REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH)

PREPARATORY SURVEY FOR EXPRESSWAY PROJECTS IN MEGA MANILA REGION

CAVITE LAGUNA EXPRESSWAY PROJECT (Laguna Section)

FINAL REPORT MAIN TEXT

NOVEMBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

CTI ENGINEERING INTERNATIONAL CO., LTD
MITSUBISHI RESEARCH INSTITUTE, INC.
ORIENTAL CONSULTANTS CO., LTD
METROPOLITAN EXPRESSWAY CO., LTD

EI
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CALAX

EXCHANGE RATE

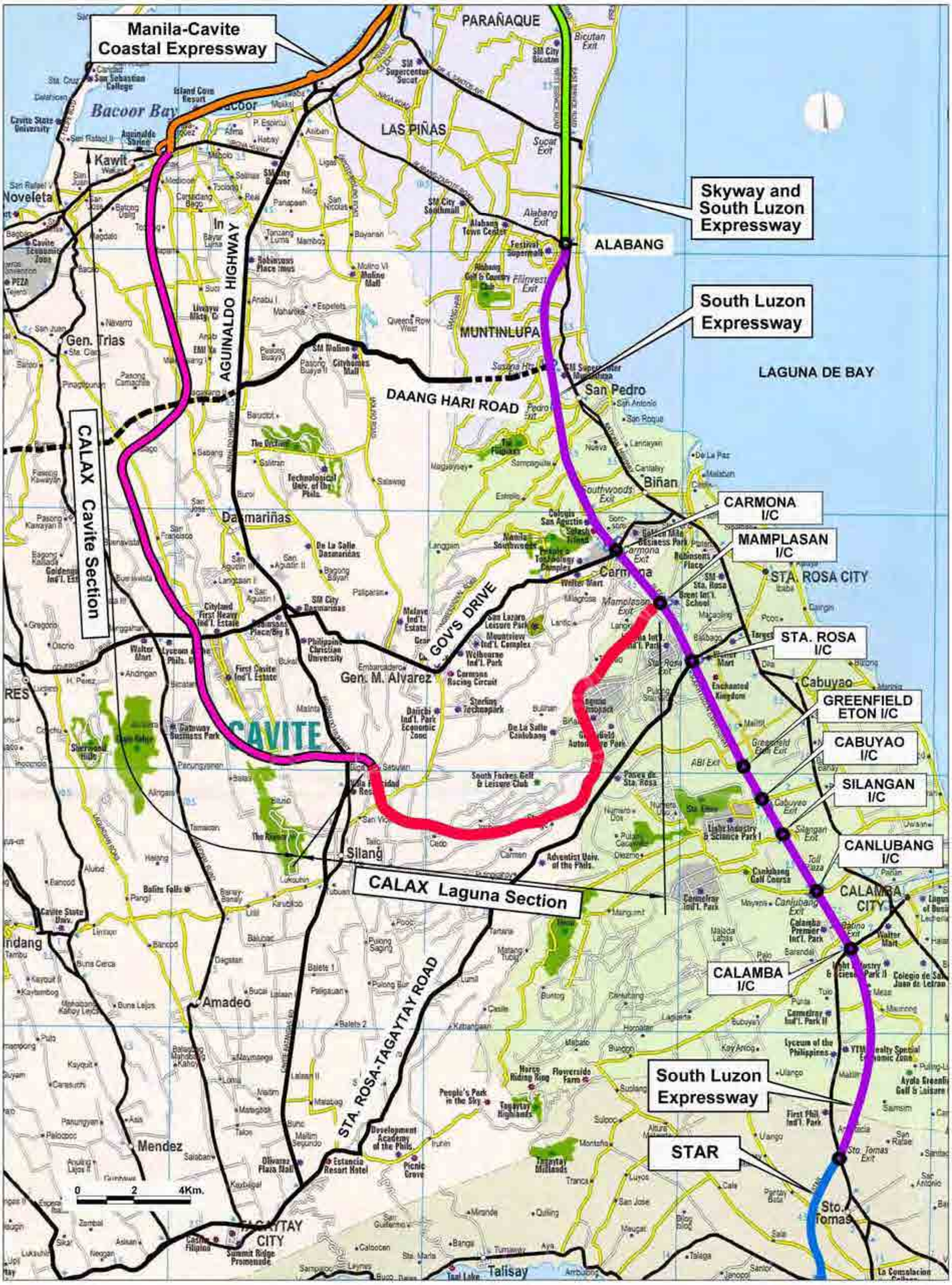
June 2012

1PhP= 1.86 Japan Yen

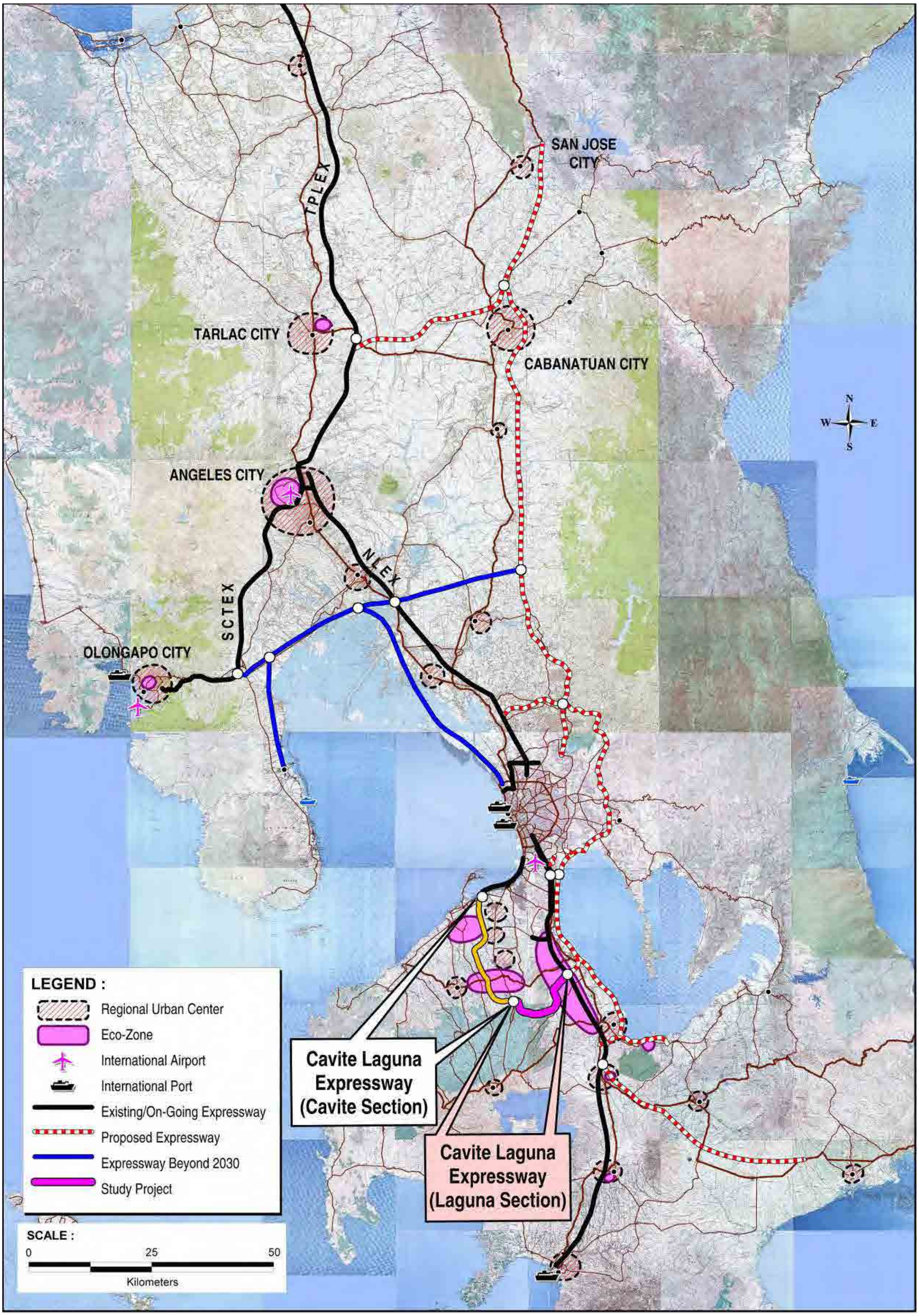
1US$=42.7Philippine Peso

1US$= 79.7 Japan Yen

Central Bank of the Philippines



LOCATION MAP OF CALAX



LOCATION MAP OF CALAX

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ACRONYMS AND ABBREVIATIONS

ADB	:	Asian Development Bank
B/C	:	Benefit/Cost Ratio
BCDA	:	Bases Conversion Development Authority
BLT	:	Build-Lease-Transfer
BOT	:	Build-Operate and Transfer
CAAP	:	Civil Aviation Authority of the Philippines
CDCP	:	Construction Development Corporation of the Philippines
CLEx	:	Central Luzon Expressway
DBFO		Design, Build, Finance and Operate
DBP	:	Development Bank of the Philippines
DENR	:	Department of Environment and Natural Resources
DBM	:	Department of Budget and Management
DOF	:	Department of Finance
DOTC	:	Department of Transportation and Communications
DPWH	:	Department of Public Works and Highways
DTI	:	Department of Trade and Industry
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
EIS	:	Environmental Impact Statement
EO	:	Executive Order
FIRR	:	Financial Internal Rate of Return
GDP	:	Gross Domestic Product
GFS	:	Government Financing Support
GOCCs	:	Government-Owned and Controlled Corporations
GOJ	:	Government of Japan
GRP	:	Government of the Republic of the Philippines
HSH	:	High Standard Highway
ICC	:	Investment Coordinating Committee
IEE	:	Initial Environmental Examination
IFC	:	International Finance Corporation of World Bank Group
IRR	:	Internal Rate of Return
JICA	:	Japan International Cooperation Agency
KOICA	:	Korean International Cooperation Agency
LAPRAP	:	Land Acquisition Plan and Resettlement Action Plan
LGUs	:	Local Government Units
LRTA	:	Light Rail Transit Authority
MARINA	:	Maritime Industry Authority
MRG	:	Minimum Revenue Guarantee
MIAA	:	Manila International Airport Authority
MMDA	:	Metro Manila Development Agency
MRT	:	Mass Rail Transit
MRTC	:	Metro Rail Transit Corporation
NCR	:	National Capital Region
NDC	:	National Development Corporation
NEDA	:	National Economic Development Authority
NGO	:	Non-Governmental Organization
NLEx	:	North Luzon Expressway
NPER	:	Net Public Expenditure Reduction
NPV	:	Net Present Value
O&M	:	Operation and Maintenance
ODA	:	Official Development Assistance
OSG	:	Office of the Solicitor General
PD	:	Presidential Decree
PEA	:	Philippine Estate Authority
PEGR	:	Philippines-Australia Partnership for Economic Governance Reform
PIP	:	Public Investment Plan
PMO-BOT	:	Project Management Office for Build-Operate-Transfer
PNCC	:	Philippine National Construction Company
PNR	:	Philippine National Railways
PPA	:	Philippine Port Authority
PPP	:	Public-Private Partnership
R.A.	:	Republic Act
RAP	:	Resettlement Action Plan
ROW	:	Right of Way
SC	:	Steering Committee
SCTEx	:	Subic-Clark-Tarlac Expressway
SLEx	:	South Luzon Expressway
SPC	:	Special Purpose Company
STAR	:	Southern Tagalog Arterial Road
STOA	:	Supplemental Toll Operation Agreement
TCA	:	Toll Concession Agreement
TOA	:	Toll Operation Agreement
TOC	:	Toll Operation Certificate
TOR	:	Terms of Reference
TPLEx	:	Tarlac-Pangasinan-La Union Expressway
TRB	:	Toll Regulatory Board
TWG	:	Technical Working Group
USAID	:	United States Agency for International Development
WACC	:	Weighted Average of Capital Cost
WB	:	World Bank

EXECUTIVE SUMMARY

1. BACKGROUND OF CALAX PROJECT

Cavite and Laguna are neighboring provinces of Metro Manila and rapid urbanization is taking place which is causing traffic congestions in both provinces. Many economic zones/industrial parks have been and are being developed. The two provinces are now the core center of the secondary industry of the Philippines. Cavite-Laguna Expressway (CALAX) provides vital transport access to provinces of Cavite and Laguna; where rapid urbanization propelled by the private developers is on-going and economic/industrial zones have and are being developed. CALAX will support sound urbanization of the two provinces and industrial development and economic development of the provinces as well as reduction of traffic congestion of the two provinces.

In 2006, JICA-assisted Feasibility Study and Implementation Support on the CALA East-West National Road Project (hereinafter referred to as the "2006 FS") was undertaken. The 2006 FS studied three (3) roads as follows;

- North-South Road (for CAVITEX to north of Governor's Drive)
- Daang Hari Road
- CALA Expressway (from Governor's Drive to SLEX), section from Governor's Drive to CAVITEX Extension was not included due to uncertain alignment and implementation of CAVITEX Extension.

After the 2006 FS, the DPWH tried to implement CALAX and several stakeholders meeting inviting concerned private land developers, however, most of land developers objected the CALAX Project because their development plans are severely affected. Thus, DPWH suspended further actions for implementation. Meantime, the DPWH continued discussions with the CAVITEX operator and concerned LGUs in Cavite Province and selected CALAX corridor alignment of the Cavite side.

In 2009, the World Bank decided to finance the transaction services for the Cavite section of CALAX project through its loan. The Consultant for the transaction services was selected and the work commenced in September 2011. JICA also decided to provide technical assistance for the Laguna section of CALAX in 2010.

2 NESSECITY OF CALAX PROJECT

Therefore the improvement in transport sector is necessary as follows.

- Traffic congestion of National Roads in Cavite and Laguna Provinces. Needs to reduce traffic congestion
- Economic and Social activities in the area are quite active. Transport infrastructure needs to support these activities
- Urbanization is quite rapid in the area. Need to support sound urbanization.
- Lack of Public Roads. Needs more public roads in the area

- Expressway network is not formed and expressways are functioning independently. Needs formation of expressway network

3 OBJECTIVE OF CALAX PROJECT

Based on the background the existing situation of Cavite-Laguna Provinces, the objectives of the CALAX project are as follows:

OBJECTIVES OF THE PROJECT

(i) To provide fast, safe, comfortable and reliable means of transport in Cavite and Laguna Provinces.
(ii) To decongest traffic of roads in Cavite and Laguna Provinces.
(iii) To support economic development by providing better transport access to economic/industrial zones in the area, this contributes to promote local/foreign investments in the area.
(iv) To support sound urbanization in the area.

The CALAX is divided into two sections namely, Cavite Section and Laguna Section. The Feasibility Study and Transaction Advisory Service of Cavite Section has been implemented with the finance of the World Bank. The Laguna Section of the CALAX is studied under this study.

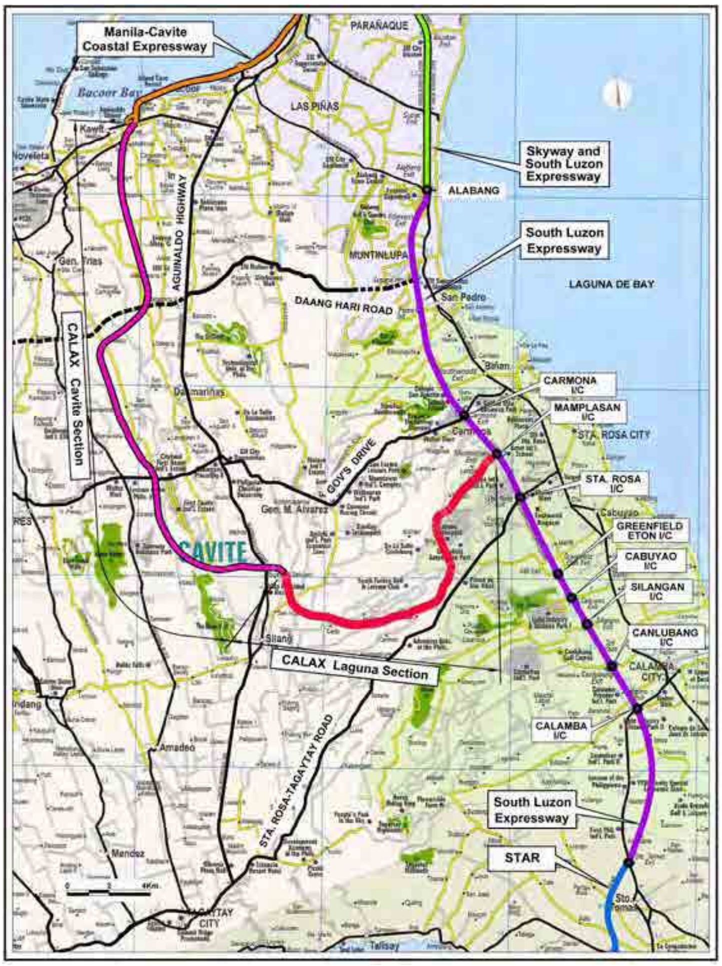


FIGURE 3-1 LOCATION OF CALAX

4 ALIGNMENT STUDY OF LAGUNA SECTION OF CALAX

4.1 Review of the 2006 FS

(1) Proposed Alignment by the 2006 FS

CALAX was studied in the JICA-assisted Feasibility Study and Implementation Support on the CALA East-West National Project. The alignment recommended by the 2006 FS is shown in **FIGURE 4.1-1**. The recommended alignment starts at Eton/Greenfield Interchange (IC) of SLEX and goes westwards crossing Sta. Rosa – Tagaytay Road and reaches to Aguinaldo Highway. From there, it goes north-east direction and ends at Governor's Drive.

(2) Objection to the Proposed Alignment by the Land Developers

Many land developers such as Eton Properties Philippines, Inc., Greenfield Development Corporation, and University of Sto. Tomas, etc., purchased the lands in the corridor from SLEX and Sta. Rosa – Tagaytay Road. DPWH undertook the stakeholders meeting in 2006 and 2007 in order to realize the project, however, most land developers did not agree to the proposed alignment because their land development plan was severely affected. Thus, DPWH suspended the further actions for implementation.

(3) Engineering Concept

CALAX was planned as a national road and not as an access-controlled expressway, thus no toll facilities were planned, although grade separations at intersections with major roads were planned.

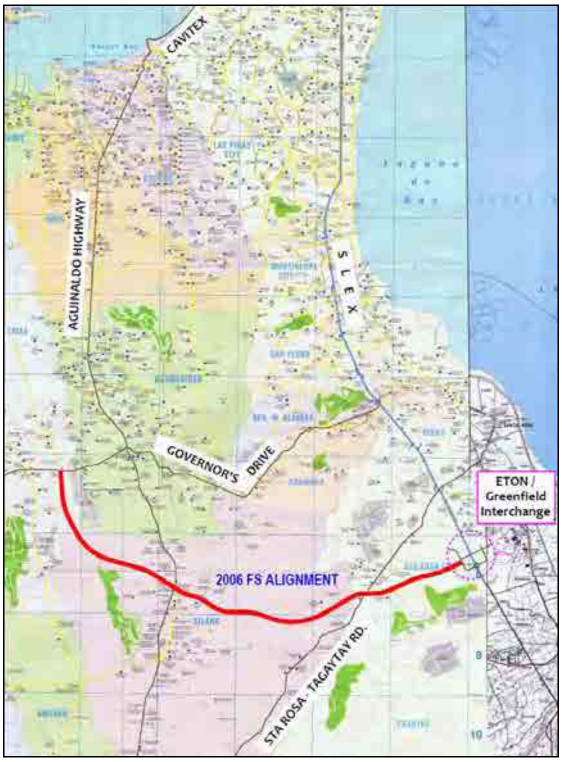


FIGURE 4.1-1 CALAX ALIGNMENT RECOMMENDED BY THE 2006 FS

4.2 Selection of the Beginning Point of Laguna Section (Connection Point of Cavite and Laguna Sections)

Three (3) alternative alignments were developed focusing on minimization of social impact or dislocation of people on the beginning point of Laguna Section. The Alternatives prepared are as follows.

- Alternative-1: Alignment Recommended by the 2006 FS
- Alternative-2: North Alignment to minimize social impact in the northern area of Silang Municipality town proper.
- Alternative-3: South Alignment to minimize social impact in the southern area of Silang Municipality town proper.

Three alternative alignments were evaluated as shown in **TABLE 4.2-1** and Alternative-2 was recommended due to minimize social impact and construction cost.

TABLE 4.2-1 EVALUATION OF ALTERNATIVE ALIGNMENTS AT BEGINNING POINT

Alternatives			Alternative 1		Alternative 2		Alternative 3	
Concept			Alignment proposed by 2006 FS		To minimize social impacts in the northern area of Silang Municipality.		To minimize social impacts in the southern area of Silang Municipality.	
Road Length (km)			5.50		6.27		6.66	
Evaluation	Cost (Billion Pesos)	Construction ROW Total	0.798 0.414 1.212 (1.00)	△	0.910 0.213 1.123 (0.93)	○	0.966 0.354 1.320 (1.09)	△`
	Connection to Aguinaldo Highway		Difficult due to no appropriate area for interchange.	X	Easy to connect by trumpet type of interchange.	○	Easy to connect by trumpet type of interchange.	○
	Social Impact	No. of Residential Houses affected	38	X	17	○	44	X
		No. of Large	2 (Cavite State		0		0	

		Buildings affected	University)					
	Natural Environment		• Same condition among alternatives. • No serious problem.	○	• Same condition among alternatives. • No serious problem.	○	• Same condition among alternatives. • No serious problem.	○
	Evaluation		○: 1, △: 1, X: 2		○: 4, △: 0, X: 0 **Recommended**		○: 2, △: 1, X: 1	

4.3 Alignment Alternatives of CALA

The alignment study has been carried out in this study from the viewpoints as follows:

- Land area acquired by private land developers
- Road network status in the project area
- Existing land use and development plan in the project area
- Connection with existing and planned road network, interchange location

The six alternative alignments have been developed as shown in the **FIGURE 4.3-1**.

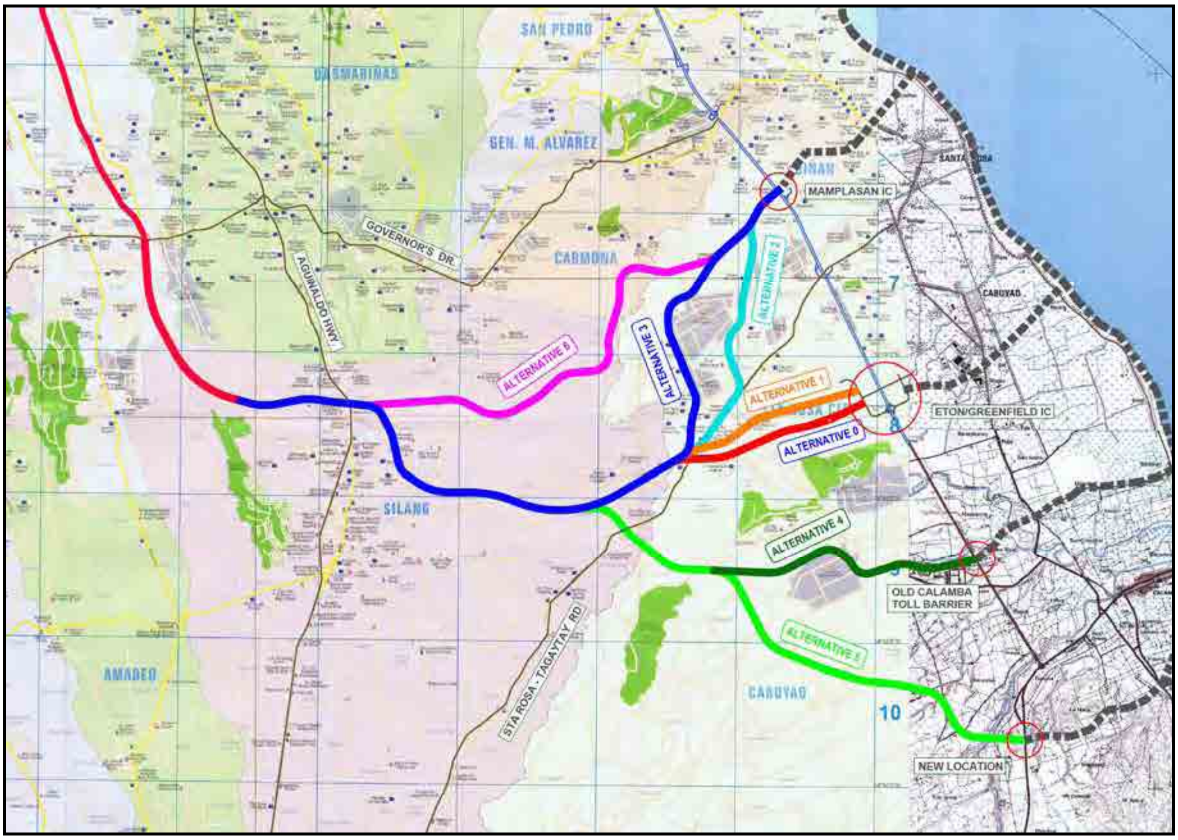


FIGURE 4.3-1 ALTERNATIVE ALIGNMENTS OF LAGUNA SECTION OF CALAX

The comparative analysis with the multi criteria evaluation method is show in **TABLE 4.3-1,** and Alternative-3 was recommended due to the following reasons;

- Cost is within 10% increase compared to the minimum cost alternative (Alternative-6). (Alternative-6 attracts least traffic). Second lowest alternative (Alternative-1) and Alternative-3 is almost the same cost.
- High traffic volume is attracted. Alternative-3 attracts the 2nd highest traffic. Highest is Alternative-4 and difference is 900 vehicle per day (or 1.6% difference).

- Social impact in terms of dislocation of people is the smallest.
- Since this alternative utilizes the 60m ROW of existing private road (for about 1/3) of the total expressway length), implementation in terms of ROW acquisition is the easiest and the fastest.
- Other alternatives affect people who have newly acquired a lot from the private land developers. When they bought their lots, they were not informed that their lots will be affected in the future by this project. Therefore, their life plan will have a drastric change. On the part of DPWH, ROW acquisition negotiation will take time.

TABLE 4.3-1 CHARACTERISTICS AND EVALUATION RESULT OF ALTERNATIVES ALIGNMENT

Alternatives		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Concept		• Revised alignment of 2006 proposal. • Provide shorter connection. • Provide access to residential subdivisions and industrial estates.	• Utilize existing private road ROW (40m). • Provide access to residential subdivisions and industrial estates.	• Utilize existing private road ROW (60m). • Provide access to residential subdivisions and industrial estates.	• Provide access to residential subdivisions and industrial estates. • Reduce traffic on SLEX.	• Provide access to residential subdivisions and industrial estates. • Reduce traffic on SLEX.	• Provide shortest connection.
Expressway Distance (km)		16.4	18.6	18.6	18.4	21.6	14.8
SLEX Connection		• Greenfield/Eton Interchange (direct or indirect connection)	• Mamplasan Interchange (direct or indirect connection)	• Existing Mamplasan Interchange (direct or indirect connection)	• New Interchange (direct connection)	• New Interchange (direct connection)	• Existing Mamplasan Interchange (direct or indirect connection)
Road Structure	Road Section	10.7 km	8.6 km	9.7 km	10.6 km	13.5 km	6.6 km
	Bridge/Viaduct	5.7 km	10.0 km	8.9 km	7.8 km	8.1 km	8.2 km
Cost (M Php)	Civil Work	11,710	15,106	14,562	14,210	15,790	14,244
	ROW	5,444	4,308	3,401	4,725	5,489	2,943
	Total	17,154	19,414	17,963	18,935	21,279	17,187
Estimated Traffic Volume (2020)	Volume (veh/day)	48,500	38,100	52,500	65,000	52,200	32,400
	Veh.-km.	609,100	466,600	495,000	632,000	643,200	384,700
Cost Performance		35.5	24.0	27.6	33.4	30.2	22.4
Utilization of Private Road ROW which is to be acquired by DPWH		-	Greenfield Parkway W = 40 m L = 4.4 km (1/4 of total length, but widening is required.)	Laguna Blvd. W = 60 m L = 6.2 km (1/3 of total length, and no widening is required.)	-	-	-
Residential Subdivision Affected	Already Residing	1.0 km	4.5 km 1.0 km (one-side only)	-	-	-	-
	Lots for Sale	2.6 km	-	-	2.8 km	6.2 km	1.0 km
Industrial Estate Affected	Under Operation	-	1.0 km (one-side only)	-	2.6 km	0.2 km	-

Alternatives		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
University Affected		University of Sto. Tomas (UST)	-	-	Adventist University of the Philippines (AUP)	Adventist University of the Philippines (AUP)	-
Status of Land Development of Each Developer	People already residing	• Adelfa /Fine Properties Inc.	• VALENZA • Sta. Rosa Estate • Greenfield City • Laguna Bel-Air I & II	• Ayala Land Corp. (Private Road ROW only)	-	-	• Ayala Land Corp. (Private Road ROW only)
	Lots for sale	• Greenfield Development Corp. • MESSA Homes	• Greenfield Development Corp.	-	• Ayala/Nuvali Properties Inc.	• Ayala/Nuvali Properties, Inc. • Sentosa, Inc. • Greenwood Park, Inc.	• Tamayo Property, Inc.
	No Development Yet	• Stateland, Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Eton Properties	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Greenfield Development Corporation	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Greenfield Development Corporation	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • San Ramon Holdings, Inc.	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • San Ramon Holdings, Inc. • Carmelray Town	• Stateland Inc. • Greenfield Development Corporation
Industrial Estate in operation			• Laguna Techno Park	• Laguna Techno Park (property is not affected)	• Silangan Industrial Park	• Filinvest Technology Park	
Evaluation results by multi criteria method	Relative superiority	○ = 4 △ = 5 × = 1	○ = 2 △ = 4 × = 4	○ = 5 △ = 4 × = 1	○ = 4 △ = 4 × = 2	○ = 3 △ = 4 × = 3	○ = 2 △ = 2 × = 6
	Score	**88.33**	**69.67**	**91.12** **[Recommended]**	**78.29**	**61.02**	**72.82**

4.4 Viaduct along Laguna Blvd.

The proposed alignment utilized the existing Laguna Blvd. which was developed by Ayala Corporation and is operated as a private road, therefore, all vehicles cannot pass the road but only those with sticker at present.

The east side of the road is the Laguna Techno Park (industrial estate) and the west side of the road is mostly residential subdivisions.

The road has a right-of-way width of 60m. About 1/3 of the section is 4-lane divided road and the rest is a 2-lane road. Due to roadside development, there are many intersections as shown in **FIGURE 4.4-1.**

CALAX was planned to fly over all existing intersections and the profile of the section between intersections was planned to lower as much as possible to reduce the construction cost, thus, the section along Laguna Blvd. comprises of Viaduct Section and the mechanically stabilized earth wall (MSE Wall).

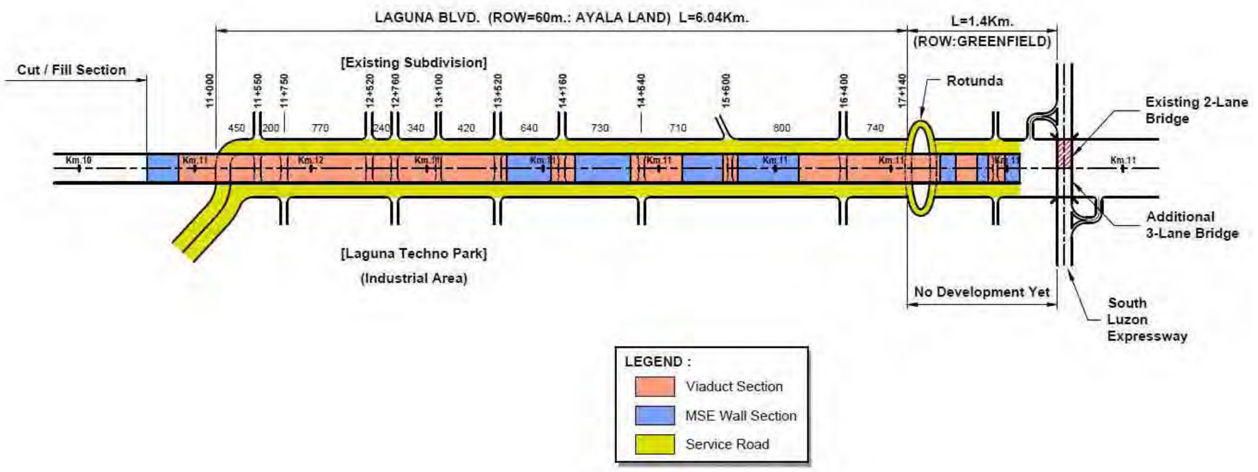


FIGURE .4.4-1 VIADUCT ALONG LAGUNA BLVD.

4.5 Mamplasan Interchange Connection

(1) Connection Method between CALAX and SLEX

Two types of connection methods were studied as follows;
Case-1: Direct connection between CALAX and SLEX (**FIGURE 4.5-1**)
Case-2: Indirect connection between CALAX and SLEX (**FIGURE 4.5-2**)

Both schemes were evaluated and Case-2: Indirect Connection was recommended due to the following reasons;

- Although the direct connection is ideal for the smooth traffic flow from/to CALAX to/from SLEX, however,
  - This scheme is quite expensive compared to Indirect Connection Method. (Higher by 1.67 times, or an additional Php 1,467 Million required.)
  - Accessibility to establishment/residents near the existing Mamplasan Interchange becomes worse than at present.
- Traffic flow of Indirect Connection Method can be improved by adopting flyovers at major intersections.

(2) Development Plan of Greenfield Development Corp. (GDC)

The area of about 1.2 km section adjacent to the Mamplasan Interchange is owned by Greenfield Development Corporation (GDC). GDC has a development plan of this area. GDC strongly requested CALAX not to follow the existing road, since GDC will totally change the road network in line with their development plan. It is also requested a rotary type of intersection (rotunda) be built near the Mamplasan Interchange. GDC committed to provide a 50m road right-of-way for the alignment of CALAX.

Many meetings were held and GDC agreed to follow the scheme shown in **FIGURE 4.5-3.**

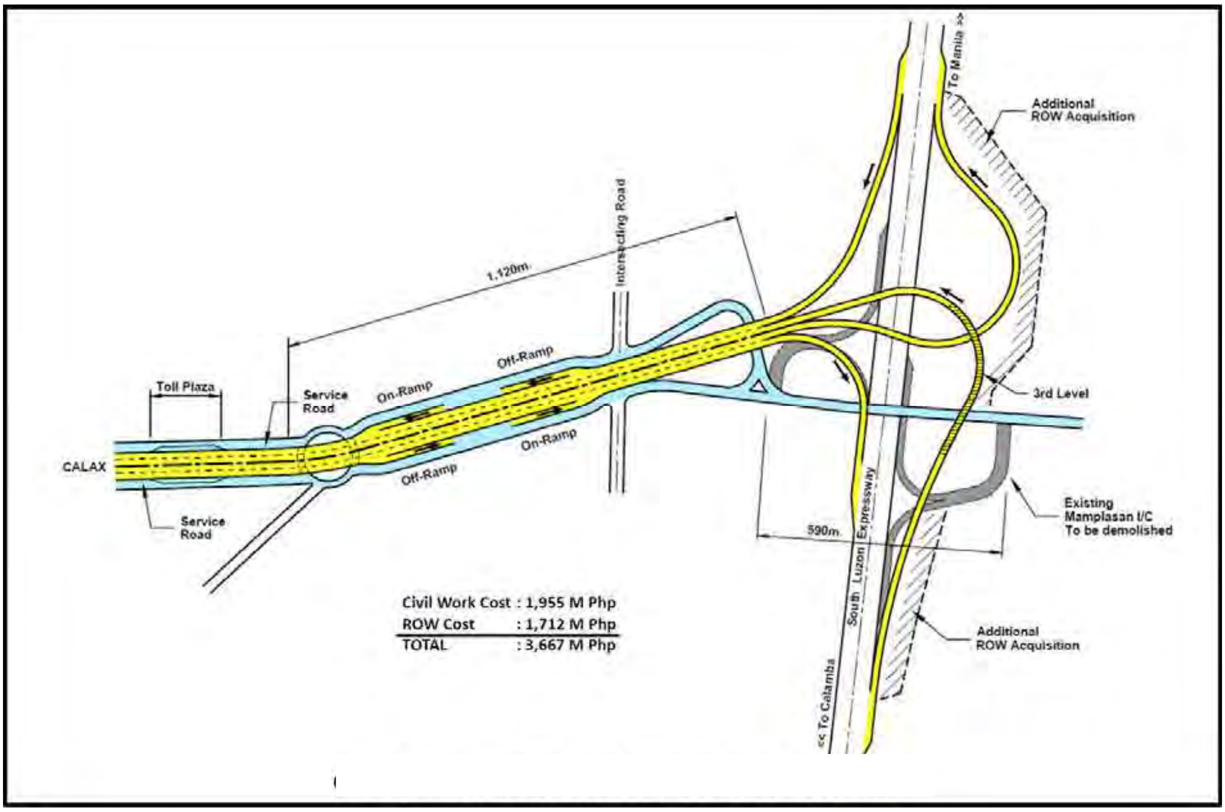


FIGURE 4.5-1 CASE-1: DIRECT CONNECTION BETWEEN SLEX AND CALAX

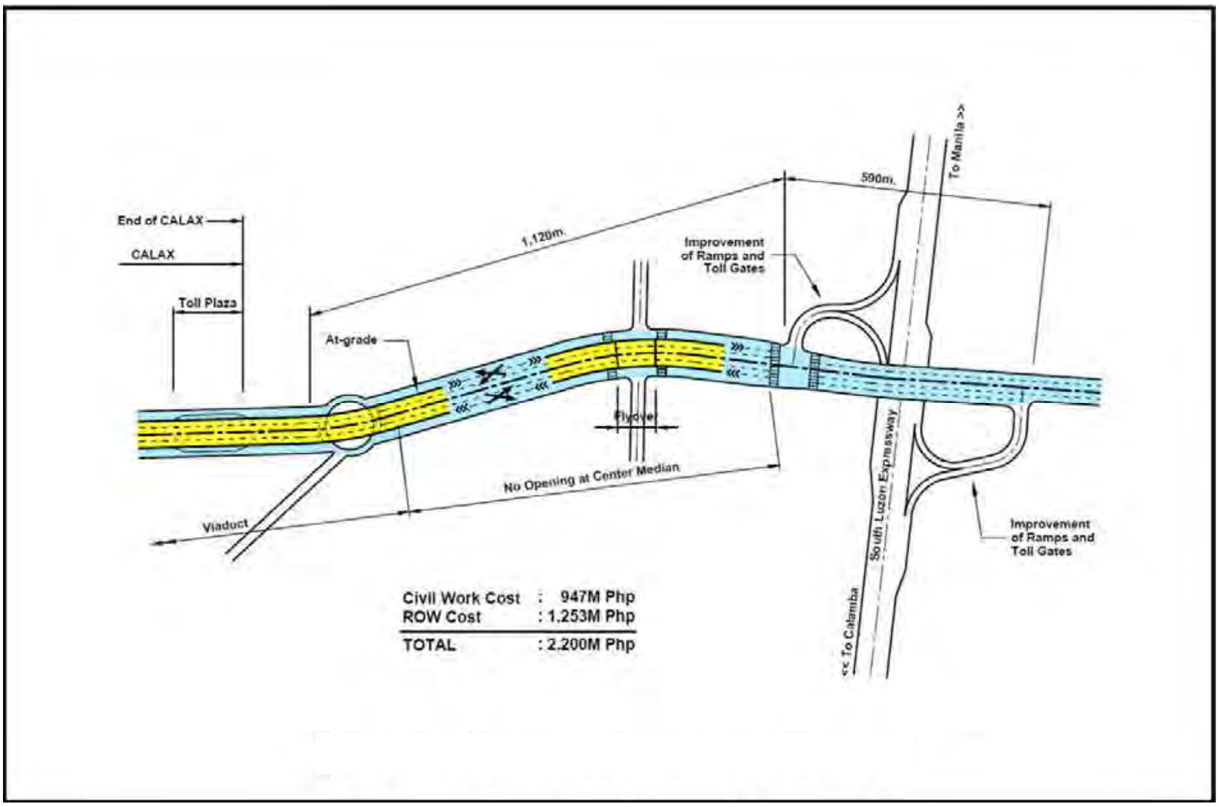


FIGURE 4.5-2 CASE-2: INDIRECT CONNECTION BETWEEN SLEX AND CALAX

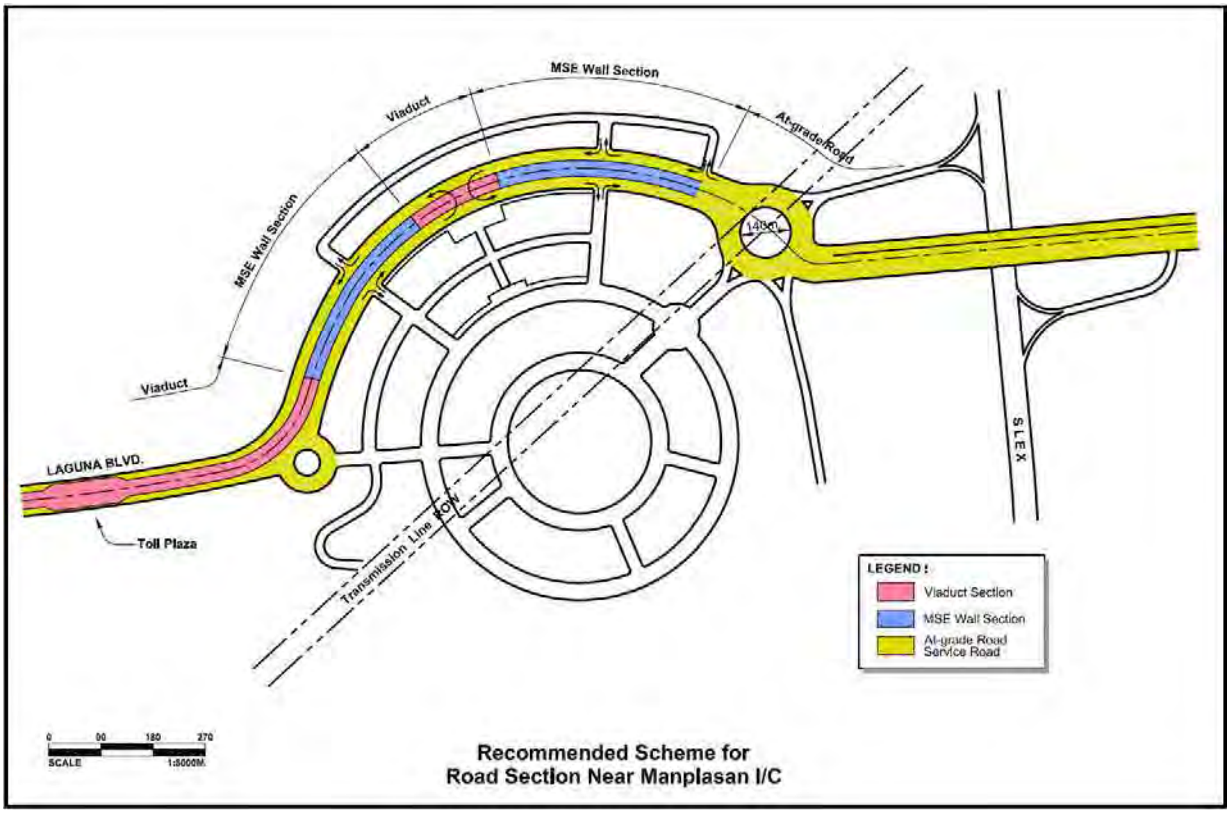


FIGURE 4.5-3 CASE-3: AGREED SCHEME FOR ROAD SECTION NEAR MAMPLASAN I/C

5 TRAFFIC DEMAND FORECAST

5.1 Existing Traffic Volume

FIGURE 5.1-1 shows the traffic volumes of the road network in Cavite area and some portions of Laguna province. The number denotes vehicles. The following were observed regarding the captured traffic volume:

- Traffic volume at the section of SLEX inside Metro Manila is extremely high compared to the sections outside of Metro Manila indicating that there are high numbers of vehicles using the expressway having their OD within Metro Manila.
- There is also a very high volume of vehicles between Metro Manila and coastal towns of Cavite which is served by the Manila-Cavite Expressway. These towns along with other towns within the periphery of Metro Manila are functioning as residing place of workers in the capital.
- Likewise, traffic volume at the trunk roads like Aguinaldo Highway and Governor’s Drive is also high especially at the sections of these roads passing urban areas like in Dasmariñas City and Gen. M. Alvarez, and Carmona. Through traffic and local traffic like jeepneys and tricycles merges at this road section.

5.2 Existing Travel Speed

The travel time of selected routes are depicted in **FIGURE 5.2-1**. General observation appears that serious traffic congestion is experienced while the national road is passing a city center or the area has substantial number of economic zones and industrial parks. Congestion is also experienced when a road is about to merge with another important road.

5.3 Toll Rate vs. Revenue

In order to set the proper toll rate of CALAX, the traffic volume and the amount of revenue are estimated by traffic assignment model. **FIGURE 5.3-1** shows the result of traffic assignment of toll rate in year 2011.

- In case of toll free, total traffic volume to enter CALAX is 69,316 vehicles/day
- The toll rate for getting higher revenue is about 4 to 15 Peso/km and the amount of revenue is about 3.7 and 4.2 million Peso/day. Although maximum amount of revenue is 10 peso case, traffic volume to enter CALAX is only 19,819 vehicle /day which is about 30% of toll free case.
- The desirable toll rate for attractive to motorist and higher revenue is 4.0 Peso/km. Total traffic volume to enter CALAX is 41,567 vehicle/day (60% of toll free case). This toll rate is the almost same as that of Manila Cavite Toll Expressway (herein CAVITEX) phase-1 and it is cheaper than that of other new present expressways such as CAVITEX Phase-2 and Skyway Phase-2. Most motorists may still accept the 4.0 peso/km in year 2011.

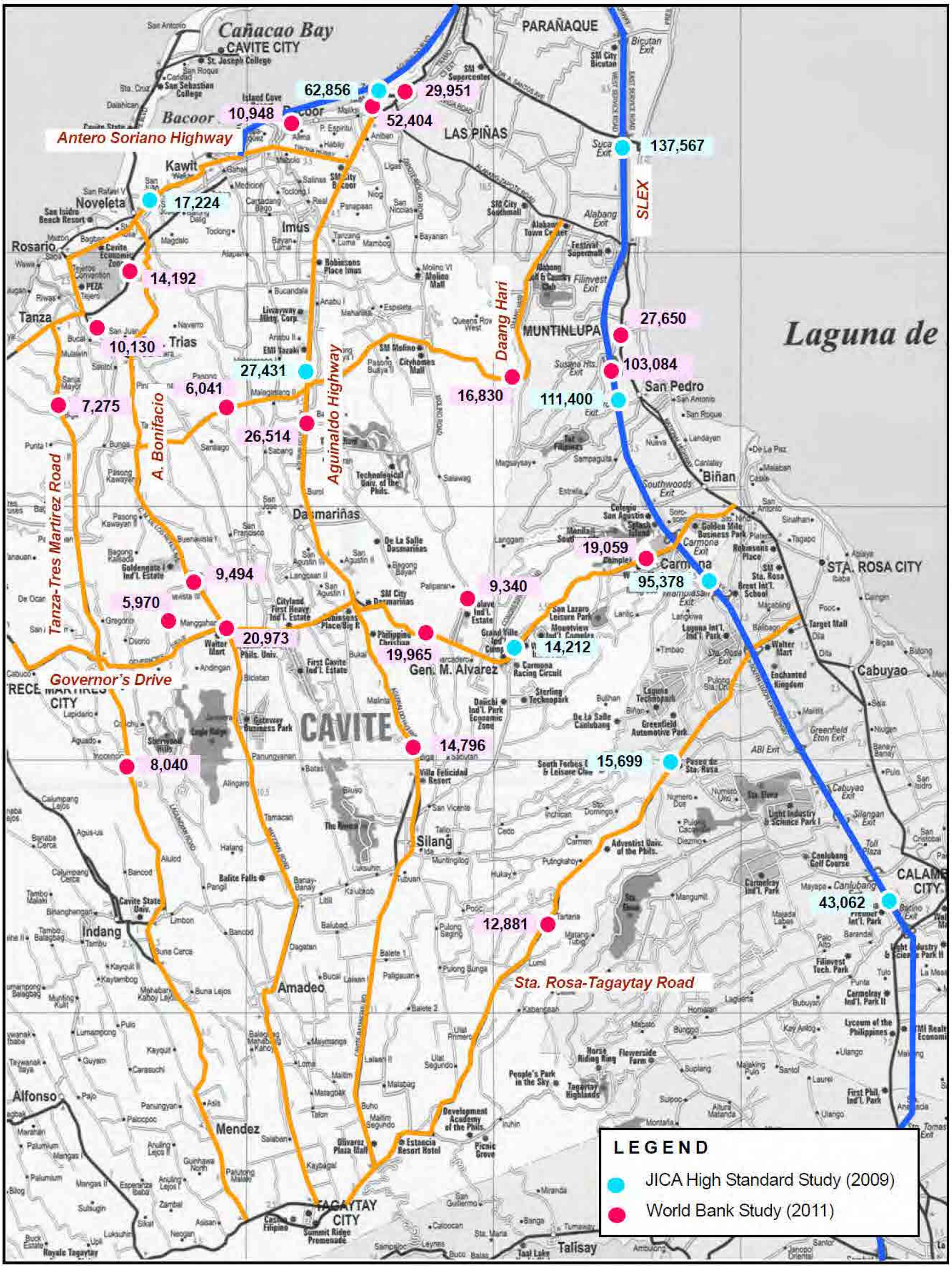


FIGURE 5.1-1 EXISTING TRAFFIC VOLUME

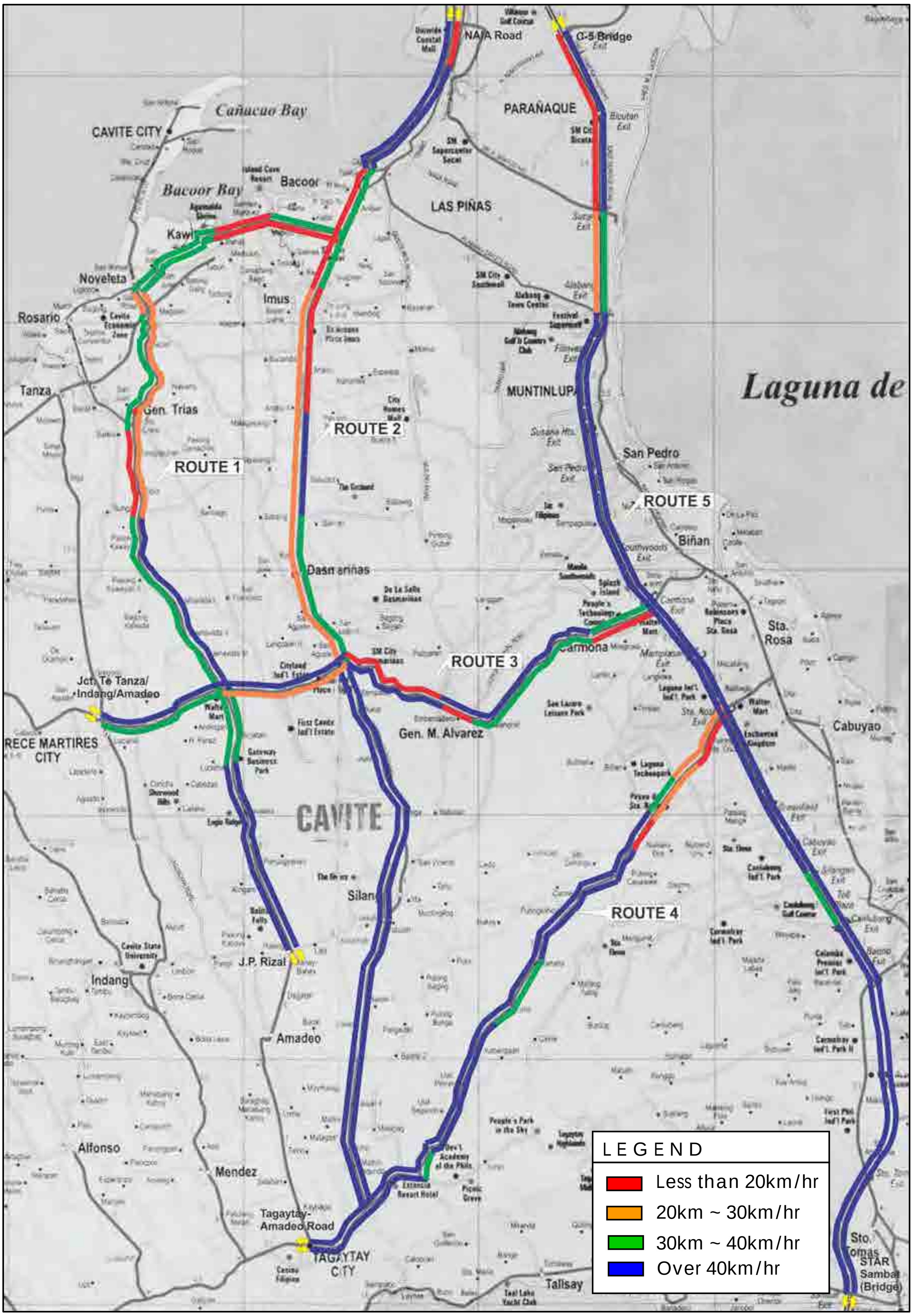


FIGURE 5.2-1 TRAVEL SPEED OF MAJOR CORRIDORS IN THE SOUTH OF METRO MANILA (AFTERNOON PEAK HOURS)

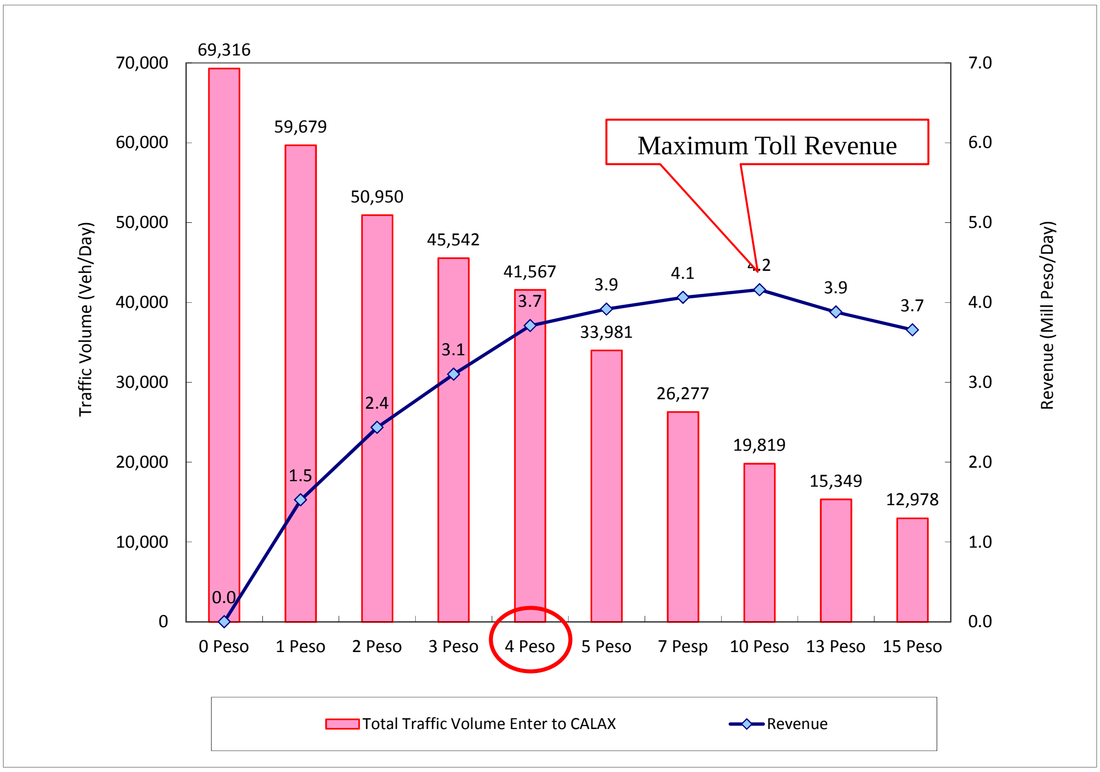


FIGURE 5.3-1 TOLL RATE VS REVENUE (CALAX, YEAR 2011)

5.4 Traffic Assignment

Figures 5.4-1 to **5.4-3** show the estimated traffic volume of CALAX Laguna section. The highest traffic volume interchange section is between Sta.Rosa-Tagaytay IC and Laguna Blvd. IC, which number of traffic are 23,208 (vehicle/day) in year 2017, 31,122 (vehicle/day) in year 2020 and 48,796 (vehicle/day) in year 2030.

TABLE 5.4-1 shows the total traffic volume to enter CALAX Laguna section and total vehicle km of CALAX Laguna Section.

TABLE 5.4-1 TRAFFIC VOLUME AND VEHICLE KM (CALAX LAGUNA SECTION)

Item	Vehicle Class	Year 2017	Year 2020	Year 2030
Traffic Volume (Veh./day)	Class 1	22,595	31,108	60,091
	Class 2	8,143	9,712	14,870
	Class 3	3,845	4,347	5,855
	Total	34,583	45,167	80,816
Vehicle*km	Class 1	204,109	275,222	510,503
	Class 2	87,460	106,403	151,367
	Class 3	45,718	53,809	73,808
	Total	337,287	435,434	735,678
Toll Revenue (Million Php/day)	All classes	2.8	4.0	10.5

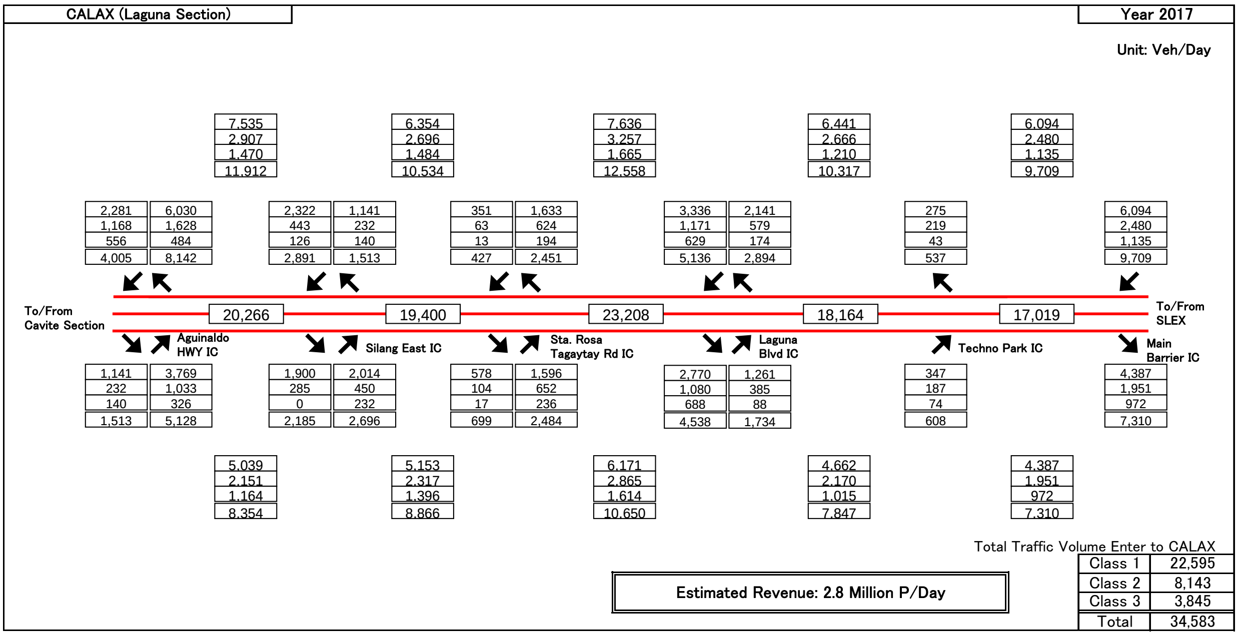


FIGURE 5.4-1 TRAFFIC PROJECTION (YEAR 2017) OF CALAX LAGUNA SECTION

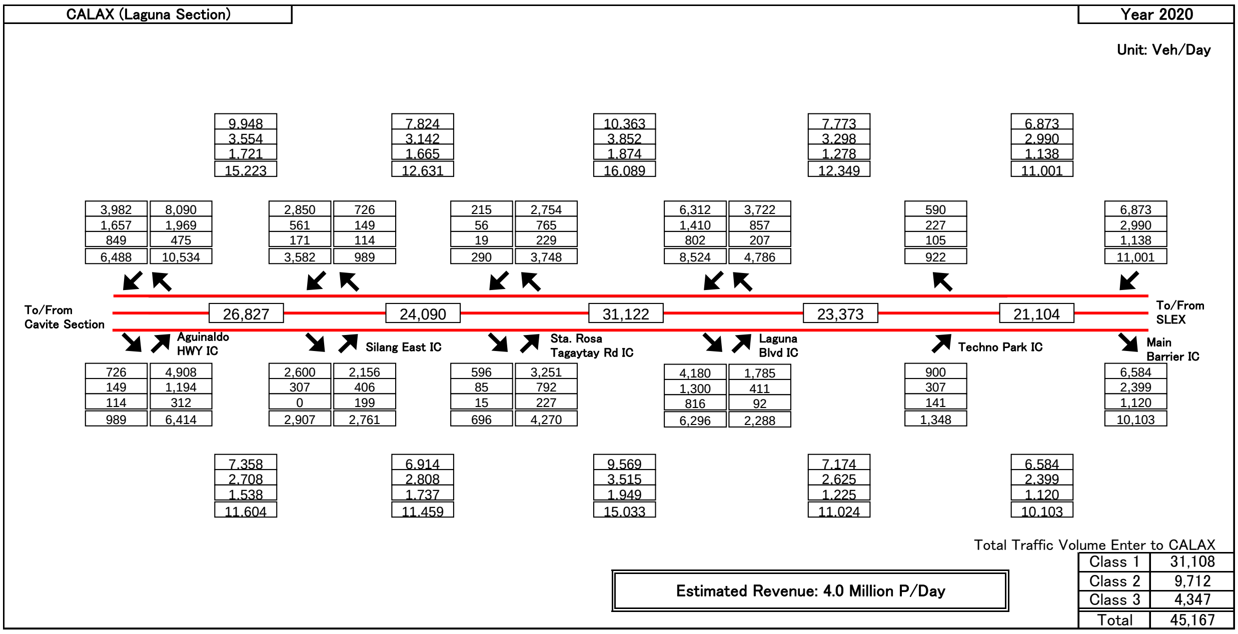


FIGURE 5.4-2 TRAFFIC PROJECTION (YEAR 2020) OF CALAX LAGUNA SECTION

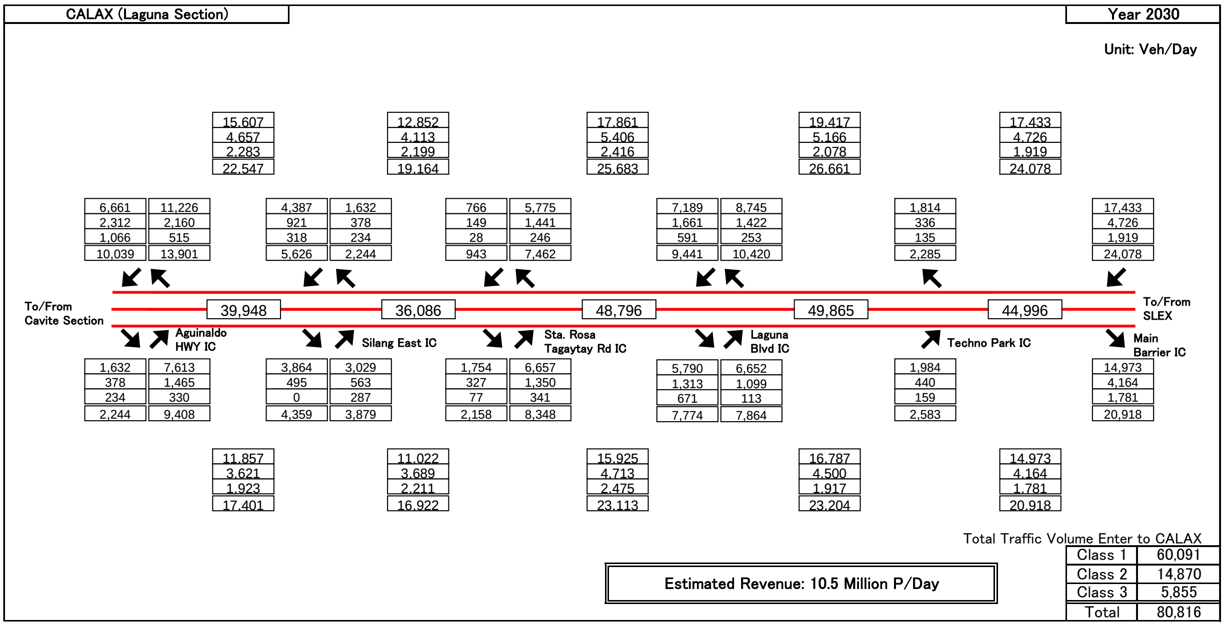


FIGURE 5.4-3 TRAFFIC PROJECTION (YEAR 2030) OF CALAX LAGUNA SECTION

6 SCOPE OF THE PROJECT

6.1 Outline of CALA Laguna Section Project

The proposed CALAX (Laguna Section) is to be constructed in the provinces of Cavite and Laguna, which are part of Region IV-A. The starting point of the expressway is at Aguinaldo highway, Silang Municipality and ends at Mamplasan Interchange of SLEX, Binan City.The proposed The CALA Laguna Section has 18.10 kilometers long as a limited access 100 kph 4-lane divided toll expressway with 4 interchanges, namely Silang East IC, Sta. Rosa-Tagaytay Road IC, Laguna Blvd. IC and Techno Park IC, and one toll barrier. CALA Laguna Section has 13 bridges with the total length of 2,220 meters and viaduct sections over Laguna Blvd. with the total length of 5,035 meters. The ROW is the width of 50 to 60 meters throughout the Laguna Section

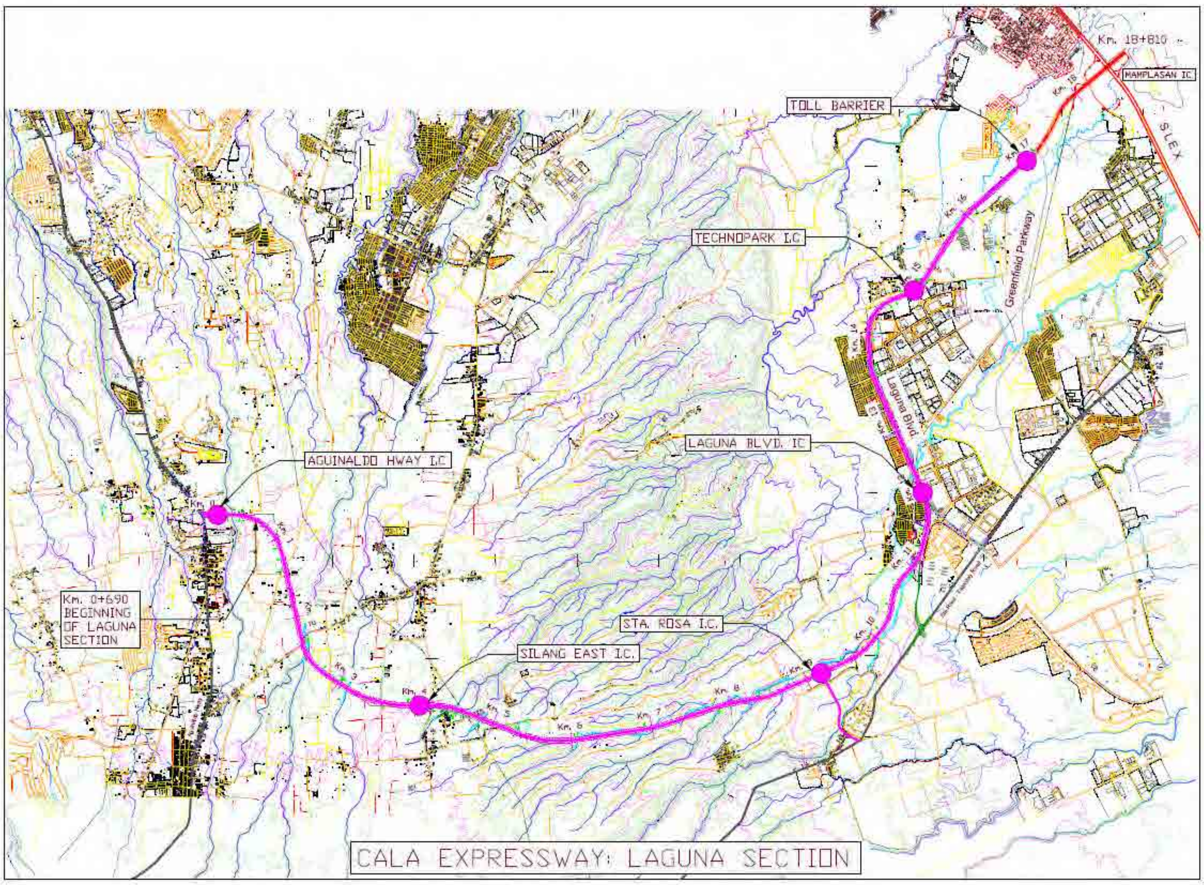


FIGURE 6.1-1 CALAX ROUTE MAP

6.2 Design Standard

The design concept is to provide a high speed toll road that allows safe and efficient movement of traffic as an expressway with fully controlled access, especially to improve the access from Aguinaldo Highway to South Luzon Expressway (SLEX). The following standard is mainly used as reference in CALA design, and the geometrical design standards are set up as shown in **TABLE 6.2-1**.

- A Policy on Geometric Design of Highways and Streets, AASHTO 2004
- Highway Safety Design Standards Part 1 Road Safety Design Manual, May 2004, DPWH
- Japan Road Association, Road Structure Ordinance,2004
- Highway design manual, Metropolitan Expressway Co., Ltd., Japan
- Highway design manual, NEXCO, Japan

TABLE 6.2-1 GEOMETRICAL DESIGN STANDARD OF CALAX

Category	Item	Unit	Roadway Standard	Ramp way Standard
Basic Element	Design Speed	km/h	100	40
	Design Vehicle	-	WB-15	WB-15
	Stopping Sight Distance	m	185	50
	Passing Sight Distance	m	670	270
Cross Section Element	Pavement Type	-	Asphalt Concrete	Asphalt Concrete
	Number of lane	nos	4	1
	Lane Wide	m	3.50	3.50
	Median Width	m	2.00	1.00
	Inner Shoulder Width	m	0.75	0.75
	Outer Shoulder Width	m	2.50	2.50
	Normal Cross fall	%	2.00	2.00
	Maximum Super Elevation		6.00	6.00
	Super Elevation	%	Exhibit 3-26	Exhibit 3-26
	Maximum relative Gradients	%	0.43	0.66
Horizontal Alignment	Minimum Radius	m	437	50 (absolute 43)
	Minimum Transition Curve length	m	56	22
	Minimum Radius not requiring Transition Curve	m	2560	525
	Super elevation Run off	%	0.43	0.66
Vertical Alignment	Maximum Vertical Gradient	%	3 (absolute 4)	6 (absolute 7)
	Minimum K Value Crest	%	85.0	6.0
	Minimum K Value Sag	%	52.0	9.0
	Minimum Vertical Curve Length	%	60	60
	Maximum Composition Grade	%	10.0	11.5
	Vertical Clearance (Road)	m	5.200	5.200

6.3 Typical Roadway Cross Section

Typical cross sections are shown in **Figures 6.3-1** to **6.3-3**.

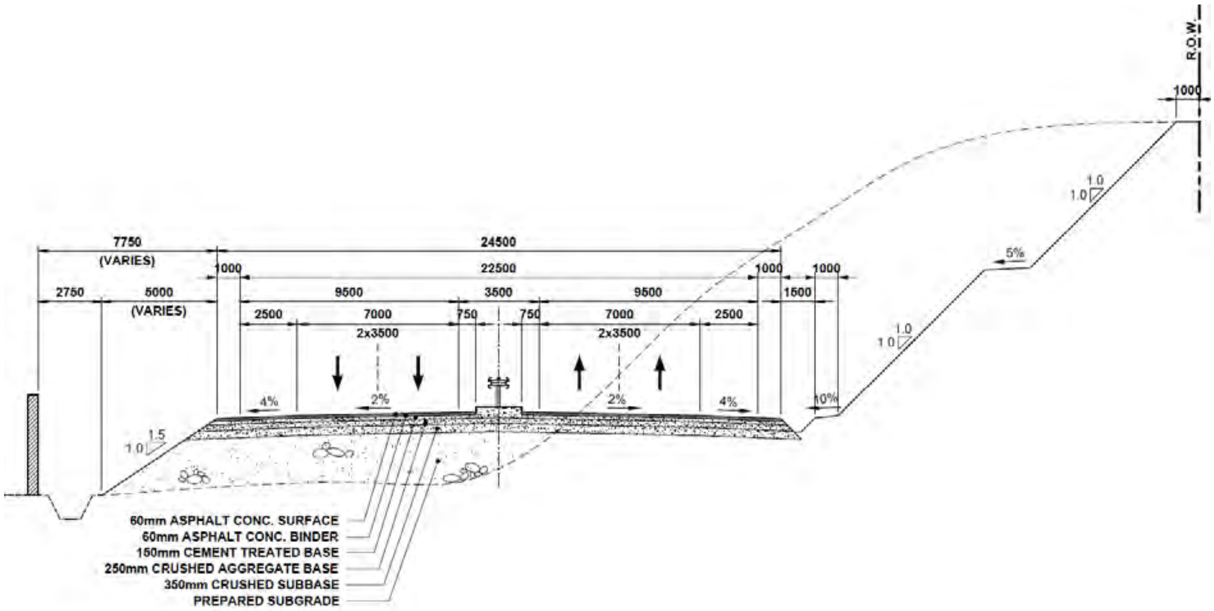


FIGURE 6.3-1 TYPICAL CROSS SECTION: EMBANKMENT AND CUT SECTION

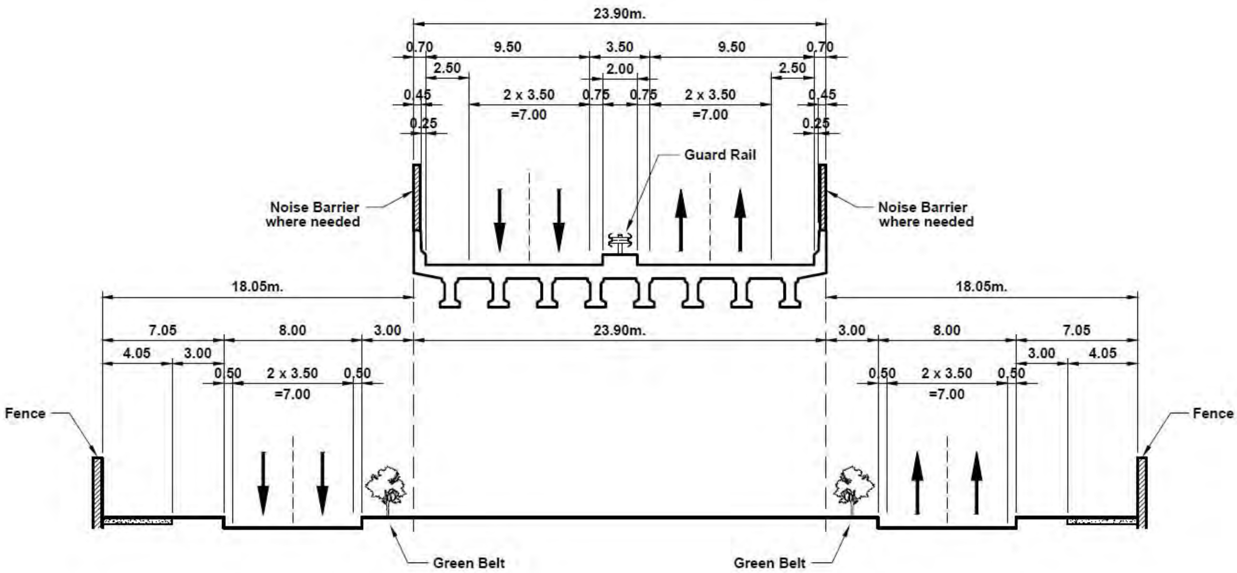


FIGURE 6.3-2 TYPICAL CROSS SECTION: FLYOVER SECTION

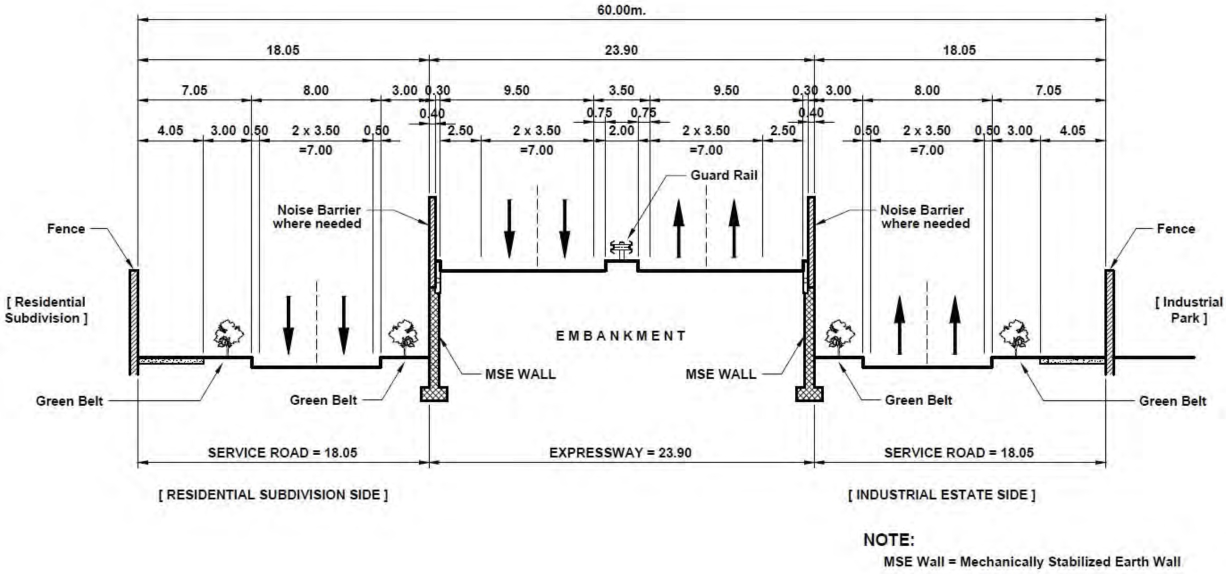


FIGURE 6.3-3 TYPICAL CROSS SECTION: MSE WALL SECTION

7 PROJECT COST

The estimated project costs are summarized by currency component (foreign, local and tax) and by cost sharing (GOP, ODA, and Private Components) and shown in **TABLE 7-1**. The operation and maintenance cost is shown in **TABLE 7-2**.

TABLE 7-1 ESTIMATED PROJECT COST

Unit : Million Php in January 2012 Prices

Item		Cost (Million Php)	Cost Component (Million Php)			Cost Sharing (Million Php)		
			Foreign	Local	Tax	GOP	Yen Loan	Concessionaire
Civil Work (Base Cost)	Civil Work	**12,278.65**	4,388.35	6,375.49	1,514.81	1,514.81	10,763.84	-
	Toll Facility Installation	**553.38**	197.64	287.47	68.27	-	-	553.38
	Sub-total	**12,832.03**	**4,585.99**	**6,662.96**	**1,583.08**	**1,514.81**	**10,763.84**	**553.38**
Engineering Services Cost (Base Cost)	Detailed Engineering Design	**210.82**	170.68	17.55	22.59	22.59	188.23	-
	Tender Assistance for Contractor Selection	**78.61**	61.64	8.55	8.42	8.42	70.19	-
	Construction Supervision	**474.54**	321.39	102.30	50.85	50.85	423.69	-
	Sub-total	**763.97**	**553.71**	**128.40**	**81.86**	**81.86**	**682.11**	**-**
ROW Acquisition Cost (Base Cost)		**3,589.01**	**-**	**3,204.47**	**384.54**	**3,589.01**	**-**	**-**
Physical Contingency (5%)	Civil Work	**613.93**	219.42	318.77	75.74	75.74	538.19	-
	Toll Facility Installation	**27.67**	9.88	14.38	3.41	-	-	27.67
	Engineering Services	**38.20**	27.69	6.42	4.09	4.09	34.11	-
	ROW Acquisition	**179.45**	-	160.22	19.23	179.45	-	-
	Sub-total	**859.25**	**256.99**	**499.79**	**102.47**	**259.28**	**572.30**	**27.67**
Administrative Cost (1.5% of Civil Work Cost)		**192.50**	-	192.50	-	192.50	-	-
Total		**18,236.76**	**5,396.69**	**10,688.12**	**2,151.95**	**5,637.46**	**12,018.25**	**581.05**

TABLE 7-2 ESTIMATED OPERATION AND MAINTENANCE COST

Unit: Million Pesos in 2011 price

Description	Estimated Cost (Million Php)
Routine Maintenance Cost	33.25
Operation Cost	188.53
Annual O & M Cost	221.78
Periodic Maintenance Cost (every 5 years)	294.23

8 ECONOMIC EVALUATION

8.1 Assumption and Indicators of Economic Analysis

Economic costs and benefits throughout the project life periods were compared by a discount cash flow analysis. The discount rate used is at 15%, which is widely used in Philippines as a social discount rate. For economic evaluation, three indicators were calculated: EIRR, B/C and NPV. In addition, the economic life was assumed to be 30 years. The Unit VOC and travel time cost applied were shown in **TABLE 8.1-1** and **8.1-2**.

TABLE 8.1-1 UNIT VOC BY FOUR (4) VEHICLE TYPES IN 2011 (PESO/KM/VEH)

Speed (km/hr)	Passenger Car	Jeepney	Bus	Truck
20	14.46	10.32	26.16	37.93
30	13.05	9.14	23.23	34.01
40	11.64	7.97	20.30	30.09
50	10.23	6.79	17.37	26.16
60	10.04	6.73	17.40	25.94
70	9.86	6.66	17.43	25.71
80	9.67	6.59	17.45	25.48
90	9.76	6.81	17.50	25.69
100	9.86	7.02	17.54	25.90

TABLE 8.1-2 UNIT TRAVEL TIME COST IN 2011 (PESO/MIN/VEH)

Vehicle Type	2011
Passenger Car	7.18
Jeepney	7.83
Bus	29.36
Truck	1.33

8.2 Results of Economic Analysis

Two case were examined as follows;

Case-1: Economic Return of Both Cavite and Laguna Sections

Case-2: Economic Return of Laguna Section only

Economic evaluation results are shown below and the project was evaluated as highly feasible.

Case	EIRR	B/C	NPV (Million Pesos)
Case-1	33.0%	2.85	47,807
Case-2	35.0%	2.92	21,209

8.3 Project Sensitivity

Project sensitivity was tested for various cases and summarized below.

RESULTS OF SENSITIVITY TEST: EIRR

	CASE -1			CASE -2		
	Base	Cost plus 10%	Cost plus 20%	Base	Cost plus 10%	Cost plus 20%
Base	33.0%	31.0%	29.2%	35.0%	32.7%	30.7%
Benefit less 10%	28.7%	26.8%	25.2%	30.0%	28.0%	26.2%
Benefit less 20%	24.3%	22.6%	21.2%	25.1%	23.3%	21.8%

9 PPP MODALITIES AND FINANCIAL EVALUATION

9.1 PPP Modalities Studied

The possible four (4) types of the PPP modalities are as shown below;

Type-1(base Type): BOT with GFS

Design and construction work for both Cavite section and Laguna section will be undertaken by the single concessionaire with the government financial support (GFS). The same single concessionaire will operate and maintain both sections.

Type-2: Segment divided Type (pattern 1)

Each of Cavite section and Laguna section will be implemented independently. Namely, Cavite section will be designed, constructed and operated by the concessionaire with GFS, while the design and construction of Laguna section will be undertaken by GOP with ODA loan, and O & M Concessionaire is selected for this section.

Two different concessionaires will operate and maintain each section independently. The one concessionaire will operate and maintain Cavite section under the self financing business scheme, while the other concessionaire will undertake Laguna section under the lease business scheme.

Type-3: Segment divided Type (pattern 2)

Each section is designed and constructed independently. However operation and maintenance is undertaken by the single concessionaire, selected by the Cavite Section.

Cavite section is designed and constructed by the concessionaire with GFS, while the design and construction of Laguna section will be undertaken by GOP with ODA loan.

The concessionaire selected for Cavite Section will operate and maintain both sections and the Concessionaire pays the lease fee to GOP as concession fee of Laguna section

.

Type-4: Lease Type

Both sections are designed and constructed by GOP with ODA loan. The single concessionaires will operate and maintain both sections under the lease business scheme.

The above four (4) types of the PPP modality are shown in **FIGURE 9.1-1.**

TABLE 9.1-1 PPP MODALITY FOR CALAX

		Cavite Section	Laguna Section	Examples	Remarks
Type-1: BOT with GFS	**Design &Construction**	Concessionaire A (with GFS)		**TPLEX**	• GOP expenditure for ROW acquisition is included in subsidy.
	O&M	Concessionaire A			
Type-2: Segment divided Case (pattern 1)	**Design &Construction**	Concessionaire A (with GFS)	GOP (with ODA loan)	**TPLEX (Cavite Section)** **SCTEX (Laguna Section)**	• Tendering for Cavite sec. can be ahead of the Laguna section. • Interoperability agreement for both sections for especially toll collection must be secured. • Commencement of construction work for Cavite sec. can be done earlier than the one for Laguna sec.. However the time of completion of construction work for both sections should be almost same. • Same toll rates will not necessarily be applied to both sections. • Construction work for Laguna section undertaken by GOP is not considered as subsidy.
	O&M	Concessionaire A	↓ **Lease** Concessionaire B		
Type-3: Segment divided Case (pattern 2)	**Design &Construction**	Concessionaire A (with GFS)	GOP (with ODA loan)	**STAR (GOP segment completed ahead of private segment)**	• Tendering for Cavite section will be done ahead of the Laguna section. • Commencement of construction work for Cavite section can be done earlier than the one for Laguna section. However, the time of completion of construction work for both sections should be almost same. • Same toll rates will not necessarily be applied to both sections. • Construction work for Laguna section undertaken by GOP is not considered as subsidy.
	O&M	Concessionaire A	↓ **Lease** Concessionaire A		
Type-4: Lease Type	**Design &Construction**	GOP (with ODA loan)		**SCTEX**	• Construction work for both sections undertaken by GOP is not considered as subsidy. • This is the same scheme as SCTEX
	O&M	↓ **Lease** Concessionaire A	↓ **Lease**		

9.2 Results of Financial Analysis of PPP Modalities

1) Results of Financial Analysis

Results of financial analysis are shown in **TABLE 9.2-1,** and summarized as follows;

Type-1 : In case that 50% of construction cost and 100% of ROW acquisition cost is shouldered by the Government, percent (%) of subsidy exceeds 50% of the Project Cost, which is not allowed by BOT Law (should be less than 50%).

When 40% of construction cost and 100% of ROW acquisition cost is shouldered by the Government, Equity IRR is below benchmark. Possible Government's subsidy for construction cost will be between 40% and 50% (say about 48%).

Type-2 : Cavite Section will require subsidy of about 40% of construction cost, in addition to ROW acquisition cost. Laguna Section can adopt higher lease fee than assumed (50% of toll revenue) or toll rate can be lowered.

Since this type assumed that each section is independently managed and operated, the profit of Laguna Section can not be shared by the Laguna Section. On the other hand, Type-3 can share profit of Laguna Section.

Type-3 : Subsidy of 20% of Cavite Section construction cost and about 16% of lease fee for Laguna Section satisfies IRR benchmark.

Type-4 : Lease fee of more than 50% of toll revenue is possible (in this case, the Government can enjoy high income from lease fee), or toll rate can be lowered.

This scheme does not require the private sector's investment for construction. The private sector is quite positive to finance construction of this expressway, thus it will be advantageous to select another type of scheme to fully utilize financing capability of the private sector.

Based on the above results, Type-1 and Type-3 were further studied.

TABLE 9.2-1 (1/3) CALAX: SUMMARY OF FINANCIAL ANALYSIS (TYPE 1 AND 2)

Case	PPP Scheme	Condition (Amount of Subsidy & Lease Fee) *(Note-1)*	Results of Financial Analysis: IRR for SPV (%)	Results of Financial Analysis: Equity IRR (%)	% of Subsidy *(Note-3)*	ODA Repayment vs. Income of Lease Fee *(Note-1)*	Net Government Expenditure (Php) *(Note-2)*
Type-1: (Cavite + Laguna) as one Project	BOT with 40% Subsidy	• Subsidy ❖ 40% of Construction Cost **(11.65 Billion)** ❖ 100% of ROW Acquisition Cost **(7.58 Billion)** ❖ **Total 19.23 Billion**	12.6 (OK)	12.9 (Low)	• 47% of Project Cost	–	• GOP Expenditure 14.61 Billion • GOP Income 4.72 Billion • Net GOP Expenditure 9.89 Billion
	BOT with 50% Subsidy	• Subsidy ❖ 50% of Construction Cost **(14.57 Billion)** ❖ 100% of ROW Acquisition Cost **(7.58 Billion)** ❖ Total **22.15 Billion**	14.2 (OK)	15.5 (OK)	• 53% of Project Cost (Exceeds 50%)	–	• GOP Expenditure 16.57 Billion • GOP Income 4.77 Billion • Net GOP Expenditure 11.80 Billion
Type-2: Two Individual Project	Cavite Section: BOT with 40% Subsidy	• Subsidy ❖ 40% of Construction Cost **(6.52Billion)** ❖ 100% of ROW Acquisition Cost **(4.00 Billion)** ❖ **Total 10.52 Billion**	13.7 (OK)	14.7 (Marginally OK)	• 46% of Project Cost	–	• GOP Expenditure 8.23 Billion • GOP Income 3.08 Billion • Net GOP Expenditure 5.15 Billion
	Cavite Section: BOT with 50% Subsidy	• Subsidy ❖ 45% of Construction Cost **(7.34Billion)** ❖ 100% of ROW Acquisition Cost **(4.00 Billion)** ❖ Total **11.34 Billion**	14.5 (OK)	16.0 (OK)	• 50% of Project Cost	–	• GOP Expenditure 8.78 Billion • GOP Income 3.09 Billion • Net GOP Expenditure 5.69 Billion
	Laguna Section: ODA with Lease Type	• Subsidy ❖ 100% of ROW Acquisition Cost **(3.58 Billion)** • Lease Fee ❖ 50% of Toll Revenue	21.3 (Too High)	26.4 (Too High) *(Note-4)*	-	• ODA Loan Repayment Amount 19.18 Billion • Lease Fee Income 50.36 Billion (Too High)	• GOP Expenditure 5.70 Billion • GOP Income 4.55 Billion • Net GOP Expenditure 1.15 Billion

Note-1 : 2012 Price
Note-2 : NPV (Discount Rate = 15%)
Note-3 : % of Discounted Amount
Note-4 : Can adopt higher lease fee, or reduce toll rates.
Source: JICA Study Team
General Note: Above analysis is base on the estimated cost as of March, 2012.

TABLE 9.2-1 (2/3) CALAX: SUMMARY OF FINANCIAL ANALYSIS (TYPE 3)

Case	PPP Scheme	Condition (Amount of Subsidy & Lease Fee) *(Note-1)*	Results of Financial Analysis: IRR for SPV (%)	Results of Financial Analysis: Equity IRR (%)	% of Subsidy *(Note-3)*	ODA Repayment vs. Income of Lease Fee *(Note-1)*	Net Government Expenditure (Php) *(Note-2)*
Type-3: Hybrid Type	Cavite: BOT with subsidy Laguna: ODA with Lease Type O & M: One Concessionaire	• Subsidy ❖ 40% of Construction Cost of Cavite Section **(6.52 Billion)** ❖ 100% of ROW Acquisition Cost of Both Section **(7.58Billion)** ❖ **Total 14.10 Billion** • Lease Fee ❖ 20% of Toll Revenue of Laguna Section	16.3 (OK)	18.9 (OK)	• 46% of Project Cost	• ODA Loan Repayment Amount 18.18 Billion • Lease Fee Income 20.15 Billion	• GOP Expenditure 15.77 Billion • GOP Income 5.84 Billion • Net GOP Expenditure 9.94 Billion
		• Subsidy ❖ No subsidy for Construction Cost ❖ 100% of ROW Acquisition Cost of both Sections **(7.58 Billion)** • Lease Fee ❖ 5% of Toll Revenue of Cavite Section	12.6 (OK)	12.8 (Low)	• 21% of Project Cost	• ODA Loan Repayment Amount **18.18 Billion** • Lease Fee Income **5.04 Billion** (Lease Fee not enough to cover ODA Loan Repayment) *(Note-1)*	• GOP Expenditure 8.97 Billion • GOP Income 4.90 Billion • Net GOP Expenditure 4.07Billion
		• Subsidy ❖ 30% of Construction Cost of Cavite Section **(4.89 Billion)** ❖ 100% of ROW Acquisition Cost of Both Section **(7.58 Billion)** ❖ **Total 12.47 Billion** • Lease Fee ❖ 15% of Toll Revenue of Cavite Section	15.2 (OK)	17.0 (OK)	• 40% of Project Cost	• ODA Loan Repayment Amount **18.18 Billion** • Lease Fee Income **15.11 Billion** (lower than Loan Repayment Amount)	• GOP Expenditure 14.07 Billion • GOP Income 5.54 Billion • Net GOP Expenditure 8.53 Billion
		15%	13.4	14.2			6.02
		20%	13.9	15.0			6.85
		25%	14.5	16.0			7.69

Note-1: 2012 Prices
Note-2: NPV (Discount Rate = 15%)
Note-3: % of discounted amount

Source: JICA Study Team

General Note: Above analysis is base on the estimated cost as of March, 2012.

TABLE 9.2-1 (3/3) CALAX: SUMMARY OF FINANCIAL ANALYSIS (TYPE 4)

Case	PPP Scheme	Condition (Amount of Subsidy & Lease Fee) *(Note-1)*	Results of Financial Analysis		% of Subsidy *(Note-3)*	ODA Repayment vs. Income of Lease Fee *(Note-1)*	Net Government Expenditure (Php) *(Note-2)*
			IRR for SPV (%)	Equity IRR (%)			
Type-4: ODA with Lease Fee (Cavite + Laguna) as one Project	(Cavite + Laguna) with ODA : Lease Type	• Subsidy ❖ 100% of ROW Acquisition Cost of Both Sections **(7.20 Billion)** • Lease Fee ❖ 50% of Toll Revenue of Both Sections	33.2 (Too High) *(Note-4)*	56.7 (Too High)	–	• ODA Loan Repayment Amount 41.20 Billion • Lease Fee Income 136.41 Billion (Too High)	• GOP Expenditure 11.84 Billion • GOP Income 12.35 Billion • Net GOP Expenditure -0.51 Billion (Negative means GOP "Profit")

Note-1 : 2012 Price
Note-2 : NPV (Discount Rate = 15%)
Note-3 : % of discounted amount
Note-4 : Can adopt higher lease fee, or reduce toll rates.
Source: JICA Study Team

General Note: Above analysis is base on the estimated cost as of March, 2012.

2) Comparison of Type-1 and Type-3

Type-1 and Type-3 are possible schemes for comparison. **TABLE 9.2-2** shows the comparison of two schemes.

TABLE 9.2-2 COMPARISON OF TYPE-1 AND TYPE-3

Item	**Type-1** (40% subsidy for construction cost)	**Type-3** (20% subsidy for construction cost of Cavite Section. 15% Lease Fee)	Remarks
Amount of Government's subsidy for Construction Cost and ROW Acquisition (2012 prices)	11.65 + 7.58 = 19.23 Billion Php (1.00)	3.26 + 7.58 = 10.84 Billion Php (0.56)	The Government has to prepare about 20 Billion Php for Type-1.
Amount of Private Sector Fund required for Construction (2012 prices)	17.46 Billion Php (1.00)	13.04 Billion Php (0.75)	The private sector has to prepare about 17.5 Billion Php for construction under Type-1.
% of Subsidy	47%	30%	-
Net Government Expenditure (NPV : Discounted at 15%)	9.89 Billion Php (1.00)	6.85 Billion Php (0.69)	NGE of Type-1 is higher by about 1.4 times than Type-3.

3) Recommendations on PPP Modality

As shown in **TABLE 9.2-2**, Type-3 has the following advantages over Type-1;

- Type-3 can reduce the Government subsidy by about 60% compared to Type-1 (or from 19.2 Billion Php to 10.84 Billion Php).
- When the Government's subsidy for construction cost is compared, Type-3 requires about 3.26 Billion Php, whereas Type-1 requires about 11.65 Billion Php which is about 3.6 times of Type-3.
- The private sector is also benefitted. For Type-1, the private sector is required to raise about 17.5 Billion Php, whereas Type-3 requires 13.0 Billion Php. The private sector can reduce its risk drastically and can expect the same financial return of Type-1.
- Net Government Expenditure (NGE) of Type-3 is about 70% of Type-1.

In view of above, Type-3 was recommended for the PPP modality of this project.

10 RISK MATRIX

Risk matrix of Type -3 is shown in **TABLE 10-1.**

TABLE 10-1 CALAX RISK MATRIX: PPP SCHEME TYPE-3

Implementation Stage	Cavite Section (Up to Construction by BOT with Subsidy, O & M : Both Section)				Laguna Section (Up to Construction by ODA)	
	Risk of GOP		Risk of the Private		Risk of GOP	
	Risk	Mitigation Measure	Risk	Mitigation Measure	Risk	Mitigation Measure
Detailed Design Stage	-	• Include Liquidated damage clause in TCA.	Delay in Detailed Design	• Employment of competent engineering firm.	Delay in Detailed Design	• Employment of competent engineering firm.
	-	• Jointly undertake extensive consultation meeting.	Change of Scope of Civil Work	• Extensive consultation meetings with LGUs and other concerned agency and PAPs.	Change of Scope of Civil Work	• Extensive consultation meetings with LGUs and other concerned agency and PAPs.
	-	• Periodic meetings with the Design Consultant.	Delay in Approval of Detailed Design	• Periodic consultation meetings with BOD of DPWH and TRB.	Delay in Approval of Detailed Design	• Periodic consultation meetings with BOD of DPWH and TRB.
	-	• Check Value Engineering results.	Over Design/ Under Design	• Undertake value engineering.	Over Design/ Under Design	• Undertake value engineering.
	-	• Require Professional Indemnity Insurance clause in TCA.	Design Error	• Design checking by Independent Consultant (IC). • Professional Indemnity Insurance.	Design Error	• Design checking by Independent Consultant (IC). • Professional Indemnity Insurance.
	-	• Jointly undertake consultation meetings with PAPs.	Objection of Residents on Alignment Design	• Intensive stakeholders meeting with PAPs.	Objection of Residents on Alignment Design	• Intensive stakeholders meeting with PAPs.
	-	• Receive reports from IC, if they are following same standards and specifications.	Different Design Standards and Materials Specification	• Adopt the same standards and specifications.	Different Design Standards and Materials Specification	• Adopt the same standards and specifications.

Implementation Stage	Cavite Section (Up to Construction by BOT with Subsidy, O & M : Both Section)				Laguna Section (Up to Construction by ODA)	
	Risk of GOP		Risk of the Private		Risk of GOP	
	Risk	Mitigation Measure	Risk	Mitigation Measure	Risk	Mitigation Measure
ROW Acquisition Stage	Delay in ROW Acquisition and Delivery to the Concessionaire	• Early start of ROW acquisition. • Put enough manpower.	Delay in Financial Closure due to delayed ROW Acquisition and delayed start of construction.	• GOP be imposed Liquidated damage to be paid to the private.	Delay in ROW acquisition and delivery to Contractor.	• Ask the private developers to issue "Permit to enter" prior to ROW acquisition.
	Delay in release of ROW Acquisition Budget	• Arrange with the private sector for advancing ROW acquisition cost.	-	-	Delay in release of ROW Acquisition Budget.	• Arrange in advance the release of budget.
	Delay in payment of PAPs due to lack of complete documents.	• Arrange with the Private Sector for advancing ROW acquisition cost, if Key documents are prepared.	-	-	Delay in payment to PAPs due to lack of complete documents.	• Arrange with the COA for flexible payment to PAPs.
Construction Stage	-	-	Delay in Financial Closure with other reasons than delayed delivery of ROW.	• The private sector be imposed Liquidated Damage payable to GOP.	-	-
	-	-	Delay in Construction Completion	• The private sector be imposed Liquidated Damage payable to GOP.	Delay in Construction Completion and Delay in Delivery of Facility	• Contractor be imposed liquidated damage payable to GOP. • GOP be imposed Liquidated Damage payable to the Concessionaire
	-	-	Poor quality of work (materials and workmanship)	• Employment of qualified contractor. • Strict checking by IC.	Poor quality of work (materials and workmanship)	• Employment of qualified contractor. Preparatory Survey for Expressway

Implementation Stage	Cavite Section (Up to Construction by BOT with Subsidy, O & M : Both Section)				Laguna Section (Up to Construction by ODA)	
	Risk of GOP		Risk of the Private		Risk of GOP	
	Risk	Mitigation Measure	Risk	Mitigation Measure	Risk	Mitigation Measure
						Projects in Mega Manila Region • Strict construction supervision.
	-	-	Cost Overrun	• Responsibility of the Concessionaire and no adjustment of toll rates.	Cost Overrun	• Responsibility of the Contractor. • No adjustment of Contract Amount.
	-	-	Suspension or abandonment of Construction Work due to Concessionaire's own reasons.	• Sanction against the Concessionaire to be specified in the TCA.	Suspension or abandonment of Construction Work due to Contractor's own reasons.	• Sanction against the concessionaire to be specified in the Contract.
	-	-	Failure to follow environmental requirements	• Strict monitoring by IC. • Penalty to be imposed on the Concessionaire.	Failure to follow environmental requirements.	• Strict monitoring of environmental requirements.
	Delayed issuance of Government's Permits	• Liquidated damage to be paid to the Concessionaire.	Delayed Issuance of Government's Permits	-	-	-
	-	-	Poor Traffic Management	• Proper coordination with the LGUs. • Penalty imposed to the Concessionaire.	Poor traffic management.	• Proper coordination with LGUs. • Strict construction supervision.
O & M Stage	Delay in the delivery of Laguna Section to the Concessionaire	• Delivery date shall be specified with some allowance (say 6 months). • Liquidated damage to be paid to the Concessionaire.				

Implementation Stage	Cavite Section (Up to Construction by BOT with Subsidy, O & M : Both Section)				Laguna Section (Up to Construction by ODA)	
	Risk of GOP		Risk of the Private		Risk of GOP	
	Risk	Mitigation Measure	Risk	Mitigation Measure	Risk	Mitigation Measure
	Delay in Issuance of Toll Operation Certificate (TOC)	• Liquidated damage to be paid to the Concessionaire.				
	Delay in Approval of Toll Rates	• Liquidated damage to be paid to the Concessionaire.				
	Delay in Approval of Toll Rates Adjustment	• Liquidated damage to be paid to the Concessionaire.				
			Failure or Delay in Commencement of Operation.	• Liquidated damage to be paid to GOP.		
			Less traffic demand and toll revenue than expected.	• Ramp-up factor to be considered in the financial analysis.		
			Failure to satisfy Minimum Performance Requirement.	• Pay penalty to GOP in accordance with the TCA.		
			Delay in Payment of Lease Fee (or Concession Fee) to the Government	• Pay compensation to GOP in accordance with the TCA.		
	Failure or Delay in Payment of Compensation of Foregone Toll Income	• Toll rate adjustment or extension of toll concession period.				
					Premature deterioration of Facility.	• IC to judge and impose compensation to be paid to the Concessionaire.

Implementation Stage	**Cavite Section (Up to Construction by BOT with Subsidy, O & M : Both Section)**				**Laguna Section (Up to Construction by ODA)**	
	Risk of GOP		**Risk of the Private**		**Risk of GOP**	
	Risk	**Mitigation Measure**	**Risk**	**Mitigation Measure**	**Risk**	**Mitigation Measure**
Common to all Stages	Force Majeure	• Both parties should discuss how to cope with the situation in accordance with the TCA.	Force Majeure	• Partially covered by All Risk Insurance.		
		• Toll rate adjustment or extension of toll concession period.	Change in Laws including Taxation			
		• Both parties should discuss how to cope with the situation in accordance with the TCA.	Economic Risk (extraordinary high inflation, foreign exchange rates, oil crisis, worldwide economic recession, etc.)			

Source: JICA Study Team

11 ENVIRONMENTAL AND SOCIAL CONSIDERATION

11.1 Assessment of Environmental Impact, Mitigation Measures and Monitoring

Environmental and social impacts of the project was assessed, mitigation measures were proposed and monitoring items were identified as shown in **TABLE 11.1-1** for pre-construction and construction stage, and **TABLE 11.1-2** for the operation and maintenance stage.

