DEPARTMENT OF TRANSPORTATION (DOTr)
THE REPUBLIC OF THE PHILIPPINES

FEASIBILITY STUDY
ON
THE NORTH SOUTH RAILWAY PROJECT
- SOUTH LINE (COMMUTER)
(NORTH-SOUTH COMMUTER RAILWAY EXTENSION PROJECT)
IN
THE REPUBLIC OF THE PHILIPPINES

DRAFT FINAL REPORT
(SOLIS-CALAMBA SECTION)

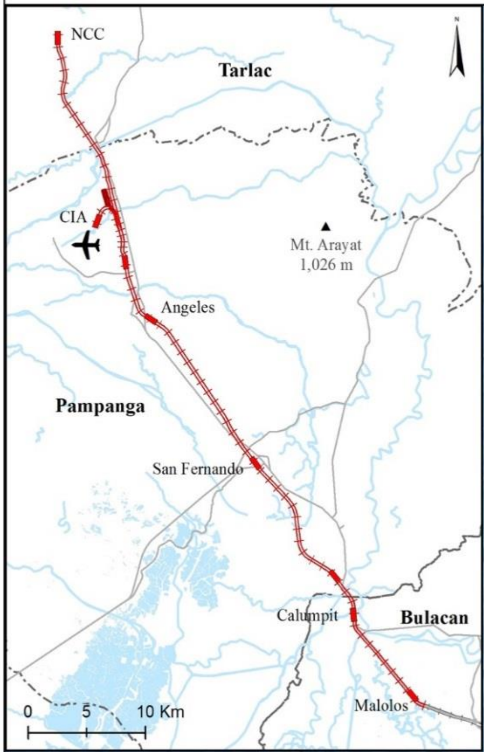
OCTOBER 2018

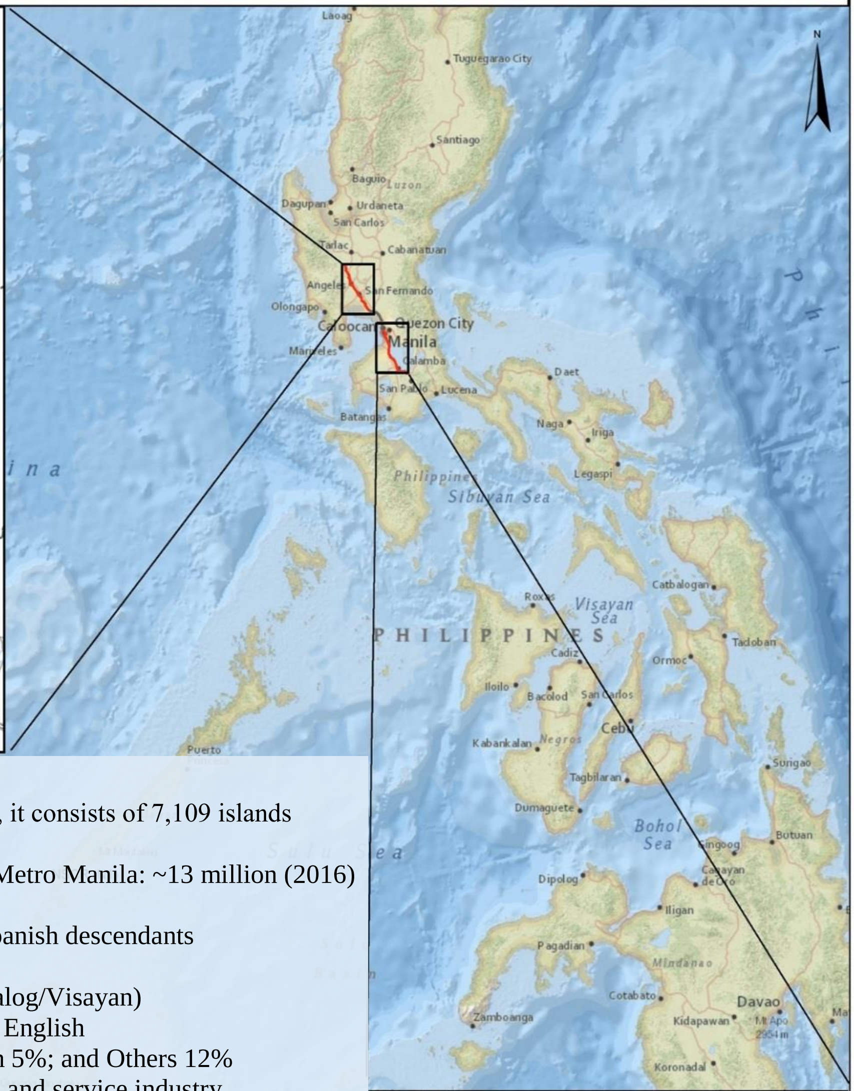
JAPAN INTERNATIONAL COOPERATION AGENCY

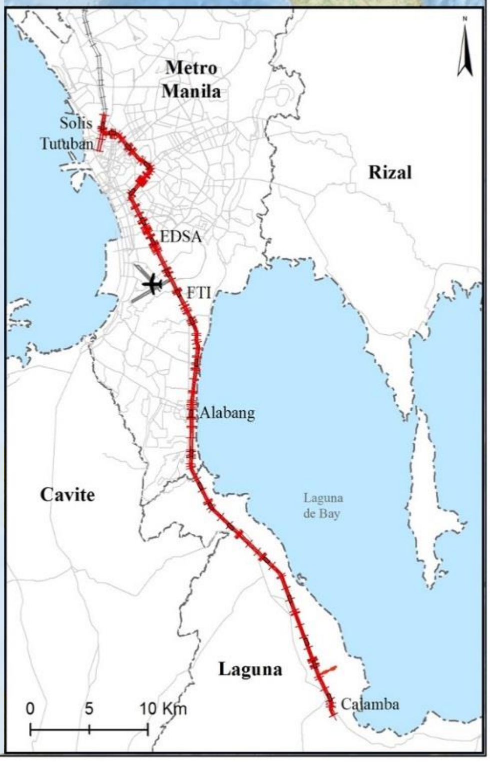
ORIENTAL CONSULTANTS GLOBAL CO., LTD.
JAPAN INTERNATIONAL CONSULTANTS FOR TRANSPORTATION CO., LTD
TONICHI ENGINEERING CONSULTANTS, INC.
KATAHIRA & ENGINEERING INTERNATIONAL
PACIFIC CONSULTANTS CO., LTD.
TOKYO METRO CO., LTD

Republic of the Philippines

Fact sheet





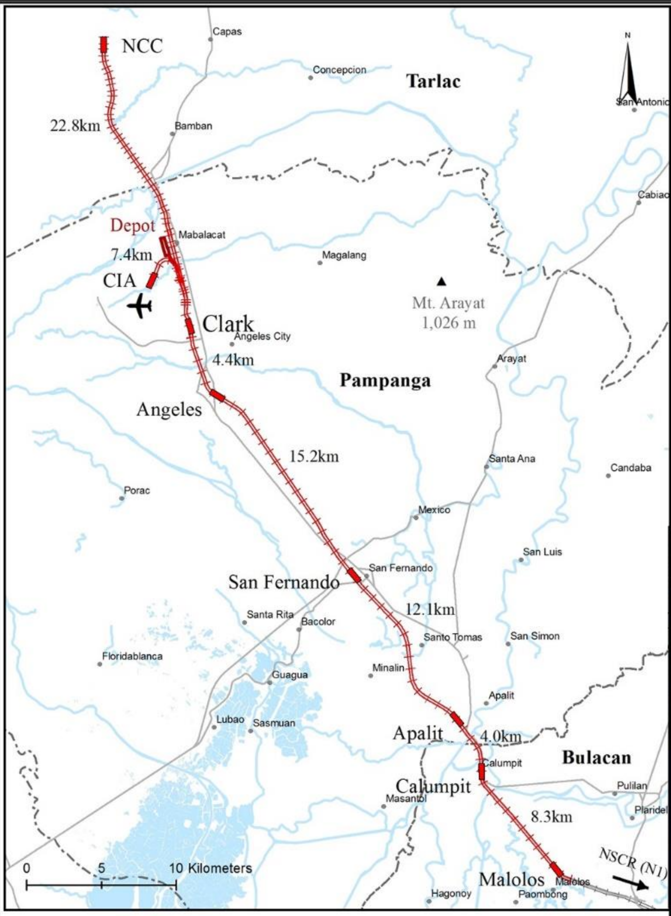


- Land area[1/]: ~299 thousand km[2/]
  (0.8 times of Japan's land mass), it consists of 7,109 islands
- Population: ~103 million (2016)[3/]
- Population of Greater Capital Region/Metro Manila: ~13 million (2016)
- Capital City: Manila
- Ethnic groups: Malay, Chinese, and Spanish descendants
- Languages:
  - National Language: Filipino (Tagalog/Visayan)
  - Official Languages: Filipino and English
- Religions: Roman Catholic 83%; Islam 5%; and Others 12%
- Major industries: Agriculture, forestry, and service industry
- GDP per capita: $ 3,100（IMF-2016）
- Current economic growth rate[2/]: 6.8% p.a.
- Inflation rate[2/]: 1.8% p.a.
- Total trade - FOB value (2016)[2/]:
  - Exports: US$57 billion
  - Imports: US$84 billion
- Major trade items[2/]:
  - Exports: Electronics/Electrical equipment, and transport equipment
  - Imports: Material, intermediate product, capital equipment, oil, and consumable goods.
- Currency: Philippine Peso
  - PHP1＝¥2.27 (Jan.2018) [5/]
  - US$1＝PHP50.51 (Jan.2018) [4/]
- Aid from Japan (cumulative, up to 2015) [1/]:
  - Loan: ¥2.47 trillion (E/N) [6/]
  - Grant: ¥2.81 trillion (E/N) [6/]
  - Technical cooperation: ¥2.26 trillion

Sources:
[1/]Ministry of Foreign Affairs of Japan, Countries and Regions
[2/]Philippine Statistics Authority (PSA)
[3/]Asian Development Bank (ADB)
[4/]Bangko Sentral ng Pilipinas (BSP)
[5/]Japan International Cooperation Agency (JICA)
[6/]E/N - Exchange of Notes

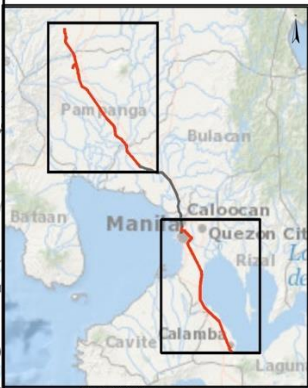
Malolos Clark Railway and North South Railway-South Line (Commuter)
(North-South Commuter Railway Extension Project)

Projects Factsheet



Malolos-Clark-NCC MCRP Railway (N2)

- Line length: 74km; + Depot Spur 3.5km Viaduct
- No. of stations: 7; (Elevated: 5; U/G: 2); 1 Depot.
- Connects with NSCR (N1) line in the south at Malolos station
- Passes through the cities/municipalities of: Malolos, Calumpit, Apalit, Minalin, Santo Tomas, San Fernando, Angeles, Mabalacat, Bamban, and Capas.
- Design speed: 160km/h
- Opening year: May 2022
- Proposed fare: PHP20 + PHP2/km
- Alignment Configuration- Standard gauge double track.
- At-grade: 2km; Viaduct: 63km; U/G: 9km; Total 74km.

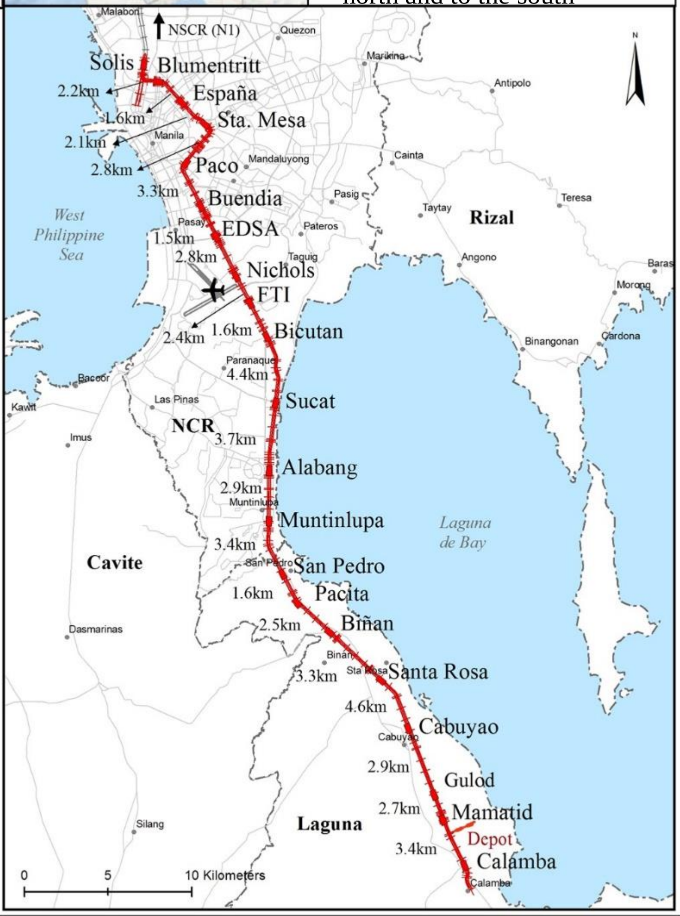


Connecting GCR by Railways

- A facility for millions of residents of GCR
- A backbone of transportation system connecting North and South through Metro Manila
- A high speed railway system
- Would extend the currently under construction, Tutuban-Malolos line, to the north and to the south

North South Railway-South Line (Commuter) Solis to Calamba

- Line length: 55.6km
- No. of stations: 21; at-Grade: 2; Elevated: 18; U/G: 1.
- Connects with NSCR (N1) line in the north at Solis station and MMSP line in the middle at FTI and Bicutan station.
- Passes through the cities/municipalities of: Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Santa Rosa, Cabuyao, and Calamba
- Design speed: 120km/h
- Opening Year: November 2023
- Proposed fare: PHP20 + PHP2/km (Commuter)
- PNR Current fare:
  Tutuban - Alabang: PHP30 A/C; PHP24 Non-A/C
- Alignment configuration:
  - Standard gauge; Double track
  - At-Grade: 12.6km;
  - Viaduct: 42km;
  - U/G: 1km.



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List of Abbreviations

Abbreviation	Explanation
AAQ	Ambient Air Quality
AASHTO	American Association of State Highway and Transportation
ACEL	The Association of Carriers & Equipment Lessors Inc.
AD	Ancestral Domain
ADB	Asian Development Bank
A&D	Alienable and Disposable
AFCS	Automatic Fare Collection System
AFP	Armed Forces of the Philippines
AIDS	Acquired Immunodeficiency Syndrome
AISC	American Institute of Steel Construction
AP	Access Point
APG	Angiosperm Phylogeny Group
APS	Auxiliary Power Supply
APSI	Air Pollution Source Installation
AR5	IPPC's Fifth Assessment Report
As	Arsenic
ASTM	American Society for Testing and Materials
AT	Auto Transformer
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Stop
AUVs	Asian Utility Vehicles
AWS	American Welding Society
AWARE	Airport Weather Advanced Readiness Toolkit
BAFs	Bureau of Agriculture and Fisheries Standards
BCDA	Bases Conversion Development Authority
BCR	Benefit and Cost Ratio
BD	Basic Design
BEM	Bangkok Expressway and Metro Public Company limited
BFP-SRU	Bureau of Fire Protection – Special Rescue Unit
BGC	Bonifacio Global City
BIR	Bureau of Internal Revenue
BLT	Build-Lease-and-Transfer
BMA	Bangkok Metropolitan Administration
BMB	Biodiversity Management Bureau
BMCL	Bangkok Metro Company Limited
BMTA	Bangkok Mass Transit Authority
BOD	Biochemical Oxygen Demand
BOI	Board of Investments
BOO	Build-Own-and-Operate

BOT	Build-Operate-and-Transfer
BP	Beginning Point
BPF	Band-Pass Filter
BPO	Business Process Outsourcing
BRGY	Barangay
BRT	Bus Rapid Transit
BS	British Standard
BSWM	Bureau of Soils and Water Management
BT	Battery
BT	Booster Transformer
BT	Build-and-Transfer
BTO	Build-Transfer-and-Operate
BTSC	Bangkok Mass Transit System Public Co., Ltd.
Ca	Calcium
CADC	Certificate of Ancestral Domain Claim
CADT	Certificate of Ancestral Domain Title
CALA	Cavite Laguna
CALABARZON	Cavite, Laguna, Batangas, Rizal, and Quezon
CALC	Certificate of Land Claims
CALT	Certificate of Ancestral Land Title
CAO	Contract-Add-and-Operate
CAPEX	Capital Expenditures
CARI	Contractor's All Risk Insurance
CARP	Comprehensive Agrarian Reform Program
CAVITEX	Manila-Cavite Expressway
CBTC	Communication Based Train Control
CCA	Climate Change Adaptation
CCC	Climate Change Commission
CCTV	Closed-circuit Television
Cd	Cadmium
CDC	Clark Development Corporation
CDM	Clean Development Mechanism
CE	Critically Endangered Species
CEMMAP	Contractor's Environmental Management Plan
CENRO	City Environment and Natural Resources Office
CEZ	Clark Economic Zone
CFZ	Clark Freeport Zone
CGC	Clark Green City
CHSRA	California High-Speed Rail Authority
CIA	Clark International Airport
CIAC	Clark International Airport Corporation
Cl	Chloride
CLLEx	Central Luzon Link Expressway
CLUP	Comprehensive Land Use Plan

CLUDP	Comprehensive Land Use and Development Plan
CMR	Compliance Monitoring Report
CMVR	Compliance Monitoring and Validation Report
CMWPI	Construction Materials Wholesale Price Index
Cn	Cyanide
CN	Curve Number
CNC	Certificate of Non-Coverage
CNO	Certificate of No Overlap
CO	Carbon Monoxide
COAG	Council of Australian Governments
CP	Compressor
CPCS	Canadian Pacific Consulting Services
CPDO	City Planning and Development Office
CPL	Central Plain of Luzon
Cr	Chromium
Cr+6	Chromium Hexavalent
CR	Critically Endangered
CS	Conservation Status
CSELR	CBT and South East Light Rail
CSEZ	Clark Special Economic Zone
CSZ	Clark Sub-Zone
CT	Current Transformer for measuring
CTC	Centralized Train Control
CTF	Cable Termination Frame
CWD	Civil Works Division
DA	Department of Agriculture
DAIP	Duterte Administration’s Infrastructure Plan
DAO	DENR Administrative Order
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
dB	Decibel
dBA	A-weighted decibels
DC	Direct Current
DCT	Current Transformer for DC measuring
DD / DED	Detailed Design Stage / Detailed Engineering Design Stage
dbh	Diameter at Breast-Height
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DGCS	DPWH Design Guidelines, Criteria and Specifications
DIA	Direct Impact Area
DILG	Department of Interior and Local Government
DMU	Diesel Multiple Unit
DO	Dissolved Oxygen
DOF	Department of Finance

DOH	Department of Health
DOST	Department of Science and Technology
DOT	Develop-Operate-and-Transfer
DOTC	Department of Transportation and Communications
DOTr	Department of Transportation
DPWH	Department of Public Works and Highways
DRR	Disaster Risk Reduction
DSPEWPC	Department of Sustainability, Environment, Water and Population Communities
DSR	Digital Space Radio
DSWD	Department of Social Welfare and Development
DTI	Department of Trade and Industry
DTM	Digital Elevation Model
DUPA	Detailed Unit Price Analysis
DVT	Voltage Transformer for DC measuring
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDSA	Epifanio delos Santos Avenue
EF	Emission Factor
EGF	Environmental Guarantee Fund
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EIAMD	Environmental Impact Assessment and Management Division
EIS	Environmental Impact Statement
EISR	Environmental Impact Statement Report
E&M	Electrical and Mechanical Systems
EMB	Environmental Management Bureau
EMC	Electro Magnetic Compatibility
EMF	Environmental Monitoring Fund
EMI	Electro Magnetic Interference
EMoP	Environmental Monitoring Plan
EMP	Environmental Management Plan
EMU	Electric Multiple Unit
EN	Endangered Species
ENPV	Economic Net Present Value
ENRO	Environment and Natural Resources Officer
EO	Executive Order
EOCC	End of Circular Curve
EP	End Point
EPC	Engineering Procurement Construction
EPRMP	Environmental Performance Report and Management Plan
EQPL	Environmental Quality Performance Level
EQS	Environmental Quality Standard

ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Engineering Support Division
ESRD	Environment, Social and ROW Division
ETC	End of Transition Curve
ETCS	European Train Control system
FACP	Fire Alarm Control Panel
FBDC	Fort Bonifacio Development Corporation
FBI	Field Based Investigation
FC	Foreign Currency
FDIs	Foreign Direct Investments
FFU	Fiber Reinforce Foamed Urethene
FGD	Focus Group Discussion
FIRR	Financial Internal Rate of Return
FMEA	Failure Modes and Effects Analysis
FMB	Forest Management Bureau
FNPV	Financial Net Present Value
FPIC	Free, Prior and Informed Consent
FS,F/S	Feasibility Study
FTI	Food Terminal Incorporated
FV	Field Validation
GAA	General Appropriations Act
GAF	Grievance Action Form
GCEs	Government Corporate Entities
GCR	Greater Capital Region
GDP	Gross Domestic Product
GE	Ground Elevation
GFIs	Government Financial Institutions
GHG	Greenhouse Gas
GICPs	Government Instrumentalities with Corporate Powers
GNI	Gross National Income
GOCCs	Government-Owned and/or Controlled Corporations
GOP	Government of the Philippines
GPRAM	Generic Preferred Risk Allocation Matrix
GPS	Global Positioning System
GRDA	General Residential Development Area
GRDP	Gross Regional Domestic Product
GRM	Grievance Redress Mechanism
GSM-R	Global System for Mobile communications - Railway
GTI	Geosphere Technologies Inc.
GVA	Gross Value Added
GW	Ground Water
HCM	Highway Capacity Manual
HCO3	Bicarbonate

HEC-RAS	the Hydrologic Engineering Canter's River Analysis System
HIV	Human Immunodeficiency Virus
HG	Total Mercury
HSEC	Health, Safety and Environment Committee
HSH	High Standard Highway
HSHs MP	High Standard Highways Master Plan
HUDGC	Housing and Urban Development Coordinating Council
Hz	Hertz
IA	Implementing Agency
IBAs	Important Bird Areas
IC	Industrial, Commercial
ICC	Indigenous Cultural Communities
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICT	Information Communication Technology
IEA	International Energy Agency
IEC	Information Education and Communication
IEE	Initial Environmental Examination
IESAM	Institute of Environmental Science and Management
IFC	International Finance Corporation
IGBT	Insulated Gate Bipolar Transistor
IIA	Indirect Impact Area
IOS	International Organization for Standardization
IP	Indigenous Peoples
IPC	Indigenous Peoples Communities
IPCC	Intergovernmental Panel on Climate Change
IPP	Indigenous People Plan
IP-PBX	Internet Protocol Private Branch eXchange
IPRA	Indigenous Peoples Rights Act
IRR	Internal Rate of Return
IRR(Chapter 9)	Implementing Rules and Regulations
IRRI	International Rice Research Institute
ISF	Informal Settler Families
ISP	Internet Service Provider
IUCN	International Union for Conservation of Nature
IV	Importance Value
JBIC	Japan Bank For International Cooperation
JDT	JICA Design Team
JICA	Japan International Cooperation Agency
JOIN	Japan Overseas Infrastructure Investment Corporation for Transport and Urban Development
JIS	Japanese Industrial Standards
JPY	Japanese Yen
JRIS	Japanese Railway Industrial Standards
JV	Joint Venture

K	Potassium
KBA	Key Biodiversity Area
KPI	Key Performance Indicator
Km	Kilometer
Kv	Kilovolts
KW/H	Kilowatt per hour
LAeq	Equivalent continuous sound pressure level
LC	Least Concern
LCC	Low Cost Carrier
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEED	Laguna Lakeshore Dyke Expressway
LGU	Local Government Unit
LIAC	Local Inter-Agency Committee
LLDA	Laguna Lake Development Authority
LMA	Limit of Movement Authority
LOS	Line Of Sight
LPA	Low Pressure Area
LPF	Low-Pass Filter
LRC	Luzon Railway Corporation
LRFD	Load Resistance Factor Design
LRGB	Last Relevant Balise Group
LRMC	the Light Rail Manila Corporation
LRS	Land Readjustment Scheme
LRT	Light Rail Transit
LRT-1,2	Light Rail Transit Line 1 & Line 2 in Metro Manila
LRTA	Light Rail Transit Authority
LRV	Light Rail Vehicles
LTFRB	Land Transportation Franchising and Regulatory Board
LVC	Land Value Capture
M&E	Materials & Equipment
MA	Movement Authority
MBAS	Methylene Blue Active Substances
MCLUPZO	Manila City Comprehensive Land Use Plan and Zoning Ordinance
MCRP	Malolos Clark Railway Project
MDBF	Mean Distance Between Failure
MERACLO	Manila Electric Railroad and Light Company
METI	Ministry of Economy, Trade and Industry
Mg	Magnesium
MGB	Mines and Geosciences Bureau
MH	Merchantable Height
MICT	Manila International Container Terminal
MIGA	Multilateral Investment Guarantee Agency
MLIT	Ministry of Land, Infrastructure, Transport and Tourism

MMDA	Metro Manila Development Authority
MMFR	Mount Makiling Forest Reserve
MMSP	Metro Manila Subway Project
MMT	Multi-partite Monitoring Team
MMTC	Metro Manila Transit Corporation
MMSS 3	Metro Manila Skyway Stage 3
MMUTIS	Metro Manila Urban Transportation Integrated Study
MNTC	Manila North Tollways Corporation
MoA	Mall of Asia
MOA	Memorandum of Agreement
MoU	Minutes of Understanding
MPN	Most Probable Number
MRF	Materials Recovery Facility
MRT	Metro Rail Transit
MRT-3	Metro Rail Transit Line 3 in Metro Manila
MRTC	Metro Rail Transit Corporation Limited
MSWMB	Municipal Solid Waste Management Board
MSMEs	Micro, Small and Medium Enterprises
MT	Metric Ton
MUCEP	The Project for Capacity Development on Transportation Planning and Database Management in the Republic of the Philippines
Na	Sodium
NAAQGV	National Ambient Air Quality Guideline Values
NAIA	Ninoy Aquino International Airport
NAMRIA	National Mapping and Resource Information Authority
NBCP	National Building Code of the Philippines
NBSAO	National Biodiversity Strategy and Action Plan
NCC	New Clark City
NCCA	National Commission for Culture and the Arts
NCCAP	National Climate Change Action Plan
NCIP	National Commission of Indigenous Peoples
NCR	National Capital Region
NECP	Non-Environmentally Critical Project
NEDA	National Economic Development Authority
NEX	Narita Express
NEXI	Nippon Export and Investment Insurance
NFSCC	National Framework Strategy on Climate Change
NGA	National Government Agency
NGCP	National Grid Corporation of the Philippines
NGO	Non-Government Organization
NHA	National Housing Authority
NHCP	National Historical Commission of the Philippines
NIED	Japan National Research Institute for Earth Science and Disaster Prevention
NIPAS	National Integrated Protected Areas System

NLEX	North Luzon Expressway
NLRC	North Luzon Railways Corporation
NM	National Museum
NMTT	Navotas-Malabon-Tenejeros-Tullahan River
NO2	Nitrogen Dioxide
NO3-N	Nitrate
NPCC	National Pollution Control Commission
NPV	Net Present Value
NSCR	North South Commuter Railway Project
NSCP	National Structure Codes of the Philippines
NSRP	North South Railway Project – South Line (Commuter)
NTC	National Telecommunications Commission
NTP	Notice to Proceed
O3	Ozone
OCC	Operation Control Center
OCD	Office of Civil Defense
ODA	Overseas Development Assistance
O&G	Oil and Grease
O&M	Operation & Maintenance
OPEX	Operating Expenditures
OSH	Occupational Safety and Health
OTS	Other Threatened Species
OWS	Other Wildlife Species
P2P	Point to (2) Point
PA	Philippine Army
PAF	Project Affected Families
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PAP	Project Affected Persons
PAR	Philippine Area of Responsibility
PAST	Paleontological Statistical Software
PAWB	Protected Areas and Wildlife Bureau
Pb	Lead
PBX	Private Branch eXchanger
PC	Prestressed Concrete
PC	Pre-cast
PCE	Passenger Car Equivalent
PCSD	Project Control Support Division
PCU	Passenger Car Unit
PCUP	Presidential Committee for the Urban Poor
PD	Presidential Decree
PDCA	Plan-Do-Check-Action
PDP	Philippines Development Plan
PDR	Project Description Report

PEC	Philippine Electrical Code
PEISS	Philippine Environmental Impact Statement System
PEMAPS	Project Environmental Monitoring and Audit Prioritization Scheme
PENRO	Provincial Environment and Natural Resources Office
PEPRMP	Programmatic Environmental Performance Report and Management Plan
PET	Polyethylene Terephthalate
PF	Power Fuse
PGM	Philippine Geoid Model
PH	Public Hearing
pH	Potential of Hydrogen
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP, PhP, Pesos	Philippine Peso
PLDT	Philippine Long Distance Telephone Company
PM	Particulate Matter (in microns)
PMO	Project Management Office
PNP	Philippine National Police
PNR	Philippine National Railways
PNS	Philippine National Standard
PNSC	Philippine National Structural Code
PNSDW	Philippine National Standard for Drinking Water
PO4-P	Phosphate
PO	People Organizations
PoE	Power over Ethernet
POP	Persistent Organic Pollutant
POS	Point of Sale System
PPCC	Philippine Plant Conservation Committee
PPE	Personal Protective Equipment
PPHPD	Passengers Per Hour Per Direction
PPP	Public Private Partnership
PPP Center	Public-Private-Partnership Center of the Philippines
PPP-LCC	PPP life cycle costs
PRA	Philippines Railway Authority
PRC	Programmed Route Control
PRI	Philippine Railway Institute
PRS	Philippine Reference System
PSA	Philippine Statistical Authority
PSC	Public Sector Comparator
P-SCAN	Projection-Scan
PSCCA	Philippine Strategy in Climate Change Adaption
PSD	Platform Screen Door
PT	Pantograph
PTAC	Pilotage Trading and Construction
PTSMP	Philippine Transportation System Master Plan

PTZ	Pan Tilt Zoom
PUD	Planned Unit Development
PUJ	Public Utility Jeepney
PUV	Public Utility Vehicle
PUVMP	Public Utility Vehicle Modernization Program
PWU	Philippines Women's University
Qh	Recent deposits
QoL	Quolity of Life
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
QVP	Quaternary Volcanic Pyroclastic
R	Radius of Curve
RA	Republic Act
RAMS	Reliability, Availability & Maintainability Studies
RAP	Resettlement Action Plan
RBC	Radio Block Centre
R/C	Revenue and Cost Ratio Analysis
R&D	Research & Development
RDP	Regional Development Plan
REG	Region
RF	Rainfall
RHU	Rural Health Unit
RIC	RAP Implementation Committee
RIDF	Rainfall-Intensity-Duration-Frequency
RIE	Residential, Institutional, Educational
ROO	Rehabilitate-Own-and-Operate
ROSCO	Rolling Stock Company
ROT	Rehabilitate-Operate-and-Transfer
ROW	Right-of-Way
RPM	Revised Procedural Manual
RPT	Real Property Tax
RRR	Reinforced Railroad with Rigid Facing Facing-Method
RS	Residency Status
RSD	Rolling Stock Division
RTK	Realtime Kinematic
RTP	Real-time Transport Protocol
RTU	Remote Terminal Unit
SAFDZ	Strategic Agriculture and Fisheries Development Zone
SB	Sangguniang Bayan
SBD	Secondary Business District
SCADA	Supervisory Control and Data Acquisition
SCF	Standard Conversion Factor
SCM	Stakeholder Consultation Meeting
SCPW	Society for the Conservation of Philippine Wetlands Inc.

SCS	Soil Conversation Service
SCTEX	Subic-Clark-Tarlac Expressway
SDH	Synchronous Digital Hierarchy
SDP	Social Development Plan
SDR	Software Defined Radio
SEMS	Social and Environmental Management Systems
SEZ	Special Economic Zone
SHFC	Social Housing Finance Corporation
SIC	Semi-conductor
SIP	Session Initiation Protocol
SLEX	South Luzon Expressway
SMR	Self-Monitoring Report
SNC	Philippines Second National Communication on Climate Change
SO2	Sulfur Dioxide
SO4	Sulfate
SPC	Special Purpose Company
SPS	Safeguard Policy Statement
SPT	Standard Penetration Test
SRTM	Shuttle Radar Topography Mission
STEP	Special Terms for Economic Partnership
STOA	Supplemental Toll Operating Agreement
STP	Sewage Treatment Plant
STPP	Sucat Thermal Power Plant
SUCs	State Universities and Colleges
SW	Surface Water
SWMP	Solid Waste Management Plan
TBM	Tunnel Boring Machine
TC	Trailer Car
TCLP	Toxicity Leaching Procedure
TCU	Total Color Unit
TD	Tropical Depression
TDD	Tagum-Davao-Digos
TDS	Total Dissolved Solids
TESDA	Technical Education and Skills Development Authority
TH	Total Height
TIF	Tax Increment Finance
TIA	Traffic Impact Assessment
TIF	Tax Increment Finance
TMP	Traffic Management Plan
TMS	Train Management System
TMV	Ticket Vending Machine
TOC	Train Operating Company
TOD	Transit Oriented Development
TOR	Terms of Reference

TRIP	Three-Year Rolling Infrastructure Program
TS	Tropical Storm
TSI	Technical Specification for Interoperability
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TTC	Travel Time Cost
TX	Tsukuba Express
TY	Typhoon
UH	Unit Hydrograph
ULC	Universal LRT Corporation
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UP	University of the Philippines
UPS	Uninterruptible Power-supply System
UR	Urban Resistance Agency
URS	Urban Redevelopment Scheme
USD	United States Dollar
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTC	Coordinated Universal Time
UTP	Unshielded Twisted Pair
VAT	Value Added Tax
VCR	Volume Capacity Ratio
VCT	Voltage Current Transformer for measuring
VFM	Value For Money
VGF	Viability Gap Fund
VL	Vibration Level
VLAN	Virtual Local Area Network
VOCs	Vehicle Operations Costs
VoIP	Voice over Internet Protocol
VT	Voltage transformer for Measuring
VU	Vulnerable Species
VVVF	Variable Voltage and Variable Frequency
WACS	Waste Analysis Characterization Study
WB	World Bank
WBCP	Wild Bird Club of the Philippines
WBCSD	World Business Council for Sustainable Development
WFP	Work and Financial Plan
WHO	World Health Organization
WQG	Water Quality Guidelines
WRI	World Resources Institute
WSS	Water Sampling Site

Note: The Project name "The North South Railway Project-South Line (Commuter)" shall be replaced with "The North South Railway Project-South Line (Commuter) (North-South Commuter Railway Extension Project)" in this report.

CHAPTER 1 INTRODUCTION

1.1 Project Background and Development

1.1.1 Philippines Railways History

The Philippine Rail Road Company operated some 800km or railways at the beginning of the 1900's up and down Luzon Island and with many spur lines. In 1917 it was nationalized to be Philippine National Railway and it expanded its network to ~1,140km by 1941. During the second world war much of the network was destroyed and at the end of the war only ~450km network was operational. Post war repairs rehabilitated much of the network, and by 1951 about 85% of the pre-war network was operational. In late 1950's much of the steam network was replaced with diesel locomotives from USA. The 1964 Republic Act 4156 established Philippine National Railway (PNR).

However, due to natural calamities and other issues the services went in to steep decline and only a handful of services remained operational by the end of the last century. As a result, the current operational services are limited to Tutuban-Alabang and limited service onward from Alabang to Calamba. The services to the north were halted in June 1991 with mount Pinatubo exploding and burying much of the system under ash.

However, in late 1990's GOP decided to revive the northern part of the rail system and Northrail project was started. The project involved upgrading of the existing single track to a dual-track system, converting the rail gauge from narrow to standard gauge. Linking Metro Manila (MM) to Malolos City in Bulacan and further on to Angeles City, Clark Special Economic Zone (CSEZ) and the Clark International Airport (CIA).

Preparatory construction began in early November 2006. Due to delays in the construction work, the project was cancelled in March 2011. Later in 2011, President Aquino administration scrapped the project due to lingering legal and administrative issues. The Philippine Supreme Court in March 2012 handed down a decision for the annulment of the allegedly overpriced Northrail project contract.

The Department of Transportation and Communications (DOTC) has examined reviving the project by commissioning feasibility studies for Manila Clark Railways with the help of JICA in 2012/13. Tutuban-Calamba-Los Banos commuter line study under its own program to rehabilitate the Philippine's Luzon railways.

1.1.2 Background – Clark Airport Link and Other Studies

To improve the situation mentioned above, JICA supported formulation and GOP approved of a roadmap namely "Roadmap for Transport Infrastructure Development for Metro Manila and its Surrounding Areas" (Roadmap 1). In this project, it was recommended that the necessity to lead the further development of Metro Manila to be in the direction of north and south in order to disperse the socioeconomic activities. In addition, there are proposals of new urban cities and further strengthening of the North-South rail and road corridors Through Metro Manila. Based on the results of the Roadmap 1, and Manila-Clark Airport Express/ commuter rail feasibility studies. The "North-South Commuter Railway Project (Tutuban – Malolos) Detailed Design Study" (NSCR) was implemented through a JICA grant which was completed in December 2017. At present, general consulting services of this project including bidding process assistance are underway through the ODA of Japanese Yen loan provision.

The current Philippine government, which started its tenure on June 30, 2016, announced the economic policy with infrastructure development as its main pillar. In that policy, it showed that the infrastructure investment of the Philippine government had stayed at only 2.4% of GDP on average over the past 50 years. In response to this shortage in infrastructure investment, the economic policy aims to increase the infrastructure investment to 5.4% of the GDP from 2017 onwards. It had presented fourteen priority infrastructure projects. One of these priority projects is the Malolos-Clark Railway Project (MCRP), which connects Clark International Airport (CIA) with Metro Manila area. The other project is North-South Railway Project-South Line (Commuter): NSRP that connects Metro Manila with its southern suburbs.

1.1.3 North South Railway Project – South Line (Commuter) Study Background

The length of the NSRP-South Line (Commuter) will be approximately 56.5 km from Solis to Calamba Station. It is estimated that 42km section will be elevated on viaduct, 12.6km of the alignment will be at grade and approximately 1km underground. The line will have twenty-one stations on this section of the NSRP-South line, two of these stations planned to be at-grade, 18 on viaduct and one underground. One depot will be located between Mamatid and Calamba Stations. The alignment of the line is to follow the currently operational PNR route, which is in a dilapidated state and in dire need of rehabilitation.

Table 1.1.1 Chronologial Table of Events Leading to this NSRP Line Study

Year/Month	Events
2014	Implementation of Roadmap 1
2016/ June	New Administration launched economic plan with Investment in Infrastructure
2017/ Mar	Implementation of ADB F/S (Study on NSCR-South Line (PNR South) 46309-001
2017/June	The project (MCRP & NSRP South) was approved

Source: JICA Design Team

The Feasibility Study completed for the ADB in March 2017 was conducted to update the results and findings of the 2015 Study of North-South Railways for the PPP Center of the Government of the

Philippines. The 2015 study was approved by NEDA for implementation. The ADB FS provided the revised cost estimate of the project and initial land resumption requirements for the project. This is to include the additional ROW for the PNR future freight railways and the necessity of the PNR to keep its southern operation during the construction of the NSCR South Line. The ADB FS recommended the project for implementation with some technical alignment changes to reduce the construction cost.

GOP has requested the Government of Japan for assistance to modernize this line on the existing alignment to a state-of-the-art commuter line with design speed of 120kph, providing a comfortable, reliable, dependable, and most of affordable commuter service from the south of MM metropolis to the heart of Makati CBD and also connect to the railways to the north. This project is in response to this request of Government of the Philippines (GOP).

1.2 Objectives of the NSRP-South Line (Commuter) Project

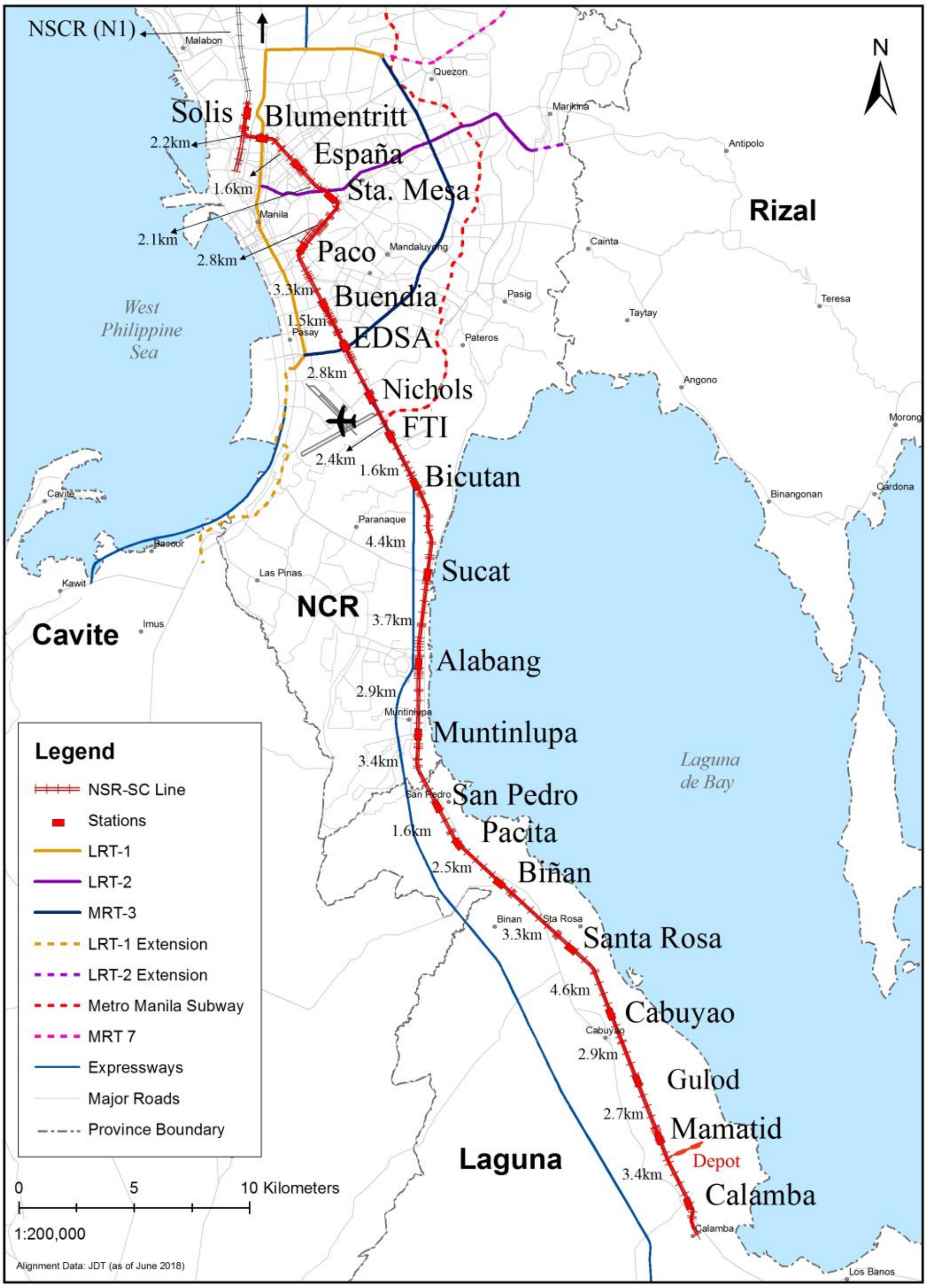
The key objectives of the Project are to conduct a complementary study to the JOIN F/S and ADB F/S to cover the technical and other aspects not covered by these two studies, and to confirm the ‘full’ feasibility of the NSRP-South Line (Commuter). Subsequently, this project aims to conduct a detailed examination of the civil structures and E&M systems of the project by setting the design standards. The project would propose construction plans in compliance with the technical standards, considering the optimum construction contract forms, contract packages, and prepare draft bid documents for the ODA loans for the construction and implementation of the project.

1.3 Project Study Area

1.3.1 North South Railway Project – South Line (Commuter)

The study area for this project extends from City of Manila (Solis Station on the current Tutuban – Malolos line) to Calamba. It will run in the RoW of the current South Luzon railway line. This corridor would serve the heart of Metro Manila, cities of Makati new urban centers like Alabang and continues into Laguna province. The line will have twenty-one stations to serve these areas with a fast, modern, state-of-the-art fully electrified, secure, reliable, and affordable commuter railway with design speed of 120kph.

The length of the NSRP-South is approximately 55.6km from Solis to Calamba Station. The NSRP-South study area is depicted in Figure 1.3.1. The Figure also illustrates the twenty-one station location and distances between stations.



Source: JICA Design Team

Figure 1.3.1 North South Rail Project-South Line (Commuter) – Study Area

1.4 NSRP-South Line (Commuter) Study Phasing and Scope of Work

1.4.1 Feasibility Study Phase I (December 2017 – August 2018)

The proposed project was studied by an ADB F/S completed in March 2017. The synopsis of the study is presented above in section 1.1.3. The tasks necessary for an ODA loan for a railway project are: conceptual/ preliminary/ detail design of the project, latest cost estimate, environmental and social considerations (environmental assessment or environmental impact assessment, EIA), and resettlement Action plan (RAP). The results of the Phase I of this project would cover the above aspects and the findings/ outcome is to be reported by this Feasibility Study.

1.4.2 NSRP-South Line (Commuter) Study Phase-I Scope of Work

The scope of the studies for Phase-I are summarized in Table 1.4.1 below.

Table 1.4.1 NSRP South Line (Commuter) – Scope of Studies for Phase-I

(1) Supplementary FS and Development of Basic/ Concept Railway system	
1	Necessity and Background of the Project
2	Topographic and Geologic Survey
3	Route Alignment Plan
4	Developing Project Plan
5	Developing Project Implementation Plan
6	Developing Project Implementation Structure
7	Social and Environmental Impacts
8	Assessment of Project Effectiveness
(2) Basic Design	
1	Design Criteria
2	Design Specification
3	Documentation for Procurement of Contractor

Source: JICA Design Team

1.4.3 JICA JDT Coordination Meetings with DOTr-PMO

The Coordination Meetings for the project that has been held to-date are listed in Table 1.4.2 below.

Table 1.4.2 List of Coordination Meetings

No.	Date	Venue	Reference
1	December 14, 2017	DOTr Clark Office	Attachment 1
2	January 15, 2018	DOTr Clark Office	Attachment 2
3	January 31, 2018	ADB Office	Attachment 3
4	February 21, 2018	LRTA Office	Attachment 4
5	April 18, 2018	LRTA Office	Attachment 5
6	August 3, 2018	BCDA Office BGC	Attachment 6

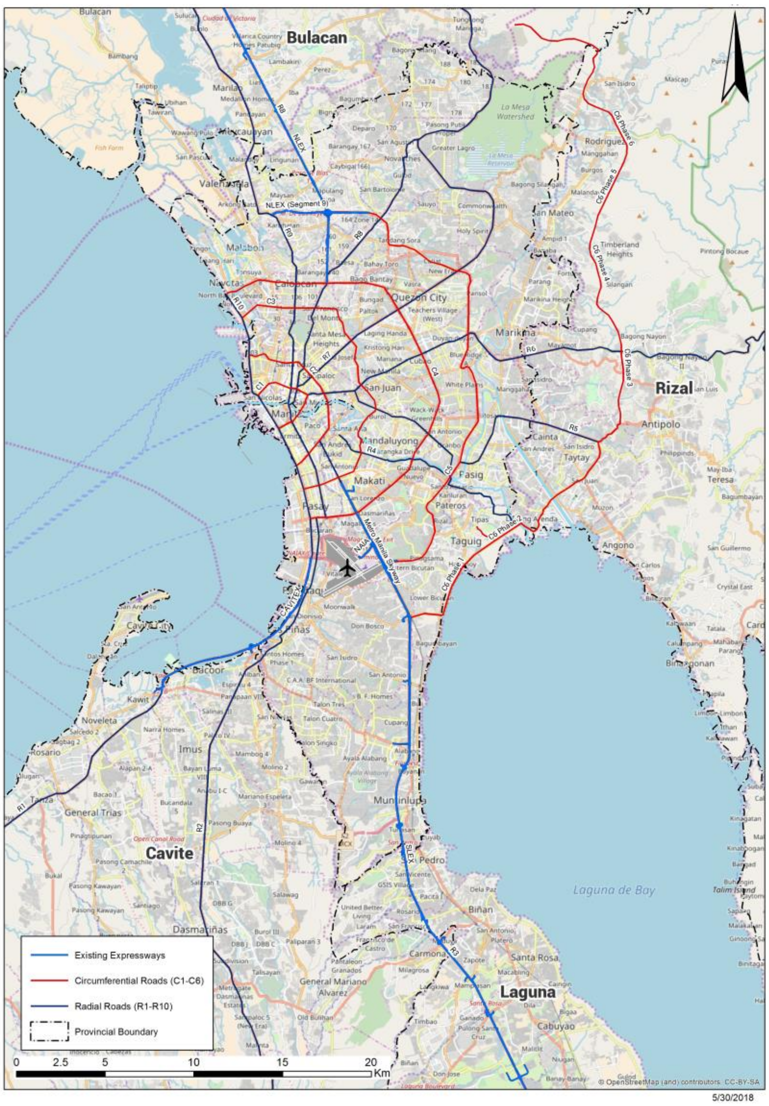
Source: JICA Design Team

CHAPTER 2 NECESSITY OF THE PROJECT

2.1 Overview and Issues of Transport Sector in GCR

2.1.1 Road and Expressway Network

Metro Manila has ten radial roads and five circumferential roads. Outside Metro Manila, MacArthur Highway is the only highway which connects Metro Manila with Bulacan and Pampanga Provinces, in the north. In wider area, Metro Manila is linked by expressways to Laguna on the south by the South Luzon Expressway (SLEx ~51km) and Skyway (16km); to Bulacan and Pampanga on the north by the North Luzon Expressway (NLEx ~84km), which T-connects to Subic-Clark-Tarlac Expressway (SCTEx ~94km). In the southwest MM is linked to Cavite province by Manila-Cavite Expressway (CAVITEx ~14km). Complete existing highway and expressway network is depicted in Figure 2.1.1.



Source: JICA Design Team

Figure 2.1.1 Existing Roads, Highways and Expressways Network in Greater Metro Manila

2.1.2 GCR Railway Network

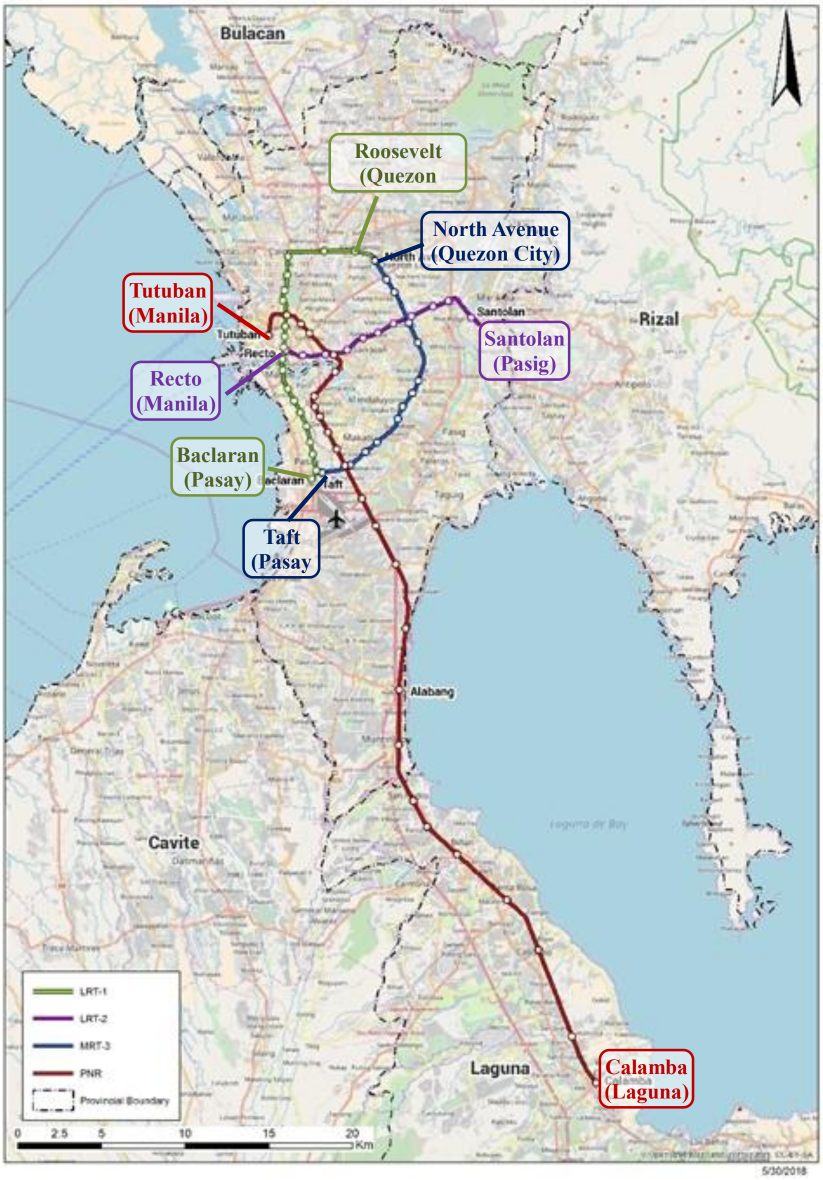
(1) Rail Network Characteristics and Operation

The railway system in Greater Capital Region of Manila consists of the Philippine National Railway (PNR) for inter-urban or suburban service, and three LRTs for inner-city urban travel. PNR currently provides limited frequency service. The PNR service albeit unreliable provides a services to the south - from Tutuban in Manila, heart of the old city to Calamba in Laguna province. Revival of the operation to the north via a commuter service from Tutuban in Manila City to Malolos in Bulacan province had been stalled since the last decade due to the collapse of the Northrail project. The current performance of the 4 railway lines are summarized in Table 2.1.1. The rail network is illustrated in Figure 2.1.2.

Table 2.1.1 Summary of Railway Systems in GCR

Characteristics	PNR	LRT Line 1	LRT Line 2	MRT Line 3
Guideway & Railway Type	At-grade (HRT, narrow-gauge)	Elevated (LRT, std gauge)	Elevated w/UG (LRT, std gauge)	Elevated, w/UG (LRT, std gauge)
Route	Tutuban (Manila)-Calamba (Laguna)	Roosevelt (Quezon City) - Baclaran (Pasay)	Santolan (Pasig) - Recto (Manila)	North Avenue (Quezon City) – Taft (Pasay)
Route Length	~56 km	18.1 km	13.5 km	16.9 km
No. of Stations	25	20	11	13
Capacity	-	1,358 pax/train	1,628 pax/train	1,182 pax/train
Maximum Speed	-	60 kph	80 kph	65 kph
Operating Speed	-	38 kph	33 kph	30 kph
Fare (distance-based)	PhP15 - (AC PhP60	PhP11 + 1/km[2/]	PhP11 + 1/km[2/]	PhP11 + 1/km[2/]
Travel Time	~2.5 hours	~28 minutes	30 minutes	30 minutes
Headway	30 minutes (variable)	2 minutes	4~5 minutes	3 minutes

Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

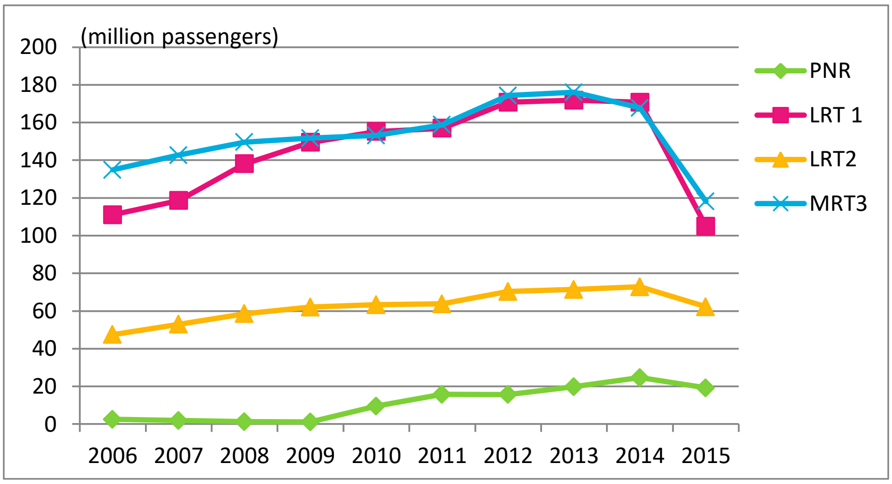


Source: JICA Design Team

Figure 2.1.2 Existing Railway Network in Greater Metro Manila

(2) Ridership

The aggregate number of railway passengers in 2015 was more than 304 million passengers - of which, MRT3 accounted for 39%, followed by LRT-1 (34%). Passenger volumes for the four lines has shown healthy growth from 2006 to 2014. The trend in patronage has been illustrated below in Figure 2.1.3. The precipitous decline after 2014 was primarily caused by 45% reduction in train availability on MRT-3, about 20% on LRT-1, and ~16% on PNR. The frequency of incidents / disruptions on MRT3 alone have been observed to be more than 10 times a week since 2017.



Source: Statistics from DOTr.

Figure 2.1.3 Railway Passengers in GCR 2006-2014

2.1.3 Road Based Public Transport System

Buses, jeepneys and Asian Utility Vehicle (AUV) basically comprise the road-based public transport services in the Study Area In many local communities other paratransit like trishaws, Pedi-cab provide service mainly for short distances and as feeder service to access main roads served by Jeepneys or buses. Almost all public transport vehicles are owned and operated by the private sector, but are regulated by the Land Transportation Franchising Regulatory Board (LTFRB). Besides, DOTr (formally DOTc) launched the point to point (P2P) premium bus services in December 2015, this to cover the shortfall in PT supply caused by lack of trains for MRT-3. Aside from a fixed departure and arrival schedule, the P2P service uses premium buses with free WiFi and GPS to provide comfortable and convenient ride for commuters. As of December 2016, P2P is operated along 11 routes. Other than the P2P, no new bus services have been added or issued any new franchises within MM/ GCR.

2.1.4 Airports

There are two international airports in the Study Area. Ninoy Aquino International (NAIA) located in Pasay City, Metro Manila. It is the gateway airport for the Philippines mainly due to its close proximity to business centers of Metro Manila. Currently, NAIA is handling approximately 34 million passengers per annum including both international and domestic the majority of NAIA passengers are domestic from/to Metro Manila and southern Luzon and other Islands. On the other hand, Clark International Airport (CIA) located in Mabalacat City, Pampanga Province is currently utilized by mainly low-cost carrier (LCC) airlines. CIA is handling less than one million passengers per annum. CIA does not attract many airlines/ passengers due to its poor accessibility to/from Metro Manila. The capacity of NAIA is assumed approximately 35 million passengers per annum and 250,000 aircraft movements.[1] In 2016, the passenger traffic at NAIA was 39.5 million in 2016 (excluding general aviation) and the number of aircraft movements was more than 258,000. Thus, NAIA has already reached its capacity. For CIA,

[1] JICA, "Information Collection Survey for New Manila International Airport in the Philippines", Jan 2016

although the existing passenger terminal building had expanded to accommodate 5 million international and domestic passengers per year, the annual passenger counts as of 2014 was only 878,000 passengers. However, in the future, CIAC has planned for extension capacity, it will be extended to 46 million / year on 3rd phase[2].

In road map II Study, a strategy has been proposed for the airport which is the gateway of GCR as below, CIA is written that future expansion plans will be made, and it will absorb NAIA's excess demand.

Table 2.1.2 GCR Gateway Airport by Roadmap II

Airport	Phase 1 (2018-2022)	Phase 2 (2023-2029)	Phase 3 (2030 upward)
CIA	Complete the new CRK International Passenger Terminal in tandem with private O&M	Expand capacity and upgrade systems to absorb spill over from & provide relief to existing NAIA	Build the 2nd and 3rd runway, as well as expand Pax Terminal building & Cargo Terminal
NAIA	Complete the transfer of General aviation from NAIA to Sangley Terminal space expansion & management improvements (T1 to T4) via PPP	Build a new NAIA in another site south of NCR (if not Sangley 1, then Laguna Lake or Lipa-Batangas)	Shutter existing NAIA and convert to “green lungs of NCR” plus socialized housing community
Regional airports outside GCR	Complete the night landing facilities in other airports feeding into NAIA	Complete full development of regional airports, as well as tourism-based airports (Bohol, Palawan, etc.)	Aviation policies to steer traffic growths from GCR to regional airports (Cebu, Davao, Iloilo, Laoag)

Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

2.1.5 Current Key Transport Issues

(1) Overview of Traffic Congestion

The significant increase in traffic volume resulted in congestion level much worse than that in the late 1960’s, in some cases leading to total grid-locks on key arterial and circumferential roads. Traffic congestions occur not only on road traffic but also on railways, especially on LRT1 and MRT3, where passenger queues for considerable time even to access the station entrance. The cheap fare on LRTs compared to other public transport modes, faster travel times and the lack of railway network attracts passengers to LRT1 an MRT3 beyond their current operating capacities. This results in overcrowding on the platforms (sometime reaching dangerous levels) with queues of passengers in concourses waiting to go to the already overcrowded platforms. The passengers suffer unnecessary delays and discomfort due to delayed/ cancelled trains.

The overloaded railway infrastructure has been facing technical problems, causing accidents and operation suspensions. In addition, the problems of the railway system in Metro Manila are caused by lack of physical and service integration among the three railway lines as well as institutional integration to manage the railway systems.

Similarly, the airport has been facing the congestion, specially at NAIA the busiest airport in the Philippines which has reached its capacity. The air passenger movement in NAIA has been increasing

[2] http://madaboutsolutions.space/staging/amchamwp/wp-content/uploads/2017/06/feb23.pdf

inline with economic growth of the Philippines. The penetration of the LCC airlines in the Philippines has pushed NAIA runways to their capacity limits. However, it is extremely difficult to expand NAIA capacity due to its location and congested surrounding areas. The Philippine Government declared in 1994 to utilize CIA as a premier international gateway airport for the Philippines so that air traffic demand of Metro Manila could be handled by NAIA and CIA togather. However, CIA is underutilized because of unpredictable travel time to/from Metro Manila in the absence of high speed rail link.

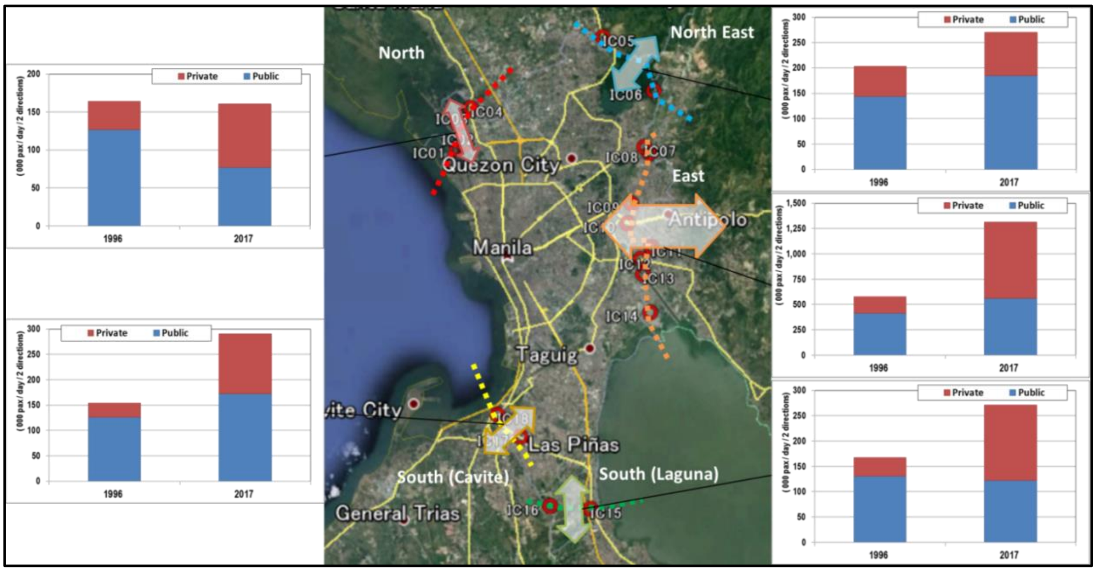
The population of Metro Manila, the capital city of the Philippines increased by 1.5 times from 8.0 million in 1990 to over 12.0 million in 2010. With a population density of 20,000 per km^2, Manila is home to about 13% of the population of the Philippines and the main economic center accounting for 38% of the country's GDP.

Severe traffic congestion and environmental degradation characterize Metro Manila particularly at city centers, where high density development continues unabated. Urban sprawl has spilled over onto surrounding northern and southern provinces which are within daily commuting distance from Metro Manila. With increasing vehicle ownership, congestion is expected to worsen, further increasing travel times of commuters to unacceptable levels.

Figure 2.1.4 Current Traffic Congestion on EDSA

(2) Road Traffic Demand

Comparing the traffic count results along the boundary of Metro Manila of 1996, 2012, and 2017, the daily traffic has been increasing in the period 1996–2017 as illustrated in Figure 2.1.5. In particular, the traffic to and from east and south increased about three-fold. This implies the rapid expansion of urban areas of Rizal, Laguna, and Cavite provinces. Comparing the growth of the number of passengers with the number of PCU, the number of passengers increases 1.8 times on average, while the number of PCU increases 2.7 times in during the same period. This implies that more people use private vehicles rather than public transport such as bus and jeepney, i,e, increase has been mostly in the number and use of private vehicles, whereas share of public transport has either declined or remained roughly the same over the same period.



Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

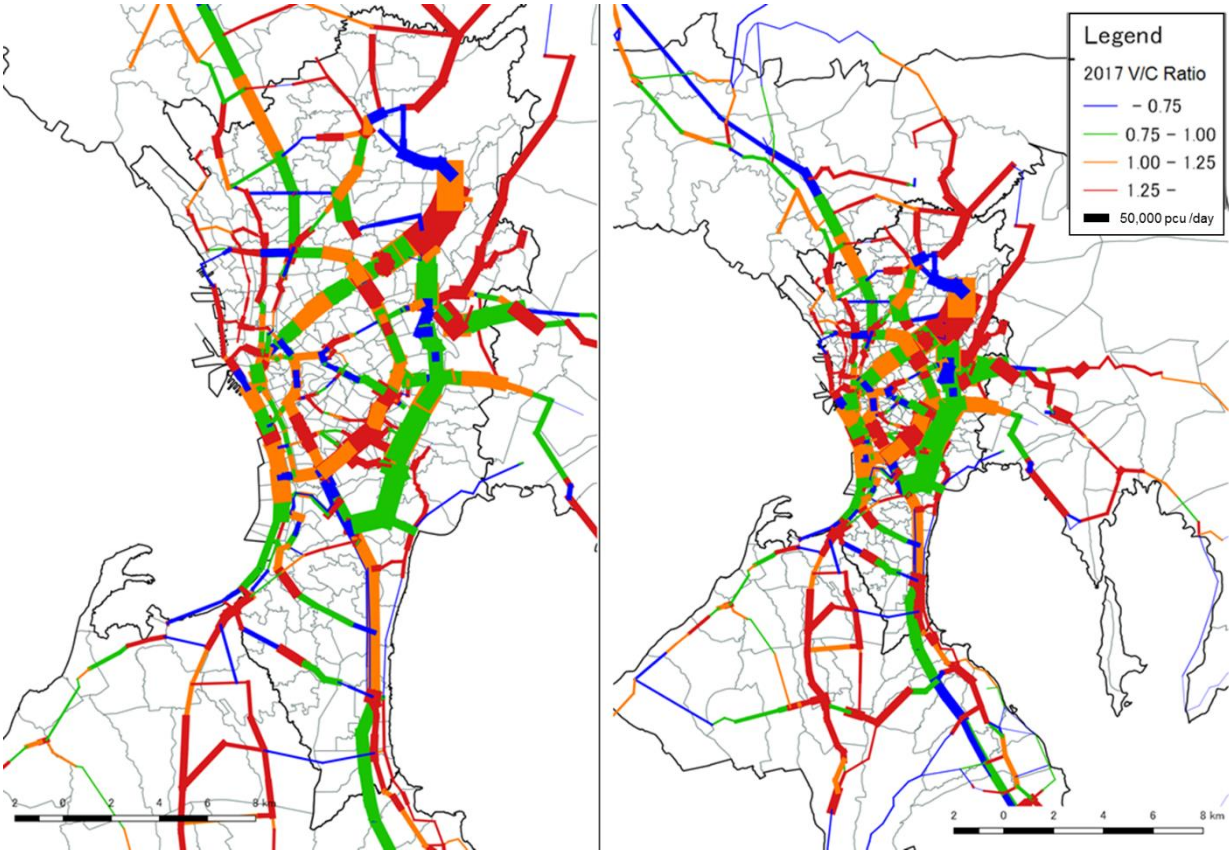
Figure 2.1.5 Changes in Daily Traffic Crossing Metro Manila Boundary

(3) Existing Road Network Performance

In Mega Manila, the daily traffic volume on most of the roads are nearly or exceed their capacity. When the traffic volume of a road exceeds 50% of its capacity, the travel speed starts to decrease dramatically and such road condition may be referred to as heavy traffic.

The traffic volume/capacity ratio of road sections in Mega Manila and Metro Manila are shown in Figure 2.1.6. Orange and red colors in the figures indicate road sections with volume/capacity ratio >=1.0. Or could be defined having reached capacity and require additional capacity to meet demand.

Metro Manila	Mega Manila



Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

Figure 2.1.6 Traffic Volume and V/C Ratio on Existing Road Network—Based on Traffic Model

(4) Impact of Traffic Congestions

The estimated congestion costs[3] in Metro Manila and the adjoining provinces are estimated to be PhP 3 and 2 billion/day, respectively. Besides congestion cost, environmental emission can also be converted to monetary value. Based on the market value of CO_2 in November 2017,[4] CO_2 emission in Metro Manila and the adjoining areas cost about PhP75,000 and PhP68,000 per day, respectively.

(5) Summary of Issues

The traffic congestions in Metro Manila and adjoining provinces have been getting worse by the day. The congestion is not only in the morning and evening peak rush hours, but also, prevails throughout the day. The congestion is spreading to the outer areas and adjoining provinces. It is estimated that the cost of congestions exceeds PhP3.0 billion/day in Metro Manila and PhP2.0 billion daily in the adjoining

[3] Congestion cost is the difference between the actual transport cost and the transport cost with free-flow traffic. The free-flow traffic in this Study was assumed that the travel speed of expressways, primary roads and secondary roads are 60 kph, 35 kph and 20 kph, respectively. The transport cost consists of (i) Vehicle Operating Cost and (ii) Travel Time Cost of all road users. The unit costs by vehicle type were estimated in MUCEP Study and updated to the price in 2017. Value of Time by the vehicle types are as follows: Public (86.2 php/hr), Motorcycle (81.1 php/hr)、Car (131.5 php/hr).

[4] 1 ton of CO_2 = EUR7.26 (CO_2 EUROPEAN EMISSION ALLOWANCES) on 16 November 2017.
EUR7.26 =PhP435 (JICA Conversion Rate in November 2017)

provinces comprising of Bulacan, Rizal, Cavite, and Laguna. This huge economic loss is due to increase in vehicle operating cost and travel time also affect the peoples' life significantly.

Causes of the traffic congestions are complex. Primarily, traffic demand exceeds capacities of infrastructure. This does not mean that more construction of roads and rail infrastructures is the solution. Before expansion of roads, negative factors attributed to the existing facilities may be identified in a long list such as, but not limited to:

(i) Inadequate road intersection management:

Capacities of roads as a network are constrained due to non-signalized intersection, signalized intersection with adequate traffic flow control, including cycle time of traffic signals, channelization of intersections, and enforcement of traffic rules at and around intersections.

(ii) Lack of corridor management:

This includes loading and unloading of bus/jeepney passengers, which is particularly obvious in the CBD area and at LRT/MRT stations, illegal road side parking and vendors, driving behavior, inadequate pedestrian crossing facilities and jaywalking, etc.

(iii) Lack of enforcement capacity:

Impact of traffic congestion on land use is also notable. In 1970 and 1980, the most significant CBD was in the City of Manila, therefore, traffic distribution was planned radially which justified the radial road development and LRT Line-1. Thereafter, CBD center of gravity gradually shifted to Makati and Ortigas areas. Today, urban spatial structure in Metro Manila is more complex and a number of activities centers have emerged.

Traffic congestion does not only cause travel cost and time losses, but also deteriorates air quality and the living environment. The main vehicle emissions consist of CO_2, NOx, and PMx. These will affect not only climate change, but also human health.

2.2 Review of Current Development Policies and Plans

2.2.1 National Transport Policy (NTP)

The NTP envisions the establishment of "a safe, secure, reliable, efficient, integrated, intermodal, affordable, cost-effective, environmentally sustainable, and people-oriented national transport system that ensures improved quality of life of the people" as the Transport Vision.

The Philippine Government will adopt the NTP to achieve the Transport Vision, which all elements of the transport system and all sub-sectors of transportation, including passengers, shippers, service providers, investors, agencies and instrumentalities of government and those involved in the movement of people and goods and in the provision of transport infrastructure, facilities and services, shall abide by and use as guidance in transport development, management, operations, and use.

The NTP was approved and adopted by NEDA Board in June 2017 meeting and is expected to unify all transport-related projects in the country.

2.2.2 Philippines Development Plan (2017-2022)

The Philippine Development Plan (PDP) 2017–2022 was officially approved by the National Economic Development Authority (NEDA) Board in February 2017. The development plan aims to lay a stronger foundation for inclusive growth, a high-trust society, and a globally-competitive economy towards realizing the vision by 2040. The target of PDP 2017–2022 is to reduce poverty incidence from 21.6 percent in 2015 to 14.0 percent by 2022.

To support a higher growth trajectory and improve the quality of life in both urban and rural communities, and infrastructure development will remain among the top priorities. Moreover, initial steps were taken towards developing new railway and other mass transit systems in and outside Metro Manila. For more efficient use of road infrastructure, the movement of people and goods will be prioritized over private vehicles. The desired shift from private to public transport with emphasis on mass transport will be encouraged by ensuring the accessibility, availability, affordability, adequacy, convenience, and reliability of rail transport and bus priority systems.

2.2.3 Philippine Transportation System Master Plan (PTSMP)

The formulation of a comprehensive transport master plan on a nationwide scale is one of the strategies espoused in the NTP, particularly to ensure the holistic and evidence-based program/project selection process.

The study aims to come up with a master plan, formulated based on a detailed assessment of the existing national transport network and the results of a comprehensive analysis of the gaps therein. The PTSMP aims to guide the rational development of an intermodal transport network in the country through coordinated planning and operation of projects and programs as an integrated network of intermodal sub-systems. It also aims to promote sub-regional economic cooperation/agglomeration and utilization of multimodal transport system for more efficient connectivity between industrial/production areas, major cities, and rural areas in line with the Government's direction to decentralize development away from highly urbanized cities and metropolis.

2.2.4 Public Utility Vehicle Modernization Program (PUVMP)

The PUVMP is a road-based transport reform program that envisions a restructured, modern, well-managed, and environmentally sustainable transport sector. Where drivers and operators have stable, sufficient, and dignified livelihoods while commuters get to their destinations quickly, safely, and comfortably. It was declared that with the program, "By 2022, Filipinos will have a pleasant commuting experience."

It is envisaged that the benefits of the PUVMP are (i) congestion reduction especially in highly urbanized area; (ii) improvement of public transport level of service; (iii) passenger and commuter welfare; (iv) Improvement of welfare for the transport sector; (v) creation of more jobs/employment by engaging the local manufacturing industry; (vi) reduction of both environmental and social costs (health) through less production of carbon dioxide and particulate matter emissions; and (vii) improvement of take-home pay for the drivers. The major components of the PUVMP are shown in Figure 2.2.1.

The Department of Transportation (DOTr) is in the process of seeking the support of all stakeholders for the government initiative to upgrade public utility jeepneys as part of the PUVMP.

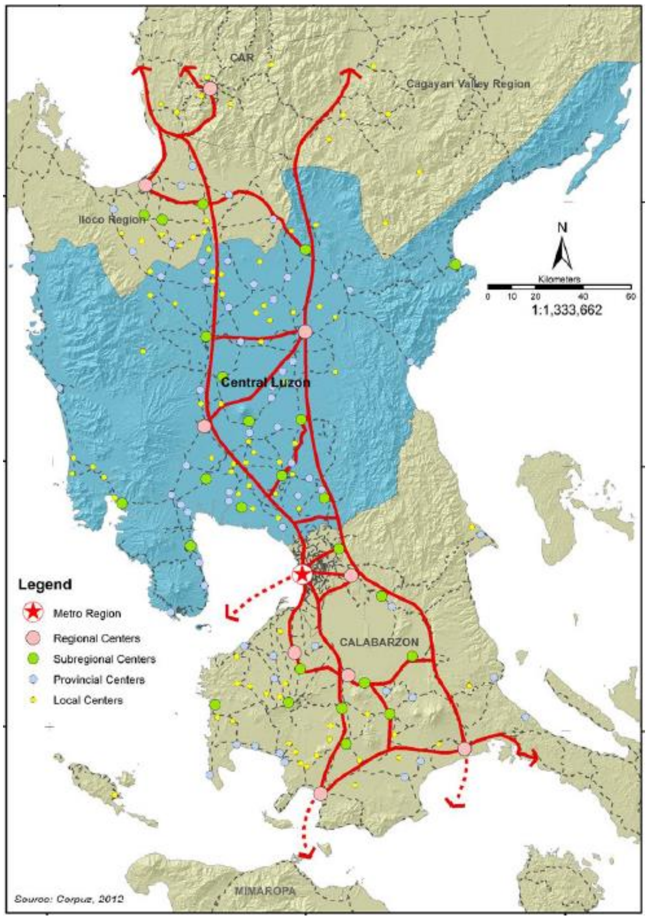
Source: DOTr

Figure 2.2.1 Major Components of the PUV Modernization Program

2.2.5 Central Luzon Regional Development Plan 2017–2022

Central Luzon Regional Development Plan (RDP) 2017–2022 states that the vision of the region is: "to have globally competitive human resources, a highly productive and profitable agricultural sector, seamless and integrated physical access, and a transshipment and logistics hub in the Asia-Pacific Region."

Access and circulation between and among the different sub-regional, provincial, and town centers will be facilitated through the development of backbone, lateral, and strategic all-access roads. The critical sections of the existing MacArthur and Pan- Philippine Highways (north–south arterial backbone roads) will be rehabilitated or widened to improve capacity (Figure 2.2.2).



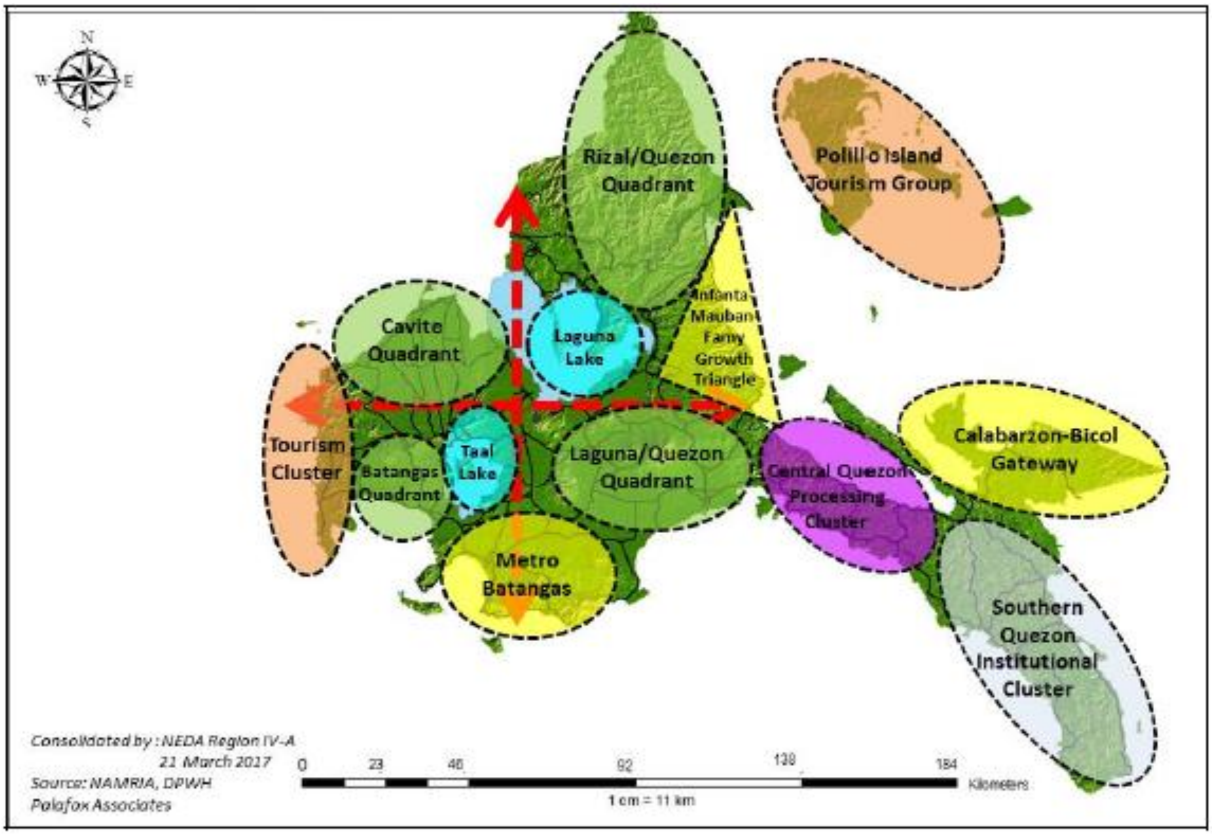
Source: Central Luzon Regional Development Plan 2017 - 2022

Figure 2.2.2 Twin-spine Connectivity Framework Showing Linkages between Urban Centers

2.2.6 Regional Development Plan for CALABARZON 2017–2022

The CALABARZON Regional Development Plan (RDP) 2017–2022 states that the vision of Region 4-A is "a region of vibrant economic diversity and vitality with progressive, well-planned town clusters inhabited by God-loving people enjoying globally competitive, balanced, and resilient ecosystems."

To realize the region's vision, in 2011, the plan proposed a spatial development strategy called Center/Cluster-Corridor-Wedge (CCW) to enhance development along the west–east and north–south axes. However, this was refined in CALABARZON RDP 2017–2022 and a five-tier network or hierarchy of settlements was proposed, which became consistent with the population and economic trends. Consistent with the spatial development strategy of the country (concentration, connectivity, and vulnerability reduction), settlements were grouped based on their commonalities in terms of physical configuration, roles, and socio-economic potentials and constraints to improve their viability and competitiveness in the role they are expected to perform (Figure 2.2.3).



Source: CALABARZON Regional Development Plan 2017–2022

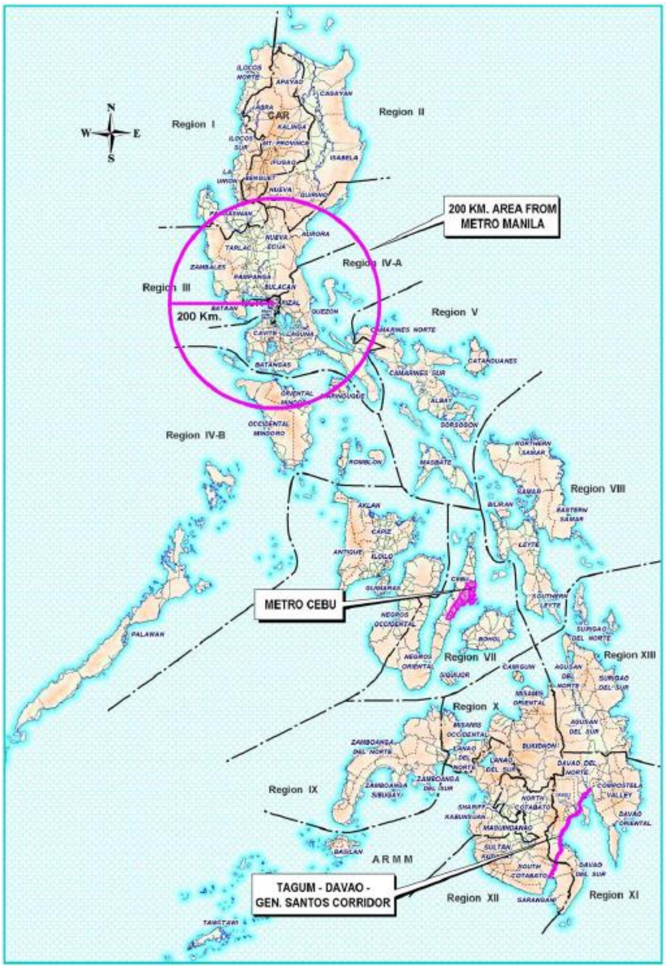
Figure 2.2.3 CLALBARZON Quadrant and Cluster Framework Concept

2.2.7 High-Standard Highway Master Plan

In response to the request of the Government of the Philippines, the Government of Japan decided to conduct the "Study of Master Plan on High Standard Highway Network Development in the Republic of the Philippines" and entrusted the study to the Japan International Cooperation Agency (JICA), which was conducted from April 2009 to May 2010.

The objectives of the High-Standard Highway Master Plan were the formulation of a Development Strategy for the High-Standard Highway (HSH) Network and the formulation of the High-Standard Highway Master Plan with the goal of eventually providing transport facilities that assure high mobility and higher transport capacity.

The study areas covered by the HSH Master Plan were the 200-km radius around Metro Manila, Metro Cebu, and the Tagum–Davao–General Santos Corridors. The location map of the study area is shown in Figure 2.2.4.



Source: The Study of Masterplan on High Standard Highway Network Development in the Republic of the Philippines

Figure 2.2.4 Location Map and Study Areas of the High-Standard Highway Network Masterplan

2.2.8 Metro Manila Greenprint 2030

The Metropolitan Manila Development Authority (MMDA) embarked on creating a green development plan for the metropolis to replace the outdated Metro Manila Development Plan. The vision of this plan is "Metro Manila for all; Green, connected, resilient; Offering talent and opportunity; Processing knowledge and delivering services at home and abroad." This plan also recommends relocation of the majority of commercial airport functions of NAIA to a site that has road and rail access to major urban nodes as well as realization of the full potential of Clark International Airport.

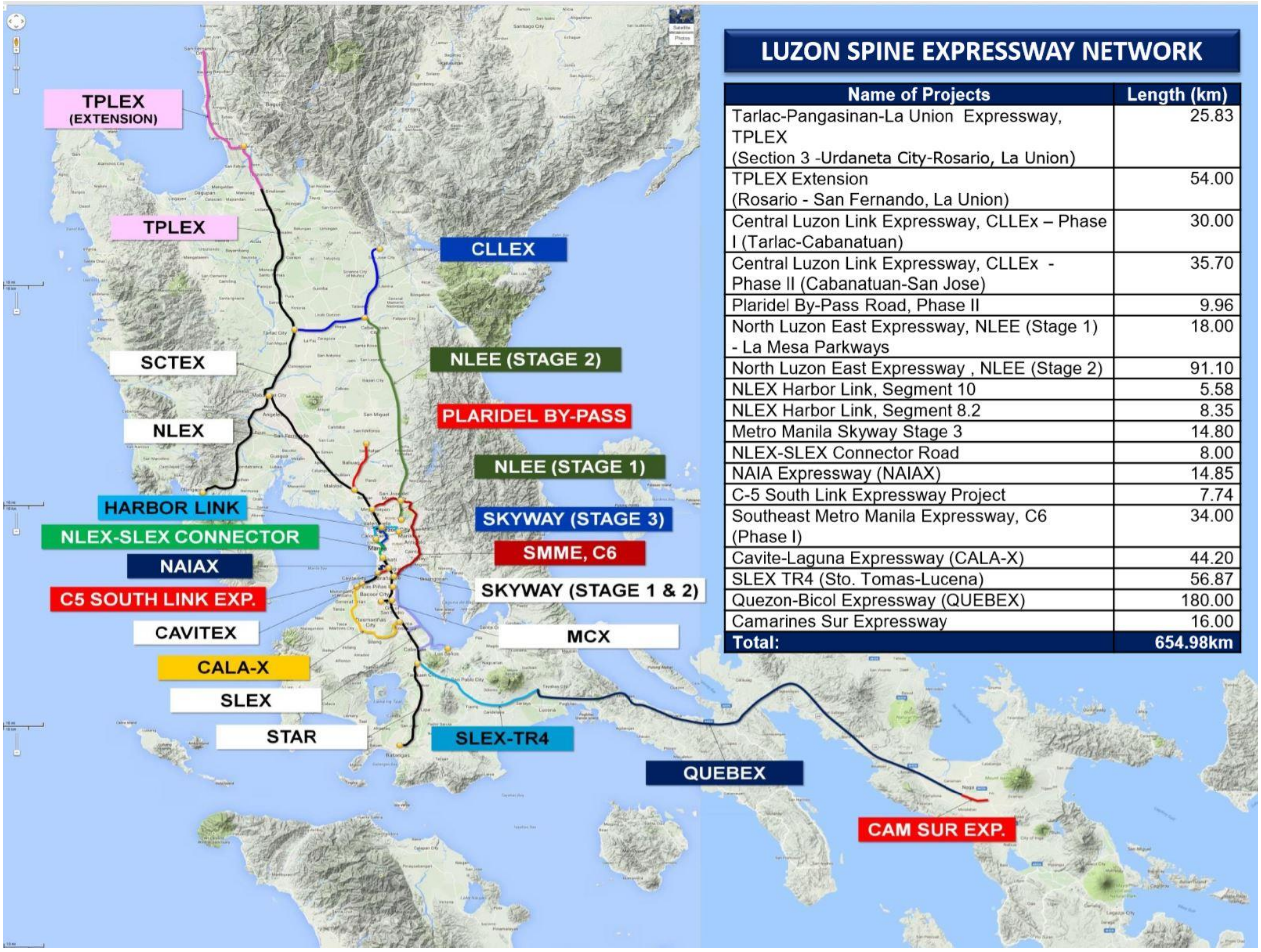
The spatial strategies for Metro Manila Greenprint 2030 was planned to be developed in two Phases. However, as of August 2017, no Phase 2 has been implemented.

2.2.9 Major Transport Projects in Greater Capital Region

(1) Urban Highways and Expressways

DPWH announced plans for 13 new bridges across Pasig and Marikina Rivers. This was followed by an announcement of a grant from China to build two bridges across Pasig River. There are also several urban road projects in the Three Year Rolling Plan (TRIP) of DPWH, but more projects are focused on Metro Manila.

The DPWH has unveiled a long-term Luzon expressway network development plan which they dubbed as the "Luzon Spine Expressway Network" (Figure 2.2.5). Although the implementation timetable is not clear, the implicit target is to complete 655 km of expressways by 2022. Approximately, 50% of this network is in GCR. A review of the records in the last three decades, as well as recent improvements in funding and ROW issues, suggests a more realistic target should be a 20-year horizon.



Name of Projects	Length (km)
Tarlac-Pangasinan-La Union Expressway, TPLEX (Section 3 -Urdaneta City-Rosario, La Union)	25.83
TPLEX Extension (Rosario - San Fernando, La Union)	54.00
Central Luzon Link Expressway, CLLEx – Phase I (Tarlac-Cabanatuan)	30.00
Central Luzon Link Expressway, CLLEx - Phase II (Cabanatuan-San Jose)	35.70
Plaridel By-Pass Road, Phase II	9.96
North Luzon East Expressway, NLEE (Stage 1) - La Mesa Parkways	18.00
North Luzon East Expressway , NLEE (Stage 2)	91.10
NLEX Harbor Link, Segment 10	5.58
NLEX Harbor Link, Segment 8.2	8.35
Metro Manila Skyway Stage 3	14.80
NLEX-SLEX Connector Road	8.00
NAIA Expressway (NAIAX)	14.85
C-5 South Link Expressway Project	7.74
Southeast Metro Manila Expressway, C6 (Phase I)	34.00
Cavite-Laguna Expressway (CALA-X)	44.20
SLEX TR4 (Sto. Tomas-Lucena)	56.87
Quezon-Bicol Expressway (QUEBEX)	180.00
Camarines Sur Expressway	16.00
Total:	654.98km

Source: DPWH

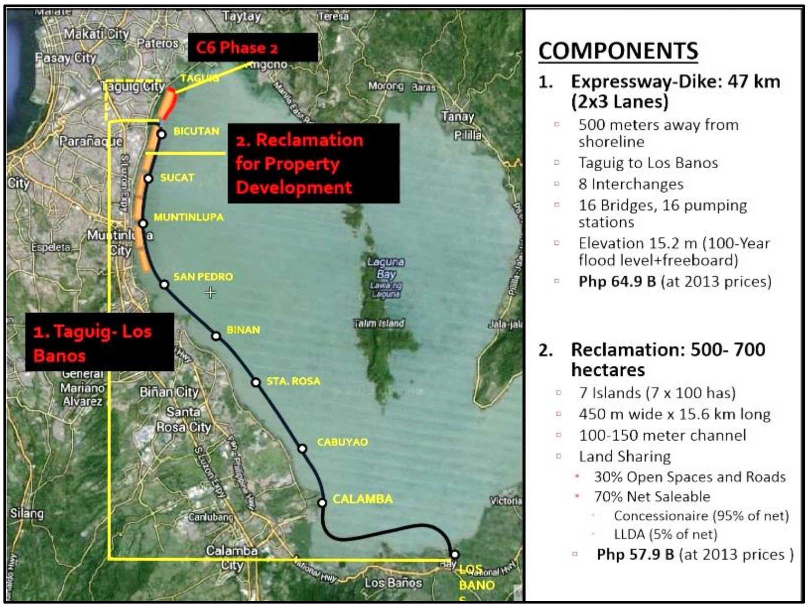
Figure 2.2.5 The DPWH Expressway Program for Luzon

The conspicuous omissions in the above network are: The Lakeshore Expressway (43-km), the Calamba-Los Baños Expressway (14.7 km), and the C-5 Expressway (46-km from Cavitex to San Jose del Monte in Bulacan). Presumably, the C-6 (proposed in the 2010 DPWH High Standard Highway program) will be in lieu of C-5. There are cogent reasons why the three projects should be included in this master plan:

(i) Extensive studies and project preparation works have already been undertaken for the three projects. Their early realization is more likely and lessons the infrastructure backlog.

(ii) The Lakeshore and Calamba projects complement the flood control projects for Laguna Lake. Traffic congestions are already severe in these areas to be served. The Lakeshore project will provide relief to SLEX, which is almost a monopoly route to the south of Makati. The PPP tender in 2015 failed due to the stiff investment hurdles. It could and should be revived – by increasing the Viability Funding Gap and putting the costs upfront. (Figure 2.2.6)

(iii) An unsolicited proposal for C-5 has been submitted in early 2017 to DPWH (Figure 2.2.7). The spatial plan for GCR favors C-5 over C-6, aside from the higher natural hazard risks and do-ability/ constructability for the later.



Source: DPWH

Figure 2.2.6 Alignment of Laguna Lakeshore Expressway

Source: DPWH

Figure 2.2.7 Alignment of C-5 Expressway

There are two other expressways that have been put forwards recently by the private sector. These are:

(i) The NLEX-Cavitex Port Expressway Link Project, in two phases. Phase 1 is 6.4km from R10 to MICT. Phase 2 is 8.6km from MICT to Cavitex along R-1. This was proposed by MNTC/MPIC.

(ii) The C-3 Expressway, 8.6km from Sta Mesa to the Mall of Asia complex, submitted by AC Infrastructure to DPWH in March 2017. Variations of this project have been considered by DPWH for the last 10 years. (Figure 2.2.8)

Source: DPWH

Figure 2.2.8 C3 Expressway to MoA

(2) Railway Projects

It is nearly impossible to sustain a megalopolis the size of GCR without an extensive network of mass rail transit system. There is a limit to road expansion; whilst motor vehicles continue to grow unabated. Construction of much-needed railway lines, however, has been very slow, compounded by failure to complete committed investments. Construction of the 35-km Northrail project commenced in 2005, but it was aborted in 2012 without completing a single kilometer. The 4-km extension of LRT-2 could have been completed in 2014, but the schedule has skidded to 2019.

The plans for the rail network of GCR have always been grand and ambitious but have not materialized for various reasons. Lethargic implementation could be ascribed to lack of financing – from 1990 to 2010. The 15-year MMUTIS Plan that was completed in 1999 contained a scaled-back rail network plan that took into account a projected budget envelope as well as corollary improvements in the road network to year 2015. Very little of this plan has been implemented, as demonstrated in Table 2.2.1.

The urban railway PPP projects have been also proposed but most of them failed. The main problems and issues are outlined as follows:

(i) In general, railway projects especially green-field projects have uncertainty of the passenger demand and their profitability is unclear for the private sector involvement.

(ii) The tendering processes of PPP are more complicated and more-costly than those of conventional procurement.

(iii) The project proposal tends to be not consistent with other related projects

Table 2.2.1 Railway Project in Last Decade

Name of Project	Plan Realization vis-à-vis MMUTIS		Remarks
	Plan for 2000–2012	Actual	
LRT-1 South Extension	Construction start in 2001 and completion by 2004. JV between LRTA and SNC Lavallin got signed & later terminated.	Deal with SNC Lavallin got scuttled. A new PPP tender was conducted; Concession awarded to LRMC in 2015. New completion date is 2022.	18 years behind original schedule. Faulty structure of JV and delays in the PPP tendering
LRT-2 East Extension	Construction from 2002–2004.	The viaduct was completed in 2016, but without tracks, station, power and signaling. New completion target is 2019.	Repetitive feasibility studies: 4 done from 2006–2012. Project components were unnecessarily unbundled and the implementation has been delayed.
LRT-2 West Extension	For implementation after 2004 and completion of East Extension.	None. No on-going effort to re-start.	Feasibility study updated in 2010.
LRT-3 Phase 2	Completion by 2004 of the 4-km extension from North Avenue to Monumento.	Converted into an extension of Line 1 (North Loop); completed in 2010.	Connection to MRT-3 at Trinoma was deleted from North Loop project. Issue on Common Station with MRT-7 stretched for 7 years
PNR South Commuter	Packaged into MCX as an unsolicited proposal	DOTr disregarded MCX. Rehabilitation of a 30-km line from Tutuban to Alabang completed as Phase 1 of N–S Linkage Project.	Track rehabilitation was deemed insufficient since double-tracking to Alabang fell short. Phase 2 improvements cancelled
LRT-4	Phase 1 (Recto-to-Batasan) to be completed by 2004	Abandoned. It was proposed as unsolicited proposal, but it has been not approved by the NEDA board. New proposal was published in 2017.	Competing claimants on original proponent status. BRT Line also adopted on same corridor.
MRT-7	Busway to be built on Commonwealth after completion of Line 4.	Concession awarded in 2009 to private proponent of unsolicited proposal. New completion is 2021.	Project ownership changed hands 3 times, before start of construction in 2016.
Northrail (Manila–Clark)	Suburban commuter service between Malolos and Caloocan was to be completed by 2008.	Contract with Chinese contractors signed in 2004. Implementation problems led to contract termination in 2012.	New plans as part of North-South Commuter Railway. Change in railway gauge reset timetable. Loan agreement signed with JICA in 2017.

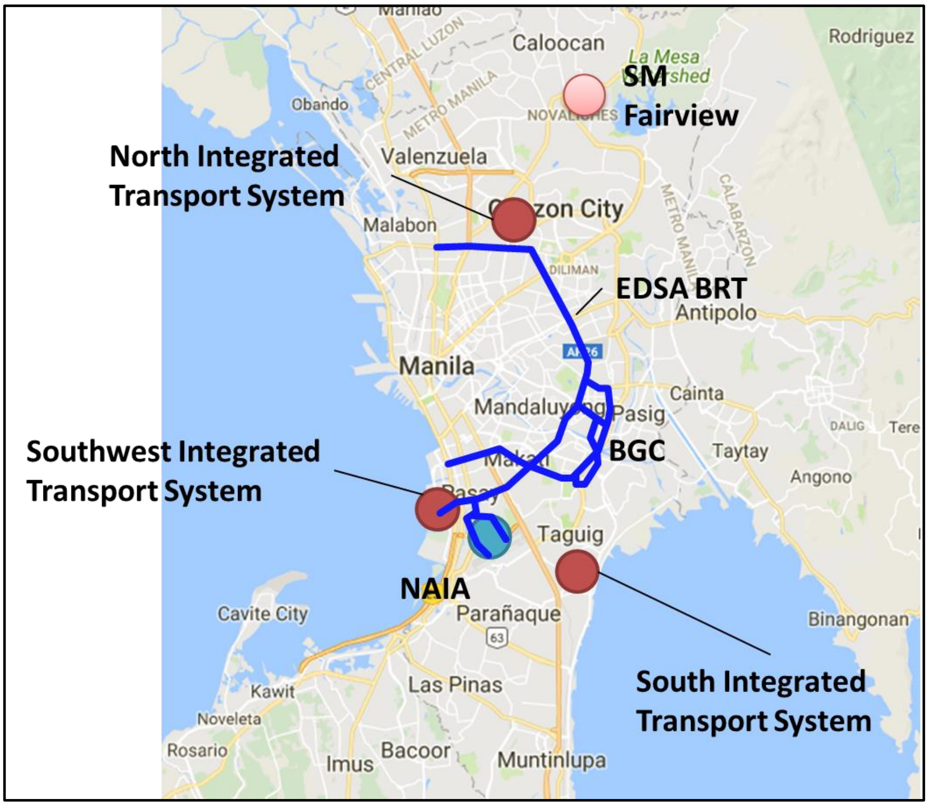
Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

(3) Road Based Public Transport System

(a) Transport Terminal Projects (Integrated Transport System): The project involves the establishment of transportation terminals at the suburbs of Metro Manila to connect passengers to/from outer areas to various transport modes. Currently, the following 3 facilities are planned to be developed; (i) North terminal planned in the north of EDSA is to serve passengers to/from Region III, planned to be completed in 2020, (ii) South Terminal (Taguig Terminal Exchange: ITX) is to serve passengers to/from Laguna and Batangas Provinces, and (iii) Southwest terminal is to serve passengers to/from Cavite Province. Ayala Land Inc. has bagged the right to build and operate 35year concession agreement for the South terminal at Php4 billion, of its 5.6 ha area. MWM Terminals awarded construction of the Southwest terminal at Php3 billion. The concessionaire can also undertake commercial development and would collect generated revenues.

(b) BRT System: The 48.6-kilometer Metro Manila Bus Rapid Transit (BRT) – EDSA was approved by NEDA in September 2016. This BRT is expected to be operational by 2020. The project route covers Monumento up to Diosdado Macapagal Avenue/Roxas Boulevard, with integrated routes between the Ortigas Business District, BGC, and the Makati Business District. It is also planned to link with the NAIA terminals and include off-corridors to the target Integrated Transport System terminals in the North, South and Southwest of Metro Manila, and near SM Fairview. The project is now shelved due to its poor FS and issues of constructability and financial viability. (Figure 2.2.9).

The location of road public transport system projects is shown in Figure 2.2.9.



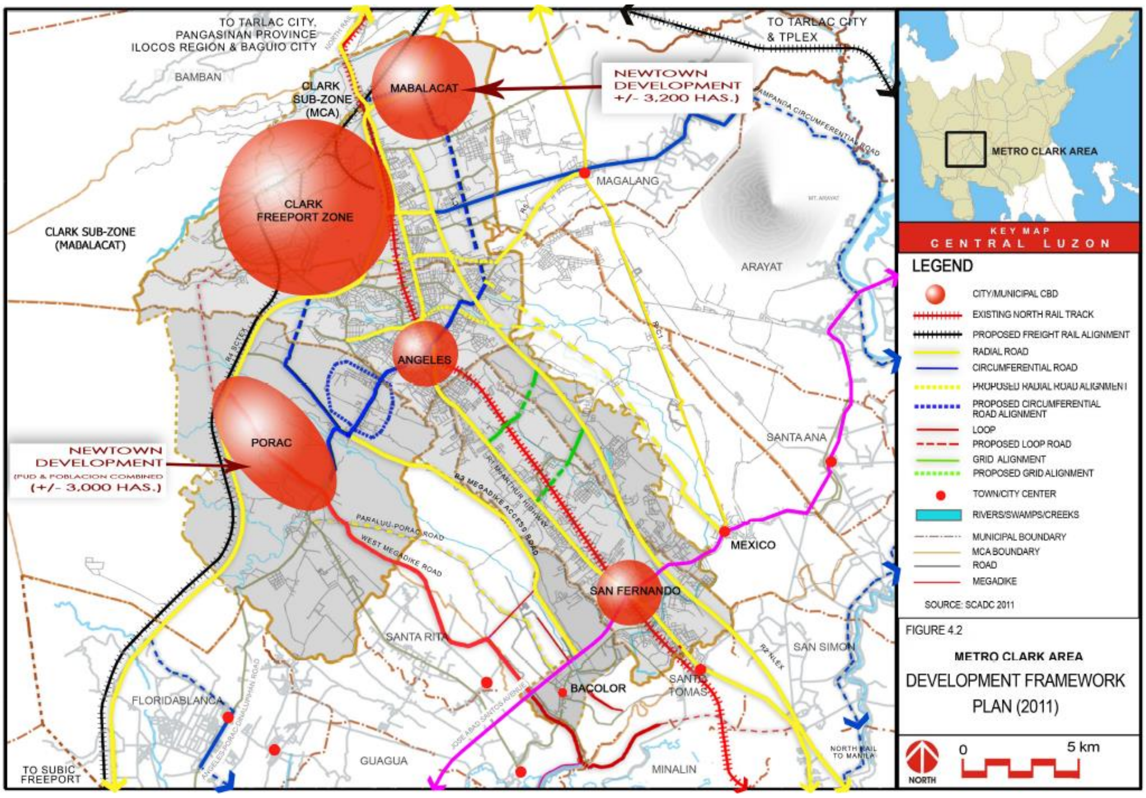
Source: Worked out by JICA Design Team based on various sources

Figure 2.2.9 Location of Road Public Transport System Projects

2.2.10 MCA Preliminary Master Development Plan

The Metro Clark Manila (MCA) spans over seven local government units (LGU) including Mabalacat, Angeles City, Porac, San Fernando, Mexico, and Bacolor. Mabalacat, Angeles City, San Fernando, and the Clark Freeport Zone (CFZ) comprise the inner core while parts of Mexico, Porac, and Bacolor make up the outer core.

CFZ will be the main economic driver of MCA and considered the central business district (CBD) of the metropolis. This primary business district will be supported by the secondary growth centers of: Mabalacat CBD, an old city center of Angeles; Porac secondary business district (SBD); and, San Fernando SBD. In order to promote the connectivity and accessibility to CBDs and SBDs, the various transportation projects are expected to be implemented: (Figure 2.2.10):



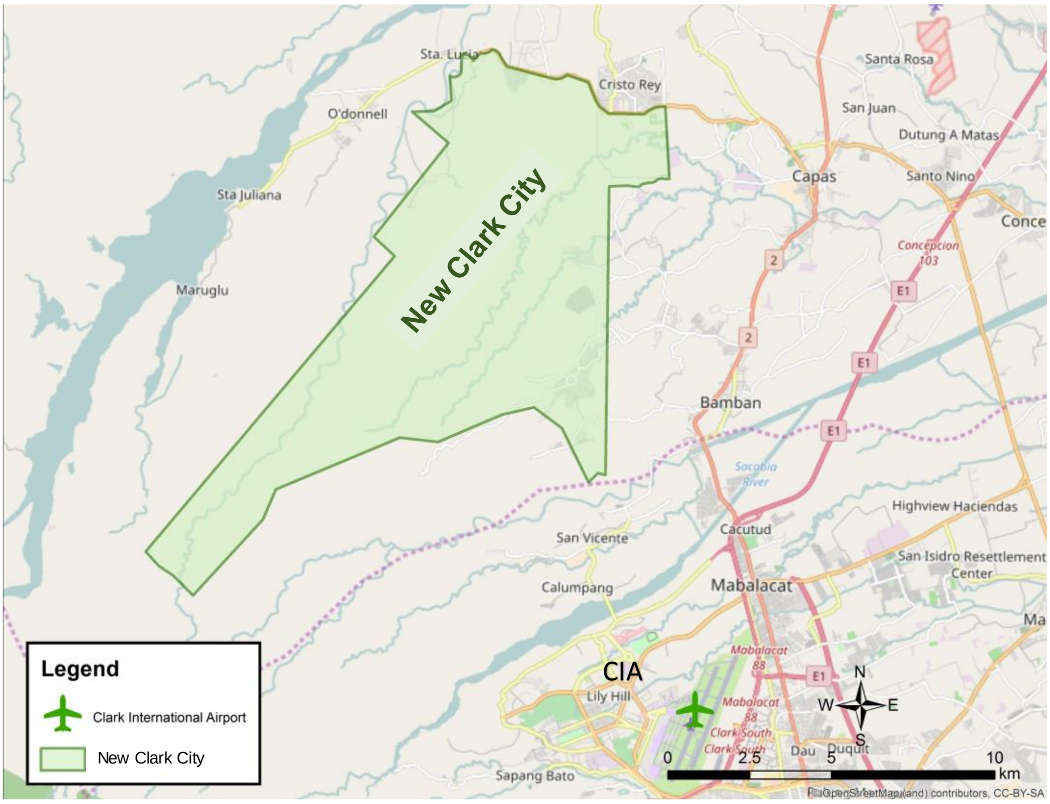
Source: Metropolitan Clark Area Preliminary Master Development Plan

Figure 2.2.10 Development Framework of Metropolitan Clark Area

2.2.11 New Clark City (NCC)

The recent NEDA approved New Clark City (NCC) Project formally known as Clark Green City (CGC) is envisioned to become the Philippines' most modern and first technologically-integrated city with a mix of residential, commercial, agro-industrial, institutional, and information technology developments. NCC will be a green, sustainable, and intelligent community for its residents, workers, and business establishments. The project is located in Tarlac province some 15~20km north of Clark International airport. The NCC will have direct access to TPLEX expressway and McArthur highway providing connectivity to the north and south of Luzon. The NCC location is depicted in Figure 2.2.11. The Location of NCC planned development projects is illustrated in Figure 2.2.12. These developments have been initiated as per Phasing of NCC vision as illustrated in Figure 2.2.13. The Figure shows the three distinct development phases of the NCC.

The impact of Phasing on the growth of population and employment from 2022 to 2065 have been explained in detail in Chapter 3, section 3.4.3 of this report. This section also illustrates a comparison of the NCC envisioned growth with similar cities developed/ developing in the world.



Source: JICA Design Team

Figure 2.2.11 Clark New City and Current Surrounding Road Network

The NCC is a flagship project of BCDA and is an integral part of Presidents' 'Build Build Build' (BBB) program. Figure 2.2.14 shows the components and funds allocated to the various projects within NCC under the BBB program. The level of commitment accorded to the NCC is reflected in that some US$4.4billion (69%) has been allocated for the key NCC projects out of the total BCDAs' BBB budget of US$6.3billion. The key four project allocation distribution is illustrated in Figure 2.2.14 below. Construction work has been stated on various NCC infrastructure projects. The Sports complex is due to open for the 2019 ASEAN Games, scheduled to start end November 2019.

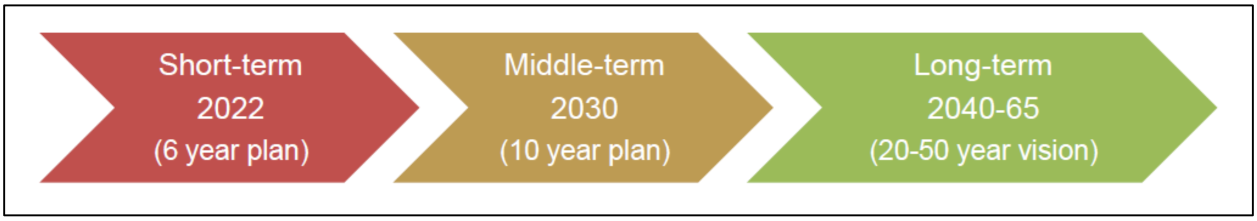
Construction work on the basic infrastructure: main roads, access roads, drainage, and other civil amenities have already started. The housing project and the athlete's village construction is also underway to be ready by November 2019. The development phasing of other projects is somewhat unclear, however, the current phase of development of NCC is rapid to say the least,

The 9,450ha area of NCC is located within CSEZ. The development is generally mixed-use and structured under six different major projects as defined by their main functions, namely Housing sector, Government District; Sports City; Academic District (mixed land use) ; Agri-Forestry Research and

Development District; and, food processing terminal. The design competition for New Clark City's conceptual master development plan is currently under formulation by a private firm. The first phase of the development of NCC would cover 1,300ha. At full development, by 2065 the future population projection is expected to be about one million residents and over half million jobs located within the NCC development.

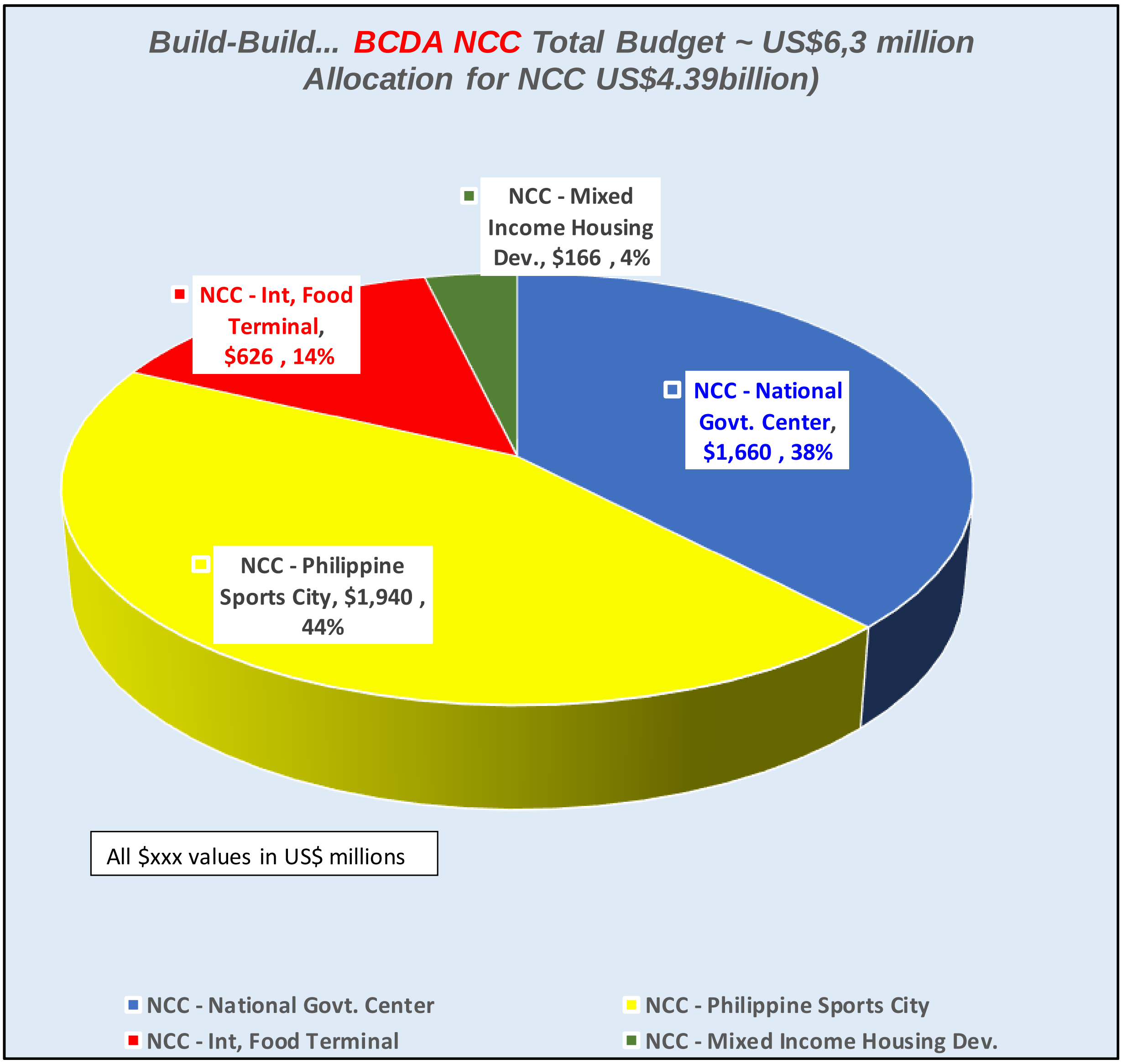
Source: BCDA

Figure 2.2.12 Masterplan of New Clark (Green) City



Source: BCDA Master Plan Chapter 2.

Figure 2.2.13 Phased Implementation of NCC Masterplan 2022 to 2065



Source: BBB Database

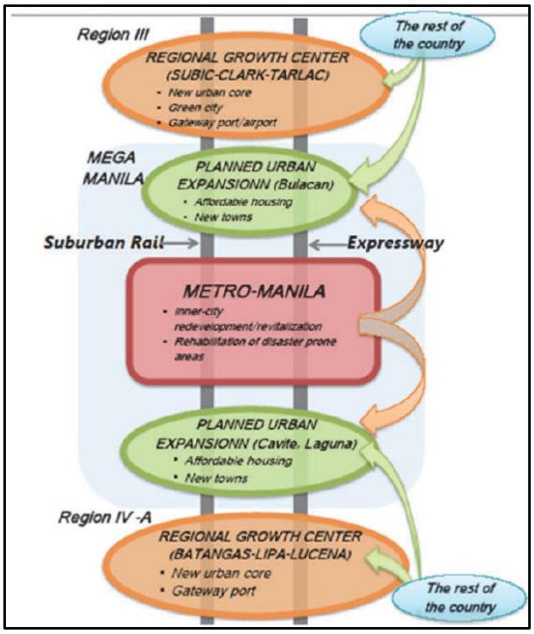
Figure 2.2.14 BCDA Budget Allocation for NCC under BBB Program

2.3 Confirmation of Project Necessity

2.3.1 Necessity of Integration with Regional Development Strategy

Integrated development as Mega Manila contributes to decentralize and complement the functions of each urban center. To promote sustainable growth in the region, it is necessary to develop north-south transport backbones consist of expressway and suburban rail network. And it contributes to meet necessity of resettlement of informal settlers from high hazard risk areas, and to formulate affordable housing plan in new urban areas with good accessibility and living environment in adjoining provinces. (Figure 2.3.1)

It is also necessary to be integrated with retrofit, regeneration and new plans of urban transportation development in port areas, new NAIA (international airport), water front and others within Metro Manila area to meet requirement of strengthening of economic competitiveness.



Source: Roadmap Study for Transport Infrastructure Development for Metro Manila and Its Surrounding Areas (Region III and Region IV-A)

Figure 2.3.1 Regional Development Strategy along North- South Corridor

2.3.2 Necessity of Solving Traffic Problem

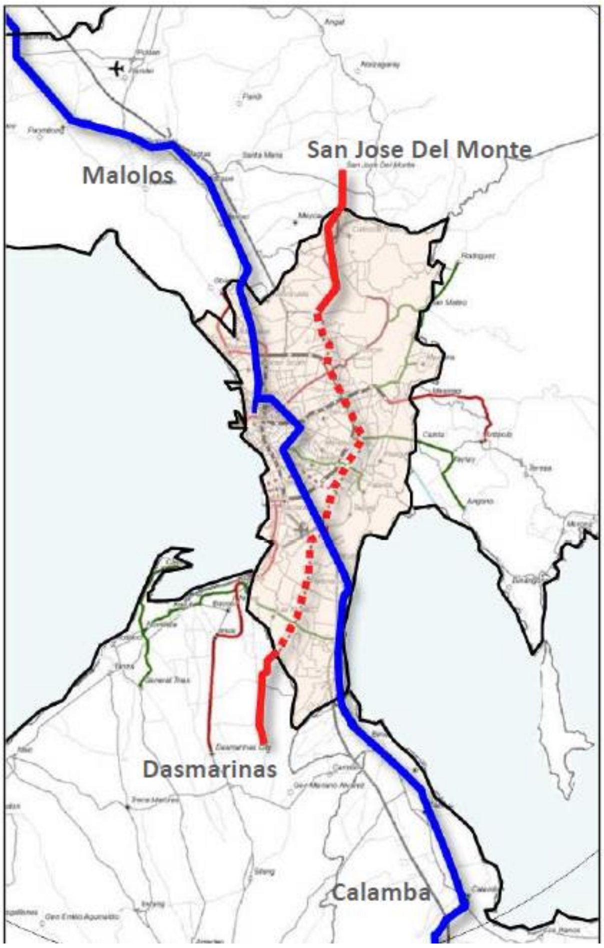
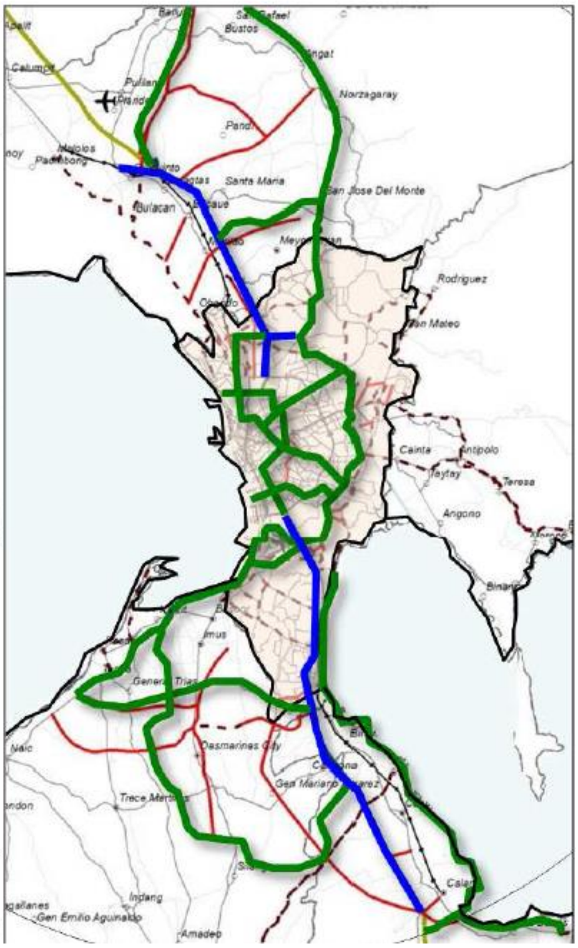
The traffic congestion causes huge economic losses. This would include lost opportunities of business, inefficiency in economy, pollution, waste of energy and resources, impact on health, decline of quality of life, increased risk of accidents, etc.

The traffic congestion in Metro Manila needs integrated approach based on urban mass transit, since improvement of road network alone cannot solve the issue. In particular, for the urban poor, a lack of transport choices significantly restricts their mobility and then reduces job opportunities, because of high transport cost.

2.3.3 Roles of Railways and Expressways

The 2 transit backbones, MMSP and NSCR and future expressway network are shown in Figure 2.3.2. To utilize both of the railway and expressway networks, the fare policy is a Key and transport network in Bangkok gives a lesson. The fare of urban railway in Bangkok is twice of the bus. The service level is also higher, and it attracts the middle-income group. As the result, the role of sharing among urban expressway (mainly for logistics and business trip), urban railway (mainly for commuting and school trips) and road transport (feeder) are established.

Unlike Bangkok, the fare of existing urban railway in Metro Manila is the same as other road-based public transport modes. Together with the serious congestion in road-based transport, urban railway service attracts more passengers than the capacity, causing machine troubles and accidents. And the low fare setting has affected profitability of the urban railway and the operating expenses are much more than the revenues. The Philippine Statistics Authority (PSA) showed the railway transportation sector receiving P8.4 billion in subsidies from the government in 2012.[5] Fare setting match with the high level of service is important for financial viability and to achieve role sharing with expressway network. The fare setting policy is mentioned in the later chapter.

MMSP / NSCR Network	Main Roads/ Network Expressways Network
	

Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

Figure 2.3.2 Proposed Railway & Expressway Network

[5] http://www.gmanetwork.com/news/money/economy/397806/psa-data-shows-subsidy-to-metro-rail-systems-reach-p8-billion-in-2012/story/

2.4 BUILD! BUILD! BUILD!

2.4.1 An Overview

President Duterte's administration released a 10-point Socio-economic Agenda as follows.

(i) Continue and maintain current macroeconomic policies, including fiscal, monetary, and trade policies.

(ii) Institute progressive tax reform and more effective tax collection indexing taxes to inflation.

(iii) Increase competitiveness and ease of doing business. This effort will draw upon successful models used to attract business to local cities (e.g., Davao) and pursue the relaxation of the constitutional restrictions on foreign ownership, except in regard to land ownership, in order to attract foreign direct investment.

(iv) Accelerate annual infrastructure spending to account for 5% of the GDP, with PPPs playing a key role.

(v) Promote rural and value chain development toward increasing agricultural and rural enterprise productivity and rural tourism.

(vi) Ensure security of land tenure to encourage investments and address bottlenecks in land management and titling agencies.

(vii) Invest in human capital development, including health and education systems, and match skills and trainings to meet the demand of businesses and the private sector.

(viii) Promote science, technology, and creative arts to enhance innovation and creative capacity towards self-sustaining, inclusive development.

(ix) Improve social protection programs, including the government's Conditional Cash Transfer program, to protect the poor against instability and economic shocks.

(x) Strengthen implementation of the Responsible Parenthood and Reproductive Health Law to enable especially poor couples to make informed choices on financial and family planning.

Among the reforms that will drive this agenda is the acceleration of infrastructure and the development of industries that will yield robust growth across the archipelago, create jobs, and uplift the lives of Filipinos. Infrastructure is among the top priorities of this administration. Public spending on infrastructure projects could reach PhP8-9 trillion from 2017–2022.

2.4.2 Transport Projects in Build!Build!Build! Program

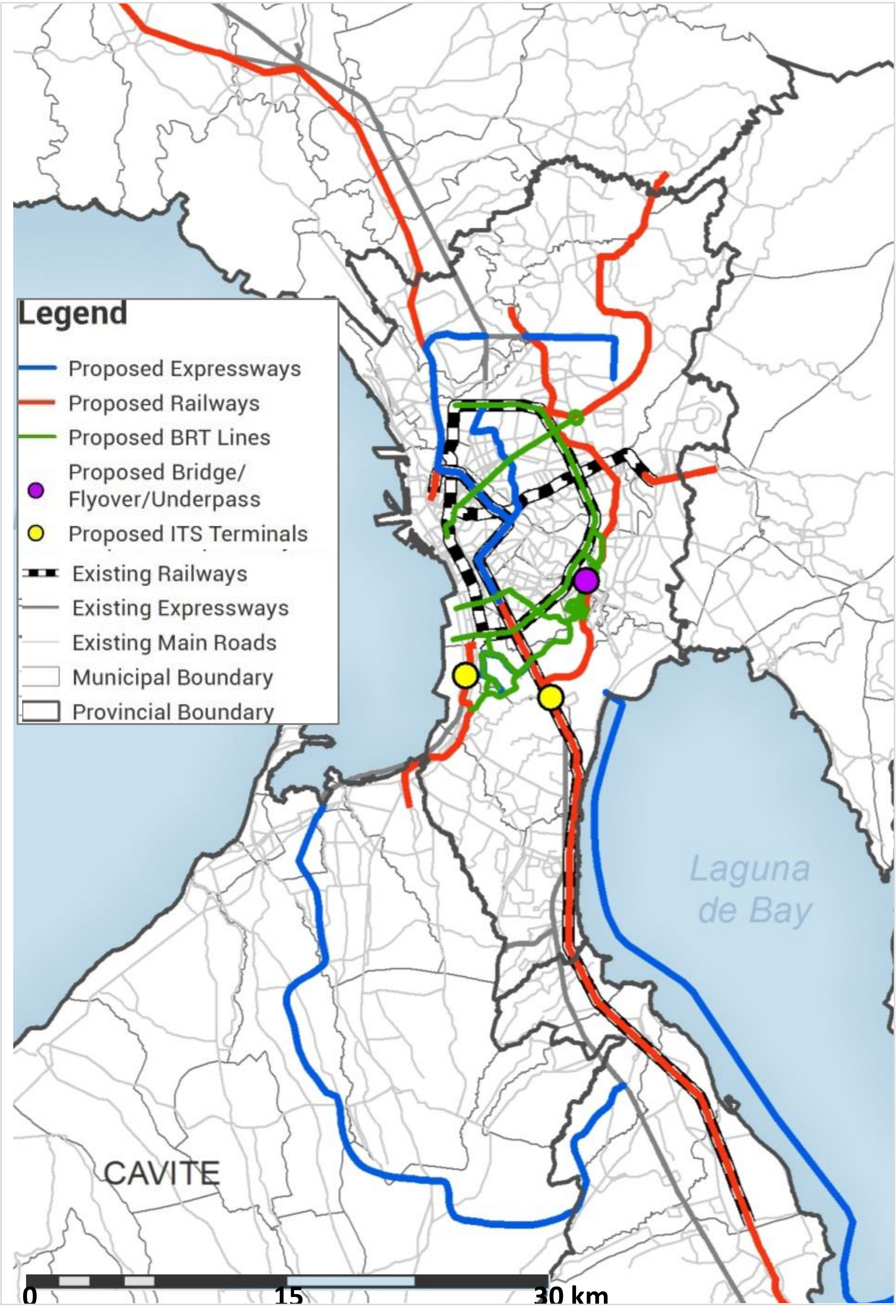
The Build!Build!Build! Program is the administration's comprehensive infrastructure development program launched in April 2017. The program identified 70 infrastructure flagship projects or high impact projects. Among the 70, 19 projects are located in Mega Manila. Besides the flagship projects, four projects were also listed as key projects. See Table 2.4.1 for full list of projects in the Build!Build!Build! Program.

The projects for Mega Manila are composed of expressway, urban road, railway, road-based public transport, and traffic management. Completion of most of the projects is within or by end of current administration, i.e. by 2022. However, seven projects are still under project development stage. In terms of location, most of the projects are in Metro Manila rather than adjoining provinces (Figure 2.4.1).

Table 2.4.1 Main Projects in Build!Build!Build! Program

Category		Project Name	Cost (PhP Bil.)	Schedule	Implementing Agency	Status
Flagship Projects	Expressway	NLEX-SLEX Connector Road	23.2	2014–2021	DPWH	Implementation
		NAIA Expressway Phase II	17.9	2013–2017	DPWH	Implementation
		NLEX Harbor Link, Segment 10	9.0		DPWH	Project Development
		Cavite - Laguna Expressway	35.4	2013–2020	DPWH	Implementation
		Laguna Lake Highway	123	2020–2025	DPWH	Procurement
	Urban Road	BGC to Origas Road Link Project	5.6	2017–2020	DPWH	Procurement
	Railway	Mega Manila Subway	355	2017–2024	DOTr	Project Development
		PNR North 1 (Malolos – Tutuban)	105	2016–2021	DOTr	Implementation
		PNR North 2 (Clark – Malolos)	139	2018–2024	DOTr	Project Development
		PNR South Commuter (Tutuban – Calamba)	134	2018–2021	DOTr	Project Development
		LRT 1 South (Cavite) Extension Project	65.9	2017–2021	DOTr	Implementation
		LRT Line 2 East (Masinag) Extension Project	0.9	2015–2019	DOTr	Implementation
		Line 7 (MRT 7)	62.7	2016–2019	DOTr	Implementation
		Unified Common Station	2.8	2016–2019	DOTr	Procurement
	BRT	Metro Manila BRT- Line 1 (Quezon Avenue BRT)	4.8	2017–2020	DOTr	Project Development
		Metro Manila BRT- Line 2 (Central Corridor)	37.8	2017–2020	DOTr	Procurement
		BGC to NAIA BRT System	24.0	2016–2021	BCDA	Project Development
	Road-based Public Transport	South Integrated Transport System (bus terminal)	4.0	2016–2019	DOTr	Implementation
		Southwest Integrated Transport System (bus terminal)	4.0	2015–2018	DOTr	Implementation
Other Key Projects	Expressway	Skyway Stage 3	26.7		DPWH	Implementation
		C5 Expressway	13.6		DPWH	Project Development
	Railway	LRT1/MRT3 Capacity Expansion	10.7		DOTr	Implementation
	Traffic Management	Intelligent Transport System (traffic signal)	4.7	2012–2022	MMDA	Implementation
Total			**1,210**			

Source: Build!Build!Build! Program website, NEDA



Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

Figure 2.4.1 Location of Main Projects in Build!Build!Build! Program

2.4.3 Roadmap for Transport Infrastructure Development for Greater Capital Region

To achieve these goals stated in PDP 2011–2016, infrastructure development in terms of revitalization of economic activities is focused. The new administration, which was established in June 2016, stated an increase in annual infrastructure expenses of up to 5% of gross domestic product (GDP) as a policy objective. Thus, the promotion of infrastructure development is still a priority agenda.

The “Roadmap for Transport Infrastructure Development for Metro Manila and Its Surrounding Areas (Region III & Region IV-A)” (Transport Roadmap), which was conducted from March 2013 to March 2014, identified the priority transport projects to realize the ideal transport network by 2030. The Transport Roadmap was approved by National Economic and Development Authority (NEDA) Board in June 2014 and was considered a long-term plan of the Philippine government. JICA has agreed to implement ”Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region” to update the roadmap and provide additional information.

The general objectives of this study are the following:

(i) Clarify the transport development policy for Metro Manila by the new administration through the Transport Roadmap update;

(ii) Identify the changes in the transport sector since the first Transport Roadmap of Metro Manila was approved. Planned, committed, ongoing, and completed transport projects after the Transport Roadmap will be reviewed;

(iii) Identify the past and present Japanese government-assisted projects, and determine the expected Metro Manila traffic decongestion due to the planned projects;

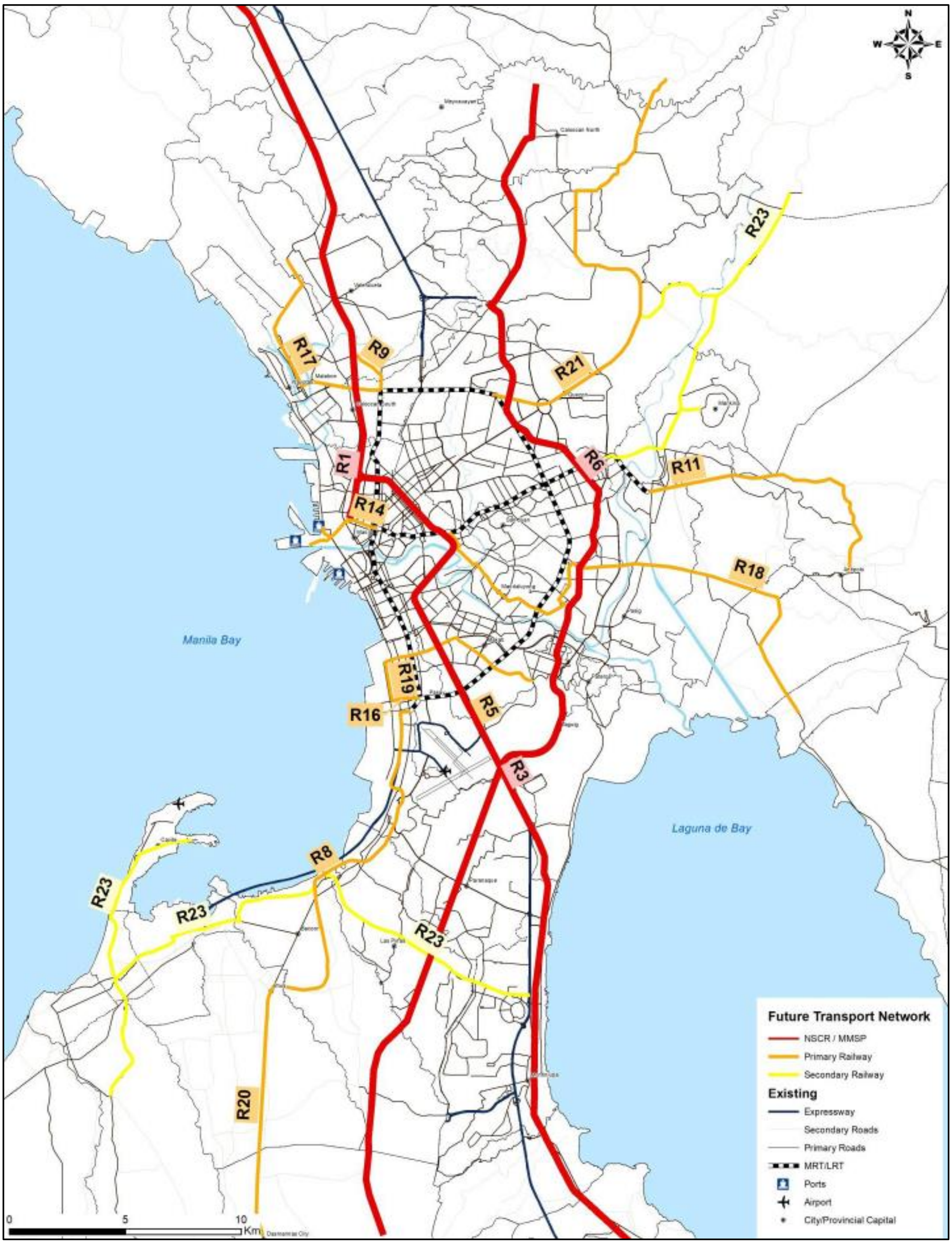
(iv) Re-estimate economic losses, environmental pollution, and disaster risks as a result of traffic congestion in Metro Manila, which were indicated in the Transport Roadmap; and,

(v) Update priority projects based on the review of the Transport Roadmap by the Philippine government.

The specific objectives of the follow-up study are: (i) to revise the transport development strategies and policies of the 2014 Transport Roadmap based on the updated transport demand forecast; and (ii) to update the Transport Roadmap with target years 2022, 2035, and 2040 and examine the validity of the priority projects. The roadmap review covers roads, expressways and highways; urban and suburban rails; ports and airports; and traffic management.

The location of proposed railway projects is shown in Figure 2.4.2. It is proposed that NSCR and MMSP are proposed will be developed as north-south transit backbones. North-South Commuter Railway provides rapid access from adjoining provinces to the Centre of Metro Manila and provides opportunities of further development along the line.

The transport demand forecast model was updated to evaluate the proposed transport projects. The transport demand forecast used in this detailed design study is based on the models updated in the follow-up study on Roadmap.



Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

Figure 2.4.2 Location of Railway Projects Proposed in Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

CHAPTER 3 NSRP CORRIDOR ANALYSIS AND TRAVEL DEMAND FORECAST

3.1 Review of pre-FS Route Alignment of North South Railway Project

The summary of estimation of the optimum route proposal in pre-F/S is described below. About the validity of this route proposal, was confirmed with DOTr. The alignment follows the current PNR operational alignment from Solis to Calamba. Potential depot site is in Banlic, Calamba City. There is a depot access track from Calamba to the Depot site.

Total Length ~ 56.5km

STATION/DEPOT	Distancee
Solis	
	1.9 km
Blumentritt	
	1.9 km
Espana	
	1.8 km
Santa Mesa	
	2.9 km
Paco	
	3.0 km
Buendia	
	1.8 km
EDSA	
	2.4 km
Nichols	
	2.2 km
FTI	
	2.6 km
Bicutan	
	4.1 km
Sucat	
	4.0 km
Alabang	
	3.1 km
Muntinlupa	
	3.6 km
San Pedro	
	1.9 km
Pacita	
	2.4 km
Binan	
	4.1 km
Santa Rosa	
	3.5 km
Cabuyao	
	2.9 km
Gulod	
	2.8 km
Mamatid	
	3.2 km
Calamba	

Source: JICA Design Team

Figure 3.1.1 Map of NSRP Route

3.2 Selection Criteria for Optimal NSRP – South Line (Commuter) Route Alignment

An evaluation basis is taken as the plan which takes into consideration the constraints of construction, economic efficiency, the delivery performance and the minimization of land acquisition by maximizing the use PNR land. It is considered as the plan which considered about approaching construction plans, such as a road plan and a railway plan. (Connector Road, Sky Stage 3, C6 Road, MMSP, PNR head office relocation)

Table 3.2.1 Evaluation Criteria of Route Planning

Item	Evaluation Criteria	Detail of Evaluation
Cost Reduction	Shorten the route length	To reduce the construction volume by shortening the construction length.
	Avoid the massive structure	To avoid the massive structures at the crossing with a river and a road.
Minimizing Land Acquisition	Utilize the existing PNR ROW	To utilize the existing available land of PNR.
Achievement of Target Travel Time	Avoid the speed limit	To avoid the speed restrictions by removing the sharp curves.
	Installation the facility to wait a train appropriately	To install the facility to wait a train appropriately not to obstruct the operation of the airport access train.

3.3 Selection of Optimal Route Alignment

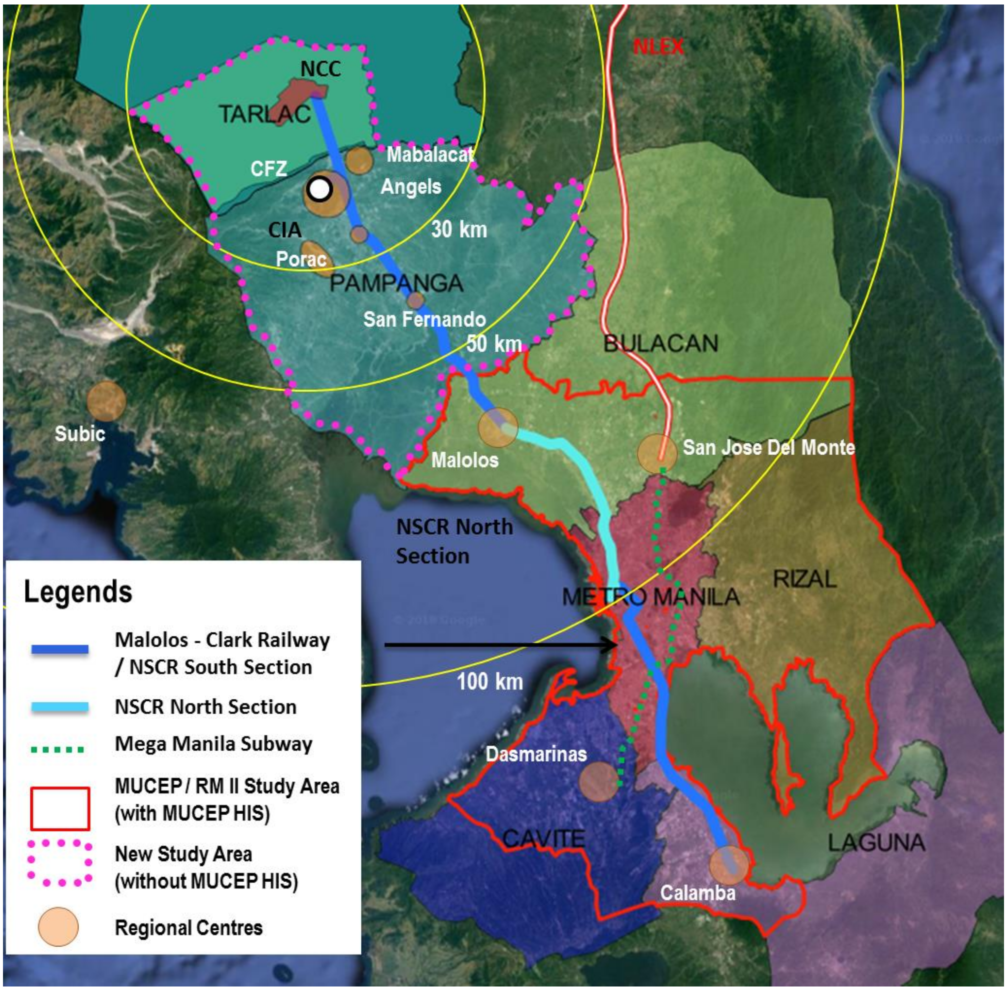
Because it is based on using the land of PNR, along the exiting alignment there is truly no alternatives for comparison for better route alignment plan.

3.4 Travel Demand Forecast

3.4.1 Study Area

The Study Area for the demand forecast is defined as the area, which covers "The Project for Capacity Development on Transportation Planning and Database Management in the Republic of the Philippines" (referred to as MUCEP Study) Area (including Metro Manila, Rizal, and a part of Bulacan, Laguna and Cavite Provinces), Pampanga Province and several municipalities of Tarlac Province. As the special traffic zones, CIA and NCC are also included.

The location of the Study Area with distribution of major cities is shown in Figure 3.4.1. As the transit backbones, both the commuter rail and Mega Manila Subway are planned to connect Metro Manila and Sub-urban centres in adjoining areas.



Source: JICA Design Team

Figure 3.4.1 The Study Area for Demand Forecast

3.4.2 Socio-economic Framework of the Study Area

The socio-economic framework of the Study Area is based on the "Follow-up Survey on Roadmap for transportation infrastructure development for Greater Capital Region (GCR)" (referred to as Roadmap II). And that of Tarlac and Pampanga Provinces were developed from the statistical information and the local development plans.

The population projection by LGU is shown in Table 3.4.1. The main points are as follows:

Currently, some LGUs are densely populated and the population is expected to be decreased in the future.

However, total population in Metro Manila is estimated to increase until 2040.

The future population growth in adjoining provinces including Pampanga, Tarlac is estimated to be much higher than of Metro Manila.

Table 3.4.1 Projection of the Night-time Population of the Study Area

Province	LGU	2015			Population Projection (000)			Population Net Density (person/ha)			Annual Growth Rate (%/year)		
		Population (000)	AGR 10-'15 (%/yr)	Net Density (/ha)	2022	2035	2040	2022	2035	2040	15-'22	22-'35	35-40
Metro Manila	Caloocan City	1,584	1.2	303.1	1,666	1,665	1,622	318.7	318.6	310.4	0.7	-0.0	-0.5
	Las Pinas City	589	1.3	186.9	621	624	609	197.1	198.0	193.2	0.8	0.0	-0.5
	Makati City	583	1.9	277.8	643	704	709	306.7	335.5	338.3	1.4	0.7	0.2
	Malabon City	366	0.7	296.8	370	344	326	300.1	279.1	264.3	0.2	-0.6	-1.1
	Mandaluyong City	386	3.3	357.4	467	605	651	432.1	559.7	602.2	2.7	2.0	1.5
	Manila	1,780	1.5	504.5	1,906	1,970	1,943	540.1	558.1	550.6	1.0	0.3	-0.3
	Marikina City	451	1.2	205.8	473	472	459	216.1	215.5	209.7	0.7	-0.0	-0.5
	Muntinlupa City	505	1.9	132.9	554	600	602	145.9	158.0	158.7	1.3	0.6	0.1
	Navotas City	249	0.0	424.8	241	206	189	410.5	350.6	321.5	-0.5	-1.2	-1.7
	Paranaque City	666	2.5	139.6	763	896	928	160.1	187.9	194.7	2.0	1.2	0.7
	Pasay City	417	1.2	219.7	436	432	419	229.9	227.7	221.0	0.7	-0.1	-0.6
	Pasig	755	3.8	232.9	946	1,309	1,445	291.8	403.7	445.6	3.3	2.5	2.0
	Pateros	64	-0.1	388.7	61	51	47	372.4	313.1	285.3	-0.6	-1.3	-1.8
	Quezon City	2,936	1.2	177.0	2,981	2,790	2,650	179.7	168.3	159.8	0.2	-0.5	-1.0
	San Juan	122	0.9	214.8	125	120	115	220.4	210.5	201.5	0.4	-0.4	-0.9
	Taguig City	805	4.5	235.5	1,060	1,608	1,839	310.1	470.5	538.1	4.0	3.3	2.7
	Valenzuela City	620	1.5	160.5	665	689	680	172.0	178.2	175.9	1.0	0.3	-0.3
	Subtotal	12,877	1.7	224.4	13,978	15,084	15,233	243.5	262.8	265.4	1.2	0.6	0.2
Bulacan		2,640	2.7	28.9	2,871	3,424	3,546	31.4	37.5	38.8	1.2	1.4	0.7
Cavite		3,315	3.7	49.1	3,622	4,545	4,795	53.7	67.4	71.1	1.3	1.8	1.1
Laguna		1,888	3.3	54.9	2,032	2,475	2,590	59.0	71.9	75.3	1.1	1.5	0.9
Rizal		2,884	3.0	23.1	3,054	3,765	3,948	24.5	30.2	31.7	0.8	1.6	1.0
Pampanga		2,198	1.8	11.0	2,435	2,861	3,025	12.2	14.3	15.1	1.5	1.2	1.1
Tarlac		1,366	1.4	4.5	1,537	1,807	1,910	5.0	5.9	6.3	1.7	1.2	1.1
Study Area Total		56,541	2.4	37.6	61,193	70,782	73,053	40.6	47.0	48.5	1.1	1.1	0.6

1) Net Land: Without Cemetery, Airport, and Port Area

Source: JICA Design Team

The projection of the employment at workplace by LGU is shown in Table 3.4.2. Unlike the population projection, LGUs in Metro Manila will be increased. The workers in Adjoining Provinces are expected to commute to Metro Manila.

Table 3.4.2 Projection of Employment (at workplace) in the Study Area (000)

Province	LGU	2015				2022				2035			
		Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total	Primary	Secondary	Tertiary	Total
Metro Manila	Caloocan City	34	73	466	574	35	75	479	590	36	74	491	600
	Las Pinas City	18	47	200	265	19	48	206	273	19	47	212	279
	Makati City	35	81	544	660	38	87	587	712	43	94	657	793
	Malabon City	11	22	112	144	11	21	110	143	10	19	105	135
	Mandaluyong City	21	47	294	362	25	55	347	428	33	70	461	564
	Manila	42	122	1,212	1,376	44	126	1,269	1,440	46	129	1,343	1,518
	Marikina City	8.8	35	194	238	9	36	200	245	9	35	204	248
	Muntinlupa City	20	49	246	315	22	52	264	337	24	56	292	372
	Navotas City	14	11	56	82	13	11	53	77	12	9	47	67
	Paranaque City	22	53	335	411	25	59	376	460	30	69	451	550
	Pasay City	18	30	235	283	18	30	241	289	18	29	244	292
	Pasig	31	83	360	473	38	101	440	579	53	137	624	814
	Pateros	2.0	0.9	14	17	1.9	0.8	13	16	1.6	0.7	11	14
	Quezon City	142	254	1,587	1,983	141	250	1,575	1,966	134	231	1,510	1,875
	San Juan	2.1	6.7	57	66	2.1	6.6	58	66	2.0	6.2	56	65
	Taguig City	26	73	314	413	34	93	404	530	52	139	627	818
	Valenzuela City	23	61	212	296	24	63	222	309	26	64	236	325
	Subtotal	471	1,048	6,439	7,958	501	1,114	6,844	8,460	548	1,210	7,572	9,329
Bulacan		107	208	888	1,202	116	224	958	1,298	144	275	1,201	1,620
Cavite		127	466	1,479	2,072	136	496	1,582	2,214	170	618	2,019	2,808
Laguna		92	213	775	1,081	98	225	819	1,142	121	276	1,027	1,425
Rizal		115	225	835	1,175	119	230	849	1,197	139	263	967	1,369
Pampanga		60	107	473	639	65	116	513	693	77	137	617	831
Tarlac		37	66	294	397	41	73	324	438	49	86	390	525
Study Area Total		1,010	2,332	11,182	14,524	1,075	2,478	11,888	15,441	1,248	2,866	13,793	17,907

Source: JICA Design Team

3.4.3 Socio-economic Framework for New Clark City (NCC)

The socio-economic framework of New Clark City is assumed as given in Table 3.4.3. Assumption of Population conflicts with 2 patterns, 1) Socio economic framework of Original Clark Green City (CGC) M/P (as of JOIN F/S), 2) Socio-economic framework proposed in the report of Consultancy Services of a Comprehensive Master Development Plan for the Clark Green City (CGC). The DOTr Provided the latest socio-economic framework of CGC now called as New Clark City (NCC). The original CGC master plan was very ambitious in that it expected to develop a new city of 1.1million inhabitants by 2045 with over 800,000 jobs. Where as the revised plan of over a million inhabitants and 540,000 jobs by 2065 is still has some uncertainties and was assumed to be conservative and was adopted by the JDT.

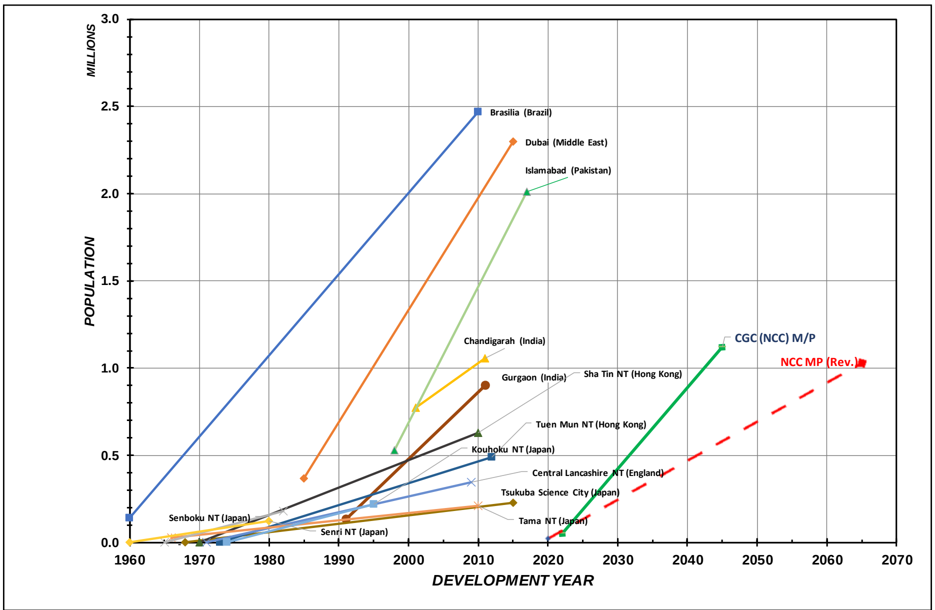
Figure 3.4.2 shows a comparison of NCC (and Original CGC) master plan population data with cities around the world which have developed over the last six decades either as new urban centers to relieve population pressure on the current metropolis or as new Capitals or Government Centers. It can be seen that the original CGC plan was rather too ambitious whereas growth rate of NCC is more in line with a group of cities developed since 1960's.

Alternatively, Figure 3.4.3 illustrates the growth of cities (population) over periods of forty to fifty years. The figure illustrates that the CGC MP growth rate was much higher than achieved by any other city, where is NCC growth and ultimate population of just over one million inhabitants is very much in line with cities such as Denentoshi, Brasilia etc.

Table 3.4.3 The assumption of the Socio-economic Framework of New Clark City

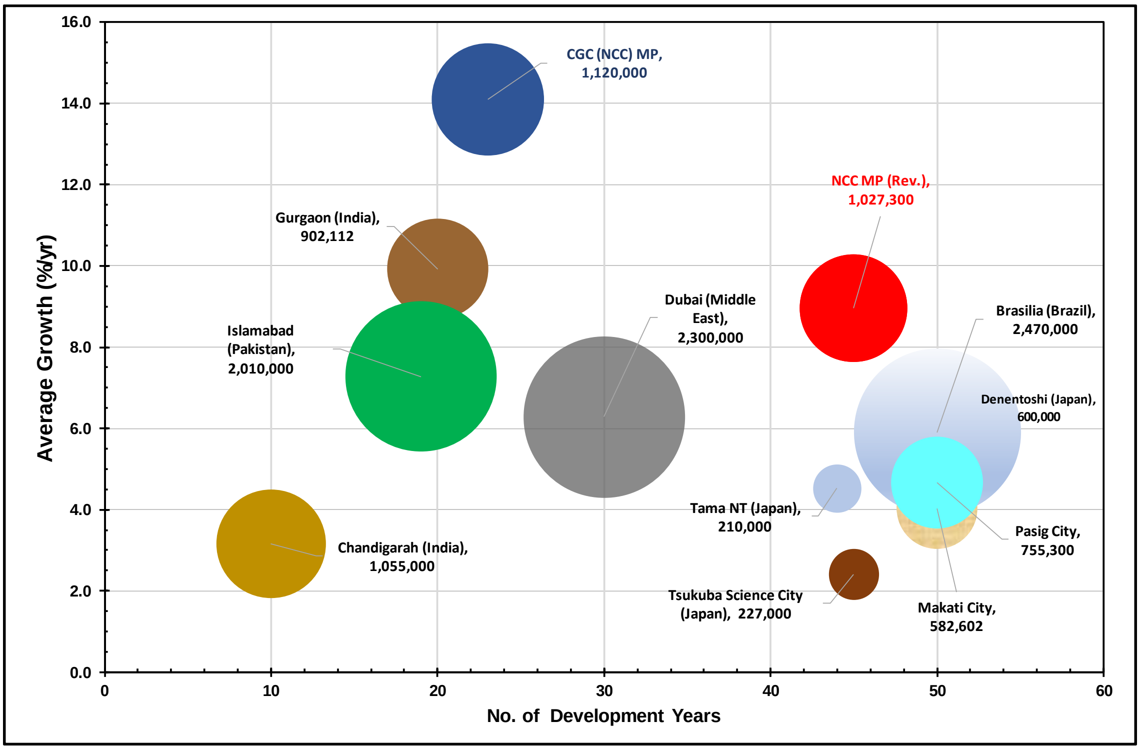
Characteristics		1) CGC (NCC) Original M/P (As of JOIN F/S)	2) Consultancy Services of a Comprehensive Master Development Plan for the Clark Green City (NCC)
Socio-economic Framework	Population	672,000	344,700
	Employment	480,000 (around 70 % of night time population)	176,800 (around 50% of night time population)
Trip Rate (Trip / person)		1.76	1.41
Intra trip rate (Share of the trips within NCC)		45.1 % for all transport modes (Intra trip ratio of Bulacan Area is applied)	
Trip Distribution		Trip distribution patterns are estimated from the generalized cost from / to each area. The trip patterns are based on the transport database developed in MUCEP / Road Map II Study	
Modal Share (%)	Motorcycle	13.5	
	Car	25.5	
	Public	61.0	

Source: JICA Design Team



Source: JICA Design Team

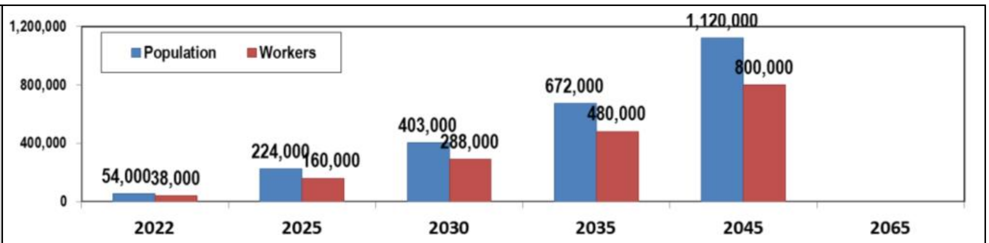
Figure 3.4.2 Comparison of Population and Development Year Between Other New Cities CGC and NCC Over Last Six Decades



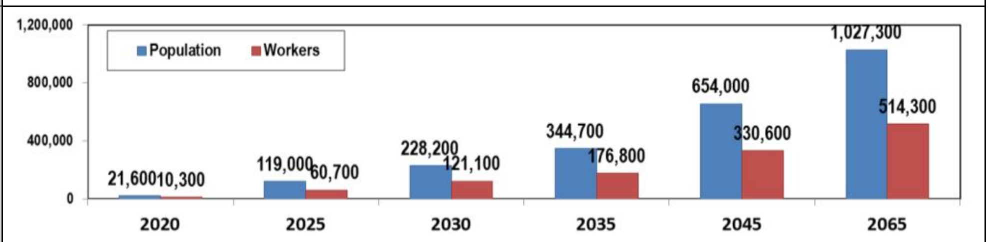
Source: JICA Design Team

Figure 3.4.3 Comparison of Population Growth in Different Cities of the World, and Planned CGC & NCC

1) CGC (NCC) Original M/P (As of JOIN F/S)



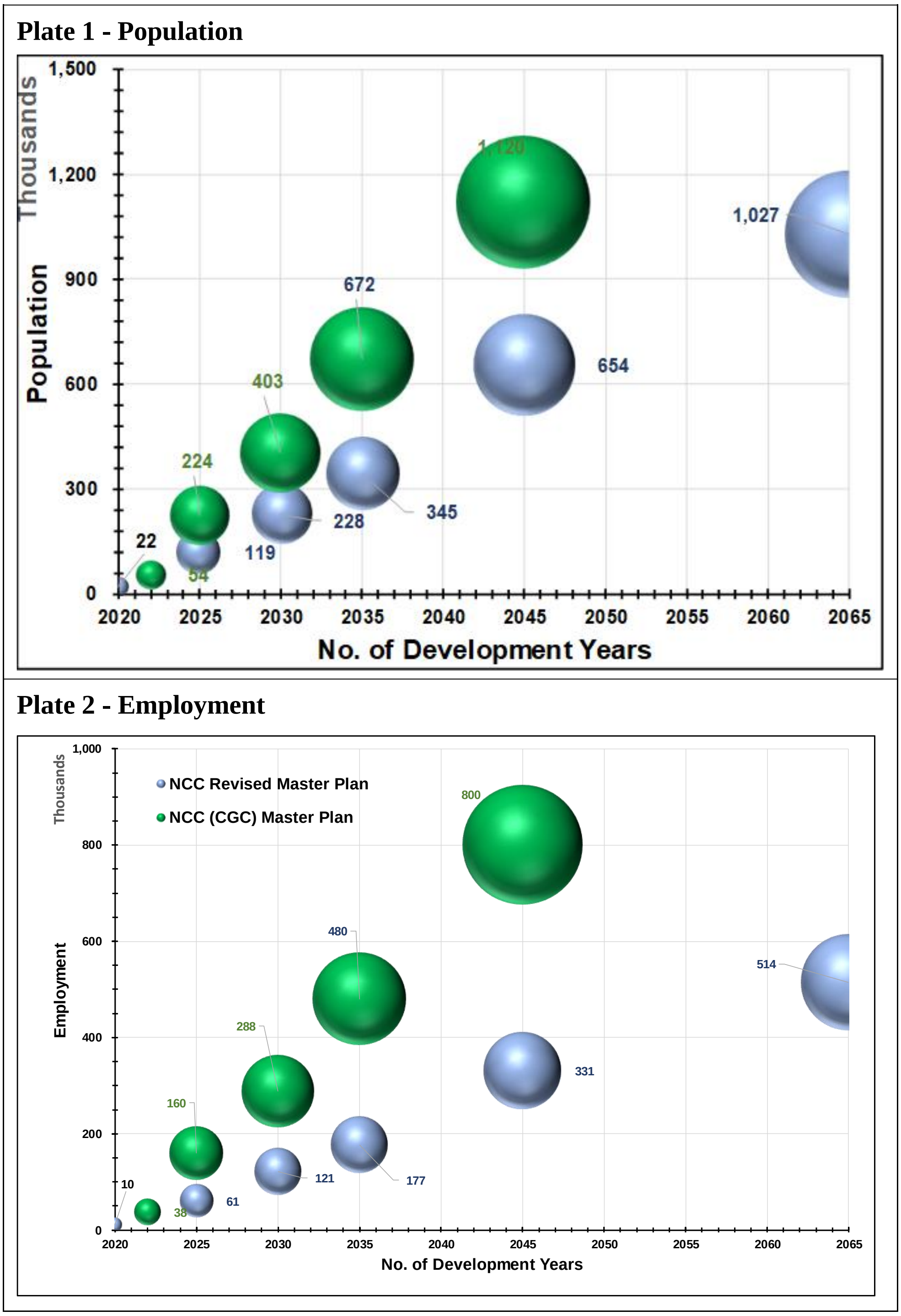
2) Consultancy Services of A Comprehensive Master Development Plan for the Clark Green City (NCC)



Source: JICA Design Team

Figure 3.4.4 Socio-economic Framework of NCC

The socio-economic framework (population – Plate-1, and Employment Plat-2) of CGC and NCC is further below in Figure 3.4.5. The growth rate of CGC were way to ambitions whereas that of NCC appears to be plausible and given the current (on-going) rapid development program and allocation of substantial funding it could be realized by 2065.



Source: JICA Design Team

Figure 3.4.5 Growth of Population and Employment in NCC

Future travel demand of NCC in 2035, is estimated through the assumed socio-economic framework as shown in Table 3.4.4. The result shows that the 45.1% of total trips are within NCC. The modal share was estimated from value of the adjoining area.

Table 3.4.4 Traffic demand of the New Clark City in 2035

000Trip/day			Motor Cycle	Car	Public	Total
1) CGC (NCC) Original M/P (As of JOIN F/S)	Modal Share (%)		13.5	25.5	61	100
	No. of Trips (000 / day)	To / from NCC	88.1	166	394	648
		Within NCC	72.6	137	325	534
		Total	161	303	719	1,182
2) Consultancy Services of A Comprehensive Master Development Plan for the New Clark City (NCC)	Modal Share (%)		13.5	25.5	61	100
	No. of Trips (000 / day)	To / from NCC	36.2	68.1	162	266
		Within NCC	29.8	56.1	133	219
		Total	66.0	124	295	485

Source: Estimated by JICA Design Team

3.5 Passenger Forecast for NSRP-South

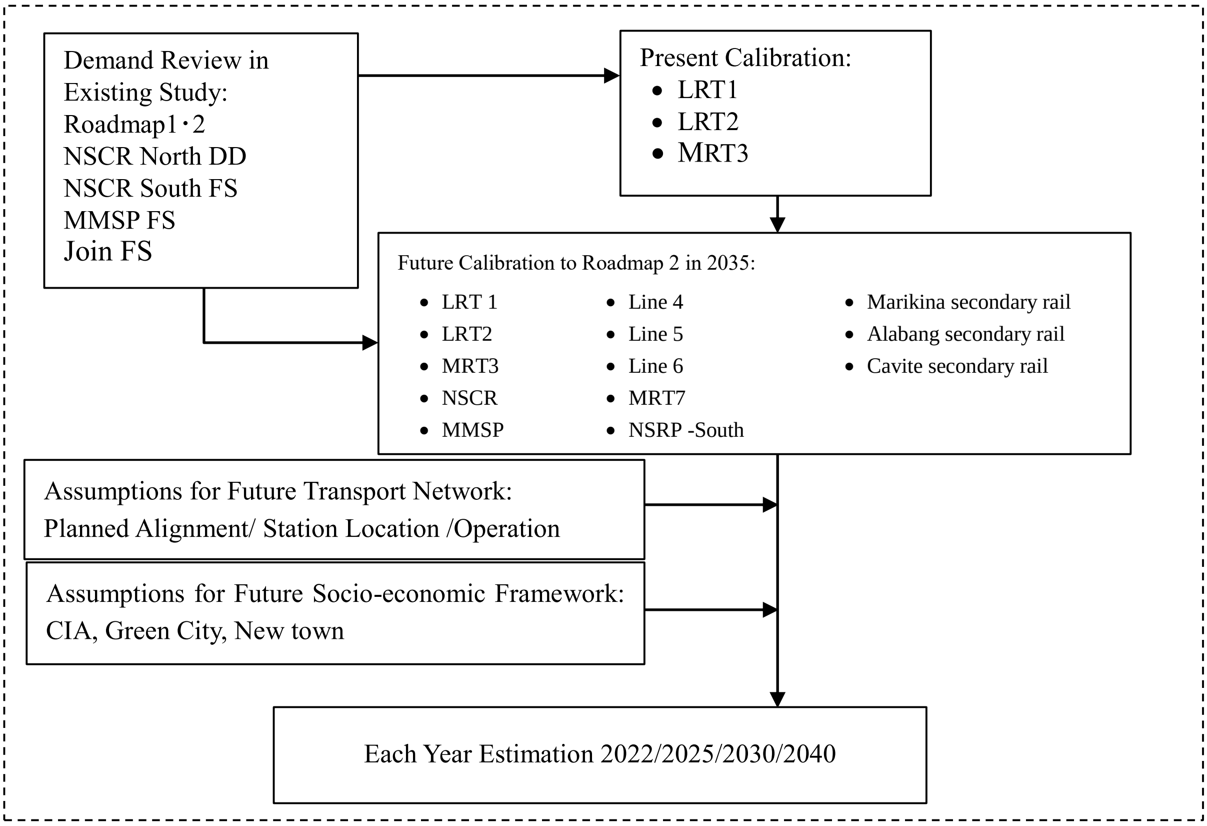
The implementation schedule of road and railway projects was based on Roadmap II (Table 3.5.1). The main findings by category are as follows:

3.5.1 Overview of Model Development

The demand forecast approach is based on the models used in the Feasibility Study on Clark-Manila Railway Project (JOIN, 2017), The Detailed Design Study of the North-South Commuter Railway Project in the Republic of the Philippines (Malolos-Tutuban section) of the JICA survey and Supporting Regional Project Development for Association of Southeast Asian Nations Connectivity Study on NSCR-South Line (PNR South) (ADB, 2016).

The demand forecast model was considered in Road Map II Study, which is an updated version from the MUCEP transport database.

The MUCEP transport database is based on the Person Trip Survey conducted in 2014. The covered area is Mega Manila Area. In this Study, Pampanga province and several municipalities of Tarlac province are additionally included. The trip pattern in this area is estimated from the data obtained by the traffic surveys conducted in Roadmap II Study.



Source: JICA Design Team

Figure 3.5.1 Flow Chart of Demand Forecast Methodology

The demand forecast model is based on a kind of basic 4-step model, which is composed of generation/attraction, distribution, modal split, assignment model. In this study, population data such as NCC and CIA user for future is considered by the model.

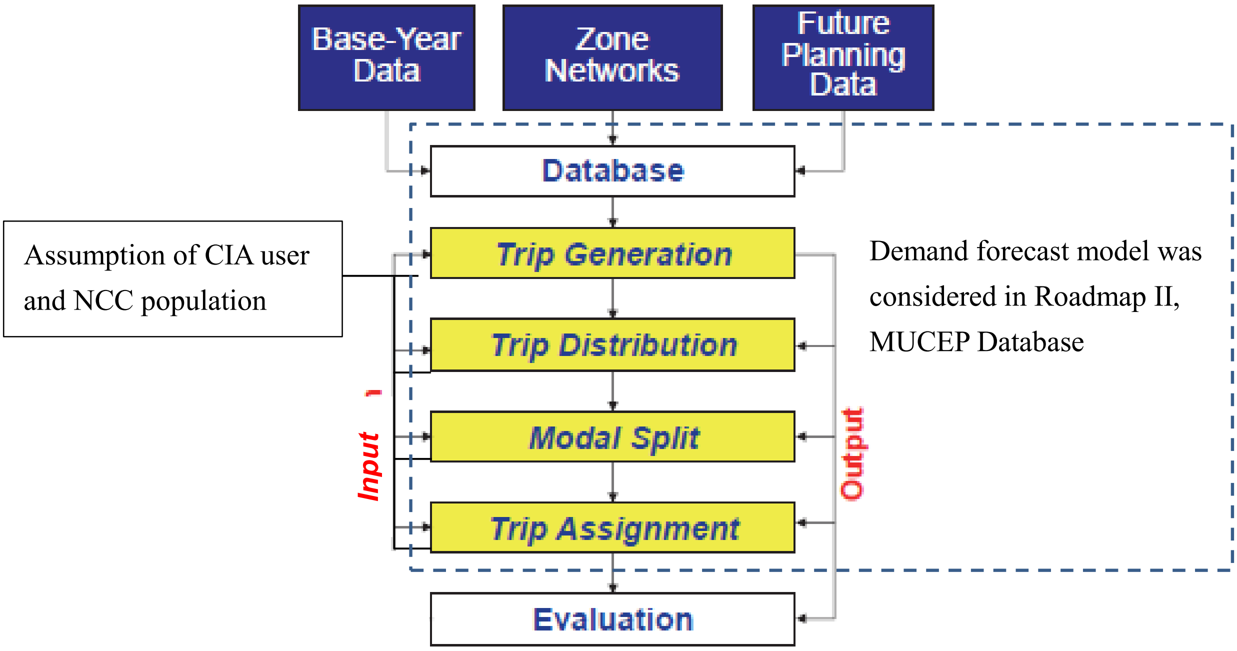


Figure 3.5.2 Demand Forecast Model

3.5.2 Basic Assumptions

In demand forecast, the transport network and station construction schedule by each of the forecast years are assumed. The implementation schedules of other sections are assumed through discussions between DOTr and JDT, and these are modified as necessary.

(1) Station construction schedule

The construction schedule of the stations, which is assumed in the demand forecast, is shown in Table 3.5.1. In 2021, only 10 stations of the NSCR North section will be opened. And after 2025, MMSP is entering to NSCR each other from Bictan to Calamba.

Table 3.5.1 The Assumed Station Construction Schedule of Malolos-Clark section and NSCR

Section	Station	Year of opening				Assumption
		2022	2023 (October)	2025	2030	
Malolos-Clark (MCRP)	NCC			●	●	Assumption of NCC Plan
	CIA	●	●	●	●	Assumption of Air Pax is 46mil.per year
	Clark	●	●	●	●	Branch to NCC and CIA
	Angeles	●	●	●	●	
	San Fernando	●	●	●	●	
	Apalit	●	●	●	●	
	Calumpit	●	●	●	●	
NSCR North	Malolos	●	●	●	●	
	Malolos South				●	
	Guiguinto	●	●	●	●	
	Tuktukan				●	
	Balagtas	●	●	●	●	
	Bocaue	●	●	●	●	
	Tabing Ilog	●	●	●	●	
	Marilao	●	●	●	●	
	Meycauayan	●	●	●	●	
	Valenzuela	●	●	●	●	
	Valenzuela Polo				●	
	Malabon				●	
	Caloocan	●	●	●	●	
	Solis	●	●	●	●	Can transfer to NSRP-South
	Tutuban	●	●	●	●	Can transfer to LRT2 ext.
NSCR South	Blumentrit	●	●	●	●	Can transfer to LRT1
	Espana		●	●	●	
	Santa Mesa		●	●	●	
	Paco		●	●	●	
	Buendia		●	●	●	
	Pasay Road					
	EDSA		●	●	●	
	Nichols		●	●	●	
	FTI		●	●	●	
	Bicutan		●	●	●	Entering to MMSP after 2025
	Sucat		●	●	●	Entering to MMSP after 2025
	Alabang		●	●	●	Entering to MMSP after 2025
	Muntinlupa		●	●	●	Entering to MMSP after 2025
	San Pedro		●	●	●	Entering to MMSP after 2025
	Pacita		●	●	●	Entering to MMSP after 2025
	Binan		●	●	●	Entering to MMSP after 2025
	Santa Rosa		●	●	●	Entering to MMSP after 2025
	Cabuyao		●	●	●	Entering to MMSP after 2025
	Gulod		●	●	●	Entering to MMSP after 2025
	Mamatid		●	●	●	Entering to MMSP after 2025
	Calamba		●	●	●	Entering to MMSP after 2025

Source: JICA Design Team

(2) Stop Stations of Express / Limited Express Services

The train operation schedule as stop stations by service which are assumed in the demand forecast are shown in Table 3.5.2.

Table 3.5.2 The Assumed Stop Stations by Service Operation

Section	Station	Limited Express CIA-Alabang	Commuter Express CIA-Calamba	Commuter CIA-Calamba	Commuter Express NCC-Tutuban	Commuter NCC-Tutuban	Entering to MMSP
Malolos-Clark (MCRP)	NCC				●	●	
	CIA	●	●	●			
	Clark		●	●	●	●	
	Angeles			●		●	
	San Fernando		●	●	●	●	
	Apalit			●		●	
	Calumpit			●		●	
NSCR North	Malolos		●	●	●	●	
	Malolos South			●		●	
	Guiguinto			●		●	
	Tuktukan			●		●	
	Balagtas			●		●	
	Bocaue		●	●	●	●	
	Tabing Ilog			●		●	
	Marilao		●	●	●	●	
	Meycauayan			●		●	
	Valenzuela		●	●	●	●	
	Valenzuela Polo			●		●	
	Malabon			●		●	
	Caloocan		●	●	●	●	
	Solis	●		●		●	
	Tutuban				●	●	
NSCR South	Blumentrit		●	●			
	Espana			●			
	Santa Mesa		●	●			
	Paco			●			
	Buendia	●	●	●			
	Pasay Road						
	EDSA		●	●			
	Nichols			●			
	FTI	●	●	●			
	Bicutan			●			●
	Sucat		●	●			●
	Alabang	●	●	●			●
	Muntinlupa			●			●
	San Pedro			●			●
	Pacita			●			●
	Binan			●			●
	Santa Rosa		●	●			●
	Cabuyao		●	●			●
	Gulod			●			●
	Mamatid			●			●
	Calamba		●	●			●

Source: JICA Design Team

3.5.3 Road Based Public Transport Projects

The expansion of the mass transit network will entail a more massive investment than roads. A total of 268 km of main rail lines (in 6 corridors) and 60 km of secondary transit lines must be provided as an integrated system. Hence, the urgency of clearing the backlog of railway projects by 2018, such as LRT-1 Cavite extension (12 km), LRT-2 east extension (4 km), LRT-2 west extension (3 km), reconstructing PNR North commuter service (38 km), LRT-4 (19 km), MRT-5 (20 km), LRT-6 (19 km), MRT-7 (22 km), and Mega Manila Subway (25 km for Phase 1).

(1) Road Based Public Transport Projects

As the road based public transport systems, the Integrated Transport System and bus priority systems are included into the assumed transport network.

To compensate for the long gestation for railways, developing the bus priority or BRT mass transit ahead of the rail line in specific corridors should be pursued. BRT operation may be terminated and replaced with the rail transit. In Road Map Study II, the development of BRT Line 1 on Quezon Boulevard corridor is proposed, due to lower hurdles to overcome on the corridor and function as pre-METRO, BRT operation is terminated and replaced with the rail transit. However, in discussion with DOTr, the development of BRT Line 1 is excluded from the assumed transit network due to the duplication with MRT Line 7, which is planned to be developed in early stage.

(2) Road & Expressway Projects

The road and expressway network as proposed in Road Map II Study is extensive to connect suburban centres and Metro Manila, and between suburban centres. (Table 3.5.3 & Figure 3.5.3 & 3.5.4)

C5 Expressway connecting proposed Central Luzon Expressway and Laguna Lakeshore Dyke Expressway are expected to strengthen the north–south traffic flow. With the second expressway connecting both north–south expressway corridors can effectively complement each other and strengthen the resilience of road network. With the proposed network, Metro Manila is provided with integrated urban expressway system together with east–west expressways and contribute to dramatically to reduce the at-grade traffic congestion.

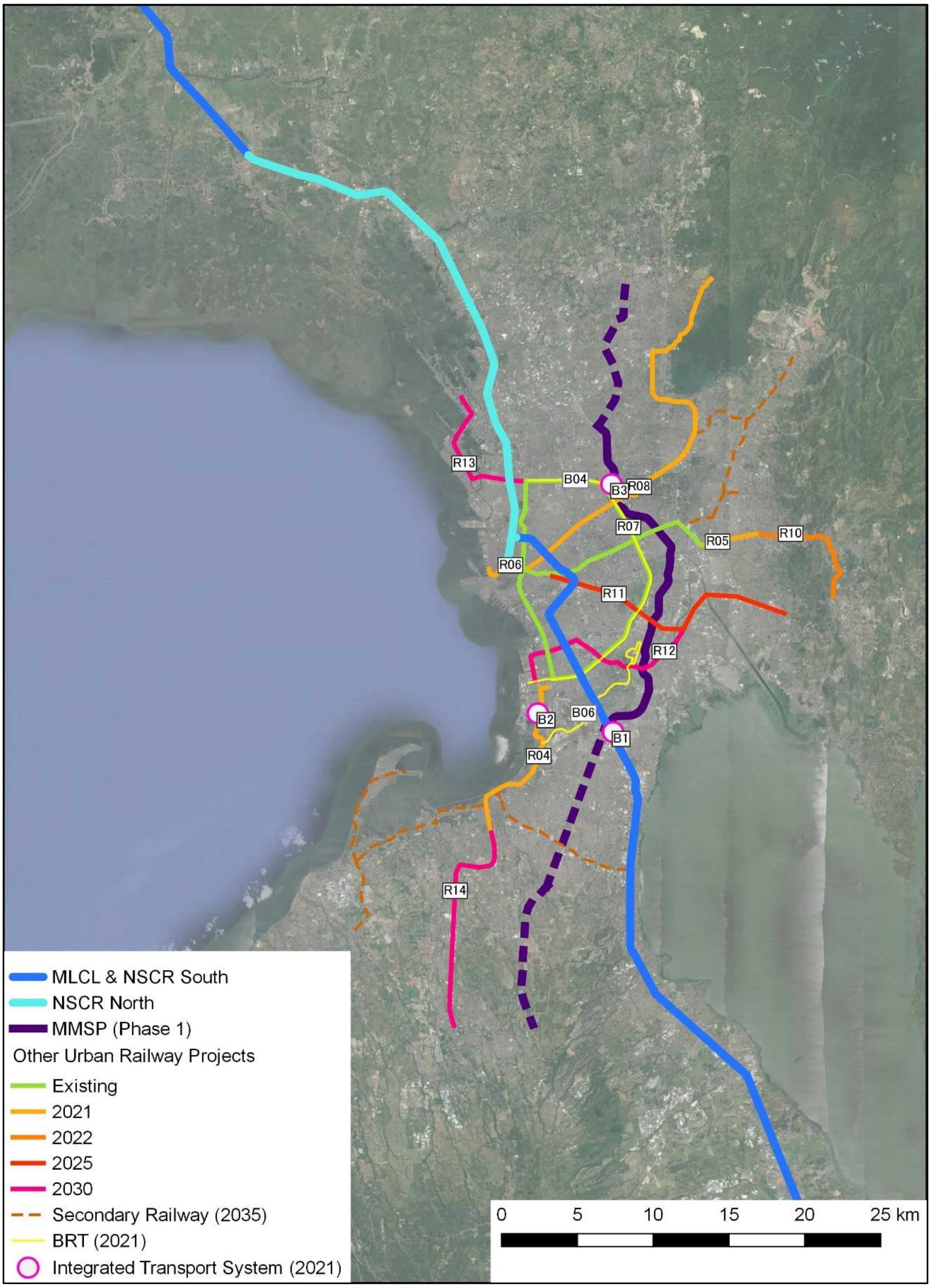
From future road and expressway projects proposed in Road Map II Study, Laguna Lakeshore Expressway is omitted through the discussion with DOTr. This expressway project is selected as the priority project and proposed to be opened in 2025. But the currently the project has been halted indefinitely.

Table 3.5.3 The Implementation Schedule of Road and Railway Projects

Category	No.	Project	2022	2025	2030	2035	2040	Project cost (PHP mil.)
Railway	R01	MCRP	●	●	●	●	●	This study
	R02	North South Commuter Rail	●	●	●	●	●	117,304
	R03	NSRP-South	●	●	●	●	●	This study
	R04	LRT Line 1 Cavite Extension	●	●	●	●	●	64,915
	R05	LRT Line 2 East (Masinag) Extension Project	●	●	●	●	●	9,759
	R06	LRT Line 2 West Extension	●	●	●	●	●	10,118
	R07	MRT 3 Capacity Expansion Project	●	●	●	●	●	8,633
	R08	MRT Line7	●	●	●	●	●	62,700
	R09	Mega Manila Subway		Phase1	Phase1	Phase2	Phase2	227,000
	R10	LRT-1 North Extension	●	●	●	●	●	15,920
	R11	LRT-2 East Extension (Phase II)	●	●	●	●	●	80,480
	R12	LRT Line 4 Project		●	●	●	●	85,000
	R13	Metro Manila Line 5		●	●	●	●	301,801
	R14	MRT-3 Extension - South and West			●	●	●	68,600
	R15	MRT-3 Extension - North			●	●	●	68,600
	R16	LRT Line 6				●	●	64,710
	R17	Ortigas Secondary Railway (Marikina, Pasig, Alabang, Cavite)				●	●	-
Road Based Public Transport	B01	South Integrated Transport System Project	●	●	●	●	●	4,000
	B02	Southwest Integrated Transport System (ITS) Project	●	●	●	●	●	3,153
	B03	Integrated Transport System-North Terminal Project	●	●	●	●	●	4,000
Road/ Expressway	E01	NLEX Harbor Link, Segment 10	●	●	●	●	●	9,000
	E02	Skyway Stage 3	●	●	●	●	●	26,656
	E03	NLEX–SLEX Connector Road Project	●	●	●	●	●	23,320
	E04	Metro Manila Expressway Project (C-6)	●	●	●	●	●	31,320
	E05	Plaridel Bypass Phase III	●	●	●	●	●	1,184
	E06	Cavite-Laguna Expressway	●	●	●	●	●	35,426
	E07	C6 North Section	●	●	●	●	●	4,330
	E08	Laguna Lakeshore Expressway Dike						122,861
	E09	CAVITEX - C-5 - San Jose Del Monte (Bulacan)			●	●	●	13,640
	E10	Sta. Mesa - Pasig (Shaw Boulevard) R-4 Expressway			●	●	●	23,430
	E11	Manila City - Quezon City (Quezon Av.) R-7 Expressway				●	●	24,480
	E12	North Luzon Expressway (SJ Del Monte-Cabanatuan-San Jose)				●	●	24,850
	E13	CAVITEX Extension West to Rosario				●	●	12,710
	U16	Circumferential Road 3 (C-3), Southern Segment from N. Domingo St. in San Juan City to Buendia Avenue in Makati City	●	●	●	●	●	10,500
	U17	Alabang-Zapote Areas	●	●	●	●	●	9,470
	U18	Marcos Highway	●	●	●	●	●	1,450
	U19	Calamba Local Area Roads Package	●	●	●	●	●	3,090
	U20	Rosario Package	●	●	●	●	●	4,010

Note: JDT Agreed with GOP on 25th April 2018. Project cost is based on the information of web site.

Source: JICA Design Team



Source: JICA Design Team

Figure 3.5.3 Existing / Proposed Railway Projects

Source: JICA Design Team

Figure 3.5.4 Existing and Proposed Expressway / Road Projects

(3) Development of Clark International Airport

In road map II Study, a strategy has been proposed for the airport which is the gateway of GCR as below, CIA is written that future expansion plans will be made, and it will absorb NAIA's excess demand.

Table 3.5.4 GCR Gateway Airport by Roadmap II

Airport	Phase 1 (2018-2022)	Phase 2 (2023-2029)	Phase 3 (2030 upward)
CIA	Complete the new CRK International Passenger Terminal in tandem with private O&M	Expand capacity and upgrade systems to absorb spill over from & provide relief to existing NAIA	Build the 2nd and 3rd runway, as well as expand Pax Terminal building & Cargo Terminal
NAIA	Complete the transfer of General aviation from NAIA to Sangley Terminal space expansion & management improvements (T1 to T4) via PPP	Build a new NAIA in another site south of NCR (if not Sangley 1, then Laguna Lake or Lipa-Batangas)	Shutter existing NAIA and convert to "green lungs of NCR" plus socialized housing community
Regional airports outside GCR	Complete the night landing facilities in other airports feeding into NAIA	Complete full development of regional airports, as well as tourism-based airports (Bohol, Palawan, etc.)	Aviation policies to steer traffic growths from GCR to regional airports (Cebu, Davao, Iloilo, Laoag)

Source: Follow-up Survey on Roadmap for Transport Infrastructure Development for Greater Capital Region (GCR)

Meanwhile, according existing reports, there are several numbers in the CIA's airport demand level following below.

Table 3.5.5 CIA Airport Demand

Case	Assumption of CIA demand
Case A: Domestic passengers are dominant due to a better attraction of passenger from CIA catchment area	Low: 26 million. Based on the forecast in "Information Collection Survey for New Manila International Airport (JICA, 2016)" Planned New Manila International Airport will be dominant
	Middle: 46 million / year Based on the target in "CRK Master Development Plan"
	High: 79 million / year Based on the forecast in "Feasibility Study of the Extension of CIA (DOTr, 2014)"
Case B: All international flights operate to/from CIA: the trip pattern is based on the NAIA.	High: 79 million / year Based on the forecast in "Airport Strategy Study for the GCR (JICA, 2011)"

Source: Estimated by JICA Design Team

In the result of discussion with DOTr, the assumption of CIA's passenger will be as of Middle Case A (46 million/ year), considering competition with NAIA, which new airport is planned. The demand of CIA, including working and well-wisher, is estimated using surveyed traffic volume in Roadmap II and above the number of user.

Table 3.5.6 The Demand at CIA

Year	Passenger (pax/year)	Passenger (pax/day)	Total No. of Trips for CIA (000trip/day)
2016	951,007	2,605	-
2017	2,828,048	7,748	14
2040	46,000,000	126,027	238

Source: Estimated by JICA Design Team

3.5.4 NSRP-South Passenger – Station and Line Volumes

(1) Calibration of Current Demand

In demand forecast, the current traffic demand was calibrated by reviewing input data and verified. The following materials were referred:

- Number of operations
- Connectivity with other transportation methods
- Review of construction projects

The comparison between the statistics of railway ridership in 2016 and present calibration result by model are shown in Table 3.5.7. The estimated value is about 1.0 times against statistics and it proves that the model is predictable.

Table 3.5.7 Validation of Demand Model (daily passenger)

2016		Statistics (A)	Calibrated Estimation (B)	(B)/(A)
LRT1	000 pax/day	453	469	1.04
LRT2	000 pax/day	126	129	1.02
MRT3	000 pax/day	425	455	1.07

Source: JICA Design Team

(2) Consistency with Roadmap

The comparison between estimated demand of roadmap and this study is shown in Table 3.5.8. The forecast result in this study is almost same volume and similar to Roadmap II and the model result in this study has the consistency with Roadmap II result. In this Study, the connectivity by each station was reviewed and reflected on the demand forecast. Through the update the ridership of LRT Line 2 increased by 1.6 times and MRT Line 3 decreased by 0.84.

Table 3.5.8 The Consistency between Roadmap II and the Study (Daily Passenger)

2035		Roadmap II Estimation (A)	This Study Estimation (B)	(B)/(A)
LRT1	000pax/day	642	629	0.98
LRT2	000pax/day	270	430	1.59
MRT3	000pax/day	440	370	0.84
NSCR	000pax/day	785	787	1.00
MMSP	000pax/day	673	677	1.01

Source: JICA Design Team

(3) Overview of the Ridership Demand Forecast

Ridership Demand forecast based on operation plan is shown in Table 3.5.9. The socio-economic framework of NCC was updated from the projection in the Consultancy Services of A Comprehensive Master Development Plan for the Clark Green City, and the demand of Malolos-CIA/NCC section is less than the result of previously reported. The JOIN-F/S report anticipated a high demand because of generating the demand from/to the NCC development area, but the future demand was updated by updated information and the demand became be less than JOIN-F/S demand. Because NCC development largely affects on the Malolos-Clark section, the demand of the Malolos-Clark section is smaller than JOIN-F/S report.

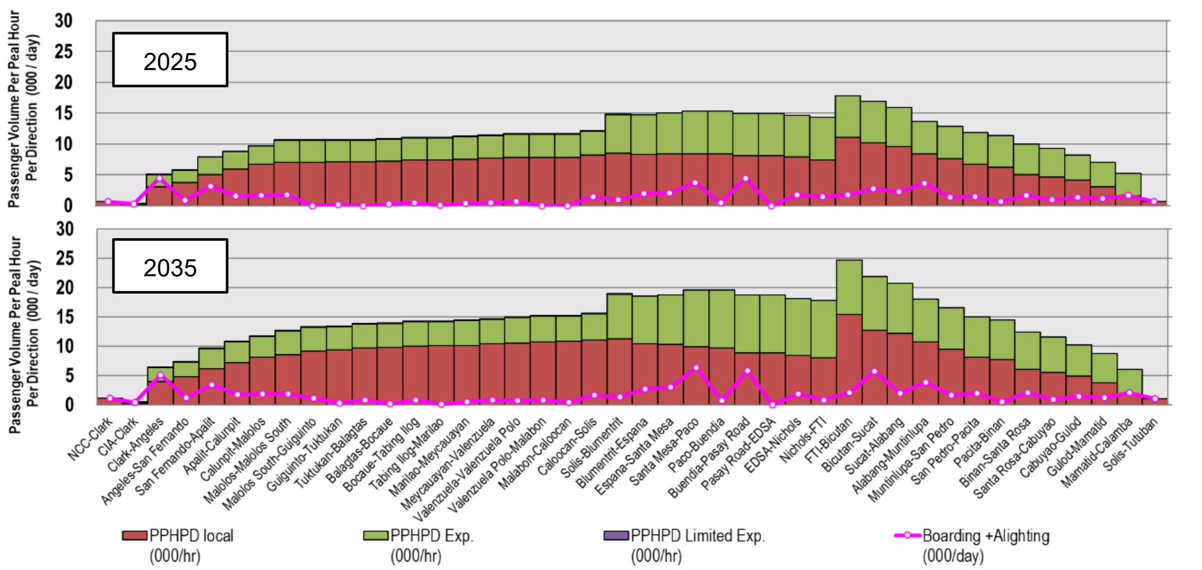
Table 3.5.9 Overview of the Demand Forecast Results

Section		2022	2023 October	2025	2035	2040	JOIN-F/S Report (2035)
Ridership (000/day)	Malolos-CIA/NCC	185	193	184	222	248	427
	Tutuban-Malolos	276	238	262	357	409	375
	Solis-Calamba	76	523	516	706	815	717
	Total	**337**	**555**	**549**	**767**	**883**	**n/a**
PPHPD (000/hr)	Malolos-CIA/NCC	9.3	10.5	9.6	11.6	13.0	11.8
	Tutuban-Malolos	11.1	12.3	12.0	15.5	17.8	19.2
	Solis-Calamba	4.8	16.8	17.5	24.6	27.9	24.9

Source: JICA Design Team

(4) Cross-sectional traffic volume and alighting and boarding passenger

The estimation results of cross-sectional traffic volume and alighting and boarding are shown in the Figure 3.5.5, Table 3.5.10. The maximum cross section is between FTI-Bictan stations.



