JAPAN INTERNATIONAL COOPERATION AGENCY

Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

THE STUDY ON THE IMPROVEMENT OF EXISTING BRIDGES ALONG PASIG RIVER AND MARIKINA RIVER IN THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT MAIN TEXT (3/3)

JULY 2004

KATAHIRA & ENGINEERS INTERNATIONAL

CTI ENGINEERING INTERNATIONAL CO. LTD.

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct the Study on the Improvement of Existing Bridges along Pasig River and Marikina River in the Republic of the Philippines and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA dispatched a study team headed by Mr. Tsuneo Bekki of Katahira & Engineers International, and consisting of Katahira & Engineers International CTI Engineering International Co. LTD., to the Republic of the Philippines, five times between October 2002 and June 2004.

The team held discussions with the officials concerned in the Government of the Republic of the Philippines, and conducted field surveys on eighteen bridges (seventeen bridges : existing bridges, one bridge : a new bridge) . Upon returning to Japan, the team prepared this report.

I hope that this report will contribute to the improvement of the bridges in the Republic of the Philippines and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government and those concerned in the Republic of the Philippines for the close cooperation they extended to the study.

July 2004

Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency

Mr. Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency
Tokyo, Japan

July 2004

Dear Mr. Matsuoka,

Letter of Transmittal

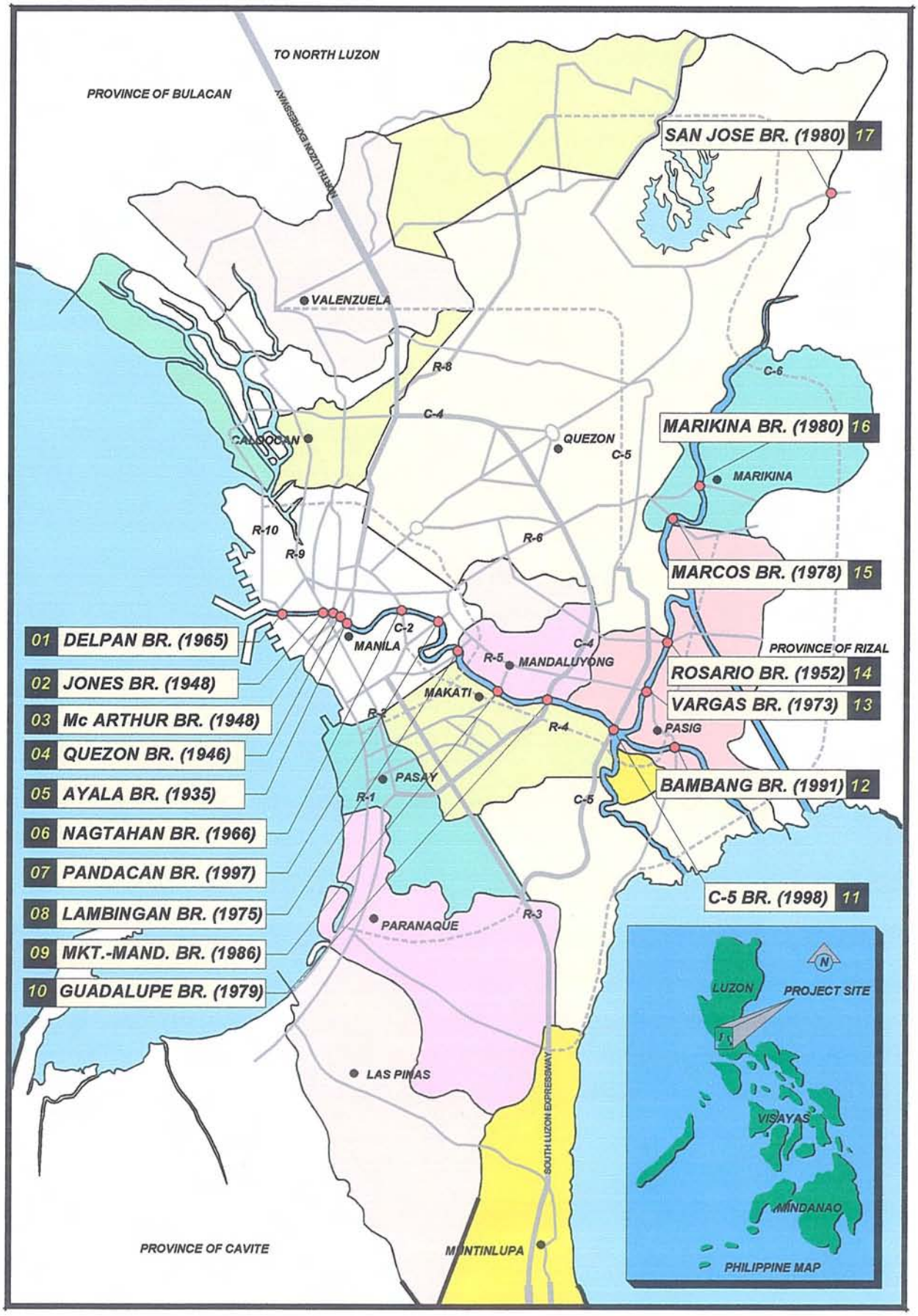
We are pleased to submit to you the report of "The Study on the Improvement of Existing Bridges along Pasig River and Marikina River in the Republic of the Philippines". The report includes the advises and suggestions of the authorities concerned of the Government of Japan and your agency as well as the comments made by the Department of Public Works and Highways and other authorities concerned in the Republic of the Philippines.

This report studies and analyses the condition of seriously and heavily damaged and deteriorated existing seventeen (17) bridges along Pasig River and Marikina River and presents the improvement works of these bridges. The report also studies the construction of new bridge in line with improvement of traffic function of Ayala Bridge. Moreover, this report proposed the urgent improvement works of seven (7) bridges (existing six (6) bridges and new construction of one (1) bridge) to be implemented in the period 2004 – 2010. The Study concludes that these projects are technically, economically, financially and environmentally viable and will contribute the socio-economic development in Metro Manila. In view of the urgency of improving bridges in Metro Manila, we recommend the Government of the Philippines to implement the projects with top priority.

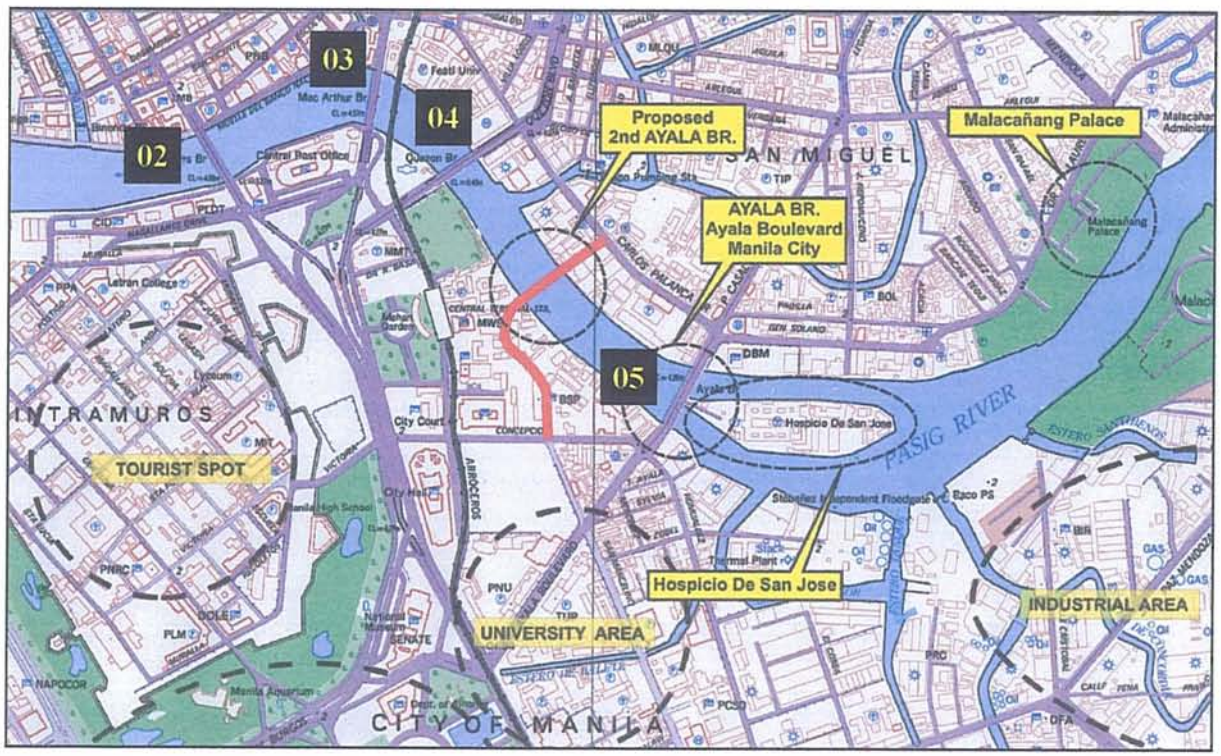
We wish to take this opportunity to express our sincere gratitude to your agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport. We also wish to express our deep gratitude to the Governmental Agencies concerned in the Republic of the Philippines for the close cooperation and assistance extended to us during the Study. We hope this report will contribute to the development of Metro Manila.