TABLE 11.1-1 ENVIRONMENTAL AND SOCIAL IMPACTS, MITIGATION MEASURES AND MONITORING FOR PRE-CONSTRUCTION AND CONSTRUCTION PHASE

Item	Assessment	Mitigation Measures	Monitoring Items
Involuntary Relocation/ Resettlement	• A total of 36 structures (i.e. residential houses) with 50 households (or 197 people) will be affected and relocated. All of them are formal settlers. A total of about 77 farm land lots (or 64.7 ha.) will be affected. About 70.1% are land owners, about 5.2% are tenants. 24.7% are free occupants with permit of land owners. Number of people whose farm lands affected are estimated at about 460.	• To prepare Final RAP with full consensus with PAPS, and inventories of land and other assets. • To provide just (or fair) compensation, or land swapping (if feasible), and other supports that are stated in LARRIPP/WB OP 4.12.	• If inventory of land and assets were made • If valuation of land and assets were made by replacement cost.
Land Use	• About 118.8 ha of lands, of which 64.7 ha. are farming/natural vegetation will be lost and changed to CALAX. These lots along the new road and around the interchanges might be converted to market places / shopping malls, or residential uses.	• Respective LGUs shall amend city/municipality Land Use Plan and Zoning Ordinance to control unorderly urban development along CALAX and to restrict conversion of farm land to other land use purposes, and strictly enforce amended zoning ordinance. LGUs should also freeze the development within the proposed ROW.	• If zoning ordinance is amended and implemented. • If development within the proposed ROW is freeze.
Farm Land	• About 64.7 ha of farmland/ natural vegetation will be lost by this project in exchange to the expressway. Negative impact to farmers is expected in a form of loss of lands.	• To provide just (or fair) compensation, replacement of land when feasible and other supports such as disturbance compensation and rehabilitation assistance in accordance with LARRIPP/WB OP 4.12. • Detailed design shall be undertaken focusing on existing farm roads to assure accessibility to farm lands.	• If fair valuation is made, fair compensation is estimated and paid.
Means of Livelihood for the Poor and Socially Vulnerable	• About 84% of affected households belong to the poor (or below Region IV-A poverty threshold). • (+) Demands for labor to the construction and related work are expected to be increased temporarily, which further stimulates local economy.	• Qualified skilled workers and laborers in the Direct Impact Areas (DIA) duly endorsed by the Brgy. Captains will be given priority in hiring during implementation of the project. • To include condition of priority employment of PAPs below poverty line into construction	• If these are specified in the contract. • If these were

Item	Assessment	Mitigation Measures	Monitoring Items
	• (-) Shops and small businesses locating on CALAX construction sites will have to be relocated.	contractor's contract. • To provide just (or fair) compensation for income loss and rehabilitation assistance in accordance with LARRIPP/WB OP 4.12.	implemented. • If these were implemented.
Sanitation	• Sanitary condition around construction site is anticipated to become worse due to generation of wastes during the construction.	• Temporary sanitation facilities such as garbage bins and portable toilets must be provided by the Contractor at the construction area. • Regular disposal of the solid and domestic wastes to the designated disposal areas duly-approved by respective LGUs and DPWH must be strictly complied with. • Weekly inspection of the work sites must be undertaken by DPWH to ensure proper management of the solid and domestic wastes generated.	• If these conditions are specified in the contract. • If these requirements are implemented.
Accident	• Accidents involving construction works, vehicles and machineries operation are anticipated. Traffic accidents may happen by construction vehicles and heavy machines during construction. • Fall down from higher position such as piers and bridges may happen.	• To construct temporary construction road within road right-of-way, implement traffic management plan in coordination with local police and inform construction schedule, etc. to people within the project area to prevent traffic accidents. • To educate construction workers on various construction safety measures, and strictly implement such safety measures. • To provide adequate lighting and reflectors and construction warning signs at construction sites as well as at traffic accident-prone sections of related roads. • To provide temporary fences so as ordinary people not to enter in the construction sites.	• If these are specified in the contract. • If these are properly implemented.
Soil Erosion	• During the construction stage, erosion is likely to occur mainly by intense rain.	• To provide proper temporary drainage system to prevent water concentration at certain locations. • To provide temporary dike within the road right-of-way to prevent flow of eroded soils. • For high cut or embankment construction section, to cover embankment by vinyl sheet during heavy rain for prevention of slope collapse.	• If these are specified in the contract. • If these are properly implemented.
Global	• It is estimated that total emission	• To use clean filters and mufflers	• Measure

Item	Assessment	Mitigation Measures	Monitoring Items
Warming	of CO_2 will be about 78,908 tons during construction phase.	of engines. • To minimize idling of engines. • To minimize traveling frequencies between construction sites and origin by making and executing efficient construction materials transportation schedule. • To prohibit old model equipment and vehicles. • To follow mitigation measures suggested for AIR POLLUTION. • To off-set this impact, plant enough trees along expressway and interchange sites.	
Air Pollution	• Air quality was measured at 6 stations in dry season (2012). Results shows that highest values of TSP, SO_2 and NO_2 are 147 (DENR Standard: 300), 31 (DENR Standard: 340) and 11 (DENR Standard: 260), respectively. All parameters are far below DENR standards. • Air pollution will be expected due to emissions from construction vehicles and dust generated from construction activities during construction period. In dry and wet weather pollutants and particulates matters disperse to further distance and might affect sensitive area such as hospital and residential area	• To spray exposed ground with water to minimize dust re-suspension. • To cover temporary stockpiles of excavated materials and construction spoils with tarpaulin or sack materials. • To transport and dispose construction spoils regularly to hauled areas duly-approved by the DENR/LGUs. • To perform regular maintenance of construction vehicles, heavy equipment and machineries. • Follow mitigation measures suggested for GLOBAL WARMING. • Aggravation of air pollution will be minimized by adoption of above measures, considering that most of construction sites are located in the rice field areas.	• Measure air quality quarterly. • If these are specified in the contract. • If these are properly implemented.
Water Pollution	• Water quality was measured at 3 stations in dry season (2012). Total Coliform exceeds DENR Standard at all stations. Other parameters (ph, TSS, Lead, Dissolved Oxygen and BOD) did not exceed DENR. It is important not to worsen water quality than at present.	• To adopt construction method minimizing generation of water pollution (e.g. Extra care shall be made to prevent cut/embankment and other materials to fall into the river). • To seal, remove, or contain solid wastes and other construction hazardous materials off from bare ground to prevent seeping into the ground especially when it rains. • To install and manage portable toilets for construction workers properly. • To maintain machineries and generators and to prevent oil leakage. • Aggravation of water quality will	• Measure water quality quarterly. • If these are specified in the contract. • If these are properly implemented.

Item	Assessment	Mitigation Measures	Monitoring Items
		be minimized by adoption of above measures.	
Solid Waste	• Construction debris and excavated soil are generated during the construction. Human waste will be generated from workers during construction and operation.	• To seal, remove, or contain solid wastes and other construction wastes. • To dispose them at the disposal sites approved by respective LGUs and DPWH. • To select eco-friendly waste disposal methods. • To edificate and educate construction workers. • To conduct EIS on the disposal site if the site is to be newly developed for the project. • Effect of waste will be minimized by adoption of above measures.	• If these are specified in the contract. • If these are properly implemented.
Noise and Vibration	• Noise level was measured at 6 stations in dry season (2012). Noise level at all stations exceeded DENR Standard. It is important to adopt measures not to worsen noise level than at present. • Noise and vibration occur from machineries and vehicles used during construction work, hence construction work and transporting of materials need to be carefully done.	• To bore piles should be adopted during foundation works instead of pile driving. • To use noise suppressors equipped machineries. • To work in day time or non-critical time to minimize noise disturbance to adjacent residential areas. • To install temporary noise barriers at noise sensitive areas such as residential, schools, and places of worships to maintain noise level at permissible limit. • To strictly prohibit overloading on trucks. • Aggravation of noise and vibration will be minimized by adoption of above measures.	• Measure noise quarterly. • If these are specified in the contract. • If these are properly implemented
Traffic Congestion	• During the construction, trucks transporting construction materials will cause traffic congestion.	• To implement traffic management plan in coordination with local police. • To transport materials during off-peak hours. • To prohibit parking of construction-related vehicles on the national/provincial roads. • To use temporary construction road built within the acquired road right-of-way as much as possible. • To educate truck drivers.	• If these are specified in the contract. • If these are properly implemented. •

TABLE 11.1-2 ENVIRONMENTAL AND SOCIAL IMPACTS, MITIGATION MEASURES AND MONITORING ITEMS FOR OPERATION AND MAINTENANCE PHASE

<table>
<tr><th>Item</th><th>Assessment</th><th>Mitigation Measures</th><th>Monitoring Items</th></tr>
<tr><td>Involuntary Relocation/ Resettlement</td><td>• (-) Chances of PAFs degrade quality of livelihood after relocation</td><td>• PAF's recovery way of life after resettlement needs to be taken care of.
• DPWH shall monitor impacts after construction.</td><td>• If PAPs recovered their way of life.</td></tr>
<tr><td>Farm Land</td><td>• Estimated monetary values of crops that would yield in the land acquired for CALAX were estimated to be 570,000 pesos per year. Some of PAPs who lose farm land might face financial difficulty if their losses of income sources are not properly compensated or alternative means of compensation have been provided.</td><td>• To adopt high productivity farming methods and high yield seeds.
• To educate and finance farmers so as for them to adopt above
• Proper compensation such as job training and prioritized job opportunity.</td><td>• Check the agricultural production of Cavite and Laguna Provinces.</td></tr>
<tr><td>Accident</td><td>• CALAX will be built as 4-lane divided facility with center median and international geometric design standard is adopted therefore, occurrence of accidents will be unlikely due to quality of the facility. Accident may occur only when a driver does not follow traffic rules and regulations. Traffic on existing roads will be decreased, thus accidents will be expected to reduce.
• Traffic accident on ordinary roads will occur at the entrances/exits to/from the expressway.</td><td>• Provide traffic signal controlled intersection with channelization to minimize traffic accidents.
• Provide sidewalks with guardrails, pedestrian crossings on the ordinary roads near interchanges.
• Educate drivers to follow traffic rules and regulations.
• Install traffic signboards at appropriate places.
• Regularly repair roads and bridges to ensure good condition for vehicle movement.</td><td>• Check the report of concessionaire.</td></tr>
<tr><td>Air Pollution</td><td>• Predicted air qualities such as NOX, $SO^2$and PM-10 are less than 1μg/Ncm with CALAX. During O & M period,all parameters are estimated to be below DENR Standards.
Maximum Predicted Air Quality along CALAX(Laguna section)
<table>
<tr><th>Year</th><th>NOX (μg/Ncm)</th><th>SO^2 (μg/Ncm)</th><th>PM-10 (μg/Ncm)</th></tr>
<tr><td>2017</td><td>11.724</td><td>31.0009</td><td>147.014</td></tr>
<tr><td>2020</td><td>11.884</td><td>31.0011</td><td>147.019</td></tr>
<tr><td>2030</td><td>12.163</td><td>31.0017</td><td>147.027</td></tr>
<tr><td>DENR</td><td>260</td><td>340</td><td>300</td></tr>
</table></td><td>• To use clean filters and mufflers of engines
• To minimize idling of engines
• To maintain vehicle mechanics, engines, oil filter, exhaust pipe, and such in proper shape
• To prohibit old model vehicles
• To strengthen vehicle emission regulation</td><td>• Measure air quality quarterly.</td></tr>
<tr><td>Noise</td><td>• Predicted noise level at church and school (13points) along CALAX are from 51.2 to 74.9 dBA during day time period and from 47.4 to 71.1 dBA for night time period on year 2020.Since the noise level standard of DENR during the day time and night time are 50 dBA and 40 dB respectively, noise level of all point excess the standard.
• For residential area (5 points), predicted</td><td>• Noise barriers can achieve 10dBA noise level reduction according to noise model prediction.
• Noise barriers will be constructed at the sensitive areas along CALAX before</td><td>• Measure noise quarterly.</td></tr>
</table>

	noise level on year 2020 are from 67.6 to 78.3 dBA during day time period and from 63.8 to 74.5 dBA during night time period. Since the noise level standard of DENR during the day time and night time are 65 dBA and 55 dB respectively, all points exceed noise standard during daytime and nighttime. • It is necessary to reduce noise levels and make them acceptable based on the DENR regulation and/or at least the present average noise level of the area.	operation.	

Source: JICA Study Team

11.2 RAP Implementation

1) Overall RAP Requirements

Overall RAP requirements of this project are summarized in **TABLE 11.2-1.**

TABLE 11.2-1 OVERALL RAP REQUIREMENTS

	Compensation Structure	LARRIPP, 2007	This Project
Compensation	For Structure	• Cash including cost of restoring the remaining structure • Determined by Appraisal Committee • No deduction for salvaged building materials (Replacement Cost)	• No. of residential houses affected: 36 (50 HH, 197 persons)
	For Other Improvement	• Cash • Replacement cost for the affected portion of public structure to the Government or non-Government agencies or to the community • Cost for reconnecting the facility such as water, power and telephone	• Commercial Structure: 2 • Auxiliary Structure: 34 • Public Infrastructure: 6
	For Crops, Trees and Perennials	• Cash • Commercial value as determined by DENR or Appraisal Committee • PAFs given sufficient time to harvest crops • Compensation for damaged crops (palay, corn) at market value • Fruit-bearing trees based on assessment of Provincial/Municipal Assessors	• Fruit bearing/crops: 524+3730 = 4254 • None Fruit Bearing Trees: 5253
	For Land	• Replacement Cost – Initial Offer: Zonal Valuation – Second Offer: Market Value • Land Swapping if feasible (Land for Land) (Cash compensation when affected holding has a higher value than relocation plot.)	• Residential house land: 36 lots (36 owners, all severe) • Farm Land: Approximately 77 lots (Severe 62, Marginal 15) • Survey Result…70.1% are land owners, 5.2% are tenants and 24.7% are free occupation with permit.
	Informal Settlers	• No informal settlers is affected.	•
	Other Types of Assistance or Entitlement	**Disturbance Compensation** • Lessees: 5 times the average of gross harvest for the past three years, but not less than Php15,000. • Tenant: Value of gross harvest of 1 year and not less than Php15,000 per ha. (E.O. 1035)	• About 70.1% of farm lands are owned. • No Lessee • 5.2% are classified as tenant farmers • 24.7% are free occupation with permit.

	Compensation Structure	LARRIPP, 2007	This Project
		Income Loss • Loss of business/income, entitled to an income rehabilitation assistance not to exceed Php15,000 or based on tax record.	• Two (2) small-scale owners are affected.
		Inconvenience Allowance • Php10,000 to PAF when severely affected structures which require relocation and new construction.	• Thirty six (36) residential houses (50 households)
		Rehabilitation Assistance • Skills training and other development activities equivalent to Php15,000 per family	• Max. fifty (50) households who lose income. • Some farmers who become land less.
		Rental Subsidy • Without sufficient additional land to allow reconstruction of their lost house. • Equivalent to prevailing average monthly rental. • Period between delivery of house compensation and the delivery of land compensation	• When availability of relocation sites is delayed, this should be considered (maximum of 50 households)
		Transportation Allowance and Assistance	• 50 households

Note: Severe –More than 20% of Total Land/Properties affected
Marginal – Less than 20% and still viable for continued use.

Source: JICA Study Team (2012)

2) RAP Implementation Organization

RAP Implementation organization is shown in **FIGURE 11.2-1.**

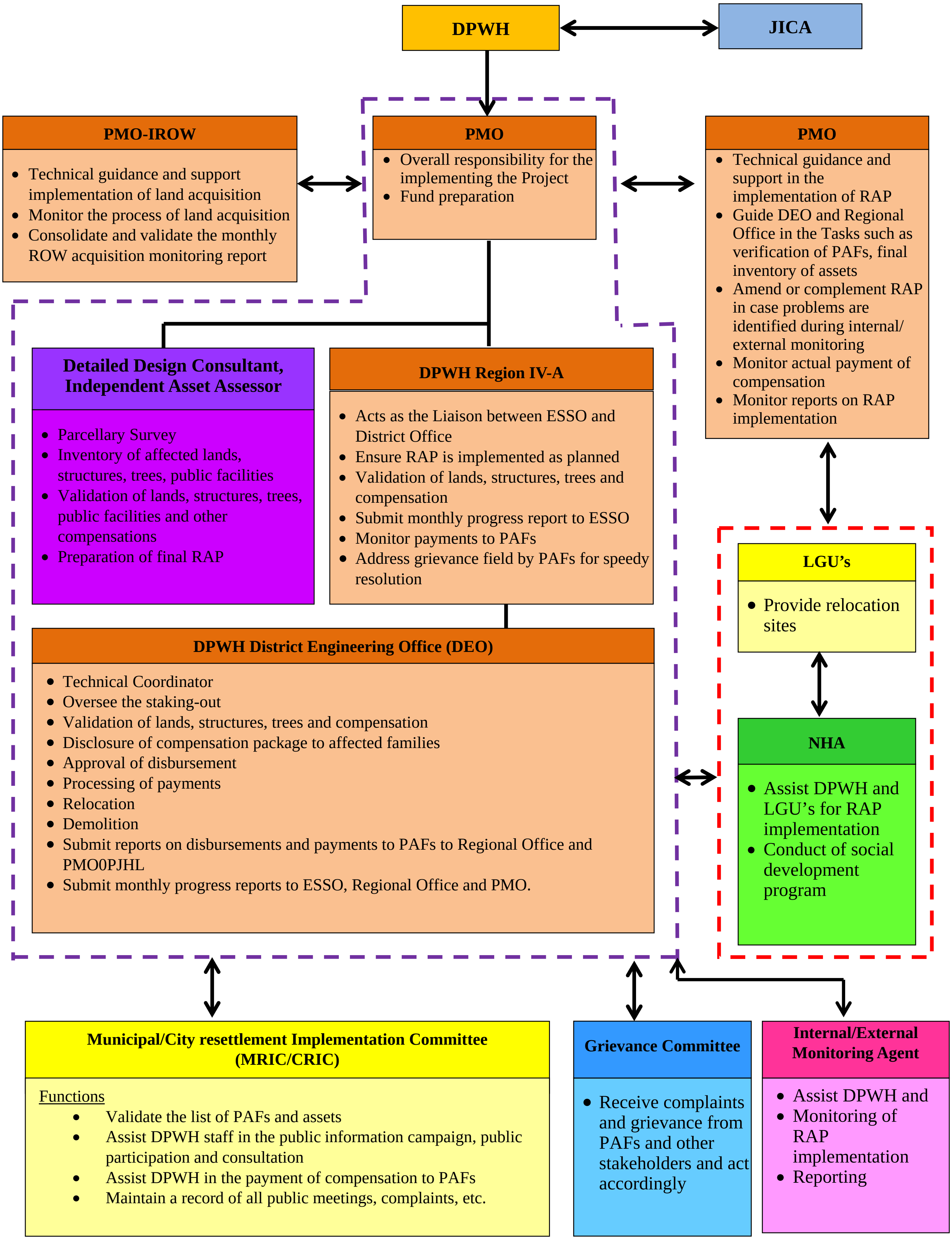


FIGURE 11.2-1 RAP IMPLEMENTATION ORGANIZATION

3) RAP Implementation Process

RAP implementation process is shown in **FIGURE 11.2-2.**

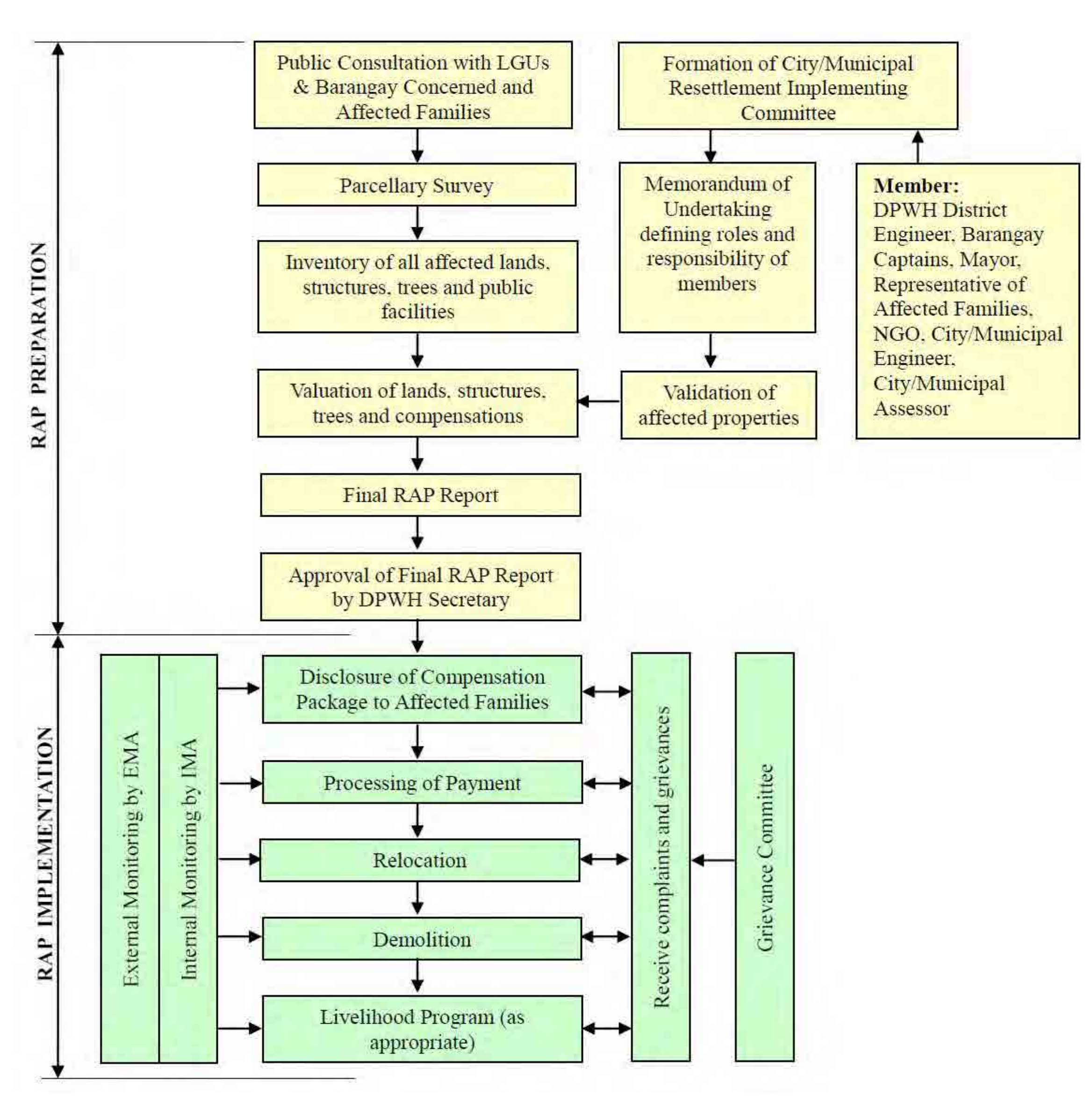
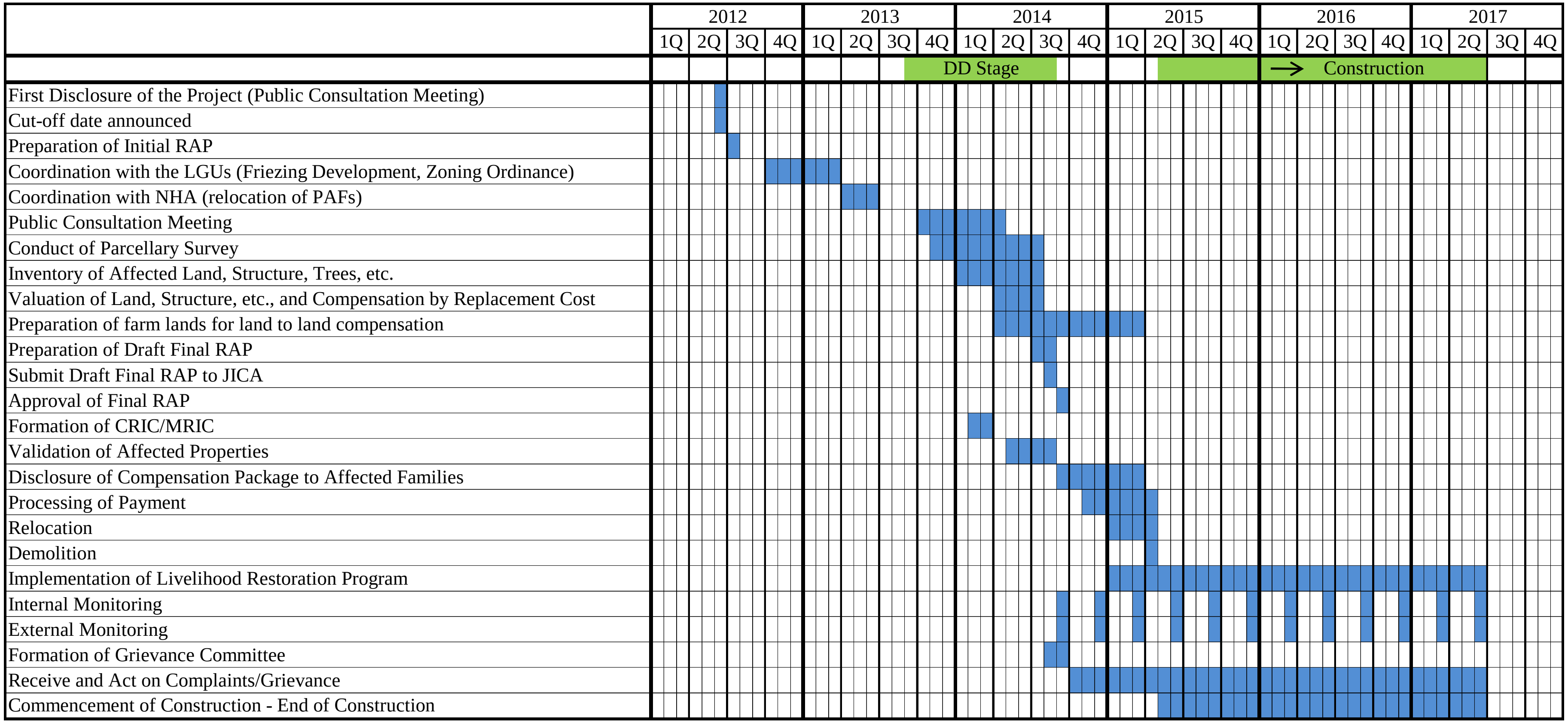


FIGURE 11.2-2 RAP IMPLEMENTATION PROCESS

4) RAP Implementation Schedule

RAP implementation schedule is shown in **TABLE 11.2-2.**

TABLE 11.2-2 RAP IMPLEMENTATION SCHEDULE



Source: JICA Study Team (2012)

12 PROJECT IMPLEMENTATION

12.1 Implementation Schedule

Implementation schedule is shown in **TABLE 12.1-1.**

Cavite Section

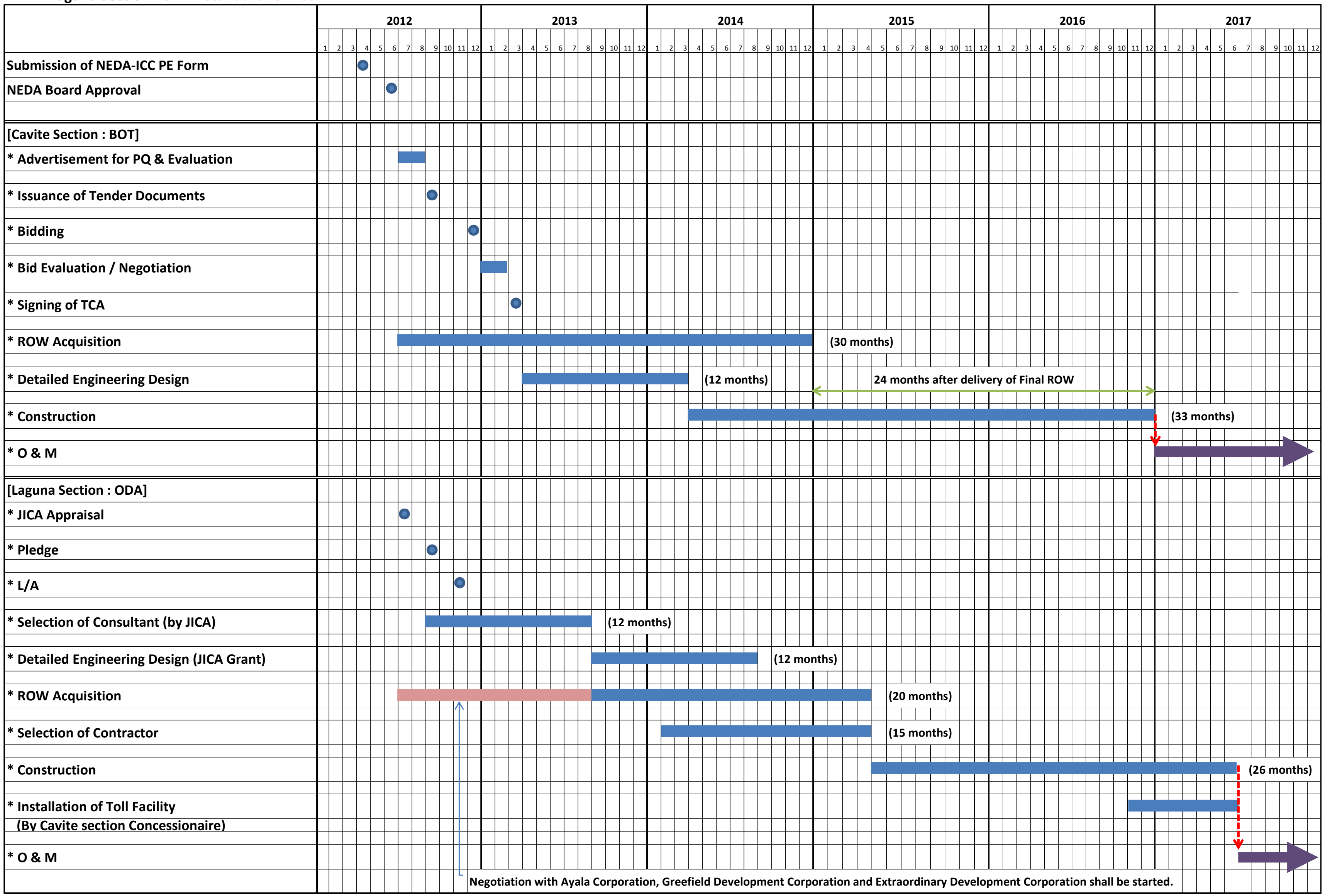
- Soon after the project is approved by NEDA Board (July 2012), Cavite Section will be advertized for the pre-qualification of interested investors/bidders.
- Bidding is expected to be held in December 2012.
- Toll Concession Agreement (TCA) is expected to be signed in March 2013.
- Since the parcellary survey is included in the current WB Consultant's scope of work, ROW acquisition is expected to start by July 2012 (soon after the project is approved by NEDA Board). ROW acquisition is estimated to require 30 months.
- Detailed Engineering Design will start by May 2013 and will be completed in April 2014.
- Construction is expected to start by June 2016 and will be completed in November 2016.
- Operation and Maintenance will start by December 2016.

Laguna Section

- Project Appraisal by JICA is expected in November 2012.
- Loan Agreement is expected to be signed in March 2013.
- Selection of Consultant for the detailed engineering design will start in January 2013 and end in August 2013.
- Detailed engineering design will start from September 2013 and be completed in August 2014.
- Selection of contractor will start April 2014 and be completed in April 2015.
- ROW Acquisition will start in September 2013 and be completed in April 2015 (20 months).
- DPWH should start negotiation with Ayala Corporation, Greenfield Development Corporation and Extraordinary Development Corporation for the land value to be paid to them soon after the Project is approved by NEDA Board.
- Construction will start May 2015 and be completed in June 2017 with the construction period of 26 months.
- Installation of toll facility will be done by the selected concessionaire for Cavite Section. It will start November 2016 and completed in June 2017.
- Completion of Laguna Section will be about 6 months behind that of the Cavite Section.

TABLE 12.1-1 IMPLEMENTATION SCHEDULE: CAVITE SECTION BY BOT, LAGUNA SECTION BY ODA

Laguna Section - ODA : StandardYen Loan



Source: JICA Study Team

12.2 Civil Work Contract Packaging

Laguna Section is divided into two (2) contract packages considering the cost, scale of works and characteristics of works.

Contract Package 1 :	Km. 0 + 690 ~ Km. 10 + 600	(L = 9.91 km)
Contract Package 2 :	Km. 10 + 600 ~ Km. 18 + 810	(L = 8.21 km)

12.3 Procurement Plan

Consultancy services and civil work contractor will be procured through the following method in accordance with JICA Guidelines for Procurement under Japanese ODA Loans, March 2009.

1) Consultancy Services

Consultancy services will be procured by two (2) steps, Pre-qualification and Tendering, under the International Competitive Bidding (ICB). Quality- and Cost-Based (QCBS) method will be adopted.

2) Civil Work Contractor

Civil work contractor will be provided by 2 steps, Pre-qualification and Tendering, under the International Competitive Bidding (ICB).

12.4 Organizational Structure

Implementing agency is the Department of Public Works and Highways (DPWH).

Implementing office is the Project Management Office – Build-Operate-Transfer (PMO-BOT). PMO-BOT is currently implementing or preparing the following projects;

- Daang Hari – SLEX Connector Road (Detailed Design is on-going.)
- TPLEX (under Construction)
- NLEX – SLEX Connector Road (under evaluation of the unsolicited proposal)
- NAIAX (preparation for bid)
- CALAX – Cavite Section (preparation for bid)

It is necessary for PMO-BOT to reinforce its staff from other PMOs who have experiences of Japan's ODA projects such as PMO-PJHL and PMO-URPO. Environmental and RAP related staff should be also reinforced.

12.5 Financial Plan

1) Project Cost

TABLE 12.5-1 shows the project cost by JICA portion and others. Total JICA portion is estimated at Php 13,410.69 Million which is 80% of the total project cost.

TABLE 12.5-1 PROJECT COST

Million Peso
(Million Yen)

Breakdown of Cost	Foreign Currency Portion			Local Currency Portion			Total		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Civil works	4,388.35	4,388.35 (¥8,206.21)		6,375.49	6,375.49 (¥11,922.17)		10,763.84	10,763.84 (¥20,128.38)	0.00
Price Escalation	373.33	373.33 (¥698.12)		649.65	649.65 (¥1,214.84)		1,022.97	1,022.97 (¥1,912.96)	0.00
Physical Contingency	219.42	219.42 (¥410.31)		318.77	318.77 (¥596.11)		538.19	538.19 (¥1,006.42)	0.00
Consulting Service	617.83	617.83 (¥1,155.34)		146.49	146.49 (¥273.94)		764.32	764.32 (¥1,429.27)	0.00
Land Acquisition	0.00			3,543.96		3,543.96	3,543.96	0.00	3,543.96
Administration Cost	0.00			207.43		207.43	207.43	0.00	207.43
VAT	0.00			1,996.86		1,996.86	1,996.86	0.00	1,996.86
Import Tax	0.00			265.91		265.91	265.91	0.00	265.91
Interest During Construction	0.00			356.56		356.56	356.56	0.00	356.56
Commitment Charge	0.00			65.45		65.45	65.45	0.00	65.45
Total	**5,598.92**	**5,598.92** (¥10,469.98)	**0.00**	**13,926.56**	**7,490.40** (¥14,007.05)	**6,436.16**	**19,525.48**	**13,089.32** (¥24,477.03)	**6,436.16**

Note:

Physical Contingency	:	5%
Foreign Exchange Rate	:	US$ 1 = 79.7 Yen = 42.7 Pesos
Price Escalation	:	Foreign – 2.1 % per annum
		Local – 2.5 % per annum

2) Annual Fund Requirement

In accordance with the implementation schedule, the annual fund requirement was estimated as shown in **TABLE 12.5-2** and is summarized in **TABLE 12.5-3**.

TABLE 12.5-2 ANNUAL FUND REQUIREMENT (1/2)

Project Cost

	2013	2014	2015	2016	2017	2018	Total
1. Civil Works							
Foreign Exchange Costs			1,350.26	2,025.39	1,012.70		4,388.35
Local Costs			1,961.69	2,942.53	1,471.27		6,375.49
Tax			466.10	699.14	349.57		1,514.81
Total			**3,778.05**	**5,667.07**	**2,833.53**		**12,278.65**
2.Price Escalation							
Foreign Exchange Costs			86.87	175.57	110.89		373.33
Local Costs			150.84	305.47	193.34		649.65
Tax			35.84	72.58	45.94		154.36
Total			**273.54**	**553.62**	**350.17**		**1,177.33**
3.Physical Contingency (5%)							
Foreign Exchange Costs			67.51	101.27	50.63		219.42
Local Costs			98.08	147.13	73.56		318.77
Tax			23.30	34.96	17.48		75.74
Total			**188.90**	**283.35**	**141.68**		**613.93**
4.Sub-Total							
Foreign Exchange Costs			1,504.64	2,302.23	1,174.22		4,981.09
Local Costs			2,210.61	3,395.13	1,738.17		7,343.91
Tax			525.24	806.68	412.99		1,744.91
Total			**4,240.49**	**6,504.04**	**3,325.38**		**14,069.91**
5.Consulting Services							
5.1 Detailed Eng. Design							
Foreign Exchange Costs	56.89	113.79					170.68
Local Costs	5.85	11.70					17.55
Tax	7.53	15.06					22.59
Total	**70.27**	**140.55**					**210.82**
5.2Tender Assistance							
Foreign Exchange Costs		41.09	20.55				61.64
Local Costs		5.70	2.85				8.55
Tax		5.61	2.81				8.42
Total		**52.41**	**26.20**				**78.61**
5.3 Construction Supervision							
Foreign Exchange Costs			98.89	148.33	74.17		321.39
Local Costs			31.48	47.22	23.61		102.30
Tax			15.65	23.47	11.73		50.85
Total			**146.01**	**219.02**	**109.51**		**474.54**
5.4 Consultant Base Cost(5.1~5.3)							
Foreign Exchange Costs	56.89	154.88	119.44	148.33	74.17		553.71
Local Costs	5.85	17.40	34.33	47.22	23.61		128.40
Tax	7.53	20.67	18.45	23.47	11.73		81.86
Total	**70.27**	**192.95**	**172.22**	**219.02**	**109.51**		**763.97**
5.5 Price Escalation for Consultant							
Foreign Exchange Costs	1.19	6.57	7.68	12.86	8.12		36.43
Local Costs	0.15	0.88	2.64	4.90	3.10		11.67
Tax	0.19	1.05	1.42	2.44	1.54		6.63
Total	**1.53**	**8.50**	**11.74**	**20.20**	**12.77**		**54.73**
5.6 Physical Contingency for Consultant(5%)							
Foreign Exchange Costs	2.84	7.74	5.97	7.42	3.71		27.69
Local Costs	0.29	0.87	1.72	2.36	1.18		6.42
Tax	0.38	1.03	0.92	1.17	0.59		4.09
Total	**3.51**	**9.65**	**8.61**	**10.95**	**5.48**		**38.20**
5.7 Sub-Total							
Foreign Exchange Costs	60.93	169.20	133.09	168.61	86.00		617.83
Local Costs	6.29	19.15	38.68	54.48	27.89		146.49
Tax	8.09	22.75	20.79	27.08	13.86		92.59
Total	**75.32**	**211.10**	**192.57**	**250.17**	**127.75**		**856.90**

TABLE 12.5-2 ANNUAL FUND REQUIREMENT (2/2)

6.1 Land Acquisition Cost							
Foreign Exchange Costs							0.00
Local Costs	320.45	1,922.68	961.34				3,204.47
Tax	38.45	230.72	115.36				384.54
Total	**358.90**	**2,153.41**	**1,076.70**				**3,589.01**
6.2 Price Escalation for Land Acquisition Cost							
Foreign Exchange Costs							0.00
Local Costs	8.01	97.34	73.92				179.27
Tax	0.96	11.68	8.87				21.51
Total	**8.97**	**109.02**	**82.79**				**200.78**
6.3 Physical Contingency(5%)							
Foreign Exchange Costs							0.00
Local Costs	16.02	96.13	48.07				160.22
Tax	1.92	11.54	5.77				19.23
Total	**17.95**	**107.67**	**53.84**				**179.45**
6.4 Sub-Total							
Foreign Exchange Costs	0.00	0.00	0.00				0.00
Local Costs	344.48	2,116.15	1,083.33				3,543.96
Tax	41.34	253.94	130.00				425.28
Total	**385.82**	**2,370.09**	**1,213.33**				**3,969.24**
7.1 Administrative Cost							
Foreign Exchange Costs							0.00
Local Costs	38.50	38.50	38.50	38.50	38.50		192.50
Tax							0.00
Total	**38.50**	**38.50**	**38.50**	**38.50**	**38.50**		**192.50**
7.2 Price Escalation for Administrative Cost							
Foreign Exchange Costs							0.00
Local Costs	0.96	1.95	2.96	4.00	5.06		14.93
Tax							0.00
Total	**0.96**	**1.95**	**2.96**	**4.00**	**5.06**		**14.93**
7.3 Sub-Total							
Foreign Exchange Costs	0.00	0.00	0.00	0.00	0.00		0.00
Local Costs	39.46	40.45	41.46	42.50	43.56		207.43
Tax	0.00	0.00	0.00	0.00	0.00		0.00
Total	**39.46**	**40.45**	**41.46**	**42.50**	**43.56**		**207.43**
8. Total Cost(1-7)							
Foreign Exchange Costs	60.93	169.20	1,637.73	2,470.84	1,260.22		5,598.92
Local Costs	390.23	2,175.75	3,374.08	3,492.11	1,809.62		11,241.79
Tax	49.43	276.69	676.03	833.76	426.85		2,262.77
Total	**500.60**	**2,621.64**	**5,687.84**	**6,796.71**	**3,496.69**		**19,103.48**
9.Interest During Construction							
Foreign Exchange Costs	0.01	0.02	21.10	53.35	69.80	0.00	144.28
Local Costs	0.00	0.00	30.95	78.49	102.83	0.00	212.28
Total	**0.01**	**0.03**	**52.06**	**131.84**	**172.63**	**0.00**	**356.56**
10.Comittment Charge							
Foreign Exchange Costs	5.60	5.60	5.60	5.60	5.60		27.99
Local Costs	7.49	7.49	7.49	7.49	7.49		37.45
Total	**13.09**	**13.09**	**13.09**	**13.09**	**13.09**	**0.00**	**65.45**
11. GRAND TOTAL							
Foreign Exchange Costs	**66.54**	**174.82**	**1,664.43**	**2,529.79**	**1,335.62**	**0.00**	**5,771.19**
Local Costs	**397.72**	**2,183.24**	**3,412.52**	**3,578.09**	**1,919.94**	**0.00**	**11,491.52**
Tax	**49.43**	**276.69**	**676.03**	**833.76**	**426.85**	**0.00**	**2,262.77**
Total	**513.69**	**2,634.76**	**5,752.99**	**6,941.64**	**3,682.40**	**0.00**	**19,525.48**

	2013	2014	2015	2016	2017	2018	Total
A. Yen Loan Portion							
Foreign Exchange Costs	60.93	169.20	1,637.73	2,470.84	1,260.22	0.00	5,598.92
Local Costs	6.29	19.15	2,249.29	3,449.61	1,766.06	0.00	7,490.40
Total	**67.22**	**188.35**	**3,887.02**	**5,920.45**	**3,026.28**	**0.00**	**13,089.32**

Note:Price Escalation Rate: Foreign 2.1% per year, Local 2.5% per year

TABLE 12.5-3 SUMMARY OF ANNUAL FUND REQUIREMENT

Unit : Million Php (Million Yen)

Million Peso
(Million Yen)

Breakdown of Cost	Total		
	Total	JICA Portion	Others
Year			
2012	0.00	0.00 (¥0.00)	0.00
2013	513.69	67.22 (¥125.70)	446.47
2014	2,634.76	188.35 (¥352.21)	2,446.41
2015	5,752.99	3,887.02 (¥7,268.73)	1,865.97
2016	6,941.64	5,920.45 (¥11,071.24)	1,021.19
2017	3,682.40	3,026.28 (¥5,659.14)	656.13
2018	0.00	0.00 (¥0.00)	0.00
Total	**19,525.48**	**13,089.32** **(¥24,477.03)**	**6,436.16**

Note:

Physical Contingency	:	5%
Foreign Exchange Rate	:	US$ 1 = 79.7 Yen = 42.7 Pesos
Price Escalation	:	Foreign – 2.1 % per annum
		Local – 2.5 % per annum

13 OPERATION AND EFFECT INDICATIORS

Summarized operation and effect indicators are shown in **TABLE 13-1.**

TABLE 13-1 OPERATION AND EFFECT INDICATORS

	Indicators	Road Name	Baseline (2011)	Target (2020)	Data Collection Method
Operation Indicators	Traffic Volume (vehicle /day)	CALAX (Aguinaldo IC ~ East Silang IC)	-	26,827	Traffic count survey
	Toll Revenue (Thousand Peso/day)	CALAX (Laguna Section)		4,156	Data collection from Operator
Effect Indicators	Traffic Congestion Rate (V/C Rate)	Aguinaldo Highway (Imus)	1.33	1.15	Calculation based on Traffic count survey
		Governor's Drive (Carmona)	1.12	1.05	
		Sta.Rosa-Tagaytay Road(Sta.Rosa)	1.03	1.05	
	Travel Time (hr:min)	Silang – NAIA (Morning Peak)			Travel Time Survey
		Via Aguinaldo + Coastal Rd	1:05	Via CALAX and SLEX 0:34	
		Via Govener's Dr +SLEX	1:11		
	Travel Time Saving (hours/day)	Aguinaldo Highway, Governor's Drive and Sta. Rosa-Tagaytay Road to CALAX	-	20,840	Calculation based on Travel Time Survey
	Travel Time Cost Saving (Peso/year)		-	5.42 billion	Calculation based on Time Cost and Travel Time Survey

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND AND BRIEF HISTORY OF THE PROJECT

1.1.1 Background of the Project

The Philippines has been experiencing relatively slower economic development partly due to limited flow of direct investments into manufacturing sector compared to other rapidly growing ASEAN countries after the recovery from Asian Economic Crisis. In order to foster both domestic and foreign investments, improving overall investment climate including road network has been an urgent matter. In particular, the economic activities are extremely concentrated in Metro Manila where 37% of GDP and 13% of total population are accumulated in merely 0.2% of the country's land. This extreme concentration causes serious congestion and delays of distribution of goods and movement of people, resulting to huge damage to economy and lowering the country's international competitiveness as an investment destination. Likewise living condition in Metro Manila has eroded due to air pollution and traffic noise caused by chronic congestion. In summary, solving traffic congestion in Metro Manila by networking surrounding cities and upgrading/expanding highways around Mega Manila – the area covering Metro Manila, Central Luzon and CALABARZON – contributes to improvement of both investment climate and living climate. Cavite-Laguna Expressway (CALAX) is located along the Subic-Clark-Manila–Batangas Logistic Corridor (or known as North-South Industrial Development Beltway), and provides vital transport access to provinces of Cavite and Laguna including Batangas Port; where rapid urbanization propelled by the private developers is on-going and economic/industrial zones have and are being developed. CALAX will support sound urbanization of the two provinces and industrial development and economic development of the provinces as well as reduction of traffic congestion of the two provinces.

This report covers Cavite-Laguna Expressway Project (Laguna Section) (hereinafter referred to as "CALAX (Laguna Section)" or "the Project").

1.1.2 Brief History of the Project

The Government of Japan has been providing financial and technical assistance for the Project area.

In 1991, financial assistance (or yen loan) was provided to "the Cavite Export Processing Zone Development and Investment Promotion Program".

In 1998, financial assistance (or yen loan) was provided to "the development Project on the Port of Batangas".

In 2006, JICA-assisted Feasibility Study and Implementation Support on the CALA East-West National Road Project (hereinafter referred to as the "2006 FS") was undertaken. The 2006 FS studied three (3) roads as follows;

- North-South Road (for CAVITEX to north of Governor's Drive)
- Daang Hari Road
- CALA Expressway (from Governor's Drive to SLEX), section from Governor's Drive to CAVITEX Extension was not included due to uncertain alignment and implementation of CAVITEX Extension.

After the 2006 FS, the DPWH tried to implement CALAX and several stakeholders meeting inviting concerned private land developers, however, most of land developers objected the CALAX Project because their development plans are severely affected. Thus, DPWH suspended further actions for implementation.

Meantime, the DPWH continued discussions with the CAVITEX operator and concerned LGUs in Cavite Province and selected CALAX corridor alignment of the Cavite side.

In 2009, the World Bank decided to finance the transaction services for the Cavite section of CALAX project through its loan. The Consultant for the transaction services was selected and the work commenced in September 2011.

JICA also decided to provide technical assistance for the Laguna section of CALAX in 2010 and dispatched the JICA Study Team in 2011.

1.2 OBJECTIVES OF THE PROJECT

Objectives of the project are as follows:

OBJECTIVES OF THE PROJECT

(i)	To provide fast, safe, comfortable and reliable means of transport in Cavite and Laguna Provinces.
(ii)	To decongest traffic of roads in Cavite and Laguna Provinces.
(iii)	To support economic development by providing better transport access to economic/industrial zones in the area, this contributes improvement of local/foreign investments in the area.
(iv)	To support sound urbanization in the area.

1.3 THIS REPORT

This report presents all the findings and recommendations so far made for the Cavite - Laguna Expressway (CALAX) Project.

CHAPTER 2
ROAD SECTOR OVERVIEW

2.1 PHILIPPINE DEVELOPMENT PLAN (2011 – 2016)

Philippine Development Plan (PDP), 2011-2016 was announced in 2011. Development policies of infrastructure are as follows;

DEVELOPMENT POLICIES OF INFRASTRUCTURE

"**Accelerating Infrastructure Development**"

(1) To optimize resources and investment
- Improve project preparation, development and implementation
- Synchronize planning and budgeting
- Coordinate and integrate infrastructure initiative

(2) To attract investments in infrastructure
- Improve the institutional and regulatory environment of the infrastructure sector
- Encourage PPPs

(3) To foster transparency and accountability in infrastructure development
- Encourage stakeholder participation

(4) To adopt to climate change and mitigate the impacts of natural disasters
- Institutionalize Climate Change Act (CCA) and Disaster Risk Reduction Management (DRRM)

(5) To provide productive employment opportunities
- Adopt a labor-intensive scheme where applicable.

With regards to the transport sector, issues and challenges are established as follows;

TRANSPORT SECTOR ISSUES AND CHALLENGES

(a) Assessment and Issues
- Lack of integrated and coordinated transport network
- Overlapping and conflicting functions of transport and other concerned agencies
- Transport safety and security concerns

(b) Strategic Plan and Focus
- Adopt a comprehensive long-term National Transport Policy (NTP)
- Develop strategic transport infrastructure assets
  - Prioritize asset preservation
  - Provide access to major and strategic tourism destinations and production areas
  - Promote environmentally sustainable and people-oriented transport

(c) Develop an Integrated Multi-modal Logistics and Transport System
- Identify and develop strategic logistics corridors based on a National Logistics Master Plan
- Improve RORO terminal system
- Explore ASEAN connectivity through sea linkages

(d) Separate the Regulatory and Operation Functions of Transport and Other Concerned Agencies. To address the overlapping and conflicting functions of transport and other concerned agencies.
(e) Comply with Safety and Security Standards. To ensure transport safety and standards.
(f) Provide Linkages to Bring Communities into the Mainstream of Progress and Development. To promote conflict-affected and highly impoverished areas.

2.2 ROAD DEVELOPMENT GOALS

Public Investment Program (PIP) (2011 - 2016) was formulated by DPWH in 2011. Goals were set as follows;

DEVELOPMENT GOALS UNDER PIP

1. Provide safe environment through quality infrastructure facilities;
2. Increase mobility and total connectivity of people through quality infrastructure resulting to improved quality of life;
3. Strengthen national unity, family bonds and tourism by making the movement of people faster, cheaper and safer;
4. Facilitate the decongestion of Metro Manila via a transport logistics system that would ensure efficient linkages between its business centers and nearby provinces;
5. Implement more Public-Private Partnership (PPP) projects for much needed infrastructure and level playing field for investment;
6. Study the mechanism for longer maintenance period for roads and bridges; and
7. Generate more transport infrastructure with minimal budget cover or contingent liabilities.

Strategic focuses were set as follows;

STRATEGIC FOCUS

- Implement activities in the following order of priorities:
  a. Maintenance or asset preservation – to preserve existing roads in good condition
  b. Rehabilitation – to restore damaged roads to their original designed condition
  c. Improvement – to upgrade road features so that they efficiently meet traffic demands; and
  d. New Construction
- Prioritize upgrading of the national road network, as to quality and safety standards
- Prioritize national roads to address traffic congestion and safety in urban centers and designated strategic tourism destinations
- Completion of on-going bridges along national roads
- Develop more Public-Private Partnership (PPP) projects for much needed infrastructure and level playing field for investments
- Study the mechanism for a longer maintenance period (5 – 10 years) in road and bridges construction contract provision
- Prioritize flood control projects in major and principal river basins to address climate change based on master plan and adopting new technologies in flood control and slope management
- Prioritize adequate flood control and upgraded drainage design standards and facilities in flood-disaster prone areas to mitigate loss of river and damage to properties
- Promote innovative technology such as geo-textiles and coco-netting in slope protection and

soil erosion control
- Promote retarding basin and rain water harvesting for non-domestic use
- Prioritize water supply in designated strategic tourist destinations/centers

2.3 BRIEF HISTORY OF EXPRESSWAY PPP PROJECTS IN THE PHILIPPINES

The expressway development has evolved through three distinct approaches, namely "Franchise Approach", in Joint Venture Approach" and "BOT Law Approach".

(1) Franchise Approach: Late 1970s to 2000s

The first toll road with the private sector participation in the public infrastructure project was North Luzon Expressway (NLEx) and South Luzon Expressway (SLEx). Both expressway were originally constructed by the public fund. To allow the private sector to operate, maintain and expand the facility, Presidential Decree (PD) No. 1112 called as "Toll Operation Decree" was issued 1977 and the Toll Regulatory Board (TRB) was created. The TRB was authorized to enter into contracts for the construction, operation and maintenance of toll facilities such as but not limited to national highways, roads, bridges and public thoroughfares.

Under PD No. 1113 in 1977, the Construction and Development Corporation of the Philippines (CDCP) was granted, for a period of thirty (30) years from May 1, 1977, the right privilege and authority to construct, operate and maintain toll facilities with extension to Pangasinan of the North Luzon Expressway (NLEx) and Quezon of the South Luzon Expressway (SLEx).

Through PD No. 1894 in 1983, the Philippine National Construction Corporation (PNCC formerly CDCP) was further granted the authority to construct, maintain and operate any and all such extension, linkages or stretches from any part of NLEx and/or Metro Manila Expressway. The franchise for the Metro Manila Expressway and all extensions/linkages shall have a term of thirty (30) years commencing from the date of completion of the project.

Major project implemented under this approach were;

- North Luzon Expressway (NLEx)
- South Luzon Expressway (SLEx)
- Manila-Cavite Coastal Expressway (CAVITEx)

(2) Joint Venture Approach: Early 1990s to Present

With the increase of traffic and deteriorated conditions of franchised expressways needs of rehabilitation, improvement and widening of the facilities increased sharply. Since the original franchise holders did not have enough financial capacity to undertake such works, the private investors submitted unsolicited proposal to the original franchise holders for financing of required rehabilitation/widening/improvement of the facilities under the joint venture approach. The private investors in joint venture with the original franchise holder implemented the necessary works and the Joint Venture Company contracted the supplemental toll operation agreement (STOA) with TRB.

Major projects implemented under this approach were;

- Rehabilitation, improvement and widening of NLEx

- Rehabilitation, improvement and widening of SLEx
- Construction of Skyway Pahse I and Phase II over SLEx
- Extension of CAVITEx

(3) BOT Law Approach: Middle of 1990s to Present

In 1990, Republic act (RA) No. 6597, otherwise known as the BOT Law, authorized the financing, construction, operation and maintenance of infrastructure projects by the private sector.

In 1994, RA No. 6597 was amended by RA No. 7718, which, among other things, allows more BOT variants, recognizes the need for private investors to realize rates of return reflecting market conditions, allows government support for BOT projects and allows unsolicited proposals, although it is actually discouraging unsolicited proposals by limiting the Government Financial Support. The Revised Implementing Rules and Regulations (Revised IRR) for the BOT Law, as amended, have been prescribed to cover all private sector infrastructure or development projects.

Major projects implemented under this approach were:

- Southern Tagalog Arterial Road (STAR)
- Subic-Clark-Tarlac Expressway (SCTEx)
- Tarlac-Pangasinan-La Union Expressway (TPLEx) which is under construction at present

2.4 MASTER PLAN ON HIGH STANDARD HIGHWAY NETWORK

The study of master plan on High Standard Highway (HSH) Network Development was conducted in Year 2010. **Figure 2.4-1** shows the proposed HSH network in Metro Manila and 200 km sphere. Based on this master plan, Public Investment Program (2011-2016) for expressway projects was formulated.

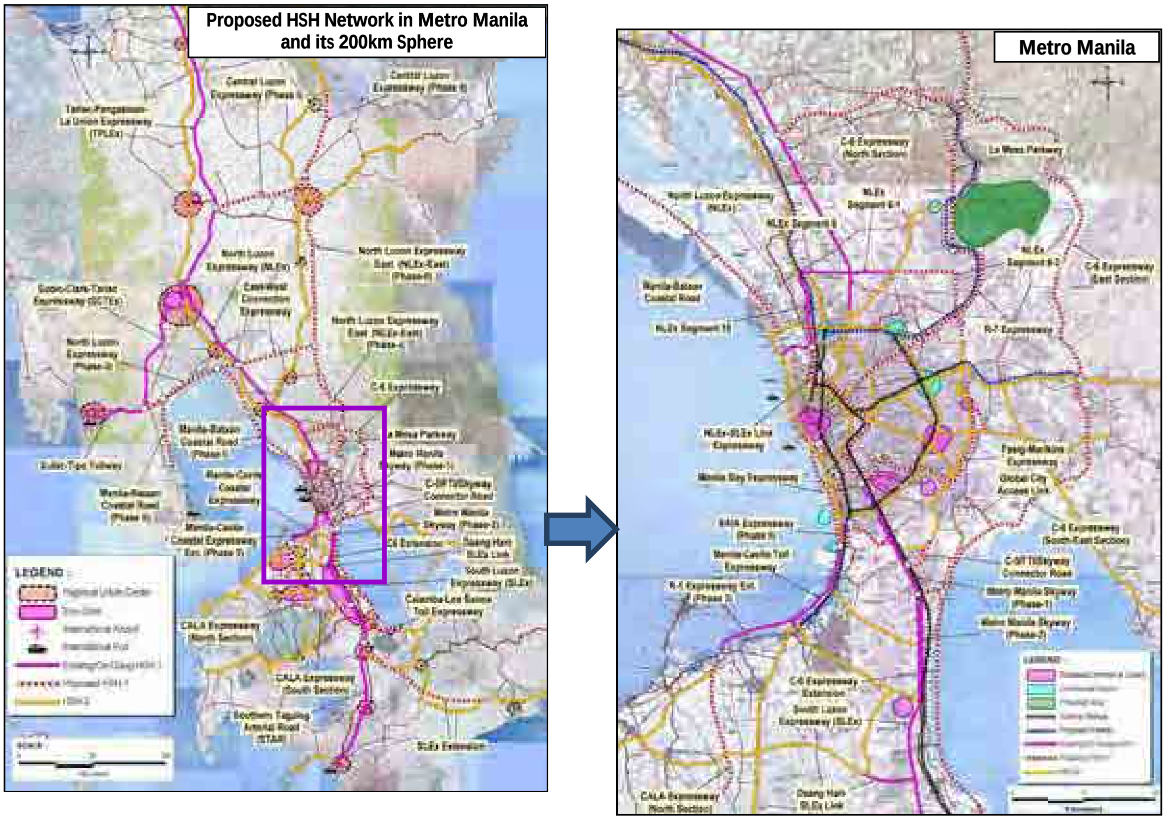


FIGURE 2.4-1 PROPOSED HSH NETWORK

Source: The Study of Master plan on High Standard Highway Network Development, 2010, JICA

CALA Expressway is one of the 1st priority projects in this Master plan shown in **TABLE 2.4-1**.

TABLE 2.4-1 PROPOSED HSH PROJECTS PRIORITY

	Name of HSH	Length (km)	Cost (billion pesos)
1st Priority Group	NLEx–SLEx Link Expressway	13.4	31.14
	CALA Expressway	41.8	19.67
	C-5/FTI/SKYWAY Connector Rd.	3.0	4.76
	NAIA Expressway (Phase 2)	4.9	12.18
	C-6 Expressway/Global City Link	66.5	54.29
	Central Luzon Expressway (CLLEX)	63.9	29.23
	SLEx Extension (to Lucena)	47.8	16.45
	Calamba-Los Banos Expressway	15.5	5.23
	Sub-total	256.8	172.95
2nd Priority Group	R-7 Expressway	16.1	25.81
	NLEX East / La Mesa Parkway	103.0	38.94
	Manila – Bataan Coastal Road	70.3	72.94
	NLEX (Phase 3)	36.2	28.42
	East-West Con. Expressway	26.6	16.48
	C-6 Extension	43.6	18.61
	Manila Bay Expressway	8.0	46.54
	Pasig Marikina Expressway	15.7	49.58
	Sub-total	319.5	297.32
TOTAL		576.3	470.27

Source: The Study of Master plan on High Standard Highway Network Development, 2010, JICA

2.5 CURRENT ROAD INFRASTRUCTURE SECTOR AND ITS DEVELOPMENT PLAN RELATED TO THE PROJECT

DPWH Public Investment Program (PIP) for 2011 -2016 contains the following target and priority programs

TABLE 2.5-1 TARGET OUTCOMES OVER THE MEDIUM TERM

	Year			Requirement
	2011	2014	2016	
a. National Arterial Roads (15,987 km)	94% Paved	100% Paved in good condition		• Paving of 1,443km • Rehab./ widening/ upgrading/ construction of 2,828km
b. National Secondary Roads (15,372 km)	72% Paved	81% Paved	100% Paved in good condition	• Paving of 3,329km • Rehabilitation of 1,798km
c. National Bridge (330,089m) (7,792 bridges)	95%	98%	100% Permanent	• Replacement of 8,544 lm of temporary bridges • Improvement of 6,047 lm of existing bridges • Construction of 2,154 lm new bridges • Repair/rehabilitation of 104,293 lm of bridges

Source: Public Investment Program (2011-2016) As of April 2012, DPWH

Under the PIP for 2011-2016, DPWH is envisaging a total investment of 698,084 million pesos. Of this total investment requirement in the PIP, 585,938 million pesos or 84% is earmarked for the highway sector, 83, 948 million pesos (12%) for flood control works and 28,198 million pesos (4%) for other locally-funded projects over the six (6) year program.

The total investment requirement for 2013 up to 2016 is based on the annual 10% increase from the approved budget of 99,490 million pesos for Y2012.

TABLE 2.5-2 (2011-2016) PUBLIC INVESTIMENT PROGRAM SUMMARY

List of Project	Prior Year	Proposed Allocation (in Million Pesos)						
		2011	2012	2013	2014	2015	2016	Total (2011-2016)
1.Roads	**75,703**	**75,047**	**81,246**	**91,697**	**101,347**	**113,722**	**122,878**	**585,938**
-Foreign assisted project	41,490	19,566	14,257	30,313	28,889	35,186	39,162	167,645
-PPP	-	-	1,474	11,164	7,450	4805	-	24,894
-Locally funded project	34,213	55,481	65,243	50,219	65,008	73730	83,715	393,398
2.Flood Control	**19,692**	**11,166**	**10,816**	**12,523**	**13,854**	**14,960**	**20,628**	**83,948**

Project								
-Foreign assisted project	13,283	2,978	2,300	2,670	3,728	6656	12,406	30,738
-Locally funded project	6,419	8,188	8,517	9,853	10,127	8304	8,221	53,211
3. Other Locally Funded DPWH Project	**36,288**	**4,474**	**7,428**	**5,219**	**5,181**	**3,738**	**2,157**	**28,198**
GRAND TOTAL	**131,683**	**90,687**	**99,490**	**109,439**	**120,383**	**132,421**	**145,663**	**698,084**

Source: Public Investment Program (2011-2016) As of April 2012, DPWH

2.6 PAST AND FUTURE PLAN OF OTHER DONOR'S PROJECT RELATED TO PPP POLICIES

(1) Technical Assistance by ADB, AusAID, and CIDA

In terms of capacity building, "Technical Assistance for Strengthening Public-Private Partnerships in the Philippines" are being carried out as of November 2011. This is a capacity development program financed by ADB AusAID (the Australian Agency for International Development), and CIDA (The Canadian International Development Agency). The purpose of the program is to help the Philippines to clear obstacles and to pave the way for PPP. Under this program, ADB provides a US$1.5 million grant, AusAID provides a US$7 million grant and CIDA provides a US$1.2 million grants. The program is to run from April 2011 to July 2013.

The expected outputs of the program are 1) Strengthening of PPP Enabling Framework, 2) Strengthening Capacity of the PPP Center, 3) Institutionalization of PPP Best Practice and 4) Establishment of Long-term Financing and Risk Guarantee Mechanisms.

(2) Other Programs and Activities

Besides ADB TA, there are several assistance programs planned by GoP and foreign agencies.

Singapore Cooperation Enterprise (SCE) has agreed with GoP to provide TA to promote PPP. The objectives of SCE TA are to:

- Achieve an in-depth understanding of the benefits and challenges for greater private sector participation in the financing of public sector projects; and the policy actions required to strengthen the enabling environment, legislative and regulatory frameworks for PPP;
- Build capabilities for key public sector officials involved in the procurement and implementation of infrastructure projects, through the implementation of a pilot PPP transaction; and
- Provide examples of Singapore's infrastructure procurement process by sharing Singapore's lessons and experience in developing successful and commercially viable PPP projects.

It was agreed that SCE will provide a grant worth approximately S$1.423 million (P48.373 Million) to DOTC for PPP capacity development of DOTC. GoP will provide counterpart fund of S$ 270,100. The grant will cover one-year period. Based on the Joint Press Release issued by SCE and Temasek Foundation on March 31, 2011, SCE will work with the DOTC to develop institutional capabilities for key agencies within the Philippine Government responsible for the procurement of infrastructure projects under the PPP framework.

Furthermore, according to the Joint Press Release, SCE will send a team of Singapore PPP experts to work with DOTC to prepare and structure a pilot project for procurement under the PPP framework. The pilot project will provide a real-life and hands-on case study where Philippine Government officials can adapt relevant lessons from Singapore to bring projects to a biddable and bankable stage.

SCE will also help DOTC organize a series of capacity building workshops to build capacity for some 100 Philippine Government officials in the development and implementation of PPP transactions. During these workshops, Singapore public sector agencies, such as Public Utilities Board, Singapore Sports Council and Institute of Technical Education, will share with the workshop participants the key challenges Singapore had faced, including the policy considerations, regulatory framework and practical experiences in implementing Singapore's PPP projects. The Singapore private sector players involved in Singapore's PPP projects will also share the perspective of the private sector investors and project developers in investing in a PPP project.

There is also information about assistance coming from the World Bank. According to the World Bank's website, they are interested in helping specific projects, such as expansion of the LRT System and the sewerage system in Manila. There can be further assistance that is directed towards individual projects.

2.7 RELATION BETWEEN OTHER ODA LOAN PROJECTS

Projects related of NAIAX are below.

- Daang Hari SLEX Link Project
- NLEx-SLEx Connector Road Project

1. Daang Hari SLEX Link Project

- Daang Hari SLEX Link aims to additional access between Metro Manila and Cavite where rapid urbanization is being experienced.
- New 4 kilometer, 4-lane paved toll road that will pass through the New Bilibid Prison reservation that will connect Bacoor, Cavite to the South Luzon Expressway thru Susana Heights shown in **Figure 2.7-1**.
- Daang Hari SLEX Link bagged by the Ayala group, Civil works is expected to commence by May 2012 and the expressway to be fully operational on or before November 2013 following the Build-Transfer-Operate (BTO) arrangement for a period of 30 years.

FIGURE 2.7-1 LOCATION MAP OF DAANG HARI SLEX LINK PROJECT

3. NLEx-SLEx Connector Road Project

Currently, Metro Pacific Tollways Development Corp (MPTDC) and San Miguel Corp-backed Citra Metro Manila Tollways Corp (CMMTC), headed by San Miguel have presented their proposal on their respective NLEx-SLEx connector road projects.

The road projects will link Makati City to Caloocan and Balintawak.

Linking NLEx and SLEx has been in the pipeline since 2010, when MPTDC submitted an unsolicited proposal for it. It was supposed to be just one project until CMMTC submitted its own proposal, claiming it has the right to develop the project as an extension of its Skyway. The two proposals covered different routes for the proposed link.

TWO ROADS. Metro Pacific and San Miguel-Citra propose to build separate roads connecting NLEx and SLEx. MPIC's proposal is the pink line, while San Miguel-Citra's is the shorter, dark blue line. Illustration from the SMC-Citra group

FIGURE 2.7-2 LOCATION MAP OF NLEX-SLEX CONNECTOR ROADS

2.8 LESSON AND COUNTERMEASURE FROM THE SIMILAR PAST PROJECT

Interview surveys were conducted to government officials and the private O& M companies in order to identify the bottleneck and recommendation in the Preparatory Survey for PPP infrastructure Development Project (JICA 2011).

Table 2.8-1 shows the summary of major issues and bottlenecks of PPP project and corresponding recommendations.

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	Recommendations
1. Legal Framework	1.1 There are two laws/E.O. to allow the private sector to invest infrastructure projects: a) RA 7718 (BOT Law) and its IRR b) EO 423 and its Guidelines and Procedure for entering into joint venture agreement between the Government and the private entities. ▪ No NEDA ICC nor NEDA Board's project approval is required. ▪ Head of Agency has authority to approve the JV Agreement regardless of project cost.	1.1 Options: **Option 1** : EO 423 be abolished and integrated into RA 7718 **Option 2** : Modification of Guidelines and Procedure - Project should be approved by NEDA ICC or NEDA Board - Ceiling of project cost should be specified. - Enough time should be given to challengers.
	1.2 Modification of IRR of RA 7718 Amendments of IRR is being studied on i) Approval of Individual Projects and Draft Contract, ii) List of Priority Projects, iii) Publication of Invitation, iv) Approving Authority for the Contract, v) Contract Variation, vi) Protest Fee, vii) Timelines, viii) Substitution/Withdrawal of a Member of a Consortium/Joint Venture, ix) Government Shoulder the Differential, x) Period of Comparative Bids Preparation, xi) Information Disclosure of Unsolicited Proposal, xii) New ROW Acquisition Under Unsolicited Proposal	1.2 Amendments should be finalized as early as possible.
	1.3 Creation of PPP Laws Present BOT Law is for the one type of PPP schemes, which should be improved by adding other PPP schemes so as to add more flexibility to other types of PPP schemes and to specify the Government's responsibilities.	1.3 Study on creation of PPP Law should start.

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	Recommendations
2. Institutional Framework	2.1 Lack of Experiences/Capacity of Government Officials for Planning and Implementation of PPP Projects - Historically, planning and implementation of BOT projects was led by the private sector's initiative. - The Government is discouraging the unsolicited proposals. - The Agencies are required to be more pro-active and take a leadership for PPP projects.	2.1 Agencies should take a leadership for promotion of PPP projects. - Develop priority projects with implementation priority and firm implementation schedule. - The roles of the private sector, government agencies and other authorities as well as LGUs in transport infrastructure development in operation and management needs to be defined.
	2.2 No PPP Project Specialized Office except DPWH.	2.2 Organize PPP Specialized Office.
	2.3 BOT Center has been not so active.	2.3 In close coordination with Agencies, BOT center should be more active in project development of PPP projects.
	2.4 Strengthening of DPWH Planning Service and PMO-BOT - In line with the DPWH Rationalization Plan, DPWH is planning to upgrade existing PMO-BOT to PPP Service.	2.4 PMO-BOT should be upgraded to PPP Service as early as possible.
	2.5 Materials for PPP Capacity Development and manuals/standards are incomplete. - Training materials for PPP - Standard PQ/Tender and Draft Toll Concession Agreement - O & M manual	2.5 Necessary materials, standards and manuals should be prepared. DPWH should establish regular PPP training course.
3. PPP Project Financing	3.1 Long period (sometimes years) is required for financial closure due to unfavorable offer of banks to the investor (short repayment period with no grace period and high interest rate). Some commercial banks are not familiar with the PPP project financing.	3.1 PPP fund to finance the private entities needs to be created.
	3.2 Delay in ROW acquisition delays financial closure.	3.2 Refer to 4.4

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	Recommendations
3. PPP Project Financing	3.3 Project Development Fund (PDF) of BOT Center is not fully utilized.	3.3 PDF needs to be revitalized by increasing fund as well as establishment of rules and guidelines for usage.
	3.4 On the part of financing the Government expenditure, it is still relying on the project loans from the international lending institutions and/or bilateral sources.	3.4 PPP fund to finance the Government expenditure needs to be studied and established.
4. Bottlenecks in PPP Project Cycle	4.1 <u>Master Plan/Basic Plan/Project Identification Stage</u> • Master Plan and/or basic plans were not updated. • Listing of projects and their implementation schedule was not updated. • Project promotion has been largely relied on the private sector.	4.1 Master Plan, project list and project implementation priority should be always updated and firm implementation schedule and corresponding budgeting should be done.
	4.2 <u>Business Case/Feasibility Study Stage</u> • Level of feasibility studies has been incomplete/inadequate. • Soon after a feasibility study is completed, it has been difficult to go into a tendering stage due to unfixed ROW, lack of ECC, lack of LGUs' endorsement, etc. • Agencies' capacity and local consultants' capacity to undertake a feasibility study of PPP project is not sufficient.	4.2 • More fund and time should be spent for this study • Complete information and documents for NEDA's project approval and succeeding tendering should be prepared.
	4.3 <u>Project Approval Stage</u> • Lengthy time is required until the project is approved by NEDA ICC or NEDA Board.	4.3 • Complete information and documents should be prepared during the feasibility study stage. • NEDA should undertake seminars on "ICC Project Evaluation Procedure and Guidelines".

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	**Recommendations**
4. Bottlenecks in PPP Project Cycle	4.4 ROW Acquisition / Resettlement Stage • Preparation of IROW plan and parcellary plan takes long time due to inaccurate land registration, difficulty to locate land owners, inaccurate record of lot boundary, etc. • A lot of documentations are needed and lot owners have difficulty to prepare required documents. • Land valuation is made based on BIR land valuation for the first offer, and based on Provincial/ City Appraisal Committee or Land Bank valuation for the second offer, these are close to, but still lower than market value. • In case that land owners fail to prepare complete documents, expropriation is the only solution. • ROW acquisition Teams are not provided sufficient logistics (like service vehicles, computers, etc.). • More staff who are familiar with ROW acquisition are needed. • Some Toll Concession Agreements include the private sector's funding for ROW acquisition.	4.4 • Preparation of IROW plan and parcellary plan and succeeding ROW acquisition should start soon after the project is approved by NEDA Board or NEDA ICC. • Once major critical documents are prepared, cash advance by the private sector should be made to PAPs through the Government, which shall be refunded to the private sector. This arrangement should be specified in TCA. • Land value should be based on the prevailing market price. • Enough logistics support such as service vehicles, computers, etc. should be provided for ROW acquisition team, cost of which should be included in the project cost. • IROW Procedural Manual should be updated and more staff should be trained.
	4.5 Tender Stage 1) *Government Projects* • Selection of Consultants and Contractors takes lengthy time. - Consultant selection - over 8 months - Contractor selection - over 10 months 2) *Selection of Project Proponent of PPP Project* • Selection of project proponent takes lengthy time - over 12 months 3) *Unsolicited Proposal* • Takes much longer time to finalize due to many disputes and counteroffers and negotiation of contract terms such as toll rates, risk allocation, etc.	4.5 1) *Government Projects* • Selection of Consultants should target 6 months or less. • Selection of Contractor should target 8 months or less. 2) *Selection of Project Proponent of PPP Project* • Selection of Project Proponent should target 10 months or less. • Agency should undertake project campaign and enough information should be disclosed before the project is advertized. • All tender conditions and draft Toll Concession Agreement should be agreed between DPWH and TRB before advertisement.

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	Recommendations
4. Bottlenecks in PPP Project Cycle	4.6 <u>Contracting Stage</u> • Review of Toll Concession Agreement (TCA) by TRB usually takes lengthy time. • Approval of NEDA Board also takes lengthy time.	4.6 • Close coordination between NEDA and Agencies should be made.
	4.7 <u>Toll Operation Agreement Stage</u> • Review by TRB of toll adjustment formula and other O & M aspects take considerable time.	4.7 • From the feasibility study stage, TRB should be involved.
	4.8 <u>Fund Procurement/Preparation Stage</u> • Government - Budget constraints and delay in budget release - Difficult to cope with cost overrun. • Private - Delay in attaining financial closure due to difficulty in meeting lender's requirement such as complete ROW acquisition, government financial support, approval of toll rates and toll rate adjustment formula. - Difficult to find appropriate financer (short repayment period with no grace period, and high interest rates). - Unexpected changes requiring additional costs due mainly to additional facilities required by LGUs and LGU fees.	4.8 • Government - Needs provision of adequate annual budget. - Needs to tap ODA. • Private - Creation of fund to finance the private sector for infrastructure project implementation should be studied.
	4.9 <u>Detailed Design Stage</u> • Lacks proper coordination with LGUs, thus modification of design, requirement of additional facilities, etc. is required by LGUs. • Lacks proper coordination with utility companies for relocation/protection of public utilities affected.	4.9 • Proper coordination with LGUs and utility companies should be done during the feasibility study. • Value engineering should be exercised.

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

TABLE 2.8-1 MAJOR ISSUES AND BOTTLENECKS OF PPP PROJECTS

	Issues and Bottlenecks of PPP Projects	**Recommendations**
4. Bottlenecks in PPP Project Cycle	4.10 <u>Construction Stage</u> • Delayed construction due to delayed delivery of ROW and financial closure. • Needs more strict quality control and schedule control.	4.10 • An Independent Certificate Engineer should be employed at the cost of the Government.
	4.11 <u>Operation and Maintenance Stage</u> • Approval of toll fee and adjustment of toll fee by TRB is delayed. • Increase of toll fee is usually objected by the people and politicians and adoption of new toll rate is delayed.	4.11 • TRB should approve toll fee and its adjustment in accordance with provisions of TCA. • The Government should compensate the loss of revenue due to delayed increase of toll rates. • TRB and operators should jointly make information disclosure to the people why toll rates and toll adjustment are needed and determined and what are benefits of users.
	4.12 <u>End of Contract and Facility Transfer Stage</u> No experience on this stage, yet.	-

Source: Preparatory Survey for Public-Private Partnership (PPP) Infrastructure Development Project (JICA2010)

2.9 DPWH ORGANIZATION AND CURRENT O& M COMPANY

(a) DPWH Organization (Central Office)

Organization chart of DPWH is shown in **Figure 2.9-1**. Offices within the DPWH which are related to the development of PPP projects are highlighted and discussed below.

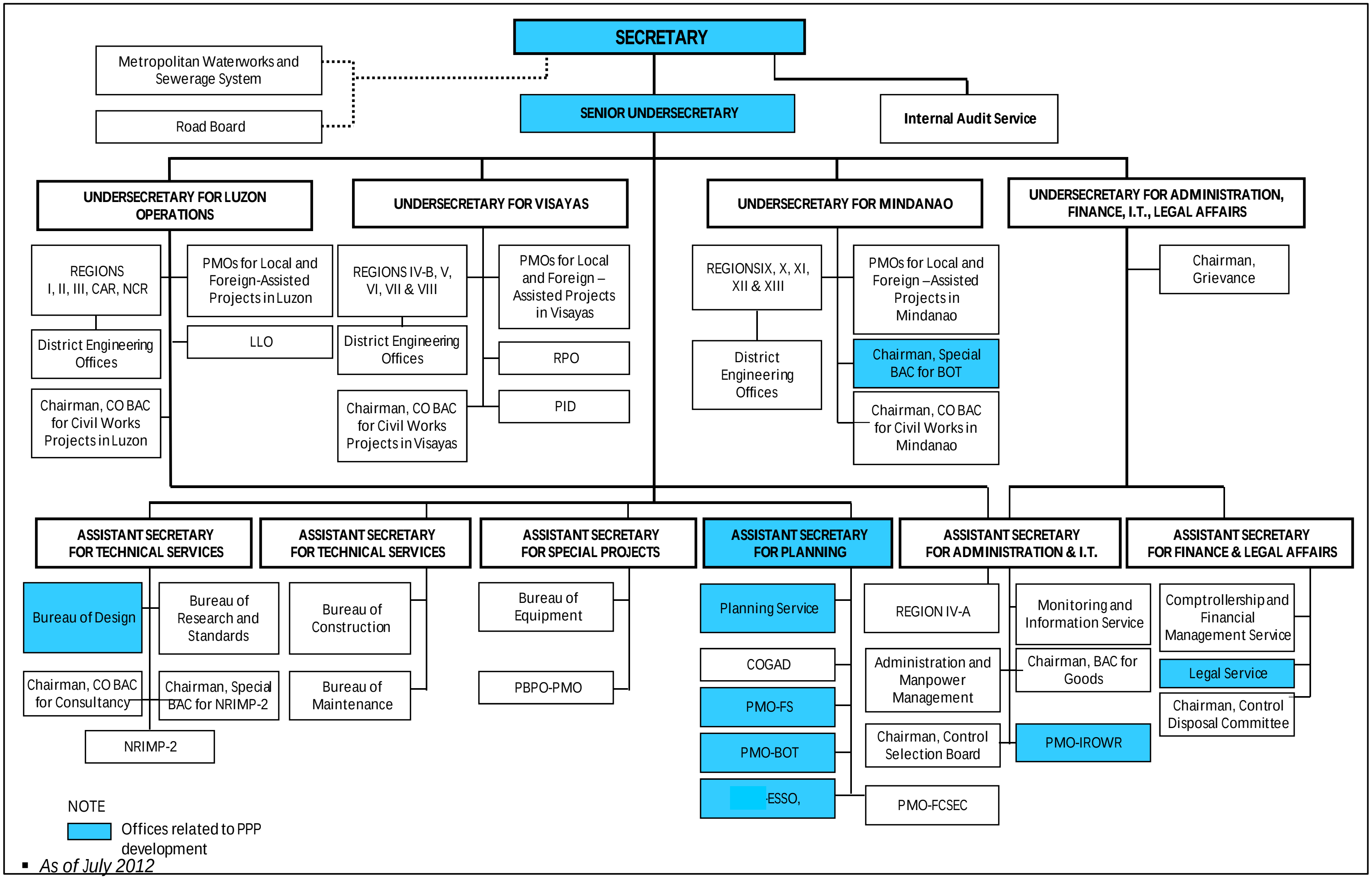
Planning Service (PS)
Tasked to formulate policies, plans and programs for the development of the national road network, which includes expressways; prepare PPP proposals for ODA financing; maintain a national road database; and prepare multi-year and annual budgets for the construction (including right-of-way and engineering) and maintenance of national roads.

PMO-Feasibility Studies (PMO-FS)
Assigned to conduct/supervise FS of major foreign-assisted and locally-funded road and expressway projects; and assist the PS and PMO-BOT in preparing project proposals for ODA financing.

PMO-Built-Operate-Transfer (PMO-BOT)
Tasked to identify and initiate projects for BOT/PPP implementation; prepare/review feasibility studies (FS) and proposals for BOT/PPP projects for approval of the NEDA-Investment Coordinating Committee (ICC); prepare bidding documents; participate in negotiations and finalization of BOT/PPP contracts; and monitor/supervise the implementation of BOT/PPP projects.

Environmental and Social Services Office (ESSO)
Involved in preliminary planning activities related to Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), Rapid Social Assessment, Resettlement Action Plan (RAP); conduct public consultations on PPP projects; conduct Information, Education and Communication (IEC) on environment-related concerns; and compliance and effects monitoring of ECC conditions and Environmental Management Plan (EMP).

PMO-Infrastructure Right-of-Way and Resettlement (PMO-IROWR)
Tasked to consult with LGUs, local communities, project affected persons, and the designer/contractor for PPP projects; coordinate with the Presidential Commission for the Urban Poor (PCUP) and the National Housing Authority (NHA) on the relocation of squatter families; conduct census and tagging of affected lots and improvements; coordinate with the Bureau of Internal Revenue or BIR (for zonal valuation), Registry of Deeds (for titles), Assessor's Office, and DAR (for land conversion); coordinate and negotiate with affected property owners on the sale of their properties; coordinate with the Office of the Solicitor General (OSG) for filing of expropriation proceedings; and effect payment of affected properties.



Source: DPWH website

FIGURE 2.9-1 ORGANIZATION CHART OF DPWH

(b) Overview of Current toll expressway companies for construction and O&M

Table 2.9-1 shows the summary of toll expressway investors and O&M companies and **Table 2.9-2** shows the summary of current toll collection system and traffic control system.

TABLE 2.9-1 Toll Expressway Company

Investors	Operating Expressway(length)	O&M Companies	Remarks
Manila North Tollways Corp.(MNTC)	• North Luzon Expressway (82.6km) • Subic-Tipo Tollway (8.5km)	Tollways Management Corp.	Metro Pacific Investment Corp.(Hong Kong Fund)
(BCDA)	• Subic-Clark-Tarlac Expressway (93.8km) •	Tollways Management Corp.	Construction by ODA fund
Private Infrastructure Development Corp. (PIDC)	• Tarlac-Pangasinan-La Union Expressway (88.0km under construction)	—	PIDC was established by ten (10) local contractor companies
UEM-MARA Philippine Corp.	• Manila-Cavite Coastal Expressway (8.8km) and Extension (11.2km)	Direct operation	Malaysian Fund
Citra Metro Manila Tollways Corp./ San Miguel Corp.	• Skyway：PhaseI (9.4km) • South Luzon Expressway (13.4km) • Skyway：PhaseII (6.8km)	Skyway O&M Company	Indonesia Fund
San Miguel Corp.	• South Luzon Expressway (37.2km)	South Luzon Tollways Corp.	Philippine Fund
Ayala Corp/	• Daang Hari SLEx Link Road		Philippine Fund
San Miguel Corp.	• Southern Tagalog Arterial Road (STAR) (41.9km)	Star Infrastructure Development Corp.	Philippine Fund

TABLE 2.9-2 Toll Expressway's Toll Collection System and Traffic Control System

Operating Expressway(length)	Toll Collection System	Traffic Control System
• North Luzon Expressway (82.6km)	• Cash, EC-tag, Easy Trip	Yes, CCTVs, Vehicle detectors and VMSs (Variable Message e Sign) are installed.
• Subic-Clark-Tarlac Expressway (93.8km) • Subic-Tipo Tollway (8.5km)	• Cash only	Not yet installed
• Manila-Cavite Coastal Expressway (8.8km) and Extension (11.2km)	• Cash only	Not yet installed
• Skyway：PhaseI (9.4km) • South Luzon Expressway (13.4km) • Skyway：PhaseII (6.8km)	• Cash, E-pass	Yes, CCTVs are installed.
• South Luzon Expressway (37.2km)	• Cash, E-pass	Yes, CCTVs and VMSs are installed.
• Southern Tagalog Arterial Road (STAR) (41.9km)	• Cash only	Not yet installed

CHAPTER 3
SOCIO-ECONOMIC CONDITION OF THE PROJECT AREA

3.1 SOCIO-ECONOMIC CONDITIONS

3.1.1 Physical Profile

The project is located in Region IV-A specifically in the provinces of Cavite and Laguna. Region IV-A is composed of five provinces of Batangas, Cavite, Laguna, Quezon, Rizal and the lone city of Lucena City. The region covers about 16,612 square kilometers or equivalent to 4.9% of land area of the country. **Table 3.1.1-1** shows the land area share of Region IV-A to country as well as share of neighboring regions to the country.

TABLE 3.1.1-1 POPULATION SHARE

Region	Land Area (sq. km.)	Share to Philippines (%)
Philippines	344,879	
NCR	619	0.2
Region III	22,014	6.4
Region IV-A	**16,612**	**4.9**

Source: National Statistics Office

3.1.2 Demographic Trend

The population of Region IV-A reaches 11.7 million in 2007. This number represents 13.3% of the total population of the country. Growth rate in the region is higher than that of the national average as well as the growth rate of Region III and NCR. Between 2000-2007, the annual growth rate in Region IV-A is 3.36% while Region III had 2.45% and NCR posted only 2.18% as presented in **Table 3.1.2-1**. This trend is expected to continue partly due to population spillover from NCR and continuing expansion of economic zones and other industries in the area.

Population of Barangays Directly Affected by the Expressway Project (Laguna Section)

The population of barangays directly affected by the alignment of CALAX totaled 137.707 of which Cavide province has 39,177 and Laguna province has 98,530. The total area covered by these barangays is about 65.6 km^2 of which 35.8 km^2 is located in Cavite side and the remaining is on the side of Laguna. Barangays directly affected by the expressway project is illustrated in **Figure 3.1.2-1.**

TABLE 3.1.2-1 DEMOGRAPHIC TREND IN THE STUDY AREA

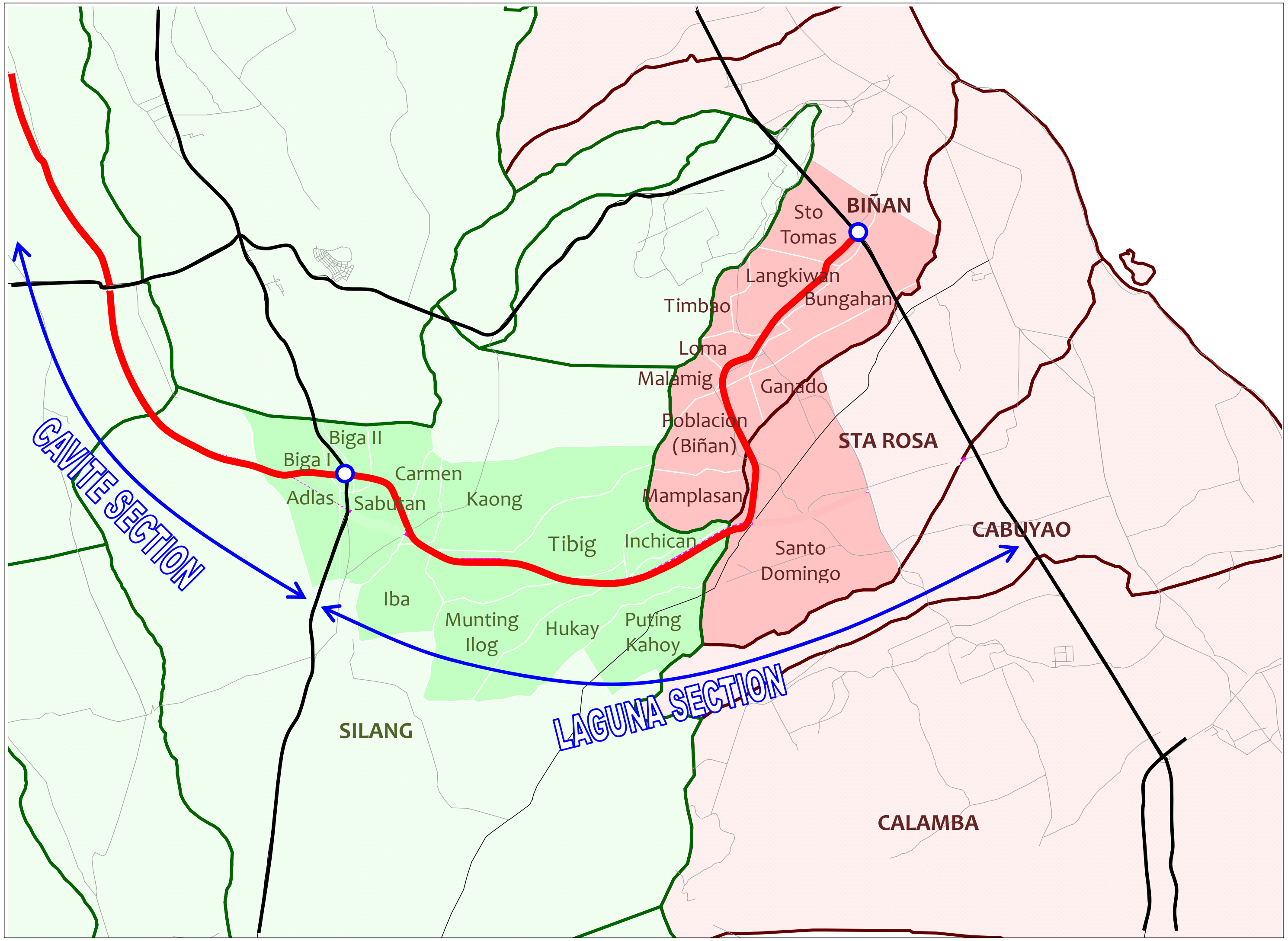
Region	Province	Actual Population				Land Area	Density (persons/sq km)				Past Annual Population Growth Rate (%)		
		1990	1995	2000	2010	(sq km)	1990	1995	2000	2010	1990-1995	1995-2000	2000-2010
Philippines		60,703,206	68,616,536	76,504,077	92,337,852	340,575	178	201	225	260	2.48	2.20	2.12
NCR		7,948,392	9,454,040	9,932,560	11,855,975	620	12,830	15,261	16,033	18,650	3.53	0.99	2.02
Region III		6,338,590	7,092,191	8,204,742	10,137,737	22,015	288	322	373	442	2.27	2.96	2.37
Region IV-A		6,349,452	7,750,203	9,320,629	12,609,803	16,873	376	459	552	696	4.07	3.76	3.49
	Batangas	1,476,783	1,658,567	1,905,348	2,377,395	3,120	473	532	611	720	2.35	2.81	2.41
	Cavite	**1,152,534**	**1,610,324**	**2,063,161**	**3,090,691**	**1,574**	**732**	**1,023**	**1,311**	**1,815**	**6.92**	**5.08**	**5.05**
	Laguna	**1,370,232**	**1,631,082**	**1,965,872**	**2,669,847**	**1,918**	**714**	**850**	**1,025**	**1,290**	**3.55**	**3.80**	**3.39**
	Quezon	1,221,831	1,359,991	1,482,955	1,740,638	9,070	135	150	164	182	2.17	1.75	1.78
	Rizal	977,448	1,312,489	1,707,218	2,484,840	1,192	820	1,101	1,432	1,916	6.07	5.40	4.77
	Lucena City	150,624	177,750	196,075	246,392	69	2,199	2,595	2,862	3,451	3.37	1.98	2.49

Source: NSO,
*Note:*CALAX is located in the provinces of Cavite and Laguna*

TABLE 3.1.2-2 POPULATION OF BARANGAYS DIRECTLY AFFECTED BY THE PROJECT

	Province / City / Municipality	Barangay Name	Land Area (Sq. Km)	Population	
				2000	2010
	CAVITE		**1574.200**	**2,063,161**	**3,090,691**
	Silang		128.790	156,137	213,490
		Adlas	3.826	1,432	4,956
		Carmen	0.995	1,280	1,768
		Hukay	4.580	1,238	1,414
		Iba	2.509	2,995	3,875
		Inchican	0.973	2,009	4,284
		Kaong	5.854	4,602	6,767
		Munting Ilog	4.240	2,757	2,995
		Puting Kahoy	3.274	3,467	5,838
		Sabutan	3.868	3,964	4,616
		Tibig	5.653	2,042	3,119
	LAGUNA		**1,917.900**	**1,965,872**	**2,669,847**
	Biñan		36.916	201,186	283,396
		Bungahan	4.072	876	1,709
		Ganado	2.180	2,381	3,952
		Langkiwan	2.326	1771	25,709
		Loma	1.039	1,601	6,769
		Malamig	0.892	1,089	2,929
		Mamplasan	2.138	2,681	6,086
		Poblacion	.262	2,842	3,640
		Sto Tomas	3.152	30,113	38,990
		Timbao	0.737	1,837	8,746
	Sta. Rosa		39.733	185,633	284,690
		Santo Domingo	13.017	1,295	3,178
	Total (Cavite Side)		**35,772**	**29,301**	**39,177**
	Total (Laguna Side)		**29.815**	**46,486**	**98,530**
	Grand Total		**65,587**	**75,787**	**137,707**

Source: NSO,



BARANGAY MAP
CALA EXPRESSWAY (LAGUNA SECTION)

Note: Final alignment still to be selected

0 1 2 3 4 Kilometers

Source: JICA Study Team

FIGURE 3.1.2-1 ALIGNMENT OF CALAX SHOWING DIRECTLY AFFECTED BARANGAYS

3.1.3 Economic Trend

The economic performance of Region IV-A as well as neighboring provinces is depicted in **Figure 3.1.3-1**. These three regions, NCR, Region III and Region IV-A, are considered the economic engine of the country contributing 56.8% of the country's economic output. NCR consistently surpassed the national average. Region IV-A's growth rate is just a bit lower that the national average but still a strong growth at 6.1%

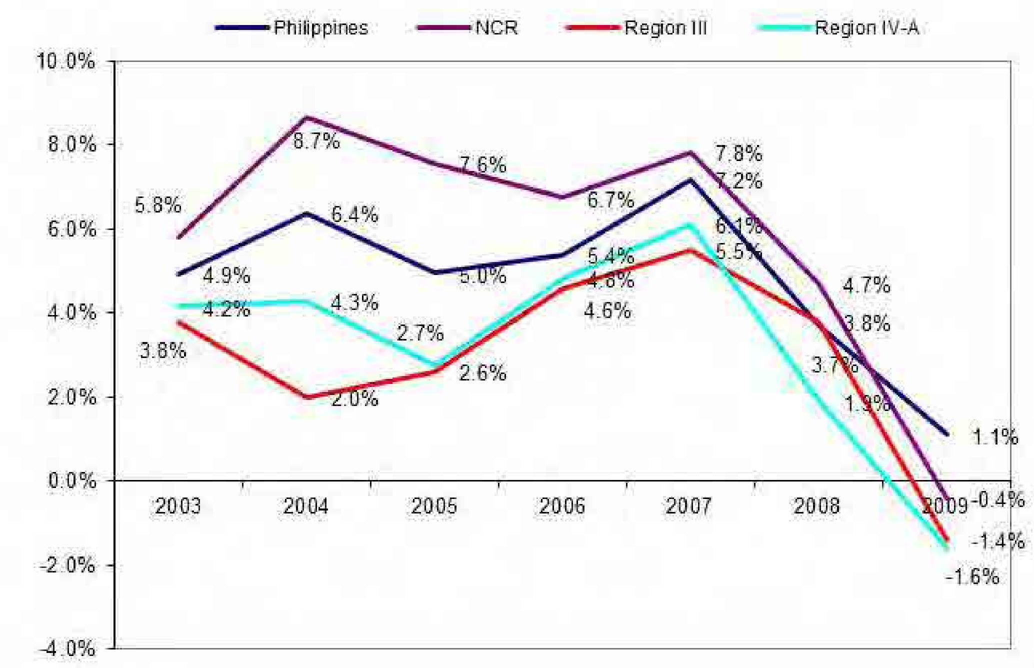


FIGURE 3.1.3-1 GDP AND GRDP GRWOTH RATE

The industrial structure of the economy of Region IV-A is as follows: Primary Sector (19%), Secondary Sector (40%), and Tertiary Sector (42%) as shown in **Table 3.1.3-1**. The region has the most number of economic zones. Construction of CALAX will further boost the attractiveness of the region as it is the prime economic zone location in the country.

TABLE 3.1.3-1 INDUSTRIAL STRUCTURE OF THE ECONOMY, 2008

	Primary	Secondary	Tertiary	Total
Philippines	259,406	465,017	694,530	1,418,953
NCR	1	161,980	306,401	468,382
Region III	28,798	41,895	47,031	117,724
Region IV-A	**31,533**	**66,836**	**69,930**	**168,299**
IN PERCENTAGE				
Philippines	18%	33%	49%	100%
NCR	0%	35%	65%	100%
Region III	24%	36%	40%	100%
Region IV-A	**19%**	**40%**	**42%**	**100%**

Source: NSO, 2007

In terms of economic growth rate, the country in general posted high economic growth from 2002 to 2009. High growth is particularly observed from 2006 to 2007 where 7.18% growth rate was recorded. After 2007, growth rate was decreased. At regional level, Region IV-A registered -1.56% from 2008 to 2009; Region III had -1.42% and NCR with -0.36% in the same period as depicted in **Table 3.1.3-2**.

TABLE 3.1.3-2 ECONOMIC GROWTH RATE (2002-2007)

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Philippines	4.93 %	6.38 %	4.95 %	5.40 %	7.18 %	3.69%	1.06%
NCR	5.82 %	8.67 %	7.56 %	6.74 %	7.84 %	4.65%	-0.36%
Region III	3.79 %	2.00 %	2.74 %	4.83 %	6.11 %	3.75%	-1.42%
Region IV-A	**4.15 %**	**4.27 %**	**2.59 %**	**4.57 %**	**5.49 %**	**1.90%**	**-1.56%**

Source: NSCb, 2011

3.1.4 Per Capita GDP and GRDP

The per capita GRDP in current price and constant price are shown in **Table 3.1.4-1** and **Table 3.1.4-2** respectively. As expected, NCR being the capital of the country has the highest per capita GRDP which almost 3 fold higher than the national average. Per capita GRDP of Region IV-A is a bit lower than that of the national average at 0.83. The country's per capita GRDP grew by 3.8% per annum from 2003 to 2009. Highest growth is realized in NCR and followed by Region IV-A and then by Region III as presented in **Table 3.1.4-2**.

TABLE 3.1.4-1 PER CAPITA GRDP IN CURRENT PRICE

Unit: Peso

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	
Philippines	52,718	58,149	63,556	69,365	74,947	81,910	83,261	1.00
NCR	148,743	165,814	184,758	205,117	223,332	243,528	246,753	2.96
Region III	39,407	42,256	45,789	49,469	52,351	58,460	57,862	0.69
Region IV-A	50,997	55,213	59,320	63,640	67,466	70,320	68,895	0.83

Source: NSCB, 2011

TABLE 3.1.4-2 PER CAPITA GRDP IN CONSTANT PRICE

Unit: Peso

	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Growth Rate**
Philippines	13,252	13,789	14,186	14,681	15,429	15,666	15,528	2.29
NCR	31,730	33,867	35,742	37,856	40,252	41,541	40,838	3.67
Region III	11,092	11,054	11,142	11,448	11,904	12,039	11,636	0.69
Region IV-A	13,853	14,068	14,159	14,439	14,891	14,750	14,209	0.36

Source: NSCB, 2011

3.1.5 Employment

The number of establishment in Region IV-A reaches 114,208 in 2007. This number is higher that the number of establishment recorded in the neighboring provinces except Metro Manila. The said number of establishments generated 856,193 employments in the region.

