A sewage treatment plant is established in Barranquillita. The National Law for environmental health obligates every public and private entity to treat waste water prior to dumping. However, the city of Barranquilla, as yet, does not have the Master Plan for its own public sewage treatment system. The sewage treatment plant in Barranquillita is planned in accordance with the guidelines set by National Law. However, until the Master Plan for the city of Barranquilla is developed by EPM and the other concerned bodies, the plant in Barranquillita will serve as an independent system exclusively for the sewage of the Study Area. Therefore, the plant will serve as a model for the future city wide system.

12-2. Land Preparation and Filling of Canals

12-2-1. Planning Principles for Land Preparation and Drainage

1) Basic Idea of Land Preparation

The filling of the Study Area is required for flood control. A detailed hydrological analysis by the Study Team was prepared with data recorded at the Terminal Maritimo station; the maximum water level on record in 46 years (from 1940 to 1985) is 1.8m. FIG. 12-1 shows the area whose existing ground level is lower than 1.8m.

As it has been analyzed, flooding and the resulting stagnation of stormwater in low lying areas within the Study Area is caused by the high intensity of rainfall and the lack of drainage facilities. The water level is less of a factor.

There are two alternatives for a land preparation system as shown in FIG. 12-2. Case 1 (pump system) requires filling and a drainage system in addition to the surrounding bank and pump facilities.
Case 1 is not an effective system, because construction of pump equipments and banks is expensive, and maintenance problems will remain. Accordingly, Case 2 (filling system) is recommendable.

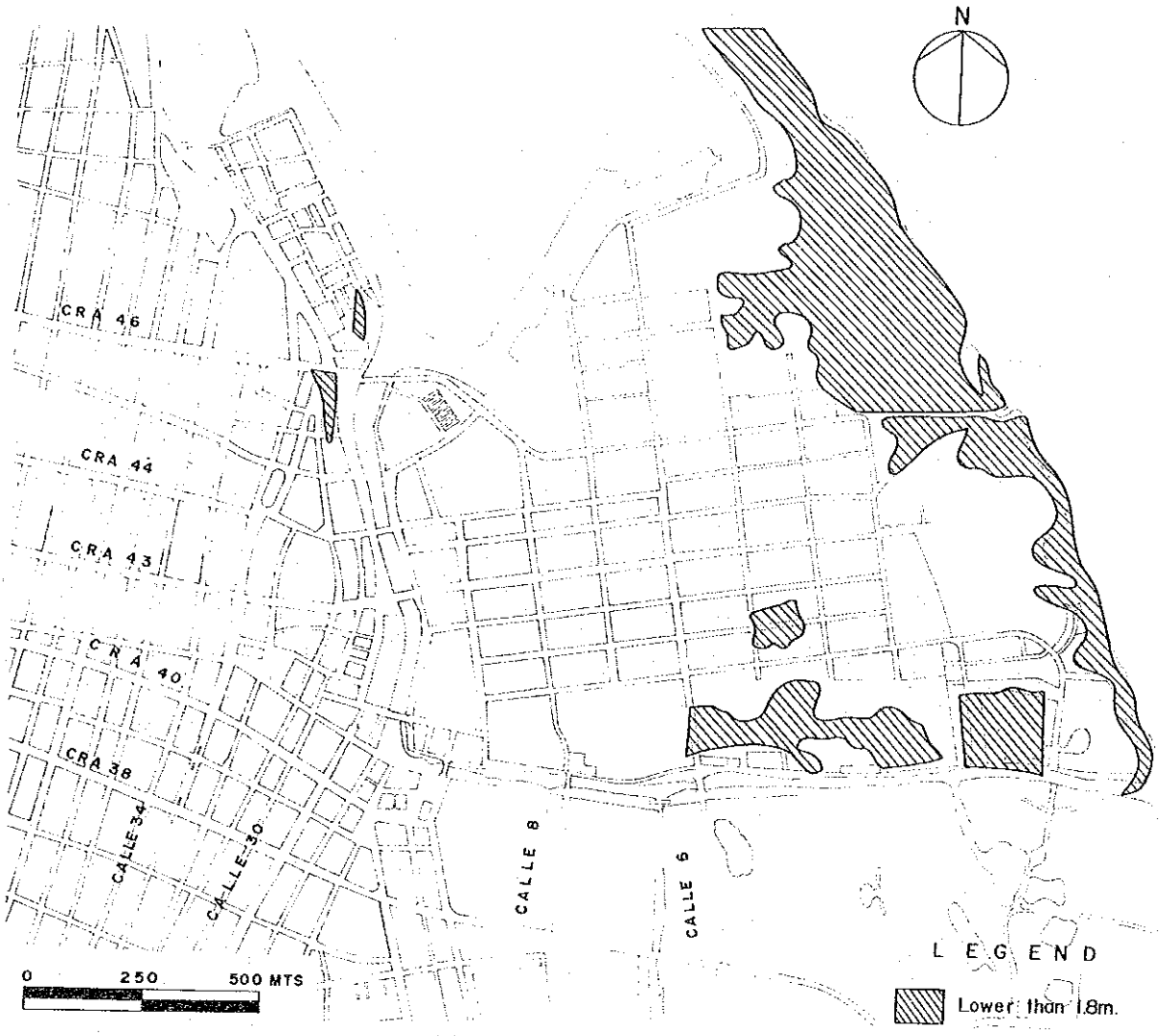
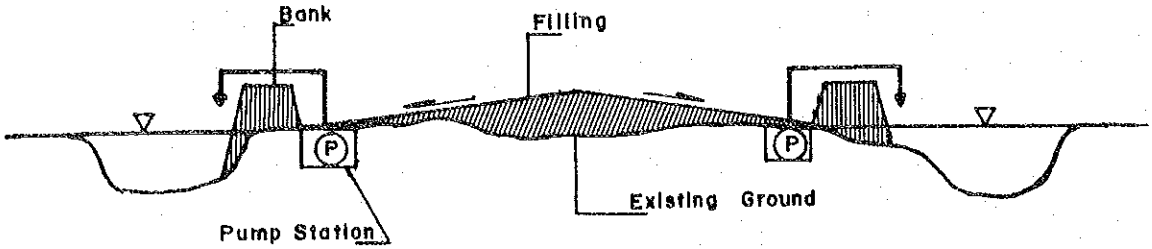


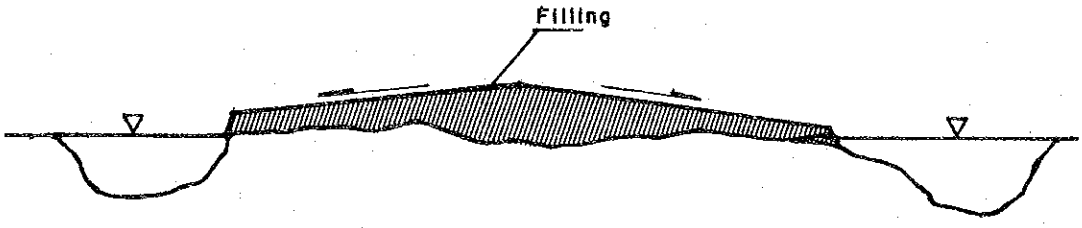
FIG. 12-1 LOW GROUND AREA

2) Land Preparation for the Study Area

The land of the Study Area is prepared by filling with a gradient of more than 0.15% for drainage of surface water. The prepared land level is 3.2m to 2.0m. The land preparation level and drainage system are so planned that the rain water can be drained to the surrounding canals and river even when it reaches the maximum water level of 1.8m. FIG. 12-3 shows the plan of land preparation of the Study Area.



CASE 1- PUMP SYSTEM



CASE 2- FILLING SYSTEM

FIG. 12-2 LAND PREPARATION SYSTEMS

3) Schedule of Filling

The filling proceeds phase by phase as shown in FIG. 12-4. The quantities of soil required for filling of both land and canals in respective phases is shown in TABLE 12-1. FIG. 12-5 shows the distribution of filling soil quantities which will be required in the Study Area.

Additional filling required for landscaping is carried out at the time of building construction, and the soil from the building foundation work may be available.

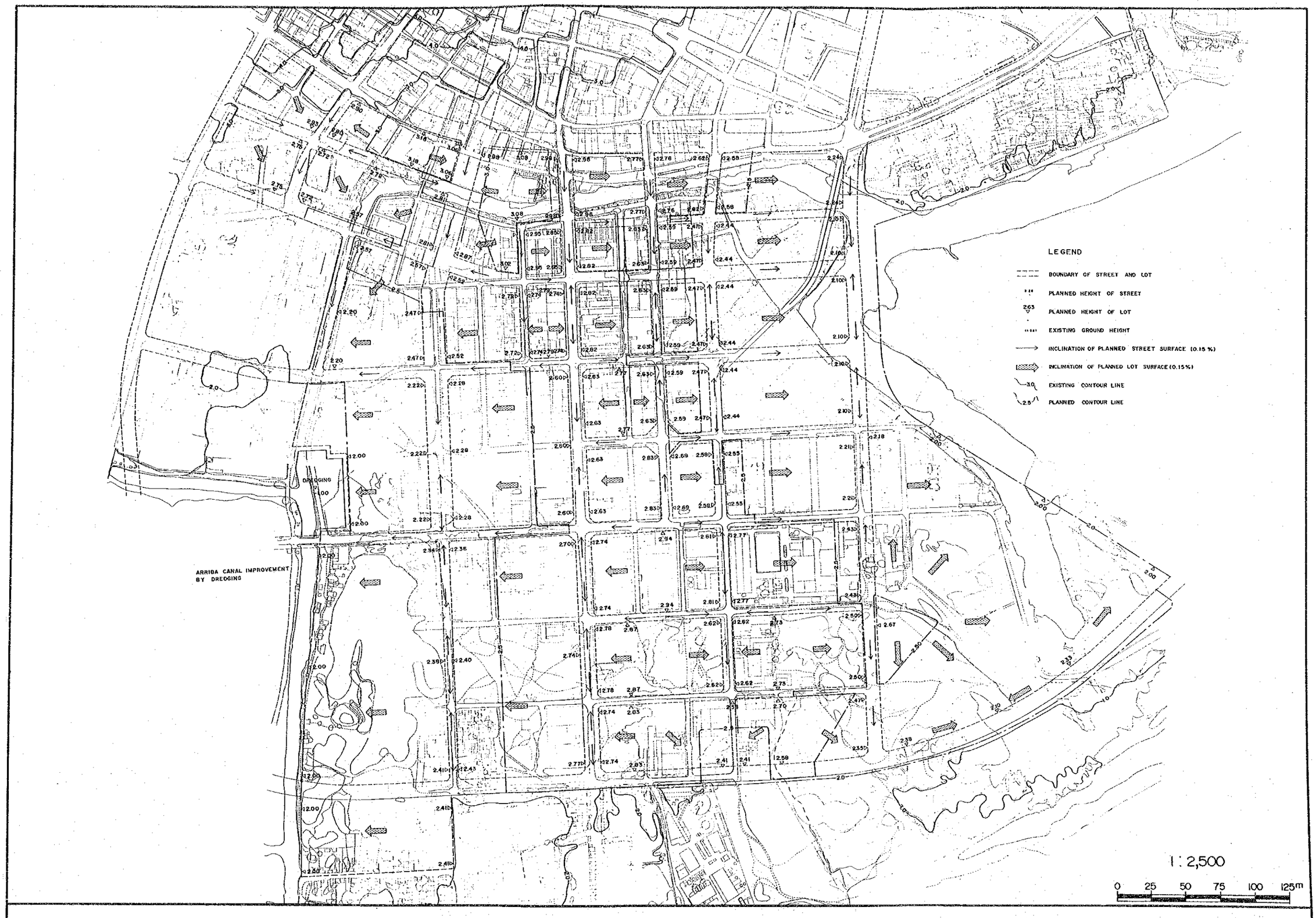


FIG. 12-3 PLAN OF LAND PREPARATION

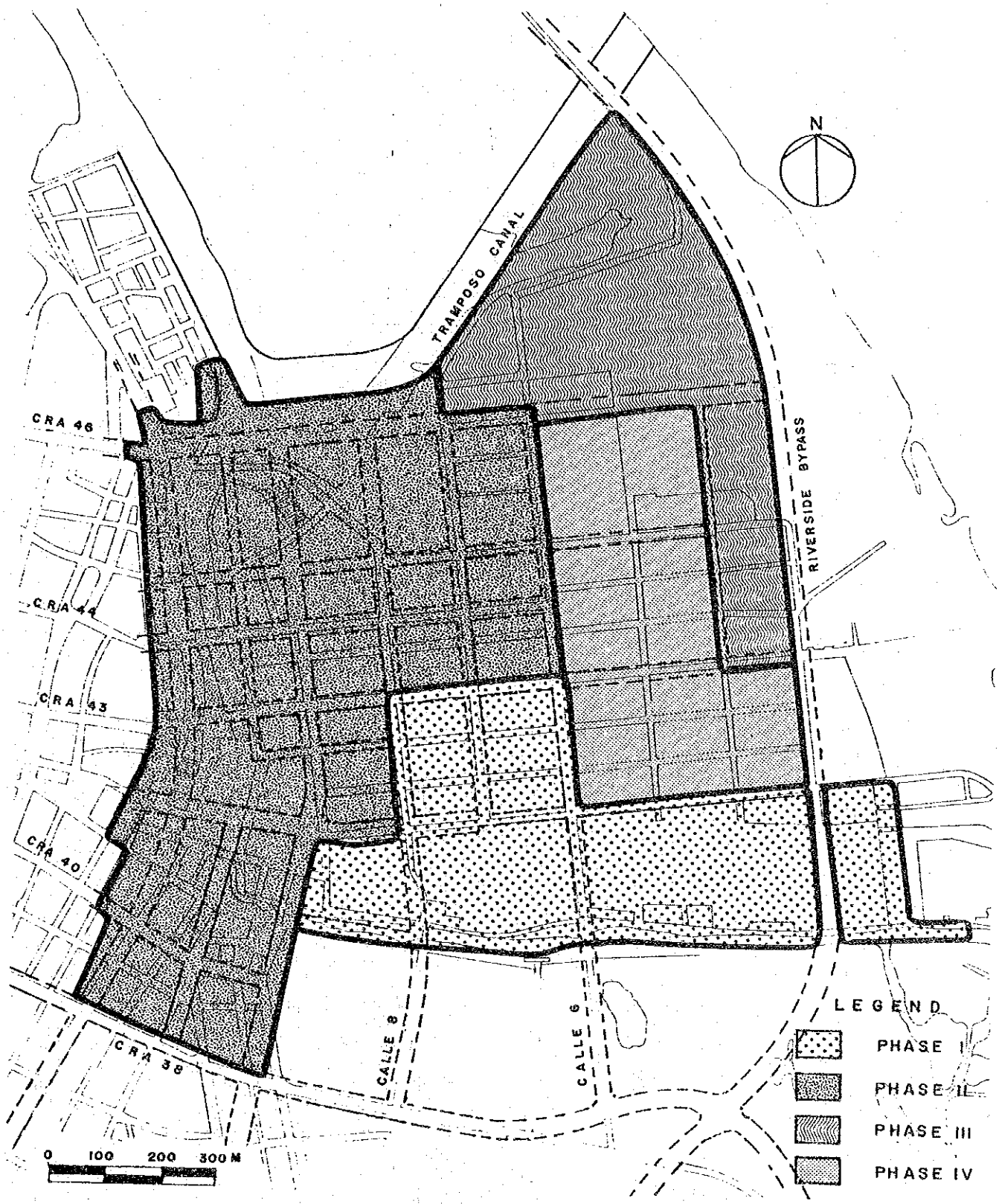


FIG. 12-4 PHASING PLAN OF INFRASTRUCTURE

TABLE 12-1 QUANTITY OF REQUIRED FILLING SOIL BY PHASE

	Required soil quantity (m^3)		
Phasing	Filling of land	Filling of canal	Total
Phase I	103,000	17,500	120,500
Phase II	152,100	115,300	267,400
Phase III	159,400	-	159,400
Phase IV	109,300	-	109,300
Total	523,800	132,800	656,600

12-2-2. Supply of Filling Soil

The top soil of the quarries of the Cementos del Caribe is a recommendable filling material. The Cemento del Caribe will produce the top soil of 700,000 m^3 annually in the next 10 years. FIG. 12-6 shows the location and soil condition of the quarries.

