DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS (DOTC)
REPUBLIC OF THE PHILIPPINES

STUDY ON RAILWAY STRATEGY FOR ENHANCEMENT OF RAILWAY NETWORK SYSTEM IN METRO MANILA OF THE REPUBLIC OF THE PHILIPPINES

FINAL REPORT

VOLUME 2

LRT LINE 2 EAST EXTENSION PROJECT

JULY 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.
ALMEC CORPORATION
KATAHIRA & ENGINEERS INTERNATIONAL
TONICHI ENGINEERING CONSULTANTS, INC.

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VOLUME 2

LRT LINE 2 EAST EXTENSION PROJECT

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Abbreviation List

Term	English
AASHTO	American Association of State Highway and Transportation Office
AC	Alternate Current
ADB	Asian Development Bank
AFC	Automatic Fare Collection
APS	Audio/Paging System
ASCOM	Army Support Command
ASTM	American Society for Testing and Materials
ATC	Automated Train Control
ATO	Automated Train Operation
ATP	Automated Train Protection
ATS	Automated Train Supervision
AVI	Automatic Vehicle Identification
B/C	Benefit/Cost
BCDA	Base Conversion Development Authority
BIR	Bureau of Internal Revenue
BGC	Bonifacio Global City
BOT	Build-Operate-Transfer
BPO	Business Processing Outsourcing
CAAP	Civil Aviation Authority of the Philippines
CBD	Central Business District
CCTV	Closed-Circuit Television
CDCP	Construction Development Corporation of the Philippines
CDM	Clean Development Mechanism
CER	Certificated Emission Reduction
CIF	Cost, Insurance and Freight
CIIP	Comprehensive and Integrated Infrastructure Program
CNC	Certificate of Non-Coverage
CTMS	Central Traffic Control System
DAO	Department Administrative Order
DBM	Department of Budget and Management
DBP	Development Bank of the Philippines
DC	Direct Current
DED	Detailed Engineering Design
DENR	Department of Environment and Natural Resources
DFS	Detailed Feasibility Study
DILG	Department of Interior and Local Government
DOF	Department of Finance
DOTC	Department of Transportation and Communications
DPWH	Department of Public Works and Highways
DSCR	Debt Service Coverage Ratio
ECA	Environmentally Critical Area

Term	English
ECB	Emergency Call Box
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDSA	Epifanio de los Santos Avenue
EIA	Environmental Impact Assessment
EIAD	Environmental Impact Assessment Division
EIARC	Environmental Impact Assessment Review Committee
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau
EMP	Environment Management Plan
EO	Executive Order
EPABX	Electronic Private Automatic Branch Exchange
EPRMP	Environmental Performance Report and Management Plan
ETC	Electronic Toll Collection
FACE	JBIC Facility for Asia Cooperation and Environment
FIRR	Financial Internal Rate of Return
FMB	Forest Management Bureau
FOB	Free on Board
FOE	Fixed Operational Equipment
FOTL	Fiber Optic Transmission Line
FWD	Falling Weight Deflection Meter
GDP	Gross Domestic Product
GEH	Geoffrey E. Havers (Modeling statistics)
GFI	Government Financial Institutions
GOP	Government of The Philippines
HCP	Hollow Core Plank
HGC	Home Guarantee Corporation
HOV	High Capacity Vehicle
HUDCC	Housing and Urban Development Coordinating Council
ICC	Investment Coordination Committee
ISO	International Organization for Standardization
ISM	International School of Manila
ITS	Intelligent Transport Systems
JBIC	Japan Bank International Cooperation
JETRO	Japan International Cooperation Agency
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
LCC	Life Cycle Cost
LCX	Leaky Coaxial Cable
LGU	Local Government Unit
LLDA	Laguna Lake Development Authority
LRT	Light Rail Transit System (Manila)

Term	English
LRTA	Light Rail Transit Authority
MERALCO	Manila Electric Company
METI	Ministry of Economy, Trade and Industry
MIAA	Manila International Airport Authority
MIS	Management Information System
MMDA	Metropolitan Manila Development Authority
MMSW	Metro Manila Skyway
MMUTIS	Metro Manila Urban Transportation Integration Study
MNTC	Manila North Tollways Corporation
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPIC	Metro Pacific Investment Corporation
MPTC	Metro Pacific Tollways Corporation
MRT	Metro Rail Transit System (Manila)
NAIA	Ninoy Aquino International Airport
NAMRIA	National Mapping and Resource Information Authority
NCR	National Capital Region
NEDA	National Economic Development Authority
NEPC	National Environmental Protection Council
NEXCO	Nippon Expressway Company Limited
C NEXCO	Central Nippon Expressway Company Limited
W NEXCO	West Nippon Expressway Company Limited
NHA	National Housing Authority
Ni-Cd	Nickel-Cadmium
NLEX	North Luzon Expressway
NOE	Non-Operational Equipment
NPCC	National Pollution Control Commission
NPV	Net Present Value
O&M	Operation and Maintenance
OCC	Operational Control Center
OCS	Overhead Contact System
OD	Origin-Destination
ODA	Official Development Assistance
OEM	Original Equipment Manufacturer
OMA	Operation Management Agreement
PABX	Private Automatic Branch exchange
PAGCOR	Philippine Amusement and Gaming Corporation
PC	Prestressed Concrete
PCU	Passenger Car Unit
PCUP	Presidential Commission on Urban Poor
PD	President Decree
PDR	Project Description Report
PFI	Private Finance Initiative

Term	English
PMO	Project Management Office
PNCC	Philippine National Construction Corporation
PNP	Philippine National Police
PNR	Philippines National Railroad
POS	Point of Sales
PPA	Philippine Ports Authority
PPHPD	Peak passengers per hour per direction at maximum load point
PPP	Public Private Partnership
PSSD	The Philippine Strategy for Sustainable Development
RA	Republic Act
RAP	Resettlement Action Plan
RC	Reinforced Concrete
RIMS	Road Maintenance Information Management System
RORO	Roll-on, roll-off
ROW	Right of Way
RSS	Rectifier SubStation
RSU	Road Safety Unit
SCADA	Supervisory Control and Data Acquisition
SCTEX	Subic-Clark-Tarlac Expressway
SDH	Synchronous Digital Hierarchy
SFEX	The Subic Freeport Expressway
SLEX	South Luzon Expressway
SNC	Ernst & Young ShinNihon LLC
SPC	Special Purpose Company
STOA	Supplemental Toll Operation Agreement
STRADA	System for Traffic Demand Analysis
TCS	Traffic Control System
TDM	Traffic Demand Management
TEG-NCRPO	Traffic Enforcement Group under National Capital Regional Police Office
TMP	Traffic Management Plan
TOA	Toll Operation Agreement
TPCS	Toll Plaza Computer System
TRB	Toll Regulatory Board
TSP	Total Suspended Particulate
TTC	Travel Time Cost
VCR	Vehicle Capacity Ratio
VICS	Vehicle Information and Communication System
VOC	Vehicle Operation Cost
UIC	Union Internationale des Chemins de fer
UMAK	University of Makati
UPS	Uninterruptible Power Supply
URPO	Urban Roads Project Office
VMS	Variable Message Sign

Term	English
VOC	Vehicle Operation Cost
VRS	Voice Recording System
VVVF	Variable Voltage Variable Frequency
WACC	Weighted Average Cost of Capital
WB	World Bank

CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

The Megatren, more popularly known by its generic name LRT Line 2, is a 13.8 km mass transit line that traverses four cities in Metro Manila namely Pasig, Quezon, San Juan and Manila along the major thoroughfares of Marcos Highway, Aurora Boulevard, Ramon Magsaysay Boulevard, Legarda and Recto Avenue. The Megatren, which started initial commercial operation in April 2003, is the latest of its kind in the world today. It is an Automatic Train Operation system which is at par in terms of facilities and technology with those in other parts of the world. It is equipped with a CCTV system that enables the railway operator to monitor activities of passengers and employees at the stations and inside the trains. Moreover, the LRT 2 is commuter friendly and has facilities especially designed for the elderly and persons with disabilities. The Megatren system has 18 new four (4) - car trains. Each train is 92.6 meters long and consists of four motorized cars. One train can seat 232 passengers. It can accommodate 1,396 more standing passengers along its spacious coaches.

In order to expand the public transport network and to correct the excessive dependence on the vehicular traffic in Metro Manila, the LRT Line 2 extension project has high necessity, and implementation of the assistance for this also has high necessity.

This project has been positioned as a high priority in the transport sector in Metro Manila, and it has been selected as a governmental PPP priority project. This makes it clear that the intention of the government is to implement this project and that the government will give it all possible assistance.

1.2 Implementation Scheme

Several PPP options were studied, including the operation and maintenance of the expanded LRT 2 line, and the selected scheme, is a Hybrid scheme (PPP-ODA), where capital cost for implementation will be funded by government under a mixed scheme of traditional Government Appropriations Act (GAA) and Official Development Assistance (ODA) procurement processes, and upon completion it leases the completed assets for O&M management to the private investor. The public sector, apart from financing, takes on the procurement, completion, and delivery risks for the public component. The GAA portion corresponds to the Civil Works of the project, and the ODA portion to the corresponding electro-mechanic subsystems.

This concession will be awarded to the bidder that offers the best concession conditions to the government.

1.3 Objective of Study

The objective of this study (regarding Line 2 only) is to review the previous report funded by JICA in 2011, the Preparatory Study for LRT Line 2 Extension Project of October 2011.

The items that have been reviewed from the previous study are:

- Demand forecast
- Civil and E&M Works
- Alignment
- Operation Plan
- Implementation Plan
- Cost Estimation
- Environmental and Social Considerations
- Project Effects

The result of the review of some of the above mentioned items concluded that the civil works and the items corresponding to the Electro-mechanic system have not been modified.

1.4 Content of this Report

This Final Report includes bellows.

- Demand forecast / Surveys
- Operation Plan
- Cost Estimation
- Implementation Plan
- Consideration on Project Effects
- Environmental and Social Considerations

CHAPTER 2
DEMAND FORECAST

CHAPTER 2 DEMAND FORECAST

2.1 Line-2 Current Patronage and Review of Past Studies for the East Extension Project

2.1.1 Introduction

A number of Feasibility Studies and reviews have been conducted for the LRT Line-2 Extension to the east from Santolan and to the west from Recto. The studies reviewed for this project are listed at the end of this Chapter. This Chapter focuses on the review and updated patronage forecast for LRT Line-2 East Extension (for two stations: Emerald and Masinag for an additional length of 4.18km) from Santolan to Masinag – the Project. Where necessary, references have been made to the other LRT Line-2 patronage demand forecast and data and have been acknowledged.

The reviews of previous demand estimates and preliminary patronage forecasts prepared for this study were reported in Progress Report Volume 1, Chapter 2 in July 2012. Since then, the results of the recently conducted traffic and passenger surveys for this project have been analysed along with the latest (up to July 2012) LRT Line-2 patronage data supplied by LRTA. As result the preliminary patronage demand estimates have been revised. This chapter presents the patronage demand forecast for the whole of Line-2 (including the extension), for 30 years from 2015 (assumed opening year) to 2045. These patronage estimates have then been used to calculate rolling stock and other infrastructure requirement, and also to estimate the project economic and financial viabilities.

2.1.2 Past Studies

Most recent of these studies is “Preparatory Study for LRT Line-2 Extension Project”, completed by JICA consultants in October 2011 (*Reference-2*). This study itself was an update of an earlier study “Line-2 West & East Extension Ridership Study” conducted by Oriental Consultants & TTPI, completed in November 2009 (*Reference-1*).

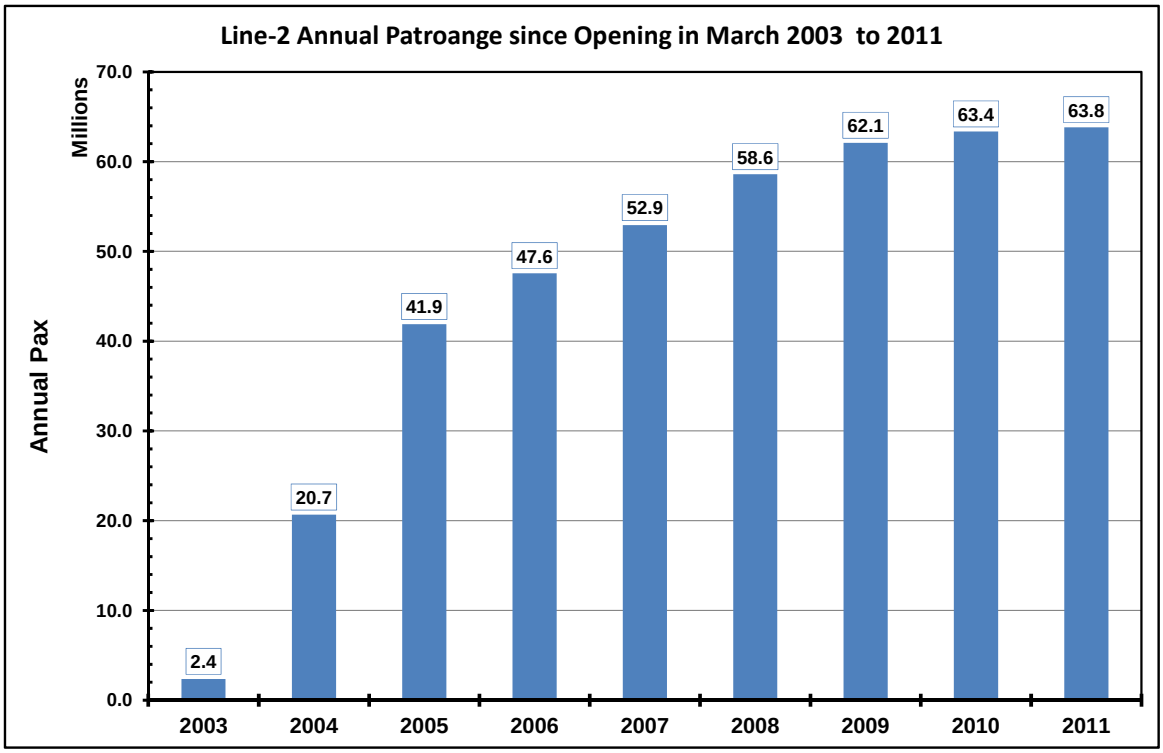
The analysis presented here has taken account of the detailed analysis given in the OC/TTPI report of November 2009, (*Reference-1*). The most recent demand forecast presented in the October 2011 study (*Reference-2)* has been also referred to where necessary.

2.1.3 Line-2 Current Patronage Characteristics

LRT Line-2 from Recto in the west to Santolan in the east (12.56km), with eleven stations opened for revenue service in April 2003. In 2004, the 1st full year of operation, the patronage on Line-2 was 20.6 million passengers (Pax). The growth in demand was instantaneous and the ridership more than doubled by 2005 to 41.9 million Pax, and increased by another 40% by 2008 to reach 58.9 million Pax. After that the demand growth rate steadied, at an average growth of about 3% from 2008 to 2011 has been recorded. By the end of 2011 the annual patronage had reached nearly 63.8 million Pax. Analysis of 1st seven month (January to July 2012) ridership data shows that it increased by 12.6% compared with the patronage for the same period of 2011. This considerable increase in ridership indicates that the patronage on the line has started to grow again, after the slow-down in the growth rate from 2008 to 2011.

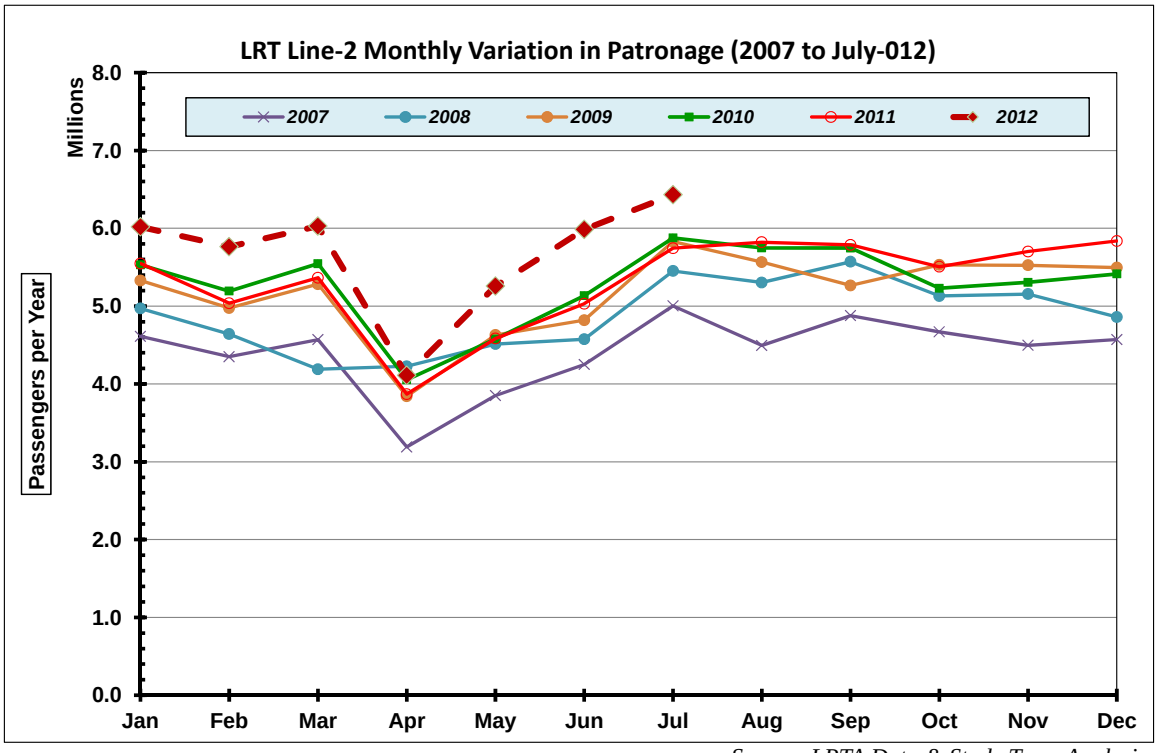
Line-2 annual patronage since opening is illustrated below in **Figure 2.1-1**. It can be seen that since 2008 the growth had steadied. However, the lower growth of the last three years has been more than compensated by higher than average growth in the 1st and 2nd quarters of 2012. **Figure 2.1-2** shows the monthly demand since 2008 to July 2012, and the high growth of 2012 is evident. Similar growth in demand is expected in the later months of the year, and if projected on the same basis the 2012 patronage is likely to be around seventy million Pax. Based on the March 2012 ridership data analysis it was found that the average weekday demand is 212,000 passengers. Even though the demand in later months June

and July grow at higher than average monthly rates, it was the March 2012 demand taken as the base case average weekday demand for 2012.



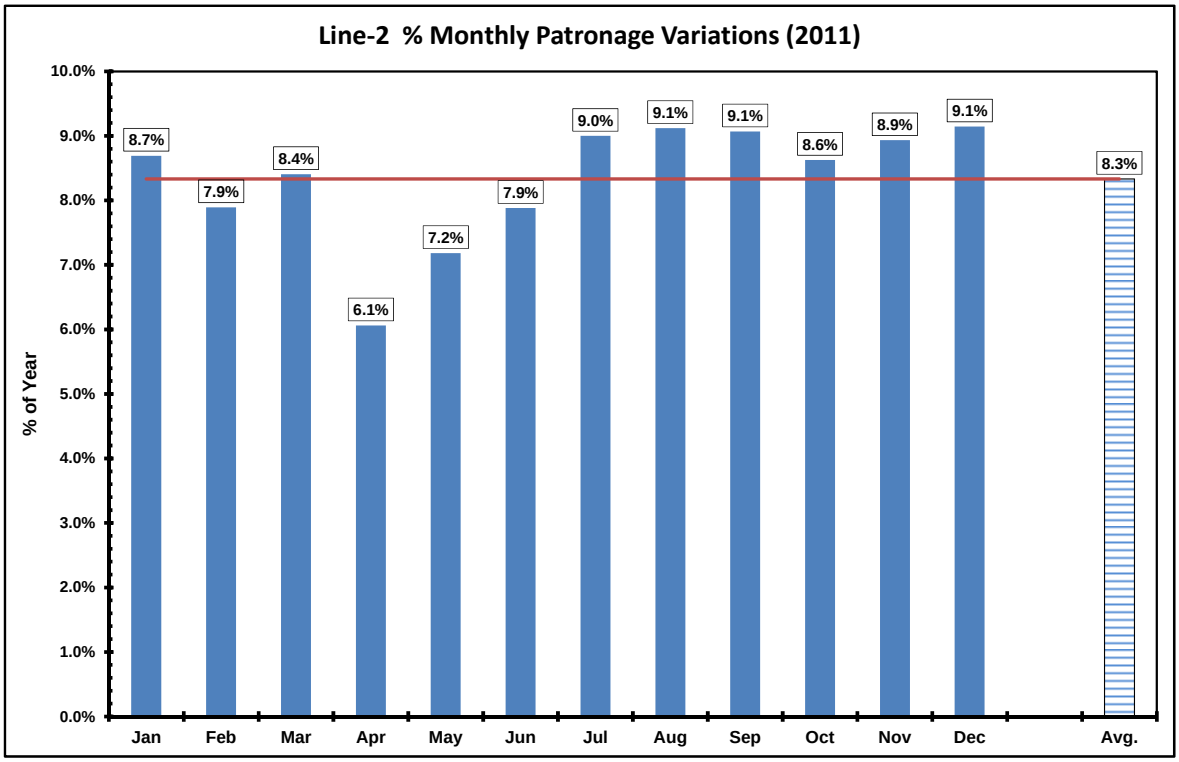
Source: LRTA Data & Study Team Analysis

Figure 2.1-1 Line-2 Ridership, 2003-2011



Source: LRTA Data & Study Team Analysis

Figure 2.1-2 Line-2 Monthly Ridership, 2007 to July 2012



Source: LRTA Data & Study Team Analysis

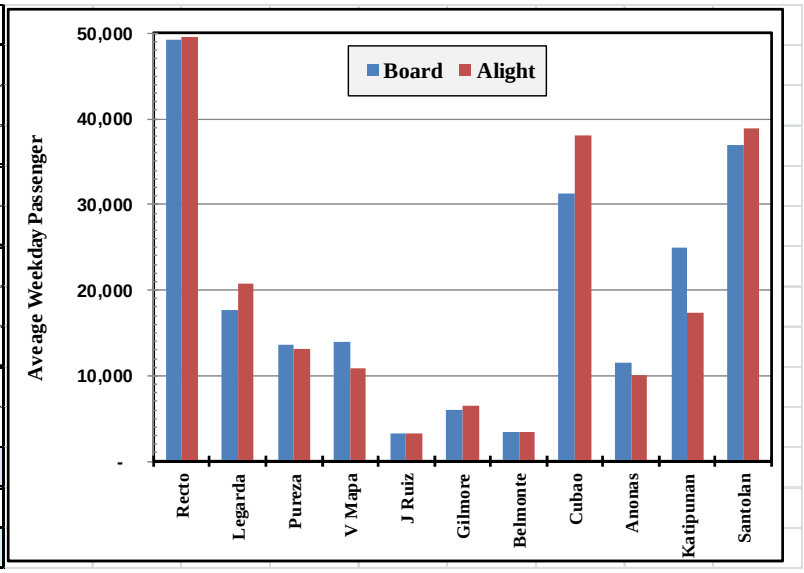
Figure 2.1-3 Line-2 Monthly Ridership 2011

It can be seen average monthly demand in 2011 was almost the same as the demand in March 2011. Analysis of daily boarding and alighting by station for the month of March was further analysed as the base case data. However, average weekday demand at Santolan station was quite skewed (more than 17%), therefore for Santolan station data for Tuesday, 26th June 2012 (the day of passenger interview surveys at Santolan for this Project) was used and the boarding and alighting at other stations was normalised to total average weekday demand of 212,000 Pax as the base case average weekday demand for 2012.

The total daily boarding and alighting estimated for an average weekday demand for 2012 is illustrated in Figure in **Figure 2.1-4**. It can be seen that busiest station is Recto, closely followed by Santolan the two terminal stations. Cubao station is the next busiest station, as it is a major hub for commercial activity and also for passengers to interchange with MRT Line-3. The daily boarding and alighting for some stations over the operational hours is quite different, in some cases like Cubao and Katipunan stations the difference is more than 10% of daily demand. This aspect was further analysed using available data from other months. It is a strange phenomenon and the directional variations changes by the day throughout the year and in some cases it is quite extreme, whereas on other days boarding and alighting for a station can be quite similar. This has to do with the choice of different modes/ routes to and from work, for example some passengers returning from work may stop of for other activities, or on the other hand some passenger may get a lift or use more comfortable mode in the morning and return by LRT. For simplicity, and for further analysis Line-2 data of Tuesday, 26th June 2012, for Santolan Station was used, as on that day boarding and alighting only differed about 5%.

It can be seen that other than the terminal and interchange stations, patronage on other station is small, particularly: J Ruiz, Gilmore and Belmonte where the daily boarding and alighting were less than 20,000 Pax per day. This goes to show that most passenger use the line from the eastern end of Metro Manila to the busy Manila centre of Legarda and Recto. This is also evident form the average trip length frequency distribution analysis of the patronage data which gives a daily average trip length of 7.9km for line of 12.6km long.

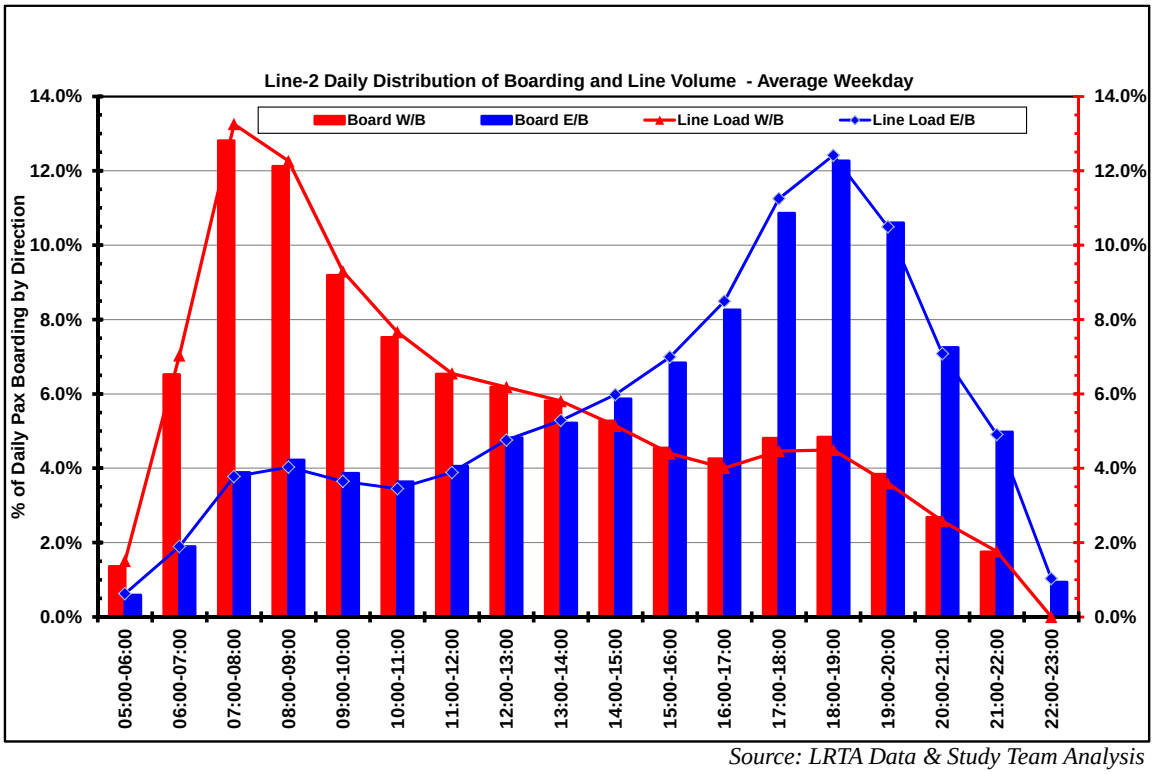
Station	Board	Alight
Recto	49,300	49,600
Legarda	17,600	20,800
Pureza	13,700	13,200
V Mapa	14,000	10,900
J Ruiz	3,200	3,200
Gilmore	6,000	6,500
Belmonte	3,500	3,400
Cubao	31,300	38,100
Anonas	11,500	10,100
Katipunan	25,000	17,400
Santolan	37,000	38,900
Total	212,200	212,200
Average Trip Length (km)		7.86



Source: LRTA Data & Study Team Analysis

Figure 2.1-4 Line-2 Daily (Average Weekday) Station Boarding & Alighting - 2012

Analysis of daily distribution of demand by direction of travel over the operational hours is illustrated in **Figure 2.1-5**. It can be seen that the AM-Peak loading on Line-2 is more pronounced than the PM-Peak. In the morning, the recorded peak is 13.3% of daily boarding in the west bound direction between 07:00 and 08:00. The evening peak ridership is lower than the morning, and it is estimated to be 12.4% of the daily demand. The evening peak occurs between 18:00 and 19:00. The patronage during the off-peak hours of 10:00-16:00 is less than 7% of the daily ridership.



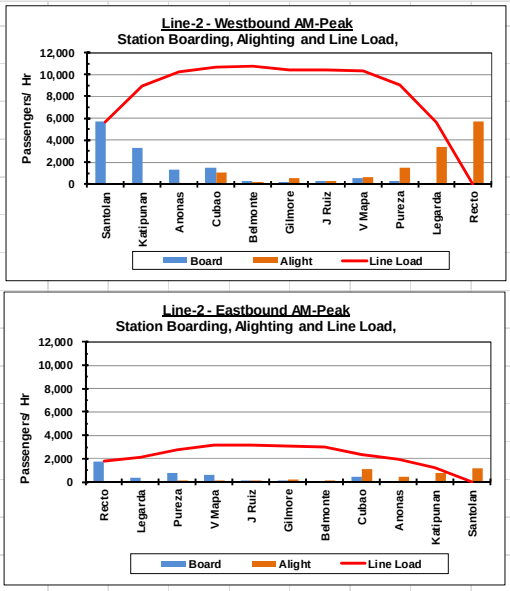
Source: LRTA Data & Study Team Analysis

Figure 2.1-5 Line-2 % of Average Weekday Ridership during Operational Hours-2012

As the AM-Peak hour (07:00-08:00) is the busiest ridership period on the line, it was adopted for all further peak demand analysis. **Figure 2.1-6** illustrates the station boarding, alighting, and line load as maximum Passengers Per Hour Per Direction (PPHPD) for both direction of travel in the morning 07:00 to 08:00. The peak hour (2-way) demand accounts for about 8.5% of the daily total (2-way) ridership. The current 2012 peak ridership (PPHPD) is estimated to be 10,800 Pax/hour/ direction between Belmonte and Gilmore stations in the west bound direction. It is also interesting to note that line load is almost similar, above 10,000 Pax from Anonas to Pureza station over half the length (7.2km) of the line, giving an average trip length of 8.5km in the peak (Westbound) direction, against an average trip length of 7km in the off-peak (Eastbound) direction.

Station	Westbound		
	Board	Alight	Line Load
Santolan	5,710	-	5,710
Katipunan	3,270	20	8,960
Anonas	1,310	40	10,230
Cubao	1,500	1,090	10,640
Belmonte	300	170	10,770
Gilmore	210	530	10,450
J Ruiz	240	320	10,370
V Mapa	540	620	10,290
Pureza	260	1,500	9,050
Legarda	20	3,400	5,670
Recto	-	5,670	-
Total	13,360	13,360	-
Maximum	5,710	5,670	10,770
Average Trip Length (km)			8.49

Station	Eastbound		
	Board	Alight	Line Load
Recto	1,780	-	1,780
Legarda	350	50	2,080
Pureza	750	90	2,740
V Mapa	580	150	3,170
J Ruiz	130	120	3,180
Gilmore	120	190	3,110
Belmonte	60	170	3,000
Cubao	420	1,100	2,320
Anonas	50	430	1,940
Katipunan	20	770	1,190
Santolan	-	1,210	-
Total	4,260	4,280	-
Maximum	1,780	1,210	3,180
Average Trip Length (km)			6.97



Source: LRTA Data & Study Team Analysis

Figure 2.1-6 Line-2 AM-Peak Hour Demand Characteristics – 2012

2.1.4 Line-2 Annualisation Factor

In order to estimate the annual patronage the LRTA 2011 daily Line-2 ridership data was analysed. The data shows a considerable difference in demand during the working days (Monday to Friday) and the weekends (Saturday and Sunday). The 2011 daily passenger boarding for Line-2 are summarised in **Table 2.1-1** below. As the demand is estimated for average weekday, a factor is required to convert the daily demand to annual demand and hence to estimate the annual revenue. Form Line-2 data analysis the annual factor is calculated to be 331.18 or say 330.

It may also be argued that as population gets more prosperous there would be more leisure trips, likely to be in the evenings or over the weekends. This may have impact on the annual factor. However, for simplicity and not to overestimate annual demand a factor of 330 was used for both Lines-2 annual demand estimates for all forecast years. In comparison, both previous studies of Line-2 had used an annual factor 320, therefore had underestimated (by about 3%) the annual revenue to be accrued.

Table 2.1-1 Calculation of Line-2 Annual Demand Factor (2011)

Day	No of Days	Total Boarding	Average Boarding
Monday	52	9,856,204	189,540
Tuesday	52	9,752,775	187,554
Wednesday	52	9,907,729	190,533
Thursday	52	10,134,080	194,887
Friday	52	10,460,834	201,171
Saturday	53	8,488,256	160,157
Sunday	52	5,231,386	100,604
Total (2011)	**365**	**63,831,264**	174,880
Week-days (Monday-Friday)	**260**	50,111,622	**192,737**
Annual Factor = Total Annual Boarding/ Average Weekday Boarding = 63,831,264/192,737 = **331.18 ~=330.**			

Source: LRTA Data, Estimate by JICA Study Team

2.1.5 Review and Comparison of Demand Forecasts of Past Studies

Table 2.1-2 below summarises the average weekday patronage demand forecasts prepared by the above referenced studies and comments explain the underlying reasons as to the reliability of these forecasts. For comparison purposes JICA study team forecast for this project is also presented for the same forecast years. The Table also compares the other attributes of the demand forecast, which influence the viability of the project. It can be seen that the previous forecast average daily trip length has been under estimated by about 11% (6.98kv vs. 7.86km) for without extension (current 2012) case; and about 18% to 22% for the future years (constant 8.2km for all years vs. 10.22~10.56km for 2015~2045). This would have serious impact on the revenue estimates prepared by the previous studies, particularly as the fares are distance based. In addition previous studies used an annualisation factor of 320 vs. 330; therefore has underestimated the revenue by more than 20% per annum.

In the previous studies the key characteristics of the line demand i.e. PPHPD was estimated independent of the peak hour demand, using a constant factor of 3.5% of daily demand. This had led to serious under-estimation of PPHPD for Line-2 with extension to Masinag, and had led to underestimation of the future rolling stock requirements. This study has estimated the peak demand (PPHPD) for each of the forecast years, according to the changes in demand along the line.