Source: JICA Design Team

Figure 3.5.5 The Forecast Results of Cross-sectional Passenger Volume and Alighting and Boarding of the Commuter Railway

Table 3.5.10 The Forecast Results of Cross-sectional Passenger Volume and Alighting and Boarding of the Commuter Railway

Station		2022			2023			2025			2035			2040		
		Section Volume (000/day/ 2directions)	PPHPD (000/hr)	Boarding +Alighting (000/day)	Section Volume (000/day/ 2directions)	PPHPD (000/hr)	Boarding +Alighting (000/day)	Section Volume (000/day/ 2directions)	PPHPD (000/hr)	Boarding +Alighting (000/day)	Section Volume (000/day/ 2directions)	PPHPD (000/hr)	Boarding +Alighting (000/day)	Section Volume (000/day/ 2directions)	PPHPD (000/hr)	Boarding +Alighting (000/day)
Malolos-Clark section	Clark to NCC	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**1**	**10.4**	**20**	**1.2**	**19.6**	**26**	**1.6**	**26.3**
	Clark to CIA	**11**	0.6	10.5	**12**	0.7	11.5	**4**	0.2	3.8	**7**	0.4	7.3	**7**	0.4	7.5
	Clark	**90**	5.4	82.9	**87**	5.2	77.3	**84**	5.0	73.1	**105**	6.3	84.8	**120**	7.2	94.7
	Angeles	**102**	6.1	16.5	**97**	5.8	12.6	**96**	5.7	15.0	**121**	7.2	19.9	**137**	8.2	23.5
	San Fernando	**135**	8.1	57.7	**145**	8.7	62.2	**132**	7.9	51.5	**160**	9.6	56.9	**181**	10.9	61.5
	Apalit	**146**	8.8	22.8	**161**	9.7	24.6	**147**	8.8	25.5	**178**	10.7	29.8	**200**	12.0	32.3
	Calumpit	**154**	9.3	25.9	**175**	10.5	22.5	**161**	9.6	28.2	**193**	11.6	31.6	**217**	13.0	34.4
NSCR North section	Malolos	**174**	10.4	60.4	**185**	11.1	17.7	**174**	10.4	27.1	**210**	12.6	31.4	**235**	14.1	33.0
	Malolos South	**174**	10.4	0	**185**	11.1	0	**174**	10.4	0	**220**	13.2	18.6	**248**	14.9	23.3
	Guiguinto	**177**	10.6	19.0	**186**	11.2	1.5	**175**	10.5	2.9	**223**	13.4	5.6	**251**	15.1	6.9
	Tuktukan	**177**	10.6	0	**186**	11.2	0	**175**	10.5	0	**229**	13.7	14.5	**259**	15.5	17.1
	Balagtas	**181**	10.8	14.8	**187**	11.2	1.6	**177**	10.6	4.3	**230**	13.8	3.4	**261**	15.6	5.2
	Bocaue	**185**	11.1	34.6	**191**	11.4	5.6	**182**	10.9	9.7	**236**	14.1	13.8	**268**	16.1	15.8
	Tabing Ilog	**184**	11.0	8.0	**191**	11.4	0.2	**183**	11.0	1.8	**236**	14.2	1.8	**268**	16.1	2.0
	Marilao	**171**	10.3	71.9	**193**	11.6	5.5	**185**	11.1	6.9	**239**	14.3	7.7	**273**	16.4	10.8
	Meycauayan	**169**	10.1	22.1	**196**	11.7	3.7	**188**	11.3	7.5	**243**	14.6	13.6	**278**	16.7	16.0
	Valenzuela	**127**	7.6	78.0	**197**	11.8	3.7	**191**	11.5	8.5	**247**	14.8	12.7	**283**	17.0	14.4
	Valenzuela Polo	**127**	7.6	0	**197**	11.8	0	**191**	11.5	0	**251**	15.1	13.8	**287**	17.2	15.8
	Malabon	**127**	7.6	0	**197**	11.8	0	**191**	11.5	0	**252**	15.1	6.1	**289**	17.4	7.1
	Caloocan	**89**	5.3	58.0	**205**	12.3	15.4	**199**	12.0	23.5	**258**	15.5	27.7	**297**	17.8	30.1
	Solis	**81**	4.8	10.0	**213**	12.8	15.8	**245**	14.7	15.2	**315**	18.9	21.6	**361**	21.7	25.9
NSCR South section	Blumentrit	0	0.0	61	**220**	13.2	30.7	**245**	14.7	34.6	**310**	18.6	48.0	**358**	21.5	57.1
	Espana	0	0.0	0	**235**	14.1	36.4	**250**	15.0	36.2	**315**	18.9	57.5	**365**	21.9	71.0
	Santa Mesa	0	0.0	0	**255**	15.3	64.1	**255**	15.3	65.6	**328**	19.7	127.1	**382**	22.9	159.8
	Paco	0	0.0	0	**258**	15.5	10.0	**256**	15.3	8.5	**329**	19.7	17.7	**382**	22.9	21.6
	Buendia	0	0.0	0	**266**	16.0	63.4	**250**	15.0	80.1	**314**	18.9	126.3	**362**	21.7	153.5
	Pasay Road	0	0.0	0	**266**	16.0	0.0	**250**	15.0	0.0	**314**	18.9	0.0	**362**	21.7	0.0
	EDSA	0	0.0	0	**277**	16.6	75.9	**243**	14.6	34.9	**302**	18.1	42.6	**345**	20.7	46.8
	Nichols	0	0.0	0	**280**	16.8	63.1	**238**	14.3	30.8	**297**	17.8	20.1	**338**	20.3	22.0
	FTI	0	0.0	0	**273**	16.4	41.8	**291**	17.5	31.1	**411**	24.6	44.6	**465**	27.9	53.4
	Bicutan	0	0.0	0	**262**	15.7	50.0	**280**	16.8	53.9	**364**	21.8	113.8	**407**	24.4	134.4
	Sucat	0	0.0	0	**249**	15.0	36.9	**264**	15.9	41.6	**345**	20.7	36.9	**384**	23.1	41.8
	Alabang	0	0.0	0	**215**	12.9	72.5	**227**	13.6	70.8	**300**	18.0	78.5	**330**	19.8	88.0
	Muntinlupa	0	0.0	0	**199**	11.9	31.4	**212**	12.7	28.2	**276**	16.5	40.9	**301**	18.1	46.4
	San Pedro	0	0.0	0	**183**	11.0	27.6	**197**	11.8	26.9	**249**	15.0	37.8	**273**	16.4	39.6
	Pacita	0	0.0	0	**175**	10.5	12.5	**189**	11.3	12.5	**241**	14.5	12.2	**265**	15.9	11.9
	Binan	0	0.0	0	**154**	9.2	30.2	**166**	9.9	33.1	**207**	12.4	44.3	**227**	13.6	49.1
	Santa Rosa	0	0.0	0	**143**	8.6	15.4	**154**	9.3	16.0	**193**	11.6	18.8	**211**	12.7	20.1
	Cabuyao	0	0.0	0	**126**	7.5	23.4	**137**	8.2	24.2	**171**	10.2	28.7	**187**	11.2	30.7
	Gulod	0	0.0	0	**107**	6.4	22.7	**117**	7.0	24.0	**146**	8.7	29.5	**160**	9.6	32.1
	Mamatid	0	0.0	0	**82**	4.9	27.9	**87**	5.2	32.6	**101**	6.0	48.4	**108**	6.5	55.8
	Calamba	0	0.0	0	0	0.0	82.0	**0**	0.0	86.8	**0**	0.0	100.7	**0**	0.0	107.5
Tutuban-Solis	Tutuban	**21**	1.3	20.9	**10**	0.6	9.7	**11**	0.7	10.9	**18**	1.1	17.9	**20**	1.2	19.6

1) Peak Hour Ratio of the commuter railway is 12.0 %, from those of NLEX.

Source: JICA Design Team

3.5.5 Fare Sensitivity Analysis

(1) Outline of the Survey

To examine the validity of the fare system of the Commuter Rail service, Willingness to Pay survey was conducted to obtain from potential users of the commuter rail.

There is a total of 9 survey stations as listed in Table 3.5.11 while their locations are indicated in Figure 3.5.6. The target number of samples size was 1,600 interviews.

Source: JICA Design Team

Figure 3.5.6 Survey Location of Willingness to Pay Survey Stations

Table 3.5.11 List of Willingness to Pay Survey Stations

Code	Survey Station	No. of Samples
1	Around CIA Station	400
2	Around Angeles Station	150
3	Around San Fernando Station	150
4	Around Malolos Station	150
5	Around Solis Station	150
6	Around Santa Messa Station	150
7	Around EDSA Station	150
8	Around Alabang Station	150
9	Around Calamba Station	150
Total		**1,600**

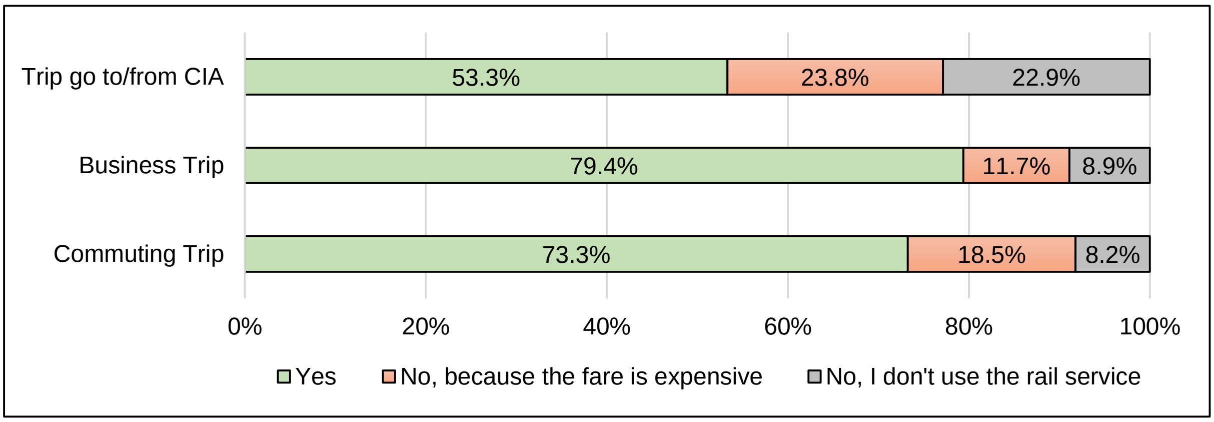
Source: JICA Design Team

1) Survey Result

In term of willingness-to-pay, respondents were asked about whether or not they use new transport service and their maximum fare that they can pay. There are 3 scenarios as follows:

i) a commuting trip under the introduction of commuter rail,
ii) a business trip under the introduction of commuter rail,
iii) a trip go to/from CIA under the introduction of commuter rail and limited express train.

Figure 3.5.7 shows the result of respondents' choice about new transport service in 3 scenarios. In the context of commuting trip, 73.3% of respondents chose commuter rail and 18.5% did not choose because the fare is expensive. The share of respondents choosing commuter rail increases to 79.4% in the context of business trip (i.e. the second scenario), and only 11.7% did not choose because the fare is expensive. In the context of trip go to/from CIA, 53.3% of respondents want to use limited express train and 23.8% did not use because the fare is expensive. Notably, the fare of commuter rail is in the range of 100 to 170 Peso, while that of limited express train is in the range of 170 to 320 Peso.



Source: JICA Design Team

Figure 3.5.7 Share of choosing new railway service

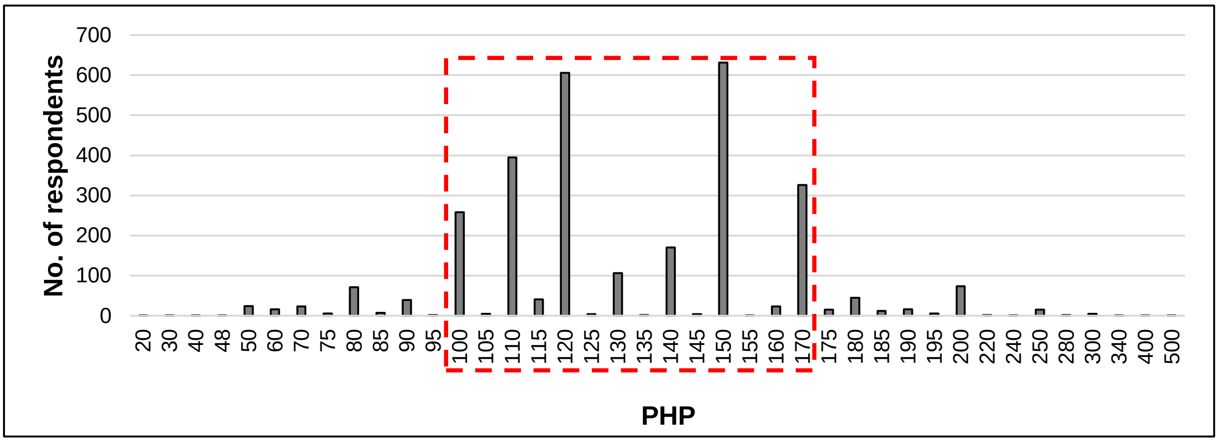
To measure and assess disparities in choosing new railway service between income groups, respondents are grouped into either low income or medium-to-high income. The main reason for dividing sample into two income groups is to simplify the discussion. With regard to the cut-off point, annual per capita GRDP in National Capital Region is 2017 was about 244,453 Peso (posted by the Philippine Statistics Authority), meaning that monthly income per capita was 20,371 Peso. Therefore, respondents with a monthly income below 20,001 Peso are ranked as low-income group and those with a monthly income of 20,001 and more are grouped into medium-to-high-income group. The result indicates a significant different in choosing new railway service by income group. As can be seen from Table 3.5.12, the percentage of medium-to-high-income respondents choosing new railway service in 3 scenarios is significantly larger than that of low-income ones. In term of the second option (i.e. No, because the fare is expensive), the share of medium-to-high-income group is relatively smaller than that of low-income group. For instance, 79% of medium-to-high-income respondents want to commute by commuter rail, and only 12.7% did not choose because the fare is expensive. As for low-income group, the rates are 71.1% and 20.7%, respectively.

Table 3.5.12 Share of choosing new railway service by income

Scenario	Category	Low income	Medium-to-high income
Commuting Trip	Yes	71.1%	79.0%
	No, because the fare is expensive	20.7%	12.7%
	No, I don't use the rail service	8.1%	8.3%
	Total	**100.0%**	**100.0%**
Business Trip	Yes	78.0%	83.2%
	No, because the fare is expensive	13.7%	6.6%
	No, I don't use the rail service	8.4%	10.2%
	Total	**100.0%**	**100.0%**
Trip go to/from CIA	Yes	50.2%	61.6%
	No, because the fare is expensive	26.0%	18.1%
	No, I don't use the rail service	23.8%	20.3%
	Total	**100.0%**	**100.0%**

Source: JICA Design Team

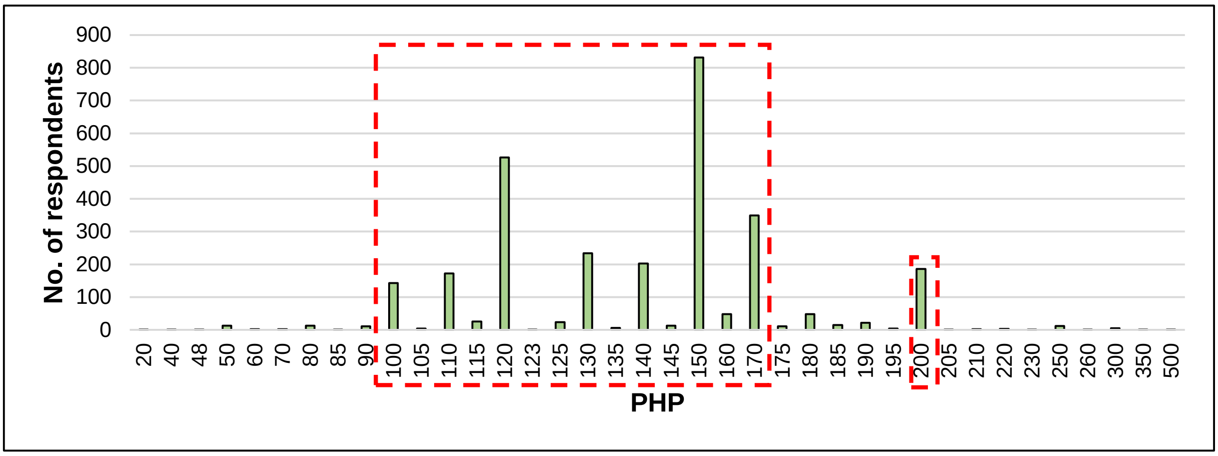
Figure 3.5.8, Figure 3.5.9 show the frequency of WTP data in different scenarios. In the context of both commuting and business trips, the most frequency of WTP is in the range of 100 to 170 Peso. However, the most frequency of WTP in the context of trip go to/from CIA is in the range of 150 to 320 Peso.



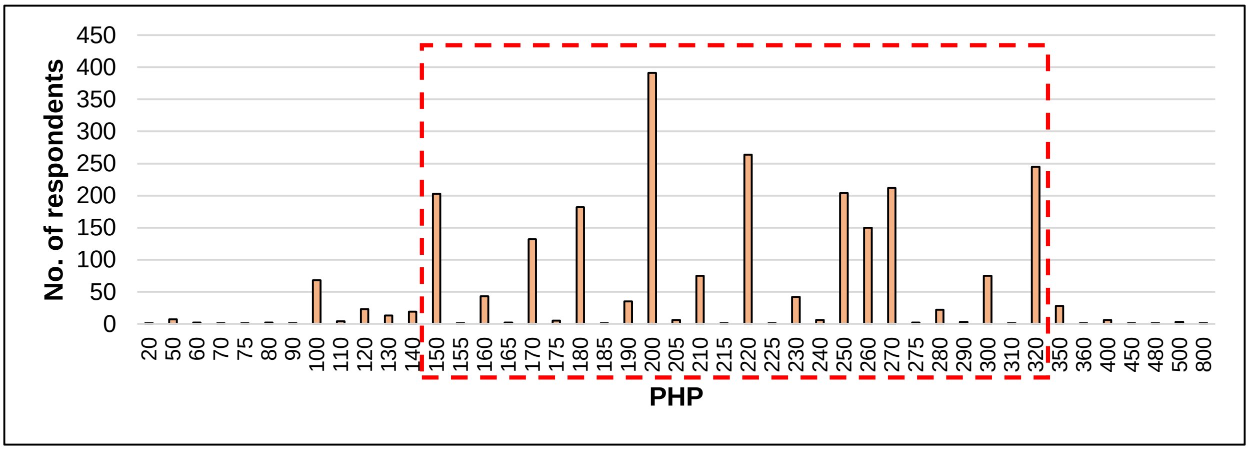
(a) Commuting Trip

Source: JICA Design Team

Figure 3.5.8 Frequency of WTP data in different scenarios (1)



(b) Business Trip



(c) Trip go to/from CIA

Source: JICA Design Team

Figure 3.5.9 Frequency of WTP data in different scenarios (2)

There is a significant difference in maximum fare by income group. In average, low-income group paid the amounts of 131, 142 and 218 Peso in three scenarios, respectively. However, those average value of medium-to-high-income group increased by about 10 Peso in each scenario. In term of maximum value, low-income people's WTP are 340 and 350 Peso in the first and second scenarios, while that of medium-to-high-income group is 500 Peso. In the context of trip going to/from CIA, such value rose to 500 Peso for low-income group, but medium-to-high-income group could pay up to 800 Peso.

Table 3.5.13 Descriptive Analysis of WTP by Income Group

Scenario	Criteria	Low income	Medium-to-high income
Commuting Trip	Average	131	139
	Min	20	50
	Max	340	500
	SD	31.4	35.5
	Sample size	**2153**	**807**
Business Trip	Average	142	149
	Min	20	50
	Max	350	500
	SD	29.2	31.1
	Sample size	**2148**	**786**
Trip go to/from CIA	Average	218	232
	Min	20	75
	Max	500	800
	SD	60.2	61.6
	Sample size	**1786**	**701**

Source: JICA Design Team

2) Sensitivity Analysis on Fare Setting

Table 3.5.14 and Figure 3.5.10 show the result of sensitivity analysis for the fare setting for the commuter railway in 2035. The result shows that the fare setting assumed (PHP 22 + 2.0 / km) is justifiable since the expected revenue is expected to be the highest in the assumed fare setting. If the fare of commuter railway is assumed as PHP 11 + 1.0 / km, the ridership is nearly twice of the base case. On the other hand, the PPHPD reached 47,000 pax. To carry the passengers, the required frequency of the railway will be 21 trains per peak hour per direction. The fare of existing urban railway in Metro Manila is same as other road-based public modes. And as traffic congestion is serious, existing urban railway service is used more than the capacity causing machine troubles and accidents.

It is difficult to change public transport fares once these are decided. “Fare setting beyond populism” is the key to the profitability of transport development projects.

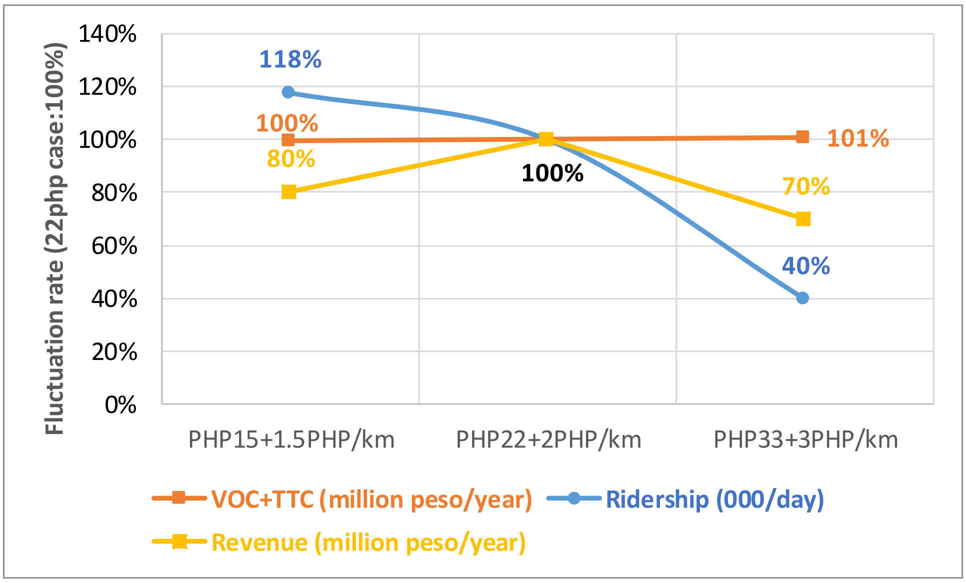
Regarding the fare setting of Limited express is based on the result of existing study[1]. According of it, the fare was analyzed on some perspective of economy, transportation engineering, acceptation for citizen. As the result, the appropriate fare was intercept of fare was same as local fare and twice of slope per km of local fare. Therefore, the fare of limited express on this study is used 22php+4php/km.

[1] Railway Strategy for Clark-Metro Manila for the Greater Capital Region in the Republic of the Philippines

Table 3.5.14 Result of Sensitivity Analysis in 2035

Description	Case 1	Case 2 (Base)	Case 3
	Php 15 + 1.5 / km	Php 22 + 2.0 / km	Php 33 + 3.0 / km
Ridership (000/day)	903	767	305
PPHPD (pax/hour)	32,000	25,000	10,000
Revenue (million peso/year)	26,881	33,521	23,383
VOC+TTC (million peso/year)	3,302,056	3,312,186	3,346,746

Source: JICA Design Team



Source: JICA Design Team

Figure 3.5.10 Result of Sensitivity Analysis in 2035

3.6 Legal Implications for the Development of NSRP Line (Commuter)

3.6.1 Introduction

The legal aspects of North-South railway project development, issues and concerns of all 'possible' stakeholders were addressed and reviewed in a comprehensive manner by the Philippine legal experts under supervision of JDT team. The full document is attached in Appendix, covering both MCRP and NSRP-South.

The review also entailed examples of issues, concerns, rights, constraints and opportunities of developing, implementing and operating similar transport infrastructure projects. It includes examples of rail and road projects. The road projects, which may not appear relevant, but do need to be given due consideration specially in terms ROW provision and land development right of all parties.

3.6.2 Synopsis of Legal Review for North-South Rail Project – South Line (Commuter)

(1) Examination of other relevant transportation infrastructure projects vis-à-vis North South Railway Project (NSRP) South Line (Commuter);

This section looks into the different concession agreements covering transportation projects executed by government with private entities, which may have some similar station locations in their alignment with that of the NSCR.

Upon scrutiny, it appears that while the said concession agreements uniformly give private concessionaires exclusive right-of-way (only) to the alignment of their respective projects, or where the rails or toll roads are actually located and other specifically designated areas like depots, there is no impediment for government to pursue other projects within the vicinity of the stations of existing projects. Simply put, so long as the new projects do not actually sit on the right-of-way of existing projects, government is not restricted from building new infrastructure and from fulfilling its fundamental service or infrastructure delivery obligation.

Further, the mandate of the DOTr authorizes it to implement projects in pursuit of the state's police power.

3.7 Assessment of Connectivity Potential of Proposed Stations

The NSRP-South stations within Metro Manila can accommodate transport hubs to serve urban mixed-mode commuting. These would include transfer facilities for: (1) rail-to-rail on existing and future lines; (2) PUV-to-rail; and (3) automobile-to-rail, such as “Park-and-Ride”, ”kiss-and-Ride” and “Ride-Share” facilities. Bike-and-Ride is another type of intermodal transfer, but it might not be suitable for NSCR station considering Filipino behavior. They are not comfortable to leave their bicycle anywhere even it is locked. Table 3.8.1 is a matrix showing the proposed stations and the possible transfer facilities for each. The possible transfer facilities for each station were determined by the criteria below. Table 3.7.1 provides list of facilities that could be provided at the NSRP-South Stations

(i) **Rail-to-Rail:** at stations that are near junctions of regional and/or inter-provincial transport routes where future rail spur lines are possible

(ii) **Rail-to-PUV:** all commuter train stations can be expected to be served by all kinds of PUVs

(iii) **Park-and-Ride/Kiss-and Ride:** stations that are surrounded by middle- and high-income residential communities whose residents are most likely vehicle owners and, therefore, will be attracted to use the commuter rail if parking and drop-off space for private vehicles are provided near the station[2]

(iv) **Ride-Share:** similar to (iii) above although the stations located in LGUs where per capita income is lower suggests that less people own cars and therefore will have less demand for ride-sharing[3]

[2] Since the per capita income data is not available at all the station areas, income level was determined by observing the communities around the stations.
[3] ditto

Table 3.7.1 Required Transfer Facilities by Station

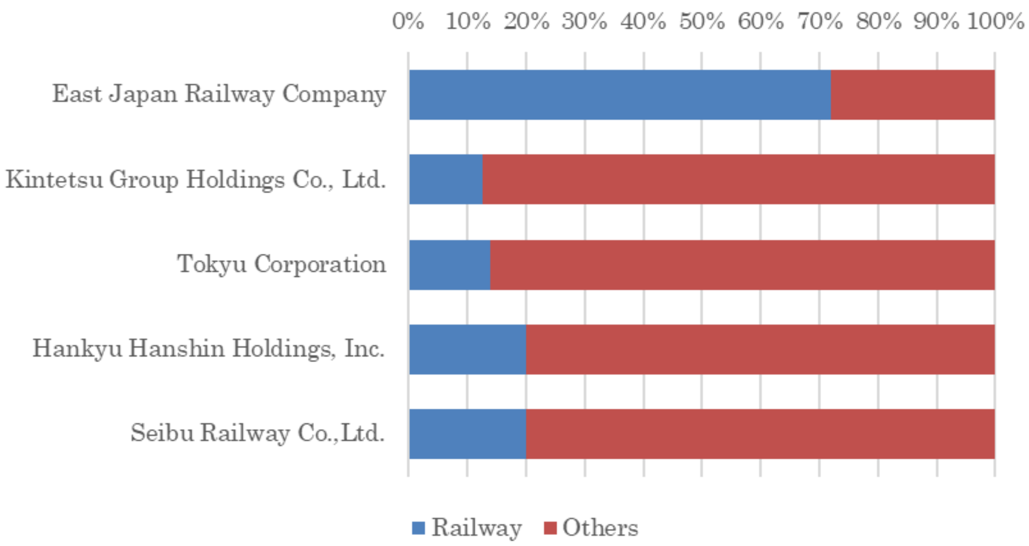
Station	Transfer Facility			
	Rail-to-Rail	PUV-to-Rail	Park-and-Ride	Ride-Share
Blumentritt	✓（LRT1）			
Espana		✓		
Sta. Mesa				
Paco		✓		
Buendia				
EDSA	✓(MRT3)	✓		
Nichols	✓(MMSP)	✓		
FTI	✓(MMSP)	✓		✓
Bicutan	✓(MMSP)	✓		
Sucat	✓(Long haul)	✓		
Alabang		✓		✓
Muntinlupa		✓	✓	
San Pedro		✓	✓	
Pacita		✓	✓	✓
Binan			✓	
Sta. Rosa		✓	✓	✓
Cabuyao			✓	
Gulod		✓	✓	
Mamatid		✓	✓	
Calamba		✓	✓	✓

Source: JICA Design Team

3.8 Estimating the Development Potential of Station Building and "Eki-Naka"

(1) Trend of development of Station Building and "Eki-naka"

For many Japanese railway operators, railway revenue constitutes less than half of their total revenue (as shown on Figure 3.8.1). For this project, having non-railway revenue would help stabilize overall project operation. For instance, operating a station building and managing space for commercial purpose located in the premises of the station building (commonly known as "Eki-naka") have synergies with the railway operations, and would thus be the areas railways operators may find interest in being involved. In this study, the candidate railway stations fit for station building operation and Eki-naka management will be identified.



Source: Compiled by JICA Design Team based on the information from the annual reports of the respective companies

Figure 3.8.1 Segment Sales of Major Railway Operators in Japan (Fiscal Year 2017)

Table 3.8.1 Eki-naka Facilities of East Japan Railway Company

Station	Daily Entry Figure (Fiscal Year 2016)	Shop Area (㎡)	Annual Sales (Fiscal Year 2016) (100,000,000 Yen)
Omiya	252,769	2,300	102
Shinagawa	371,787	1,600	71
Tachikawa	165,645	4,500	49
Nippori	110,529	300	18
Tokyo	439,554	800	55
Ueno	182,693	4,300	98
Shinagawa South (Shinagawa Station)	371,787	1,900	113
Akbane	93,534	1,645	54

Source: Compiled by JICA Design Team based on the information from East Japan Railway Company

Station name: Fujimidai

Daily Passenger Number: 27,386 (Year 2017)

Commercial Facilities:

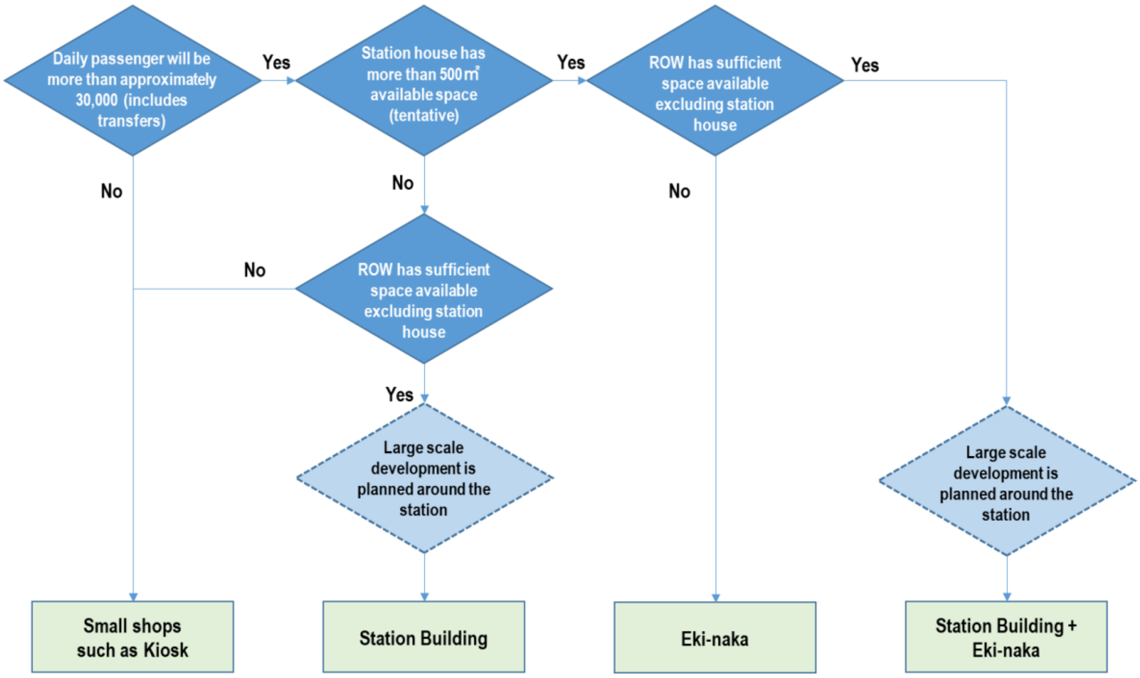
Super market, Book shop, cafe, bakery, convenience store, Flower shop and so on.

Source: Seibu Properties

Figure 3.8.2 Example of Eki-naka facility of a station in sub-urban area (Fujimidai)

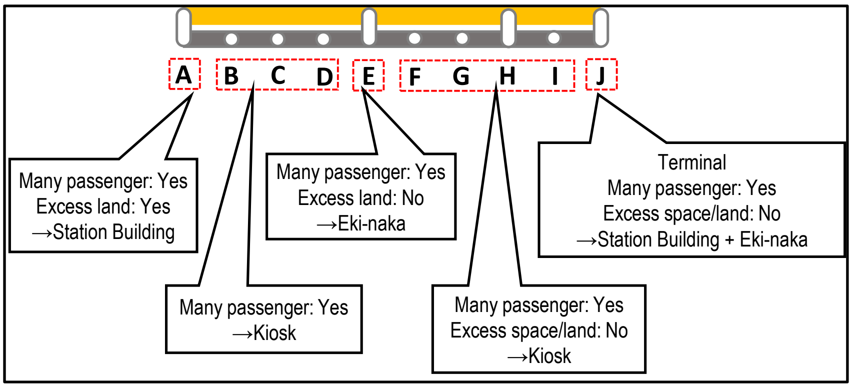
(2) Process for evaluating the potential of development of Station Building and "Eki-naka"

Considering the precedent cases in Japan, the areas fit for station building operation and Eki-naka management will be selected and grouped based on such data as the estimated daily number of passenger, space availability within the station building, ROW in the areas adjacent to station, and the results of the analysis of the potentials for Transit Oriented Development (TOD) in the station area being carried out in Chapter 5.



Source: JICA Design Team

Figure 3.8.3 Station Selection Process for Station Building and Eki-naka Development



Source: JICA Design Team

Figure 3.8.4 Example of the station building and Eki-naka Strategy

First, the utilization type for each station will be determined along with the viable area measurement that can be deployed for the station building and Eki-naka development.

(3) Result of the Analysis

The analysis based on the criteria mentioned (2) identify sixteen stations including Bicutan, Sucat, Alabang, and Calamba station as the possible station building or Eki-naka locations. However, it should be noted that the function of stations should be updated the structure of stations and station plazas considering ROW and passenger data in 2025 and 2035.

Further analysis will be implemented in the TOD study for selecting three stations considering the land ownership and intention of stakeholders, and interest of potential developers.

Table 3.8.2 Result of Preliminary analysis for selecting potential Station building/Eki-naka study

Station	Type	Notes
Blumentritt	Kiosk or Eki-naka	Although a moderate number of passenger are expected, there is little available land for station building development.
Espana	Kiosk or Eki-naka	Although a moderate number of passenger are expected, there is no available land for station building development due to its location in a highly dense area.
Santa Mesa	Kiosk or Eki-naka	Although the number of passengers are expected to be a large, there is little available land for station building development.
Paco	Kiosk	The number of passengers are expected to be relatively lower than other stations. Although there is a plaza in front of the planned location of the station, it is unclear that the said space can be allocated for station development.
Buendia	Kiosk or Eki-naka	Although a moderate number of passengers are expected, there is little available land for station building development.
Pasay Road	Kiosk	The number of passengers are expected to be lower than other stations.
EDSA	Kiosk or Eki-naka	A moderate number of passenger are expected. And the station might be an intersection connecting the nearby MRT 3 station.
Nichols	Kiosk	The number of passengers are expected to be relatively lower than other stations.
FTI	Kiosk or Eki-naka	Although the number of passengers are expected to be a large, there has already been large scale real estate development done by a Private entity.
Bicutan	Station Building	A moderate number of passenger are expected. Moreover, DOTr has a plan to acquire the land adjacent to the station for TOD purpose. Therefore, part of the said land might be allocated for the development of a station building.
Sucat	Station Building	The number of passengers are expected to be relatively lower than other stations. However, DOTr has a plan to acquire the land adjacent to the station for depot facilities. It is possible that the space above the depot will be used for a station building.
Alabang	Kiosk or Eki-naka	Although the number of passengers are expected to be a large, here is little available land for station building development.
Muntinlupa	Kiosk or Eki-naka	Although a certain number of passenger are expected, there is little available land for station building development.
San Pedro	Kiosk	The number of passengers are expected to be lower than other stations.
Pacita	Kiosk or Eki-naka	A certain number of passenger are expected. The detailed study should be implemented to evaluate the possibility of developing a station building.
Binan	Kiosk	The number of passengers are expected to be lower than other stations.
Santa Rosa	Kiosk or Eki-naka	A moderate number of passenger are expected.
Cabuyao	Kiosk or Eki-naka	The number of passengers are expected to be lower than other stations.
Gulod	Kiosk or Eki-naka	A certain number of passenger are expected. The detailed study should be implemented to evaluate the possibility of developing a station building.
Mamatid	Kiosk or Eki-naka	A moderate number of passenger are expected. A detailed study should be implemented to evaluate the possibility of developing a station building.
Calamba	Kiosk or Eki-naka	A large number for passengers are expected. However, there will be little available land for station building.

Source: JICA Design Team

CHAPTER 4 RAILWAY IMPROVEMENT PLAN

4.1 Route Planning

4.1.1 Basic Conditions

(1) Section Characteristics

PNR is currently operating commuter services in both weekdays and weekend at an interval of 30 minutes between Tutuban and Alabang. The route between Tutuban station and Caloocan depot is also used for the maintenance of rolling stocks. As the NSRP-South line has been planned along the existing PNR alignment, the Government of the Philippines decided that present PNR service shall be succeeded by the NSRP-South Line. Other basic conditions earlier studied are as follows:

- The origin of the line is set at Solis station and position on the line is expressed in positive kilo mete range;
- In principle, the NSRP South alignment is planned to use the existing PNR ROW as much as possible;
- In order to maintain the existing PNR operations at 30-minute intervals as much as possible during construction of the NSRP-South;

(2) Technical Particulars

1) Technical Specification

Technical specifications of NSRP-South were changed based on technical specifications of NSCR. The main technical parameters to be adopted are shown in Table 4.1.1.

Table 4.1.1 Major Technical Particulars of NSRP-South

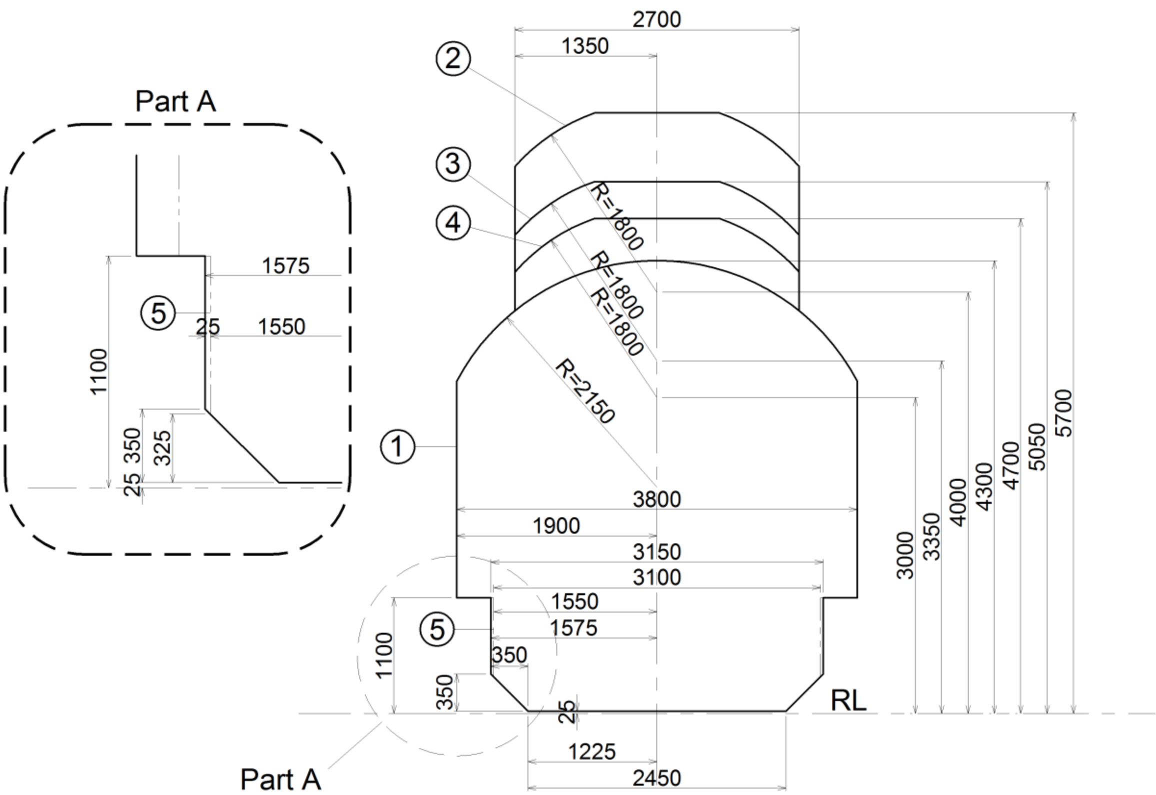
Item		Specifications	Reason for change from NSCR
Track Gauge		1,435mm (Standard track gauge)	
Design Speed	Main Line	120km/h	
	Depot	25km/h	
Horizontal Curve Radius	Main Line	300m or more (In the emergency 160m or more)	In urban areas, the constraint of the terrain is severe, so set a small radius of curvature
	Station	400m or more	
	Depot	100m or more	
Transition Curve Type		Cubic Parabolic Curve	
Transition Curve Length		Use the maximum value among L1, L2 and L3 with rounded up in 5m $L_1 = 600\ C_a$ $L_2 = 7.4x\ C_a\ x\ V_m$ $L_3 = 6.7\ x\ C_d\ xV_m$ Where, C_a:Cant deficiency C_d: Equilibrium Cant V_m: design speed	
Length of Straight Line between Transition Curves		20m or more	
Maximum Gradient	Main Line	25/1,000 (In the emergency 35/1,000)	
	Siding	15/1,000 (In the emergency as well as at section not used for the passenger transportation, such as the spur line to the depot. 35/1,000)	
	Station and Depot	0 (In the emergency 5/1,000)	
	Storage Track	0	
		R/600 shall be considered as the gradient resistance	
Vertical Curve		Gradient Changing Point Adapted for the section of more than 10/1,000 Radius of 3,000m (4,000m apply to the radius of less than 800m)	
Track Spacing		4.0m or more (or at least 3.8m)	To be set in case there are topographic restrictions in sections within urban areas.
Platform		Platform Length 180m (To adapt for 8-car train) In addition, the length of 220m shall be considered for the future expansion.	
Turnout	Main Line	Turnout number shall be #10 or more in general.	
	Depot and Siding	Turnout number shall be #8 or more in general.	

Source: JICA Design Team

2) The rolling stock gauge and structure gauge

The rolling stock gauge and structure gauge which are proposed in this project are shown in Figure 4.1.1, Figure 4.1.2.

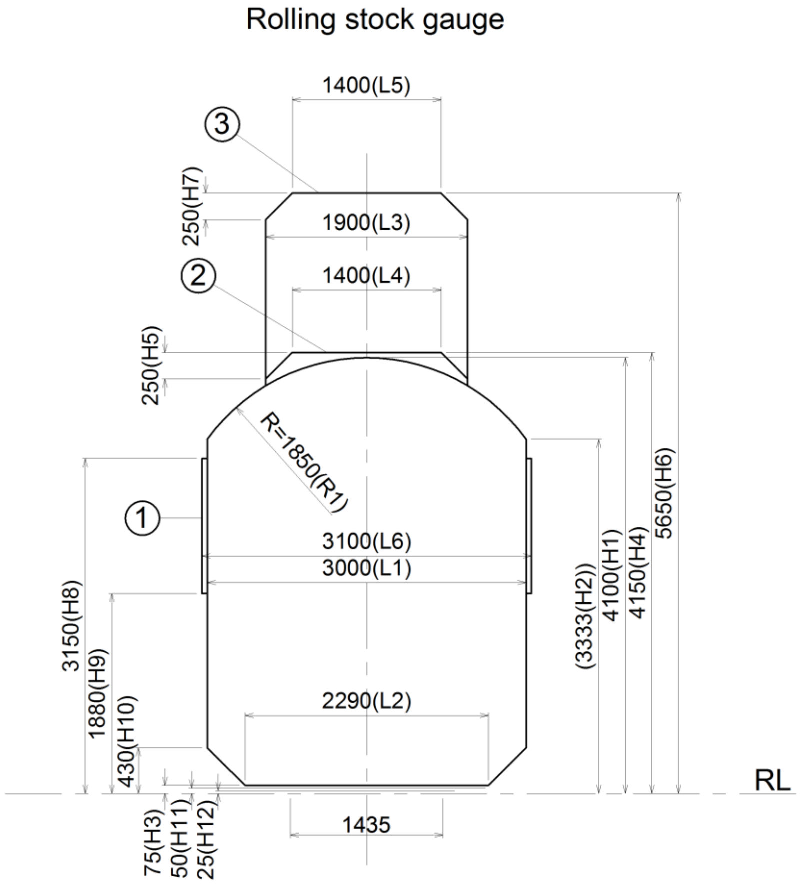
Structure Gauge



	Gauge
①	Basic Gauge
②	Gauge for track on which trains run receiving supply of direct current
③	Gauge for tunnels, bridge, overpass, along track on which trains run receiving supply of direct current.
④	Gauge for tunnel section in case of using rigid overhead wire or safe supporting system.
⑤	Gauge for platform edge. (The distance from structure gauge to rolling stock gauge shall be more than 50mm.)

Source: JICA Design Team

Figure 4.1.1 Structure gauge



		Gauge	
	——	Basic	H1,H2,H3,H10,L1,L2,R1
②	——	Gauge when current collector is folded.	H4,H5,L3,L4
③	——	Gauge in relation to top of roof when current collector is operated.	H6,H7,L3,L5
①	═══	Gauge in relation to signs,marker lamps, car side lamps.	H8,H9,L6
	——	Gauge in relation to parts that do not move vertically due to action of bogie spring.	H11,L2
	——	gauge in relation to sanding pipe,obstacle deflector, brake shoe and other parts that do not exceed the wheel rim width.	H12

Source: JICA Design Team

Figure 4.1.2 The rolling stock gauge

3) Proposed station

The station currently planned in this project is shown in the following table.

Table 4.1.2 The Station Proposed

No.	Station name	Platform type	Remarks
1	Solis	island platform serving two tracks	included in the NSCR project section
2	Blumentritt	two island platforms serving three tracks	transfer to/from LRT1
3	España	two side platforms with two tracks served	
4	Santa Mesa	two side platforms with two tracks served	transfer to/from LRT2
5	Paco	two island platforms serving four tracks	
6	Buendia	two side platforms with two tracks served	
7	EDSA	one platform with two tracks served	transfer to/from MRT3
8	Nichols	one platform with two tracks served	underground station
9	FTI	one platform with two tracks served	
10	Bicutan	two island platforms serving four tracks	possible connection to MMSP subject to discussions
11	Sucat	two side platforms with two tracks served	
12	Alabang	two island platforms serving four tracks	
13	Muntinlupa	two side platforms with two tracks served	
14	San Pedro	two side platforms with two tracks served	need to add two tracks for MMSP
15	Pacita	two side platforms with two tracks served	
16	Biñan	two side platforms with two tracks served	
17	Santa Rosa	two island platforms serving four tracks	
18	Cabuyao	two side platforms with two tracks served	
19	Gulod	two side platforms with two tracks served	need to add two tracks for MMSP
20	Mamatid	two side platforms with two tracks served	
21	Calamba	two island platforms serving four tracks	

Source: JICA Design Team

4.1.2 Site Condition

(1) Summary

The North South Railway Project – South (NSRP – South) alignment will run along the existing Philippines National Railway (PNR) right of way (ROW). The PNR ROW extends through highly dense urbanized areas to both north and south, with dense civil infrastructures and sprawling posing difficulties in the construction of railway commuter lines. These physical obstacles include rivers, highways, ramps, on-going infrastructure projects, at-grade cross roads, informal settlers and historical structures requiring conservation.

(2) Existing Crossing Roads

1) General

There are many existing crossing roads that are traversing NSRP-South alignment. These roads are used for existing live road of resident to keep traffic and community along NSRP-South, so essentially existing crossing roads should not be closed. Number of existing crossing roads are 141 as shown in Table 4.1.3. In case of structure of rail will be adopted viaduct, vertical clearance of each crossing roads and rail viaduct should be kept more than specified by DPWH criteria to design vertical alignment of NSRP-South Line. Location of existing crossing roads is shown in Figure 4.1.17 , Figure 4.1.18 and Figure 4.1.19.

Within the sections of viaduct, the existing road crossings will generally be unaffected as the viaduct will span over the road crossing. In case of embankment was adopted segment, within segments of railway embankment, provision for road crossings will need to be provided by means of underpass structures in order to maintain road access.

2) Design Concepts

The type of road crossing is selected with due consideration to existing topography, traffic demands, vehicles conflict and pedestrian safety.

Key issues addressed in this study of road crossings are follows:

a) Vertical clearance
b) Visibility
c) Signs and markings
d) Safety and provisions for pedestrians and non-motorized road users
e) Geometric implications of chosen design vehicle

Major and minor road crossings will be defined as:

- Major Road Crossing - a road crossing located at major road or streets with a minimum of four (4) lanes.
- Minor Road Crossing - a road crossing located at minor road or streets with a maximum of two (2) lanes.

Table 4.1.3 Summary of Existing Crossing Roads Along NSRP-South Line

No.	Location	Road Name	Traffic Volume		Road Width (m)	Ground Level (m)
			pcu/peak hour	pcu/day		
1	0+264	Hermosa Street				
2	0+932	Solis Street				
3	**1+470**	**Jose Abad Santos Street**	**2,957**	**42,519**	**27.80**	**5.939**
4	1+885	Tomas Mapua Street	732	11,489	10.50	8.652
5	1+980	Rizal Avenue	1,605	28,647	21.70	16.924
6	2+380	Old Antipolo Street	1,079	19,204	9.00	6.595
7	**2+720**	**Dimasalang Road**			**18.30**	**5.403**
8	2+920	Simoun Street	270	3,097	8.90	6.724
9	3+070	Maria Clara Street	513	9,048	6.83	6.864
10	3+233	Loan Laan Road	693	13,504	10.50	6.564
11	3+390	Dapitan Street	1,001	12,164	10.10	6.783

No.	Location	Road Name	Traffic Volume		Road Width (m)	Ground Level (m)
			pcu/peak hour	pcu/day		
12	3+550	Piy Margal Street	647	8,390	12.30	6.483
13	3+710	P.Florentino Street	782	8,688	10.00	7.232
14	**3+895**	**España Boulevard**	**3,392**	**73,380**	**27.10**	**6.820**
15	4+050	Loyola Street	515	10,398	10.10	7.000
16	4+210	J. Fajardo Street	1,016	14,088	9.90	7.008
17	4+690	Honradez Street	765	10,997	10.00	7.347
18	4+840	G Tuazon Street			10.00	8.512
19	**5+680**	**R.Magsaysay Boulevard**	**93**	**1,753**	**31.50**	**22.297**
20	6+160	Teresa Street	466	6,758	6.90	8.424
21	6+410	Maui Oasis Underpass			10.50	8.487
22	7+300	Beata Street	541	10,354	7.70	7.872
23	7+700	Paco-Sta.Mesa Road			7.00	6.922
24	7+950	Dr. M.L. Carreon Street	892	17,815	8.30	5.025
25	8+060	Paco-Sta.Mesa Road			7.00	3.041
26	8+150	Kahirum Ⅱ Street	152	1,668	3.38	5.545
27	9+060	Pedro Gil Street	1,752	33,922	16.00	6.762
28	9+800	San Andres / Diamante Street	857	11,231	13.00	7.336
29	10+570	Pablo Ocampo Sr. Street	1,128	19,430	10.40	6.625
30	10+612	Zobel Roxas Street	1,523	26,059	13.00	6.153
31	11+580	Malugay Street	1,285	12,149	17.80	8.265
32	**11+650**	**Sen. Gil Puyat Avenue**	**1,443**	**30,893**	**29.30**	**8.276**
33	11+870	Dela Rosa Street	1,013	15,604	10.70	7.298
34	**12+480**	**Antonio Arnaiz Avenue**	**1,286**	**27,303**	**20.00**	**8.436**
35	12+485	Skyway (Makati CBD)			7.00	24.436
36	12+955	Don Bosco Street	1,403	18,366	16.00	12.449
37	**13+740**	**EDSA Magallanes Interchange**			**33.70**	**11.249**
38	**15+850**	**Nichols Interchange**			**7.00**	**15.906**
39	**15+870**	**Nichols Interchange**	**1,680**	**29,513**	**28.20**	**15.588**
40	**17+420**	**C-5 Interchange**			**7.00**	**26.604**
41	**17+900**	**South Luzon Expressway**			**27.00**	**21.356**
42	**20+480**	**Gen. Santos Avenue**	**2,837**	**53,441**	**14.50**	**35.942**
43	21+102	Mañalac Avenue	729	13,400	9.40	31.115
44	23+094	llang llang Street			9.80	12.870
45	23+490	Our Lady of Miraculous Medal Street	205	2,614	7.20	10.985
46	24+750	Meralco Road	701	10,478	7.20	8.683
47	25+340	Concepcion Street	271	3,678	6.30	8.279
48	25+550	Espeleta Street	12	190	3.80	5.871
49	**28+193**	**Montillano Street**	**908**	**15,565**	**15.70**	**11.986**
50	28+293	T. Molina Street	49	789	5.30	14.661
51	29+200	Bautista Street	487	7,490	5.90	11.116
52	29+300	Falleda Road	8	113	3.50	10.050
53	29+930	Private Road	13	408	7.70	8.125
54	30+450	NIA Road	9	347	6.00	10.026
55	30+930	Bruger Street	407	5,887	6.50	9.655

No.	Location	Road Name	Traffic Volume		Road Width (m)	Ground Level (m)
			pcu/peak hour	pcu/day		
56	31+400	Quezon Street	128	2,114	6.40	12.934
57	31+500	Rizal Street	442	7,091	5.60	13.899
58	31+610	Upper Prinza Street	49	703	6.30	13.684
59	31+760	La Guerta Street	334	4,571	7.40	12.726
60	32+330	Sto. Niño / St. Andrew Street	255	4,047	9.54	9.629
61	32+920	E. Rodriguez Jr. Street	521	9,122	7.60	14.293
62	33+390	RMT Industrial Complex Road	214	3,458	11.20	13.000
63	33+630	unknown	15	313	6.20	11.591
64	33+930	A. Mabini Street	1,172	19,950	11.30	11.681
65	34+220	Quezon Street	64	768	5.20	11.893
66	**34+450**	**Maharlika Highway**				**18.000**
67	34+570	San Vicente Road	826	11,919	6.00	12.234
68	34+730	G. Garcia Street	520	8,108	6.50	11.106
69	35+280	Main Road	658	10,018	8.50	9.966
70	36+560	Pacita Avenue I	514	9,562	6.50	8.903
71	36+650	Pacita Avenuw II	1,132	20,102	8.70	10.366
72	37+510	Almasora Street			6.50	11.254
73	37+890	San Francisco Barangay Road	513	7,026	4.30	12.096
74	38+070	Chocolate Street / Halang Diversion	433	7,563	6.50	11.967
75	38+380	Golden City Subdivision Road	309	3,877	7.90	12.084
76	**39+090**	**Gen. Malvar Street**	**1,544**	**27,857**	**12.30**	**12.763**
77	39+300	San Vicente Road	515	6,434	5.00	13.238
78	39+380	Sto. Niño Road	45	520	4.00	13.458
79	39+760	Heaven Garden Memorial Park Road	23	174	9.10	11.920
80	39+940	Mamplasan Access Road	654	10,312	16.20	14.542
81	40+220	Mamplasan Access Road	946	11,718	18.10	13.827
82	40+870	G. Sigue Road	63	809	4.50	14.813
83	40+950	Mercado Street	87	1,040	4.10	14.100
84	41+600	Tagapo Access Road	141	1,902	4.70	13.018
85	**41+750**	**Manila South Road**			**18.00**	**20.971**
86	42+580	Leon Arcillas Road	888	11,728	6.00	13.935
87	42+750	Orient Drive Road	100	867	7.40	12.007
88	42+915	West Drive Road	63	892	5.00	12.695
89	43+380	Rizal Boulevard Road	1,102	17,297	6.20	15.276
90	43+650	East Drive Road	17	199	5.30	11.486
91	43+920	Villa Mercedes Road	48	744	6.00	10.841
92	44+185	Capt. Perlas Road	262	2,413	5.60	9.075
93	44+800	Flood Gate Road	66	394	4.60	7.049
94	45+500	Mabuhay Homes Road	10	276	4.00	8.742
95	46+650	Bigaa Road	497	6,240	4.90	10.914
96	46+850	Felix Limcaoco Street	8	145	4.40	10.367
97	47+325	Sergio Osmena Street	937	14,382	5.70	10.676
98	47+590	unknown			6.00	11.078
99	47+830	unknown			6.50	13.020

No.	Location	Road Name	Traffic Volume		Road Width (m)	Ground Level (m)
			pcu/peak hour	pcu/day		
100	48+760	unknown			5.00	15.578
101	49+480	Katapatan Road	874	10,611	7.80	16.300
102	51+310	San Isidro Road	582	8,342	4.50	16.637
103	52+528	Mamatid Road	882	13,261	6.70	19.269
104	53+030	unknown	352	4,178	4.80	20.687
105	54+720	NIA Road	36	455	4.00	12.630
106	55+045	Parian Road	937	12,657	8.00	17.147
107	55+480	J.P. Rizal Street	723	14,811	7.70	18.855
108	55+850	Sampaguita Street			6.20	19.265
109	56+270	Manila South Road			16.50	20.823
110	56+620	Halang Road			7.50	20.538
111	56+900	Chipeco Avenue Extension			13.50	17.735
112	57+675	Ipil-ipil Street			12.50	14.655
113	58+070	Narra Street			7.50	14.211
114	58+320	Bucal Bypass Road			17.50	11.278
115	**58+600**	**Manila South Road**			**13.50**	**8.884**
116	58+800	unknown			3.50	10.106
117	59+050	unknown			9.70	10.950
118	59+350	unknown			7.50	11.571
119	59+650	unknown			4.50	10.797
120	59+800	S. Barretto Street			6.50	9.130
121	60+125	Resurreccion Road			7.20	9.291
122	61+810	unknown			7.50	6.279
123	62+000	Bagong Kalsada Road			6.50	9.439
124	62+675	Subdivision Road			8.00	6.979
125	63+700	unknown			5.50	8.548
126	64+125	unknown			3.00	12.532
127	64+450	Rizal Overpass Road			7.50	24.771
128	64+590	Burgos Street			3.50	13.880
129	64+635	M. Aquino Street			4.00	12.729
130	64+660	Depasupil Street			5.00	12.526
131	64+730	Lopez Jaena Street			5.00	13.259
132	64+850	Rizal Street			8.00	13.772
133	66+070	Makiling Street			5.00	12.472
134	66+620	J.Aquino Road			6.50	15.133
135	67+230	unknown			6.50	14.536
136	**67+440**	**Manila South Road**			**12.00**	**15.809**
137	67+700	Daang Kalabaw Road			4.50	16.680
138	68+530	Maahas Road			7.50	18.706
139	68+810	Pili Drive			14.00	16.964
140	70+240	IBP Road			5.50	17.525
141	70+660	unknown			5.50	20.592

Note: Boldface is Major Roads

Source: JICA Design Team

(3) Major Critical Points

JDT identified 10 critical points along the proposed NSRP – South alignment. The critical points are mostly due to existing infrastructures, such as highways, railway stations, ramps and on-going infrastructure projects. Table 4.1.4 lists the locations and type of complications at the critical points. Figure 4.1.3 shows aerial photos of each critical point.

Table 4.1.4 Critical Points along NSRP-South

	Critical Point	Issues	Location
1	Connector Road and Skyway Stage 3	Overlap of superstructure and substructure with PNR/ NSRP ROW	All along Connector Road Santa Mesa / Pasig Bridge Pandacan section
2	NSCR – NSRP South Junction	Physical connection of both lines	Solis Station
3	NSRP – LRT1 Intersection	Conflict with Blummentritt station and connector road ROW	LRT1 Blummentritt station
4	NSRP South – LRT2 – Magsaysay Bridge Intersection	Existing Magsaysay bridge and LRT2 Viaduct conflict with NSRP South vertical clearance	Santa Mesa
5	Pasig River Bridge	Conflict between: PNR Pasig Bridge, J. Jacinto Road, Mayniland Water Pipes and NGCP power lines, and Skyway Stage 3	Pasig River at Santa Mesa
6	Paco Pandacan Road Flyovers	Limited vertical and horizontal clearance imposed by flyovers	Pandacan
7	A. Arnaiz Flyovers	Limited vertical clearance below flyovers	Skyway Makati entrance
8	PNR EDSA station	Limited vertical clearance imposed by pedestrian bridge	PNR EDSA station
9	PNR Nichols station	Limited vertical clearance imposed by ramps Road crossing	PNR Nichols station
10	PNR FTI station	Limited vertical clearance imposed by Skyway C6 Interchange pier locations and vertical clearance	FTI

Source: JICA Design Team

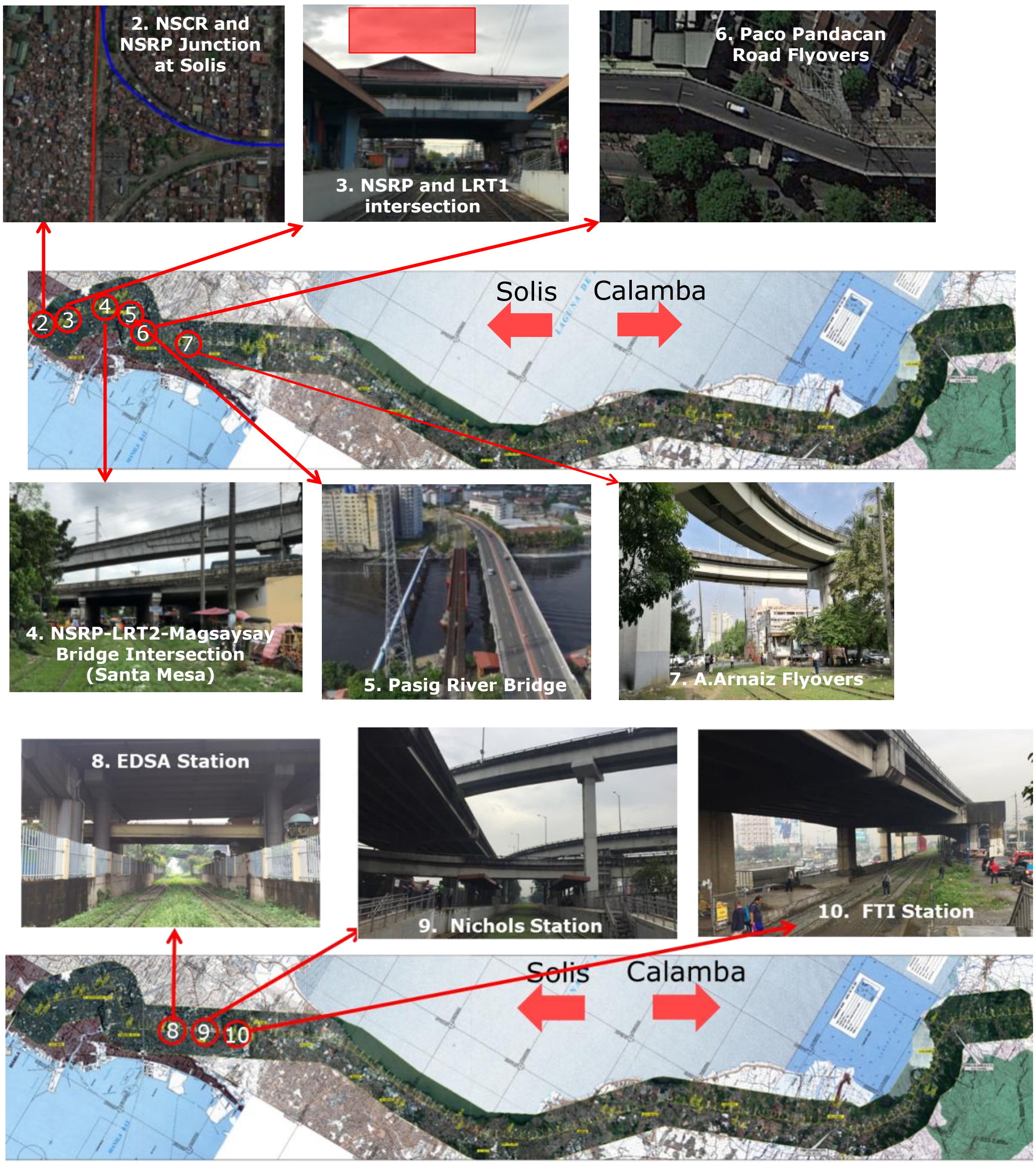


Figure 4.1.3 Location and aerial photos of each critical points (2 ~ 10)

(4) Historical structures

In the ROW of NSCR-South there are old PNR station buildings, existing bridges and crossroad bridges. Some of these structures are regarded as the historical buildings in the Philippines, built over 50 years ago.

The JDT survey results of the historic structures that are thought to affect the NSCR-south routing planning are shown in the table below. Currently, based on the results of this survey, it is confirming PNR's target structure and conservation policy.

4.1.3 Alignment

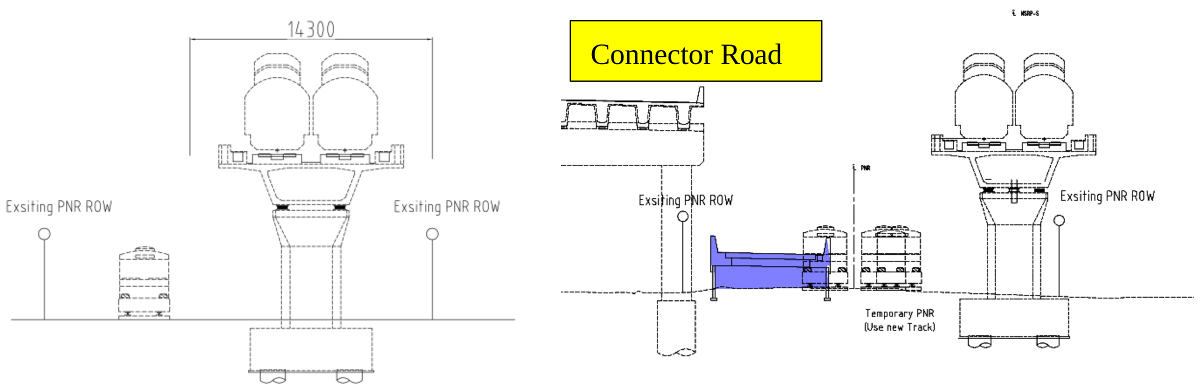
(1) Basic Policy

The NSRP-South alignment is designed considering the follows.

- Place alignment within the existing PNR ROW as much as possible.
- Place alignment of NSRP-South at east side at Pasig river and from EDSA to Sucat.
- Place alignment of NSRP-South at west side from Sucut to Calamba
- Consider the critical points
- Secure the space of PNR temporary track alignment for single track operation.
- Vertical alignment of NSRP-South is designed considering future traffic volume of crossing roads, flood risk, etc.

1) Place alignment within the existing PNR ROW as much as possible

The NSRP-South alignment is designed within the existing PNR ROW as much as possible. However, the NLEX-SLEX Connector Road running between Solis and Pasig River, also occupies significant – portions of PNR ROW. To avoid critical interference, the NSRP-South alignment is largely diverted from PNR ROW, which results in requirement of the additional land acquisition (shown in Figure 4.1.4).

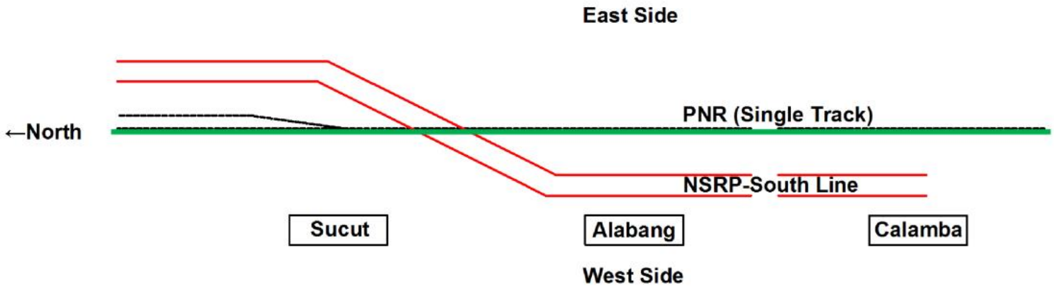


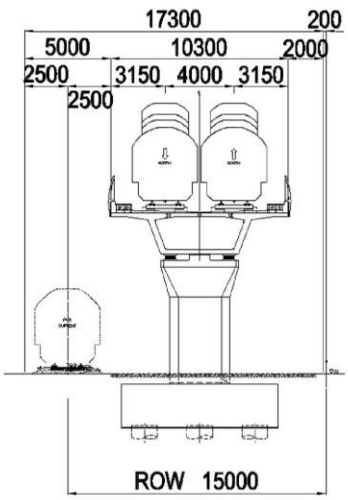
Source: JICA Design Team

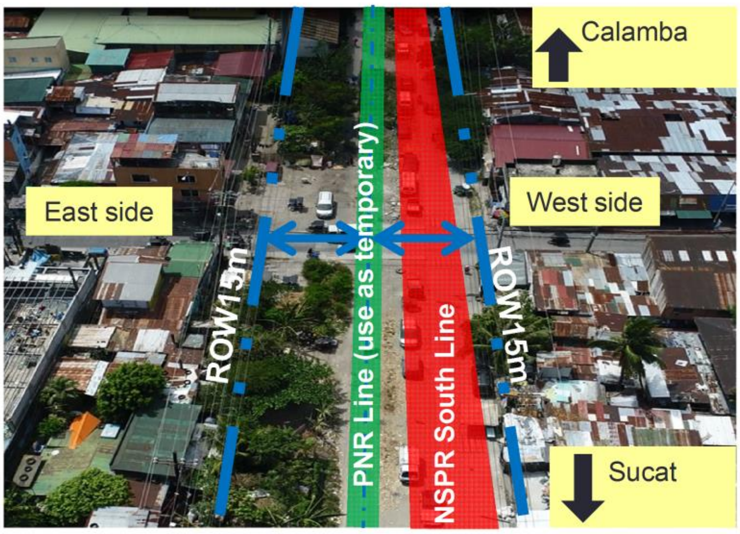
Figure 4.1.4 Horizontal Alignment of the NSRP South

2) Place alignment of NSRP-South at west side from Sucat to Calamba

Considering the request from DOTR that it is desirable that the location of station from Sucat to Calamaba be the west side where development is expected to progress in the future (shown in Figure 4.1.5).







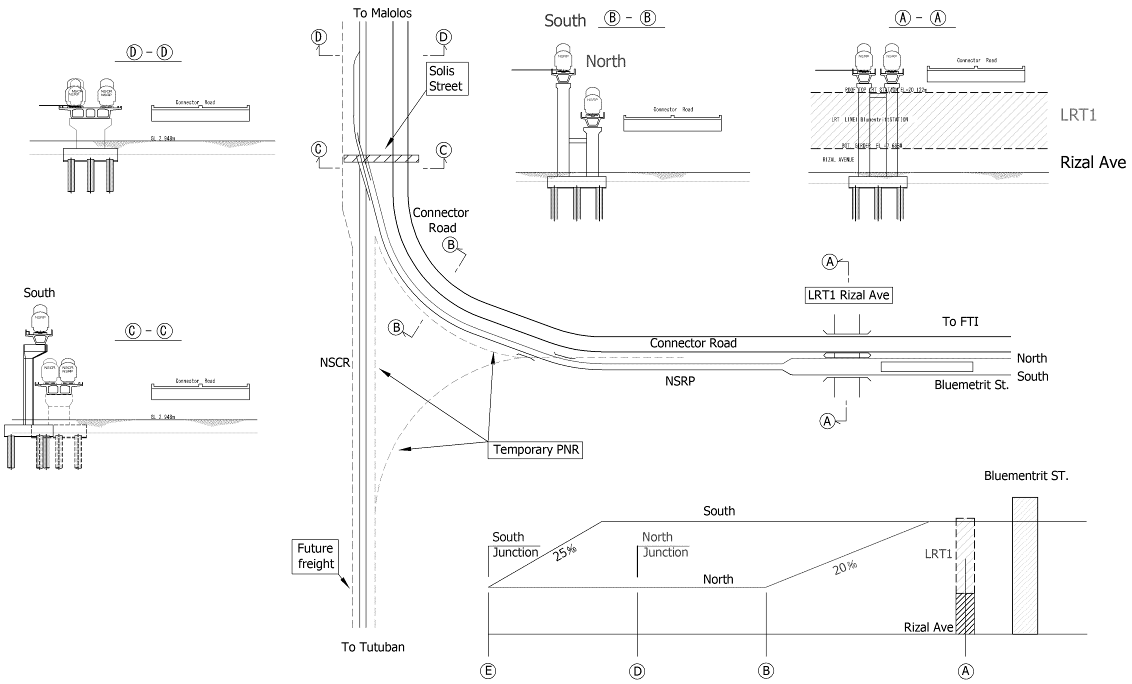
Source: JICA Design Team

Figure 4.1.5 Horizontal Alignment of the NSRP South from Sucat to Calamba

3) Consider the critical points

a) Solis - Blumentritt

Southbound NSRP- South branches from the NSCR at the south of Solis Station. To overpass the NSCR main line, this alignment needs to be elevated at its maximum allowable gradient in single track structure. The north bound also branches from NSCR and raises its vertical alignment so that it can connect to double-tracked elevated structure before Blumentritt station. This configuration mandates application of a small curve with radius of 280 m within short transition. The speed limit in this transition will be very low at 45 km/h. Blumentritt station adopts an elevated structure over LRT1. See Figure 4.1.6.



Source: JICA Design Team

Figure 4.1.6 Solis-Blumentritt Alignment Summary Figure

b) Blumentritt - España

The alignment considers space for PNR temporary track along the Connector Road. The speed limit will be 75km/h, because the curvature radius becomes as small as 300m in order to avoid deviation from PNR ROW. Near Blumentritt station, additional 15m width of the land acquisition is necessary.

c) España - Santa Mesa

Nearby ＋5km500m on the north bound is a church, which makes the Connector Road encroach within PNR ROW. Thereby, NSRP South alignment deviates greatly from PNR ROW about 15-25m. Moreover, LRT2 viaduct and Magsaysay Bridge are located adjacent to Santa Mesa Station. - In case, Magsaysay Bridge is to be in place, the vertical alignment in this section needs to be elevated, to avoid substantial its essential re-configuration.

d) Santa Mesa - Paco

Near +6 km500 m are a junction of the Connector Road and Skyway Stage 3, and many bridge piers within PNR ROW. The junction of both superstructures is planned to be supported by a portal pier which encroaches the current PNR alignment. NSRP-South may needs to deviate from PNR ROW greatly in this section. In order to reduce additional land acquisition, non-straight alignment is inevitable, which enforces the speed limit about 45km/h.

Further south near ＋8km000m the Paco Pandacan Roads and Skyway Stage 3 overpass the PNR tracks. In order to avoid extremely higher crossing at this point, the vertical alignment of the NSRP

South is lowered from Santa Mesa Station, to be at grade level. After passing this crossing, the alignment is raised again, to reach Paco Station is elevated. Additionally, PNR informed JDT that their Head Office is to be relocated to Paco Station. Further discussions on this topic are ongoing.

e) Paco - Buendia

At Around ＋9km000m, a ramp of the Skyway Stage 3 and buildings near Buendia station adjacent to the alignment are carefully taken into account.

f) Buendia - Pasay Road

Skyway ramps near PNR Pasay Road station (＋12km500m) and road crossing at grade are a critical point. The ramps overpass the PNR tracks securing an ample vertical clearance of about 13m. At this section, NSRP-South viaduct will adopt a U-type through girder to secure the vertical clearance in between the ramps and roads below. However, right after this, the alignment needs to be adjusted towards Pasay Road station and the traveling speed may be restricted to 45km/h and 80km/h near the station. Also, attention should be drawn to the nearby buildings close to Pasay Road in the designing.

g) Pasay Road - EDSA

NSRP-South line connects MRT3 line at EDSA station as the transfer station. Also, there is a road junction supported by a number of piers. To avoid extremely higher overpass, it is desirably to adopt at-grade alignment at this crossing. To avoid interference with the piers, the new station is shifted north from the present PNR EDSA station. This section may limit the travelling speed to 45 km/h.

h) EDSA - Nichols

Before Nicholls Station at +15km500 m, Skyway changes its direction eastward overpassing PNR tracks. In addition, around Nichols Station is a complex junction with ramps and bridges supported by many piers. In order to avoid a long span and high elevated structure, this section is planned at grade. Nichols Station is also constrained between Skyway and adjacent roads to approximately 25m width. To secure the required width for the platform width, further studies are in progress.

i) Nichols - FTI

A road ramp near ＋17km500m is supported by bridge piers at a narrow interval. Without detailed survey data available in hand yet, details to provide the alignment for NSRP-South and space for PNR temporary line will be studied, once the on-going survey data become available. Further, there is a plan to build the C6 junction at FTI station ＋18km000m without consideration of NSRP-South. Discussions and coordination with the relevant authorities, such as DPWH, LGUs will be required. Moreover, the ITX bus terminal is planned on the east side of FTI station, and MMSP station is also planned on the north area of the NSRP-South alignment. It is therefore necessary to consider access to these facilities during examination.

j) FTI - Bicutan

On account of the demand at Bicutan, a station with two side platforms serving four tracks was adopted. The alignment will be located on government owned land east of the station. Land acquisition is not possible on the west side of the station because of the existing Skyway ramp. The vertical alignment adopts the elevated section to secure the above General Santos Ave. located on the south side of the station. In this section, the ground gradually increases, and it is necessary to consider based on the survey result.

k) Bicutan - Sucat

The section from +21km500m to +21km500m is planned to at-grade as there are no crossroads on the alignment. The remaining section is elevated. Sucat station is not located at the current PNR station location, but it is located at the site of the thermal power plant on Laguna De Bay side. Therefore, in the section from +23km800m to +24km500m, +25km000m to +25km300m, land acquisition is newly necessary.

l) Sucat - Alabang

In the alignment avoiding the meandering river on the south of Sucat, the speed limit will be 85 km/h. The track position south of Sucat, Laguna de Bay is located on the east side of PNR, and there are more passengers from the west side area. Therefore, NSRP-South is located on the west side, PNR temporary line on the east side. The vertical alignment is viaduct. Alabang station interferes with parking lot of shopping mall in northwest.

m) Alabang - Muntinlupa

In this section there are no particular issues as there is enough land for the ROW.

n) Muntinlupa - San Pedro

In this section there are no particular issues as there is enough land for the ROW.

o) San Pedro - Pacita

There is the historical heritage on the south side of San Pedro station. The alignment avoids this building and the overpass viaduct is 80 m span. Also, in order to avoid interference between the PNR temporary line and the historical heritage, the temporary line and the station are arranged in the curved section.

p) Pacita - Binan

In this section there are no particular issues as there is enough land for the ROW.

q) Binan - Santa Rosa

In this section there are no particular issues as there is enough land for the ROW.

r) Santa Rosa - Cabuyao

In this section there are no particular issues as there is enough land for the ROW. The unknown cross roads with a small traffic volume shall be closed and the vertical alignment around +44km 600m to +45km 800m shall be at-grade.

s) Cabuyao - Gulod

In this section there are no particular issues as there is enough land for the ROW. The unknown cross roads with a small traffic volume shall be closed and the vertical alignment around +48km to +48km 800m shall be at-grade.

t) Gulod - Mamatid

In this section there are no particular issues as there is enough land for the ROW.

u) Mamatid - Calamba

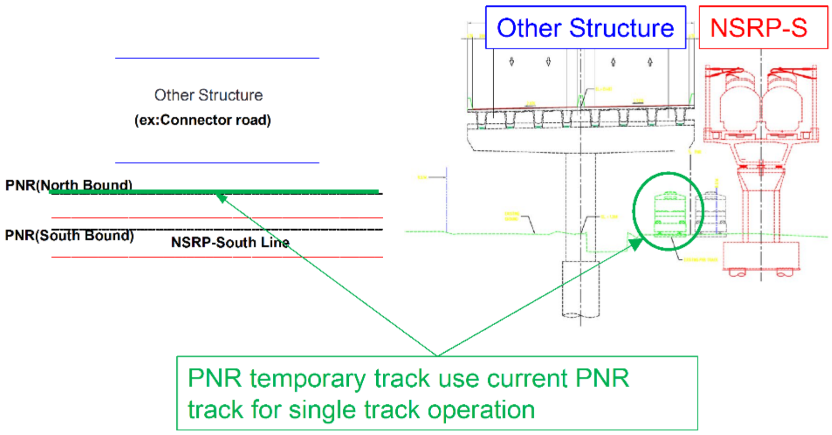
South Depot is planned in this section, and access track from depot is connected to Calamba station. There are two truss bridges in this section, and the PNR temporary line plan to pass through these bridges. Moreover, Calamba station is planned to have a station with 2 platforms serving 4 tracks with departures possible from all tracks.

4) Secure the space of PNR temporary track alignment (single track)

Concept of PNR temporary track arrangement is follow.

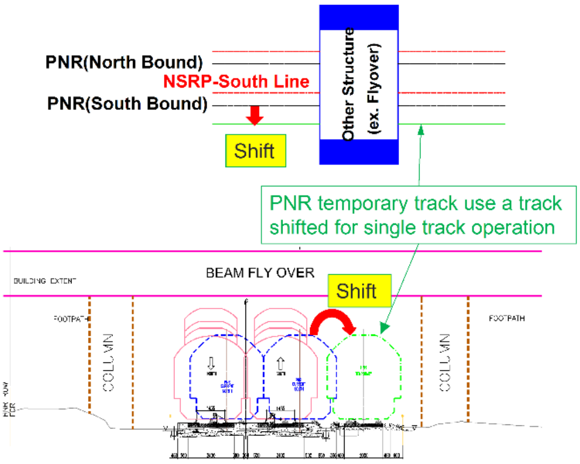
a) In the double track section (North side from Sucat)

- Use either of north or south bound track as much as possible (shown in Figure 4.1.7)
- Shift current PNR track for secure the space of NSRP-South (shown in Figure 4.1.8)



Source: JICA Design Team

Figure 4.1.7 Use current PNR track as much as possible

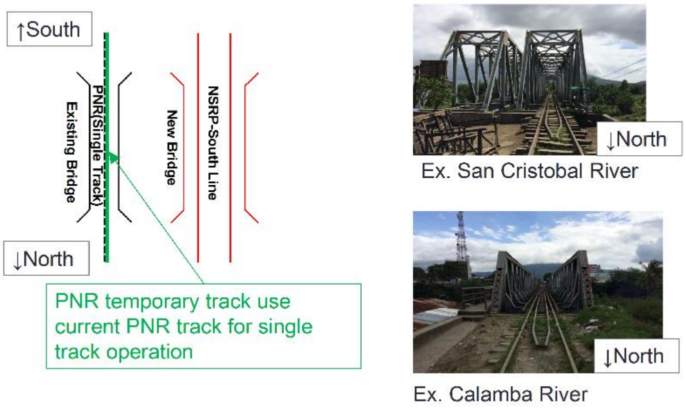


Source: JICA Design Team

Figure 4.1.8 Shift current PNR track

b) In the double track section (South side from Sucut)

- Use current track/bridges/girders as much as possible(shown in Figure 4.1.9)



Source: JICA Design Team

Figure 4.1.9 Use current PNR track as much as possible

(2) Typical Section

Figure 4.1.10 and Figure 4.1.11 show the relationship between the location of NSRP-South Line and PNR Temporary Line (hereafter referred to as positional relationship). Based on this positional relationship, the structural planning is carried out.

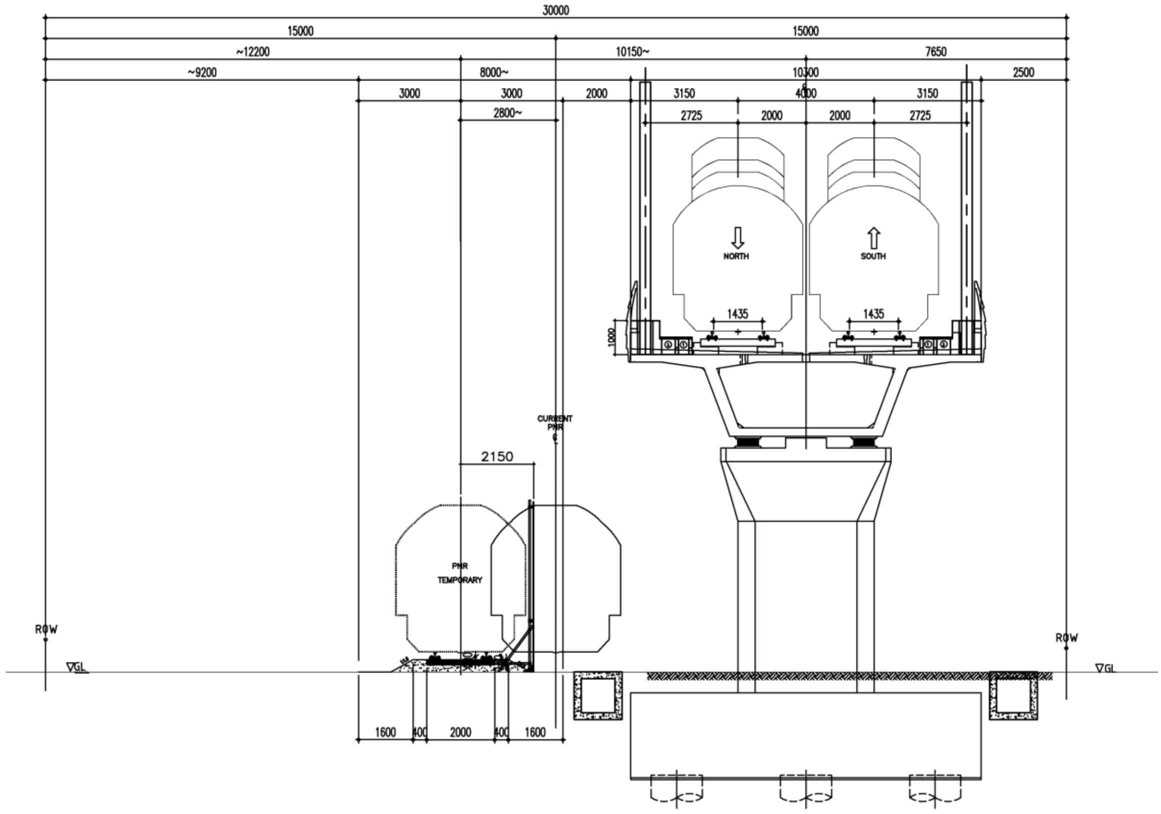


Figure 4.1.10 Positional Relationship between NSRP-South Line and PNR Temporary Line: Viaduct Section

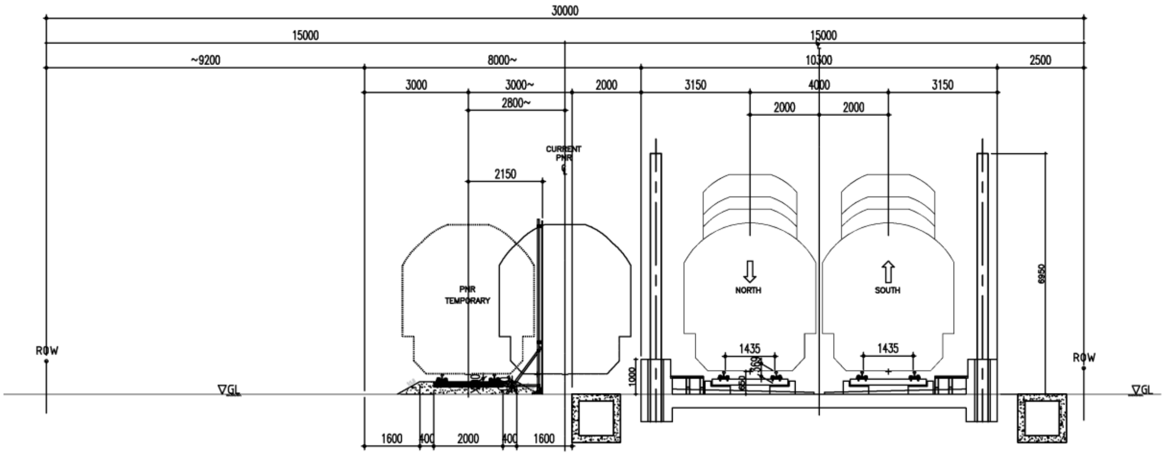


Figure 4.1.11 Positional Relationship between NSRP-South Line and PNR Temporary Line: At-Grade Section

(3) Active Faults

NSRP-South is planned near or across Marikina valley faults (West valley faults) according to the hazard map which is provided by the Philippines Institute of Volcanology and Seismology (PHIVOLCS). These are active faults and their location is shown in Figure 4.1.12 to Figure 4.1.15. In the past 200 to 400 year cycle, magnitude 7 earthquakes have had their epicenter located in this fault. This fault is a right-lateral strike-slip fault, the angle of the fault is estimated to be approximately 70 degrees, and the lateral deviation amount by the earthquake is estimated to be approximately 2 m. On the other hand, the displacement of this fault is not only due to the occurrence of the earthquake. Fault creep which is shifted with time has also occurred. The amount of creep obtained from past survey indicates a maximum vertical displacement of 20 to 30 mm per year.

Figure 4.1.12 Active Faults Location

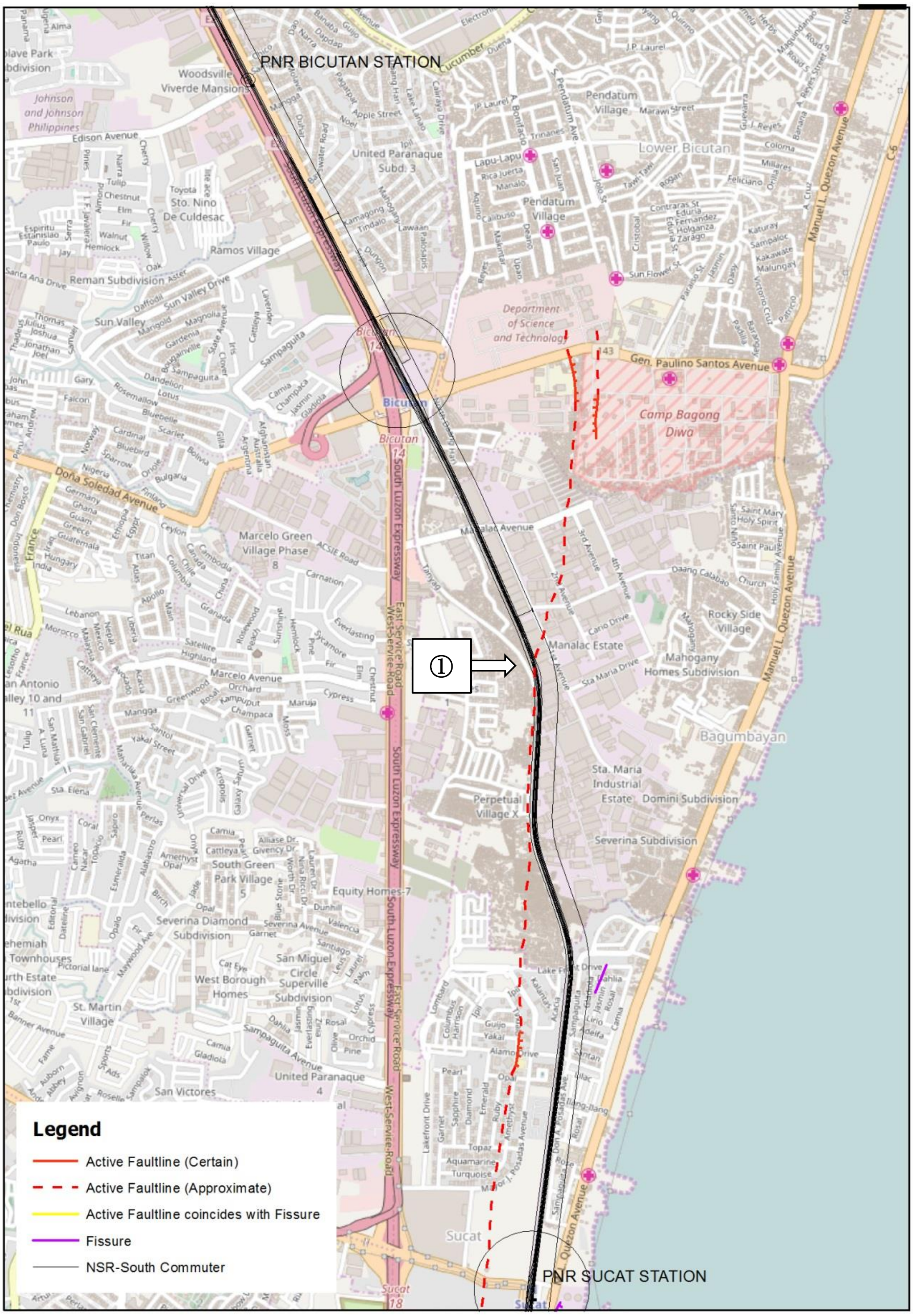


Figure 4.1.13 Detail of Active Faults Location (1/3)

Figure 4.1.14 Detail of Active Faults Location (2/3)

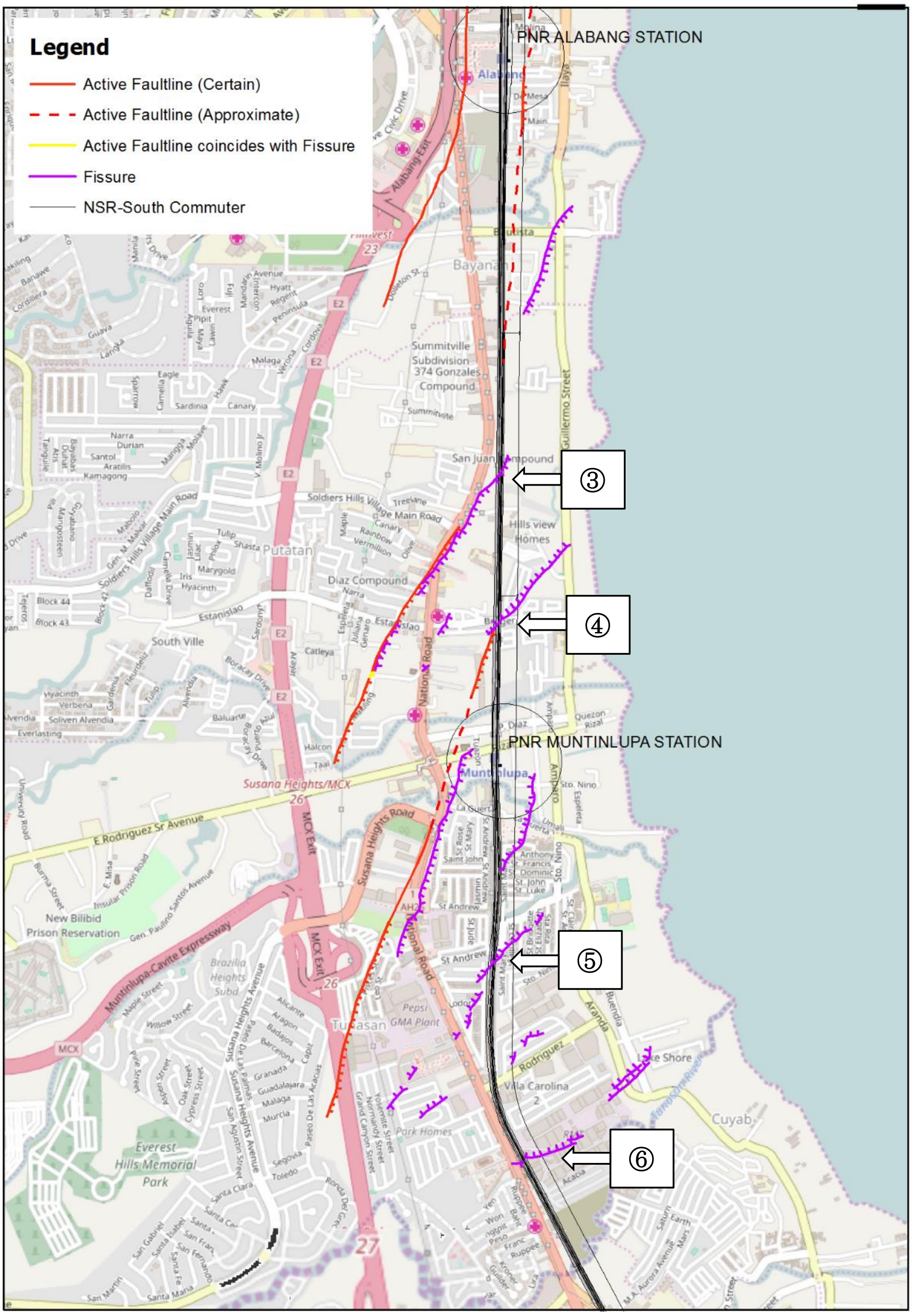


Figure 4.1.15 Detail of Active Faults Location (3/3)

As shown in Figure 4.1.13, No.1 active fault intersects with NSRP-South. The creep faults of No. 2 to 6 intersect with NSRP-South.

(4) Study of vertical alignment

JDT determines the vertical alignment of NSRP-South in consideration of "traffic volume of crossing road", "flood risk", "critical point by surrounding structures" and "effect of active fault".

1) Future traffic volume (in 2025)

At the bottleneck railway crossing for transportation, the elevated structure is applied. The bottleneck railway crossing frequently occur congestion due to heavy traffic volume. The definition of a bottleneck railway crossing for transportation is more than 10,000 PCU / day. This definition was referred to "Promoting improvement of railway crossing" of the Ministry of Land, Infrastructure and Transport of Japan.

The railway crossing with small traffic volumes and detours is closed. At-grade is applied. Or else, considering convenience, we applied an all elevated structure.

2) Flood risk (From 100 year flood hazard map by NOAH)

The rail level in the at-grade section set above the flood height. However, at the railway crossing, it is necessary to change the slope of the crossing road and to match the difference in elevation with the PNR temporary line. In that case, the influence on the surrounding structure is very large, and construction is difficult. Therefore, the elevated structure is applied.

The rail level of the elevated section is determined in consideration of the structure gauge of the crossing road. The structure gauge of crossing road is considered to raise the road surface above the flood height in the future.

3) Critical points with surrounding structures

On critical points with flyover roads, LRT, SKYWAY etc., apply the elevated structure. However, in the section where the upper part is limited or the elevated structure is unrealistic, we apply at-grade. Furthermore, in the section where at-grade cannot be applied, the underground structure is applied.

4) Active fault section

JDT recommends the elevated plan in order to reduce direct damage to the tracks caused by level 2 earthquake ground motion as much as possible (the at-grade plan is directly damaged by fault displacement).

The comparison table for vertical alignment is shown in Table 4.1.5. The economic loss of each option is shown in the table. As the result of comparison, option 3 is applied.

Table 4.1.5 Comparison table of Vertical Alignment Options of NSRP South

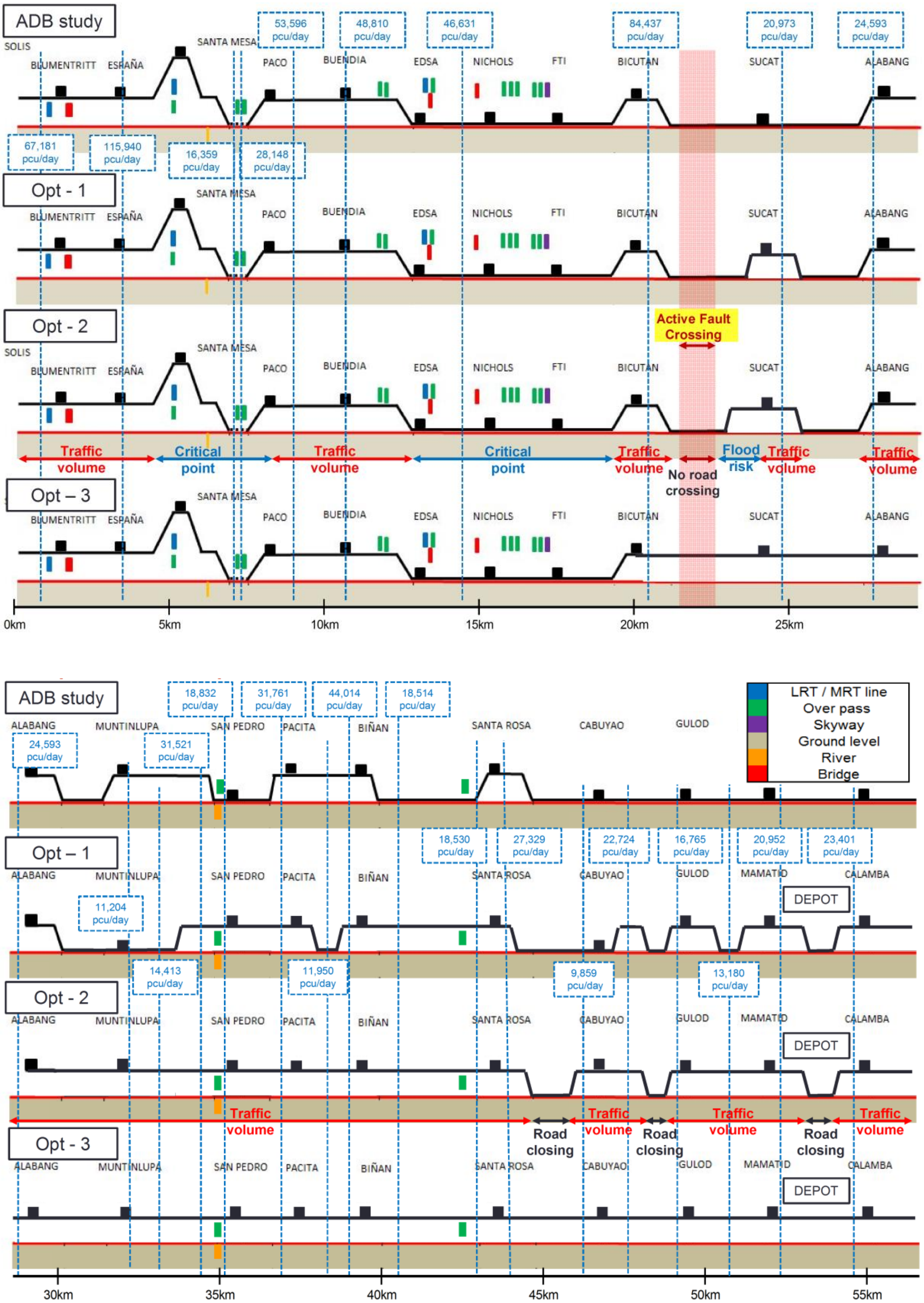
Criteria	ADB study	Option-1	Option-2	Option-3
Primary policy perspective	Primary policy follow CPCS study	Current traffic volume	Future traffic volume Flood risk	All elevated plan
Current Traffic volume	C	A	A	A
Future Traffic volume (2025)	C	C	B	A
Flood risk	C	C	A	A
Critical points	C	A	A	A
Restorability for active fault	B	B	B	B
Cost evaluation				
Construction cost *				
Elevated – Unit plice – 1,100 M php/km	25.0 km 27,500 M php	32.4 km 35,640 M php	42.2 km 46,420 M php	48.0 km 52,800 M php
At grade – Unit plice – 100 M php/km	30.7 km 3,070 M php	23.3 km 2,330 M php	11.2 km 1,120 M php	5.4 km 540 M php
At grade – Number – Railway crossing	Non	14 points	0 points	0 points
At grade – Number – Road closed	41 points	11 points	3 points	1 points
Underground – Unit plice – 2,600 M php/km	0.0 km 0 M php	0.0 km 0 M php	2.3 km 5,980 M php	2.3 km 5,980 M php
Station	32,400 M php	33,000 M php	33,300 M php	33,300 M php
Total (A)	55.7 km 62,970 M php (100%)	55.7 km 70,970 M php (113%)	55.7 km 86,820 M php (138%)	55.7 km 92,620 M php (147%)
Economical loss per year (Initial Calculation)				
In 2035 – VOC	753,731 M php	749,187 M php	748,319 M php	748,319 M php
In 2035 – TTC	591,564 M php	585,273 M php	583,138 M php	583,138 M php
Total (B)	1,345,295 M php Difference from "ADB study" (100%)	1,334,460 M php -10,835 M php (99.2%)	1,331,457 M php -13,838 M php (99.0%)	1,331,457 M php -13,838 M php (99.0%)

* E&M Cost not included

VOC : Vehicle Operating Cost
TTC : Travel Time Cost

Source: JICA Design Team

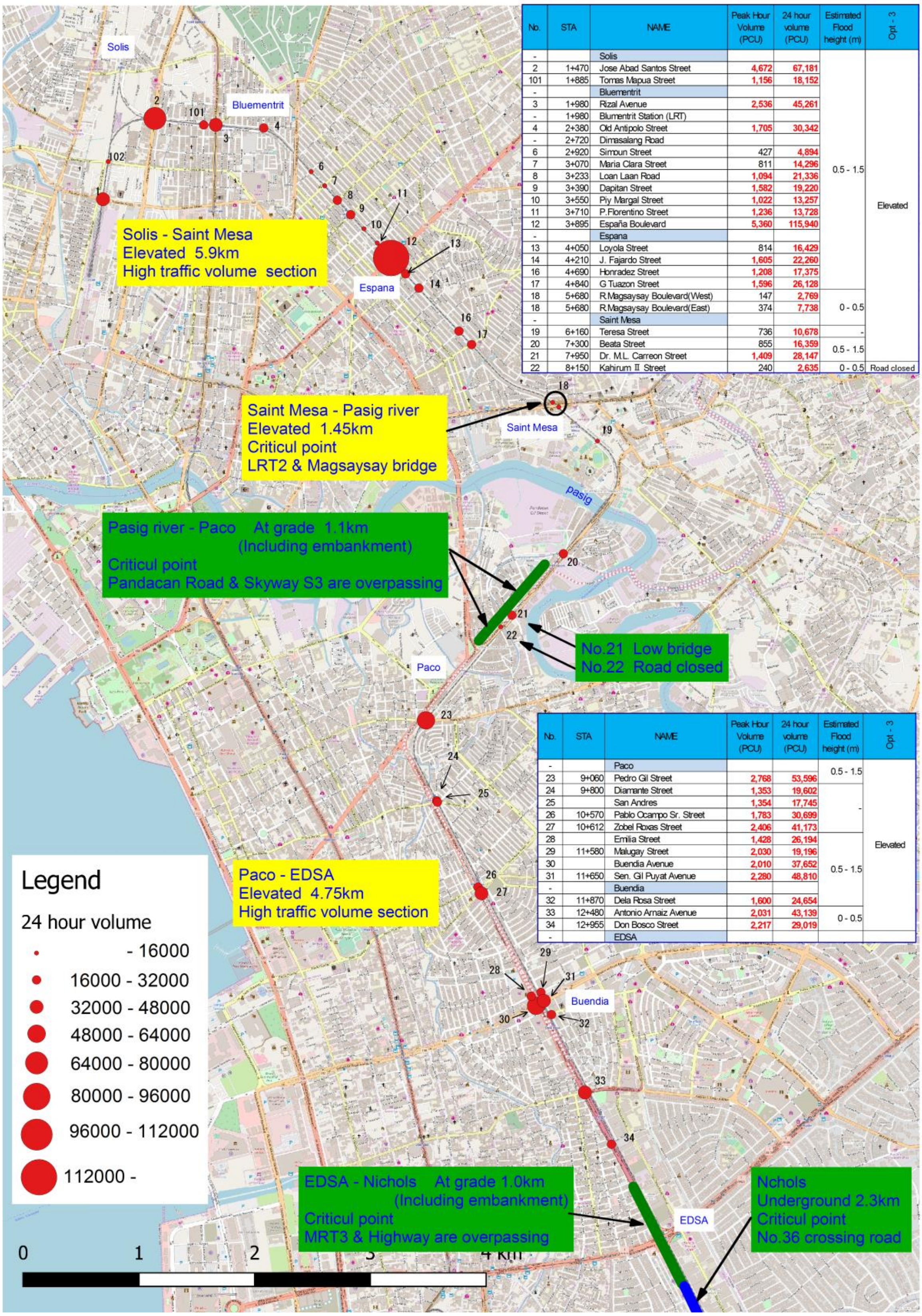
The schematic vertical alignment of each option is shown in Figure 4.1.16.



Source: JICA Design Team

Figure 4.1.16 Schematic of Vertical Alignment Options of NSRP South

Option-3 description Plan view for NSRP-South Line is shown in Figure 4.1.17 to Figure 4.1.19.

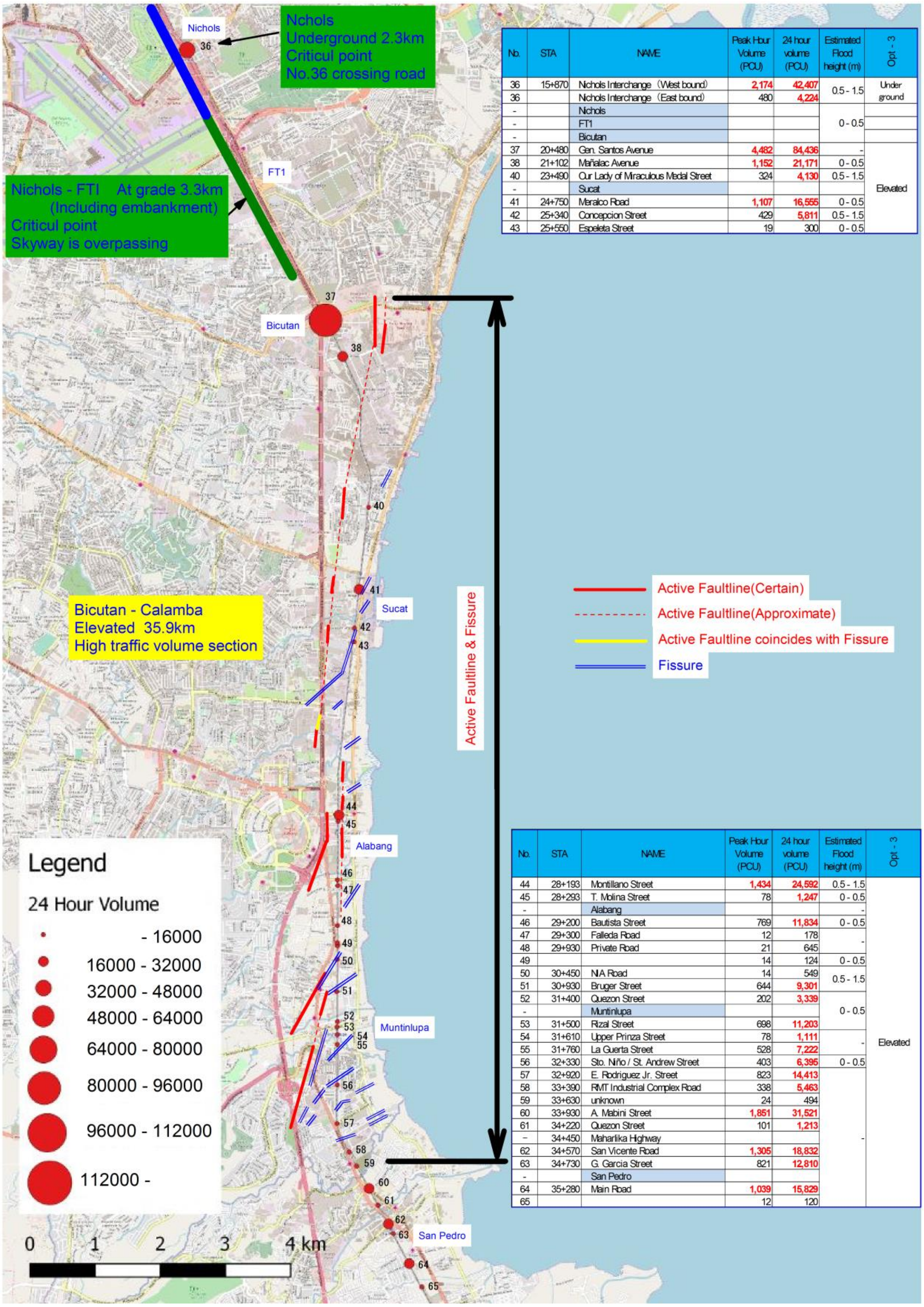


No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
-		Solis			0.5 - 1.5	Elevated
2	1+470	Jose Abad Santos Street	4,672	67,181		
101	1+885	Tomas Mapua Street	1,156	18,152		
-		Bluementrit				
3	1+980	Rizal Avenue	2,536	45,261		
-	1+980	Blumentrit Station (LRT)				
4	2+380	Old Antipolo Street	1,705	30,342		
-	2+720	Dimasalang Road				
6	2+920	Simoun Street	427	4,894		
7	3+070	Maria Clara Street	811	14,296		
8	3+233	Loan Laan Road	1,094	21,336		
9	3+390	Dapitan Street	1,582	19,220		
10	3+550	Piy Margal Street	1,022	13,257		
11	3+710	P.Florentino Street	1,236	13,728		
12	3+895	España Boulevard	5,360	115,940		
-		Espana				
13	4+050	Loyola Street	814	16,429		
14	4+210	J. Fajardo Street	1,605	22,260		
16	4+690	Honradez Street	1,208	17,375		
17	4+840	G Tuazon Street	1,596	26,128		
18	5+680	R.Magsaysay Boulevard(West)	147	2,769	0 - 0.5	
18	5+680	R.Magsaysay Boulevard(East)	374	7,738		
-		Saint Mesa				
19	6+160	Teresa Street	736	10,678	-	
20	7+300	Beata Street	855	16,359	0.5 - 1.5	
21	7+950	Dr. M.L. Carreon Street	1,409	28,147		
22	8+150	Kahirum II Street	240	2,635	0 - 0.5	Road closed

No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
-		Paco			0.5 - 1.5	Elevated
23	9+060	Pedro Gil Street	2,768	53,596		
24	9+800	Diamante Street	1,353	19,602	-	
25		San Andres	1,354	17,745		
26	10+570	Pablo Ocampo Sr. Street	1,783	30,699		
27	10+612	Zobel Roxas Street	2,406	41,173		
28		Emilia Street	1,428	26,194	0.5 - 1.5	
29	11+580	Malugay Street	2,030	19,196		
30		Buendia Avenue	2,010	37,652		
31	11+650	Sen. Gil Puyat Avenue	2,280	48,810		
-		Buendia				
32	11+870	Dela Rosa Street	1,600	24,654		
33	12+480	Antonio Arnaiz Avenue	2,031	43,139	0 - 0.5	
34	12+955	Don Bosco Street	2,217	29,019		
-		EDSA				

Source: JICA Design Team

Figure 4.1.17 Option-3 description Plan view for NSRP-South Line (1/3)

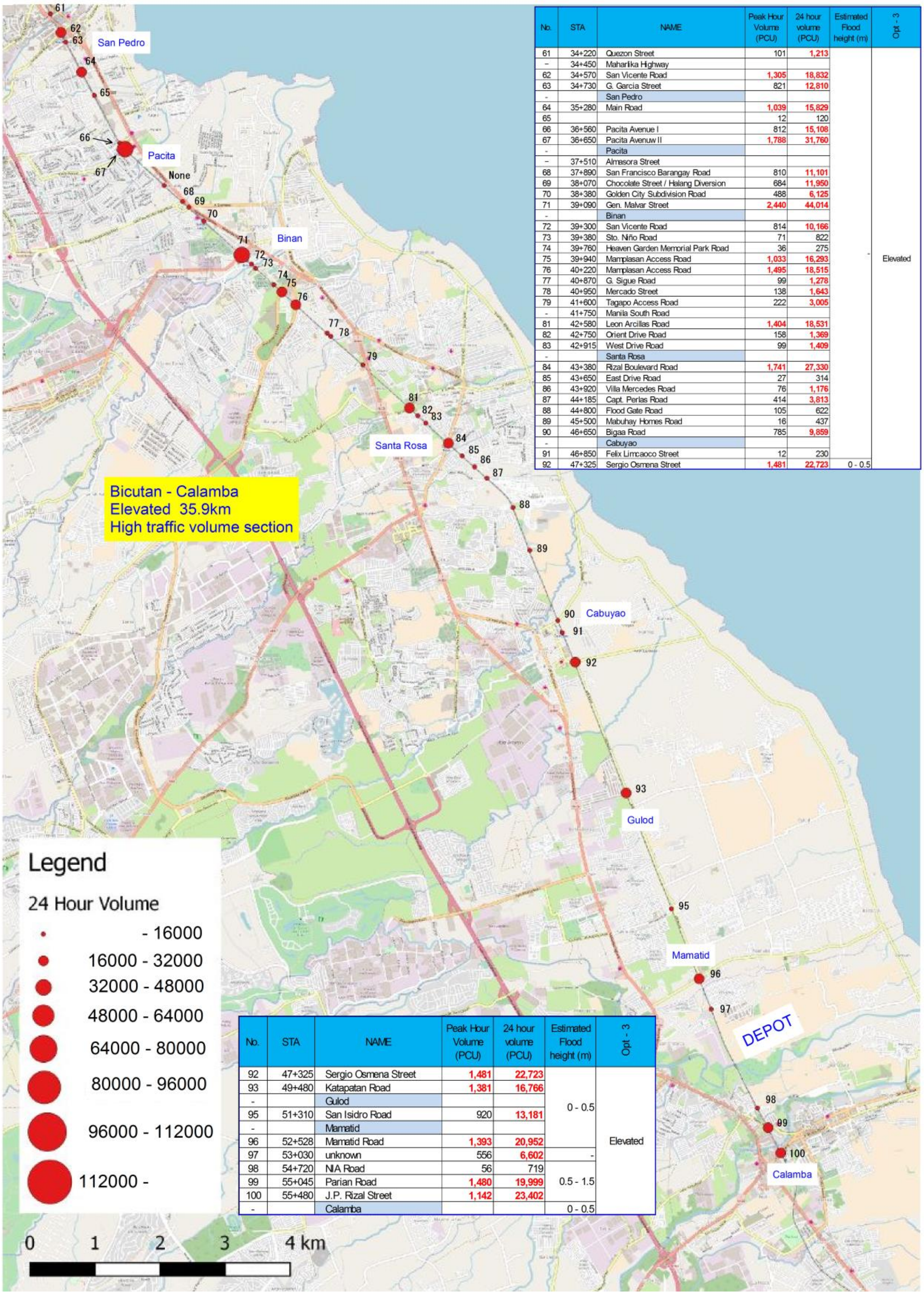


No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
36	15+870	Nichols Interchange （West bound）	2,174	42,407	0.5 - 1.5	Under ground
36		Nichols Interchange （East bound）	480	4,224		
-		Nichols			0 - 0.5	
-		FT1				
-		Bicutan				
37	20+480	Gen. Santos Avenue	4,482	84,436	-	Elevated
38	21+102	Mañalac Avenue	1,152	21,171	0 - 0.5	
40	23+490	Our Lady of Miraculous Medal Street	324	4,130	0.5 - 1.5	
-		Sucat				
41	24+750	Meralco Road	1,107	16,555	0 - 0.5	
42	25+340	Concepcion Street	429	5,811	0.5 - 1.5	
43	25+550	Espeleta Street	19	300	0 - 0.5	

No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
44	28+193	Montillano Street	1,434	24,592	0.5 - 1.5	Elevated
45	28+293	T. Molina Street	78	1,247	0 - 0.5	
-		Alabang			-	
46	29+200	Bautista Street	769	11,834	0 - 0.5	
47	29+300	Falleda Road	12	178	-	
48	29+930	Private Road	21	645		
49			14	124	0 - 0.5	
50	30+450	NIA Road	14	549	0.5 - 1.5	
51	30+930	Bruger Street	644	9,301		
52	31+400	Quezon Street	202	3,339	0 - 0.5	
-		Muntinlupa				
53	31+500	Rizal Street	698	11,203		
54	31+610	Upper Prinza Street	78	1,111	-	
55	31+760	La Guerta Street	528	7,222		
56	32+330	Sto. Niño / St. Andrew Street	403	6,395	0 - 0.5	
57	32+920	E. Rodriguez Jr. Street	823	14,413	-	
58	33+390	RMT Industrial Complex Road	338	5,463		
59	33+630	unknown	24	494		
60	33+930	A. Mabini Street	1,851	31,521		
61	34+220	Quezon Street	101	1,213		
−	34+450	Maharlika Highway				
62	34+570	San Vicente Road	1,305	18,832		
63	34+730	G. Garcia Street	821	12,810		
-		San Pedro				
64	35+280	Main Road	1,039	15,829		
65			12	120		

Source: JICA Design Team

Figure 4.1.18 Option-3 description Plan view for NSRP-South Line (2/3)



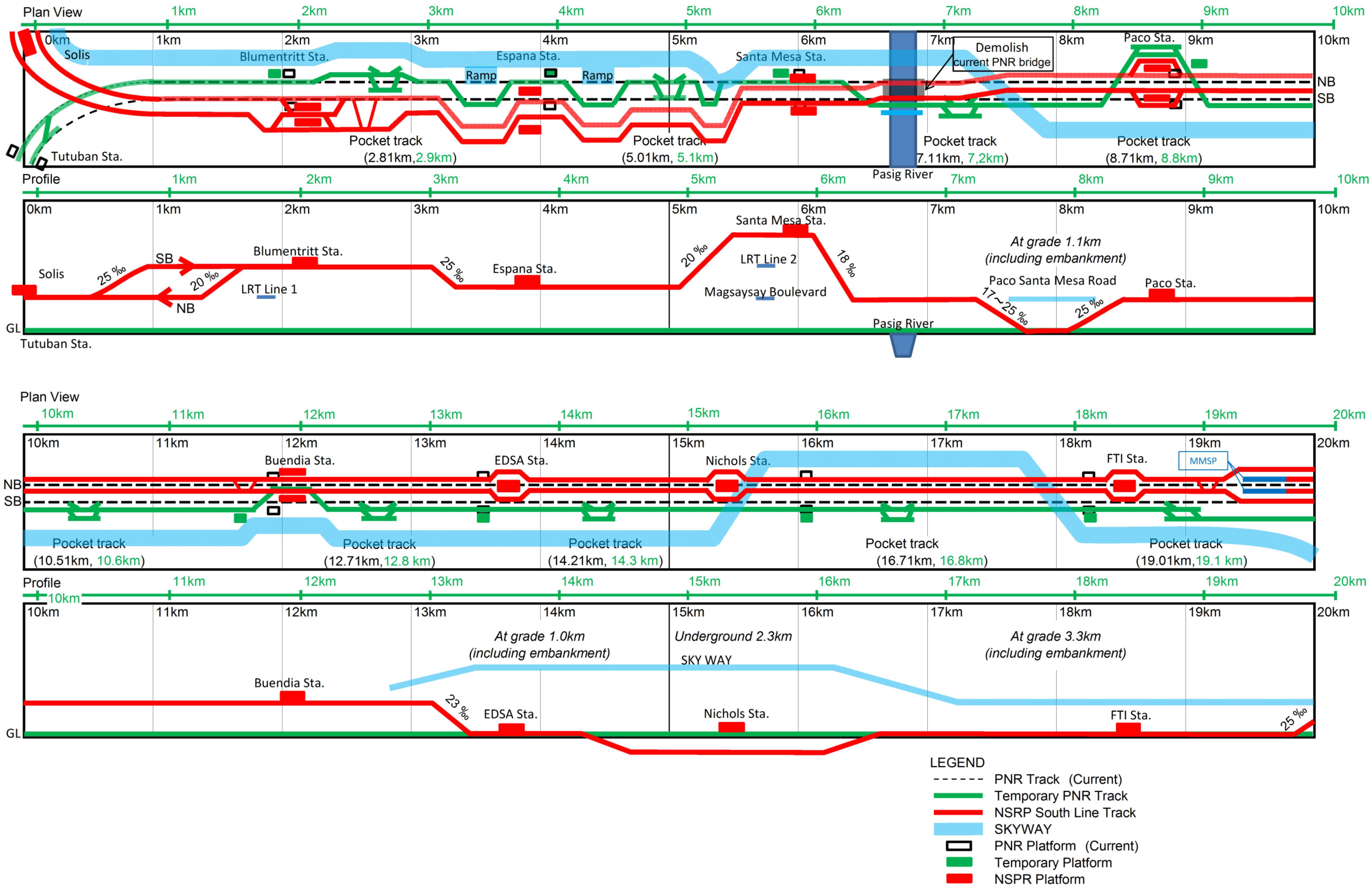
No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
61	34+220	Quezon Street	101	1,213	-	Elevated
–	34+450	Maharlika Highway				
62	34+570	San Vicente Road	1,305	18,832		
63	34+730	G. Garcia Street	821	12,810		
-		San Pedro				
64	35+280	Main Road	1,039	15,829		
65			12	120		
66	36+560	Pacita Avenue I	812	15,108		
67	36+650	Pacita Avenuw II	1,788	31,760		
-		Pacita				
–	37+510	Almasora Street				
68	37+890	San Francisco Barangay Road	810	11,101		
69	38+070	Chocolate Street / Halang Diversion	684	11,950		
70	38+380	Golden City Subdivision Road	488	6,125		
71	39+090	Gen. Malvar Street	2,440	44,014		
-		Binan				
72	39+300	San Vicente Road	814	10,166		
73	39+380	Sto. Niño Road	71	822		
74	39+760	Heaven Garden Memorial Park Road	36	275		
75	39+940	Mamplasan Access Road	1,033	16,293		
76	40+220	Mamplasan Access Road	1,495	18,515		
77	40+870	G. Sigue Road	99	1,278		
78	40+950	Mercado Street	138	1,643		
79	41+600	Tagapo Access Road	222	3,005		
-	41+750	Manila South Road				
81	42+580	Leon Arcillas Road	1,404	18,531		
82	42+750	Orient Drive Road	158	1,369		
83	42+915	West Drive Road	99	1,409		
-		Santa Rosa				
84	43+380	Rizal Boulevard Road	1,741	27,330		
85	43+650	East Drive Road	27	314		
86	43+920	Villa Mercedes Road	76	1,176		
87	44+185	Capt. Perlas Road	414	3,813		
88	44+800	Flood Gate Road	105	622		
89	45+500	Mabuhay Homes Road	16	437		
90	46+650	Bigaa Road	785	9,859		
-		Cabuyao				
91	46+850	Felix Limcaoco Street	12	230		
92	47+325	Sergio Osmena Street	1,481	22,723	0 - 0.5	

No.	STA	NAME	Peak Hour Volume (PCU)	24 hour volume (PCU)	Estimated Flood height (m)	Opt - 3
92	47+325	Sergio Osmena Street	1,481	22,723	0 - 0.5	Elevated
93	49+480	Katapatan Road	1,381	16,766		
-		Gulod				
95	51+310	San Isidro Road	920	13,181		
-		Mamatid				
96	52+528	Mamatid Road	1,393	20,952		
97	53+030	unknown	556	6,602	-	
98	54+720	NIA Road	56	719	0.5 - 1.5	
99	55+045	Parian Road	1,480	19,999		
100	55+480	J.P. Rizal Street	1,142	23,402		
-		Calamba			0 - 0.5	

Source: JICA Design Team

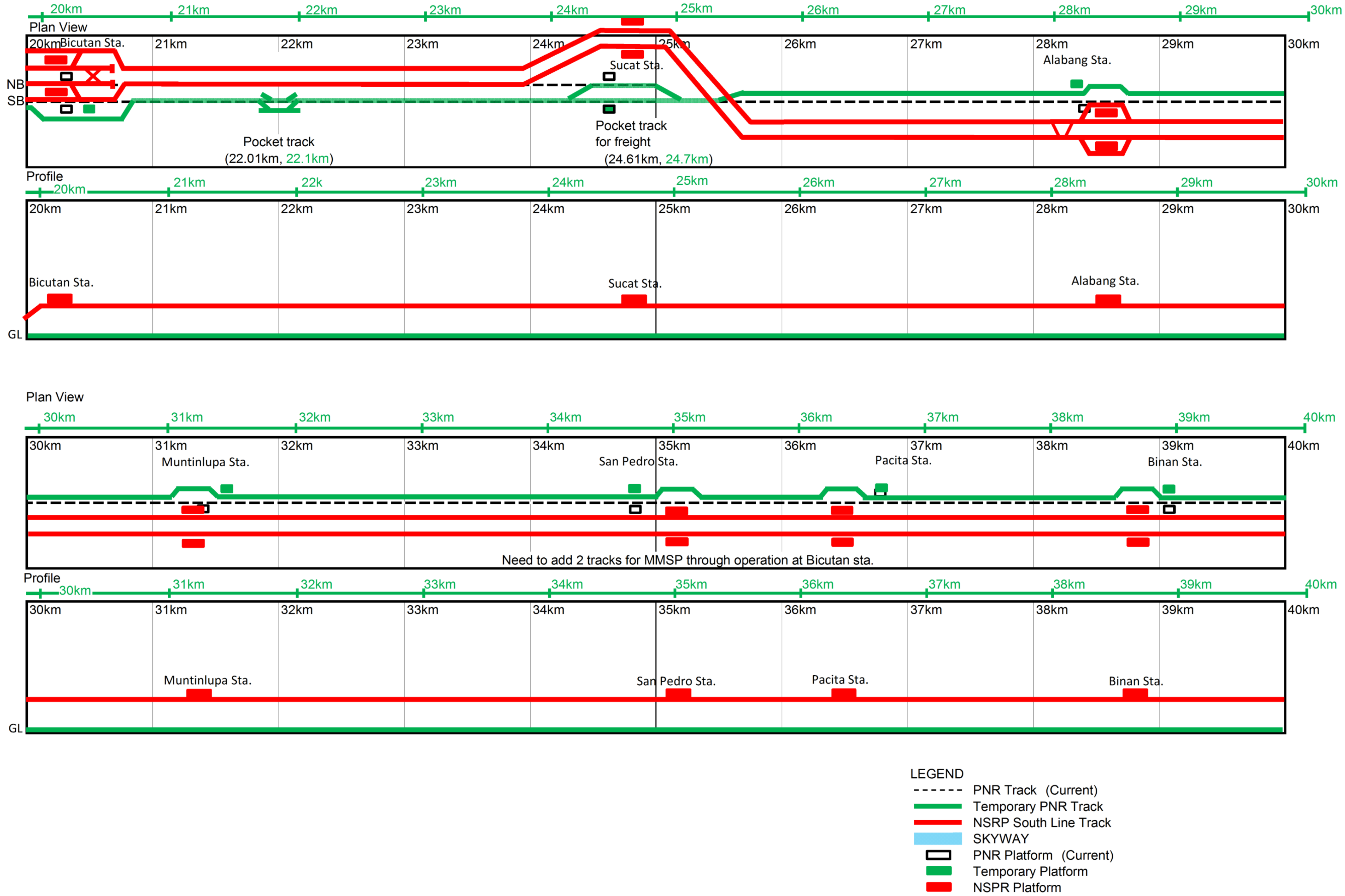
Figure 4.1.19 Option-3 description Plan view for NSRP-South Line (3/3)

(5) Schematic alignment



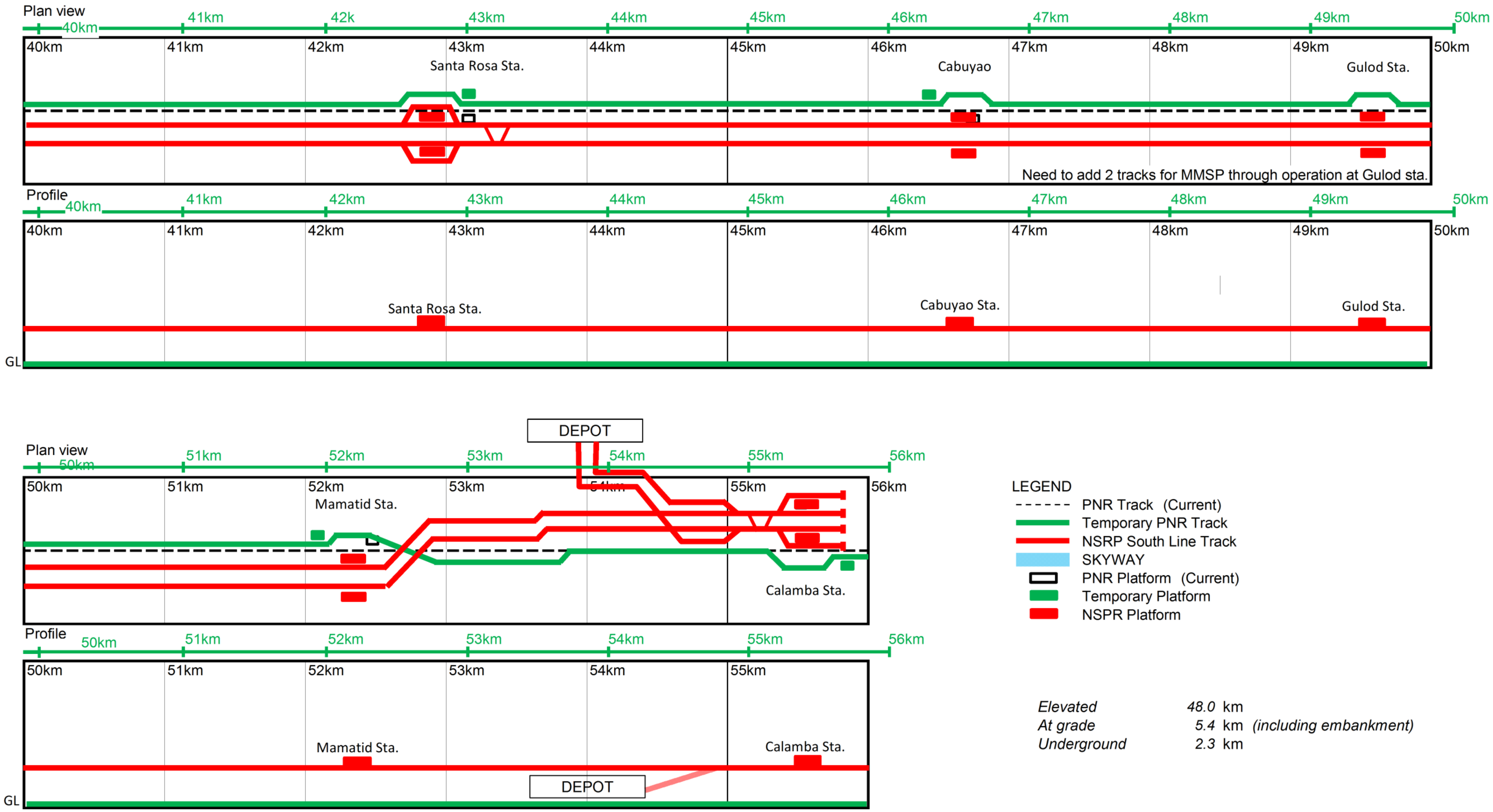
Source: JICA Design Team

Figure 4.1.20 Option-3 Schematic alignment for NSRP-South Line (1/3)



Source: JICA Design Team

Figure 4.1.21 Option-3 Schematic alignment for NSRP-South Line (2/3)



Source: JICA Design Team

Figure 4.1.22 Option-3 Schematic alignment for NSRP-South Line (3/3)

4.2 Infrastructure Plan

4.2.1 Structural Type

(1) Standard Type of Viaducts

1) Overview

It was determined that 40m-span PC segmental box girder is the optimal span in terms of constructability and economic benefits in NSCR Project. The policy of the optimal span will be considered according to the ground conditions and construction assumption based on previous projects.

Source: JICA Design Team

Figure 4.2.1 PC Segmental Box Girder

2) Comparison Proposal

JDT studied verify whether the adoption of the precast PC box selected in the NSCR project is also appropriate for the NSRP-South project as the optimal structure form. The judgment of validity was made on the effect of shortening the construction period. JDT compared the following three options.

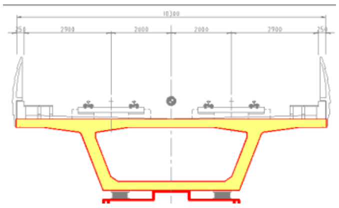
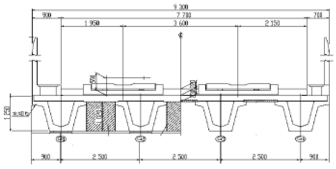
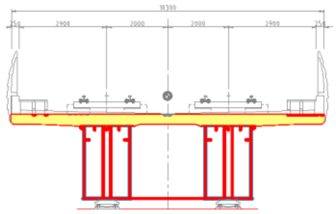
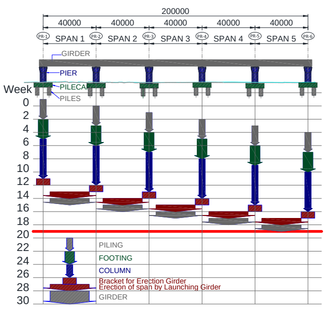
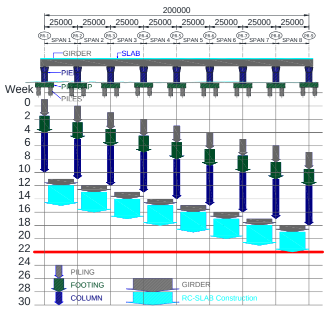
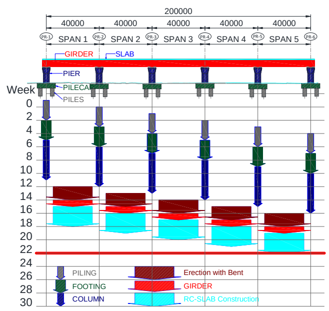
Option-1: Precast PC Box girder (Segmental method); Span length L=40 m
Option-2: Precast PC-U Composite girder (RC composite deck); Span length L=25 m
Option-3: Steel Box girder (RC composite deck); Span length L=40m

3) Comparison Result

As a result of the comparison shown in Table 4.2.1, Option-1(Precast PC box girder) with the highest construction speed is selected. The critical factors to speed up the construction of a long distance railway structures are as follows;

- ✓ Increase the number of construction teams, erection girder and man power
- ✓ Secure sufficient area and number of precast casting yards
- ✓ Ensure a transportation route of the viaduct segments

Table 4.2.1 Comparison of Bridge Structural Forms for Viaduct

Items	Option-1	Option-2	Option-3
Structural forms	Precast PC Box girder (Segment method)	Precast PC-U Composite girder (RC composite deck)	Steel Box girder (RC composite deck)
Span Length	L=40m	L=25m	L=40m
Cross section			
Construction	➢ Can be constructed using temporary erection girders. ➢ Can be transported as short length segments. ➢ The slab needs not to be casted in place the slab. → Save one step of construction period	➢ Crane installation. Crane installation space required on the side of the viaduct. ➢ Transportation weight is light. However, the girder length that can be transported is limited. ➢ It is necessary to cast the slab in site. → one more step of construction compared with Box Girder	➢ Can be constructed using temporary construction gantries. ➢ Transportation weight is light. However, the girder length that can be transported is limited. ➢ It is necessary to cast the slab in site. → one more step of construction compared with Box Girder
Required resources	➢ Piling rig; 2 set ➢ Footing; 3 team ➢ Column; 4 set ➢ Crane; 4 ➢ Erection girder; 1	➢ Piling rig ; 2 set ➢ Footing; 3 team ➢ Column; 4 set ➢ Crane; 4 ➢ Heavy lifting crane ; 1	➢ Piling rig ; 2 set ➢ Footing; 3 team ➢ Column; 4 set ➢ Crane; 4 ➢ Heavy lifting crane ; 1
Construction process			
Construction Speed	➢ 19 Weeks/200m ➢ 1.5 m/Day	➢ 22 Weeks/200m ➢ 1.3 m/Day	➢ 22 Weeks /200m ➢ 1.3 m/Day
Conclusion	Fastest Construction Method	-----	-----

Source: JICA Design Team

(2) Study of Alignment and Structure Plan with Consideration of the Critical Points

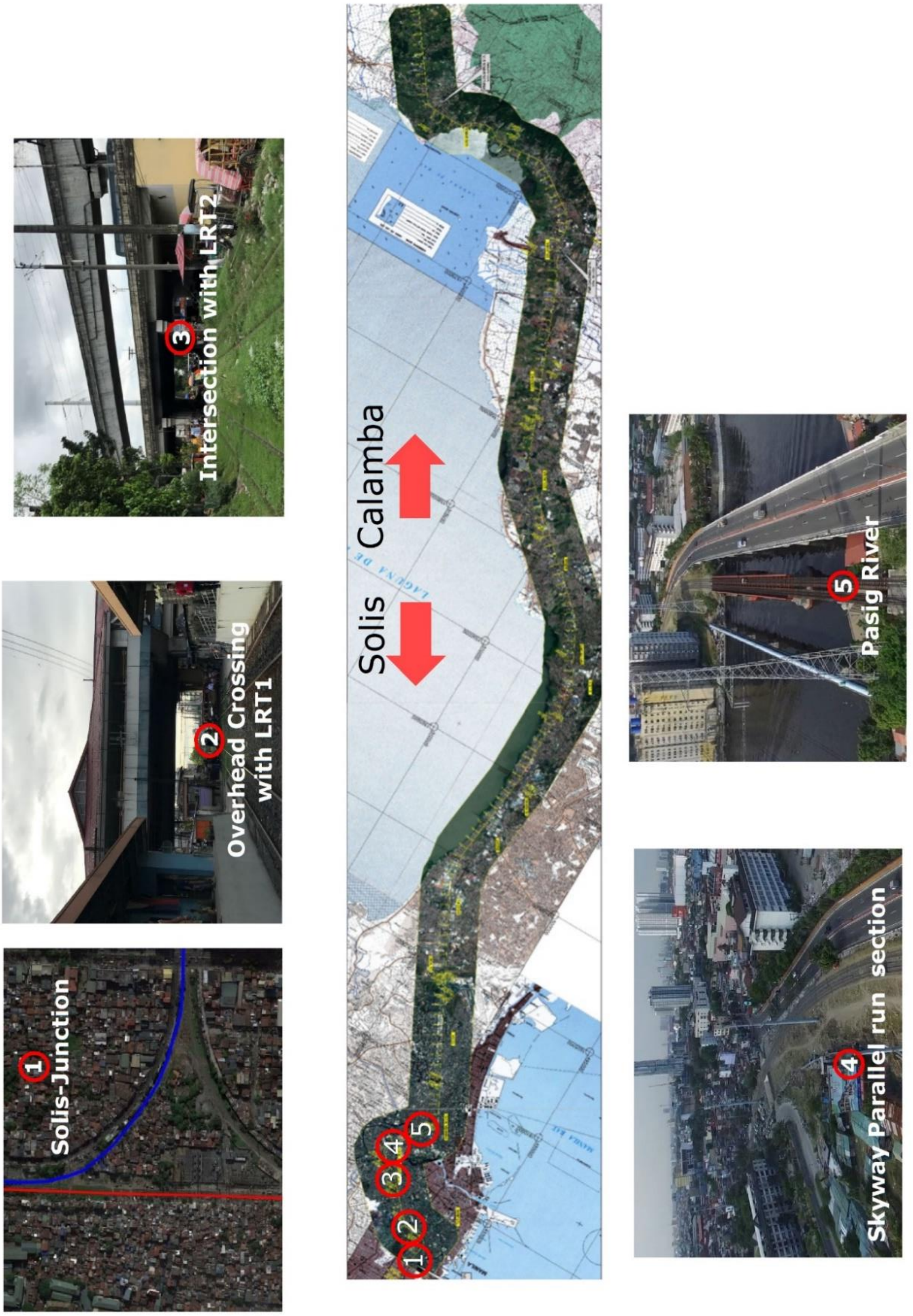
1) Critical Points

The PNR Right of Way (hereinafter, “ROW”) will be used for the NSRP-South Line, which is located along heavily urbanized areas, crossing, bridges, highways, and other civil structures. There are also several sections where an elevated expressway is being constructed parallel to the PNR ROW. Based a preliminary study conducted by ADB, and JDT site inspection, several critical points were identified as listed in Table 4.2.2.

Table 4.2.2 Critical Places where Construction is Difficult

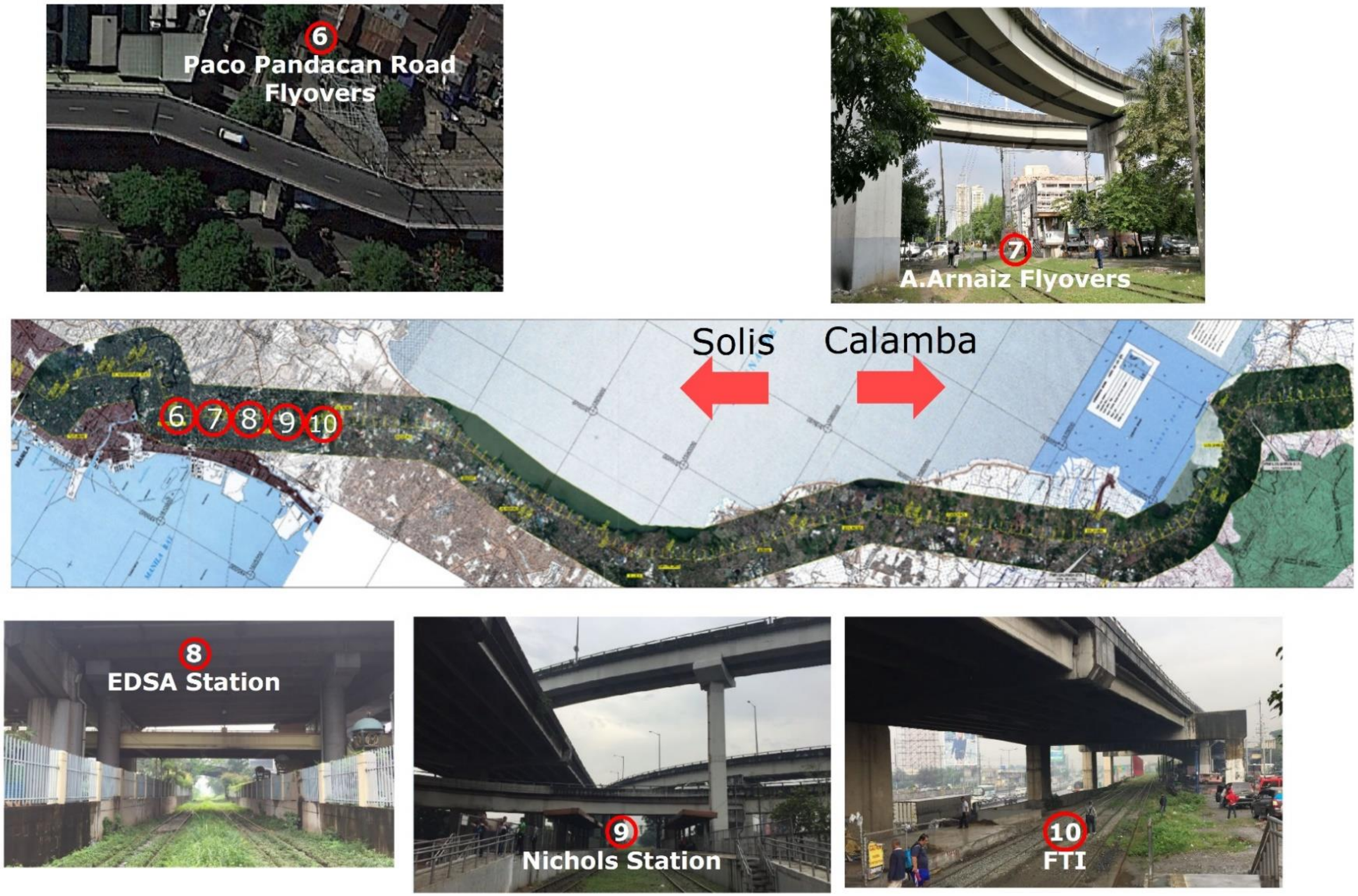
No.	Critical Places
1	Solis-Junction
2	Overhead Crossing with LRT1
3	LRT2 and Magsaysay Bridge intersection
4	Skyway Stage 3 Alignment Conflict
5	Pasig River
6	Paco Pandacan Road Flyovers
7	A.Arnaiz Avenue Flyovers
8	EDSA Station
9	Nichols Station
10	FTI Station
11	Connection of NSRP-South and MMSP

Source: JICA Design Team



Source: JICA Design Team

Figure 4.2.2 Critical Points of the NSRP-South (1)



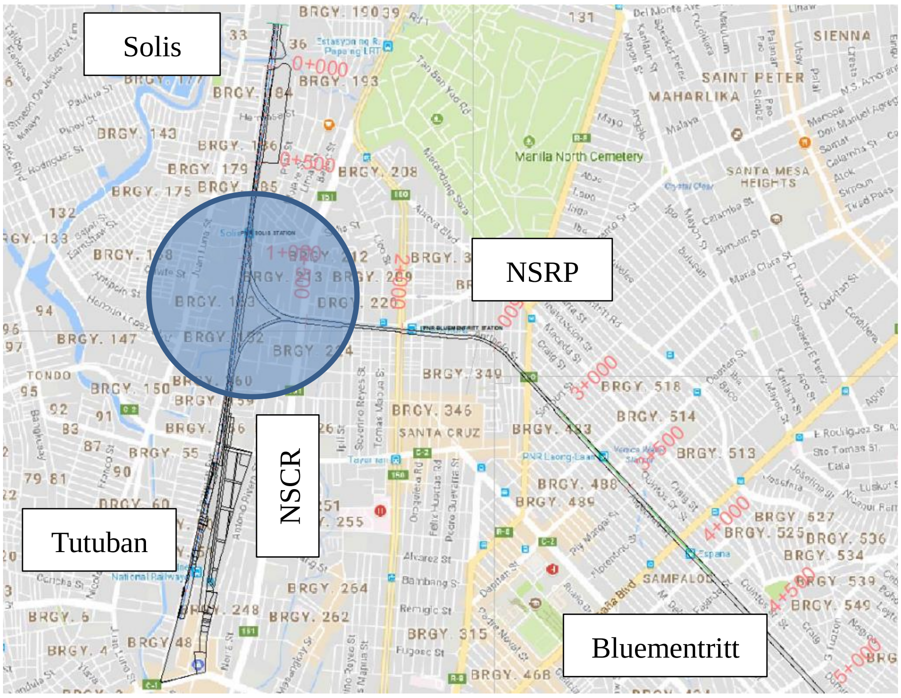
Source: JICA Design Team

Figure 4.2.3 Critical Points of the NSRP - South (2)

2) Solis-Junction

a) Location

The NSRP-South Line and the NSCR Line will be connected at Solis Station. The location of the junction is shown in Figure 4.2.4.



Source: JICA Design Team

Figure 4.2.4 Solis Junction

b) Related Projects (the NLEX-SLEX Connector Road, MMSS3)

As shown in Figure 4.2.5, the NLEX – SLEX Connector Road (white line) is planned to run parallel to the proposed NSRP – South (red line) from Solis to Santa Mesa section. At several sections, the structures of the NLEX - SLEX Connector Road are planned to be built inside the PNR ROW, posing a direct conflict with the proposed NSRP – South alignment. Therefore, at several sections, additioanl land acquisition will be needed to compensate the ROW occupied by the structures of NLEX – SLEX Connector Road. (Figure 4.2.6) Moreover, at Santa Mesa section, before Pasig River, the NLEX – SLEX Connector Road is planned to connect with Skyway Stage 3. Similar to the Connector Road, the structures of Skyway Stage 3 are also planned within the PNR ROW, limiting the vertical and horizontal clearance of the NSRP – South alignment and viaducts, specially at Santa Mesa juntion point and Pandacan area.

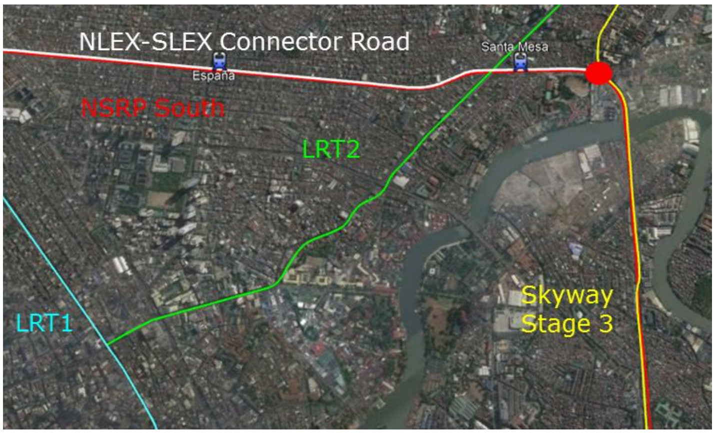


Figure 4.2.5 NLEX –SLEX Connector Road, Skyway Stage 3 and NSRP – South alignments

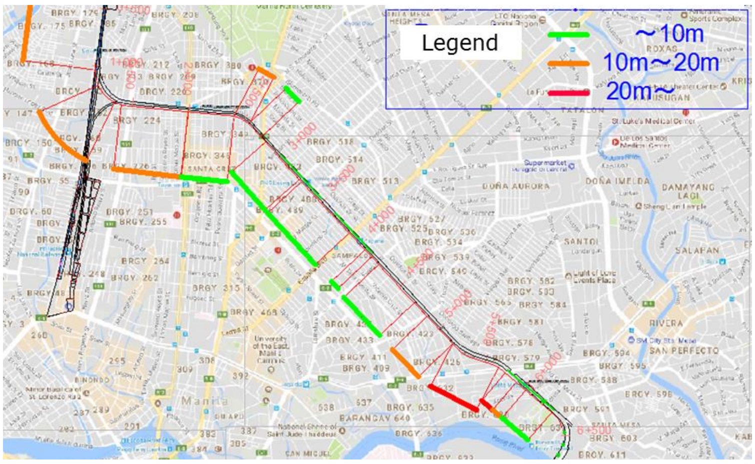


Figure 4.2.6 Additional land acquisition along NLEX – SLEX Connector Road

c) Related Projects (NSCR)

The North South Railway Project – South (NSRP – South) is planned to connect with the North South Commuter Railway (Malolos – Tutuban) (NSCR) at Solis station. In order to connect the NSRP – South line to the NSCR, special structural considerations and additional land acquisition will be needed at the junction of NSCR and NSRP – South.

Figure 4.2.7 NSCR – NSRP South Junction at Solis

The south bound track of NSRP-South Line crosses over the NSCR Line. The vertical alignment (elevation) of the south bound track of NSRP-South line is increased to its maximum gradient at the location overpassing the NSCR Line (see Figure 4.2.8, Section C-C).

Referring to the Section B-B to A-A in Figure 4.2.8, the north bound track of NSRP-South Line gradually increases in elevation towards the Blumentritt Station and reaches the same elevation as the south bound track before arriving the station.

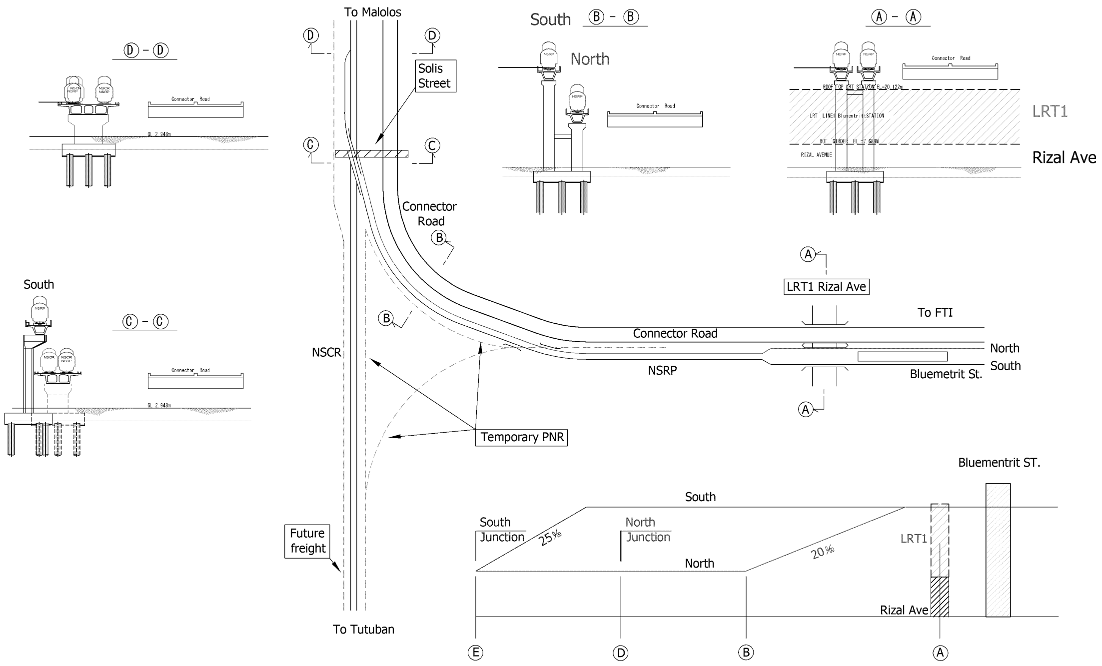


Figure 4.2.8 Connection between the NSCR and NSRP-South between Solis and Blumentritt Station

d) Location and Structure Type of Piers of NSRP-South (SB)

i) Overview

NSRP-South (SB) needs to pass over the NSCR line, So JDT conducted a study on the arrangement of piers of NSRP-South(SB) at the point.

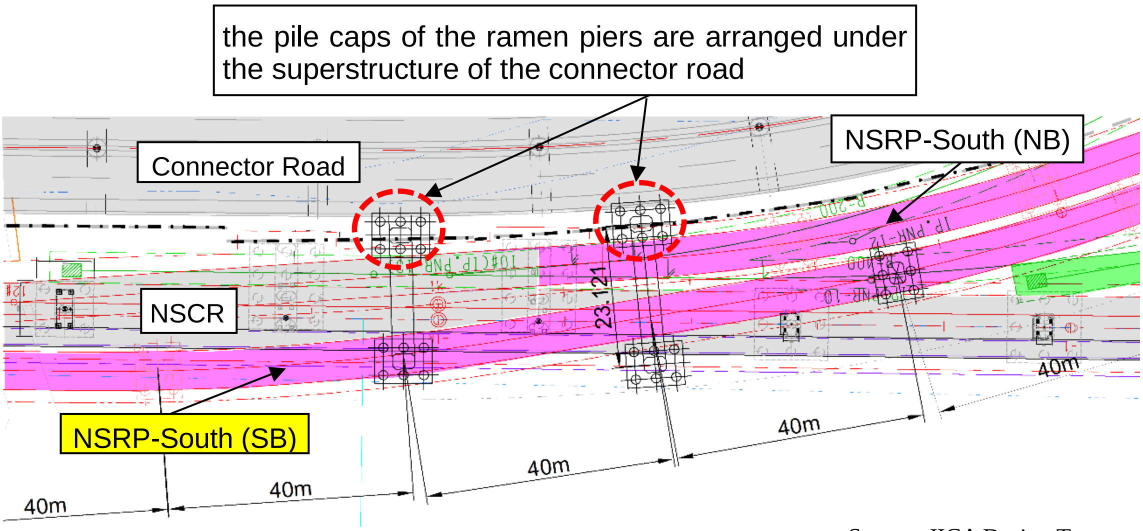
ii) Basic Policy

Basic policy of the piers arrangement is shown below.

- Policy 1: The span length is based on 40 m to use the typical viaduct as much as possible.
- Policy 2: The location of the piers should not be lapped flatly with NSCR, NSRP - South (north bound), SLEX - NLEX Connector Road.
- Policy 3: Based on policy 2, the structure type of the piers of the NSRC intersection section shall be RC ramen.

iii) Plan of the Piers' Location

Figure 4.2.9 shows a span layout for NSRP-South (SB) based on the above policy. In this case, since the pile caps of the ramen piers are arranged under the superstructure of the connector road, confirmation by consultation with DPWH is necessary. In addition, it is also necessary to check whether the operability of the PNR Line during the construction period is possible or not.



Source: JICA Design Team

Figure 4.2.9 Span layout of NSRP-South(SB) at crossing point with the NSCR

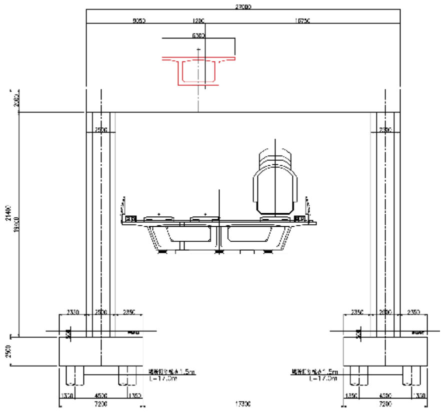


Figure 4.2.10　Ramen type

3)　Overhead Crossing with LRT Line1 (Blumentritt)

a)　Location

The alignment of NSRP-South intersects with the Brumentritt station of LTR1 (shown in Figure 4.2.11). The vertical clearance between the ground level and the soffit of Blumentritt Station is 5.30 m, which is not enough to accommodate NSRP-South.

Current

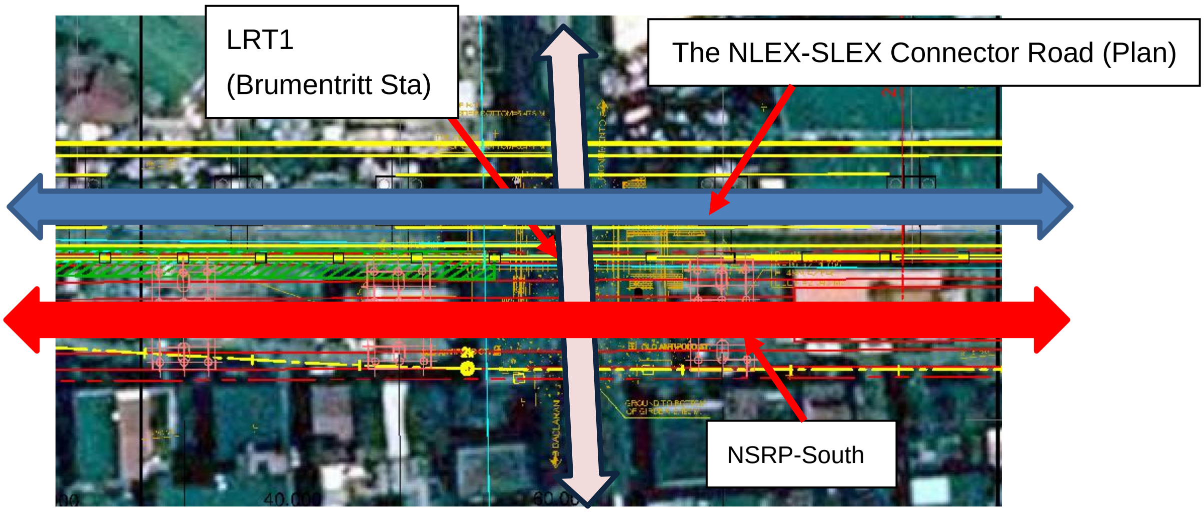
Clearance from GL to the bottom surface of LRT-1 girder	5.3m
Height of station roof of LRT-1 from GL	18.0m

Source: JICA Design Team

Figure 4.2.11　PNR Line beneath LRT 1 Blumentritt Station

b) Related Project (the NLEX-SLEX Connector Road)

The NLEX-SLEX Connector Road is planned, the alignment is set parallel to the NSRP-South .



Source: JICA Design Team

Figure 4.2.12 Location at LRT 1 Blumentritt Station

c) Study of Vertical alignment of NSRP-South at the Brumentritt Station

JDT considered 3 options for virtical alignment of NSRP-South as below.

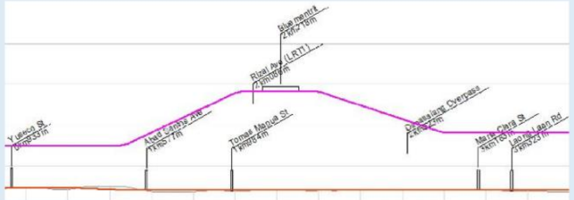
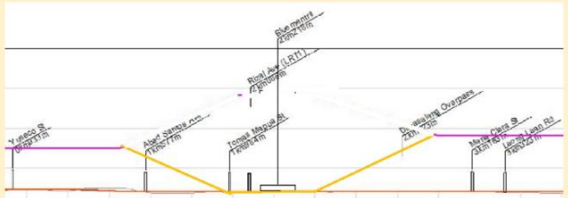
Option1: Cross over the Brumentritt station of LRT1

Option2: At-grade

Option3: Underground

As a result of the comparison, JDT considered that adoption of Option1 was appropriate(shown in Table 4.2.3). Cost of option2 (at-grade) is the cheapest of all the considered options. However, such construction would involve the restriction of traffic along the main track. The underground alignment proposal is on the other hand the most expensive option.

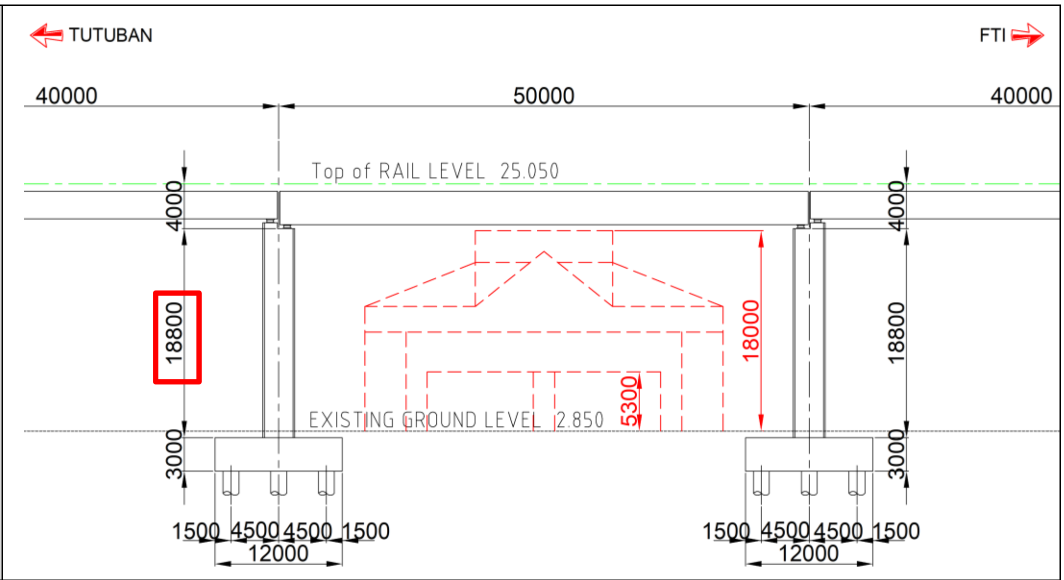
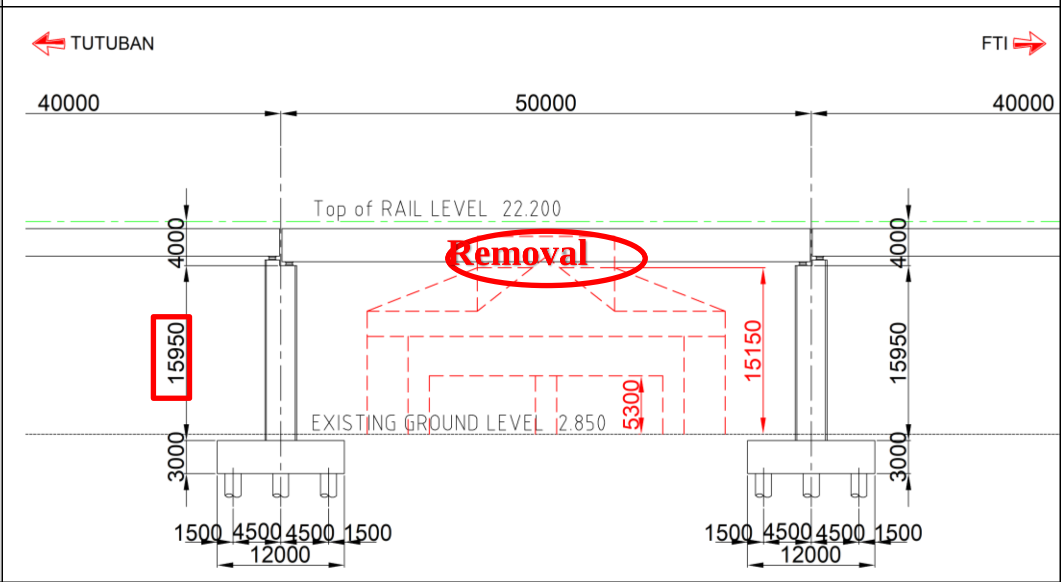
Table 4.2.3 Structure comparison proposal Blumentritt Station

Option		Feature of a structure	Environmental consideration	Constructability	Cost Estimate	Evaluation
Option1 **Viaduct**		- Take down to an elevated bridge over LRT1 after it to the height which does not interfere in a cross street - Existing PNR lets a ground level pass - Plan Freight line lets a ground level pass	- Almost no influence which have on other structures - Bridge pier quantity is about 20 m	A	B	A
Option2 **At-grade**		- Ailway lets a ground level pass - Existing PNR lets a ground level pass - Plan Freight line lets a ground level pass	- Cost of construction is low - Grade crossing with RIZAL Ave of a trunk road - Time of road closing by a grade crossing increases	C	A	C
Option3 **Underground**		- NSRP-S lets underground pass - Existing PNR lets a ground level pass - Plan Freight line lets a ground level pass	- Necessity has the design of the deep position which avoided the bridge pier foundation of LRT1	B	C	B

Source: JICA Design Team

d) Design Considerations for Bridge Overpassing Blumentritt Station

Two piers' heights are proposed for the bridge overpassing Blumentritt Station. The first option is the plan which is considered not demolishing the top of the station roof, to give a total pier height of 18m. It is also possible to reduce the pier height by 2.85 m, however the top of the station roof would need to be removed. In this sense, two options are investigated at this section, as shown in Figure 4.2.13.

Option1-1	
Option1-2 (Roof removal)	

Source: JICA Design Team

Figure 4.2.13 Bridge height proposals above Blumentritt Station

The roof of Blumentritt station is shown in Figure 4.2.14. Site inspection has proved that the station roof cannot be easily altered for the following reasons. Therefore, adopt option 1-1.

- Many temporary supports would be needed to keep stability of the roof (which can't be removed until demolition is finished).

- Temporary support would leave a short vertical clearance for the passengers and train.
- New temporary roof would leave a short vertical clearance for the passengers and train.
- Catenary is hanging from the roof, therefore it would have to be attached to the temporary support then the new roof.

Source: JICA Design Team

Figure 4.2.14 The Roof of Blumentritt Station (LRT1)

4) NSRP Intersection with LRT2 and Magsaysay Bridge

a) Location

As shown in Figure 4.2.15, the NSRP-South alignment intersects the LRT2 viaduct, Magsaysay Bridge, and service roads at around 6 km 000m.

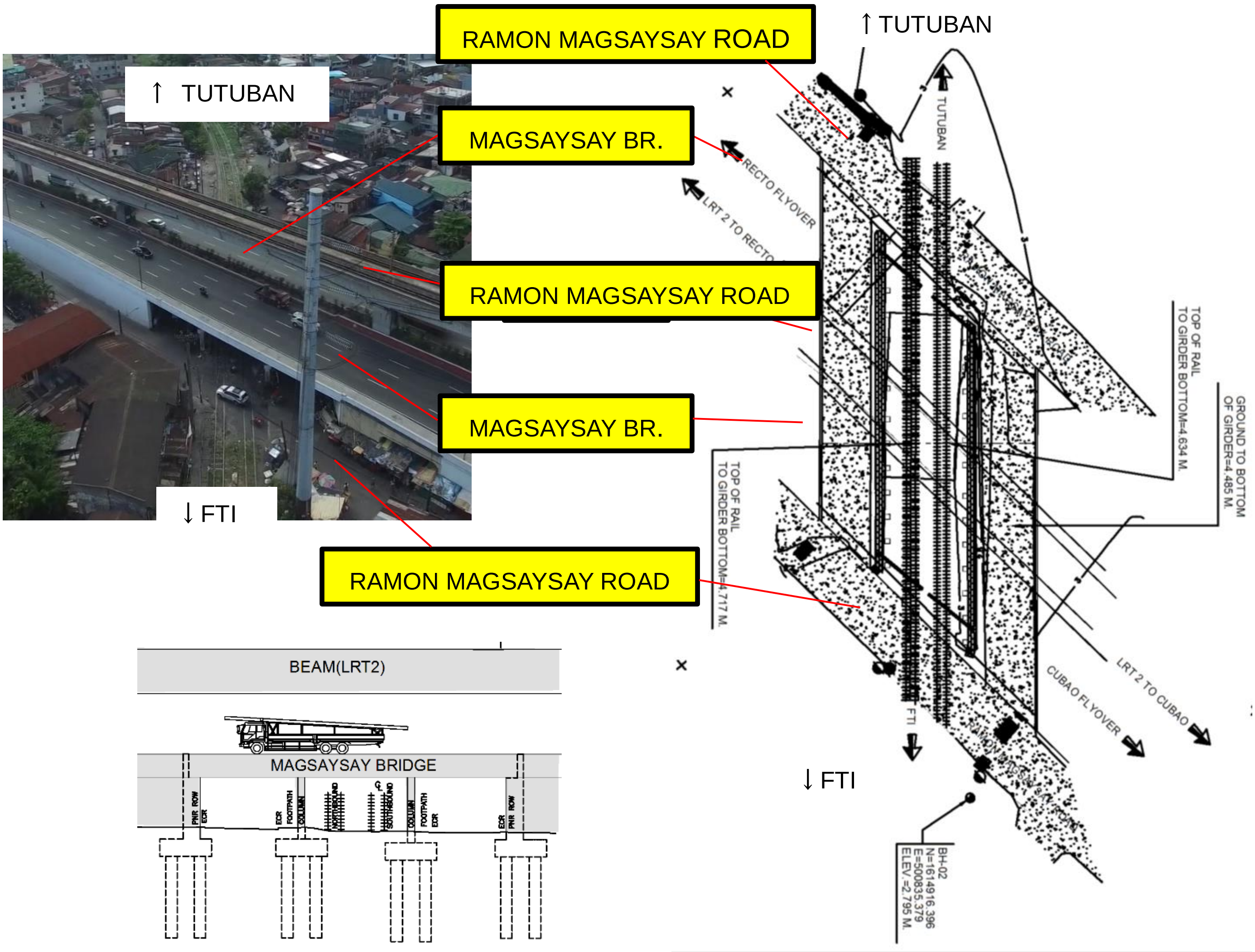


Figure 4.2.15   LRT1 Viaduct and Magsaysay Bridge

b) Study of Crossing Method

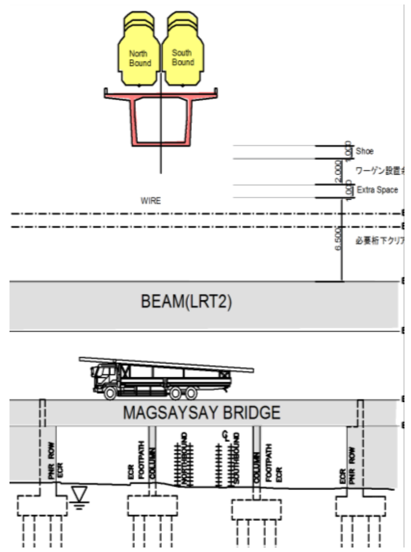
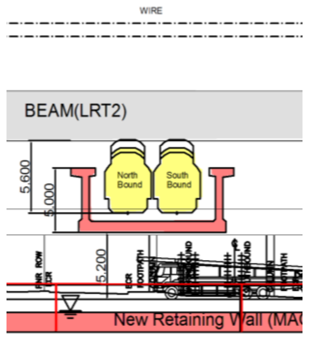
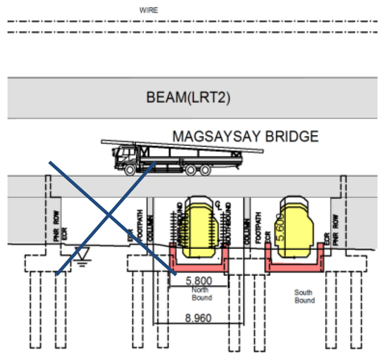
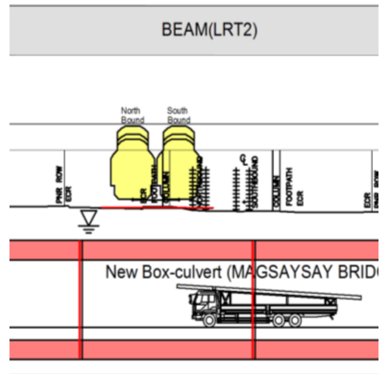
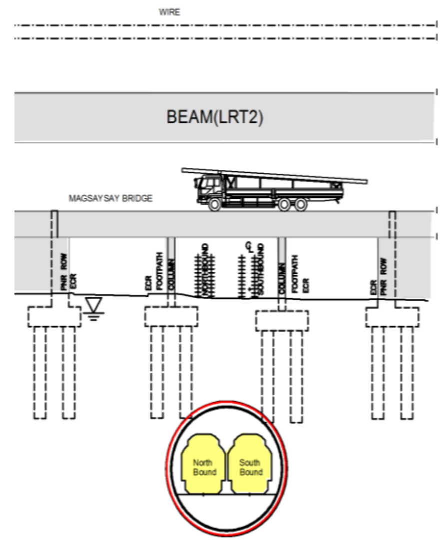
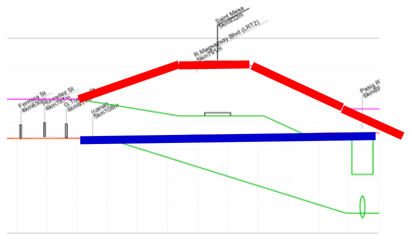
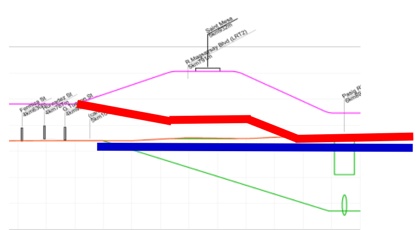
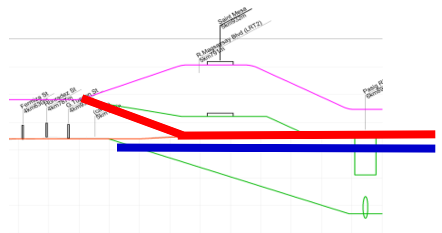
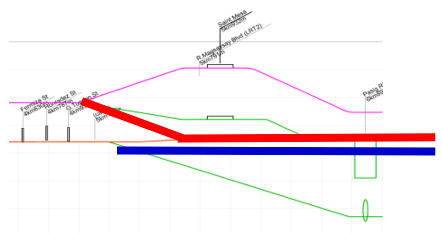
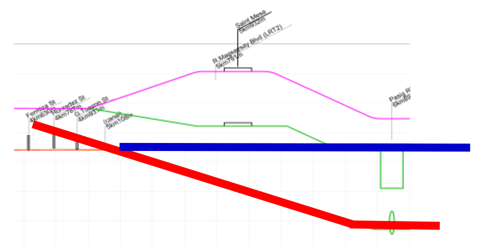
This study is conducted to determine vertical alignment of the NSRP-South Line. The planning at this section needs to consider the LRT2 viaduct, Magsaysay Bridge and the PNR Line. In addition, Magsaysay Road Bridge is a civil structure protected by the National History Committee of the Philippines (NHCP) for being over 50 years old. Based on the above considerations, JDT proposes five options as presented in Table 4.2.4. Based on the implemented criteria, JDT proposes the first option for the following reasons.

- Reasons why Option-2 and 4 are discarded:
  These two options require to remove the Magsaysay Bridge, acquire additional land for replacement, and take measures to secure road traffic at the time of removal. In order to realize these plans, it is necessary to coordinate and reach a consensus with DPWH and the NHCP for the removal of the historical structures, which is expected to be very difficult. Additionally, Option 2 is also disqualified in the consideration because it will be impossible to keep PNR operations during construction because Magsaysay Bridge will be replaced by an underground structure and will interrupt the PNR operations during its construction. Based on the above, the plans are deemed not to be feasible.

- Reason why the Option-3 was not selected as best option:
  Option-3 proposes to locate the NSRP-South beneath Magsaysay Bridge between the bridge piers and abutment without removing the Magsaysay Bridges. However, the planned NLEX-SLEX connector road bridge piers are located within the PNR ROW, impeding the provision for space for the temporary line. Based on the above considerations, the plan is also judged to be inappropriate.

- Comparison result of Options 1 and 5:
  As a result of comparison between Option-1 and Option 5 from the costs point of view, it was concluded that Option-1 is the most viable.

Table 4.2.4 Comparison of Vertical Alignment Options at Magsaysay Bridge – LRT2 Viaduct Intersection with NSRP-South

	Option-1 **Pass on the LRT2**	**Option-2** **Pass under theLRT2**	**Option-3** **Pass under the Magsaysay Bridges**	**Option 4** **At-Grade**	**Option 5** **Tunnel**
x-section					
Profile (Red: NSRP-South, Blue: temporary line)					
Structure type of NSRP-South	Bridge	bridge	Retaining wall	At-grade	Tunnel
Necessity of Removal Magsaysay Bridges	No Need	Need (Reconstruction U-shape wall)	No Need	Need (Reconstruction Box-culvert)	No-Need
Operation of PNR during construction	Possible	Impossible	Possible(Depends on construction time of Connector road)	Possible	Possible
Reach consensus with DPWH	Easy	Hard	Hard	Hard	Easy
Cost(Ratio)	1.00	—	—	–	1.40
Evaluation	○				

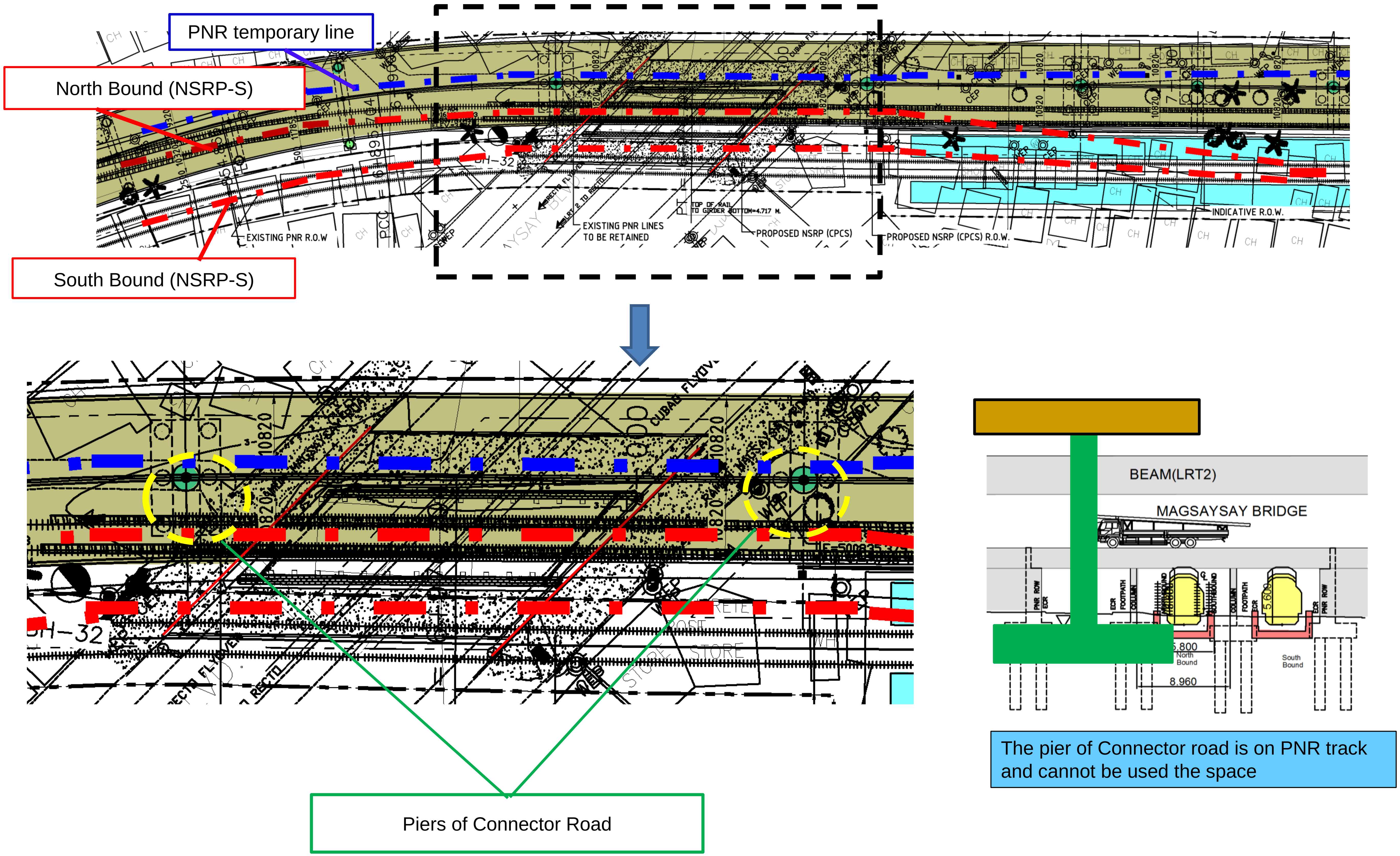


Figure 4.2.16 Plan View for Option 3

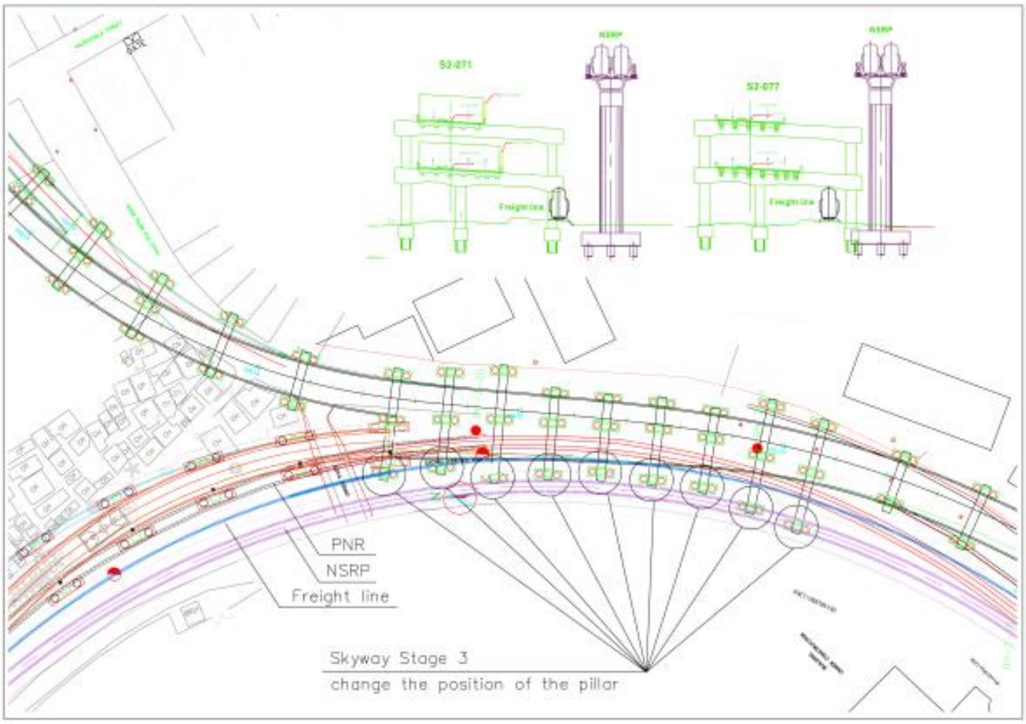
5) Alignment Conflict between MMSS3 and NSRP-South Line

a) Location and Issue

MMSS3 (SkywayStage3) and the NLEX-SLEX Connector Road intersect before Pasig River, occupying part of the PNR ROW. Skyway Stage 3 is planned to cross Pasig River parallel to the proposed NSRP-South alignment (see Figure 4.2.17, Figure 4.2.18 and Figure 4.2.19). The NLEX–SLEX Connector Road and MMSS3 junctions will be a double decker highway. The substructures of the Skyway Stage 3 are planned to be located within the PNR ROW, directly affecting the design of the NSRP-South Line and PNR temporary track.

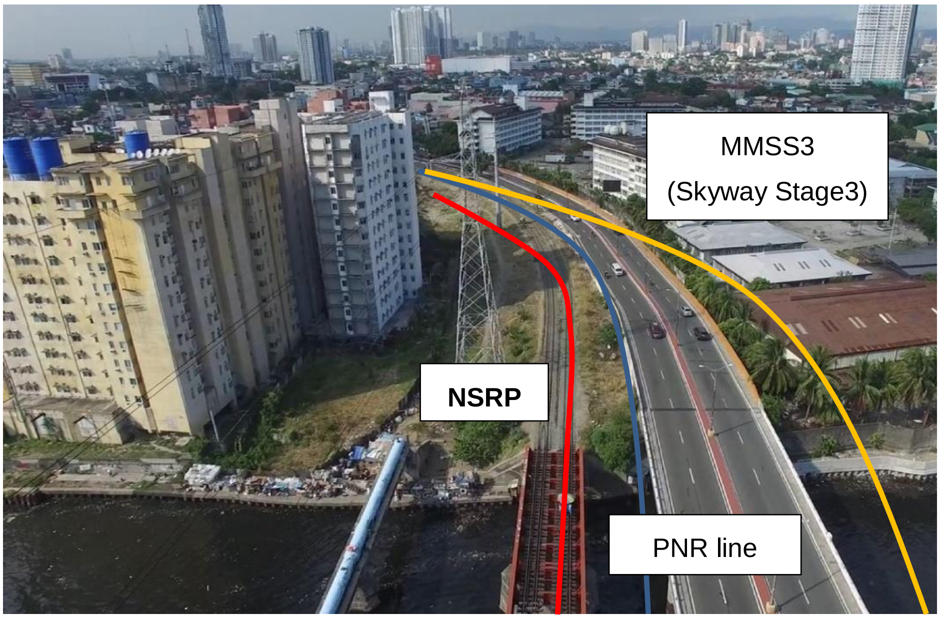
b) Alignment Plan for NSRP-South

As for MMSS3, there is information (unofficially) that the alignment will change drastically, so future consultation is very important. JDT requested change the location of alignment and piers of MMSS3 to TRB via DoTr. Therefore, JDT studied the alignment for NSRP-South without considering MMSS3 in FS stage. It is necessary to discuss and confirm about the conflict.



Source: JICA Design Team

Figure 4.2.17 Plan View of NLEX-SLEX Connector Road and MMSS3 Junction



Source: JICA Design Team

Figure 4.2.18 Future Plan at Pasig River

Source: JICA Design Team

Figure 4.2.19 NLEX-SLEX Connector Road and MMSS3 Junctions before Pasig River

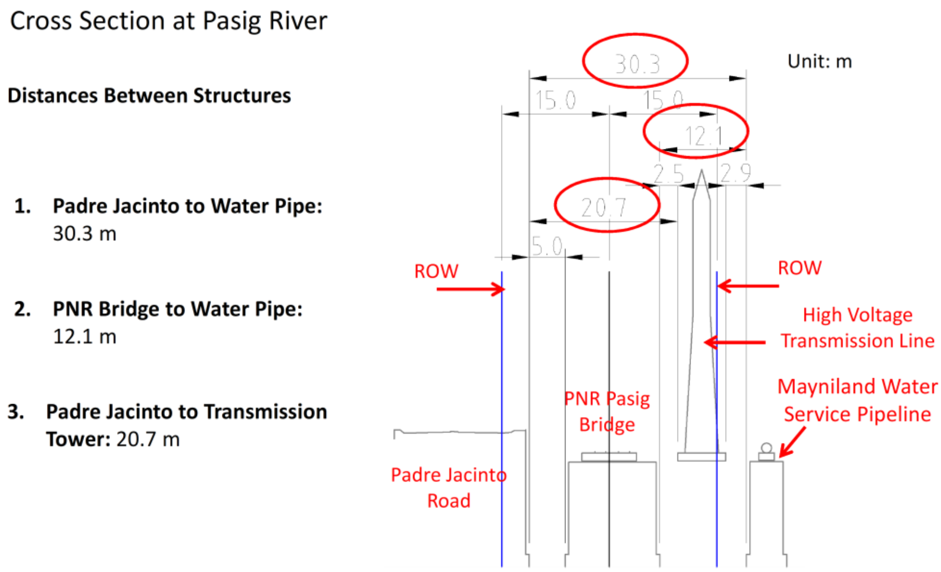
6) Pasig River

a) Location

The NSRP-South Line is proposed to run along the existing PNR ROW. There are several infrastructures are located adjacent to PNR Line. These structures are a Mayniland Water Service Pipeline, two high voltage towers, Padre Jacinto Road Bridge, and the planned MMSS3. Since it is necessary to secure space for a single track for PNR temporary operations, either the existing PNR Pasig Bridge, high voltage towers, or both, need to be removed (Figure 4.2.20).

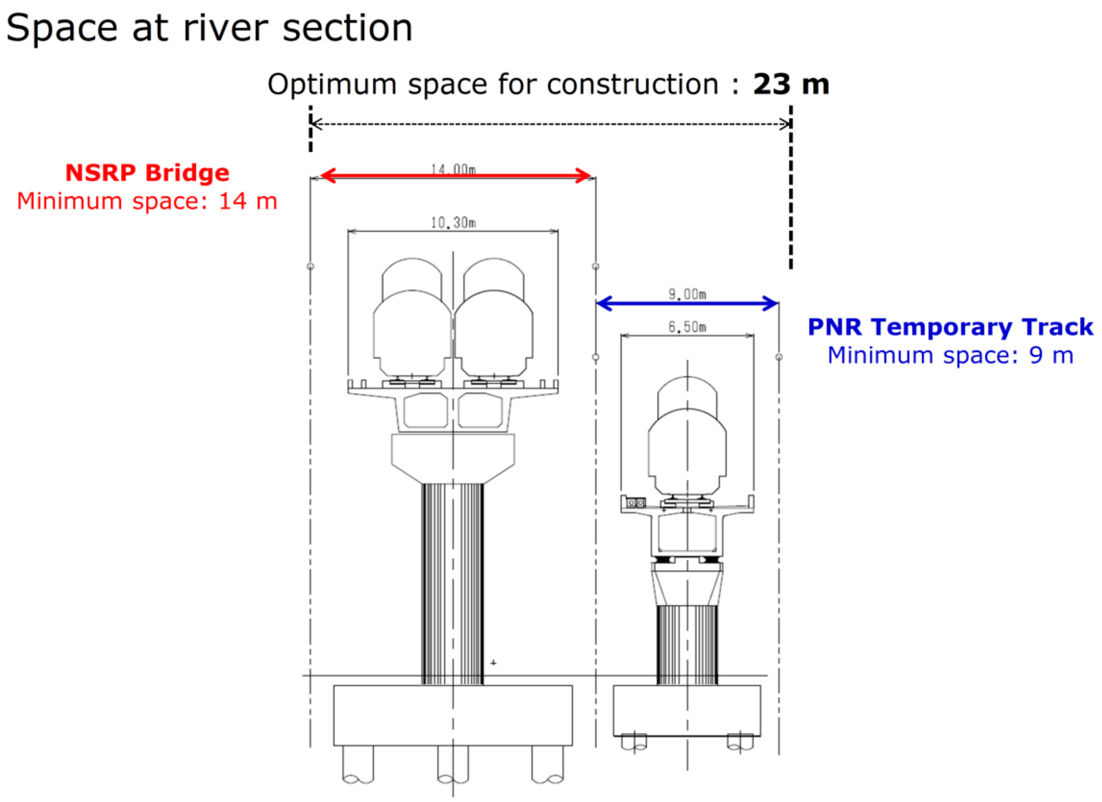
Source: JICA Design Team

Figure 4.2.20 Present Situation of Structure Placement at Pasig River



Source: JICA Design Team

Figure 4.2.21 Cross Section and Horizontal Clearances between the Existing Structures



Source: JICA Design Team

Figure 4.2.22 Optimal Horizontal Clearance for the NSRP-South, PNR Temporary Track

b) Options of Study

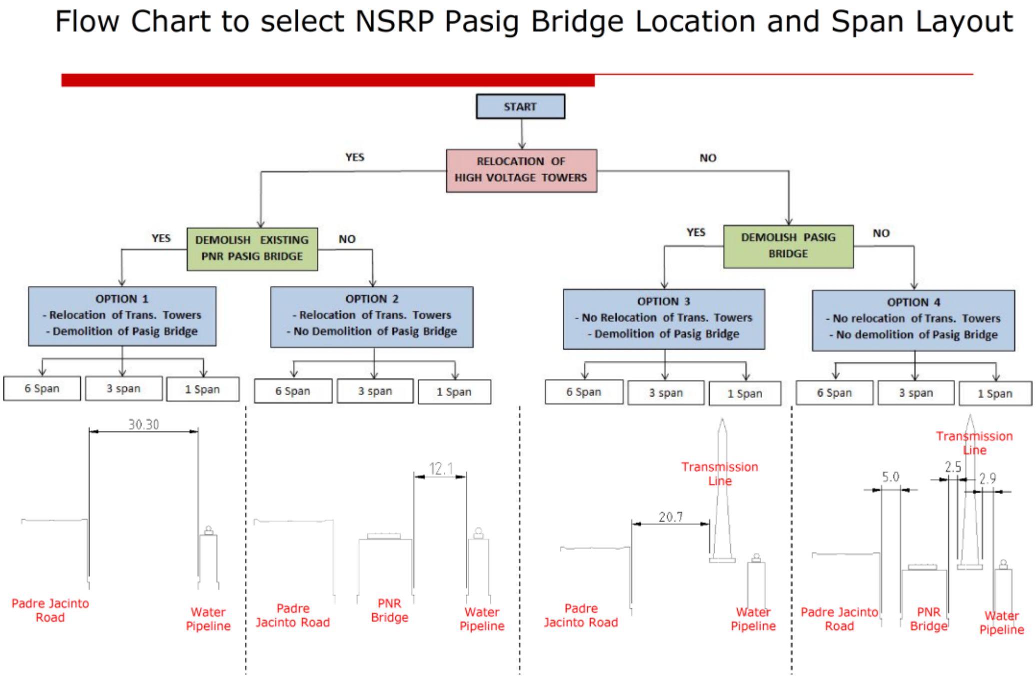
It is necessary to secure enough space for construction NSRP-South and PNR temporary track. So, several current structures are needed to be removed or demolished. JDT proposes and 4 options. For these options, JDT study available space and constructibity.