TABLE 3.1.5-1 NUMBER OF ESTABLISHMENTS AND EMPLOYMENTS BY REGION/PROVINCE: LUZON

Region/Province	No. of Establishments			No. of Employments		
	2005	2006	2007	2005	2006	2007
Philippines	782,980	783,065	783,869	5,479,297	4,984,883	5,187,793
NCR	195,412	195,632	196,426	1,976,359	1,869,507	2,025,751
Region III	84,368	84,344	84,361	480,020	419,320	421,962
Region IV-A	**114,182**	**114,114**	**114,208**	**924,867**	**857,361**	**856,193**
Batangas	19,606	19,579	19,599	128,134	113,700	109,162
Cavite	**28,737**	**28,705**	**28,709**	**286,300**	**266,149**	**261,334**
Laguna	**27,028**	**27,015**	**27,059**	**318,264**	**311,564**	**322,732**
Quezon	16,219	16,223	16,223	67,586	53,952	52,475
Rizal	22,592	22,592	22,618	124,583	111,996	110,490
Luzon Total	**362,654**	**362,819**	**363,539**	**2,790,975**	**2,564,084**	**2,723,991**

Source: NSO, Statistical Sampling and Operations Division, 2000 List of Establishments

3.2 REGIONAL DEVELOPMENT PLAN

The Philippine Development Plan (2011 – 2016) is pursuing the following national development policies;

NATIONAL DEVELOPMENT POLICIES

- Development of an integrated multi-modal logistics/transport system to achieve an economic corridor
- Decongestion of Metro Manila
- Promotion of development of impoverished area
- Promotion of PPP projects for acceleration of infrastructure development

Due to economic growth in the capital regions, economic sphere is expanding from Metro Manila towards its neighboring regions of Region III and Region IV-A. Thus, the development strategy cannot be planned only for Metro Manila but involving Region III and Region IV-A as a whole. Overall development strategy will be as follows;

1) 200 km radius sphere from Metro Manila

- Metro Manila together with Region III and Region IV-A will continue to propel the country's economy.
- To promote decentralization and to mitigate overconcentration of Metro Manila, regional urban centers outside Metro Manila shall be developed. (see **Figure 3.2-1)**
- Strategic areas along the Pacific coast shall be regarded as the impoverished areas for universal development and accessibility to those areas shall be strengthened. (see **Figure 3.2-2)**
- In order to support tourism development, the tourism development axes shall be developed for the strategic areas of tourism development. (see **Figure 3.2-2)**

2) Metro Manila and its suburbs

- Due to accumulation of infrastructure of expressways, international airports and ports and economic zones along the north-south direction, the north-south industrial development beltway which connects Batangas-Metro Manila-Clark-Tarlac will be the key axis for the development of the Metropolitan areas and the country as a whole. (see **Figure 3.2-3)**

- Sound urbanization of Metro Manila and its suburbs shall be achieved. (see **Figure 3.2-1)**

3) North of Metro Manila

- Clark-Subic corridor shall be developed as a logistic axis not only for the country but also for the southeast and ASEAN countries. (see **Figure 3.2-3)**

- To support the development of CAR and Region I, the North-West Luzon development axis shall be developed. (see **Figure 3.2-3)**

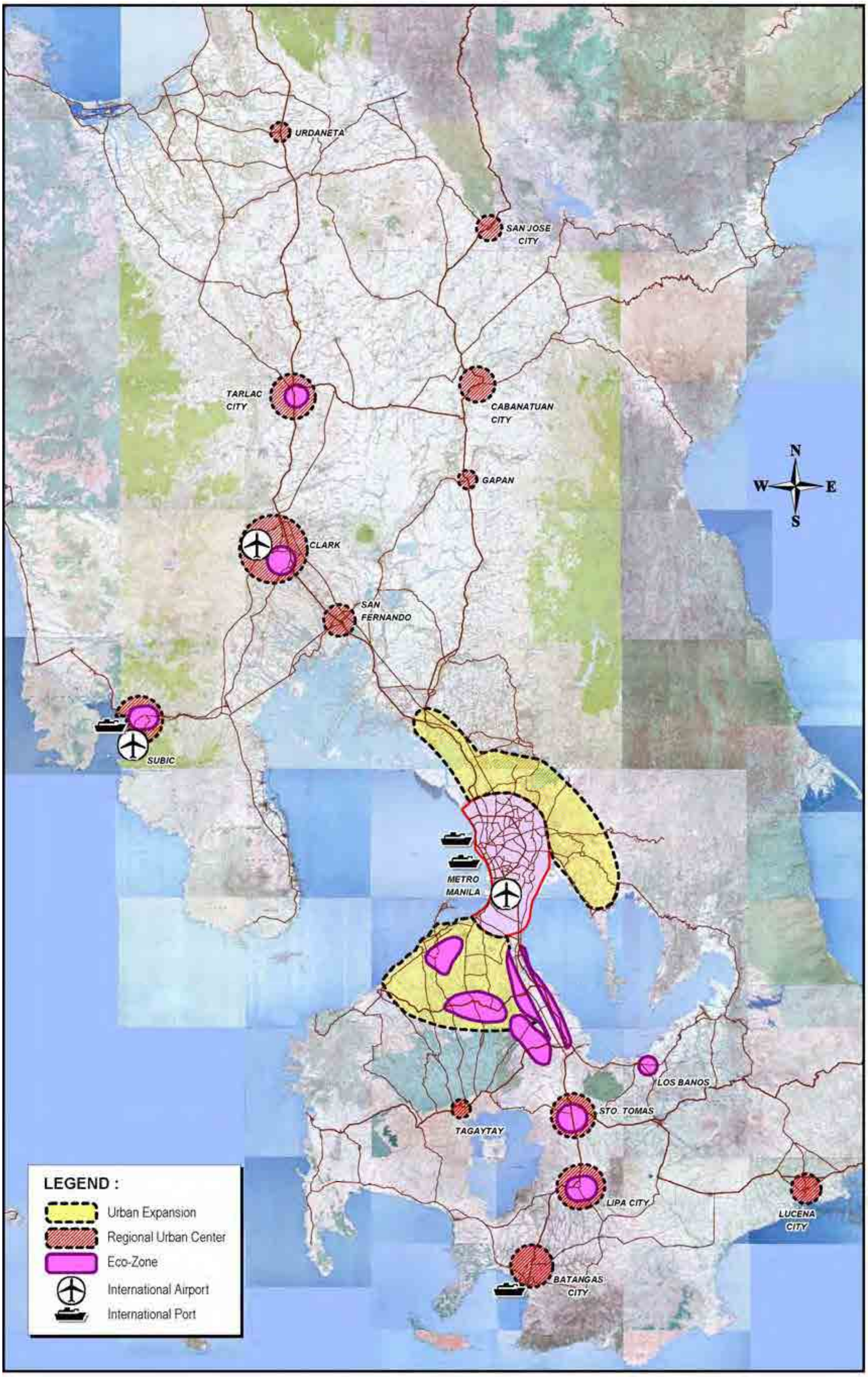
- For the development of Region II, the North-East Luzon development axis shall be developed. (see **Figure 3.2-3)**

4) South of Metro Manila

- To support the development of Region V, the South-Luzon development axis shall be developed. (see **Figure 3.2-3)**

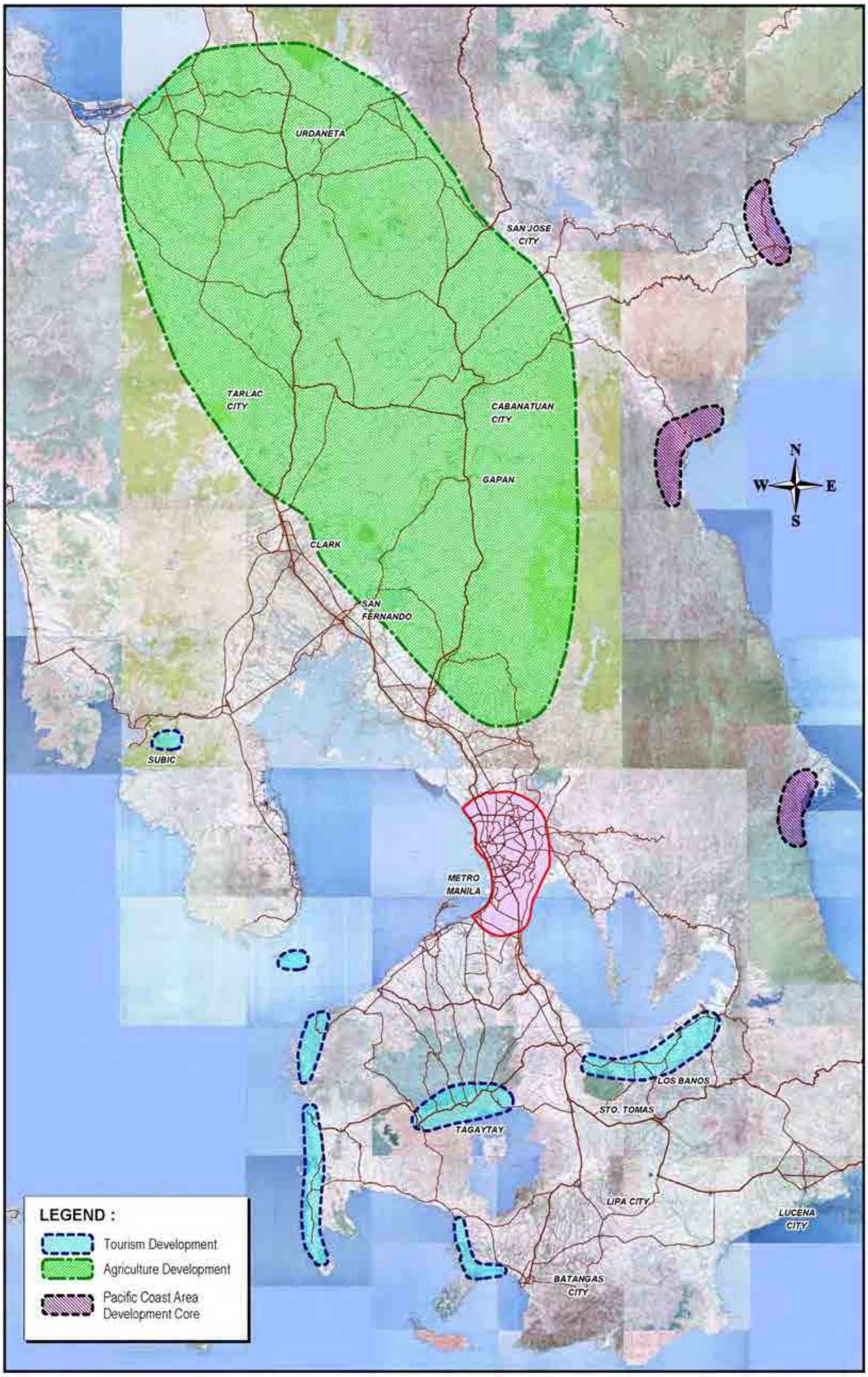
5) Overall Regional Development Scenario

- Overall regional development scenario is shown in **Figure 3.2-4.**



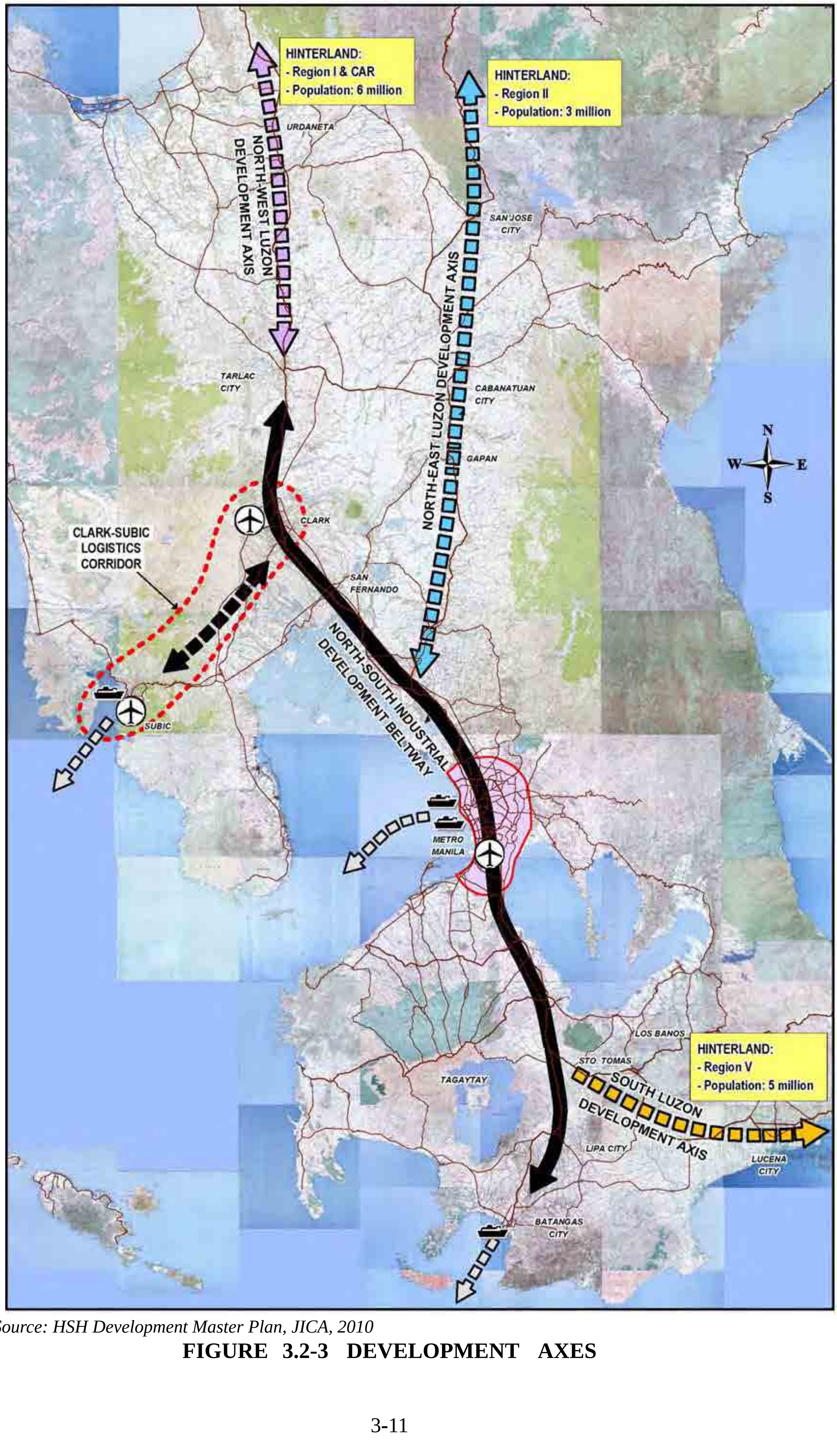
Source: HSH Development Master Plan, JICA, 2010

FIGURE 3.2-1 URBAN DEVELOPMENT STRUCTURE



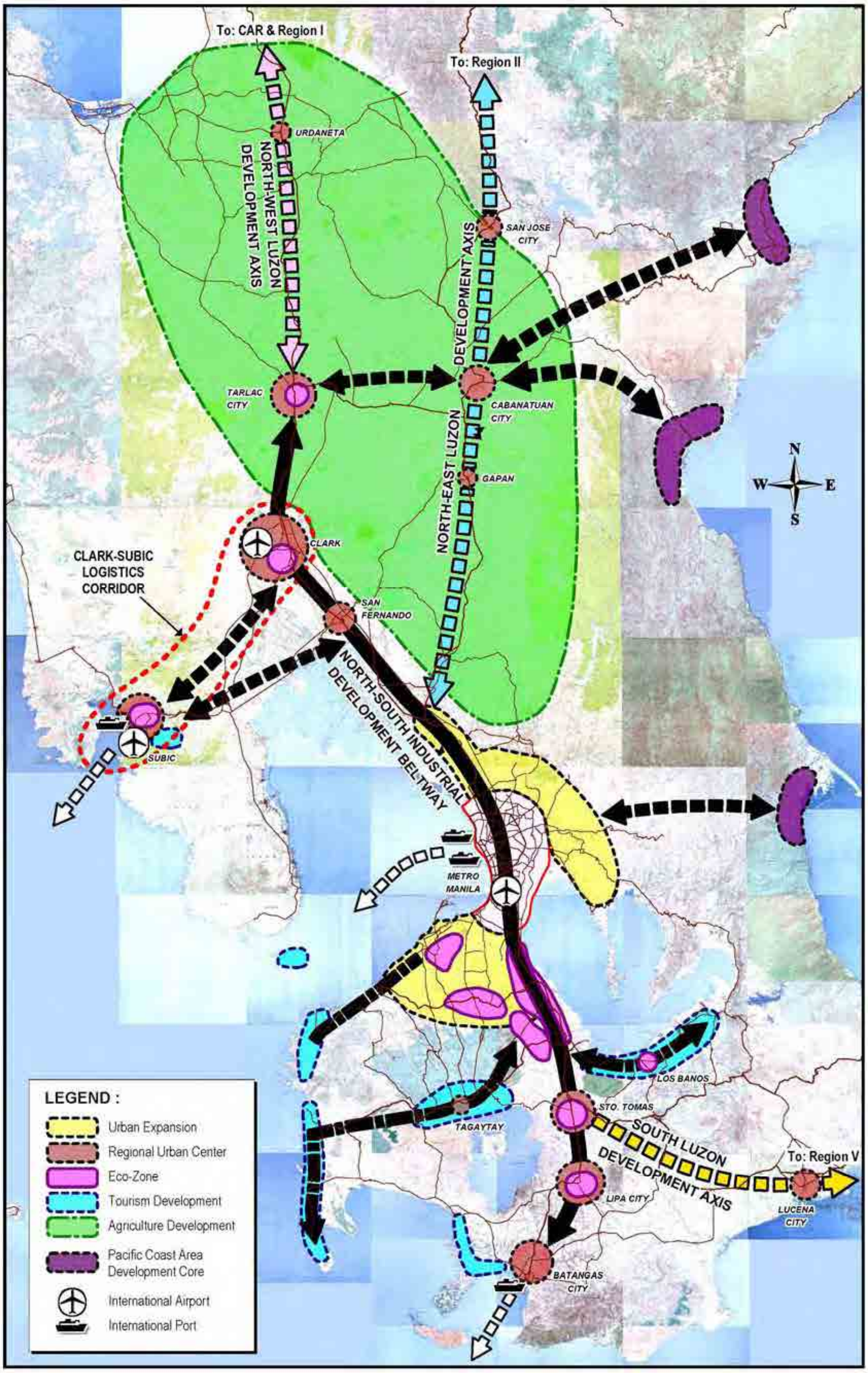
Source: HSH Development Master Plan, JICA, 2010

FIGURE 3.2-2 AGRICULTURE AND TOURISM DEVELOPMENT AND PACIFIC COAST DEVELOPMENT



Source: HSH Development Master Plan, JICA, 2010

FIGURE 3.2-3 DEVELOPMENT AXES



Source: HSH Development Master Plan, JICA, 2010

FIGURE 3.2-4 DEVELOPMENT STRATEGY : 200KM RADIUS SPHERE OF METRO MANILA

3.3 MANUFACTURING COMPANIES IN THE PROJECT INFLUENCE AREA

3.3.1 Japanese firms in the Philippines and the Project Area

According to the statistics of the Embassy of Japan (EOJ), as of October 2010, there are 1,075 Japanese firms in the Philippines. Table 3.3.1-1 shows distribution of Japanese firms by area. A total of 902 Japanese firms or (83.9%) are situated in the project influence area.

Table 3.3.1-1 DISTRIBUTION OF JAPANESE FIRMS BY AREA

Area		No. of Japanese Firms	% Share
Project Influence Area	Metro Manila	531	49.4%
	Laguna Province	187	17.4%
	Cavite Province	140	13.0%
	Batangas Province	44	4.1%
	Sub-total	902	83.9%
Other Areas of Luzon		34	3.2%
Visayas		127	11.8%
Mindanao		12	1.1%
Total		1,075	100.0%

Source: Embassy of Japan

3.3.2 Economic Zones in the Project Area

By taking advantage of the proximity to Metro Manila, many economic zones/industrial estates have been developed in Cavite and Laguna Provinces as shown in **Figure 3.3.2-1**. Many manufacturing companies are in operation in those economic zones/industrial estates, contributing to development of manufacturing industry, economic development and employment. Number of Japanese manufacturing companies in major economic zones/industrial estates is shown in **Table 3.3.2-1**.

TABLE 3.3.2-1 NUMBER OF JAPANESE MANUFACTURING COMPANIES BY ECONOMIC ZONE/INDUSTRIAL ESTATE

Name of Economic Zone/Industrial Estate	Number in Figure 3.3.2-1	No. of Japanese Manufacturing Company
Laguna Technopark	16	86
Cavite Economic Zone	1	68
First Cavite Industrial Estate	6	37
Carmelray Industrial Park I	19	17
Light Industry & Science Park II	22	15
Light Industry & Science Park I	18	13
Carmelray Industrial Park II	21	8
Gateway Business Park	4	6
First Philippine Industrial Park	24	1 (Note-1)
Toyota Special Economic Zone	17	3(Note-1)

Note-1: Survey for JICA-assisted HSH Master Plan Study, 2010
Source: Embassy of Japan, 2010

Transport access to these economic zones/industrial estates are basically made by Aguinaldo Highway, Governor's Drive, and two expressways of SLEX and CAVITEX. Since the two national roads of Aguinaldo Highway and Governor's Drive are already heavily congested, the economic zone/industrial estate locators are hoping that CALAX will be built as early as possible.

Many Japanese manufacturing companies want to utilize Batangas Port instead of Manila Port, since access roads to Manila Port is heavily traffic-congested. CALAX will improve the accessibility to Batangas Port, this many Japanese manufacturing companies are expecting early completion of CALAX.

Figure 3.3.2-2 shows the information of economic zones/industrial estates, such as area, number of locators, number of Japanese company and share of product using port..

3.3.3 Types of Factories Located in Economic Zones

JICA-assisted High Standard Highway (HSH) Master Plan study conducted the interview survey to the economic zones/industrial estates in 2009. The types of factories located in the selected economic zones are shown in **Table 3.3.3-1**.

- Many electrical and electronics related factories are in operation.
- There are also many factories manufacturing automobiles and spare parts.
- Many economic zones employ over 10,000 people.

TABLE 3.3.3-1 TYPE OF FACTORIES LOCATED IN SELECTED ECONOMIC ZONES

Name of Eco-zone	No. in Map	Location and Area (ha.)	No. of Locator (No. of Employees)	Type of Factory						
				Electrical, Electronics	Automobiles, parts	Process, Food, Beverages	Textile	Iron, Steel	Non Metallic Mineral	Others
Cavite Economic Zone	1	Rosario, Cavite (278 ha.)	257 (N.A.)	88	9	-	31	43	25	61
Gateway Business Park	4	General Trias, Cavite (90 ha.)	22 (13,661)	14	-	1	-	2	-	5
First Cavite Industrial Estate	6	Dasmariñas, Cavite (119 ha.)	97 (16,419)	24	8	4	13	-	12	36
Toyota Special Economic Zone	17	Sta. Rosa, Laguna (120 ha.)	5 (3,258)	-	5	-	-	-	-	-
First Philippine Industrial Park	24	Sto. Tomas, Batangas (315 ha.)	49 (14,254)	15	7	-	-	2	-	25

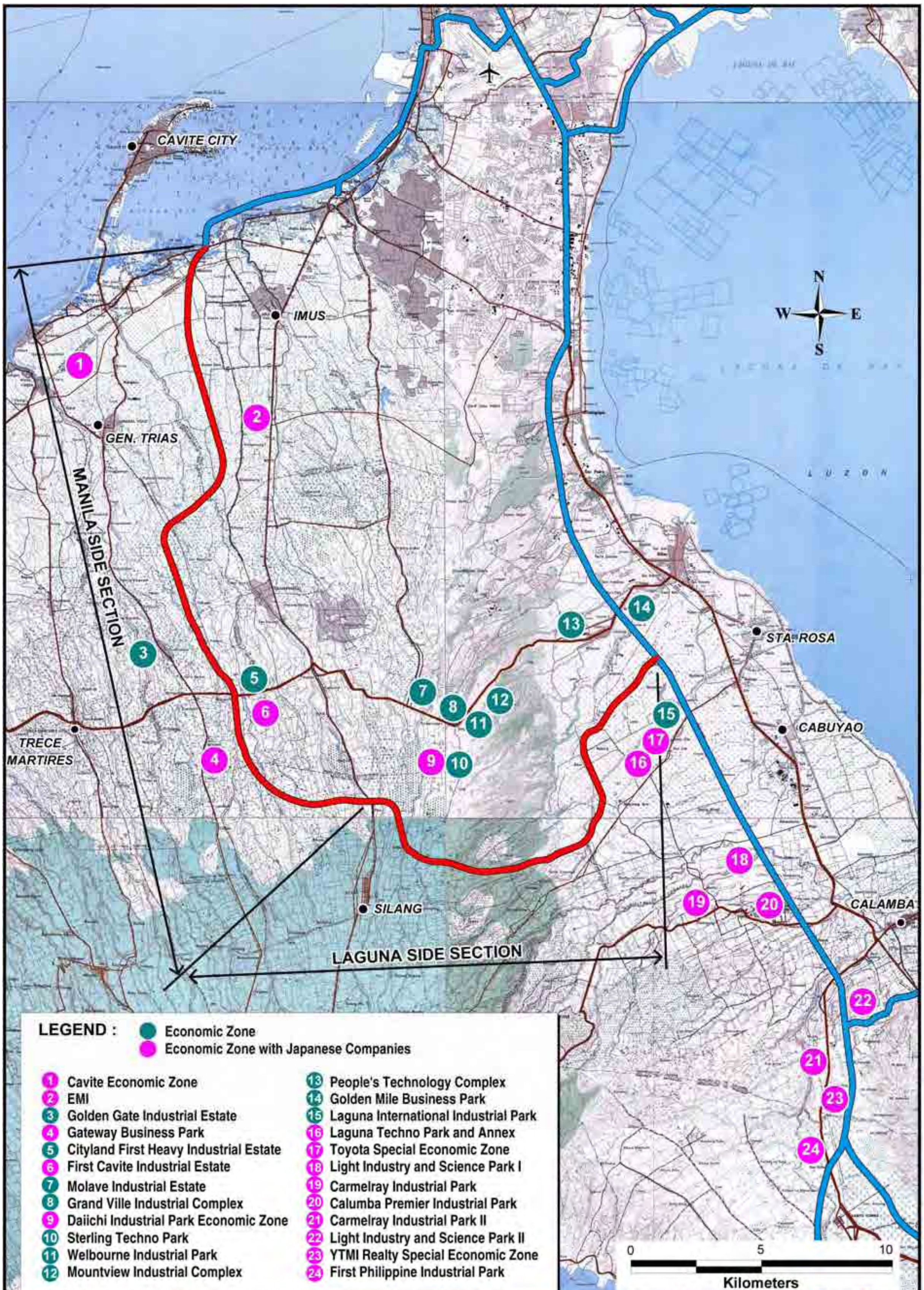


FIGURE 3.3.2-1 DISTRIBUTION OF ECONOMIC ZONES ALONG CALA EXPRESSWAY

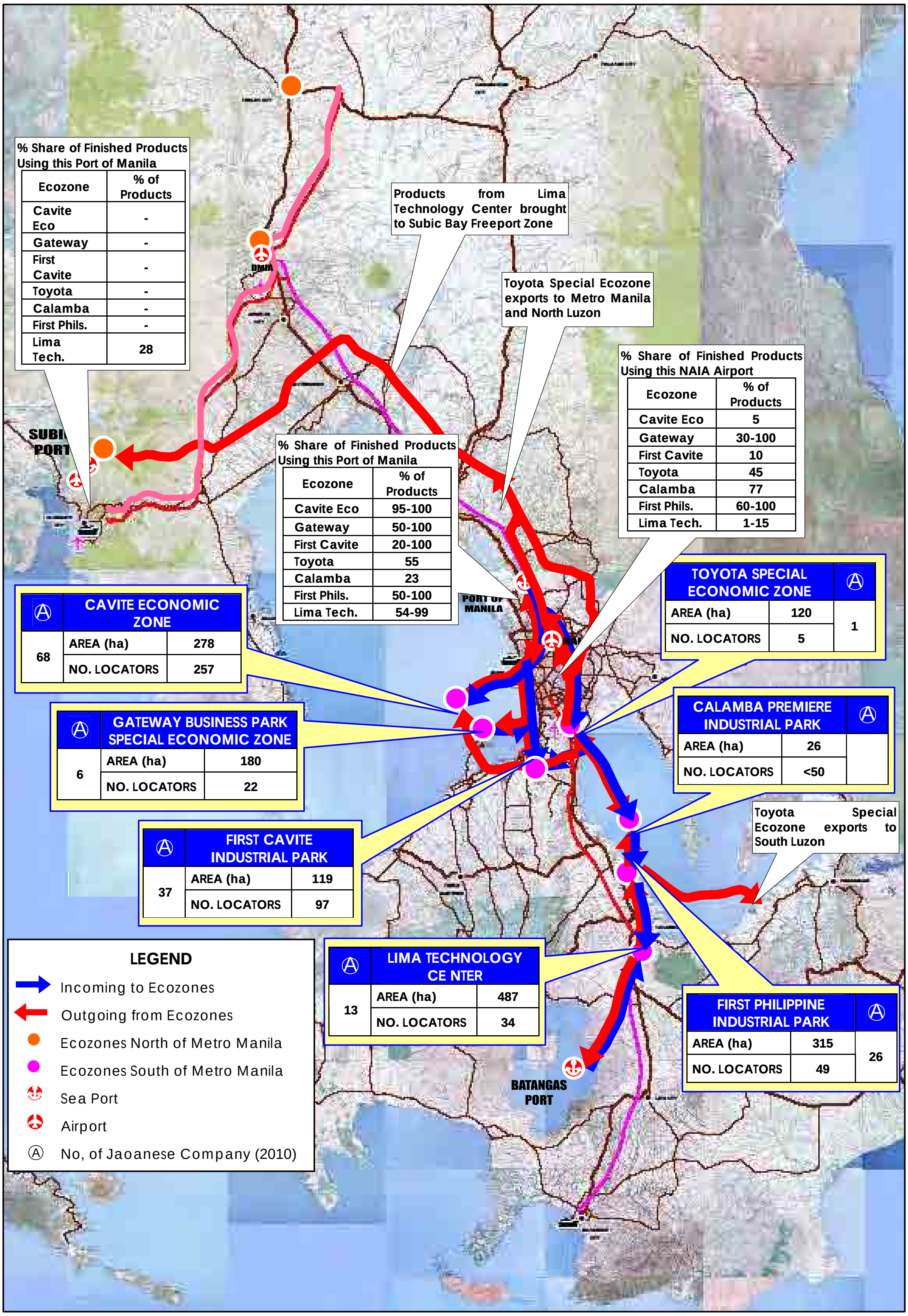


FIGURE 3.3.2-2 ECONOMIC ZONES INTERVIEWED SOUTH OF METRO MANILA

CHAPTER 4
TRAFFIC STUDY

4.1 PRESENT TRAFFIC CONDITION

4.1.1 Type of Surveys Carried Out

A number of surveys were carried out to better understand the characteristics of the study area as well as to get the opinion of stakeholders on the proposed expressway (see **Table 4.1.1-1** including World Bank Survey). Each survey is discussed separately in the succeeding section. Likewise, survey results of previous JICA-assisted study like the "The Study of Master plan on High Standard Highway Network Development" were utilized for this study like traffic volume. Similarly, the traffic count data of on-going WB-assisted study entitled Cavite-Laguna Tollway Project was also reflected in the report to have a holistic appreciation of entire stretch of the expressway.

TABLE 4.1.1-1 TYPE OF SURVEYS CARRIED OUT

Survey Type	Number of Samples	
	JICA	World Bank (SMEC)
(a) Travel Speed Survey	5	-
(b) Car's Willingness to Pay (WTP) Survey	1,126	-
(c) FX Willingness to Pay (WTP) Survey	161	-
(d) Interview Survey to Truck Company	20	-
(e) Interview Survey to Bus Company	11	-
(f) Interview Survey to Manufacturing Company	18	-
(g) Manual Traffic Count Survey (including OD survey)	-	24
(h) Roadside Interview Survey	-	9
(i) Axle Load Survey	-	2

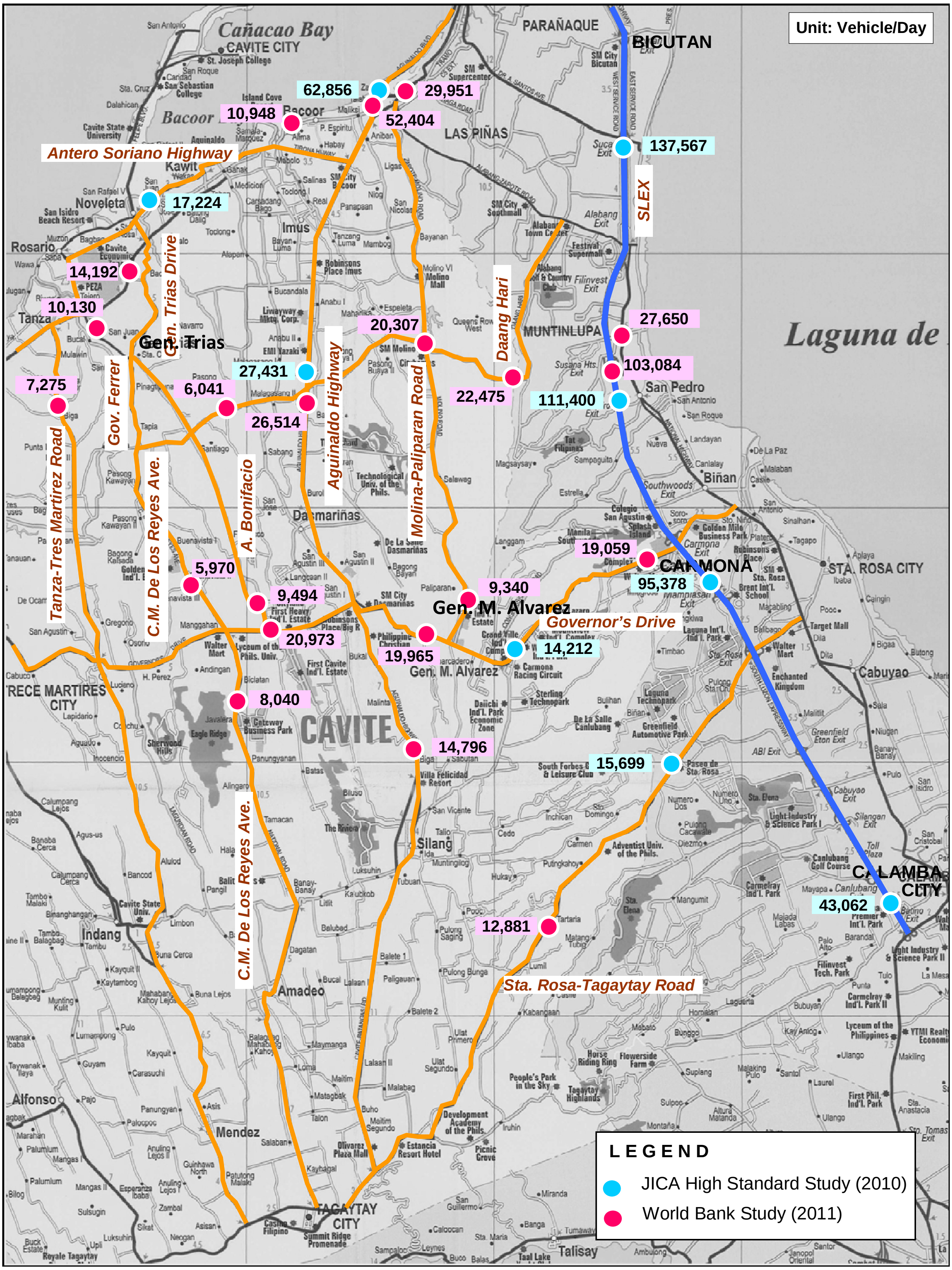
4.1.2 Traffic Volume

Figure 4.1.2-1 shows the traffic volumes of the road network in Cavite area and some portions of Laguna province. The number denotes vehicles. The following were observed regarding the captured traffic volume:

- Traffic volume at the section of SLEX inside Metro Manila is extremely high compared to the sections outside of Metro Manila indicating that there are high numbers of vehicles using the expressway having their OD within Metro Manila.

- There is also a very high volume of vehicle between Metro Manila and coastal towns of Cavite which is served by the Manila-Cavite Expressway. These towns along with other towns within the periphery of Metro Manila are functioning as residing place of workers in the capital.

- Likewise, traffic volume at the trunk roads like Aguinaldo Highway and Governor's Drive is also high especially at the sections of these roads passing urban areas like in Dasmarinas city and Gen. M. Alvarez, and Carmona. Through traffic and local traffic like jeepneys and tricycles merges at this road section.



Note: JICA data is AADT; WB data is average of 2-day 24 hrs count; motorcycles and bicycles were not included

FIGURE 4.1.2-1 TRAFFIC VOLUME

4.1.3 Hourly Variation of Traffic Volume

The following were observed hourly traffic fluctuation in the following routes:

SLEX

- The highest number of vehicles was recorded between 16:00 to 17:00 and the direction was going inside Metro Manila. Generally, there was no big difference of volume of vehicles from 6:00 to 22:00 (traffic volume was constantly almost 6,000 vehicles).
- However, for the section of SLEX outside of Metro Manila – peak hours follow the usual trend. That is 7:00 to 8:00 in the morning and 16:00 to 17:00 in the afternoon.

Unit: Vehicle/Hour

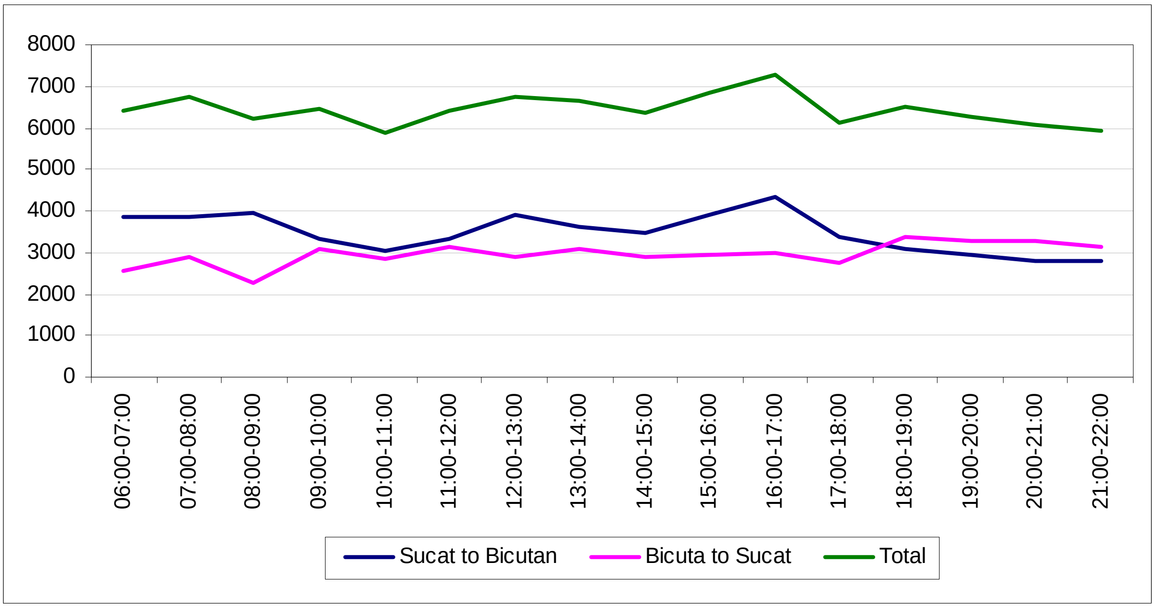


FIGURE 4.1.3-1 HOURLY VARIATION OF TRAFFIC AT SLEX (SUCAT – BICUTAN SECTION)

Unit: Vehicle/Hour

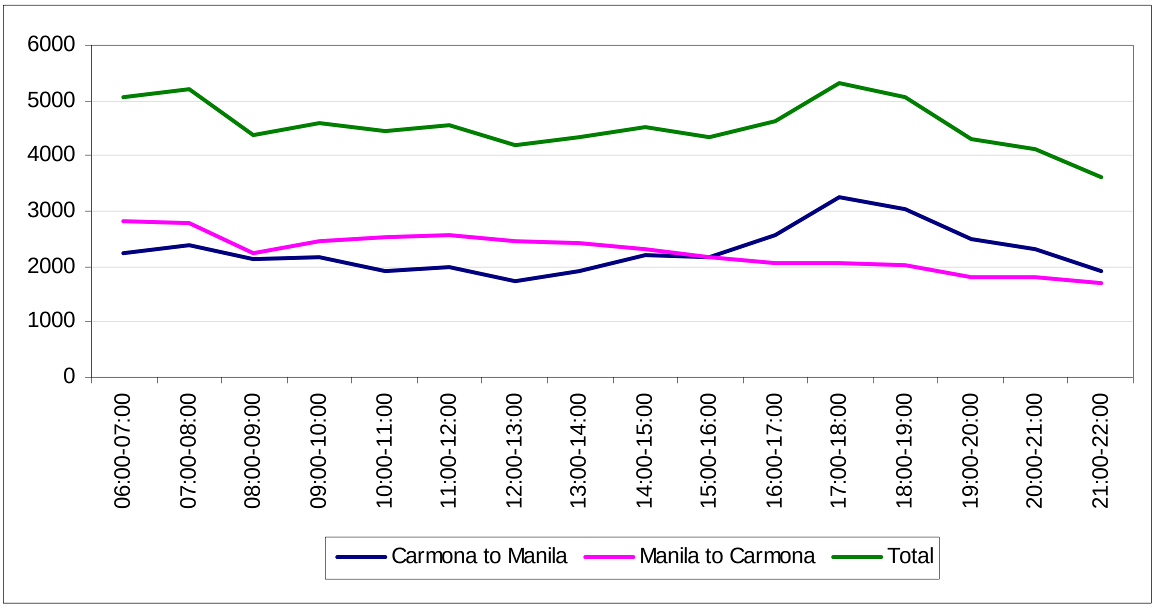


FIGURE 4.1.3-2 HOURLY VARIATION OF TRAFFIC AT SLEX (NEAR CARMONA INTERCHANGE)

Aguinaldo Highway

- Peak hour was observed at 11;00 to 12:00 and significant volume of traffic was also observed during morning peak hour at 7:00 to 8:00. Traffic drastically declined from 21:00 onwards. This road is a major highway connecting medium towns in Cavite to Metro Manila. These towns serve as residential places of most people having their work in the capital.

Unit: Vehicle/Hour

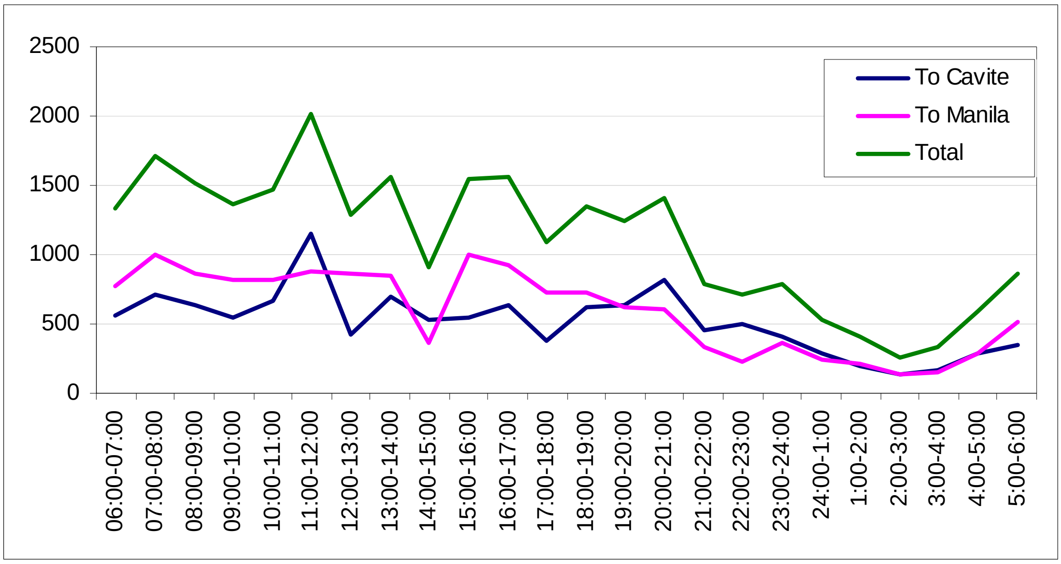


FIGURE 4.1.3-3 HOURLY VARIATION OF TRAFFIC AT AGUINALDO HIGHWAY (BET. TIRONA HIGHWAY & BUHAY NA TUBIG ST.)

Unit: Vehicle/Hour

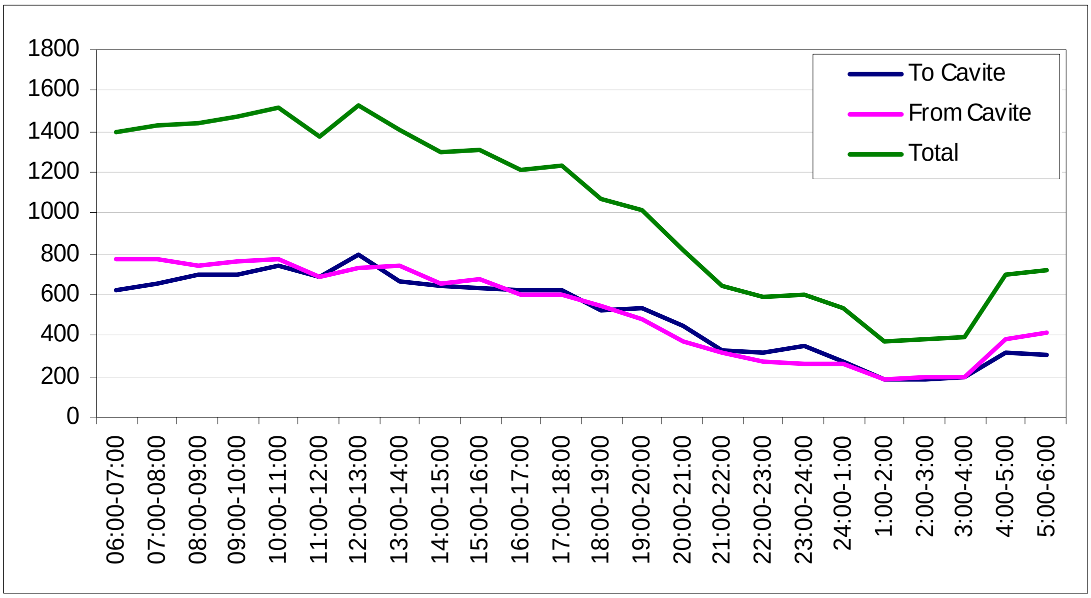


FIGURE 4.1.3-4 HOURLY VARIATION OF TRAFFIC AT AGUINALDO HIGHWAY (BET. IMUS AND DASMARINAS)

Molina – Paliparan Road

- This road branched out from Aguinaldo Highway at Bacoor and runs parallel until it reaches Governor's Drive. Like users of Aguinaldo Highway, traffic in this road will have an option of using the CALAX expressway if constructed in future. During the peak hour in the morning, vehicles entering Metro Manila is higher that those moving in opposite direction. Perhaps these traffics are commuters catching their work in the morning. The movement of traffic is then reverse in the afternoon where most of the traffic is leaving the capital.

Unit: Vehicle/Hour

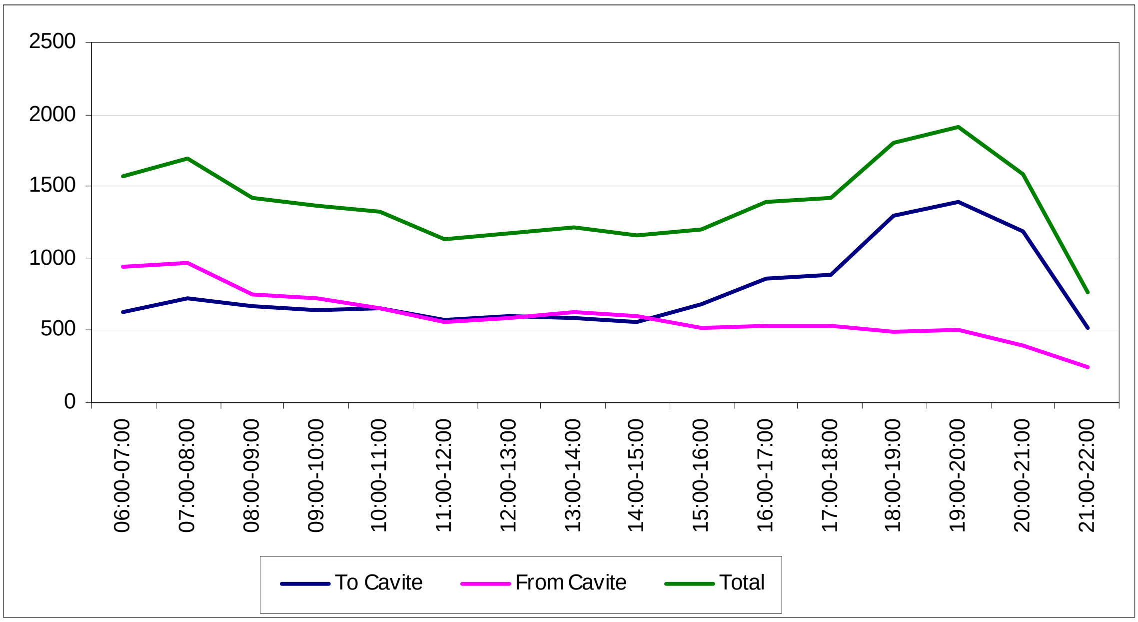


FIGURE 4.1.3-5 HOURLY VARIATION OF TRAFFIC AT MOLINA-PALIPARAN ROAD (MOLINO BLVD. AT BRGY. MAMBOG IV, BACOOR (NORTH OF PALICO DAANAN ST.)

Unit: Vehicle/Hour

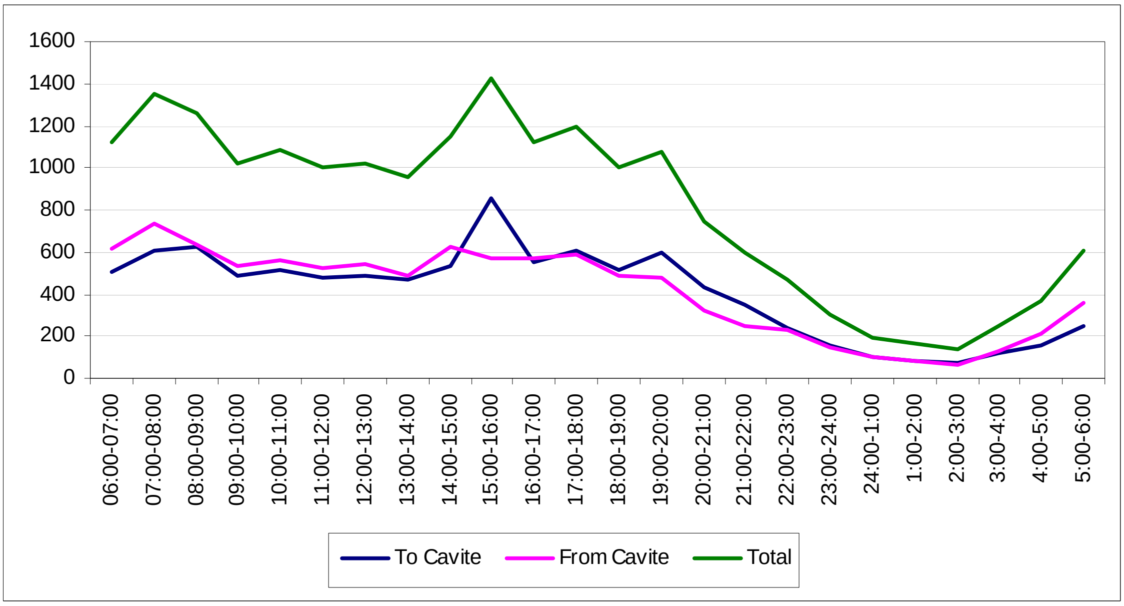


FIGURE 4.1.3-6 HOURLY VARIATION OF TRAFFIC AT MOLINA-PALIPARAN ROAD (AFTER DAANG HARI.)

Governor's Drive

- This road is carrying heavy traffic which is more than one thousand per hour during peak hour in the morning and afternoon. Number of vehicles in both directions is almost equal where outgoing traffic is believed to be heading to Metro Manila and incoming traffic are workers of several manufacturing companies in the area.

Unit: Vehicle/Hour

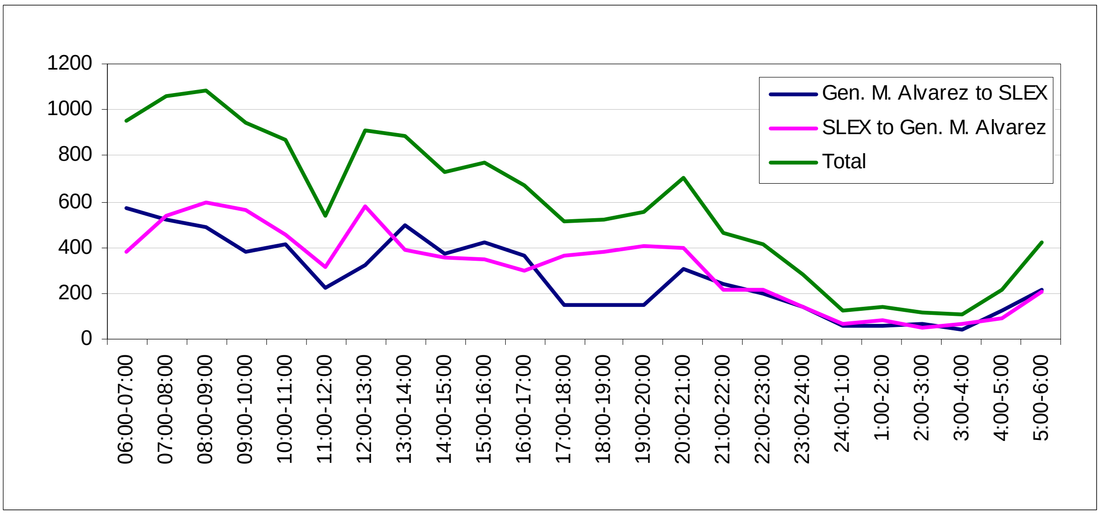


FIGURE 4.1.3-7 HOURLY VARIATION OF TRAFFIC AT GENERAL TRIAS (BETWEEN ANTERO SORIANO HIGHWAY & GOV. FERRER ST.)

Unit: Vehicle/Hour

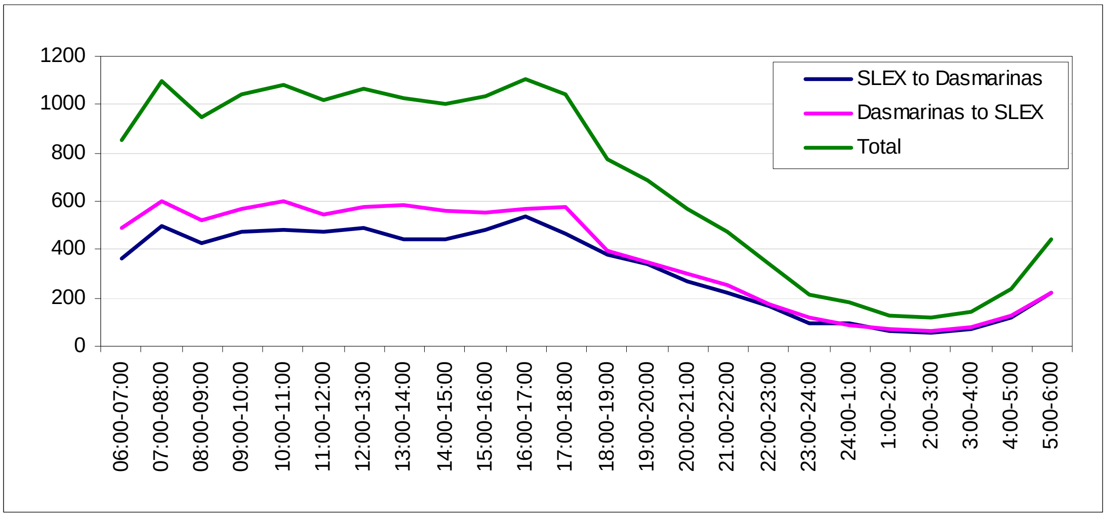


FIGURE 4.1.3-8 HOURLY VARIATION OF TRAFFIC AT CRISANTO DE LOS REYES AVE. (BRGY. BUENAVISTA III, GENERAL TRIAS, NORTH OF GOVERNOR'S DRIVE)

Gen. Trias Drive and Pag-asa Street (near Governor's Drive)

- Users of this road will also benefit to the services provided by the CALAX expressway. Volume of vehicles is close to 800 per hour during peak hour and reduces to almost 450 during off peak. At the other end of the road, the volume of traffic significantly decreases and peak hour volume is merely about 430 per hour.

Unit: Vehicle/Hour

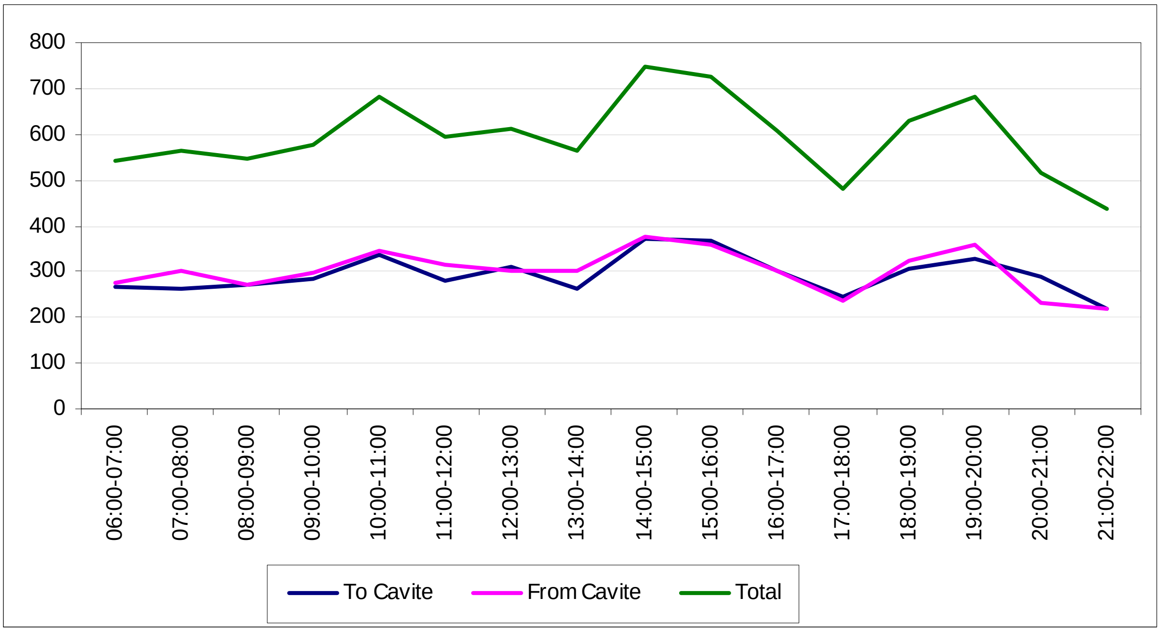


FIGURE 4.1.3-9 HOURLY VARIATION OF TRAFFIC AT CARMONA - TRECE MARTIREZ ROAD

Unit: Vehicle/Hour

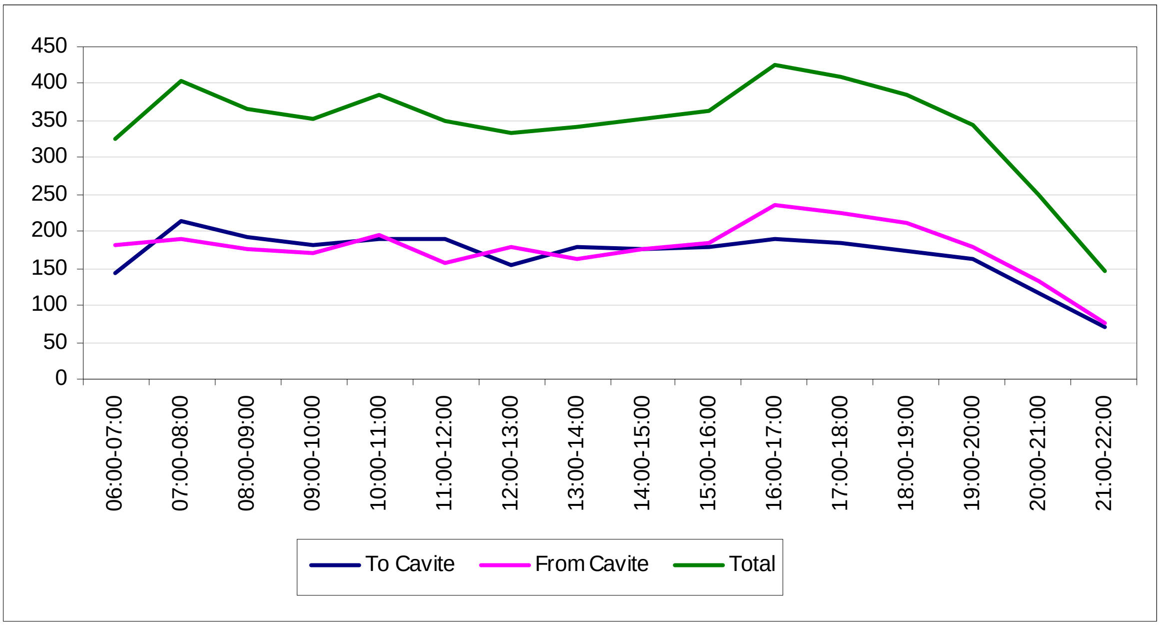


FIGURE 4.1.3-10 HOURLY VARIATION OF GOVERNOR'S DRIVE AT BRGY. PALIPARAN I, DASMARIÑAS (WEST OF PALIPARAN ROAD)

4.1.4 Traffic Composition

- The volume of vehicles at Bicutan section of the expressway is very high. Cars continued to be the main users of SLEX and the number of trucks using the expressway to deliver their cargoes on time is noticeable. Note that tricycle and motorcycles were recorded at Calamba section since the survey station was positioned after the exit.
- Traffic composition at Aguinaldo Highway shows typical mixing of different transport mode in the road network of the country when a national road passes urban center. Combined number of Jeepneys, motorbikes, and tricycles are more than half of the total traffic. Traffic congestion in this area is very heavy.
- At Governor's Drive, car has the highest share followed by tricycle/motorcycle. Share of truck is also significant due to the presence of several manufacturing companies.
- At the coastal road which connects coastal tows of Cavite to Metro Manila, since the two survey stations were position at the urban center, share of tricycle and motorcycle are almost the same as share of cars. Tricycles and motorcycles entering the main road are observed almost every part of the country which disrupts the smooth flow of traffic.
- At the Sta. Rosa – Tagaytay Road, share of trucks is significant (over 3,000) and this is because of the presence of manufacturing companies in the area.

Unit: Vehicle/Day

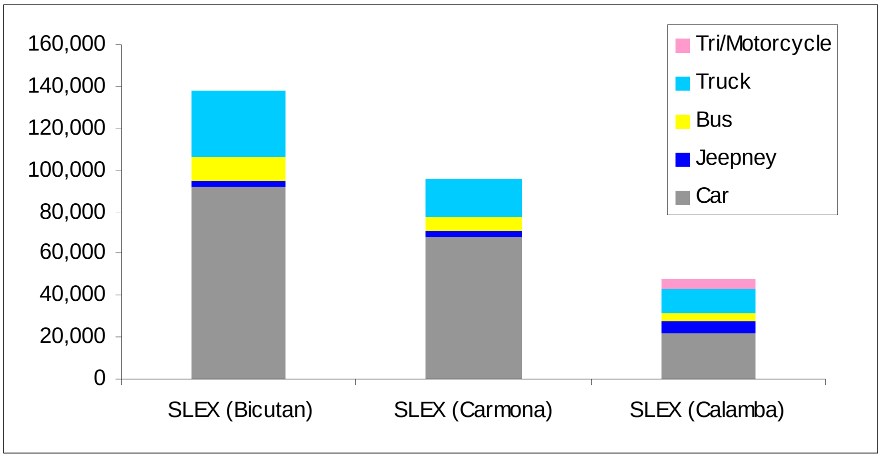


FIGURE 4.1.4-1 TRAFFIC COMPOSITION AT SLEX

Unit: Vehicle/Day

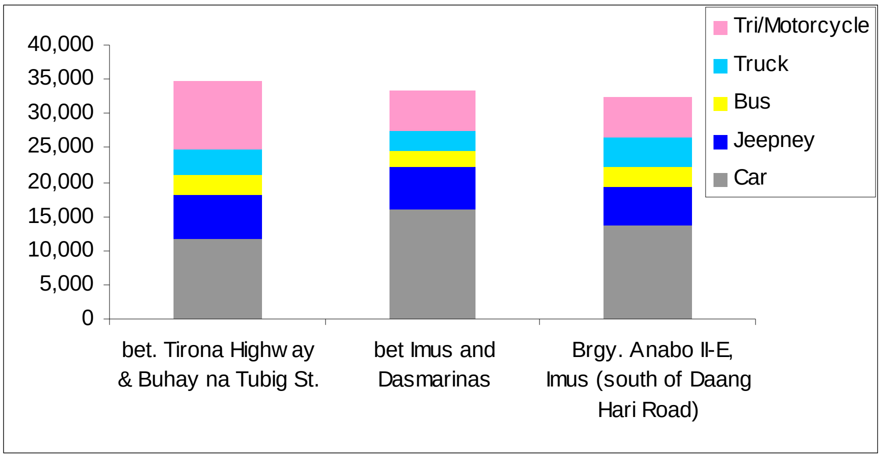


FIGURE 4.1.4-2 TRAFFIC COMPOSITION AT AGUINALDO HIGHWAY

Unit: Vehicle/Day

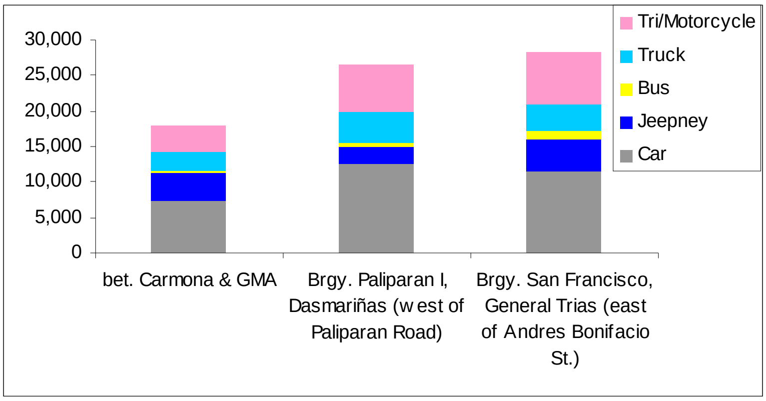


FIGURE 4.1.4-3 TRAFFIC COMPOSITION AT GOVERNOR'S DRIVE

Unit: Vehicle/Day

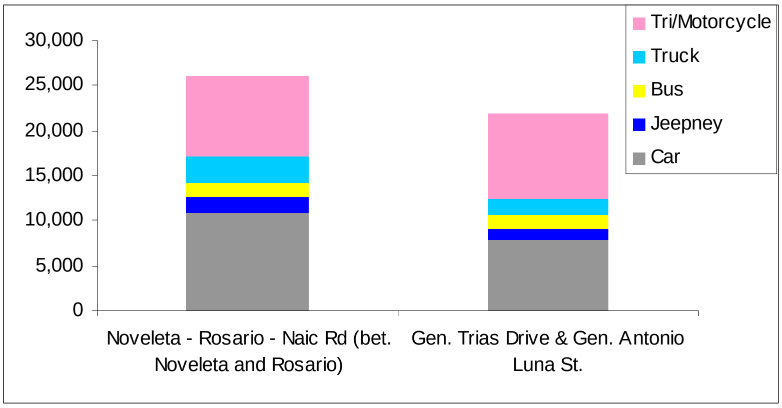


FIGURE 4.1.4-4 TRAFFIC COMPOSITION AT COASTAL ROAD (TO CAVITE)

Unit: Vehicle/Day

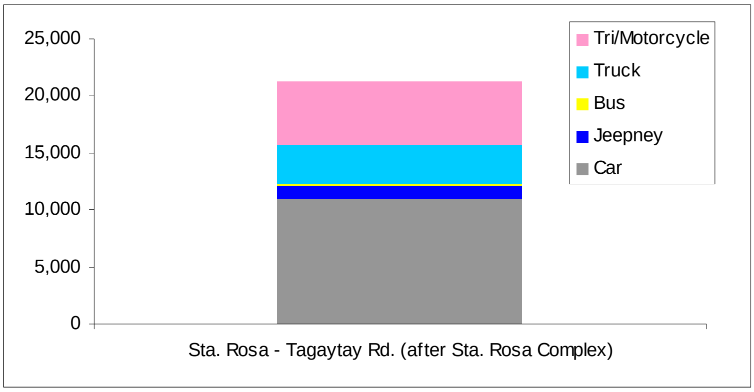


FIGURE 4.1.4-5 TRAFFIC COMPOSITION AT STA. ROSA – TAGAYTAY ROAD

4.1.5 Travel Speed Survey

The travel time of selected routes are depicted in **Figure 4.1.5-1**. General observation appears that serious traffic congestion is experienced while the national road is passing a city center or the area has substantial number of economic zones and industrial parks. Congestion is also experienced when a road is about to merge with another important road. **Table 4.1.5-1** presented the causes of traffic congestion in each route.

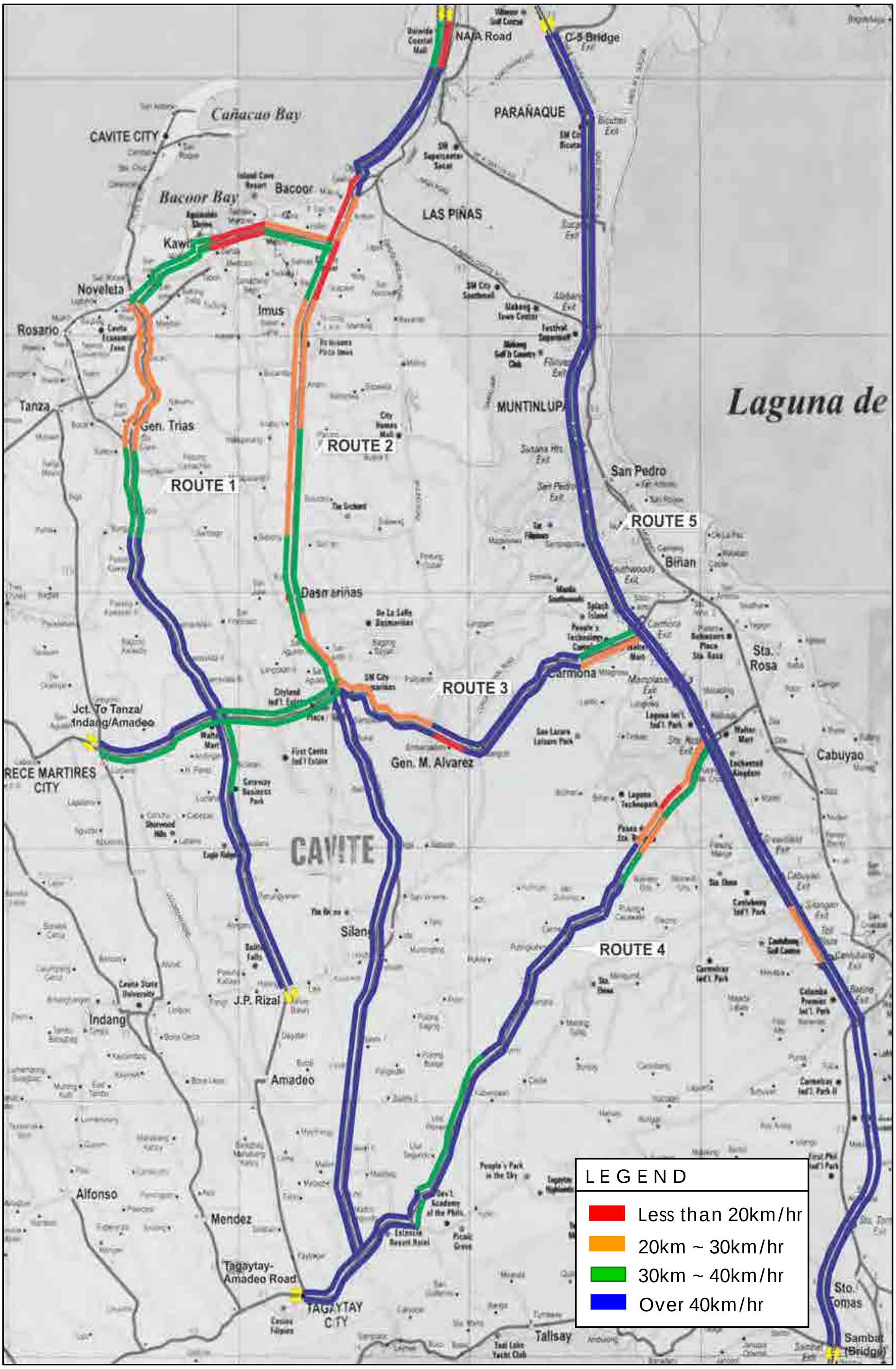


FIGURE 4.1.5-1 (1) TRAVEL SPEED OF MAJOR CORRIDORS IN THE SOUTH OF METRO MANILA (MORNING PEAK HOURS)

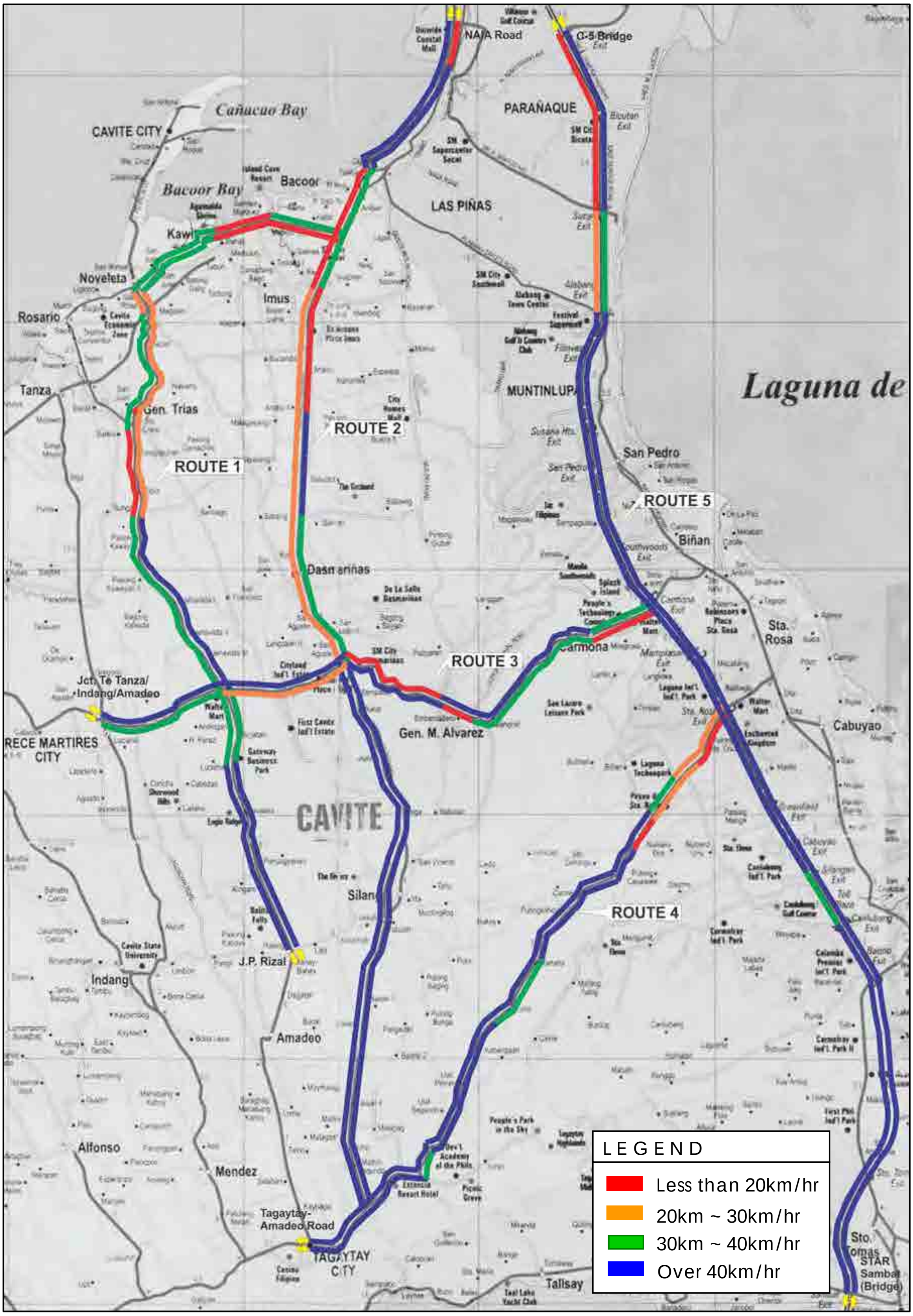


FIGURE 4.1.5-1 (2) TRAVEL SPEED OF MAJOR CORRIDORS IN THE SOUTH OF METRO MANILA (AFTERNOON PEAK HOURS)

TABLE 4.1.5-1 TRAVEL SPEED ROUTES AND OBSERVED CAUSES OF TRAFFIC CONGESTION

	Afternoon Peak Hours
Route 1	• This route supports many economic zones located in middle and eastern part of Cavite province as well as important corridors for commuters from the municipalities of Kawit, Noveleta, Rosario, Tanza, Gen. Trias, and Amadeo. Substantial number of working force in Metro Manila has their residence in these municipalities thus they have a daily movement between Cavite and Metro Manila. Traffic volume in this road section reaches over 17,000 vehicles per day (cars 63%, trucks 18%, jeepneys 10% and buses 9%). • Motorists moving in the direction of Cavite are experiencing heavy congestion in the following sections: Evangelista bridge to Aguinaldo, and Gen. Antonio (Jct. Gen. Trias Drive/A. Bonifacio) to Gov. Ferrer (Open Canal). Travel speed in these two sections is merely 15 km/hr and 16 km/hr respectively. This road is common road for commuters for several municipalities in the coastal area of Cavite province. Thus motorists moving in both directions are experiencing heavy congestion from this road section. • For motorist heading Metro Manila, traffic congestion starts at Bagong Kalsada until they reached Anterio Soriano Highway (Gen. Trias area). This can be attributed to significant number of mini-buses and jeepneys that are loading and unloading passengers often without properly parking their vehicles to roadside to avoid disruption of traffic.
Route 2	• This route is a major corridor that serves over 27,000 vehicles per day (between Imus and Dasmarinas section) and a critical link to Metro Manila for commuters from Imus municipality, Dasmarinas city, Silang municipality and Tagaytay city. Likewise, this is also a vital highway for locators in the economic zones for delivery of their cargoes to international ports and airports of Manila. Number of trucks passing this road reaches to about 3,000 per day in 2009 which represents 10% of the total traffic. Private car however still dominates the road network with a total share of 58%. Similar to municipalities mentioned in Route 1, these municipalities are also hosting substantial number of people commuting daily to Metro Manila to attend their work. • Bottleneck sections for motorists in the direction of Metro Manila are particularly serious from Daang Hari to Palico-Daanan. Heavy traffic is experienced again from Pacific Avenue to NAIA Road of Roxas Boulevard. • For motorists going in the direction of Cavite, traffic congestion starts at Alabang Zapote Road and this slow movement of vehicles continues until reaching Dasmarinas City all the way to the junction of Aguinaldo – Pala-pala Road. This particular time saw heavy movement of commuters (employees and students) who have their work in Metro Manila but have their residence in Cavite area.
Route 3	• This route is supporting significant number of economic zones and traversing several medium-sized cities, large shopping malls and universities. This route is also classified as east-west lateral arterial road by the DPWH which indicates that the road is an important backbone of the country's transportation network. Traffic volume reaches over 14,000 (between Carmona and Gen. M. Alvarez) and share of cars is 53% and share of trucks' reaches as high as 19%. As mentioned, this high volume of trucks is servicing economic zones in the area. • Motorists moving in the direction of SLEX have to endure heavy traffic congestion particularly at Gen. M. Alvarez municipality proper where travel speed is just 15km/hr. This speed is further reduced to merely 7 km/hr from Carmona until entrance to SLEX. • For traffic moving in opposite direction, the congested section is G. M. Alvarez municipality to Dasmarinas city. Perhaps there is a significant number of people working at economic zones located in the said municipality but have their residence in Dasmarinas city.
Route 4	• This route serves as alterative to Aguinaldo Highway for motorists going to Tagaytay city and vice versa. Motorists from Metro Manila travels using SLEX depart at Sta. Roxa exit and moves south-west all the way to Tagaytay city. • This route is still generally free from traffic congestion except at the section after exiting from the expressway to Nuvali road. This area is populated by industrial parks and some universities have their campus here. Traffic volume in this road reaches over 15,000 vehicles of which 22% are trucks and 70% are cars.
Route 5	• This route, an expressway, is the main backbone of cities and industries in the south of Metro Manila. Congestion is only experienced at the section of Skyway (direction of south) which is due to high volume of vehicles entering the expressway at same time after office hour. Motorists departing Metro Manila have to endure severe traffic congestion at the off-ramp that connects Skyway and SLEX. Note that this survey was carried out in May 5, 2011 and during this time, Phase 2 of Skyway which offer seamless connection to SLEX has yet to open. • The green color with signifies slow travel speed (30-40 km/hr) for motorist traveling south is due to presence of toll both at Canlubang.

4.1.6 Willingness to Pay Survey for Use of CALAX (Private Car User)

Figure 4.1.6-1 shows the hypothetical questions and different routes considered in asking the car user's respondents.

Expressway Projects in Mega Manila Region in the Republic of the Philippines

WILLINGNESS TO PAY SURVEY (FORM 2) — **FOR STUDY PURPOSE ONLY**

General Info.

Sample ID No: [ ][ ][ ]   Date (month/day) [ ][ ] [ ][ ]

Location:
- [ ] Aguinaldo Highway (Dasmarinas City)
- [ ] Aguinaldo Highway (Silang)
- [ ] Along Governor's Drive
- [ ] Sta. Rosa-Tagaytay Road
- [ ] SLEX Service Area

Time [ ][ ] [ ][ ]

Personal Information

1-Sex [ ]
1-Male 2-Female

2-Age 1)20-29 2)30-39 3)40-49 4)50-59 5)>60 [ ]

3-Occupation [ ][ ]

1- Admin.	2- Professional	3- Tech./assist.	4- Clerk	5- Sale/Services	6- Farmer/fisher
7- Craftman	8- Production	9- Unskilled	10- Student	11- House wife	12- Retired
13- Jobless	14- Other (specify):				

4-Monthly Income (Pesos) [ ][ ]

1) None	4) 10,000 - 14,999	7) 30,000-39,999	10) 100,000-149,000
2) Under 5,000	5) 15,000 - 19,999	8) 40,000-59,999	11) 150,000 and above
3) 5,000-9,999	6) 20,000 - 29,999	9) 60,000-99,9999	

Trip Information

5- Trip OD

Where did you start this trip? ____________________ [ ][ ][ ][ ][ ][ ]
(City/Municipality)

Where do you end this trip? ____________________ [ ][ ][ ][ ][ ][ ]
(City/Municipality)

6- Trip purpose [ ][ ]

1.Work	4.Selling/Delivering	7.Shopping/Eating	10.Medical treatment
2.Education	5.Meeting/business	8.Sending/ Fetching	11.Social
3.Home	6.Return to work place	9.Recreation	12.Other

Willingness to Pay

Hypothetical Question

The government is planning to construct the Cavite-Laguna Expressway (CALA Expressway) to increase people's mobility and transport of goods. Like other expressways in the country, certain amount will be collected to use the expressway.

If CALAX is built, will you use it for your travel?

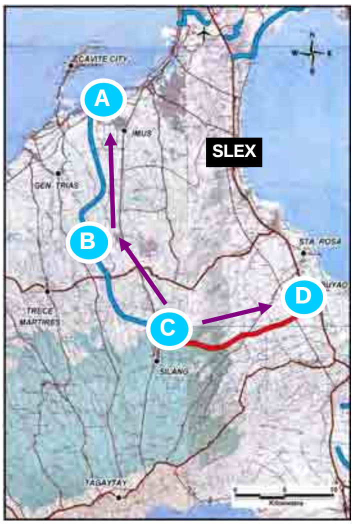
7 - From A to D [Ordinary road = 95 min] [CALA Expressway = 35 min] — **Time Saved is about 60 min!**
1) Yes → How much you are willing to pay? [ ]
a) 60 b) 120 c) 200
2) No, I will take ordinary road

8 - From B to A [Ordinary road = 30 min] [CALA Expressway = 15 min] — **Time Saved is about 15 min!**
1) Yes → How much you are willing to pay? [ ]
a) 20 b) 40 c) 60
2) No, I will take ordinary road

9 - From B to D [Ordinary road = 65 min] [CALA Expressway = 20 min] — **Time Saved is about 45 min!**
1) Yes → How much you are willing to pay? [ ]
a) 40 b) 60 c) 100
2) No, I will take ordinary road

10 - From C to B [Ordinary road = 25 min] [CALA Expressway = 10 min] — **Time Saved is about 15 min!**
1) Yes → How much you are willing to pay? [ ]
a) 20 b) 40 c) 60
2) No, I will take ordinary road

11 - From C to D [Ordinary road = 40 min] [CALA Expressway = 10 min] — **Time Saved is about 30 min!**
1) Yes → How much you are willing to pay? [ ]
a) 20 b) 40 c) 100
2) No, I will take ordinary road



That's All. Thank You Very Much for Your Cooperation.

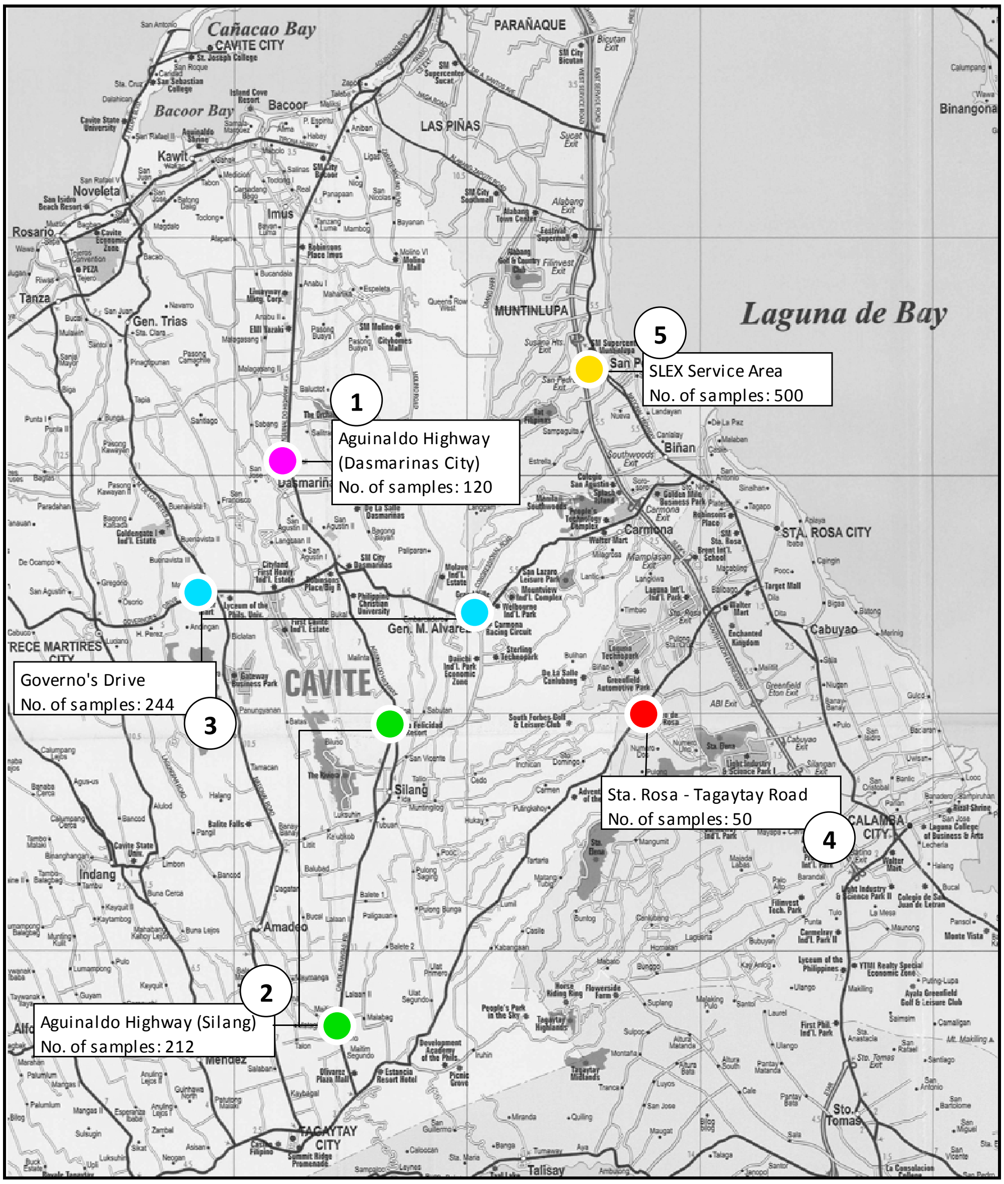
FIGURE 4.1.6-1 WILLINGNESS-TO-PAY QUESTIONNAIRE

- ***Sample Distribution***

Distribution of samples is shown in the **Table 4.1.6-1** and illustrated in **Figure 4.1.6-2**.

TABLE 4.1.6-1 SAMPLE DISTRIBUTION

Survey Station/Location	Sample	Share (%)
1. Aguinaldo Highway (Dasmarinas City)	120	10.7%
2. Aguinaldo Highway (Silang)	212	18.8%
3. Along Governor's Drive	244	21.7%
4. Sta. Rosa-Tagaytay Road	50	4.4%
5. SLEX Service Area	500	44.4%
Total	1,126	100.0%

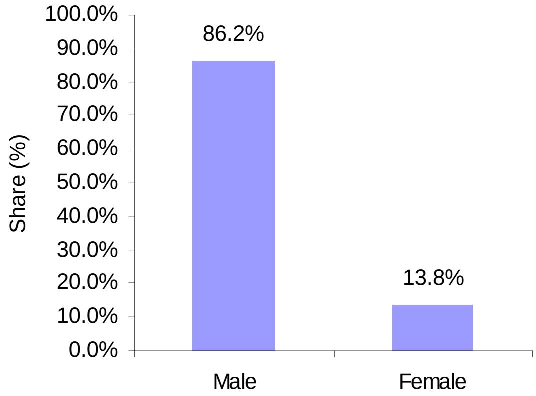


Note: the same color denotes data were combined and analyzed together

FIGURE 4.1.6-2 SURVEY LOCATIONS FOR WILLINGNESS-TO-PAY SURVEY

- ***Sex Distribution***

Most of the car users captured in the survey are composed of male (86.2%) and the remaining 13.8% are female.

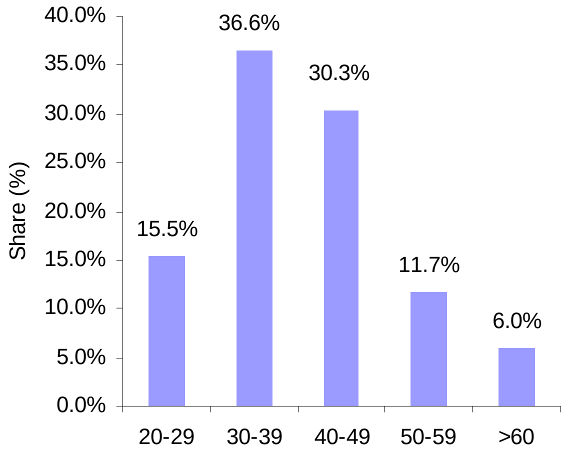


Number of sample = 1,126

FIGURE 4.1.6-3 SEX DISTRIBUTION

- ***Age Distribution***

For age distribution, more than half of the respondents (66.9%) are between the age range of 30 to 49.

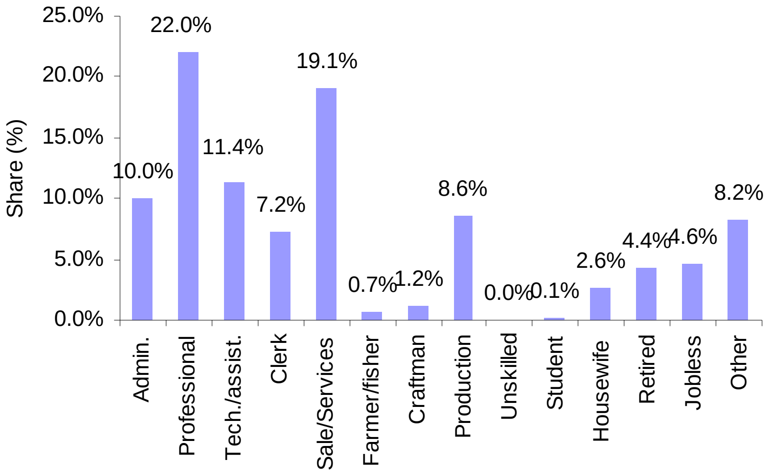


Number of sample = 1,126

FIGURE 4.1.6-4 AGE DISTRIBUTION

- ***Occupation Distribution***

For occupation of the captured respondents, most of them are engaged in professional work (22.0%) and sale/services (19.1%). Other notable professions by the respondents are technical/assistant and administration.

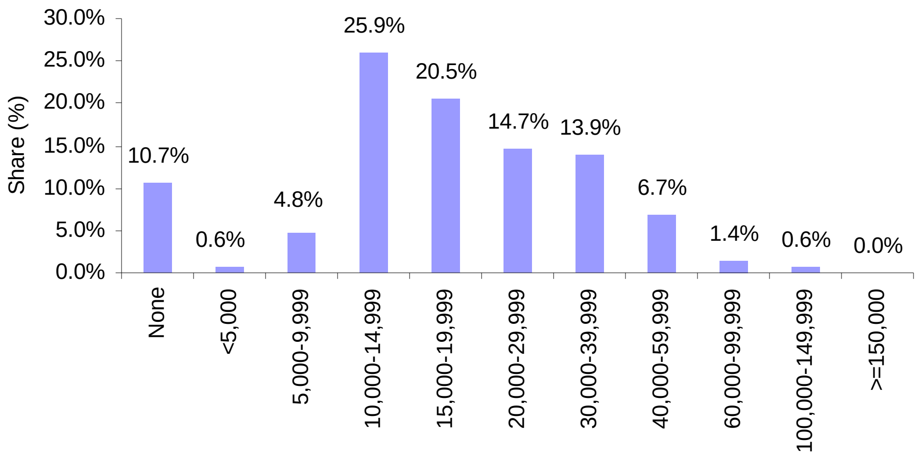


Number of sample = 1,126

FIGURE 4.1.6-5 OCCUPATION DISTRIBUTION

- ***Income Distribution***

For monthly income, notable income brackets which the respondents belong are: 10,000-14,999 (25.9%) and 15,000-19,999 (20.5%). Note that respondents which declared 'none' or lack of income are normally students or housewives.

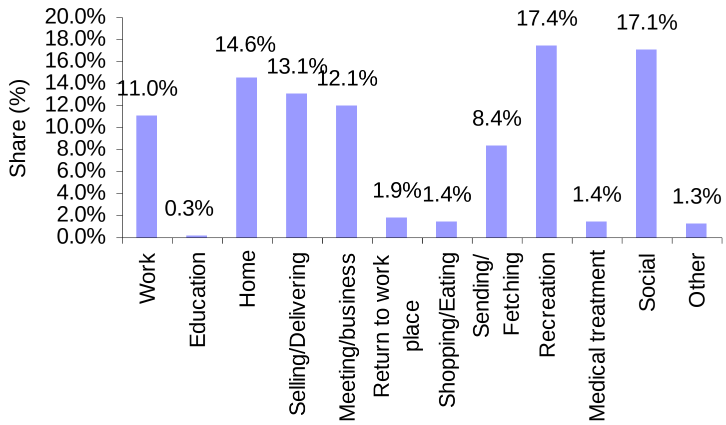


Number of sample = 1,126

FIGURE 4.1.6-6 MONTHLY INCOME DISTRIBUTION

- ***Trip Purpose***

For trip distribution, trips with substantial share are: recreation (17.4%), social (17.1%), going home (14.6%), selling/delivering (13.1%) and meeting/business (12.1%).



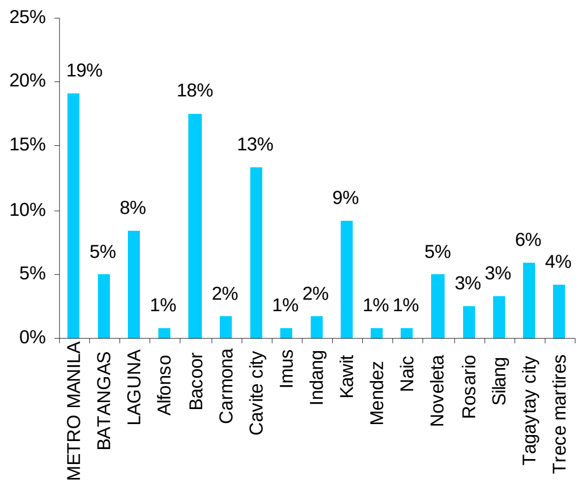
Number of sample = 1,126

FIGURE 4.1.6-7 TRIP PURPOSE DISTRIBUTION

- ***Trip OD Distribution***

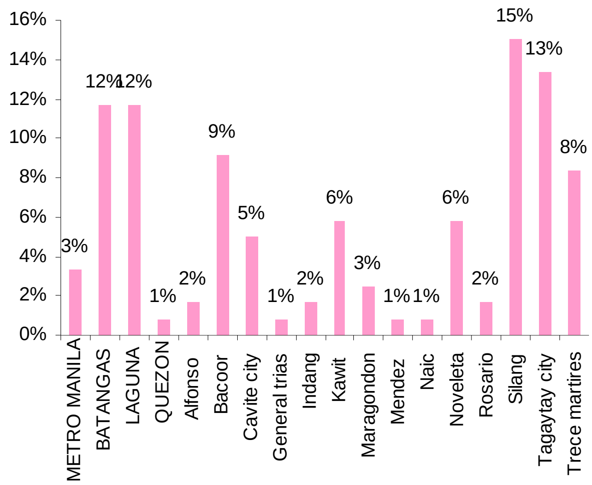
Major origins of trips at Station 1 (Aguinaldo Highway (Dasmarinas City)) are: 19% from Metro Manila, 18% from Bacoor, 13% from Cavite City. Other towns in Cavite Province with notable share are: Tagaytay (6%), Noveleta (5%), Trece Martires (4%), Silang (3%), and Rosario (3%).

For destination, major destinations are municipalities in Batangas and Laguna (24%), and municipalities of Cavite Province such as Silang (15%), and Tagaytay (14%). Other municipalities in Cavite Province with high share are: Bacoor (9%), Trece Martires (8%) Kawit (6%), Novelet (6%), Cavite City (5%), and Maragondon (3%).



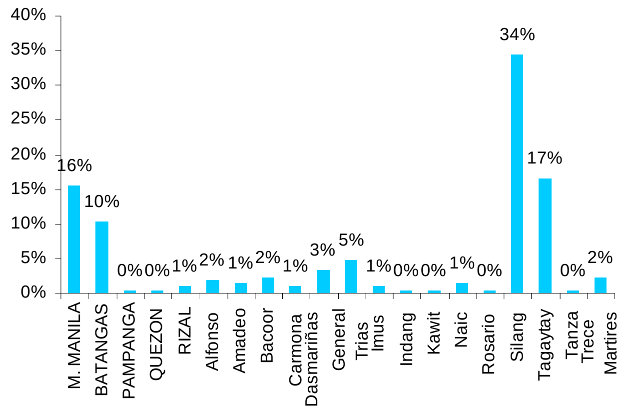
Number of sample = 120

FIGURE 4.1.6-8 ORIGIN OF TRIPS AT STATION NO. 1



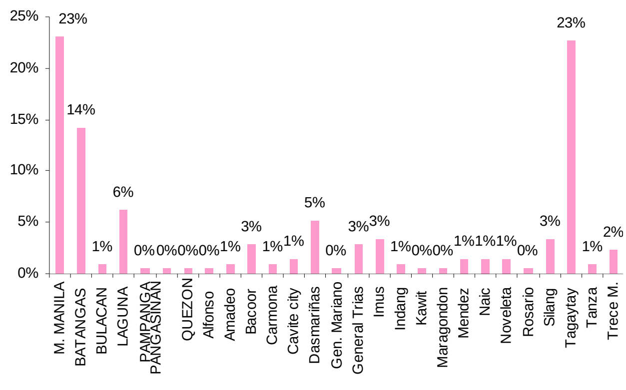
Number of sample = 120

FIGURE 4.1.6-9 DESTINATION OF TRIPS AT STATION NO. 1



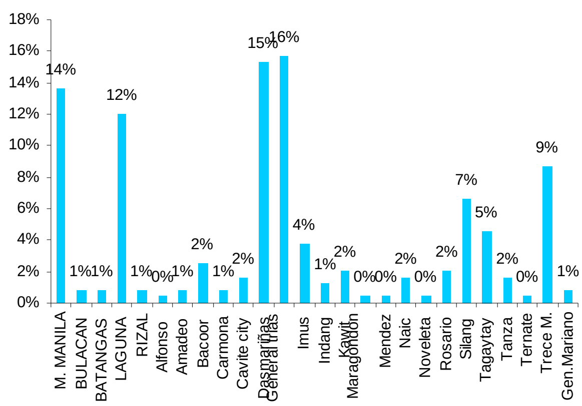
Number of sample = 212

FIGURE 4.1.6-10 ORIGIN OF TRIPS AT STATION NO. 2



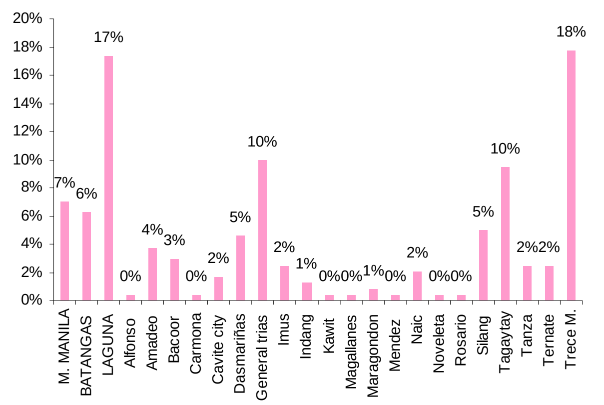
Number of sample = 212

FIGURE 4.1.6-11 DESTINATION OF TRIPS AT STATION NO. 2



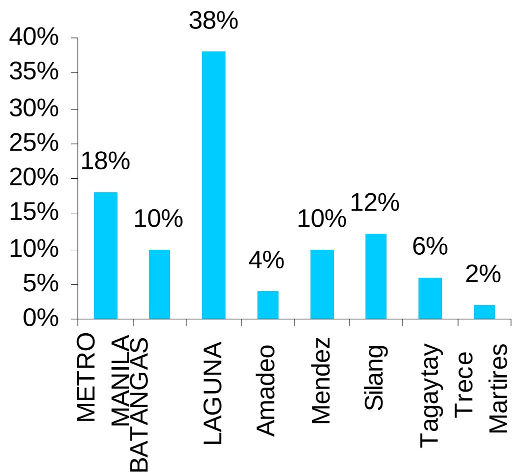
Number of sample = 244

FIGURE 4.1.6-12 ORIGIN OF TRIPS AT STATION NO. 3



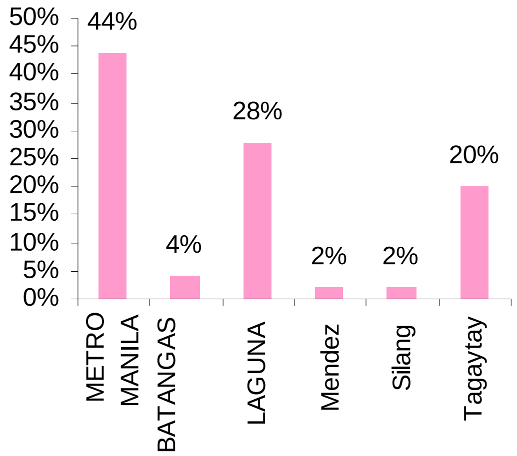
Number of sample = 244

FIGURE 4.1.6-13 DESTINATION OF TRIPS AT STATION NO. 3



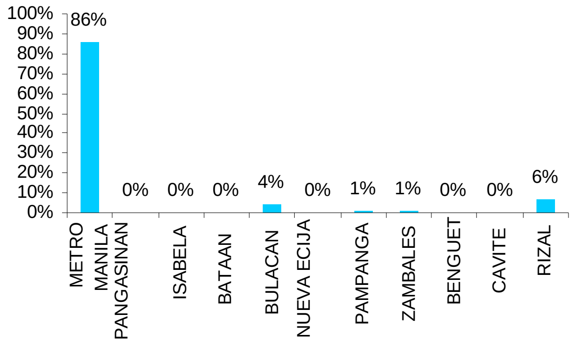
Number of sample = 50

FIGURE 4.1.6-14 ORIGIN OF TRIPS AT STATION NO. 4



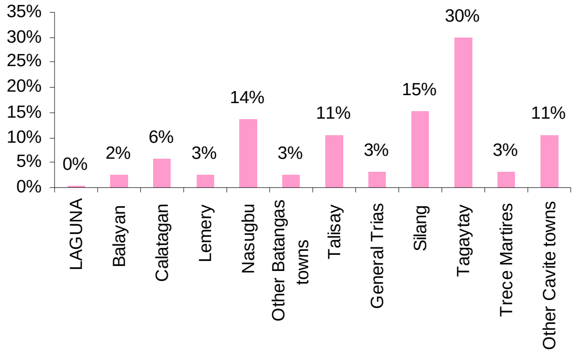
Number of sample = 50

FIGURE 4.1.6-15 DESTINATION OF TRIPS AT STATION NO. 4



Number of sample = 500

FIGURE 4.1.6-16 ORIGIN OF TRIPS AT STATION NO. 5



Number of sample = 500

FIGURE 4.1.6-17 DESTINATION OF TRIPS AT STATION NO. 5

- ***Will they Use CALA Expressway or Not***

The map in **Figure 4.1.6-18** shows the imaginary alignment of CALA expressway. Based on the travel time survey carried out by the Study Team, during peak hour, it would take around 90 to 100 minutes to cross A to D using ordinary road. Likewise, using CALA expressway, the same route can be crossed by more or less 37 minutes. It was assume then that at least the time save brought by the expressway is more or less 60 minutes. The car user individuals were then given with the following scenarios:

TABLE 4.1.6-2 ROUTE SCENARIOS AND AMOUNT OF WILLINGNESS-TO-PAY

Route Scenario	Time Save (min)	Use expressway or not?	If yes, how much willing to pay?
a. From A to D	60		
b. From B to A	15		
c. From B to D	45		
d. From C to B	15		
e. From C to D	30		

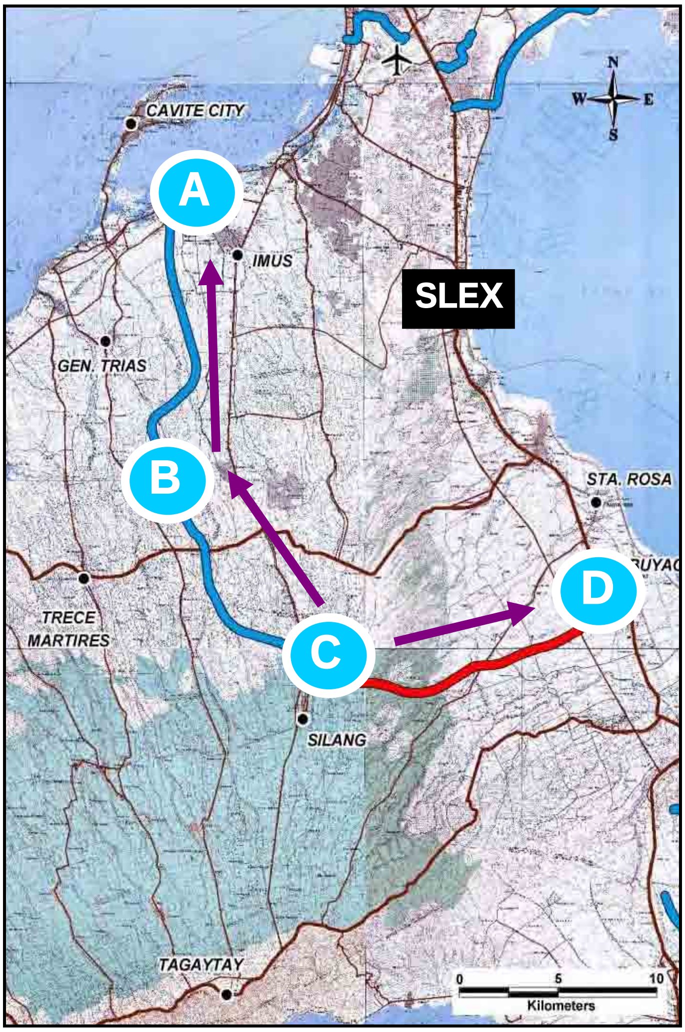


FIGURE 4.1.6-18 ROUTE SCENARIOS

The responses of car user individuals are presented from **Table 4.1.6-3** to **Table 4.1.6-7**. All motorist interviewed at Dasmarinas section of Aguinaldo Highway expressed their desire to use CALA expressway in all its route scenarios. Perhaps this is due to perceived benefits (faster travel speed) that the motorist can get from the expressway. It should be noted that arterial roads (Aguinaldo Highway and Governor's Drive) supporting the area is heavily congested.

TABLE 4.1.6-3 RESPONSE FROM AGUINALDO HIGHWAY (DASMARINAS)
(Sample size = 120)

Route Scenario	Time Save (min)	Will Use CALA?		How much willing to pay?		
		Yes (%)	No (%)			
a. From A to D	60	**100**	0	**P 60 (98.3%)**	P 120 (1.7%)	P 200 (0%)
b. From B to A	15	**100**	0	**P 20 (98.3%)**	P 40 (1.7%)	P 60 (0%)
c. From B to D	45	**100**	0	**P 40 (98.3%)**	P 60 (1.7%)	P 100 (0%)
d. From C to B	15	**100**	0	**P 20 (98.3%)**	P 40 (1.7%)	P 60 (0%)
e. From C to D	30	**100**	0	**P 20 (98.1%)**	P 40 (1.9%)	P 100 (0%)

The same is true for motorists interviewed at Silang section of Aguinaldo Highway. A very high shift to expressway is expected as shown in the table below. The low rate of shift (A to D and B to D) as compared to the rest might have something to do with the usefulness of the route. Most of the respondents are heading to Tagaytay and Silang so perhaps sections A to D and B to D is not that useful to some of them.

TABLE 4.1.6-4 RESPONSE FROM AGUINALDO HIGHWAY (SILANG)
(Sample size = 212)

Route Scenario	Time Save (min)	Will Use CALA?		How much willing to pay?		
		Yes (%)	No (%)			
a. From A to D	60	**74.5**	25.5	**P 60 (98.1%)**	P 120 (1.9%)	P 200 (0%)
b. From B to A	15	**81.1**	18.9	**P 20 (97.7%)**	P 40 (2.3%)	P 60 (0%)
c. From B to D	45	**75.0**	25.0	**P 40 (95.0%)**	P 60 (5.0%)	P 100 (0%)
d. From C to B	15	**87.7**	12.3	**P 20 (96.8%)**	P 40 (3.2%)	P 60 (0%)
e. From C to D	30	**84.4**	15.6	**P 20 (92.2%)**	P 40 (7.2%)	P 100 (0.6%)

For respondents captured along the Governor's Drive, most of them also revealed their willingness to use the CALA expressway if constructed in future. Dominant amount of fee they are willing to pay are the following: 60 pesos for A to D section; 20 pesos for B to A section; 40 pesos for B to D section; 20 pesos for C to B section and 20 pesos for C to D section.

TABLE 4.1.6-5 RESPONSE FROM ALONG GOVERNOR'S DRIVE
(Sample size = 244)

Route Scenario	Time Save (min)	Will Use CALA?		How much willing to pay?		
		Yes (%)	No (%)			
a. From A to D	60	**80.3**	19.7	**P 60 (96.4%)**	P 120 (3.6%)	P 200 (0%)
b. From B to A	15	**79.5**	20.5	**P 20 (92.8%)**	P 40 (7.2%)	P 60 (0%)
c. From B to D	45	**88.5**	11.5	**P 40 (95.4%)**	P 60 (4.6%)	P 100 (0%)
d. From C to B	15	**80.7**	19.3	**P 20 (94.4%)**	P 40 (5.6%)	P 60 (0%)
e. From C to D	30	**96.7**	3.3	**P 20 (90.7%)**	P 40 (8.9%)	P 100 (0.6%)

All respondents at the Sta. Rosa – Tagaytay Road station expressed their intention to use CALA expressway if built in future. The dominant toll fee price is the same as that recorded in respondents captured along Governor's Drive.

TABLE 4.1.6-6 RESPONSE FROM STA. ROSA – TAGAYTAY ROAD
(Sample size = 50)

Route Scenario	Time Save (min)	Will Use CALA?		How much willing to pay?		
		Yes (%)	No (%)			
a. From A to D	60	**100**	0	**P 60 (100.0%)**	P 120 (0.0%)	P 200 (0%)
b. From B to A	15	**100**	0	**P 20 (84.0%)**	P 40 (14.0%)	P 60 (0%)
c. From B to D	45	**100**	0	**P 40 (96.0%)**	P 60 (4.0%)	P 100 (0%)
d. From C to B	15	**100**	0	**P 20 (84.0%)**	P 40 (14.0%)	P 60 (2.0%)
e. From C to D	30	**100**	0	**P 20 (84.0%)**	P 40 (16.0%)	P 100 (0.6%)

Respondents captured from the service area of SLEX have negative inclination to use CALA expressway except for the C to D section. Perhaps, one of the reasons for their unwillingness to use the CALA expressway is due to presence of SLEX which already served the areas of their interest. Likewise, C to D section can be used to reach Tagaytay after branching out from SLEX. So this can be an area of interest to them which could not be served by SLEX.

