社会開発調査部報告書 AL COOPERATION AGENCY (JICA)
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

No. 62

METRO MANILA URBAN EXPRESSWAY SYSTEM STUDY FINAL REPORT VOLUME III MAIN TEXT (FEASIBILITY STUDY)

# METRO MANILA URBAN EXPRESSWAY SYSTEM STUDY

## FINAL REPORT

## VOLUME III

## MAIN TEXT (FEASIBILITY STUDY)

OCTOBER 1993

KATAHIRA & ENGINEERS INTERNATIONAL



| S S F |
|---|
| J R |
| 93−098 |

EXCHANGE RATES

**April 1993**
**1 US$ = 25.50 Pesos**
**1 Peso = 4.50 Yen**

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
REPUBLIC OF THE PHILIPPINES

# METRO MANILA URBAN EXPRESSWAY SYSTEM STUDY

## FINAL REPORT

## VOLUME III

## MAIN TEXT (FEASIBILITY STUDY)

OCTOBER 1993

KATAHIRA & ENGINEERS INTERNATIONAL

## PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a master plan and feasibility study on Metro Manila Urban Expressway System and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Tsuneo Bekki, Katahira & Engineers International, three times between March 1992 and August 1993.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between the two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of the Philippines for their close cooperation extended to the team.

October, 1993

Kensuke Yanagiya

**Kensuke Yanagiya**
President
Japan International Cooperation Agency

October 29, 1993

**Mr. Kensuke Yanagiya**
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Yanagiya,

Letter of Transmittal

We are pleased to submit to you the Final Report of the Metro Manila Urban Expressway System Study. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above mentioned project. Also included are comments made by the Department of Public Works and Highways of the Republic of the Philippines during technical discussions on the draft report which were held in Manila, Philippines.

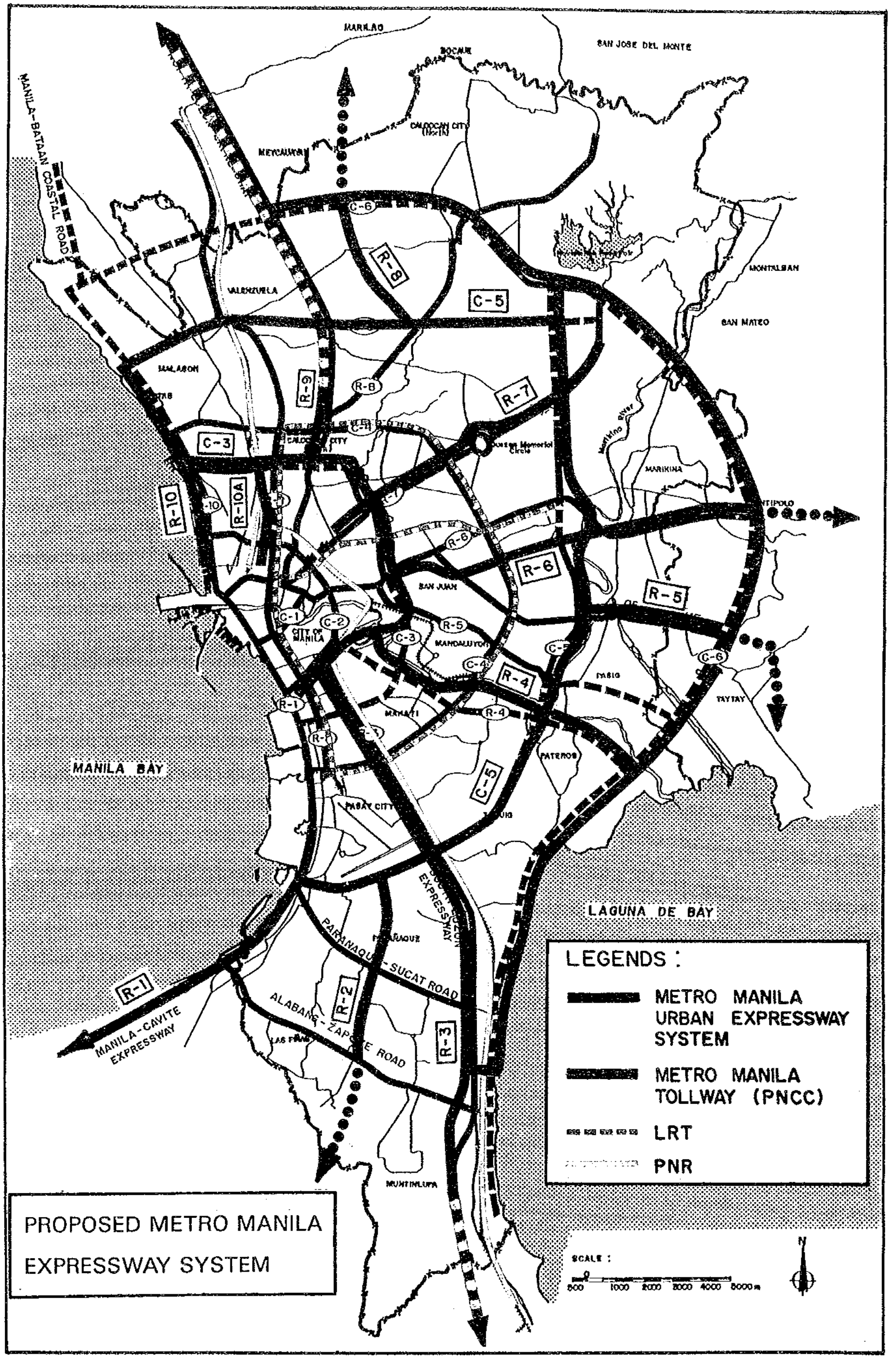
This report presents a master plan for Metro Manila Urban Expressway System (MMUES) which comprises of about 150 kms. expressways to cope up with the rapidly increasing traffic demand as well as to support and guide sound urban development of Metro Manila. MMUES will be developed in three stages in a time span of 19 years. This report also presents a feasibility study of the first stage expressways (about 59 kms.) which will significantly improve overall transport efficiency of Metro Manila and derive high economic return.

In view of the urgency of the urban expressway system in Metro Manila and of the need for socio-economic development of the Philippines as a whole, we recommend that the Government of the Philippines implements this project as a top priority.

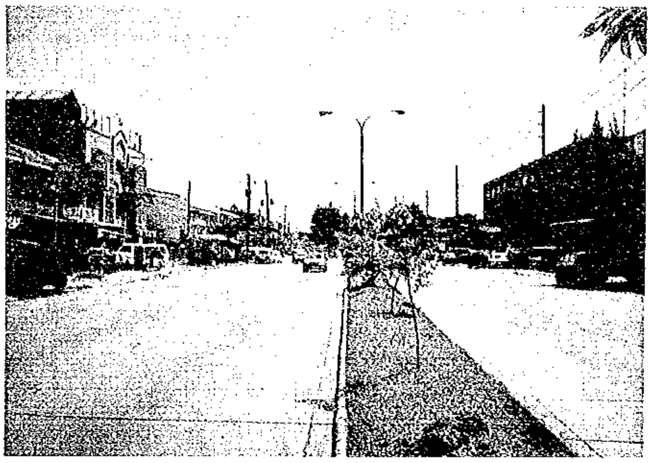
We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Construction. We also wish to express our deep gratitude to the Department of Public Works and Highways and other authorities concerned of the Government of the Philippines for the close cooperation and assistance extended to us during the course of the study.

Very truly yours,

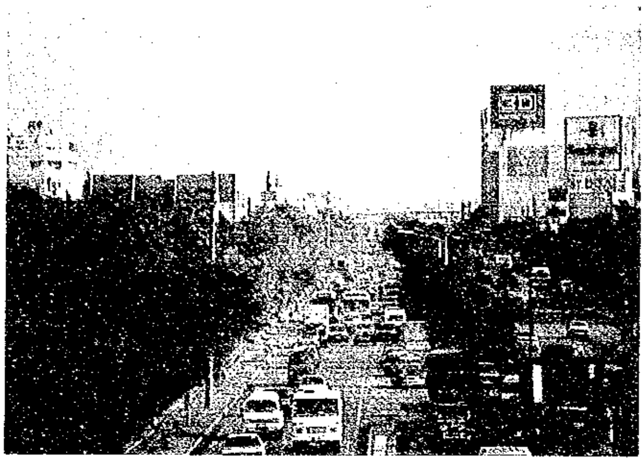
**Tsuneo Bekki**
Team Leader
Metro Manila Urban Expressway System Study



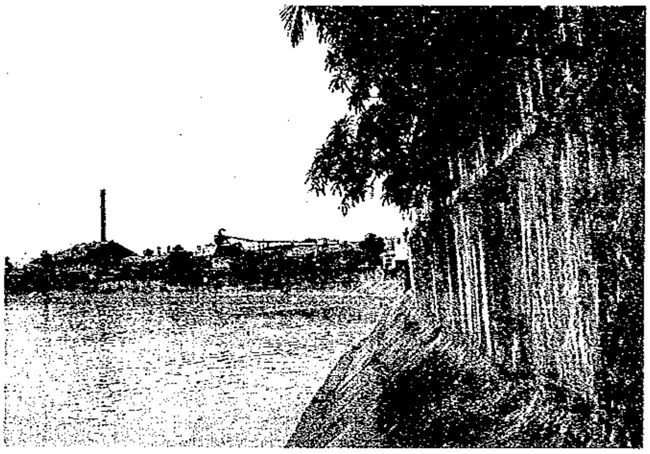

PROPOSED METRO MANILA EXPRESSWAY SYSTEM



At-grade C-3 (Araneta Avenue) over which Inner Circumferential Expressway (EXPRESSWAY ROUTE C-3) will be constructed.

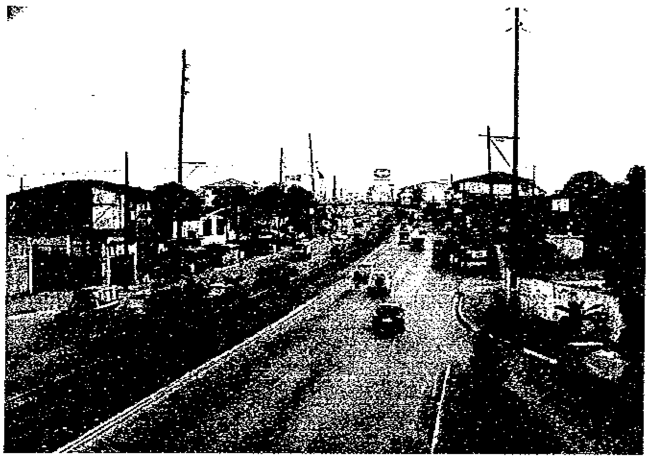


South Super Highway over which EXPRESSWAY ROUTE R-3 will be constructed.

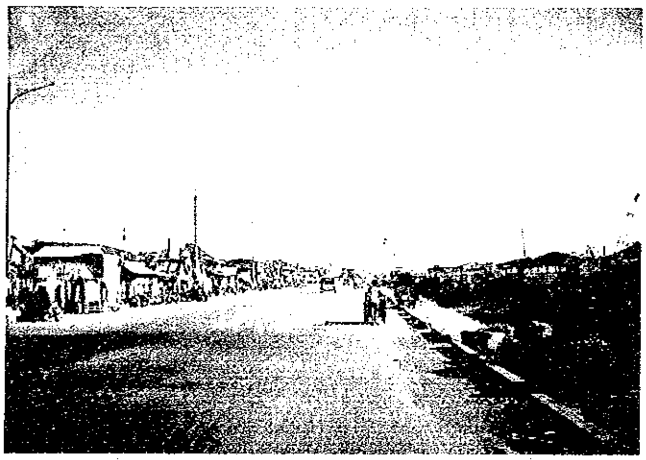


Pasig River along which EXPRESSWAY ROUTE R-4 will be constructed.

Quezon Avenue over which EXPRESSWAY ROUTE R-7 will be constructed.

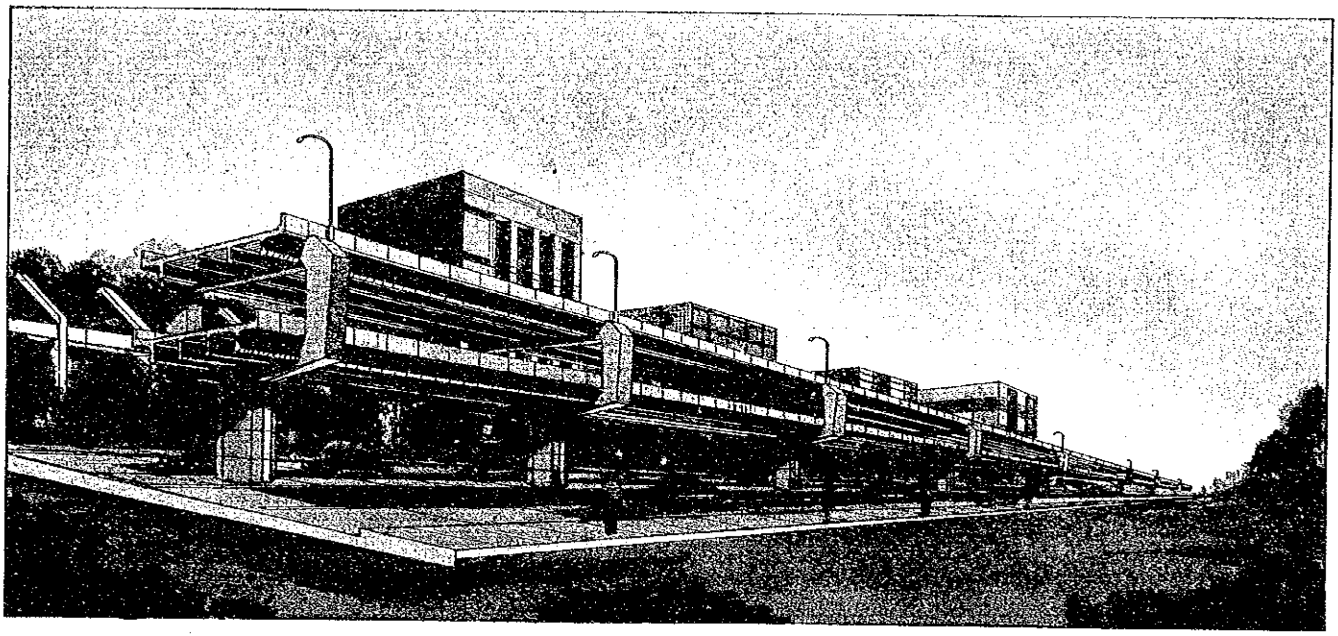


A. Bonifacio Avenue over which EXPRESSWAY ROUTE R-9 will be constructed.

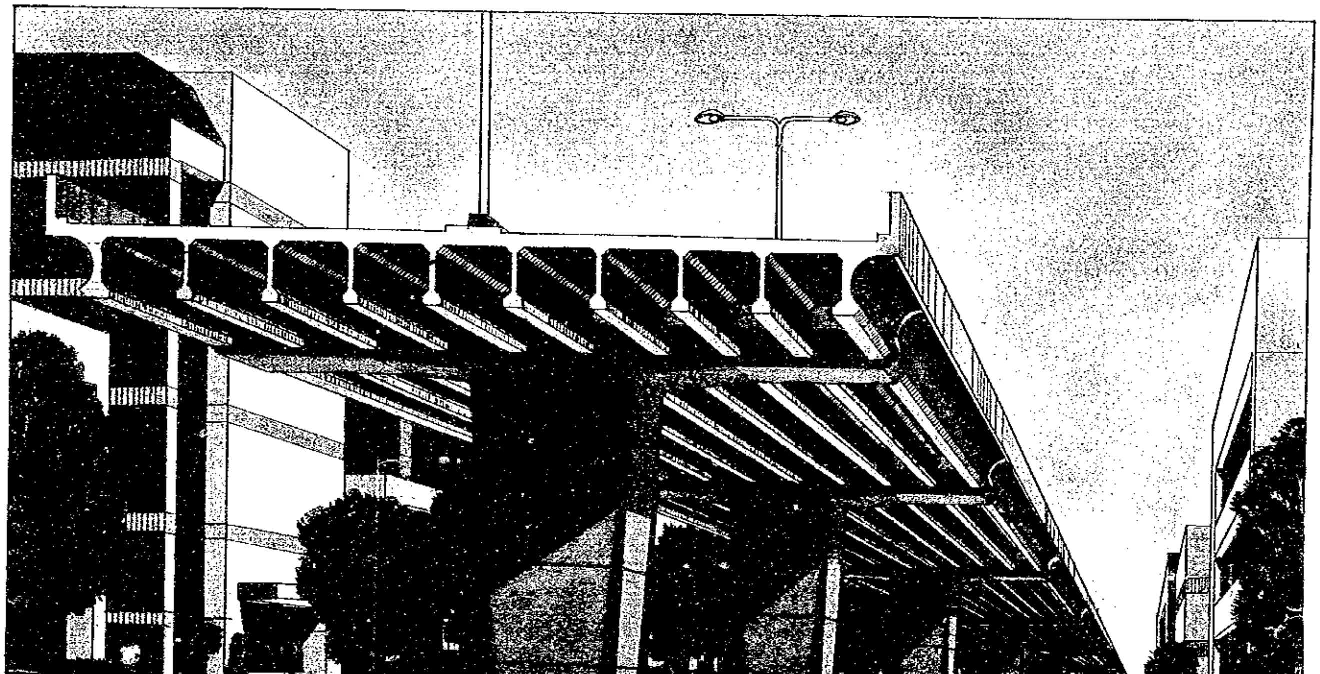


At-grade R-10 over which EXPRESSWAY ROUTE R-10 will be constructed.