Table 2.1-2 Average Daily Patronage (Pax, 000) Forecast by Previous Studies

Source	Study Description & (Comments)	2012	2015	2020	2025	2030	2035
LRTA	LRTA 2012 Actual Ridership to July 2012, and extrapolated to 2012 average weekday demand)	212.2	–	–	–	–	–
Ref-1.	JICA Forecasts of November 2009, – based on fare of PHP 9.8+0.98/km – ***Without Extension***	–	254.1	280.5	325.2	377.0	437.1
	JICA Forecasts of November 2009, – based on fare of PHP 9.8+0.98/km – ***With East Extension to Masinag***	–	383.1	422.9	490.3	568.4	658.9
	Increase Due to East Extension	–	129.0	142.4	165.1	191.4	221.8
	PPHPD (3.5% of Total Demand)	–	13,400	14,800	17,160	19,890	23,060
Ref-2.	JICA Forecasts of October 2011, – based on fare of PHP 11+1.0/km – ***Without Extension***	–	218.6	241.3	279.8	324.3	376.0
	JICA Forecasts of October 2011, – based on fare of PHP 11+1.0/km – ***With East Extension to Masinag***	–	335.6	370.5	429.6	498.0	577.3
	Increase Due to East Extension	–	117.0	129.2	149.8	173.7	201.3
	PPHPD	–	*Not Reported*				
Ref 1&2.	*Average Trip length(km)*	6.98	8.20 (constant)				
	Annualisation Factor	320	320				
JICA August 2012	JICA – Line-2 ***Without Extension*** (2012 based on current fares & Forecasts based on fare of PhP11+1.0/km)	212.2	231.8	262.3	289.6	315.8	340.2
	JICA – Line-2 ***With East Extension to Masinag*** (Based on fare of PHP 11+1.0/km)	–	306.0	350.7	392.3	432.3	469.0
	Increase in Demand Due to Extension	–	74.2	88.4	102.7	116.4	128.7
	Average Trip length(km)	7.86	10.22	10.31	10.41	10.49	10.53
	PPHPD	10,800	17,700	20,600	23,300	26,000	28,400
	Annualisation Factor	330	330				

Note: Ref-1 & 2, Refer to the reference list given at the end of this Chapter, in Section 2.5.
Source JICA Study Team

Table 2.1-2 above also includes the JICA Study Team demand forecast prepared for this project for ease of reference. Both of the previous forecasts of November 2009 (*Reference-1*) and October 2011 (*Reference 2*) opening year (2015) patronage is estimated using a demand model (no details are provided). Whereas following year forecast for 2015 to 2020 is a simple growth factor of 2% p.a. both for the existing line and with east extension. It is highly unlikely that patronage growth will be the same for the existing line and with extension of two stations to the east covering an additional 4.6km of catchment area.

Similarly, growth for later years 2020 to 2035 and beyond to 2045 is assumed to be 3% per annum, at a higher rate than from 2015 to 2020, again for both existing section of Line-2 and the east extension. This is a clear contradiction in itself that growth would be lower in earlier years, 2015-2020 and higher in later years from 2020 to 2045. Also no account is taken of capacity restraint or other exogenous factors like future capacity limit of the line or earlier year development which would follow the extension of the line into Masinag area. Therefore it is important to prepare more plausible demand forecast for the existing line and the impact of extension based on demand forecasting techniques rather than an assumed single growth factor for all years.

2.2 Demand Forecast Methodology

2.2.1 Introduction

The patronage demand forecast methodology is same for both Line-1 and Line-2, and has been discussed in detail in Volume-1 Chapter-2. For this project most recent Line-2 data (up to July 2012) has been provided by LRTA. The analysis of LRTA Line-2 data has been presented and discussed above to get the base case demand for LRT Line-2, and to ensure that the demand forecast is based on most recent data for the opening year of 2015.

Considerable work has already been done in the past on travel demand estimates through demand modelling. For this study, it is felt that a full-scale modelling approach is not realistic. A simplified approach of validation of previous forecasts (for the year's to-date) against current LRTA Line-2 patronage data, and projection of future ridership estimates for this project would take account of the previous study's modelled results for the opening year. This latest demand forecasts are based on the analysis of most recent data, analysis of past trends, previous study estimates, study team own estimate derived from recent LRTA data and recent (June 2012) LRT passenger interview surveys and Marcos Highway traffic & vehicle occupancy survey data.

2.2.2 LRT Lines-2 Demand Forecast Methodology – An Outline

The demand forecast for Line-2 assessment has four main components:

1. Converted Demand (A): Passengers who currently travel to Santolan station either by walk or other modes and transfer to Line-2; however after extension these passengers would transfer not at Santolan but either at Emerald or Masinag stations. This would cause reduction in demand at Santolan station, but does not cause increase patronage but results in increase in Pax-km travelled on LRT.
2. Converted Demand (B): Passengers who currently travel to Metro Manila by other modes (especially to areas closer LRT/MRT stations), would switch to using Line-2 at Emerald or Masinag stations, because they have comparatively better time savings from Emerald or Masinag than before.
3. Diverted Demand: Passenger who will divert to Masinag from Other highways and then use LRT. (considered to be minimal).
4. Generated (Local) Demand: Passenger with origin and destination between Santolan, Emerald and Masinag stations. It is expected that there would also be additional demand (though limited) from Emerald and Masinag to other stations, which were not made before the extension.

The methodology adopted to cover all four types demand is mostly based on traffic and passenger interview surveys conducted for this study and most recent patronage data. The key components of the methodology adopted is outlined below, the survey data used in the analysis is described in the following sections and the details results are given in the Traffic Survey Report submitted under separate cover. The outline demand forecast methodology is:

- A thorough analysis of most recent Line-2 data to establish base case demand and latest trends;
- Estimate base case (2012) daily and peak demand;
- Estimate peak, and annualisation factors;
- Estimate daily and peak patronage demand for the existing Line-2 (without extension), for the opening year of 2015 based on past trends;
- Estimate the daily reduction in demand at Santolan, and converted, diverted and additional daily demand (components 1-4 described above) due to east extension of line for the two stations: Emerald and Masinag;

- Estimate travel demand distribution pattern for demand from Emerald and Masinag, based on previously modelled demand of November 2009 study (*Reference-1*);
- Estimate total daily travel demand and pattern (station-to-station matrix) for Line-2 with extension for the opening year (2015);
- Estimate demand for the next 30 years to 2045, in steps of 5 years for the additional station and the existing line;
- Estimate total Daily travel demand, station boarding and alighting;
- Estimate average trip length for the daily demand;
- Estimate AM-Peak hour demand with extension, and estimate PPHPD for the AM-peak hour;
- Estimate annual ridership and fare-box revenue.

2.2.3 Traffic and LRT Line-2 User Interview Surveys – Overview

Traffic volume, vehicle occupancy, highway and LRT passenger interview surveys were conducted as outlined below:

- Traffic volume counts 100% sample of all vehicles, by 11 types of vehicle for 16 hours (06:00-22:00) at three locations along Marcos Highway between Sumulong Highway and west of Santolan LRT station;
- A Sample (5~10%) survey of passenger vehicle (9 types, excluding goods vehicles) occupancy for the same time period as traffic counts at three locations along Marcos Highway.
- Private and public passenger vehicle interview surveys of a sample of occupants at one location on Marcos Highway (west of Sumulong Highway
- LRT boarding and alighting passenger interview surveys at Santolan Station – a sample of 400 (200 boarding and 200 alighting) passengers.

2.2.4 Traffic Count, Vehicle Occupancy and Passenger Interview Surveys

These surveys were conducted at four locations as described below. The reason for the choice of these sites was to fully ascertain the characteristics of the current LRT demand at Santolan and non-LRT demand along Marcos Highway.

1. Traffic count, vehicle occupancy and private vehicle driver & public transport passenger interview surveys at Marcos Highway – west of Sumulong Highway Station -01 (STN.01);
2. Traffic count and vehicle occupancy surveys at Marcos Highway – west of Emerald Drive, Station -02 (STN.02);
3. Traffic count and vehicle occupancy surveys at Marcos Highway – west of Santolan LRT Station, Station -03 (STN.03).
4. LRT passenger interview surveys at Santolan Station.

The results of Marcos Highway traffic count and occupancy survey results are illustrated in Appendix C, Figures C.1 to C.3 respectively for stations 1-3, and observed person trips are summarised below in **Table 2.2-1**.

Table 2.2-1 Traffic Volume (Person & Vehicle Trips) at 3 Survey Stations (01-03)

Person Trips by Mode	STN. 03 (Santolan) 2-Way		STN. 02 (Emerald) 2-Way		STN. 01 (Masinag) 2-Way	
Private (Incl. 2/3 Wheel)	90,600	27%	120,900	33%	125,900	38%
Taxi & FX	27,400	8%	41,100	11%	22,500	7%
Jeepney	133,200	40%	203,100	55%	185,900	55%
Bus	2,100	1%	900	0%	600	0%
Sub-tot Public	162,700	49%	245,100	67%	209,000	62%
LRT (26-Jun-12)	**78,200**	**23%**	-	0%	-	0%
Public + LRT	240,900	72%	245,100	67%	209,000	62%
Total (Priv+Pub)	**331,500**	**100%**	**366,000**	**100%**	**334,900**	**100%**

Vehicle Trips by Mode	STN. 03 (Santolan) 2-Way		STN. 02 (Emerald) 2-Way		STN. 01 (Masinag) 2-Way	
Private (Incl. 2/3 Wheel)	58,250	71%	59,960	73%	61,670	77%
Taxi & FX	12,670	16%	10,900	13%	5,820	7%
Jeepney	10,500	13%	10,770	13%	12,290	15%
Bus	110	0%	100	0%	110	0%
Sub-tot Public	**23,280**	**29%**	**21,770**	**27%**	**18,220**	**23%**
Total (Priv+Pub)	**81,530**	**100%**	**81,730**	**100%**	**79,890**	**100%**

Survey by TTPI & JICA Study Team Analysis

The survey showed the contribution of the LRT to the travel along the Marcos Highway, there is considerable reduction in the number of Jeepney and Jeepney passengers which mostly transfer to the LRT. At Santolan the LRT accounts for 23% of all person trips and almost 1/3 of the public transport trips. This also results in reduction of about 15% drop in Jeepney flows, and 8% drop in private vehicles between Santolan and Masinag. Analysis of passengers using the LRT Station at Santolan by mode of arrival and departure is summarised below for the expanded data in **Table 2.2-2**. (The sample survey passenger interview data has been expanded to the daily LRT boarding and alighting at Santolan Station on Tuesday 26-June-2012 – the survey day).

Table 2.2-2 Passenger Mode of Arrival & Departure at Santolan Station

Pax Mode of Arrival/ Departure	Boarding Pax	Alighting Pax	Total (B+A)	% by Mode
Private (Incl. 2/3 Wheel)	5,591	7,506	13,097	17%
Taxi & FX	5,167	4,152	9,319	12%
Jeepney	23,282	24,154	47,436	63%
Walk	**2,960**	**3,114**	**6,074**	**8%**
Total (LRT Pax on 26-Jun-12)	**37,000**	**38,926**	**75,926**	**100.0%**

Survey by TTPI & JICA Study Team Analysis

The survey also recorded the LRT passenger trip origin and destination zone (areas) at the Santolan end. Table below summarises the trip O/D by mode of arrival. This clearly demonstrates the local demand of Santolan, Emerald, Masinag and Other Areas. The results are summarised in **Table 2.3-3**. This immediately yielded the Santolan station local demand, demand from Emerald and Masinag, and other areas of passengers using the Santolan Station. It can be seen that by far the largest (more than 73%) demand is from other areas and 37% of the O/D to/from Pasig, Antipolo and Cainta areas - mostly east of Masinag.

Table 2.2-3 Passenger Mode of Arrival & Departure at Santolan by Area or O/D

Pax Mode of Arrival/ Departure	Santolan	Emerald	Masinag	Other	Total
Private (Incl. 2/3 Wheel)	770	1,545	1,570	9,212	13,097
Taxi & FX	570	715	1,170	6,864	9,319
Jeepney	1,226	3535	3,110	39,565	47,436
Walk	4,554	1520	-	-	6,074
Total (LRT Pax on 26-Jun-12)	**7,120**	**7,315**	**5,850**	**55,641**	**75,926**

Survey by TTPI & JICA Study Team Analysis

This is further confirmed form the analysis of LRT passenger home location and trip generation and attraction locations as summarised in **Table 2.2-4.** Some 43% of all passengers have home in Masinag and surrounding areas of Antipolo and alike. Whereas another 32% of the current users travel from remainder of the Rizal province and 4% have homes in Marikina valley areas.

Only 8% of the passengers have homes in Metro Manila and even half of them lived with the catchment area of the LRT Line-2 stations other than Santolan. This clearly establishes that the almost 92% of the Line-2 demand is resident in the eastern part of Santolan station. In order to understand the overall transport demand of the eastern areas interview surveys were conducted on Marcos Highway at Masinag (STN.01). Analysis of these roadside interview surveys conducted at Masinag are summarised by home zone and by mode of travel in **Table 2.2-5.**

Table 2.2-4 LRT Passenger by Home Location at Line-2 Santolan Station

Area of Home Zone	Generation Zone	Attraction Zone	Home Zone	% of Home Zone
Santolan	7,120	-	4,969	7%
Emerald	7,315	-	4,877	6%
Masinag	5,850	-	5,416	7%
Pasig, Antipolo & Cainta	27,970	-	27,225	36%
Marikina & San Mateo	3,260	-	3,101	4%
Other MM Station Zones	-	49,212	3,392	4%
Rest of MM	-	26,537	2,790	4%
Rest of Rizal	24,340	-	24,051	32%
Other Areas	71	177	105	0%
Total Person Trips	75,926	75,926	75,926	100%

Survey by TTPI & JICA Study Team Analysis

Table 2.2-5 Person Trips by Home Location at Marcos Highway (STN.01)

Area of Home Zone	Private	Taxi + FX	Jeepney	Total
Santolan	1,846	19	4,289	6,155
Emerald	1,382	363	1,799	3,545
Masinag	2,191	342	1,676	4,209
Pasig, Antipolo & Cainta	54,432	15,379	152,798	222,609
Marikina & San Mateo	14,285	2,013	11,742	28,039
Other MM Station Zones	4,279	677	3,084	8,039
Rest of MM	9,739	1,907	6,996	18,642
Rest of Rizal	4,043	1,152	3,178	8,373
Other Areas	2,346	670	317	3,332
Total Person Trips	94,542	22,523	185,878	302,943

Survey by TTPI & JICA Study Team Analysis

From the analysis above the patronage of LRT Santolan station could be estimated as 7,120 Pax. If the LRT is to exit today then the demand at Emerald station would be 7,315 Pax, plus additional local demand. Similarly the demand at Masinag would be the current demand of 5,580 Pax, plus Masinag local demand (walk in/out etc), and those travelling to Santolan through Masinag i.e. =(75,926 – 7,120 – 7,315 – 5,580)= 55,641 Pax. The above estimation of demand covers Item-1 of demand as described above under section 2.2.2 'Demand Forecast Methodology'.

The estimation of additional local demand (Item-2) for Emerald and Masinag was estimated on the same basis as the demand by mode of access & egress at Santolan station. Similarly, the diverted demand, converted & generated demand (Item-3 & Item-4) were estimated on the basis of mode-split at Masinag on Marcos Highway. The final total demand estimation for the three stations is summarised below in **Table 2.2-6**. This results in total demand of 9,590 Pax at Emerald and 127,120 Pax at Masinag. The increase in demand at Masinag is about 67% of the current Santolan patronage. The total increase in demand is estimated to be 67,904 Pax daily. This is an increase of about 32% in the current LRT Line-2 demand. This is considered reasonable, as compared to previous forecasts of all well above 100,000 Pax increase per day.

The total demand at Masinag by mode of arrival is compared below in **Table 2.2-7** and the mode share (after transfer to LRT at Masinag) is comparable to the mode share at Santolan. Yes, there is an increase in LRT mode share, because additional demand which will transfer at Masinag because of additional time saving for passenger from the east to be able to change at Masinag rather than at Santolan.

Table 2.2-6 LRT Passenger by Home Location at Line-2 Santolan Station

Station Demand by Type	Local Demand	Additional Local / Generated Demand*	Diverted & Generated Demand	Total Station Demand
Santolan	**7,120**	-	-	**7,120**
Emerald Diverted from Santolan	7,315	2,275	-	**9,590**
Masinag - Local Demand @ Santolan	5,850	-	-	5,850
Masinag - Additional Local Area Demand (walk in/out; pick & drop)		7,188		+7,188
Masinag - Diverted from Santolan	55,641	-		+55,641
Masinag - Additional Demand Diverted from Other Modes and Other Roads		-	58,441	+58,441 =**127,120**
Masinag Total Demand Incl. Walk-in/out				**127,120**
Total Person Trips	**75,926**	9,463	58,441	**143,830**

Note: Additional Local / Generated Demand Include Walk-in/out trip. *JICA Study Team Analysis*

Table 2.2-7 compares the current (2012) forecast demand by mode of arrival & departure and resultant modal split of traffic both at Santolan and Masinag assuming that LRT is extended to Masinag station. Masinag walk-i/out demand of 5,520 Pax is excluded from comparison. It should be noted that this is the demand as if the Emerald and Masinag stations exist today. Masinag demand shown in the Table excludes the walk-in and walk-out patronage, as these trips were not part of the Station-03 road surveys. The public and LRT demand at Masinag is estimated to be 66% still being conservative compared to the 72% demand at Santolan, However, LRT share is estimated to increase from 23% to 36% at Masinag due to additional diverted and converted traffic. Most of the diverted demand would be from Jeepney to the LRT as the Jeepney share of Pax at Masinag would drop from 55% to 27%, compared to 40% share at Santolan. The demand forecast for future years is estimated by growth factor techniques using the 2012 demand as the base case demand for the existing and extension stations. The net increase in demand for 2012 is therefore estimated to be (143,830-75,926=) **67,900** Pax daily in 2012.

Table 2.2-7 Person Trips at Santolan and Masinag With & Without Extension

Person Trips by Mode	Santolan STN. 03 (2-Way)		Masinag (STN.01) 2-way Person Trips Before Extension		After Extension	
Private (Incl. 2/3 Wheel)	90,600	27%	125,900	38%	112,800	34%
Taxi & FX	27,400	8%	22,500	7%	9,900	3%
Jeepney	133,200	40%	185,900	55%	90,000	27%
Bus	2,100	1%	600	<1%	600	<1%
Sub-tot Public	162,700	49%	209,000	62%	100,500	30%
LRT	**78,200**	**23%**	**-**	0%	***121,600**	**36%**
Public + LRT	**240,900**	**72%**	**-**	**62%**	**222,100**	**66%**
Total (Priv+Pub)	**331,500**	**100%**	**334,900**	**100%**	**334,900**	**100%**

*Note: * Excludes Walk Trips to/from LRT.* *JICA Study Team Analysis*

2.2.5 Patronage Forecast Process

Using the above estimate of demand for extension station and the current LRT reported patronage for the exiting stations (except Santolan) as the base case 2012 demand the future demand has been based on growth factors derived from past trends, and changes on socio-economic framework (population growth of about 3% p.a. for eastern districts and GDP growth of 3~5% p.a. for the next 5~10years). The growth factored used also varied by year according to population growth and trends in LRT Line-2 demand for exiting station for about 3% from 2012 to 2015, and declining thereafter as the impact of population and economic changes would be limited, and only impact would due to worsening of road congestion, which would force more Jeepney Passengers to LRT. The growth in demand for Santolan and the two extension station was assumed to be at a higher rate than other station due to additional growth in and around the station areas, and higher rate of population growth in the eastern areas than the rest of Metro Manila.

The total future estimated each station patronage was growth factored to get the 2015 to 2045 demand using the '*Furness*' distribution process to give the daily station-to-station demand matrix for the whole line with extension to Masinag. Peak demand was then estimated using peak factors derived from the LRTA Line-2 patronage data of hourly boarding and alighting by station and by direction of travel. The estimated patronage demand for each station (boarding and alighting) and by direction of travel is detailed in Volume 2, **Appendix C Tables C-4** to **C-17**. This also provides the PPHPD volume for each section of the line – peak values would be used to determine the future operational headways and related rolling stock requirements.

This process would also yield Pax-km travelled on the line. The previous work on the estimation of fare revenue is based on distance based fares. Hence this approach would provide a direct estimate of fare-box revenue from the patronage, and Pax-km travelled.

The annual revenue estimate would be calculated using the average weekday demand and annualisation factor 330, as reported above in Section 2.1.4. Both previous studies have used the same annualisation factor of 320 for Line-2. However, the use of annualisation factor of 330 would enhance the revenue to be accrued by about +3.1%.

2.2.6 The Limitations and Advantages of this Simplified Approach

It is clearly understood by the JICA study team that the approach has limitations, such as that full scale demand modelling is not used for forecast purposes. However, as explained above, a considerable work has been done, documented and reported using such models. Therefore, in this study, full and extensive

use has been made of the past work, and it is felt that repeating the same exercise would not necessarily provide better/ more reliable patronage forecast.

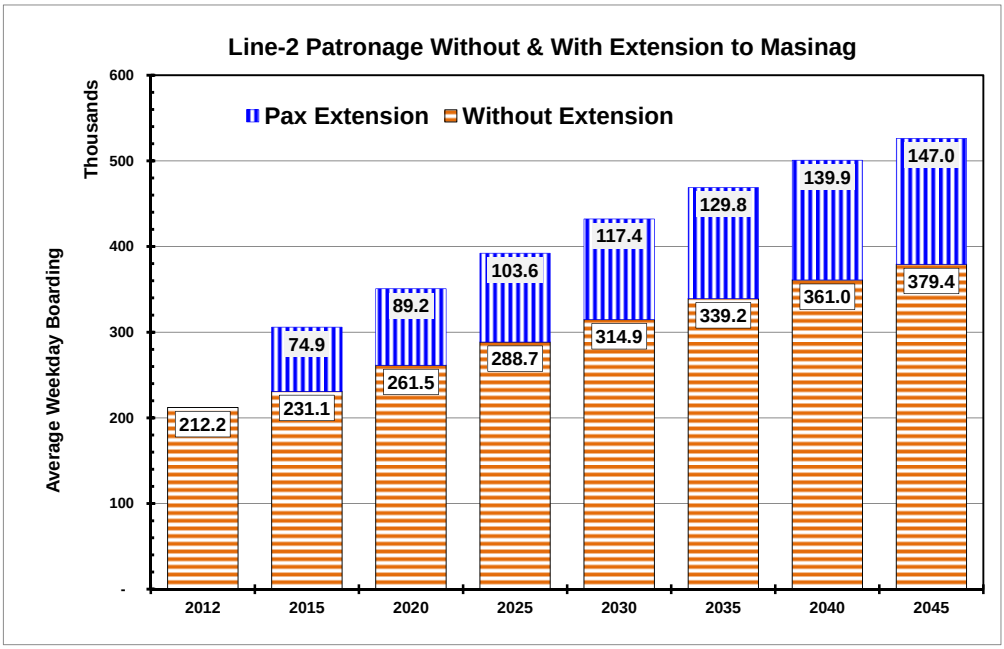
Furthermore, full scale demand modelling is very data hungry; particularly database like that collected by the MMUTIS study during late 1990's would be required. As a result demand forecast has relied on the previously modelled demand and updated with the latest survey results.

2.3 Demand Forecasts

2.3.1 Total Daily (Average Weekday) Passenger Demand

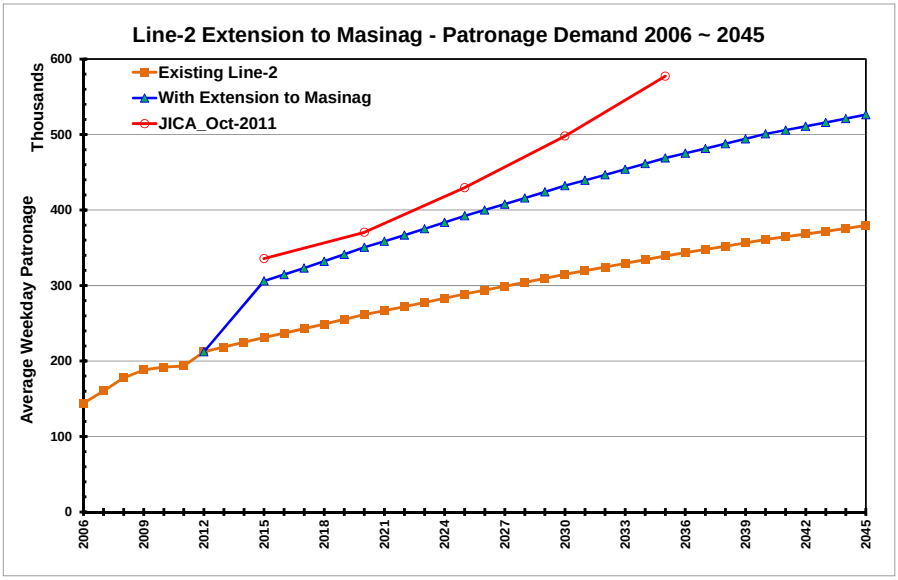
The average weekday demand forecast prepared by the study team is presented below in **Figure 2.3-1** and summarised in **Table 2.3-1**. It can be seen that even the most recent forecast has over-estimated the demand, by using a constant rate of growth for long term forecast to 2045. It is also felt that the increase in demand due to extension had been overestimated for the opening year, as explained above. This may have been caused by the fact that much of the existing boarding of Santolan would shift to Masinag (55,640+5,850= **61,490,** see **Table 2.2-6** above) about 81% of Santolan demand), and would be about 74,900 Pax by 2015, opening year of the extension.

Line-2 demand forecast without extension has been estimated to grow at about 3.5% per annum for the 2012-21013 and declining after that about 0.5% per year after every 5 years. The JICA Study Team demand forecast for the extension are estimated for each station taking account of potential catchment area of each station and the likely passenger who would change to LRT at Masinag rather than Santolan. In addition travel between Santolan-Emerald-Masinag was also estimated on the basis that the local demand would be limited, but similar to the Santolan area, as general land use in the eastern side of Metro Manila is similar – i.e. dormitory residential areas for population working in Metro Manila. Total additional demand likely to accrue due to extension to Masinag was estimated to be about 74,900 passengers per day by 2015, and then increasing a slightly higher rate than the remaining existing demand. The patronage forecast for Line-2 with and without extension demand is compared with previous forecast in **Figure 2.3-2.**



Source: JICA Study Team

Figure 2.3-1 Average Weekday Patronage (Pax, 000) Forecast



Source: JICA Study Team

Figure 2.3-2 Average Weekday Patronage and Previous Forecast

Table 2.3-1 Average Weekday Patronage (Pax) Forecast by JICA

Description	Unit	2012	2015	2020	2025	2030	2035	2040	2045
Average Week Day Boarding (Without Extension)	Pax	212,200	231,100	261,500	288,700	314,900	339,200	361,000	379,400
Increase in Daily Patronage (Av. Week Day Pax)	Pax	-	**74,900**	**89,200**	**103,600**	**117,400**	**129,800**	**139,900**	**147,000**
Total Patronage with Extension (Av. Week Day Pax)	**Pax**	**212,200**	**306,000**	**350,700**	**392,300**	**432,300**	**469,000**	**500,800**	**526,400**
AM Peak Hour (0700-0800) Boarding Eastbound	Pax/Hr	13,360	20,580	23,710	26,670	29,510	32,090	34,320	36,070
AM Peak Hour (0700-0800) Boarding Westbound	Pax/Hr	4,260	6,090	6,900	7,760	8,510	9,190	9,810	10,320
Total AM Peak Hour (0700-0800) Boarding Both Direction	Pax/Hr	17,620	26,670	30,610	34,430	38,020	41,280	44,130	46,390
AM-Peak Hour Boarings as % of Daily Boardings	Ratio(%)	8.30%	8.72%	8.73%	8.78%	8.79%	8.80%	8.81%	8.81%
Pax/Hr/Per Direction (Max AM-PK Hr 0700~0800)	**PPHPD**	**10,770**	**17,700**	**20,570**	**23,340**	**25,990**	**28,380**	**30,390**	**31,950**
AM_Peak Hour Average Trip Length Westbound	km	8.49	11.52	11.61	11.71	11.78	11.83	11.84	11.84
AM_Peak Hour Average Trip Length Westbound	km	6.97	8.77	8.84	8.93	9.00	9.06	9.09	9.10
Average Week Day Trip Length	**km**	**7.86**	**10.22**	**10.31**	**10.41**	**10.49**	**10.53**	**10.56**	**10.56**
Annual Factor	**Days**	330	330	330	330	330	330	330	330
Annual Passenger	**Pax Million**	70.03	100.98	115.73	129.46	142.66	154.77	165.26	173.71
Annual Passenger*km	**Million*km**	550.40	1,032.02	1,193.19	1,347.67	1,496.49	1,629.73	1,745.19	1,834.40

Source: JICA Study Team

2.4 Summary and Conclusions

The travel demand presented here is based on thorough analysis of LRTA data since the opening of Line-2, trends in growth and current patronage characteristics of Line-2, as determined through direct passenger interview surveys. The demand forecast growth is mostly based on latest LRTA data, recent traffic data, anticipated socio-economic growth, with adjustments/modifications, where possible, through sound judgment and based on the considerable experience of the study team of such projects. The base case forecasts for the two extension stations: Emerald & Masinag, and the impact of extension on exiting station patronage, mainly Santolan are based on the recently conducted traffic and travel demand surveys at Santolan station and along Marcos Highway, on which all stations would be located.

Extending Line-2 to Masinag, just for two stations may not appear to be attractive on simple marginal cost/benefit approach for extending the line, as the patronage from east are already using the LRT by changing at Santolan. However, if a state-of-the-art multi-modal terminal could be built at Masinag, it is estimated that about 58,400 additional passengers would switch to LRT mainly from Jeepneys at Masinag, rather than to continue on the current mode they are using. The reasons that only a limited passenger choose to transfer at Santolan because transfer facilities are rudimentary (pickup & drop-off on road-side),

there is no land to improve these facilities (a direct link to concourse etc.). Extension to Masinag would increase the catchment area of Line-2 further, and additional time saving for passengers from Antipolo to Cubao would be attractive enough to switch to LRT at Masinag, whereas ta present they continue the journey on the same mode they have chosen at the start of the trip in Antipolo.

It is estimated that the patronage would continue to grow as the areas between Santolan and Masinag along Marcos Highway Line-2 extension alignment would develop further over time, with increase in housing and commercial activity beyond the opening of the extension by 2015. The development potential farther east in the Rizal province land is considerable, due to availability of land. The patronage would also benefit considerably by the provision of feeder routes from Antipolo to Masinag with easy/convenient/attractive transfer facilities at Masinag. In addition the introduction of integrated public transport e-ticketing system would further add to the Line-2 patronage for passengers transferring at Masinag.

2.5 References

1. Line-2 West & East Extension Ridership Study Final Report, by Oriental Consultants Co. Ltd; and Transport and Traffic Planning, Inc. Final Report – 27th November 2009.
2. JICA, Preparatory Study for LRT Line-2 Extension Project, by Oriental Consultants Co. Ltd; and Others, Final Report – October 2011.

CHAPTER 3
TRAIN OPERATION PLAN

CHAPTER 3 TRAIN OPERATION PLAN

3.1 Line Route

The line alignment corresponds to the Case 1 of the previous JICA Study of 2011.

Figure 3.1-1 indicates the Route of Line 2.

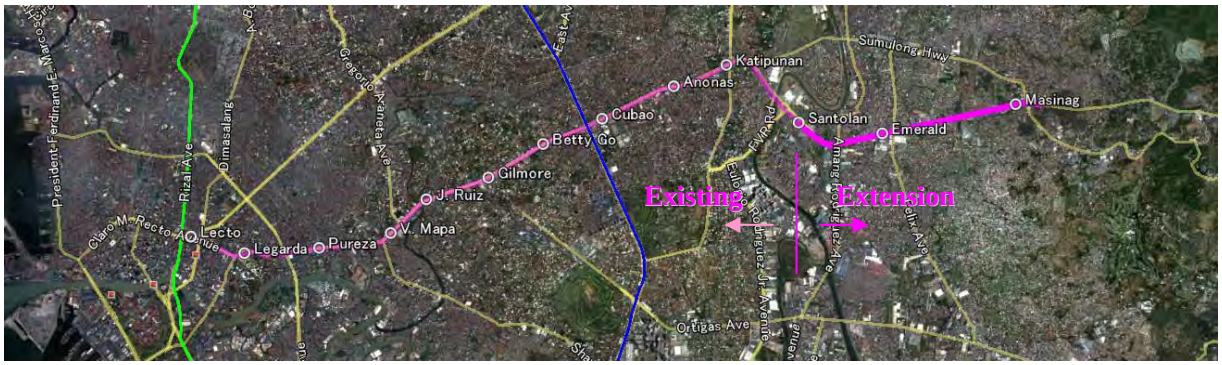


Figure 3.1-1 Route of Line 2

3.2 Train Operation Plan

3.2.1 Demand Forecast

Demand forecast is indicated as follows.

Table 3.2-1 Demand Forecast

	2012	2015	2020	2025	2030	2035	2040	2045
Daily passengers	212,200	331,200	378,700	422,800	465,100	504,000	537,900	565,400
PPHPD	11,500	18,100	20,900	23,800	26,500	28,900	31,000	32,600

3.2.2 Train Capacity

Train capacity is as follows depend on loading condition.

Table 3.2-2 Passenger Capacity

Type	Definition	Passenger capacity per train		
		Seated	Standee	Total
AW0	Empty	0	0	0
AW1	Seated	232	0	
AW2	Seated + 4 p/m2(standee)	232	794	1026
AW3	Seated + 7 p/m2(standee)	232	1396	1628

AW3 is applied for peek hour transportation capacity. Capacity of one train is assumed 1628 passengers.

3.2.3 Headway

Based on demand forecast and train capacity operation headway of peak hour of each year shall be as follows.

Table 3.2-3 Headway in Peak Hour

	2012	2015	2020	2025	2030	2035	2040	2045
PPHPD	11,500	18,100	20,900	23,800	26,500	28,900	31,000	32,600
Headway	5min	5min	4min	4min	3.5min	3min	3min	2.5min
Number of trains Per hour	12	12	15	15	17.2	20	20	24
Transportation capacity/hour	19,536	19,536	24,420	24,420	27,909	32,560	32,560	39,072

3.2.4 Traveling Time

Currently travel time of one way is 23 minutes and turn back time for one terminal is 7minutes. 60 minutes is current round trip time. It will take about 6 minutes for running two stations of extended section by simulation including dwell time. Therefore 72 minute will be the round trip time after extension.

3.2.5 Required Number of Rolling Stock

Required number of trains will be calculated from round trip time and operation headway at peak hour. **Table 3.2-4** indicates the number of trains.

Table 3.2-4 Number of Trains

	2012	2015	2020	2025	2030	2035	2040	2045
Headway	5min	5min	4min	4min	3.5min	3min	3min	2.5min
Number of trains in operation	12	15	18	18	21	24	24	29
Reserved train	2	2	3	3	3	3	3	4
Required Number of train	14	17	21	21	24	27	27	33

3.2.6 Rolling Stock Procurement Plan

The maximal capacity of the Santolan Depot is 24 trains and there are no proper spaces for expansion of the depot and also it is not possible to accommodate additional trains for stabling along the line. Therefore, it will not be possible to procure additional rolling stocks after 2035 at this moment. It will be the subject for further study. **Table 3.2-5** shows the procurement plan of rolling stocks.