Option-1：High Voltage Tower→Remove、Current PNR Bridge→demolish

Option-2：High Voltage Tower→Remove、Current PNR Bridge→not demolish

Option-3：High Voltage Tower→Not remove、Current PNR Bridge→demolish

Option-4：High Voltage Tower→Not remove、Current PNR Bridge→Not demolish



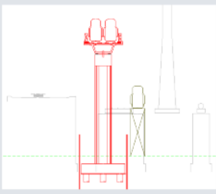
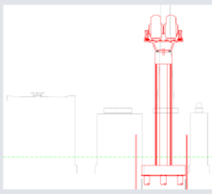
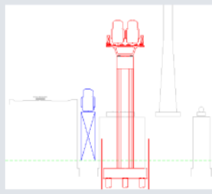
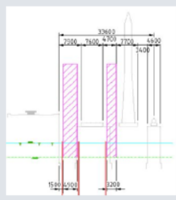
Source: JICA Design Team

Figure 4.2.23 Flow Chart to Select Pier Locations, Span Layout and Bridge Type

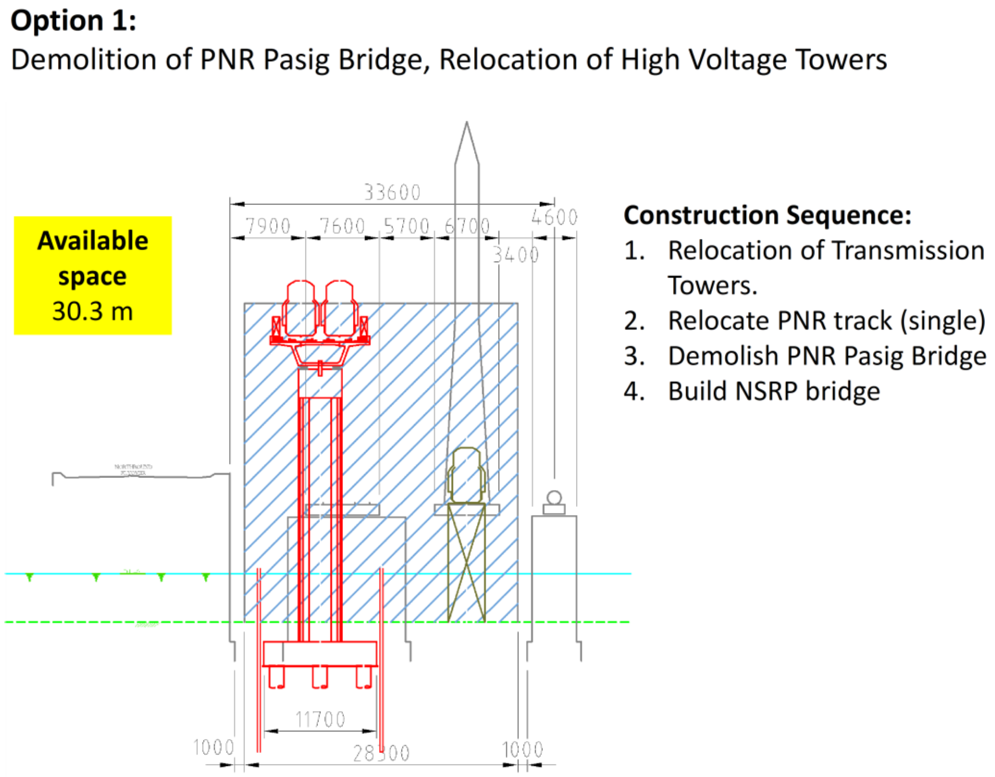
c) Result of Study

As a result of comparison, the Option-1 which can secure a sufficient installation space and is excellent in workability is selected.

Table 4.2.5 Comparison Table of Possible Scenarios

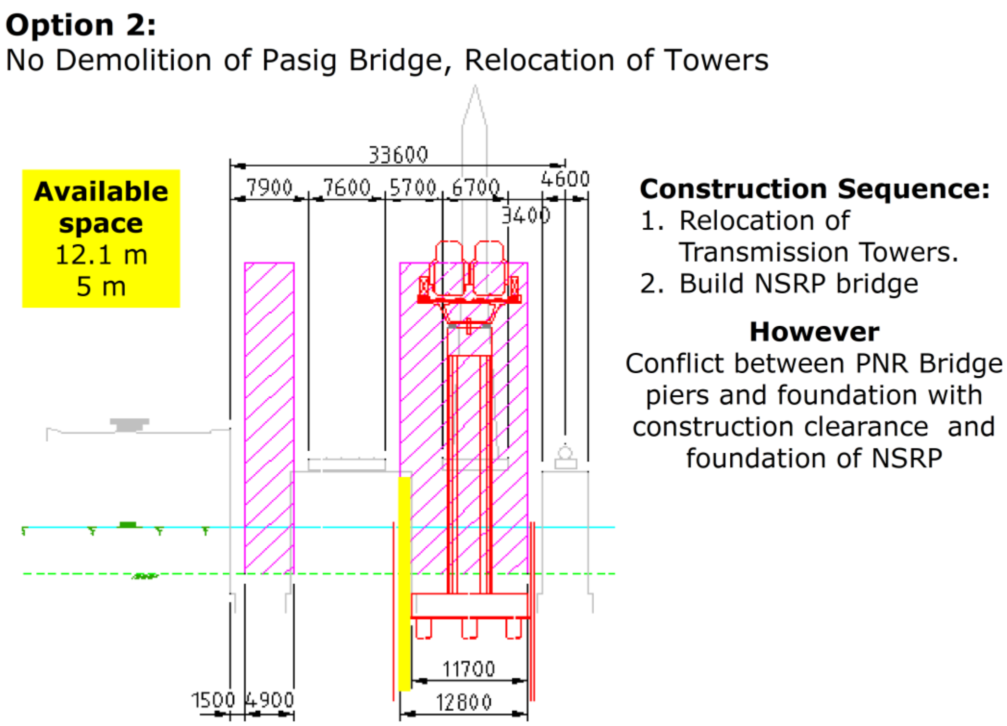
	OPTION 1	OPTION 2	OPTION 3	OPTION 4
Cross Section				
Available Space for construction	30.3	12.1, 5	20.7	5, 2.4, 2.9
Demolition of PNR Pasig Bridge	Yes	No	Yes	No
Relocation of Trans. Towers	Yes	Yes	No	No
PNR Operations	Possible	Possible	Possible	Possible
Construction	**Standard**	**Conflicting**	**Complicate**	**Impossible**
Related authorities to reach consensus	PNR Power company	Power company	PNR	N/A
Evaluation	A	C	B	F

Source: JICA Design Team



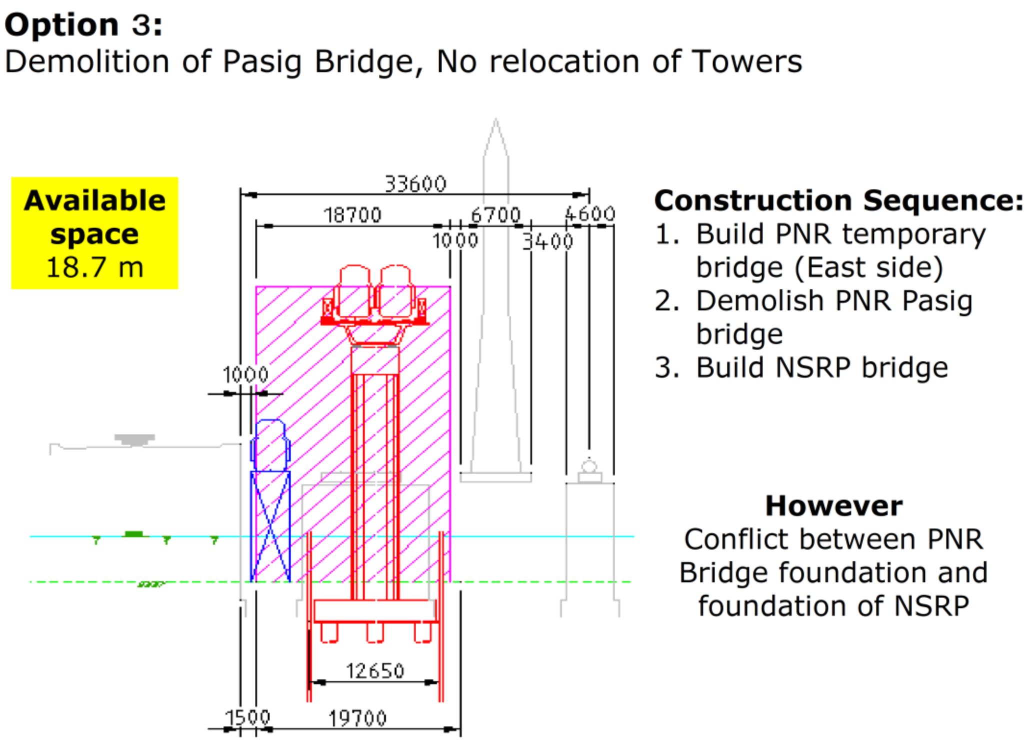
Source: JICA Design Team

Figure 4.2.24 Available Space after Demolition of PNR Pasig Bridge and Relocation of High Voltage Towers



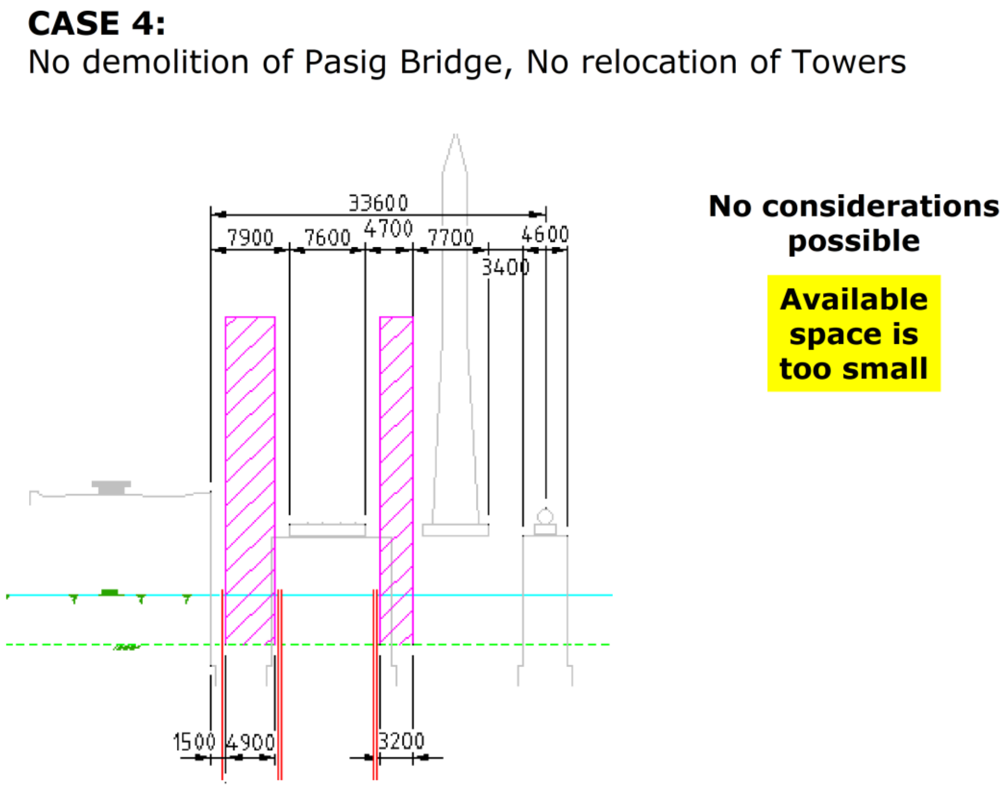
Source: JICA Design Team

Figure 4.2.25 Available Space after Relocation of High Voltage Towers



Source: JICA Design Team

Figure 4.2.26 Available Space after Demolition of PNR Pasig Bridge

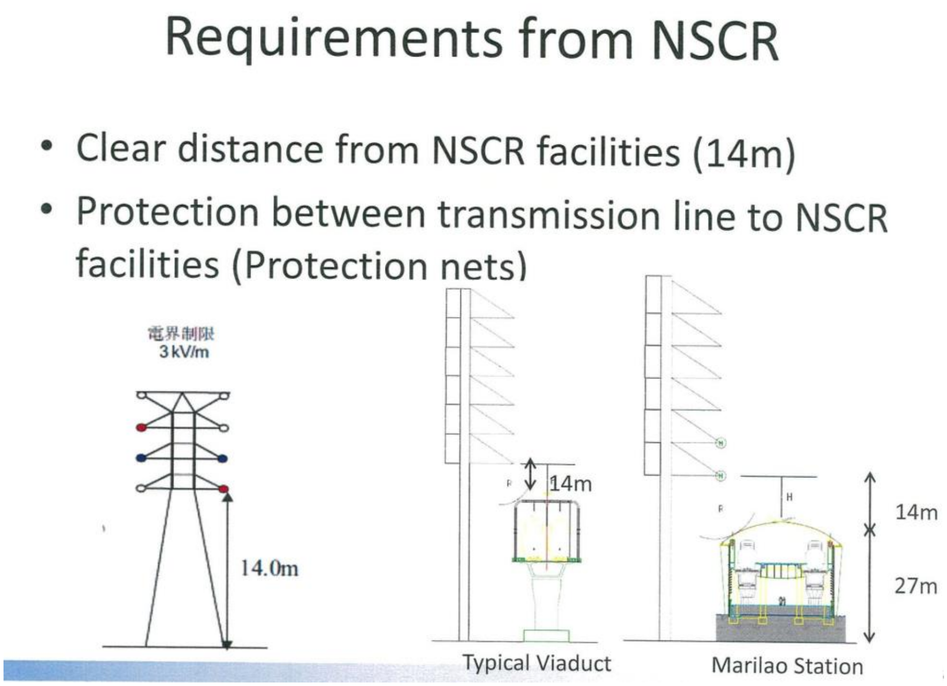


Source: JICA Design Team

Figure 4.2.27 Available Space without the Demolition of PNR Pasig Bridge and Relocation of High Voltage Towers

d) Future Problems with Nearby High Voltage Towers

The clearance between the NSRP-South structures and high voltage cables needs to be more than 14m as described in Figure 4.2.28.



Source: JICA Design Team

Figure 4.2.28 Clearance between Superstructures and High Voltage Transmission Cables

It is necessary to discuss the following items.

- Discussion with PNR: Confirmation about the removal of the PNR Pasig Bridge
- Discussion with NGCP: Confirmation of the relocation of the high voltage towers

7) Paco Pandacan Road Flyovers

a) Around PNR Pandacan Station

i) Location

JDT studies the NSRP-South alignment between PNR Pandacan Station and PNR Paco Station. At this location, the PNR alignment and Paco Pandacan Road intersect, where the PNR alignment passes under the elevated Paco Pandacan Road. Additionally, Skyway Stage 3 is also planned to run next to Paco Pandacan Road and cross over the PNR alignment. For these reasons, this section is very restricted in terms of horizontal and vertical clearance. (see Figure 4.2.29)

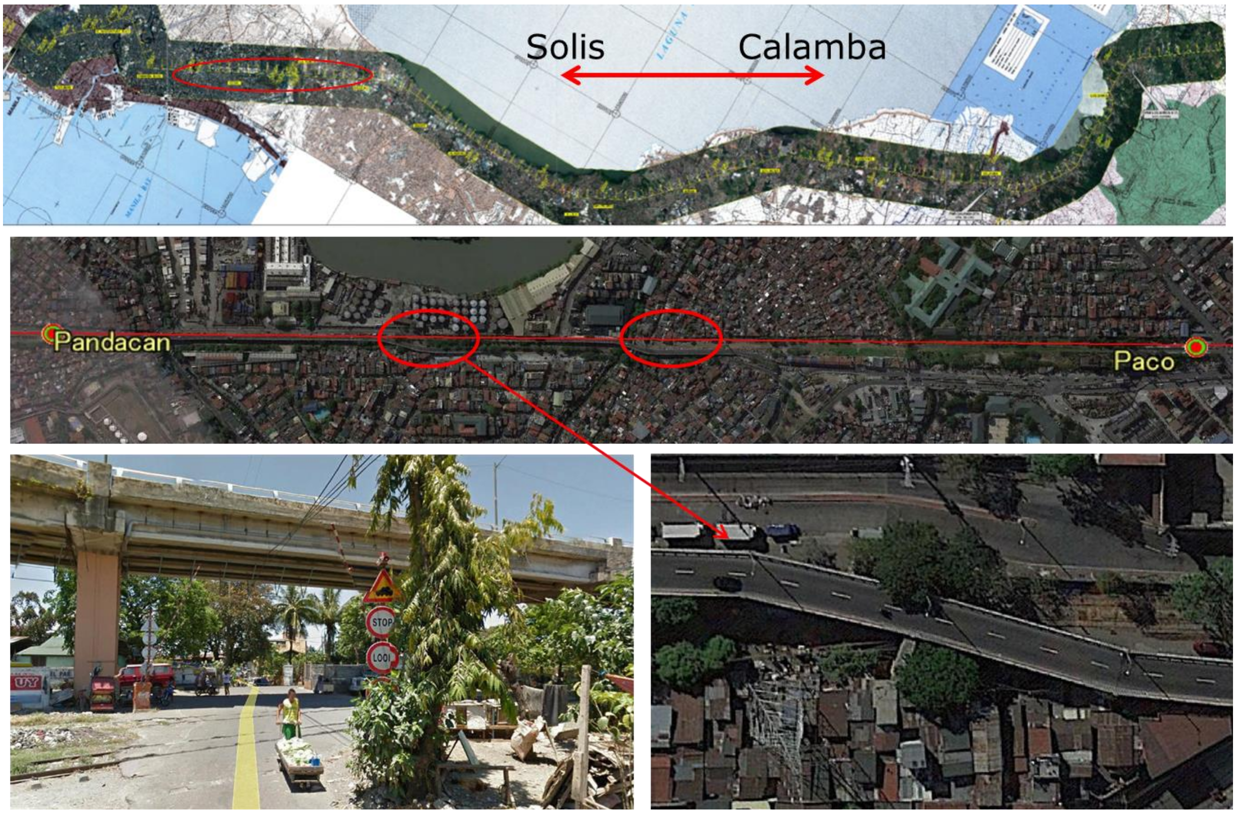


Figure 4.2.29 PNR Alignment and Paco Pandacan Road

ii) Intersection of PNR Line, Paco Pandacan Road and Skyway Stage 3

As shown in Figure 4.2.30, Section A-A is the narrowest section. At this location, the PNR Line is restricted by the pier of the planned Skyway Stage 3 and the portal pier of the existing Paco Pandacan Road.

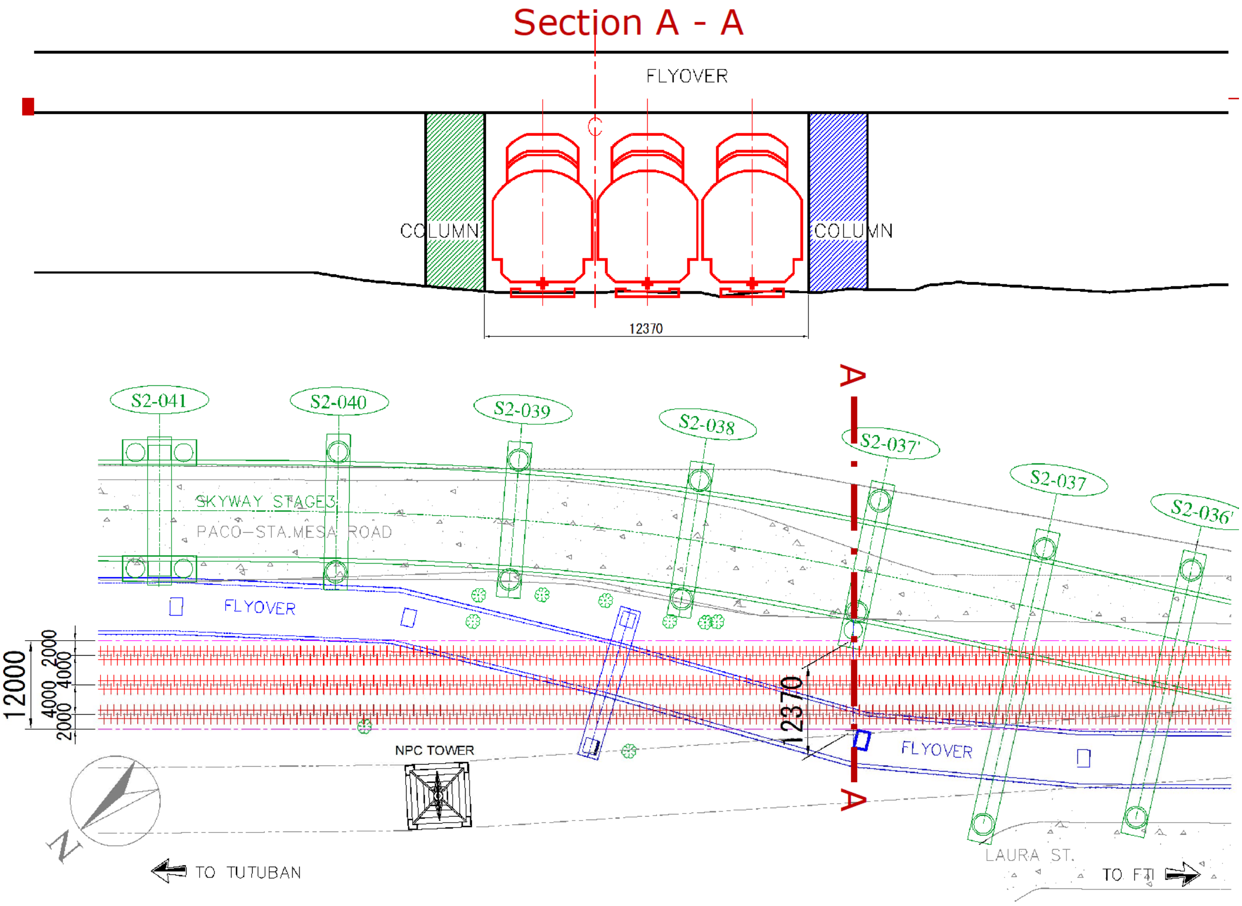


Figure 4.2.30 Distance between Paco Pandacan Road Piers and Skyway Stage 3 Piers

iii) Future Tasks

Close coordination and cooperation with the Toll Regulatory Board (TRB) will be necessary to secure the space of the PNR Line.

b) Paco Station

i) Location

JDT studies the alignment between PNR Pandacan Station and PNR Paco Station. Similar to the previous section, at this location the PNR Line and Paco Pandacan Road intersect, where the PNR Line passes under the elevated Paco Pandacan Road. Additionally, Skyway Stage 3 is also planned to run next to Paco Pandacan Road and cross over the PNR alignment. (see Figure 4.2.31) For these reasons, this section is very restricted in terms of horizontal and vertical clearance.

Figure 4.2.31 PNR Alignment and Paco Pandacan Road

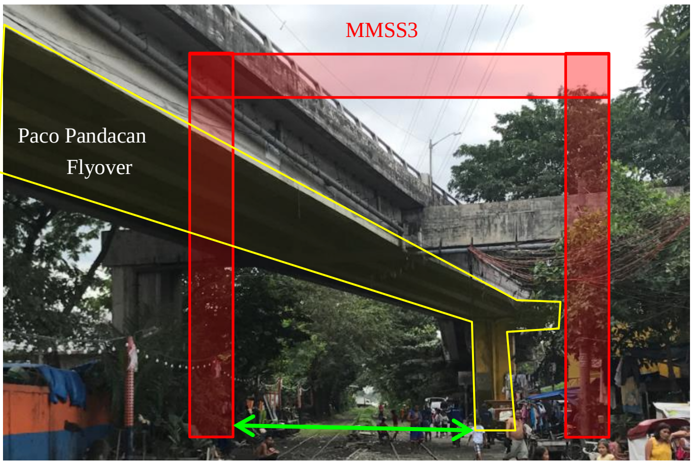


Figure 4.2.32 Horizontal clearance set by Paco Pandacan Flyover and MMSS3 superstructure

ii) Position with PNR Line, Paco Pandacan Road and MMSS3

As shown in Figure 4.2.33, Section A – A is the narrowest section. At this section, the PNR Line is restricted by the pier of the planned MMSS3 and the bridge of the existing Paco Pandacan Road.

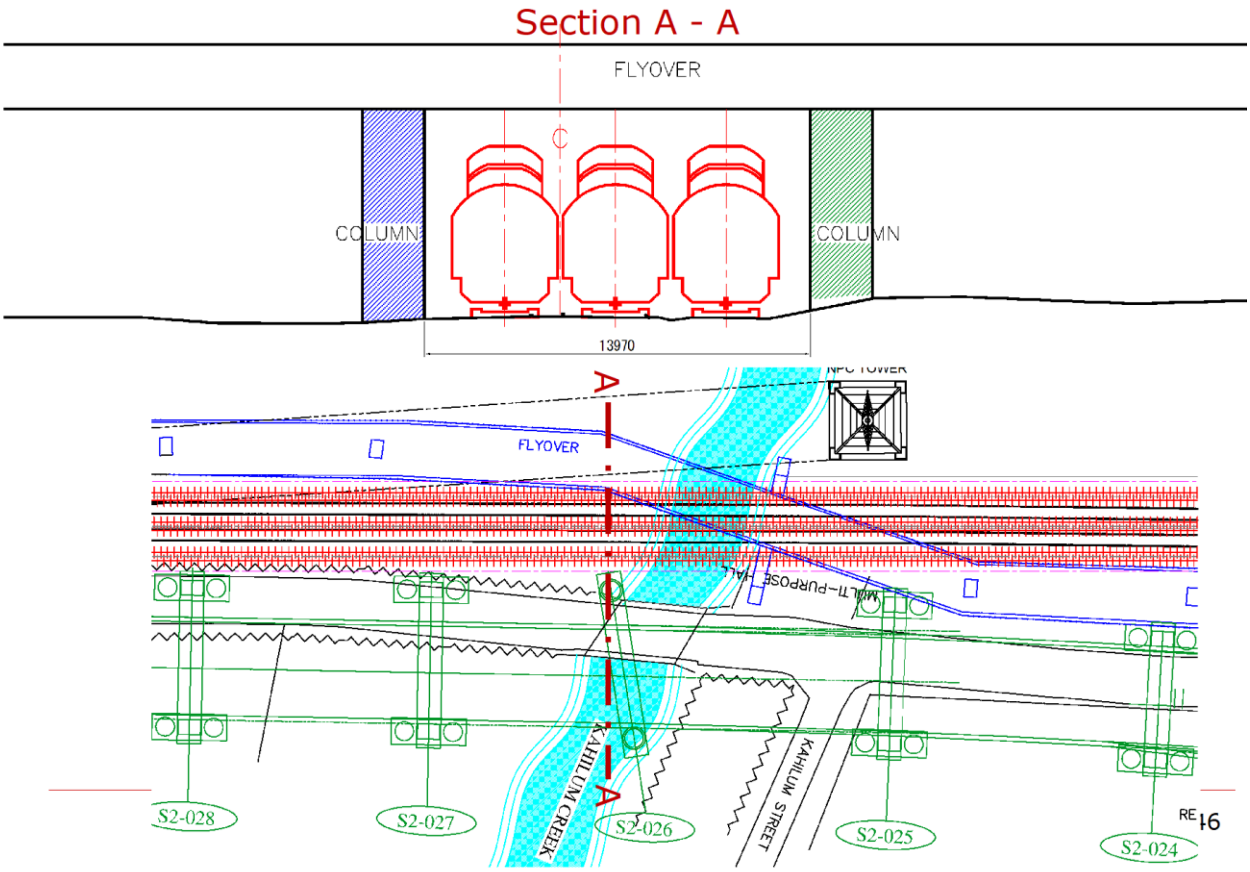


Figure 4.2.33 Distance between of Paco Pandacan Road Piers and MMSS3 Piers

iii) Future Tasks

Close coordination with TRB will be necessary to secure the space of the PNR Line.

8) A. Arnaiz Avenue Flyovers

a) Location

At this location, Metro Manila Skyway intersects the PNR alignment near PNR Pasay Road Station. The PNR alignment runs under A. Arnaiz Flyovers. Additionally, below the ramps, there is a road crossing that connects Amorsolo Street and SLEX (see Figure 4.2.34).

Figure 4.2.34 Pasay Road PNR Station and PNR Alignment under Skyway Ramps

b) Study of Viaduct type for NSRP-South

At this section, the required horizontal clearance can be secured. In order to secure the required vertical clearance between the road and the soffit of the NSRP-South viaduct, a U-type girder will be adopted at this section.

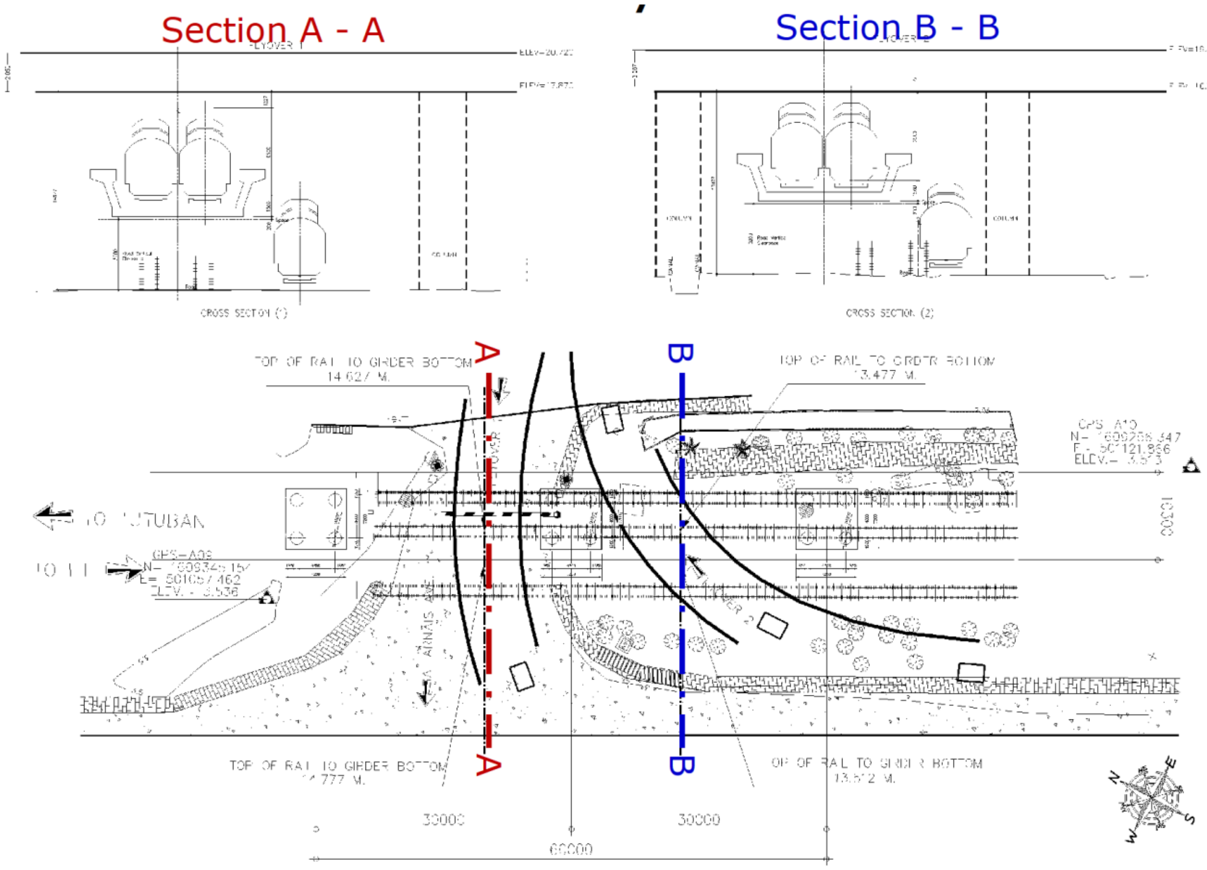


Figure 4.2.35 Vertical and Horizontal Clearance beneath Skyway Ramps

c) Future Tasks

Special considerations and design need to be implemented at this section in order to secure the vertical clearance between the road and the NSRP-South viaduct.

9) EDSA Station

a) Location

PNR EDSA station is located among various superstructures that severely constrain the vertical and horizontal clearance. Approaching EDSA station from both north and south, two ramps on each side overpass the PNR tracks to connect EDSA Boulevard with SLEX. Moreover, immediately adjacent to EDSA station, EDSA Boulevard and MRT3 flyovers run above the PNR alignment, with a pedestrian bridge beneath them connecting both sides of SLEX.

The vertical clearance at this section is governed by the pedestrian bridge. The horizontal clearance is governed by the piers of the MRT3 flyover, which are located on both sides immediately next to the PNR tracks.

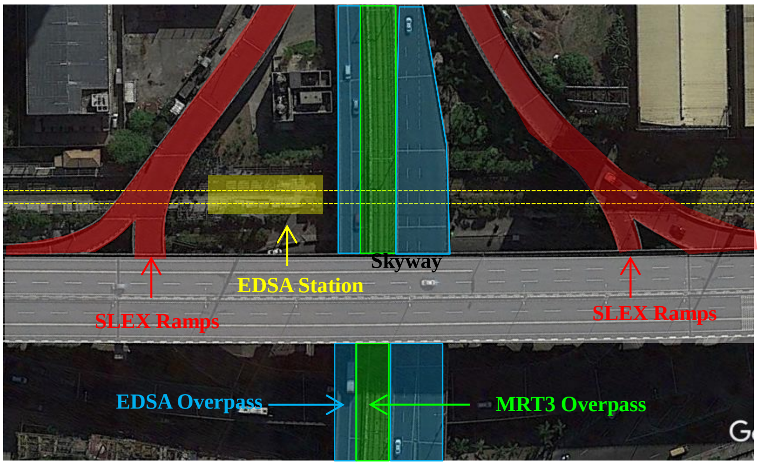


Figure 4.2.36 Plan view of EDSA station and surrounding infrastructures

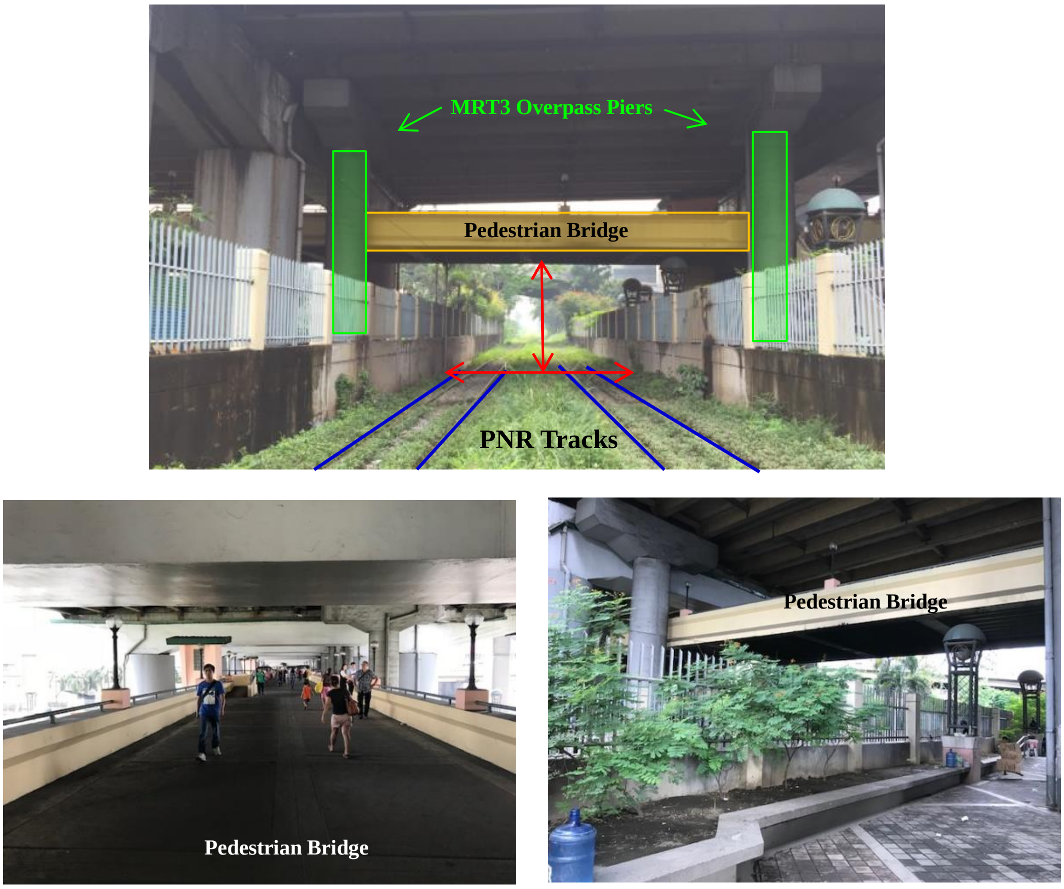


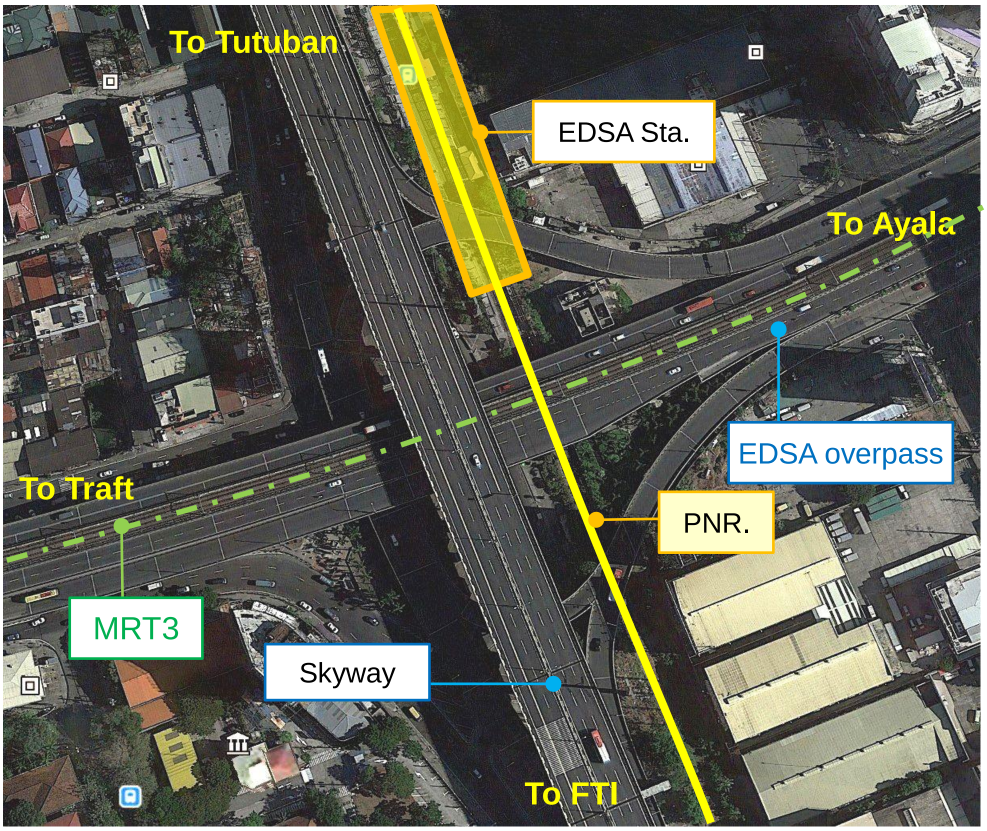
Figure 4.2.37 Pedestrian bridge and MRT3 piers

Source: JICA Design Team

Figure 4.2.38 Location Map

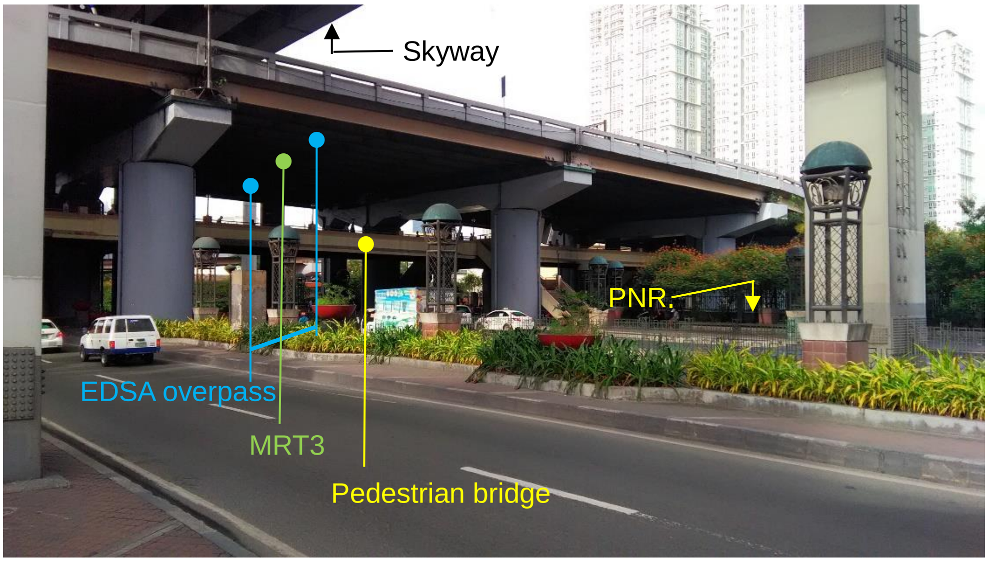
b) Intersection Condition

Around EDSA Station, EDSA Boulevard, the MRT3 viaduct and a pedestrian bridge cross over the PNR Line. The pedestrian bridge is under the MRT3 viaduct, therefore it controls the vertical clearance of the NSRP-South alignment at this section.



Source: JICA Design Team

Figure 4.2.39 Points of Intersection around EDSA Station



Source: JICA Design Team

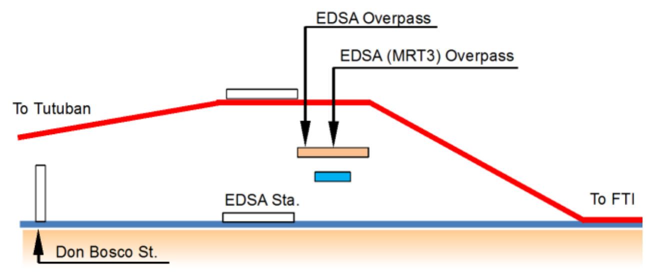
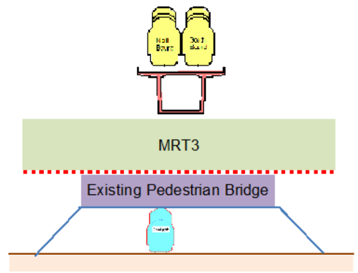
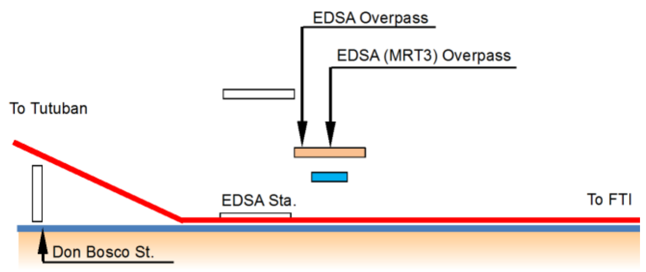
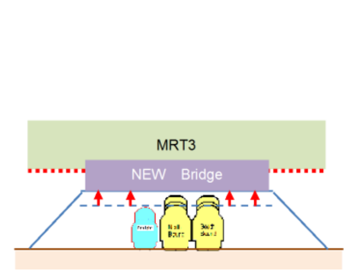
Figure 4.2.40 EDSA Overpass, MRT3 Viaduct and Pedestrian Bridge crossing PNR Alignment

c) Study of Vertical Alignment at EDSA Station

JDT examined 2 options. The option-1 is the plan that NSRP-South runs over EDSA overpass and MRT3 viaduct. The option-2 is the plan that NSRP-South is at-grade. In Option-1, it is assumed that only the NSRP-South alignment runs on a viaduct, while the PNR temporary track uses the current the PNR alignment. Based on the result of a Supplementary Survey on the NSCR, it was confirmed that the NSRP-South and PNR temporary line can run parallel (at-grade) at this section.

The result of the comparison is summarized in Table 4.2.6. As a result of comparison, JDT recommends to adopt Option-2, as this option is more feasible.

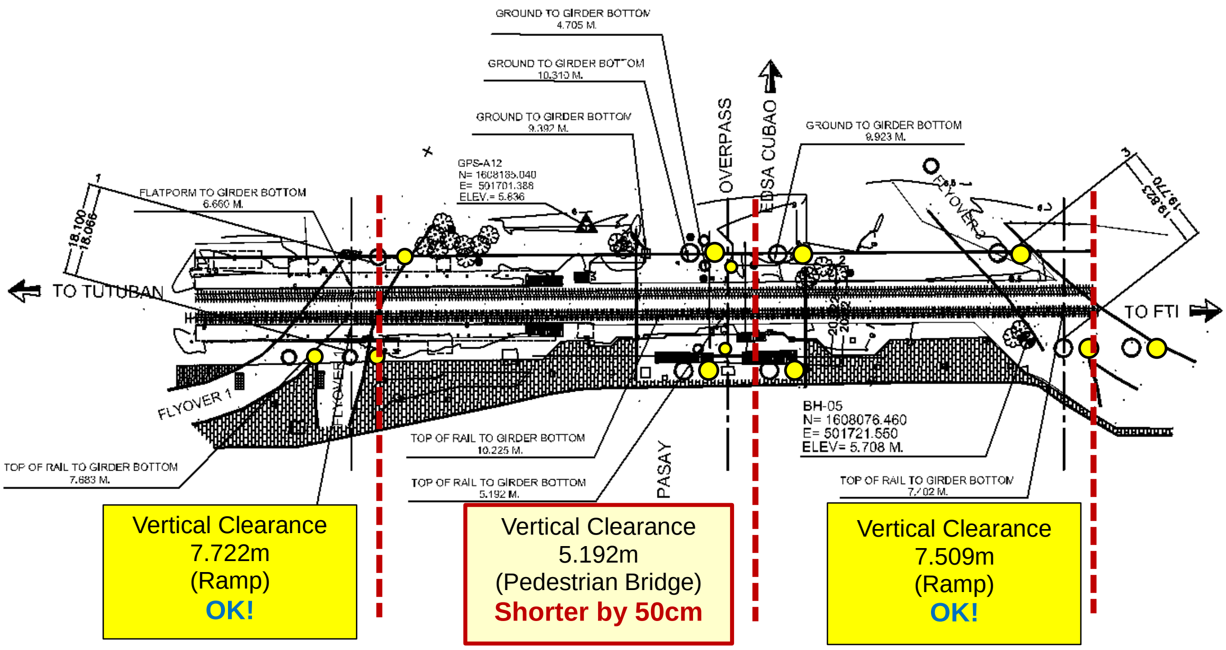
Table 4.2.6 Comparison of Vertical Alignment

<table>
<tr><th></th><th colspan="2">Overview</th><th></th></tr>
<tr><td rowspan="2">Option 1</td><td>
</td><td>
</td><td rowspan="2">B</td></tr>
<tr><td colspan="2">Comment:
NSRP-South over EDSA
PNR temporary line at-grade
Pier height is about 20m
Costly plan</td></tr>
<tr><td rowspan="2">Option 2</td><td>
</td><td>
</td><td rowspan="2">A</td></tr>
<tr><td colspan="2">Comment:
NSRP-South at-grade
PNR temporary line at-grade
Existing pedestrian bridge is removed.
Economical plan</td></tr>
</table>

Source: JICA Design Team

d) Vertical Clearance of the NSRP-South Line

Based on the survey works conducted around PNR EDSA Station, it was determined that the vertical clearance from the rail level of the PNR Line to the bottom of the pedestrian bridge is 5.192m, 50cm short to the required vertical clearance gauge (standard 5.7 m) of the NSRP-South. For this reason, JDT further examined Option-2 into Option2-1 and Option2-2.



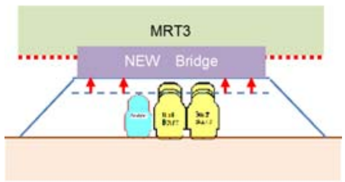
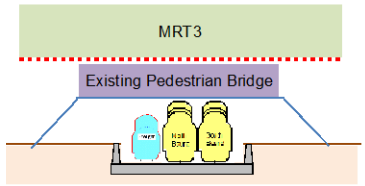
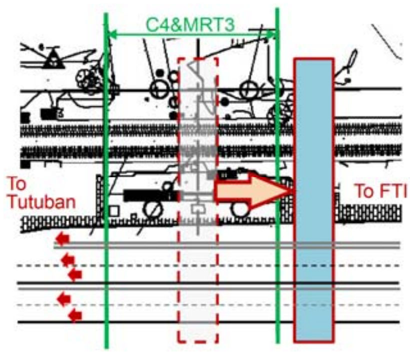
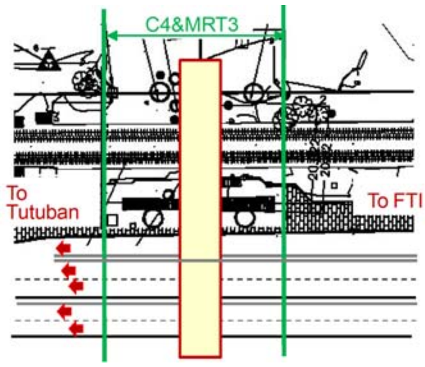
Source: JICA Design Team

Figure 4.2.41 Survey Result around PNR EDSA Station

Option-2-1 considers relocation of the pedestrian bridge to the south side of the EDSA viaduct. Option-2-2 considers lowering the vertical alignment of the NSRP-South to accommodate the necessary vertical clearance. This option however requires the construction of a retaining wall on the track sides.

The results of the detailed examination of both options are summarized in Table 4.2.7. The cost of Option2-1 is higher than Option2-2, and Option2-1 is necessary to relocate the pedestrian bridge. It is difficult because it is required to stop road traffic under construction. On the other hand, in Option-2-2, it is necessary to construct a new retaining wall under the PNR temporary line operating (in the case of securing clearance 5.7m). So, JDT is studying reduction of construction gauge under condition not be relocated the pedestrian bridge.

Table 4.2.7 Study on securing clearance of NSRP-S

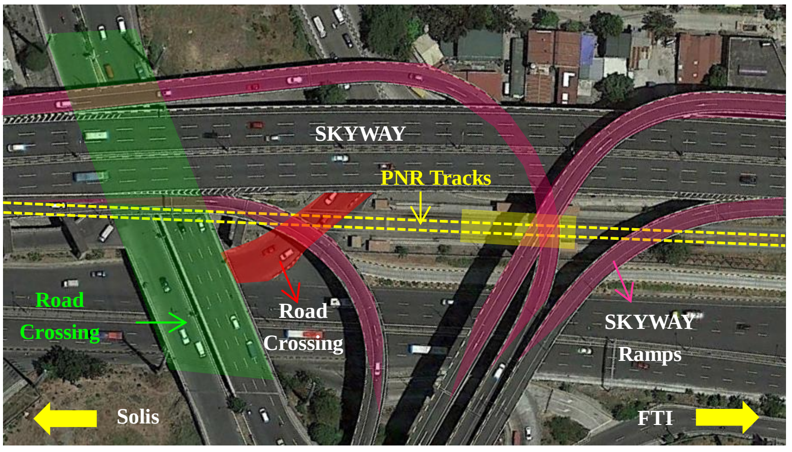
	Option-2-1	Option-2-2
Cross section		
Plan View		
Need structure	New pedestrian bridge	U Shape wall (Refurbishment)
Operation of PNR during construction	Easy	Difficulty (Construction in the ROW of PNR)
Reach consensus with DPWH	Necessary	No need
Cost	[redacted]	[redacted]
Evaluation	A	B

Source: JICA Design Team

10) Nichols Station

a) Location

Similar to EDSA station, Nichols station is located between several infrastructures, such as ramps, bridges, overpasses and road crossings. North of Nichols Station, Lawton Avenue crosses the PNR tracks at level two, and immediately between Lawton Avenue and Nichols station, there exists a road crossing connecting the traffic circulating from Sales Road to SLEX. Moreover, further on the north of Nichols station and Lawton Avenue, Metro Manila Skyway crosses over the PNR alignment. The portal piers of the Metro Manila Skyway leave sufficient horizontal clearance beneath to allocate the double PNR tracks. On the south of Nichols station, three ramps connecting Sales Road with Skyway overpass the PNR alignment and Nichols station. The lowest ramp located on top of Nichols station, determines the vertical clearance of PNR alignment and the future NSRP alignment (Figure 4.2.43).



Source: JICA Design Team

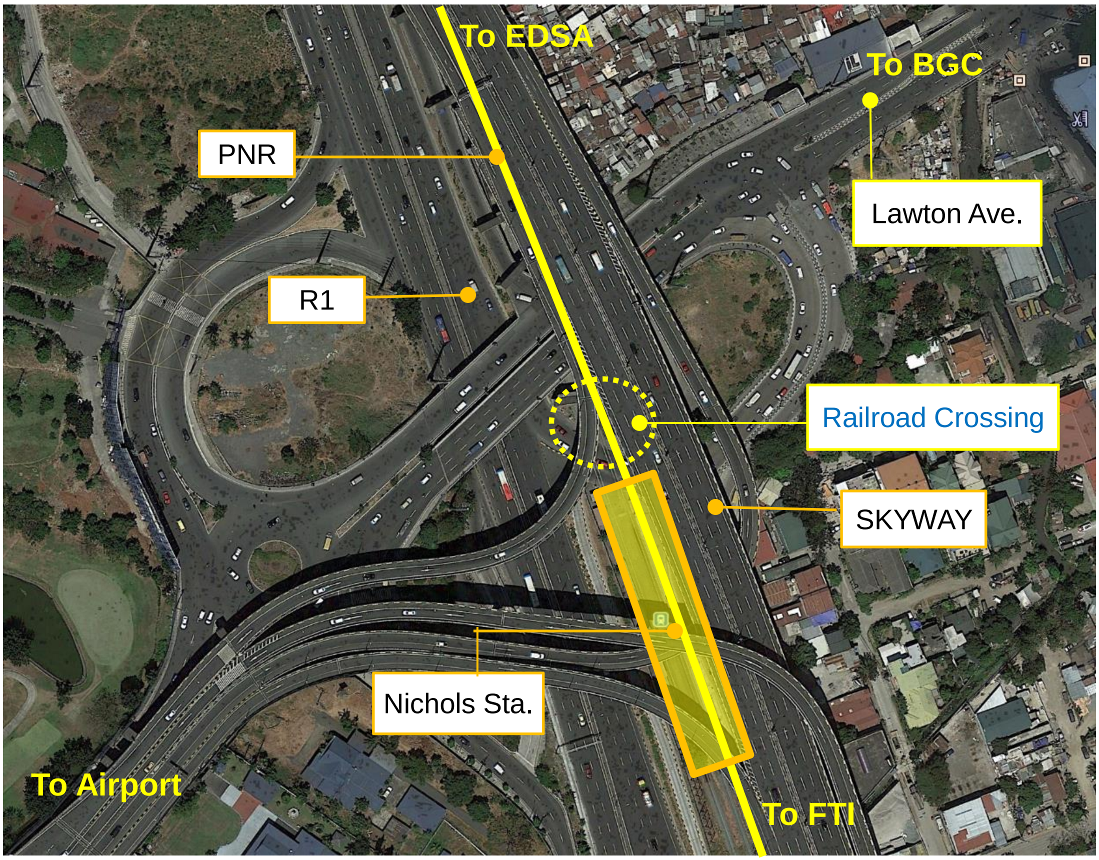
Figure 4.2.42 Infrastructure (Ramps, overpass, bridge and road crossing) around PNR Nichols station

Source: JICA Design Team

Figure 4.2.43 PNR Nichols station and surrounding infrastructure (Skyway and ramps)

b) Intersection condition

Skyway runs parallel above PNR Line and crosses over the PNR alignment after PNR Nichols Station. Lawton Avenue, connecting Manila International Airport and BGC, also crosses over the PNR alignment. Additionally, north of PNR Nichols Station, there is a highly congested road crossing that the East Service Road with NLEX.



Source: JICA Design Team

Figure 4.2.44 Intersection Condition at Nichols Station

c) Clearance of the NSRP-South

Based on the Supplementary Survey on the NSRP-South around Nichols Station, it was determined that the clearance between the PNR Line to the soffit of the ramp crossing over Nichols Station is 5.533m. This available vertical clearance is approximately 10cm short of the minimum vertical clearance (5.7m) of the NSRP-South.

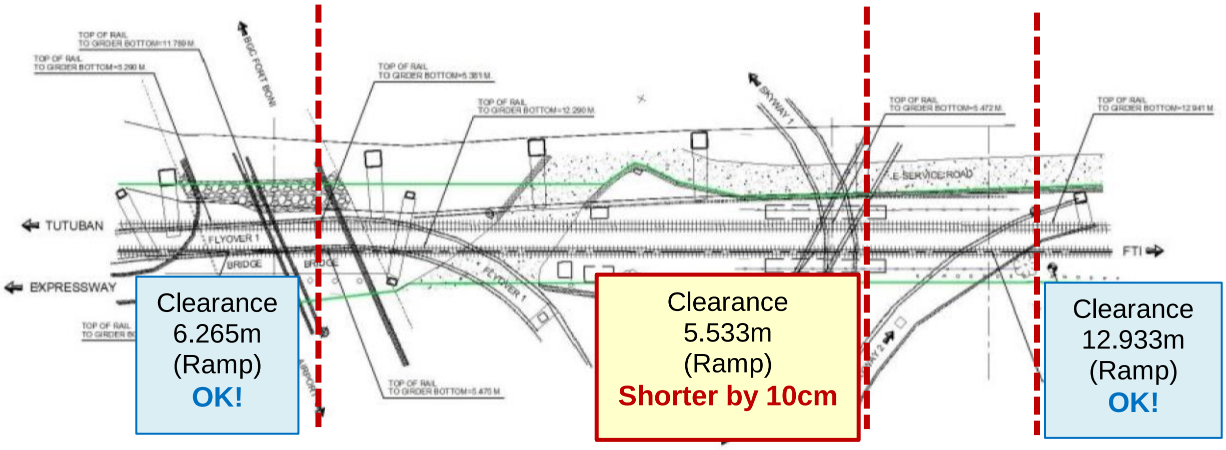


Figure 4.2.45 Survey Result near Nichols Station

d) Study of Vertical Alignment

JDT examined three options for the NSRP-South vertical alignment.

- Option-1: Viaduct plan
- Option-2: At-grade plan
- Option-3: Underground plan

In Option-1, the piers of the viaduct must be arranged avoiding the Skyway and Lawton Avenue above PNR Line. Therefore, the position where the bridge piers can be installed is limited, resulting in a span length of over 180m long. Also, because this option involves the construction of the NSRP-South viaduct above Skyway Viaduct (3rd layer), a pier with a height of approximately 30m will be required. Therefore, Option-1 is deemed not to be feasible. Therefore, JDT focused in the study of Option-2 and Option-3.

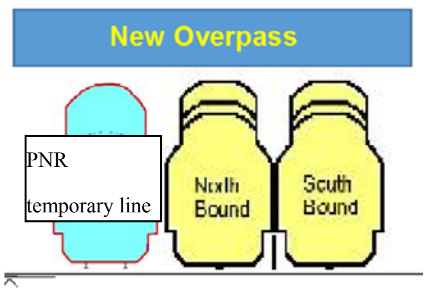
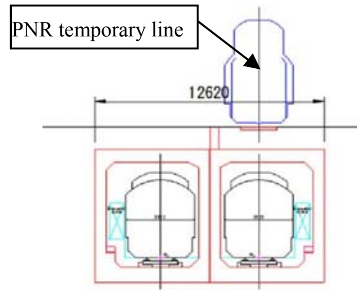
Source: JICA Design Team

Figure 4.2.46 Location of Piers and Span Layout for Option-1

The comparison table (Option-2 and Option-3) is presented in Table 4.2.8. As the result of comparison, JDT recommends Option-3. The reason is as follows.

- Option-2 is shorter by 10cm, so the rail level has to be lowered. For this reason, the railway crossing north of Nichols Station is closed. Therefore, the new connection road from Lawton Avenue to the National Route 1 should be constructed. The connection road is flyover. By JDT study, to plan the alignment, it is necessary to use 1 lane as the right turn lane of the southbound road (2 lanes in the current state). JDT think that lane reduction on the south bound road becomes a factor of functional deterioration (such as the possibility of occurrence of traffic congestion etc.) to the current road traffic.
- Based on above, the option-3 seems to be reasonable though it is a plan not to change current traffic though cost is high.

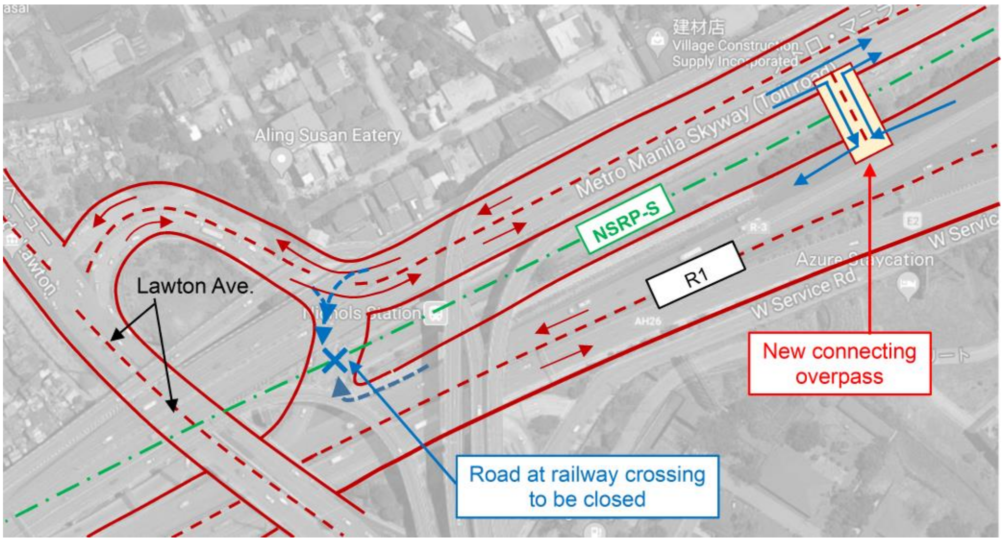
Table 4.2.8 Examination results of vertical alignment

	Option-2	Option-3
Cross section		
Structure Type	At-grade	Underground
Need of New structure	Need overpass	Need tunnel
Operation of PNR during construction	Possible	Possible
Impact on Road Traffic	Large	-
Reach consensus with DPWH	Difficult	Easy
Cost	[redacted]	[redacted]
Evaluation		○

Source: JICA Design Team

e) Examination of Connection with National Highway No.1 (Option-2)

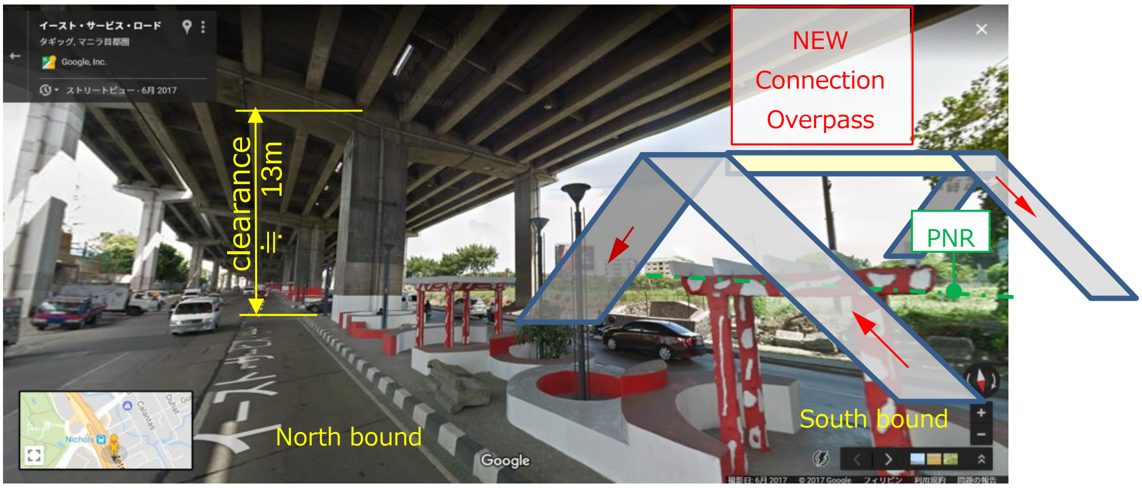
Lowering the rail level to secure the required vertical clearance beneath the ramp above Nichols Station makes it also necessary to lower the rail level at the rail-road crossing of north of Nichols Station. Moreover, the distance from the station to the rail-road crossing of the National Route 1 is extremely short (approximately 20m) and the train operation interval of the NSRP-South will be much shorter than the current PNR operation so that this rail-road crossing will experience heavy traffic congestion of the cars on the National Highway No. 1 accessing from the airport. For this reason, the rail-road crossing is proposed to be closed (Option-2). As a countermeasure, JDT proposes to habilitate a new access overpass bridge south of Nichols Station.



Source: JICA Design Team

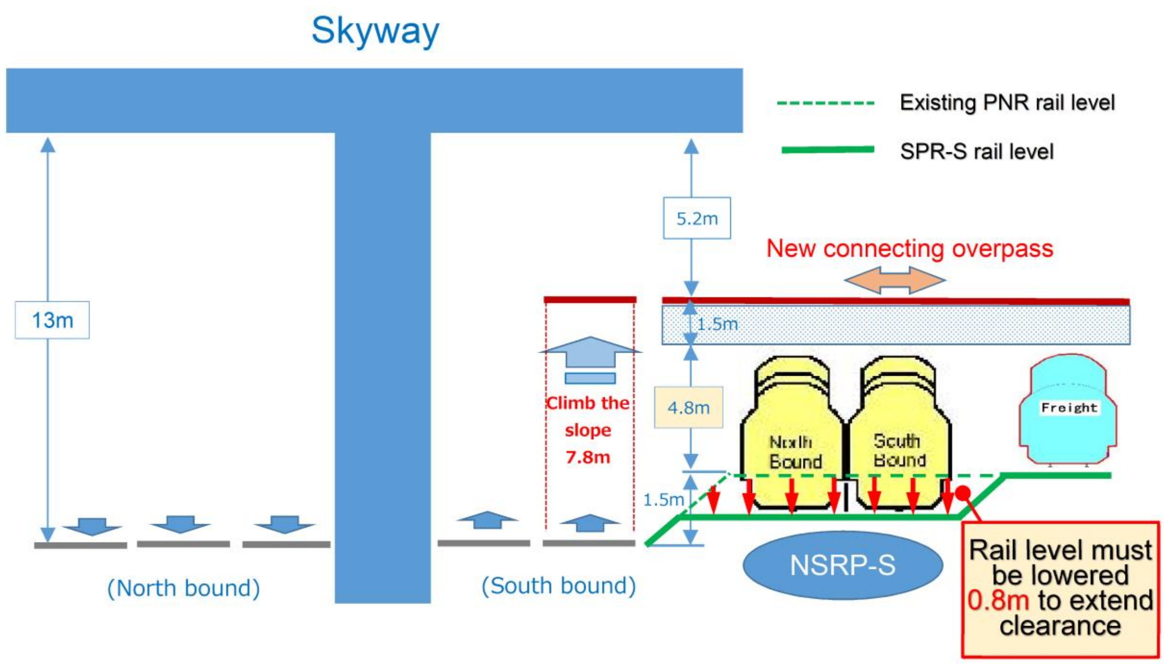
Figure 4.2.47 Planning of New Overpass above PNR Line

JDT proposes that the new bridge cross over the NSRP-South Line and PNR temporary line. The access ramp to the proposed new overpass will occupy one lane of the East Service Road (south bound), that will allow connectivity between the service road and the national highway. According to a simple survey result, the vertical clearance of the Skyway's soffit is about 13m. In order to secure the clearance gauge on the overpass bridge, it is necessary to lower the vertical alignment of the NSRP-South by about 0.8m.



Source: JICA Design Team

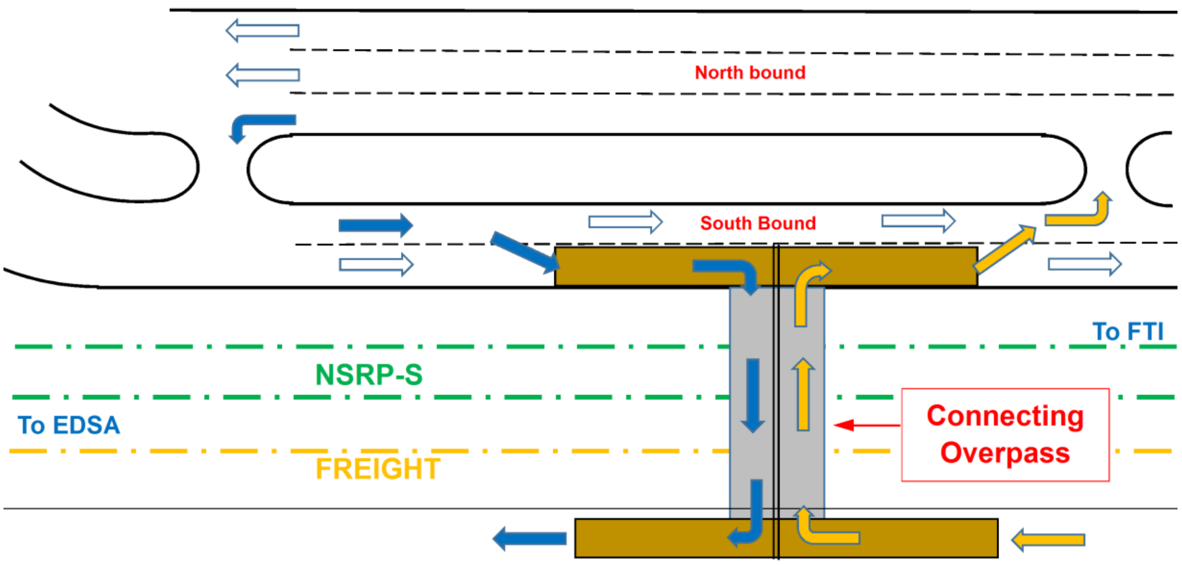
Figure 4.2.48 Concept of the New Overpass



Source: JICA Design Team

Figure 4.2.49 Concept of the New Overpassing the NSRP-South Line

In addition, vehicles going north approach the bridge using a U turn habilitated immediately after the new overpass.

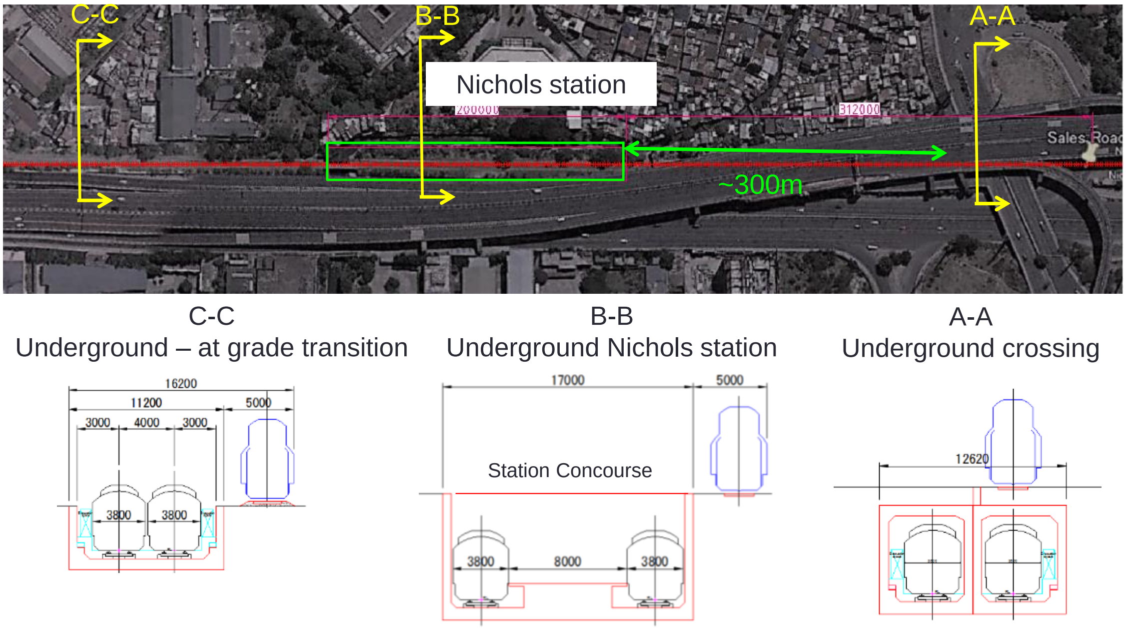


Source: JICA Design Team

Figure 4.2.50 Access Plan for Northbound Vehicles

f) Study of the Underground option

The access ramp (south bound) to the proposed new overpass is a fear of causing heavy traffic congestion as it occupies one lane of the south bound road. Furthermore, the embankment of the access ramp will obstruct the access to the new station. As a result, in order to solve these problems, we propose an underground structure. The validity of the underground structure plan is currently being considered, taking into account the relationship of Skyway substructure, temporary line of PNR, the neighboring canals, the station location. Figure 4.2.51 shows the underground option.



Source: JICA Design Team

Figure 4.2.51 Underground option

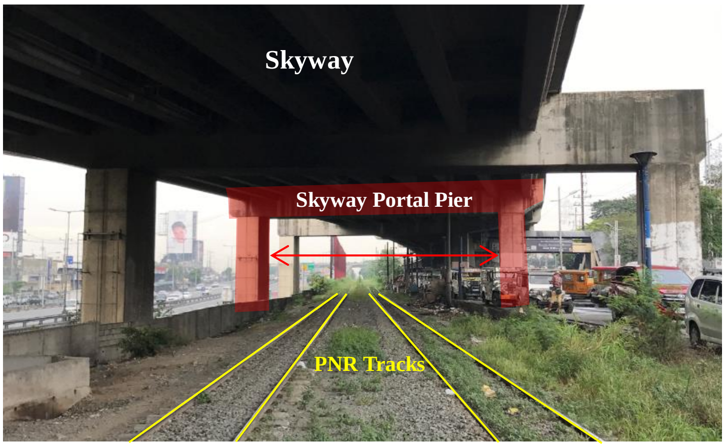
11) FTI

a) Location

PNR FTI station is located adjacent to the Metro Manila Skyway on its east. On the north of PNR FTI station, the Metro Manila Skyway crosses over the PNR alignment. At this location, the Metro Manila Skyway is supported by several portal piers, which determine the horizontal and vertical clearances of the railway alignment (Figure 4.2.52). Although the current site condition does not pose many complications for the planning of the NSRP – South alignment and NSRP – South FTI station, it is important to take into consideration the future plans of the C6 interchange and Mega Manila Subway alignment and its station (Figure 4.2.54).

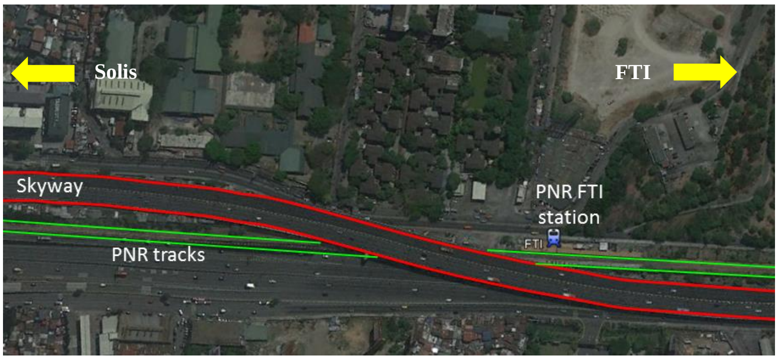
The proposed plan of the C6 Interchange will include various ramps overpassing the PNR alignment that will connect the new circular road with the Metro Manila Skyway. Several pier locations of the C6 Interchange ramps are proposed to be located within the PNR ROW and will pose a direct conflict with the NSRP - South alignment.

Moreover, the FTI Mega Manila Subway Station will be also at this location. Any earth works, e.g., excavations, construction of foundations, etc., need to take into account the location of the future station as well as the details of the subway tunnel, proposed to run right beneath the PNR alignment.



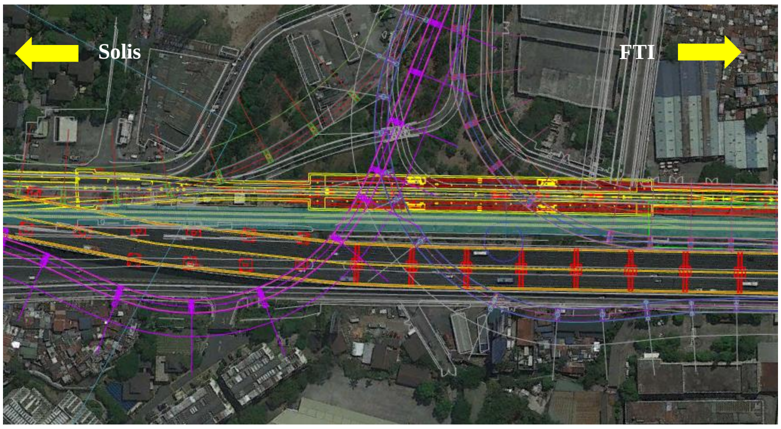
Source: JICA Design Team

Figure 4.2.52 Skyway overpassing PNR tracks and portal piers defining the horizontal clearance



Source: JICA Design Team

Figure 4.2.53 Current situation at PNR FTI Station



Source: JICA Design Team

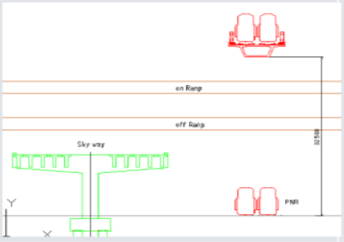
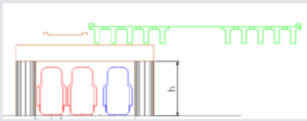
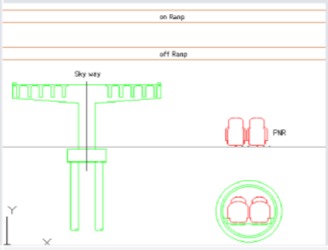
Figure 4.2.54 C6 Interchange plan at FTI and MMSP FTI proposed station

b) Study of Vertical Alginment

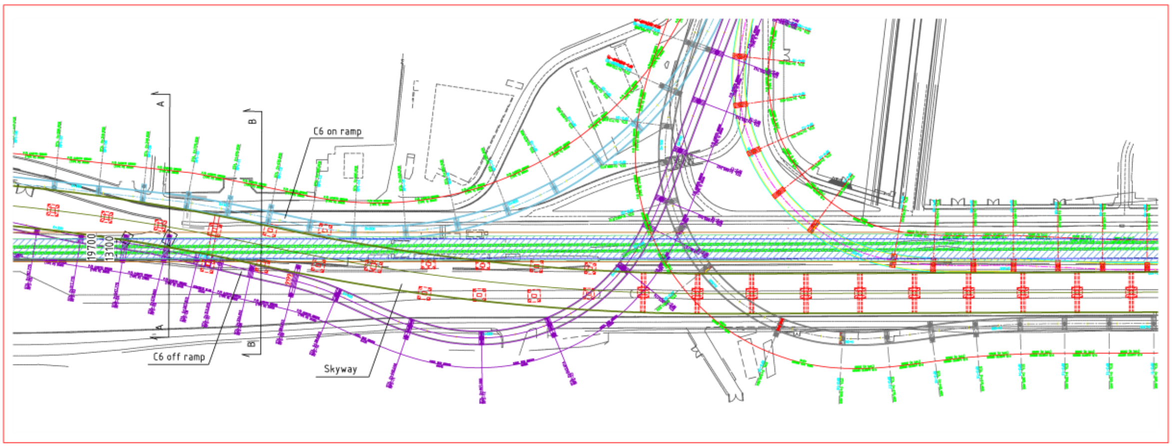
The distance between the Skyway piers is more than 19m at its narrowest section. This horizontal clearance satisfies the necessary horizontal clearance of 12.7m to allocate the NSRP-South and PNR temporary track. It is important to take into consideration of the future C6 Interchange Ramps that will also cross over the PNR alignment On the other hand, distance between piers of the planned C6 Interchange is about13.1m at the minimum. Therefore the Option-1 is the optimal plan (shown in Table 4.2.9).

Table 4.2.9 Comparison of Vertical Alignment at FTI

Comparison of Vertical Alignment

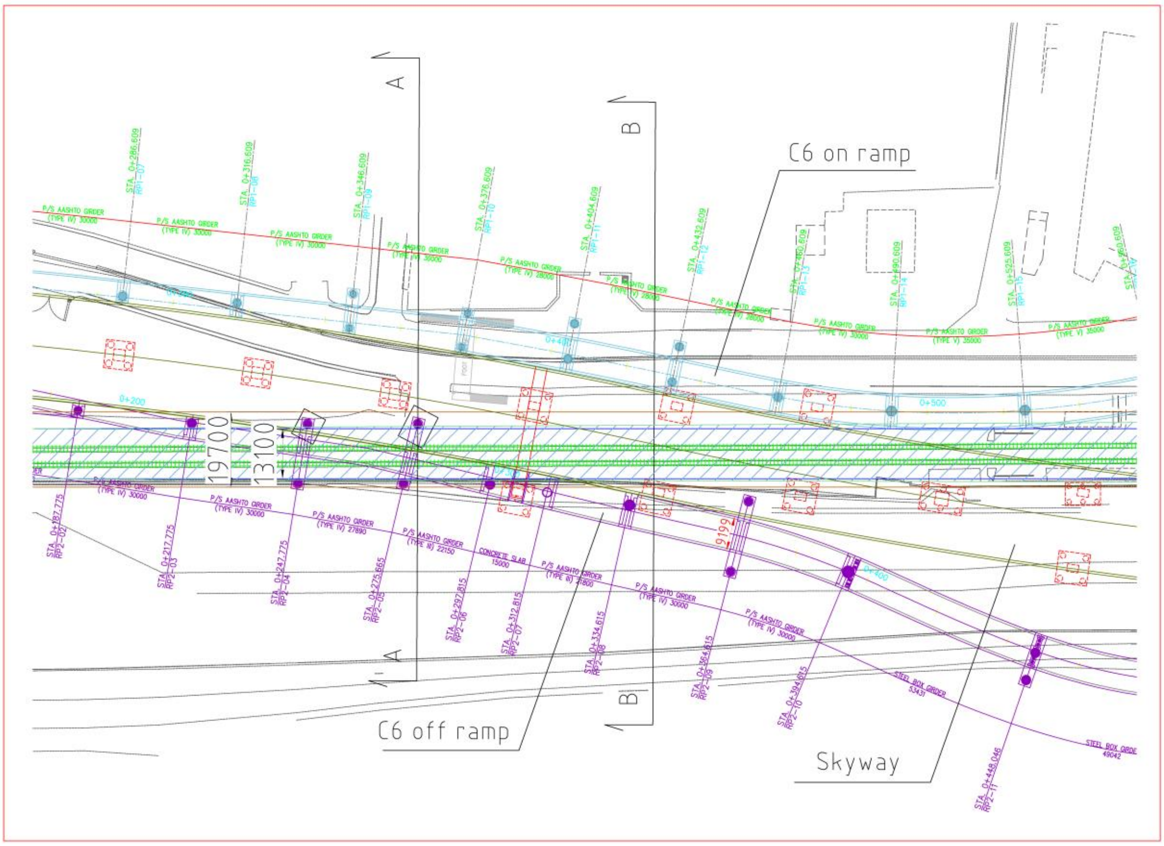
Option	Option 1	Option 2	Option 3
Cross Section			
Construction Difficulties	**Unrealistic** Viaduct / bridge height (>30 m) Long Span Bridge (200 m) Conflict with existing piers	**Fair** Possibly need to reduce rail level	**Difficult** Difficult construction due to many nearby foundations
Conflicting Structures	Skyway C6 Interchange Ramps Carlos P. Garcia Avenue Overpass	Carlos P. Garcia Avenue Overpass	Skyway C6 Interchange Ramps Carlos P. Garcia Avenue Overpass
PNR Operations	Possible	Possible	Possible
Freight Track	Possible	Possible	Possible
Cost	Very Expensive	Fair	Very Expensive
Evaluation	F	A	C

Source: JICA Design Team



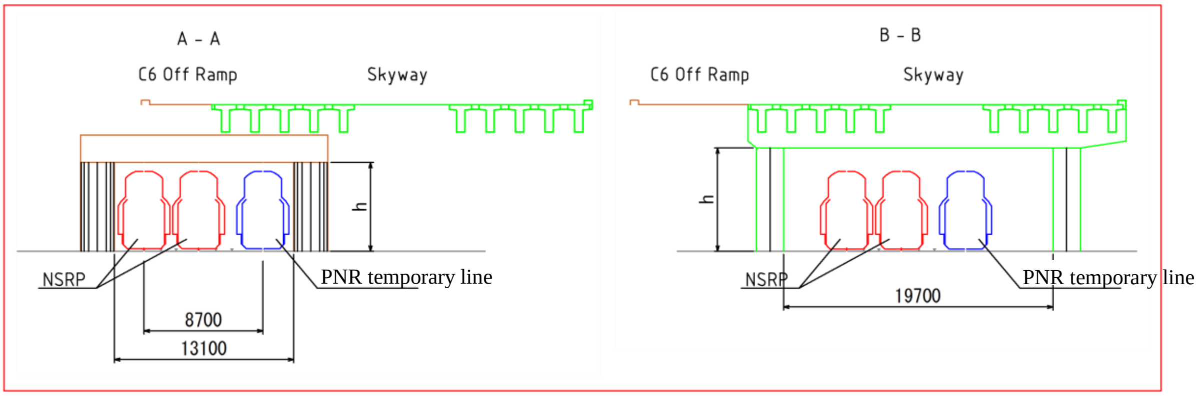
Source: JICA Design Team

Figure 4.2.55 Columniation at FTI Section



Source: JICA Design Team

Figure 4.2.56 Detailed Ground Plan at FTI Section



Source: JICA Design Team

Figure 4.2.57 Planned Cross Section at FTI Section beneath Skyway and C6 Ramps

Source: JICA Design Team

Figure 4.2.58 Skyway on Top of PNR Line

c) Future Tasks

- Confirmation of Construction Gauge of NCRP-South

  A part of the supporting beam of C6 off-ramp is planned under Skyway, so it is necessary to confirm whether of the vertical clearance of the NCRP-South can be secured (see Figure 4.2.57).

- Discussion with DPWH about bridge position of C-6 off-ramp overlapping with Sky way

  For the required width of 12.7 m, the available width is 13.1 m, however the margin is small. Therefore, it is necessary to discuss consultations requesting review of the column position of the C - 6 OFF - Ramp.

(3) Study of the special structure plan and type

1) Overview

In the NSRP-South line, there are many intersections (rivers, crossing roads, existing structures, and so on). So, it is necessary to consider the optimum structure plan considering interesting objects.

Table 4.2.10 List of Major intersections

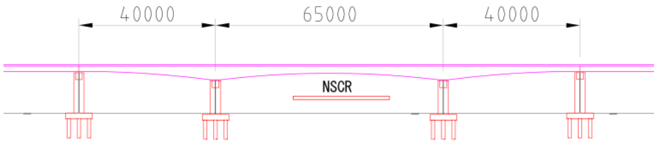
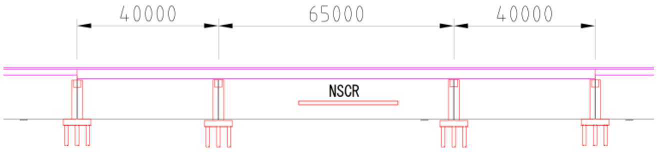
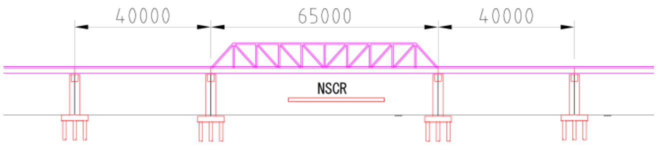
CH	Intersection
1k350m	Solis overpass at the crossing point of PNR tracks
1k946m	Blumentrit Station(LRT1)
5k619m	LRT2, Magsaysay Bridge
6k745m	Pasig river
33k882m	A Mabini Street
34k330m	Maharlika Highway(Flyover)
39k227m	Biñan River
41k627m	Manila South Road
54k000m	San Cristabal River (NSRP)
54k000m	San Cristabal River (DEPOT access line)
55k345m	Calamba River

2) Solis overpass at PNR track

There are 2 lines in the section, which are turn out tracks (plan) and existing track of PNR. Therefore it is necessary to decide piers location of NSRP-South considering avoiding the tracks. So, NSRP-South line needs long span bridge.

As a result of comparison of bridge type, JDT proposes PC-box girder (option 1).

Table 4.2.11 Comparison of Bridge Type at Solis Overpass

General view	Comment		
Option-1 PC Box Girder(3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Usually Free Fair	A
Option-2 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good (Coloring) Free Expensive	B
Option-3 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Expensive	C

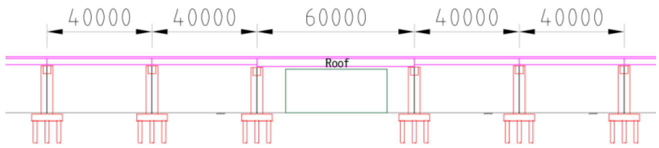
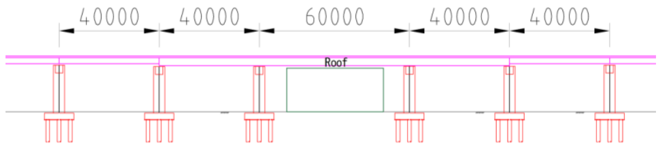
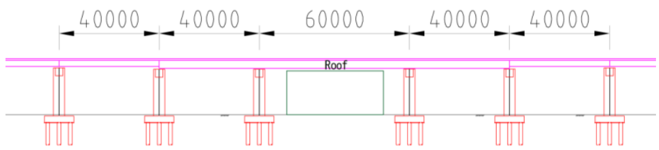
Source: JICA Design Team

Figure 4.2.59 Turnout tracks and existing track of PNR

3) Brumentritt Station

As a result of comparison of bridge type, JDT proposes PC-box girder (option 1).

Table 4.2.12 Comparison of Bridge Type at Brumentritt Station

General view	Comment		
Option-1 Simple steel box girder 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Usually Free Fair	B
Option-2 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Usually Free Expensive	C
Option-3 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Usually Free Fair	A

Source: JICA Design Team

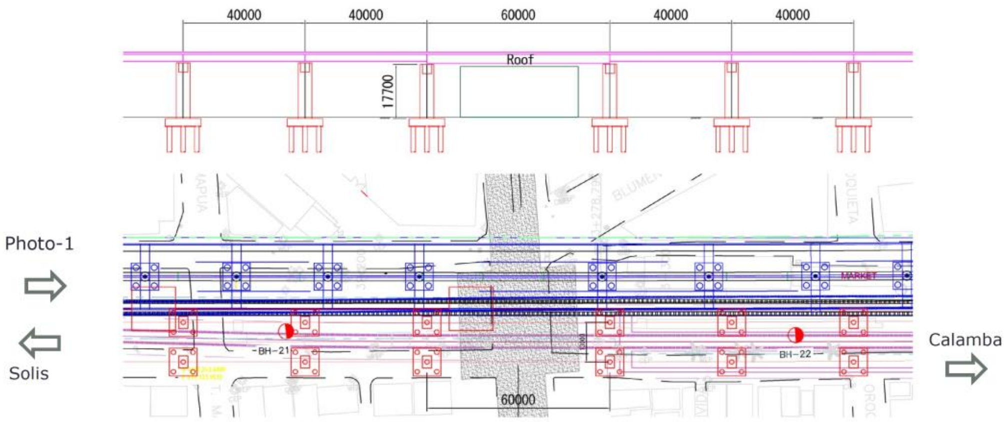


Photo-1

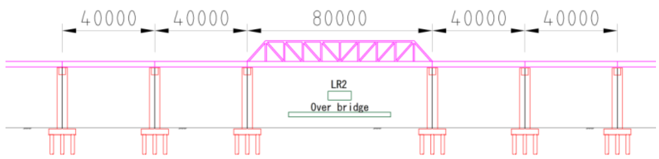
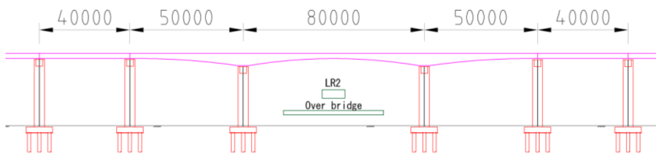
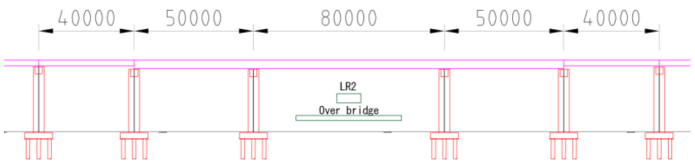
Source: JICA Design Team

Figure 4.2.60 Bridge Arrangement Drawings

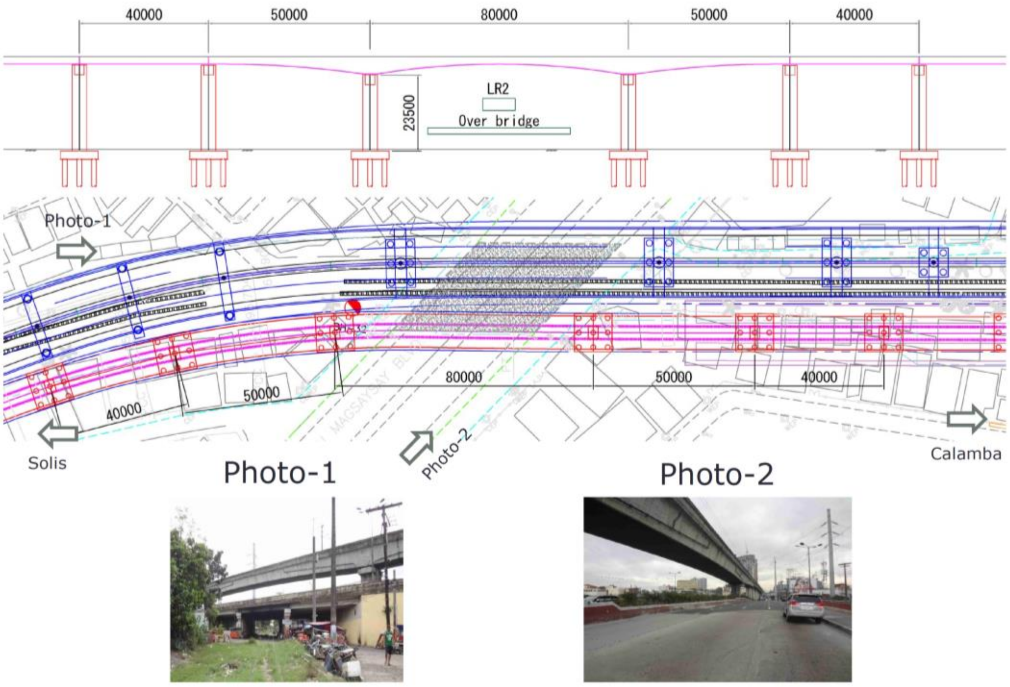
4) LRT2 and Magsaysay Bridges

As a result of comparison of bridge type, JDT proposes PC-box girder (option 1).

Table 4.2.13 Comparison of Bridge Type at LRT2 and Magsaysay Bridge

General view	Comment		
Option-1 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard difficult Great Free Expansive	C
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible good Free Fair	A
Option-3 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard difficult Good(Coloring) Free Expansive	B

Source: JICA Design Team



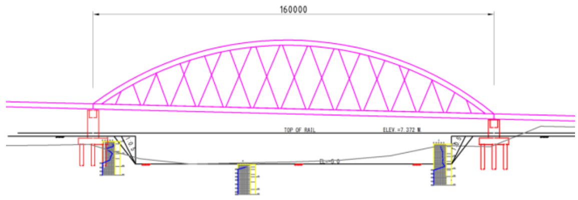
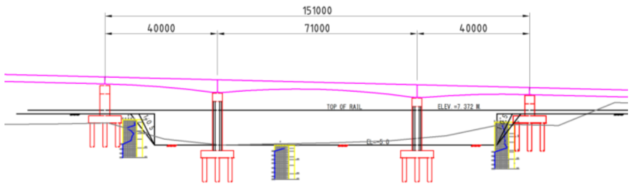
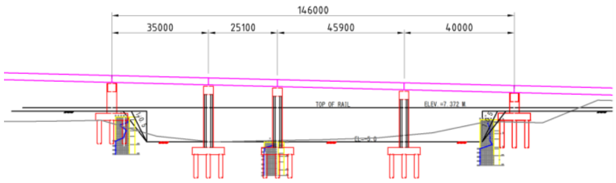
Source: JICA Design Team

Figure 4.2.61 Bridge Arrangement Drawings

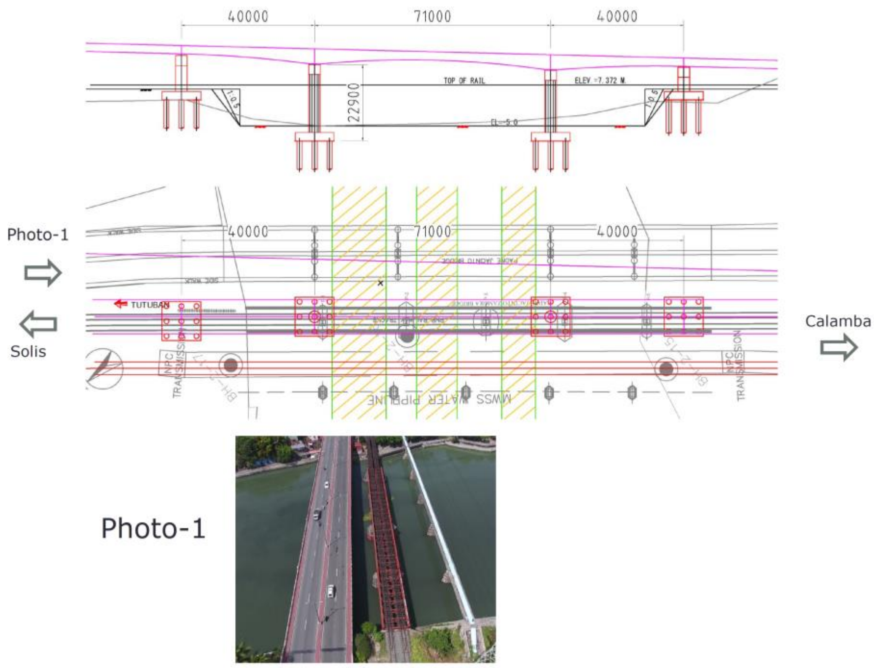
5) Pasig River

As a result of comparison of bridge type, JDT proposes PC-box girder (option 1).

Table 4.2.14 Comparison of Bridge Type at Pasig River

General view	Comment		
Option-1 Arch Bridge 	Structural characteristic	Exceeds applicable span length	F
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost (Million PHP)	Standard Possible good Free 529(1.04)	A
Option-3 Pc Box Girder (4-span) 	Structural characteristic Workability Landscape Maintenance Construction cost (Million PHP)	Standard difficult Good (Coloring) Free 510(1.00)	B

Source: JICA Design Team



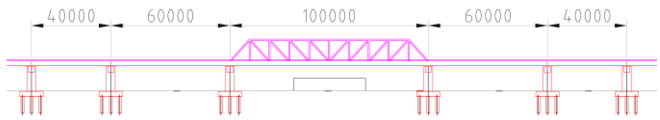
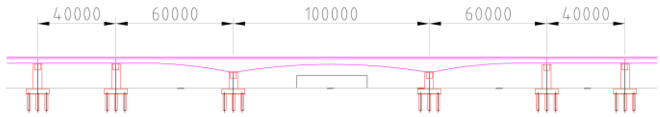
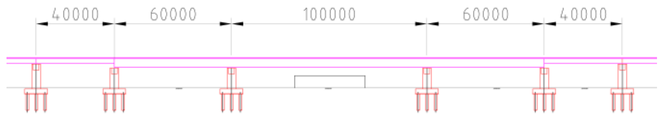
Source: JICA Design Team

Figure 4.2.62 Bridge Arrangement Drawings

6) A Mabini Street

As a result of comparison of bridge type, JDT proposes PC-box girder (option 2).

Table 4.2.15 Comparison of Bridge Type at A Mabini Street

General view	Comment		
Option-1 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Expensive	C
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	A
Option-3 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good (Coloring) Free Expensive	B

Source: JICA Design Team

Source: JICA Design Team

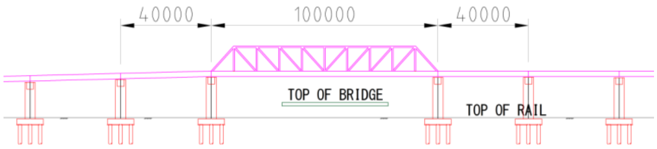
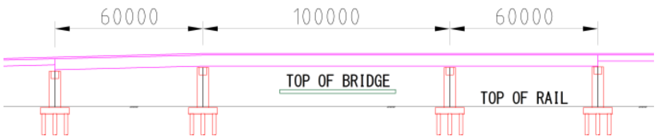
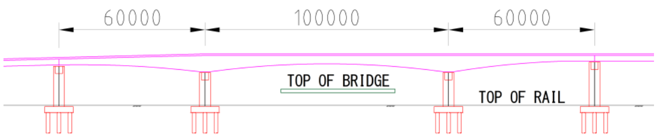
Figure 4.2.63 Bridge Arrangement Drawings

7) Maharlica Highway

The road is on-going widening work. Therefore it is necessary to decide piers location of NSRP-South considering to provide new piers avoiding the highway. So, NSRP-South line needs long span bridge.

As a result of comparison of bridge type, JDT proposes PC-box girder (option 2).

Table 4.2.16 Comparison of Bridge Type at Maharlica Highway

General view	Comment		
Option-1 Truss Bridge (1-span)  	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Expensive	C
Option-2 Pc Box Girder (3-span)  	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	A
Option-3 Steel Box Girder (3-span)  	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good (Coloring) Free Expensive	B

Source: JICA Design Team

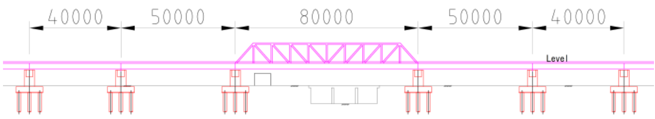
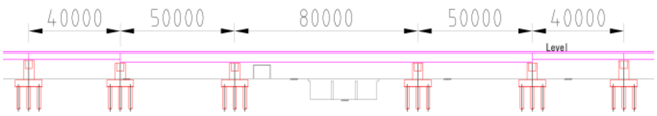
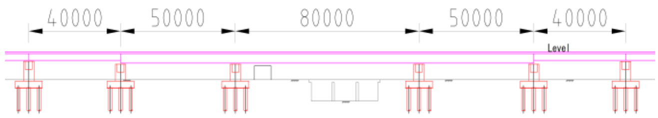
Source: JICA Design Team

Figure 4.2.64 Bridge Arrangement Drawings

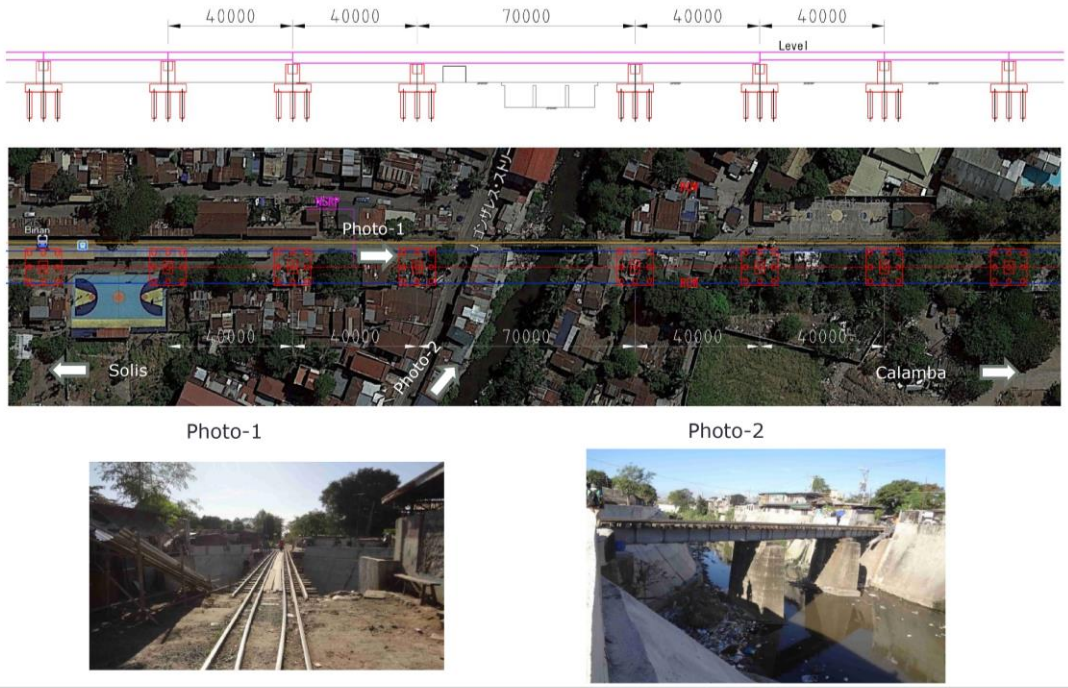
8) Binan River

As a result of comparison of bridge type, JDT proposes PC-box girder (option 2).

Table 4.2.17 Comparison of Bridge Type at Binan River

General view	Comment		
Option-1 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Expensive	C
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	A
Option-3 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good(Coloring) Free Expensive	B

Source: JICA Design Team



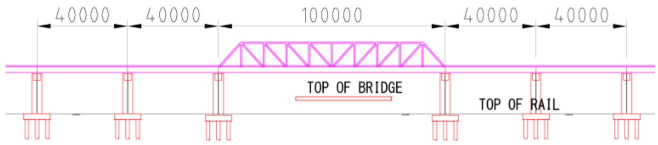
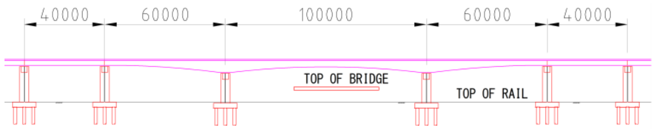
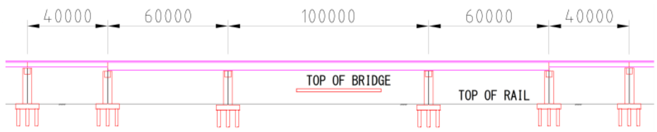
Source: JICA Design Team

Figure 4.2.65 Bridge Arrangement Drawings

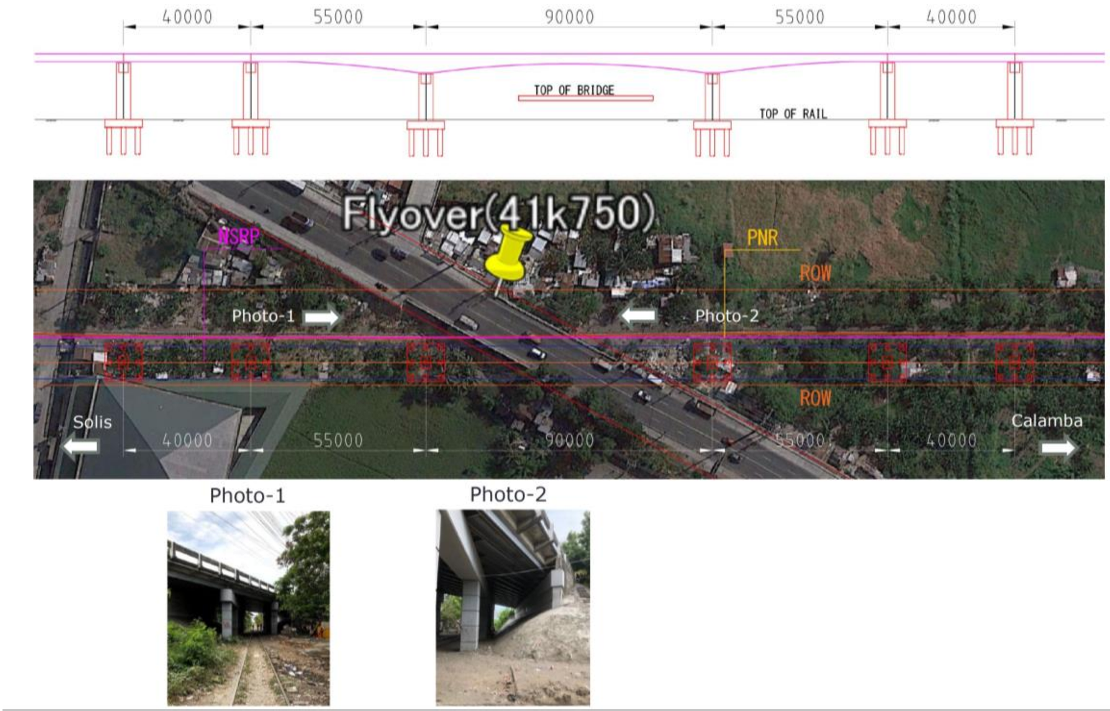
9) Manila South Road

As a result of comparison of bridge type, JDT proposes PC-box girder (option 2).

Table 4.2.18 Comparison of Bridge Type at Manila South Road

General view	Comment		
Option-1 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Expensive	C
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	A
Option-3 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good (Coloring) Free Expensive	B

Source: JICA Design Team



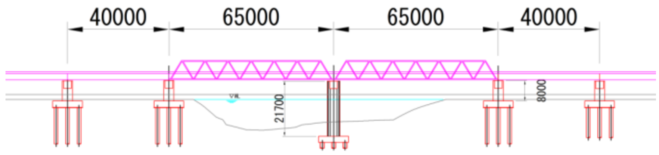
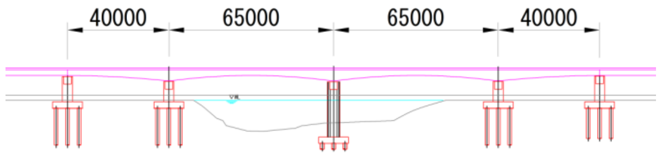
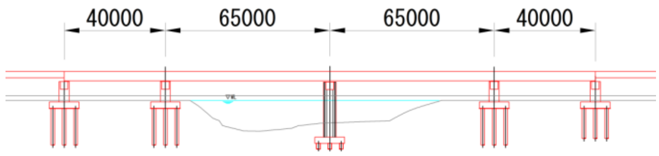
Source: JICA Design Team

Figure 4.2.66 Bridge Arrangement Drawings

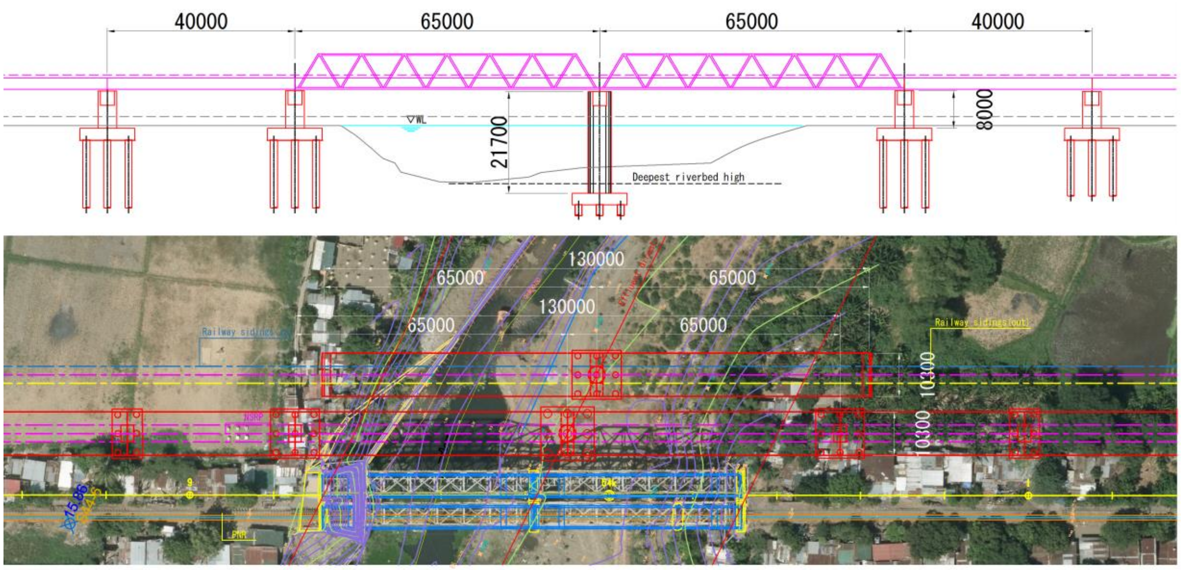
10) San Cristobal river（NSRP South）

As a result of comparison of bridge type, JDT proposes Truss (option 1).

Table 4.2.19 Comparison of Bridge Type at San Cristobal river (NSRP South)

General view	Comment		
Option-1 Truss Bridge (2-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Fair	A
Option-2 Pc Box Girder (4-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	B
Option-3 Steel Box Girder (4-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good (Coloring) Needed Expensive	C

Source: JICA Design Team



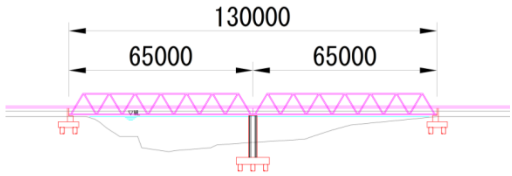
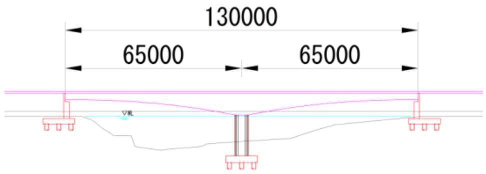
Source: JICA Design Team

Figure 4.2.67 Bridge Arrangement Drawings

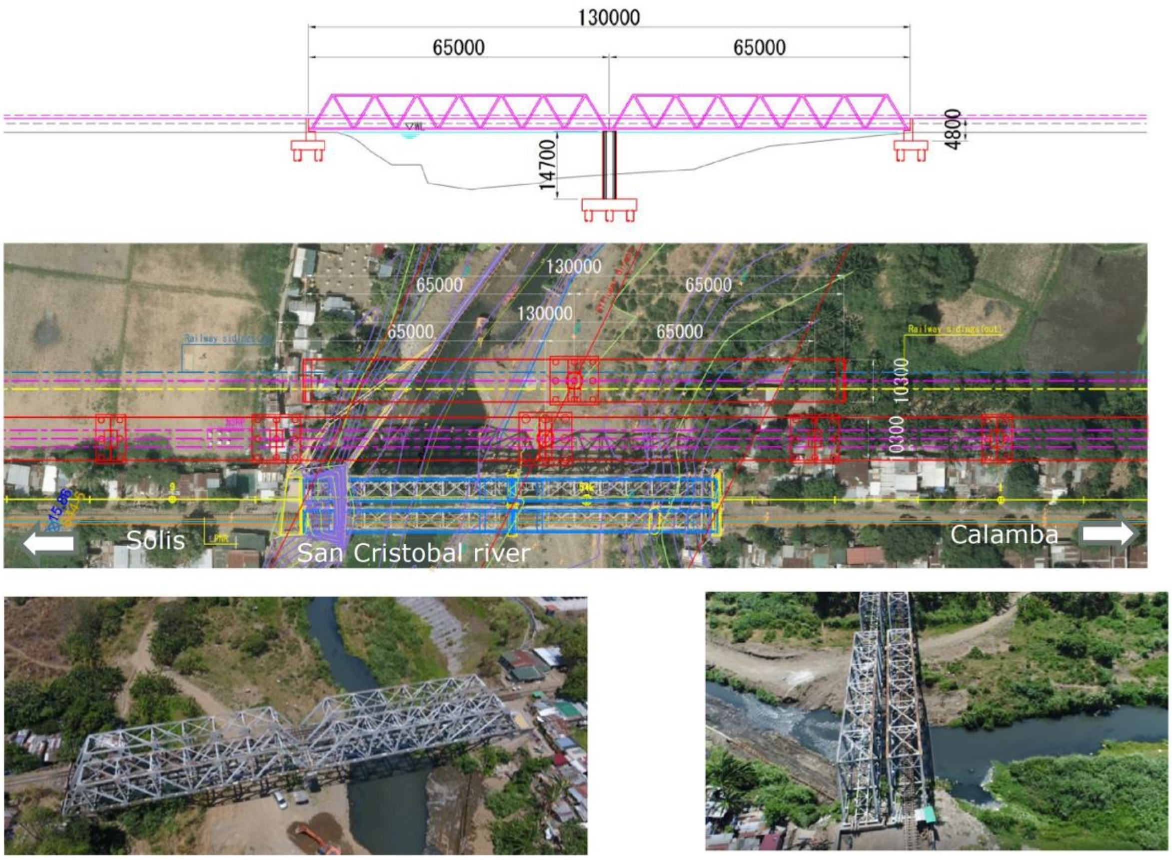
11) San Cristabal river (Depot Access line)

As a result of comparison of bridge type, JDT proposes Truss (option 1).

Table 4.2.20 Comparison of Bridge Type at San Cristobal river (Depot Access line)

General view	Comment		
Option-1 Truss Bridge (2-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Great Free Fair	A
Option-2 Pc Box Girder (2-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Difficult Possible Good Free Fair	B

Source: JICA Design Team



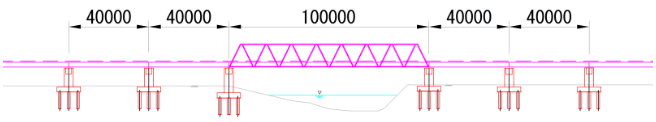
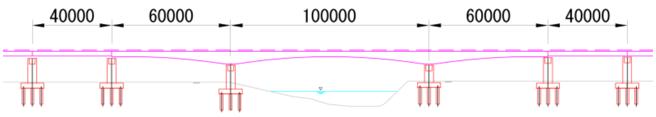
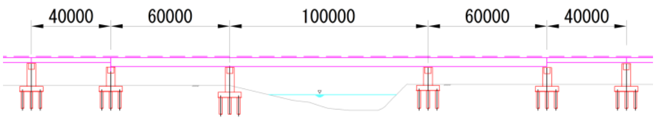
Source: JICA Design Team

Figure 4.2.68 Bridge Arrangement Drawings

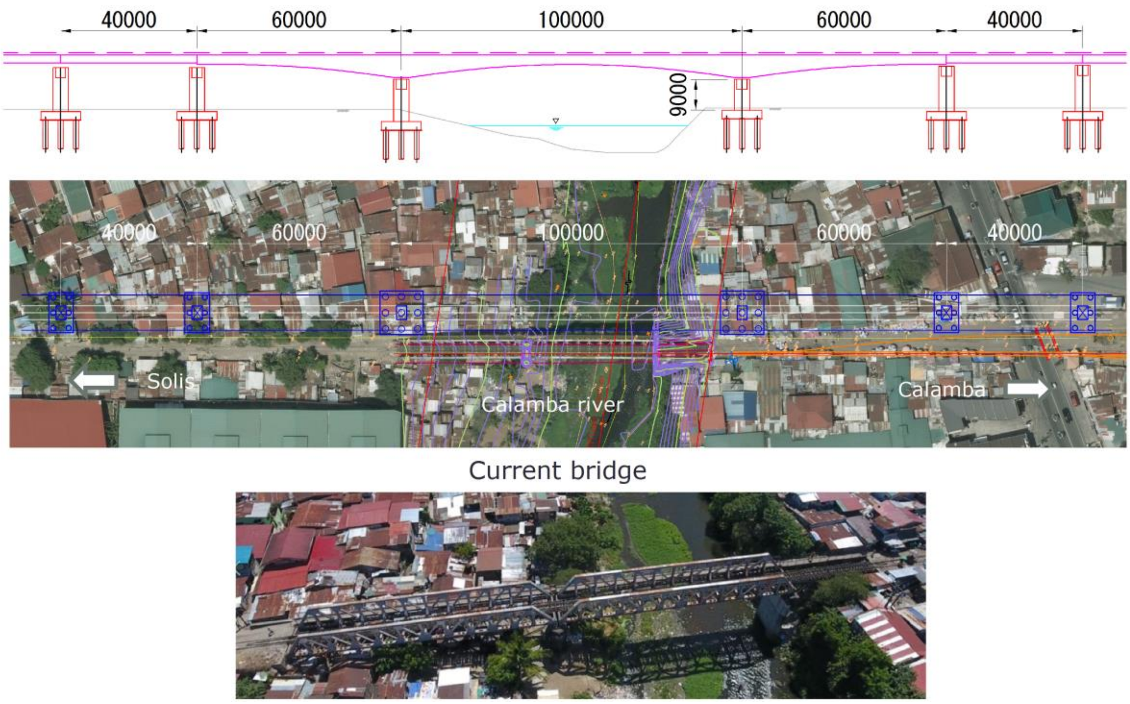
12) Calamba river

As a result of comparison of bridge type, JDT proposes Truss (option 2).

Table 4.2.21 Comparison of Bridge Type at Calamba river

General view	Comment		
Option-1 Truss Bridge (1-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Difficult Great Free Expensive	B
Option-2 Pc Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Standard Possible Good Free Fair	A
Option-3 Steel Box Girder (3-span) 	Structural characteristic Workability Landscape Maintenance Construction cost	Special Good (Coloring) Needed Expensive	C

Source: JICA Design Team



Source: JICA Design Team

Figure 4.2.69 Bridge Arrangement Drawings

(4) Connection of NSRP-South and MMSP

MMSP subway line will be connected at the Bicutan Station and operated until Calamba Station using NSRP-South tracks. Therefore JDT will study structure plan of NSRP-South corresponding to the connection.

Table 4.2.22 Study List

Item	Item of Study	Note
FTI-Buictan	Study of Construction type (Scope: at-grade section and Viaduct section of MMSP line)	
San Pedro Station , Gloud Station	Study of Construction type (Scope: Viaduct section corresponding 2 platforms and 4 tracks)	

4.2.2 Track

The track structure adopts the same structure type as NSCR track as a basis, but it shall be modified according to the load generated by the speed, running conditions of the passing train, and the alignment, civil structure supporting condition of formation level.

Source: JICA Design Team

Figure 4.2.70 Ballast less Track structure
(elastic sleeper directory fastened track on concrete bed)

(1) Comparison of Ballasted Track and Ballast-less Track

At the beginning of railway development ballasted track was applied. Crushed stone is used for track bed to support sleepers. This is a simple structure, the construction cost is relatively low, and it can be easily corrected against roadbed displacement. From this reason ballasted track have been adopted in all over the world railways up to the present age.

The main advantages of ballasted track are easy replacement of track components, good damping of noise and vibration. As the speed is increasing, high precision laying of track is done using large maintenance machines and it has been adopted in 300 km/h sections.

The general problem with ballasted track is relatively heavy loads on the viaducts or bridges, vertical and lateral irregularities due to repeated train load are likely to occur on the track, and consequent maintenance is required.

On the other hand, many ballast-less tracks (BLT) have been developed in the second half of the 20th century for the purpose of reducing maintenance work. The main advantages of ballast-less track are relatively light, little displacement, higher stability and reliability. The disadvantage is that the initial construction cost is higher than the ballasted track. However long-term life cycle cost is judged to be lower than ballasted track by small maintenance cost. Noise and vibration were slightly higher than ballasted track in the past, but the vibration level approximately becomes equivalent to ballast track by many improvements.

A comparison of characteristic for ballasted track and ballast-less track is provided in Table 4.2.23.

Table 4.2.23 Comparison of Ballasted Track and Ballast-less Track

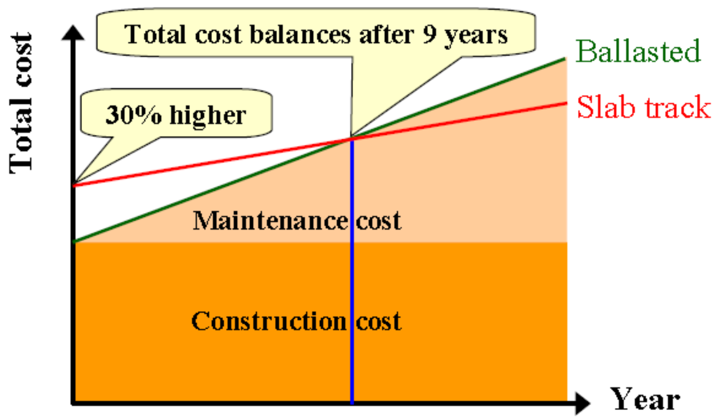
	Ballasted Track	Ballast-less Track
Components	1. PC Sleeper 2. Crushed stone Ballast	1. RC sleeper/ PC Sleeper 2. Elastic support
Construction Cost	Relatively low	+20 ~ 30% Higher than ballasted track
Noise & Vibration	Relatively small	Within the tolerable limits
Riding Quality	Satisfactory level	Superior level
Life Cycle	15-20 years serviceable or more	30-40 years serviceable or more
Maintenance Requirement	Maintenance (realignment) required but easy. Roadbed Strength and track precise in construction is essential to minimize maintenance works.	Basically, maintenance free. In the case of differential settlement, maintenance work is not easy and require time.

Source: JICA Design Team

(2) Life Cycle Cost of Ballasted and Ballast-less Track

The schematic of the life cycle cost of ballasted and ballast-less track is shown in Figure 4.2.71.

According to the past experience the initial construction cost of ballast-less track is about 20-30% higher than that of the ballasted track. But the total cost including construction and maintenance will be balanced at 9th-10th year later to that of the ballasted track. Another merit of ballast-less track is relatively light weight that can reduce the design dead load for viaducts and bridges.



Source: JICA Design Team – from original RTRI document

Figure 4.2.71 Comparison of Total Cost of Ballasted Track and Ballast-less Track

(3) Track-Form/ Structure of Ballast-less Track

There are many kinds of ballast-less track used in the world. The representative features of that are as follows. Common ballast-less track forms include the J-Slab track, the plinth track, Rheda track, and the elastic sleeper directly fastened track. (refer Figure 4.2.72)

These tracks should be evaluated for the aplication of viaducts, bridges and embankment from the point of view of workability, functionality, maintainability and the life cycle cost.

1) Plinth Track

Pedestal called plinth is constructed on roadbed concrete and rail is fastened to directly on it. It has simplest structure in ballast less track. Only rail pads provide elasticity for the track. Plinth track has been laid in many countries in Europe, Canada and Southeast Asia, and Manila LRT 2, MRT 3 in Philippines.

[Achievements in Japan] That corresponds to the Direct Fastened track on concrete bed with base-plate/ tie plate. This track structure has been adopted in mountain tunnel and subway tunnel of long term.

2) Rheda Track

The name of Rheda is attributed to the place name of Germany and this track has been developed in Germany. Monoblock PC sleepers or Bi-block RC sleepers are held by around concrete layer on roadbed. Only rail pads provide elasticity for the track. Similar type tracks have been laid in Japan, China and many countries.

[Achievements in Japan] That corresponds to the Direct Fastened track on concrete bed with sleepers. This type is common in the subway tunnel and station. Recent trend is using elastic material under the sleeper to reduce noise and vibration

3) Elastic Sleeper Directly Fastened Track

Sleeper attached elastic material on bottom surface is held by a height-adjustable concrete on formation level. As elasticity of the track, rail pad and elastic material for sleeper perform as a serial spring. Similar track using bi-block sleeper have been laid even in France, Switzerland, USA, Manila LRT1 north extension line. Recent years mono-block sleeper supported both ends has been laid in Japan as shown in Figure 4.2.72, which contributes to reduce dead load on the viaduct.

[Achievements in Japan] It has been used for Shinkansen since 1970's. Recently there are many achievements in conventional lines near urban areas. The noise vibration level shows the same measurement value as ballasted track. This type is common in the subway tunnel and station. In Shinkansen and urban area line that track has been laid more than 200 km.

4) J-Slab Track

J-slab track have been developed in Japan that concrete slab of 5 m length is laid on concrete roadbed without sleepers. The slab is held by protruding concrete at both ends. Cement asphalt mortar is injected under the slab, since that spring constant is very hard, the elasticity of the track is given by rail pads. Slab track have also been laid in Germany and Italy, Japanese frame type slab with center hollow is laid in Taiwan. Special large machines are required for laying the slab, then construction cost becomes extremely high in case of less than 100 km.

[Achievements in Japan] Since the 1960's testing laying has been done, there have been many achievements in the Shinkansen and middle speed lines. That track has been laid more than 1,200 km in Shinkansen, more than 400 km in middle speed line.

(i) Plinth Track

(ii) Rheda Track

(iii) Elastic Sleeper Directly Fastened Track

(iv) J-Slab Track

Source: JICA Design Team

Figure 4.2.72 Various Types of Ballast Less Track

(4) NSRP-SOUTH (Solis-Calamba) Track

From Solis to south bound, currently PNR has been operated. The NSRP-SOUTH railway is planned within the ROW of PNR with standard gauge double track, maximum speed 120 km/h. There are many intersections existing railway LRT1, LRT2, expressways and general roads, and there are also many vertical alignment changes. Then at grade section shall be planned in addition to viaducts, bridges and existing embankment.

Construction of new NSRP line shall be done while continuing train operation of the current PNR line. In order to continue the operation of PNR line, it is necessary to switch the track alignment many times. High construction skill and cautiousness are required in close narrow area.

In the detailed design of NSCR (Tutuban-Malolos) the above-mentioned elastic sleeper direct fastened track was adopted in viaduct or bridge section and RRR method embankment. For the turnout in mainline it was proposed to use Plastic/Fiber-reinforced Foamed Urethane sleepers in ballast-less, direct fixation system.

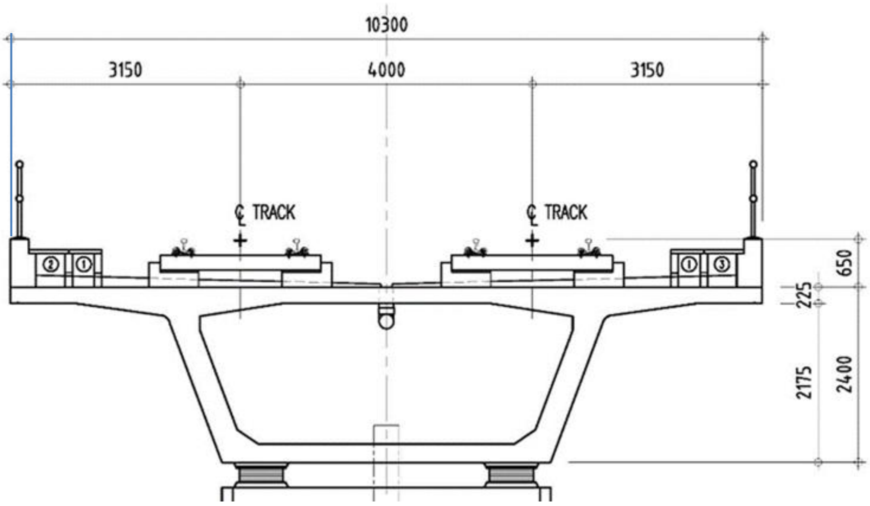
Even in NSRP-SOUTH the direct fastened track shall be possible to adopt in same structure section as NSCR.

The RRR method embankment developed in Japan is constructed. The RC slab with 300 mm thickness is laid at the top of embankment. The elastic sleeper directly fastened track is laid on this concrete roadbed that has the effect of spread decreasing pressure on soil foundation. (refer Figure 4.2.74)

Fixed crossing is used for turnout in main line at maximum speed 120 km/h. For the turnout in mainline it was proposed to use plastic/ Fiber-reinforced Foamed Urethane (FFU) sleepers in ballast-less, direct fixation section.

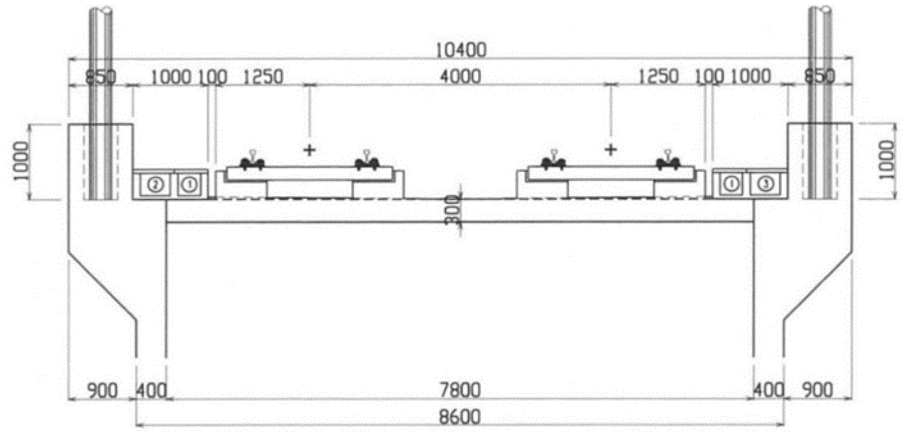
However in the existing embankment and at grade section, it is necessary to evaluate previously the strength of roadbed material. In the section where there is a possibility of settlement in future, ballasted track shall be adopted generally. For ballasted track on soil roadbed, it is considered to adopt asphalt roadbed that is well drainable and good stability.

In depot area traveling speed is low, ballasted track with mono-block PC sleeper is suitable which is laid on sub-ballast layer and low construction cost.



Source: JICA Design Team

Figure 4.2.73 Elastic Sleeper Directly Fastened Track at Elevated Section



Source: JICA Design Team

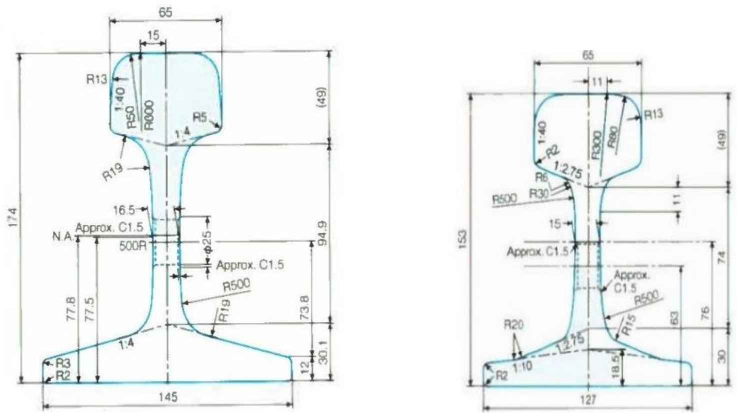
Figure 4.2.74 Elastic Sleeper Directly Fastened Track at Embankment Section

(5) Track Components

Track components options of the NSRP-SOUTH is selected with consideration to below materials.

1) Rails

Rolling stock's dynamic load is supported by rails directly. Larger bending stiffness shall have an advantage against durability of the track, pressure force distribution on sleeper, reduction of noise and vibration. Rail cross-section 60 kg/m is suitable for mainline 120 km/h operation. 50 kg/m rail is suitable for depot lower 35 km/h. (refer Figure 4.2.75) Steel material quality of rail is very important to avoid breakage or wear problems. Rail quality shall conform to stringent Japanese standards or equivalent international standard. Head hardened rail is desired to use at outer rail in curvature less than 800m radius section for controlling extensive wear and tear. Compromise rail shall be used the site where rail section changes 60 kg/m and 50 kg/m rail, etc.



(i) 60kg Rail (JIS60) **(ii) 50kg Rail (JIS50N)**

Source: NIPPON STEEL & SUMITOMO METAL

Figure 4.2.75 Rail Profile

2) Rail Joint

Expansion joint is installed in required continuous welding rail section. That has the function to reduce excessive longitudinal axial force between bridge/ viaduct and continuous welding rail. Particularly it is necessary to set near the long span bridge and turnouts. Glued insulated joint shall be laid as necessary for track signaling circuit in continuous welding rail section

Normal length rail is laid at stabling track in depot area, side track and pocket track connected to main line. In that case rails are connected by normal fishplate joint.

3) Rail Welding

Continuous welding rails (CWR) is recommended which contributes to improve riding quality and reduce maintenance works, noise and vibration. Interaction between rail and structure should be studied to reduce rail axial force within allowable limits, and to prevent excessive axial force acting on structures.

As types of rail welding there are Flash butt pressure welding, Gas pressure welding and Alumino-thermit welding, and they are appropriately selected and used at each site.

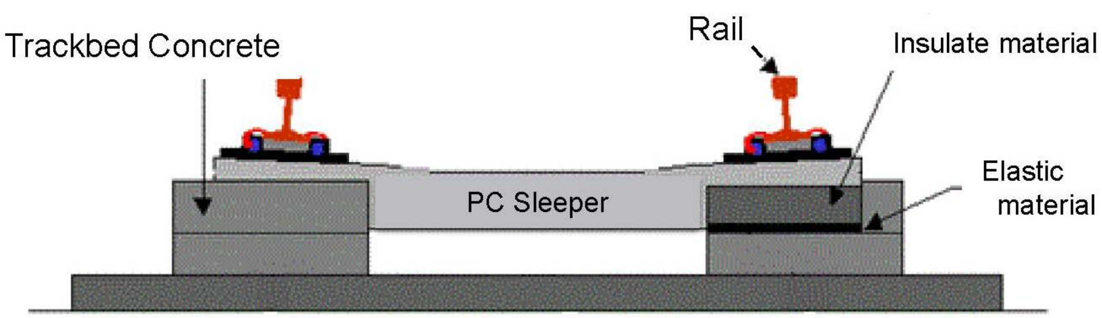
4) Sleeper

There are three type sleepers proposed for NSRP-SOUTH track.

The first type sleeper has glued elastic material on bottom face. This is supported to the roadbed concrete on viaduct or bridge. Rail is fastened to the sleeper via rail pad and the sleeper is supported by track bed concrete via elastic material. Its major advantage is absorption of noise and vibrations and better riding quality. This track structure using mono-block sleeper panel has been developed in Japan and used extensively in Japanese railways. (refer Figure 4.2.76)

The second type sleeper is traditional mono-block PC sleeper on ballasted track. That sleepers shall be used for ballasted track section and depot area.

The third type sleeper is a plastic sleeper for turnout section. For the turnout in mainline that sleeper is proposed to use as Direct Fixation System.



Source: JICA Design Team

Figure 4.2.76 Elastic Sleeper Directly Fastened Track

5) Rail Fastening System

Rail clips provides resilient supporting force under dynamic loads. Wire clip type widely used in Philippines (PNR, LRT, MRT) is proposed. Those clips by spring steel have elasticity against dynamic loads. That is fastened to anchor of shoulder directly or with baseplate into PC Sleeper.

Elastic sleeper directly fastened system on viaduct is difficult for realignment maintenance because sleepers are fastened in concrete bed. Then at necessarily case rail realignment should be adjusted at base-plate position for lateral or vertical direction by using the adjustable type fastening with base plate.

Mono-block PC sleeper is used for ballasted track at stabling yard in depot. Realignment work for irregularity is relatively easy. Rail fastening system without base-plate type is suitable for ballasted track and relative low cost.

6) Ballast

Crushed stone ballast is consented to requirement on rock quarry by the Employer's Representative before being incorporated at construction site. The ballast shall consist of crushed Granite, Basalt, Rhyolite, Quartzite, Andesite or equivalent. Weathered rock shall not be acceptable. The ballast produced from crushing hard rock, clean angular fragments shall be free from deleterious material and without thin or elongated pieces. That shall have a high percentage of fractured faces and be cuboids in shape.

The track ballast shall be laid minimum 150 mm thickness between the bottom of sleeper and the sub-ballast layer at surface compaction in depo area. Ballast throw and compaction works shall be laid at two stages and be finished to top level of sleeper.

7) Turnout

In main line #12 or #10 simple turnout is laid, scissors crossing is inserted at necessary site. Elastic sleepers are used for turnout on viaduct.

In depot area #8 simple turnout in general part and #6 simple turnout for maintenance vehicle stabling track are laid, scissors crossing is inserted at necessary site. Timber sleepers is used for turnout at ballasted track.

The main figures of each simple turnout are shown in Table 4.2.24.

Table 4.2.24 Turnout in NSRP-SOUTH

Simple Turnout	Crossing Angle	Lead Rail Radius
No.12	4°46′	374.060m
No.10	5°43′	259.496m
No.8	7°9′	165.328m
No.6	9°32′	91.914m

Source: JICA Design Team

8) Summary of Track Components

Track components of elastic sleeper directly fastened track in main line are shown in Table 4.2.25.

Table 4.2.25 Track Components of Elastic Sleeper Directly Fastened Track

No.	Component	Proposed
1.	Track Form	Elastic sleeper directly fastened track on concrete bed in main line
2.	Rail Section	Weight 60 kg/m rails for mainline, Standard length 25m
3.	Continuous Welded Rails (CWR)	CWR with expansion joints at necessary locations required. Rail shall generally be Flash Butt Welded (FB), Gas Pressure (GP) Welded or Alumino-thermic (AT) welded.
	Short Welded Rails (SWR)	SWR or normal fish plated track at other than CWR locations.
4.	Sleepers	Mono-block pre-stressed concrete sleepers are adopted. Normal 667 mm spacing between sleeper centers using 12 numbers per 8m. shortening 625mm at curvature radius less than 600 m. Elastic sleepers are adopted turnout section.
5.	Fastening system	Wire spring with base-plate, Anti-theft type is selected for elastic sleepers
6.	Turnouts	#12 or #10 turnouts with 60kg/m rail on elastic sleepers. rigid crossing is used along 120km/h speed section.
7.	Expansion Joints	Expansion Joints is used at necessary site of CWR (continuous welded rail) at near long span bridge and near turnouts.
8.	Insulated joints	Glued insulated joints is used in CWR tracks at necessary site depending on signaling system.

Source: JICA Design Team

Track components of ballasted track in depot area are shown in Table 4.2.26.

Table 4.2.26 Track Components of Ballasted Track

No.	Component	Proposed
1.	Track Form	Ballasted track in at-grade of main line and depot.
2.	Rail Section	Weight 50 kg/m rails, Standard length 25m.
3.	Sleepers	Mono-block pre-stressed concrete sleepers are adopted. 37 sleepers per 25m for normal 675 mm spacing between sleeper centers.
4.	Fastening system	Wire spring non tie-plate for PC sleeper, Anti-theft type is selected.
5.	Ballast	Crushed stone ballast of minimum 150 mm thickness under sleeper. Ballasted track is laid on subballast layer surface.
6.	Turnouts	#8 or #6 turnouts with 50kg/m rail on timber sleepers.
7.	Insulated joints	Insulated joints is used near turnout and at necessary site depending on signaling system.

Source: JICA Design Team

(6) Maintenance Practices

Maintenance of track is aimed to maintain initial good condition and to perform the safety function. These activities include both technical and administrative functions.

Preventive maintenance of equipment is intended to prevent breakdown, to prolong the equipment, to repair damaged parts and to maintain good condition. This aim is to delay the deterioration of parts and to maintain running safety and good riding quality. For example, rail grinding is concerned with this activity. Condition monitoring is for preventive maintenance and measurement of riding quality is also one of them. Track maintenance include realignment, removal of damaged parts, detailed cleaning, parts adjustment, parts replacement and so on.

Overall repair maintenance is carried out when spot corrective maintenance is less effective or un economical. This involve the replacement of the minor rubber pads, elastic clips, parts of turnout, tongue rail, lead rail, crossing etc. This scheduled shall be considered for safety and savings.

Comprehensive tamping for ballasted track in depot and access line shall be conducted by inspecting track condition after one year train operation. Ballast replacement shall be carried out to maintain durability as necessary at any time. Joint gap maintenance and adjustment of fastening torque shall be done.

Minimum quantities(numbers or volumes) of spare parts, rails in main line and depot, PC sleepers, Elastic sleepers, rail fastening systems, expansion joints, glued insulated rail joints, assembly of turnouts, thermit welding kits etc., shall be provided to ensure the future track maintenance works.

(7) Track Maintenance Equipment

Main track maintenance is replacement of materials, rail grinding, tamping, re-alignment etc. Materials to be replaced are rails, rail fastenings, sleepers, ballast etc.

For operation, working schedule table is necessary assuming track works volume per day. Degradation of the track depends on train gross tonnage. Actual track works frequency, maintenance working length per day are planned by the department of track works by observation record of track inspection and measurement data.

The main equipment required for track maintenance is shown in Table 4.2.27.

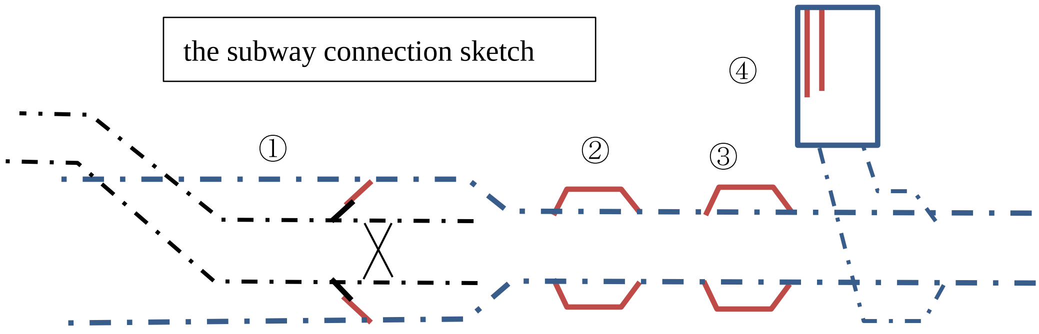
Table 4.2.27 Track Maintenance Equipment

Maintenance Equipment	
Motorcar with crane	Tie Tampers with Generator Set
Open wagon with side plate	Field Welding Hardware Sets and Welding Kits
Rail carrying open wagon	Rail heater
Track geometry measuring car	Rail tensor
/ Track Geometry Measuring Equipment	Weld shear
Rail profile grinding car	Refueling facility for maintenance car
/ Rail Grinding Machine (hand operation)	Tolls equipment for track maintenance
Ultrasonic rail inspection equipment	Track work tools for human powered
Rail roughness inspection equipment	
Surveying equipment	

Source: JICA Design Team

(8) Review about the accompanied work of track due to the subway connection with NSRP line

The track expansion sketch is shown in Figure 4.2.77 and ①-④ are additional facilities.



Source: JICA Design Team

Figure 4.2.77 sketch of the track expansion or inserting

The track structure uses the elastic sleeper directly fastened track on concrete bed in general.

The ballast track may be used in order to adjust the vertical irregularity of track when sinking along such section a differential settlement possibly expected

1) Track construction work accompanied to the subway (MMSP) connection with NSRP line

Here, it supposes the increasing quantity being generated from the subway connection.

The details should plan a track construction breakdown according to the specification of the whole of the project. (refer Table 4.2.28)

Table 4.2.28 Track work item for the subway connection

№	increasing place	The increase item and the quantity
1	Bicutan station	The subway track connection Two sets of standard turnout/ simple turnout
2	San Pedro station	Adding the passing way station 2 lines of the sub main track, four sets of simple turnouts
3	Gulod station	Adding the passing way station 2 lines of the sub main track, four sets of simple turnouts
4	Depot	Equip for the first trains and last trains 5 storage tracks and five sets of simple turnouts
5	General	The confirmation of the running safety of the train: speed at straight line, curve speed, turnout passage confirmation

Source: JICA Design Team

2) The confirmation of the safety about the connection of the subway

The safety check to the vehicle running in different lines may be done as next generally.

It confirms that the flange width of the wheel can run the flangeway width of the guard furnished in turnout.

4.2.3 Design criteria for Civil work

Design conditions for designing civil engineering structures (bridges, viaducts and earth structures) of NSRP are shown below.

(1) Design standards

Design of structures including viaducts, bridges, embankments are basically follows appropriate latest design codes widely used in the republic of the Philippines, Japan and/or internationally. These referenced design codes are indispensable for the application of this specification and listed in Table 4.2.29.

Table 4.2.29 List of Track and Structure Design Codes

Items	Name of Design Codes
Track Alignment and Track Structure	• Japanese Technical Regulatory Standards on Japanese Railways (Civil Engineering), and its Approved Model Specifications (2007). • Japanese Industrial Standards (JIS) or equivalent specifications
Bridge, Viaduct and Embankment Structure	For design: • AASHTO LRFD Bridge Design Specifications, 6th ,7th Edition (2012, 2014) • AASHTO Guide Specification for LRFD Seismic Bridge Design, 2nd Edition (2011). • DPWH Guide Specifications - LRFD Bridge Seismic Design Standard, 1st Edition (2013). • AREMA Manual for Railway Engineering (2015) • The National Structural Code of the Philippines (2010) • Japanese Design Standards for Railway Structures [Retaining Structure] (2012) Reference depending on necessity: • CHSRA Technical Memorandum - Structure Design Loads (TM2.3.2) (2011) • ACI 318 Building Code Requirements for Structural Concrete and Commentary For verification: • Japanese Design Standards for Railway Structures [Seismic Design] (2012)
Drainage	• Japanese Design Standards for Railway Structures [Earth structures] • Guideline for Planning & Design of Wastewater Facilities (Japan Sewage Works Association) • Other appropriate standards and guidelines
Materials	In general • American Society for Testing and Materials (ASTM) • American Institute of Steel Construction (AISC) • American Welding Society (AWS) • Japanese Industrial Standards (JIS) • Other appropriate material standards and guidelines. Concrete and Aggregates • ASTM, JIS and equivalent specifications Ballast/Sub-ballast • Japanese Design Standards for Railway Structures [Track Structures] Embankment • Japanese Design standards for Railway Structures [Earth Structures] • ASTM, JIS and equivalent specifications

Source: JICA Design Team

(2) Planning conditions

1) Track Type and Contents

Elastic Sleeper Direct Fasten track is adopted. The composition of track element in total height (RL to SL) of 650mm is as follows:

- 60kgN(60N)Rail : 174 mm
- Rail Pad etc. : 10 mm
- Base Plate : 35 mm
- PC Sleeper : 175 mm
- Elastic pad : 30 mm
- Drain Slope Concrete : 226 mm

Total 650 mm

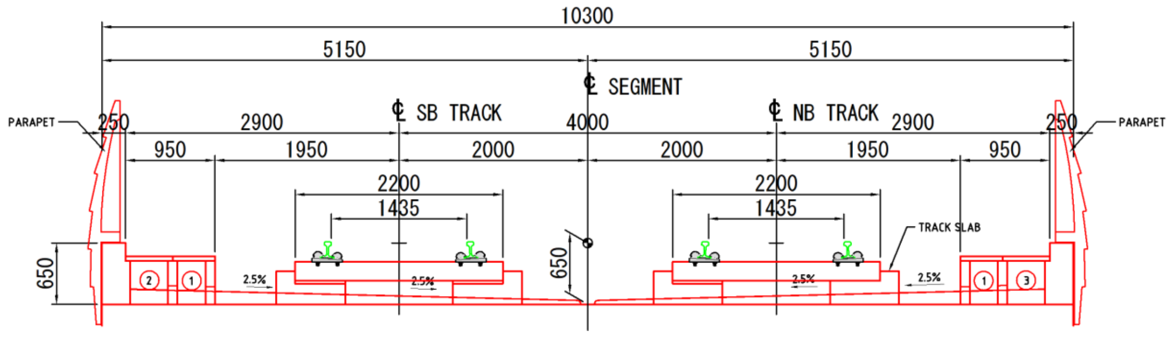
2) Fixtures and Provisions on Viaduct and Bridge

Fixtures and provisions on viaduct and bridge structures which support railway track and equipment are shown in Figure 4.2.78 to Figure 4.2.82 Double track is placed at 4m of distance between each track center for NSCR. The following fixtures and provisions on viaduct and bridge are required:

- Kinematic and structural gauge for the proposed rolling stock,
- Cabling and ducting requirements,
- Drainage for deck surface,
- Location and clearance to overhead catenary systems (OCS),
- Maximum cant at curvature section which considers radius in the horizontal alignment and the allowable passing speed,
- Walkway for maintenance,
- Walkway for emergency access,
- Noise barrier and parapet (noise assessment in progress).

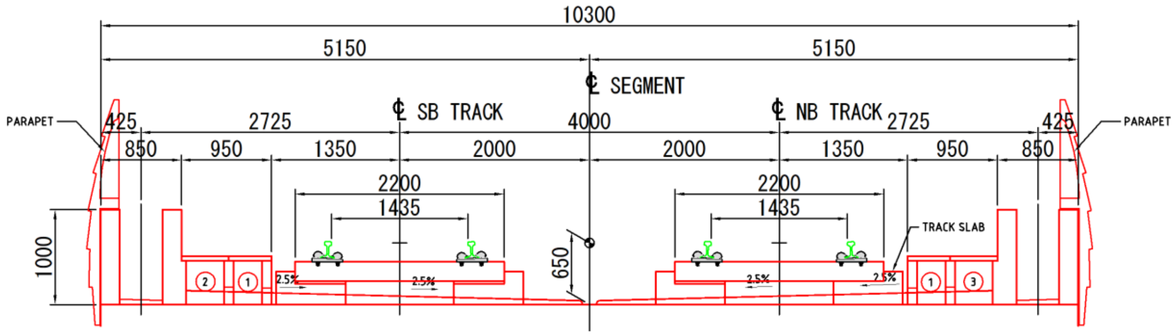
These fixtures and provisions are unified over the alignment regardless of horizontal alignments or installation of OCS poles.

a) Typical cross section of double track



Source: JICA Design Team

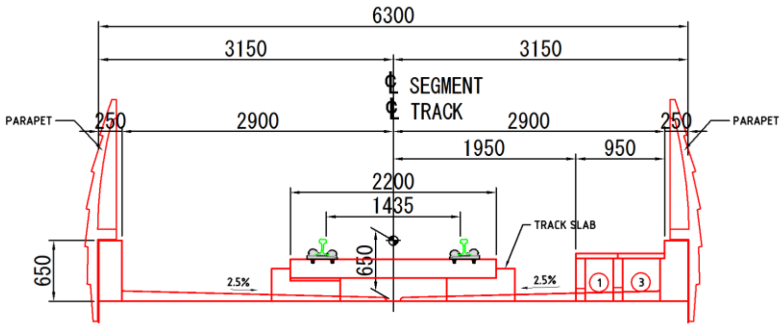
Figure 4.2.78 Fixtures in Typical Cross Section



Source: JICA Design Team

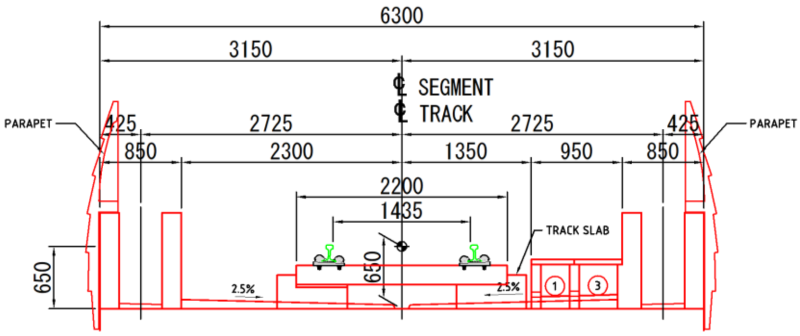
Figure 4.2.79 Fixtures in Typical Cross Section Double Track with OCS Pole

b) Typical cross section of single track



Source: JICA Design Team

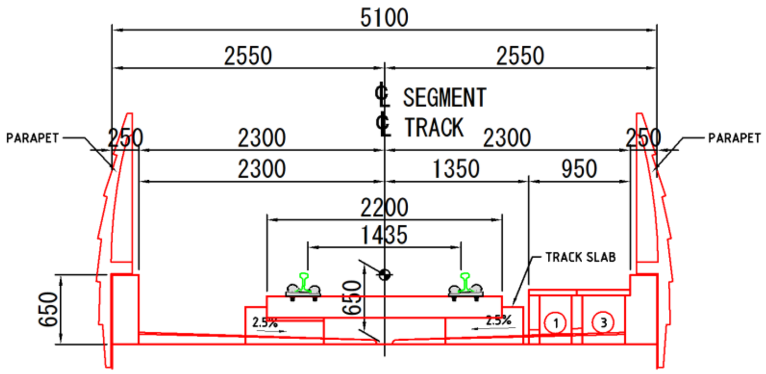
Figure 4.2.80 Fixtures in Typical Cross Section of Single Track



Source: JICA Design Team

Figure 4.2.81 Fixtures in Typical Cross Section of Single Track with OCS Pole

c) Typical cross section of single track for station (required at Island type Platform Station)



Source: JICA Design Team

Figure 4.2.82 Fixtures in Typical Cross Section of Single Track for Station

(3) Load Conditions

The following loading conditions for bridge structures (both superstructures and substructures) are considered and to be determined in accordance with AASHTO (AREMA) or referring to the Philippines codes of practice as appropriate:

○ Dead Load

- Unit Weight of Materials
  (Reinforced Concrete, Prestressed Concrete, Plain Concrete, Reinforcing Bar or Steel, Prestressing Strand, Ballast, Backfilling Soil)
- Weight related to Tracks (Weight of Rail & Sleeper & Fastening, Weight of Ballast)
- Weight of Bridge Railing and Power Pole

○ Live Load

- Train Load (Axle Load: 160kN×4 Axle / 1 Vehicle)
- Impact Load
- Braking Load / Starting Load
- Centrifugal Load
- Wind Load
- Pedestrian Load
- Handrail Thrust Force
- Prestress Force
- Shrinkage Effect
- Creep Effect
- Temperature Change Effect
- Earth Pressure
- Earthquake Load

Combination of these design loads is configured by each design limit state. The load combination and load factors are in accordance with AASHTO LRFD and AREMA shown in Table 4.2.30.

Each load combination is defined as follows:

Table 4.2.30 Load Combination and Load Factors Used in the Design of the NSCR

Load Comb. or Limit State	DC DD DW EV EH ES EL	LL IM CE BR PL LS	WA FR	WS	WL	TU	TG	SE	CL	EQ1	EQ2 WA ED
Strength I	1.25	1.75	1.0	-	-	1.0	0.5	1.0	-	-	-
Strength II	1.25	-	1.0	1.4	-	1.0	0.5	1.0	-	-	-
Strength III	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Strength IV	1.25	1.35	1.0	0.4	1.0	1.0	0.5	1.0	N/A	N/A	N/A
Extreme I	1.25	0.5	1.0	-	-	-	-	-	-	1.0	-
Extreme II	1.00	0.5	1.0	-	-	-	-	-	1.0	-	-
Extreme III	1.0	0.5	1.0	-	-	-	-	1.0	-	-	1.0
Service I	1.0	1.0	1.0	0.45	1.0	1.0	0.5	1.0	-	-	-
Service II	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fatigue	-	1.0	-	-	-	-	-	-	-	-	-

Source: JICA Design Team

"Strength 1" is the basic load combination for normal use.

"Strength 2" is the load combination for the structure exposed to wind.

"Strength 3" is the load combination for very high dead load to live load force effect ratios. This is not required for the viaduct.

"Strength 4" is the load combination for normal use when exposed to wind.

"Extreme 1" is the load combination for normal use when designing columns for Operating Basis (Level 1) seismic events.

"Extreme 2" is the load combination for collision.

"Extreme 3" is the load combination for Extreme seismic events: Maximum Considered Earthquake (Level 2).

"Service 1" is the basic service load combination for normal use with wind.

"Service 2" is the service load combination intended to control yielding of steel structures and slip of slip-critical connections due to train load. Not applicable for the concrete viaduct

Where;

DD = down drag
DC = dead load of structural components and nonstructural attachments
DW = dead load of wearing surfaces and utilities

EH = horizontal earth pressure load
EL = accumulated locked-in force effects resulting from the construction process, including the secondary forces from post-tensioning
ES = earth surcharge load
BR = vehicular braking force
CE = vehicular centrifugal force
CR = creep
CT = vehicular collision force
CV = vessel collision force
EQ = earthquake
FR = friction
IM = vehicular dynamic load allowance
LL = vehicular live load
LS = live load surcharge
PL = pedestrian live load
SE = settlement
SH = shrinkage
TG = temperature gradient
TU = uniform temperature
WA = water load and stream pressure
WL = wind on live load
WS = wind load on structure

The factored force shall be modified by the load modifier specified in AAHSTO 3.4.1.

The total factored force effect shall be taken as :

$Q = \Sigma \eta i \cdot \gamma i \cdot Qi$

ここに

Hi = Load modifier specified in Article 1.3.2
Qi = Force effects from loads specified herein
γi = Load factors specified in Tables 1 and 2

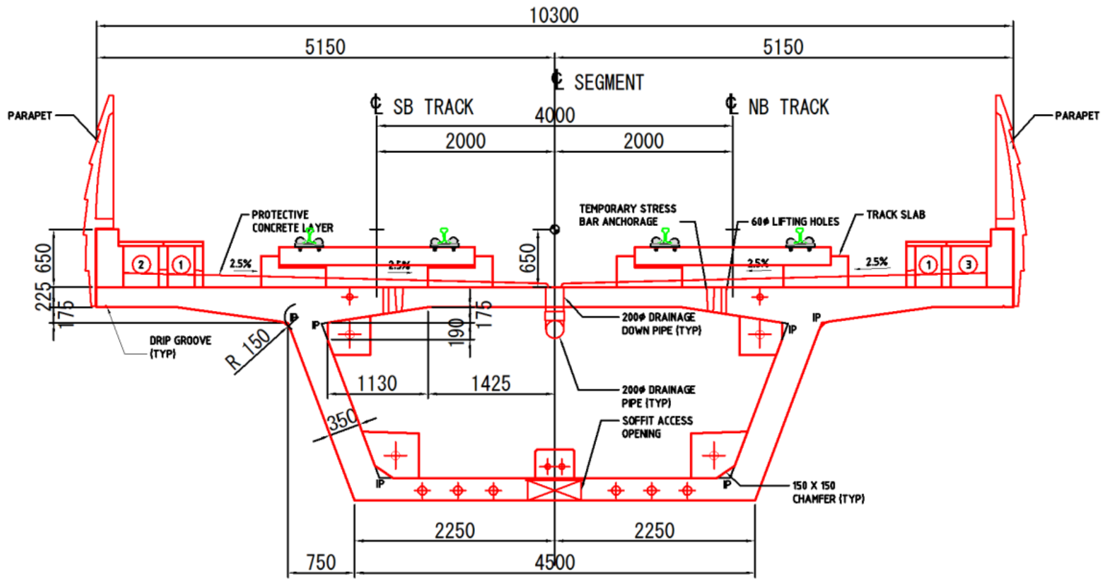
1) Dead Load

The following unit weights shall be considered in the design:

PSC/Reinforced Concrete	25 kN/m^3
Plain Concrete	24 kN/m^3
Structural Steel	78 kN/m^3
Wearing Coat	24 kN/m^3
Soil	19 kN/m^3
Ballast	19 kN/m^3

2) Superimposed Dead Load

The superimposed loads are shown in Figure 4.2.83 and Table 4.2.31.



Source: JICA Design Team

Figure 4.2.83 Locations of Superimposed Loads

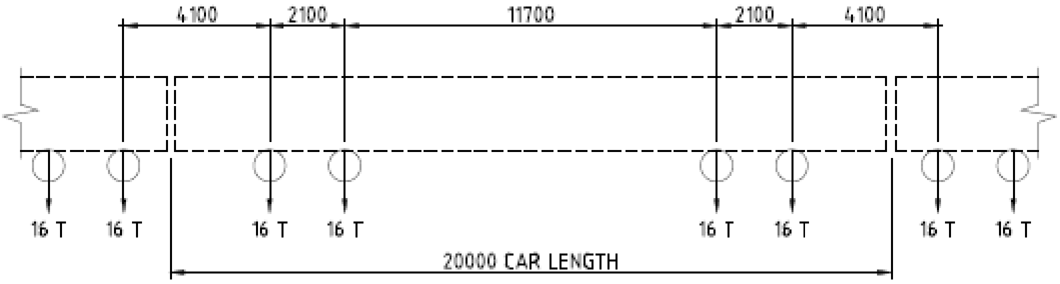
Table 4.2.31 Superimposed Loads (Summary)

Load Case	Description	Loading (kN/m)
Protective Concrete	100mm average thickness except under track slab	20.8 kN/m run
Rail + Fastening + Slab + Mortar layer	13.0 kN/m run per track	26 kN/m run
Bridge Railings inc. heel guard and noise barrier	10.0 kN/m run each side	20 kN/m run
Electrical, signal and communication cables (inc. ducts)	4.5 kN/m run each side	9 kN/m run
Weight of OHS poles	75 kN/pole each side	150 kN per section
	For girder design	150 kN located at mid span of girder;
	For pier design	150 kN located at centre line of pier
OHS Imposed loadings due to tensioning of electrical supply wires	OHW moment about axis transverse to track	±450 kNm at 2 m c/c 4 nos per span
	OHW concentrated load acting longitudinally to track	±70 kN
	OHW concentrated load acting transverse to track	± 30 kN
	OHW moment about axis longitudinal to track	±180 kNm

Source: JICA Design Team

3) Live Load

Axle loads of 16T (160 kN) with axle spacing are as shown in Figure 4.2.84.



Source: JICA Design Team

Figure 4.2.84 Typical Train Loading

Axle load = 16T= 160 kN
Maximum number of successive cars = 10 car units

4) Braking and Traction

The braking and traction forces are given in AREMA 2012 Clause 2.2.3 (j).

For a given rolling stock, braking and traction forces are taken as 30% of the vertical axle load at each axle, acting horizontally at the top of rail parallel to the center-line of track.

5) Centrifugal Force

The centrifugal force shall be taken in accordance with AREMA 2012 Clause 2.2.3 (e) 4. It will be applied acting at height of 1.5m above from the top of rail and acting radially.

$$C = 0.00117\ S^2D \qquad \textbf{EQ 2-1}$$
$$C = 0.000452\ S^2D \qquad \textbf{EQ 2-1M}$$

$$E = 0.0007\ S^2D - 3 \qquad \textbf{EQ 2-2}$$
$$E = 0.0068\ S^2D - 75 \qquad \textbf{EQ 2-2M}$$

$$S = \sqrt{\frac{E+3}{0.0007D}} \qquad \textbf{EQ 2-3}$$

$$S = \sqrt{\frac{E+75}{0.0068D}} \qquad \textbf{EQ 2-3M}$$

where:

C = Centrifugal force in percentage of the live load
D = Degree of curve (Degrees based on 100 foot (30 m) chord)

E = Actual superelevation in inches (mm)
S = Permissible speed in miles per hour (km/hr)

6) Impact Load

Impact load is set in accordance with AREMA 2012 – Volume 2 Chapter 8 Part 2 Clause 2.2.3 (d),

- $L \leq 4$ m … $I = 60$ (%)
- 4 m $< L \leq 39$ m … $I = 125 / L^{0.5}$ (%)
- $L > 39$ m … $I = 20$ (%)

Herein, L: Span Length of Bridge (m)

7) Multiple track factor for railway bridges.

Multiple track factor shall be 1 for both single and double tracks.

8) Wind Loading

Wind loading shall be considered as per the requirements of the DPWH-DGCS Section 10.13.

An wind speed of 160 km/hour has been considered as per the requirements in the DPWH-DGCS

9) Pedestrian Loading

Non-public footpaths are those designated for use by only authorized persons when there are no train operations. Pedestrian, cycle and general maintenance loads should be represented by a uniformly distributed load with a characteristic value q = 3.5 kN/m^2 over the width of emergency walkways.

10) Loads on Balustrade for Pedestrian Railing

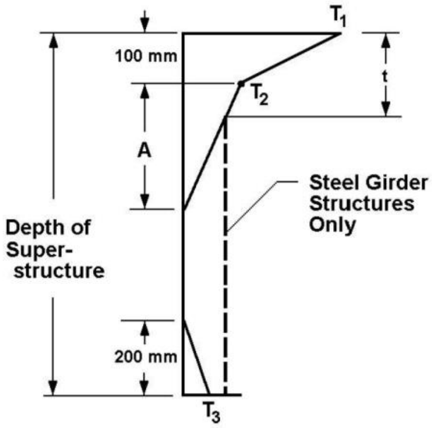
Pedestrian Handrail Load of 0.7 KN/m shall be used

11) Temperature Loading

The temperature range (expansion and contraction) shall be applied as per the requirements of DPWH-DGCS Clause 10.16.1 Procedure A and Table 10.16.1-1. Climate is set as moderate and temperature range of -12 to +27 degrees C variations with base temperature of 28ºC assumed.

12) Differential Temperature (Temperature Gradient)

The temperature profile for the effect of differential temperature is in accordance with AASHTO LRFD 2015 Figure 4.2.85.



Source: JICA Design Team

Figure 4.2.85 Differential Temperature Gradient

13) Time Dependent Effects of Creep and Shrinkage

Concrete shrinkage is considered in accordance with CEB-FIP 2010 Code. (Refer AASHTO LRFD Clause 5.4.3.2.1)

Concrete creep is considered in accordance with CEB-FIP 2010 Code. (Refer AASHTO LRFD Cause 5.4.3.2.1)

14) Bearing Friction

Elastomeric bearings will be used on all simple supported spans of the elevated structure. Such bearings are capable of transferring horizontal loads from deck to supporting members, either via friction, shear deformation or assisted by mechanical devices. The compressive and shear stiffness of the bearing adopted will be input into the analysis model.

15) Seismic Load

For the load of the inertial force at the time of earthquake, refer to the “4.2.3(5) Seismic Design Requirements” described later.

(4) Following Standard of Materials and Concrete Cover

Standard of materials and Concrete cover for viaduct structure are shown in Table 4.2.32.

Table 4.2.32 Quality of Materials to be Use

	Member / Item	Superstructure (PC)		Substructure (RC)	
		Box Girder		Pier (Column & Footing)	Cast-in -place Pile
		Precast	Cast-in-Situ		
Concrete	Design Standard Strength (MPa) (CYLINDER)	50 (Strength at the Moment of Prestressing Installation 75%= 40) (Cast-in-place: 40)	40 *2 (Strength at the Moment of Prestressing Installation 75%= 30) (Cast-in-place: 40)	40	40
Reinforcing Bar	Standard (Grade)	ASTM 615M GRADE 60 *2		ASTM 615M GRADE 60*2	ASTM 615M GRADE 60*2
	Design Tensile Yield Strength (N/mm^2)	520		520	520
	Standard Type of Diameter (mm)	Deformed Bar 12, 16, 20, 24,28,32,36,40mm			
Prestressed Concrete Steel	Standard (Grade)	ASTM A722/A 722M, GRADE 275 7-Strand Wires Dia.15.7mm		–	–
	Design Tensile Strength (N/mm^2)	1,860		–	–
	Apparent Relaxation Rate (%)	Low Relaxation Type =2.5%		–	–
	Friction Wobble Coefficient:K	0.003/m		–	–
	Friction Curvature Coefficient:K	0.2		–	–
	Maximum Permissible Slip	6 mm		–	–

*1: Design standard strength of "Lean Concrete" shall be 15 MPa.
*2: Materials are different from NSCR (Cast-in-Situ Concrete 50 MPa, Reinforcing Bar GRADE 75) due to rapid construction, quality control and ease of material procurement..

Source: JICA Design Team

Concrete grade and covering for the viaduct and bridge structures are shown in Table 4.2.33

Table 4.2.33 Concrete Grade and Concrete Cover

Items	Exposure Condition	Concrete Grade	Concrete Cover To Outermost Re-Bar
Piles	Moderate	40 Mpa	75mm
Pile Cap	Moderate	40 Mpa	75mm if cast against soil 50mm elsewhere
Abutment	Moderate	40 Mpa	75mm if cast against soil 50mm elsewhere
Approach Slab	Moderate	40 Mpa	75mm if cast against soil 50mm elsewhere
Pier	Moderate	40 Mpa	75mm if cast against soil 50mm elsewhere
Precast PSC/RCC Beams	Moderate	50 Mpa-PSC 40 Mpa-RCC	40mm
Precast PSC Box-Girder		50 Mpa	35mm
Track Slab		40 Mpa	40mm to upper surface 35mm to soffit where protected by precast girder or permanent formwork

Source: AASHTO LRFD

(5) Seismic Design Requirements

Basically, the design standard of bridge and viaduct applied is AASHTO which is generally used in the Philippine except for seismic load quoted from DPWH-BSDS. In order to consider resilience in seismic events beyond the design conditions prescribed above, verification will be also carried out in accordance with “Design Standards for Railway Structures and Commentary (Seismic Design)” of Japanese Railway Standards.

1) Seismic Type

The seismic types applied to the design are shown in Table 4.2.34.

Table 4.2.34 Example of Expected Seismic Activity and Performance Level

Design Seismic Acceleration	Probability of Occurrence	Seismic Performance Requirement
Level 1	• Has the probability of occurring multiple times during the design life of the structure.	• Maintain sound functionality during and after earthquake. • Limit damage to the minimal.
Level 2	• The largest seismic acceleration that can be conceived for area of construction of the structure • May happen once or never during the design life of the structure. For japan; Hansin-Awaji or the Tohoku earthquake is considered.	• Prevent Collapse • Sustain limited damages that can be recovered within a short time.

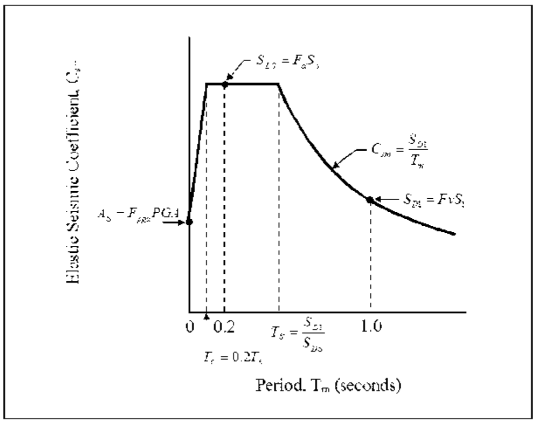
Source: JICA Design Team

It is necessary to study the seismic loads that are located near active faults.

2) AASHTO

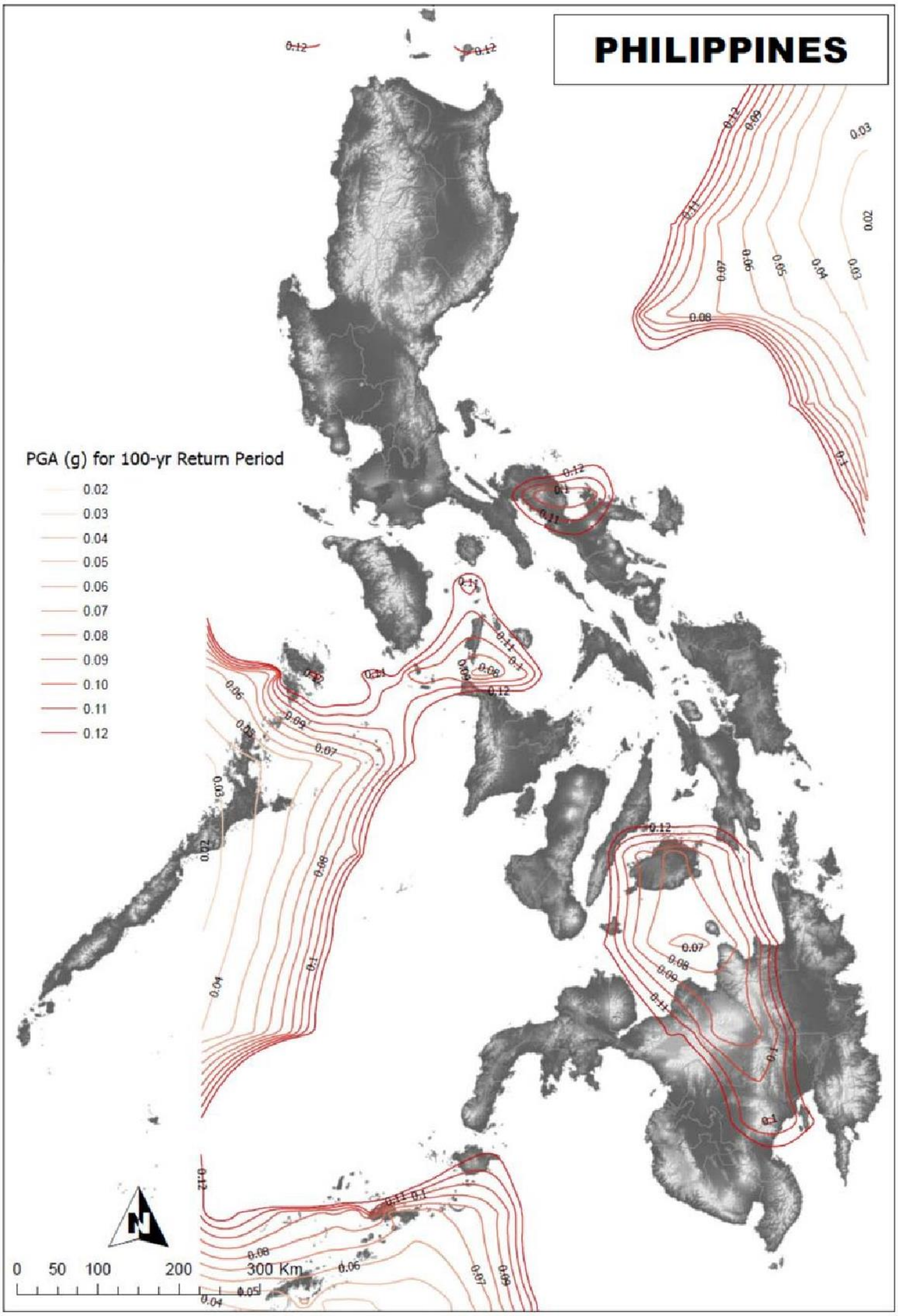
The seismic loads based on「LRFD Bridge Seismic Design Specifications 1st Edition, 2013」(DPWH) are applied when the seismic design is implemented according to AASHTO. The response spectrum of level I and II are shown in Figure 4.2.87 ~ Figure 4.2.92

Design seismic load is obtained from, considering the soil type and condition.



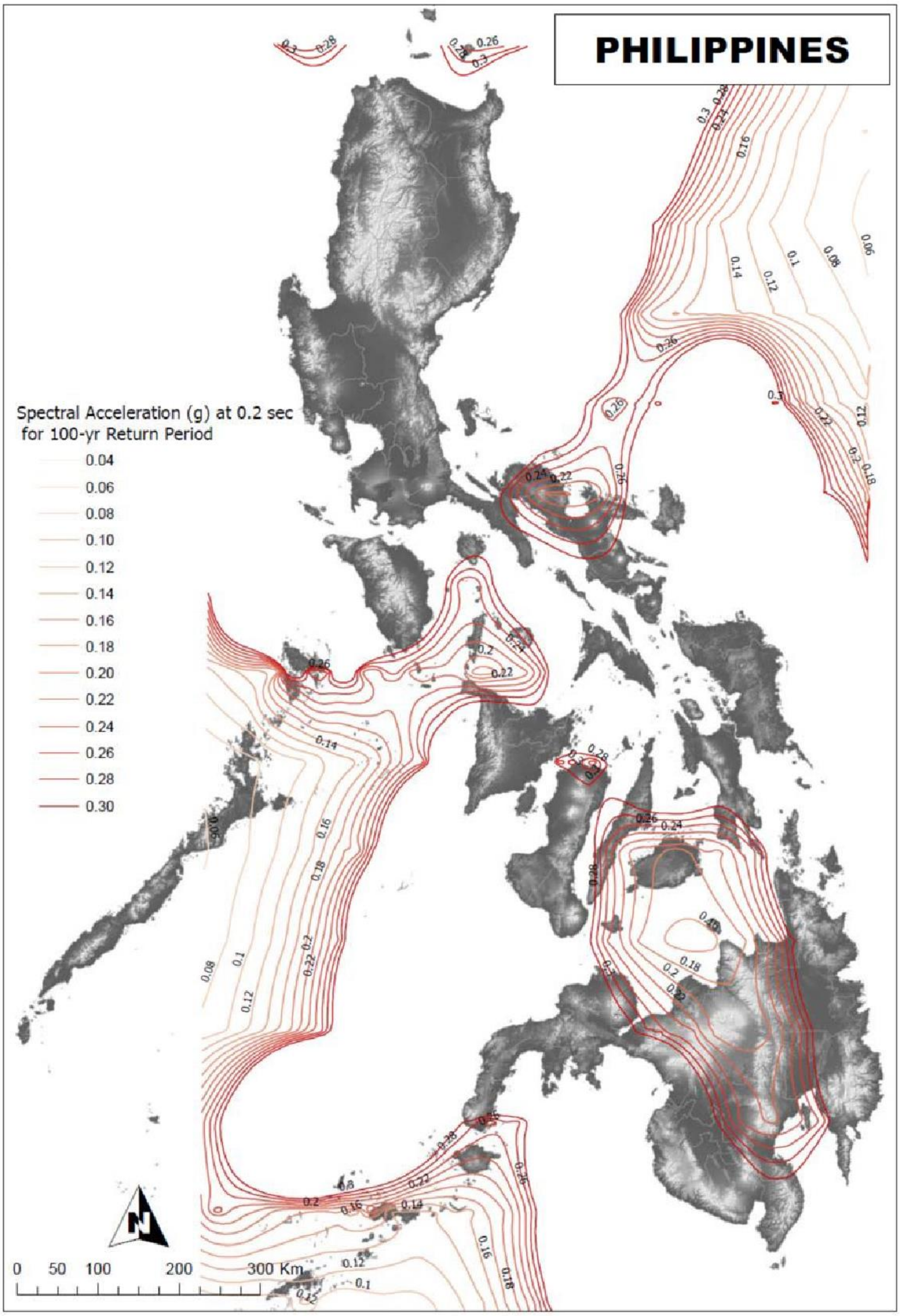
Source: “*LRF*D Bridge Seismic Design Specifications 1st Ediiton,2013” (DPWH)

Figure 4.2.86 Design Response Spectrum



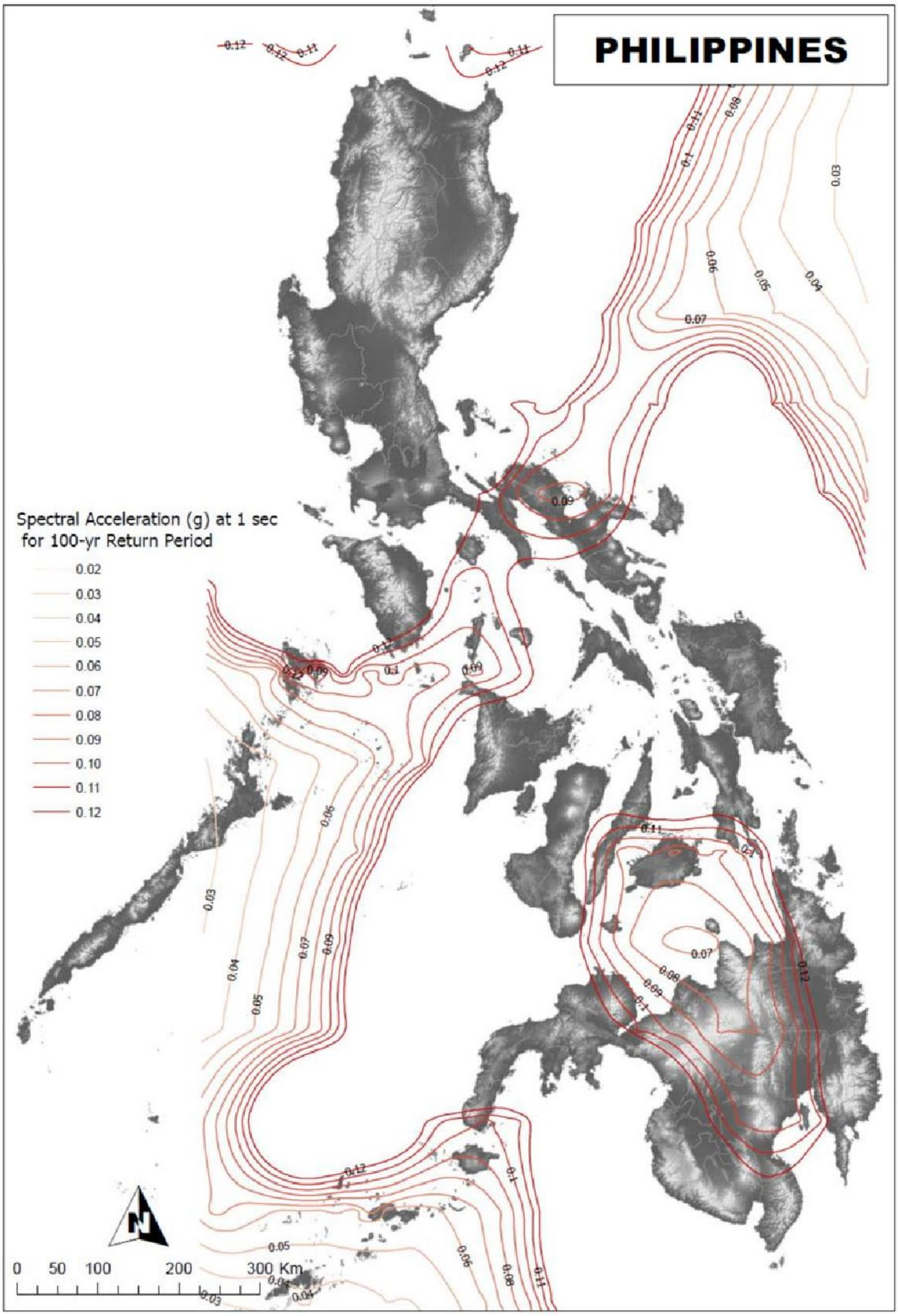
Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

Figure 4.2.87 Horizontal Peak Ground Acceleration Coefficient (PGA) with 53% percent Probability of Exceedance in 75 Years (Approximately 100-year Return Period) for Level 1 Earthquake Ground motion



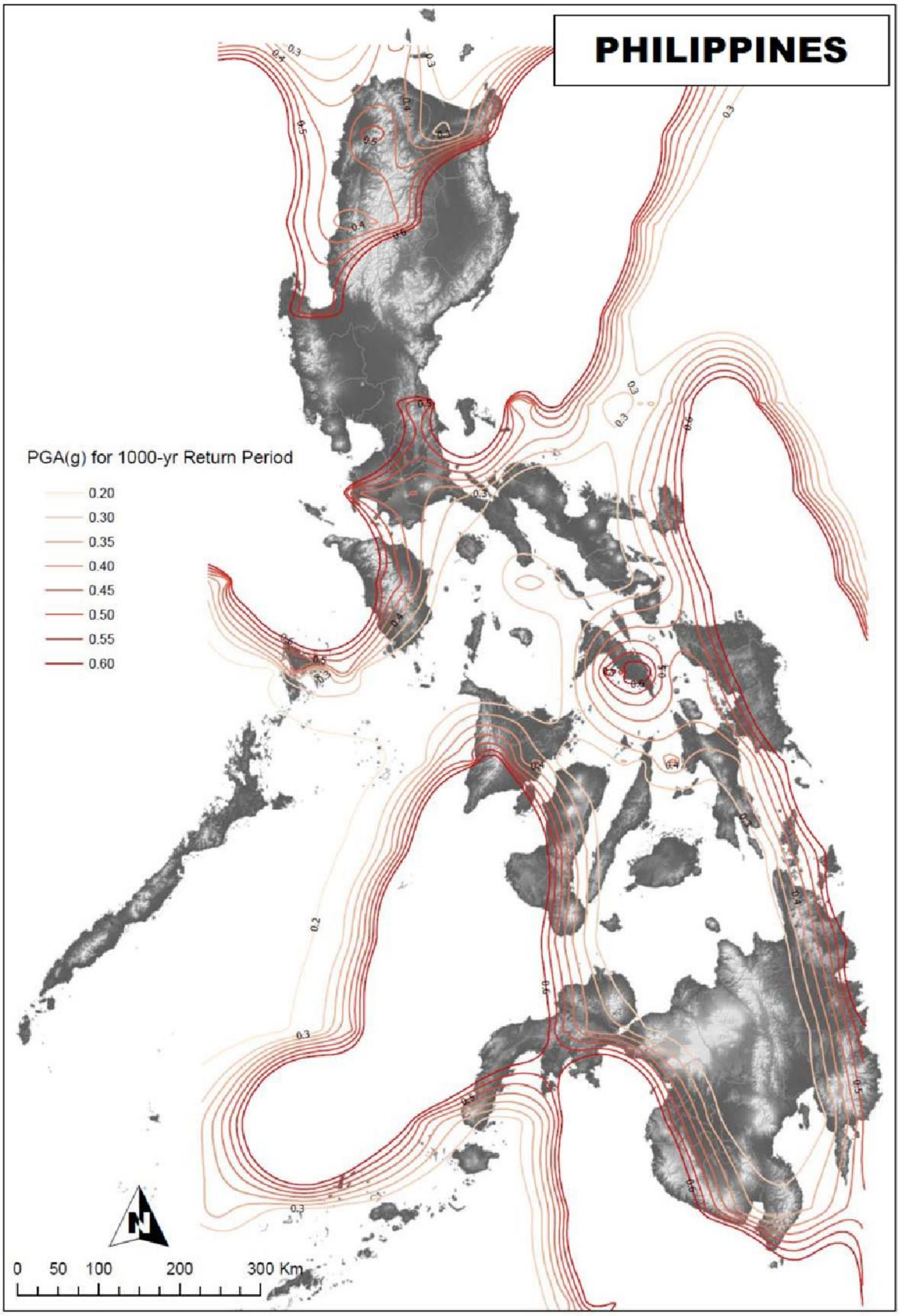
Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

Figure 4.2.88 Horizontal Peak Ground Acceleration Coefficient at Period of 0.20-sec (Ss) with 53% percent Probability of Exceedance in 75 Years (Approximately 100-year Return Period) for Level 1 Earthquake Ground motion



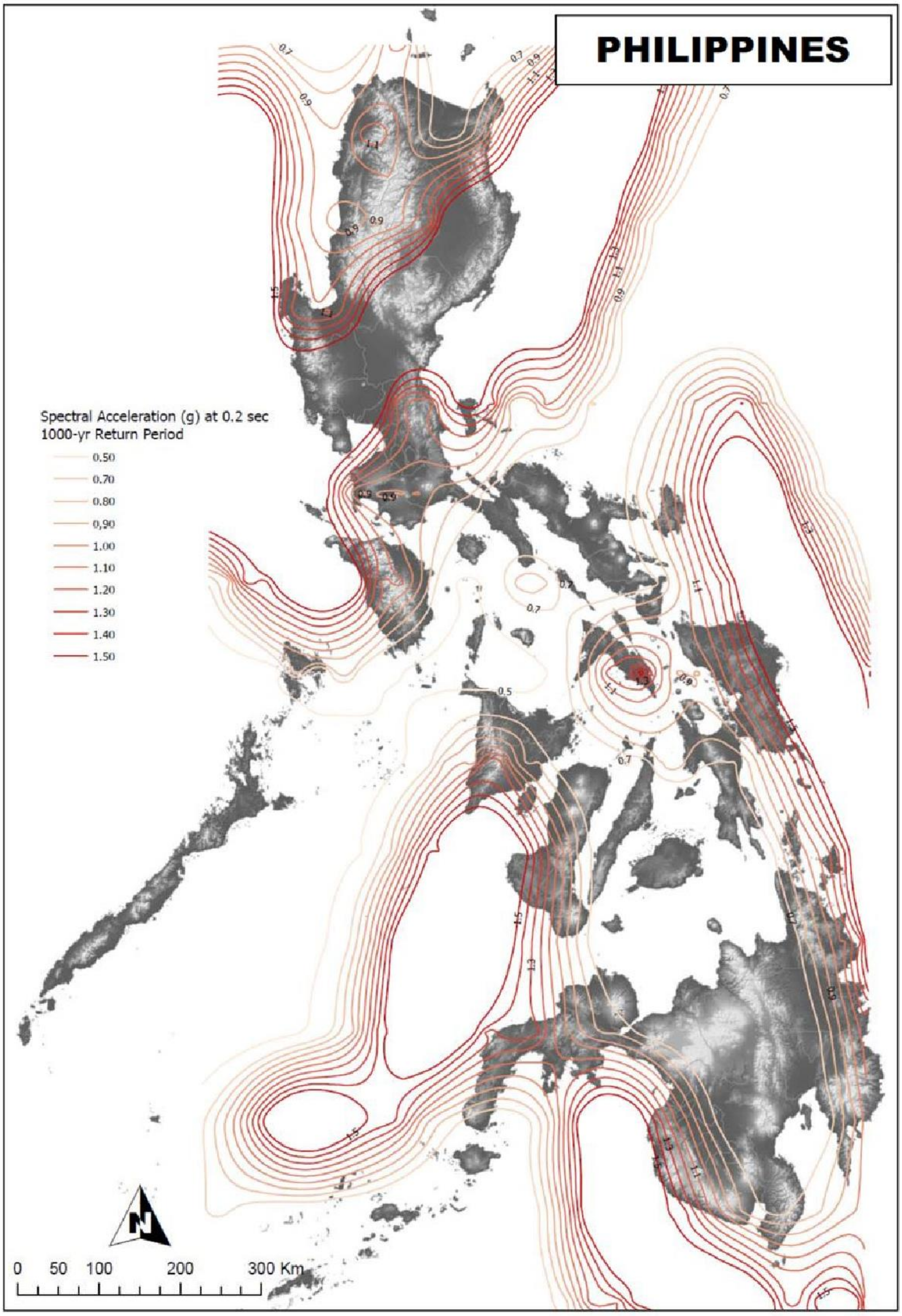
Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

Figure 4.2.89 Horizontal Peak Ground Acceleration Coefficient at Period of 1.0-sec (S1) with 53% percent Probability of Exceedance in 75 Years (Approximately 100-year Return Period) for Level 1 Earthquake Ground motion



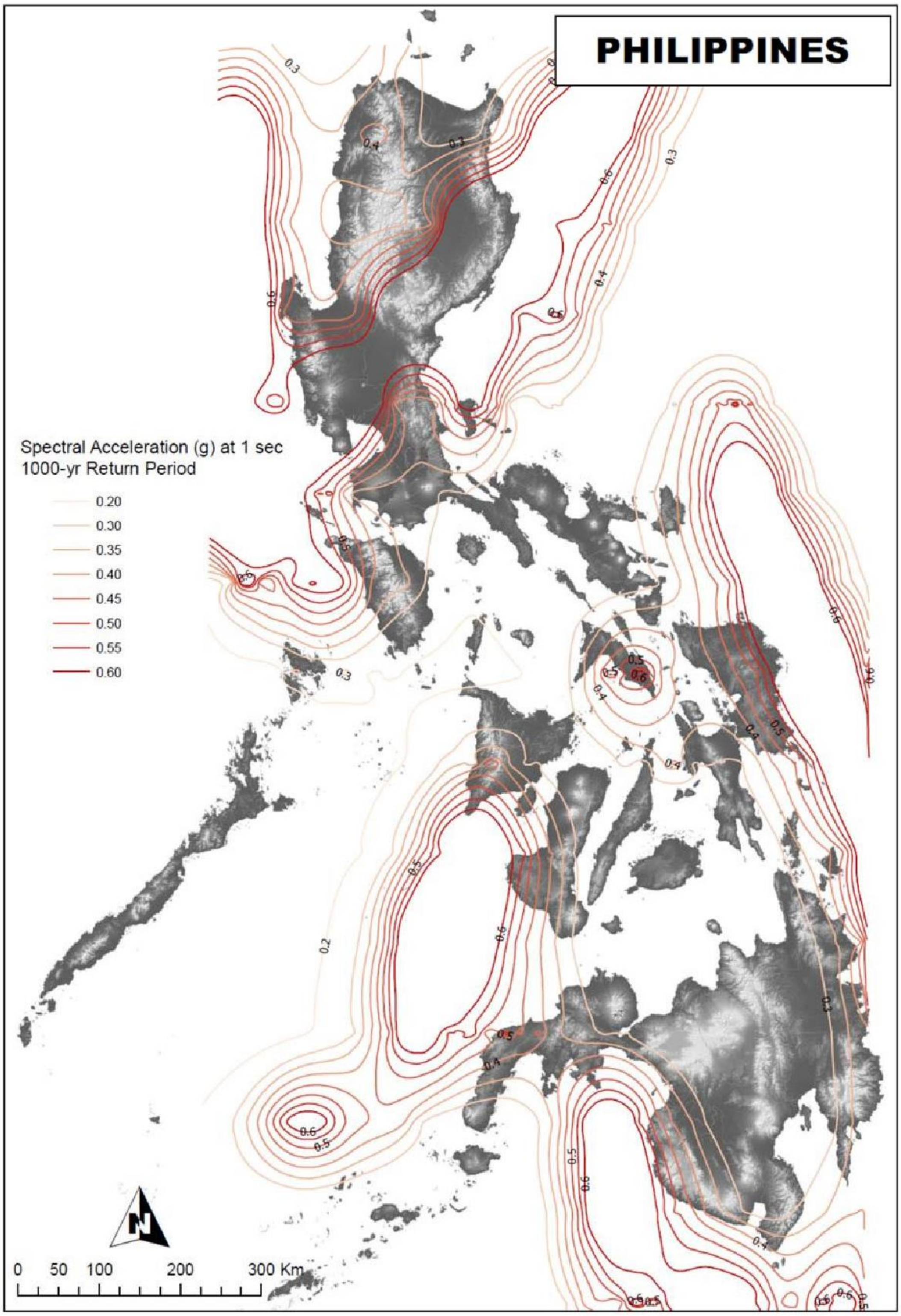
Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

Figure 4.2.90 Horizontal Peak Ground Acceleration Coefficient (PGA) with Seven percent Probability of Exceedance in 75 Years (Approximately 1,000-year Return Period) for Level 2 Earthquake Ground motion



Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

Figure 4.2.91 Horizontal Peak Ground Acceleration Coefficient at Period of 0.20-sec (Ss) with Seven percent Probability of Exceedance in 75 Years (Approximately 1,000-year Return Period) for Level 2 Earthquake Ground motion



Source: "LRFD Bridge Seismic Design Specifications 1st Ediiton,2013" (DPWH)

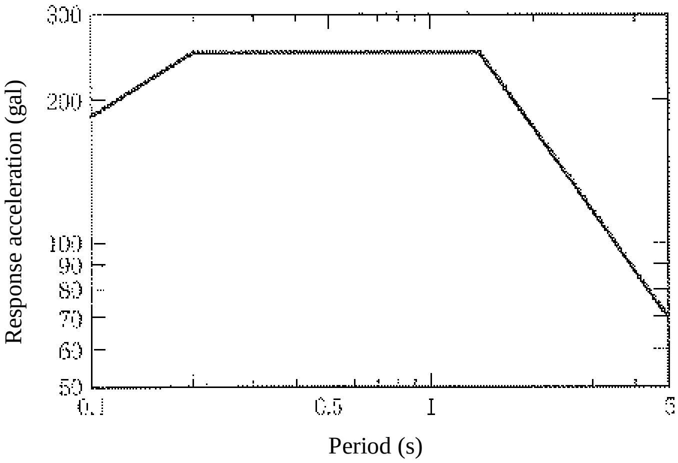
Figure 4.2.92 Horizontal Peak Ground Acceleration Coefficient at Period of 1.0-sec (S1) with Seven percent Probability of Exceedance in 75 Years (Approximately 1,000-year Return Period) for Level 2 Earthquake Ground motion

3) Seismic loads based on Railway Standards

Seismic design loads are determined according to Design Standards for Railway Structures and Commentary (Seismic Design) revised in 2012 (Railway Technical Research Institute) (herein Railway Standards).

a) Level 1

Level 1 seismic motion is decided according to considering the location factor.