EXISTING CONDITION OF FIRST STAGE EXPRESSWAY ROUTES



VIEW OF DOUBLE DECK TYPE EXPRESSWAY



TYPICAL VIEW OF ELEVATED EXPRESSWAY

TABLE OF CONTENTS

## LISTS OF FIGURES (MAIN TEXT)

## LISTS OF TABLES (MAIN TEXT)

## ABBREVIATIONS

| | | |
|---|---|---|
| AASHTO | : | American Association of State Highway and Transportation Officials |
| AC | : | Asphalt Concrete |
| ADB | : | Asian Development Bank |
| AFP | : | Armed Forced of the Philippines |
| B/C Ratio | : | Benefit - Cost Ratio |
| BOT | : | Build-Operate-and-Transfer |
| BT | : | Build-and-Transfer |
| CBD | : | Central Business District |
| CDCP | : | Construction and Development Corporation of the Philippines |
| DECS | : | Department of Education, Culture and Sports |
| DENR | : | Department of Environment and Natural Resources |
| DILG | : | Department of Interior and Local Government |
| DOF | : | Department of Finance |
| DOTC | : | Department of Transportation and Communications |
| DPWH | : | Department of Public Works and Highways |
| D-S Gap | : | Demand-Supply Gap |
| ECC | : | Environmental Compliance Certificate |
| EDSA | : | Epifanio delos Santos Avenue |
| EIA | : | Environmental Impact Assessment |
| EIRR | : | Economic Internal Rate of Return |
| EIS | : | Environmental Impact Statement |
| EMB | : | Environmental Management Bureau |
| FIRR | : | Financial Internal Rate of Return |
| GDP | : | Gross Domestic Product |
| GNP | : | Gross National Product |
| HIS | : | Household Interview Survey |
| HLRB | : | Housing and Land Use Regulatory Board |
| IBRD | : | International Bank for Reconstruction and Development |
| I/C | : | Interchange |
| ICC | : | Investment Coordinating Committee |
| IEIS | : | Initial Environmental Impact Study |
| ILI | : | International Lending Institution |
| JICA | : | Japan International Cooperation Agency |
| JUMSUT | : | Metro Manila Transportation Planning Study |
| LGU | : | Local Government Unit |
| LRT | : | Light Rail Transit |
| MC | : | Motorcycle |
| MCCRRP | : | Manila-Cavite Coastal Road and Reclamation Project |
| MMA | : | Metro Manila Authority |
| MME | : | Metro Manila Expressway |
| MMEA | : | Metro Manila Expressway Authority |
| MMT | : | Metro Manila Tollway |
| MMUES | : | Metro Manila Urban Expressway System |
| MRT | : | Mass Rapid Transit |
| MSDR | : | Manila South Diversion Road |
| MST | : | Manila South Tollway |
| MV | : | Motor Vehicle |
| NAIA | : | Ninoy Aquino International Airport |
| NCR | : | National Capital Region |
| NEDA | : | National Economic Development Authority |
| NHA | : | National Housing Authority |
| NLE | : | North Luzon Expressway |

| | | |
|---|---|---|
| NPV | : | Net Present Value |
| NSO | : | National Statistics Office |
| NTPP | : | National Transportation Planning Project |
| OD | : | Origin Destination |
| OECF | : | Overseas Economic Cooperation Fund |
| PCC | : | Portland Cement Concrete |
| PC Girder | : | Prestressed Concrete Girder |
| PCU | : | Passenger Car Unit |
| PEA | : | Public Estates Authority |
| PM | : | Particulate Matter |
| PMO | : | Project Management Office |
| PNCC | : | Philippine National Construction Corporation |
| PNR | : | Philippine National Railway |
| QMC | : | Quezon Memorial Circle |
| RA | : | Republic Act |
| ROW | : | Right-of-Way |
| SLE | : | South Luzon Expressway |
| SSH | : | South Super Highway |
| TC | : | Tricycle |
| TEC | : | Traffic Engineering Center |
| TP | : | Toll Plaza |
| TRB | : | Toll Regulatory Board |
| UP | : | University of the Philippines |
| UPTTC | : | University of the Philippines Transport Training Center |
| UTDP | : | Urban Transport Development Project |
| UTSMMA | : | Urban Transportation Study for Manila Metropolitan Area |
| V/C Ratio | : | Volume Capacity Ratio |
| VOC | : | Vehicle Operating Costs |

# CHAPTER 1

## INTRODUCTION

# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND OF THE STUDY

Metro Manila with its concentration of people and economic activities is growing rapidly. Similar with other metropolitan areas of the developing world, this expansion has continued to produce far reaching and complex problems, namely: unorderly development of urban areas, aggravation of urban environment and a progressively inefficient urban transportation system.

The present road network consisting of 3,091 km of public roads, of which about 907 km are classified as national roads, has become inadequate to meet the travel demands of the expanding metropolis. The network is characterized by partially developed primary road system, lack of well planned and developed secondary arterial and distributor roads, uncoordinated and inaccessible private roads and inadequate and often outdated pavement, drainage structures and road appurtenances.

The deterioration of the road condition and the public transport services have greatly inconvenienced the daily commuters and motorists, wasted valuable resources, compromised safety and environmental stability, and adversely affected economic activities.

In 1973, a JICA-assisted Urban Transportation Study for Metro Manila Areas (UTSMMA) prepared a master plan for Metro Manila transportation system involving development of an expressway system. The first expressway study in Metro Manila was undertaken in 1980 by the Construction and Development Corporation of the Philippines (CDCP) now known as the Philippine National Construction Corporation (PNCC). In 1985, the National Transportation Planning Project (NTPP) reviewed the proposed Metro Manila Expressway (MME) in comparison with the development of Circumferential Road 5 (C-5). Again, in 1989, PNCC commissioned the University of the Philippines Transport Training Center (UPTTC) to update the study as tollway, now known as the Metro Manila Tollway (MMT), in the light of the increasing traffic congestion in the area.

The heavy traffic congestion in the inner area of Metro Manila (inside C-4 or EDSA) needs strengthening of the road network to improve the situation. Important missing road links are under various stages or implementation. Due however, to the heavy roadside developments, widening of existing primary roads are expensive and difficult. The high rate of increase in the transport demand will saturate the road network in the very near future unless expansion of the road network is undertaken.

The establishment of an urban expressway system for Metro Manila and the conduct of a detailed feasibility study of identified priority section is urgently needed to cope up with transport problems. With this view, the Government of the Philippines (GOP) has decided to undertake "the Feasibility Study on Metro Manila Urban Expressway System (the Study)". GOP through Department of Public Works and Highways (DPWH) has sought a technical assistance from the Government of Japan (GOJ) for the Study in May 1990.

In response to the request of GOP, GOJ has decided to provide a technical assistance for the conduct of the Study and exchanged the Notes Verbals with GOP concerning the implementation of the Study. Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs of GOJ, has organized and dispatched a Study Team to the Philippines on March 25, 1992 in accordance with the Implementing Arrangement signed on October 31, 1991 between DPWH and JICA Preliminary Survey Mission.

## 1.2 OBJECTIVES OF THE STUDY

The objectives of the Study are as follows:

- Master plan study shall be conducted on the Intra-Urban Expressway Network System in Metro Manila to select high priority corridors in the system, taking into consideration transportation and infrastructure development plans in this region.

- Feasibility study shall be undertaken on the high priority corridors of the system taking into consideration the resource implication, both physical and financial.

## 1.3 STUDY AREA

The study area shall cover the whole of Metro Manila.

## 1.4 STUDY FRAMEWORK

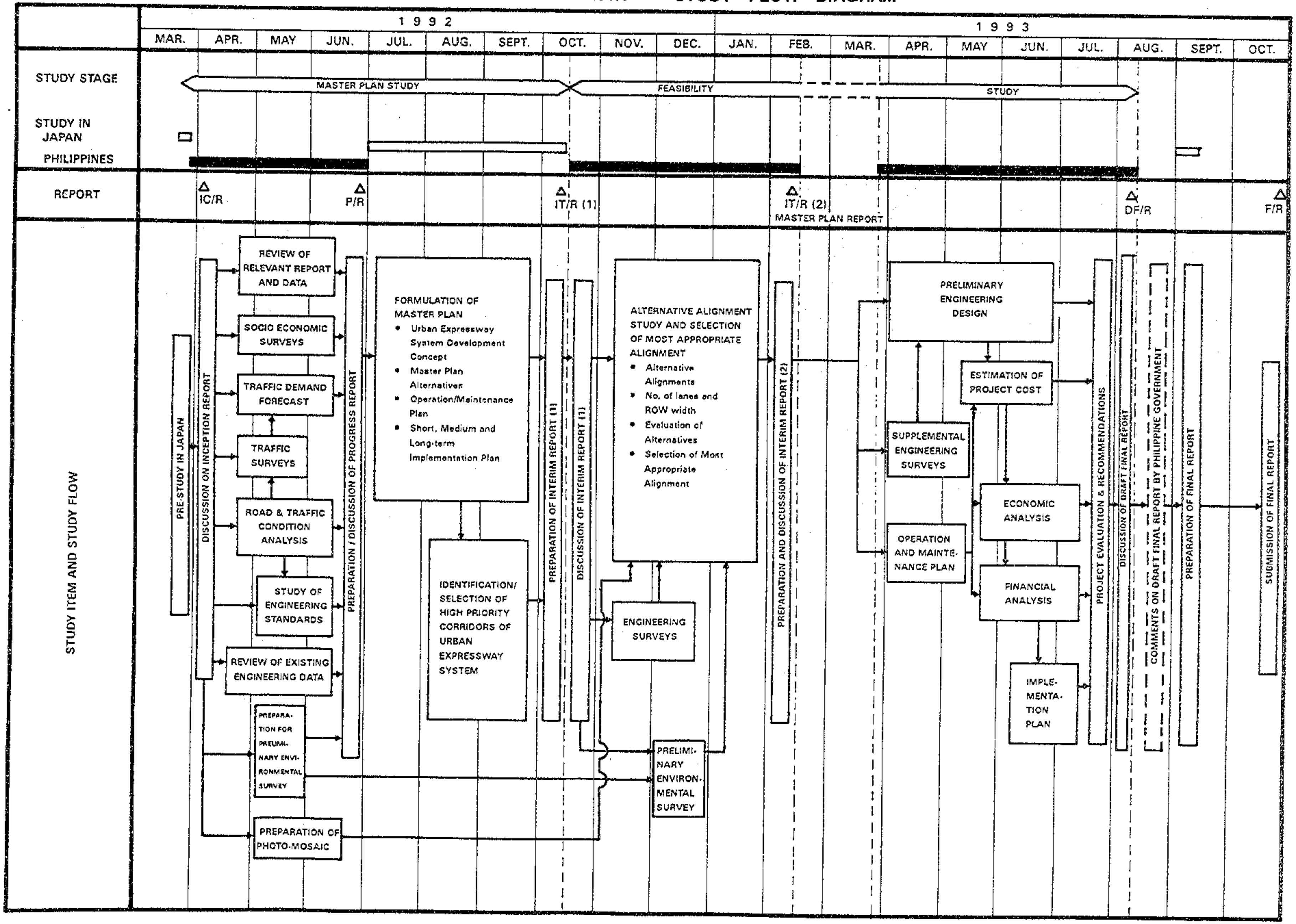
The study will be carried out in two stages, namely:

- Master Plan Study
- Feasibility Study on High Priority Corridors

The study flow diagram is presented in Figure 1.4.1. Major study items, major outputs and time frames are summarized as follows:

| STUDY STAGE | STUDY IN | MAJOR STUDY ITEMS | MAJOR OUTPUTS | REPORTS | TIME FRAME |
|---|---|---|---|---|---|
| Pre-Study | Japan | • Review of Data<br>• Establishment of Study Direction and Methodology | • Basic Study Policy/Direction<br>• Methodology | • IC/R | March, 1992 |
| Master Plan Study | Philippines | • Socio-economic survey<br>• Road/Traffic Conditions Analysis<br>• Traffic Demand Forecast<br>• Study of Engineering Standards<br>• Preparation of Photo-mosaic | • Future Traffic<br>• Existing Transport Problems<br>• Needs of Urban Expressway<br>• Conceptual Plan of Expressway System | • P/R | April, 1992 to June 1992 |
| | Japan | • Formulation of Master Plan<br>• Selection of High Priority Corridors | • Urban Expressway System Master Plan<br>• Short, Medium Long-Term Implementation Plan<br>• High Priority Corridors | • IT/R (1) | July, 1992 to Oct. 1992 |
| Feasibility Study on High Priority Corridors | Philippines | • Alternative Alignment Study<br>• Engineering Surveys<br>• Preliminary Environmental Survey | • Most Appropriate Alignment for Each Corridor | • IT/R (2)<br>• Final Master Plan Report | Oct. 1992 to Feb. 1993 |
| | Philippines | • Preliminary Engineering Design<br>• Economic/Financial Analysis<br>• Project Evaluation<br>• Implementation Plan | • Plan and Profile<br>• Project Cost<br>• Feasibility of the Project<br>• Conclusions<br>• Recommendations<br>• Implementation Plan | • DF/R | Apr. 1993 to Aug. 1993 |
| Preparation of Final Report | Japan | • Revision/Modification of Draft Final Report | • Final Report | • F/R | Sept. 1993 to Oct. 1993 |

FIGURE 1.4.1 STUDY FLOW DIAGRAM



## 1.5 ORGANIZATION FOR EXECUTING THE STUDY

The Study was undertaken jointly by the JICA Study Team and the DPWH Counterpart Team. The Study Team was guided by the Inter-agency Steering Committee and the JICA Advisory Committee. The organization chart is shown in Figure 1.5.1.

The members participated in the Study are listed below:

<u>Inter-agency Steering Committee</u>

| | | |
|---|---|---|
| Chairman | Teodoro T. Encarnacion | DPWH |
| Member | Manuel M. Bonoan | DPWH |
| Member | Jose C. Pendoza (Mar. '92-Mar. '93) | DPWH |
| Member | Jose F. Almeda (Apr. '93-Sep. '93) | DPWH |
| Member | Bienvenido C. Leuterio | DPWH |
| Member | Manuel B. Mapa (Mar. '92-Apr. '93) | DPWH |
| Member | Clarita A. Bandonillo (May-Sep. '93) | DPWH |
| Member | Godofredo Z. Galano | DPWH |
| Member | George Esguerra | DOTC |
| Member | Robert C. Nacianceno | MMA |
| Member | Miguel L. Añonuevo (Mar.-Dec. '92) | PNR |
| Member | Antonio C. Garcia (Jan.-Sept. '93) | PNR |
| Member | Ryogi Hagiwara (Mar. '92-July '92) | DPWH |
| Member | Yukihiro Tsukada (July '92-Sep. '93) | DPWH |

<u>DPWH Counterpart Team</u>

| | |
|---|---|
| Team Leader | Elisa P. Joson |
| Highway Engineer | Eden G. Miro |
| Highway Engineer | Flordeliza S. Barcelona |
| Traffic/Transport Economist | Florencio Rey M. Alano |
| Researcher | Hermilayda M. Agor |
| Researcher | Jocelyn P. Sibayan |
| Researcher | Richard C. Santillan |
| Secretary | Isobelle V. Valmonte |
| Word Processor | Virgilio A. Venturanza, Jr. |
| Word Processor | Allan M. Laurio |
| Draftsman | Jessica R. Lozano |
| Draftsman | Wilfredo A. Buce |
| Draftsman | Isagani C. Rivera |
| Draftsman | Armando L. Ignacio |
| Draftsman | Alfredo R. Reyes |
| Draftsman | Aniceto C. Sta. Rita |

<u>JICA Study Team</u>

| | |
|---|---|
| Team Leader/Highway Planner | Tsuneo Bekki |
| Deputy Team Leader/Transport Planner | Shizuo Iwata |
| Deputy Team Leader/Highway Engineer | Mitsuo Hatakeyama |
| City/Regional Planner | Masato Koto |
| Environmental Specialist | Ramon P. Abracosa |
| Traffic Analyst | Takashi Okamura |
| Geodetic Engineer | Chifuyu Horiuchi |
| Structural Engineer | Takashi Okumura |
| Geo-technical Engineer | Ken Kusano |
| Cost Estimate/Construction Expert | Yasuaki Muramoto |
| Transport Economist | Takashi Shoyama |

JICA Advisory Committee

| | |
|---|---|
| Chairman | Hideo Tsuji (March 1992 - May 1992) |
| Chairman | Makoto Nakamura (June 1992 - Oct. 1993) |
| Member | Yukihira Tsukada (March 1992 - June 1992) |
| Member | Hiroyoshi Miyauchi (March 1992 - Oct. 1993) |

