical Layout of Petroleum Storage Area and Commodities Distribution Center

Appendix I-97 illustrates a typical layout for the petroleum storage facilities. In this layout, the major considerations were as follows:

- to prepare the marine transport facility in connection with the refinery in Bataan; and
- to provide a green belt for protection against adverse environmental impact.

Appendixes I-98 and I-99 illustrate a typical layout for the commodities distribution center. The layout plans also consider the factors related to the connection between marine and road transport.

Workers

Assumptions regarding the density of workers:

Petroleum Storage area	30 workers/ha
Commodity distribution center	75 workers/ha

The total number of workers, therefore, is as follows:

Alternative I	1,725 workers
Alternative II	1,050 "
Alternative III	1,425 "

5.2.5 Parks and Recreation Fields

The objectives of parks and recreation fields are:

- to improve the quality of life for inhabitants and workers in the reclaimed area;
- to provide recreational amenities in terms of physical needs;
- to enhance and protect the natural environment; and
- to function as a transition belt between the different land uses.

In the master plan, the following parks which parallel the hierarchy of the community unit will be provided:

- neighborhood parks;
- community parks; and
- recreational parks.

A typical community park is shown in Appendix I-100.

5.2.6 Transportation Plans

The transportation system in the reclaimed area consists of two principal elements; a roadway network and marine transportation.

The roadway network consists of two elements:

i) for the regional traffic for Metro Manila.

ii) local traffic within the reclaimed area.

The marine transportation identifies limited facilities which will serve for the freight supplies and distribution requirements within the reclaimed areas, particularly for industrial factories and storage facilities.

The objectives of the road network are:

- to accommodate the traffic needs;
- to provide necessary Right-Of-Way (ROW) to accommodate the traffic demand;
- to provide freedom of mobility and accessibility; and
- to function as a transition belt for land uses.

In making the road network plan, the Team examined two alternatives which are shown in Appendix I-101. As a result of the evaluation of road network, it was concluded that alternative I is the most advantageous considering the high bridge construction cost and small traffic volume generated from reclaimed area including through traffic. Therefore, the road network in the master plan basically adopted alternative I for the road network. The basic criteria adopted in the plan are as follows:

- to separate local traffic and through traffic movements;
- to provide accessibility from the major roadway network to all land use areas; and
- to maintain consistency with the urban environments.

5.3 Road System

5.3.1 Road System Planning Policy

The major planning polcies of the road system derived from the master plan for the reclamation area are as follows:

- to create an industrial park town;
- to form a effective network between the two transport systems, land and marine;
- to serve effectively all traffic generators in accordance with the characteristics of their traffic demand;
- to separate the through traffic from the local traffic in order to avoid the inefficiency in mixing with each other; and
- to preserve and enhance the working and living environment.

5.3.2 Characteristics of Generated Traffic in the Reclamation Area

The reclamation area would generate peak vehicular and pedestrian traffic in the morning between 7 and 8 o'clock.

The area would largely be classified into two categories as follows:

Category I - Residential Area and Town Center Area

The Area is characterized with a high population density, high traffic and pedestrian generation and predominant use of passenger cars including jeepneys and buses.

Category II - Industrial and Commodity Distribution

The area is characterized with comparatively low population density, low traffic concentration but predominant use of trucks during the day time.

5.3.3 Road Network

A. Primary Road Network

The primary road network in the reclamation area is composed of the Coastal Road, C-5 and C-6.

A major road junction is provided for the inbound and outbound traffic for each block of reclaimed land.

These major road junctions are desirable for the at-grade intersection at the initial stage.

B. Street Network

The street network in the reclamation area consists of the arterial streets and service roads.

The street network in the reclamation area must effectively function in the following order:

Marine transport ↔ Development Unit ↔ Service Road ↔ Arterial Street ↔ Primary Road Network

C. Location of Major Road Junction

It is important that the major road junctions shall be located at an adequate interval on the Coastal Road to attain the utmost efficiency for both the thoroughfare and the street network.

According to this basic policy and preliminary traffic demand analysis, two alternative plans for major road junctions were studied.

Both alternative plans, A and B shown in Appendixes I-102 and I-103 have the same criteria, namely:

- At least one major road junction will be located in each reclaimed block, and the interval of these major road junctions are desirable to be located at a minimum distance of 800 meters;
- The junction locations should serve as key points so as to attain the equal trip length to any development units as much as possible; and
- The bridge clearance between B-1 and B-2 of reclaimed block is utilized for local traffic.

Based on the results of comparison (See Table IV-5-5), Alternative A would be recommended as the major road junction between the Coastal Road and the reclaimed area.

Table IV-5-5 COMPARISON OF THE MAJOR ROAD JUNCTIONS

Item	Alternative A	Alternative B
Local Service	1.5 km to the farthest point at Block III	2 km to the farthest point at Block III
Construction Cost	Lower construction cost (at-grade intersection at initial stage)	Higher construction cost (one set of grade separations at the channel between Blocks II & III)

D. Street Layout

In line with the planning policy for the reclamation area the following criteria are adopted in planning the street layout:

- Arterial street shall serve each reclaimation block uniformly;
- Arterial streets shall be located adjacent to industrial sites which are closely related to traffic generator such as commodities distribution center;
- Service road shall serve all development units uniformly, and be firmly connected to the arterial streets; and
- Frontage roads, provided for the Coastal Road, shall be considered as service roads.

The service road systems for each reclaimed block, therefore, are recommended to be composed as follows, and as shown in Dwg. of Vol. III. The service roads will form the grid road system based on the subdivision plan.

5.3.4 Street Design Standards

A. General

A modified Japanese standard is recommended to be adopted for the design of arterial streets and service roads in the reclamation area since no relevant standards were available in the Philippines.

Each item of geometric design criteria adopted for the planned streets is described below.

B. Terrain Condtion

Flat due to newly produced reclaimed land.

C. Design Speed

Street	Design Speed (Km/hr)
Alterial street	40
Service road	30

The above design speed for each street has been recommended based on the conditions described below:

- Short trip traffic limited to the reclamation area; and
- All intersections are planned at-grade.

D. Right-Of-Way Width

Because no serious controls are anticipated in newly developed reclamation area, a comparatively wide right-of-way width would be favorable and is presented as follows:

RECOMMENDED RIGHT-OF-WAY WIDTH

Planned Street	Number of Lane	Recommended Right-Of-Way Width
Arterial street	2 x 2 lane divided 2-way	40m in residential and town center areas and 30m in industrial areas and commodity distribution center
Service road	2-lane 2-way	20 m

E. Number of Lane and Lane Width

4-lane 2-way arterial street was adopted considering the decrease in road capacity from stalled vehicles and the operating condition of jeepneys. The lane width of 3.35 meters for the arterial street is determined based on the priority status of the street.

The following presents the recommended widths for the planned streets:

RECOMMENDED LANE WIDTH

Planned Street	Recommended Lane Width
Arterial street	3.35 m
Service road	3.00 m

F. Shoulder and Parking Lane Widths

The left and right shoulders of the arterial street, each of 0.5-meter width, were recommended considering the road capacity and the road characteristics.

No shoulder would be provided for service road because of the provision of parking lane.

The provision of 2.5 meters wide parking lanes on both sides of the service road is recommended, considering parking vehicles and also providing sufficient road width for turning movements of trucks at intersections.

G. Median Width

Median would be provided only for arterial street, and not for the service road. The median width of 2 meters is adopted.

H. Sidewalk

The sidewalk width for the arterial street, 5 meters in residential and town center areas, and 3 meters in industrial areas and commodity distribution center, are recommended considering the bigger demand and the daily usage.

I. Cross Slope of Pavement

A pavement cross slope of 2.5 percent is recommended considering bad weather conditions.

J. Vertical and Horizontal Alignments

Because of the adoption of the grid pattern street system and flat ground condition of the reclamation area, favorable vertical and horizontal alignments standards are provided as summarized in the geometric design criteria shown in Tables IV-5-6 and IV-5-7.

K. Summary of Geometric Design Standards

Tables IV-5-6 and IV-5-7 present the summary of geometric design standards.

5.3.5 Typical Cross-Section of Street

The elements of cross-section component applicable to the street were described in Section 5.3.4. The Figs. IV-5-1 and IV-5-2 show the typical cross-sections of arterial street and service road.

Table IV-5-6 STREET GEOMETRIC DESIGN CRITERIA

ARTERIAL STREET

Item	Unit	Recommended Design Standard
Design Speed	km/h	40
Reserved R.O.W. Width	meter	40 in residential and town center areas and 30 in industrial areas and commodity distribution center
Lane	meter	3.35
Shoulder Width	meter	0.5
Median Width	meter	2.0
Cross Slope of Pavement	%	2.5
Type of Pavement	-	Asphalt Concrete Pavement
Maximum Superelevation	%	10
Minimum Radii	meter	60
Maximum Gradient	%	7
Stopping Sight Distance Distance	meter	40
Minimum Vertical Curve Length		
Crest	meter	4.5A
Sag	meter	4.5A
Sidewalk Width	meter	5.0 in residential and town center areas and 3.0 in industrial areas and commodity distribution center

Table IV-5-7 STREET GEOMETRIC DESIGN CRITERIA

SERVICE ROAD

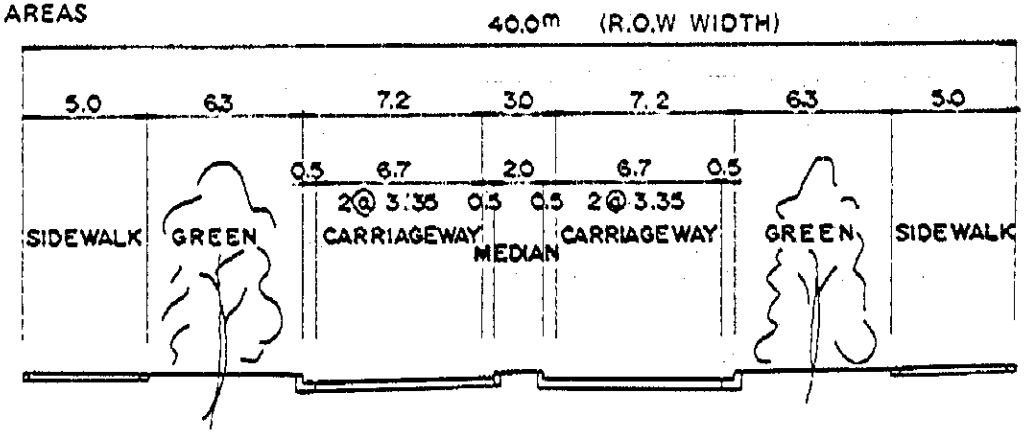
Item	Unit	Recommended Design Standard
Design Speed	km/h	30
Reserved R.O.W. Width	meter	20
Lane Width	meter	3.0
Parking Lane Width	meter	2.5
Cross Slope of Pavement	%	2.5
Type of Pavement	-	Asphalt Concrete Pavement
Maximum Superelevation	%	10
Minimum Radii	meter	30
Maximum Gradient	%	8
Stopping Sight Distance	meter	30
Minimum Vertical Curve Length		
Crest	meter	2.5 A
Sag	meter	2.5 A
Sidewalk Width	meter	3.0

Fig. IV-5-1 TYPICAL CROSS SECTION

ARTERIAL STREET

SCALE = 1:300
DIMENSIONS IN METER

SECTION: RESIDENTIAL AND TOWN CENTER AREAS



SECTION: INDUSTRIAL USE AND COMMODITY DISTRIBUTION CENTER

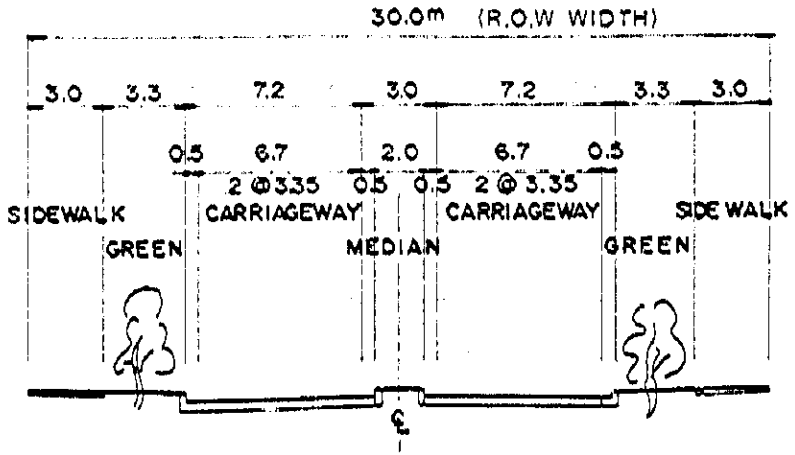
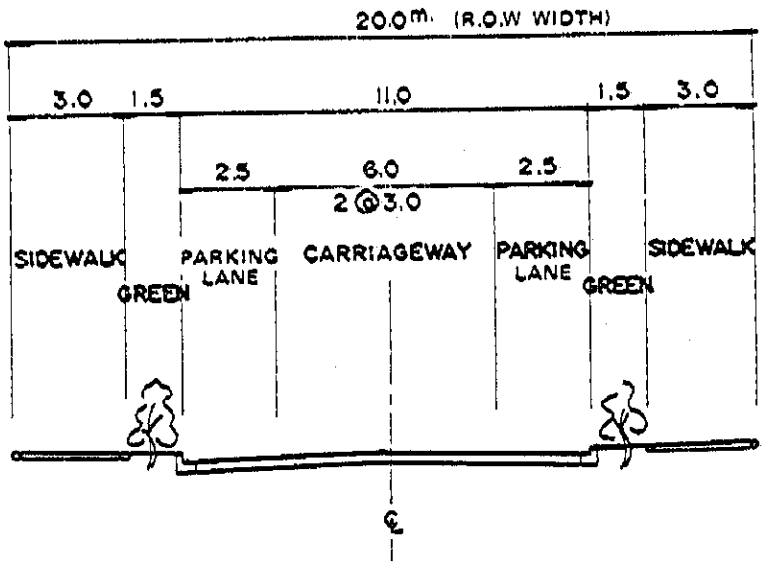


Fig. IV-5-2 TYPICAL CROSS SECTION

SERVICE ROAD

SCALE = 1:200
DIMENSIONS IN METER

SECTION: ALL RECLAIMED AREA



5.4 Utilities

5.4.1 Water Supply System

A. General

Water is currencly supplied at the rate of 1,200 mega liters per day in Metro Manila. According to the Metropolitan Waterworks and Sewerage System (MWSS), the supply will be increased to 2,000 mega liters per day before 1982. The reclamation area will be covered by the MWSS services.

B. Water Consumption

The estimated water consumption for each land use is as shown in Table IV-5-8.

Table IV-5-8 WATER CONSUMPTION IN THE RECLAMATION AREA

Land Use	Water Consumption
Industrial area and commodities distribution center	250 kiloliters/ha/day
Residential area	130 liters/capita/day
Town center and institutional area	200 kiloliters/ha/day

C. Service Storage

The emergency storage capacity should be sufficient to provide against interruptions of inflow due to failures of the supply system. Approximately 30% of daily average which is equivalent to 16,000 tons was adopted considering the waiting time till complete restoration.

D. Distribution Network

i) Design Flow

The design flow of distribution pipes should be sufficient to provide water for normal operations during the maximum hourly demand. It should also be sufficient to meet the water needs for Fire Fighting plus the maximum daily demand.

The following peak flows were assumed in this study.

Land Use	Peak Flow Rate
Industrial area and commodities distribution center area	1.7 times the average daily flow
Residential area	Twice the average daily flow
Town center and institutional area	Twice the average daily flow

ii) Pipe Size

The velocity in distribution pipes was assumed 2.5m/sec. The size of distribution pipes were determined by the Hazen-William's formula. A minimum diameter in the deadend branching pipes of 75mm, except in special cases, was adopted.

The network for water mains is shown in Appendix I-104. A main pipe of 900mm is to be connected with the 900mm main along the Litre road (C-4 new alignment) which is, according to MWSS, to be installed by 1980.

In the reclamation area, water mains should be between 300 and 900mm diameter. Within the residential, towk center and institutional areas, pipes should be between 100 and 150 mm diameter while the industrial area and commodities distribution center area, between 300 and 500mm diameter. A residential pressure at house connections should be not less than 7 meters of water head. For the water distribution plan, see also Water Supply System in Volume III.

iii) Fire Hydrants

Fire hydrants should be spaced at less than 250 meters apart on distribution mains and less than 100 meter apart on branching pipes.

iv) Gate Valves

Gate valves should be installed so that failure of supply is limited to a small service area by operating a minimum number of valves. These sectionalizing valves should be placed in distribution lines 500 - 1,000 meters apart and downstream of each branching point from the main.

v) Pipe Materials

For the distribution mains, concrete pipes were adopted. For diameters of 200mm and under, unplasticized P.V.C. service pipes should be suitable because of their easy availability and handling in the Philippines.

vi) Location of Pipes

Pipes should be laid at sufficient depth beside frontage roads of primary roads, arterial streets and service roads.

5.4.2 Sewerage and Sewage Treatment

A. General

In the reclamation area, a separate sewage system is proposed.

- Ordinary sewage system, collection and treatment, to be included in the project; and
- Industrial wastewater collection and treatment system, not to be included in the project.

In the industrial area and commodities distribution center every factory is expected to treat its own industrial wastewater before discharging the effluent. The treatment should fulfill the standards set by the National Pollution Control Commission.

B. Sewage Quantity

The sewage volume excluding industrial wastewater is assumed to be same to that of water consumption. In each block the approximate sewage volume is estimated as follows:

Block	Sewage Quantity (in thousand cu.m per day)
I and II	4.7
III	1.6
IV	2.5

C. Sewer Construction

1) General

Since the terrain of the reclamation area is fairly flat and slightly above sea level, the groundwater level is approximately 2 to 3 meters below grade.

There are two ideas for the construction of the sewer network: one is a shallow sewer which accompanies several pumping stations on the main sewer, and the other is a deeper sewer which does not require pumping stations. The latter system was selected since the reclamation will be constructed by stages and sewer treatment plants will be provided at three (3) locations (See Appendix I-105).

ii) Collection Network

The layout plan of sewer trunk lines is shown in Appendix I-105. Pipes should be between 600 and 1,000mm diameter and minimum slope of sewer within 0.1% of the minimum velocity of 0.7 m/sec. The value of "n" to be used with the Kutter or Manning formula is 0.015 and manholes should be at most 60 meter apart, 45m on average. See Dwg. in Vol. III for the detailed sewer collection network.