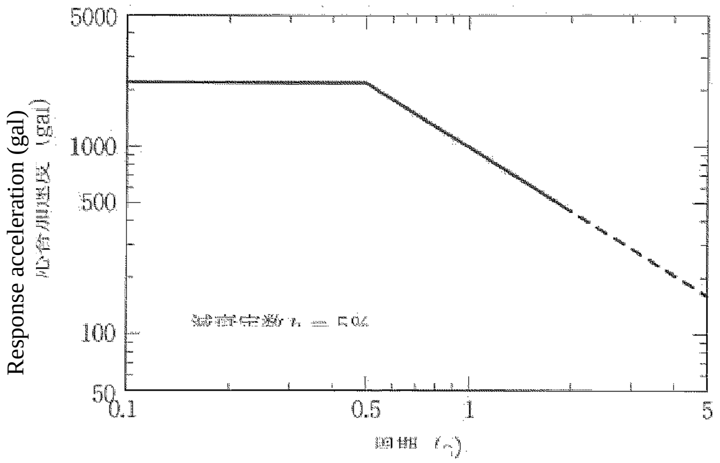


Source: Design Standards for Railway Structures and Commentary (Seismic Design) revised in 2012 (Railway Technical Research Institute)

Figure 4.2.93 Plastic acceleration response spectrum of Level 1 seismic motion

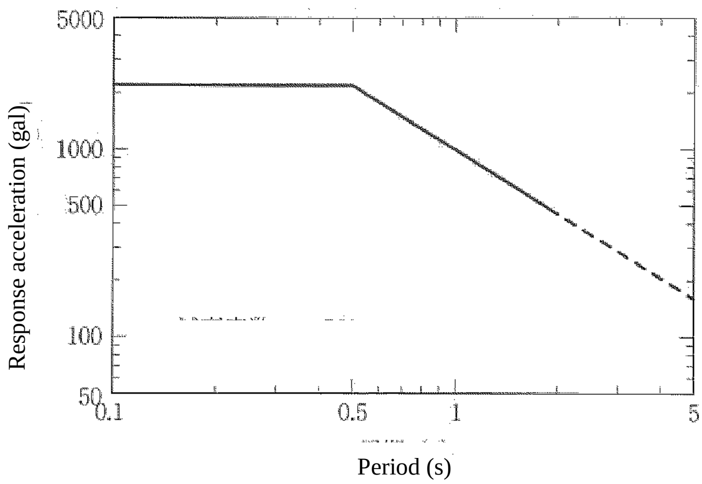
b) Level 2

Level 2 seismic motion should be applied considering the largest one which is expected to occur at the construction location. For large-scale marine earthquake (spectrum I) and earthquake occurred by inland active faults (spectrum II) are used in seismic design. Spectrum I, II are shown in Figure 4.2.94, Figure 4.2.95.



Source: Design Standards for Railway Structures and Commentary (Seismic Design) revised in 2012 (Railway Technical Research Institute)

Figure 4.2.94 Plastic acceleration response spectrum of Spectrum 1



Source: Design Standards for Railway Structures and Commentary (Seismic Design) revised in 2012 (Railway Technical Research Institute)

Figure 4.2.95 Plastic acceleration response spectrum of Spectrum II

(6) Geotechnical Design Condition

1) Design Policy

For MSRP, boreholes of depths ranging from a few meters to as deep as 40m were drilled at about 600 locations along the approximately 69km length of the project route. Ideally all piers should be design using the geotechnical conditions obtained through field and laboratory test of the nearest borehole to the said pier. However, in large projects such as the NSRP where cost and project time becomes critical, it is general practice to group the boreholes into a manageable set of representative cases that are used in the design of substructures.

The actual length of piles for all the structures shall be determined based on specific borehole nearest to the respective substructures.

2) Geotechnical models used in the design of substructures

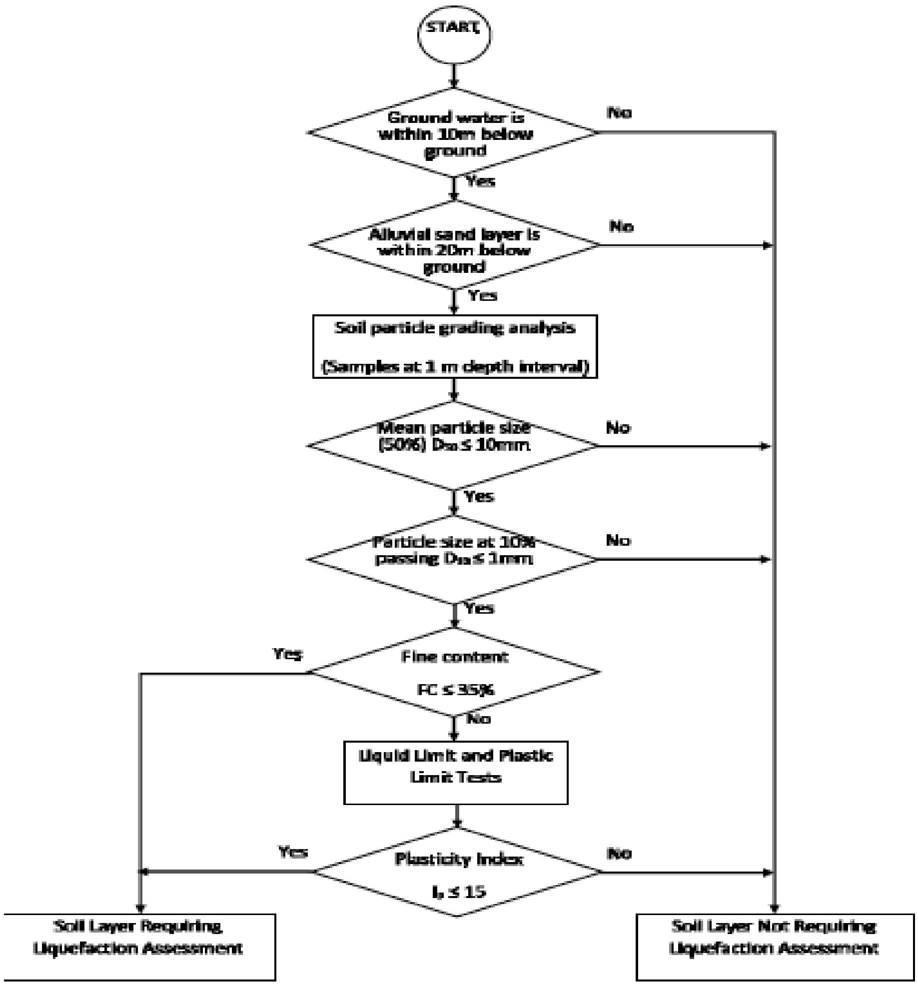
A combination of probabilistic (using statistical parameters such as mean, standard deviations and correlation of borehole data) and deterministic approach (use of professional engineering experience and judgement) were used to develop geotechnical models based on Standard Penetration Test (N values) data.

By analyzing the SPT-N values of all the boreholes from the geotechnical investigation, a) the average SPT-N value up to a certain depth of the soil profile, and b) the depth which SPT-N value becomes greater than 50 were used as parameters to classify all the boreholes into Model cases that were used in design of the substructure. Prior to grouping of the boreholes, liquefaction susceptibility evaluation was carried out in accordance with the flow chart shown in Figure 4.2.96

Liquefaction evaluation was carried out based on the DPWH Guide Specification- LRFD Bridge Seismic Design Specification. Soils that much the following considers are considered as prone to liquefaction, and requiring liquefaction assessment.

- Saturated soil layer with depth less than 20m below the ground surface and having ground water level higher than 10m below the ground surface.
- Soil layer containing a fine content (FC) of 35% or less, or soil layer having plasticity index, IP, less than 15, even if FC is larger than 35%.
- Soil layer having a mean particle size (D50) of less than 10mm and a particle size at 10% passing (D10) (on the grading curve) is less than 1 mm.

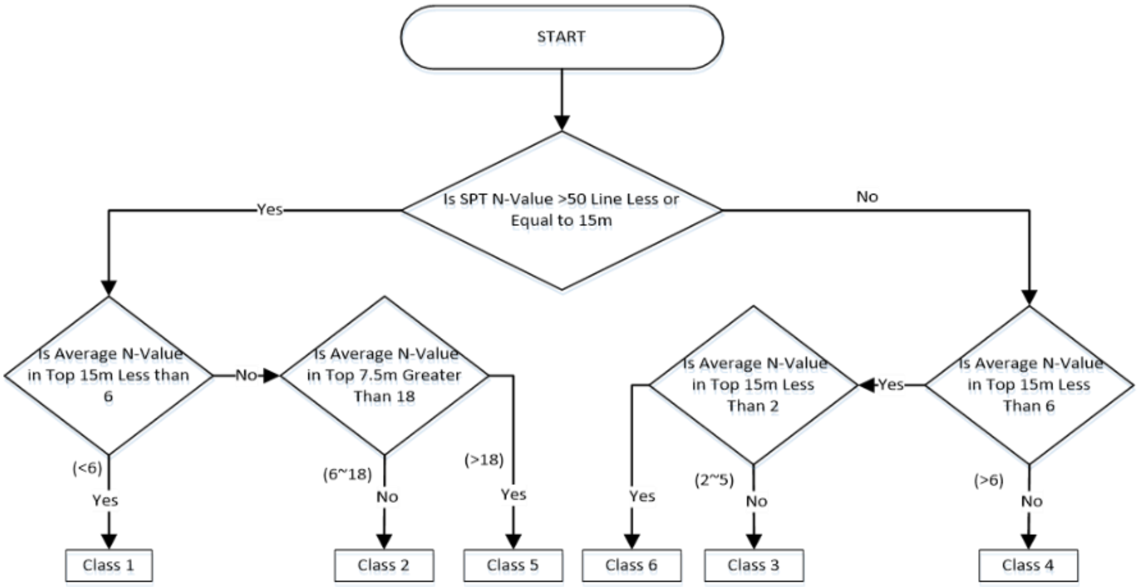
Where a layer or layers in a given borehole is known to be susceptible to liquefaction, the liquefaction reduction factor D_E for that layer is calculated and its SPT-N value modified accordingly.



Source: NSCR Report

Figure 4.2.96 Determination of Liquefaction Assessment Necessity Flow

After the effect of liquefaction for all the boreholes have been considered and applied to each and every borehole, realistic models that will result in economical and safe foundation were developed using the flow chart shown in Figure 4.2.97, and the actual Models used in the design of typical substructures shown in Table 4.2.35.



Source: JICA Design Team

Figure 4.2.97 Soil Model Selection Flow

Table 4.2.35 Soil Models used in the Design of NSRP Typical Substructure Design

Depth (m)	Model 1	Model 2	Model 5	Model 6	Model 3	Model 4
1.5	2	6	15	0	2	6
3.0	2	6	15	0	2	6
4.5	2	6	20	0	2	6
6.0	2	6	20	0	2	6
7.5	2	6	20	0	2	6
9.0	2	6	50	2	2	6
10.5	2	6	50	2	2	6
12.0	2	6	50	2	2	6
13.5	2	6	50	2	2	6
15.0	2	6	50	2	2	6
16.5	50	50	50	10	10	15
18.0	50	50	50	10	10	15
19.5	50	50	50	10	10	15
21.0	50	50	50	10	10	15
22.5	50	50	50	10	10	15
24.0	50	50	50	50	10	15
25.5	50	50	50	50	10	15
27.0	50	50	50	50	10	15
28.5	50	50	50	50	10	15
30.0	50	50	50	50	10	15
31.5	50	50	50	50	50	50
33.0	50	50	50	50	50	50
34.5	50	50	50	50	50	50
36.0	50	50	50	50	50	50
37.5	50	50	50	50	50	50
39.0	50	50	50	50	50	50
40.5	50	50	50	50	50	50
42.0	50	50	50	50	50	50
43.5	50	50	50	50	50	50
45.0	50	50	50	50	50	50

Legend: N value 0 2 6 10 15 20 50

Source: JICA Design Team

In Table 4.2.35 above, values represented in the vertical direction is the SPT N value at every depth of the soil profile. The color spectrum is simply to indicate the differences in the SPT N value in the various layers from deep from top to bottom.

In the same way, the color spectrum is simply to indicate the SPT V-value in the various layers from top to bottom. The lighter color highlights show soft conditions, and stronger/darker colors indicates harder conditions.

(7) Other Ancillary Structures

1) Foundation of OCS Pole (Cast-in place concrete)

Set up for t supporting OCS Pole.

2) Cable Trench (with the exception of cap, Cast-in place concrete. Cap; precast concrete)

Set up for power distribution cables, signaling and telecommunication cables.

3) Noise Barrier (Precast concrete)

Set up for cutting the noise.

4) Drainage

Set up for smooth drainage from the upper surface of the super structure.
Drainage set inside the box girder with consideration for aesthetic aspect.

5) Expansion Joint

Set up for preventing water leakage from the joint.

6) Expansion of slab due to setting signal related facilities.

The slab should be expanded due to setting of impedance bond, electric point machine, and, shunting signal.

7) Waterproofing

Waterproofing is not required for the reason that precast segment box girders are applied as the form of superstructures, and tendons are arranged in the top slab, then no water leakage occurs.

8) Track Slab (Cast-in place concrete)

Refer to chapter 6.1.

9) Signal related facilities

Refer to chapter 12.

4.2.4 Geotechnical and Topographic Surveys

(1) Geotechnical Survey

The Geotechnical Survey on the NSRP-South Line aims to provide a sufficient level of geotechnical information on the underlying soils and rock to facilitate the engineering design of the project. The scope of work comprises to the proposed alignment in the Figure 4.2.98 of field investigation by rotary drilling and laboratory testing in accordance with the American Society for Testing and Materials (ASTM) standards.

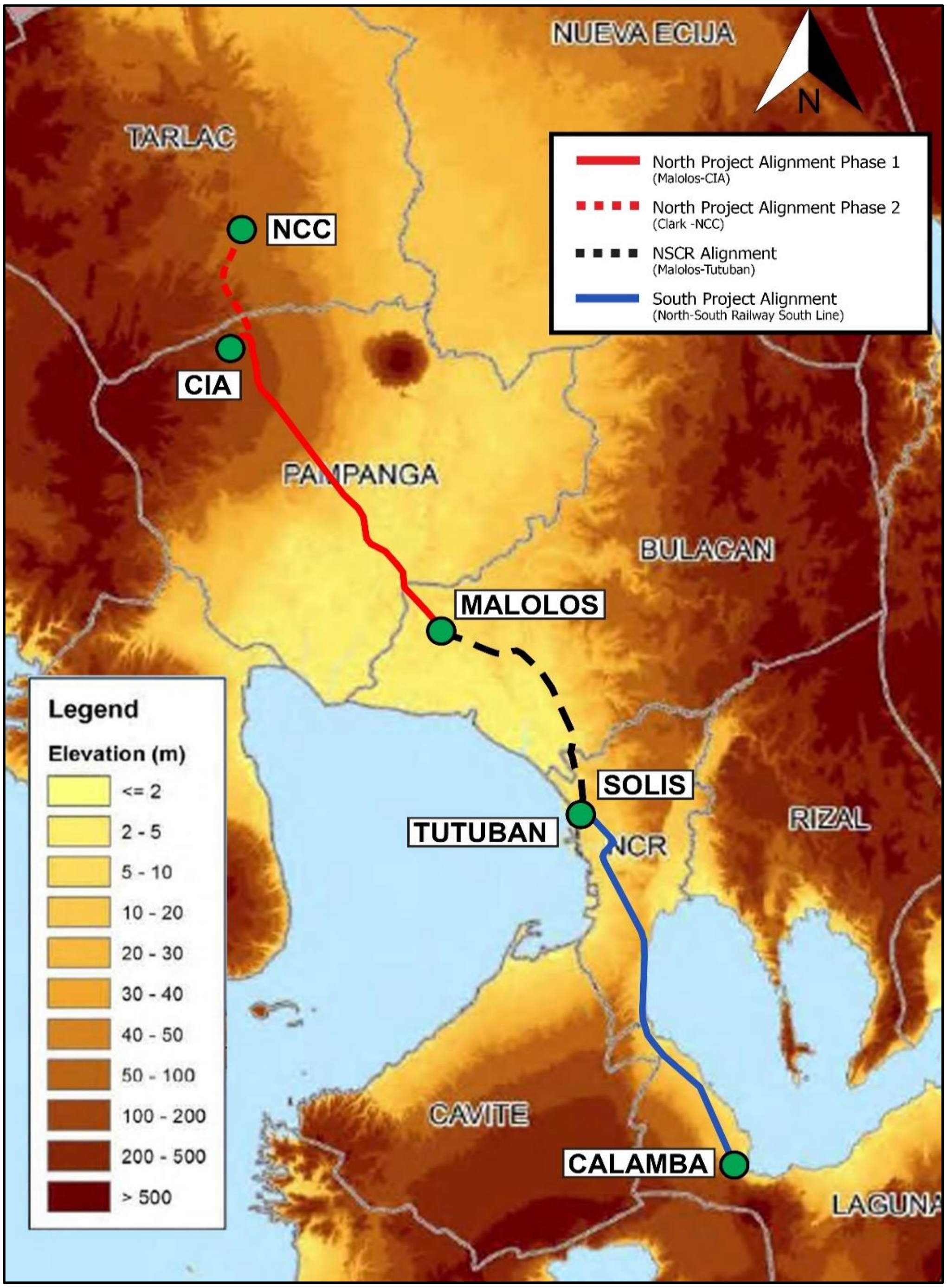
Source: JICA Design Team

Figure 4.2.98 Area Map of Proposed Alignment

1) Summary of Physiography and Geology

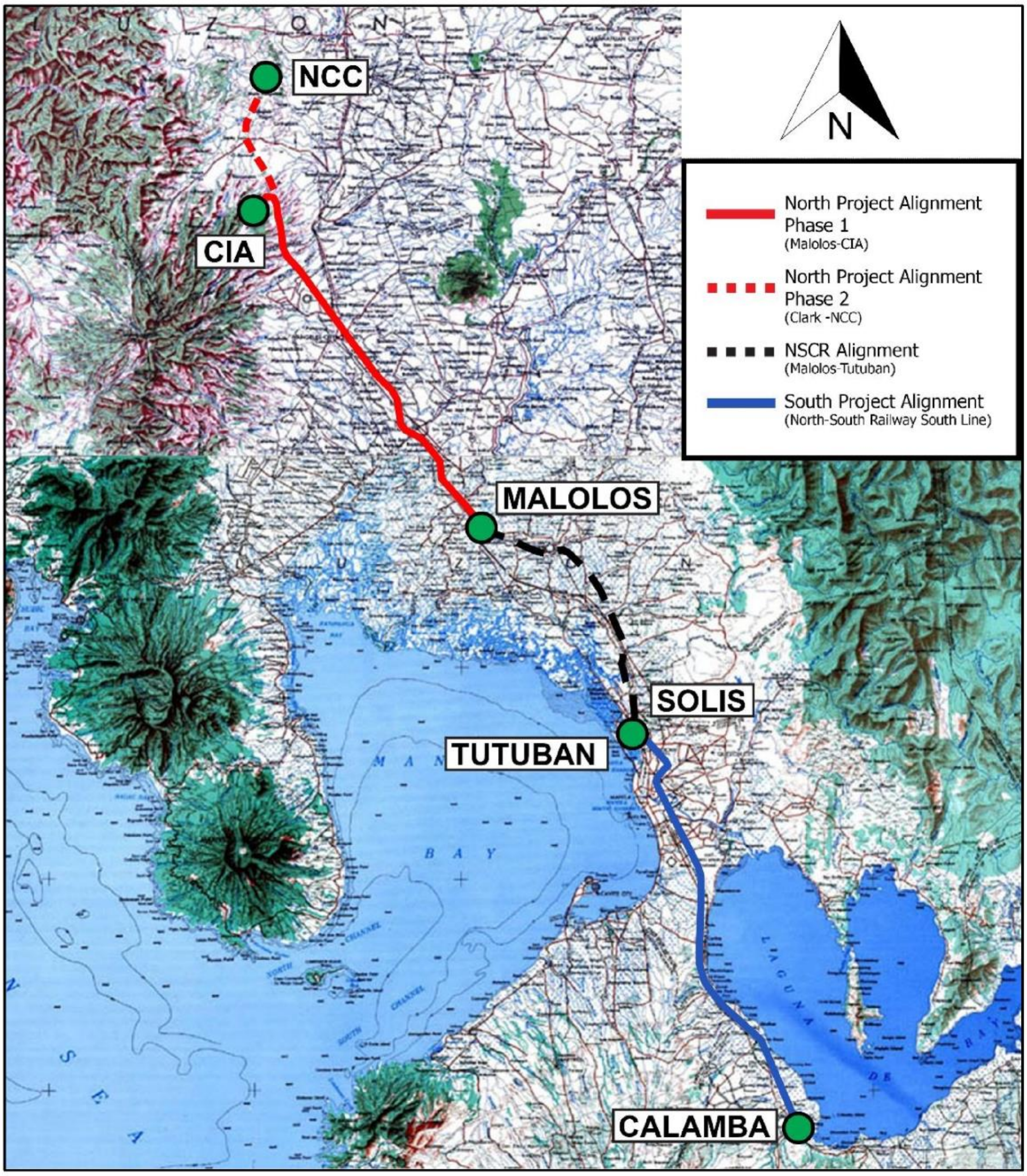
a) Physiography

In Metro Manila and Laguna areas, the alignment generally lies in low elevations. Figure 4.2.99 also shows that the alignment of the NSRP-South Line in Laguna Province is located beside higher elevated areas.



Source: Roadmap for Transport Infrastructure Development of Metro Manila and its Surrounding Areas

Figure 4.2.99 Elevation Map of the Project Area



Source: NAMRIA

Figure 4.2.100 Extract from the Topographic Map

b) Regional Geology

The NSRP-South alignment transects parts of the Central Luzon Basin and the Southwest Luzon Uplands. Based on Figure 4.2.101, the south line is generally underlain by Recent Deposits mainly of alluvium and fluviatile deposits. Pliocene – Pleistocene Deposits, which are characterized by volcanic plain or volcanic piedmont deposits and/or volcanic debris at the foot of volcanoes, are present in the Taguig area. Pliocene – Quaternary and Recent Deposits underlie the Calamba and Los Baños areas. The Pliocene – Quaternary Deposits are made up of non-active cones (generally pyroxene andesite); also dacitic and/or andesitic plugs. Basaltic dikes are also present in some parts of Luzon. (Source: Geology of the Philippines)

Stratigraphy

The stratigraphy of Metro Manila and Laguna where the alignment of the proposed railway lies, can be categorized into two (2) major geologic formations: 1) Guadalupe Tuff Formation, and 2) Taal Tuff. The areas of Metro Manila and the northern parts of Laguna (San Pedro, Sta. Rosa and Calamba) are mostly underlain by the Guadalupe Tuff Formation and Quaternary Alluvium. Los Baños in Laguna is largely underlain by Quaternary Volcanic Deposits and the Taal Tuff.

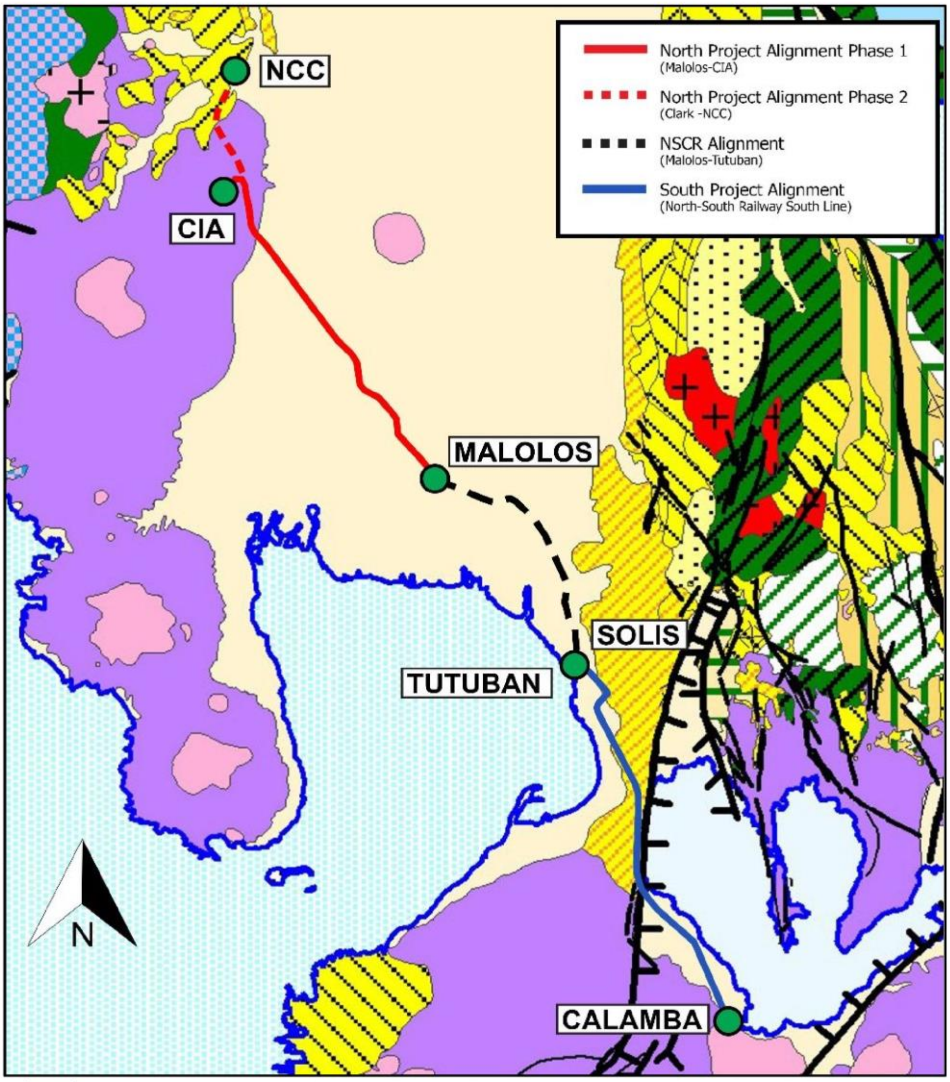
The Quaternary Alluvium Deposits are unconsolidated deposits of silt, sand and gravel along valleys and coastal plains. Most of these deposits are found in San Pedro, Sta. Rosa and Calamba, Laguna. Relatively thin layers can be found at the southern part of Metro Manila. While, Quaternary Volcanic deposits are mainly basalt and andesite flows with associated pyroclastic deposits. Based on available geologic information from the Geology of the Philippines (Source: Mines and Geosciences Bureau) the aforementioned formations are described as follows:

Guadalupe Tuff Formation

The Guadalupe Tuff Formation, or GTF, is the regional bedrock in Metro Manila. The thickness of the formation is around 1,500 – 2,200 m and is of Pleistocene age. It is composed of two members: (1) Alat Conglomerate member composed of conglomerate, sandstone and mudstone, and (2) Diliman Tuff member composed of tuffs, pyroclastic breccias and tuffaceous sandstones. It is a horizontally rock referred to as “adobe.” It consists of well laid rock formation of minor fine to medium grained tuffaceous sandstone, tuffaceous siltstone, and shale being the weakest member.

Taal Tuff

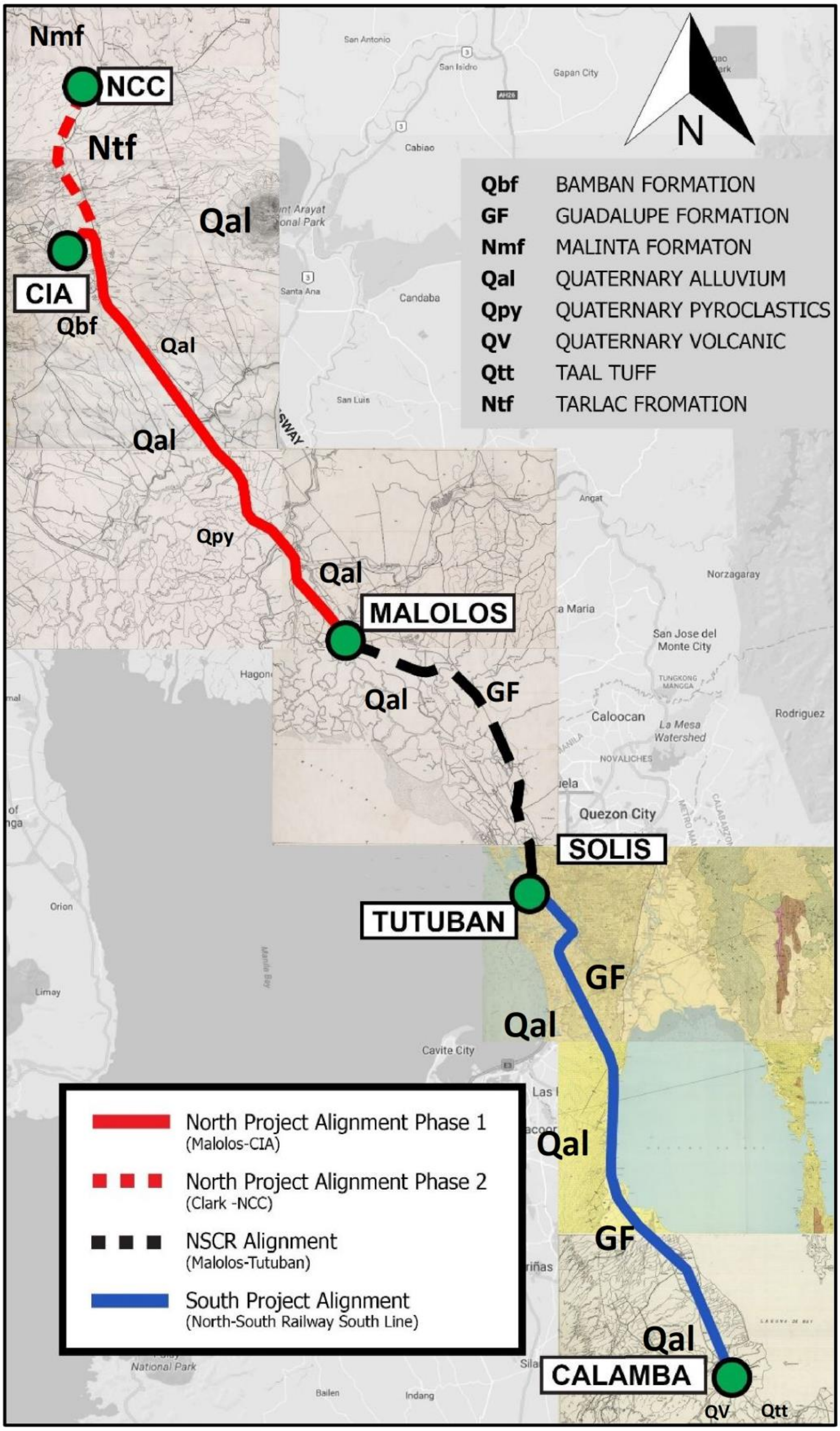
The Taal tuff, which lies along the vicinity of the Taal Lake, is described as fine to medium grained and thin to medium-bedded basaltic tuff. Based on the Lexicon of Philippine Stratigraphy (Teves, 1954), this formation also consists of thinly laminated white ash, and occasionally, a few stringers of black cinder. The maximum thickness of the Taal Tuff is around 400 meters.



(legend swatch)	Qh	QUATERNARY (Holocene)	Alluvium, fluviatile, lacustrine, paludal, and beach deposits; raised coral reefs, atolls, and beachrock.
(legend swatch)	N3 + Q1	PLIOCENE-PLIESTOCENE	Marine and terrestrial sediments. Associated with extensive reef limestone in the western coastal area of Luzon, Bicol region, Visayas, and Mindanao; with pyroclastics in western and southern Central Luzon Basin and in northern Bicol Lowland. Predominantly marl and reworked tuff in places. Sporadic terrace gravel deposits in some coastal and fluvial tracts. Plateau red earths and/or laterites in some elevated flat land surfaces. Deformation limited to gentle warping and vertical dislocation.
(legend swatch)	N2	UPPER MIOCENE-PLIOCENE	Largely coarse marine clastics overlain by extensive, locally transgressive pyroclastics (chiefly tuff, tuffites) and tuffaceous sedimentary rocks. Associated with calcarenite and/or silty limestone in some parts of Luzon, central Visayas, and Mindanao. Reef limestone lenses intercalated with dacite and andesite flows in Zamboanga (western Mindanao). Chiefly sandstones and limestones in Palawan. Local bog iron; laterite deposits in some elevated near-peneplaned surfaces.
(legend swatch)	QVP	PLIOCENE-QUATERNARY	Volcanic plain or volcanic piedmont deposits. Chiefly pyroclastics and/or volcanic debris at foot of volcanoes. Plateau basalt in Pagadian and Lanao regions, Mindanao; associated with pyroclastics north and east of Laguna de Bay, Luzon.
(legend swatch)	QV	PLIOCENE-QUATERNARY	Non-active cones (generally pyroxene andesite); also dacitic and/or andesitic plugs. Basaltic dikes in Binga, Mt. Province, Luzon and in Misamis Oriental, Mindanao.

Source: MINES AND GEOSCIENCES BUREAU

Figure 4.2.101 Geologic Map of the Project Alignment



Source: MINES AND GEOSCIENCES BUREAU

Figure 4.2.102 Combined Detailed Geologic Maps of the Project Site

c) Hydrology

The groundwater levels will be based on the borehole logs. Under natural conditions, groundwater moves along flow paths from areas of recharge to areas of discharge along streams, lakes and oceans.

d) Tectonic Activity

The Philippines accounts for 3.2% of the world's seismicity. It is situated in the Circum-Pacific Belt a.k.a. "Ring of Fire", where 80% of the world's earthquakes occur. Philippine seismicity is mainly related to plate subduction and in part to strike-slip motions along trans-current faults.

The country is a north-south strip of lithosphere built partly on obducted oceanic basement rocks, and by portions of drifted continental crust from southern China. It is pictured as "a wedge caught in between two opposite dipping trenches". The northwestward moving Pacific Plate pushes the Philippine Sea Plate beneath the eastern side of the archipelago at the rate of about 7 centimeters per year (PHIVOLCS, 1991). The oceanic parts of the slower moving Eurasian Plate are being subducted along the western side of Luzon and Mindoro at the rate of 3 centimeters per year.

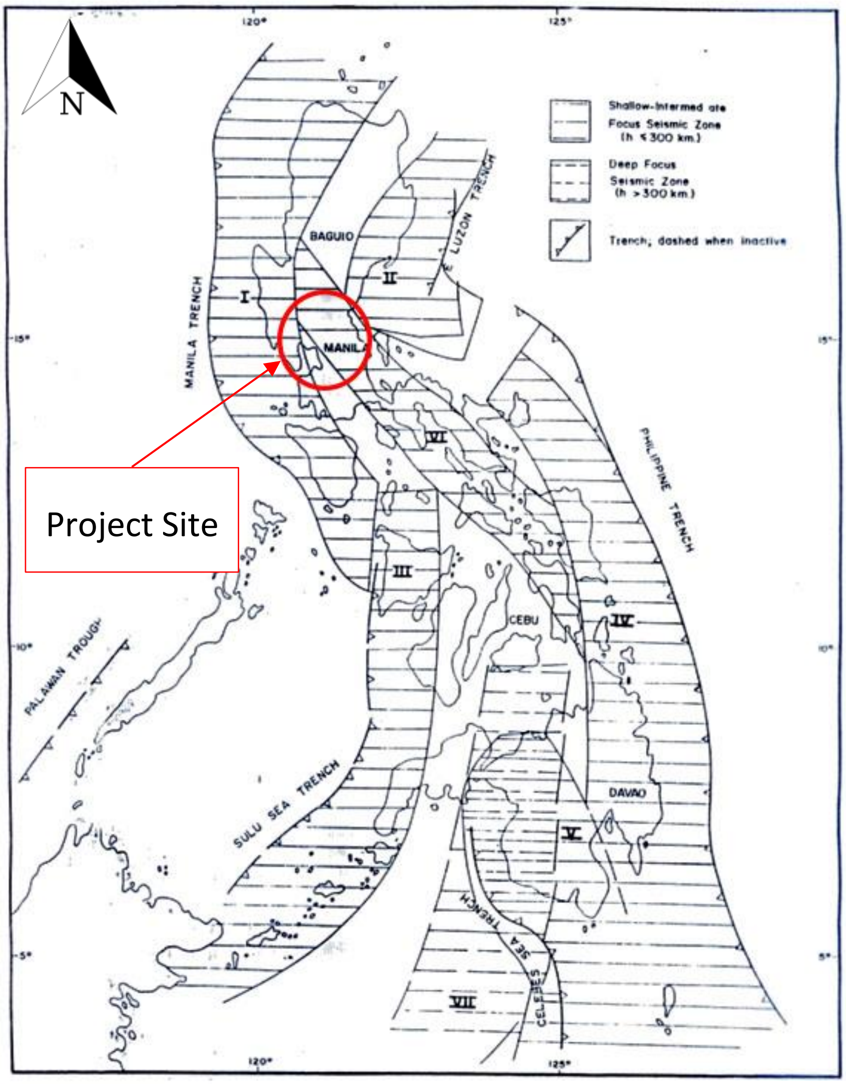
Table 4.2.36 and Figure 4.2.103 show the seven (7) regional seismic zones in the Philippines. These are delineated and interpreted as follows in the succeeding pages.

Table 4.2.36 Philippine Seismic Zones and Earthquake Sources

ZONE-I	Related to the east-dipping Manila Trench
ZONE-II	Related to the west-dipping East Luzon Trench
ZONE-III	Related to the east dipping Sulu Trench and Antique Trough
ZONE-IV	Related to the west-dipping Philippine Trench
ZONE-V	Related to the east-dipping Cotabato Trench
ZONE-VI	Related to the activities along the Philippine Fault and its splays
ZONE-VII	Possibly related to a west dipping subduction zone surfacing at the Agusan-Davao Trough

Source: Geology and Mineral Resources of the Philippines, Vol.1, 1981

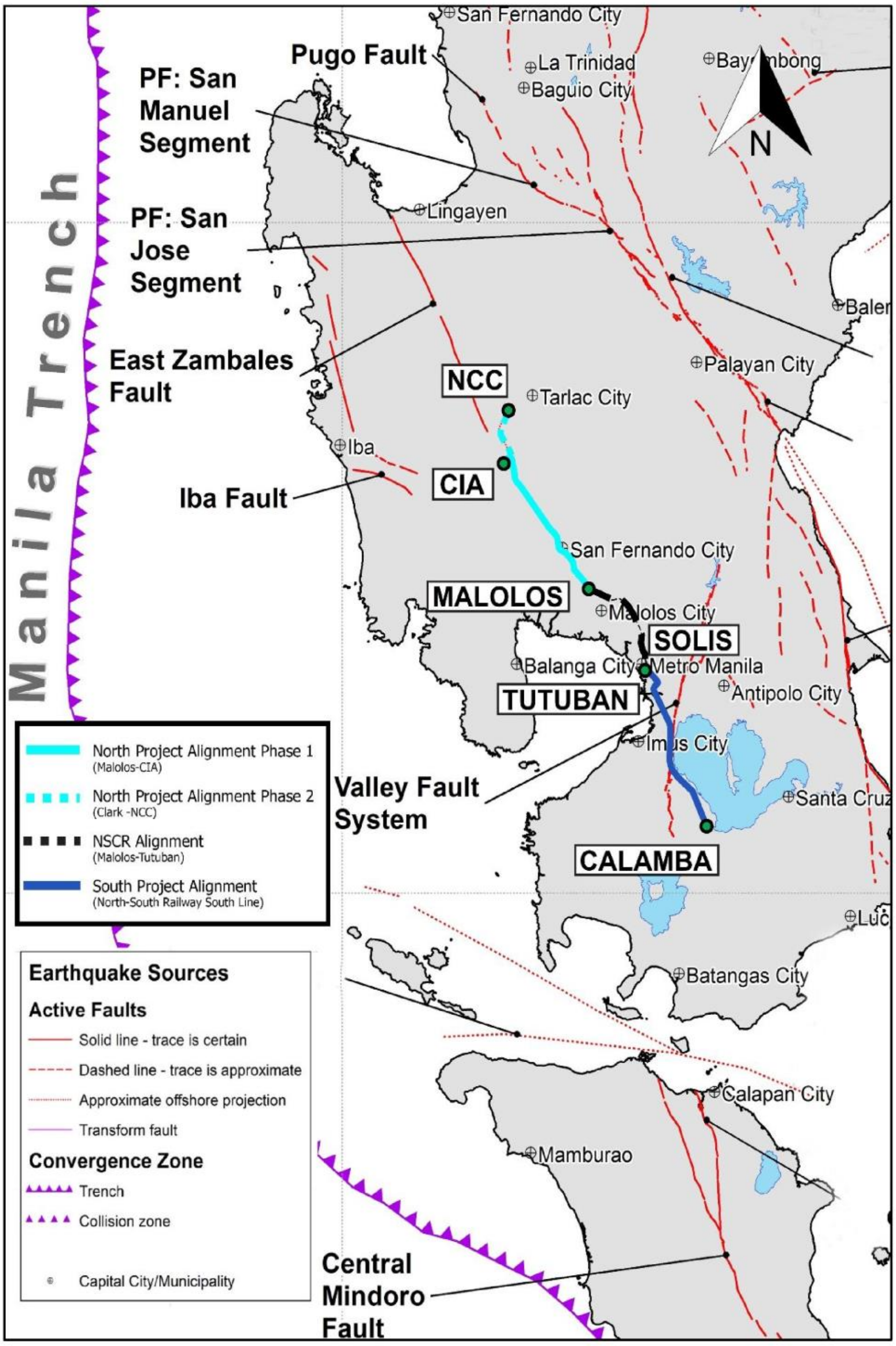
The study thus far indicates the high probability that the regional seismicity of the site would be related to Zone-I and VI, meaning damaging earthquakes are to be brought about by east-dipping Manila Trench and Philippine Fault.



Source: MINES AND GEOSCIENCES BUREAU

Figure 4.2.103 Seismic Zones in the Philippines

Based on the seismic map published by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), the South Line crosses the Valley Fault System. Four stations from the South Line (Sucat Station, Alabang Station, Muntinlupa Station, San Pedro Station) almost lie along the fault system (see Figure 4.2.104).



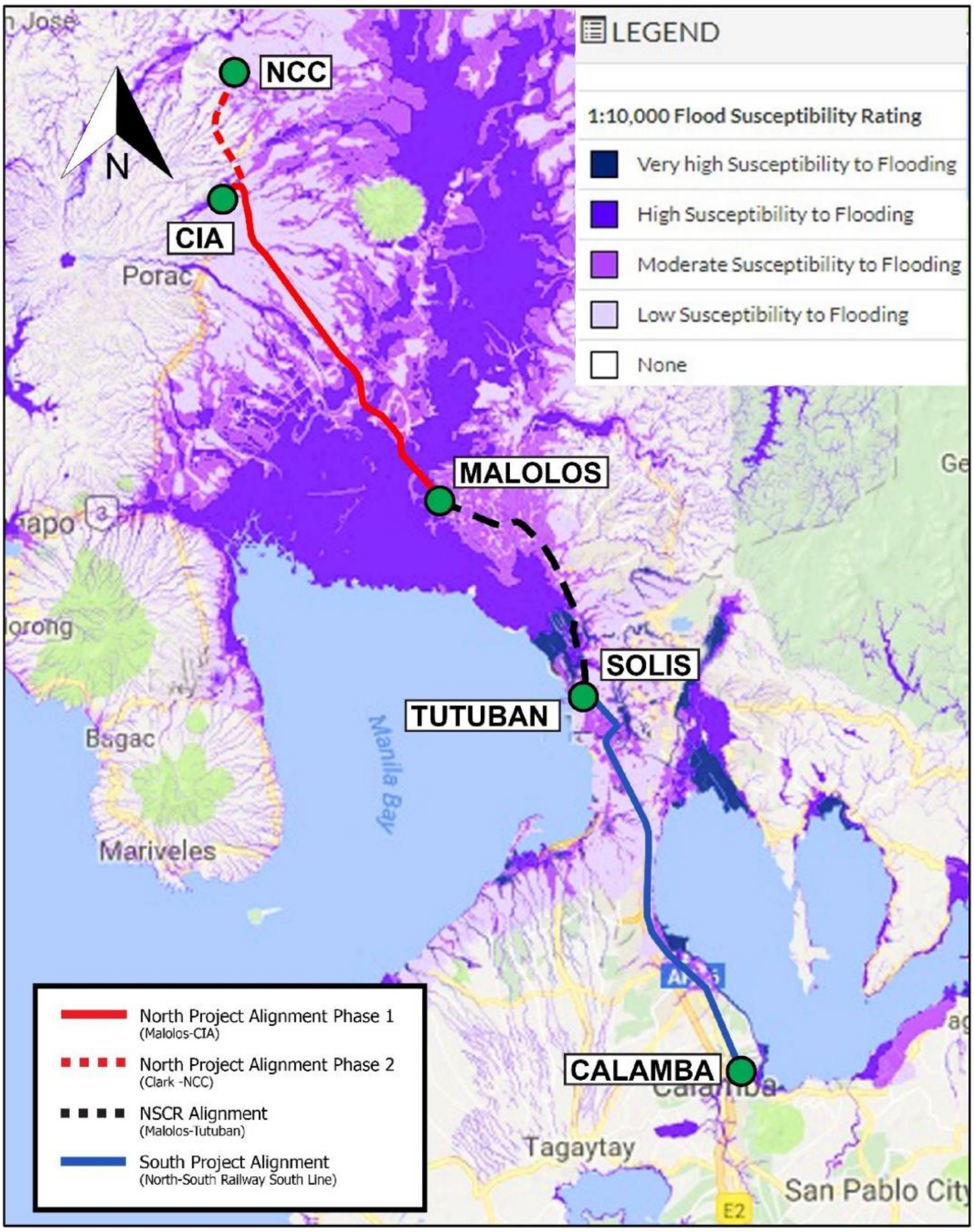
Source: PHIVOLCS

Figure 4.2.104 Extract from the Distribution of Active Faults & Trenches

e) Natural Hazard

Flood and Landslide

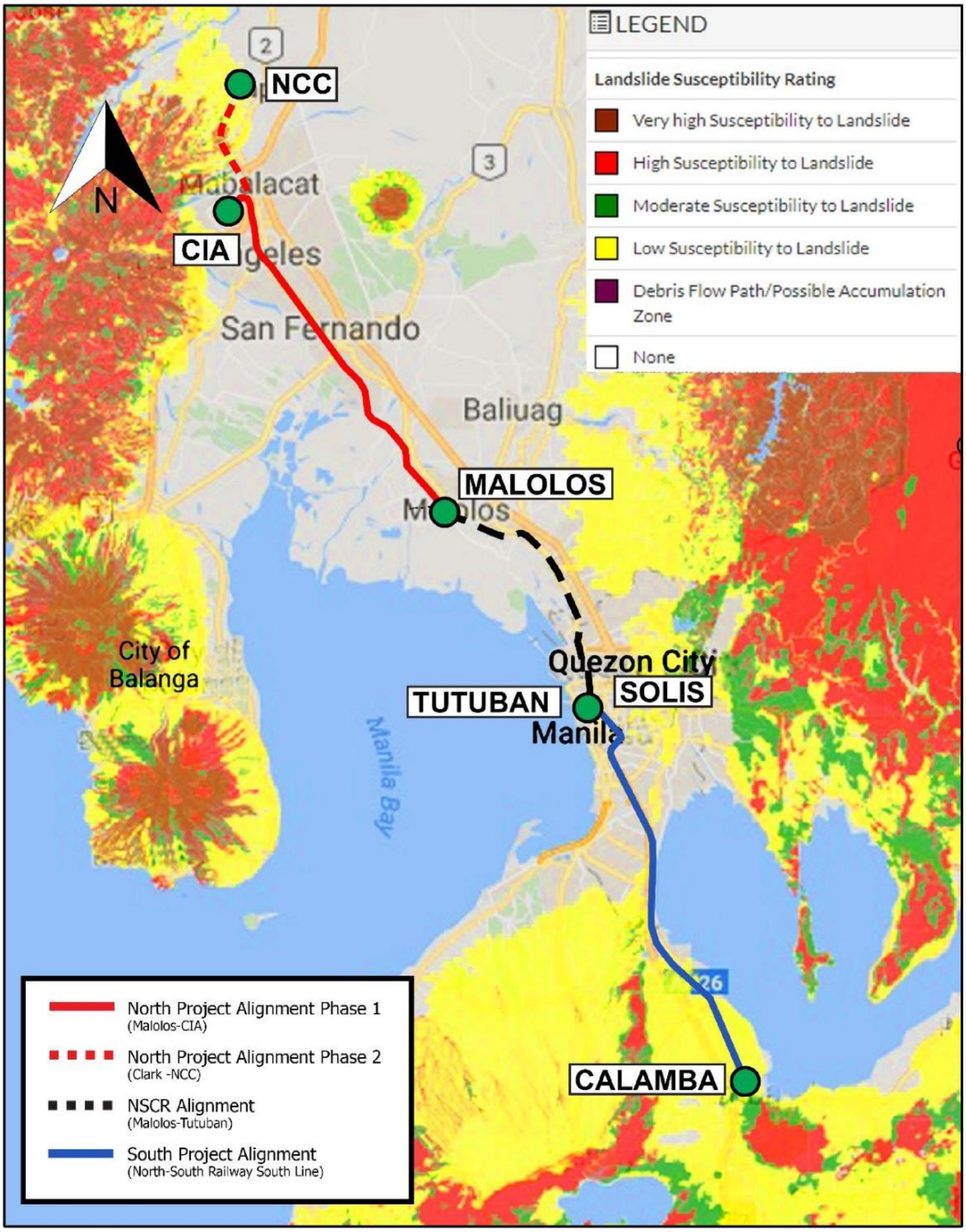
Based from the Mines and Geosciences Bureau (MGB) flood inundation map (see Figure 4.2.105), for the South Line, the first few stations located in Manila are moderately susceptible to flooding. This is mainly due to a major body of water (Pasig River) that bisects Manila City into northern and southern halves.



Source: Mines and Geosciences Bureau

Figure 4.2.105 Flood Susceptibility Map (Mines and Geosciences Bureau)

On the other hand, the landslide hazard map (see Figure 4.2.106) shows that the alignment is generally not susceptible to landslides.



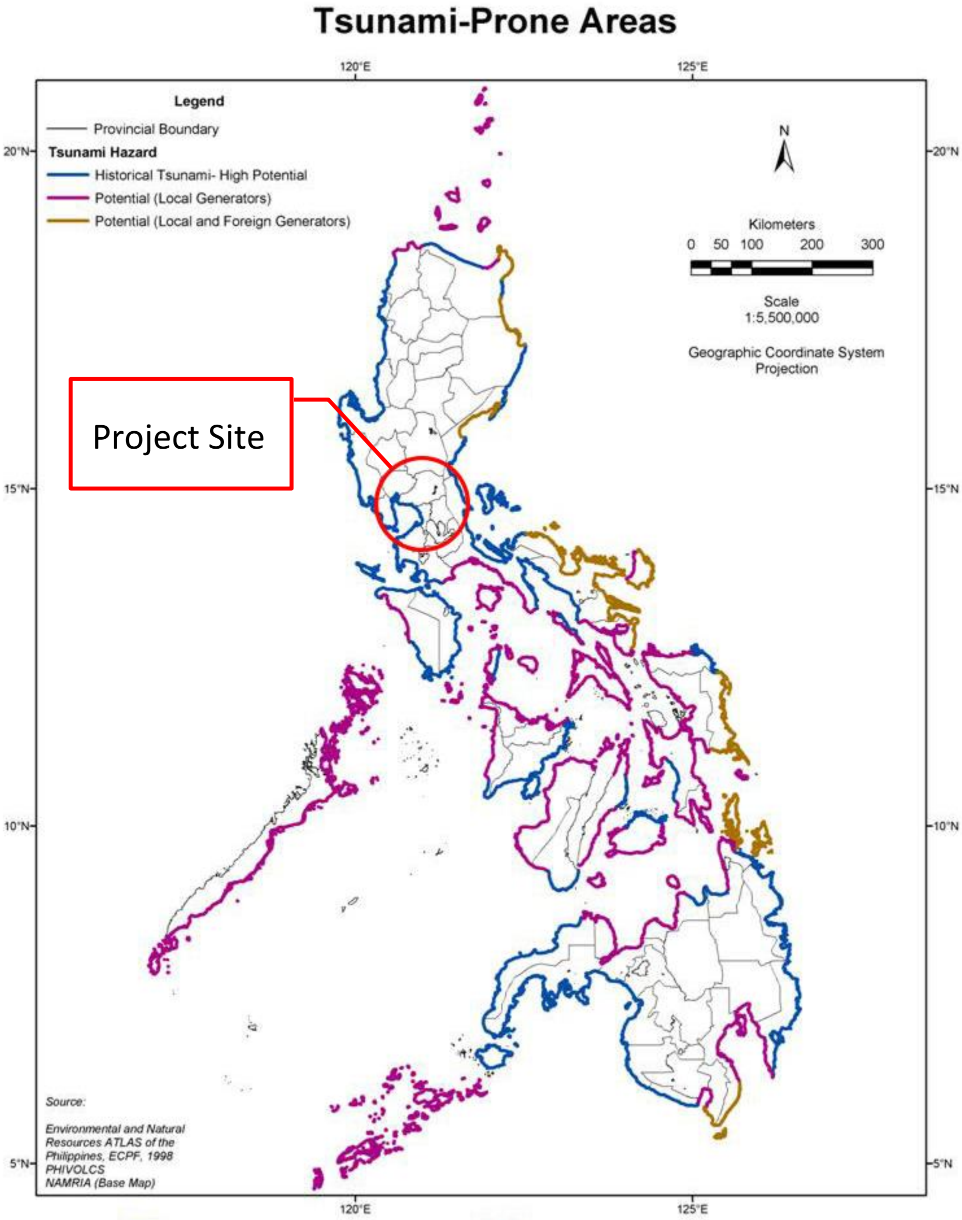
Source: Mines and Geosciences Bureau

Figure 4.2.106 Landslide Susceptibility Map (Mines and Geosciences Bureau)

Tsunami

Tsunami is a sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands. (Ref: Manila Observatory)

With the proximity of Manila Bay to the project site, in Metro Manila the susceptibility to tsunami is potentially high as classified by the following Figure 4.2.107 published by Manila Observatory and DENR.



Source: Manila Observatory & Department of Environmental and Natural Resources

Figure 4.2.107 Tsunami Vulnerability Map of the Philippines

2) Subsurface Investigation Status

North South Railway-South Line Project (Solis-Calamba) : approximately 950 borings

Numbers for accomplishment of Boring work : approximately 63％, As of Oct 24 2018

The Boring work is finished other than the depo area and the alignment change within STPP area, and the Laboratory tests is being conducted.

3) Summary of Stratification

According to the results of the subsurface investigation until now, stratification for the section is shown below;

- Solis-Sucut Section

  Guadalupe layer mainly composed of Tuff Formation of Pleistocene is distributed, the fine bearing layer with N value over than 50 is distributed from in shallow layer. Alluvium with mixed gravel, sand, silt and clay is distributed at some areas in lowlands along the river.

  Water Level:GL-0.18~9.07m

- South region of Sucut Section

  Active Marikina fault is running nearby in parallel. Topographically, ridges and valleys are repeatedly distributed in from the northeast to south-west direction. Therefore the stratum run across or along the alignment are full in variety. Due to many boulders distributed under ground, the disturbed samples cannot be taken by Standard Penetration Test (SPT) at several depth.

  Water Level:GL-Full~17.20m

4) Laboratory test

Laboratory tests, which is carrying out for this project, include the Mechanical Property Test and the Physical Property Test. The Mechanical Property Test includes Triaxial Compression Test (UU), Consolidation Test, and Unconfined Compression Test (UCT). The Physical Property Test includes Specific Gravity, Unit Weight, Natural Moisture Content, Atterberg Limits and Grain Size Analysis (Using Sieve and Hydrometer), including Unified Soil Classification System (USCS).

Physical test is performing at intervals at approximately 200 meters in the horizontal direction and at intervals 1.5 meters in the vertical direction.

Mechanical Test is Performing for the Unconfined Compression Test (UCT) for the soft rock core of the Guadalupe Layer.

5) Liquefaction

For the seismic design, the liquefaction resistivity will be analyzed when occurrences of liquefaction is supposed.

(2) Topographic Survey

For the scope of works for the topographic survey, surveying coverage, surveying works was conducted along the PNR alignment corridor of about 70 km. From Solis station to Los Banos whose is necessary for the detailed engineering design work. However, the detailed design coverage was later reduced from Solis station to Caramba. Along with this change, the creation range of various survey maps etc. was changed to 56.0 km. However, as the work scope such as reference point survey was almost completed, it was set to 71 km as originally planned.

Status of current survey work is scheduled to end at the end of October for all terrain survey items except for historic buildings survey. However, due to progress in information design additional instrumentation, continue implementing topographic surveying.

1) Survey Area

North–South Railway Project (South Line)

1. Solis Railway Station to PNR Los Banos: 70km
   Item: Satellite Ortho Imagery, Field Reconnaissance, Basic Control Point Survey, and aerial Photo Survey.

2. Solis Railway Station to PNR Los Banos: 56km
   Item: River Survey, Major cross Road Survey, Topographic Mapping, Profile and Cross section

The reconnaissance and inventory survey on the existing railway property in the North and South sections was executed for the preparation of the technical specifications, methodologies and work schedule required during the conduct of topographic survey.

Prior to production of the topo-map in 1/1,000 scale, a satellite imagery was undertaken control with NAMRIA map of 1/50,000 scale for Pre-DD work and accuracy standard deviation 1m horizontally. The satellite Ortho-imagery was produced which imageries obtained from the latest archive not earlier than year 2016 at level 3 with 0.5m resolution. And this imagery was rectified in NAMRA map of 1/50,000 scale. Then work item 5.1 will produce DTM to generate 2m contour interval line.

Table 4.2.37 Topographic Survey Work Schedule

No	Topographic Survey Work Item	2017 Dec	2018 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2019 Jan
1	Railway Property Site Reconnaissance														
2	Railway Structures Inventory Survey														
3	Historical Building Survey														
4	Produce satellite ortho-imagery 0.50 m resolution														
5	Topographic Survey for DD study														
5.1	Satellite imagery DTM with 2m contour line 1/10,000														
5.2	Basic Control Point Survey														
	-1 GPS Survey														
	-2 Primary Traverse Survey														
	-3 Control Direct Leveling														
5.3	Photogrammetric Survey														
	-1.Aerial Photography & Airborne LiDAR														
	-2.Topographic Mapping 1/1,000 scale														
	-3. Profile and Cross section by Photo-method														
5.4	Photogrammetric & Ground Survey														
	-1. River Survey by Photogrammetric method (SP)														
	-2. Major cross Road Survey by Ground method (TS)														
5.5	CAD processing work & Survey Report														

Legend : Executed Scheduled

Source: JICA Design Team

2) Survey Mapping Work Reference

The Survey shall be carried out according to the criteria shown below, with due consideration of the preparation for the Philippines transition to the world geodetic system.

The standards of geodetic reference system and mapping elements to create Geo-spatial are as follows:

1. Philippine Reference System (PRS92)
2. Reference Ellipsoid: Clark Spheroid of 1866
3. Horizontal Datum: Luzon Datum
4. Vertical Datum: Mean Sea Level
5. Geoid Model: PGM2014

3) Topographic Mapping Survey

The Topo-Mapping Survey is divided into eleven (11) work items as:

1. Production of Ortho-rectified Satellite Image (Geometric correction work using GCP data)
2. Horizontal Control Point Survey (GPS Static Differential method)

3. Preliminary Traverse Points Survey (Total Station (TS) method)
4. Control Leveling Survey
5. Airborne LiDAR and Digital Photography Acquisition
6. Topographic Mapping (1/1,000) Survey (Photographic measurement method)
7. Sounding Survey on the fish pond and swamp area
8. Photogrammetric Profile and Cross Section Survey
9. River (Topo, Profile and Cross Section) Survey
10. Major Cross Road Topographic (1/500) Survey (Ground Survey method)
11. Auto CAD Mapping Processing Work & Preparation of Final Survey Report

4) Production of Orthorectified Satellite Imagery

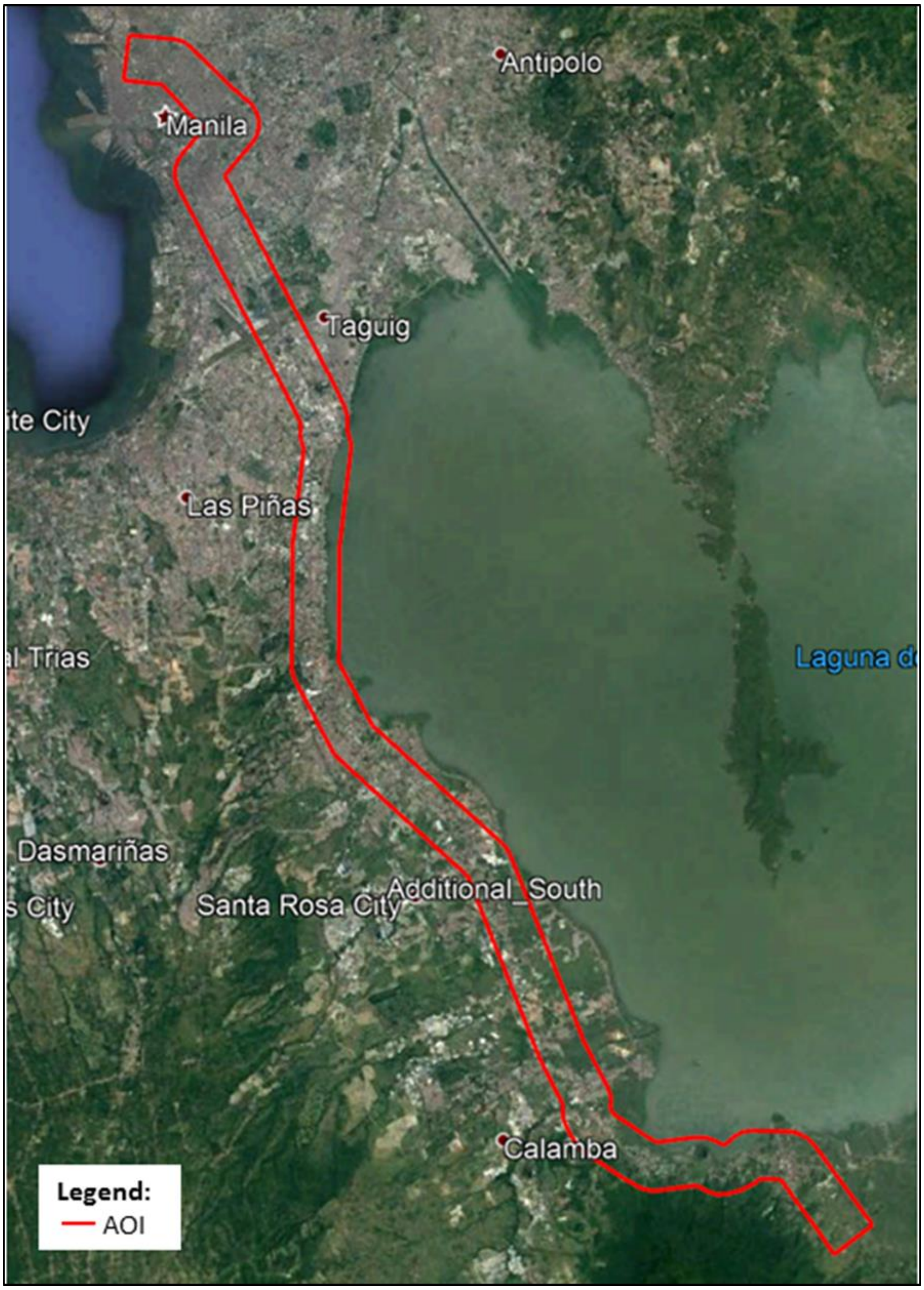
It's should be applied ortho-rectified satellite image of 50cm resolution (GSD) Pleiades. The work conducted geometric correction for the provided images by using Ground Control Points (GCPs) established. The product scale to be 1:10,000 together with the 2m interval contour lines generated from DTM data.

The production of Pleiades ortho-imageries is produced to assist the Design Team in used for the preparation of the basic design of the NSCR Project covering portions of Solis to Los Baños (South Section) in the Philippines, as indicated in the following table and AOI Map:

Table 4.2.38 Area of Coverage

Section	AREA [Hectares]
South Section (Solis to Los Baños)	18,000
TOTAL	18,000

Source: JICA Design Team



Source: JICA Design Team

Figure 4.2.108 AOI Map South Section (Manila to Los Baños)

For the Solis to Los Baños section, Table 4.2.39 below shows the specifications of Pleiades VHR satellite imageries used, while Table 4.2.40 summarizes the list of archive Pleiades VHR satellite imageries used for the aforementioned section.

Table 4.2.39 Specifications of the PLEIADES VHR Satellite Imagery

Portion of NSCR South Section (Solis to Los Baños)	
Pleiades Product Type:	Archive

Total Area:	180 km²
Product level:	Orthorectified
Date of Imagery:	2016,2017 Pleiades Archive Imageries
Spatial Resolution:	0.50m-resolution
Spectral bands combination:	Natural Color 3-bands
Projection:	PTM Zone 3, PRS92 Datum
Bit depth:	16bits
Product format:	GeoTIFF, ECW, IMG

Source: JICA Design Team

Table 4.2.40 Archive Pleiades VHR Satellite Imageries for the Portion of NSCR South Line

	Scene ID	*Date of Imagery*
1	DS_PHR1A_201604110246426_FR1_PX_E121N14_0113_01664	April 11, 2016
2	DS_PHR1A_201602140235194_FR1_PX_E120N14_1213_06640	February 14, 2016
3	DS_PHR1A_201609020239313_FR1_PX_E121N14_0206_03390	September 2, 2016
4	DS_PHR1A_201609020239124_FR1_PX_E121N14_0406_05884	September 2, 2016
5	DS_PHR1A_201705080231128_FR1_PX_E121N14_0207_01654	May 8, 2017

Source: JICA Design Team

5) Horizontal Control Point Survey

There are a total of sixty (60) Horizontal Control Points selected for the south section. The horizontal controls points were named as GPSS1 to GPSS60. The locations selected are near the railway alignment where intervisible pairs of GPS points with spacing of more or less 200 meters were installed. The monuments were constructed according to the recommended specifications. The monuments for the horizontal control for the north part are installed in Kalookan City, Manila, Makati, Taguig City in NCR, Muntinlupa City, San Pedro City, Binan City, Sta. Rosa City, Cabuyao City in the province of Laguna, .

Existing ground control points by DENR-LMB and NAMRIA were included in the network observations. RINEX data for the NAMRIA PAGENET stations nearest to the project area (PSTC, PTAG and PTGY) were downloaded and were used as fixed reference points for the GNSS processing. The NAMRIA and DENR ground control points were included

The GNSS observations were done from April 14 until April 27 for 13 observation days. GNSS observations were also done on existing Ground Control Points (GPS-38, GPS-4 and GPS-5) established and used in another project (MCRP), for coordinate comparison and analysis. Preliminary field processing results were obtained using Trimble Business Center. The final coordinates were computed and adjusted using the PTM Zone 3 projection and Philippine Reference System of 1992(PRS92).

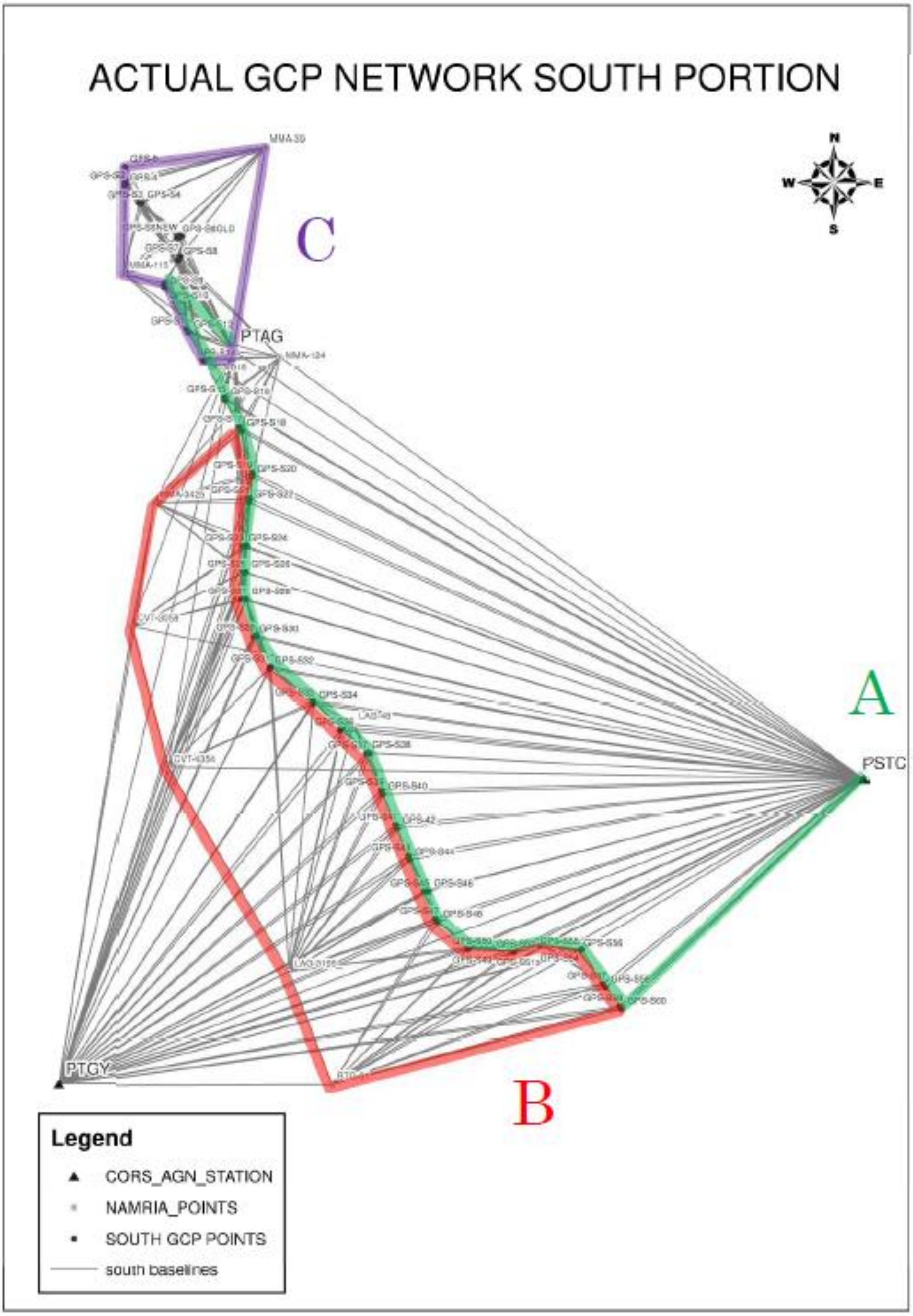
The closure error of Section A (56 edges) is dN = -0.091, dE = -0.014 and dU = 0.001. TOR tolerance is 0.149 for dN and dE, 0.224 for dU.

For Section B, dN = -0.057, dE = -0.053 and dU = 0.021. TOR tolerance is 0.105 for dN and dE, 0.315 for dU.

For Section C, dN = -0.033, dE = -0.019 and dU = -0.005. TOR tolerance is 0.054 for dN and dE, 0.162 for dU.

All of these results are satisfied the TOR tolerances.

Following figure and tables show the course of horizontal control point survey and the results of quality control.



Source: JICA Design Team

Figure 4.2.109 Actual GCP network of south portion

In the following table, the error of closure between the existing control points [Section A]

Table 4.2.41 The error of closure between the existing control points [Section A]

Route： PSTC to PTAG

StartPoint product : PSTC		-3222396.375	5276126.7	1563210.486
Name		dX	dY	dZ
GPS-S60		11280.790	11232.923	-14671.728
GPS-S59		122.270	27.612	155.371
GPS-S58		943.347	206.245	1205.885
GPS-S57		172.243	38.652	221.334
GPS-S55		1451.690	226.432	2188.562
GPS-S56		174.360	146.587	-127.173
GPS-S54		1885.966	1008.065	424.408
GPS-S53		155.557	100.140	-18.773
GPS-S52		1486.364	1037.883	-459.304
GPS-S51		-14.704	-60.220	199.985
GPS-S50		2540.063	1534.975	-9.491
GPS-S49		-52.130	-80.412	159.930
GPS-S48		1936.329	701.895	1610.743
GPS-S47		159.738	45.978	185.949
GPS-S46		609.312	-152.210	1750.717
GPS-S45		228.395	136.983	8.729
GPS-S44		1049.030	48.809	1993.376
GPS-S43		123.384	-3.185	261.724
GPS-S42		835.773	-15.421	1742.981
GPS-S41		111.699	3.322	214.811
GPS-S40		965.439	-14.335	1990.370
GPS-S39		125.243	-1.444	257.841
GPS-S37		929.551	-137.838	2333.069
GPS-S38		183.512	104.199	23.676
GPS-S36		1625.497	555.872	1448.480
GPS-S35		-92.568	-113.870	189.541
GPS-S33		1812.126	612.848	1609.850
GPS-S34		-16.501	35.728	-152.080
GPS-S32		2701.190	971.096	2188.346
GPS-S31		-69.905	-75.579	113.008
GPS-S30		1169.794	143.608	1897.803
GPS-S29		-111.877	-98.840	82.501
GPS-S28		861.961	-169.811	2306.828
GPS-S27		270.749	164.570	17.676
GPS-S26		-3.965	-533.821	1739.489
GPS-S25		91.709	58.696	4.821
GPS-S24		257.842	-339.248	1638.406
GPS-S23		-200.944	-123.931	4.643
GPS-S22		249.572	-680.606	2766.763
GPS-S21		-0.603	-79.203	261.430
GPS-S20		56.386	-383.881	1396.392
GPS-S19		10.597	-65.506	244.642
GPS-S18		938.266	-214.541	2677.051
GPS-S17		142.226	6.519	260.396
GPS-S16		1013.219	81.023	1711.288
GPS-S15		95.336	11.389	145.760
GPS-S14		1428.792	130.566	2360.100
GPS-S13		107.443	18.499	153.201
GPS-S12		970.200	83.226	1646.717
GPS-S11		124.694	11.564	207.846
GPS-S10		1590.505	147.445	2659.793
GPS-S9		31.034	-47.025	220.719
GPS-S8		-563.577	-791.136	1490.867
GPS-S7		-106.744	-118.010	177.531
GPS-S6NEW		91.616	-340.386	1304.614
PTAG		-3801.659	-52.268	-7214.078
	Σ Δ=	38075.632	14940.622	27203.336
	Obs result =	-3184320.743	5291067.322	1590413.822
EndPoint product : PTAG		-3184320.743	5291067.295	1590413.910
error of closure	dX,dY,dZ	0.000	0.027	-0.088
error of closure	dN,dE,dU	-0.091	-0.014	0.001
Tolerance	Num of edges =56	0.149		0.224

※ TOR Tolerance : ΔN, ΔE=20mm√N , ΔU=30mm√N
0.149 0.224
※Japanese Tolerance : ΔN, ΔE=60mm+20mm√N , ΔU=150mm+30mm√N
0.209 0.374

Source: JICA Design Team

In the following table, the error of closure between the existing control points [Section B]

Table 4.2.42 The error of closure between the existing control points [Section B]

Route: BTG-51 to BTG-51

StartPoint product : BTG-51	-3195913.662	5298085.989	1543860.429
Name	dX	dY	dZ
GPS-S60	-15201.891	-10726.370	4678.352
GPS-S59	122.270	27.612	155.371
GPS-S58	943.347	206.245	1205.885
GPS-S57	172.243	38.652	221.334
GPS-S56	1626.036	373.040	2061.395
GPS-S55	-174.360	-146.587	127.173
GPS-S54	2060.321	1154.659	297.238
GPS-S53	155.557	100.140	-18.773
GPS-S52	1486.364	1037.883	-459.304
GPS-S51	-14.704	-60.220	199.985
GPS-S50	2540.063	1534.975	-9.491
GPS-S49	-52.130	-80.412	159.930
GPS-S48	1936.329	701.895	1610.743
GPS-S47	159.738	45.978	185.949
GPS-S46	609.312	-152.210	1750.717
GPS-S45	228.395	136.983	8.729
GPS-S44	1049.030	48.809	1993.376
GPS-S43	123.384	-3.185	261.724
GPS-S42	835.773	-15.421	1742.981
GPS-S41	111.699	3.322	214.811
GPS-S40	965.439	-14.335	1990.370
GPS-S39	125.243	-1.444	257.841
GPS-S37	929.551	-137.838	2333.069
GPS-S38	183.512	104.199	23.676
GPS-S36	1625.497	555.872	1448.480
GPS-S35	-92.568	-113.870	189.541
GPS-S33	1812.126	612.848	1609.850
GPS-S34	-16.501	35.728	-152.080
GPS-S32	2701.190	971.096	2188.346
GPS-S31	-69.905	-75.579	113.008
GPS-S30	1169.794	143.608	1897.803
GPS-S29	-111.877	-98.840	82.501
GPS-S28	861.961	-169.811	2306.828
GPS-S27	270.749	164.570	17.676
GPS-S26	-3.965	-533.821	1739.489
GPS-S25	91.709	58.696	4.821
GPS-S24	257.842	-339.248	1638.406
GPS-S23	-200.944	-123.931	4.643
GPS-S22	249.572	-680.606	2766.763
GPS-S21	-0.603	-79.203	261.430
GPS-S20	56.386	-383.881	1396.392
GPS-S19	10.597	-65.506	244.642
GPS-S18	938.266	-214.541	2677.051
GPS-S17	142.226	6.519	260.396
MMA-3425	4034.848	3869.929	-4853.004
CVT-3059	167.061	2511.729	-7872.039
CVT-4354	-3230.025	843.777	-8831.702
LAG-3199_	-8340.733	-1117.636	-13043.910
BTG-51	-3243.196	45.788	-7088.462

	ΣΔ=	0.028	0.057	-0.050
	Obs result =	-3195913.634	5298086.046	1543860.379
EndPoint product : BTG-51		-3195913.662	5298085.989	1543860.429
error of closure	dX,dY,dZ	0.028	0.057	-0.050
error of closure	dN,dE,dU	-0.057	-0.053	0.021
Tolerance	Num of edges =49	0.105		0.315

※ TOR Tolerance : H=15mm√N , V=45mm√N
0.105 0.315

※Japanese Tolerance : ΔN, ΔE=20mm√N , ΔU30mm√N
0.140 0.210

Source: JICA Design Team

In the following table, the error of closure between the existing control points [Section C]

Table 4.2.43 The error of closure between the existing control points [Section C]

Route : MMA-39 to MMA-39

StartPoint product : MMA-39		-3184350.098	5287160.594	1603247.559
Name		dX	dY	dZ
PTAG		29.360	3906.702	-12833.663
GPS-S14		1556.481	1088.093	-647.212
GPS-S13		107.443	18.499	153.201
GPS-S12		970.200	83.226	1646.717
GPS-S11		124.694	11.564	207.846
GPS-S10		1590.505	147.445	2659.793
GPS-S9		31.034	-47.025	220.719
MMA-115		2306.480	1192.723	635.956
GPS-4		684.363	-1262.219	5494.792
GPS-S2		1.533	-48.690	162.703
GPS-S1		-7.878	-75.942	234.752
GPS-5		138.631	-150.009	775.899
MMA-39		-7532.832	-4864.354	1288.464
	Σ Δ=	0.014	0.013	-0.033
	Obs result =	-3184350.084	5287160.607	1603247.526
EndPoint product : MMA-39		-3184350.098	5287160.594	1603247.559
error of closure	dX,dY,dZ	0.014	0.013	-0.033
error of closure	dN,dE,dU	-0.033	-0.019	-0.005
Tolerance	Num of edges =13	0.054		0.162

※ TOR Tolerance : H=15mm√N , V=45mm√N
0.054 0.162
※Japanese Tolerance : ΔN, ΔE=20mm√N , ΔU30mm√N
0.072 0.108

Source: JICA Design Team

6) Preliminary Traverse Survey

Instrument accuracy angle min. gradient 1" & distance measurement: + (5mm + 5mm x 10-6 x D). Where D is distance in km. The traverse points to be established in 200m - 300m range along the railway.

The traverse survey was done to establish the horizontal coordinates of the densified ground controls along the project area. The monuments for the primary traverse controls were based on the TOR specifications. The survey was performed using electronic total station (ETS) equipment using the following method:

- Horizontal angles were measured using two pairs of observation which are direct and reverse with gradient 0° and 90°. The final angles were computed by averaging the two results.
- Vertical Angles were recorded using the direct and reverse constant angle of 30"
- Distance measurements were doubled for the forward and backward tolerance of 30 mm.
- Angle closure tolerance between adjacent GPS controls is set at 10"√n.
- Coordinate closure tolerance was set at 1/20,000

For the south section, there are twenty-nine (29) loops surveyed for the primary traverse survey starting from pairs of GPS control points towards the succeeding pairs of GPS control points.

Table 4.2.44 GPSS points of each loop

Loop	From	To	Traverse Points
1	GPS-S1 & GPS-S2	GPS-S3 & GPS-S4	S2-1 to S2-9
2	GPS-S3 & GPS-S4	GPS-S5 & GPS-S6	S4-1 to S4-14
3	GPS-S5 & GPS-S6	GPS-S7 & GPS-S8	S6-1 to S6-9
4	GPS-S7 & GPS-S8	GPS-S10 & GPS-S9	S8-1 to S8-10
5	GPS-S10 & GPS-S9	GPS-S11 & GPS-S12	S9-1 to S9-12
6	GPS-S11 & GPS-S12	GPS-S13 & GPS-S14	S12-1 to S12-7
7	GPS-S13 & GPS-S14	GPS-S15 & GPS-S16	S14-1 to S14-12
8	GPS-S15 & GPS-S16	GPS-S17 & GPS-S18	S16-1 to S16-8
9	GPS-S17 & GPS-S18	GPS-S19 & GPS-S20	S18-1 to S18-11
10	GPS-S19 & GPS-S20	GPS-S21 & GPS-S22	S20-1 to S20-5
11	GPS-S21 & GPS-S22	GPS-S23 & GPS-S24	S22-1 to S22-12
12	GPS-S23 & GPS-S24	GPS-S25 & GPS-S26	S24-1 to S24-8
13	GPS-S26 & GPS-S25	GPS-S28 & GPS-S27	S25-1 to S25-8
14	GPS-S28 & GPS-S27	GPS-S29 & GPS-S30	S27-1 to S27-11
15	GPS-S30 & GPS-S29	GPS-S31 & GPS-S32	S29-1 to S29-10
16	GPS-S32 & GPS-S31	GPS-S33 & GPS-S34	S31-1 to S31-14
17	GPS-S33 & GPS-S34	GPS-S35 & GPS-S36	S34-1 to S34-10
18	GPS-S36 & GPS-S35	GPS-S38 & GPS-S37	S35-1 to S35-10
19	GPS-S37 & GPS-S38	GPS-S39 & GPS-S40	S38-1 to S38-10
20	GPS-S39 & GPS-S40	GPS-S41 & GPS-S42	S40-1 to S40-7
21	GPS-S41 & GPS-S42	GPS-S43 & GPS-S44	S42-1 to S42-7
22	GPS-S43 & GPS-S44	GPS-S45 & GPS-S46	S44-1 to S44-9
23	GPS-S46 & GPS-S45	GPS-S47 & GPS-S48	S45-1 to S45-12
24	GPS-S47 & GPS-S48	GPS-S49 & GPS-S50	S48-1 to S48-12
25	GPS-S49 & GPS-S50	GPS-S52 & GPS-S51	S50-1 to S50-15
26	GPS-S52 & GPS-S51	GPS-S56 & GPS-S55	S51-1 to S51-13
27	GPS-S52 & GPS-S51	GPS-S56 & GPS-S55	S54-1 to S54-12
28	GPS-S56 & GPS-S55	GPS-S57 & GPS-S58	S55-1 to S55-10
29	GPS-S57 & GPS-S58	GPS-S59 & GPS-S60	S58-1 to S58-5

Source: JICA Design Team

Following table shows the result of quality control of traverse survey. Result of miss closure and closure accuracy are satisfied the TOR tolerance.

Table 4.2.45 Quality control records of Traverse Survey

Loop No.	Total length	Inner angle number	Angle Closure		Number of sides	Check Computation	
						Accuracy	
			Closure	Tolerance		Closure	Tolerance
	km		Sec.	Sec.			
1	2.109	11	-10	33	10	1/30,509	1/20,000
2	3.462	16	4	40	15	1/22,027	〃
3	1.847	11	17	33	10	1/23,209	〃
4	2.21	12	32	34	11	1/21,169	〃
5	3.335	14	-6	37	13	1/25,755	〃
6	1.915	9	10	30	8	1/27,174	〃
7	2.768	14	0	37	13	1/126,627	〃
8	1.993	10	-11	31	9	1/20,795	〃
9	2.922	13	17	36	12	1/23,703	〃
10	1.45	7	2	26	6	1/50,015	〃
11	2.984	14	37	37	13	1/22,822	〃
12	1.889	10	3	31	9	1/57,127	〃
13	1.913	10	2	31	9	1/20,494	〃
14	2.953	13	1	36	12	1/91,750	〃
15	2.348	12	-21	34	11	1/59,443	〃
16	3.667	16	18	40	15	1/33,083	〃
17	2.623	12	-22	34	11	1/24,641	〃
18	2.449	12	-33	34	11	1/26,276	〃
19	2.638	12	31	34	11	1/23,185	〃
20	2.212	9	25	30	8	1/21,117	〃
21	1.938	9	12	30	8	1/22,041	〃
22	2.267	11	20	33	10	1/29,814	〃
23	2.113	14	35	37	13	1/37,062	〃
24	3.05	14	-16	37	13	1/39,994	〃
25	3.123	17	-35	41	16	1/234,606	〃
26-27	5.109	30	40	54	29	1/30,967	〃
28	2.862	12	8	34	11	1/20,903	〃
29	1.545	7	18	26	6	1/34,158	〃

Source: JICA Design Team

7) Control Leveling Survey

The elevations of the previously-established GPS Horizontal Controls and Primary Traverse Control Stations were determined by leveling survey for South sections of the project area. Digital Level instrument was used with a bubble accuracy 10” and / or equivalent.

The Leveling survey was performed using the following method:

- Double-run (forward and backward) differential leveling survey was performed.

- The leveling survey was tied to existing NAMRIA BMs (mean sea level datum)
- The leveling survey was performed along the newly-established GPS Control and Traverse points.
- Tolerance of forward and backward: 10mm √D where D is distance in km
- The distance between level instrument and level staff is maintained at 70m max.
- The level instrument was checked by Two-peg method on a daily basis. Tolerance: 3mm.

Following table shows the result of quality control leveling survey. Result of round trip accuracy meets the TOR tolerance.

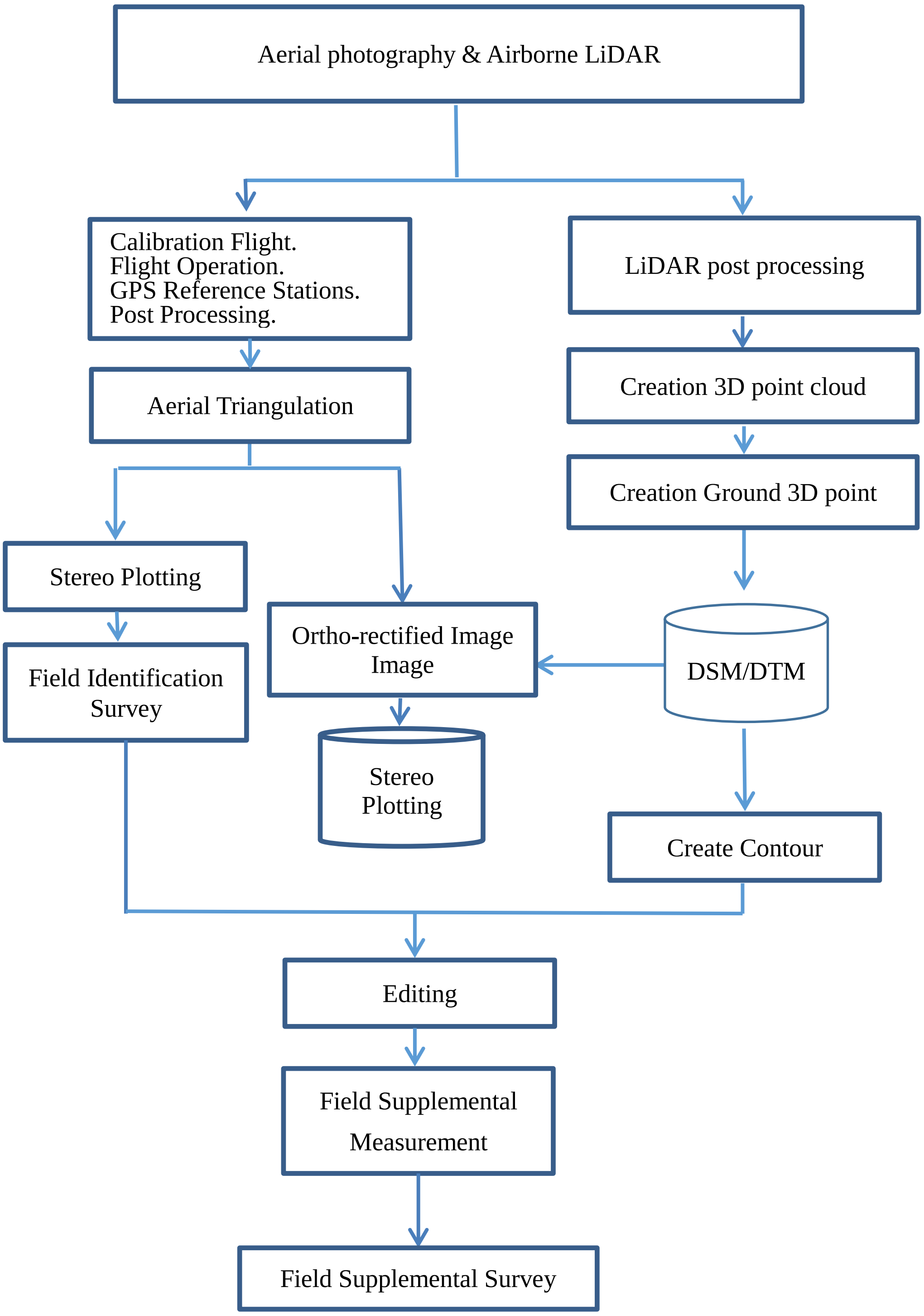
Table 4.2.46 Results of quality control leveling survey

Loop No.	Length (km)	Tolerance	Limit(10mm√‾km)
		mm	mm
1	2.683	11	16
2	3.022	3	17
3	2.019	1	14
4	2.576	15	16
5	3.399	16	18
6	2.300	4	15
7	2.765	3	16
8	2.522	0	15
9	3.371	1	18
10	1.793	4	13
11	3.405	7	18
12	2.008	5	14
13	1.864	3	13
14	3.143	7	17
15	2.677	6	16
16	4.076	20	20
17	2.360	2	15
18	2.575	6	16
19	3.116	1	17
20	2.553	9	15
21	2.068	3	14
22	2.994	14	17
23	2.446	15	15
24	3.288	0	18
25	3.350	6	18
26	3.217	2	17
27	2.845	5	16
28	2.872	1	16
29	2.028	13	14

Source: JICA Design Team

8) Aerial photography & Airborne LiDAR Measurement

Aerial photography and airborne LiDAR measurement were planned to proceed with following work flow.

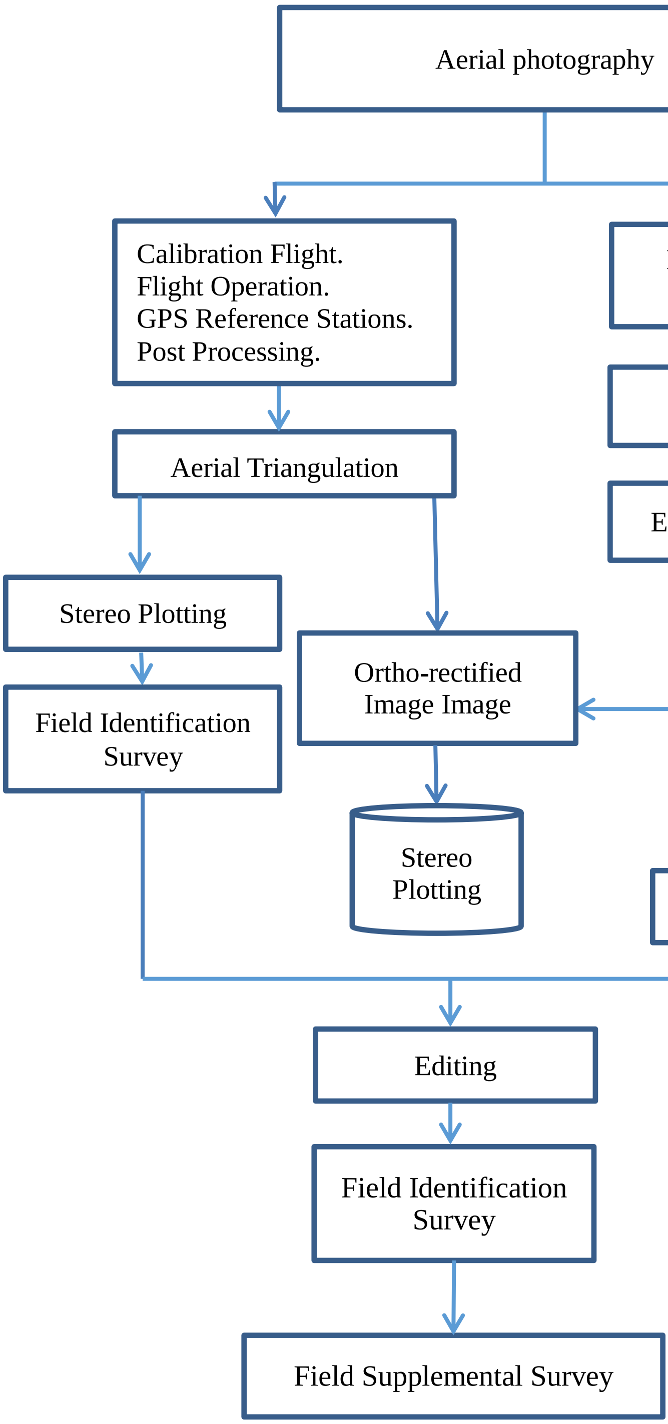


Source: JICA Design Team

Figure 4.2.110 Work flow of aerial photography and aerial LiDAR measurement

However because of the hardware trouble of LiDAR equipment, the workflow was changed to following one. Photogrammetry method was applied for topographic survey (DSM/DTM) instead of using LiDAR.

These changing are agreed with JDT.

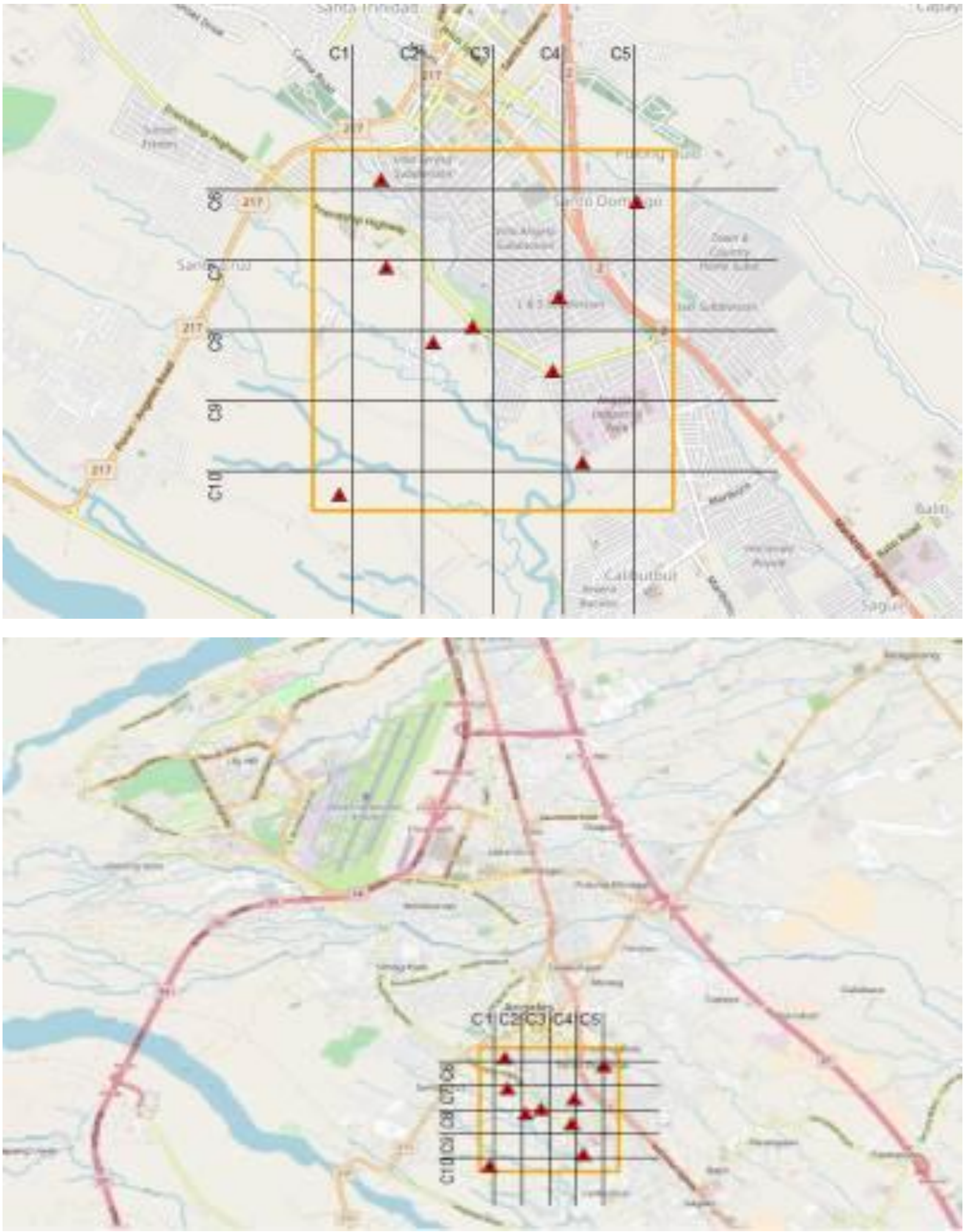


Source: JICA Design Team

Figure 4.2.111 Work flow of aerial photography measurement

a) Calibration Flight

In order to correct the misalignment of the GPS/IMU and the ULTRACAMx sensor near this Clark Airport, a field for boresight calibration is set up. Prior to Aerial Triangulation, calibration photographing of this place is performed, and correction value is obtained beforehand.



Source: JICA Design Team

Figure 4.2.112 Calibration Flight Site

A control point for calibration was set up in order to conduct checking and correction of the 3D measurement data. The number of required control points for correction according to Japanese standards is 9 points. These points shall be set up at an equal distance from each other in each area in the target area. The independent observation by means of RTK method has done used as an observation method.

b) Flight Operation

We shall use UltraCAMx (UCX) as Digital Aerial Camera manufactured by Vexcel Imaging. Since this UCX is a 14,430 x 9,420 pixels of Image Size and 7.2 μm of physical pixel size, it can be used at a 10 cm GSD even at a ground altitude of 1,500 m. Also, when shooting from 1,500 m altitude, the shooting width is about 1.4 km, so you can cover the target area with a single flight. Describe the photographs of UCX used below and their specifications.

Source: JICA Design Team

Figure 4.2.113 ULTRACAMx(Digital Camera)

In this measurement, we plan the measurement with the following specifications.

Table 4.2.47 Aerial Photography parameter

Flight Height	1,500 m
Cruise speed	140kts
Focal length	104mm
Pixel Size	14,430pixels x 9,420pixels
Ground Resolution	10 cm
Photographing range	1,400 m (width) x 940 m (flight direction)
Photographing interval	405 m (overlap 60%)
Number of courses	19 courses

Source: JICA Design Team

The airplane used for aerial photography was Aero Commander 685 owned by Certeza Infosys Corporation (CIC).

Source: JICA Design Team

Figure 4.2.114 Aero Commander 685

Certeza Infosys Corporation (CIC) was in charge of the airplane operation. For this reason, CIC was in charge of flight permission application work.

Aerial Photography was done on May 29th, and it is confirmed that there is no problem after checking the photo data. The distance and progress of each course are shown below.

Table 4.2.48 Flight course and progress

SOUTH RAILWAY

CAMERA	UCX
FRAME SIZE	17,310x11,310
GSD	16cm
PIXEL SIZE	6.0µm
Length of photo center	740m (overlap60%)

Solis to LosBanos

Strip ID	Strip Length(km)	Progress
C-19	1.93	100%
C-20	1.92	100%
C-21	3.46	100%
C-22	2.04	100%
C-23	3.43	100%
C-24	13.30	100%
C-25	2.25	100%
C-26	5.90	100%
C-27	5.96	100%
C-28	4.39	100%
C-29	8.80	100%
C-30	13.50	100%
C-31	3.92	100%
C-32	3.17	100%
C-33	1.81	100%

C-34	2.96	100%
C-35	2.81	100%
C-36	5.73	100%
C-37	4.25	100%
TOTAL	91.53	100%

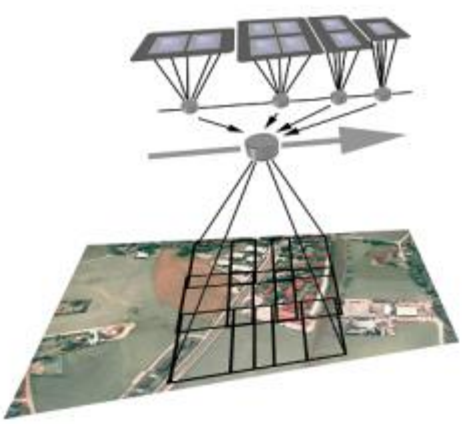
Source: JICA Design Team

c) GPS Reference Stations

In order to identify the position of the Digital Camera by kinematic GPS surveying, control stations need to be set up on the ground when an aircraft is flying. As a general rule, these stations need to be set up within a range of 50 km of where measuring is performed at target area. The final locations of the control stations have determined by taking 5 numbers, such as PTAG, PFLO, PSTC, PTGY, PSRF of NAMRIA Active Geodetic Control.

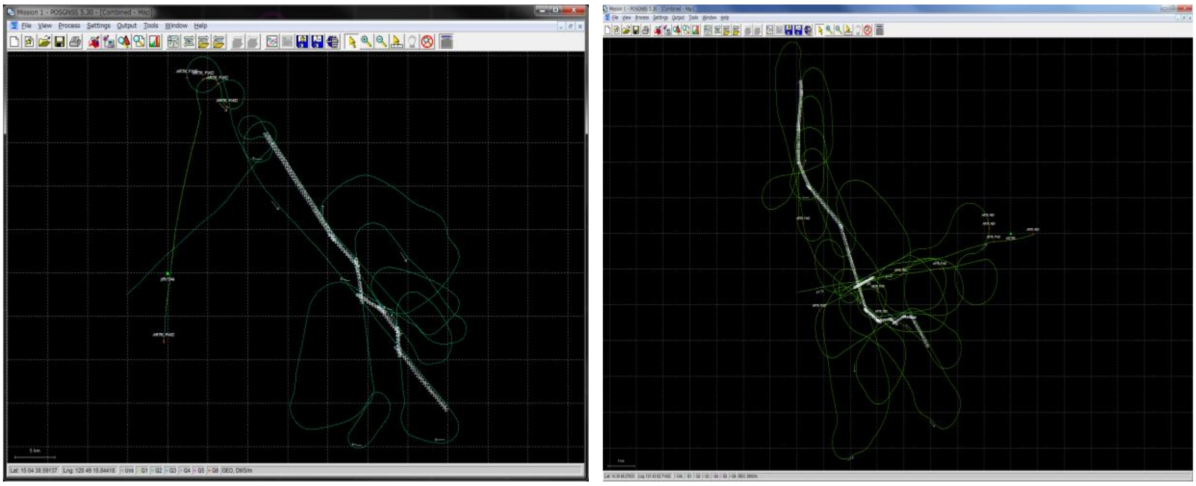
d) Post Processing

After taking aerial Photography by UCX, there are two types of data acquired, one is image data and another one is GNSS/IMU data. Downloading image raw data from UCX equipped with aircraft, it was performed image compositions using "ULTRAMAP" software attached. On the other hand, for GNSS / IMU raw data, the processing is performed to calculate the Camera exposure position and attitude (exterior orientation parameter) by using "POSGNSS" software.



Source: JICA Design Team

Figure 4.2.115 Mechanism image compositions by UCX



Source: JICA Design Team

Figure 4.2.116 GNSS/IMU analysis

e) Aerial Triangulation

Aerial triangulation is done based on aerial photo image and GNSS / IMU of the camera at the exposure time and GCP, and calculated the exterior orientation parameter of the camera. The accuracy of aerial triangulation is shown in the following table, and the state of photo observation during aerial triangulation is shown in the following figure.

The accuracy of aerial triangulation was determined to be 5 cm in the horizontal and 1 cm in the vertical direction.

Table 4.2.49 Aerial Triangulation Quality Control

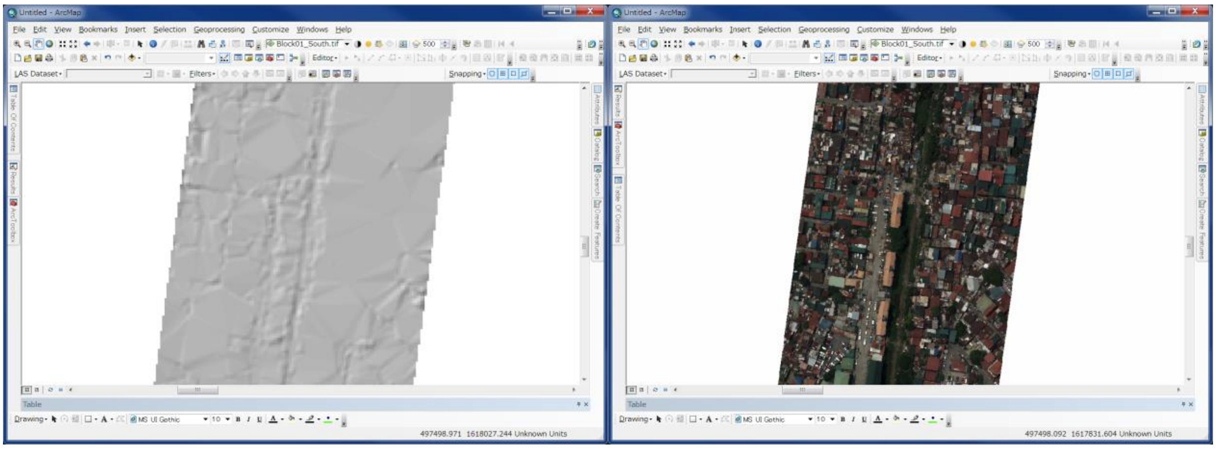
Control point No.	XY residuals (m)	Z residuals (m)
HH33	0.04	-0.01
HH34A	0.01	0.01
HH35H	0.01	0.00
H36-1	0.03	-0.01
H37-1	0.02	-0.02
HH37B	0.03	-0.01
HH38A	0.04	0.01
HH39A	0.04	0.01
HH40A	0.01	0.01
HH41A	0.06	0.03
HH42A	0.06	0.01
HH43A	0.01	0.00
HH45	0.01	0.00
H46	0.01	0.00
H48	0.05	-0.01
HH49A	0.03	-0.01
HH50	0.06	0.02
HH51A	0.09	0.00
HH52	0.06	-0.01

Control point No.	XY residuals (m)	Z residuals (m)
HH53A	0.03	0.00
HH54	0.08	-0.01
HH55	0.02	0.00
HH56A	0.04	0.01
H57	0.03	0.01
HH58A	0.04	0.01
HH59	0.12	-0.01
HH60A	0.05	0.01
HH61	0.13	-0.03
HH62	0.02	0.01
HH63	0.02	-0.01
HH64	0.03	-0.01
HH65A	0.05	-0.02
HH66	0.09	0.00
HH67A	0.10	0.01
HH68A	0.08	0.01
HH105	0.01	-0.02
HH106A	0.01	-0.01
HH107	0.04	0.01
HH108	0.09	0.01
HH109	0.01	0.00
RMSE	0.05	0.01

Source: JICA Design Team

f) Ortho-rectified Image

Create a DTM based on stereo models using the aerial photo image on which aerial triangulation has been completed. And it was ortho-rectified each aerial photograph using this DTM. The ortho-rectified aerial photographs were mosaiced in the mosaic line, and Ortho-photo was created.

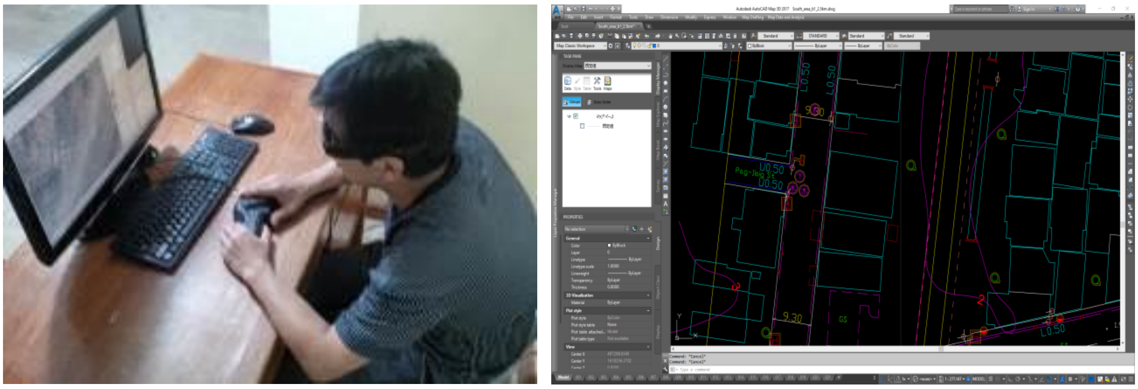


Source: JICA Design Team

Figure 4.2.117 DTM (Left) & Ortho Image (Right)

g) Stereo Plotting

After completing the aerial triangulation, the target area was stereo plotting using a photogrammetric workstation. The topographical map item to be acquired by stereo mapping was based on the acquisition procedure of Japan's 1/1,000 scale. The photogrammetry workstation and stereo plotting data are shown below.



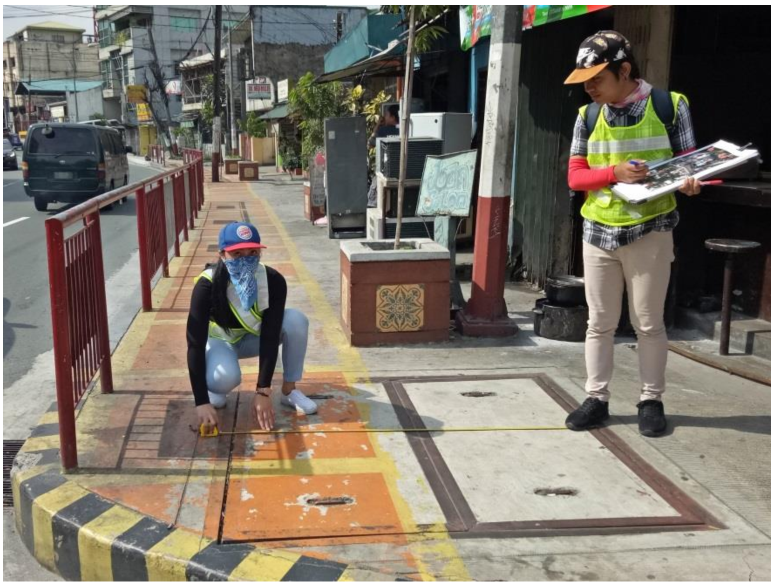
Source: JICA Design Team

Figure 4.2.118 Photogrammetric WorkStation & Stereo Plotting data

h) Field Identification Survey

Field Identification work were conducted to identify the unclear points in the Stereo Plotting and photo interpretation, and to collect additional information available only from the field. In addition, the secular changes in the roads and road facilities were surveyed, as well as visual confirmation of existing above ground utilities, such as manholes and utility posts.

The secular change data on newly constructed roads, electric transmission lines, sub stations, and public facilities were collected from the related agencies that controlled the information and materials on the data. In addition, these secular changes verified and surveyed in the field.



Source: JICA Design Team

Figure 4.2.119 Field Identification Survey Activities

i) Editing

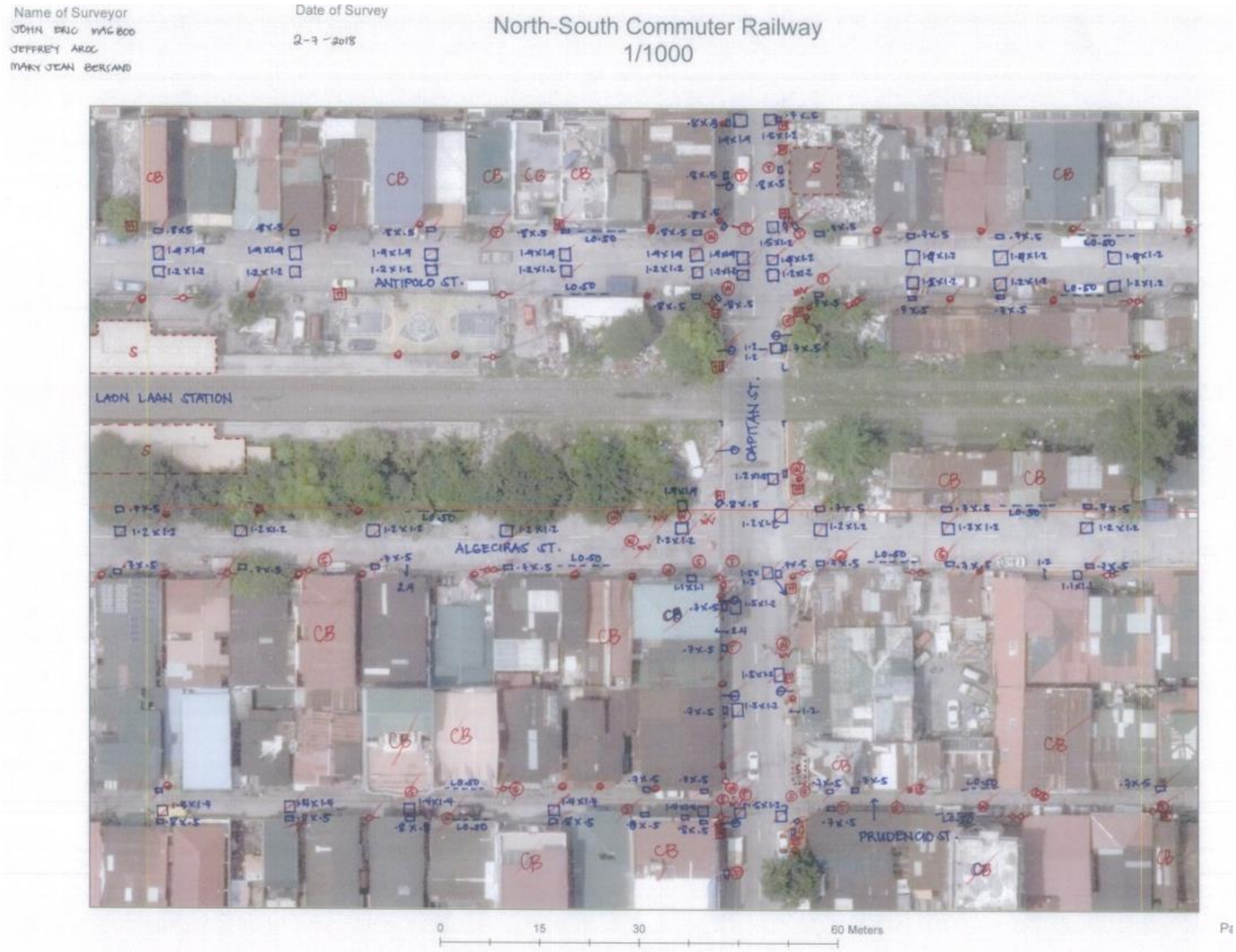
Structural Compilation of the stereo plotting data were done wherein the Stereo Plotting data were inspected, verified and corrected for logical errors (edge mismatching, undershoot, overshoot, area overlap and inconsistency of area classification), and topologically structured (i.e all topographic features were classified into proper geometry of line, polygon, or point) in accordance with the specifications. AutoCAD software, combined with GIS software were used for structural compilation and editing.

- Additional features gathered during the field identification survey, as well as data from Utility Survey were added and compiled together with the stereo plotting output, and finally converted to suitable CAD (.dwg) format as final topographic data.

j) Field Supplemental Survey

Doubtful, unclear points and secular changes that were found in digital plotting and compilation were verified through supplemental field survey.

The points that could be interpreted referring to the materials provided by utility companies and agencies were also verified and discussed before inclusion in the final manuscript.



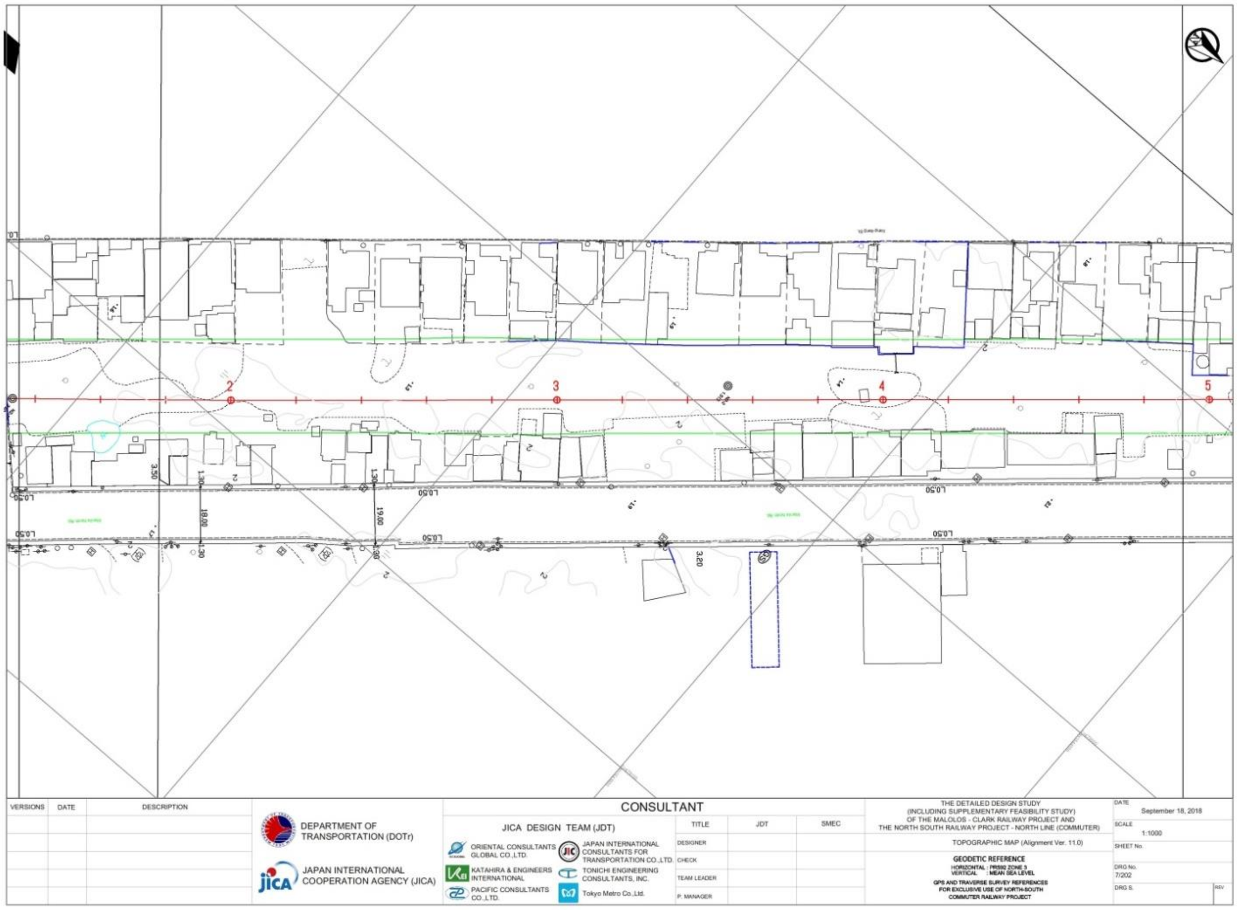
Source: JICA Design Team

Figure 4.2.120 Field ID survey Manuscript

9) Topographic Map Creation

Data gathered from the different survey process, such as, GPS survey, Leveling survey, as well as collected information from Major Cross Roads Mapping, were compiled to create the final Topographic Map data at 1/10,00 scale.

- Contour lines were automatically extracted from filtered data of DTM (Digital Terrain Model)
- Topographic features interpreted from Orthophoto and other survey data were manually digitized using stereo plotting methodology.
- GIS capable and Remotes sensing software, such as ArcGIS and ERDAS imagine were used to verify the correctness and accuracy of the compiled data to produce final Topographic Map suitable for reproduction



Source: JICA Design Team

Figure 4.2.121 Final Topographic Map Layout at 1:1,000 scale

a) Field Supplementary Survey at Water Area

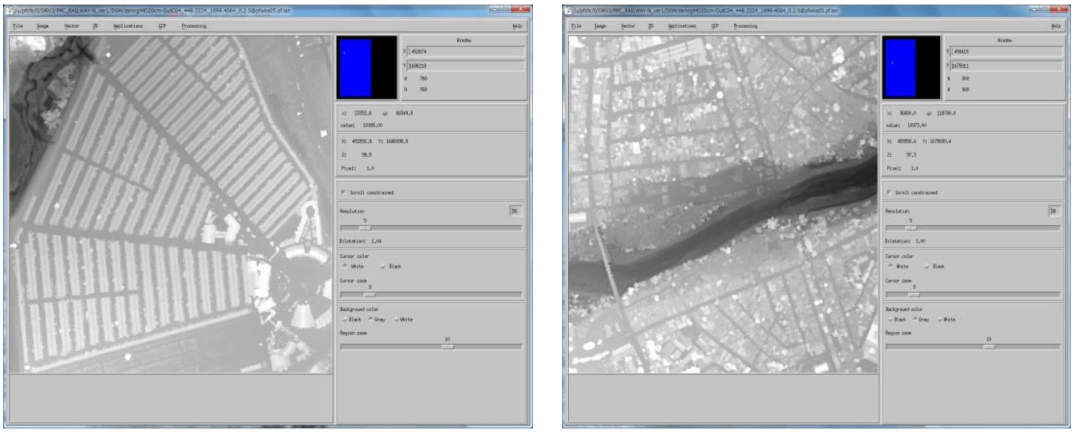
There are no water areas for field supplementary survey in south section.

b) Photogrammetric Profile and Cross-Section Survey

The profile data to be generated using the DSM/DTM data created with photogrammetric method. Also, to generate Cross-Section data at 20m intervals with standard 100m width 50 m on both sides from the center.

DSM data was created from stereo model by digital image correlation method. The original GRID size of DSM is 0.2 x 0.2 m.

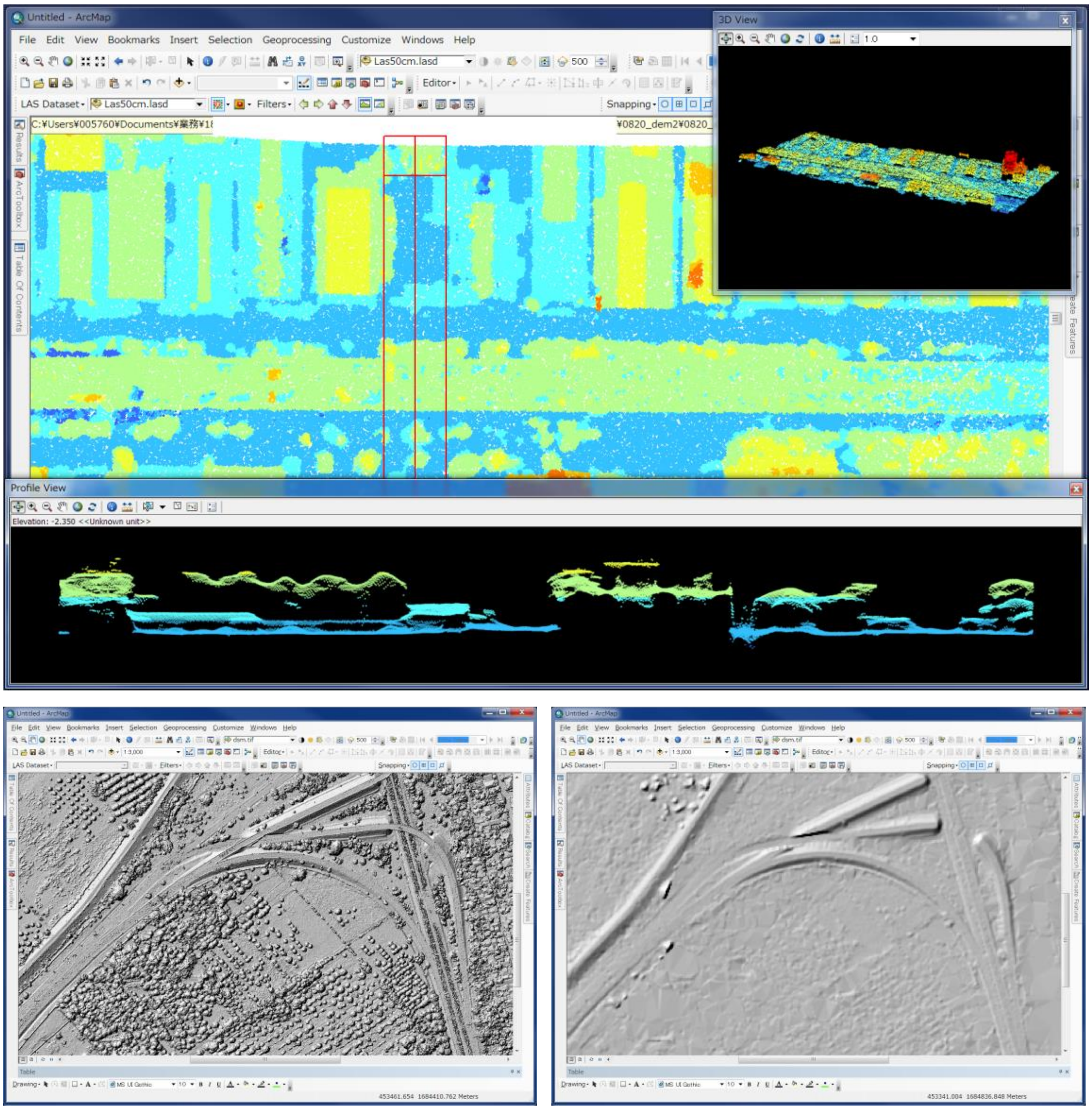
Following images shows the process of DSM processing.



Source: JICA Design Team

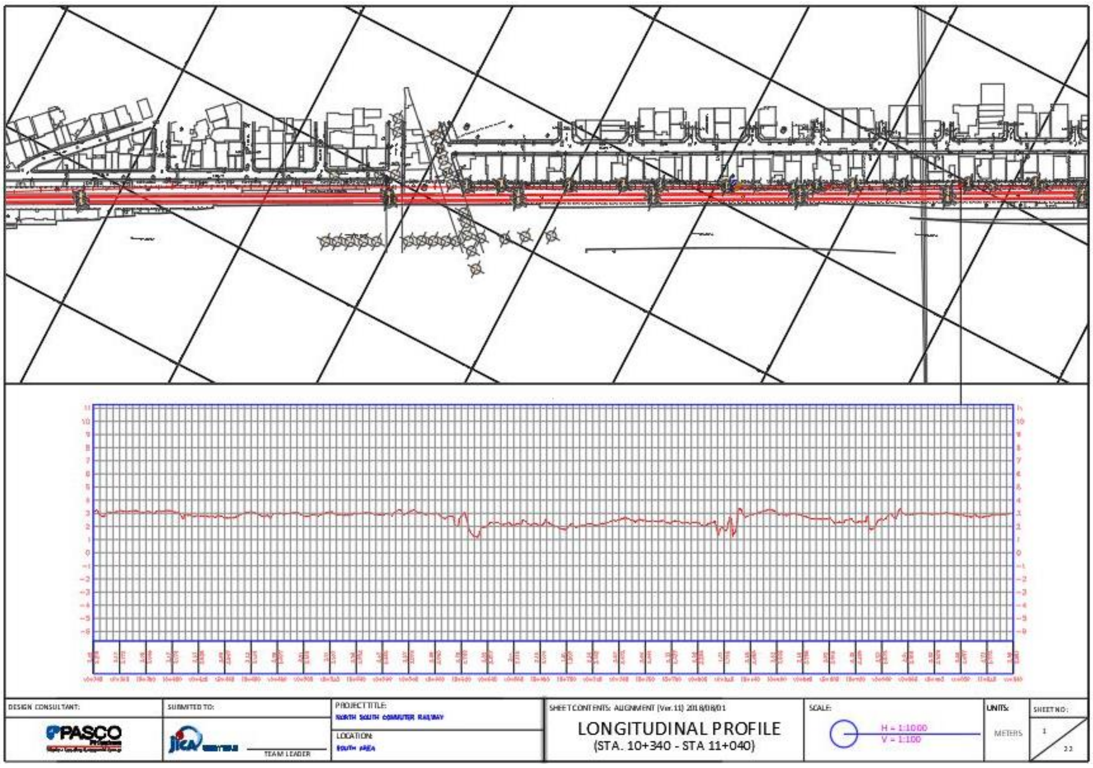
Figure 4.2.122 DSM Processing

DTM data was created from this DSM data with filtering method. The original GRID size of DTM is 0.5 x 0.5m.



Source: JICA Design Team

Figure 4.2.123 DSM Filtering



Source: JICA Design Team

Figure 4.2.124 Longitudinal Profile

Profile and cross section data is created from this DTM. First product of profile and cross section data are used for feasibility study. Based on this study, JDT will consider the probability of current alignment and re-design them. After this process, profile and cross section data will be modified.

10) River Surveys

Pre-selected rivers and creeks traversed by or near the railway alignment were surveyed using both total station survey method and sounding measurements.

For the south part, the surveyed covered 51 small rivers/creeks and bridges surveyed and 3 priority large rivers (Pasig River, San Cristobal and Calamba River). The other sites are either medium-size river and creeks as listed below.

Table 4.2.50 List of Rivers and Creeks Surveyed at the South Part

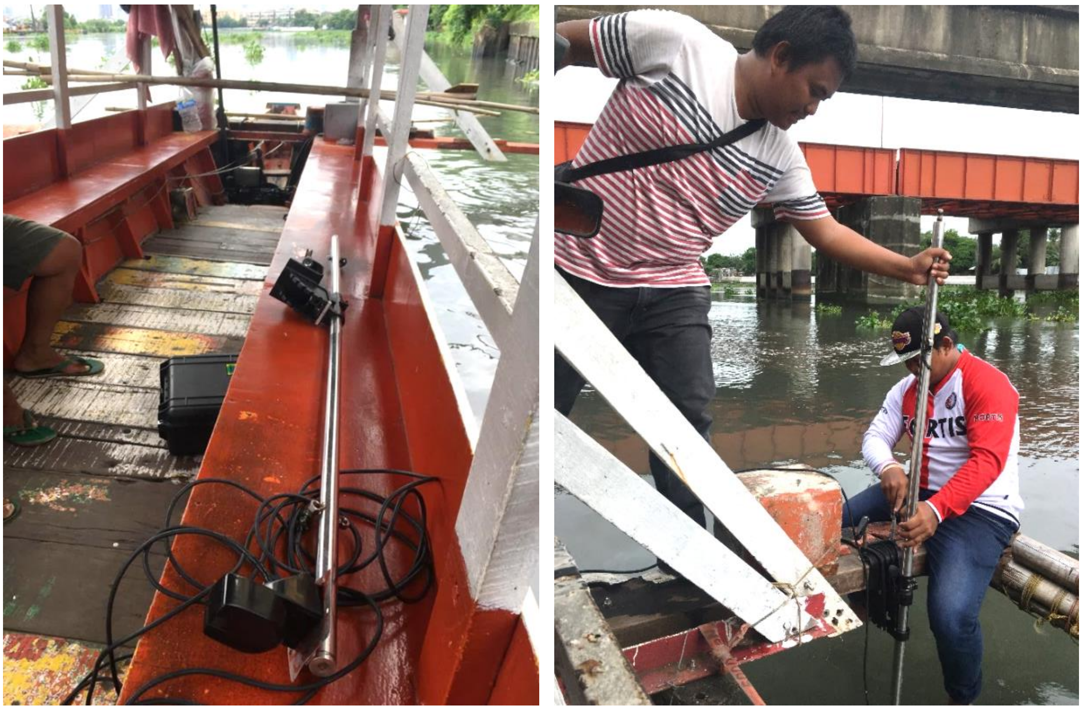
No.	Name	Sta.	Description
1.	unknown	3+590	Small
2.	unknown	5+020	Small
3.	Pasig River	6+735	Large
4.	unknown	7+310	Small
5.	unknown	8+060	Small
6.	unknown	8+540	Small
7.	unknown	9+400	Small

No.	Name	Sta.	Description
8.	San Andres Creek	9+650	Medium
9.	unknown	11+355	Small
10.	unknown	13+270	Small
11.	unknown	15+050	Small
12.	unknown	15+390	Small
13.	unknown	24+905	Small
14.	Sucat / Buli River	25+170	Medium
15.	unknown	25+800	Small
16	unknown	26+870	Small
17	Alabang River	27+350	Medium
18	Bayanan River	29+096	Small
19	unknown	30+460	Small
20	Poblacion River	31+320	Medium
21	Magdaong River	31+650	Medium
22	unknown	32+250	Small
23	unknown	33+220	Small
24	Tunasan River	33+775	Medium
25	unknown	34+310	Small
26	San Isidro River	34+450	Large
27	unknown	34+840	Small
28	unknown	36+950	Small
29	Binan River	39+330	Medium
30	unknown	41+070	Small
31	unknown	41+610	Small
32	unknown	42+070	Small
33	Silang Santa Rosa River	42+585	Medium
34	unknown	42+650	Small
35	unknown	43+515	Small
36	unknown	44+200	Small
37	unknown	44+710	Small
38	Floodway Channel	44+815	Small
39	unknown	45+000	Small
40	unknown	45+830	Small
41	unknown	46+060	Small
42	Cabuyao River	46+385	Medium
43	unknown	47+080	Small
44	unknown	47+725	Small
45	unknown	47+855	Small
46	unknown	48+100	Small
47	unknown	48+260	Small
48	Cabuyao River	48+490	Large
49	unknown	48+850	Small
50	unknown	52+700	Small
51.	San Cristobal River	54+000	Large
52.	Calamba River	55+345	Large
53.	unknown	55+440	Small
54.	unknown	56+050	Small

Source: JICA Design Team

For large rivers, the extent includes 500 m upstream and 250 meters downstream for an approximate length of 750 meters. The width of the cross section varies since each cross section include ground points surveyed on both sides at 50 meters inland from the river banks (or less depending on the actual situation on the ground). For small rivers or creeks, the extent is 50 meters with a spacing of 10 meters per section measuring until the top banks only.

For navigable rivers, echo sounder equipment was used for the depth measurements. The logging specification was set at 5 meters interval. The corrected horizontal and vertical positions were recorded along with the depths. The horizontal coordinates were automatically corrected through RTK. The GNSS base is stationed at the nearest ground control while the rover is connected to the echo sounder.



Source: JICA Design Team

Figure 4.2.125 Major equipment installation status (echo sounder)

Source: JICA Design Team

Figure 4.2.126 Major equipment installation status (GNSS)

Source: JICA Design Team

Figure 4.2.127 Observation situation

For non-navigable rivers/creeks, optical/laser measurements were performed using electronic total station equipment. The ETS were set at pre-established pairs of ground control points (GPS and Traverse Points or densified ground control points).

For large/wide non-navigable rivers, the following points along each cross section were measured:

- Top bank at the left (TB)

- Top bank at the right
- Edge of water at the left(EW
- Edge of water at the right(EW
- Center line(CTR)
- Approximate midpoint or point in-between the Centerline and water edge at the left(RB)
- Approximate midpoint or point in-between the Centerline and water edge at the right(RB)

Source: JICA Design Team

Figure 4.2.128 Non-navigable shallow river surveyed

For narrow or smaller creeks, the following points along each cross section were measured:

- Top bank at the left (TB)
- Top bank at the right (TB)
- Water edge at the left (EW)
- Water edge at the right (EW)
- Center line (CTR)

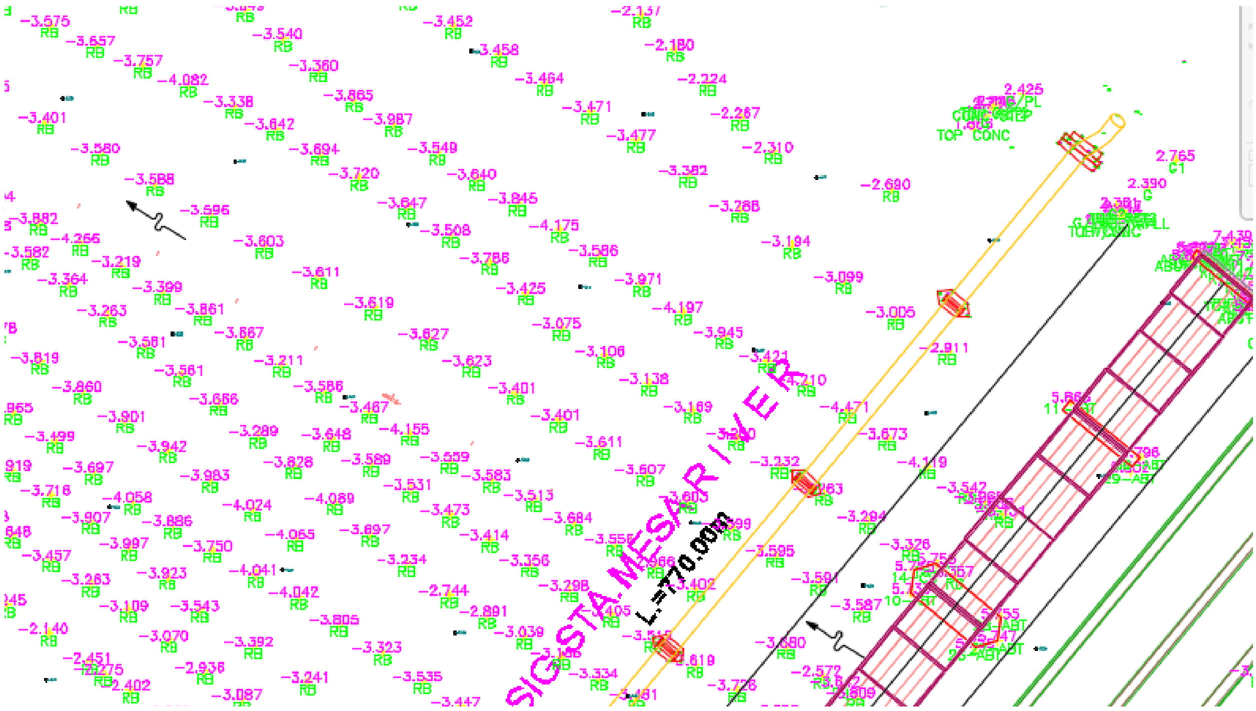
The raw data for the river cross section survey were downloaded in CSV format. The csv files were then loaded to AutoCAD Civil 3D 2016 where the surface contours were generated.

Table 4.2.51 CSV File

Point Nam	Northing	Easting	Elevation	Point Code
S6-7	1614058.259	501166.690	10.751	ST
1	1614076.920	501273.027	-2.051	BATHY
2	1614076.897	501281.568	-0.040	BATHY
3	1614075.992	501290.639	-5.085	BATHY
4	1614067.458	501316.193	-4.500	BATHY
5	1614065.841	501321.181	-4.379	BATHY
6	1614064.477	501326.031	-5.342	BATHY
7	1614062.976	501331.057	-5.503	BATHY
8	1614061.309	501336.000	-5.487	BATHY
9	1614060.044	501340.853	-5.449	BATHY
10	1614058.593	501345.809	-5.581	BATHY
11	1614057.602	501350.748	-4.837	BATHY
12	1614056.769	501355.688	-5.431	BATHY
13	1614056.021	501360.968	-4.517	BATHY
14	1614055.070	501366.057	-4.566	BATHY
15	1614053.895	501371.086	-4.909	BATHY
16	1614052.317	501375.985	-3.867	BATHY
17	1614051.122	501381.007	-3.933	BATHY
18	1614050.239	501386.154	-3.560	BATHY
19	1614049.194	501391.210	-3.166	BATHY
20	1614047.922	501396.330	-3.231	BATHY
21	1614046.511	501401.417	-2.865	BATHY
22	1614044.411	501406.087	-2.523	BATHY

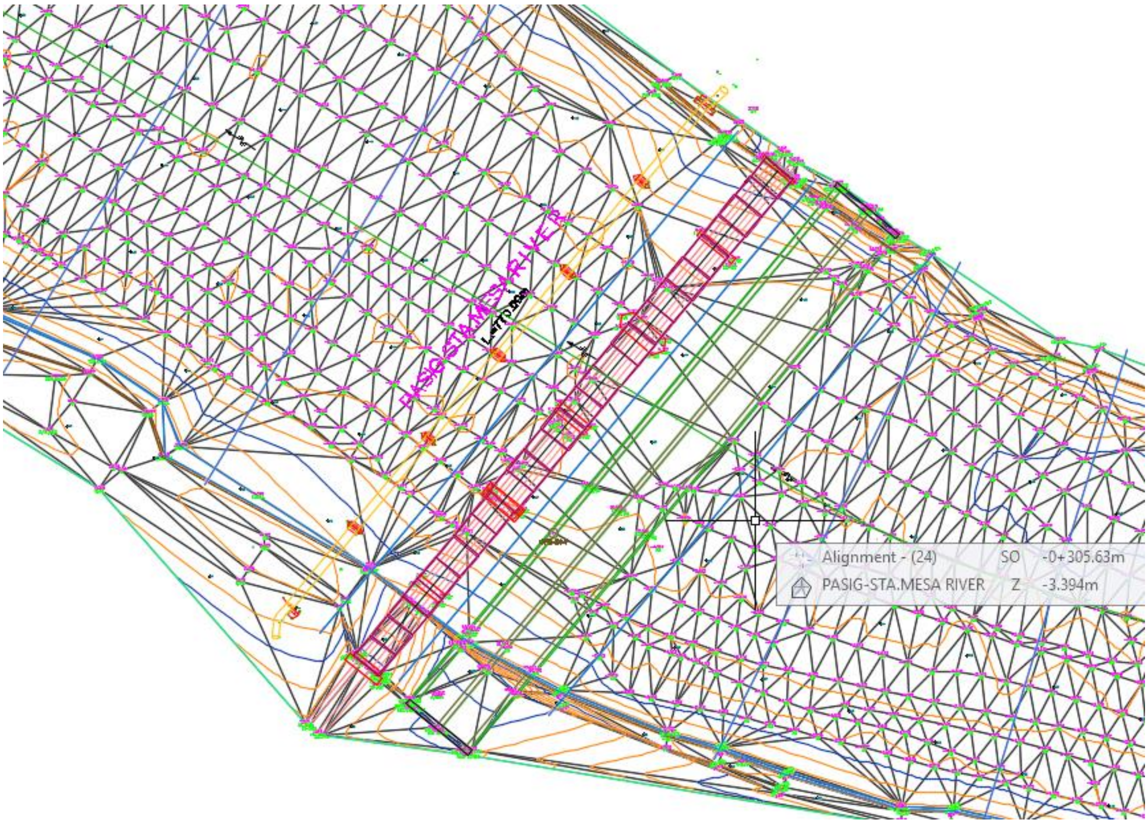
1	1613946.580	501437.423	2.977	0+300
2	1613959.409	501388.231	3.000	0+250
3	1613946.580	501437.423	2.978	0+300
4	1613959.408	501388.235	2.999	0+250
5	1613941.127	501458.352	2.979	SUB 1
6	1613941.127	501458.352	2.979	SUB 1
7	1613946.580	501437.423	2.977	0+300
8	1613941.127	501458.352	2.978	SUB 1
9	1613946.579	501437.428	2.978	0+300
10	1613928.324	501485.522	2.990	0+350
11	1613927.053	501484.900	3.077	PL
12	1613927.510	501485.733	2.985	EDGE SW
13	1613928.375	501486.219	2.993	EDGE SW1
14	1613928.384	501486.271	3.674	TOP R
15	1613928.604	501486.272	3.675	TOP R1
16	1613929.154	501486.020	2.220	TB
17	1613928.787	501486.063	3.047	TB
18	1613928.874	501486.083	3.039	TB1
19	1613928.989	501486.256	2.213	LB
20	1613929.560	501486.390	2.199	LB1
21	1613930.066	501486.568	0.549	EW/WL
22	1613959.409	501388.231	3.000	0+250
23	1613946.580	501437.423	2.977	0+300
24	1613959.409	501388.231	2.999	0+250

Source: JICA Design Team



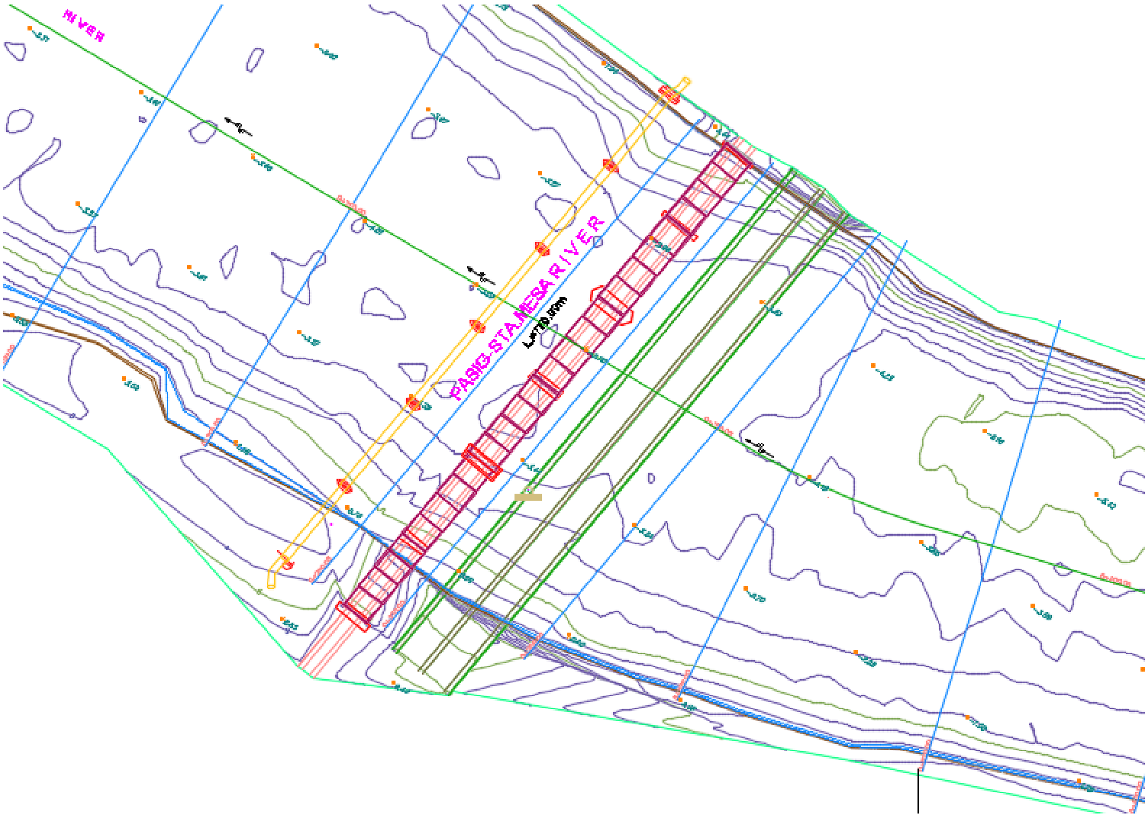
Source: JICA Design Team

Figure 4.2.129 Independent elevation point occurrence situation



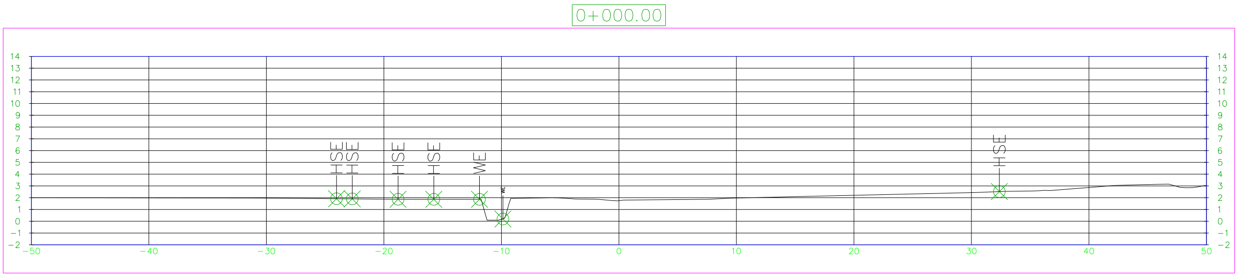
Source: JICA Design Team

Figure 4.2.130 Surface TIN



Source: JICA Design Team

Figure 4.2.131 Surface Plan generated from the TIN



Source: JICA Design Team

Figure 4.2.132 Cross-Section view of a river Survey

11) Major Cross Road Topographic Survey

As per instruction of the Client, spot heights for the center lines of major roads crossing the railway alignment were selected and surveyed using electronic total stations (ETS) equipment, at fifty (50) meters on both sides (left and right). Points along the road center lines were measured at every ten (10) meters interval. The nearest horizontal and vertical control points (GPS and traverse control points) were used as survey reference. The vertical datum used is MSL, and elevations are based on the leveling survey results. There are about thirty-seven (37) road cross sections for the south part.

The spot heights of other roads (like a community road) were measured from photogrammetric data.

Table 4.2.52 Road crossing survey site list

NO.	STA.	NAME	DESCRIPTION	MUNICIPALITY
1	0+264	Hermosa Street	2 Lanes (1 Lane on one side)	Manila
2	0+932	Solis Street	2 Lanes (1 Lane on one side)	Manila
3	1+470	Jose Abad Santos Street	8 Lanes (4 Lane on one side)	Manila
4	1+885	Tomas Mapua Street	1 Lane (2-way traffic)	Manila
5	1+980	Rizal Avenue	2 Lanes (1 Lane on one side)	Manila
6	2+380	Old Antipolo Street	1 Lane	Manila
7	2+920	Simoun Street	1 Lane	Manila
8	3+070	Maria Clara Street	1 Lane	Manila
9	3+233	Loan Laan RD	2 Lanes (1 Lane on one side)	Manila
10	3+390	Dapitan Street	2 Lanes (1 Lane on one side)	Manila
11	3+550	Piy Margal Street	2 Lanes (1 Lane on one side)	Manila
12	3+710	Florentino Street	2 Lanes (1 Lane on one side)	Manila
13	3+895	España Blvd	8 Lanes (4 Lane on one side)	Manila
14	4+050	Loyola Street	1 Lane (2-way traffic)	Manila
15	4+210	Fajardo Street	3 Lanes (oneway)	Manila
16	4+690	Honradez Street	1 Lane (2-way traffic)	Manila
17	4+840	G Tuazon Street	1 Lane (2-way traffic)	Manila
18	6+160	Teresa Street	1 Lane (2-way traffic)	Manila
19	6+410	Oasis Underpass	2 Lanes (1 Lane on one side)	Manila
20	7+300	Beata Street	2 Lanes (1 Lane on one side)	Manila
21	7+950	Menandro Street	2 Lanes (1 Lane on one side)	Manila
22	9+060	Pedro Gil Street	4 Lanes (oneway)	Manila
23	9+800	Diamante Street	6 Lanes (3 Lane on one side)	Manila
24	10+570	Pablo Ocampo Sr. Street	3 Lanes (oneway)	Manila
25	10+612	Zobel Roxas Street	3 Lanes (oneway)	Manila
26	11+580	Malugay Street	4 Lanes (2 Lane on one side)	Makati
27	11+650	Sen. Gil Puyat Ave	8 Lanes (4 Lane on one side)	Makati
28	11+870	Dela Rosa Street	2 Lanes (1 Lane on one side)	Makati
29	12+480	Arnaiz Ave	4 Lanes (2 Lane on one side)	Makati
30	12+955	Don Bosco Street	4 Lanes (2 Lane on one side)	Makati
31	20+480	Gen. Santos Ave	4 Lanes (2 Lane on one side)	Taguig
32	28+193	Montillano Street	4 Lanes (2 Lane on one side)	Muntinlupa
33	32+920	E. Rodriguez	1 Lane (2-way traffic)	Muntinlupa
34	33+930	A. Mabini	1 Lane (2-way traffic)	San Pedro
35	39+090	General Malvar Street	1 Lane (2-way traffic)	Biñan
36	39+940	Mamplasan Access Road	1 Lane (4-way traffic)	Biñan
37	40+220	Mamplasan Access Road	1 Lane (4-way traffic)	Biñan

Source: JICA Design Team

a) Road Cross Section Survey and as-Built Survey of Overbridges

There are eleven (11) pre-identified sites for road cross sections with over-bridges. Both ground points/spot heights and modified as-built survey for the over-bridge was performed using total station survey. Using the prism-less electronic total station, side shots were taken to capture the 3D positions the elevated sections of the bridge and the pillars. The lowest elevations of the over-bridge were measured. Spacing used for the cross section is based on the positions of the pillars.

Source: JICA Design Team

Figure 4.2.133 Situation photo 13+740 EDSA Magallanes

These data are not able to get from aerial photographic data. The measurement targets are covered by objects.

Road cross section survey and as build survey of over bridges are integral part of deciding the configuration of design.

b) Alignment Survey

Additionally, alignment survey were undertaken as required by the JICA Design Team. For south section, the alignment survey was done from Solis to Calamba for total length of 56 kilometers from 0+000 to 56+050.

The purpose of alignment surveys is for ensure the necessary accuracy for designing and decision making.

The alignment of the existing railway was surveyed in the following manner:

- Measure the inner edges of the steel rails

- Measure the ground point to the left of the railway
- Measure the ground point to the right of the railway

The spot heights of the sections were measured at an interval of 100 meters for straight lines and every 10 meters for curve sections. The center line of the alignment is then drawn using the midpoint of the rail alignment for both ways, using CAD software.

Source: JICA Design Team

Figure 4.2.134 Status of existing track

12) The Survey Work Progress

Following table shows the planned and implemented quantity list.

Table 4.2.53 Planned and implemented quantity list

Item	Unit	Qty.	Progress	Rate
Satellite Image data adjusted by GPS H & V				
Image adjusted by GPS data & DTM draw contouring	LS	1	1	100%
Horizontal Control Point Survey				
Reconnaissance	km	70	70	100%
New Points Selection Work	Point	60	60	100%
30cmx30cmx100cm Concreting Work	Point	60	60	100%
Observation and Calculation	Point	60	60	100%
Description of GPS station	Point	60	60	95%

Item	Unit	Qty.	Progress	Rate
Primary Traverse Survey (TS Survey)				
Primary Traverse point selection 200-300m	Pc	292	292	100%
Primary 20cmx20cmx70cm Concreting Work	Pc	292	292	100%
Primary Observation and Calculation	Pc	292	292	100%
Description of TS point	PC	292	292	95%
Control Leveling Survey (Digital Level)				
Control Leveling Observation(0km - 70km)	km	79	79	100%
Aerial Photography & Airborne LiDAR Measurement				
Process Applications flight clearance PND & Aviation		1	1	100%
Mobilization of Aerial LiDAR and Camera		1	1	100%
Flight Operation_UCX	Course	19	19	100%
Flight Operation_Lidar	Course	19	-	-
Clibration_UCX	Times	1	1	100%
Clibration_Lidar	Times	1	-	-
Pre Mark Survey	Point	67	67	100%
Aerial Triangulation Survey	Course	19	19	100%
DSM Process Work	km	61.6	61.6	100%
DTM Process Work	km	61.6	61.6	100%
Orth Photo Production South 1/1.000 km0.0-6.0	km	6	6	100%
Orth Photo Production South 1/1.000 km6.0-24.5	km	18.5	18.5	100%
Orth Photo Production South 1/1.000 km24.5-56.0	km	31.5	31.5	100%
Topographic map Solis - Sta. Blumentritt km 0.0 - 2.5	km	2.5	2.5	100%
Topographic map Sta.Blumentritt - Sta. Mesa km2.5 - 6.0	km	3.5	3.5	100%
Topographic map STA. Mesa - Buendia km 6.0 -11.5	km	5.5	5.5	100%
Topographic map Buendia - Nichols km 11.5 -16.0	km	4.5	4	100%
Topographic map Nichols - Bicutan km 16.0 - 20.5	km	4.5	4	100%
Topographic map Bicutan - Sucat km 20.5 - 24.5	km	4	3.7	100%
Topographic map Sucat - Calamba km 24.5 - 56.0	km	31.5	8	100%
CALAMBA-LOS BANOS km 56.0 -71.6 (low priority)	km	15.6	-	-
Profile　Photogrammetric method	km	2.5	2.5	100%
Profile　Photogrammetric method	km	53.5	40.2	100%
Quick Longitudinal section 20m interval km 0.0 - 2.5	km	2.5	2.5	100%
Quick Longitudinal section 20m interval km 2.5 - 56.0	km	53.5	6	100%
Quick Cross section width 50m both sides km 0.0 - 2.5	Cross	125	125	100%
Quick Cross section width 50m both sides km 2.5 - 56.0	Cross	2675	120	100%
Ortho Map (initial) 0.0-56.0 (Gairyaku Heimen)	km	56	56	100%
Ortho Map (Batch01) 0.0-6.5km　(Gairyaku Heimen)	km	6.5	6.5	100%
Ortho Map (Batch02)0-11.5km　(Gairyaku Heimen)	km	5	5	100%
Ortho Map(Batch03)0-24.5km　(Gairyaku Heimen)	km	13	13	100%
Ortho Map(Batch04)0-56.0km　(Gairyaku Heimen)	km	31.5	31.5	100%
River Survey				
River survey Sounding RTK or TS or Echo sounder	No	54	54	100%
Major Cross Road Topographic Survey				
Major Cross Road Topo-Survey South	Cross	37	37	100%
Historical Building Survey				
Historical Building Survey	Cross	37	37	80%

Item	Unit	Qty.	Progress	Rate
Topographic Survey for DD study				
Topo Mapping, Longitudinal and Cross Section	Cross	37	37	0%

Source: JICA Design Team

(3) Relocation Survey Objectives

- To identify the Philippine National Railway (PNR) right-of-way (ROW) based from existing documents – land titles, cadastral maps, etc.
- To locate and establish boundary monuments on ground for the PNR ROW
- To generate a relocation plan for the PNR ROW

1) Project Area

North South Railway (NSRP)

1. Solis ~ Calamba : 56km

Table 4.2.54 NSRP Project Area

Metro Manila	Laguna
Manila	San Pedro
Makati	Biñan
Parañaque	Sta. Rosa
Taguig	Cabuyao
Muntinlupa	Calamba

Source: JICA Design Team

2) Work Schedule

Table 4.2.55 Relocation Survey Progress Schedule

Activity	Weight	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24	Progress
Research of land titles, maps and plans	20%																									
Accomplishment								100%																		20%
Preparation of base maps	10%																									
Accomplishment														100%												10%
Mobilization of Survey Party																										
Coordination Meetings	10%																									
Accomplishment												100%														10%
Field Surveys																										
NSRP																										
Reconnaissance and referenceing	5%																									
Accomplishment														100%												5%
Relocation Survey	15%																									
Accomplishment															(NSRP - 40/60.6km) 66%											10%
Monumenting	5%																									
Accomplishment																										0%
Data Analysis and Plan Preparation	5%																									
Accomplishment																	(85.5/106.1km) 80%									4%
Final Plans and Report	5%																									
Accomplishment																										0%

Legend : Accomplishment : Plan

Source: JICA Design Team

3) Research

- Identification of affected parcels along the existing railway
- Data gathering for parcel information from cadastral maps, tax maps, tax declarations, lot data computations, and so on
- Sources of information:
- Land Management Bureau (LMB)

- Land Registration Authority (LRA)
- Department of Environment and Natural Resources (DENR)
- Registry of Deeds (RD)
- Local Government Units (LGU)

4) Survey Activities

1. Determination of control points for reference using previously established Ground Control Points (GCPs) and other existing reference points
2. Establishment of control points using static GPS
3. Parcellary survey of properties using Real-Time Kinematic (RTK) GPS stationed on determined corners of the parcels
    - For areas with intermittent signal, Total Station will be utilized for boundary determination
4. Monumenting of determined corners for property boundaries
    - Establishment of monuments for every parcel corner
    - For longer boundaries, intermediate monuments are to be established at 100-meter intervals

5) Data Processing/Analysis and Plan Preparation

- Data processing of research-based information
    1. Georeferencing of plans and maps
    2. Digitization/plotting of parcel boundary and corresponding details
        - Property identification
        - Lot number
        - Adjacent boundaries
        - Owner name
        - Available references
- Data processing of field-based information
    1. RTK-GPS data processing and plotting of determined lot corners
    2. Land data matrix
    3. Report generation
- Consolidation of processed data based on existing plans and documents and of field-based data
- Documentation of references
- Quality assessment and quality control – comparison analysis should there be differences between the processed datasets
- Generation of land data matrix and corresponding geodatabase
- Generation of plans and land information system containing all surveyed data

4.2.5 Hydrology

4.2.5.1 Instruction

(1) Objectives of the Hydrologic and Hydraulic Analysis

This report will cover the design of the drainage system and the influence of the piers on the river-water elevation and the riverbed erosion around the piers for the proposed alignment of the NSRP-South Line (Commuter).

The objective of this design is to minimize the adverse impact of the project by safely conveying runoff from the rail to the identified discharge points and introducing applicable improvements to rivers affected by the alignment.

(2) Scope and Limitations

The scope and limitations of the hydrologic and hydraulic analysis will be defined or determined after gathering data and information, maps and reports relevant to the analysis.

The study rage is as follows;

- Hydraulic analysis in rivers
  - The influence of the piers on the river water elevation
  - The erosion analysis of the riverbed around the piers
- Drainage system
  - Design conditions
  - Drainage planning and design of elevated and station sections
  - Drainage planning and design of embankment
  - Drainage planning and design of vehicle base

4.2.5.2 Data Collection

Table 4.2.56 is the list of the data collection and the source about the hydrologic and hydraulic data.

Table 4.2.56 Required Data for Hydrologic and Hydraulic Analysis

No.	Object	Collected data	Purpose
1	General	Design Criteria	JICA Design Team, DPWH etc.
2	Rainfall Intensity	Rainfall Intensity	PAGASA
		Climate change condition	PAGASA
3	Catchment area	Topographic map and satellite photograph	NAMRIA
		Existing drainage facilities ,planned facilities	Local government, DPWH, MMDA
4	Rainfall outflow	Drainage area, land use, rain intensity	NAMRIA
5	Design flood level	Flood hazard map, Flood level record	DPWH, PAGASA
6	Flooding analysis	Topography, hydrological survey	JICA Design Team
7	Drainage design	Destination condition	Local government, JICA Design Team

Source: JICA Design Team

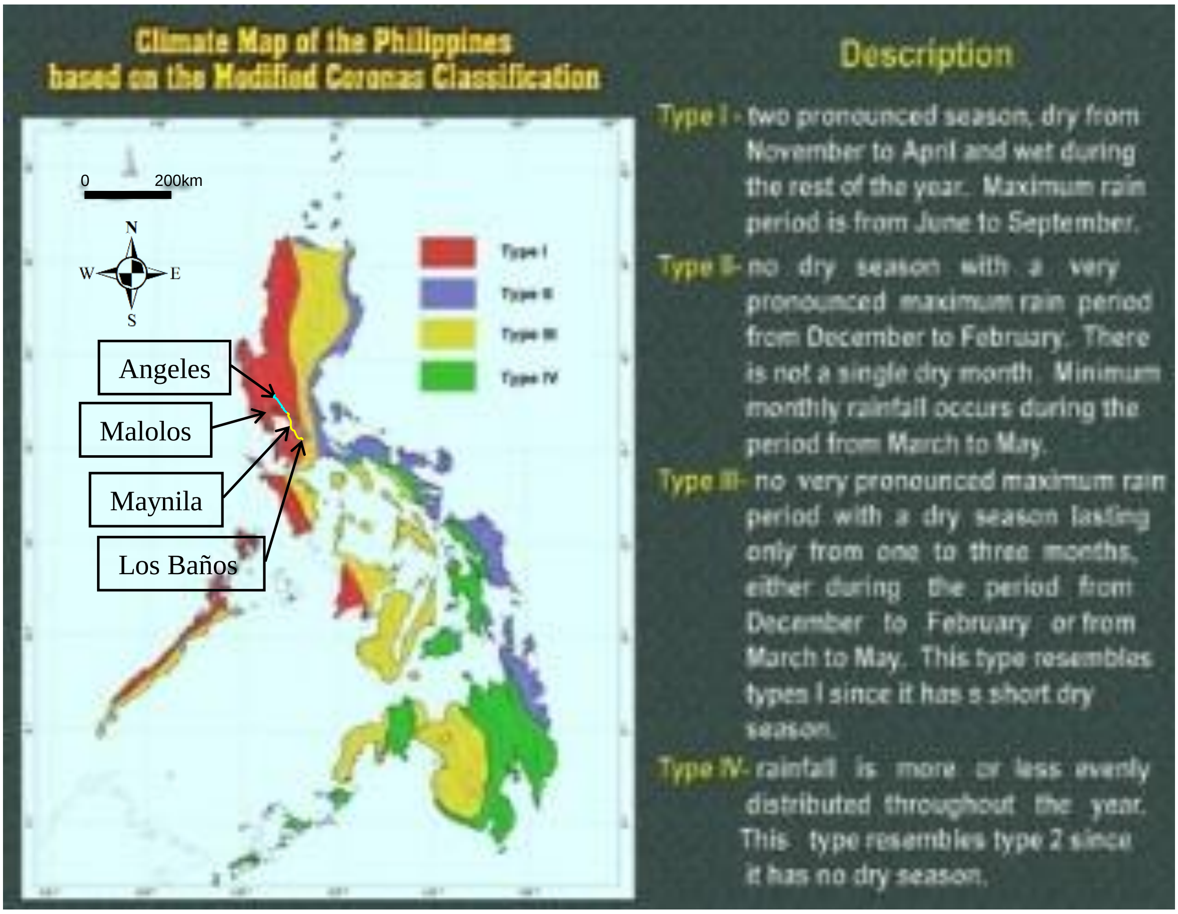
4.2.5.3 Existing Conditions

(1) Climatology

PAGASA characterizes the climate in the Philippines in terms of temperature, humidity and rainfall as shown in Figure 4.2.135.

The project site is located in a Type 1 climate, wherein there are “two pronounced seasons, dry from November to April and wet during the year and maximum rain period is from June to September” as stated in the Climate Map.

Although it is generally rainy season from May to November, rain and storms are also known to occur frequently in December and January. Summer starts in April (extreme heat) and ends in May (extreme heat and humidity). In order to prevent the floods due to the rainy season from affecting stations and users, we should collect data such as hazard maps by NOAH and consider the flood level along the railroad tracks.



Source: PAGASA

Figure 4.2.135 Climate Map of the Philippines

(2) Existing Topography

Initial 1:50,000 (metric) topographic maps were obtained from the National Mapping and Resource Information Agency (NAMRIA).

The project area and alignment is located on relatively flat slopes. A more accurate description will be available once detailed topographic survey has been completed.

The topographic maps from NAMRIA are used to delineate watershed areas for the streams and rivers traversing the project alignment.

The following topographic maps have been obtained and will be used to support the hydrological analysis:

- 3031-I O'Donnell
- 3031-IIMountPinatubo
- 3130-I Malolos City
- 3130-IVGuagua
- 3131-IIIAngelesCity
- 3131-IV Tarlac City
- 3229 -III CALAMBA
- 3229-IV Muntinlupa City
- 3230-III Quezon City
- 7172 II Manila
- 7271-II San Pablo

(3) Existing Drainage Facilities

Onsite inspections reveal that certain sections of the alignment have earth ditches that run through the northbound and southbound edge of the ROW. Nearby road drainage structures such as RCBCs, covered ditches and RCPC are also accessible as discharge points.

The existing drainage facilities can be comprehensively analyzed as the updated topographic surveys are received.

(4) Location and Tapping points

River crossings are considered as discharge points. Additional discharge points of the drainage system will be identified once the topographic surveys have been completed and received. At the present stage, field survey was conducted and the drainage outfalls was confirmed (see appendix).

(5) Existing and Proposed River Improvement Projects

River improvement plans executed by the DPWH on the North South Railway Project – South Line (Commuter) alignment were not proposed.

4.2.5.4 Design Criteria

The reference document for identifying design flood frequencies in the Philippines is the DPWH Design Guidelines Criteria and Standards Volume 4 (DGCS Vol. 4). This document does not specifically outline criteria for railways, however, if the NSRP-South Line is considered as equivalent to an "Expressway," then the design flood frequencies as outlined in the following sections for "Expressway" will apply to the culverts, ditches and inlets for the embankments and viaducts of the North South Railway Project – South Line (Commuter).

The drainage system of the stations is considered a minor system while the drainage system of the Valenzuela Depot (due to its large area) is considered a major system. This may also include the detention pond or basin.

The design frequency to be used in drainage design are the enumerated below.

The design requirements for drainage structures located on major transport link, shall be as shown in Table 4.2.57.

Table 4.2.57 Design Flood Frequency for Roads (DGCS 2015, Volume 4, pg. 5-8)

Road Classification	Culverts		Roadside Ditches & Inlets		Median Ditches & Inlets		Curb Drop Inlets	
	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood
Expressway	50 yr	100 yr	25 yr	50 yr	25 yr	50 yr	25 yr	50 yr
National Road	25 yr	50 yr	10 yr	25 yr	10 yr	25 yr	10 yr	25 yr
Other Roads	20 yr	50 yr	5 yr	10 yr	5 yr	10 yr	5 yr	10 yr

Source: JICA Design Team

The design requirements for drainage structures not located on major transport link, shall be as shown in Table 4.2.58.

Table 4.2.58 Minimum Capacity of Drainage Infrastructure (DGCS 2015, Volume 3, pg. 6-2)

Land-use (Note 1)	Minor System		Major Drainage System Drainage Capacity (note 2)
	Design Capacity	Check Capacity	
Drainage Pipes	15 year flood	25 year flood	100 year flood
Culverts (Note 1)	25 year flood	50 year flood	
Esteros/creeks/drainage channels	15 year flood	25 year flood	

Note 1: Refer to Volume 4 for highway cross drainage structure capacities
Note 2: Freeboard for buildings are detailed in Volume 6: Public Buildings and Other Related Structures

Source: JICA Design Team

Design requirements for drainage structures relating to bridges shall be as shown in Table 4.2.59.

Table 4.2.59 Design Flood Frequency for Bridges (DGCS 2015, Volume 5, pg. 3-6)

Road Classification	River				Bridge Drainage	
	Structure		Hydraulic Scour			
	Design Flood	Check Flood	Design Flood	Check Flood	Design Flood	Check Flood
Expressway	100 yr	200 yr	*100 yr	*500 yr	25 yr	50 yr
National Road	50 yr	100 yr	*100 yr	*500 yr	10 yr	25 yr
Other Roads	25 yr	50 yr	50 yr	100 yr	5 yr	10 yr

* or from an overtopping flood of lesser recurrence level, whichever is the more severe based on AASHTOLRFD 2012 Sec 2.6.4.4.2 Bridge Scour

Source: JICA Design Team

4.2.5.5 Design approach

① Planned rainwater volume
We collect the latest rainfall data from the rain station from PAGASA. Basically follow the design standards created at NSCR. As shown in the DPWH Design Guidelines In Vol.4, we will verify the falling ability by the calculation of open channel.

② Wastewater gradient
For the structure drainage slope, a slope of 2.5% was set in NSCR. In this study, we will verify the flow rate and falling ability in catchment area using latest rainfall data.

(1) Drainage planning and design of elevated and station sections

Basically follow the design standards created at NSCR. We plan to consider as soon as the shape of the elevated and embankment area is decided.

(2) Drainage planning and design of embankment

Basically follow the design standards created at NSCR.

Collect the rainwater from the orbital side groove and discharge it to a river or the like by a vertical drain pipe via a catchment basin.

(3) Drainage planning and design of vehicle base

Basically follow the design standards created at NSCR. It is decided by consultation with stakeholders.

(4) Rivers and Stream Crossings

Revetments or river bank protection and river bed protection will be provided at rivers and stream crossings whenever necessary. Bridge abutments and bridge pier foundation may also be provided protection, if warranted. Grouted riprap, gabion wall, gabion mattress or sheet pile will be used for protection, depending on the site conditions (river characteristics, bed and bank material among others), tidal effects and bridge design configuration.

4.2.5.6 Hydrologic analysis

(1) Rainfall Intensity

The rainfall intensity for the entire alignment is obtained from PAGASA Synoptic Stations. The rainfall intensity – duration – frequency (RIDF) applicable to the North South Railway Project – South Line (Commuter) are 7 stations (Sc. Garden, PORT AREA, NAIA, ANGONO, SANGLEY POINT, AMBULONG, and TAYABAS), as provided in Table 4.2.61. However, since the NAIA station has the highest RIDF of the North South Railway Project – South Line (Commuter), this will be used for the whole North South Railway Project – South Line (Commuter) for uniformity of calculations and to provide a greater factor of safety.

The RIDF data of the NAIA station contains 43 years of rainfall data. As for the rain intensity formula, we adopt a Sherman type rainfall intensity formula as shown in the following equation.

$$I = \frac{a}{T_c^b}$$

Where, I = rainfall intensity [mm/hr], Tc= time of concentration [minutes], and the constant a and exponent b are parameters determined from regression analysis. The Sherman equation for the short-duration (less than 150 minutes) and long-duration (greater than 150 minutes) of RIDF is shown in Table 4.2.60.

Table 4.2.60 Sherman Equation for Short Duration and Long Duration of RIDF

Return Period	100yr	50yr	25yr	20yr	10yr	5yr
t < 150 min						
COEFF[a]	172.20	151.87	131.45	124.84	103.9	82.086
EXP[b]	0.492	0.493	0.495	0.495	0.498	0.503
t > 150 min						
COEFF[a]	211.23	185.67	160.24	151.68	126.02	98.58
EXP[b]	0.701	0.7	0.701	0.699	0.701	0.701

Source: JICA Design Team

An applicable return period will be used for the design of the different components of the drainage system.

Table 4.2.61 RIDF NAIA (PAGASA)

Republic of the Philippines
Department of Science and Technology
PHILIPPINE ATMOSPHERIC, GEOPHYSICAL AND ASTRONOMICAL SERVICES ADMINISTRATION (PAGASA)
FLOOD FORECASTING BRANCH
WFFC, BIR Road, Quezon City 1100 Tel. No. 928-27-54/926-50-60 Fax. 929-40-65
Webpage: http://pagasa.dost.gov.ph

RAINFALL INTENSITY - DURATION FREQUENCY ANALYSIS DATA

for

NAIA

Based on **43** years of record

COMPUTED EXTREME VALUES (in mm) OF PRECIPITATION

T (yrs)	**10 mins**	**20 mins**	**30 mins**	**1 hr**	**2 hrs**	**3 hrs**	**6 hrs**	**12 hrs**	**24 hrs**
2	19.4	30.1	37.3	49.4	65.9	77.6	101.1	125.5	143.8
5	31.8	49.3	61.4	82.1	112.1	132.9	173.6	215.3	246.9
10	40.1	62.0	77.3	103.7	142.6	169.5	221.5	274.7	315.2
20	48.0	74.1	92.6	124.4	171.9	204.6	267.5	331.7	380.7
25	50.5	78.0	97.4	131.0	181.2	215.8	282.1	349.8	401.5
50	58.2	89.9	112.4	151.2	209.9	250.1	327.1	405.6	465.5
100	65.9	101.7	127.2	171.3	238.3	284.2	371.7	460.9	529.1

EQUIVALENT AVERAGE INTENSITY (in mm/hr) OF COMPUTED EXTREME VALUES

T (yrs)	**10 mins**	**20 mins**	**30 mins**	**1 hr**	**2 hrs**	**3 hrs**	**6 hrs**	**12 hrs**	**24 hrs**
2	116.3	90.4	74.5	49.4	33.0	25.9	16.9	10.5	6.0
5	191.0	147.9	122.7	82.1	56.0	44.3	28.9	17.9	10.3
10	240.5	185.9	154.6	103.7	71.3	56.5	36.9	22.9	13.1
20	287.9	222.4	185.2	124.4	86.0	68.2	44.6	27.6	15.9
25	303.0	234.0	194.9	131.0	90.6	71.9	47.0	29.2	16.7
50	349.4	269.7	224.8	151.2	104.9	83.4	54.5	33.8	19.4
100	395.4	305.1	254.5	171.3	119.2	94.7	62.0	38.4	22.0

prepared by:
the HYDROMETEOROLOGICAL DATA ANALYSIS SECTION (HMDAS)
Hydro-Meteorology Division, PAGASA

requested by: Simon S. Dabu/ JICA Study Team
Date: 26 February 2018

Source: PAGASA

(2) Rational Formula

Roadway drainage is calculated using the Rational Method wherein a coefficient of runoff *c* is defined. This coefficient is dependent on the ground cover of the tributary area. The DGCS Vol. 4 provides the following formula to be used.

$$Q = \frac{cIA}{3.6}$$

Where, Q=rate of runoff (m^3/s), c=Coefficient of runoff, I=rainfall intensity (mm/hr), A=catchment area (square kilometers).

The Rational Method is considered applicable for rural catchments less than 20 km^2 and for urban catchments less than 5 km^2 (Section 3.4.1.1, DGCS Vol. 4). Since all catchment areas for the project are less than 5 km^2, the Rational Method can be applied for the project.

(3) Flood Peak Analysis of Rivers and Streams Using HEC-HMS

The US Army Corps of Engineers' Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) will be applied for peak flood analysis of the rivers in which piers are constructed on this projects. Section 3.5.2 of DCGS Vol.4 provides a brief discussion of HEC-HMS. For this study, it is initially contemplated that the SCS Unit Hydrograph (UH) and the SCS Curve Number (CN) methods will be used in the initial loss computation and the rainfall-runoff transformation, respectively. The Muskingum method will be used in the flood routing along the river channels.

The CN of a basin or sub-basin is obtained from tables published in Technical Report 55 (SCS, 1986) and provided in Section 1.5.2. Depending on the land use, soil type and the antecedent moisture condition, the CN is read from the table. A weighted CN is determined if there is more than one land use and soil type in the basin. CN value ranges from 30 (permeable soils with high infiltration) to 100 (water bodies). The maximum retention, S, is calculated as

$$S = (25400 - 254 * CN) / CN$$

The initial loss or abstraction in the watershed, Ia, is given by the equation

$$Ia = 0.2 * S$$

The % impervious area in the basin will be determined from the updated land use maps, satellite imagery and data from the field reconnaissance and inventory that will be conducted.

The SCS Unit Hydrograph (UH) method uses a dimensionless, single-peaked UH unit hydrograph where the UH peak, UP, and the time to peak, TP, are related by the equation

$$UP = 2.08 * A / TP$$

where, A = watershed area in sq. km. The TP is calculated as

$$TP = \frac{1}{2} \Delta t + t_{lag}$$

where, t is the specified computational time for the model and t_{lag} in hours is determined from the empirical equation

$$t_{lag} = 0.6\ tc$$

The Muskingum method is suitable for channels with small slopes, so the general mass conservation equation is given as

$$S_t = K[XI_t + (1 - X)O_t]$$

where, K = travel time of the flood wave through each reach and X = dimensionless weight (0 < X <0.5).

4.2.5.7 Hydraulic analysis

(1) Flow Capacity of Open Channel, Reinforced Concrete Pipe and RCBC

Manning's Formula is a general equation for uniform flow in open channels and it will be used to size the drainage structures. The formula is empirical and hydraulics. And then, this formula is dependent on slope and the Manning's coefficient of roughness '*n*'. The flow capacity of U-Ditch open channels is outlined in Table 4.2.62.

Table 4.2.62 Flow Capacity of U-Ditch Open Channels

Size	Depth	Roughness coefficient	Slope	Velocity	Volume	Froude number
	(m)		%	(m/s)	(m^3/s)	
0.45 x 0.50	0.4	0.013	0.10	0.67	0.12	0.34
	0.4	0.013	0.50	1.49	0.27	0.75
	0.4	0.013	1.00	2.11	0.38	1.07
	0.4	0.013	2.00	2.99	0.54	1.51
0.40 x 0.60	0.5	0.013	0.10	0.66	0.13	0.3
	0.5	0.013	0.50	1.49	0.3	0.67
	0.5	0.013	1.00	2.1	0.42	0.95
	0.5	0.013	2.00	2.97	0.59	1.34
0.60 x 0.60	0.5	0.013	0.10	0.8	0.24	0.36
	0.5	0.013	0.50	1.78	0.53	0.8
	0.5	0.013	1.00	2.52	0.76	1.14
	0.5	0.013	2.00	3.56	1.07	1.61
0.8 x 0.80	0.7	0.013	0.10	0.98	0.55	0.37
	0.7	0.013	0.50	2.18	1.22	0.83
	0.7	0.013	1.00	3.09	1.73	1.18
	0.7	0.013	2.00	4.37	2.45	1.67

Source: JICA Design Team

The falling capacity of a typical box culvert is organized as follows.

Table 4.2.63 Flow Capacity of RCBC

Size	Depth	Roughness coefficient	Slope	Velocity	Volume	Froude number
	(m)		%	(m/s)	(m^3/s)	
1.0x 1.0	0.9	0.013	0.10	1.14	1.03	0.38
	0.9	0.013	0.50	2.55	2.3	0.86
	0.9	0.013	1.00	3.61	3.25	1.21
	0.9	0.013	2.00	5.1	4.59	1.72

Source: JICA Design Team

The falling capacity of a reinforced concrete pipe is organized as follows.

Table 4.2.64 Flow Capacity of Reinforced Concrete Pipe

Size	Depth	Roughness coefficient	Slope	Velocity	Volume	Froude number
	(m)		%	(m/s)	(m^3/s)	
910mmø	0.8	0.013	0.10	1.03	0.62	0.32
	0.8	0.013	0.50	2.29	1.39	0.72
	0.8	0.013	1.00	3.24	1.96	1.02

Source: JICA Design Team

(2) Flood Analysis Using HEC-RAS

Flood simulation and inundation analysis of the rivers in which piers are constructed on this projects will be undertaken using the Hydrologic Engineering Center – River Analysis System (HEC-RAS) developed by the USACE. The design peak floods calculated for each basin using the HEC-HMS will be the input flood to HEC-RAS.

The one-dimensional (1D) HEC-RAS version 4.1 performs steady (gradually- or rapidly-varied) flow and unsteady flow simulations on river channels and adjacent flood plains. The computation for steady flow condition is done using the standard step method. The computation for unsteady state flow condition is done using an implicit finite difference scheme procedure to solve the continuity and momentum partial differential equations.

The Manning's equation is used in the computation of conveyance in the channel and overbank areas. The main channel conveyance is usually taken as one conveyance element but the left and right overbank can have one or more subdivisions for conveyance computation. The total conveyance at a cross-section is the sum of the main channel conveyance and all conveyances of the overbank subdivisions.

The general Manning's equation is given as:

$$Q = \sum_{i=1}^{n} \left(\frac{1}{n} A R^{2/3}\right)_i S_f^{1/2}$$

Where, n = Manning's roughness coefficient, $R = A/P$ = hydraulic radius in m, A = cross-sectional area in m^2, P = wetted perimeter in m for each subdivision i and S_f is the representative friction slope.

Manning's *n* values for natural river channels, flood plains and man-made channels and ditches are given in Table 4.2.65 to Table 4.2.67 (Tables 4-2, 4-3 and 4-4, respectively, in Section 4.5.2.1 DCGS Vol. 4).

Table 4.2.65 Range of Values of Manning's 'n' for Natural Channels

Description	Minimum	Maximum
Fairly Regular Section		
1. Some grass & weeds, little or no bush	0.028	0.033
2. Dense growth of weeds, flow depth greater weed height	0.033	0.040
3. Some weeds, light bush on banks	0.035	0.050
4. Some weeds, heavy bush on banks	0.050	0.070
5. Some weeds, dense trees	0.060	0.080
For trees within channel, with branches submerged at high flood increase above values by	0.010	0.020
6. Winding, some pools & shoals, clean (1.)	0.035	0.045
7. Winding, some pools & shoals, clean, lower stages, more ineffective sections	0.045	0.055
8. Winding, some pools & shoals, clean, some weeds & stones (3.)	0.040	0.050
9. Winding, some pools & shoals, clean, lower stages, more ineffective sections, stony sections	0.050	0.060
10. Sluggish river reaches, rather weedy or with deep pools (4.)	0.060	0.080
11. Very weedy reaches (5.)	0.100	0.150
Irregular sections, with pools, slight meander; increase above values by about	0.010	0.020
Mountain streams, no vegetation in channel, bank steep, tree & brushes along banks submerged at high flood		
1. Bottom of gravel, cobbles & few boulders	0.040	0.050
2. Bottom of cobbles, with large boulders	0.050	0.070
Large Stream Channels (top width > 30m) Reduce smaller stream coefficients by 0.10		

Source: JICA Design Team

Table 4.2.66 Range of Values of Manning's 'n' for Floodplains

Description	Minimum	Maximum
1. Pasture, short grass, no brush	0.030	0.035
2. Pasture, tall grass, no brush	0.035	0.050
3. Cultivated land-no crop	0.030	0.040
4. Cultivated land, nature field crops	0.045	0.055
5. Scrub & scattered brush	0.050	0.070
6. Wooded	0.120	0.160

Source: JICA Design Team

Table 4.2.67 Range of Values of Manning's 'n' for Man-made Channels and Ditches

Description	Minimum	Maximum
1. Earth, straight & uniform	0.020	0.025
2. Earth bottom, rubble sides/riprap	0.030	0.035
3. Grass covered	0.035	0.050
4. Dredged	0.028	0.033
5. Stone lined & rock cuts, smooth & uniform	0.030	0.035
6. Stone lined & rock cuts, rough & irregular	0.040	0.045
7. Lined – smooth concrete	0.014	0.018
8. Lined – grouted riprap	0.020	0.030
9. Winding sluggish canals	0.025	0.030
10. Canals with rough stony beds, weeds on earth banks	0.030	0.040

Source: JICA Design Team

(3) Erosion Analysis Using HEC-RAS

The HEC-RAS is also used for erosion (scour) analysis of the river bed and river banks in the vicinity of bridge piers and bridge abutments. The erosion analysis will determine whether river bed and bank scour protection will be necessary.

The equations for the computation of contraction scour (live bed and clear water) and local scour (pier scour and abutment scour) for bridges, scour at bends and other scour conditions on different structures in a river channel are discussed in detail in Annex A Estimating Scour of the DCGS Vol 4.

4.2.5.8 Results and Recommendations

At this stage, an on-site investigation was conducted, and the place where the rainwater drainage outlets were determined was visually recorded. Field investigation records were collected in the attached report. Based on the catchment area and the recently obtained rainwater data, the rainwater drainage calculation was carried out, and a flow calculation table was prepared. As a future issue, artificial drainage roads and underground drainage roads can also be considered as drainage outlets.

4.2.5.9 Drainage Tables

Using the drainage outlets confirmed at the present stage, the slope is assumed to be a certain value, and the ROW area is used as the basin area, and the rainfall intensity formula is used to calculate the rainwater flow. And we also made the corresponding railway rainwater drainage drawings. After obtaining detailed measurement data, it will be updated against the topographic map. We will also further reflect the contents of the map, such as surface elevation, water level, etc., and arrange detailed drainage plans.

4.2.5.10 Assessment of Flood Risk

(1) Analysis of Flood Risks – North-South Railway Corridor

The North South Railway Project - South Line (Commuter) area is known to be flood prone area. Therefore, the vertical alignment is designed in consideration of flood height and future crossing roads rising improvement over the flood height in future as much as possible, because the area roads get hit by floods frequently.

The maximum flood height on the alignment can be applied for results of based on interview survey of local residents and flood height indicated in the Project NOAH (National Operational Assessment of Hazards) flood risk map, respectively.

The flood risk map is made to conduct the numerical simulation with momentum and continuity equations under the simulation conditions as follows;

- Initial conditions: Uses LIDAR DEM acquired in 12-15 February 2013 (1m resolution) and coefficient of roughness based on DPWH guideline volume3.
- Boundary conditions: Inputs rainfall (1/5, 1/25 and 1/100 return period, respectively)

As you can see in Figure 4.2.136, there is no simulation data between near Muntinlupa Station and Cabuyao Station. Therefore, the maximum flood height is decided only based on the interview.

Figure 4.2.136 Flood Risk Map (100-year return period)

The recommended design flood height is adopted higher data by the comparing interview data and NOAH data as shown in Table 4.2.68. The letter "-" of the interview and NOAH in Table 4.2.68 mean that any local residents does not live around the point and no simulation data, respectively.