JICA Headquarters

| | |
|---|---|
| JICA Project Officer | Fumio Ishikawa (March 1992 - April 1993) |
| JICA Project Officer | Toshihisa Hasegawa (May 1993 - Oct. 1993) |

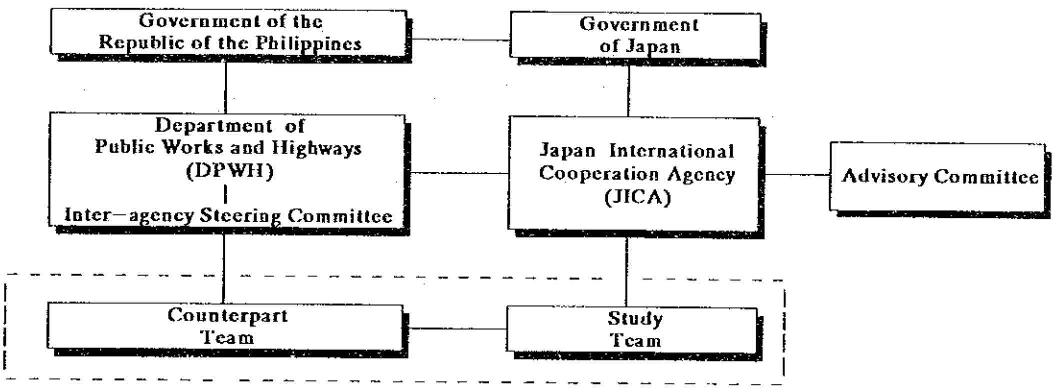



FIGURE 1.5.1 **ORGANIZATION CHART**

## 1.6 REPORTS

### 1.6.1 Reports Prepared

The following reports were prepared and submitted to DPWH during the course of the study:

- Inception Report — April 1992
- Progress Report — June 1992
- Interim Report (1) — October 1992
- Master Plan Report — February 1993
- Interim Report (2) — February 1993
- Draft Final Report — August 1993

### 1.6.2 Organization of the Final Report

The final report is organized as follows:

| | | |
|---|---|---|
| Volume I | : | EXECUTIVE SUMMARY |
| Volume II | : | MAIN TEXT (MASTER PLAN) |
| Volume III | : | MAIN TEXT (FEASIBILITY STUDY) |
| Volume IV | : | APPENDICES |
| Volume V | : | DRAWINGS |

This report: Volume III, MAIN TEXT of the feasibility study, consist of 12 chapter as shown below:

CHAPTER 1 INTRODUCTION gives the background, objectives, scope and organization of the study,

CHAPTER 2 EXPRESSWAY CORRIDORS SELECTED FOR F/S presents brief descriptions subject corridors,

CHAPTER 3 PHYSICAL FEATURES OF METRO MANILA gives topographic and geological condition of Metro Manila and engineering surveys conducted for the study,

CHAPTER 4 SELECTION OF ROUTE ALIGNMENT presents alternative alignments, evaluation and selected alignment for each expressways

CHAPTER 5 CONSTRUCTION PHASING OF FIRST STAGE EXPRESSWAYS presents construction phasing alternatives and the recommended construction phasing. Succeeding chapters were discussed based on the recommended construction phasing,

CHAPTER 6 TRAFFIC FORECAST gives expressway traffic by toll level, ramp and interchange traffic and characteristics of expressway traffic,

CHAPTER 7 PRELIMINARY DESIGN gives preliminary engineering study outputs,

CHAPTER 8 EXPRESSWAY OPERATION, MANAGEMENT AND MAINTENANCE presents systems and organization for operation, management and maintenance of expressways,

CHAPTER 9 COST ESTIMATES gives estimated investment cost and operating/ maintenance costs,

CHAPTER 10 PROJECT EVALUATION presents economic, financial and technical evaluation of the project including environmental impacts,

**CHAPTER 11** **PROJECT IMPLEMENTATION** discusses implementing issues and implementation program,

**CHAPTER 12** **RECOMMENDATIONS** presents recommendations for smooth implementation of the project.

# CHAPTER 2

## SELECTED HIGH PRIORITY CORRIDORS FOR F/S

# CHAPTER 2

## SELECTED HIGH PRIORITY CORRIDORS FOR F/S

### 2.1 METRO MANILA URBAN EXPRESSWAY SYSTEM (MMUES)

Metro Manila Urban Expressway System (MMUES) is composed of two (2) circumferential expressways, namely Route C-3 and Route C-5, and 11 radial expressways. Routes C-3 and C-5 are located 6 to 8 kms. apart and are connected with each other by six (6) radial expressways at an interval of 4 to 8 kms. In the area inside Route C-3, three (3) radial expressways are extended towards Manila CBD. In the area outside Route C-5, eight (8) radial expressways are extended towards outer area of Metro Manila, three (3) in the south, two (2) in the east and three (3) in the north.

MMUES is presented in Figure 2.1.1 with Metro Manila Tollway which is regarded as committed and to be implemented by the Philippine National Construction Corporation (PNCC).

MMUES includes about 150 kms. of expressways, 17 interchanges, and 61 each of on-ramps and off-ramps.

Characteristics of MMUES are summarized as follows:

- MMUES intends to contribute to the strengthening of Metro Manila major road network from traditional radial/circumferential pattern to north-south ladder pattern. Although the expressway routes are to be constructed mainly along the existing road space, planning intention is placed to strengthen north-south axes to meet the urban development trend and policy.

- MMUES intends to strengthen the major road network in a more balanced manner, while at the same time it contributes to relieving traffic concentration in the inner city and especially along EDSA.

- MMUES intends to meet transport development needs both from short-term as well as from long-term viewpoints. R-3/C-3/R-9 axis with branches is expected to directly meet the present urban transport demands, while R-2/C-5/R-8 axis is expected to generate organized urban/transport activities in the outer areas where urbanization is in rapid progress.

- MMUES will be integrated effectively with existing/planned major roads at strategic points so that road users can have alternative high quality services. This will vitalize socio-economic activities in Metro Manila.

- MMUES will be constructed in such a way that future requirements of construction space by urban rail transit such as LRT and PNR could be adequately satisfied.

Outline of expressways comprising of MMUES is presented in Table 2.1.1.

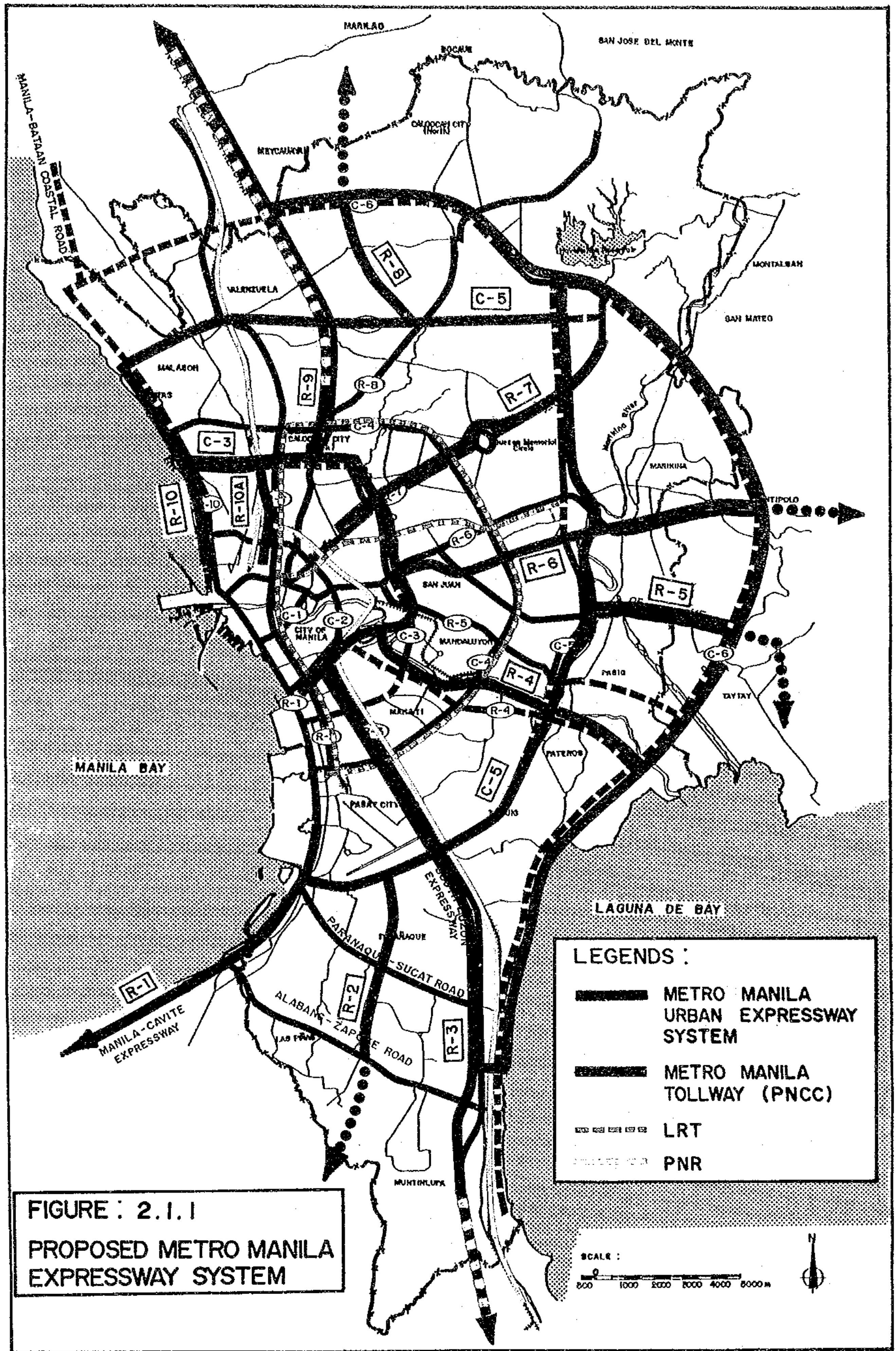



FIGURE : 2.1.1
PROPOSED METRO MANILA EXPRESSWAY SYSTEM

TABLE 2.1.1 OUTLINE OF EXPRESSWAYS COMPRISING OF MMUES

| | ROUTE NO. | ROUTE LOCATION | LENGTH (KM.) | ELEVATED OR AT-GRADE | STATUS OF AT-GRADE ROAD | NOTES |
|---|---|---|---|---|---|---|
| Circumferential Expressways | C-3 | • Inner Circumferential Expressway<br>• Starts at Quirino Avenue Adriatico intersection and follows Quirino Ave., PNR, and R. Magsaysay Blvd. up to Aurora Blvd. From Auroa Blvd. to R-10, follows more or less alignment of at-grade C-3 | 17.5 | • All elevated | • At-grade C-3 from A. Mabini St. to Araneta Ave. is still incomplete. Sections from A. Mabini St. to Rizal Ave. Ext. and from Rizal Ave. Ext. to Araneta Ave. is scheduled to be completed by 2000 and 1995, respectively | • Major alignment alternatives are along at-grade C-3 or along San Juan River |
| | C-5 | • Central Circumferential Expressway<br>• Follows more or less the alignment of at-grade C-5 | 45.8 | • At-grade from R-1 to R-4 and from Luzon Ave. to R-10<br>• Elevated from R-4 to Republic Ave. | • Still incomplete except section from Pasig River to Commonwealth Ave.<br>• Sections from R-1 to SLE and from Commonwealth Ave. to R-10 are scheduled to be completed by 2000, section from SLE to R-4 by 1995 | • Sections from R-1 to SLE, from Commonwealth Ave. to NLE and from NLE to R-10 are proposed to be implemented by BOT Scheme |
| Radial Expressways | R-1 | • Along Manila Bay Coastal Line<br>• Existing R-1 Ext. itself is utilized | – | (• Completed as at-grade road) | | • PEA has a plan to convert this to a tollway |
| | R-2 | • New link. Passes through about the center between South Luzon Expressway (SLE) and R-1 Extension | 7.4 | • At-grade or elevated | • No at-grade road | • At-grade expressway is 60-m ROW can be acquired if not, elevated expressway<br>• Candidate for connection with future inter-city expressway |
| | R-3 | • Called as Manila South Tollway (MST)<br>• Along South Super Highway (SSH) and SLE from Quirino Ave. to Alabang | 20.8 | • All elevated except 1-km section near NAIA due to the air navigational clearance | • Both SSH and SLE are existing | • Major alignment alternatives, over PNR ROW or over SSH |
| | R-4 | • Along Pasig River from Route C-3 to Route C-5 | 7.2 | • All elevated | | • Mostly along the southern bank of the River. Partially the northern bank utilized |
| | R-5 | • Along Ortigas Ave. Ext. from C-5 to C-6 | 5.3 | • All elevated | • Ortigas Ave. Ext. is being widened and completed by 1995 | • Ortigas Ave. Ext.'s ROW is not wide enough, double deck type of structure needed<br>• Candidate for connection with future inter-city expressway |
| | R-6 | • Along Santolan Road and Marcos Highway Route C-3 to Sumulong Highway | 12.0 | • All elevated | • Santolan Road has to be widened | • Careful slignment study especially inside EDSA needed<br>• Candidate for connection with future inter-city expressway |
| | R-7 | • Along Quezon Ave. and Commonwealth Ave. from Wlecome Rotonda to Capitol Hills | 12.4 | • Elevated from Welcome Rotonda to Quezon Memorial Circle<br>• Quezon Memorial Circle be underpassed<br>• At-grade along Commonwealth Ave. | • Both Quezon Ave. and Commonwealth Ave. existing with wide ROW | |
| | R-8 | • Along Mindanao Ave. from C-5 to C-6 | 4.7 | • At-grade or elevated | • Mindanao Ave. between C-5 and C-6 is still missing and to be completed by 2000 | • At-grade expressway, if 60-m ROW is acquired<br>• Candidate for connection with future inter-city expressway |
| | R-9 | • Along A. Bonifacio Ave. and North Luzon Expressway from C-3 to about 0.5 km north of toll plaza | 3.8 | • All elevated | • Both A. Bonifacio and NLE existing | • ROW of A. Bonifacio is rather narrow, a double deck type of structure may be required |
| | R-10 | • Along at-grade R-10 from Moriones Ave. to C-5 | 8.6 | • All elevated | • 25-m portion of 50-m ROW completed<br>• Ultimate stage will be completed by 2010 | • One half of ROW occupied by squatters. Relocation of them needed |
| | R-10A | • Along Abad Santos Ave. and PNR North Line from C-1 to C-3 | 4.0 | • All elevated | • Abad Santos Ave. is existing | • Relocation of squatters along PNR needed. |
| | | TOTAL | 149.5 | | | |

## 2.2 STAGE DEVELOPMENT PLAN OF MMUES

Three alternatives of stage development were studied during Master Plan Stage. Recommended was the traffic demand oriented plan comprising of three stages as shown in Figure 2.2.1. The First Stage of MMUES is composed of the following six expressways:

First Stage Expressways

- Expressway Route C-3
- Expressway Route R-3
- Expressway Route R-4 from Expressway Route C-3 to Makati Access Ramp
- Expressway Route R-7
- Expressway Route R-9
- Expressway Route R-10 from Moriones Street to Expressway Route C-3

## 2.3 EXPRESSWAY CORRIDORS SELECTED FOR F/S

The First Stage Expressways were selected for feasibility studies. Outline of the First Stage Expressways is described hereunder:

Expressway Route C-3

This route serves as an inner circumferential expressway and distributes traffic to/from radial expressways.

The route starts at Quirino Ave./Adriatico intersection and follows Quirino Ave. towards the east up to about Paco Station of PNR. From that point, the route extends towards northeast direction following the existing PNR line, or San Juan River or an at-grade C-3 up to Aurora Blvd. Then, follows Araneta Ave. up to Sgt. Rivera St. At the intersection between Araneta Ave. and Sgt. Rivera St., the route goes towards the west until it merges with Expressway Route R-10 which is the end of the route.

The route has an approximate length of 16.0 to 17.5 kms. depending on an alignment to be selected and will be an elevated expressway.

The expressway crosses over LRT Line-1 at Taft Ave., LRT Line-2 at E. Rodriguez Ave. and LRT Line-1 at Rizal Ave. Extension.

The route between Araneta Ave. and R-10 utilizes ROW of at-grade C-3 where DPWH is encountering difficulty in acquiring ROW. ROW acquisition for at-grade C-3 will be one of the key factors to realize this route, therefore, should be expedited.

The interchange between this route and Route R-7 (Quezon Avenue-Commonwealth Ave. Route) will be a 4-leg interchange which requires ROW acquisition of wide area. All other interchanges with radial expressways are planned to be 3-leg interchanges.

Expressway Route R-3

This route is also called as Manila South Tollway (MST) and located along South Super Highway (SSH) and South Luzon Expressway (SLE). It starts at the intersection between Quirino Ave. and SSH, then runs towards the south up to Alabang Interchange of SLE. Total length of the route is approximately 21 kms.