The excavation of the quarries, transportation of filling material, and filling of the Study Area can be accomplished with an effective and efficient combination of heavy equipment. The filling of 17,000 m^3 monthly is possible with heavy equipment available in Barranquilla. See FIG. 12-7 for an illustration of one such scenario.

The top soil of the Cementos del Caribe is not available indefinitely. If delays are great in the implementation of the Study Area, development, other sources of topsoil have, to be considered. Filling soil may also be obtained through the excavation of either the river side of Barranquillita or municipal land in the city.

MAP OF DISTRIBUTION OF REQUIRED FILLING SOIL QUANTITY

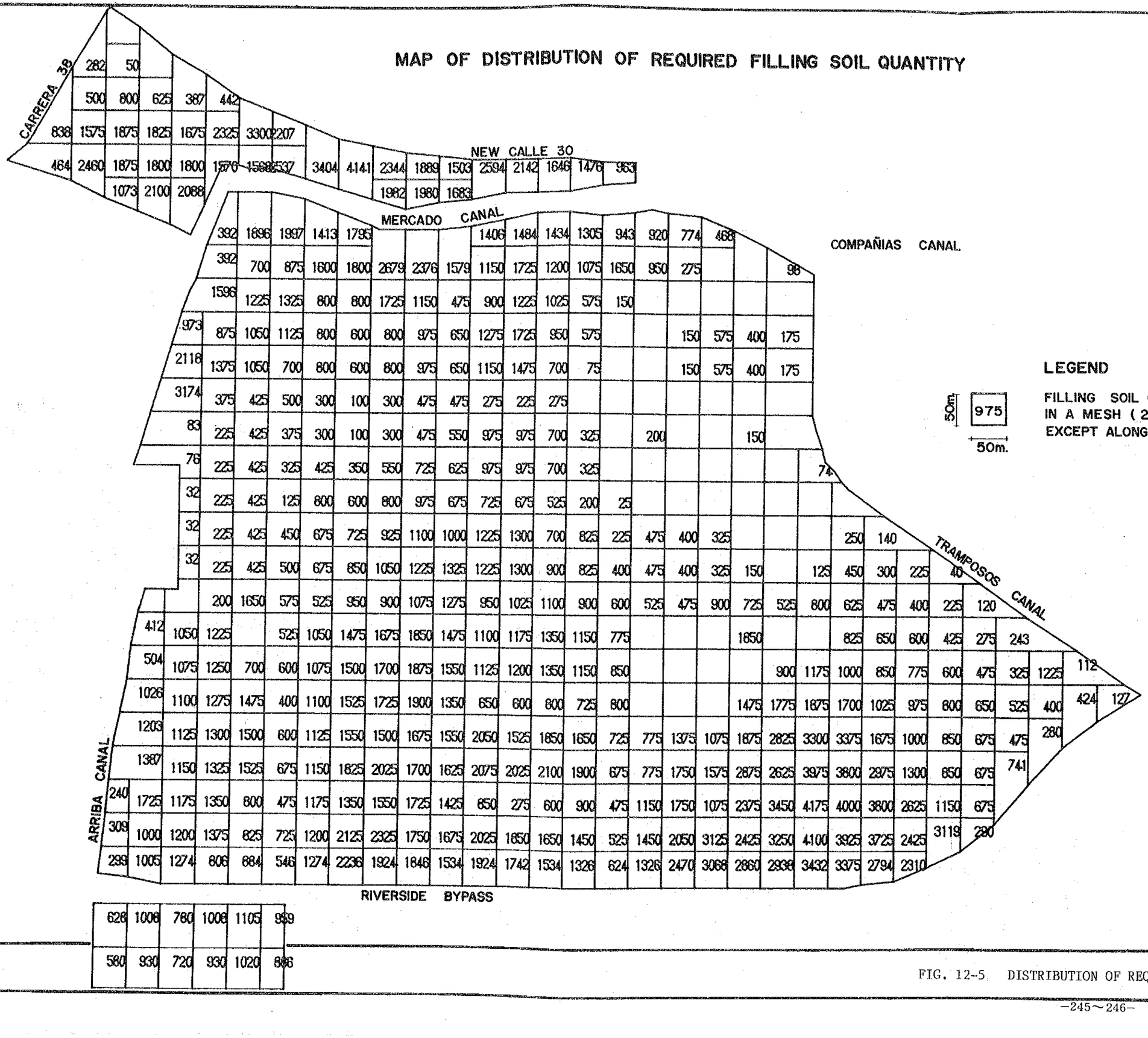
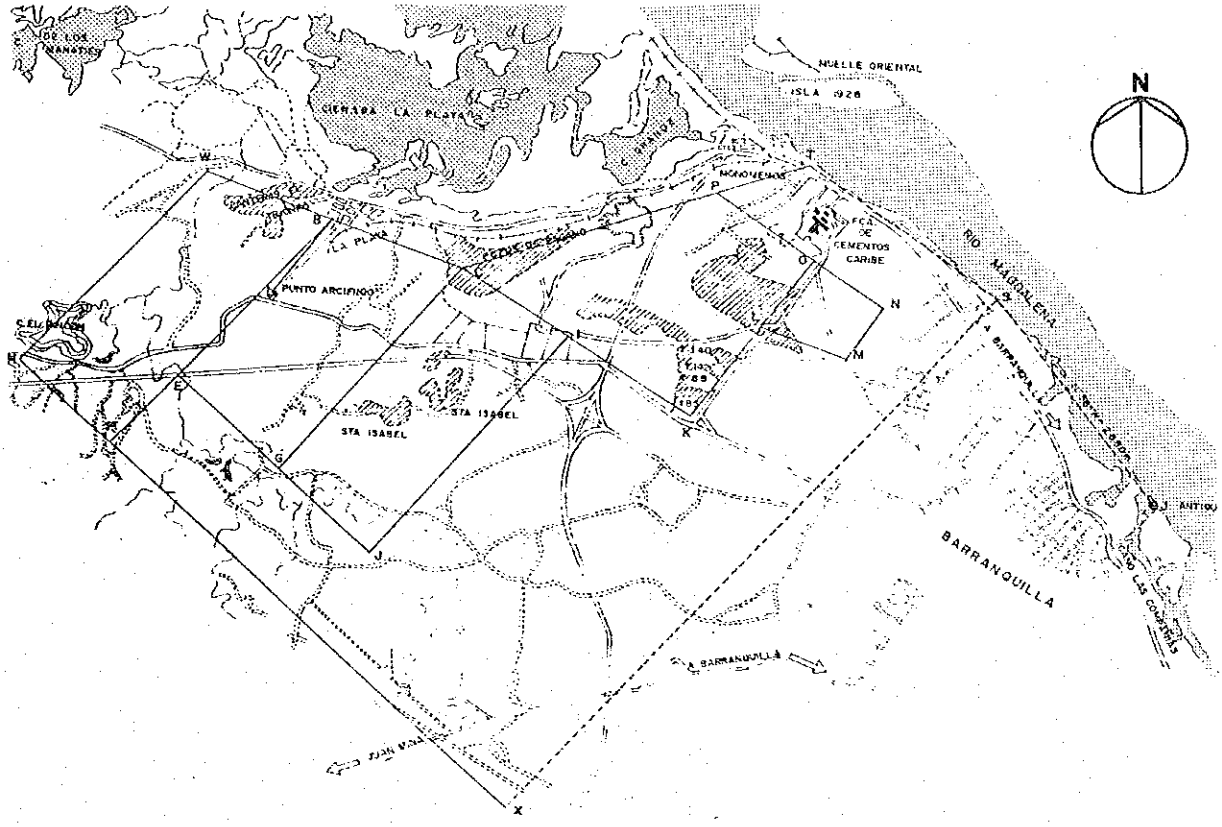
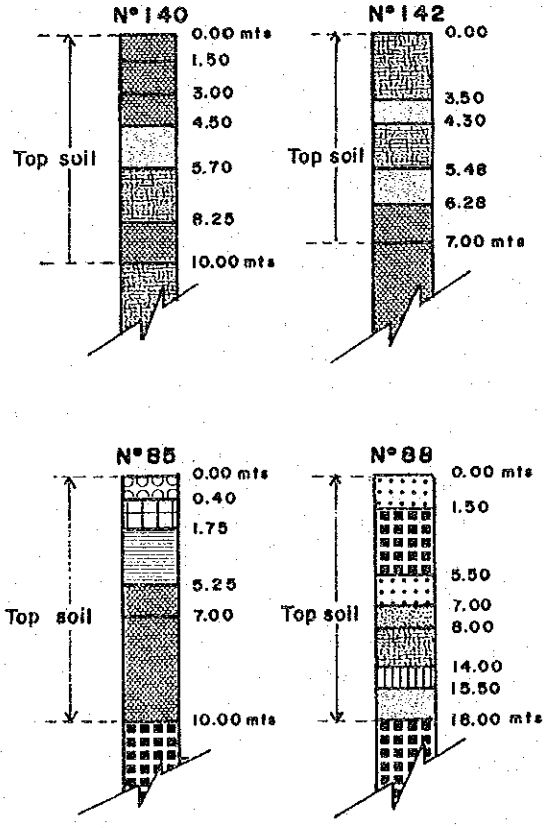


FIG. 12-5 DISTRIBUTION OF REQUIRED FILLING SOIL QUANTITY



BORING LOG



Quarries to be exploited
+ Nº 140 Location of Boring Log.

LEGEND

- Brown-yellowish Sandy limestone
- Argillaceous silt
- Calcareous sandstone
- Sandy limestone with gravels
- Yellow sand
- Vegetable layer
- Calcareous conglomerate
- Greenish silts
- Old exploitations debris
- Silty clay

FIG. 12-6 LOCATION OF QUARRIES AND BORING LOG

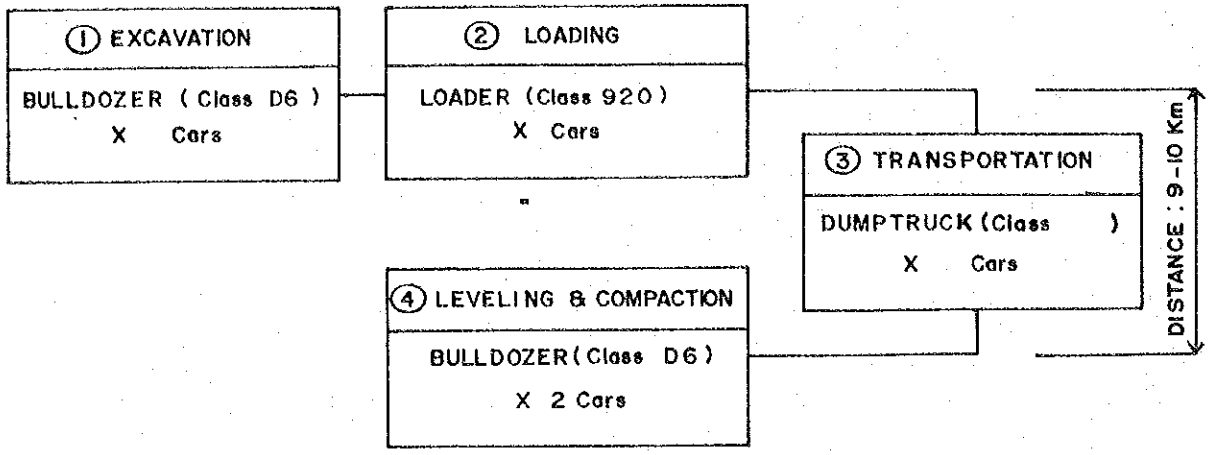


FIG. 12-7 A SAMPLE OF COMPOSITION OF HEAVY EQUIPMENT

12-2-3. Method of Canal Filling

1) Preparatory Works

Presently, the Mercado and Arriba canals have function as collectors of sewage and Arroyo water.

Substitutions for the functions of the canals must be completed prior to the filling of the canals. The Study has identified three preparatory tasks. They are as follows:

a. Construction of main drainage system in order to lead the Arroyo La Paz and the Arroyo Bolivar to the Companias and Arriba canals without passing the mid-central area.
b. Improvement of the Arriba Canal from the intersection with the Ahuyama Canal to the Magdalena River.
c. Installation of pipeline which leads the sewage from the Cerveceria Aguila (a beer factory) to the existing No. 2 sewage pump station.

See also FIG. 12-8.

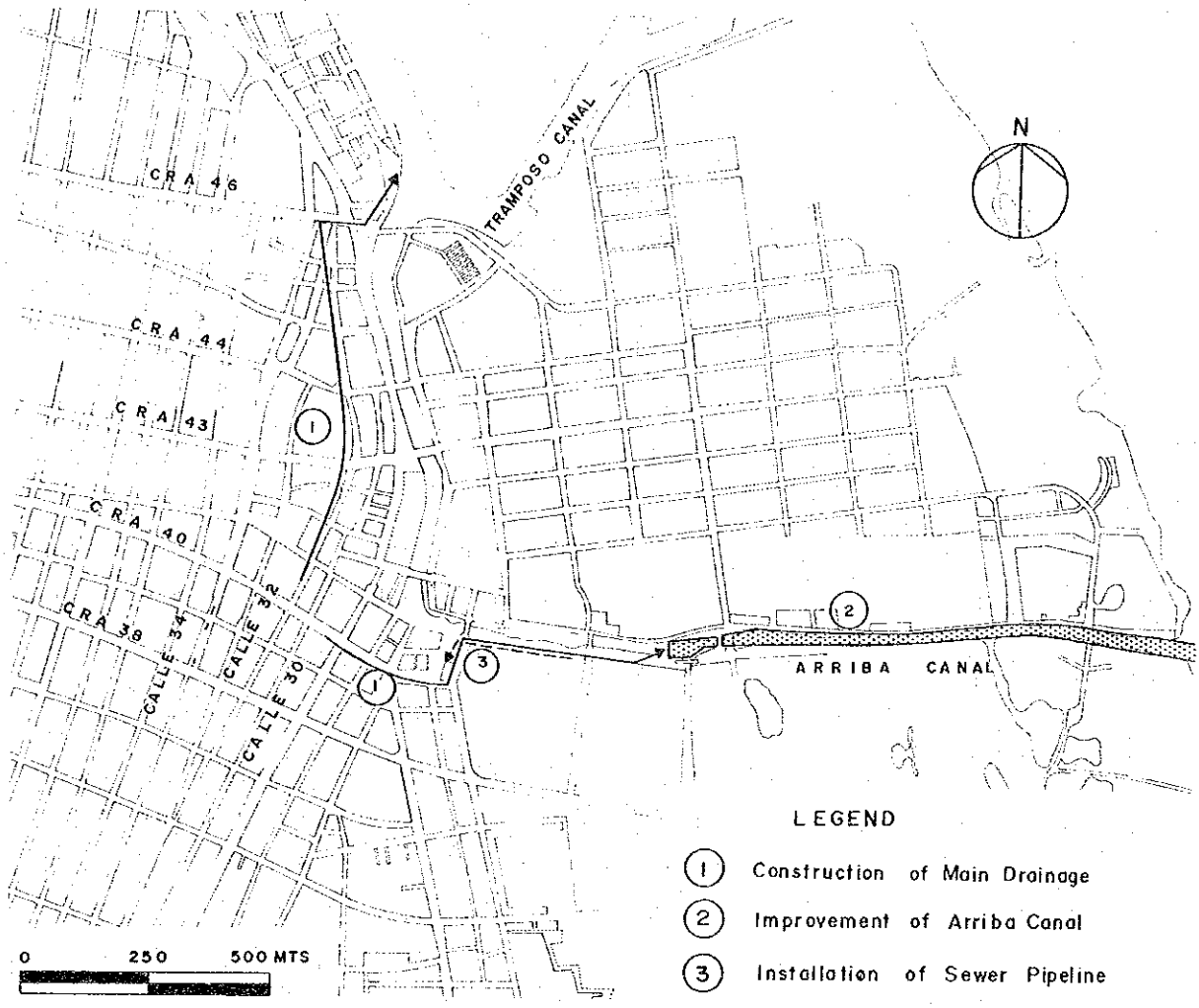


FIG. 12-8 PREPARATORY WORKS

2) Method of Filling

The projected land use surrounding the filled canal is park and greenery. Therefore, poor soil and organic materials deposited in the canal may remain and be filled over.