Table 4.2.68 Estimated Flood Height

CITY / MUNICIPALITY	STATION	NAME OF ROAD	Interview	NOAH (m)	Design Flood Height (m)
	0+000	Solis Station	1.5	0.5-1.5	1.5
	0+264	Hermosa Street	0.3	0.5-1.5	1.5
	0+932	Solis Street	0.6	0.5-1.5	1.5
	1+470	Jose Abad Santos Street	0.3	0.5-1.5	1.5
	1+885	Tomas Mapua Street	1.0	0.5-1.5	1.5
	1+980	Rizal Avenue	-	0.0-0.5	0.5
	1+980	Blumentrit Station (LRT)	0.5	0.0-0.5	0.5
	2+171	Blumentrit Station	0.8	0.0-0.5	0.8
	2+380	Old Antipolo Street	1.0	0.5-1.5	1.5
	2+720	Dimasalang Road	-	0.5-1.5	1.5
	2+920	Simoun Street	0.0	0.5-1.5	1.5
	3+070	Maria Clara Street	0.5	0.5-1.5	1.5
	3+233	Loan Laan Road	0.9	0.5-1.5	1.5
	3+390	Dapitan Street	1.0	0.5-1.5	1.5
	3+550	Piy Margal Street	0.8	0.5-1.5	1.5
	3+710	P.Florentino Street	1.0	0.5-1.5	1.5
	3+769	España Station	0.6	0.5-1.5	1.5
	3+895	España Boulevard	-	0.5-1.5	1.5
	4+050	Loyola Street	1.0	0.5-1.5	1.5
	4+210	J. Fajardo Street	0.5	0.5-1.5	1.5
	4+690	Honradez Street	0.5	0.5-1.5	1.5
	4+840	G. Tuazon Street	0.5	0.5-1.5	1.5
	5+680	R.Magsaysay Boulevard	0.5	0.0-0.5	1.0
	5+680	LRT Line 2	0.5	0.0-0.5	1.0
	6+108	Santa Mesa Station	0.5	0.5-1.5	1.5
	6+160	Teresa Street	0.5	0	1.5
	6+410	Maui Oasis Underpass	0.0	0	0.0
	7+300	Beata Street	0.0	0.5-1.5	1.5
	7+700	Paco-Sta.Mesa Road	0.0	0.5-1.5	1.5
	7+950	Dr. M.L. Carreon Street	0.0	0.5-1.5	1.5
	8+060	Paco-Sta.Mesa Road	0.0	0.5-1.5	1.5
	8+150	Kahirum Ⅱ Street	1.0	0.0-0.5	1.0
	8+748	Paco Station	-	0.0-0.5	0.5
	9+060	Pedro Gil Street	0.5	0.5-1.5	1.5
	9+800	San Andres / Diamante Street	0.6	0	0.6
	10+570	Pablo Ocampo Sr. Street	-	0	1.5
	10+612	Zobel Roxas Street	0.0	0	0.5
	11+580	Malugay Street	-	0.5-1.5	1.5
	11+650	Sen. Gil Puyat Avenue	0.1	0.5-1.5	1.5

CITY / MUNICIPALITY	STATION	NAME OF ROAD			
			Interview	NOAH (m)	Design Flood Height (m)
	11+870	Dela Rosa Street	0.5	0.5-1.5	1.5
	12+032	Buendia Station	0.5	0.5-1.5	1.5
	12+480	Antonio Arnaiz Avenue	0.5	0.0-0.5	1.5
	12+955	Don Bosco Street	0.5	0.0-0.5	0.6
	13+469	Edsa Station	-	0	0.0
	13+800	MRT-3	0.6	0.5-1.5	1.5
	15+870	Nichols Interchange	0.5	0.5-1.5	1.5
	16+149	Nichols Station	-	0	0.0
	18+284	FTI Station	-	0	0.0
	20+354	Bicutan Station	0.0	0	0.0
	20+480	Gen. Santos Avenue	0.5	0	0.5
	21+102	Mañalac Avenue	0.4	0.0-0.5	0.5
	23+094	llang llang Street	0.0	0.0-0.5	0.5
	23+490	Our Lady of Miraculous Medal Street	0.0	0.5-1.5	1.5
	24+614	Sucat Station	-	0	0.0
	24+750	Meralco Road	0.5	0	0.5
	25+340	Concepcion Street	0.5	0.5-1.5	1.5
	25+550	Espeleta Street	0.2	0.0-0.5	1.3
	28+193	Montillano Street	0.0	0.5-1.5	1.5
	28+293	T. Molina Street	0.0	0.0-0.5	0.5
	28+434	Alabang Station	0.2	0	0.2
	29+200	Bautista Street	0.0	0.0-0.5	0.5
	29+300	Falleda Road	0.1	0	0.1
	29+930	Private Road	0.0	0	0.0
	30+450	NIA Road	0.0	0.0-0.5	0.5
	30+930	Bruger Street	0.0	0.5-1.5	1.5
	31+400	Quezon Street	0.0	0.0-0.5	0.5
	31+404	Muntinlupa Station	0.2	0	0.2
	31+500	Rizal Street	0.3	0.0-0.5	0.5
	31+610	Upper Prinza Street	0.0	0	0.3
	31+760	La Guerta Street	0.0	0	0.1
	32+330	Sto. Niño / St. Andrew Street	0.0	0.0-0.5	0.5
	32+920	E. Rodriguez Jr. Street	0.0	-	0.0
	33+390	RMT Industrial Complex Road	0.0	-	0.5
	33+630	unknown	0.0	-	0.1
	33+930	A. Mabini Street	0.5	-	0.5
	34+220	Quezon Street	0.5	-	0.5
	34+570	San Vicente Road	1.0	-	1.5
	34+730	G. Garcia Street	0.5	-	0.8
	34+904	San Pedro Station	0.5	-	0.5
	35+280	Main Road	0.1	-	0.3
	36+560	Pacita Avenue I	0.0	-	0.5
	36+650	Pacita Avenue II	0.5	-	0.5
	36+852	Pacita Station	-	-	0.0

CITY / MUNICIPALITY	STATION	NAME OF ROAD			
			Interview	NOAH (m)	Design Flood Height (m)
	37+890	San Francisco Barangay Road	1.0	-	1.2
	38+070	Chocolate Street / Halang Diversion	1.0	-	1.0
	38+380	Golden City Subdivision Road	0.3	-	0.3
	39+090	Gen. Malvar Street	1.2	-	1.2
	39+192	Binan Station	1.0	-	1.5
	39+300	San Vicente Road	1.0	-	1.2
	39+380	Sto. Niño Road	1.2	-	1.2
	39+760	Heaven Garden Memorial Park Road	0.8	-	0.8
	39+940	Mamplasan Access Road	1.0	-	1.0
	40+220	Mamplasan Access Road	0.8	-	0.8
	40+870	G. Sigue Road	0.0	-	0.5
	40+950	Mercado Street	0.0	-	0.0
	41+600	Tagapo Access Road	2.0	-	2.0
	41+750	Manila South Road	1.0	-	1.8
	42+580	Leon Arcillas Road	-	-	0.5
	42+750	Orient Drive Road	0.6	-	0.6
	42+915	West Drive Road	0.1	-	1.0
	43+212	Santa Rosa Station	-	-	1.1
	43+380	Rizal Boulevard Road	1.2	-	1.2
	43+650	East Drive Road	1.0	-	2.0
	43+920	Villa Mercedes Road	0.0	-	0.4
	44+185	Capt. Perlas Road	0.0	-	0.0
	44+800	Flood Gate Road	0.0	-	0.0
	45+500	Mabuhay Homes Road	0.0	-	0.0
	46+650	Bigaa Road	0.0	-	0.0
	46+765	Cabuyao Station	0.0	-	0.8
	46+850	Felix Limcaoco Street	0.0	-	0.3
	47+325	Sergio Osmena Street	0.0	0.0-0.5	0.5
	47+590	unknown	0.0	0.0-0.5	0.5
	47+830	unknown	-	0.0-0.5	0.5
	48+760	unknown	-	-	0.3
	49+480	Katapatan Road	0.0	0.0-0.5	0.5
	49+710	Gulod Station	-	0.0-0.5	0.5
	51+310	San Isidro Road (should be 51+400)	0.4	0.0-0.5	0.5
	52+390	Mamatid Station	-	0	0.0
	52+528	Mamatid Road	0.0	0.0-0.5	0.5
	53+030	unknown	0.0	0	0.0
	54+720	NIA Road	0.0	0.5-1.5	1.5
	55+045	Parian Road	0.0	1.5 above	1.5
	55+480	J.P. Rizal Street	0.4	0.5-1.5	1.5
	55+585	Calamba Station	0.0	0	0.0

4.3 E&M System

4.3.1 Outline

DOTr plans the commencement of MCRP from Malolos to CIA and starting an interoperable train operation with NSCR at May 2022. The inauguration of NSRP-South and the extension of MCRP from CIA to NCC are planned after that. DOTr plans 3 types of train service.

1) Commuter service
2) Commuter express service
3) Airport limited express service

Commuter and commuter express service are for daily commuter passenger. Commuter train stops every station and commuter express skips some stations to shorten travel time. Airport limited express service is designed for CIA airline passengers. This service is planned connecting CIA and the center of Manila within 1 hours.

In NSRP-South from Solis to the center of Manila, Airport limited express will be operated.
In addition, it is necessary to examine in detail that the study from Metro Manila Subway Project (MMSP) to NSRP-South is acceptable.

Source: JICA Design Team

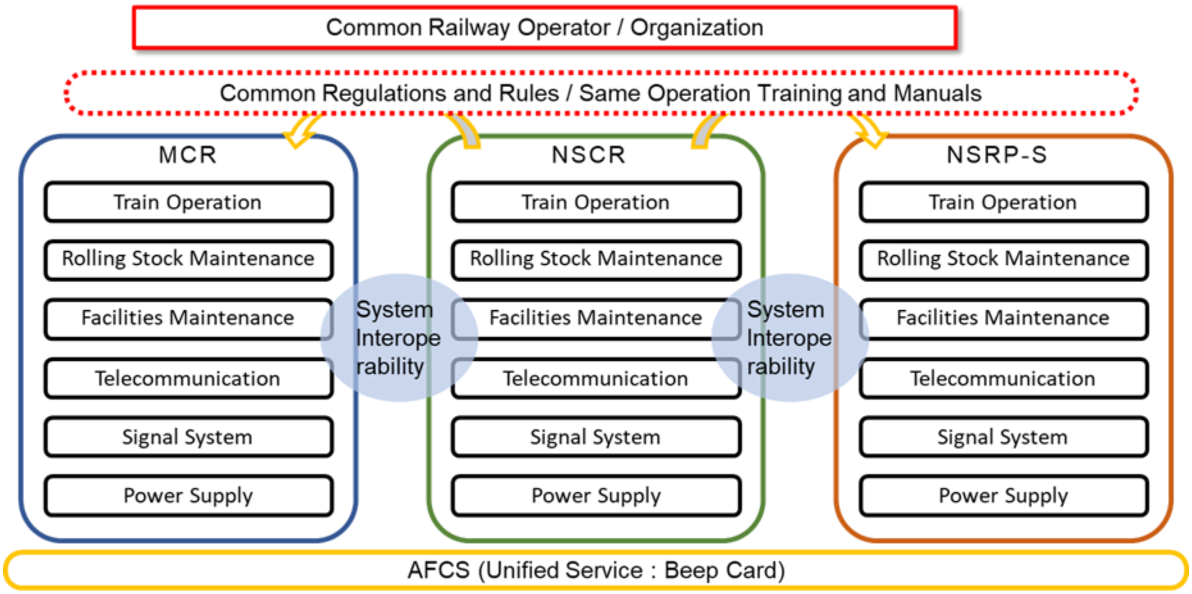
Figure 4.3.1 Line Image of MCRP, NSCR and NSRP-South

NSRP-South is planned to connect NSCR (Malolos ~ Tutuban) at Solis station. The technical specifications and the basic performances of E&M system shall be compatible with NSCR for safe, stable and economical railway operation. From this view point, this project has some special preconditions for designing railway system and rolling stock.

(1) Interoperability

The basic specifications of rolling stock and E&M system (gauge, axle weight, power supply system, signalling system, communication system, etc.) in each line shall be compatible for keeping safe and stable train operation.

DOTr is planning to establish PRI (Philippine Railway Institute) for making common railway regulation and rules in the Philippines. PRI certifies driver' license and railway engineer. DOTr plans to employ common railway operator for MCRP, NSCR and NSRP-South. Those DOTr policies help to achieve the safe and stable interoperability in NSRP-South and NSCR.



Source: JICA Design Team

Figure 4.3.2 Image of Common Railway Operator

(2) Technical Standards and Technical Specifications

The railway system and rolling stock for NSRP-South are designed in accordance with the railway technology and related regulations in Japan for safe and reliable train operation. The Technical Standards and Technical Specifications shall be defined for keeping a safe and stable train operation, and for manufacturing high quality and standardized railway system.

Table 4.3.1 Outline of Technical Standards and Technical Specifications

Contents		Related Standards
Technical Standards	• Minimum requirement for operating railway safe and stable. • Railway principals and guidance for the railway system considering the O&M and the interoperability	• Technical Regulatory Standards on Japanese Railways • Japanese Railway Industry Standards • Japanese Electro Technical Committee • International Electrotechnical Commission • International Organization for Standardization • Philippine Electrical Code etc.
Technical Specifications	• Basic parameters to design the railway system and the structures. • Proposing based on Technical Parameters • Using related Standards for determining parameters	
PDPS Work	• PDPS (particular Design Performance Specification) for Railway system with technical discussions and field studies considering Technical Standards and Technical Specifications.	

Source: JICA Design Team

(3) Technical Parameters

In consideration of the interoperability among NSRP-South and NSCR and also of their common maintenance, the technical parameters for railway system, including rolling stock, shall be applicable to all three lines. The main technical parameters such as rolling stock envelopment, power supply system and signalling system, and maintenance regulations shall be consistent among NSRP-South and NSCR.

The following table shows the proposed main technical parameters subject to modification in the course of progress in this study work.

Table 4.3.2 Technical Parameters Regarding the Interoperability with NSRP-South

	ITEM	Technical Specifications of NSCR		Reason
1	Train Operation	General	Trains drive on right hand side. One-man train driver operation. Passenger Load factor is less than 100%. Working hour of drivers is about 4hours/day.	Philippine's rule in existing urban railway
2	Rolling Stock Design	General	Acceleration(Design):3.3km/h/s (Weighting 20t/car,1350V,0~30km/h Instantaneous acceleration) or more Deceleration(Design):4.2km/h/s(Max service brake, Instantaneous deceleration) 4.7 km/h/s(Emergency brake, Instantaneous deceleration) Design operation Max speed:120km/h(Express:160km/h)	It is basically unified in Japan to provide a safe and smooth through service. In particular, it is important to unify them for the convenience and safety of customers, the operation plan, the crew handling and handling at times of abnormality.
		Gauge	1,435mm (Standard Gauge)	
		Electric Power Supply	DC1,500V overhead catenary	
		Capacity of Train	Calculated by 7person/m^2	
		Rolling Stock Gauge	Refer to Detailed design	
		Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler	
		Body Structure	MAX:1,9500mm (Length)×2,950 mm (Width)×3,655 mm (Height)	
			MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm(Height of floor)	
			Straight structure without hem aperture	
			Maximum longitudinal compression force of rolling stock end is 490kN.	
			Material used for the car body shall comply with the Japanese Ministerial Ordinance article 83	
			Adopting front strengthened structure of the car, and Securing survival space of driver in case of an accident (common structure of Japanese commuter rolling stock)	
			Driver unit : right side	
		Maximum Axle Weight	16t	
		Door Layout	4 doors as commuter trains	
		Standards	Technical Regulatory Standards on Japanese Railways, Japanese Industry Standards(JIS), Japanese Railway Industry Standards(JRIS), Japanese Electro Technical Committee and related standards would be used for the technical standards.	
3	Rolling Stock Maintenance Facility	General	Common Design method	One operator will have 3 depot; onMCRP, NSCR,and NSPR-South lines. And so, these depot should have common method for operator to use these facilities in 3 depot efficiently.
			Employing same designed maintenances facilities	Preconditions for MCRP and NSPR-South should be same as for NSCR basically except depending on Express Rolling Stock's specification because it one operator can't manage 3 depots efficiently if methods on each facility in MCRP and NSPR-South depot are different from in NSCR Depot.
			Basic way of Inspection and Repair for Rolling Stock	One Operation will operate Rolling Stock in common on MCRP, NSCR,and NSPR-South lines.
		Maintenance Category	Departure Inspection(Before departure),Daily Inspection (Within 6days),Monthly Inspection(Within 3 months :90days), Semi Overhaul(Within 4 years or Within 600,000Km), Overhaul(Within 8years or Within 1,200,000km)	And, Express Rolling Stock will be designed also based on Japanese technology and knowledge.
4	Signal system	General	CBTC	Compatible with Signal System of NCSR
5	Power Supply System	General	Substation facilities comply with JIS, JEC etc. and NSCR specifications	It shall be complied with NCSR system specifications
		Voltage for Operation	1,500V	The same trains of NSCR will be running in these areas
		Method of Receiving Electric Power	The same method of NSCR	It is easy to negotiate with Electric Power Companies.
6	Power Distribution System	General	Distribution facilities comply with JIS, JEC etc. and NSCR specifications	It shall be complied with NCSR system specifications
		Voltage of distribution Line	6.6kV	
		Voltage of Supplying Loads	440V / 230V	
7	Over Head Contact System	General	The OCS complies with JIS, JEC etc.	It shall be complied with NCSR system specifications
		Maximum Train Speed	120km/h	
		Weather Conditions	Philippine's weather data	Precondition of supports and poles strength calculation
		Track gauge	Standard gauge (1,435mm)	It is as same as it of the rolling stocks
8	Communication System	Common Backbone System	System: SDH or equivalent IP	It shall be complied with NCSR system specifications. The specifications regarding this matters are proposed based on LRT-2 communication system.
			Speed: 1Gbpt to 10Gbps	
			Redundancy: Duplicated Devices with STP	
			Segment: Data & LAN, CCTV, PIS, PA, BMS, AFC	
			Utilities: NMS, QoS	
		Signal Backbone System	Necessary specification will be prepared based on an applicable signal system for MCRP and NSPR-South.	Compatible with NCSR
		Radio System	Necessary specification will be prepared based on an applicable signal system for MCRP and NSPR-South.	Compatible with NCSR
		Dispatcher Communication System	Necessary specification will be prepared based on an applicable signal system for MCRP and NSPR-South.	Compatible with NCSR
		Voice and Data System	MDF: RJ45 24Port with Patch-Code(Cat5e)	It shall be complied with NCSR system specifications
			Redundancy: L/A Up-link and SW Stacking	
			Authentication: WEB and MAC	
		IP Telephone	PBX: PCM time division, storage program control	
			Protocol: VoIP and QoS	
			Traffic: 6HCS	
		CCTV System	Camera: PTZ and/or Fixed Type,Format:MPEG-4,Commpression:H.264	
		Time Server and Master Clock	Reference Time:UTC from GPS,Protcol:NTP	
		Others	Backplane: more than 24Gbps,Throughput: at least 1Gbps	
			Cable:OFC(SM with 0-disperison wavelength),Throughput: at least 1Gbps	
			EMC:appleied, RAMS: applied	
9	AFCS	General	The Beep cards system shall be employed	
10	Others	Platform Screen	No applicable	NSCR train without Platform Screen control system will be operated in MCRP and NSPR-South.
		Construction gauge	The same gauge of NSCR	It shall be complied with NCSR system specifications

Source: JICA Design Team

(4) Partially PNR operation plan while the construction of NSRP-South

NSRP-South is constructed mostly in the existing ROW of PNR. The train operation of PNR has long been suspended to the north of Solis, but southbound from Tutuban is still continued. PNR train runs between Tutuban and Alabang every 30 min on double tracks. While constructing NSRP-South, the present PNR operation should be maintained partially on single track to give enough work space for the construction activities. Based on the request from DOTr, JDT will have technical discussions with PNR and propose a basic single track PNR operation plan during construction of NSRP-South.

(5) Through operation between NSRP-South and Metro Manila Subway Project (MMSP)

MMSP tries to take though operation between Metro Manila Subway Project and NSRP- South in consideration, since April 2018. MMSP and NSRP-South have discussed about the main topics related to through operation, as follows:

- How to connect the both lines at Bicutan station
- The number of trains which go through the both lines

DOTr and JICA have decided to consider the issues regarding to the through operation between Metro Manila Subway Project and NSRP-South in detail, at the joint coordination meeting on August 3rd, 2018. JDT have to start verifying the through operation, and discussing and negotiating it with MMSP. Moreover, it should be proposed the best way about the through operation by cooperating with the both projects.

(6) Possibility of Partial Operation

Construction of some sections of NSRP-South may not be completed by May 2022. However, DOTr has requested to consider the partial operation in May, 2022. JDT proposed to construct the area from Solis to Blumentritt to ensure the partial operation for this section, and DOTr has permitted this proposal.

JDT will conduct further study related to the partial operation in detail and take the acceleration plan in consideration.

4.3.2 Train operation plan

(1) Pre-conditions for train operation plan

1) Railway construction plan

Though JDT refers to the previous studies on MCRP line by JOIN, and on NSRP-South line by ADB, the railway construction plan is assumed as follows in response to the request of GOP:

- All sections of MCRP line (about 70km, 7 stations) are to be opened in 2022 and connected to NSCR at Malolos station:
- All sections of NSRP-South line (about 72km, 21 stations) are to be opened in 2023 and connected to NSCR at Solis station:

2) Through-operation plan

Through-operation is implemented among NSCR, MCRP and NSRP-South lines so that the passengers can move on each line without transferring trains.

3) Alignment planning

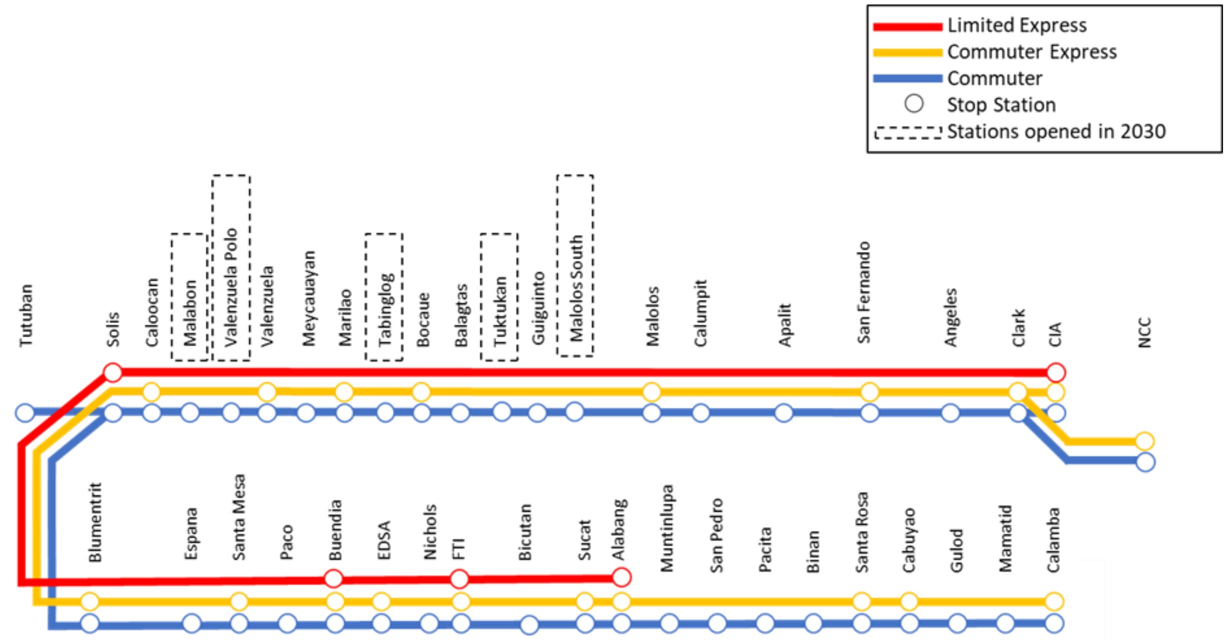
a) Alignment planning of NSRP-South line

The train operation plan of NSRP-South line has been studied referring to ADB. And NSRP-South line is based on discussions in a series of meetings with DOTr for the following items.

- Not sharing the tracks with future freight or long-haul line

(2) Types of the Train Service

In the 3rd Coordination Meeting, it was agreed with DOTr that Commuter express in addition to Limited express and Commuter were considered. Limited express trains basically will be operated in the section between Alabang and CIA. Commuter express trains and commuter trains will be operated as the through-operation in all sections. Limited express trains will be operated between CIA and Makati city in response to the request of DOTr. At the 4th Coordination Meeting Alabang station has turnouts for turn back, so it is being considered that Limited express trains will be operated between Alabang and CIA. Figure 4.3.3 is a route map and stops for each type of trains.



Source: JICA Design Team

Figure 4.3.3 Route map and stops for each type of trains

(3) System capacity

1) Train capacity

In this study, JDT considers configuration of all trains as 8 cars. The capacity of each train is shown in Table 4.3.3 and Table 4.3.4.

Table 4.3.3 Train capacity (Express)

Train composition	No. of passengers		
	Seated	Standing	Total
8 cars	400	0	400

Source: JICA Design Team

Table 4.3.4 Train capacity (Commuter express, Commuter)

Train composition	No. of passengers		
	Seated	Standing	Total
8 cars	414	1,828	2,242

The number of standing passengers is calculated based on 7 passengers/m^2

Source: JICA Design Team

2) Number of operated trains in peak hour

In the 4th Coordination Meeting, it was decided that the future requirements of design would be 2 Limited express trains/hour, 4 commuter express trains/hour, and 6 commuter trains/hour in NSCR.

And considering the capacity of NSCR, train operation plan until the facility enhancement is completed was agreed with DOTr that 1 Limited express train/hour, 4 commuter express trains/hour, and 5 commuter trains/hour.

(4) Traveling time

The traveling time is calculated by train performance curve based on the data of rolling stocks and alignment. Regarding the alignment data, the data of MCRP line was July 2018 and the data of NSCR line was NSCR report and the data of NSRP-South line was February 2018. In addition, the waiting time for other train which is limited express and commuter express is added. Figure 4.3.4 shows the regular running time of limited express train, Figure 4.3.5 and Figure 4.3.6 show the regular running time of commuter express train and commuter train.

Traveling Time (NCC→Calamba)				Station	Traveling Time (Calamba→NCC)			
Limited Express train					Limited Express train			
Running time	Dwell time	Traveling Time	Pattern of stops		Pattern of stops	Running time	Dwell time	Traveling Time
			●	CIA	●			1:15:30
05:30						05:45		
	00:00	0:05:30		Clark			00:00	1:09:45
02:30						02:30		
	00:00	0:08:00		Angeles			00:00	1:07:15
06:15						06:00		
	00:00	0:14:15		San Fernando			00:00	1:01:15
04:45						04:45		
	00:00	0:19:00		Apalit			00:00	0:56:30
02:45						02:45		
	00:00	0:21:45		Calumpit			00:00	0:53:45
03:15						03:00		
	00:00	0:25:00		MALOLOS			00:00	0:50:45
02:00						02:00		
	00:00	0:27:00		MALOLOSSOUTH			00:00	0:48:45
01:30						01:30		
	00:00	0:28:30		GUIGUINTO			00:00	0:47:15
01:30						01:30		
	00:00	0:30:00		TUKTUKAN			00:00	0:45:45
01:30						01:30		
	00:00	0:31:30		BALAGTAS			00:00	0:44:15
02:15						02:15		
	00:00	0:33:45		BOCAUE			00:00	0:42:00
01:45						01:45		
	00:00	0:35:30		TABINGLOG			00:00	0:40:15
01:30						01:30		
	00:00	0:37:00		MARILAO			00:00	0:38:45
01:00						01:00		
	00:00	0:38:00		MEYCAUYAN			00:00	0:37:45
01:45						01:45		
	00:00	0:39:45		VALENZUELA			00:00	0:36:00
01:45						01:45		
	00:00	0:41:30		VALENZUELAPOLO			00:00	0:34:15
02:00						02:00		
	00:00	0:43:30		MALABON			00:00	0:32:15
01:00						01:00		
	00:00	0:44:30		CALOOCAN			00:00	0:31:15
01:45						01:45		
	01:30	0:46:15	●	SOLIS	●		01:30	0:28:00
03:00						03:15		
	00:00	0:50:45		Blumenrit			00:00	0:24:45
01:30						01:30		
	00:00	0:52:15		Espana			00:00	0:23:15
01:30						01:30		
	00:00	0:53:45		Santa Mesa			00:00	0:21:45
02:30						02:45		
	00:00	0:56:15		Paco			00:00	0:19:00
02:45						02:15		
	01:30	0:59:00	●	Buendia	●		01:30	0:15:15
02:30						03:00		
	00:00	1:03:00		EDSA			00:00	0:12:15
02:15						02:00		
	00:00	1:05:15		Nichols			00:00	0:10:15
02:00						01:30		
	01:30	1:07:15	●	FTI	●		01:30	0:07:15
01:30						02:00		
	00:00	1:10:15		Bicutan			00:00	0:05:15
02:30						02:30		
	00:00	1:12:45		Sucat			00:00	0:02:45
03:00						02:45		
		1:15:45	●	Alabang	●			
1:11:15	0:04:30	1:15:45		Total		1:11:00	0:04:30	1:15:30

Source: JICA Design Team

Figure 4.3.4 Estimated Traveling Time between Stations of Limited Express

Traveling Time (NCC→Calamba)								Station	Traveling Time (Calamba→NCC)							
Commuter Express				Local train					Commuter Express				Local train			
Running time	Dwell time	Traveling Time	Pattern of stops	Running time	Dwell time	Traveling Time	Pattern of stops		Pattern of stops	Running time	Dwell time	Traveling Time	Pattern of stops	Running time	Dwell time	Traveling Time
			●				●	CIA	●			1:50:45	●			2:21:30
06:15				06:15						06:15				06:15		
	00:30	0:06:15	●		00:30	0:06:15	●	Clark	●		00:30	1:44:00	●		00:30	2:14:45
03:00				03:30						03:00				03:45		
	00:00	0:09:45			00:30	0:10:15	●	Angeles			00:00	1:41:00	●		00:30	2:10:30
08:45				09:00						08:45				09:15		
	00:30	0:18:30	●		00:30	0:19:45	●	San Fernando	●		00:30	1:31:45	●		00:30	2:00:45
07:00				07:30						07:00				07:30		
	00:00	0:26:00			00:30	0:27:45	●	Apalit			00:00	1:24:45	●		00:30	1:52:45
03:00				04:00						03:00				04:00		
	00:00	0:29:00			00:30	0:32:15	●	Calumpit			00:00	1:21:45	●		00:30	1:48:15
04:15				04:45						04:15				04:45		
	00:30	0:33:15	●		00:30	0:37:30	●	MALOLOS	●		00:30	1:17:00	●		00:30	1:43:00
02:30				02:55						02:15				02:55		
	00:00	0:36:15			00:30	0:40:55	●	MALOLOS SOUTH			00:00	1:14:45	●		00:30	1:39:35
01:30				02:40						01:45				02:40		
	00:00	0:37:45			00:30	0:44:05	●	GUIGUINTO			00:00	1:13:00	●		00:30	1:36:25
01:30				02:20						01:30				02:20		
	00:00	0:39:15			00:30	0:46:55	●	TUKTUKAN			00:00	1:11:30	●		00:30	1:33:35
01:30				02:20						01:30				02:20		
	00:00	0:40:45			00:30	0:49:45	●	BALAGTAS			00:00	1:10:00	●		00:30	1:30:45
02:45				03:30						02:45				03:30		
	00:30	0:43:30	●		00:30	0:53:45	●	BOCAUE	●		00:30	1:06:45	●		00:30	1:26:45
02:15				02:45						02:00				02:45		
	00:00	0:46:15			00:30	0:57:00	●	TABINGLOG			00:00	1:04:45	●		00:30	1:23:30
02:00				02:35						02:00				02:35		
	00:30	0:48:15	●		00:30	1:00:05	●	MARILAO	●		00:30	1:02:15	●		00:30	1:20:25
01:30				02:00						01:30				02:00		
	00:00	0:50:15			00:30	1:02:35	●	MEYCAUYAN			00:00	1:00:45	●		00:30	1:17:55
02:15				02:45						02:15				02:45		
	00:30	0:52:30	●		00:30	1:05:50	●	VALENZUELA	●		00:30	0:58:00	●		00:30	1:14:40
02:00				02:30						02:00				02:30		
	00:00	0:55:00			00:30	1:08:50	●	VALENZUELA POLO			00:00	0:56:00	●		00:30	1:11:40
02:00				02:55						02:00				02:55		
	00:00	0:57:00			00:30	1:12:15	●	MALABON			00:00	0:54:00	●		00:30	1:08:15
01:15				01:50						01:15				01:50		
	00:30	0:58:15	●		00:30	1:14:35	●	CALOOCAN	●		00:30	0:52:15	●		00:30	1:05:55
02:00				02:25						02:15				02:25		
	00:00	1:00:45			00:30	1:17:30	●	SOLIS			00:00	0:50:00	●		00:30	1:03:00
03:30				03:30						03:15				03:30		
	00:30	1:04:15	●		00:30	1:21:30	●	Blumenrit	●		00:30	0:46:15	●		00:30	0:59:00
01:45				02:00						01:45				02:00		
	00:00	1:06:30			00:30	1:24:00	●	Espana			00:00	0:44:30	●		00:30	0:56:30
01:45				02:15						01:45				02:00		
	00:30	1:08:15	●		00:30	1:26:45	●	Santa Mesa	●		00:30	0:42:15	●		00:30	0:54:00
02:45				03:15						03:00				03:15		
	00:00	1:11:30			00:30	1:30:30	●	Paco			00:00	0:39:15	●		00:30	0:50:15
02:45				02:45						02:30				02:45		
	00:30	1:14:15	●		00:30	1:33:45	●	Buendia	●		00:30	0:36:15	●		00:30	0:47:00
02:45				02:45						02:45				02:45		
	00:30	1:17:30	●		00:30	1:37:00	●	EDSA	●		00:30	0:33:00	●		00:30	0:43:45
02:30				02:45						02:15				02:45		
	00:00	1:20:30			00:30	1:40:15	●	Nichols			00:00	0:30:45	●		00:30	0:40:30
01:45				02:00						01:45				02:15		
	00:30	1:22:15	●		00:30	1:42:45	●	FTI	●		00:30	0:28:30	●		00:30	0:37:45
01:45				02:00						01:45				02:00		
	00:00	1:24:30			00:30	1:45:15	●	Bicutan			00:00	0:26:45	●		00:30	0:35:15
03:00				03:30						03:00				03:30		
	00:30	1:27:30	●		00:30	1:49:15	●	Sucat	●		00:30	0:23:15	●		00:30	0:31:15
03:00				03:00						03:00				03:00		
	00:30	1:31:00	●		00:30	1:52:45	●	Alabang	●		00:30	0:19:45	●		00:30	0:27:45
02:15				02:30						02:15				02:30		
	00:00	1:33:45			00:30	1:55:45	●	Muntinlupa			00:00	0:17:30	●		00:30	0:24:45
02:15				03:00						02:00				03:00		
	00:00	1:36:00			00:30	1:59:15	●	San Pedro			00:00	0:15:30	●		00:30	0:21:15
01:15				02:00						01:15				02:00		
	00:00	1:37:15			00:30	2:01:45	●	Pacita			00:00	0:14:15	●		00:30	0:18:45
01:30				02:15						01:15				02:15		
	00:00	1:38:45			00:30	2:04:30	●	Binan			00:00	0:13:00	●		00:30	0:16:00
02:45				03:00						02:45				03:00		
	00:30	1:41:30	●		00:30	2:08:00	●	Santa Rosa	●		00:30	0:09:45	●		00:30	0:12:30
03:00				03:00						03:00				03:00		
	00:30	1:45:00	●		00:30	2:11:30	●	Cabuyao	●		00:30	0:06:15	●		00:30	0:09:00
02:15				02:30						02:15				02:30		
	00:00	1:47:45			00:30	2:14:30	●	Gulod			00:00	0:04:00	●		00:30	0:06:00
01:30				02:30						01:30				02:30		
	00:00	1:49:15			00:30	2:17:30	●	Mamatid			00:00	0:02:30	●		00:30	0:03:00
02:30				03:00						02:30				03:00		
		1:51:45	●			2:21:00	●	Calamba	●				●			
1:43:45	0:08:00	1:51:45		2:02:00	0:19:00	2:21:00		Total		1:42:45	0:08:00	1:50:45		2:02:30	0:19:00	2:21:30

Source: JICA Design Team

Figure 4.3.5 Estimated Traveling Time between Stations of Commuter Express and Commuter (Betweem Calamba and CIA)

Traveling Time (NCC→Calamba)								Station	Traveling Time (Calamba→NCC)							
Commuter Express				Local train					Commuter Express				Local train			
Running time	Dwell time	Traveling Time	Pattern of stops	Running time	Dwell time	Traveling Time	Pattern of stops		Pattern of stops	Running time	Dwell time	Traveling Time	Pattern of stops	Running time	Dwell time	Traveling Time
			●				●	NCC	●			1:57:15	●			2:28:00
13:00				13:00						12:45				12:45		
	00:30	0:13:00	●		00:30	0:13:00	●	Clark	●		00:30	1:44:00	●		00:30	2:14:45
03:00				03:30						03:00				03:45		
	00:00	0:16:30			00:30	0:17:00	●	Angeles			00:00	1:41:00	●		00:30	2:10:30
08:45				09:00						08:45				09:15		
	00:30	0:25:15	●		00:30	0:26:30	●	San Fernando	●		00:30	1:31:45	●		00:30	2:00:45
07:00				07:30						07:00				07:30		
	00:00	0:32:45			00:30	0:34:30	●	Apalit			00:00	1:24:45	●		00:30	1:52:45
03:00				04:00						03:00				04:00		
	00:00	0:35:45			00:30	0:39:00	●	Calumpit			00:00	1:21:45	●		00:30	1:48:15
04:15				04:45						04:15				04:45		
	00:30	0:40:00	●		00:30	0:44:15	●	MALOLOS	●		00:30	1:17:00	●		00:30	1:43:00
02:30				02:55						02:15				02:55		
	00:00	0:43:00			00:30	0:47:40	●	MALOLOS SOUTH			00:00	1:14:45	●		00:30	1:39:35
01:30				02:40						01:45				02:40		
	00:00	0:44:30			00:30	0:50:50	●	GUIGUINTO			00:00	1:13:00	●		00:30	1:36:25
01:30				02:20						01:30				02:20		
	00:00	0:46:00			00:30	0:53:40	●	TUKTUKAN			00:00	1:11:30	●		00:30	1:33:35
01:30				02:20						01:30				02:20		
	00:00	0:47:30			00:30	0:56:30	●	BALAGTAS			00:00	1:10:00	●		00:30	1:30:45
02:45				03:30						02:45				03:30		
	00:30	0:50:15	●		00:30	1:00:30	●	BOCAUE	●		00:30	1:06:45	●		00:30	1:26:45
02:15				02:45						02:00				02:45		
	00:00	0:53:00			00:30	1:03:45	●	TABINGLOG			00:00	1:04:45	●		00:30	1:23:30
02:00				02:35						02:00				02:35		
	00:30	0:55:00	●		00:30	1:06:50	●	MARILAO	●		00:30	1:02:15	●		00:30	1:20:25
01:30				02:00						01:30				02:00		
	00:00	0:57:00			00:30	1:09:20	●	MEYCAUYAN			00:00	1:00:45	●		00:30	1:17:55
02:15				02:45						02:15				02:45		
	00:30	0:59:15	●		00:30	1:12:35	●	VALENZUELA	●		00:30	0:58:00	●		00:30	1:14:40
02:00				02:30						02:00				02:30		
	00:00	1:01:45			00:30	1:15:35	●	VALENZUELA POLO			00:00	0:56:00	●		00:30	1:11:40
02:00				02:55						02:00				02:55		
	00:00	1:03:45			00:30	1:19:00	●	MALABON			00:00	0:54:00	●		00:30	1:08:15
01:15				01:50						01:15				01:50		
	00:30	1:05:00	●		00:30	1:21:20	●	CALOOCAN	●		00:30	0:52:15	●		00:30	1:05:55
02:00				02:25						02:15				02:25		
	00:00	1:07:30			00:30	1:24:15	●	SOLIS			00:00	0:50:00	●		00:30	1:03:00
03:30				03:30						03:15				03:30		
	00:30	1:11:00	●		00:30	1:28:15	●	Blumenrit	●		00:30	0:46:15	●		00:30	0:59:00
01:45				02:00						01:45				02:00		
	00:00	1:13:15			00:30	1:30:45	●	Espana			00:00	0:44:30	●		00:30	0:56:30
01:45				02:15						01:45				02:00		
	00:30	1:15:00	●		00:30	1:33:30	●	Santa Mesa	●		00:30	0:42:15	●		00:30	0:54:00
02:45				03:15						03:00				03:15		
	00:00	1:18:15			00:30	1:37:15	●	Paco			00:00	0:39:15	●		00:30	0:50:15
02:45				02:45						02:30				02:45		
	00:30	1:21:00	●		00:30	1:40:30	●	Buendia	●		00:30	0:36:15	●		00:30	0:47:00
02:45				02:45						02:45				02:45		
	00:30	1:24:15	●		00:30	1:43:45	●	EDSA	●		00:30	0:33:00	●		00:30	0:43:45
02:30				02:45						02:15				02:45		
	00:00	1:27:15			00:30	1:47:00	●	Nichols			00:00	0:30:45	●		00:30	0:40:30
01:45				02:00						01:45				02:15		
	00:30	1:29:00	●		00:30	1:49:30	●	FTI	●		00:30	0:28:30	●		00:30	0:37:45
01:45				02:00						01:45				02:00		
	00:00	1:31:15			00:30	1:52:00	●	Bicutan			00:00	0:26:45	●		00:30	0:35:15
03:00				03:30						03:00				03:30		
	00:30	1:34:15	●		00:30	1:56:00	●	Sucat	●		00:30	0:23:15	●		00:30	0:31:15
03:00				03:00						03:00				03:00		
	00:30	1:37:45	●		00:30	1:59:30	●	Alabang	●		00:30	0:19:45	●		00:30	0:27:45
02:15				02:30						02:15				02:30		
	00:00	1:40:30			00:30	2:02:30	●	Muntinlupa			00:00	0:17:30	●		00:30	0:24:45
02:15				03:00						02:00				03:00		
	00:00	1:42:45			00:30	2:06:00	●	San Pedro			00:00	0:15:30	●		00:30	0:21:15
01:15				02:00						01:15				02:00		
	00:00	1:44:00			00:30	2:08:30	●	Pacita			00:00	0:14:15	●		00:30	0:18:45
01:30				02:15						01:15				02:15		
	00:00	1:45:30			00:30	2:11:15	●	Binan			00:00	0:13:00	●		00:30	0:16:00
02:45				03:00						02:45				03:00		
	00:30	1:48:15	●		00:30	2:14:45	●	Santa Rosa	●		00:30	0:09:45	●		00:30	0:12:30
03:00				03:00						03:00				03:00		
	00:30	1:51:45	●		00:30	2:18:15	●	Cabuyao	●		00:30	0:06:15	●		00:30	0:09:00
02:15				02:30						02:15				02:30		
	00:00	1:54:30			00:30	2:21:15	●	Gulod			00:00	0:04:00	●		00:30	0:06:00
01:30				02:30						01:30				02:30		
	00:00	1:56:00			00:30	2:24:15	●	Mamatid			00:00	0:02:30	●		00:30	0:03:00
02:30				03:00						02:30				03:00		
		1:58:30	●			2:27:45	●	Calamba	●				●			
1:50:30	0:08:00	1:58:30		2:08:45	0:19:00	2:27:45		Total		1:49:15	0:08:00	1:57:15		2:09:00	0:19:00	2:28:00

Source: JICA Design Team

Figure 4.3.6 Estimated Traveling Time between Stations of Commuter Express and Commuter (Between Calamba and NCC)

(5) Train operation schedule

In the 4th Coordination Meeting, it was decided that the future requirements of design would be 2 Limited express trains/hour, 4 commuter express trains/hour, and 6 commuter trains/hour in NSCR.
And considering the capacity of NSCR, train operation plan when the line is to be opened was agreed with DOTr that 1 Limited express train/hour, 4 commuter express trains/hour, and 5 commuter trains/hour.

1) Draft train operation plan of Malolos-CIA opened in 2022 (peak hour)

Draft train operation plan of Malolos-CIA opened in 2022 (peak hour) is 1 Limited express train/hour, 4 commuter express trains/hour, and 5 commuter trains/hour. As a reason, in the report of NSCR, it was planning that 10 commuter trains/hour and considering the capacity of NSCR.

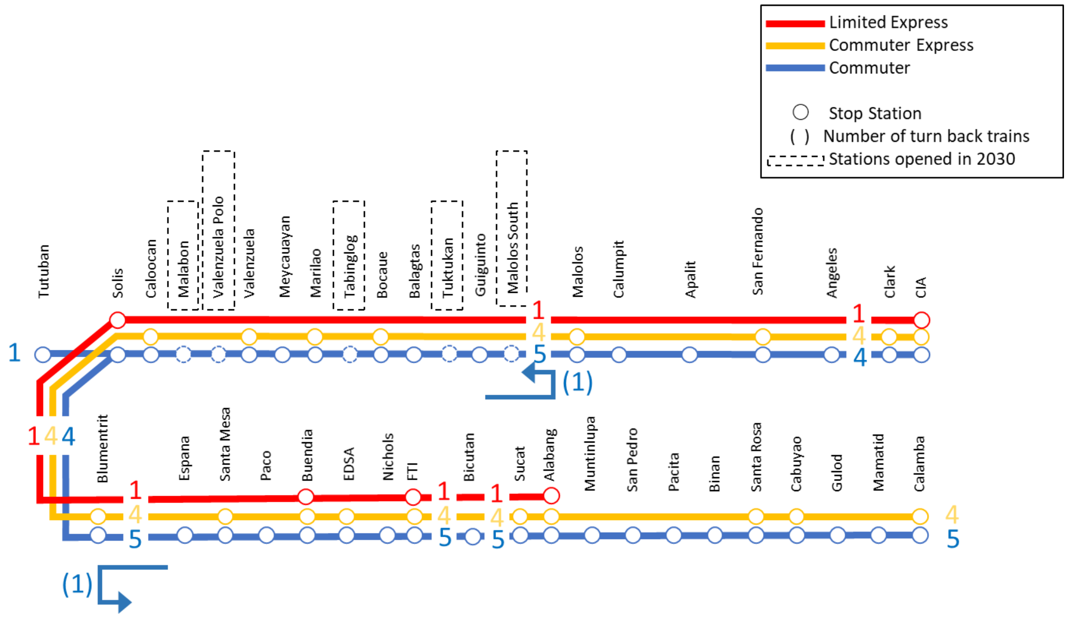
Regarding commuter, JDT considered the turn back in Malolos which has turnout. Figure 4.3.7 is shown the operation plan.

Source: JICA Design Team

Figure 4.3.7 Draft train operation plan of Malolos-CIA opened in 2022 (peak hour)

2) Draft train operation plan of NSRP-South opened in 2023 (peak hour)

Draft Train operation plan of NSRP-South opened in 2023 (peak hour) is considering the transport capacity of NSRP-South and the demand of Tutuban. Figure 4.3.8 is shown the operation plan.

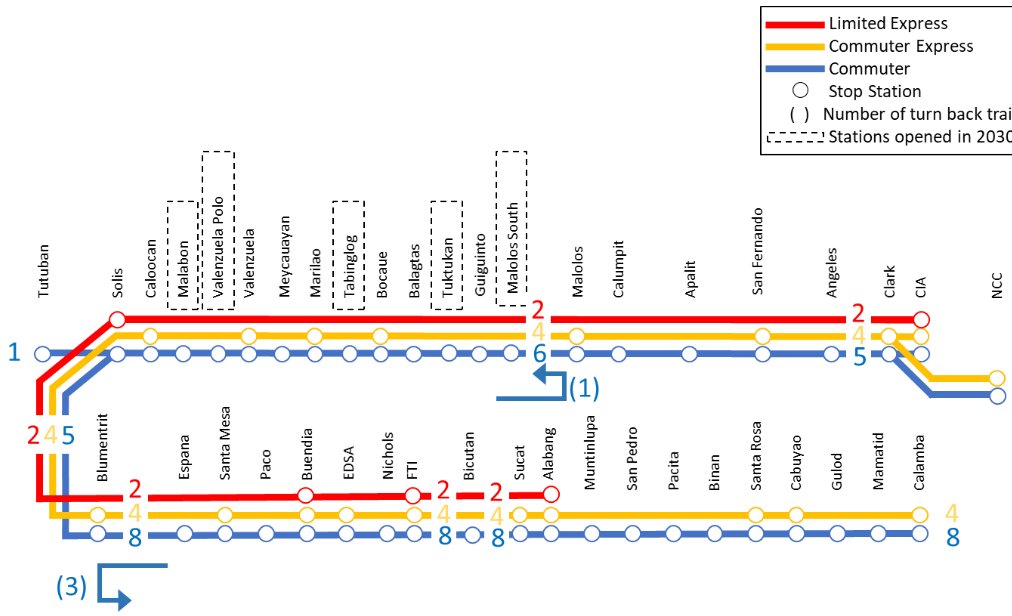


Source: JICA Design Team

Figure 4.3.8 Draft train operation plan of NSRP-South opened in 2023 (peak hour)

3) Draft train operation plan in 2040 (peak hour)

Draft train operation plan in 2040 (peak hour) is 2 Limited Express trains/hour, 4 Commuter Express trains/hour, and 6 Commuter trains/hour in NSCR. And it is considering the transport capacity of NSRP-South and demand of Tutuban. Figure 4.3.9 shows the operation plan.



Source: JICA Design Team

Figure 4.3.9 Draft train operation plan in 2040 (peak hour)

(6) Result of train operation plan

Based on the train operation plan, JDT calculated the number of stabling train sets at each depot, total train kilometer per day. The number of stay train sets at each depot, total train kilometer per day of Malolos-CIA opened in 2022 are shown Table 4.3.5 and Table 4.3.6.

Table 4.3.5 Total train kilometer of each train in 2022

Type/Location	Total train km (km/day)
Limited Express	3,799
Commuter (Include Commuter Express)	23,782

Source: JICA Design Team

Table 4.3.6 Number of stabling train sets at each depot in 2022 (Exclude spare train sets)

Type/Location	North Depot	Valenzuela Depot	Alabang St.	Total
Limited Express	2	1	1	4
Commuter (Include Commuter Express)	16	10	0	26

Source: JICA Design Team

The number of stabling train sets at each depot, total train kilometer per day of NSRP-South opened in 2023 are shown Table 4.3.7 and Table 4.3.8.

Table 4.3.7 Total train kilometer of each train in 2023

Type/Location	Total train km (km/day)
Limited Express	5,048
Commuter (Include Commuter Express)	32,406

Source: JICA Design Team

Table 4.3.8 Number of stabling train sets at each depot in 2023 (Exclude spare train sets)

Type/Location	North Depot	Valenzuela Depot	South Depot	Alabang St.	Total
Limited Express	2	0	0	2	4
Commuter (Include Commuter Express)	19	6	18	0	43

Source: JICA Design Team

The number of stabling train sets at each depot, total train kilometer per day in 2040 are shown in Table 4.3.9 and Table 4.3.10.

Table 4.3.9 Total train kilometer of each train in 2040

Type/Location	Total train km (km/day)
Limited Express	9,048
Commuter (Include Commuter Express)	36,503

Source: JICA Design Team

Table 4.3.10 Number of stabling train sets at each depot in 2040 (Exclude spare train sets)

Type/Location	North Depot	Valenzuela Depot	South Depot	Alabang St.	Total
Limited Express	4	2	0	2	8
Commuter (Include Commuter Express)	21	6	25	0	52

Source: JICA Design Team

(7) Train drivers plan

Based on the train operation plan, JDT calculated the number of the required train drivers. JDT tentatively calculated the numbers from the existing organization, considering driver in the Philippines work for 4 hours a day. The number of train drivers is shown Table 4.3.11, Table 4.3.12, and Table 4.3.13.

Table 4.3.11 Number of required train drivers in 2022 (Include NSCR)

Attendance per day	Number of drivers
105	185

Source: JICA Design Team

Table 4.3.12 Number of required train drivers in 2023 (Include NSCR)

Attendance per day	Number of drivers
160	278

Source: JICA Design Team

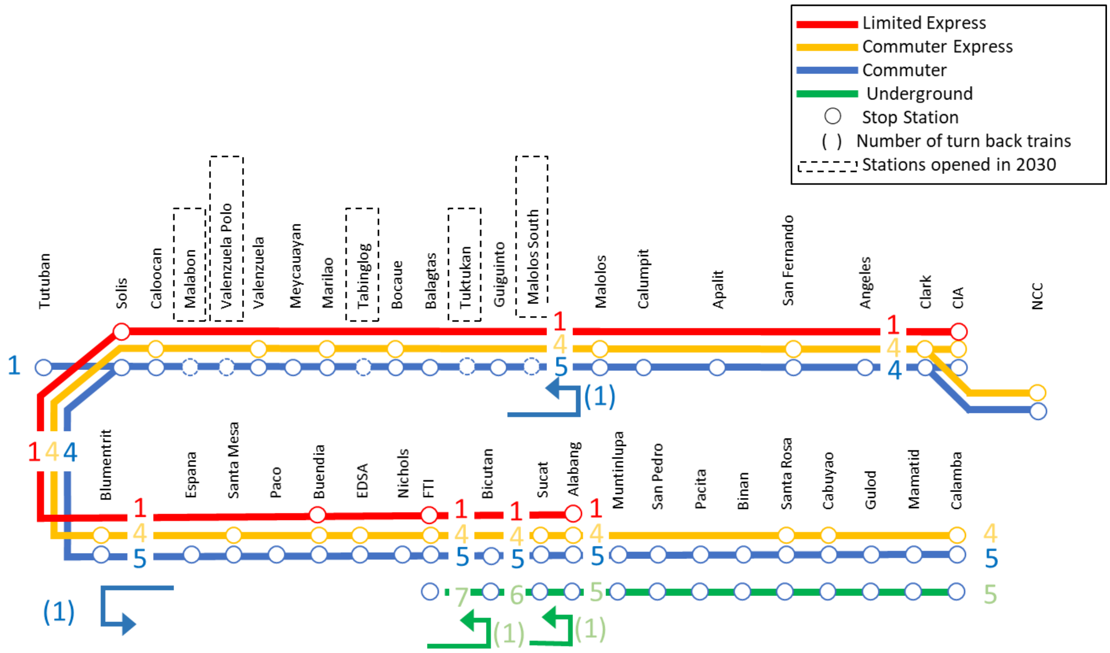
Table 4.3.13 Number of required train drivers in 2040 (Include NSCR)

Attendance per day	Number of drivers
187	328

Source: JICA Design Team

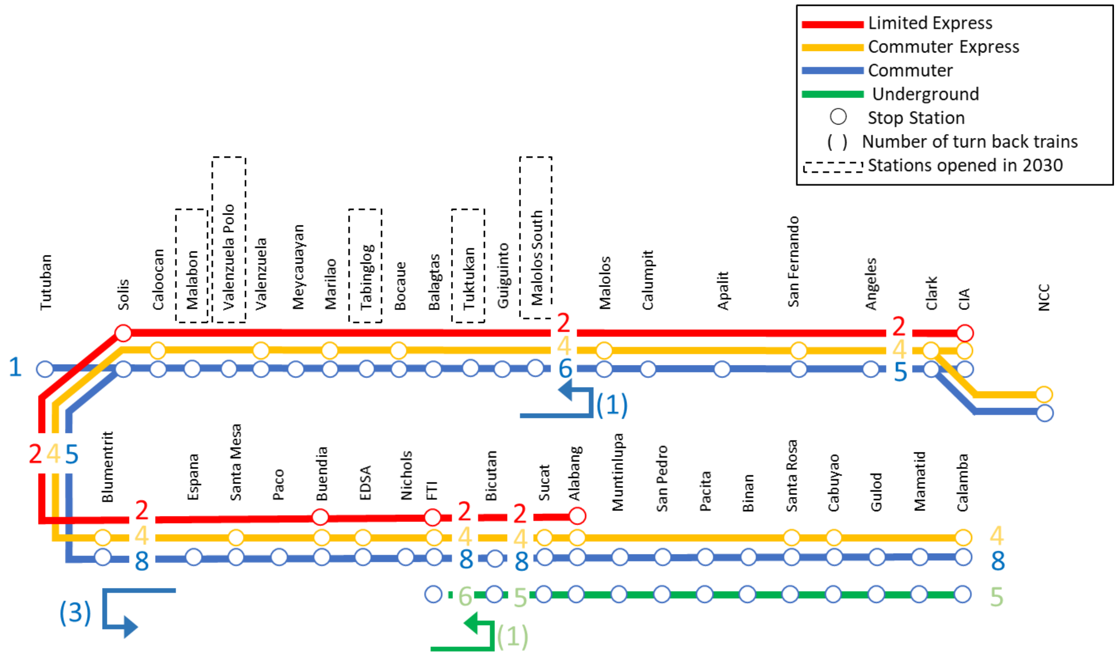
(8) Study for through operation between NSRP-South and MMSP

Through operation between NSRP-South and MMSP is planned in 2025. Draft through operation plan in 2025 (peak hour) is shown Figure 4.3.10. Draft through operation plan in 2040 (peak hour) is shown in Figure 4.3.11. It is necessary to conduct detailed studies.



Source: JICA Design Team

Figure 4.3.10 Draft operation plan of through operation between NSRP-South and MMSP in 2025.



Source: JICA Design Team

Figure 4.3.11 Draft operation plan of through operation between NSRP-South and MMSP in 2040

4.3.3 Rolling Stock Design Plan

(1) Outline

NSRP-South is planned to enable an interoperable train operation with NSCR by the same railway operator. Based on these prerequisites and operation plan accommodating the passenger demand forecast, JDT will propose the specifications of rolling stocks for commuter train service in this work.

The proposed train configurations are shown in Table 4.3.14. The number of cars in one train- set is 8 cars, but it has the possibility that the number of cars in one train-set will be 10 cars in the future. The number of train sets is yet to be evaluated and proposed since the train operation plan has not been finalized

Table 4.3.14 Required Train Type for NSRP Project

	Required Numbers
Train Configuration	8 cars
Number of required Train-set	To be decided based on Operation Plan

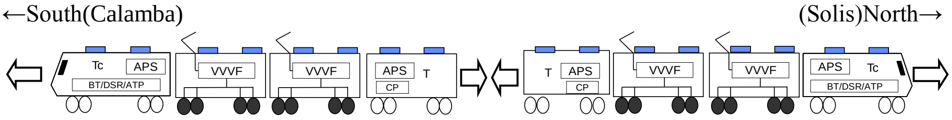
Source: JICA Design Team

(2) Preconditions for Rolling Stock Design Plan

The standards and specifications applying to the rolling stock shall be adapted from those of rolling stock described in reports of NSCR Detailed Design Study (DD) because of the interoperation with NSCR. On the other hand, the specifications and performance of the rolling stock shall pay attention to the latest technology trends, manufacturer's production record, and so on.

Table 4.3.15 shows the draft specifications and performance of Rolling Stock of NSRP. Those may be reviewed according with the progress of the study and work.

Table 4.3.15 Specifications and Performance of NSRP Train (Draft)

<table>
<tr><th>No</th><th>Item</th><th>Specification, Performance</th></tr>
<tr><td>1</td><td>Basic</td><td>Commuter Train DC1,500V
Tc: Trailer Car with driver's cab M: Motor car T: Trailer car</td></tr>
<tr><td>2</td><td>Basic Configuration</td><td>In case of 4M4T (Tc+M+M+T+T+M+M+Tc) (Empty weight 264t) following is for reference
←South(Calamba) (Solis)North→


32.5t ATP DSR BT APS / 34.0t VVVF PT / 34.0t VVVF PT / 31.5t APS CP / 31.5t APS CP / 34.0t VVVF PT / 34.0t VVVF PT / 32.5t ATP DSR BT APS
Legend ● :Motor Axle ○ :Trailer Axle ⇦ :Tight lock coupler
ATP: Automatic Train Protection, DSR: Digital Space Radio,
VVVF: VVVF inverter, CP: Compressor, APS: Auxiliary power Supply,
PT: Pantograph, BT: Battery, : Air Conditioner</td></tr>
</table>

No	Item	Specification, Performance
3	Performance	Acceleration(Design):3.3km/h/s Deceleration(Design):4.2km/h/s (Max service brake, Instantaneous deceleration) 4.7 km/h/s (Emergency brake, Instantaneous deceleration) Design operation Max speed:120km/h
4	Gauge	1,435mm(standard gauge)
5	Electric system	DC1,500V　overhead catenary
6	Capacity	Leading car：266(45), Intermediate car : 285(54) (　　):seat number calculated by 7persons/m^2 (Standee)
7	Body	Material: Light weight stainless steel or Aluminium MAX:19,500mm (Length)×2,950 mm (Width)×3,655 mm (Height) MAX Height 4,150mm, when pantograph is folded,　1,130～1,150 mm(Height of floor) Straight structure without hem aperture Driver unit : right side The length of leading cars may be longer than the above
8	Bogie	Bolster less type, Max axle weight:16t
9	Coupler	Driver's cab side of leading-car, and between 4th intermediate-car and 5th intermediate-car : tight lock coupler Others : semi-permanent coupler Connectable with NSCR train without adapter
10	Current Collection	Single arm type 4 pantographs/1 train-set (With high voltage train line)
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 units / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan
13	Propulsion system	VVVF inverter(Self cooling) 1C4M×4sets/train-set The device for VVVF inverter will be applied Hybrid-SiC due to more energy saving. Maximum current of train-set : Approx.3,200A (Powering) , Approx.5,000A (Regenerating)
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control) Parking brake(leading car), Slide control(Trailer car)
15	Compressor	With air drier 2 or 3 units/train-set Main power: 3-phase 440V・60Hz
16	Auxiliary Power Supply	SIV: 3-phase inverter with IGBT or Hybrid-SiC (self-cooling)　4 units/train-set DC1500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V Maximum current of train-set : Approx.500A
17	Battery	Sintered alkaline storage battery: DC100V　2 units/train-set
18	Door system	Electric (With adjacent door control backup function) or Pneumatic (With weakened function)
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door・Emergency car side light: LED type
20	Fun	Line flow fun
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz Distribution mounting of 2 units /a car
22	Heater	Not mounted

No	Item	Specification, Performance
23	PA system	Passenger broadcast: automatic volume control function with a variance amplification, automatic broadcast and outside speaker Broadcast simultaneously by the crew operating unit (Inside and outside) Intercom between crew cab, Interactive emergency communication equipment (with conversation function with the OCC and a broadcast function from the OCC)
24	Space Radio	Digital space radio
25	ATP	CBTC
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera (4 units /a car) Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	LCD type (17 inch wide) 8 units/car various guidance display
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance and air conditioner command etc. Trouble monitoring and memory with support guidance, inspection function on the train, On-board driving information system (24hour each device condition memorized) Display function for pressure gauge, ammeter, powering and braking conditions etc. Ethernet type・Control transmission : duplex and loop system or duplex and ladder system with redundancy, Information of CCTV and Monitor transmission for guidance etc. : single system
30	Universal Design	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair (free) space
31	Others	Preparation for WiFi etc.

Source: JICA Design Team

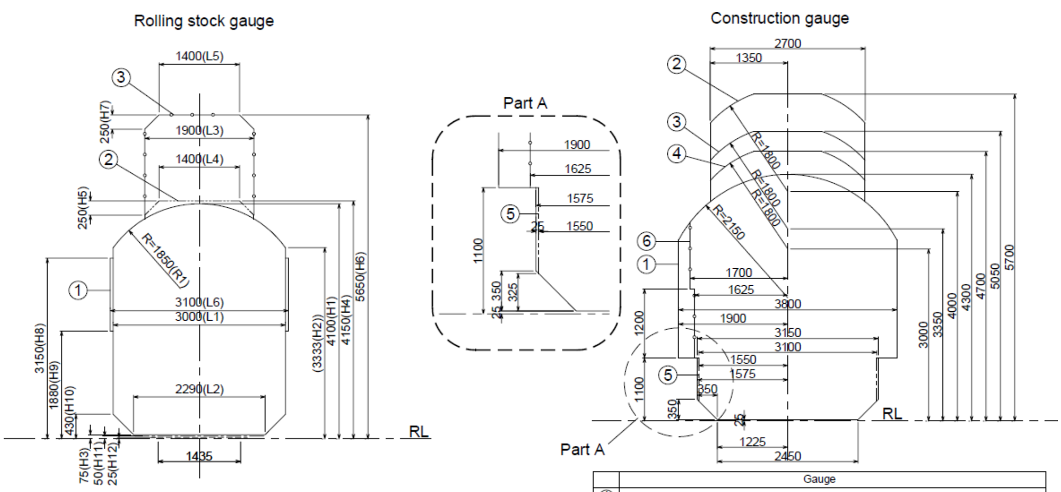
(3) Car Body

1) Car Body Material

Recently, stainless steel and aluminium alloy are widely used as the car body material for commuter train because of the high strength and light weight. There is a tendency to use light aluminium alloy for subway train, which requires higher acceleration performance to accommodate comparatively short distance between stations. Both aluminium alloy and stainless steel can be applied to the car body in this project.

2) Rolling Stock Gauge and Construction Gauge

Considering through operation to NSCR, the Rolling Stock Gauge shall be the same dimensions as reports of NSCR-DD. Figure 4.3.12 shows the proposed dimensions of Rolling Stock Gauge and Construction Gauge. This is the same as commuter vehicles described in reports of NSCR-DD. Regarding the technical specification of rolling stock for NSRP, Japanese Industrial Standards (JIS) will be basically applied. According to item 8.2.2.1 and item 8.2.2.1A in JIS E 4041 (2009), Kinematic Rolling Stock Gauge does not have to be considered if Static Rolling Stock Gauge is stipulated as below.



		Gauge	
	——	Basic	H1,H2,H3,H10,L1,L2,R1
②	—··—	Gauge when current collector is folded.	H4,H5,L3,L4
③	—o—	Gauge in relation to top of roof when current collector is operated.	H6,H7,L3,L5
①	═	Gauge in relation to signs,marker lamps, car side lamps.	H8,H9,L6
	— — —	Gauge in relation to parts that do not move vertically due to action of bogie spring.	H11,L2
	- - - -	gauge in relation to sanding pipe,obstacle deflector, brake shoe and other parts that do not exceed the wheel rim width.	H12

	Gauge
①	Basic Gauge
②	Gauge for track on which trains run receiving supply of direct current.
③	Gauge for tunnels, bridge, overpass, along track on which trains run receiving supply of direct current.
④	Gauge for tunnel section in case of using rigid overhead wire or safe supporting system.
⑤	Gauge only platform edge. —‒‒— Remark : It can be applied when the passage velocity of a train is 120 km/h or less. The use in the case of 120 km/h or more is forbidden strictly.
⑥	Gauge only Platform screen door. -o—o— Remark : It can be applied when the passage velocity of a train is 120 km/h or less. The use in the case of 120 km/h or more is forbidden strictly.

Source: JICA Design Team

Figure 4.3.12 Rolling Stock Gauge and Construction Gauge for NSRP

(4) Capacity, Train Configuration and Accommodations for Rolling Stock

1) Capacity and Train Configuration

The passenger capacity is as same (7 standees/m^2) as reports of NSCR-DD. The number of passenger capacity for each car, based on floor space which, excepted for 250mm from seat, and having both valid width over 550mm and valid height over 1900mm, is shown below, where values in bracket ( ) are the seat capacities. The proposed train composition for NSRP is eight (8) cars based on the operation plan.

Leading Car	: 266 (45) persons
Intermediate Car	: 285 (54) persons
Capacity of train (8 cars)	: 2,242 (414) persons

The proposed configuration of commuter train set for NSRP will be two (2) trailer cars with cab, four (4) motor cars and two (2) trailer cars in total of eight (8) cars, i.e., 4M4T (MT-ratio 1:1). The train configuration based on the operation plan will be detailed by JDT.

2) Accommodations

Considering similar environment, e.g., travelling time, objectives, preferences, etc., of commuting passengers in Metro Manila to that in Tokyo, commuter trains in Tokyo are considered as the reference for NSRP. An example of the accommodation for commuter train in Tokyo is shown in Figure 4.3.13.

Source: Tokyo Metro

Figure 4.3.13 The example of accommodation for the commuter train in Tokyo

3) Number of Passenger Door and Pitch of Passenger Door

The number of passenger door per car should be decided in consideration of stopping time at station, number of passenger, and door positon of PSD and Rolling Stock.

PSD will be installed in North South Railway Project - South Line (Commuter), so pitch of opening width of PSD and train passenger doors should be fit to get on and off the train. In this project, train configuration will be changed from 8-cars to 10-cars in the future, so even if the train configuration is changed, passenger doors of each configuration train should fit the opening pitch of PSD completely. Moreover, in case of coexisting operation of 8-cars trains and 10-cars trains, passenger door pitch and PSD pitch should fit completely.

To make it possible, door pitch of the leading cars and intermediate cars should be the same and at regular intervals. Therefore, the specification based on “JRIS-R1001 Standard Specification Guideline for Commuter Trains” regulated by “Japan Association of Rolling Stock Industries” is proposed.

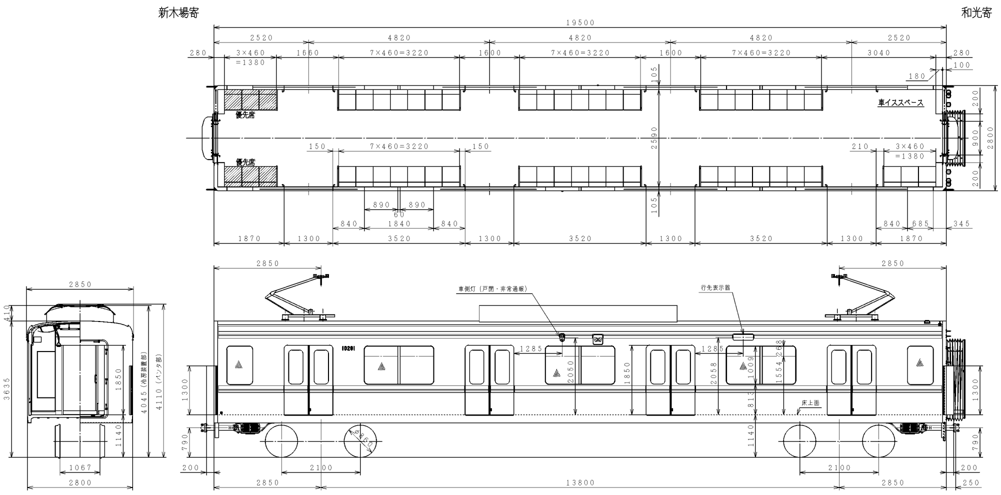


Figure 4.3.14 Sample of subway commuter train in Japan (Motor car)

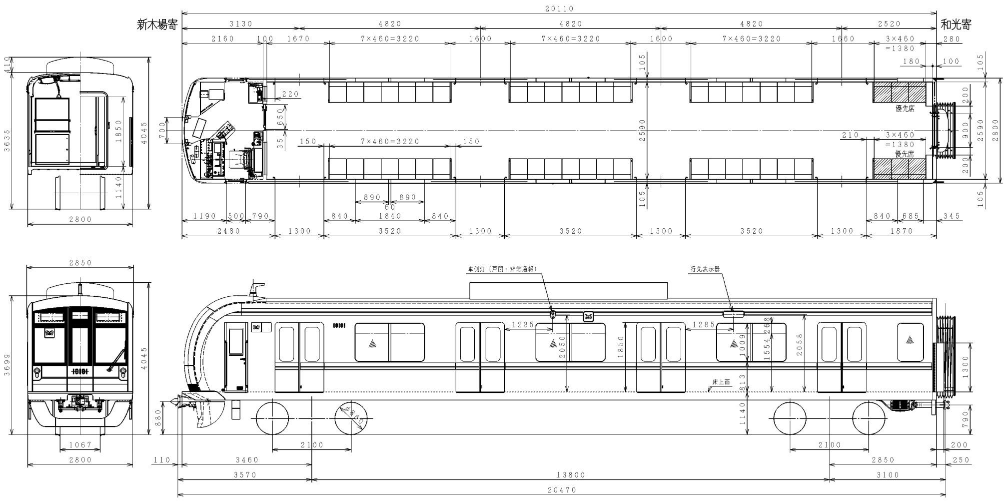


Figure 4.3.15 Sample of subway commuter train in Japan (Trailer car with driver cab)

(5) Acceleration and Deceleration for Commuter Train

1) Acceleration

The acceleration performance of rolling stock in for NSRP-South is determined in consideration of the demand forecast, the alignment and the energy saving of train operation in particular. In principle, these are adapted from report of NSCR-DD as follows:

Starting acceleration : 3.3 km/h/s (at the condition of 20ton/car load, Design value),
Maximum speed: 120 km/h.

2) Deceleration

The deceleration performance of rolling stock train for NSRP is shown below. These are the same as the deceleration of report of NSCR-DD.

Maximum service braking: 4.2 km/h/s (at the condition of 20ton/car load, design value),
Instantaneous emergency braking: 4.7 km/h/s (at the condition of 20ton/car load, design value).

The specifications of deceleration performance of NSRP are determined in consideration of the demand forecast, the alignment and the energy saving of train operation in particular.

(6) Bogie

The bogie of commuter train shall be the same basic specifications as report of NSCR-DD and should comply with the specifications proven in service shown below.

Bogie Type	: Bolster-less type
Primary Suspension	: Coil Springs
Secondary Suspension	: Air Springs
Bogie Frame	: to be fabricated by steel, welded hollow girder in H shape

(7) Main Electric Equipment for Commuter Train

1) Objective of Design

The same design policy of report of NSCR-DD shall be applied to the specifications of main electric equipment for NSRP. To ensure the safety and stable railway operation in NSRP-South, much of technical knowledge and know-how accumulated in Japanese manufacturers is favourably applied, including introduction of new technology like SiC element, etc. Design of the electric equipment proven in Japan should be applied to the rolling stock for NSRP as much as possible.

The design of electric equipment shall employ fail-safe concept against unusual malfunction with providing a redundancy in the system. The equipment for recording of operational information and failure analysis shall be employed as a measure to realise fail-safe concept.

The design of electric equipment shall consider easy maintenance and energy saving. For example, application of the totally-enclosed high-efficiency traction motor (the non-disassemble type for replacing the bearings) will result in tight pollution protection of the internal of motor, easy replacement of the bearings, reduction of loss, and energy saving by increasing regenerative power.

With those design considerations, easy maintenance and high energy saving can be realized, thereby ensuring stable operation of the rolling stock in longer operation life.

2) Propulsion System

In consideration of sufficiency in the normal running conditions, redundancy in the system upon unusual malfunction, energy saving and easy maintenance, as well as appropriate margin in the passenger demand, the specifications for propulsion system are proposed as below:

- Self-cooling and four(4) traction motors control system,
- Hybrid-SiC device,

- Application of high-efficiency totally enclosed traction motor and Non-disassemble type for replacing the bearings,
- Capable of continuous round-trip when the one (1) unit cut (equivalent to the cut of four(4) motors),
- (Part of regenerative function will be restricted.)
- Capable of one round-trip when the two (2) unit cut (equivalent to the cut of eight(8) motors),
- (Part of regenerative function will be restricted or all of regenerative function will be cut.),
- The 8 cars-composition train without any failure is able to tow or rescue the failed 10 cars-composition train at the uphill slope of 35‰.

Recently, electrical devices made of SiC (Silicon-Carbide) has been widely applied to VVVF inverter in Japan to achieve further energy saving. The manufacturers in Japan have enabled mass production of such VVVF inverter. The possibility of applying the SiC system will be considered.

An example of reducing the energy consumption using the high-efficiency induction motor and SiC system at Tozai-Line of Tokyo Metro is shown in Figure 4.3.16. Tokyo-Metro has achieved substantial reduction in the energy consumption of 26% compared with the conventional VVVF system brought by regenerative braking at the high-speed area.

Tokyo Metro Series 05

Tokyo Metro Series 15000

Car Type	Rate of Electric Power Consumption of Powering	Rate of Regenerative Electric Power	Regenerative Factor	Rate of Electric Power Consumption	Reduction Effect of Electric Power Consumption
	kWh/c・km	kWh/c・km	%	kWh/c・km	%
Series 05 with VVVF invertor	2.04	0.83	40.1%	1.21	
Series 15000 with VVVF invertor and High Efficiency Induction Motor	1.87	0.84	45.4%	1.03	-14.9
Series 15000 with SiC and High Efficiency Induction Motor	1.82	0.93	51.1%	0.89	**-26.4**

Source: Tokyo Metro

Figure 4.3.16 Reduction Effect of Electric Power Consumption Attributed by High Efficiency Motor and SiC

3) Brake System

Service brake, emergency brake and security brake shall be equipped. The security brake is also served as a backup upon breakdown of the emergency brake. In the leading car, parking brake is equipped to be used when a vehicle is placed.

The service brake is to undertake the regenerative braking force of the trailer car in order to maximize the effective use of regenerative braking. When the regenerative braking force is insufficient to the required total braking force, firstly pneumatic braking force is applied to the trailer car. In case insufficiency persists, the secondary pneumatic braking force is applied to the motor car. The brake system will control the brake force balance for all train set by sharing regenerative brake and service brake in trailer car while it keeps a good riding condition and prevents from skidding.

During rainfall, the vehicle towards the top is prone to skid. In order to minimize ride deterioration by skidding and braking distance, the braking force in the preceding vehicle is reduced and the additional braking force shall be supplemented at the succeeding vehicle. At the same time, the required braking force for the entire vehicle is ensured by TMS. Regenerative braking should be restricted to an appropriate torque.

The trailer cars are equipped with a skidding suppression device in order to prevent damage to the wheel. The motor cars are not equipped with this device, because the skid-slide is controlled by the propulsion system.

4) Signalling System

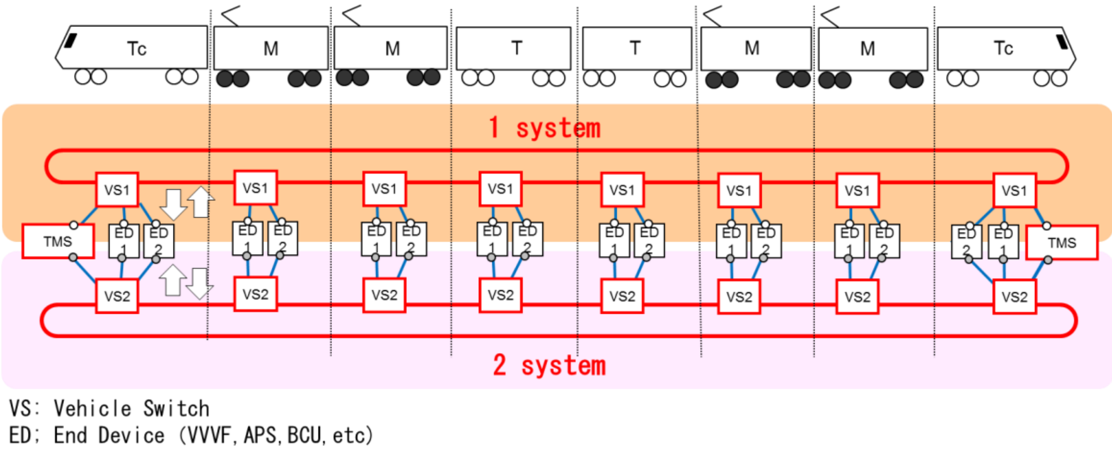
CBTC has been determined to be adopted to the signalling system of NSCR. So the signalling system of NSRP shall also employ CBTC to realise the interoperability with NSCR.

5) Train Management System (TMS)

TMS is a network and information system for the various commands and information management in the train set. TMS shall be designed to sufficiently keep the service record in Japan or other countries. TMS should have versatility and redundancy and employ the design complying with the respective international standards.

100 Mbps network shall be installed in the train set. The various commands, the operating information of each device and the video of CCTV will be transmitted by TMS network. Information transmitted shall be displayed on the TMS monitor in the driver cab and be stored in the memory of the TMS. The stored information can be checked upon failure or trouble. In Japan, this operating information record is extremely helpful to grasp the situation upon trouble and to identify the failure in equipment, etc.

The control command system of train operation consists of two independent systems and each forms a loop network configuration. When one loop is down, all system can continue to operate normally with the other loop. Even if the transmission is interrupted in the middle of the loop, all system can continue to operate normally by being transmitted from the other way round. Usually TMS employs the loop system diagram for keeping a high redundancy. It is also applicable to ladder type duplex system for keeping the same high reliability.



Source: JICA Design Team

Figure 4.3.17 Image of TMS Network

6) PSD Control

PSD will be introduced to NSRP. Various methods of PSD control have been introduced into Japanese railway. Oldest method with mass record is that when the operator operates the door opening / closing button of the cab, the PSD and the vehicle door open and close in cooperation. PSD system operates exchanging information between the on-board antenna and the ground antenna.

Source: Tokyo Metro

Figure 4.3.18 Sample of PSD of Tokyometro Namboku Line (Full Height type)

Source: Tokyo Metro

Figure 4.3. 19 Sample of PSD of Tokyometro Fuku-toshin Line (Half Height type)

7) Driver Cab (meter indicator, radio operator, ATP switch, door opening / closing switch)

In addition to the master controller, a meter indicator for CBTC, a radio controller for, an ATP switch, a door opening and closing button, etc., are required for the driver cab.

ATO indicator

ATO start button

Manual → ATO
(Not rocked)
ATO → Manual
(Electric rocked)

ATO operation mode switch

ATO, manual mode switch

Source: Tokyo Metro

Figure 4.3.20 Sample of ATO・PSD switch (Tokyo metro、10000 series)

It is necessary that the functions not used in other lines are invalidated by the line recognition of the driver key and the changing switch. Also, it is necessary to consider the circuit configuration that takes into consideration the abnormality.

8) Countermeasures against inductive interference

Generally, in case on board antenna of ATP is mounted on Rolling stock, in order to eliminate the influence of electromagnetic noise from the motor, the auxiliary power supply, the VVVF inverter, etc., the on-board antenna is required to be separated from the devices or another on-board antenna by a certain distance or more. Therefore, since the on-board antenna is generally mounted at the top of the car, it tends to avoid mounting the motor and the auxiliary power supply in the leading car. Even if it is inevitably installed, it is necessary to take measures such as installing a shielding plate or to secure a certain distance or more from the noise source, but the requirement varies depending on the manufacturer.

It is desirable that the on board antenna is mounted on nearby the center of bogie as possible in order to secure coupling the on board antenna and the ground antenna at curve. Therefore, this is contradictory to requiring separation from the motor as a countermeasure against inductive interference.

In the request for the mounting of the on-board antenna of a certain manufacturer, it is required to take a distance of 3.5 m or more from another on-board antenna or the high-frequency noise source.

In Japan, inductive interference to on-board antenna caused by electromagnetic generator unit is difficult to settle especially on through service operation where several units from different brand are involved because in some cases, a large cost may arise and it's important that we be aware of it.

9) Stopping accuracy at station fixed point stopping for PSD

According to ever study, PSD system will be set on NSRP. In this case, Rolling stock design and consistency with ground system considering ATO operation and Stopping accuracy at station fixed point stopping shall be required.

In this project, reduction of regenerative force, or regenerative fault will be sometimes happened. In this case, the pneumatic braking force is necessary. Therefore, deceleration characteristics may change due to maintenance such as monthly inspection and regular inspection or disturbance such as grease or water adhesion between the wheel tread and the brake shoe, so which can cause deterioration of the ATO stopping accuracy. In the Japanese subway, some trains are equipped with ATO can grasp the characteristics of the vehicle sequentially and correct the ATO vehicle model to reduce the influence of changes in deceleration characteristics and individual differences on stopping accuracy, and some trains are equipped with braking shoe which can remove grease attached to the wheel tread. Above should be used as a reference.

In addition to stopping accuracy, it is necessary to pay attention to ride comfort from the viewpoint of passenger service, and it is necessary to design an optimum stopping pattern such as the low deceleration stopping pattern while keeping the predefined running time.

For high stopping accuracy and comfortable ride ATO operation, main things to consider are as follows.

- Increasing regenerative voltage limiter for regenerative brake stabilization
- Brake shoes with less friction coefficient fluctuation against speed range, disturbance (oil, water etc.)
- Periodic cleaning of bogie (removal of oil on brake shoe and wheel tread)
- Suitable station stopping pattern for each station（ATO programing）
- Brake force balance between regenerative brake and pneumatic brake
- Velocity sensor that can detect accurately up to extremely low speed range
- Learning function of Rolling stock characteristics (learn and modify deceleration characteristics over time)

(8) Concept of design life

Commuter trains operated in Japan are manufactured to a design life as shown below. Moreover, railway operator has achieved the high availability and reliability by appropriate maintenance and supervision, investigating cause of failure, and implementing appropriate countermeasure in cooperation with the manufacturers.

Body / bogie	: over 30 years
Power conversion element, filter capacitor	: over 25 years
General electrical parts	: over 12 years
Some special parts	: about over 8 years

(9) Standards

The following Japanese standards are used for the both projects as for Rolling Stock described in report of NSCR-DD:

- JIS (Japanese Industrial Standards),
- JRIS (Japanese Railway Industrial Standards),
- Ministry of Land Infrastructure, Transport and Tourism (MLIT) (JAPAN).

(10) Maintenance

1) Maintenance Type and Cycle

The type and cycle of maintenance of rolling stock shall be as follows from the typical maintenance practice in Japan.

Table 4.3.16 Type and cycle of maintenance (Draft)

Category		Period
Departure Inspection		Before departure
Light Maintenance	Weekly Inspection	Within 6 days
	Monthly Inspection	Within 3 months (90 days)
Heavy Maintenance	Semi overhaul	Within 4 years or Within 600,000 km
	Overhaul	Within 8 years or Within 1,200,000 km
	General overhaul (Renewal)	Every 10 to 15 years
Other Maintenance	Unscheduled Repair	Whenever necessary

Source: JICA Design Team

2) Maintainability

Without maintenance, rolling stock is not secured to be in order over the service period. If the operator intends to operate the rolling stock without trouble, it should be properly maintained. Maintenance is very important for railway operation for preventing troubles. There are three types of the maintenance, namely breakdown maintenance, preventive maintenance and condition based maintenance, described hereunder.

- **Breakdown Maintenance**

  Upon break down of rolling stock in operation, the operator takes it to the depot, repairs there, and then reuses. Disadvantage of this maintenance is a disruption in the railway schedules.

- **Preventive Maintenance**

  The operator regularly takes rolling stock to depot and periodically repairs as required. Advantage of this maintenance is to prevent unexpected breaking down of the rolling stock in operation, thereby avoiding disruption in the operation schedule.

- **Condition Based Maintenance**

  Each device of rolling stock is monitored at all times, and when there is a sign of breakdown in the device, the operator takes that rolling stock to depot and repairs it.

  Theoretically, the advantage of this maintenance is continuous use of the rolling stock full time until its failure. It is therefore called advanced maintenance. In practice, difficulties in identifying the sign of breakdown in reasonable advance, use of the rolling stock full time until onset of breakdown is not possible. Many railway operators in the world adopt the preventive maintenance method for the reason that there is no disruption in the operation schedule. This maintenance method is considered as the best option among others for stable train operation.

Irrespective of the maintenance methods above mentioned, it is essential to plan appropriate budget to secure sufficient amount of consumable parts, spare parts, and repair parts. Those parts should be always available upon repair of rolling stocks.

Irrespective of the maintenance methods abovementioned, it is essential to plan appropriate budget to secure sufficient amount of consumable parts, spare parts, and repair parts. Those parts should be always available upon repair of rolling stocks.

4.3.4 Depot Facility and Equipment for Rolling Stock

The railway transportation system is an essential public infrastructure to serve for socio-economic activities. Because of the importance and responsibility for public human activities, it should be absolutely safe for handling a large number of passengers. Also, rolling stock for the railway is required to be kept in a good condition for the above role and function. By practicing the preventive maintenance, it is indispensable to keep the railway system sustainable and highly safe. Facilities and equipment to be provided at depot for maintenance is also described in this section, in respect of the design policy and conditions considered in the Project(s).

(1) Policy to Design

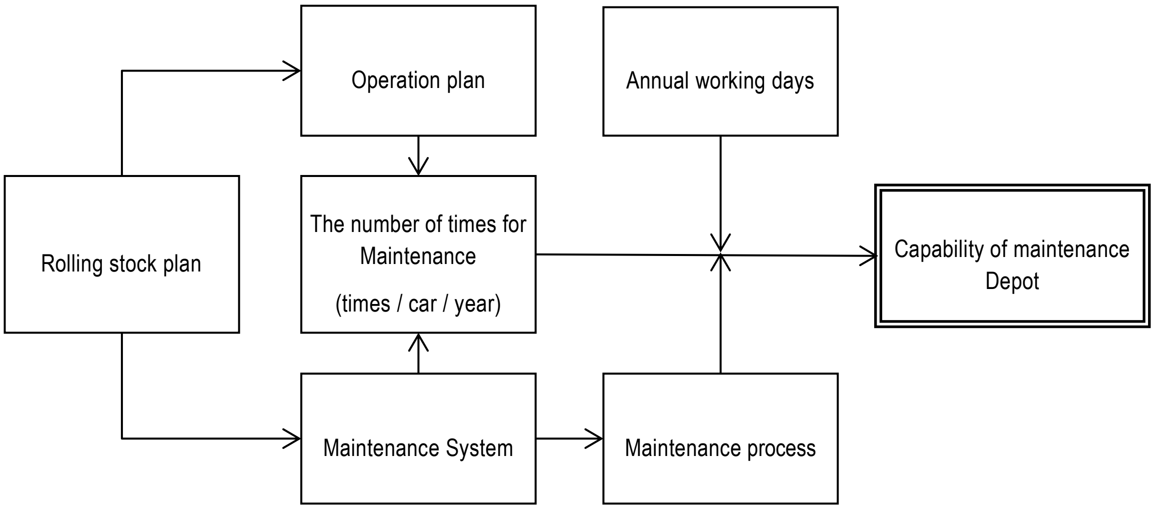
“Inspection”, “repair”, and “cleaning” for rolling stock maintenance shall be consistent with the rolling stock itself. The following conditions are considered adequate for maintenance facilities in the depot(s) (Figure 4.3.21).

- Maintenance for rolling stock
  - Rolling stock type (EMU trains) and the number of cars in a train set
  - Maintenance categories (as same as in NSCR-DD, Table 4.3.2)
  - Work flow of each maintenance (as the same method as in NSCR-DD)

- Operation plan
  - Required number of train sets for operation
  - Kilometric performance per day and train set
  - Section of train operation

- Number of working days
  - Annual working days per year in the Philippines (as same as in NSCR-DD conditions)

Capacity of the depot(s), and its required facilities and equipment are determined following the schematic flow chart as shown in Figure 4.3.21.



Source: JICA Design Team

Figure 4.3.21 Planning Flow for Maintenance Depot

In addition, the following basic concepts will be considered into the design.

- Facilities will be reasonably allocated to secure high work efficiency,
- Introduction of latest and proven facilities will be planned for shortening the inspection process and improving productivity, and,
- By introducing these facilities, improvement in maintenance quality and working environment will be achieved as well.

(2) Pre-conditions for Design

DOTr considers interoperability among three lines and requested that all these depots, including one in Valenzuela for NSCR, will be commonly used for MCRP and NSRP-South rolling stocks.

Pre-conditions for designing the Depots and workshop under this request are the followings.

1) Rolling Stock

Rolling Stock was already described in 4.3.3. There are 3 packages in the Project(s);

- MCRP Limited express train,
- MCRP Commuter train, and,
- NSRP-South Commuter train.

These trains have 8 cars for one train-set and future additional plan: 10 cars for one train-set. In addition, Commuter trains have the common specifications for operation with NSCR Commuter train.

2) Rolling Stock Maintenance System

Table 4.3.17 shows Rolling Stock Maintenance System for Commuter trains.

Table 4.3.17 Basic Rolling Stock Maintenance System for Commuter trains

Category		Period	Maintenance Content
Departure Inspection		Before departure	Check in-service monitoring, visual check of major parts of cars.
Light Repair	Weekly Inspection	Within 6 days	Check status of bogies, wheels, pantograph, doors and other items while cars are connected. Replace consumables for brakes, pantographs and other items.
	Monthly Inspection	Within 3 months (90 days)	Confirm the status of cars and their functions while cars are connected. Replace consumables, measure voltage of auxiliary circuits, control circuit and other circuits, inspect functioning of main circuit, etc.
Heavy Repair	Semi overhaul	Within 4 years or Within 600,000 km	Remove bogies, wheels, wheel axles, brakes, main motors and other major parts, perform detailed inspection and replace parts
	Overhaul	Within 8 years or Within 1,200,000 km	Disassemble almost all parts, perform detailed inspection of devices.
	General overhaul (Renewal)	Every 12 to 15 years	General overhaul shall carry out replacement of the major electronic parts with new one. If it is necessary, the interior is renewed.
Other Maintenance	Unscheduled Repair	Whenever necessary	Replace broken-down parts. (Bogies, pantograph, air conditioner, etc.).
	Wheel re-profiling	150,000km	Use wheel profiler to correct wheel shape and maintain ride comfort level.
Train Preparation	Turn back cleaning	Every shop-in and turn back	Pick up trash.
	Daily cleaning	Within 3 days	Interior cleaning (floor and window) Exterior cleaning (front and rear windshield) Car-body side panel cleaning by automatic car-body washer
	Monthly cleaning	Within 1 month (30 days)	Interior cleaning (floor waxing and all interior parts cleaning) Exterior cleaning (car-body, front and rear windshield)

Source: JICA Design Team

This maintenance system is same as NSCR Commuter train. On the other hand, Table 4.3.18 shows Rolling Stock Maintenance System for Limited Express train.

Table 4.3.18 Basic Rolling Stock Maintenance System for Limited Express train

Category		Period	Maintenance Content
Departure Inspection		Before departure	Check in-service monitoring, visual check of major parts of cars.
Light Repair	Weekly Inspection	Within 6 days	Check status of bogies, wheels, pantograph, doors and other items while cars are connected. Replace consumables for brakes, pantographs and other items.
	Monthly Inspection	Within 3 months (90 days)	Confirm the status of cars and their functions while cars are connected. Replace consumables, measure voltage of auxiliary circuits, control circuit and other circuits, inspect functioning of main circuit, etc.
Heavy Repair	Semi overhaul	Within 4 years or Within 600,000 km	Remove bogies, wheels, wheel axles, brakes, main motors and other major parts, perform detailed inspection and replace parts. Paint car body.
	Overhaul	Within 8 years or Within 1,200,000 km	Disassemble almost all parts, perform detailed inspection of devices. Paint car body.
	General overhaul (Renewal)	Every 12 to 15 years	General overhaul shall carry out replacement of the major electronic parts with new one. If it is necessary, the interior is renewed.
Other Maintenance	Unscheduled Repair	Whenever necessary	Replace broken-down parts. (Bogies, pantograph, air conditioner, etc.).
	Wheel re-profiling	100,000km	Use wheel profiler to correct wheel shape and maintain ride comfort level.
Train Preparation	Turn back cleaning	Every shop-in and turn back	Pick up trash.
	Discharge Sewage	Within 2 days	Discharge sewage from tank on the train.
	Daily cleaning	Within 3 days	Interior cleaning (floor and window) Exterior cleaning (front and rear windshield) Car-body side panel cleaning by automatic car-body washer
	Monthly cleaning	Within 1 month (30 days)	Interior cleaning (floor waxing and all interior parts cleaning) Exterior cleaning (car-body, front and rear windshield)

Source: JICA Design Team

There are a little difference specifications and their operations between Commuter train and Limited Express train. For example, Limited express train has the toilet, and, the car body of Limited express may be painted. JICA Design Team assumed that Wheel re-profiling will be conducted within 100,000km because the kilometric performance of Limited Express train is longer than Commuter trains. Moreover, JICA Design Team also assumed that the car body of Limited Express train needs to be painted when Heavy Repair is conducted.

3) Candidate Sites for Depot and Workshop

Candidate Sites for Depot and Workshop are the land connecting to Clark station and the land near Mamatid connecting to Calamba Station (as described in 4.5.1).

4) Train Operation Plan

Train Operation plans were already described in 4.3.2. This Train Operation Plan based on the forecast demand that was requested to study by JICA on last June at JICA-FF mission and agreed from JICA and DOTr is treated as the pre-condition of design. Number of stabling trains is shown in Table 4.3.19. On Table 4.3.19, Valenzuela Depot will be constructed on NSCR line, North Depot will be constructed on MCRP line, and South Depot will be constructed on NSRP-South line.

Table 4.3.19 Number of Stabling Trains at Each Depot in 2040 (Tentative)

Type / Location	North Depot	Valenzuela Depot	South Depot	Alabang Station	Total
Limited Express	4	2	0	2	8
Commuter (Include Commuter Express)	21	6	25	0	52

Source: JICA Design Team

The kilometric performance of this is shown in Table 4.3.20.

Table 4.3.20 Kilometric Performance of Each Train in 2040 (Tentative)

Type	Total Kilometric performance	Number of Train set for operation	Average of Kilometric performance for operation
Limited Express	9,048 km / day	8	1,131 km / day / train-set
Commuter (Include Commuter Express)	36,503 km / day	52	702 km / day / train-set

Source: JICA Design Team

This train operation plan is determined.

5) Valenzuela Depot and Workshop

When design is conducted, the capacity of Valenzuela Depot and Workshop should be considered. In the Project(s), Verification for Rolling Stock operation will be only conducted.

6) Through operation between NSRP-South and MMSP

This study were requested by DOTr and is under studying. Based on the train operation considering this through operation, 5 MMSP trains will be stable at South Depot. Moreover, only MMSP trains will be operated for this through operation. Therefore, in this report, the facility and equipment plan for this through operation is described summary because this study is undergoing. If these pre-conditions will be changed, the design of each facility and equipment has to be examined again. Moreover, if necessary, the design have to be conducted again.

(3) Setting conditions for Design

Based on Pre-conditions, the setting conditions are made as follows.

1) Facility Plan with Consideration on Rolling Stock Packages

It should be mentioned that Depot and Workshop in NSCR project is out of scope in the Project(s). The depot facilities and equipment will be designed according to the specifications for each type of rolling stock. In NSCR project, the bidding for rolling stock is on design-build basis. It means the contractor shall design the rolling stock on a condition that their maintenance is to be conducted at

Valenzuela depot. The facilities and equipment, including special tools, jigs and test equipment, to be provided shall be also designed to meet the requirement for maintenance at Valenzuela depot. In order not to affect the bid prerequisites of NSCR, it is proposed that the depot plan at Valenzuela for NSCR will not be changed, and those depots for MCRP and NSRP-South will be designed without considering NSCR trains. The reason for this is that NSCR line will be opened earlier than other two lines and the bid documents of NSCR rolling stock are not opened at this moment.

In case the depots for MCRP and NSRP-South have not become available upon interoperable services among three lines, the maintenance and cleaning for MCRP and NSRP-South commuter trains can be conducted at Valenzuela depot, because these commuter trains share the same specifications as NSCR train. However, in this case, the operator of Valenzuela depot has to ensure the capacity and specifications of facilities and equipment, whether all trains can be accommodated there or not. In consideration of the above and the prerequisites explained in (4.3.1), the proposed plan for depots in MCRP and NSRP-South is summarised in Table 4.3.21. Red highlights on Table 4.3.21 means the scope of this project. This table was agreed with DOTr at 5th Coordination Meeting.

Table 4.3.21 Depot and Workshop Function Plan

Place / Function	North Depot and Workshop				Valenzuela Depot and Workshop (Ref.)				South Depot			
	NSCR Com. (Ref.)	MCRP Exp.	MCRP Com.	NSRP Com.	NSCR Com. (Ref.)	MCRP Exp.	MCRP Com.	NSRP Com.	NSCR Com. (Ref.)	MCRP Exp.	MCRP Com.	NSRP Com.
Stabling Rolling Stock	Done	Done	Done	Done	Done	Done	Done	Done	Done		Done	Done
Weekly Inspection	Done	Done	Done	Done	Done	Done	Done	Done	Done		Done	Done
Monthly Inspection		Done	Done		Done							Done
Wheel re-profiling		Done	Done		Done							Done
Unscheduled Repair		Done	Done		Done							Done
Train Preparation	Done	Done	Done	Done	Done	Done	Done	Done	Done		Done	Done
Heavy Repair		Done	Done	Done	Done							

Note Com.: Commuter train, Exp. : Limited Express train, Heavy Repair: Semi overhaul, Overhaul, and General overhaul.

Source: JICA Design Team

In case study for through operation between NSRP-South and MMSP, the operation: 5 MMSP trains stabling at South Depot is treated as the pre-condition in this report. Therefore, the 5 stabling tracks at South Depot are considered at this moment.

2) Depot Function

a) Basic Method of Maintenance Works

Depot has basically 5 functions; "Stabling", "Light Repair", "Unscheduled Repair", "Wheel re-profiling", and, "Train Preparation". The main purpose of maintenance works at Depot is not to overhaul equipment, but to check or inspect the condition and the function of a rolling stock in operating condition. Therefore, these maintenance works is conducted in operating condition. It is not necessary to uncouple the train set to one by one. This method is being considered into design of Depot.

b) Major Facilities and Equipment

Major facilities and equipment are shown in Table 4.3.22.

Table 4.3.22 Major Items of Facilities/equipment for Depot

Kind of Function	Major items of facilities/equipment
Stabling	Stabling Tracks for 10 cars' length
Light Repair	(Light Repair Shop) Pit, Deck, Height scaffold, Front car maintenance platform, Disconnect switch
Unscheduled Repair	(Unscheduled Repair Shop) Bogie replacing equipment, Underfloor equipment lifter, Movable lifting platform, Overhead traveling crane
Wheel re-profiling	(Wheel Re-profiling Shop) Underfloor wheel re-profiling lathe, Shunting locomotive
Train Preparation	(Light Repair Shop) Deck, Sewage discharge pipe (In Depot Area) Automatic car body washer,

Source: JICA Design Team

3) Workshop Function

Workshop has the function to overhaul. However, South Depot don't need to have the function to overhaul because Heavy Repair for all rolling stock in this project will be conducted at North Depot.

4) Required Time for Maintenance and Annual Working days

From above pre-conditions and setting conditions, Required Time is set. And also, Annual Working days is set based on the present condition in the Philippines as shown in Table 4.3.23.

Table 4.3.23 Required Time and Annual Working Days for Each Maintenance (Tentative)

Category		Required Time	Annual Working days
Light Repair	Weekly Inspection	2 hours / train	363 days/year, 16 hours/day (2 shifts)
	Monthly Inspection	1 day (8 hours) / train	241 days/year, 8 hours/day (daytime)
Heavy Repair	Semi overhaul	(Commuter) 17 days / train (Limited Express) 19 days / train	241 days/year, 8 hours/day (daytime)
	Overhaul	(Commuter) 20 days / train (Limited Express) 22 days / train	241 days/year, 8 hours/day (daytime)
Other Maintenance	Unscheduled Repair	(depends on failure content) (Assumption : 10 days)	241 days/year, 8 hours/day (daytime)
	Wheel re-profiling	2 hours / car	241 days/year, 8 hours/day (daytime)
Train Preparation	Discharge Sewage	2 hours / train	363 days/year, 16 hours/day (2 shifts)
	Daily cleaning	2 hours /train	363 days/year, 16 hours/day (2 shifts)
	Monthly cleaning	1 day (8 hours) / train	241 days/year, 8 hours/day (daytime)

Source: JICA Design Team

“Required Time” on Table 4.3.23 has been still studied because this table will be determined after Facilities and Equipment Layout is designed.

(4) Basic Design

In this section, results of studies, calculations, and, designs are described.

1) Rolling Stock Operation Plan and Required Capability of Depot and Workshop

Rolling Stock Operation Plan has to be made considering Maintenance work schedule and Train Operation. This Plan should be made at the same time as when Required Capability of Depot and Workshop is calculated.

Moreover, Maintenance base for each rolling stock should be determined because there are 4 rolling stock package including NSCR Commuter train. Based on Table 4.3.21, Table 4.3.24 is set.

Table 4.3.24 Base Depot and Workshop of Rolling Stock

Package	Base Depot	Base Workshop
Ref.) NSCR Commuter train	Valenzuela Depot	Valenzuela Workshop
MCRP Limited Express train	North Depot	North Workshop
MCRP Commuter train	North Depot	North Workshop
NSRP-South Commuter train	South Depot	North Workshop

Source: JICA Design Team

As a result of this study, Rolling Stock Operation Plan is shown in Table 4.3.25 and Table 4.3.26.

Table 4.3.25 Rolling Stock Operation Plan for Commuter Train (Tentative)

Depot / Workshop	For Operation		For Maintenance				Total
	Operation	Stand-by	Heavy Repair	Monthly Inspection	Wheel re-profiling	Monthly Cleaning	
MCRP	21 trains	1 train	2 trains	2 trains			26 trains
Ref.) NSCR	6 trains	1 train	1 train	1 train			9 trains
NSRP-South	16 trains	1 train		2 trains			19 trains
Total	43 trains	3 trains	3 trains	5 trains			54 trains

Source: JICA Design Team

Table 4.3.26 Rolling Stock Operation Plan for Limited Express Train (Tentative)

Depot / Workshop	For Operation		For Maintenance				Total
	Operation	Stand-by	Heavy Repair	Monthly Inspection	Wheel re-profiling	Monthly Cleaning	
MCRP	4 trains		1 train	2 trains			7 trains
Ref.) NSCR	3 trains	1 train					4 trains
NSRP-South							
Total	7 trains	1 train	1 train	2 trains			11 trains

Source: JICA Design Team

These tables are planned considering Table 4.3.27 that is the result of calculation under pre-conditions and setting conditions.

Table 4.3.27 Required Capability of Depot and Workshop (Tentative)

(train-set / day)

Type	Depot & Workshop	Heavy Repair	Light Repair		Wheel re-profiling	Train Preparation		
			Monthly Inspection	Daily Inspection		Monthly Cleaning	Daily Cleaning	Discharge Sewage
Limited Express train	MCRP	0.60	0.18	0.16	0.04	0.61	0.30	0.62
	Ref.) NSCR	(None)	(None)	0.09	(None)	(None)	0.17	(None)
	NSRP-South	(None)	(None)	(None)	(None)	(None)	(None)	(None)
Commuter train	MCRP	1.23	0.26	0.58	0.03	1.46	1.13	(None)
	Ref.) NSCR	0.80	0.34	0.20	0.04	0.50	0.39	(None)
	NSRP-South	(None)	0.33	0.43	0.04	1.07	0.82	(None)

Source: JICA Design Team

Table 4.3.27 shows the number of train sets that can be maintained at one time. The number of Limited express train-sets for overhaul at the same time is 0.60 train-sets. However, since electric multiple unit (EMU) works in a train formation, 0 or 1 train-set can be in maintenance for overhaul at the same time. Furthermore, it is necessary to secure train-sets for maintenance as train-sets cannot be operated while in maintenance. Therefore, the number of spare Limited express trains for Heavy Repair is 1 as shown in Table 4.3.26. Each required number of spare train-set can be calculated the same way (Table 4.3.25 and Table 4.3.26).

2) Facility Plan of Depot and Workshop

Based on 4.3.4 (4) 1), the calculation result of required number of facility line is as shown in Table 4.3.28.

Table 4.3.28 Depot and Workshop Facilities / Equipment Plan (Tentative)

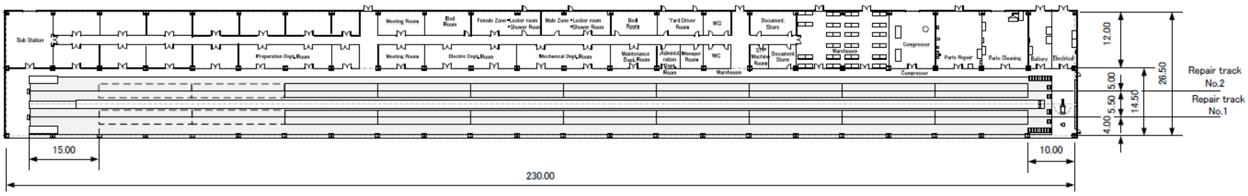
Facilities and Equipment	North Depot and Workshop	Valenzuela Depot and Workshop (Ref.)	South Depot
Stabling Rolling Stock	33	15	19
Light Repair	1	1	1
Wheel re-profiling	1	1	1
Unscheduled Repair	1	1	1
Train Preparation	2	2	1
Overhaul	1	1	0

Source: JICA Design Team

As a result of calculation, Facilities and Equipment at Valenzuela Depot and Workshop can be also satisfied with the required capability after opening MCRP and NSRP-South (Table 4.3.25, Table 4.3.26, and Table 4.3.27).

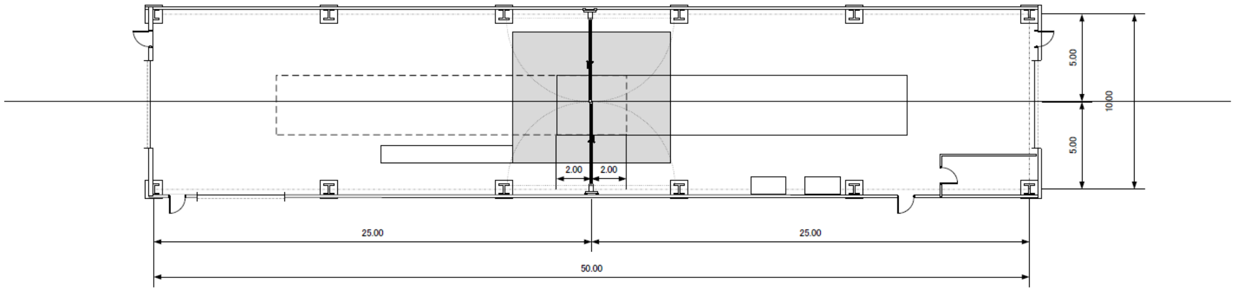
3) Shop Layout

Shop Layouts have been designed considering work flow of all maintenance. These are finalized after all studies are finished. Shop Layouts for each maintenance are as follows.



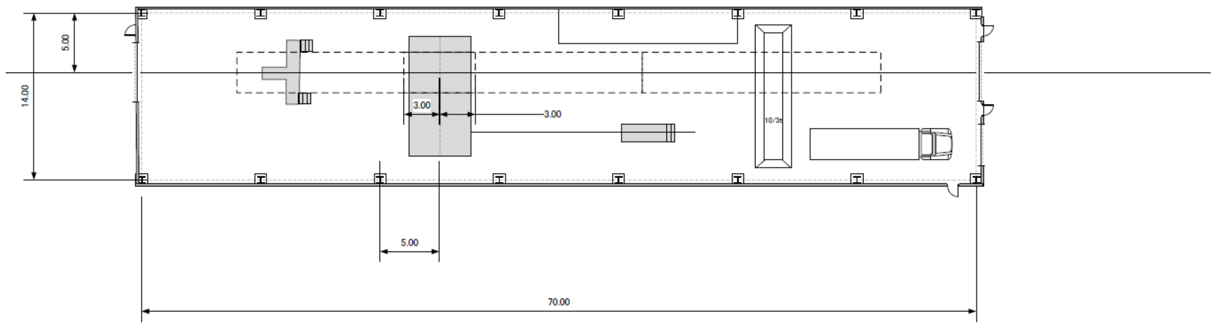
Source: JICA Design Team

Figure 4.3.22 Shop Layout for Light Repair and Train Preparation



Source: JICA Design Team

Figure 4.3.23 Shop Layout for Wheel re-profiling



Source: JICA Design Team

Figure 4.3.24 Shop Layout for Unscheduled Repair

4) Depot Layout

Depot Layout has also been designed considering work flow of all maintenance. Figure 4.3.25 show South Depot Layout. This layout will be finalized after all discussions and studies are finished. If the pre-conditions and setting conditions will be changed, this layout has to be designed from the start again.

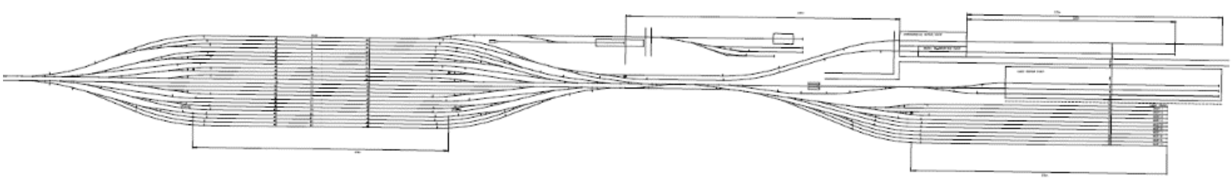


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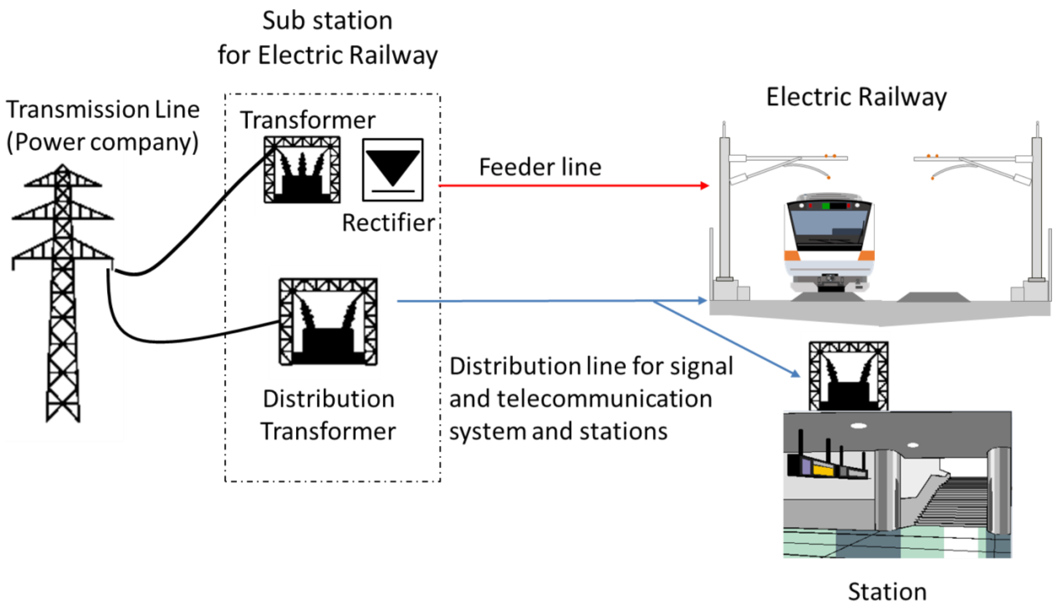
Figure 4.3.25 South Depot Layout

(5) Detailed Design Approach of Facility and Equipment to be provided at Depot

The facility and equipment in each depot will be designed cooperating with civil, architecture, rolling stock, and, other E&M experts. Moreover, the layout of Depot and Workshop will be finalized after all studies is finished.

4.3.5 Power Supply System

As described in 4.3.3, the rolling stocks are proposed to adopt DC electric multiple units, which require power supply system for the rolling stocks sufficient for train operation in this project. This section describes the power supply system for electric railway. Electric power for electric railway is generally supplied from the power grid of power supply organization in the area. The receiving electric power at a substation is three-phases for electric railway. Figure 4.3.26 shows schematic chart of power supply system for electric railway



Source: JICA Design Team

Figure 4.3.26 Schematic chart of Power supply system (DC type)

"Feeding" means supplying electric train with electric power. There are two types of feeder system, DC and AC feeding systems. Characteristics of the feeding system are shown in Table 4.3.29. DC feeding system is usually adopted in urban commuter railway. The interval of substations for DC feeding system becomes short to prevent drop in DC voltage. On the other hand, AC feeding system is usually adopted for high-speed railway or low frequent train operation line. AC feeder system requires transferring power in three phases to single phase. High-speed railway requires much power to operate. If high-speed railway adopts DC feeding system, large current flows and voltage drop will cause difficulty in maintaining stable operation. Moreover, requirement of many substations in this system is not practical. AC feeding system has a comparative advantage for high-speed railway. In case of employing AC feeding system for urban railway, the number of substations can be reduced, compared to DC feeding system. However, it is required to install transformers on each rolling stock. Suitable power feeding system shall be chosen considering total design of the railway system, including cost implication.

Table 4.3.29 Characteristic of feeding systems

Contents	DC feeding system		AC feeding system	
			AT*[1] method	BT*[2] method
Supplying Voltage to train	600-750V	1500-3000V	20kV or 25kV	20kV or 25kV
Substation Distance	1-2 km	3-10 km	About 50km	About 30km
Feeding Method	Parallel		Single way	Single way
Consideration issues	Galvanic corrosion		Induction problems	

*1 AT: Auto Transformer feeding system (2×25kV feeding system)
*2 BT: Booster Transformer feeding system

Source: JICA Design Team

For NSRP-South, DC supplying system is proposed for the following reasons:

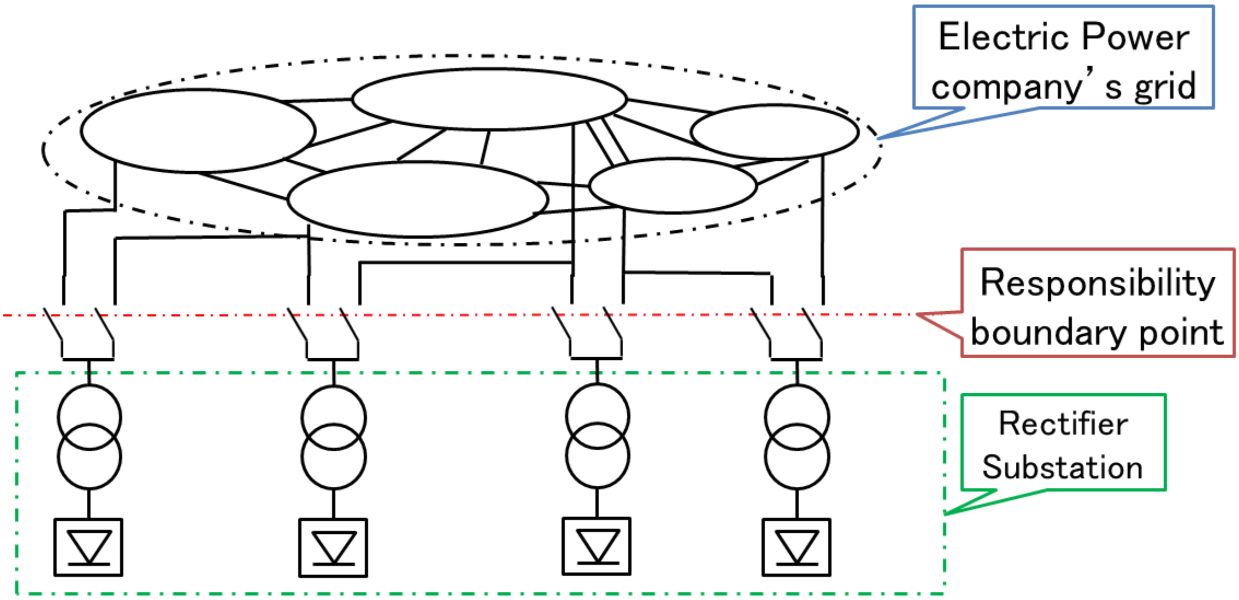
- Compatibility with the NSCR project,
- Number of operating trains,
- Interoperability,
- Total investment cost of rolling stocks and substations.

(1) Substation

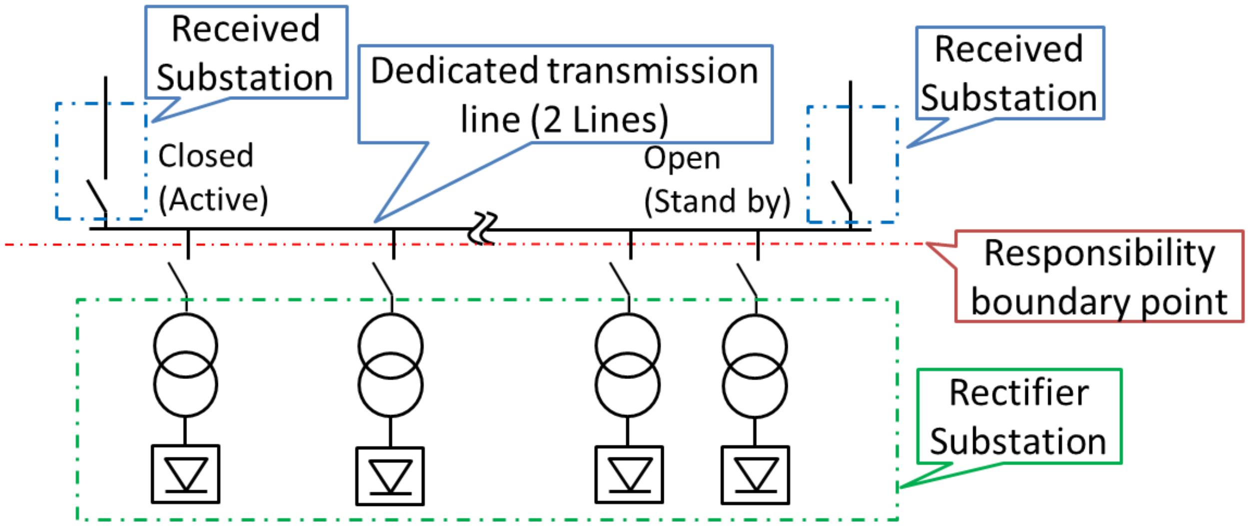
1) Receiving power method

Electric railway system is generally supplied from the power grid of a power supply organization, like MERALCO in the Philippines. There are two general methods of power supply. One is to receive power directly from the power grid. The other is to provide a dedicated supply system by preparing power receiving substations and dedicated transmission line. Figure 4.3.27 shows overview of these two methods. Receiving power is provided active/standby two lines.

For NSRP-South, MERALCO will supply electric power all along the line. Depended on the grid of MERALCO, The receiving voltage of the substation for railway system will become either 34.5 kV, 69 kV, or 115 kV. In the case of 115 kV, JDT has to consider the receiving facilities. For instance, the tank type GIS and the 115kV transformer will be required to install. Moreover, since the receiving facilities become larger, facilities layout shall be considered.



(a) Receiving from the power grid directly



(b) Constructing power receiving substations and dedicated transmission line

Source: JICA Design Team

Figure 4.3.27 Receiving power methods

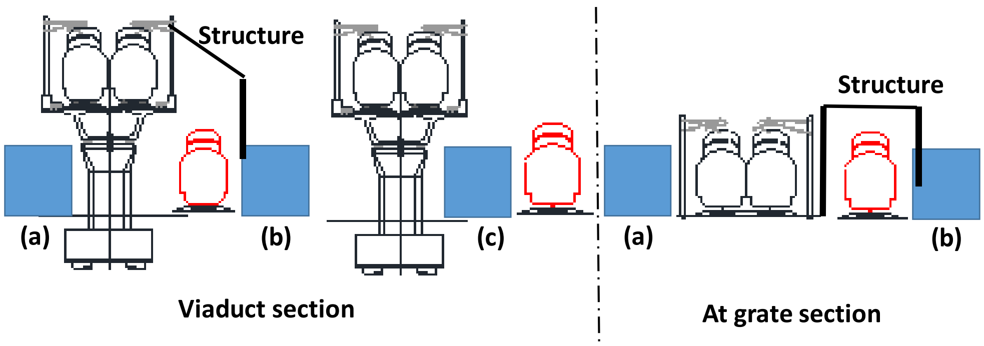
2) Substation location

a) Substation location requirement

Substation locations shall satisfy following preconditions:

- Distance between substations : from 3 km to 5 km as long as possible
- Away from Station location : at least 200m
- Substation area : at least 500m^2 (the land width: at least 10 m)
- Construction within ROW of PNR, as much as possible

In an elevated section, a substation shall be installed under viaduct, at a grade section, next to the tracks. It shall consider the freight project. Figure 4.3.28 shows the image of substation installation. In the elevated section, there are three types of installation, (a), (b) and (c), at the grate section, there are two types of installation, (a) and (b) .In case of installation location next to the Freight line, it is required to construct a structure to overpass the PNR or Long Haul.



Black line: commuter Red line: PNR or Long Haul

Source: JICA Design Team

Figure 4.3.28 The image of substation installation

b) Proposal of substation location

Based on the preconditions and results of site inspection, the every substation location is proposed for Table 4.3.30. No.S4 substation area is not so large space, it has to consider whether this area can be expanded or not. If it can't, it will have to be required for voltage drop countermeasures because the distance between No.S3 and No.S5 is about 7 km.

Table 4.3.30 Substation locations

Substation Number	The distance from Solis station
No.S1	4k 800m
No.S2	9k 450m
No.S3	13k 100m
No.S4	16k 800m
No.S5	20k 730m
No.S6	24k 180m
No.S7	28k 090m
No.S8	32k 040m
No.S9	36k 780m
No.S10	41k 540m
No.S11	46k 500m
No.S12	49k 980m
No.S13 *	53k 830m

*The south depot is supplied from No.S13 substation because of this substation location near the depot.

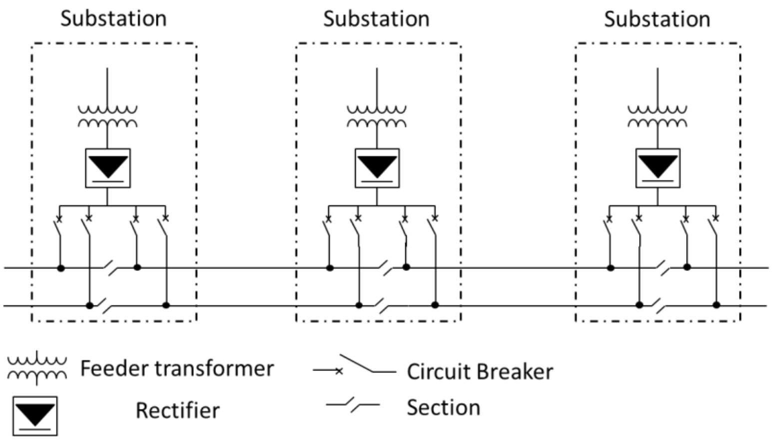
Source: JICA Design Team

c) Substation location issues

No.S4 substation location is the place sandwiched between SLEX and High way, and a part of ROW has already been used as the road. In case of using this place as substation, it has to negotiate with related organizations and need time as well. Table 4.3.30 shows the substations locations.No.S4 substation location in this table is previous location. JDT proposes to make Nichols station underground, because of difficulty to close level crossing near the PNR Nichols station. Along with this, JDT consider plan to install the substation at the top of the tunnel section. Furthermore, it shall be required to discuss with MERALCO regarding substation location and power receiving method etc.

3) Substation facilities outline

Figure 4.3.29 shows an example of basic DC feeding system composition. DC feeding system is normally parallel feeding method, other than from both ends of the line to the adjacent substations. Section will be required to distinguish feeding areas.



Source: JICA Design Team

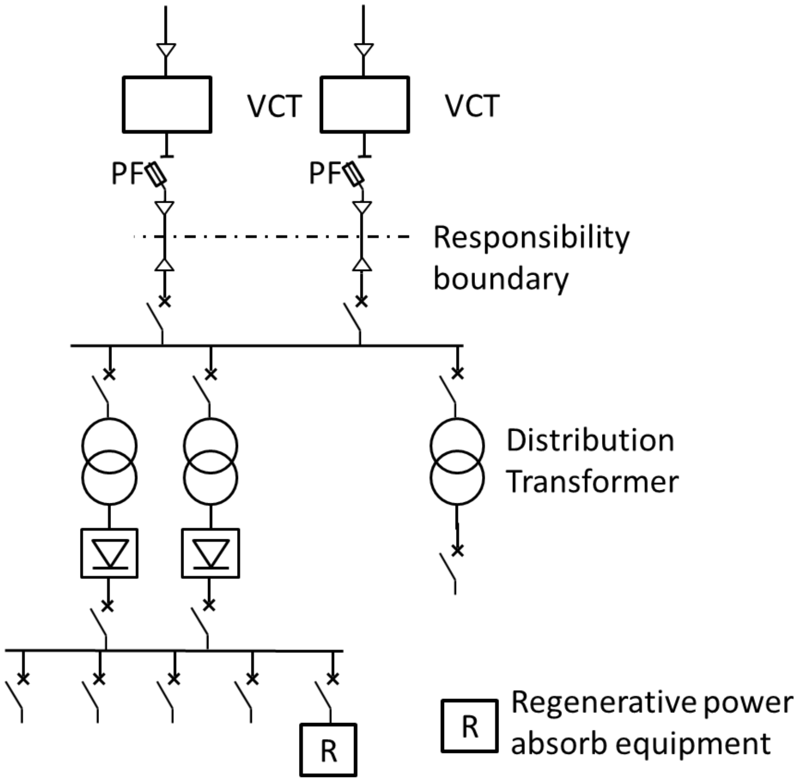
Figure 4.3.29 DC feeding system composition

Substation facilities can be classified into three major elements. They are i) receiving facilities, ii) transformers and rectifiers, and iii) facilities of supply to railway. Table 4.3.31 shows main substation facilities. Figure 4.3.30 shows single-line diagram of Substation in instance.

Table 4.3.31 Main Facilities at Substation

Division		Facilities
Receiving facilities from power supply company		Disconnection Switch, Circuit Breaker, Power Fuse(PF) Voltage Current Transformer for measuring (VCT)
Transformers and Rectifiers		Feeding Transformer, Distribution Transformer, Rectifier Voltage Transformer for measuring (VT) Current Transformer for measuring (CT)
Facilities of supplying to railway	Feeder	Disconnection Switch, Circuit Breaker for DC Voltage Transformer for DC measuring (DVT) Current Transformer for DC measuring (DCT) Regenerative energy absorbing equipment, Batteries
	Distribution line	Disconnection Switch, Circuit Breaker, VT, CT

Source: JICA Design Team



Source: JICA Design Team

Figure 4.3.30 Example of the Single-Line Diagram

4) General standards and regulations for Substation facilities

The Substation facilities shall be satisfied the following main Standards and Regulations etc.:

- Technical regulatory standards on Japanese railways (TRTRS): 2012
- The interpretation of the technical regulatory standards on Japanese railways: 2005
- IEC 60044-1, JEC 1201-2007 for CT
- IEC 60044-2, JEC 1201-2007 for PT
- IEC 60076 for Power transformer
- JIS C 4304-2013 for Power transformer
- JIS C 4306-2013 for Power transformer
- JEC 2200-1995 for Power transformer
- IEC 60287 for cable current capacity calculation
- IEC 60502 for 1～30kV cables
- IEC 60850 for IEC Railway Applications-Supply Voltage of traction systems
- IEC 60947 for HV and LV switchgear
- JIS C 4620-2004 for HV switchgear
- JEM 1425-2011 for HV switchgear
- JEC 2300-2010 for HV switchgear
- JEC2310-2015 for HV switchgear

- IEC 61992 for IEC Railway Applications Fixed installation –DC Switch gear
- JIS C 8201 for LV switchgear
- JEM 1038-1990 for LV switchgear
- JEM 1265-2006 for LV switchgear
- JEC 2300-2010 for LV switchgear
- JEC 2310-2015 for LV switchgear
- NATIONAL STRUCTUAL CODE OF THE PHILIPPINES 2015

5) Special Specification

The substation facilities shall be took in consideration with the following specifications:

- Receiving facilities: Receiving voltage and protection coordination etc. by the power supply company designation.
- Traction voltage range: Between 1,800V and 1,000V
- Voltage regulation of Rectifier: 6%
- Distribution standard voltage: 6,600 V
- Feeder cable: XLEP cable or equivalent cable with terminal and cable support to Viaduct/Pillar
- Return cable: PVC cable or equivalent cable with terminal and cable support to Viaduct/Pillar
- Substation area: Fence on perimeter, CCTV installation, and supervision at OCC
- Countermeasures for voltage rise by regenerative power:
  - Regenerative power absorb facilities
  - Power storage system for energy conservation

6) Substation Capacity

Substation capacity is determined by power for feeding system and for distribution power system.

a) Preconditions for feeding system

Table 4.3.32 shows preconditions for feeding system.

Table 4.3.32 Preconditions for feeding system

Train headway	5 minutes (Each bound)
Maximum acceleration current	4,000A (Limited Express) 3,200A (Commuter)
Auxiliary power supply capacity of Rolling stocks	600 kVA
Train weight	424 tons

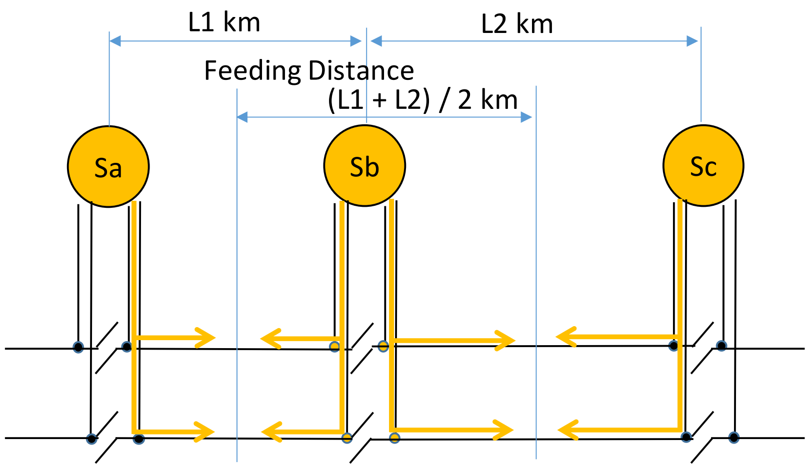
Source: JICA Design Team

b) Estimated rectifier capacity

To determine the rectifier capacity, it has to be calculated the instant maximum power and the one hour average maximum power. The rectifier capacity has to cover both maximum power. And the calculation is considered for the following two cases:

- Normal Operation (Refer to Figure 4.3.31)

  In this case, every substation is working with required conditions and can supply the power to feeders. Figure 4.3.31 shows an example of basic DC feeding system composition. DC is normally parallel feeding method, other than from both ends of the line to the adjacent substation. Section will be required to distinguish feeding areas. For example Substation Sb's feeding distance is (L1+L2)/2.

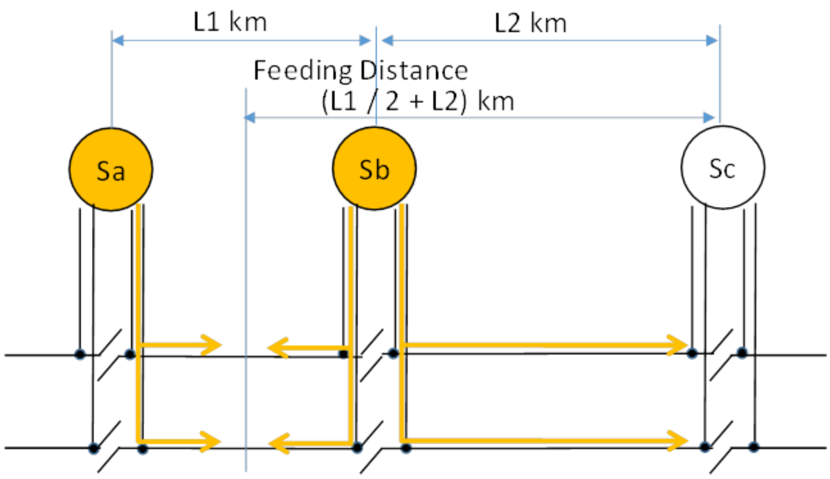


Source: JICA Design Team

Figure 4.3.31 Normal DC feeding composition

- Emergency Operation (Refer to Figure 4.3.32)

  In this case, an adjacent substation is shut down with some reason. Figure 4.3.32 shows an example DC feeding composition. For example Substation Sc is shut down, Sb's feeding distance is (L1/2+L2) which is longer than normal operation and more DC power required as shown Table 4.3.33.



Source: JICA Design Team

Figure 4.3.32 Emergency DC feeding composition

Table 4.3.33 Maximum power of rectifiers

Substation Number	Normal Operation			Emergency Operation		
	Feeding Distance	Maximum Power		Feeding Distance	Maximum Power	
		One hour Av.	Inst.		One hour Av.	Inst.
	(km)	(kW)	(kW)	(km)	(kW)	(kW)
No.S1	5.205	3,946	14,263	7.530	5,709	18,118
No.S2	4.150	3,146	12,358	6.475	4,530	15,583
No.S3	3.675	2,786	11,455	5.525	4,189	14,818
No.S4	3.815	2,892	11,725	5.780	4,382	15,254
No.S5	3.690	2,797	11,484	5.655	4,287	15,041
No.S6	3.680	2,790	11,465	5.635	4,272	15,007
No.S7	3.930	2,979	11,944	5.905	4,477	15,465
No.S8	4.345	3,294	12,720	6.715	5,091	16,809
No.S9	4.750	3,601	13,457	7.130	5,405	17,480
No.S10	4.860	3,685	13,654	7.340	5,565	17,816
No.S11	4.220	3,199	12,489	6.700	5,079	16,785
No.S12	3.665	2,779	11,436	5.590	4,238	14,930
No.S13	3.725	2,824	11,552	5.650	4,283	15,032

Source: JICA Design Team

Table 4.3.33 shows the results of the calculation. Substation S1 shall be required the largest power of all substations for NSRP-south. The capacity of the rectifier is determined based on the maximum power of S1. This capacity is 6,000kW of type D or type E. it is needed more detail calculation which type is better. It is installed two sets of rectifier as active and stand by system, except for the rush hour. In this system, it becomes easy to make the maintenance plan. And even though one of adjacent substation stops, the capacity is enough to supply electric power to trains by managing two rectifiers.

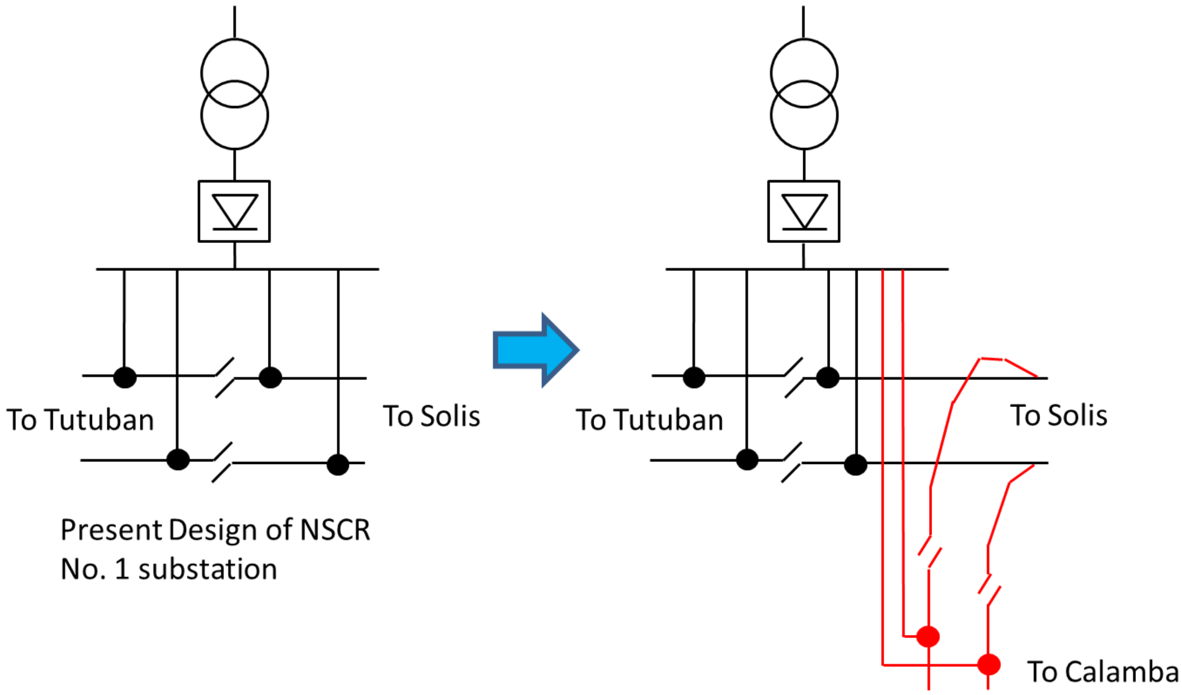
c) Estimated distribution power transformer capacity

According to estimated consumption of stations, signalling house, telecommunication house etc. and possibility of distribution power line distance, the capacity of distribution power transformer at a substation is estimated 3,000 kW or 5,000kW.

JDT will further calculate the distribution transformer capacities of every substation in detail.

d) How to supply NSRP-South line branches from NSCR

NSRP-South line branches from NSCR, between Tutuban and Solis. Power supply to this line from the NSCR No.1 substation shall be studied in this work (Refer to Figure 4.3.33).



Source: JICA Design Team

Figure 4.3.33 Supplying to NSRP-South Line from the NSCR No.1 Substation

In case of precondition showed in Table 4.3.32, by supplying to NSRP-South, feeding power of NSCR No.1 Substation will increase as Table 4.3.34.

Table 4.3.34 Additional feeding power of NSCR No.1 substation

Maximum Power			
Normal Operation		Emergency Operation	
One hour Av	Inst.	One hour	Inst.
about 1,500kW	about 8,000kW	about 4,000kW	about 14,000kW

7) Remote control

Control equipment is installed for operation and protection of main facilities at a substation. Control equipment consists of protective relay, measuring equipment, monitors, detectors, switch gears, display and program controller for configuring logic program. This controller can aggregate measuring data and transmit them to P-SCADA (Power- Supervisory Control and Data Acquisition System) at OCC. P-SCADA protocol is took in consideration the compatibility of the system of NSCR as well.

There are usually no supervisors at substations. Substations facilities are supervised and controlled by P-SCADA. P-SCADA is used by operators at OCC.

8) Reconsideration of substation location with through operation of the subway

Based on discussion with DoTr, MMSP and NSRP-south, the consideration of though operation will be required. Two lines, which are Subway and South line, are connected at Bicutan station.
Since the number of trains increases with through operation, it is possibility of the voltage drop increase, in case of the proposed substation location (Refer to Table 4.3.35). Table 4.3.35 shows the substation location with through operation of the subway. As further study, JDT has to consider the facilities capacities etc. in detail.

Table 4.3.35 Substation location（Case of through operation）

Substation Number	The distance from Solis station
No.S1	4k 800m
No.S2	9k 450m
No.S3	13k 100m
No.S4	16k 145m
No.S5	20k 550m
No.S6	23k 150m
No.S7	25k 450m
No.S8	28k 090m
No.S9	30k 950m
No.S10	33k 850m
No.S11	36k 780m
No.S12	40k 000m
No.S13	42k 800m
No.S14	45k 700m
No.S15	48k 960m
No.S16	51k 500m
No.S17 *	53k 400m

*The south depot is supplied from No.S17 substation because of this substation location near the depot.

Source: JICA Design Team

9) Consideration issues

JDT will further study the following issues:

- Adjustment about receiving facilities specification with power companies

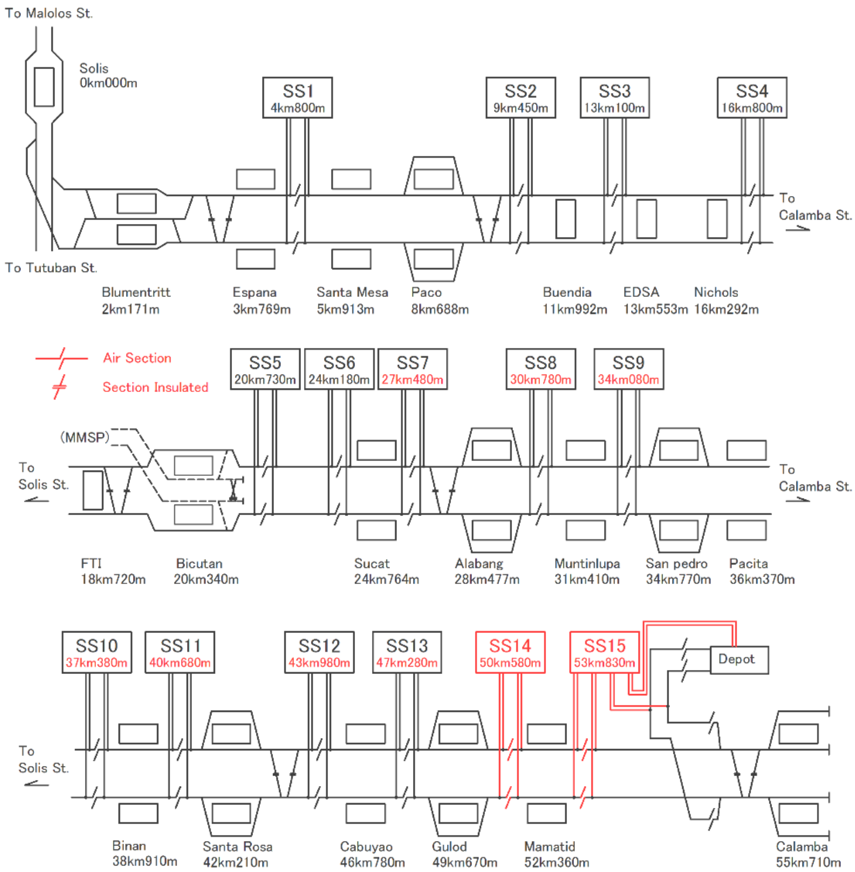
- Capacity calculation for depot
- Power supply upon emergency in detail
- Machine layout, foundation, structures, and electricity house etc. in substations
- Voltage drop countermeasure
- Testing and commissioning
- Training and maintenance
- Substation location and capacity with through operation of the subway

(2) Overhead Catenary system

1) Outline

Overhead Contact System (OCS) is part of this section, a maximum speed is planned 120km/h, and the OCS shall be required its speed.

Supplying voltage is DC 1,500 V at the standard. OCS specifications shall be considered with construction, examinations, synthesis adjustment and maintenance vehicles. Figure 4.3.34 shows the route alignment of NSRP-South.



Source: JICA Design Team

Figure 4.3.34 Route Alignment of NSRP-South

2) Conditions related to OCS

In the consideration to the OCS component and equipment on the basic design, it is required the following several conditions:

- Civil structure and orbit conditions (Refer to Table 4.3.36)
- Rolling stocks characters (Refer to Table 4.3.36)
- Ambient conditions and Environment parameters (Refer to Table 4.3.37)
- Traction voltage conditions (Refer to Table 4.3.38)

Table 4.3.36 Conditions related to the OCS consideration

Items		Solis-Calamba
Civil Structure	Viaduct	43.3 km
	Earthwork section	12.5 km
	Curve radius	More than 300 m
Orbit Specification	Track gauge	1,435 mm
	Rail classification	UIC 60
Train	Maximum speed	120 km/h

Source: JICA Design Team

Table 4.3.37 Ambient Conditions and Environments Parameters

Items	Values
Ambient Temperature	Max. : 40℃ Min. 15℃
Max. Solar radiation value	1kW/m^2
Max. Wind power	54m/s (Consideration to atmospheric pressure and humidity at the Typhoon)
Frequency of lightning	Over 25/km^2/year
Salt damage	N/A
Earthquake resistant Level	Level 2

Source: NSCR Final Report

Table 4.3.38 Traction Voltage condition

No.	Requirements	Basic value	Source
1	Over-voltage	1850V	Ref. of specification in TSS (Traction Substation) and rolling stock
2	Under-voltage	900V	Ref. of rolling stock spec.
3	Design-voltage of minimum voltage at a point pantograph receiving for from the TSS	1000V	

Source: NSCR Final Report

3) Related standard and regulations

The OCS shall be satisfied the following main Standards and Regulations etc.:

- Technical regulatory standards on Japanese railways (TRTRS): 2012
- The interpretation of the technical regulatory standards on Japanese railways: 2005

- JIS E 2001-2002: Electric traction contact lines –Vocabulary
- JIS C 3803: 1977 Glossary of terms for insulator and bushing
- JIS E 4001: 2011 Railway rolling stock-vocabulary
- IEC 60913: 1988 Electric traction overhead lines
- IEC 60059: 1999 standard current ratings and the series
- IEC 60273 Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltages Greater Than 1000 V
- IEC 60287: 2015 Calculation of permissible current in cables at steady state rating and the series
- IEC 60494: 2013 Rolling stock pantographs and the series
- IEC 61000-5-1: 2016 Electromagnetic compatibility (EMC). Installation and mitigation guidelines. General considerations. Basic EMC publication and the series
- IEC/TR 61245: Artificial pollution tests on high-voltage insulators to be used on d.c. systems
- IEC 62561: 2012 Lightning protection system components (LPSC) and the series
- JEC-2374: 2015 Gapless metal oxide arrester

4) Contact line system

a) General contact line system and their characteristics

DC supply system is proposed for the feeder system in previous subsection. The type of contact line system for DC supply shall be studied here. Contact line system is classified into three major types, i.e., i) OCS, ii) Rigid Suspension System and iii) Third Rail System. Outline of these systems is shown in Table 4.3.39.

Table 4.3.39 Outline of Contact Line Sytem

	OCS	Rigid Suspension System	Third Rail System
Current Collection	Stable Current Collection at Higher Running Speed	Less Smooth Pantograph Dynamics Need to many supports	Unstable Current Collection at Higher Running Speed
Running Speed	More than 100 km/h	Maximum Approx. 100km/h	Maximum Approx. 80 km/h
Maintenance Work	Maintenance Work at Higher Place	Easy Maintenance for RSS and Track work	Easy Maintenance but Danger of Electrical Shock at Track Work
Electrical Shock Accident	Less	Less	Protection for Electrical Shock Required
Initial Investment	High	High	Low
Natural Disaster	Affected by Strong Wind and Earth Quake	Depend on the location	Less Affected by Strong Wind and Earth Quake
Impact on Urban Landscape	Impact on Surrounding Landscape	Depend on construction location	Small Impact on Surrounding Landscape
Section to be adopted	Tunnel, At-grade and Elevated Section	Tunnel Section	Tunnel, At-grade and Elevated Section

Source: JICA Design Team

Because of the maximum speed in NSRP-South, at the maximum 120 km/h, OCS is to be adapted.

A special attention is needed in OCS, which requires sufficient followability of pantographs as the train speed increases. There are several types of OCS structure. Table 4.3.40 shows some of these representative structures.

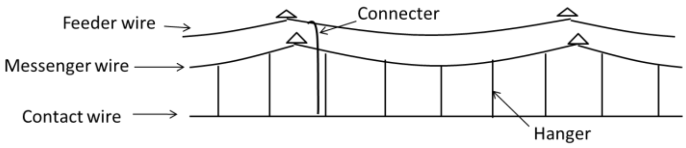
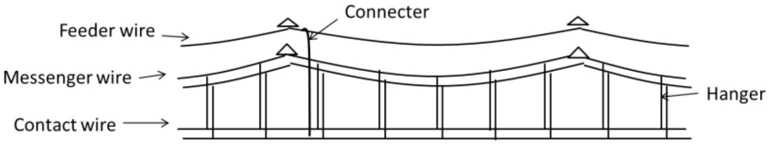
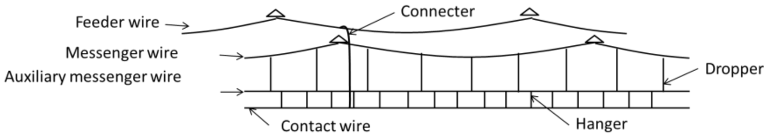
Simple catenary is used for train speed about 100km/h or/and moderate frequency of train services. This catenary requires generally feeder to prevent significant drop of supplying voltage and to secure enough current capacity and permissible temperature of contact wires. This structure is also simple and has an advantage of lower cost.

As the train speed or the service frequency increases, compound catenary is adopted in Japan. This catenary structure is a bit complex. The construction cost and maintenance cost become higher than simple catenary.

Twin simple catenary comprises two simple catenaries installed in parallel. This catenary is applicable to sections where train service frequency changes from middle to high. This system can reduce the additional equipment cost for increasing load capacity. However, it requires complexed structure. Hence, maintenance is difficult and requires higher cost. This catenary is not suitable for new line construction.

Overhead rigid conductor rail system comprises a formed rigid aluminium conductor profile with a catenary wire inserted at the bottom. The system has a disadvantage of contact loss at pantograph in high speed operation. Moreover, it is required many supports to consider deflection of the rigid casing. On the other hand, from its simple configuration, it is advantageous for easy maintenance, less risk in wire cut and less space requirement overhead, which enables smaller diameter of tunnel works. Because of these advantages, it is widely applied to tunnel sections of subway, etc., without high speed operation.

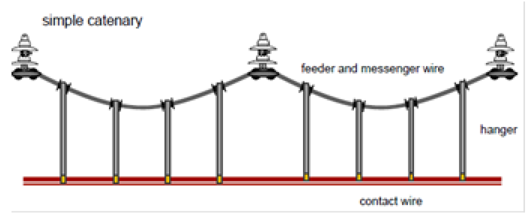
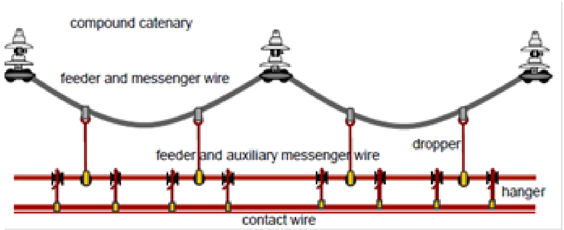
Table 4.3.40 Outline of OCS

Overhead Catenary System	Usage
Simple catenary 	Train density: Middle Train speed : Middle (Less than about 120km/h) Workshop/Depot
Twin simple catenary 	Train density: High Train speed : Middle (Less than about 120km/h)
Compound catenary 	Train density : High Train speed : High (More than 100 km/h)
Overhead rigid conductor rail system 	Subway without high speed operation (less than 80km/h)

Source: JICA Design Team

The feeder messenger system is one of overhead catenary systems. The wire of this system functions both as messenger and feeder (Refer to Table 4.3.41). In Japan, this system is adopted in narrow tunnels, etc. With the development of tension balancer, this system is widely used for replacement of twin simple catenary system for its simple configuration. The system requires less number of wires than other catenary systems and enables cost reduction in construction and O&M. It also has a simple appearance preferable from an aesthetic point of view. It has been widely used for DC traction system and applied to a high speed operation at 160km/h in Narita-Airport access line.

Table 4.3.41 Feeder-Messenger Catenary System

Feeder-Messenger Catenary System	Usage
	• Use messenger as feeder. In case of current capacity shortage, two feeder-messengers are installed in parallel. • Spread as a simple integration of twin simple catenary system. • Adoption to new lines construction
	• Use messenger and auxiliary messenger as feeders. • Realization of 160km/h operation, in the Narita-airport access line which "Keisei sky liner" is running.

Source: JICA Design Team

In view of the above, the feeder messenger system is proposed in this project considering lower cost in construction and maintenance and its simple facilities. Table 4.3.42 shows its catenary system in each section.

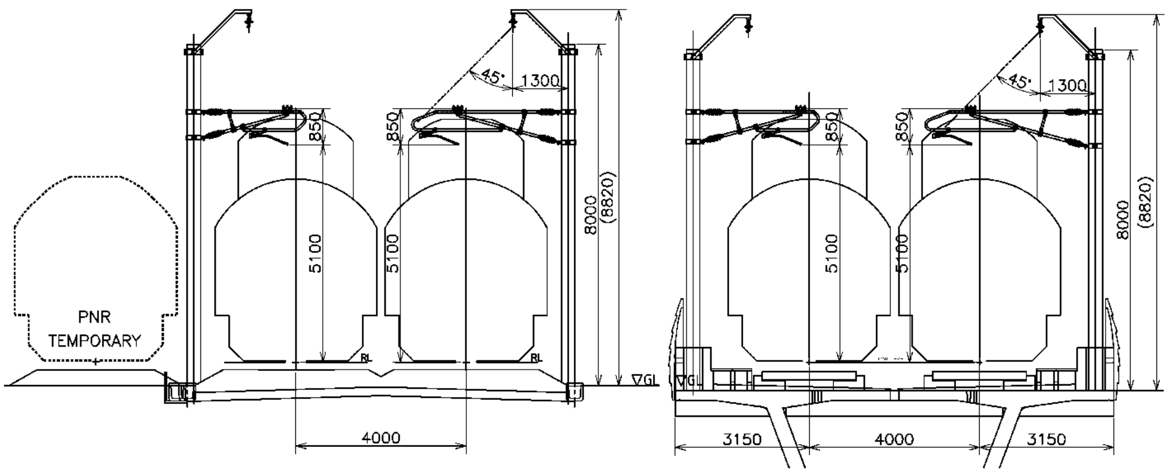
Table 4.3.42 Catenary System in each Section

Section	Planned Operation Speed	Applicable Catenary System
Main Line -Open Section	120 km/h	Feeder messenger simple catenary system M: PH 356 (19.6 kN) × 2-Tr: GTM 170 (14.7 kN)
Station Sub Line, Crossover Line	- -	Feeder messenger simple catenary system M: PH 150 (14.7 kN) - Tr: GTM 170 (9.8 kN)
Access tracks	- -	Feeder messenger simple catenary system M: PH 356 (19.6 kN) -Tr: GTM 170 (9.8 kN)
Depot	- -	Simple catenary system M: St 90 (9.8 kN) - Tr: GT 110 (9.8 kN)-F : H325(11.8kN)

Source: JICA Design Team

b) Structure Chart

In the general method, feeder wire is installed above the catenary. Pole is required the length for a feeder supporting arm. However, feeder messenger catenary system is not required its length, because the wire of this system functions both as messenger and feeder. That is why Pole length can become shorter at least 1 m and more. Figure 4.3.35 shows the structure charts.



Standard of AT-Grade Section **Standard of Viaduct Section**

Source: JICA Design Team

Figure 4.3.35 Structure chart of overhead catenary system

c) Span of OCS poles

Table 4.3.43 shows the standard span of OCS poles. It is determined with consideration of a contact wire deviation at the curve section.

Table 4.3.43 Standard OCS pole span

Section	Standard span
Straight section	40 m
Curve section	Variation according to curve radius
Special section	Maximum 55 m

Source: JICA Design Team

d) Contact wire height

Table 4.3.44 shows Standard contact wire height of OCS from the rail level.

Table 4.3.44 Standard Contact wire height

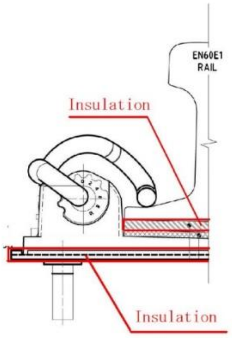
Section		Standard Contact wire height
Open section		5,100mm (Max. 5,200mm / Min. 4,600mm)
Tunnel section		4,600mm (Max. 4,700mm / Min. 4,550mm)
Depot	Stabling rolling stock	5,100mm (Max. 5,200mm / Min. 4,600mm)
	Repair house	5,300mm (Max. 5,400mm / Min. 5,250mm)

Source: JICA Design Team

e) Return Circuit

Rail is a part of electrical circuit, and called return circuit. In general, there is an insulation resistance between the rail and the ground. However it may decrease by ambient environment. In this case, a leakage current flows through the ground. This current is one of the factors causing electrolytic corrosion of the buried pipe etc. Return cables are installed along with tracks and it is connected the rails not to be flow the leakage current. In Japan case, double insulated track fasteners shown in Figure 4.3.36 are adopted as countermeasure of the leakage current. Table 4.3.45 shows the insulation performance of the rail and this fastener. The leakage current doesn't flow by these resistances difference. It has become unnecessary that return cables are installed along with tracks by this fastener.

For NSRP-South, it is proposed to adopt this fastener, as the reduction of construction cost.



Source: JICA Design Team

Figure 4.3.36 Double insulated track fastener

Table 4.3.45 Insulation performance

Contents	**Type**	Resistance value
Rail	UIC 60	0.0262 Ω/km
Between Fastener and ground	--	140 Ω/km

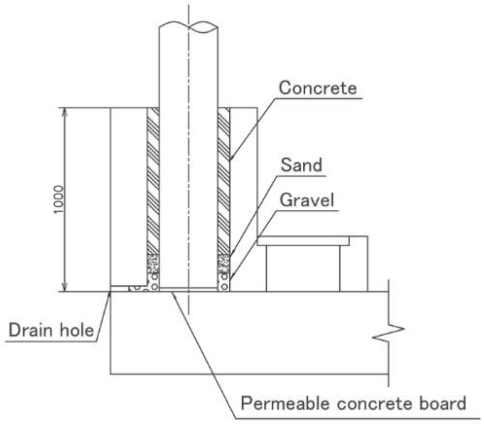
Source: JICA Design Team

f) Poll foundation and pole

There are two types of pole foundation, one is the bolt type and the other is the open dump type. In civil work, the Open dump type foundation is more efficient than bolt type foundation. In the case of the open dump type foundation, there is a gap between a pole and a foundation. It has to be filled to fix the pole. The filling methods are two types, one is filling sand and packing mortar, and the other is filling concrete.

The Filling sand and packing mortar method has to be done maintenance of the mortar packing, because it may be cracked. On the other hand, the filling concrete method is unnecessary to be done maintenance and is applied to the new earthquake resistant design as well. Figure 4.3.37 shows the pole foundation schematic.

The Pole of the OCS shall be adopted a steel pipe column, because of lightweight, toughness and avoiding resonance phenomena.



Source: JICA Design Team

Figure 4.3.37 Pole foundation (Viaduct section)

g) Guy

Guy shall be installed for reinforcement at the detention pole.

h) Automatic Tension Balancer

Every wire expands and contract depended on ambient temperature. The tension of wire has to be maintained constantly, because of not slacking contact wire. Automatic tension balancer shall be installed. Table 4.3.46 shows the type and classification of the balancer.

Table 4.3.46 Type and use classification of Automatic tension balancer

Type	Use classification	How to use
Automatic tension balancer Spring type	For simple catenary type 53.9kN	If catenary length is 800 m or more, both, If catenary length is less than 800m, Attach it to one end of catenary.
	For simple catenary type 24.5kN	
	For simple catenary Type19.8kN	
Manual tension device	Wire turnbuckle	Attach to the active side at both ends of the feeder messenger, auxiliary messenger and contact wire.

Source: JICA Design Team

i) Measure against Lightning

Protective wire and arresters shall be installed for protecting the OCS from lightning.

The standard interval of arrester nitration is 500 m or less.

j) Disconnecting Switch and Rail Leakage Current Suppressing Device in the Depot

In the depot, a disconnecting switch shall be installed for rolling stocks maintenance. Table 4.3.47 shows disconnecting switch type of each location.

A rail leakage current suppressing device shall be installed at each track in depot, if necessary.

Table 4.3.47 Disconnecting Switch Type

Location	Drive system		Pole		Remark
	Manual	Motor	Mono	Twins	
Access line	○		○		For electricity classification
Stabling rolling stock	○		○		
Train preparation Automatic car body washer	○		○		
Unscheduled Repair		○		○	
Wheel re-profiling		○		○	

Source: JICA Design Team

5) Planning to directly connected the subway

There is a plan to directly connected subway (MMSP) to Bicutan station, detailed investigation is necessary along with the addition of substation and the change of route plan.

6) Further issues to be studied

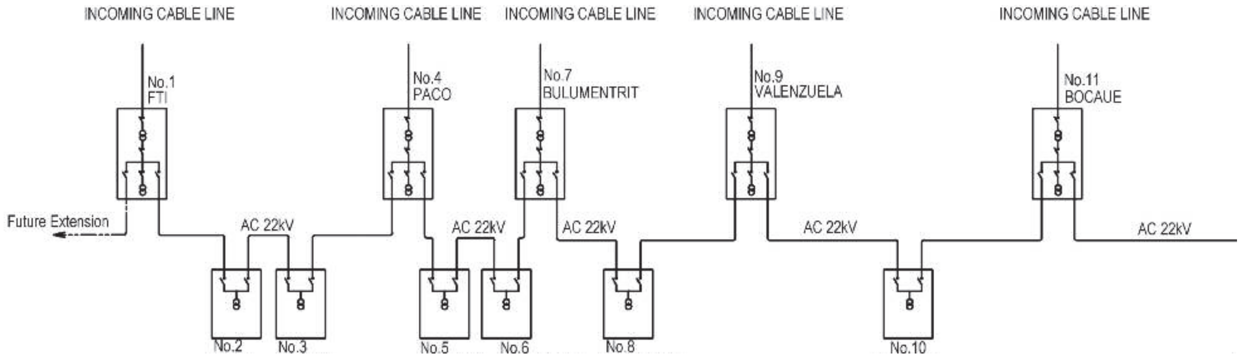
JDT will further study on details as follows:

- Pole foundation structure and load calculation.
- Study for seismic design method of OCS pole.
- Power system of Depot.
- Sign type and shape.

(3) Power distribution system

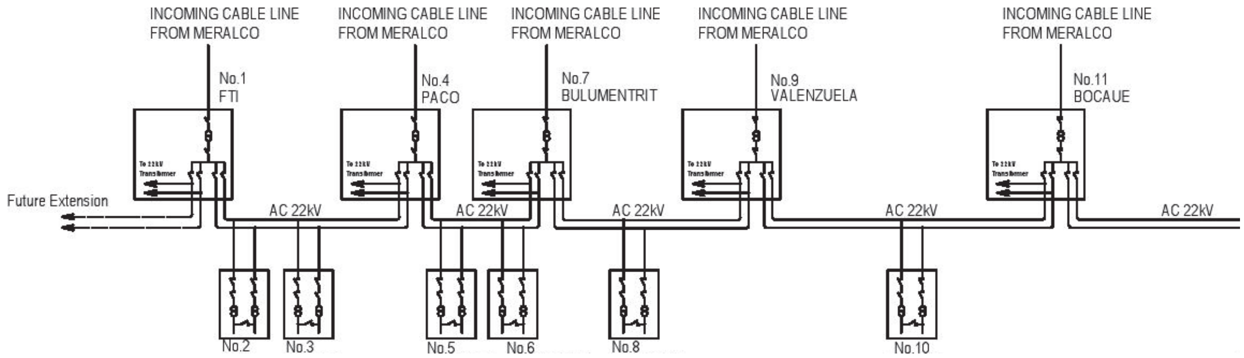
1) Power distribution system outline

B For NSCR 6.6 kV power distribution is adopted and standardized step-down transformer from 34.5kV to 6.6kV is selected for this possible. The same distribution system is one of the candidates for this project. The power distribution system is installed along with the tracks and supplies power to the load of stations, signalling houses, telecommunication houses, equipment for depot and buildings related for railway operation etc. Two types of power distribution system are considered applicable to this project. One is loop system, and the other is parallel system. They are schematically shown in Figure 4.3.38 and Figure 4.3.39, respectively. The loop system has advantages in its lower cost than the parallel system and existing use in the Philippines. If more reliability is required, the parallel system should be considered. In this project, JDT will follow the distribution method of NSCR and propose the loop system.



Source: JICA Design Team

Figure 4.3.38 Example of Loop Type Power Distribution System



Source: JICA Design Team

Figure 4.3.39 Example of Parallel Type Power Distribution System

For the NSRP-South, the power distribution system is proposed the loop type for following reasons:

- Simple network
- Easy operating and maintenance, because of existing system in Philippine
- Lower construction cost

2) General Standards and regulations for power distribution system facilities

The power distribution system facilities shall be satisfied the following main Standards and Regulations etc.:

- Technical regulatory standards on Japanese railways (TRTRS): 2012
- The interpretation of the technical regulatory standards on Japanese railways: 2005
- IEC 60044-1, JEC 1201-2007 for CT
- IEC 60044-2, JEC 1201-2007 for PT
- IEC 60076 for Power transformer
- IEC 60287 for cable current capacity calculation
- IEC 60502 for 1～30kV cables
- IEC 60598 Classification of an illuminator
- IEC 60850 for IEC Railway Applications-Supply Voltage of traction systems

- IEC 60947 for HV and LV switchgear
- JIS C 4304-2013 for Power transformer
- JIS C 4306-2013 for Power transformer
- JIS C 4620-2004 for HV switchgear
- JIS C 8201 for LV switchgear
- JEC 2200-1995 for Power transformer
- JEC 2300-2010 for HV and LV switchgear
- JEC 2310-2015 for HV and LV switchgear
- JEM 1038-1990 for LV switchgear
- JEM 1265-2006 for LV switchgear
- JEM 1425-2011 for HV switchgear
- NATIONAL STRUCTUAL CODE OF THE PHILIPPINES 2015

3) Special specification

The distribution power system facilities shall be took in consideration with the following specifications:

- Distribution standard voltage: 6,600 V for primary, 400V or 230V for secondary, 60Hz frequency.
- Distribution power system for High voltage : 3-phase 3 wire system
- Distribution power system for Low voltage : 3-phase 4 wire system
- Voltage regulation rate for 6,600 V : Within 10 %
- Distribution power line shall be used Cables.
- Cables shall be installed in troughs or ducts etc.
- Transformers are required a manual tap changer for adjusting voltage.
- Transformer capacity shall be determined in consideration with load demands of supplying facilities
- Power supply system shall be separated operating facilities like signalling system and telecommunication system, and other facilities like stations.

4) Demarcation in stations and buildings

The scope of work for distribution power system is to supply power to the load of stations and buildings related for railway operation etc. Distribution power system construction shall be based on the demarcation shown in Table 4.3.48.

Table 4.3.48 Demarcation in station and buildings

		Facilities for 6,600V	MDB* for Low voltage	Cable between MDB and each DB**	DB	Cables for electrical facilities	AC***	LS****
In station	Electrical Room	D	D	A	A	A	A	A
	Signalling room	-	-	D	D	S	A	A
	Telecommunication Room	-	-	D	D	T	A	A
	Electrical Facilities for stations	-	-	A	A	A	A	A
Independence	Electrical house for operating facilities	D	D	D	D	D	A	D
	Signalling house	-	-	D	D	S	A	D
	Telecommunication house	-	-	D	D	T	A	D
Buildings		D	D	A	A	A	A	A
*	MDB : Main Distribution Board							
**	DB : Distribution Board							
***	AC : Air Conditioner							
****	LS : Lighting system							
D	distribution power system work							
A	Architecture work							
S	Signalling system work							
T	Telecommunication system work							

5) Outside Facilities in the Depot

It shall be required lighting system for the access roads of each building and for the corridors for drivers in stable tracks, as distribution power system work.

The following equipment as well is installed in the Depot.

- LED ON OFF indicator (outdoor large size).
- LED ON OFF indicator (indoor large size) height
- LED ON OFF indicator (indoor small size) under food hold
- Power simple disconnection container and return automatic switching arrangement
- Check stand ascent and descent door on the roof
- Disconnection container investment warning (flashlight)
- Disconnection container investment warning (buzzer)

6) Emergency Generator and Building Facilities

OCC and Nichols station shall be required to install emergency generator for disaster prevention, fire and outage of electric power company.

Nichols station is planned as the underground station and there is about 2 km tunnel section. In the tunnel section, drainage pump and lighting etc. equipment are required. Therefore, it has to be considered how to supply equipment.

4.3.6 Signalling System

(1) Premise of Signalling system and target line

1) Target line; Blumentritt St. to Calamba St. (20 stations, 55.710km)

2) Maximum operation speed; 120km/h

3) Target train traffic density; 5 min. headway

4) Vehicle formation; 8-car formation (10-car formation in future)

5) Train driving direction; Right side

6) Reverse direction operation; No reverse direction operation. .(under consideration)

7) Single track parallel operation; Not carried out.

8) Limited Express operation; Implementation. Plan to overtake at Solis St. to Alabang St.

9) Emergency operation; Returning at the station on the way

10) Mutual direct operation; Needed mutual direct operation with NSCR, MCRP and MMSP.

11) Train operation;
    - Main line to Depot access line; One driver operation with ATO
    - Depot; One driver manual operation without ATO

12) Operation way in Depot;
    (i) Control up to Depot access line by ATO. However, taking into consideration the conditions of the track layout. The final control range is decided at Detail/Design phase. From the Depot access line to the stabling yard; One-driver manual operation by the ATP on board signal without ATO.
    (ii) From the Depot access line to the stabling yard; One-driver manual operation by the ATP on board signal without ATO.
    (iii) From the Stabling yard to the factory and the maintenance line; With manual operation in Depot mode. In Depot mode, the driver performs manual operation according to the display of the shunting signal installed on the track side.

13) Fixed point stop: Fixed point stop control by ATO is required.

14) Train protection device: Install a push button for train protection on the platform, and transmit emergency stop signals from the ATP ground device to the target train by operation of passengers and station staff. (Handling of emergency button is under consideration.)

15) OCC (Operation Control Center) building; Installation in Depot area.

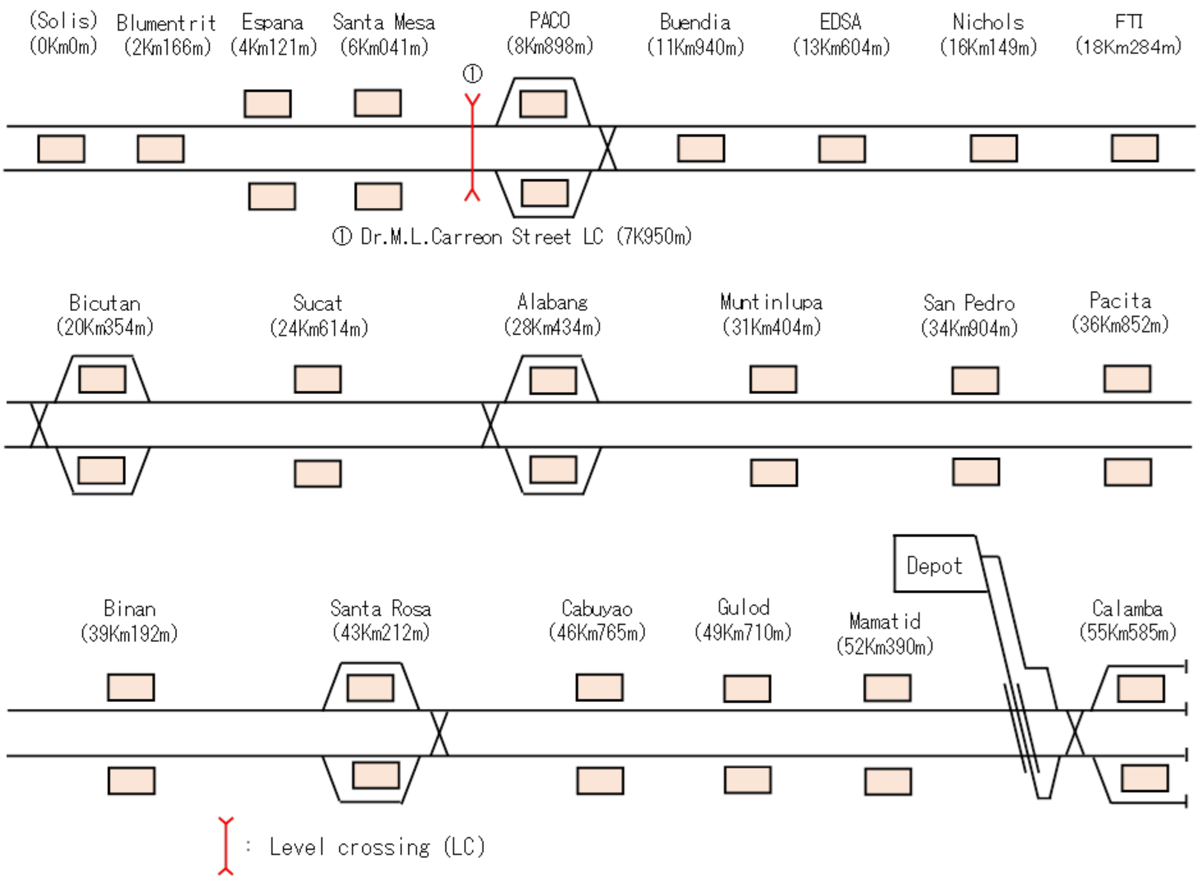
16) OCC room; Installation in OCC building.

17) CER (Central Signal Equipment Room); Installation in OCC building.

18) SER (Station Signal Equipment Room); Installation in Stations with turnout and stations without turnout.

19) Measures against power failure: Installation UPS as a measure against power failure for OCC, CER equipment and station signal equipment.
    (i) For OCC, CER equipment; Since it switches to emergency power supply in case of power failure or outage, 30 minutes UPS power supply is installed in CUR (Central signal UPS Room).
    (ii) For SER equipment; Since there is no emergency power supply in case of power failure or outage, 3 hours UPS power supply shall be installed in SUR (Station signal UPS Room).

20) Target line and station layout is shown in Figure 4.3.40.



Source: JICA Design Team

Figure 4.3.40 Target line and station layout

21) Stations with turnout; 5 stations (Paco St., Bictan St., Alabang St., Santa Rosa St., and Calamba St.)

    Stations without turnout; 15 stations (Blumentrit St Espana St., Santa Mesa St., Buendia St., EDSA St., Nichols St., FTI St., Sucat St., Muntinlupa St., San Pedro St., Pacita St., Binan St., Cabuyao St., Gulod St.,and Mamatid St.)

22) Depot;
    - (i) Signalling equipment is installed to CER (Central Equipment Room) in OCC building in Depot.
    - (ii) Power system for OCC and CER equipment are installed to CUR (Central UPS Room).

23) Level crossing is to be installed at one point. between Santa Mesa St. and Paco St. (See Figure 4.3.40) Dr.M.L.Carreon Street LC (7K950m)

(2) Basic concept and Standard

In the signalling system, the following specified standards are referred to. Consider the contents of these standards.

1) Design Criteria and Standard

<Design Criteria>

(i) CBTC shall be used as ATP (Automatic Train Protection).

(ii) Train detection;
   - a) For stations with turnout; it is assumed to be the track circuit detection.
   - b) For Depot; it is assumed to be the track circuit detection.
   - c) For Main line / stations without turnout; it is assumed to be CBTC detection (counting distances by tachometer on the train, and correction by Balise (absolute point) on the ground.

(iii) Detection of the broken rail:

Since the track circuit is laid in the station with turnout and Depot, the broken rail detection is possible. There is no track circuit for train detection for the main line / stations without turnout, so the broken rail detection cannot be performed. Therefore, a track circuit of about 1 to 2 loops between stations is installed for the broken rail detection.

(iv) Backup when CBTC fail;

As a backup system at CBTC failure, make one train in a track circuit loop between stations to operate.

(v) In CBTC, the communication between the train and the ground ATP equipment shall be based on 2.4 GHz radio communication.

(vi) The ATP system shall satisfy the operation of 5 minutes interval headway.

<Design Standard>

For the Signalling system, the following specified standards shall be applied.

(i) CBTC standard; IEEE 1474.1 shall be applied.

(ii) The other system and equipment; JIS or EN/IEC shall be applied.

(iii) Common to the whole system; EN/IEC shall be applied for RAMS, Safety and EMC standard.

<JIS standard>

(i) Ministry Ordinance, Technical Standard regarding Railway, MLITT

(ii) JIS: Japanese Industrial Standard

(iii) JEITA: Japan Electronics and Information Technology Industry Association

<EN/IEC standard>

(i) ISO: International Standards Organization

(ii) EN: European Norm

(iii) ETCS: European Train Control System

(iv) EIRENE: European Integrated Radio Enhanced Network

(v) ETSI: European Telecommunications Standards Institute

(vi) IEC: International Electro-Technical Commission

(vii) IEEE: The Institute of Electrical and Electronics Engineers, Inc. (in the USA)

For the Signalling system, the following specified standard shall be referred. The contents on these standards shall be considered.

<EMC related>

(i) EN 50121/IEC 62236 Railway applications- Electromagnetic compatibility

<Safety, RAMS related>

(i) IEC 61508 Functional safety of electrical/electronic/programmable electronic safety –related systems

(ii) EN 50126/IEC 62278 Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS)

<Other EN/IEC standard>

(i) EN 50128/IEC 62279 Railway applications- Communication, Signalling and processing systems – Software for railway control and protection systems

(ii) EN 50159-1/IEC 62280-1 Railway applications – Communication, Signalling and processing systems – Part 1: Safety-related communication in closed transmission systems

(iii) EN 50159-2/IEC 62280-2 Railway applications – Communication, Signalling and processing systems – Part 1: Safety-related communication in open transmission systems

(iv) EN 50129/IEC 62425 Railway applications - Communication, Signalling and processing systems - Safety related electronic systems for Signalling

(v) IEC 62427 Railway applications - Compatibility between rolling stock and train detection systems.

(vi) IEEE1474.1

<Other IEC/JIS standard>

In case to comply with the JIS standard system, it is needed to apply the following standards or equivalent or higher standards.

IEC61000,IEC60364,IEC60529,IEC60947,IEC62498,JIS E 3001,JIS E 3003,JIS E 3011,JIS E 3013,JIS E 3014,JIS E 3015,JIS E 3017,JIS E 3018,JIS E 3019,JIS E 3020,JIS E 3021,JIS E 3022,JIS E 3031,JIS C 3102,JIS E 3303,JIS C 3401,JIS C 3605,JIS H 8641.

2) System Assurance

System assurance to ensure that the requirements for safety, reliability, availability, and maintainability (RAMS) for Signalling system shall be carried out.

System assurance activities shall include RAMS activities and the preparation of all supporting documentation. System assurance activities shall comply with the requirement in accordance with EN50126 or IEC62278 Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS).

System RAMS plan and its associated RAMS analysis shall be undertaken at system level to demonstrate the reliability, availability, maintainability and safety plan.

RAMS report including the internal audit result by the CONTRACTOR's organization and audit by third party specialist shall be submitted.

The report indicating that the safety of ATP system with CBTC and Interlocking (CBI) system satisfies SIL4, including the internal audit result by the CONTRACTOR's organization and audit by third party specialist shall be submitted. Also SIL4 shall be applied to ORP (Over Run Protection), FSP (False Starting Protection) and TSR (Temporary Speed Restriction).

3) RAMS Index

The Signalling system failure of more than 30 minutes interrupting the train operation shall be less than 0.5/year.

(i) Availability Target:
   a) ATP (Ground Equipment), CBI; 99.99 %
   b) ATP (On board Equipment);99.99 % (for each train)
   c) ATS; 99.98%

(ii) Maintainability Target: MTTR: 1.5Hr

It shall be ensured that the Signalling system meets this value based on the reliability calculation.

4) Safety Requirement

Signalling system consists of main components as follow;

(i) Automatic Train Protection System – ATP*1 (Ground system and On-board equipment)

(ii) Train Detection System – TD*1

(iii) Computer Based Interlocking System –CBI*1

(iv) Automatic Train Operation—ATO *2

(v) Automatic Traffic Supervision System – ATS*2

(vi) ORP (Over Run Protection)*1

(vii) FSP (False Starting Protection)*1

(viii) TSR (Temporary Speed Restriction)*1

(ix) Level crossing system*1

Safety design concept shall be applied according to RAMS standard.

*1; Vital component; SIL4 shall be applied.
*2; Non vital component

Concerning the safety of the Signalling system, EN 50129/IEC 62425 shall be referred.

The safety level of TD system, ATP system with CBTC and Interlocking system (CBI) shall satisfy the SIL4 in IEC 61508.

The safety principle material related to the above systems shall be made and submitted.

Each expected failure rate related to the above systems shall be calculated and respectively show the safe failure and hazard failure.

It shall be required to be accompanied by the internal audit material by the CONTRACTOR’s organization or third party specialist audit.

A frequency allocation from the relevant authority shall be obtained if necessary.

5) Reliability Requirements

With respect to the sub-systems that interfere with the train operation in case of system failure, reliability shall be enhanced with the redundant method.

The reliability calculation sheets concerning all sub-systems in the Signalling system shall be submitted.

6) Maintenance Requirements

Fundamentally, the system shall be designed based on low maintenance requirements

The monitoring system shall be conducted in order to support the maintenance staff to focus on the failure with journal data of transmitting/receiving signal level record and operation record.

7) Electromagnetic Compatibility (EMC) Requirements

The EMC of signalling system after the installation of these systems shall be evaluated.

The EMC evaluation stated above shall be carried out complying with EN50121/IEC62236.

The signal and noise level shall be measured especially in the site near the substation.

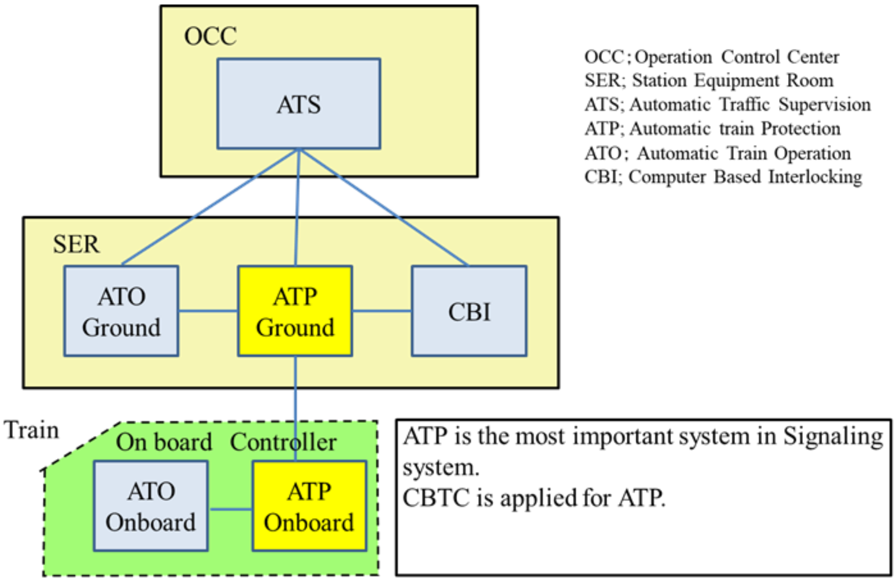
The EMC based on this measured data shall be evaluated.

The data confirmation shall be submitted to the Employer for approval after site testing.

(3) Signalling system outline

1) Signalling system configuration

The configuration of general signalling system is shown in Figure 4.3.41.



Source: JICA Design Team

Figure 4.3.41 Signalling system configuration

2) Main function of Signalling system

The functions of the main subsystems (ATP, ATO, CBI, and ATS) of the signalling system is shown in Table 4.3.49.

Table 4.3.49 Main function of signalling system

Subsystem	Function	Comment
ATP(Automatic Train Protection)	ATP carries out automatic brake control cooperated between ground equipment and onboard equipment in order to ensure safety to avoid trains collision.	SIL 4 is applied
ATO(Automatic Train Operation)	ATO controls all phases of train operation from acceleration to precise stopping, cooperated with ATP which only controls braking to ensure safety.	
CBI(Computer Based Interlocking system)	CBI set and lock routes related to each train located in an area under its responsibility, in order to ensure safety.	SIL 4 is applied
ATS(Automatic Traffic Supervisory)	ATS carries out train tracking, monitoring of train and traffic, route control, diagram management, and rescheduling of diagram when diagram is disturbed.	

SIL4; Safety Integrity Level 4, Dangerous side failure rate; below10-9/h

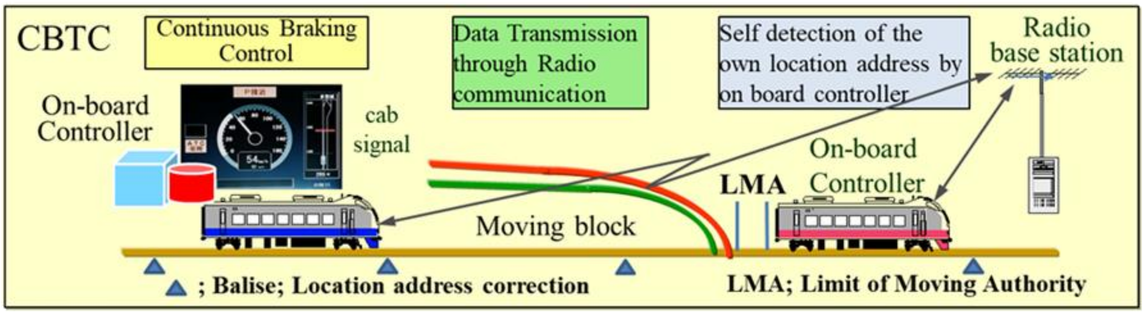
Source: JICA Design Team

3) Automatic Train protection (ATP)

The most important system in the signalling system is ATP (Automatic Train Protection). CBTC (Communication Based Train Control) is applied, CBTC is the latest technology for urban railway which is a state-of-the-art signalling system that uses radio communication.

a) Outline of CBTC

Overview of CBTC is shown in Figure 4.3.42.



Source: JICA Design Team

Figure 4.3.42 Outline of CBTC

In CBTC, radio communication is used instead of track circuit. The preceding train detects the own train position, and the on board equipment transmits the data to the following train by radio communication through CBTC ground equipment. The following train controls the brake pattern so as to stop until the front of LMA (Limit of Moving Authority). This is not the fixed block system, and it is the moving block system.

CBTC is State of art technology in Signalling system, and today it is being introduced to many urban railways in the world.

b) Key issue of CBTC

a. Broken rail detection.

Broken rail may cause a serious accident. No problem in conventional ATP because of using Track circuit (TC).

In case of CBTC, Basically TC is not used. (Partially used in Turnout station and Depot.) Then how to realize this function is important issue. But broken rail detection is realized by the introduction of a simple TC structure (1 or 2 loop between stations) for even TC unnecessary area (station without turnout and main line).

b. Back up when CBTC fails or unavailable.

CBTC shall be a reliable system. However, if the CBTC fails, it is necessary to provide a minimum backup system.

As the backup system of the train detection means, the track circuit is installed 1 or 2 loops between the stations, as for train detection, there is a proposal of an axle counter other than the track circuit, but in this case, it is decided to introduce a track circuit considering broken rail detection.

c. Strengthening means for 2.4GHz Radio Communication

In case of CBTC, as general purpose radio frequency 2.4 GHz is used, this frequency band may be disturbed, then the following means are adopted. Radio communication security measures consistent with the features of the proposed CBTC shall be adopted. The following is an example of radio communication security measures.

(a) Radio transmission enhancement measures;

- Measures to improve the radio propagation performance.
- Frequency changing, Receiving position changing, and Time changing (Twice transmission) etc.

(b) Improvement of security

- Encryption; AES,
- Authentication technology; ISO/IEC9798-2

d. Safety and Reliability

(a) Vital (Critical) component; SIL4 is applied-----ATP, CBI

(b) SIL4 (Safety Integrity Level 4); Dangerous failure rate 10-9/h or less.

c) ATP system (CBTC) Evaluation Summary

CBTC is generally capable of the 90 seconds interval headway operation for the signalling system (assuming no facility constraints).

Since CBTC uses radio communication for data transmission, compared to Digital ATP that performs data transmission through the track circuit, installation and maintenance costs of the ground facilities are small.

CBTC has a lot of experience in urban railways around the world, and Japanese manufacturers have also gained experience of CBTC, so the application of CBTC is appropriate as the ATP system of NSRP-South.

However, NSRP-South is planning mutual operation with NSCR and MCRP. Consistency with the signalling system related to the mutual operation must also be considered.

d) ATP system (Ground system, On-board equipment)

(a) On-board ATP equipment shall calculate the continuous brake profile with information from Ground ATP system to continuously control brake application.
(b) Communication method between On-board and the ground should be with Radio Frequency (RF).
(c) The headway calculation for implementing train headway of 5 minutes at Solis St. and Calamba St shall be submitted for Employer's Representative approval.
(d) The Cab signal layout, DMI (Driver Machine Interface) and design of operation mode switch shall be submitted.
(e) The operation method by ATP (operation mode, interface etc.) shall be considered and adjusted with the Rolling stock team.

e) Data Transmission System

The aim of the Data Transmission System is a bi-directional, reliable, and secured data exchange between OCC and station signal equipment and wayside equipment.

The data transmission between Ground Signalling system and On-board equipment shall be realized by 2.4GHz Radio communication system.

These optical fiber cable shall be provided by Communication system.

4) Train Detection system (TD)

(i) Train detection at CBTC is the on-board detection method. Based on Balise on the ground, measure the traveled distance by a tachometer of on board equipment and find the position of the train. In the case of a tachometer, there is a possibility of errors due to slipping of wheels and so it is necessary to use a correction by Balise in combination.

(ii) Besides this, there are methods such as correction by Doppler radar or correction by wireless. Since these differ according to the CBTC method, the bidders need to propose the required technology at the time of bidding.

(iii) SIL 4 must be applied since the train detection system is an important structural component of ATP and is a vital component.

(iv) Train detection system in station with turnout, Depot access line and Depot
  a. Track circuit is applied.

(v) Train detection system in main line and station without turnout
  a. CBTC detection is applied.
  b. Track circuit is installed to main line and station without turnout as a backup system which is 1 or 2 loop between stations is installed in case of CBTC failure or unavailable.

(vi) The track circuit shall withstand train acceleration current DC 1500 V, maximum current 4200 A.

(vii) The train detection device shall conform to EN 50121 / IEC 62236 in order to prevent induction by induction action or the like.

(viii) Broken rail detection by track circuit is applied to all rails except the maintenance line.

(ix) To keep the track circuit resistant to lightning surge, install arresters, varistors, etc. in the equipment.

5) Automatic Train Operation system –ATO

(i) Outline of ATO

ATO in this project have two main functions, PSD control and running control. Regarding PSD control, the PSD control device in this section refers to devices for ensuring PSD control interlock and transmission between the ground and onboard. And can prevent misoperations by the crew member.

Meanwhile, ATO shall control departing at platform and running between stations and stopping at fixed position in platform automatically, and shall provide not only high stop accuracy for fixed position but also comfortable cruise for passengers in any situations.

(ii) Function of ATO

i) PSD control

ATO shall control PSD by electromagnetic coupling, between onboard antenna and on-grand antenna for PSD control installed between rails, which enable control information and status information send/receive.

a) Interlocks for PSD control

PSD control passenger shall not endanger passengers, by interlocks. The basic matters to be observed for interlocks of PSD control are as follows.

A. PSD control shall be valid when train stop fixed position and, is not commanded for propulsion and, stop solidly by brake force.
B. PSD control shall be initiated by door open/close operation by crew.
C. Both train doors and PSD shall not open when crew intends to open doors in wrong side which does not correspond with the platform side. In this situation, crew shall be alarmed misoperation, by alarm sounds and so on.
D. Train door and PSD shall open/close in combination. Only either of train door and PSD shall not open/close.

ii) Running control

Running control shall be initiated by crew operation. Running from place of departure to fixed position of arrival station shall be controlled automatically based on grand-antennas for correcting calculated distance. Train shall be controlled not only to stop at fixed position correctly without position correction and to keep predetermined running time, but also to run comfortably and energy-saving.

1. Numbers of grand-antennas and position of grand-antennas

   The basic matters to be observed for grand-antennas installation are as follows, however, contractor shall consider suitable numbers and position of grand-antennas for stop accuracy and comfortable cruise.

2. Basic Control

   A. Stopping at station/ out of station

   Braking notches shall be commanded to stop solidly in consideration of gradient, when train stop. Braking notches shall be low as possible in consideration of ride comfort when starting.

   B. Staring control at station/out of station

   Train shall start by crew's starting operation. Propulsion notches and starting jerk shall be controlled to reduce shock when starting. Movement for back direction shall be not acceptable, of course, ride comfort shall be not deteriorated even if brake notch commands and propulsion notch commands are lapped when starting.

   C. Running between stations, off propulsion control, constant speed control

   Running between stations shall be assumed to keep predetermined running time, however, coaster operation shall be adopted as possible for improving ride comfort and saving-energy. Especially coaster operation shall be adopted actively during down slope section to save energy. Also, rapid acceleration and deceleration shall be not adopted for improving ride comfort. On the other hand, in case of constant speed control is commanded when recovery operation set, train shall be controlled to follow target speed which is defined within range not to over the CBTC brake pattern even at any gradient.

D. Stopping at fixed position

Low deceleration shall be kept constant during decelerating as possible, control for reducing train stopping shock such as weakening braking force just before stopping. Also, stopping pattern shall suppress stopping at over position as much as possible.

3. Requirements for ATO

The ATO equipment is effective only when the ATP equipment is operating. If ATP is not working, ATO shall not operate. ATO shall operate within the limit speed of ATP.

4. Others

(a) Regarding the operation method by ATO, it is necessary to adopt the acceleration / deceleration control command according to the operation curve based on manual operation in principle.

In the case of it is forced to change for improving ride comfort etc., confirm with the Rolling Stock team on the simulation that the performance of the propulsion system has no problem.

(b) The operation method by ATO (operation mode, interface etc.) shall be considered and adjusted with the Rolling stock team.

6) CBI (Computer Based Interlocking system) - CBI

(i) CBI is a computer-based interlocking system that controls the interlock with the related point machine and the signal. CBI sets a route. Also, the CBI shall be held until the train passes through the set route and it shall be fail-safe. SIL4 shall be applied for CBI.

(ii) As CBI, there are distributed CBI and centralized CBI. Here, distributed CBI is described as a base, but bidders shall propose an appropriate CBI system.

a. In the case of distributed CBI, CBI will be installed to the stations with turnout: 5 stations (Pako St., Bictan St., Alabang St., Santa Rosa St., and Calamba St.)

b. The CBI of Depot is installed at CER in OCC. Depot access line is controlled from CBI of Depot.

(iii) CBI is managed by ATS (Automatic Train Supervision). If ATS fails, CBI is manually controlled by OCC's IL-CT. When functions are disconnected due to OCC ATS and IL-CT failure, CBI is controlled by IL-ST of each station with turnout.

(iv) CBI is an important component in terms of safety, and it must comply with the basic concepts and corresponding standards in Section (2). Also, since it is a vital component, SIL 4 shall be applied.

(v) The CBI shall have the following functions.

a. Lock after setting route

b. Track locking while the train is passing through the set route

c. While the train is approaching, when canceling the route, the route shall be locked for a fixed period

d. While traveling on a point machine, the point machine shall be locked

(vi) CBI shall maintain fail-safe

(vii) CBI shall be independent from TD and ATP. Even if TD or ATP fails, the CBI must operate safely.

(viii) Contractor shall make an interlocking chart, and submit it to the employer, and obtain approval.

7) Automatic Traffic Supervision system -ATS

The ATS system shall have the train schedule (diagram) management function, the train tracking function, the automatic route control function, the operation adjusting function and the man-machine communication function.

The ATS system collects information necessary for train operation from the signalling system. Data transmission is performed through a fiber optic cable of the communication system management.

(i) Train schedule (diagram) management function; this shall include the following contents.

a. The basic diagram is planned by a dispatcher who is supported to make train diagram in the train diagram planning system.

b. For the basic diagram, weekday diagram, holiday diagram, spares (4 types of patterns) shall be made.

c. The practicable diagram is made from the basic diagram. The practicable diagram has the day diagram, the previous day diagram and the next day diagram. The practicable diagram shall be monitored based on the actual train operation in the ATS. Also, the actual result schedule (diagram) is managed in accordance with the actual train operation results.

d. The ATS performs route control according to the practicable diagram. It is also necessary to check the train number which is input from on board controller. When the train diagram is changed, the practicable diagram shall be changed, and the route control shall be executed accordingly.

e. There are three kinds of train types as follows.

a) Commuter train

b) Rapid Commuter train

c) Limited express train

When making train diagram or changing train diagram, it is necessary to set 2 or 3 required driving time for each train type and each station.