D. Treatment Plant

i) Alternatives

Before deciding treatment process, the effluent quality should be taken into consideration in order to minimize the water pollution problem.

There are two major alternatives regarding the treatment plant:

Alternative 1 - Stabilization ponds

Alternative 2 - Mechanical treatment plants such as trickling filters or activated sludge.

ii) Technical Description of Alternatives

Waste stabilization ponds are most suitable for locating where land is isolated and inexpensive, climatic conditions are suitable and loadings may fluctuate considerably.

Waste stabilization ponds are classified into aerobic, facultative anaerobic, mechanically aerated and a combination of these ponds. Of these types of ponds, facultative ponds are commonly recommended because of their comparatively low BOD removal and simpler maintenance, and most existing ponds are of this type. The facultative pond is divided into an upper aerobic layer with algae and a lower anaerobic layer with sludge deposits.

Generally, the construction costs (excluding land acquisition and compensation) of stabilization ponds are on the order of 50 percent of costs of alternate mechanical plants and the maintenance and operation costs are only about two tenths.

Mechanical treatment plants consists of screens, grit chambers, preliminary sedimentation tanks, trickling filters or aeration tanks with activated sludge, final sedimentation tanks, disinfection chambers and sludge disposal facilities. The trickling-filter and activated sludge process are similar in principle in that both depend on biochemical oxidation of complex organic matter in the sewage.

Performances of activited sludge processes are somewhat better than those of low-rate trickling filters when influent quantity and quality are relatively constant.

Construction costs of the activated sludge process are a little higher and maintenance and operation costs are much higher than those of low-rate trickling filters.

iii) Selected Treatment System

Activitated sludge process was selected since it is more advantageous than other methods. Its merits are shown as:

- High grade purification;
- Compactness of the treatment plant;
- Elimination of expensive land acquisition and compensation cost;
- Odor not generated; and
- Loss of head is a little compared with trickling filter type.

The outline of flow diagram for the activated sludge plant is shown on Fig. IV-5-3.

5.4.3 Storm Drainage System

A. Rainfall

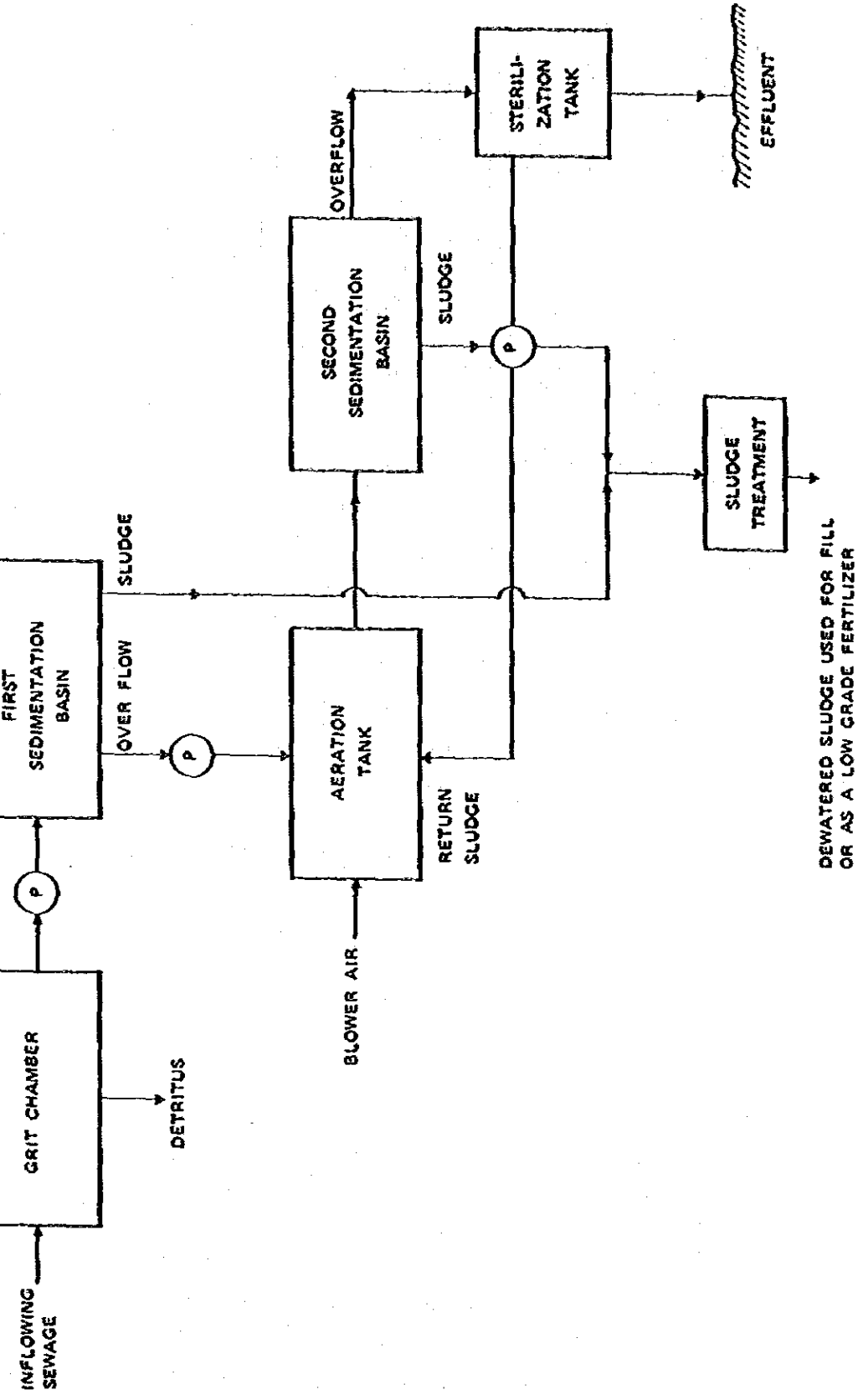
The "Rainfall Intensity Duration Curves for the Manila Area" were used (See Sub-Section 7.8.3 in Part III for further explanations).

B. Run-Off Estimation

The design peak rate of run-off was estimated by using the rational formula (See Sub-Section 7.8.4 in Part III).

Adopted values in the calculation are as follows:

Fig. IV-5-3 ACTIVATED SLUDGE PLANT



- Design frequency : 10-year frequency
- Intensity of rainfall : r = 126 mm/hr.
- Time of concentration : t = 20 min
- Run-Off coefficient : f = 0.7

C. Drainage Network

The reclaimed area is very flat and lying at 3 meters above the H.L.L.W. level. The main feature of storm drainages is that channels are generally directed to the southwest shore side as illustrated in Appendix I-106. This drainage system consists of open channels made of adobe, with some reinforced concrete box culverts in road crossing. See also Drawing in Volume III for detailed storm drainage system.

5.4.4 Electrical Power Supply System

A. Demand

The electrical power consumption was assumed as follows based on consultations with MERALCO:

ELECTRICAL POWER DEMAND OF EACH LAND USE

Land Use	Demand
Industrial area and commodities distribution center	1,450 KWH/ha/day
Residential area	10 KWH/house/day
Town center and institutional area	1,450 KWH/ha/day

B. Reliability of Electrical Power Supply System

In the industrial area, the reliability of the electrical power supply is a critical point. However, it is difficult to quantitatively express the reliability of the electrical power supply system, because quantitative information about the social influences in the interrupted area was not available.

Ordinarily, expressions of reliability are indicated by the number and total duration of interruptions per year.

It is considered that the maximum allowable number of interruptions will be 10 per year with a total duration of 600 minutes based on examples in important international industries.

C. Flexibility of Electrical Power Supply System

The reclamation area will be developed in two stages and the electrical demand will be staged accordingly.

The demand will increase step by step during Stage-1 and Stage-2 as the construction of superstructures will not be done simultaneously.

The electrical equipment of factories, shops and other buildings will increase yearly. Therefore it is important to provide sufficient capacity to satisfy the requested demand in all steps.

D. Classification of Electrical System

All facilities of the electrical system in the reclamation project are classified by construction as follows:

- Electrical power transmission line;
- Electrical power feeder line (I);
- Electrical power feeder line (II);
- Street lighting; and
- Sub-station.

Transmission line are the power lines installed alongside the Coastal Road. (Twisted copper with 19/3.2㎜ 150㎟ was adopted).

Feeder lines (I & II) are the power lines installed alongside the arterial streets and service road (twisted copper wire 7/3,2㎜ 55㎟ for feeder line (I) and 7/2.0㎜ 22㎟ for feeder line (II) were adopted).

Street lighting is the street lighting system for all arterial streets and service roads planned in the reclamation area, excluding the system for the Coastal Road.

The electrical power will be supplied by the MERALCO and delivered to the sub-stations in the reclaimed area at 34.5 KV.

The sub-station above-mentioned will brings it down to 230V by transformers to meet the requested demand.

The layout of electrical power transmission and feeder lines are shown in Appendix I-107. For detailed layout, see Dwg. in Volume III.

5.4.5 Telecommunication System

The telephone system in MMA is operated by Philippine Long Distance Telephone Company which is under the administrative jurisdiction of National Telecommunication Commission of MOTC. The system will cover the telecommunication system on the reclaimed area.

A. Demand

It is assumed that one out of ten households will install the telephone line and every industrial establishment will have three telephone lines. In addition, there will be 20 lines of fire and emergency lines on the four-blocks. The numbers are summarized by each alternative master plan as follows.

Table IV-5-9 NUMBER OF TELEPHONES TO BE INSTALLED IN THE RECLAMATION AREA

Alternative	Residential Areas	Industrial Areas	Emergency Lines	Total
I	450	830	20	1,300
II	1,100	450	20	1,570
III	900	600	20	1,520

B. Proposed Network

The main cables will be set in a duct through which they will be linked to the mother system of PLDTC. The duct has 300 mm diameter, 15.1 mm wall thickness and is made of unplasticized P.V.C. It will be laid at a sufficient depth along the Coastal Road. A steel conduit will be also used in crossing the roads.

Manholes will be constructed at every 150 m distance and the shift points of the main duct. The cables will shift at appropriate points to the secondary overhead network utilizing the poles of electric system. The overhead network will be extended to distribute the pair cable to the users of household and establishments.

The layout of telecommunication system is shown in Appendix I-108.

CHAPTER 6 PRELIMINARY RECLAMATION ENGINEERING

6.1 General

The Study is concerned with the work undertaken for the preliminary design of the offshore reclamation, and deals only with the engineering aspects of the project. The financial and economic feasibility of the said reclamation is detailed in Chapters 9 and 10 respectively.

The aim of the Study is to carry out the Preliminary Engineering to a degree of accuracy that will permit estimates of principal quantities of construction with an accuracy of ±20% of the final quantities. The principal quantities of construction will include filling, rock mound work, sand piling, steel and P.C sheet piling and others.

Engineering investigations including topographical survey, sounding and soils and materials surveys were undertaken also by the Study Team hiring local consultants.

The physical conditions of the reclamation site such as hydrography, oceanography, meteorology, geological condition as well as environmental constraints of the proposed reclamation were identified in Chapter 3 in this Part. The previously identified factors will be also considered in this study.

6.2 Basic Data

6.2.1 Aerial Mosaics

Aerial photos of the project area flown in 1977, to a contact scale of 1:8,000 and working mosaics of the area using the above to the same scale (1:8,000) were mainly used in the cost study.

6.2.2 Topographical Survey and Sounding

Topographical survey and sounding using echo sounding equipment were conducted by Acre Surveying and Development Inc. at the reclamation site.

6.2.3 Soils and Materials Survey

The Survey was carried out during July, August and September 1979, as preparatory work, prior to the preliminary engineering.

The field work and laboratory testing was executed by a local consultant, Development and Technology Consultants, Inc. The Study Team planned and supervised all the fieldwork and laboratory testings.

The result of the said soils and materials investigation is discussed in the engineering study.

6.2.4 Land Form of the Reclaimed Area

The land form established in the Conceptual Development Plan of the Reclaimed Area concurred by the Inter-Agency Steering Committee for further master planning and preliminary engineering was adopted in this study (See Fig. IV-6-1 Location Plan of Reclaimed Area, and Appendix I-109 Land Form of the Reclaimed Area).

6.3 Geological and Sub-Surface Soils Conditions of the Reclamation Site

6.3.1 Geological Conditions

The reclamation site is made up of a thick layer of alluvial soil, predominantly dark gray organic rich clay. It is also composed of deltaic deposits of unconsolidated, soft to very soft clay silts, sandy and rarely coral gravel. The thickness of the soil is variable, about 10-20 meters. Below the layer of alluvial soil lies materials composed mostly of volcanic lavas associated with pyroclastic rocks of Pliocene to Pleistocene age. These rocks constitute the so called Guadalupe formation. This strata consists commonly of fine to coarse tuffs, agglomerates, silts, sand and gravels.

6.3.2 Sub-Surface Soils Conditions

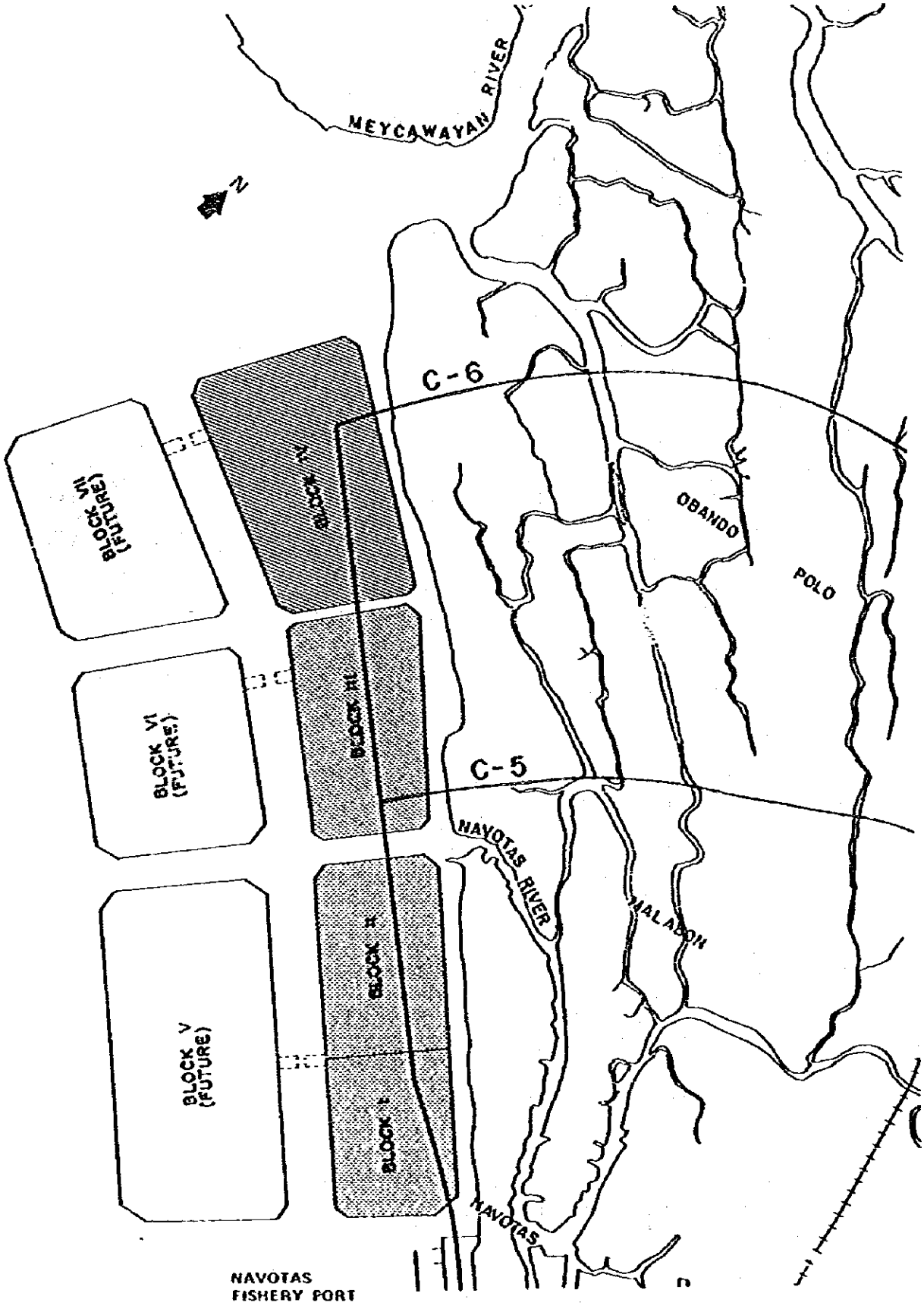
Preliminary soils investigations are necessary to grasp the sub-surface soils conditions of the site for the study of land use, establishment of location, dredging and bulkhead planning. After consulting with the reclamation, highway and structural engineers engaged in the PROJECT, the location for the boreholes was selected as shown in Appendix I-110.

As shown in Appendix I-111, the hard layer suitable as bearing strata of heavy structures is situated at a depth of between 15 m and 25 m. In the area near the estuary of Meycawayan River, a very complicated subsoil structure is to be found which consists of silts, silty fine sand, clay, seashell layers and this continues down to a depth of more than 30 m until shaly tuff.

6.3.3 Soils Suitable for Borrow Materials

It is not an over statement to say that the method of utilizing good materials found through soils investigations of borrow areas will govern the success or failure of reclamation project. The soils conditions at the site of this project are divided into two groups: one consists of a thick layer of silt or clay with a hard tuff layer, and the other is a silty fine sand and shells with a hard tuff or fine sand in deeper layers.

Fig. IV-6-1 LOCATION PLAN OF RECLAIMED AREA



The quality of fill material is mainly evaluated by grain size. The most suitable type of soil for reclamation is sand mixed with small amount of silt or clay. Sand which is too pure is blown away in larger quantity by wind as its surface becomes dried and is at times difficult to compact.

Soil with a high content of sandy materials has good retention and a large bearing capacity, whereas, soil with high content of silty or clayey material is exactly the opposite.