TABLE 4.1.6-7 RESPONSE FROM SLEX SERVICE AREA
(Sample size = 500)

Route Scenario	Time Save (min)	Will Use CALA?		How much willing to pay?		
		Yes (%)	No (%)			
a. From A to D	60	0.2	**99.8**	P 60 (100.0%)	P 120 (0.0%)	P 200 (0%)
b. From B to A	15	0.6	**99.4**	P 20 (66.7%)	P 40 (33.3%)	P 60 (0%)
c. From B to D	45	5.8	**94.2**	P 40 (89.7%)	P 60 (10.3%)	P 100 (0%)
d. From C to B	15	0	**100**	P 20 (0%)	P 40 (0%)	P 60 (0%)
e. From C to D	30	**79.6**	20.4	**P 20 (58.5%)**	P 40 (39.9%)	P 100 (1.5%)

Willingness to Pay (FX Operator)

If CALA Expressway is realized in the future, one of transport groups that will benefits from the new facility is the FX operators. Most of these FX cars are plying routes between Metro Manila and neighboring municipalities such as Dasmarinas, Silang and others. Figure below shows the hypothetical questions and different routes considered in asking the respondents.

Expressway Projects in Mega Manila Region
in the Republic of the Philippines

WILLINGNESS TO PAY SURVEY - FOR FX DRIVERS (FORM 5) **FOR STUDY PURPOSE ONLY**

General Info.

Sample ID No: ☐☐☐ Date (month/day) ☐☐ ☐☐

Location ____________ Time ☐☐ ☐☐

Personal Information

1-Sex ☐
1-Male 2-Female

2-Age 1)20-29 2)30-39 3)40-49 ☐
4)50-59 5)>60

3-Monthly Income (Pesos) ☐☐
1) None
2) Under 5,000
3) 5,000-9,999
4) 10,000 - 14,999
5) 15,000 - 19,999
6) 20,000 - 29,999
7) 30,000-39,999
8) 40,000-59,999
9) 60,000-99,9999
10) 100,000-149,000
11) 150,000 and above

4-Trip Frequency ☐
1) 1 to 2
2) 3
4) 4
5) 5 or more

5-Currently, which expressway do you use? ☐
1) Coastal Expressway
2) SLEX
3) I don't use expressway
4) My route is not served by expressway

Trip Information

6- Trip OD

Write the location of parking terminal? ____________ ☐☐☐☐☐☐
(City/Municipality)

Where is your end trip? ____________ ☐☐☐☐☐☐
(City/Municipality)

Willingness to Pay

Hypothetical Question
The government is planning to construct the Cavite-Laguna Expressway (CALA Expressway) to increase people's mobility and transport of goods. Like other expressways in the country, certain amount will be collected to use the expressway.

If CALAX is built, will you use it for your travel?

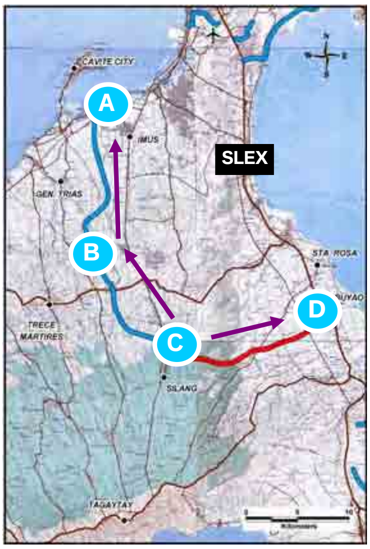
7 - From A to D **[Ordinary road = 95 min]**
[CALA Expressway = 35 min]
Time Saved is about 60 min!
1) Yes → How much you are willing to pay? ☐
a) 60 b) 120 c) 200
2) No, I will take ordinary road

8 - From B to A **[Ordinary road = 30 min]**
[CALA Expressway = 15 min]
Time Saved is about 15 min!
1) Yes → How much you are willing to pay? ☐
a) 20 b) 40 c) 60
2) No, I will take ordinary road

9 - From B to D **[Ordinary road = 65 min]**
[CALA Expressway = 20 min]
Time Saved is about 45 min!
1) Yes → How much you are willing to pay? ☐
a) 40 b) 60 c) 100
2) No, I will take ordinary road

10 - From C to B **[Ordinary road = 25 min]**
[CALA Expressway = 10 min]
Time Saved is about 15 min!
1) Yes → How much you are willing to pay? ☐
a) 20 b) 40 c) 60
2) No, I will take ordinary road

11 - From C to D **[Ordinary road = 40 min]**
[CALA Expressway = 10 min]
Time Saved is about 30 min!
1) Yes → How much you are willing to pay? ☐
a) 20 b) 40 c) 100
2) No, I will take ordinary road



That's All. Thank You Very Much for Your Cooperation.

FIGURE 4.1.6-19 WILLINGNESS-TO-PAY QUESTIONNAIRE

- ***Sample Distribution***

The sample size per survey location is presented in **Table 4.1.6-8**.

TABLE 4.1.6-8 SAMPLE SIZE PER SURVEY LOCATION

Survey Station (Terminal)	Sample	Share (%)
Festival Mall (Alabang)	44	27.3%
Star Mall (Alabang)	36	22.4%
Metro Point (EDSA)	20	12.4%
Taft Ave.	20	12.4%
Baclaran	41	25.5%
Total	161	100.0%

- ***Age Distribution***

For age distribution of driver respondents, having the highest share are belong to age bracket of 30-39 (43.5%) and 40-49 (38.5%).

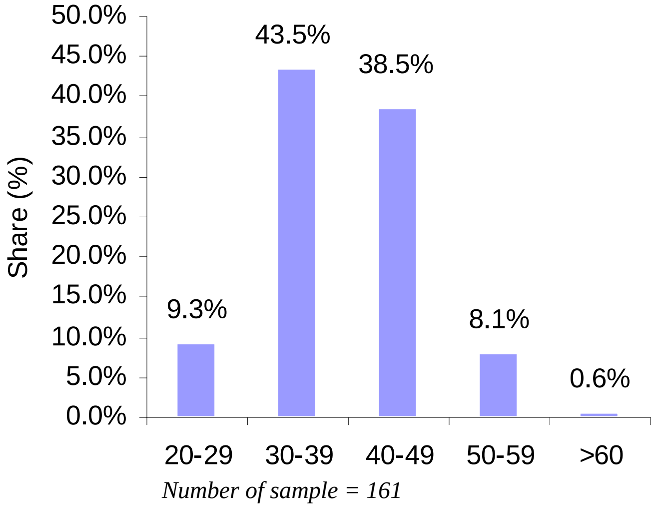
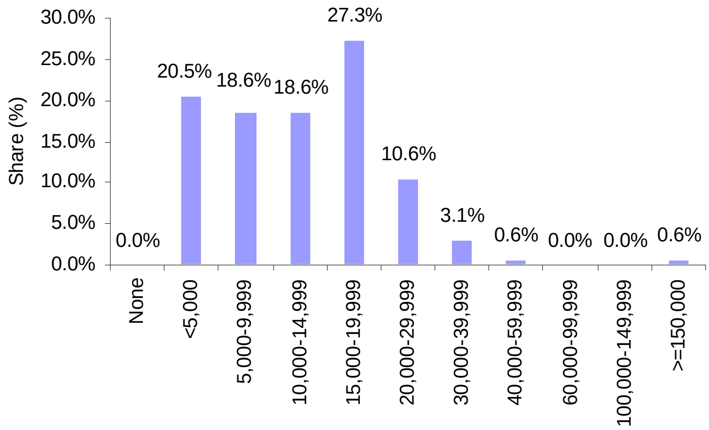


FIGURE 4.1.6-20 AGE DISTRIBUTION

- ***Monthly Income Distribution***

For monthly income, 27% of the respondents have monthly income between 25,000 to 19,999 pesos. It is noted that there are substantial number of respondents whose income range from 5,000 to 14,999 pesos. Their total share is about 57%.

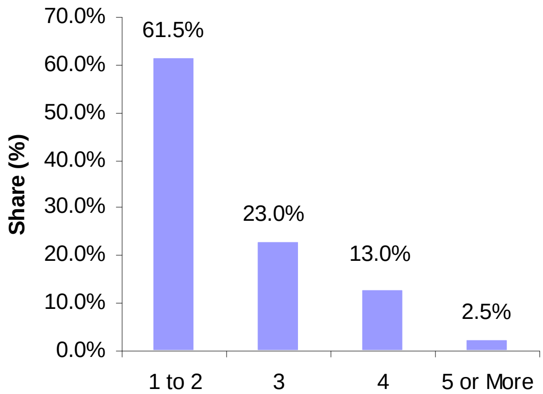


Number of sample = 161

FIGURE 4.1.6-21 MONTHLY INCOME DISTRIBUTION

- ***Trip Frequency***

For trip frequency, more than half of the respondents stated that they have 1 to 2 trips a day. Some drivers however managed to have 3 to 4 trips a day which might be due to short distance nature of their routes. (See **Figure 4.1.6-22**)



Number of sample = 161

FIGURE 4.1.6-22 FREQUENCY OF TRIPS

- ***Expressway in Use***

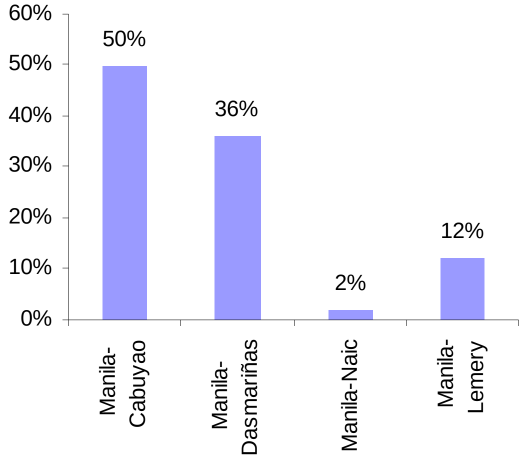
Table 4.1.6-9 shows that most of the captured respondents revealed that they are plying through South Luzon Expressway (SLEX) and followed by drivers using the Manila-Cavite Coastal Expressway. Likewise, 2.5% respondents stated that despite the presence of expressway in their route, they prefer not to use the expressway.

TABLE 4.1.6-9 EXPRESSWAY IN USE

Expressway	Sample	Share (%)
Coastal Expressway	43	26.7%
SLEX	102	63.4%
I don't use expressway	4	2.5%
My route is not served by expressway	12	7.5%
Total	161	100.0%

- ***Trip Origin – Destination (Trip Routes)***

For routes served by these FX operators, half of the respondents are plying the Manila-Cabuyao (Laguna province). Next having the highest share are drivers serving the Manila-Dasmarinas (Cavite province) route. The remaining drivers served the Manila-Naic route (Cavite province), and Manila-Lemery (Batangas province). (See **Figure 4.1.6-23**)



Number of sample = 161

FIGURE 4.1.6-23 TRIP OD

- ***Willingness-to-pay and Amount willing to pay***

The same procedure carried out with car user's interview survey was applied for FX operator's willingness-to-pay survey. The FX drivers were then given with the following scenarios:

TABLE 4.1.6-10 ROUTE SCENARIOS AND AMOUNT OF WILLINGNESS-TO-PAY

Route Scenario	Time Save (min)	Use expressway or not?	If yes, how much willing to pay?
a. From A to D	60		
b. From B to A	15		
c. From B to D	45		
d. From C to B	15		
e. From C to D	30		

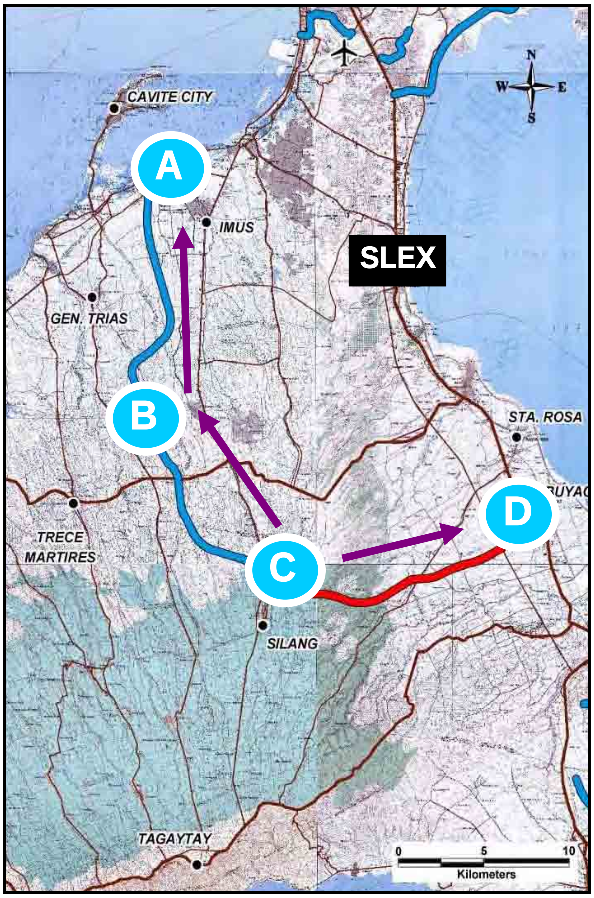
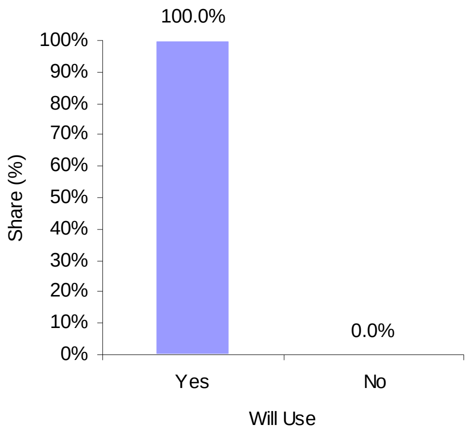


FIGURE 4.1.6-24 ROUTE SCENARIOS

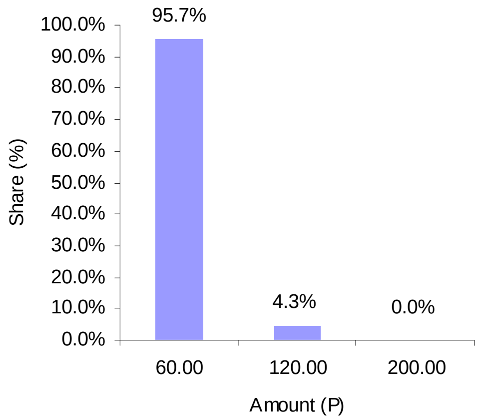
The response of FX drivers is presented from **Figure 4.1.6-25** to **Figure 4.1.6-34**. All 161 FX operators signified their intention to use the CALA expressway if this will be built in future. Pressed for their reasons for their willingness to use the tolled expressway, most of them believed that using expressway would increase their income by means of increased number of trips. It should be noted that currently, most of them are having just 1 to 2 trips a day.

- ***Will they Use CALA Expressway for A to D travel? Time Save is about 60 minutes.***



Number of sample = 161

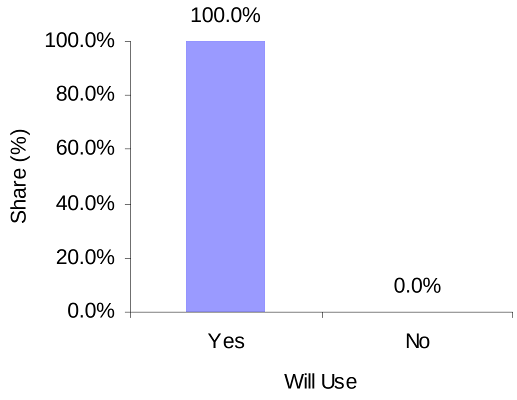
FIGURE 4.1.6-25 SHARE OF THOSE WHO WILL USE AND NOT USE THE EXPRESSWAY



Number of sample = 161

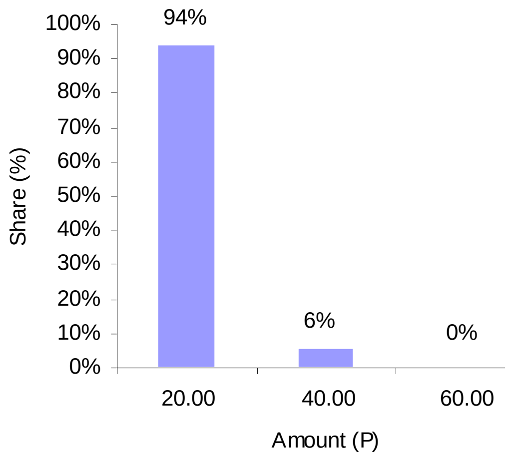
FIGURE 4.1.6-26 AMOUNT WILLING TO PAY

- ***Will they Use CALAX Expressway for B to A travel? Time Save is about 15 minutes.***



Number of sample = 161

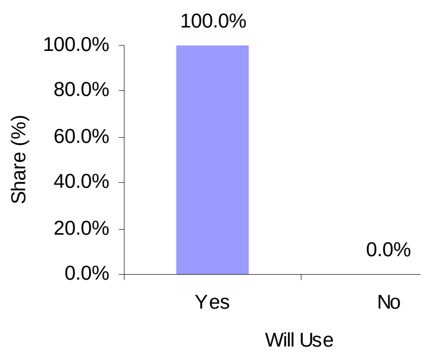
FIGURE 4.1.6-27 SHARE OF THOSE WHO WILL USE AND NOT USE THE EXPRESSWAY



Number of sample = 161

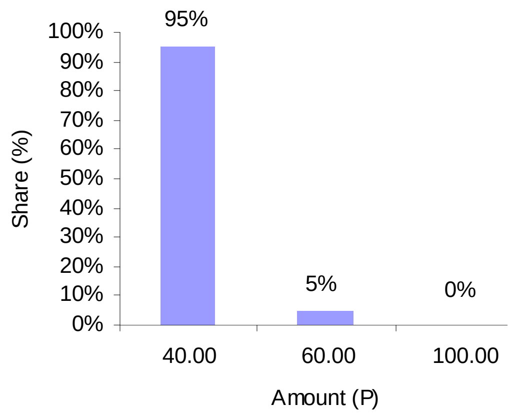
FIGURE 4.1.6-28 AMOUNT WILLING TO PAY

- ***Will they Use CALAX Expressway for B to D travel? Time Save is about 45 minutes.***



Number of sample = 161

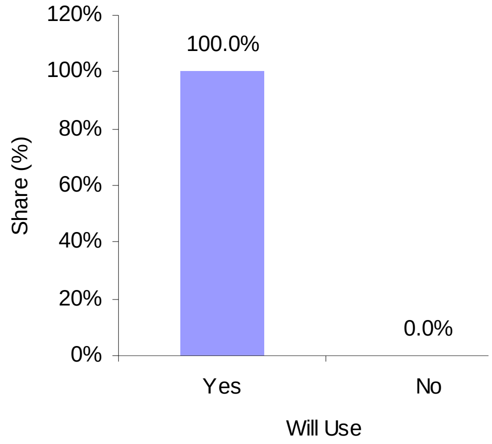
FIGURE 4.1.6-29 SHARE OF THOSE WHO WILL USE AND NOT USE THE EXPRESSWAY



Number of sample = 161

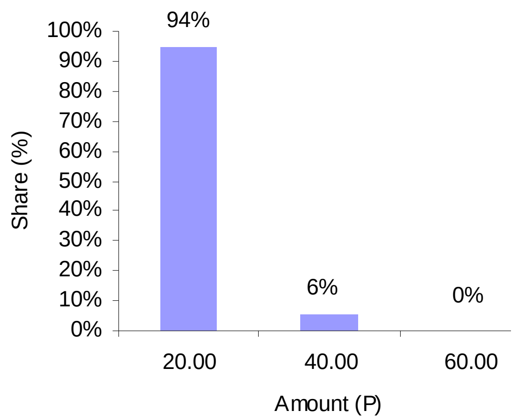
FIGURE 4.1.6-30 AMOUNT WILLING TO PAY

- ***Will they Use CALAX Expressway for C to B? Time Save is about 15 minutes.***



Number of sample = 161

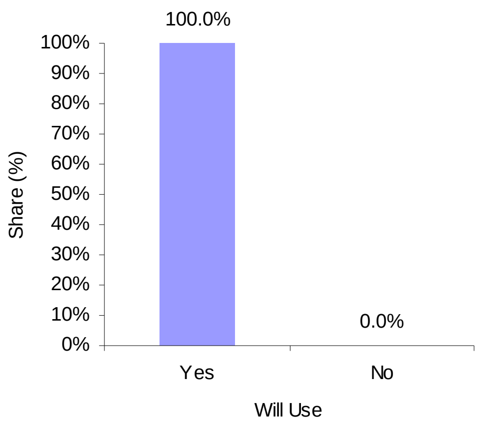
FIGURE 4.1.6-31 SHARE OF THOSE WHO WILL USE AND NOT USE THE EXPRESSWAY



Number of sample = 161

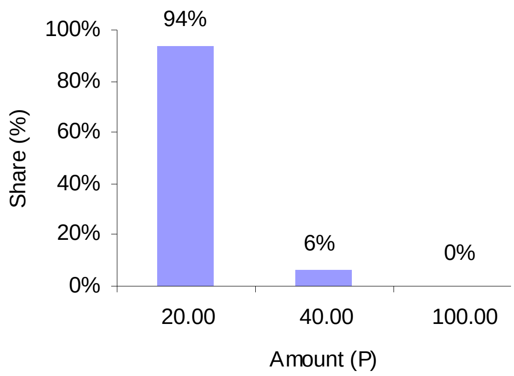
FIGURE 4.1.6-32 AMOUNT WILLING TO PAY

- ***Will they Use CALAX Expressway for C to D travel? Time Save is about 30 minutes.***



Number of sample = 161

FIGURE 4.1.6-33 SHARE OF THOSE WHO WILL USE AND NOT USE THE EXPRESSWAY



Number of sample = 161

FIGURE 4.1.6-34 AMOUNT WILLING TO PAY

4.1.7 Willingness to Pay Survey for Use of CALAX (Bus Operators)

a. How many buses you owned? (Q5)

The number of bus owned and used for operation by the ten (10) bus companies interviewed is presented in **Table 4.1.7-1**. The total number of bus used by theses ten (10) bus companies is 1,013 bus unit or an average of 101 buses per company. Taking into account the share of each type of bus, 60% are composed of two-seater air-conditioned bus and this followed by others (2x3 bus which means five seats in one row all together) with share of 28.7%. Ordinary busy has a share of 10.3% and mini-bus with merely 0.2%.

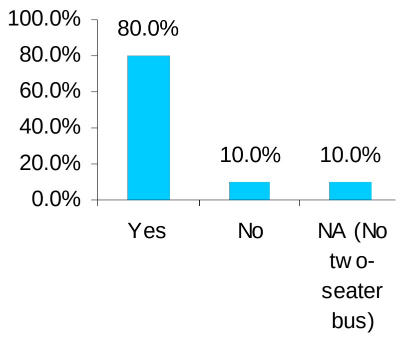
TABLE 4.1.7-1 NUMBER OF BUS OWNED BY BUS COMPANIES

Bus Type	BC 1	BC 2	BC 3	BC 4	BC 5	BC 6	BC 7	BC 8	BC 9	BC 10	Total
Mini-bus								2			2
Ordinary bus			54			50					104
Air-conditioned bus (single-seater)											
Air-conditioned bus (two-seater)	200			150		120				146	616
Others (2x3)		86	12		38		20	35	100		291
Total	**200**	**86**	**66**	**150**	**38**	**170**	**20**	**37**	**100**	**146**	**1,013**

Note: BC = Bus Company

b. Do you allow your two-seater bus drivers to use expressways? (Q7)

Most of the managers of bus companies interviewed revealed that they allowed their drivers to use expressway during their trip. Only 10% of interviewed managers said that they don't allow their drivers to use the expressway.



No. of sample = 10

FIGURE 4.1.7-1 BUS MANAGERS RESPONSE IF THEY ALLOW OR NOT THEIR BUS DRIVERS TO USE AN EXPRESSWAY

c. Willingness-to-pay Survey Results (Part III)

- (A to D) Most of the respondents (80%) will not shift to expressway from A to D. Only 20% will allow their drivers to use the expressway. All of the interviewed managers that would allow their bus drivers to use expressway revealed that they are willing to pay 200 pesos.

- (B to A) The percentage of those willing to use the expressway rose to 30% for B to A section. This section covers Manila – Dasmarinas. Preferred amount of toll fee they are willing to pay is 60 pesos.

- (B to D) This section generally covers Dasmarinas – Tres Martires – Silang area, the percentage of those willing to use expressway for fee is still 30%. All of them expressed their readiness to pay 60 pesos as toll fee.

- (C to B) This section covers Silang – Dasmarinas and the number of willing to use the expressway is still 30%. The preferred toll fee amount of those who expressed their willingness to use the expressway is 60 pesos.

- (C to D) This section is from Silang area to SLEX and the number of willing to use the expressway increases to 40%. All of them expressed 80 pesos as preferred amount of toll fee.

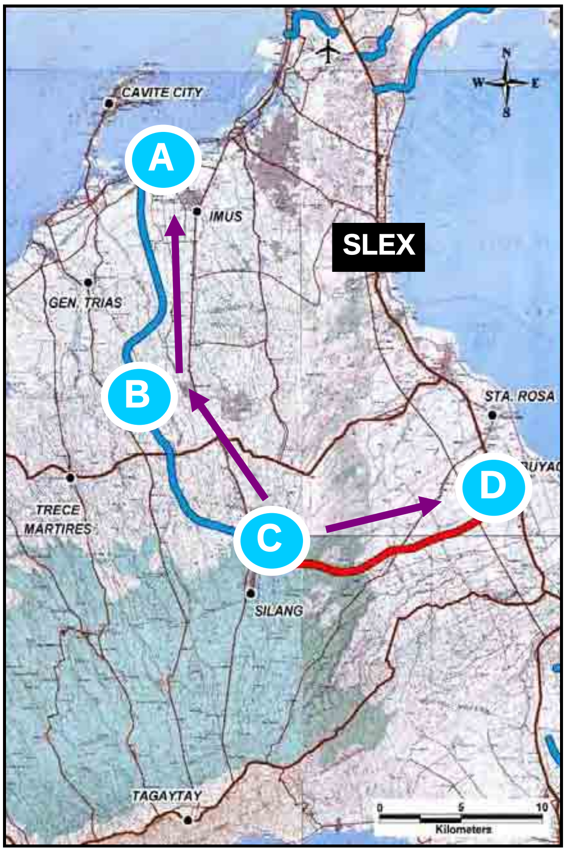
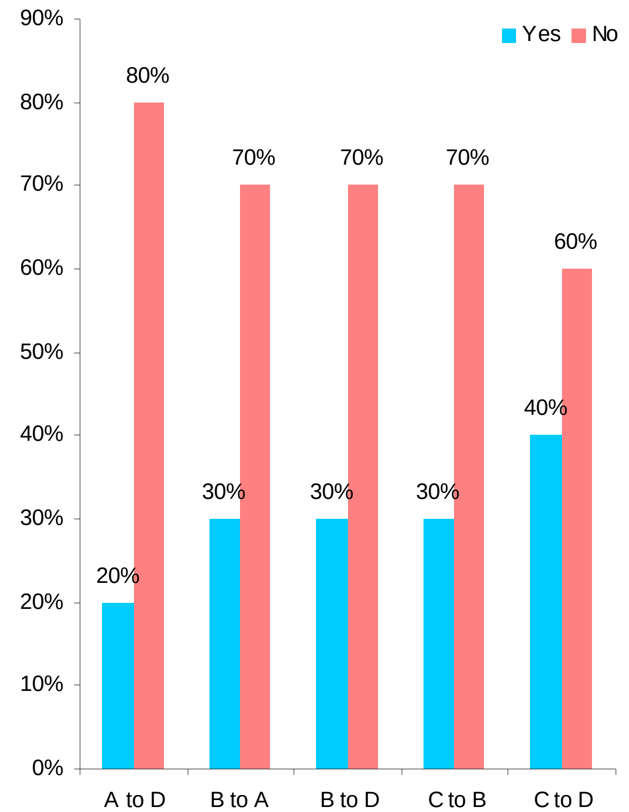


FIGURE 4.1.7-2 CALA EXPRESSWAY



No. of sample = 10

FIGURE 4.1.7-3 WILLING TO USE CALA EXPRESSWAY

By observing bus routes captured in the survey, it seems that one of the reasons why some bus operators are not inclined to use CALAX expressway is because it is not serving their routes (e.g. buses plying Manila – Laguna route and Manila – Batangas route are using SLEX). Another reason of their rejection of expressway use is they want to continue their practice of picking up/discharging passengers along the highways which they could not do so in an expressway. See **Table 4.1.7-2** for percentage share of willing to use the expressway and amount they are willing to pay.

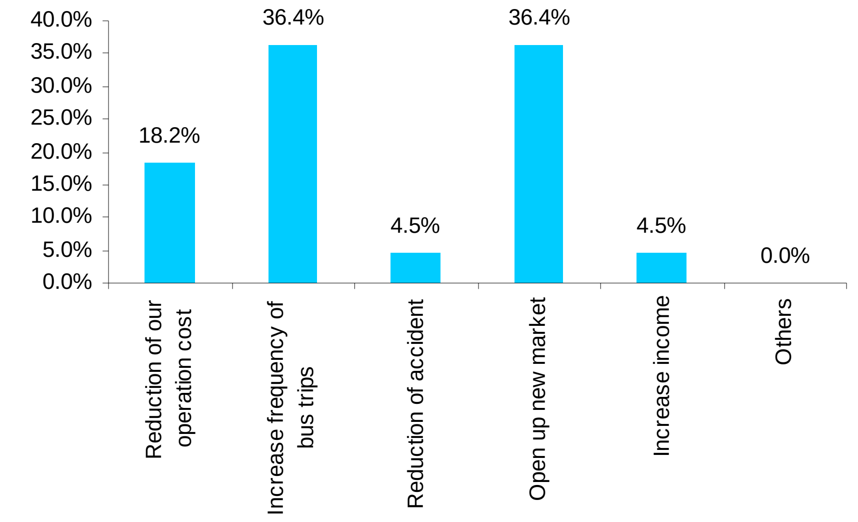
The C to D section of CALAX serves the attractive route of Manila-Tagaytay by linking Aguinaldo Highway to SLEX thus bypassing congested portion of highway in Dasmarinas City, Imus Municipality, Bacoor City all the way to Quirino Avenue in Manila. Tagaytay is a top tourist attraction of the country and known for beautiful landscape and cooler climate but suffering from poor access provided by the Aguinaldo Highway. This might be the main reason of high number of bus operators willing to use expressway from C to D section even if toll fee is as high as 80 pesos (4 out of 10 bus operators).

TABLE 4.1.7-2 AMOUNT OF FEE THEY ARE WILLING TO PAY

Route Scenario	Time Save (min)	Toll Fee					
		Amount (P)	Share	Amount (P)	Share	Amount (P)	Share
A to D	60	200	100%	250	0%	300	0%
B to A	15	60	100%	80	0%	100	0%
B to D	45	60	100%	80	0%	100	0%
C to B	15	60	100%	80	0%	100	0%
C to D	30	80	100%	100	0%	150	0%

d. *Perceived Benefits by Bus Managers from CALAX (Q14)*

If the expressway is constructed in the future, managers of bus companies were asked if what kind of benefits that this new infrastructure can bring to their business. Most managers believed that the new expressway would increase the frequency of their buses (36.4), open up new market (36.4%), reduction of operation cost (18.2%). Some believed that it would help in reduction of accident (4.5%) as well it would somehow contribute to increase their income (4.5%). (See **Figure 4.1.7-4**)



No. of sample = 10

FIGURE 4.1.7-4 PERCEIVED BENEFITS BY BUS OPERATORS FROM CALAX

e. *Problems Encountered by Bus Company in their daily operations. (Q15)*

Interviewed operation managers of ten (10) bus companies reveal the following as the problems they encountered:

- Traffic congestion – mentioned by the 10 bus managers as serious problem which affect their operations
- Problem with law enforcers – this relates to corrupt practices of some personnel of the government agencies like MMDA, LTO, etc.
- Fuel price hike
- Traffic accidents

f. Comments and Suggestions to Improve Business Operation of Bus Industry. (Q16)

The following were the comments and suggestions expressed by the interviewed bus managers' which could help improve their operation.

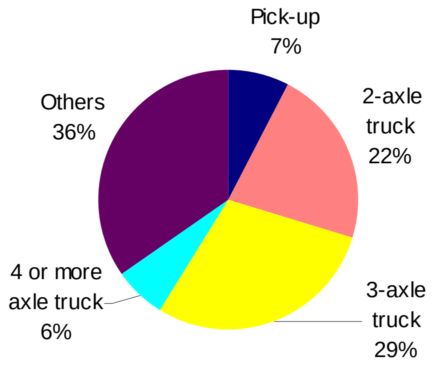
- Improve road infrastructure by construction of more roads and widening of existing roads
- Improve traffic management system to improve traffic condition
- Reduce toll fee
- Give special discount for frequent expressway users
- Lower fuel cost

4.1.8 Willingness to Pay Survey for Use of CALAX (Truck Operators)

a. How many vehicles used for operation? (Q5)

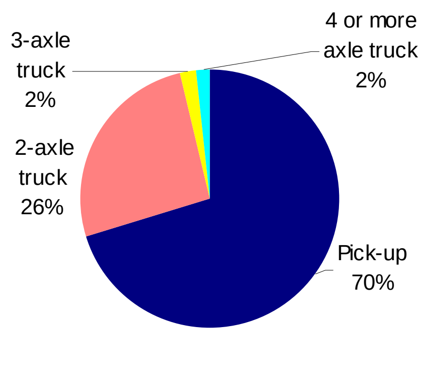
The average number of trucks owned by each company is about 13 trucks. Likewise, average number of trucks rented by each company is about 3 trucks. In total, each company is utilizing 16 trucks for their operation.

For type of trucks used by these companies (owned), the dominant types are: 3-axle trucks (29%), 2-axle trucks, and other type of vehicles (e.g. vans, pick-up, canter). For trucks leased by these companies, more than half is composed of pick-up.



No. of sample = 20

FIGURE 4.1.8-1 OWNED

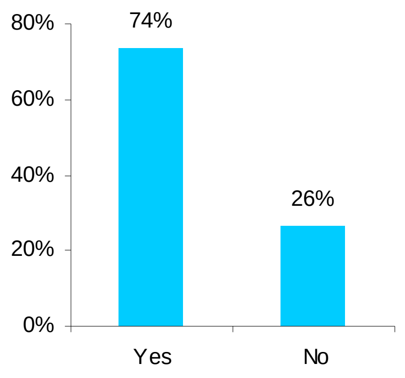


No. of sample = 20

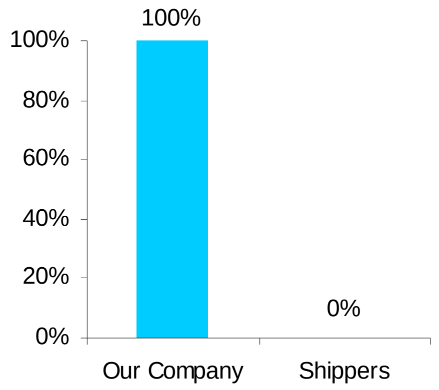
FIGURE 4.1.8-2 RENTED

b. Do you allow your drivers to use expressways? (Q6)

When the truck company managers were asked if they allow their drivers to use expressway in their trips, 74% revealed that they allow them. The remaining 26% said that they don't allow their bus drivers to use expressway. For the issue of toll fee, all interviewed managers said that their company is the one shouldering the toll fee.



No. of sample = 20



No. of sample = 20

FIGURE 4.1.8-3 YES OR NO **FIGURE 4.1.8-4 WHO PAY FOR TOLL FEE**

c. Willingness-to-pay Survey Results?

- (A to D) This section covers the entire section of CALA Expressway. The number of truck managers which would allow their drivers to use the expressway reaches 75%. All of the truck managers pointed out that the amount they are willing to pay is 200 pesos.

- (B to A) The share of willing to use expressway is still the same at 75%. Most of them are willing to pay 60 pesos (93%) while some are willing to pay 80 pesos (7%)

- (B to D) The number of willing to use the expressway is very high at 85%. Most of them are willing to pay 60 pesos (94%) and the remaining 6% is willing to pay as high as 100 pesos.

- (C to B) This section covers Silang – Dasmarinas and the number of willing to use the expressway is 65%. All of them expressed their readiness to pay 60 pesos as toll fee.

- (C to D) This section is from Silang area to SLEX and the number of willing to use the expressway increases to 85%. Most of the truck managers (94%) revealed that they are willing to pay 80 pesos and the remaining 6% are willing to pay 100 pesos.

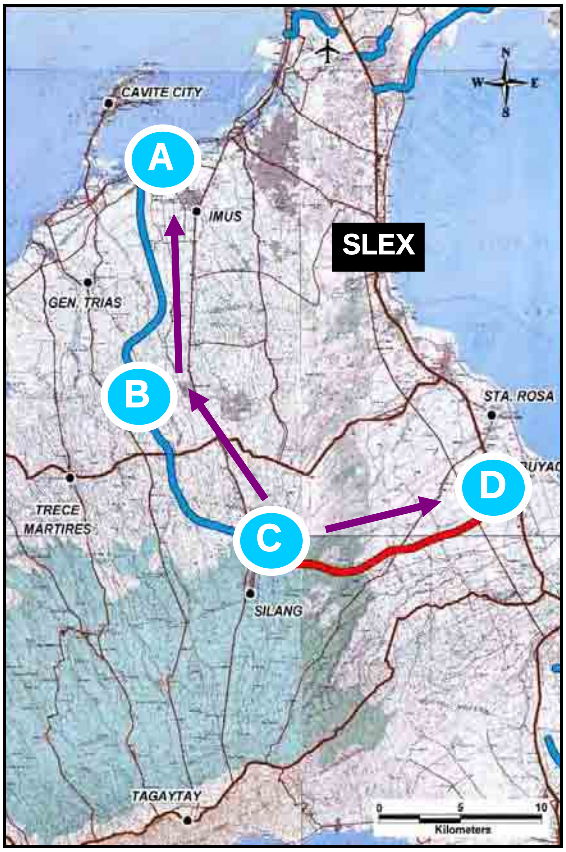


FIGURE 4.1.8-5 CALA EXPRESSWAY

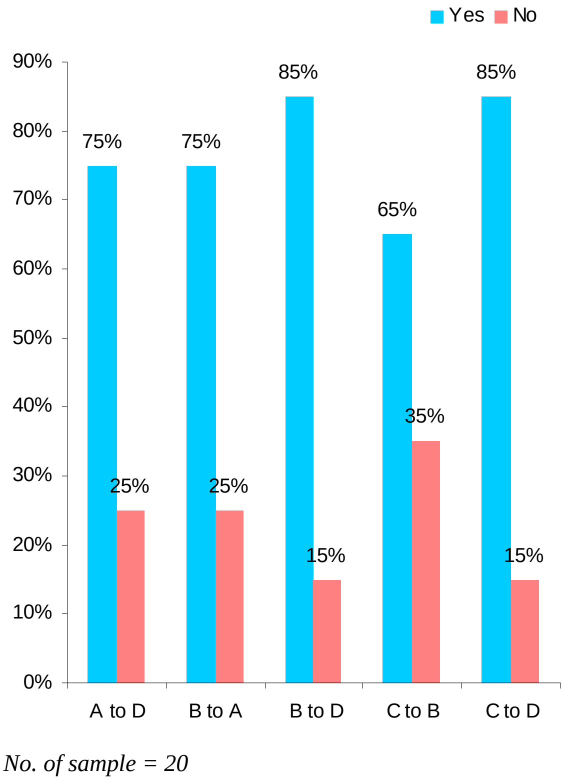


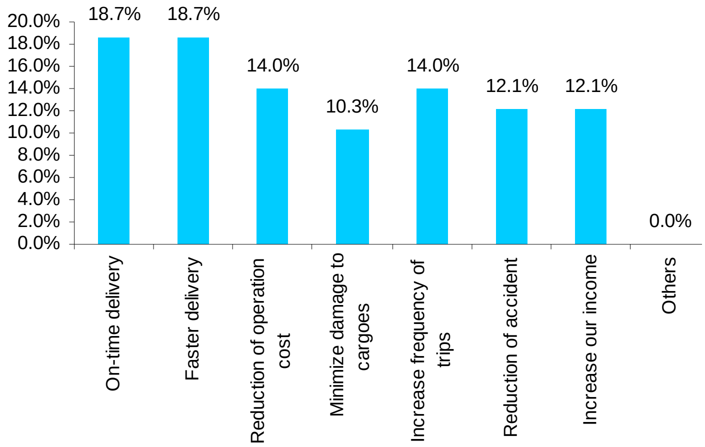
FIGURE 4.1.8-6 WILLING TO USE CALA EXPRESSWAY

TABLE 4.1.8-1 AMOUNT OF FEE THEY ARE WILLING TO PAY

Route Scenario	Time Save (min)	Toll Fee					
		Amount (P)	Share	Amount (P)	Share	Amount (P)	Share
A to D	60	200	100%	250	0%	300	0%
B to A	15	60	93%	80	7%	100	0%
B to D	45	60	94%	80	0%	100	6%
C to B	15	60	100%	80	0%	100	0%
C to D	30	80	94%	100	6%	150	0%

d. *Benefits from Expressway? (Q14)*

Truck managers were asked if what kind of benefits CALA Expressway can bring to their business. Most managers believed that it would help them to deliver their cargo on time (18.7%) and they can realize faster delivery of cargo (18.7%). They also expect reduction of operation cost (14.0%) as well as increase in frequency of trips (14%). Other expected benefits derived from the construction of expressway are: reduction of accident (12.1%), increase of income (12.1%) and minimize damage to cargoes (10.3%).



No. of sample = 20

FIGURE 4.1.8-7 PERCEIVED BENEFITS BY TRUCK OPERATORS FROM CALAX

e. Problems Encountered in their operations? (Q15)

The common problems mentioned by the twenty (20) managers of trucking companies are:

- Heavy traffic congestion particularly access roads to ports and along R-10
- Truck ban
- Road repair
- Traffic accident mainly due to flat tire
- Harassment of MMDA/LTO personnel in a hope of receiving money
- Complains from customers due to delay of delivery
- High toll fees
- Robbery and hold-up particularly at Parola area of MICP (Manila International Container Port)
- Increase in transport operation (increase of gas, oil, salary for overtime, etc)

f. Comments that could improve their business operations? (Q15)

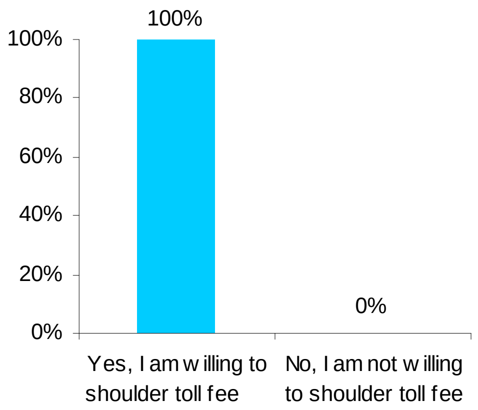
The most following were comments made by the managers of trucking companies:

- Privatize traffic management to improve traffic flow
- Add lights along busy roads
- Proper planning of exit/entrance of trucks at MICT and South Harbor.
- Government should issue a policy to ask all municipalities to stop collecting annual fees to all truckers
- Extend x-ray time of loaded containers from 8pm to 6am instead of 8pm to 12 midnight at international port.
- Lower toll fee
- Improve road network to have more alternative routes
- Try to reduce traffic congestion
- Increase road widening
- Construction of more roads, enforcement of road regulations and laws, honest law enforcement personnel, improve road signage and its visibility to drivers and reasonable toll fees.
- Improve port facility

4.1.9 Willingness to Pay Survey for Use of CALAX (Manufacturing Companies)

a. Are you willing to shoulder the toll fee of Expressway?(Q7)

The eighteen (18) manufacturing companies interviewed revealed that they are willing to shoulder the toll fee if this can help their cargoes to arrive faster. (See **Figure 4.1.9-1**) This willingness fee by the company managers to pay expressway toll fee demonstrates their growing concern for delayed delivery of their cargoes which essentially affect their business operations.

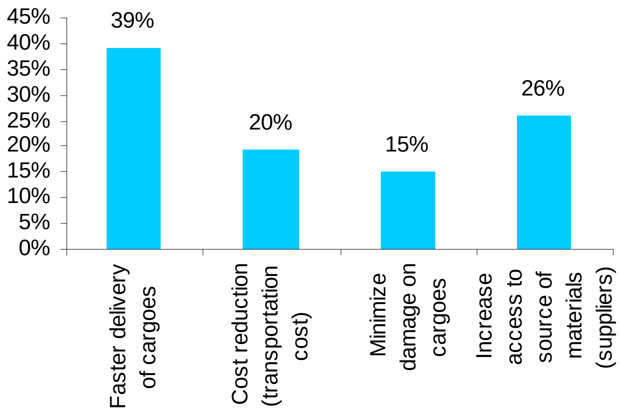


Number of sample =18

FIGURE 4.1.9-1 PERCENTAGE OF WILLING AND NOT WILLING TO SHOULDER TOLL FEE

b. Benefits from CALAX (Q8)

For the benefits they are hoping to get after the construction of expressway, these are: faster delivery of cargoes (39%), increase access to source of materials (26%), transport cost reduction (20%) and minimize damage on their cargoes (15%).



No. of sample = 18

FIGURE 4.1.9-2 PERCEIVED BENEFITS BY MANUFACTURING COMPANIES FROM CALAX

c. Plans after construction of CALA Expressway (Q9)

The plans after the construction of CALA expressway revealed by interviewed officials of manufacturing companies are:

- We will meet with the forwarders to discuss the merit and demerit of using the new constructed expressway.
- We will meet with the forwarders/trucking companies regarding the possibility of additional cost/charges for the use of expressway.
- We are going to use the expressway in finding new market or find new client in Cavite area.
- We will instruct our drivers to take this expressway to avoid delay in deliveries.
- We will reduce our inventory stock level
- We will negotiate delivery cost with forwarders/trucking companies
- If travel time decrease because of the use of expressway, we will request supplier to decrease delivery charges on raw materials

d. Problems Encountered by Manufacturing Companies (Q10)

The problems mentioned by the officials of manufacturing companies are:

- Delayed/late delivery due to traffic congestion even at expressways
- Road repair works affect delivery of our products and sometimes even our staff arrival to work were delayed.
- Abrupt increase of toll fee in the expressway
- Increase of price of raw material and fuel which causes increase of our production output
- Tight delivery schedule due to tight schedule of our production operation and urgency to produce the products ordered to us by the client.

e. Comments by Manufacturing Companies (Q11)

The following were comments made by officials of manufacturing companies:

- Improve traffic enforcement along ordinary and national roads
- This expressway project will help all the investors since it will improve the delivery of cargoes on time and would provide easy access to our material suppliers.
- We will support construction of new expressway.
- It would be better if road construction/repair will be done during night time, and make it sure that the workers will not leave the “repaired portion” in unsafe condition.
- Possibly improve and/or expand fiscal incentives to export oriented companies.

f. Summary of Transportation Routes of Manufacturing Companies

Out of eighteen (18) manufacturing companies interviewed in Cavite province (10 Japanese affiliated-companies and 8 partly foreign-owned companies), thirteen (13) companies are located in an area where they can be served by CALA expressway (the other five answered “not use CALA Expressway” because they are located along the coastal towns of Cavite and some are located close enough to SLEX). All these 13 companies expressed their readiness to utilize the CALAX if it is constructed in future. On the other hand, two companies close to SLEX will continue to use this expressway while the three companies in coastal towns of Cavite will continue to use local roads and Manila-Cavite expressway. Below is the discussion on each company that will utilize CALAX. See **Figure 4.1.9-3** for the summary of their transportation routes.

1. Manufacturing Company A (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of aluminum extrusion and hardware for Al & PVC Frames

- Raw materials (aluminum frames and plastic injection parts) come from foreign countries. These materials are unloaded via ports in Manila.
- From ports in Manila, these will be brought to the factory in Dasmarinas via SLEX then Governor's Drive.
- Transportation time from ports in Manila to factory is around 4 to 5 hours.
- Production outputs (extrusion and hardware) are then sent abroad via ports of Manila.
- Transportation time from factory to Manila ports in Manila is about 4 to 5 hours.
- ***If CLLEX is constructed, the company is planning to use it to avoid heavy traffic congestion along Governor's Drive and to reduce transportation time.***

2. Manufacturing Company B (Japanese Company)

Location: General Trias, Cavite
Products: Producers of Connector Parts, Plastic Molding Parts, LED, Tool Parts, Lead frames

- The company is delivering their outputs in Paranaque, Rosario (Cavite), Binan (Cavite), and Lipa (Bantangas).
- From factory (Gen. Trias) to Paranaque, route is Aguinaldo Highway which is very congested and it takes them about two (2) hours to reach destination. If CALAX is constructed in the future, they intend to use the expressway to achieve fast delivery.
- From factory (Gen. Trias) to Binan (Laguna), they are using the Governor's Drive road until they reached Binan. ***If CALAX is constructed in the future, they intend to use the expressway to achieve fast delivery.***
- From factory (Gen. Trias) to Lipa, route is Governor's Drive, then follow the SLEX until Lipa City. If CALAX is constructed in the future, they intend to use the expressway instead of Governor's Drive to achieve fast delivery.

3. Manufacturing Company C (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of Fabricated Structures, Fabricated Transtainer Crane, Fabricated Engine Room Facility, Fabricated Wind Mill

- Steel materials are brought from different parts of Metro Manila to their factory in Dasmarinas, Cavite.
- They use SLEX and then take Governor's Drive until reaching the factory in Dasmarinas. It usually takes them three (3) hours.
- Finished products are brought back to different parts of Metro Manila using Governor's Drive and SLEX.
- ***If CALAX is constructed in the future, they intend to use the expressway in getting raw materials and delivering finished products to achieve fast delivery.***

4. Manufacturing Company D (Japanese Company)

Location: Rosario, Cavite
Products: Producers of plastic parts for car audio, automotive, weighing scale and Plastic protectors for wire harness

- Raw materials come from Binan (Laguna), Cabuyao (Laguna), and Velenzuela (Metro Manila). Currently, they are using C5 and Cavite Coastal Road to get supplies from Velenzuela. For supplies from Binan and Cabuyao, they are using Governor's Drive until they reached Rosario.
- ***If CALAX is constructed in the future, they intend to use the expressway instead of heavy congested Governor's Drive to achieve fast delivery.***

5. Manufacturing Company E (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of various plastic parts for car accessories; panel meter, visor upper, remote controls

- Some materials use for different products like paint are bought from Metro Manila and brought to the factory via SLEX and Governor's Drive. Transportation time is about three (3) hours.
- Finished products are then brought to Sta. Rosa (Laguna) via Governor's Drive and SLEX. Transportation time is about one (1) hour and thirty (30) minutes.
- ***If CALAX is constructed in the future, they intend to use the expressway instead of Governor's Drive to achieve fast delivery.***

6. Manufacturing Company F (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of Evaporator & Parts, Aluminum & copper ribes

- Raw materials (aluminum) come from foreign countries via ports of Manila. Raw materials are brought from Manila to factory in Dasmarinas via SLEX and Governor's Drive and it takes 2 to 3 hours to transport the materials.
- Finished products (evaporator) are brought back to port via the same route while other is brought to a factory located in Rizal Province.
- ***If CALAX is constructed in the future, they intend to use the expressway to avoid Governor's Drive which is heavily congested.***

7. Manufacturing Company G (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of fuel pump parts, tank covers, gear blanks, pipes

- Pipes come from foreign countries via ports of Manila. From port, this is transported to the factory in Dasmarinas via Aguinaldo Highway which takes almost three (3) hours.
- Finished products are then transported to factory houses for final packaging located in Sto. Tomas (Batangas), Calamba (Laguna), and Carmona Cavite.
- ***If CALAX is constructed in the future, they intend to use the expressway to avoid Governor's Drive which is heavily congested.***

8. Manufacturing Company H (Japanese Company)

Location: Dasmarinas, Cavite
Products: Producers of Halogen Lamps, Xenon Lamps, UV Lamps

- Raw materials arrived at NAIA and MICP. These will be brought to company factory in Dasmarinas via SLEX and Governor's Drive which would take them about two (2) hours.
- Finished products (Halogen lamps and Xenon lamps) are then sent back for export via NAIA and MICP using the same route.
- ***If CALAX is constructed in the future, they intend to use the expressway to realize shortest route and to avoid Governor's Drive which is heavily congested.***

9. Manufacturing Company I (Foreign-Owned Company)

Location: Rosario, Cavite
Products: Producers of S/S Fittings, S/S Flanges, S/S Pipes, S/S Carbon

- Raw materials arrived at Manila port are transported to the factory via regular route (Osmena Highway – Cavite Coastal Road).
- Finished products are then ship-out of the country via Manila port and using the same transportation route.
- Their route does not require the use of CALAX however ***they intend to use NAIAX and NLEX-SLEX connector if constructed in the future. These two expressways are useful to their route from Manila port to factory in Rosario.***

10. Manufacturing Company J (Foreign-Owned Company)

Location: Dasmarinas, Cavite
Products: Producers of air pumps and parts, electric magnet

- Raw materials come from Binan (Laguna) and Sto. Tomas (Batangas). Route is via SLEX and Governor's Drive.
- Finished products are ship-out abroad for export via Manila port. Route is Governor's Drive then SLEX until they reach Manila port.
- ***If CALAX is constructed, this company is planning to use this expressway in getting their raw materials from Sto. Tomas (Batangas) and in bringing their finished products to Manila port.***

11. Manufacturing Company K (Foreign-Owned Company)

Location: Rosario, Cavite
Products: Producers of Wires and Cables

- Raw materials come from foreign countries. These materials are unloaded via ports in Manila.
- From ports in Manila, these will be brought to the factory in Dasmarinas via Cavite Coastal Road.
- Finished products are brought to Sta. Rosa via Governor's Drive and transportation time is around two (2) hours.
- ***If CALAX is constructed, they intend to use the expressway in bringing their finished products to Sta. Rosa (Laguna).***

12. Manufacturing Company L (Foreign-Owned Company)

Location: Dasmarinas, Cavite
Products: Producers of assorted industrial fasteners

- Raw materials come Rosario (Cavite) and transported to factory in Dasmarinas via ordinary road which takes them about three (3) hours. Finished products are brought to three (3) locations: Lipa (Batangas), Sta. Rosa (Cavite) and Rosario (Cavite).
- ***If CALAX is constructed, they will utilize it especially in transporting their finished products to avoid delay.***

13. Manufacturing Company M (Foreign-Owned Company)

Location: General Trias, Cavite
Products: Producers of automobile parts

- Raw materials come from Sta. Rosa (Cavite) and brought to the factory in Gen. Trias via SLEX and Governor's Drive. Transportation time is about one (1) hour.
- Finished products are sent back to Sta. Rosa via the same route.
- ***If CALAX is constructed, they will utilize it in getting their supply from Sta. Rosa and in bringing back their finished products to Sta. Rosa.***

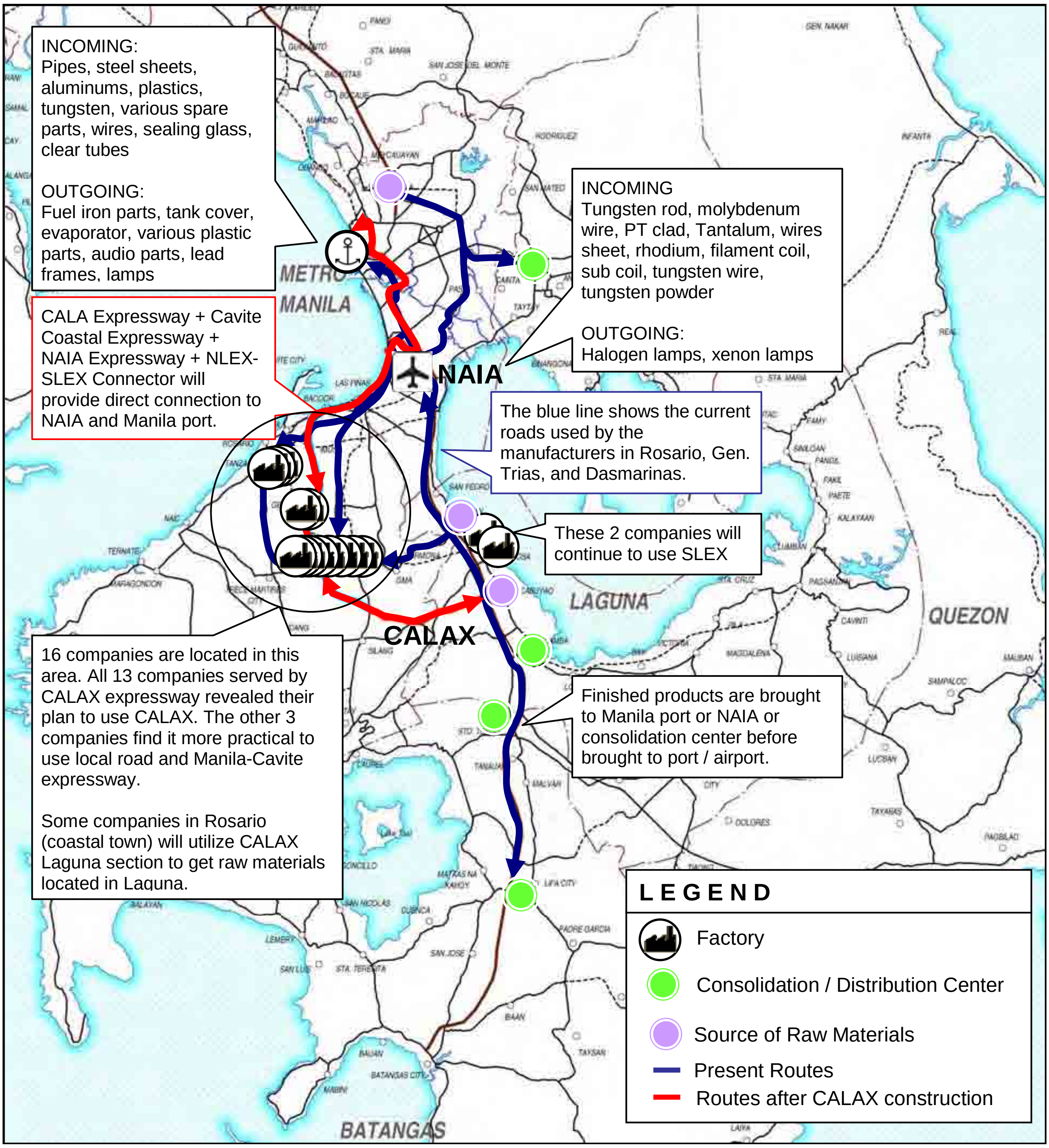


FIGURE 4.1.9-3 ROUTES PATTERN OF MANUFACTURING INDUSTRY IN CALAX

4.2 FUTURE TRAFFIC DEMAND

4.2.1 Approach

To estimate the traffic volumes on CALAX, traffic demand forecast was conducted. **Figure 4.2.1-1** shows the traffic forecast procedure.

(1) Present Traffic Assignment

Based on year 2009 OD tables prepared by the Study of Master Plan on High Standard Highway Network Development (herein HSH Study), present OD table was updated as year 2011. Traffic assignment was conducted using the updated present OD table and present network then validation was conducted the traffic count data and assigned traffic volume on each link.

(2) Future Traffic Assignment

After validation of present OD table, future traffic demand was forecasted. Future traffic assignment was conducted using future OD table and future road network (with CALAX case and without CALAX case) considering toll fare conversion to time.

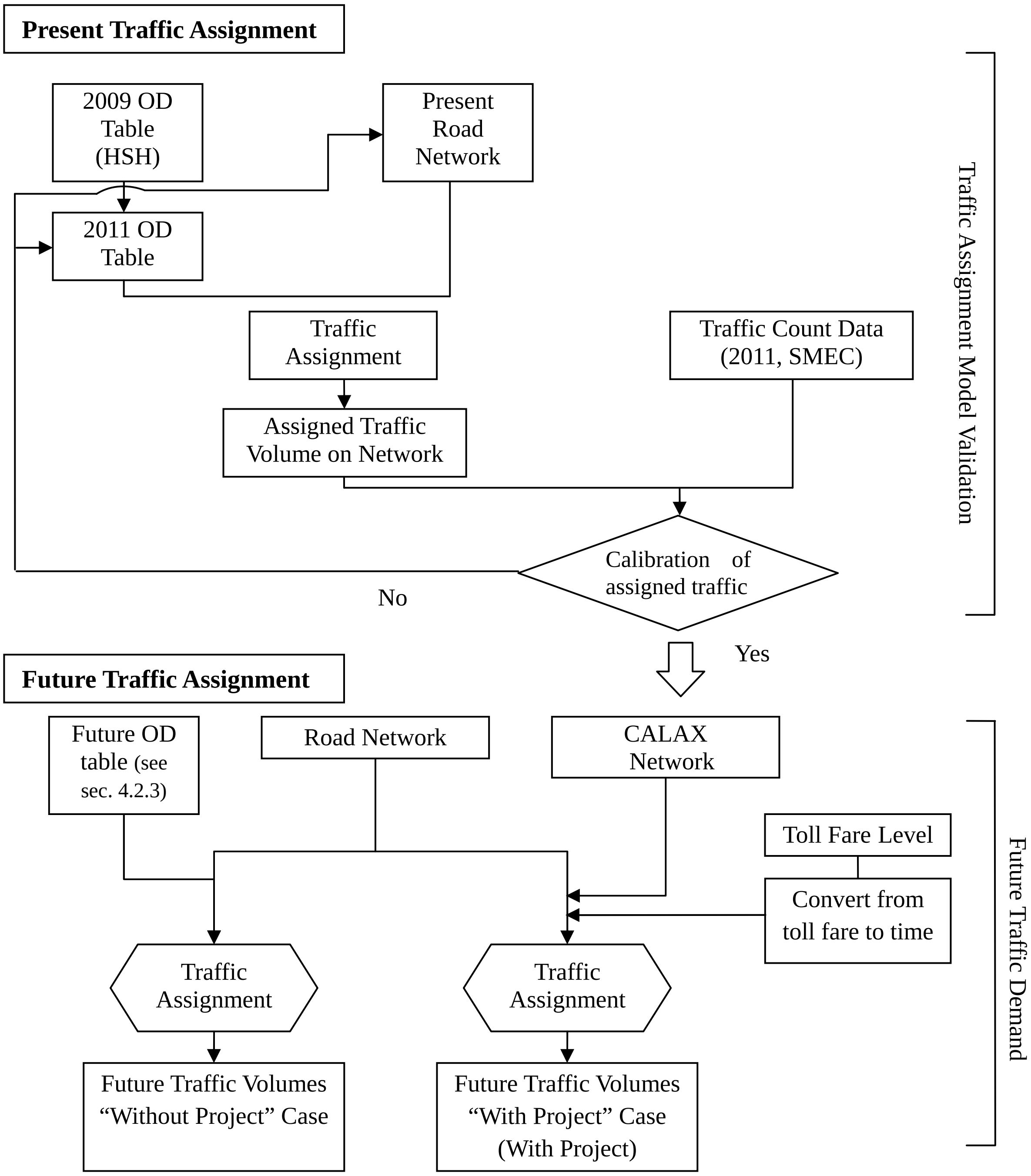


FIGURE 4.2.1-1 FORECAST OF TRAFFIC VOLUMES ON ROAD NETWORK

In this Study, the zoning system comprised of Region IV-A (Cavite, Laguna, Rizal, Batangas, etc.), NCR (Metro Manila). The zoning system is modified as divided zoning in the Study Area (Cavite and Laguna Provinces) using that of the HSH Study. The total zoning number is 206 zones, presented in **Figure 4.2.1-2** to **-4** and **Table 4.2.1-1(1)** to **(3)**.

TABLE 4.2.1-1 (1) TRAFFIC ZONING SYSTEM

Small Zone	Barangay	Medium Zone	City/Municipality	Large Zone	Province	Region
1	City of Manila 1 - Barangay 20	1	City of Manila	1	Metro Manila	NCR
2	City of Manila 2 - Barangay 105					
3	City of Manila 3 - Barangay 375					
4	City of Manila 4 - Barangay 48					
5	City of Manila 5 - San Nicolas					
6	City of Manila 6 - Binondo					
7	City of Manila 7 - Barangay 310					
8	City of Manila 8 - Quiapo					
9	City of Manila 9 - Barangay 413					
10	City of Manila 10 - San Miguel					
11	City of Manila 11 - Barangay 570					
12	City of Manila 12 - Barangay 450					
13	City of Manila 13 - Port Area					
14	City of Manila 14 - Intramuros, Ermita					
15	City of Manila 15 - Paco					
16	City of Manila 16 - Malate					
17	City of Manila 17 - Santa Ana					
18	City of Manila 18 - Barangay 601					
19	City of Manila 19 - Pandacan					
20	Pasay City 1 - Barangay 46	2	Pasay City			
21	Pasay City 2 - Barangay 132					
22	Pasay City 3 - Barangay 183					
24	Pasay City 4 - Barangay 1					
82	Pasay City 5 - Barangay 76					
23	Parañaque City 1 - Don Bosco	3	Parañaque City			
25	Paranaque City 2 - Baclaran					
84	Parañaque City 2 - Sun Valley, San Martin De Porres					
85	Parañaque City 3 - Marcelo Green Village					
86	Parañaque City 4 - B.F. Homes					
92	Parañaque City 5 - San Isidro					
93	Parañaque City 6 - San Dionisio					
26	Makati City 1 - Bangkal, San Lorenzo	4	Makati City			
27	Makati City 2 - Palanan					
28	Makati City 3 - Olympia					
29	Makati City 4 - Guadalupe Viejo					
30	Makati City 5 - Bel-Air					
31	Makati City 6 - Rizal, Pembo					
34	Makati City 7 - Magallanes					
32	Santa Ana		Pateros			
33	Taguig 1 - Western Bicutan	5	Taguig			
81	Taguig 2 - Upper Bicutan					
83	Taguig 3 - Signal Village, Lower Bicutan					
35	Mandaluyong City 1 - Poblacion	6	Mandaluyong City			
36	Mandaluyong City 2 - Plainview					
37	Mandaluyong City 3 - Mauway					
39	Mandaluyong City 4 - Wack-wack Greenhills					
40	San Juan 1 - West Crame		San Juan			
41	San Juan 2 - Corazon de Jesus					
38	Pasig City 1 - Ugong	7	Pasig City			
78	Pasig City 2 - Santolan					
79	Pasig City 3 - Santa Lucia					
80	Pasig City 4 - Pinagbuhatan					
42	Quezon City 1 - Tatalon, Damayang Lagi	8	Quezon City			
43	Quezon City 2 - Santo Domingo (Matalahib)					
44	Quezon City 3 - Baesa, Sangandaan					
45	Quezon City 4 - Bagong Pag-asa					
46	Quezon City 5 - Pinyahan, (Trinoma/SM West)					
47	Quezon City 6 - Paltok, Del Monte					
48	Quezon City 7 - Kamuning					
49	Quezon City 8 - E. Rodriguez, Crame					
50	Quezon City 9 - Camp Aguinaldo					
51	Quezon City 10 - Kamias (East/West)					
52	Quezon City 11 - U.P. Campus					
53	Quezon City 12 - Pasong Tamo					
54	Quezon City 13 - Batasan Hills					
55	Quezon City 14 - Commonwealth					
56	Quezon City 15 - Payatas					
57	Quezon City 16 - North Fairview					
61	Quezon City 17 - Greater Lagro, Novaliches Proper					
62	Quezon City 18 - Tandang Sora					
75	Quezon City 19 - Pansol, Loyola Heights					
77	Quezon City 20 - White Plains, Libis (Eastwood)					
58	Kalookan City (North) 1 - Barangay 178	9	Kalookan City (North)			
59	Kalookan City (North) 2 - Barangay 176					
60	Kalookan City (North) 3 - Barangay 171					
63	Valenzuela City 1 - Ugong	10	Valenzuela City			
64	Valenzuela City 2 - Canumay, Maysan					
65	Valenzuela City 3 - Malinta					
66	Valenzuela City 4 - Malanday					
71	Valenzuela City 5 - Marulas					

TABLE 4.2.1-1 (2) TRAFFIC ZONING SYSTEM

Small Zone	Barangay	Medium Zone	City/Municipality	Large Zone	Province	Region
67	Malabon 1 - Concepcion	11	Malabon	1	Metro Manila	NCR
70	Malabon 2 - Potrero					
68	Navotas - North Bay Blvd South		Navotas			
69	Kalookan City (South) 1 - Barangay 12		Kalookan City (South)			
72	Kalookan City (South) 2 - Baranagay 132					
73	Kalookan City (South) 3 - Barangay 120					
74	Marikina City 1 - Concepcion Uno, Parang	12	Marikina City			
76	Marikina City 2 - Malanday					
87	Muntinlupa City 1 - Sucat		Muntinlupa City			
88	Muntinlupa City 2 - Alabang					
89	Muntinlupa City 3 - Putatan					
90	Las Pinas City 1 - Almanza (Uno, Dos)	13	Las Pinas City			
91	Las Pinas City 2 - B.F. International Village					
94	Las Pinas City 3 - Zapote					
97	Maliksi, Habay, Salinas	14	BACOOR	2	CAVITE	Region IV-A
98	Aniban, San Nicolas					
99	P.F Espiritu, Mambog					
100	Molino					
101	Poblacion		IMUS			
102	Alapan					
103	Malagasang, Anabu I-A/B, II-B to F					
104	Anabu I-C to I-G, II-A					
105			CAVITE CITY			
106	Tabon I, Sta Isabel		KAWIT			
107	Marulas, Toclong					
108			NOVELETA			
109		15	ROSARIO			
110	Tejero, Pinagtipunan		GENERAL TRIAS			
111	Pasong Camachile II, Tapia					
112	Buebavista, San Francisco					
113	Biclatan					
114	Amaya		TANZA			
115	Halayhay, Sahud Ulan					
116	Tres Cruses, Punta					
118	Molino, Palangue 3	16	NAIC			
119	Malainen Luma, Palangue 1 & 2					
147			GENERAL EMILIO AGUINALDO			
117		17	TRECE MARTIRES CITY (Capital)			
120	San Agustin I, Luzviminda II		DASMARIÑAS			
121	Paliparan II & III, Salawag					
122	Langkaan I, Sampaloc					
123	Litlit, Tabuan, Malaking Tatyao	18	SILANG			
124	Maguyam, Carmen, Iba, Tibig					
125	Munting Ilog, Ihican, Putting Kahoy					
126	Tartaria, Pooc II, Pulong Bunga					
127	Balubad, Balite I, Ulat					
129			GEN. MARIANO ALVAREZ			
130			CARMONA			
148			AMADEO			
149			ALFONSO			
150			TAGAYTAY CITY			
128		19	SAN PEDRO	3	LAGUNA	
131	San Francisco (Halang)		BIÑAN			
132	Canlalay, Sto Tomas (Calabuso)					
133	Bungahan, Loma					
134	Malamig, Mamplasan					
135	Balibago		CITY OF SANTA ROSA			
136	Pulong Sta Cruz, Malitlit					
137	Don Jose					
138	Sto Domingo					
139	Sala, Banaybanay	20	CABUYAO			
140	Diezmo					
141	Pittland, Casile					
142	Mapagong, Mayapa, Prinza		CITY OF CALAMBA			
143	Halang, Turbina, Tulo, Makiling					
144	Kay-Anlog, Barandal, Palo Alto, Burol					
145	Canlubang					
146			BAY			
151		21	SANTA MARIA			
152			MABITAC			
153			FAMY			
154		22	KALAYAAN			
155			CAVINTI			
146		23	LILIW			
157			PAGSANJAN			
158		24	ALAMINOS			
159	Del Remedio		SAN PABLO CITY			
160	Santisimo Rosario					
161	San Francisco					
162	Santo Angel					

TABLE 4.2.1-1 (3) TRAFFIC ZONING SYSTEM

Small Zone	Barangay	Medium Zone	City/Municipality	Large Zone	Province	Region
163		25	BALAYAN	4	BATANGAS	Region IV-A
164			AGONCILLO			
165			LAUREL			
166		26	CITY OF TANAUAN			
167			SANTO TOMAS			
168			BALETE			
174	Marauoy		LIPA CITY			
175	Antipolo Del Norte					
176	Lodlod					
177	San Jose					
169		27	CUENCA			
173			ALITAGTAG			
170		28	PADRE GARCIA			
171			SAN JUAN			
172			LOBO			
178	Santa Rita Karsada	29	BATANGAS CITY (Capital)			
179	Gulod Itaas					
180	Libjo					
181	Pinamucan					
182		30	GENERAL NAKAR	5	QUEZON	
183			LUCBAN			
184		31	CITY OF TAYABAS			
189			LUCENA CITY (Capital)			
190			AGDANGAN			
185		32	SARIAYA			
186			CANDELARIA			
187			DOLORES			
188			SAN ANTONIO			
95		33		6	BULACAN	Region III
96				7	RIZAL	
191				8	BATAAN	
192				9	PAMPANGA	
193				10	TARLAC	
194				11	ZAMBALES	
195				12	NUEVA ECIJA	
196				13	AURORA	
197				14	PANGASINAN	Region I
198				15		CAR, Region I
199				16	ALL PROVINCE	Region IV-B
200				17	ALL PROVINCE	Region V
201	Port Terminal	34	City of Manila	1	Metro Manila	NCR
202	Ninoy Aquino International Airport Terminal 1	35	Pasay City			
203	Ninoy Aquino International Airport Terminal 2					
204	Ninoy Aquino International Airport Terminal 3					
205	Domestic Terminal					
206	Cargo Terminal					

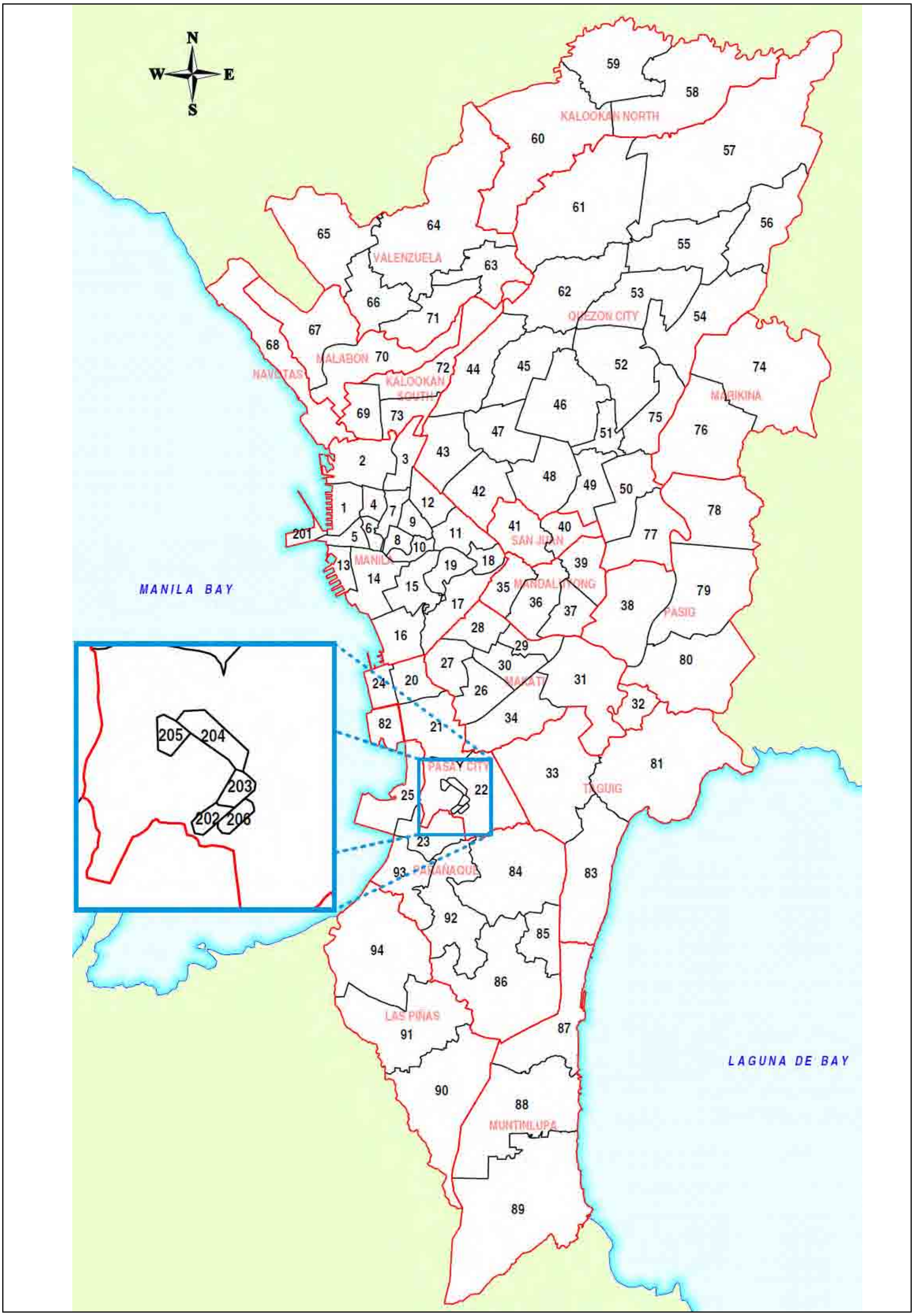


FIGURE 4.2.1-2 ZONING MAP – METRO MANILA

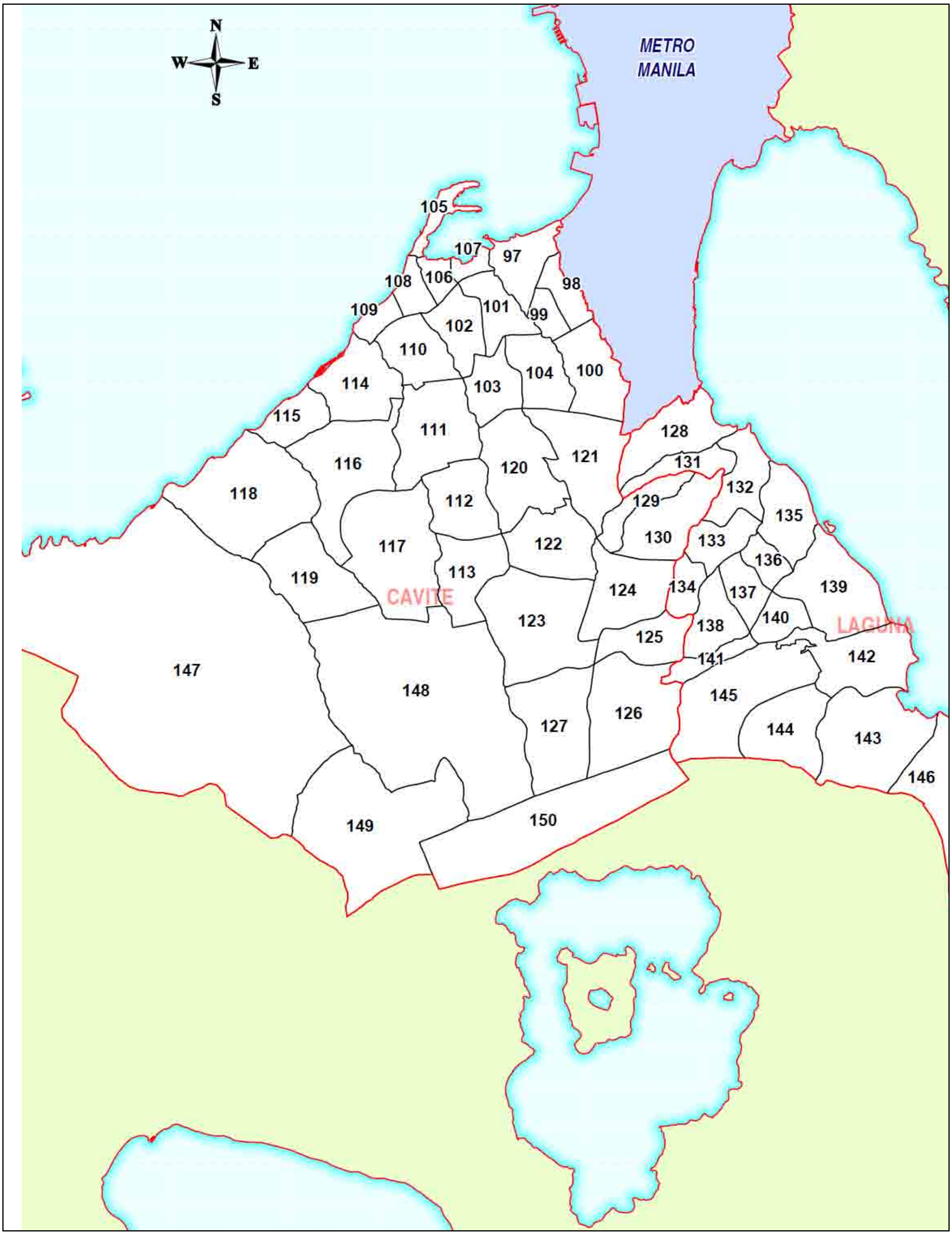


FIGURE 4.2.1-3 ZONING MAP – CALA

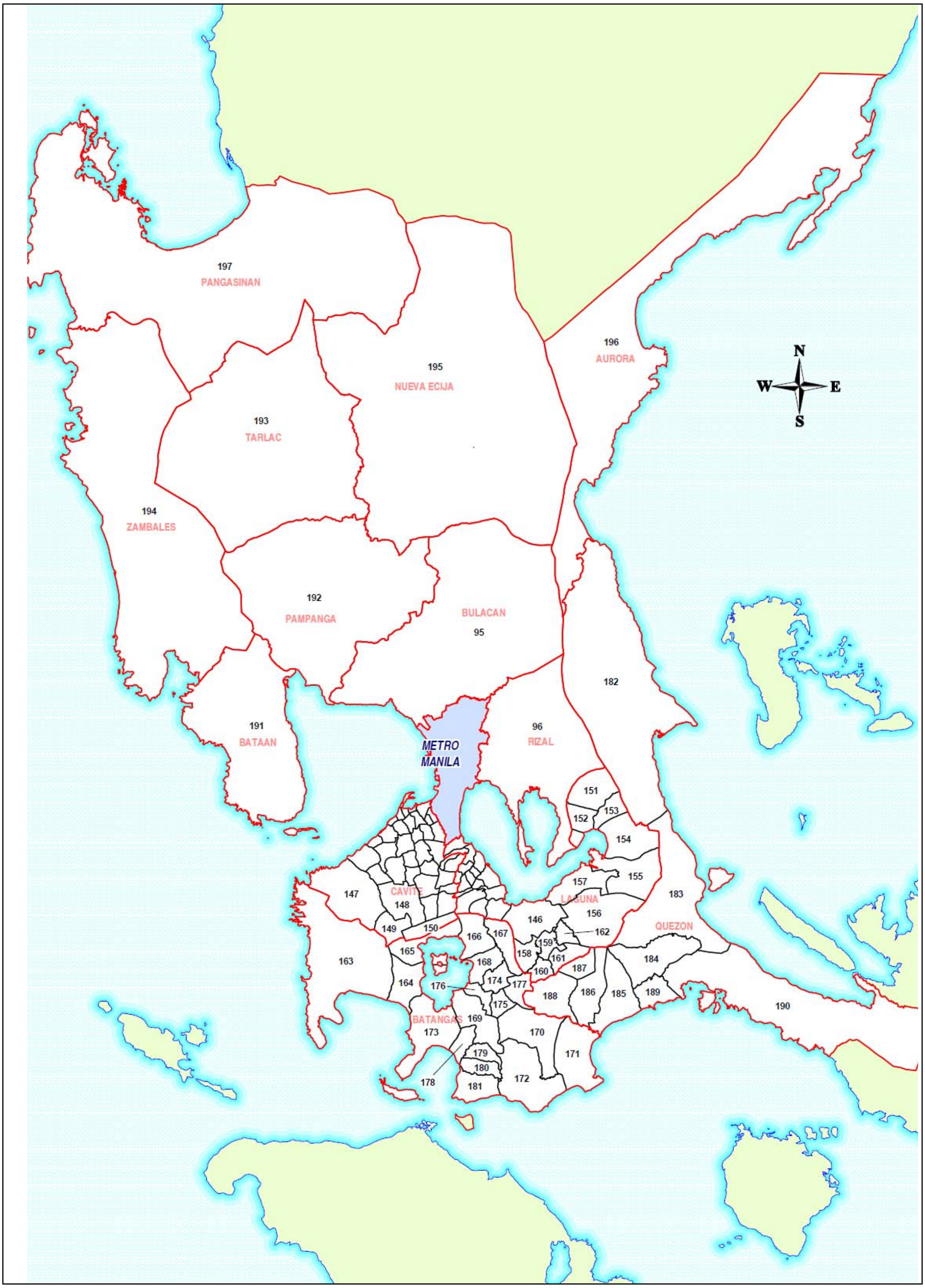


FIGURE 4.2.1-4 ZONING MAP – MEGA MANILA

4.2.2 Future Socio-economic Framework

The future socio-economic indicators were formulated by the Study of Master Plan on High Standard Highway Network Development (herein HSH Study) based on the past trend.

In the study area, most of the lands have been acquired by big private investors and these lands will be converted from agri-land to industrial, commercial, and residential development. Though many private investors have a large development plan, detailed target socio-economic indicators of all development plans were confidential.

Based on the projected socio-economic indicators by the HSH Study, future socio-economic framework was revised considering the current development direction and the mature of each private developer in the Study Area by JICA Study Team.

The socio-economic profile is summarized below.

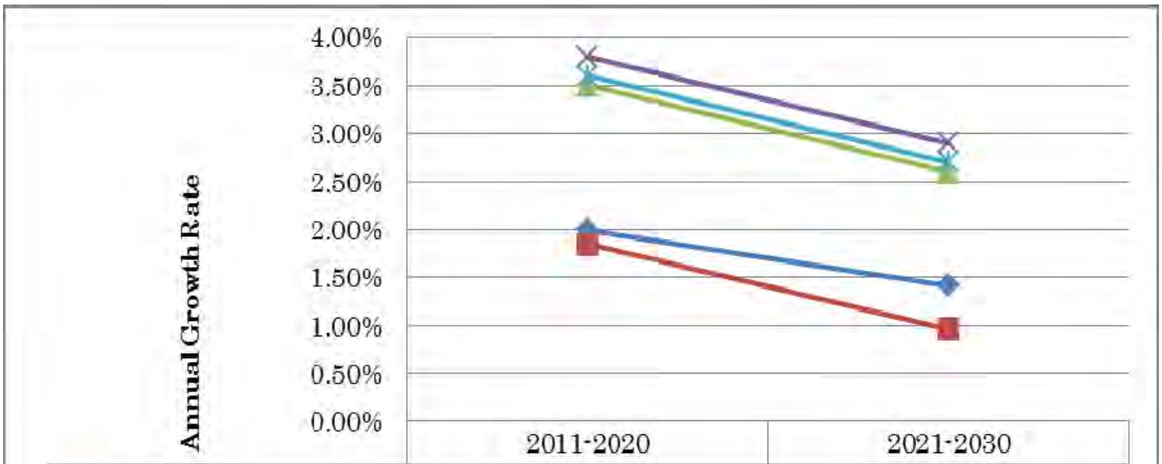
(1) Population Projection

The population of the Study Area is revised based on the acquired private developer’s plan and land use plan.

Figure 4.2.2-1 shows the summary of future annual growth rate of the Study Area, NCR and Philippines. As same as projected population of HSH study, the growth rate of the Study Area is much higher than national growth rate.
Average growth rate in the Study Area is 3.60% from year 2011 to year 2020 and 2.70% from year 2021 to year 2030.

Table 4.2.2-1 shows the revised population projection considering the development Area. Projected population of each zone is the sum up of projected population by HSH and development population at new private development project. Development areas in Laguna section are located in Silang (Zn.123, 124 and 125), Carmona (Zn.130), Binan (Zn.133, 134) Santa Rosa (Zn, 136,137 and 138), Cabyao (Zn.140 and 141) and Calamba (Zn.144 and 145). Since these zones will be converted from agriculture land, vacant area to residential area, the growth rate of population become high.

Figure 4.2.2-2 shows the bar chart of zone base population and **Figure 4.2.2-3** shows the population density. Traffic zones adjacent to Metro Manila and passing along SLEx will become high population density (pink or red color) in the future shown in **Figure 4.2.2-3**.



	2011-2020	2021-2030
Philippines	1.99%	1.41%
NCR(Metro Manila)	1.85%	0.97%
Cavite(Zn97-130)	3.50%	2.60%
Laguna(Zn128,131-145)	3.80%	2.90%
Cavite and Laguna	3.60%	2.70%

Note: Philippines and NCR Population projection by HSH Study

FIGURE 4.2.2-1 GROWTH RATE OF POPULATION PROJECTION

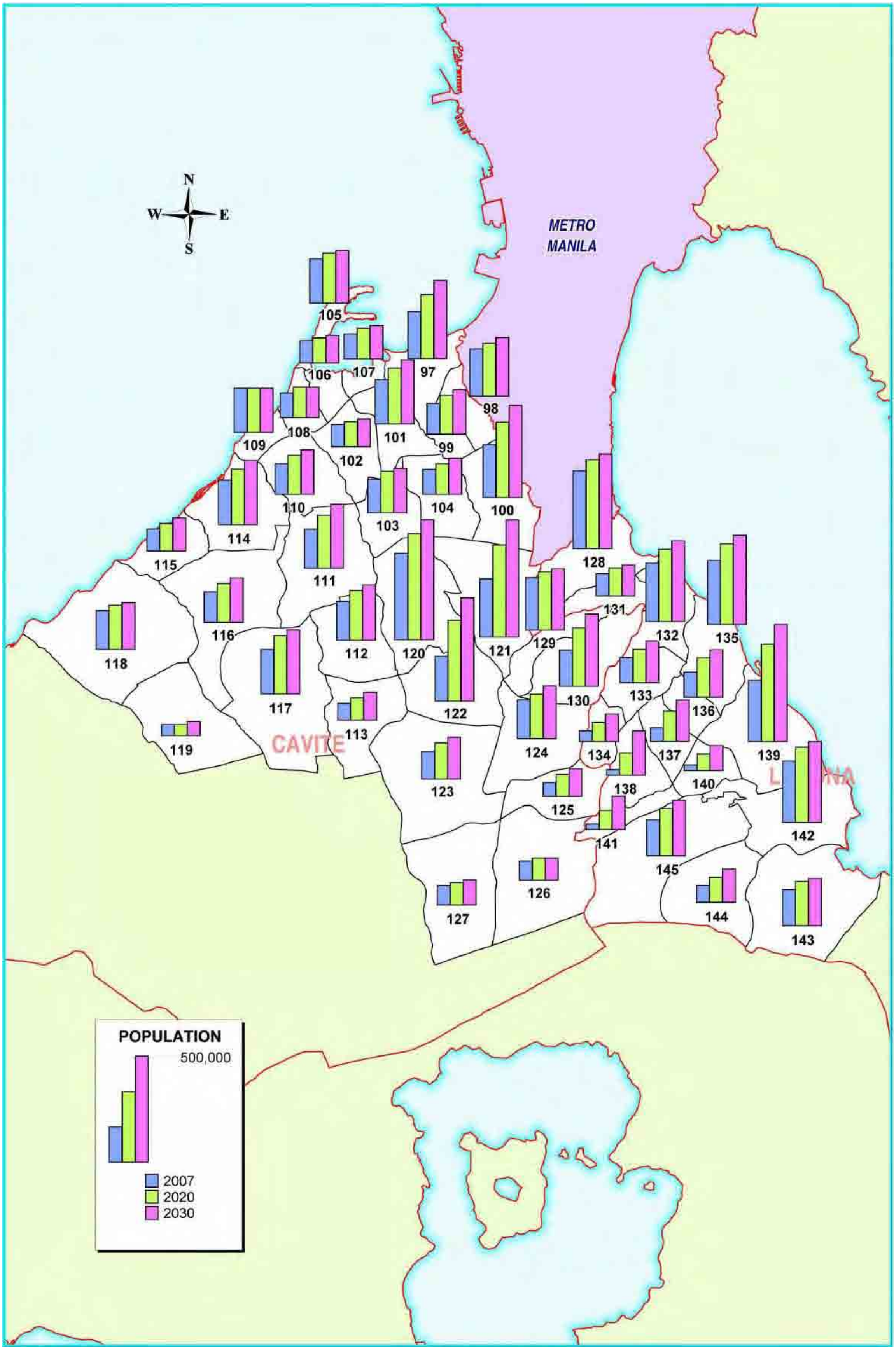
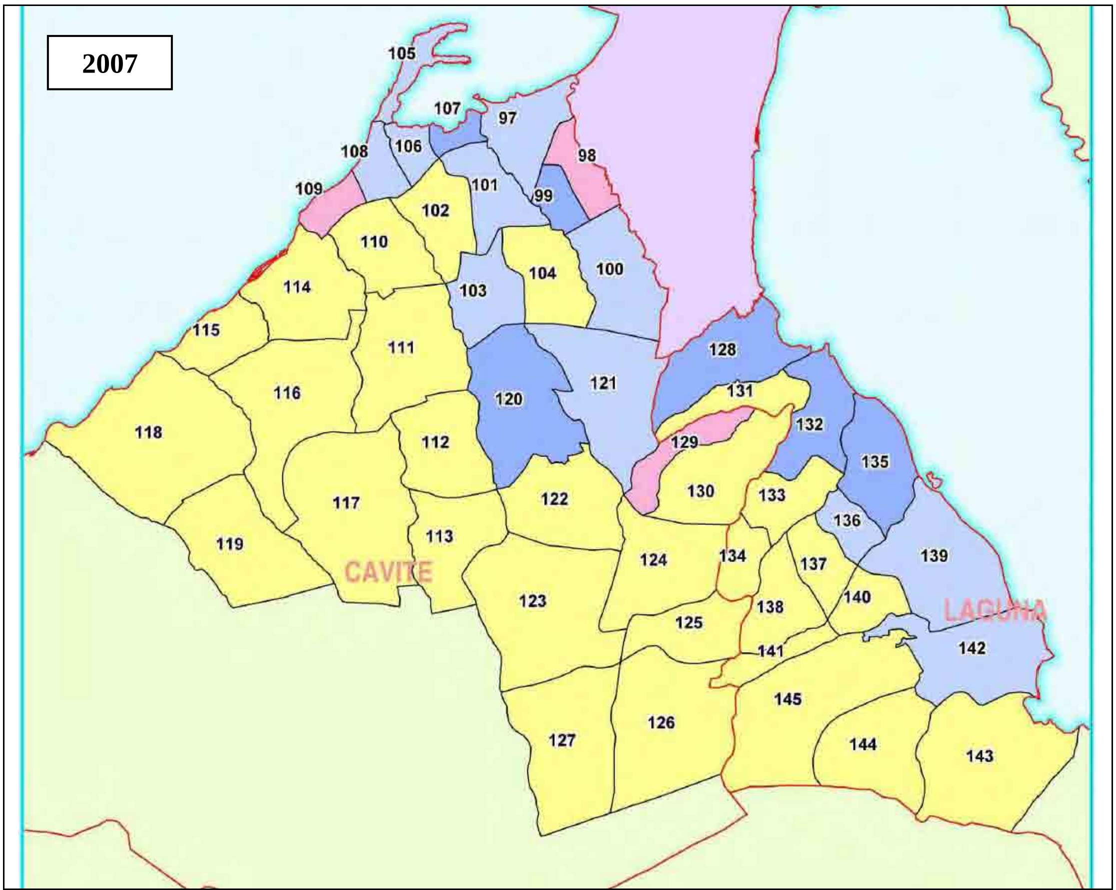


FIGURE 4.2.2-2 PROJECTED POPULATION IN THE STUDY AREA

Source: JICA Study Team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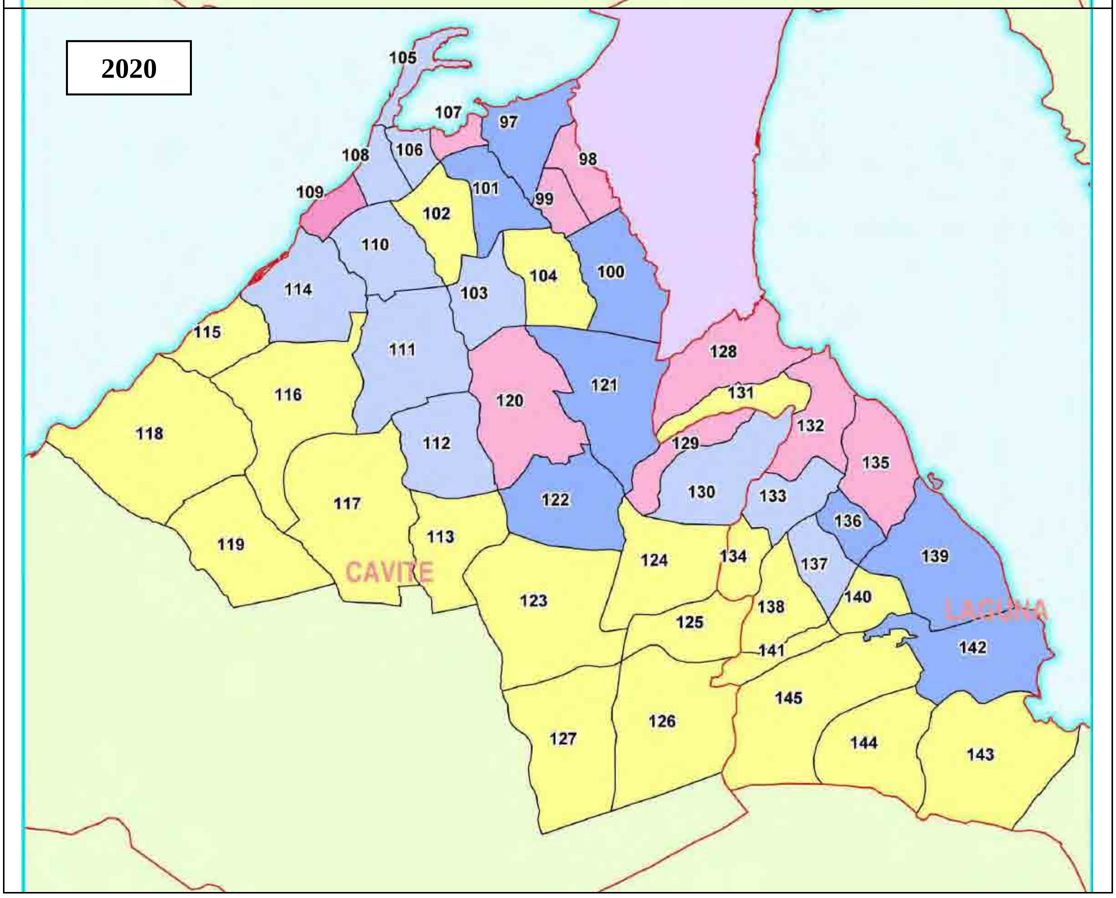
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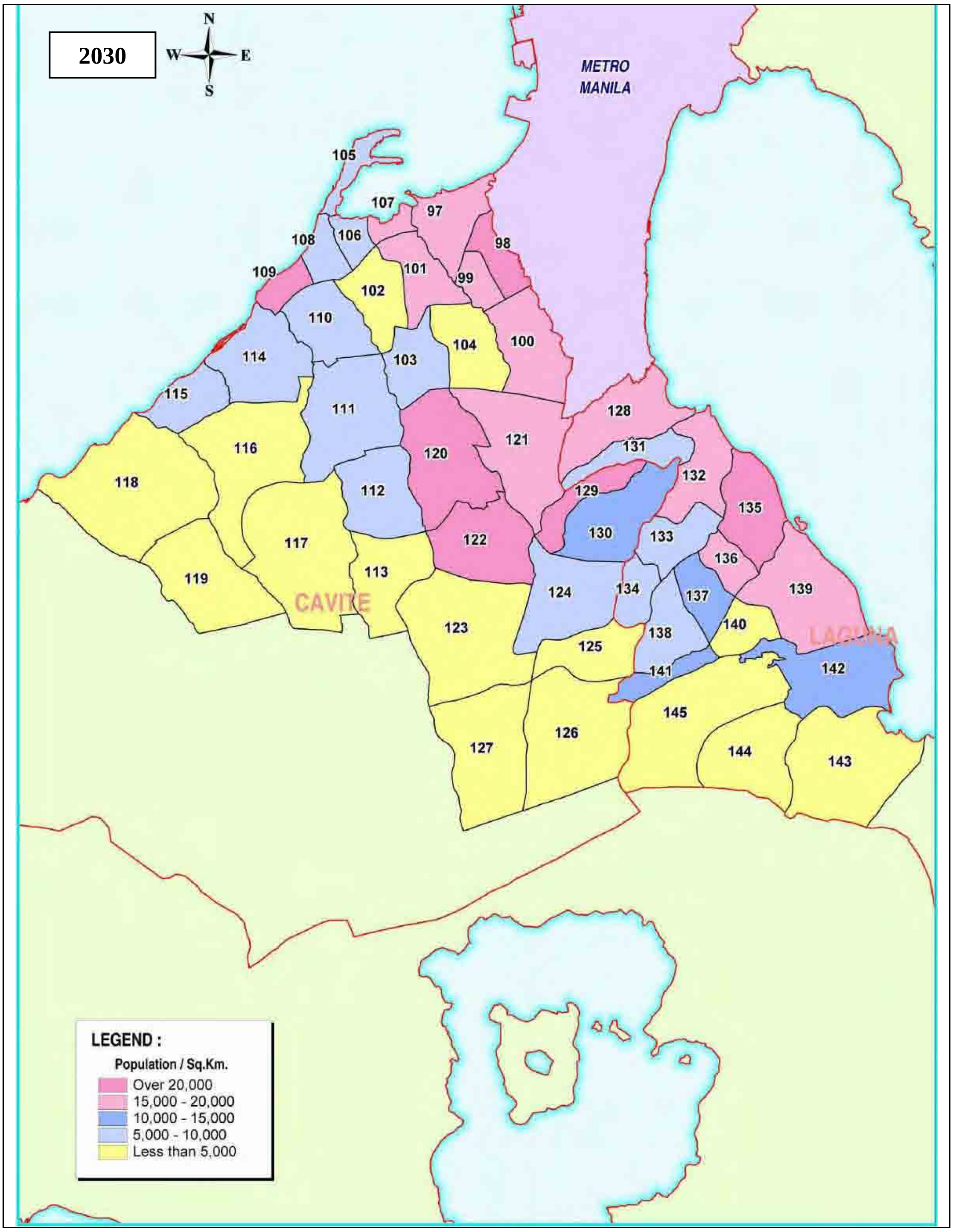


FIGURE 4.2.2-3 PROJECTED POPULATION DENSITY

Source: JICA Study Team

TABLE 4.2.2-1 FUTURE POPULATION AND DENSITY IN THE STUDY AREA

Zone	Province	City/Municipality	AREA (km2)	Year 2007		Year 2020		Year 2030		AAGR(%)		Remarks
				Population	Dnsty(Pop/km2)	Population	Dnsty(Pop/km2)	Population	Dnsty(Pop/km2)	07-20	21-30	
97	Cavite	BACOOR	14.79	116,573	7,884	205,207	13,879	285,241	19,291	4.4%	3.3%	
98	Cavite	BACOOR	7.84	118,486	15,117	152,806	19,495	177,128	22,598	2.0%	1.5%	
99	Cavite	BACOOR	5.74	59,982	10,443	87,686	15,266	109,345	19,037	3.0%	2.2%	
100	Cavite	BACOOR	20.22	146,156	7,227	273,559	13,526	394,163	19,489	4.9%	3.7%	
101	Cavite	IMUS	12.98	112,061	8,632	168,598	12,986	207,959	16,018	3.2%	2.1%	
102	Cavite	IMUS	13.88	31,143	2,244	43,810	3,157	52,197	3,761	2.7%	1.8%	
103	Cavite	IMUS	13.55	68,995	5,090	97,059	7,160	115,639	8,531	2.7%	1.8%	
104	Cavite	IMUS	16.14	40,959	2,538	61,624	3,819	76,010	4,710	3.2%	2.1%	
105	Cavite	CAVITE CITY	15.73	111,000	7,058	130,203	8,279	144,153	9,167	1.2%	1.0%	
106	Cavite	KAWIT	4.98	33,316	6,696	42,552	8,553	49,325	9,914	1.9%	1.5%	
107	Cavite	KAWIT	3.38	43,089	12,741	55,034	16,273	63,794	18,863	1.9%	1.5%	
108	Cavite	NOVELETA	6.53	43,000	6,585	53,604	8,209	61,569	9,429	1.7%	1.4%	
109	Cavite	ROSARIO	5.22	104,000	19,939	108,988	20,895	112,275	21,525	0.4%	0.3%	
110	Cavite	GENERAL TRIAS	16.75	53,000	3,164	84,042	5,018	111,669	6,667	3.6%	2.9%	
111	Cavite	GENERAL TRIAS	29.95	90,000	3,005	155,090	5,178	204,218	6,819	4.3%	2.8%	
112	Cavite	GENERAL TRIAS	20.05	81,631	4,072	130,994	6,534	167,863	8,374	3.7%	2.5%	
113	Cavite	GENERAL TRIAS	19.86	21,581	1,087	34,631	1,744	44,378	2,234	3.7%	2.5%	
114	Cavite	TANZA	22.59	107,000	4,737	163,702	7,248	204,137	9,038	3.3%	2.2%	
115	Cavite	TANZA	11.58	33,000	2,850	50,488	4,360	62,958	5,437	3.3%	2.2%	
116	Cavite	TANZA	36.34	61,000	1,679	91,119	2,507	109,558	3,015	3.1%	1.9%	
117	Cavite	TRECE MARTIRES CITY	44.79	115,000	2,567	175,941	3,928	211,546	4,723	3.3%	1.9%	
118	Cavite	NAIC	49.71	84,000	1,690	105,993	2,132	118,434	2,382	1.8%	1.1%	
119	Cavite	NAIC	29.00	10,000	345	11,170	385	12,254	423	0.9%	0.9%	
120	Cavite	DASMARIÑAS	30.08	354,000	11,768	502,803	16,715	613,443	20,393	2.7%	2.0%	
121	Cavite	DASMARIÑAS	30.60	173,000	5,654	390,364	12,758	593,468	19,395	6.5%	4.3%	
122	Cavite	DASMARIÑAS	23.27	116,000	4,985	313,281	13,464	476,278	20,469	7.9%	4.3%	
123	Cavite	SILANG	43.00	51,125	1,189	75,791	1,763	97,855	2,276	4.1%	2.6%	New Dev.
124	Cavite	SILANG	24.84	82,459	3,320	115,329	4,643	143,686	5,785	3.3%	2.2%	New Dev.
125	Cavite	SILANG	14.96	14,400	963	29,451	1,969	44,139	2,951	8.5%	4.1%	New Dev.
126	Cavite	SILANG	38.02	23,456	617	29,597	779	34,308	902	1.8%	1.5%	
127	Cavite	SILANG	33.56	28,385	846	35,817	1,067	41,518	1,237	1.8%	1.5%	
128	Laguna	SAN PEDRO	21.69	295,000	13,599	367,747	16,953	408,925	18,851	1.7%	1.1%	
129	Cavite	GEN. MARIANO ALVAREZ	9.38	148,000	15,770	174,666	18,612	192,492	20,511	1.3%	1.0%	
130	Cavite	CARMONA	22.01	78,000	3,543	171,764	7,803	250,913	11,399	7.2%	3.9%	New Dev.
131	Laguna	BIÑAN	9.50	32,250	3,395	45,368	4,776	54,458	5,733	2.7%	1.8%	
132	Laguna	BIÑAN	15.67	182,981	11,677	257,408	16,427	308,983	19,718	2.7%	1.8%	
133	Laguna	BIÑAN	11.57	38,178	3,299	67,408	5,824	95,914	8,287	5.3%	3.6%	New Dev.
134	Laguna	BIÑAN	7.49	9,326	1,246	28,821	3,850	49,595	6,625	11.8%	5.6%	New Dev.
135	Laguna	CITY OF SANTA ROSA	17.83	212,992	11,945	314,369	17,630	372,354	20,882	3.0%	1.7%	
136	Laguna	CITY OF SANTA ROSA	6.68	37,153	5,566	87,384	13,091	125,928	18,865	7.8%	3.7%	New Dev.
137	Laguna	CITY OF SANTA ROSA	9.40	14,181	1,509	55,079	5,862	98,028	10,432	13.6%	5.9%	New Dev.
138	Laguna	CITY OF SANTA ROSA	13.71	2,617	191	36,300	2,648	104,834	7,648	21.8%	11.2%	New Dev.
139	Laguna	CABUYAO	30.55	199,505	6,531	424,748	13,905	588,662	19,272	6.0%	3.3%	
140	Laguna	CABUYAO	8.53	2,689	315	18,349	2,151	38,352	4,496	19.6%	7.7%	New Dev.
141	Laguna	CABUYAO	6.58	3,182	484	26,247	3,988	67,695	10,287	20.5%	9.9%	New Dev.
142	Laguna	CITY OF CALAMBA	26.53	191,877	7,232	266,693	10,051	317,092	11,951	2.6%	1.7%	
143	Laguna	CITY OF CALAMBA	38.57	76,000	1,971	105,634	2,739	125,596	3,256	2.6%	1.7%	
144	Laguna	CITY OF CALAMBA	23.88	20,859	874	40,764	1,707	68,468	2,867	7.2%	5.3%	New Dev.
145	Laguna	CITY OF CALAMBA	41.65	71,545	1,718	116,347	2,794	168,334	4,042	4.5%	3.8%	New Dev.
	Cavite		**691.31**	**2,753,797**	**3,983**	**4,322,765**	**6,253**	**5,583,915**	**8,077**	**3.5%**	**2.6%**	
	Laguna		**289.82**	**1,390,335**	**4,797**	**2,258,666**	**7,793**	**2,993,218**	**10,328**	**3.8%**	**2.9%**	
	Total		**981.12**	**4,144,132**	**4,224**	**6,581,431**	**6,708**	**8,577,133**	**8,742**	**3.6%**	**2.7%**	

Note: JICA Study Team Projection

(2) Employment projection

The employment at job site was selected as an index to reflect traffic generation/attraction. The number of projected employment is made by HSH Study based on the Establishment survey, the development direction and land use plan.
Table 4.2.2-2 shows the projected employment of medium zoning.