Table 3.2-5 Rolling Stock Procurement Plan

	2012	2015	2020	2025	2030	2035~
1st Generation Train	18	18	18	18	18	18
2nd Generation Train			**3**	3	3	3
3rd Generation Train					**3**	3
Total number of trans	18	18	21	21	24	24

CHAPTER 4
COST ESTIMATION

CHAPTER 4 COST ESTIMATION

4.1 Basis

This section focuses on the preliminary cost estimation of the ODA JICA portion of the LRT Line 2 East Extension Project only. The estimation is based on revisions on the foreign exchange rate only, as all of the parameters of the project remain the same.

Future capital investment is not considered in this table as not being part of the JICA Loan.

1. Preconditions

Preconditions are set according to information provided by JICA.

- The Rate of fund: JICA 100% and Philippine 0%
- Exchange Rate of Currency: US$1=Yen 82.43, US$1=PHP 43.6 , PHP1=Yen1.89
- Price Escalation: FC=2.1%, LC=2.5%
- Physical Contingency: Construction 5%, Consultant 5%
- Billing Rate of Consultant Expert (referred information from JICA)
- Rate of Tax (VAT 12%, Import Tax 0% (paid by GOP)
- Rate of Administration Cost : 5% (following information from JICA)
- Rate of Interest during Construction: Construction 0.2%, Consultant 0.01%
- Rate of Commitment Charges: 0.1%

2. Pending items

The Consultancy Services item has not yet being estimated with a certain level of accuracy, and it is included in the cost of Consultancy mentioned in Volume 1 of this report

4.2 Implementation Plan

The implementation plan presented herein covers the entire project, GAA and ODA portions. Close coordination with the Civil and E&M works' portion is paramount for the success of the project. Furthermore, the completion of related projects, such as implementation of the Common Ticketing System, is crucial as well for the proper implementation of the Line 2 EEP.

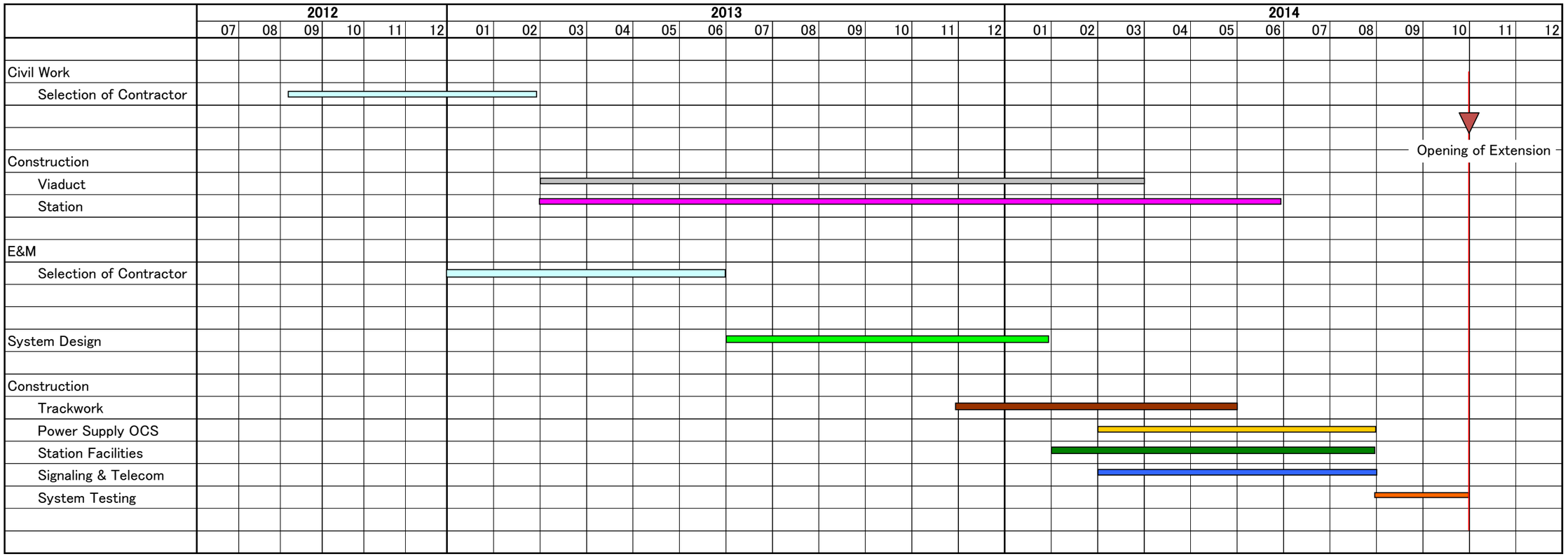


Figure 4.2-1 Implementation Schedule of Line 2 Extension

4.3 Cost of JICA ODA Portion

The summary of the cost for the JICA portion is shown in **Table 4.3-1**. The figures are shown in foreign (JpY) and local (PhP) portions, and summarized in US$.

Table 4.3-1 Total Cost of JICA Loan

Breakdown of Cost	Jpn Yen ('M)			Phi Peso ('M)			Total (Jpn Yen)('M)			Total (US$ M)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Power and Catenary	778	778	0	59	59	0	889	889	0	10.79	10.79	0.00
Signalling and Telecom	1,382	1,382	0	55	55	0	1,486	1,486	0	18.03	18.03	0.00
System Miscellaneous	239	239	0	2	2	0	242	242	0	2.94	2.94	0.00
Track	876	876	0	60	60	0	989	989	0	12.00	12.00	0.00
Rolling Stock	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SubTotal Direct ODA	*3,276*	*3,276*	*0*	*175*	*175*	*0*	*3,606*	*3,606*	*0*	***43.75***	*43.75*	*0.00*
Consulting Services	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SubTotal Direct Loan	*3,276*	*3,276*	*0*	*175*	*175*	*0*	*3,606*	*3,606*	*0*	***43.75***	*43.75*	*0.00*
Price Escalation	136	136	0	9	9	0	152	152	0	1.85	1.85	0.00
Physical Contingency	171	171	0	9	9	0	188	188	0	2.28	2.28	0.00
Land Acquisition	0	0	0	2	0	2	4	0	4	0.05	0.00	0.05
Administration Cost	0	0	0	104	0	104	198	0	198	2.40	0.00	2.40
VAT	0	0	0	251	0	251	474	0	474	5.75	0.00	5.75
Import Tax	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Interest during construction	16	16	0	0	0	0	16	16	0	0.20	0.20	0.00
Commitment Charge	8	8	0	0	0	0	8	8	0	0.10	0.10	0.00
SubTotal Indirect Cost	*331*	*331*	*0*	*375*	*18*	*357*	*1,040*	*364*	*676*	***12.62***	*4.42*	*8.20*
Total	**3,606**	**3,606**	**0**	**550**	**193**	**357**	**4,646**	**3,970**	**676**	**56.36**	**48.17**	**8.20**

Source: Study Team

Breakdown of disbursement schedule for the JICA Loan portion is shown in **Table 4.3-2**.

Table 4.3-2 Cost Disbursement Schedule for JICA Loan

Breakdown of Cost	Annual Disbursement (Million Jp Yen)				
	2013	2014	2015	2016	Total
Power and Catenary	0.00	889.02	0.00	0.00	889.02
Signalling and Telecom	0.00	1,486.36	0.00	0.00	1,486.36
System Miscellaneous	0.00	241.94	0.00	0.00	241.94
Track	158.22	830.66	0.00	0.00	988.89
Rolling Stock	0.00	0.00	0.00	0.00	0.00
SubTotal Direct ODA	**158.22**	**3,447.98**	**0.00**	**0.00**	**3,606.20**
Consulting Services	0.00	0.00	0.00	0.00	0.00
SubTotal Direct Loan	**158.22**	**3,447.98**	**0.00**	**0.00**	**3,606.20**
Price Escalation	3.39	148.89	0.00	0.00	152.29
Physical Contingency	8.08	179.84	0.00	0.00	187.92
Land Acquisition	4.07	0.00	0.00	0.00	4.07
Administration Cost	8.69	188.84	0.00	0.00	197.52
VAT	20.85	453.21	0.00	0.00	474.06
Import Tax	0.00	0.00	0.00	0.00	0.00
Interest during construction	0.34	7.89	7.91	0.00	16.14
Commitment Charge	3.96	3.96	0.00	0.00	7.93
SubTotal Indirect Cost	**49.39**	**982.64**	**7.91**	**0.00**	**1,039.93**
Total	**207.61**	**4,430.62**	**7.91**	**0.00**	**4,646.14**

CHAPTER 5
CONSIDERATION ON PROJECT EFFECTS

CHAPTER 5 CONSIDERATION ON PROJECT EFFECTS

5.1 Methodology

"Preparatory Study for LRT Line 2 Extension Project", hereinafter "Previous Study", was completed in October 2011. So, CONSIDERATION ON PROJECT EFFECT about Line 2 East Extension Project is mainly just reviewed the recent study.

5.2 Operation / Effect Indicators

The calculation of indexes is done for whole section including existing section and extension section. The results of operation/effect indicators are shown in **Table 5.2-1.**

Table 5.2-1 Calculation result of operation or effect indicators

No.	Operation or effect indicators	Actual in 2011	Desired in 2018 (2 years after opening)
1.	Passenger-km	1,691	3,464
2.	The number of trains in operation	342	428
3.	Workable car ratio	83.3%	95%
4.	Train-km	1,514,315	2,523,959
5.	Fare revenue	856.84	-
6.	Fare Box Ratio	0.85	-
7.	Non-railway revenue	30.20	-
8.	Load factor	38.99	-

Source: Study team

5.3 Qualitative Effects for Surrounding Area of New Stations Along the New Line

Study team confirmed that there is no remarkable change in surrounding area of new stations along the new line since Previous Study, by checking population census 2010, latest version map, and site survey.

5.4 Estimating Greenhouse Gas Reduction

The effects of reduction of CO_2 emission are shown referring to "Climate Finance Impact Tool for Mitigation and Adaptation (Summary) Ver. 1.0, JICA, 2011". **Table 5.4-1** shows the result of the estimation of reduction of greenhouse gas. The project is effective for the reduction of greenhouse gas. The balance for reduction of CO_2 emission will be increasing gradually.

Table 5.4-1 Result of the estimation of reduction of greenhouse gas

Unit: tCO_2 /year

Items		2015	2020	2025	2030	2035
Base Line		10,112	11,442	12,633	13,776	14,840
Project	Conversion from PUJ	481	544	601	655	706
	Increasing	154	183	213	241	267
Reduction of CO_2 emission		9,477	10,715	11,819	12,879	13,868

Source: Study team referring "Climate Finance Impact Tool for Mitigation and Adaptation (Summary) Ver. 1.0, JICA, 2011"

5.5 EIRR & FIRR (Economic & Financial Evaluation)

5.5.1 Economic Analysis

The project is evaluated to determine its economic viability based on the EIRR estimate by comparing the economic costs and benefits over the life of the Project, which is normally assumed to be 30 years after opening.

1) Methodology and Assumptions

a. Methodology

The Project is evaluated from the economic perspective, following a prevailing method of cost-benefit analysis, in which the project cost and benefit are measured in economic price and compared through the project life. Economic cost is the initial investment cost, rolling stock cost and O&M cost of the Project.

b. Economic Benefit Items to be analyzed

Economic benefit of the Project is defined as the savings in VOC (Vehicle Operation Costs) and TTC (Travel Time Costs) attributable to the Project. The benefit is the most direct one and comparatively easy to quantity. The benefit is estimated through "with and without" comparison of traffic demand analysis.

- LRT User's Benefit: Reduction in vehicle operating cost (VOC) and savings in travel time cost (TTC) due to usage of LRT extension section (due to shift from private/public transport on road to LRT)
- Road User's Benefit along LRT Line 2 Corridor: Reduction in traffic congestion on the existing road (along LRT Line 2 corridor), as can be seen in increases in travel speeds and reduction in VOCs
- Benefit by CO_2 Reduction: CO_2 reduction by decrease of traffic volume on the existing road (along LRT Line 2 corridor), as can be seen in shifting from road transport to LRT.

The Project would generate other economic benefits such as decrease of traffic accidents, improvement in passengers' comfort ability and contribution to regional development in the long run. However, these benefits are difficult to measure and tend to be an arbitrary estimate, even they can be measured. For that reason, economic benefit is limited to the most direct ones to make the analysis safer.

c. Economic Cost Items to be analyzed

Economic cost is defined as a net consumption of goods and service for implementation of the project. In order to estimate this economic cost of the Project, the initial cost, rolling stock cost and the O&M cost stated in this Report, which is measured in financial cost, need to be converted to costs in economic price. According to various feasibility studies conducted in the Philippines, NEDA has seemingly suggested the following methods for this conversion;

- Application of Standard Conversion Factor (SCF): Economic cost is simply estimated by multiplying SCF to financial cost. The previous projects by JICA or ADB, adopted this method using 0.83 as the value of SCF. The project costs excluding land acquisition are converted using SCF.

d. Other Assumptions

- Project Life: Durable life of a transportation project is usually very long, that is, 50 to 60 years if it is properly maintained. On the other hand, economic project life is considered much shorter than the physical life, that is, around 30 years because the facility soon becomes outdated and uneconomical due to rapid innovation. This project life is defined as 33 years including 2 year of construction period, namely, 2013 to 2046.
- Social Discount Ratio: As the opportunity cost of capital, 15% per annum is assumed as the social discount rate.
- Exchange Rate: USD 1 = Pesos 43, Peso 1 = 1.81 Japanese Yen (Same as Preparatory Study for LRT LINE2 Extension Project)

2) Economic Cost

a. Capital Cost (Initial Cost & Rolling Stock Cost)

An initial estimate of project cost is discussed in this Report. This is summarized in **Tables 5.5-1** and broken down into financial and economic costs. Total economic cost is 172,275.80 million Peso, 83% of the financial cost.

Table 5.5-1 Project Cost in Financial and Economic Terms

Unit Million Peso

Year	Financial Costs	Economic Costs
2013	8,312.24	6,899.16
2014	7,496.98	6,222.49
2020	2,502.50	2,077.08
2030	2,502.50	2,077.08
Total	20,814.22	172,275.80

Source : Study Team

b. O&M Expenses

The O&M costs for LRT Line 2 extension section are shown in the following table. Detail estimate of O&M work is discussed in this Report

Table 5.5-2 O&M Expenses for LRT Line 2 Extension Section in Benchmark Years

Unit Million Peso

Year	Financial Costs	Economic Costs
2015	635.18	527.20
2020	1,146.61	951.69
2025	1,146.61	951.69
2030	1,658.05	1,376.18
2035	1,658.05	1,376.18

Source : Study Team

3) Economic Benefit

a. Vehicle Operating Cost (VOC)

The saving in VOC is one of the major sources of economic benefits in transport projects. **Table 5.5-3** shows the VOCs. The most important is that the VOC should be a function of vehicle speed so that the improvement of road condition would be duly reflected as economic benefit.

Table 5.5-3 Vehicle Operation Cost, 2010

*Unit: Peso/ Vehicle (Train)*km*

Ave. Speed (km/h)	LRT	Jeepney	Private Car
20	-	10.91	12.01
25	-	10.36	11.41
30	-	9.38	10.45
32.8	1.57	-	-
40	-	8.29	9.25
50	-	7.85	8.65
60	-	7.74	8.29

Source : Preparatory Study for LRT LINE2 Extension Project

b. Value of Time (VOT)

The saving in passenger time cost is another major source of economic benefit of transport projects. The following table presents the unit value of time assumed by the result of SP survey. VOT of LRT user is higher than that of Jeepney.

Table 5.5-4 Unit Value of Time (VOT), 2013

Mode	LRT	Private Car	Jeepney
Peso/Min.	1.61	1.85	1.09
Peso/Hour	96.7	111.1	65.5

Source : Study Team

c. Carbon Price

The price of CO_2 emission seems to be depending heavily on economic market. The carbon price is set as 829 Peso in 2010 price in this analysis, same as "Preparatory Study for LRT LINE2 Extension Project".

d. Estimation of Economic Benefits

By applying above unit costs to the result of traffic demand and summing VOC, TTC and CO_2 reduction, aggregated transportation cost was estimated. Economic benefit is the difference of the aggregate costs between "with project" case and "without project" case. The following table shows the economic benefit in benchmark years. In 2015, about 60% of benefit will be travel time cost saving. The share of benefit by CO_2 reduction is very low compare with that of other benefits.

Table 5.5-5 Economic Benefit in Benchmark Years

Unit: Million Peso/ Year

Mode	LRT	Private Car	Jeepney
Peso/Min.	1.61	1.85	1.09
Peso/Hour	96.7	111.1	65.5

Year	Economic Benefit			
	VOC Saving	TTC Saving	CO_2 Reduction	Total
2015	937.88	1,504.84	13.43	2,456.16
2020	1,451.63	3,587.92	15.19	5,054.74
2025	2,626.61	10,359.39	16.75	13,002.75
2030	582.18	4,366.04	18.26	4,966.48

Source : Study Team

4) Cost Benefit Flow and EIRR

The following table shows the economic cash flow over the project period for calculating economic internal rate of return (EIRR). According to NEDA's criteria, the threshold value to judge the economic feasibility of a project is 15% in the Philippines. EIRR is 24.11%, which proved to be a feasible from the economic viewpoint.

Table 5.5-6 Cash Flow of Economic Cost and Benefit

Unit: Million Peso

	Year	Capital Cost	O&M Cost	Economic Benefit	Net Cash Flow
1	2013	6,899.16	0.00	0.00	-6,899.16
2	2014	6,222.49	0	0.00	-6,222.49
3	2015	0.00	527.20	2,456.16	1,928.95
4	2016	0.00	527.20	2,803.00	2,275.80
5	2017		633.33	3,210.85	2,577.53
6	2018		739.45	3,694.94	2,955.49
7	2019		845.57	4,275.74	3,430.17
8	2020	2077.08	951.69	5,054.74	2,025.97
9	2021		951.69	5,934.22	4,982.53
10	2022		951.69	7,037.43	6,085.73
11	2023		951.69	8,450.66	7,498.97
12	2024		951.69	10,308.02	9,356.33
13	2025		951.69	13,002.75	12,051.06
14	2026		1,036.59	12,064.37	11,027.78
15	2027		1,121.49	8,048.20	6,926.71
16	2028		1,206.39	4,667.46	3,461.07
17	2029		1,291.29	4,763.65	3,472.37
18	2030	2077.08	1,376.18	4,966.48	1,513.22
19	2031		1,376.18	4,852.29	3,476.11
20	2032		1,376.18	4,738.10	3,361.92
21	2033		1,376.18	4,623.91	3,247.73
22	2034		1,376.18	4,509.72	3,133.54
23	2035		1,376.18	4,468.28	3,092.10
24	2036		1,376.18	4,366.02	2,989.84
25	2037		1,376.18	4,263.76	2,887.57
26	2038		1,376.18	4,161.49	2,785.31
27	2039		1,376.18	4,059.23	2,683.05
28	2040		1,376.18	3,975.09	2,598.91
29	2041		1,376.18	3,889.22	2,513.04
30	2042		1,376.18	3,803.35	2,427.16
31	2043		1,376.18	3,717.47	2,341.29
32	2044		1,376.18	3,631.60	2,255.42
33	2045		1,376.18	3,545.73	2,169.55
		17,275.80	35,657.59	163,343.94	24.11%

Source : Study Team

5) Sensitivity Analysis

Sensitivity analysis was made by changing the projected cost upward and benefit downward. This analysis was done using following scenarios by "ICC Project Evaluation Procedures and Guidelines" of NEDA.

- Scenario I: Increase in projected costs by 10% or 20%
- Scenario II: Decrease in benefit by 10% or 20%
- Scenario III: Combination of Scenario I and II

The following table shows the result of sensitive analysis by changing cost and benefit. The case of Cost Increase 20% and Benefit Decrease 20% shows EIRR over 15%, so each case has a viability.

Table 5.5-7 Sensitive Analysis by Changing Cost and Benefit

Changing in Cost &Benefit		Cost Increase		
		Base (0%)	10% Up	20% Up
Benefit Decrease	Base (0%)	24.11%	22.13%	20.37%
	10% Down	21.92%	20.01%	18.31%
	20% Down	19.57%	17.72%	16.06%

Source : Study Team

5.5.2 Financial Analysis

Conducting a financial evaluation of LRT extension project is very important to assess possible PPP schemes. The FIRR will be estimated by comparing project costs and fare revenues as well as other revenues (Miscellaneous Revenues) over the LRT's life. Depending upon the level of FIRR, cost-sharing between public and private sectors will differ. Cash flow analysis also is made.

1) Assumptions

a. Revenue

Total revenue is composed of fare box revenue and miscellaneous revenue, as shown below;

- Fare box Revenue: The fare box revenue is estimated using the result of demand forecast.
- Miscellaneous Revenue: The miscellaneous revenue is assumed as 5% of fare box revenue, based on the existing financial situation and the experience of other countries.

Table 5.5-8 Revenue in Benchmark Years

Unit: Million Peso

Year	Revenue
2017	2,137.46
2020	2,385.14
2025	2,742.93
2030	3,104.61
2035	3,181.10

Source : Study Team

b. Expense

The expense is composed of the construction cost and O&M cost, as shown in the following table.

Table 5.5-9 Expense on Construction Stage

Unit: Million Peso

Year	Expense
2013	8,312.24
2014	7,496.97
2020	2,502.50
2030	2,502.50
Total	20,814.22

Source : Study Team

Table 5.5-10 Expense on O&M in Benchmark Years

Unit: Million Peso

Year	Expense
2015	635.18
2020	1,146.62
2025	1,146.62
2030	1,658.05
2035	1,658.05

Source : Study Team

c. Other Assumptions

- Project Life: The project life is defined as 33 years including 2 year of construction period, namely, 2013 to 2046, same as setting for economic analysis.
- Exchange Rate: USD 1 = Pesos 43, Peso 1 = 1.81 Japanese Yen (Same as "Preparatory Study for LRT LINE2 Extension Project")
- Taxes: 12% of value-added tax (VAT) in Philippines should be considered for both of foreign and domestic currency portion. The import tax for foreign currency portion is excluded from this analysis.
- Inflation: Inflation is excluded from this analysis.

CHAPTER 6

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

CHAPTER 6 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

6.1 Methodology

The study on the environmental and social considerations is conducted by the following steps:

(i) Review the existing documents such as Environmental Impact Assessment (EIA) Report, Resettlement Action Plan (RAP) and Environmental Compliance Certificate (ECC);
(ii) Field Reconnaissance;
(iii) Study of the supplementary items to be improved of the existing EIA and RAP, in accordance with "JICA Guidelines for Environmental and Social Considerations (April, 2010)" (herein referred to as JICA Guidelines)
(iv) Conduct the surveys on the supplementary EIA and RAP reports by entrusting reliable and experienced local consultants, if necessary; and
(v) Assist DOTC/LRTA to prepare the supplementary EIA and RAP reports.

For the LRT Line 2, the review of the existing documents was done for the whole components of the extension project covered by the EIA report. The JICA Study Team also considers the supplemental EIA for the whole components of LRT Line 2 Extension Project.

6.2 Legal and Institutional Framework for Social and Environmental Considerations in the Philippines

Please refer to Chapter 7 in Volume I.

6.3 Review of EIA Report

6.3.1 ECC Application

In 2011, an EIA study for LRT Line 2 Extension Project was conducted by JICA Preparatory Study. The JICA Study Team assisted LRTA to prepare the Environmental Performance Report and Management Plan (EPRMP: the Environmental Impact Statement (EIS) for the existing projects for modification or re-start-up).

In October 2011, LRTA contacted with the Environmental Management Bureau, Department of Environment and Natural Resources (DENR-EMB) in order to apply for Environmental Compliance Certificate (ECC). DENR/EMB requested LRTA to submit a document "Project Environmental Monitoring and Audit Prioritization Scheme (PEMAPS) Questionnaire".

LRTA completed the PEMAPS and applied to DENR-EMB for ECC with the EPRPM on August 14, 2012. After reviewing the EPRMP, DENR-EMB will issue the ECC for LRT Line 2 Extension Project in September 2012.

6.3.2 EPRPM Review

The comparative study of EPRPM and recommendations for mitigation measures are summarized in **Table 6.3-1** for pre-construction and construction phase and in **Table 6.3-2** for operational phase. The comparative study of EPRMP and recommendations for the Environmental Monitoring Plan are summarized in **Table 6.3-3** for pre-construction and construction phase and in **Table 6.3-4** for operational phase.

The results of monitoring will be provided to JICA on a quarterly basis as a part of the progress reports during construction and biannually until two (2) years after completion of the Project by filling the Monitoring Form. The draft Monitoring Form is referred to **Appendix B-1**.

Table 6.3-1 Comparative Study of EPRPM and JICA Guidelines and Recommendations on Additional Mitigation Measures Pre-Construction and Construction Phase

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
Anti-pollution measures				
Air quality	○	○	Dust control: •Regular water sprinkling •Regular hauling of construction spoils and excavated materials •Covered temporary stockpiles with tarpaulin or sack materials •TSP monitoring Emission control: •Daily routine check-ups of equipment and machinery •Regular maintenance of construction equipment and machineries •Regular NO_2 and SO_2 monitoring.	•Stockpiled sands and soils shall be wetted, particularly in windy conditions. •Locate plants and stockyard away from residential and sensitive areas. •Reduce the emission of air pollutants by utilizing low-emission construction machines and vehicles. •Stop unnecessary idling.
Water quality	○	○	Bacteriological pollution: •Provision of portable toilets and garbage bins at the construction areas •Regular disposal of wastes generated by the personnel •Conduct regular inspection of the construction areas •Regular coliform monitoring Siltation: •Regular hauling of construction spoils and excavated materials • Covered temporary stockpiles with tarpaulin or sack materials •Temporary stockpiles of excavated materials and construction spoils will not be located anywhere near natural	•Avoid the improper land mound to prevent soil erosion from the construction sites, especially during rainy season.

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
			waterways •Regular TSS level monitoring Oil and grease: •Prohibit washing of equipment and machineries along or anywhere near the waterways •Daily routine check-ups of equipment and machinery •Regular maintenance of construction equipment and machineries •Conduct regular oil and grease monitoring pH: •Prohibit washing of transit mixers and related equipment along and near the waterways •Close supervision during concrete pouring of alignment sections crossing the waterways; •Conduct regular pH level monitoring	•For pavement construction, there will be no work during rainy days. •Provide proper construction machines and heavy vehicles and maintain them properly. •Oil and grease traps in drainage system from workshops, vehicles and plant washing facilities and service and fueling areas will be established to prevent contamination of water. •Sediment tanks will be installed for the effluents from the facilities such as crushing plant, quarry, batching plant and other related facilities.
Waste	○	X	-	•Proper waste management plan to minimize waste generated from construction works shall be included in the construction plan. •Waste disposal sites shall be identified during detailed design stage. •Implement proper management and disposal of construction waste. •Contractor shall be adequately educated on applicable methods for a) restraint of generation; b) classified collection; c) storage; d) transportation; e) proper maintenance of disposal areas. •Re-use and disposal of excess excavated materials on selected areas. •Excavated waste soil, sand and sediment shall be properly disposed or treated based on the contaminated levels of toxic substances.
Soil contamination	○	X	-	•Avoid pollution of water bodies and soil due to leachate •Provide proper construction machines and heavy vehicles and maintain them properly. •Treat properly wastewater from asphalt wearing and concrete pavement work.

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
				•Oil and grease traps in the drainage system from workshops, vehicles washing facilities, and service and fuelling areas shall be established to prevent contamination of water.
Noise and vibration	○	○	•Bored piles using a low noise boring equipment •Installation of noise suppressors onto various heavy equipment and construction machineries •Installation of temporary noise barriers; •Scheduling of high noise generating activities during daytime •Regular noise level monitoring at noise sensitive receptor areas	•Inform construction schedule to residents in advance.
Subsidence	X	X	-	-
Odor	X	X	-	-
Sediment	X	X	-	•Same measures for 'water quality' will be able to be taken into account, in order to avoid sediment in rivers and creeks.
Natural environment				
Protected areas	X	X	-	-
Ecosystem	○	○	• Minimize loss of vegetation covers and tree cutting along the centre islands and areas to be affected by the construction •"Permit to Cut" shall be secured and reforest site/s designated by DENR-EMB •Careful balling out and relocation of saplings, juvenile and medium-sized trees •Aesthetical restoration of affected vegetated areas through landscaping	-
Hydrology	○	○	Flooding along the route corridors: •Provision of alternative power supply located in an area where there will not be flooded •Natural and engineered drainage lines will be kept free of obstruction	•Provide enough capacity of drainage system •Temporary stockpiles of excavated materials and construction spoils will not be located anywhere near natural waterways

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
Topography and geology	○	○	Liquifaction risk •Prepare the Engineering Geological and Geo hazard Assessment Report (EGGAR) prior to implementation of the project.	•Ground settlement monitoring shall be carried out.
Management of abandoned sites	○	X	• Conduct a joint site inspection at the work site to ensure that construction spoils/debris, solid and domestic wastes are properly disposed to approved disposal sites and not abandoned in the construction areas. • All temporary sanitation facilities, especially the portable toilets are properly dismantled and no wastes are abandoned. • Contractor/Sub-Contractor must ensure that all affected service utilities are immediately and properly restored to their normal operation; • Close coordination with the concerned entities must be undertaken to ensure immediate relocation and restoration of affected basic social service facilities to their normal functions.	Demobilization and decommissioning of auxiliary facilities (e.g. work camp): • Construction camp may be turned over or donated to local government units. • Exposed areas shall be planted with suitable vegetation.
Social environment				
Resettlement	X	X	-	-
Living and livelihood	○	○	• Local employment rate (+) • Close coordination with utility companies and measures for minimizing possible interruption of the service utilities (water, electricity) •Measures for securing the safety of pedestrians and residents in the vicinity •Traffic Management Plan, including secure the safety of U-turning vehicles along Marcos Highway	•Disseminate information on a construction plan (schedule, traffic restriction section, and etc.) through the media such as radio and paper. •Perimeter fence shall be installed within the construction area, especially around excavation areas.
Heritage	X	X	-	-

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
Landscape	X	X	-	-
Ethnic minorities and indigenous peoples	X	X	-	-
Working conditions (including occupational safety)	○	X	•Provision of Personal Protective Equipment (PPE) such as hard hats, ear muffs, safety shoed, goggles and other protective gears especially to heavy equipment operators •First aid stations supervised by the Environment and Safety Health Officer of the Contractor will be located within the construction site •Emergency vehicles will be on stand-by within the construction area at all times	<u>Construction Camp Management Plan</u> •The Contractor will construct and maintain all workers' accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. •The Contractor will also provide potable water facilities within the precincts of every workplace in an accessible place, as per standards set by the Philippines Occupational Safety and Health Standards (As Amended), 1992. •The contractor will also guarantee the following: i) Supply of sufficient quantity of potable water in every workplace/ camp site at suitable and easily accessible places and regular maintenance of such facilities. ii) If any water storage tank is provided that will be kept such that the bottom of the tank at least 1m from the surrounding ground level. iii) If water is drawn from any existing well, the contractor shall ensure that sharing water will not cause any shortage in the local community. iv) Testing of water will be done every month as per parameters prescribed in the Philippine National Standards for Drinking Water 2007. •The sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. •Separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women. •Adequate water supply is to be provided in all toilets and urinals. •Provide hand washing facilities at all cooking and eating areas. •Provide good mobile toilets for each construction site. Alternatively, install two chamber septic tanks toilets for each construction team of 50 - 100 workers

JICA Guidelines		Impact Management Plan in EPRMP 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
				•The contractor shall provide segregated rubbish bins in the camps and ensure that these are regularly emptied and disposed off as per the Waste Management Plan. •Provide many rubbish bins around camp. Discourage throwing of garbage, waste food, cigarettes, drinks cans on ground. Empty bins to skips regularly and transfer to landfill when full or at least weekly. •Arrangements for disposal of night soils (human excreta) approved by the MMDA/LGUs or as directed by the SC will have to be provided by the contractor. •Improve awareness of infectious diseases prevention, particularly HIV/AIDS and flu for workers. •Set up a medical facility for large-size construction camps for first aid and health care for workers. •Install sign boards, lighting system at the construction sites, borrow pits, or places which may cause accidents for people and workers. •Fill up holes, ponds created by filling, cutting and earthworks to prevent health risk and remove vector growth places. •Fill up ponds at worker sites and kill rats, bugs, flies and mosquitoes. •Ensure the abandonment of construction camp after the completion of the project •Donate the camp buildings as a public facility such as a barangay center.
Accident prevention measures	○	○	•Measures for securing the safety of pedestrians and residents in the vicinity •Traffic Management Plan, including secure the safety of U-turning vehicles along Marcos Highway	•The routes for construction vehicles shall be determined through the meeting with stakeholders, MMDA and LGUs. •Disseminate information on a construction plan (schedule, traffic restriction section, and etc.) through the media such as radio and paper. •Provide adequate education and training to construction workers regarding traffic safety. •Perimeter fence shall be installed within the construction area, especially around excavation areas to prevent untoward accidents.