(ii) Train tracking function; this includes the following contents.

a. Based on the train detection data reported from the train and the train number data, all the trains are always tracked, and the train position and train number are displayed on the terminal (ATS-T) and the large display panel in OCC.

b. Processing train number data in the computer (ATS) and train number data getting from on board equipment shall always be compared; if there´s a discordance between these two, an alarm shall be triggered.

(iii) Route control function; this shall include the following contents.

a. The route control function has three route setting modes.

a) Automatic route setting mode by ATS based on the practicable diagram.

b) Manual route setting mode from the ATS-T terminal in operation of the ATS (In this time, it is possible to set it by interrupting the automatic route control mode of ATS. Also, the train number is displayed.),

c) In case of ATS failure in which both ATS and ATS-T are unusable, a manual route setting mode by IL-CT which is a CBI terminal in OCC.

b. In order for the train to enter the station, When train approach, it is necessary to set the route (home route) in the place.

c. Departure route shall be set a certain time before departure time. However, if the train is delayed, its route will be set immediately. That route will be set soon to regain the delay.

d. Automatic route setting shall be carried out under the following conditions.

- The route is not occupied.
- Conflict and facing route are not set.
- The entrance route shall be restored after the train has entered.
- The departure route shall be restored when the train enters the route and passes through a section outside the route.

(iv) Operation adjusting function; this shall include following contents.

- When the train operation is disturbed by any accident, ATS shall support the traffic dispatcher by the operation adjusting function.
- ATS shall have the following functions for the recovery of train delay.
- To automatically adjust the stopping time at all stations;
- Diagram modification shall be proposed by the communication with traffic dispatcher.
- The contents of diagram modification are shown as follows but not limited to:

The train diagram modification function is shown in Table 4.3.50.

Table 4.3.50 Train diagram modification function

Item	Contents
New train diagram	New train diagram which is not prepared in the practicable diagram that day
Cancel of diagram	Cancel operation of a particular train and a certain station
Diagram revival	Revival of prepared but unused diagram
Order exchange	Change the order of specific trains after appointed station
Operation exchange	Change appointed diagram to other diagram after appointed station
Destination change	Change the appointed train destination
Arrival Line change	Change the arrival line of appointed train at appointed station
Time shift	Shift the time of appointed diagram towards before/after the time.

Source: JICA Design Team

(v) Large video display; This shall be used as the operation indicator (Mimic Panel)

a. The following information shall be indicated on the large video display and ATS Terminal in OCC:
- All the main line track lay out including Depot access line
- Train location and train number
- Route setting (Route lock)
- Point Machine directional condition
- Other necessary indication

b. The following operation records shall be memorized and printed out when necessary.
- Records of arrival/departure time for each train
- Operation records in comparison with practicable diagram and actual time
- Operation records by dispatchers.
- Failure records

(vi) Train Diagram making system; this shall be provided for supporting diagram planning staff in OCC.

The train diagram making system shall use an ATS-DS as dedicated terminal in Off-line, also have at least the following functions. Have at least the following functions.

a. Enter the operation curve (performance curve) data of the train created by the operation plan division so that the minimum train running time data etc. can be calculated.

b. Be able to make diagrams based on running time data of train, time interval data between stations, stop time data at station, platform effective track length, track number,

c. Be able to copy a diagram to make another diagram or to make a pattern drawing. Also, the manually entered diagram shall be automatically checked the rationality of the diagram.

d. When making train diagram, it is necessary to set 2 or 3 required driving time for each train type and each station.

e. The train diagram making system shall be used to make the basic diagram and the practicable diagram. This system has the storage capacity to store six kinds of diagrams.
   - Basic diagram; Weekdays, holidays, and spare four basic diamonds
   - Practicable diagram; the day diagram, the previous day diagram, and the next day diagram

8) Signalling system in Depot

(i) There are the stabling yard and the maintenance yard (including car washing plant) in Depot.

(ii) The signalling system (including CBI) of Depot is installed in the CER (Central Signal Equipment Room) of the OCC.

(iii) Entering / Departing train operation is carried out between the Depot access line and the stabling yard. The entering train is at Depot access line, the departing train is at the stabling yard, the driver switches to the Normal Depot mode, and operate manually according to the on board signal (with the destination line indication), the speed is limited to less than 25 km / h. The brakes are applied automatically when the limit speed (25 km / h) is exceeded.

(iv) Control of entering / departing signal of train is automatically controlled by Depot PRC. Moreover, the operation status can be monitored by IL-DT which is Depot operation terminal in OCC. When Depot PRC fails, connect IL-DT to Depot CBI and perform manual control.

(v) The train operation of the maintenance yard is controlled manually (less than 25 km / h) from the IL-DT by the shunting signal (or shunting indicator) and the route indicator.

(vi) Install ORP (Over Run Protection) at the end of the stabling yard. When the train exceeds the limit stop point, it is stopped by the emergency brake.

(vii) The route setting operation of Depot is executed by the operation of "Start point to destination point”.

(viii) Route indicator
The route indicator shall be installed together with the shunting signal (including the shunting indicator) in order to indicate the direction of the route signal. The route indicator shall be a two-digit numeric indicator and shall be visible for more than 100 m

9) Miscellaneous Signalling system

(i) Train number
- Train number shall be input from DMI of train cab when train start. Train number is transmitted from DMI to ATP (ground) and ATS through CBTC radio.
- Train number shall be used for the train tracking check and route control check in ATS.

(ii) Signal monitoring
- Objective of Signalling Monitor is to supply Facility Maintenance Dispatcher with the information of system working status, system failure and maintenance.

- Signalling monitor shall monitor working status, failure, and sequential movement of each sub-system, including power supply system for Signalling system and ATS system.
- Signalling monitor shall also collect failure information at each subsystem of ATP, TD system.
- Signalling Monitor shall transmit the three following information statuses for each Signalling sub-system and ATS system.
  - Serious Failure : Immediate repair should be required.
  - Minor Failure : Minor failure in which train operation is uninterrupted.
  - Normal status : Information of normally working condition is transmitted.

(iii) Substitution Block system

a. Purpose of substitution block system; the substitution block system is a backup system in the case of CBTC failure. In this case, the CBI and the track circuit must be available.
b. In this case, the substitution block system sets one to two block between stations (including station with turnout and stations without turnout).
c. Operation of substitution block system is done by OCC dispatcher. The dispatcher confirms that the preceding train leaves the preceding station, that there is no train between the preceding station and the train station, and tells the driver the permission by train radio.
d. In this case, the speed of the train is limited to 25 km / h or less.
e. If OCC is not available, use IL-ST of station BMS.

(iv) Shunting Signal, Shunting indicator

a. Shunting signal shall be installed for Shunting work in the stations with turnout and Depot
b. Function of shunting signal
   a) The shunting signal is provided for each route of the train to be shunted. However, when there are two or more routes from the same line, and a route indicator is attached, the shunting signal can be shared.
   b) The shunting signal is used in two display types, Y (Go) and R (Stop). In addition, semi-automatic type is adopted as the shunting signal.
   c) The shunting signal shows the stop signal in the following cases.
      - When a train on the protection area of the shunting signal.
      - When the point machine in the area of the shunting signal is not turned on to the opening direction
      - When another train takes a vehicle contact limit at a branch point or an intersection point and interferes with the protection section of the shunting signal.
      - The visible distance of the shunting signal shall be 200 m or more during the daytime and fine weather.

- The shunting signal is used in two display types, Y (Go) and R (Stop). In addition, semi-automatic type is adopted as the shunting signal.

c. The shunting indicator shall be installed in Depot.

d. Function of Shunting indicator

a) The shunting indicator shall be installed in the case that the route shunting is carried out by the sign.

b) The shunting indicator shall be indicated by the opening of the route, the related point machine locked.

c) When there are two or more routes from the same line, a shunting indicator can be shared, in this case, the route indicator shall be installed.

d) When a shunting signal is installed at the same point with shunting indicator, the mechanism can be shared with their mechanism.

e) The visible distance of the shunting signal shall be 200 m or more during the daytime and fine weather.

(v) Point machine

a. The Electric point machine internally locks and the tongue rail has been tightened after changing the branch from stereotaxic to disposition (or disposition to stereotactic), and notifies the CBI that the locking is done.

b. Having a mechanism that can be manually changed by handles.

c. Since the control power is turned off at the time of manual change, it can be changed manually.

d. Electric point machine is installed to the branch in the stations with turnout, Depot access line and Depot except maintenance line.

e. Have a conversion time that can correspond to the operation headway 5 minutes.

f. Install a manual controlled turning machine (with arrow feather handle) on the branch of Depot maintenance line.

(vi) Overrun Protection system (ORP)

a. Objective of Overrun Protection is as follows.

- Stop just before the buffer stop.
- Over run protection for shunting area.
- Turn back operation in terminal station

b. This function is realized with ATP (on-board equipment) and Balise.

c. ORP is a vital component.

(vii) False Starting protection

In order to suppress the false departure of the train when the stop signal is on in the station with turnout and Depot, False starting protection function is realized by On-board ATP/ATO equipment.

In the equipment of ATP / ATO, if the driver intends to start when the departing signal is not ON, the brake is automatically applied.

(viii) Power supply system

a. The power system receives AC power of 3 phases 400 V (60 Hz) from each low voltage distribution room of each station and Depot. And the power supply device supplies electric power without instantaneous interruption according to the type of power supply required by each signal equipment. (except the point machine motor)
b. Power supply system shall keep power supply for at least 30 minutes in OCC, and for at least 3 hours in stations whenever power failure occurs.
c. The power supply system has a redundant configuration.
d. The power system shall enhance insulation and ensure adequate surge protection.
e. The earth of the isolation transformer shall be connected to the common earth terminal of the building

(ix) Temporary speed restriction system (TSR)

a. The purpose of the TSR is to temporarily restrict the train speed in some specific section.
b. The TSR shall impose the restricted speed to ATP system.
c. The data of TSR is displayed on the screen by the OCC dispatcher. The TSR data is transmitted to the on-board equipment through the TSR server and the ATP ground equipment.

(x) Signage:

The following signs shall be set at side of the main track and track in the depot. The sign is an appropriate symbol in English. (But not limited to this)

a. Train stop sign
b. Once stop sign
c. Track name
d. Exchange line sign

The contractor shall meet all the signage requirements and consult with the employer and decide.

(xi) Balise (train position correction, ORP)

a. The train is informed of its position by Balise.
b. Balise is set in track.
c. Balise is used for train position correction and ORP (Over Run Protection).

(xii) Maintenance support tool

a. When a control failure occurs, it is necessary to prepare a maintenance tool for each subsystems having display function for acquisition and analysis of time series event data for rapid analysis of failure.
b. The target devices are interlocking system (CBI) and ATP on-board equipment.

c. Data acquisition and display method;
   i) CBI; acquisition data; CBI input data, CBI output data
      Display method; Maintenance terminal for CBI, IL-CT
   ii) ATP on-board equipment; acquired data; Balise input data, CBTC input / output data
      Display method: Maintenance terminal for on-board equipment
   iii) ATP ground equipment; acquisition data; CBTC input/output data.
      Display method; Maintenance terminal for CBTC

(xiii) TID (Train Information Display) Terminals, Server

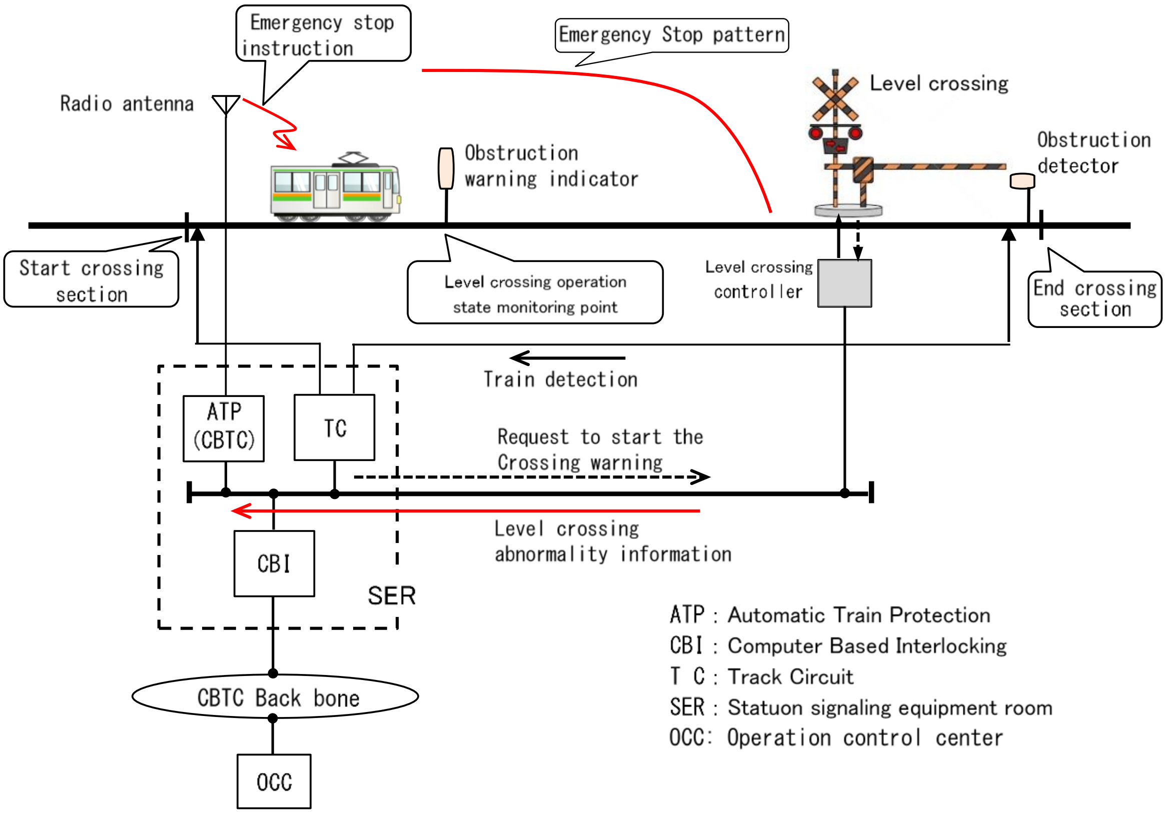
a. TID terminal is the terminal that displays the train traffic situation.
b. Installation location: Station, Depot, OCC, etc.
c. Number of terminals: 23 in total
d. TID server is a server gathering train traffic information and distributes it to terminals. The installation location is in CER.

10) Level crossing system

In the level crossing system, the crossing warning time must be suitable for the train's position, speed and class. CBTC can alert appropriately by ATP on-board device with the above these kinds of data. However, CBTC has not introduced the level crossing system. Thus, the conventional level crossing system is adopted as the proven and safe system.

(i) Level crossing system is composed of the warning light, train direction indication, emergency button, electric barrier machine, level crossing obstruction detector, obstruction warning indicator alerting to drivers and electric train detector indicating the start and end of alarm.

The system configuration of the level crossing is shown in Figure 4.3.43.



Source: JICA Design Team

Figure 4.3.43 System configuration of level crossing

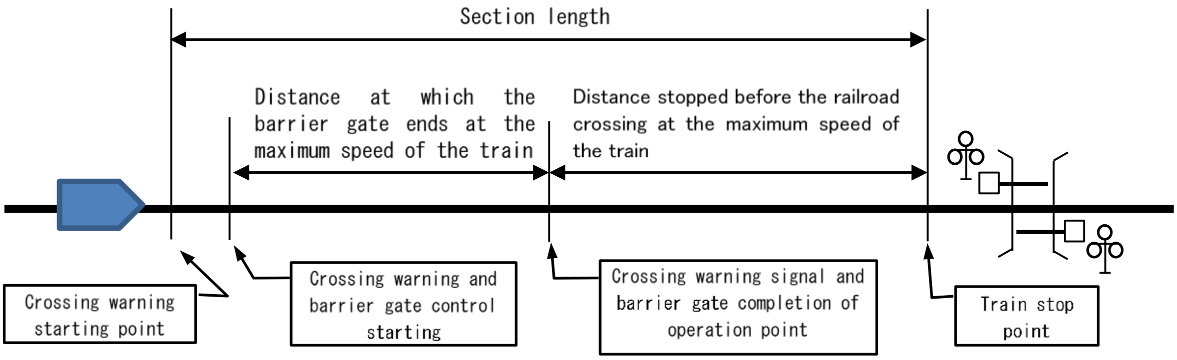
(ii) Level crossing is to be installed at one point: Dr.M.L.Carreon Street (7K950m)

(iii) Train detection

- Crossing warning and crossing gate work safely and accurately by the train detection based on the track circuit.
- Crossing warning starts and ends by a train entering and leaving the track circuit section.

(iv) Start and end of warning

- The point to start waning is determined by the length of track circuit section based on the maximum train speed. (See Figure 4.3.44)



Source: JICA Design Team

Figure 4.3.44 Start point of crossing warning and track circuit section

(v) Crossing gate activation

i) The level crossing control device is requested to start and end the warning by a train entering the starting point and leaving the end point.

ii) Upon receiving the request signal to start warning, the level crossing control device activates the warning (warning indicator and crossing alarm) for a certain time. After that, the crossing gate is activated. (Right crossing gate comes down first) If activated correctly, the signal of “Level crossing activated correctly” is transmitted to OCC center (or BMS iL-ST terminal).

iii) If emergency happens on the railway crossing after the request signal to start warning, for example, the malfunction of level crossing device, the detection of false approach into the crossing (the obstruction detection device) and the emergency button pressed, the obstruction warning indicator at 600m in front of crossing gets activated and alerts a driver to the emergency.

However, if CBTC radio as well as ATP ground/on-board device is working correctly, ATP ground device transmit the request signal of emergency stop to the on-board device. The on-board device generates the emergency stop pattern to stop behind the level crossing. It also transmits the signal of emergency on the railway crossing to OCC center (or BMS iL-ST).

iv) There are various types of the obstruct detection device installed at the level crossing, such as, the optical sensor, the ultrasonic sensor and the stereo camera. The suitable system for the environmental conditions shall be proposed.

v) The start of the warning section shall be determined with considering the train speed (120km/h), the activation time of the warning light and the barrier machine, and the transmitting and responding time of CBTC to ensure the certain alerting time for a train to stop behind the level crossing safely and completely. Also, the end of the warning section shall be the point where the last carriage surely passes.

vi) The control device is installed near the level crossing. Therefore, it shall be stored in the heat-resistant device box.

vii) The range of the visibility of the obstruction warning indicator shall ensure 800m or more.

viii) The level crossing device shall be withstand train acceleration current DC 1500 V, maximum current 4200 A.

ix) The level crossing device shall have the countermeasure against the lightning surge such as the arrester and the varistor.

11) Operation mode

(i) The operation mode is classified into a train operation mode and a system operation mode.

(ii) Each mode has several degrade modes depending on the failure mode.

(iii) Train operation mode;

The train operation mode is shown in Table 4.3.51.

a. ATO / ATP mode
  a) Normally, operation of the main line is performed in ATO / ATP mode.
  b) Shunting operation of the main line is also performed in ATO / ATP mode.

b. ATP mode
  a) Normal main line mode
    - Manual operation under ATP monitoring (Maximum speed is limited to 120 km / h.)
    - Operation at ATO failure
    - Shunting operation in the station can be also performed in ATP normal main line mode.
  b) Normal Depot mode
    - Manual operation under ATP monitoring in Depot (Maximum speed is limited to 25 km / h.)
    - ORP (Over Run Protection) is used together. Automatic stop when it is likely to become over run.
    - In this case, onboard signal is used.
  c) Restriction mode, ATP cut off mode
    (a) Restriction mode
      - Operation mode when Ground ATP fails.
      - It is a manual operation with On-board ATP.
    (b) Cut Off mode
      - Operation mode when On-board ATP fails
      - It is a manual operation without ATP.

c. Wayside signal mode
  - It is a manual operation by Wayside signal (Shunting signal or Shunting indicator) in Depot.

Table 4.3.51 Train operation mode

(Introduction of ATO is under consideration.)

<table>
<tr><th colspan="2">Train operation mode</th><th>Note</th></tr>
<tr><td colspan="2">ATO/ATP mode</td><td>a) Normal operation on Main line
b) Shunting on Main line with ATO</td></tr>
<tr><td rowspan="2">ATP mode</td><td>Normal main line mode</td><td>a) Manual operation with ATP (Max. speed is 120 km/h)
b) Operation when ATO fails.</td></tr>
<tr><td>Normal Depot mode</td><td>a) Manual operation with ATP (Max. speed is 25 km/h*1)
b) With ORP (Over Run Protection)
c) With On-board signal</td></tr>
<tr><td rowspan="2">Restriction mode, ATP Cut off mode (Rolling stock mode)</td><td>Restriction mode</td><td>a) Operation when Ground ATP system fails.
b) Manual operation with On-board ATP
c) Max. speed is 25km/h*1.</td></tr>
<tr><td>Cut-off mode</td><td>a) Operation when Onboard ATP fails.
b) Manual operation without ATP (Max. speed is 25km/h*1)</td></tr>
<tr><td colspan="2">Wayside signal mode</td><td>a) Operation with the wayside signal in Depot. Area.
b) Maximum speed is 25km/h*1.</td></tr>
</table>

*1: Specific speed is under consideration

Source: JICA Design Team

(iv) System operation mode

Table 4.3.52 shows the system operation mode with the degrade mode in case of ATS failure.

a. The operation mode when the ATS is normal is the automatic mode (Automatic mode), and ordinary automatic route control is performed. The terminal ATS-T in OCC displays the operation status of the train. The train schedule is displayed on ATS-DS, and when any diagram disturbance occurs, use ATS-DS in order to adjusting diagram.

b. Even during normal ATS operation, the dispatcher can set the manual route using ATS - T. In this case, the train number is also displayed on the ATS-T.

c. When ATS fails, ATS-T cannot be used, so use the IL-CT (terminal of CBI) in OCC to connect with the CBI of the station with turnout and set the manual route.

d. When OCC's ATS and IL-CT are disconnected due to any failure etc., these cannot be used in OCC, IL-ST located at station with turnout is connected with CBI and set manual route.

Table 4.3.52 System operation mode

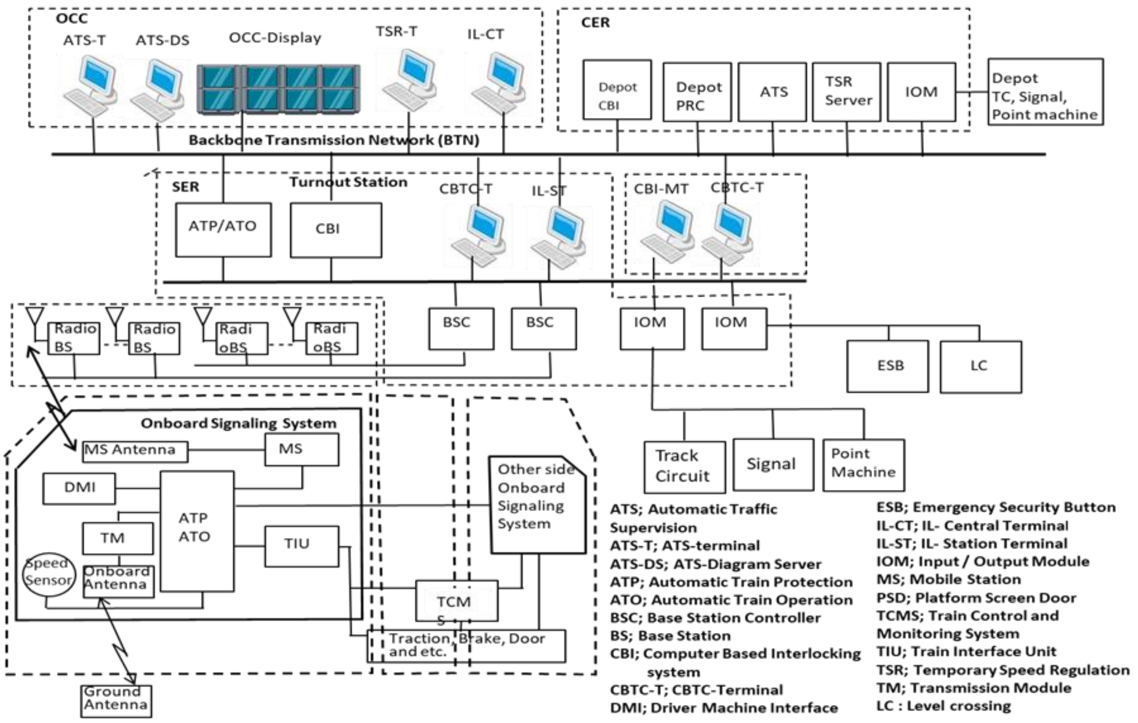
System operation mode		Note
ATS control mode	Automatic	a) Normal operation b) ATS system performs route control automatically. c) ATS-T; Train traffic status d) ATS-DS; Diagram management
	Manual(Temporary manual intervention)	a) Dispatcher performs route control manually by using ATS-T.
IL-CT operation mode (When ATS fails)		a) Dispatcher performs route control manually by using IL-CT to every station with turnout.
Station IL-T operation mode (When ATS and IL-CT fails)		a) Station staff performs route control manually by using station IL-ST to each station with turnout

ATS-T; Automatic Traffic Supervision- Terminal, ATS-DS; ATS-Diagram server
IL-CT; Interlocking system – Central Terminal
IL-ST; Interlocking system – Station Terminal

Source: JICA Design Team

12) System configuration

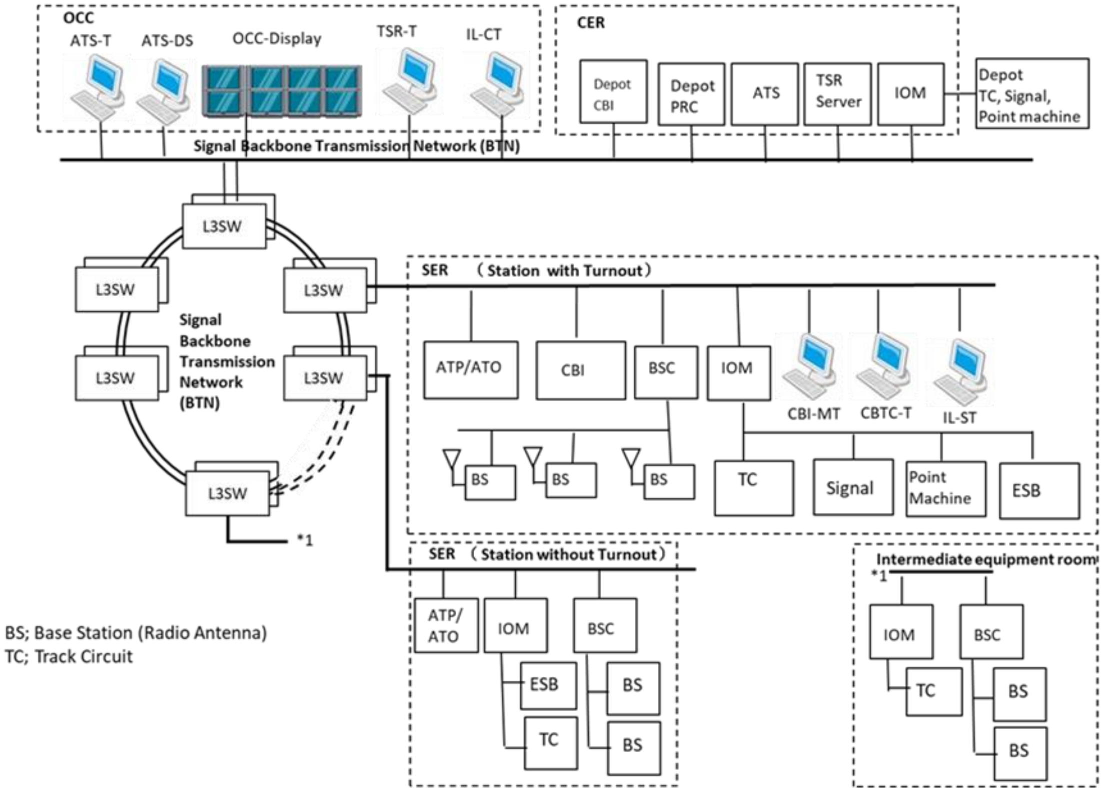
System configuration is shown in Figure 4.3.45.



Source: JICA Design Team

Figure 4.3.45 Signalling system configuration for NSRP-South

Signal Backbone Transmission Network (BTN) is shown in Figure 4.3.46. Optical fiber cable is, which is used for this system, provided by Communication system.



Source: JICA Design Team

Figure 4.3.46 Signal Backbone Transmission Network (BTN) configuration

(4) Requirement Specification (Performance, Interface)

1) Performance Requirement

Performance requirement is shown in Table 4.3.53.

Table 4.3.53 Performance requirement

Item	Requirement
1. Train Detection system	
a) Main line, without turnout stations	a) CBTC with bi-directional digital transmission system which utilizes radio to send data between ground and on-board equipment shall be adopted. b) Rail broken detection by track circuits should be adopted. The track circuit mentioned above should work as the backup system when CBTC system fails. However this system is not required to operate in minimum headway. c) As Backup system when CBTC fails, Track circuit (Uninsulated Track Circuit) is used with 1 or 2 loop between stations.
b) Stations with turnout, Depot and Depot Access line	Track circuit (Insulated Track Circuit) shall be adopted for exact train detection.
2. Interlocking system	
a) Method	a) Computer Based Interlocking system(CBI) shall be adopted b) There are two types of CBI: distributed type and centralized type. • In the case of distributed CBI, CBI is installed at the station with turnout. The CBI of Depot is installed at CER in OCC. Depot access line is controlled from CBI of Calamba station. • In the case of the centralized CBI, the logic of CBI of all stations with turnout is integrated into the centralized CBI installed at CER. The input / output module with each signal equipment is located at each stations with turnout. The CBI of Depot is installed at the CER of the OCC. c) The appropriate CBI system shall be proposed.
b) Redundancy	Hot standby duplex or 2 out of 3 configurations shall be adopted.
c) System cycle	System cycle shall be less than 200～400ms.
d) Safety level	Safety level shall comply with clause (2)4) (Safety Requirement) SIL4 shall be applied.
e) Number of routes	More than 600 routes per system are required.
3. CBTC system	
a) Reference standard	IEEE1474.1 compliant
b) Redundancy	SIL4 shall be applied to parts where safety design is required among CBTC, CBI, and On-board equipment. For this equipment Hot stand-by Duplex or 2 out of 3 redundant systems shall be adopted.
c) On-board speed control method	On-board equipment shall generate brake and speed profile pattern, based on received data to automatically initiate brake in case of restricted speed is exceeded.
d) On-board rack	On-board equipment shall be mounted on 19 inch rack.
e) Train IF	Train IF shall be relay contact or TCMS interface.
f) Odometry	On-board equipment shall use 2 wheel sensors and Doppler radar.
g) ODDRS(Onboard Driving Data Recording System)	a) On-board equipment shall have ODDRS which is compliant with IEC62625.
h) Main Information between on-board and ground equipment	The information shall contain the following but not limited to: a) Track Condition (Ground →On-board); b) Movement Authority (Ground →On-board); c) Position report (On-board →Ground); d) Temporary Speed Restriction (Ground →On-board) e) Train number (On-board →Ground/ Ground →On-board) f) Emergency train stop at Level crossing system failure (Ground →On-board)
l) Safety level	Safety level shall comply with Clause (2)4(Safety Requirement)
j) On-board Fail-safe CPU	On-board CPU shall consist of 2 MPUs and comparator to guarantee the fail-safe calculation output in compact size.
k) On-board Power consumption	Total power consumption of On-board unit shall be less than 600W.

Item	Requirement
l) Train Number input	a) Method On-board setting which shall be done by the driver, shall not be changed by unintentional operation. b) Transmission between on-board and ground Radio communication shall be adopted continuously. c) Train Number 8 figures numeric shall be adopted.
4. ATS	
a) Control method	It shall be computerized control.
b) Redundancy	It shall be duplicated system or equivalent system. It shall be applied the hot standby method to ensure continuity of control.
c) External transmission	Optical Fiber Cable LAN shall be adopted.
d) Transmission speed	It shall be equal or more than 100Mbps
e) System Configuration	It shall be central convergence or equivalent
f) Train Diagram types	They include followings but not limited to: The basic diagram; weekday diagram, holiday diagram and spare basic diagram The practicable diagram; the day diagram, the previous diagram and the next day diagram
g) Console type	It shall be graphic user interface with VDT or equivalent
h) Mimic panel type	It shall be large display
5. Miscellaneous system	
5-1 Signal maintenance terminal	
a) Human machine interface	Human machine interface shall be done by laptop or desktop personal computer or equivalent.
b) Memory	Memory shall be equal or more than 40GB HDD.
c) Redundancy	Single system can be applied.
5-2 Point machine	
a) Switching time	Switching time shall be decided as follows: Main line: less than 8 sec. Depot area: less than 8 sec.
b) Supplying Voltage	Supplier should select the suitable supplying voltages (control and detection). AC230V,DC24V(for control)
c) Environmental condition	Structure of the machine shall be water proof.
5-3 Overrun Protection system	
a) Method	ORP profile on-board is generated based on location from way-side
b) Transmission	Balise or equivalent shall be utilized.
c) Transmission Module	It shall be Balise or equivalent module.
5-4 Power Supply system for station	
a) uninterrupted time	It shall be more than 3 hours.
b) Redundancy	It shall be Duplex system or equivalent.
5-5 Power Supply system for OCC and Depot	
a) uninterrupted time	It shall be more than 30 minutes.
b) Redundancy	It shall be Duplex system or equivalent.
5-6 Temporary Speed Restriction	
a) Method	TSR shall be imposed to any place on the main line.

Source: JICA Design Team

2) Technical Requirement

(i) Fail Safe Technology

a. The fail-safe principles for all subsystems and their detailed methods shall be clarified.

b. The following subsystems shall comply with the requirements of safety requirements ((2)4) safety requirements). For the safety of the signalling system, reference shall be made to EN 50129 / IEC 62425.

Basically, the safety level of each device shall meet IEC 61508 SIL 4.

a) Interlocking system (CBI)
b) CBTC system (Ground system, On-board equipment)
c) Train detection system
d) ORP (Over Run Protection)
e) FSP (False starting protection)
f) TSR (Temporary speed restriction system)
g) Level crossing system

(ii) Communication Recovery Technology

The communication protocol between the on-board equipment and the CBTC ground equipment and the recovery technology at the time of abnormality are considered and submitted as documents and shall be approved by Employer.

(iii) Ergonomic Technology (specification OCC systems)

Systems with human-machine interface such as console and mimic panel for ATS system shall be designed to conduct human engineering. Especially color for indication, switches and buttons layout for operation shall be designed with ergonomic technology.

CONTRACTOR shall state how ergonomic technology is conducted within the system.

(iv) Redundancy Technology

a. CBTC consists of Ground system and On-board equipment. Ground system is redundant and shall be designed to operate even if the equipment and / or component fails. If a failure occurs in Ground system, it is necessary to immediately issue a fault alarm and inform the OCC.

b. CBTC shall be clarified the safety and reliability of the train in the RAMS process.

c. The following systems (devices) are required for redundant systems.

   i) CBI: To ensure security, 2 out of 3 or 2 out of 2 configuration and their redundant for further reliability shall be adopted. Regarding redundancy, in order to ensure continuity of control, it shall be Hot Stand-by method.

   ii) ATS; Since SIL 4 in safety is not required, it is necessary to adopt a normal dual system configuration, but as for redundancy, it shall be Hot Stand-by method to ensure continuity of control.

3) Interface Requirement

The Signalling system shall require the interface of Civil contractor with other contractors (based on contract package about stations and Depot), and the interface to Track work and Architecture of items stated below. (At a minimum but not limited to).

Interface requirement is shown in Table 4.3.54.

Table 4.3.54 Interface requirement

Requirement section	Requirement Item	Document or Drawing
Structural (Elevated section and Depot)	Structural drawing for Signalling Devices and Cable trough installed at track side in Depot	Detailed drawing of installation location
Structural (Underground section)	Structural drawing for Signalling Devices and Cable trough installed at track side in underground station area.	Detailed drawing of installation location
Architecture (Elevated section and Depot)	Space, Specification and cable route of CER、CUR in Depot (OCC)	Floor space of CER, CUR in OCC, and cable duct
	Space and Specification of Control Room in OCC, and cable route	Layout of OCC control room, cable duct
	Space and Specification of SER, SUR in stations, and cable route	Floor area of SER, SUR at each station, cable duct
	Space and Specification of BMS in stations, and cable route	Floor area of BMS at each station, cable duct
Architecture (Underground section)	Space and Specification of Station Management room (BMS) at each station, and cable route	Floor space of BMS in each station, and cable duct
Architecture (Underground section)	Space and Specification of Station Management room (BMS) at each station, and cable route	Floor space of BMS in each station, and cable duct
	Space and Specification of SER and SUR in underground section, and cable route	Floor space of SER and SUR in each station, and cable duct
Rolling Stock	ATP/ATO equipment for on-board/ground radio bi-directional data transmission.	Interface specification including timing.
	Mounting ATP/ATO equipment	ATP/ATO device drawing
	Mounting Antenna	Antenna drawing
	1) Balise for train position correction of tachometer 2) Balise for ORP; 3) Balise for FSP (False starting protection) is not needed because of Onboard signal by CBTC.	Interface specification including timing
	DMI as a Train Number setting device	DMI drawing
	EMC between on-board and Track circuit	Using frequency and tolerant noise level etc.
	EMC between on-board and CBTC	Using frequency and tolerant noise level etc.

Requirement section	Requirement Item	Document or Drawing
Telecommunication System	Master Clock	Interface specification
	Back bone Transmission system	core number and OFC Specification
	Signalling equipment in OCC and Passenger information display (PID)	Interface specification
	Mounting Telecommunication equipment at Console in OCC (CER) and SER.	Layout and Optical fiber interface
Power Distribution System	Power Distribution Board Interface	Power consuming capacity
Catenary, Substation	Track circuit allocation for considering return circuit	Location of Impedance bond
Track work	Insulation of Track circuit Track circuit constant Balise layout in the track Track traversing duct Train protection equipment for Set-off device	Layout of Track circuit Leakage current (attenuation / km) Balise layout, Balise drawing Cable specification Specification of Train protection equipment

Source: JICA Design Team

(5) OCC (Operation Control Center) Facility

1) Overview

There is a central traffic monitoring large display and a terminal used for monitoring and control of train traffic situation. These systems are connected to ATS, signalling system, interlocking system (CBI), and passenger service system.

2) OCC functions and structure

(i) The mission of OCC Operator

a) Train traffic Operator (Dispatcher)
- Train tracking, Traffic monitoring
- Diagram management, Diagram re-scheduling at Diagram disturbance

b) Depot train traffic Operator
- Depot entrance and Departure management and control by Depot PRC (Programmed Route Control)

c) Power system Operator
- Power system status monitoring
- Power system failure monitoring, management

d) Telecommunication Operator
- Telecommunication Equipment failure monitoring and operation
- Weather information monitoring (wind, rain, temperature, earthquake)
- CCTV monitoring (Platform, Concourse, etc.)

e) Signalling system Operator
   - Signalling system failure monitoring (Main line and Depot)

f) Train traffic dispatching manager
   - OCC total management
   - Mainly Train traffic monitoring , Diagram monitoring and management

(ii) Operator clarification and Terminal large display
Large display shall have 8 logical screens (physical screen; 4 displays)

(iii) Contractor shall make appropriate proposals on the number of terminals, the operator desks and the display contents of large displays in OCC.

(iv) OCC Operator classification and terminals is shown in Table 4.3.55.

Table 4.3.55 OCC Operator classification and terminals (example)

Operator	System	Terminal	Large Display (logical screen)
Train traffic Operator Depot Operator	ATS Depot PRC CBI	Main line; ATS-T×2, ATS-DS×2 Depot; IL-DT×2, TSR Terminal×1, TID×1 ATS Failure back up; IL-CT×2	Main line;3 Depot;1
Power system Operator	P-SCADA	Terminal×2	Power system;2
Telecommunication Operator	Communication CCTV	Communication terminal×2 CCTV monitoring×3	CCTV;2
Signalling system Operator	Signalling system monitor	Signal monitor×1	
Dispatching (Operation) manager	ATS	ATS-T×2, ATS-DS×1, TSR Terminal×1, IL-DT×1, TID×1	

Source: JICA Design Team

3) Explanation of Terminals

(i) ATS-T; Terminal for ATS. The train traffic status and the route control status monitored by ATS are displayed. ATS-T is also used even when the operator manually sets the route during ATS automatic route control.

(ii) ATS-DS; Terminal for ATS. Used to display and set train diagram. It is also used to change the diagram easily with the mouse operation at the diagram adjustment.

(iii) TSR-T (TSR terminal); TSR-T is used when Temporary Speed Restriction is set. It is installed at OCC, and used by OCC Operator.

(iv) IL-DT; IL-DT is a terminal for Depot PRC, Used to display the train operation status and the route control status, also it is used to set the rout. When the route of the maintenance yard is set, IL-DT is connected with Depot CBI, and set manually.

(v) IL-CT; IL-CT is a terminal for CBI, located in OCC. When ATS and ATS-T cannot be used due to failure or unavailable, IL-CT is directly connected to CBI, and manual route setting is carried out.

(vi) Signal monitoring terminal; Signal monitoring terminal is the terminal for Signal Operator in OCC. The alarm monitoring and alarm data collection are carried out.

(vii) TID-T; TID-T is a terminal for station staff and the train traffic operation related staff. TID-T is installed to OCC and stations TID-T is used for the monitoring only, Control input cannot be performed.

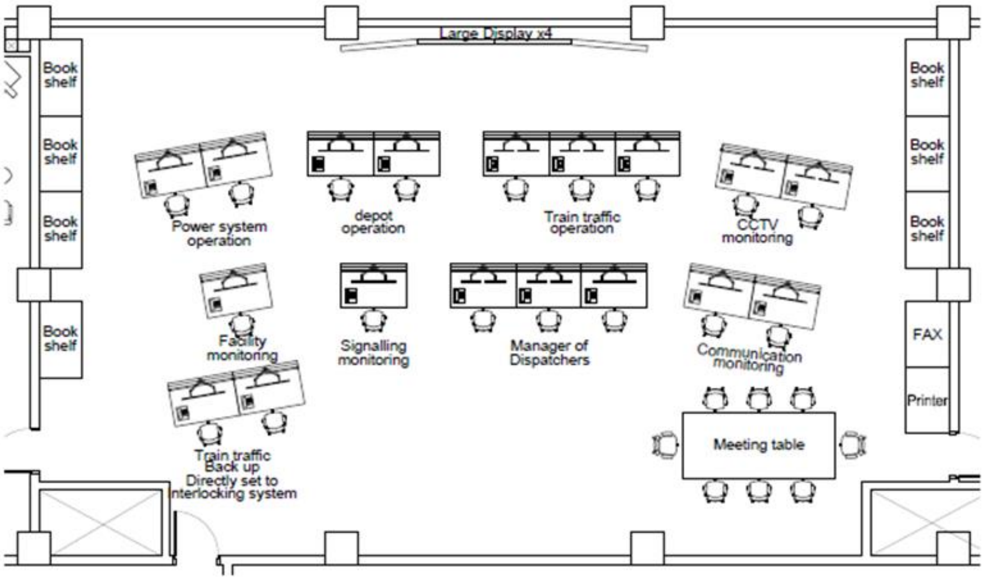
(viii) IL-ST; IL-ST is a terminal for CBI which is installed to station with turnout. When IL-CT is not available, the manual route setting by IL-ST is carried out.

4) Equipment layout

(i) OCC Equipment layout is shown in Figure 4.3.47.

(ii) Furniture procumbent; the following furniture shall be procured by signalling system.

- Operator desk with chair; 18
- Meeting table with 8 chairs; 1
- Book shelf; 7



Source: JICA Design Team

Figure 4.3.47 OCC Equipment Layout

(6) Study on the passing from Subway (MMSP)

1) Outline of proposed plan of the through operation from Subway (MMSP)

i) Each the through operation from MMSP to NSRP-South and from, NSRP -South to MMSP are carried out at Bicutan station. At Bicutan station, in order to be possible the through operation, the line layout is changed, and the cooperation of Signal systems between MMSP and NSRP-South is needed.

ii) Change the line layout of NSRP-South 2 stations (San Pedro station, Gulod station) to 2-way 4 lines so as not to affect the express train at NSRP-South.

2) Consideration items; The following items are needed to be deepened in detail design in the future.

i) Both MMSP and NSRP-South OCC and signalling equipment are different, so it is necessary to study the details of both interfaces, information delivery and so on.

ii) Consider communication methods when trains enter into both areas each other, and aim for smooth OCC processing.

(7) Test

1) Test overview

The test is divided into the following stages. Define the test and decide the procedure and implement it.

(i) Type test

(ii) Factory acceptance test (carried out before shipment of equipment)

a. Hardware test

a) All hardware equipment shall be tested before shipment.

b) Three types of tests are required.

Equipment test

Environmental test

Interface test (hardware level)

b. Software test

a) Communication protocol test of each type of interface

b) Terminal Human Interface Test

c) Function test

d) Performance test

(iii) Site acceptance test and integrated test

(iv) Trial run

2) Test general

3) Test plan and procedure

4) Test cost

5) Test record

(8) Operation and Maintenance Support

O&M support is as follows.

1) Operation and Maintenance document

2) Software Support

3) Security obligations
4) Support during Defects Liability Period
5) Workshop Repair
6) Support and call-out services
7) Monthly Maintenance Meeting
8) Spares
9) Special tools and test equipment
10) Documentation

(9) Training

1) Scope of Training
   Training is as follows. Define the training items and decide the procedure and implement it.
2) General Requirement
3) Training courses
4) Operating Courses
5) Maintenance Courses
6) Training Materials
7) Training Records

4.3.7 Telecommunication System

(1) General

This Telecommunication System contributes to safe and functional operation of train of NSRP-South, and safety and convenience of passengers. Applicable range is the railway line from Solis station to Calamba station and each station building, OCC, Depot.

The NSRP-South line is planned to be operated directly with the NSCR line and the MCRP line.

(2) Definitions and Abbreviations

1) Definition

definition	Description
Console	Input-output device to operate the computer including but not limited to a keyboard, display and mouse.
Employer's Representative	The agent who consults the employer to examine the specification and the system
Grounding/ Earth	Connecting the cabinet of the equipment etc. to a standard electric potential point (the earth) with an electric conductor.
Main Line	NSRP-South between Solis station and Calamba station
MTBF	MTBF means the time from when the system breaks down to when it recovers from trouble. This is a standard indicating the reliability of system and is shown with the average.
RAMS	Reliability, Availability, Maintainability, Security

definition	Description
Telecommunication system	Backbone system
	Radio system
	Voice and Data system
	CCTV system
	Passenger Information Display (PID) system
	Public Address (PA) system
	Time server and Master Clock system
	Meteorological and Seismic Monitoring system
	Telecommunication equipment monitoring system
	Uninterruptible Power Supply (UPS) system
	Telecommunication cables
Train Number	A unique alphanumeric character assigned to each train
Work station	High-performance small computer with high-speed operation processing capacity, big memory capacity, high resolution display for image processing, and network connection function.

Source: JICA Design Team

2) Abbreviation

Abbreviation	Description
AC	Alternating Current
AFC	Automatic Fare Correction
ALM	Alarm
ATS	Automatic Train Supervision
BD	Blu-ray Disc
BMS	Building Management System
CCTV	Closed Circuit Television
CISPR	Comité International Spécial des perturbations Radioélectriques
CNR	Carrier to Noise Ratio
DC	Direct Current
EB	Emergency Brake
EIA	Electronic Industries Alliance
EMC	Electro-Magnetic Compatibility
EMI	Electro Magnetic Interference
GPS	Global Positioning System
HCS	IDS/IPSHCS
IEC	International Electrical Codes
IEEE	The Institute of Electrical and Electronics Engineers, Inc.
IP	Internet Protocol
IP-PBX	IP-Private Branch Exchange
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union-Telecommunication Standardization Sector
ITU-R	International Telecommunication Union-Radiocommunication Standardization Sector
JICA	Japan International Cooperation Agency
L2SW	Layer2 Switch
L3SW	Layer3 Switch
LA	Link Aggregation
LAN	Local Area Network
LCD	Liquid Crystal Display
LCX	Leaky Coaxial cable system

Abbreviation	Description
M/C	Media Converter
MDF	Main Distribution Frame
MM	Multi-Mode
MTBF	Mean Time Between Failures
MTTR	Mean Time to Restore
NTC	Philippine National Telecommunication Commission
NTP	Network Time Protocol
OCC	Operation Control Center
ODF	Optical Distribution Frame
OFC	Optical Fiber Cable
OTDR	Optical Time Domain Reflectometer
OJT	On the Job Training
PA	Public Address
PEC	Philippines Electrical Code
PID	Passenger Information Display
PLDT	Philippine Long Distance Telephone
PoE	Power over Ethernet
POI	Point Of Interface
PSTN	Public Switched Telephone Network
PTZ	Pan-Tilt-Zoom
QoS	Quality of Service
RAMS	Reliability Availability Maintainability Safety
RFC	Request For Comments
SCADA	Supervisory Control and Data Acquisition
SM	Single Mode
SNTP	Simple Network Time Protocol
STP	Shielded Twist Pair
TIS	Train Information System
UDP	User Datagram Protocol
UPS	Uninterruptible Power Supply
UTM	Unified Threat Management
UTP	Unshielded Twisted Pair
VLAN	Virtual LAN
VoIP	Voice over Internet Protocol
WAN	Wide Area Network
VoIP	Voice over Internet Protocol
WAN	Wide Area Network

Source: JICA Design Team

(3) Reference standards

1) Standards

The Telecommunication system is to be designed, manufactured, installed and tested in compliance with the following relevant standards, codes and local regulations.

- DOTr Order, Philippines
- Public Telecommunication Policy Act (NTC)

- ANSI: American National Standards Institute
- CISPR: Comité International Spécial des perturbations Radioélectriques
- DIX: Dec, Intel, Xerox
- EIA: Electronic Industries Alliance
- IEC: International Electrical Codes
- IEEE: Institute of Electrical and Electronics Engineers
- IETF: Internet Engineering Task Force
- ISO: International Organization for Standardization
- ITU-T: International Telecommunication Union - Telecommunications
- ITU-R: International Telecommunication Union - Radio communications
- RFC: Request For Comments

Table 4.3.56 Standards and Details

Standard	Series	Details
ANSI/IEEE	802	IEEE Standard for Information Technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements
CISPR	22	Information Technology Equipment – Radio disturbance characteristics – Limits and methods of measurement
DIX		The ethernet standard used for TCP / IP, etc.
EIA	568B	Specification of twist pair cable for LAN
ISO	3864	Graphic symbols – Safety colors and safety signs
	11801	Information technology – Generic cabling for customer premises
	144156	Information technology – Coding of Audio visual objects
IEC	60332	Test on electric and optical fiber cables under fire conditions
	605215	Test device to verify protection against spraying and splashing water
	60754	Test on gases evolved during combustion of materials from cables
	607154	Optical fiber cable
	62236	EMC Directive
	62305	Protection against lightning
IEEE	802	Standard about local area network among the IEEE standards
ITU-T	G series	Transmission system and media, digital systems and networks
	I series	Integrated services digital network
	K series	Protection against interference
	Q series	Switching and signalling, and associated measurements and tests
	V series	Data communication over the telephone network
	P series	Telephone transmission quality, telephone installations, local line networks
	X series	Data networks, open system communications and security
ITU-R	General	International Principle of Radio Frequency Allocation, Elimination of Radio Interference
RFC	1065	Structure and Identification of Management Information for TCP/IP-based internets
	1157, 3411-3418	Simple Network Management Protocol (SNMP)
	1213	Management Information Base for Network Management of TCP/IP-based internets: MIB-II
	1305/5905	Network Time Protocol (Version 3/ Version 4)
	2328	OSPF Version 2
	3768	Virtual Router Redundancy Protocol (VRRP)

Source: JICA Design Team

(4) System Overview

The Telecommunication system installed on the NSRP-South consists of 11 systems as defined in in (2) Definitions and Abbreviations, 1) Definition. The systems of 11 shall be installed in the stations, OCC, Depot, and the like.

1) General

a) Backbone system

- It is a transmission infrastructure for all services of NSRP-South, it is a core network realizing large capacity and high reliability.
- Lay optical fiber cables for configuring large capacity and double ring in the trough, duct, etc.
- For connection with Backbone system, the port of L3SW/L2SW shall be the point of interface (POI) of responsibility.
- The transmission path of the power SCADA system and the signalling system shall not be accommodated in the Backbone system.
- The transmission path for the power SCADA system is constructed by the power system side by using the core wire of the optical fiber cable. For this reason, optical fiber shall be provided for power SCADA system.
- The transmission path for the signalling system is constructed by signalling system side by using the core line of the optical fiber cable. For this reason, optical fiber shall be provided for the signalling system.

b) Radio system

- The Radio system provides voice service about train operation between OCC, train drivers, and station staffs, or between workers in the Depot.
- Basically, Base station system shall be mounted in the station equipment room. When the base station interval becomes too long, it is adjusted based on the link budget calculation.
- The frequency and type examination and type approval of the radio set shall be applied to the NTC.

c) Voice and Data system

- Voice and Data system provides voice communication service to workers in NSRP-South.
- The IP phone connects to the Public Switched Telephone Network (PSTN).
- Telephone calls are connected via the Backbone system.
- Provide a means of data communication to staffs working in NSRP-South line.
- The data communication network consists of Wi-Fi.

d) CCTV system

- Provide a means of monitoring to ensure safety and security within railway facilities.

- The cameras in this system shall be capable in selective use from fixed or PTZ types according to their locations.
- The camera image can be recorded for one month.
- CCTV systems installed in Rolling Stock are not included.

e) Passenger Information Display (PID) system

- In order to improve the safety and convenience of passengers, the PID system shall be able to display guidance information such as train operation status, delay information, emergency evacuation, etc.
- Display information such as train operation is automatically updated with the Automatic Train Supervision (ATS) of the train signalling system.
- Passenger information devices installed in Rolling Stock are not included.

f) Public Address (PA) system

- The system provides audio announcement on train operation, train approaching, railway accident etc. to secure safety and passenger's convenience.
- The content of the automatic announcement is done according to the Automatic Train Supervisor (ATS) of the train signalling system.
- Manual announcement is possible from OCC and stations microphones.

g) Time Server and Master Clock system

- The system provides the accurate time for all the relevant systems for passenger's convenience and correct synchronization among them.
- The time information shall be obtained from GPS and delivered through IP network.

h) Meteorological and Seismic Monitoring system

- In order to protect railway facilities and secure passenger safety, this system provides disaster prediction information such as strong wind, rain, earthquake, etc. with sensors installed along the railway.
- The information shall be sent to OCC on IP network for the decision support on the train operation.

i) Telecommunication Equipment Monitoring system

- Conditions and failures of Telecommunication equipment along stations and railway can be monitored at OCC by Telecommunication equipment monitoring system.
- In the event of a failure, alert can be issued to notify the maintenance personnel, so that it is possible to respond promptly.

j) Power Supply system

- To supply power to the Telecommunication system, UPS shall be installed to ensure a stable power supply without the influence of power failure, instantaneous power failure, and voltage drop.

k) Telecommunication Cable

- Optical fiber cable used for Backbone system shall be a single mode (SM) cable.
- Single mode optical cable must be capable of long distance transmission between OCC, stations and Depot and capable of large capacity communication up to 10 Gbps.
- The optical fiber cable is laid in the trough, duct, etc. so that a ring configuration can be formed.

(5) Design Criteria

1) Environmental Condition

a) Temperature

- Indoor (Open Area) : 30 ^{o}C or lower
- Outdoor : 40 ^{o}C or lower

b) Relative humidity

- Indoor 90% or lower
- Outdoor 100% or lower

c) Altitude : 50m or lower

d) Reference Wind Velocity : 40m/sec

e) Lightning Area : Sever Lightning Area

f) Sault Damage District : around 10km from coastline

g) Flood and Earthquake : Action Required

2) Design Condition

a) Common Items

♦ Compliance with standards

The Telecommunication system shall comply with international standards, standard conforming to international standard and Philippine standards.

♦ Availability of Telecommunication system

Redundancy of the Telecommunication system shall be secured with adopting duplicated transmission path, duplicated and stacking of equipment or Link Aggregation (LA), etc.

♦ EMC: Electromagnetic Compatibility

The equipment of the Telecommunication system shall satisfy the following conditions for Electro Magnetic Interference (EMI).

- Electro Magnetic Compatibility (EMC) shall comply with international standard IEC 62236 in railway field.
- The EMI emitted by the equipment of the Telecommunication system shall not affect other equipment
- The equipment of the Telecommunication system shall operate satisfactorily even if it receives EMI generated by other equipment.

♦ Surge current

To protect the communication equipment from the surge current, the copper cable is provided with a protection device to absorb the surge current, etc.

♦ Grounding

The Telecommunication facilities shall be connected to the grounding device:-

- Telecommunication system
- Main Distribution Frame (MDF)
- Optical Distribution Frame (ODF)
- Surge current protection device
- Terminal box for Telecommunication cable
- Messenger wire for optical fiber cable
- Other if any

b) Backbone system

- Transmission scheme of the Backbone system shall be with IP.
- Redundancy is performed by double ring configuration specified in the Availability of Telecommunication system section.
- The L3SW implements the stacking function to achieve redundancy.
- The link between L3SW and L2SW is redundant by the LA technology.
- The transmission capacity of the Backbone system shall allow a margin of 50% to the total value.
- QoS shall be implemented for the IP line involved with voice that is real-time communication using UDP.

c) Radio system

- Basically, the radio base station is installed in the equipment room of the station. In the installation of the radio base station, the lowest receiver sensitivity must be satisfied based on the link budget calculation.
- The condition of the building failure shall be the metropolitan class.
- Equipment related to train operation shall be redundant.

d) Equipment installation

- In principle, the Telecommunication equipment is installed in a rack in the equipment room.
- Rack, etc. shall be subjected to earthquake resistance measures.
- Anti-rat (rodent control) measures should be taken on cable ducts of the equipment room.

e) Telecommunication cable

- Optical fiber cable shall be single mode (SM) cable.
- In the case of short distance transmission, multi-mode (MM) fiber may be used.
- The optical fiber cable used for the backbone system does not terminate at other than the ODF in the equipment room.
- When protecting the optical fiber cable with a trough or the like, take anti-rat (rodent control) measures.
- In principle, the tension member of the optical fiber cable shall be non-metallic, and the allowable bending range shall be as follows.
  - ✓ When laying the optical fiber cable: 20 times or more than the cable outer diameter
  - ✓ When fixing the optical fiber cable: 10 times or more the cable outer diameter
- Telecommunication cables shall basically be of Flame Retardant, Low Smoke and Zero-Halogen.

f) The Other

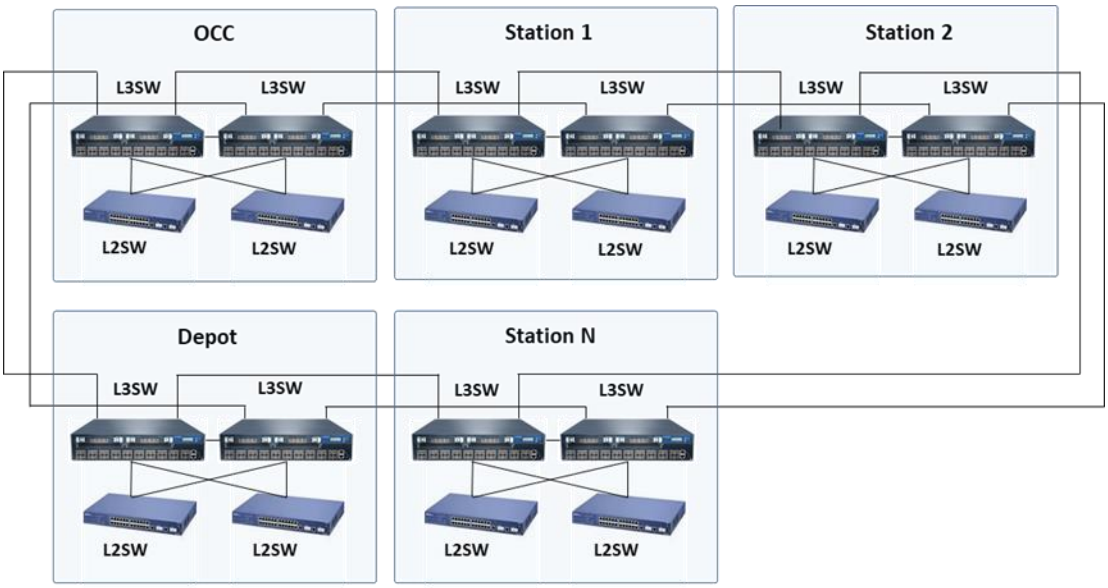
- The latest technologies shall be adopted positively as far as they are confirmed to be safe.
- Power supply to the terminal devices in the Telecommunication system shall be made from PoE switches (HUB) as much as possible.
- Power supply to the equipment units for the Telecommunication shall be via UPS.
- Basically, the Equipotential grounding method shall be applied as the Telecommunication system.

3) Respective Requirement

a) Backbone system

- The Backbone system is a ring network configuration in which OCC and stations are connected by single mode (SM) fiber cable.
- The Backbone system has a dual ring configuration to ensure network redundancy.

- The transmission speed of the Backbone system realizes high-speed communication of 1 Gbps to 10 Gbps
- The Backbone system consists of L3 and L2 switches.
- The Backbone system secures redundancy by installing two L3SWs in the Telecommunication equipment room of OCC and stations.
- L3SW supports Internet protocols and is a highly reliable network device that can be IP routed.
- If one of two L3SWs installed at OCC, stations and Depot fails, it shall automatically configure a detour route to enable communication.
- The Backbone system shall be closed to NSRP-South in order to ensure security.
- Secure security logically by appropriately setting the VLAN.
- The priority of data can be set by the Quality of Service (QoS) function.
- The point of interface (POI) between the Backbone system and the subsystem is input/output port of L3SW or L2SW. The cable to be connected is prepared on the subsystem side.
- It is assumed that redundancy of L3SW is performed by stacking technology.
- It is assumed that the redundancy of the link between the L3SW and the L2SW is performed by the link aggregation (LA) technology.
- Example of system configuration
- Example of the Backbone system configuration is shown in Figure 4.3.48.



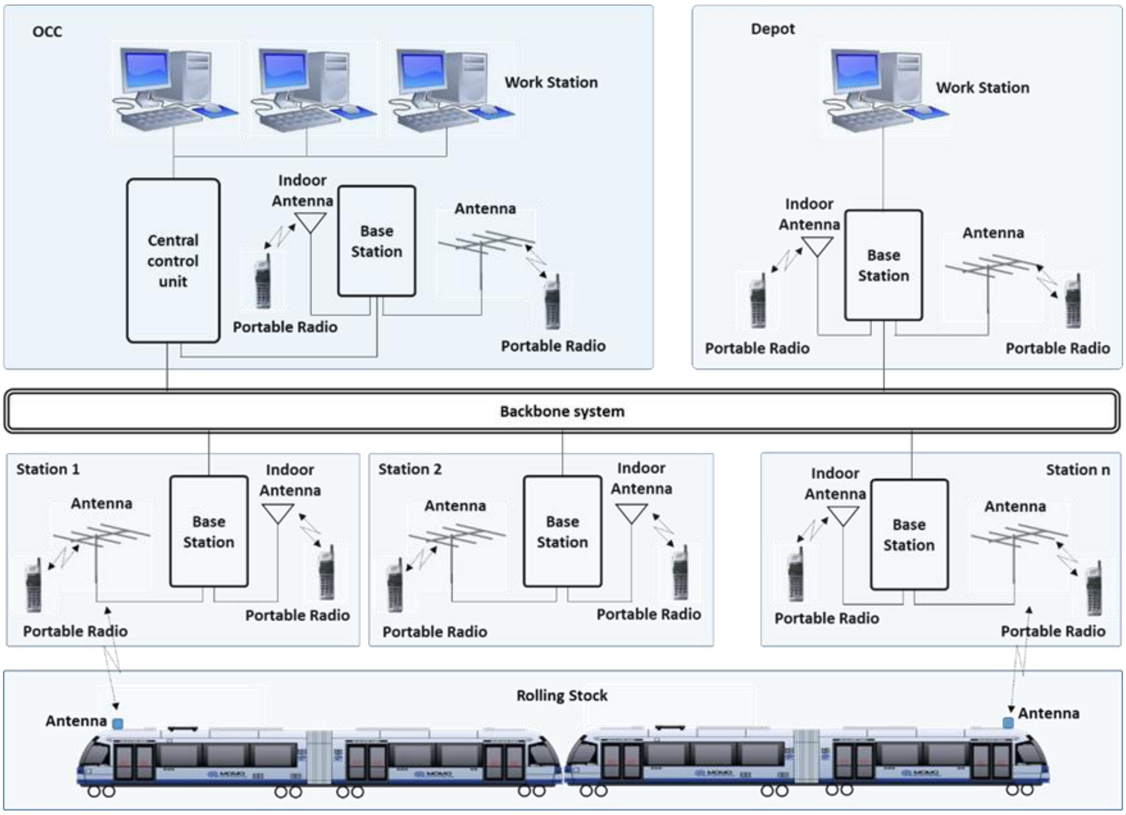
Source: JICA Design Team

Figure 4.3.48 Example of the Backbone system configuration

b) Radio system

- The Ground Radio system consists of a central control unit, a workstation, a base station, an antenna / LCX cable, a portable radio terminal, etc.
- On-board Radio system consists of mobile radio terminal, operation panel, antenna, etc.

- Call types are emergency calls and normal calls.
- Emergency calls are used for abnormal cases, and normal calls are used when normal.
- There is individual call, broadcasting call, group call, call between train drivers, and an emergency call.
- The call mode is as follows.
  - ✓ Calls between OCC operators and individual train drivers and individual maintenance personnel shall be full duplex communication.
  - ✓ Calls between OCC operators and multiple train drivers or multiple maintenance personnel shall be half duplex communication.
- The data when EB system operates or the data (TIS information) such as a train number are transmitted to the OCC. The on-board radio station has an interface for connecting with the TIS
- The service areas of Radio system are main line, station, Depot etc. The service area of the main line is 100% because it directly affects the operation of the train. Station area includes platform, entrance, and concourse. And all places where maintenance personnel and other staffs are located. Depot area includes Storage (stabling) tracks, inside of buildings, etc.
- The number of radio channels secures at least 4 channels.
- Antennas for main line are basically set at stations. As the type of antenna, a directional antenna such as Yagi antenna, parabolic antenna etc. is used.
- Where the installation of the antenna is unsuitable, the LCX shall be laid.
- In principle, the antenna in Depot shall be non-directional and covers a wide service area. Also, the support of the antenna has a strong structure and the safety rate of wind pressure load is double.
- Example of system configuration
- Example of the Radio system configuration is shown in Figure 4.3.49.



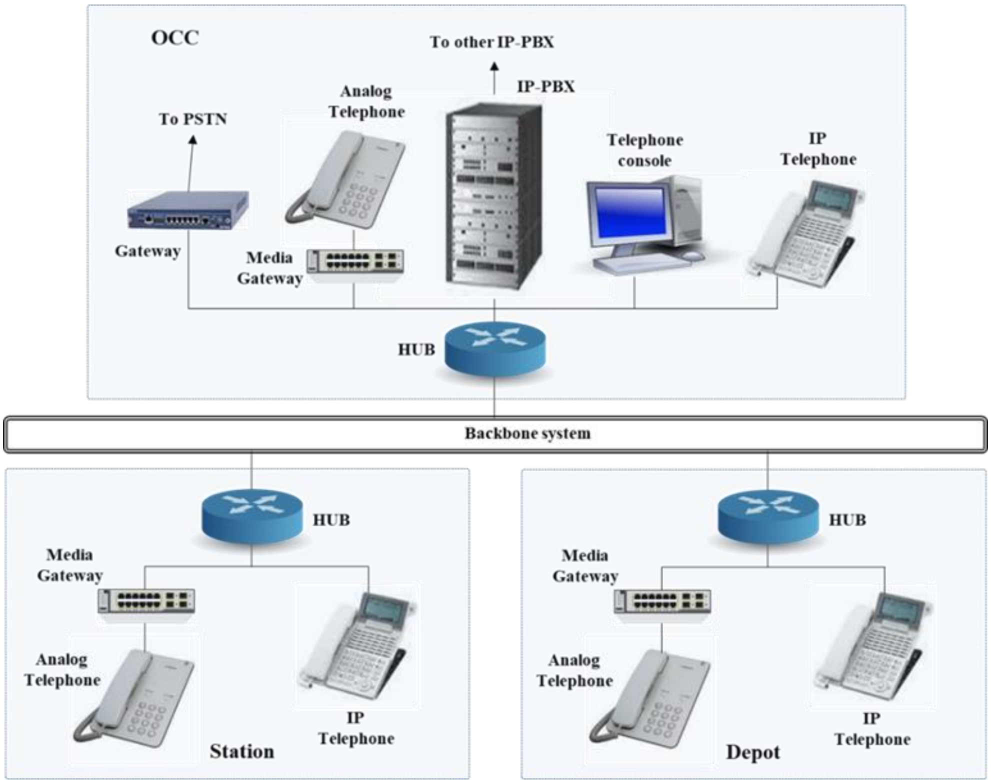
Source: JICA Design Team

Figure 4.3.49 Example of the Radio system configuration

c) Voice and Data system

- Voice system consists of IP-PBX, gateway, media gateway, PoE HUB, and telephone terminals.
- In accordance with the installation location, IP telephone set or analog telephone set is installed.
- The analog telephone connects to the IP-PBX via the media gateway. The PSTN is connected via a gateway.
- IP-PBX is configured as a duplex configuration for redundancy.
- IP-PBX is 100% non-blocking for all calls.
- The IP-PBX design has a modular structure to facilitate maintenance and expansion.
- The maximum capacity of the IP - PBX can be increased to the maximum value of the subscriber number.
- The IP-PBX connects to a public switch telephone network, PSTN (PLDT: Philippine Long Distance Telephone network). For connection with the PSTN, Point of Interface (POI) is set up in the OCC.
- The IP-PBX makes it possible to connect IP phones and analog phones.
- The free capacity of the telephone line is 25%.
- The IP telephone terminal is powered by a HUB having a Power over Ethernet (PoE) function conforming to IEEE802.3af.

- The data system consists of a mail server, web server, firewall, PoE HUB, etc.
- The server and the PoE HUB are connected by a backbone system.
- It is connected to the Internet via UTM (Unified Threat Management) or a firewall.
- The interface of the PoE HUB shall be 10/100 / 1000Bace-T and 100 / 1000Bace-TX.
- In access from the terminal, it is connected to the data network by Wi-Fi.
- UTM has functions such as IDS / IPS, anti-virus, anti-spam, Web filtering in addition to the function of the firewall.
- The server consists of a mail server, a Web server, a file server, etc., and it is installed in the equipment room of OCC.
- Example of system configuration
- Example of IP-PBX system configuration is shown in Figure 4.3.50.



Source: JICA Design Team

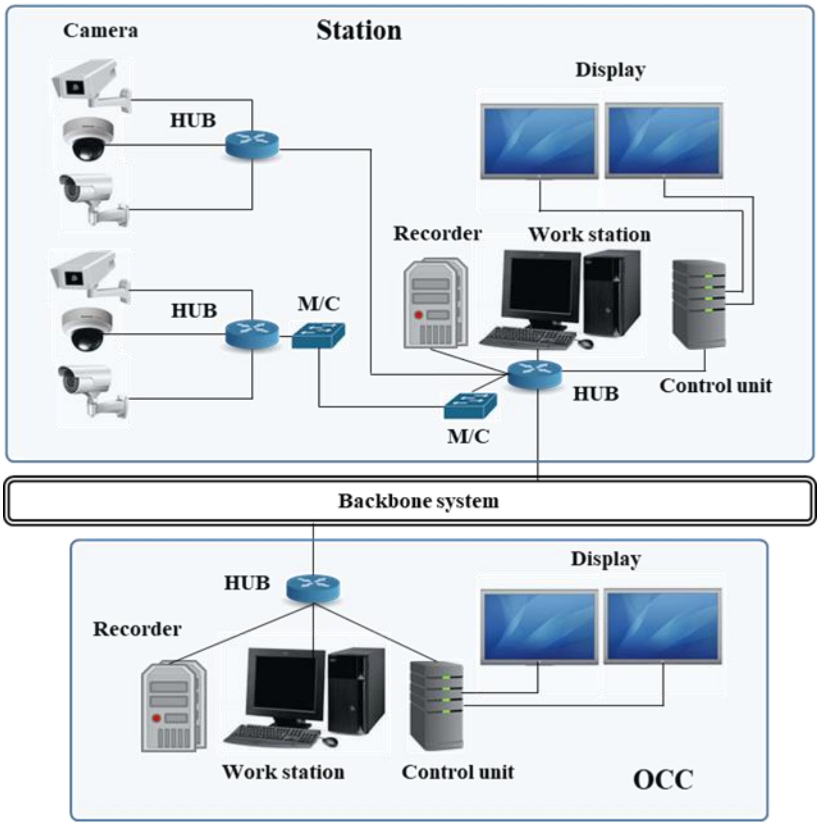
Figure 4.3.50 Example of IP-PBX configuration

d) CCTV system

- The CCTV system consists of cameras, control units, workstations, HUBs with PoE function, recorders, etc.
- Cameras such as fixed cameras, PAN, TILT, ZOOM (PTZ) cameras, and dome cameras should be installed in places suitable for the application. The image of the camera should be color.
- In places where dust is generated much, the camera is housed in the camera housing.
- For cameras installed outdoors, it is necessary to consider environmental resistance conditions. Therefore, dustproof and waterproof performance of the housing shall be IP66 or more of the

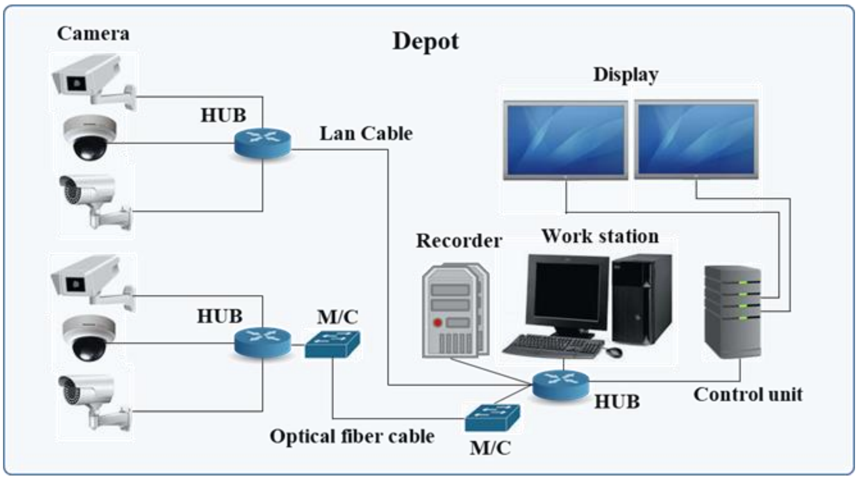
EC60529 standard.

- The camera shall operate under lighting conditions from normal illumination level (1000 lx) to emergency illumination level (5 lx).
- The workstation installed at each station shall be able to set and control the camera. Also, software that can be used by maintenance personnel is installed there, and the maintenance of the camera shall be possible. The video of the camera shall be recorded at each station.
- The workstations installed in the OCC shall be able to monitor and control all cameras at all stations.
- The storage period of the recorded video data shall be one month. New data overwrites the data that passed one month.
- The camera shall be an IP network camera.
- The camera is connected to the network with Ethernet LAN cable when it is 100 m or less. If the distance exceeds 100 m, it can be relayed by Ethernet HUB. It is also possible to use an optical fiber cable by using a media converter.
- The frame rate of the camera is set to 5 fps at the normal time and 25 fps at the time of abnormality occurrence.
- Example of system configuration
- Examples of CCTV system configuration are shown in Figure 4.3.51 and Figure 4.3.52.



Source: JICA Design Team

Figure 4.3.51 CCTV system configuration for main line

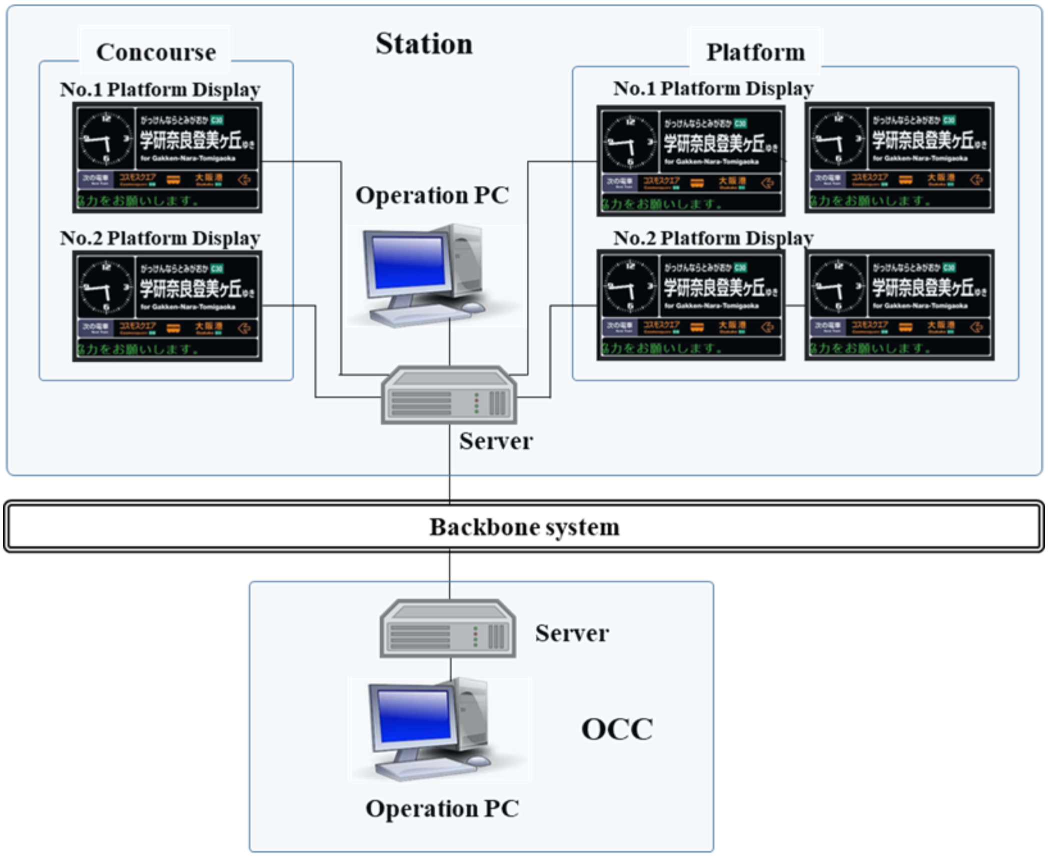


Source: JICA Design Team

Figure 4.3.52 CCTV system configuration for Depot

e) Passenger Information Display (PID) system

- Passenger Information Display consists of operation consoles, displays, control servers, etc.
- The display shall be easy to see with universal design. Example is a Liquid Crystal Display (LCD).
- On the display board, letters and images, etc. input to the control server are displayed.
- The resolution of the display shall not be less than 1920 × 1080.
- Display contents are automatically updated with data received from ATS (Automatic Train Supervision) of signalling system.
- Time information is obtained from Time server system.
- Information input operation can be done from the station and also OCC.
- Arbitrary information shall be displayed from OCC's console, to one station, predetermined group stations, all stations.
- The control server shall be able to receive arbitrary content from the OCC and display it on the display board.
- The control server is redundant with a dual configuration.
- On the console, the contents of the display are monitored.
- The display of the display and console shall be able to select English and Tagalog.
- In the event of fire, fire information is automatically displayed on the board in interlocking with Fire Alarm system, and Evacuation guidance of passengers is carried out. In the case of other abnormalities, by displaying the information input manually from the operation panel, it is possible to provide passengers with appropriate information.
- Example of system configuration
- Example of PID system configuration is shown in Figure 4.3.53.



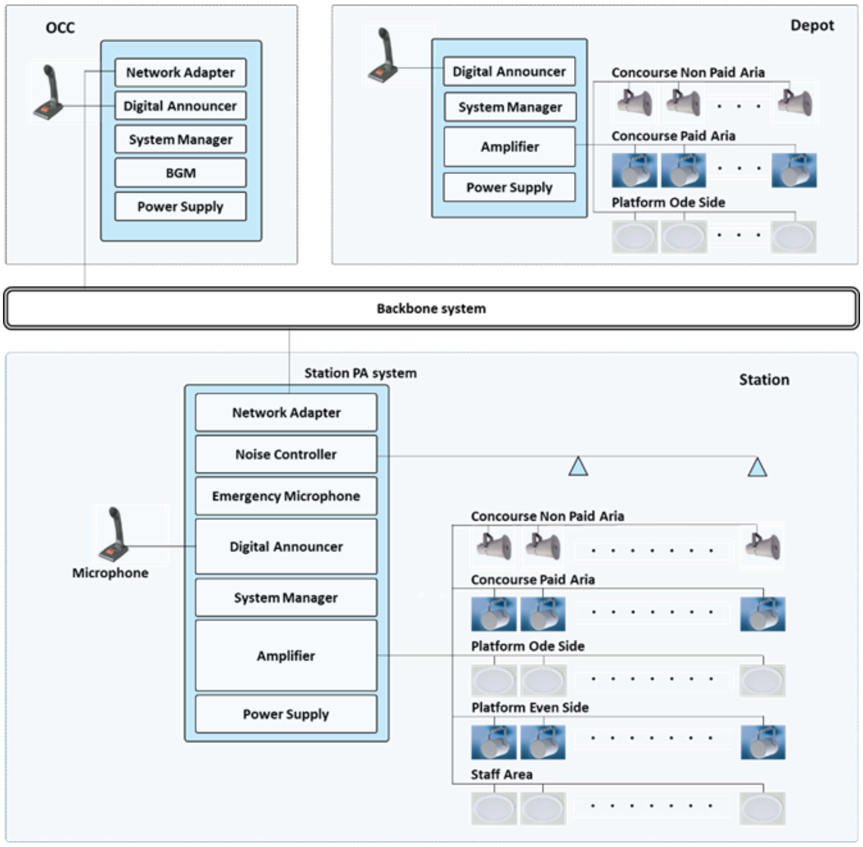
Source: JICA Design Team

Figure 4.3.53 Example of PID system configuration

f) Public Address (PA) system

- PA system consists of amplifiers, speakers, microphones, noise cancellers, etc.
- The speaker system shall be redundant by using two amplifiers in one broadcasting area.
- Broadcast area of platform shall be independent for each platform.
- The devices of PA system installed at OCC and each station are connected via IP network of Backbone system.
- PA system shall be able to detect disconnection, short circuit, leakage current of speaker line by maintenance function.
- Even if all external power supply is downed, the PA system shall be able to continue broadcasting with the built-in battery installed in the PA system.
- The speaker cable of the PA system shall be a heat and fire resistance cable.
- If a fault occurs in the PA system, alarms should be displayed for each unit to identify the fault location.
- The PA system receives train operation information from ATS of the train signalling system and automatically broadcasts the information to the platform and the concourse.
- The PA system detects the noise with the noise sensor and adjusts the output level by the automatic level adjustment function. By adjusting the output level, the PA system can broadcast with comfortable volume in all areas.

- In case of emergency, evacuation guidance announcement can be made for all broadcasting areas with the highest priority by pressing the emergency button.
- PA system has a standby amplifier, and it is a redundant configuration that automatically switches to the standby amplifier in case of failure.
- The Broadcast contents shall be able to select English and Tagalog.
- The PA system shall be able to automatically announce fire occurrence to all broadcasting areas in linkage with Fire Alarm system.
- Example of system configuration
- Example of PA system configuration is shown in Figure 4.3.54.



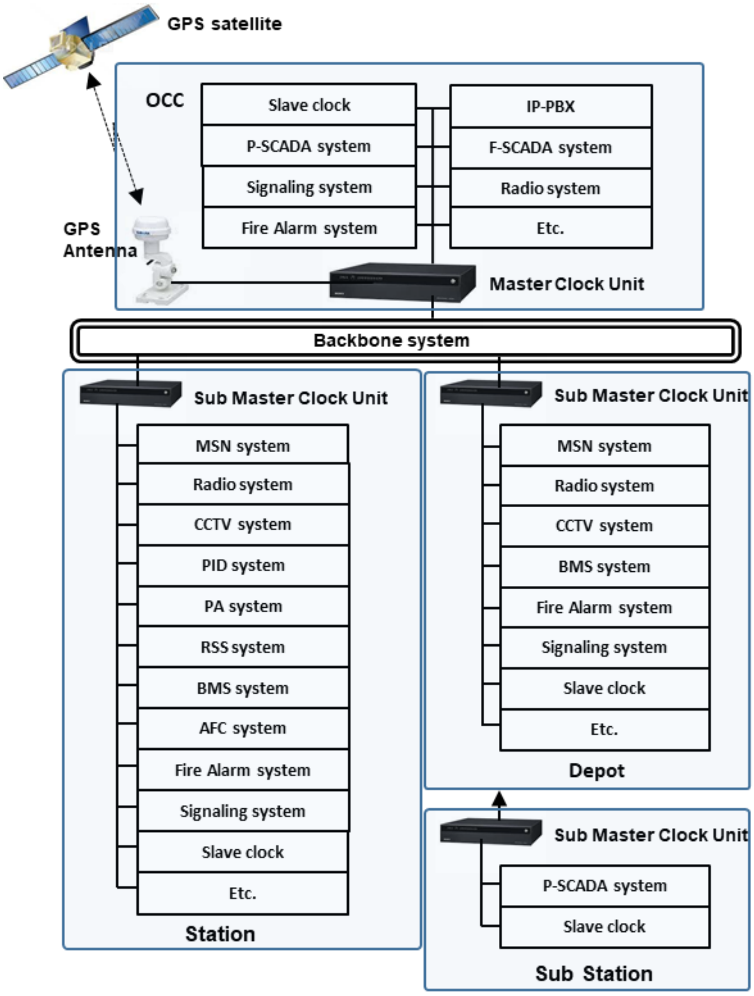
Source: JICA Design Team

Figure 4.3.54 Example of PA system configuration

g) Time Server and Master Clock system

- The Time Server and Master Clock system is composed of a Master Clock unit, a sub Master Clock unit, Clock controller, a Slave Clock, etc.
- The Time Server and Master Clock system shall support the provision of time to Ethernet TCP / IP networks.
- The Time Server and Master Clock system shall have a Time Server function to supply time to other systems by NTP/SNTP/Time Protocol.

- When a surge voltage such as lightning is applied, the surge protector protects the Time Server and Master Clock system by flowing the surge current from the antenna to the ground.
- The antenna shall be waterproof and weather resistant against direct sunlight, wind, rain, etc.
- The antenna shall be installed in an appropriate position that can be confirmed with the eyes. Also, the support of the antenna has a strong structure and the safety rate of wind pressure load is double.
- The Master Clock unit shall have a GPS receiver function, in order to acquire accurate time from the GPS.
- The Master Clock unit converts the signal received from the GPS into SNTP. The Master Clock unit distributes time to the systems and the Slave Clocks of OCC.
- The Master Clock unit has crystal (quartz) inside and can hold exact time by itself.
- The Master Clock unit distributes time to all sub-Master Clock units via Backbone system.
- The Sub-Master Clock unit synchronizes with the Master Clock unit and distributes the time to Slave Clocks.
- The Sub-Master Clock unit has crystal (quartz) inside, and it is possible to hold accurate time by itself.
- The Clock Controller is necessary when the Slave Clock does not have the function of receiving the time directly from the network.
- The Clock Controller is installed at the OCC and at the stations to make it easy to add and replace the Slave Clock.
- The Clock Controller receives the time from the Sub-Master Clock unit and multicasts the time to the Slave Clock.
- Since the Clock Controller controls the Slave Clock, it is not necessary to allocate IP addresses to individual Slave Clocks at the time of addition or replacement of the Slave Clock.
- The power of the Clock Controller shall be powered by PoE conforming to IEEE802.3af.
- The Slave Clock receives the time transmitted from the Master Clock unit or the Sub-Master Clock unit and displays the time in analog or digital form.
- The Slave Clock is connected to the Master Clock unit or the Sub-Master Clock unit via LAN.
- The Slave Clock shall have automatic adjustment function. When the signal is restored after the signal has been interrupted due to a failure of the Master Clock unit or the sub Master Clock unit or disconnection of the cable, the accurate time must be displayed automatically and immediately.
- The Slave Clock has a crystal (quartz) inside and the time should be held independently by itself, even if the signal from Master Clock unit or Sub-Master Clock unit is lost.
- There are two types of Slave Clock, analog Slave Clock and digital Slave Clock. The time display on the passenger information display is also possible.
- The Slave Clock is powered from PoE conforming to IEEE 802.3af.
- Example of system configuration
- Example of Time Server and Master Clock system configuration is shown in Figure 4.3.55.



Source: JICA Design Team

Figure 4.3.55 Example of Time Server and Master Clock system configuration

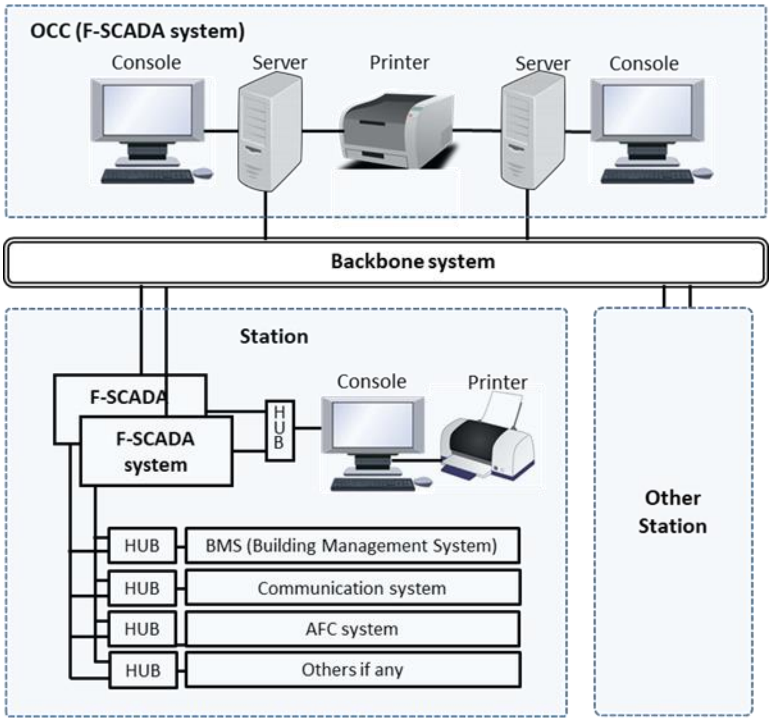
h) Meteorological and Seismic Monitoring system

- Meteorological and Seismic Monitoring system consists of sensors (anemometer, rain gauge, seismograph and water level gauge) and measuring equipment.
- Measurement of instantaneous wind direction, mean wind direction, instantaneous wind speed, mean wind speed and maximum instantaneous wind speed should be possible.
- When the wind speed value exceeds the threshold value or when a failure occurs in the equipment, an alarm signal shall be output.
- Alarm values about an hour rainfall, daily rainfall, continuous rainfall, rainfall with time, effective rainfall is set for the rain gauge, and if it exceeds these values, an alarm shall be issued.
- The rain gauge shall take countermeasures against surge penetration from the outside and shall have a structure resistant to static electricity and external noise.
- The rain gauge can store measured data and can transfer data to an external terminal such as a PC.

- The seismograph shall be able to calculate the seismic intensity from the acceleration and period of the vibration and to display the seismic intensity on the seismograph measuring device.
- When an earthquake occurs, an alarm shall be generated and made known.
- Measure the water level of a river, etc. When the water level rises, alarm indication can be made in multiple stages depending on the degree of rise in water level.
- The display of the alarm at multiple stages shall be able to set arbitrarily.

i) Telecommunication Equipment Monitoring system

- The Telecommunication Equipment Monitoring system consists of servers, consoles and printers which is installed in the OCC, and alarm collecting devices, consoles and printers which is installed in each station.
- The Telecommunication Equipment Monitoring system shall display the alarm of the Telecommunication system on the console installed in each station. Also, the console installed in the OCC shall display alarms of Telecommunication facilities installed at all stations and Depot.
- The server, console and alarm collecting device shall be redundant.
- The alarm of the Telecommunication system is connected to the alarm collecting device. The alarm collecting device is connected to the OCC server via Backbone system.
- Failure indication of the console at the stations and OCC shall be based on the implementation drawing of each system. If a failure occurs, the failed part of the mounting diagram will blink.
- Divide by color according to failure type. When a failure occurs, the color displayed on the console changes. At the same time, it notifies the occurrence of the failure with an alarm sound. The alarm sound continues until the person checks and pushes the alarm sound stop button. Also, the color does not change until the failure returns to a normal state.
- When a failure occurs, it is possible to record the date and time of occurrence, the equipment name, the location of the failure, etc.
- All logging data and failure information shall be recorded in the storage for three months or more. The recorded data can be copied to External recording medium (CVD, Blu-ray Disc, etc.).
- Example of system configuration
- Example of Telecommunication Equipment Monitoring system configuration is shown in Figure 4.3.56.



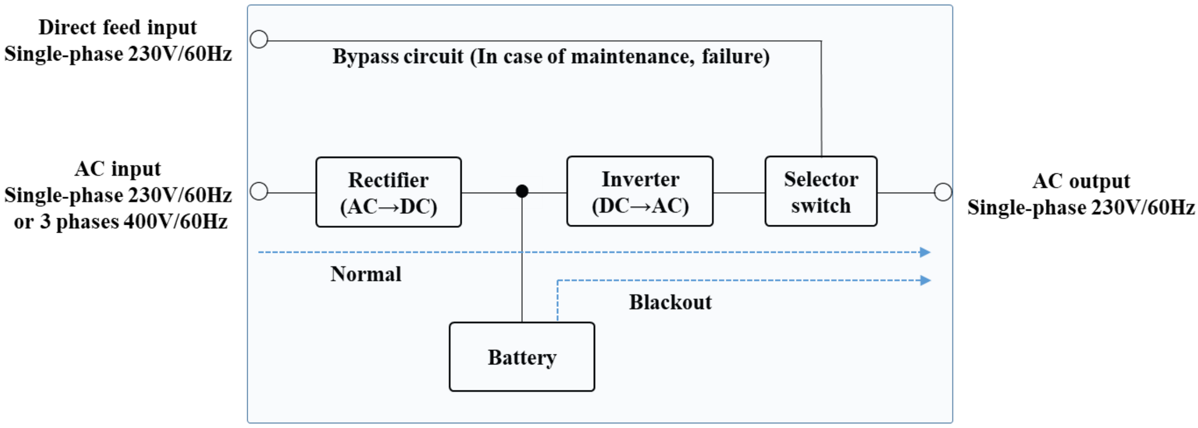
Source: JICA Design Team

Figure 4.3.56 Example of Telecommunication Equipment Monitoring system configuration

j) Power Supply system

- The UPS consists of rectifiers, inverters, batteries, a distribution board for Telecommunication system, and so on.
- The UPS shall be installed in equipment room of the OCC and stations.
- The UPS receives a power of single-phase 230 V / 60 Hz and supplies uninterruptible power to Telecommunication system. In the event of a power outage, power shall be supplied from the emergency generator.
- The rectifier is a device that receives single-phase 230 V / 60 Hz power and rectifies it to direct current. The output is supplied to inverters and batteries.
- The inverter receives DC power from the rectifier and outputs single-phase 230 V / 60 Hz. The output is connected to the distribution board for Telecommunication system.
- The battery receives DC power from the rectifier and stores it. When a power outage or rectifier fails, etc., the battery supplies DC power to the inverter.
- The battery shall have a capacity of 3 hours for the load of the connected Telecommunication system.
- The distribution board relays the output of inverter unit and supplies single-phase 230 V / 60 Hz power to Telecommunication system.
- The distribution board has terminals corresponding to the number of power lines of the equipment to be connected, and circuit breaker suitable for each power load is installed.
- Example of system configuration

- Example of Power Supply system configuration is shown in Figure 4.3.57.



Source JICA Design Team

Figure 4.3.57 Example of Power Supply system configuration

k) Telecommunication cables

- Optic fiber cable is mainly used to construct the Backbone system.
- Single mode (SM) fiber cable conforming to ITU-T G.652B is used as optic fiber cable.
- The optical fiber cable shall be laid in the trough, duct, etc. so that a ring structure can be formed.
- SM optical fiber cable is capable of long distance transmission between OCC, each station and Depot, and it is capable of large capacity communication of up to 10 Gbps.
- In principle, the tension members of the optical fiber cable shall be non-metallic.
- Insertion loss due to fusion splicing shall be 0.2 dB or less.
- The sheath of the optical fiber cable shall use a stainless laminate or a corrugated steel tube in order to prevent damage from the rat.
- In order to terminate the optical fiber cable, ODF shall be installed in the equipment room of stations and the OCC. The Optical fiber cable is terminated at ODF.
- LCX cable is used for countermeasure of weak radio field strength, to achieve better RF coverage.
- LCX cable shall be refractory specification.
- UTP/STP cable is a cable made by twisted pair electric wires defined by IEEE 802.3, and it is used for telephone lines and Ethernet, etc.
- The Shielded Twist Pair (STP) cable is available in case that it pass the route where noise measure is necessary to be taken.

(6) Though operation in from the Metro Manila Subway

Metro Manila Subway (MMS) trains have though operation plans to enter the NSRP-South line.

Though operation plan is connected at Bicutan station.

Radio system is directly related to train service. For this reason, the Radio system of the NSRP-South line is required to be able to seamlessly communicate with the Radio system of the Metro Manila subway. Radio systems of NSRP-South line and Metro Manila subway will need to be studied to make frequency, modulation scheme, and occupied frequency band width etc. match.

(7) Others

The following drawings are attached on the APPENDIX.

- Drawing List
- Backbone system
- Radio system
- Voice and Data system
- CCTV system
- Passenger Information Display system (PID system)
- Public Address system (PA system)
- Time Server and Master Clock system
- Meteorological and Seismic Monitoring system
- Telecommunication Equipment Monitoring system

(8) Test

1) Test stage

The tests shall be divided into the following aspects.

- Factory tests
- Installation test
- Integration test
- Commissioning (Trial Run)

2) Factory test

The factory test shall include at least the following items.

- Visual Inspection
- Dimension and Shape Check
- Function Tests,
- Operation Tests
- Software Confirmation Tests
- Dustproof and Waterproof Check

3) Installation test

The Installation test shall include at least the following items.

- Cleaning
- Performance
- Rated Value of Equipment
- Position and Level
- Termination and Marking
- Protection of Cable
- Cable Bending Radius
- Terminal Condition
- Separation Distance
- Matching with Drawing,
- Grounding Connection
- Power Source Breaker

4) Integration test

The Integration test shall include at least the following items.

- Function Confirmation
- Performance Confirmation
- Software Confirmation
- Communication Check between Devices
- Visual Confirmation of Equipment Performance
- Interface Confirmation
- Demonstration in Operation.

(9) Measurement and measuring instruments

- For maintenance and repair in the Telecommunication system, necessary and sufficient measuring instruments shall be provided.
- An operation manual of the measuring instrument shall be provided.

(10) Spares parts

- Necessary and sufficient Spare Parts and Consumable shall be provided for the Telecommunication system.
- Spare parts shall be 10% of the delivery price of the equipment.

(11) Training

- For maintenance and repair in the Telecommunication system, training necessary for maintenance personnel shall be carried out.
- The Training shall include the following.
  - ✓ Daily Inspection and Recording
  - ✓ Operation and Control

- ✓ Calibration Measuring Instrument
- ✓ Monitoring of Telecommunication system
- ✓ Troubleshooting
- ✓ OJT

(12) Major Material Installation

The major materials for the Telecommunication system are installed as per the following Table 4.3.57.

Table 4.3.57 Major Material Installation of Main line

	Station name	Km	OCC	OFC	L3SW	L2SW	RS	TEL	CCTV	PID	PA	MON	UPS
1	Solis	0.36	△	△	△	△	△	△	—	—	—	△	—
				◎									
2	BLUMENTRITT	2.22	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
3	ESPANA	4.10	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
4	STA. MESA	5.93	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
5	PACO	8.88	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
6	BUENDIA	11.84	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
7	EDSA	13.65	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
8	NICHOLS	16.08	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
9	FTI	18.31	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
10	BICUTAN	20.91	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
11	SUCAT	24.97	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
12	ALABANG	29.02	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
13	MUNTINLUPA	32.15	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
14	SAN PEDRO,L.	35.72	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
15	PACITA	37.60	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
16	BINAN	40.03	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
17	SANTA ROSA	44.16	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
18	CABUYAO	47.62	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
19	GULOD	50.51	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
20	MAMATID	53.32	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎
				◎									
21	CALAMBA	56.47	○	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎

【Note】◎: Major material installation, ○: monitoring & control, △: Installation as necessary

Source JICA Design Team

Table 4.3.58 Major Material Installation of Depot

	Building name etc.	OFC	L3SW	L2SW	RS	TEL	CCTV	Clock	PA	UPS
1	Security room	◎	◎	◎	◎	◎		◎	◎	◎
2	Light repare shop					◎		◎	◎	
3	Unscheduled repare shop					◎		◎	◎	
4	Wheel re-orofiling shop					◎		◎	◎	
5	Depot's outer wall	◎					◎			
6	Depot's entrance	◎					◎			
7	Depot's railway entrance	◎					◎			
8	Depot's warehouse	◎					◎			

【Note】◎: Major material installation

Source JICA Design Team

4.3.8 AFCS (Automatic Fare Collection System)

(1) Definitions and Abbreviations

1) Definitions

Antenna: Unit for data communication with contactless IC card

Black list: List of cards deemed to be rejected by the system

Card: In this specification, the word “card” stands for contactless IC card.

Clearing house: An organization to collect and distribute information to settle payment between member organizations

Contactless IC card: A card which transmits data by modulated radio frequency signal

Employer: Department of Transportation

Employer’s Representative: The agent who consults the employer to examine the specifications and the system

O&M Company: Company that undertakes to operate and maintain the AFC system

Security access module: A module that contains key data for encryption and mutual authentication for communication between the card and the device

2) Abbreviations

AFC(S)	Automatic Fare Collection (System)
AG	Automatic Gate
CCS	Central Computer System
GS	General Specification
HT	Handheld Terminal
LAN	Local Area Network
MCBF	Mean Cycle Between Failure
POS	Point Of Sales Terminal
SAM	Security Access Module
SCS	Station Computer System

SJT	Single Journey Ticket
SVC	Stored Value Card
TVM	Ticket Vending Machine
UPS	Uninterrupted Power Supply

Source: JICA Design Team

3) Related rules and standards

ISO/IEC14443	Identification Cards – Contactless Integrates Circuit Cards – Proximity Cards
ISO/IEC15408	Information Technology -- Security Techniques -- Evaluation Criteria for IT Security
ISO24014-1	Public Transport – Interoperable Fare Management System – Part 1 Architecture
Republic ACT No.7277	The Magna Carta for Disable Person
(confidential)	Transpo^{TM} Automatic Fare Collection Scheme – Core Operating Rules
(confidential)	PPP for the Automatic Fare Collection System Project for LRT Lines 1&2 and MRT 3 Minimum Performance Standards and Specifications

Source: JICA Design Team

(2) Scope of Works

1) General

a) This system is installed in the NSRP-South line and is capable of interoperating with existing LRT 1, 2, MRT 3 AFC systems, and with the AFC system of the north - south commuting line which is planned to be constructed in the future. In the future, the card will be developed as a common card that can be used for multiple purposes in the Manila metropolitan area, including new or expanded transportation facilities.

b) Central Clearing House System and Card 1st Issuer are prepared at the higher level of this system for settlement and 1st Issuing of the common use cards.
Therefore, upon constructing this system, the interface with the clearing house and the card must receive information from the clearing house operator side and card issuer side, and obtain the necessary cooperation.

c) Since this system is required to be equivalent to the existing AFC system as described above, the performance should conform to the MPSS (Minimum Performance Standards and Specifications) in the Concession Agreement of "PPP for the Automatic Fare Collection System Project for LRT Lines1 & 2 and MRT3" except section 2.12 (Level 4 Infrastructure MPSS).

d) The airport access limited express train is scheduled to be operated, and we are considering introducing a limited express ticket sale system including the seat reservation necessary for getting on the train. The results of the study will be reported separately.

e) The through operation between the NSCR-south line and the subway is scheduled. The basic influence to be considered is described in the section 4.3.8 (8).

2) Scope of Equipment Supply

a) Main Components of the System

The main components of the AFC system shall be, but not limited to the following.

i) Station computer system
ii) Automatic Gate, Ticket Vending Machine, Point of Sales, Handheld Terminal, and Uninterruptible Power Supply
iii) Central Computer System
iv) Cash Handling System
v) Contactless IC Card

b) Station AFC Facilities

The station facilities shall supply, as a minimum, include the following.

i) Station computers and Station Assist Terminals
ii) Automatic Gates
iii) Ticket Vending Machines
iv) Point of sales / Analyzer, Dispenser
v) Handheld Terminals
vi) Special Tools for cash counting
vii) Furniture within AFC Rooms, Customer Service Rooms and Control Rooms.
viii) Uninterruptible Power Supplies in AFC UPS Rooms
ix) Power Supply distribution facilities
x) Cable Routes and earthing
xi) Local Area Network (LAN) and Interfaces to the Communication Backbone Network

c) OCC AFC Facilities

The OCC facilities shall, as a minimum, include the following.

i) Central Computer and assist terminal
ii) AFC Room Facilities
iii) Local Area Network (LAN) and Interfaces to the Communication Backbone Network
iv) Cable Routes and earthing

d) Maintenance Shop and Training Room

i) Maintenance facilities
ii) Training devices
iii) LAN Facilities
iv) Cable Routes and earthing

e) AFC OCC Interface to External Locations

The interfaces to external transmission networks shall be supplied, as a minimum, include interfaces to external transmission networks to provide communication links to the following.

i) Central Clearing House
ii) Off-Site Sales Terminals (in future)

iii) Commercial Banks and Credit Card Agencies for the handling of financial transactions (in future)
iv) Future AFC systems provided by other Service Provider

f) AFC Ticket Media

The initial quantity of smartcards shall be provided.
Additional cards will be procured separately by the Employer as and when required.
The card media for revenue operation for one year and the initial minimum quantity of 1,000 card media for test purposes shall be provided by the system supplier.

g) Spare parts, Special Tools and Test, Training Equipment

The followings, as a minimum, shall be supplied.

i) Spare units and spare parts
ii) Maintenance tools and test equipment
iii) Training equipment

h) Software

i) At least the following software including development system, operating system, antivirus system, etc. shall be supplied.
  - Central Computer System
  - Station Computer System
  - Automatic Gate
  - Ticket Vending Machine
  - Point of sales / Analyzer, Dispenser
  - Handheld Terminal

ii) Each software shall be downloadable from the central computer.

3) Installation

a) The installation work of equipment and cables in the system shall be included as the AFC scope.

b) Construction boundaries at each station are as follows.

i) For power supply and ground, after the distribution board in the AFC UPS room
ii) For communication, after the connection port of the communication backbone network in the communication equipment room

c) The construction boundaries in the OCC building are as follows.

i) For power supply and ground, after the distribution board in the AFC room, ground is after common ground point
ii) For communication, after the connection port of the communication backbone network in the communication equipment room

4) Documentation

The following documents shall be submitted.

i) System specification, Software specification, Hardware Specification, Software source code
ii) Operation manual for the station stuff
iii) Maintenance manual for the maintenance staff
iv) Installation related drawings
v) Consumables list, maintenance parts list

5) Training

The necessary training shall be given to the number of station staff and maintenance staff who are necessary at the commencement of the revenue service.

(3) System Description

This section defines system description.

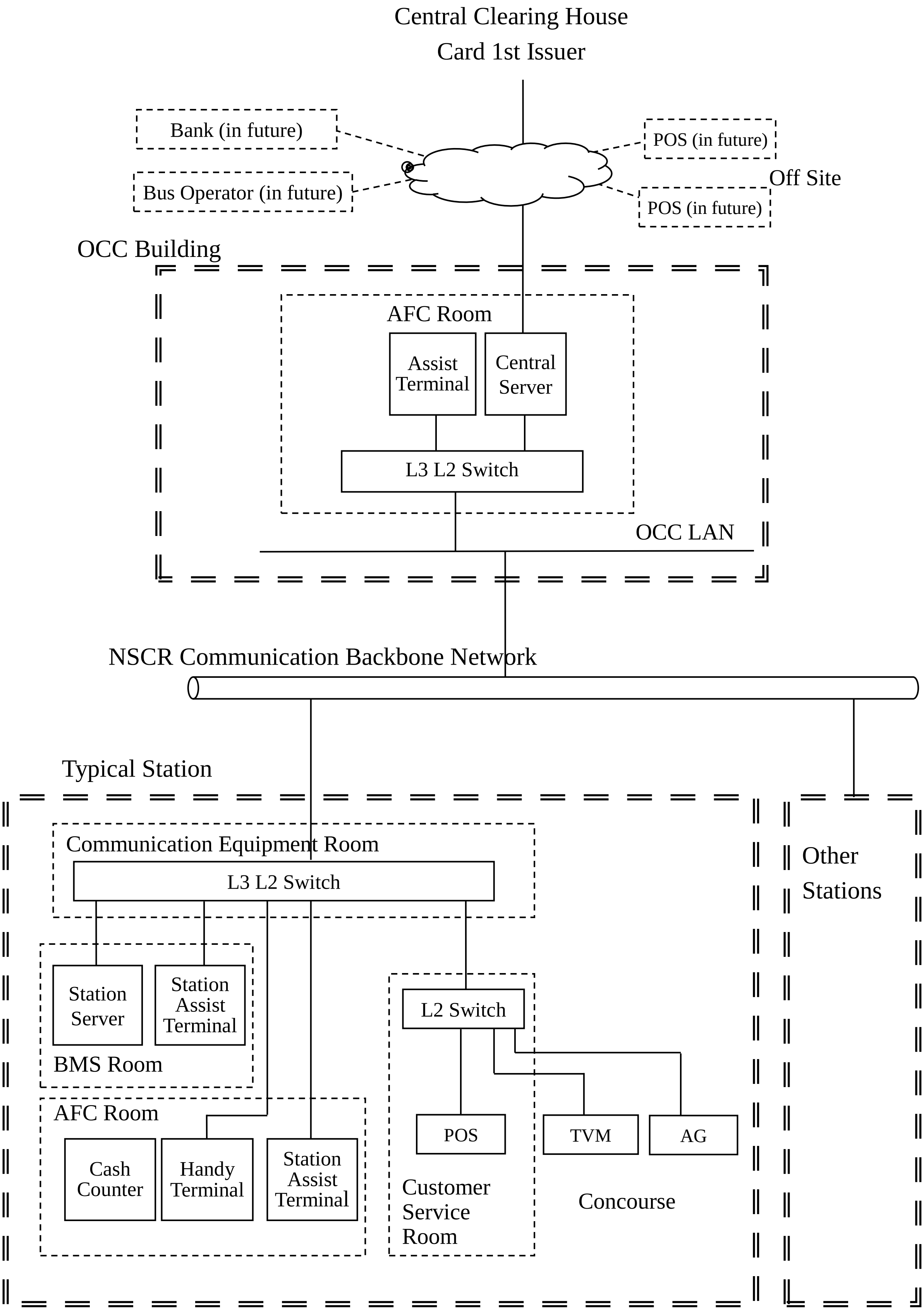
1) Common Use Card

a) Cards used in this system shall be mutually usable with LRT and MRT in Grater Manila Area. And cards used in this system shall be mutually usable with the north - south commuting line, which are planned. That is, cards issued in this system are valid for LRT, MRT, the north - south commuting line and the reverse is also true.

b) For clearing of common usage cards, Central Clearing House System is prepared at the higher level of this system, and card history management, security management, blacklist management, etc. are performed in addition to clearing work.

c) All card media of this AFC system shall be contactless IC cards.

d) The basic structure of this system is shown in Figure 4.3.58.



Source: JICA Design Team

Figure 4.3.58 AFC System Basic Structure

2) Type of Tickets

a) There shall be at least 2 types of tickets.
   i) Single journey ticket (SJT)
   ii) Stored value card (SVC)

b) Anonymous SVC will be used for the staffs of the O&M Company.

c) At the commencement of revenue service, SJT and SVC shall be anonymous. But the personalized card service for the SVC shall be taken into consideration in system design. This means that the system shall be able to be accepted these new cards without any system modification when personalized cards are newly issued in the future under the condition no discount applied to these cards.

3) General Operation

a) Recycle and Deposit

   i) All types of ticket which are anonymous shall be recycled.
   ii) SVC shall require deposit. The amount of deposit shall be able to be changed by the O&M Company without software modification, and shall be encoded within each card. The system supplier shall propose minimum and the maximum limit for data range of setting deposit amount.
   iii) Measures shall be taken to avoid deceiving deposit return by false or copied card, including claims by disguising those cards as damaged. These measures shall be proposed and submitted to the Employer's Representative for review in coordination with the O&M Company.

b) Card issuance and Card Status

   i) Card issuance is how and when to write secure information within cards for use.
   ii) Card issuance shall be conducted in 3 steps.
      - (zero)th issuance
        0th issuance is to format the card, encode unique serial ID number and manufacture's transportation security key in the card. Transportation security key or some other measures for transportation security shall be proposed by the 1st issuer.
      - First (1st) issuance
        1st issuance is to release manufacture's transportation key (or some other transportation security), encode using the 1st issuer's format on the card. The card shall not be used yet at this step.
        The 1st issuer shall be responsible for 1st issuance, excluding testing card, training card, and maintenance card. 1st issuance of testing card, training card, and maintenance card shall be handled by the system supplier.

- Second (2^{nd}) issuance

  The O&M Company shall be responsible for 2nd issuance, excluding testing card, training card, and maintenance card. 2nd issuance of SJT and SVC shall be handled at station machines.

  2^{nd} issuance of testing card, training card, and maintenance card shall be handled by the system supplier.

iii) Cards which are not 2^{nd} issued shall not be used by passengers.

iv) When returned, cards shall be encoded with card return information, in order to deactivate and to avoid faulty use.

v) Card status shall be able to be checked by every related machine included in the system. Information of card status change shall be collected to the central server to be referred by AFC machines when required.

c) Generate the O&M Company's Security Key

i) The O&M Company's security key data shall be decided in consultation with the card 1st issuer and the central clearing house operator.

ii) How to generate the O&M Company's security key shall be proposed by the system supplier and shall be submitted to the Employer's Representative for review in coordination with the O&M Company.

d) Card Printing

i) Card printing for SJT and SVC shall be conducted by the card 1^{st} issuer.

e) Unique Card Identification Number

i) Every card shall be numbered uniquely for system identification and card stock management.

ii) This unique card identification number shall be able to be inscribed on the card, as to be easily defined case of card damage.

iii) This unique card identification number shall include the following information.

- Issue data
- Issue operator code
- Issue machine number
- Serial number

iv) The number of digit and available characters shall be proposed by the system supplier in consultation with the card 1^{st} issuer. It shall be approved by the Employer or the Employer's Representative in coordination with the O&M Company.

f) Confirmation of Card Information

Information within the card shall be able to be confirmed at TVM, POS and HT.

g) Refunds

i) The measures to refund unused SJT and SVC shall be provided.
ii) The measures to refund used SJT and SVC shall be operable by only station POS.
iii) The refund system shall be considered for the measures against fraud, both passengers and staff.
iv) The refund system shall be considered for collecting handling fee.

h) Pricing

i) Actual pricing should be fixed 24 months prior to the start of revenue service.
ii) The system supplier shall submit plans for finalization of fare to the O&M Company.

4) Single Journey Ticket

a) Fare Structure

Requirements for the fare structure of the system include the following.

i) The system shall support graduated fare structure. It shall be flexible enough to support zone (or partly zoned) fare structure.
ii) The system shall be able to provide fare discount.
iii) The system shall be able to change the version of fare easily, for example but not limited to, holding at least two fare versions which can be switched by date and time.
iv) The system shall be able to support at least 16 types of fare within one version for SJT, which is for future discount. Each type of fare shall be able to support at 256 fare stages, which is for future increase of lines or stations.

b) Issue (including 2nd issuance)

i) SJT shall normally be issued by the TVM. But station POS shall also be equipped to issue SJT.
ii) TVM shall indicate on the display names of stations for passengers' convenience when purchasing.
iii) Person to travel single journey shall purchase a SJT with amount of necessary fare. Purchased amount of fare shall be encoded within SJT card.
iv) TVM shall be able to give change back to him.

c) Validity

SJT is valid only for the purchased fare amount without exit from any gate during the date and time specified by the system.

d) Enter Gate

i) The SJT holder shall touch his ticket on the read / write antenna unit of the entry gate. The entry gate shall acknowledge the transaction both audibly and visually. The discounted tickets (in the future) shall be able to be distinguished.

ii) The passenger gate shall check the validity of the ticket.

iii) When a ticket was detected as invalid, the entry gate shall close and not allow the ticket holder to proceed within the paid concourse, and the gate shall display appropriate message to the station staff and the ticket holder.

e) Exit Gate

i) The SJT holder shall insert his ticket into the ticket insert slot. The exit gate shall acknowledge the both audibly and visually. The discounted tickets (in the future) shall be able to be distinguished.

ii) The passenger gate shall check the validity of the ticket.

iii) When a ticket holder gets off at a station where the fare is equal or less than the purchased amount, the gate shall allow the ticket holder to pass through the gate and the ticket shall be captured. The ticket holder renounces its right for further riding even if under fare without any refund.

iv) When a ticket holder gets off at a station further than his planned destination excess of his purchased amount, he has to adjust fare before exit the gate.

v) The gate shall encode exit information within the card.

vi) When an inserted ticket was detected as invalid, the exit gate shall close and not allow the ticket holder to proceed out of the paid concourse, and the gate shall display appropriate message to the station staff and him, and the ticket shall be returned to him.

f) Adjust Fare

i) When a ticket holder needs to adjust fare, he shall pay necessary amount of fare handled by POS terminal at customer service room.

ii) Amount of fare adjustment shall be encoded in the SJT card. It shall be encoded separately from the initially purchased amount.

g) Recycle

i) Cards captured and collected in the exit gate or at the POS terminal shall be able to be recycled.

ii) The detailed measures for recycling cards shall be proposed by the system supplier.

h) Deactivate or Damage

i) When SJT is deactivated or damaged, it shall be handled by POS terminal.

ii) Handling fee for reissuing the card shall be required according to the reason of deactivation or damage.

5) Stored Value Card

a) Fare structure

Requirements for the fare structure of the system are as follows.

i) The system shall support graduated fare structure.
ii) The system shall be able to provide discount fares.
iii) The system shall be able to change the version of fare data table easily, for example, holding at least two fare versions which can be switched by date and time.
iv) The system shall be able to support at least 16 types of fare within one generation for stored fare. Each type of fare shall be able to support at 256 fare stages.
v) It should be considered that a mutual direct train operation is carried out with routes operated by other carriers in the future and fares are spanning two routes.

b) Issue (including 2nd issuance)

i) SVC shall normally be issued by the TVM. But station POS shall also be equipped to issue SVC.
ii) TVM shall indicate on the display amount of initial top-ups when issued.
iii) Person to purchase SVC pays for the top-ups plus the deposit. Amount of top-ups and that of deposit shall be encoded separately within SVC.
iv) TVM shall be able to give change back to him.

c) Top-ups

i) SVC can be topped-up.
ii) Top-ups of the SVC shall be operated by TVM or POS terminal.

d) Validity

SVC is valid until either the card expiration date, or specified period from the last time used, whichever comes earlier. The specified period shall be able to be changed by the O&M Company.

e) Enter Gate

i) The SVC holder shall touch the SVC on the read / write antenna unit of the entry gate. The entry gate shall acknowledge the transaction both audibly and visually. The discounted tickets (in the future) shall be able to be distinguished.
ii) The passenger gate shall check the validity of the card. This check includes that the minimum fare is left in the card.
iii) When a card was detected as invalid, the entry gate shall close and not allow the card holder to proceed within the paid concourse, and the gate shall display appropriate message to the station staff and the card holder.

f) Exit Gate

i) The SVC holder shall touch the card on the card antenna unit of the exit gate. The exit gate shall acknowledge the both audibly and visually. The discounted tickets (in the future) shall be able to be distinguished.
ii) The exit gate checks the remainder of the card. When the remainder is enough, the exit gate deducts the fare between the origin and the destination. When the remainder is not enough for adjustment at the exit gate, the card holder shall be blocked at the exit gate. He has to adjust fare before gate, and then exit the gate.
iii) It should be considered that the possibility to settle the cards entered on the route of another operator by mutual direct train operation.
iv) The gate shall encode exit information within the card.
v) When a touched card was detected as invalid, the exit gate shall close and not allow the card holder to proceed out of the paid concourse, and the gate shall display appropriate message to the station staff and him.

g) Adjust Fare

i) When a card holder needs to adjust fare, he can adjust or top-up more than the shortened amount at the customer service room.
ii) Amount of fare adjustment shall be encoded in the SVC. It shall be encoded separately from the top-up amount.

h) Return

i) SVC can be returned at POS terminal in customer service room. When returned, deposit plus the remaining stored value is returned to the card holder, deducting handling fee.
ii) To handle returning of SVC shall be able to set and changed easily by O&M company.
iii) The system shall be able to handle plural types of handling fee, according to not the reason.
iv) Due date for the deposit return shall be able to be set and changed easily by the O&M company.

i) Recycle

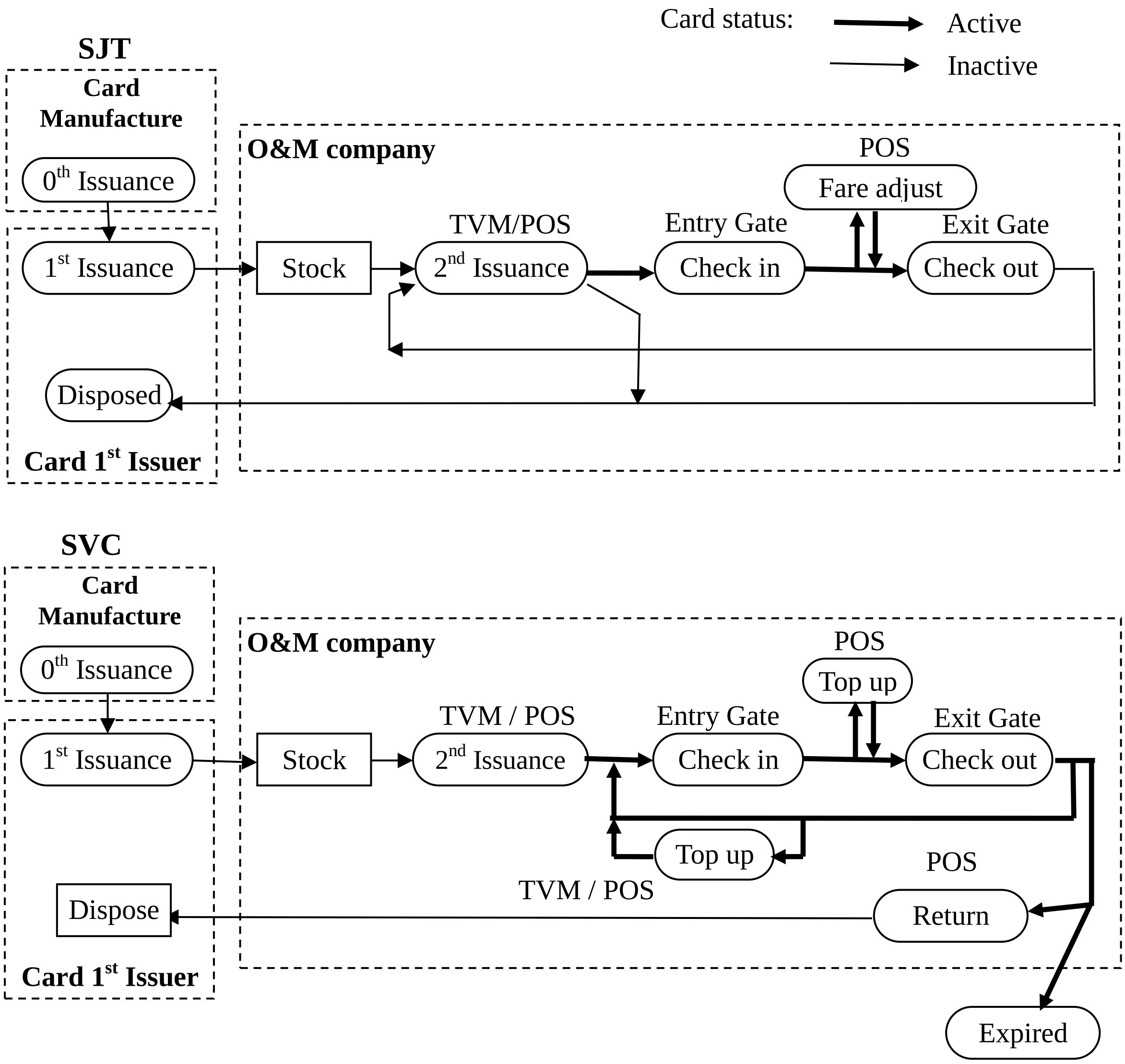
i) Cards collected at the POS terminal shall be able to be recycled.
ii) The detailed measures for recycling cards shall be proposed by the system supplier.

j) Deactivate or Damage

i) When SVC is deactivated or damaged, it shall be handled by the POS terminal.
ii) Handling fee for reissuing the card shall be required according to the reason of deactivation or damage.

6) Card Lifecycle

The card lifecycle is shown in Figure 4.3.59.



Source: JICA Design Team

Figure 4.3.59 Card Lifecycle

7) Monitoring

a) Equipment Monitoring

i) Station computer shall monitor real time status of at least following AFC equipment.

- Ticket vending machine
- Automatic gate
- Point of Sales / analyzer dispenser

ii) Central computer shall monitor real time status of at least following AFC equipment.

- Ticket vending machine
- Automatic gate
- Point of Sales / analyzer dispenser
- Station computer

iii) Assist terminal shall be included as a part of the central computer, which will be placed in OCC building. Monitoring information on the central computer can also be monitored on the assist terminal.

The operator shall be able to receive the real time status of at least following AFC equipment on the assist terminal.

- Ticket vending machine
- Automatic gate
- Point of Sales / analyzer dispenser
- Station computer

Assist terminal shall be able to extract transaction of specific card from clearing house system via central computer. The result shall be able to output by data or by printing.

b) Card Status Monitoring

i) The card status change information shall be collected at the central computer and be sent to the clearing house. Card status change includes, but not limited to, the followings.

- 2nd issue
- Enter gate
- Exit gate
- Top-ups
- Fare adjustment
- Return

ii) The card's status and its past records can be confirmed on the POS terminal.

c) Card Stock Management

i) All returned cards excluding SJT card shall be sent to ACF Room in the OCC building. SJT card shall be able to be recycled within the station, which means to be re-issued from the TVM or the POS terminal.

ii) Central computer shall produce card stock management data. This data shall include, but not limited to, those numbers of card at each station.

- 2nd issued card
- Returned card
- Damaged card
- Deactivated card
- Expired card (Past due date of deposit return)
- Theoretical amount of valid card shall be calculated in the central clearing house system.

d) Blacklist Monitoring

i) The central computer shall create a list of duplicated or fraudulent cards detected by the system. Those detected card shall be blacklisted, which means that the list of numbers is downloaded to AFC equipment to be rejected by the system. The list shall be sent to the central clearing house and integrated as the new blacklist.
Administrative staffs of the O&M Company shall be able to output the blacklist.

ii) The system shall allow administrative staffs of the O&M Company to add a list of blacklisted card.

8) Emergency Mode

a) Means shall be provided to place all automatic gates in emergency mode. In an emergency mode, gates shall be opened for passengers to exit without tickets.

b) There shall be an alternative means, provided mechanically, to set all gates to emergency mode. This shall not depend on the availability of the central computer, the station computer, network connection, nor the power supply.
This alternative means shall consider measures against fraud.

9) Calendar and Operating Day

a) Operating Day
The AFC system shall have at least two dates, calendar date and operational date.
The Calendar date means the Gregorian calendar date.

b) Calendar

i) The calendar date and time shall be acquired from telecommunication at least once a day.
ii) The central computer shall acquire time from the Master Clock. Each station computer shall acquire time from the central computer.
iii) TVM, AG, POS and HT shall acquire time from the station computer.

10) Data Transmission

a) General

i) The security for all data transmission shall be considered. Especially data transmission related to revenue data shall employ high-security encryption in order to avoid data modification.
ii) The general ways of data transmission shall be employed, so that the O&M Company will be able to replace part of the system easily in the future.
iii) The secure measures against data loss shall be considered.

b) Transmission data

i) Central computer shall receive through station computer the transaction data from AFC machines including at least the followings.
- TVM
- AG
- POS
- HT
- Station computer

ii) Transaction data shall be made whenever there is a change in the status of the card. The central computer shall transfer the data to the central clearing house.

iii) If there is a possibility that the transaction might be incomplete, machines shall send temporary transaction data, in order to avoid the loss of data.

iv) The system supplier should consider that the central computer to be able to exchange data with other servers, such as server for bus service, or e-cash server.

v) Transaction data shall be able to be retained in each machine and in station computer at least seven (7) days, considering troubles such as network failure. Measures for offline data collection shall be considered.

vi) Transaction data shall be transferred and stored in financial system of the O&M Company NOT included in this contract for at least ten (10) years.

c) Revenue Data

i) Central computer shall receive revenue (including accounting information, cash amount, and stocktaking of the cards) data through station computer.

ii) Revenue data shall indicate sum for each calendar date.

iii) The central computer shall transmit revenue data to financial server of the O&M Company.

iv) Each station computer shall be able to print out the revenue data of each station.

v) Assist terminal shall be able to print out the summary of each station.

vi) Measures shall be taken to monitor loss or lack of revenue data in each station.

d) Traffic Data

i) Central computer shall receive traffic data through station computer.

ii) The central computer shall transmit traffic data to financial server of the O&M Company.

iii) Each station computer shall be able to print out the traffic data of each station.

iv) Assist terminal shall be able to print out the summary of each station.

e) Operation and Maintenance Data

i) Each station computer shall be able to collect and output the operation and maintenance data of each station.

ii) Central computer shall receive operation and maintenance data through station computer upon request from the assist terminal.

iii) Assist terminal in OCC building and assist terminal in maintenance shop shall be able to output operation and maintenance data received by the central computer.

f) Downloads

i) The central computer shall download to the station computers all fare tables, operating parameters, commands, blacklist and software upgrades for AFC equipment including at least the followings.

- TVM
- AG
- POS
- Station computer

ii) Station computer, installed at all stations, shall perform data and software transfer function for AFC equipment including at least the followings.

- TVM
- AG
- POS
- Station computer

iii) At least two generation of fare, operating parameters, and software shall be managed by system.

11) Others

a) The operation for card and system security shall be proposed by the system supplier to obtain Notice of No-objection by the employer's representative to coordinate with the O&M Company.

b) The maximum number of station capable to be handled by the system shall be proposed by the system supplier to obtain the Notice of No-objection by the employer's representative to coordinate with the O&M Company.

(4) System Requirements

1) General Requirements

a) General

The requirements in this section shall be considered in addition to those specified in the general specification.

b) Power Supply and Grounding

i) Power supply is 60Hz, 220V AC single phase or 380V three phase. Voltage varies ±10%

ii) The UPS shall be provided in the AFC-UPS room for each station, and the operation of the AG in the station for at least 30 minutes against power failure shall be guaranteed.

iii) The system supplier shall take measured against data loss or damage in case of power trouble.

iv) AGs, TVMs and POS terminals in stations shall not start shutting down unless power trouble lasts for more than 1 minute.

c) Climate Conditions

i) AFC equipment shall consider hot and humid climate conditions in Manila. The climate condition shall be referred to Section NN of GS.
ii) The limit of climate conditions (including temperature and humidity) that AFC machines can operate normally, shall be clarified.
iii) AFC equipment shall consider shutting down in order to retain revenue data, in case air-conditioning unit breaks down and could not maintain normal operations.

d) The coordination shall be taken with the related people on architecture, installation, power supply, wiring and the air conditioning condition of related rooms.

e) Design Life

i) Design life shall be more than 10 years.
ii) Life expectancy of total AFC system shall be at least 5 years from the commencement of revenue service.
iii) These 5 years does not include years for development or testing.

f) Data Retain

i) The AFC system shall consider measures against any damage or loss of data. The measurements shall be considered from the point of view of both software and hardware.
ii) The AFC system shall consider measures against power failure or trouble.
iii) The AFC system shall consider measures against network failure.
iv) The AFC system shall retain backup data for operation trace for 30days or more. Targeted machine shall include, but not limited to, the followings.
- TVM
- POS terminal
- AG
- HT
- Station computer
- Central computer

g) Software Requirements

i) The list of all software shall be submitted to the Employer's Representative.
The software shall be considered being maintainable and re-configurable by the O&M Company.
ii) All data transmission shall consider security. The system supplier shall submit security design for data transmission to the Employer's Representative for review in coordinate with the O&M Company.

iii) Software design shall consider measures against vandalism or fraud.

h) Hardware Requirements

i) Hardware design of AFC machines shall consider the followings.
- Measures against vandalism (including wrenched open or damage touch-panels)
- Measures against fraud
- Measures against dust

ii) The AFC system shall be designed considering passengers' safety and convenience, especially the aged, children, expected mothers, and the handicapped.

iii) The AFC system shall be designed considering the safety and convenience of operating staffs.

i) Use by the Handicapped

i) The operation of AFC equipment by the handicapped passengers shall be clarified.

ii) The handicap includes the followings.
- Total blindness
- Weakness in sight
- Color blindness
- Use of wheelchair

j) Size and Weight

i) The size and weight of AFC facilities shall be provided to related system suppliers.

ii) TVM shall consider front-opened type, but rear-opened type can be acceptable.

iii) The width of the normal- type automatic gate shall be at 550mm wide between the machines. The width of the wide-type automatic gate shall be at least 900mm wide between the machines, considering the use of wheelchair passengers. The system supplier shall propose width between the machines to the Employer's Representative for review. The width of each gate machines shall be 300mm or less, unless first coordinated with the other system suppliers, and then be reviewed by the Employer's Representative in coordinate with the O&M Company.

k) Bills and Coins

i) The TVM shall accept Philippines bills and coins. Acceptable types of bill and coin shall be proposed by the system supplier, and be reviewed by the Employer's Representative in coordinate with the O&M Company.

ii) Acceptable bills and coins shall be finalized 24 months prior to the start of revenue service. Finalization cost shall be included in the contract. Cost to handle new bills or coins issued after finalization is not included in this project, and shall be discussed with the Employer's Representative in coordinate with the O&M Company.

iii) The acceptance rate of Philippines bills and coins shall be reported to the Employer's Representative and the O&M Company the before start of the static commission. The acceptance rate shall be measured by:

- Fresh bills and coins; and
- Used (circulating) bills and coins.

Rejected bills and coins and the reason shall be shown to the Employer's Representative and the O&M Company.

iv) The TVM shall detect and reject fate or unacceptable bills and coins, unless impossible for considerate reason.

v) The TVM shall have escrow function.

vi) The TVM shall be able to accept plural number of bills and coins for each passenger.

vii) The TVM shall be able to give change to the passengers. It shall have money circulating function (inside the TVM), in order to avoid inconvenience of passengers and station staffs.

viii) The TVM shall be designed so that station staffs do not need to touch money, unless troubles such as jamming occur. Cash cassette of AFC machines shall be locked. The number and variation of locks shall be reviewed by the Employer's Representative in coordinate with the O&M Company. Each cassette shall be labelled with its own identification number. This identification number shall be identified electronically by machine. The station staff shall input his / her identification number before removing the cash cassette, in order to record cash handling operation.

ix) Machines such as TVM shall be designed so that it can count the number of bills and coins inside.

l) Card Handling

i) Machines such as TVM shall be designed so that station staffs do not need to touch card, unless troubles such as jamming occur. Card cassettes of AFC machines shall be locked. The number and variation of locks shall be reviewed by the Employer's Representative in coordinate with the O&M Company. Each cassette shall be labelled with its own identification number. This identification number shall be identified electronically by machine. The station staff shall input his / her identification number removing the card cassette, in order to record card handling operation.

ii) Machines such as TVM and POS terminal shall be designed so that can count the number of cards inside the machine.

m) Revenue Closing

i) TVM and POS terminal requires revenue closing.

ii) Revenue closing shall include the followings.

- Collecting cash
- Reloading cash (for change)
- Collecting cards

- Reloading cards
- Reloading consumables (if required)

iii) Data shall be uploaded to central computer through the station computer.
iv) Time required for revenue closing shall be no more than ten (10) minutes for each machine.
v) AG shall not require manned revenue closing.

n) Maintenance Requirements

i) Not more than one maintenance person shall be required to repair the following, but not limited to, machines.
- TVM
- AG
- POS terminal
- Station computer
- Cash handling equipment
- Money trolley

ii) Units shall be considered to shorten the time required to repair for the following, but not limited to, machines.
- TVM
- AG
- POS terminal
- Station computer

o) Reliability Requirements

i) Reliability of TVM, AG, and POS terminal shall be measured by mean cycles before failure (MCBF).
ii) MCBF shall be counted as failures which require parts replacement, and shall not consider failures such as jam or those which are by other external causes.
iii) MCBF of TVM, AG, and POS terminal shall be 100,000 cycles or more.
iv) The demonstration of the system complying with the reliability requirements shall be taken.

2) Security

a) The security of AFC system shall be secured from the following, but not limited to, viewpoints.
i) Forgery, modification, misappropriation of tickets
ii) Equipment malfunction, mis-operation, illegal operation, violent destruction
iii) Loss, damage, alteration of data in equipment, data on communication line
iv) Any damage to equipment due to power failure, lightning surge, malfunction

b) The data retained in each equipment shall be kept for at least one week if the host equipment cannot receive it.

3) Performance

a) The AFC system shall be able to process passengers on weekday peak hour at each station smoothly, based on the demand forecasts.

b) Consider the processing time of AG and the number of AGs so that the passengers shall exit within 3 minutes.

c) Consider the processing time of TVM and POS, and the number of them so that the passenger waiting time shall be less than 3 minutes.

d) The performance of this system shall basically satisfy the performance indicated in the concession agreement of the AFC system project of LRT 1 & 2 and MRT 3 (the Concession Agreement of "PPP for the Automatic Fare Collection System Project for LRT Lines 1 & 2 and MRT 3"-- except Section 2.12 Level 4 Infrastructure MPSS).

4) Trial Estimation of Required Equipment

Estimate the peak hour demand from the demand forecast data and make a rough estimate of the number of devices in 2040.

a) Assumptions

i) Inwards traffic flow is fairly constant though the peak 15minutes.

ii) Approximately 1/3 of the peak hour numbers pass through in the peak 15 minutes. (the peak within the peak)

iii) Exit traffic arrives in train load every 6 minutes and should be cleared within 3 minutes.

iv) Rate of passage of gate
Entry gate: = 45 pass/min (no ticket insertion)
Exit gate: =45 pass/min for SVC (no ticket insertion)
=20 pass/min for SJT (with ticket insertion)

v) Time for Ticket purchase or add value by TVM= 15sec

vi) Time for Ticket purchase or add value at POS terminal in the customer service room
= 20sec

vii) Take up of SVC = 80%

viii) SVC users add value every 12 trips in average.

ix) Fare adjustment at POS terminal in the customer service room is performed for 1% of exit passengers and it takes 30sec each.

x) Ticket sales are performed for 80% in TVM and for 20% at POS terminal in customer service room.

xi) Two additional machines per station for AG and TVM, and one machine for POS, have been added in this estimation.

xii) Devices for issuing limited express tickets are not included here.

Table 4.3.59 Number of Automatic Gate, TVM and POS

		AG	TVM	ENT POS	EXT POS
1	Blumentritt	7	7	3	2
2	Espana	9	7	3	2
3	Santa Mesa	15	14	5	2
4	Paco	5	4	2	2
5	Buendia	15	13	5	2
6	EDSA	9	8	3	2
7	Nichols	5	4	2	2
8	FTI	7	7	3	2
9	Bicutan	15	14	5	2
10	Sucat	7	6	3	2
11	Alabang	10	9	4	2
12	Muntinlupa	7	6	3	2
13	San Pedro	7	6	3	2
14	Pacita	4	3	2	2
15	Binan	7	6	3	2
16	Santa Rosa	7	7	3	2
18	Cabuyao	9	8	3	2
18	Gulod	6	5	2	2
19	Mamatid	7	6	3	2
20	Calamba	12	10	4	2
Total		170	150	63	40

Source: JICA Design Team

(5) Equipment, Design and Materials Requirements

1) Automatic Gate

a) General

This section defines requirements for Automatic Gate (AG).

b) Type of AG

i) The following two types of AG shall be considered.
- Normal-width
- Wide-width

ii) Wide-width gate shall be able to be used by wheelchairs.

iii) Normal-width gate shall have 3 types of traffic directions.
- Entry Gate which is specially reserved for entry aisle
- Exit Gate which is specially for exit aisle
- Reversible Gate which is bi-directional aisle

iv) Wide-width gate shall be bi-directional.

c) Requirements

i) The gate shall pass at least sixty (60) passengers per minute (counted in the testing condition).

ii) AG shall be with flap-door barriers in order to increase the throughput and realize the wide gate for wheelchair. Design of the gate shall be reviewed by the employer's representative in coordinate with the O&M Company. Table 4.3.60 is a comparison of two types of flap type doors as a reference.

Table 4.3.60 Comparison of the door type of AG

	Flap Door (Japanese stile)	Retractable Door (fan stile)	Turn Stile Door
Appearance			
Throughput	45 (max60) passengers/min	45 (max60) passengers/min	35 (max45) passengers/min
Wide Gate for Wheelchair	Applicable	Applicable	Not Applicable
Passenger Safety	High (The passenger can pass safely without hitting children's head and pregnant body.)	Low (There is a possibility that the doors hit children or pregnant women.)	--
Availability	High (It can be used without damage by passenger and machine trouble.)	Low (The doors are liable to be damaged by passenger or cause machine trouble.)	--
Machine Size (Width)	Narrow =< 200mm	Wide Approx. 300mm	Wide Approx. 300mm

Source: JICA Design Team

iii) Measures shall be taken to prevent an unauthorized person. These measures shall be reviewed by the Employer's Representative.

iv) The gate status shall be indicated to passengers.

v) The gate shall be normally closed. The gate shall be able to be opened by station staff in case of emergency.

vi) The gate shall consider safety of children, expected mothers, the aged, and the handicapped.

vii) The gate shall be capable of being operated in the following configurations.

- Controlled entrance, locked exit
- Controlled exit, locked entrance
- Free Exit, Free entrance
- Locked entrance, locked exit

- Controlled entrance, controlled exit

The differing configurations indicated above shall be determined by SCS, which transmits the necessary commands to set the AGs in their preselected mode.

viii) The gate shall collect the SJTs at the exit and store them in the cassette. The cassette is carried to TVM and it shall be able to be used for the next SJT issue.

ix) The ticket insertion slot of exit gate shall be shaped that the passengers easily insert their tickets.

2) Ticket Vending Machine

a) General

This section defines requirements for Ticket Vending Machine (TVM).

b) Basic Functions

i) TVM must have at least following functions for passengers.
- Issue Stored Value Card (SVC) and Single Journey Ticket (SJT).
- Collect deposit for SVC.
- Top-up SVC.
- Show the data inside the card.

ii) The TVM shall issue receipts on passengers demand.

c) Credit Card

The TVM shall consider future use of credit cards.

d) Interface for Passengers

The TVM shall have touch-panel interface.

i) It should be considered that station names are indicated on the display when passenger buys SJT.

ii) Language to be used shall be English as standard and Tagalog language can be selected.

iii) Man-machine Interface design of the TVM shall be reviewed by the Employer's Representative in coordinate with the O&M Company.

e) Other Requirements

i) The TVM shall be accessible to wheelchair users without difficulty.

ii) The TVM shall be able to handle four (4) passengers per minutes (counted in the testing condition).

3) Point of Sales / Analyzer-Dispenser

a) General

This section indicates requirements for Point of Sales / Analyzer-Dispenser (POS)

b) Basic Functions

i) POS shall be the window machine which is operated by a station staff and shall have at least the following functions.

- Issue Stored Value Card (SVC) and Single Journey Ticket (SJT)
- Collect deposit for SVC
- Top-up SVC
- Adjust fare for SVC and SJT
- Show the data inside the card
- Analyze the data inside the card

c) Requirements

i) POS shall include secure cash drawers.
ii) POS shall be able to request card information to the center computer.
iii) The information of processed card shall be sent to the CCS.
iv) POS shall have a passenger display for show the price of the ticket, the remaining value inside the card, excess fare and so on.

4) Station Computer System

a) General

i) This section indicates requirements for Station Computer System (SCS).
ii) SCS shall be provided at each station.

b) Requirements

i) The SCS exchanges information with the AFC equipment through the LAN in the station. It also exchanges information with CCS through communication backbone network between stations and OCC.
ii) The main function of SCS is as follows.
- Transaction data and event data collection and transmission
- Cash data and Card data collection and transmission
- Ticket recycle management
- Ticket data inquiry
- Passenger flow data generation and transmission
- Machine status monitoring and control
- Data and parameter management
- Blacklist management
- Time management
- Stuff account management
- Data input/output management
- Log data/ maintenance record management

iii) Station computer shall have security protection for data and user access.

5) Central Computer System

a) General

i) This section indicates requirements for Center Computer System (CCS).
ii) CCS is placed in the OCC building.

b) Requirements

i) The CCS shall include assist terminal for monitoring and control.
ii) The main function of CCS is as follows. (*) Sign means sending and/or receiving the data with the central clearing house.
- Transaction data and event data collection and transmission (*)
- Cash data and card data collection and transmission
- Ticket inventory management
- Ticket data inquiry (*)
- Passenger flow data generation and transmission
- Machine status monitoring and control
- Data and parameter management
- Blacklist management (*)
- Time management
- Stuff account management
- Data input/output management
- Log data/ maintenance record management
- SAM authentication and transaction authentication (*)

iii) The central computer system generates fare data and distributes it to the AFC equipment via the station computer. The fare data includes not only the inside of this system but also the fare data if there is a line of other businesses that can cross each other without passing through the gate.
iv) The following functions are performed by the central clearing house.
- Clearing function
- Black list generation management
- Card status (including balance information) management
- Security key management
- SAM management

v) Central computer shall be able to handle expected number of passengers until 2030 including other future lines
vi) The data capacity requires for the central computer shall be engineered and proposed.

6) Handheld Terminal

The Handy Terminal is placed at each station and used offline for card information checking, entrance / exit processing. Transaction data is sent to the station computer when connected to the station LAN.

7) Smart Card

a) General Requirements

i) The card media shall be the same media used in the system of LRT1,2, MRT3 (ISO/IEC14443 Type A)

ii) Shape of the card shall be credit card size;
SJT: (85.47-85.72mm)×(53.92-54.03mm)×(0.50±0.05mm)
SVC: (85.47-85.72mm)×(53.92-54.03mm)×(0.80±0.05mm)

iii) Base material of the card shall be PET or other types of that are environmentally benign when incinerated.

iv) Data retention period shall be at least 10 years for SVC and 5 years for SJT in normal use.

(6) Communication Network and Interface

1) Communication Network

a) General

i) This section indicates requirements for communication network.

ii) Data communication network shall be provided between station AFC equipment, station computer system, central computer system, card issuing system, card recycling system, and stuff-pass issuing system. Cash handling equipment is not required to be connected to the network.

iii) Optical fiber cables between stations and the OCC building shall be prepared by the Telecommunication system.

iv) Network facilities in stations and the OCC building shall be prepared as AFC facilities.

b) Requirements

i) Requirements for cable are as follows.

- The cable shall meet national or international standards appropriate to data processing and data transmission required.
- The measures to define cables easily apart from other systems shall be proposed.
- The cable shall be manufactured from fire retardant, low smoke, halogen free materials.
- The cable shall be sufficiently shielded to minimize its susceptibility to external noise.
- The cable shall be anti-termite, rodent and pest resistant. If chemicals are used, those shall conform to the requirements of related Philippines regulation.

ii) Installation of the cable shall be carried out in accordance with requirements of Philippines laws, regulations, and standard. The special attention shall be paid to, but not limited to, the cable installation through fire protection wall.

iii) Network facilities shall consider measures against power failure, in order to protect or conserve data.

iv) Network engineering shall be proposed to and be approved by the Employer or the Employer's Representative. Network engineering includes the followings.

- Protocol used for all data communication, such as TCP/IP, and addresses
- Network components and their performance
- Operating speed of LAN in stations and OCC building
- Measures against illegal access to LAN
- Measures against data loss in case of power failure

(7) Cash and Card Handling

1) Cash Handling

a) General

i) This section indicates requirements for cash handling.

ii) Cash handling is assumed to be conducted in the AFC room of each station.

iii) Cash handling equipment shall include, but not limited to, the followings.

- Coin sorting and counting equipment
- Coin bagging equipment
- Bill counting equipment; and
- Money trolley.

iv) Consumables for cash counting and handling are not included in the contract.

b) Requirements

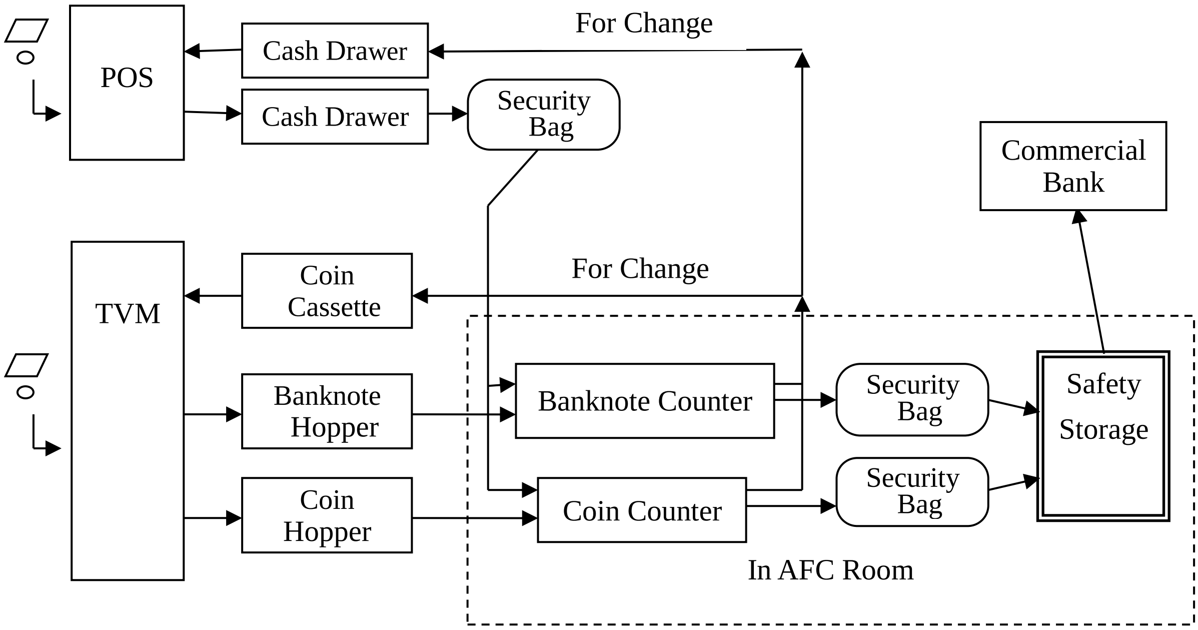
i) The following matters shall be proposed to the Employer's Representative in coordinate with the O&M company and be reviewed.

- Operation of cash handling
- The number of cash handling equipment at each station

ii) Cash counting equipment shall have functions to check the types of bill or coin.

iii) Money trolley shall be designed for one-manned operation.

iv) Cash handling is shown in Figure 4.3.60.



Source: JICA Design Team

Figure 4.3.60 Cash Handling

2) Card Handling

a) General

This section indicates requirements for card handling.

b) Requirements

i) The cards shall be supplied by the 1st issuer outside this contract and be recycled as shown in Figure 4.3.59 Card life cycle.

ii) The card stock, the cards in the equipment, the number of cards temporarily stored in the AFC room for recycling, the cards recovered due to defects, and the cards returned must always be clearly managed.

iii) The cards shall be kept in a safe or locker with key and can be taken out only by authorized persons.

(8) The through operation with the subway

1) The through operation between the NSCR-south line and the subway is scheduled. The expansion of the system shall be prepared accordingly and make it possible to deal with the system upgrade without major change.

The main influence on the anticipated system is as follows.

i) There is a possibility of increasing / decreasing the number of station terminal equipment required due to increase / decrease in passenger demand.

ii) Processing contents of the station terminal equipment, the station computer, the central computer, the central clearing house become complicated as the range of sale and fare adjustment of tickets / cards includes the subway line.
iii) Subway issue SJT gathered at the station shall be returned to the subway operator.

(9) Installation

1) Installation of AFC equipment

i) The AFC equipment shall be set up at a specified place. AGs and TVMs must be installed avoiding direct sunlight, raindrops and splashes.
ii) Equipment shall be fixed so as not to fall over or move due to earthquake, mischief etc., securing operation space and maintenance space.

2) Installation Duct and Cables

i) The power cable and communication cable to be supplied to the AFC equipment shall be installed.
ii) Cables shall be installed in measurement that is safe to each environment. Also, there shall be no danger to passengers and station staff.
iii) The communication cable shall be installed so that the influence of noise from the power cable is minimized as much as possible.

(10) Testing, Commissioning and Verification

1) This section indicates the requirements for tests to be performed on AFC equipment included in the contract.
2) At least, but not limited to, following tests shall be conducted.
   a) Independently witnessed tests: confirm that each unit is completely functioning
   b) First article inspection: evaluate for each type whether the product manufactured first meets specifications and quality
   c) Factory acceptance tests: confirm that each product / system function and quality before delivery
   d) Partial acceptance tests: Partial sequential function confirmation, such as confirmation of standalone function of each device, communication function with upper computer, function of the upper computer, etc. after site installation
   e) System acceptance tests: Test the entire system, including stations, central computer, and clearing house
   f) Integration testing & commissioning: Run the whole system in almost the same form as actual use, and confirm that all processes, including result data, are processed without problems.
3) The simulation for testing shall be provided in case the interfacing equipment is not available, or in case testing patterns is not cleared enough by testing machines. In case the interfacing

equipment is not available, the interfacing tests shall be conducted as soon as the interfacing equipment is ready.

(11) Consumables and Spare Parts

1) The consumables, spare parts and its list necessary for operation and maintenance of the AFC system shall be prepared.
2) Consumables and spare parts shall be prepared for three years including warranty period.

(12) Training

1) The maintenance training and operation training shall be conducted for the related staff of the O&M company.
2) The training program shall enable staff to operate, service, enhance, maintain, and interact with AFC facilities.
3) The training plan shall be conducted under the assumption that the O&M company's staff have no knowledge or experience concerning related systems. Final level of training shall be aimed as that the staff are fully adequate of the object.
4) The competent instructors, training manuals, training facilities, all necessary aids and materials in support of all training courses shall be provided.

(13) Maintenance

1) Repair or restore works at site shall be conducted by unit replacement, unless approves by Employer or the Employer's Representative in coordination with the O&M company.
2) Machines shall be designed that unit replacement shall be able to be conducted basically by one person.
3) In the maintenance shop, a maintenance assistance terminal and a printer shall be provided to inform the equipment operation status and trouble information, of all the stations, and printout the maintenance report.
4) Machines shall be designed and maintenance training shall be conducted so that repair or restore works at site shall be within 30 minutes after the arrival of maintenance staff. This repair or restore works do not include resuming from damages caused by vandalism, theft, fire or nature disaster.
5) Maintenance data shall be able to be checked by the Operation company whenever required.
6) The maintenance reports shall be submitted to the Operation company via the Employer's representative.

(14) Packaging, Shipping, Storage and Delivery

1) It shall be considered so that quality will not be impaired in the packing, shipping, transportation and storage of equipment, units and parts. In particular, it should not be affected by long-term high temperature and high humidity environment by shipping service and vibration during land transportation.

2) Quality shall not be impaired during storage in site.

4.3.9 Platform Screen Doors (PSD)

(1) Introduction

In modern urban railways, Platform Screen Doors (PSD) system has been introduced in consideration of safety at the station platforms (including barrier-free for passengers with disabilities). JDT proposes introduction of PSD in NSRP-South as well.

(2) Characteristics of PSD

The advantages and disadvantages of PSD are presented in Table 4.3.61.

Table 4.3.61 Advantages and Disadvantage of Platform Screen Doors

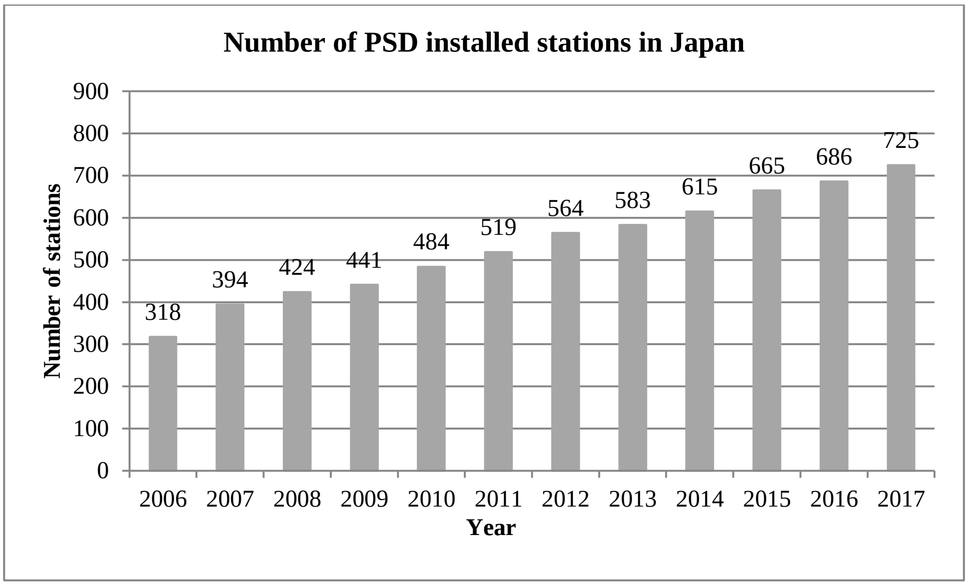
Advantage	Disadvantage
Not only prevent passengers on the platform from falling on the track, but also prevent train delays due to falling and contact accidents.	Increasing initial cost (including augmentation of relevant signals and communication facilities, etc.).
Since the safety on the platform improves by installing PSD, staff for safety confirmation is reduced, and safety management of the station is possible with a minimum number of staff.	When PSD are installed, the number and position of the doors of the rolling stock are limited by the opening position of the PSD. It will be difficult to change the number and position of the doors of the rolling stock after installing the PSD.
When full-height PSD are installed in an underground station, conditioned air at underground station remains in the platform, enabling efficient and economical cooling with reduced cooling energy consumption. (Reducing energy consumption by about 40%).	Because stop time of train is increased by about 5 to 10 seconds per station due to opening and closing of PSD, transport capacity at the peak is decreased.

Source: JICA Design Team

In urban railways, introducing PSD makes it possible to prevent delays in train operation due to accidents on the platform, thereby improving convenience. The following shows the introduction status of PSD in major cities in Japan and Asia.

1) PSD in Japanese Railway

After the Barrier Free Act is enacted in Japan in 2006, a law promoting easier movement for the elderly and disabled, consideration was given to the safety of elderly people and persons with disabilities. As a result, the introduction of PSD in railway system has been advanced. As of the end of March 2018, PSDs are installed in 73 routes (725 stations) including Shinkansen, conventional line, subway, monorail and new lines. Half-height PSDs are widely introduced.



Source: Ministry of Land, Infrastructure and Transport (Japan)

Figure 4.3.61 Number of PSD installed stations in Japan

2) PSD in Urban Railways in Asian Cities

Status of PSD installation in urban railways in Asian Cities is shown in Table 4.3.62.

Table 4.3.62 Status of PSD in Asian Cities

Line	Length	Date of commencement	PSD	
Delhi Metro Line1,2,3,4,5,6	190km	2002	E	None
			U	None
Singapore North South Line	45km	1987	E	Half
			U	Full
Singapore East West Line	57km	1987	E	Half
			U	Full
Bangkok MRT	21km	2004	U	Full
Beijing Metro Line 4	28km	2009	E	Half
			U	Full
Hong Kong MRT West Rail Line	31km	2003	E	Half
			U	Full
Ho Chi Minh MRT Line 1	24km	2020 Under Construction	E	Half
			U	Full
Jakarta MRT Line 1	16km	2019 Under Construction	E	Half
			U	Full

Note: E: Elevated Station, U: Underground Station

Source: JICA Design Team

(3) Type of PSD

There are two types of PSD 1:) Full-height PSD and 2:) Half-height PSD. The main features of Full-height PSD and Half-height PSD are shown in Table 4.3.63. Generally, Half-height PSDs are often introduced in at-grade stations and elevated stations in consideration of installation cost, Full-height PSDs are often introduced in underground stations for the purpose of high level of safety and air conditioning efficiency. Both types are introduced in Japan.

Table 4.3.63 Features of Full-Height PSD and Half-height PSD

	Full-Height Type	**Half-Height Type**
Appearance		
Summary	Wall-like structure provided on the platform, and it is a structure which prevents any passenger body to be let out to the railway side.	Wall-like structure with a height of about 1.3m provided on the platform. There is less oppressive feeling for passenger than Full-height PSD.
Initial Cost	High (about twice expensive than Half-height PSD)	Medium
Safety	Very high	High (There is no contact with the rolling stock unless intentionally overcomes the fence.)
Air-conditioning Efficiency	Effective (About 40% energy consumption can be reduced)	-
Suitable station type	Underground Station	Elevated and at-grade Station

Source: JICA Design Team

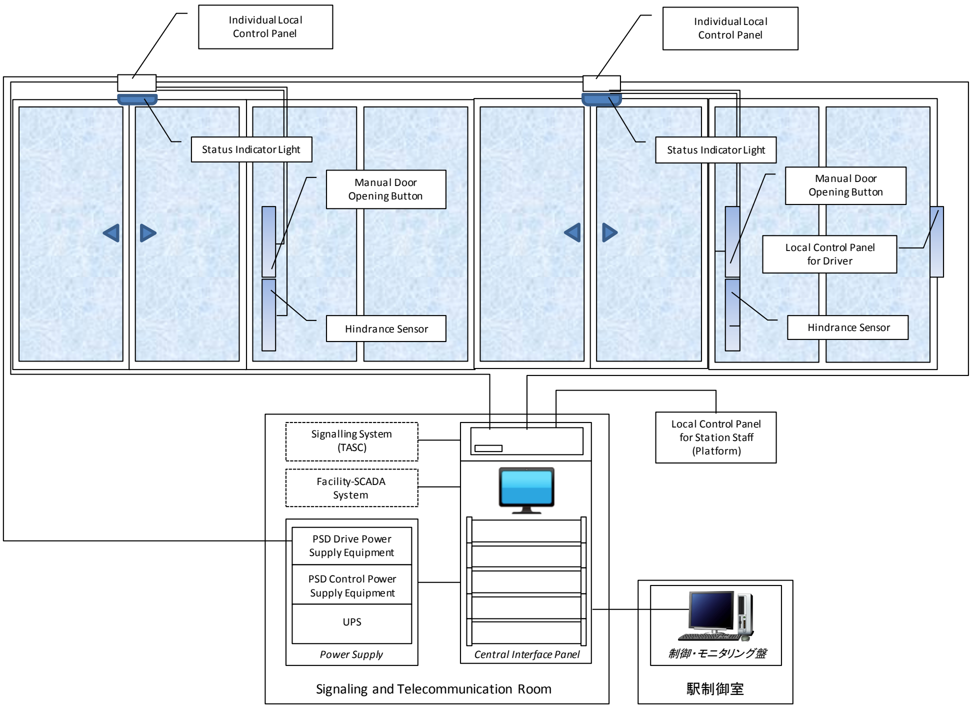
There are total of 21 stations including 1 underground station and 20 elevated and at grade stations in NSRP-South, whereas JDT proposes to introduce Half-height PSD at all stations. Given the number of underground stations is only one, the initial cost can be reduced by unifying specifications at all stations. Half-height PSDs have similar performance as Full-height PSD in terms of passengers' safety. Furthermore, as regards express trains, the wide screen door is required if the door position of the express train is different from the one of the commuter train. But there is no plan that the wide screen door with Full-height PSD is introduced. From the above, JDT proposes to introduce Half-height PSD.

(4) System configuration of PSD and cooperation between PSD and other systems

1) System configuration of PSD

System configuration of the PSD is shown in Figure 4.3.62 and Figure 4.3.63.

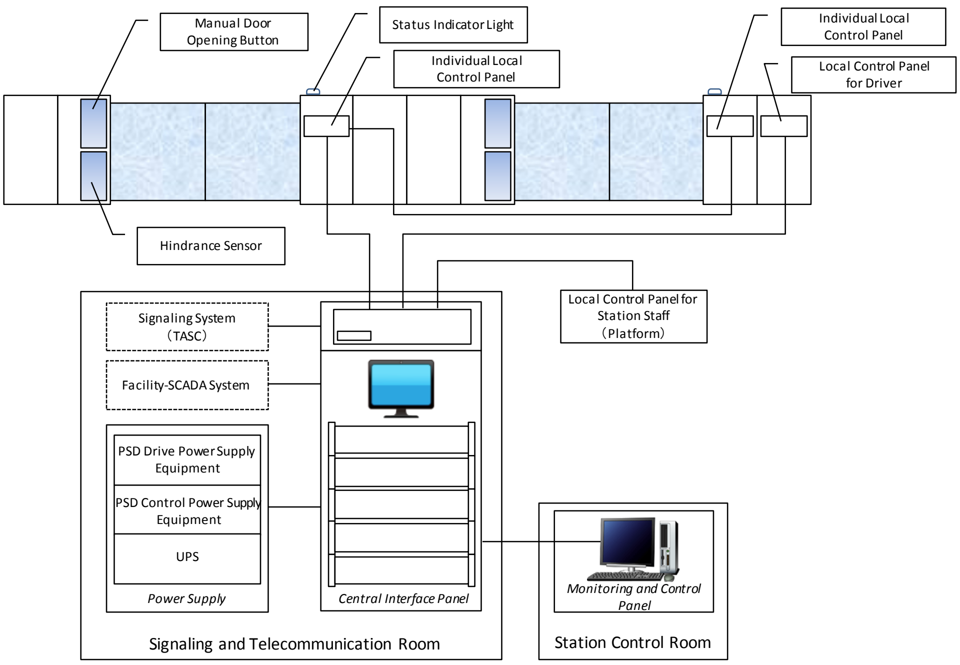
a) Full-height PSD



Source: JICA Design Team

Figure 4.3.62 System Configuration of Full-height PSD

b) Half-height PSD



Source: JICA Design Team

Figure 4.3.63 System Configuration of Half-Height PSD

2) Cooperation between PSD and other systems

a) Introduction of PSD requires coordination with signalling system, telecommunication system and rolling stock. Since it is required to accurately stop the car at the sliding door part of the PSD, safe and accurate train control by the signalling system must be realized. Train controlled by signalling system is executed by the following path: ground signalling equipment (including TASC: Train Automatic Stopping Controller) - Communication path - ground antenna (CBTC) - Radio communication (train control by CBTC) – on-board antenna - Radio communication (train control by CBTC) – on-board signalling equipment (CBTC including ATP, ATO).

b) When the train stops at station, the stop control of the train is carried out by the above-mentioned path. The TASC ground unit and the TASC on-board unit obtain the information of position of the entering train in platform, and train stops at the accurate position of the sliding door of the PSD with an accuracy of ± 350 mm. The PSD system receives a signal that the train has stopped at the correct position from the signalling device, then opens and closes the door.

c) The operation status of the PSD is monitored by the central facility monitoring system (SCADA facility).

3) Normal operation

During normal operation, the train and the PSD interchange signals and mutually confirm the status, and perform door opening / closing operation to ensure passenger safety. Specifically, when the train arrives, the PSD opens first, then the train door opens. When the driver performs a door closing operation at the time of departure, the train door first closes, and then the PSD closes. In case the operation of the PSD is not completed due to objects getting caught or the passengers being left behind, the train is not allowed to start.

4) Handling in case of trouble

Handling in the event of trouble can be divided into different cases. When failure occurs in individual door of PSD, disabling the operation of the failed door from the PSD by the driver’s control panel, which is designed to operate for each individual door, should return to normal operation. When failure occurs in the whole PSD system, disconnecting the interlock function between the train and PSD enables the train to depart. This operation can be carried out from either the driver's control panel or the station attendant control board. The failure information is sent as alarm to the station control room or the central facility monitoring system and corresponding necessary repair is done.

(5) Measures to be required by installing PSD

1) Determination of the number of cars to be set and the number of doors

While introducing PSD to the railway system, it is necessary to determine the number of train sets, the number of doors per train car and the specification of PSD accordingly. Regarding the number of train cars to be formed, PSD will also be in line with the 8-car train set, as it is assumed that trains of 8-car per train set will be operated from the beginning of operation. In addition, there is a plan to increase to 10-car per train set in the future, PSD also have a system structure that can be extended to 10-car train set. Regarding the number of doors per train car, there are two types of commuter train and limited express train, which are different from each other. The commuter train is designed to have 4 doors per one train car per side to ensure common specifications with the Metro Manila Subway Project. Limited Express train is planned with 2 doors per train car per side to secure more seats. As a result, it is necessary for PSD to refer to 4 doors type, recognize the train type, and have a function of selecting which PSD doors to be opened. In order to handle with both express and commuter trains, it is necessary to adopt a wide screen door design to accommodate the difference in door position.

2) Reliability Provision

There are no international standards indicating reliability of PSD. However, PSD system is responsible for train operation and passenger safe getting on and off as well as signalling system. Therefore, JDT proposes that reliability of PSD in NSRP-South is defined as follows, with reference to the reliability of PSD shown in the procurement of PSD system in recent years.

- Design Life：20 years
- MCBF（Mean Cycle Between Failures）：more than 2,000,000
- MTTR（Mean Time to Repair）：less than 60 minutes

3) Installation requirements

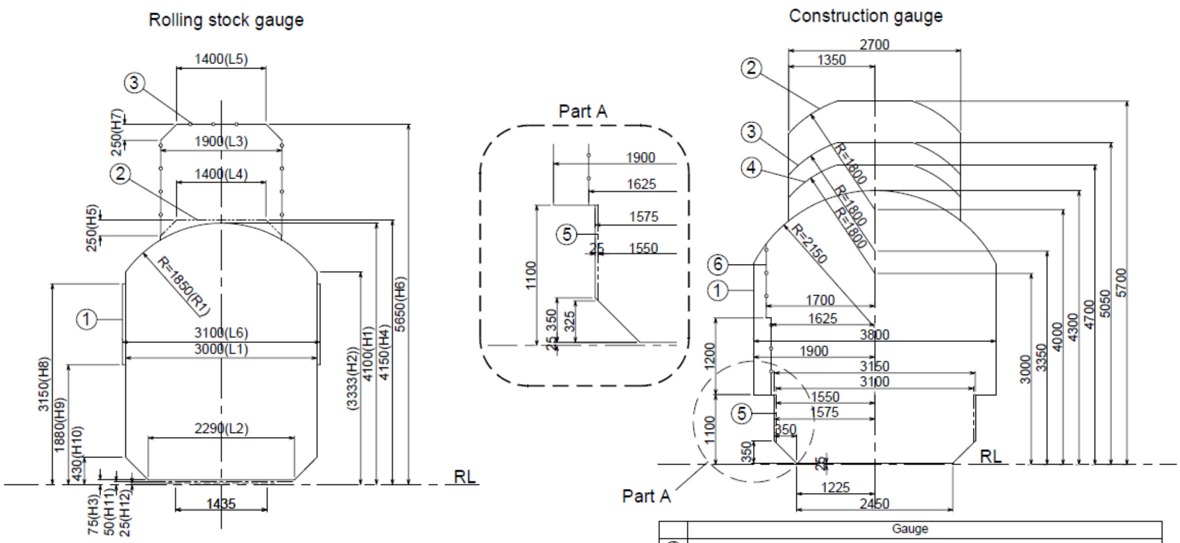
The requirements for installing PSD are as follows.

a) Securing load capacity and insulation treatment of platform

In the case of the half-height PSD proposed in NSRP-South, since weighing approximately 2,000 kg to 2,500 kg per train car, it is necessary to secure platform load capacity. In addition, in order to prevent the influence on the passenger by the potential difference between the train car and PSD, insulation treatment of the connection part between the platform and PSD is necessary, and insulation coating is also applied to PSD main body.

b) Reduced Construction Gauge

Because the PSD is installed close to the car, it is necessary to reduce construction gauge on platform. Reduced construction gauge is shown in Figure 4.3.64



		Gauge	
	——	Basic	H1,H2,H3,H10,L1,L2,R1
②	—··—	Gauge when current collector is folded.	H4,H5,L3,L4
③	—○—	Gauge in relation to top of roof when current collector is operated.	H6,H7,L3,L5
①	═	Gauge in relation to signs,marker lamps, car side lamps.	H8,H9,L6
	—·—	Gauge in relation to parts that do not move vertically due to action of bogie spring.	H11,L2
	----	gauge in relation to sanding pipe,obstacle deflector, brake shoe and other parts that do not exceed the wheel rim width.	H12

	Gauge
①	Basic Gauge
②	Gauge for track on which trains run receiving supply of direct current.
③	Gauge for tunnels, bridge, overpass, along track on which trains run receiving supply of direct current.
④	Gauge for tunnel section in case of using rigid overhead wire or safe supporting system.
⑤	Gauge only platform edge. —---— Remark : It can be applied when the passage velocity of a train is 120 km/h or less. The use in the case of 120 km/h or more is forbidden strictly.
⑥	Gauge only Platform screen door. —○—○— Remark : It can be applied when the passage velocity of a train is 120 km/h or less. The use in the case of 120 km/h or more is forbidden strictly.

Figure 4.3.64 Reduced construction gauge fops

(6) Quantity of PSD

The quantity of PSD proposed to introduce to NSRP-South is shown in Table 4.3.64. The total quantity is 1,664 doors because one side of the platform (with track) consists of 32 doors.

Table 4.3.64 Quantity of PSD

No	Line Name	Station Name	Station Type	PSD Type	Tracks	PSD	Doors
1	NSRP- South	Solis	Elevated	Half-height	2	2	64
2	NSRP- South	Blumentritt	Elevated	Half-height	4	4	128
3	NSRP- South	Espana	Elevated	Half-height	2	2	64
4	NSRP- South	Santa Mesa	Elevated	Half-height	2	2	64
5	NSRP- South	Paco	Elevated	Half-height	4	4	128
6	NSRP- South	Buendia	Elevated	Half-height	2	2	128
7	NSRP- South	EDSA	At Grade	Half-height	2	2	64
8	NSRP- South	Nichols	Underground	Half-height	2	2	64
9	NSRP- South	FTI	At Grade	Half-height	2	2	64
10	NSRP- South	Bicutan	Elevated	Half-height	2	2	64
11	NSRP- South	Sucat	Elevated	Half-height	2	2	64
12	NSRP- South	Alabang	Elevated	Half-height	4	4	64
13	NSRP- South	Muntinlupa	Elevated	Half-height	2	2	128
14	NSRP- South	San Pedro	Elevated	Half-height	2	2	64
15	NSRP- South	Pacita	Elevated	Half-height	2	2	64
16	NSRP- South	Binan	Elevated	Half-height	2	2	64
17	NSRP- South	Santa Rosa	Elevated	Half-height	4	4	64
18	NSRP- South	Cabuyao	Elevated	Half-height	2	2	128
19	NSRP- South	Gulod	Elevated	Half-height	2	2	64
20	NSRP- South	Mamatid	Elevated	Half-height	2	2	64
21	NSRP- South	Calamba	Elevated	Half-height	4	4	64
		TOTAL			52	52	1,664

Source: JICA Design Team

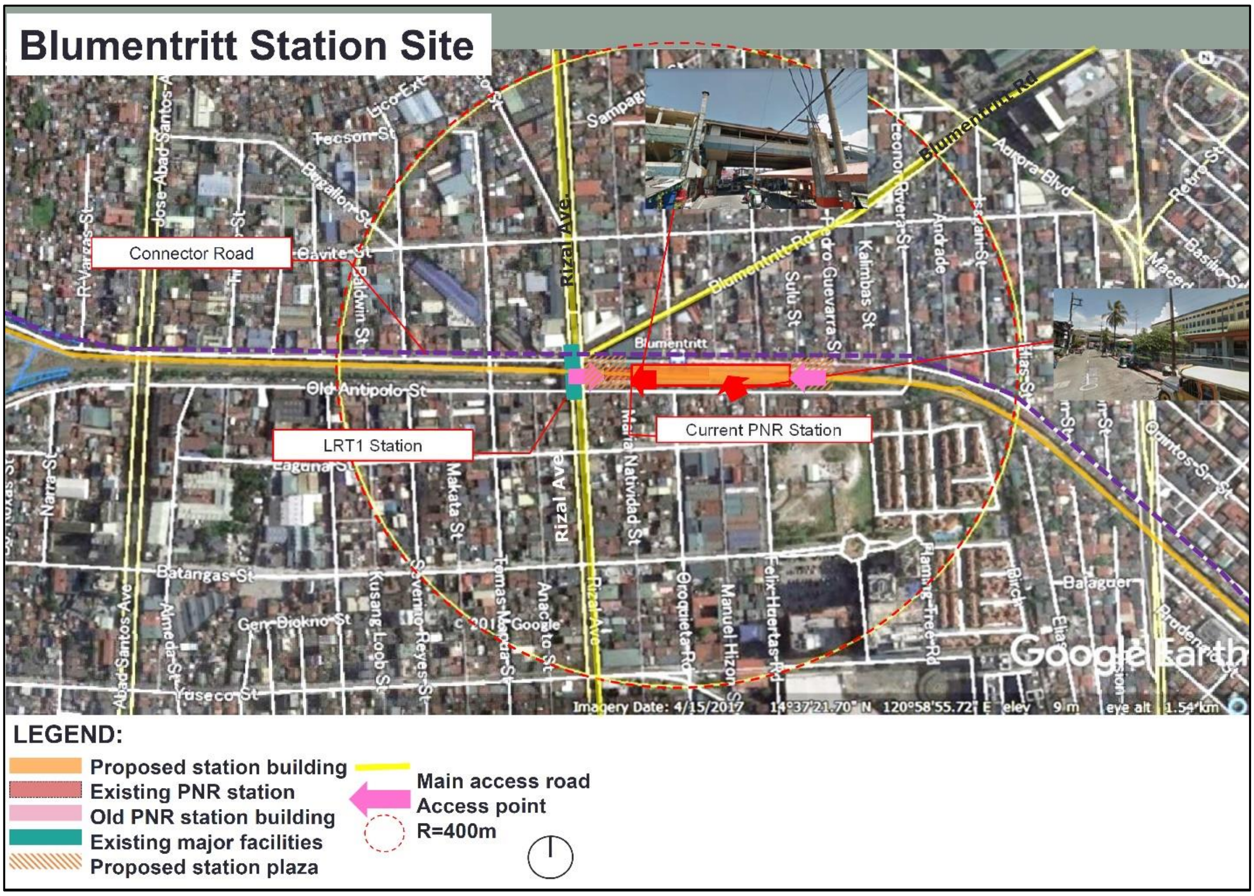
4.4 Station and Architecture

4.4.1 Location of the Station

(1) Blumentrit Station

Since Blumentrit station is located within the jurisdiction of Blumentrit, the City of Manila has to accepted the proposed location of existing PNR Blumentrit station and its access beside Rizal Ave. and cross to LRT1 Blumentrit station. To connection to LRT 1 station located 50m west from the station, New pedestrian bridge shall be provided over LRT1 alignment.

The installation of the station square and other related buildings, are to the scope of the Philippine Government. The JICA Design Team presented the site plan as shown in Figure 4.4.1 below to DOTr who is entity currently coordinating with the related agencies, such as Metro Manila.

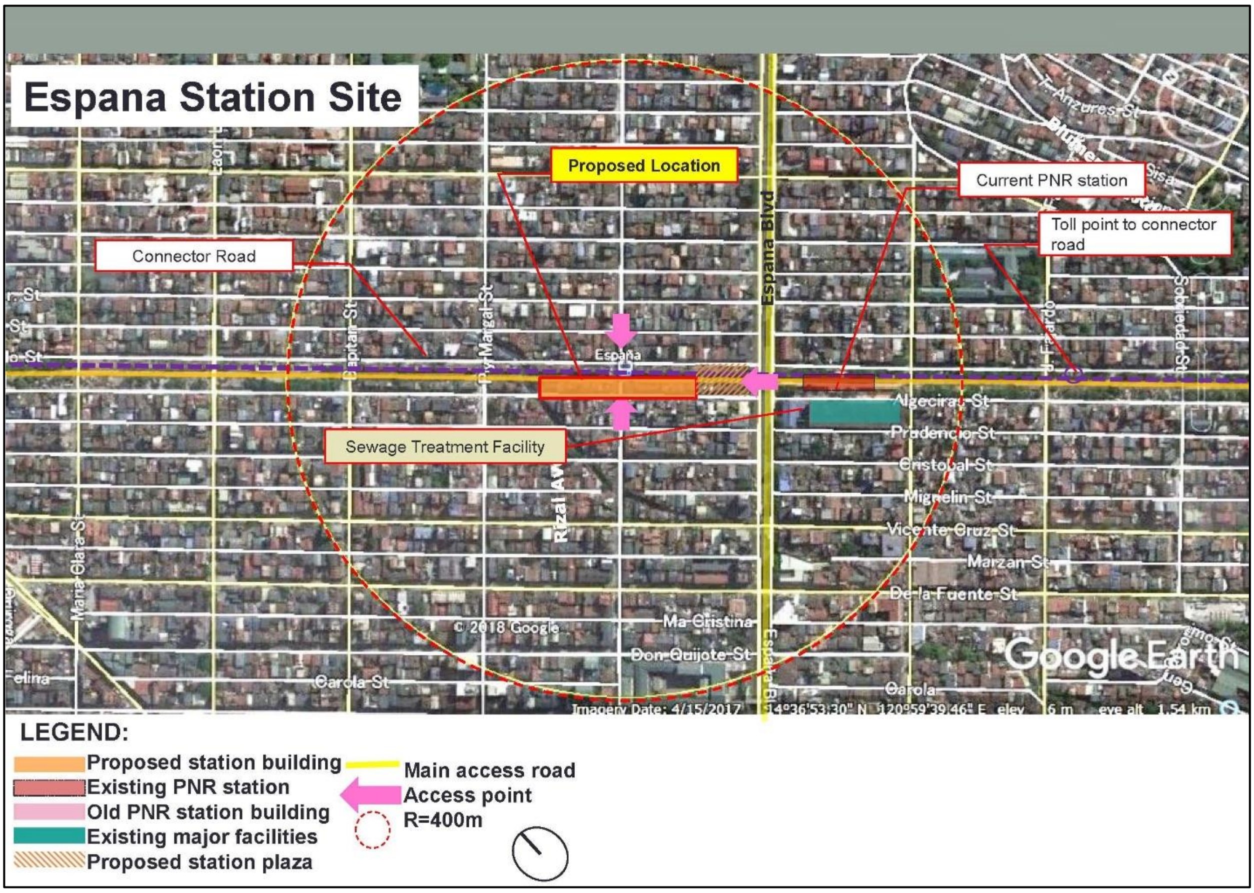


Source: JICA Design Team

Figure 4.4.1 Location of Bulumentrit Station

(2) Espana Station

Since Espana station is located within the jurisdiction of Espana, the City of Manila has to accepted the proposed location of beside Espana Blvd. Northan part of NSRP alighmnet will be affected by future connector road and Espana station will be located 200m North from existing PNR station avoiding a water pumping station and reservoir. The JICA Design Team presented the site plan as shown in Figure 4.4.2 blow to DOTr who is currently coordinating with the relevant agencies in Metro Manila.



Source: JICA Design Team

Figure 4.4.2 Location of Espana Station

(3) Santa Mesa Station

Since Santa Mesa station is located within the jurisdiction of Santa Mesa, the City of Manila has accepted the proposed location of along Anonas St. and the opposite side of Polytechnic University of the Philippines. To connection to LRT 2 Pureza station located 600m West from the proposed station, previded new pedestrian bridge is recommended to along Magsaysay Blvd..

Future connector road will be affected to NSRP alightment and it is under concideration with DPWH. The JICA Design Team presented the site plan as shown in Figure 4.4.3 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.

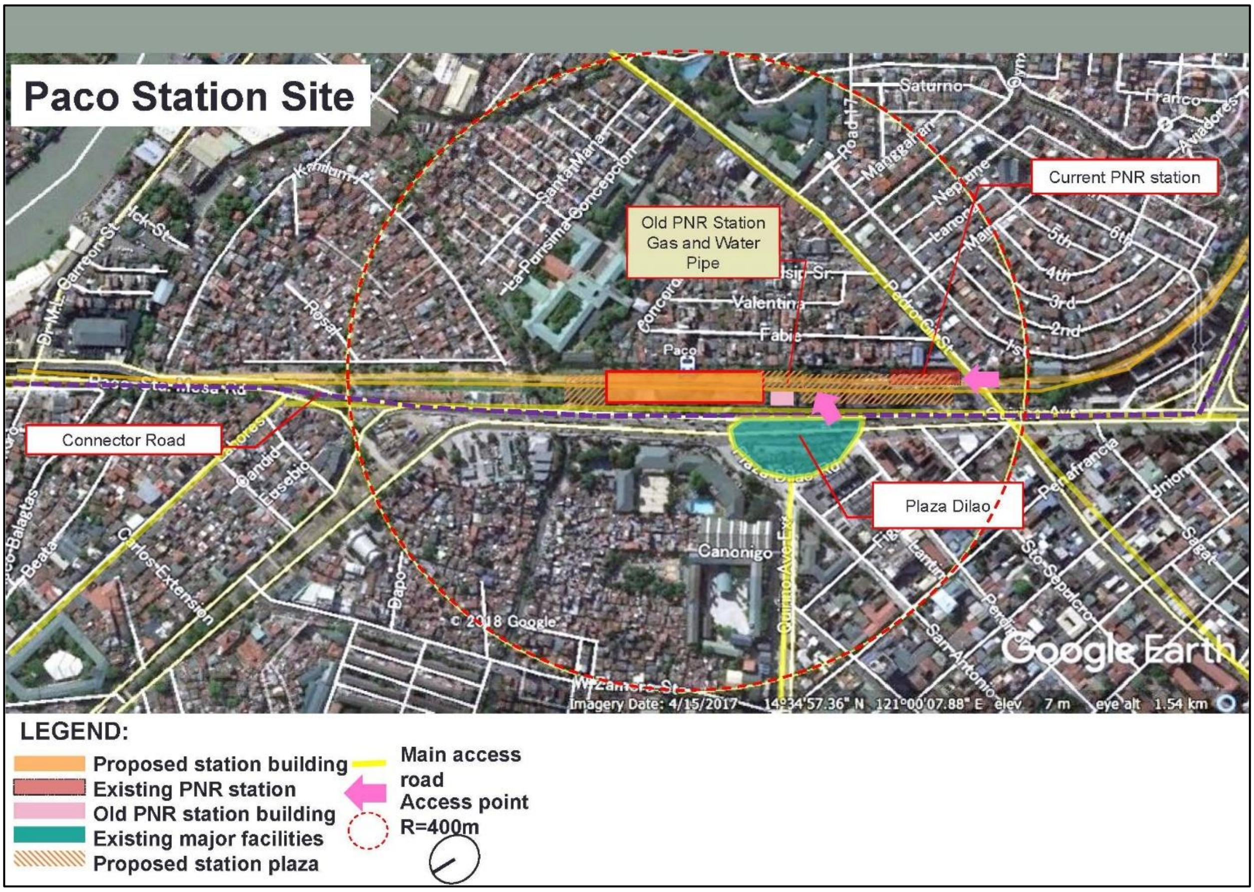
Source: JICA Design Team

Figure 4.4.3 Location of Santa Mesa Station

(4) Paco Station

Since Paco station shall be located within the jurisdiction of Paco, the City of Manila has accepted the proposed location of along Quirino Ave. and the opposit of Plaza Dilao with "Monument of Ukon Takayama". The station shall state beside historical PNR station.

The JICA Design Team presented the site plan as shown in Figure 4.4.4 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



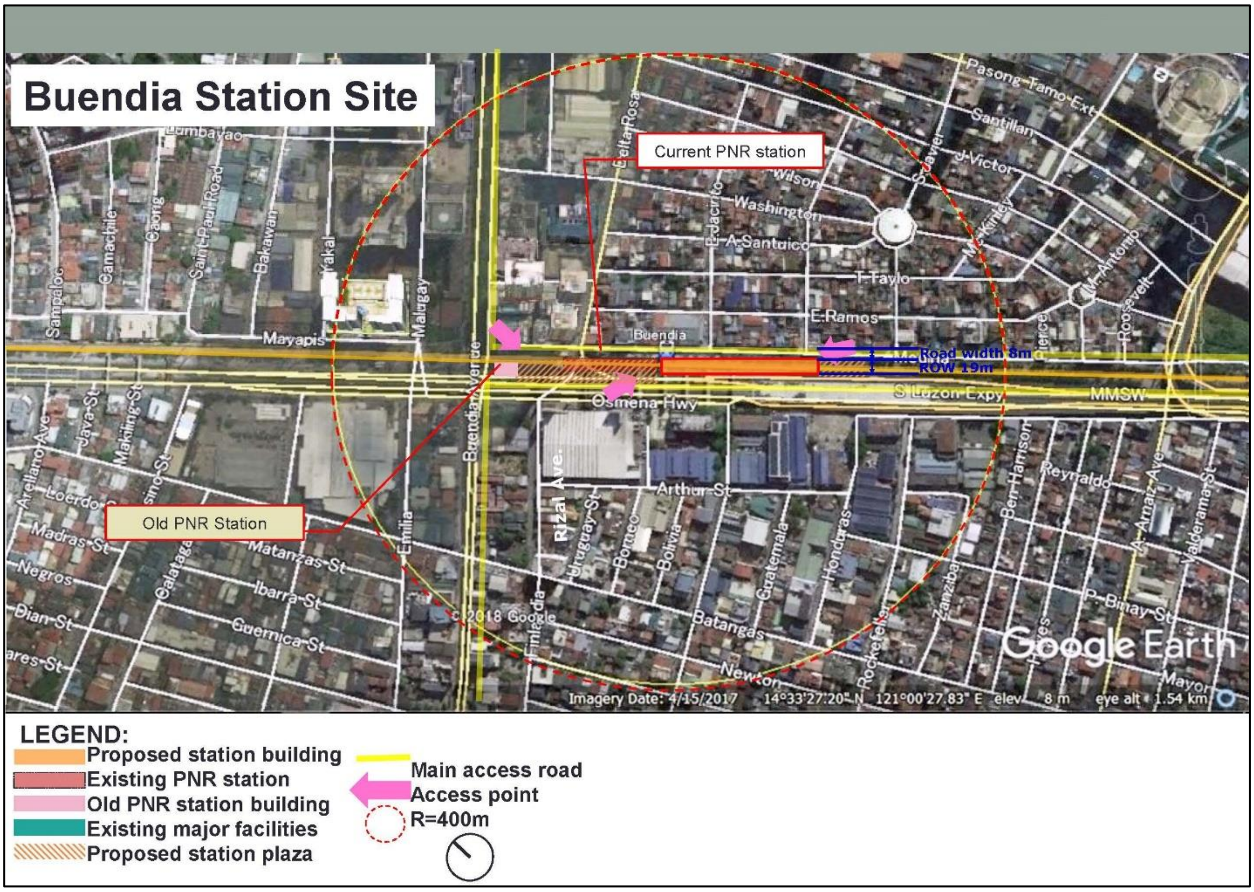
Source: JICA Design Team

Figure 4.4.4 Location of Paco Station

(5) Buendia Station

Since Buendia station is located within the jurisdiction of Buendia, the municipality of Makati has accepted the proposed location of along Osmena Hwy and Medina str.. The station is located adjacent to North of existing PNR station.

The JICA Design Team presented the site plan as shown in Figure 4.4.5 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



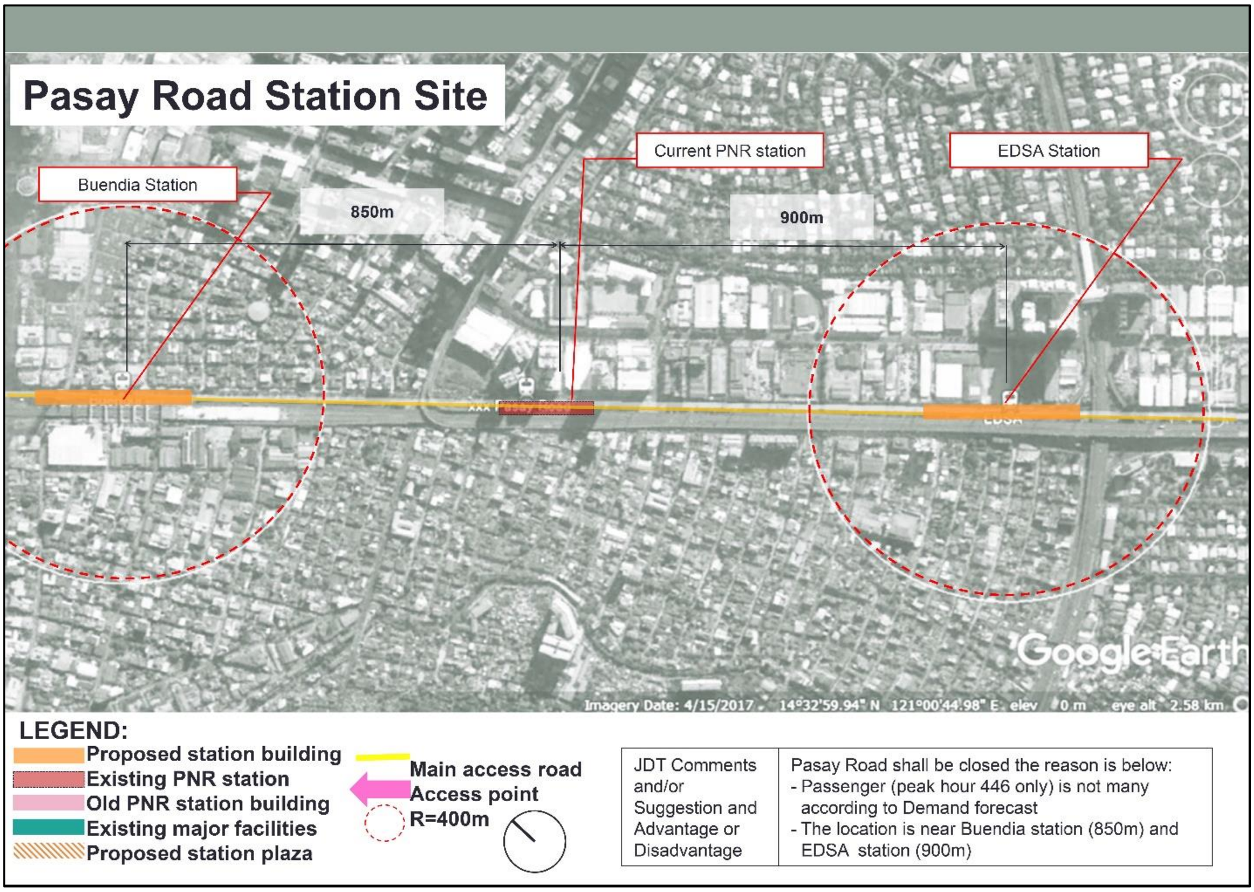
Source: JICA Design Team

Figure 4.4.5 Location of Buendia Station

(6) Pasay Road Station (Cancelled)

Pasay Road station was cancelled because of 1) the number of passenger in the peak hour is only 450 persns according to the demand forcaast and 2) distance from the current station to next stations are short such as, Buendia station (northan) is 880m and EDSA station (southan) is 900m.

The JICA Design Team presented current situation as shown in Figure 4.4.6 below and cancelation of Pasay Road Station is accepted by DOTr.