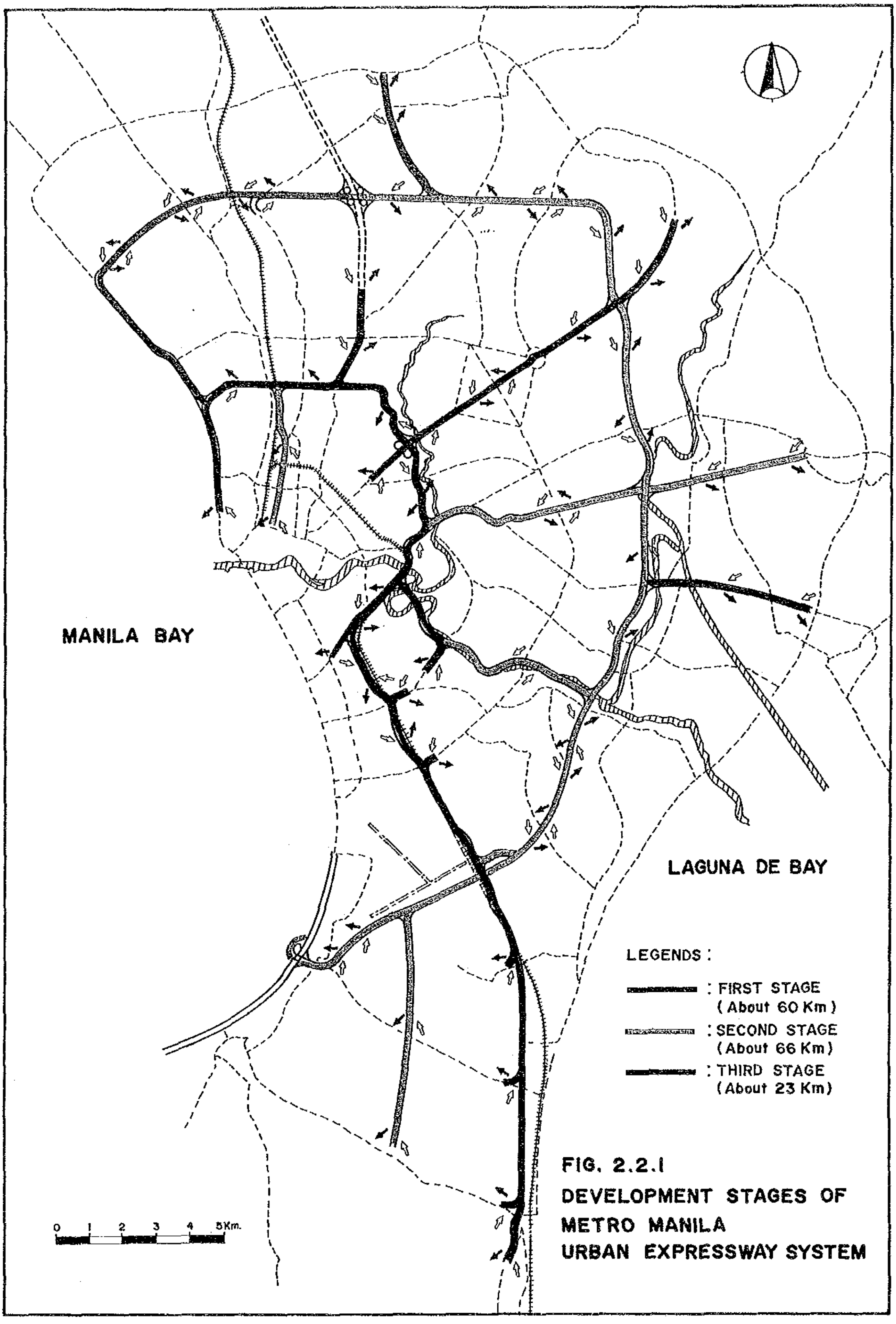



FIG. 2.2.1
DEVELOPMENT STAGES OF METRO MANILA URBAN EXPRESSWAY SYSTEM

There are two options for its alignment, one is to utilize PNR ROW and the other SSH and SLE ROW. Most of the sections of this route will be elevated over PNR or SSH/SLE.

This corridor is one of the most heavily traffic loaded ones. The route will greatly improve accessibility to Makati CBD. Connections with EDSA and C-5 should be carefully studied. The former has physical constraints due to the existing MSDR interchange and the latter due to proximity to NAIA.

Expressway Route R-4

The route runs along Pasig River from Route C-3 to Route C-5 for an extension of about 7.2 kms. and is constructed as an elevated structure.

Included in STAGE-1 (or the high priority section) is the section from Expressway Route C-3 to Makati Access Ramp for an extension of about 2.5 kms. The rest of the sections of this expressway is proposed to be implemented in STAGE-2.

It will be constructed mostly along the southern bank of Pasig River, however, the northern bank will be partially utilized along Coronado St. in Mandaluyong.

Factories, warehouses and residential houses have been built up to the edge of the river banks and squatters have also been settled along the banks, therefore, social impact study should be carefully undertaken.

Access ramp to Makati CBD from this route will be very important, which will branch off at about Sta. Ana Race Track, then go over South Ave. and be extended close to Buendia Ave.

Expressway Route R-7

This corridor is one of the most heavily traffic loaded ones in Metro Manila. Particularly, private trip demand along this corridor is expected to increase sharply.

The route starts at Welcome Rotonda and goes along Quezon Ave. and Commonwealth Ave. up to Batasang Pambansa. The route has a length of about 12.4 kms.

The expressway will be elevated from Welcome Rotonda up to Quezon Memorial Circle. It will pass under Quezon Memorial Circle and be at-grade along Commonwealth Ave. with viaducts at intersections with cross roads.

Expressway Route R-9

The route is connected with North Luzon Expressway and serves as a vital link to distribute traffic from NLE into area of Metro Manila or vis-a-vis.

The route starts at Expressway Route C-3, goes over A. Bonifacio Ave. and NLE and ends at about 0.5 km north of NLE Toll Plaza. It has a length of about 4.0 kms.

A. Bonifacio Ave. has rather narrow ROW (28 meters), therefore, a double deck type of structure may have to be planned.

Expressway Route R-10

The route will be constructed over at-grade R-10 from Moriones Ave. to C-5 for an extension of about 8.6 kms. The priority section selected for F/S is the section from Moriones Ave. to Expressway Route C-3 which has an extension of about 3.3 kms.

The route is a vital link to serve for traffic to/from Manila International/Domestic Harbors.

At-grade R-10 has a wide ROW of 50 meters, however, one half of ROW has been occupied by squatters. Relocation of affected people will have to be done so as to minimize social problems.

# CHAPTER 3

# PHYSICAL FEATURES OF METRO MANILA AND ENGINEERING SURVEYS CONDUCTED

# CHAPTER 3

# PHYSICAL FEATURES OF METRO MANILA AND ENGINEERING SURVEYS CONDUCTED

## 3.1 PHYSICAL FEATURES OF METRO MANILA

### 3.1.1 Topography

Metro Manila is located at about latitude 14°35' north and longitude 121°00' east. The westside is contiguous to Manila Bay; the northwest side is a low and damp area with widespread fish ponds; the northside is the Central Plains of Luzon; and the eastside from northeast is the Sierra Madre Mountain range and the southeastside is the Laguna de Bay.

Metro Manila is topographically categorized into two, namely the hilly land of Guadalupe Plateau (or Plateau), and flat lowlands which are the Manila Coastal Margin, the Marikina Valley and the Laguna Lowland (see Figure 3.1.1).

The Guadalupe Plateau, which traverses the center of Metro Manila, north to south, has a breadth of about 15 kilometers in its northern part, about five kilometers by the Pasig River, and about eight kilometers in the south for an area size of about 395 square kilometers or 62% of Metro Manila. Ground elevations range from 20 to 100 meters from the mean sea level.

The Manila Coastal Margin is a strip of lowland consisting of sand, gravel, silt and clay and extending for about 30 kilometers north to south along Manila Bay with the maximum breadth of about six kilometers by the Pasig River and the minimum width of about one kilometer at the southern end, for the size of 102 square kilometers or 16% of Metro Manila in its western part. Ground elevation range from 0 to 10 meters from the mean sea level.

The Marikina Valley constitutes 18% of Metro Manila land area (or 118 square kilometers) with a length of about 25 kilometers and a width ranging from about two kilometers upstream to about eight kilometers downstream. Ground elevations range from 0 to 20 meters from the mean sea level. The Laguna Lowland is a 21-square kilometer land representing 3% of Metro Manila with a length of about 17 kilometers and a width ranging from one to 1.5 kilometers and spreads along Laguna Bay on both sides of the estuary of the Marikina River. Ground elevations range from 0 to 10 meters from the mean sea level.

### 3.1.2 Geology

Geology and geologic structure of Manila City and adjoining areas are shown in Figure 3.1.2.

The Guadalupe Plateau is of soft rocks presumably deposited in the late Tertiary or the early Quarternary period and hardened with the admixture of volcanic ash, pebbles and sand. Often seen in this Plateau are the strata, particularly shallow layers, in which sand of non-volcanic origin is predominant and which are somewhat hardened by the presence of silica and clay in the sediments. Thick layers of rudaceous tuff with a well balanced composition are often seen particularly in Quezon City through Novaliches and the vicinity, as well as in a part of Bulacan.

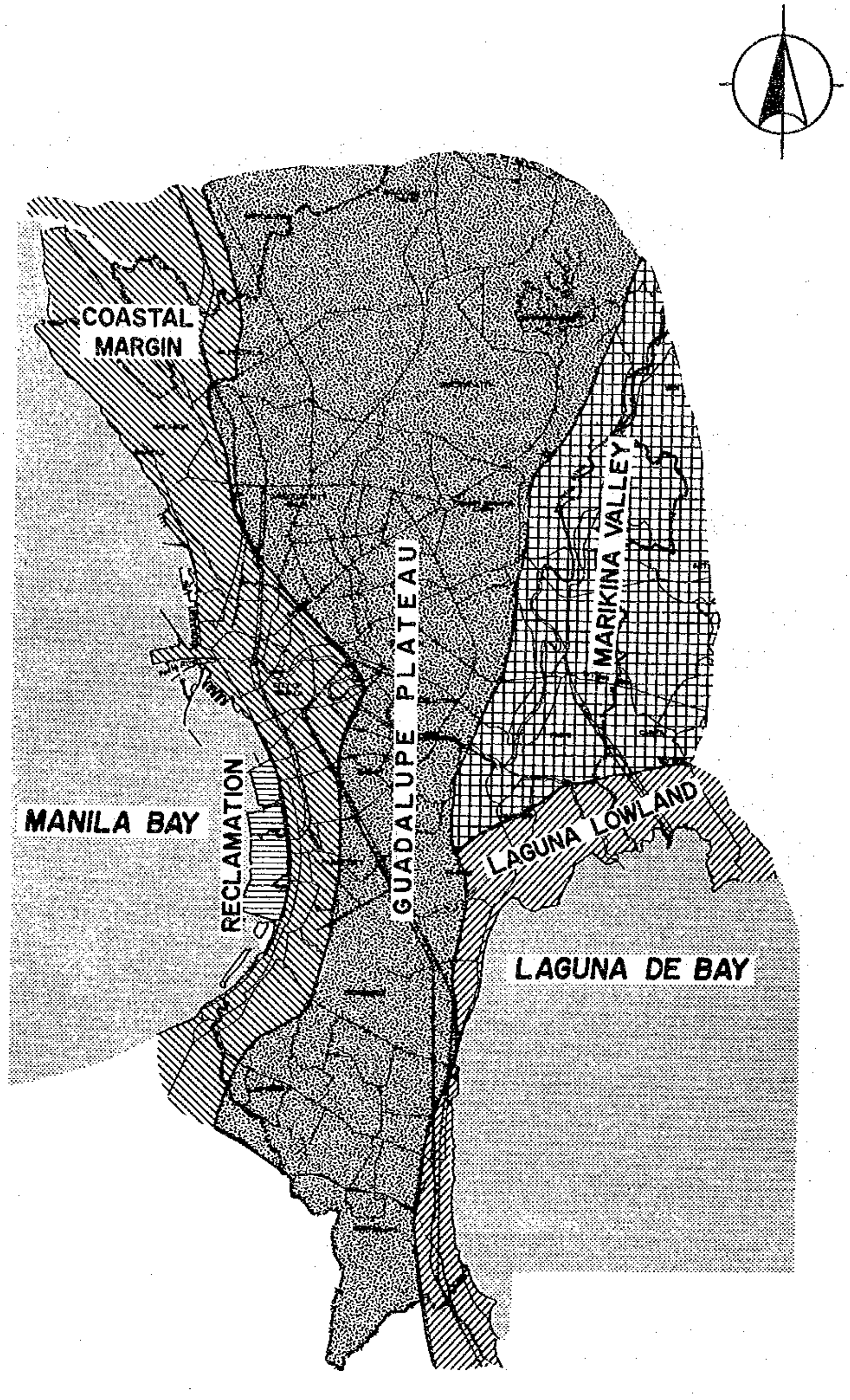



FIGURE 3.1.1 LAND STRUCTURE OF METRO MANILA

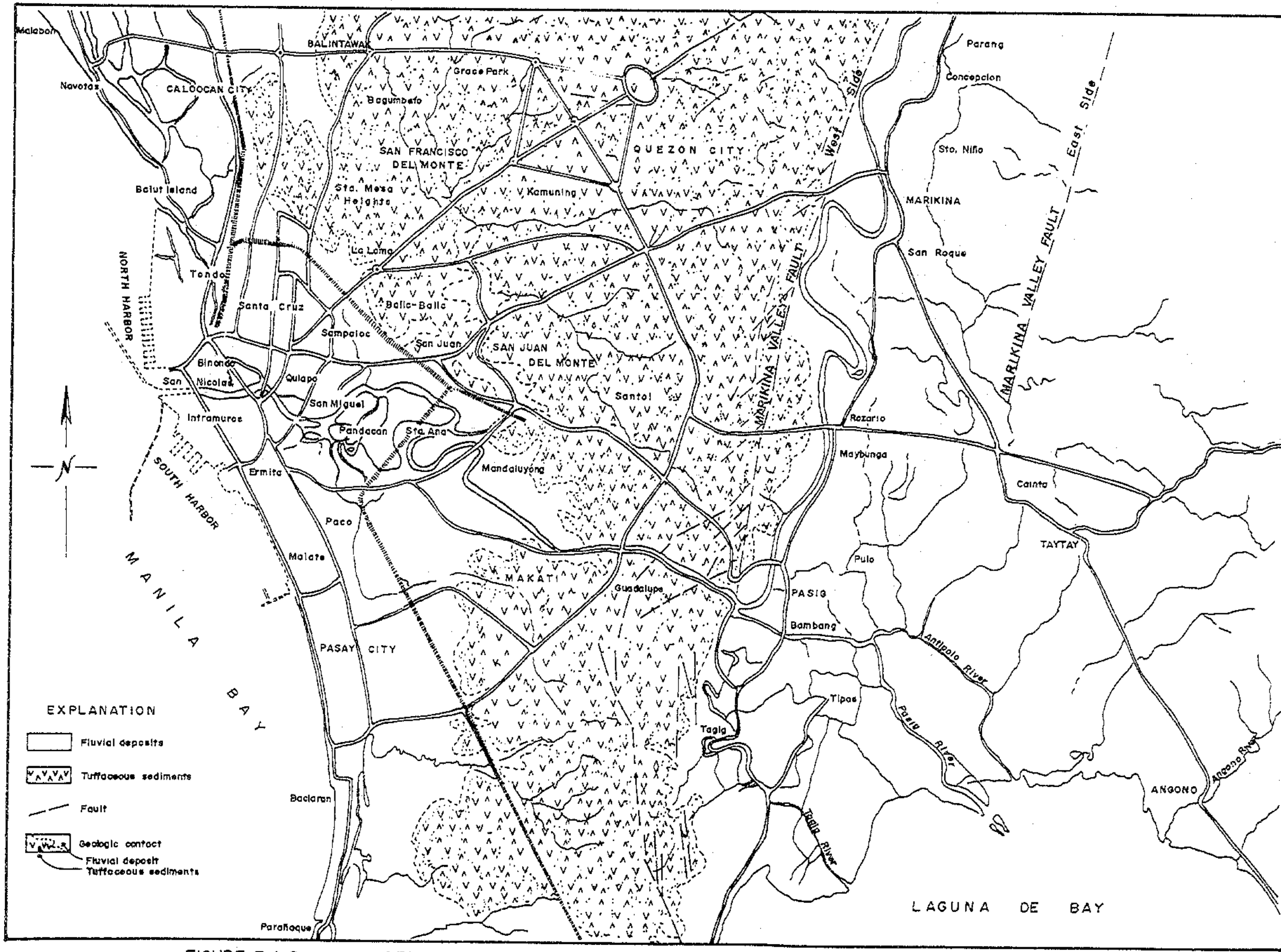



FIGURE 3.1.2 GEOLOGY AND GEOLOGIC STRUCTURES OF MANILA AND ADJOINING AREAS

SCALE

METERS

The Manila Coastal Margin, the Marikina Valley and the Laguna Lowland are the alluvial land consisting of sand, gravel, silt and clay.

Based on the available boring data and field reconnaissance, soil profiles along the west-east and the north-south cross sections were roughly estimated and presented in Appendix 3.1.1.

### 3.1.3 Climate

Metro Manila has two seasons; dry season from November to April and wet season from May to October mainly caused by Southwest Monsoon, which comes from the China Sea.