Source: Study Team

Table 6.3-2 Comparative Study of EIS and JICA Guidelines and Recommendations on Additional Mitigation Measures
Operational Phase

JICA Guidelines		Impact Management Plan in EIS 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
Anti-pollution measures				
Air quality	○	○	•Positive effects on air pollutants reduction •Strategic location of multimodal facilities (jeepeny and bus terminal)	-
Water quality	○	X	-	•Proper operation and maintenance of wastewater treatment facilities at the stations •Regular monitoring of effluent water quality (pH, TSS, BOD, COD, Oil/Grease, Phenol, Fiscal Coliforms) from wastewater treatment facilities at stations (in accordance with the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992)
Waste	○	X	-	•Regular monitoring in accordance with the Solid Waste Management Plan
Soil contamination	X	X	-	-
Noise and vibration	○	○	•Expected to be insignificant •Parapet wall as for noise barriers	•Trees should be planted beneath the guideways and stations where possible •Regular monitoring of noise levels •Regular maintenance to keep railways in good conditions •Develop a mechanism to record and respond to monitoring results and complaints
Subsidence	○	X	-	•Regular monitoring of ground settlement
Odor	X	X	-	-
Sediment	X	X	-	-
Natural environment				
Protected areas	X	X	-	-
Ecosystem	○	X	-	•Regular monitoring of replanted trees
Hydrology	○	X	-	•Monitoring of flood levels of rivers and creeks during heavy rains
Topography and geology	○	X	-	•Regular maintenance of revegetation areas
Management of abandoned sites	X	X	-	-

JICA Guidelines		Impact Management Plan in EIS 2012		Recommendations on Additional Mitigation Measures
Check Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Mitigation Measures	
Social environment				
Resettlement	X	X	-	-
Living and livelihood	○	○	LRTA must ensure: •Enhancement of workforce mobility and productivity •Enhancement of acceptability of Off-Metro Manila relocation sites •Provide faster and safer mode of mass transport	•Regular monitoring on living and livelihood conditions
Heritage	X	X	-	-
Landscape	X	X	-	-
Ethnic minorities and indigenous peoples	X	X	-	-
Working conditions (including occupational safety)	X	X	-	-
Accident prevention measures	○	X	-	•Regular monitoring on safeness of pedestrians •Regular monitoring in smoothness of traffic flow

Source: Study Team

Table 6.3-3 Comparative Study of EIS and JICA Guidelines and Recommendations on Additional Monitoring Items Pre-Construction and Construction Phase

JICA Guidelines		Environmental Monitoring Plan in EIS 2012		Recommendations on Additional Monitoring Items
Monitoring Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Monitoring Plan	
Anti-pollution measures				
Air quality	○	○	• TSP, NO_2 and SO_2	-
Water quality	○	○	• Rivers and creeks: E. Coliform, Oil & Grease, pH, TSS	•Add BOD
Waste	○	○	•Solid and domestic wastes management and disposal	•Construction site conditions and cleanliness •Practice of 3R activities
Soil contamination	○	X	-	•Quality survey of waste soil/sand and sediment from piling and excavation to check whether the toxic substances are exist or not.
Noise and vibration	○	○	• Noise Level	-
Subsidence	○	X	-	•Ground settlement levels
Odor	X	X	-	-
Sediment	X	X	-	-
Natural environment				
Ecosystem	○	X	• Tree Cutting/Balling/Relocation	-
Protected species	X	X	-	-
Social environment				
Resettlement	X	X	-	-
Living and livelihood	○	○	• Effectiveness of traffic management plan •Compliance of Contractors to occupational health and safety rules and regulation - Supply of basic Utilities - Safety of pedestrians - Safety of motorists	•Regular monitoring of local employment rates

Source: Study Team

Table 6.3-4 Comparative Study of EIS and JICA Guidelines and Recommendations on Additional Monitoring Items Operational Phase

JICA Guidelines		Environmental Monitoring Plan in EIS 2012		Recommendations on Additional Monitoring Items
Monitoring Items	Necessity ○:Yes/ X: No	Considered ○:Yes/ X: No	Monitoring Plan	
Anti-pollution measures				
Air quality	X	X	-	-
Water quality	○	X	-	·Regular monitoring of effluent water quality (pH, TSS, BOD, COD, Oil/Grease, Phenol, Fiscal Coliforms) from wastewater treatment facilities at stations (in accordance with the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992)
Waste	○	X	-	·Proper implementation of separate collection and disposal
Soil contamination	X	X	-	-
Noise and vibration	○	X	-	·Regular monitoring of noise and vibration
Subsidence	○	X		·Ground settlement levels
Odor	X	X	-	-
Sediment	X	X	-	-
Natural environment				
Ecosystem	○	X	-	·Regular monitoring of tree growth
Protected species	X	X	-	-
Social environment				
Resettlement	X	X	-	-
Living and livelihood	○	○	•Fast and safe mode of transportation	-

Source: Study Team

6.4 Supplementary EIA Study

The EPRMP was prepared by the JICA Study in October 2011 in accordance with JICA Guidelines. In addition, any changes have been observed since last year in and around the Marcos Highway where the alignment of the extension line will be planned. Therefore, any supplemental environmental survey will not be needed to follow up the baseline conditions.

6.5 Review of RAP

The JICA Preparatory Study in 2011 indicated that no people shall be displaced as a result of Right-of-Way (ROW) acquisition for the extension line and new stations. Therefore, any RAP was not prepared. In addition, no indigenous people shall be affected so an Indigenous Peoples' Action Plan (IPAP) was also not considered necessary.

6.6 Supplementary RAP Study

The alignment of LRT Line 2 Extension Project has not been changed. In addition, any change in the vicinity of the alignment have bas not been observed since last year in and around the Marcos Highway where the alignment of the extension line has been planned. Therefore, any supplemental RAP will not be necessary.

6.7 Review by JICA Environmental Checklist

The JICA Study Team assisted LRTA with elaborating the JICA Environment Checklist to comply with the JICA Guidelines.

The draft JICA Environment Checklist is shown in **Appendix B-2.**

CHAPTER 7
SUMMARY OF FINDINGS

CHAPTER 7 SUMMARY OF FINDINGS

This chapter summarizes the major findings of this study.

7.1 Ridership

The travel demand presented here is based on thorough analysis of LRTA data since the opening of Line-2, trends in growth and current patronage characteristics of Line-2, as determined through direct passenger interview surveys. The demand forecast growth is mostly based on latest LRTA data, recent traffic and passenger interview survey data, anticipated socio-economic growth, with adjustments/modifications, where possible, through sound judgment and based on the considerable experience of the study team of such projects. The base case forecasts for the two extension stations: Emerald & Masinag, and the impact of extension on exiting station patronage, mainly Santolan are based on the recently conducted traffic and travel demand surveys at Santolan station and along Marcos Highway, on which all stations would be located.

Extending Line-2 to Masinag, just for two stations may not appear to be attractive on simple marginal cost/benefit approach for extending the line, as the patronage from east are already using the LRT by changing at Santolan. However, if a state-of-the-art multi-modal terminal could be built at Masinag, it is estimated that about 58,400 additional passengers would switch to LRT mainly from Jeepneys at Masinag, rather than to continue on the current mode they are using. The reasons that only a limited passenger choose to transfer at Santolan because transfer facilities are rudimentary (pickup & drop-off on road-side), there is no land to improve these facilities (a direct link to concourse etc.). Extension to Masinag would increase the catchment area of Line-2 further, and additional time saving for passengers from Antipolo to Cubao would be attractive enough to switch to LRT at Masinag, whereas ta present they continue the journey on the same mode they have chosen at the start of the trip in Antipolo.

It is estimated that the patronage would continue to grow as the areas between Santolan and Masinag along Marcos Highway Line-2 extension alignment would develop further over time, with increase in housing and commercial activity beyond the opening of the extension by 2015. The development potential farther east in the Rizal province land is considerable, due to availability of land. The patronage would also benefit considerably by the provision of feeder routes from Antipolo to Masinag with easy/convenient/attractive transfer facilities at Masinag. In addition the introduction of integrated public transport e-ticketing system would further add to the Line-2 patronage for passengers transferring at Masinag. The results of the analysis are summarized in **Table 7.1-1**. The forecast patronage on the existing line possible additional demand if the line is extended to the Masinag in the east is illustrated in **Figure 7.1-1** and compared with the previous forecast for the same extension of the line in **Figure 7.1-2**.

Table 7.1-1 Summary of Patronage Forecast for Line-1

Description	Unit	2012	2015	2020	2025	2030	2035	2040	2045
Average Week Day Boarding (Without Extension)	Pax	212,200	231,100	261,500	288,700	314,900	339,200	361,000	379,400
Increase in Daily Patronage (Av. Week Day Pax)	Pax	-	**74,900**	**89,200**	**103,600**	**117,400**	**129,800**	**139,900**	**147,000**
Total Patronage with Extension (Av. Week Day Pax)	**Pax**	**212,200**	**306,000**	**350,700**	**392,300**	**432,300**	**469,000**	**500,800**	**526,400**
AM Peak Hour (0700-0800) Boarding Eastbound	Pax/Hr	13,360	20,580	23,710	26,670	29,510	32,090	34,320	36,070
AM Peak Hour (0700-0800) Boarding Westbound	Pax/Hr	4,260	6,090	6,900	7,760	8,510	9,190	9,810	10,320
Total AM Peak Hour (0700-0800) Boarding Both Direction	Pax/Hr	17,620	26,670	30,610	34,430	38,020	41,280	44,130	46,390
AM-Peak Hour Boarings as % of Daily Boardings	Ratio(%)	8.30%	8.72%	8.73%	8.78%	8.79%	8.80%	8.81%	8.81%
Pax/Hr/Per Direction (Max AM-PK Hr 0700~0800)	**PPHPD**	**10,770**	**17,700**	**20,570**	**23,340**	**25,990**	**28,380**	**30,390**	**31,950**
AM_Peak Hour Average Trip Length Westbound	km	8.49	11.52	11.61	11.71	11.78	11.83	11.84	11.84
AM_Peak Hour Average Trip Length Westbound	km	6.97	8.77	8.84	8.93	9.00	9.06	9.09	9.10
Average Week Day Trip Length	**km**	**7.86**	**10.22**	**10.31**	**10.41**	**10.49**	**10.53**	**10.56**	**10.56**
Annual Factor	**Days**	330	330	330	330	330	330	330	330
Annual Passenger	**Pax Million**	70.03	100.98	115.73	129.46	142.66	154.77	165.26	173.71
Annual Passenger*km	**Million*km**	550.40	1,032.02	1,193.19	1,347.67	1,496.49	1,629.73	1,745.19	1,834.40

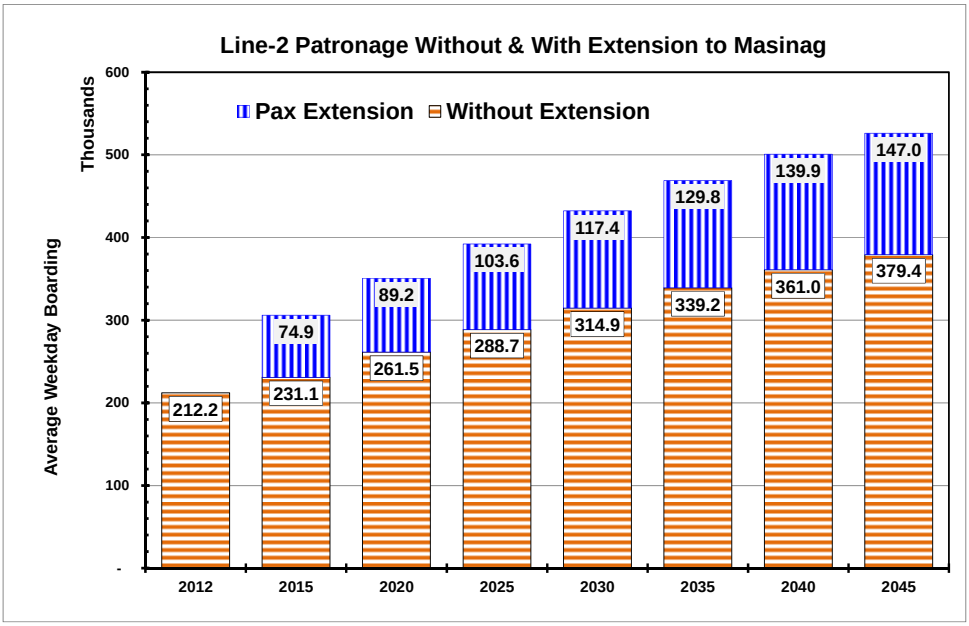


Figure 7.1-1 Average Weekday Patronage Forecast on Line-2 & Extension

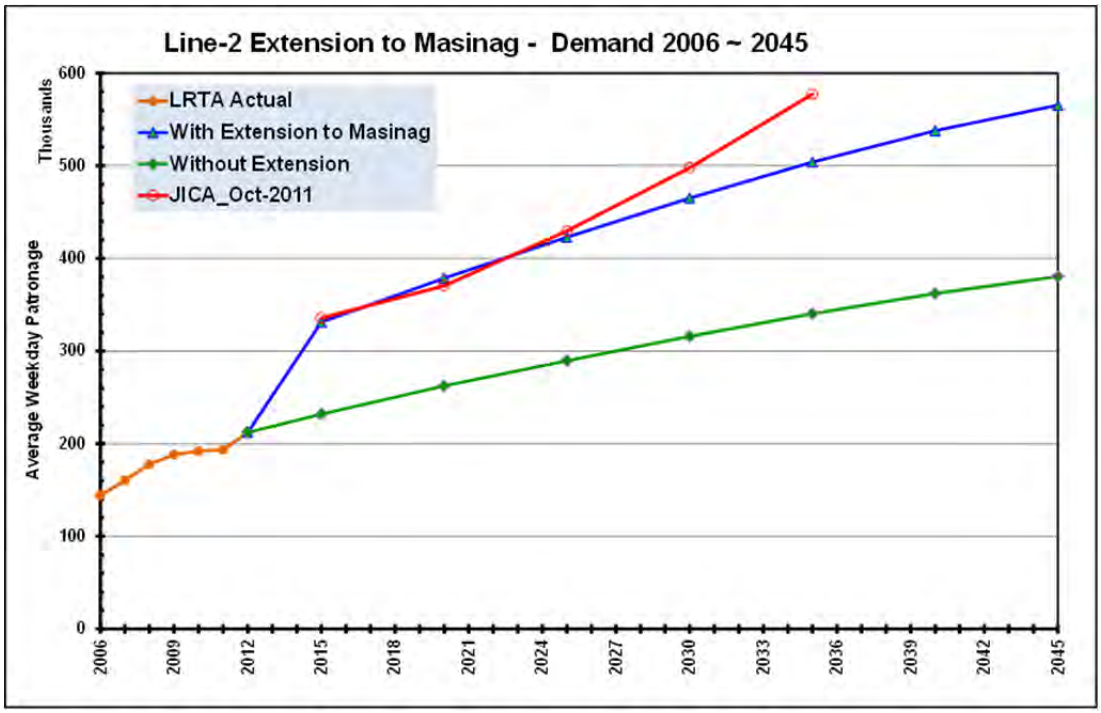


Figure 7.1-2 Average Weekday Patronage Forecast by current and past studies

7.2 Route Review

The project has been submitted to NEDA as the East Extension, so Case 1 of the JICA Preparatory Study for LRT Line 2 Extension Project has been selected for implementation at this time. Thus, the civil and mechanical portions of the West Extension are not considered in this report, and deleted from the cost and system description items.

7.3 Operation Plan

1) Operation Schemes

There will be only one simple scheme which operates trains from terminal to terminal of the extended Line 2. Based on forecasted demand mentioned in Chapter 2, the headway and required capacity of the system are determined and summarized in **Table 7.3-1**

Table 7.3-1 Summary of Headway and Capacity on Peak Hours for Line-2

	2012	2015	2020	2025	2030	2035	2040	2045
PPHPD	11,500	18,100	20,900	23,800	26,500	28,900	31,000	32,600
Headway	5min	5min	4min	4min	3.5min	3min	3min	2.5min
# of trains/hour	12	12	15	15	17.2	20	20	24
Transportation capacity/hour	19,536	19,536	24,420	24,420	27,909	32,560	32,560	39,072

2) Fleet Requirement

Required number of trains will be calculated from round trip time and operation headway at peak hour.

Table 7.3-2 Required Number of Trains

	2012	2015	2020	2025	2030	2035	2040	2045
Headway	5min	5min	4min	4min	3.5min	3min	3min	2.5min
Number of trains in operation	12	15	18	18	21	24	24	29
Reserved train	2	2	3	3	3	3	3	4
Required Number of train	14	17	21	21	24	27	27	33

The maximal capacity of the Santolan Depot is 24 trains and there are no proper space for expansion of the depot and also it is not possible to accommodate additional trains for stabling along the line. Therefore, it will not be possible to procure additional rolling stocks after 2035 at this moment. It will be the subject for further study. **Table 7.3-3** shows the procurement plan of rolling stocks.

Table 7.3-3 Rolling Stock Procurement Plan

	2012	2015	2020	2025	2030	2035~
1st Generation Train	18	18	18	18	18	18
2nd Generation Train			**3**	3	3	3
3rd Generation Train					**3**	3
Total number of trans	18	18	21	21	24	24

7.4 Implementation Plan

The implementation plan has been shortened remarkable in comparison with the implementation plan presented in JICA report of 2011.

Several PPP options were studied, including the operation and maintenance of the expanded LRT 2 line, and the selected scheme, is a Hybrid scheme (PPP-ODA), where capital cost for implementation will be funded by government under a mixed scheme of traditional Government Appropriations Act (GAA) and Official Development Assistance (ODA) procurement processes, and upon completion it leases the

completed assets for O&M management to the private investor. The public sector, apart from financing, takes on the procurement, completion, and delivery risks for the public component. The GAA portion corresponds to the Civil Works of the project, and the ODA portion to the corresponding electro-mechanic subsystems.

Close coordination with the Civil and E&M works' portion is paramount for the success of the project. Furthermore, the completion of related projects, such as the Common Ticketing System is crucial as well for the proper implementation of the Line 2 EEP.

7.5 Cost of JICA ODA Portion

The summary of the cost for the JICA portion is shown in **Table 7.5-1**. The figures are shown in foreign (JpY) and local (PhP) portions, and summarized in US$. The disbursement schedule for the JICA Loan portion is shown in **Table 7.5-2**.

Table 7.5-1 Total Cost of JICA Loan

Breakdown of Cost	Jpn Yen ('M)			Phi Peso ('M)			Total (Jpn Yen)('M)			Total (US$ M)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Power and Catenary	778	778	0	59	59	0	889	889	0	10.79	10.79	0.00
Signalling and Telecom	1,382	1,382	0	55	55	0	1,486	1,486	0	18.03	18.03	0.00
System Miscellaneous	239	239	0	2	2	0	242	242	0	2.94	2.94	0.00
Track	876	876	0	60	60	0	989	989	0	12.00	12.00	0.00
Rolling Stock	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SubTotal Direct ODA	*3,276*	*3,276*	*0*	*175*	*175*	*0*	*3,606*	*3,606*	*0*	***43.75***	*43.75*	*0.00*
Consulting Services	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
SubTotal Direct Loan	*3,276*	*3,276*	*0*	*175*	*175*	*0*	*3,606*	*3,606*	*0*	***43.75***	*43.75*	*0.00*
Price Escalation	136	136	0	9	9	0	152	152	0	1.85	1.85	0.00
Physical Contingency	171	171	0	9	9	0	188	188	0	2.28	2.28	0.00
Land Acquisition	0	0	0	2	0	2	4	0	4	0.05	0.00	0.05
Administration Cost	0	0	0	104	0	104	198	0	198	2.40	0.00	2.40
VAT	0	0	0	251	0	251	474	0	474	5.75	0.00	5.75
Import Tax	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Interest during construction	16	16	0	0	0	0	16	16	0	0.20	0.20	0.00
Commitment Charge	8	8	0	0	0	0	8	8	0	0.10	0.10	0.00
SubTotal Indirect Cost	*331*	*331*	*0*	*375*	*18*	*357*	*1,040*	*364*	*676*	***12.62***	*4.42*	*8.20*
Total	**3,606**	**3,606**	**0**	**550**	**193**	**357**	**4,646**	**3,970**	**676**	**56.36**	**48.17**	**8.20**

Source: Study Team

Table 7.5-2 Cost Disbursement Schedule for JICA Loan

Breakdown of Cost	Annual Disbursement (Million Jp Yen)				
	2013	2014	2015	2016	Total
Power and Catenary	0.00	889.02	0.00	0.00	889.02
Signalling and Telecom	0.00	1,486.36	0.00	0.00	1,486.36
System Miscellaneous	0.00	241.94	0.00	0.00	241.94
Track	158.22	830.66	0.00	0.00	988.89
Rolling Stock	0.00	0.00	0.00	0.00	0.00
SubTotal Direct ODA	**158.22**	**3,447.98**	**0.00**	**0.00**	**3,606.20**
Consulting Services	0.00	0.00	0.00	0.00	0.00
SubTotal Direct Loan	**158.22**	**3,447.98**	**0.00**	**0.00**	**3,606.20**
Price Escalation	3.39	148.89	0.00	0.00	152.29
Physical Contingency	8.08	179.84	0.00	0.00	187.92
Land Acquisition	4.07	0.00	0.00	0.00	4.07
Administration Cost	8.69	188.84	0.00	0.00	197.52
VAT	20.85	453.21	0.00	0.00	474.06
Import Tax	0.00	0.00	0.00	0.00	0.00
Interest during construction	0.34	7.89	7.91	0.00	16.14
Commitment Charge	3.96	3.96	0.00	0.00	7.93
SubTotal Indirect Cost	**49.39**	**982.64**	**7.91**	**0.00**	**1,039.93**
Total	**207.61**	**4,430.62**	**7.91**	**0.00**	**4,646.14**
	4.47%	***95.36%***	***0.17%***	***0.00%***	***100.00%***

Source: Study Team

7.6 Consideration on Project Effects

"Preparatory Study for LRT Line 2 Extension Project", hereinafter "Previous Study", was completed in October 2011. This chapter about Line 2 East Extension Project is mainly just reviewed the recent study.

The calculation of indexes is done for whole section including existing section and extension section. The result of operation/effect indicator is shown in **Table 7.6-1**.

Study team confirmed that there is no remarkable change in surrounding area of new stations along the new line since Previous Study, by checking population census 2010, latest version map, and site survey.

The effects of reduction of CO_2 emission are shown referring to "Climate Finance Impact Tool for Mitigation and Adaptation (Summary) Ver. 1.0, JICA, 2011". **Table 7.6-2** shows the result of the estimation of reduction of greenhouse gas. The project is effective for the reduction of greenhouse gas. The balance for reduction of CO_2 emission will be increasing gradually.

Table 7.6-1 Calculation result of operation or effect indicators

No.	Operation or effect indicators	Actual in 2011	Desired in 2018 (2 years after opening)
1.	Passenger-km	1,691	3,464
2.	The number of trains in operation	342	428
3.	Workable car ratio	83.3%	95%
4.	Train-km	1,514,315	2,523,959
5.	Fare revenue	856.84	-
6.	Fare Box Ratio	0.85	-
7.	Non-railway revenue	30.20	-
8.	Load factor	38.99	-

Table 7.6-2 Result of the estimation of reduction of greenhouse gas

Unit: tCO_2 /year

Items		2015	2020	2025	2030	2035
Base Line		25	28	31	34	37
Project	Conversion from PUJ	1	2	2	2	2
	Increasing	1	1	1	1	1
Reduction of CO_2 emission		23	25	28	31	34

7.7 Environmental and Social Considerations

1) Review of EIA Report

In 2011, an EIA study for LRT Line 2 Extension Project was conducted by the JICA preparatory Study. The Environmental Performance Report and Management Plan (EPRMP: the Environmental Impact Statement (EIS) for the existing projects for modification or re-start-up) has been prepared by LRTA.

The review of the existing documents was done for the whole components of the extension project covered by the EPRMP. The Study Team has made recommendations on mitigation measures and monitoring plans in accordance with the JICA Guidelines.

2) Supplemental EIA Study

The EPRMP was prepared by the JICA Study in October 2011 in accordance with JICA Guidelines. In addition, any changes have been observed since last year in and around the Marcos Highway where the alignment of the extension line will be planned. Therefore, any supplemental environmental survey will not be needed to follow up the baseline conditions.

3) Review of RAP

The JICA Preparatory Study in 2011 indicated that no people shall be displaced as a result of Right-of-Way (ROW) acquisition for the extension line and new stations. Therefore, any RAP was not prepared.

The alignment of LRT Line 2 Extension Project has not been changed. In addition, any change in the vicinity of the alignment have bas not been observed since last year in and around the Marcos Highway where the alignment of the extension line has been planned. Therefore, any supplemental RAP will not be necessary.

APPENDICES

A. Review of Specifications of Existing Railway Facilities and Systems
   1. Civil
   2. E&M System Plan of LRT Line 2 East Extension
   3. Rolling Stock

B. Others
   1. Civil
   2. Environmental and Social Considerations

C. Demand Forecast for Line 2 Extension Project

Appendix A: Review of Specifications of Existing Railway Facilities and Systems

1 CIVIL

The result of having reviewed Preparatory Study for LRT Line 2 Extension Project Final Report (October 2011) which is the last investigation report, It is judged that civil engineering facilities construction of an east extension project can be carried out by being based on the last contents of the report.

The item about civil engineering facilities planning is shown below.

1) Existing standard and specification
    * Construction standards
    * Track geometry standards
    * Maintenance standards
2) Project design standards
    * Design load
    * Track geometry standards
    * Maintenance standards
3) Civil engineering facilities plan
    * Civil construction envelop, Track center spacing
    * Viaduct
    * Stations
    * Intermodal facilities
    * Construction method

Moreover, the plan drawing of the east extension section is shown below.

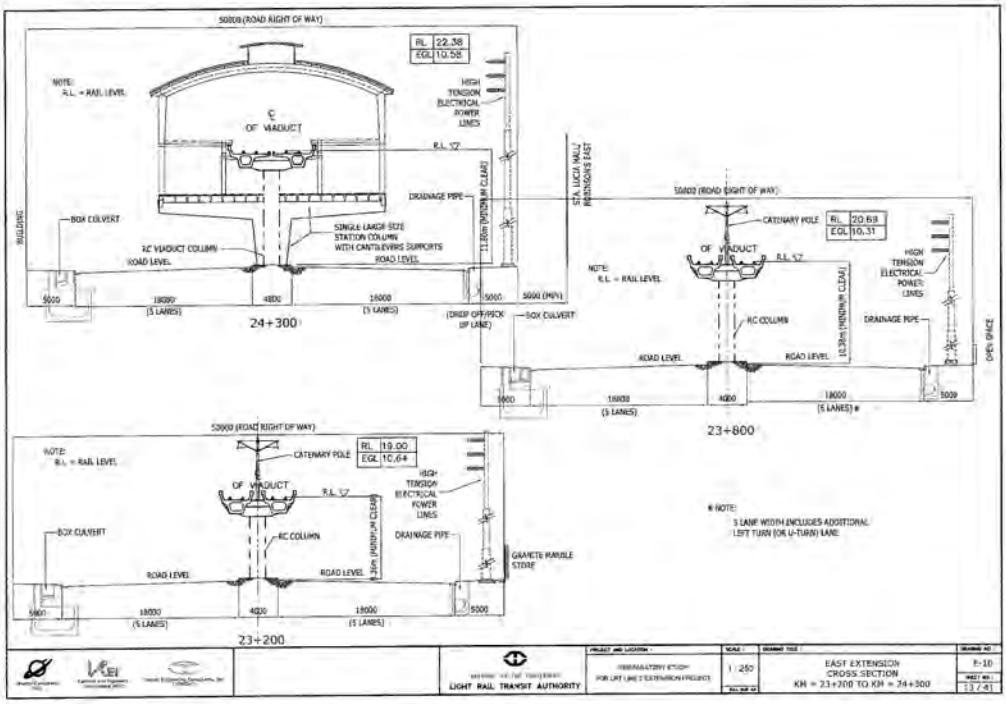


Figure 1-1 Section drawing of station (Separate platform) and elevated track

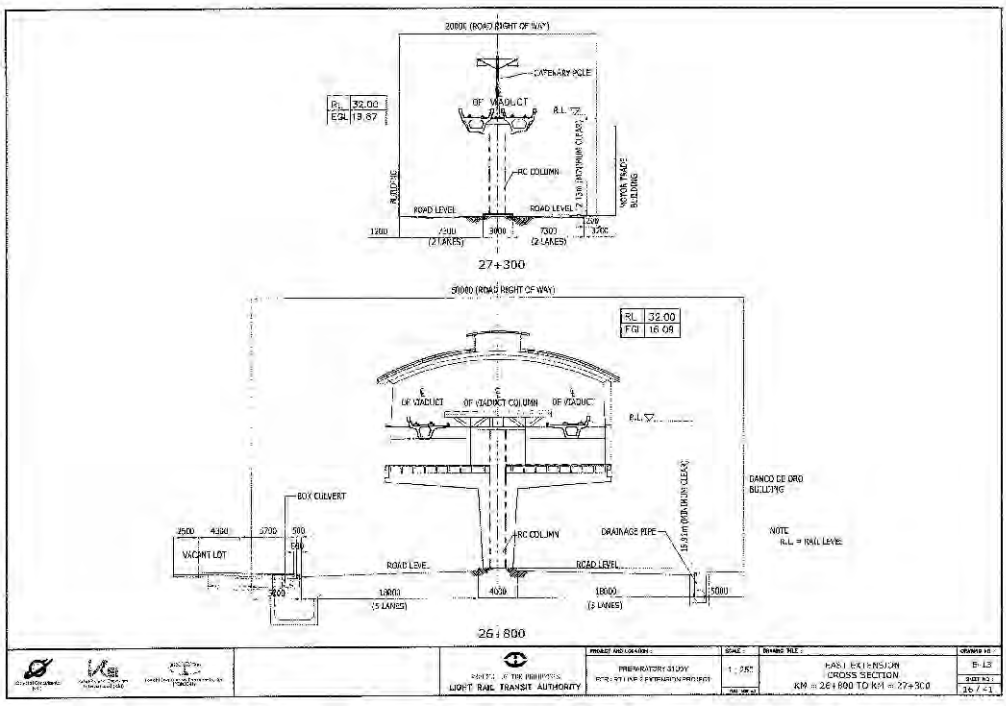


Figure 1-2 Section drawing of station (Island platform) and elevated track

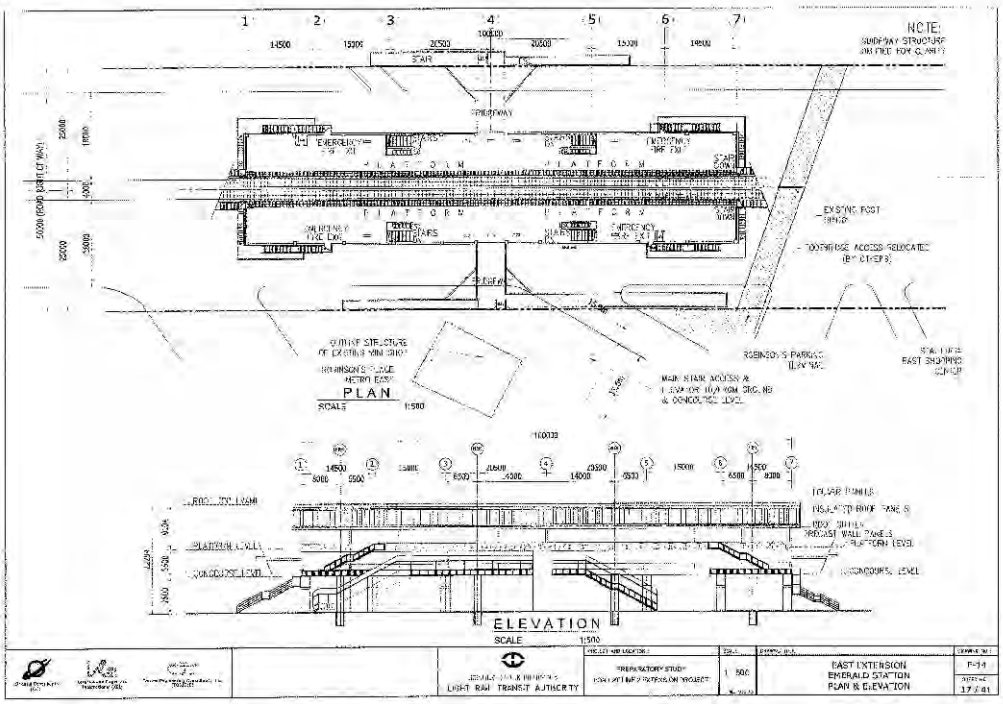


Figure 1-3 Drawing of station (Separate platform)

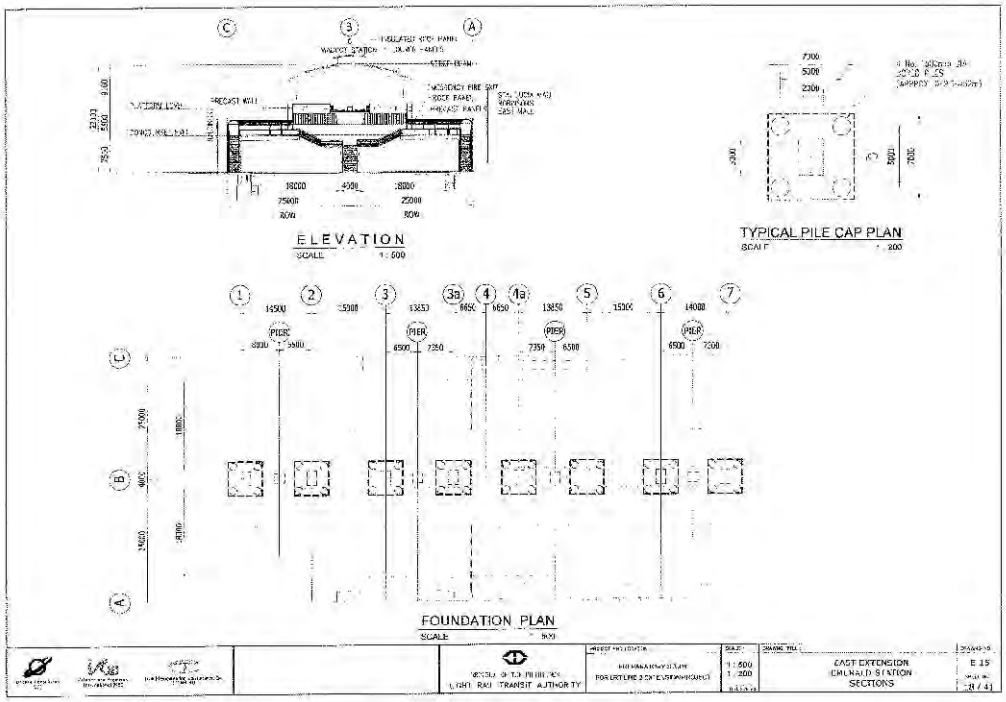


Figure 1-4 Drawing of foundation of station (Separate platform)

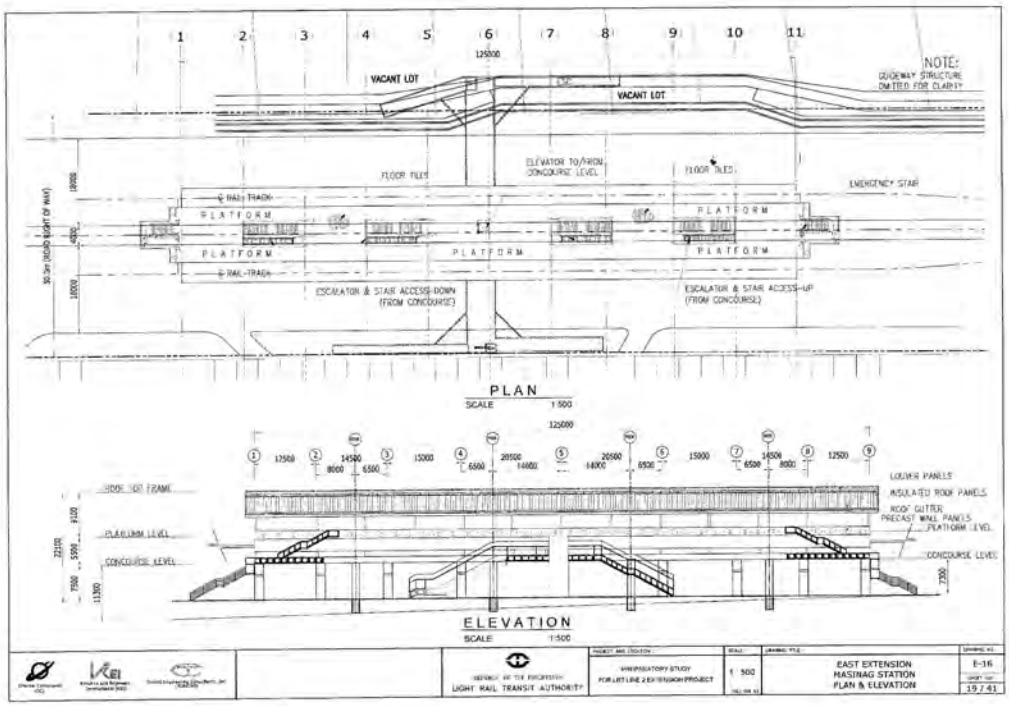


Figure 1-5 Drawing of station (Island platform)