Filling is accomplished in two stages. First, a bank is constructed where the Arriba and Ahuyama canals intersect. This will prevent inflow of water. Then, filling proceeds block by block in the direction of the Mercado Canal as illustrated FIG. 12-9.

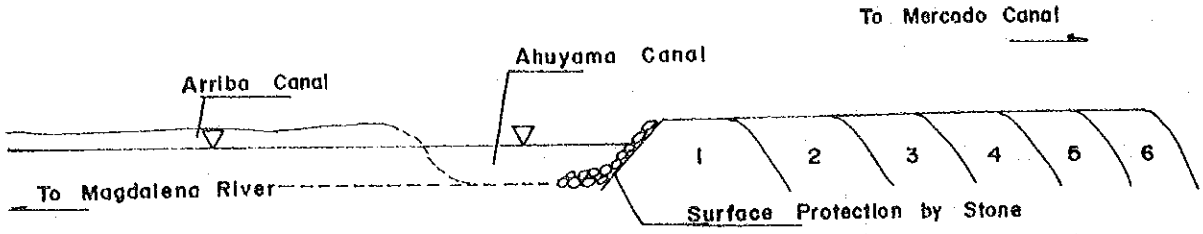


FIG. 12-9 METHOD OF FILLING

12-2-4. Arriba Canal Improvement Plan

The Arriba Canal will be improved in two ways; it will be deepened, and reinforced. The plan calls for short and long term improvement plans:

1) Short-term Plan

The detailed hydrological study by the Study Team indicates that flood water conveyance currently flowing from the Ahuyama Canal through the Mercado Canal may be rerouted effectively to the Arriba Canal if the Arriba Canal is deepened by 1m.

2) Long-term Plan

The same analysis shows that the reinforcement of flow capacity of the Ahuyama and Arriba canals is necessary to protect low ground area along the Ahuyama Canal from inundation damage.

See FIG. 12-10 for a representation of the Arriba Canal improvement plan.

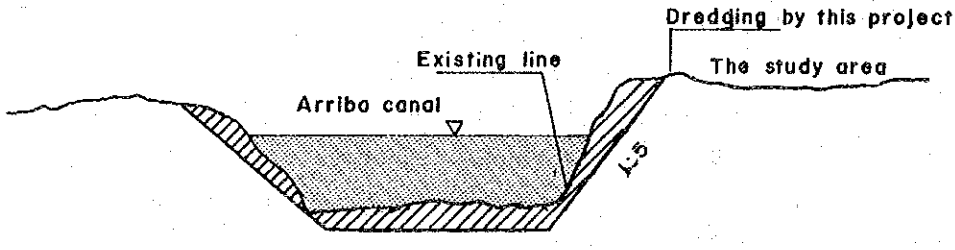


FIG. 12-10 TYPICAL SECTION OF ARRIBA CANAL

12-3. Stormwater Management

12-3-1. Actual Condition and Planning Principles

The so called drainage system in the central district is the Arroyo system; roads are used as a channels. Accordingly, the city functions are paralyzed when it rains.

To solve this problem, above all in the low land area, it is necessary to cope with all the watershed, and so the hydrological report of this Study proposed a comprehensive Arroyo control plan in the Study Area and drainage paths, including some change of their routes.

This project, however, only deals with the drainage system within the project area and in the actual watershed.

In the improvement, the optimum stormwater management plan is accomplished.

12-3-2. Drainage Plan

1) Central District

FIG. 12-11 shows the Arroyo routes and main drainage plan in the central district.

The Arroyo La Paz will be contained (or canalized) by a box culvert from new Calle 30 to the Arriba Canal, which will enable floodwater to flow across the improved Calle 30 and diminish the flood on the road.

Arroyo Bolivar is also canalized from Calle 32 to the Compañia Canal.

A box culvert is installed in Calle 32, to intercept the stormwater which flows into the project area and to lead it to the canalized Arroyo Bolivar as illustrated in FIG. 12-12.

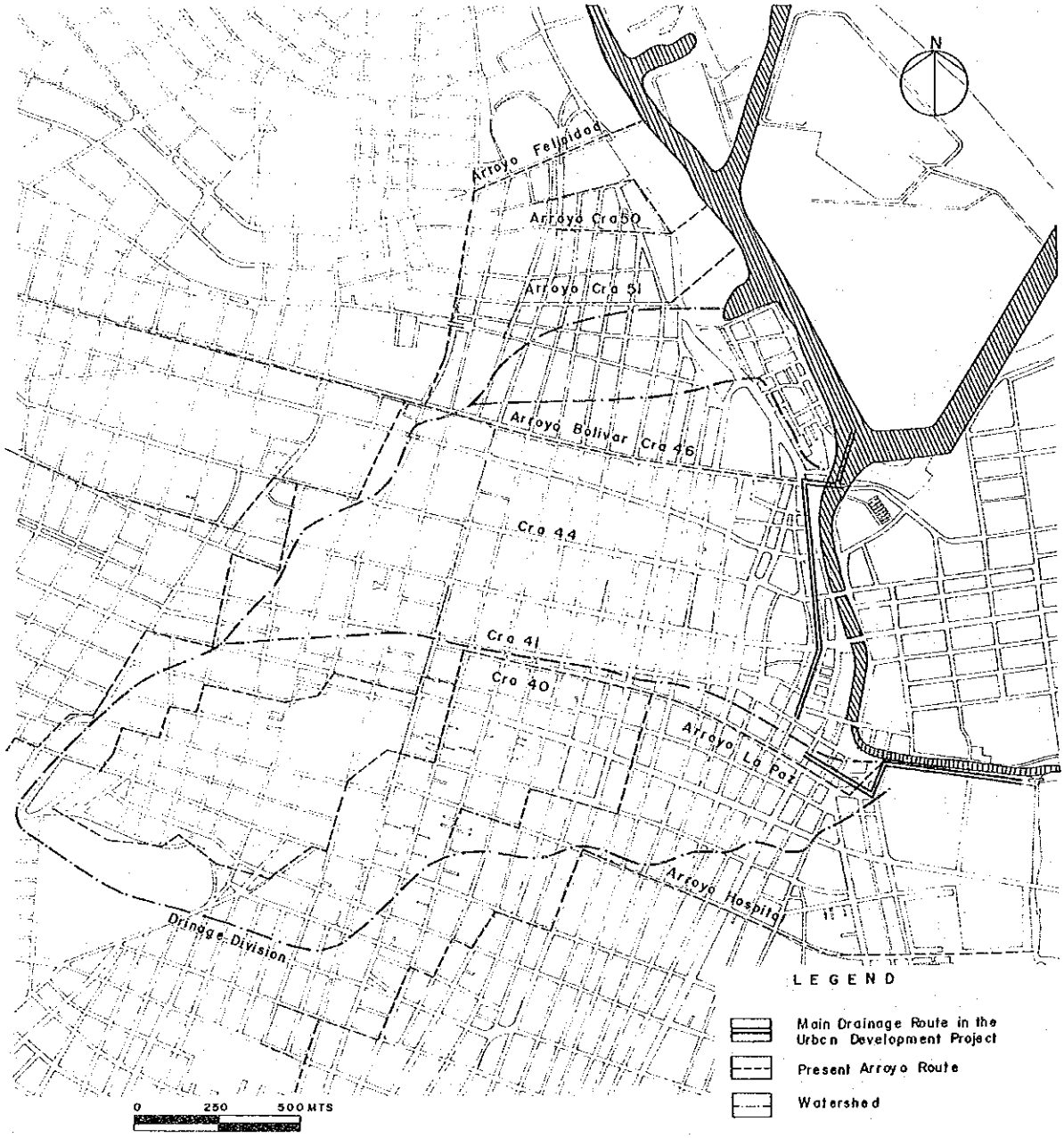


FIG. 12-11 ARROYO ROUTE AND PLANNED MAIN DRAINAGE ROUTE

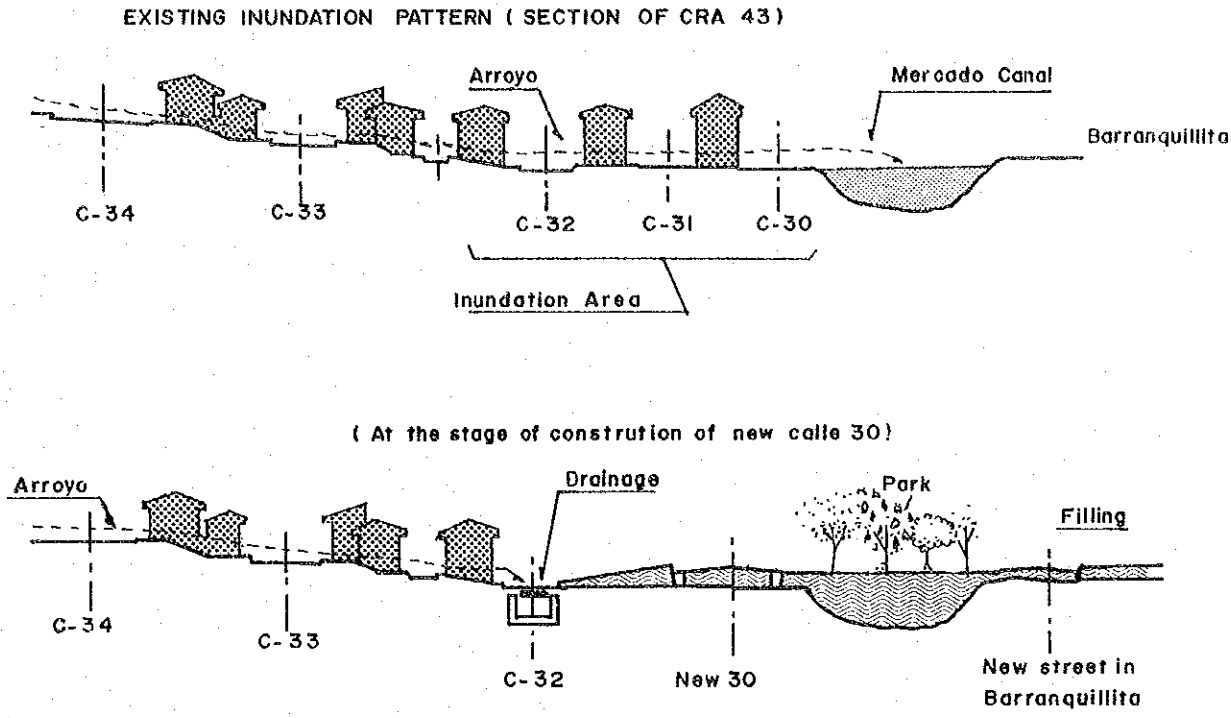


FIG. 12-12 DRAINAGE SYSTEM IN THE MID-CENTRAL AREA

This box culvert can be installed in Calle 30 if Calle 30 construction is implemented in advance of the Mercado Canal filling.

2) Barranquillita and Boliche Area

The inundation caused by rising water levels in the River and surrounding canals is protected by creating raised banks with material. The stormwater in this area is drained through the concrete channels.

12-3-3. Estimation of Runoff Rate and Decision of Dimensions

The rational method is utilized to estimate the runoff rate. In this method it is necessary to obtain the rainfall intensity once in n years

where n = the predicted time span between storms of this intensity. Normally when the greater number of n is chosen, the safer the system will be, but it will be less economical. In this case, 10 years of frequency is recommended.

However, regarding the main drainage in the center district, 5 years is adopted, because 10 years will be uneconomical when the Arroyo control plan of this area is implemented.

1) Central District

FIG. 12-13 and FIG. 12-14 show the plan, profile, and cross section of the two major arteries in the drainage system for the project area. No. 1 located in Calle 32 and Cra 46 and No. 2 located in Cra 41 and Cra 40.

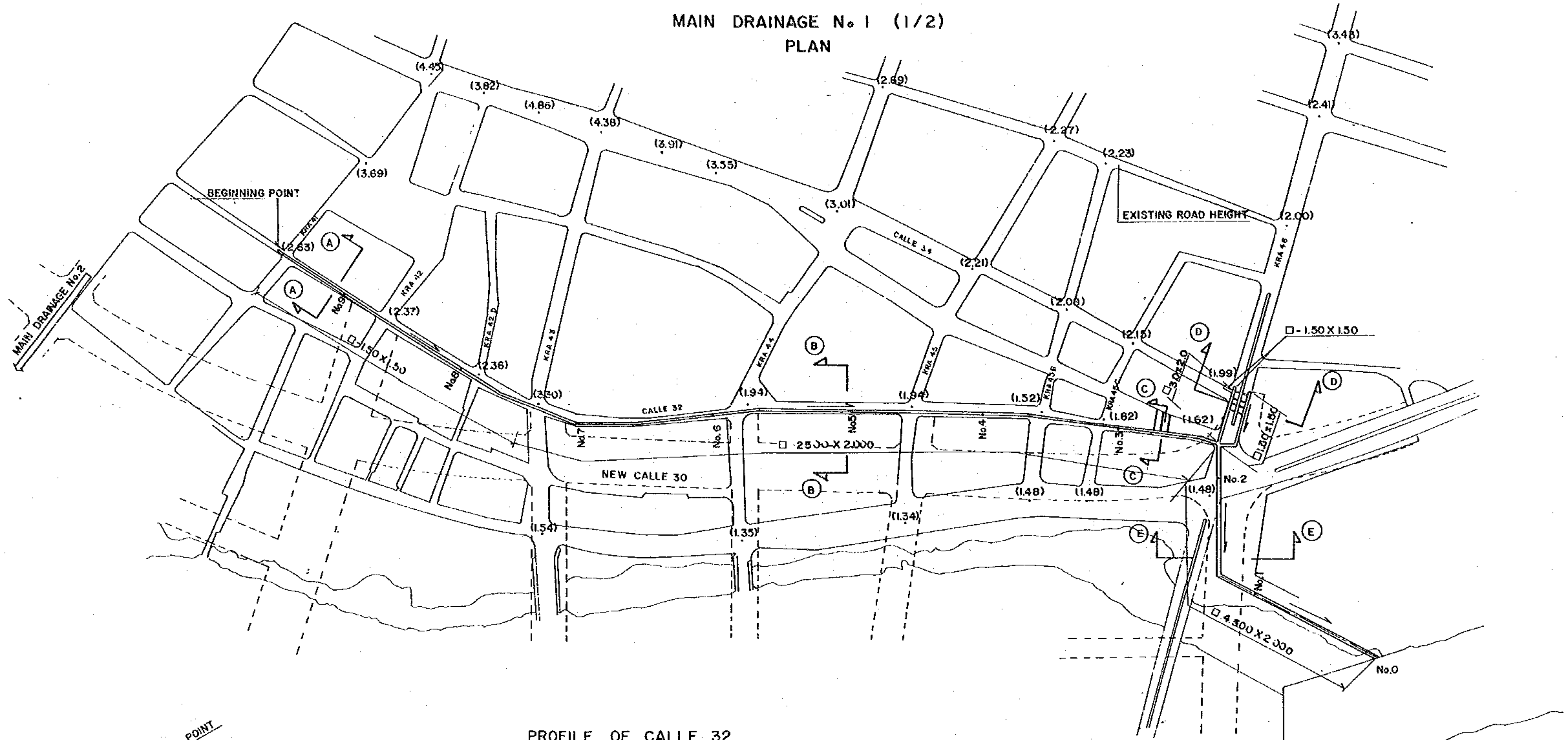
TABLE 12-2 shows respective estimated flood runoff and dimensions of the drainage system by each of the major arteries.