Very truly yours,

Mr. Tsuneo BEKKI
Team Leader
of the Study on the Improvement of Existing Bridges
along Pasig River and Marikina River
in the Republic of the Philippines



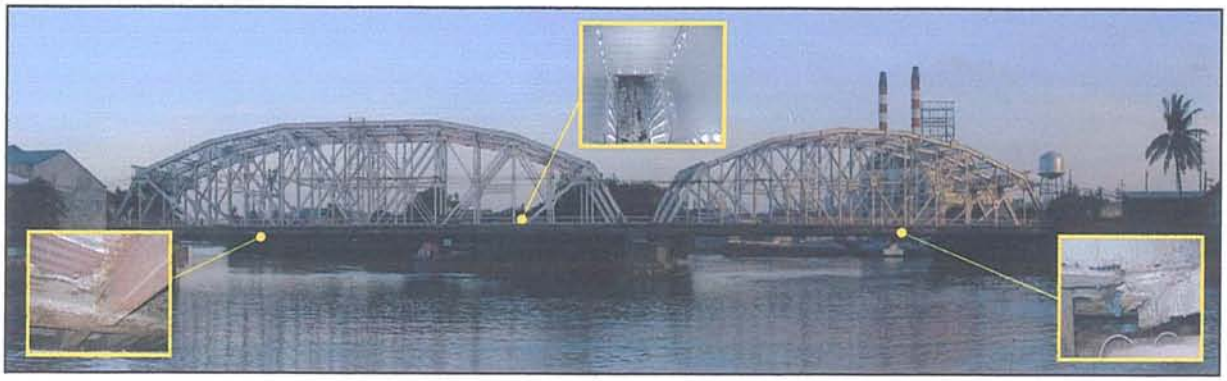
LOCATION MAP OF THE PROJECT



VICINITY OF PROPOSED SECOND AYALA BRIDGE

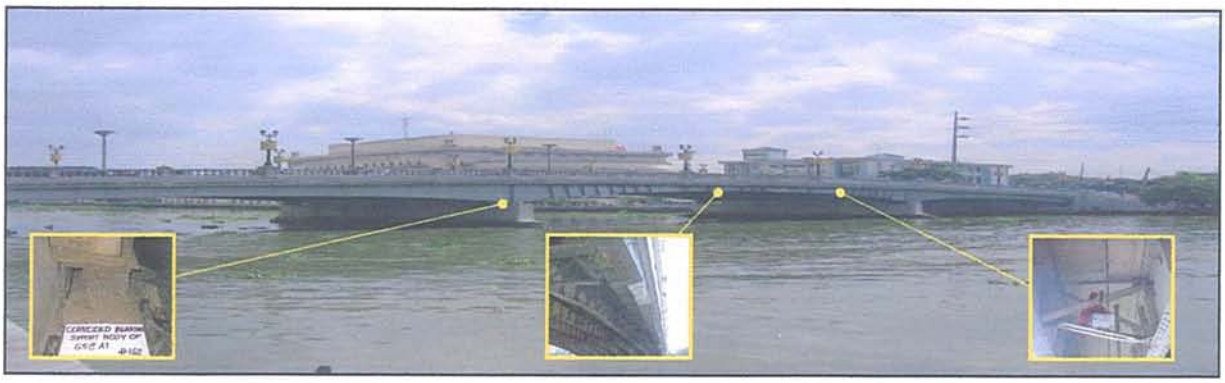
02 – JONES BRIDGE (1948)
03 – Mc ARTHUR BRIDGE (1948)
04 – QUEZON BRIDGE (1946)
05 – AYALA BRIDGE (1935)

PHOTOGRAPH OF MAIN BRIDGES



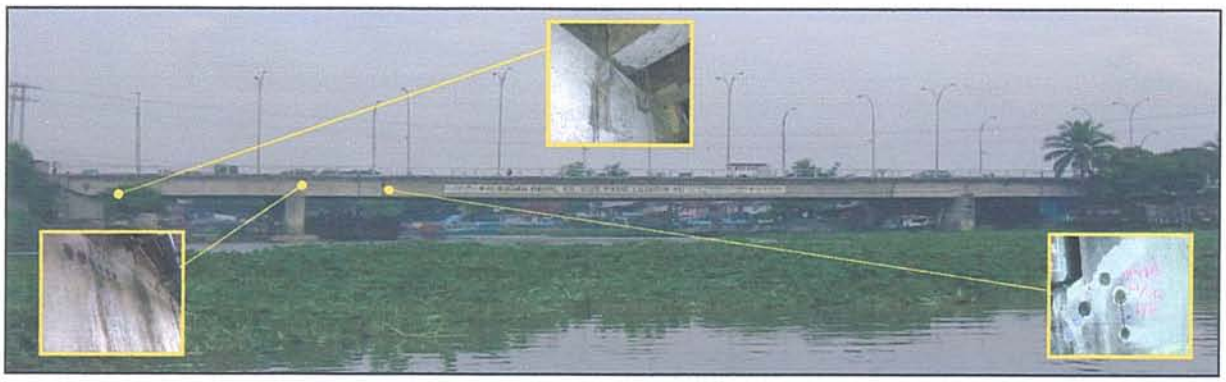
Ayala Bridge

Proposed Second Ayala Bridge



Jones Bridge

Quezon Bridge



Lambingan Bridge

Guadalupe Quezon

Vargas Bridge

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ABBREVIATIONS

AADT	: Average Annual Daily Traffic
AASHTO	: American Association of State Highway and Transportation Officials
ADB	: Asian Development Bank
ADT	: Average Daily Traffic
AIP	: Annual Infrastructure Program
AMSL	: Above Mean Sea Level
APL	: Adaptable Program Loan
AS	: Allowable Stress
ASD	: Allowable Stress Design
BCA	: Benefit / Cost Analysis
BCGS	: Bureau of Coast and Geodetic Survey
BMS	: Bridge Management System
BOC	: Bureau of Construction
BOD	: Bureau of Design
BOE	: Bureau of Equipment
BOM	: Bureau of Maintenance
BORS	: Bureau of Research and Standards
BOT	: Built, Operation and Transfer
BPH	: Bureau of Public Highways
BRP	: Bridge Retrofit Project
BRS	: Bureau of Research and Standard
BSP	: Boy Scout of the Philippines
BSWM	: Bureau of Soils and Water Management
CGS	: Coast Guard Station
COD	: Chemical Oxygen Demand
COE	: Certificate of Exemption
CLUP	: Comprehensive Lands Use Plan
CPDO	: City Planning and Development Office
Danida	: Danish International Development Assistance

DAO	: Department Administrative Order
DBM	: Department of Budget and Management
DENR	: Department of Environment and Natural Resources
DEO	: District Engineering Office
DIA	: Direct Impact Area
DO	: Department Order
DO	: Dissolved Oxygen
DOTC	: Department of Transportation and Communications
DPH	: Department of Public Highways
DPWH	: Department of Public Works and Highways
DPWTC	: Department of Public Works, Transportation and Communications
ECA	: Environmental Critical Area
ECC	: Environmental Compliance Certificate
EIA	: Environmental Impact Assessment
EIAPO	: Environmental Impact Assessment Project Office
EIRR	: Economic Internal Rate of Return
EIS	: Environmental Impact Statement
EMB	: Environmental Management Bureau
EMK	: Equivalent Maintenance Kilometer
EO	: Executive Order
EUAC	: Equivalent Uniform Annual Cost
EVF	: East Valley Fault
FCA	: First Cost Analysis
FTI	: Flood Terminal Incorporated
FYBCR	: First Year Benefit Cost Ratio
GAA	: General Appropriate Act
GMA	: Greater Manila Area
GNP	: Gross National Product
GOJ	: Government of Japan
GOP	: Government of the Philippines