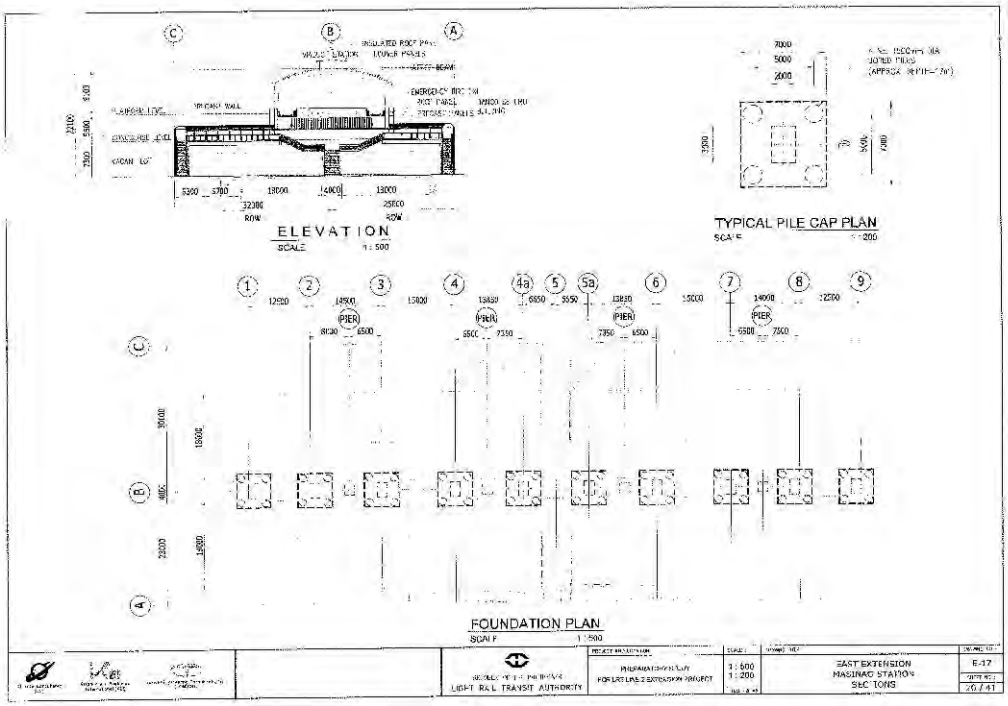


Figure 1-6 Drawing of foundation of station (Island platform)

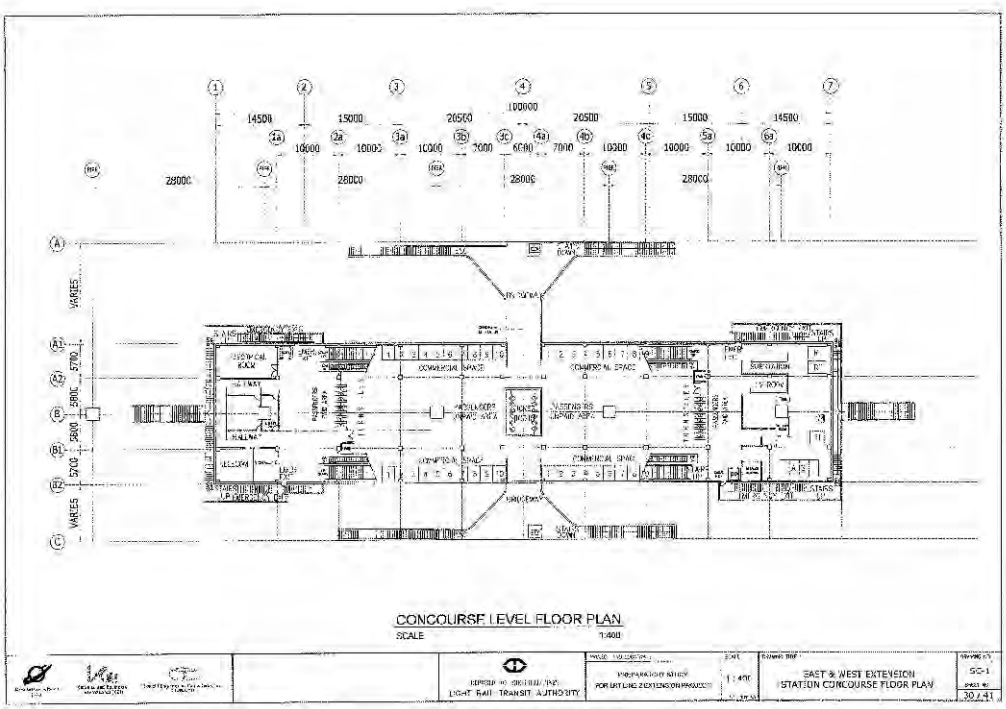


Figure 1-7 Drawing of station concourse

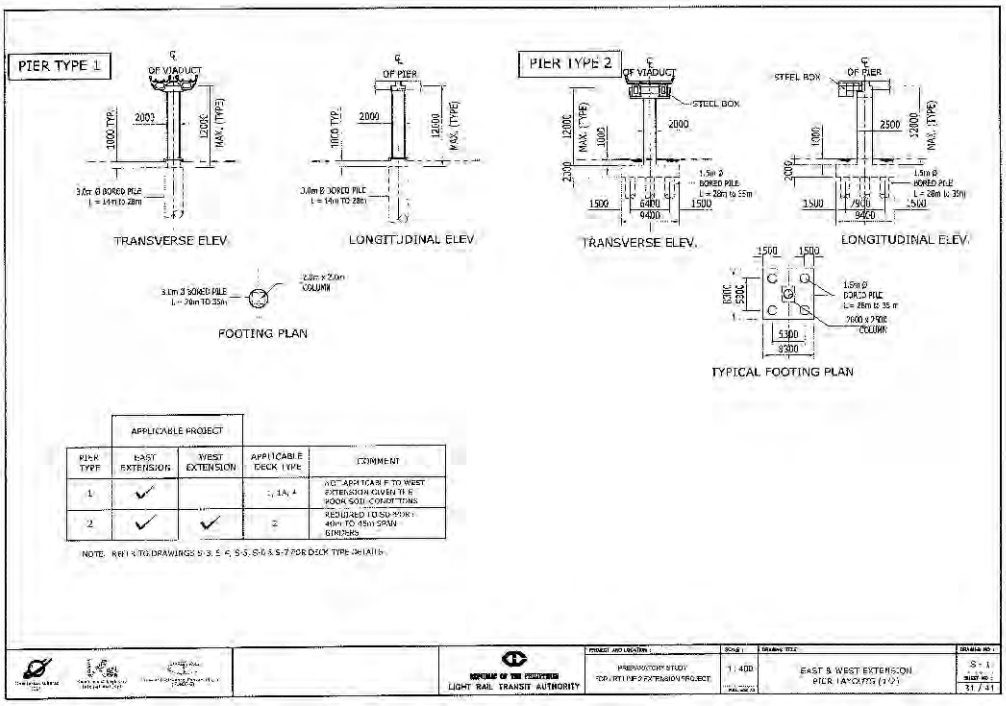


Figure 1-8 Drawing of pier (1)

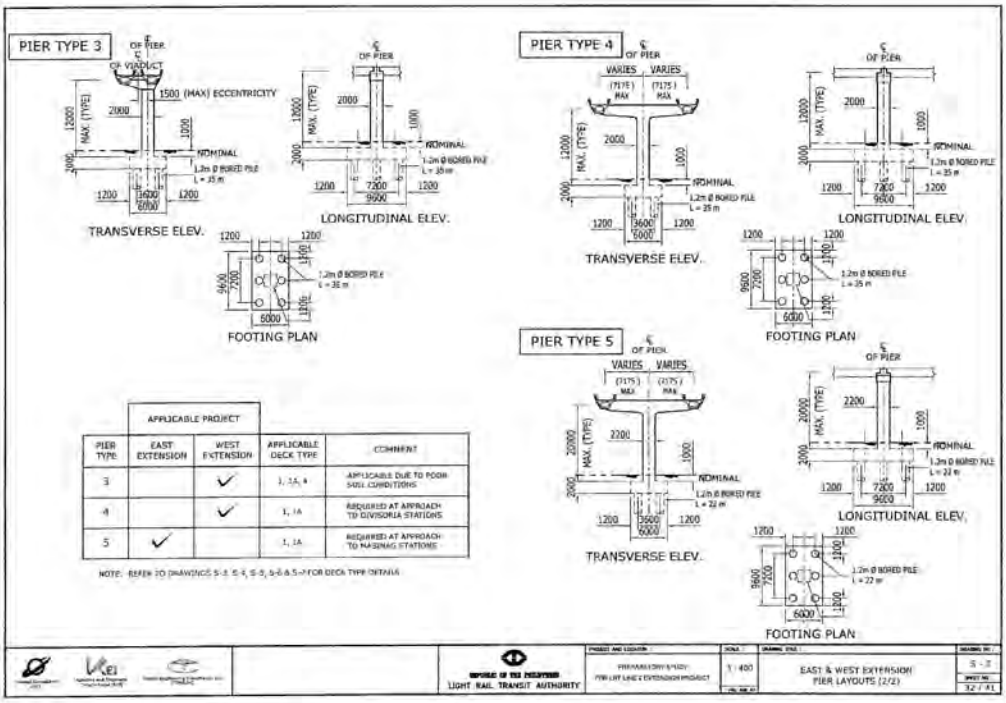


Figure 1-9 Drawing of pier (2)

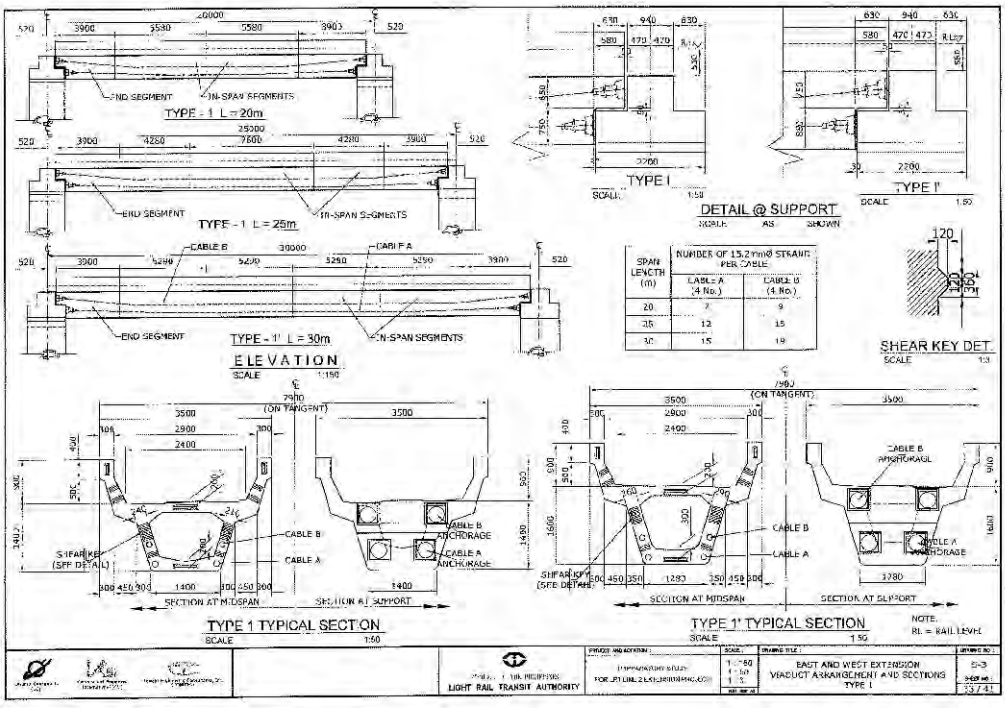


Figure 1-10 Drawing of viaduct (Box girder type)

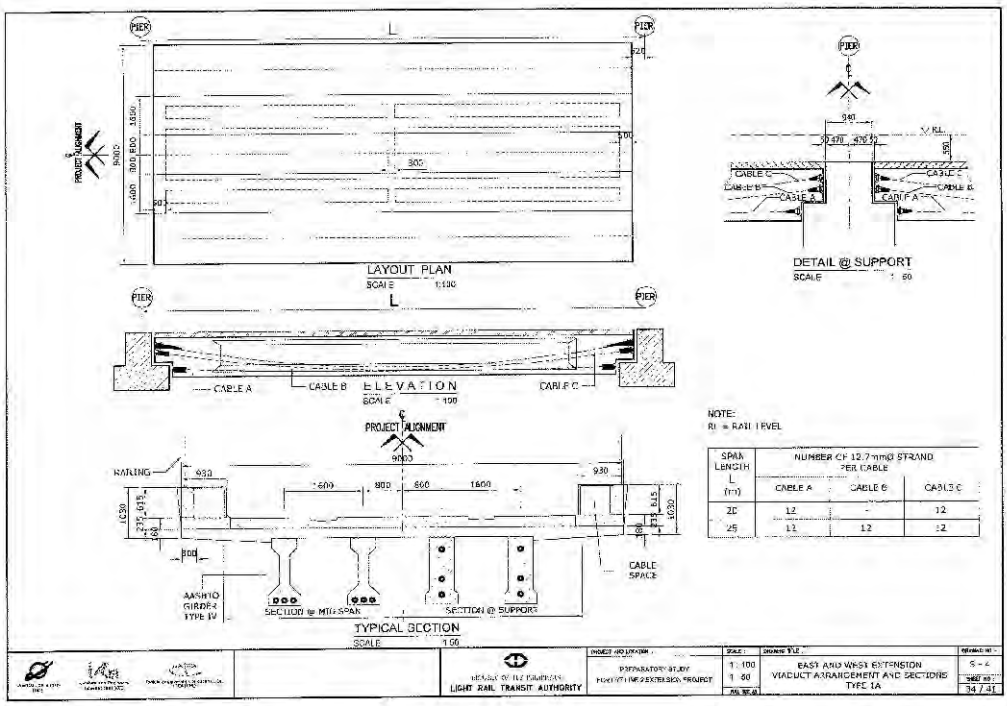


Figure 1-11 Drawing of viaduct (I beam type)

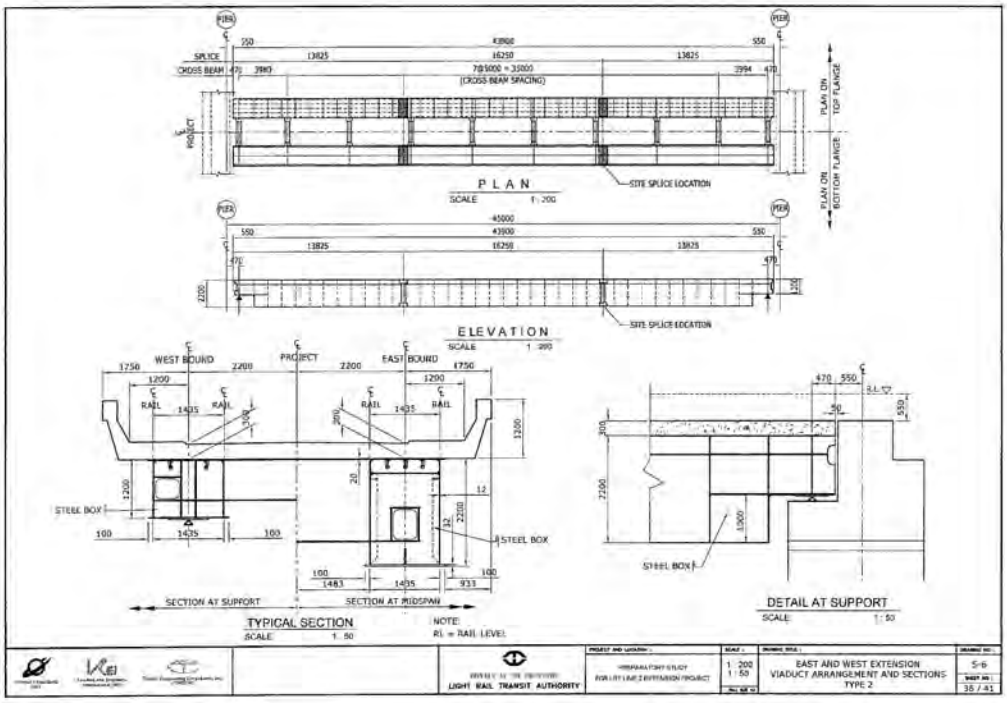


Figure 1-12 Drawing of viaduct (Steel box type)

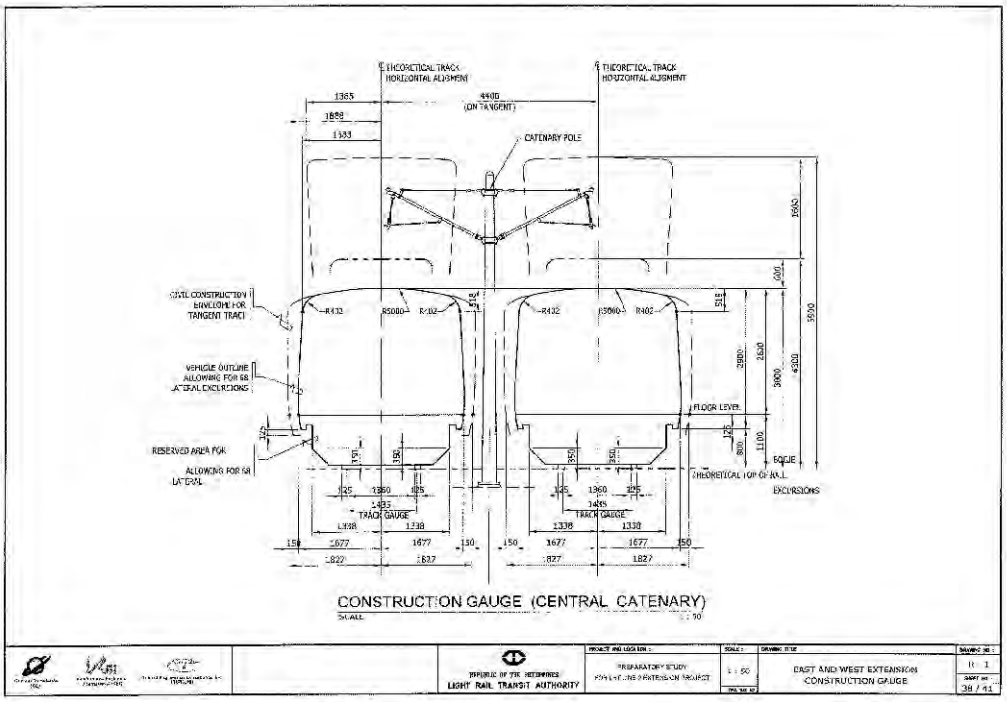


Figure 1-13 Drawing of construction gauge

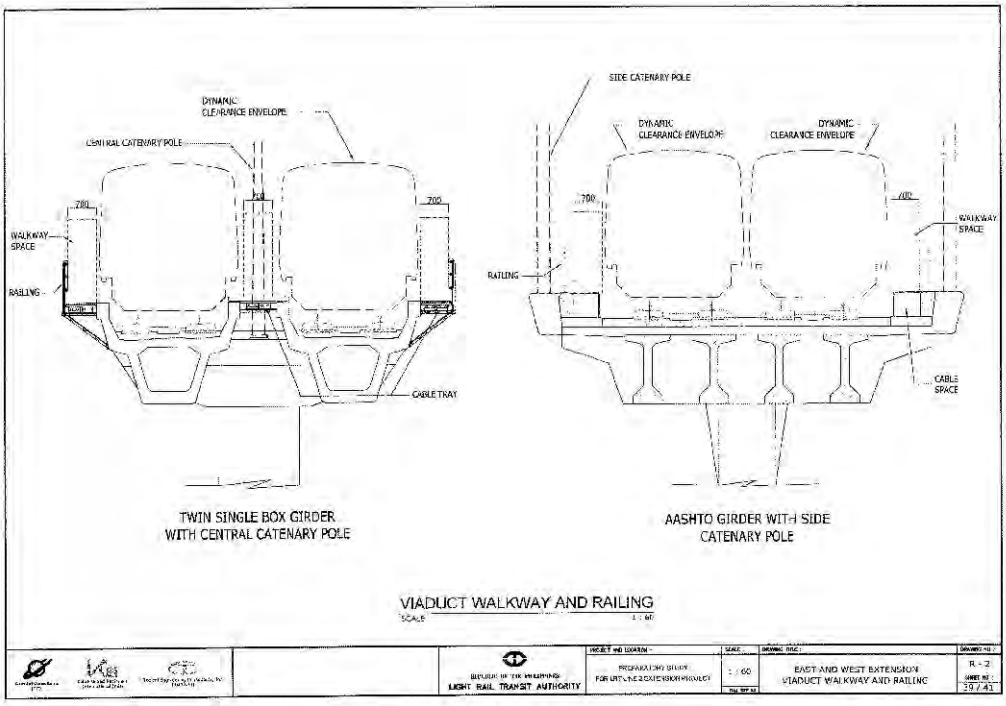


Figure 1-14 Drawing of viaduct walkway and railing

2 E&M SYSTEM PLAN OF LRT LINE 2 EAST EXTENSION

In this chapter, the contents were designed based on the review of the following reports:

a. METI report: Study on Manila LRT Line 2 east west extension project (March 2010)
b. JICA report: Preparatory study for LRT Line 2 extension project (October 2011)

2.1 Plans for Power Distribution, Machinery, Signaling, and Telecommunication Facilities

Table 2-1 Description of E&M system construction work

System	Classification	Equipment	Description of work	Scale
Power distribution	Extension	Rectifier substation	Power supply for east extension	1 location near Emerald station (RSS#7)
		Station electrical room	Power supply for equipment in new stations	2 stations in east extension
		Power distribution facilities along main line	High voltage and low voltage power distribution	4.14km in east extension
		Catenary equipment for the main line	Installation of catenary and center poles	Ditto
	Function Reinforcement	4000KW rectifier	Additional rectifier for increased power demand	RSS #1,3,4,5 (Number of locations depends on the size of the demand)
Signaling	Extension	Signaling equipment rooms, railway equipment, wiring	Signaling equipment rooms at new stations, wayside railway equipment in extension section and wiring of sigaling cables	2 stations and 4.14km in east extension
		Onboard signaling equipment for new rolling stock	Onboard signaling equipment mounted on new trains	Number of mounted equipment depends on the number of train sets
		Switch machine for the main line	Switch machine for train turn-back	Masinag station
		Passenger information displays	Installation at the platform of new stations	2 stations in east extension
	Upgrading	Train supervisor control equipment	Replacement of whole OCC equipment due to extension	OCC 1 set
		Central control equipment	Replacement of whole OCC equipment due to extension	OCC 1 set
Telecommunication	Extension	Telecommunication facilities for the stations	Installation of telecommunication equipment at new stations	2 stations in east extension
		Clock facilities	Installation of clock facilities at new stations	Ditto
		SCADA facilities	Installation of remote control terminals for new stations and substation	Ditto, RSS#7
		Telephone facilities	Installation of telephone facilities for new stations	2 stations in east extension
		APS announcement facilities	Installation of APS facilities for new stations	Ditto
		Train radio facilities	Installation of new radio stations	Masinag station
		Fiber optical transmission line for telecommunication	Extension of fiber optical transmission line	4.14km in east extension
		UPS power source facilities for telecommunication	Installation of UPS power source facilities for telecommunication facilities for new stations	2 stations in east extension

Source: Study Team

Table 2-2 Description of E&M system construction work

System	classification	Equipment	Description of work	Scale
Telecommunication	Upgrading	CCTV	Installation of CCTVs at new stations and 3 operating stations which have become unable to transmit	2 stations in east extension 3 stations in need of repair
		Fiber optical transmission line for telecommunication	Installation of dedicated fiber optical transmission line for signaling and CCTVs	17.66km
		Central control equipment	Replacement of whole OCC equipment due to extension	OCC 1 set
		Management information system	Replacement of whole OCC equipment due to extension	OCC 1 set
	Repair	SCADA	Early restoration of required system for safe management of power supply	Entire area of existing section
		APS	Early restoration of required broadcasting facilities for operation	In Depot
AFC	Upgrading	AFC	Installation of AFC facilities at new stations, and upgrading of some AFCs at existing stations	2 stations in east extension and 11 existing stations
Track works	Extension	Direct fixation concrete tracks for the main line	Construction of direct fixation concrete track structures including rail and rail fastening device	4.14km in east extension
		No.8 diamond double crossover	Installation of switch machine for train turn-back	Masinag station
		Rail joints for main line, etc.	Seamless rail welding, etc.	4.14km in east extension
	Repair	Concrete plinth	Plinth repair for safe train operation	43 points in existing section
Maintenance facilities	Repair	Under-floor wheel truing machine	Early restoration of necessary equipment for train maintenance	1 set at wheel truing line in Depot

Source: Study Team

2.1.1 Data for Cost Estimates

In order to implement the extension of LRT Line 2, construction estimates were made by the following construction types, including the extension line.

a. Costs to revise the existing system specifications, to upgrade the facilities in the existing line due to obsolescence, and to install facilities of the same specifications in the extension;
b. Costs to install facilities for the extension of the same specification as the existing systems;
c. Costs to reinforce functions of the existing facilities due to the extension; and
d. Repair costs for the existing facilities.

Specific descriptions of the categories are as follows:

1) Upgrading the Existing Systems

The upgrade of the existing systems is summarized as follows:

a. To install new SDHs and UPS in signal equipment rooms in the existing and extension line, and to separate the transmission portions of the signaling systems from the telecommunication systems;
b. To install new CCTVs at new stations and the operating stations which have become unable to transmit;
c. To install dedicated fiber optical transmission line for signaling and CCTV; and

d. The on-going project “Upgrading and Integration of the Automatic Fare Collection Systems of the LRT1, LRT2, and MRT3 railway Systems”

The quantities for the above upgraded systems are shown in **Table 2-3** Estimates for System Upgrades.

2) Construction of the Extension

The quantities for the construction of the extensions with the existing specification are shown in **Table 2-4** Estimates for the Extension.

3) Function Reinforcement of the Existing Equipment

Demand for power supply will increase upon extension as the number of operating trains increases. Each of the four existing rectifier substations (RSS#1, RSS#3, RSS#4, and RSS #6) has an empty space where one 4000kW-class rectifier can be installed. One rectifier per substation will be allocated for reinforcement in order to cope with the demand increase.

The expected quantity due to function reinforcement is shown in **Table 2-5** for Function Reinforcement of the Existing Equipment.

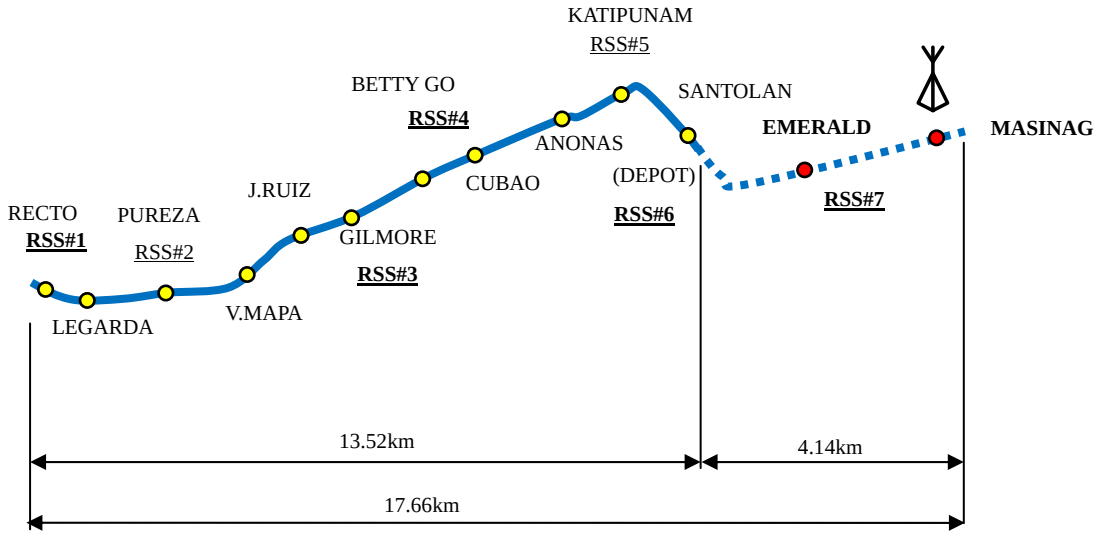
4) Repair of the Existing facilities

The answers obtained from LRTA regarding the repair items for the existing facilities and their costs are shown in **Table 5.5-1**. The estimated extensive repair cost of line 2.

5) Quantities

Route layout is as shown in **Figure 2-1** LRT Line 2 Route Layout for the purpose of cost estimates.

The results of the cost estimates are as shown in **Tables 2-3～2-5** below. The quantities indicated in **Tables 2-3～2-5** represent for the east extension. The distribution ratio of foreign and local costs was set with reference to the contract records for the construction of LRT Line 2. Cost of these items will be included in **Section 5.5**.



Source: Study Team

Figure 2-1 LRT Line 2 Route Layout

Table 2-3 Estimates for System Upgrades

Item	Unit	Quantity	Distribution ratio	
		East extension	Foreign	Local
Control center equipment for signaling	set	1	90%	10%
New CCTV (incl. existing parts)	station	New 2 Repair 3	95%	5%
New fiber optical transmission line (signaling, CCTV), including the installation of new SDHs	km	17.66	95%	5%
Control center equipment for telecommunication	set	1	95%	5%
Train supervisor control equipment (OCC)	set	1	95%	5%
New management information system (MIS)	set	1	95%	5%

Source: Study Team

"Upgrading and Integration of the Automatic Fare Collection Systems of the LRT1, LRT2, and MRT3 railway Systems" is ongoing.

Table 2-4 Estimates for the Extension

Item	Unit	Quantity	Distribution ratio	
		East extension	Foreign	Local
Rectifier substation (RSS#7)	location	1	90%	10%
Station electrical room	station	2	90%	10%
Power distribution facilities along main line	double-track km	4.14	90%	10%
Catenary equipment for the main line	single-track km	8.28	80%	20%
Signaling equipment rooms, railway equipment, wiring	station	2	90%	10%
Onboard signaling equipment for new rolling stock	train set	Depending on the number of required rolling stock	90%	10%
Switch machine for the main line	unit	4	90%	10%
Passenger information displays	station	2	90%	10%
Telecommunication facilities for the stations	station	2	95%	5%
Clock facilities	station	2	95%	5%
SCADA facilities	RTU	3	95%	5%
Telephone facilities	station	2	95%	5%
APS announcement facilities	station	2	95%	5%
Train radio facilities	base station	1	95%	5%
Fiber optical transmission line for telecommunication	km	4.14	95%	5%
UPS power source facilities for telecommunication	station	2	95%	5%
Direct fixation concrete tracks for the main line	Single-track km	8.28	85%	15%
No. 8 diamond double crossover	set	1	85%	15%
Rail joints for the main line, etc.	km	8.28	85%	15%

Source: Study Team

Table 2-5 Function Reinforcement of the Existing Equipment

Item	Unit	Quantity	Distribution ratio	
		Existing line	Foreign	Local
4000kW rectifier assembly (RSS#1,3,4,6)	set	4	90%	10%

Source: Study Team

2.1.2 Technical Consideration regarding the Function Reinforcement of the Existing Systems

Table 2-6 "Points of Technical Consideration upon Function Reinforcement" below lists additional specifications to be taken into consideration upon reinforcing the functions of the existing systems:

Table 2-6 Points of Technical Consideration upon Function Reinforcement

System	Points of Consideration
Power Supply	An approximately 300m^2 (20 x 15m) lot to the east of EMERALD Station needs to be obtained to build a new rectifier substation (RSS#7). Standard height for installing substation facilities and building structure standards should be established considering possible floods evidenced by Tropical Storm Ondoy. A possible voltage drop should be examined in detail, and high output of the substation facilities to be reinforced should be considered at the time of designing as necessary. Installation of emergency lighting systems and ventilation equipment at substations and stations' electric rooms should be considered to improve the work environment.
Overhead contact system	• Lightning arrestors should be installed on the rooftops of new station buildings and on the center poles in the extension for lighting measures.
Track works	• Continuous slab structures are preferable for expansion gaps between beams (upper piers), which does not affect the shape of direct fixation concrete track structures.
Fiber optical transmission line	• Transmission line for signaling and CCTV should be integrated as a single cable.
Telephones	• Investigate how many additional telephones are needed at the existing stations and facilities, and examine the number of additional racks that can be installed.
Train radios	• A radio wave sensitivity test should be conducted prior to setting up radio stations at each terminal station in the extended zones, and the test results should be reflected in the design of the stations.
AFC	• As part of the phased transition to the common ticketing system, it is planned to retain the exterior of automatic ticket gates and replace the interior with the contactless system successively. Thus, the specifications should be thoroughly examined upon converting the AFC system.
UPS	• Telecommunication system failures have occurred in the past due to UPS malfunction. The cause of these failures should be summarized to take measures to prevent recurrence of such failures.
CCTV	• Since the existing operational systems and new systems will be used in combination to operate CCTV for the moment, the specifications of connection areas, etc. need to be designed assuming a complete update to new systems in the future.
OCC	• Connecting between the extension and the existing lines should be done outside the hours of operation and within a short time. Therefore, the new system shall be built with other systems that will not affect the existing systems; comprehensive tests should also be conducted. • OCC facilities have already begun deteriorating; equipment including Train supervisor control equipment, control center equipment for signaling and telecommunication, and MIS, also need to be updated. • For the large operation display panel, which is currently out of service, a monitor display type is recommended.

Source: Study Team

2.2 Technical Review of Compatibility with Existing Railway System

In order to implement the extension, the study reviewed the system specifications as regards the construction of LRT Line 2 and conducted a technical examination, taking the upgrade of the existing railway facilities and systems into consideration.

This section will examine the technical aspects of ensuring consistency and compatibility between this study's proposals and the existing railway facilities and systems, and describes the ensuring of safety, maintenance, unification of spare parts, and management of drawings in terms of the operation after inauguration.

2.2.1 Technical Comparison to Ensure Consistency and Compatibility

1) Power Distribution, Machines, Signals, and Communication Equipment

Table 2-7 shows the results of the technical review regarding the upgrades of power distribution, machines, signaling, and telecommunication facilities:

Table 2-7 Result of Technical review of adjustment and compatibility with the existing equipment

System	Reexamination of the technical function	Adjustment and compatibility with the existing equipment
Signaling	Separation of the transmission line from the telecommunication system	The specification of fiber optical transmission line is changed. The current specifications for signal equipment will be applied for the extension line.
AFC	Replacement of broken equipment, Upgrading	Nearly half of the automatic ticket gates including broken equipment are converted to upgrade the function. Because the existing equipment is used in combination, AFC data transmission will use the specification equivalent of the existing equipment for the existing system and no major update will be made.
CCTV	Replacement of broken equipment, Upgrading, Installation of dedicated fiber optical transmission lines	The existing system and the new CCTV system will be used in combination for the moment. Newly dedicated fiber optical transmission line will be installed and 2 CCTV systems are to be installed so that no mutual interface will occur.
Track works	Mitigation of the squeal sound and the wear of rails and wheels	Check rails are not adopted. By applying the alternative countermeasures or reduced running speed in the curves, it is expected that the squeal sounds and the wear of rails and wheels will be mitigated.
	Deterrence of track deformation	Tracks using anti-vibration sleepers absorb vibration compared with the tracks laid by the concrete plinth method and are expected to reduce track deformation.
Maintenance facilities	Common use of maintenance facilities	By accommodating the basic specifications of additional rolling stock to the existing specification, the maintenance facilities can be shared with existing rolling stock.
Power distribution, Overhead contact system, Telephone, Clocks, Train radio, SCADA, APS, PIS	Follow the existing functions	Since the functions of these systems are satisfactory, the standards and specifications adopted in the existing line will apply to the extension line.