Appendix I-112 shows the range of grain sizes of soils which is found from the selected boring logs. The soils within the range of shaded area are suitable for reclamation, and also for sand piles as select material.

6.3.4 Determination of Design Parameters of Soils

The parameters of soils to be used for the design of bulkhead and soils stabilization were determined as follows:

i) Shear Strength

Based on the distribution of unconfined compression strength between seabed and EL. -10.00 in BH-001 thru BH-003 (See Appendix I-113) shear strength was calculated was as follows:

$$Cu = \frac{qu}{2} = 0.5^{t}/m^{2}$$

Where: Cu = Shear Strength

qu = Unconfined Compression Strength

ii) Consolidation Characteristics

From Appendix I-116 the design values of Cv will be the following:

$$Cv = 3.5 \times 10^{-2} \ cm^{2}/min$$

Where: Cv = Coefficient of Consolidation

iii) Unit Weight of Soils

Unit weight of filling materials and existing ground, in air	$= \gamma$	$= 1.6 \ t/m^{3}$
Unit weight of filling materials and existing ground, submerged	$= \gamma'$	$= 1.0 \ t/m^{3}$
Unit weight of rocks, in air	$= \gamma$	$= 1.8 \ t/m3$
Unit weight of rocks, submerged	$= \gamma'$	$= 1.0 \ t/m^{3}$

iv) Rate of Strength Increase of Cohesive Soils

$$\text{Rate of strength increase} = \frac{\Delta Cu}{\Delta P} = 0.25$$

Where : ΔCu = Shear strength increment
ΔP = Vertical stress increment

v) Angle of Internal Friction of Soils

Filling materials = $\phi = 30°$

Rocks = $\phi = 35°$

6.4 Reclamation Planning

6.4.1 Determination of the Finished Ground Level of Reclaimed Area

In a large scale reclamation project, the finished ground surface elevation (ground level) is a very important factor. Appendix I-117 shows the relationship between the filling cost and ground level. In the Project, a 10 cm difference in ground level will be equivalent to approximately P13.5 M in filling cost.

To determine the finished ground level for the reclaimed area, the minimum criteria mentioned below have been adopted:

- The ground level shall be more than 1.3 X H above MHHW (Japanese standard for design of ports and harbors);
- The ground level shall be above the highest observed tide level (Japanese standards for design of ports and harbors); and
- At the ordinary cargo ship berth location, the surface of the pier or wharf should be at least 6 feet above the high water level at spring tide (American Civil Engineering Practice).

When the design wave height (H) of 1.5 m (See Sub-Section 3.2.2 in this Part) was used, the finished ground level for the reclaimed area was as follows:

El.1.01 (MHHW) + 1.3 x 1.5 m = 2.96 m

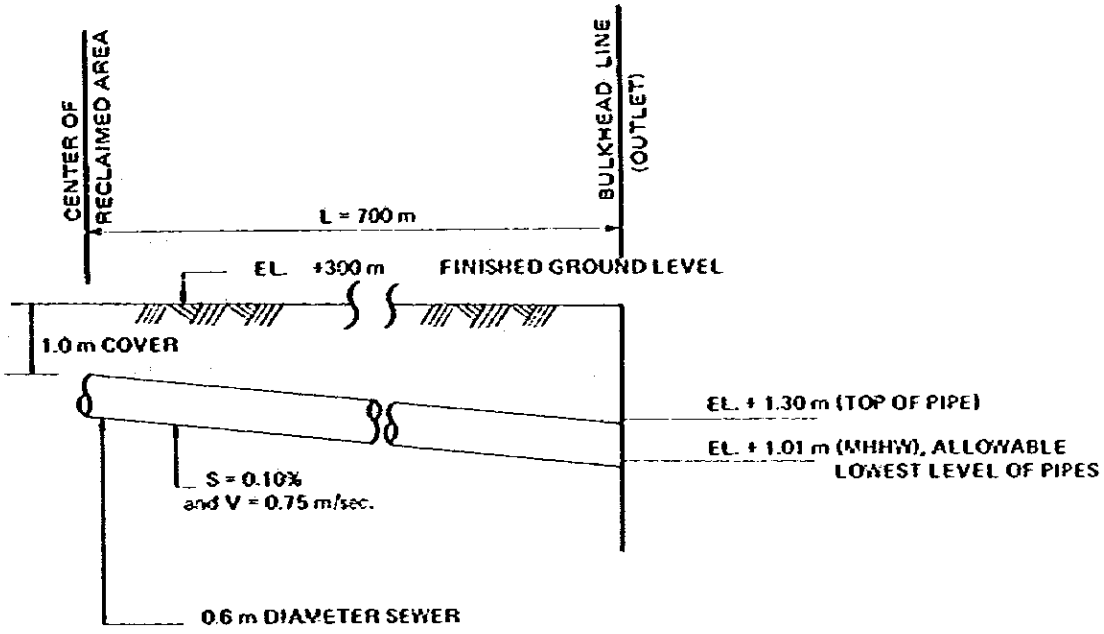
In Manila Bay, the highest observed tide occured in 1911, and a level 1.77 m above MLLW was recorded. The mean higher high water was 1.01 m.

Based on these observations, a finished ground level of 3.0 m above MLLW was adopted for the Project (See Appendix I-118).

This finished ground level has been established for several important reclamation projects in Manila Bay (i.e. MCCRRP, Manila International Ports, etc.)

The finished ground level of the reclaimed land in Japan (Tokyo Bay and Osaka Bay) varies between 2 and 3 meter above MHHW. These levels were established on the basis of the calculated abnormal high tide level.

If this finished ground level of 3.0 m is maintained, sufficient hydraulic designs for the construction of the sewers can be attained as shown below:



6.4.2 Volume of Material to be Dredged and Average Yield Ratio

A. The Volume of soil to be handled for the quantity of fill is obtained by the following equation.

$$V = \frac{Vo}{d}$$

Where: V = Volume of material to be dredged (m^3)

Vo = Quantity of fill (including extra banking) (m^3)

d = Average yield ratio in case of land fill by hydraulic dredger.

B. Extra-banking consists of fill to provide allowances for settlement during the short period of time after development until the area's transfer to the user, which differ depending on the soils conditions and the construction period, but are generally between 10 and 50 cm. The figure of 50 cm for extra-banking was adopted for this study. (See Table IV-6-9).

C. The yield ratios of hydraulic fill differ depending on size of the soil particle, the location of spillway, structure of drainage outlet, size of reclamation, ground height etc.. According to performance records, the ratios are generally around 70% for cohesive soil and around 85% for sandy soil as shown in Table IV-6-1.

Table IV-6-1 YIELD RATIO BY SOIL CLASSIFICATION

Soil Classification	Yield ratio (%)
Clay, clayey silt	Less than 70
Sand, sandy silt	70 - 95
Gravel	95 - 100

In this study 70% of yield ratio for blocks I, II, & VII and 80% for blocks III & IV were used.

Appendix I-119 shows the filling volume for each block. The required dredged volumes are given in the Table IV-6-2.

Table IV-6-2 REQUIRED DREDGED VOLUMES

Block Number	Dredged Volume (million cu.m)
I	4,228
II	12,335
III	11,443
IV	15,681
Sub-total (I-IV)	43,687
V	52,921
VI	29,043
VII	26,647
Sub-total (V-VII)	108,611
Total	152,298

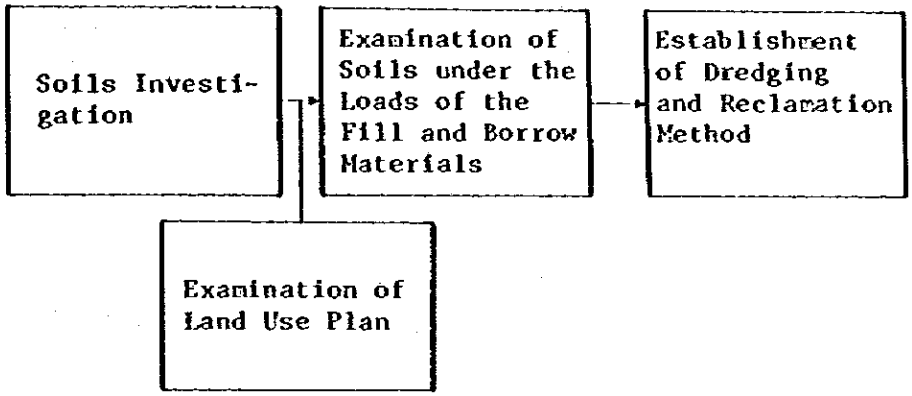
Note: See also Appendix I-119

6.4.3 Land Use and Soils Conditions of Reclaimed Area

There are few problems if the land is reclaimed by good-quality sand and if its location has good sub-urface soils conditions. However, the soils conditions of the reclamation site generally consists of clay, silty sand or sandy silt, having fine

grain size and looselayers. These characteristics of soils conditions necessitate matching the land use with the reclamation method to minimize settlement caused by fill loads.

The following is the procedure that should be followed in order to determine the reclamation and dredging method:



The classification of structures by type and by each degree of tollerable settlement are shown in Table IV-6-3 and the sub-surface soils characteristics of blocks and adopted land use are as shown in Table IV-6-4.

Table IV-6-3 CLASSIFICATION OF SIRUCTURES BY TYPE AND BY DEGREE OF TOLLERABLE SETTLEMENT

Settlement Tollerance / Type of Structure	No Settlement Allowed	Small Settlement Allowed	Settlement Allowed
Substantial Bearing Capacity Required.	Factory (Industrial Facilities	Oil tank Ship yard	
Relatively Small Bearing Capacity Required	Low rise building (Residence, Office, town center)	Bulkhead, Road Truck terminal Utilities (Sewer line, electricity line, water line, sewage treatment) .	Park, Sports Field, Lumber Yard

Table IV-6-4 SUB-SURFACE SOIL CHARACTERISTICS OF BLOCKS AND LAND ALLOCATION

Description \ Name of Blocks		Block I	Block II	Block III	Block IV
Soil Conditions	Related Bore Holes	BH - 001	BH - 002	BH - 003 (BH - 004)	BH - 005 (BH - 006)
	Top Elevation of Bearing Layer (below MLLW)	- 15.7	- 240	-15.8-26.0	-20.7 (-22.4)
	Soil Strength (Seabed-Bearing Layer)	Mainly Clay N = 0-15	Mainly Clay N = 1-3	Mainly silt, Clay N = 0-3	Mainly Fine Sand, Shell, Hard Clay N = 3-14
	Thickness of Compressive Layer	10 m	20 m	15 - 22 m	5 - 7 m
Land Use Allocation		Park, Residential area, Sports field, Town center, Utility facility	Wood industry, Ship building	Oil storage Commodities distribution center, Light industry, Utility Facility	Steel Processing Industry Light industry, Utility Facility

Block I is planned as the solid waste disposal area in the initial stage and it will in the future be transforced into a park, residential, town center and recreational area, etc. The bearing layer exists approx. 13 m below the finished ground level of general reclaimed area, and the thickness of the very weak compressive layer is 10 m.

The finished grade of sanitary fill area can be planned at 2 to 8 m above the general finished ground level of the reclaimed area to obtain more capacity. It will take a long time for a new area to become full. The total thickness of the compressive layers in sanitary fill itself and of sub-surface soils will not be large. This means that the above mentioned excessive height of fill will not produce any dangerous problem of sliding failure of the foundation or of the body of sanitary fill.

Solid waste disposal area is divided into a number of lots according to the kind of solid waste to be disposed. Table IV-6-5 shows the relation between each solid waste disposal lot and future land use.

Table VI-6-5 RELATION BETWEEN KIND OF SOLID WASTE AND FUTURE LAND USE TO BE LOCATED

Kinds of Solid Waste Disposal	Future Land Use
Putrescible Waste, Paper Glass, Plastic, Textiles	Park, Sports Field
Dust, Stones, Sands	Residential Area and Other Facilities

Blocks II and III are planned mainly as storage areas (like ship yard, lumber yard, oil tank yard, truck terminal) and relatively light weight building structures. The bearing layer for the foundation piles of structures exists approx. 25 m below the finished ground level with the weak compressive layer of approx. 15 to 20 m thickness. Structures requiring pile foundation in these blocks must consider the problems due to negative friction and lateral earth pressure during earthquakes. The portion where important facilities will be stored, like oil tanks, requires soil stabilization such as sand drain piling.

Block IV shall be utilized as the steel processing zone which will handle relatively heavy materials and products. It will accommodate factories making use of foundations. The bearing layer for the pile foundations is approximately 23 to 25 m below the finished ground level of reclaimed area. The thickness of the compressive soil layer is 5 to 7 m with relatively fair soil strength. The problems to be associated with the pile foundations above mentioned are considered to be very small.

Since the reclaimed area is intended primarily for industrial zones, port and wharf facilities are deemed indispensable. The type of facilities to be provided must suit the types of industries and soils conditions. Block II and III, which will be utilized for light industries, will handle small ships such as barges and small inter-island vessels while relatively large ships with heavy cargoes will use the port and wharf facilities at Block IV.

6.5 Dredging Planning

6.5.1 Selection of Borrow Pits

It has been shown that selective dredging and finding a good soil source are necessary in reclamation projects where good sand

is not available in sufficient quantity. Appendix I-120 indicates the selected borrow pits. Appendix I-121 shows the soil distribution by broad classification of properties of soil by depth. Table IV-6-6 gives the quantities of usable soil and the total volume of soil available.

The volume of good and ordinary soil in the whole area is found to be approximately 37 million cu.m. against the required total volume of 44 million cu.m. Good soils generally exist below bad soil layer or combined with them. Most are found in the proposed borrow pits (BP) D and E (See Appendix I-120), while very few exist in other borrow pits. When the good soil is covered by a bad soil layer, the latter is also dredged and must be use as fill material.

Only two machine borings have been conducted in the proposed borrow pit. However, after the evaluation of soils data obtained from these borings very strong correspondence between them was found. Since the area consists of soil sediments from the Meycawayan river, the soils characteristics of alluvium layer do not differ considerably and this similar nature of soils spreads out over a considerable and large area.

6.5.2 Selection of Suitable Dredger

A suitable dredging system should be selected based on the knowledge of the soils conditions of borrow pits, scale of the reclaimed areas, and on land use to be allocated.

Of the various kinds of dredgers such as pump dredger, drag suction dredger, grab dredger and bucket dredger, in this kind of project, the pump dredger (cutter suction system) is the most usual one to be adopted.

Table IV-6-6 shows the wide range of dredgers available in the Philippines. As shown in Appendix I-120, the discharging length between borrow pit and reclaimed land is quite long (approx. 3-5km); good soil exists in the deeper layer from seabed and is also very hard. Considering these conditions, the optimum class of dredger for the layer between seabed and EL. -16 m below MLLW is 4000 HP and for the layer between -16 m and -25 m is 9000 HP. Depending on the discharging length, a booster dredger is required.

6.5.3 Temporary Dike and Bulkhead, and Spillway

A. Temporary dike and Bulkhead

Temporary dike and bulkhead are for sectioning of the projected reclamation area by units according to the schedule of implementation. The reasons for providing land separation are that land areas should be completely reclaimed in the earliest stage in accordance with utilization purposes. If no land separation is provided, soil would be dispersed

Table IV-6-6 LIST OF DREDGERS IN THE PHILIPPINES 1978

Owner	Type	Pipe Diameter (inch)	Horse-power (hp)	Number of Dredger	Dredger Type	Remarks
Government	River Dredging	8"-16"	-	8	Cutter Suction	
	Harbor Dredging	-	2000-3000	2	Trailing Suction Hopper	
	Harbor Dredging	-	700	1	Grab Hopper	
	Harbor Dredging	14"-20"	900 - 2800	6	Cutter Suction	
	Harbor Dredging	-	500	3	Dipper	
	Harbor Dredging	-	100 - 300	3	Clamshell	
Private Company	Reclamation	20"-27"	4000-4500	2	Cutter Suction	
	Reclamation	20"-27"	4000	2	Cutter Suction (Max. discharge distance=4000M)	
	Reclamation	33"	9200	1	Cutter Suction (Max. discharge distance=5000M)	
	Reclamation	10"	300	1	Cutter Suction	
	Reclamation	20"-27"	4000	1	Cutter Suction	
	Harbor Dredging	12"	-	2	Suction	

throughout the area so that fine particles would flow to a great distance, and the completed land would not be adequate for use.

B. Layout of Discharge Pipes

For the layout of discharge pipes, the main pipe is where the good sand is required such as in revetment lines and in planned future road locations. In the case for branch pipelines soil particle distribution will be one-sided if the spacing is too long. An interval of 200 to 300 m is adopted for clay soil and about 100 m in case of sandy soil.

The Coastal Road is one of the most important road in this Project, hence the quality of soil must be selected carefully. The discharge pipe is set at the center of the Coastal Road so that the coarse sand will concentrate at the road portion.

C. Spillway

The spillways are required to improve the yield ratio and minimize silting in the surrounding area during the construction. To prevent a silting problem, adequate spillway must be provided. The location of the spillway as shown in Appendixes I-120 and I-123 indicates the silting influence zone from the outlet of the spillway. The gradient of overflowed soil materials from the outlet is assumed to be 1:200.

Siltation by Spillway No. 1 will not affect Navotas Fishery Port and Navotas Cut-Off Channel. Spillway No. 2 may spread siltation to the adjacent area, thereby necessitating some dredging work at the proposed shipway to remove the silted soils. Nevertheless, the volume to be dredged is not so big. Spillway No. 3 will be provided near the north edge of Block IV. Most of the soil particles from the soil spillway will settle at the dredged borrow pit. The dredging operation must therefore be carefully planned and established to avoid redredging. Since siltation will not reach the left bank of the Meycawayan River, it will avoid any adverse effects to the fisherys in the estuary.

The location of spillways were planned to keep proper distances from the proposed wharf facilities. Appendix I-124 shows the plan of spillway. This is so designed to reduce soil outflow. The ground where spillway has been provided will remain soft after the completion of the construction. Therefore, the land use of this area must consider the nature of such soft ground.

6.5.4 Maximum Distance to be Affected by Siltation During the Construction

Dredging and filling works will make the sea muddy. The seabed will be stirred by the dredger, and filling works will cause the soil particles flowing out from the spillway to suspend and spread, thereby changing the water quality in the surrounding area.