TABLE 12-2 FLOOD RUNOFF AND MAIN DRAINAGE PLAN BY MAJOR ARTERY

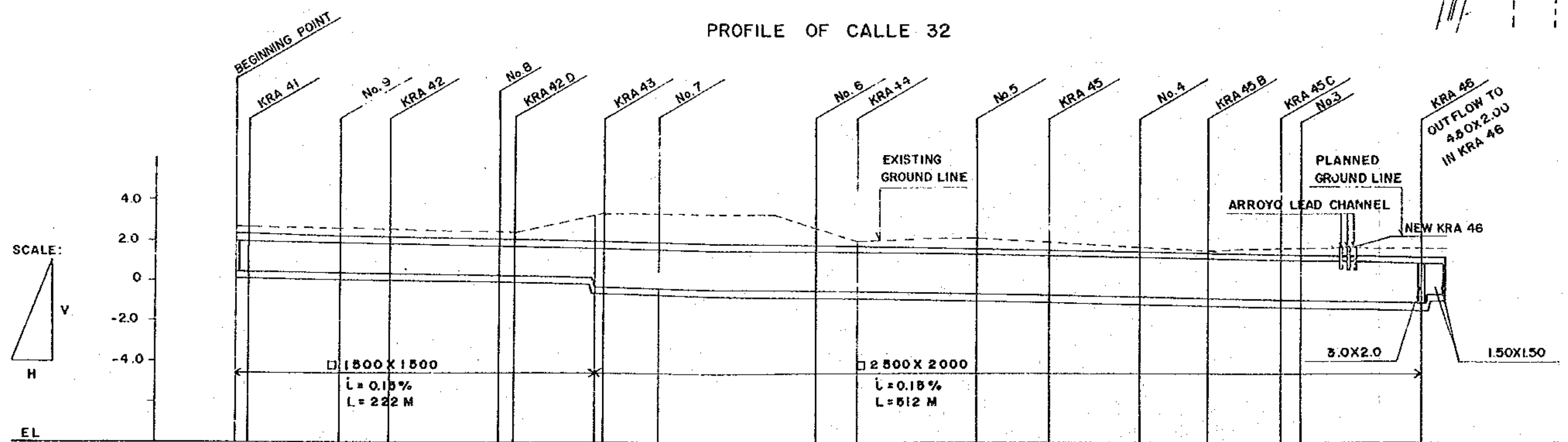
No.	Location	Drainage Area(ha)	Flood runoff expected (m^3/s)	Drainage Plan Distance (m)	Drainage Plan Dimension (box culvert)
1	Calle 32	38.0	9.6	222	1500x1500
(Arroyo				512	2500x2000
Bolivar)	Cra 46	119.3	27.4	225	4500x2000
2	Cra 40	136.6	30.2	400	5000x2000
(Arroyo					
La Paz)	Cra 41	157.3	33.1	370	5500x2000

MAIN DRAINAGE No. 1 (1/2)

PLAN



PROFILE OF CALLE 32

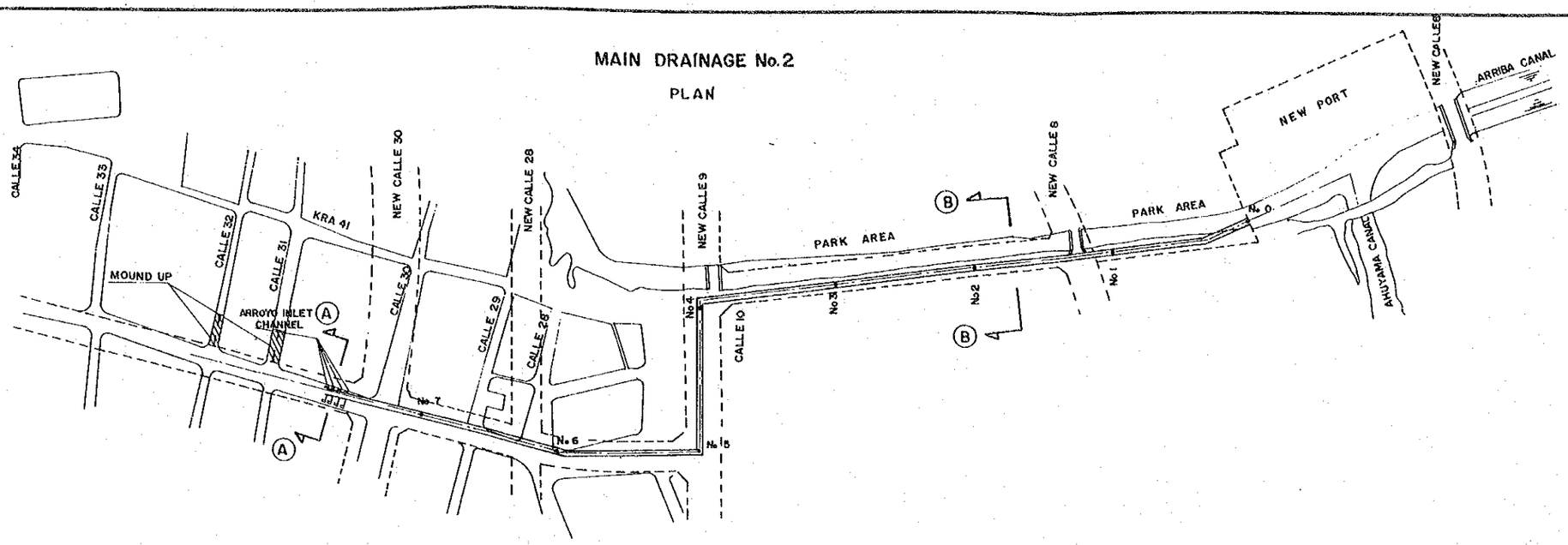


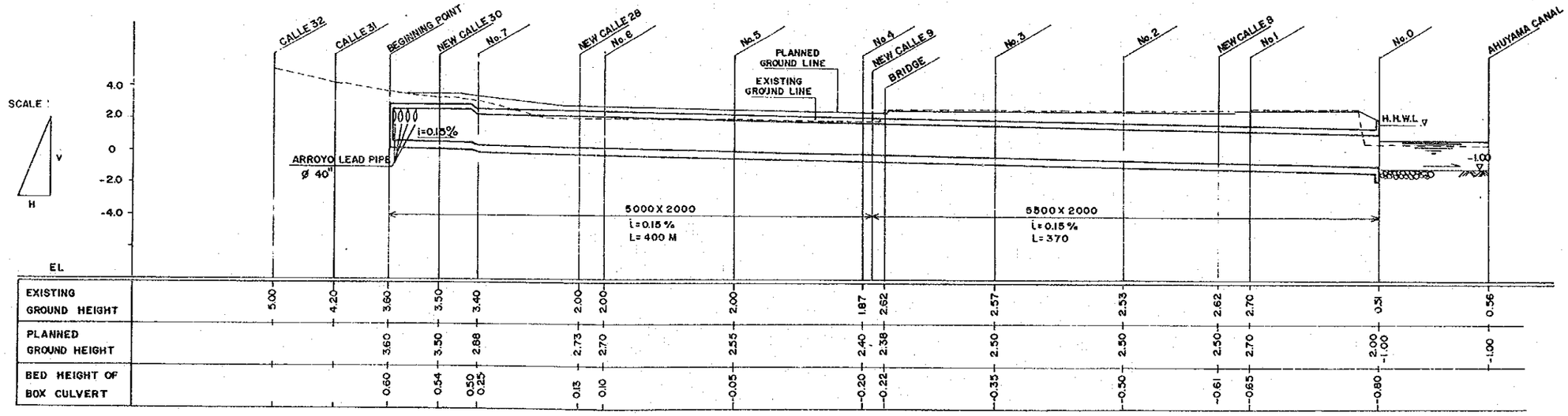
EL	BEGINNING POINT	KRA 41	No.9	KRA 42	No.8	KRA 42 D	KRA 43	No.7	No.6	KRA 44	No.5	KRA 45	No.4	KRA 45 B	KRA 45 C	No.3	KRA 46
EXISTING GROUND HEIGHT	2.65	2.63	2.60	2.37	2.40	2.36	3.30	3.35	2.60	1.94	2.15	1.94	1.70	1.52	1.62	1.62	1.62
PLANNED GROUND HEIGHT	2.65	2.63	2.60	2.37	2.40	2.36	3.30	3.35	2.60	1.94	2.15	1.94	1.70	1.52	1.62	1.62	2.15
BED HEIGHT OF BOX CULVERT	0.52	0.51	0.43	0.38	0.28	0.27	0.19 / -0.31	-0.37	-0.52	-0.56	-0.67	-0.74	-0.82	-0.88	-0.95	-0.97	-1.09

FIG. 12-13 MAIN DRAINAGE NO. 1

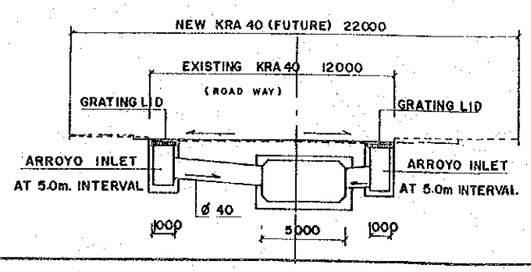
MAIN DRAINAGE No.2

PLAN





SECTION Ⓐ-Ⓐ



SECTION Ⓑ-Ⓑ

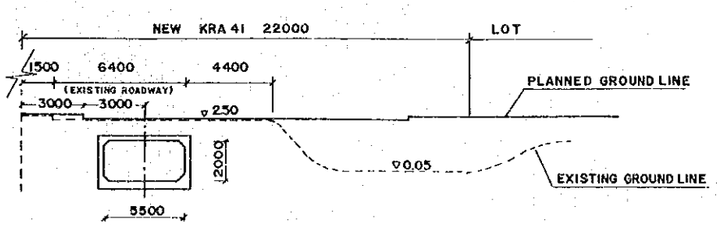


FIG. 12-14 MAIN DRAINAGE NO. 2

2) Barranquillita and Boliche Area

The drainage plan of the Barranquillita and Boliche area is shown in the FIG. 12-15. The drainage system is installed on the both sides of all new streets.

The drainage is a concrete-made channel with a concrete cover in small sections, and a box culvert in large sections and at street intersections. The maximum size of the drain is 1.50 x 1.50m. However, drain of sizes less than 0.70 x 0.70m comprise 18,200m or 78% of the total drainage length of 23,300 m.

12-4. Urban Utilities

12-4-1. Water Supply

1) Water Use and Masterplan of EPM

The Master Plan for the water supply and sewer system of the city of Barranquilla has been made by EPM in cooperation with an American consultant firm financed by FONADE in 1981. At present, some projects indicated in the Master Plan are implemented by EPM with the financial support of the World Bank.

FIG. 12-16 shows the served user projection, water demand and projected capacity of the water treatment plant up to the year 2000 estimated in the Master Plan. The water demand of the Study Area after completion of whole building facilities will be 14,000 m^3/day (0.16m^3/sec). Though the project implementation by EPM is behind the schedule set in the Master Plan, the water supply system of EPM has enough potential to supply water to the Study Area.

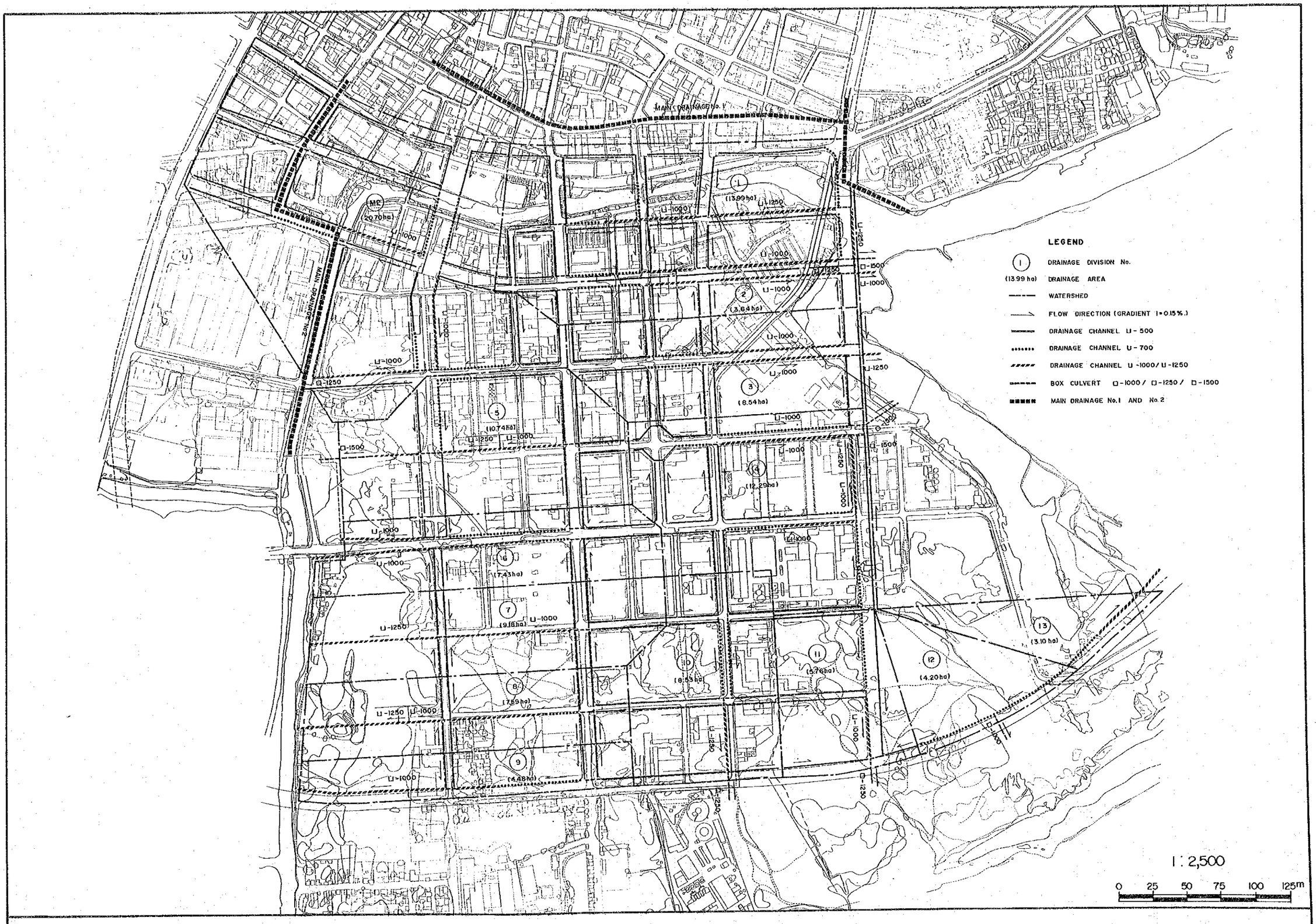


FIG. 12-15 DRAINAGE PLAN

2) Water Supply Network

Poor pavement conditions and vehicular traffic have damaged the existing water supply pipelines in Barranquillita.

In addition, the existing pipelines are old and do not have enough capacity to satisfy the increased demand resulting from the development of the Study Area. The new water supply pipeline network is established in accordance with the new land use and street plans as shown in FIG. 12-16.

The 16" pipeline in Calle 30 is a major conduit for the Study Area. The new pipeline network is also connected with the 10" pipeline in Calle 17 and with the 6" pipeline in Calle 6 in order to secure supply of water when a major conduit is out of service. Fire-hydrants are installed along the streets in accordance with the standards set by EPM.