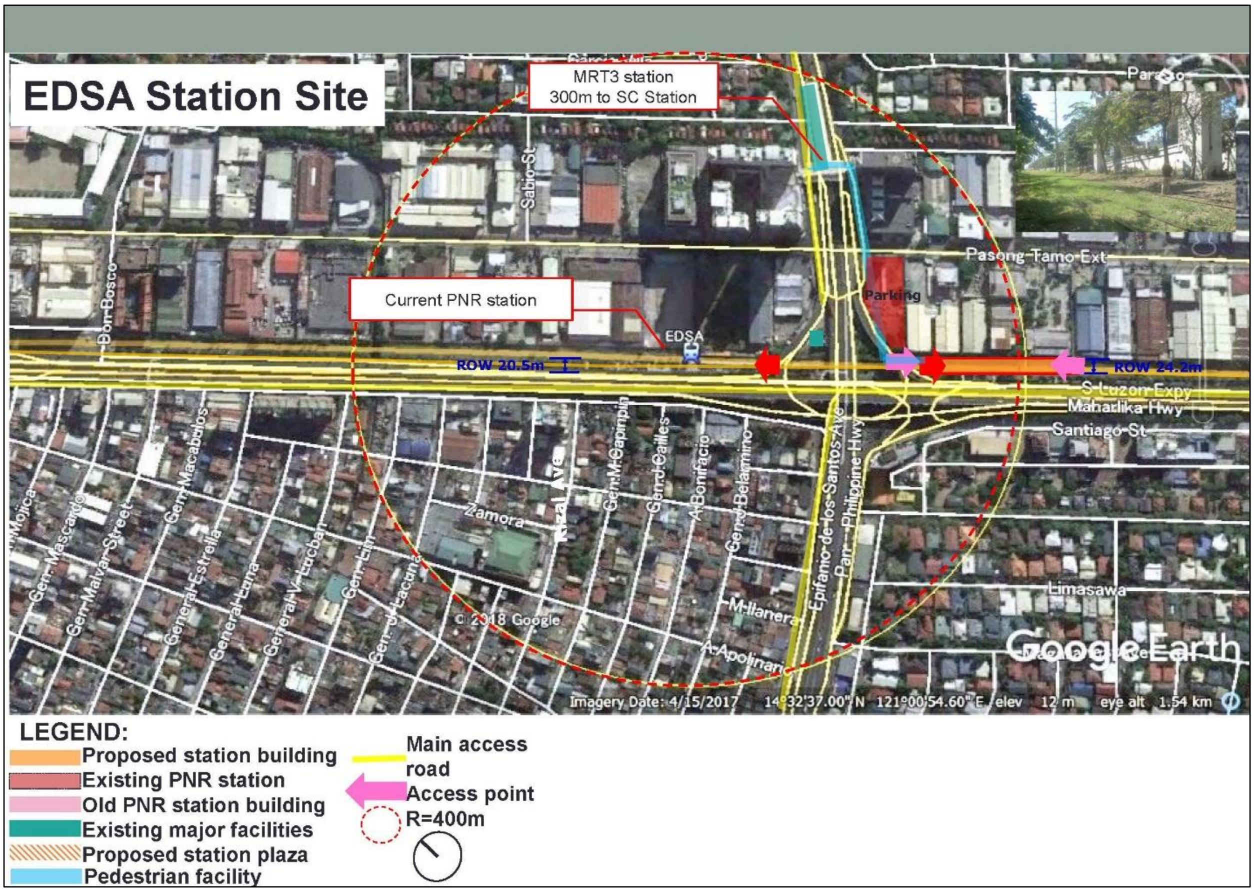
Source: JICA Design Team

Figure 4.4.6 Location of Pasay Road Station (Cancelled)

(7) EDSA Station

EDSA station is located within the jurisdiction of EDSA, the municipality of Makati has accepted the proposed location of near intersection of Metro Manila Skyway and Abenida-Epifanio de los Santos Ave.. The station is located adjacent to South of existing PNR station.

The JICA Design Team presented the site plan as shown in Figure 4.4.7 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



Source: JICA Design Team

Figure 4.4.7 Location of EDSA Station

(8) Nichols Station

Nichols station shall be located within the jurisdiction of Nichols, the municipality of Taguig has accepted the proposed location of 450m north from the intersection of Metro Manila Skyway and Lawton Ave.. The station shall state beside DSWD Office.

The JICA Design Team presented the site plan as shown in Figure 4.4.8 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.

Source: JICA Design Team

Figure 4.4.8 Location of Nichols Station

(9) FTI Station

FTI station shall be located within the jurisdiction of FTI, the municipality of Taguig has accepted the proposed location of near intersection of East Service Rd. and Champaca Rd. The station shall state beside future South Integrated Transportation System.

The JICA Design Team presented the site plan as shown in Figure 4.4.9 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.

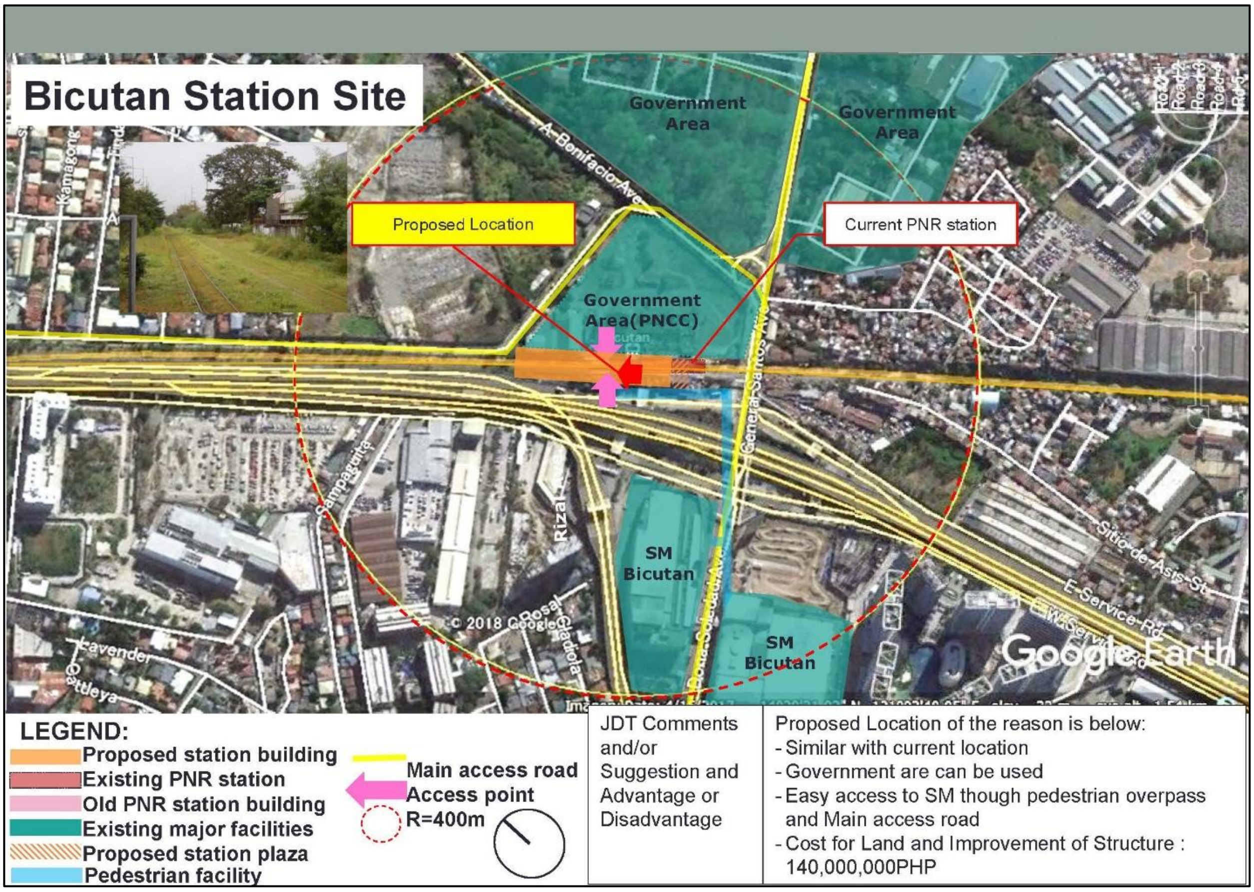
Source: JICA Design Team

Figure 4.4.9 Location of FTI Station

(10) Bictan Station

Bictuan station shall be located within the jurisdiction of Bictuan, the municipality of Panaque has accepted the proposed location of near interchange of Metro Manila Sky way and Dona Saleded Ave.. The station shall be state front of Government Area where is for future development.

The JICA Design Team presented the site plan as shown in Figure 4.4.10 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



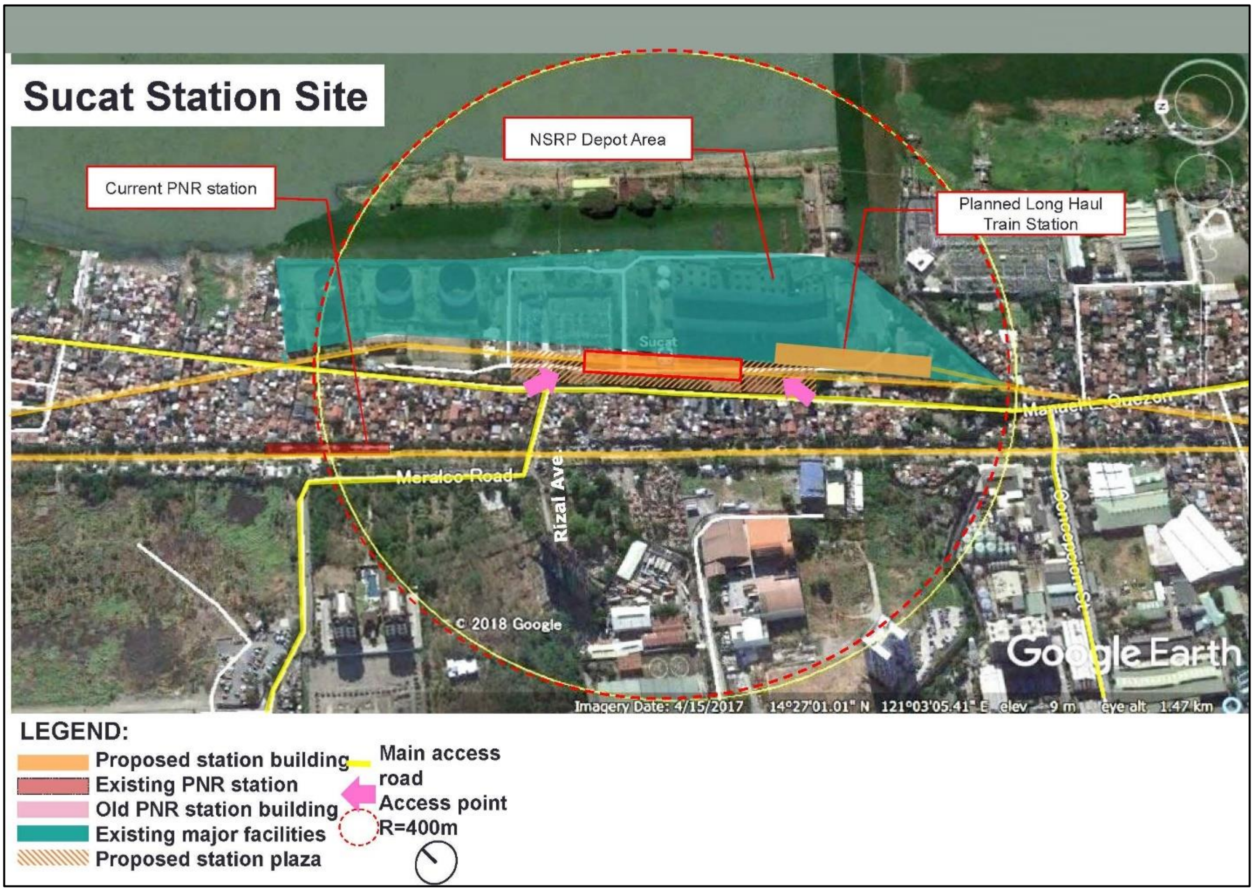
Source: JICA Design Team

Figure 4.4.10 Location of Bicutan Station

(11) Sucat Station

Sucat station shall be located within the jurisdiction of Sucat, the municipality of Muntinlupa has accepted the proposed location in previous Power plant area. The station shall be state front of Long Hall Train Station.

The JICA Design Team presented the site plan as shown in Figure 4.4.11 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



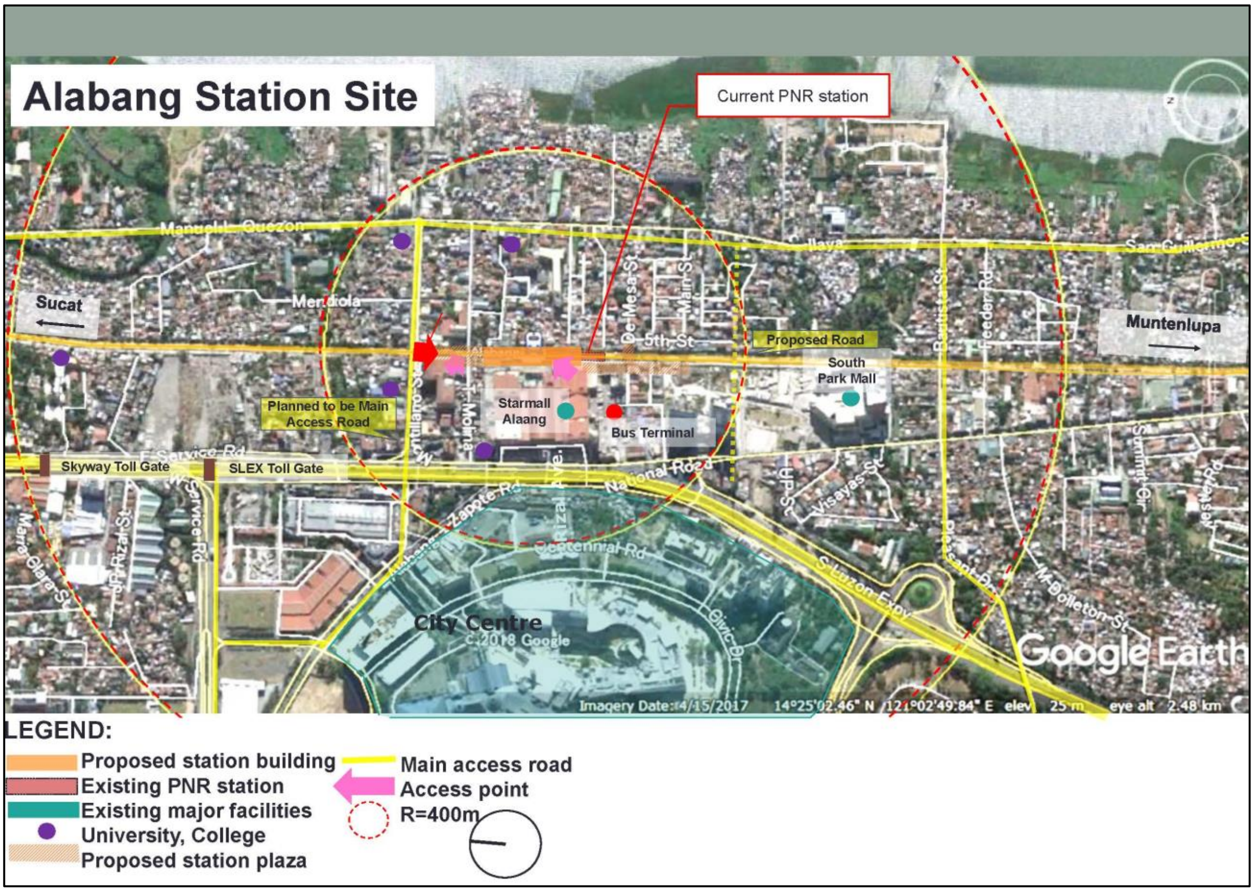
Source: JICA Design Team

Figure 4.4.11 Location of Sucat Station

(12) Alabang Station

Alabang station shall be located within the jurisdiction of Alabang, the municipality of Muntinlupa has accepted the proposed location beside Montillano St.. The station shall be state near bus terminal.

The JICA Design Team presented the site plan as shown in Figure 4.4.12 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.



Source: JICA Design Team

Figure 4.4.12 Location of Alabang Station

(13) Muntinlupa Station

Muntinlupa station shall be located within the jurisdiction of Poblacion , the municipality of Muntinlupa has accepted the proposed location between Pedro St. and Rizal St.. The station shall be state near current PNR Station for easy access.

The JICA Design Team presented the site plan as shown in Figure 4.4.13 blow to DOTr who is currently coordinating with the related agencies, such as Metro Manila.

Source: JICA Design Team

Figure 4.4.13 Location of Muntinlupa Station

(14) San Pedro Station

San Pedro station shall be located within the jurisdiction of San pedro, the municipality of San Pedro has accepted the proposed location beside G. Garcia St.. The station shall be state avoid Old PNR Station.

The JICA Design Team presented the site plan as shown in Figure 4.4.14 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Province.

Source: JICA Design Team

Figure 4.4.14 Location of San Pedro Station

(15) Pacita Station

Pacita station shall be located within the jurisdiction of Pacita, the municipality of San Pedro has accepted the proposed location along Sta. Teresita Str.. and beside sta. Sita str.. The station shall be state avoid Old PNR Station.

The JICA Design Team presented the site plan as shown in Figure 4.4.15 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.

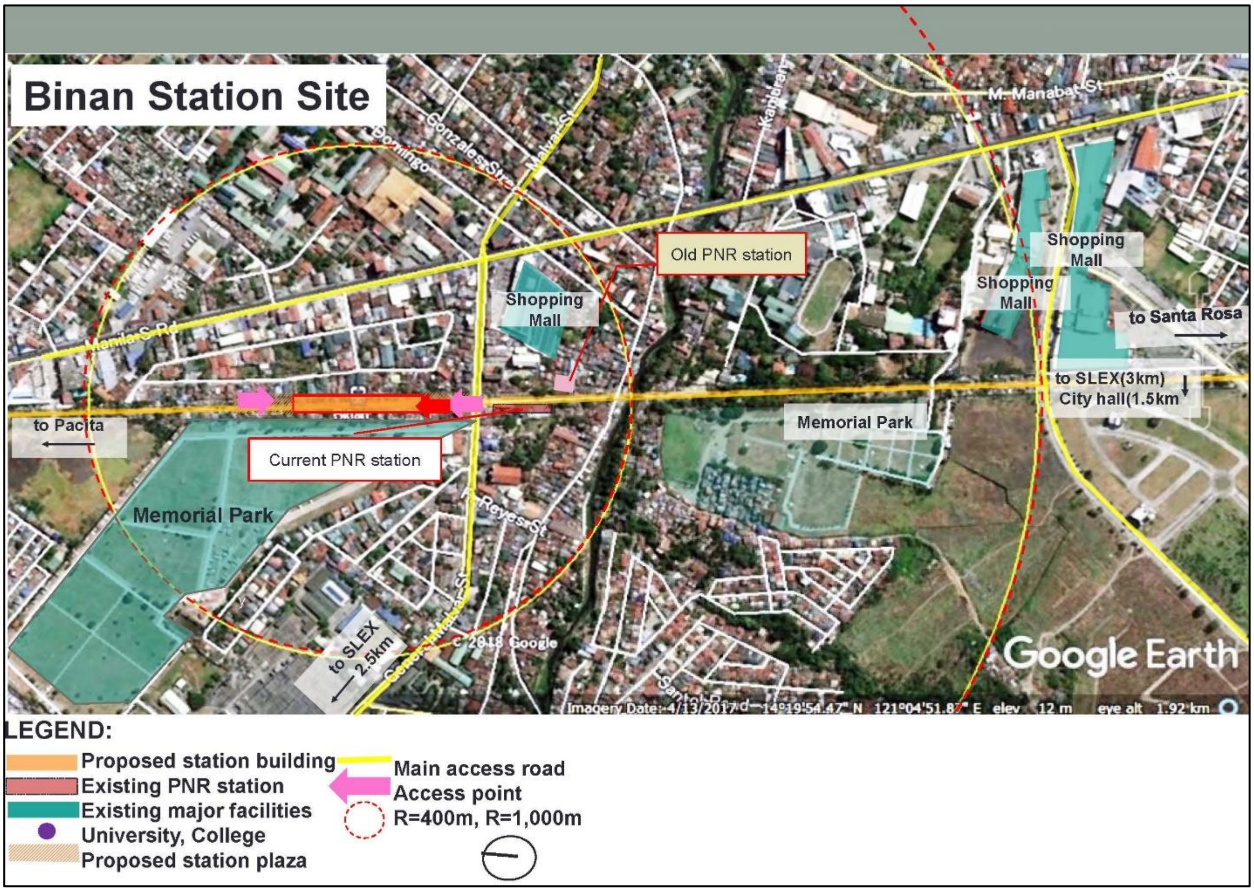
Source: JICA Design Team

Figure 4.4.15 Location of Pacita Station

(16) Binan Station

Binan station shall be located within the jurisdiction of Binan, the municipality of Binan has accepted the proposed location beside General Malvar Str.. The station shall be state near current PNR station for easy access.

The JICA Design Team presented the site plan as shown in Figure 4.4.16 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.



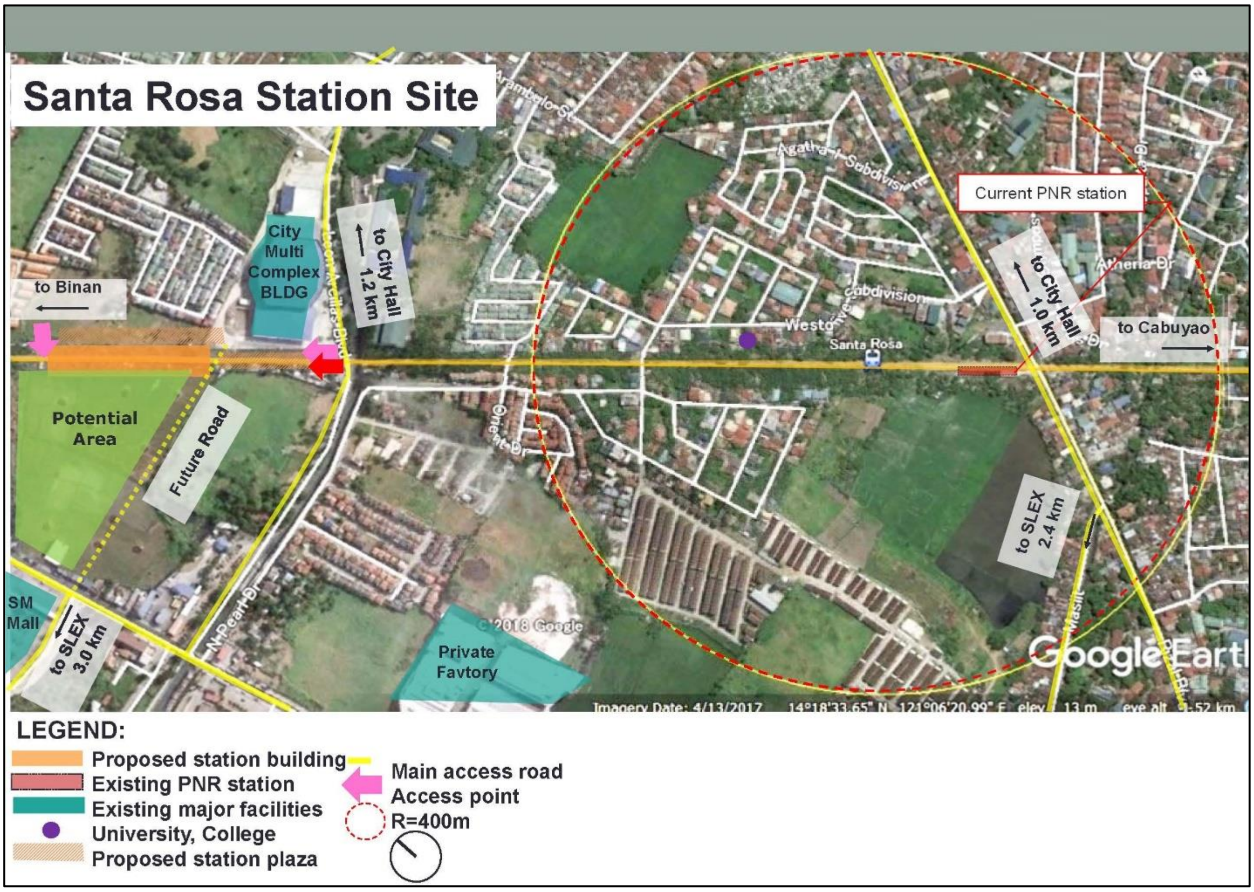
Source: JICA Design Team

Figure 4.4.16 Location of Binan Station

(17) Santa Rosa Station

Santa Rosa station shall be located within the jurisdiction of Santa Rosa, the municipality of Santa Rosa has accepted the proposed location in front of Santa Rosa City Multi Complex Building and beside Future Road. The station shall be state in front of Potencial area.

The JICA Design Team presented the site plan as shown in Figure 4.4.17 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.



Source: JICA Design Team

Figure 4.4.17 Location of Santa Rosa Station

(18) Cabuyao Station

Cabyao station shall be located within the jurisdiction of Cabuyao, the municipality of Cabuyao is considering the proposed location between Bigga Rd and Felix Limcaoco St.. The station shall be state similar with current PNR station for easy access.

The JICA Design Team presented the site plan as shown in Figure 4.4.18 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.

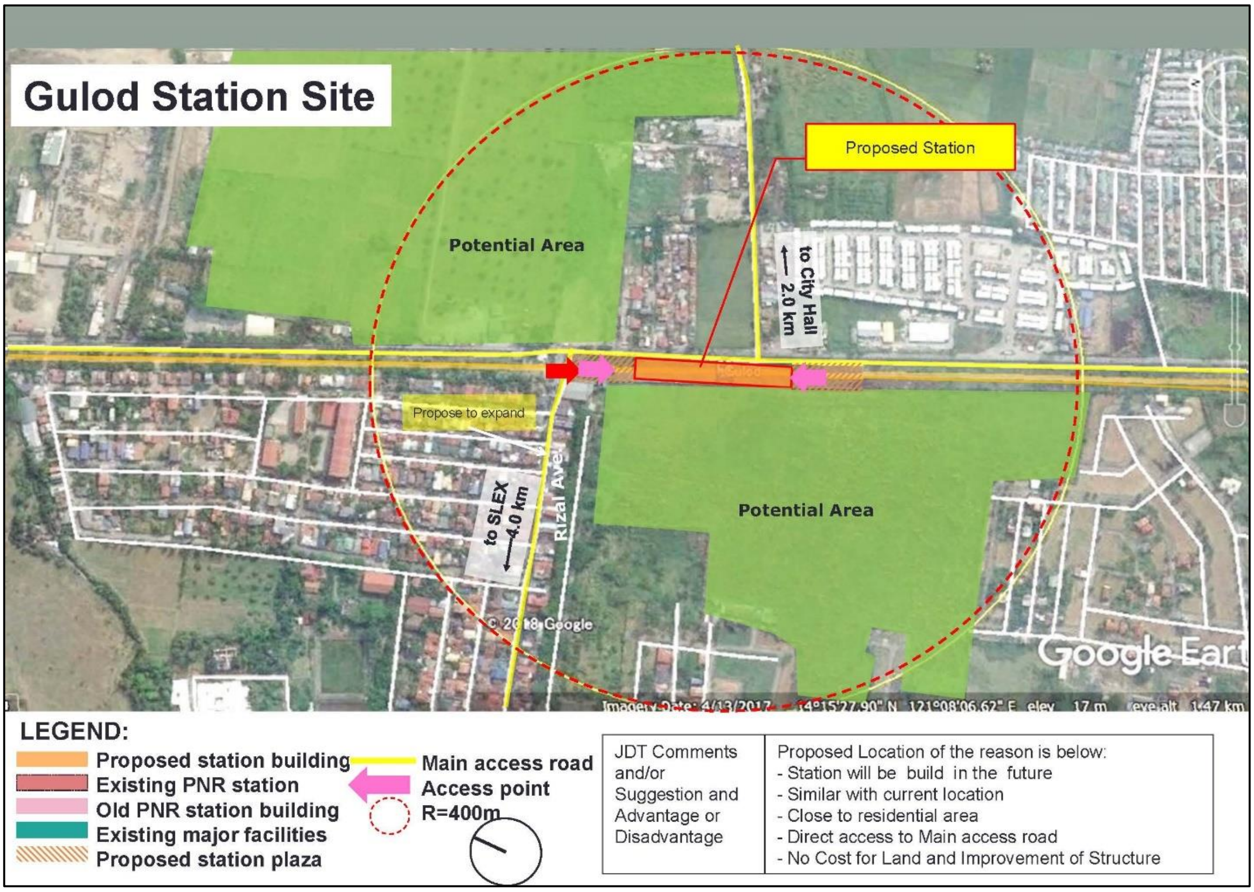
Source: JICA Design Team

Figure 4.4.18 Location of Cabyao Station

(19) Gulod Station

Gulod station shall be located within the jurisdiction of Banay-banay, the municipality of Cabuyao Cabuyao is considering the proposed location along San Isidro Rd.. The station shall be state in front of Potencial area.

The JICA Design Team presented the site plan as shown in Figure 4.4.19 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.



Source: JICA Design Team

Figure 4.4.19　Location of Gulod Station

(20) Mamatid Station

Mamatid station shall be located within the jurisdiction of Mamatid, the municipality of Cabuyao Cabuyao is considering the proposed location along San Isidro Rd.. and beside Mamatid Rd.. The station shall be state similar with current PNR station for easy access.

The JICA Design Team presented the site plan as shown in Figure 4.4.20 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.

Source: JICA Design Team

Figure 4.4.20 Location of Mamatid Station

(21) Calamba Station

Calamba station shall be located within the jurisdiction of Calamba, the municipality of Calamba has accepted the proposed location beside J.P. Rizal Str. The station shall be state similar with current PNR station for easy access.

The JICA Design Team presented the site plan as shown in Figure 4.4.21 blow to DOTr who is currently coordinating with the related agencies, such as Laguna Provonce.

Source: JICA Design Team

Figure 4.4.21 Location of Calamba Station

4.4.2 Design Policy of the Station

(1) Design Standard of Building and Structure

The implemented design standards for the design of the station buildings are mostly Philippine standards. However, in certain instances where the local standards are limited or does not consider some relevant aspects of the design, the design follows Japanese standards. The main design criteria are shown in Table 4.4.1.

Table 4.4.1 Building Design Standard

Subject	Philippine Laws/ Standards	Japanese Standards
Urban Planning and Environment	• RA7279 - urban development & housing act of 1992 • P.D.s and IRRs (as applicable) e.g. 1586 – environmental impact statement system; 1216 – open spaces; 1151 – environmental policy; 1152 – environmental code; 1067- water code; 957 – subdivisions & condominiums; 953 – tree-planting; 856 – sanitation code; 757 – national housing authority; 296 – clear waterways; • duly-approved local government unit (LGU) Zoning Ordinance (ZO, with official zoning map/ OZM) i.e. based on the duly-approved Comprehensive Land Use Plan (CLUP) • special development-related LGU ordinances, as applicable • environmental laws and regulations e.g. clean air (RA8749), clean water (RA9275), solid waste management (RA9003), toxic waste (RA6969), climate change adaptation (RA9729), disaster risk reduction & management (RA10121), environmental impact assessment, heritage conservation (RA10066); indigenous peoples (RA8371), environmental planning (RA10587), resettlement & socialized housing (BP220), department of environment & natural resources (DENR) department administrative orders (DAOs), • Housing and Land Use Regulatory Board (HLURB) issuances e.g. guidebooks, guidelines, standards, manuals, etc. • Department of public works & highways (DPWH) Design Guidelines, Criteria & Standards (DGCS) Vol. 6 Public Buildings & Other Related Structures 2015 • Department of transportation (DOTr) transportation planning studies	N/A
Building and Space Planning / Barrier-Free Design	• PD1096 - National Building Code of the Philippines (NBCP), its 2004 Revised Implementing Rules and Regulations (IRR) and derivative regulations (DRs), including DPWH issuances such as DAOs and Memorandum Circulars (MCs) • Referral Codes of the NBCP (both laws and self-regulatory documents) such as BP344 - Accessibility Law; the Philippine Electrical Code (PEC), the Mechanical Code, the National Philippine Electrical Code Plumbing Code of the Philippines, DPWH 2000 architectural code of the Philippines (ACP, as applicable) and the like • DPWH DGCS Vol. 6 Public Buildings & Other Related Structures 2015 • DPWH-promulgated 2015 Philippine Green Building Code (PGBC) • Department of Energy (DoE) Guidelines on Energy Conserving Design on Buildings, 2008 • RA6716 - rainwater collection • 2016 NBCP: Illustrated data compact disc (CD)applicable standards by other infrastructure agencies such as the Department of Transportation (DoTr) • applicable DoTr standards • RA386, the 1949 New Civil Code of the Philippines • BP 344 - Accessibility Law and its IRR • RA7277, The Magna Carta for Disabled Persons	• The Building Standard Law of Japan. • Ordinance of the Building Standard Law of Japan • Guideline to Improve Barrier Free Access for Public Transport Passenger Facilities for the Enforcement of 2006 LAW N.19. Edited by Ministerial Ordinance MLITT of Japan

Subject	Philippine Laws/ Standards	Japanese Standards
Fire Protection and Safety Evacuation Design	• PD1096 - National Building Code of the Philippines (NBCP) & 2004 Revised IRR • RA 9514 - Fire Code of the Philippines (FCP) and IRR of 2008 • Philippine Mechanical Engineering Code • Philippine Electrical Code • DPWH DGCS Vol. 6 Public Buildings & Other Related Structures 2015 • Illustrated FCP	• The Building Standard Law of Japan (Ministerial Ordinance, MLITT of Japan) • The Fire Laws of Japan (The Fire Defense Agency of Japan)
Building Material	• 2013 DPWH Standard Specifications • PD1096 - National Building Code of the Philippines (NBCP) & its 2004 Revised IRR • DPWH Bureau of Research & Standards (BRS) certification, if applicable • Dept. of Trade & Industry (DTI) Bureau of Product Standards (BPS) product certification, if applicable • National Structural Code of the Philippines (NSCP) 2010	• Japanese Industrial Standards (JIS)

Source: JICA Design Team

Table 4.4.2 Structural Design Standard

Subject	Philippine Laws/ Standards	Japanese Standards
General	• Presidential Decree (PD) No. 1096 (National Building Code of the Philippines NBCP) • National Structural Code of the Philippines (NSCP) 2010	• The Building Standard Law of Japan (Ministerial Ordinance, MLITT of Japan)
Design Guidelines	• Presidential Decree (PD) No. 1096 (National Building Code of the Philippines NBCP) • National Structural Code of the Philippines (NSCP) 2010	• The Building Standard Law of Japan. • Enforcement Order Revised (Ministerial Ordinance, MLITT of Japan 2008)
Design Loading	• National Structural Code of the Philippines (NSCP) 2010	• Building Standard Law, Cabinet Order, Notification. • Recommendation for Loads on Buildings 2004 (Architectural Institute of Japan 2004)
Concrete Structure	• National Structural Code of the Philippines (NSCP) 2010	• AIJ Standard for Structural Calculation of Reinforced Concrete Structures (based on Allowable Stress concept).
Steel Structure	• National Structural Code of the Philippines (NSCP) 2010	• Design Standards for Steel Structures (based on Allowable Stress concept) (Architectural Institute of Japan 2005)
Membrane Structure	N/A	• Technical Standard for Membrane Structure and Materials 2003 (Japan Membrane Association 2003)
Foundation Structure	• National Structural Code of the Philippines (NSCP) 2010	• Recommendation for Design of Building Foundation 2001 (Architectural Institute of Japan 2001)

Source: JICA Design Team

(2) Station Matrix

As of May 2018 the station matrix is as follows (see next page)

Table 4.4.3 Station Matrix

Station		Solis (EX)	Blumentrit	Espana	Santa Mesa	Paco	Buendia (EX)	EDSA	Nichols	FTI (EX)	Bicutan	Sucat	Alabang (EX)
Chainage (draft)		(0km000m)	*2km200m*	*3km750m*	5km913m	8km688m	11km992m	*14km063m*	*15km400m*	18km720m	20km340m	24km764m	28km477m
*Top of Railway Level (draft)		GL+12.55	GL+23.25	GL+14.23	GL+25.35	GL+15.00	GL+15.00	GL+	GL-14.80	GL+	GL+10.39	GL+15.00	GL+15.00
Structure Type (draft)		Elevated 3 Stories	**Type F'** Elevated 4 Stories	**Type C** Elevated 3 Stories	**Type B** Elevated 4 Stories	**Type A'** Elevated 3 Stories	**Type C'** Elevated 3 Stories	**Type E** At-grade 2 Stories	**UG'** Underground 2 Stories	**Type E'** At-grade 2 Stories	**Type A** Elevated 2 Stories	**Type C** Elevated 3 Stories	**Type A'** Elevated 3 Stories
Number of Platforms		1	2	2	2	2	2	1	1	1	2	2	2
Number of Tracks		2	3	2	2	4	2	2	2	2	4	2	4
Schematic													
Peak Hour Max Boarding Passenger (Target year)		3179 (2040)	3,532 (2022)	4,170 (2040)	9,673 (2040)	1,456 (2040)	9,270 (2040)	4,907 (2023)	1,590 (2040)	3,674 (2023)	9,751 (2040)	3,086 (2025)	6,044 (2040)
Designed platform Width		10.3m	8.35	7.5	7.5	10	6.7/11.3	8.2	9.2	10	10	7.5	10
No. of Stairs/ESC on Platform		3	3	4	4	4	4	4	4	4	4	3	4
Station Width	Length of the eaves	2.5	2.2	2.4	2.4	2.2	1	2.4	N/A	2.4	2.2	2.4	2.2
	Clearance to building edge	4.635	5.4	1	1	5.4	1	4.5	N/A	4.5	5.4	1	5.4
	Platform width	10.3	8.35	7.5	7.5	10	6.7	8.2	9.2	10	10	7.5	10
	Track width	N/A	3.1	7.1	7.1	7.1	7.1	N/A	8.9	N/A	7.1	7.1	7.1
	Platform width	N/A	8.35	7.5	7.5	10	11.3	N/A	N/A	N/A	10	7.5	10
	Clearance to building edge	4.635	5.4	1	1	5.4	1	4.5	N/A	4.5	5.4	1	5.4
	Length of the eaves	2.5	2.2	2.4	2.4	2.2	1	2.4	N/A	2.4	2.2	2.4	2.2
	StationWidth without eaves	19.57	30.6	24.1	24.1	37.9	27.1	17.2	18.1	19.0	37.9	24.1	37.9
	Total StationWidth	24.57	35.0	28.9	28.9	42.3	29.1	22.0	18.1	23.8	42.3	28.9	42.3
Required Width of ROW		28.57	60.0	60.0	60.0	60.0	Unknown	Unknown	Unknown	Unknown	60.0	60.0	60.0

Station		Muntinlupa	San Pedro	Pacita	Binan	Santa Rosa	Cabuyao	Gulod	Mamatid	Calamba
Chainage (draft)		31km410m	34km770m	36km370m	39km092m	42km210m	46km780m	49km670m	52km360m	55km710m
*Top of Railway Level (draft)		GL+15.00	GL+15.00	GL+15.00	GL+15.00	GL+15.00	GL+15.00	GL+15.00	GL+15.00	GL+15.00
Structure Type (draft)		**Type C** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type A'** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type C** Elevated 3 Stories	**Type A'** Elevated 3 Stories
Number of Platforms		2	2	2	2	2	2	2	2	2
Number of Tracks		2	2	2	2	4	2	2	2	4
Schematic										
Peak Hour Max Boarding Passenger (Target year)		2,825 (2040)	2,833 (2040)	752 (2025)	2,937 (2040)	3,662 (2040)	4,627 (2040)	2,330 (2040)	3,441 (2040)	6,475 (2040)
Designed platform Width		7.5	7.5	7.5	7.5	10	7.5	7.5	7.5	10
No. of Stairs/ESC on Platform		3	3	3	3	4	4	3	3	4
Station Width	Length of the eaves	2.4	2.4	2.4	2.4	2.2	2.4	2.4	2.4	2.2
	Clearance to building edge	1	1	1	1	5.4	1	1	1	5.4
	Platform width	7.5	7.5	7.5	7.5	10	7.5	7.5	7.5	10
	Track width	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
	Platform width	7.5	7.5	7.5	7.5	10	7.5	7.5	7.5	10
	Clearance to building edge	1	1	1	1	5.4	1	1	1	5.4
	Length of the eaves	2.4	2.4	2.4	2.4	2.2	2.4	2.4	2.4	2.2
	StationWidth without eaves	24.1	24.1	24.1	24.1	37.9	24.1	24.1	24.1	37.9
	Total StationWidth	28.9	28.9	28.9	28.9	42.3	28.9	28.9	28.9	42.3
Required Width of ROW		60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0

Source: JICA Design Team

4.4.3 Basic Design of Station

(1) Station Type

Based on the station matrix shown in the above Table 4.4.3 hereinafter, JICA Design Team is carrying out further design of station type as follwings.

1) Type A and A'

4 Tracks and 2 Platforms of Elevated 2 stories station (Type A) and 3 stories station (Type A')

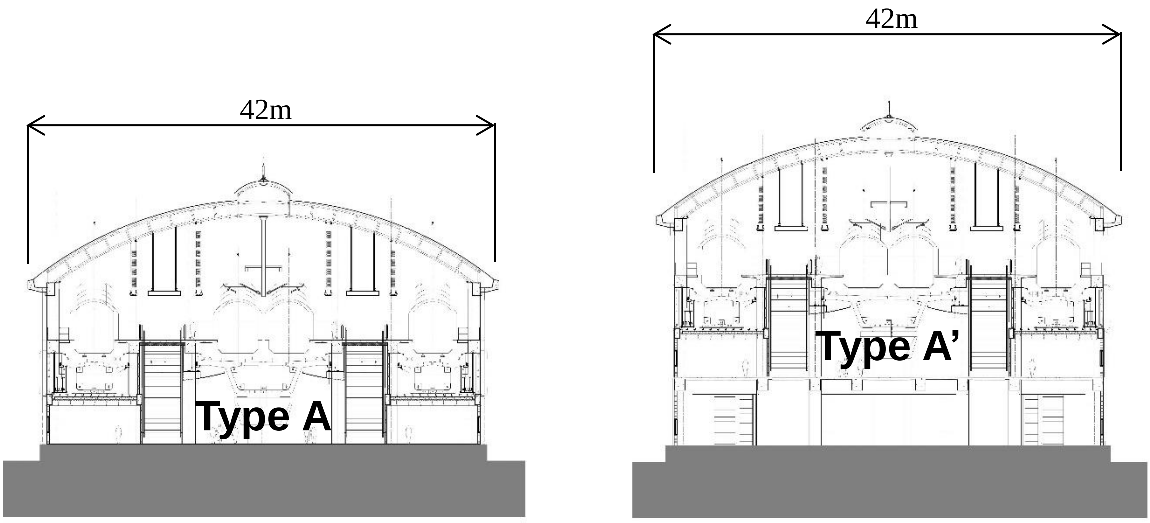


Figure 4.4.22 Type A & A'

2) Type B, C and D

2 Tracks and 2 Platforms of Elevated 4 stories station (Type B), 3 stories station (Type C) and 2 stories station (Type D)

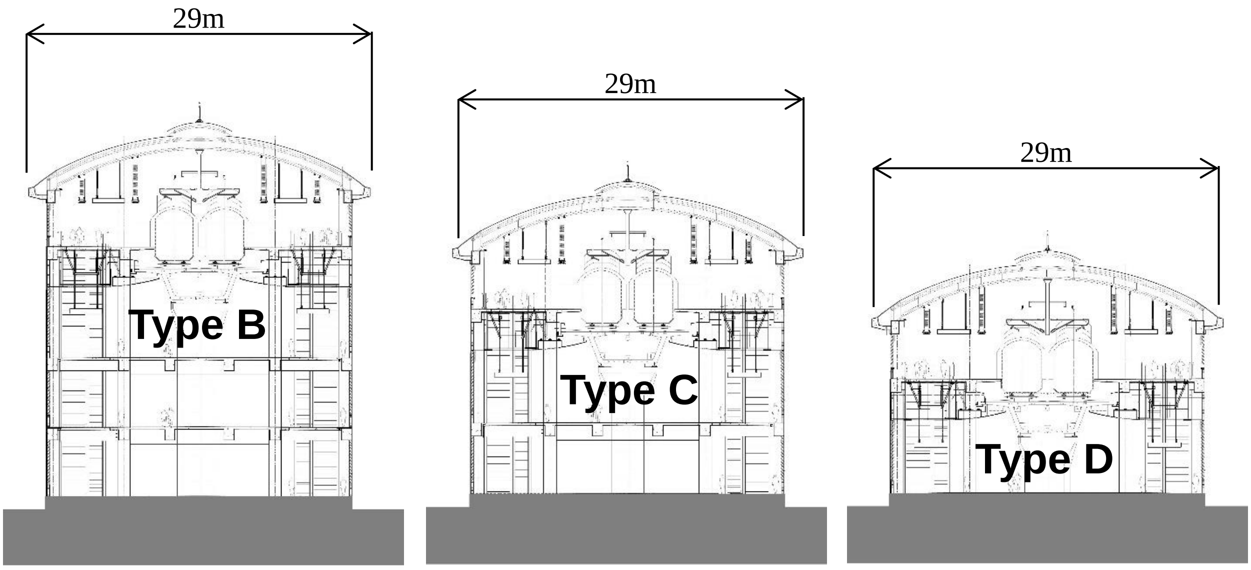


Figure 4.4.23 Type B, C & D

3) Type E and E'

2 Tracks and 1 Platform of At-Grade station, wide 23m (Type E) and wide 25m (Type E')

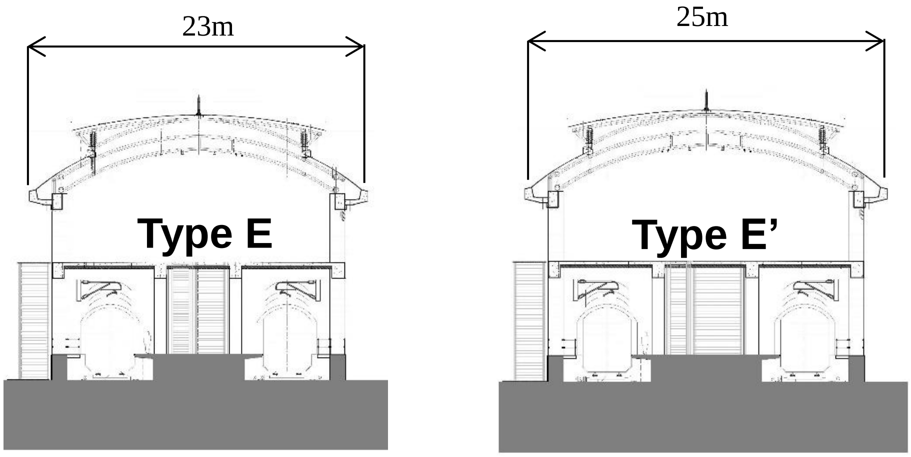


Figure 4.4.24 Type E & E'

4) Type F and F'

2 Tracks and 1 Platform of Elevated 3 stories station (Type F) and 4 stories station (Type F')

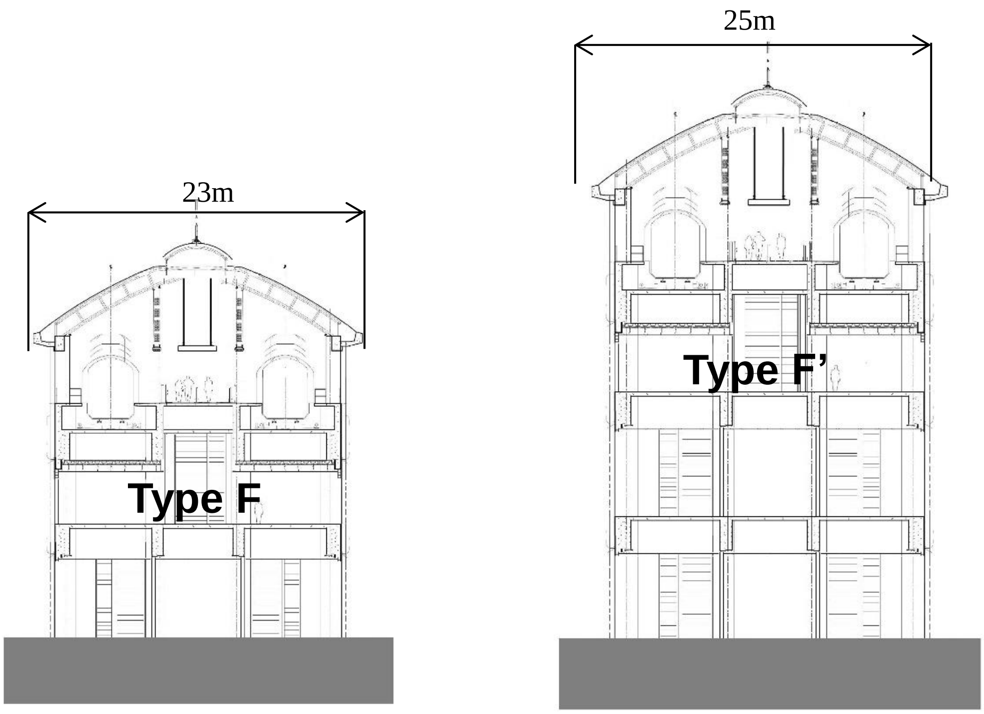


Figure 4.4.25 Type E & E'

(2) Image of Station Building

The JICA Design Team is on going to design of the stations, such as external image sample showed Figure 4.4.26 and typical internal image showed Figure 4.4.27.

Source: JICA Design Team

Figure 4.4.26 External images for Station Building

Source: JICA Design Team

Figure 4.4.27 Internal images for Station Building

(3) Substation: Location and Plan

The location and plan of substation shall be consulted and coordinated with Manila Electric Company (MERALCO).

The substations shall be designed to be located under the viaduct in order to facilitate efficient workability and maintenance of the facility. Typical plan of substation is shown in Figure 4.4.28.

Source: JICA Design Team

Figure 4.4.28 Typical plan of Substation

(4) Structural Planning of the Station

The structural design of the station building is based on the "National Building Code of the Philippines (1977 Presidential Decree No.1096)" and "National Structural Code of the Philippines 2015 (NSCP)".

The earthquake resistance design is based on the "Japanese Building Standards Act" and "Structural Relation Technical Standards Explanation for the 2015 Version Building (Ministry of Land, Infrastructure and Transport, etc.)".

The design ensures the stability, serviceability and safety of structure.

The main structural features are as follows

1) Super structure

- The structure of the station building shall be structured differently from the structures such as the girder and struts related to the track.
- The main structure of the station building is a reinforced concrete rigid-frame structure.
- The roof section is a large span steel frame, adopting a lightweight membrane material.

2) Foundation

- According to the geotechnical survey conducted around each station, there is no support layer near the ground surface, therefore all station buildings shall be supported by a set of pile foundations
- To the bending moment induced by the superstructure is supported by the pile foundation. if it is no reduce the number of the piles and if ground conditions are adequate, it is possible to implement the beam foundation connecting each pile cap.
- In order to reduce the levels of noise and vibration induced by the piling works, the pile shall be cast-in-place. Penetration is required for the tip of the pile to penetrate 1m or more into the support layer (N value is equal or larger than 50). However, in the case of short piles, the slenderness ratio of the pile (ratio of the length to the diameter of the pile) needs to be adjusted as to be 5 to 10 or more.

(5) Design Load Condition

Based on the NSCP, the following loadings had been considered in the structural analysis

- Dead load
- Live load
- Wind load
- Seismic load
- Earth pressure, water pressure (only for underground structure)
- Load caused by temperature difference.

In addition to the above.

- Load of facility equipment (considered as loading load or special load)
- Load such as overhead lines and signs (considered as special loads)
- Tension of membrane material and others

(6) Structural Material

The following materials specified in the “American Society for Testing and Materials (ASTM)” and/or “Japanese Industrial standard (JIS)” shall be used for the structural members.

- Concrete: ordinary concrete, design basis strength Fe = 31 N/mm^2
- Reinforcing bar: bell shaped steel
  D10, D12(orD13) ASTM A615 Grade 40 or JIS G3112 SD295
  (yield point strength of 275 N//mm^2 or more)
  D16 or more ASTM 615 Grade 60 or JIS G3112 SD390
  (yield point strength of 390 N//mm^2 or more)
- Steel frame: rolled steel material for general structure ASTM A36 or JIS G3101 SS400 (yield point 235 N/mm^2 or more)

(7) Roof Structure

On the platform of each station building, in order to reduce the number of columns as much as possible for the convenience of the users, the span of orthogonal structural members shall be a large span. Also, in consideration of reducing the burden on the steel frame members and the lower works of the roof, the roof will be made of a light membrane as to reduce the loading on the roof.

The load of the membrane material is transmitted to the lower structure via the steel beams adopted for the roof. In that case, the steel beams are affected by the tension induced by membrane material. Therefore, bracings are provided on the roof surface to increase the rigidity. The material end condition is determined according to the shape of the joint portion with the reinforced concrete structure.

(8) Seismic Design

For the seismic design of the station building, two different types of earthquake are considered, namely: medium seismic motion (earthquake motion occurring 2 to 3 times during the lifetime of the structure) and large earthquake motions (earthquake motion that occurs once during the service life of the structure).

1) Ensuring seismic safety against medium earthquake motion

During medium intensity earthquake motions, it is aimed that the structures suffer no structure damage after being struck 2 to 3 times during its lifetime According to the NSCP and Japanese Building Standards mentioned above, the allowable stress intensity should allow the structure to suffer no significant structural damage and stay intact.

2) Ensuring seismic safety against large earthquake motion

The safety against large earthquake is based on the Japanese Building Standard "Structural Relations Technical Standards Reference Book on Building 2015 Edition", The Japanese Standards indicates that the horizontal load carrying capacity of the station building should not exceed the required horizontal stress capacity, as to reduce the structural damage and assure the safety of the users.

The goal of the seismic safety is to allow the building to undergo small damage and require only small repair works of structures after large earthquake motions, ensuring the function of the station building and safety of its users. In this sense, the horizontal loading capacity of the building shall be greater than 1.25 times the required horizontal load capacity. The building when calculating the horizontal tolerance possessed by the building shall be of reinforced concrete and the deformation limit shall be the interlinear deformation angle 1/200. Moreover, given that the structure under consideration is a train station it is also necessary to consider the structural integrity of the track and viaduct.

(9) Other structural design

Other structural design has been done as followings

- Final confirmation such as equipment load and overhead load.
- Check the structure of the hoist way on the load, elevator and the escalator.

- Determination of the foundation (pile length): pile length etc. when the support layer height difference exists.
- Consideration of basic from of substation (including piles).
- Final adjustment with civil engineering (orbit), other

4.4.4 Station Electrical and Mechanical Systems

(1) General

The detailed design of the all stations has been addressed and summarized in this report.

The systems include Station Electrical and Mechanical (E&M) systems, including fire protection system and sanitary plumbing system.

The all station facilities will consist of seven (7) types.

All the station facilities system will be designed for 8 cars train operation and design target year in 2040.

The design consideration/basis shall follow the local design code/requirements and/or MLIT-J (Ministry of Land, Infrastructure, Transport and Tourism of Japan) design guide books/requirements and Japan Fire Code/requirements and the like.

To assist the Contractor with the construction design of the works, the Consultant/Employer has provided the detail design and outline design details to address various aspects of the E&M building services as indicated in Table 4.4.4.

Table 4.4.4 Design Contractual Obligations Under Construction Contract

Work Items	Design	Design Responsibility
• LV power supply • Lighting fixtures, and socket outlet • Fire alarm services • Lightning protection service • Grounding services • Water supply, plumbing and drainage services • AC and ventilation service • Fire protection services • Rainwater reuse services	Detail Design provided by Employer Contractor to adjust where required and the Detail Design shall accommodate to the equipment	Design responsibility by Employer
• Building management system • Waste treatment plant system	Employer to provide outline design Contractor to develop the Outline Design shall accommodate to the E&M system-wide equipment	
Combined Services Drawings (CSD) and Structural Electrical Mechanical Drawings (SEM)	GC/Employer shall instruct the Contractor to provide the CSD and SEM Drawings Contractor to develop the CSD and SEM drawings to accommodate the equipment/systems	Design responsibility by Contractor to elaborate the CSD and SEM drawings

Source: JICA Design Team

(2) Design Criteria

The design of the E&M systems of the station shall be based on the applicable local codes, regulations and standards issued by the statutory authorities or agencies, as well as the latest Japanese Standards and codes of practice which shall include the following where applicable:

1) Code and Standards

Relevant Philippines Code and Standards for Design and installation services for Building, Fire and Mechanical, Plumbing and Drainage, Electrical services

Such as:

- National Building Code of Philippines
- Philippine Mechanical Engineering Code
- Philippine Electrical Codes, Part I & II
- Philippine Fire Code and Revised Fire Code of Philippines - Implementing Rules and Regulation of Act-No9514 otherwise known as the Fire Code of the Philippines of 2008(IRR-Act No9514)
- Metropolitan Water works and Sewage System (MWSS)
- Local Water Utilities Administration Standards (LWUA)
- Mayniland Water Service Incorporation (MWCI) Standards
- Building Electrical and Mechanical Installation Code of Industry in Philippines
- National Plumbing Code of the Philippines 2000 (NPCP)
- Revised National Plumbing Code of the Philippines
- International Electro-technical Commission (IEC)
- International Organization for Standardization (ISO)
- Philippine Mechanical Engineering Code
- The American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE)
- Institute of Electrical & Electronics Engineers Inc. (IEEE)

The following standards also shall be applied where the station E&M equipment is not specified in the above mentioned standards;

- Relevant standard issued in the Manual of Building E/M services for Design guide-line and construction by the Ministry of Land Infrastructure, transport and Tourism (MLIT-J) of Japan
- Relevant Japanese Industrial Standards (JIS)
- Relevant Japan Building Code and Standards (JBC)
- Relevant Japan design Manual for Mechanical System of the Society of Hearting, Air-conditioning and Sanitary Standards of Japan (HASS-J)
- Relevant Japan Fire Code and Standards (JFC)

2) Noise Conditions

Designed Noise Condition shall not exceed requirements as per Local Building/Environmental Codes and Standards and relevant Japan standards as follows:

Urban, Residential area	---	50db (A)
Urban mixed area	---	55db (A)
Urban, non-residential	---	65db (A)
Industrial area	---	65db (A)

3) E&M equipment Failure Tolerance Strategy

The station E&M system can tolerate a single equipment failure and the station operation can be continued with a degraded of 75% of services. A 20% of spare capacity and 150% sizing strategy of Major and/or Railway system room AC equipment, water and Fire Pumps, electrical control panel and etc. are reserved in it the design so that it will be sufficient capacity to meet in future introduction of modifications that O&M contractor will consider necessary. Duty and Standby arrangement and served policy had been adopted consider to achieve this purpose

4) Design Target Year

The system configuration and equipment sizing to meet target year of after completion of construction has been based on in year 2040. The Equipment room spaces to meet with demand of target year will be 20 years' design life.

(3) Station Electrical Systems Description

The station electrical system shall be as follows;

- LV power supply system
- Lighting fixtures system and Socket outlet (Receptacle) system
- Grounding System
- Lightning Protection System
- Fire Alarm and Detection system
- Building Management System
- Solar Power Generation System (PV System)

1) LV Power Supply System

Low voltage power supply shall be distributed by HV loop distribution power supply of the railway system, the station facility from the station railway distribution transformer located at each station building.

The local electric cooperative distribution transformers shall be provided for sole use of the station facility. Utilization voltage shall be 380 volts for three- phase voltage, 220 volts for single-phase voltage. The interior wiring shall be insulated copper building wires running in conduits.

The facility shall have provision for connecting all essential loads such as lighting, convenience outlets and computers.

Electrical system shall consist of main low voltage power supply, low voltage distribution and wiring, normal lighting/socket outlets, building management system, fire detection and alarm system and lightning protection system.

Each station's low voltage power supply shall be supplied and derived from the railway system network dedicated traction substation by the railway system of this project.

The secondary low voltage power supply of the station will distribute normal power supply to both station E&M systems and AFC of the railway system.

2) Lighting Fixtures System and Socket Outlet (Receptacle) System

The main purpose is to provide general, localized and task illumination for different lighting requirements. The supply of the lighting system shall be 220 volts, 60Hz with LED type lighting fixtures.

All platform lighting systems shall be operated automatically from BMS. All non-automatic lighting circuits shall be operated from manual switches installed in the respective rooms/areas. The wiring method to be implemented shall be installed in the ceilings or walls and in intermediate metal conduit (IMC) for exposed installations.

The locations and specifics regarding the exit signs and lighting shall follow the local codes and/or MLIT-J requirements.

Emergency lights shall be self-contained with battery back-up.

The self-contained battery sets shall automatically recharge when normal power is available.

For exterior or lamp location, surfaces or imbedded, watertight receptacles for lighting switches shall be mount.

The wiring method to be used shall be for installations embedded in walls or floor slabs and IMC for exposed installations. The facility shall be provided with 220 volt general purpose receptacle outlets. All receptacles shall be grounding type. The location of the receptacle outlets shall be based on the furniture arrangement of the facility.

Lighting Level and Type and Number of Socket Outlet shall be indicated in Table 4.4.5.

Table 4.4.5 Lighting Level and Type of Small Power Outlet

Room	Lighting Level N/E/D (lux)	Small Power	Remarks
Paid concourse	300 / 1	T54	Each TSO shall cover an area of 25m in radius
Unpaid concourse	300 / 1	T54 x FSU	Each TSO shall cover an area of 25 m in radius. At least 2 T54s are fixed for a disaster One FSU to be provided for one tenant
Platform	100 / 1	T54	Each TSO shall cover an area of 25m in radius
Customer service	500 / 1	3xTSO	
POS	500 / 1	2xTSO	
AFC room	200 / 1	2xTSO	
First aid room	200 / 1/50	2 xTSO	One T54 is for a disaster
AFC UPS	200 / 1	2xTSO	
COM equipment room	200 / 1	2xTSO	
COM UPS	200 / 1	2xTSO	
SER	200 / 1	2xTSO	
SUR	200 / 1	2xFSU	
Escalator – entrance / exit	300 / 1		
Escalator general	300 / 1		
Elevator – entrance / exit	300 / 1		
Security staff room	200 / 1/100	2 x TSO	
Station manager room	200 / 1/100	2 x TSO	
Station staff/BMS room Meeting corner	200 / 1/100	8 x TSO	Two T54s are for a disaster
Staff W/C (M&F)	100 / 1/50	3x FSU	
Staff pantry	100/1	2x FSU	
Station storage room	100 / 1	2xFSU	
Corridor	100 / 1/50	FSU	Each TSO shall cover an area of 25 m in radius
Janitor's Cleaners room	100 / 1	1 x FSU	
OCS room	200 / 1	1xFSU	
WC (M/F/D)	100 / 1/50	3x T54	One T54 is fixed in each WC
Railway electrical room	200 / 1	4 x FSU	
Station electrical room	200 / 1/100	4 x FSU	
Fire services / water tank / pump room	200 / 1/50	2 x T54	Two T54s are fixed in each room
Refuge store	100 / 1/50	1 x FSU	
Elevator machine pit		1 x FSU	
Elevator shaft pit		1 x FSU	
Distribution Board Room / EPS	200 / 1/100	1 x TSO	
Gender & Development	100 / 1	1 x TSO	
Breast Feeding Room	100 / 1	1 x TSO	

Abbreviation
- N/E/D : normal/emergency/disaster normal = essential lighting, disaster=at the time of disaster
- T54 : Twin Socket outlet with IP54
- TSO : Twin Socket outlet
- FSU : Fused Spur Unit

Source: JICA Design Team

3) Lightning Protection System

A lightning protection system shall be designed for each station, each substation and auxiliary buildings.

The building shall be protected from lightning strike by implementing a pre- caution lightning streamer of lightning protection system consisting of air terminals, down conductors, ground rods and ground ring. The code and requirements shall be in complying with Philippine code and requirements and/or MLIT-J Electrical Design requirement.

4) Grounding system

Grounding system shall be equipotential grounding. This system should be for the purpose of suppressing the potential difference between each other's equipment. Equipotential grounding terminal bar shall be provided connection of electrical equipment in the following rooms.

- Station electrical room
- Railway electrical room
- Distribution board room
- OCS room
- AFC room
- AFC UPS room
- SER room
- SUR room
- COM room
- COM UPS room
- BMS room

5) Fire Alarm and Detection System

An addressable type of fire alarm system shall be provided and installed in accordance with the requirements of the Philippine Electrical Code, Part 1, Philippine Fire Code and/or MLIT-J electrical design requirement.

The system shall consist of analog addressable smoke and temperature detectors, manual pull stations and fire alarm assembly. Loop-type wiring shall be provided in all circuits.

The minimum size of the conduit to be used shall be 20 mm in nominal diameter by the design requirement and shall be rigid for embedded and underground installations and Electrical Metallic Tubing (EMT) for concealed applications. MLIT-J Fire Code and requirements

Fire Alarm and Detection System shall be provided for all of station area as table shown:

Table 4.4.6 Provision of Fire Alarm and Detection System

Room	Fire Protection Provision
	Detection
Paid Concourse	PS
Unpaid Concourse	PS
Station Platform	PS
Staircase	PS
Escalator	PS
Elevator-Entrance & Exit	PS
AFC Room	PS
Customer Service	PS
AFC UPS	PS
SER Room	PS
SUR Room	PS
COM Room	PS
COM UPS	PS
Station Master Room	PS
Station Staff Room / BMS	PS
First Aid Room	PS
Staff W/C (M&F)	PS
Storage	PS
Corridor	PS
Janitor's Room	PS
WC (M / F / D)	HD
Railway Electrical Room	PS
Station Electrical Room	PS
Fire Services / Water Tank / Pump Room	PS
POS	PS
Security Staff Room	PS
Pantry	PS
OCS Room	PS
Elevator Shaft	PS

Abbreviation:
PS : Optical Type Smoke Detector
HD : Heat Detector
BLANK : No Provision

Source: JICA Design Team

6) Building Management System

A Building Automation System for all stations will be provided by a common alarm status control.

All equipment alarm conditions and status shall be displayed on a CPU software. The following systems and items shall be monitored and displayed in the status system.

Table 4.4.7 Provision of Building Management System

Items	Operation	Indication	
		Status	Alarm
Low Voltage Switchgear for the station building (Main Breaker)	Open / Close	Open / Close	Fault
Low Voltage Switchgear for the station building (Branch Breaker) (*3)	Open / Close	Open / Close	Fault
Fire Pump No.1,2 & Jockey Pump		Run / Stop	Fault
Fire Water Tank		Low & High	
Potable Water Pump No.1,2		Run / Stop	Fault
Potable Reservoir Tank		Low & High	
Waste Water Treatment Plant			Fault (Lump)
Ventilation Fans			Fault
Air Conditioners			Fault
Lighting System (Platform : 10% of the total)	On / Off	On / Off	Fault
Lighting System (Platform : 50% of the total)	On / Off	On / Off	Fault
Lighting System (Platform : 100% of the total)	On / Off	On / Off	Fault
Roller Shutter Door		Open / Close	Fault
Escalator	Operation On / Off	Service / Not service	ES (*1) EF (*2)
Elevator	Operation On / Off	Service / Not service	ES (*1) EF (*2)
Fire Alarm Control Panel			Fault (Lump)
Drain water reservoir Tank		Low & High	Fault (Lump)
PV System (for future)	Grid connection/ Isolated operation	Grid connection/ Isolated operation	Fault (Lump)
Distribution Board for Isolated Operation (for future)	Commercial/ PV system	Commercial/ PV system	Fault (Lump)

*1 ES: Emergency Stop
*2 EF: Escalator/Elevator Fault
*3 Generation Power by PV system is measured (for future)

Source: JICA Design Team

Individual monitoring devices shall be installed in the same room such as the fire alarm. Security CCTV camera shall be mounted in the applicable location inside station and its server and monitor shall be installed in the BMS room.

7) Solar Power Generation System (PV System)

PV system is not planned to provide and install on the project. However the space installing photovoltaic modules is considered on the roof.

(4) Station Mechanical System

The station mechanical system shall be as follows:

- Air-conditioning system
- Ventilation system
- Fire protection system

1) Air Conditioning

The air conditioning system is comprised of air-conditioning and mechanical ventilation for the stations.

For non-air-conditioned areas such as concourse and platform, water tank and pump rooms and all the storage rooms, sufficient air exchange by means of natural ventilation or mechanical ventilation will be provided in accordance with local code requirements, or the design guidelines of the MILT-J (Ministry of Land, Infrastructure, Transport and Tourism of Japan) and other authorized Japanese technical codes.

The capacity of the air conditioning system for railway equipment rooms such as SER, SUR, Communication equipment room, Communication equipment UPS room, AFC and AFC UPS room shall be sufficient to provide 150% of the anticipated cooling load, including the allowances for stand-by equipment.

Each air-conditioned room will be provided with a mechanical ventilation system for fresh air intake.

As the stations are basically open stations and all areas are equipped with fire proof/smoke proof materials, no provision has been provided for smoke exhaust systems in line with MLIT-J requirements for station structures.

Non-air-conditioned rooms such as toilets, station/railway electrical rooms and distribution board rooms will be fitted with mechanical ventilation systems. Each of the rooms will be controlled by mechanical ventilation based on the volume of air changes or the room temperature not exceeding 40 degrees centigrade, as indicated in Table 4.4.8.

2) Design Provision for AC and Ventilation Systems are specified below.

The design provision for AC and ventilation systems are specified below:

- Consist of individual air-conditioning (cooling only) systems and ventilation fans.
- Natural ventilation will be sufficient for concourse and platform as these areas are semi-open/open spaces.
- Individual AC units (air-cooled separate cooling units) are designed for all staff rooms, offices and other station rooms as indicated in Table 4.4.8.
- The structure of the stations will not be provided with smoke exhaust systems in accordance with MLIT-J and design requirement.

Table 4.4.8 Machine Equipment Design Condition

Design Conditions	**Outdoor Temperature: 37.7 degrees C (DB), 27.7 Degrees C (WB)**				
Room	**AC and Ventilation Provisions**		**AC Equipment /Ventilation**	**Operation and Control Requirements**	**Remarks**
Paid Concourse	NV				
Unpaid Concourse	NV				
Platform	NV				
Customer Service	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	2--6 staffs
AFC Room	A/C	22^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit Stand-by at 75% each HRV	Type 2	3 staffs
AFC UPS Room	A/C	22^{0}C DB, 50% RH, OA/Exh 5AHC	Split Unit Stand-by at 75% each HRV	Type 2	
SER Room	A/C	22^{0}C DB, 50% RH, OA/Exh 5AHC	Split Unit Stand-by at 75% each HRV	Type 2	
SUR Room	A/C	22^{0}C DB, 50% RH, OA/Exh 5AHC	Split Unit Stand-by at 75% each HRV	Type 2	
Communication Equipment Room	A/C	22^{0}C DB, 50% RH, OA/Exh 5AHC	Split Unit Stand-by at 75% each HRV	Type 2	
Communication UPS Room	A/C	22^{0}C DB, 50% RH, OA/Exh 5AHC	Split Unit Stand-by at 75% each HRV	Type 2	
First Aid Room	A/C	24^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HTV	Type 1	2 staffs
Security Room	A/C	24^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	12 staffs
Station Manager Room	A/C	24^{0}C DB, 50% RH, OA/Exh30 m^3/hr for person	Split Unit HRV	Type 1	1 staff
BMS Room	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	30 staffs
Maintenance Office	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	
OCS	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	4 staffs
Training Maintenance	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	
Staff Room	A/C	24 ^{0}C DB, 50% RH, OA/Exh 30m^3/hr for person	Split Unit HRV	Type 1	20 staffs
Storage	MV	Exhaust, 5ACH	Exhaust Fan	Type 2	

Design Conditions	Outdoor Temperature: 37.7 degrees C (DB), 27.7 Degrees C (WB)				
Room	**AC and Ventilation Provisions**		**AC Equipment /Ventilation**	**Operation and Control Requirements**	**Remarks**
Staff Male Toilet	MV	Exhaust, 10ACH	Exhaust Fan	Type 1	
Staff Female Toilet	MV	Exhaust, 10 ACH	Exhaust Fan	Type 1	
Driver Waiting Room	A/C	24^0C DB, 50% RH, OA/Exh 30 m^3/hr for person	Split Unit HRV	Type 1	
Shower Room	MV	Exhaust, 10 ACH	Exhaust Fan	Type 1	
Janitor's Room	MV	Exhaust, 10ACH	Exhaust Fan	Type 1	
Male Toilet	MV	Exhaust, 15ACH	Exhaust Fan	Type 3	
Female Toilet	MV	Exhaust, 15ACH	Exhaust Fan	Type 3	
Toilet for the Disabled	MV	Exhaust, 15ACH	Exhaust Fan	Type 3	
Railway Electrical Room	MV	Max 40^0C (HL)	2 Exhaust Fans (75% flow for each)	Type 2	See note 1
Station Electrical Room	MV	Exhaust 10ACH	2 Exhaust Fans (75% flow for each)	Type 2	See note 1
Distribution Board Room	MV	Exhaust 10ACH	2 Exhaust Fans (75% flow for each)	Type 2	See note 1
Fire & Domestic Water Tanks and Pump Room	MV	Exhaust, 5 ACH	2 Exhaust Fans (75% flow for each)	Type 3	See note 1
Wastewater Treatment Plant Equipment Room	MV	OA Supply, Design air flow rate required by the plant	OA Supply Fan	Type 4	See note 1

Abbreviation

A/C	:	Air conditioning
ACH	:	Air change times per hour
DB	:	Dry Bulb
FAN	:	Ventilation Fan
HL	:	Design flow rate shall be calculated based on the heat load.
HRV	:	Heat Recovery Ventilator
MV	:	Mechanical Ventilation
NV	:	Natural Ventilation
RH	:	Relative Humidity
WB	:	Wet Bulb
TYPE 1	:	Thermostat Control of Room Temperature, Continuous Operation based on the station operation hours.
TYPE 2	:	Thermostat Control of Room Temperature, Continuous Operation at 24 hours/day, 7 days/week
TYPE 3	:	Software Timer Control at 24 hours/day, 7 days/week

Notes

Each of two duplex fans/AC Units shall be equipped with minimum 75% of the design air flow rate.
The air pressure balance shall be considered between the independent room and the adjacent spaces.
The makeup conditioned air for the mechanical ventilated areas shall be drawn from the adjacent conditioned areas.

Source: JICA Design Team

The AC design concepts for each room shall include the following:

a) Cooling Load Calculation

Cooling load calculations for the conditioned areas shall be performed as follows:

b) Design Conditions

- Outdoor: 37.7°C dry bulb (DB), 27.7°C wet bulb (WB)
- Indoor:
  Staff Room, Train Operation Room, Station Control Room
  24 °C (DB), 50% RH ±10%
  Equipment Rooms (Signal/Telecom/AFC Room)
  22°C (DB), 50% RH ±10%
- Indoor Air Quality
  For design air flow rates of ventilation and air-conditioned spaces, refer to the above table of the design requirements.

3) Fire Protection

a) Fire protection systems for all the structures in the project shall comply with the requirements of the Revised Fire Code of the Philippines and the Japan Fire Code and Regulations.

b) All the station structures shall be protected by a fire hydrant system, with standby-fire pumps and the hydrant nozzle where water pressure is manually controlled. The pump operation will be remote-controlled at each hydrant push-button in accordance with local Fire Codes and regulations.

c) Electrical rooms and such concerned electrical board rooms not exceeding 500m^2 for the stations structures shall not be provided with Carbon Dioxide Fire Extinguishing System (CO_2) as specified in the Japan Fire Code and Requirement of MLIT-J.

In contrast, those rooms shall be provided with fire separation walls and fire-resistant material control in accordance with local codes and/or the Japan Fire Code and requirement of MLIT-J for purpose of fire prevention and the minimum operation cost.

d) All the interfaced information shall be coordinated with the local Fire Departments and any other concerned authorities.

e) The Fire Protection Provision is shown in Table 4.4.9.

Table 4.4.9 Provision of Fire Protection

Room	Fire Protection Provision		
	Fire Hydrant/ Hose Reel	**Portable Fire Extinguisher**	**Clean Gas extinguishers**
Paid Concourse	Y	Y	
Unpaid Concourse	Y	Y	
Platform	Y	Y	
Staircase-Entrance & Exit	Y	Y	
Staircase-General	Y		
Escalator-Entrance & Exit	Y		
Elevator-Entrance & Exit	Y		
Customer Service 1&2	Y	Y	
AFC Room	Y	Y	
AFC UPS	Y	Y	CO_2 portable Room Fire separation and materials controls
SER Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
SUR Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
Common Equipment Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
Common UPS Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
Station Manager Room	Y	Y	
Staff Room/BMS Room	Y	Y	
First Aid Room	Y	Y	
Staff Toilet (Male & Female)	Y	Y	
Station Store	Y	Y	
Corridor	Y	Y	
Cleaners Room	Y	Y	
WC (Male / Female / the Disabled)	Y	Y	
Railway Electrical Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
Station Electrical Room	Y	Y	CO_2 portable, Room Fire separation and materials controls
Fire Pump / Water Tank / Pump Room	Y	Y	
Refuge Store	Y	Y	

Abbreviation:
Y: Yes
BLANK; No Provision

Source: JICA Design Team

(5) Station Plumbing System

The proposed sanitary/plumbing system shall be as follows:

1) Water distribution system
2) Sanitary drainage and vent system including storm water, wastewater treatment plant
3) Rainwater reuse system

The sanitary plumbing system design shall be undertaken in accordance with the following:

i) National Plumbing Code of the Philippines (NPCP), 2000; and
ii) MLIT-J design guide-book and requirements (Japan).

1) Water Distribution System

The station water supply system shall be designed based on the following:

a) The water storage tank and booster pumping unit shall be supplied for hand washing, toilet flushing and building cleaning etc.
b) The water tank shall have a one-day capacity in according to local authority requirements, and be of prefabricated, above-floor construction with a separation wall for maintenance purposes.
c) The water supply system shall comprise a booster pumping system with variable speed motor pumps.
d) The design flow rate shall be developed in accordance with the fixture unit method. Simultaneous use of fixtures shall be considered according to actual or assumed percentage of use.
e) Equivalent fixture units shall be based on the Philippine Plumbing Code and/or MLIT-J requirements and shall comprise the water saving performance of the installed fixtures and fittings. The number of fixtures in toilets will be based on the passenger demand forecast, as well as on the station layout plan and local building code requirements.
f) The design flow rate and flow pressure shall be based on the Philippine Plumbing Code and/or MLIT-J design guide book.

2) Sanitary Drainage and Vent System

The station sanitary drainage and vent system shall be designed based on the following:

a) The waste water from toilet flushing shall be collected to a waste treatment plant located on the station ground floor in accordance with local authority requirements. The treatment plant shall be compliant with local codes and regulations.
b) Each station shall have an on-site waste-water treatment plant; the treated water shall be the quality shown the following Table 4.4.10.
c) Other waste water will be discharged directly by a gravity drain to the public sewage system, including rail water.

d) The sanitary waste drainage system shall be designed using drainage fixture unit values as given in Philippine Plumbing Code and/or MLIT-J design guide-book.

e) The sanitary waste drainage systems shall be designed with a minimum slope of two percent (2%) for less than or equal to 75 mm diameter pipe, and one percent (1%) for more than or equal to 100 mm diameter pipe, or the slope permitted by the Philippine Code and/or MLIT-J Code.

f) The size of vent system pipe shall be designed in accordance with the Philippine Code and/or MLIT-J design guide-book.

Table 4.4.10 Treated Water Quality

Item	unit	Classification of water bodies (C)
Chemical Oxygen Demand (COD)	mg/L	100
Biochemical Oxygen Demand (BOD)	mg/L	50
SS: Suspended Solids	mg/L	100
T-N	mg/L	14
T-P	mg/L	1
Total CO	MPL/100ml	10,000
Oil and Grease	mg/L	5

Source: the effluent standards of DENR Administrative Order No.2016-08 for Class C Inland Water

3) Rainwater Reuse System

The rainwater is impounded to the reservoir thank using drain collecting devices from 2 downspouts. The reserved drain water is use as the water for people who are unable to return home after disasters. The reservoir tank capacity shall be determined based on the demand forecast of peak hour of each station.

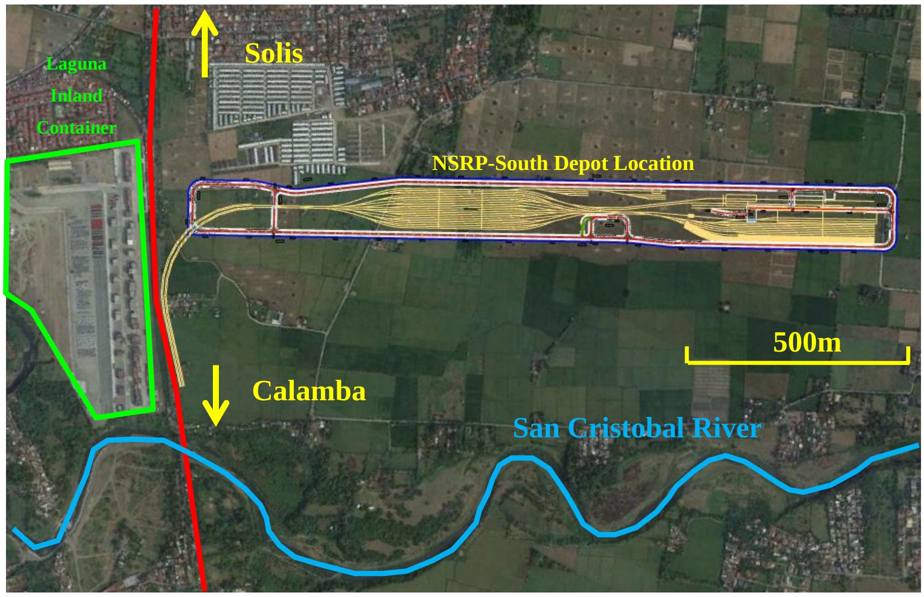
4.5 South Depot

4.5.1 Design Concepts of the Depot

(1) Location of Depot

The depot location of the South Depot is planned to be located in the Banlic Barangay in Laguna, between the NSRP-South Mamatid and Calamba stations, and east of the NSRP-South main line (Source: JICA Design Team

Figure 4.5.1). The total area is around 30 hectares. Additionally, west to the South Depot location the Laguna Inland Container Terminal is located on the opposite side of the NSRP-South main line and Manila South Road is running on the west of that.



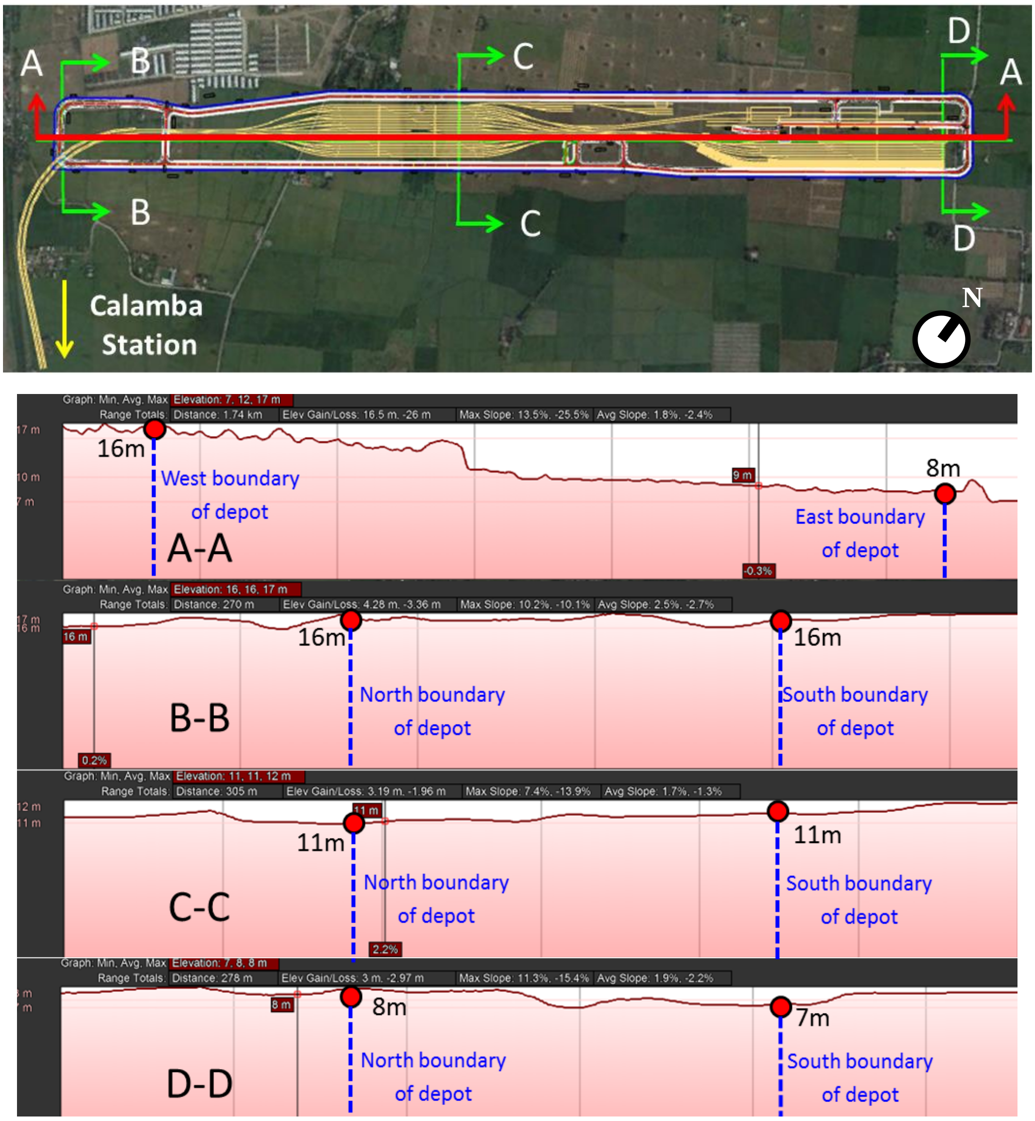
Source: JICA Design Team

Figure 4.5.1 Location of South Depot

(2) Natural Condition of Depot Site

1) Terrain

The topographical conditions of the South Depot site are presented in Figure 4.5.2. The maximum elevation of the terrain is 16 m above the sea level (hereafter refer as a.s.l) on the west edge of the depot (and adjacent to the main line) and the minimum elevation is 8 m a.s.l according to Google Earth data. Although the elevation of the terrain decreases longitudinally by approximately 8 m, the natural slope is gentle and smooth, namely, transverse sections (north-south) of the depot are the same elevation of both as shown in Figure 4.5.2.



Source JICA Design Team

Figure 4.5.2 Longitudinal (west-east) ground elevation and transverse (north-south) ground elevation

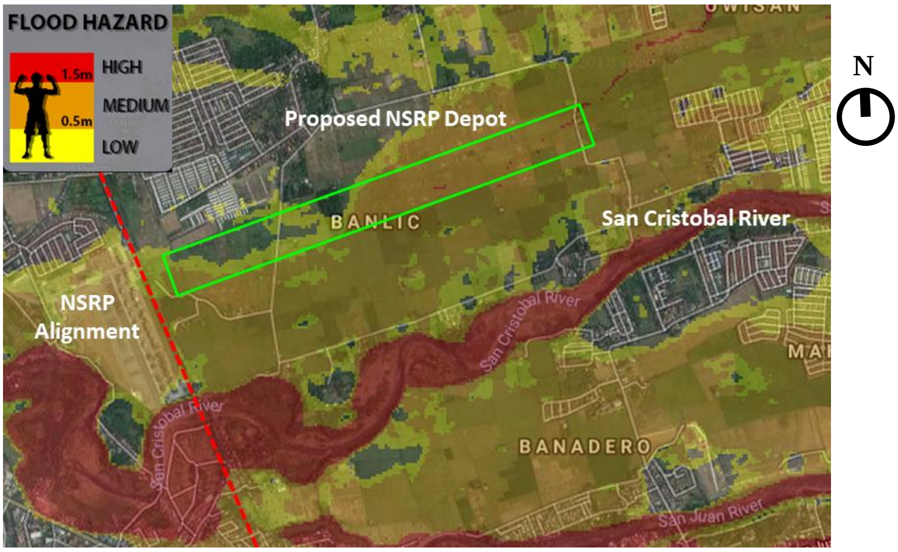
2) Geotechnical Features

A geotechnical soil investigation is under surveying at the South Depot location. After completion of the geotechnical survey, JDT will study the details of the geotechnical features at the South Depot area.

3) Flood risk

The flood risk at the South Depot location is studied using a 100-year return period flood hazard map obtained from the Nationwide Operational Assessment Hazards (NOAH) as shown in Figure 4.5.3.

The flood hazard map indicates that more than 0.5m flooding has been expected to happen and will be overflown from the river channel, especially around PNR San Cristobal Bridge. Additionally, this hazard map also indicates that the east side of the proposed depot site will be affected more than 1.5m depth flood. Based on the flooding information, the height of the depot needs to be determined, and any countermeasure will be considered in the detail design of the depot.



Source JICA Design Team

Figure 4.5.3 NOAH 100-year flood hazard map at South Depot Location

(3) Design Condition of South Depot

1) Facilities in the Depot

The capacity of storing trains and the number of cars per train is in accordance with the result of the study on an operation of NSRP-South. The number of cars per train is 8 and the number of storage track is 32.

The track structure in the depot is Ballasted Track and the required facilities shown below should be placed properly.

a) Train storage tracks
b) Rolling stock maintenance facilities
c) Operation control center (OCC)
d) Catenary and track maintenance shops
e) Sub stations
f) Sewage treatment plant, storm water reservoir, emergency facility
g) Access road inside depot, car parking, light, fence etc.

Table 4.5.1 Required Number of Tracks and Facilities in the South Depot

Item	No. of tracks	Remark
Stabling tracks	33 tracks	
Access track	1 double-track	
Unscheduled repair track	1 track	
Light repair track	3 tracks	For regular inspection at Light Repair Shop
Car washing track. (Automatic)	1 train	
Wheel re-profiling track	1 track	
Track maintenance car track	1 track	
Stabling track for OCS	1 track	

Source JICA Design Team

2) Permissible Deformation of the Railway Track in the Depot

The track of the depot is proposed to be a ballasted track. The permissible deformation of the railway track in the case of liquefaction during an earthquake or consolidation settlement under the depot can be determined in accordance to Table 4.5.2 referring to “Design Standards for Railway Structures and Commentary - Earth Structure” published by Railway Technical Research Institute.

Table 4.5.2 Permissible Deformation of the Railway Track (Ballast Track)

Level of the settlement	Grade 2
Situation of damage	Small
Criterion for ballast track	Normal Embankment; less than 20cm Gap between an abutment or a earth retaining structure and the backfill ; less than 10cm

Source: Design Standards for Railway Structures and Commentary-Earth Structure” (Railway Technical Research Institute)

(4) Depot Track Layout, Buildings and Facilities

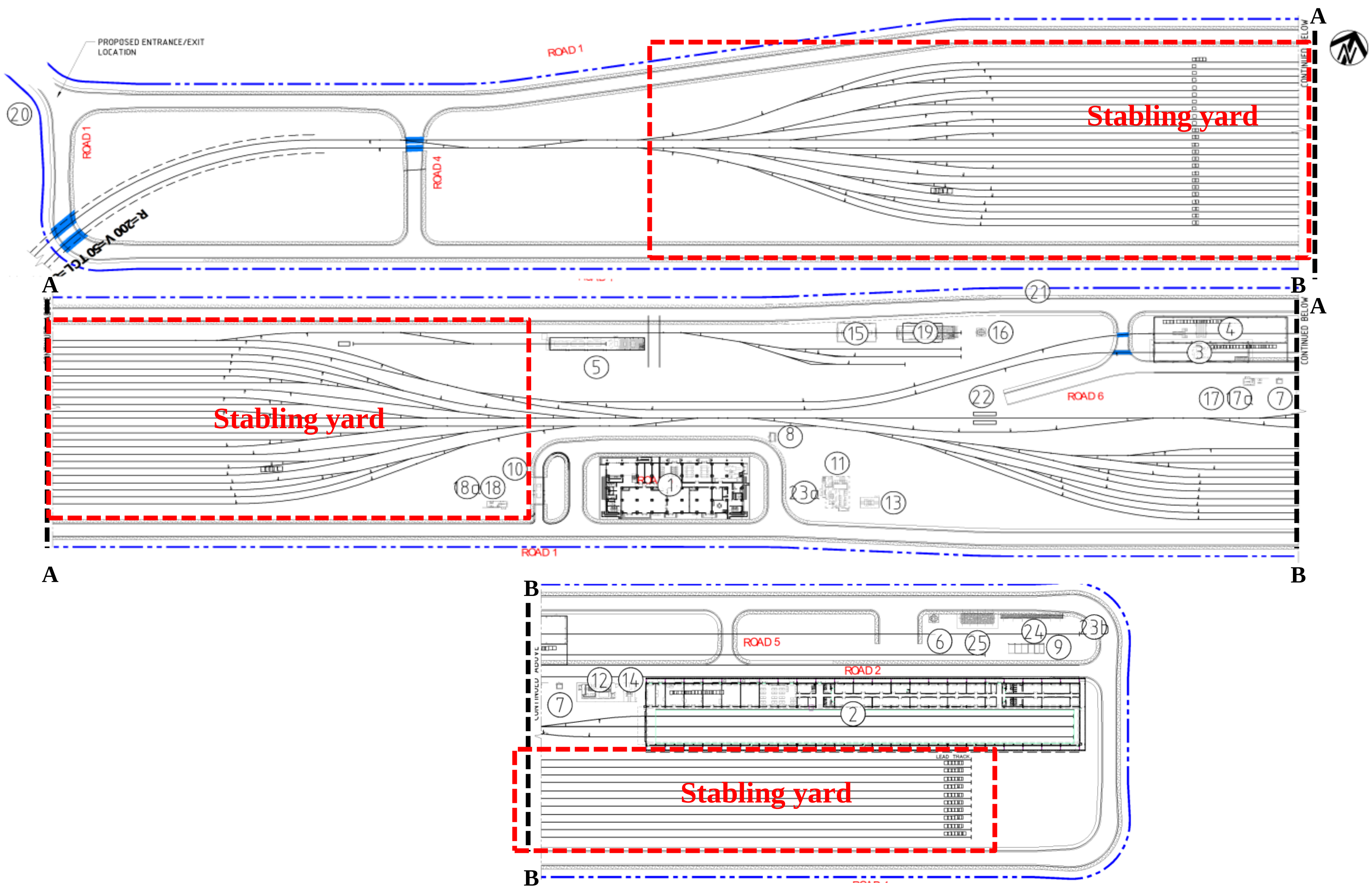
1) Stabling Tracks

The South Depot will be provided with 33 stabling tracks, and the access track to the depot will be a double track to accommodate the incoming and outgoing traffic on separate tracks. The access track will be connected to Calamba station. The stabling track layout is presented in Figure 4.5.4.

As shown in Figure 4.5.5, the South Depot will connect to the south bound and north bound tracks of the main line the following manner:

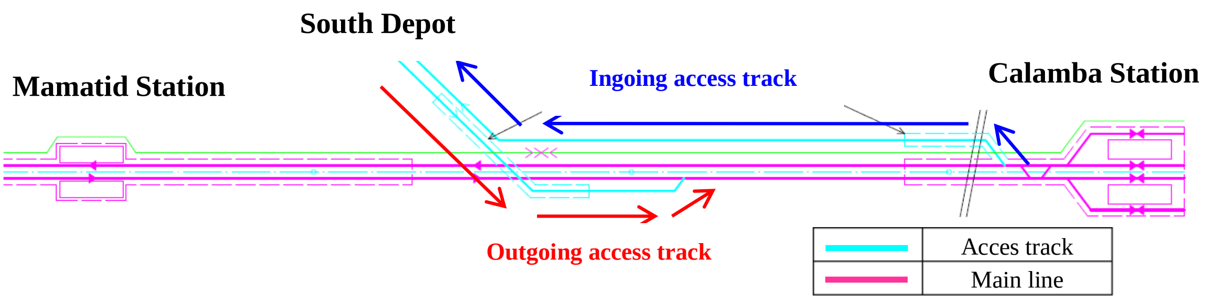
The incoming train will detach of the north bound main track and access to the depot, transitioning from viaduct to at-grade alignment.

The outgoing trains from the South Depot will first cross the main line (both north and south bound) and merge with the south bound main track.



Source: JICA Design Team

Figure 4.5.4 Layout of the South Depot Stabling Tracks



Source JICA Design Team

Figure 4.5.5 South Depot Access Tracks

2) Buildings and Facilities

The buildings and the railway system facilities necessary for the maintenance and operation of the depot are shown Table 4.5.3 and the location of the facilities are shown in Figure 4.5.4.

Details of the buildings and contained E&M facilities in the buildings are described in a separate section.

Table 4.5.3 Facilities and Building necessary in the South Depot

List of Building and Facility (No. of building and Facilities are shown in Figure 4.5.4)	
1 . OCC BUILDING	16. FUEL PUMP AND TANK FOR MAINTENANCE
2 . LIGHT REPAIR SHOP	17. FIRE WATER TANK
3 . UNSCHEDULED REPAIR SHOP	18. SUPPLY AND FIRE WATER TANK
4 . WHEEL RE-PROFILING SHOP	19. TRACK MAINTENANCE OFFICE
5 . CATENARY MAINTENANCE VEHICLE SHOP	20. SECURITY HOUSE 1
6 . FUEL PUMP HOUSE 1	21. SECURITY HOUSE 2
7 . OIL STORAGE FOR LIGHT REPAIR SHOP	22. CAR WASHING TRACK
8 . HAZARDOUS STORE	23. CAR PARKING (UNCOVERED)
9 . GARBAGE SHED FOR LIGHT REPAIR SHOP	24. BICYCLE PARKING SHED
10. TRUCK GARAGE	25. MOTORCYCLE SHED
11. SUBSTATION 1	26. DETENTION BASIN 1
13. DISTRIBUTION BOARD SPACE 1	27. DETENTION BASIN 2
15. MAINTENANCE CAR SHOP	

Source: JICA Design Team

3) Internal Roads

The internal roads in the depot are designed in consideration of the width necessary for the transportation of the train cars or large size equipment and accessibility between buildings and facilities within the depot. The periphery 2-lane depot road will be arranged to transport new railway vehicles, rail, ballast, and equipment for the shops. Also some internal roads will be arranged to connect the buildings or facilities with other buildings, facilities or car parks inside the depot.

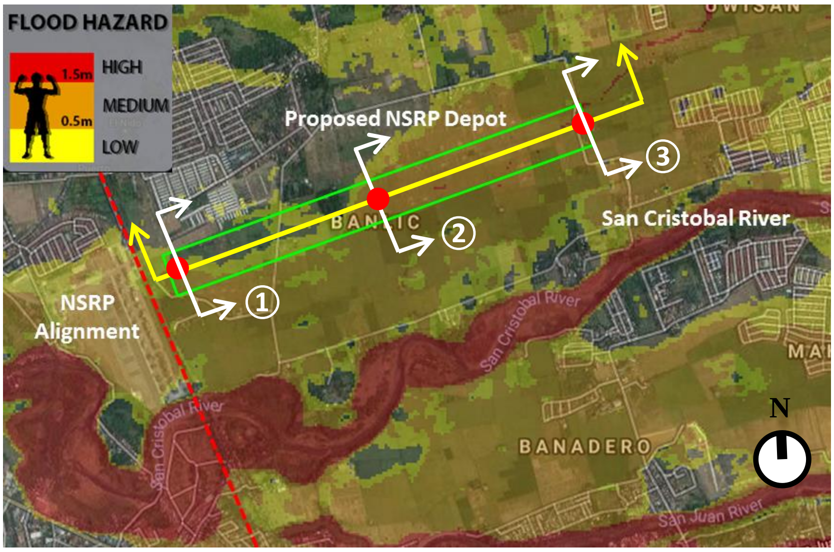
The internal roads are basically designed in accordance with the standard specified by DPWH; the width of the peripheral depot road is 3.35 m (total width is 0.5+3.35+3.35+0.5=7.7m), the width of the other internal roads is 5.0 m (1lane) to 7.7 m (2 lane). In addition, some corner of the periphery depot road is widened to enable the trailer transporting new train car to path the corner by the running path analysis. Also, 1 m to 2 m width footpath arranged beside the internal roads within an area which does not affect the usage of buildings or facilities in the depot.

(5) Civil Structure of Depot

1) Height of Depot

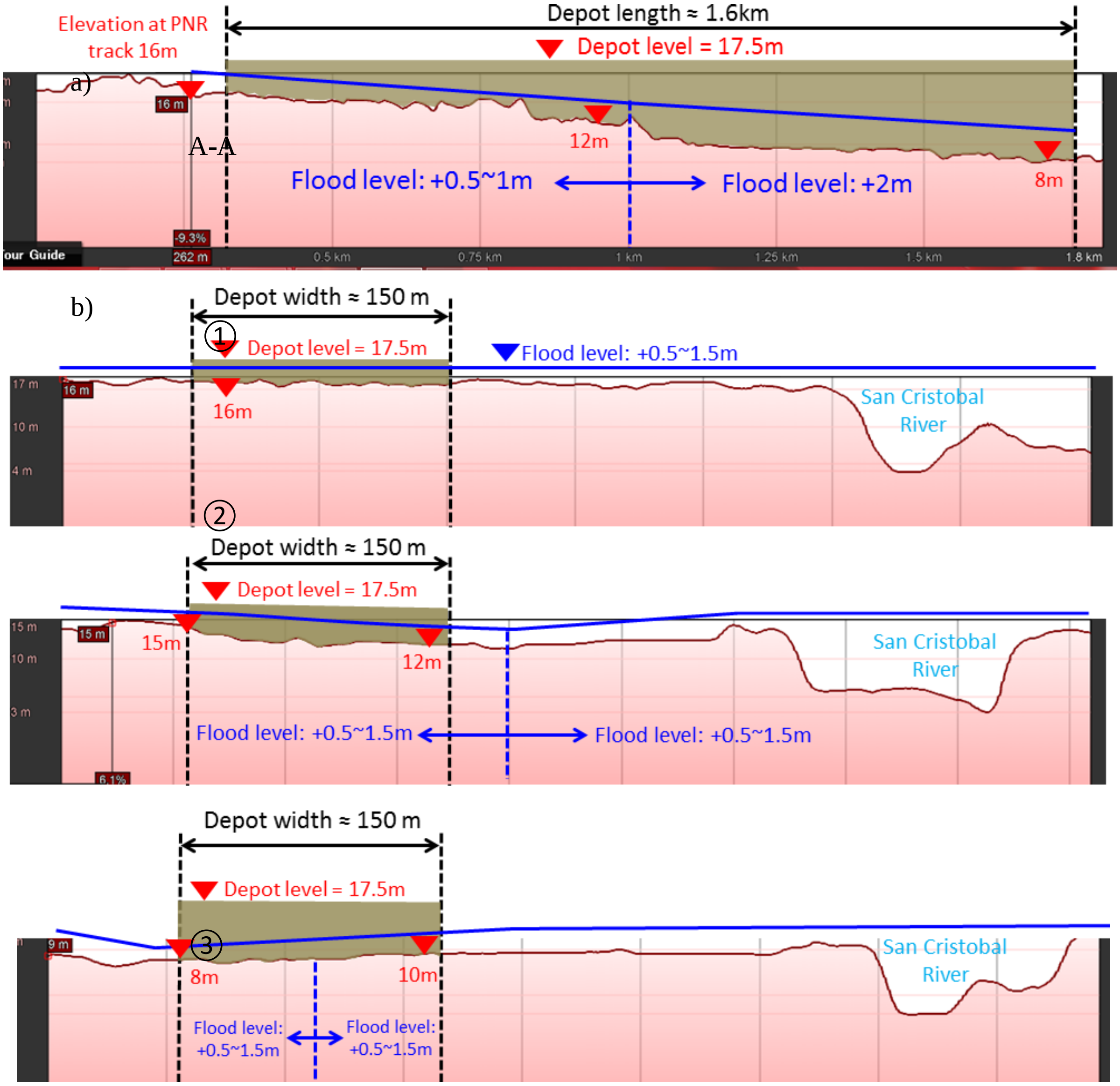
The height of the depot is determined based on the ground elevation and the highest predicted flood level around the depot. Figure 4.5.6 and Figure 4.5.7 show the 100-year NOAH flood hazard map and flooding level, respectively. Considering the highest predicted flood level in a 100-year return period and the topographical characteristics of the terrain at the depot location, an elevation for the South Depot of 17.5m a.s.l is proposed.

In order to level the terrain to the determined elevation of 17.5m a.s.l, the South Depot is proposed to be constructed on an embankment. Given the large difference in height (8m) between the west and east of the depot edges, and considering the highest predicted flood level, the east perimeter of the depot will be a 10 m high embankment. On the other hand, the difference in height between the north and south of the depot is not as large, only 3 m at the largest height difference, the height of the depot will vary between 1.5 m to 3m.



Source JICA Design Team

Figure 4.5.6 100-year flood hazard map



Source JICA Design Team

Figure 4.5.7 South Depot Site, (a) longitudinal (west-east) cross section, (b) transversal (north-south) cross section

2) Settlement of Depot embankment

Based on the soil investigation and laboratory test results, a settlement and liquefaction assessment has to be determined. If required, adequate counter measures to reduce any adverse impact to the depot structures will be designed. Due to the large embankment needed as the supporting structure in the South Depot and the soil conditions of the area, it is expected that soil improvement will be needed at the depot site. Among the commonly used soil improvement methods available in the Philippines, adequate to implement if required are cement-soil mix soil improvement method and piling. A detailed analysis and assessment will be conducted once the geotechnical parameters are available.

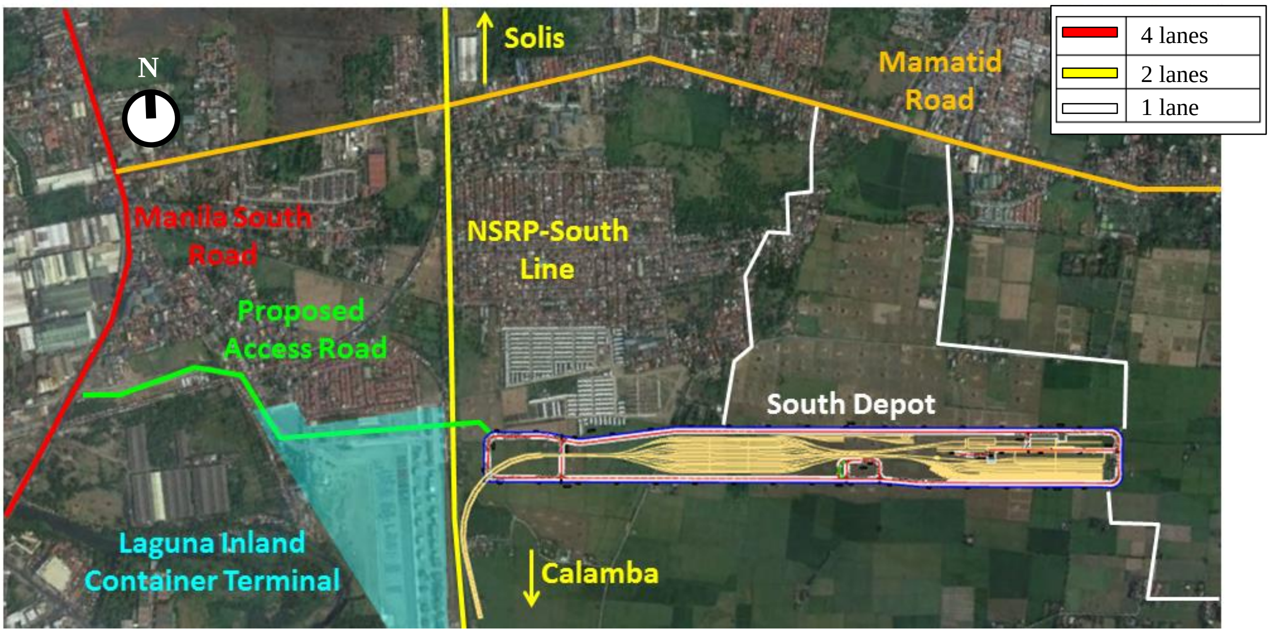
3) Depot Access Roads

The main road to access the depot shall be planned considering convenient accessibility for employees, visitors, transportation of equipment such as new train car, ballast, sleeper, rail etc. during the operation of the depot. Additionally, it is also crucial to secure convenient and efficient roads that will allow access during construction.

Currently, around the depot area, there are several major roads that could potentially feed the permanent depot access roads for operation of the NSCR-South line and in it can also be used for the construction works. However, there are no existing public adequate roads that can be used for the depot access road that can bear the load and volume of the traffic. Additionally, expanding the existing roads would be difficult since it is heavily urbanized along the roads.

From the point of view of efficiency and distance to major roads, it is proposed to utilize Manila South Road as the main feeder to the depot access road. Furthermore, given the near location of the Laguna Inland Container Terminal, it is proposed to use the existing access road to the container terminal as the access road of the depot after extending to further connect to the South Depot. This access road can function as the main entrance to the South Depot, since it has enough horizontal clearance for the transportation of heavy machinery and equipment, as well due to its convenient location close to Manila South Road.

Additionally, some of the existing roads connecting Mamatid Road with the existing farming fields to the depot can serve as emergency routes in case the main access is damaged or disrupted, as well as it can serve as an alternative route for the access of the employees of the depot.



Source: JICA Design Team

Figure 4.5.8 Proposed Access Roads to the South Depot along Manila South Road and Mamatid Road

4) Drainage System

The drainage system in the depot include the storage track yard shall be designed properly.

The perimeter drainage is also installed along the periphery of the depot between the retaining wall and boundary to prevent that the rainwater fallen outside of the depot will not flow into the depot. Details of the drainage system are described in Section 4.5.6.

5) Other Facilities

Other facilities such as the entrance, guard house, lighting system, fence, etc. shall be located and designed properly. Details of the fence and the gate are described in Section 4.5.7.

4.5.2 Design of the Depot Buildings

The Depot is expected to be the hub of the entire railway system and service. Being central to railway system as well as containing the Operations Control Center and administrative offices, the Depot is expected to be the repository of all key technologies for the system i.e. rail system, rolling stock, O&M operations, and the like. As such, it must be maintained as a highly secure area that must be safe even if external threats are present at the host site but it must never pose a danger to the host community.

(1) Design Policy and Concepts in the Depot Buildings Design

Design policy of the Depot buildings are as follows:

1) Design policy

The implemented design standards for the design of the station buildings are mostly Philippine standards. However, in certain instances where the local standards are limited or does not consider some relevant aspects of the design, the design follows Japanese standards.

Table 4.5.4 Building Design Standard

Subject	Philippine Laws/ Standards	Japanese Standards
Urban Planning and Environment	• RA7279 - urban development & housing act of 1992 • P.D.s and IRRs (as applicable) e.g. 1586 – environmental impact statement system; 1216 – open spaces; 1151 – environmental policy; 1152 – environmental code; 1067-water code; 957 – subdivisions & condominiums; 953 – tree-planting; 856 – sanitation code; 757 – national housing authority; 296 – clear waterways; • duly-approved local government unit (LGU) Zoning Ordinance (ZO, with official zoning map/ OZM) i.e. based on the duly-approved Comprehensive Land Use Plan (CLUP) • special development-related LGU ordinances, as applicable • environmental laws and regulations e.g. clean air (RA8749), clean water (RA9275), solid waste management (RA9003), toxic waste (RA6969), climate change adaptation (RA9729), disaster risk reduction & management (RA10121), environmental impact assessment, heritage conservation (RA10066); indigenous peoples (RA8371), environmental planning (RA10587), resettlement & socialized housing (BP220), department of environment & natural resources (DENR) department administrative orders (DAOs), • Housing and Land Use Regulatory Board (HLURB) issuances e.g. guidebooks, guidelines, standards, manuals, etc. • Department of public works & highways (DPWH) Design Guidelines, Criteria & Standards (DGCS) Vol. 6 Public Buildings & Other Related Structures 2015 • Department of transportation (DOTr) transportation planning studies	N/A
Building and Space Planning / Barrier-Free Design	• PD1096 - National Building Code of the Philippines (NBCP), its 2004 Revised Implementing Rules and Regulations (IRR) and derivative regulations (DRs), including DPWH issuances such as DAOs and Memorandum Circulars (MCs) • Referral Codes of the NBCP (both laws and self-regulatory documents) such as BP344 - Accessibility Law; the Philippine Electrical Code (PEC), the Mechanical Code, the National Philippine Electrical Code Plumbing Code of the Philippines, DPWH 2000 architectural code of the Philippines (ACP, as applicable) and the like • DPWH DGCS Vol. 6 Public Buildings & Other Related Structures 2015 • DPWH-promulgated 2015 Philippine Green Building Code (PGBC) • Department of Energy (DoE) Guidelines on Energy Conserving Design on Buildings, 2008 • RA6716 - rainwater collection • 2016 NBCP: Illustrated data compact disc (CD)applicable standards by other infrastructure agencies such as the Department of Transportation (DoTr) • applicable DoTr standards • RA386, the 1949 New Civil Code of the Philippines • BP 344 - Accessibility Law and its IRR • RA7277, The Magna Carta for Disabled Persons	• The Building Standard Law of Japan. • Ordinance of the Building Standard Law of Japan • Guideline to Improve Barrier Free Access for Public Transport Passenger Facilities for the Enforcement of 2006 LAW N.19. Edited by Ministerial Ordinance MLITT of Japan

Subject	Philippine Laws/ Standards	Japanese Standards
Fire Protection and Safety Evacuation Design	• PD1096 - National Building Code of the Philippines (NBCP) & 2004 Revised IRR • RA 9514 - Fire Code of the Philippines (FCP) and IRR of 2008 • Philippine Mechanical Engineering Code • Philippine Electrical Code • DPWH DGCS Vol. 6 Public Buildings & Other Related Structures 2015 • Illustrated FCP	• The Building Standard Law of Japan (Ministerial Ordinance, MLITT of Japan) • The Fire Laws of Japan (The Fire Defense Agency of Japan)
Building Material	• 2013 DPWH Standard Specifications • PD1096 - National Building Code of the Philippines (NBCP) & its 2004 Revised IRR • DPWH Bureau of Research & Standards (BRS) certification, if applicable • Dept. of Trade & Industry (DTI) Bureau of Product Standards (BPS) product certification, if applicable • National Structural Code of the Philippines (NSCP) 2015	• Japanese Industrial Standards (JIS)

Source: JICA Design Team

2) Sustainable design (Environment protection, natural energy) ;

a) Environmental load-reducing and attention to circumference environment;

The depot must never become an environmental nuisance to the host community at any time during its entire design life.

b) Natural energy (Solar panel system);

Design for roof-mounted solar panels where feasible on the OCC building if it will be necessary in the future.

3) Design for the Philippine climate and culture.

a) Seismic design;

Refer to the 4.5.4 Structure Design for the Depot Buildings.

b) Thermal insulation;

Design for the Tropics (the hot-humid Philippine climate)
Solar and prevailing (and storm) wind orientations of the Depot building;

c) Easy maintenance;

Use simple form and smooth materials.

d) Security;

Safety, security and privacy will be considered in the design.
Security camera are arbitrarily installed in the building.

(2) Design Specifications of Depot Buildings

1) Building/ Structure Types

The Depot buildings to be built above grade are as follows:

- Operation control center (OCC) building;
- Light repair shop;
- Unscheduled repair shop;
- Wheel re-profiling shop;
- Catenary maintenance vehicle shop;
- Shunting car shop;
- Fuel pump house;
- Oil storage for light repair shop;
- Hazardous store;
- Garbage shed for light repair shop;
- Truck garage;
- Substation 1;
- Distribution board space 1;
- Maintenance car shop;
- Water pump house 1;
- Track maintenance office;
- Security house 1;
- Security house 2;
- Bicycle parking shed;
- Motorbike parking shed

4.5.3 Architectural Design for the Depot Buildings

(1) Building Design

Building design of Depot are as follows:

1) Most of the Depot buildings shall be at 1 level, but roof height will be very high due to building usage;
2) The vertical access system shall consist of an array of stairs, elevators (only as absolutely needed) and ramps;
3) The height of the Depot building is in relation to adjacent/ neighboring buildings/ structures, which affect shadows cast and wind speed/ air movement for ventilation purposes;
4) Natural ventilator and high side light are applied for saving energy.

1) Plan of Buildings

Plans of the Depot buildings are as follows:

a) The Column put in equally intervals span make contribute for structural performance and economic efficiency.
b) Area of room is accounted by demands of functions and needed personnel numbers.
c) Efficient pipe plan and avoidance of leaking water under rooms by concentrating the area using water and aligning the vertical position is
d) Hall way is simply short for daily operations and escape in emergency.

2) Elevation

Elevation planning of the Depot buildings are as follows:

a) Depot buildings is unified design image by adopting integrated exterior wall finishes of building.
b) It is harmonious for landscape to adopt soft colors on exterior materials with simple design.
c) Windows and louver of buildings are designed by considering function and operations.
d) The size of doors is designed by referring to demands of E/M system team.

3) Section

Section planning of the Depot buildings are as follows:

a) Height of ceiling is basically 2.7m but be arbitrarily modified by considering condition.
b) The room high ceiling is put on upper floor of the building for considering structural stability.

(2) Finishing Materials

Finishing materials of the Depot buildings are as follows:

1) Exterior Finishing

a) Wall: exterior cladding of insulated aluminum composite panel on painted steel frames;
b) Roof: built up steel supports; pre-painted metal roof with injected insulation; provide roof-mounted solar panels where feasible if it will be necessary in the future.

2) Interior Finishing

a) Floor: polished concrete flooring or epoxy-painted concrete flooring (where required);
b) Wall: interior walls shall be of concrete hollow block (CHB) construction and gypsum board;
c) Ceiling: exposed roof insulation.

4.5.4 Structure Design for the Depot Buildings

(1) Structural Materials

Major structural materials to be used in the Project conform to ASTM (American Society of Testing and Materials) or JIS (Japanese Industrial Standard) as follows:

- Concrete: Normal concrete with the design standard strength f'c = 31 MPa (to be applied to other than the below)
  Normal concrete with the design standard strength f'c = 36 MPa (to be applied to the in-situ concrete bored piles)

- Reinforcing Bars: Deformed bars

D10, D12 (or D13)	ASTM A615 Grade 40, or JIS G 3112 SD295A
D16 and more	ASTM A615 Grade 60, or JIS G 3112 SD390

- Structural Steel: ASTM A36 "Carbon Structural Steel", or
  JIS G 3101 SS400 "Rolled Steel for General Structure"

(2) Structural Basic Design

The primary function of the Depot is the maintenance and inspection of the rolling stocks and the associated infrastructure in the Project, which will be of an industrial nature. Among these series of the buildings, the Light Repair Shop (hereinafter referred to as LRS) is the main building. In addition to those, the Operations Control Center (OCC) Building is planned within the Depot.

1) Light Repair Shop

a) The salient structural features of the superstructures of the LRS

The salient structural features of the superstructures of the LRS include the followings:

i) Steel roof and wall cladding on the cold formed purlins and girts are provided on the structural steel beams and columns;

ii) The lateral resistance against earthquake or strong wind in the transverse direction is via portal action, assuming semi-fixed supports consisting of anchor bolts and steel base plates for the portal columns.
Through the provision of the horizontal roof braces, the longitudinal lateral loads caused by earthquake or strong wind are transferred to the vertical wall bracing, which then transfer the lateral load down to the foundation level;

iii) To eliminate the adverse effects on the structures due to temperature fluctuation, and to remove accumulation of erection errors, two expansion joints are introduced in the longitudinal directions of the building, which make each building component less than 100 meters in length; and

iv) Considering the roof huts for natural ventilation installed on the main roof are structures that are set on the long span beams, they are planned to be of lightweight structures with high safety.

b) The slab and foundation structures on the ground floor of the LRS

The slabs and foundation structures on the ground floor of the LRS include the followings:

i) Concrete slabs on the ground floor are planned to have suitable abrasion resistance against vehicular and forklift wheel loads;

ii) As the floor is planned as suspended structural slabs, no expansion joints are introduced on the ground floor. However, since the concrete casting area is so large, it is envisioned that the ground floor will be cast in a number of sections separated by the construction joints. Typically, the contractor will propose the location and details of the construction joints based on their batching volume capacity and their ability to manage the curing requirements as per the specification. The proposed construction joints shall be detailed so as to mitigate any potential issues due to the concrete contraction between the adjacent concrete casting sections;

iii) One large floor pit is planned to maintain the rolling stocks on the ground floor. Due wastewater is generated in the pit along with the inspection and the cleaning work of the rolling stocks. The amount of the wastewater and the drainage gradient may vary depending on the maintenance machinery actually employed. In order to minimize any undesirable effects to the primary structures, no foundation beams in the transverse direction are installed to the areas where the floor pit is planned. Any column supported directly by the pile cap without employing foundation beams are planned to have a pair of piles, regardless of the axial force of the column, in order to resist the bending moment transmitted from the column base through tension/compression pile couple forces;

iv) To minimize undesirable effects of noises and vibrations caused by the piling work to the neighborhood, cast-in-place concrete bored piles are planned, which generate minimal noises and vibrations compared to other piling methods, such as driven precast concrete piles. The pile tips are to penetrate a minimum of 1.0 x pile diameters into the supporting soil strata with N-values of over 50. Where the supporting strata appears near the ground surface and the slenderness ratio of the piles becomes consequently less than 5.0, such piles may be increased in length to penetrate into the supporting strata by more than 1.0 x pile diameters to attain the adequate pile slenderness ratio; and

v) A rigid foundation structure (building structure support foundations and track support foundations are integral) has the following benefits over a non-rigid foundation structure (building structure support foundations and track support foundations are independent):
   - Increased resistance to seismic loading due to mobilization of a greater number of piles compared to a non-rigid foundation structure;
   - Reduced likelihood of differential settlement occurring with an integral foundation structure. In a non-rigid foundation, the foundation elements supporting the tracks and the elements supporting the building structure are independent, thus if one area of the

LRS is founded on a poorer material then an adjacent area, differential settlement is likely to occur.

c) The structural analysis and safety assurance of the LRS

The outline of the structural analysis and the safety assurance of the LRS are as follows:

i) The structural analysis for the LRS is carried out by an elastic analysis as the three-dimensional frames including the foundation beams;

ii) The structural analysis is carried out in consideration of the loads prescribed in the NSCP as follows;

- Dead loads
- Live loads
- Wind loads
- Earthquake loads
- Soil lateral loads including lateral water pressure (applicable to the sub-grade structures)
- Self-straining forces arising from temperature fluctuation.

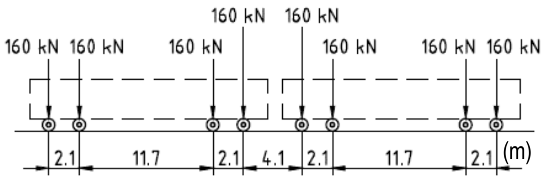
iii) As the NSCP does not prescribe live loads representing the weight of forklifts or rolling stocks moving about in the building, the live load on the ground floor of the LRS is evaluated considering the wheel pressures and the impact factors caused by forklifts and rolling stocks as follows;

Live loads applying to:

- Floor slabs and secondary foundation beams: 20 kPa
- Primary foundation beams, columns and foundations: 18 kPa
- Evaluation of earthquake weight: 13 kPa

iv) Point loads due to train wheel loading are as follows;

- Axle loads (160kN) with axle spacing are as shown below;
- Maximum number of successive cars = 10 car units



v) The seismic base shear coefficients and the parameters adopted to determine the coefficients are as shown in the Table 4.5.5;

Table 4.5.5 Evaluation of Base Shear Coefficient at the LRS

Building		LRS	
Direction		Longitudinal	Transverse
Seismic Zone		Zone 4	
Seismic Zone Factor	**Z**	0.4	
Soil Profile Type		To be determined based on the results of the geological survey	
Seismic Coefficients	**Ca**	0.32Na ~ 0.44Na, depending on the Soil Profile Type	
	Cv	0.32Nv ~ 0.96Nv, depending on the Soil Profile Type	
Maximum Moment Magnitude		A (8.4≥ M ≥ 7.0)	
Closest Distance to known Seismic Source	**D**	D ≦ 2.0 km	
Near-Source Factor	**Na**	1.5	
	Nv	2.0	
Evaluation Method of Base Shear Coefficient		Static	
Importance Factor*1		1.0	
Structure Material		Steel structure	
Basic Seismic-Force Resisting System *2		SCBF	SMRF
R Factor		6.0	8.0
Building Height above Ground (m)	**hn**	9.37	
Fundamental Period of Vibration (Sec.)	**T**	0.26	0.46
Base Shear Coefficient *3	**C**	0.20 ~ 0.28	0.15 ~ 0.21

*1 Specified based on NSCP, which may differ from those specified by Japanese codes.
*2 SCBF: Special Concentrically Braced Frame
SMRF: Special Moment-Resisting Frame
*3 "Base shear coefficient" varies depending on the Soil Profile Type.

Source: JICA Design Team

vi) The safety assurance of the structural members is carried out by the "Load and Resistance Factor Design" (LRFD) method in accordance with the NSCP.

d) Typical Cross Section of the Structural Members

The cross-sectional dimensions of structural members representing the LRS are shown in the Table 4.5.6;

Table 4.5.6 Typical Section Dimensions for Structural Members at LRS

Structural Members	LRS
Primary Columns	W27x161 W24x117
Primary Beams (Transverse Direction)	W24x146 W24x117
Primary Beams (Longitudinal Direction)	W14x68
Secondary Beams	W14x53 W12x35 W10x30
Steel Mullions	W16x67 W8x35
Vertical Braces （Longitudinal Direction）	2L3-1/2x3-1/2x7/16 L3x3x3/8
Roof Braces	L3x3x1/4

Source: JICA Design Team

2) OCC Building

a) The salient structural features of the OCC Building

The salient structural features of the OCC building include the followings:

i) The OCC Building consists of in-situ reinforced concrete moment frames supporting reinforced concrete slabs with non-load bearing exterior and interior concrete hollow block walls;

ii) Regardless of the above, the roof beams with a span of larger than 10m over the OCC Room are planned to be made of steel;

iii) Same as the LRS, cast-in-place concrete bored piles are planned to support the OCC Building;

iv) The floors on the ground floor are planned to be reinforced concrete slabs supported by foundation beams in both the longitudinal and transverse directions;

v) The external walls and the internal walls that need fire resistance are made of hollow concrete blocks;

vi) A basement floor is planned to secure the adequate room for piping of the building facilities under the entire ground floor; and

vii) To cater for the large number of services and utilities within the OCC building, critical areas such as the OCC Room shall have a sunken floor to cater for 'false' flooring and/or topping slab requirements. To ensure the Finished Floor Level (FFL) is consistent across the entire floor area, the structural beams and slabs shall be lowered accordingly.

b) The structural analysis and the safety assurance of the OCC Building

The outline of the structural analysis and the safety assurance of the OCC building are as follows:

i) The structural stress analysis for the OCC building is carried out by an elastic analysis as the three-dimensional frames including the foundation beams;

ii) The structural analysis is carried out in consideration of the loads prescribed in the NSCP as follows;

- Dead loads
- Live loads
- Wind loads (applicable to the roof steel structures)
- Earthquake loads
- Soil lateral loads including water lateral pressures (applicable to the sub-grade structures).

iii) The seismic base shear coefficients and the parameters adopted to determine the coefficients are as shown in the Table 4.5.7;

Table 4.5.7 Evaluation of Base Shear Coefficients at the OCC Building

Building		OCC Building
Direction		Both Directions
Seismic Zone		Zone 4
Seismic Zone Factor	**Z**	0.4
Soil Profile Type		To be determined based on the results of the geological survey
Seismic Coefficients	**Ca**	0.32Na ~ 0.44Na, depending on the Soil Profile Type
	Cv	0.32Nv ~ 0.96Nv, depending on the Soil Profile Type
Maximum Moment Magnitude		A (8.4 ≥ M ≥ 7.0)
Closest Distance to known Seismic Source	**D**	D ≦ 2.0 km
Near-Source Factor	**Na**	1.5
	Nv	2.0
Evaluation Method of Base Shear Coefficient		Static
Importance Factor*1		1.0
Structure Material		Reinforced Concrete Structure
Basic Seismic-Force Resisting System		Special reinforced concrete moment frames
R Factor		8.5
Building Height above Ground (m)	**hn**	23.1
Fundamental Period of Vibration (Sec.)	**T**	0.77
Base Shear Coefficient *2	**C**	0.10 ～ 0.19

*1 Specified based on NSCP, which may differ from those specified in Japanese codes.
*2 "Base shear coefficient" varies depending on the Soil Profile Type.

Source: JICA Design Team

iv) The safety assurance of the structural members is carried out by the "Load and Resistance Factor Design" (LRFD) method in accordance with the NSCP.

c) Typical Cross Section of the Structural Members

The cross-sectional dimensions of structural members representing the OCC building are shown in the Table 4.5.8;

Table 4.5.8 Typical Section Dimensions for Structural Members at OCC Building

Structural Members	Floor	Cross Sections (mm)	
Primary Columns	4th, 5th Floor 2nd, 3rd Floor B1, Ground Floor	B x H = 900x 900 1050x1050 1100x1100	
Primary Beams		Longitudinal Dir.	Primary Beams
	Roof 5th Floor 4th Floor 3rd Floor 2nd floor	B x D = 500x800 600x800 600x900 600x900 650x1000	600x850 600x850 700x950 800x1000 900x1100
	Ground Floor	650x1000, 650x1000～1400	
Foundation Beams	Basement Floor	B x D =1000x2000, 650x2000	
Secondary Beams	Roof to 2nd Floor Ground Floor	B x D = 400x800 350x600 B x D = 500x100	
Floor Slabs	Roof to 2nd Floor Ground Floor	t = 150 200	

Source: JICA Design Team

4.5.5 Electrical and mechanical Design for the Depot Buildings

(1) General Design Principles

This section presents the basic design criteria and standards established for the mechanical and electrical systems of the Train Depot facilities within the design scope of the Building Mechanical and Electrical Systems (hereinafter referred to as “Building M&E Systems”).

The mechanical systems include ventilation and air-conditioning, plumbing, water supply and fire protection, and pumping system. The mechanical elements include piping, valves, pumps, ducts, sprinklers, fittings and other mechanical devices.

The electrical systems, on the other hand, include lighting, power supply and emergency power system. The systems also include low voltage power distribution, lightning and utility distribution piping for Train Depot Equipment. The electrical elements consist of wirings, circuit breakers, receptacles, lighting fixtures, and other electrical devices.

The Train Depot area will be developed to accommodate several buildings necessary for the upkeep and continuous usage of the trains during the revenue service.

(2) Design specifications

1) Design Codes, Standards and Criteria

The development of Basic Design of the Building Mechanical and Electrical Systems was based on the approved local codes, standards and design guidelines usually applied to similar and related infrastructure projects in the country and other applicable international manuals as recommended by various concerned government agencies.

2) Electrical System

The electrical systems proposed for the Depot area / facility, which include lighting, power supply and emergency power supply were designed based on the following approved local codes, standards and guidelines and other applicable and acceptable international manuals. And also follow MLIT-J Design Code Standard Guideline, such as:

(a) Low Voltage Power Distribution System・Lighting・Receptacle・Lightning Protection System
- a) Philippine Electrical Code, Parts I & II
- b) National Building Code of the Philippines
- c) Institute of Electrical and Electronics Engineers, Inc. (IEEE)
- d) Occupational Safety and Health Administration (OSHA)

(b) Fire Detection and Alarm System
- a) Philippine Electrical Code, Parts I & II
- b) Revised Fire Code of the Philippines
- c) Institute of Electrical and Electronics Engineers, Inc. (IEEE)

d) Occupational Safety and Health Administration (OSHA)

e) Fire Code of Japan

3) Mechanical System

(a) Ventilation and Air-Conditioning System

a) Philippine Mechanical Engineering Code

b) National Building Code of the Philippines

c) The society of Heating, Air-conditioning and Sanitary Engineers of Japan standard. (HASS)

(b) Plumbing

a) Revised National Plumbing Code of the Philippines

b) Philippine Mechanical Engineering Code

c) National Building Code of the Philippines

d) The society of Heating, Air-conditioning and Sanitary Engineers of Japan standard. (HASS)

(c) Fire Protection System

a) Philippine Mechanical Engineering Code

b) National Building Code of the Philippines

c) Revised Fire Code of the Philippines

d) FM Global Standards

e) Fire Code of Japan

(d) Water Supply Distribution and Pumping System

a) Local Water Utilities Administration Standards

b) Manila Water Services Incorporated (MWCI) Standards

c) Philippine Mechanical Engineering Code

d) National Building Code of the Philippines

(3) Electrical Design for the Depot Buildings

1) Low Voltage Power Distribution System

The system will be provided to provide low voltage power for lighting system, receptacle system and the building M&E equipment. Low voltage power will be distributed from the Power Sub-Station to each building distribution panel for power and lighting requirements of each floor of the building, and to the motor control panel to supply power for electric motor driven equipment such as elevators, pumps, power tools and other electrical devices.

Power supply for important building electrical equipment and vital operational load relating the Railway System will be distributed as essential power supply connected with emergency generator.

The Photovoltaic system also secures PV panel installation space and piping route.

a) Low Voltage Feeder Lines

Low voltage feeder line, which extends from main low voltage distribution board in the electric room to the building distribution panels will be of 3 phase, 4 wire, 380 / 220V, 60 Hz. Feeder cables will be laid on cable tray/ladder and connected to each of the building distribution panels for lighting and power requirements of the building and of mechanical equipment in the facility.

b) Power Distribution for Mechanical Equipment

Low voltage power separately circuited from Local distribution panel for mechanical equipment will be 3 phase, 3wire, 380 V, 60 Hz. Earth leakage circuit breaker will be provided to protect the circuit of the mechanical equipment installed outside the building and/or under high humid conditions.

c) Grounding system

Grounding system shall be designed based on equipotential grounding method. Equipotential ground system will be employed to control the electric potential difference between the equipment. Equipotential grounding terminal bar will be provided for the connection of the Railway System.

2) Interior Lighting System

a) Interior Lighting Fixtures

Types of the interior lighting fittings will be selected in consideration of architectural constrains and according to the usage conditions in locations, size and designs. Distributed power cabling extended from local distribution panel to lighting fittings will be controlled by room lighting switches provided on nearby doors.

Illumination level for rooms and areas will be planned as follows;

(i) Operation Control Center

Room	Type	Lux
Telecommunication Equipment Rm. :	LED, Reassessed	300
Electrical Rm.:	LED, Ceiling mounted	300
Signal Equipment Rm.:	LED, Reassessed	300
UPS Rm. (Depot):	LED, Reassessed	300
Entrance Lobby:	LED, Downlight	200
Toilet, Shower Rm.:	LED, Downlight	150
Kitchen Rm.:	LED, Reassessed	300
Monitor Rm.:	LED, Reassessed	300
Central Control Rm.:	LED, Low-Bay	500
Office:	LED, Reassessed	300
Conference Rm.:	LED, Reassessed	300
Corridor:	LED, Downlight	200

(ii) Light Repair Shop

Room	Type	Lux
Office:	LED, Reassessed	300
Conference Rm.:	LED, Reassessed	300
Mech. & Elec. Rm.:	LED, Ceiling mounted	200
Toilet, Shower Rm.:	LED, Downlight	150
Locker Rm.:	LED, Reassessed	150
Working Area:	LED, High-Bay	300
Corridor:	LED, Downlight	200
Storage:	LED, Ceiling mounted	100

b) Emergency and Exit Lighting

Emergency lights, battery built-in type, and exit lights will be provided at the required locations as per the requirements of the relevant building Laws. Emergency lights having dedicated circuit will be satisfied with the illumination level more than 1 lux. Type of emergency light will be of LED battery built-in type 9W×2.

Exit sign, battery built-in type will be provided for the evacuation of the occupants. Exit signs are required to be normally "On" and capable of lighting more than 30 minutes. Distance between exit signs will be 20 – 30 meters as per the local Laws.

3) Receptacle System

Single phase receptacles will be provided at the certain points of the room and spaces inside the building. Type of the receptacle required is 1phase, 2 wire 220 V 2P+E (16A), and one single circuit will be required to connect not more than 6 receptacles. Occupied rooms will be provided with wall recessed type and non-occupied rooms will be surface mounted type receptacles. Earth leakage circuit breaker will be considered to protect the receptacle and the circuit installed outside the building and/or under high humid conditions.

4) Fire Detection and Alarm System

For the purpose of early detection and notification of fire, automatic fire detection and alarm system will be provided in each of the rooms within the building. System consists addressable type fire alarm panel, smoke and heat detectors and wirings and will be required to comply with FCP (Fire Code of the Philippines) and Fire Service Act, Japan where applicable.

5) Low Voltage Power Distribution Cabling for Depot Equipment

Low voltage power distribution system will be provided for Depot equipment including overhead crane installed inside the buildings such as Main Work Shop, Light Repair Shop, Wheel Pro-filing Shop, and other buildings. Low voltage power will be required to separately distribute from low voltage circuit for building services provided on the main distribution board of the electric room.

System will be required to distribute the power for receptacles of the Depot Equipment for maintenance.

6) Lightning Protection System

The building shall be protected from lightning strike by a conventional type of lightning protection system consisting of air terminals, down conductors, ground rods and ground ring.

Lightning protection system will be provided on the roof of the buildings in order to safe guard the people and buildings from the fire risk and related hazards associated with lightning exposure.

Design of the system and the equipment in types and locations will be required to comply with the requirements of the Codes and Standards of local Building Codes.

7) Building Remote Monitoring System

Operation Control Center Rm. in OCC will be provided with Building Remote Monitoring System to monitor and control the building mechanical electrical systems. The systems shown in the table will be monitored through the supervisory monitoring equipment located in Operation Control Centre Rm.

Table 4.5.9 Monitoring Schedule

System	Condition/Indication	Critical Alarm
Lighting control:	-	Trouble with Alarm
Air-conditioning:	-	Ditto
Elevator.:	-	Ditto
Security:	Surveillance & Unlocking	Ditto
Sub-station:	Power outage	Ditto
Generator):	On/Off Operation	Ditto
CCTV:	-	Ditto
Water supply pump:	-	Ditto
Drainage pump:	-	Ditto
Sprinkler pump:	-	Ditto
Fire Alarm (OCC):	Fire Alarm	Ditto
Fire Alarm (MWS):	Ditto	Ditto
Fire Alarm (LRS):	Ditto-	Ditto
Fire Alarm (Small building):	Ditto-	Ditto
Facilities at each station:	On/Off Operation	Ditto

8) Access Control System

In consideration of the operation of the security system, access control equipment is installed in the OCC building where important equipment is installed. The zoning controlled area is divided into a general area and an office area, and electric locks and numeric keypads are installed in corridors and entrances. The status display monitor of the electric lock is installed in the OCC Building Monitoring Room.

(4) Water supply and drainage Design for the Depot Buildings

The different components of the mechanical systems under this scope include the following:

(a) Plumbing Water Supply System (Domestic Cold / Hot Water)
(b) Waste Water and Sewage Drainage System and Plumbing Fixtures
(c) Fire Protection System (Outdoor Hydrant System, Hose Reel &Stand Pipe System,)

The minimum requirements for the design of the Plumbing System of the Project shall be largely determined by the applicable provisions of standing planning and design regulations, professional and construction codes and standards as presented above. Said requirements shall form part of the Plumbing Design Criteria that will be evolved for the Project.

1) General Design Principles

The policy in designing plumbing systems is to provide economy and reliability and each system shall comply with applicable published codes, standards and specifications.

The systems should be designed to affect the greatest possible economy, meaning that:

a) All fixtures, equipment and piping material shall be compatible with the design life of the structure; and
b) In permanent type structures, piping arrangement shall be concealed; and
c) Energy conservation shall also be considered.
   The systems shall be designed with reliability as key criteria since interruption of a service would drastically reduce the efficiency of a facility.
   The systems shall be designed stressing simplicity, cleanliness and functionality. Ornate decoration is not required. Materials should be non-combustible and in material selection, health and sanitation should be considered, not only for personnel served by the systems, but also for operating and maintenance personnel.
d) The water supply system shall be designed to provide a flow of water to meet the peak demand requirements of the building. Pipe sizes will be based on maximum velocities. A minimum flowing pressure of 15 psi at the highest level fixtures shall be provided, except for fixtures equipped with thermostatic valves, blowout pattern water closets, urinals and fire hose racks, which require a minimum pressure of 25 psi. Maximum water pressure entering the building will be 60 psig. If the supply water pressure is higher, a pressure regulating valve shall be provided.

2) Estimating water demand and determining pipe size

The following procedure will be employed in determining water requirements and pipe sizes for the water supply system of the facility:

a) Determine the maximum and minimum water-working pressures in the street main and the elevation of the main at the building site to be supplied;

b) Select the kind of pipe to be used;
c) Estimate water demand from the National Standard Plumbing Code;
d) Develop a schematic evaluation of the complete water system. All fixtures and risers will be identified by letters, numbers or a combination thereof. All valves and fillings will be shown;
e) Add all water supply requirements for other building equipment, such as lawn sprinklers and air conditioning equipment and other usages to the estimated water demand;
f) Determine sizes of mains, branches and risers in accordance with the National Standard Plumbing Code;
g) The greatest equivalent length of pipe from the street main to the most remote fixture will be used to determine pipe function; and
h) Size pipes on the basis of minimum required water pressure with velocities of 5 to 8 feet per second depending on the type of pipe material.

Other water supply appurtenances will be designed as required to provide an efficient but economical plumbing system. Some of these appurtenances include water hammer arrestors or air chambers, check valves for sanitation, bypass lines and others. Hot water equipment will be designed as required, but normally, office buildings located in tropical areas are not provided with this system.

3) Plumbing Drainage System (Wastewater and Sewerage Drainage System and Plumbing Fixtures)

The plumbing drainage system involves the collection of waste water from toilet facilities through sewer pipes and septic tanks. The design of the system involves determination of the required pipe sizes for waste pipes and vents.

Oily waste will be drained through a separate drain piping system with a grease interceptor. Waste water effluence from the grease interceptor are provided immediately under the kitchen sink. This is to remove grease and minimize clogging of sewer. Grease interceptor can be placed outside the building as it carries the source of grease will be discharged to the external sewer main.

Similar to the water supply system, the plumbing drainage system of a facility is designed based on the number of fixtures installed in the facility. The equivalent number of fixture units is determined using tables and graphs presented in various plumbing design manuals, notably the National Standard Plumbing Code. From the derived number of fixture units, the corresponding design discharge is determined from the same manual.

Pipe sizes are determined by applying the method of open-channel flow and using Manning's Equation, where:

Q = 1/n R2/3S1/2

Where:

Q = Design discharge in cubic meter per sec

n = Roughness coefficient of pipe

R = Wetted perimeter of pipe
S = Hydraulic gradient of pipe

Based on the same design discharge, the corresponding capacity of storage tank for wastes and the required capacity of the proposed treatment system are also determined.

After determining the required pipe sizes and location of storage and treatment facilities, the system layout is finalized to include the required venting system.

(5) Ventilation and Air-Conditioning Design for the Depot Buildings

The different components of the mechanical systems under this scope include the following:

(a) Air-Conditioning and Ventilation System
(b) Utility (Steam/Compressed Air) Distribution Piping for Depot Equipment

1) Air-Conditioning System

In general, the factors or elements to be considered during the design process for the air conditioning and ventilation systems are as follows:

(a) Temperature and Humidity
(b) Adequate collection of discharge water from evaporation, condensers, and machinery
(c) For centralized air conditioning system, ducts will be designed with non-combustible materials
  i) Provision of access doors at all automatic dampers, fire dampers, thermostats, and other apparatus for servicing and inspection.
  ii) Provision of fire resistant materials around walls where ducts pass to prevent passage of flames and smoke.
  iii) Outside design condition will be established in accordance with the prevailing weather conditions in the Philippines as published by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).
  iv) Indoor design conditions will be established in accordance with the prevailing practice or as per Client's requirements.
  v) Design parameters and assumptions will be established based on the following factors:
  Thermal Coefficient (Glass, Roof and Exterior Wall)
  Fresh Air Supply at a rate of 7.5 CFM/person, other areas will be ventilated at a rate of 10 air changes per hour
(d) Outside Design Conditions
Outside design conditions for the project were obtained from the PAGASA as follows;
  Cooling Design (0.4 %) Temp. : 37.7℃ (dry bulb)/27.7℃ (wet bulb)
(e) Inside Design Temperature
Inside air-Conditioning design temperature conditions for this project will be as follows;

Space	Summer
Occupied Spaces (Offices, etc.)	25.0℃ (DB) / 50% RH
Communication Rooms Control Center	22.0℃ (DB) / 50% RH

(f) Equipment Heat Release Data and Building Population

Actual equipment heat release data will be obtained from the equipment manufacturer; building population will be estimated from the proposed organizational structure; time of use data will be defined for heat load calculation and capacity of the air conditioning equipment will be determined, all of which will be used to establish the required equipment to support the inside design temperature conditions within the facility.

(g) Type of Air-Conditioning System

- Offices and occupied rooms in Shop Buildings:
  Individual air-cooled split type air-conditioning unit will be recommended for the offices and other occupied rooms in the Workshop and Light Repair Shop to minimize power consumption while providing comfort economically. Spot cooling for certain work area in Work Shop will be provided with mobile type spot cooling equipment for industrial use.
- OCC (Operation Control Center) Building;
  VRF (Variable Refrigerant Flow Control) multi-split type air conditioning system will be provided for the OCC.

2) Ventilation System

Ventilation air (fresh air) volume required for proper ventilation of the non- air-conditioned rooms and space will be generally determined according to the size and use of the rooms/space.

Shop Area of the Workshop, Sub-station Room. Mechanical and Electrical Rooms. Battery Rm. Storage Room., Toilet, Kitchen, etc. will be provided with ventilation fans in power roof ventilators, supply and exhaust air fans, etc. Required ventilation rate (air change rate per hour) will be determined in compliance with the requirement of ASHRAE Standards and/or applicable local laws and standards. Following are the air change rates for each type of the rooms to apply in the design of the ventilation system.

- Electrical Rooms : 10 L/s-m^2
- Sub-station (Transformer Rm.) : 5 – 10 ACH
- Switchgear Room. : 5 – 10 ACH
- Battery Room. : 4 ACH
- Shop Area in Work Shop : 8-10 ACH
- Pump Room. : 5 ACH
- Warehouse : 2 ACH
- Storage : 7.5 L/s-m^2
- Toilet : 35 L/s per WC or Ur

- Kitchen : 3.5 L/s-m^2

3) Utility (Steam/Compressed Air) Distribution Piping for Depot Equipment

a) Steam Distribution System

Steam distribution system will be provided for Depot equipment installed in Main Work Shop. Provision of air compressor unit and its auxiliary subsystems in the Compressor Room. will be in separate design group (out of design scope of Building M&E System. Design for this system by Building M&E will be only air distribution piping between air compressor and Depot equipment. Required steam for Depot equipment is estimated in total of 37.4 m^3/min. and 7.5 m^3/min under usage factor of 20% respectively. Design for distribution piping will be in compliance with the requirements of Philippine Mechanical Engineering Code.

b) Compressed Air Supply System

Compressed air distribution system will be provided for the operation of machine tools and Depot equipment and this system will be installed in Main Work Shop and Light Repair Shop. Provision of air compressor unit and auxiliary subsystems will be by separate design group (out of design scope of Building M&E System. Design for this system by Building M&E System will be only compressed air distribution piping between air compressor unit and machine tools/Depot equipment. Required pressure of the machine tools and Depot equipment is 0.49 MPa in maximum. Design for distribution piping shall be in compliance with the requirements of Philippine Mechanical Engineering Code.

(6) Fire Fighting System Design for the Depot Buildings

1) General Design Principles

An effective firefighting system shall be provided for all building facilities in the Depot, including fire protection provisions and response mechanism (including evacuation and fire-fighting).

2) Fire Protection System (Outdoor Hydrant System, Hose Reel &Stand Pipe System,)

Design process calls for establishment of various parameters and criteria such as:

i) Classification as to type of occupancy
ii) Type of Equipment

Portable equipment such as fire extinguishers are also required in critical areas.

a) hydrant

hydrant are required in every building with four or more storeys in height. Size shall be capable of delivery adequate quantity of water or 900 liters per minute from each of any three outlets. These will be located within enclosed stairway landings or near such stairways as possible or immediately inside of an exterior wall and within 300 mm of an opening in a stairway enclosure of a balcony. All 100 mm standpipes will be equipped with a two (2) way Siamese fire department connection.

b) Water Pumping

Installation of pumping equipment to supply buildings/ structures from existing water supply system will be provided as necessary and designed in accordance with the rules and regulations of the local government building codes. Appurtenances include pressure tank which will be sized based on the building population and appropriate water demand load. Adequate storage capacity will be provided as required.

c) Combination Automatic Wet Sprinkler System and Wet Standpipe System

The Facilities/Buildings shall be provided throughout with a combination automatic wet sprinkler system and wet standpipe system in accordance with the Revised Fire Code of the Philippines, with the exception of the Electrical, Transformer, Genset Rooms and some small structures.

1-1/2" fire hose stations complete with hose, nozzle and Type ABC Portable Fire Extinguishers shall also be installed and strategically located to be used by the building occupants to supplement the sprinkler system in extinguishing small fires.

Fire Department Connections shall likewise be provided for the Fire Department's use.

d) Exterior Hydrant System

Exterior Fire Hydrants shall likewise be provided for the Entire Train Depot Area. Number and layout of the exterior hydrants shall be in accordance with the requirements of the Fire Code of the Philippines.

e) Fire Pumps

Fire Pumps shall be provided for the facility to serve the fire water requirement of the entire facility.

The Fire Pumps and its components shall be UL listed / FM approved. The Fire Pump serving the buildings shall be horizontal split case, or vertical turbine type as required taking water from a 45,000 gallon fire reserve to meet the minimum 30 minute fire demand.

f) Sprinkler System and Inert Gas Extinguishing Systems

Buildings and structures requiring fire sprinkler protection shall be provided with hydraulically designed sprinkler systems. The systems will be designed using the Area/Density Method including hose stream allowance and duration of fire water supply requirements. Current design of the shop area of the Work Shops and multi-story Operation Control Centre (OCC) including Electrical rooms show certain area or rooms to be protected with pre-action and or wet type sprinkler system respectively. Sprinkler system requires provision of pumps and the fire water storage tank and the respective capacities will be determined as per the requirements of Fire Code of the Philippines and Fire Service Act, Japan where applicable.

Operation Control room monitoring train operation is equipped with electronic control consoles, monitors and telecommunication equipment such that inert gas extinguishing system will be provided as per the Fire Code of the Philippines and Fire Service Act, Japan where applicable.

g) Stand pipe and Hose Reel System

Fire standpipe systems shall be provided in the buildings and structures where appropriate and the capacity will be determined in accordance with the requirements of local Laws. The basic design of the Operation Control Centre (OCC) proposes multi story building structure, and therefore OCC will be protected with stand pipe system in accordance with Fire Code of the Philippines and Fire Service Act, Japan where applicable.

h) Gas Suppression Systems

Operation Control Rm. with train operation electronic control consoles, monitors and telecommunication equipment will be required to provide inert clean gas extinguishing system. All other rooms/areas containing sensitive and expensive electronic equipment shall likewise be provided with gas suppression system as per the Fire Code of the Philippines where applicable.

i) Fire Extinguishers

Fire extinguishers will be provided in all the buildings and auxiliary houses in the Train Depot area. Type, locations and capacity of the fire extinguishers will be determined in accordance with applicable local fire laws. Main Work Shop, Light Repair Shop and Wheel Re-Profiling Shop having large spaces will need mobile type fire extinguishers in addition to the portable type.

3) Location of Fire Hydrant

The location of the Exterior Hydrant System shall be in accordance with the requirements of the Fire Code of the Philippines and will be based on the following:

a) Hydrant piping shall be sized to ensure 2.8 kg/cm^2 (40 psi) residual pressure at the hydraulically remotest point.
b) The velocity in the hydrant main shall not exceed 3.5 m/s (11.5 fps).
c) Exterior hydrants shall be provided at a maximum spacing of 152 meters (500 ft.) distance.
d) Building shall be deemed to be protected by a hydrant if the hydrant is within 15 meters of the building.

4.5.6 Water supply, Drainage, Sewerage System

(1) Water Supply System

1) General

The proposed water supply system of the depot will consist of a water main line to be connected to the existing service provider in the area. Control and regulating valves will be installed at strategic locations within the water line network to facilitate distribution and maintenance.

2) Applicable Design Code, Standard and Design Condition

The design of the water supply system will be based on the guidelines and standards of the service provider and other local codes such as those of the local water utilities required amount of water supply

The required amount of water supply was estimated based on the projected users of the depot and on the specific requirement for each particular fixture and equipment requiring water supply. The total unit water demand is the sum of the unit consumption plus the unaccounted-for water.

3) Study for Water Supply Facility

a) Method of Water Supply System

The water supply source to depot is based on water supply from a water supply company. If impossible, we develop self-water source by well etc.

There are two types of water supply systems. One uses an elevated tank and the other is a pressure water supply by pump system. We will consider and select the optimal method.

b) Design Volume of Water Supply

The required amount of water supply will be reviewed and set based on the projected users and the specific requirement for each particular fixture and equipment requiring water supply.

c) Storage Requirement

It is a standard engineering practice for water supply to provide sufficient amount of water to meet a variable demand. Generally, the source capacity is designed to cope with the maximum-day water demand. Furthermore, the storage capacity is provided to meet the excess demand during peak hours.

The storage capacity is estimated based on operational requirements, emergency storage and fire-fighting storage.

4) Plan and Design of Receiving Tank

The receiving tank (storage tank) should be installed as necessary.If installing a receiving tank, The receiving tank has two purposes. One is the domestic water supply and the other is the fire-fighting system.

5) Plan and Design of Distribution Pump

Set capacity and number of distribution pumps according to demand of vehicle base.

6) Plan and Design of Water Supply Pipeline

The water supply pipeline is designed under all the roads within the depot in order to distribute water to all buildings, outside taps, fire hydrant, and other facilities.

(2) Drainage System

1) General

The drainage system of the facility consists of the following:

a) Exterior storm drainage system – functions include the collection and conveyance of surface discharge from building drain boxes and street or road drainage system.
b) Pavement surface drainage system – functions include the collection and conveyance of surface runoff discharge roads or paved surfaces through curb inlet manholes and drainage pipelines.

It should be noted that the Depot site is green space. After the Depot is built, the coefficient of run - off will rise. Therefore, the amount of runoff will increase.

Therefore, a retarding basin will be provided for the purpose of suppressing outflow of rainwater.

By setting up the adjustment Retarding Basin, the flooding of rivers of the discharge destination will be limited within the same amount of discharge as existing.

2) Applicable Design Code, Standard and Design Condition

The design of the drainage system is based on applicable local codes, standards and criteria included in the National Building Code of the Philippines, Department of Public Works and Highways, national entities having jurisdiction of the drainage system when the pipe outlet of the proposed development is connected to the existing national road drainage system, and those of the Department of Environment and Natural Resources, when the discharge outlet is connected to existing natural bodies of water such as creeks and rivers and other natural waterways.

3) Design Storm Water Amount

a) Applicable Calculation Method for Amount of Storm Water

The amount of rain water is calculated using the Rational Formula, which uses the storm rainfall intensity – duration – frequency data obtained from the rainfall stations managed by the Philippine Atmospheric Geophysical Astronomical Services Administration (PAGASA). This data is derived using the temporal storm durations ranging from 5 minutes to 48 hours for 2 to 100 years of recurrence interval. This method is acceptable for catchment areas smaller than 3 km^2.

The hydraulic analysis of the drainage structures like the side ditches, and storm drainage pipes to determine the actual carrying capacities of these sections or structures is based on the basic open channel principle using the following equations:

(i) Flow rate

$$Q = AV$$

where:

A = flow area in m^2

V = mean velocity “V” by Manning’s equation:

(ii) Velocity

$$V = \frac{1}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

where:

V = mean velocity in m/sec

R = hydraulic radius in m

S = channel slope in m/m

n = roughness coefficient

(iii) Hydraulic radius

$$R = A / P$$

where:

A = flow section area in m^2

P = wetted perimeter in meters

b) Runoff Coefficient

The runoff coefficient, C, is dependent on the type of surface where the surface runoff will flow and the values differ for vegetated and paved surfaces.

c) Return Period

The return period varies from 2 to 100 years recurrence interval.

d) Concentration Time

The temporal storm durations range from 5 minutes to 48 hours, though the estimated concentration time is calculated as the time elapsed for the surface runoff to travel from the farthest point to the point of discharge.

e) Drainage/Catchment Area

The drainage catchment area is the whole area of the Depot facility, which measures 13 hectares. Each drainage line however, will have different catchment areas depending on the development plan proposed for a particular area.

4) Drainage Collection System

a) Summary

The proposed drainage collection system of the facility is composed of underground drainage pipes connecting the drainage inlet manholes at specific intervals, covered concrete U - Ditch with perforated holes whenever there is not sufficient cover for the installation of underground drain pipes, under-drains for areas with high ground water table and open ditch or canals and catch basins for unpaved area drainage.

b) Water Collection Method

The rainwater collection method will be examined separately for road drainage, railway tracks drainage, and construction drainage. They will be adopted the optimum water collection method.

5) Road Drainage

The road surface drainage is collected in an L-type street core with a road crossing slope, and collected in a box culvert drainage type.

6) Railway Tracks Drainage

The trajectory of the Depot is constructed ballast trajectory. Therefore, the rainwater in the rail way will be drained by means of a French drain.

7) Building Drainage

The rainwater captured on the building is collected on the rooftop and then drained with a vertical gutter to a collection system on the ground.

8) Rainwater Retarding Basin

a) Location

The rainwater adjustment reservoir should be installed in a location that will not interfere with other facilities.

b) Structure

The capacity of the Retarding Basin is equal to the volume of rainwater to be collected.

(3) Sewerage System/Wastewater Treatment Plant (WWTP)

1) General

The proposed sewerage system of the depot facility intends to provide the required sanitation standards as mandated by the concerned agencies protecting the natural resources and environment of the project area. The system includes wastewater collection, storage and treatment structures.

2) Applicable Design Code, Standard and Design Condition

The design of the sewerage system of the facility will be based on the applicable guidelines, criteria and standards as recommended by the service provider in the project area and those as established by the local and national authorities as contained in the National Plumbing Code of the Philippines, and those as by the Manila Waterworks and Sewerage System and other applicable international codes and manuals.

a) Effluent Standards

Water quality standards and general drainage standards have been published by the Ministry of the Environment of the Philippines and domestically adopted.

Table 4.5.10 The Effluent Standard

Item	Unit	Classification of water bodies
		C
COD	mg/L	100
BOD	mg/L	50
SS	mg/L	100
T-N	mg/L	14
T-P	mg/L	1
Total CO	MPN/100ml	10,000
Oil and Grease	mg/L	5

Source: the effluent standards of DENR Administrative Order No. 2016-08 for Class C Inland Water.

The wastewater treatment method is determined so as to satisfy the above criteria.

3) Amount of Wastewater, Influent of Wastewater and Effluent Standard

a) Summary

The determination of wastewater flow rates are a basic step in the planning and design of a sewer system. These flow rates determined from available wastewater flow data and actual flow measurement or by calculations in the absence of measurements are as follows:

Average Daily Flow	(ADF)* is the average flow rate occurring over a 24-hour period based on available flow data or calculations. It is used for evaluating a treatment plant capacity and the basis of establishing other flow rates.
Maximum Daily Flow	(MDF) is the maximum flow rate over a 24-hour period. The MDF is used in the design of facilities involving retention time such as retention ponds and chlorine-contact tanks.
Peak Hourly Flow	(PHF) * refers to the peak sustained hourly flow rate occurring during a 24-hour period. PHF is used for the design of the collection and interceptor sewers, pumping stations, etc.
Minimum Daily Flow	(MDF) is the minimum flow rate that occurs over a 24-hour period. MDF is important in the sizing of pipes or conduits where solids may settle at low flow rates.
Minimum Hourly Flow	(MHF) is the minimum sustained hourly flow rate occurring over a 24-hour period. MHF is most useful in the design of treatment plant facilities.
Sustained Flow	(SF) refers to the flow rate value sustained or exceeded for a specified number of consecutive days. SF is used in sizing equalization basins and other plant hydraulic components.

b) Determination of Wastewater Volume and Sewage Volume

As for the amount of wastewater and sewage at the base of the Depot, the amount of wastewater will calculate from the amount of water used by the equipment assumed in each building. In addition, the amount of sewage will calculate by multiplying the per capita wastewater unit based on the number of working employees assume in each building.

c) Inflow Water Quality

Inflow water quality was set as follows. The value was determined referring to hearing result from Railway Technical Research Institute.

Table 4.5.11 Inflow Water Quality for the Depot

Items	Unit	Influent		
		Sewage	Liquid Waste	
			Work Shop	Light Repair Shop
pH	-	-	2.3 ~ 12.9	2.0 ~ 7.2
COD	mg/ℓ	180	100	74
BOD	mg/ℓ	387	100	59
SS	mg/ℓ	300	150	55
Oil	mg/ℓ	-	120	15
Total Coliforms	MPN/100ml	-	-	-

Source: JICA Design Team

4) Selection of Treatment Process

a) Summary

For the selection of the sewage treatment system, it is necessary to consider the arrangement of the facilities and the wastewater treatment, etc., and select them.

b) Facility Placement Plan

Placement of the facility is currently under consideration.

As a premise, the wastewater treatment facility should be located near the facility where wastewater and sewage are generated. The conditions are shown below.

(i) Wastewater Treatment Facility

- Install an oil separator near the facility where wastewater is generated.
- If a pump is required, install it with an oil separator.
- If it is advantageous to install the wastewater facility in the building, it is installed in the building.
- The treated water treated with the wastewater is discharged in the rainwater piping in the site.

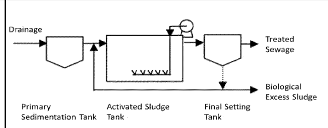
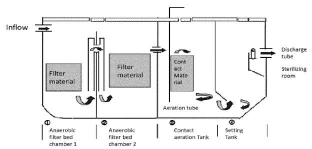
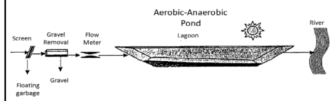
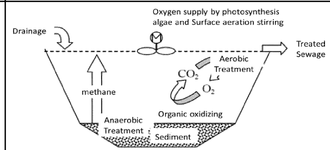
(ii) Sewage Treatment Facility

- The sewage treatment facilities to include such treatment facilities include, OCC, workshop, and the light repair shop. Since the facility is dotted, consider the individual processing rather than a set processing.
- OCC and the workshop consider the consolidation processing because facilities are nearby.

(iii) Facility Placement Plan

The sewage treatment plant in a location that is easy to collect and easy to maintain and manage.

Table 4.5.12 Comparison of Wastewater Treatment Process

Type		Conventional Activated Sludge Process	Combination Treatmet Septic Tank	Waste Stabilization Pond	Aerated Lagoon
Structure					
Mode of Processing		Aerobic treatment process	An−aerobic treatment process + Aerobic treatment process	An−aerobic treatment process + Aerobic treatment process	An−aerobic treatment process + Aerobic treatment process
Technical Summary		Convetinoal Activated Sludge Process is generally used in developed countries including Japan. Even though this cost is high and not appropriate in developoing countries, this process is the most fundamental technology in domestic waste water treatment. Suspended solid is removed in primary sedimentation tank. After the process, the effluent flow into activated sludge tank and organic matter is decomposed and removed in the tank. Activated sludege flow with treated water so that the sludge is settled and separeted from the treated water in final settling tank. The settled sludge is returned into the activated sludge tank and it is recycled.	This treatment system can be applied to the place which is not established the centralized sewerage system in the developped country. Combination treatment septic tank is treated not only wastewater from the toilet but also wastewater from the kitchen and the bath room. Removable rate of BOD is more than 90 % and effluent quality of BOD is less than 20 mg/litter	Waste water is treated by aerobic and anaerobic bacteria based on oxygen from algae in ponds. Oxygen is supplyed from air and photosynthetic reaction, which is significantly long.	Waste water flow into a large pond called "lagoon" and settleable organic matter is settled down in the bottom of the pond and it is decomposed into methane. On the other hand, soluble organic matter is decomposed into carbon dioxide by aerobia using oxygen from aeration and photosynthetic reaction by algae.
Compariso n	Electric power expense & chemical expense	Poor	Fair	Good	Fair
		Need larger electric power than other method	Requires only low voltage facilities and it is not necessary to use the chemical agent.	Not need electric power and chemical	Need only electric power of pump, Not need chemical cost
	installing area	Fari	Good	Poor	Poor
		The second smollest place	Most smallest place	Most largest place	The second largest place
	Operation & Maintenance	Poor	Good	Good	Fair
		A manager having technical knowledge is necessary to maintain activated sludge. Grime processing facilities are necessary.	Periodical maintenance is required, however, maintenance itself is very simple. One time of sludge removal is required	(The maintenance requiremments of ponds are siognificatnly simple but must be run regularly.)	(Waste water is drained annually and scrape out sludge left in the bottom of lagoon, which is based on the condition of settlement. The sludge is dried in land and used by local farmers as fertilizers)
	odor	Fair Primary sedimentation basin is odor	Good Combination treatment septic tank is installed under the ground, therefore, there is no odor.	Poor Dich is opened , therefore ,there is odor.	Poor Dich is opened , therefore ,there is odor.
	Results & applicability in developing countries	Fair	Good	Fair	Fair
		There is a case that small scale facility (2,400m3/day) is operated in Bangkok city in Thai but there is no facility having scalce of (500m3/day).	Combination treatment septic tank is small sized treatment faciliy and it is applicable in Depot. Maintenance is easy and only one time of sludge removable is reuired. Recently this system becomes wildly used in the developping contry.	Maintenance is easier than others, and this processing method has low cost. In addition, as for this processing method, it is adopted most in developing countries However, It is difficult by the following conditions. It is difficult to secure plottage to set up this processing facilities. In addition, a house sticks to the outskirts, and a bad smell becomes the problem.	This processing method is adopted a lot in the developing countries of Southeast Asia. However, It is difficult by the following conditions. It is difficult to secure plottage to set up this processing facilities. In addition, a house sticks to the outskirts, and a bad smell becomes the problem.
Construction Expense		Construction cost is expensive	Construction cost is medium.	Construction cost is cheap	Construction cost is medium.
Operationj & Maintenance Cost		Construction cost is expensive	Operation and maintenance cost is also medium.	Construction cost is cheap	Operation and maintenance cost is also medium.
Suitability for this project		Not applicable	Most applicable	Not applicable	Not applicable

references"Life drainage processing technique handbook for developing countries" (Daiwa/Raschel/GEF/Environmental technology spread support project in Asia)
references Duncan Mara "Domestic WASTEWATER TREATMENT IN DEVELOPING COUNTRIES"

Source: JICA Design Team

(4) Sewer Network System

1) Summary

For the planning and design of the sewer network system, apply DPWH or DENR criteria.

a) Pipe Material

Sewer pipes shall be made of inert materials or internally coated with inert materials. The purpose of using inert materials is to prevent corrosion problems from hydrogen sulfide.

Such inert sewer pipes include clay pipes, PVC pipes, & PVC lined concrete pipes with T-lock. Other pipes that are manufacturer-certified as inert can be used.

The choice for the pipe material should consider local conditions such as possibility of septicity, soil characteristics, external loadings abrasion and other related considerations that might result in problems.

The choice of pipe materials should also consider conditions of construction. Pipes which require special provisions for handling, bedding, backfilling, inspection, and/or testing should not be accepted. The impact of the construction of the sewage on the traffic and congestion must be carefully considered, as to dig the pit, install the sewage pipe, backfill the pit and resume normal road operations in a rapid manner.

Force mains may be steel and ductile iron pipes. Due to a normal full flow, hydrogen sulphide corrosion is insignificant.

b) Minimum Pipe Size

Sewer pipes transporting wastewater shall not be less than 300 mm in diameter. However, a service connection could use a minimum pipe size of 100 mm in diameter with larger sizes in accordance with the National Plumbing Code of the Philippines, except that for multiple dwelling unit structures, a minimum of 150 mm diameter is recommended.

Sewer pipes may be designed to have a full flow or a half-full flow at PHF, depending upon funding for the increase in size resulting from design at half full. A design for a half-full flow at PHF allows for an accordance of infiltration and inflow from wet weather events.

c) Depth

All sewers should be sufficiently deep to receive the wastewater flow from basements.

The soil cover over the buried pipe should be adequate for structural consideration. The recommended soil covers depths are similar to those used in drainage pipes for RCPPC.

a) Sewer laterals and submain (200 mm to 500 mm) – 1.5 m
b) Mains and submains (600 to 3000 mm dia) – 2.1 m
c) Sub-laterals not subject to traffic loads – 1.0 m

d) Slope and Minimum Velocity

All sewers shall be designed and constructed to yield mean velocities, when flowing full, of not less than 0.6 m/s, based on the Kutters formula using an "n" value of 0.013. The minimum slopes (m/100m) should be provided;

Table 4.5.13 Relationship between Pipe Diameter and Minimum Slope

Sewer Size (mm dia)	Minimum Slope (m/100m)
200 (8")	0.40
300 (12")	0.22
450 (18")	0.12
600 (24")	0.08
750 (30")	0.058
900 (36")	0.046

Source: JICA Design Team

The minimum velocity of 0.6 m/s of the pipe flowing full is to minimize any settling of solids. A maximum velocity of 3 m/s at full flow is allowed to protect pipe from scouring.

The pipe diameter and slope shall be selected as to obtain the greatest practical velocities to minimize any settling problems.

e) Alignment

Sewer pipes 600 mm or less in diameter shall be laid in a straight alignment between manholes. Sewers larger than 600 mm may be laid on a curved alignment. The maximum radius shall be four times the pipe diameter. Interceptor shall be placed immediately before and after a segment of a curve sewer line.

The sewer line should be normally located along the southern and western portion of a street or road.

f) Design Period for Sizing of Sewer Pipes

Sewer pipes and outfalls should normally be sized to serve a projected population of 50 years. Otherwise the sizing of all sewers shall be the concession period of 25 years.

g) Appurtenant Structures

The following criteria and guidelines will be used on the following appurtenant structures of the sewer system.

(i) Interceptor Boxes or Sewer Manholes

Interceptor boxes or sewer manholes should be installed: at the end of each line; at all changes in grade, size, or alignment; at all intersections and at the specified spacing of:

- Not greater than 120 m for 400 mm pipe or less
- Not greater than 150 m for 450 mm to 1,000 mm pipe,

- Not greater than 250 m for 1,100 mm and larger pipe.

When the difference in elevation between the incoming and outgoing sewers is 0.60 m or more, a drop manhole should be used whereby the flow falls vertically through an outside pipe and enters the manhole near the bottom.

The minimum diameter of manholes should be 1.20m. Larger diameters are preferable for large diameter interceptors. The minimum diameter of manholes is 0.56 m.

(ii) Inverted Siphon

Inverted siphons are usually employed whenever it is necessary to divert the sewer in order to pass under streams and other obstructions.

The pipe sizes for the siphon should be selected to secure velocities of not less than 0.90 m/s at the average flows. If there is sufficient head to permit the minimum velocity, a single pipe can be used. Should there is little head, several pipes in parallel can be used.

(iii) Pipeline Laying Plan

Regarding the installation plan of the pipeline, it was installed a pipe that satisfies the conditions described in the outline.

(5) Intermittent Pump Station/Man Hole Pump

The pumping station structures and electromechanical equipment should be located at appropriate sites as to protect it from any physical damage by large floods and assure its full operation during large floods.

The station should be accessible by maintenance vehicles during all weather conditions.

The wastewater pumping station should be of the wet well/ dry well type. Other types such as suction lift pumps or submersible pumps stations may be considered during the engineering design stage.

Design Capacity and Lift

The pumping station should have the capacity to handle a flow equal to twice the peak dry weather flow, in order to allow infiltration / inflow equal in flow to the peak dry weather flow.

For planning purposes, the lift or head provided by a pump station will be at most 10 m.

Pumps shall be multiple –units to have the station operate varying delivery rates at approximately the rate of inflow to the station. At least one (1) stand by- pump shall be provided with a capacity equal to that of the largest pump.

4.5.7 Fence and Gate

The fence (perimeter wall) shall be installed around the depot and the gates shall be installed at the entrances of the depot.

(1) General

A fence (perimeter wall) and gate is necessary for the security and safety of the depot. Any unauthorized persons are restrained to enter the depot perimeter are totally forbidden to trespass. Additionally, special care has to be given to the danger imposed by fires occurring in the neighbouring residences. In this sense, the perimeter wall will serve as a barrier to external threats to the depot.

(2) Applicable Design Code, Standard and Design Condition

The 1977 National Building Code of the Philippines (NBCP), subsection P.D.No. 1096 and its IRR, shall primarily be the bases for the position and height of the fence (perimeter wall) and gate system. The Department of Public Works and Highway (DPWH) specifies the standard drawing of the fence (Perimeter wall).

The design and construction of the gate system shall comply with applicable local design/ construction/ industry codes, particularly on welding standards and on foundation/ wall reinforcement requirements.

(3) Selection of Type of Fence

The fence (perimeter wall) will be a bearing wall structure with spikes placed at the top of the wall following the standard drawing of DPWH (see Figure 4.5.9 below).

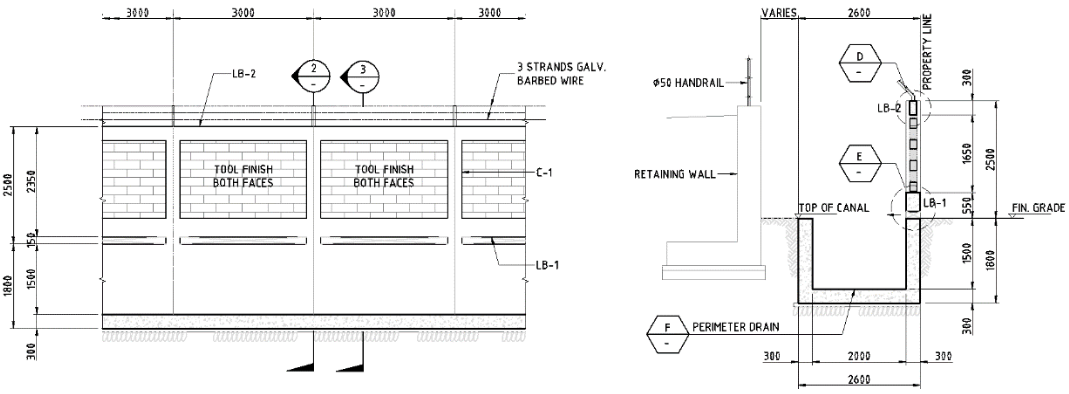
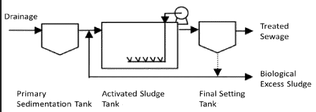
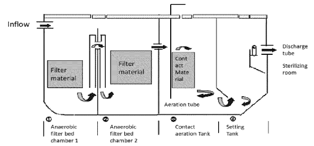
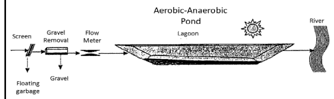
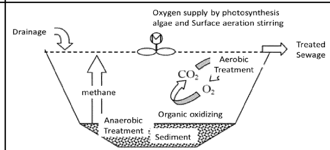


Figure 4.5.9 Fence in the perimeter of the South Depot

Table 4.5.14 Comparison of Wastewater Treatment Process

Type		Conventional Activated Sludge Process	Combination Treatmet Septic Tank	Waste Stabilization Pond	Aerated Lagoon
Structure					
Mode of Processing		Aerobic treatment process	An-aerobic treatment process + Aerobic treatment process	An-aerobic treatment process + Aerobic treatment process	An-aerobic treatment process + Aerobic treatment process
Technical Summary		Convetinoal Activated Sludge Process is generally used in developed countries including Japan. Even though this cost is high and not appropriate in developoing countries, this process is the most fundamental technology in domestic waste water treatment. Suspended solid is removed in primary sedimentation tank. After the process, the effluent flow into activated sludge tank and organic matter is decomposed and removed in the tank. Activated sludege flow with treated water so that the sludge is settled and separeted from the treated water in final settling tank. The settled sludge is returned into the activated sludge tank and it is recycled.	This treatment system can be applied to the place which is not established the centralized sewerage system in the developped country. Combination treatment septic tank is treated not only wastewater from the toilet but also wastewater from the kitchen and the bath room. Removable rate of BOD is more than 90 % and effluent quality of BOD is less than 20 mg/litter	Waste water is treated by aerobic and anaerobic bacteria based on oxygen from algae in ponds. Oxygen is supplyed from air and photosynthetic reaction, which is significantly long.	Waste water flow into a large pond called "lagoon" and settleable organic matter is settled down in the bottom of the pond and it is decomposed into methane. On the other hand, soluble organic matter is decomposed into carbon dioxide by aerobia using oxygen from aeration and photosynthetic reaction by algae.
Comparison	Electric power expense & chemical expense	Poor	Fair	Good	Fair
		Need larger electric power than other method	Requires only low voltage facilities and it is not necessary to use the chemical agent.	Not need electric power and chemical	Need only electric power of pump, Not need chemical cost
	installing area	Fari	Good	Poor	Poor
		The second smollest place	Most smallest place	Most largest place	The second largest place
	Operation & Maintenance	Poor	Good	Good	Fair
		A manager having technical knowledge is necessary to maintain activated sludge. Grime processing facilities are necessary.	Periodical maintenance is required, however, maintenance itself is very simple. One time of sludge removal is required	(The maintenance requiremments of ponds are siognificatnly simple but must be run regularly.)	(Waste water is drained annually and scrape out sludge left in the bottom of lagoon, which is based on the condition of settlement. The sludge is dried in land and used by local farmers as fertilizers)
	odor	Fair Primary sedimentation basin is odor	Good Combination treatment septic tank is installed under the ground, therefore, there is no odor.	Poor Dich is opened , therefore ,there is odor.	Poor Dich is opened , therefore ,there is odor.
	Results & applicability in developing countries	Fair	Good	Fair	Fair
		There is a case that small scale facility (2,400m3/day) is operated in Bangkok city in Thai but there is no facility having scalce of (500m3/day).	Combination treatment septic tank is small sized treatment faciliy and it is applicable in Depot. Maintenance is easy and only one time of sludge removable is reuired. Recently this system becomes wildly used in the developping contry.	Maintenance is easier than others, and this processing method has low cost. In addition, as for this processing method, it is adopted most in developing countries However, It is difficult by the following conditions. It is difficult to secure plottage to set up this processing facilities. In addition, a house sticks to the outskirts, and a bad smell becomes the problem.	This processing method is adopted a lot in the developing countries of Southeast Asia. However, It is difficult by the following conditions. It is difficult to secure plottage to set up this processing facilities. In addition, a house sticks to the outskirts, and a bad smell becomes the problem.
Construction Expense		Construction cost is expensive	Construction cost is medium.	Construction cost is cheap	Construction cost is medium.
Operationj & Maintenance Cost		Construction cost is expensive	Operation and maintenance cost is also medium.	Construction cost is cheap	Operation and maintenance cost is also medium.
Suitability for this project		Not applicable	Most applicable	Not applicable	Not applicable

references"Life drainage processing technique handbook for developing countries" (Daiwa/Raschel/GEF/Environmental technology spread support project in Asia)
references Duncan Mara "Domestic WASTEWATER TREATMENT IN DEVELOPING COUNTRIES"

Source: JICA Design Team

(4) Sewer Network System

1) Summary

For the planning and design of the sewer network system, apply DPWH or DENR criteria.

a) Pipe Material

Sewer pipes shall be made of inert materials or internally coated with inert materials. The purpose of using inert materials is to prevent corrosion problems from hydrogen sulfide.

Such inert sewer pipes include clay pipes, PVC pipes, & PVC lined concrete pipes with T-lock. Other pipes that are manufacturer-certified as inert can be used.

The choice for the pipe material should consider local conditions such as possibility of septicity, soil characteristics, external loadings abrasion and other related considerations that might result in problems.

The choice of pipe materials should also consider conditions of construction. Pipes which require special provisions for handling, bedding, backfilling, inspection, and/or testing should not be accepted. The impact of the construction of the sewage on the traffic and congestion must be carefully considered, as to dig the pit, install the sewage pipe, backfill the pit and resume normal road operations in a rapid manner.

Force mains may be steel and ductile iron pipes. Due to a normal full flow, hydrogen sulphide corrosion is insignificant.

b) Minimum Pipe Size

Sewer pipes transporting wastewater shall not be less than 300 mm in diameter. However, a service connection could use a minimum pipe size of 100 mm in diameter with larger sizes in accordance with the National Plumbing Code of the Philippines, except that for multiple dwelling unit structures, a minimum of 150 mm diameter is recommended.

Sewer pipes may be designed to have a full flow or a half-full flow at PHF, depending upon funding for the increase in size resulting from design at half full. A design for a half-full flow at PHF allows for an accordance of infiltration and inflow from wet weather events.

c) Depth

All sewers should be sufficiently deep to receive the wastewater flow from basements.

The soil cover over the buried pipe should be adequate for structural consideration. The recommended soil covers depths are similar to those used in drainage pipes for RCPPC.

d) Sewer laterals and submain (200 mm to 500 mm) – 1.5 m
e) Mains and submains (600 to 3000 mm dia) – 2.1 m

f) Sub-laterals not subject to traffic loads – 1.0 m

d) Slope and Minimum Velocity

All sewers shall be designed and constructed to yield mean velocities, when flowing full, of not less than 0.6 m/s, based on the Kutters formula using an "n" value of 0.013. The minimum slopes (m/100m) should be provided;

Table 4.5.15 Relationship between Pipe Diameter and Minimum Slope

Sewer Size (mm dia)	Minimum Slope (m/100m)
200 (8")	0.40
300 (12")	0.22
450 (18")	0.12
600 (24")	0.08
750 (30")	0.058
900 (36")	0.046

Source: JICA Design Team

The minimum velocity of 0.6 m/s of the pipe flowing full is to minimize any settling of solids. A maximum velocity of 3 m/s at full flow is allowed to protect pipe from scouring.

The pipe diameter and slope shall be selected as to obtain the greatest practical velocities to minimize any settling problems.

e) Alignment

Sewer pipes 600 mm or less in diameter shall be laid in a straight alignment between manholes. Sewers larger than 600 mm may be laid on a curved alignment. The maximum radius shall be four times the pipe diameter. Interceptor shall be placed immediately before and after a segment of a curve sewer line.

The sewer line should be normally located along the southern and western portion of a street or road.

f) Design Period for Sizing of Sewer Pipes

Sewer pipes and outfalls should normally be sized to serve a projected population of 50 years. Otherwise the sizing of all sewers shall be the concession period of 25 years.

g) Appurtenant Structures

The following criteria and guidelines will be used on the following appurtenant structures of the sewer system.

(i) Interceptor Boxes or Sewer Manholes

Interceptor boxes or sewer manholes should be installed: at the end of each line; at all changes in grade, size, or alignment; at all intersections and at the specified spacing of:

- Not greater than 120 m for 400 mm pipe or less
- Not greater than 150 m for 450 mm to 1,000 mm pipe,
- Not greater than 250 m for 1,100 mm and larger pipe.

When the difference in elevation between the incoming and outgoing sewers is 0.60 m or more, a drop manhole should be used whereby the flow falls vertically through an outside pipe and enters the manhole near the bottom.

The minimum diameter of manholes should be 1.20m. Larger diameters are preferable for large diameter interceptors. The minimum diameter of manholes is 0.56 m.

(ii) Inverted Siphon

Inverted siphons are usually employed whenever it is necessary to divert the sewer in order to pass under streams and other obstructions.

The pipe sizes for the siphon should be selected to secure velocities of not less than 0.90 m/s at the average flows. If there is sufficient head to permit the minimum velocity, a single pipe can be used. Should there is little head, several pipes in parallel can be used.

2) Pipeline Laying Plan

Regarding the installation plan of the pipeline, it was installed a pipe that satisfies the conditions described in the outline.

(5) Intermittent Pump Station/Man Hole Pump

The pumping station structures and electromechanical equipment should be located at appropriate sites as to protect it from any physical damage by large floods and assure its full operation during large floods.

The station should be accessible by maintenance vehicles during all weather conditions.

The wastewater pumping station should be of the wet well/ dry well type. Other types such as suction lift pumps or submersible pumps stations may be considered during the engineering design stage.

Design Capacity and Lift

The pumping station should have the capacity to handle a flow equal to twice the peak dry weather flow, in order to allow infiltration / inflow equal in flow to the peak dry weather flow.

For planning purposes, the lift or head provided by a pump station will be at most 10 m.

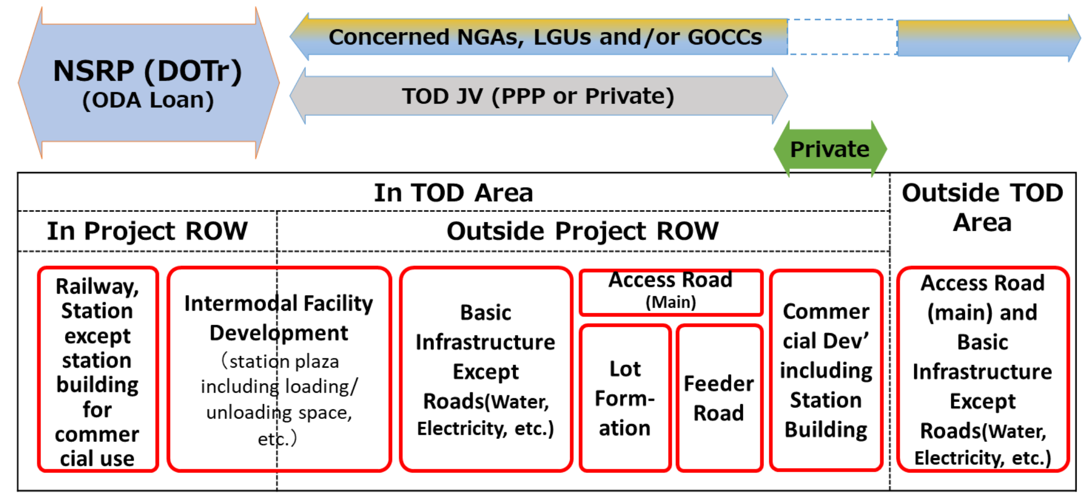
Pumps shall be multiple –units to have the station operate varying delivery rates at approximately the rate of inflow to the station. At least one (1) stand by- pump shall be provided with a capacity equal to that of the largest pump.

CHAPTER 5 TRANSIT ORIENTED DEVELOPMENT (TOD)

5.1 TOD Approach

The development of railway infrastructure is expected to contribute to improve inter-regional, inter-city, urban corridor connectivity, promote local economic activities and sustainable development. However, those effects are not always achieved by the development of railway infrastructure only; the comprehensive approach for encouraging the use of public transport is required. Transit Oriented Development (TOD) is a development approach that promotes public transportation with multiplier effects attained through the integration of transportation development with other types of development e.g., commercial, office, and residential development in the vicinity of mass transit stations. Therefore, although many of the infrastructure which comprise TOD are not directly included in the NSRP as shown at Figure 5.1.1, it is essential to establish a consensus on the importance of TOD among the potential stakeholders especially LGUs as the planning and supervising authority of the area development in their respective localities.

On the other hand, there has been no comprehensive and planned TODs in the Philippines. Therefore, the lack of capability of stakeholders for planning, developing and managing TODs is one practical limitation. Furthermore LGUs which are expected to be the main stakeholders in the TOD initiatives, have long-standing fiscal limitations and capabilities to finance such. Therefore, it is important to show the image of the TOD concept for each station area and the process for enabling the TOD projects from technical, regulatory framework and financial perspectives. TOD concept for targeted stations is shown at Appendix 5.2-5.



Source: JICA Design Team

Figure 5.1.1 Image of responsible parties for developing TOD related infrastructure/facilities

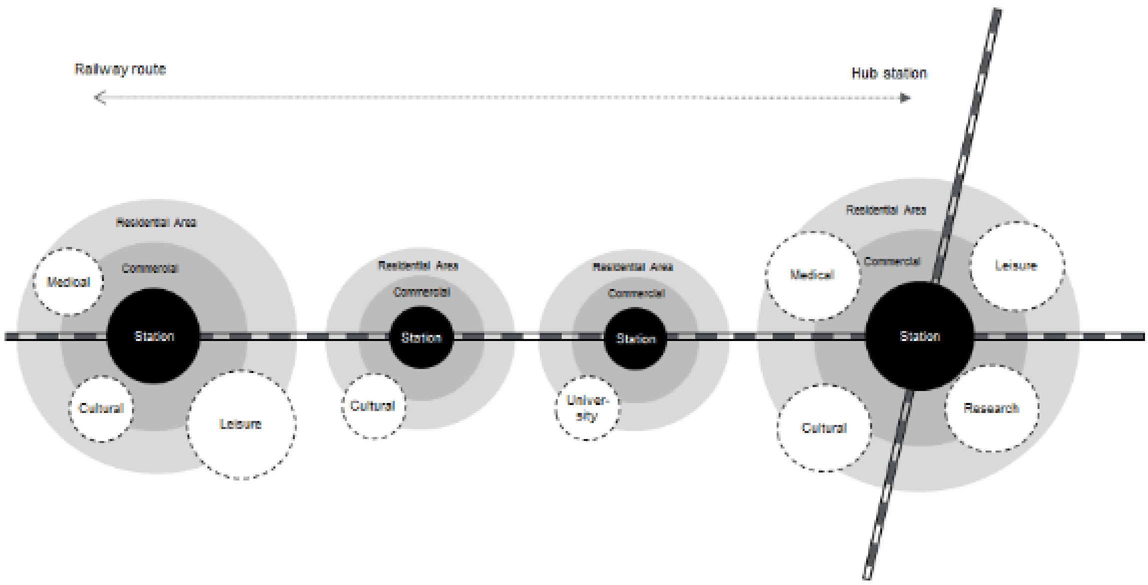
5.1.1 Definition of TOD

Although idea of TOD has been diffused recently, there has been no unified definition. However, it can be said that TOD is the approach for creating dense mixed-use and dense area development near public transportation hub. The enhancement of transportation capacity and accessibility as well as the promotion of integrated property development are essential to implement a successful TOD that contributes to the promotion of public transportation.

Table 5.1.1 Sampling of Definitions of TODs

"A multidisciplinary planning and design strategy to ensure compact, mixed-use, pedestrian and two-wheeler friendly, and suitably dense urban development organized around transit stations" (World Bank Group)
"A mix of commercial, residential, office and entertainment centered around or located near a transit station. Dense, walkable, mixed-use development near transit attracts people and adds to vibrant, connected communities." (Federal Transit Administration in the U.S Department of Transportation)
"Practice of developing or intensifying land-use near stations"(M. Boarnet and R. Crane)
"A mixed-use community that encourages people to live near transit and to decrease their dependency on driving" (P. Still)
"A compact community, centered on a transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more" (M. Bernick and R. Cervero)

Source: World Bank Group, the U.S Department of Transportation, and ADB



Source: Integrated Station-City Development – the Next Advanced of TOD / Nikken Sekkei

Figure 5.1.2 Integrated TOD Concept Along the Railway

For applying the idea of TOD to the MCRP, the concerned NGAs initiated by DOTr has created the TOD Policy Statement (DRAFT) as shown at Table 5.1.2. The TOD Policy Statement is expected to let the stakeholders of both NGAs and LGUs set the common definition and goal of TOD and their role for planning, developing and managing related projects through the support and cooperation of private entities if necessary. Same policy is expected to be applied to TOD on NSRP.

Table 5.1.2 TOD Policy Statement (DRAFT)

Principle # 1: TOD must be inclusive. It must accommodate and cater to all income groups and sectors of Philippine society to ensure equitable access to the benefits that TOD generates.
Principle # 2: TOD may be flexible in size. Depending on its considered and projected economic viability, a TOD can be as small as an area with a 400-meter radius a 1,000- meter radius of a transit station. It can also be separate from the transit station provided that, it is connected and easily accessible to the transit station.
Principle # 3: The land for TOD shall be unified in purpose. The land parcels for developing a TOD project should be unified in purpose such that developments around the station have a mixture and balance of commercial, social and cultural functions.
Principle # 4: The TOD should be mixed-use, walkable, bicycle-friendly, and with adequate public open space. It should be able to accommodate a mix of land uses and land users, including especially public parks and open spaces. Its layout should foster walking and bicycling and overall, promote a healthy and safe environment. It should also integrate existing developments in the area whenever possible.
Principle # 5: Planning and Development of TOD sites should consider the need for future feeder network developments. Design, planning and implementation of TOD site development activities should take into account prospective needs to establish feeder networks that may involve other modes of mass transport. Establishing trunk and feeder networks can further strengthen the viability of ridership and further enhance the convenience of the traveling public.
Principle # 6: The TOD sites along the rail line should complement each other. Each TOD site should strategically complement each other and optimize the convenience of accessing different establishments along the rail line. Redundant establishments along the rail line should be avoided to ensure that the benefits of TOD policy along the entire line is optimized.
Principle # 7: The TOD should be economically and financially viable as much as possible. It should take into consideration the marketability and economic viability of its components in order to achieve financial sustainability.
Principle # 8: The TOD must be environmentally responsible and disaster-resilient. It must respect the natural environment and establish measures to minimize ecological disturbance as well as to address disaster risks and climate change considerations.
Principle # 9. The planning of TOD shall be done under the partnership of the National Government and Regional Bodies as well as concerned Local Government Units. The National Government shall work with regional bodies and concerned LGUs in a coordinated manner to ensure that their respective mandates and concerns are integrated into the TOD plan.
Principle # 10. The financing and implementation of the TOD projects will be under the supervision of the National Government. A TOD Management Committee and a Technical Working Group will be established by concerned National Government Agencies for the purpose of steering the TOD concept particularly in the funding or financing of the TOD's implementation, as well as the management of the revenue that is expected to be generated by the TOD's operations
Principle # 11: The LGUs must, to the extent possible, be active partners in supporting the viability of the railway project. The importance of LGUs as active partners and cooperators in their respective TOD areas is a central aspect of this initiative. Considering that the railway project will undoubtedly impart economic benefits to localities, the relevant LGUs must contribute to the long-term viability of the railway project.
Principle # 12: Formal coordination and cooperation between all key governance actors are essential for effective delivery of TOD initiatives. Synergy among national government agencies, concerned local governments and if necessary, private sector is essential in TOD development. This extends to the management and maintenance of the TODs in an efficient and effective manner.

Source: TOD Technical Working Group

5.1.2 Effect of TOD

As TOD is a comprehensive area development approach, its effects and impacts reach a wide range of sectors such as economic, environmental and social ones. The combination of the use of the public transportation system and dense and mixed-use area development with open space and walkers and bicycle-friendly facilities are expected to contribute to vibrant economy with improved efficiency, preservation of greenery, less energy consumption, good health and higher quality of life.

Table 5.1.3 Effects of TOD

Sector	Examples of Effect
Economical	• Time Saving • Energy Saving • Space Efficiency • Infrastructure Cost Saving • Functional • Enables Agglomeration Economy • Synergy & Creativity
Environmental	• Air Pollution Reduction (CO_2, Lead, GHGs and other harmful air contaminants) • Land & Greenery Preservation • Care of Biodiversity • Higher aesthetic value of the locality
Social	• Enhanced access to Jobs, Services and Other Opportunities • Housing Provision

Source: JICA Design Team

5.2 Scope of the TOD Study

5.2.1 Selection of Targeted Station

Five stations are the targets of the TOD study. As of the end of August, three of five stations are identified; Bicuta, Sucat and Santa Rosa. Remaining two stations will be identified accordingly.