GRDP : Gross Regional Domestic Product

HDSJ : Hospicio de San Jose

HPD : Historical and Preservation Division

HTL : Highest Tide Level

IBRD : International Bank for Reconstruction And Department

ICC : Investment Coordinating Committee

ID : Inspectorate Division

IEE : Initial Environmental Examination

IIA : Indirect Impact Area

IRR : Implementing Rules and Regulations

ISD : Inventory Statistics Division

JBIC : Japan Bank for International Corporation

JICA : Japan International Cooperation Agency

JRA : Japan Road Association

LBCR : Laguna de Bay Coastal Road

LCA : Lifecycle Analysis

LF : Load Factor

LFD : Load Factor Design

LGUs : Local Government Units

LOS : Level of Service

LR : Load Rating

LRF : Load and Resistance Factor

LRFD : Load Resistance Factor Design

LTFRB : Land Transportation Franchising and Regulatory Board

LTO : Land Transportation Office

LTPBMC : Long Term Performance Based Maintenance Contract

MARINA : Maritime Industry Authority

MBA : Maintenance By Administration

MBC : Maintenance By Contract

MBE : Manila Bay Expressway

MCGS : Marikina Central Gate Structure

MCTE : Manila-Cavite Toll Expressway

MGB : Mines and Geosciences Bureau

MHHW : Mean Higher High Water

MMDA : Metro Manila Development Authority

MMD : Monitoring and Method Division

MMETROPLAN: Metro Manila Transport, Land Use and Development Planning Project

MMUEN : Metro Manila Urban Expressway Network

MMUESS : Metro Manila Urban Expressway System Study

MMUSTRAP : Metro Manila Urban Transportation Strategy Planning Project

MMUTDP : Metro Manila Urban Transportation Development Plan

MMUTIP : Metro Manila Urban Transportation Improvement Project

MMUTIS : Metro Manila Urban Transportation Integration Study

MMUTPS : Metro Manila Urban Transportation Planning Study

MNT : Manila North Tollway

MOOE : Maintenance, Operations and Other Expenses

MPH : Ministry of Public Highways

MPW : Ministry of Public Works

MPWH : Ministry of Public Works and Highways

MRT : Metro Rail Transit

MSHW : Mean Springs High Water Level

MSL : Mean Sea Level

MTC : Ministry of Transportation and Communication

MTDP : Medium-Term Transportation Development Plan

MTPDP : Medium-Term Philippine Development Plan

MVFS : Marikina Valley Fault System

MVUC : Motors Vehicle Users Charge

NAIA : Ninoy Aquino International Airport

NAPOCOR : National Power Corporation

NEDA : National Economic Development Authority

NEPC	: National Environmental Protection Council
NG	: National Government
NHA	: National Housing Authority
NHI	: National Historical Institute
NLE	: North Luzon Expressway
NLEE	: North Luzon Expressway East
NPV	: Net Present Value
NRIMP	: National Roads Improvement and Management Program
NSCB	: National Statistical Coordination Board
NSCP	: National Structural Code of the Philippines
NSO	: National Statistics Office
NCR	: National Capital Region
NHI	: National Historical Institute
OD	: Origin Destination
OSG	: Office of Solicitor General
PAF	: Project Affected Families
PAGASA	: Philippine Atmospheric Geophysical Astronomical Services Administration
PAP	: Project Affected Person
PAR	: Philippine Area of Responsibility
PCB	: Polychlorinated Biphenyls
PCG	: Philippine Coast Guard
PCU	: Passenger Car Unit
PHIVOLCS	: Philippine Institute of Volcanology and Seismology
PHMMS	: Philippine Highway Maintenance Management System
PIAM	: Participatory Impact Assessment Method
PIP	: Public Investment Program
PLDT	: Philippine Long Distance Telephone Company
PMO	: Project Management Office
PMP	: Preventive Maintenance Program
PNCC	: Philippine National Construction Corp.

PPA	: Philippine Ports Authority
PPD	: Planning and Programming Division
PPP	: Public-Private Partnership
PPP	: Piso Para sa Pasig
PRDP	: Pasig River Development Program
PRRC	: Pasig River Rehabilitation Commission
PRRP	: the Pasig River Rehabilitation Program
PS	: Planning Service
PSCG	: Pre-stressed Concrete Girder
PSG	: Presidential Security Group
PTFRPR	: Presidential Task Force on the Rehabilitation of the Pasig River
PTM	: Philippine Transverse Mercator
PUB	: Public Utility Bus
PUJ	: Public Utility Jeep
PW	: Present Worth
PWA	: the Public Works Act
QA	: Quarterly
RA	: Republic Act
RBIA	: Road and Bridge Information Applications
RDC	: Regional Development Council
RF	: Rating Factor
RHT	: Recorded Highest Tide
RIS	: Road Information System
RMS	: Root-Mean-Square
RO	: Regional Office
ROW	: Right-of-Way
RRS	: River Rehabilitation Secretariat
SAPROF	: Special Assistance for Project Formation
SLE	: South Luzon Expressway
STTC	: Saving Travel Time Cost

SVOC	: Saving Vehicle Operating Cost
TCM	: Traffic Capacity Manual
TD	: Tropical Depression
TSC	: Transportation Systems Center
TSP	: Total Suspended Particulate
TSS	: Total Suspended Soil
TT	: Tropical Typhoon
TTC	: Travel Time Cost
TWG	: Technical Working Group
UFG	: Ultrasonic Flaw Detection Test
UP-NCTS	: National Center for Transportation Study
UPV	: Ultrasonic Pulse Velocity
URPO	: Urban Road Projects Office
UTG	: Ultrasonic Thickness Gauging
UTSMMA	: Urban Transport Study in the Manila Metropolitan Area
VFC	: Vehicle Fixed Cost
VOC	: Vehicle Operating Cost
WDDT	: Daily Traffic Volume at Weekday
WEDT	: Daily Traffic Volume at Weekend
WVF	: West Valley Fault

PART IV

FEASIBILITY STUDY ON SELECTED BRIDGES

CHAPTER 19

FEASIBILITY STUDY OF THE SECOND AYALA BRIDGE CONSTRUCTION PLAN

CHAPTER 19

FEASIBILITY STUDY OF THE SECOND AYALA BRIDGE CONSTRUCTION PLAN

19.1 ROAD ROUTE STUDY

As discussed in **Chapter 14**, through a series of consultations and discussions with concerned organizations, it was recommended to adopt improvement works for the Ayala Bridge that would maintain its existing configuration after reconstruction. It is required that the existing Ayala Bridge configuration shall not be altered due to its historical value and significance. However, with this improvement type, the traffic capacity of the Ayala Bridge cannot be increased.

On the other hand, the traffic volume on the bridge was forecasted to be beyond its capacity in the near future as discussed in **Section 5.4**. For this reason, the second Ayala Bridge is proposed to improve the traffic condition in the vicinity area and expected to play a role to complement the traffic function of the existing Ayala Bridge as well as the Quezon Bridge.

19.1.1 Present Road Network and Land Use

(1) Present Road Network

The road network system in the central area of Metro Manila is shown in **Figure 19.1.1-1**. The Ayala Bridge is located along C-1 connected to the most of radial arterial road such as R-2, R-5, R-6, R-7, R-8 and R-9.

Figure 19.1.1-2 shows the present road network in the vicinity of the Ayala Bridge. The road width of the primary arterial roads vary approximately from 16 to 25 meters, and those of the secondary arterial road varying 10 to 16 meters. The secondary roads are under one-way traffic control at the western area of the Ayala Bridge.

The Ayala Bridge has been functioning as the only access road to the Hospicio de San Jose located at the isolated island in Pasig River. The Hospicio de San Jose is being used for facilities of children's welfare, accommodation for physically handicapped person and functioning as a hospital and a school.

The Malacañang compound is widely extended along both sides of riverbank of the Pasig River. For this reason, the public traffic is regulated in Malacañang Palace compound in the Northern area of Pasig River in terms of the security of the compound.