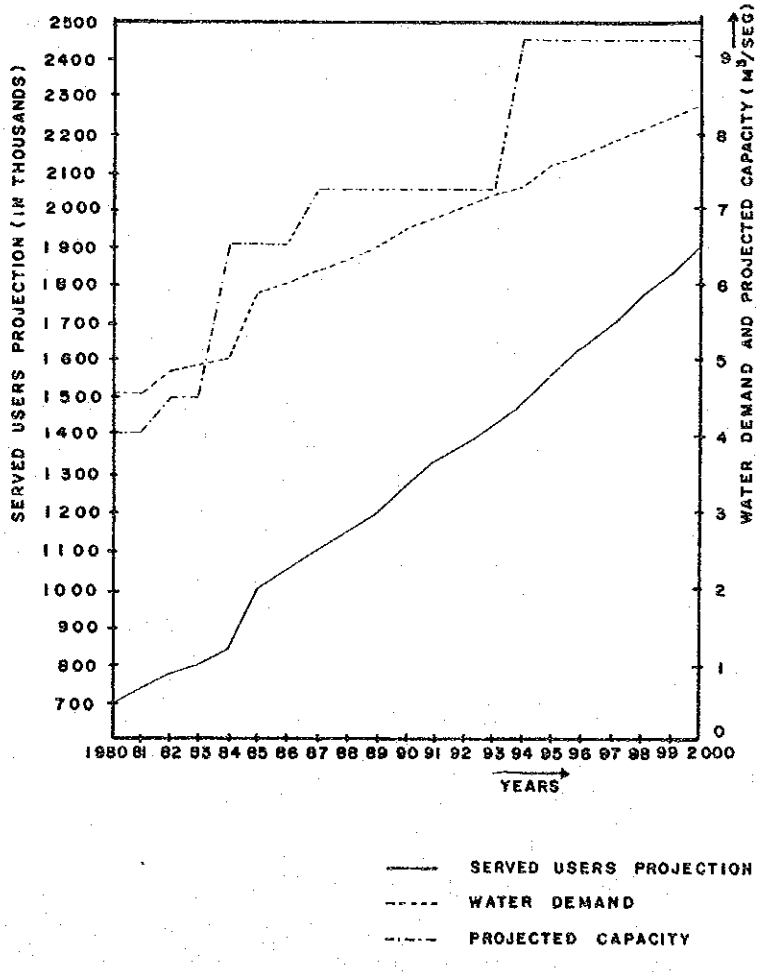


FIG. 12-16 SERVED USERS PROJECTION, WATER DEMAND AND PROJECTION CAPACITY IN THE MASTERPLAN

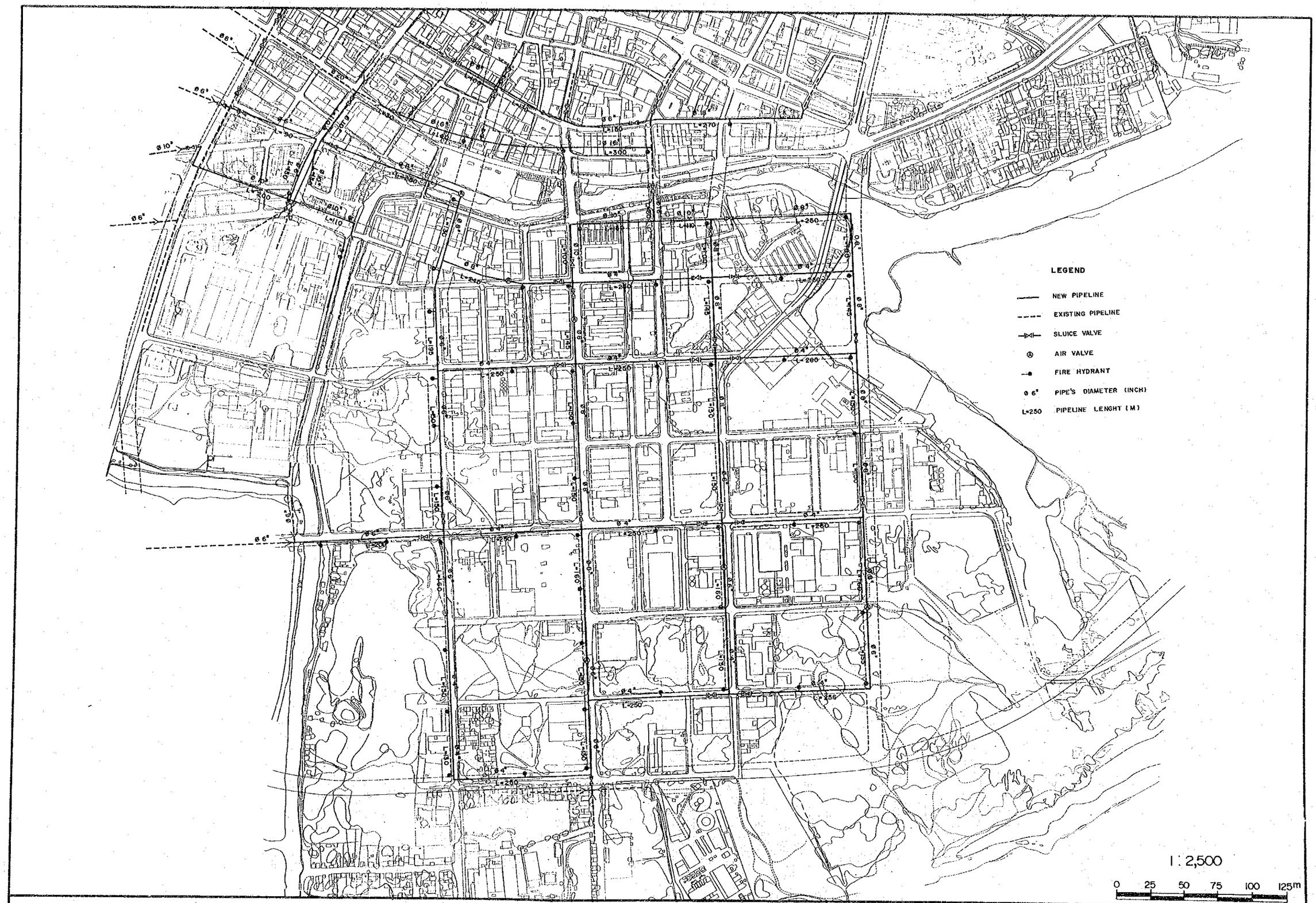


FIG. 12-17 PLAN OF WATER SUPPLY NETWORK

12-4-2. Sewerage System

1) Sanitary Sewer

a. Boliche Area

At present, the sewage of the Boliche area flows into the No. 2 pump station through the sewer pipeline. The sewage from the Cerveceria Aguila (a beer factory) is discharged directly to the Arriba Canal. The following works are required for development of the Study Area:

a) Rearrangement of sewer pipeline in Boliche area corresponding to the new land use and street plans.

b) Installation of sewer pipeline from the Cerveceria Aguila to the No. 2 pump station prior to filling the Arriba Canal.

b. Replacement of No. 2 Pump Station

The existing No. 2 pump station interferes with the new Calle 9. It is located to the new park area located along the filled Arriba Canal when the new Calle 9 is constructed.

The gravity-flow pipeline which connects the existing No. 2 pump station and the new pump station is installed in order to lead the existing sewage to the new pump station. The collected sewage is discharged to the Magdalena river through the existing 24" pressure pipeline.

c. Barranquillita Area

No public sewer exists in the Barranquillita area. The new sewer network is established in the Barranquillita area as shown in FIG. 12-18. All sewage generated in the Barranquillita area is led to the sewage treatment plant to be established on the eastern side of the Riverside Bypass.

2) Sewage Treatment Plant

a. National Standards for Disposition of Water

National standards for environmental sanitation are set by the

Ministry of Public Health with a law, covering sanitary disposal of water and solid waste enforced in 1979, and amended in 1983 and 1984. The Decree 1594 of 1984 regulates disposition of water as follows:

i) All materials disposed into a receiving water must comply with the following specifications according to Article 72 regulating dumping into bodies of water:

Item	Existing user	New user
-pH	5 to 9	5 to 9
-Temperature	40°C	40°C
-Visible gross matter	Not detectable	Not detectable
-Fat and oil	removal 80% on load	removal 80% on load
-Suspended solids (SS) domestic or industrial	removal 50% on load	removal 80% on load
-Biochemical Oxygen Demand (BOD) for domestic wastewater	removal 30% on load	removal 80% on load
for industrial wastewater	removal 20% on load	removal 80% on load

ii) Each building, groups of buildings and urban, touristic or industrial developments located out of the coverage area of the public sewarage system must be provided with a collection system and sewage treatment according to the special standards the Health Ministry and EMAR are assigning to each case.

b. Expected Development Pattern of Sewage Treatment System

The development pattern of sewage treatment system in the city of Barranquilla is expected as shown in FIG. 12-19. The 1st step in the pattern is taken for the time being because no public system

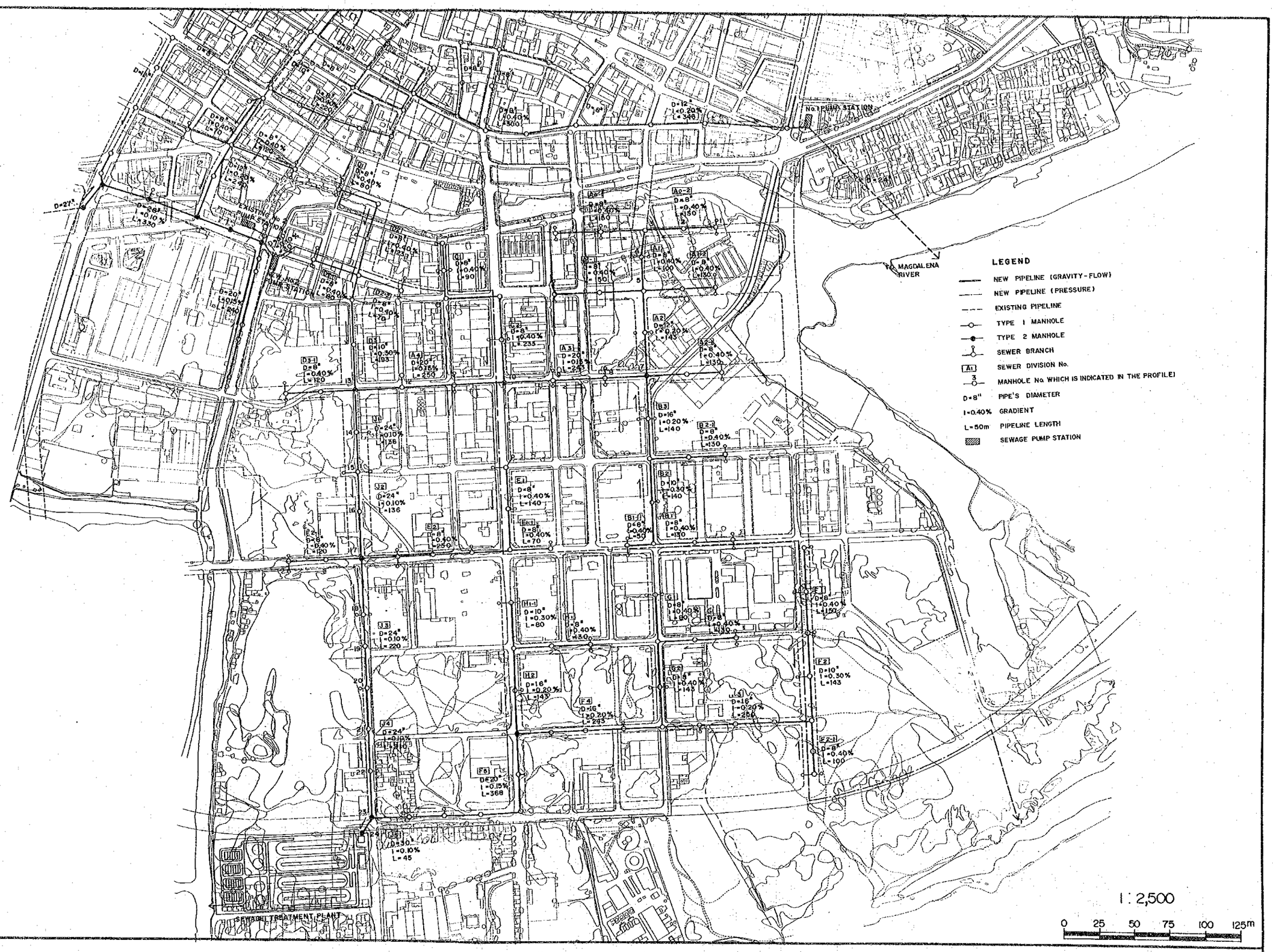
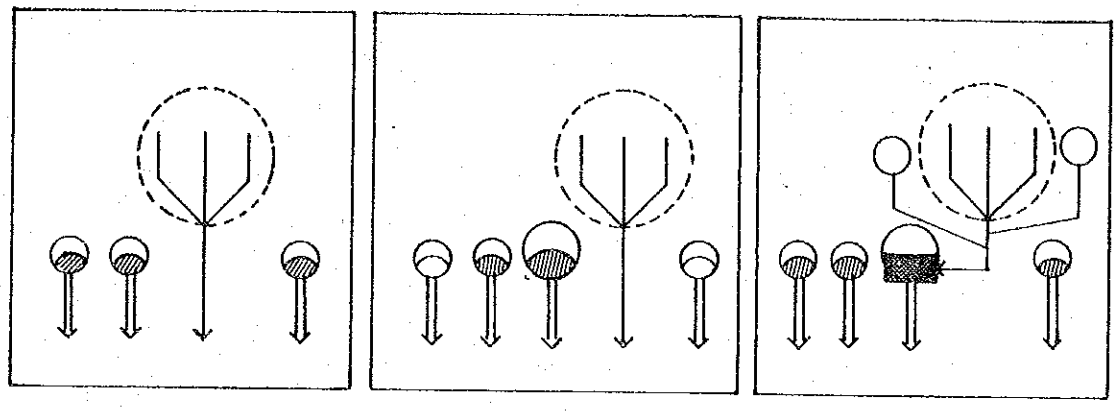


FIG. 12-8 PREPARATORY WORKS

currently exists.

Afterwards, it will proceed to the 2nd and 3rd steps according to the development of the public system. In the 3rd step the development may be required to share in the cost of extending the public system.



LEGEND

- Existing Public Sewer System.
- Public Sewage Treatment System.
- Individual Development.
- Sewage Treatment System for Individual Development.
- Disposition of Treated Water
- Disposition of Sewage Without Treatment

FIG. 12-19 DEVELOPMENT PATTERN OF SEWAGE TREATMENT SYSTEM

c. Relationship with Sewage Treatment System

For the time being, the sewage treatment plant for the Project to be established in Barranquillita is planned as an independent system.

The Master Plan for the public sewage treatment systems of Barranquilla should be made by EPM and the other concerned bodies as early as possible. In case EPM decides to place one of the public sewage treatment plants in Barranquillita and its implementation schedule meets that of the Project, the plant of the later phases for the Project may be involved in the EPM's public sewage treatment plant.

d. Sewage Treatment Plant for the Project

In Colombia, a few small-scale sewage treatment plants comprised of activated sludge units combining a conventional system and an oxidation ditch system are in operation, and U.A.S.B. (upflow anaerobic sludge blanket) process is under development. Conventional activated sludge systems and the U.A.S.B. system are not suitable for this project, because the former has expensive construction and maintenance costs, and the latter does not meet sewage regulations in this stage of development. An oxidation ditch system, which requires less maintenance and whose treatment efficiency is confirmed in many other tropical climate countries, is applied for this project.