Wind

The high atmospheric pressure are that predominates over the continent of Asia during the cold months of November to February causes the northeast monsoon which prevails over Metro Manila. During the months of March, April and May, the east trade wind is observed most frequently. From June to October, the Southwest Monsoon prevails over Metro Manila.

Rainfall

The pronounced rainy season is from June to October. There is approximately 75% of total rainfall in a year during the rainy season. The highest rainfall is about 480 mm/month in August and lowest is less than 10mm/month in February.

Sangley Point situated in the south of Manila has the annual average rainfall of 1,600 mm. and Montalban situated in the north of Manila has an average of 2,700 mm. In Quezon City where the Project is located, the average rainfall is 2,300 mm.

Thunderstorms are observed between April and November and their average frequency is eight (8) days per month.

Temperature

The highest temperature ever recorded was 38.6°C in May 1915 and lowest was 14.5°C in January 1914. The warmest month is May with average temperature of 29.6°C, which gradually decreases to 25.9°C, in January, the coolest month. The temperature begins to increase in February until it reaches its peak in May.

Humidity

Average humidity of 87% in September is the highest in a year and that of 67% in April is the lowest.

Tropical Cyclones

The mean percentage frequency of tropical cyclone passing Manila ranges from 0 to 10% of the 19 cyclones that are expected to enter the Philippine area, that is 0 to 2 cyclones are expected to occur from May to November.

## 3.2 ENGINEERING SURVEYS CONDUCTED

Following engineering surveys were conducted:

- Preparation of aerial photo-mosaics
- Topographic surveys
- Geo-technical surveys

### 3.2.1 Preparation of Aerial Photo-mosaics

For the purposes of the alignment study and the preliminary engineering study of the expressway corridors selected for a feasibility study, the aerial photography was undertaken and photo-mosaics were prepared as shown below:

- New aerial photography

  Aerial photographs were taken in September 1992 covering the area of about 250 square kilometers. Photo scale was 1 : 12,500.

- Semi-controlled photo-mosaics

  Semi-controlled photo-mosaics at a scale of 1 : 12,500 were prepared mainly for the purpose of the alignment study. The area coverage is shown in Appendix 3.2.1.

- Semi-controlled photo-mosaics along expressway corridors selected for a feasibility study.

Semi-controlled photo-mosaics at a scale of 1 : 2,500 were prepared for the purpose of the alignment study as well as the preliminary engineering study. Both print copies and reproducible mylar films were produced and the latter were utilized as base maps for a plan and profile drawing. Index map of photo-mosaics is attached in Appendix 3.2.1.

### 3.2.2 Topographic Surveys

Aerial photo-mosaics were used as base maps for engineering studies. To supplement aerial photo-mosaic information, following ground surveys were undertaken to obtain information on ground elevations:

- River cross-section survey: 12 cross-sections were surveyed, 6 of Pasig River and 6 of San Juan River.

- Profile leveling survey: Spot elevations along expressway corridors selected for a feasibility study (about 61.5 km) were surveyed.

- Spot elevation survey at interchange sites: Spot elevation within an interchange area and an access ramp area were surveyed at the following sites:

  - Routes C-3/R-3 interchange
  - Routes C-3/R-4 interchange
  - Routes C-3/R-6 interchange
  - Routes C-3/R-7 interchange

- Routes C-3/R-9 interchange
- Routes C-3/R-10 interchange
- EDSA Access Ramp along Route R-3
- Bicutan Access Ramp along Route R-3
- Sucat Access Ramp along Route R-3
- Alabang Access Ramp along Route R-3

### 3.2.3 Geo-technical Surveys

The following geo-technical surveys and laboratory tests were conducted along the expressway corridors selected for a feasibility study:

- Drilling work for 17 holes with an aggregate length of 360 meters along selected corridors in order mainly to determine depth of bearing strata for foundations of structure.

- Standard penetration test at 2 meter interval for 360-meter drilled length.

- Disturbed sampling was done for each soil layer and/or at every 5 to 6 meters and 75 samples in total were collected.

- Laboratory test were conducted for collected 75 samples comprising of the following:

    - Specific gravity
    - Natural moisture content
    - Liquid limit and Plastic limit
    - Grading (sieve analysis)

Location may of boring holes, boring logs, and soil profiles along expressway corridors selected for a feasibility study which were developed based on data obtained by this survey and previously conducted borings are presented in Appendix 3.2.2.

# CHAPTER 4

## SELECTION OF EXPRESSWAY ROUTE ALIGNMENT

# CHAPTER 4

# SELECTION OF EXPRESSWAY ROUTE ALIGNMENT

## 4.1 PROCEDURE AND METHODOLOGY FOR SELECTING ROUTE ALIGNMENT

### 4.1.1 Procedure

Several alternative alignments for each expressway corridor were established and evaluated to select the most appropriate alignment in accordance with the following procedure (see Figure 4.1.1):

STEP-1: <u>Preparatory Work</u>

Field reconnaissance was undertaken along the expressway corridor to identify available public space and control points, to assess land use and urban development conditions and to have an idea for possible alignment. Topographic maps (scale 1:10,000) and photo-mosaic (scale 1:12,500) were also examined.

STEP-2: <u>Identification of Available Public Space</u>

All available public spaces within the corridor such as roads, PNR, rivers and government lands were identified based on the activities in STEP-1.

STEP-3: <u>Identification of All Control Points</u>

All control points within the corridor were identified based on the activities in STEP-1 and plotted on the 1/10,000 topographic maps.

STEP-4: <u>Establishment of Alternative Alignments</u>

Based on the findings of STEP-2 and STEP-3, several alternative alignments were established, focusing on the maximum utilization of public spaces.

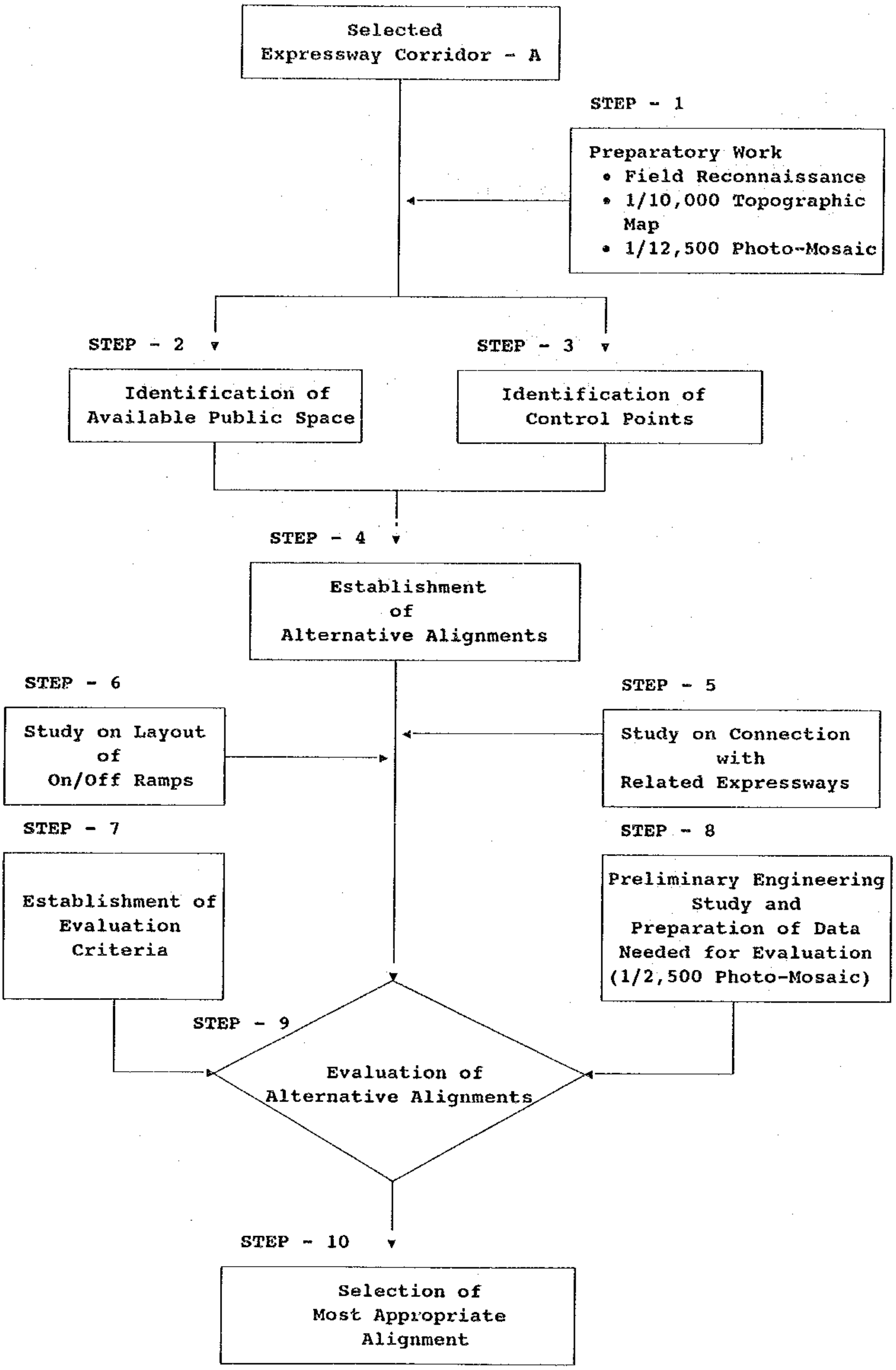
STEP-5: <u>Study on Connection with Related Expressways</u>

An alignment of related expressways which are to be connected with the expressway under study was roughly studied and a location of an interchange was selected.

STEP-6: <u>Study on Layout of On/Off Ramps</u>

On/Off ramp layout was studied in due consideration of interchange interval, on/off ramp interval and at-grade roads to be accessed.

FIGURE 4.1.1 PROCEDURE FOR SELECTING MOST APPROPRIATE ROUTE ALIGNMENT



STEP-7: <u>Establishment of Evaluation Criteria</u>

Evaluation factors and index to be used for each factor were selected and weight of each factor was determined.

STEP-8: <u>Preparation of Data Needed for Evaluation</u>

Preliminary engineering study was conducted for each alternative alignment in order to prepare data for evaluation.

STEP-9: <u>Evaluation of Alternative Alignments</u>

Each alternative alignment was rated in accordance with evaluation criteria and its ranking was determined.

STEP-10: <u>Selection of Most Appropriate Alignment</u>

Based on the ranking as well as planning/engineering judgment, the most appropriate alignment was selected.

### 4.1.2 Evaluation Criteria

1) Evaluation Factors and Indices

Following evaluation factors were selected (see Table 4.1.1):

a) Expressway network efficiency

An alignment of an expressway should not be evaluated independently, but as one link of an expressway network. Linkage with other related expressways should be well-formed.

To attract more expressway users, on/off ramps should be provided as many as possible, which will also make possible easier and efficient traffic control especially when an expressway is congested or when removal of a vehicle is required due to a traffic accident or a vehicle breakdown.

This factor was evaluated by two sub-factors as follows:

a-1. Linkage with related expressways and appropriateness of an alignment as a part of network (qualitatively evaluated)

a-2. On/Off ramps layout (evaluated by number of on/off ramps)

b) Harmony with at-grade road

This factor was evaluated by three sub-factors as follows:

b-1. Traffic impact on at-grade road due to reduction in number of lanes (when an expressway is constructed over an at-grade road, number of lanes of the latter is usually reduced due to construction of viaduct substructures of which traffic impact on the latter is sometimes extensive. This factor evaluated by "lane reduction rate" and its extension).

b-2. Traffic operation at on/off ramp area (Ramps and at-grade roads are connected with each other by means of intersection or merging/diverging lanes. On/off ramp area's traffic management is quite important to assure smooth traffic flow of not only an expressway but also an at-grade road. This factor was evaluated by number of intersections to be needed. Hence, the more intersections are needed, the more traffic interruption is expected.)

b-3. Impact of grade separation of at-grade roads (Traffic congestion at existing major intersections are getting serious year by year. Grade separations of such intersections might be implemented ahead of an expressway. Design of grade separation project must fully take into account an expressway alignment and an expressway interchange plan so as not to paralyze an expressway project. This impact was evaluated by number of potential intersections along an expressway alignment which might be grade separated prior to an expressway.)

c) Initial Investment Requirement

Initial investment requirement greatly influences economic as well as financial viability of the project. Fund preparation and arrangements with various sources is another important issue. This was evaluated by two sub-factors:

## TABLE 4.1.1 EVALUATION CRITERIA

| EVALUATION FACTOR | EVALUATION SUB-FACTOR | EVALUATION INDEX | WEIGHT | |
|---|---|---|---|---|
| a) Expressway Network Efficiency | a-1. Linkage with related expressways and appropriateness of an alignment as a part of network | • Good, Good/Fair, Fair, Fair/Bad, Bad | 10 | 4 |
| | a-2. On-/Off- ramps layout | • No. of on-/off-ramps | | 6 |
| b) Harmony with at-grade road | b-1. Traffic impact on at-grade road due to reduction in number of lanes | • Lane reduction rate (No. of lanes with expressway/Existing No. of lane) and its length | 10 | 5 |
| | b-2. Traffic operation at on-/off ramp area | • No. of new intersection needed due to construction of a ramp | | 3 |
| | b-3. Impact of grade separation of at-grade roads | • No. of potential intersections which may be grade separated prior to construction of an expressway and which become serious physical constraints for an expressway | | 2 |
| c) Initial Investment Requirement | c-1. Magnitude of construction cost (local and foreign sources of fund) | • Construction Cost | 25 | 15 |
| | c-2. Magnitude of ROW acquisition and compensation cost (basically local fund only) | • ROW acquisition and compensation cost | | 10 |
| d) Social/Environmental Impact | d-1. Social impact on people | • No. of residents affected | 20 | 10 |
| | d-2. Impact on employment and economic activities | • No. of commercial buildings/ factories affected | | 5 |
| | d-3. Traffic pollution (air, noise, and vibration) | • Section length passes through residential areas | | 5 |
| e) Implementation Difficulty | e-1. Difficulty in acquiring lands | • Land areas to be acquired | 25 | 15 |
| | e-2. Difficulty in relocating squatters | • No. of squatter families to be relocated | | 7 |
| | e-3. Necessity of coordination with other agencies in connection with utilization of space | • Required, or not required | | 3 |
| f) Construction Difficulty | f-1. Constructability | • Section length which requires complex structures/construction methods | 5 | 2 |
| | f-2. Traffic management during construction | • Section length where no. of lanes need to be reduced during construction | | 3 |
| g) Soundness of an Alignment | g-1. Soundness of horizontal alignment | • No. of S-shaped curves | 5 | 3 |
| | g-2. Soundness of vertical alignment | • Section length of which gradient is more than 4% | | 2 |
| | | | 100 | 100 |

c-1. Magnitude of construction cost (fund sources can be seeked locally and internationally.)

c-2. Magnitude of ROW acquisition and compensation cost (fund source is basically local)

d) Social/Environmental Impact

This aspect was evaluated by three sub-factors as follows:

d-1. Social impact on residents affected (Most residents affected are usually unable to locate or afford comparable living space and conditions, thus are subjected to severe hardship. This factor was evaluated by number of residents including squatters affected.)

d-2. Impact on employment and economic activities (When commercial establishments or factories are to be relocated, employment opportunities are lost and economic activities are affected. This impact was evaluated by number of commercial buildings and factories affected.)

d-3. Traffic pollution (The most severely affected by pollution such as noise, air and vibration caused by expressway traffic are those who are living near an expressway. This factor was evaluated by section length which passes through residential area.)

e) Implementation Difficulty

Many of highway projects in Metro Manila have been facing implementation difficulty due mainly to ROW acquisition and its associated problems and implementation of some of projects has been suspended or is deferred. This impact was evaluated by three sub-factors as follows:

e-1. Difficulty in acquiring land (evaluated by land areas to be acquired.)

e-2. Difficulty in relocating squatters (evaluated by number of squatter families. Relocation sites for squatters is getting more difficult to find within Metro Manila, thus relocation sites would be outside Metro Manila where squatters are reluctant to settle. Relocation of squatters takes long time and requires patient negotiation.)

e-3. Necessity of coordination with other agencies (When land areas or space which belong to agencies other than DPWH are to be utilized for an expressway, an agreement must be reached with regard to terms and conditions for utilization of their lands or space.)

f) Construction Difficulty

Two sub-factors were employed to evaluate this aspect:

f-1. Constructability (Evaluated by section length which requires complex structures and/or special construction methods.)

f-2. Traffic management during construction (Evaluated by section length where some lanes need to be reduced during construction.)

g) Soundness of an Alignment

All alternative alignments were so planned that minimum requirements of the proposed geometric standards are met, therefore, no big difference among alternative alignments is expected. This factor was evaluated by the following two factors:

g-1. <u>Soundness of horizontal alignment</u> (Evaluated by number of S-shaped curves.)

g-2. <u>Soundness of vertical alignment</u> (Evaluated by section length of which grade is more than 4%.)

2) Weight of Evaluation Factors

An alignment must be so selected that its implementation is easier to avoid prolonged implementation. Considering the fact that some road projects are being delayed or deferred or suspended in certain cases due mainly to ROW acquisition and affected residents' relocation, high priority shall be given to implementation aspect.