The environmental effect of dredging is influenced by the characteristics of soils (like grading, specific gravity, water content, sediment speed, cohesion, etc.), the oceanographic conditions (like tidal current, wind and wave, sea depth, etc.), terrain conditions and the type of dredger to be used. At present, however, the method to evaluate the extent of these effects have not been established yet.

Nevertheless, two pertinent data are herein presented for reference:

A. Data I : The muddiness caused by a dredger

i) Dredging Conditions Given

Type of dredger : 500 HP, Cutter suction type,
Sea depth : -15 m
Type of soils : Sand
Location : Port Area

ii) The surveyed Record of Water Quality During the Dredging

The muddiness is represented by SS density. (SS is an index of muddy materials which passes through a standard diameter membrane filter).

SS density (near the dredger) = 103-335 ppm

SS density (500 m far from the dredger) = 10-14 ppm

B. Data II : The muddiness Caused by Filling Work

Appendix I-125 shows the spread rate of muddiness from the spillway obtained from the compiled record of dredging work by the pump dredger at a port. According to this figure the increased values of SS density is 5 ppm at the distance of 1100 m and 2 ppm at 1350 m from the spillway.

Here SS : base index of muddiness for the surrounding sea area without dredging work.

Appendix I-126 shows the record of muddiness investigated at the reclamation project in OKINAWA. The SS rate was surveyed at the surface of the sea from the spillway towards the sea.

When SS density at the outlet of the spillway is SSo (about 70 ppm), SS density at the distance x from the outlet is SS and the base SS for the surrounding sea area is SS_∞ (about 0.5 ppm), the relation of the assumed dilution magnification n and liear distance x is the following:

$$n = \frac{SSo - SS_\infty}{SS - SS_\infty} = 1 + \alpha x$$

The curves in Appendix I-126 illustrate the above equation.

$\alpha = 0.014/m$ (x = 1 km), $\alpha = 0.045/m$ (x = 1.8 km)

Dilution magnification is accelerated at the length of 1 km from the spillway.

C. Conclusion

From these data, if can be said that the influence area by dredging and filling works, as far as the muddiness of sea is concerned is less than 2 km from the outlet of spillway.

6.6 Shipways and Wharf Facilities

Minimum transport cost of raw materials and products is an important factor that contributes to the development of manufacturing industries. This factor is brought about by among others, the presence of wharf facilities in the coastal industrial zones.

The opportunity to achieve an economical transport cost through the wharf facilities makes the coastal industrial zones more advantageous than the inland ones.

Since, this reclamation project will be extended for a coastal industrial zone, shipways and wharf facilities shall be provided. The shipway will be obtained by dredging and the wharf through the construction of a bulkhead. Based on the above concept, planning for the port has been established.

Appendixes I-127 and I-128 show the plan and section of shipway and wharf. Table IV-6-7 shows the capacity and size of wharf facilities and dimensions and dredging volumes of shipways.

Table IV-6-7 SCALE OF SHIPWAYS & WHARF

Name	Maximum Vessel Size	Length and/ or Width (m)	Number of Ships to be Docked	Remarks
Wharf I	5000 DWT	1200 W	5	
Wharf II	1000 DWT	1000 M	8	
Shipway I	5000 DWT	L x W 3400 x 300	-	Dredging volume (zone 2.3M cu.m)
Shipway II	1000 DWT	L x W 1300 x 300	-	Dredging volume (zone 0.8M cu.m)

In this project, it has been considered that only domestic vessels will use the channel and port and wharf facilities. If ocean-going vessels will be accommodated, the channel must be dredged deeper and the wharf facilities be improved by constructing additional structures in front of the bulkhead.

6.7 Bulkhead and Breakwater Structures

A bulkhead is a structure which is built to separate land and sea and to enclose land already existing or newly reclaimed. It protects the land from tides and waves and prevents soil therein from being washed away into the sea. The proper type of bulkhead varys depending on the soils conditions, oceanographic conditions, land use of hinterland, availability of materials, construction schedule and construction cost. Table IV-6-8 gives a comparison of different types of bulkheads for different required conditions. Following are outlines of the adopted types of bulkhead and breakwater structures (See Fig. IV-6-2, Appendixes I-129 thru I-134).

6.7.1 Rock Bulkhead

A rock bulkhead has been used in previous reclamation projects in Manila Bay for the bulkhead and breakwater because materials are easily available from Bataan peninsula. In this project, it is also considered as the major structure.

The problems associated with rock bulkhead and the corresponding selections are as follows:

- If the sub-surface soils are soft, sliding failure and settlement must be considered because of the heavy materials which make up the structure. In this case, soil stabllization must be applied;

- A rock bulkhead cannot be used as a wharf because of the slope required to maintain stability. A wharf structure will be an additional investment;

- Filled soil is easily washed away because of its porous characteristics unless filter layers or shield sheets are provided; and

- Construction speed is slow. Some marine equipment must be available for the construction.

6.7.2 Prestressed Concrete Sheet Pile

Prestressed concrete sheet pile is considered as the bulkhead of channels which separate the reclamation block. All the necessary materials and equipment are locally available. However, there are disadvantages in using this type:

- Its resisting strength against earth pressure is small. It is therefore, applicable only in shallow waters; and

- Its resistance against wave pressure before backfilling is poor, so that its location must be at a portion where it will not be subjected to direct wave action.

6.7.3 Steel Sheet Pile

Steel sheet piling is planned to be used at the side of Navotas fishery Port at Block I and the small ships berthing wharf at Block III. The advantages of this plan are the following:

- Steel sheet pile is extremely watertight. It will minimize water pollution and silting problems; and

- A structure which has greater resisting strength against earth pressure is required in some portion in Block I since the area has a depressed part where the reclamation materials were taken for the construction of past reclamation project.

6.7.4 Interlocking Pipe Pile Wall

An interlocking pipe pile wall is composed of steel pipe pile with interlocking junction pipe. It can be used as bulkhead and also as a wharf structure. Its advantages are:

- It has greater strength against earth and wave pressure; and
- It can also be used as a part of the foundation of port loading and unloading facilities because it has enough bearing capacity for vertical load. This type will be used in Block IV of this project.

6.7.5 Corrugated Steel Cell

Corrugated steel cells composed of the corrugated steel plate and the filled sand can be used as the temporary bulkhead because of its construction economy and speediness, and durability. This type is used as the partition between Block I and Block II.

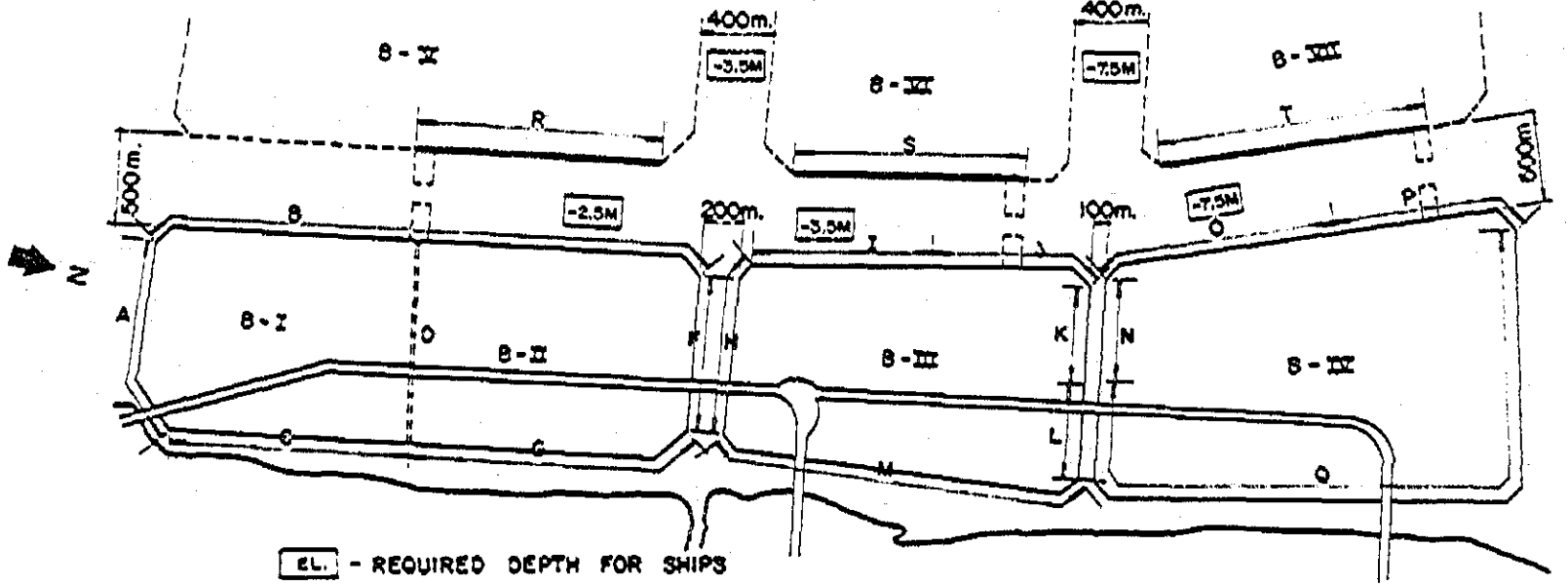
Table IV-6-8 SELECTION OF BULKHEAD

TYPE	KIND OF BULKHEAD											
	(a)	O	Δ	O	O	O	O	X	O	O	X	O
	(b)	O	X	O	O	O	O	O	O	X	X	X
	(c)	O	X	O	O	O	Δ	Δ	O	Δ	Δ	X
	(d)	O	X	O	O	O	X	Δ	O	Δ	Δ	X
	(a)	X	X	O	O	O	X	X	O	O	Δ	O
	(b)	Δ	Δ	X	O	O	X	O	O	Δ	Δ	O
	(c)	O	O	Δ	O	O	Δ	O	O	Δ	Δ	O
	(a)	X	X	O	O	O	X	X	X	O	O	X
	(b)	O	Δ	Δ	O	O	X	X	Δ	O	O	O
	(c)	X	O	O	O	O	X	X	X	O	O	X

O
Δ
X

Fig. IV-6-2 PLAN OF BULKHEAD STRUCTURE

SCALE 1:40,000



BLK.	SYM.	TYPE	LENGTH (M.)	SEA DEPTH (M.)	REMARKS
B-I	A	XIII	1100	-3.5	Sheetpiling with sandpiles
	B	V	1580	-3.5	Rock bulkhead with sandpiles
	C	I	1430	± 0.0	Rock bulkhead with sandpiles
B-II	D	IX	1100	- 1.5	Corrugated cell bulkhead with Filling sand
	F	III	820	- 1.5	Rock bulkhead with sandpiles
	G	I	1690	± 0.0	Rock bulkhead with sandpiles
B-III	H	III	965	- 1.5	Rock bulkhead with sandpiles
	I	XIII	1000	- 3.5	Sheetpiling with sandpiles (for wharf)
	J	III	915	- 1.5	Rock bulkhead with sandpiles

BLK.	SYM.	TYPE	LENGTH (M.)	SEA DEPTH (M.)	REMARKS
B-III	K	XII	535	- 1.0	Sheetpiling
	L	VI	535	± 0.0	Sheetpiling
	M	I	1670	± 0.0	Rock bulkhead with sandpiles
B-IV	N	XII	555	- 1.0	Sheetpiling
	O	IX	1200	- 7.5	Sheetpiling (for wharf)
	P	II	1130	- 1.0	Rock bulkhead
	Q	VI	4245	± 0.0	Sheetpiling
B-XII	R	XI	1500	- 2.5	Breakwater
B-XII	S	XII	1300	- 3.0	Breakwater
B-XIII	T	XIII	1380	- 3.5	Breakwater

6.7.6 Breakwater

The reclaimed land will be affected by waves from the southwest. Hence, breakwater will be placed at the bulkhead line of the future reclaimed land. It will serve as a breakwater for this project and as the bulkhead for the future project. The materials to be used for the breakwater are rocks, (See Sub-Section 6.7.1 Rock Bulkhead).

6.8 Soil Stabilization of Reclaimed Land

The reclaimed area of this project will be utilized primarily for industrial land use purposes. Since the area consists mainly of poor density and soft soils, the allocation of land use should be studied viz-a-viz the soil conditions. This section deals with the problems associated with soft soil and the land allocation which are problems that will arise even after selective land allocation has been examined.

6.8.1 Treated Surface Layer of the Reclaimed Area

The surface of the reclaimed area will be soft since it will be reclaimed with soft cohesive soils with almost no bearing capacity. It may be silty or clayey, and during rains the surface would have very poor trafficability.

This will hinder various construction works which should start after reclamation. The time losses due to this factor cannot be ignored. The surface soils of at least one meter thickness must be selected good soils.

6.8.2 Settlement of the Reclaimed Area

Settlement will occur at the portion where the soil below the seabed and the reclaimed ground are compressible. This settlement will continue for 10 years or more after reclamation, and additional settlement will start if new loads are applied.

Even with the presence of comparatively light structures (such as one-story buildings, streets, sidewalks, and buried utilities on the reclaimed area), the soil layer beneath the finished grade will be compressed and result settlement over a long period depending on the weight of the fill.

Table IV-6-9 shows the calculated settlement for each block. These values are calculated on the basis of the results of laboratory tests. The settlement of the dilluvial layer is neglegted because of the limited and slight probability of settlement. Detailed soils investigations and settlement analysis shall be done during the detailed engineering to determine required extra-banking in each block.

Table IV-6-9 SETTLEMENT OF THE DEVELOPED LAND

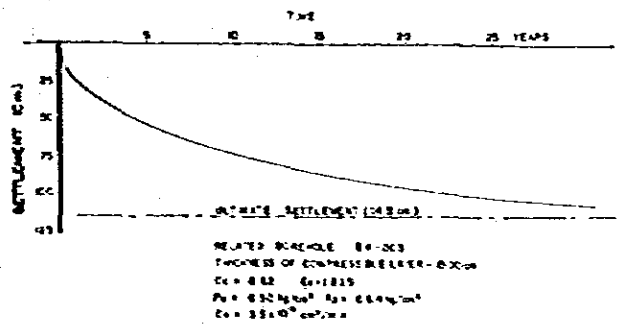
Description \ Block	I	II	III	IV
Calculated Settlement value (in meters)	0.5	1.6	1.1	0.3
Thickness of clay, silt (in meters)	10	20	15	5
Compressible layer of sand (in meters)	-	-	-	13
Related Bore Hole	BH-001	BH-002	BH-003	BH-006

Notes: Surchage Load ——— 1 t/m^2
Unit Weight of Filling Materials ——— 1.6 t/m^3 (in air)
– do – ——— 1.0 t/m^3 (submerged)

Fig. IV-6-3 shows the time-settlement curve calculated by using the laboratory test results of BH-003. The Study Team's recommendations on soil stabilization are as follows:

- Pile foundations should be applied for important structures, where settlement cannot be permitted;
- If settlement is permissible to a certain degree, a sand piling can be applied; and
- When there is ample time allowance for using the surcharge method sand pilings are not be required.

Fig. IV-6-3 TIME-SETTLEMENT CURVE



6.8.3 Foundation of Structures

Various types of structures will be built during and after the construction of the reclamation area including industrial factories stock yards (oil, ship, wood, commodities), roads, bulkhead, wharf and other utilities. The factories and other heavy

structures will be supported by piles extending down to a deep hard layer, but the stock yards, roads and other facilities will be supported by the ground itself.

When pile foundations are adopted, the following must be considered.

The pile foundations will be affected not only by the lateral force during earthquakes, but also by the lateral earth pressure caused by the surrounding surcharges at the stock yards, if the soil in the upper layer is very loose and weak.

The negative friction causing soil around the piles to hang downwards through the settlement of the upper layer is also one the problems in the soft soil area. This will be predominant in Blocks II and III, but in Block IV it will not be big problem.

Slide failure is also a matter to be considered for the soft soils. The results of the circular slip calculation of the bulkhead and embankment are indicated in Appendixes I-135 ∿ I-139. From an examination of these figures, the circular slip safety factor of the original ground is low, but after consolidation by using the sand piles, these structures will become stable.

The project area can be said to be a soft soil zone, but compared with the coastal industrial districts in Japan, like Tokyo or Osaka Bay, this area is better and by the appropriate land allocation and reclamation method soft soil problems will be minimized.

6.9 Construction Schedule

The time schedule of reclamation work is shown in Figs. IV-11-1 and IV-11-2. This schedule includes the bulkhead construction, filling work, and construction of breakwater, main road, utilities which cover the total area of 890 ha. The total required period for construction including detailed engineering is approximately 7 years if all works would be done continuously. This schedule is estimated based on the following:

- The required period is estimated based on the equipment schedule shown in Appendixes I-140 and I-141;
- Filling work should start preferably after the completion of bulkhead structure construction;
- Soil stabilization work, if necessary, should preceed bulkhead construction;
- Main road and utilities should be completed before the land is transfered to the users; and
- The reclamation work should be undertaken block by block.

CHAPTER 7. ENVIRONMENTAL IMPACTS OF THE DEVELOPMENT OF THE RECLAMATION AREA

7.1 General

Environmental impacts were evaluated according to the same pattern described in Section 8.1 in Chapter 8 of Part III.

The following components were adopted as the basis for this study.

Reclamation Area

- Approximately 890 hectares.

Affected Areas

- Direct influence zone of the Project; and
- MMA

Time Period for Consideration of Environmental Impact

- During construction; and
- After construction.

The preliminary qualitative analysis of the reasonably foreseeable effects of the development of the Reclamation Area on the above environmental indicators was carried out.

7.2 Probable Environmental Impacts and Mitigation of Adverse Effects

7.2.1 Existing Environmental Conditions and Alternative Schemes

Descriptions of the existing environmental conditions are given in previous sections of this Part and Appendix I-59. Alternative schemes, land use allocation, development policy and preliminary reclamation engineering have already been discussed and analysed in respective sections mentioned below:

Description	Part/ Appendix	Chapter	Section/ Sub-section
Study objectives	IV	1	1.2
Location and land form of the reclamation area	IV	6	6.2.4
Development policy and objectives of the reclaimed area	IV	4	4.2
Alternative master plans and their general features	IV	5	5.1 & 5.2

Cont.