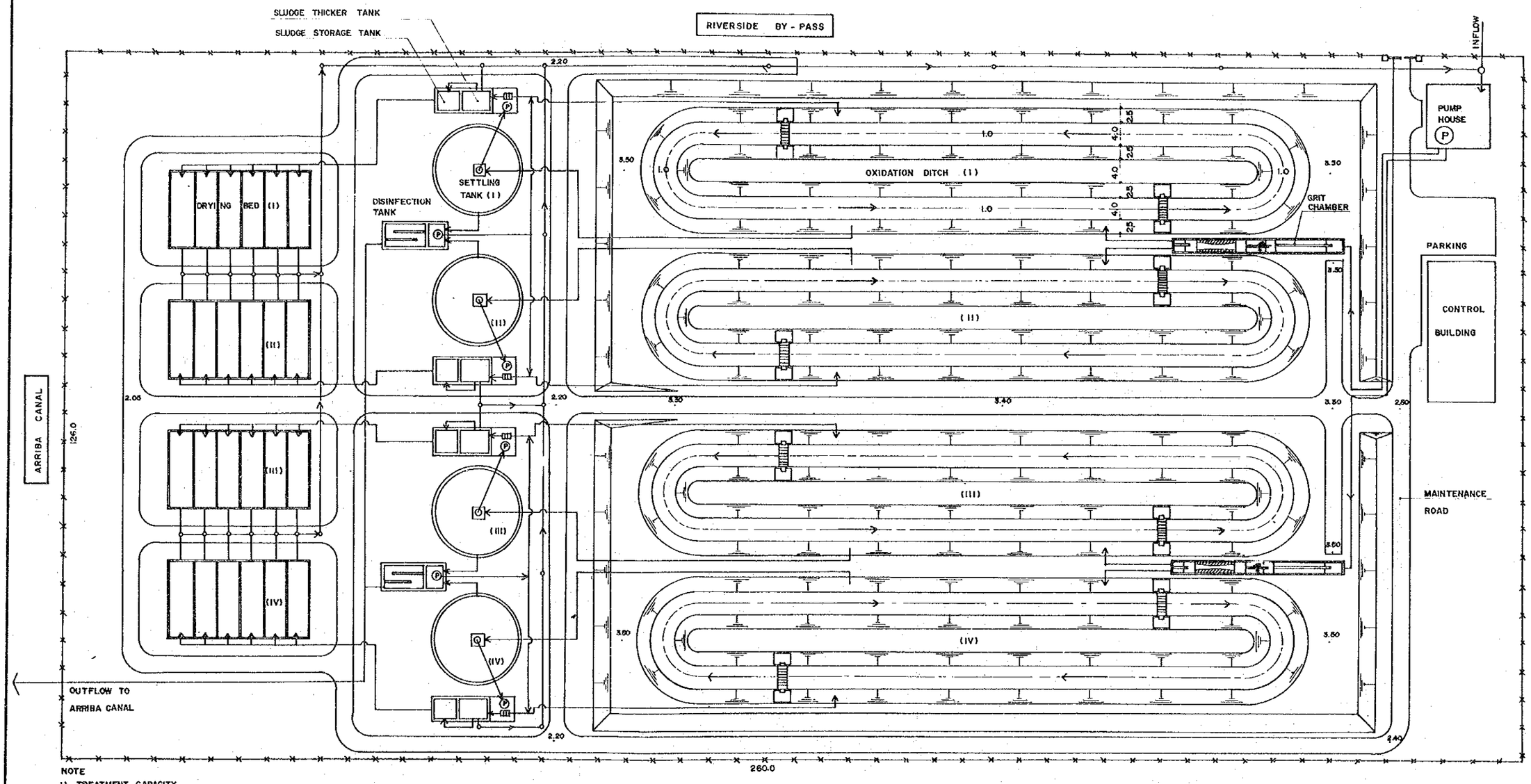
FIG. 12-20 and FIG. 12-21 show the layout plan and flow diagram of the plant. The plant is constructed phase by phase in accordance with an increase of activity and in the Study Area. A total treatment capacity after completion of phase IV is 12,800 m^3/day.

12-4-3. Electricity Distribution

1) Planning Premises

The El Rio sub-station,located along Calle 3 in Barranquillita is distributing the electricity not only to the central district but also to the north and east ward section of the city. The 15 intermediate voltage circuit lines run through Barranquillita as shown in Fig. 12-22.

LAYOUT PLAN OF SEWAGE TREATMENT PLANT



NOTE

1) TREATMENT CAPACITY

3,200 M^3/DAY x 4 LINES = 12,800 M^3 /DAY

2) TREATMENT EFFICIENCY

	INFLOW	OUTFLOW
BOD	250 ppm	LESS THAN 50 ppm
SS	300 ppm	LESS THAN 60 ppm

1 : 500

0 5 10 15 20 25m

FIG. 12-20 LAYOUT PLAN OF SEWAGE TREATMENT PLAN

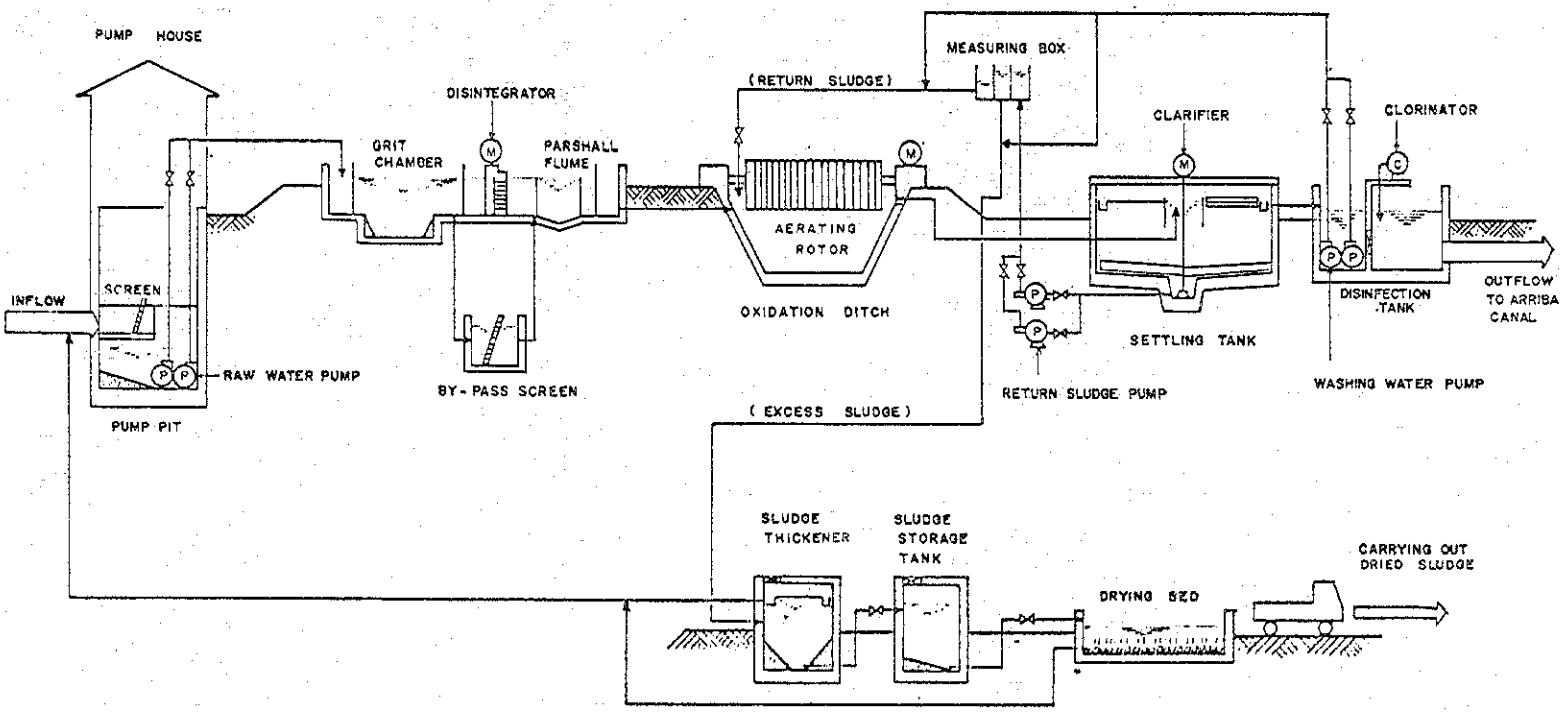


FIG. 12-21 FLOW DIAGRAM

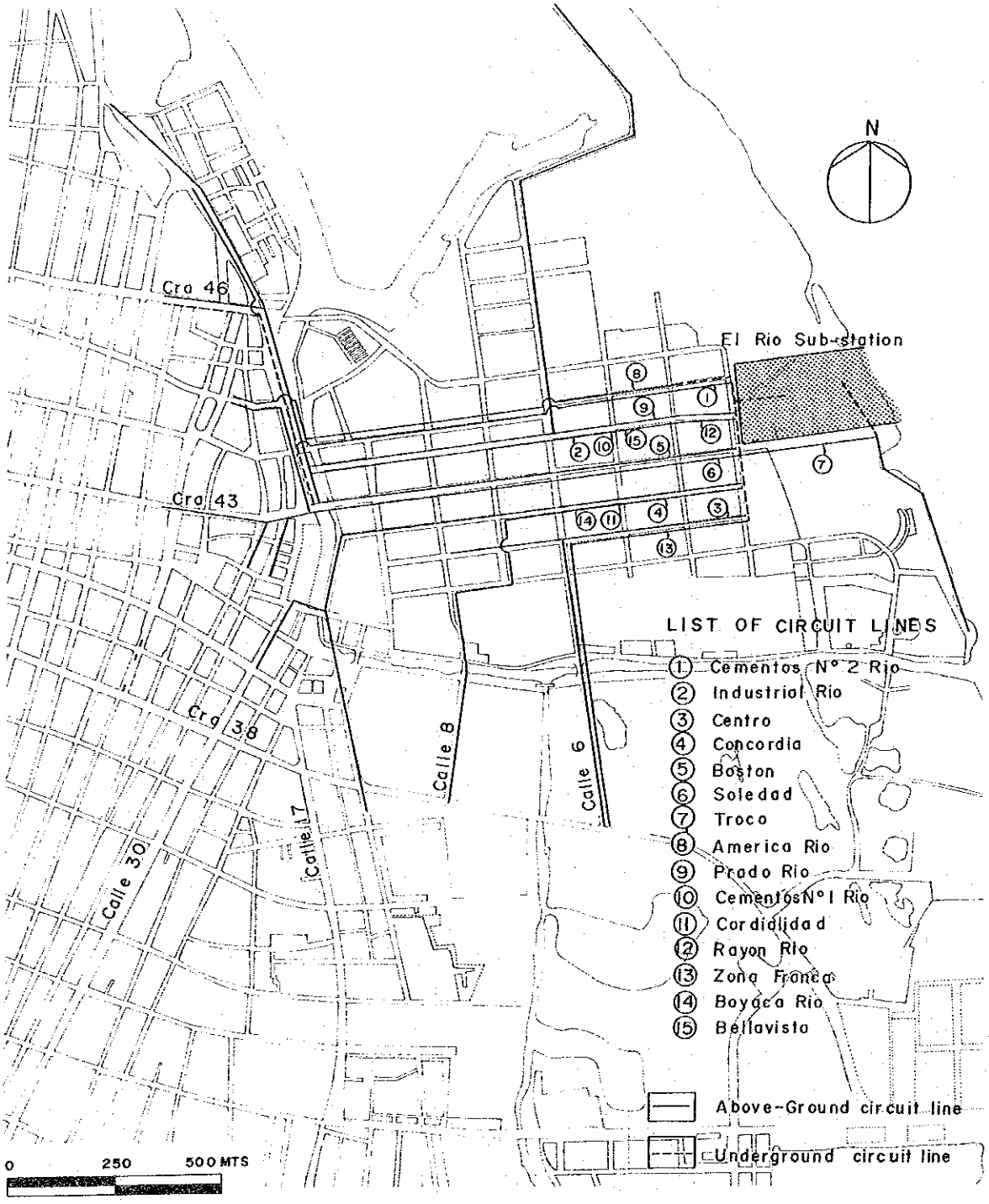


FIG. 12-22 EXISTING INTERMEDIATE VOLTAGE CIRCUIT LINES

FIG. 12-23 PLAN OF ELECTRICITY SUPPLY AND DISTRIBUTION NETWORK

They must be replaced. ELECTRANTA has plans to shift the present above-ground wiring to the underground wiring system. However, the time schedule for its implementation is pending because of lack of funding.

2) Distribution Network

ELECTRANTA is implementing the following plans to meet the increase of electricity demand of the city:

a. Construction ofthreeadditionalsub-stations:as LasFlores, Oasis and Centro.

b. Construction of transmission line for leading the electricity generated in Sabanalarga to Barranquilla.

The existing supply and distribution system of ELECTRANTA has the potential to supply electricity to the Study Area.

The supply source of the electricity for the Study Area is the EL Rio substation. The Study Area is provided with the street lighting and adequate public outdoor lighting for security. FIG. 12-23 shows the replaced 15 intermediate voltage circuit lines and the intermediate voltage distribution network of the underground wiring system in the Study Area.

12-4-4. Telephone system

At present, the Study Area is within the coverage of the EMT Central exchange office. The Barranquilla area is provided with 760 lines and it will be reinforced up to 1,500 lines in accordance with the EMT's plan.

When the construction of planned buildings facilities in the Study Area proceeds, EMT will install only the trunk line which connects the Central exchange office to the facility at the expense of EMT.

Three (3) mobile exchanges each with a 3000 lines capacity, are required within the Study Area by the final development stage in order to supply telephone services from the provided trunk line to the individual users who move into the area. All telephone cable lines are installed underground.

12-4-5. Gas supply system

The two high pressure PROMIGAS gas pipeline run through Barranquillita. PROMIGAS also is supplying gas to the existing factories in Barranquillita.

At present, PROMIGAS (for industry) and GASES DEL CARIBE (for residential, commercial and office buildings) are extending the coverage of gas supply in the city.

Both entities will supply gas to the housing, offices and factories to be constructed in the Study Area. The sub-stations for dropping gas pressure and the intermediate and low pressure gas pipeline are provided by the two entities at their expense in accordance with the building construction schedule. During the construction of new streets in the Study Area any protection measures for the existing high pressure gas pipelines may be required.

FIG. 12-24 shows a typical arrangement of utilities lines in a street in the Study Area.