Source: Study Team

2.2.2 Technical Review Viewing Operation after Inauguration

1) Power Distribution, Machines, Signals, and Communication Equipment

a. Ensuring safety

Deformation of the concrete plinth for the tracks could reduce the safety of the running trains and appropriate train operation. Detailed inspection will be required where track deformation is expected to occur. High voltage cables are installed right under the inspection passage for workers in the existing lines, and power is supplied through the center pole to the overhead catenaries. In the extension lines, it is desirable to install high voltage cables at a sufficient distance from the inspection passage considering the safety of the workers.

b. Maintenance

Although the existing AFC system equipment is currently being repaired by LRTA, it is desirable to outsource it in terms of operational efficiency in compliance with the common ticketing system concepts. Since the existing power and telecommunication cables are installed under the inspection passage between the track beams of the up and down lines, it is not easy to inspect them due to the need to open the inspection passage which is covering the duct. It is desirable to install cable troughs on the same surface as tracks and at distance from the inspection passage. Maintaining the correct shape of the wheel treads helps to improve the ride quality and reduce wheel and rail noise and abrasion. It is important to repair and maintain an under-floor type wheel turning machine, which is currently out of service, so that it is available for use at all times.

c. Unification of spare parts

Expendables and spare parts (e.g. parts, materials, tools) for track works and power distribution should be standardized with the same items as or equivalent to those used in the existing systems, so that they can be used in the main line including the extension. It is often difficult to standardize electronic parts, which are redesigned at a rapid pace. Especially in the CCTV system, parts management will be required so that parts will not be mixed when old and new systems are used at the same time.

3 ALIGNMENT

3.1 Route Planning

Based on Preparatory Study for LRT Line 2 Extension Project - Final Report (October 2011), it reviewed about the LRT Line2 east extension route. The east extension section of LRT Line 2 goes to the east on Marcos Highway from Santolan station, and about 4.1-km section to Masinag station. An intermediate station is one place of Emerald station, and is not different from last year.

Therefore, the plan of a route of Line 2 east extension presupposes that it is the same as that of the route examined by the above-mentioned study.

The whole east extension section route is shown in **Figure 3-1**, and the route drawing classified by section is shown in **Figure 3-2** to **3-8**.

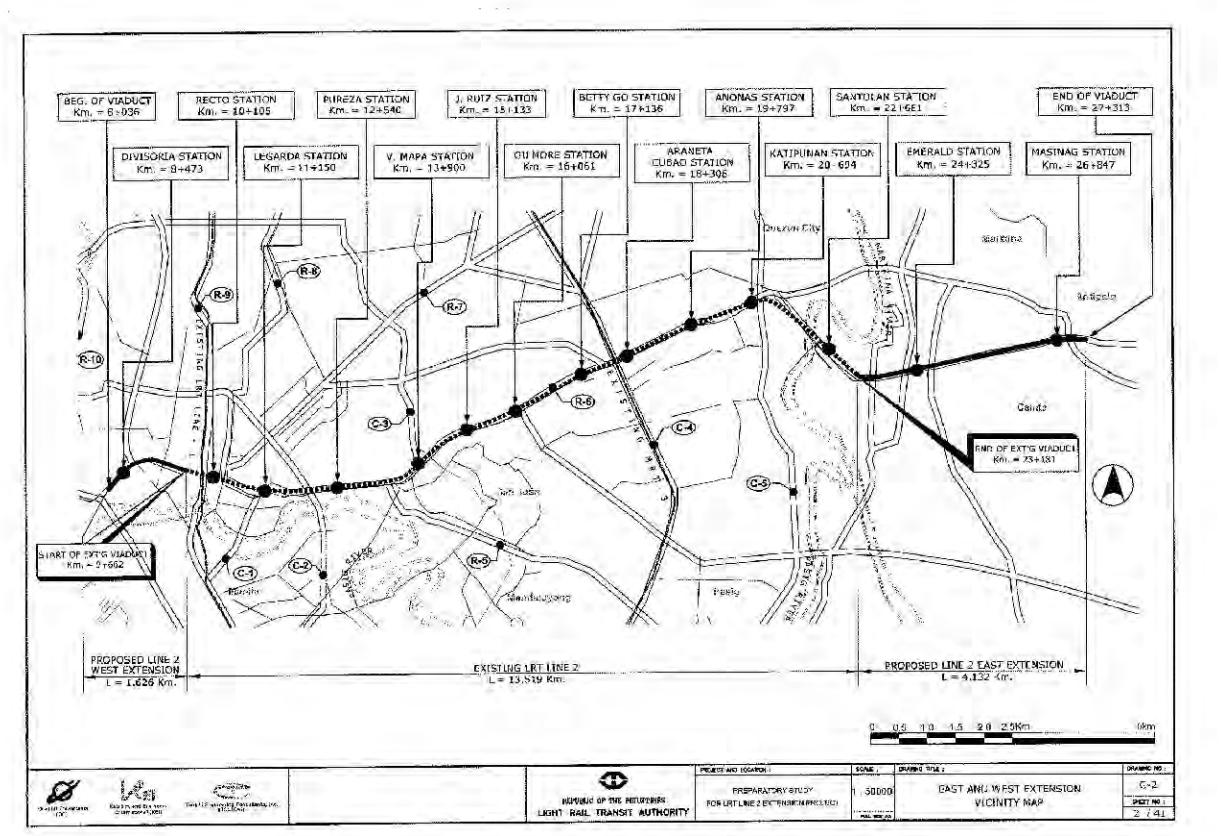


Figure 3-1 Entire map of route

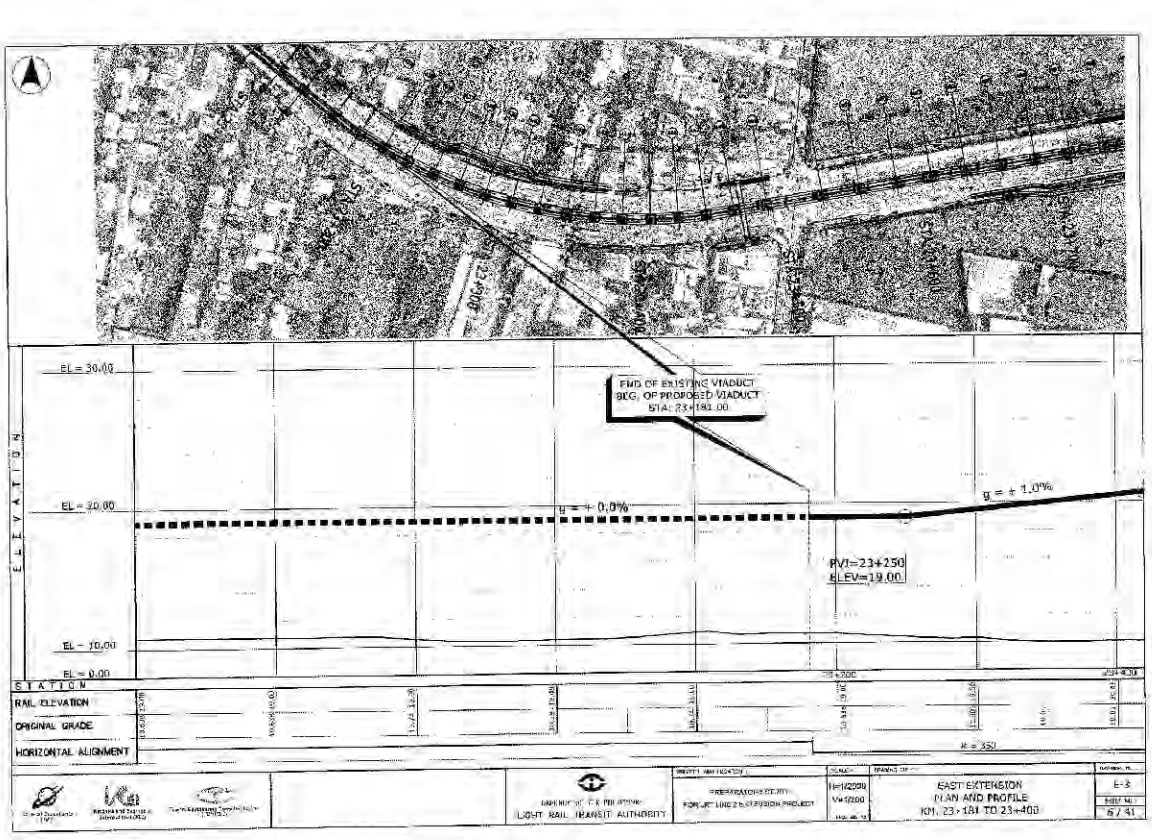


Figure 3-2 Route plan (1)

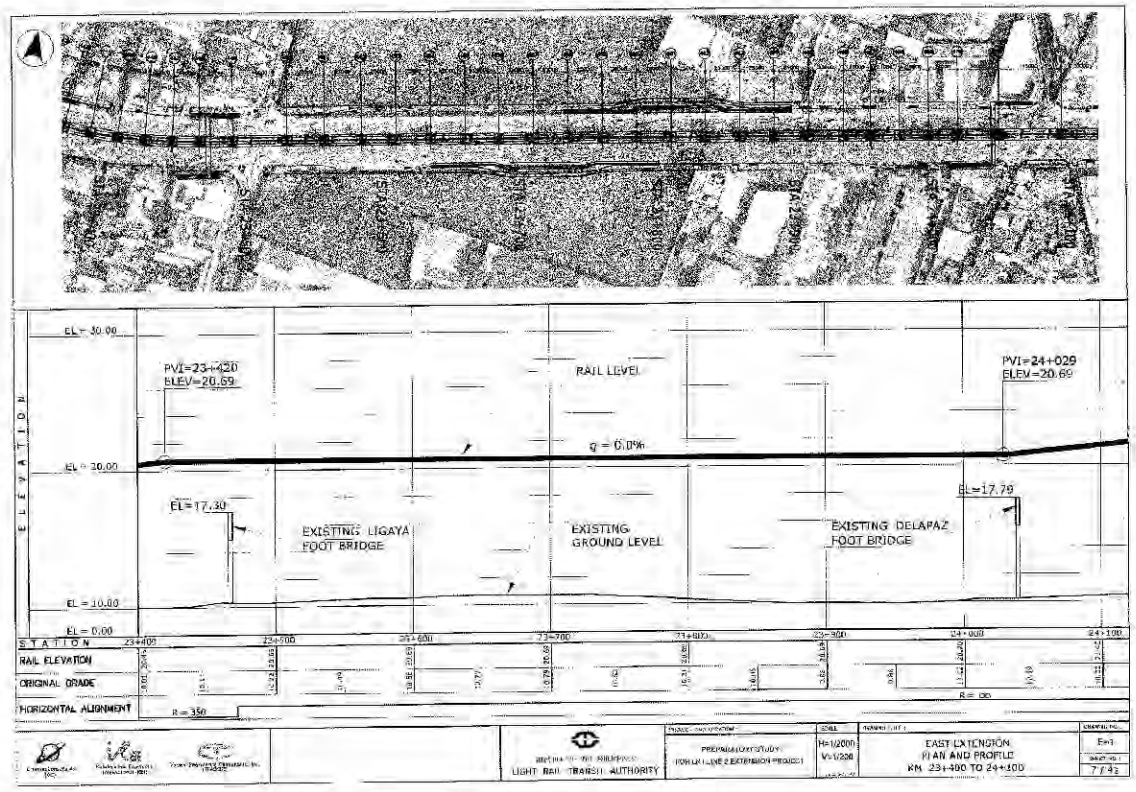


Figure 3-3 Route plan (2)

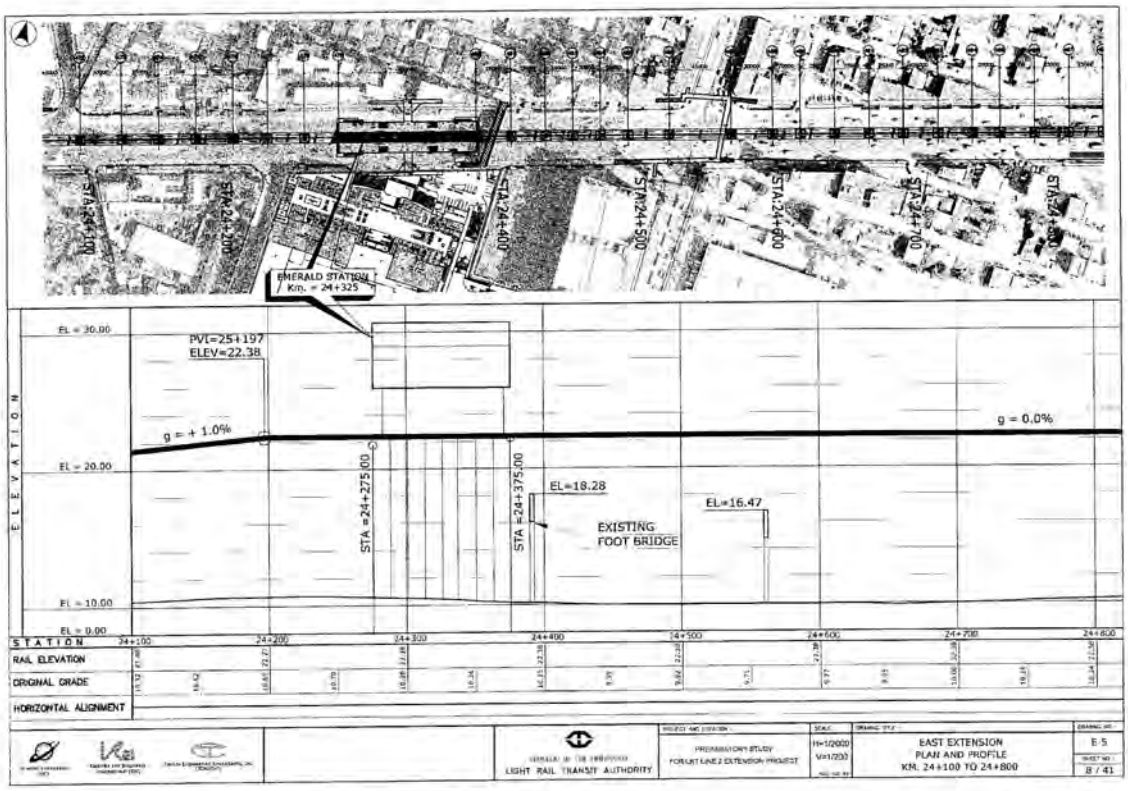


Figure 3-4 Route plan (3)

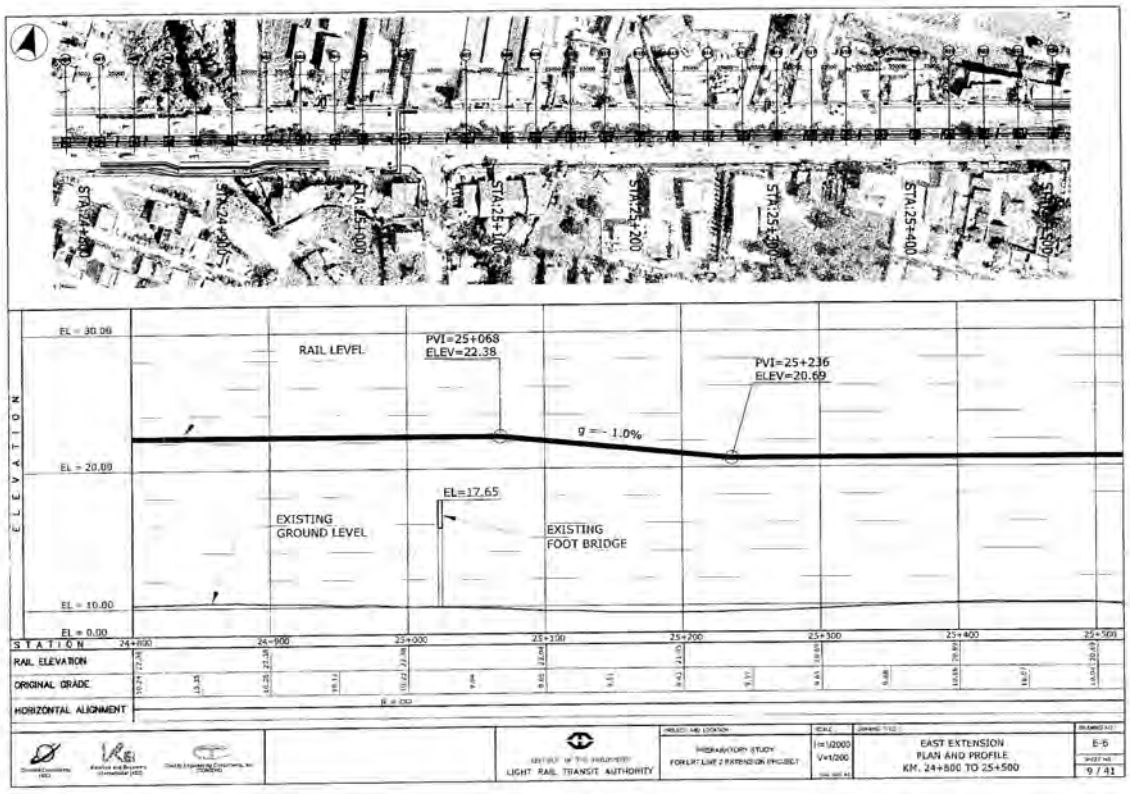


Figure 3-5 Route plan (4)

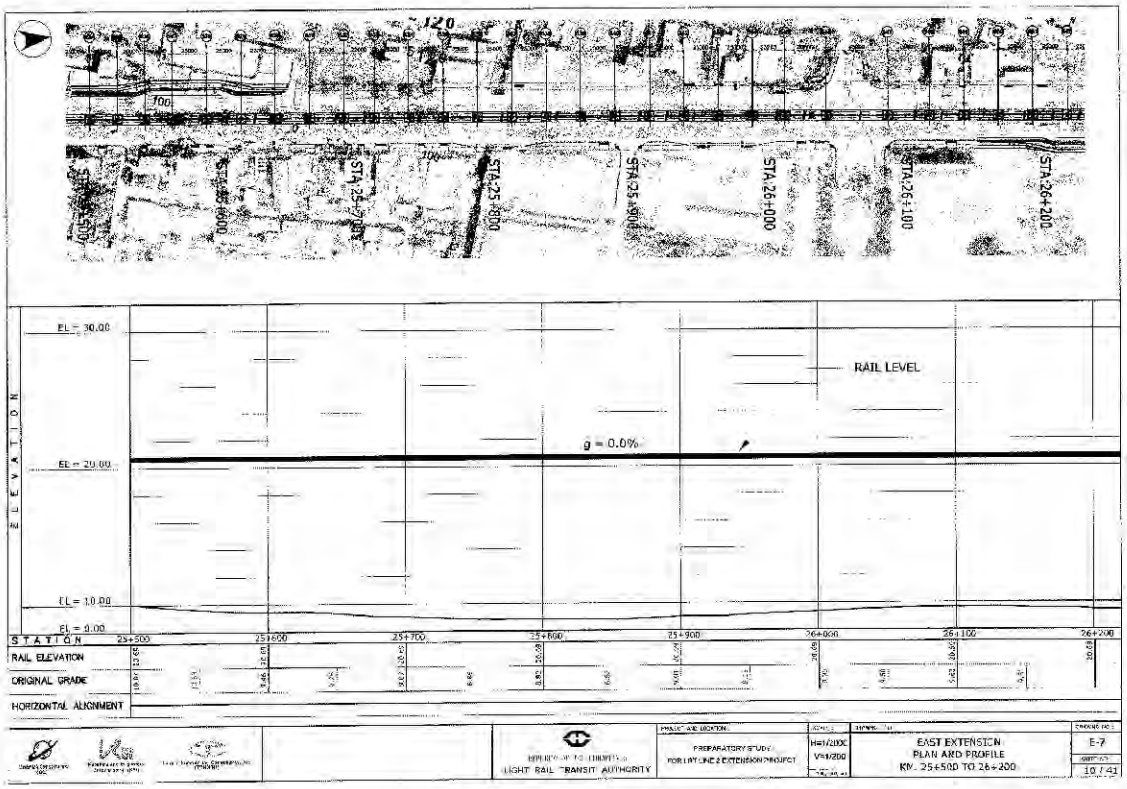


Figure 3-6 Route plan (5)

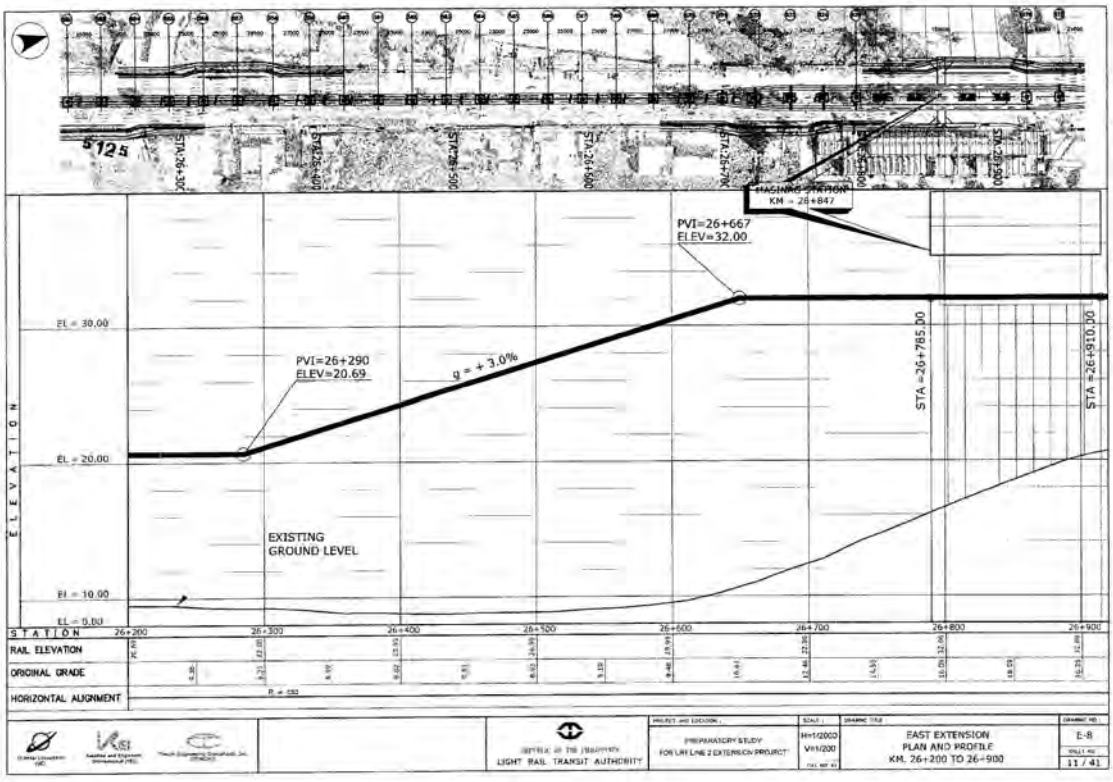


Figure 3-7 Route plan (6)

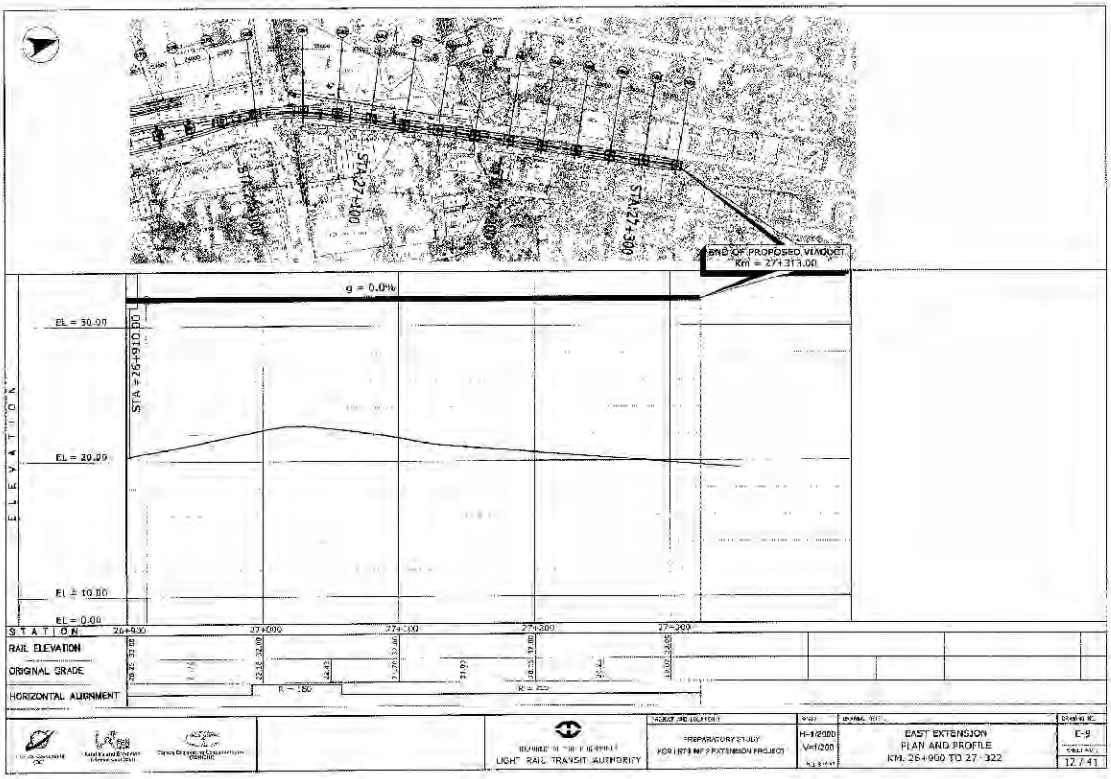


Figure 3-8 Route plan (7)

Appendix B: Others

1 CIVIL

The result of having reviewed Preparatory Study for LRT Line 2 Extension Project Final Report (October 2011) which is the last study report, although stated also within the report, it recommends construct in consideration of the following points.

1) Parapet railing on viaduct

The guard rail is not installed on the outside of the viaduct in the elevated section of LRT line 2. It should be taken guard rail or fall preventive measures against the outside of the viaduct for malfunction of door opening, or safe reservation of the passenger in an emergency.

2) Central walkway on viaduct

In the existing viaduct section of LRT line 2, the passage in the central part of the up-and-down line is used for maintenance or passenger refuge in an emergency. However, although the width of this passage is 1500 mm, since the catenary pole stands in the center, it is narrow and it is hard to pass along it, and it also has the danger of contact with a train.

Therefore, the walk passage which took fall preventive measures is installed in the outside of the viaduct, and it should enable it to use it as the walkway for maintenance people, or an evacuation walkway of the passenger in an emergency.

3) Station roof design

By LRT Line 2, the roof structure of a station building requires the following consideration.

* Hard to make the nest of a bird.
* Good as a wind.
* Cleaning is easy.
* Installation and exchange of lighting are easy.

2 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Appendix B-1 Environmental Management Plan JICA Monitoring Form for LRT Line 2 Extension Project

Table 1 Construction Phase

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/ Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
Construction of guideway and stations	Local economy (Employment)	Hire unskilled labor (>50%) and skilled labor (>30%) from the vicinity of the project sites	Employment rate	Barangays in the vicinity	Employment record		RA 6685		LRTA	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Traffic congestion	Traffic Management Plan	Continuous flow of traffic	All construction sites	Daily monitoring for a construction period		-		LRTA/MMDA/ LGUs/	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Community Health and Safety	Public Meetings	Opinions, grievance	Barangays in the vicinity	For a construction period		-		DPWH/ MMDA/LGUs	・Quarterly Monitoring Report submitted to DOTC and JICA
Labor Camp	Occupational Health and Safety	Supply the works: -clean water and safe food -toilets/sewage treatment facilities -domestic solid waste management	Camp conditions	All camps	Weekly inspection		The Philippines Occupational Safety and Health Standards (As Amended), 1992		LRTA	・Quarterly Monitoring Report submitted to DOTC and JICA
Tree cutting	Loss of trees	Tree replanting should be implemented Regular monitoring of replanted trees	Cutting trees and progress of replanting	Road sides and central reserves	Visual inspection of tree growth		-		LRTA/LGUs DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Air pollution	Dust control measures: sprinkling of water; covers of the trucked material during transportation; locate the stockyard away from residential and sensitive areas Pollutant emission control measures: low emission construction vehicles, maintenance and inspection.	Ambient air quality TSP, NO_2, SO_2	Construction sites	Methods specified by the Implementing Rules and Regulations of the Philippine Clean Air Act of 1999 Weekly during construction		The Implementing Rules and Regulations of the Philippine Clean Air Act of 1999 WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide, Global Update 2005		LRTA/ DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Noise and vibrations	Proper service of equipment; installation of sound barriers for pile driving activity; mufflers and noise suppressors and regular maintenance of heavy equipment, construction machinery; use low-noise construction machines and heavy vehicles; construction activities to be restricted during day time hours only; inform construction schedule to residents in advance.	Noise level: L_{Aeq} (day and night)	Construction sites	Methods specified by the National Pollution Control Commission (NPCC) Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise Weekly during construction		NPCC Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise General EHS Guidelines; Environmental Noise Management, IFC 2007		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
			Vibration acceleration	Construction sites	Methods specified by the 2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH) Weekly during construction		2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH)		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/ Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
Construction of guideway and stations	Surface water quality degradation	Monitoring of TSS to avoid large increase of turbidity in surface water. To use the less turbidity-diffusive dredging method.	Surface water quality (TSS, BOD, Oil/Grease)	Construction sites of bridges and satellite depot	Methods specified by the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992		The Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992		LRTA/ DENR	・Quarterly Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Waste generation	Solid Waste Management Plan. Proper implementation of separate collection and disposal	Site conditions and cleanliness	All construction sites and labor camp	Daily site inspection		Ecological Solid Waste Management Act of 2001		LRTA/DENR	・Quarterly Monitoring Report submitted to DOTC and JICA

Source: Study Tea

Table 2 Operation Phase

Project Activity	Potential Environmental Impact	Mitigation Measures (Proposed/Implemented)	Parameters to be Monitored	Location	Methods, equipment and frequency of Measurement (Date and/or time of Measurement)	Measured Value (Average/Max/Total, etc)	Philippine Standards/ Standard for Contract/Referred International Value	Input (e.g. cost, M/M)	Responsible Institution	Reporting
Construction of guideway and stations	Loss of trees	Monitor the growth of replanting trees	Trees' height and diameter	Replanting sites	Once a year		-		LRTA/DENR/ LGUs	・Annual Monitoring Report submitted to DOTC and JICA
Construction of guideway and stations	Subsidence	Regular monitoring of ground settlement	Settlement level	Potential sites	Once a year		-		LRTA	・Annual Monitoring Report submitted to DOTC and JICA
Wastewater treatment at stations and depots	Surface water quality degradation	Proper operation and maintenance of wastewater treatment facilities at stations	Effluent water quality (pH, TSS, BOD, COD, Oil/Grease, Phenol, Fiscal Coliforms)	Wastewater treatment facilities at stations and depots	Methods specified by the Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992 2times per year		The Revised Effluent Regulations of 1990, Revising and Amending the Effluent Regulations of 1992		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
Operation at the stations and depots	Waste generation	Proper implementation of separate collection and disposal	Cleanliness	Stations and depots	Site Monitoring		Ecological Solid Waste Management Act of 2001		LRTA/MMDA/ LGUs	・Biannual Monitoring Report submitted to DOTC and JICA
Train operation	Noise and vibration	Noise and vibration attenuation measures: installation of noise barriers or shock absorber pads and ballast	Noise level: L_{Aeq} (day and night)	Noise sensitive areas such as residential area, school religious facilities along the extension line	Methods specified by the National Pollution Control Commission (NPCC) Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise 2times per year		NPCC Memorandum Circular No. 002 Series of 1980, Section 78-Ambient Noise Quality and Emission Standards for Noise General EHS Guidelines; Environmental Noise Management, IFC 2007		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
			Vibration acceleration	Sensitive areas such as residential area, school religious facilities along the extension line	Methods specified by the 2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH) 2times per year		2002/44/EC (EC Vibration Directive) or American Conference of Industrial Hygienists (ACGIH)		LRTA/ DENR	・Biannual Monitoring Report submitted to DOTC and JICA
Operation of trains and stations	Congestion and disorder	・Efficient traffic management measures and parking restrictions ・Efficient of public and private transit operations	Traffic congestion	Two new stations	Daily site patrol		Traffic Management Plan		LRTA/MMDA/ LGUs	・Biannual Monitoring Report submitted to DOTC and JICA

Source: Study Tea

Appendix B-2 Draft Environmental Checklist (Railways) for LRT Line 2 Extension Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) N (c) N (d) Y	(a) Environmental Performance Report and Management Plan (EPRMP: EIA report for the existing projects for modification or re-start-up) has been completed in October 2011. (b) EPRMP was submitted to the Environmental Management Bureau (EMB) with "Project Environmental Monitoring And Audit Prioritization Scheme (PEMAPS) Questionnaire" in August 2012, to obtain the Environmental Compliance Certificate (ECC). (c) After reviewing the documents, EMB will issue the ECC in September 2012. (d) The LLDA Clearance shall be secured before commencement of construction. Infrastructure projects such as roads bridges, viaducts, railways, power plants etc. within the Laguna de Bay Region shall secure the LLDA Clearance in accordance with Laguna Lake Development Authority (LLDA) Board Resolution No.408, Series of 2011.
	(2) Explanation to the Local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) The dissemination information campaign and consultation with the people and the concerned authorities is required according to the Philippines EIA system (PEIS). Two (2) sets of consultation meetings have been undertaken, one during METI Study and the other during the JICA preparatory study. (b) Proper responses on the comments from the people or the authorities concerned are required by PEIS. All concerns raised were properly addressed such as noise and vibration during construction, construction schedule, night-time work, removal of roadside trees, and permission for occupancy of road area.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The Project, as currently proposed, is a result of a selection process which considered the minimization of social and environmental impacts.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2. Pollution Control	(1) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Do effluents from the project facilities, such as stations, comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a) N (b) N	(a) There is no large-scale filling and cutting work since the guide way is elevated concrete structure. (b) The design of physical structures will conform to the Philippine building and environmental standards and regulations. Since there is no negative impact such as contamination problem caused by drainage from stations, railroads other facilities for the existing LRT Line, no effect is expected for the proposed line in this project.
	(2) Wastes	(a) Are wastes generated from the project facilities, such as stations and depot, properly treated and disposed of in accordance with the country's regulations?	(a) Y	(a) The Project is governed by Presidential Decree No. 984 and Department of Environment and Natural Resources Administrative Order No. 35, Series of 1992 (DAO 35) – regulations on effluents and Republic Act No 6969 – regulations on hazardous wastes. Specific permits (e.g., discharge permit, authority to construct wastewater treatment facilities, etc.) will be secured later.
	(3) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a)Y	(a) Complaints from residents are expected against noise from LRT Operations. There is no standard regarding vibration in the Philippines. Mitigation measures are considered and the monitoring plan of noise and vibration be implemented in order to ensure that standards as required by laws are maintained.
	(4) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence (especially in case of Undergrounds/Subways)?	(a) N	(a) Not Applicable
3. Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The present land use in the area along proposed railway is mainly commercial area. There are no protected area designed by the country’s laws or international treaties and conventions.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of rail roads will have impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(a) N (b) N (c) N (d) N (e) N (f) N	(a) The proposed railway starts on the existing main road in Manila; and, the present land use in the area along the proposed railway is mainly categorized as commercial area. Therefore no effect on ecosystem is expected. (b) Refer to (a) (c) Refer to (a) (d) Refer to (a) (e) Native plant species will be used for re-vegetation. (f) Not Applicable
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) N	(a) There will be no alteration of topographic features. There will be no need for tunneling along the entire alignment.
	(4) Topography and Geology	(a) Is there a soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting	(a) N (b) N (c) Y,Y	(a) Although there are areas that are prone to liquefaction along the proposed extension line. Geotechnical investigation show that the potential results for liquefaction is low. (b) There is no large-scale filling and cutting work. (c) Contractor will be prohibited from stockpiling construction

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?		spoils anywhere near watercourses nor artificial drainage systems to avoid clogging of these drainage systems. Conventional sediment and erosions control measures will be put in place. Sufficient and effective drainage systems will be incorporated in the detailed design of the structures and stations to offset effects of increase in amount of impermeable surfaces as well as to compensate for the differences in elevation between the raised (constructed) areas and the surrounding low-lying communities.
4. Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(a)N (b)N/A (c)N/A (d)N/A (e)N/A (f)N/A (g)N/A	(a) No displacement of communities will be necessary. (b) No residential areas will be affected (c)(d)(e)(f)(g) No relocation necessary. Note: N/A means Not Applicable.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a) Where railways are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of inhabitants other than the affected inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., by causing increases in traffic congestion and traffic accidents)? (e) Is there any possibility that railways will impede the movement of inhabitants? (f) Is there any possibility that structures associated with railways (such as bridges) will cause a sun shading and radio interference?	(a) Y (b) N (c) N (d) N (e) N (f) Y	(a) There is a possibility that this project will affect a lot of existing public transport groups (public bus, jeepney, tri-cycles, etc.) which operates passenger jeepneys at Santolan and Recto station, but the associated workers may move to other locations such as the new stations. The Project will not cause any significant changes in sources of livelihood and unemployment. (b) The Project will not cause any significant adversely impacts on the living conditions of other inhabitants. (c) Since workers will be locally employed in accordance with Republic Act No. 6685, no influx of workers from other areas is expected. (d) In this project, the introduction of the LRT system will cause the transition in the means of transportation from motor vehicle railway; and, will subsequently, lead to a decrease in motor vehicle traffic flow volume as well as the improvement of traffic congestion. (e) Since the railway is elevated guide way, the movement of inhabitants is not changed. (f) Sun Shading: The project facilities may cause partial sun shading. However, sun shading is considered to be minor impact. Radio Wave Interference: Since there is no negative impact such as the radio ware interference for the existing LRT Line, no effect is expected for the proposed line in this project.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
4. Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archaeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) There are no local archaeological, historical, cultural and religious heritage sites along proposed railway.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Design sympathetic with the local landscape will be considered for the guide way structure form.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Where ethnic minorities and indigenous peoples are living in the right-of-way, are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous people? (b) Does the project comply with the country's law for rights of ethnic minorities and indigenous peoples?	(a) N (b) N	(a) & (b) Ethnic minorities and indigenous peoples are not living along proposed railway.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Y (b) Y (c) Y (d) Y	(a) LRTA shall not violate any Laws and Ordinances associated with the working condition in the project. On the contrary, such laws and ordinances shall be strictly observed and implemented. (b) LRTA shall ensure safety measures for the individuals involved in the project; this provision shall be incorporated in the Health and Safety Management Plan that shall be established as part of the contracts between the proponent and the contractor. (c) Safety instruction for new recruits, safety meetings and safety patrols shall be undertaken periodically. (d) LRTA shall ensure that security guards shall not violate the safety of other individuals involved or local residents; this provision shall also be incorporated as part of the Health and Safety Management Plan to be established by the contractor with approval of the project proponent.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b) - (c)Y (d)Y	(a) Noise, turbid water and wastes are expected to generate during construction. Adequate measures against these impacts should be adopted consistent with the Impact Management Plan in the EPRMP. On the other hand, there is no standard regarding vibration in the Philippines. The adoption of low vibration methods shall be considered in the selection of construction equipment and construction methods. (b) The proposed railway will commence on the present main road. The present land use in the area along proposed railway is mainly commercial area. No negative impact is expected. (c) The disturbance of existing traffic flow will be expected due to the lane regulation during construction. The Traffic Management Plan shall be submitted to the authorities concerned prior to the construction. (d) The Traffic Management Plan shall be drew up during the Detailed Design Stage.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) (b) (c) & (d) A Environmental Management and Monitoring Program will be established as stipulated in Department of Environment and Natural Resources (DENR) Administrative Order No. 30, Series of 2003 (DAO 2003-30), a Multi-Partite Monitoring Team (MMT) must be formed immediately after the issuance of the ECC. The main goal of the MMT is to monitor the Proponent's as well as the Contractor's compliance to the ECC conditions, the IMP, and other applicable laws, rules, and regulations.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) Y (b) Y	(a) A permit to cut shall be secured by the Contractor from the DENR prior to cutting of trees along the road sides and in the central reserve. (b) The Program Management Office will start the utility management planning process during the Preliminary Design Phase, and will establish an inter-active dialogue and communication with the authorities and companies having jurisdiction over utilities. The Program Management office will produce and obtain approval for detailed Utility Management Plans during the detailed design and construction phases.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans boundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) The LRT system will have positive impacts in terms of reduction of Greenhouse Gas due to transition in the mode of transportation from motor vehicle to railway.