Description	Part/ Appendix	Chapter	Section/ Sub-section
Dredging planning	IV	6	6.5
Shipways and wharf facilities	IV	6	6.6
Bulkhead and breakwater structures	IV	6	6.7
Relationship of the project to national development plans and land resource use policies	Appendix I-59		
Required size of the Navotas river extension	III	7	7.8.6
Physical environment of the Project Area	Appendix I-59		
Biological environment of the Project Area	Appendix I-59		
Socio-economic environment of the influence area	II	2	2.1 ∿ 2.5

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

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

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

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

Another consideration in determining the land uses in the area was to avoid polluting types of industries in view of the existing regional environmental policies. Table IV-4-2 shows the selection of types of industry found to be suitable for the proposed reclaimed area.

7.2.2 Favorable Environmental Impacts

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

A. Increase of Transport Mobility and Accessibility

The proposed reclamation will provide the land required for the right-of-way for the Coastal Road. Hence, it could be said that the reclamation project will indirectly contribute to the increase of transport mobility and accessibility to the direct influence zone. For further descriptions, see paragraph 8.2.2 A in Part III.

B. Creation of New Land

The proposed reclamation will provide about 890 hectares of land which can be utilized for land development purposes geared towards maximizing productive uses that will induce social and economic benefits to the region with minimal adverse effects and conservation of the existing natural environment.

C. Realization of Land Use Potentiality

Land use potentiality in the direct influence zone, especially the district adjacent to the reclamation area, will be highly developed for industrial and housing land uses.

D. Establishment of Labor-Intensive and Export-Oriented Industries

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

E. Promote Urban Renewal

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

F. Generation of Employment Opportunities

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

G. Establishment of P.O.L. Storage Area

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

of the tank farm area.

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

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

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

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

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

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

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

H. Establishment of Solid Waste Disposal Area

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

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

7.2.3 Summary of Adverse Effects and Their Mitigation

Project elements reducing environmental quality and expected mitigation are summarized as follows:

Adverse Effect	Mitigation
1. Temporary water	Spillways will be provided to minimize silting in the surrounding area during the construction. For further descriptions, see Paragraph 6.5.3 C in Part IV.
2. Loss of bottom dwelling area for sea organisms.	Sea beds will be stirred by the dredger, thereby changing the water quality temporarily in the surrounding area. The environmental effect of dredging is influenced by the characteristics of soils, oceanographic conditions, hydrographical conditions, type of dredger to be used and the size of borrow pit (area) planned. Therefore by adopting proper dredger and proper construction management (i.e., concentrated dredging at good soil areas) the adverse effect will be significantly reduced.
3. Loss of Fishing grounds.	Offshore areas occupied by the reclamation will be sufficiently compensated. To facilitate the fishery and fish carrier boats, the provision of approach ramps or nodal point areas will be planned at sufficient locations, since these facilities will mitigate fisherman's losses by increasing accessibility to consumer market.
4. Temporary air and water pollution during construction.	Nuisance and inconvenience during construction should be significantly reduced by introduction of proper construction management and supervision and adoption of proper construction equipment and methods.
5. Probable water and air pollution	Only light industries will be established, with provision for sewerage treatment plant. The locationing of each type of industry has been determined by considering the labor intensive (low energy consumption); therefore, air contamination will be small.
6. There will be possible pollution from tank cleaning and accidental oil spills.	This can be minimized if the P.O.L. storage area is properly designed, equipped and operated.

CHAPTER 8. CONSTRUCTION COST ESTIMATES

8.1 General

See Section 9.1 in Chapter 9 of Part III.

8.2 Construction Quantities

The quantities for work items were calculated based on the following figures and drawings:

Desceiption	Applicable Figure Number
Land form of reclaimed area	Appendix I-109
Existing hydrographical condition	Appendix I-110
Reclamation and borrow pit	Appendix I-120
Classification of borrow pit soil	Appendix I-121
Spillway	Appendix I-124
Plan of bulkhead and breakwater	IV-6-2
Typical section of bulkhead and breakwater structure	Appendixes I-129 thru I-134
Arterial street and service road	Preliminary drawings in Vol. III
Utilities	- ditto -

The Team endeavored to limit the bill of quantities to the minimum number of price items with accurate rates for operations and materials.

8.3 Unit Price Analysis

In addition to that is described in Section 9.3 in Chapter 9 of Part III, Tables IV-8-1 and IV-8-2 has been added.

8.4 Preliminary Construction Cost Estimates of the Reclamation and Infrastructure

The preliminary construction cost estimates are carried out for several alternatives as shown in Tables IV-8-3 thru IV-8-5 and Appendixes I-142 thru I-147. The cost is split into foreign currency component, local currency component and taxes.

Table IV-8-1 UNIT CONSTRUCTION COST

Unit: in pesos

WORK ITEM	UNIT	F C	L C	TAX	TOTAL
101. Dredging, Shallow	cu.m	7.49	1.41	1.64	10.54
102. Dredging, Deep	cu.m	11.82	2.15	2.65	16.62
103. Sand Mat	cu.m	41.76	13.19	8.53	63.48
104. Rockfill	cu.m	79.00	68.55	21.43	168.98
105. Sand pile, ϕ40cm	l.m	76.77	18.52	17.08	112.37
106. Sand pile, ϕ70cm	l.m	124.68	36.68	28.38	189.74
107. P.C. pile, 350x600	l.m	338.17	270.15	112.60	720.92
108. Sheet pile III, 400x130x13	l.m	320.07	42.83	32.81	395.71
109. Sheet pile IV, 400x160x16	l.m	395.50	52.35	37.18	485.03
110. Steel pipe pile, ϕ800mm	l.m	1,534.40	77.00	170.00	1,781.40
111. Corrugated cell, ϕ6.0m	l.m	5,969.97	1,107.72	1,226.11	8,303.80
112. Tierod, L = 20m, F-130T	each	5,660.00	1,130.00	1,210.00	8,000.00
113. Tierod, L = 15m, F-50T	each	2,660.00	770.00	570.00	4,000.00
114. Tierod, L = 12m, F-30T	each	1,950.00	630.00	420.00	3,000.00
115. Shield Sheet	sq.m	45.40	39.80	14.80	100.00

Note: LC – Local currency component and
FC – Foreign currency component

Table IV-8-2 HOURLY COST OF CONSTRUCTION EQUIPMENT

Unit: in pesos

EQUIPMENT	F C	L C	TAX	TOTAL
R-1. Dredger, 4000 PS	4,193.0	503.0	894.0	5,590.0
R-2. Pile driving ship, D-40	906.0	108.0	193.0	1,207.0
R-3. Crane ship, D-22	484.0	58.0	103.0	645.0
R-4. Tug Boat, 2000 PS	314.0	37.0	66.0	417.0
R-5. Barge, 60 m^3	113.0	13.0	24.0	150.0

Note: LC – Local currency component and
FC – Foreign currency component

Table IV-8-3 COST OF THE RECLAMATION - ALTERNATIVE I 1) (₱'000 in 1979 prices)

Description		B I ∿ B III				B IV				B I			
		For	Loc	Taxes	Total	For	Loc	Taxes	Total	For	Loc	Taxes	Total
Reclamation	B I	116,602	41,941	23,488	182,031								
	B II	150,745	52,041	34,869	237,655								
	B III	180,547	57,257	38,665	276,469								
	Total	447,894	151,239	97,022	696,155	258,398	86,933	56,112	401,443				
Road	B II	10,017	9,783	3,183	22,983								
	B III	11,087	10,828	3,523	25,438								
	Total	21,104	20,611	6,706	48,421	18,079	17,710	5,757	41,546	6,816	6,639	2,144	15,599
Water supply	B II	1,715	9,004	553	11,272								
	B III	3,817	11,459	1,127	16,403								
	Total	5,532	20,463	1,680	27,675	4,839	16,210	1,382	22,431	3,851	5,665	990	10,506
Drainage	B II	2,581	3,068	894	6,543								
	B III	3,415	3,984	1,114	8,513								
	Total	5,996	7,052	2,008	15,056	3,983	4,675	1,392	10,050	4,455	5,169	1,432	11,056
Sewerage	B II	4,278	7,044	1,603	12,925								
	B III	6,038	9,234	2,147	17,419								
	Total	10,316	16,278	3,750	30,344	8,136	12,904	2,938	23,978	4,626	7,274	1,658	13,558
Power &	B II	4,598	2,569	1,057	8,224								
Telephone	B III	5,100	2,851	1,172	9,123								
	Total	9,698	5,420	2,229	17,347	7,152	4,382	1,668	13,202	4,180	2,351	949	7,480
Sub Total		500,540	221,063	113,395	834,998	300,587	142,814	69,249	512,650	23,928	27,098	7,173	58,199
Prof. & Ovhd.	25%	125,135	55,266	28,349	208,750	75,147	35,704	17,312	128,163	5,982	6,775	1,793	14,550
Total		625,675	276,329	141,744	1,043,748	375,734	178,518	86,561	640,813	29,910	33,873	8,966	72,749
Det. Eng. & Sup.	4%	25,027	11,053	5,670	41,750	15,029	7,141	3,462	25,632	1,196	1,355	359	2,910
	6%	37,541	16,580	8,505	62,626	22,544	10,711	5,194	38,449	1,795	2,032	538	4,365
Total		688,243	303,962	155,919	1,148,124	413,307	196,370	95,217	704,894	32,901	37,260	9,863	80,024
Fishery compensation			15,000		15,000								
Phis. contingen	10%	68,824	31,896	15,592	116,312	41,331	19,637	9,522	70,490	3,290	3,726	986	8,002
Total		757,067	350,858	171,511	1,279,436	454,638	216,007	104,739	775,384	36,191	40,986	10,849	88,026

Note: 1) Excluding the portion of reclamation for the Coastal Road.

Table IV-8-4 COST OF THE RECLAMATION - ALTERNATIVE II 1) (₱'000 in 1979 prices)

Description		B I ~ B III				B IV				B I			
		For	Loc	Taxes	Total	For	Loc	Taxes	Total	For	Loc	Taxes	Total
Reclamation	B I	116,602	41,941	23,488	182,031								
	B II	150,745	52,041	34,869	237,655								
	B III	180,547	57,257	38,665	276,469								
	Total	447,894	151,239	97,022	696,155	258,398	86,933	56,112	401,443				
Road	B II	10,017	9,783	3,183	22,983								
	B III	12,382	11,820	3,939	28,141								
	Total	22,399	21,603	7,122	51,124	20,823	20,822	6,780	48,425	6,816	6,639	2,144	15,599
Water supply	B II	1,715	9,004	553	11,272								
	B III	3,035	9,239	924	13,198								
	Total	4,750	18,243	1,477	24,470	5,097	16,680	1,390	23,167	3,851	5,665	990	10,506
Drainage	B II	2,581	3,068	894	6,543								
	B III	3,551	4,172	1,154	8,877								
	Total	6,132	7,240	2,048	15,420	4,316	4,963	1,511	10,790	4,455	5,169	1,432	11,056
Sewerage	B II	4,278	7,044	1,603	12,925								
	B III	5,576	8,443	1,912	15,931								
	Total	9,854	15,487	3,515	28,856	10,178	16,165	3,592	29,935	4,626	7,274	1,658	13,558
Power &	B II	4,677	2,583	1,073	8,333								
Telephone	B III	5,851	3,306	1,395	10,552								
	Total	10,528	5,889	2,468	18,885	10,562	6,327	2,546	19,435	4,180	2,351	949	7,480
Sub total		501,268	216,735	116,907	834,910	314,760	149,100	69,335	533,195	23,928	27,098	7,173	58,199
Prof. & Ovhd.	25%	125,317	54,184	29,227	208,728	78,690	37,275	17,334	133,299	5,982	6,775	1,793	14,550
Total		626,585	270,919	146,134	1,043,638	393,450	186,375	86,669	666,494	29,910	33,873	8,966	72,749
Det. Eng. & Sup.	4%	25,063	10,837	5,845	41,745	15,738	7,455	3,467	26,660	1,196	1,355	359	2,910
	6%	37,595	16,255	8,768	62,618	23,607	11,183	5,200	39,990	1,795	2,032	538	4,365
Total		689,243	298,011	160,747	1,148,001	432,795	205,013	95,336	733,144	32,901	37,260	9,863	80,024
Fishery compensation			15,000		15,000								
Phis. contingen	10%	68,924	31,301	16,075	116,300	43,280	20,501	9,534	73,315	3,290	3,726	986	8,002
Total		758,167	344,312	176,822	1,279,301	476,075	225,514	104,870	806,459	36,191	40,986	10,849	88,026

Note: 1) Excluding the portion of reclamation for the Coastal Road.

Table IV-8-5 COST OF THE RECLAMATION - ALTERNATIVE III 1) (₱'000 in 1979 prices)

Description		B I ~ B III				B IV				B I			
		For	Loc	Taxes	Total	For	Loc	Taxes	Total	For	Loc	Taxes	Total
Reclamation	B I	116,602	41,941	23,488	182,031								
	B II	150,745	52,041	34,869	237,655								
	B III	180,547	57,257	38,665	276,496								
	Total	447,894	151,239	97,022	696,155	258,398	86,933	56,112	401,443				
Road	B II	10,017	9,783	3,183	22,983								
	B III	11,087	10,828	3,523	25,438								
	Total	21,104	20,611	6,706	48,421	16,206	16,205	5,276	37,687	6,816	6,639	2,144	15,599
Water supply	B II	1,715	9,004	553	11,272								
	B III	3,817	11,459	1,127	16,403								
	Total	5,532	20,463	1,680	27,675	5,837	19,102	1,592	26,531	3,851	5,665	990	10,506
Drainage	B II	2,581	3,068	894	6,543								
	B III	3,415	3,984	1,114	8,513								
	Total	5,996	7,052	2,008	15,056	4,312	4,959	1,509	10,780	4,455	5,169	1,432	11,056
Sewerage	B II	4,278	7,044	1,603	12,925								
	B III	6,038	9,234	2,147	17,419								
	Total	10,316	16,278	3,750	30,344	9,435	14,986	3,330	27,751	4,626	7,274	1,658	13,558
Power &	B II	4,518	2,556	1,039	8,113								
Telephone	B III	5,013	2,837	1,155	9,005								
	Total	9,531	5,393	2,194	17,118	9,163	5,512	2,212	16,887	4,180	2,351	949	7,480
Sub total		500,373	221,036	113,360	834,769	307,579	145,743	67,757	521,079	23,928	27,098	7,173	58,199
Prof. & Ovhd.	25%	125,093	55,259	28,340	208,692	76,895	36,436	16,939	130,270	5,982	6,775	1,793	14,550
Total		625,466	276,295	141,700	1,043,461	384,474	182,179	84,696	651,349	29,910	33,873	8,966	72,749
Det. Eng. & Sup.	4%	25,019	11,052	5,668	41,739	15,379	7,287	3,388	26,054	1,196	1,355	359	2,910
	6%	37,528	16,578	8,502	62,608	23,068	10,931	5,082	39,081	1,795	2,032	538	4,365
Total		688,013	303,925	155,870	1,147,808	422,921	200,397	93,166	716,484	32,901	37,260	9,863	80,024
Fishery compensation			15,000		15,000								
Phis. contingen	10%	68,801	31,892	15,587	116,280	42,292	20,040	9,317	71,649	3,290	3,726	986	8,002
Total		756,814	350,817	171,457	1,279,088	465,213	220,437	102,483	788,133	36,191	40,986	10,849	88,026

Note: 1) Excluding the portion of reclamation for the Coastal Road.

CHAPTER 9. FINANCIAL ANALYSIS

9.1 Elements of Financial Analysis

Financial analysis was conducted to forecast the financial performance of the reclamation project. The result of the analysis is shown by the net surplus of cashflows which is the balance between the income and the expenditure of the project. The income is comprised of the following sources.

- Revenue of the sale of residential and industrial lots on the reclaimed area;
- Contribution of funds from the government agencies for the construction of infrastructures; and
- Borrowings from banks and other financing establishments.

The project expenditure is comprised of the following items:

- Engineering and construction work;
- Interest payment;
- Repayment of loans;
- Land acquisition and compensations;
- Maintenance and administration; and
- Subsidies for the purchase of residential lots.

Major elements of revenues and expenditures are studied in the following sections.

9.2 Land Values

9.2.1 Surveys

Market values of lots on the reclaimed land are needed for the determination of the financial and economic viability of the reclamation. For this purpose, existing prices of open land lots, mainly in the municipalities of Navotas, Malabon, Valenzuela and Quezon, etc., were surveyed.

Sources of information were:

- Fair market values registered at the assessor's office in the municipality.
- Valuation by staff of private developers; and

- Sale advertisements in the newspapers.

A. Fair Market Values Registered at the Assessor's Office

Each municipal assessor has a table of fair market values of the land per sq.m for the lots within the municipality for assessment of annual municipality tax. These fair market values were established in 1977-78 and will be revised again after 3-5 years. The values were determined by reviewing records of sales registered in the years before the revision of 1977-78.

Since 1977/78, there has been no change in the announced fair market value. Consequently, these values become less accurate as time passes. Furthermore, the price of transactions, as is generally known, is often registered at a lower price in order to alleviate tax levies.

Although the fair market prices indicate considerably lower prices than the actual level of transactions, the prices in the assessors office are the only source of systematized information. Table IV-9-1 presents the summary of fair market prices (Sometimes called "the government price"), in Navotas, Malabon, Valenzuela, and Quezon.

Table IV-9-1 FAIR MARKET VALUES FOR LAND

Unit: Pesos per m^2

Land Use	Navotas	Malabon	Valenzuela	Quezon
Commercial[1)]	150-300	120-420	70-300	500-1,500 (Commercial Complex 1,500-2,200)
Industrial[1)]	150-300	120-420	70-300	520-780
Residential[1)]	150-300	120-420	70-300	60-780
Rice field	3.0	4.0-5.0	3.0-5.0	-
Rishpond	2.5	3.0-10.0	2.5-4.0	-

Source: The assessors of municipalities listed above. August, 1979.

Notes: 1) Except Quezon City there is no difference of market value among the land use categories. Assessed value was obtained by multiplying 0.5 to the above values for Commercial and Industrial lots and 0.3 for Residential lots in all cities.