TABLE 4.2.2-2 PROJECTED POPULATION AND EMPLOYMENT BY MEDIUM ZONE

Zone No.	Province	City/Muni	Year 2011		Year 2020		Year 2030	
			Pop.	Emp.	Pop.	Emp.	Pop.	Emp.
1	Metro Manila	City of Manila	1,696,568	662,783	1,768,429	847,423	1,795,133	1,023,071
2	Metro Manila	Pasay City	427,128	271,814	481,003	353,601	526,086	434,253
3	Metro Manila	Parañaque City	617,200	69,146	779,475	97,545	927,115	132,484
4	Metro Manila	Makati City,Pateros	613,873	1,205,531	717,448	1,542,431	809,932	1,879,800
5	Metro Manila	Taguig	679,650	190,287	825,000	225,573	911,295	257,608
6	Metro Manila	Mandaluyong City, San Juan	451,480	131,737	496,787	148,756	543,634	150,885
7	Metro Manila	Pasig City	675,137	569,123	795,315	731,588	869,859	897,947
8	Metro Manila	Quezon City	2,977,457	926,459	3,700,693	1,182,734	4,190,059	1,435,243
9	Metro Manila	Kalookan City (North)	872,103	80,181	1,037,000	91,448	1,053,250	95,683
10	Metro Manila	Valenzuela City	619,277	110,977	741,380	140,221	818,928	184,006
11	Metro Manila	Kalookan City (South),Malal	1,241,004	205,707	1,399,903	225,573	1,452,520	234,055
12	Metro Manila	Marikina City, Muntinlupa C	943,572	329,496	1,107,189	426,760	1,294,399	544,656
13	Metro Manila	Las Pinas City	569,051	68,404	657,884	91,448	748,586	110,403
14	CAVITE	CAVITE CITY	1,041,246	326,073	1,371,741	441,040	1,736,523	528,730
15	CAVITE	TANZA	817,269	364,641	1,345,429	493,206	1,945,158	724,176
16	CAVITE	GENERAL EMILIO AGUIN	200,587	33,893	235,735	45,843	268,974	43,204
17	CAVITE	TRECE MARTIRES CITY	774,063	210,370	1,206,448	284,542	1,683,189	349,744
18	CAVITE	TAGAYTAY CITY	734,687	233,744	971,976	316,157	1,221,049	411,463
19	LAGUNA	CITY OF SANTA ROSA	925,375	475,080	1,259,883	643,723	1,619,018	845,741
20	LAGUNA	CITY OF CALAMBA	885,506	633,953	1,259,885	862,119	1,674,247	1,136,105
Metro Manila			**12,383,499**	**4,821,646**	**14,507,506**	**6,105,101**	**15,940,797**	**7,380,093**
Study Area(Cavite Zn 14-18)			**3,567,852**	**1,168,721**	**5,131,329**	**1,580,787**	**6,854,894**	**2,057,317**
Study Area(Laguna Zn 19-20)			**1,810,881**	**1,109,033**	**2,519,768**	**1,505,842**	**3,293,265**	**1,981,845**
Total			**17,762,232**	**7,099,400**	**22,158,603**	**9,191,730**	**26,088,956**	**11,419,256**

Source: HSH 2009 and JICA Study Team's Projection

4.2.3 Present and Future OD Matrix

Present OD matrix was revised as Year 2011based on 2009 OD matrix. Traffic assignment model was validated using this present OD matrix (see section 4.2.5 Assignment Validation).

In order to formulate the future OD table, traffic demand forecast was conducted by applying the revised future socio economic indicators.

(1) Future OD Estimation Approach

The future OD Matrix was prepared by the following steps/procedure as shown in **Figure 4.2.3-1**.

- Trip Generation and Attraction – the prediction of trips produced and attracted to each zone;
- Trip Distribution – the prediction of origin-destination flows, the linking of trip ends predicted by trip generation;
- Modal Split – the estimation of percentages of trip flows made by each transportation mode in the model.

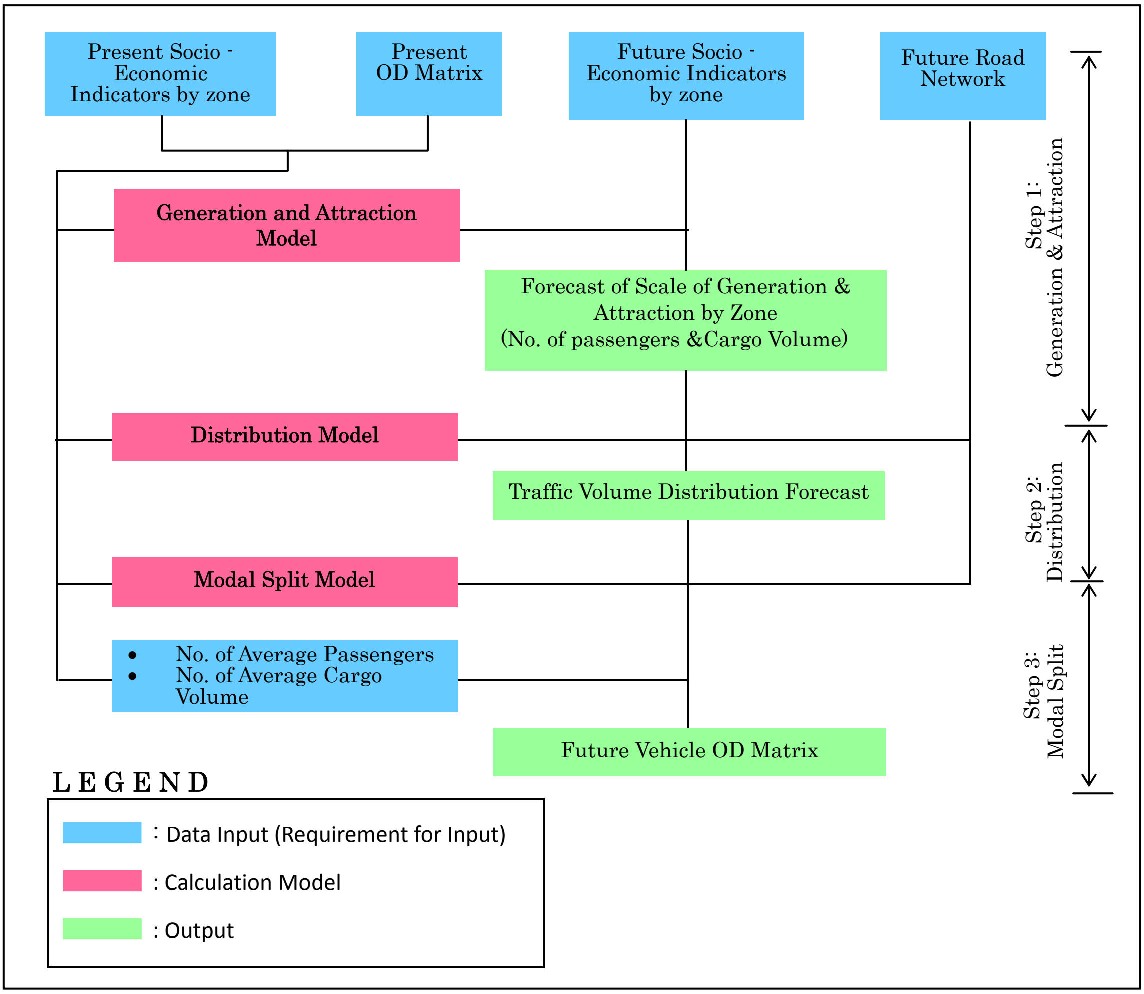


FIGURE 4.2.3-1 FUTURE OD MATRIX ESTIMATION PROCEDURE

(2) Modeling and Forecasting Tools

In all steps of travel model calibrations and demand forecast, JICA STRADA system was employed. JICA STRADA is a software tool for planning, managing, and analyzing of transportation systems. The software provides a set of tools for traffic demand modeling as well as capabilities for presentation graphics and transportation models. Modeling and forecasting in trip generation, trip distribution and traffic assignment was computed by JICA STRADA system.

(3) Traffic Demand Forecast Modeling

1) Trip Generation and Attraction Model

The objective of trip generation and attraction model is to forecast the number of trips that will start and arrive in each traffic zone within the study area. The linear regression models were adopted. The model parameters are shown in **Table 4.2.3-1** and **Table 4.2.3-2** and Dummy variables are shown in **Table 4.2.3-3** using population and employment in year 2011 shown in **Table 4.2.3-4**

$G_i = a_i * X1_i + b_i * X2_i + c_i * D_i + C$
$A_j = a_j * X1_j + b_j * X2_j + c_j * D_j + C$

Where,

G_i – Trip Generation in zone i
A_j – Trip Attraction in zone j
$X1_i$, $X2_j$ – Attributes in zone i,j
D_i, D_j – Dummy Variables
a_i, aj, b_i,b_j – Coefficients
C – Constant

TABLE 4.2.3-1 GENERATION/ATTRACTION MODELS (PASSENGER TRIPS)

Model Type	Subject Area	Attributes		Dummy Variable	Constant	R^2 Multiple Correlation Coefficient
		Population	Employment			
Trip Generation	Metro Manila (MM)	1.932	0.884	-913,810	-229,565	0.978
	Cavite, Laguna	0.824	0.436	-224,857	-170,251	0.983
Trip Attraction	Metro Manila (MM)	1.836	0.866	-757,777	-255,323	0.974
	Cavite, Laguna	0.806	0.460	-227,532	-156,667	0.980

Source: JICA Study Team

TABLE 4.2.3-2 GENERATION/ATTRACTION MODELS (CARGO MOVEMENT)

Model Type	Subject Area	Attributes		Dummy Variable	Constant	R^2 Multiple Correlation Coefficient
		Population	Employment			
Trip Generation	Metro Manila (MM)	-	0.247	193,903	13,438	0.959
	Cavite, Laguna	-	0.109	-13,186	388	0.987
Trip Attraction	Metro Manila (MM)	-	0.229	198,082	20,161	0.948
	Cavite, Laguna	-	0.130	-13,177	-3,415	0.990

Source: JICA Study Team

TABLE 4.2.3-3 DUMMY VARIABLE OF GENERATION/ATTRACTION MODEL

Medium Zone No.	Province	City, Municipality	Generation for Passenger	Attraction for Passenger	Generation for Cargo	Attraction for Cargo
1	Metro Manila	City of Manila	2	2	1	1
2		Pasay City	0	0	0	0
3		Parañaque City	0	0	0	0
4		Makati City,Pateros	0	0	-1	-1
5		Taguig	0	0	0	0
6		Mandaluyong City, San Juan	0	-1	0	0
7		Pasig City	1	1	-0.5	-0.5
8		Quezon City	0	0	1	1
9		Kalookan City (N)	1	1	0	0
10		Valenzuela City	0	0	0	0
11		Kalookan (S),Malabon, Navotas	1	1	0.5	0.5
12		Marikina City, Muntinlupa City	0	0	0	0
13		Las Pinas City	0	0	0	0
14	Cavite	Bacoor	0	0	1	1
15		Tanza	1	1	1	1
16		NAIC	0	0	0	0
17		Dasmarinas	0	0	0	0
18		Silang	0	0	0	0
19	Laguna	Binan	-1	-1	-1	-1
20		Calamba	0	0	0	0

Source: JICA Study Team

TABLE 4.2.3-4 PRESENT POPULATION AND EMPLOYMENT FOR G/A MODEL

Medium Zone No.	Province	City/Muni	2011 Population	2011 Employment
1	NCR(Metro Manila)	City of Manila	1,696,568	662,783
2		Pasay City	427,128	271,814
3		Parañaque City	617,200	69,146
4		Makati City,Pateros	613,873	1,205,531
5		Taguig	679,650	190,287
6		Mandaluyong City, San Juan	451,480	131,737
7		Pasig City	675,137	569,123
8		Quezon City	2,977,457	926,459
9		Kalookan City (North)	872,103	80,181
10		Valenzuela City	619,277	110,977
11		Kalookan City (South) Malabon ,Navotas	1,241,004	205,707
12		Marikina City, Muntinlupa	943,572	329,496
13		Las Pinas City	569,051	68,404
14	Cavite	Bacoor	1,097,917	326,073
15		Tanza	776,065	364,641
16		NAIC	197,406	33,893
17		Dasmarinas	707,998	210,370
18		Silang	733,320	233,744
19	Laguna	Binan	918,694	475,080
20		Calamba	900,772	633,953

Source: JICA Study Team

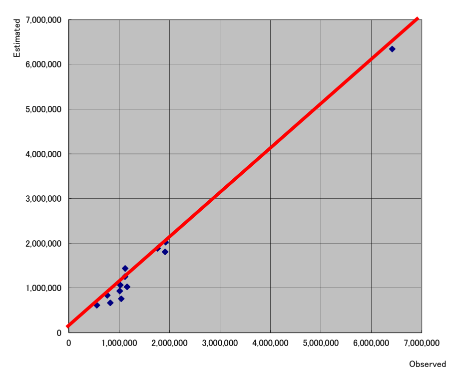
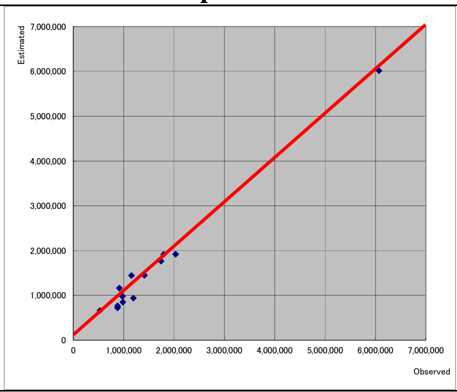
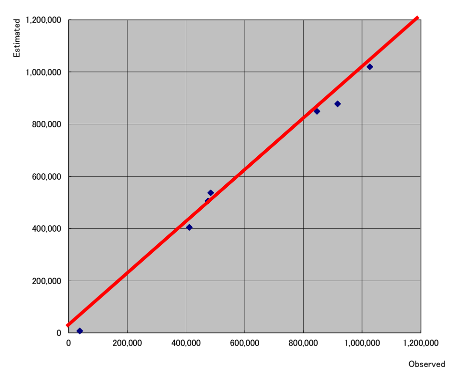
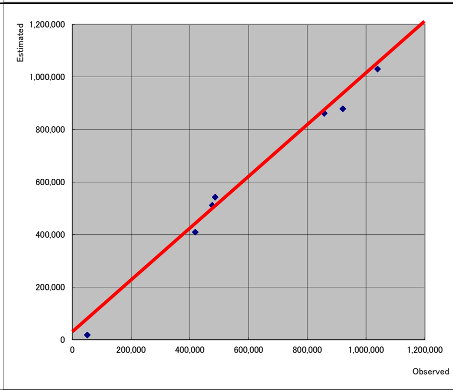
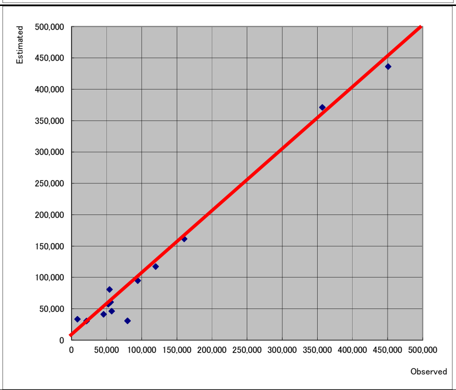
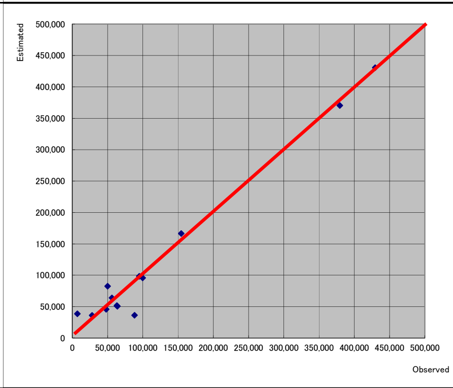
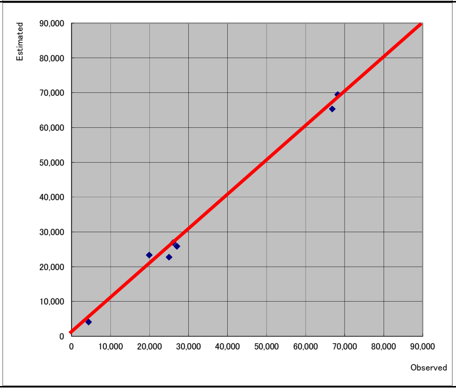
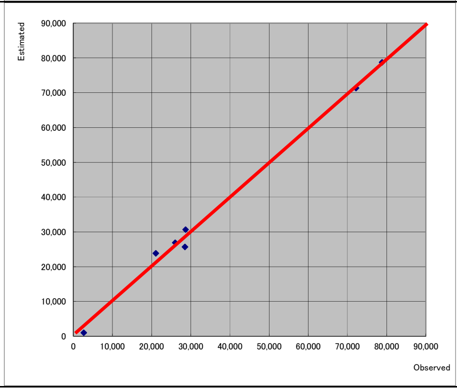
Figure 4.2.3-2 shows the verification results between observed (present OD trips) and estimated trips for passenger trips and cargo movement.

2) Forecasting Trip Distribution Model

Trip distribution is the second major step in the traffic demand modeling process. Trip production (the first major step) provided methodology for estimating trip generations and attractions within each zone. Trip distribution is the process that links the generations and attractions with each zone.

The distribution model was applied using the present pattern to estimate the future trip distribution.

Figure 4.2.3-3 shows the desire line in the Study Area.

		Trip Generation Model		Trip Attraction Model	
Passenger Trips	Metro Manila		N=13 R^2= 0.978		N=13 R^2= 0.974
	Cavite, Laguna		N=7 R^2= 0.983		N=7 R^2= 0.980
Cargo Movement (tons)	Metro Manila		N=13 R^2= 0.959		N=13 R^2= 0.948
	Cavite, Laguna		N=7 R^2= 0.987		N= 7 R^2= 0.990

Source: JICA Study Team

FIGURE 4.2.3-2 VERIFICATION OF TRIP GENERATION AND ATTRACTION MODEL

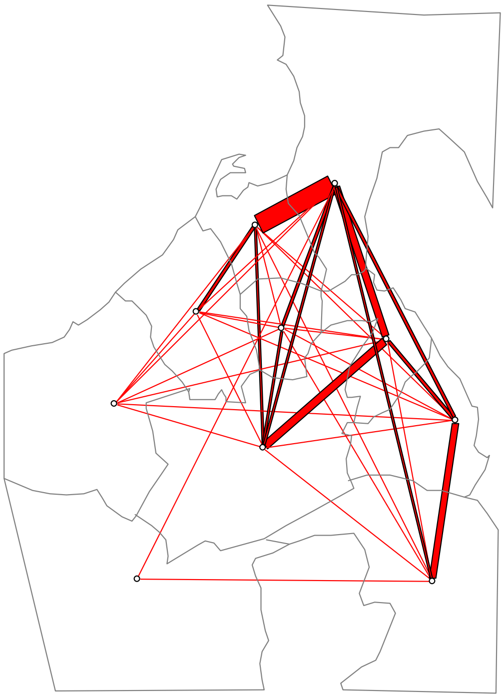
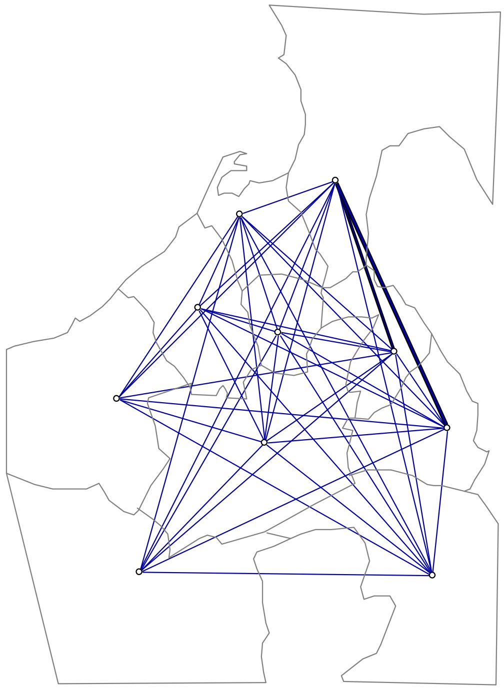
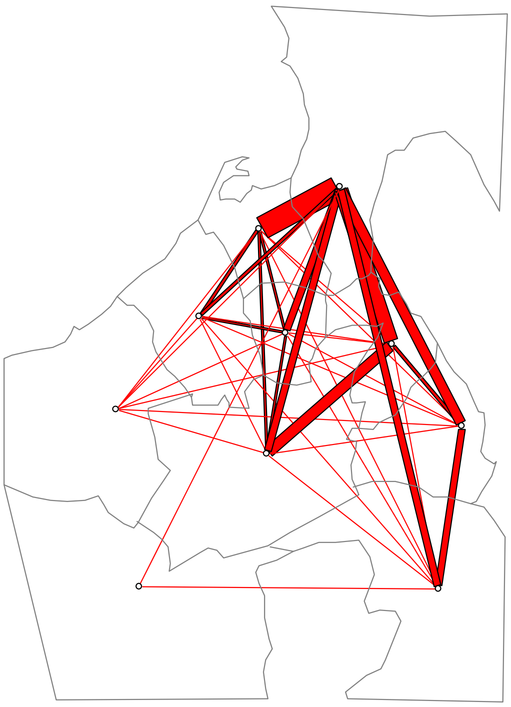
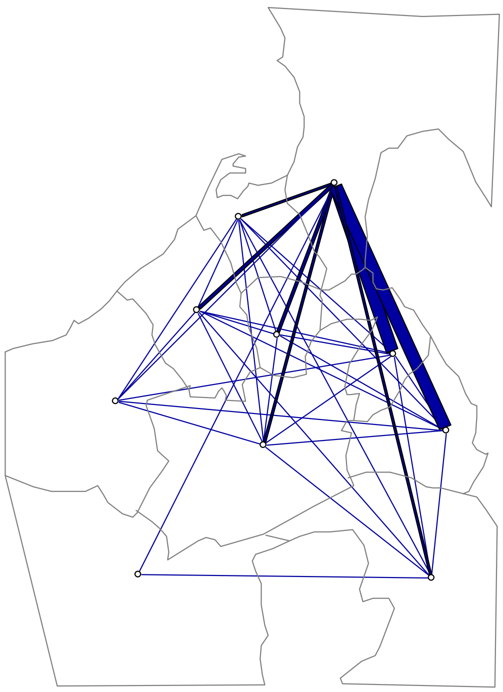
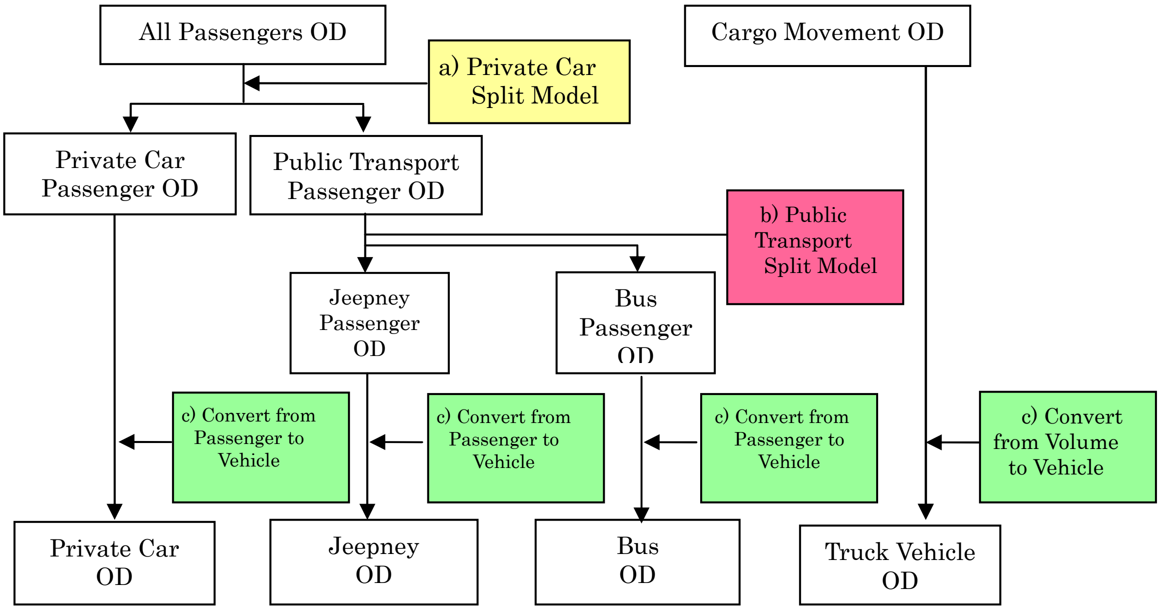
Passenger Trips	Truck
Year 2011 	Year 2011 
Year 2030 	Year 2030 

FIGURE 4.2.3-3 DESIRE LINE

Source: JICA Study Team

3) Modal Split Model

Figure 4.2.3-4 shows the procedure of Modal Split Model. Modal Split Model was applied as the same model as HSH Project.



Source: JICA HSH Study

FIGURE 4.2.3-4 STRUCTURE OF MODAL SPLIT MODEL

a) Private Car Split Model

Table 4.2.3-5 shows that the number of vehicle registration and annual rate in Region IV-A and other area. Annual growth rate in Region IV-A is higher than that in other regions. JICA Study Team assumed that this trend will keep in the future, because there are not yet public transport plan such as new railway project in the Study Area and new residential family who living the development area are relative rich. They will own the private car for commuting, shopping and so on.
Based on the above assumption, the number of private car trips was projected shown in **Table 4.2.3-6**.

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Number of public transport passenger was estimated by subtracting number of private car passenger from all passengers (see **Table 4.2.3-7**).

TABLE 4.2.3-5 VEHICLE REGISTRATION OF CAR AND SPORT UTILITY VEHICLE (Y2006-Y2009)

unit: vehicle

	Y2006	Y2007	Y2008	Y2009	AAGR
Region IV-A (Cavite,Laguna)	98,811	100,807	105,007	109,894	3.7%
NCR and Region III	630,813	615,812	629,947	687,516	3.0%

Source: LTO

TABLE 4.2.3-6 ESTIMATED NUMBER OF PRIVATE CAR TRIP

Area	Present	Estimated Data		Assumed Growth Rate	
	Y2011	Y2020	Y2030	AAGR	
	1,000 Person Trip	1,000 PT	1,000 PT	'11-20	'21-30
	(a)	$(b=a*(1+d)^{10})$	$(c=b*(1+e)^{10})$	(d)	(e)
Cavite	903	1,302	1,950	3.7%	4.1%
Laguna	504	725	1,085	3.7%	4.1%
Others	10,598	14,238	18,267	3.0%	2.5%
Total	**12,005**	**16,265**	**21,302**		

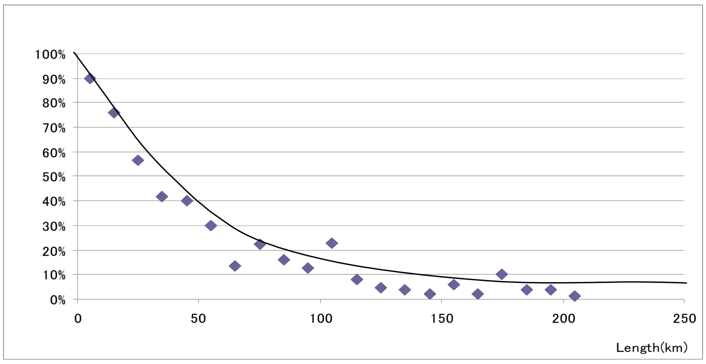
TABLE 4.2.3-7 ESTIMATED NUMBER OF PRIVATE CAR AND PUBLIC TRANSPORT TRIP

	Vehicle Type	Y2011		Y2020(Estimated)		Y2030(Estimated)	
		1,000 PT	Share	1,000 PT	Share	1,000 PT	Share
Cavite	**Total(a)**	3,355	100%	4,635	100%	6,389	100%
	Private Car(b)	903	27%	1,302	28%	1,950	31%
	Public T(a-b)	2,452	73%	3,333	72%	4,439	69%
Laguna	**Total(a)**	1,898	100%	2,617	100%	3,614	100%
	Private Car(b)	504	27%	725	28%	1,085	30%
	Public T(a-b)	1,394	73%	1,892	72%	2,529	70%
Total incl. MM	**Total(a)**	34,722	100%	43,944	100%	53,274	100%
	Private Car(b)	10,598	31%	14,238	32%	18,267	34%
	Public T(a-b)	24,124	69%	29,706	68%	35,008	66%

Source: JICA Team

b) Public Transport Split Model

The modal split between bus and Jeepny was estimated by using the relationship between zone *i* and zone *j* in distance calculated on the basis of Present OD matrix. **Figure 4.2.3-5** shows the modal share of Jeepny to the public transport trips.



Source: JICA HSH Study (2010); Note: Year 2009, Roadside OD Survey Result.

FIGURE 4.2.3-5 MODAL SHARES OF JEEPNEY TRIPS TO TOTAL PUBLIC TRANSPORT TRIPS

c) Convert from Passenger, Cargo Movement to Vehicle

The vehicle trips are estimated by converting passenger trips and cargo movement into equivalent number of vehicle traffic. Conversion rate is presented in **Table 4.2.3-8**.

TABLE 4.2.3-8 CONVERSION RATE

Vehicle Type	Conversion Rate
Private Car	3.5 person/vehicle
Jeepney	9.3 person/vehicle
Bus	30.8 person/vehicle
Truck	4,008 kg/vehicle

Source: JICA HSH Study (2010)

4) Future Vehicle OD Trips

As shown in **Table 4.2.3-9**, the total vehicle trips in the Study Area (Cavite and Laguna) by applying average passenger occupancy and loading weight are estimated to be 1.52 million trips per day in 2030, which will be two times of current demand. Among them, the growth rate of car trips will be high; therefore, the modal share of car to the total vehicle will increase from 53% at present to 57% in 2030 shown in **Figure 4.2.3-6.**

TABLE 4.2.3-9 TOTAL VEHICLE TRIPS

Area	Vehicle Type	Y2011		Y2020		Y2030		Increased Ratio	
		Trips	Share	Trips	Share	Trips	Share	20/11	30/11
		1000 veh/day	%	1000 veh/day	%	1000 veh/day	%		
Cavite	Car	258	54%	372	55%	557	58%	1.44	2.16
	Jeepny	151	32%	216	32%	272	29%	1.43	1.80
	Bus	34	7%	43	6%	62	7%	1.26	1.82
	Truck	33	7%	46	7%	62	7%	1.39	1.88
	Total	**476**	**100%**	**677**	**100%**	**953**	**100%**	**1.42**	**2.00**
Laguna	Car	144	50%	207	51%	310	55%	1.44	2.15
	Jeepny	87	30%	124	31%	156	27%	1.43	1.79
	Bus	19	7%	24	6%	35	6%	1.26	1.84
	Truck	36	13%	50	12%	67	12%	1.39	1.86
	Total	**286**	**100%**	**405**	**100%**	**568**	**100%**	**1.42**	**1.99**
Total including Metro Manila and other areas	Car	3028	55%	4068	57%	5219	59%	1.34	1.72
	Jeepny	1468	27%	1896	26%	2211	25%	1.29	1.51
	Bus	340	6%	392	5%	469	5%	1.15	1.38
	Truck	654	12%	807	11%	974	11%	1.23	1.49
	Total	**5490**	**100%**	**7163**	**100%**	**8873**	**100%**	**1.30**	**1.62**

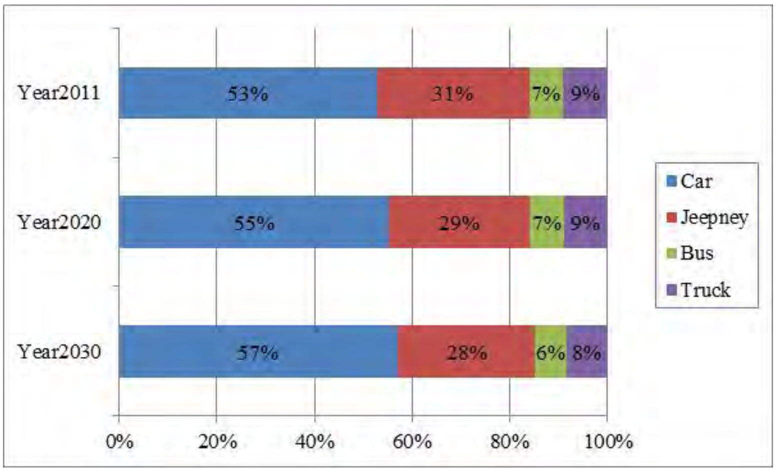


FIGURE 4.2.3-6 MODAL SHARES IN 2011, 2020 AND 2030(VEHICLE BASE)

4.2.4 Traffic Assignment Model

The traffic assignment procedure allocates vehicle traffic into individual road links. This step uses as input the matrix of flows (vehicles) that indicate the volume of traffic between origin and destination pairs.

1) Assignment Method

There are many assignment techniques that can be used to estimate traffic volume ranging from manual methods to complex iterative procedures by computer programs. In this study, the capacity restraint assignment which is the most straightforward for use in network models was applied. This assignment technique is based on the speed – flow relationship. Flowchart of the applied methodology is presented in **Figure 4.2.4-1**.

In this assignment technique, and by calculating the required travel time for each link according to its travel speed and road conditions, the program determines the fastest routes between each origin and destination by evaluating the consuming time on links, and assigns the trips between the given origin and destination. As congestion increases until a certain level, alternative routes are introduced to handle the unassigned traffic. Zone-to-zone routing is built, which is the fastest path from each zone to any other, and all trips are assigned to these optimum routes.

Regarding tolled expressway, travel time adds the sum up of travel time conversion from toll fee (= toll fee divided by time evaluation value) and time calculation from travel speed.

Since the link-travel time varies with the traffic volume of vehicles using that link, which can be explained as a degree of link congestion, the OD tables are divided to apply an iteration procedure on ten stages. At each iteration, and depending upon the current link loadings, the flows are divided between all the shortest routes generated and a new travel time is computed for the average assigned link flow at each pass. The iteration continues to re-estimate the speed on that links considering the assigned traffic on links, and to produce alternative routes so that more accurate allocation can be achieved. The accumulated assigned traffic volume from each OD pair on the links composes the total assigned traffic volumes per direction for the network. JICA STRADA is used to estimate traffic volumes.

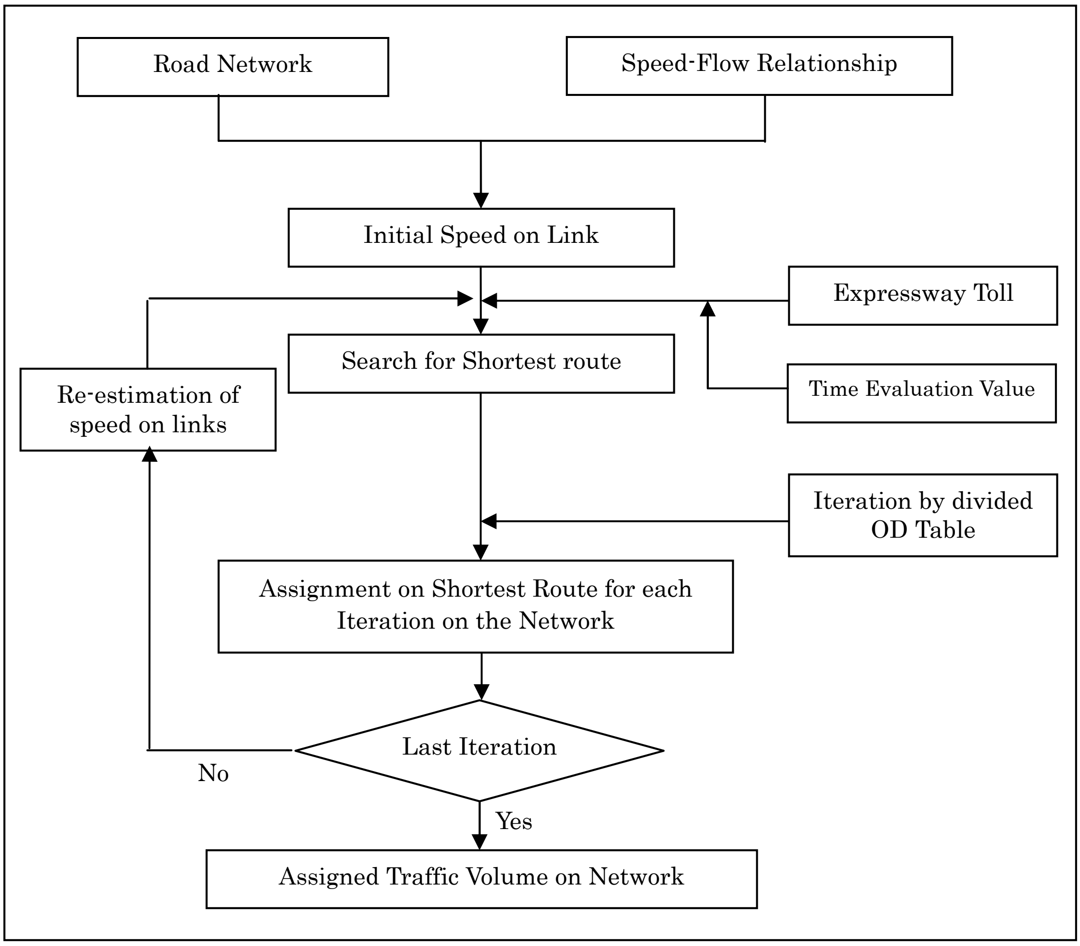


FIGURE 4.2.4-1 TRAFFIC ASSIGNMENT PROCEDURE

2) Speed Flow Relationship

The speed-flow relationship used in the traffic assignment procedure is shown in **Figure 4.2.4-2**. When the traffic volumes are over the maximum capacity 0.3*Qmax, it is assumed that vehicle speed drastically reduces. The basic free flow and capacity is shown in **Table 4.2.4-1**.

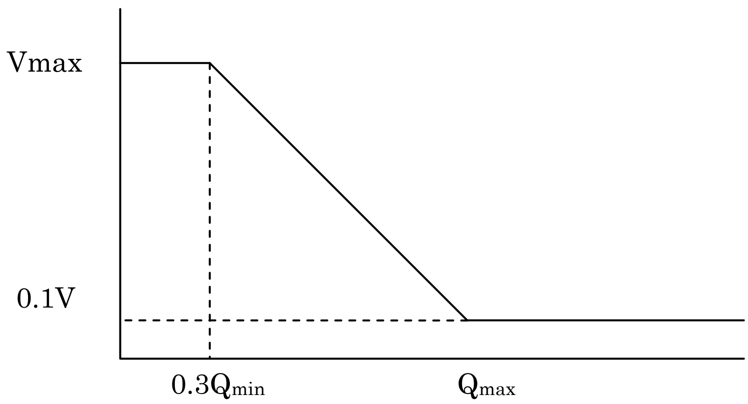


FIGURE 4.2.4-2 SPEED – FLOW RELATIONSHIP

TABLE 4.2.4-1 FREE SPEED AND CAPACITY BY ROAD TYPE

QV Type	Pavement	Road Class	Topography	Lane	Vmax	Qmax
1	Paved	Inter-Urban Expressway	Plain	4	100	80,000
2				3	100	60,000
3				2	80	40,000
4				1	70	20,000
5			Mountains	2	70	28,000
6				1	60	10,500
7		Intra-Urban Expressway	Plain	3	80	60,000
8				2	60-80	40,000
9				1	60	15,000
10		Interstate Highway	Plain	4	40	60,000
11				2	30	18,000
12			Mountains	4	30	42,000
13				2	25	12,600
14		Urban Arterial	Mountains	10	60	120,000
15				8	60	96,000
16				6	50	72,000
17				4	40	48,000
18				2	30	14,400
19		Local	Plain	4	40	40,000
20				2	30	12,000
21			Mountains	2	30	8,400
22	Unpaved		Plain	2	20	6,000
23			Mountains	2	10	4,200

3) Passenger Car Unit

Table 4.2.4-2 shows the Passenger Car Unit (PCU) used in vehicle traffic conversion. This value is the same used by the DPWH.

TABLE 4.2.4-2 PASSENGER CAR UNIT (PCU)

Vehicle Type	Passenger Car Unit
Passenger Car	1.0
Jeepney	1.5
Bus	2.2
Truck	2.5

4) Time Evaluation Value

An important input for the demand forecast is the trip maker’s time value. This time value is the basis for a trip maker to decide whether to use toll expressway or not. The time values were derived from MMUEN (JICA, The Development of the Public –Private Partnership Technique for the Metro Manila Urban Expressway Network) survey results. Though MMUEN data is based on the Metro Manila and surrounding area, Time Evaluation Value in Region IV-A is lower than that of MMUEN. Based on the rate of GRDP per capita (GRDP per capita of Region IV-A / that of NCR and Region IV-A = 61,473 peso / 96,505 peso = 0.637), Time Evaluation Value in Region IV-A was set.

Supposing time value in the future will increase in accordance with inflation rate of 4.0% per year, the figures in **Table 4.2.4-3** will be the time value.

TABLE 4.2.4-3 TIME EVALUATION VALUE BY VEHICLE TYPE

Unit: Peso/hour

Area	MMUEN (Metro Manila and surrounding Area)	Region IV-A (Study Area)			
Year	Y2009	Y2009	Y2011	Y2020	Y2030
	(a)	(b=a*0.637)	($c=b*1.05^2$)	($d=c*1.04^{10}$)	($e=d*1.04^{10}$)
Car	331.4	211.1	232.7	331.3	490.3
Jeepney	465.9	296.8	327.2	465.7	689.4
Bus	1,524.2	970.9	1,070.4	1,523.6	2,255.2
Truck	873.2	556.2	613.2	872.8	1,292.0

4.2.5 Assignment Validation

The procedure of model validation entails two steps: first, the present OD matrix is assigned on an existing network. Second, the assigned traffic volume is compared with the result of the traffic count surveys at each corresponding location. This verification aims to check the accuracy of both the current OD matrix and an existing network model representing the existing transport situation.

Table 4.2.5-1 presents traffic volumes generated from traffic assignment and observed traffic (traffic count survey). **Figure 4.2.5-2** shows the result of comparison between the assigned traffic volumes and observed traffic volume. This comparison between observed traffic count and assigned traffic flow at individual sites is done via the Mean Absolute Difference (MAD)[1] Ratio. For daily traffic counts, the value of the MAD ratio is 0.21 which is considered to reflect a good calibration. By all indicators the assignment has accurately replicated year 2011.

TABLE 4.2.5-1 COMPARISON OF OBSERVED (SURVEY DATA) AND ASSIGNED TRAFFIC VOLUME

Unit: Vehicle/day

Road Name	Location	Observed Traffic Volume	Assigned Traffic Volume	Difference	Rate
Quirino Ave.	Zapote, Las Piñas	29,951	26,917	3,034	11%
Aguinaldo Highway	Talaba VI, Bacoor	52,404	47,078	5,326	11%
Molino Blvd.	Mambog IV, Bacoor	28,628	27,559	1,069	4%
Aguinaldo Highway	Real I, Bacoor	24,697	25,776	-1,079	-4%
Cavite Expressway	Bacao II, General Trias	10,948	13,235	-2,288	-17%
Antero Soriano Highway	Samala-Marquez, Kawit	14,192	11,635	2,557	22%
General Trias Drive	Tejero, General Trias	10,130	12,111	-1,981	-16%
Tanza - Trece Martires Road	Sanja Mayor, Tanza	7,275	8,504	-1,229	-14%
Open Canal Road	Malagasang II, Imus	6,041	7,555	-1,515	-20%
Aguinaldo Highway	Anabo II-E, Imus	26,514	24,462	2,051	8%
Daang Hari Road	Pinagbuklod, Imus	16,830	14,497	2,333	16%
Molino Road	Almanza Dos, Las Piñas	20,307	19,350	957	5%
Daang Hari Road	Brgy Molino I, Bacoor	22,475	19,077	3,398	18%
SLEX	Petron & Caltex Stations	95,215	98,165	-2,950	-3%
Manila South Road	Tunasan, Muntinlupa	27,650	29,432	-1,782	-6%
Governor's Drive	Mabuhay, Carmona	19,059	20,418	-1,359	-7%
Sta. Rosa - Tagaytay Road	Sto. Domingo, St. Rosa	12,881	13,409	-528	-4%
Paliparan Road	Paliparan I, Dasmariñas	9,340	12,043	-2,703	-22%
Governor's Drive	Paliparan I, Dasmariñas	19,965	17,253	2,712	16%
Aguinaldo Highway	Biga II, Silang	14,796	15,186	-390	-3%
Governor's Drive	San Francisco, General Trias	20,973	22,770	-1,797	-8%
Andres Bonifacio St.	San Francisco, General Trias	9,494	11,549	-2,055	-18%
Crisanto De Los Reyes Ave.	Buenavista III, General Trias	5,970	8,815	-2,845	-32%
Crisanto De Los Reyes Ave.	Biclatan, General Trias	8,040	10,424	-2,384	-23%

[1] MAD Ratio is defined by the following formula: MAD Ratio = $\sum \left| \frac{Count - assignment}{assignment} \right| / n$ where n is the number of observations.

Road Name	Location	Observed Traffic Volume	Assigned Traffic Volume	Difference	Rate
Governor's Drive	Sabang, Naic	2,388	3,319	-932	-28%
Antero Soriano Highway	Lambingan, Tanza	6,402	6,670	-268	-4%
Total		522,561	527,209	-4,648	-1%

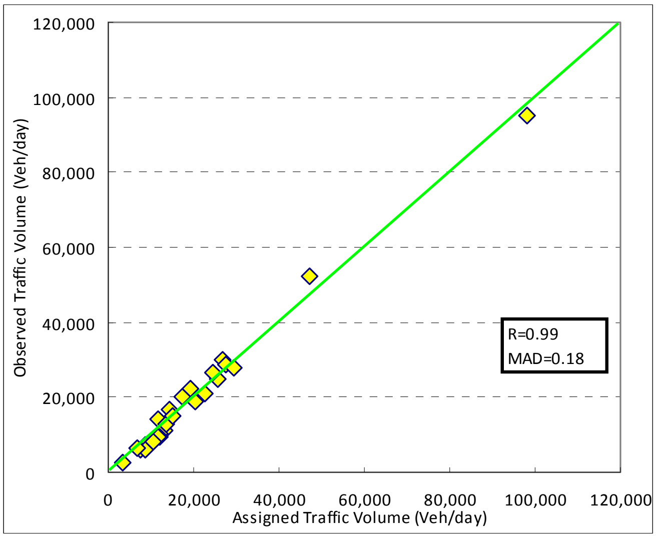


FIGURE 4.2.5-1 COMPARED OBSERVED TRAFFIC VOLUME AND ASSIGNED TRAFFIC VOLUME

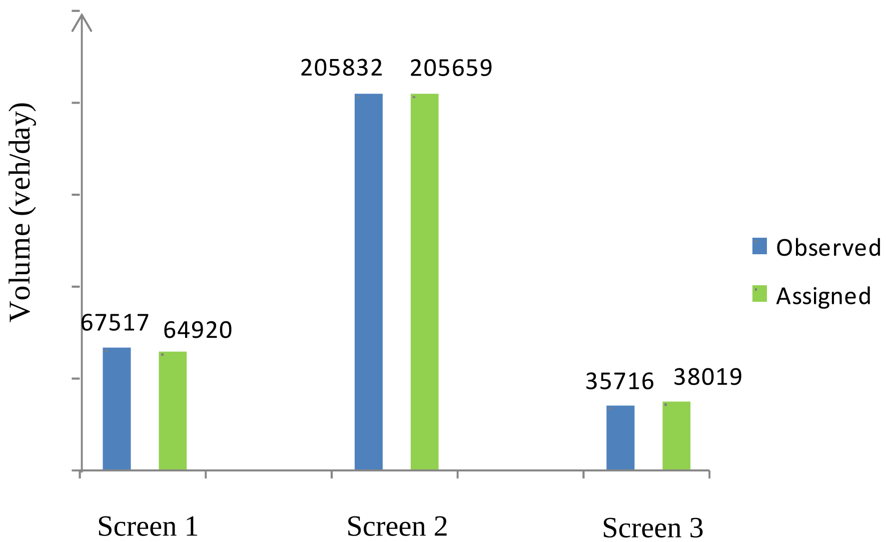


FIGURE 4.2.5-2 COMPARED OBSERVED TRAFFIC VOLUME AND ASSIGNED TRAFFIC VOLUME AT SCREEN-LINE

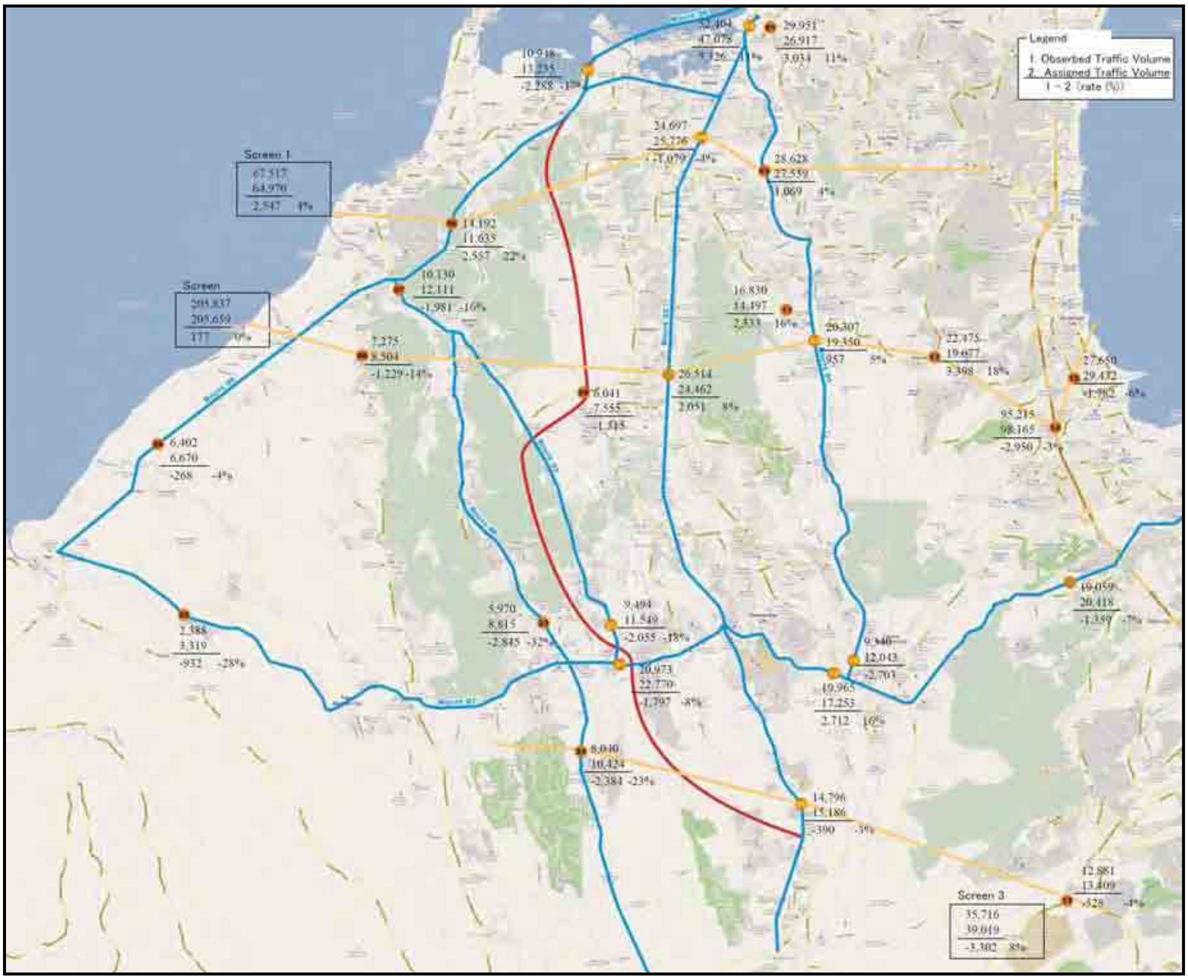


FIGURE 4.2.5-3 MAP OF OBSERVED TRAFFIC VOLUME AND ASSIGNED TRAFFIC VOLUME

4.2.6 Toll Rate vs. Revenue

In order to set the proper toll rate of CALAX, the traffic volume and the amount of revenue are estimated by traffic assignment model. **Figure 4.2.6-1** shows the result of traffic assignment of toll rate in year 2011.

- In case of toll free, total traffic volume to enter CALAX is 69,316 vehicles/day

- The toll rate for getting higher revenue is about **4 to 15** Peso/km and the amount of revenue is about 3.7 and 4.2 million Peso/day. Although maximum amount of revenue is 10 peso case, traffic volume to enter CALAX is only 19,819 vehicle /day which is about 30% of toll free case.

- The desirable toll rate for attractive to motorist and higher revenue is **4.0 Peso/km**. Total traffic volume to enter CALAX is 41,567 vehicle/day (60% of toll free case). This toll rate is the almost same as that of Manila Cavite Toll Expressway (herein CAVITEX) phase-1 and it is cheaper than that of other new present expressways such as CAVITEX Phase-2 and Skyway Phase-2 (see **Table 4.2.6-1**). Most motorists may still accept the 4.0 peso/km in year 2011.

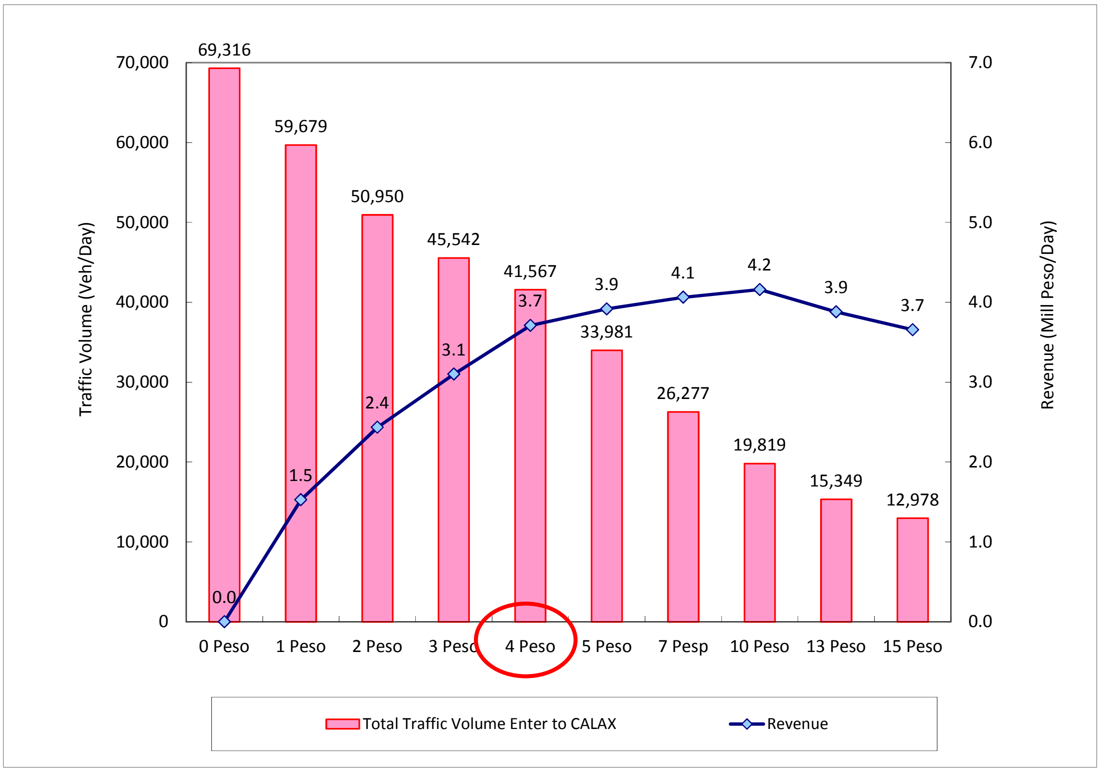


FIGURE 4.2.6-1 TOLL RATE VS REVENUE (YEAR 2011)

TABLE 4.2.6-1 PRESENT TOLL RATE

(Peso/km)

Toll Road		Class 1 *Car, Jeep, Pick-up*	Class 2 *Light Truck*	Class 3 *Heavy Truck, Trailer*	Remarks
Metro Manila Skyway (MMS)	Elevated Phase 1	6.84	13.68	20.53	Skyway/Buendia - Bicutan (9.50 km)
	Elevated Phase 2	11.92	23.84	35.76	Alabang - Bicutan (6.88 km)
	At grade	7.85	15.70	23.56	Magallanes - Alabang (13.50 km)
North Luzon Expressway (NLEX)		2.38	5.92	7.08	
South Luzon Expressway (SLEX)		3.02	6.04	9.10	
Manila Cavite Toll Expressway	Phase 1	3.33	6.82	9.85	R-1 Extension to Bacoor (6.6 km)
	Phase 2	8.96	17.92	26.87	Bacoor Bay to Kawit (6.475 km)
Southern Tagalog Arterial Road (STAR)		1.43	2.86	4.26	
Subic-Clark-Tarlac Expressway (SCTEX)		2.68	5.36	8.04	

Source: TRB, 2011 May

Toll rate is assumed as 8% adjustment as every two years since 4peso/km in year 2011.

TABLE 4.2.6-2 ASSUMED TOLL RATE OF CALAX

Unit: Peso /km

	Class-1	Class-2	Class-3
Year 2011	4.0	8.0	12.0
Year 2017	5.0	10.0	15.0
Year 2020	5.4	10.8	16.2
Year 2030	7.9	15.8	23.7

Source JICA Study Team

4.2.7 Traffic Assignment Result

Traffic assignment was conducted as following two cases.

Case-1	**Cavite section and Laguna section Construction Case**
Case-2	**Laguna section only Construction Case**

1) Case-1 CALAX (Cavite Section and Laguna Section)

a) Total Traffic Efficiency

Table 4.2.7-1 shows the traffic assignment of without CALAX case and with case.

TABLE 4.2.7-1 TRAFFIC INDICATORS OF W/O CALAX (CAVITE AND LAGUNA SECTION) CASE AND WITH CASE

Year	Case	Total Travel Time (PCU*hr)	Total Vehicle Km (PCU*km)	Average Travel Speed (km/hr)
2017	With	908,836	25,586,464	28.2
	W/O	983,977	25,890,328	26.3
	With-W/O	-75,141	-303,864	1.8
2020	With	1,084,733	29,186,268	26.9
	W/O	1,194,959	29,559,040	24.7
	With-W/O	-110,226	-372,772	2.2
2030	With	1,620,295	37,741,397	23.3
	W/O	1,779,212	37,236,284	20.9
	With-W/O	-158,917	505,114	2.4

Source JICA Study Team
Note: PCU: Passenger Car Unit

- Total travel time will decrease if CALAX was constructed. The difference of total travel time is 75,141 hours/day in year 2017 which much traffic time can be saved by CALAX.

- If CALAX was constructed, many motorists may use this expressway even though their trips become longer. Total PCU*km of with case in year 2030 will be higher than that of without case.

b) Traffic Assignment

Figure 4.2.7-1 to **4.2.7-3** shows the estimated traffic volume of CALAX Laguna section.

- The highest traffic volume interchange section is between Sta.Rosa-Tagaytay IC and Laguna Blvd. IC, which number of traffic are 25,943 (vehicle/day) in year 2017, 32,567 (vehicle/day) in year 2020 and 50,847 (vehicle/day) in year 2030.

Figure 4.2.7-4 to 4.2.7-6 shows the traffic assignment result with CALAX and **Figure 4.2.7-7 to 4.2.7-9** shows the difference of traffic volume with case and without case.

- If CALAX is constructed, traffic volume of major arterial road will decrease excluding CAVITEX shown in **Figure 4.2.7-7** to **4.2.7-9**.

Table 4.2.7-2 shows the total traffic volume to enter CALAX Laguna section and total vehicle km of CALAX Laguna Section.

- The number of traffic using CALAX Laguna section is estimated as 37,916 in year 2017, 47,128 in year2020 and 80,625 in year 2030.

TABLE 4.2.7-2 TOTAL TRAFFIC VOLUME AND TOTAL VEHICLE KM(CASE: WITH CAVITE & LAGUNA SECTION)

Year	Total Traffic Enter to CALAX Laguna Section (Veh/day)				Total vehicle*km(Laguna Section only)			
	Class1	Class2	Class3	Total	Class1	Class2	Class3	Total
2017	24,792	8,769	4,355	37,916	253,047	102,418	56,064	411,529
2018	27,110	9,164	4,467	40,742	277,104	107,085	57,545	441,734
2019	29,646	9,578	4,582	43,806	303,449	111,965	59,064	474,478
2020	32,418	10,010	4,700	47,128	332,298	117,067	60,624	509,990
2021	34,507	10,372	4,801	49,680	348,818	120,839	62,277	531,934
2022	36,730	10,747	4,905	52,382	366,159	124,732	63,975	554,866
2023	39,097	11,135	5,011	55,243	384,362	128,751	65,718	578,832
2024	41,616	11,537	5,120	58,272	403,470	132,899	67,510	603,880
2025	44,297	11,953	5,230	61,481	423,528	137,181	69,350	630,060
2026	47,152	12,385	5,344	64,880	444,583	141,601	71,241	657,426
2027	50,190	12,832	5,459	68,482	466,685	146,164	73,183	686,032
2028	53,424	13,296	5,577	72,297	489,886	150,873	75,178	715,937
2029	56,866	13,776	5,698	76,340	514,240	155,734	77,227	747,201
2030	60,530	14,274	5,821	80,625	539,804	160,752	79,332	779,889

Note: With Cavite and Laguna Section Case. The figure is shown only traffic volume of Laguna Section.

CASE-1(CAVITE AND LAGUNA SECTION CONTRUCTION CASE)

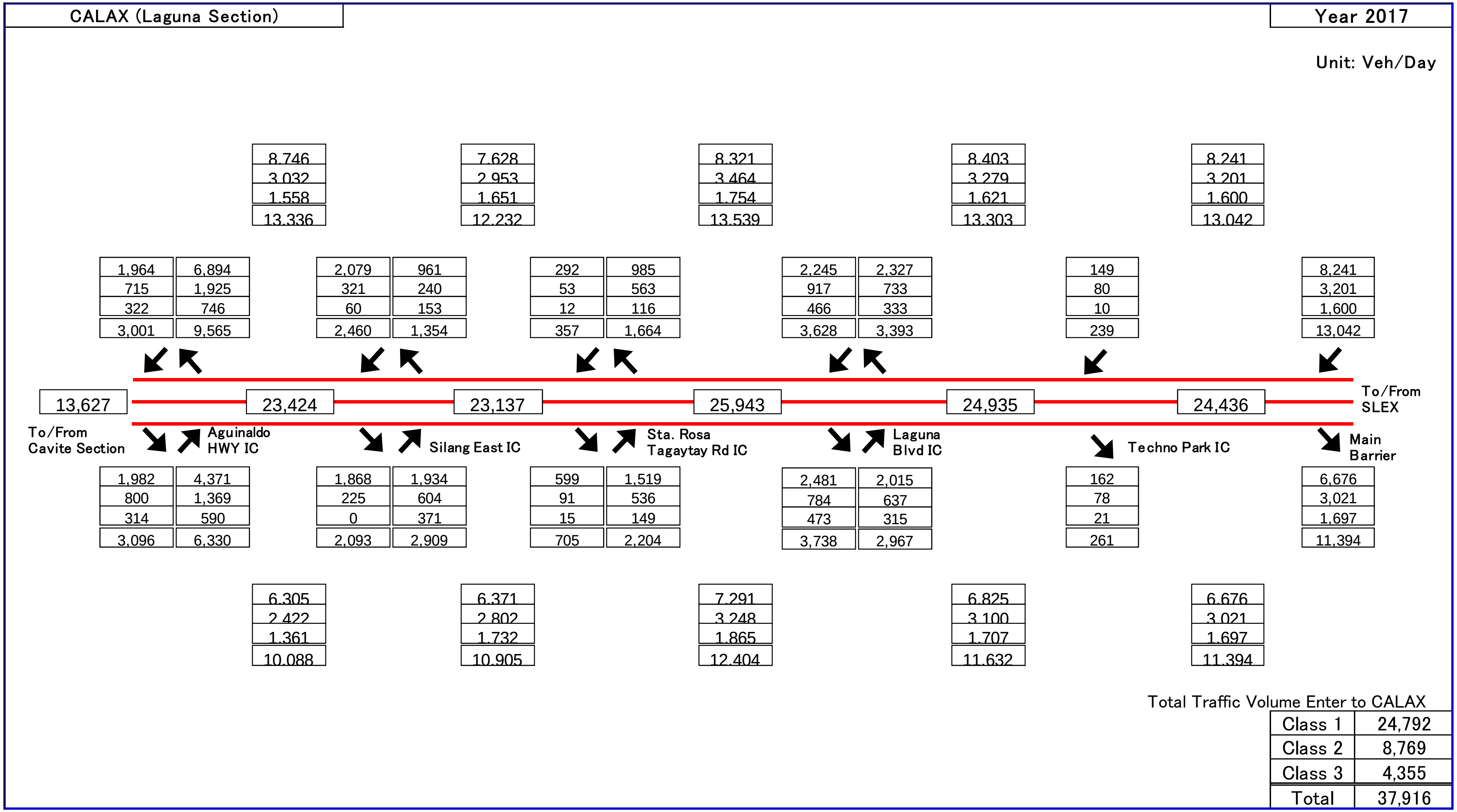


FIGURE 4.2.7-1 TRAFFIC PROJECTION (YEAR 2017) OF CALAX LAGUNA SECTION (CASE-1)

CASE-1(CAVITE AND LAGUNA SECTION CONTRUCTION CASE)

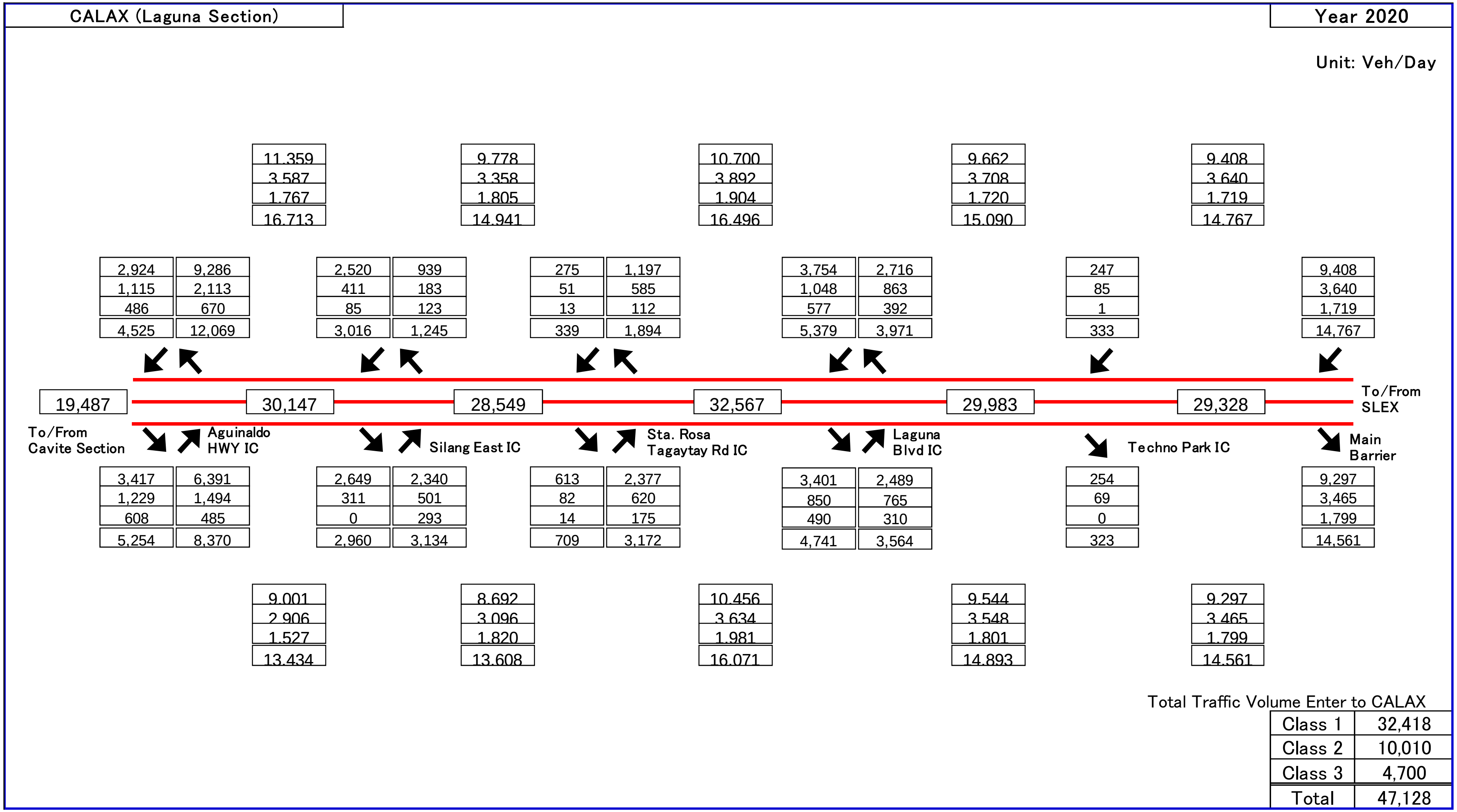


FIGURE 4.2.7-2 TRAFFIC PROJECTION (YEAR 2020) OF CALAX LAGUNA SECTION (CASE-1)

CASE-1(CAVITE AND LAGUNA SECTION CONTRUCTION CASE)

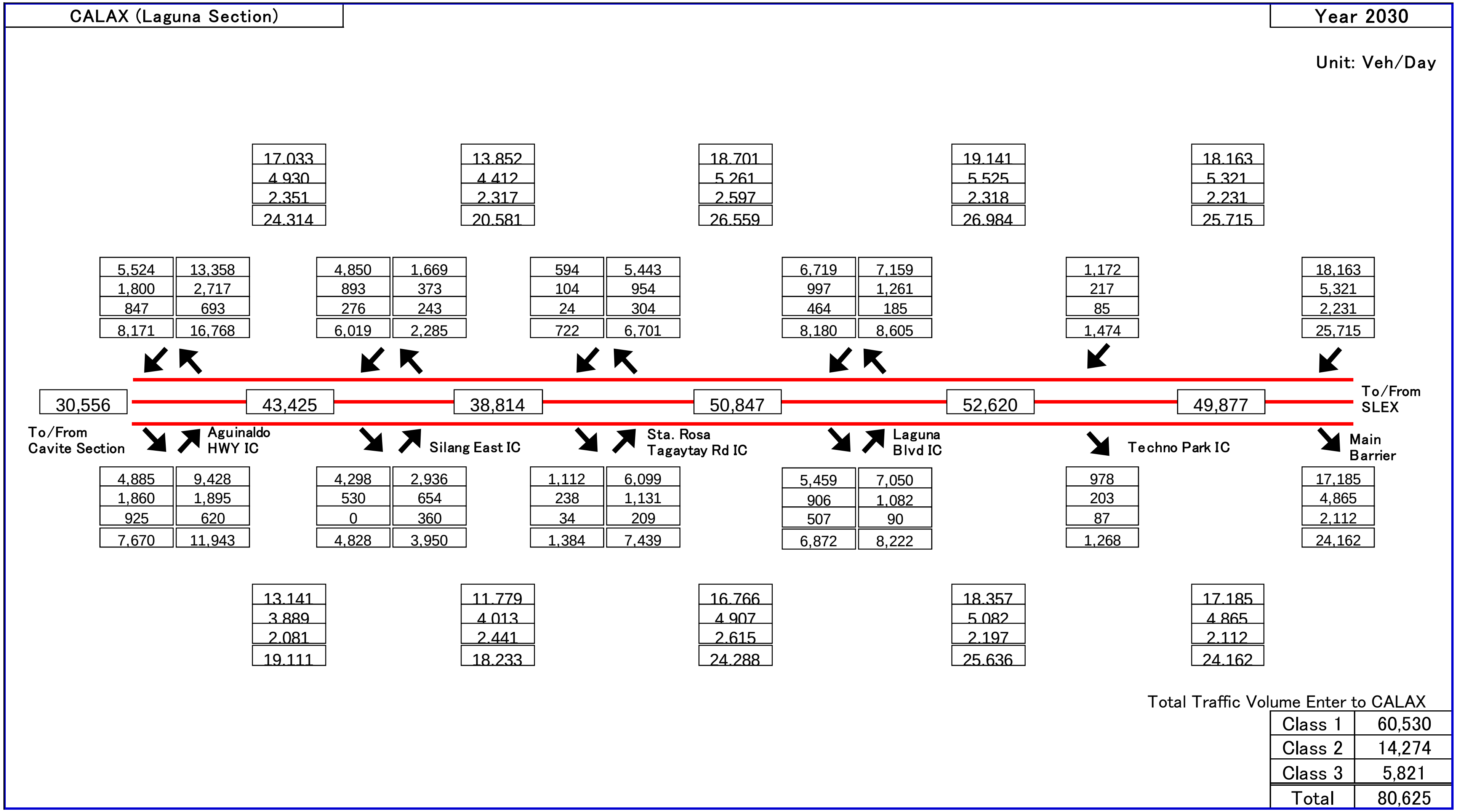


FIGURE 4.2.7-3 TRAFFIC PROJECTION (YEAR 2030) OF CALAX LAGUNA SECTION (CASE-1)

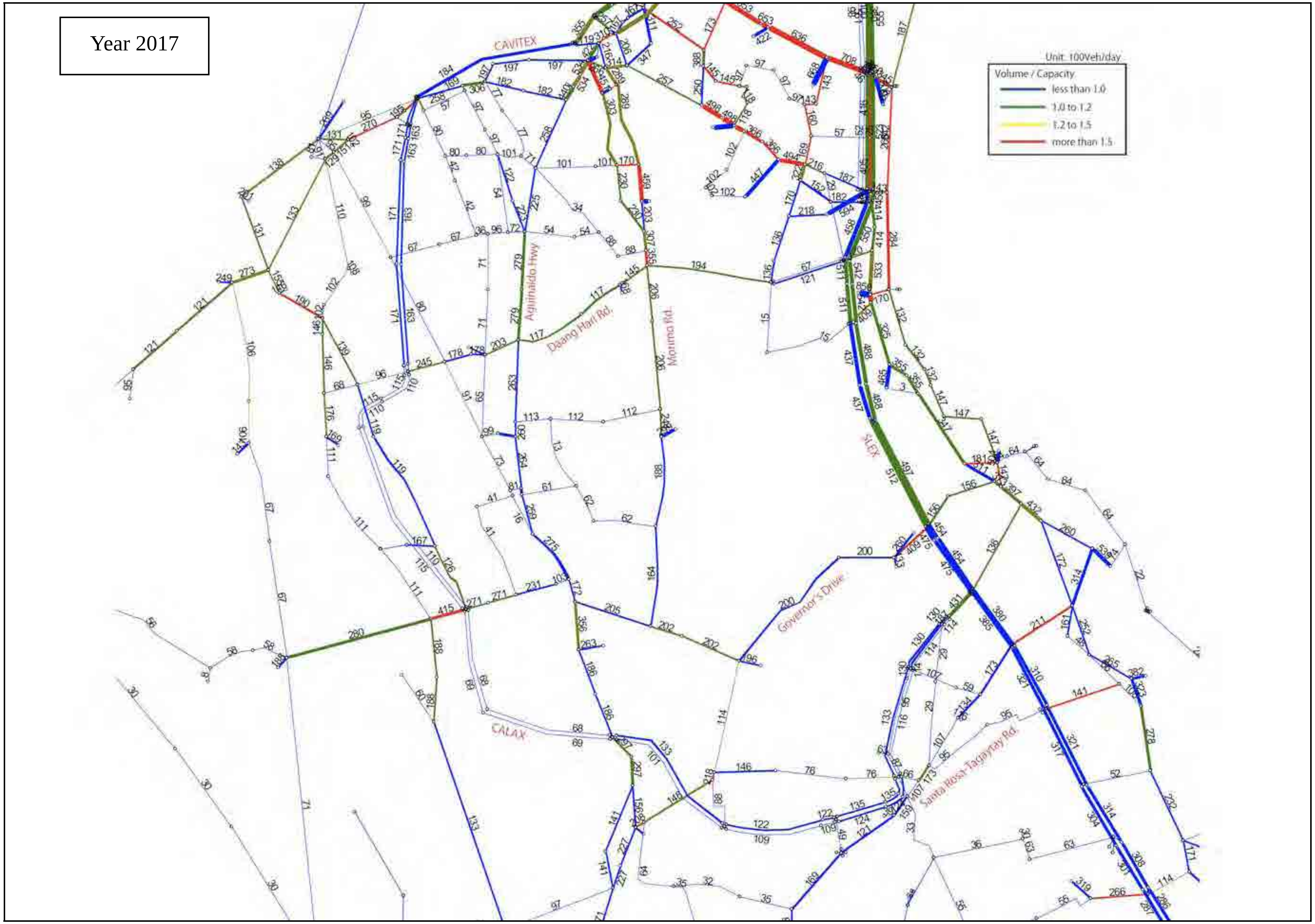


FIGURE 4.2.7-4 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2017 (CASE-1)

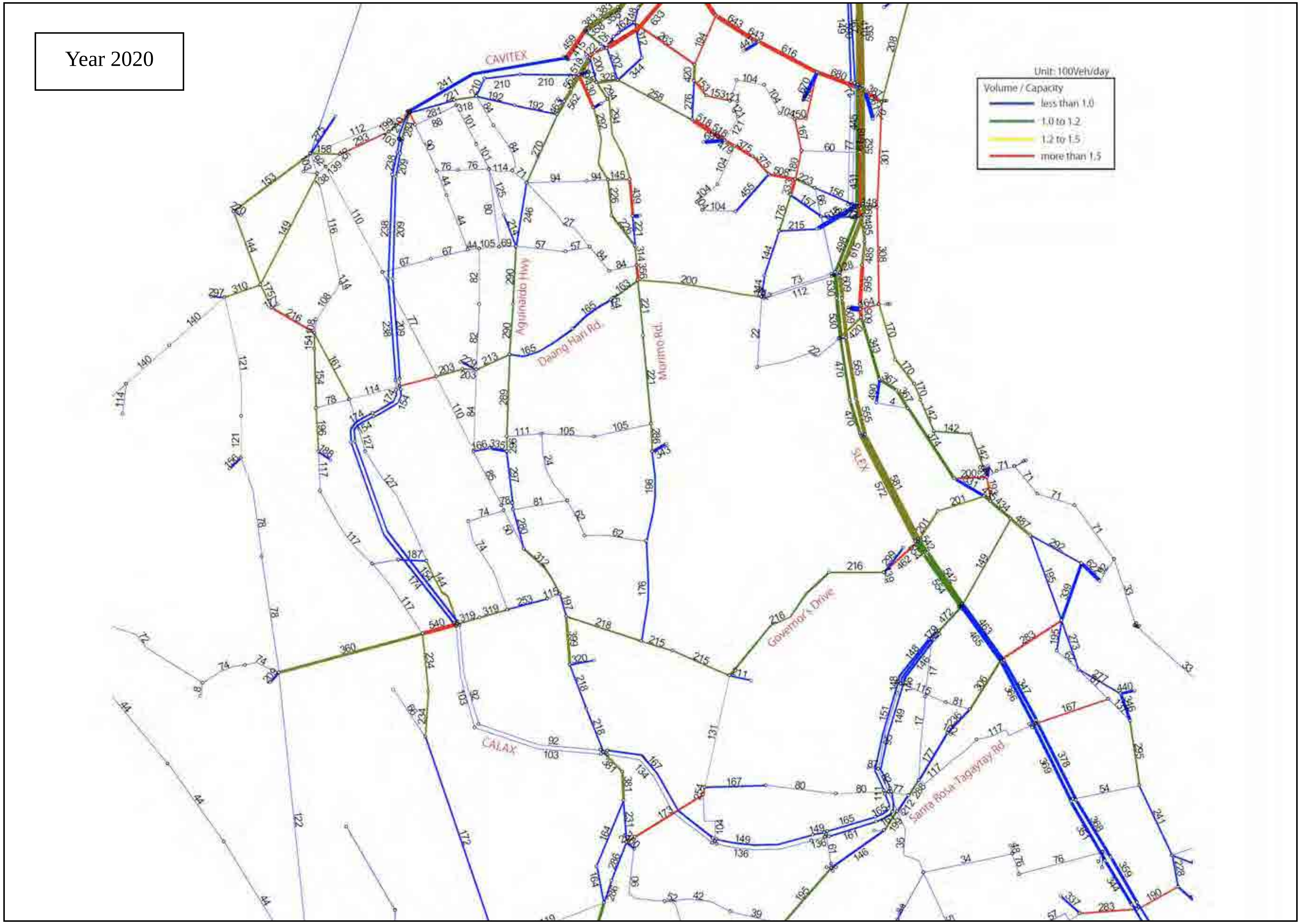


FIGURE 4.2.7-5 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2020 (CASE-1)

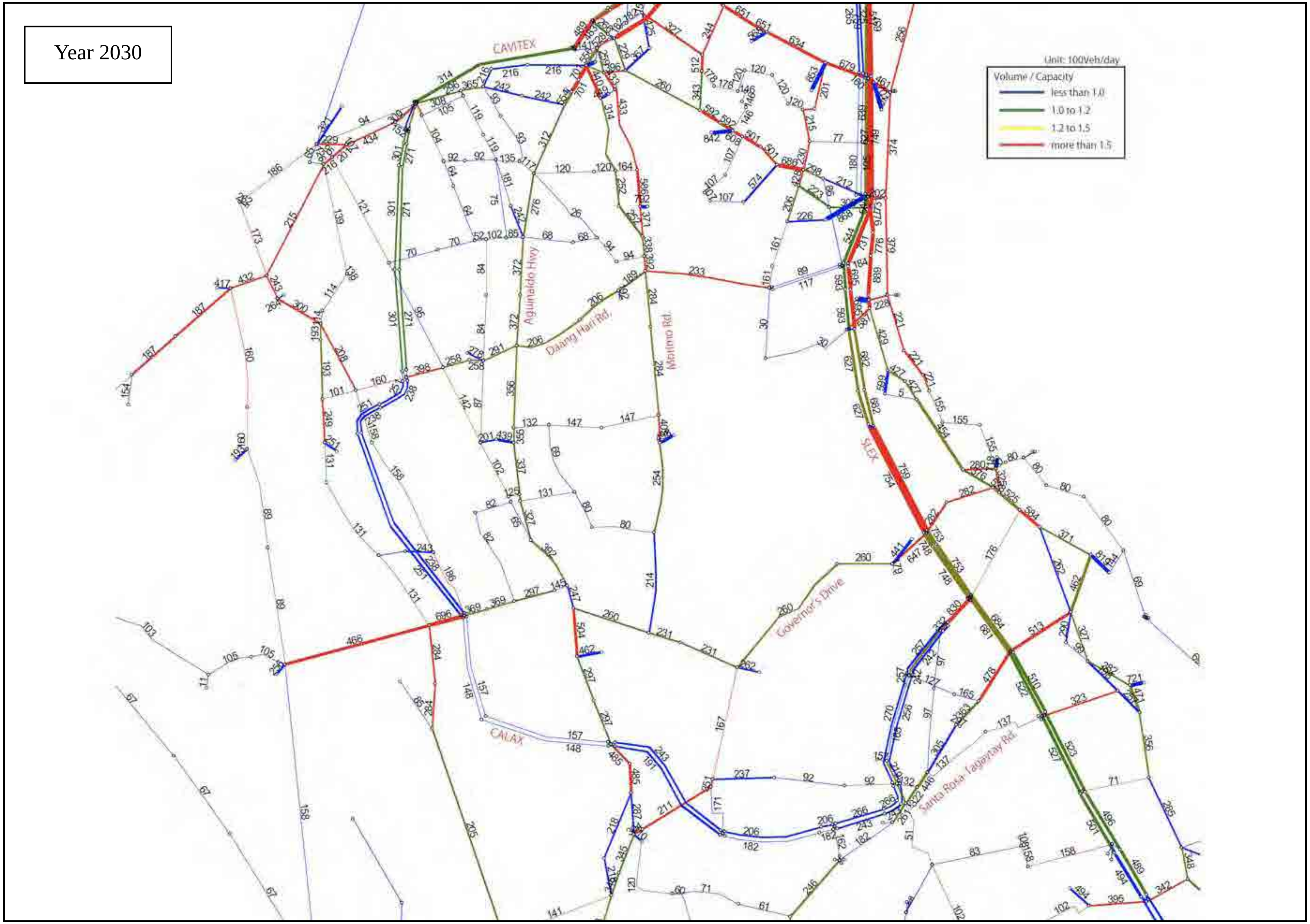


FIGURE 4.2.7-6 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2030 (CASE-1)

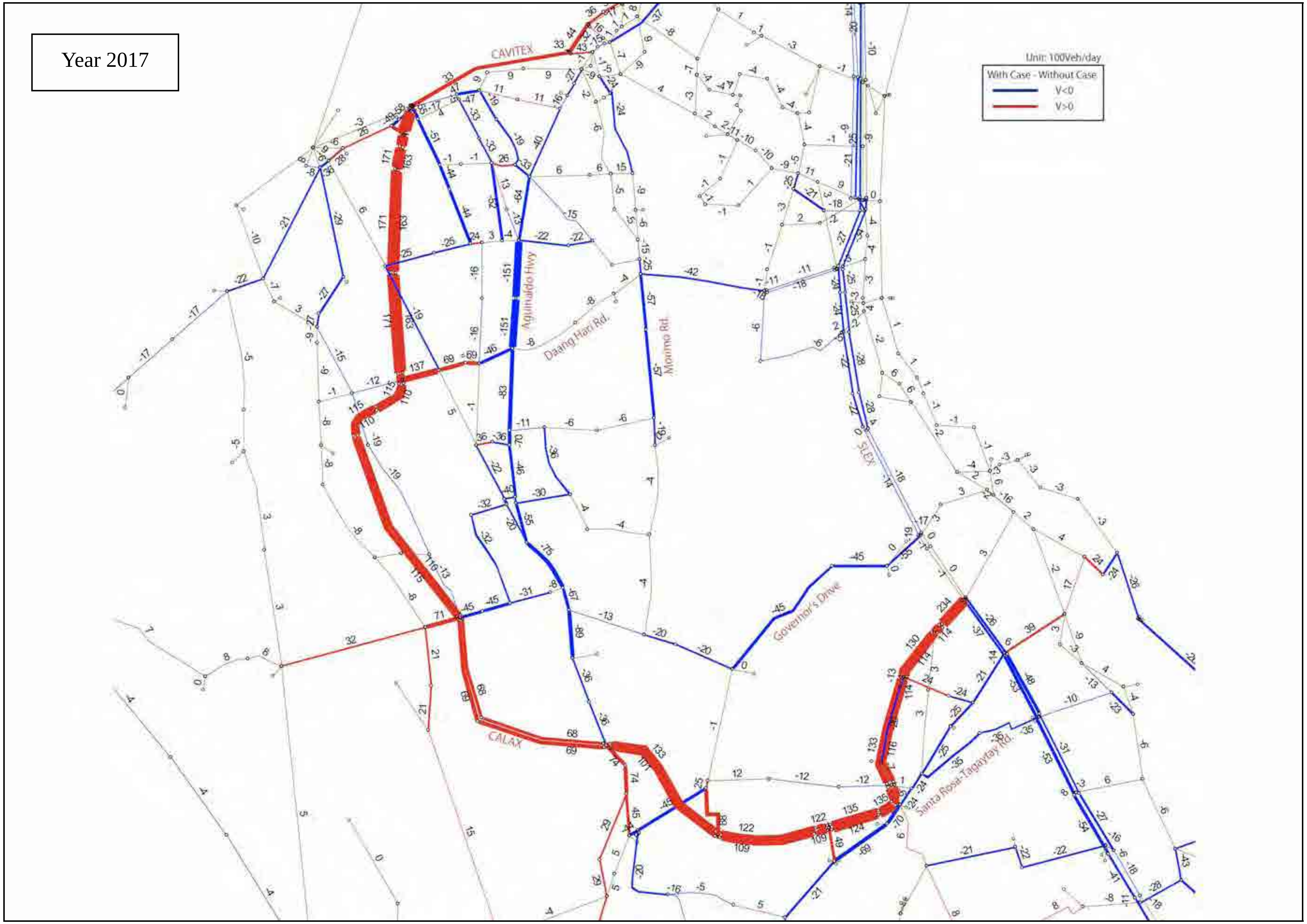


FIGURE 4.2.7-7 COMPARISON OF WITH CASE AND WITHOUT (CAVITE AND LAGUNA SECTION) CASE IN YEAR 2017

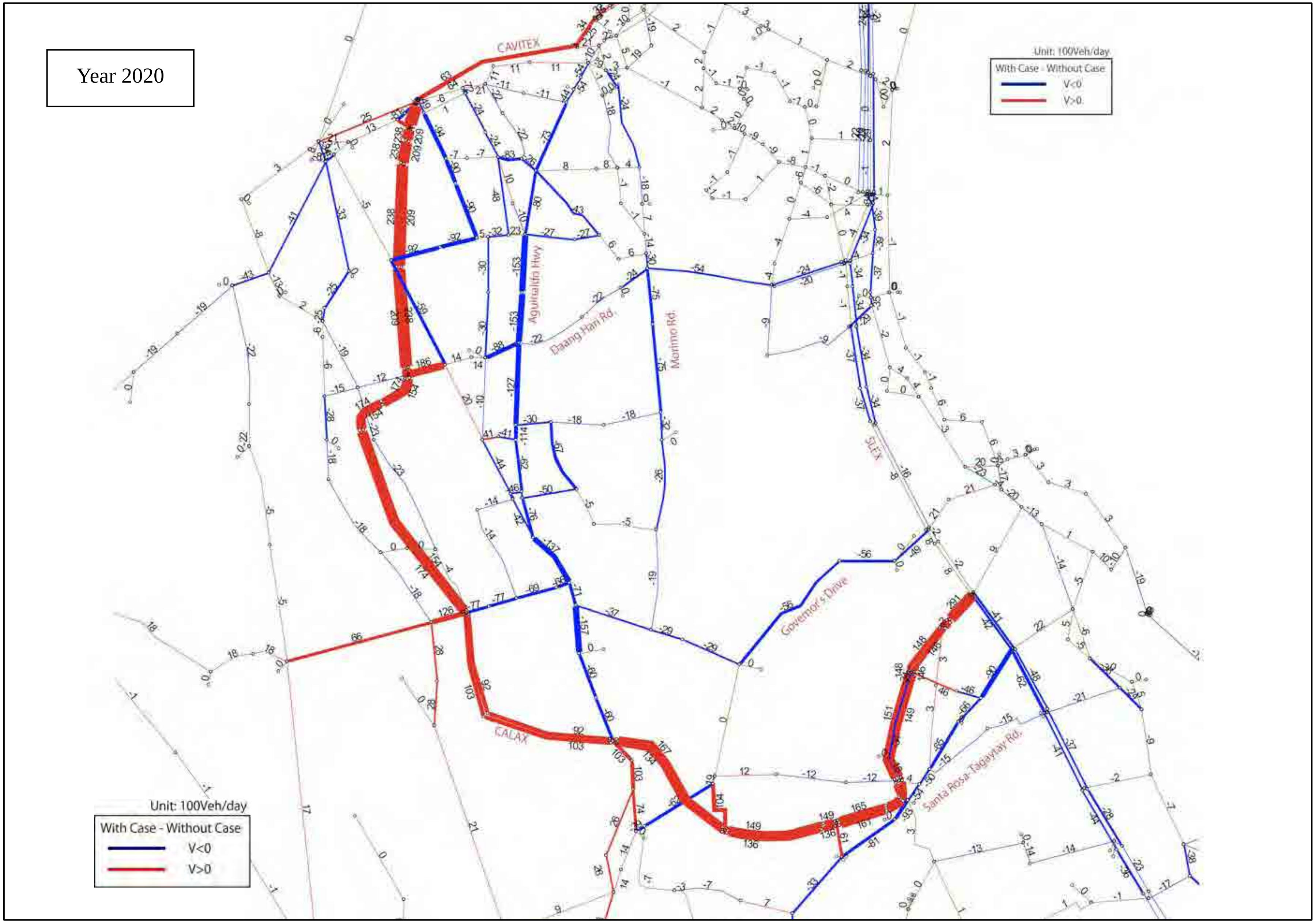


FIGURE 4.2.7-8 COMPARISON OF WITH CASE AND WITHOUT (CAVITE AND LAGUNA SECTION) CASE IN YEAR 2020

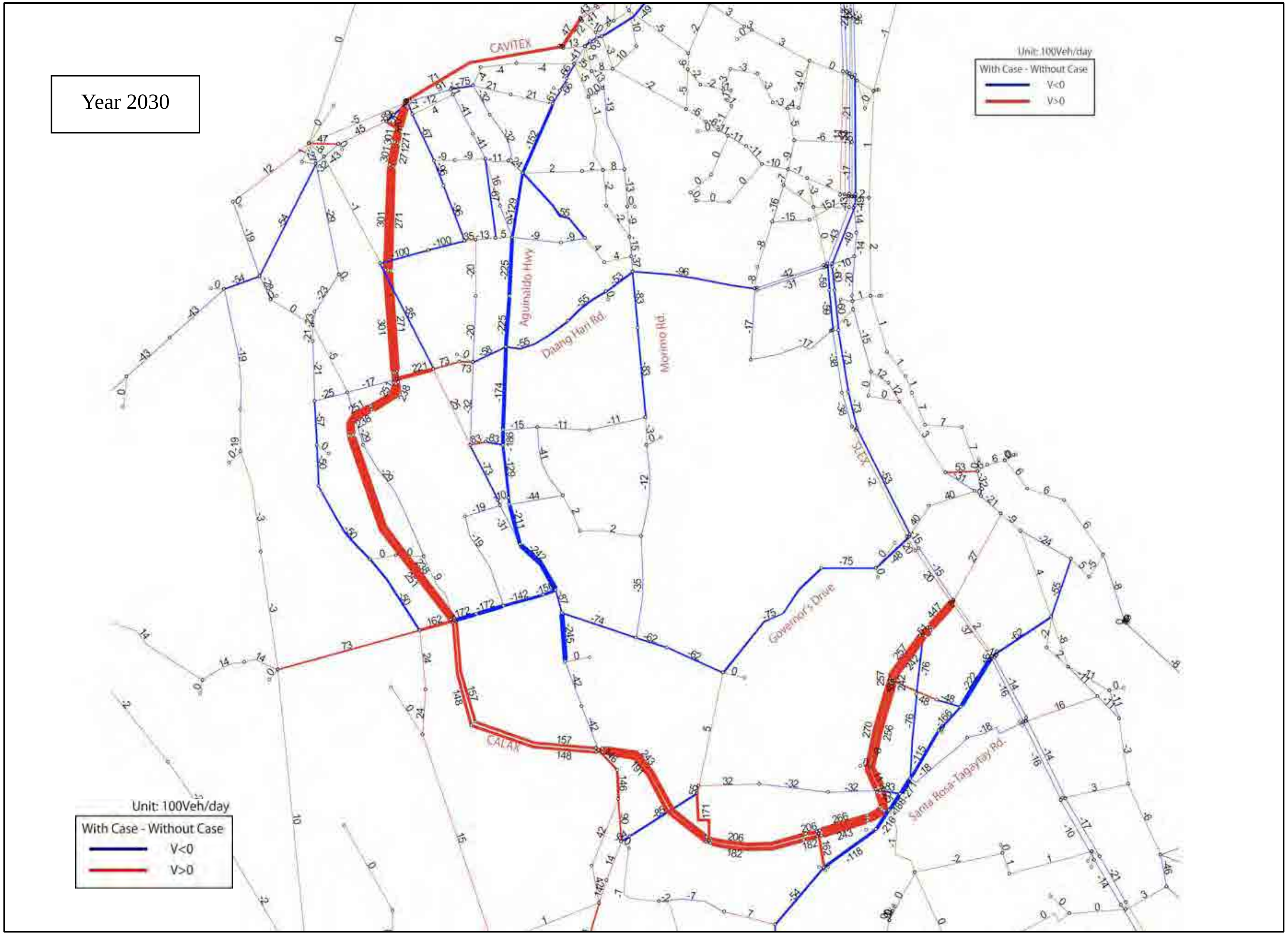


FIGURE 4.2.7-9 COMPARISON OF WITH CASE AND WITHOUT (CAVITE AND LAGUNA SECTION) CASE IN YEAR 2030

2) Case-2 CALAX (Laguna Section only)

a) Total Traffic Efficiency

Table 4.2.7-3 shows the traffic assignment of without CALAX case and with case.

TABLE 4.2.7-3 TRAFFIC INDICATORS OF W/O CASE AND WITH LAGUNA SECTION CASE

Year	Case	Total Travel Time (PCU*hr)	Total Vehicle Km (PCU*km)	Average Travel Speed (km/hr)
2017	With	942,372	25,379,915	26.9
	W/O	983,977	25,890,328	26.3
	With-W/O	-41,604	-510,413	0.6
2020	With	1,137,266	28,922,060	25.4
	W/O	1,194,959	29,559,040	24.7
	With-W/O	-57,692	-636,980	0.7
2030	With	1,701,499	37,260,027	21.9
	W/O	1,779,212	37,236,284	20.9
	With-W/O	-77,713	23,743	1.0

Source JICA Study Team

Note: PCU: Passenger Car Unit

- Total travel time will decrease if CALAX Laguna section was constructed. The difference of total travel time is 41,604 hours/day in year 2017 which much traffic time can be saved by CALAX.

2) Traffic Assignment

Figure 4.2.7-10 to **4.2.7-12** shows the estimated traffic volume of CALAX Laguna section.

- The highest traffic volume interchange section is between Sta.Rosa-Tagaytay IC and Laguna Blvd. IC, which number of traffic are 27,743 (vehicle/day) in year 2017, 35,240 (vehicle/day) in year 2020 and 52,799 (vehicle/day) in year 2030.

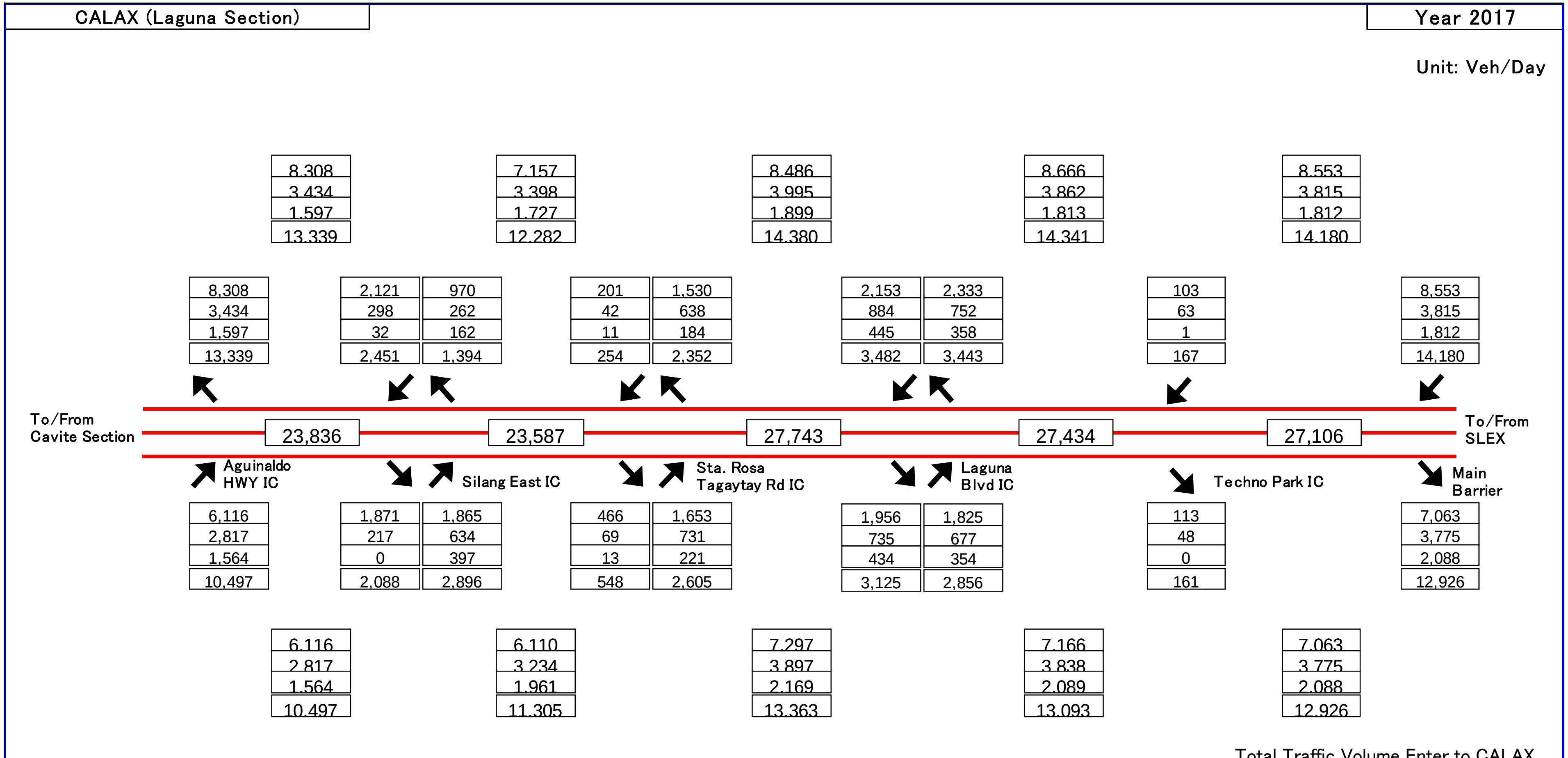
Figure 4.2.7-13 to 4.2.7-15 shows the traffic assignment result with CALAX and **Figure 4.2.7-7 to 4.2.7-12** shows the difference of traffic volume with case and without case.

Table 4.2.7-4 shows the total traffic volume to enter CALAX Laguna section and total vehicle km of CALAX Laguna Section.