Another important factor is the investment requirement. Magnitude of the project in terms of investment requirement is so huge that fund preparation and arrangement will be one of the critical issues.

Social impact is another factor to be given serious consideration. Number of affected residents and squatters should be minimized to mitigate adverse social impact.

Weight of each evaluation factor was determined giving priority on implementation difficulty, initial investment requirement and social/environmental impact, as shown below:

| Evaluation Factor | Weight |
|---|---|
| • Implementation difficulty | 25 points |
| • Initial investment requirement | 25 points |
| • Social/Environmental impact | 20 points |
| • Expressway network efficiency | 10 points |
| • Harmony with at-grade road | 10 points |
| • Construction difficulty | 5 points |
| • Soundness of an alignment | 5 points |
| Total | 100 |

### 4.1.3 Methodology

1) Control Points

Facilities, buildings, etc. which should not be affected were selected as "control points" for an alignment study. Control points were classified into two (2) depending upon the degree of difficulty to relocate or demolish. Facilities classified under each class of control points were as follows:

Control Points: Class - A

Those which must be kept remained or shall not be affected and those of which relocation is quite costly are classified under this category. An alignment must be planned to completely avoid these. Following are classified under this category:

- Church, mosque and temple
- Cemetery
- Oil tank
- Permanent building of more than 5 stories
- Hospital
- MWSS water reservoir

Control Points: Class -B

Classified under this category are those which must not be, in principle, affected, however, may be affected when necessity arises and no other solution is found. An alignment must be planned to avoid these as much as possible. Following are classified under this category:

- Factory
- School
- Chapel
- Permanent building of 3 to 4 stories
- Public market

2) Methodology for developing alternative alignments

Basic principles for developing alternative alignments were as follows:

- Public spaces such as public roads, river banks, PNR ROW and other available public lands shall be utilized to a maximum extent to avoid social problems associated with people dislocation, to minimize ROW acquisition cost and to attain smooth implementation.
- Control points classified as class - A shall not be affected.

All control points along an expressway corridor and public spaces which can be utilized for an expressway were plotted on the topographic maps (scale 1:10,000) to develop alternative alignments.

An alignment of a related expressway was studied to determine an appropriate interchange site.

Based on above studies, several alternative alignments were prepared.

3) Methodology for preparation of data needed for evaluation

A preliminary engineering study was undertaken for each alternative alignment. Horizontal alignments of all alternatives were drawn on the photo-mosaic maps at a scale of 1:2,500. Vertical alignments were prepared at a scale of 1:10,000 (horizontal) and 1:500 (vertical) to determine structural height and type of substructure which were reflected for cost estimate. Interchange alignment and on/off-ramps layout were drawn on the photo-mosaic maps (at this stage, type of interchange and on/off-ramp layout were pre-determined adopting commonly used type.)

Based on above materials, rough costs both for construction and ROW acquisition/compensation were estimated and other data as shown below were also obtained:

- Route length
- Land ownership (private or public) along an expressway
- Land area to be acquired
- No. of residential houses and squatter shanties
- No. of commercial buildings, factories, warehouses and gasoline stations
- No. of schools
- No. of permanent buildings of 3 to 4 - storey
- Section length which passes through residential areas

## 4.2 EXPRESSWAY SECTIONS WHERE ALIGNMENT STUDY REQUIRED

Expressway sections where a detailed alignment study was required are summarized in Table 4.2.1 and shown in Figure 4.2.1. No competitive alignment was found for the rest of the expressway sections.

**Table 4.2.1 EXPRESSWAY SECTIONS WHERE ALIGNMENT STUDY REQUIRED**

| Expressway | Section | Major Alternatives |
|---|---|---|
| Route C-3 | Section-1 (from Quirino Ave./SSH Intersection to Aurora Blvd./Araneta Ave. Intersection | • Along PNR and San Juan River<br>• Along Pasig River and San Juan River<br>• Along PNR and R. Magsaysay Blvd.<br>• Along Quirino Ave., Estero de Pandacan and San Juan River |
| | Section-2 (from Aurora Blvd./ Araneta Ave. Intersection to End of Araneta Ave.) | • Along Araneta Ave.<br>• Along San Juan River |
| | Section-3 (from End of Araneta Ave. to R-10 | • Rotary Type of Interchange for Expressways Route C-3 and Route R-9<br>• Independent alignment for each of Expressways Route C-3 and Route R-9 |
| Route R-3 | Section-1 (from Araneta Ave. to EDSA) | • Over South Super Highway (SSH)<br>• Over PNR |
| | Section-2 (from C-5 to Bicutan I/C) | • Over South Luzon Expressway (SLE)<br>• Over PNR |
| | Section-3 (near Alabang I/C) | • New Alignment<br>• Exp. Route R-3 to be merged with the existing Alabang I/C |
| Route R-4 | Section near Makati Access Ramp | • Exp. Route R-4 at northern bank of Pasig River<br>• Exp. Route R-4 at southern bank of Pasig River |
| Route R-7 | Section near Quezon Memorial Circle | • An overpass<br>• An underpass |

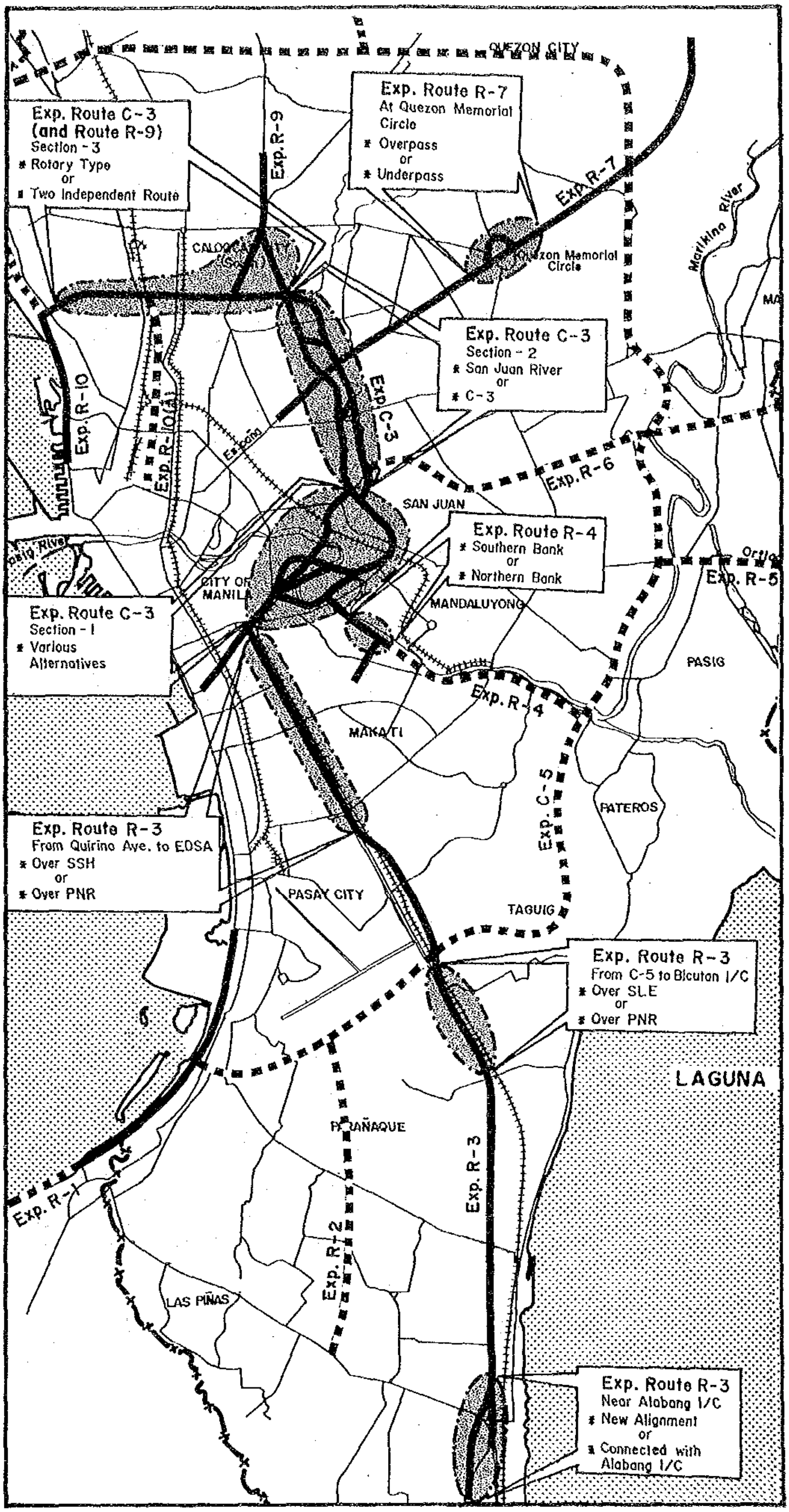



FIGURE 4.2.1 EXPRESSWAY SECTIONS WHERE ALIGNMENT STUDY REQUIRED

## 4.3 EXPRESSWAY ROUTE C-3

### 4.3.1 Features of the Corridor

Expressway Route C-3 constitutes an inner circumferential expressway. To be connected with this expressway are six (6) radial expressways extending towards suburban areas and three (3) towards the inner urban core (Manila CBD).

This route functions as the important distributor of traffic to/from radial expressways as well as traffic to/from Manila CBD. This route also functions as one of north-south transport axes and connects the existing inter-city expressway of North and South Luzon Expressways via Expressways Route R-3 and R-9.

At the first stage of implementation, this inner circumferential expressway is to be connected with radial expressways R-3, R-4 (about 2 kms. section only), R-7, R-9 and R-10 (inner section only).

The route starts at Quirino Ave./Adriatico intersection, then follows Quirino Ave. up to about 0.5 km. east of Paco Station of PNR. From there, it goes towards the north-east to reach at the Aurora Blvd./Araneta Ave. intersection, then extends toward the north up to the end of Araneta Ave. where it turns toward the west and ends at R-10.

### 4.3.2 Division of the Route into Sections for an Alternative Alignment Study

The route was divided into three (3) sections which several alternative alignments were independently evaluated. Three (3) sections are as follows (see Figure 4.3.1):

Section - 1 : From Quirino Ave./South Super Highway intersection to Aurora Blvd./ Araneta Ave. intersection

Section - 2 : From Aurora Blvd./Araneta Ave. intersection to the end of Araneta Ave.

Section - 3 : From the end of Araneta Ave. to R-10

### 4.3.3 Section - 1 Alignment

1) Alternative Alignments

Four (4) alternatives and one (1) variation were developed as shown in Figure 4.3.2 Outline of each alternative is summarized in Table 4.3.1. Bases for developing alternatives such as available public spaces, control points, and special issues along this section is presented in Appendix 4.3.1.

2) Evaluation of Alternative Alignments

In accordance with the evaluation criteria, all alternative alignments were evaluated. An interchange between Route C-3 and Route R-4 was selected at respective location for each alternative alignment of Route C-3, accordingly length of Route R-4 varies depending upon an alternative alignment. Construction cost, land area to be acquired, etc. for Route R-4 were assessed and included in the evaluation.

Evaluation of alternative alignments is shown in Table 4.3.2. Alternative alignments can be categorized into two as follows:

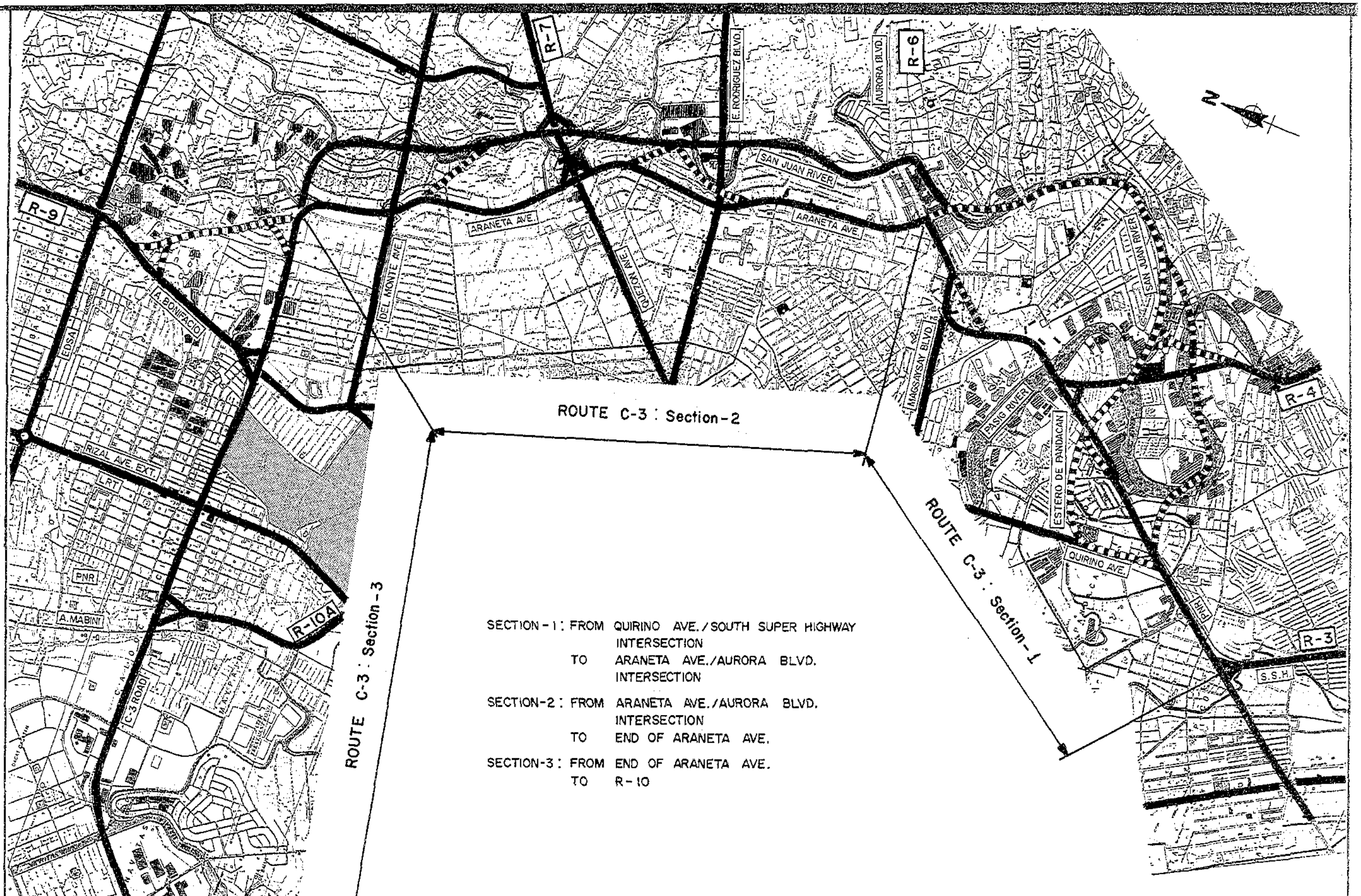
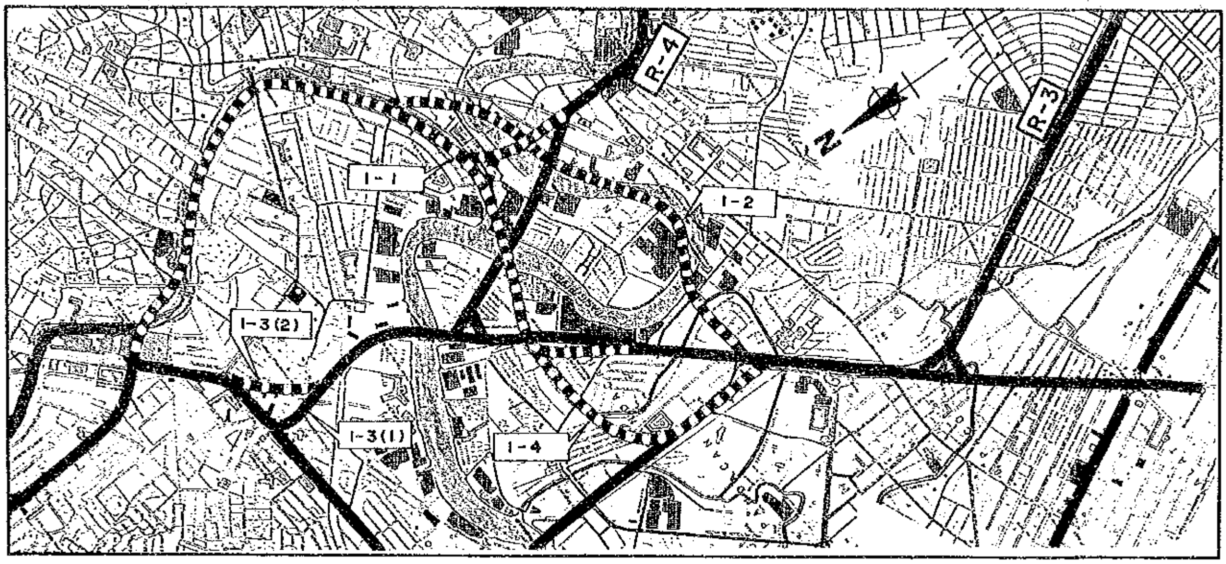
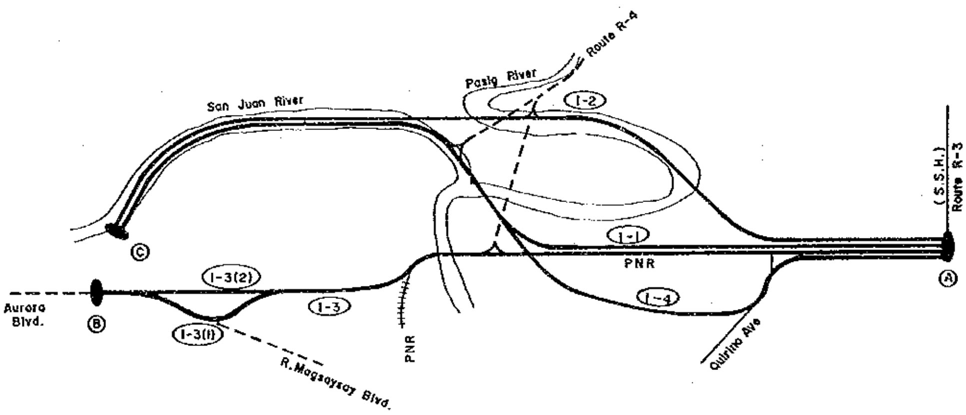