B. Private Developers & Real Estate Dealers

The team approached a few real estate dealers to determine representative prices of residential, commercial and industrial lots in the cities within the MMA. (See Appendixes I-148 and I-149 for the price estimates of private developers). It was found that land price information of these realty dealers was based on their own sales and hence an accurate average range was difficult to determine.

However, the data in general reflected a unit price for normal commercial land two times higher than that of residential lots in the same municipality.

For the industrial zone, unit prices were higher by 30-50% than the residential area. For lots located in an area where no explicit zoning boundaries are established, the unit prices were similar to the residential lots in the surrounding area because of possible adverse effects of infrastructure services which may be necessary for industrial establishments to construct.

C. Advertisements in the Newspaper

Land sale advertisements in the Bulletin Today during the 21st to 31st of August 1979 were examined to find the distribution of prices per square meter in and around MMA. Appendix I-150 is the summary of the data. Since the realty dealers and developers usually propose some reductions in the course of negotiation, agreed prices were not available from these data.

9.2.2 Conclusion

A. General

The wide range of land prices as described above indicates that a number of assumptions are necessary to find the average land price, for each category of land use and location. For the reclaimed land of the project, the necessary detailed assumptions cannot be established at this stage of the analysis.

In the financial and economic study, the overall average price of commercial, residential and industrial areas in the reclaimed land, not the estimated price for each of detailed classified lot, are based on the following findings.

B. Findings

i) Comparing the lot prices in Navotas-Malabon, Valenzuela, Quezon City and Makati, the prices are highest in Quezon and Makati. It is likely that the prices will be the lowest in Navotas-Malabon area.

ii) The prices of land in commercial area is approximately twice that in residential area. The difference in prices between the industrial and residential lots is not as large as between residential and commercial areas.

iii) The study team's findings of average land prices per m^2 in these districts are summarized below:

Land Use	Navotas, Malabon	Valenzuela	Quezon
Commercial	500	600	800
Industrial	325	450	550
Residential	250	350	400

C. Estimate of Prices on the Reclaimed Lands

The major factors which will affect the price of reclaimed land are the following:

- Since it is quite likely that the reclaimed land can hardly support multi-story buildings without additional civil works for stabilizing foundation, the market value of the reclaimed land will decrease;

- The use of land in the reclaimed area will be regulated to have sufficient open and green space just like that in Bataan Export Zone. This regulation will reduce the magnitude of actual land utilization therein as compared to other areas outside the redemption, thereby resulting in a lower prices per square meter;

- Since power, water, sewarage system will be provided at the boundary of lots before the sale of new lands in the industrial zones, higher prices will result;

- Wharves of the reclaimed islands will be able to be used for direct shipment by the establishments located on the reclaimed lands. However, if necessary, a port structure could be developed into container operation and/or public port, serving as part of Manila international and domestic port; and

- The reclaimed area will have better accessibility to the center of Manila, particularly to the North port (Domestic) and South port (International), through the Coastal Road and R-10. Also, it will have road services to Quezon, Makati and other places through the network including C-3, C-4, C-5 and C-6.

The majority of residential lots will be occupied by people who work in the establishments located in the industrial area of the reclaimed land. The market price of these lots should be higher than that in Navotas and Malabon, but lower than in Makati. The price will be competative with that of Valenzuela and Quezon.

From the conservative viewpoint, the Mid-1979 price in Valenzuela was adopted for the price on the reclaimed land. That is ₱350.00/m^2.

There will be no large scale commercial or shopping complex on the reclaimed land. Commercial and business areas will be small and located along streets and in town center areas. The price is estimated at ₱600.00/m^2, the same as that of industrial lots.

In case of industrial lots, they will have many locational advantages over residential lots. The establishments located will even have more advantages than those located along EDSA. The establishments will also benefit from the reduction of transport costs.

The price of industrial lots will be higher than that of Valenzuela and Quezon. It has been adopted as ₱600/m^2 on reclaimed lands.

In summary, the prices of land in the reclaimed area in 1979 prices was determined as follows:

Residential lots	₱350.00/m^2
Commercial lots	₱600.00/m^2
Industrial lots	₱600.00/m^2

9.3 Income Required for Land Tenure

In determining the required income for housing expenses, the expenditure on land tenure is taken into consideration. The expenditure for the cost of dwelling construction is excluded at this stage of the study because there are a number of uncertain factors associated with the cost estimate of a dwelling unit, such as the spacing, materials, design, availability of saving funds, etc.

9.3.1 Affordability

It is assumed that the lots of residential area are sold out without installment. But, the percentage of the income which is spent on the land tenure is usually measured in terms of monthly income. Accordingly, the comparison of the sale price and the affordable amount of monthly expense is conducted by converting the sale price into an equivalent monthly installment amount over 25 years under an interest rate.

Interest charges applicable to the loans for the land and house acquisition vary between 9% and 20%. The rate of 12% is assumed since it is used by the Development Bank of the Philippines for lot and housing loans.

According to the NHA staff and based on other studies such

as Daggat-Dagatan Project[1/] the amount of income which can be spent on housing (land plus house) is considered to be a maximum of 20%. In this study, the maximum affordable expenditure on a land lot is assumed to be 15, 12, 10 and 8%, according to the level of income, respectively. The above figure is determined after considering a an allowance for dwelling construction expenditure. If the monthly payment to cover the development cost exceeds by far the monthly affordability, then there will be a smaller demand for land purchase or there will be a need to subsidize the balance between the payment and the affordable expenditure.

Household income of those who would demand the lots on the reclaimed land are classified into four groups, each with an average monthly income in 1979, 1988 and 1998 as shown in Table IV-9-2. The upper middle class and the social class are taken to represent those living in the residential area. In 1979, the monthly income was P1,250 and P400 respectively, of which the affordable expenditure budget for land tenure is P150 for the former and P32 for the latter. These amounts are assumed to increase 3% p.a. for the years over the period of construction, resulting from the growth of the real GNP of the Philippines.

Table IV-9-2 AVERAGE HOUSEHOLD INCOME AND AFFORDABILITY IN THE RESIDENTIAL AREA OF THE RECLAIMED LAND

		Annual Income in 1979 Prices	Monthly Income[3] in 1979 Prices	Affordability for Lot Purchase	
				in percent (%)	P/month, 1979
1979	Higher Middle	24,000	2,000	(15)	300
	Upper Middle	15,000	1,250	(12)	150 2)
	Middle	9,000	750	(10)	75
	Social	4,800	400	(8)	32 2)
1988 1)	Higher Middle	31,300	2,608	(15)	391
	Upper Middle	19,600	1,633	(12)	196 2)
	Middle	11,700	975	(10)	98
	Social	6,300	525	(8)	42 2)
1993 1)	Higher Middle	36,312	3,026	(15)	453
	Upper Middle	22,695	1,891	(12)	227 2)
	Middle	13,617	1,135	(10)	114
	Social	7,262	605	(8)	48 2)

Notes: 1) It is assumed that the household income increases by 3% p.a.
2) These two classes are adopted for studying the subsidies.
3) An example of monthly income distribution is shown below.

Example of Monthly Income Distribution *

Percentiles	Monthly Income
10th	270
20th	340
30th	410
40th	480
50th	600
60th	730
70th	900
80th	1,230
90th	1,620

* Source : NCSO, quoted and adjusted to that of 1978 by the Second Feasibility Study of Dagat Dagatan (NHA, Llewelyn-Danies Kinhill Pty. Ltd. and Sycip Gorres Velayo Co., July 1978).

1/ NHA and Llewelyn-Denis Kinhill Pty Ltd with Sycip Gorses Velayo Co. The Second Feasibility Study of Dagat Dagatan, (July 1978).

9.3.2 Subsidies

If the required monthly payment to cover the development cost exceeds by far the monthly affordability, there will be a need to subsidize the balance. There are a number of types of subsidies which can be considered for such a kind of housing development project. In order to hold a simplified presentation, it is assumed that these subsidies will be associated with the development cost of the land. The balance between the allocated cost of the development of a residential lot and the present worth (i = 12%, n = 25 years) equivalent to the monthly affordable allowance of a household income is assumed to be covered by subsidies.

NHA usually finds that the financial source of subsidies is the surplus resulting from the sales of industrial/commercial lots in the same project. This project would follow the same policy of subsidy financing. The total amount of subsidies in the sales of residential lots is shown in the Appendix I-151.

Since the development cost is estimated to be P401 - P469 per square meter of the open lot in the residential area, the subsidies are determined to fill the balance between the average allowance of income on land tenure and the development cost of a lot based on the above cost. The forecast amount of total subsidies are shown in Appendix I-151 and the figures for the alternative plans are shown below:

Alternative Master Plan	Number of Families	Total Amount of of subsidies in P million
I	4,274	116.72
II	12,754	346.24
III	8,734	236.72

9.4 Cost of the Reclamation and Infrastructure

Appendixes I-142 thru I-147 present the estimated cost for the alternative Master Plan, respectively. These costs are summarized below in financial cost at 1979 prices:

Alternative I	2,143 million pesos
Alternative II	2,174 million pesos
Alternative III	2,155 million pesos

The Alternative II registers the highest cost since it contains the largest area of residential use among the three, while Alternative I proposes the largest industrial zone.

The Alternative III is a midpoint plan between Alternative I and II.

The cost of infrastructure construction in the Block-I is shown separately since this construction is scheduled to start in 1993 after the Block is filled by garbage dumped as engineered fill (See Sub-Section 2.2.9 of Part IV).

9.5 Source of the Funds

The offshore reclamation and construction of the infrastructure would require intra-ministrial adjustment for the preparation, implementation and funding of the project. A considerable amount of the funds would be procured from the private sector because the total amount of the required cost exceeds the amount which can normally be included in the ordinary budgetary allocation of the government.

To facilitate the management of the implementation of the project, it is proposed to establish a public corporation with the paid in capital of P20 millions, which is to be paid by the Government. This corporation would be in charge of supervising all of the preparatory engineering, construction and the sales of the open lots. The contributed funds of the government agencies and the loans from banks would be managed and operated by this corporation.

In this study it is proposed that several kinds of infrastructure construction be financed for this corporation by the appropriate government agencies. On the other hand, the reclamation cost should be mostly covered by the loans from the banking consortium, which will be repaid from the revenue from the sale of the lots.

Infrastructure construction is divided into the sectors to which the respective government agencies should be responsible for financing the cost in the appropriate years. The cost includes the indirect costs and physical contingencies. The amount will be disbursed in the years based on the construction program. This information is shown in Table IV-9-4.

The loans from financial institutions are estimated to be approximately P1.20 billion to be borrowed during 1983 - 87, which would be paid back during 1988 and 1989 from the revenue of the sales of the lots. The bank interest is assumed to be 12% annually, which is the normal interest rate on the loan of Philippine Development Bank for housing and development projects. The proposed scheme is shown in Table IV-9-3.

Table IV-9-3 BORROWING OF THE PROJECT

(P '000 in 1979 Prices)

Alternative	Borrowing Repayment	1983	1984	1985	1986	1987	1988	1989	1991	1993	Total
I	Borrowing	100	300	250	400	150					1200
	Repayment						650	550			1200
II	Borrowing	100	300	250	300	250			150		1350
	Repayment						650	550		150	1350
III	Borrowing	100	250	300	300	250					1200
	Repayment						650	550			1200

Source: Quoted from Appendix I-153.

Table IV-9-4 SOURCES AND ALLOCATION OF FUNDS

(In financial cost of 1979 at ₱'000)

Descriptions	Government Agencies	Alternative I			Alternative II			Alternative III		
		Block I~III	Block IV	Block I	Block I~III	Block IV	Block I	Block I~III	Block IV	Block I
1. Roads 1)	MPH	66,579	57,126	21,449	70,296	66,584	21,449	66,579	51,820	21,449
2. Water System 1)	MWSS	38,053	30,843	14,446	33,646	31,855	14,446	38,053	36,480	14,446
3. Drainage & Sewage 1)	MPW & MWSS	62,425	46,780	33,844	60,880	55,997	33,844	62,425	55,997	33,844
4. Power & Telecommunication 1)	MELCO & PLDTC	23,853	18,153	10,285	25,967	26,725	10,285	23,539	23,219	10,285
5. Parks & Town Centers 1)	Ministry of Human Settlement	41,843	20,452	53,811	66,356	63,639	53,811	31,085	57,639	53,811
6. Sanitary Fill Site 1)	MMA	78,167	-	-	78,167	-	-	78,167	-	-
7. Detailed Engineering and Supervision	MPH & Others	114,814	70,489	8,003	114,800	73,315	8,003	114,782	71,649	8,003

Notes: 1) Overheads & physical contingencies are included by multiplying the ratio of 1.375 times the direct cost.

2) One third of the allocated cost for parks and town centers as shown in Appendix I-146 thru I-151 is assumed to be financed by the Ministry of Human Settlement.

3) Half of the construction cost of the bulkhead of the Block-I is assumed to be financed by MMA.

The revenue from the sales of the lot will begin to be received after 1988. In this study it is assumed that all lots will be sold for cash. No long period installment payments are assumed in order to maintain a simple analytical presentation. It is quite likely however, that the installment payments by entrepreneurs can be accepted. In that case, it is understood that a bank loan to the establishment for the mortgage of the land would be contracted so that the corporation would receive the amount immediately. Appendix I-152 presents the forecast revenue from the sales of the lots.

9.6 Average Cost of the Reclamation Area

The cost is aggregated into the total as follows in 1979 prices, which does not include the cost of the reclaimed portion for the coastal road. In order to find out the cost allocation for residential zone, industrial zone, etc., the total cost is broken down into items as shown in Appendixes I-142 thru I-147.

(₱ '000 in 1979 prices)

Alternative	Block I	Block II	Block III	Block IV	Total
I	368,849	458,648	539,968	775,383	2,142,848
II	368,849	458,814	539,661	806,458	2,173,782
III	368,849	458,482	539,789	788,133	2,155,253

The cost per m^2 is calculated resulting in the average cost as shown in Table IV-9-5. The cost per m^2 for residential area is higher than that of the industrial zone since the former requires intensive networks of infrastructure which are requisite to have a high land value as evaluated in Section 9.2 of Part IV. The figures include all costs up to physical contingencies.

Table IV-9-5 AVERAGE COST PER M2

(Pesos in 1979 Prices)

Designation		Residential Area			Industrial Area		
		Alt. I	Alt. II	Alt. III	Alt. I	Alt. II	Alt. III
Block I	a.	359	359	359	-	-	-
	b.	445	445	445	-	-	-
		(354.2)	(354.2)	(354.2)	-	-	-
Block II	a.	-	-	-	248	252	249
	b.	-	-	-	267	273	271
		-	-	-	(1447)	(1278.4)	(1433.8)[2]
Block III	a.	-	388	-	265	279	271
	b.	-	475	-	287	299	291
		-	(160.2)	-	(1356.4)	(620.4)	(1222.0)
Block IV	a.	-	319	340	241	257	254
	b.	-	403	421	261	277	285
			(535.9)	(369.6)	(2266.0)	(948.8)	(1191.2)

Remarks: a. The cost of the net area only is included.

b. The cost of the service roads in both the residential and industrial area is included. (See Appendixes I-142 thru I-147)

Notes: 1) Overhead, profit and other items down to physical contingencies are included by multiplying 1.5125.

2) ( ) indicates the net area in 1,000 m2.

3) The cost for parks, open spaces for utilities and arterial street as well as land acquisition and compensation (fishery compensation) are not included in the above unit average cost.

If one reclamation block is developed into a residential area, the development cost including the paved streets, water, sewerage, power, telecommunication and drainage systems would be ₱401 per m2. On the other hand, if the block is utilized as an industrial area the average cost would be ₱276, less by 30% of the residential area. The average cost for the industrial area is less because their infrastructure network is less complex than that of the residential area.

9.7 Statement of Income and Expenditure

Incomes and expenditures of the reclamation corporation are estimated and shown in Appendixes I-153 thru I-155. In this estimate the loan interest is estimated to be 12% annually. No equity receipt is shown in the tables since any receipt or dividend is part of the surplus, which development projects.

The contribution of the government agencies, loans and repayment, interest payment, and the administrative costs of the corporation are all included in these tables.

Assuming all construction work is completed in the staged program during the years of 1983 - 1992 and the sale of the lots advances under the forecast program, the surplus of the corporation (virtually, it is a revenue to the government) and internal rate of return would be as follows based on 1979 prices of million pesos:

Alternative	Included Blocks	Without discounting	Discounted at 15%	IRR
I	I ∿ IV	3,697.6	713.6	more than 60%
II	I ∿ IV	1,410.3	260.3	" "
III	I ∿ IV	2,418.0	478.2	" "

The income and expenditure flows indicate a feasible return for all cases. Alternative I presents a higher surplus than the others because of the larger area in the industrial zone. Alternative II presents the lowest surplus because of higher development costs for the extensive housing area.

9.8 Sensitivity Analysis

A calculation is made based on the assumption that the costs might increases by 20% while the revenue from the lot sales are not changed. The results will be as follows.

Alternative	Included Blocks	Net Surplus (P' mil.) discounted at 15%	IRR
I	I ∿ IV	382.3	33.8%
II	I ∿ IV	86.7	8.9%
III	I ∿ IV	146.9	23.5%

If the lots are not sold as forecast, for example, one third of industrial lots and residential lots remain in the corporation, the revenue decreases by one third resulting in the following surplus. Alternative I presents still a higher surplus, but Alternative II has a negative PW and Alternative III has a modest surplus.

Alternative	Included Blocks	Net Surplus (P' mil.) discounted at 15%	IRR
I	I ∿ IV	68.6	12.1%
II	I ∿ IV	-398.2	-
III	I ∿ IV	-226.3	-

If the cost increases by 20% and one third of the lots are not sold resulting in the deficits for all alternative cases. Among them, Alternative I has an modest deficit.

Alternative	Included Blocks	Net Surplus (P' mil.) discounted at 15%	IRR
I	I ∿ IV	-400.0	2.7%
II	I ∿ IV	-745.3	-
III	I ∿ IV	-557.5	-

Through these sensitivity tests, it is found that the Alternative Master Plan I of the reclamation project is the most financially viable plan. However, it is found that the financial performance of the corporation is very sensitive to the changes in the development cost and/or the revenue generated from the location of business establishments.