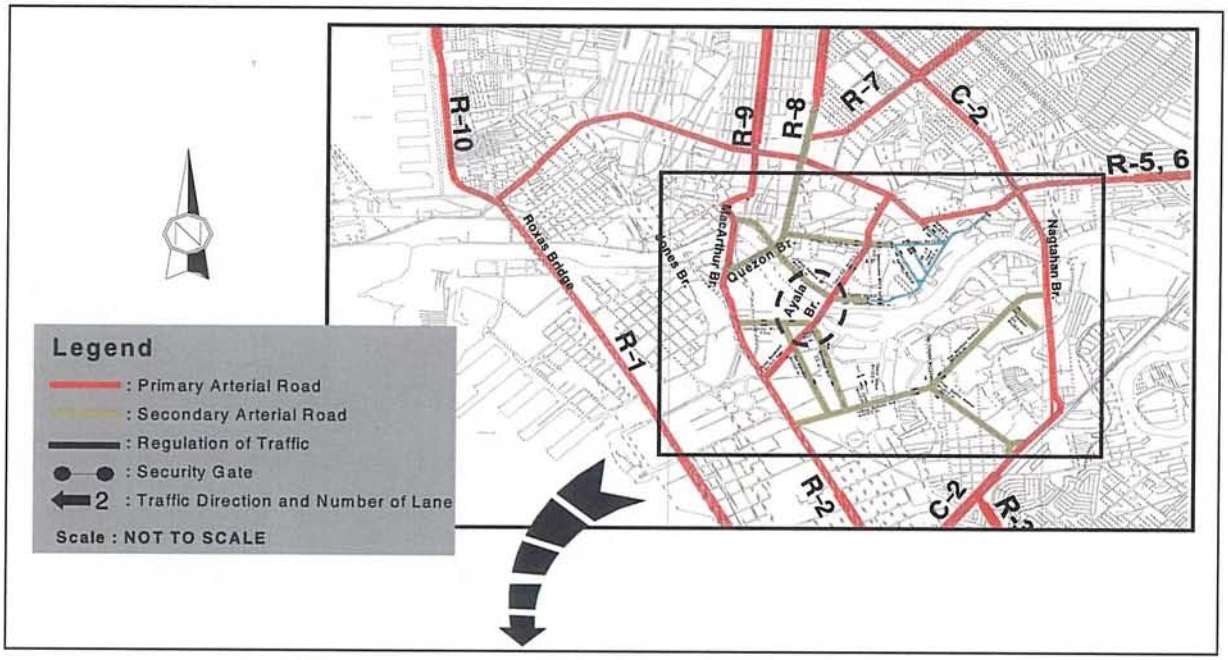


Figure 19.1.1-1 Road Network Systems of Central Metro Manila

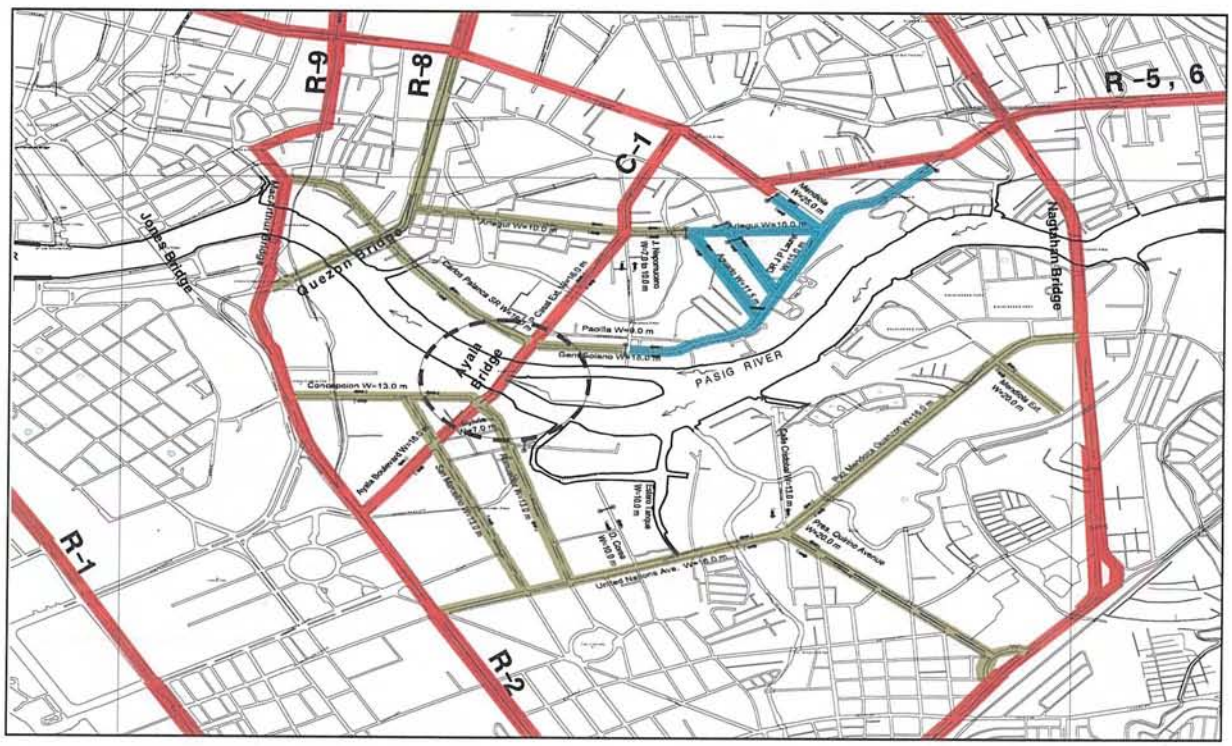


Figure 19.1.1-2 Road Network Systems in the Vicinity of Ayala Bridge

(2) Land Use

Figures 19.1.1-3 and **19.1.1-4** show the present land use and future land use plan in the vicinity areas, respectively. The future land use plan was proposed by the City of Manila.