TABLE 4.2.7-4 TOTAL TRAFFIC VOLUME AND TOTAL VEHICLE KM CASE-2(LAGUNA SECTION CONSTRUCTION)

Year	Total Traffic Enter to CALAX Laguna Section (Veh/day)				Total vehicle*km(Laguna Section only)			
	Class1	Class2	Class3	Total	Class1	Class2	Class3	Total
2017	24,600	9,945	4,837	39,382	250,738	120,376	62,914	434,028
2018	27,039	10,427	4,952	42,418	277,249	127,378	64,403	469,030
2019	29,720	10,933	5,070	45,723	306,563	134,786	65,927	507,277
2020	32,666	11,463	5,191	49,320	338,976	142,626	67,488	549,090
2021	34,640	11,779	5,255	51,674	354,258	145,858	68,746	568,862
2022	36,734	12,105	5,319	54,158	370,229	149,163	70,028	589,420
2023	38,954	12,439	5,385	56,777	386,920	152,543	71,334	610,797
2024	41,308	12,782	5,451	59,541	404,363	156,000	72,664	633,027
2025	43,804	13,135	5,518	62,457	422,593	159,535	74,020	656,147
2026	46,452	13,497	5,586	65,535	441,644	163,150	75,400	680,194
2027	49,259	13,870	5,654	68,784	461,554	166,847	76,806	705,207
2028	52,236	14,253	5,724	72,213	482,362	170,628	78,238	731,228
2029	55,393	14,646	5,794	75,834	504,108	174,494	79,698	758,300
2030	58,741	15,051	5,865	79,657	526,835	178,448	81,184	786,467

CASE-2(LAGUNA SECTION CASE)



Total Traffic Volume Enter to CALAX

Class 1	24,600
Class 2	9,945
Class 3	4,837
Total	39,382

FIGURE 4.2.7-10 TRAFFIC PROJECTION (YEAR 2017) OF CALAX LAGUNA SECTION,

CASE-2(LAGUNA SECTION CASE)

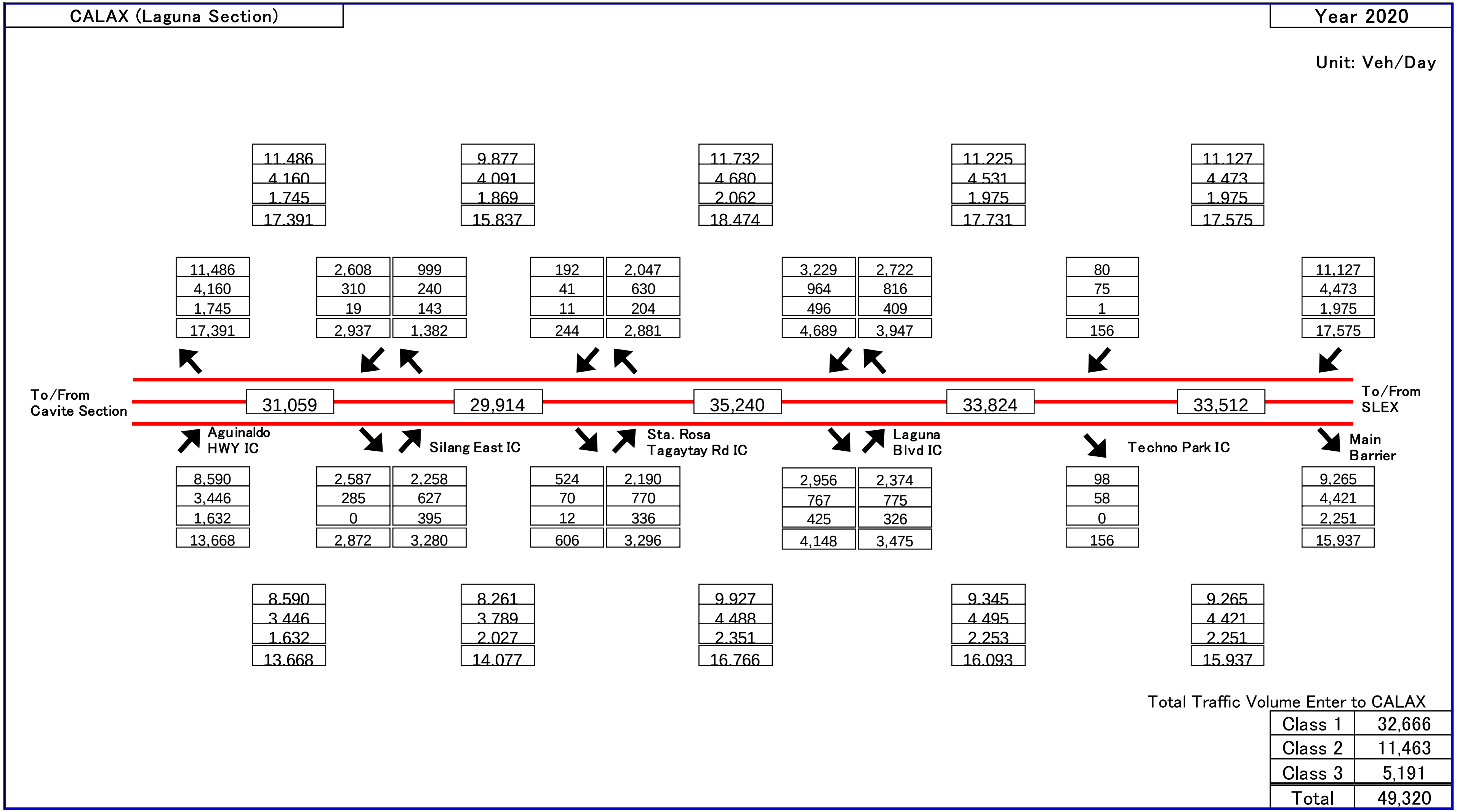


FIGURE 4.2.7-11 TRAFFIC PROJECTION (YEAR 2020) OF CALAX LAGUNA SECTION

CASE-2(LAGUNA SECTION CASE)

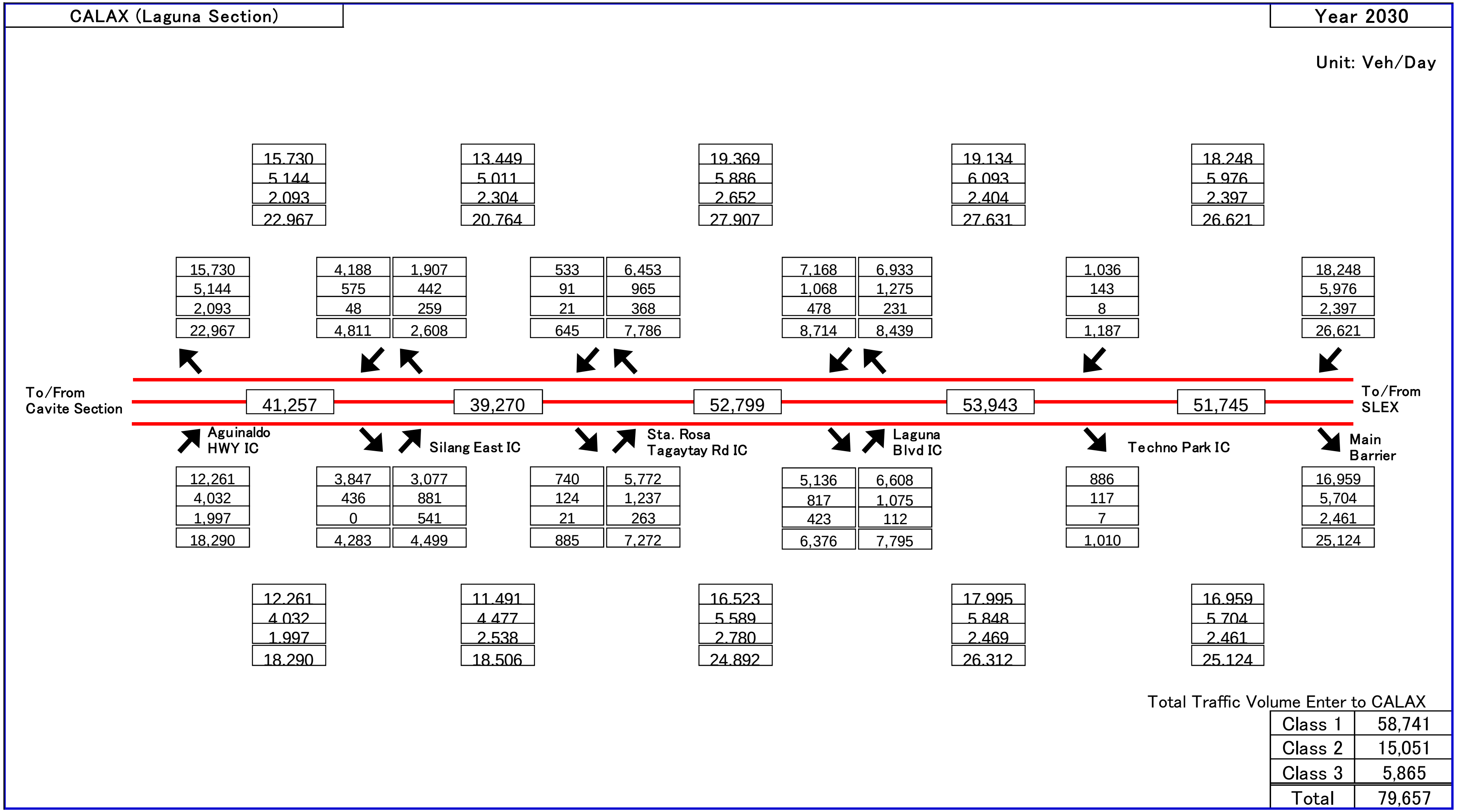


FIGURE 4.2.7-12 TRAFFIC PROJECTION (YEAR 2030) OF CALAX LAGUNA SECTION

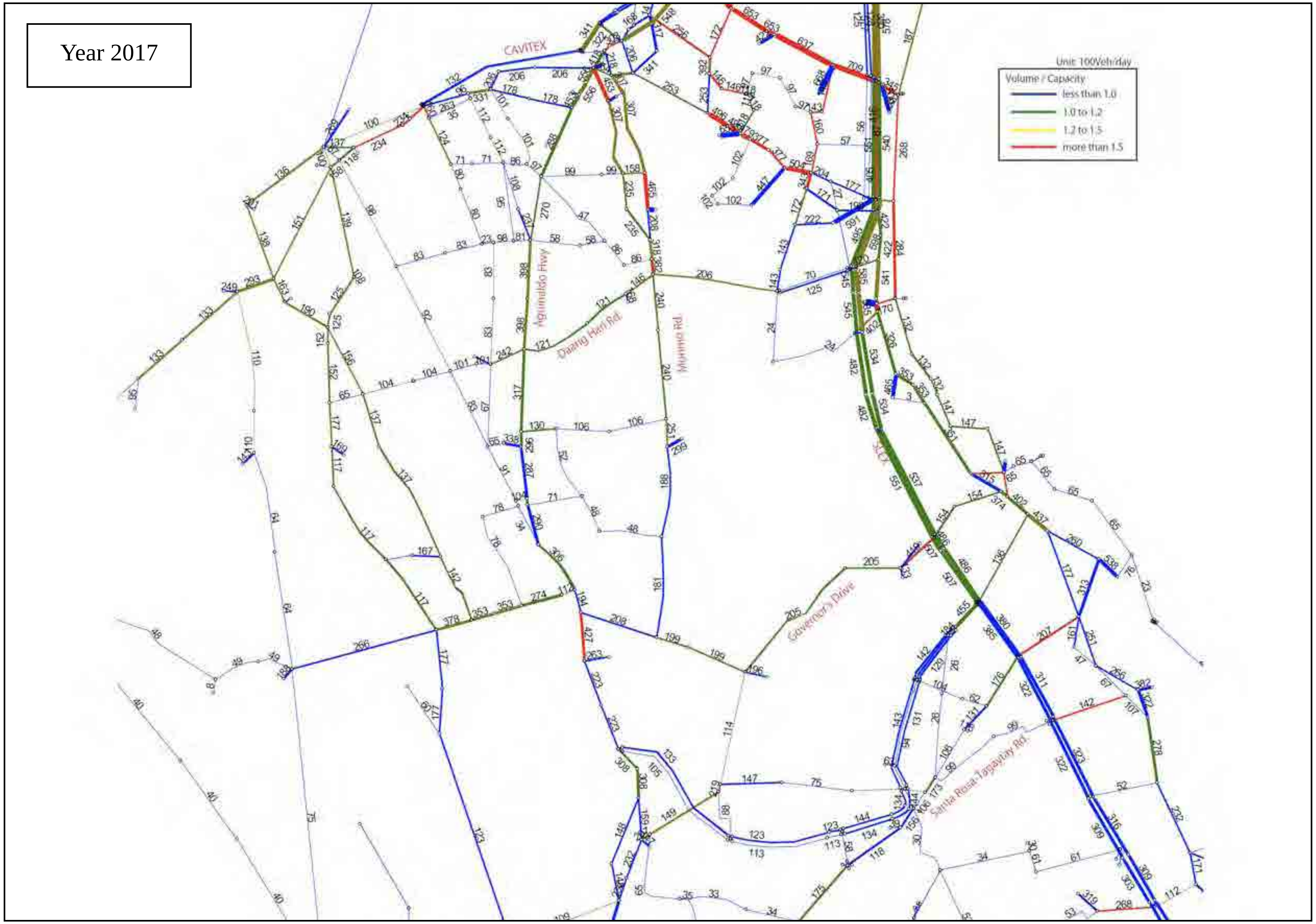


FIGURE 4.2.7-13 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2017 (CASE-2)

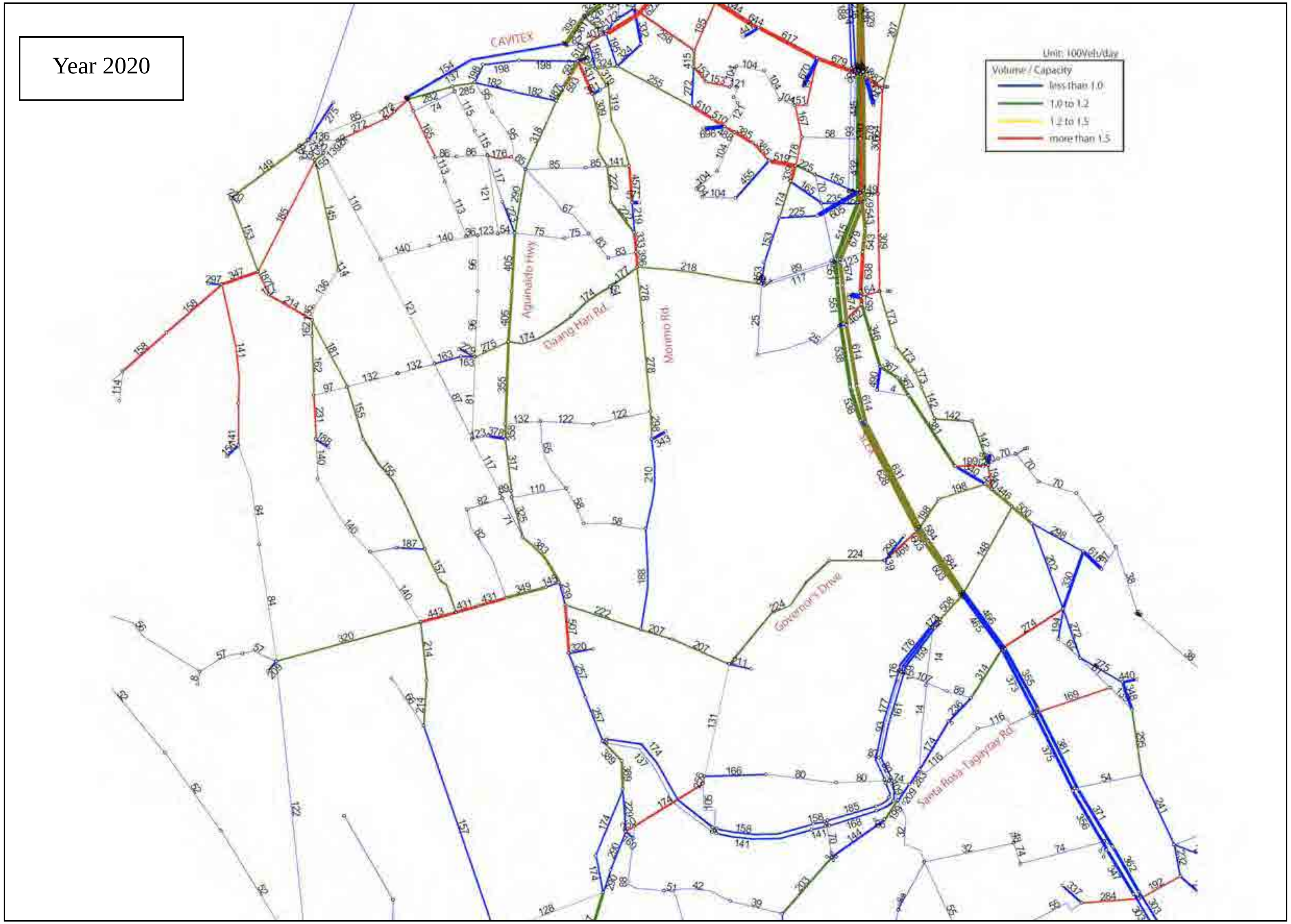


FIGURE 4.2.7-14 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2020 (CASE-2)

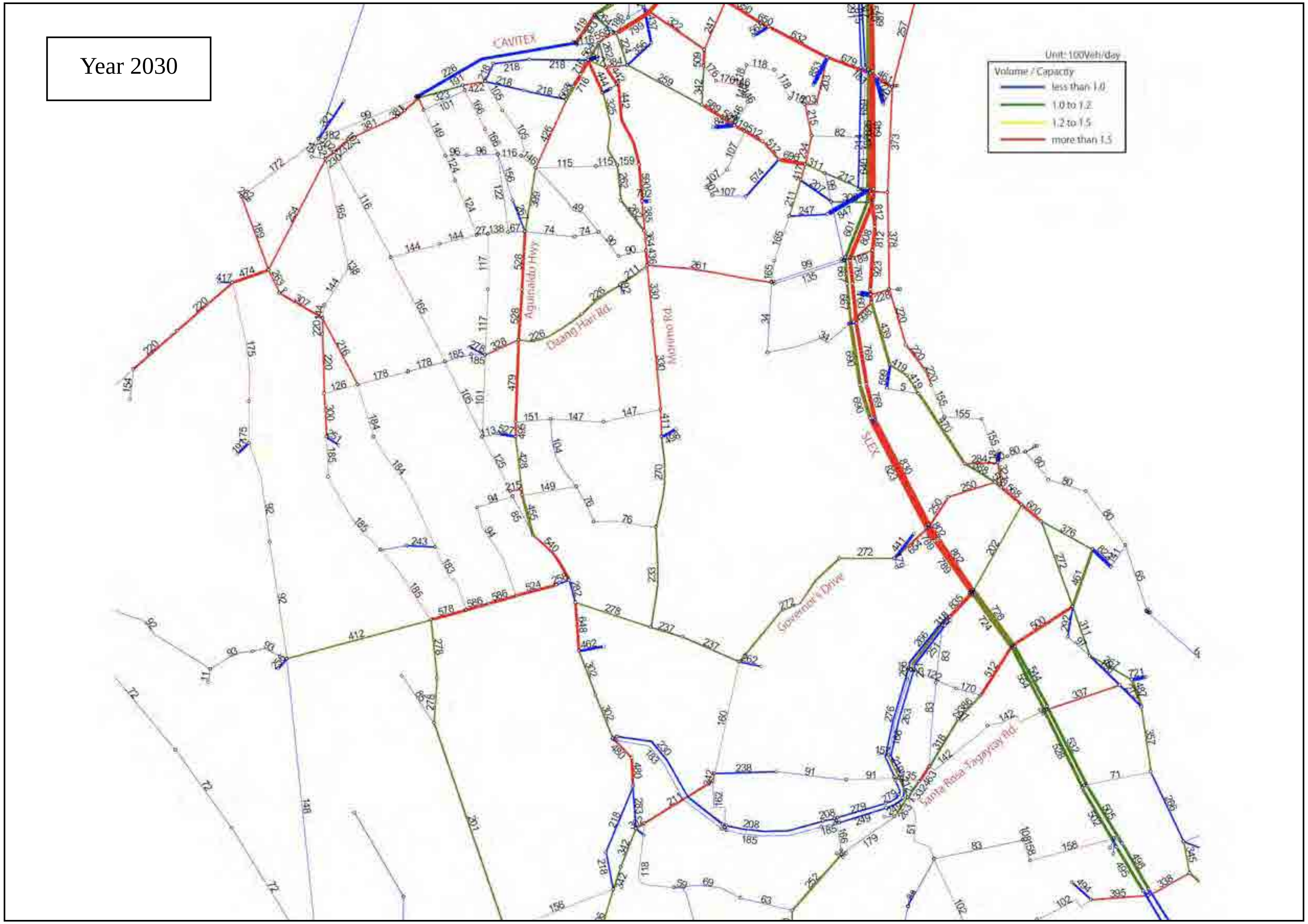


FIGURE 4.2.7-15 RESULT OF TRAFFIC ASSIGNMENT IN YEAR 2030 (CASE-2)

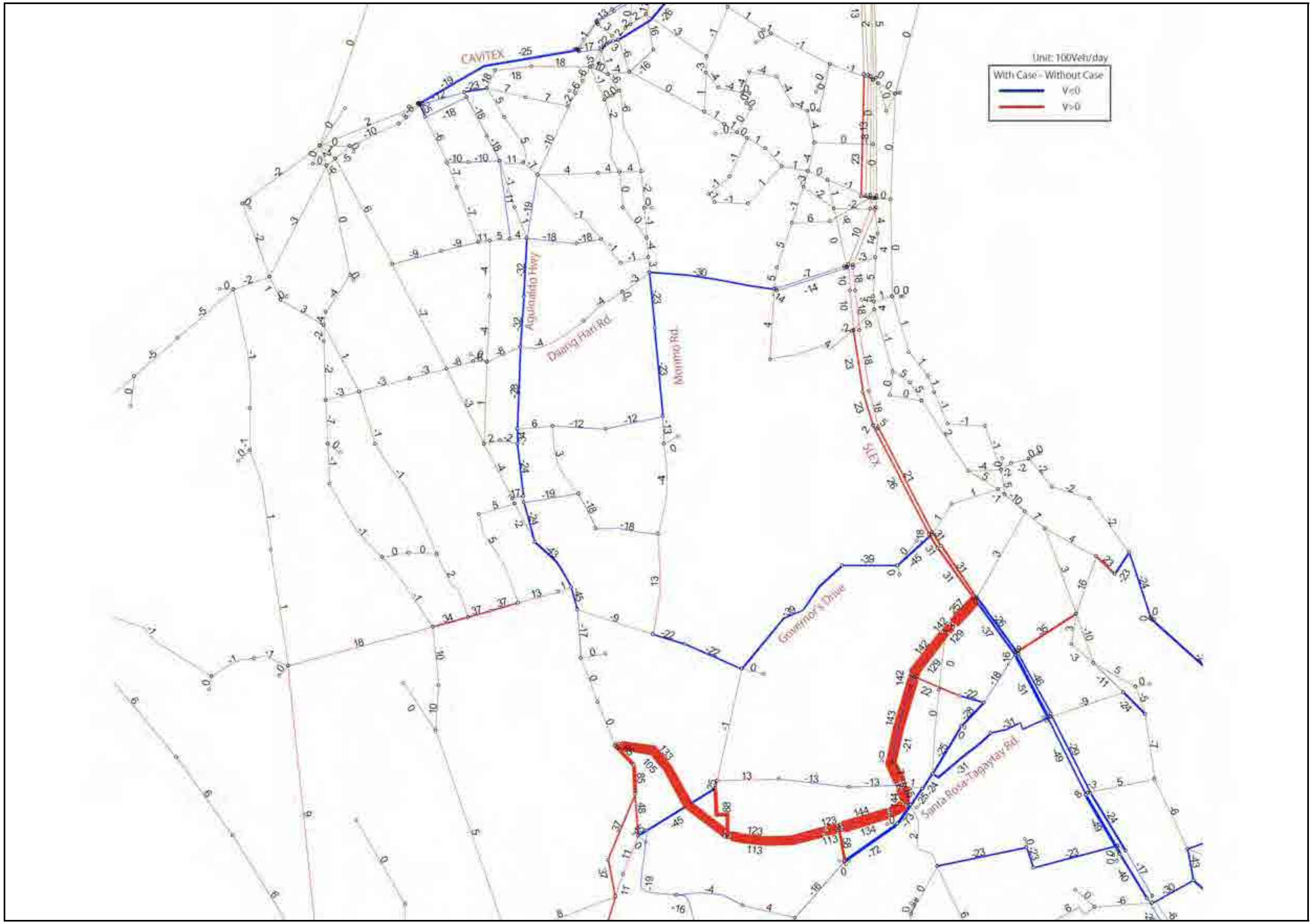


FIGURE 4.2.7-16 COMPARISON OF WITH CASE AND WITHOUT (LAGUNA SECTION)

CASE-2 IN YEAR 2017

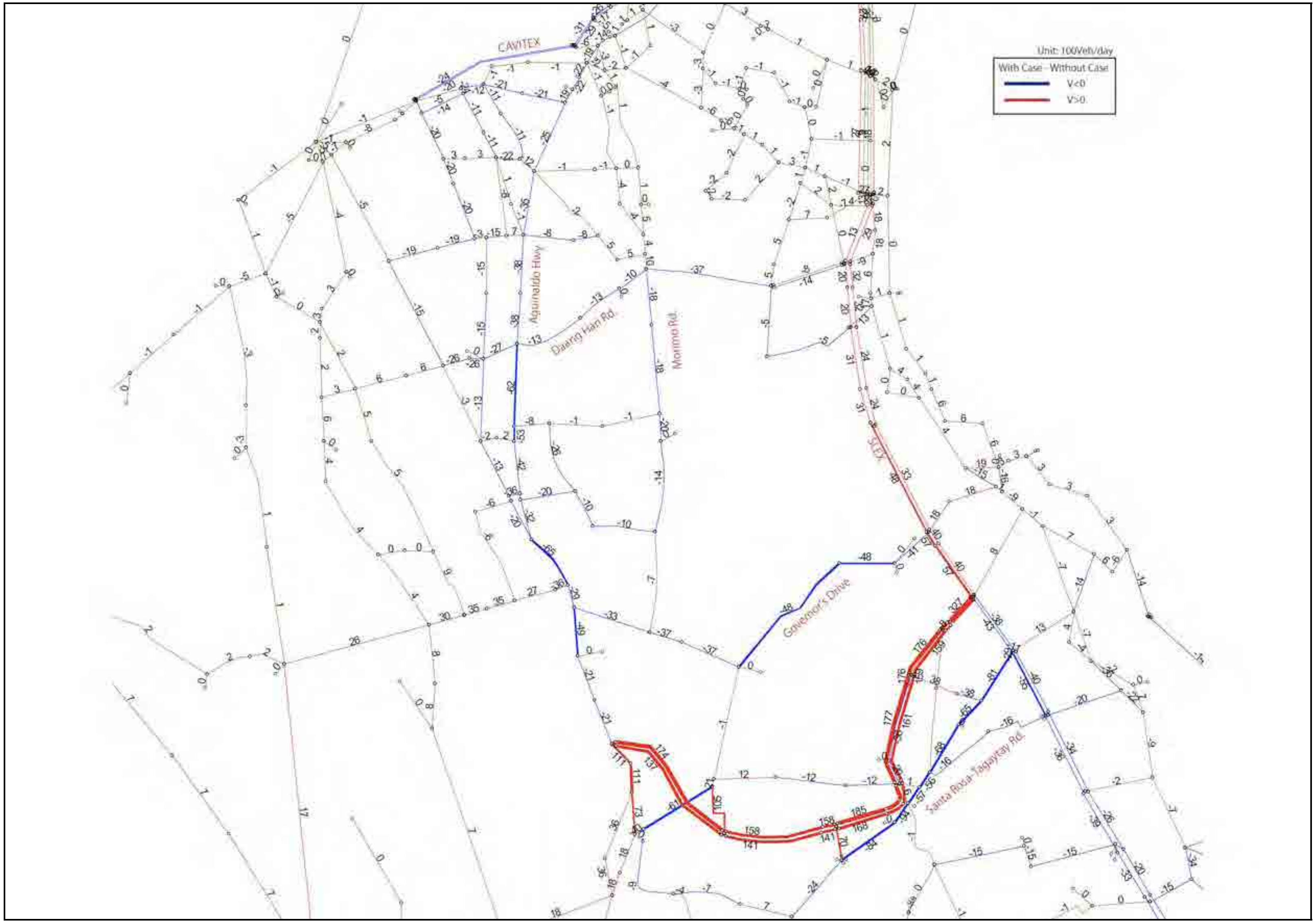


FIGURE 4.2.7-17 COMPARISON OF WITH CASE AND WITHOUT (LAGUNA SECTION)

CASE-2 IN YEAR 2020

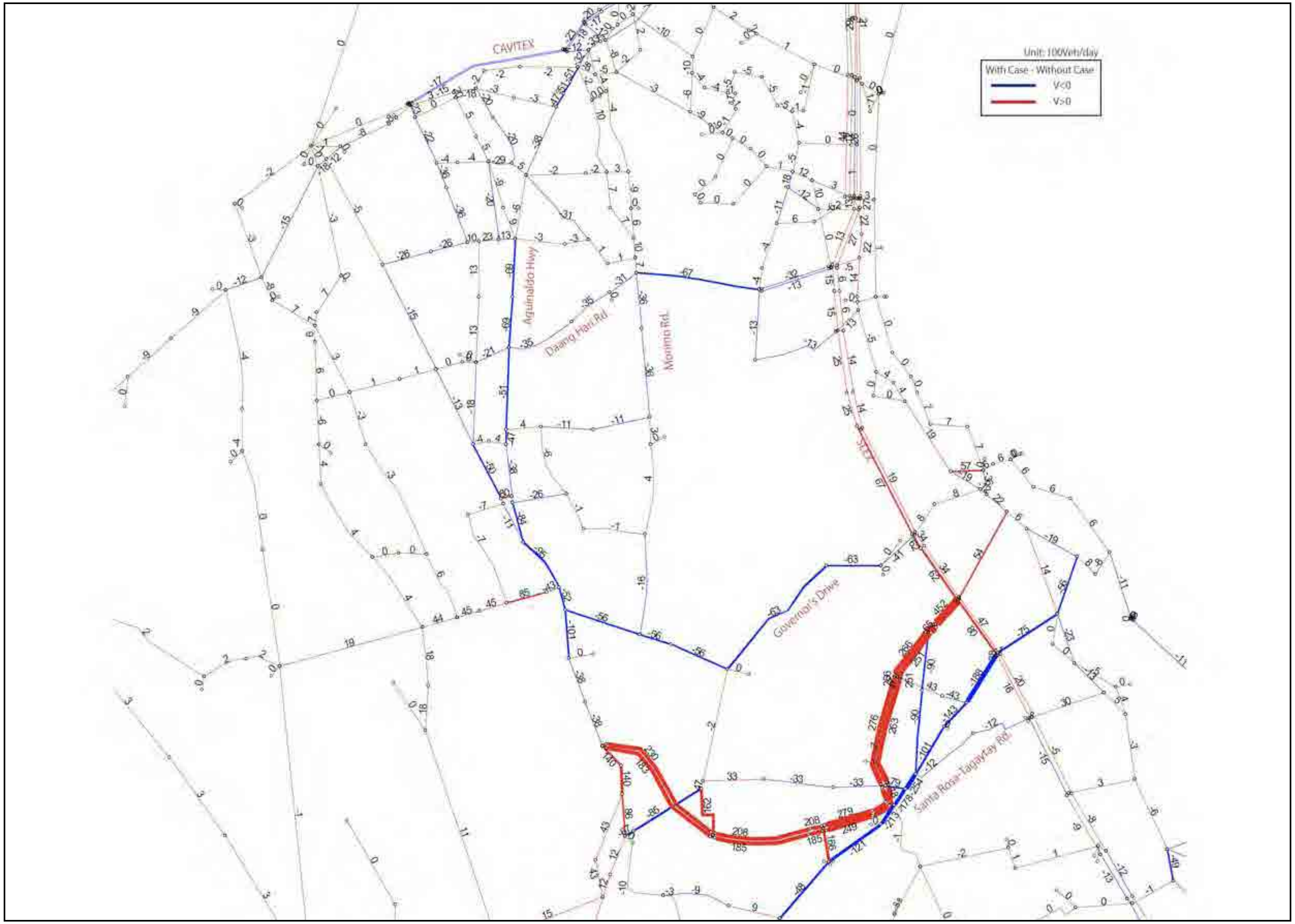


FIGURE 4.2.7-18 COMPARISON OF WITH CASE AND WITHOUT (LAGUNA SECTION)

CASE-2 IN YEAR 2030

4.2.8 Level of Service (LOS) Analysis

Definition of Level of Service (LOS) by Highway Capacity Manual (HCM) 2000 of USA for the 2-lane highway and for the multi-lane highway is shown in **Table 4.2.8-1**.

TABLE 4.2.8-1 DEFINITION OF LOS FOR MULTI-LANE HIGHWAY

LOS A	Free-flow operations. Free-flow speeds prevail. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.
LOS B	Reasonably free flow. Free-flow speeds are maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high.
LOS C	Flow with speeds at or near the Free Flow Speed of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver.
LOS D	The level at which speeds begin to decline slightly with increasing flows and density begins to increase somewhat more quickly. Freedom to maneuver within the traffic stream is more noticeably limited, and the driver experiences reduced physical and psychological comfort levels.
LOS E	Operation at capacity. Operations at this level are volatile, because there are virtually no usable gaps in the traffic stream. Vehicles are closely spaced leaving little room to maneuver within the traffic stream at speeds that still exceed 80 km/h. Maneuverability within the traffic stream is extremely limited, and the level of physical and psychological comfort afforded the driver is poor
LOS F	Breakdowns in vehicular flow. Such conditions generally exist within queues forming behind breakdown points. Breakdowns occur for a number of reasons: • Traffic incidents can cause a temporary reduction in the capacity of a short segment, so that the number of vehicles arriving at the point is greater than the number of vehicles that can move through it. • Points of recurring congestion, such as merge or weaving segments and lane drops, experience very high demand in which the number of vehicles arriving is greater than the number of vehicles discharged. • In forecasting situations, the projected peak-hour (or other) flow rate can exceed the estimated capacity of the location.

Source: *HCM 2000*

 LOS A	 LOS B
 LOS C	 LOS D
 LOS E	 LOS F

Source: *HCM 2000*

FIGURE 4 .2.8-1 LEVEL OF SERVICE FOR MULTI-LANE HIGHWAY

<u>Appropriate Level of Service by AASHTO</u>

A Policy on Geometric Design of Highways and Streets, 2004 (AASHTO) suggests the appropriate level of service for each functional class of road as follows;

TABLE 4.2.8-2 GUIDELINES FOR SELECTION OF DESIGN LEVEL OF SERVICE

Functional class	Appropriate level of service for specified combinations of area and terrain type			
	Rural level	Rural rolling	Rural mountainous	Urban and suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

According to the above guidelines, expressways are recommended that LOS be "B" or "C", however, the guideline seems to be aiming quite high LOS. LOS may be lowered by one rank, say from "B" to "C".

<u>Service Traffic Volume of four-lane CALAX</u>

In accordance with HCM formula, the service traffic volume of four-lane CALAX was estimated as shown in **Table 4.2.8-3**. Estimated traffic volume and LOS is shown in **Table 4.2.8-4**. The LOS of the 4-lane CALAX at the opening year will be "B", and it will be "D" in year 2030. The widening to a 6-lane expressway should be made before LOS reaches to "E". In consideration of some allowance, Laguna Section of CALAX will not need to be widened for 15 years.

TABLE 4 .2.8-3 SERVICE TRAFFIC VOLUME OF FOUR-LANE CALAX

LOS	Service volume for LOS	
	Veh/Hour (4-lane)	Veh/Day (4-lane)
A	Less than 1,050	Less than 21,875
B	Less than 1,660	Less than 34,583
C	Less than 2,410	Less than 50,208
D	Less than 3,140	Less than 65,416
E	Less than 3,500	Less than 72,916
F	More than 3,500	More than 72,916

Consultant's estimate based on Highway Capacity Manual 2000 (HCM2000)

Note: Assumptions: *Rural Area, 23 percent truck and bus; free flow speed; 100km/hr.*

TABLE 4.2.8-4 ESTIMATED 4-LANE CALAX TRAFFIC VOLUME
(STA. ROSA TAGAYTAY ROAD IC – LAGUNA BLVD IC SECTION)

Year	Daily Traffic Assignment (Veh./day) **(both directions)**	Daily Traffic Assignment (Veh./day) **(one direction)**	Peak Hour Traffic Volume (Veh./hour) **(one direction)**	LOS	Volume/Capacity Ratio
	(a)	(b = a * 0.6)	(c = b * 0.08)		
2017	25,943	15,566	1,245	B	0.36
2018	27,986	16,792	1,343		0.38
2019	30,190	18,114	1,449		0.41
2020	32,567	19,540	1,563		0.45
2021	34,168	20,501	1,640		0.47
2022	35,847	21,508	1,721	C	0.49
2023	37,609	22,565	1,805		0.52
2024	39,457	23,674	1,894		0.54
2025	41,397	24,838	1,987		0.57
2026	43,431	26,059	2,085		0.60
2027	45,566	27,339	2,187		0.62
2028	47,805	28,683	2,295		0.66
2029	50,155	30,093	2,407		0.69
2030	52,620	31,572	2,526	D	0.72

Assumptions: *60/40 directional split, Peak hour rate : 8 percent*

4.2.9 Influence Degree of Traffic for Not Implemented of each section

The influence degree of CALAX traffic was studied in case of another section was not implemented. The summary of total traffic of CALAX is shown in **Table 4.2.9-1** and **Table 4.2.9-2**.

TABLE 4.2.9-1 TOTAL VEHICLE-KM OF CALAX

Unit: vehicle-km/day

	Both Sections Implemented			Only Cavite Section Implemented	Only Laguna Section Implemented
	Cavite	Laguna	Total		
Y2017	654,252 (1.00)	411,529 (1.00)	1,065,781	600,464 (0.92)	434,028 (1.05)
Y2020	895,855 (1.00)	509,990 (1.00)	1,405,844	822,988 (0.92)	549,090 (1.08)
Y2030	1,288,037 (1.00)	779,889 (1.00)	2,067,926	1,221,862 (0.95)	786,467 (1.01)

TABLE 4.2.9-2 THE NUMBER OF TRAFFIC ENTER TO CALAX

Unit: vehicle/day

	Both Sections Implemented		Only Cavite Section Implemented	Only Laguna Section Implemented
	Cavite	Laguna		
Y2017	49,259 (1.00)	37,916 (1.00)	46,845 (0.95)	39,382 (1.04)
Y2020	66,433 (1.00)	47,178 (1.00)	66,140 (0.99)	49,320 (1.05)
Y2030	90,784 (1.00)	80,625 (1.00)	87,693 (0.97)	79,657 (0.99)

- Generally traffic of Cavite section will decrease if the construction of Laguna section were not implemented. The maximum decrease rate is 8% (= 600,462 / 654,252 in year2017).
- Traffic of Laguna section will increase if Cavite section were not constructed. Since many traffic from/to Manila and Tagaytay will use Laguna section if Cavite section was not constructed, traffic in only Laguna section implemented case will higher than that in both sections implemented case. **Figure 4.2.9-1** illustrated the traffic route information using Laguna section (Laguna Blvd IC ~ Techno Park IC). To compare with both-section implemented case, traffic in only Laguna section increase especially from/to Manila using SLEX.

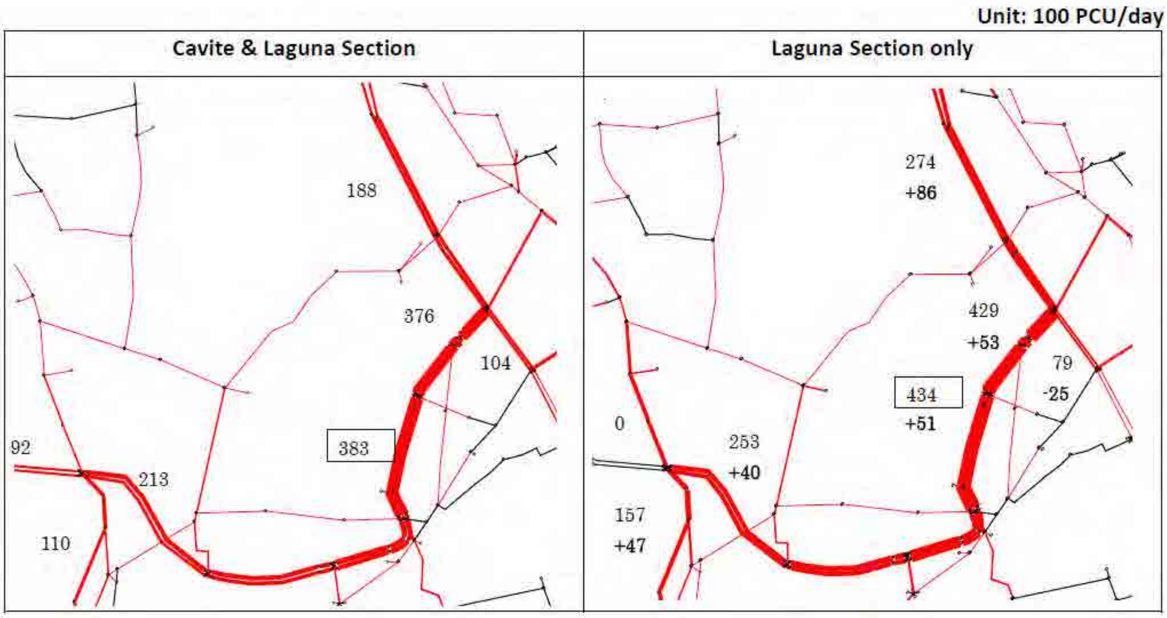


FIGURE 4.2.9-1 COMPARISON TRAFFIC TRAVELING CALAX LAGUNA SECTION (YEAR 2017)

CHAPTER 5
REVIEW OF THE 2006 FS AND ALIGNMENT STUDY

5.1 NECESSITY OF THE PROJECT

CALAX is needed from the following viewpoints;

(1) Traffic Congestion of National Roads in Cavite and Laguna Provinces

Both Cavite and Laguna Provinces are neighboring provinces of Metro Manila. The two provinces are rapidly urbanizing to accommodate spilled over population from Metro Manila. Population growth rates of the two provinces are quite high (4.76% per annum in the Cavite Province and 3.34% per annum in the Laguna Province from 2000 to 2007. Economic activities, particularly manufacturing industry, are also quite active. Thus, two provinces are within socio-economic activities of Metro Manila.

In spite of rapid urbanization, the road network development was not so significant, only widening of Aguinaldo Highway and Governor's Drive to a 4-lane road was made and a portion of DaangHari Road was constructed in the last 20 years. Road network development was lagged behind the rapid urbanization. There are several Provincial Roads, however, that are still 2-lane roads.

Insufficient road network development is now resulting in traffic congestions of national roads and most of provincial roads.

High capacity roads which allows fast, safe, comfortable and reliable means of transport is highly needed in the areas to reduce traffic congestions in Cavite and Laguna Provinces.

(2) Economic and Social Activities in the Two Provinces

Many economic zones/industrial estates have already been operated and will be further developed in two provinces by making advantages of proximity to Metro Manila. The two provinces are now the center of manufacturing industry in the Philippines contributing to economic development of the country and generation of a lot of job opportunities.

Many universities and high schools have been transferred or established in the area, such as the Technological University of the Philippines and De La Salle in Dasmariñas, Cavite; Adventist University of the Philippines in Silang, Cavite; University of Sto. Tomas in Sta. Rosa, Laguna, etc.

Various real estate companies (land developers) are developing commercial areas and residential areas in the project areas. They have already acquired lands and some areas have been developed and have been sold out or are selling lands/lots they developed. It is expected that their lands will be sold out within 10 to 15 years and will be fully urbanized.

Above development will stimulate economic and social activities in the two provinces, thus transport network to support such economic and social activities is definitely needed.

(3) Urbanization

As mentioned in (2) above, urbanization of the area is lead by the private sector, particularly by land developers. With the lack of land development master plan by the Government, and developers only plan within their own properties and transport access to/from their properties is only made to the existing roads and/or existing expressway.

Sound urbanization should be guided/lead by the proper road network. National road network in the area of Laguna section is quite scarce, thus CALAX is needed to be planned to guide/lead sound urbanization of the area.

(4) Lack of Public Roads

The area of Laguna section lacks public roads which are only Aguinaldo Highway, Governor's Drive and Sta. Rosa – Tagaytay Road. Instead, there are many private roads developed by land developers, most of which are not open to the general public and only these cars allowed by the land owners can pass. Thus, the development of public roads which can be used by the general public is needed.

(5) Expressway Network

There are two expressways in Cavite and Laguna Provinces, namely SLEX and CAVITEX, however they are functioning individually and the expressway network is not formed yet. If something happens and traffic of an expressway becomes interrupted, travelers have no other choice but to select/use the congested road.

5.2 REVIEW OF THE 2006 FS

1) Proposed Alignment by the 2006 FS

CALAX was studied in the JICA-assisted Feasibility Study and Implementation Support on the CALA East-West National Project.

The alignment recommended by the 2006 FS is shown in **Figure 5.2-1.**

The recommended alignment starts at Eton/Greenfield Interchange (IC) of SLEX and goes westwards crossing Sta. Rosa – Tagaytay Road and reaches to Aguinaldo Highway. From there, it goes north-east direction and ends at Governor's Drive.

2) Objection to the Proposed Alignment by the Land Developers

Many land developers such as Eton Properties Philippines, Inc., Greenfield Development Corporation, University of Sto. Tomas, etc., purchased the lands in the corridor from SLEX and Sta. Rosa – Tagaytay Road.

DPWH undertook the stakeholders meeting in 2006 and 2007 in order to realize the project, however, most land developers did not agree to the proposed alignment because their land development plan is severely affected. Thus, DPWH suspended the further actions for implementation.

Thus, the proposed alignment is required to be re-studied.

3) Engineering Concept

CALAX was planned as a national road and not as an access-controlled expressway, thus no toll facilities were planned, although grade separations at intersections with major roads were planned.

4) Comparison with Proposed Alignment vs. 2006 FS Alignment

As mentioned above, since fast urbanization are developing in this area,project of 2006 FS alignment was suspended. A green dot line shown in **Figure 5.2-1** is proposed alignment by this Study.Instead of connect ETON/Greenfield Interchange, this alignment connect with Mamplasan IC. As this proposed alignment use existing private road (ROW=60m, 6.2km) for avoid residential area and existing buildings, expressway structurewill become viaduct. Construction cost of proposed alignment may be much higher than that of 2006 FS alignment.

FIGURE 5.2-1 CALAX ALIGNMENT RECOMMENDED BY THE 2006 FS

5.3 ALIGNMENTSTUDYOFLAGUNASECTIONOFCALAX

5.3.1 Characteristics of Laguna Section Area

(1) Land Area Acquired by Private Land Developers

Land area acquired by the private land developers is shown in **Figure 5.3.1-1**. Most of the lands of the project area have been purchased and owned by the large scale land developers (real estate companies).

There are many economic zones/industrial estates along SLEx and Governor's Drive. Residential subdivisions were and will be developed in the project area. Mixed uses area such as residential subdivision/commercial complexes/leisure facility (mostly golf courses) also widely occupy the project area. Areas along SLEx (4 to 5 km. areas from SLEx) has been and/or being developed.

Since land development by private companies are quite active in the project area, most of the project area will be fully urbanized in 15 to 20 years.

(2) Road Network in Project Area

Road network in the project area is shown in **Figure 5.3.1-2**. Major roads are as follows;

- South Luzon Expressway (8-lane, toll road)
- Aguinaldo Highway (4-lane, national road)
- Governor's Drive (4-lane, national road)
- Sta. Rosa-Tagaytay Road (2 to 4-lane, national road)

As shown above, national road network density is quite scarce. Private roads are providing access to the project area, however, there are following problems; ①Some of private roads are limited to vehicles with sticker sold by the private land developers, thus usage of private roads are limited and not for general public. ② Private roads are developed to provide access to each land developer's area, thus, continuity of road is not always good. Sometimes, it is not possible to go from one land developer's area to another.

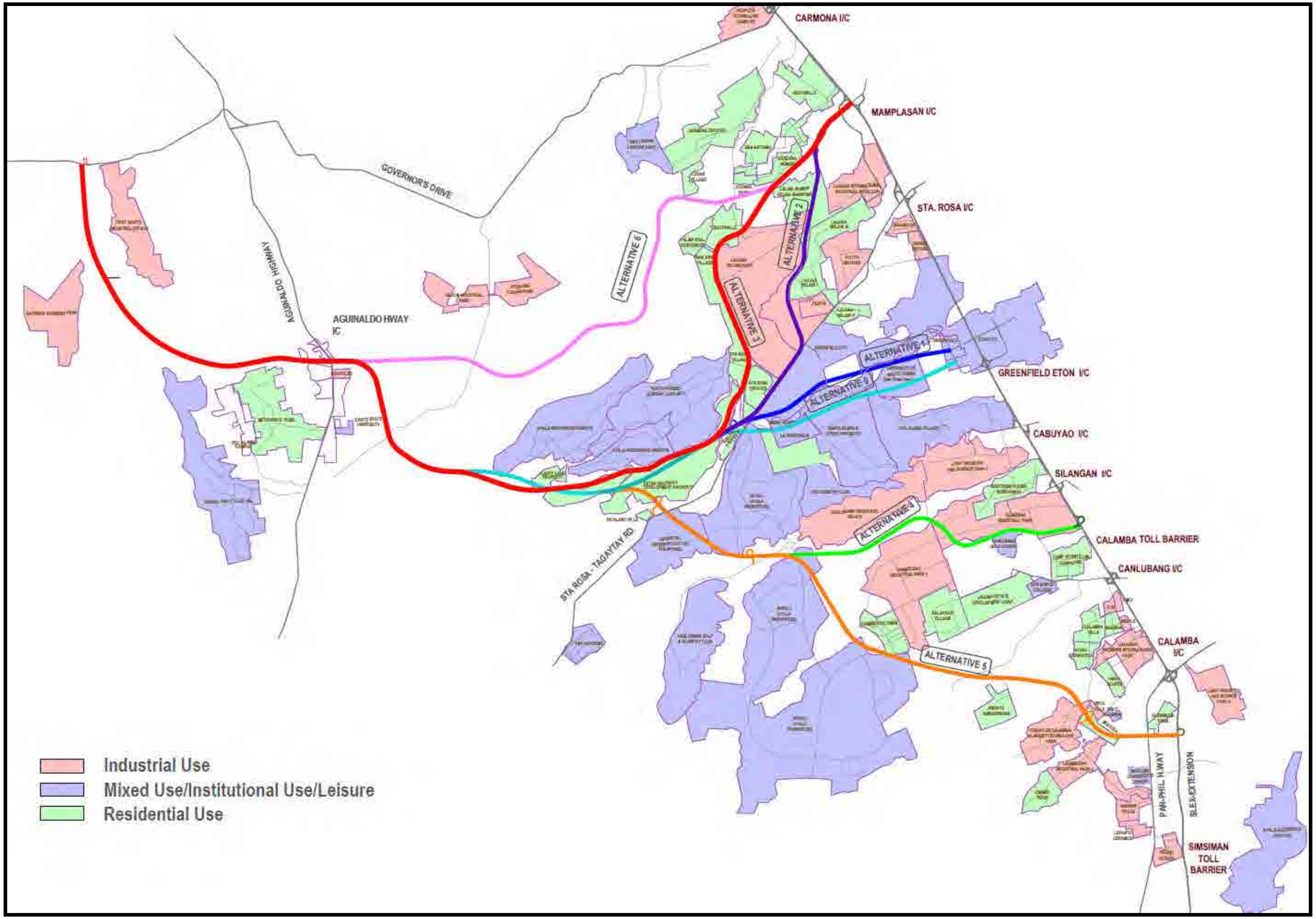


FIGURE 5.3.1-1 LAND AREA ACQUIRED BY PRIVATE LAND DEVELOPERS

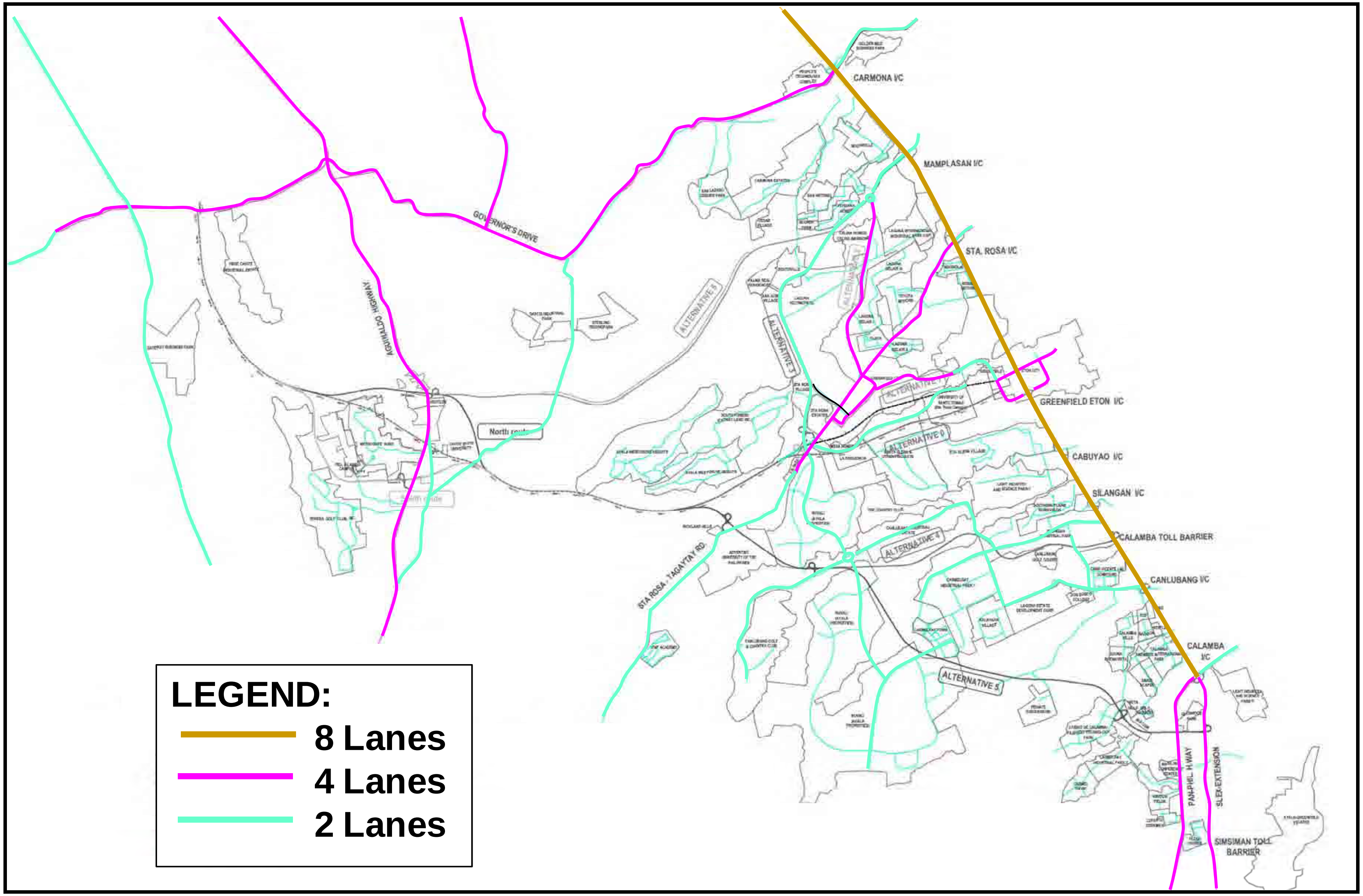


FIGURE 5.3.1-2 ROAD NETWORK IN PROJECT AREA

5.3.2 Procedure of Alignment Study

Alignment study was undertaken in accordance with the following steps;

Step-1	:	Selection of the beginning point of Laguna Section (connection point of Cavite and Laguna sections).
Step-2	:	Selection of the end point at SLEx.
Step-3	:	Selection of the alignment to connect the beginning point and end point. Various alternative alignments were studied.

5.3.3 Step-1 : Selection of the Beginning Point of Laguna Section (Connection Point of Cavite and Laguna Sections)

Three (3) alternative alignments were developed focusing on minimization of social impact (or dislocation of people) as shown in **Figure 5.3.3-1**.

Alternative-1	:	Alignment Recommended by the 2006 FS
Alternative-2	:	North Alignment to minimize social impact in the northern area of Silang Municipality town proper.
Alternative-3	:	South Alignment to minimize social impact in the southern area of Silang Municipality town proper.

Three alternative alignments were evaluated as shown in **Table 5.3.3-1** and Alternative-2 was recommended due to the following reasons;

- Alternative-2 achieves minimum social impact.
- Alternative-2 achieves minimum cost.

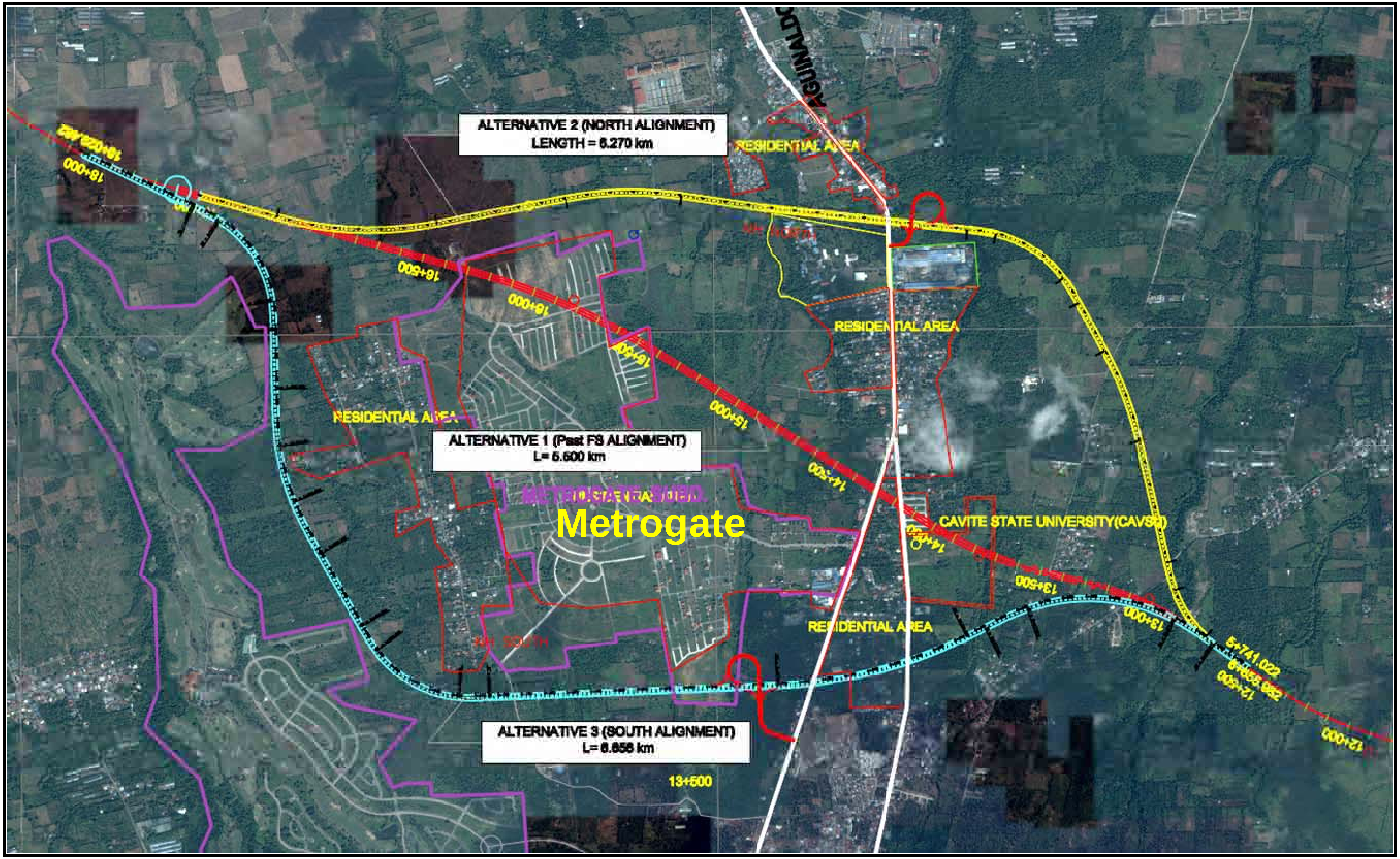


FIGURE 5.3.3-1 ALTERNATIVE ALIGNMENTS OF BEGINNING POINT OF LAGUNA SECTION

TABLE 5.3.3-1 EVALUATION OF ALTERNATIVE ALIGNMENTS AT BEGINNING POINT

Alternatives			Alternative 1		Alternative 2		Alternative 3	
Concept			Alignment proposed by 2006 FS		To minimize social impacts in the northern area of Silang Municipality.		To minimize social impacts in the southern area of Silang Municipality.	
Road Length (km)			5.50		6.27		6.66	
Evaluation	Cost (Billion Pesos)	Construction	0.798	△	0.910	○	0.966	△
		ROW	0.414		0.213		0.354	
		Total	1.212 (1.00)		1.123 (0.93)		1.320 (1.09)	
	Connection to Aguinaldo Highway		Difficult due to no appropriate area for interchange.	X	Easy to connect by trumpet type of interchange.	○	Easy to connect by trumpet type of interchange.	○
	Social Impact	No. of Residential Houses affected	38	X	17	○	44	X
		No. of Large Buildings affected	2 (Cavite State University)		0		0	
	Natural Environment		• Same condition among alternatives. • No serious problem.	○	• Same condition among alternatives. • No serious problem.	○	• Same condition among alternatives. • No serious problem.	○
	Evaluation		○ 1 △ 1 X 2		○ 4 △ 0 X 0 **Recommended**		○ 2 △ 1 X 1	

5.3.4 Step-2 : Selection of the End Point at SLEx.

(1) Existing Interchange Interval along SLEx

Many interchanges have been built along SLEx. **Table 5.3.4-1** and **Figure 5.3.4-1** show existing interchanges in the project area along SLEx from Carmona Interchange to Simsiman Toll Barrier.

TABLE 5.3.4-1 EXISTING INTERCHANGES IN PROJECT AREA ALONG SLEX

Name of Interchange	Interval of Interchanges (km)
Carmona I/C	
	2.53
Mamplasan I/C	
	2.33
Sta. Rosa I/C	
	4.00
Greenfield/Eton I/C	
	1.48
Cabyao I/C	
	1.46
Silang I/C	
	1.40
Calamba Toll Barrier (removed at present)	
	0.80
Canlubang I/C	
	2.40
Calamba I/C	
	4.00
Simsiman Toll Barrier	

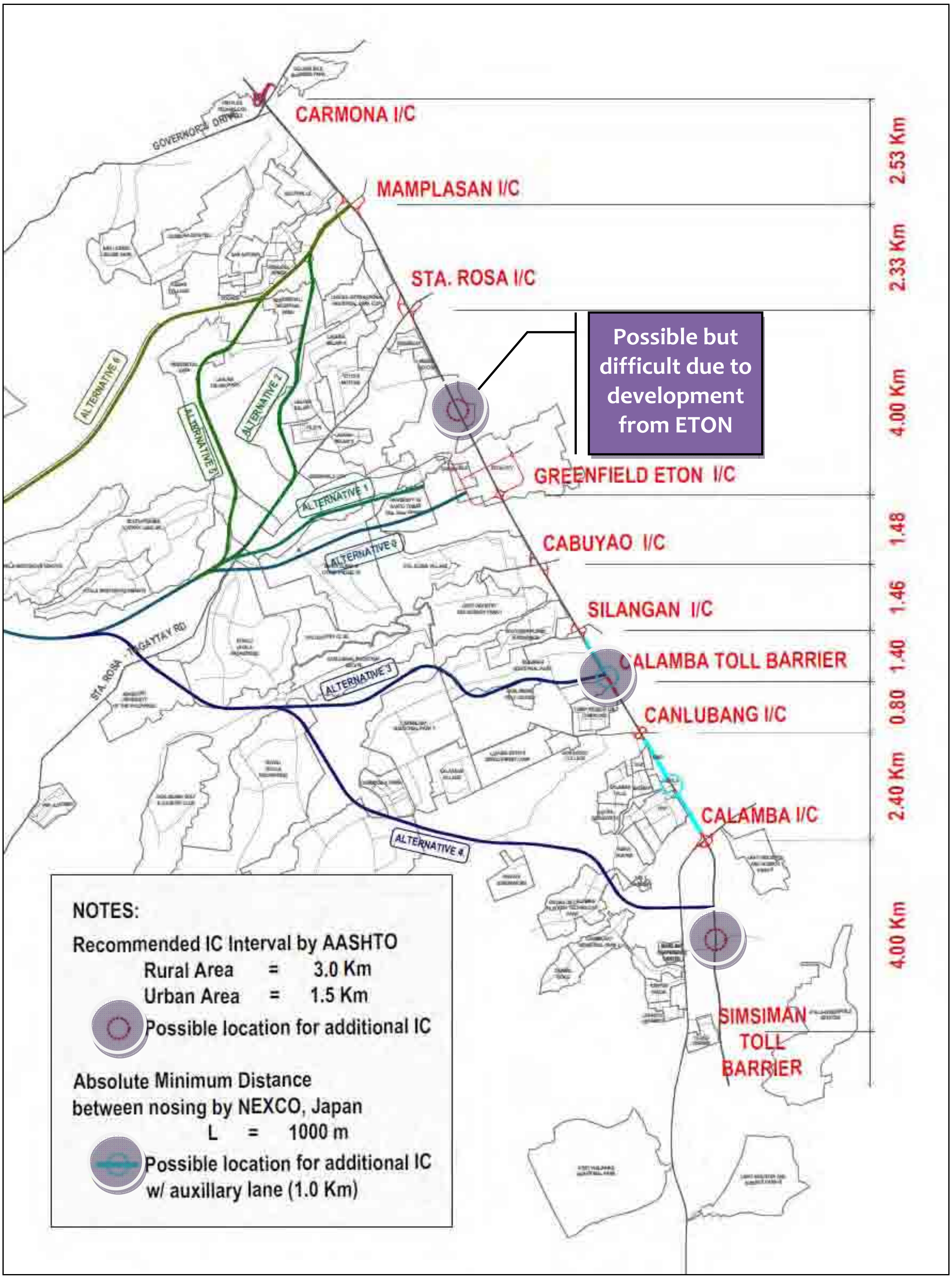


FIGURE 5.3.4-1 EXISTING INTERCHANGES IN PROJECT AREA ALONG SLEX

(2) Standard Minimum Interval Between Interchanges

Standard minimum interval between interchanges is recommended by AASHTO, as follows;

MINIMUM INTERVAL BETWEEN INTERCHANGES

- Rural Area = 3.0 km
- Urban Area = 1.5 km

In the Philippines, 2.0 km. is adopted for the minimum interval between interchanges.

When additional lane along the main line of expressway is added as an auxiliary lane, minimum nose to nose distance of 1 km. is accepted in Japan.

(3) Possible Location to Construct New Interchange

Possible locations to construct new interchange between existing interchanges are as follows;

POSSIBLE LOCATION FOR NEW INTERCHANGE

- Between Sta. Rosa I/C and Greenfield/Eton IC
- Between Calamba I/C and Simsiman Toll Barrier
- At Calamba Toll Barrier (now removed) with auxiliary lane

Among three (3) candidate locations, however, to construct new interchange between Sta. Rosa I/C and Greenfield/Eton I/C is quite difficult due to the following (see **Figure 5.3.4-2**);

- Eton Properties is now developing "South Lake Project"
- CALAX needs to be an elevated expressway over Sta. Rosa-Tagaytay Road, however, it has only 20 m road right-of-way and cannot accommodate an elevated expressway.
- Some other developments by Greenfield Development Corporation is on-going.

Remaining candidate locations for new interchange are as follows;

- Between Calamba I/C and Simsiman Toll Barrier
- At Calamba Toll Barrier which was removed at present

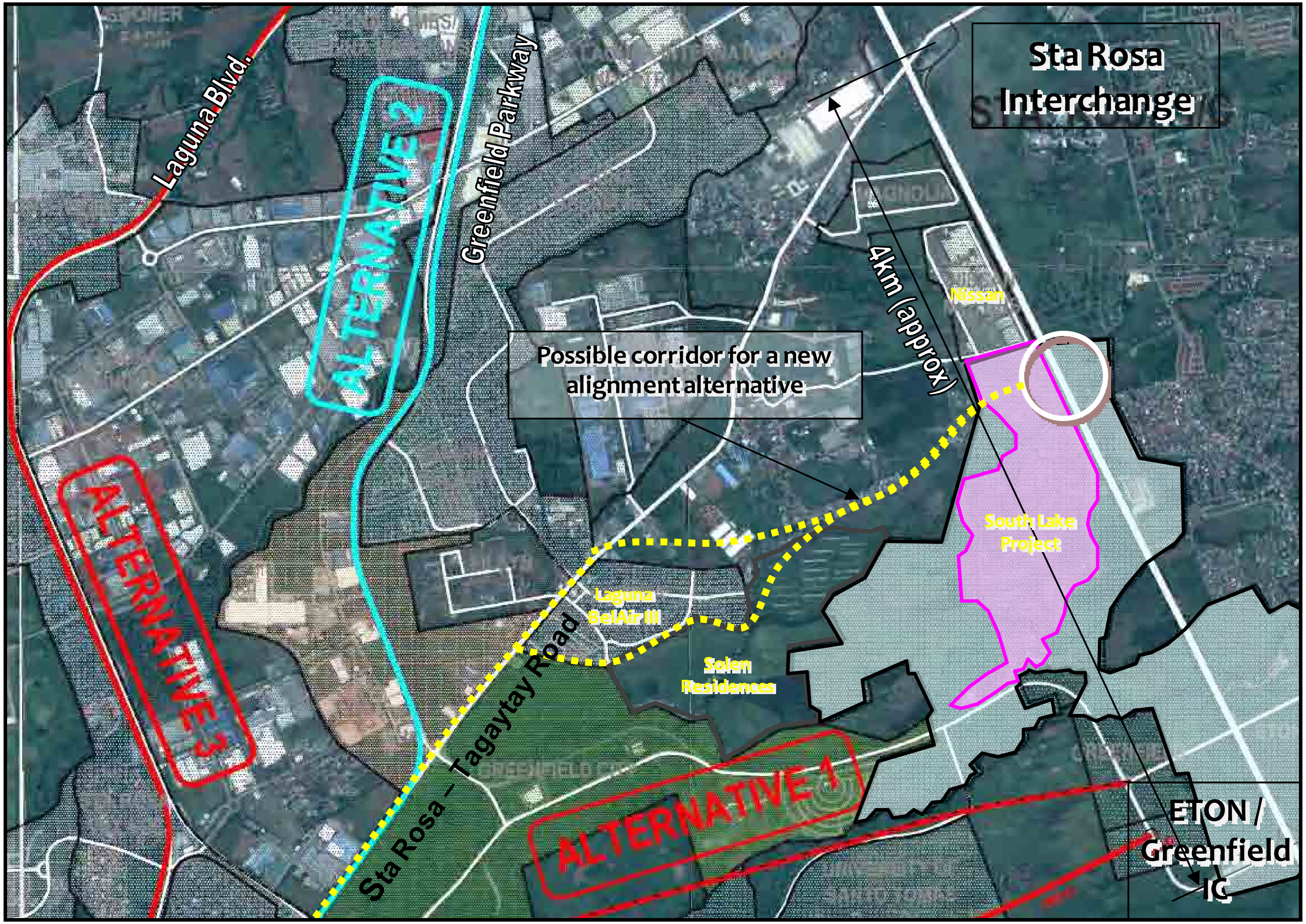


FIGURE 5.3.4-2 DEVELOPMENT CONDITION BETWEEN STA. ROSA I/C AND ETON/GREENFIELD I/C

(4) Connection with Existing SLEX Interchanges

There are two (2) methods to connect CALAx with the existing SLEx Interchanges.

a. CALAx is directly connected with SLEx at existing SLEx interchange. In this case, existing SLEx interchange must be converted to achieve direct connection between 2 expressways (this type is called as "Junction" in Japan). This requires drastic conversion of an existing interchange.

b. CALAx and SLEx are indirectly connected through a public road between CALAx and SLEx. Improvement of an existing interchange is required such as installation of additional toll booths, improvement of intersections, and widening of some portions of ramps.

<u>**Direct Connection by Converting Existing Interchange**</u>

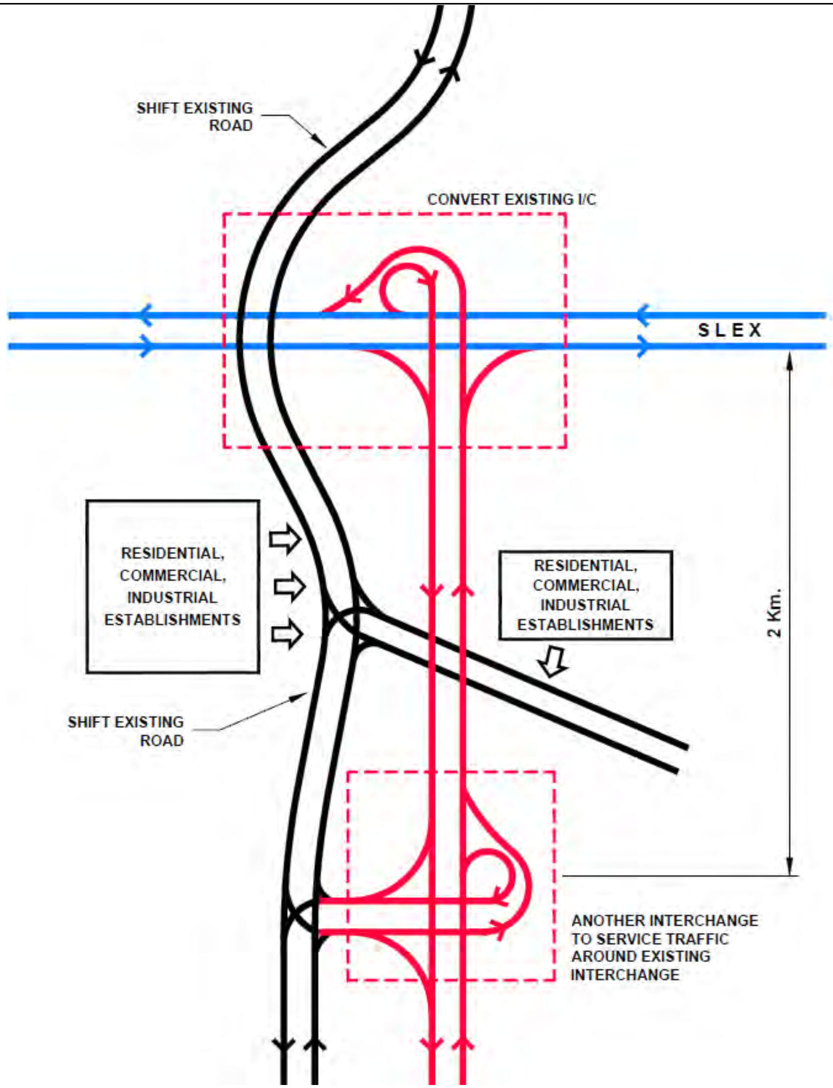
Two (2) examples are shown in **Figure 5.3.4-3**.

Example-1

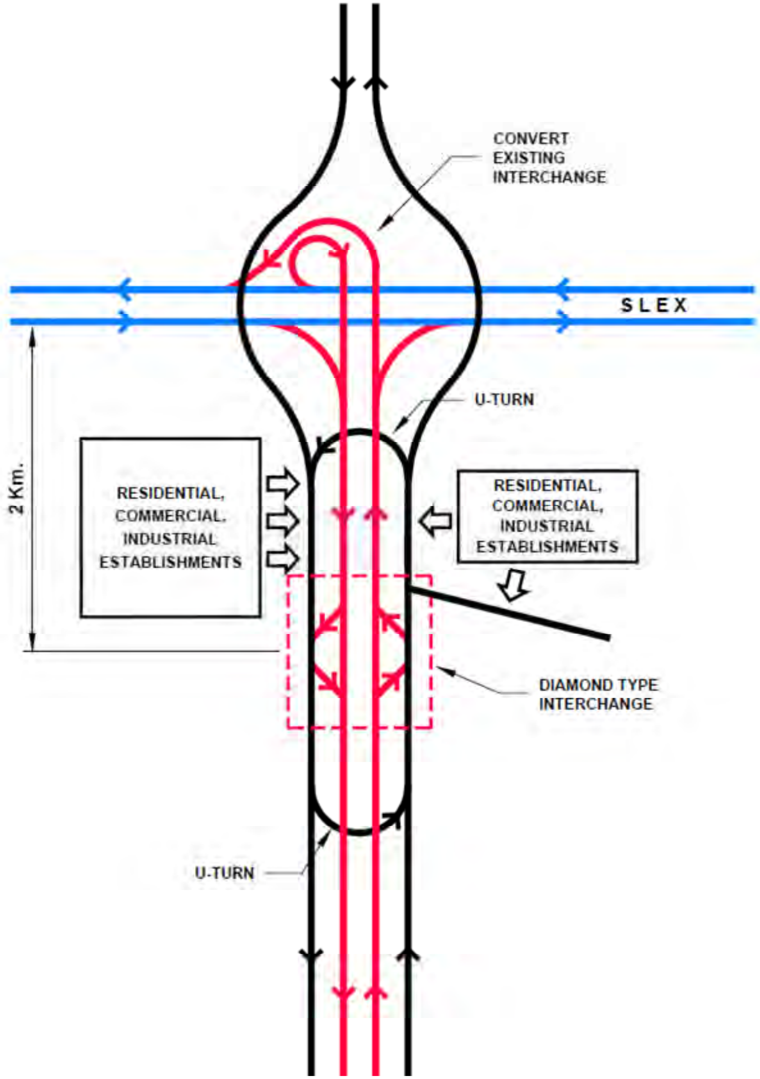
- Existing road is to be shifted (which is quite difficult due to ROW acquisition) to maintain accessibility to neighboring establishments of an existing interchange.
- Another interchange is needed at about 2 km away from SLEx to provide accessibility to existing establishments near the existing interchange.

Example-2

- Wide road right-of-way of about 60 m is required (which is also difficult due to ROW acquisition)
- Diamond type of interchange is to be constructed at about 2 km from SLEx and U-turn slots are also needed to provide accessibility to existing establishments near the existing interchange.



DIRECT CONNECTION WITH CONVERSION OF EXISTING INTERCHANGE: EXAMPLE - 1



DIRECT CONNECTION WITH CONVERSION OF EXISTING INTERCHANGE: EXAMPLE - 2

FIGURE 5.3.4-3 EXAMPLES OF DIRECT CONNECTION

In-Direct Connection by Improving Existing Interchange

In-direct connection means CALAx and SLEx is not directly connected, instead both expressways are connected via short section of public road. CALAx will end before reaching to SLEx and a gap between two expressways is connected by a public road as shown in **Figure 5.3.4-4**.

Demerit of this Scheme

- Continuity of travel on an expressway is interrupted.
- Travel speed at the public road section is reduced, thus transport efficiency is affected.

Merit of this Scheme

- Existing and future establishments near the existing SLEx interchange can enjoy the present level of accessibility even during construction/improvement.
- No extensive ROW acquisition is needed.
- In case of Direct Connection Case, temporary closure of the existing interchange is required, however, this scheme does not require temporary closure of existing interchange.
- Civil work cost is much cheaper than the direct connection scheme.

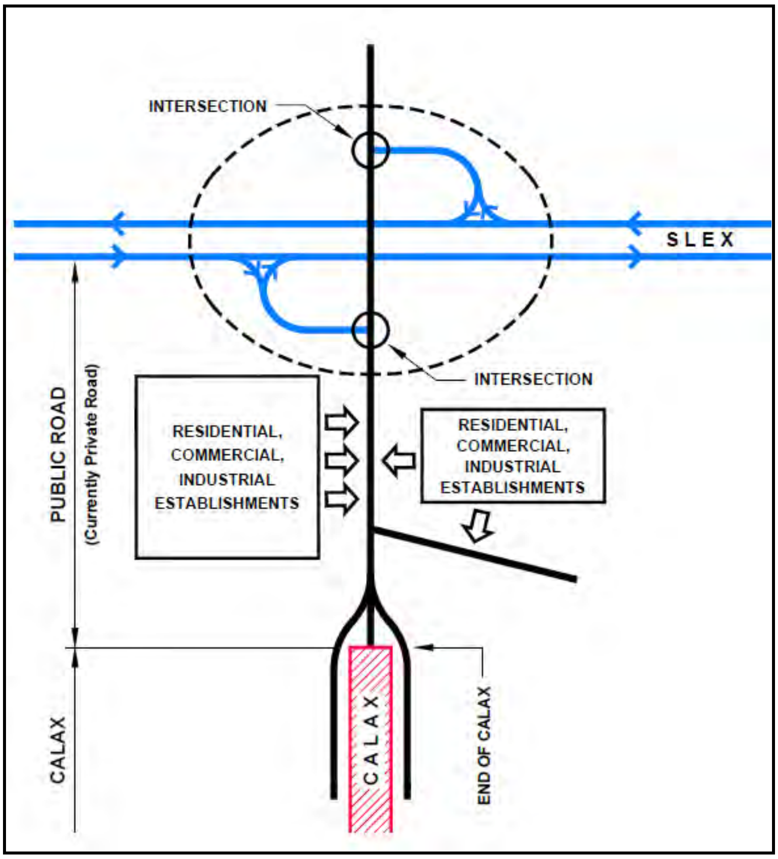


FIGURE 5.3.4-4 INDIRECT CONNECTION VIA PUBLIC ROAD TO EXISTING INTERCHANGE

5.3.5 Step-3 : Alternative Alignments and Evaluation

The beginning section was selected as discussed in Section 5.3.3. The end point has several alternatives as discussed in Section 5.3.4 and the following points were selected as an alternative end point;

Alternative End Points (Connection with SLEx)

- Existing Mamplasan Interchange
- Existing Eton/Greenfield Interchange
- Old Calamba Toll Barrier
- New Location between Calamba Interchange and Simsiman Toll Barrier

(1) Alternative Alignments

Six (6) alternatives were developed as shown in **Figure 5.3.5-1**.

Alternative-1

- This is the revised alignment of the 2006 FS and connected with the existing Eton/Greenfield Interchange.
- This route is the second shortest alignment among the alternatives.
- Intended to capture generated traffic from the on-going and future development areas.

Alternative-2

- End point is Mamplasan Interchange.
- Intended to utilize the existing private road of Greenfield Parkway (ROW width is 40 m.)
- Intended to capture generated traffic from the existing, on-going and future development areas.

Alternative-3

- Same concept as Alternative-2 above.
- Intended to utilize the existing private road of Laguna Blvd. (ROW width is 60 m.)

Alternative-4

- End point is Calamba Toll Barrier which was shifted to Simsiman Toll Barrier of SLEx Extension, and new interchange is constructed.
- Intended to capture generated traffic from the existing, on-going and future development areas.

Alternative-5

- End point is located at about the middle point between Calamba Interchange and Simsiman Toll Barrier and new interchange is constructed.
- This is the longest route among the alternatives.
- Intended to capture traffic from the existing, on-going and future development areas.
- Generated traffic from the developing areas can utilize both CALAx and SLEx.

Alternative-6

- This is the shortest route among the alternatives, however, it has to pass through steep slope areas.
- This route functions as a bypass route of Governor’s Drive.

Each alignment of alternatives is shown in **Figures 5.3.5-2 (1) to (6)**.

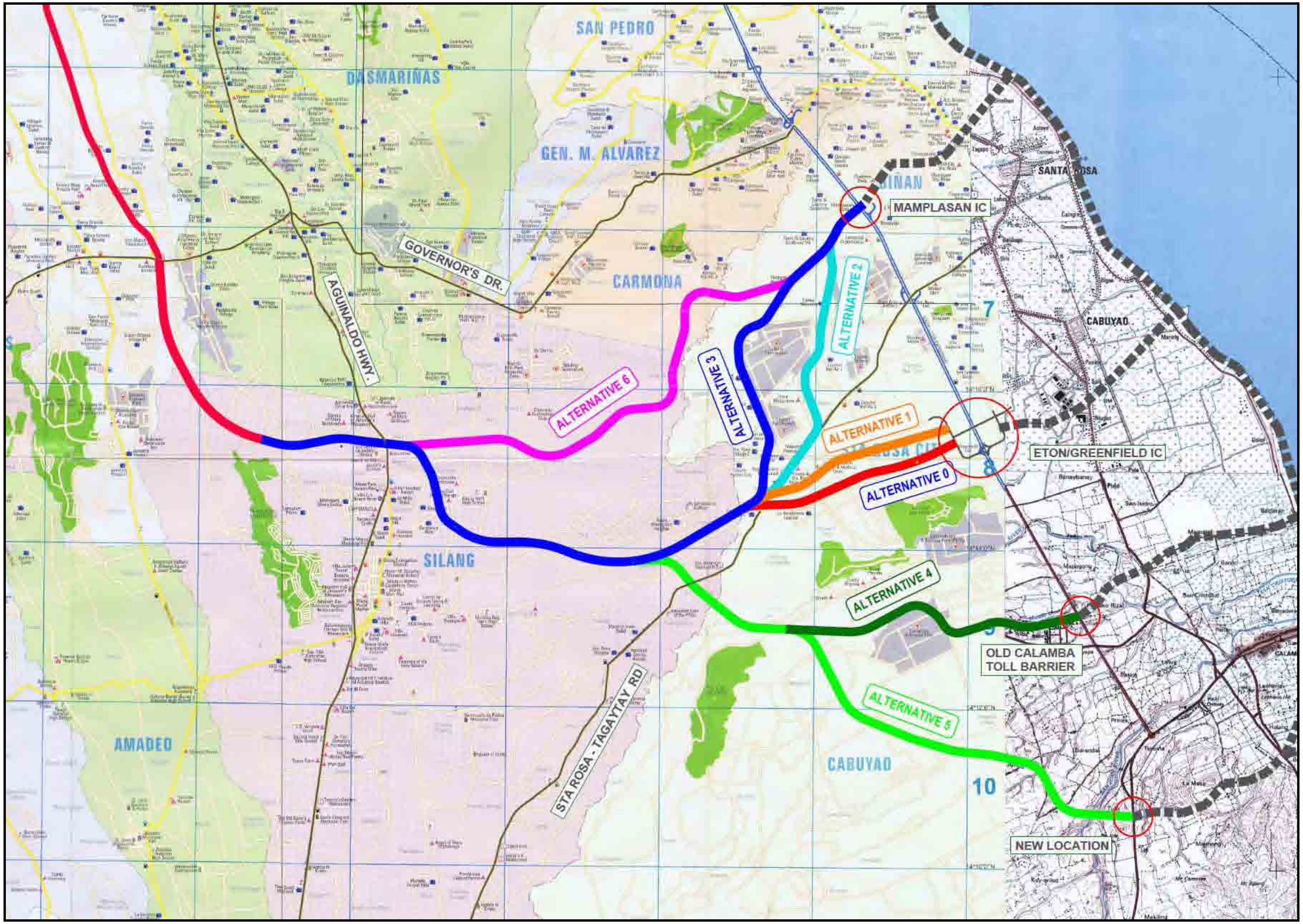


FIGURE 5.3.5-1 ALTERNATIVE ALIGNMENTS

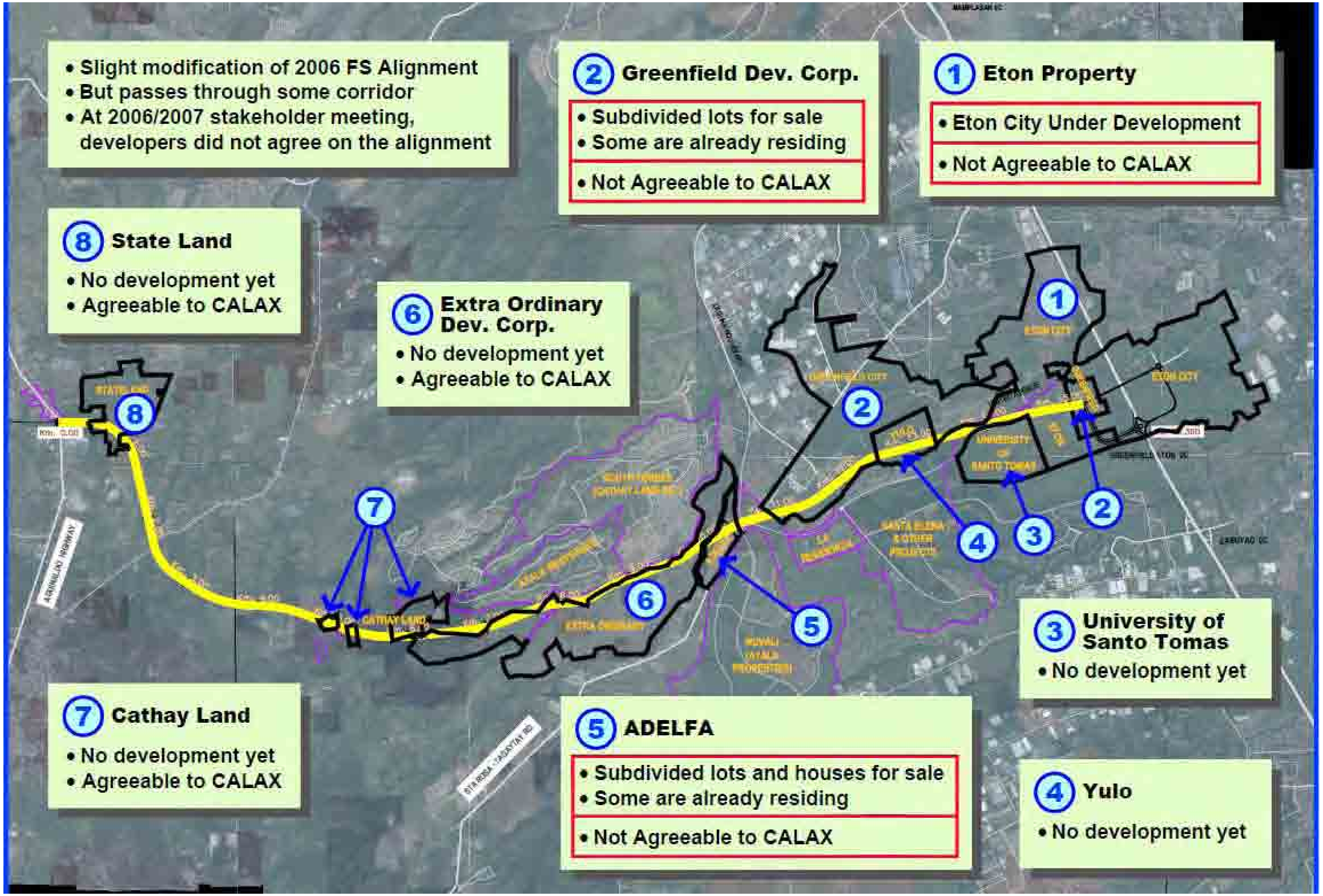


FIGURE 5.3.5-2 (1) ALTERNATIVE ALIGNMENT 1

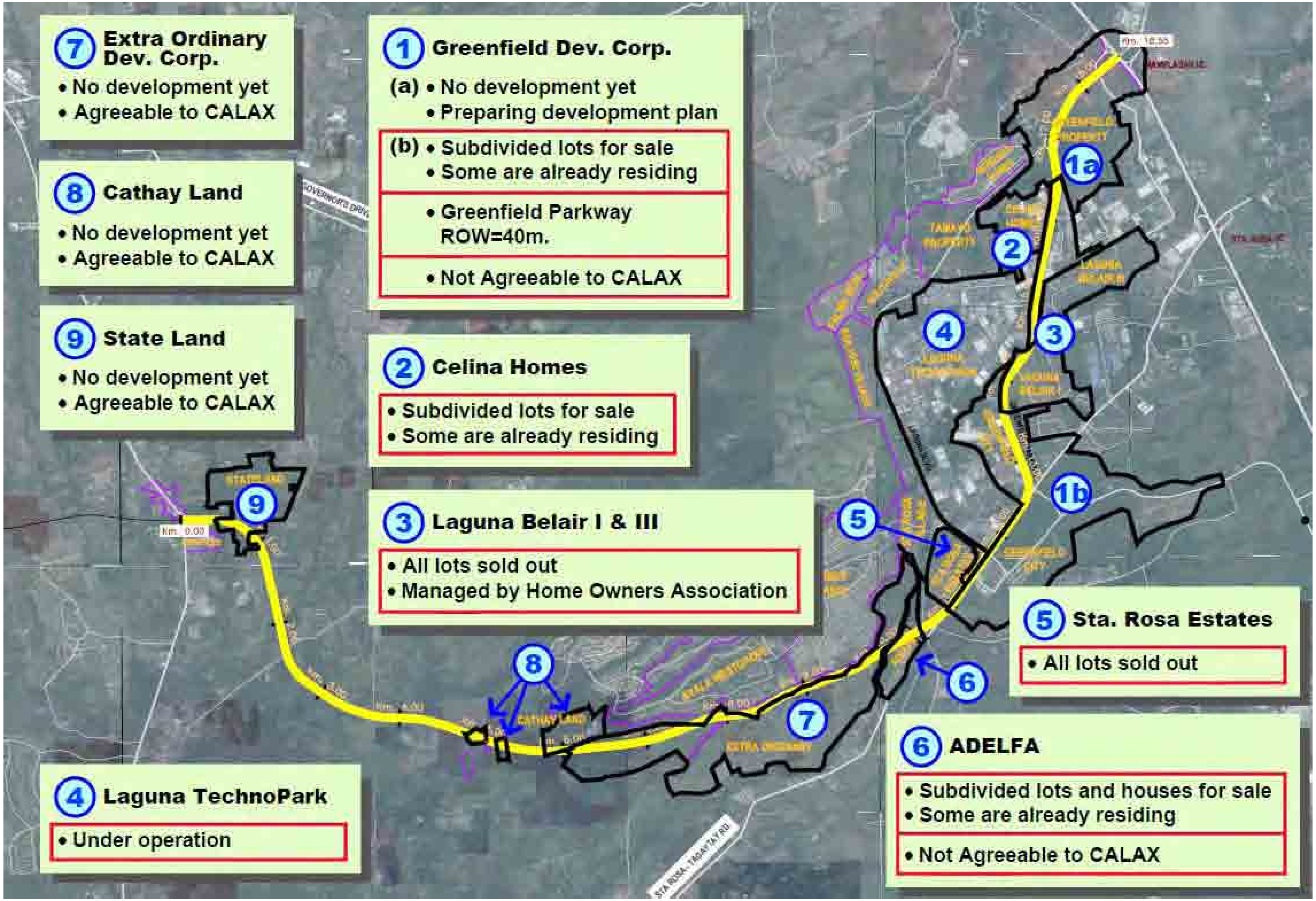


FIGURE 5.3.5-2 (2) ALTERNATIVE ALIGNMENT 2

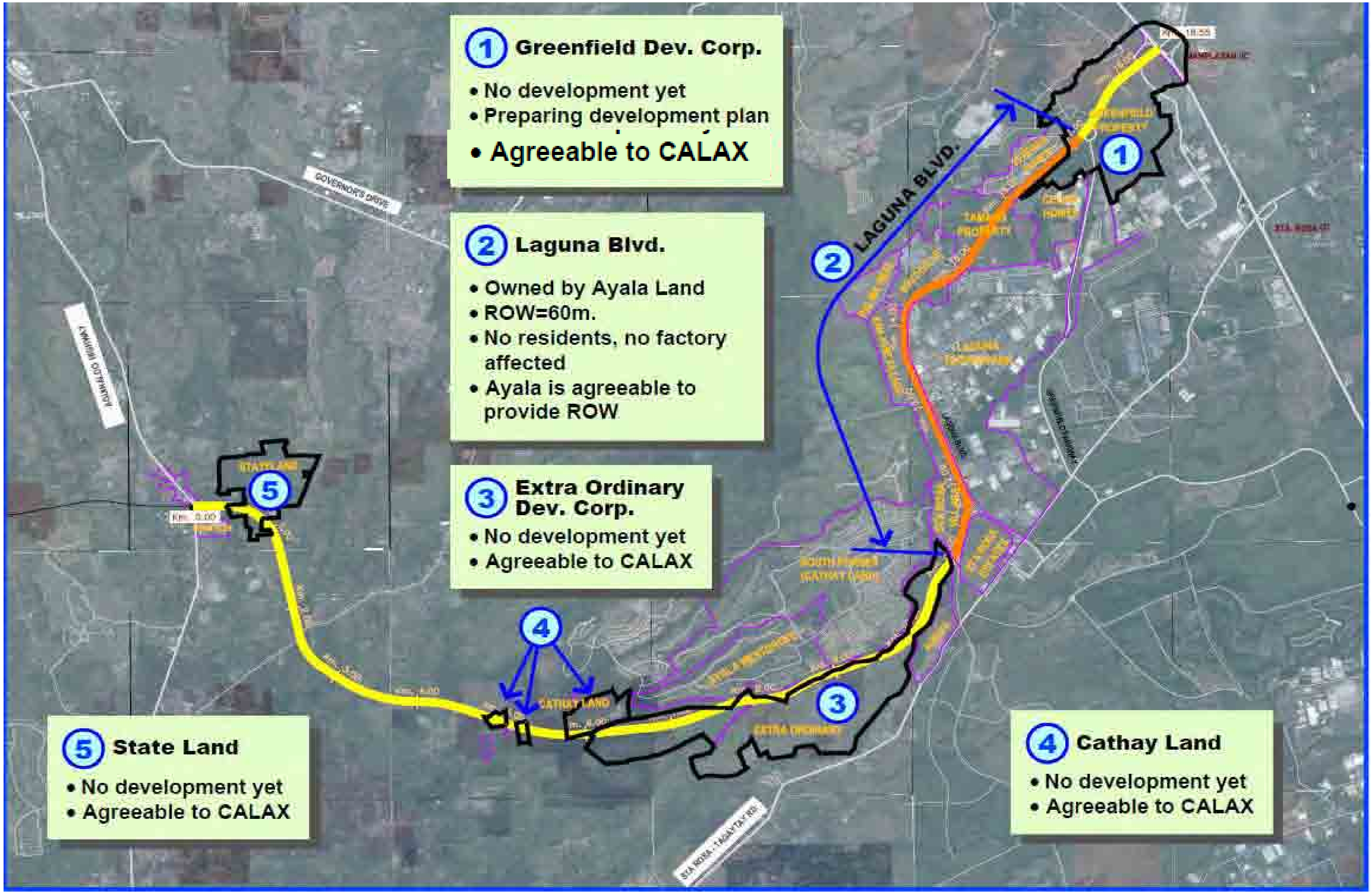


FIGURE 5.3.5-2 (3) ALTERNATIVE ALIGNMENT 3

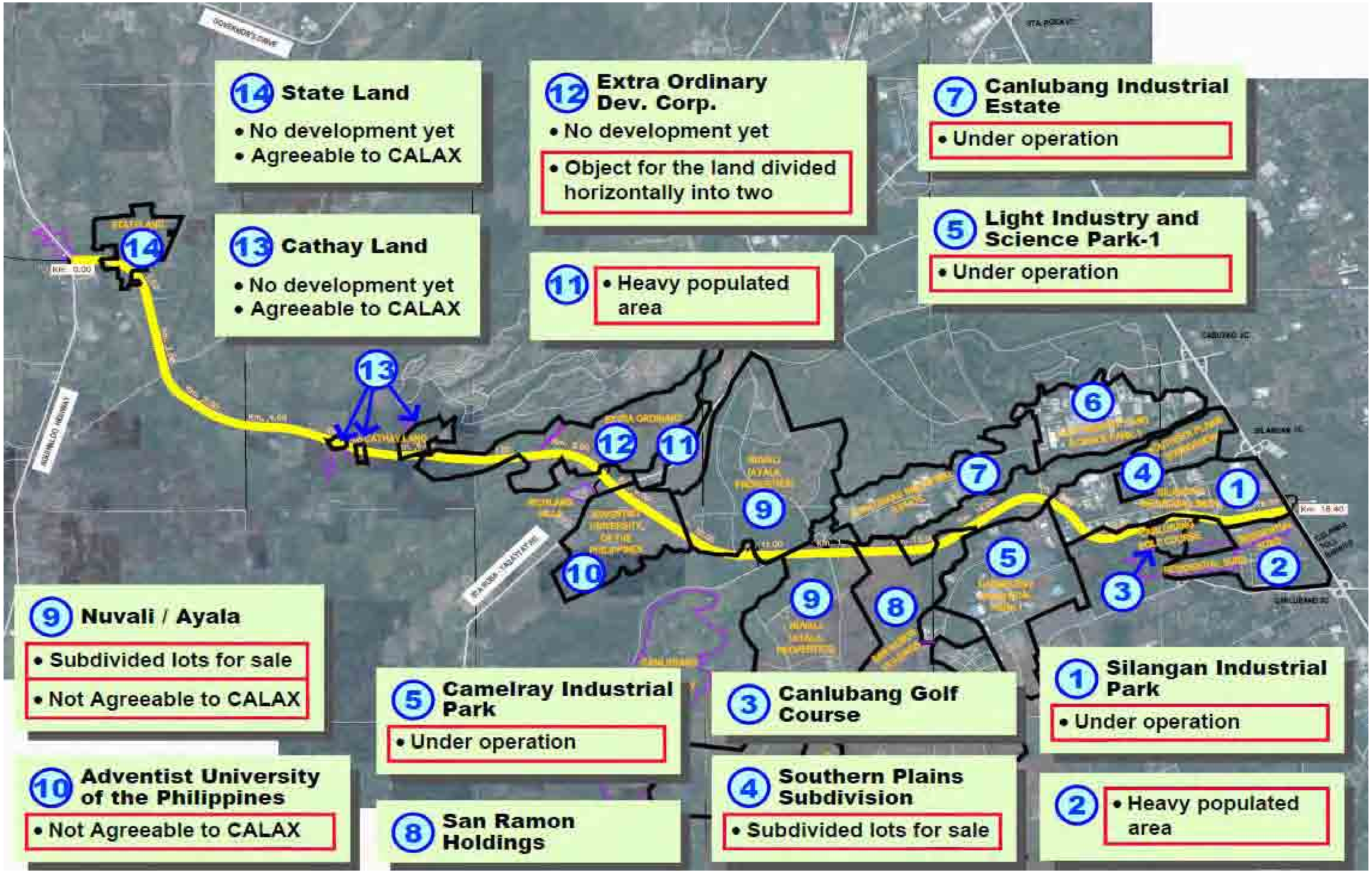


FIGURE 5.3.5-2 (4) ALTERNATIVE ALIGNMENT 4

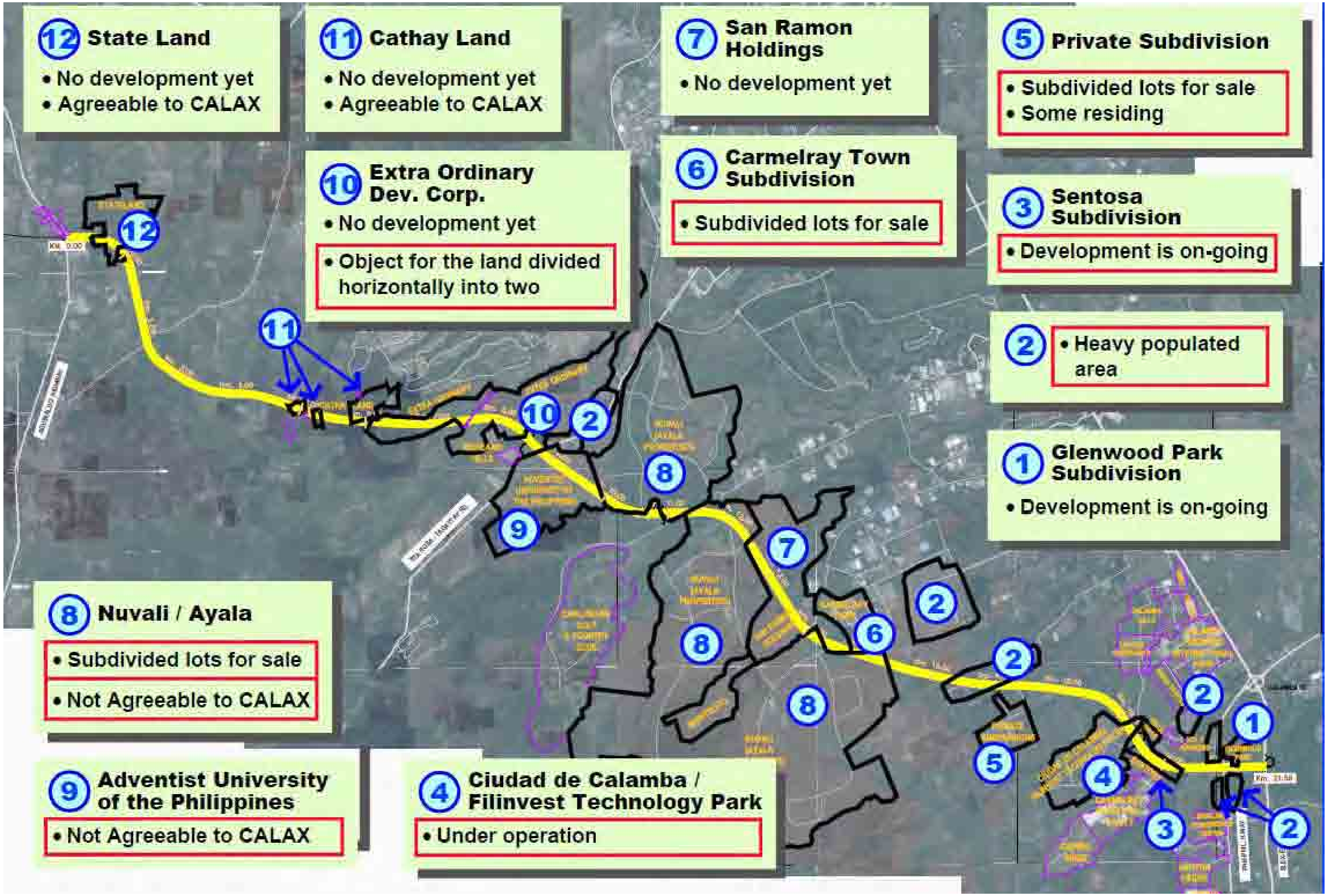


FIGURE 5.3.5-2 (5) ALTERNATIVE ALIGNMENT 5

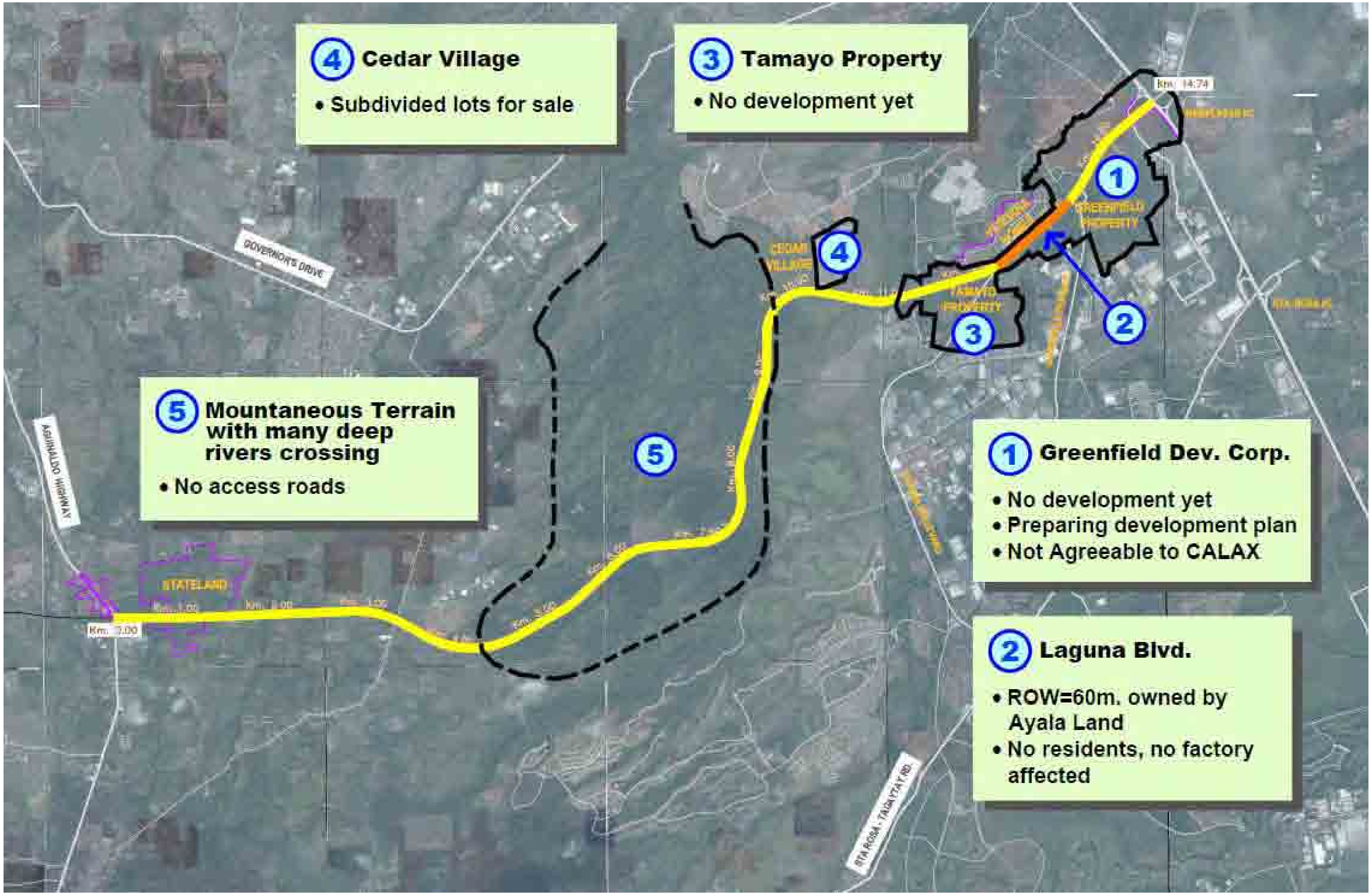


FIGURE 5.3.5-2 (6) ALTERNATIVE ALIGNMENT 6

(2) Civil Work Component and Cost Estimate

Civil work component of each alternative is shown in **Table 5.3.5-1**. Since all alternatives pass through urbanized/to be urbanized area, viaduct type was planned.