FIGURE 4.3.1 SECTION FOR AN ALTERNATIVE ALIGNMENT STUDY




Alignment I-1 : Along PNR and San Juan River, L = 5.4 Km

Alignment I-2 : Along Pasig River and San Juan River, L = 5.4 Km

Alignment I-3(1): Along PNR, Magsaysay Blvd., and Aurora Blvd., L = 4.2 Km

Alignment I-3(2): Along PNR and Aurora Blvd., L = 4.0 Km

Alignment I-4 : Along Quirino Ave., Estero de Pandacan and San Juan River, L = 5.7 Km

FIGURE 4.3.2 ALTERNATIVE ALIGNMENTS : SECTION - I

## TABLE 4.3.1 OUTLINE OF ALTERNATIVE ALIGNMENTS : SECTION – 1

| Alignment | Planning Objectives | Length (km) | Major Land Use Under Expressway (km.) | | | | | Connection with Expressways R–4 and R–6 | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | Public Roads | PNR | River Bank | River Crossing | Private Land | | |
| 1–1 | ● Maximum utilization of San Juan River bank and partially utilize PNR and Estero de Pandacan | 5.44 | 1.01 (18.6%) | 0.35 (6.4%) | 2.57 (47.2%) | 0.44 (8.1%) | 1.07 (19.7%) | ● Exp. R–4 be longer by 0.3 km than Alignment 1–2 | ● Nagtahan Link Road Project |
| 1–2 | ● To avoid relocation problem of squatters along PNR, utilize Pasig River bank and San Juan River bank | 5.45 | 1.01 (18.5%) | – | 2.71 (49.7%) | 0.86 (15.8%) | 0.87 (16.0%) | | ● Cross Pasig River 3 times and San Juan River |
| 1–3 (1) | ● Shortest route<br>● Maximum utilization of PNR ROW, though squatter relocation problem expected | 4.22 | 1.69 (40.0%) | 1.62 (38.4%) | – | 0.13 (3.1%) | 0.78 (18.5%) | ● Exp. R–4 be longer by 0.87 km. than Alignment 1–2<br>● Alignment of Exp. R–6 shall be along Aurora Blvd. | ● Nagtahan Link Road Project |
| 1–3 (2) | ● Shortest route<br>● Maximum utilization of PNR ROW, though squatter relocation problem expected | 4.00 | 1.47 (36.8%) | 1.51 (37.8%) | – | 0.13 (3.2%) | 0.89 (22.2%) | ● Exp. R–4 be longer by 0.87 km. than Alignment 1–2<br>● Alignment of Exp. R–6 shall be along Aurora Blvd. | ● Nagtahan Link Road Project |
| 1–4 | ● To avoid relocation problem of squatters along PNR, utilize Estero de Pandacan & San Juan River bank | 5.75 | 1.45 (25.2%) | – | 3.12 (54.3%) | 0.44 (7.6%) | 0.74 (12.9%) | ● Exp. Route R–4 be longer by 0.3 km than Alignment 1–2 | |

Group A: Utilizes PNR right-of-way and public roads (R. Magsaysay Blvd./Aurora Blvd.). Alternative alignments 1-3(1) and 1-3(2) belong to this group.

Group B: Utilizes river banks extensively. Included in this group are Alternative Alignments 1-1, 1-2 and 1-4.

Evaluation results indicate the superiority of Group A over Group B. Advantages of Group A are as follows:

- Initial investment cost is much lower due to shorter alignment length and less utilization of private land.

- Implementation difficulty is expected to be much less due to less requirement of land acquisition.

Whereas, disadvantage of Group A is in the aspect of social impact. Many squatter families who has been settled within PNR right-of-way have to be relocated, although about 60% of existing squatters would have been relocated by the Nagtahan Link Road Project.

Utilization of river banks was found not so advantageous as expected. Many residential houses, factories, warehouses and squatters occupy lands up to the edge of the bank. Extensive land acquisition is required and adverse social impact is expected to be high, though severity is less than Group A.

In terms of expressway network efficiency and harmony with at-grade road, difference between two groups is very small.

Major difference between 1-3(1) and 1-3(2) exists in on/off ramp layout. The former can accommodate on/off ramps at R. Magsaysay Blvd. which improves accessibility to Manila CBD, however, the latter cannot, because it diverts from R. Magsaysay Blvd./Aurora Blvd. soon after an interchange with Route R-6.

In view of the above, Alignment 1-3(1) was selected for Section - 1.

## TABLE 4.3.2 EVALUATION OF ALTERNATIVE ALIGNMENTS: ROUTE C-3, SECTION -1

| EVALUATION ASPECT | EVALUATION INDEX | WEIGHT | | ALTERNATIVE ALIGNMENTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1-1 (5.44 km) | | 1-2 (5.45 km) | | 1-3 (1) 4.22 km | | 1-3(2) 4.00 km | | 1-4 (5.75 km) | |
| a) Expressway Network Efficiency | a-1. Linkage with related expressways and appropriateness of an alignment as a part of network | 10 | 4 | Good/Fair | 3 | Good/Fair | 3 | Good | 4 | Good | 4 | Good/Fair | 3 |
| | a-2. No. of on-/off-ramps | | 6 | On-4, Off-3 Total 7 | 6 | On-4, Off-3 Total 7 | 6 | On-3, Off-2 Total 5 | 4.5 | On-2, Off-1 Total 3 | 2.5 | On-3, Off-4 Total 7 | 6 |
| b) Harmony with at-grade road | b-1. Lane reduction rate and its length | 10 | 5 | Quirino 6/8, 1.01 km | 5 | Quirino 6/8, 1.01 km | 5 | Quirino/Magsaysay 6/8, 1.69 | 2 | Quirino/Aurora 6/8, 1.48 | 3 | Quirino 6/8, 1.45 km | 3 |
| | b-2. No. of new intersection needed due to construction of a ramp | | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 2 | 2 | 2 | 2 |
| | b-3. No. of potential intersections which may be grade separated | | 2 | 0 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2 |
| c) Initial Investment Requirement | c-1. Construction cost | 25 | 15 | 3.50 + 0.60 = ₱ 4.10 B | 6.5 | 4.48 + 0.47 = ₱ 4.95 B | 4 | 1.76 + 0.76 = ₱ 2.52 B | 12 | 1.68 + 0.76 = ₱ 2.44 B | 15 | 3.62 + 0.60 = ₱ 4.22 B | 5 |
| | c-2. ROW acquisition and compensation cost | | 10 | ₱ 0.52 B | 4.5 | ₱ 0.51 B | 5 | ₱ 0.38 B | 10 | ₱ 0.43 B | 7 | ₱ 0.56 B | 3.5 |
| d) Social/ Environmental Impact | d-1. No. of residents affected | 20 | 10 | 13,500 | 5 | 10,200 | 8 | 14,600 | 3.5 | 14,100 | 4 | 10,000 | 10 |
| | d-2. No. of commercial bldgs./factories affected | | 5 | 15 | 2 | 16 | 2 | 9 | 4 | 7 | 5 | 19 | 1.5 |
| | d-3. Section length passes through residential areas | | 5 | 4.38 | 3.5 | 3.28 | 5 | 3.44 | 4.5 | 3.66 | 4.5 | 5.22 | 3 |
| e) Implementation Difficulty | e-1. Land areas to be acquired | 25 | 15 | 86,000 | 6 | 92,000 | 4 | 50,000 | 15 | 56,000 | 11 | 90,000 | 4.5 |
| | e-2. No. of squatter families to be relocated | | 7 | 2,070 | 3 | 1,590 | 5 | 2,300 | 2 | 2,200 | 2.5 | 1,400 | 7 |
| | e-3. Negotiation with other agency. Required, or not required | | 3 | Required | 1 | Not required | 3 | Required | 1 | Required | 1 | Not required | 3 |
| f) Construction Difficulty | f-1. Section length which requires complex structures construction methods | 5 | 2 | 0.53 + 0.9 = 1.43 | 1 | 0.86 | 2 | 0.36 + 1.10 = 1.46 | 1 | 0.36 + 1.10 = 1.46 | 1 | 0.53 | 3 |
| | f-2. Section length where no. of lanes need to be reduced during construction | | 3 | 1.01 | 3 | 1.01 | 3 | 1.69 | 1.5 | 1.48 | 2 | 1.45 | 2 |
| g) Soundness of an Alignment | g-1. No. of S-shaped curves | 5 | 3 | 3 | 1 | 3 | 1 | 2 | 2 | 1 | 3 | 1 | 3 |
| | g-2. Section length of which gradient is more than 4% | | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| | Total Score | 100 | 100 | | 56.5 | | 62 | | 73 | | 70.5 | | 63.5 |

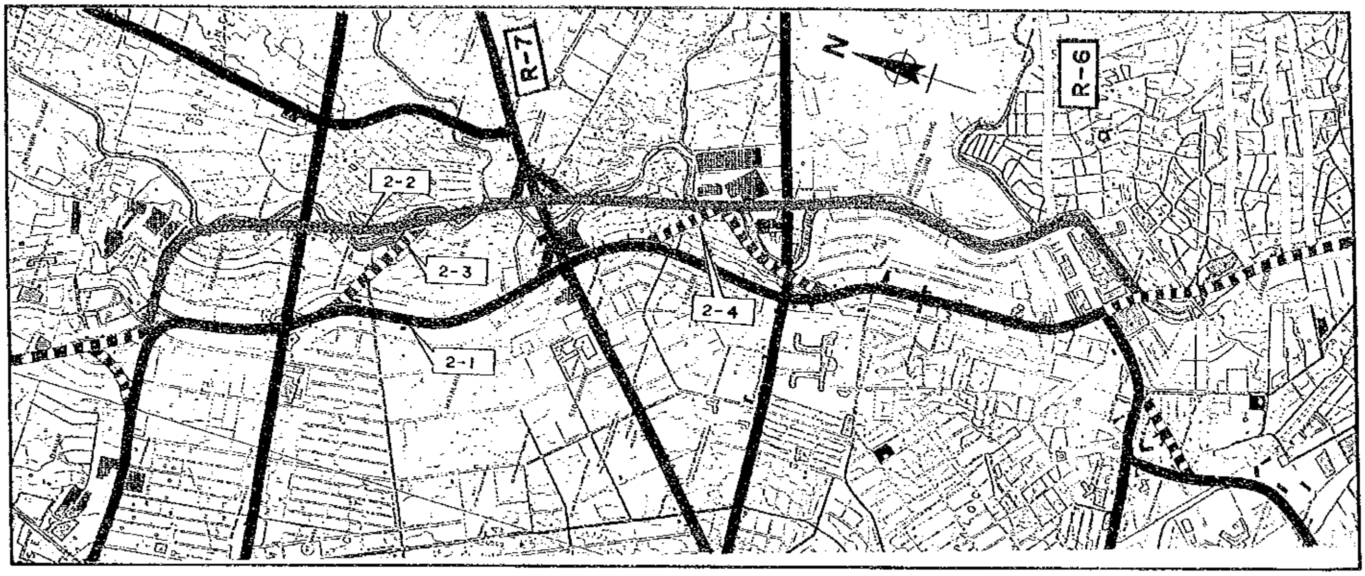
### 4.3.4 Section - 2 Alignment

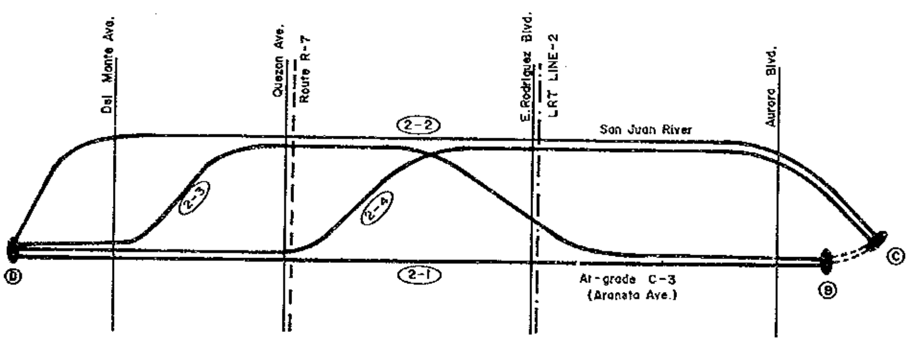
#### 1) Alternative Alignments

Four (4) alternatives were developed as shown in Figure 4.3.3. Outline of each alternative is summarized in Table 4.3.3. Bases for developing alternatives such as available public spaces, control points, and special issues along this section is presented in Appendix 4.3.2.

**TABLE 4.3.3 OUTLINE OF ALTERNATIVE ALIGNMENTS: SECTION-2**

| Alignment | Planning Objectives | Length (km) | Major Land Use Under Expressway (km.) | | | | Connection with Expressways R-4 and R-6 | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | Public Roads | River Bank | River Crossing | Private Land | | |
| 2-1 | • Full stretch utilizes Araneta Avenue (ROW = 40 meters) to minimize ROW acquisition | 4.90 | 4.90 | – | – | – | • Interchange area is developed with 2-4 – story commercial buildings | • LRT Line -2 along Rodriguez Blvd. |
| 2-2 | • Maximum utilization of San Juan River Bank | 5.52 | – | 1.87 | 0.95 | 2.70 | • Interchange area is less developed than that of Alignment 2 – 1 | • LRT Line -2 along Rodriguez Blvd. |
| 2-3 | • Variation of Alignment 2 – 1<br>• If grade separation is constructed at Araneta Ave./Quezon Ave., it will be a serious physical constraint for Alignment 2 – 1. Alignment 2 – 3 is one of the solutions for the problem. | 5.08 | 2.12 | 0.67 | 0.42 | 1.87 | • Same as Alignment 2 – 2 | • LRT Line -2 along Rodriguez Blvd. |
| 2-4 | • Variation of Alignment 2 – 2<br>• San Juan River is winding at various locations between Rodriguez Blvd. and Del Monte Ave., thus river bank of San Juan River is not utilized effectively, accordingly affecting private lands. To avoid such problem, this alignment was proposed. | 5.29 | 2.47 | 1.68 | 0.42 | 0.72 | • Same as Alignment 2 – 1<br>• Exp. R-6's alignment shall be along Aurora Blvd. | • LRT Line -2 along Rodriguez Blvd. |




Alignment 2-1 : All Along Araneta Ave., L = 4.9 Km

Alignment 2-2 : All Along San Juan River, L = 5.5 Km

Alignment 2-3 : Along Araneta Ave., San Juan River and Araneta Ave., L = 5.1 Km

Alignment 2-4 : Along San Juan River and Araneta Ave., L = 5.3 Km

FIGURE 4.3.3 ALTERNATIVE ALIGNMENTS : SECTION - 2

2) Evaluation of Alternative Alignments

Evaluation results are shown in Table 4.3.4. Evaluation results show absolute superiority of Alignment 2-1 over other alignments which require bigger land area to be acquired because of winding alignment of San Juan River and high initial capital investments.

One disadvantage of Alignment 2-1 exists at the intersection between C-3 and Quezon Ave. where an interchange between Route C-3 and Route R-7 is proposed to be constructed. Thus, the said intersection must be reserved for an expressway interchange. Should a grade separation of at-grade roads be required ahead of construction of an expressway, it must be planned in due consideration of future interchange of an expressway.

Alignment 2-1 was selected for Section - 2.