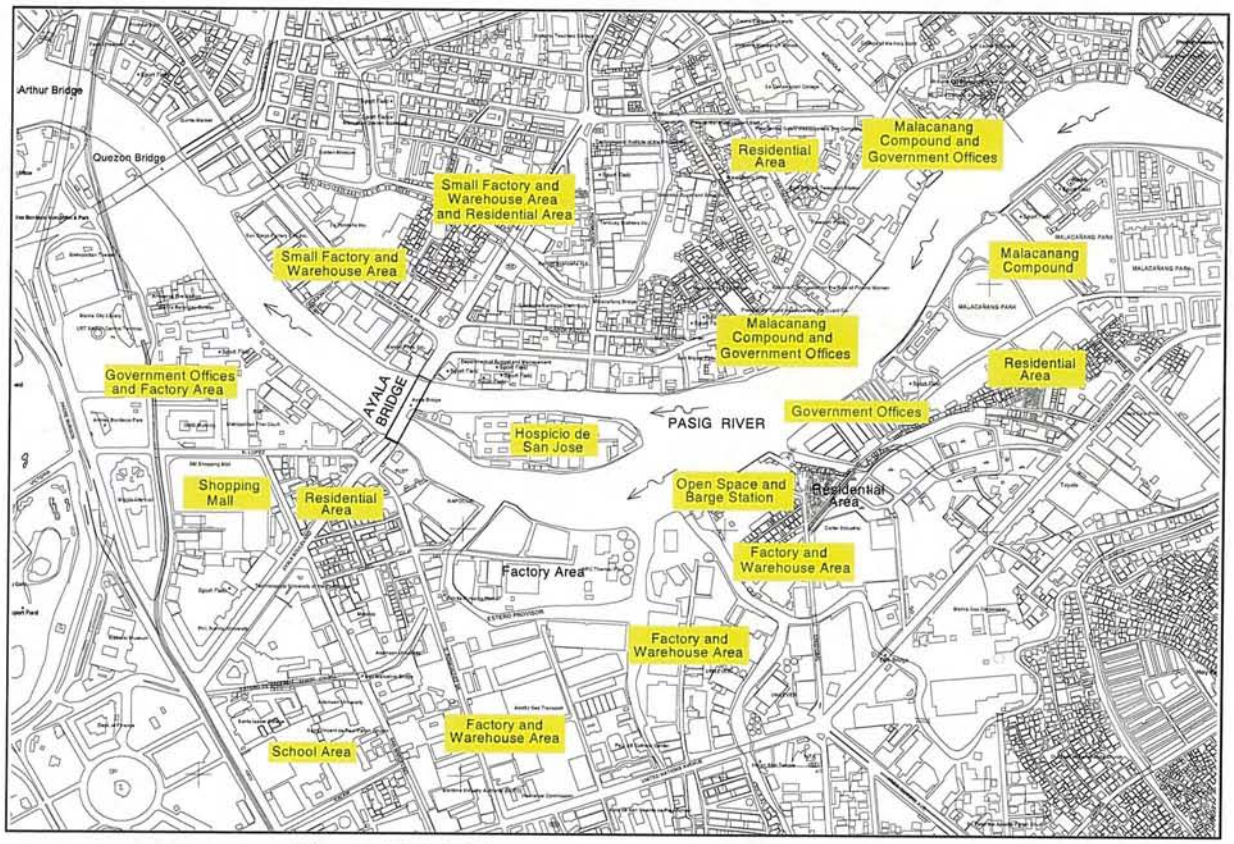


Figure 19.1.1-3 Present Land Use in the Study Area

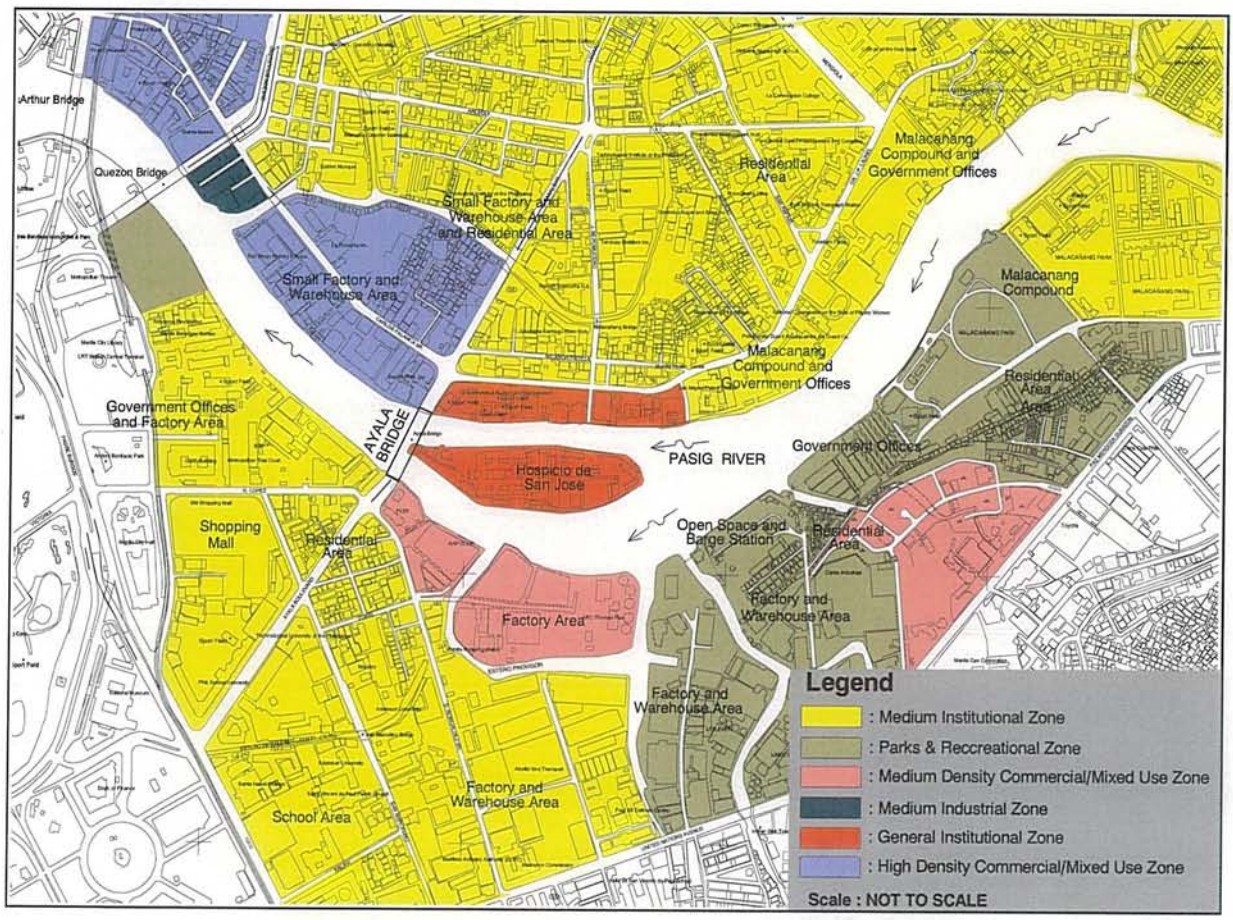


Figure 19.1.1-4 Future Land Use in the Study Area

19.1.2 Road Route Study

(1) Possible Route Alternatives

In **Figure 19.1.2-1**, three (3) alternative routes were prepared as the possible routes with two (2) routes crossing the Pasig River between Ayala Bridge and Nagtahan Bridge, while other at the down stream side of Ayala Bridge. **Table 19.1.2-1** describes the three possible routes.

Table 19.1.2-1 Description of the Routes

Route	Description	Total Length
Route-1	• Connecting between Mendiola Ext. and Mendiola • Crossing over the Malacañang Park and Malacañang Palace	710 m
Route-2	• Connecting between United Nations Ave. and Dr. J P Laurel	830 m
Route-3	• Connecting Marcelino and Carlos Palanca Sr.	410 m

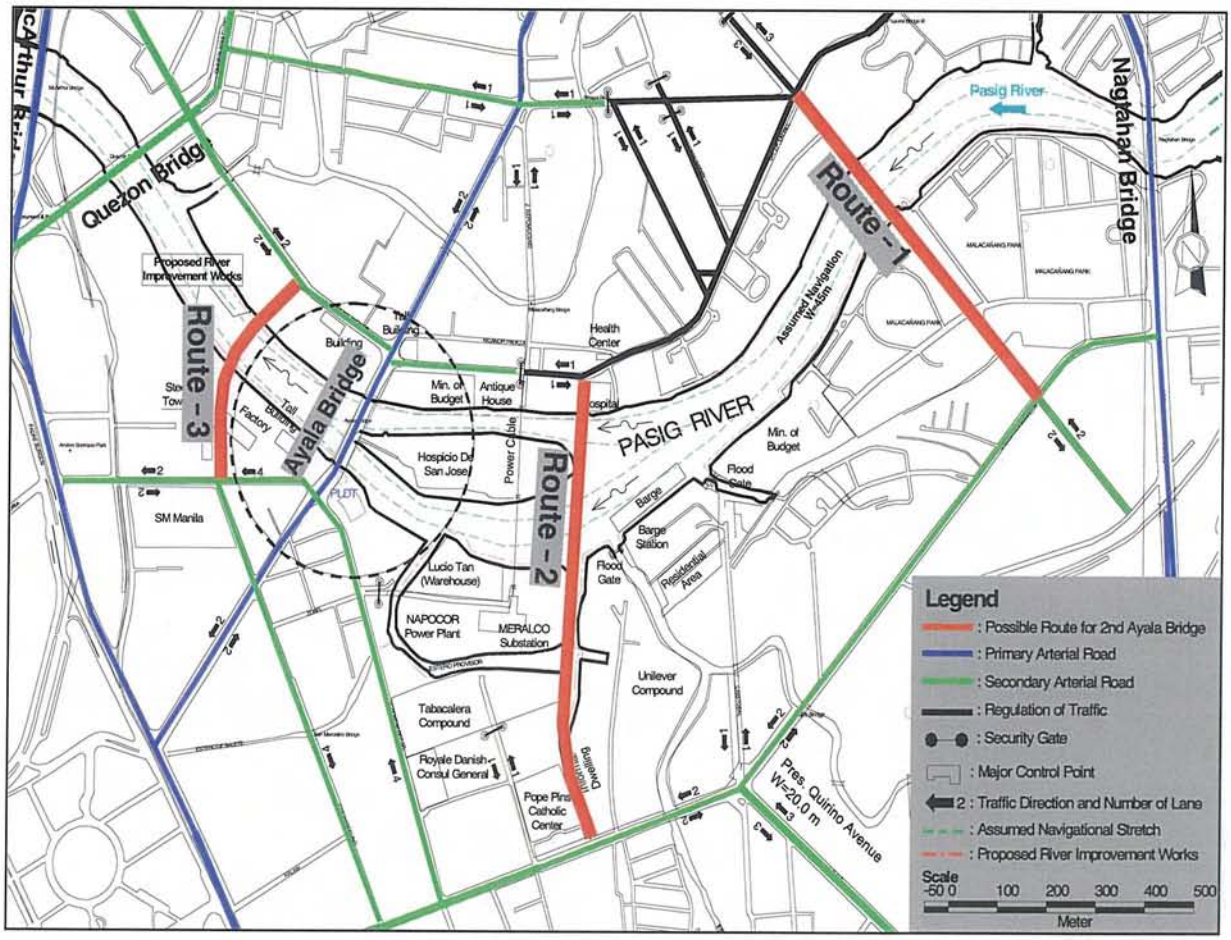


Figure 19.1.2-1 Possible Routes

(2) Interview Survey on Proposed Routes

Interview survey with major concerned organizations and land owners along the proposed routes and immediate vicinities was conducted to ensure that important concerns, ideas, apprehensions, and other issues are taken into consideration during the evaluation of alternatives routes viability. The interview results are shown in **Table 19.1.2-2**.

Table 19.1.2-2 Results of Interview Survey

	Comments
(i) Hospicio de San Jose	• No objection to any route
(ii) City Engineering Office, City of Manila	• Route 2 is favorable
(iii) Presidential Security Group (PSG)	• Strong objection to construct between Nagtahan Bridge and Ayala Bridge
(iv) National Historical Institute (NHI)	• No objection to any route
(v) National Power Corporation (NAPACOR)	• No objection to any route
(vi) City Planning and Development Office (CPDO)	• Route 3 is preferable
(vii) Ayala Foundation	• No objection to any route

(3) Comparative Study on Route Alternatives

(a) Evaluation Criteria

The following three (3) factors were taken into consideration for the evaluation of the possible route alternatives.

- Social Environment Impact
- Traffic Function
- Interview Survey Result

(b) Evaluated Results

The results of comparative study on the route alternatives were summarized as shown in **Table 19.1.2-3**.

Table 19.1.2-3 Evaluated Results of the Route Alternatives

Route Alternatives	Evaluation Items				Rating (Score)
	Special Environment		Traffic Function	Interview * Result	
	Affected Houses	ROW			
Route 1	50 A	1,000m^2 A	High A	Not Allowed X	X 2
Route 2	50 A	1,000m^2 A	Medium B	Not Allowed X	X 3
Route 3	50 A	6,000m^2 C	Low C	Ok A	Ok 1
Remarks	* : Any bridge construction is not allowed between Nagtahan Bridge and Ayala Bridge due to strong objection by PCG.				

The PSG member of the DPWH Steering Committee strongly expressed that Route 1 and Route 2, presents security problems with the Malacañang Palace.

In due consideration of this comment, the DPWH Steering Committee eventually recommended Route 3 as the most acceptable route to complement the traffic function of the existing Ayala Bridge.