9.9 Marketing Strategies

Sales advertisement for the new lots would be conducted by the corporation and the sales campaign would be extended to the entrepreneurs in foreign countries as well as to those in the Philippines.

A success in the development of the Bataan Export Processing Zone should be taken into account. The merits and demerit of the custom-free zoning and adoption of location-encouragement policies should be studied extensively.

The land use zoning for the industrial sectors was presented in Chapter 4 of the Part IV, which was proposed after forecasting the growth of these sectors in the country or in the MMA. However, site selection factors of entrepreneurs on the lots of the reclaimed area have not yet been studied. Before the completion of the reclamation, during the next ten years studies should be conducted to explore these factors.

The market price of the lots has been estimated as an overall average. There would be a range of prices due to the differences in position, scale, zoning, etc. The price would also be influenced by the land use zoning policy and regulations of the Metro Manila Commission and Ministry of Human Settlement. The price differentiation and these influences are the subjects to be studied during the years of construction.

CHAPTER 10. ECONOMIC ANALYSIS

10.1 Cost and Benefits of Reclamation

10.1.1 Adjustment Factors

Adjustment factors to be applied in the estimate of economic cost and benefits are the same as those in the economic analysis of the road project (See the Sub-Section 10.3.1 in Chapter 10 of Part III).

10.1.2 Economic Cost

The economic cost of each alternative is shown in Table IV-10-1 which is summarized from Tables IV-8-3 thru IV-8-5.

10.1.3 Economic Benefits

A. Rent of the New Land

i) Background

When a land reclamation project such as under study is implemented, it usually takes about ten years or more from the time of feasibility study to that of completion. Hence, it is practically impossible at the stage of feasibility study to determine the economic value of land utilization, allocation of industrial land use, and the magnitude of each establishment to be located.

Also, the estimated cost of the production input requirements for the establishments which would settle in the reclaimed lands such as energies, manpower, building and equipment, raw materials and the subsequent economic gains are meaningless to forecast at this stage of the study because there are lot of uncertainties involved in the estimate.

Under these circumstances, it is considered reasonable to measure the economic benefits by finding the margin between the market price of the land and its cost [1/] because the land will be purchased at a market price by the located establishment which, in turn will amortize the purchased cost as the cost of output for years to come. The entrepreneur must have confidence to gain a surplus in the sales of his output or otherwise he would not set up an establishment on the reclaimed land.

1/ The margin between the market price and the cost of supply is called "rent", which is compatible with the concept of consumers surplus. A reference is E.J. Mishan, Elements of Cost-Benefit Analysis Union University Books, London, 1975

Table IV-10-1 ECONOMIC COST OF THE ALTERNATIVES

Alternative	Block(s) & Infrastructure included	Foreign[1] Cost	Local[1] Cost	Shadowed Foreign Cost (1)x1.15	Shadowed Local Cost (2)x0.98	Total of Shadow & Con. Cost. (3)+(4)
		(1)	(2)	(3)	(4)	(5)
I	BI ∿ BIII	757,067	350,858	870,627	343,841	1,214,468
	BIV	454,638	216,007	522,834	211,687	734,521
	Infrastr. for BI	36,191	40,986	41,620	40,166	81,786
	Total	1,247,896	607,851	1,435,081	595,694	2,030,775
II	BI ∿ BIII	758,167	344,312	871,892	337,426	1,209,318
	BIV	476,075	225,514	547,486	221,004	768,490
	Infrastr. for BI	36,191	40,986	41,620	40,166	81,786
	Total	1,270,433	610,812	1,460,998	598,596	2,059,594
III	BI ∿ BIII	756,814	350,817	870,336	343,801	1,214,137
	BIV	465,213	220,437	534,995	216,028	751,023
	Infrastr. for BI	36,191	40,986	41,620	40,166	81,786
	Total	1,258,218	612,240	1,446,951	599,995	2,046,946

Note: 1) From Appendix I-156 thru I-158

ii) Market prices of land

Land value on the reclaimed land was determined after surveying the market prices in the areas from Navotas to Quezon, as presented in Section 9.2 of Part IV. The determined market values of land are summarized below, without classification by industries.

Industrial lot : ₱ 600/m^2 in 1979 prices
Commercial lot : ₱ 600/m^2 in 1979 prices
Residential lot : ₱ 350/m^2 in 1979 prices

If the value of land is assumed to increases by 5% p.a. in constant prices, the land prices in 1988 would be as follows:

Industrial lot : ₱ 930/m^2
Commercial lot : ₱ 930/m^2
Residential lot : ₱ 543/m^2

The sales of land would be spread over several years, from 1988 to 1996, depending on the stages of construction. The schedule of the sales is already shown in Appendix I-153. It is assumed that those establishments who purchased the land would construct production facilities within 2 or 3 years, and households would construct dwellings within one year.

The subsidies on the purchase of residential lots are estimated. The total subsidies can be covered by the revenue of the sale of industrial lots. They are included in Section 9.3 of the previous chapter.

iii) Supply and cost of Land

The economic cost of reclamation and infrastructure has been shown in the previous section 10.1.2 The costs allocated in the reclaimed and industrial areas has been compared with the market value of that area. The comparison of the cost and benefit streams are presented in the next Section 10.2.

B. Savings in Transport Cost of Solid Waste Disposal

i) Existing situation

At present waste and garbage in the Manila City are collected and dumped at Balut site, just outside the Manila North Harbor. The quantity dumped at the site has already exceeded the capacity limit and it is rumored that the site will be closed in the near future because it is in the right-of-way of R-10 and the area has been designated to be developed into an industrial port complex area. The MMA commission is urgently looking for other places.

New dump sites, not yet confirmed by the MMA commission, would be located beyond the periphery of the urban area, 15 to 20 km away from the center of Manila. This will require a longer hauling distance and additional trucks.

If the land in the reclaimed area is utilized for a dumping site, the transport cost of garbage trucks will be reduced compared to the hauling cost to new sites outside the urbanized area. The cost savings are considered as an economic benefit associated with the dumping site included in the reclamation project.

ii) Volume of Solid Waste

As stated in Section 2.2.9 of PART IV, MMC operates 315 dump trucks and 27 packer trucks serving the entire Metropolis. Manila has 109 operational vehicles out of the total of MMC public and private operators. Average daily collection is 1,000 tons or 2,500 cubic meters. If it is divided by the population of 1,631,000 in 1979, it indicates 0.61 kg/per capita/day.

Beside the above public operation, it is known that private establishments dump the waste using their own transport. The National Pollution Control Commission of Ministry of Human Settlements suggests that the per capita figure including private dumpings would be 0.80 based on the figures for Hongkong (0.87 kg/day) and Singapore (0.85 kg/day).

If the total volume of waste increases in proportion to the increase in per capita real national income (assumed to grow at 3% p.a., as shown in Section 4.1 of Part III) and the population growth of the City (estimated to increase 1.4% p.a. as shown in Section 2.1.1 of Part II), the waste will increase by approximately 5% p.a. for coming 20 years. Accordingly, the number of collecting trucks for Manila should increase at 5% p.a. to meet the requirement of solid waste disposal.

iii) New dumping sites

When the Study Team interviewed the commission staff in August 1979, the commission had not yet finalized either new dumping spots to substitute for the Balut site or a drastically new plan for a collection-hauling-selection-dumping system.

It is quite likely that new dumping sites will be located on the periphery of MMA, at 15 km or more from the city. The use of reclaimed land for a dumping site which is 7 km away from the city will at least result in savings of dump truck hauling costs.

C. Savings in Transport Cost

Table IV-10-2 presents the estimates of savings in dump-trucks hauling cost. Assuming the waste volume in 1979 of 1,300 tons per day, the savings of the trucks hauling cost would be 4.0 million pesos per annum. If the waste is assumed to increase at the rate of 5% p.a., the savings will be P5.31 million in 1984. The stream of this benefit will continue until the allocated site is full with the waste, which is forecast to be in 1993.

10.2 Benefit Cost Estimate

10.2.1 Assumptions

The adopted assumptions for benefit cost estimates are as follows:

- Detailed engineering will start in 1981;
- The reclamation and the infrastructures on all the reclamation blocks of BI - BIV will be completed in 1995;
- The last revenue from the sale of the lots will be received in 1996;
- No installment payment is assumed for the sale of lots. All revenue is estimated at the present value in the year when the lot is sold; and
- The opportunity cost of the capital is assumed at 15% p.a. which is usually applied by NPH on project studies.

Table IV-10-2 COST SAVING ALTERNATIVE FOR SOLID WASTE IN MANILA CITY, 1979

Description	Existing Balut Island	New Sites Outside the Urban Area	A new Site on the Reclaimed Island
1. Distance from the City	5 km via existing roads	15 km via main through fares	7 km via R-10
2. Operation	2 shifts 109 trucks, 2 turns per shift.	2 shift 109 trucks, 2 turns per shift. Additional 54 trucks necessary to fill in the operation of long distance of hauling.	2 shifts 109 trucks, 2 turns per shift.
3. Hauling	109x2x2x5	164x2x2x15	109x2x2x7
Distance in vehicle km/year	x 365 = 795,797	x 365 = 3,591,160	365 = 1,113,980
Vehicle running cost (VRC) per km per year	0.585x795,700 = 465,500	0.585x3,591,600 = 2,101,100	0.585x1,113,900 = 651,700
Vehicle time cost (VTC) per hour	9,823x2hrx109x365	9,823x6hrx164x365 = 3,528,000	9,823x2.5hrx109x365 = 977,000
4. Savings: Differences in hauling cost.			

VRC	1,635,600			VRC	1,449.400
VTC	2,746,400			VTC	2,551,000
Total	4,382,000			Total	4,000,400
		VRC	186,200		
		VTC	195,400		
		Total	381,600		

10.2.2 Benefit Cost Calculation

The streams of the cost and the benefit for the alternative master plans are shown in Appendixes I-156 and I-157. The discount rate of 15% p.a. is adopted to result in the following figures, Alternative I is the most economically feasible project.

(₱' million in 1979 prices)

Descriptions	Alternative I	Alternative II	Alternative III
Cost	965.9	1,027.0	991.4
Benefits	1,419.7	985.9	1,189.4
Present Worth	453.7	-41.0	198.0
B/C Ratio	1.470	0.960	1.200
Internal Rate of Return	25.2%	13.6%	20.4%

10.2.3 Sensitivity Analysis

A calculation is made to find the range of variation in benefits and cost figures. If the cost increases by 20% while the revenue from the lot sale is not changed, the result is shown as the option 1 in the following table. The Alternative I holds the highest internal rate return of 20%.

The effect of the case where the revenue of the lot sale decreases by 33% is shown as the option 2 in the same table. The Alternative I still indicates the internal rate of return at 15%. The result is shown as option 2 in the same table.

If the cost increases by 20% and the revenue decreases by 33%, the result is shown in Table IV-10-3 as the option 3. The Alternative I presents the internal rate of return at 10%. It is found that the Alternative I would not lose its priority in the range of these variations. It is the most viable project among the three plans.

Table IV-10-3 SENSITIVITY TEST OF INTERNAL RATE OF RETURN

Alternative	Option 1, the cost increases by 20%	Option 2, the benefit decreases by 33%	Option 3, a Combination of Opt. 1 & Opt. 2
I	19.3%	14.6%	9.9%
II	7.6%	0.4%	-
III	14.9%	8.4	2.9%

CHAPTER 11. IMPLEMENTATION PLAN

11.1 General

To complete the construction, it is assumed that the Government will engage a contractor by international tendering. As this project requires the construction of a complex reclamation and infrastructure, it should preferably be executed by a contractor who has experience in this type of work. The contractors, therefore, should be pre-qualified.

11.2 Construction Schedule

11.2.1 Construction Period

According to the overall construction schedule for the Reclamation (Blocks I ∿ III) and infrastructure, the maximum possible construction period of five years was selected.

11.2.2 Working Day

Number of working day in a month is shown in Chapter 11, Part III.

11.2.3 Construction Division and Stages

The Reclamation Blocks I ∿ III will be constructed simultaneously in the initial stage and Block IV in later.

The construction of the Project Road requires also a large financial investment. For this reason and to obtain the maximum economic benefit from the Project Roads, it is desirable to complete the reclamation of the right-of-way for the Coastal Road as soon as possible.

11.3 Implementation Schedule

After careful study of the data collected during the field investigations and of the construction cost estimates for the reclamation project, it was determined that the Reclamation Blocks I ∿ III can be constructed as one single construction section.

Before beginning construction, it is necessary to carry out such preconstruction preparatory work as detailed sounding, soils investigation, detailed design, land acquisition, and financial preparation. The period required for such preparatory procedures is estimated to be about 2 years.

The detailed design will take about eighteen months and, assuming that at the same time, negotiations on financial procurement are successful, land acquisition can begin. During the period required for land acquisition to be completed, the contract for construction can be approved and awarded.

Mobilization for construction can begin after the contract is awarded. It is assumed that this process will take about six months.

The construction for the reclamation and provision of infrastructure is as follows:

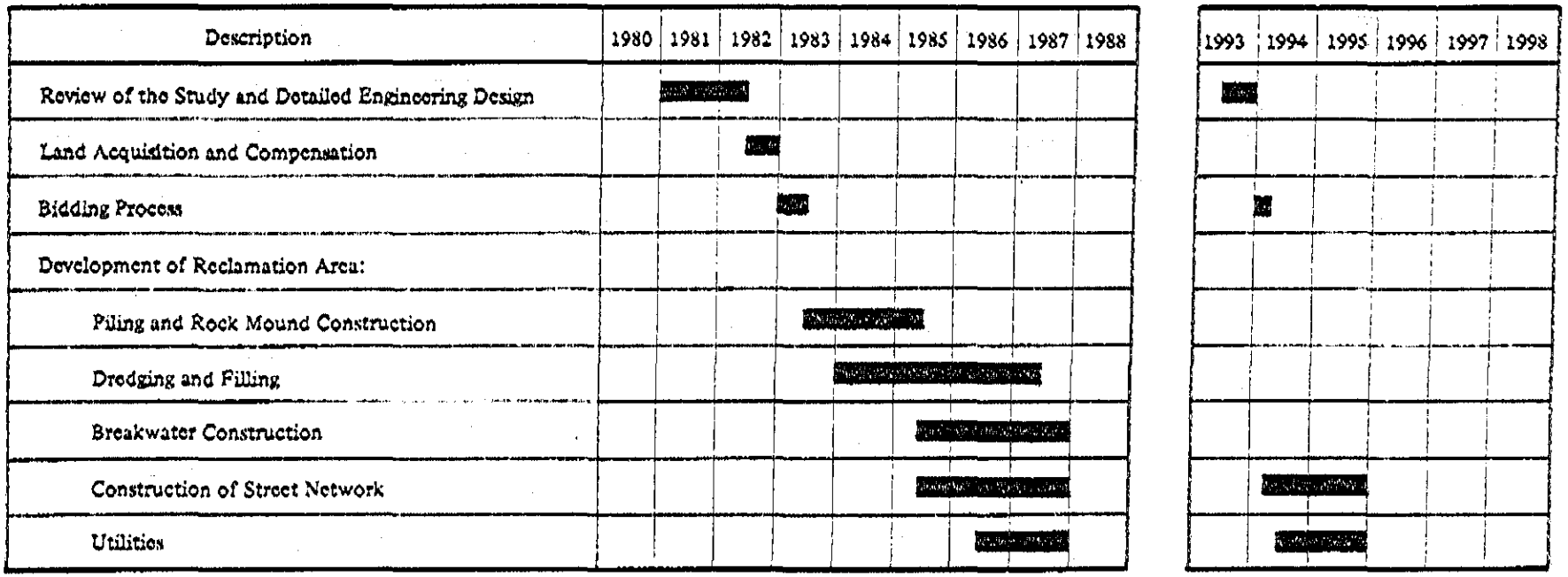
Stage I Completion of the Reclamation Blocks I ∿ III by 1987

Stage II Completion of the Reclamation Block IV by 1992.

According to the stage construction schedule and cost estimates discussed in the foregoing, it is judged desirable that the reclamation project be executed in accordance with the implementation schedule shown in Figs. IV-11-1 and IV-11-2 (See Section 6.9 in Chapter 6 of Part IV for further description).

The implementation of Stage II (Block IV development together with the construction of the approach road) is provisionary separated from that of Stage I. Since the Block IV is situated next to Block III having no direct influence on the construction of Stage I elements, Stage II is recommended to be separated from Stage I. The timing of the Stage II implementation should be finalized by considering the progress of the Stage I program.

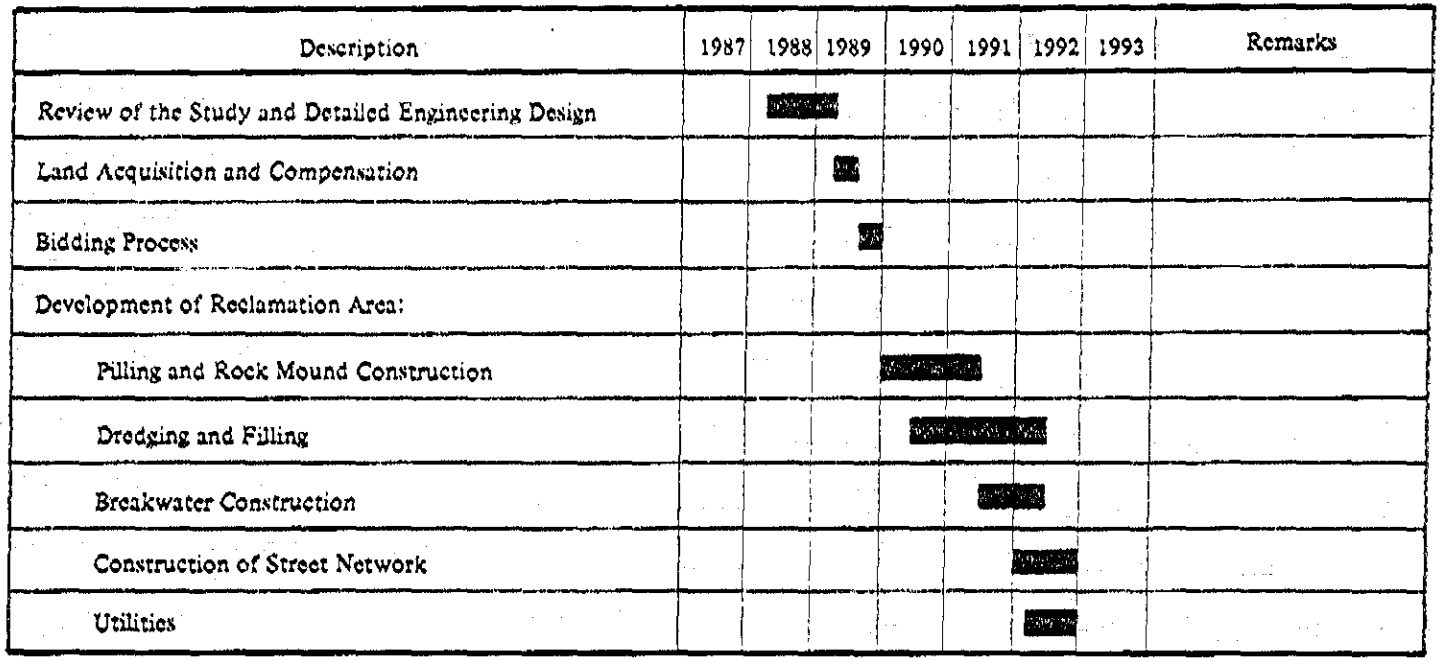
Fig. IV–11–1 IMPLEMENTATION SCHEDULE – STAGE I (RECLAMATION BLOCKS II & III)



Note: 1) The bulkhead of Block I shall be constructed during 1983 – 1985.