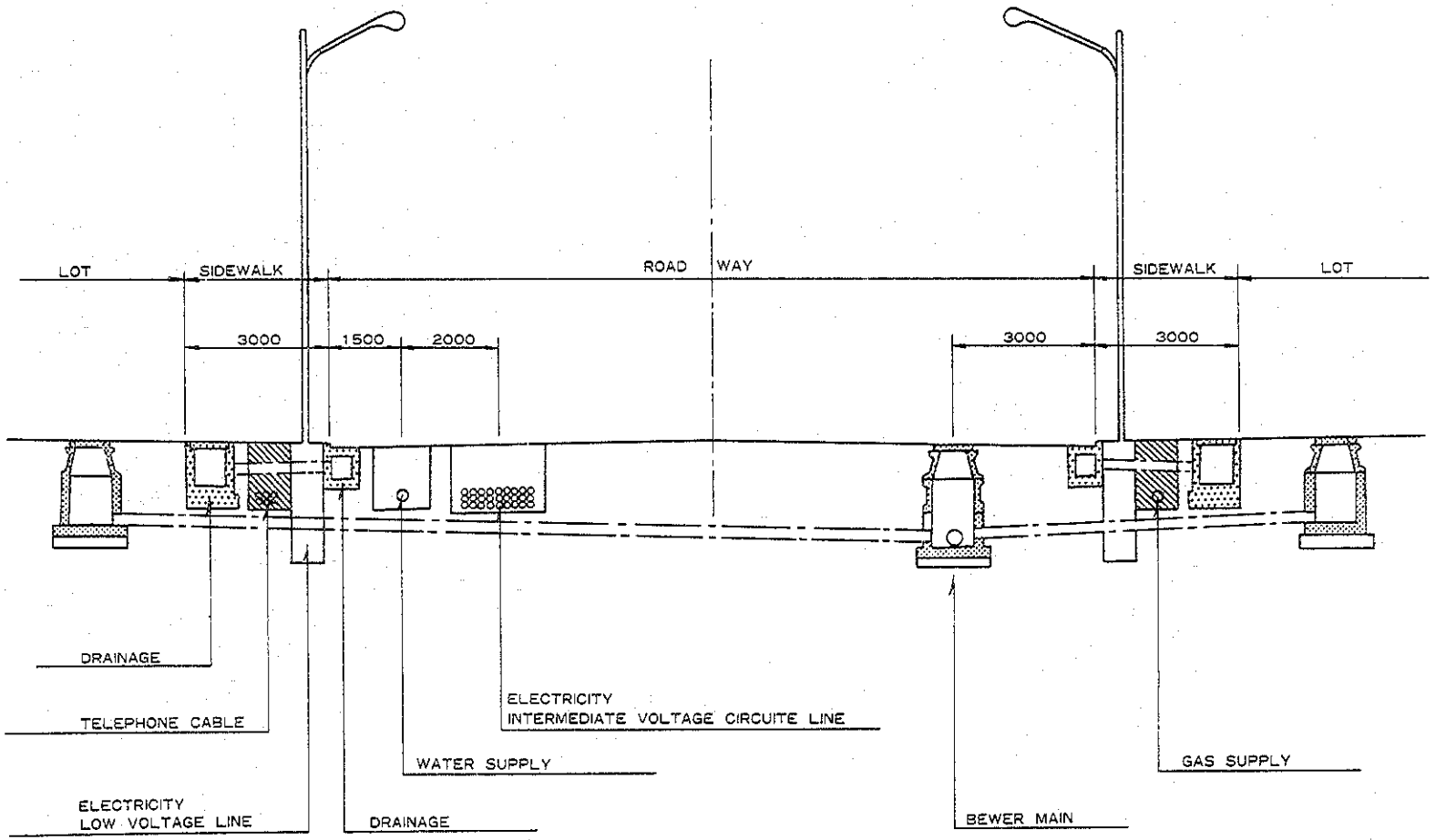


FIG. 12-24 TYPICAL ARRANGEMENT OF UTILITY LINES IN STREETS

PART Ⅲ

PROJECT IMPLEMENTATION PROGRAM

PART III PROJECT IMPLEMENTATION PROGRAM

INTRODUCTION

The main projects of this Study are all urban infrastructures in a broad sense. Generally they have essential characteristics that they are feasible economically but hardly feasible financially.
In addition, in this project there are many hurdles to clear in front of them institutionally and socially.

The following Study is based on an assumption that construction costs can be shared among various responsible organizations. Main matters that require attention are shown below:

a. The proposed development system has an idea that the executive body can acquire land for future public use free of charge. As a result, the capital gain of land owners are reduced, compared with the total land trust system, although they get a considerable profit.

b. If a development is conducted by the total purchase system and lands are acquired step by step, the price of adjacent land to the already developed area will rise by a spillover effect and/or speculative expectations for succeeding development. It is the main reason why the total purchase system is actually difficult to be applied to the Barranquillita development, but this is neglected when the financial evaluation of this system and the economic evaluation of the total urban development.

Chapter 13

ESTIMATION OF PROJECT COST

13-1. Basic Method of Cost Estimation

13-1-1. Grouping of Projects

There are six major projects of different types. For total urban development of Barranquillita, it is necessary to construct various commercial and office buildings, factories, houses and public service facilities in addition to the six projects of this Study.

The methods and the degree of precision of cost estimation are not necessarily same among them. For estimating cost, the projects can be grouped as follows:

a. Projects of this Study
   - a-1. Buildings
     - Bus Terminal
     - Public Market
   - a-2. Parks
   - a-3. Roads
     - Calle 30
     - Riverside Bypass
   - a-4. Urban Infrastructure

b. Other Facilities
   - b-1. Commercial and Office Buildings
   - b-2. Factories
   - b-3. Houses
   - b-4. Public Service Facilities

Although the project costs of the facilities belonging to the a-group are fundamentally necessary for this feasibility study, the costs of b-

group facilities are also estimated roughly, in order to show the total investment scale of Barranquillita development, and to determine how each sector (public, private and mixed) could participate.

13-1-2. Base Year and Category Division of Cost Estimation

The base year for cost estimation is set at 1987. Inflation rate (in case of preparing financial statements) or discount rate (in case of discount cash flow analysis) is applied to this 1987 prices.

For projects evaluation, both financial and economic costs of the projects are necessary. Also, foreign and local portions of the costs should be separated as a basic information for studying finance. Therefore, the costs of the a-group projects are estimated separately for material cost, equipment cost and labor cost (skilled labor and unskilled labor), and also by another division for foreign and local portion (separating tax).

The b-group projects are subject only to rough estimation of financial costs.

13-1-3. Estimation Method of Direct Construction Cost

A construction work is divided into work section, considering the construction schedule. The direct construction cost is estimated by multiplying unit costs of work item by work quantity, which are obtained for each work section. A unit cost of work item is obtained by combining material costs, equipment costs and labor costs of each sub-work item. The foreign portion of construction cost is composed of CIF prices of imported materials and equipments and labor costs for foreign specialists. Taxes are customs duty and import tax for imported articles and value added tax for all materials and equipments.

The construction costs of b-group facilities are estimated by multiplying unit construction cost per floor area by roughly estimated

total floor areas.

13-1-4. Estimation Method of Total Construction Cost

Referring to cost estimation documents of various projects in Colombia, a total construction cost is obtained by multiplying the direct construction cost by the following coefficients in the study:

Direct construction cost	(A)	
Indirect construction cost	(B)	: A x 0.3
Design and engineering cost	(C)	: A x 0.05
Supervision cost	(D)	: (A + B) x 0.06 = A x 0.078
Administration cost	(E)	: A x 0.03
Physical contingency	(F)	: A x 0.15
Total construction cost	(G)	: A + B + C + D + E + F
		= A x 1.608

13-1-5. Land and Building Acquisition Cost

Based on the 1987 land and building prices valuated by IGAC, market prices of land and building are estimated by applying a revision factor, which is obtained by studying the differences between IGAC prices and market price examples.

13-1-6. Basic Figures Used

Main basic figures used for cost estimation are as follow:

a. Wage of Unskilled Laborer.

683.67 pesos per day (excluding transportation cost), which is the minimum wage established by the National Wage Council.

b. Rate of Value Added Tax. 10%

c. Revision Factor of IGAC Price.

1.66 times in all cases

d. Increase Rate of Construction Cost.

22% annually, based on the recent movement of construction cost indices published by CAMACOL and MOPT.

e. Increase Rate of Revaluation of Land and Building.

Up to 1994, 13.8% per annum, which is the average increase rate of IGAC price during the past 4 years (From Jan. 1 of 1983 to the same day of 1987) is used; and from 1995 and afterwards, 22% per annum or the same as the increased rate of construction cost, considering that the development of Barranquillita will be put on track after that time.

13-2. Direct Construction Cost of Projects

The cost estimation is made by accumulating the costs of small work items. Therefore, the unit costs shown in the following tables are the results of the division of the total cost by quantity.

13-2-1. Building Projects

Construction costs of building projects are estimated by cumulating costs of each work item. The unit cost is based on the general standard of architectural quality. When there are some similar types of buildings, a detailed estimation is made for a typical example, and for the rest of the same type the costs are set proportionally to their floor areas.

The unit costs are obtained from the July, 1987 issue of the magazine CAMACOL (edition for construction prices).

Foreign/local portions of the construction costs are divided for only main works and materials, and it is assumed that almost all costs of work items of small quantity are local.

Tax is mainly value added tax for all materials and equipments, but for some special imported materials custom duties and import tax are added.

1) Intermunicipal Bus Terminal

The main building is structured of reinforced concrete, with walls of brick and roof of iron truss. The interior of the building has two floors. The second forms a mezzanine from which the central area of the first floor may be observed.

Adding the cost of the exterior landscaping, the total direct construction cost of the intermunicipal bus terminal is estimated at 381,821 thousand pesos.

TABLE 13-1 DIRECT CONSTRUCTION COST OF INTERMUNICIPAL BUS TERMINAL

(in thousand pesos)

	Area (m^2)	Unit Cost	Construction Cost	Remarks
Building	12,296	28.143	346,046	incl. repair shop
Exterior	20,304	1.762	35,775	
Total			381,821	

2) Markets

Markets are classified into public markets and open markets.

Public markets are composed of two semi two-story buildings and two one-story buildings. In addition, the administration buildings and a warehouse are located at the rear.

They are all structured of reinforced concrete with brick walls.

As for open markets, there are three types of facilities.

Type A: Except 4 water service areas at the corners, the site is perfectly open. Therefore, almost all of construction cost comes from pavement of the floor.

Type B: These are of semi-open type, with roofed main passage and entrance. General selling spaces are covered by tenting.

Type C: These are reinforced concrete structures with roofs. One building is two-story and the other is semi two-story.

The construction cost of markets by block is summarized as shown in TABLE 13-2.

TABLE 13-2 DIRECT CONSTRUCTION COST OF MARKETS

(in thousand pesos)

	Area (m^2)	Unit Cost	Construction Cost	Remarks
Public Market				
Building (Block 6)	10,896	25.445	277,249	incl. administrative Office 796m^2
Building (Block 7)	10,057	21.751	218,754	incl. depot 1,840m^2
Subtotal			496,003	
Open Market				
Type A (Block 1)	15,567	2.396	37,300	pavement and water service
Type B (Block 3)	11,390	8.627	98,261	
Type B (Block 5)	9,844	7.204	70,916	
Type C (Block 2)	9,103	14.520	132,180	
Type C (Block 2)	4,064	19.769	80,341	
Subtotal			418,998	
Total			915,001	

13-2-2. Parks

Parks are classified into urban parks and a recreation park. They are different in type respectively. Therefore, the materials and equipments used for construction are selected in conformity with the quality of finishing and the facilities provided for each park. The total construction cost is estimated by cumulating the cost of each construction section, based on the preliminary design.

1) Urban Parks

The cost of urban parks are estimated by determining cost by square meter. Three urban parks are planned, and as each has distinct characteristics, cost estimations must be done separately.

The large multipurpose park, located along the Calle 30 on Mercado Canal landfill, is designed as a series of gathering places with cultural, recreational, and educational facilities for all age groups. The size and quality of the environment necessitate a larger investment than the other parks. The park near the market area, located on Arriba Canal landfill, is designed to provide a pleasant environment for strolling or sitting. No additional or special facilities are planned for this space. The third park runs along the Tramposos Canal and offers a view of the activity in the canal. This area requires additional investment.

Considered separately is the construction cost of a fishing and docking wharf near the Arriba Canal Park. Cost estimation of the wharf is shown as a lump sum.

TABLE 13-3 DIRECT CONSTRUCTION COST OF URBAN PARKS

(in thousand pesos)

	Area (m^2)	Unit Cost	Construction Cost	Remarks
Multipurpose Park	66,855	3.933	262,952	
Arriba Canal Park	25,531	1.336	34,113	
Tramposos Canal Park	19,628	2.242	44,000	
Subtotal			341,065	
Wharf	lump sum		4,782	
Total			345,847	

2) Recreation Park

For cost estimation purposes, the recreation park may the composed of the following 4 parts: a) landscaping and parking facilities, b) sports ground, c) play yard, and d) sports building. The cost is estimated by cumulating the cost of each part.

TABLE 13-4 DIRECT CONSTRUCTION COST OF RECREATION PARK

(in thousand pesos)

	Area (m^2)	Unit Cost	Construction Cost
Landscaping and parking	10,863	1.560	16,946
Major Sport Fields	35,305	2.700	95,324
Minor Yard Courts	6,518	2.000	13,036
Administration and Recreation Building	1,629	24.000	39,096
Total			164,402

13-2-3. Road Projects

The road projects are the widening and improvement of Calle 30 and the construction of Riverside Bypass. The common methods of estimating the construction cost of both projects are as follows:

a. Scale of Preliminary Design and Minimum Section

The total cost of each construction section is estimated by multiplying unit cost by quantities of work items which are obtained for each 50 meters sub-section, based on the preliminary design at 1/2000 scale.

As for the structures, most of which are installed in Riverside Bypass, the costs are estimated by using mainly 1/400 scale preliminary design.

b. Machinery Cost

All construction machinery are assumed to be leased from construction machinery distribution firms (Almost of them are imported ones). Leasing fees are based on the "Rental Tariffs for Construction Machines" (1987 edition, ACIC).

c. Material Cost

Material cost is estimated at the construction site cost including transportation cost between place of production and construction site.

d. Labor Cost

Labor cost is based on the labor force and wage rate for operating each construction machine according to the above mentioned document and on the wage rate for construction laborers published in the July, 1987 issue of the magazine CAMACOL.

e. Foreign Portion, Local Portion and Tax

The foreign and local portions for construction machinery are estimated by referring to the rates of various costs and taxes necessary for imported machines described in the ACIC document. The rates of customs duties and import tax are different depending on the kind of machine, but roughly speaking, the foreign portion is 60 to 62% and the local portion is 38 to 40% including tax portion of 23 to 24%.

Most of construction materials are supplied domestically, such as cement and steel. But many of the machines and equipments of production of these materials, equipments for production of consumed energy such as electricity, and vehicles for transportation are imported or installed by foreign investment. Therefore, in the case

of cement, the foreign portion is 21% and the local portion is 79% including tax portion of 10%; and in the case of steel the foreign portion is 16% and the local portion is 84% (tax 13%).

1) Calle 30

Calle 30 is constructed on three construction section plans. Characteristics of each section are summarized as follows:

Section I (Cra 1F to Carrera 21)
The right of way is already acquired, so the purchase of land and existing buildings is not necessary. Some measures should be taken against 4 arroyo pathways.

Section II (Carrera 21 to Carrera 38)
Some lots and shop buildings along the road have to be purchased. Measures against Arroyo Hospital, which flows into Carrera 35 are necessary, but in this Study only the cost of civil works from Calle 31 to Calle 30 is added.

Section III (Carrera 38 to Carrera 46)
Since the route is moved to the west, land and building acquisition costs become expensive. The cost of the pedestrian overpass is included here.

Estimated results are shown in TABLE 13-5. The unit cost of Section I is very low comparing with the others, since the construction work of this section is only widening on both sides based on the existing center line.

TABLE 13-5 DIRECT CONSTRUCTION COST OF CALLE 30

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost	Remarks
Section I	m	2,630	42.067	110,635	incl. 1,017 for 4 arroyo paths
Section II	m	2,076	79.073	164,156	incl. 11,639 for Arroyo Hospital
Section III	m	1,109	103.531	114,816	incl. 13,567 for overpass
Total				389,607	

Land acquisition and building compensation costs are estimated based on the following criteria:

a. In case that more than 30% of a lot is included in the right-of-way: buy total lot and building

b. In case of less than 30% : buy necessary area of land and building paying corresponding prices proportional to the area.

As shown in TABLE 13-6 the total cost is estimated to be 263 million pesos, most of which is for Section III.

TABLE 13-6 LAND AND BUILDING ACQUISITION COST OF CALLE 30

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost
Land				
Section I	m^2	-	-	-
Section II	m^2	17,742	0.668	11,856
Section III	m^2	21,349	4.731	101,010
Subtotal				102,866
Building				
Section I	m^2	-	-	-
Section II	m^2	22,363	1.648	36,856
Section III	m^2	44,439	2.557	113,655
Subtotal				150,511
Total				263,377

2) Riverside Bypass

Riverside Bypass is constructed on three construction section plans. Each section has the following characteristics:

Section I (Access road to Pumarejo Bridge to Carrera 38)
Since the ground is a little soft, the cost of foundation work might be expensive. It is necessary to purchase land and buildings of the residential areas near Free Zone.

Section II (Carrera 38 to Carrera 46)
There is a bridge over Arriba Canal.

Section III (Carrera 46 to Via 40)
There are some factors which will add to the construction cost such as high banking around Tramposos Canal and construction of a bridge over Companias Canal securing a clearance enough for passage of boats.

The estimated construction cost is shown in TABLE 13-7. The cost of Section III amounts to about 1,180 million pesos occupying 62.5% of the total. 540 million pesos are for construction of bridges in Section III, especially the Companias C Bridge which will cost 300 million pesos.