(c) Recommendation on Future Extension of Route 3

Figure 19.1.2-2 presents the recommendations for the possible extension corridor alternatives of Route 3 to further improve the traffic condition in the vicinity.

The extension of the route has the following advantages:

- Manila City has a plan to redevelop the areas where the proposed extension corridor goes through, including new road construction.
- Extension of the route is to be in conformity with Manila City Plan, according to interview survey with City officials.
- By providing extension road, traffic congestion in areas A and B will be considerably improved.

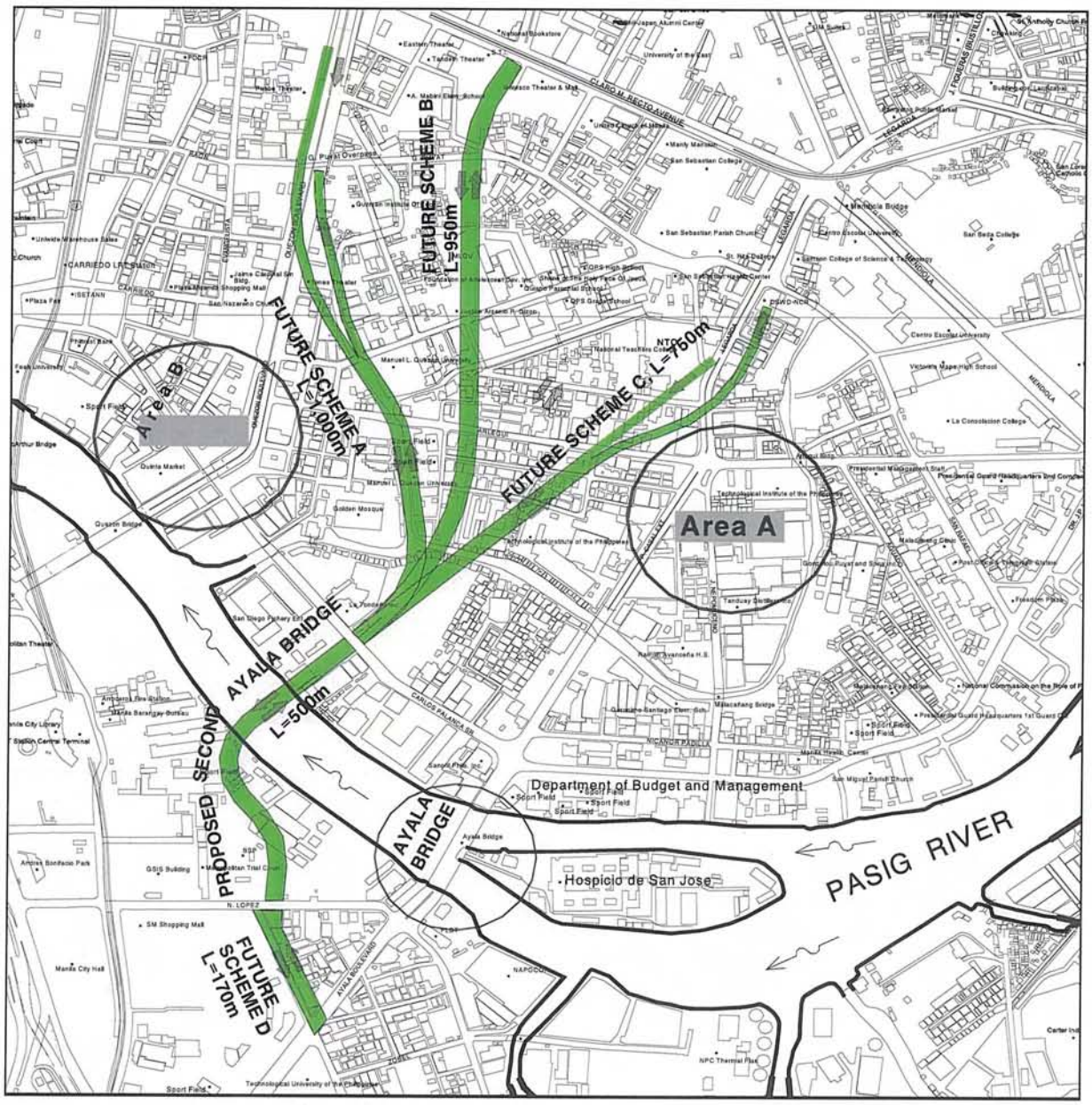


Figure 19.1.2-2 Possible Extension of Corridor

19.2 COMPARATIVE STUDY ON ALIGNMENT AND BRIDGE TYPE

19.2.1 Natural Condition Survey

(1) Topographic Survey

(a) Control Monument

Two (2) GPS Stations were established as control points for the Second Ayala Bridge as shown in **Table 19.2.1-1**.

Table 19.2.1-1 GPS Stationing and Coordinates

STATION	GPS COORDINATES		
	NORTHING	EASTING	ELEVATION
GPS – A1NEW	1613645.933	498185.577	11.829
GPS – A2NEW	1613652.067	498298.208	11.975

All elevations were reckoned from existing PCGS, BM and were added a constant 10.475 meter to be consistent with the previous study's vertical control system.

(b) Topographic Survey

Topographic Survey was conducted using the established control points and through the use of Calibrated Total Stations Survey Instrument with Electronic Data Recorder. The two (2) GPS Stations established were tied to the existing NAMRIA GPS Stations MMA-1 and MMA-46 located at Fort Bonifacio and Cultural Center of the Philippines to conform with the PRS-92 coordinates system.

Table 19.2.1-2 shows the scope of works of topographic survey. Topographic plan is shown in **Appendix 19.2.1-1**.

Table 19.2.1-2 Scope of Work of Topographic Survey

Description	Original Scope	Actual Work
Control Point Survey (GPS)	1	2
Profile Survey	230 m Bridge Section + 250 m Each of Both Approach Roads (500) Total = 980 m	230 m Bridge Section + 250 m Each of Both Approach Roads (500) Total = 980 m
Road Cross-Section Survey	Approach Roads (250 m): @ 20 M Interval Width: 200 m (Approach Roads) and 30 m Each Intersecting Roads (5 legs) Total = 38 Sections	Approach Roads (250 m): @ 20 M Interval Width: 200 m (Approach Roads) and 30 m Each Intersecting Roads (5 legs) Total = 38 Sections
Topographic Survey	250 m (Length) x 200 m (Width) + 30 m x 500 m = 65,000 sq. m	250 m (Length) x 200 m (Width) + 30 m x 500 m = 65,000 sq. m
River Cross-Section Survey	Edges of Bridge: 2 Upstream Side: 2 Downstream Side: 2 Total: 6 Sections	Edges of Bridge: 2 Upstream Side: 2 Downstream Side: 2 Center Profile of Bridge: 1 Total: 7 Sections

(2) Geotechnical Survey

Three (3) exploratory boreholes were drilled at the proposed bridge site, one each of the abutments and the third at the pier locations (refer to the Borehole Location Plan) (see **Appendix 19.2.1-2** for the Geotechnical Survey of Second Ayala Bridge). The boreholes were drilled down to a final depth of 30.0 to 40.0 meters from the existing ground line.

Alluvial soil formation was encountered at the proposed bridge site, as revealed by the boreholes. The alluvial layer is found at the upper 27.0-meters of the first abutment (BH-1), 12.0 meters at the piers (BH-2) and 22.0 meters of the second abutment (BH-3). The formation is made up of alternating layers of cohesive and granular materials of varying consistencies and relative densities. The results of geotechnical survey are shown in **Appendix 19.2.1-2**.

19.2.2 Road Alignment Alternatives

(1) Provision of Road Alignment Alternatives

The road alignment alternatives for the Second Ayala Bridge are proposed to be between Quezon Bridge and Ayala Bridge. These alternatives connect the secondary arterials of Natividad Lopez (Concepcion) and Carlos Palanca, as shown in **Figure 19.2.2-1**. Shoe Mart (SM) Manila City located at the corner of Natividad Lopez (Concepcion) and San Marcelino serves as the control point for the beginning of alignment.