2) The schedule in the years from 1993 – 1995 is for the construction of the street network and utilities on Block I.

Fig. IV–II–2 IMPLEMENTATION SCHEDULE–STAGE II (RECLAMATION BLOCK IV)



PART V

PROJECT INTEGRATION AND RECOMMENDED IMPLEMENTATION PROGRAM

CHAPTER 1. OVERALL FEATURE OF THE PROJECT

1.1 Integration of the Road and Reclamation Project

It should be emphasized that the reclamation project and the road project are inseparable from the standpoint of project implementation. Until the reclamation project can provide the reclaimed right-of-way for the Coastal Road, the road project can hardly be started. Moreover, the construction of C-5 alone without the Coastal Road can not be justified on the basis of traffic needs. The same thing can be said for the reclaimed area, since the area contributes to the economic development only when good access to the Port of Manila and other places can be provided.

Accordingly, all the major project components are integrated together to form a development program of the infrastructure in the direct zone of the project. The pertinent aspects of the project are summarized again and the economic effects of the integrated project are studied in this Part V, through which a recommended investment program is concluded.

1.2 Salient Features and Recommendations for Each Construction Component of the Project

1.2.1 Phasing and Staging of the Project

The continuous growth of Metro Manila is anticipated which entails urbanization towards the northwest area of MMA. The Government has proposed a number of development plans to support and initiate better communities in the area.

Development plans of the Government and the findings of the Study depict a development plan associated with the road system in the northwest area of MMA in which the project is situated. The conclusive findings of the Study can be understood with regard to the initial phase of this long term development plan.

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

Table V-1-1 PHASES AND STAGES OF DEVELOPMENT

Phase	Stage	Construction Component
I	I	Construction of the Coastal Road and C-5
		Development of Reclamation Blocks II - III (including bulkhead construction of Stage I)
		Construction of street network and utilities on Blode I.
		Construction of the grade separation structures and overlay for the Coastal Road and C-5

Cont.

Phase	Stage	Construction Component
I	II	Construction of the extension of the Coastal Road upto Reclamation Block IV
		Development of Reclamation Block IV.
II		Construction of C-6
		Development of Reclamation Blocks V - VII
		Construction of the extension of the Coastal Road to Bataan (Phase II of Manila-Bataan Coastal Road)

Described hereafter the salient features of each construction component and the Study Team's recommendations.

1.2.2 Phase I of the Project

The Phase I of the integrated project (See Table V-1-1 for construction components included) was found to be feasible technically, economically and financially. The overall cost and benefit studies are summarised as follows:

i) Total Project Cost of the Phase I of the Project

The total cost of the road project Plan 3 & 4 and the reclamation project of Alternative I are shown below in 1979 prices of ₱ million.

Description	Foreign	Local	Taxes	Total
Road Project Plan 3 & 4	392	344	98	834
Reclamation Project Alt. I	1,248	608	287	2,143
Total Integrated Project	1,640	952	385	2,977

ii) Benefit-Cost Analysis Results of the Phase I of the Project

The economic benefit-cost analysis of the integrated project produced the following viable results:

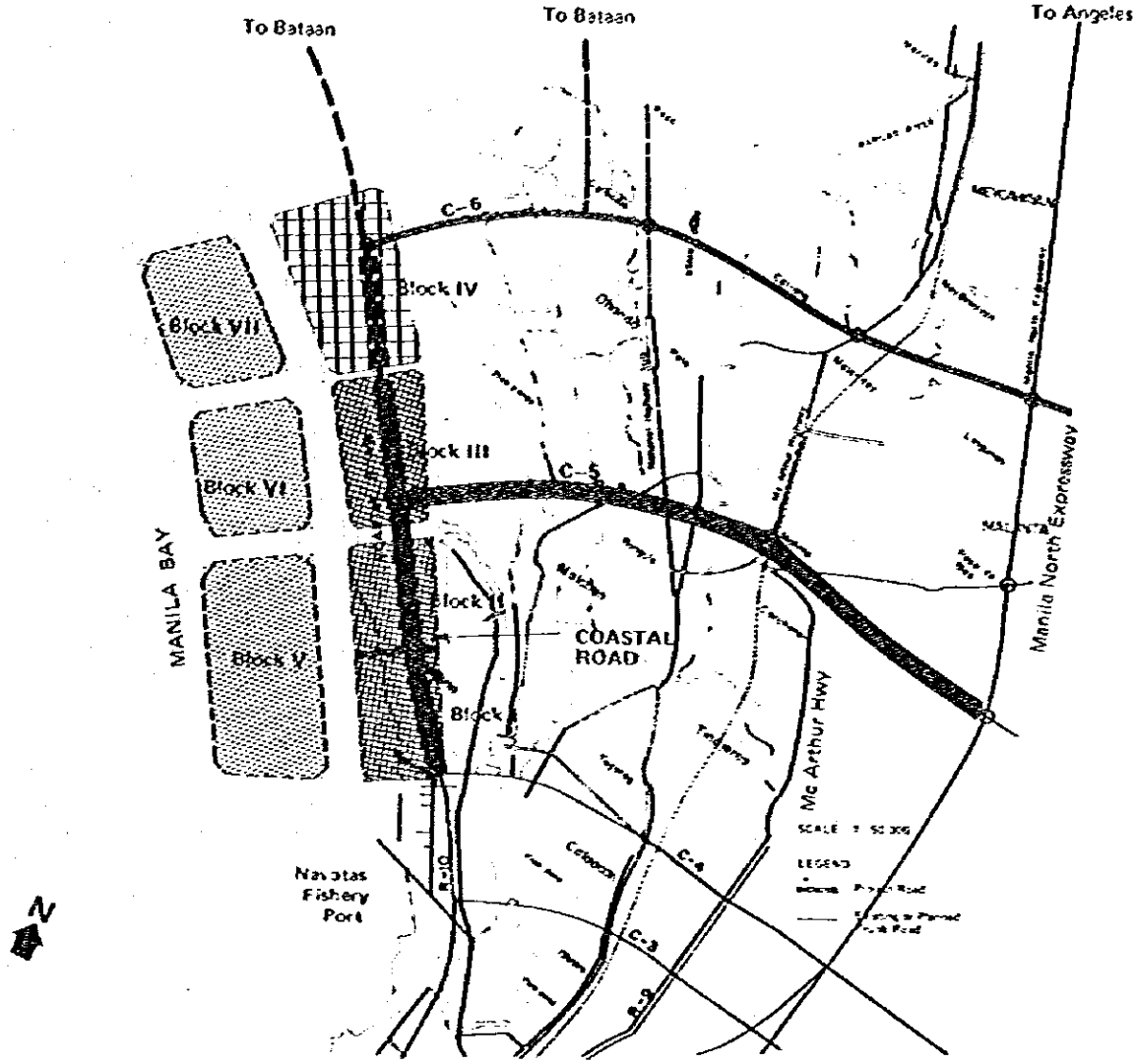
IRR : 24.4
P.W. (₱ million 1979 prices) : 843.1 at i = 15%
B/C Ratio : 1.633 at i = 15%

The financial consequences of the Master Plan I were also found to be favorable as shown below (in 1979 prices):

Net surplus discounted at 15% p.a. : 713.6 (₱ million)
Internal Rate of Return : more than 60%

The above economic B-C values were better than those of the Road Plan 2 which proposed the road network without reclamation.

Fig. V-1-1 PROJECT PHASING



LEGEND :

- Construction of Project Roads, Stage I of Phase I
- Construction of Project Road, Stage II of Phase I
- Construction of Project Road, Phase II
- Alternative Routes of the Phase II Manila–Bataan Coastal Road
- Existing or Planned Trunk Road
- Development of the Reclamation Area, Stage I of Phase I
- Development of the Reclamation Area, Stage II of Phase I
- Development of the Reclamation Area, Phase II

iii) Staged Construction

It is recommended that Phase I of the integrated project be divided into Stages I and II. The main reasons for the staging, with which the project does not lose its viability, are as follows:

- Long period of implementation which will inevitably entail uncertain factors beyond the extent of the sensitivity test. The project should be implemented in stages to avoid the adverse influence of the above mentioned factors: and

- The higher the investment cost, the larger burden on the budget of the Government. If the cost is less, the implementation will be easier.

It is further recommended that, in Stage I, part of the first step (i.e., Construction of the Coastal Road and C-5 and Development of Reclamation Block I-III) will be completed by 1987 and the other part in the first step (i.e., Construction of streets and utilities systems on Block I) will be completed by 1995. The second step of Stage I which includes the construction of grade separation structures and resurfacing for the Coastal Road and C-5 will be completed by 1997.

The implementation of Stage II (Block IV development together with the construction of the approach road) is provisionary separated from that of Stage I. Since Block IV is situated next to Block III having no direct influences on the construction of Stage I elements, Stage II is recommended to be separated from Stage I. The timing of the Stage II implementation, although it is tentatively fixed as in Fig. IV-11-2, should be finalized by considering the progress of the Stage I program.

1.2.3 Phase II of the Project

Phase II of the project is composed of the three construction components as shown in Table V-1-1. The salient features and recommendations for each construction element are as follows:

i) Construction of C-6

It is considered that the timing of the construction of the C-6 should be determined by the growth of traffic demand. It is found in the Study that the C-5 as planned in Stage I will be able to meet the traffic demand for the beginning 20 years. Accordingly, the decision to construct the C-6 should be made based on other studies to be carried out in future.

ii) Development of the Reclamation Blocks V - VII

If the programs in Phase I are implemented successfully and urban redevelopment plans in MMA require an urgently new

area adjacent to Blocks I - IV, another reclamation project should be studied. The feasibility study should be conducted whenever it becomes necessary, however the timing will be years away from now.

iii) Phase II of Manila-Bataan Coastal Road

Since the daily traffic between MMA and Bataan and Olongapo was 1,900 in 1979, the traffic volume is too small to consider the economic viability of the immediate construction of the Road. The construction cost will be high because of the unfavorable conditions in the delta area of the Pampanga River.

It is recommended therefore, that a long-range overall development plan for the region (Bataan, Pampanga and Zambales) be considered. The plan would include not only the industrial sector but also agriculture (fishery sectors) and Road should be evaluated in terms of its importance in the transport network which will support the development of the region.

1.2.4 Summary of Findings of the Project Roads Study

A. Alternative Plans

The alternative plans of the Project Roads are shown in Fig. V-1-2.

The economic cost of the proposed roads including the cost of construction, detailed design, supervision and physical contingencies was estimated. Based on the traffic forecast, the savings in traffic cost were estimated by taking into account the road conditions and the degrees of congestion on the main roads in the direct influence zone. Benefit-cost analysis was conducted to compare these alternatives. The results indicate that Plan 3 & 4 were the most viable plan.

B. Design Features of Road Plan 3 & 4

Major designed criteria for Plan 3 & 4 are as shown below:

Length	:	C-5 8.6 km and Coastal Road 3.8 km
Lane width	:	3.5 m for roadway and 1.5 - 2.5 m for shoulder width.
Number of lanes	:	4 lanes divided by a median of 4.5 m width
Right-of-way	:	70 m for Coastal Road and 50 m for C-5
Frontage road	:	6.5 m width. Sidewalk 3.0 m width
Design speed	:	80 km/hr.

Pavement : Concrete pavement on the eastern part of C-5 and asphaltic concrete on the other part of C-5 and the whole section of the Coastal Road.

C. Construction of the Project Roads

No serious technical difficulty was found for the construction of the roads and structures. For the supply of necessary amounts of borrow and other materials, the quarry sites were confirmed at a certain distance away from the project area. The acquisition of the right of way will not be extremely difficult since the road alignment is determined outside the heavily congested housing area.

Fig. V-1-2 ALTERNATIVE ROAD PLANS

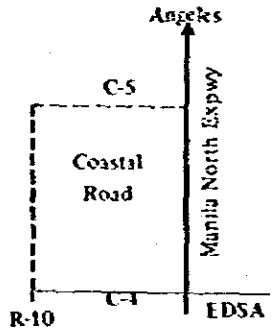
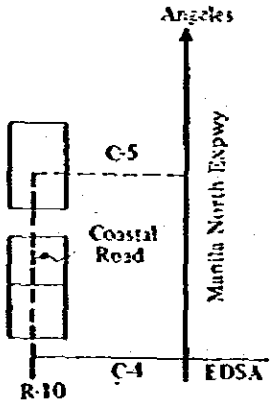
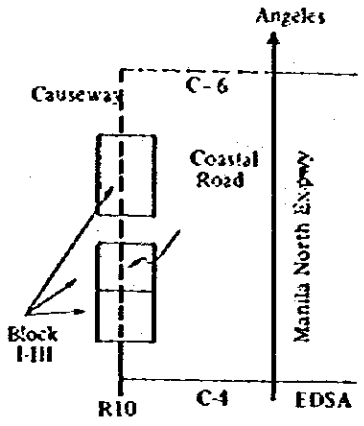
Diagram	Description
Plan 1	No Project Roads, which is taken as the case without project.
Plan 2 	The Project Roads are constructed into two parts: the Coastal Road as a causeway in the sea and C-5. No reclamation project is implemented simultaneously.
Plan 3 & 4 	The Project Roads are constructed simultaneously with the reclamation work of Blocks I - III. Coastal Road is located on the reclaimed area and linked to Manila North Expressway by C-5.
Plan 5	

Diagram	Description
Plan 5 	The Project Roads are constructed simultaneously with the reclamation work of Blocks I - III. The Project Roads are constructed into three sections: The Coastal Road on the reclaimed areas, the Coastal Road as a causeway in the sea and C-6 section.

1.2.5 Summary of Findings of the Reclamation Area Development Study

A. The Extent of Reclamation Area

The reclamation area is proposed at offshore of Navotas municipality. The combined factors of land demand, investment cost for the reclamation, and environmental constraints suggested that the northern limit of reclamation area should be the south bank of the Meycawayan River, with any further northward expansion reserved for a future project.

The most suitable size for the reclaimed land was determined to be 900 hectares, since the reclamation cost is mainly influenced by the distance of the off-shore limit of reclamation from the shore line. The study illustrated the fact that the reclamation can be achieved most economically up to an area of 900 hectares.

Strip development is recommended as the development pattern for the reclaimed area, i.e., development shall start with the shallow water zone along the entire stretch from the starting point of the Coastal Road up to C-5 then C-6 and proceed later with areas further offshore.

B. Land Use Allocation

Land demand and tentative cost analysis upholds the allocations of reclaimed land primarily for industrial uses, with some patches for solid waste disposal, residential, and other land uses. Opportunities for better transport facilities to handle freight and commodity and the selling price which the industries can afford to make the site ideal for industrial location.

The zoning of the industrial sectors was determined by reviewing the growth of the sector in the past, the restraints of the expansion at the existing location, and the development forecast. In the residential area, the lot size was designed to have 70 m^2 or 110 m^2 for each family unit depending on class. Social and middle income classes will move in the area.

Open spaces for public uses, parks, and administration-education areas were also delineated. No definite plan for the scale of the port facilities was incorporated in the study. New establishments can provide wharfs if they find it advantageous and these can be developed as auxiliary to the Port of Manila (i.e., for POL terminal).

A solid waste dumping site was proposed in Block I of the reclaimed area. The new site should serve as a substitute for the existing Balut site for receiving the waste and refuse of the Manila city for ten years from 1984. Residential zone and parks are planned to be established on Block I in 1996.

C. Alternative Master Plans

Three alternative plans of land use on the reclaimed area were proposed: the first with larger area for industrial use, the second with larger area for residnetial use, and the third between the above two. The zonal area is shown in the following table.

Table V-1-2 ZONING PLANS

Zoning \ Alternative	I ha. (%)	II ha. (%)	III ha. (%)
Industrial Area	547 (61)	303 (34)	422 (47)
Park & Green Area	141 (16)	250 (28)	185 (21)
Town Center, etc.	10 (1)	30 (3)	22 (2)
Roads and Utilities	140 (16)	157 (18	157 (18)
Residential Area	52 (6)	150 (17)	104 (12)
Total	890 (100)	890 (100)	890 (100)

After the preliminary engineering studies, the cost of reclamation and infrastructure construction was estimated with the total cost as follows.

Alternative Master Plans	I	II	III
Cost in market prices of June 1979, ₱ million	2,143	2,174	2,155

The land value of the reclaimed area with the prepared infrastructure was estimated by studying the prices of land

in the northern MMA. Assuming that the open lots would be sold to establishments and residents at market prices, the financial and economic analysis were conducted. The results indicate that Alternative I was the most viable plan among the three master plans.

D. Dredging and Filling and Development of the Reclaimed Area

It was found that the required amount of selected soils could be dredge from the borrow pits studied. However, the further dredging planning based on the more comprehensive soils and materials survey is recommended to finalize the construction schedule. It is believed that the reclamation will produce negligible adverse effects on the shows of Navotas and the other river systems.