TABLE 5.3.5-1 CIVIL WORK COMPONENT OF ALTERNATIVES

Alternative	Length (km.)	Cost (Million Pesos)				No. of IC
		Roadway	Bridge	MSE Wall	Viaduct	
1	16.4 (100%)	10.20 (62%)	1.49 (9%)	2.90 (18%)	1.81 (11%)	3
2	18.6 (100%)	10.00 (54%)	1.09 (6%)	2.40 (13%)	5.11 (27%)	4
3	18.6 (100%)	10.50 (81%)	1.09 (6%)	2.20 (12%)	4.81 (26%)	4 + 1/2
4	18.4 (100%)	10.80 (59%)	1.69 (9%)	1.60 (9%)	4.31 (23%)	3
5	21.6 (100%)	13.40 (62%)	2.09 (10%)	3.00 (14%)	3.11 (14%)	3
6	14.8 (100%)	8.58 (58%)	3.29 (22%)	1.60 (11%)	1.33 (9%)	3

Civil work cost and right-of-way acquisition cost were roughly estimated and shown in **Table 5.3.5-2** and **Figure 5.3.5-3**.For cost estimate, the following unit prices per km was used;

- Cut/Embankment Section — 250 Million Php/km
- SME wall Section — 450 Million Php/km
- Bridge/Viaduct Section — 1,000 Million Php/km

ROW acquisition cost was based on BIR Zonal Value.

TABLE 5.3.5-2 ROUGHLY ESTIMATED COST OF ALTERNATIVES

Alternative	Length (km.)	Cost (Million Pesos)			Cost per Km (Million Pesos)		
		Civil Work	ROW	Total	Civil Work	ROW	Total
1	16.4	10,056 (65.5%)	5,303 (34.5%)	15,359 (100%)	613	323	937
2	18.6	13,196 (76.2%)	3,975 (23.8%)	17,171 (100%)	709	214	923
3	18.6	12,700 (80.5%)	2,962 (19.5%)	15,662 (100%)	683	159	842
4	18.4	12,484 (74.2%)	4,419 (25.8%)	16,903 (100%)	678	240	919
5	21.6	13,152 (74.2%)	4,581 (25.8%)	17,733 (100%)	609	212	821
6	14.8	11,869 (83.2%)	2,391 (16.8%)	14,260 (100%)	802	162	964

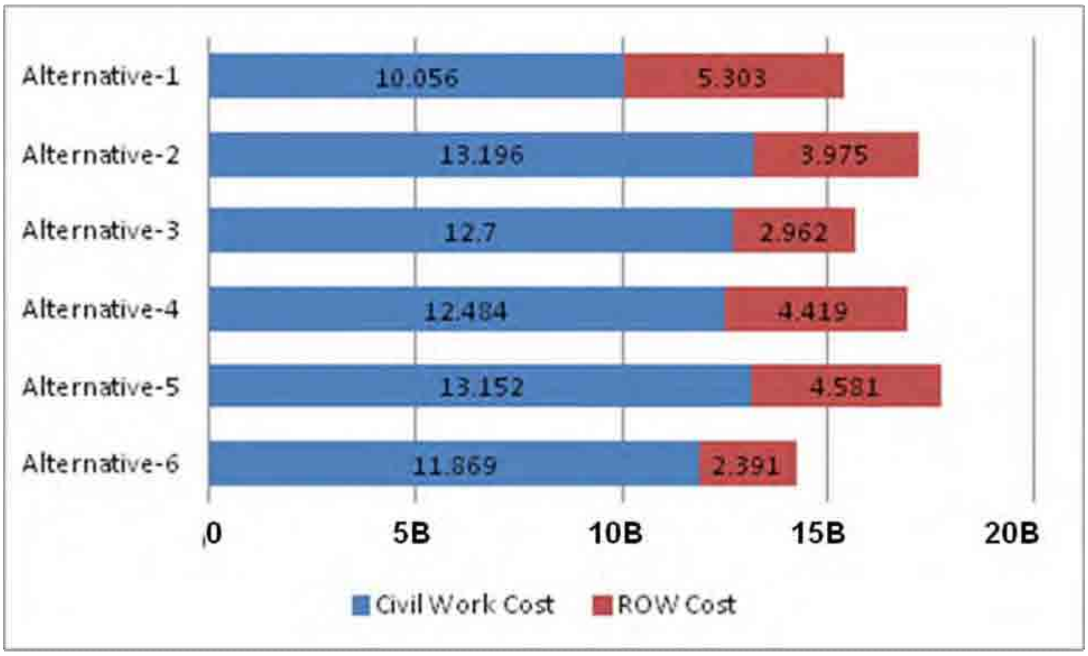


FIGURE 5.3.5-3 ROUGHLY ESTIMATE COST OF ALTERNATIVES

(3) Traffic Volume Attracted to Expressway

Traffic volume in 2020 was estimated as shown in **Table 5.3.5-3**.

TABLE 5.3.5-3 TRAFFIC VOLUME ATTRACTED TO CALAX (YEAR 2020)

Alternative	Length (km)	Traffic Volume which Enter CALAX per Day	Average Section Traffic Volume per Day	Vehicle-km per Day	Average Trip Distance (km)
1	16.4	48,500	36,800	609,100	12.6
2	18.6	53,900	31,400	548,100	10.2
3	18.6	57,600	34,300	576,800	10.0
4	18.4	58,500	30,600	591,300	10.1
5	21.6	52,200	28,500	643,200	12.3
6	14.8	37,100	27,100	434,200	11.7

(4) Characteristics of Alternatives

Characteristics of alternatives are summarized in **Table 5.3.5-4**.

TABLE 5.3.5-4 CHARACTERISTICS OF ALTERNATIVES

Alternatives		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Expressway Distance (km)		16.4	18.6	18.6	18.4	21.6	14.8
SLEX Connection		• Greenfield/ Eton Interchange (direct or indirect connection)	• Mamplasan Interchange (direct or indirect connection)	• Existing Mamplasan Interchange (direct or indirect connection)	• New Interchange (direct connection)	• New Interchange (direct connection)	• Existing Mamplasan Interchange (direct or indirect connection)
Road Structure	Road Section	10.2 km	10.0 km	10.5 km	10.8 km	13.4 km	8.6 km
	Bridge/ Viaduct	3.3 km	6.2 km	5.9 km	6.0 km	5.2 km	4.6 km
	MSE Wall	2.9 km	2.4 km	2.2 km	1.6 km	3.0 km	1.6 km
Cost (M Php)	Civil Work	10,056	13,196	12,700	12,484	13,152	11,869
	ROW	5,303	3,975	2,962	4,419	4,581	2,391
	Total	15,359	17,171	15,662	16,903	17,733	14,260
Estimated Traffic Volume (2020)	Volume (veh/ day)	48,500	53,900	57,600	58,500	52,200	37,100
	Veh.-km.	609,100	548,100	576,800	591,300	643,200	434,200
Cost Performance		39.7	31.9	36.8	35.0	36.3	30.4
Utilization of Private Road ROW which is to be acquired by DPWH		-	Greenfield Parkway W = 40 m L = 4.4 km (1/4 of total length, but widening is required.)	Laguna Blvd. W = 60 m L = 6.2 km (1/3 of total length, and no widening is required.)	-	-	-
Residential Subdivision Affected	Already Residing	1.4 km	3.5 km (one-side) 1.8 km (both-side)	-	-	-	-
	Lots for Sale	2.2 km	-	-	2.8 km	6.2 km	1.0 km
Industrial Estate Affected	Under Operation	-	1.0 km (one-side only)	-	2.2 km	0.2 km	-

Alternatives		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
University Affected		University of Sto. Tomas (UST)	-	-	Adventist University of the Philippines (AUP)	Adventist University of the Philippines (AUP)	-
Status of Land Development of Each Developer	People already residing	• Adelfa /Fine Properties Inc.	• VALENZA • Sta. Rosa Estate • Greenfield City • Laguna Bel-Air I & II	• Ayala Land Corp. (only Private Road ROW will be utilized, thus no one will be dislocated.	-	-	• Ayala Land Corp. (only Private Road ROW will be utilized, thus no one will be dislocated.
	Lots for sale	• Greenfield Development Corp. • MESSA Homes	• Greenfield Development Corp.	-	• Ayala/Nuvali Properties Inc.	• Ayala/Nuvali Properties, Inc. • Sentosa, Inc. • Greenwood Park, Inc.	• Tamayo Property, Inc.
	No Development Yet	• Stateland, Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Eton Properties	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Greenfield Development Corporation	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • Greenfield Development Corporation	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • San Ramon Holdings, Inc.	• Stateland Inc. • Cathay Land, Inc. • Extraordinary Development Corporation • San Ramon Holdings, Inc. • Carmelray Town	• Stateland Inc. • Greenfield Development Corporation
Industrial Estate in operation			• Laguna Techno Park	• Laguna Techno Park (property is not affected)	• Silangan Industrial Park	• Filinvest Technology Park	

(5) Evaluation of Alternatives

Method : Relative superiority of an alternative.
All evaluation items were equally evaluated.
Relative superiority among alternatives.

Good : O
Medium : △
Bad : X

Superiority of an alternative was evaluated by number of "Good, O"

a) Contribution to improvement of accessibility to the Project Area and Area Development

- Whether CALAX passes through an existing, on-going or proposed development area;
  - More than 70% of section ………………..… O
  - 50% to 70% ……………………………….….. △
  - Less than 50% ……………………………... X

b) Connection with SLEX

- Direct Connection ………………………..………. O
- Direct Connection is possible, but quite expensive … △

c) Traffic Volume Attracted

When higher traffic is attracted, it contributes more to reduce traffic congestion of public roads and the project is economically and financially feasible, thus an alternative which attract higher traffic is evaluated better than other alternatives.

- More than 50,000 veh./day ………………………….. O
- 40,000 to 50,000 veh/day ……………………………. △
- Less than 40,000 veh/day ……………………………. X

d) Cost (Civil Work Cost + ROW Acquisition Cost)

Smaller cost is better for the project. When the smallest cost is set as 1.00, increase rate of other Alternative was evaluated as follows;

<u>Cost Ratio</u>

1.0 to 1.10 ……………………………………………. O
1.10 to 1.20 …………………………………………... △
Over 1.20 …………………………………………….. X

e) Impact on Natural Environment

Major natural environmental impact of this project will be soil erosion and loss of greenery.

e-1) Soil Erosion

The project area is prone from slight to moderate soil erosion, depending on the gradient of land slope. Since slope cutting will affect soil erosion, thus evaluation indicator used is the volume of slope cutting.

Large scale of slope cut (over 500,000 m^3) required …………..….. X

Medium scale of slope cut (200,000 to 500,000 m^3) required ……... △
Small scale of slope cut (less than 200,000 m^3) required ……….… ○

e-2) Loss of Greenery

Loss of greenery is evaluated as the quantity of cut trees.

A large number of trees are cut …………………………………… X
Medium number of trees are cut ………………………………….. △
Small number of trees are cut ………….……………………….. ○

f) Social Impact

Evaluated by the number of houses to be affected.

10 or less houses …………………………………………….... ○
10 to 30 houses ………………………………………………... △
Over 30 houses ……………………………………..………. X

g) Cost Performance

Cost performance = veh.km/cost in Million Php

High Efficiency over 35 ……………………..…………... ○
Medium Efficiency 30 to 35 ….………..………………………. △
Low Efficiency less than 30 ……………………………….. X

h) Easiness of Implementation (ROW Acquisition)

Development status of properties of land development companies is different and can be classified as follows;

(a) Lots were sold out and some people are already residing.
(b) Lots are being sold.
(c) No development is made yet.

Those who bought a lot sold by the land development companies were not informed that an expressway will be built and their properties may be affected by the project. Therefore, it will take a longer time to negotiate with these people, and DPWH will have a hard time to acquire the road right-of-way. Evaluation was made as follows;

- Lots are not affected or land development has not started yet ….. ○
- Some lots are being sold ………………………………………… △
- Many lots have been sold out or are being sold and some people are already residing …………………………… X

i) Easiness of Construction

This was evaluated as follows;

- Wide construction space is available, existing traffic is not disturbed, access road for construction needed, but its construction is easy. ………………… ○
- Above conditions become rather severe ………………………….. △
- Construction of access road itself is difficult due to terrain, and construction can start only at the beginning side and end side …………………………... X

TABLE 5.3.5-5 EVALUATION OF ALTERNATIVES: METHOD-1

Evaluation Item		Alternatives											
		1		2		3		4		5		6	
a) Contribution to improvement of accessibility		Pass through development area	○	Pass through development area	○	Pass through development area	○	Pass through development area	○	Pass through development area	○	Pass through steep slope area	X
b) Connection with SLEX		Indirect	△	Direct or indirect	△	Direct or indirect	△	Direct	○	Direct	○	Direct or indirect	△
c) Traffic Volume Attracted		48,500	△	53,900	○	57,600	○	58,500	○	52,200	○	37,100	X
d) Cost		15,359 (1.08)	○	17,171 (1.20)	X	15,662 (1.10)	○	16,903 (1.19)	△	17,333 (1.24)	X	14,260 (1.00)	○
e) Impact on Natural Environment	Slope Cutting	Medium Scale (380,000 m^3)	△	Medium Scale (380,000 m^3)	△	Medium Scale (380,000 m^3)	△	Medium Scale (380,000 m^3)	△	Medium Scale (380,000 m^3)	△	Large Scale (750,000 m^3)	X
	Tree Cutting	Medium Number	△	Medium Number	△	Medium Number	△	Medium Number	△	Medium Number	△	Large Number	X
f) Social Impact		20 houses	△	30 houses	△	10 houses	○	40 houses/factory	X	60 houses	X	10 houses	○
g) Cost Performance		39.7	○	31.9	△	36.8	○	34.9	△	36.3	○	30.4	△
h) Easiness of Implementation (ROW acquisition)		3.6 km	X	6.3 km	X	-	○	5.0 km	X	6.4 km	X	1.0 km	△
i) Easiness of Construction		Easy	○	Easy	○	Easy	○	Easy	○	Easy	○	Difficult	X
Evaluation		○ : 4 △ : 5 X : 1		○ : 3 △ : 5 X : 2		○ : 7 △ : 3 X : 0 [Recommended]		○ : 4 △ : 4 X : 2		○ : 5 △ : 2 X : 3		○ : 2 △ : 3 X : 5	

(6) Evaluation and Recommendation

Results of evaluation shows that Alternative-3 is the most preferable alternative. Advantages of Alternative-3 are as follows;

Alternative – 1: Not recommended

- Many land development companies are objecting to this alignment. ROW acquisition is extremely difficult and takes a long time for negotiating with them as well as those households who recently purchased lots.

Alternative -2: Not recommended

- Many land development companies are objecting to this alignment. ROW acquisition is extremely difficult and takes a long time for negotiating with them as well as those households who are residing along the alignment.

Alignment – 3: Recommended

- Cost is within 10% increase compared to the minimum cost alternative (Alternative-6).
- High traffic volume is affected. Although the alternative which attracts the highest traffic is Alternative – 4, however, difference between Alternative – 4 and this alternative is only 1.6% (or 900 vehicles per day).
- Number of people dislocated by this alternative is the smallest among alternatives, since this alternative utilize the existing private road right-of way for about 1/3 of the alignment.
- ROW acquisition is the easiest among alternatives, utilizes the existing 60m ROW of Laguna Blvd. for about 1/3 of the alignment.

Alignment – 4: Not recommended

- Although this alignment attracts the highest traffic volume, lands of four (4) existing industrial estates are taken by this alignment and industrial activities will be affected. Also, lands of a university and many of residential subdivisions are affected.
- Due to above, ROW acquisition will be extremely difficult and takes a long time.

Alignment – 5: Not recommended

- The alignment is the longest in length and the most expensive alternative.
- Land of one (1) industrial estates, many residential subdivisions and one (1) university are taken by this alignment, thus ROW acquisition is extremely difficult and takes a long time for negotiation with those affected.

Alternative – 6: Not recommended

- Although this alignment is the shortest and the cost is the smallest among alternatives, but this alternative attract the least traffic.
- This alignment passes through mountainous area, thus impact of this alignment on the urbanization and economic development is the smallest.

In view of the above, **Alternative-3** was **recommended**.

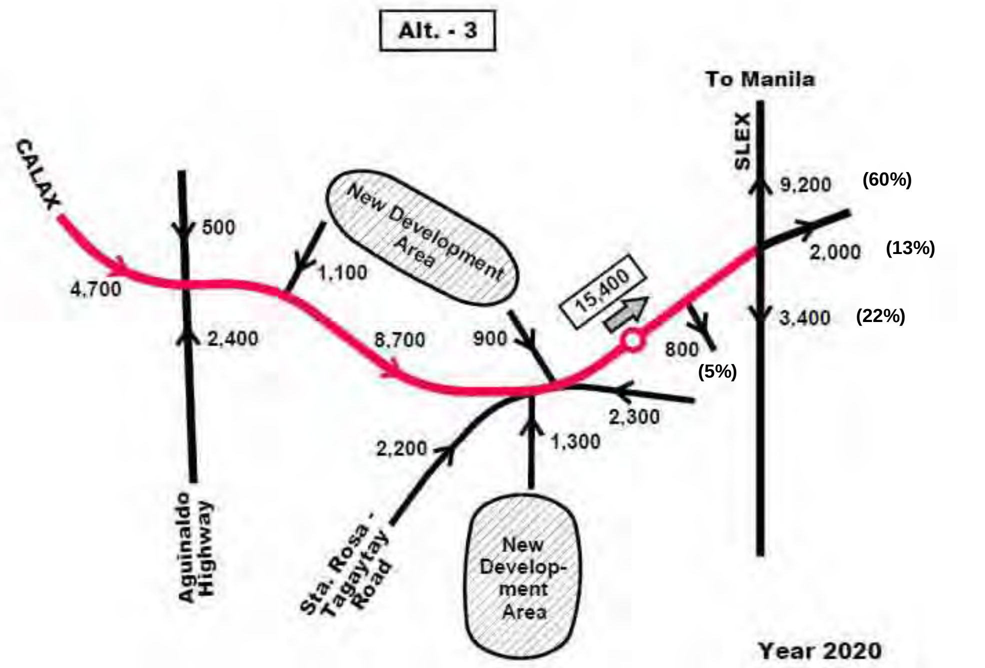
5.3.6 How CALAX will be Used?

Directionof traffic flow at the section over Laguna Blvd. is shown in **Figure 5.3.6-1** and summarized in **Table 5.3.6-1**.

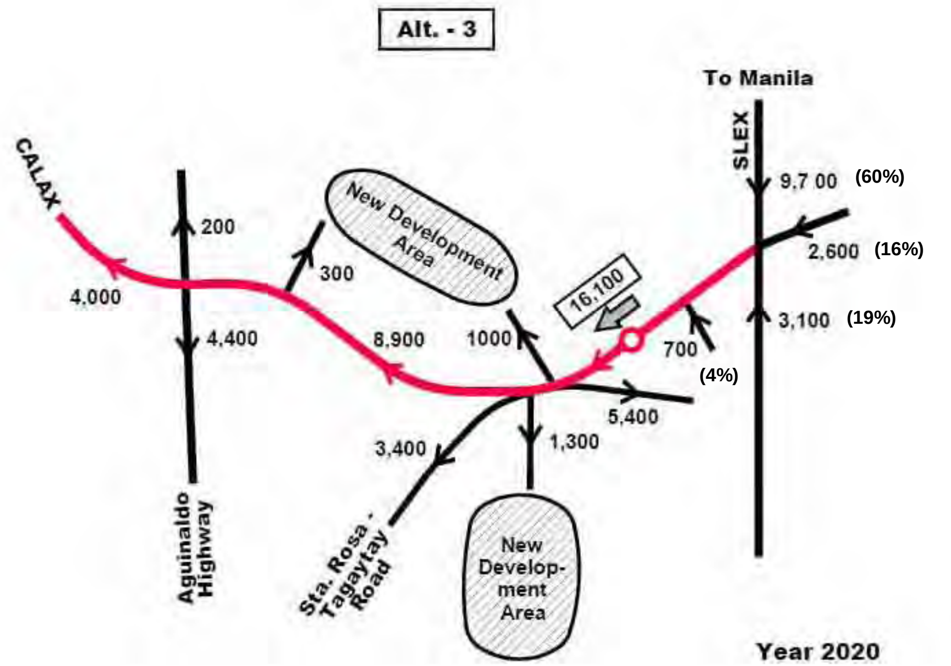
TABLE 5.3.6-1 DIRECTION OF TRAFFIC ON CALAX OVER LAGUNA BLVD.

Direction		Traffic Volume	% Share
Metro Manila related	To Metro Manila	9,200	60%
	From Metro Manila	9,700	60%
	Total	18,900	60%
Calamba (South of IC) or toward South related	To South	3,400	22%
	From South	3,100	19%
	Total	6,500	21%
Laguna Bay (East) side related	To East	2,000	13%
	From East	2,600	16%
	Total	4,600	15%
Industrial Estate Related	To Estate	800	5%
	From Estate	700	5%
	Total	1,500	5%

As shown in the table, 60% of CALAX traffic is to/from Metro Manila (towards the north), Calamba (or south of Mamplasan Interchange) is 21%, Laguna Bay-related (towards the east) is 15%, and Industrial Estate-related is 5%.



Traffic Direction to Mamplasan Interchange



Traffic Direction from Mamplasan Interchange

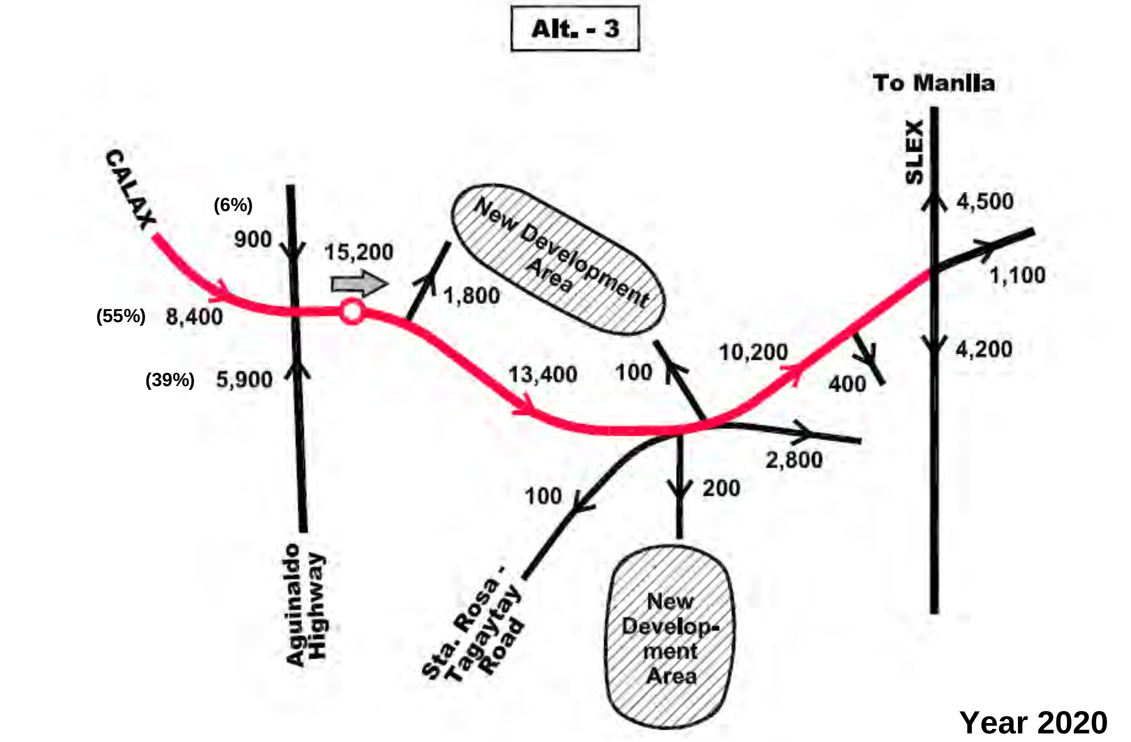
FIGURE 5.3.6-1 DIRECTION OF TRAFFIC NEAR MAMPLASAN INTERCHANGE

Direction of traffic flow at the section near Aguinaldo Highway is shown in **Figure 5.3.6-2** and summarized in **Table 5.3.6-2.**

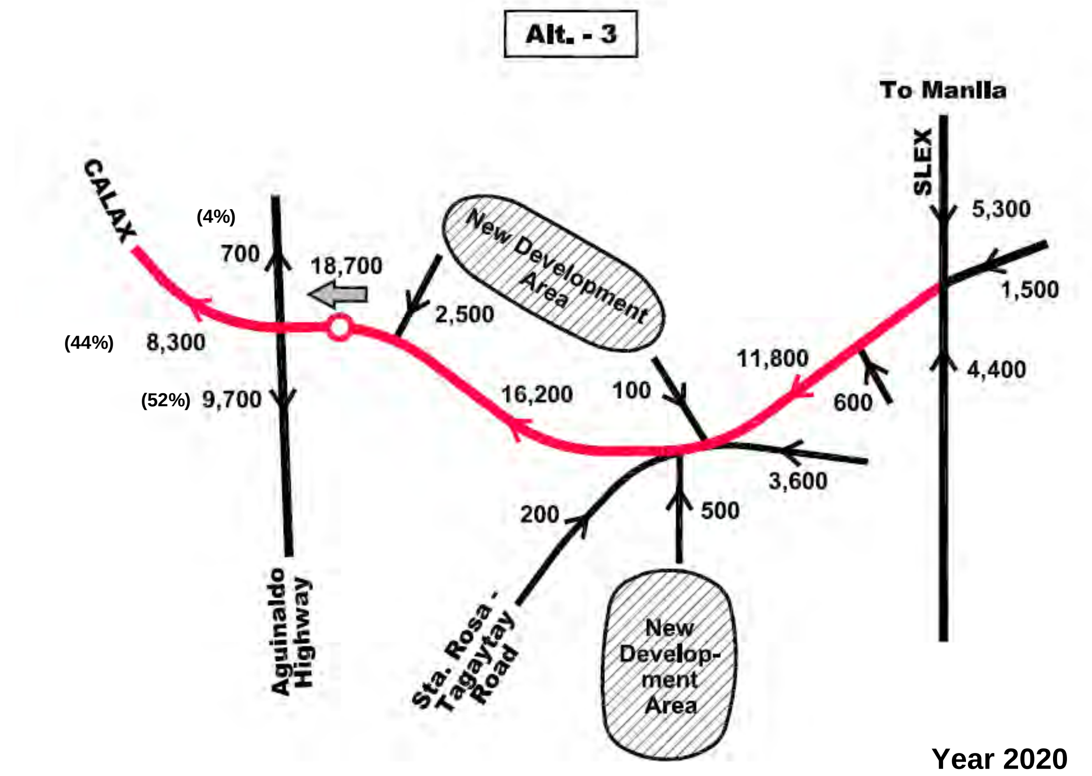
- 49% is to/from Cavite Section.
- 46% is to/from Tagaytay (or South) side via Aguinaldo Highway.
- 5% is to/from Dasmariñas (or North) side via Aguinaldo Highway.

TABLE 5.3.6-2 DIRECTION OF TRAFFIC ON CALAX SECTION NEAR AGUINALDO HIGHWAY

Direction		Traffic Volume	% Share
Cavite Section related	To Cavite Section	8,300	44%
	From Cavite Section	8,400	55%
	Total	16,700	49%
Aguinaldo Highway: Tagaytay (south) related	To Tagaytay	9,700	52%
	From Tagaytay	5,900	39%
	Total	15,600	46%
Aguinaldo Highway Dasmariñas (north) related	To Dasmariñas	700	4%
	From Dasmariñas	900	6%
	Total	1,600	5%



Traffic Direction From Cavite Section / Aguinaldo Highway



Traffic Direction to Cavite Section / Aguinaldo Highway

FIGURE 5.3.6-2 DIRECTION OF TRAFFIC NEAR AGUINALDO HIGHWAY

5.3.7 Viaduct along Laguna Blvd.

The proposed alignment utilized the existing Laguna Blvd. which was developed by Ayala Corporation and is operated as a private road, therefore, all vehicles cannot pass the road but only those with sticker.

The east side of the road is the Laguna Techno Park (industrial estate) and the west side of the road is mostly residential subdivisions.

The road has a right-of-way width of 60m. About 1/3 of the section is 4-lane divided road and the rest is a 2-lane road. Due to roadside development, there are many intersections as shown in **Figure 5.3.7-1.**

CALAX was planned to fly over all existing intersections and the profile of the section between intersections was planned to lower as much as possible to reduce the construction cost, thus, the section along Laguna Blvd. comprises of Viaduct Section and the mechanically stabilized earth wall (MSE Wall) as shown in **Figure 5.3.7-1.** Typical cross section of viaduct section and MSE Wall Section is shown in **Figure 5.3.7-2** and **Figure 5.3.7-3**, respectively.

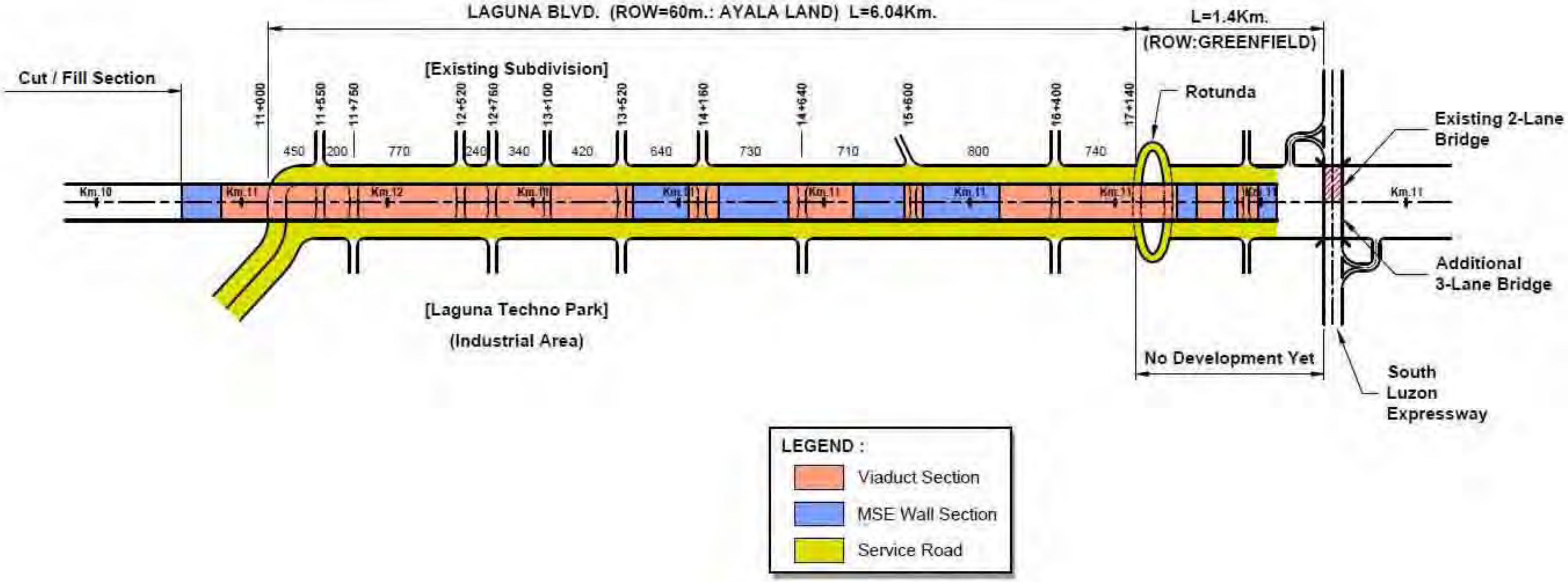


FIGURE 5.3.7-1 VIADUCT ALONG LAGUNA BLVD.

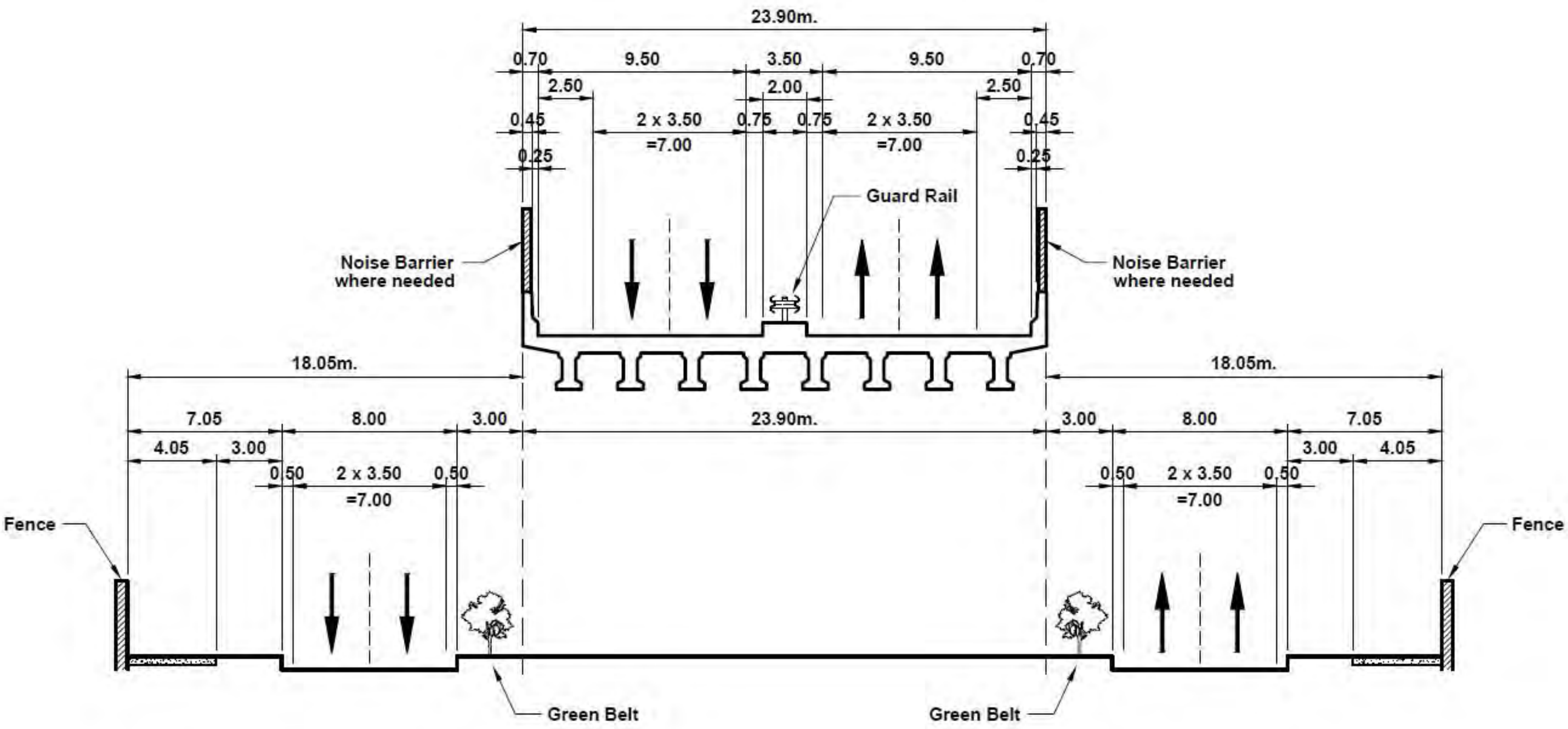


FIGURE 5.3.7-2 TYPICAL CROSS SECTION: FLYOVER SECTION

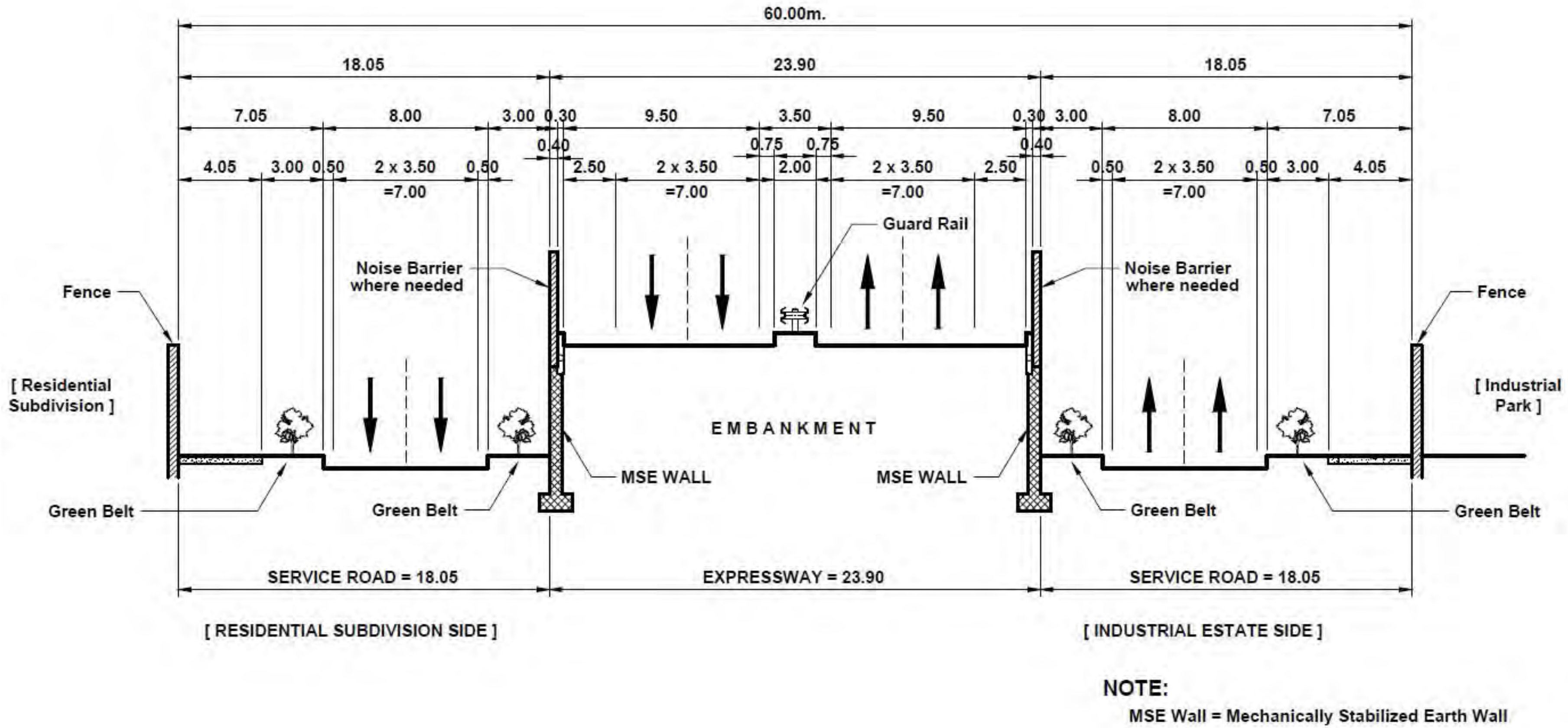


FIGURE 5.3.7-3 TYPICAL CROSS SECTION: MSE WALL SECTION

5.3.8 Mamplasan Interchange Connection

(1) Connection Method between CALAX and SLEX

Two types of connection methods were studied as follows;

Case-1: Direct connection between CALAX and SLEX (**Figure 5.3.8-1**)
Case-2: Indirect connection between CALAX and SLEX (**Figure 5.3.8-2**)

Both schemes were evaluated and Case-2: Indirect Connection was recommended due to the following reasons;

- Although the direct connection is ideal for the smooth traffic flow from/to CALAX to/from SLEX, however,
  - This scheme is quite expensive compared to Indirect Connection Method. (Higher by 1.67 times, or an additional Php 1,467 Million required.)
  - Accessibility to establishment/residents near the existing Mamplasan Interchange becomes worse than at present.
- Traffic flow of Indirect Connection Method can be improved by adopting flyovers at major intersections.

(2) Development Plan of Greenfield Development Corp. (GDC)

The area of about 1.2 km section adjacent to the Mamplasan Interchange is owned by Greenfield Development Corporation (GDC). GDC has a development plan of this area as shown in **Figure 5.3.8-3.** GDC strongly requested CALAX not to follow the existing road, since GDC will totally change the road network in line with their development plan. It is also requested a rotary type of intersection (rotunda) be built near the Mamplasan Interchange. GDC committed to provide a 50m road right-of-way for the alignment of CALAX.

Many meetings were held and GDC agreed to follow the scheme shown in **Figure 5.3.8-4.**

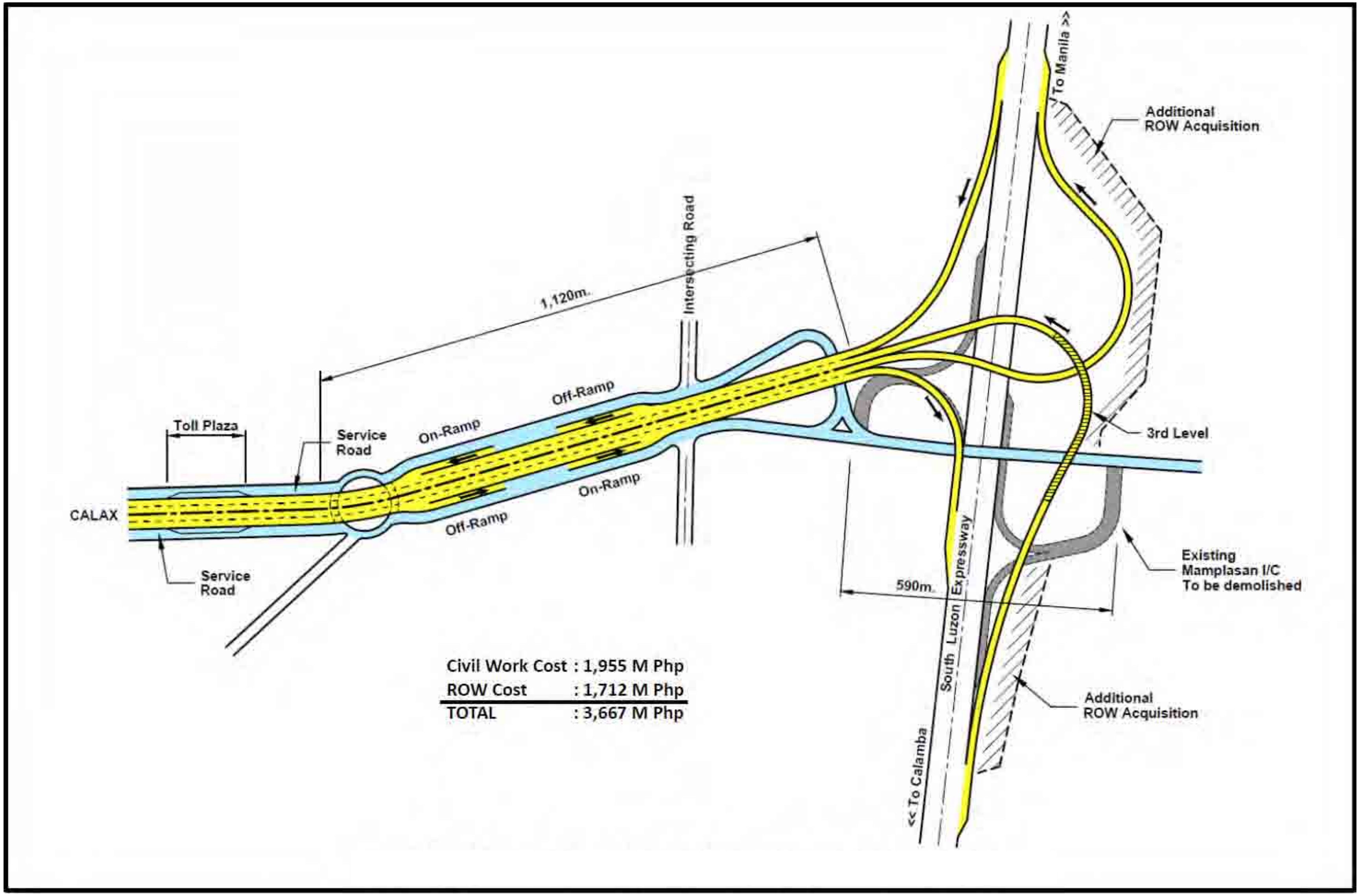


FIGURE 5.3.8-1 CASE-1: DIRECT CONNECTION BETWEEN SLEX AND CALAX

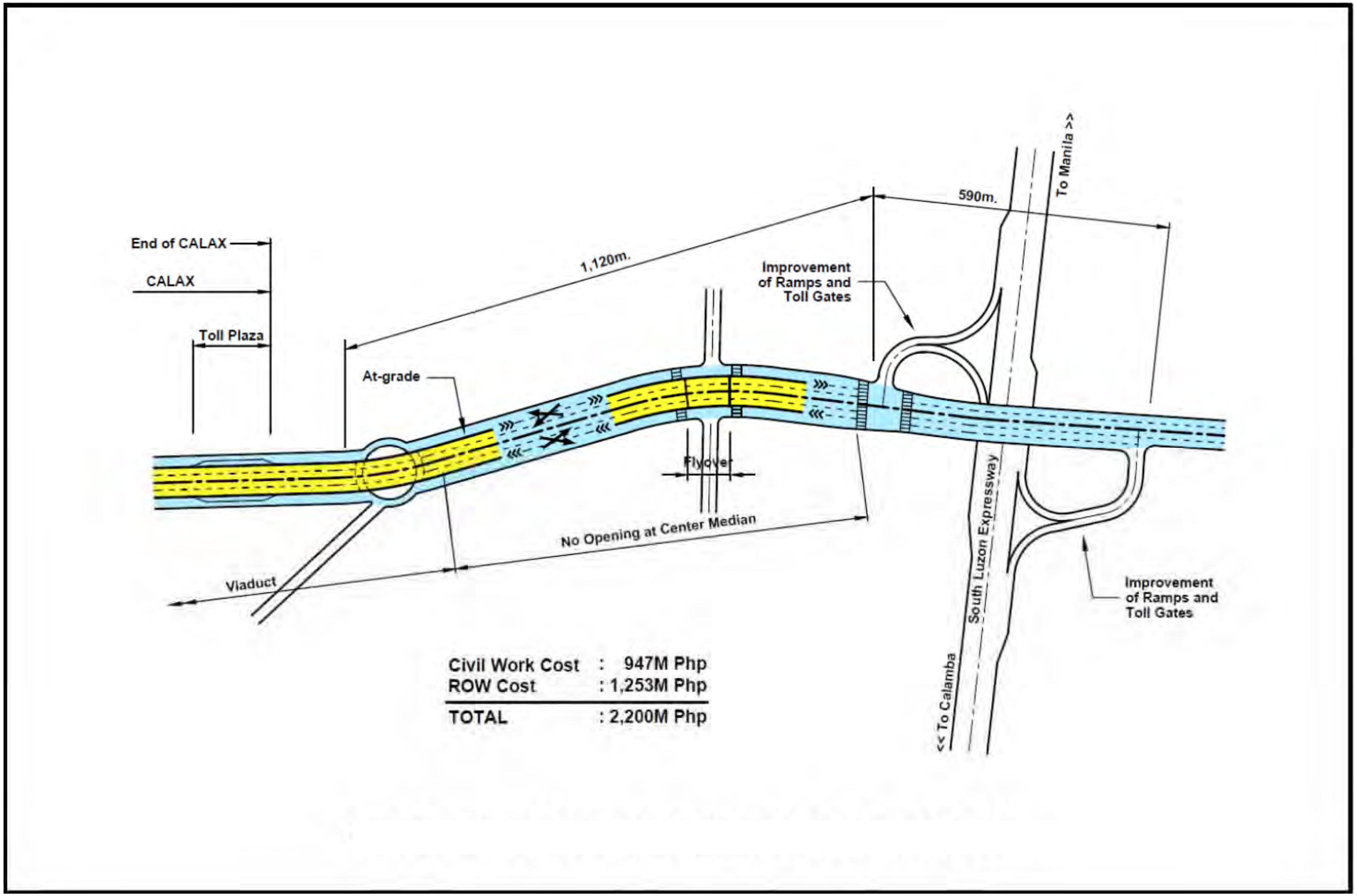


FIGURE 5.3.8-2 CASE-2: INDIRECT CONNECTION BETWEEN SLEX AND CALAX

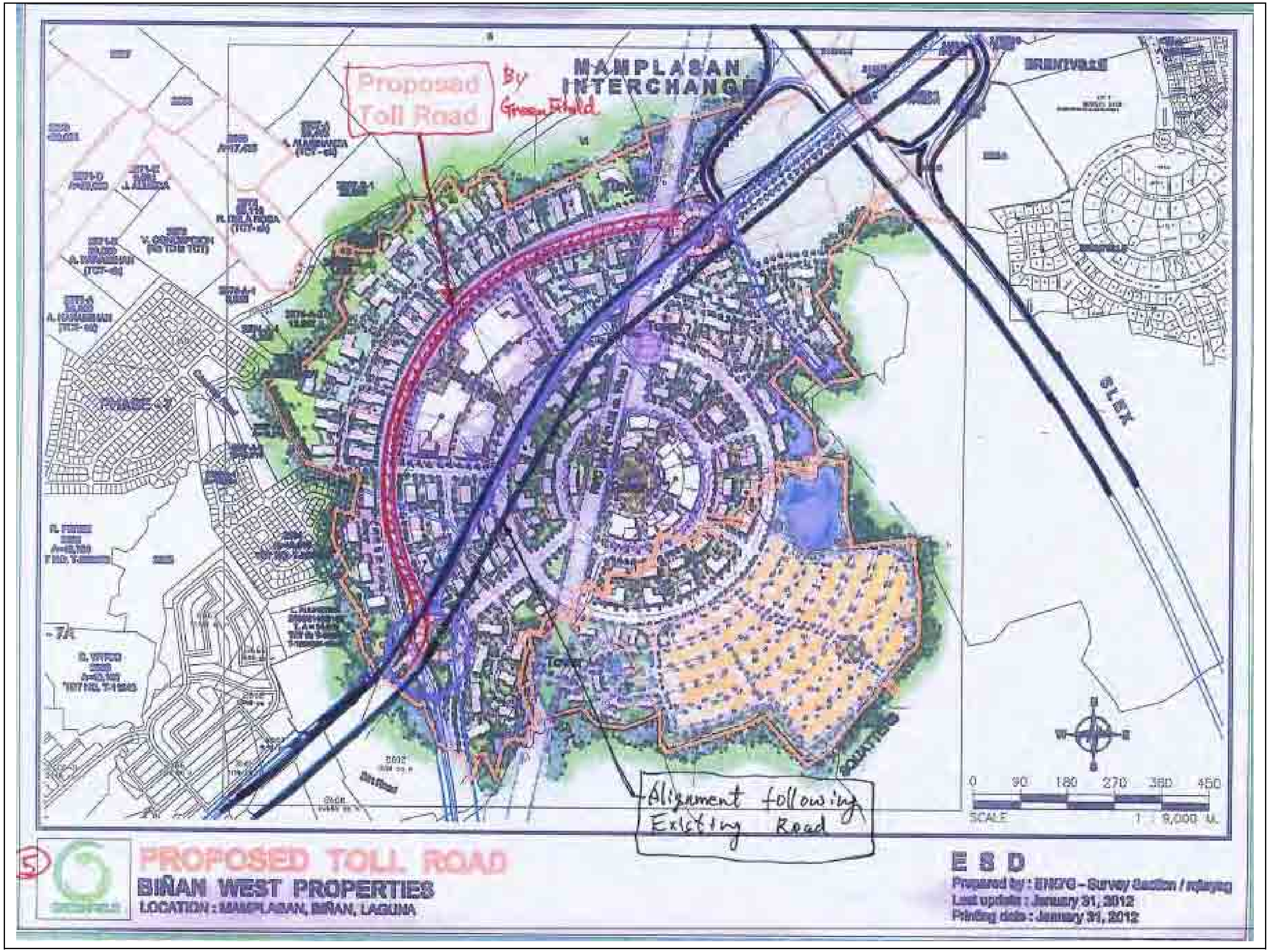


FIGURE 5.3.8-3 DEVELOPMENT PLAN OF GDC

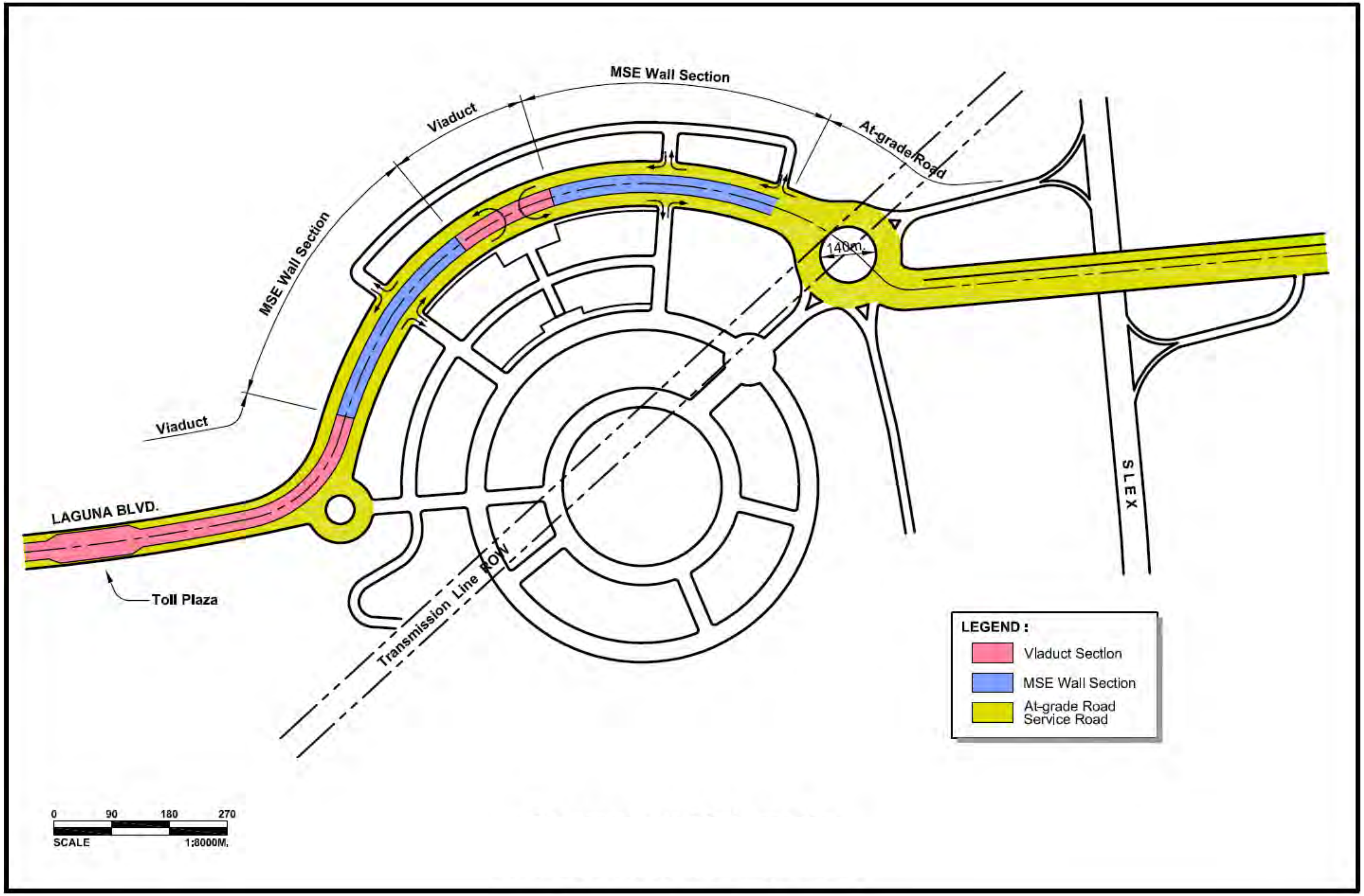


FIGURE 5.3.8-4 AGREED SCHEME FOR ROAD SECTION NEAR MAMPLASAN I/C

CHAPTER 6
PRELIMINARY DESIGN

6.1 ENGINEERING SURVEYS UNDERTAKEN

6.1.1 General

This section of the report highlights the engineering surveys undertaken for the proposed.

Following two (2) engineering survey was conducted;

(1) Topographical Survey
(2) Soils and Geo-technical Investigation

6.1.2 Topographical Survey

Table 6.1.2-1 shows summary of survey work conducted.

TABLE 6.1.2-1 SUMMARY OF TOPOGRAPHICAL SURVEY

No	Item	Value	Remark
1	Coordinate. grid	PRS-92	
2	Methodology	Conformed to DAO* DENR regulation	
3	Reference for Horizontal	NAMRIA CVT-3057	1st Order
4	Reference for Horizontal	NAMRIA CV-09	3rd Order
5	Road Centerline Survey	17.128 km	50 m interval
6	Road Centerline Profile Survey	17.128 km	50 m interval
7	Bridge Site Topographical Survey	14 Bridges	
8	Interchange Site Survey	3 IC	600 m x 600 m topo
9	Intersecting Road Survey	6 sites	
10	Cross Sectional Survey	343 cross section	Every 50m interval 60m both sides from center line

*DAO-Department Administrative Order. DENR-Department of Environment and Natural Resources

6.1.3 Soils and Geo-technical Investigation

The geotechnical survey was conducted along the proposed road alignment. **Table 6.1.3-1** shows the number of geo-technical survey. **Figure 6.1.3-1** shows the location of the geotechnical map.

TABLE 6.1.3-1 LIST OF GEOTECHNICAL TEST

No.	Test	Number
1	Drilling of bore hole	7
2	Test Pit	15
3	Auger Boring	14
4	Material Source	2

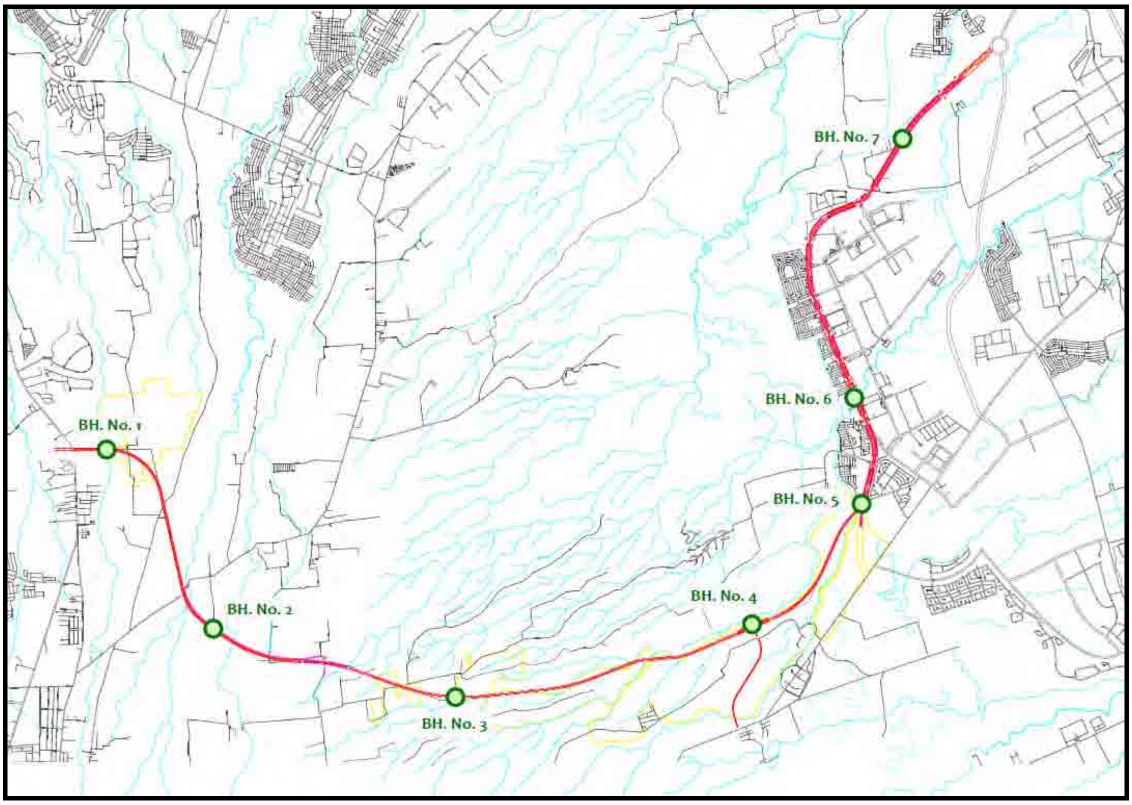


FIGURE 6.1.3-1 GEO-TECHNICAL TEST LOCATION MAP

(1) Summary of Geo-technical Survey Results

1) Bridge Site Investigation

The profile accomplished by the borehole test result is shown in **Table 6.1.3-2** and **Figure 6.1.3-2**.

TABLE 6.1.3-2 BOREHOLE TEST LOCATION

BH I.D.	Coordinates		Elevation (m)	Final Depth (m)
	Northing	Easting		
BH-1	1576401.3908	497426.7004	249.0	16.20
BH-2	1574373.3516	498764.1303	289.0	15.30
BH-3	1573605.8446	501112.6767	276.0	11.26
BH-4	1574340.7997	504623.8536	141.0	13.37
BH-5	1576004.0942	506065.6296	83.0	28.09
BH-6	1576962.0647	505920.3461	68.0	9.26
BH-7	1579848.9562	506447.5465	38.0	34.41

Source: JICA Study Team

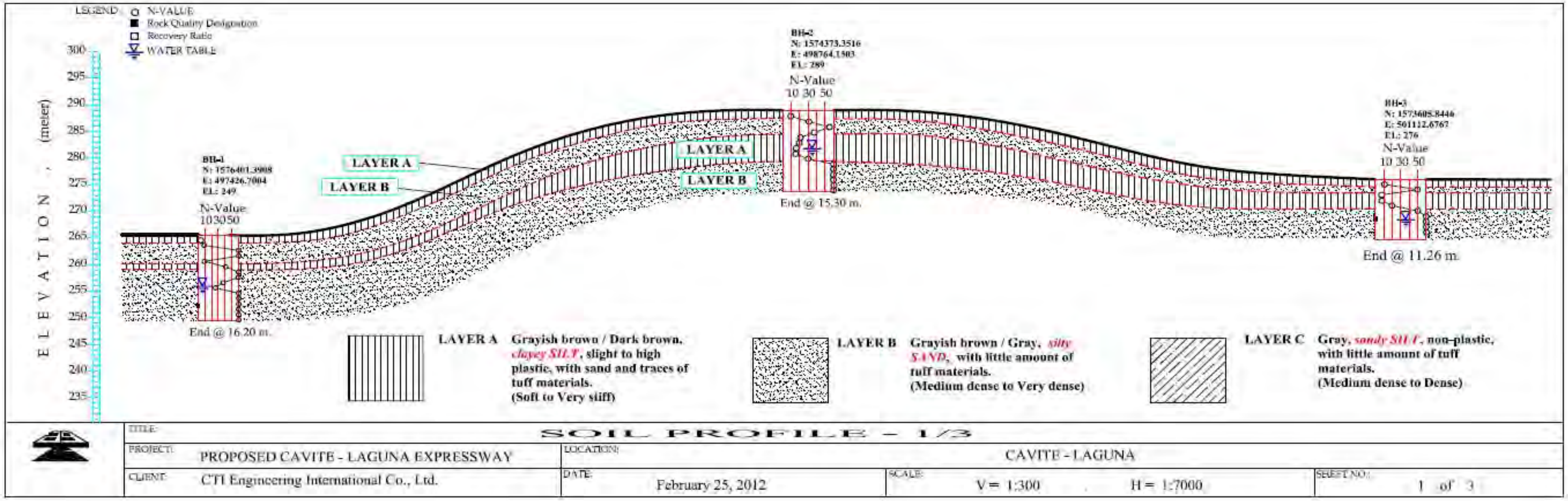


FIGURE 6.1.3-2 GEOGRAPHICAL PROFILE (1/3)

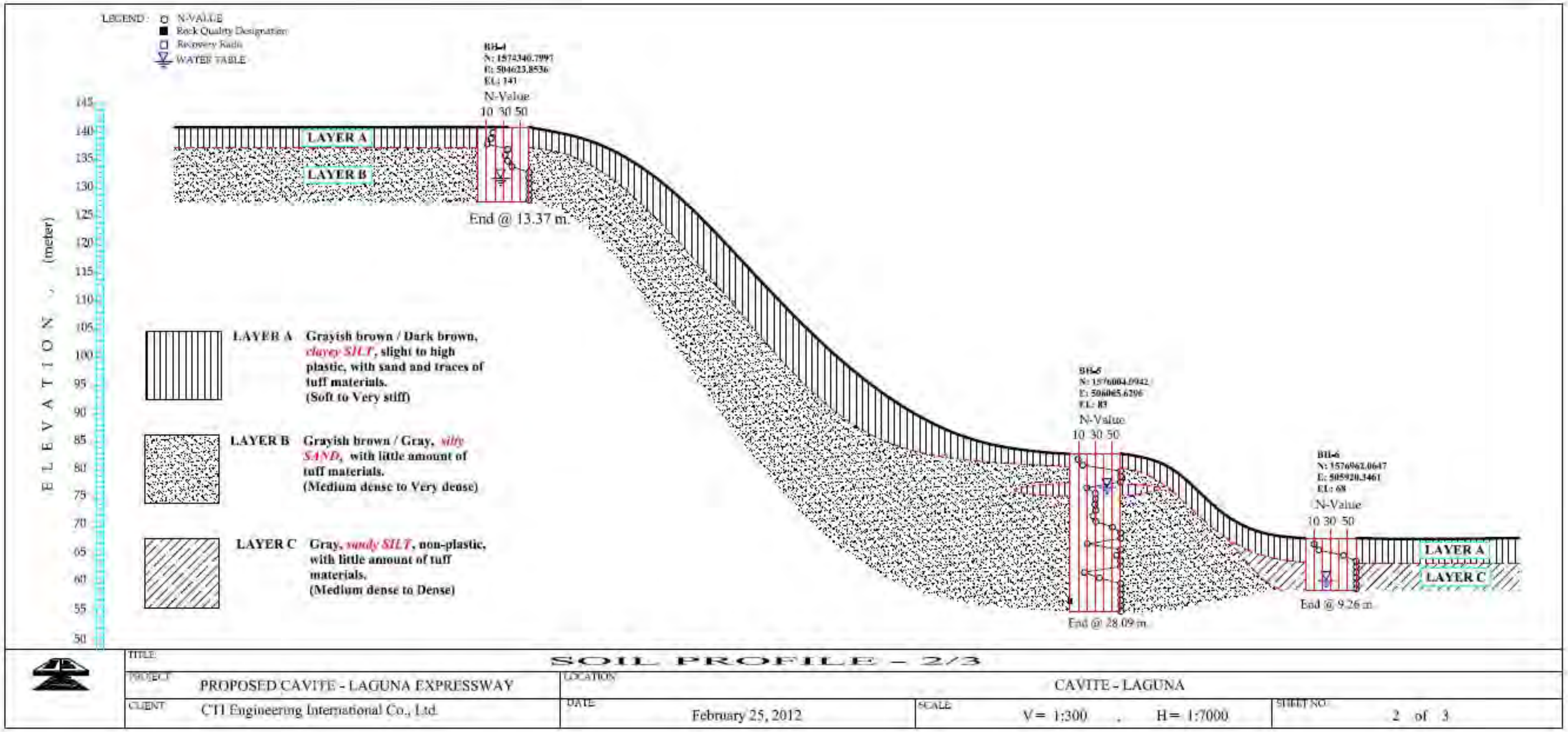


FIGURE 6.1.3-2 GEOGRAPHICAL PROFILE (2/3)

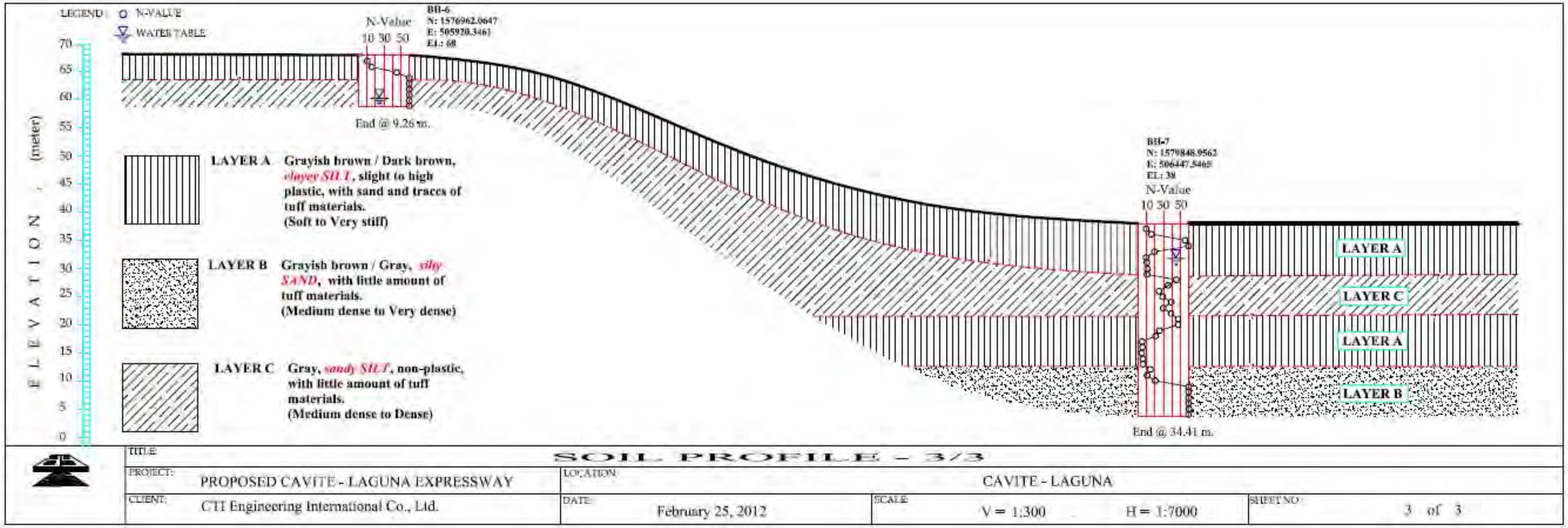


FIGURE 6.1.3-2 GEOGRAPHICAL PROFILE (3/3)

In general and based on the results of the seven (7) boreholes, the project site is underlain by alternating layers of silt and sands. The soft to very stiff Silt forms the uppermost cover, followed by the dense to very dense fine Sand where most of the boreholes were terminated.

The uppermost layer is described as grayish brown, slight to high plastic clayey Silt (ML/MH), with appreciable amount of sand and traces of tuff materials. Consistency of the layer is soft and becoming very stiff towards the bottom of the layer, with recorded SPT blow counts ranging from a low of 4 in the upper stretches to as high as 30. It has to be noted that this layer is thickest in BH-7, which was about 29.0 meters and thinnest in other boreholes (only about 2-4 meters).

Underneath the uppermost cohesive layer is the very dense silty Sand (SM), with some content of tuff materials. Generally, this layer forms the bottom of the boreholes where blow counts usually hit practical refusals (N>50).

All the seven (7) boreholes were terminated after hitting five (5) meters thick of competent bearing stratum (N>50).

2) Pits and Auger Holes

Based on the field and laboratory test results of the fifteen (15) test pits and fourteen (14) auger holes, the excavated soils taken at the uppermost 1.2 to 2.0 meters depth mainly consisted of cohesive materials described as medium plastic Clay, with some content of sand and tuff materials.

The results of the Modified Compaction (ASTM D1557 / AASHTO T180) and California Bearing Ratio (ASTM D1883 / AASHTO T193) is shown in **Table 6.1.3-3**.

TABLE 6.1.3-3 TEST RESULT OF TEST PIT

TP No.	Depth (meters)	Soil Description	AASHTO Class	Max. Dry Density (g/cc)	Optimum Moisture Content (%)	% CBR @ 95% MDD
1	0.6 – 1.2	Clay	A-7-5 (9)	1.41	24.5	3.5
2	0.77 – 1.5	Clay	A-7-5 (20)	1.42	26.5	3.2
3	0 – 2.0	Clay	A-7-5 (7)	1.52	21.25	5.2
4	0 – 2.0	Clay	A-7-5 (14)	1.50	23.5	6.6
5	0.7 – 1.8	Clay	A-7-5 (11)	1.40	25.25	4.8
6	0.9 – 2.0	Clay	A-7-5 (20)	1.47	23.0	6.4
7	0 – 2.0	Clay	A-7-5 (11)	1.46	22.5	3.0
8	0 – 1.44	Clay	A-7-5 (10)	1.40	28.0	4.8
9	0 – 1.44	Clay	A-7-5 (19)	1.47	25.5	3.4
10	0 – 2.0	Clay	A-7-5 (10)	1.41	26.5	3.2
11	1.5 – 2.0	Clay	A-7-5 (10)	1.40	27.0	3.1
12	0 – 1.1	Tuff	A-2-4 (0)	1.59	18.75	9.0
	1.1 – 2.0	sandy Clay	A-7-5 (4)	1.58	17.75	8.0
13	1.0 – 2.0	Clay	A-7-6 (8)	1.39	26.25	3.2
14	0 – 0.8	Clay	A-6 (4)	1.54	22.2	6.2
	0.8 – 1.2	Tuff	A-2-7 (0)	1.50	22.5	5.4
15	0.5 – 2.0	Tuff	A-2-4 (0)	1.59	18.25	11.5

3) Material Source Investigation

The following two (2) potential sites are identified and surveyed; Location of the material source **is shown in** Figure 6.1.3-3 **(green colored portion).**

a) BALANAC RIVER

Location : Brgy. Balanac, Magdalena, Laguna
Type of Materials : Gravel with sand
Approx. Quantity : Unlimited

b) MARAGONDON QUARRY

Location : 3.5 km. Left of Maragondon –
Ternate Road, Pinagsanghan, Maragondon, Cavite
Type of Materials : Clay
Approx. Quantity : Unlimited

Laboratory test result is shown in **Table 6.1.3-4**.

TABLE 6.1.3-4 LABORATORY TEST RESULT OF MATERIAL SOURCE INVESTIGATION

Laboratory Tests Results		Balanac River	Maragondon Quarry
Sieve Analysis (% Passing)	3"		
	2"	100	
	1.5"	93	
	1"	80	
	3/4"	73	
	1/2"	62	
	3/8"	56	
	# 4	44	
	# 8	35	
	# 10	32	
	# 16	26	100
	# 30	17	99
	# 40	13	98
	# 50	9	97
	# 100	5	96
	# 200	4	95
Atterberg Limit	Liquid Limit	NP	60
	Plastic Limit	NP	34
Classification		A-1-a (0)	A-7-5 (18)
Soundness (%)	Fine Aggregates	3.35	-
	Coarse Aggregates	0.3	-
Los Angeles Abrasion, %		36.38	-
Apparent Specific Gravity	Fine Aggregates	2.78	2.70
	Coarse Aggregates	2.76	-
Absorption (%)	Fine Aggregates	2.84	5.66
	Coarse Aggregates	1.8	-
Moisture Density Relation	MDD (g/cc)	2.19	1.51
	OMC (%)	9.75	22.5
California Bearing Ratio	@ 95% MDD	30.0	4.80
	@ 100% MDD	48	7.6
Flakiness		3.16	-
Organic Matter (%)		0.9	4.2

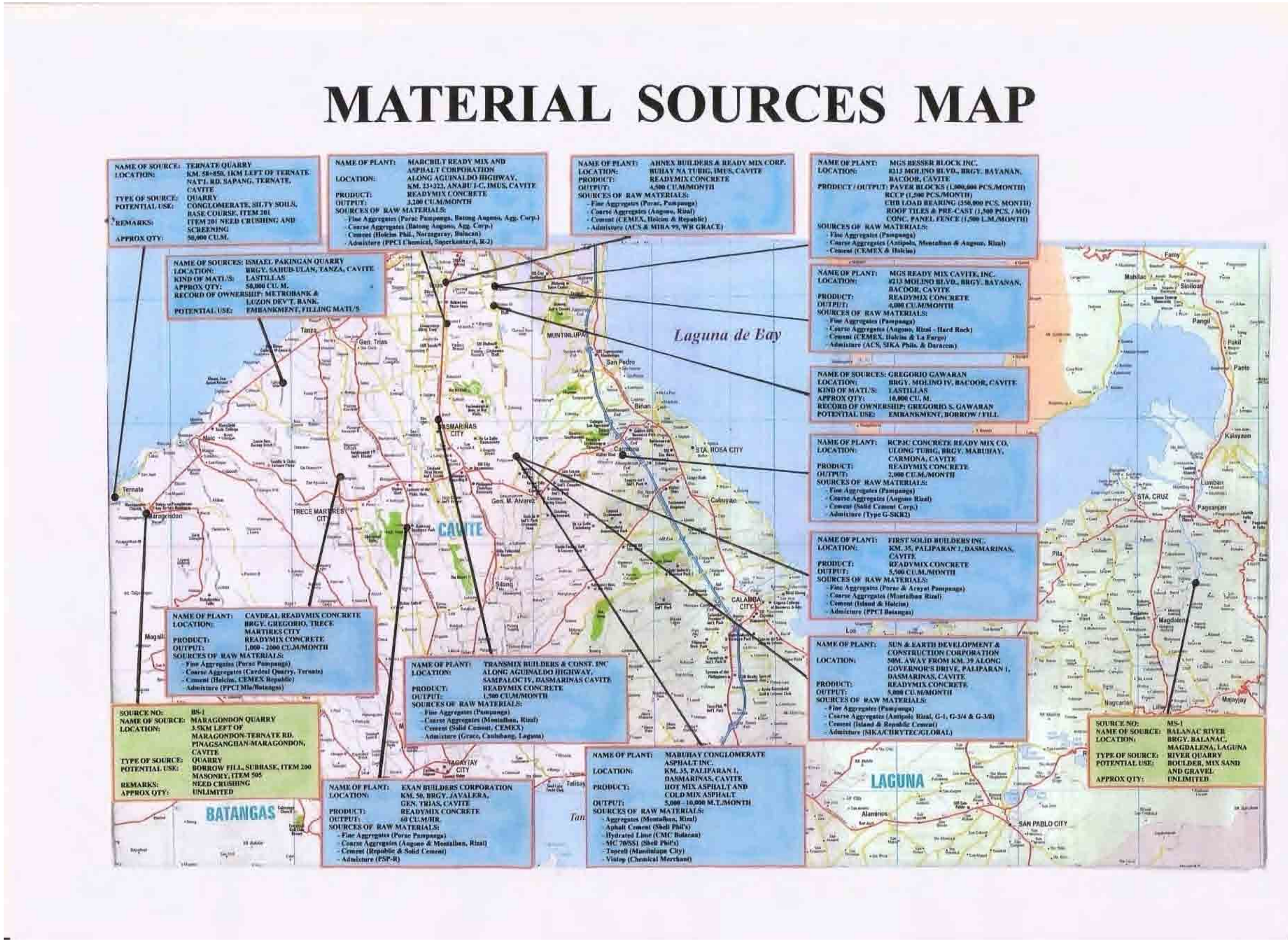


FIGURE 6.1.3-3 LOCATION MAP OF SAMPLE MATERIAL

6.1.4 Other Geo-technical Information

Including some important description of the past feasibility study, geotechnical feature is described below:

(1) Topography

A greater part of the land structure in CALA is underlain by volcanic tuff. **Figure 6.1.4-1** shows the topographic map in the study area. The Marikina Fault borders the Laguna Province on the west and gradually curves further to the west as it approaches the Batangas-Cavite boundary at the Tagaytay Ridge. The Lipa Fault is characterized by a prominent fault scarp along the southeastern coast of Laguna de Bay. It extends beyond Lumban on the north and cuts across the northern foothills of Mt. Nagcarlan and Mt. Lagula along the southeastern direction.
CALA is made up of four characteristic landscapes, namely:

- coastal landscapes
- alluvial plains
- piedmont plains and foothills (plateau)
- hills and mountains

(a) Coastal Landscapes

These are basically the transitional areas between land and sea or lake that are formed by the interplay of marine and terrestrial processes. These include the beaches and ridges and active and former tidal flats in Cavite and the freshwater marshes and the lake terraces in Laguna.

In Cavite, the strip of coastal landscapes extends from Bacoor and Cavite City in the north to Ternate in the south. In Laguna, coastal landscapes are common features in the towns bordering Laguna de Bay from San Pedro in the west to Mabitac in the east. Coastal landscapes are nearly level with slopes ranging from 0% to 2%.

(b) Alluvial Lowlands

The alluvial lowlands are those nearly flat to gently sloping alluvial plains formed from lateral erosion or soil deposition of running streams or rivers.

In Cavite, broad and minor alluvial plains form the transition area between the strip of coastal landscapes and the piedmont plains and foothills. These have slopes ranging from 0% to 5% and extend from Bacoor and Imus in the north through General Trias, Tanza and Naic to Maragondon. Approximately 75% are flat, 20% are gently sloping and 5% are levee.

In Laguna, the alluvial lowland is basically an extension of the minor alluvial plain in Taguig and Muntinlupa. It covers the low depressed areas of the towns bordering the western and southern shores of Laguna de Bay (i.e., from San Pedro to Santa Cruz). Slope ranges from 0% to 3%.

(c) Piedmont Plains and Foothills (Plateau)

This landscape extends from the Guadalupe Plateau in Metro Manila and culminates in the foothills of the Tagaytay Ridge. It comprises the undulating tuffaceous plains and the rolling tuffaceous plateau, including steep hills, ridges and elevated inland valley that are below higher hills or mountain foot slopes.

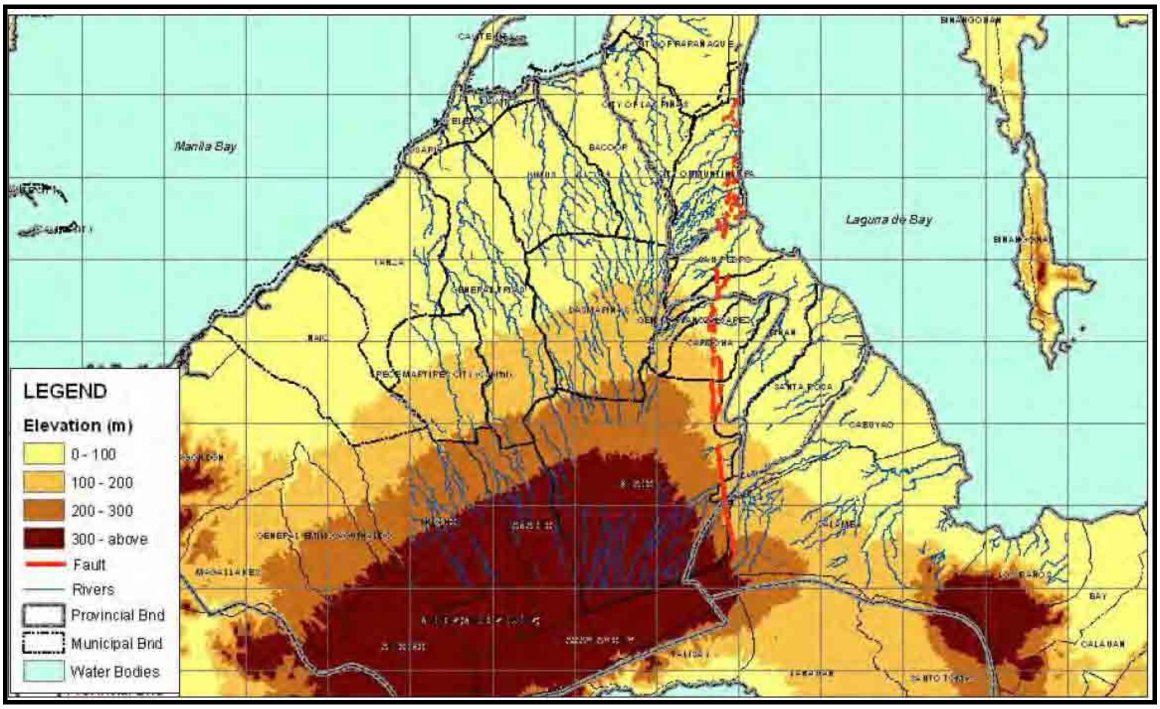
Parent soil material is volcanic tuff; clayey and/or loamy in texture; poorly drained and is plastic. Effective soil depth varies from very shallow to moderately deep.

Groundwater availability may be through deep wells and could be difficult in higher areas.
In Cavite, piedmont plains are characterized with elevation relief ranging from a low 20 meters above sea level to a high of nearly 550 meters above sea level. Slope ranges from 2% to 8%, although side slopes from 8% to 15% can be found in Carmona and Silang areas where the fault lines traverse.

In Laguna, the piedmont plains commence at a low elevation in the areas immediately adjoining Metro Manila. These extend up to Calamba, and join the higher elevations in Carmona and Silang, as these narrowly pass between the heights of Mt. Makiling and the Tagaytay ridge to the direction of Sto. Tomas in Batangas and San Pablo City. Slope generally ranges from 3% to 8%, although foothills possess 8% to 18%.

(d) Hills and Mountains

These are the areas at very high elevations with slopes over 18% and include higher hills and mountains. In Cavite, these include the mountains in Maragondon and the Tagaytay Ridge, forming the boundary of Cavite with Batangas Province in the south. In Laguna, these include Mt. Makiling, portions of Mt. Banahaw and the mountains bordering Laguna and Quezon Provinces.



Source: The feasibility Study and Implementation Support on the CALA East-West National Road Project

FIGURE 6.1.4-1 TOPOGRAPHY OF THE STUDY AREA

(2) Soil Characteristics

Table 6.1.4-1 summarizes the soil characteristics in the study area.

TABLE 6.1.4-1 SOIL CHARACTERISTICS IN THE STUDY AREA

Feature	Coastal Landscape	Alluvial Plains	Piedmont Plains and Foothills	Hills and Mountains
Effective Soil Depth	Shallow to moderately deep	Shallow to moderately deep	Shallow to deep	Shallow to deep
Composition	Organic	Organic	Non-organic	Non-organic
Soil Plasticity	High	Very high	Low	Low
Soil Drainage	Poor	Moderate	Good	Good

Source: The feasibility Study and Implementation Support on the CALA East-West National Road Project

(a) Coastal Landscapes

Parent soil material is fluvio-marine/alluvium. Soil is sandy and sometimes clayey and loamy in texture and is highly plastic.

(b) Alluvial Lowlands

In Cavite, parent soil material is largely fine clay that is poorly drained in flat to nearly flat areas and moderately drained in gently sloping areas. Fine loam is found in the levee areas. As such, the levee areas in the Cavite lowlands are moderately or well drained. In Laguna, soil varies from sandy to silty clay loam to clay and is somewhat poorly drained. The area possesses potentials for high yielding wells.

(c) Piedmont Plains and Foothills (Plateau)

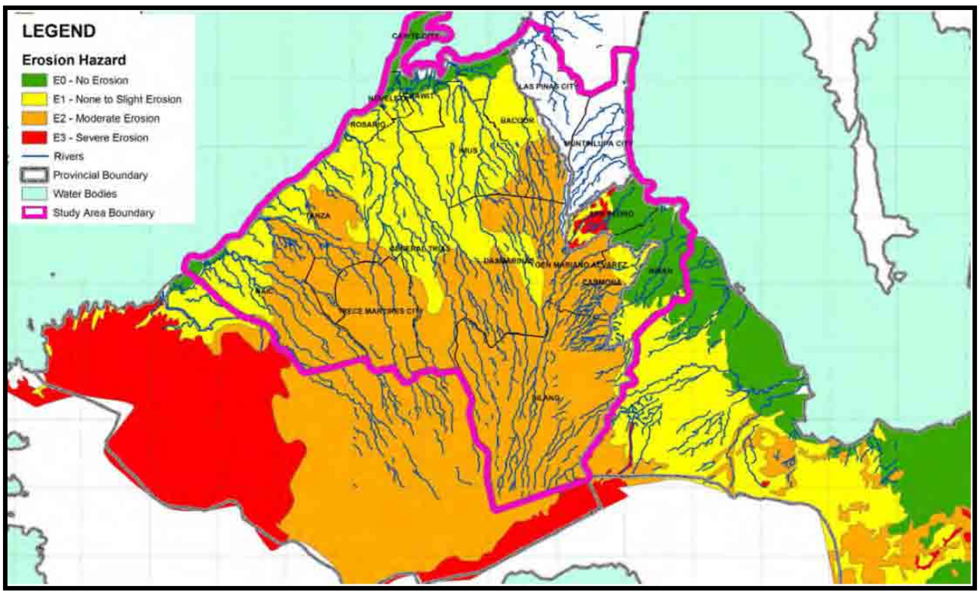
Parent soil material is volcanic tuff; clayey and/or loamy in texture; poorly drained and is plastic. Effective soil depth varies from very shallow to moderately deep.

(d) Hills and Mountains

Parent soil material is sandy loam or loam that is drained well. Effective soil depth varies from very shallow to deep.

(3) Soil Erosion

The study area includes moderately eroded area or severely eroded area as shown in the soil erosion map (**Figure 6.1.4-2**). Small parts of San Pedro are especially designated as severely eroded areas.



Source: The feasibility Study and Implementation Support on the CALA East-West National Road Project

FIGURE 6.1.4-2 SOIL EROSION MAP

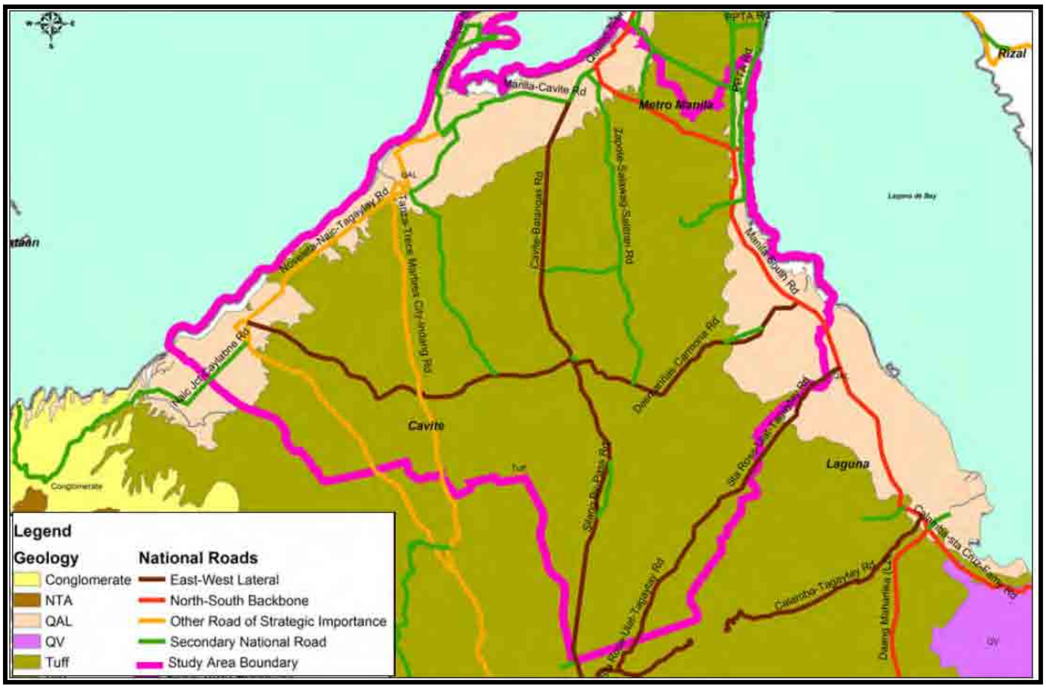
(4) Geological Condition

The study area is underlain by rocks of various origins and characteristics consisting primarily of QAL and Tuff as described in **Table 6.1.4-2**. These occur in association with other properties.

TABLE 6.1.4-2 GEOLOGIC DESCRIPTION OF THE STUDY AREA

Symbols	Description
QAL	Quatemary Alluvium: Unconsolidated deposits of silt, sand and gravel along valleys and coastal plains
Tuff	Tall Tull: Thin to medium-bedded, fine grained vitric tuffs, welded volcanic breccia with conglomerate, tuffaceous sandstone and shale

Source: The feasibility Study and Implementation Support on the CALA East-West National Road Project



Source: The feasibility Study and Implementation Support on the CALA East-West National Road Project

FIGURE 6.1.4-3 GEOLOGICAL MAP OF THE STUDY AREA

6.2 DESIGN STANDARD

6.2.1 Design Concept

The design concept is to provide a high speed toll road that allows safe and efficient movement of traffic as an expressway with fully controlled access, especially to improve the access from

Aguinaldo Highway to South Luzon Expressway (SLEX).

6.2.2 Design Standard

The following standard is mainly used as reference in Cavite Laguna Expressway (CALAX) design.

- A Policy on Geometric Design of Highways and Streets, AASHTO 2004.
- Highway Safety Design Standards Part I Road Safety Design Manual, May 2004, DPWH.
- Japan Road Association, Road Structure Ordinance, 2004.
- Highway Design Manual, Metropolitan Expressway Co., Ltd., Japan
- Highway Design Manual, NEXCO, Japan

6.2.3 Design Speed

(1) Main Alignment

Recommended design speed by the previous feasibility study was 100 km. in accordance with Road Safety Design Manual (DPWH, 2004) as well as considering to the moderate topographic condition and safety of the traffic of staging construction, the recommended design speed is **100 kph** fro the expressway.

(2) Interchange Ramps

The interchange ramp design speed was employed as **40 kph** which is 40% of the highway design speed and described minimum design speed in AASHTO 2004.

6.2.4 Design Vehicle

A **WB-15** is considered as design vehicle of the main alignment and ramp.

6.2.5 Summary of Expressway Geometry

Geometry applied to the design of main alignment and ramp is summarized in **Table 6.2.5-1** and **Table 6.2.5-2.**

TABLE 6.2.5-1 GEOMETRY OF CALAX (MAIN ALIGNMENT) (100KM/HR)

Geometric Design Standards

Project: **CALAx** **Main**

Item	Unit	Standard	Absolute	Remark
Design Speed	kmh	100		
Design Vehicle	-	WB-15		
Stopping Sight Distance	m	185		page 56, Table 16.3, DPWH Rad Safety Design Manual
Passing Sight Distance	〃	670		Page 69, Table 16.4 DPWH Road Safety Design Manual
R.O.W	m	50-60		50m: km 17+200 to End Other Section: 60m
Terrain Condition		Rolling		

1. Cross Section Elements

Item	Unit	Standard	Substandard	Remark
Pavement Type				Asphalt Concrete
Lane Width	m	3.50		12ft(AASHTO2004)for high type highway, p311,Highway Design Safety Manual 2004,p53
Median Width(Center Separator)	〃	2.00		Guard rail, drainage, tree planting included, refer to NEXCO
Inner Shoulder Wdth	〃	0.75		
Outer Shoulder width	〃	2.50		Accommodate WB-15(w=2.44m)
Number of Lanes	nos	4		
Normal Crossfall	%	2.00		
Maximum super elevation	%	6.00		page 53, table 16.1 DPWH Road Safety Design Manual
Super elevation	%	exhibit 3-26		page 168, exhibit 3-26, ASSHTO 2004
Maximum relative gradients	%	0.43		page 62, super elevation DPWH, Road Safety Design Manual

2.Horizontal Alignment

Item	Unit	Standard	Absolute	Remark
Minimum Radius	m	437		Page 147, exhibit 3-15, ASSHTO 2004
Min. Transition Curve Length	〃	56		Page 61, Figure 16.3 DPWH Road Safety Design Manual
Min.Radius not requiring Transition Curve	〃	2560		page 168, exhibit 3-26, ASSHTO 2004 (2.0%)
Superelevation run off	%	0.43		p62 for 100kmh DPWH, Road Safety Design Manual

3. Vertical Alignment

Item		Unit	Standard	Absolute	Remark
Max Vertical Gradient		%	3	4	Page 53,Table 16.1 DPWH Road Safety Deisgn Manual
Min.K value	Crest	〃	85.0		1500(1000) JPN Standard
	Sag	〃	52.0		2000(1400)JPN Standard
Min. Vertical Curve Length		〃	60		Page 636, DPWH Design Guidelines, Criteria and Standards Vol II
Max.Composition Grade		%	10.0		

4.Vertical Clearance

Object	Vertical Clearance (m)	Remark
Road	5.200	DPHW Requirement, 4.9m(16feets) Clearance +0.3m (Fugure AC Overlay)

TABLE 6.2.5-2 GEOMETRY OF CALAX (RAMP) (40KM/HR)

Geometric Design Standards

Project: CALAx Ramp

Item	Unit	Standard	Absolute	Remark
Design Speed	〃	40		
Design Vehicle	-	WB-15		Exhibit 2-4, p22 AASHTO 2004
Stopping Sight Distance	〃	50		page 56, Table 16.3, DPWH Rad Safety Design Manual
Passing Sight Distance	〃	270		Page 69, Table 16.4 DPWH Road Safety Design Manual

1. Cross Section Elements

Item	Unit	Standard	Substandard	Remark
Pavement Type				Asphalt Concrete
Lane Width	m	3.50		NEXCO A Type
Median Width	〃	1.00		NEXCO A Type
Inner Shoulder Strip	〃	1.00		NEXCO A Type, 1 direction 1lane ramp
Inner Shoulder Strip	〃	0.75		NEXCO A Type, 2 direction 2lane ramp
Outer Shoulder Strip	〃	2.50		NEXCO A Type
Number of Lanes	nos	1		
Normal Crossfall	%	2.00		
Maximum super elevation	%	6.00		page 53, table 16.1 DPWH Road Safety Design Manual
Super elevation	%	exhibit 3-26		page 168, exhibit 3-26, ASSHTO 2004
Maximum relative gradients	%	0.66		page 62, super elevation DPWH, Road Safety Design Manual

2.Horizontal Alignment

Item	Unit	Standard	Absolute	Remark
Minimum Radius	m	50	43	Page 825,Page 147, exhibit 3-15, ASSHTO 2004
Min. Transition Curve Length	〃	22		Page 61, Figure 16.3 DPWH Road Safety Design Manual
Min.Radius not requiring Transition Curve	〃	525		page 168, exhibit 3-26, ASSHTO 2004 (2.0%)
Superelevation run off	%	0.66		p62 for 40kmh DPWH, Road Safety Design Manual

3. Vertical Alignment

Item		Unit	Standard	Absolute	Remark
Max Vertical Gradient		%	6	7	Page 53,Table 16.1 DPWH Road Safety Deisgn Manual
Min.K value	Crest	〃	6.0		( ) is recommended value
	Sag	〃	9.0		( ) is recommended value
Min. Vertical Curve Length		〃	60		Page 636, DPWH Design Guidelines, Criteria and Standards Vol II
Max.Composition Grade		%	11.5		

4.Vertical Clearance

Object	Vertical Clearance (m)	Remark
Road	5.200	DPHW Requirement, 4.9m(16feets) Clearance +0.3m (Fugure AC Overlay)

6.2.6 Vertical Clearance

The vertical clearance of the highway and crossing road shall be at least 5.2 m (4.9 m (16 feet) + 0.3 m (overlay)).

6.2.7 Number of Lanes

Number of lane is set as 4 lanes in accordance with the traffic demand forecast.

6.2.8 Carriageway, Shoulder and Median Width

The cross sectional configuration is reviewed and recommended as below;

(3) Main Alignment

The carriageway of the main alignment is **3.5 m** in accordance with Road Safety Manual (DPWH 2004). The inner shoulder is designated as **0.75 m**. The outer shoulder is designed as **2.50 m.** This allows emergent stops at the shoulder without serious conflict to the traffic on the main lanes. The width of median is designed as **2.0m** with guard rail post.

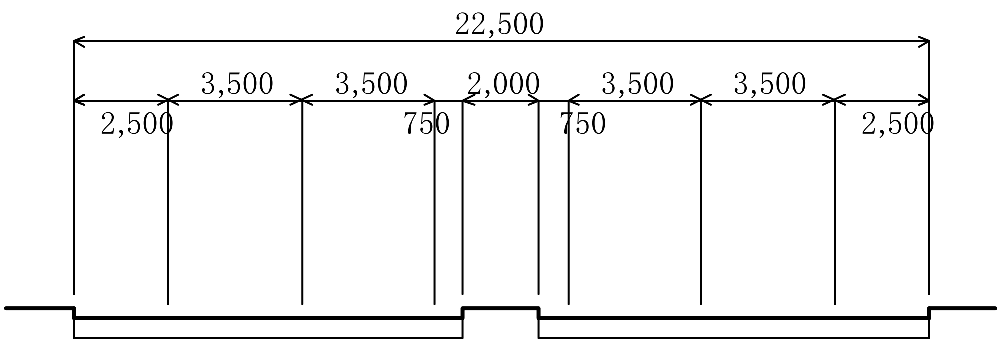


FIGURE 6.2.8-1 CROSS SECTIONAL CONFIGURATION (4 LANES)

(4) Ramp

The carriageway of the ramp is recommended same width as main alignment, namely **3.5m**. Widening of **1.0m** is added to this carriageway. The inner shoulder is designed as **1.0 m** and outer shoulder **2.5 m** with provision for passing a stalled vehicle of predominantly P vehicles but consideration for WB-15 trailers.

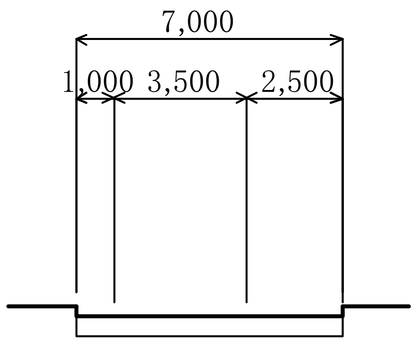


FIGURE 6.2.8-2 CROSS-SECTIONAL CONFIGURATION (1 LANE RAMP)

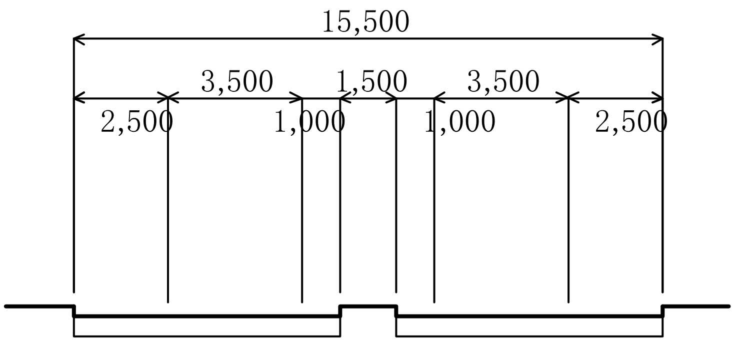


FIGURE 6.2.8-3 CROSS-SECTIONAL CONFIGURATION (2 DIRECTION 2 LANE RAMP)

(5) Medium/Small size bridge (L=< 100 m)

For small and medium size bridge (L=< 100 m), cross sectional configuration shall be the same as embankment roadway section.