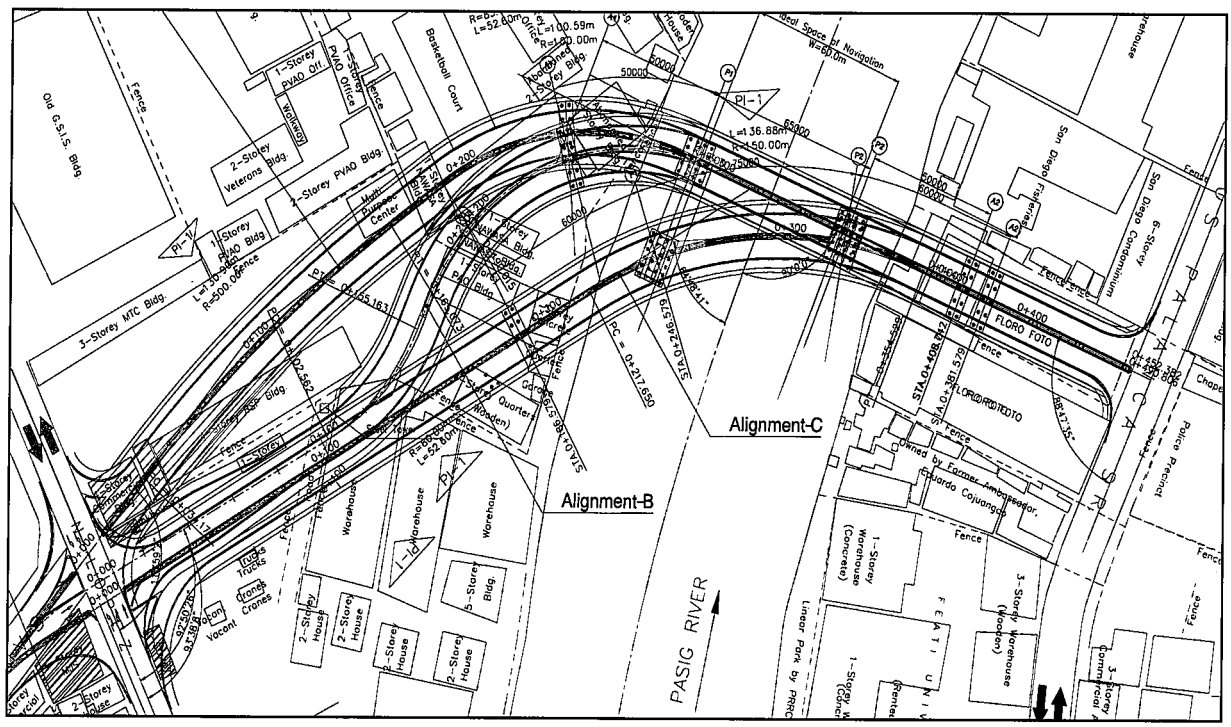


Figure 19.2.2-1 Road Alignment Alternatives

Outline of each alignment is described in **Table 19.2.2-1.**

Table 19.2.2-1 Outline of Alignments

Alternatives	Start	River Crossing	End	Total Length
Alignment A	Straight from San Marcelino	Orthogonal with River Flow	Nearly Orthogonal with Carlos Palanca Sr. (Florofoto Compound)	491 (m)
Alignment B	Nearly Orthogonal with Natividad Lopez (Concepcion)	Orthogonal with River Flow	Nearly Orthogonal with Carlos Palanca Sr. (Florofoto Compound)	541 (m)
Alignment C	Nearly Orthogonal with Natividad Lopez (Concepcion)	Skewed	Nearly Orthogonal with Carlos Palanca Sr. (Florofoto Compound)	453 (m)

- Scheme A is connected straightly with San Marcelino in the south side of Pasig River. This scheme will transverse the three (3) stories reinforced concrete main office building of Boy Scout of the Philippines (BSP). Intersection with Natividad Lopez (Concepcion) is skewed. The bridge piers are same direction with river flow. The approaches on the north side of the Pasig River is occupied by Frolofoto Company. The land is owned by Mr. Villalon of Cebu City. Most of the buildings in the area had been burnt down.

- Scheme B is connected nearly orthogonally with Natividad Lopez (Concepcion). This scheme is a reversed curve so that the main office building of BSP will not be demolished.

- Scheme C is connected nearly orthogonally with Natividad Lopez (Concepcion) similar to Scheme B. This scheme is an alignment with single radius introduced near the end alignment towards the intersection. Alignment is skewed/curved at the bridge section.

(2) Design Criteria for Comparative Study

Design criteria for the comparative study complies with that of Section **19.3.1**, including standard cross section.

(3) Evaluation Criteria for Comparative Study

The road alignment alternatives were compared from the following items:

- Traffic Functionality
- Structural Aspects
- Social/Environmental Impact
- Construction Cost (Bridge cost was assumed as PC Box Girder Type)

(4) Selection of the Best Alignment

Table 19.2.2-2 shows the comparative study on the proposed alignments. According to the study, **Scheme B** alignment is selected as the best scheme, based on the following reasons:

- Scheme B alignment can avoid major buildings including the 4-storey RC building for Boy Scout activities and a 4-storey commercial building which DPWH recommended to avoid. (See **Figure 19.2.2-1**)

- Structures affected by Scheme B are only light structures such as warehouses,(See **Figure 19.2.2-1**)

- Scheme B alignment is orthogonally connected to Natividad Lopez (Concepcion). The improvement of the local traffic conditions could be expected since the traffic flow at the intersection is smoothly traveled than Scheme A,

- The center span length of the bridge with Schemes A and B may be shorter than that of Scheme C, since the skew angle of Scheme C is more severe than that of Schemes A or B. Therefore, the construction cost of Schemes A and B is lower than that of Scheme C,

- Scheme B alignment may discourage drivers to make faster speed by employing the reversed small curvatures,

- Since the existing driving speed near the intersection at SM Building may be 20~30km/h, it is better for the traffic safety to keep slower speed near the intersection, and

- Scheme B alignment crosses the river at right angle, which may give better condition to the passage of vessels and water flow.

19.2.3 Bridge Type Alternatives

(1) Provision of Bridge Type Alternatives

The following alternatives were prepared for the comparative study:

- Type-A : Prestressed Concrete Deck Girder (PCDG)
  Type with 4-span

- Type-B : Prestressed Concrete Box Girder (PCBG)
  Type with 3-span

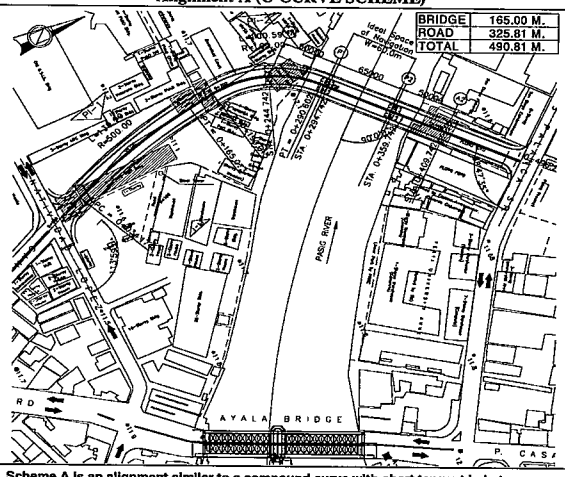
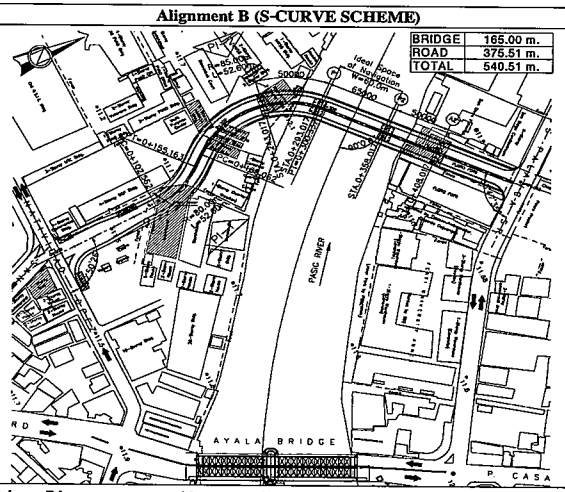
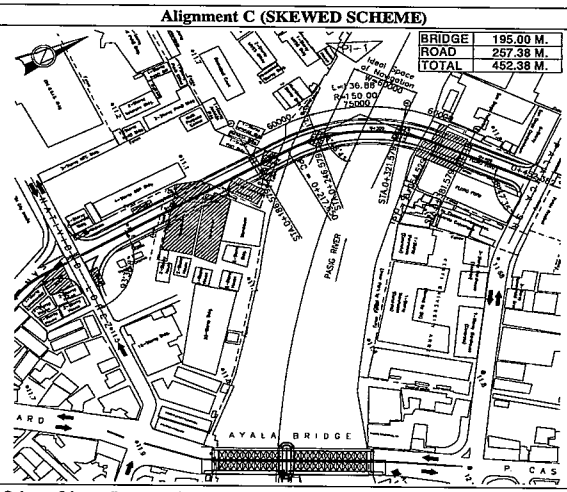
- Type-C : Steel Box Girder (SBG)

(2) Evaluation Criteria for Comparative Study

The bridge type alternatives were compared from the following items:

- Construction Cost
- Construction Difficulty
- Navigation Clearance
- Aesthetic Aspect