Source: Study Team

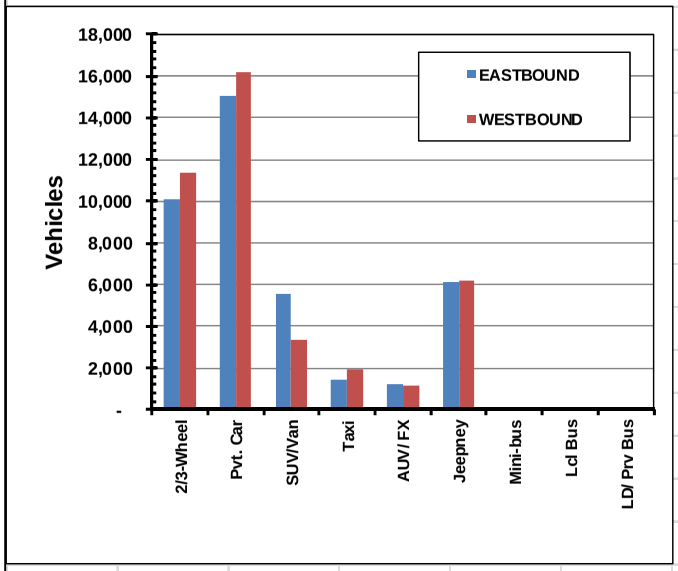
Appendix C: Demand Forecast for Line 2 Extension Project

MANILA LRT DEMAND FORECAST FOR LINE 2 EXTENSION PROJECT

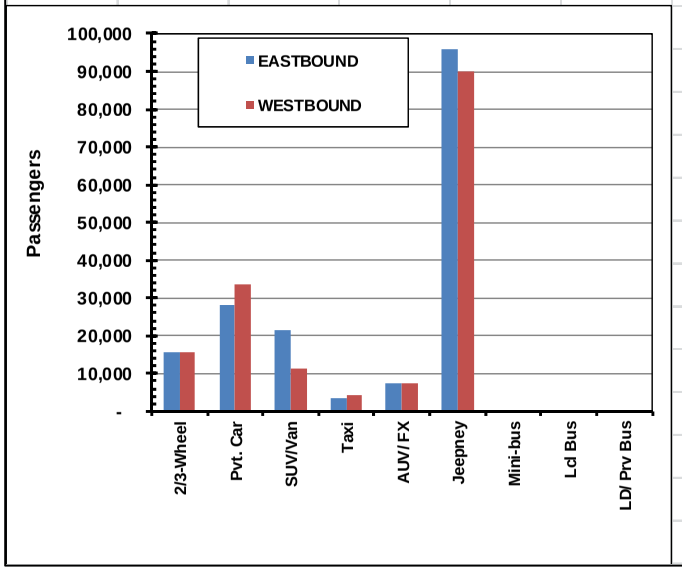
APPENDIX-C

CONTENTS

Traffic and Passenger Volumes along Marcos Highway @ Masinag — **STN. 01**

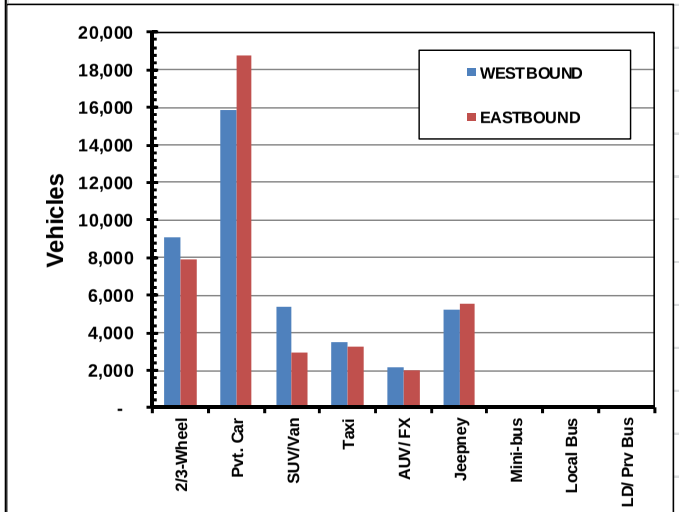


STN. 01	Vehicles		
	EASTBOUND	WESTBOUND	2-Way
2/3-Wheel	10,072	11,401	21,473
Pvt. Car	15,048	16,187	31,235
SUV/Van	5,578	3,383	8,961
Taxi	1,476	1,951	3,427
AUV/ FX	1,258	1,139	2,397
Jeepney	6,097	6,190	12,287
Mini-bus	-	-	-
Lcl Bus	18	67	85
LD/ Prv Bus	8	12	20
Total	**39,555**	**40,330**	**79,885**
% by Dir.	**49.5%**	**50.5%**	**100%**

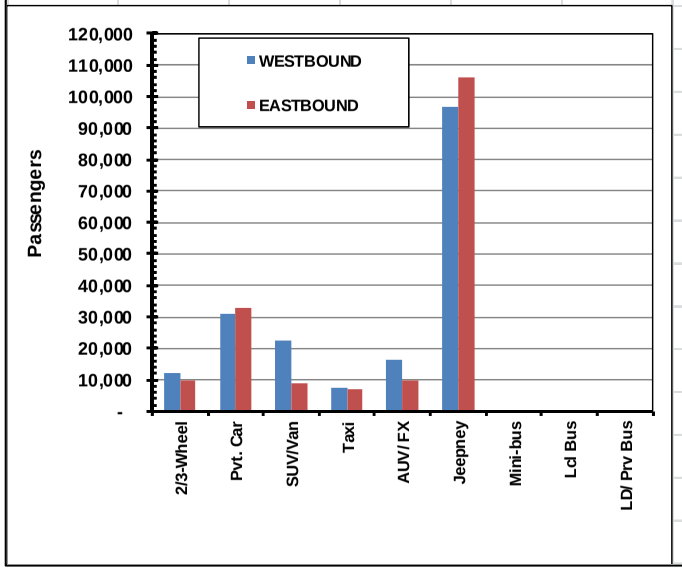


STN. 01	Passengers		
	EASTBOUND	WESTBOUND	2-Way
2/3-Wheel	15,733	15,684	31,417
Pvt. Car	28,149	33,686	61,834
SUV/Van	21,327	11,380	32,707
Taxi	3,342	4,069	7,411
AUV/ FX	7,574	7,538	15,112
Jeepney	95,923	89,955	185,878
Mini-bus	-	-	-
Lcl Bus	212	281	493
LD/ Prv Bus	90	43	133
Total	**172,350**	**162,636**	**334,986**
% by Dir.	**51.4%**	**48.6%**	**100%**

Traffic and Passenger Volumes along Marcos Highway @ Emerald — **STN. 02**

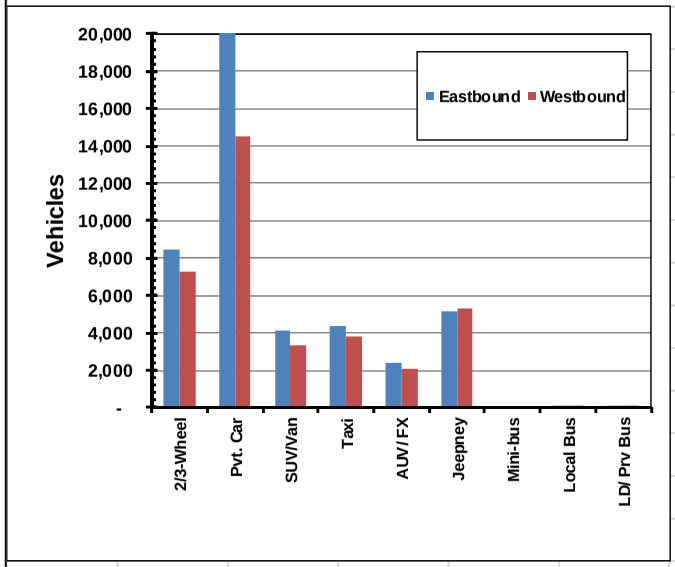


STN. 02	Vehicles		
	WESTBOUND	EASTBOUND	2-Way
2/3-Wheel	9,085	7,905	16,990
Pvt. Car	15,847	18,749	34,596
SUV/Van	5,421	2,956	8,377
Taxi	3,496	3,234	6,730
AUV/ FX	2,130	2,039	4,169
Jeepney	5,229	5,537	10,766
Mini-bus	-	-	-
Local Bus	28	49	77
LD/ Prv Bus	10	5	15
Total	**41,246**	**40,474**	**81,720**
% by Dir.	**50.5%**	**49.5%**	**100%**

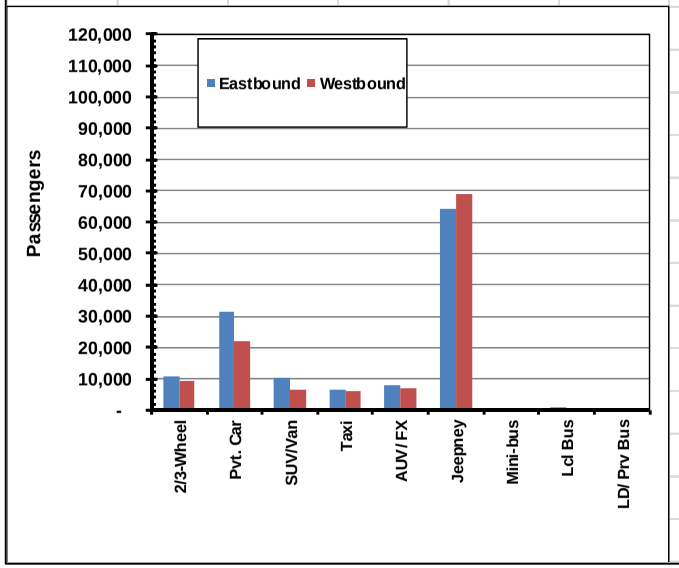


STN. 02	Passengers		
	WESTBOUND	EASTBOUND	2-Way
2/3-Wheel	12,071	9,667	21,738
Pvt. Car	31,172	32,655	63,826
SUV/Van	22,604	9,013	31,617
Taxi	7,336	6,950	14,286
AUV/ FX	16,418	9,820	26,238
Jeepney	96,953	106,066	203,018
Mini-bus	-	-	-
Lcl Bus	146	596	743
LD/ Prv Bus	41	15	56
Total	**186,741**	**174,782**	**361,523**
% by Dir.	**51.7%**	**48.3%**	**100%**

Traffic and Passenger Volumes along Marcos Highway @ Santolan — STN. 03



STN. 03	Vehicles		
	Eastbound	Westbound	2-Way
2/3-Wheel	8,465	7,291	15,756
Pvt. Car	20,472	14,504	34,976
SUV/Van	4,155	3,361	7,516
Taxi	4,353	3,819	8,172
AUV/ FX	2,401	2,099	4,500
Jeepney	5,174	5,327	10,501
Mini-bus	-	-	-
Local Bus	50	31	81
LD/ Prv Bus	9	18	27
Total	**45,079**	**36,450**	**81,529**
% by Dir.	**55.3%**	**44.7%**	**100%**



STN. 03	Passengers		
	Eastbound	Westbound	2-Way
2/3-Wheel	10,973	9,141	20,114
Pvt. Car	31,467	22,112	53,580
SUV/Van	10,302	6,604	16,907
Taxi	6,432	5,869	12,301
AUV/ FX	7,963	7,178	15,141
Jeepney	64,376	68,840	133,216
Mini-bus	-	-	-
Lcl Bus	789	500	1,289
LD/ Prv Bus	408	360	767
Total	**132,710**	**120,603**	**253,313**
% by Dir.	**52.4%**	**47.6%**	**100%**

Table C.4 Line-2 Average Week Day Station Boarding and Alighting-2015

Station	Board	Alight
Recto	64,100	65,200
Legarda	22,900	27,300
Pureza	17,800	17,300
V Mapa	18,200	14,400
J Ruiz	4,200	4,300
Gilmore	7,800	8,500
Belmonte	4,500	4,400
Cubao	40,600	50,000
Anonas	15,000	13,300
Katipunan	32,400	22,900
Santolan	3,900	3,900
Emerald	5,200	5,200
Masinag	69,500	69,500
Total	306,000	306,000
Average Trip Length (km)		10.22

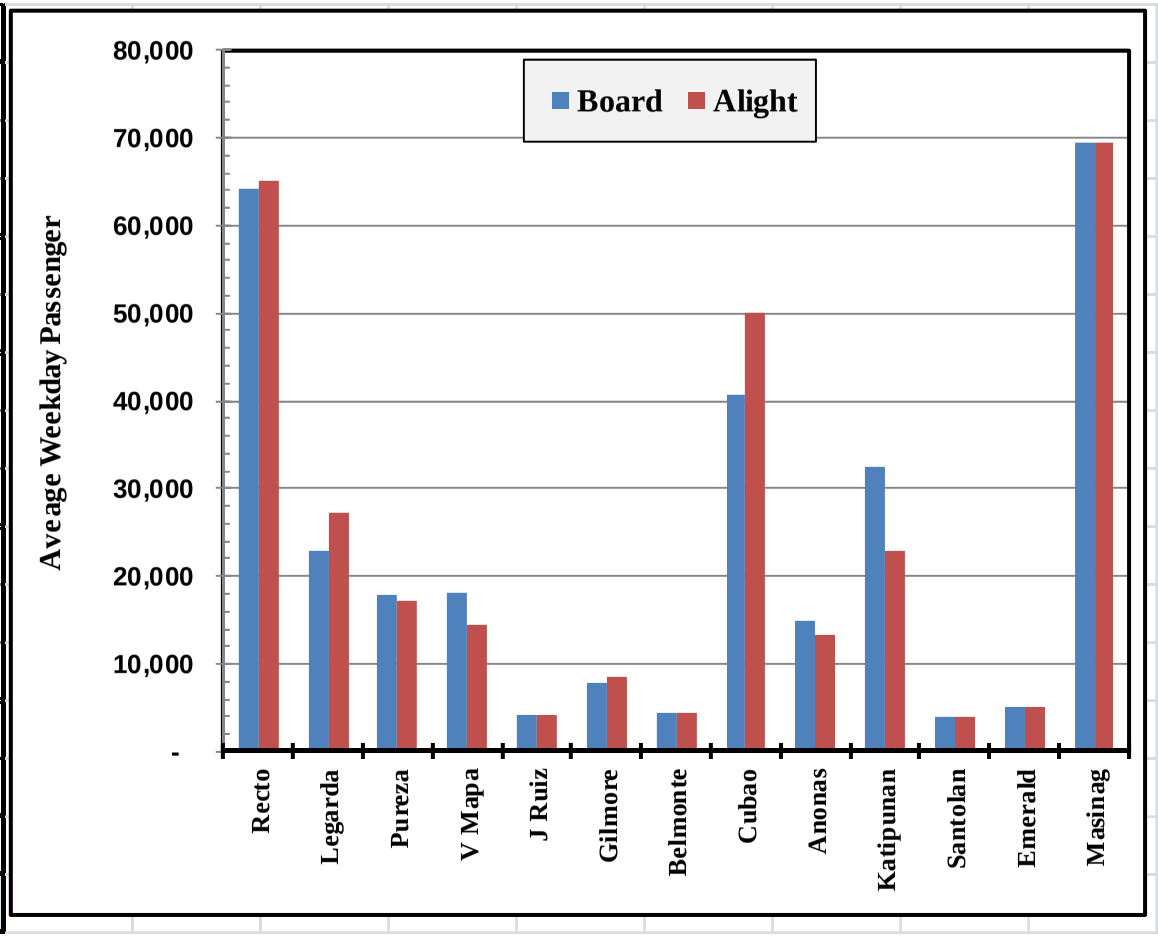
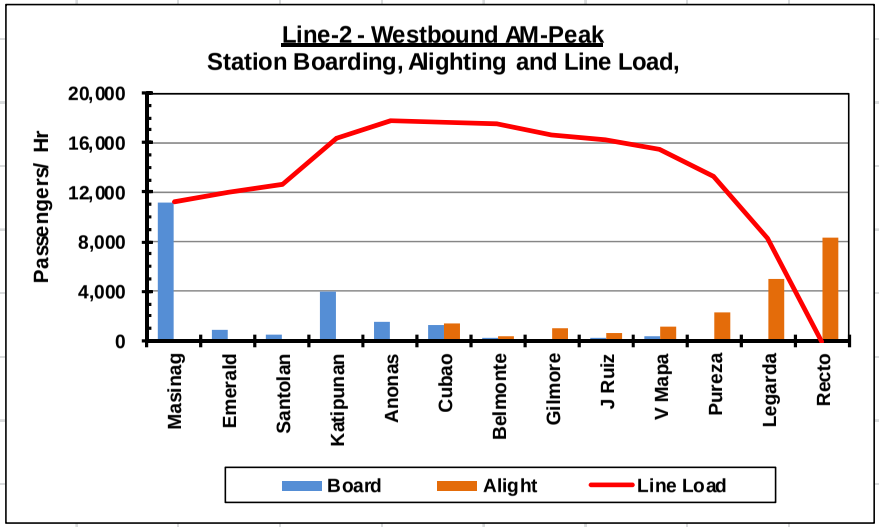


Table C.5 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2015

Station	Westbound		
	Board	Alight	Line Load
Masinag	11,210	-	11,210
Emerald	850	10	12,050
Santolan	560	30	12,580
Katipunan	3,940	170	16,350
Anonas	1,530	180	17,700
Cubao	1,260	1,380	17,580
Belmonte	300	410	17,470
Gilmore	160	1,000	16,630
J Ruiz	200	640	16,190
V Mapa	390	1,110	15,470
Pureza	170	2,330	13,310
Legarda	10	5,020	8,300
Recto	-	8,290	-
	20,580	20,570	-
Maximum	11,210	8,290	17,700
Average Trip Length (km)			11.52

Station	Eastbound		
	Board	Alight	Line Load
Recto	2,130	-	2,130
Legarda	430	30	2,530
Pureza	1,020	50	3,500
V Mapa	890	110	4,280
J Ruiz	220	90	4,410
Gilmore	210	140	4,480
Belmonte	130	150	4,460
Cubao	860	1,470	3,850
Anonas	120	520	3,450
Katipunan	80	990	2,540
Santolan	-	120	2,420
Emerald	-	170	2,250
Msinag	-	2,240	10
Total	6,090	6,080	-
Maximum	2,130	2,240	4,480
Average Trip Length (km)			8.77



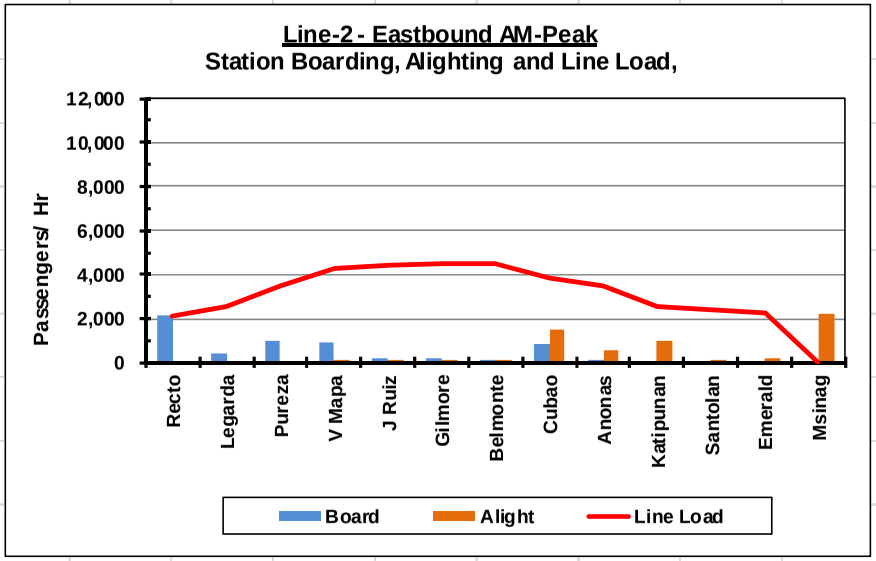


Table C.6 Line-2 Average Week Day Station Boarding and Alighting-2020

Station	Board	Alight
Recto	72,500	73,700
Legarda	25,900	30,900
Pureza	20,100	19,600
V Mapa	20,600	16,200
J Ruiz	4,700	4,800
Gilmore	8,800	9,600
Belmonte	5,100	5,000
Cubao	46,000	56,600
Anonas	17,000	15,000
Katipunan	36,700	25,900
Santolan	4,600	4,600
Emerald	6,200	6,200
Masinag	82,500	82,500
Total	350,700	350,700
Average Trip Length (km)		10.31

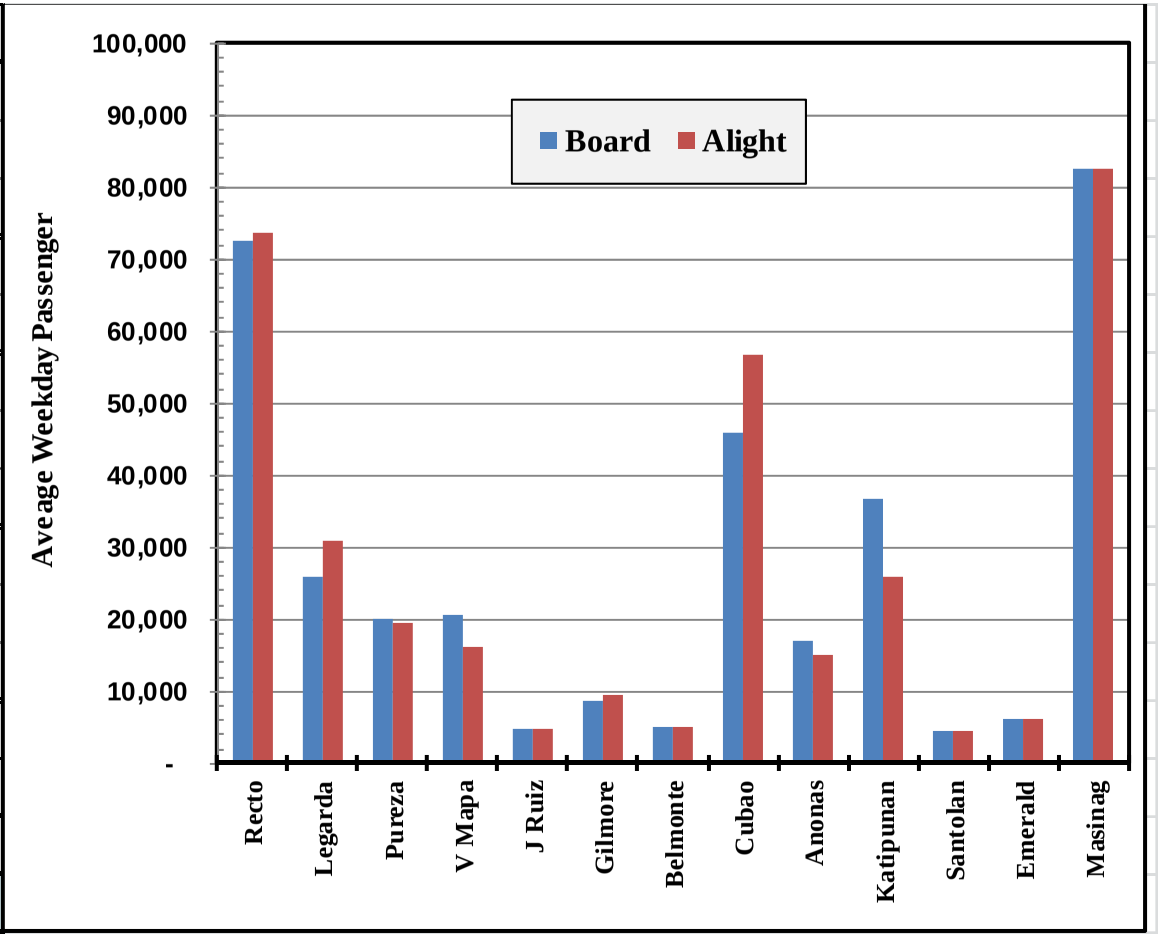
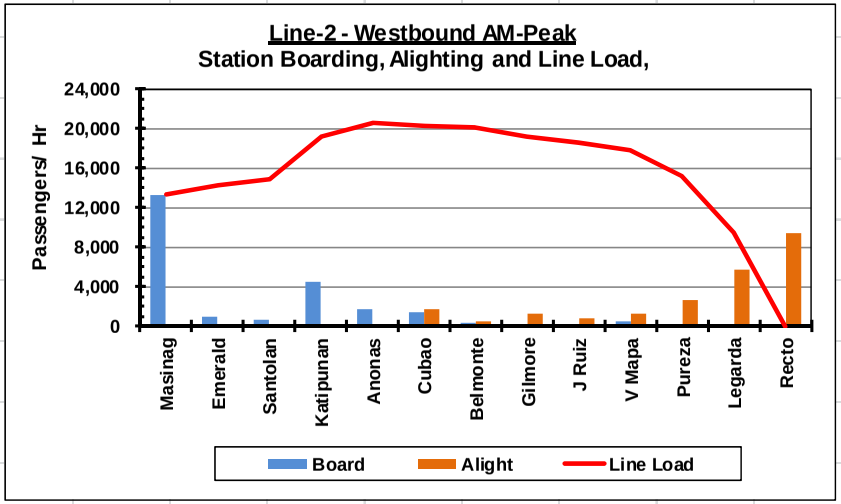


Table C.7 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2020

Station	Westbound		
	Board	Alight	Line Load
Masinag	13,280	-	13,280
Emerald	1,000	20	14,260
Santolan	660	30	14,890
Katipunan	4,420	220	19,090
Anonas	1,700	220	20,570
Cubao	1,340	1,650	20,260
Belmonte	320	480	20,100
Gilmore	170	1,160	19,110
J Ruiz	220	750	18,580
V Mapa	410	1,290	17,700
Pureza	180	2,680	15,200
Legarda	10	5,740	9,470
Recto	-	9,460	-
	23,710	23,700	-
Maximum	13,280	9,460	20,570
Average Trip Length (km)			11.61

Station	Eastbound		
	Board	Alight	Line Load
Recto	2,380	-	2,380
Legarda	480	30	2,830
Pureza	1,150	60	3,920
V Mapa	1,010	120	4,810
J Ruiz	250	90	4,970
Gilmore	240	150	5,060
Belmonte	150	160	5,050
Cubao	1,010	1,630	4,430
Anonas	140	580	3,990
Katipunan	90	1,110	2,970
Santolan	-	140	2,830
Emerald	-	200	2,630
Msinag	-	2,660	(30)
Total	6,900	6,930	-
Maximum	2,380	2,660	5,060
Average Trip Length (km)			8.84



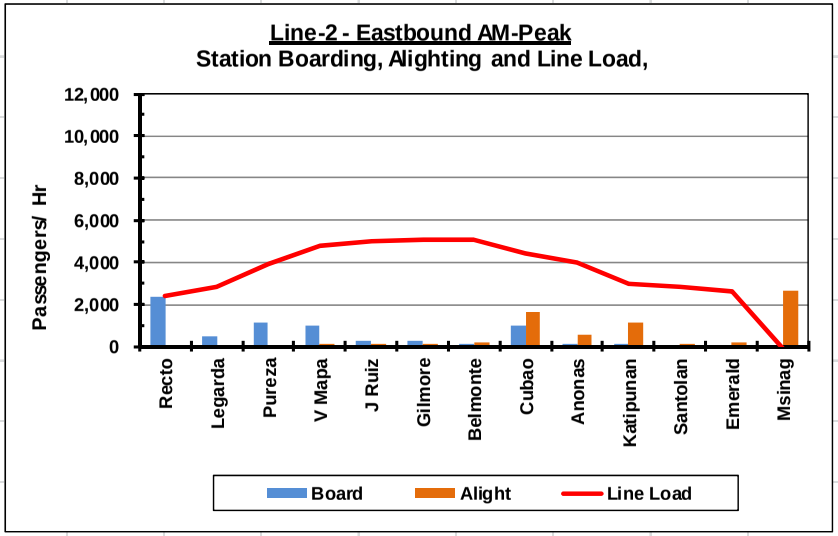


Table C.8 Line-2 Average Week Day Station Boarding and Alighting-2025

Average Weekday Station-Station Boarding & Alighting - 2025

Station	Board	Alight
Recto	80,000	81,400
Legarda	28,600	34,100
Pureza	22,200	21,600
V Mapa	22,700	17,900
J Ruiz	5,200	5,300
Gilmore	9,700	10,600
Belmonte	5,600	5,500
Cubao	50,800	62,500
Anonas	18,700	16,600
Katipunan	40,500	28,600
Santolan	5,400	5,400
Emerald	7,200	7,200
Masinag	95,600	95,600
Total	**392,300**	**392,300**
Average Trip Length (km)		**10.41**