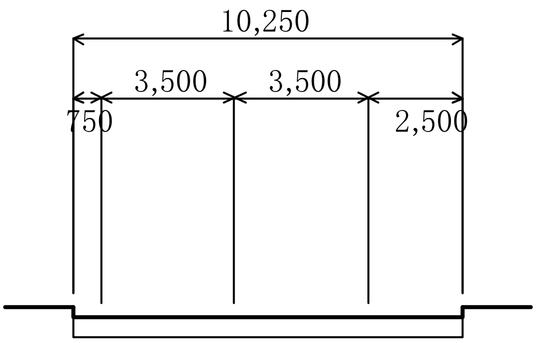


FIGURE 6.2.8-4 CROSS SECTIONAL CONFIGURATION (MEDIUM/SMALL SIZE BRIDGE (L=< 100 m)

(6) Viaduct Bridge (L>100 m)

For viaduct bridge, inner shoulder shall be reduced to **0.5m** and outer shoulder shall be reduced to **1.5m** for economical reason. (see **Figure 6.2.8-5**)

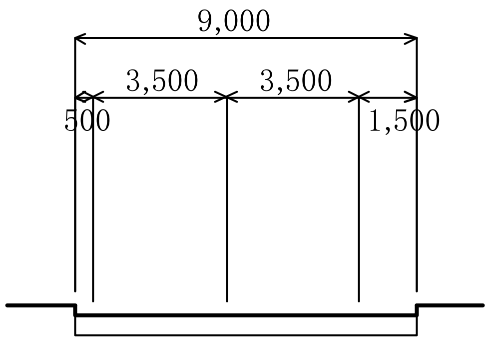


FIGURE 6.2.8-5 CROSS SECTIONAL CONFIGURATION FOR VIADUCT (STANDARD)

(7) Typical Cross Section

Typical cross sections are shown in **Figure 6.2.8-6 (1) to (6).**

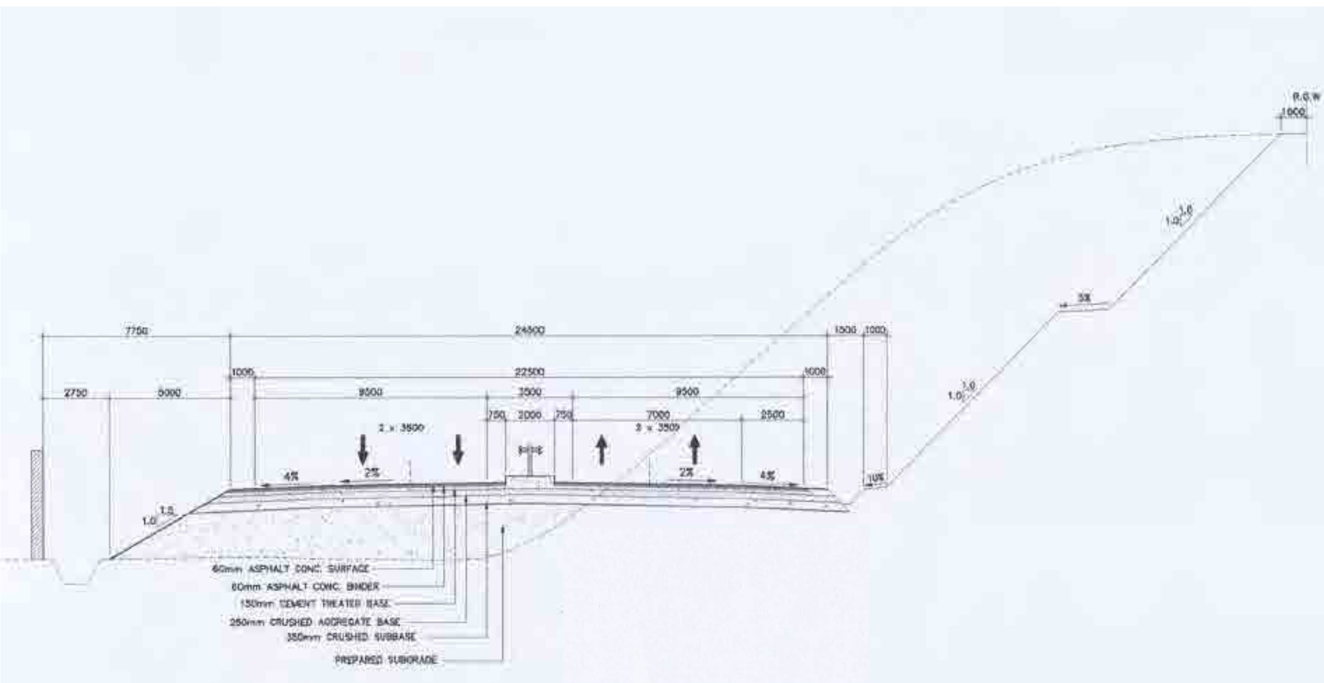


FIGURE 6.2.8-6 (1) TYPICAL CROSS SECTION
EMBANKMENT AND CUT

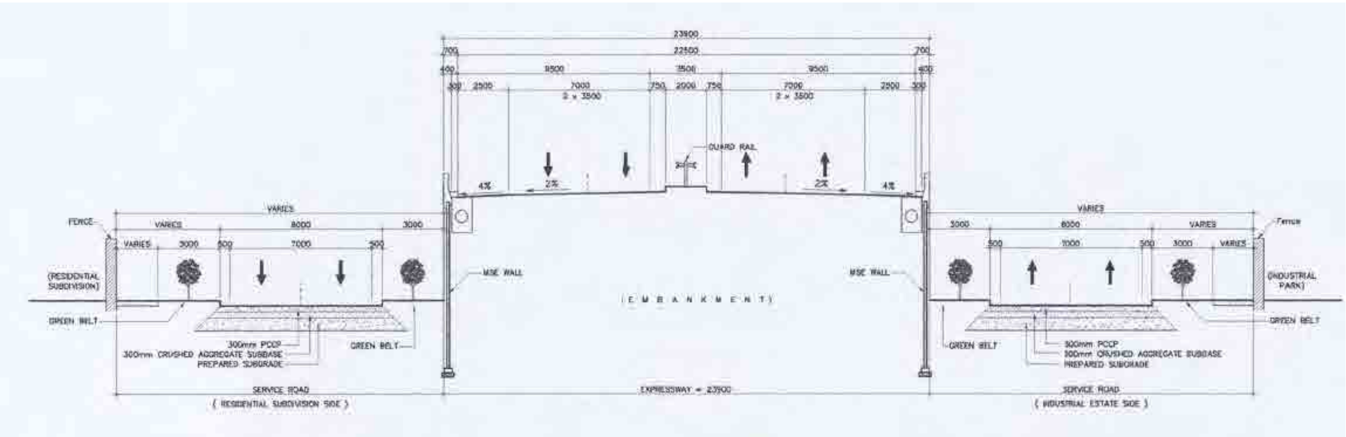


FIGURE 6.2.8-6(2) TYPICAL CROSS SECTION (MSE WALL SECTION)

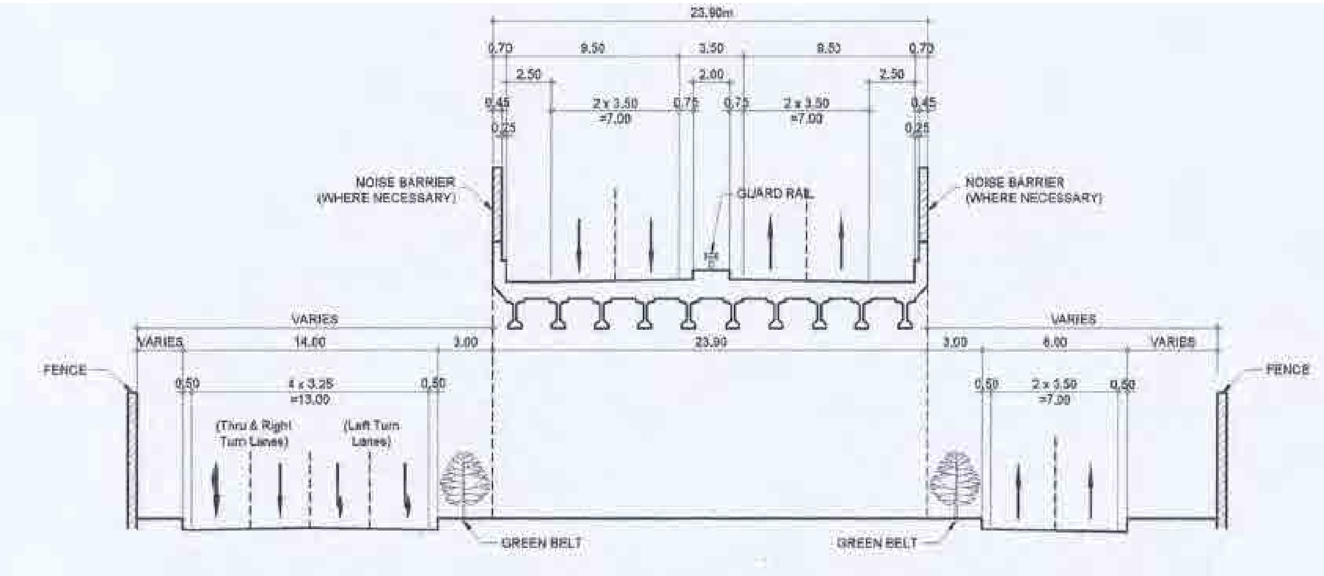


FIGURE 6.2.8-6(3) TYPICAL CROSS SECTION (VIADUCT SECTION): ROW = 60.0m

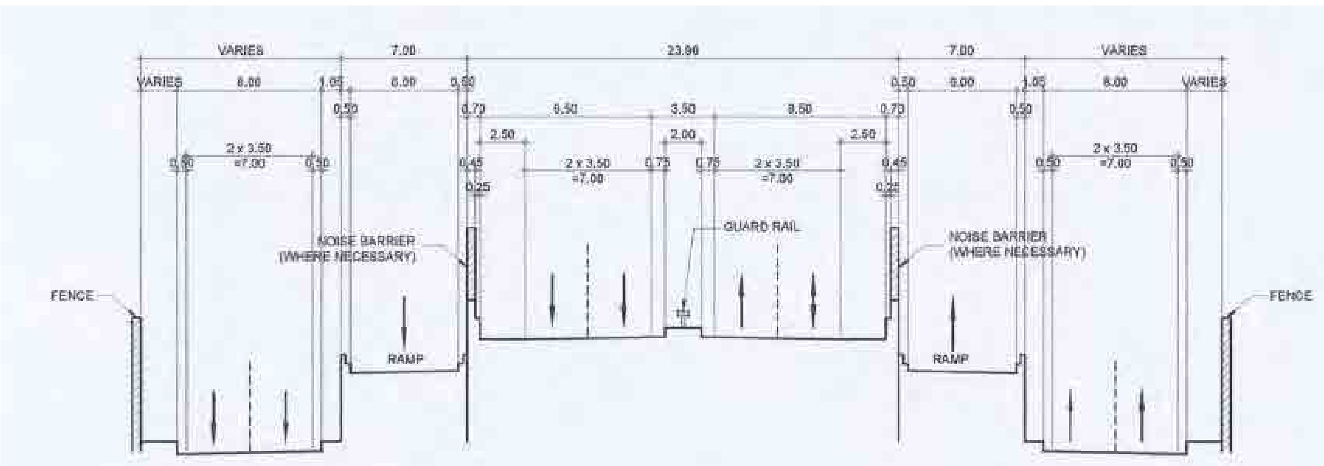


FIGURE 6.2.8-6(4) TYPICAL CROSS SECTION AT INTERCHANGE: ROW = 60.0 m

6.2.9 Stopping Distance

According to Road Safety Design Manual (2004, DPWH); the stopping distance for design speed of 100 kph is 185m. and the stopping distance for design speed of 40 kph is 50m.

6.2.10 Cross fall Development

Super elevation of the carriageway shall be considered to accommodate recommendation of AASHTO 2004 as shown in **Table 6.2.10-1**. The maximum value of super elevation is 6.0% as guided in Road Safety Manual (2004) in page 53. The super elevation rate for the applied design speed is shown in **Table 6.2.10-1**.

In principal, the super elevation is attained within spiral curve. The run-off rate of super elevation is considered 0.43% for 100 kph and 0.65% for 50 kph in accordance to the Road Safety Design Manual.

TABLE 6.2.10-1 MINIMUM RADDI FOR DESIGN SUPERELEVATION RATES, emax=6.0%

METRIC

e (%)	V_d = 20 km/h R (m)	V_d = 30 km/h R (m)	V_d = 40 km/h R (m)	V_d = 50 km/h R (m)	V_d = 60 km/h R (m)	V_d = 70 km/h R (m)	V_d = 80 km/h R (m)	V_d = 90 km/h R (m)	V_d = 100 km/h R (m)	V_d = 110 km/h R (m)	V_d = 120 km/h R (m)	V_d = 130 km/h R (m)
1.5	194	421	738	1050	1440	1910	2360	2880	3510	4060	4770	5240
2.0	138	299	525	750	1030	1360	1710	2090	2560	2970	3510	3880
2.2	122	265	465	668	919	1230	1530	1680	2300	2670	3160	3500
2.4	109	236	415	599	825	1110	1380	1700	2080	2420	2870	3190
2.6	97	212	372	540	746	1000	1260	1540	1890	2210	2630	2930
2.8	87	190	334	488	676	910	1150	1410	1730	2020	2420	2700
3.0	78	170	300	443	615	831	1050	1290	1590	1870	2240	2510
3.2	70	152	269	402	561	761	959	1190	1470	1730	2080	2330
3.4	61	133	239	364	511	697	882	1100	1360	1600	1940	2180
3.6	51	113	206	329	465	640	813	1020	1260	1490	1810	2050
3.8	42	96	177	294	422	586	749	939	1170	1390	1700	1930
4.0	36	82	155	261	380	535	690	870	1090	1300	1590	1820
4.2	31	72	136	234	343	488	635	806	1010	1220	1500	1720
4.4	27	63	121	210	311	446	584	746	938	1140	1410	1630
4.6	24	56	108	190	283	408	538	692	873	1070	1330	1540
4.8	21	50	97	172	258	374	496	641	812	997	1260	1470
5.0	19	45	88	156	235	343	457	594	755	933	1190	1400
5.2	17	40	79	142	214	315	421	549	701	871	1120	1330
5.4	15	36	71	128	195	287	386	506	648	810	1060	1260
5.6	13	32	63	115	176	260	351	463	594	747	980	1190
5.8	11	28	56	102	156	232	315	416	537	679	900	1110
6.0	8	21	43	79	123	184	252	336	437	560	756	951

6.2.11 Minimum Radius without Super elevation

When the curve radius is larger than R = 2560 m, super elevation can be omitted in accordance with AASHTO 2004.

6.2.12 Minimum Curve Length

(1) Minimum Curve Length

The length of the spiral curve is recommended to take for 2 seconds of the design speed by AASHTO 2004.

50 kph	:	Ld = 13.9 (m/s) x 2 (sec) = 27.8 m (28 m)
100 kph	:	Ld = 27.7 (m/s) x 2 (sec) = 55.5 m (56 m)

(2) Minimum Spiral Curve

The spiral lengths listed lengths listed in **Table 6.2.12-1** are recommended as desirable values for highway design by AASHTO 2004. Spiral curve length shall be as long as to adequate the desired super elevation runoff. Minimum spiral curve length for super elevation runoff is shown in **Table 6.2.12-2**.

TABLE 6.2.12-1 DESIRABLE LENGTH OF SPIRAL CURVE TRANSITION

Design Speed (km/h)	Spiral Length(m)
20	11
30	17
40	22
50	28
60	33
70	39
80	44
90	50
100	56
110	61
120	67
130	72
AASHTO 2004, p189	

TABLE 6.2.12-2 MINIMUM SPIRAL CURVE LENGTH FOR SUPERELEVATION RUNOFF (Ld)

4 lane Main alignment

Super elevation(%)	Radius	We(m)	e(m)	S(%)	Ld	Remark
6.00	437	9.5	0.570	0.430	133	100km/h
5.00	755	9.5	0.475	0.430	110	100km/h
4.00	1000	9.5	0.380	0.430	88	100km/h
3.00	1690	9.5	0.285	0.430	66	100km/h
2.00	2560	9.5	0.190	0.430	44	100km/h

2 direction 2lane Ramp

Super elevation(%)	Radius	We(m)	e(m)	S(%)	Ld	Remark
6.00	437	6.25	0.375	0.660	87	40km/h
5.00	755	6.25	0.313	0.660	73	40km/h
4.00	1000	6.25	0.250	0.660	58	40km/h
3.00	1690	6.25	0.188	0.660	44	40km/h
2.00	2560	6.25	0.125	0.660	29	40km/h

1 direction 1 lane Ramp

Super elevation(%)	Radius	We(m)	e(m)	S(%)	Ld	Remark
6.00	437	2.75	0.165	0.660	38	40km/h
5.00	755	2.75	0.138	0.660	32	40km/h
4.00	1000	2.75	0.110	0.660	26	40km/h
3.00	1690	2.75	0.083	0.660	19	40km/h
2.00	2560	2.75	0.055	0.660	13	40km/h

6.2.13 Speed Change Lanes

The deceleration and acceleration length requirements are calculated based on AASHTO (2004).

(1) Deceleration Lane Length and Acceleration Lane Length

TABLE 6.2.13-1 DECELERATION LENGTH

Highway Design Speed, V (KPH)	Speed Reached, Va (KPH)	Stop Condition	20	30	40	50	60	70	80
		For Average Running Speed on Exit Curve, V'a (KPH)							
		0	20	28	35	42	51	63	70
50	47	75	70	60	45	-			
60	55	95	90	80	65	55	-		
70	63	110	105	95	85	70	55	-	
80	70	130	125	115	100	90	80	55	-
90	77	145	140	135	120	110	100	75	60
100	85	170	165	155	145	135	120	100	85
110	91	180	180	170	160	150	140	120	105
120	98	200	195	185	175	170	155	140	120

Where:

V	=	Design Speed of Toll-way (KPH)
Va	=	Average Running Speed on Toll-way (KPH)
V'	=	Design Speed of Exit (KPH)
V'a	=	Average Running Speed on Exit Curve (KPH)

TABLE 6.2.13-2 ACCELERATION LENGTH

Highway Design Speed, V (KPH)	Speed Reached, Va (KPH)	L (meters) for Entrance Curve Design Speed, V' (KPH)							
		Stop Condition	20	30	40	50	60	70	80
		And Initial Speed, V'a (KPH)							
		0	20	28	35	42	51	63	70
50	37	60	50	30	-	-			
60	45	95	80	65	**45**	-	-		
70	53	150	130	110	90	65	-	-	
80	60	200	180	165	145	115	65	-	-
90	67	260	245	225	205	175	125	35	-
100	74	345	325	305	285	255	205	110	40
110	81	430	410	390	370	340	290	200	125
120	88	545	530	515	490	460	410	25	245

Where:

V	=	Design Speed of Toll-way (KPH)
Va	=	Average Running Speed on Toll-way (KPH)
V'	=	Design Speed of Entrance Curve (KPH)
V'a	=	Initial Speed on Entrance Curve (KPH)

TABLE 6.2.13-3 SPEED CHANGE LANE ADJUSTMENT FACTORS AS A FUNCTION OF GRADE

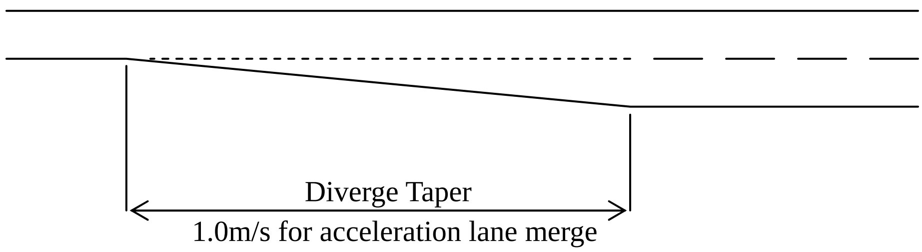
Highway Design Speed, V (kph)	Radius of Length on Grade to Length on Level for Design Speed of Turning Curve (kph)	
All Speeds	3 to 4% Upgrade 0.90	3 to 4% Downgrade 1.2
All Speeds	5 to 6% Upgrade 0.80	5 to 6% Downgrade 1.35

TABLE 6.2.13-4 SPEED CHANGE LANE ADJUSTMENT FACTORS AS A FUNCTION OF GRADE

Highway Design Speed, V (KPH)	Ratio of Length on Grade to Length on Level for Design Speed of Turning Curve (Km/h)					
	40	50	60	70	80	All Speeds
	3 to 4 % Upgrade					3 to 4 % Downgrade
60	1.3	1.4	1.4			0.70
70	1.3	1.4	1.4	1.5		0.65
80	1.4	1.5	1.5	1.5	1.6	0.65
90	1.4	1.5	1.5	1.5	1.6	0.6
100	1.5	1.6	1.7	1.7	1.8	0.6
110	1.5	1.6	1.7	1.7	1.8	0.6
120	1.5	1.6	1.7	1.7	1.8	0.6
	5 to 6 % Upgrade					5 to 6 % Downgrade
60	1.5	1.5				0.6
70	1.5	1.6	1.7			0.6
80	1.5	1.7	1.9	1.8		0.55
90	1.6	1.8	2.0	2.1	2.2	0.55
100	1.7	1.9	2.2	2.4	2.5	0.5
110	2.0	2.2	2.6	2.8	3.0	0.5
120	2.3	2.5	3.0	3.2	3.5	0.5

(2) Diverging Taper

*Vertical Gradient less than 3.0%

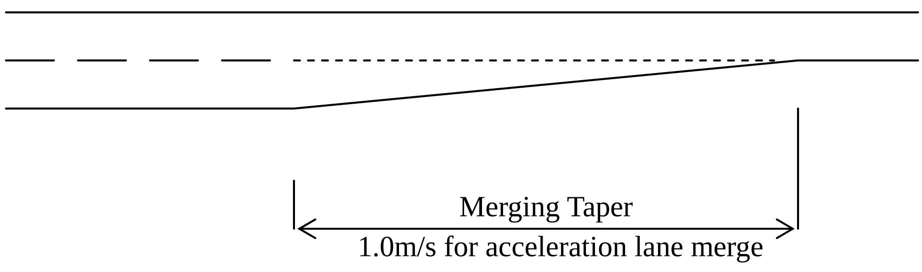


Diverging Taper = Design Speed (100 km/hr) x Lane Width

= 27.78 (m/s) x 3.5 m

= 97 m

(3) Merging Taper



Merging Taper = Design Speed (100 km/hr) x Lane Width

= 27.78 (m/s) x 3.5 m

= 97 m

6.2.14 Maximum Gradient

For the main alignment with design speed of 100kph, the maximum vertical gradient could be applied is **4%** by referring to Road Safety Manual (2004 DPWH) while desirable max gradient is **3%**.

For interchange On and Off Ramp with design speed of 50kph, the maximum gradient recommended to apply is **6.0%** while absolute grade is **7.0%**.

6.3 EXPRESSWAY DESIGN

6.3.1 General

This section of the report highlights the engineering studies undertaken for the proposed project following the AASHTO and DPWH technical guidelines and procedures.

This section contains following technical studies;

(1) Crossing Road Design
(2) Vertical Control
(3) Interchange Design

6.3.2 Crossing Road and Water Way Design

(1) Technical Approach

In order to maintain the present accessibility after the construction of the highway, crossing road (under the highway or overpass the highway) and service road are designed.

Technical approach of the design is described as below;

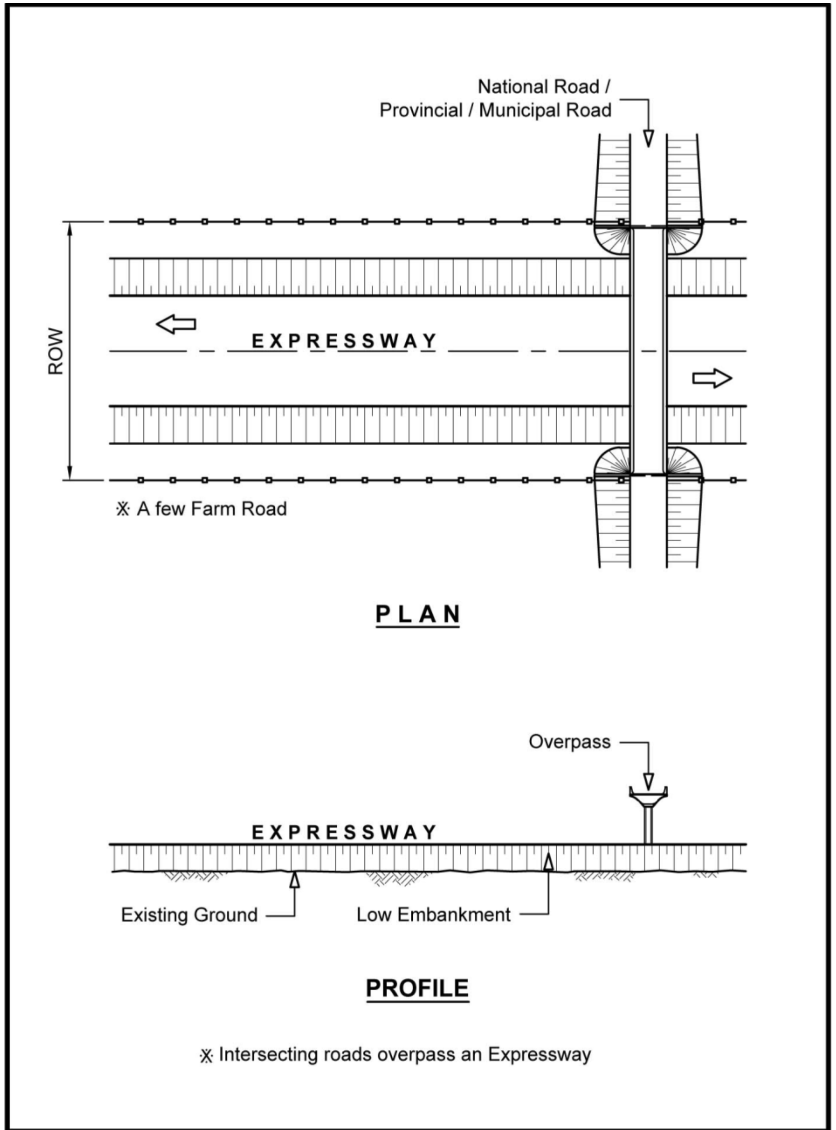
(1) To provide crossing road to maintain present accessibility after the construction
(2) To provide enough road width considering future traffic demand.
(3) To provide enough vertical clearance in accordance with road category

(2) Typical Condition of Crossing Road

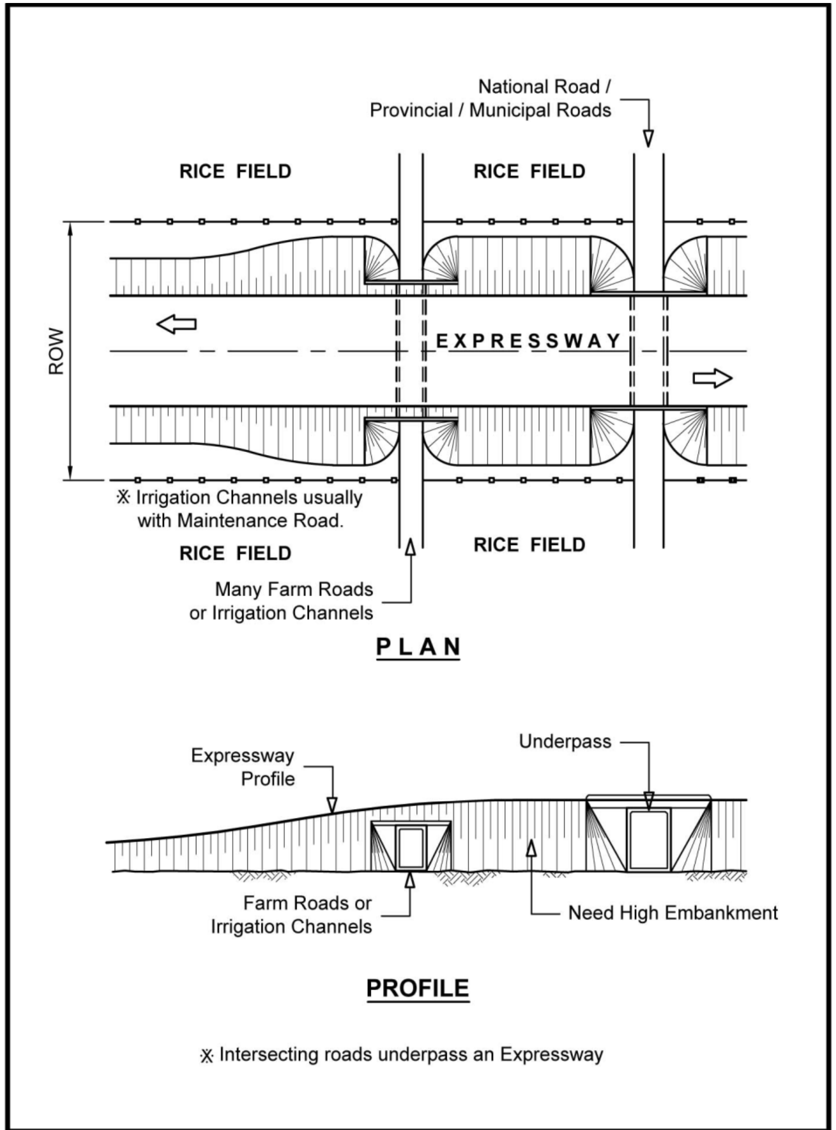
Figure 6.3.2-1 shows the typical crossing road of expressway (underpass or overpass).
Cross sectional configuration of the crossing road and vertical clearance is designed According to present condition of the road, as shown in **Table 6.3.2-1.**

(3) List of Crossing Road and Water Way

List of crossing road and water way is shown in **Table 6.3.2-1.**



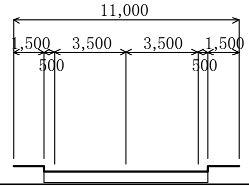
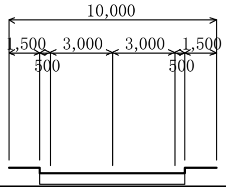
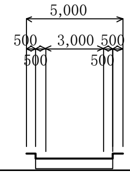
Overpass Method



Underpass Method

FIGURE 6.3.2-1 TYPICAL CROSSING ROAD OF EXPRESSWAY

TABLE 6.3.2-1 CROSS SECTIONAL CONFIGURATION OF CROSSING ROAD

No	Road Category	Road width (m)	Cross Sectional Configuration	Vertical Clearance (m)	Remark
1	Extra Ordinary Access Road			Vertical clearance (4.9 m) + overlay (0.3m) = 5.2 m 5.2 m	
2	Municipality Road	10.0m		Vertical clearance (4.9 m) + overlay (0.3 m) = 5.2 m 5.2 m	
3	BRGY Road (2 lane)	5.0 m		Vertical clearance (4.9 m) + overlay (0.3 m) = 5.2 m	

6.3.3 Vertical Control

(1) Technical Approach

The Expressway is situated in the very hills and plain land. The profile was studied in accordance with following orientations;

1) To Minimize Construction Cost: The embankment and cut height shall be minimum while providing sufficient clearance at road crossing points.

2) To Secure smoothness of drive: The minimum distance between PI point of vertical profile shall be 600m in order to secure smoothness of drive.

3) To accommodate surface drainage: It is also important to accommodate surface drainage to secure drivers safety during rain. The minimum vertical gradient is set as 0.3% for this reason.

(2) Vertical Control and Clearance List

Vertical Control List is shown in **Table 6.3.3-1**.

TABLE 6.3.3-1 VERTICAL CONTROL LIST

No	Station	Control Name	Crossing Type	Type of Crossing Structure	Existing GL	Minimum Vertical Clearance	Finished Elevation
1	1 + 323	Municipal Road	Overpass	Bridge	258.997	5.20	267.260
2	2 + 293	Municipal Road	Underpass	Bridge	270.188	5.20	271.747
3	2 + 860	Farm Road	Overpass	Bridge	288.359	5.20	283.500
4	4 + 050	Interchange	Underpass	Bridge	289.673	5.20	298.186
5	4 + 740	Farm Road	Underpass	RCBC	278.575	4.00	281.551
6	5 + 107	Municipal Road	Overpass	Bridge	278.926	5.20	274.878
7	5 + 360	Farm Road	Overpass	Bridge	273.190	5.20	266.430
8	9 + 300	Interchange	Underpass	Bridge	124.661	5.20	131.058
9	9 + 980	Access Road	Underpass	Bridge	106.379	5.20	114.081
10	11 + 106	Service Road	Underpass	Bridge	87.031	5.20	94.914
11	11+ 546	Road Crossing	Underpass	Bridge	79.460	5.20	88.008
12	11 + 746	Road Crossing	Underpass	Bridge	78.099	5.20	86.242
13	12 + 519	Road Crossing	Underpass	Bridge	75.000	5.20	78.077
14	12 + 760	Road Crossing	Underpass	Bridge	69.998	5.20	78.823
15	13 + 100	Road Crossing	Underpass	Bridge	69.012	5.20	77.717
16	13 + 520	Road Crossing	Underpass	Bridge	64.000	5.20	71.442
17	14 + 160	Road Crossing	Underpass	Bridge	55.966	5.20	63.439
18	14 + 880	Road Crossing	Underpass	Bridge	49.001	5.20	56.831
19	15 + 600	Road Crossing	Underpass	Bridge	39.794	5.20	46.409
20	16 + 400	Road Crossing	Underpass	Bridge	32.997	5.20	40.611
21	17 + 267	Road Crossing	Underpass	Bridge	28.627	5.20	36.611
22	17 + 850	Road Crossing	Underpass	Bridge	25.543	5.20	33.611
23	18 + 750	SLEX	Overpass	Bridge	21.595	5.20	27.020

6.3.4 Interchange Design

(1) Technical Approach

Followings are basic technical approach to design interchange of CALAX (Laguna Section).

1) To provide number of toll booth lane in accordance with traffic demand forecast.
2) To provide weigh station and U turn space for overloaded vehicle
3) To provide necessary widening of the existing road at future intersection

(2) Selection of Interchange location

Figure 6.3.4-1 shows selected interchange locations.

Aguinaldo Highway Interchange

- This interchange is located at the end portion of Cavite section and provide access to Aguinaldo Highway which is one of the major national roads in Cavite Province.

Silan East Interchange

- This interchange is intended to provide access to A-1 area where the urbanization is rapidly progressing and to B-2 area where the development is expected. Both A-1 and B-2 areas currently have no good land transportation access, therefore, this interchange will drastically improve the accessibility to both areas.

Sta. Rosa Interchange

- This interchange is intended to provide access to B-1 area where the residential/commercial development is planned and to Sta. Rosa-Tagaytay Road.
- Sta. Rosa-Tagaytay Road is already congested, thus traffic on Sta. Rosa-Tagaytay Road is expected to divert to CALAX.

Laguna Blvd. Interchange

- This interchange is intended to provide access c: Laguna Technopark Industrial Estate and to Areas A-2 and A-3 where rapid urbanization is progressing.
- This interchange provides access to Sta. Rosa-Tagaytay Road of which some traffic will be diverted to CALAX, and relieve traffic congestion of Sta. Rosa-Tagaytay Road.

Techno Park Interchange

- This interchange is intended to provide access to Laguna Technopark Industrial Estate.

Mamplasan Interchange of SLEX

- CALAX is connected to Mamplasan Interchange of SLEX.

- Necessary improvement such as toll booths, widening of bridge over SLEX, etc. are planned to be implemented by this project.

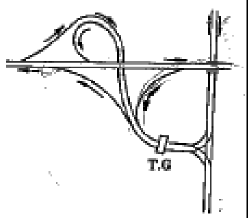
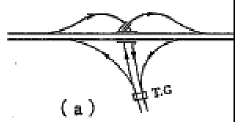
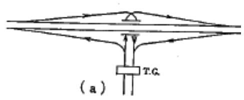
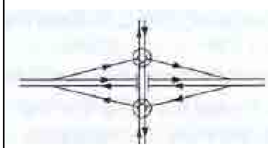
(3) Typical Toll booth layout

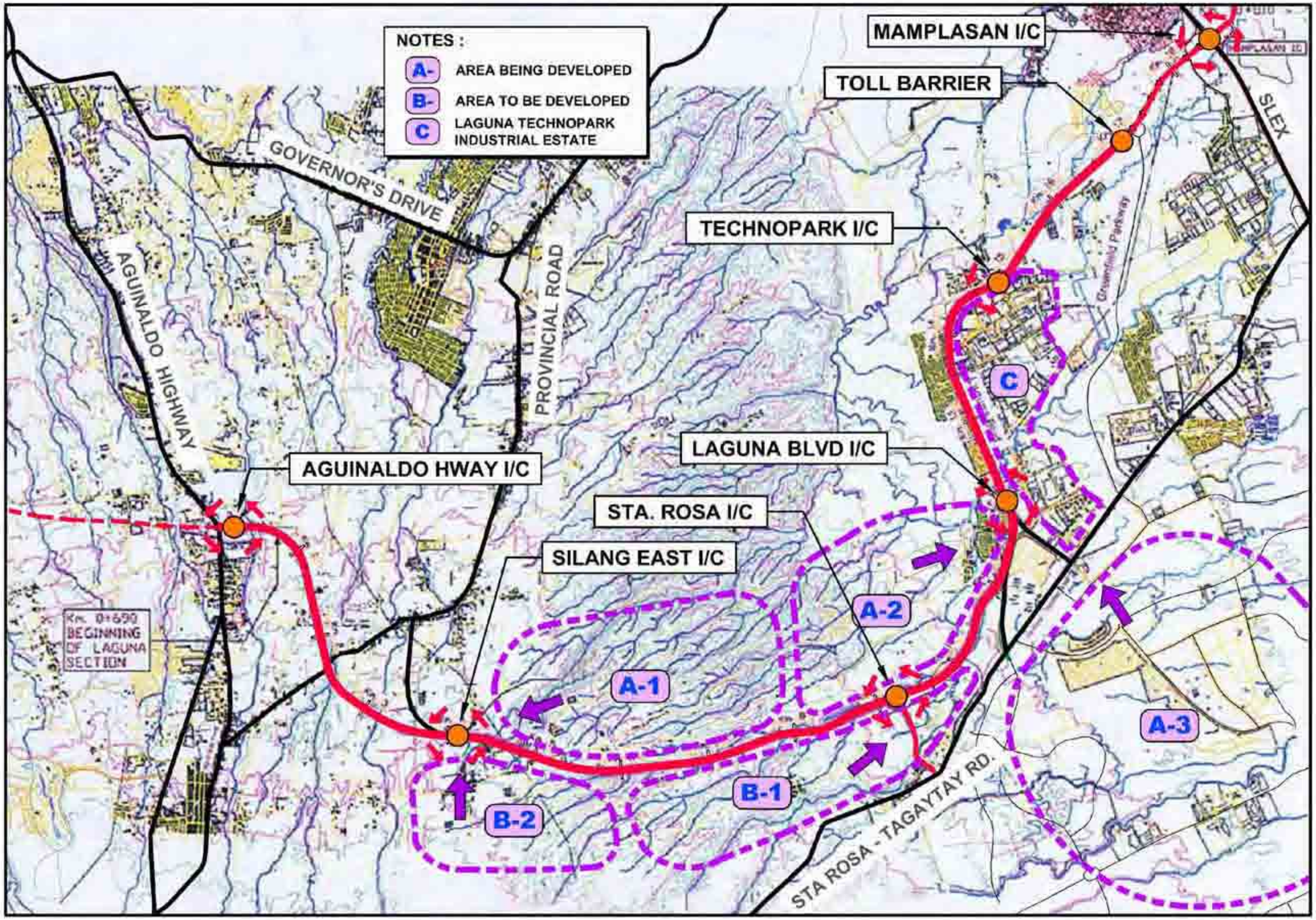
Basic layout and dimension of toll booth is referred to TPLEX which is under construction, as shown in **Figure 6.3.4-2.**

(4) Selection of Interchange Type

Table 6.3.4-1 shows typical interchange type.
Trumpet type is most popular structure for interchange. Y type is often used where Trumpet type is difficult such as in terms of land acquisition. Flat Y type and Diamond type is the smallest structure and most economical in cost with least land acquisition. This type is adequate when In and Out traffic volume is small because two ramps are crossing by intersection.

TABLE 6.3.4-1 TYPICAL INTERCHANGE TYPE

Plan				
Type	Trumpet Type	Y Type	Flat Y Type	Diamond Type
Structure	2F	3F	2F	2F
Traffic	Large	Large	Small	Small
Land Acquisition	Large	Medium	Small	Small
Cost	Middle	High	Low	Low
CALAX	Aguinaldo highway IC due to high traffic. (Cavite Section)	-	• Sta. Rosa – Tagaytay Rd. IC	• Silang East IC • Laguna Blvd. IC • Techno Park IC



SELECTION OF INTERCHANGE LOCATION

FIGURE 6.3.4-1 LOCATION OF IC

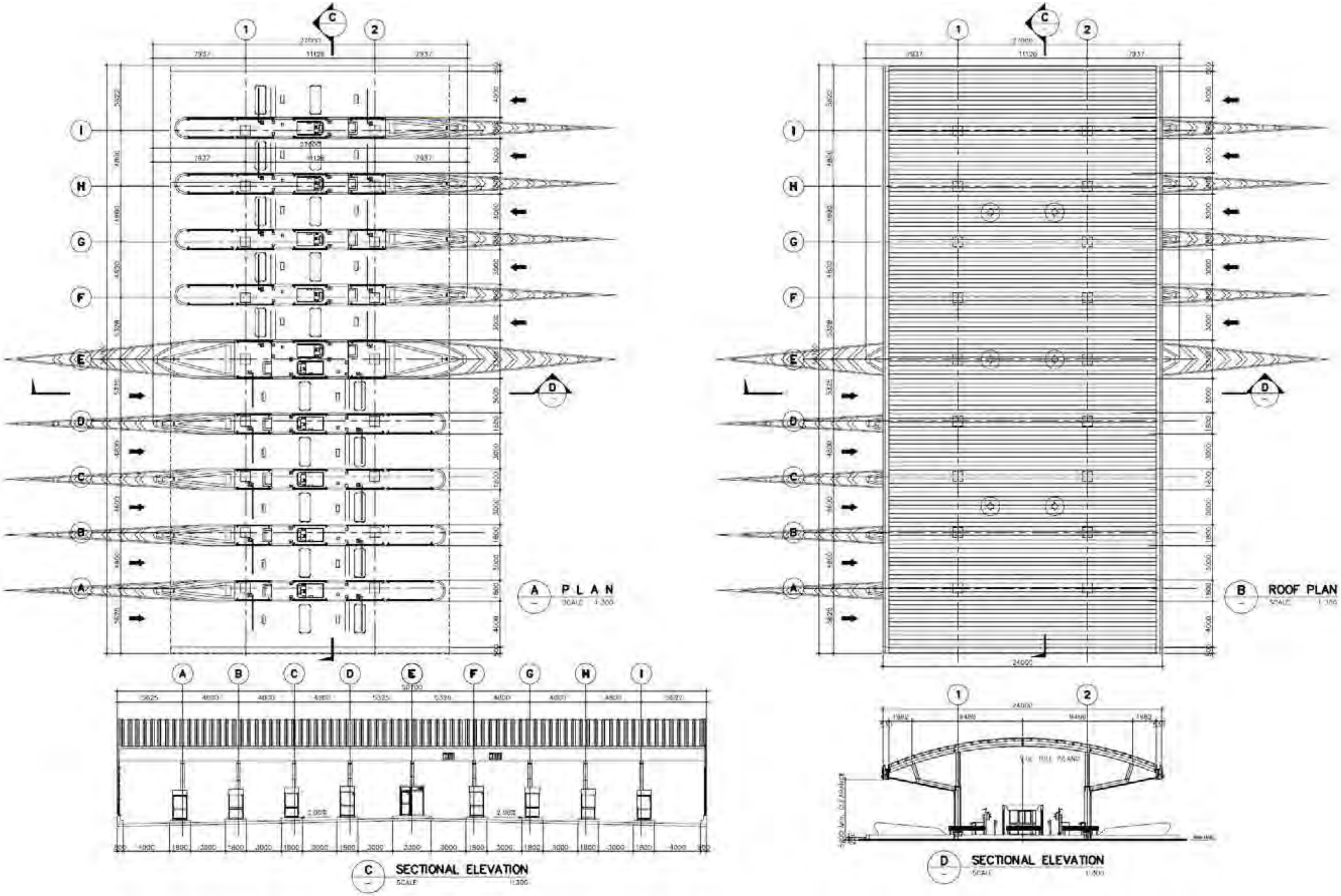


FIGURE 6.3.4-2 (1) TYPICAL DRAWING OF TOLL BOOTH LAYOUT (9 BOOTHS)

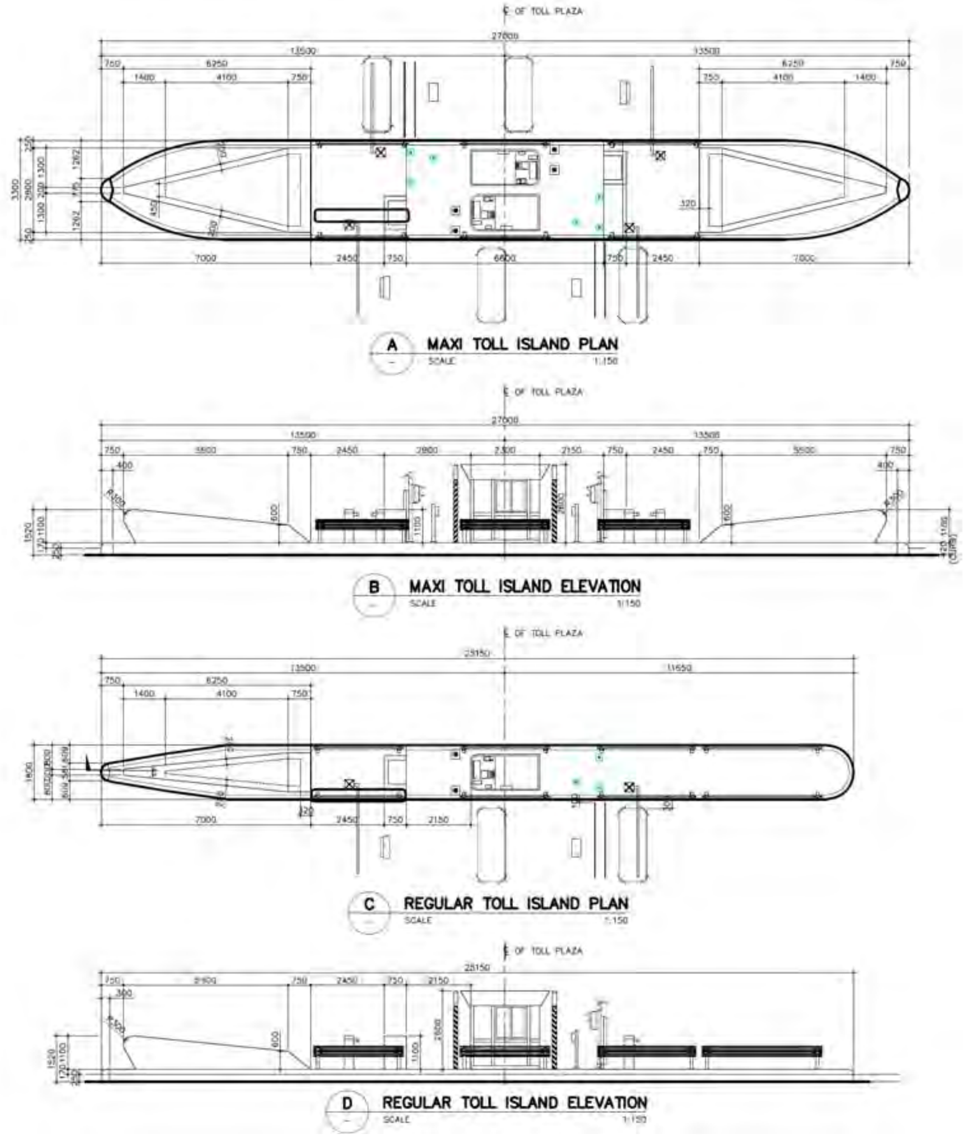


FIGURE 6.3.4-2 (2) TYPICAL DRAWING OF TOLL BOOTH

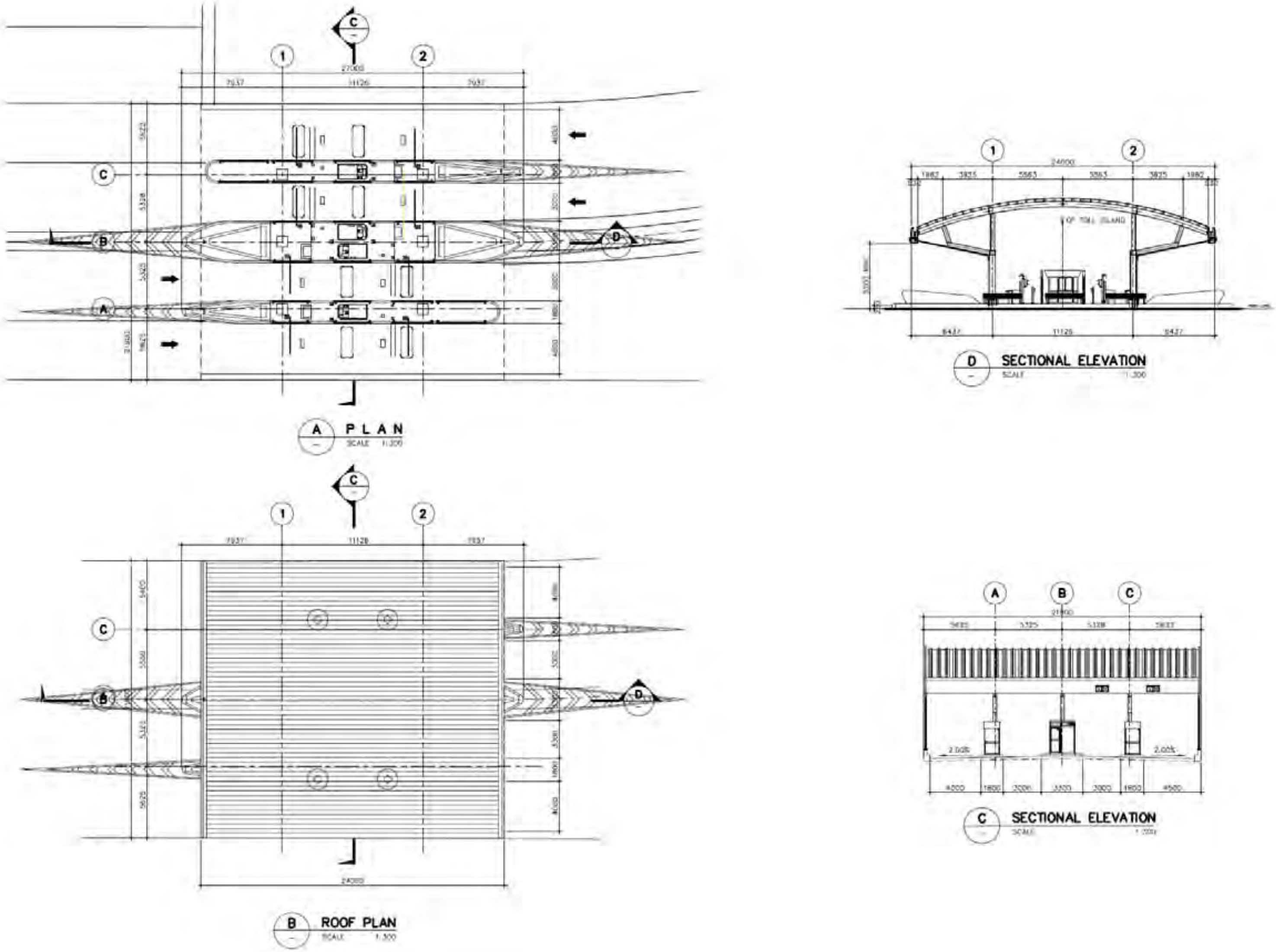


FIGURE 6.3.4-2 (3) TYPICAL DRAWING OF TOLL BOOTH LAYOUT (3 BOOTHS)

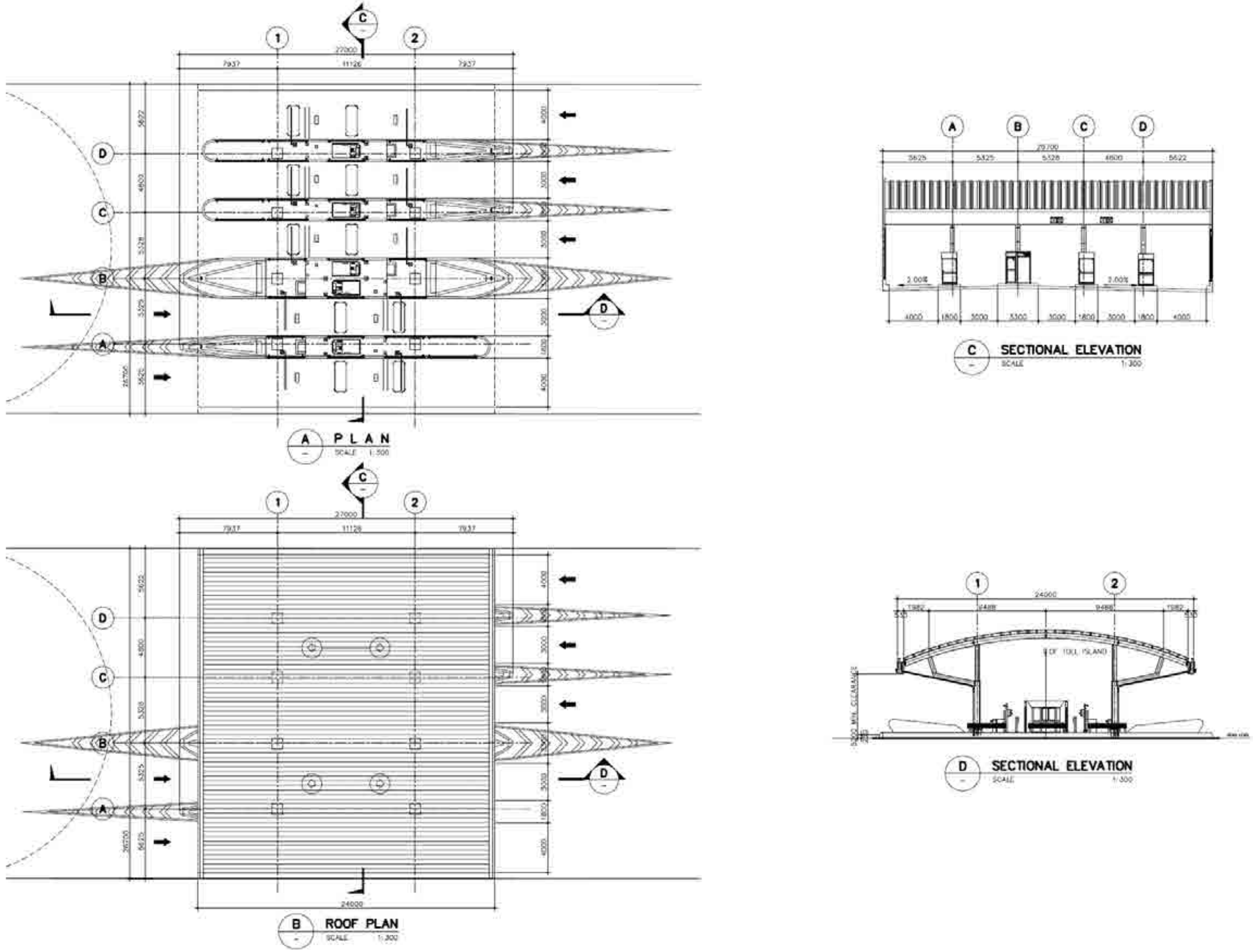


FIGURE 6.3.4-2 (4) TYPICAL DRAWING OF TOLL BOOTH LAYOUT (4 BOOTHS)

FIGURE 6.3.4-3 SILANG EAST INTERCHANGE

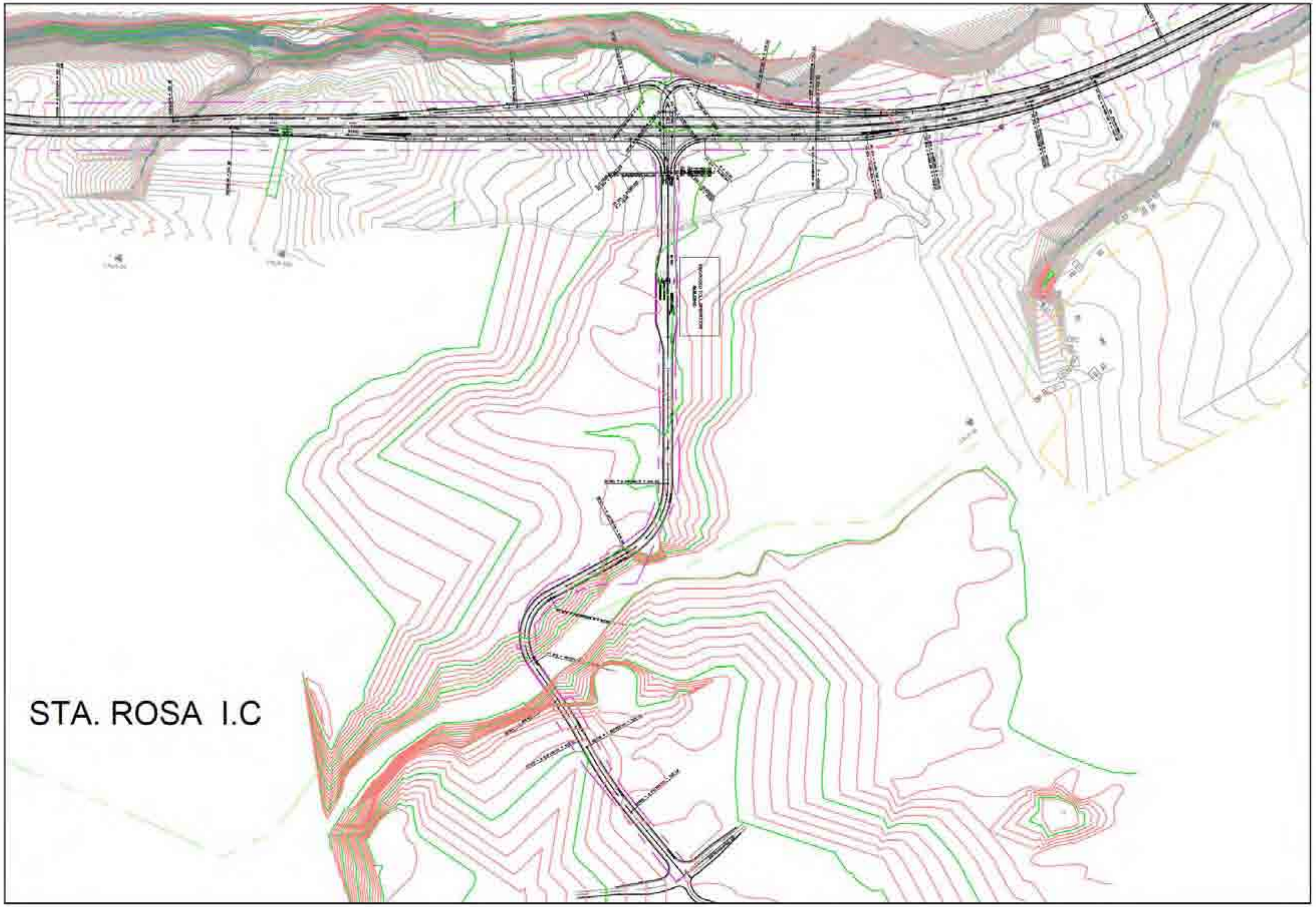


FIGURE 6.3.4-4 STA. ROSA INTERCHANGE

FIGURE 6.3.4-5 LAGUNA BLVD. INTERCHANGE (1/2)

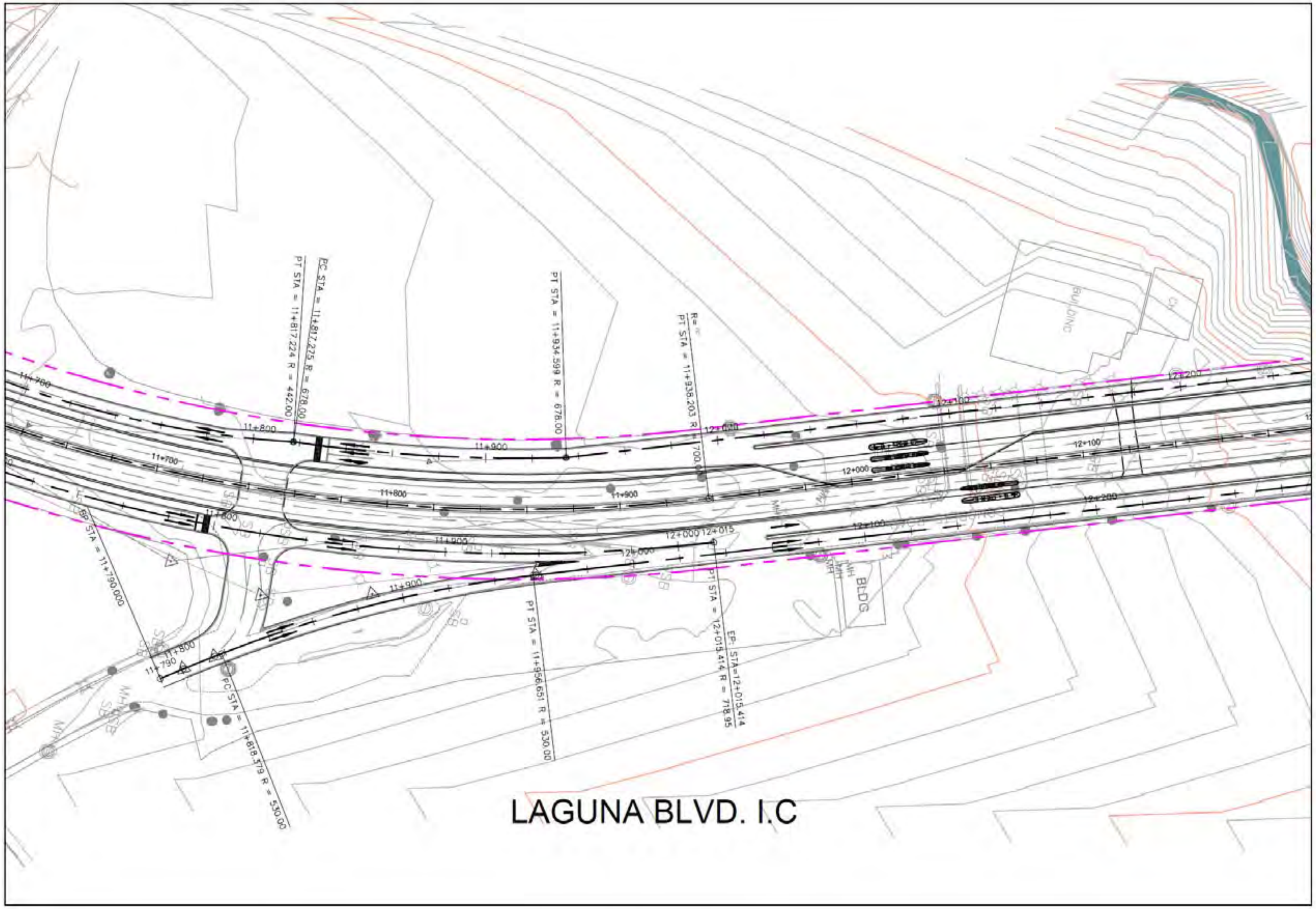


FIGURE 6.3.4-6 LAGUNA BLVD. INTERCHANGE (2/2)

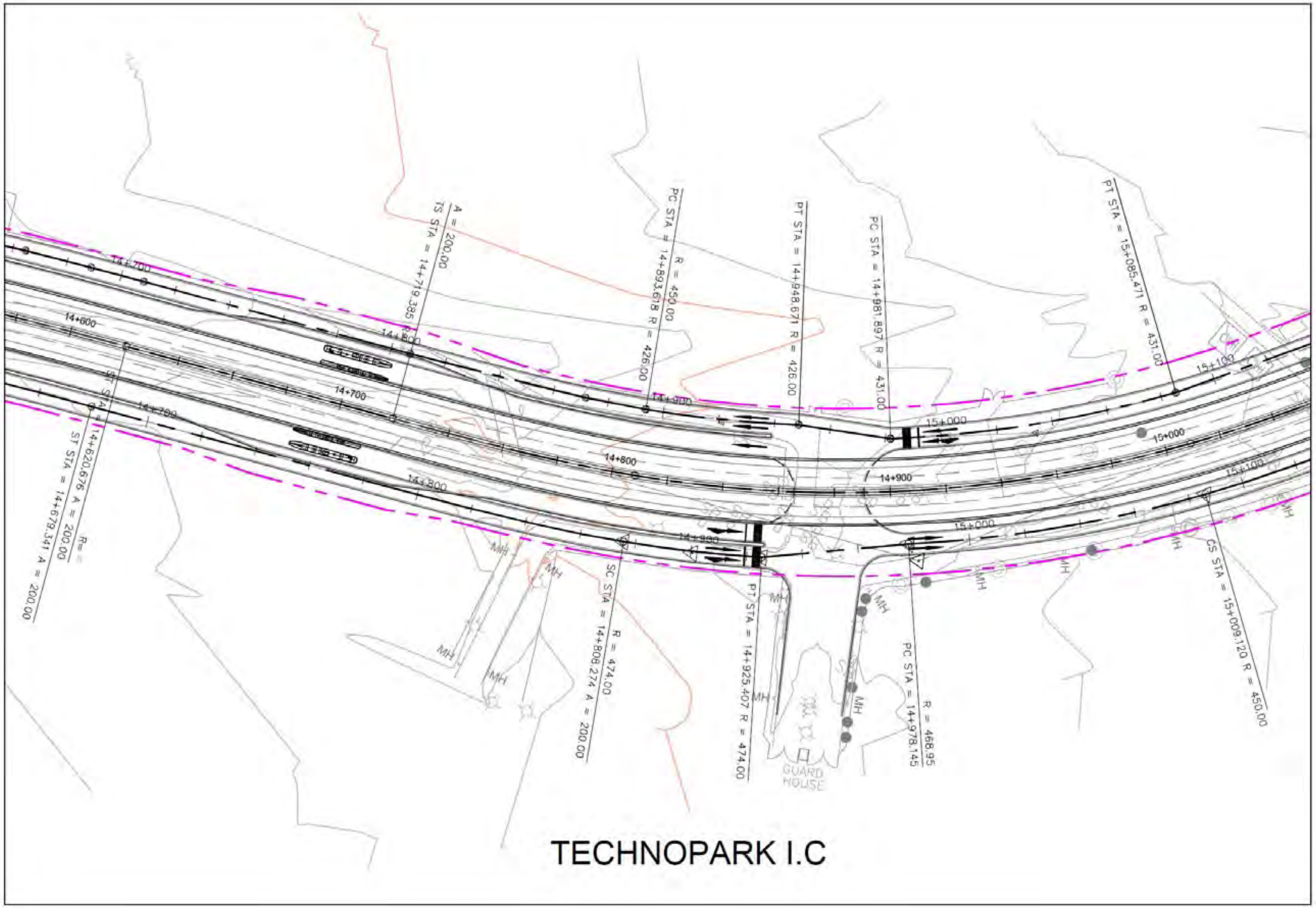


FIGURE 6.3.4-7 TECHNOPARK INTERCHANGE

(5) Design Traffic Volume and Required Lane Number

In accordance with traffic forecast (Chapter 4), the required lane number is studied below. The recommendation is shown in **Table 6.3.4-2**.

a. The number of lane shall be sufficiently the peak hour traffic for Average Annual Daily Traffic (AADT)
b. Capacity of traffic per lane for the design speed of 40km/h is 1200 /day.

The lane number is studied in year of **2030**.

TABLE 6.3.4-2 REQUIRED LANE NUMBER OF INTERCHANGE RAMP

Year 2030

No.	Interchange	Direction	ON/OFF	AADT (2030)	Peak (%)	Peak Hr. Traffic	Capacity 1-lane (Veh/h)	Required lane number
				(a)	(b)	(c=a*b*)	(d)	
1	Aguinaldo IC		ON	8,936	8%	715	1,200	1
2			OFF	13,245	8%	1,060	1,200	1
3	Silang East IC	West	ON	4,931	8%	394	1,200	1
4		West	OFF	4,495	8%	360	1,200	1
5		East	ON	4,101	8%	328	1,200	1
6		East	OFF	2,278	8%	182	1,200	1
7	Sta. Rosa-Tagytay IC		ON	10,251	8%	820	1,200	1
8			OFF	9,996	8%	800	1,200	1
9	Laguna Blvd. IC	West	ON	8,520	8%	682	1,200	1
10		West	OFF	6,562	8%	525	1,200	1
11		East	ON	10,951	8%	876	1,200	1
12		East	OFF	10,898	8%	872	1,200	1
13	TechnoPark IC	West	ON	1,935	8%	155	1,200	1
14		West	OFF	2,124	8%	170	1,200	1

(6) Required Toll Booth Number

In accordance with traffic demand forecast, the required toll booth is estimated below.

The booth number estimated in year 2020 and 2030. It is assumed that the ETC user in year 2020 is 10% and that in the year 2030 is 40%. The capacity for entry booth is 600 vehicle/hour and that for exit booth is 255 vehicle /hour.

Based on this calculation, the required toll booth is shown in **Figure 6.3.4-8**.

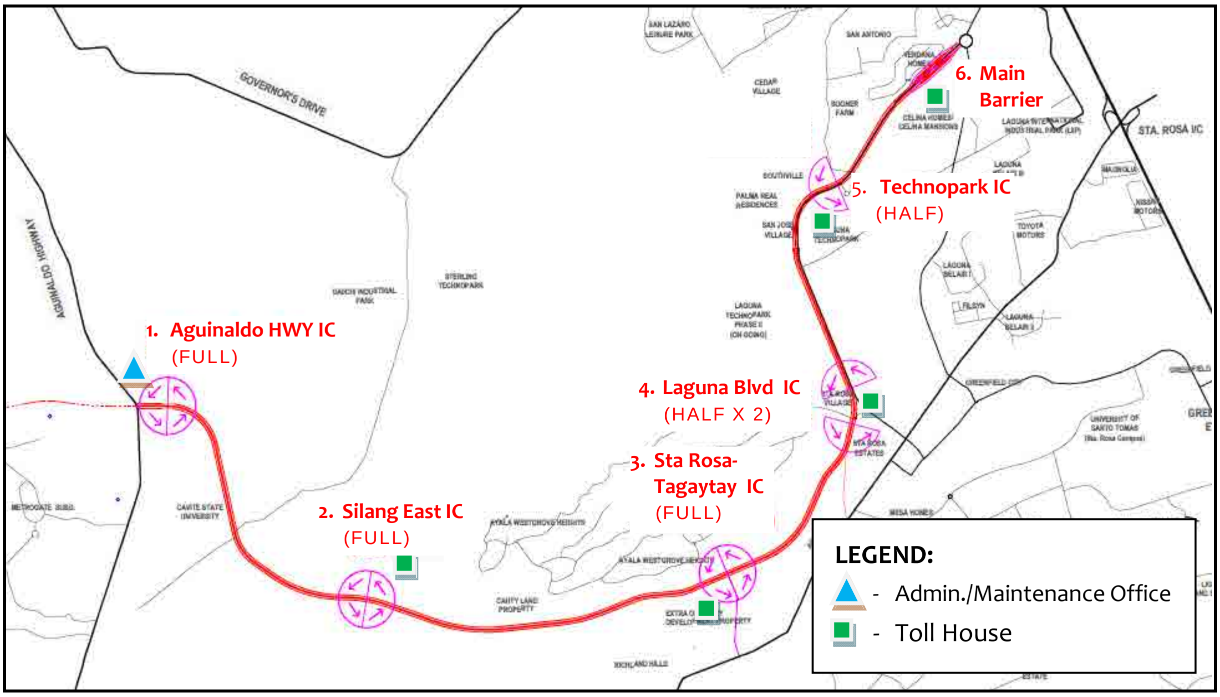
TABLE 6.3.4-3 REQUIRED TOLL BOOTH OF INTERCHANGE

Year 2020				ETC User	10%									
No.	Interchange	Type	Direction	ON/OFF	AADT (2020)	Peak (%)	Peak Hr. Traffic Manual	Peak Hr. Traffic ETC	Toll Collection Type	Toll Capacity (Manual)	Toll Capacity (ETC)	Required Toll Booth (Manual)	Required Toll Booth (ETC)	Required Toll Booth (Total)
					(a)	(b)	(c=a*b*(No_ETC)	(d=a*b*(ETC)		(e)	(f)	(g=roundup(c/e))	(h=roundup(d/f))	(i=g+h)
1	Aguinaldo IC	Trumpet		ON	6,180	8%	445	49	Ticket	600	900	1	1	**2**
2				OFF	10,275	8%	740	82	Pay	255	900	3	1	**4**
3	Silang East IC	Diamond	Western	ON	3,625	8%	261	29	Ticket	600	900	1	1	**2**
4			Western	OFF	2,972	8%	214	24	Pay	255	900	1	1	**2**
5			Eastern	ON	2,433	8%	175	19	Ticket	600	900	1	1	**2**
6			Eastern	OFF	842	8%	61	7	Pay	255	900	1	1	**2**
7	Sta. Rosa-Tagytay IC	Flat Y		ON	5,245	8%	378	42	Ticket	600	900	1	1	**2**
8				OFF	4,709	8%	339	38	Pay	255	900	2	1	**3**
9	Laguna Blvd.IC	Diamond	Western	ON	7,117	8%	512	57	Ticket	600	900	1	1	**2**
10			Western	OFF	6,550	8%	472	52	Pay	255	900	2	1	**3**
11			Eastern	ON	2,750	8%	198	22	Ticket	600	900	1	1	**2**
12			Eastern	OFF	3,967	8%	286	32	Pay	255	900	2	1	**3**
13	TechnoPark IC	Diamond (Half)	Western	ON	900	8%	65	7	Ticket	600	900	1	1	**2**
14			Western	OFF	920	8%	66	7	Pay	255	900	1	1	**2**
15	Toll Barrier			ON	12,483	8%	899	100	Ticket	600	900	2	1	**3**
16				OFF	11,335	8%	816	91	Pay	255	900	4	1	**5**
													Total	**41**

Exit	255	
Entry	600	

Year 2030			ETC User	40%										
No.	Interchange	Type	Direction	ON/OFF	AADT (2020)	Peak (%)	Peak Hr. Traffic Manual	Peak Hr. Traffic ETC	Toll Collection Type	Toll Capacity (Manual)	Toll Capacity (ETC)	Necessary Toll Booth (Manual)	Necessary Toll Booth (ETC)	Necessary Toll Booth (Total)
					(a)	(b)	(c=a*b*(No_ETC)	(d=a*b*(ETC)		(e)	(f)	(g=roundup(c/e))	(h=roundup(d/f))	(i=g+h)
1	Aguinaldo IC	Trumpet		ON	8,936	8%	429	286	Ticket	600	900	1	1	**2**
2				OFF	13,245	8%	636	424	Pay	255	900	3	1	**4**
3	Silang East IC	Diamond	Western	ON	4,931	8%	237	158	Ticket	600	900	1	1	**2**
4			Western	OFF	4,495	8%	216	144	Pay	255	900	1	1	**2**
5			Eastern	ON	4,101	8%	197	131	Ticket	600	900	1	1	**2**
6			Eastern	OFF	2,278	8%	109	73	Pay	255	900	1	1	**2**
7	Sta. Rosa-Tagytay IC	Flat Y		ON	10,251	8%	492	328	Ticket	600	900	1	1	**2**
8				OFF	9,996	8%	480	320	Pay	255	900	2	1	**3**
9	Laguna Blvd.IC	Diamond	Western	ON	8,520	8%	409	273	Ticket	600	900	1	1	**2**
10			Western	OFF	6,562	8%	315	210	Pay	255	900	2	1	**3**
11			Eastern	ON	10,951	8%	526	350	Ticket	600	900	1	1	**2**
12			Eastern	OFF	10,898	8%	523	349	Pay	255	900	3	1	**4**
13	TechnoPark IC	Diamond (Half)	Western	ON	1,935	8%	93	62	Ticket	600	900	1	1	**2**
14			Western	OFF	2,124	8%	102	68	Pay	255	900	1	1	**2**
15	Toll Barrier			ON	26,688	8%	1,281	854	Ticket	600	900	3	1	**4**
16				OFF	26,485	8%	1,271	848	Pay	255	900	5	1	**6**
													Total	**44**

LOCATION FOR TRAFFIC AND MAINTENANCE OFFICE



INTERCHANGE	DESCRIPTION		IC TYPE	NO. OF TOLL BOOTH	WEIGH IN MOTION	ADMIN / MAINT. OFFICE
1. Silang East IC	From Cavite From SLEX	Entry Exit Entry Exit	Diamond	2 2 2 2	-	-
2. Sta Rosa–Tagaytay Rd IC	ENTRY EXIT		Flat "Y"	2 3	-	1
3. Laguna Blvd. IC	From Cavite From SLEX	Entry Exit Entry Exit	Diamond	2 3 2 4	-	-
4. Techpark IC	From SLEX	Entry Exit	Diamond (Half)	2 2	-	-
5. Main Barrier	ENTRY EXIT		-	4 6	2	-
TOTAL				**38**	**2**	**1**

FIGURE 6.3.4-8 LOCATION OF IC AND FACILITIES

6.4 STRUCTURE DESIGN

In reference to the previous study, review of structure design and design standard and conceptual design for structures (bridge and box culvert) are proposed for this section.

6.4.1 Structure Design Standard

(1) General

The Structure Design Standard shall be in accordance with the following codes and guidelines:

- AASHTO Standard Specifications for Highway Bridges 17th edition 2002,
- DESIGN Guidelines Criteria and Standard for Department of Public Works And Highways,
- Basic Specifications – DPWH Standard Specifications 2004, Highways, Bridges and Airports
- Alternatively, Japanese Standards also will be adopted as the structure design standards.

(2) Loading Specifications

Structure shall be designed to carry the following loads and forces:

1) **Dead Load**

2) **Live Load**
   Live Load shall be MS18 (HS-20-44)

3) Impact Load
   I = 15.24/(L+38)

4) Sidewalk Live Load
   4.07 KPa of sidewalk area

5) Earthquake Load
   A = 0.4g, SPC D

6) Earth Pressure
   Coulomb's Formula

7) Wind Load

For the Superstructure design, 2,394Pa of wind load shall be applied horizontally at right angle to the longitudinal axis of girders and beams.

8) Thermal Forces

The range of temperature shall be as follows:
17.8 °C to 48.9 °C
16.7 °C temperature rise
22.2 °C temperature fall

(3) Seismic Design

Seismic Design shall be in accordance with AASHTO Standard Specifications Division I-A. Acceleration coefficient of 0.4g shall be adopted to consider importance classification and past/recent experience in the Philippines.

(4) Superstructure

1) Bridge Type

The following bridge types shall be adopted depending on the span length, economy, and sight conditions:

a) Simple span prestressed concrete AASHTO I-Girders with continuous concrete deck slab every three or four spans.

b) Simple/multi span reinforced concrete deck girder.
Deck discontinuity such as expansion joints shall be kept to minimum in accordance to the DPWH Design Advisory.

2) Expansion Joint

The following types of expansion joints shall be adopted depending on the bridge type and movement.

a) Hot poured joint sealer with angles type,
b) Closed cell elastomeric sealer made of Neoprene type.

3) *Bridge Drainage*

Catch basins shall be made of cast iron and PVC drainpipes shall be used for bridge surface drainage system.

4) *Bearings Shoe*

Elastomeric bearing pad shall be used for prestressed concrete girder supports.

5) *Bridge Pavement*

Asphalt concrete pavement with 5 cm thickness shall be laid on concrete deck slab.

6) *Construction Force and Effect*

Forces and Effects developed during construction shall be considered in design.

(5) Substructure and Foundation

1) *The following type of pier shall be adopted in accordance to the site conditions and restrictions:*

a) Reinforced concrete column with pier-head type pier,
b) Reinforced concrete hammerhead type pier.
Pile bent-type shall be allowed for ramps and multi column type pier.

2) *Depth of Footing*

Footings in the ordinary condition shall be embedded into the ground at least 1.0 meter from the top of footing, and at least 2.0 meters shall be taken in the river area. Where necessary, effect of buoyancy on the structure shall be verified.

3) *Foundation Type*

Depending on the result of the sub-surface investigation of the site, construction constraints and other factors, the following types of foundation shall be used:

a) Spread footing type,

b) Cast in place concrete pile (1.2m to 2.0m diameter of piles will be adopted).

(6) Materials

All materials to be used in the project shall conform to DPWH Standard Specifications (2004), and AASHTO Code.

1) Concrete

DESCRIPTION	fc' (Min.) MPa	MAXIMUM SIZE OF CONCRETE AGGREGATES (mm)	MINIMUM CONCRETE COVER (mm)
a. Superstructure			
- Deck slabs, Diaphragms	28	20	Deck slab with BWS Top: 50 Bottom: 50 Others: 35
- Sidewalk, railings, parapets, medians	21	20	
- PSC I-Girders	38	20	PSC I-Girders: 35
b. Substructure			
- PC Pier copings, columns, footings	28	20	Pier Copings, RC & PSC: 50 PSC Hammerheads: 40 RC columns: 50 Footing and Bored Piles: 75 Abutment Walls: 50
- PSC Pier copings, rotating pier head	38	20	
- RC Abutment walls, footings	28	20	
- Bored piles	28	20	
c. Earth covered RC Box structures	28	20	Earth covered Box structures: 50
d. Other concrete (normal use)	21	20	
e. Lean concrete (for leveling)	17	25	
f. Non shrink grout	41	40	

2) Reinforcement Steel

All reinforcing steel shall be Grade 60, fy = 414 MPa.

All reinforcing steel shall be free from rust, paints, oil and any deleterious material that will tend weaken its strength or its bonding properties with concrete.

3) *Prestressing*

All prestressing steel shall be high strength stress relieved wires or strands with an ultimate stress, fs’=1860 MPa.

Prestressing steel shall be free from kinks, notches and other imperfections that will tend to weaken its strength or its bonding properties with concrete.

4) *Structural Steel*

All structural steel shall conform to the requirements of AASHTO or ASTM Designations as follows:

a) Structural Steel Shapes - AASHTO M 270 (ASTM A 36) Gr 36 and (ASTM A572) Gr 50.

b) Steel Sheet Pile - AASHTO M 202 (ASTM A 328)

c) Bridge Bearing - AASHTO M 270 (ASTM A 36) AASHTO M 106 (ASTM B 100) AASHTO M 103 (ASTM A 27) (Copper Alloy Bearing Expansion Plates Grade 70 – 36 of Steel and Sheets)

d) Deck Drain - AASHTO M 105 (ASTM A 46) Class No. 30 (Gray Iron Casting)

e) Bridge Railing - Sch. 40 Galvanized Steel Pipe

5) *Elastomeric Bearing Pads*

Elastomeric bearing pads shall be 100% virgin chloroprene (neoprene) pads with durometer hardness 60. Unless otherwise specified in the plans, bearing pads shall be laminated type bearing pads consisting of layer of elastomer, restrained at their interfaces by bonded laminations are required on the plans, laminated plate shall be non-corrosive mild steel sheet.

6) Joint Filler

Joint filler, hot poured elastic type, used for expansion joint shall conform to AASHTO M 213.

7) Bituminous Wearing Course

Bituminous wearing course to be used as surface overlay shall conform to the requirements of DPWH Standard Item 307 with minimum dry compressive strength of 1.4 MPa (200 pal). The wearing course may be used to adjust elevations on the vertical grade by varying the thickness from 50mm (min.) to 75mm (max).

6.4.3 Structure Type Study

A total of thirty four (34) bridges and one (1) reinforced concrete box culverts (RCBC) were proposed for the proposed expressway. Twenty nine (29) along the expressway, two (2) along a municipal roads crossing over the expressway, two (2) along a farm roads crossing over the expressway, One along the proposed Tagaytay access road and one RCBC road crossing. Refer to Plan and Profile.

(1) General

Marketability and constructability shall be mainly considered for CALAX project. And review of the previous study (feasibility study in Year 2006), bridge types were determined. The general features of bridges are described as follows:

1) AASHTO Girder

As the standard bridge type, AASHTO Girder – prestressed concrete I-section girder was adopted, because it is the most economical and widely used (many suppliers and local productions are existed in the Philippines). And the erection is not affecting to the underneath traffic and consideration of handling in the construction.

To apply the span ranged over 25 up to 35 m length (pier center to center length) was determined.

2) DPWH Standard Bridge – RCDG

DPWH standardized Reinforced Concrete Deck Girder, RCDG is adopted the bridge span raged up to 24m length.

3) Steel Panel I-Beam with Composite Slab Deck type Viaduct

Steel I-Beam girder with Composite Slab Deck type superstructure is adopted for simplified and quick/Easy construction to make shorter construction period.

4) Single/Multi Column type Pier

Single or multi column with pier-head type pier was adopted. The column section is adopted cylindrical or circular shape, especially in the river area to minimize the streaming inhibition. And the shape could be given mild impact to the road user and vicinity viewers.

5) Reversed T-shape Abutment

Based on the vertical alignment, abutment height is ranged from 10 to 12m. Most popular type of abutment in the range – reversed T shape was adopted, and the type for the height could be stable and minimized the cost.

6) Bored Pile Foundation

Bored pile foundation was considered because the hard stratum (assumed bearing strata) exists deeper than 8m (deepest is more than 24m) in the Project area based on the soil survey data of both previous and this study. The pile diameter is adopted ranged from 1.2m to 2.0m.

7) RCBC

DPWH Standard RCBC is adopted for the most of the crossing structure and partially medium section sized RCBC is referred to Japanese Standard on this study.

(2) Structure Features

Each bridge and RCBC structures are described in **Tables 6.4.3-1** through **6.4.3-2**. General views of the bridges are shown in ATTACHMENT – GENERAL VIEW OF BRIDGES.

TABLE 6.3.4-1 BRIDGE FEATURES - MAIN ALIGNMENT

PACKAGE I

Bridge No.	Location	Features
1	2+186.00 - 2+221.00 Waterway (L= 35.0 m)	Single 35 meter span PSC I-Girder (AASHTO TYPE-V) bridge with inverted tee abutments founded on 10 - 1.20m. diameter bored piles.
2	2+275.00 - 2+310.00 Road Crossing (L= 35.0 m)	Single 35 meter span PSC I-Girder (AASHTO TYPE-V) bridge with inverted tee abutments founded on 10 - 1.20m. diameter bored piles.
3	2+440.00 - 2+525.00 Waterway (L=85.0 m)	Multi-span (25-35-25m.) PSC I-Girder (AASHTO TYPE-V) bridge with single column piers founded on 4 – 1.80m. diameter bored piles. Abutments founded on 10 - 1.20 m diameter bored piles.
4	3+105.50 - 3+140.50 Waterway (L=35.0m)	Single 35 meter span PSC I-Girder (AASHTO TYPE-V) bridge with inverted tee abutments founded on 10 - 1.20 m diameter bored piles.
5	3+965.50 - 4+605.00 Waterway (L=639.5m)	Multi-span PSC I-Girder (AASHTO TYPE-V) Elevated roadway (flyover) of about 0.64km. in length, with variable pier to pier span lengths (25, 30 and 35 meters). Substructures are single column piers at the main viaduct and two column piers at sections where ramps are connected. Pier columns are founded on 4-1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles. The proposed viaduct crosses the area that will be developed as interchange .
6	4+798.00 - 4+848.00 Waterway (L=50.0m)	Single 50.00 meter span steel box Girder bridge with inverted tee abutments founded on 10 - 1.20m. diameter bored piles.
7	5+660.00 - 6+115.00 Waterway (L=455.0m)	Multi-span PSC I-Girder (AASHTO TYPE-V) bridge with a uniform pier to pier span length of 35 meters. Substructures are either single or two column piers founded on bored piles, 4-1.80m. diameter for single column piers and 4-1.50m. diameter for two column piers. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
8	6+602.50 - 6+777.50 Waterway (L=175.0m)	Multi-span PSC I-Girder (AASHTO TYPE-V) bridge with variable pier to pier span lengths (28 and 35 meters). Except for the abutments, the superstructures and piers at the east and west directions were designed to be independent from each other taken into considerations to the topography and skewed river flow at the bridge site. Intermediate piers are single cylindrical column (2.20m. diameter) piers founded on a single 2.80m. diameter bored piles. Abutments are beam type on 2 – 2.20m. diameter bored piles.

Bridge No.	Location	Features
9	6+953.50 - 7+048.50 Waterway (L=95.0m)	Multi-span (35m.-35m.-25m.) PSC I-Girder (AASHTO TYPE-V) bridge. Intermediate piers are single column piers founded on 4 – 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
10	7+822.00 - 7+958.00 Waterway (L=136.0m)	Multi-span PSC I-Girder (AASHTO TYPE-V) bridge with variable pier to pier span lengths (23 and 35 meters). Except for the abutments, the superstructures and piers at the east and west directions were designed to be independent from each other taken into considerations the topography and skewed river flow at the bridge site. Intermediate piers are single cylindrical column (2.00m. diameter) piers founded on a single 2.50m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
11	8+167.00 - 8+377.00 Waterway (L=210.0m)	Multi-span PSC I-Girder (AASHTO TYPE-V) bridge with a uniform pier to pier span length of 35 meters. Intermediate piers are single column pier founded on 4 – 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
12	8+644.00 - 8+719.00 (East Bound) 8+647.00 – 8+722.00 (West Bound) Waterway (L=75.0m)	Multi-span (15m.-25m.-35m.) PSC I-Girder bridge. AASHTO Type IV I girders for 15 and 25m. span and Type V for 35m. span. East and west bound were designed as separate independent bridge structures, taken into considerations the topography and the skew river flow at the bridge site. Intermediate piers are single cylindrical column (2.20m. diameter) piers founded on a single 2.80m. diameter bored piles. Abutments are beam type on a 2.20m. diameter bored piles.
13	9+282.50 - 9+317.50 Interchange (L=35.0m)	Single 35m. span PSC I-Girder (AASHTO TYPE-V) bridge over a proposed roadway. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
14	9+860.00 - 10+070.00 Waterway (L=210.0m)	Multi-span (6-35m span) PSC I-Girder (AASHTO TYPE-V) bridge crossing an area intended to be developed for accessibility between the areas adjacent to the proposed expressway. Intermediate piers are single column piers founded on 4-1.80m diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.

PACKAGE II

Bridge No.	Location	Features
15	10+860.00 - 13+606.50 Viaduct (L=2,746.5m)	Elevated roadway (viaduct) of about 2.75km. over existing waterways, developed areas and other areas be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. The proposed viaduct is a combined PSC I-Girder (AASHTO Type V) and Steel I-Girder type with variable pier to pier span lengths of 25~35 meters. Intermediate piers are either single or two column piers. Columns are founded on 4- 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
16	14+074.00 - 14+354.00 Road Crossing (L=280.0m)	Multi-span (8-35m span) combined PSC I-Girder (AASHTO Type-V) and Steel I-Girder type bridge over an area to be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. Intermediate piers are either single or two column piers founded on bored piles, 4-1.80m. diameter for single column piers and 4-1.50m. diameter for two column piers. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
17	14+790.50 - 15+175.50 Road Crossing (L=385.0m)	Multi-span (11-35m.span) combined PSC I-Girder (AASHTO TYPE-V) and Steel I-Girder type bridge over an area to be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. Intermediate piers are single column piers founded on 4 – 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
18	15+510.50 - 15+685.50 Viaduct (L=175.0m)	Multi-span (5-35m.span) PSC I-Girder (AASHTO TYPE-V) type bridge over an area to be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. Intermediate piers are single column piers founded on 4 – 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
19	16+080.50 - 17+359.45 Viaduct (L=1,278.95m)	Elevated roadway (viaduct) of about 1.28km. over an existing developed areas and other areas be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. Intermediate piers are single column piers at the main viaduct and two or three column piers at the toll plaza section. Single column piers are founded on 4-1.80m. diameter bored piles. For the two and three column piers, the exterior columns are founded on 2-1.80m. diameter bored piles and 4-1.80m. diameter bored piles for the middle columns. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.

Bridge No.	Location	Features
20	17+797.40 - 17+902.40 Roadway (L=105.0m)	Multi-span (3-35m.span) PSC I-Girder (AASHTO TYPE-V) type bridge over an area to be developed to provide access between the proposed service roads which are adjacent to the proposed expressway. Intermediate piers are single column piers founded on 4 – 1.80m. diameter bored piles. Abutments are inverted tee type founded on 10 – 1.20m. diameter bored piles.
21	18+724.00 - 18+784.00 Mamplasan Interchange SLEX (L=60.0m)	One directional three lane, two span (2-30m.) Steel I-Girder Bridge over the existing South Luzon Expressway (SLEX) just beside the existing Mamplasan Interchange bridge. The intermediate pier is a single column pier founded on 4-1.20m. diameter bored piles. Abutments are inverted tee type founded on 6 – 1.20m. diameter bored piles.

RAMPS

Ramp No.	Location	Features
IC-1 Ramp A	4+425.23 - 4+520.23 Interchange 1 (L=95.0m)	Single lane, 3-span (35m.-35m.-25m.), PSC I-Girder (AASHTO TYPE-V) interchange ramp bridge crossing an existing waterway. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter bored piles. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
IC-1 Ramp B	4+425.109 - 4+520.109 Interchange 1 (L=95.0m)	Single lane, 3-span (35m.-35m.-25m.), PSC I-Girder (AASHTO TYPE-V) interchange ramp bridge crossing an existing waterway. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter bored piles. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
Main Ramp A	11+080.00 - 11+174.00 Road Crossing (L=94.0m)	Single lane, 3-span (25m.-35m.-35m.), PSC I-Girder (AASHTO TYPE-V) interchange ramp bridge crossing a proposed road. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
Main Ramp B	11+082.50 - 11+177.50 Road Crossing (L=95.0m)	Single lane, 3-span (25m.-35m.-35m.), PSC I-Girder (AASHTO TYPE-V) interchange ramp bridge crossing a proposed road. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter

Ramp No.	Location	Features
		bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
Ramp C	12+209.00 - 12+339.00 Waterway (L=130.0m)	Single lane, 4-span (35m.-35m.-35m.-25m.), PSC I-Girder (AASHTO TYPE-V) ramp bridge crossing a waterway and connected to Bridge no. 15. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
Ramp D	12+163.00 - 12+258.00 Waterway (L=95.0m)	Single lane, 3-span (35m.-35m.-25m.), PSC I-Girder (AASHTO TYPE-V) ramp bridge crossing a waterway and connected to Bridge no. 15. Intermediate piers are single cylindrical column (1.80m. diameter) piers founded on a 2.20m. diameter bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.

AT-GRADE BRIDGES

At-grade-A	12+262.50 - 12+337.50 Waterway (L=75.0m)	Two lane, 3-25m. span, PSC I-Girder (AASHTO TYPE-V) bridge crossing a waterway. Intermediate piers are single cylindrical column (2.00m. diameter) piers founded on a 2.50m. diameter bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.
At-grade-C	12+262.50 - 12+337.50 Waterway (L=75.0m)	Two lane, 3-25m. span, PSC I-Girder (AASHTO TYPE-V) bridge crossing a waterway. Intermediate piers are single cylindrical column (2.00m. diameter) piers founded on a 2.50m. diameter bored pile. Abutments are inverted tee type founded on a 2.20m. diameter bored pile.

MUNICIPAL ROAD CROSSING

Station	Features
1+322.850 Municipal Road	Two lane, 2-35m. span, PSC I-Girder bridge along a municipal road crossing the proposed expressway. Intermediate pier is a single cylindrical column (2.00m. diameter) pier founded on a 2.50m. diameter bored pile. Abutments are beam type founded on a 2.20m. diameter bored pile.
5+107.106	Two lane, 2-35m. span, PSC I-Girder bridge along a municipal road

Station	Features
Municipal Road	crossing the proposed expressway. Intermediate pier is a single cylindrical column (2.00m. diameter) pier founded on a 2.50m. diameter bored pile. Abutments are beam type founded on a 2.20m. diameter bored pile.

FARM ROAD CROSSING

Station	Features
2+870.00 Farm Road	Single lane, 2-20m. span, PSC I-Girder bridge along a farm road crossing the proposed expressway. Intermediate pier is a single cylindrical column (1.80m. diameter) pier founded on a 2.20m. diameter bored pile. Abutments are beam type founded on a 2.20m. diameter bored pile.
5+360.00 Farm Road	Single lane, 2-20m. span, PSC I-Girder bridge along a farm road crossing the proposed expressway. Intermediate pier is a single cylindrical column (1.80m. diameter) pier founded on a 2.20m. diameter bored pile. Abutments are beam type founded on a 2.20m. diameter bored pile.

TAGAYTAY ACCESS

Station	Features
10+082.50	Two lane, Three span (25m.-35m.-20m.) span, PSC I-Girder bridge along the proposed Tagaytay Access Road. Intermediate piers are single cylindrical column (2.20m. diameter) piers founded on a 2.80m. diameter bored pile. Abutments are founded on a 2.20m. diameter bored pile.

TABLE 6.4.3-2 RCBC FEATURES

Station	Features
4+740.00 Farm Road	Single Barrel, 4.00m. x 4.00m. reinforced concrete box culvert (RCBC) type, along a farm road crossing the proposed expressway.

6.5 PAVEMENT DESIGN

6.5.1 General

This section describes pavement design for the project expressway. The pavement design are based on the following;

1) The results and findings of the subgrade characteristics over which the road is to built;
2) The traffic load anticipated to traverse the proposed road alignments over the selected design life; and
3) The type of pavement to be adopted based on the technical and economical advantages.

6.5.2 Pavement Design Standards

The pavement design are in accordance with the ”Guide for Design of Pavement Structures, 1993” by the American Association of State Highway and Transportation Officials and in reference also to “Design Guidelines, Criteria and Standards for Public Works and Highways” by the Department of Public Works and Highway.

6.5.3 Technical Approach

The design parameters used in the pavement design includes time constrains, traffic, design serviceability loss, reliability, subgrade strength and material properties for pavement structure design.

Followings are major design conditions;

1) Design period

10 years

It is assumed that the design life of pavement consummates the 20-year design period before rehabilitation is performed.

2) Traffic

The structural design of the pavement is based on fatigue loads. Fatigue loading is taken as the cumulative number of passes of an Equivalent Standard Axle Load (ESAL) of 8,300kgs (18kips) per axle, to which the pavement structure will be subjected throughout its design life.

6.5.4 Recommended Pavement Structures

(1) Pavement Structure for Main Expressway

1) Main Carriage Way

The recommended pavement structures for both directions of the expressway main carriageway is as below;

No.	Thickness	Pavement Structure
1	60 mm	Asphalt Concrete Surface Course
2	60 mm	Asphalt Concrete Binder Course
3	150 mm	Cement Treated Base Course
4	250 mm	Crushed Aggregate Base Course
5	350 mm	Crushed Sub-Base Course

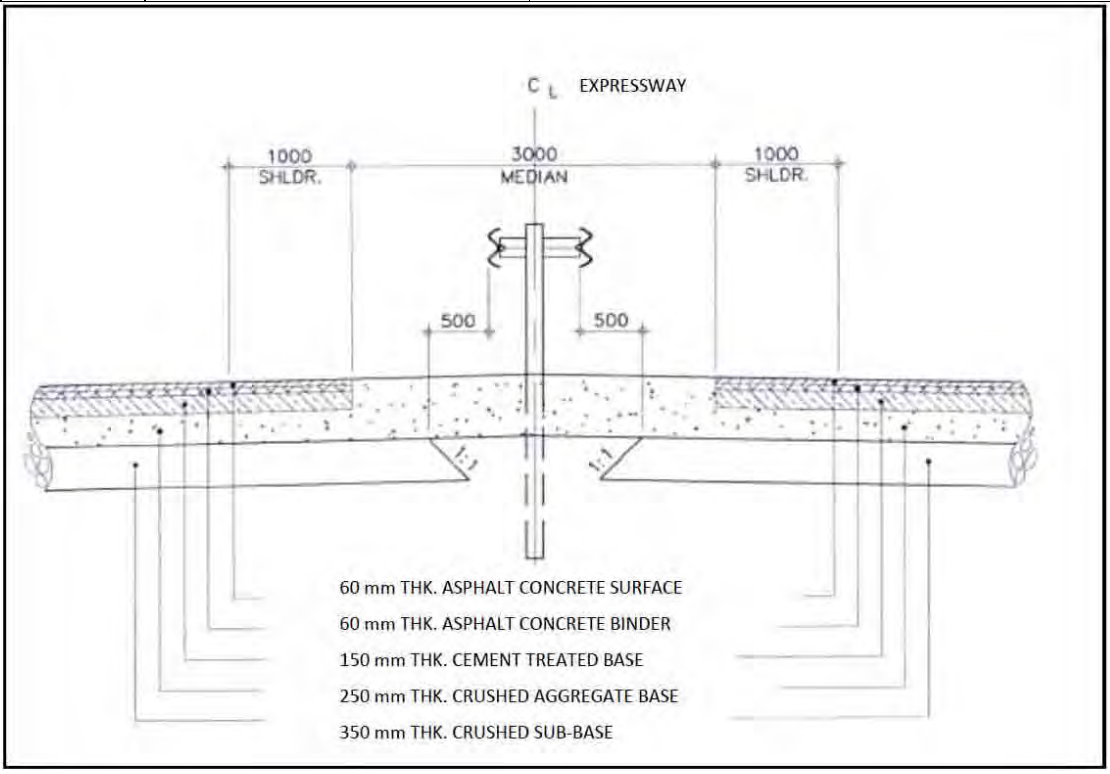


FIGURE 6.5.4-1 PAVEMENT STRUCTURE OF MAIN CARRIAGEWAY

2) *Shoulder of Main Expressway*

The pavement structure for shoulder followed the designed for the main carriageway. However, the surface course is not applied because shoulders is not subjected to carry full traffic on the expressway but only to accommodate vehicle emergency parking and temporary use of maintenance activities.

No.	Thickness	Pavement Structure
1	60mm	Asphalt Concrete Binder Course
2	150mm	Cement Treated Base Course
3	250mm	Crushed Aggregate Base Course
4	350mm	Crushed Sub-Base Course

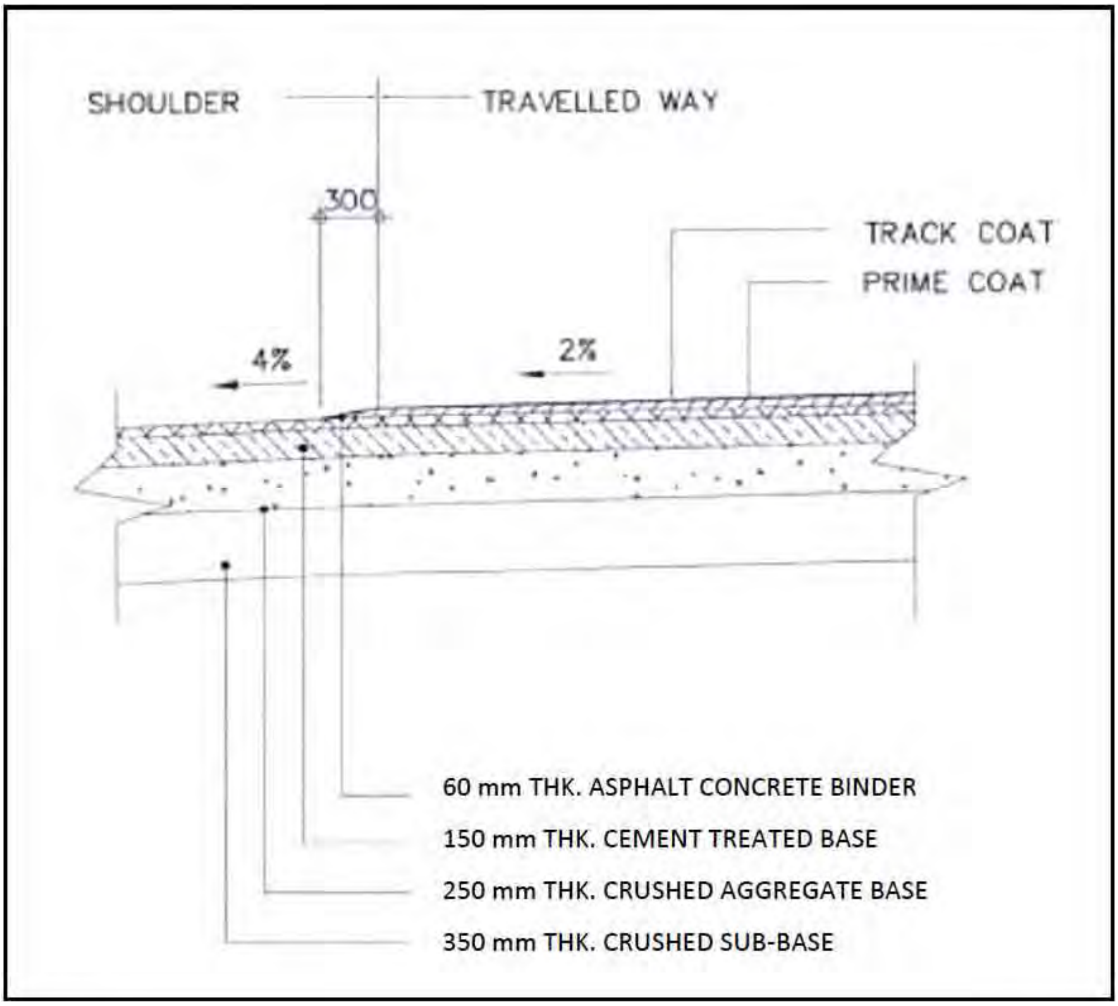


FIGURE 6.5.4-2 PAVEMENT STRUCTURE OF SHOULDER

(2) Pavement for Interchange Ramps

1) Carriage way of Ramp

The pavement structure of carriage way of ramp follows the same as the expressway.

2) Shoulder of Ramp

The pavement structure of carriage way of ramp follows the same as the expressway.

3) Toll plaza

Portland Cement Concrete Pavement (PCCP) will be used at least 50m both side from the center of toll gate.

No.	Thickness	Pavement Structure
1	350mm	Portland Cement Concrete Pavement
2	200mm	Crushed Aggregate Base Course
3	200mm	Crushed Aggregate Sub-Base Course

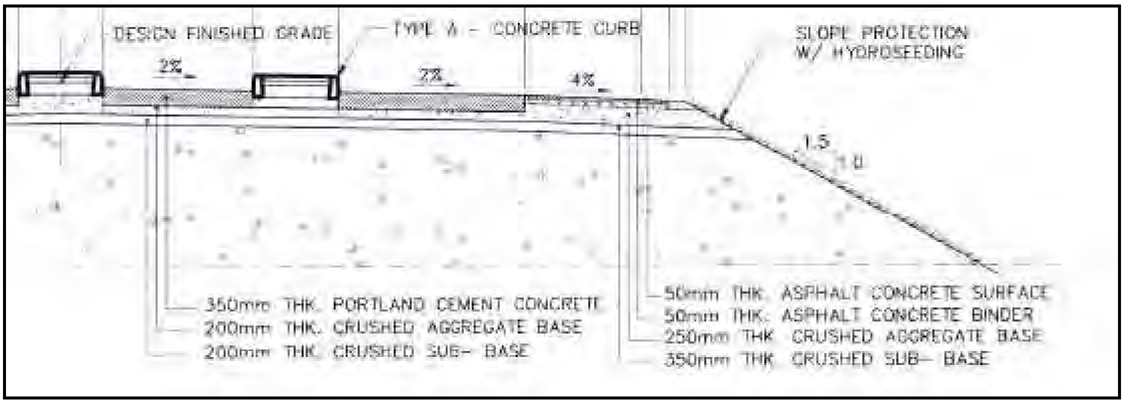


FIGURE 6.5.4-3 PAVEMENT STRUCTURE OF TOLL PLAZA

6.5.5 Pavement Design Calculation

Pavement calculation is shown as follows;

Traffic Volume and Cumulative Equivalent Standard Axle Load (ESAL)(W18kips)

［Design Period : 10 years］

Project Title : CALAX(Laguna Section)

Year				Total	Large V/Tota	Large V	Class 1	Class 2			Class 3		Total
			Vehicle Type				Cars	Bus/Trucks			Trailer		
			Traffic Volume in 2017	19,924	8%	1,503	14,381	4,040			1,503		
			Load Equivalence Factor (LEF)**			-	0.0001	5.7000			15.4000		
			Grouth Rate*	5.00%			5.00%	5.00%			5.00%		
	2017	1	Open				1.44	23,030.17			23,139.41		46,171.02
1	2018	2					1.51	24,181.68			24,296.38		48,479.57
2	2019	3					1.59	25,390.76			25,511.20		50,903.55
3	2020	4					1.66	26,660.30			26,786.76		53,448.73
4	2021	5					1.75	27,993.32			28,126.10		56,121.16
5	2022	6					1.84	29,392.98			29,532.40		58,927.22
6	2023	7					1.93	30,862.63			31,009.02		61,873.58
7	2024	8					2.02	32,405.77			32,559.47		64,967.26
8	2025	9					2.12	34,026.05			34,187.44		68,215.62
9	2026	10	in 10 years				2.23	35,727.36			35,896.82		71,626.40
Cummulative ESAL													580,734.11

one lane　　lane adjustment coefficient

580,734.11 × 365days × 0.5 × 0.8 = 84,787,180 (Design ESAL)

* Based on Traffic Demand Forecast

** Source:CY2008, Summary of Traffic Data by Project Evaluation Division, Planning Service, Report as of January 31,2009

SV03243LZ_AL, S00935LZ, Daang Maharika Highway (LZ), Nueva Ecija 2nd District Engineering Office

Flexible Pavement Design

Design Standard: Guide for Design of Pavement Structures, 1993, American Association of State Highway and Transportation Offcials
Design Case: 2016 to 2035 (20 years)
Project Title: CALAX(Laguna Section)

1. Calcuation of Structural Number

(1) Basic Fomula

The fomula shown below is applied for flexible pavement design in accordance with AASHTO design guideline.
Structural Number is computed to accommodate the basic fomula.

$$\log_{10}(W_{18}) = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}[\triangle PSI/(4.2-1.5)]}{0.40 + 1094/(SN+1)^{5.19}} + 2.32 \times \log_{10}(MR) - 8.07$$

(2) Design Condition

Design Condition		Index	Value	Grounds	Remarks
	Design Period		10	2017 ～2026（10 Years）	Design life of pavement of initial pavement structure
1. Traffic	Design ESAL	W18	84,787,180		
2. Level of Reliability	Reliability	R(%)	85	Interstate and other Freeways (AASHTO)	The possibility to satisfy road user during design period. Stronger pavement structure is required in accordance with
	Standard Normal Deviate	ZR	-1.037	Value corresponding to R=85%	Corresponding to R
	Overall Standard Deviation	S0	0.45	Average of Flexible Pavement	Variation of reliabiity according to regoinal traffic difference
3. Serviceabiity	Initial Serviceability Index	P0	4.2	Standard of AASHTO	5: Perfect 0: Inperfect
	Terminal Serviceability Index	P1	2.5	Standard of AASHTO	Serviceability expected at the end of design period
	Present Serviceability Index	ΔPSI	1.7	PSI = P0- Pt	
4. Pavement Support Layer	CBR(%)	CBR	6		
	Resilient Modulus	MR	9,000	MR=1,500×CBR	Soil Subgrade Strength

(3) Computation of SN

1. Left side of Basic Fomula	log10(W18)	7.928
2. Value of Righ side of Basi Fomula		7.928
3. SN Value required	SN	**6.059**

2. Pavement Structure

Pavement Structure		Layer Coefficient (a)	Thickness D (cm)	Thickness d (inch)	Drainage Coeffient (m)	Structural Number SN=a×m×D1	Remarks
Asphalt Concrete Surface	new	0.390	6.00	2.362	-	0.921	
Asphalt Concrete Binder	new	0.390	6.00	2.362	-	0.921	
Cement Treated Base	new	0.230	15.00	5.906	1.0	1.358	Cement treated base course
Crushed Aggregate Base	new	0.140	25.00	9.843	1.0	1.378	Crushed aggregate,CBR>20
Crushed sub-base	new	0.110	35.00	13.780	1.0	1.516	Crushed aggregate
Evaluation	Required SN			6.059	<	6.094	OK

W18 : Predicted number of 18-kip equivalent single axle load applications
ZR : Standard normal deviate
S0 : Combined standard error of the traffic prediction and performance prediction)
MR : Resilient modulus (psi)
D : Layer thickness(inches)
m : Layer drainage coeficient
SN is equal to the structural number indicative of the total pavement thickness required:

$$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$