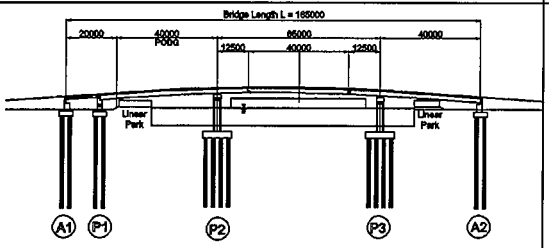
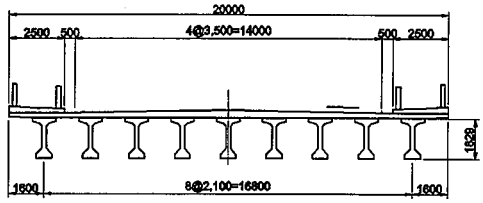
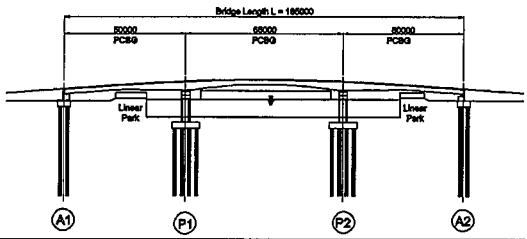
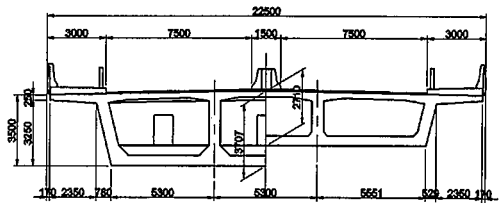
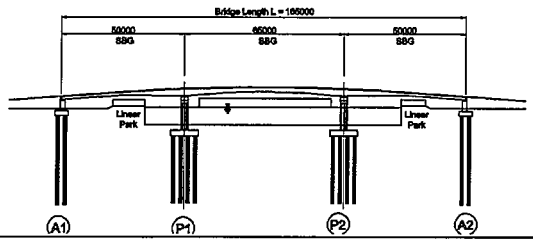
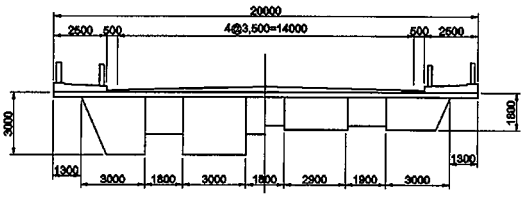
Table 19.2.2-2 Comparative Study on Alignment Alternatives

	Alignment A (C-CURVE SCHEME)	Alignment B (S-CURVE SCHEME)	Alignment C (SKEWED SCHEME)
PLAN			
FEATURES	• Scheme A is an alignment similar to a compound curve with short tangent in between curves. Alignment is normal to bridge section • Intersection is skewed.	• Scheme B is a reverse curve with a tangent in between curves. Alignment is normal at the bridge section. • Intersection is approximately at right angle.	• Scheme C is an alignment with a single radius introduced near the end alignment towards intersection. Alignment is skewed/curved at the bridge section • Intersection is approximately at right angle
TRAFFIC FUNCTIONALITY	• Scheme A is efficient at a design speed of 50 kph. However, it is unavailable to have a short broken back alignment. • Intersection at Natividad Lopez St. is skewed thereby reducing speed and sight distance to vehicle approaching intersection. • Limited channelization area since it will need more right-of-way. PI-1 / PI-2: Radius 500.00m / 100.00m; Length of curve 130.90m / 100.59m; Superelevation NC=2.0 % / NC=4.0%; Max. Gradient 7.0% B	• Scheme B is efficient at a design speed of 50 kph, only it has to use a radius of absolute minimum 80 m to make the bridge section normal to the river. A better alignment than Scheme A. • Intersection at Natividad Lopez St. is at right angle making it desirable to sight distance factor. • A channelized intersection is introduced to efficiently guide traffic flows. PI-1 / PI-2: Radius 80.00m / 85.00m; Length of curve 52.60m / 132.27m; Superelevation NC=4.0% / NC=4.0%; Max. Gradient 7.0% A	• Scheme C is efficient at a design speed of 50 kph. A single radius and a straight alignment make it better for sight distance and speed factor. However, it is detrimental to the river navigation due to position of foundation on skewed alignment. • A curve much nearer to the intersection makes it also undesirable • A channelized intersection is also introduced to efficiently guide traffic flows. PI-1: Radius 150.00m; Length of curve 136.88m; Superelevation NC=3.7%; Max. Gradient 7.0% A
STRUCTURAL ASPECT	• Bridge piers are same direction with the river. • South span is at curve portion of the roadway • Clearance under girder at the abutment is maintained at 2.0˜ 2.5m. • Center span to side span ratio 1.3 : 1.0 • Girder height to span length ratio is 1 : 18.5 • Direction of abutment is perpendicular to the alignment. MAJOR CONTROL POINTS: Warehouses; Steel Tower; Floro Foto Building A	• Bridge piers are same direction with the river • South span is at curve portion of the roadway • Clearance under girder at abut. is maintained at 2.0˜ 2.5m • Center span to side span ratio is 1.3 : 1.0 • Girder height to span length ratio is 1 : 18.5 • Direction of abutment is perpendicular to the alignment. MAJOR CONTROL POINTS: Boy Scout of the Philippines Building; Floro Foto Building A	• Bridge piers are same direction with the river. • Bridge is at curve portion of the roadway • Bridge skew = 65° • Clearance under girder at the abutment is maintained at 2.0˜ 2.5m. • Center span is much longer than Schemes A & B. • Direction of abutment is perpendicular to the alignment. MAJOR CONTROL POINTS: Boy Scout of the Phil. Building; Steel Tower; Floro Foto Building C
SOCIAL/ENVIRONMENTAL ASPECT	• Scheme A has the least number of structures To be affected but a 4-storey BSP building and a 4-storey commercial building will be affected. High trees are present within BSP compound. • Property of BSP shall be divided, providing access to the other side of property will be necessary. Project Affected Buildings: 6 Land Acquisition: Govt. 5572 sq.m.; Private 7180 sq.m.; Total 12753 sq.m. • Carlos Palanca will be elevated about 1.0m from existing road. C	• Scheme B has the most number of structures to be affected but all are small buildings. Some of these are just quarters and some are already abandoned buildings except for the old warehouse at south side of the river. • This scheme avoided the BSP building. • Two 1-storey commercial buildings will be affected within the intersection at Natividad Lopez St. Project Affected Buildings: 8 Land Acquisition: Govt. 1328 sq.m.; Private 9938 sq.m.; Total 11266 sq.m. • Carlos Palanca will be elevated about 1.0m from existing road. B	• Scheme C has the most number of structures to be affected especially old warehouses and Floro Foto building will also be affected. • This scheme avoided the BSP building. Property of BSP will not be divided. • Two 1-storey commercial buildings will be affected at the intersection of Natividad Lopez St. Project Affected Buildings: 7 Land Acquisition: Govt. 2644 sq.m.; Private 8459 sq.m.; Total 11103 sq.m. • Carlos Palanca will be elevated Much higher than both schemes, thus longer reconstruction of the street. B
CONSTRUCTION COST	• Scheme A is the cheapest among the schemes in terms of road and bridge construction due to its lesser length. But the difference is insignificant to Scheme B. • Scheme A has the largest land acquisition cost due to properties that are no longer useful because of the division of the said property. • Overall cost will be the least among the schemes. Bridge 3630.0 m² 150,000 545 M; Road 7168.0 10,000 72 M; Total 10798.0 617 M; Construction Period 30 Months A	• Scheme B has the longest alignment. Road construction would be slightly higher than Scheme A. • Scheme B would acquire lesser land area than Scheme A. • Overall cost would be slightly higher than Scheme A. Bridge 3713.0 m² 150,000 545 M; Road 8449.0 10,000 85 M; Total 12162.0 630 M; Construction Period 30 Months A	• Scheme C has the shortest alignment but construction of skewed bridge require longer spans and bigger structures at midspan, thereby its construction cost. • Scheme C would acquire least land area than Scheme A and Scheme B. • Overall cost would be highest among the schemes Bridge 4290.0 m² 200,000 858 M; Road 5663.0 10,000 57 M; Total 9953.0 915 M; Construction Period 32 Months C
RECOMMENDATION	• Not recommended	• Recommended	• Not recommended
NOTE	A – Good B – Medium C – Not Good		

(3) Selection of the Best Bridge Type

Table 19.2.3-1 shows the comparative study on the proposed bridge types. According to the study, the type-B was selected as the best scheme.

Table 19.2.3-1 Comparative Study on Bridge Type Alternatives

Bridge Type		
Type	Side View	Cross Section
A PCDG		 PC Deck Girder(PCDG)
B PCBG		
C SBG		 Steel Box Girder (SBG)

Comparison

Type	Construction Cost		Construction		Structure		Appearance		Evaluation	
A PCDG	630 MP	A	Normal	B	Not Good	C	Not Good	C		10
B PCBG	650 MP	B	Easy	A	Good	A	Good	A	Recommended	18
C SBG	680 MP	C	Normal	B	Good	A	Good	A		15

Notes: 1. The evaluation value: A=5, B=3, C=1
2. Structure: The adopted span length is suitable or not for the bridge type.