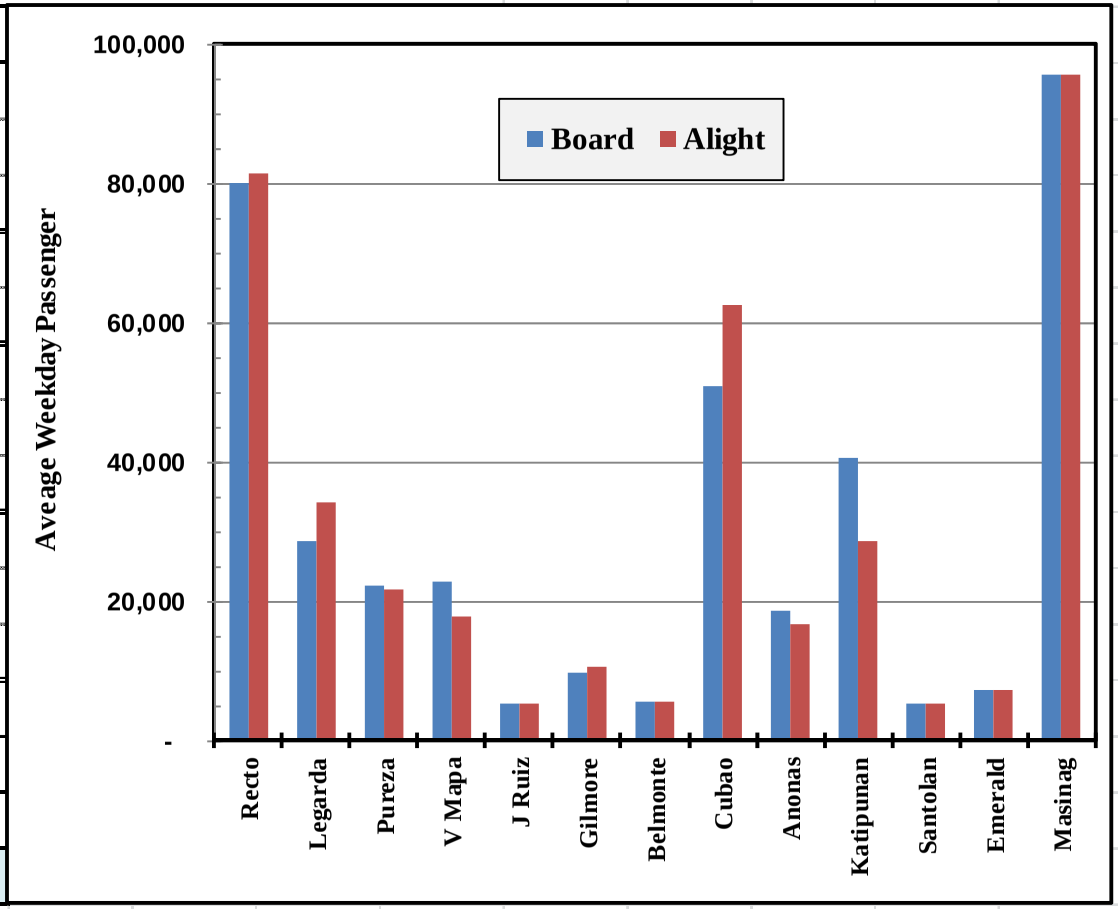
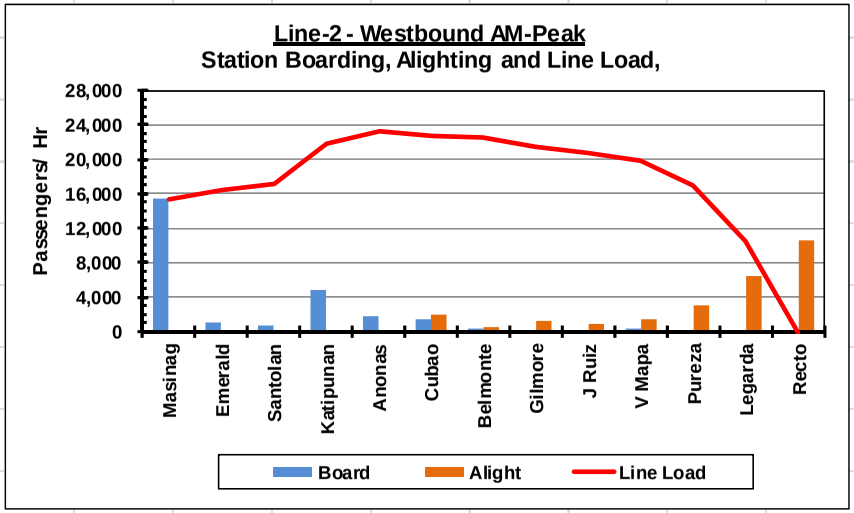


Table C.9 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2025

Station	Westbound		
	Board	Alight	Line Load
Masinag	15,360	-	15,360
Emerald	1,160	20	16,500
Santolan	750	40	17,210
Katipunan	4,830	270	21,770
Anonas	1,840	270	23,340
Cubao	1,370	1,930	22,780
Belmonte	340	560	22,560
Gilmore	180	1,320	21,420
J Ruiz	230	850	20,800
V Mapa	420	1,460	19,760
Pureza	180	3,000	16,940
Legarda	10	6,400	10,550
Recto	-	10,550	-
	26,670	26,670	-
Maximum	15,360	10,550	23,340
Average Trip Length (km)			11.71

Station	Eastbound		
	Board	Alight	Line Load
Recto	2,610	-	2,610
Legarda	530	30	3,110
Pureza	1,270	60	4,320
V Mapa	1,130	120	5,330
J Ruiz	290	100	5,520
Gilmore	280	160	5,640
Belmonte	180	160	5,660
Cubao	1,160	1,760	5,060
Anonas	170	630	4,600
Katipunan	120	1,220	3,500
Santolan	10	170	3,340
Emerald	10	230	3,120
Msinag	-	3,100	20
Total	7,760	7,740	-
Maximum	2,610	3,100	5,660
Average Trip Length (km)			8.93



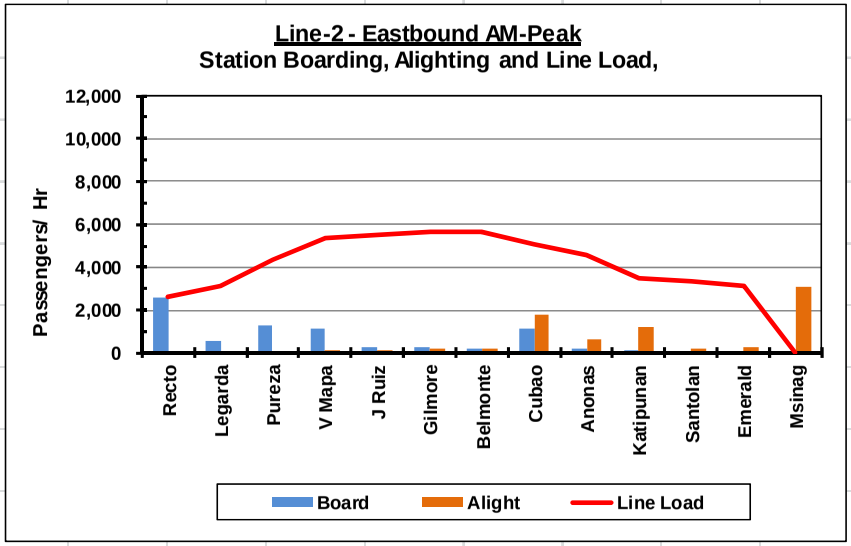


Table C.10 Line-2 Average Week Day Station Boarding and Alighting-2030

Station	Board	Alight
Recto	87,300	88,800
Legarda	31,200	37,200
Pureza	24,200	23,600
V Mapa	24,700	19,600
J Ruiz	5,700	5,800
Gilmore	10,600	11,600
Belmonte	6,100	6,000
Cubao	55,400	68,100
Anonas	20,400	18,100
Katipunan	44,200	31,200
Santolan	6,100	6,100
Emerald	8,200	8,200
Masinag	108,200	108,200
Total	432,300	432,300
Average Trip Length (km)		10.49

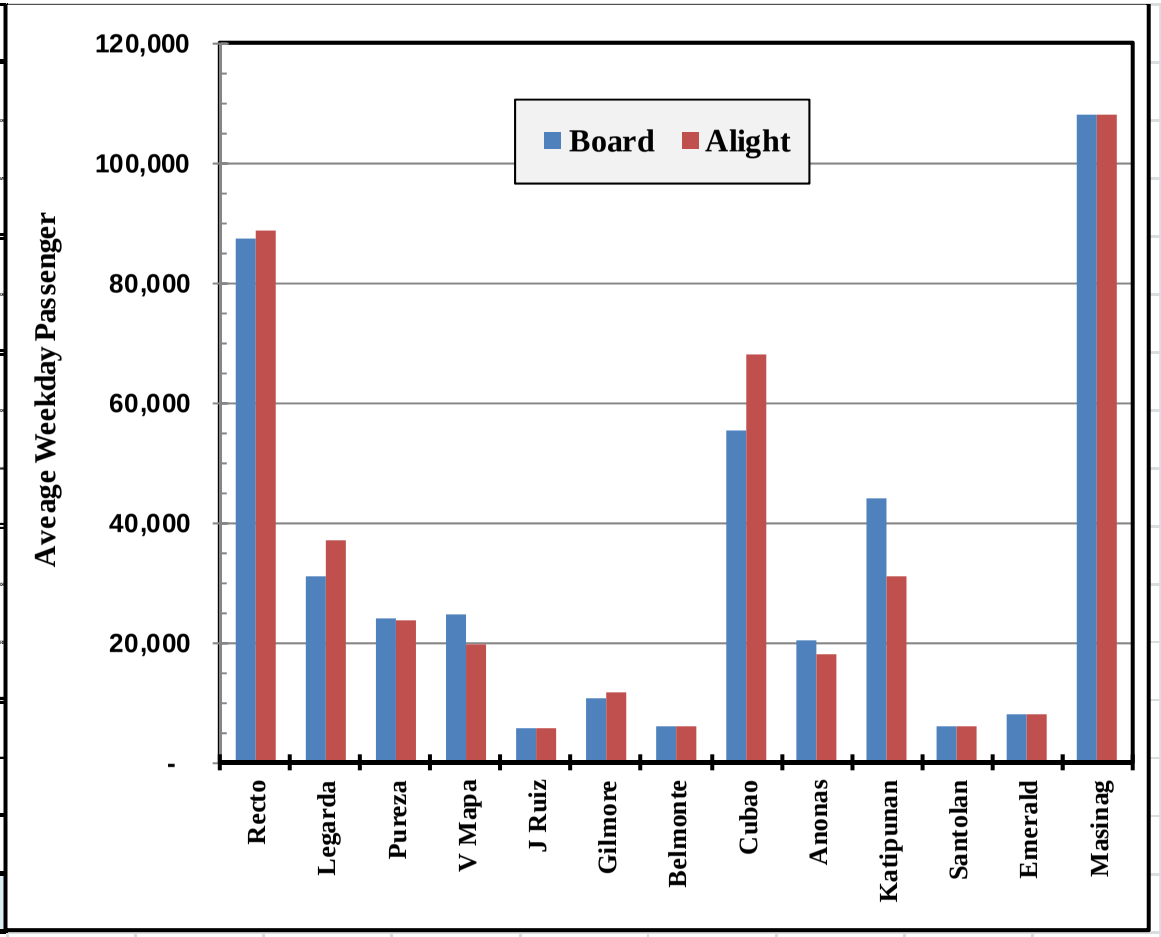
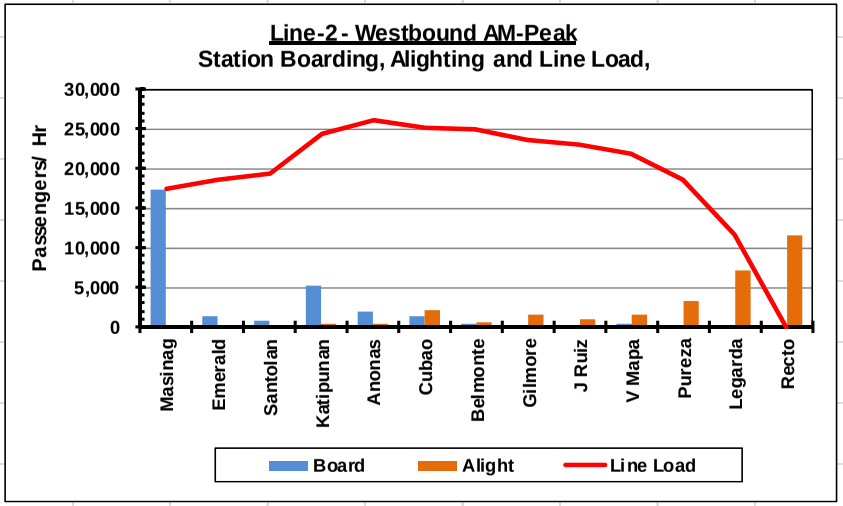


Table C.11 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2030

Station	Westbound		
	Board	Alight	Line Load
Masinag	17,340	-	17,340
Emerald	1,310	20	18,630
Santolan	850	50	19,430
Katipunan	5,220	320	24,330
Anonas	1,970	310	25,990
Cubao	1,410	2,200	25,200
Belmonte	360	630	24,930
Gilmore	180	1,460	23,650
J Ruiz	240	950	22,940
V Mapa	430	1,620	21,750
Pureza	190	3,310	18,630
Legarda	10	7,040	11,600
Recto	-	11,590	-
	29,510	29,500	-
Maximum	17,340	11,590	25,990
Average Trip Length (km)			11.78

Station	Eastbound		
	Board	Alight	Line Load
Recto	2,820	-	2,820
Legarda	570	30	3,360
Pureza	1,390	60	4,690
V Mapa	1,240	130	5,800
J Ruiz	320	100	6,020
Gilmore	310	160	6,170
Belmonte	200	170	6,200
Cubao	1,300	1,880	5,620
Anonas	200	680	5,140
Katipunan	140	1,320	3,960
Santolan	10	190	3,780
Emerald	10	260	3,530
Msinag	-	3,520	10
Total	8,510	8,500	-
Maximum	2,820	3,520	6,200
Average Trip Length (km)			9.00



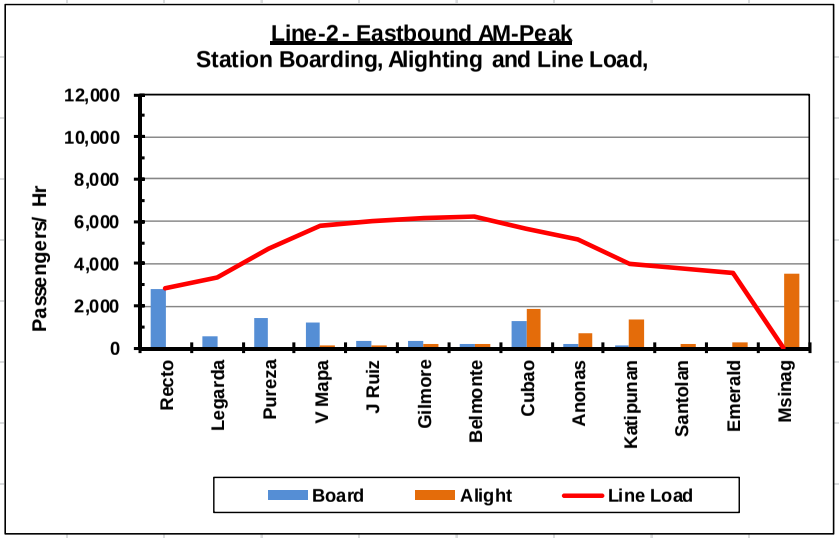


Table C.12 Line-2 Average Week Day Station Boarding and Alighting-2035

Station	Board	Alight
Recto	94,000	95,600
Legarda	33,600	40,100
Pureza	26,100	25,400
V Mapa	26,700	21,100
J Ruiz	6,100	6,300
Gilmore	11,400	12,500
Belmonte	6,600	6,500
Cubao	59,700	73,400
Anonas	22,000	19,500
Katipunan	47,600	33,600
Santolan	6,700	6,700
Emerald	9,000	9,000
Masinag	119,500	119,500
Total	469,000	469,000
Average Trip Length (km)		10.53

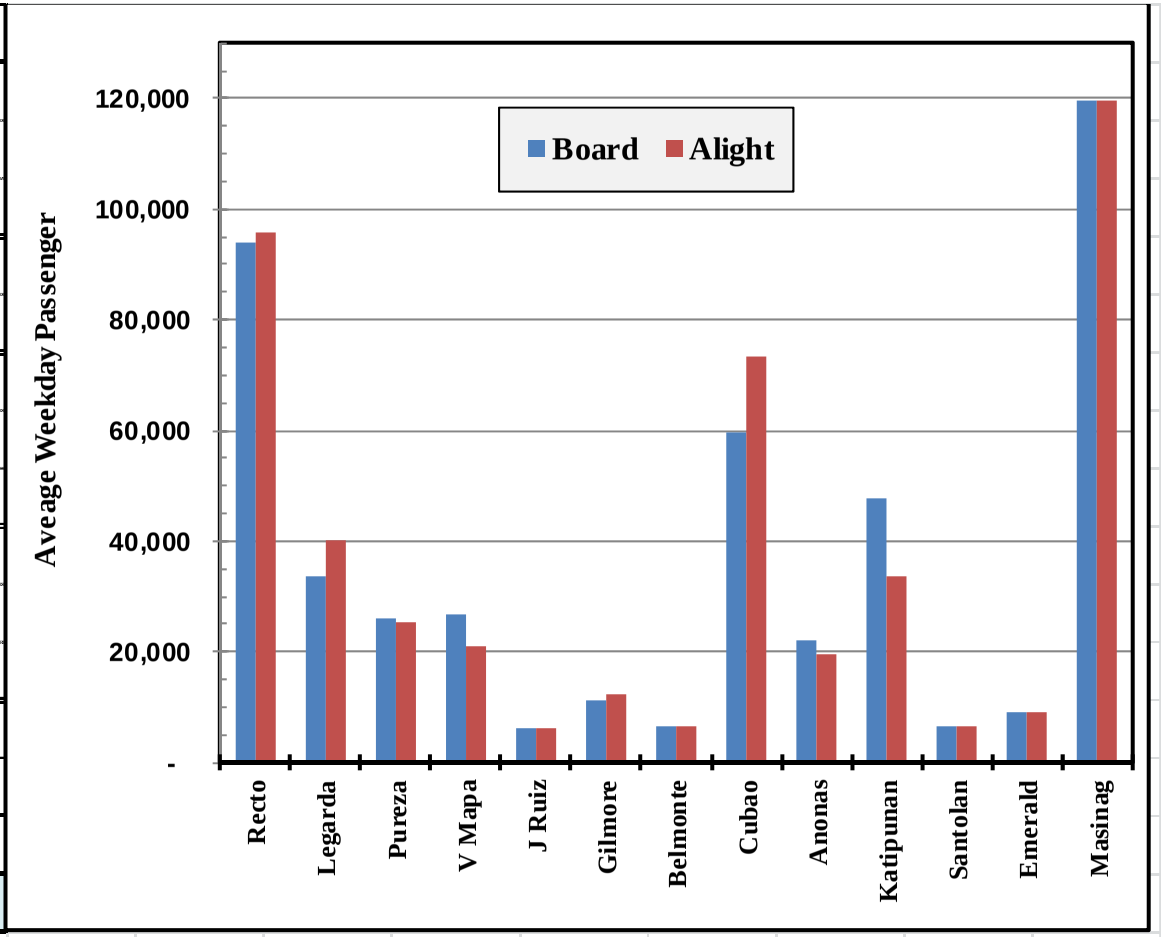
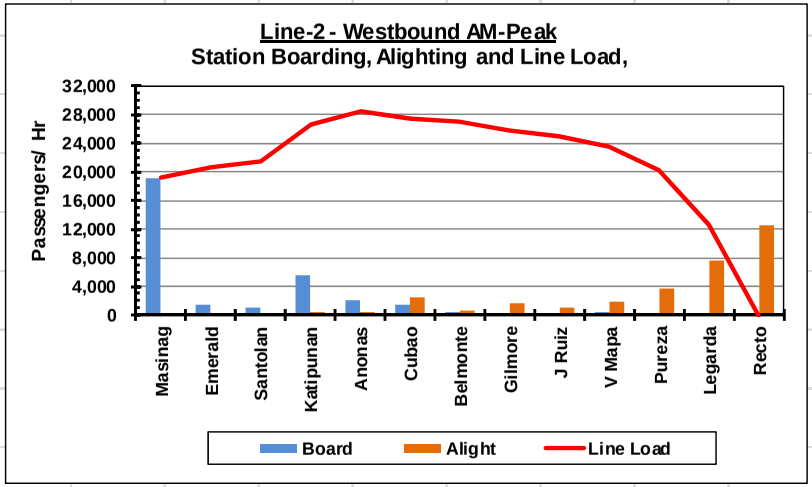


Table C.13 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2035

Station	Westbound		
	Board	Alight	Line Load
Masinag	19,120	-	19,120
Emerald	1,440	30	20,530
Santolan	930	60	21,400
Katipunan	5,590	360	26,630
Anonas	2,100	350	28,380
Cubao	1,460	2,440	27,400
Belmonte	370	690	27,080
Gilmore	190	1,600	25,670
J Ruiz	250	1,030	24,890
V Mapa	440	1,770	23,560
Pureza	190	3,600	20,150
Legarda	10	7,620	12,540
Recto	-	12,550	-
	32,090	32,100	-
Maximum	19,120	12,550	28,380
Average Trip Length (km)			11.83

Station	Eastbound		
	Board	Alight	Line Load
Recto	3,020	-	3,020
Legarda	620	30	3,610
Pureza	1,490	60	5,040
V Mapa	1,340	130	6,250
J Ruiz	340	100	6,490
Gilmore	330	170	6,650
Belmonte	220	180	6,690
Cubao	1,430	1,990	6,130
Anonas	220	730	5,620
Katipunan	160	1,410	4,370
Santolan	10	210	4,170
Emerald	10	290	3,890
Msinag	-	3,890	-
Total	9,190	9,190	-
Maximum	3,020	3,890	6,690
Average Trip Length (km)			9.06



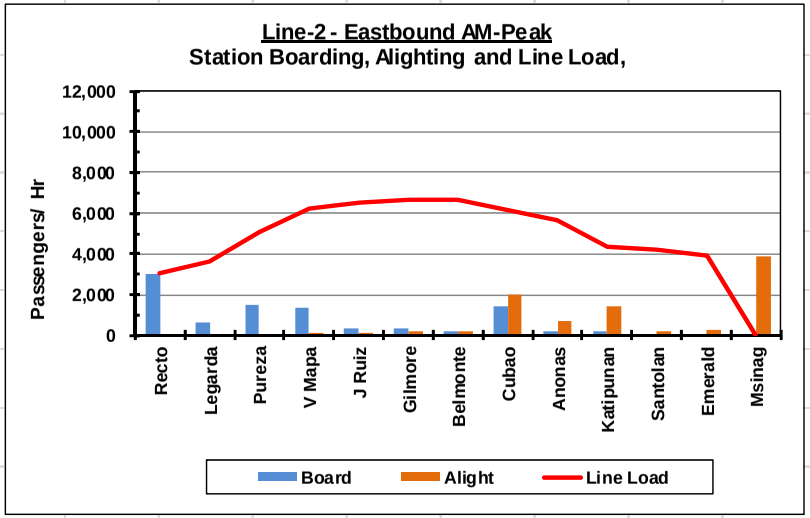


Table C.14 Line-2 Average Week Day Station Boarding and Alighting-2040

Station	Board	Alight
Recto	100,100	101,800
Legarda	35,800	42,700
Pureza	27,800	27,000
V Mapa	28,400	22,400
J Ruiz	6,500	6,700
Gilmore	12,100	13,300
Belmonte	7,000	6,900
Cubao	63,500	78,100
Anonas	23,400	20,700
Katipunan	50,600	35,700
Santolan	7,200	7,200
Emerald	9,700	9,700
Masinag	128,700	128,700
Total	500,800	500,800
Average Trip Length (km)		10.56

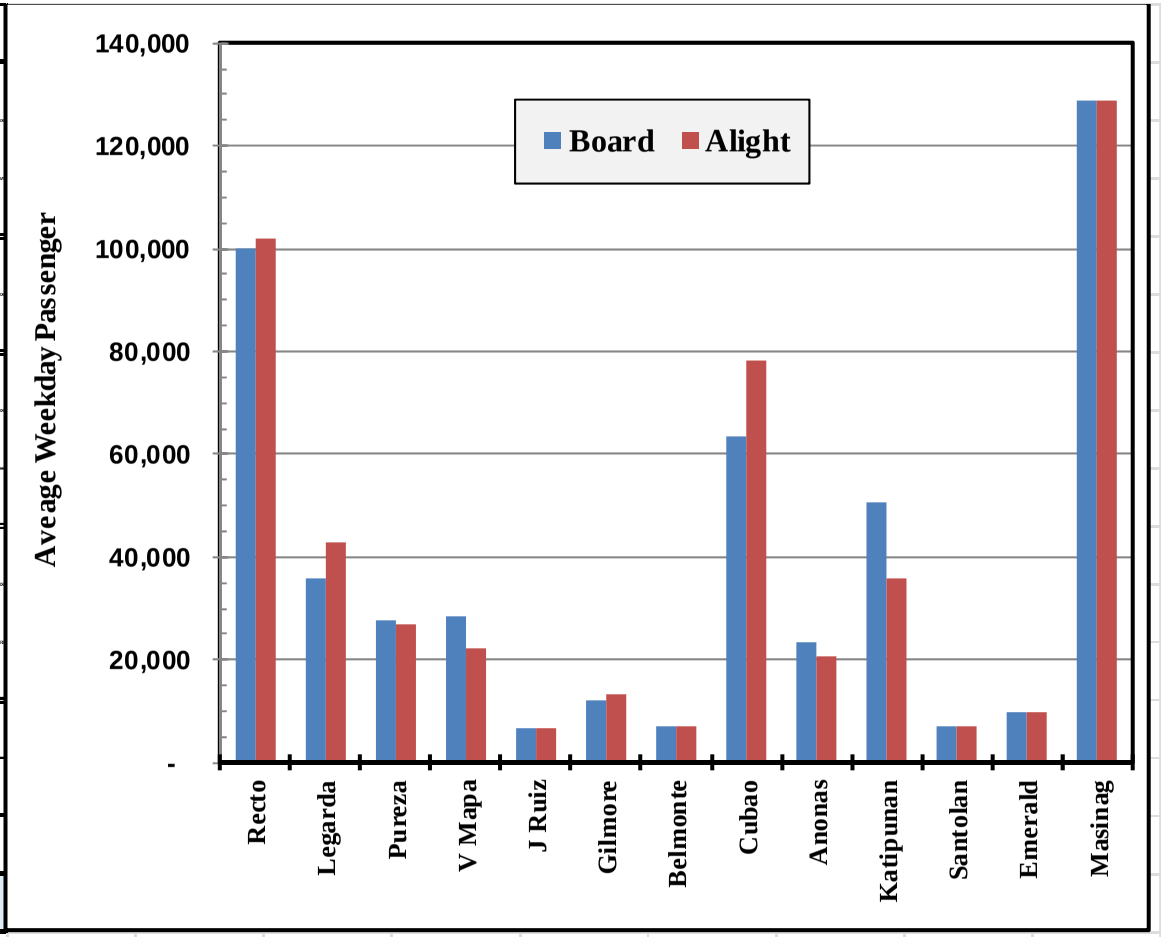
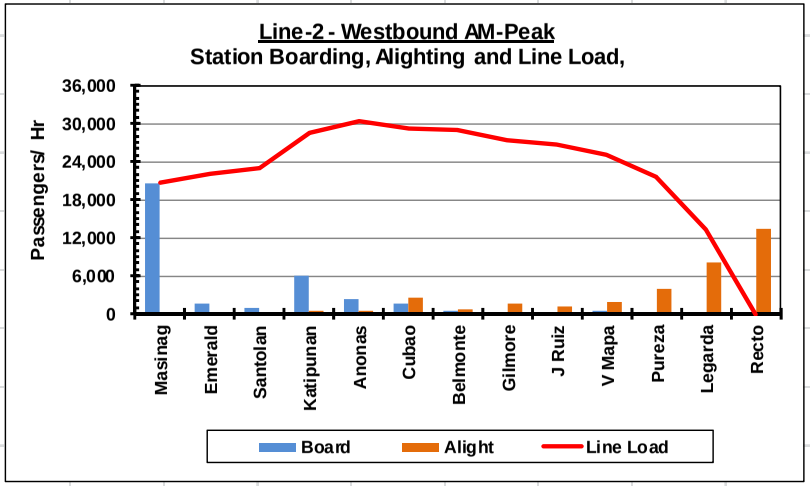


Table C.15 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2040

Station	Westbound		
	Board	Alight	Line Load
Masinag	20,580	-	20,580
Emerald	1,550	30	22,100
Santolan	1,000	70	23,030
Katipunan	5,930	400	28,560
Anonas	2,220	390	30,390
Cubao	1,520	2,640	29,270
Belmonte	390	740	28,920
Gilmore	200	1,710	27,410
J Ruiz	260	1,110	26,560
V Mapa	460	1,900	25,120
Pureza	200	3,840	21,480
Legarda	10	8,130	13,360
Recto	-	13,380	-
	34,320	34,340	-
Maximum	20,580	13,380	30,390
Average Trip Length (km)			11.84

Station	Eastbound		
	Board	Alight	Line Load
Recto	3,210	-	3,210
Legarda	650	30	3,830
Pureza	1,590	60	5,360
V Mapa	1,430	140	6,650
J Ruiz	370	110	6,910
Gilmore	350	170	7,090
Belmonte	240	190	7,140
Cubao	1,540	2,100	6,580
Anonas	240	770	6,050
Katipunan	170	1,500	4,720
Santolan	10	220	4,510
Emerald	10	310	4,210
Msinag	-	4,210	-
Total	9,810	9,810	-
Maximum	3,210	4,210	7,140
Average Trip Length (km)			9.09



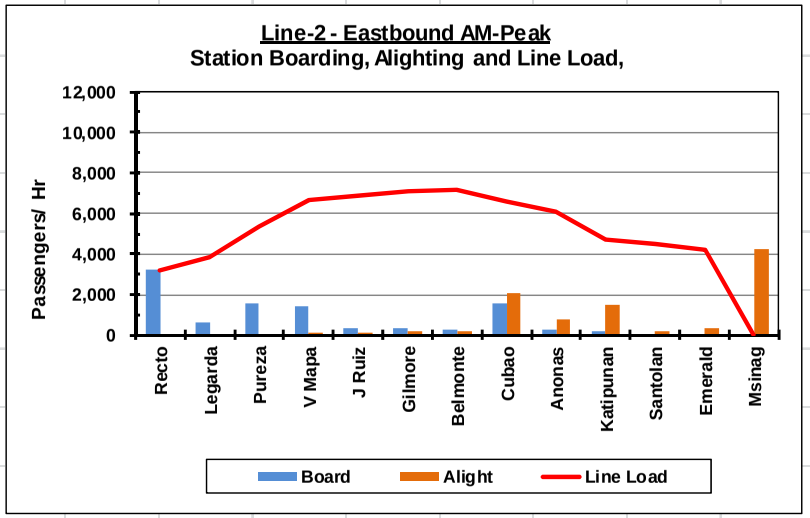


Table C.16 Line-2 Average Week Day Station Boarding and Alighting-2045

Station	Board	Alight
Recto	105,200	107,000
Legarda	37,600	44,800
Pureza	29,200	28,400
V Mapa	29,800	23,600
J Ruiz	6,900	7,000
Gilmore	12,800	13,900
Belmonte	7,400	7,200
Cubao	66,700	82,100
Anonas	24,600	21,800
Katipunan	53,200	37,600
Santolan	7,600	7,600
Emerald	10,200	10,200
Masinag	135,300	135,300
Total	526,400	526,400
Average Trip Length (km)		10.56

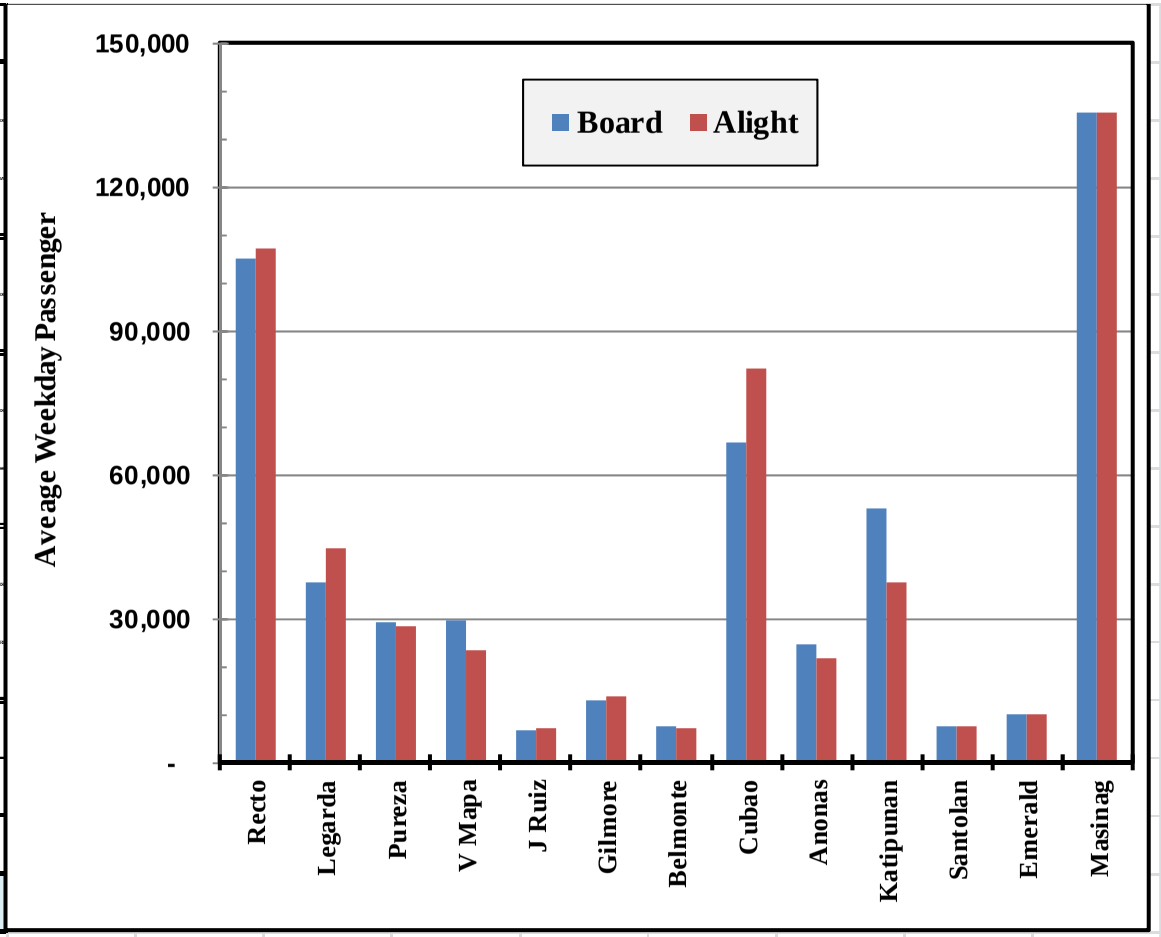


Table C.17 Line-2 AM Peak Hour (07:00-08:00) Station and Line Loading-2045

Station	Westbound		
	Board	Alight	Line Load
Masinag	21,630	-	21,630
Emerald	1,630	30	23,230
Santolan	1,050	70	24,210
Katipunan	6,230	420	30,020
Anonas	2,340	410	31,950
Cubao	1,600	2,770	30,780
Belmonte	410	780	30,410
Gilmore	210	1,800	28,820
J Ruiz	270	1,170	27,920
V Mapa	480	2,000	26,400
Pureza	210	4,040	22,570
Legarda	10	8,540	14,040
Recto	-	14,080	-
	36,070	36,110	-
Maximum	21,630	14,080	31,950
Average Trip Length (km)			11.84

Station	Eastbound		
	Board	Alight	Line Load
Recto	3,370	-	3,370
Legarda	690	30	4,030
Pureza	1,670	70	5,630
V Mapa	1,500	140	6,990
J Ruiz	390	110	7,270
Gilmore	370	180	7,460
Belmonte	250	190	7,520
Cubao	1,620	2,210	6,930
Anonas	260	810	6,380
Katipunan	180	1,580	4,980
Santolan	10	240	4,750
Emerald	10	330	4,430
Msinag	-	4,440	(10)
Total	10,320	10,330	-
Maximum	3,370	4,440	7,520
Average Trip Length (km)			9.10