### TABLE 4.3.4 EVALUATION OF ALTERNATIVE ALIGNMENTS: ROUTE C-3, SECTION-2

| EVALUATION ASPECT | EVALUATION INDEX | WEIGHT | | ALTERNATIVE ALIGNMENTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2-1 (4.90 km) | | 2-2 (5.52 km) | | 2-3 (5.08 km) | | 2-4 (5.29 km) | |
| a) Expressway Network Efficiency | a-1. Linkage with related expressways and appropriateness of an alignment as a part of network | 10 | 4 | Good | 4 | Good | 4 | Good | 4 | Good | 4 |
| | a-2. No. of on-/off-ramps | | 6 | On-2, Off-3 Total 5 | 4 | On-2, Off-4 Total 6 | 6 | On-2, Off-3 Total 5 | 4 | On-3, Off-3 Total 6 | 6 |
| b) Harmony with at-grade road | b-1. Lane reduction rate and its length | 10 | 5 | None | 5 | None | 5 | None | 5 | None | 5 |
| | b-2. No. of new intersection needed due to construction of a ramp | | 3 | 0 | 3 | 2 | 1 | 0 | 3 | 1 | 2 |
| | b-3. No. of potential intersections which may be grade separated | | 2 | 1 | 1 | 0 | 2 | 0 | 2 | 1 | 1 |
| c) Initial Investment Requirement | c-1. Construction cost | 25 | 15 | ₱1.93 B | 15 | ₱3.68 B | 4.5 | ₱2.41 B | 9.5 | ₱3.13 B | 6 |
| | c-2. ROW acquisition and compensation cost | | 10 | ₱0.22 B | 10 | ₱0.64 B | 2 | ₱0.48 B | 3 | ₱0.44 B | 4 |
| d) Social/ Environmental Impact | d-1. No. of residents affected | 20 | 10 | 250 | 10 | 6,800 | 0 | 3,300 | 1 | 5,600 | 0.5 |
| | d-2. No. of commercial bldgs./factories affected | | 5 | 23 | 5 | 35 | 3 | 34 | 3 | 29 | 4 |
| | d-3. Section length passes through residential areas | | 5 | 2.06 | 5 | 5.31 | 2 | 2.25 | 4.5 | 3.75 | 3 |
| e) Implementation Difficulty | e-1. Land areas to be acquired | 25 | 15 | 25,000 | 15 | 133,000 | 1.5 | 90,000 | 2.5 | 75,000 | 4 |
| | c-2. No. of squatter families to be relocated | | 7 | 30 | 7 | 950 | 0 | 390 | 0.5 | 870 | 0 |
| | e-3. Negotiation with other agency. Required, or not required | | 3 | Not required | 3 | Not required | 3 | Not required | 3 | Not required | 3 |
| f) Construction Difficulty | f-1. Section length which requires complex structures construction methods | 5 | 2 | 2.3 | 0 | 0 | 2 | 1.5 | 0.5 | 1.0 | 1 |
| | f-2. Section length where no. of lanes need to be reduced during construction | | 3 | 4.90 | 0 | 0 | 3 | 2.12 | 1 | 2.47 | 1 |
| g) Soundness of an Alignment | g-1. No. of S-shaped curves | 5 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 2 | 2 |
| | g-2. Section length of which gradient is more than 4% | | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| | Total Score | 100 | 100 | | 92 | | 43 | | 51.5 | | 48.5 |

### 4.3.5 Section - 3 Alignment

1) Alternative Alignments

This section could not be evaluated for Route C-3 alone, but together with Route R-9. This was due mainly to R-9 problem. Route R-9 passes over A. Bonifacio Ave. which has a ROW width of 28 meters. When a 4-lane expressway is constructed, the horizontal clearance between an expressway and the building line is about 4 meters which cannot satisfy the target clearance of 5 meters. There are two solutions to solve this problem, as follows:

- To introduce a double deck type structure for Route R-9
- To introduce one-way operation for Route R-9, Route C-3 and one additional link to form a rotary

Figure 4.3.5 shows cross sections of A. Bonifacio Ave. with an expressway for these solutions.

Three (3) alternatives were developed as follows (See Figure 4.3.6).

| | | |
|---|---|---|
| Alternative 3-1 : | To sacrifice the target clearance | |
| | Route C-3 | : 4-lane 2 way |
| | Route R-9 | : 4-lane 2 way |
| Alternative 3-2 : | To introduce a double deck structure for Route R-9 | |
| | Route C-3 | : 4-lane 2 way |
| | Route R-9 | : Double deck (2-lane + 2-lane) |
| Alternative 3-3 : | To introduce a rotary | |
| | Route C-3 | : 3-lane one way |
| | Route R-9 | : 3-lane one way |
| | Additional Link | : 3-lane one way |

These alternatives' subjective area extends from Araneta Ave. to Rizal Ave. Extension along Route C-3 and from C-3 to EDSA (C-4) along Route R-9. A section of Route C-3 from Rizal Ave. Extension to R-10 will be constructed over an at-grade C-3 which has ROW width of 32 to 40 meters.

2) Evaluation of Alternatives

Evaluation was tentatively made in accordance with evaluation criteria of which results are shown in Table 4.3.5. However, alternatives in this section have to be evaluated at different viewpoints. Critical issue is whether the target horizontal clearance should be sacrificed or not. Horizontal clearance of at least 5 meters is desired due to the following:

- Working space for maintenance and repair of structure or buildings
- Protective space against possible fire damage
- Space for ladders and other fire-fighting equipment to reach upper floors of the buildings from the street
- Space for preservation of environment
- Space for preservation of urban aesthetic

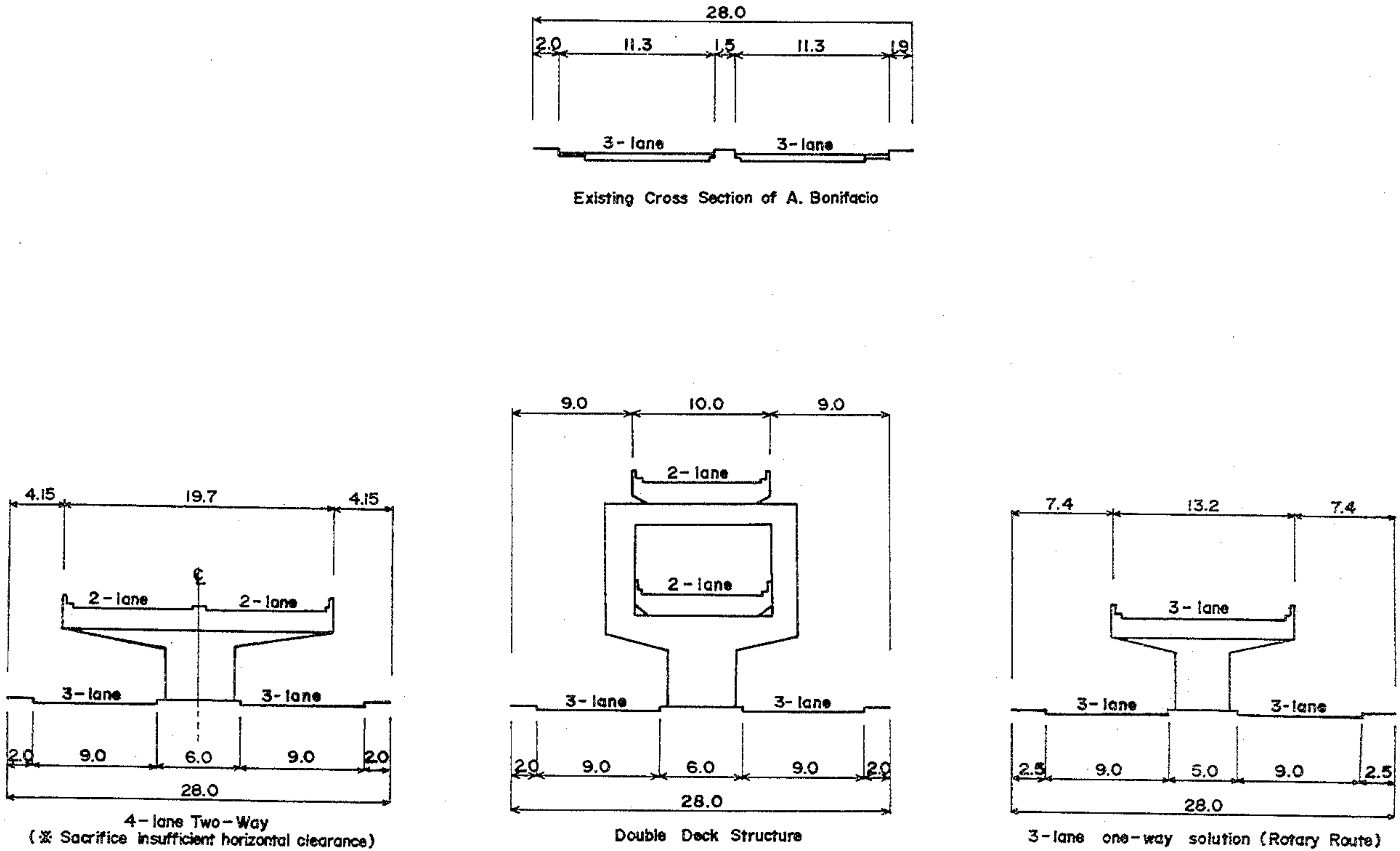
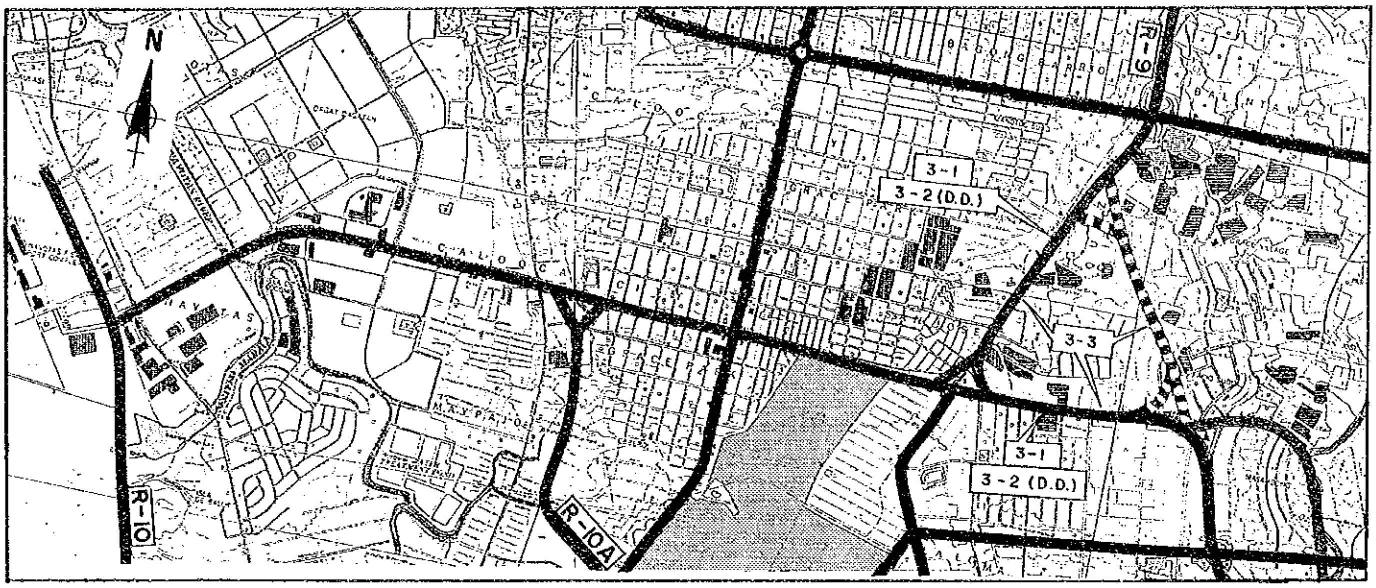
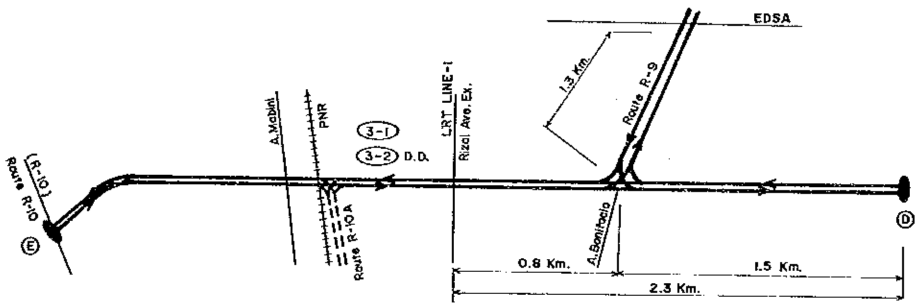
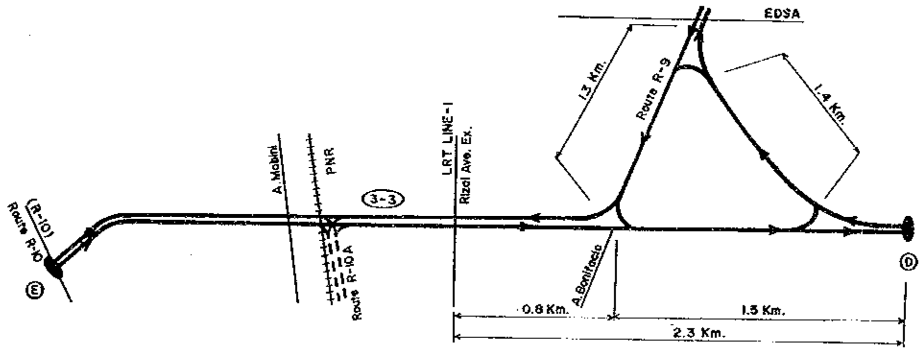



FIGURE 4.3.5 INTRODUCTION OF AN EXPRESSWAY ALONG A. BONIFACIO




Alternative 3-1 : 4-lane 2 way for Exp. Route R-9

Alternative 3-2 : Double Deck Structure for Exp. Route R-9

Alternative 3-3 : Introduction of Rotary

FIGURE 4.3.6 ALTERNATIVE ALIGNMENTS : SECTION - 3

Additional costs for construction and ROW acquisition and land areas required for alternative solutions are as follows:

| Compared with Alternative 3-1<br>Additional of | Alternative 3-2<br>(Double Deck Structure) | Alternative 3-3<br>(Rotary Type) |
|---|---|---|
| Construction Cost | 80 million ₱ | 200 million ₱ |
| ROW Acquisition Cost | 0 | 90 million ₱ |
| Land Area Required | 0 | 14,000 sq. m. |

Additional construction cost of Alternative 3-2 is minimal and no additional cost for ROW acquisition is required, therefore, Alternative 3-2 (a double deck type expressway along A. Bonifacio was selected as the best solution for the section - 3.

**TABLE 4.3.5 EVALUATION OF ALTERNATIVE ALIGNMENTS: ROUTE C−3, SECTION −3**

| EVALUATION ASPECT | EVALUATION INDEX | WEIGHT | | ALTERNATIVE ALIGNMENTS | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 3−1 | | 3−2 | | 3−3 | |
| a) Expressway Network Efficiency | a−1. Linkage with related expressways and appropriateness of an alignment as a part of network | 10 | 4 | Good | 4 | Good | 4 | Good/Fair | 3 |
| | a−2. No. of on−/off−ramps | | 6 | On−2, Off−2 Total 4 | 6 | On−2, Off−2 Total 4 | 6 | On−2, Off−2 Total 4 | 6 |
| b) Harmony with at−grade road | b−1. Lane reduction rate and its length | 10 | 5 | None | 5 | None | 5 | None | 5 |
| | b−2. No. of new intersection needed due to construction of a ramp | | 3 | 0 | 3 | 0 | 3 | 0 | 3 |
| | b−3. No. of potential intersections which may be grade separated | | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| c) Initial Investment Requirement | c−1. Construction cost | 25 | 15 | ₱ 2.63 B | 15 | ₱ 2.71 B | 11.5 | ₱ 2.83 B | 9 |
| | c−2. ROW acquisition and compensation cost | | 10 | ₱ 0.34 B | 10 | ₱ 0.34 B | 10 | ₱ 0.43 B | 6.5 |
| d) Social/ Environmental Impact | d−1. No. of residents affected | 20 | 10 | 830 | 10 | 830 | 10 | 1,130 | 6 |
| | d−2. No. of commercial bldgs./factories affected | | 5 | 22 | 5 | 22 | 5 | 28 | 3 |
| | d−3. Section length passes through residential areas | | 5 | 4.29 | 5 | 4.29 | 5 | 5.9 | 3 |
| e) Implementation Difficulty | e−1. Land areas to be acquired | 25 | 15 | 56,000 | 15 | 56,000 | 15 | 70,000 | 9.5 |
| | e−2. No. of squatter families to be relocated | | 7 | 140 | 7 | 140 | 7 | 140 | 7 |
| | e−3. Negotiation with other agency. Required, or not required | | 3 | Not required | 3 | Not required | 3 | Not required | 3 |
| f) Construction Difficulty | f−1. Section length which requires complex structures construction methods | 5 | 2 | 0 | 2 | 1.3 | 0 | 0 | 2 |
| | f−2. Section length where no. of lanes need to be reduced during construction | | 3 | 6.8 | 3 | 6.8 | 3 | 6.8 | 3 |
| g) Soundness of an Alignment | g−1. No. of S−shaped curves | 5 | 3 | 4 | 3 | 4 | 3 | 6 | 2.5 |
| | g−2. Section length of which gradient is more than 4% | | 2 | 0 | 2 | 0 | 2 | 0 | 2 |
| | Total Score | 100 | 100 | | 99.0 | | 93.5 | | 74.5 |