TABLE 13-7 DIRECT CONSTRUCTION COST OF RIVERSIDE BYPASS

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost	Remarks
Section I	m	3,036	164.200	498,511	Incl.cost of Bridges 176,227
Section II	m	1,448	144.886	209,795	Incl. cost of Bridges 49,173
Section III	m	2,829	418.051	1,182,665	Incl. cost of Bridges 539,161
Total				1,890,971	

Land acquisition cost amounts to about 170 million pesos. As for building acquisition, almost all of the cost is for Section I, because small houses are concentrated in the area around Section I, while Section II and III are constructed through quasi-vacant land.

TABLE 13-8 LAND AND BUILDING ACQUISITION COST OF RIVERSIDE BYPASS

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost	Remarks
Land					
Section I	m^2	87,727	0.700	61,409	
Section II	m^2	31,790	0.966	30,708	
Section III	m^2	106,430	0.700	74,501	
Subtotal				166,618	
Building					
Section I	m^2	59,402	2.000	118,804	
Section II	m^2	10,950	0.362	3,967	
Section III	m^2	3,026	2.000	6,052	
Subtotal				128,821	
Total				295,439	

13-2-4. Urban Infrastructure

In this project land preparation, installation of urban utilities and street pavement are included.

For the estimation of total construction cost, complex unit costs are estimated at first, combining unit costs of fundamental work and unit quantity of fundamental works in construction items. Then the total cost is estimated by multiplying complex unit cost by the calculated quantity of work by item.

As for the division into foreign/local portion and into material, equipment and labor cost, percentage composition of complex unit cost is estimated based on the information about fundamental work. The total construction cost is divided by applying this composition to each quantity of work item.

1) Land Preparation and Urban Utilities

In this cost estimation, the costs of gas facilities are excluded. These costs are assumed to be paid by the existing gas company.

The result is shown in TABLE 13-9.

2) Streets, Terminal Plaza and Pedestrian Facilities

General streets are paved by asphalt concrete and the level of finishing is at an average grade. The pavement unit costs of pedestrian streets are set at four levels according to the quality of tiles used(3,700 pesos/m^2, 3,000 pesos/m^2, 2,100 pesos/m^2 and 1,800 pesos/m^2). 2,100 pesos/m^2 is used for most of the pedestrian streets. Other cost items are planting, street furnitures and local drainage system.

TABLE 13-9 DIRECT CONSTRUCTION COST OF LAND PREPARATION AND URBAN UTILITIES

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost	Remarks
Land Preparation					
Reclamation	m^3	656,639	0.985	646,789	
Dredging	m^3	51,970	0.415	21,568	
Demolition of Streets	m^2	128,743	0.546	70,345	
Subtotal				738,702	
Drainage					
Main	m	1,979	143.009	283,015	
Drainage Channel	m	23,300	14.965	348,683	
Subtotal				631,698	
Water supply					
Pipes and valves	m	10,049	7.102	71,363	
Fire hydrant	no	58	170.000	9,860	
Subtotal				81,223	
Sewers					
Pump station	lump sum			80,900	
Pipe line	m	9,851	14.090	138,803	
Subtotal				219,703	
Sewage treatment plant					
Machinery & Equip.	lump sum			457,100	
Civil & building	lump sum			190,700	
Subtotal				647,800	
Electricity					
Wiring	m	100,467	12.850	1,291,000	
Ducts	m	11,134	9.157	101,956	
Manhole	no.	32	393.000	12,576	
Connection Box	lump sum			29,742	
Subtotal				1,435,274	
Telephone					
Mobile Exchange	no.	3	225.000	675,000	
Others	lump sum			61,000	
Subtotal				736,000	
Total				4,490,400	

TABLE 13-10 DIRECT CONSTRUCTION COST OF STREETS

(in thousand pesos)

	Unit	Quantity	Unit Cost	Total Cost	Remarks
Street pavement	m^2	321,588	1.511	485,808	
Terminal Plaza	m^2	16,844	2.787	46,937	
Pedestrian streets	m^2	60,476	2.691	162,729	
Pedestrian bridge	m^2	5,847	18.549	108,456	
Total				803,930	

13-3. Total Cost of Barranquillita Development

13-3-1. Project Cost of the Study

Adding various indirect costs to the direct construction costs estimated in the previous section, the project cost of this Study is estimated to be 19,500 million pesos, including 4,410 million pesos for land and building acquisition at 1987 prices. The costs by project are shown in TABLE 13-11. In this table, projects of parks and urban infrastructure are put together into the urban development project.

TABLE 13-11 PROJECT COST OF THIS STUDY

Project	Amount (million pesos)
Urban Development	
Land Preparation	1,187.8
Drainage	1,015.8
Water Supply	130.6
Sewers	353.3
Sewage Treatment Plant	1,041.7
Electricity	2,307.9
Telephone	1,183.4
Street Pavement	781.2
Terminal Plaza	75.5
Pedestrian Streets	261.7
Pedestrian Bridge	174.4
Urban Park	556.1
Recreation Park	264.4
Subtotal	9,333.8
Building Construction	
Intermunicipal Bus Terminal	614.0
Public Market	797.6
Open Market	673.7
Subtotal	2,085.3
Road Construction	
Calle 30	626.5
Riverside Bypass	3,040.7
Subtotal	3,667.2
Total	15,086.3
Land and Building Acquisition	
Urban Development	
Land	2,025.6
Building	1,825.9
Road Construction	
Land	279.5
Building	279.3
Total	4,410.3
Grand Total	19,496.6

13-3-2. Total Cost of Development

The total cost necessary to realize the entire future urban development of Barranquillita should include the cost of urban utilities such as electricity, telephone and gas and the cost of various buildings, in addition to the cost estimated for this Study.

It is assumed that another cost of urban utilities including gas facilities is about 500 million pesos.

Since the total additional floor area is assumed to be 1 million sq. meters, the construction cost of buildings other than the Bus Terminal and Markets is estimated at about 50,000 million pesos by multiplying unit of 50,000 pesos/m^2.

Therefore, the total cost of Barranquillita development could be summarized as shown in TABLE 13-12.

TABLE 13-12 TOTAL DEVELOPMENT COST OF BARRANQUILLITA

Project	Amount (million pesos)
Urban Development	
By this Project	9,300
Others	500
Building Construction	
By this Project	2,100
Others	50,000
Road Construction	3,700
Land and Building Acquisition	4,400
Total	70,000

Chapter 14

STUDY OF PROJECT IMPLEMENTATION

14-1. Investment Schedule

In order to carry out the urban formation corresponding to the development scenario, four objectives of investment are designated by phase as follows:

a.	Phase I (1988 - 1992)	Provision of key facilities which start the development.
b.	Phase II (1991 - 1994)	Development of west half of Barranquillita and provision for Calle 30.
c.	Phase III (1994 - 1996)	Near completion with residential and recreational spaces.
d.	Phase IV (1996 - 1999)	Provision of Riverside Bypass and completion of Barranquillita development.

Opinions could be divided about the construction schedule of the Riverside Bypass. If the development effects of this road are thought to be important, the schedule would be advanced. If the correspondence to traffic demand is thought to be important, the schedule would be delayed.

As described in Chapter 13, the cost of the Riverside Bypass project is estimated at about 3,300 milion pesos, including land acquition and building compensation cost of about 300 million pesos. This amount seems to be too expensive for an ex-ante investment. On the other hand, it is sure that a considerable time will be needed to decide the route and structure of the road, for it is necessary to determine the relationship of Barranquilla Port, Free Zone and residential areas along Section I and of existing industiral facilities and canals along

Section III.

Considering the above mentioned facts, the construction of the Riverside Bypass is scheduled for Phase IV when social understanding of the necessity of this road will deepen in consequence of considerable increase of traffic demand due to the advance of urban development of Barranquillita and economic development of Barranquilla Metropolitan Area.

The tentative investment schedule is shown in FIG. 14-1. It is intended that land acquisition may start in the second half of 1988, as soon as the executive body establishes the basic policy of development. Construction work is tentatively scheduled to begin in 1990; therefore, engineers must be contracted to develop the detailed study and design no later than the end of 1989. The development of urban infrastructures of Barranquillita is scheduled to be completed in 1998, and it is expected that as many buildings as possible will be constructed up to the year 2000.

The investment cost of construction by phase are shown in TABLE 14-1. Costs are expressed at 1987 prices excluding the cost of land and building acquisition. The total amount is 15.1 billion pesos, 64% of which (9.6 billion pesos) is invested by the end of Phase II in 1994.

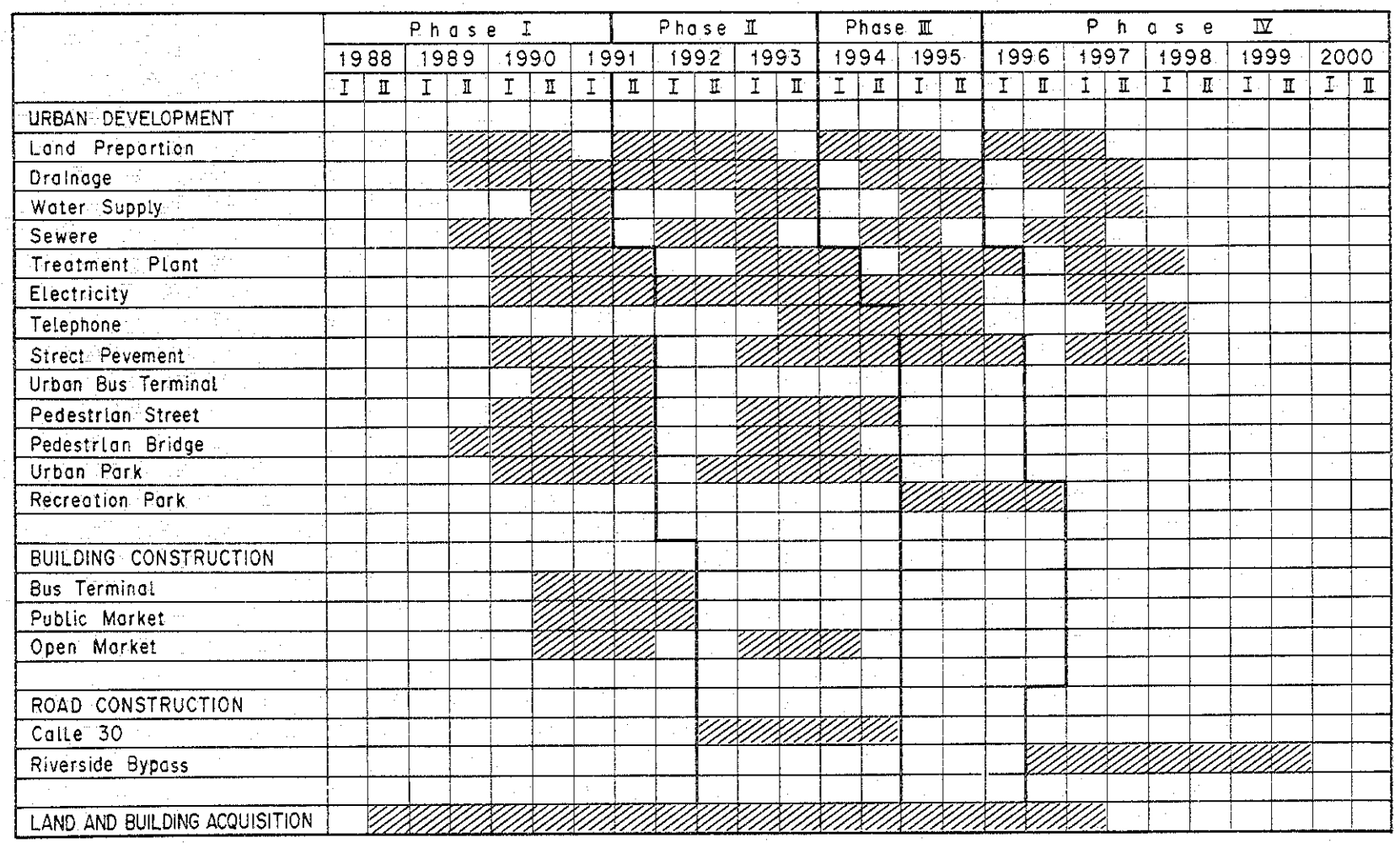


FIG. 14-1 INVESTMENT SCHEDULE

TABLE 14-1 PROJECT COST BY DEVELOPMENT PHASE

(in million pesos at 1987 price)

	Phase I 1988-1992	Phase II 1991-1994	Phase III 1994-1996	Phase IV 1996 1999	Total
Urban Development					
Land Preparation	249.2	468.4	278.8	191.4	1,187.8
Drainage	258.0	612.3	56.5	89.0	1,015.8
Water Supply	19.5	93.3	14.3	3.5	130.6
Sewers	182.0	89.1	71.9	10.3	353.3
Sewage Treatment Plant	382.9	210.6	237.5	210.7	1,041.7
Electricity	1,167.1	1,082.7	50.7	7.4	2,307.9
Telephone	-	402.0	390.7	390.7	1,183.4
Street	205.8	471.1	62.6	41.7	781.2
Terminal Plaza	75.5	-	-	-	75.5
Pedestrian Street	51.2	210.5	-	-	261.7
Pedestrian Bridge	89.1	85.3	-	-	174.4
Urban Park	62.5	493.6	-	-	556.1
Recreation Park	-	-	264.4		264.4
Subtotal	2,742.8	4,218.9	1,427.4	944.7	9,333.8
Bus Terminal	614.0	-	-	-	614.0
Market Facilities					
Public Market	797.6	-	-	-	797.6
Open Market	243.3	430.4	-	-	673.7
Subtotal	1,040.9	430.4			1,471.3
Calle 30	-	626.5	-	-	626.5
Riverside Bypass	-	-	-	3,040.7	3,040.7
Total	4,397.7	5,275.8	1,427.4	3,985.4	15,086.3
Percentage	29.2	35.0	9.4	26.4	100.0

During Phase III, a relatively small amount of 1 billion pesos is designated. However, during Phase IV 3.0 billion pesos is scheduled to be invested for Riverside Bypass.

14-2. Classification of Projects and Executive Bodies

To facilitate project evaluation and determine appropriate executive bodies, the projects of this Study can be classified and grouped as shown below:

a. Urban Development
   - Infrastructure
   - Urban Utilities
   - Streets and Pedestrian Facilities
   - Parks and Recreational Facilities

b. Bus Terminal

c. Market Facilities
   - Public Market
   - Open Market

d. Road Construction
   - Calle 30
   - Riverside Bypass

There are various existing bodies administrating the above mentioned facilities. For promoting the execution of the projects, however, it is recommend that some new executive bodies be established. Currently there are some movements toward this.

As for the urban development portion of the project, it is assumed that a new executive body will be directing the construction work for the entire portion except for gas facilities.

The Bus Terminal project will be conducted by a new bus terminal company as has been done in other cities throughout the country.

The market project includes two different types of market: one is the reconstruction of the existing public market and the other is to give a new business location to street vendors. There is discussion about establishing a new market operating company, but this has not been finalized. In any case, it is assumed that an executive body will construct the public and open markets and will be responsible for renting of selling spaces.

The road projects, Calle 30 and the Riverside Bypass, can be considered separately because of distinguishing characteristics differentiating them: Calle 30 is for urban use while the Riverside Bypass is used regionally; Calle 30 is scheduled for reconstruction in Phase II while the Riverside Bypass will not be built until Phase IV.

Although the roads are located near and related closely to each other especially around Barranquillita, and it is reasonable to assume responsibility could be taken by one executive body, it is assumed that two executive bodies, one for each road, would be established.

TABLE 14-2 CLASSIFICATION OF PROJECTS AND ASSUMED EXECUTIVE BODY

Project	Executive Body
Urban Development	New Urban Development Company
Bus Terminal	Intermunicipal Bus Terminal Company
Market Facilities	Market Operating Company
Calle 30	Municipal Valorizacion Office
Riverside Bypass	Nation or Department