5.2.2 Clarification of TOD Concept

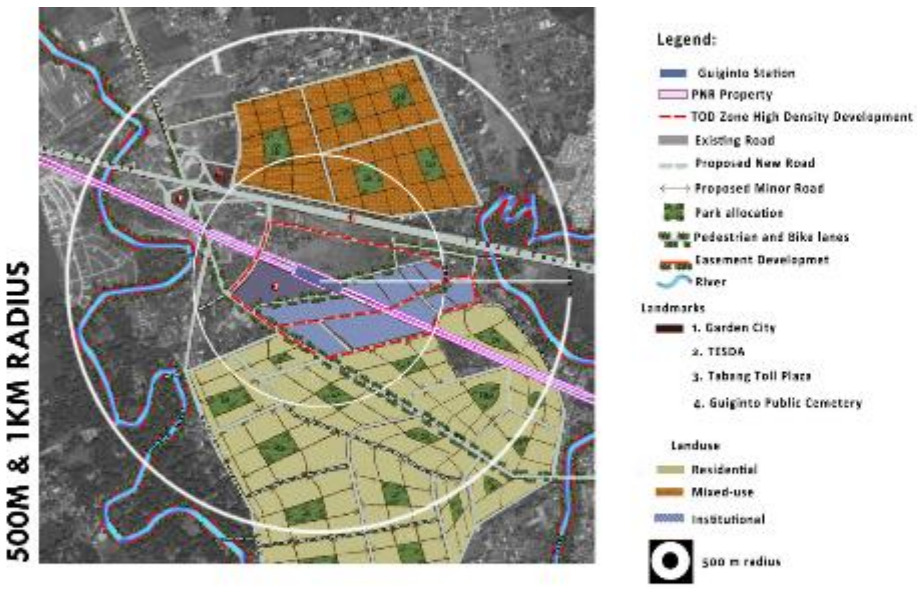
The primary TOD concept, planning, and TOD effect will be identified depending on the distance from the stations. Land use, bird’s-eye view and station plaza will be created as a part of conceptual works and development perspectives.

The primary TOD concept is suggested based on existing national, regional, provincial and local plans (e.g. Philippine Development Plan, National Spatial Strategy, National Physical Framework Plan, Regional Framework for Physical Plan, Provincial development and Physical Framework Plan, Comprehensive Land Use Plan (CLUP) and Comprehensive Development Plan (CDP), ordinances related to land use, development activities and tax system, discussion with concerned agencies.

Table 5.2.1 Target of TOD Concept

Distance	Primary TOD Concept	Planning	TOD Effect
0m~200m	Office, Commercial, Transport connection	Land Use, Bird-eye View, Station Plaza	Tax increment estimation
200m~500m	Commercial, Condominium, Public sector	Land Use, Bird-eye View	Tax increment estimation
500m~1000m	Commercial, Residential, Public space (e.g. Park)	Land Use, Bird-eye View	None

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2.1 Land Use (Sample)

Source: JICA Study Team

Figure 5.2.2 Bird's Eye View (Sample)

Source: JICA Study Team

Figure 5.2.3 Station Plaza (Sample)

5.2.3 Project Delivery Structure

As TOD is comprehensive area development approach, there is no definite or uniformed project delivery structure. In other words, the adequate project delivery structure will be decided considering various factors such as land ownership, capability of implementing agencies, and market interest, among others. On the other hand, considering the limited capability of LGUs, the overarching assistance from NGAs are essential for the successful implementation of TODs. In general, when there is a publicly- owned land in TOD areas where revenue generating activities (e.g. commercial and residential development) are expected, carrying out PPPs including JV are possible project delivery options. On the other hand, there is no public owned land, it is desirable to initiate private development based on the concept of TODs by setting a TOD masterplan and related guidelines (for more detail, please see Appendix 5.3).

5.2.4 Financing TOD

As it mentioned earlier, financing TOD related projects is one of the biggest challenges for concerned agencies. Among them, the financial capability of LGUs are limited and they cannot allocate budget for the investment on TOD related projects in current public finance framework.

Tax revenue increment (TIF) which is the financing system based on the estimation of the future land value increase and increased tax revenue which is widely adopted in local government in the United States would have a beneficial effect at the national and local government level through the implementation of TOD. Land value would be increased by enhancing accessibility and convenience that will redound to higher tax revenue such as through real property tax (RPT). Therefore, the study estimates potential land value increase through the development infrastructure and TOD (for more detail, please see Appendix 5.5).

CHAPTER 6 WORK IMPLEMENTATION PLAN

6.1 Preliminary Construction Plan

6.1.1 Overview

A construction plan at the detailed design stage is a plan to carry out construction work based on drawings and specifications which are made, taking into account surveys and geotechnical investigations. It is expected that the most appropriate plan will be prepared after fully examining a schedule of each work, proposed project schedule, construction period, safety, quality assurance, economic efficiency, and environmental impact. However, a construction plan in this report is prepared based on the plan at the current stage since surveys, geotechnical investigations, and designs are not yet finished.

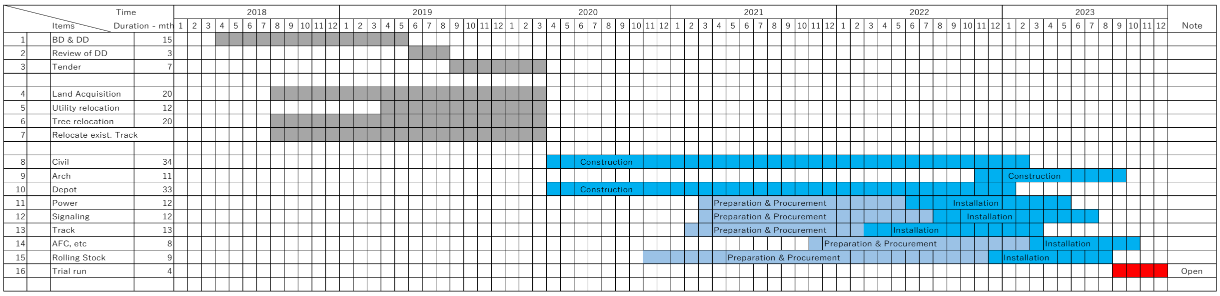
According to the Work Implementation Report, which was submitted in December 2017, the NSRP-South has the total length of 57.1km from Solis Station to Calamba Station, consists of 31.6km of the viaduct portion and 22.5 km of the at-grade portion, plus 13km from Calamba Station to the proposed depot in Los Baños. The PNR line currently operates trains on a double-track railway between Tutuban Station and Sucat Station, and a single-track railway from Sucat Station to Calamba Station. From Tutuban Station to Alabang Station, trains run every 30 minutes, while only 2 trains run in the morning and evening between Alabang Station and Calamba / Mamatid Station. The construction of the NSRP-South needs to be carried out while the PNR trains are in the operation. Furthermore, the DOTr requested for future freight line to be secured. These matter need to be studied further and then evaluated.

Since the NSRP-South line runs along highly urbanized areas between Solis Station and Bicutan Station, there are existing structures (bridges, water pipes, high voltage cables), and future viaducts (under construction, under planning) which obstruct the construction of the NSRP-South line. These issues have to be fully considered in planning.

The construction plan is described in this Sub-Section taking site survey results into consideration.

6.1.2 Construction Schedule

The construction schedule will be very tight. It is because more than half of construction sites are within urbanized areas, and there are constraints such as limited access to the construction sites, on-going and future construction in adjacent areas, and operation of the PNR during construction etc. Therefore, securing sufficient number of erection girders and segment casting yards, and crossings with existing structures will be critical in this project. Furthermore, surveys and planning including that of construction packages will be very vital. Based on these, the overall schedule is being prepared. The Figure 6.1.1 shows the provisional schedule as of now.



Source: JICA Design Team

Figure 6.1.1 Overall NSRP-South Schedule

6.1.3 Temporary Facilities

(1) Temporary Yards

A temporary yard will consist of the following.

Table 6.1.1 Temporary Facilities

Temporary Facility	Area (m^2)
Office (Contractor & Engineer), Laboratory	2,000 m^2
Workers' Quarter (1,000 workers)	5,000 m^2
Warehouse	1,000 m^2
Rebar, Formwork Fabrication Yard	3,000 m^2
Batching Plant	7,000 m^2
Segment Casting Yard	30,000 m^2
Total	**48,000 m^2**

Note: the above mentioned casting yard areas are required to fabricate typical span segments as denoted in 6.1.4(5)1)a). They have to be adjusted depending on the length of the sections to be constructed.

Source: JICA Design Team

1) Main Site Office

A site office should be set up within the construction site so that a contractor can easily monitor daily construction activities. The same could be said for an Engineer's site office. In addition to a site office, satellite offices may be needed since this is a long distance railway project. As for a laboratory, there is an option of sub-contracting the work. Thus, setting up a material laboratory in the temporary yard will be evaluated at a later stage.

2) Satellite Office

A satellite office is needed when the main site office is far from the construction site. It is typically a container office equipped with electricity, water, and toilet etc. A supervisor shall be stationed at this satellite office all the time.

3) Workers' Quarter

In the Philippines, accommodation facilities for workers should be provided in general. Hygiene management of the workers' quarter and an impact to neighborhood should be carefully considered when constructing an accommodation facility.

4) Material Storage Yard

While materials for immediate use are delivered to the site and stored there temporarily, materials to be stored for a long time will be stored and will be managed in a material warehouse or a storage yard provided in a segment casting yard.

5) Machinery Yard

Since machinery will be moved as work progresses, a machinery yard is not particularly necessary. However, temporary storage of machinery in flood-prone areas must be avoided, and machinery must be shifted to safe areas after the end of each working day.

6) Rebar / Form Fabrication Yard

A rebar & form fabrication yard should be located within or near the construction site. It is necessary to reinforce the yard by concrete etc. as a measure against heavy rain and theft.

7) Warehouse

A proper warehouse is needed to store materials and equipment. It is necessary to take anti-theft measures since important materials will be stored in the warehouse.

8) Concrete Batching Plant

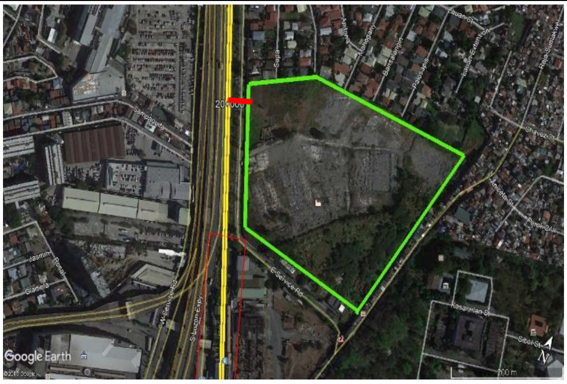
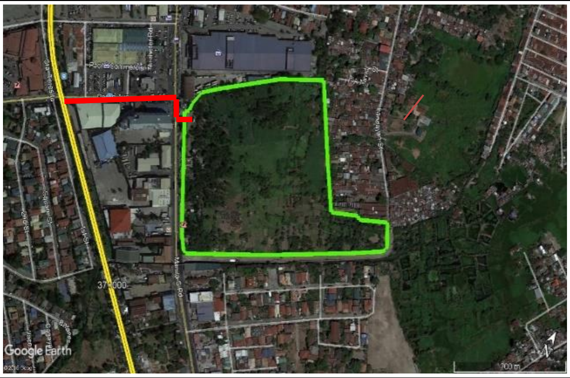
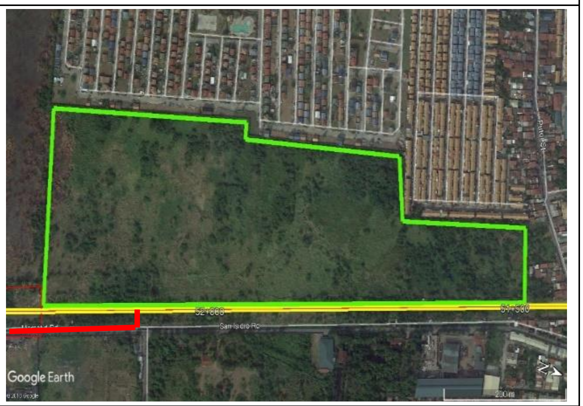
A batching plant may be provided in the construction site to secure stable supply of concrete for fabrication of precast segments etc. However, if sufficient ready-mix concrete is available from a supplier, a batching plant will not be needed. Impacts of dust, noise, and drainage system on the surrounding environment have to be considered.

9) Segment Casting Yard

The construction of viaducts accounts for a large portion of this project. Therefore, securing segment casting yards will be vital in this project.

The owners of proposed yards shown in Table 6.1.2 have not yet been identified. Therefore, it might be necessary to change proposed yards.

Table 6.1.2 Proposed Temporary Yard (Top of Photos facing North)

No.	Area (m^2)	Lot Owner/Address	Station	Access	Temporary Yard
1.	88,515		KM 20+000	East Service Road, C6 General Snatos Avenue,East Service Road Parañaque City	
2.	74,250	Virgilio Bote	KM 37+000	Manila South Road,Pacita Ave. Pacita Avenue ,4th Street San Pedro, Laguna	
3.	80,740	Various Owner	KM 43+260	Manila South Road,Rizal Blvd.PNR access Road,Macabling Road left to Masiit Road,Rizal Blvd StaRosa, Laguna	
4.	159,583	Dominium Realty and Construction Corporation	KM 51+500	Manila South Road,Banlic Mamatid Road Cabuyao, Laguna	

No.	Area (m²)	Lot Owner/Address	Station	Access	Temporary Yard
5.	71,854	Gruppo Medica Inc., Ricardo Alindayu Anacleta Quiogue Candido Habana & Potenciana Alcaraz Gruppo Medica Inc., Jose Juliano Jr.	KM 56+500	Manila South Road, Old PNR Railway, Chipeco Ave.Extn. New Road Calamba City, Calamba, Laguna	

Source: JICA Design Team

(2) Electricity / Water Supply

Site offices, batching plants and segment casting yards need water and electricity supply. Sufficient time shall be allocated for applying for water and electricity supply. Meanwhile, it is necessary to consider providing generators and water tanks as well.

(3) Temporary Access Road

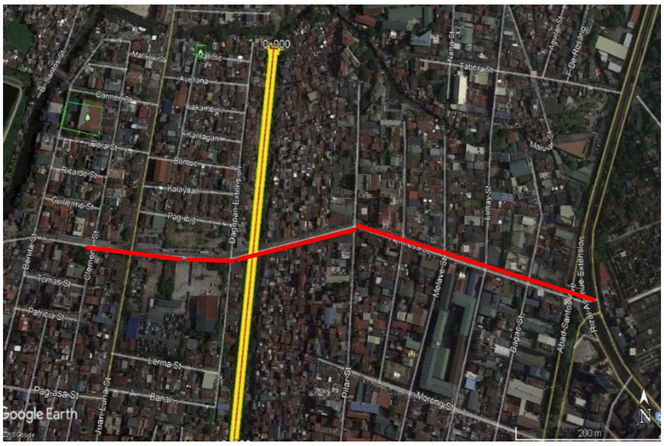
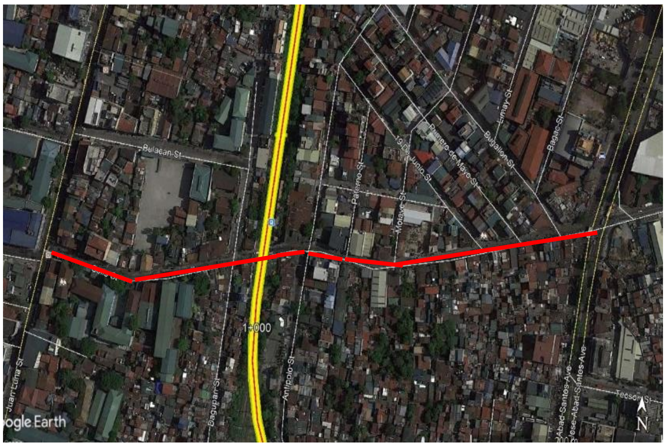
A temporary access road is an important factor for transporting equipment and materials. All temporary roads including roads which run through urban areas and narrow areas must be always maintained in good condition. A drainage system must be carefully designed. Otherwise, water puddles might embrittle roads and affect transport of equipment and materials. At the planning stage, it is important to design durable roads which won't be damaged during the dry and rainy seasons. Measures against dust should be considered for the sake of neighbors.

More than half of the construction sites are in urban areas, the access to the site will be through the public roads. Therefore, attention should be paid to general vehicles. Also consideration for the 3rd parties, such as assigning security guards, providing vehicle washing facilities at entrances and exits to the site etc. are necessary.

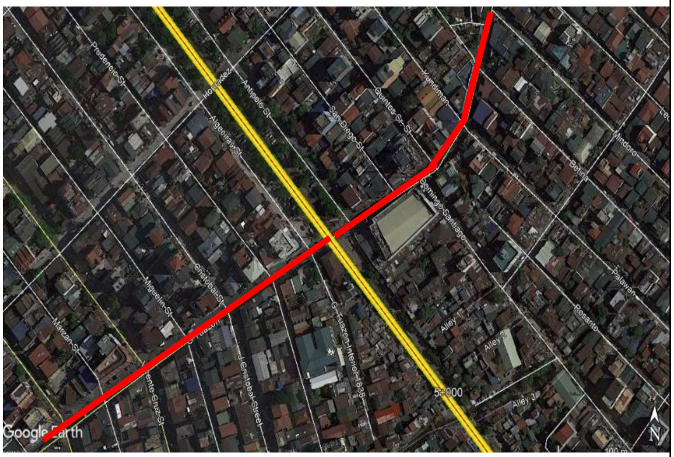
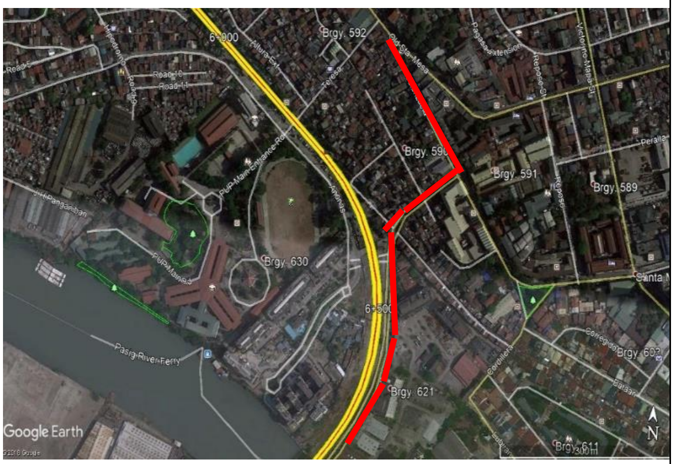
One railway track which runs in the construction site has to be secured for the operation all the time. This constrains the transporting of materials and machinery to the site. The thorough study will be needed on this matter.

Public roads shown in Table 6.1.3 can be used as access roads to the site as a result of the site investigation.

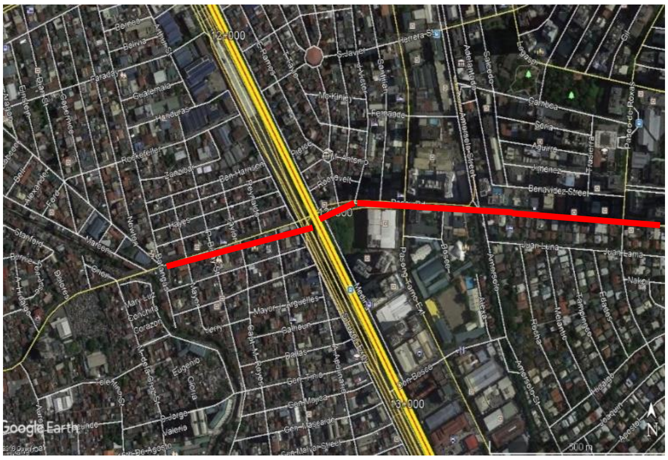
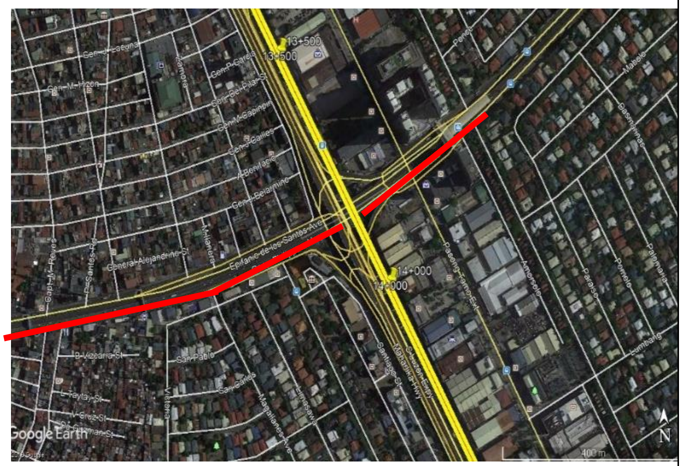
Table 6.1.3 Access Roads (Top of Photos facing North)

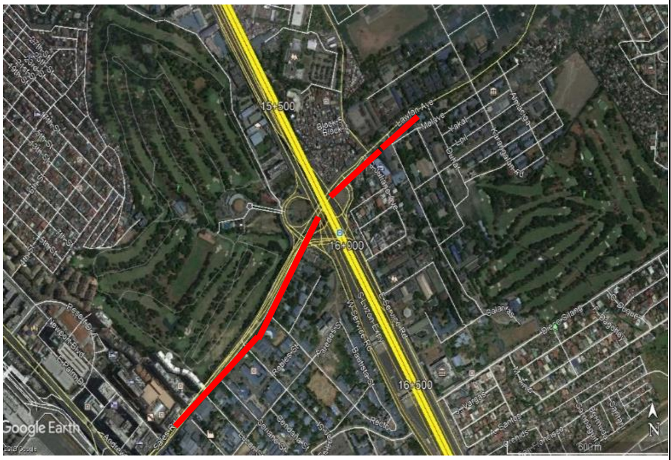
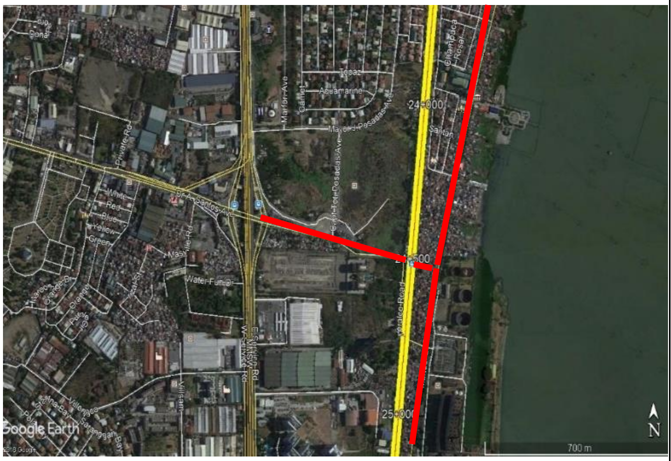
No.	Station	Access	Aerial Photograph
1.	KM 00+250	Hermosa Street, 460m West of Jose Abad Santos Ave. 175m East of Juan Luna St. Solis,Tondo Manila	
2.	KM 00+975	Solis Street, 460m West of Jose Abad Santos Ave. 350m East of Juan Luna St. Gagalangin,Tondo Manila	
3.	KM 01+500	Jose Abad Santos Ave. Antipolo St. Tondo,Manila	

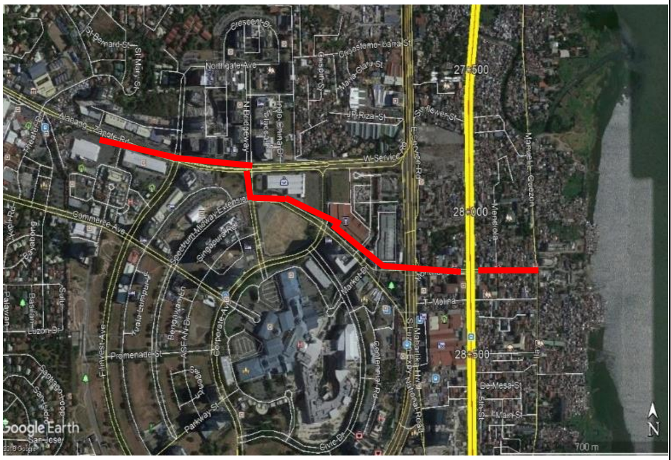
No.	Station	Access	Aerial Photograph
4.	KM 02+000	Rizal Avenue, Blumentritt PNR Railway Manila	
5.	KM 02+750	Simoun Street, Maria Clara Street Laon Laan Street PNR Railway Sampaloc,Manila	
6.	KM 03+750	España / Maceda Street Vicente Cruz Street España Sampaloc Manila	

No.	Station	Access	Aerial Photograph
7.	KM 03+300	G. Tuazon Street V. Cruz Street, D. Santiago Street Sampaloc, Manila	
8.	KM 04+850	Ramon Magsaysay Blvd. Pureza St.Extn. Old Sta. Mesa Rd Sta. Mesa Manila	
9.	KM 06+500	Paco-Sta Mesa Road, Old Sta. Mesa Road, Valenzuela Street Sta. Mesa, Manila	

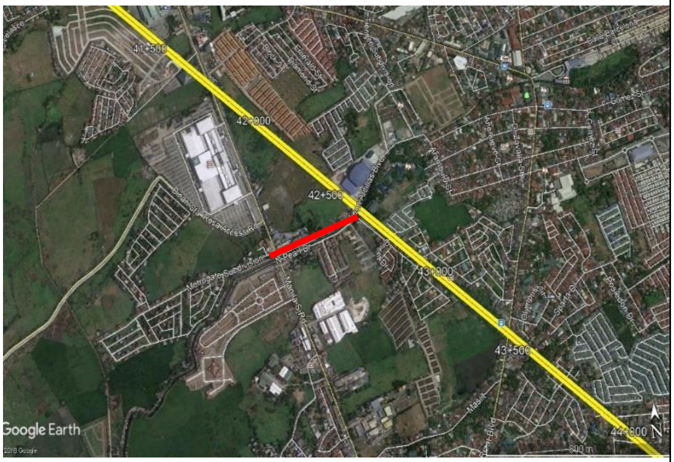
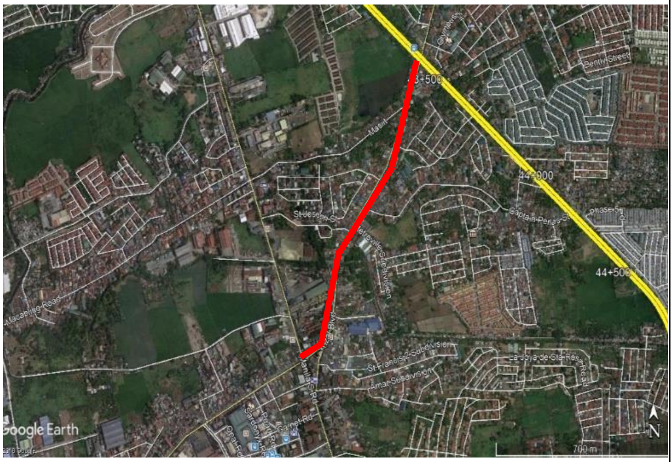
No.	Station	Access	Aerial Photograph
10.	KM 09+000	Quirino Ave., SLEX Quirino Avenue Extension Pandacan, Paco Manila	
11.	KM 09+750	SLEX, San Andres Street, Quirino Avenue Diamante Street, Onyx Street SanAndres, & Malate Manila	
12.	KM 10+700	SLEX, Ocampo Street, Radial Road 2 Zobel-Roxas Street, Kalayaan Ave. SanAndres, & Malate Manila	

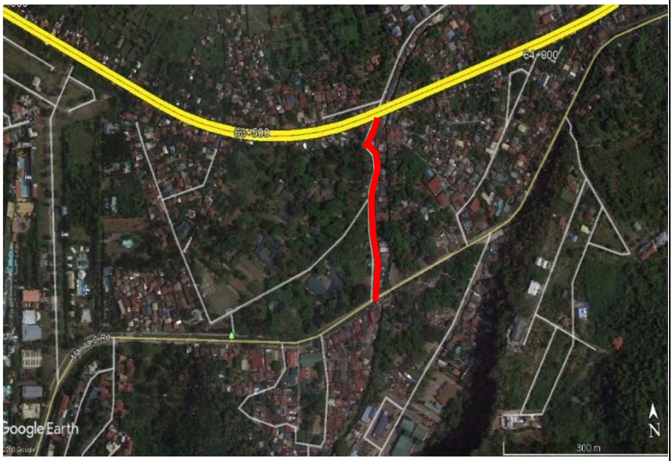
No.	Station	Access	Aerial Photograph
13.	KM 11+700	SLEX, Osmeña Highway Buendia Avenue San Isidro and Pio del Pilar Makati City	
14.	KM 12+500	SLEX, Osmeña Highway Pasay Road San Isidro and Pio del Pilar Makati City	
15.	KM 13+750	SLEX, EDSA Bangkal-Magallanes Makati City Metro Manila	

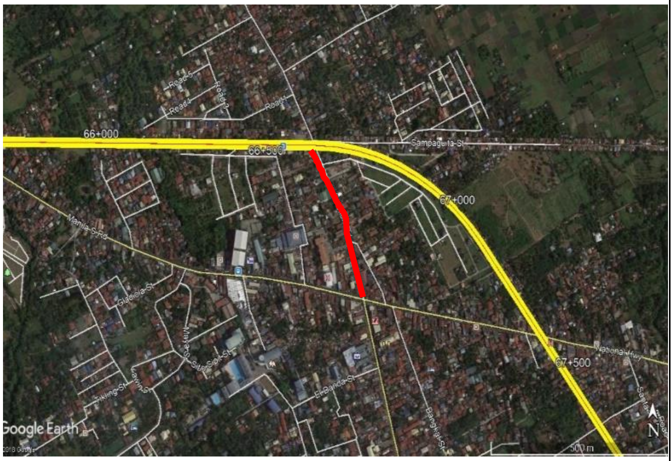
No.	Station	Access	Aerial Photograph
16.	KM 15+750	SLEX. Sales Road, Avenida-Lawton Road Villamor, Taguig Metro Manila	
17.	KM 20+500	C6 Road, General Santos Avenue East Service Road Bicutan, Parañaque-Bicutan, Taguig Metro Manila	
18.	KM 24+500	Dr. A.Bunye, Meralco Road Parañaque-Sucat Road, E Service Road Sucat, Parañaque	

No.	Station	Access	Aerial Photograph
19.	KM 28+400	Alabang-Zapote Road Montillano Street Alabang, Muntinlupa	
20.	KM 31+500	SLEX – Susana Heights Exit Manila South Road Tunansan, Muntinlupa	
21.	KM 34+000	SLEX, San Antonio Exit,Magsaysay Road,MSR,A. Mabini Street San Antonio,San Perdo,Laguna	

No.	Station	Access	Aerial Photograph
22.	KM 36+800	Manila South Road Pacita Avenue San Pedro, Laguna	
23.	KM 39+200	Manila South Road Gen. Malvar Street San Vicente, Biñan, Laguna	
24.	KM 40+000	Manila South Road Access Road Platero,Biñan, Laguna	

No.	Station	Access	Aerial Photograph
25.	KM 42+600	Manila South Road Leon Arcillas Blvd. Tagapo, Sta Rosa,Laguna	
26.	KM 43+500	Manila South Road, Rizal Blvd. Pook,Labas,Sta Rosa Laguna	
27.	KM 55+500	Manila South Road Jose P. Rizal Street Calamba, Laguna	

No.	Station	Access	Aerial Photograph
28.	KM 56+800	Manila South Road,Real Road SLEX Bacnotan Road/Chipeco Ave. Extension Tagapo, Sta Rosa,Laguna	
29.	KM 57+750	SLEX,Maharlika Highway,Manila South Road Ayala Greenfield Road La Mesa Calamba, Laguna	
30.	KM 42+600	Manila South Road New Road (access) Sucol,Calamba, Laguna	

No.	Station	Access	Aerial Photograph
31.	KM 42+600	Manila South Road Junction Road Los Baños, Laguna	

Source: JICA Design Team

6.1.4 Viaduct (Typical Span)

The viaducts of the NSRP-South will be made of precast concrete segments whose typical span length is 40m. The arrangement of erection girders and securement of segment yard will be critical in this project.

(1) Elevated Structure

Elevated structures consist of viaducts with typical span length, and portions that cannot be constructed using typical span at crossings with rivers and existing roads. These portions are now being studies.

(2) River Crossing

The existing railway bridges cross the following rivers; Pasig River, San Pedro River, Sorosoro River, Salang Langka Creek, San Cristobal River, and Calamba River. The current bridges are all made of steel. However, the types of new bridges depend on the future plan. The area at the Pasig River crossing is limited due to the existing railway bridge, the road bridge, high voltage cables, and water pipeline etc. This fact will greatly affect the future plan.

(3) Road Crossing

Sections where the NSRP-South cross existing roads are all at-grade crossings. Most of these at-grade crossings will become elevated crossings. There is a possibility that various restrictions will be imposed during construction of superstructures since these superstructures will be constructed by lifting segments using a girder. Thus, confirmation with agencies concerned is needed.

(4) Interface with Other Projects

Interfaces with other projects are, the connector road, Skyway Stage 3, Southeast Metro Manila Expressway (SEMME) C6, Taguig Integrated Terminal Exchange (ITX), and other ongoing infrastructure projects. Discussion on occupied land and alignment etc. are on-going now.

(5) Construction of Viaduct

1) Superstructure Work

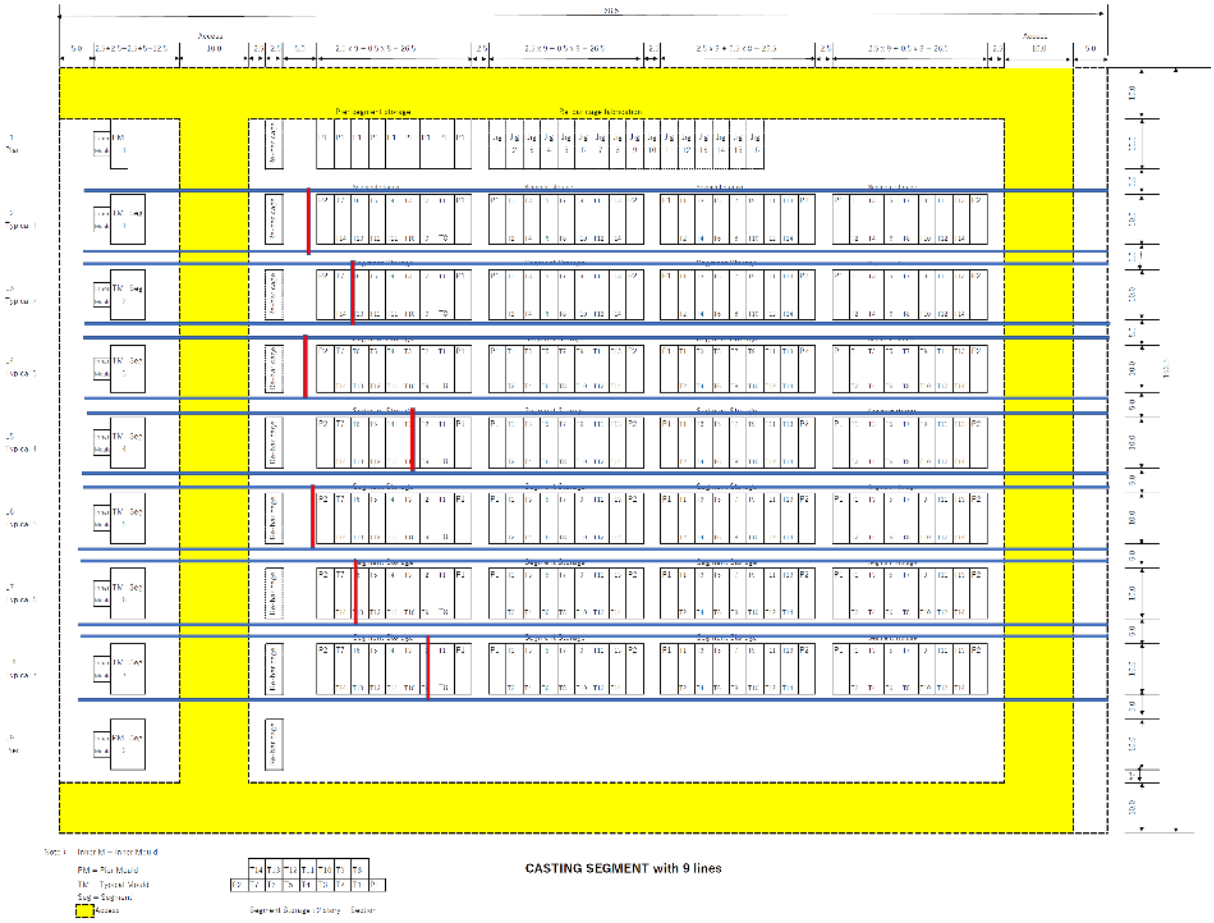
A span-by-span method is a method of constructing a viaduct. In this method, the alignment and cross section of segments produced by match casting process will be fitted and jointed between 2 segments. Normally, all segments for 1 span are lifted by an erection girder and jointed by post tensioning. Other possible methods are supporting segments by an underslung girder or falsework.

a) Fabrication of Segment

The shape of bridge girders used in continuous viaduct bridges for railway varies depending on a span length. When a span length is 15m to 30m, T-shaped girders are used. Typically box girders are used for a span length of 30m to 60m. In this project, a span length of 40m will be selected as a typical span length considering transporting of segments and short construction period. For a construction method, 2.5m precast segments fabricated by match casting process will be used to construct box girders and these box girders will be installed by span-by-span method using an erection girder.

Additionally acquired lands will be used for segment fabrication. A typical casting yard consists of fabrication molds, survey equipment tables for alignment control, storage area, rebar cutting yard, rebar cage jigs, cranes, temporary laboratory etc. A concrete batching plant will be requested when necessary.

Two types of molds are needed; a typical segment and a pier segment. The number of mold depends on the size of storage area and the speed of segment erection. However, in order to make full use of molds, 7 of typical type and 2 of pier type are suggested. The current plan is shown in Figure 6.1.2.



Source: JICA Design Team

Figure 6.1.2 Proposed Casting Yard

Segment fabrication procedure is as follows.

- Attach a segment carrier (movable bottom plate) to a fixed outer formwork
- Install a match-cast segment (previously produced segment) as per required alignment
- Install rebar and inner formwork, then cast concrete against the match-cast segment
- After checking the concrete strength, the outer formwork is stripped and the match-cast segment is pulled out using a segment carrier
- Finally, the new segment is pulled out

This newly produced segment will become the next match-casting segment. Geometry control will be very important because those segments will become final geometry of the viaducts. A casted segment will be moved to a storage yard after required marking. Production rate is 1 no. / day for a typical segment while 1no. / 2days for a pier segment. Concrete supply has a big impact on the production cycle time.

DAY 1

Time	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6
P1	Tra	S5	S5	S6	S6	S6	S6	S7	S7	S7	S8	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T1	S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9		
T2		S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9	
T3			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9
T4				S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T5					S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T6						S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T7							S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
P2														Tra	S5	S5	S6	S6	S6	S6	S7	S7	S7	S8

DAY 2

Time	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6
P1	Cu	S9	S1	S2	S3	S3	S3	S3	S4	Tra	S5	S5	S6	S6	S6	S6	S7	S7	S7	S8	S8	Con	Cu	Cu
T1	S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9		
T2		S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9	
T3			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9
T4	S9			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T5	Cu	S9			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T6	Cu	Cu	S9			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
T7	Cu	Cu	Cu	S9			S1	S2	S3	S4	S5	S6	S7	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu
P2	S8	Con	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	Cu	S9	S1	S10	S10	S10	S2	S3	S4	Tra	S5

Note)

Survey as-built	(S1)
Shift Match cast	(S2)
Strike Formwork and sift cast segment	(S3)
Clean mould and install bottom formwork	(S4)
Set cast segment as mutch cast	(S5)
Install re-bar cage and stressing sheath and others	(S6)
Insert inner mould	(S7)
Final inspection	(S8)
Cast concrete	Con
Curing	Cu
Check concrete syrength	(S9)
Strike inner formwork	(S10)
Transport match cast segment to pier mould	Tra

Source: JICA Design Team

Figure 6.1.3 Daily Casting Cycle of Segment

Number of typical spans that can be fabricated is shown below;

Table 6.1.4 Number of Typical Span Fabrication per Month

Month	Fabricated Span (assuming 100% rate of operation) a	Fabricated Span with 80% rate of operation b = a*80%	Total Length m c = b*40m	Remarks
1	0	0	0	The first month is for fabrication practice
2	7	5.6	224	
3	21	16.8	672	
4	35	28.0	1,120	
5	49	39.2	1,568	
6	63	50.4	2,016	
7	77	61.6	2,464	
8	91	72.8	2,912	
9	105	84.0	3,360	
10	119	95.2	3,808	
11	133	106.4	4,256	
12	147	117.6	4,704	
13	161	128.8	5,152	
14	175	140.0	5,600	

Source: JICA Design Team

b) Transporting Segment

Segments will be transported by a trailer using public roads from a segment casting yard to an installation location and will be stored there temporarily. Segments shall be stored and stacked in 2 layers within the span so that they can be directly lifted by a girder. In order to do so, segment width of 2.5m is planned.

When an installation location is above a river or a road where temporary storage is impossible, segments will be transported to the erection girder using the top of the already erected segments.

c) Installation Method

An erection girder will be transported to a designated location and then assembled. When it is assembled, the girder will be lifted to the top of the pier head by 2 cranes, followed by attaching various components to the girder. After a trial operation, the erection girder can start lifting a segment which is stored below the span.

A segment is lifted by a winch, then the segment is received by hoists of the erection girder. Then the next segment is lifted and received by the girder. After the whole segments for 1 span are lifted, they are temporarily tightened by post tensioning bars. Thereafter, post tensioning is carried out in accordance with the design procedure and followed by moving the span into the designated position.

d) Parapet, Protective Concrete Layer, Cable Trough, OCS Pole Foundation

Precast parapets will be installed by anchor bolts at both sides of the superstructure. The length of a parapet is 2.5m which is the same as that of a segment. During installation, height and alignment shall be checked and tightened temporarily. Installation is completed only when grouting and tightening of anchor bolts are done.

Subsequently, position checking of starter bars for the track shall be done and defective portions shall be repaired. Casting of protective concrete layer shall be proceeded, then followed by construction of cable troughs and OCS pole foundations.

Handover to a track laying contractor shall be done only after all of above mentioned work are finished.

2) Substructure Work

A footing work consists of earth retaining, excavation, pile head treatment, and footing construction.

Excavation depth of a footing is expected to be approximately 5m, and earth retaining by such as sheet piles is needed. Typically, sheet piles are installed by a vibro hammer. When sheet piling has to be carried out near existing structures, the use of a silent piler etc. might be requested instead of a vibro hammer.

For construction of a pier, steel formwork system shall be used in order to speed up the construction. A construction method which reduces scrap materials shall be taken into consideration.

Concrete shall be either once, 2 times or even more depending on the height of the pier. Laitance on construction joints shall be treated.

After completion of pier construction, pier head construction shall be carried out. Steel formwork system shall be used as well for construction of pier heads. Concrete working platforms are needed for formworks. Bearings will be installed temporarily at first, then after box girder installation, permanently installed.

Rebar fabrication shall be carried out in accordance with the bar bending schedule prepared beforehand. A working platform shall always be secured and safety always comes first when installing rebar.

Drainage pipes from superstructure are installed inside piers. Therefore, when casting concrete on a pier, it is necessary to take appropriate measures against deformation and dislocation of pipes which will be caused by heat curing and concreting.

3) Foundation Work

In the current design, all piles are cast-in-place piles. The following are the result of interviews from piling companies.

- Drilling work shall be carried out using an earth drill. During drilling, bentonite slurry shall be used as a measure against collapse of soil. Reverse circulation drilling method can be used for construction in a river when an earth drill cannot access to the pier location in a river.
- Bentonite slurry stabilizer shall be supplied by a pump installed in a backup plant. Depending on the capacity of a pump, 100m to 200m construction work can be done. After the completion of each 100m to 200m work, a backup plant shall be relocated.
- Concrete casting shall be carried out using a tremie pipe.
- Piling companies own 10 to 18 piling rigs and additional rigs could be arranged if necessary.
- Bentonite used as stabilizer is treated by a specialized subcontractor.

All work (viaduct, station building, bridge etc.) need to be started simultaneously as rapid construction is requested by the DOTr. Thereby, a total of 25 or more piling rigs are expected.

a) Plant Facilities

1. Piling Rig
2. Auxiliary Crane
3. Backhoe
4. Dump Truck
5. Bentonite Mixing Plant
6. De-Sanding Facilities
7. Bentonite Silo
8. Generator
9. Stabilizer Transfer Pump

As previously mentioned, items 5 to 9 of a backup plant need to be relocated every 100 to 200m depending on stabilizer transporting distance. Loss of time due to the relocation of a backup plant needs to be taken into consideration for schedule programming.

b) Piling Work

- Insert a casing pipe in the ground using the pile center provided by survey as a reference point
- After the insertion, check the position of the casing pipe
- Set up a piling rig and start drilling
- Drilling work is carried out using an earth drill. During drilling, stabilizer (bentonite slurry) shall be always kept in higher level than groundwater level
- When the excavated depth is confirmed, circulate stabilizer and remove slime precipitates
- Insert a prefabricated rebar cage after confirming that slime is being treated
- Tubes used for quality control shall be attached to a rebar cage beforehand
- Insert the rebar cage up to the required depth, and fix it temporarily using the casing
- Once the position is confirmed, carry out the second slime treatment
- Cast concrete
- A tremie pipe is used for concrete casting. The bottom of the tremie pipe shall be kept in the concrete at least 2m in order to keep the poor quality concrete, concrete mixed with bentonite slurry during the initial concrete casting, at the top of the casted concrete
- Check the final height of concrete
- Pull out the casing before concrete is hardened
- The quality of piles shall be tested by sonic test etc.

4) Equipment / Material Delivery

Equipment and materials are delivered to the site using public roads. Common equipment / materials will be transported to the site during daytime, while oversized equipment / materials will be delivered outside the regulated time or after obtaining permits from authorities concerned.

Once the equipment / materials are delivered to the site, temporary access roads are used to move them. However, where temporary access roads are not provided due to a river or road crossing, equipment and materials shall be transported using only public roads.

Large vehicles such as concrete truck, trailer, and dump truck etc. are banned at certain times of the day in some areas. Thus, it is necessary to conduct a prior survey and take proper measures by obtaining special permits etc.

6.1.5 Viaduct (Long Span)

For a long span bridge, the following bridge types are being considered.

- Steel Truss Bridge
- Arch Bridge (PC Box Girder)
- Truss Bridge with and Additional Pier at the Middle Point
- PC Box Girder Bridge (Cantilever Method),
- Extradosed Bridge (PC Concrete Girder)

Long span bridges are still under evaluation.

The following are locations where the span length exceeds 40m.

1. KM 1.4 Solis overpass at the crossing point of PNR tracks
2. KM 1.9 LRT Line 1 Blumentritt Station
3. KM 5.6 Magsaysay Bridge and LRT Line 2
4. KM 6.7 Pasig River
5. KM 33.9 A. Mabini Street
6. KM 34.3 Maharlika Highway (Flyover)
7. KM 39.2 Binan River
8. KM 41.6 Manila South Road
9. KM 54.0 San Cristobal River (NSRP)
10. KM 54.0 San Cristobal River (Depot access line)
11. KM 55.3 Calamba River

Construction methods of the viaduct at these locations are now being studied.

6.1.6 Viaduct (Widening Section)

Viaducts near the stations where commuter trains cross each other must be widened so that sidetracks can be provided. A station building has 4 track lines composed of 3 box girders, thus widening is needed for a section from typical span portions to a station building. Widening of station approaches are needed in Paco, Bicutan, Alabang, Santa Rosa, and Calamba stations. A span-by-span method for segment erection cannot be used for this widening sections and a cast-in-situ method will be used instead.

After the construction of a widening section, the erection girder is moved into the station building and segments will be installed by this erection girder. Segment installation by an erection girder is not possible at both sides of the station building, so construction of segments will be carried out using falsework from the ground level.

It is necessary to carefully study the timing of viaduct construction at these sections because it will affect the schedule of station building construction.

Piling work and foundation work of station buildings and viaducts will be carried out at the same time. Thereafter, construction of box girders will be carried out together with construction of station buildings.

6.1.7 Viaduct (Multi-Level Crossing with Existing Structure)

The following items have been checked based on the Study conducted by ADB in March 2017.

(1) Overhead Crossing above LRT1 (Blumentritt Station)

A connector road will be constructed above the LRT 1 Blumentritt Station. Since the NSRP-South line is set to be constructed parallel to this connector road, the roof of the station building will be an obstruction to the construction of the NSRP-South. Therefore, a plan to let the NSRP-South run above the roof of the station building is being considered.

(2) Overhead Crossing above LRT2 (Ramon Magsaysay)

The PNR crosses below the Ramon Magsaysay Bridge, and the LRT 2 viaduct spans parallel above the Ramon Magsaysay Bridge. The space below the Ramon Magsaysay Bridge is not large enough for the NSRP-South. Thus, the NSRP-South will run either underground or above the LRT 2 viaduct. However, the underground tunnel option might not be appropriate since the tunnel will be laid deep under the ground when the foundations of the viaduct are considered.

As a result of discussion, a current plan is to construct a viaduct above the LRT 2 viaduct.

(3) Connector Road

Since a connector road, which will be constructed by the DPWH between Solis and Santa Mesa, will use the RNR ROW, additional land for the construction at the interface portion with this connector road needs to be acquired. This issue is now being discussed with the DPWH. Land acquisition will be minimized by using the area below the connector road as the future freight line etc.

(4) Pasig River

There is a flyover along Pasig River and a railway viaduct in the PNR ROW. In addition to these, there are steel towers of high voltage cables, overhead cables, and a water pipeline bridge near the PNR ROW. Therefore, construction of the NSRP-South in this area has to be carried out in a limited space. At the moment, removal of the structures crossing the PNR ROW is being considered.

The current plan is to relocate high voltage cables and steel towers, to construct a temporary bridge over Pasig River, and to remove the existing railway bridge.

(5) Existing Flyover at Pandacan Section

The existing flyovers cross the PNR ROW at 2 locations between Paco and Pandacan. High voltage cables as well run across the PNR ROW. A new skyway road will also run along the existing flyover.

It will be very difficult to construct a viaduct above all these structures. Therefore, an at-grade plan is now being considered. For locations where Skyway piers will be obstructing the construction, relocation is being discussed.

(6) Flyover Structures at EDSA section

The area around the PNR EDSA Station is heavily congested due to the skyway viaduct, EDSA flyover with 2 ramps, and MRT line 3. There is a pedestrian bridge below the EDSA flyover. The vertical clearance below the pedestrian bridge is not enough for the construction of a new railway.

The JICA team is now studying two plans for the NSRP-South, an at-grade plan that will relocate all these obstructions, and a plan that will cross overhead all obstructions.

After the study, the at-grade plan will be selected, since the overhead crossing plan will be difficult.

For the pedestrian bridge, partial relocation is planned in order to secure a construction clearance.

(7) Nichols Station

Both the MM Skyway and the flyover run parallel to the PNR ROW. At-grade roads connecting to the MM Skyway cross the existing PNR line.

It will be difficult to cross all these structures by a viaduct structure, considering the span length and pier height. An alternative plan is to convert all at-grade level crossings to elevated crossings and relocate them so that a ground level clearance will be secured.

Originally, at-grade crossings were considered. However, as a result of further consideration, it is very likely that the railway structures including Nichols station will become underground structures at this location.

(8) FTI Station

MM Skyway is crossing the PNR ROW, and there is a plan of constructing C6 ramps. The piers of these structures will obstruct the construction of the NSRP-South. The JDT is currently studying 3 possibilities; overhead crossing plan, at-grade plan, and underground tunnel.

After evaluation, the at-grade plan is selected and all the obstructing structures inside the PNR ROW will be removed / relocated.

(9) Construction within NSCR Project Area

Between Solis Station and Blumentritt Station, there is a portion where the NSRP-South viaduct will be connected to the NSCR viaduct. Also, the NSRP-South viaduct will be constructed above the NSCR viaduct. Therefore, coordination with NSCR regarding construction period is essential in order to avoid a delay in completing the construction.

6.1.8 Ground-Level Section

The construction of the ground-level NSRP-South line shall be carried out by constructing railway subgrade and roadbed on the ground, and laying tracks. At first, appropriateness of the existing ground as track subsoil has to be checked. Then, trimming and compaction of the ground shall be carried out, followed by confirmation of design values. Thereafter, construction of roadbed shall be done. There are two types of roadbed; macadam roadbed and slag roadbed. Asphalt concrete layer will cover the macadam type of roadbed. Thickness of the roadbed shall be decided based on future surveys. Special attention shall be given to drainage during construction of subgrade and roadbed.

The ground-level railway section stretches for 38.5km based on the original plan. However, this section will be reduced to 8km considering traffic volume, and cut and cover tunnel section.

6.1.9 Embankment

This time, embankment section is out of scope.

6.1.10 Cut and Cover Tunnel

Since Nichols Station will become an underground station, a cut and cover tunnel method will be applied to the section around Nichols Station. A construction method which is now being studied will be described in the next report.

6.1.11 Depot

The original plan to set up a depot in Los Banos has been changed and now a depot will be located between Mamatid and Calamba. Details of a depot plan will be studied in future.

6.1.12 Operation of PNR during Construction of NSRP-South

As stated previously, currently the PNR operates trains on both single and double track railways. Especially between Tutuban-Alabang, trains run every 30 mins on both up and down tracks. If the double-track railway portions will become single-track railway during the construction, trains have to run the railway at an interval of 15 minutes. This means securing sidetracks will be crucial to the operation of the currently operating line. The present plan is to set up sidetracks at 5 locations for every 5 km.

From the viewpoint of constructability, the current double track railway will not be used and a new alternative track will be constructed. However, between Sucat and Calamba, securing the construction area will be easier because the existing railway will be single-track at this section and the PNR ROW can be fully utilized.

6.1.13 Working Hours

There is concern over noise, vibration, and lighting since the construction will be carried out day and night.

6.1.14 Aviation Regulation

The construction planning, especially for the construction of viaducts near the NAIA should be taking the aviation regulations into account.

6.1.15 Utility

Overhead high voltage cables, telephone and communication cables exist inside and near the construction area. These cables need to be treated during construction planning stage especially high voltage cables. Those cables which will obstruct the construction must be relocated. Sufficient time should be allocated for the relocation since it requires consultation with relevant utility agencies. Exact locations of underground water pipes need to be checked by gathering information and carrying out trial excavations etc.

Existing utilities are now being investigated and impact on the construction will be studied in future.

6.1.16 Contract Package

Contract packages are as follows.

Table 6.1.5 Contract Package

Contract Package	Contract Length (m)	Viaduct	Casting Yard		Station / Depot
			Area (ha)	CY to Main Road	
CP S-01	2,626	Full		Nil	Blumentritt
CP S-02	9,165	Viaduct & At grade		Nil	España/Santa.Mesa/Paco/ Buendia
CP S-03	10,642	Viaduct, At & Under ground	8.8	Adjacent to site	EDSA/Nichols/FTI/Bicutan
CP S-04	11,083	Full	7.4	Adjacent to site	Sucat/Alabang/ Muntinlupa
CP S-05	12,130	Full	8.0	Adjacent to site	San Pedro/Pacita/Binan/Santa Rosa
CP S-06	9,788	Full	15.9	Adjacent to site	Cabuyao/Gulod/Mamatid/Cala mba
CP S-07			Nil	Nil	Depot

Source: JICA Design Team

Potential segment fabrication yards for 2 contract packages have not yet been secured. For these 2 packages, further investigations shall be carried out. Locations far from the construction site, or dispersion of a yard (small yards at several locations instead of 1 large yard) shall be considered.

6.1.17 Items for Future Evaluation

(1) Fabrication and Transporting of Segment

Areas and locations of fabrication yards, and transporting methods are now being reviewed.

(2) Type and Construction Method of Pile

Surveys and geological investigations are now on-going. Based on gathered information, the most suitable /appropriate pile type and its construction method will be selected.

(3) Construction of Long Span Bridge

Long span bridges are still under evaluation.

(4) Site Condition Survey (e.g. existing structures along the proposed railway etc.)

Site surveys on surrounding areas are now ongoing. Based on survey results, an inventory list and map of adjacent structures will be prepared.

(5) Survey on Underground Utility Pipeline and Overhead Cables

An inventory and a map of utilities which will affect the construction will be prepared. Consultation with utility agencies concerned will be continued and minutes of the meeting will be prepared. Expenses and time duration needed for relocation of utilities are now being discussed.

(6) Study on Capability of Civil Contractors in the Philippines

A list of contractors which shows their company size, technical capability and available heavy machinery will be prepared.

(7) Study on Precast Segment Manufactures

There is no record of segment fabrication by match-casting in the Philippines, so segment fabrication will heavily rely on the contractor’s experience and its organization. The contractor’s experience in special work including hiring experienced staff will be critical to carry out the work.

(8) Study on Piling Company and Heavy Machinery

Information on capability, available heavy machinery, work volume etc. needs to be gathered together with evaluation of pile type. As a result of interviews with piling companies, it is confirmed that there is no problem with their experience in piling work carried out by earth drills, even though the number of piling rigs differs depending on the company.

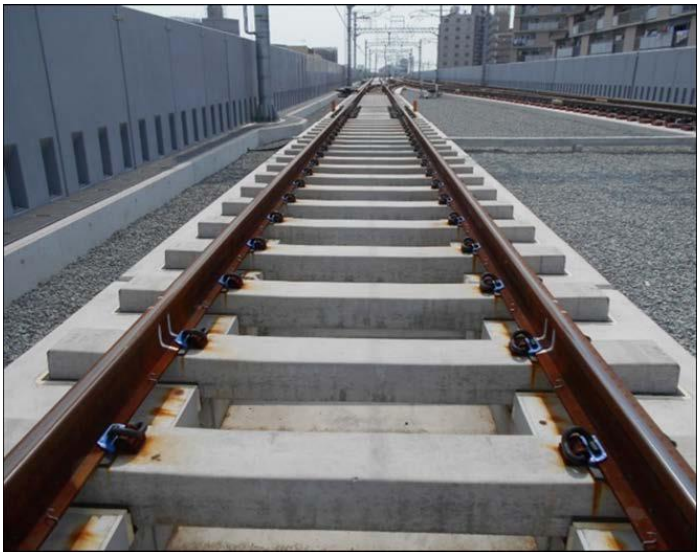
(9) Survey on the PNR ROW

As long as a piece of land belongs to the PNR, that land can be used effectively during the construction. Interviews to confirm whether the land is owned by the PNR or not is already finished. The owners of the land outside the track alignment have been identified. However, these lands are occupied by settlers and if the lands are to be used as a temporary yard, eviction of settlers etc. is needed.

6.1.18 Track Construction Method and Procedure

(1) Elastic Sleeper Directly Fastened Track

A ballastless track presupposes maintenance-free. An elastic sleeper directly fastened track shall be laid on the roadbed which sufficiently support load so that no deformation will occur. On a viaduct or a bridge, a track shall be laid on top of the concrete slab. On an embankment or a steel bridge, a concrete slab work shall be carried out and then a rack shall be laid on top of the slab.



Source: The Detailed Design Study of The NSCR Project: Final Report (Nov. 2017) JICA

Figure 6.1.4 Ballastless Track in Main Line

1) Survey for Trackwork

Surveys shall be carried out once roadbed on structures is completed for more than 500m continuously. Reference markers shall be installed at both sides of the roadbed at the formation level.

2) Transport of Materials

Rails, elastic sleepers, rail fastening system etc. will be carried up on top of viaduct structures and transported to each predetermined location.

3) Assembling of Track Panel

Rails and elastic sleepers shall be assembled into a track panel using preinstalled reference markers as reference points.

4) Trackbed Concrete

Rails and elastic sleepers shall be assembled into a track panel using preinstalled reference markers as reference points.

5) Welding of Rail

First, a track panel shall be completed with a 25 m rail. After the track panel is fixed by hardened concrete, rails shall be welded to become a long continuous welding rail. This long rail will be loosened and fastened again to prepare against constant longitudinal axial force.

6) Rail Grinding

Top of the long rail shall be ground in order to reduce noise and vibration. As a result, the rail lifetime is extended.

7) Alignment Adjustment

Track alignment shall be corrected precisely.

8) Construction Speed

An average construction speed of Elastic Sleeper Directly Fastened Track is 400m/month
50m/3day × 3day/1time × 8times/month = 400m/month

(2) Ballasted Track

Maintenance of a ballasted track is relatively easy even if roadbed deformation occurs. A ballasted track is generally laid on the soil roadbed. For durability and ease of maintenance, an asphalt layer shall be laid on the roadbed and then a ballasted trackebed shall be laid on top of this asphalt layer.

Source: JICA Design Team

Figure 6.1.5 Ballasted Track in Depot

1) Survey for Trackwork

Surveys shall be carried out once a roadbed is completed for more than 500m continuously. Reference markers shall be installed at both sides of the roadbed at the formation level.

2) Transport of Materials

Rails, PC sleepers, crushed stones, rail fastening system etc. shall be carried up on top of viaduct structures and transported to each predetermined location.

3) Assembling of Track Panel

Rails and elastic sleepers shall be assembled into a track panel using preinstalled reference markers as reference points.

4) Spraying of Ballast (crushed stone)

Crashed stones satisfying the quality standard are scattered around the track panel.

5) Welding of Rail

First, a track panel shall be completed with a 25 m rail. After the track panel is fixed by crashed stones, rails will be fastened each other by fish plates to prepare against constant longitudinal axial force.

6) Rail Grinding

Top of the long rail shall be ground in order to reduce noise and vibration. As a result, the rail lifetime is extended.

7) Alignment Adjustment

Track alignment shall be corrected precisely.

8) Construction Speed

An average construction speed of Ballasted Track is 50m/day×25days＝1250m/month.

6.1.19 Construction of Elevated Station

The structure of station buildings will be affected by station locations and viaduct height. Basic design of station buildings is now on-going. Therefore, a method of construction is not described in this report.

6.2 Traffic Management Plan

6.2.1 Scope of the Study

(1) Aim of "Traffic management"

This chapter describes the road traffic control of the Projects. Department of Transportation (DOTr) shall prepare a general traffic management and safety management plan and shall be appoint to overlook the traffic management and coordinate with the Local Government Units (LGUs) before the implementation of the Project. Items such as the Traffic Impact Assessment (TIA) and Traffic Management Plan (TMP) are likely to be requested for approval, by Department of Environment and Natural Resources (DENR). Conducting TIA would be a required condition in Environmental Compliance Certificate (ECC), which was issued by DENR on 13th August, 2018. Description related to TIA in ECC is shown below.

- Conduct a detailed Traffic Impact Assessment (TIA) in coordination with the Metro Manila Development Authority (MMDA) and concerned LGU for every proposed station prior to project construction integrating proposed road expansion projects (if any) of the concerned government agencies.
- Transport of heavy structures shall be scheduled during the period that may not cause traffic in the area.

An outline of TIA and TMP is shown in Table 6.2.1.

Table 6.2.1 Outline of TIA and TMP

Item and procedure	Contents	Elements examined
1) Selection of sites requiring measures	• Determine the sites where existing traffic may be affected by construction works (sites requiring measures). • Conduct actual traffic survey on existing traffic volume and travel time at several appropriate sites selected.	• Structure of road and crossing • Construction plan, temporary road for construction • Existing and future traffic volume
2) Forecast of negative impacts	• Based on the result of 1), impacts on sites requiring measures are forecasted (Deterioration of road congestion, increase of travel time).	• Degree of congestion and travel time
3) Study of countermeasures	• Study measures to minimize negative impacts of 2)	• Detour • Traffic control and lane control • Sign and marking • Public relations, orientation
4) Interviews with concerned authorities	• Conduct interviews to gather opinions of concerned authorities regarding to the construction impacts on the existing traffic and the TMP.	• Road manager • Traffic manager • Utility manager, LGUs

Source: JICA Design Team

The JICA Design Team supports DOTr in acquiring permissions by presenting a plan of DOTr after concrete examination for TIA and TMP.

(2) Feature of the Project and Object of 'Traffic Management'

1) Feature of the Project

Features of the Project are shown below.

- The length of the proposed line is approximately 55 km connecting with NSCR that will go through the Central Business District (CBD) of Mero Manila from north to south. The urban development along the proposed line has been progressing without appropriate public transport planning.
- Due to the inefficient public transportation system and sever traffic congestion, the citizens spend many hours daily on moving. As a consequence, it has become apparent negative social impact.

2) Objected Traffic

Trunk roads such as Manila South Road runs parallel to proposed line. The traffic generated by the Projects will affect congestion and other negative outcomes on the roads mentioned above, and on access roads to construction yards of the line and depots. Outline of the Traffic is shown in Table 6.2.2.

Table 6.2.2 Traffic raised by the Project

Period	Construction Period	Operation Period
Item	Construction vehicle for contractor Conveying vehicle for equipment for supplier	Feeder transport for station Reduction in modal shift from private vehicle to Rail

Source: JICA Design Team

(3) Traffic Assessment Survey (Actual traffic survey)

Traffic assessment survey is planned to understand the current traffic condition along the line and to obtain the data for traffic analysis in future and construction period. The items below should be considered.

- Flexibility in expanding the area for survey outside the National Capital Region (NCR).
- Detour routes considering progress of construction as planned in this study.
- Routes and time zones used for transportation of construction materials, machinery and rolling stock, considering location of construction yard, depot and substation.
- Assuming egress/ access routes from/to the existing stations for passengers.

The following considerations are to be incorporated in specifications of the survey.

- The major field survey was conducted on Thursday and Saturday in March, 2018 as regular weekday and weekend when unusual traffic is hardly anticipated unlike national holidays, etc.;
- Continuous monitoring of the traffic over 24-hours is conducted in order to identify changes in the situation of daytime and nighttime to obtain the midnight/daytime traffic ratio;
- Particular attention is needed to the traffic signal without systematic control and difficulties in identifying the dwell length at road crossing resulted from chronic congestion.

Outline of the survey is shown in Table 6.2.3.

Table 6.2.3 Contents of Actual Traffic Surveys

Item	Description	Date
Target Road	Affected road during/ after construction of the proposed line	
Contents	1) Classified Directional Vehicle Volume Counts (CDVVC) 16h/ 24h, Weekday/ Weekend 2) Directional Pedestrian Counts (DPC) 16h/ 24h, Weekday/ Weekend	March 15 (Thursday) March 17 (Saturday) Partially March 20 (Tuesday)
	3) Lane Configuration in Intersection Survey (LCIS) Width, Direction, Length for dwelling for left turn	Before March 15 (Thursday)
	4) Signal Indication Survey (SIS) 7:00-9:00, 17:00-19:00, Weekday only	March 15 (Thursday) Partially March 20 (Tuesday)
	5) Rail Crossing Survey (RCS) Closure time, Dwell length (Eastbound/ Westbound), From first train to last train (1)Tutuban – Alabang (2)Alabang - Calamba	(1) March 20 (Tuesday) (2) March 22 (Thursday)
	6) Travel Time and Delay Survey (TTDS) Northbound/ Southbound, Morning/ Afternoon/ Evening, Weekday only	March 15 (Thursday)

16h; 6:00 - 22:00, 24h; 6:00 - 6:00 of the next day

Source: JICA Design Team

(4) Feature of Survey

Table 6.2.4 below provides explanations of the other considerations not covered by the Department of Public Works and Highways (DPWH) TIA Guideline, but found to be addressed in this study.

Table 6.2.4 Other Issues to be addressed other than those covered by the DPWH TIA Guideline

Survey Type	CDVVC/DPC
TIA Guideline	DPWH has no specific guideline on the standard time period for traffic volume or pedestrian volume count surveys (e.g. 16-hour or 24-hour survey). The duration of traffic survey usually depends upon the data necessary to evaluate current travel demand within the study corridor and should capture peak periods.
This Survey	24-hour vehicle and pedestrian count surveys are conducted at a few survey stations.
Concept of This Survey	The 16-hour time period is sufficient to capture peak periods for both AM and PM. However, for critical strategic locations, 24-hour traffic and pedestrian count surveys were conducted. They are the representatives of a few areas.

Survey Type	SIS
TIA Guideline	DPWH has no specific guideline on the number of hours required to be able to obtain all permutations of traffic signal cycle.
This Survey	SIS is undertaken during weekday (Thursday) morning (7:00 AM – 9:00 AM) and afternoon / evening (5:00 PM – 7:00 PM) peak periods.
Concept of This Survey	It is unnecessary to conduct 24-hour SIS because it is enough to survey peak hours only.

Survey Type	Queue Length measurement
TIA Guideline	There are several survey methods in measuring/estimating queue lengths (manual counting of vehicles, video-based traffic monitoring, using vehicle detectors, analysis of traffic flow's shockwave profile, etc.).
This Survey	Queue length measurement is not conducted for this survey.
Concept of This Survey	Queue length is difficult to measure/calculate since it is confirmed the queue is propagated to the adjacent intersection. Instead, we conducted surveys of travel and running speed in the morning, afternoon and night time by TTDS survey, and confirmed the traffic condition at each survey site based on the speed distribution.

Source: JICA Design Team

(5) Methods

The surveys are undertaken for either periods of 16 hours (from 6:00 AM to 10:00 PM) and 24 hours (from 6:00 AM to 6:00 AM of the following day) on a weekday (Thursday) and a weekend (Saturday). Surveyors count all traffic by vehicle type using 11 classifications and by directions at every 15-minute interval.

The total number of vehicles is converted to Passengers Car Unit (PCU), which is a metric unit used in transportation engineering to assess traffic-flow rate on roads or highway. Table 6.2.5 below shows the PCU equivalent of each vehicle classification.

Table 6.2.5 PCU Equivalent per Vehicle

Vehicles	PCU
Private Vehicles	1.0
Jeepney	1.3
UV Express	1.0
Bus (Large)	2.5
Coaster	2.0
Truck (Medium)	2.0
Truck (Large)	2.5
Motorcycles	0.3
Tricycles	0.3
Construction Vehicles	2.5
Others (Bicycles, non-motor)	0.3

Source: JICA Design Team

(6) Capacity Analysis

1) Types of Analysis

The types of analysis that are performed for further assessment are as follows:

- Road sections capacity analysis of intersections,
- Queuing analysis,
- Intersection delay and level of service (LOS),
- Signal optimization of signalized intersections.

For the intersection analyses, the traffic engineering software, will be utilized. The analyses by the Software are conducted in accordance with the Highway Capacity Manual (HCM) 2010, issued by the Transportation Research Board of the National Academies of Science in the United States. HCM is a most widely used and accepted traffic analysis technique that serves as standards of several countries in defining their respective road capacity manuals.

For this study, level of service (LOS) is the parameter being used to examine the capacity of road sections and intersections. LOS is a standard index used to analyze the operating conditions of a given roadway segment or intersection. It is standard norm for public roads to maintain LOS D or better at existing intersections and roadway segments. A grade system of the LOS is defined by VCR as shown below.

2) Road Section Capacity Analysis

Volume Capacity Ratio (VCR) is used as indicator of the road section's degree of congestion as shown in Table 6.2.6. It is derived by dividing the actual traffic volume/ hour by the road's capacity. In theory, if the value of VCR approaches 0.85 or greater, the subject road section is already congested. Table 6.2.6 relates the congestion ratios (based on VCR) to the categories of LOS.

Table 6.2.6 VCR Criteria for Road Section Capacity Analysis

LOS	Characteristics	VCR
A	Condition of free flow with high speeds and low traffic volume wherein drivers can choose desired speeds without delays.	0.00 – 0.19
B	In stable flow zone wherein drivers have reasonable freedom to select their speed.	0.20 – 0.44
C	In stable flow zone wherein drivers are restricted in selecting their speed.	0.45 – 0.69
D	Approaches unstable flow and nearly all drivers are restricted. Service volume corresponds to tolerable capacity.	0.70 – 0.84
E	Traffic volumes near or at capacity and flow is unstable with momentary stoppages.	0.85 – 1.00
F	Forced or congested flow at low speeds with long queues and delays.	greater than 1.00

Source: JICA Design Team

3) Queuing Analysis

Queue length is one of the primary measures of intersection performance, whether signalized or unsignalized. Queue develops when demand exceeds capacity or when arrival headway is less than the service time. Queue length is expressed in terms of meters (m). Queue length in meters is calculated by multiplying total vehicles in queue by 7.62 meters (25 feet).

4) Intersection Delays and LOS

Another main operating parameter in determining LOS in an intersection as specified in HCM 2010 is the average vehicle control delay per vehicle. Delays are calculated in terms of seconds per vehicle (sec/veh) per approach and for the entire intersection.

Unsignalized and signalized intersections have different delay ranges primarily due to driver expectation. Signalized intersections are designed to carry higher volumes of traffic and therefore higher levels of delay are acceptable. Table 6.2.7 summarizes HCM's description of the different LOS levels for unsignalized and signalized intersections, respectively.

Table 6.2.7 LOS Criteria for Unsignalized and Signalized Intersections (HCM)

LOS	Average Control Delay per Vehicle		Remarks
	Unsignalized	Signalized	
A	≤10	≤10	Progression is very favorable; most vehicles arrive during green signal; most vehicles do not stop. Short cycle lengths may also contribute to low delay.
B	10< ≤15	10< ≤20	Progression is good and/or cycle lengths are short. More vehicles stop than for LOS A, causing higher levels of average delay.
C	15< ≤25	20< ≤35	Progression is fair and/or cycle lengths are longer. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many vehicles still pass through without stopping.
D	25< ≤35	35< ≤55	Progression is unfavorable, cycle lengths are long, or has a high flow rate to capacity ratio. Many vehicles stop, and the proportion of vehicles not stopping diminishes. Individual cycle failures are obvious.
E	35< ≤50	55< ≤80	Progression is poor, cycle lengths are long, and has a high flow rate to capacity ratio. Individual cycle failures are frequent occurrences.
F	50<	80<	Progression is very poor, cycle lengths are long. Many individual cycle failures. Arrival flow rates exceed the capacity of the intersection. This level is considered unacceptable to most drivers.

Source: JICA Design Team

5) Signal optimization of signal intersections

Traffic conditions changes over time. One way of maintaining desired LOS at intersections is by regularly updating the intersection's traffic signal cycle lengths, phasing and timing to correspond to the current traffic flow conditions.

(7) Result of Analysis

1) Current Traffic Condition

Feature of current traffic condition is shown below.

- Peak hour in current traffic is 7:00 – 8:00 AM weekday.
- Almost full capacity at major intersections in peak hour.
- Longest Average Max queue distance/ rail level crossing was observed as 253m/ train passing at Dr. M. L. Carreon St., between Pandacan and Paco on 5:00 PM to 6:00 PM.
- Maximum average dwell time/ rail level crossing was observed as 2.92 minutes/ train passing at Maugay (East), close to Buendia Station on 9:00 AM to 10:00 AM, without early morning.

Results of analysis will be organized with estimated future traffic condition.

2) Estimated Future Traffic Condition

An estimation of growth ratio of general traffic in future is progressing by demand forecast expert. Analyses in future will be done after provided it.

6.2.2 Economic loss due to traffic congestion during construction period

Economic loss due to traffic congestion during construction period will be estimated considering a result of Traffic Impact Assessment (TIA). Table 6.2.8 shows estimated severe traffic congestion points during construction period.

Table 6.2.8 Traffic congestion points in construction period

Area	Point	Description
North Section	FTI	• Construction while operating PNR • Considering Subway Project is crucial, especially extension operation between South Line and Subway. • Construction of transition section underground/ ground level will affect general traffic (FTI - Bictan).
Middle Section	Bictan, Alabang	• Construction while operating PNR • Construction site, PNR and trunk roads are in close. • Queuing length for level crossing is not enough.
South Section	Mamatid, Calamba	• Poor road network around proposed depot site • Detour route is limited for lack of road network in east side of PNR.

Source: JICA Design Team

6.2.3 Coordination with Participant

Traffic congestion has already occurred on the proposed railway alignment, and the reasons for the congestion are clearly defined. It is also important to get the cooperation of administrative agencies and the full support of the local leaders in the area in order to implement these traffic management measures, and for railway operators to grasp the development of the region in the future and to take part in the role of reducing the influence on the traffic along railroads. The related organizations are listed below and the adjustment with them is described.

- **MMDA**: NCR is a high density area, and serious obstacles can occur due to slight traffic changes. MMDA is responsible for the development of NCR area, and it is necessary for the business entities to adjust for the construction in this area and the measures for traffic related to railway management.
- **LGUs**: LGUs are responsible for the development of their area, and it is necessary for the business entities to adjust for the construction in this area and the measures for traffic related to railway management.
- **DENR**: Construction project contractor and the railway administrator are responsible for the negative impact on the broader environment caused by new traffic along the railroad (for example, the increase in noise vibration due to the dump truck during the construction period, the increase in the noise vibration of the feeder car efforts for noise and air pollution accompanying concentration) are required. These efforts need to comply with the standards enacted by the national law, and it is important for the business entities to coordinate mainly with DENR.

6.3 Guideline for Safety Management Plan

6.3.1 Basic Policy of Safe Management Plan

JICA prepared The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects in September 2014 (hereinafter referred to as "the Guidance") and has been making efforts to secure the safe construction works of the ODA projects based on "the Guidance" and to establish and spread the Japanese "Safety Culture" in Japanese ODA Projects.

As the management of safety in construction works is one of the important targets of ODA projects, it is very important to plan and execute an effective safety control of the construction works to prevent occupational and public accidents in NSRP-South (hereinafter referred to as the Project).

According to the purpose of JICA in connection with the ODA construction works mentioned above, this Guideline for Safety Management Plan (hereinafter referred to as "the Guideline") that will show the basis on the safety management plan of the construction works to be prepared by the Contractor will be prepared based on "the Guidance" and will form a part of the Tender Documents of the Project.

The specific areas to be considered in preparing the detailed safety management plan by the Contractor may include the following:

- Heavily crowded residential areas and/or squatter areas along the railway truck where electric wires are stretching densely in all directions, access roads to the construction sites are mostly narrow and areas for construction works are very limited,
- Areas along and/or close to a railway currently under operation where mostly high tension electric wires are stretching along the railway truck, 、
- Areas adjacent to streets with heavy traffic and/or narrow access roads to the construction sites,
- Areas along and/or close to a railway currently under operation where many squatter people are earning by operating skates or trolleys on the railway truck illegally, and
- Proposed most railway bridges will critically intersect the railway bridges or stations of LRT, and/or road bridges.

6.3.2 Studies being Undertaken

The studies and work that are being undertaken in connection with the safety management of the construction works of the Project are as follows:

- Detailed study and confirmation of the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects prepared in September 2014,
- Detailed study and confirmation of Final Report on NSCR-SOUTH LINE (PNR SOUTH) Project,
- Reconnaissance survey and confirmation of the site conditions of the Project area,
- Brief study and confirmation of the laws and regulations in the Philippines concerning the safety management on construction works of the Project, and

- Confirmation of the results/outputs of the detailed design of the Project structures and reflection of them to the Guideline.

6.3.3 Tentative Table of Contents

The table of contents of the Guideline for Safety Management Plan tentatively proposed will be as follows:

1. General Rules
   (1) Purpose
   (2) Scope of Application
   (3) Safety Management Plan
   (4) Roles and Responsibilities of Project Stakeholders

2. Basic Policies for Safety Management
   (1) Basic Principles
   (2) Compliance with Relevant Laws and Regulations
   (3) Safety Management by PDCA

3. Safety Plan
   (1) Composition
   (2) Compliance with Composition

4. Method Statements on Safety
   (1) Composition
   (2) Sample Template
   (3) Technical Guidance for Safe Execution of Works

5. Common Technical Guidance for Safe Execution (by Type of Works)

6. Special Technical Guidance for Safe Execution (by Type of Works)
   (1) Construction of Girder by Span-by-Span Method
   (2) Construction of Girder by Cantilever Method
   (3) Construction of Girder by Cast-in-Place Concrete Method
   (4) Cast-in-Place Concrete Foundation (Earth-drill Method)
   (5) Foundation Improvement Works

7. Technical Guidance for Safe Execution (by Type of Accidents)
   (1) Measures for Prevention of Train Accident
   (2) Measures for Prevention of Electric Accident
   (3) Measures for Prevention of Other Accidents

CHAPTER 7 PMO and O&M

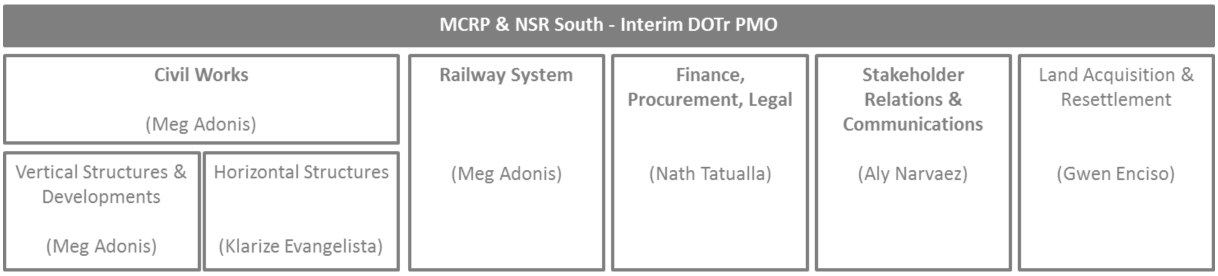
7.1 PMO

In this section, Project Management Office (PMO) of DOTr is described. It is the official entity which must be created by the department order or same-level document to help facilitate the smooth implementation of the project.

7.1.1 Organization Structure

(1) PMO at BD/DD phase

As of January 2018, six counterpart personnel of DOTr PMO in charge of MCRP and NSRP-South have been appointed to liaise with JDT for each discipline/jurisdiction as shown in the figure below. For issues requiring interface among the disciplines/jurisdictions, coordination among these officers will be arranged. For example, if there are legal issues in civil works, the personnel in charge of civil works respond in coordination with others in legal area.



Source: JICA Design Team based on the information Provided by DOTr

Figure 7.1.1 Organization Structure of DOTr PMO (Interim)

(2) PMO at Construction phase

Since man-power and knowledge for massive document-review and coordination work among stakeholders will be required in DOTr during construction phase, an increase in capacity of DOTr PMO is indispensable. DOTr also understand that they have to strengthen its human resources, and mentioned that the organization shown in Figure 7.1.1 will be reformed to the official PMOs with 25 officers as many as MMSP's PMO by early 2019 as shown in Figure 7.1.2.

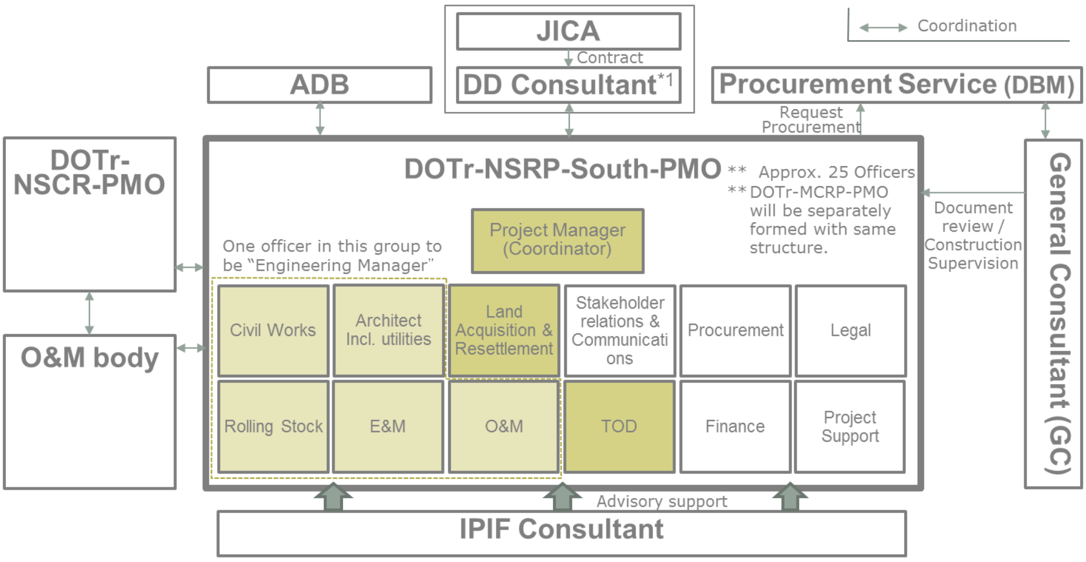
In particular, risks related to site availability, interconnectivity, construction and approvals are expected to be managed by the key personnel in DOTr PMO who possesses qualification listed in the Table 7.1.1 below.

Table 7.1.1 Key Positions of PMO

Major Risks *1					
Types of Risks	Description	In Charge			
Availability of Site	Risk that tenure/access to a selected site which is not presently owned by government or Private Partner cannot be negotiated. Risk of costs and delays in negotiating land acquisition	x	x	x	
Interconnectivity	Interconnectivity refers to the physical linkage of a project to another or to part of a network.	x	x		x
Construction	Risk that events occur during construction that prevent the facility from being delivered on time and on cost.	x	x		
Approvals	Risk that additional necessary approvals required during the course of the project cannot be obtained.	x	x		
Key Personnel *2					
Positions	Role / Criteria *2				
Project Manager (PM)	PM must act as a coordinator with external entities to run the project smoothly. He/She must possess B.S. in Engineering and, at least, five (5) national infrastructure projects' experience in project coordination. Project Management Professional certification holder is preferable.				
Engineering Manager (EM) *3	EM must be an internal coordinator to organize engineering team in PMO unit. He/She must possess B.S. in Engineering and, at least, five (5) national infrastructure projects' experience in engineering position. M.S. in Engineering is preferable.				
Land Acquisition & Resettlement	This position is expected to report critical issues in its team to PM. He/She must possess a bachelor decree and three (3) national infrastructure projects' experience in land acquisition & settlement position.				
Transit Oriented Development (TOD)	This position is expected to report critical issues in its team to PM/EM. He/She possess B.S. in Engineering and three (3) national infrastructure projects' experience in transport.				

*1: From Generic Preferred Risks Allocation Matrix (GPRAM) by the PPP Center of the Philippine
*2: It is not final, now under DOTr's consideration.
*3: Engineering Manager (EM) is an internal coordinator to organize engineering team (Civil /Architect /RollingStock /E&M /O&M) in PMO unit from a cross-cutting perspective. One officer in engineering team should take this position.

Source: JICA Design Team



According to "objective and purpose of the assignment" of Infrastructure Preparation and Innovation Facility (IPIF) consultant for transportation, they are expected to support DOTr with project preparation activities by providing access to international sources of innovation, expertise, advice, and best practices.

Source: JICA Design Team based on the information provided by DOTr and ADB website

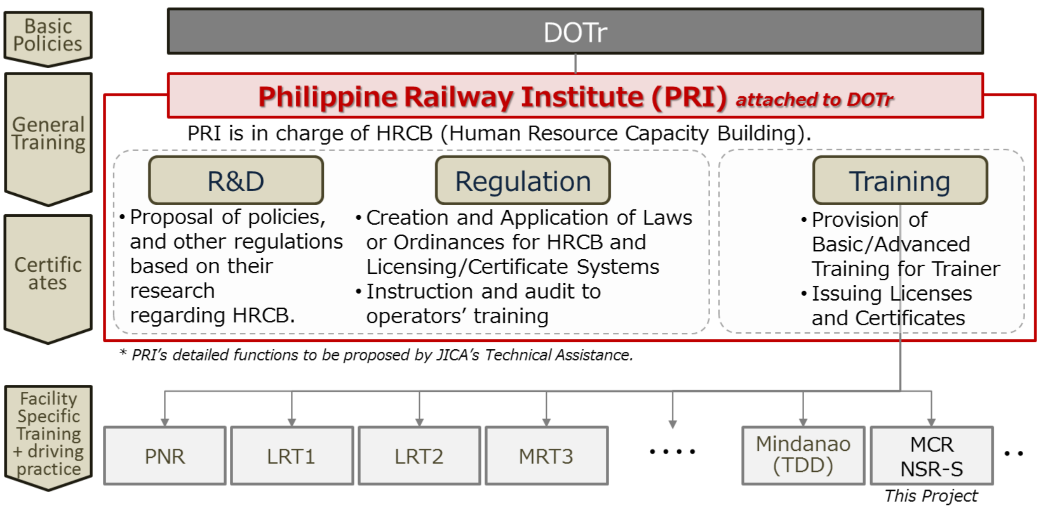
Figure 7.1.2 DOTr PMO for NSRP-South during Construction Phase

(3) Governmental Bodies After Construction Phase

As of the reporting date, there are two operating bodies attached to DOTr: PNR and LRTA. PNR is the entity established under Republic Act No. 4156 to serve as the instrumentality of the Government of the Philippines in providing a nation-wide railroad and transportation system. LRTA is a wholly owned government corporation created in July 12, 1980 under EO No. 603, as amended by EO No. 830 dated September 1982 and EO No. 210 dated July 1987 respectively. LRTA is primarily responsible for the construction, operation, maintenance and/or lease of light rail transit systems in the Philippines.

In addition to those two bodies, new bodies are now being planned to secure operational quality of railway operators in the Philippines. The one is Philippine National Railway Authority (PNRA) which is proposed as a part of "Philippine National Railway Restructuring" by the House Bill No. 6593 in October 2017. In this bill, the said Authority will regulate all aspects of the existing and the future railway operated ether by government and by private sector in Philippines.

The other one is Philippine Railway Institute (PRI) which is expected to promote/foster human resource capacity building. The establishment and capacity enhancement of PRI is scheduled to be supported by JICA technical assistance for 5 years from spring 2018. As shown in Figure 7.1.3, PRI is expected to have R&D and regulatory functions, and to provide general training to railway operators. Each railway operator must perform its facility-oriented-trainings as per regulations and training curriculums provided by PRI.



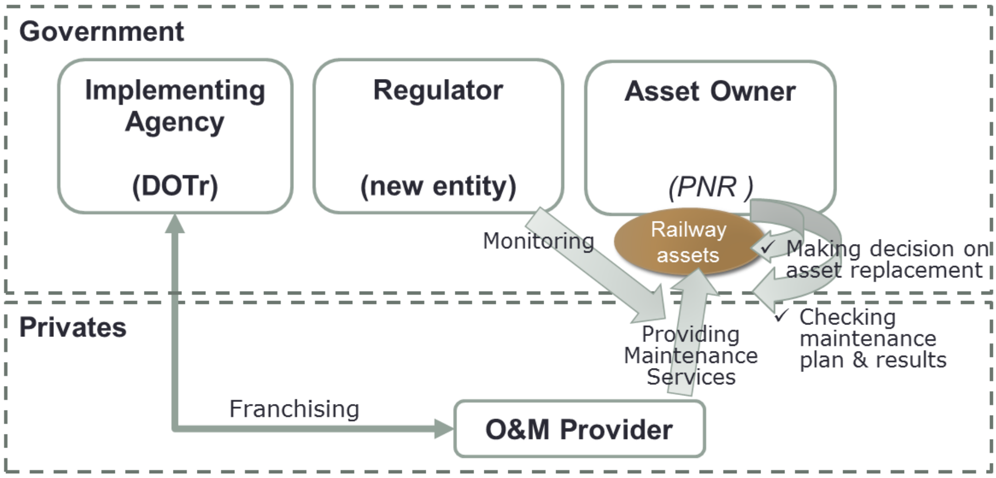
Source: JICA Design Team based on the information provided by DOTr

Figure 7.1.3 Concept of Philippine Railway Institute

In this project, the hybrid style PPP scheme is considered by GOP as other infrastructure projects are trying to apply same scheme under the 'Build, Build, Build' program. Under this scheme, the asset is retained by government, while the O&M services are provided by the private. Clark International Airport expansion project is the first hybrid PPP project rolled out under the Duterte administration. It is the joint project of DOTr and BCDA which takes the role of project implementer and asset owner. O&M service provider is being selected through the bidding invited by the project implementer: i.e. BCDA. The successful bidder will provide O&M services as per the standards set-out by the related regulators such as Civil Aviation Authority of the Philippines (CAAP).

In railway sector in South-East-Asia, Singapore public transport sector is applying a similar scheme. O&M services are provided by the railway operators, and the assets are owned by governmental body, namely Land Transport Authority (LTA). In terms of asset management, LTA has responsibility of: 1) supervising railway operators' maintenance plan and activities, and 2) making a decision on asset replacement.[1]

In the MCRP/NSRP-South, it is planned that a governmental entity other than the regulator hold the assets like Clark airport project. As of the reporting date, PNR is considered to be a default candidate of asset owner. The project implementing agency will be DOTr same as NSCR project. (Figure 7.1.4)



There may theoretically be two alternative options for an asset owner: one of Government Financial Institutions (GFIs) in terms of financial viewpoint, and a newly established body for this purpose.

Source: JICA Design Team based on the information provided by DOTr

Figure 7.1.4 Assumed Scheme related to Railway Assets

7.2 O&M Organization

In this section, described hereunder is the organization in charge of railway O&M after the completion of construction.

7.2.1 Study Policies on O&M Organization

Under the DOTr's policies, O&M is to be implemented as O&M service provider in a PPP scheme. DOTr has expressed its opinion to JDT that study on O&M organization is not required in this study, since TOR for O&M services will be formed by a transaction advisor. However, some factors of O&M organization, such as staff number, are required for design of facilities. O&M cost is required for assessment of the project viability. From those reasons, O&M organization has been studied as the basis for the project formulation and implementing framework.

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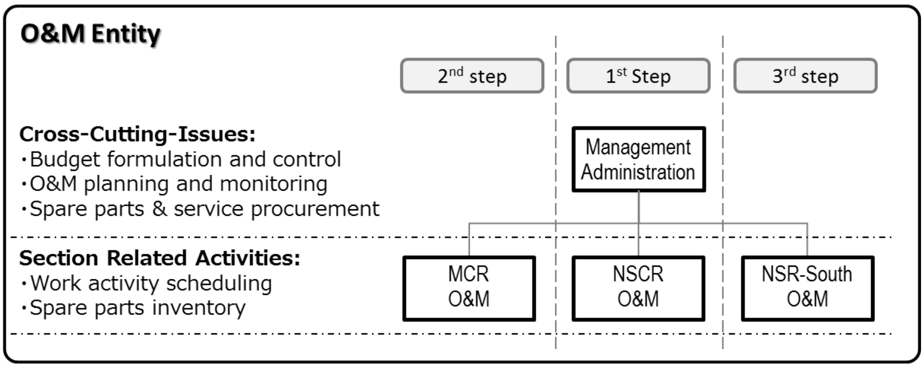
1 LTA website, https://www.lta.gov.sg/apps/news/page.aspx?c=3&id=aaf9044c-a3aa-49b5-a74a-61d634a7aa14

DOTr is planning three sections: NSCR already on-going by ODA loan, MCR and NSR-South, to be seamlessly operated by a sole entity. In other words, an entity operating NSCR will extend its scope to MCR and then to NSR-South. In this scenario, basic structure of O&M organization will be composed of two layers as shown in Figure 7.2.1. Upper layer will cover cross-cutting issues, while lower layer will take care activities related to the section.



Source: JICA Design Team

Figure 7.2.1 Basic O&M Structure

7.2.2 Study Method for O&M Organization

As described in the previous subsection, O&M organization structure is to be assumed as the basis for the project formulation and implementing framework. There are largely two factors: staff number for facilities design and O&M cost for assessment of the project viability.

As for management & administration layer, since its facility will be prepared at NSCR stage, only cost aspect is considered by index calculation in this study. As for the NSR-South O&M layer, since it is purely railway line section specific elements, the number of workforce should be estimated for facility design based on the assumed O&M activity, and cost must be accordingly estimated as per calculated man-power.

Table 7.2.1 Study Method for O&M Organization

Layer		# of People	Personnel Cost
Head Quarter	Increase in man-power will be required to cover NSR-South line.	(It is not calculated in this project.)	To be estimated by index calculation
NSR-South Unit	Purely added to NSCR organization.	To be estimated based on O&M activities assumed by JDT	To be estimated as per man-power assumed in the left column.

Source: JICA Design Team

7.2.3 O&M Organization

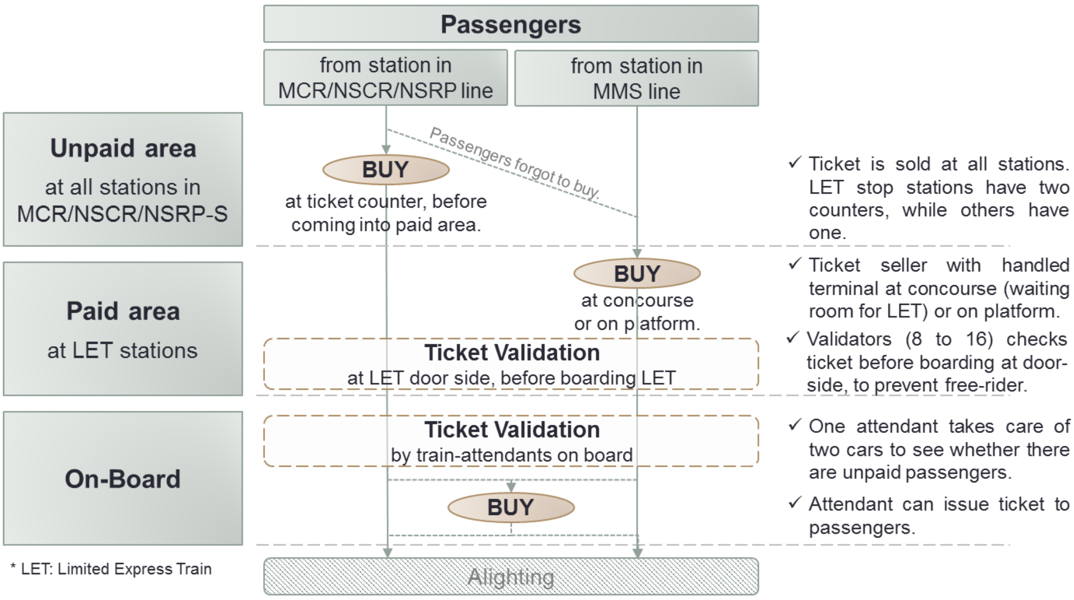
From the viewpoint of its characteristics as a railway operator, it can be largely divided into three parts: operation, maintenance and human resource training.

On the assumption that all cross-cutting issues, such as making train-diagram for all 3 sections, consolidating inspection and maintenance work plan, and procurement works, are managed by management and administration level, the following tasks are allocated to NSR-South O&M unit.

(1) Operation

Railway services are collaboratively operated by people at train, station and OCC. Train contains a driver and attendants in case of limited express for ticket validation. Station covers ticketing, passenger inquiries and securing train approaching/departing. OCC manages train operation and monitors station/facility condition remotely. In addition to the tasks above, train crew management has to be considered at the depot area.

As described in the Chapter 4, tickets for traveling and limited express train seat reservation are separately handled. Ticket for traveling is managed as existing urban railway does. Ticket for limited express train seat is the one newly introduced in this project. In order to design the required equipment and the O&M unit for the ticket handling, its process is assumed as follows: Basically, a passenger has to buy limited express ticket before the station gate. For a passenger unable to do so, such as a passenger coming from MMS line, a ticket seller is allocated at a waiting room or on a platform of the limited express train stop stations. Validators are assigned at limited express door positions on a platform to check the ticket before boarding. For further confirmation, an attendant accompanying each two train-cars checks whether a seat unsold is occupied by a passenger or not using a handheld terminal connected to a server. In case that a passenger without a seat ticket is found, an attendant sells a ticket using a handheld terminal.



Source: JICA Design Team

Figure 7.2.2 Limited Express Ticket Selling and Validating Method

(2) Maintenance

It is expected to conduct planned inspection and maintenance properly as per the overall plan comprehensively consolidated at management and administration layer. Resource allocation planning and spare parts & tools inventory are performed at the depot of each line. It is better that workers for inspection and emergency response are located at the place near track and/or station to restore facility/track etc as earlier as possible.

JDT assumes that Planning and management work and inspection work are conducted by direct-hiring, and the site work is performed by external service providers in consideration of local business circumstances.

(3) Human Resource Training

Training and capacity building of railway operators is one of the most important factors for safe and stable railway operation. As indicated in the section 7.1, each railway operator is expected to cover facility specific training at its own premises based on the PRI's common training/education programs.

As mentioned in the previous paragraph, MCR/NSR-South railway operator will cover operational aspect including inspection work by direct-hiring, while maintenance work is performed by external entities under service provider agreement. In this regard, its training will focus on only operational aspect to maintain its own resource's technical level. Maintenance workers must be trained by service provider to full fill the agreement with O&M organization.

Although the detailed training courses shall be determined according with PRI's training and human development policies and guidelines, any documents have not yet been issued from PRI at this reporting date. In order to proceed the training facility design, hereinunder, JDT assumes the basic training courses in MCR and NSR-South in reference to Japanese railway operator's training program, basic strategy of PRI and the discussions with DOTr.

Generally, training courses in Japan consist of 2 categories: 1) regular training for keeping an ability for safe railway operation; and 2) accident recovery drill. As per PRI and DOTr training strategy, Driver's reskill training and safety countermeasure training are added. As a result, four categories are defined under the operator's training courses.

Left: example of accident recovery Right: example of regular training

Source: JICA Design Team

Figure 7.2.3 On-Site Training at East Japan Railway

As mentioned previously, since railway services are collaboratively operated by people at train, station and OCC, those people must be periodically trained. OCC system is generally equipped with a stand-alone training mode in its own. Therefore, OCC operator training should be performed in the OCC building. As for the remaining two categories, since it is difficult to conduct a training at its workplace, it must be provided in the place exclusively for training purpose, i.e. training center.

Under the concept of a sole railway operator for a series of 3 lines: MCR, NSCR and NSR-South, Training program should be considered based on common operation rules and manners. Constructing a common training center for MCR and NSR-South has an advantage rather than 2 individual training centers not only because of economic reason but improving the quality of operator's skill in cooperative training. Training center is usually located in the depot because of the easiness of using reserved cars and test track and having a joint training with E&M engineers without interference to mainline operation. Because MCR depot is scheduled to be constructed earlier than that of NSR-South, the location of common training center for both lines should be in MCR depot to provide a training as earlier as possible.

The following items are basic training courses to be provided in the training center.

1) Regular Training

Every drivers and station attendants shall take a monthly regular training (1~2 hrs.) for keeping a good operation skill and an aware of safe railway operation. In consideration of facility/equipment capacity such as train simulator, E&M equipment study kit and station mock up, 5~10 trainees are suitable for this training class.

2) Accident Recovery Drill

It is not only for reskill of each railway stuff but also to achieve a smooth and effective cooperation work between train operation department and E&M engineers in railway accident. This training shall be held at test track and reserved train for studying an actual recovery operation.

3) Practice/Re-skill Training

PRI proposes the annual reskill drill for drivers. PRI is expected to issue common railway driver's license in the Philippines. The drivers will have practice training at each operator's line before starting a commercial operation and reskill drill every 3years. The detail program will be decided when PRI disclose driver's license program. Those programs will be implemented with a train simulator training and practice running in the training center.

4) Safety countermeasure drill

The purpose of this drill is improving knowledge and skill of railway stuff to cope with emergency situations (emergency cases such as fire, vandalism etc)

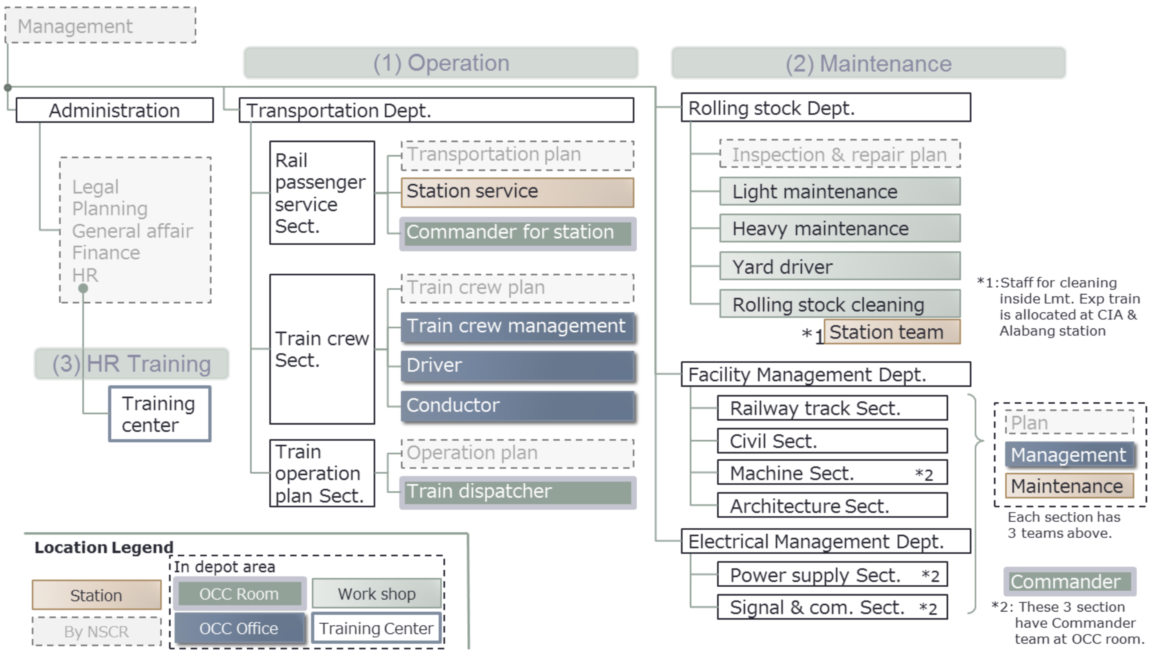
Table 7.2.2 Basic Training Plan of MCR/NSR-South

Training Course	Trainee	Outline of Training/Drill	Course Period/ Duration/#of Trainees
Regular Training	• Station attendant	• Operation and daily check of ticketing machines • Operation of safety and service equipment at station • Service training for station passengers	Monthly • 1 ~ 2 hours • 5~10 trainees
	• Train driver	• Case study for preventing railway accidents • Safety train operation training with a train simulator • Emergency measures in case of train trouble	
Accident Recovery Drill	• Station attendant • Train driver • E&M Engineer	• Recovery drill using a reserved train and test track * The script is prepared based on the actual accidents * joint-training with train operation division and engineering	• Once a year • 1 day • 50~100 trainees
Practice /Re-skill Training	• Train driver	• Practice running and training based on operator's line characters. <precondition> PRI covers the following points: * General training & licensing of driver * Periodical training and examination (every 3 years)	As per PRI regulation
Safety Countermeasure Drill	• Station attendant • Train driver	• Firefighting drill • Emergency evacuation drill (Black out / Flood etc.) • Countermeasures for vandalism	• Once a year • 1 day • 10~20

Details of training courses must be developed by O&M company as per PRI guidelines and its company policies.

Source: JICA Design Team

Based on the concept described above, the organization structure is drawn up as shown in Figure 7.2.4 and the number of required staff for the MCR O&M section is figured out in Table 7.2.3, Table 7.2.4 respectively.



Source: JICA Design Team

Figure 7.2.4 O&M Organization Structure

Table 7.2.3 The Number of Required Staff for the NSR-South Operation as of Oct/2023

Organization Structure			Work location					Human-power					
				RollingStock Depot				Position					Total
				OCC									
Department	Section	Role	Station	OCC room	Office	Work shop	Training center	Manager	Chief	Staff	Inspection Engr.	Service Provider	
Operation													
Transportation	Rail passenger service	Station service: Sales of tickets. Passenger inquiry correspondence, safety confirmation of train departure on the platform	*					20	100	780	-	-	900
		Commander for station: Monitoring of stations, Passenger inquiry correspondence, Adjustment of crew and rolling stock with other lines in case of incident		*				1	5	18	-	-	24
		Ticket validator: Limited Exp. ticket sales and validation on platform	*					-	-	135	-	-	135
	Train crew	Train crew management: formulation and management of crew plan concerning crews in own line section. inventory control of goods			*			1	-	26	-	-	27
		Driver: Train operation. Correspondence in the case of unusual incident			*			-	4	93	-	-	97
		Attendant: Ticket validation and sales on limited exp.			*			-	-	79	-	-	79
	Train operation plan	Train dispatcher: Monitoring of train operation at way-side/in yard premises. Data-input of train-diagram for own line section. Formulation and management of train operation plan on own line section in the case of incident		*				-	-	20	-	-	20
Total								22	109	1,151	-	-	1,282
Total by Hiring Types											1,282	-	1,282

Table 7.2.4 The Number of Required Staff for the NSR-South Maintenance /Training as of Oct/2023

Organization Structure			Work Location					Human-power					
				RollingStock Depot				Position					
				OCC									
Department	Section	Role	Station	OCC room	Office	Work shop	Training center	Manager	Chief	Staff	Inspection Engr.	Service Provider	Total
Maintenance													
Electrical Management	Power supply	Management: *1						1	3	15	-	-	19
		Inspection engineer: Inspection of substation, overhead contact line and power distribution. Emergency restoration in case of incident	*2			*2		-	-	-	240	-	240
		Maintenance commander		*				-	5	10	-	-	15
	Signal and communication	Management: *1			*			-	2	8	-	-	10
		Inspection engineer: Inspection of signal &communication. Emergency restoration in case of incident	*			*		-	-	-	160	-	160
		Maintenance commander		*				-	5	10	-	-	15
Facility management	Railway track	Management: *1			*			1	1	7	-	-	9
		Inspection engineer: Inspection of track. Emergency restoration in case of incident	*			*		-	-	-	80	-	80
	Civil	Management: *1			*			-	1	4	-	-	5
		Inspection engineer: Inspection of structure. Emergency restoration in case of incident	*			*		-	-	-	80	-	80
	Machine	Management: *1			*			-	1	4	-	-	5
		Inspection engineer: Inspection of machinery. Emergency restoration in case of incident	*			*		-	-	-	20	-	20
		Maintenance commander: Monitoring of machinary, Providing work orders to maintenance team		*				-	5	10	-	-	15
	Architecture	Management: *1			*			-	1	4	-	-	5
		Inspection engineer: Inspection of building equipment. Emergency restoration in case of incident	*			*		-	-	-	20	-	20
Rolling stock	Light maintenance (daily inspection, emergency responding)						*	-	1	7	12	-	35
	Train operation inside yard premises						*	-	-	-	17	-	-
	Rolling stock cleaning: cleaning of train at depot and terminal station.		*	*			*	-	-	-	-	-	94
							Total	3	31	101	600	129	864
							Total by Hiring Types				735	129	864

*1: Formulation and management of inspection and repair plan on own line section. Inventory control of goods.
*2: They are allocated to Depot, Alabang and Paco station.

Source: JICA Design Team

7.2.4 O&M Cost Estimation

Based on the O&M organization assumed in the previous subsection, O&M cost is estimated herewith for a part of project IRR calculation presented in the subsection 8.3.

(1) Estimation Method

In order to reflect the concept of sole operator for a series of 3 sections, O&M cost is estimated based on the following policies on the presumption that an entity operating NSCR extend its services to north and south respectively. Because of railway industry nature, O&M cost composes 4 items: personnel, electrical power, maintenance and other administration cost. Personnel cost for O&M unit and power cost are direct cost which is incurred directly in each section. Those items are simply evaluated as direct charge based on required staff number and power consumption. The other two costs are estimated based on the indirect costs (indirectly incurred such as management and administration layer) is accounted by allocating NSCR cost on a basis of indicators like operating-km.

Based on this calculation method, O&M costs of MCRP and NSRP-South can be estimated respectively. Whole O&M cost including NSCR project can be also extracted. Table 7.2.5 shows cost items and its calculation methods.

Table 7.2.5 O&M Cost Composition and Calculation Methods

Items	Description	Calculation
Personnel	Employee of Management and Administration	(NSR-South's O&M personnel cost / NSCR's O&M personnel cost) x NSCR's administration personnel cost
	Employee of O&M Org. *1	# of people [nos.] x average personnel cost [PHP/nos.]
Electric Power *2	Electric Power for Operation Activities	Consumption [kWh] x Tariff price [PHP/kWh]
Maintenance	Material and Outsourcing services	(NSR-South's operating km / NSCR's operating km) x NSCR's maintenance cost *3
Other administration *4	Tax, stamp fee, professional services etc	(Personnel + Power + Maintenance) x 0.3

*1: Salary level is estimated at the level of an entity established under the Philippine corporation code. Departments and staff number required by the O&M organization will be extracted based on functions required for railway O&M activities.
*2: Consumption [kWh] is estimated based on the JDT's design. Tariff price [PHP/kWh] is based on Industrial, PHP5.65/kWh@2015, announced by the Department of Energy (DOE).
*3: It includes man-power-out-sourcing fee and consumables.
*4: Other miscellaneous includes Common Carrier Tax (CCT), stamp fee, professional service fee etc are included here.

Source: JICA Design Team

(2) Results

Based on the assumption above, O&M cost is estimated as Table 7.2.6 below.

Table 7.2.6 Estimated O&M Cost of NSR-South Section

Items [Million PHP@2018]	2022	2023	2025	2040
	Open to CIA from May	-	Extend to NCC	Train Head is Increased
Personnel	367	903	940	367
Electric Power	99	1,380	2,339	99
Other administration*1	164	1,171	2,086	164
O&M Total	630	3,454	4,858	630

*1: It includes maintenance cost.

Source: JICA Design Team

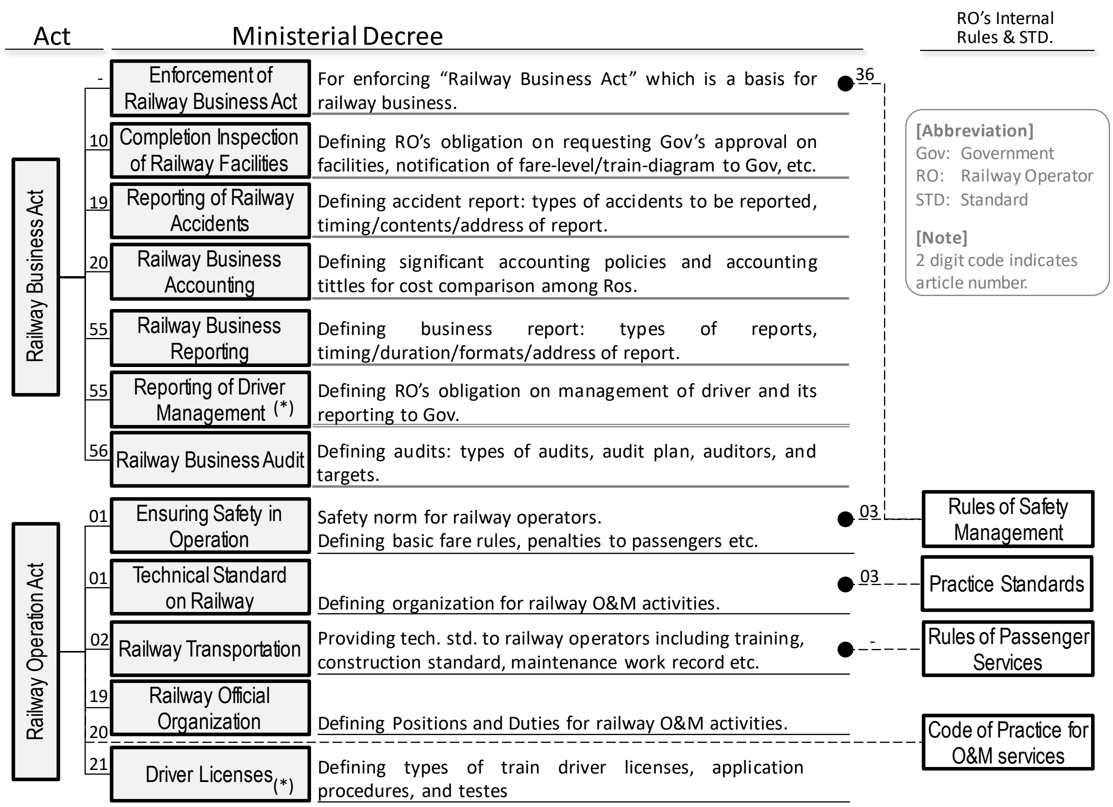
7.3 Consideration Points at Operation Stage

In this section, the points to be considered by the regulator and the O&M company at the operation stage are described respectively.

7.3.1 Consideration Points under the Regulator at Operation Stage

Currently, all railway transport is operated directly by regulatory bodies: PNR, LRTA, and DOTr without any common regulations and standards. In other words, they are running railway business based on its own internal rules and standards. The Bill no. 6593 pointed out that this framework has not successfully regulated the railway systems in ensuring that they are efficient, safe and comfortable modes of transportation. Under this situation, it becomes a challenge for GOP to regulate railway operation provided by a private entity.

In Japan, there are two acts and a lot of ministerial decrees comprehensively regulate railway business from the various viewpoints: planning, construction, operation, maintenance, statutory reporting, auditing, and abolishing. In order to ensure safe and sustainable operation, railway operators develop its internal rules and standards based on the said regulations. In particular, formulation of "rules of safety management", "practice standards" and "code of practice for O&M services" are stipulated in Japanese acts and decrees. (Figure 7.3.1)



(*) The guidelines for train driver licenses and management will be developed by the PRI project.

Source: JICA Design Team based on MLIT's information

Figure 7.3.1 Japanese Acts & Ministerial Decrees and Operator's Rule related to Railway Sector

It is expected the regulator to form the railway act, standards and supervising flamework such as monitoring and audits to regulate the railway operations ether by government and by privates in whole Philippines. For NSCR/MCR/NSR-South lines, in particular, the following three points must be taken into account in terms of PPP scheme.

(1) Service Level

In general, the level of the service provided by an operator is assessed via Key Performance Indicator (KPI). The regulator must deeply understand what kind of KPIs must be set, and define its monitoring method and frequency to effectively and efficiently manage the service. In addition to normal O&M activities, the rules for emergency response must be defined. In Japan, the Enforcement of Railway Business Act stipulates that railway operators must prepare "Rules of Safety Management". (Figure 7.3.1)

(2) Long-term Plan on Assets

Under the hybrid PPP scheme, the asset ownership is retained at the GOP, while the O&M services are provided by a private entity. In this case, long-term asset plan including the decision whether to replace or repair the assets should fall into the GOP responsibility, since infrastructure asset's life cycle is longer than PPP concession period. It is better to make a decision on asset replacement from the viewpoint of asset owner like Singapore public transport authority does it. The regulator and the asset owner must collaboratively develop asset management processes under clear policies and objectives.

(3) Fare-Level

Philippines scored high growth rate recently. It could affect O&M activities from the viewpoint of financial sustainability. In order to immunize against high economic growth rate risk exposure, fare-setting must regularly be reviewed by the regulator whether it reflects current economic condition in Philippines. The regulator must obtain fare-revision framework.

7.3.2 Consideration Points under O&M Company at Operation Stage

(1) Financial Aspect

At the beginning phase including the duration before starting commercial operation, O&M company will have to run its business with few operating-cash-in-flow. In order to respond this situation, financial support by GOP mentioned in the chapter 7 and current-assets held in the O&M company are indispensable. In particular, current-assets: cash and cash equivalent; and inventories such as spare parts for maintenance must be secured to sustainably run its business before starting commercial operation. Taking into consideration these points, the Financial statements of O&M company: financial position, comprehensive income and cash flows, will be like the tables shown in the chapter 8.

(2) Technical Aspect

Internal rules and standards of O&M company are the basis for managing O&M activities efficiently and safety. In Japan, the ministerial decrees including "Technical Regulatory Standards on Japanese Railways" are set forth to secure the safe and stable railway transport. Under these decrees, a railway operator is required to formulate its internal rules and detailed implementation standards that reflect the actual state of affairs at individual railway business operators. For example, the following points must be developed by themselves under its operation policies.

1) Human Resource Development

As mentioned in the section 7.2, basic training plan described in this chapter is tentatively assumed menu for training facility design work. O&M company must develop the internal rules for human resource development and the details of training courses as per PRI's guidelines and it company policies.

2) Facility Optimization

Signs are tools for supporting smooth and safe operation. In Japan, operators develop own rules to adopt its own facility nature. Its figures and types vary depends on operator's rule. In this project, O&M company may be required to develop its own rules and standards in this area to operate in safe and effective.

3) Emergency Response

When an accident happens, an operator must respond immediately and efficiently to keep the damage at a minimum. To be able to take action in the actual situation, developing internal rules and regularly conducting drills are indispensable.

7.4 PPP Feasibility

7.4.1 Overview of PPP Legal Systems in the Philippines

The legal framework for PPPs in the Philippines dates back to 1990 with the enactment of the Republic Act 6957 entitled, "An Act Authorizing the Financing, Construction, Operation and Maintenance of Infrastructure Projects by the Private Sector, and for other Purposes". Certain sections of the said law were eventually amended through Republic Act 7718 (otherwise known as the "BOT Law" and its accompanying Implementing Rules and Regulations (IRR) in 1994. Later on, the Aquino Administration that took office in 2010 recognized the importance of PPP as a means of private sector-led infrastructure development scheme and made further amendments to the IRR of the said law to facilitate the country's PPP program.

In 2010, PPP legal systems were functionally reinforced through Executive Order No. 8. 2010, transferring the institutional attachment of the Build-Operate and Transfer (BOT) Center from the Department of Trade and Industry (DTI) to the National Economic and Development Authority (NEDA). The organization was eventually renamed the Public-Private-Partnership Center of the Philippines (PPP Center). After launching many successful PPP projects, there has been a move to further revise this BOT Law into a so-called "PPP Act". Among the items being considered for inclusion in the proposed PPP Act are modernization of the BOT Law, institutionalization of the existing best practices and prioritization of the PPP program so it can help accelerate national infrastructure development. As of August 2018, the draft bills are at a stage of consolidation at the respective committee level and are under review at both the House of Senate and House of Representatives.

The Duterte Administration that took office in 2016 looked into promoting "Hybrid PPPs" wherein the public funding through the General Appropriations Act (GAA) allocations and Official Development Assistance (ODAs) are utilized for infrastructure development while with operations and maintenance of these said infrastructures are undertaken through PPPs. It appears the application of this type of PPP is assumed for projects with large capital outlays such as railway and airport projects.

The amended BOT Law specifies various kinds of PPP modalities such as Build-Operate-Transfer (BOT) and Build-Transfer-Operate (BTO). Generally, in PPP projects in the Philippines, the private sector is expected to maintain the infrastructure and collect fares from users. In this sense, the private sector assumes demand risks in many cases. This type of contract scheme was adopted in many toll highway projects. In the selection of a private operator, certain bid parameters are set for instance wherein the bidder with the highest concession fee (price for the rights to operate the facility) is awarded.

In the meantime, in cases wherein financial viability is low but economic benefits of a private investment may be high in a PPP project, the implementing agency is allowed to offer funding support in the form of Viability Gap Fund (VGF) to the private sector. In the selection of a private operator, the bidder with the lowest VGF is awarded the PPP contract.

Table 7.4.1 PPP Modalities based on the BOT Law

PPP Modality	Role of Private entities	Fee Collection
Build-Operate-and Transfer (BOT)	Financing, construction of an infrastructure facility, and O&M over a fixed term	Based on the BOT contract. Tolls, fees, rentals, and charges are collected from facility users
Build-and-Transfer (BT)	Financing and construction of an infrastructure or development facility	Based on an agreed payment schedule, the total investments expended on the project with a reasonable rate of return will be received
Build-Own-and-Operate (BOO)	Financing, construction, ownership, O&M of an infrastructure or development facility. The project proponent may assign O&M to a facility operator	Tolls, fees, rentals or other charges are collected from facility users to recover its total investment, O&M costs plus a reasonable return
Build-Lease-and-Transfer (BLT)	Financing and construction of an infrastructure or development facility, and leasing to the government	Based on an agreed schedule, lease payments are received
Build-Transfer-and-Operate (BTO)	Financing and construction of an infrastructure facility on a turn-key basis. Operation by the project proponent once the title of the facility is transferred to the government.	Based on the BTO contract
Contract-Add-and-Operate (CAO)	Additional construction to an existing infrastructure facility which it is renting from the government	Based on the CAO contract. Under agreed terms and schedule, rental payment will be made to the government
Develop-Operate-and-Transfer (DOT)	Construction and operation of a new infrastructure, inclusive of development of adjoining property	Fee collection based on the DOT contract and benefits from higher property or rent values etc.
Rehabilitate-Operate-and-Transfer (ROT)	Refurbishment and O&M of existing facility	Based on the ROT contract
Rehabilitate-Own-and-Operate (ROO)	Refurbishment, O&M of existing facility. Unless the operator is in violation of its franchise, it can continue to operate the facility in perpetuity	Based on the ROO contract. The government has an option to share income with the project proponent.

Source: Amended IRR of the BOT Law and IRR

Another characteristic of PPPs in the Philippines is that it allows submission of unsolicited proposals. Private sector proponents may submit unsolicited proposals for projects in which some economic benefits can be derived. Such proposals must not be listed in the government specified priority project list of implementing agencies. However, even for those listed projects, the private sector can still submit unsolicited proposals and may be accepted if it utilizes a new concept and technology to implement such.

Unsolicited proposal projects are not eligible for any government guarantee, direct subsidies and direct government investment. In the case of the Philippines, right-of-way (ROW) is also considered as a kind of government support and therefore it should not be considered in unsolicited proposals. On the other hand, provision of land by the government for a lease expense of private sector is not considered as government support and can be considered in unsolicited proposals.

If an unsolicited proposal is approved through government evaluations by NEDA and the concerned Implementing Agency (IA), the IA confers an Original Proponent status on the proponent that submitted the original proposal. The IA then posts essential aspects of the proposed unsolicited project on general newspapers for 3 weeks to solicit possible alternative proposals that would be compared against the original one. In 60 days, if no alternative proposal is submitted, then the Original Proponent is awarded the project. On the other hand, if an alternative proposal provides better terms to the government, the Original Proponent is given a chance to match the offer of the alternative bid or propose even better terms and in such case, the Original Proponent will win the bidding. On the other hand, if the Original Proponent does not match the alternative proposal or provide better terms than the ones offered by the alternative proposal, the entity that submitted the most favorable alternative proposal is awarded the contract. Such system is often referred to as the "Swiss Challenge" system.

7.4.2 Current Policy on PPP Application to Projects

As mentioned, the Duterte Administration promotes, especially in large projects, "Hybrid PPP" where the public sector, including ODAs, undertakes infrastructure development and operation and maintenance is carried out through a PPP scheme.

It is assumed that the PPP scheme is applied to O&M part of the projects covered by this study ("Malolos-Clark Railway Project" and "North-South Railway Project-South Line (Commuter)", with the 180km section between NCC and Calamba including NSCR which is separately planned).

7.4.3 PPP Utilization in the Railway Project in the Philippines

(1) Recent Trend

As of February 2018, there are three railway-related PPP projects that have been contracted to the private sector and three more are under review or evaluation (one of them being an unsolicited proposal) according to the PPP project pipeline of the PPP Center. The contract period of LRT Line 1 Cavite Extension and O&M is 32 years as it involves large infrastructure development. However, railway passenger fare collection system development and operation is contracted for less than 10 years due to the relatively low project cost. Operation and Maintenance of LRT Line 2 is a project which is focused on operations and maintenance and has a relatively shorter 15 year contract term.

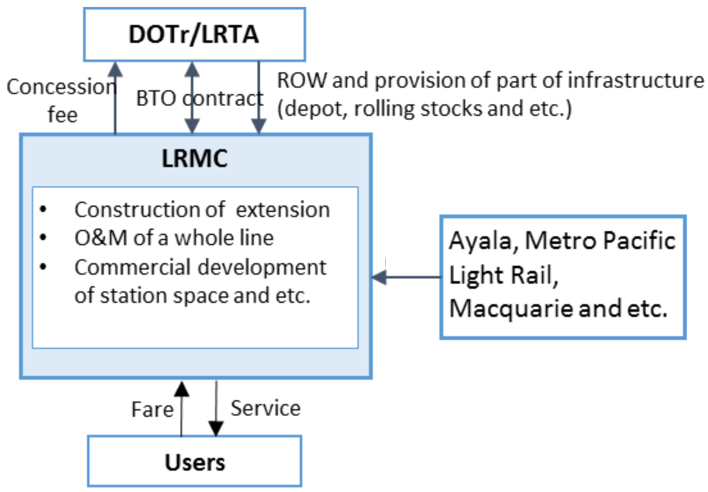
Among the risk allocation aspects between public and private sector in railway PPPs, demand risk is an especially predominant element. In LRT Line 1 Cavite Extension and O&M, while the concessionaire is responsible for demand risks, it is entitled to acquire the fare box revenue and implement station area development to further boost commerciality.

In the Operation and Maintenance of LRT Line 2, fare box revenue belongs to DOTr. However, during its PPP project development stage, revenue sharing by the public and private sector was also examined from the perspective of incentivizing private sector.

Table 7.4.2 Railway related PPPs in the Philippines as of February 6th, 2018

Project Name	Summary	PPP Modality	Total Project Cost (Billion PHP)	Status
Automatic Fare Collection System (AFCS)	Replacement of old ticketing system to contactless-based smart card technology called the Beep Card on LRT Line 1 and 2 and MRT Line 3, with the introduction of a centralized back office that will perform apportionment of revenues. The private sector operates and maintains the fare collection system.	10 years inclusive of 2 years for development / delivery	1.72	Completed
MRT Line 7 Project	Financing, design, construction, operation & maintenance of the 23-kilometer elevated railway line from San Jose Del Monte, Bulacan to MRT 3 North Avenue in Quezon City and the 22-kilometer asphalt road from Bocaue Interchange of the North Luzon Expressway (NLEX) to the intermodal terminal in Tala.	BGTOM	62.70	On-going civil works
LRT Line 1 Cavite Extension and O&M	Extension of the LRT Line 1 from its existing Baclaran Station to the future Niyog Station in Bacoor, Cavite which is approximately 11.7 kilometers. The approximately 32.4 kilometers of whole stretch of the integrated LRT 1 will be operated and maintained by the private proponent.	BTO 32 years inclusive of construction	64.90	Ongoing soft renovation and upgrades of LRT Line 1 existing system
Operation and Maintenance of LRT Line 2	The O&M of the existing LRT Line 2 from Recto to Santolan, the 4-kilometer East Extension from Santolan to Masinag and any future extensions to be implemented by the government during the term of the project.	O&M contract (15 years)	No CAPEX	Under review of implementing agency
LRT Line 6 Project	The financing, design, construction, operations and maintenance, including procurement of the rolling stocks and systems, of a new 19-kilometer light rail line from Niyog to Dasmariñas City in Cavite.	BGTOM/ BT+O&M	65.09	Under review of implementing agency

Source: PPP Center



Source: JICA Design Team

Figure 7.4.1 PPP structure of LRT Line 1 Cavite Extension and O&M

Table 7.4.3 Railway related Unsolicited Proposal in the Philippines as of Feb. 6th, 2018

Project Name	Summary	PPP Modality	Total Project Cost (Billion PHP)	Status
East-West Rail Project	The financing, design, construction, operation and maintenance of a mostly elevated 9.4-kilometer railway line with 11 stations from Diliman, Quezon City to Lerma, Manila. The proposal was submitted by the consortium of East West Rail Transit Corporation and AlloyMTD.	TBD	TBD	On-going evaluation of the members of the ICC-Technical Working Group

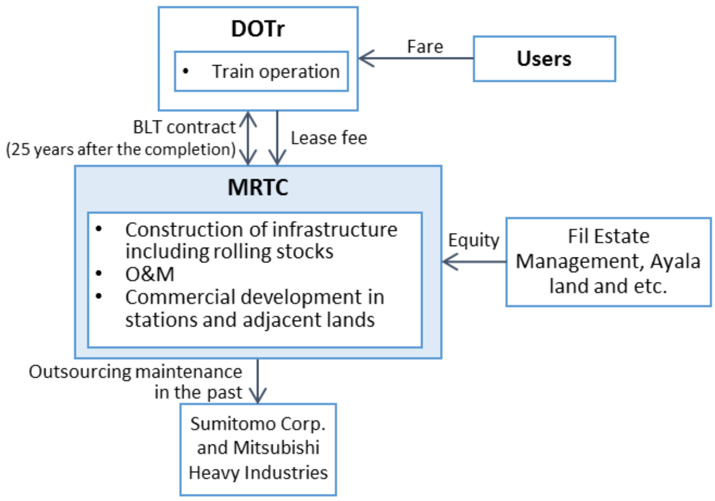
Source: PPP Center

(2) PPPs in the Philippines before the enactment of the amended BOT Law (MRT3 PPP project)

A railway project not listed in the PPP Center project pipeline is the MRT3 (Manila Metro Rail Transit System) project. MRT3 is an elevated railway developed along EDSA which is considered the busiest road in Metro Manila, connecting south and north part of Metro Manila. The length of the line is 16.9 km, going through major parts of Manila such as Ortigas and Ayala. MRT3 started its partial operation in 1999 and went on full operation the year after.

In 1995, DOTC (now called DOTr) signed a Build-Lease-and-Transfer (BLT) contract with MRTC (Metro Rail Transit Corporation), a private consortium. Under the contract, after MRTC built the railway-related infrastructure, it was set to lease the infrastructure to DOTC for 25 years. Then DOTC was responsible for its operation. The MRTC on the other hand, was responsible for maintenance and gains maintenance fee revenues from DOTC. Until 2012, MRTC outsourced the maintenance work to Japanese companies (Sumitomo Corporation and Mitsubishi Heavy Industries, Ltd.). In addition, MRTC was entitled to develop the land related to the railway for commercial use.

In order to implement the project, MRTC raised USD 190 million from a loan syndication including Export-Import Bank of Japan (currently called Japan Bank for International Cooperation or JBIC). However, over the course of the infrastructure development, the company ran out of money and received additional funding of USD 465 million in 1997. The facility came from export credit agencies of Japan and the Czech Republic, as well as some international and domestic private banks. After the start of operation, DOTC was supposed to take demand risk and pay predetermined lease fee as well as maintenance fee to MRTC. Noticeably, the lease fee was set relatively high compared to infrastructure development cost and passenger fare was set low, leaving DOTC with a substantial burden to service the demand risk and the lease fee.



Source: JICA Design Team

Figure 7.4.2 PPP structure of MRT 3 project

After the contract of maintenance works with the Japanese companies expired in October 2012, other local and international companies took over the task through contracts with shorter durations than the original one. Such contract terms proved counterproductive as contract cancellations occurred before maturity due to supposed shortcomings from maintenance providers' side. This unstable maintenance structure is generally assumed as one of the main reasons for the relatively high number of operational troubles and system malfunctions of MRT3. In line with this situation, JICA started a technical study of the entire system MRT3 system and there is a move to improve the infrastructure and operations.

Table 7.4.4 History of maintenance contract of MRT 3

Period	Contractor	Contents	Service Term	Amount
1997-2012	Japanese Companies (Sumitomo Corporation and Mitsubishi Heavy Industries)	Maintenance & Spare parts	10 years + three extensions	1.4 million USD / month
2012-2013	Local companies (PH-Trams)	Maintenance only (each month)	One year	57 million PHP / month
2013-2014	Autre Porte Technique Global Inc. (APT Global)	Maintenance only	One year and six months	131.28 million PHP / month
2015	Schunk Bahn-und Industrietechnik GmbH (SBI) and Commbuilders & Technology Philippines Corporation (CB&T).	Maintenance & Spare parts	Six months	57 million PHP / month
2016-2017	Korean companies (Consortium of 5 companies including Busan Transportation Corporation and others)	Maintenance, overhaul 43 Rail stocks, refurbishment of signal system, etc.	Three years however the contract was terminated in 2017	3.9 billion PHP for three years(About 9.4 billion JPY)

Source: JICA Design Team

7.4.4 Railway PPPs in Other Countries

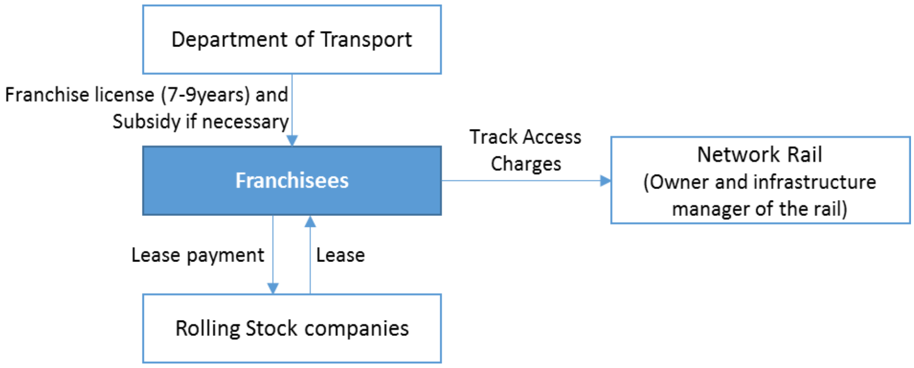
PPPs have already been adopted in many developing and developed countries. Railway PPPs are generally classified into two types: one is the full package PPPs in which a concessionaire finances, designs, constructs and manages the infrastructure for a certain period. The other type is structured wherein the concessionaire is in charge of O&M while the public sector is responsible for financing, designing and constructing the infrastructure. If the project is carried out as a PPP, it is highly likely that the operation and maintenance phase of this project will be managed through a PPP scheme. This section summarizes the characteristics of other railway PPPs in operation elsewhere in the world: franchise PPPs in the UK and Sydney LRT PPP, an Availability Payment type PPP.

(1) Passenger Railway Franchises in the UK

Under the initiative by the Conservative administration in the UK, nationally owned and managed British Rail was privatized in 1994. Unlike the privatization of the Japanese National Railways in Japan, the privatization of the British Rail broke the railway system into several operational sections: passenger transportation services, freight services, railways, rolling stocks, among others. In terms of passenger transportation services, the existing railway network was reorganized into 25 different train operating companies (TOCs) depending on regions and routes. TOCs were then offered to private companies as separate franchise for generally 7-9 year franchise term. Each TOC franchisee is selected through bidding process. At the bidding, the government presents passenger transportation service requirements (service level, upgrading, performance etc. of train service) as well as conditions on fare setting. Bidder which proposes the lowest subsidy from the government (or the highest payment to the government in case of TOCs where surplus is expected) is deemed the winner of the bidding. As British Rail was horizontally privatized, ownership and maintenance of railway infrastructure was passed on to Railtrack, a newly established company that was later acquired by Network Rail in 2002. Therefore, the railway infrastructure maintenance is not included in the scope of TOC franchisees. On the other hand, TOC franchisees are supposed to pay fees to Network Rail for their rail usage.

Moreover, TOC franchisees neither purchase nor possess rolling stocks: they lease rolling stocks from either one of three Rolling Stock Companies (ROSCOs) which were established through the British Rail privatization. As for the station facilities and space, TOC franchisees rent them from the Network Rail and obtain sub-rental incomes from retail businesses.

The purpose of adopting a franchise scheme in the UK’s rail system was meant to achieve both improved high quality service and reduction of subsidy utilizing private sector know-how and experience. However, it is worth noting that the amount of subsidy has not been reduced despite privatization. Moreover, cancellation of franchise contracts due to low profitability before and during franchise contract execution resulted in erosion of trust in the consistency of railway service. To avoid the inconsistency of the railway service, in recent years, the UK Government negotiated directly with the incumbent operators. These cases are called “Direct Awards”.



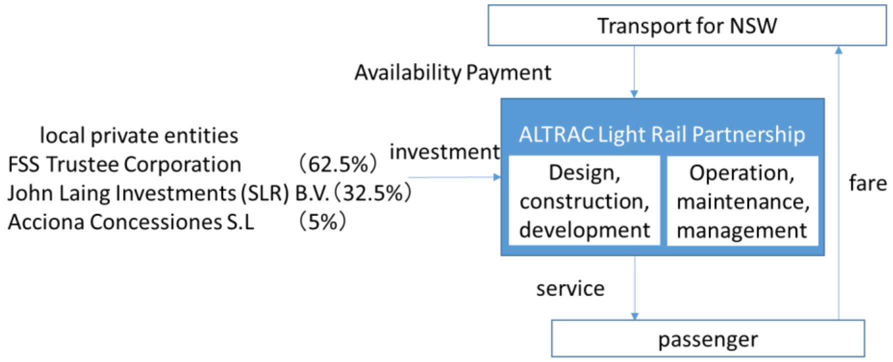
Source: JICA Design Team

Figure 7.4.3 Structure of Railway passenger franchises in the UK

(2) Sydney Light Rail PPP project

Australia introduced PPP in 1980s due to severe fiscal shortfalls of the government. However, the application of the scheme was limited to some areas such as road and water utility systems. In 2008, the Council of Australian Governments (COAG) approved the National PPP Policy and Guidelines. The guideline rationalized related basic PPP polices and guidelines across the Commonwealth, states and Territory. Its main feature is clear demarcation that core project services should be provided by public sector and non-core service (services other than core service such as cleaning, security and maintenance of social infrastructure) is handled by the private sector. This demarcation was intended to avoid causing material inconvenience to people’s lives in the case of the private sector bankruptcy. According to the guideline, projects with capital expenditures costing more than 50 million Australian Dollars are subject to Value for Money (VfM) analysis. Through these efforts, the PPP scheme in the country was utilized in a wide array of infrastructure development and operation in both economic (road, railway, airport etc.) and social (school, hospital, penitentiary etc.) infrastructures.

Sydney Light Rail PPP is a light railway project implemented under a 20-year PPP contract between Transport for NSW, a New South Wales government agency and ALTRAC Light Rail Partnership. The light railway system connects Circular Quay in the Central Business District (CBD) in Sydney and Randwick and Kingsford in the Southeastern suburban part of the city. The 12km (19 stops) CBD and South East Light Rail line (CSELR) costs 2.1 billion Australian Dollars with a target start-up in 2019 is currently under construction. The VfM of this project is estimated 92.5 million Australian Dollars.



Source: JICA Design Team

Figure 7.4.4 Structure of Sydney Light Rail PPP

With the necessary ROW provided by the public sector, the concessionaire undertook construction of the CSELR including design, construction and development. In line with this, once the infrastructure system is completed, it also operates and maintains the system together with the IWLR, an existing line. Demand risk is 100% borne by Transport for NSW. The public sector sets the fare amount, collects fare box revenue and makes monthly Service Payments to the concessionaire, which includes availability payment. If the concessionaire fails to meet certain pre-agreed standards such as timely operation, Service Payment is reduced as per SLR PPP's output specification. On the other hand, incentive payments are provided in line with positive customer satisfaction and revenue management.

Table 7.4.5 Sydney Light Rail PPP Service Payment calculation

	Addition / subtraction	Service Payment components	Measurement
(a)	+	Availability fee	Indexed
(b)	+	Insurance component	Benchmarked
(c)	+	Life cycle component	Indexed
(d)	-	Availability deduction	Measured against missed services
(e)	-	Timeliness deduction	Measured against frequency and total journey time
(f)	-	Service quality deduction	Measured against service quality KPIs
(g)	-	Revenue management deduction	Measured against service quality KPIs
(h)	+	Energy amount bid	Measured against the base energy volume and base network volume
(i)	-	Energy adjustment	Measured against a demand usage strategy designed to minimize network demand charges
(j)	+	Customer satisfaction payment	Measured against service quality KPIs
(k)	+	Revenue management payment	-
(l)	+	Asset management adjustment	Measured against compliance with the maintenance work program
(m)	+	Floating rate amount	Measured against quarterly interest rate movements
(n)	-	Final completion deduction amount	Calculated in months where OpCo has not achieved final completion
(o)	-	Transport for NSW's share of gross commercial revenue	-
(p)	-	Ticket collection amount	-
(q)	-	Traffic signal aggregate delay amount	Measured against the traffic signal delay set out in the SPR

Source: Transport for NSW, "Sydney Light Rail Public Private Partnership Contract Summary"

For measurement of service quality performed by the concessionaire, the following 8 key performance indicators (KPIs) were set out.

Table 7.4.6 Sydney Light Rail PPP service KPI

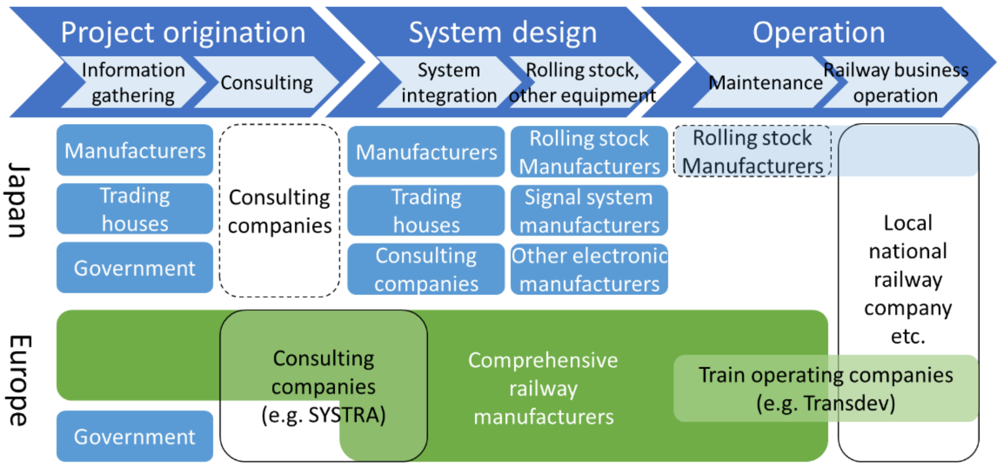
KPI #	Service Quality KPIs	KPI weighting
1	Vehicle cleanliness, condition and graffiti	20%
2	Stop and interchange cleanliness, condition and graffiti	10%
3	Corridor cleanliness, condition and graffiti	4%
4	Customer information	10%
5	Complaints management	4%
6	Customer satisfaction survey	36%
7	Asset Availability: systems at stops	6%
8	Asset Availability: systems on LRVs	10%
	Total	**100%**

Source: Transport for NSW, "Sydney Light Rail Public Private Partnership Contract Summary"

(3) Railway PPP Players around the World

According to UNIFE, an association of the European rail industry, the annual average world railway industry market from 2013 to 2015 is about 159 billion EUR (20.7 trillion JPY). Rolling stock and service segments take up 72% of the market and each sector is expanding at an annual rate of 5.8% and 4.9%, respectively. The expansion of the market is expected to continue and the market size from 2019 to 2021 is estimated to reach 185 billion EUR (24.1 trillion JPY).

Since a PPP scheme is expected to be adopted for the O&M of this railway project, railway O&M PPP players around the world are reviewed and summarized in the following sections.



Source: JICA Design Team based on MLIT "Overseas Expansion Strategy (Rail)"

Figure 7.4.5 Japanese and European Railway Businesses in Overseas Market

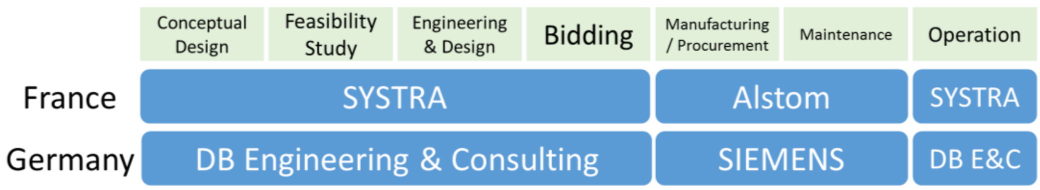
1) Japanese Players

Compared to European integrated railway businesses which typically cover most of railway business segments from upstream to downstream, Japanese counterparts are rather delineated across the value chain. Recently, some Japanese companies started to supply rolling stock together with maintenance service as a package. Hitachi supplied rolling stocks and launched a maintenance business in UK. On the other hand, East Japan Railway Company, together with Mitsui & Co. and Dutch Abellio, started a railway franchise business in also in the UK. Japan Transport Engineering Company supplied rolling stocks for the Purple Line in Bangkok, Thailand with maintenance services to be provided by Japan Transportation Technology (Thailand) Co. Ltd., a JV between East Japan Railway Company, Marubeni Corporation and Toshiba. However, railway system packages deal including rolling stock and O&M in PPP is still relatively limited for Japanese businesses.

2) The Other Players

In Europe, a system has been developed which enables European railway businesses to consistently engage in railway project from its inception phase. For example, in France, SYSTRA, an engineering company with extensive expertise in railway O&M, which is 42% owned by SNCF and another 42% by RATP respectively, helps their parent companies and their related railway operation companies such as an SNCF subsidiary Keolis expand their overseas railway businesses. The company operates in 20 countries and 55% of its employees are foreigners.

European comprehensive railway manufactures such as Alstom of France and SIEMENS of Germany collaborate with railway consulting companies such as SYTRA and DB Engineering & Consulting. It may be in their interest to incorporate EU standards into project specification to ensure European companies would have competitive advantages. As illustrated in Figure 7.4.6, comprehensive railway manufacturers also tie up with operators in their home country in bidding competitions as seen in joint bidding by Alstom and SNCF for high speed railway projects in Brazil and India.



Source: JICA Design Team based on MLIT "Overseas Expansion Strategy (Rail)"

Figure 7.4.6 Typical Railway Business Formation in Europe

The Mass Transit Railway (MTR), a railway operator in Hong Kong is aggressively expanding its overseas operations. The company participates in a number of overseas railway operation projects which include Beijing Metro Line 4 thirty year PPP, Shenzhen Metro Line 4 BOT, Stockholm Metro O&M concession, franchise businesses in the UK, Melbourne Metro O&M concession, Macau LRT Operation Consultancy and so on. The world largest rolling stock manufacturer CRRC Corporation

Limited of China expands its business through a package strategy. It sells rolling stocks together with maintenance service and it has set up a comprehensive maintenance service base in Malaysia.

Table 7.4.7 Railway O&M Related Companies

Entities (Country)	Overview	Revenue	O&M Related Activities
DB Engineering & Consulting (Germany)	• Owned by DB AG • Established in 2016 through a merger of DB ProjektBau (current DB's engineering company for infrastructure projects in Germany) and DB International (current DB's international engineering and consulting company) • More than 4.300 employees from 73 nations, located in 30 countries (5 core countries (Qatar, South Africa, Israel, Brazil, and USA) • Engineering: Design, Project management and project control, Realization management and construction supervision, Design review and acceptance test, Environment, geotechnics and surveying, Consulting: Business consulting, O&M, Logistics-	-	• UAE Etihad Rail DB Operation - operations through a JV • Qatar Integrated Railway Project: supporting operations as "shadow operator" • Metro Kochi India: consulting on O&M • China CRH: technical advisory to the maintenance of the high-speed fleet • South Africa: operations consulting for coal transport • Sydney Metro (North-West Rail Link): project management services in commissioning and operations
Systra (France)	• Railway engineering consulting firm • 42% owned by SNCF and RATP respectively • 20 overseas subsidiaries with 30 offices • 55% foreign employees • Main activity is consulting with occasional O&M Engagement	612 million EUR (2016)	• South Europe Atlantic HSL • Nantes-Châteaubriant Tram-Train • EOLE – Westward extension of the RER Line E • High Speed 1 – HSR Link between London and the Channel Tunnel • Manila Metro/LRT – Line LRT 1 • Chile: Santiago Metro (MRT) technical assistance
Keolis (France)	• 70% owned by SNCF • Actively engaged in overseas urban railway O&M • Operating in 21 cities in 16 countries • Employs 55,000 foreigners • International revenue breakdown (2016): Continental Europe 49%, North America 23.9%, Australia & New Zealand 21%, UK 5.9%	5,075 million EUR (2016)	• Norway: Bergen tram operation • The Netherlands: rail service • Germany: 12 year commuter rail (Rhine-Ruhr) operation contract • UK: 3 rail franchises (Southeastern, London Midland, Govia Thameslink Railway) and 2 tram network operation contracts (10 year operation contract for Metrolink in Manchester and Nottingham Trams) • North America: 2 USA rail network operations (VRE in Washington DC and KCS in Boston) and 1 Canadian tram network (Waterloo) to be launched in 2018 • Australia: 2 PPP contracts (10 year PPP O&M contract for the first new integrated multimodal public transport network (buses, ferries and a new light rail system) in Newcastle / 15 year O&M contract for Gold Coast tram network)

Entities (Country)	Overview	Revenue	O&M Related Activities
RATP Group (France)	• State-owned public transport operator headquartered in Paris, France. • Formed in 1948, as the public transport operator for the city of Paris. • Whilst the RATP's Paris operations are still a major part of the business, its operations have now extended to include businesses around the globe. These include involvement in the operation of bus, tram, rapid transit and inter-city rail services, located in Europe, Asia, Africa and the Americas (international revenue: 13%) .	5,447.8 million EUR (2016)	• RATP Dev Transdev Asia (RDTA), a JV with Transdev, operating: Metro Manila LRT Line 1, Seoul Metro Line 9 together with Veolia (divested), Mumbai Metro Line 1, Hong Kong tramways • Algeria: metro and tramway network operations • Morocco: Casablranca LRT • South Africa: Gautrain, regional express train • Italy: Florence tramway, 2 regional rail lines in Tuscany, Italy (minority share) • USA: the Washington DC tramway operation (5 years)
Transdev (France)	• Created by the merger of Veolia Transport and Transdev in 2011 • Operates in 19 countries. • Competitive in bus and tram businesses	6,600 million EUR (2017)	• New Zealand: Auckland Transport (AT) operation contract • Ireland: Dublin's light rail network operation • Spain: Barcelona light railway operation
MTR (Hong Kong)	• Hong Kong railway system developer & operator • Actively engaged in TOD along its network • Aggressively expanding overseas railway operations	55.4 billion HKD (2017) 8 trillion JPY * *1 KD = 14.5 JPY	• China: Beijing Metro Line 4 PPP / 4 Daxing Line O&M concession / 14 PPP (shadow tariff scheme) / 16 O&M concession (to be a PPP after full open), Hangzhou Metro Line 1 PPP / 1 Extension O&M concession / 5 (PPP, vertically separated, 25 year O&M, shadow tariff scheme) (under construction), Shenzhen Metro Line 4 BOT • Macau LRT Taipa Line (consultancy) • UK: 2 franchise (TfL Rail/Elizabeth Line, South Western Railway) • Stockholm Metro, MTR Express, Stockholm Commuter Rail (10 year concession including rolling stock maintenance) • Australia: Melbourne Metropolitan Rail Service (7 + 3 year O&M concession), Sydney Metro Northwest PPP the design, construction and financing, as well as the future O&M (under construction))
CRRC Corporation Limited (China)	• the largest rolling stock manufacturer in the world • employs 187,000 people, active through 70 subsidiaries in 103 countries including US, UK, Malaysia and South Africa • shifting to overseas expansion from rolling stock manufacturing for domestic market • one-stop business model including catenary and rail maintenance on top of rolling stock	207 billion RMB (3.5 trillion JPY) (2017) *1 RMB = 17 JPY	• O&M company in Malaysia • Tel Aviv metro (16 year maintenance contract)

Source: JICA Design Team

7.4.5 PPP Feasibility

(1) Risk Analysis

As pointed out before, the O&M of the 180km railway between NCC-Calamba or MCRP, NSRP-South including separately developed NSCR, is expected to be undertaken through a PPP. A set of general risk factors in railway PPP is shown in Table 7.4.8.

The PPP Center of the Philippines developed and published the Generic Preferred Risk Allocation Matrix (GPRAM). It shows rationales behind each risk allocation and bearable risk by public and private sector for practical foundation in PPP project formulation. For the risk allocation between public and private sector for this project, based on GPRAM, given that this is a railway project as well as an O&M PPP must be taken into consideration. Major related risks with this project are shown in Table 7.4.8

Table 7.4.8 Major Related Risks Listed in GPRAM

Type of Risk	Definition / Rationale
Availability of Site	Risk that tenure/access to a selected site which is not presently owned by government or Private Partner cannot be negotiated. Risk of costs and delays in negotiating land acquisition.
Risk Allocation with O&M Contractor	
Inter-Operability Risk	Interoperability risk refers to the risks associated with achieving clear and efficient operational arrangements with other facility operator/s. This will have to be considered in the project design and operation system requirements.
Commissioning	Risk that either the physical or the operational commissioning tests which are required to be completed for the provision of services to commence, cannot be successfully completed.
Exchange Rate	Risk that during operation, exchange rates may move adversely, affecting the Private Partner's ability to service foreign denominated debt and obtain its expected profit.
Inflation	Risk that value of payments received during the term is eroded by inflation.
Financing Unavailable	Risk that when debt and/or equity is required by the private firm for the project, it is not available then and in the amounts and on the conditions anticipated.
Sponsor Risk	Risk that the Private Partner "is unable to provide the required services or becomes insolvent".
Change in Ownership	Risk that a change in ownership or control of the Private Partner results in a weakening in its financial standing or support or other detriment to the project.
Tax Changes	Risk that before or after completion, the tax impost on the Private Partner, its assets or on the project, will change.
Lessee Risk	Risk that the major critical assets necessary for the operational stage of the project are acquired through leases and that the Private Partner defaults on those lease obligations. This leads to the assets being foreclosed and the operations of the project being interrupted.
Inputs/Operating Cost Overrun	Risk that required inputs during the operations stage cost more than anticipated, are of inadequate quality or are unavailable in required quantities.
Changes in Output Specification Outside Agreed Specification Range (Including Modifications and Augmentations)	Risk that government's output requirements are changed after contract signing whether pre or post commissioning.
Operator Failure/Short Fall in Service Quality	Risk that a subcontract operator may fail financially or may fail to provide contracted services to specification" (Failure may lead to service unavailability and a need to make alternate delivery arrangements with corresponding cost consequences.)

Type of Risk	Definition / Rationale
Technical Obsolescence or Innovation	Risk that the nature of the contracted service or its method of delivery is not keeping pace, from a technological perspective, with competition and/or public requirements. Private Partner's revenue may fall below projections either via loss of demand (user pays model) to competing services and/or operating costs increasing. Government may wish to change specifications of contracted service.
Third party liability	Risk that third parties file suits or claim damages against government for faults of the Private Partner and vice versa.
Demand Risk	Risk that operating revenues fall below forecast as a result of decrease service volume (i.e., traffic volume, water or power consumption) attributable to an economic downturn, competition in the relevant market tariff increases or change in consumer habits.
Changes in Competitive Network	Risk that an existing network is extended/changed/re-priced so as to increase competition for the facility.
Ancillary Commercial Businesses	Risk that ancillary commercial business operations adversely impact the Private Partner's fulfillment of PPP contractual obligations and/or pose additional exposures for government.
Industrial Relations	Risk of strikes or industrial action causing delay and cost to the project.
Approvals	Risk that additional necessary approvals required during the course of the project cannot be obtained.
Changes in Law/Policy	Risk of a change in law/policy of government only, which could not be anticipated at contract signing and which has adverse effects on revenues, capital expenditure or operating cost of the Private Partner.
Economic Regulation	Risk that where there is a statutory economic regulator involved there are pricing or other changes imposed on the private firm which do not reflect its investment expectations.
Availability of Government Appropriations	Risk in delays in government contractual payments to the Private Partner arising from unavailability of government budgetary appropriations.
Changes in Statutory Rates of General Application	Risk of changes in minimum wages and other regulated rates of general application affecting the Private Partner.
Force Majeure Risk	Risk that inability to meet contracted service delivery (pre or post completion) is caused by reason of force majeure events.
Default and Termination	Risk of 'loss' of provision by the Private Partner of contracted services upon the premature termination of project contract.
Residual Value on Transfer to Government	Risk that on expiry or earlier termination of the services contract the asset is not in the required condition term.
Risk Allocation with Design & Construction Contractor	
Interconnectivity Risk	Interconnectivity refers to the physical linkage of a project to another or to part of a network.
Construction	Risk that events occur during construction that prevent the facility from being delivered on time and on cost.
Maintenance and Refurbishment	Risk that design and/or construction quality is inadequate resulting in higher than anticipated maintenance and refurbishment costs.

Source: JICA Design Team based on the GPRAM by the PPP Center of the Philippines

There are some aspects wherein conventional PPP risk allocation would not apply for this project. For instance, the construction risk or completion risk should be borne by the public sector because design and construction is undertaken by the public sector. Therefore, some points in risk allocation and mitigation are shown below which need special attention in designing a railway PPP, especially if the project will mainly involve O&M.

1) Construction / Completion Risk

In GPRAM, it is basically assumed that a vertically integrated project is undertaken by the private sector. Therefore, construction and delay risk arising from construction is allocated to the private sector. Some mitigation measures are presented in GPRAM such as ensuring the implementing agency produce a Feasibility Study well in advance of the procurement process and ensuring ROW issues resolved before contract execution. In Sao Paulo Metro Line 4, a vertically separated project, public sector was obligated to inform the private sector of a possible delay 2 years prior to the original revenue start-up date. The project turned out to be delayed by almost 4 years due to procurement litigation, unavailability of counterpart funds, accidents caused by engineering defects resulting in 7 deaths and resettlement problems. These have led to the private partner seeking compensation for deferred revenues in operation. Finally, the private partner won arbitration with the state of Sao Paulo over compensation for the lost revenues. According to a World Bank evaluation, it is suggested to agree on very stiff penalties for delays in construction as well as bonus for earlier completion in PPP contract. Aside from these, it is suggested to set up clearly defined mechanisms to handle unanticipated delays. In the Sydney LRT PPP project, detailed “Relief Events” which allow certain penalties as well as incentives for delays and early completion were set out beforehand.

Table 7.4.9 Completion Risk Mitigations

Project	Mitigations / Suggested Contract Provision(s)
Sao Paulo Metro Line 4	Public sector to provide with a 2 year advance notice to private sector if delay can be expected.
Sydney LRT PPP	• Party in default is to bear delay risk / liability in the areas such as;. Public sector: approvals, legal challenges to the approvals, early works, Private sector: modification to planning approvals after financing close, responsibility to comply planning approvals, commissioning etc. • Pain and gain share mechanism (final completion deduction from Availability Payment / bonus payment for early completion) • Termination right for the public 2 years after the original completion date • “Relief Events” which are beyond private sector’s control allow certain project delays • Delay notice within 10 days after “Relief Events”
HSL-Zuid (The Netherlands)	• The project was composed of 3 major parts; infrastructure (public), rolling stock (Infrasepeed, a PPP JV) and operation (HSA a.k.a. NS Highspeed, the other PPP). • Delayed by a couple of years by incompatibility design of rolling stocks. • Eventually, completion risk was borne by the public to keep the operator unharmed.

Source: JICA Design Team

2) Maintenance and Refurbishment Risk

In GPRAM, poor design and/or construction quality resulting in higher than anticipated O&M costs is attributed to the private sector assuming a vertically integrated project. Because this railway project is vertically separated and the public sector undertakes infrastructure development, it is not likely the private sector bears maintenance and refurbishment costs caused by defective infrastructure development by the public sector. In order to achieve proper risk allocation and secure appropriate operator capability, O&M PPP procurement must accompany adequate information disclosure to private bidders at the time of bidding. Maintenance and refurbishment scope for the private sector must be clearly defined.

Table 7.4.10 Maintenance and Refurbishment Risk Mitigation

Project	Mitigation
Connex franchise in Victoria, Australia	• If the state decides that the latent defect requires rectification, it will pay for costs over and above the agreed level (initially 7 million AUD, later lowered to 3.5 million in favor of the private sector). • If it doesn't, neither the state nor the franchisees pay anything and there is no change to the infrastructure defect.

Source: JICA Design Team

The franchise agreement between the state of Victoria, Australia and Connex a railway operator specifies latent defect liabilities. This arrangement caps the maintenance and refurbishment risk of defects not known at the start of the franchise term at 3.5 million AUD for the private sector. The allocation of this risk is supposed to be reasonable from a VfM perspective as it reduces the unknown risks to the franchisees, who would have sought a premium to accept these risks. Usually, in vertically integrated PPP projects, construction sub-contractors eventually rectify any latent defects for a specified period of time from the date of practical completion (for example, 12 months). Nevertheless, as with identified defects, latent defects which arise at any time will remain the primary liability of the private sector through its contract with the public sector.

3) Demand Risk

According to the GPRAM, risk that operating revenues fall below forecast is borne by the private sector in concession PPPs because concession PPP is regarded as a financially independent modality. On the other hand, in availability PPPs, the public sector bears the demand risk. In concession PPPs, when demand and revenue can be estimated with relative certainty, the private sector is in a better position to mitigate risk through commercial management practices. In concession PPPs which are economically viable but not financially viable, a mitigation measure is presented; the public sector may assume some (capped) demand risks; and, the public sector may want to share 'super-profits' in concession PPPs. On the other hand, in availability PPPs, government is best placed to control/manage demand and the Availability Payment is made irrespective of facility usage.

Generally speaking, demand forecast in green-field projects is associated with relatively higher uncertainty compared with that in brown-field projects. Therefore, various attempts are made in railway projects in order to properly share demand risk between public and private sector such as minimum revenue guarantee and demand risk mitigation band.

Table 7.4.11 Railway Demand Risk Mitigations

Mitigation	Project	Overview
Minimum Revenue Guarantee	Seoul Metro Line 9	• When PPP concessionaire's actual revenue falls below certain level of originally agreed breakeven point, the gap between the actual and the certain level is paid by Seoul Metropolitan Government. • When actual revenue exceeds more than 10% of the breakeven point, the exceeding gap is refunded to the public sector. • After commencement of the service, when the actual revenue falls below 90% of the breakeven point, the gap was funded by the public sector. However, when the actual revenue fells even further below 50% of breakeven point, there is no subsidy from the public sector). • This initially 90% threshold was set to decrease by 10% in every 5 years and continues for 15 years until 2023. • The line stated in 2009 and for the 12 month period stated on July 2009, the public sector paid 14.2 7 billion KRW (1.427 billion JPY). • Finally, after disputes over fare setting between Seoul Metropolitan Government and the private sector, the Minimum Revenue Guarantee system was abolished.
Demand Risk Mitigation Band	Sao Paulo Metro Line 4	• When passenger number falls below the expected volume by 10%, the state government pays subsidy to the private sector SPC. The amount of subsidy differs by the extent to the shortfall in the passenger number (band). If the passenger number exceeds more than 10% of the expectation, the SPC make payments to the public sector.

Source: JICA Design Team

4) Economic Regulation Risk

In concession PPP contracts, concessionaires are usually given certain discretion to petition the revision of passenger fares to some degree. However, in consideration for passenger sentiment, approving public agencies tend to withhold fare rise approvals in many cases. Clear and appropriate fare setting and revision arrangement in PPP contract and proper implementation of such arrangement is needed. Consistent and stable regulatory framework which allows fare rise reflecting the change of economic environment during the project period is important to secure financial PPP viability.

Table 7.4.12 Fare Setting Cases

Project	Overview and notes
Seoul Metro Line 9	■ Fare setting and revision system The base initial fare of 1,000 KRW was set with the discretion to raise fare every year with CPI cap. ■ Implementation - The fare increase proposed by the private sector was not approved by the public for political considerations and the approved fare was set below cost. Consequently, SPC loss increased and due to the minimum revenue guarantee, public subsidy burden increased as well. - A lawsuit was filed for fare setting and Seoul Metropolitan Government won the case. In 2013, major shareholders of the original concessionaire divested the investment. Afterwards, fare setting became Seoul Metropolitan Government's sole direct discretion matter.
Sao Paulo Metro Line 4	■ Fare setting and revision system - Fare right after start up is set around 1 USD (irrespective of travel distance) and to be revised annually. - Because public transportation fares in Sao Paulo is integrated, the SPC can hold 100% of the fare revenue arising from passengers using only Line 4. It can hold 50% of fare revenue from passengers making transfers to or from the other lines.

Project	Overview and notes
Bangkok SkyTrain	■ Fare setting and revision system - Within an authorized fare range, PPP concessionaire can change fare at its own discretion in every 18 months. Concessionaire is required to give a 30-day advance notice to both the public sector (BMA) as well as passengers. - The authorized fare range normally allows 7% fare rise without authority approval if Bangkok CPI exceeds 5%. If it exceeds 9%, USD-THB exchange rate, interest rate, electricity price and some other factors can be incorporated in fare setting. However, this requires MBA approval. ■ Implementation Since the opening in December 1999, not until 2007 the concessionaire could raise the fare. Only twice (June 2012 and Oct. 2017) the concessionaire could raise fare after 2017 since then.

Source: JICA Design Team

(2) Possible PPP Schemes

In designing a feasible PPP framework for this railway project, the appropriate project risk sharing mechanism between the public sector and the private sector is a key factor to draw substantial interest from private companies. Considering the particular risks identified in O&M type of PPPs, two types of PPP model may be presumed for this project with properly allocated project risks between the public and private side, based on the analysis of the aforementioned general railway PPP risk characteristics.

1) Concession Term

Generally, project term of the O&M PPP tends to be short since this type of PPP requires less initial investment of private companies. The amount in this case, the private O&M entity should fully recoup their investments through their operation of the facilities in a shorter span of time, compared to other modalities of PPP. In line with this, after a certain period from the start of operation, the project term of another subsequent O&M PPP project should be longer than the initial O&M PPP project, if the subsequent PPP contract imposes the private company to renew and replace decrepit equipment or machineries during the operation and maintenance.

Given that, two PPP examples customized to the project are simulated in this study: one is an O&M type with 10 years of project term, and the other is also an O&M type, but with 15 years of project term as the latter incorporates larger investments including replacement of certain equipment of the infrastructure.

2) Demand Risk

Since O&M of this railway project covers MCR, NSCR and NSRP South as one inclusive engagement, the demand risk should be assessed on an integrated basis for these 3 sections. Further, uncertainty of the demand during the operation is assumed to be relatively higher in such a green field project compared to brown field projects. The uncertainty of the demand risk is likely to be unmanageable for private companies, and would be reluctant to bid for the O&M concession, resulting in a less competitive PPP procurement bidding. Thus, the demand risk is better shouldered by the public sector employing a form of availability payment after the inception of the operation and maintenance phase in the first O&M PPP case.

On the other hand, in the second mode of O&M PPP, it would be assumed that within the first 10 years of operation and maintenance of the facility, the private companies would have accumulated substantial experience in predicting future demand with far less volatility. This indicates that a user fee payment structure wherein demand risk is borne by a private company can be feasible in the second mode of O&M PPP. It is thus assumed that a user-payment type of PPP for the second O&M PPP option in this study is utilized.

3) Construction / Completion Risk

Since the construction work will be delivered through a traditional type of public procurement and would be exclusive from the undertakings of the O&M concessionaire, the risk of construction delay is beyond the control of the private company. The inherent tightness of the planned schedule for MCR construction work would expose the private company to the possibility of significant risks that the delay of the construction causes substantial idling losses from staffing costs, training costs, maintenance parts costs, among others. Therefore, it is crucial that the public and private sector agree to a compensation coverage mechanism to compute for reparations in case scheduled project completion dates would experience delays.

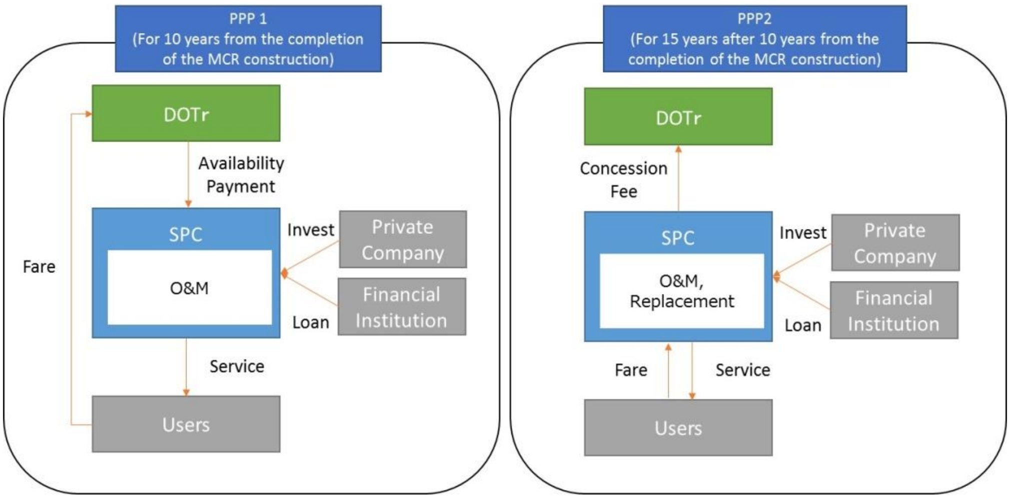
It is important to note that the commercial viability and ridership of the subject rail line is inherently linked to whether the surrounding transportation networks are implemented in line with the planned schedule. Since the predicted demand of the railway is significantly sensitive to the situation of the surrounding transportation networks, this interconnectivity risk also needs to be closely managed. As mentioned in the Chapter 4, the said transportation networks incorporate both the existing networks and ongoing or planned networks. Implementation of these planned transportation networks in line with timelines and schedules is beyond control of the private sector. Thus, in the case of the user-pay type of PPP, of which demand risk is managed by the private company, it is required that the public sector assumes compensation in case of losses arising from shortfalls from the original estimated demand due to realized interconnectivity risk.

Table 7.4.13 Examples of Possible PPP Schemes

Type	PPP 1st Phase	PPP 2nd Phase
Private company Role	O&M	O&M, Renewal
Target Alignment	MCR + NSCR + NSRP South	MCR + NSCR + NSRP South
Project Period	For 10 years from the completion of the MCR construction	For 15 years after 10 years from the completion of the MCR construction
Revenue for Private	Availability Payment	User-Pay
Main Risk handled by Public	Demand Risk Completion Risk	Interconnectivity Risk

Source: JICA Design Team

The possible PPP schemes for this railway O&M project are illustrated in Figure 7.4.7.



Source: JICA Design Team

Figure 7.4.7 Examples of Possible O&M PPP Schemes

4) Role of Private Sector

The role of private sector in these O&M PPPs are O&M and replacement investment. Some expected roles of the O&M PPP concessionaires are illustrated in Table 7.4.14.

Table 7.4.14 Examples of Role of Private Sector

Type	PPP 1st Phase 10 years after MCR completion	PPP 2nd Phase 11th year and forward after MCR completion
Role of Private Sector	• Planning of O&M (O&M organization design, business processes design, operational plans, management plans by system, safety management plans) • Operation of the entire railway system • Maintenance of the entire railway system (inspection, renewals, RAMS (Reliability, Availability & Maintainability Studies) plan, degraded operations plans, procurement strategies, etc., monitoring mechanisms to technical and safety requirements))	On top of the PPP 1st phase roles; investment of replacement components

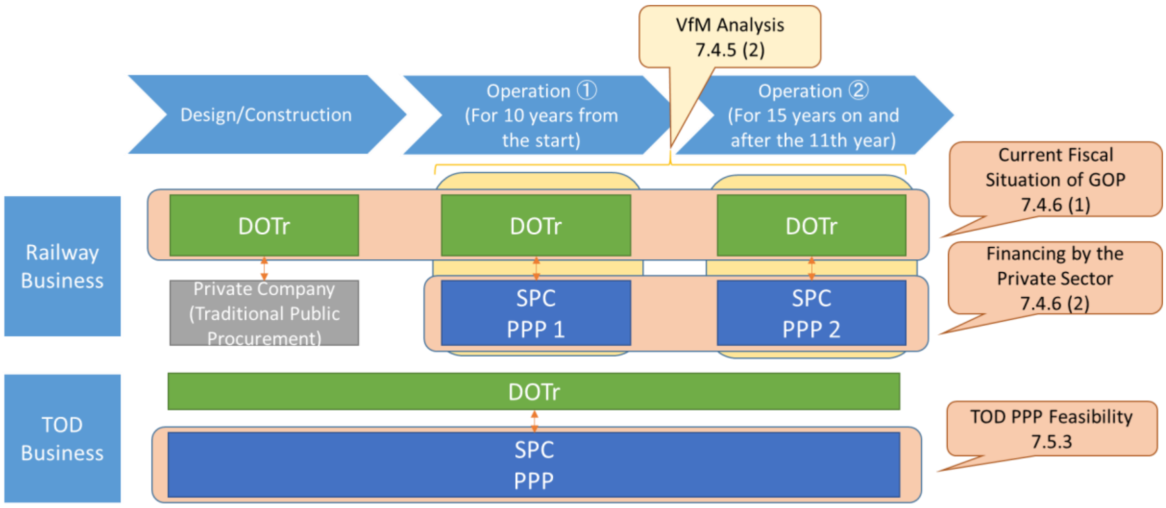
Source: JICA Design Team

(3) VfM

1) PSC and PPP-LSC Calculation Methods

In PPP project formulation process in the Philippines, appraisal and approval of proposed PPP projects commences upon submission of a project by an implementing government agency to the Investment Coordination Committee (ICC). Then the ICC Technical Working Group undertakes specific aspects of the appraisal of the PPP project. According to 4.5 b) in the Guidelines and Procedures for the appraisal of PPP Projects, published by the PPP Center, Value for Money (VfM) analysis is required. The objective of this VfM analysis is to simulate the cost efficiencies of a particular project implemented as a PPP as well as carried out as a conventional public procurement. The analysis compares Public Sector Comparator (PSC), an estimate of hypothetical, whole-of-life cost of the project delivered by government, against PPP Life Cycle Costs (PPP-LCC), an estimate of the whole-of-life cost when the project is carried out as a PPP.

In this section, a preliminary VfM analysis will be carried out in order to assess how much of VfM the aforementioned PPP structures would potentially have. Following this section, this report also includes an analysis of fiscal impact on the GOP, financial feasibility of PPPs, and TOD project feasibility analysis. The each perspective of the analysis is elaborated in Figure 7.4.8.

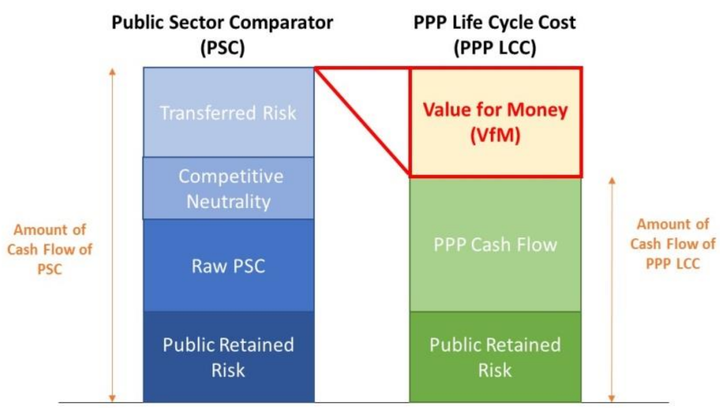


Source: JICA Design Team

Figure 7.4.8 Analysis Perspectives

2) PSC and PPP-LSC Calculation

As stated in the previous section, computation of PSC and PPP LCC for the VfM analysis must be performed in accordance with the pertinent provisions on PPPs in the Philippines. The components in the PSC and PPP LCC are represented in Figure 7.4.9.



Source: JICA Design Team

Figure 7.4.9 Components of PSC and PPP LCC

a) PSC

PSC is an estimate of hypothetical risk-adjusted costs if a project were to be implemented by the government. PSC includes the following components:

(i) Raw PSC

Raw PSC provides a base costing under the public procurement method where the underlying asset or service is owned by the public sector.

(ii) Transferred Risk

The expected value of risks to be transferred to a private company, represented by a multiple of the probability and the amounts when they occur. On PPP LCC side, this risk is not shown because it is covered by insurance funded by the public sector.

(iii) Public Retained Risk

Any expected value of the risk not to be transferred to a private company and retained by the government.

(iv) Competitive Neutrality

PSC should be computed on a basis that there is no net financial advantage of public ownership. This means that the PSC's value should not include the factors of competitive advantage that accrue to a government business by the virtue of its public ownership.

b) PPP LCC

The components of PPP LCC are as follows:

(i) PPP Cash Flow

The amount paid to (or received from) the private company when a project is delivered by a PPP.

(ii) Public Retained Risk

Any expected value of the risk not transferred to a private company and is retained by the government. In principle, this should be equal to the Public Retained Risk in PSC. Therefore, this does not affect VfM analysis.

To calculate VfM, the team utilize the project cash flow calculated in the financial and economic analysis. In addition, impact of financial instruments, depreciation, and so on will likewise be reflected. The analysis does not take into account the risk adjustments

On the other hand, PPP LCC calculation should reflect reduction/increase of the costs/revenues resulting from more efficient operation delivered by the private company. Further, it is necessary to calculate presumable amount of the concession fees or availability payments which can be calculated from the general profit levels expected by the private company.

All of those cash flows should be discounted by the long-term risk free rates for comparison.

Below is the result of the preliminary VfM calculation.

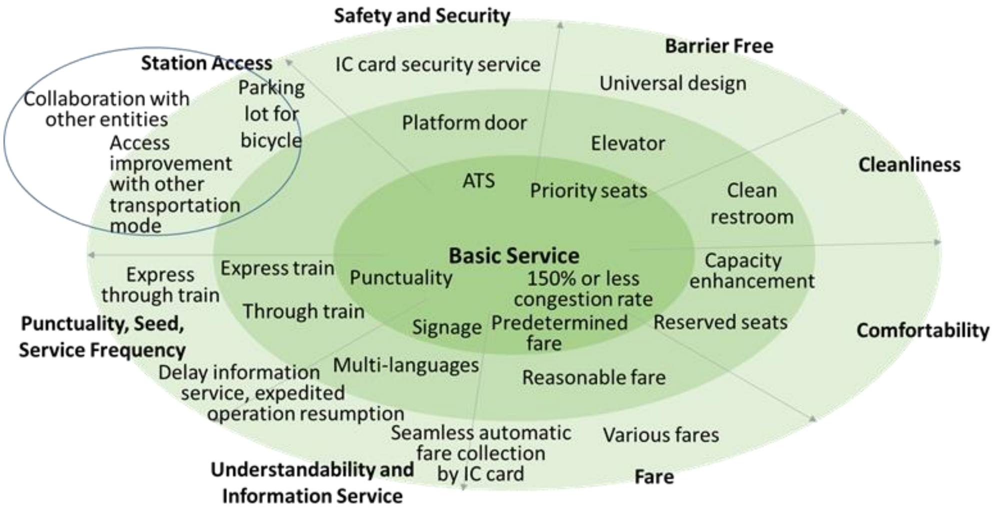
Table 7.4.15 Preliminary VfM Calculation

O&M Type	NPV in Public (PhP million)	Cost Reduction or Revenue Increase in Private (%)	NPV for Public in PPP (PhP mllion)	VfM (%)
PPP 1 (10 years from FY2022)	85,084	Cost Reduction 10%	92,037	8.2
		Cost Reduction 20%	100,800	18.5
PPP 2 (15 years from FY2032)	188,030	Cost Reduction 20%	186,172	-1.0
		Cost Reduction 20% Revenue Increase 10%	215,534	14.6

Source: JICA Design Team

(4) Requested Service Level Standards

Figure 7.4.10 shows services Japanese railway operators usually offer. The Basic Services that should be made available to the passengers are shown in the center of the figure. More diversified and sophisticated services are illustrated toward the peripheral part of the figure. For this railway project, it is desirable to redefine the services other than Basic Service based on the current condition of the Philippines. Generally speaking, compared to the other modes of transportation, rail transport is characterized by large volume, high-speed travel, stability, safety, energy efficiency and low carbon emissions. These railway attributes and the local needs of the Filipino People should be incorporated in setting service level standards the IA expects from the O&M concessionaire. This point will be further examined in the O&M concessionaire procurement process by the Transaction Advisor and defined in detail in requested service level standards.



Source: JICA Design Team based on MLIT "Current Statues of Urban Railway Service and its Problems"

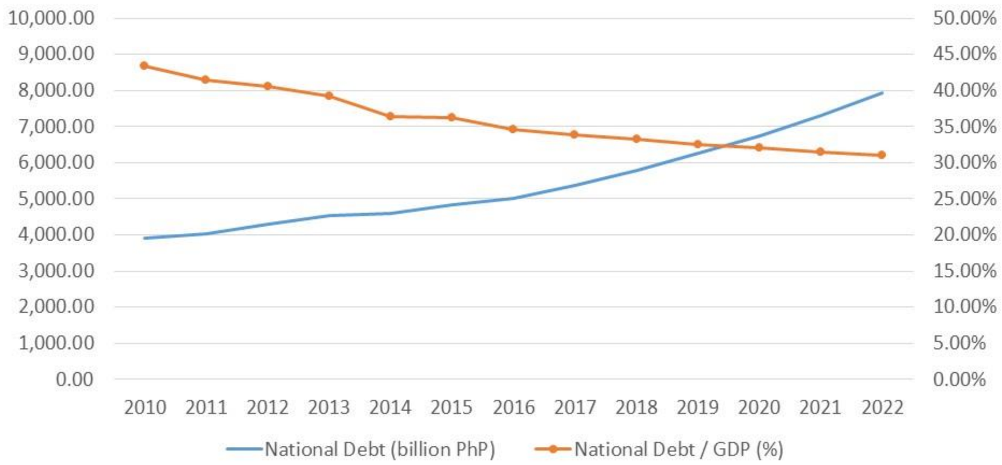
Figure 7.4.10 Railway Service Concept

7.4.6 Financing the Project

(1) Current Fiscal Situation of the Philippines Government

1) Current Fiscal Situation of the Philippines Government

Whereas the amount of the national debt of the Philippines has been rising due to increased investment spending in infrastructure programs to spur economic growth, the rate of national debt to GDP has been on a downward trend as a result of the outpacing national economic growth. To maintain this positive trend, the Duterte Administration is pushing this ratio from 5% to 7% of GDP, the rate of which had been successfully raised in part by the momentum set by the preceding Aquino Administration. While bolstering infrastructure spending, the Duterte Administration is undertaking a comprehensive tax reform program in order to raise revenues to further cover the expanding infrastructure spending. Given this situation, the general outlook by rating companies in terms of sovereign risk of the Philippines has been “stable” due to the constancy of the managed fiscal balance, despite some economic uncertainties under the current administration.



Source: IMF Outlook (2017.Oct)

Figure 7.4.11 National Debt and the rate of the National Debt to GDP

Railway projects are one of the most prioritized areas in the infrastructure development campaign. For instance, an annual 7.1 billion PhP has been budgeted for North-South Railway Project Phase 2 (PNR South) for the year 2017 and 2018. On the other hand, another 2.5 billion PhP each has been allocated to the NSCR project for the same years. The budget allocations for the major railway projects in the Philippines are shown in Table 7.4.16. In addition to the public budget, it is said that the ODA runs second among the identified sources for infrastructure financing in the country and private sector participation is regarded as the third source.

Table 7.4.16 Budget for the Main Railways 2017-2018

Particulars	2017 (GAA) (billion PhP)	2018 (Proposed) (billion PhP)
Mindanao Railway Project Phase 1	-	6.6
North South Railway Project Phase 2	7.1	7.1
MRT Line 3 Rehabilitation and Capacity Expansion	1.0	1.0
LRT Line 2 West Extension Project	0.1	0.6
LRT Line 2 East Extension Project	0.4	0.9
LRT Line 1 South (Cavite) Extension Projects	3.4	1.3
North-South Commuter Railway (NSCR) Project	2.5	2.5

Source: Technical Notes on the 2018 Proposed National Budget

The Department of Budget Management (DBM) has sought to release allotments of government agencies earlier. Hence, government agencies are enabled to carry out early procurement activities to immediately implement projects at the start of the fiscal year. Moving forward, the shift to a yearly cash-based Budget starting 2019 will further hasten the processes of government spending. The DBM also allocated the budget for Right-of-Way (ROW) payments for big-ticket projects, intending to reduce bottlenecks in the implementation of infrastructure projects. The combined ROW allocation for the DPWH and DOTr has surged from P4.2 billion in the 2015 GAA to P32.6 billion in the 2017 GAA. In the 2018 GAA, an even larger budget of P34.9 billion with the DPWH and DOTr receiving P20.5 billion and 14.4 billion, respectively has been allocated.

In spite of a more aggressive fiscal utilization policy for railway sector development, however, the existing railway operations of LRT1, LRT2, and MRT3, and PNR have not been successfully and efficiently carried as shown in the table below.

Table 7.4.17 Current Financial Operating Results of Existing Railways

Items	PNR (FY2016)	MRT3 (FY2017)	LRTs (FY 2017)
Service Revenue (million PhP)	457	26	1,272
Government Subsidy (million PhP)	810	7,094	819
Net Profit (million PhP)	166	454	-2,707

Source: Websites of Commission on Audit, DBM, MRT and LRTA

Inefficient railway operations would most likely be improved through government budgetary augmentation especially in terms of covering maintenance and other operating expenditures. In case of MRT3, apart from the aforementioned PhP 1 billion allocation for the MRT Line 3 Rehabilitation and Capacity Expansion, the government spent around 5 billion pesos as subsidy for the operation of the said problematic rail line in 2017. DOTr on the other hand envisages the new entity to operate and maintain the MRT3 would have perform better through improved budgetary requirement insights when the results of the due diligence study currently being carried out by JICA in line with identifying the necessary rehabilitation works for the said rail system.

In view of better managing railway operations in the country, three standing legislative committees of the House of Representatives endorsed a proposed bill to create the Philippine National Railway Authority in March 2018. In this bill, the Philippine National Railway Authority shall regulate all aspects of the operations of railway corporations, while it shall set the necessary routes, fares and standards on safety and security as well as managing franchise or concession agreements of the railway operations in the country. The bill also mandates the authority to establish three separate subsidiary corporations (the Luzon Railway Corp., Visayas Railway Corp. and Mindanao Railway Corp.) to operate railways in each island group.

2) Financing Options

As described above, the Duterte Administration expressed interest in implementing this railway project as a Hybrid PPP wherein the government would construct the infrastructure part of the project and later bid out the operation and maintenance of the infrastructure to a private sector as a PPP project. From the perspective of finance in the GOP, it is predicted that the expenditures would outweigh revenues, especially in the immediate term. In order to cover the shortfall, the GOP may consider two viable options; one is issuance of national bonds and the other is accessing loans from external organizations.

Table 7.4.18 National Government Financing, 2017-2018

Items	2017 (million PhP)	2018 (million PhP)
Surplus/(Deficit)	(482,085)	(523,588)
Gross Financing	**727,739**	**888,277**
External(Gross)	182,770	176,269
Program Loan	42,470	84,214
Project Loan	30,300	41,055
Bonds and other inflows	110,000	51,000
Less: Amortization	139,600	61,923
External(Net)	**43,170**	**114,346**
Domestic(Gross)	544,969	711,958
Less(Net Amortization)	3,359	5,030
Domestic(Net)	**541,610**	**706,928**

Source: Technical Notes on the 2018 Proposed National Budget

The GOP can issue long-term national bonds, or so-called "Treasury Bonds" with the options of six tenures: 2, 5, 7, 10, 20, and 25 years. However, the government has not been known to issue bonds with specific purposes such as those earmarked for financing railway infrastructure development. These bonds have normally been issued in order to compensate the deficit brought about by netting out annual revenues and expenditures. The sovereign risk of the Philippines is evaluated by Standard & Poor's, a major private rating company. As of January 31st, 2018, the long-term securities are rated as stable with the "BBB" rating.

Table 7.4.19 Outstanding Bonds (Sorted by tenure, January 2017)

Type	Tenure (year)	Numbers of issuance	Issue Date (Range)	Maturity Date (Range)	Coupon Rate (%)	Face Amount (million PhP)
Treasury Bond	3	1	2017.1-2017.3	2020.3	3.3750	45,000
	5	3	2013.5-2017.10	2018.3-2022.1	2.1250-4.0000	313,256
	7	8	2011.8-2017.10	2018.8-2024.4	3.5000-5.0000	596,743
	10	11	2008.1-2017.7	2018.11-2027.4	4.0000-8.8750	408,429
	10 (Variable)	Various	Various	Various	Variable Rate	7,043
	20	36	1998.1-2017.7	2018.1-2037.7	3.6250-15.0000	319,340
	25	9	2000.11-2012.8	2025.11-2037.8	5.7500-18.2500	235,982
Retail Treasury Bonds	3-25	11	2012.10-2017.4	2020.4-2037.10	3.2500-7.3750	1,213,771
Benchmark Bonds*	10-25	7	2010.12-2016.1	2020.12-2040.9	3.6250-8.1250	909,298
Others						75,076
Total						**4,125,941**

* The refunding bond issued from the exchange with the existing bond and the newly issued bond with longer tenure

Source: JICA Design Team prepared from the website of the Bureau of the Treasury

In terms of borrowing, the GOP may consider financing from ADB as a viable option aside from the Yen Loan facility with the Special Terms for Economic Partnership (STEP) from the Japanese government.

Table 7.4.20 Major Conditions of Comparable Finance Options

Financing Options		Allowable coverage of total project cost	Interest Rates (%)	Grace Period (year)	Maximum Tenure (year)	Procurement Condition
National Bonds		-	4.919	-	-	-
		-	6.533	-	10	
			6.001	-	20	
ODA loans from the Government of Japan	Standard	Calculated based on GNI	0.50	10	30	Untied
	Option 1	Same as above	0.45	7	25	Untied
	Option 2	Same as above	0.40	6	20	Untied
	Option 3	Same as above	0.35	5	15	Untied
	STEP	Up to 100%	0.10	12	40	Tied
ADB	Sovereign Loan Scheme (Project Loan)	Not specified	1% (grace period) / 1.5% (O&M period)	8	32	Untied
	LIBOR Based Loan	Not specified	Referred to 6 months LIBOR + Premiums	Case by case	19	Untied

Source: JICA Design Team prepared from the website of JICA and ADB

Since the O&M component of the project is envisioned to be delivered through a PPP, the possible financing option for this portion of the project would be loans from private banks or funds or investments from private entities. In addition, international public financing such as loan facilities from JBIC and IFC are primarily focused on construction of infrastructure. Thus, the possibility to apply those financing options may be relatively low for this particular aspect of the project.

3) Fiscal Impact on the GOP

In this sub-section, expected fiscal impact on the GOP by this project and financial viability of Hybrid PPP will be analyzed through financial statements for the GOP. Furthermore, based on the appropriate risk allocation in the O&M PPP scheme, sensitivity analysis will be conducted for some risk factors, such as revenue risk, finance risk (including foreign exchange rates, interest rates) and macro-economic risk (including inflation). The financial statements will be developed with the cash flows provided in Chapter 8.

(2) Financing the Project

1) Business Models

As described in Table 7.4.13, two possible options of PPP schemes are set for a simulation purpose with a coverage of O&Ms for all MCRP, NSCR and NSRP-South; one for 10 years after completion of MCRP construction, and the other for 15 years from the 11th year after completion of MCRP.

The implementing entity envisaged would be a Special Purpose Company (SPC) which is established by several concerned private entities with respective specializations and tasks in the collaborative venture. Financial models for the SPC will be prepared for each option (1&2). Some main conditions are assumed as shown in Table 7.4.21.

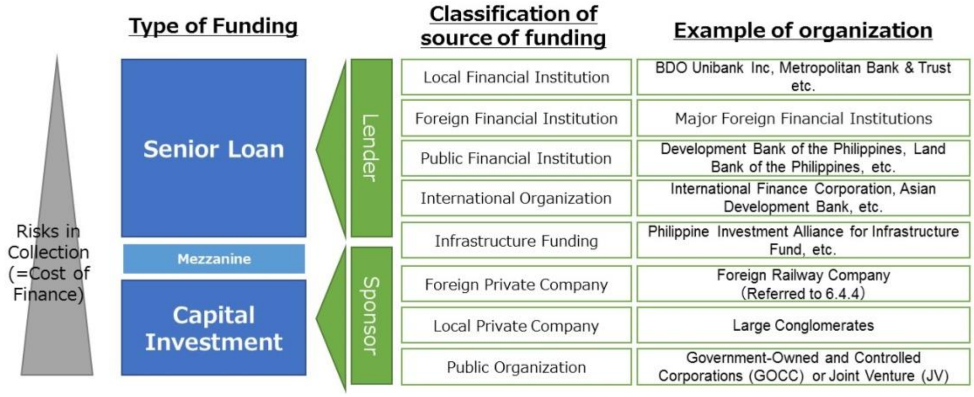
Table 7.4.21 Main Financial Model Preconditions of the SPC

Items	PPP 1	PPP 2
Implementing Company	SPC established by private entities	
Period of Construction	(Construction is out of the scope)	(Construction is out of the scope)
Period of Operation	For 10 years (after the opening MCRP)	For 15 years (from the 11th years after the opening of MCRP)
Core Business (Railway)	Railway Operation and O&M	Railway Operation, O&M, and Replacement
Main Revenue	Availability Payment from DOTr	User-pay
Range of Replacement	(N/A)	(to be confirm)
OPEX	Cost for operation and maintenance	
Financing Method	(to be confirm)	(to be confirm)
Dividend	Certain dividend based on the corporation law in the Philippines	
Tax	30% of the income tax	
Required Rate of Return	Setting the Equity IRR referred to the market level	

2) Financing Options

As this PPP entity for O&M is assumed to be an SPC, financing options for the SPC will be discussed in this section.

Generally, for infrastructure projects, project finance is employed in order to reduce the project risks for PPP PSCs. However, since this project is focused on O&M, which requires relatively less initial investment, a wide range of financial options can be employed.



Source: JICA Design Team

Figure 7.4.12 Options for Infrastructure Finance

In general, loans take up 70-90% of total financing in project finance. Consequently the portion of loan for the financial modeling also follows suit, considering the feature of this O&M PPP. Lender assumption also reflects the local context.

On the other hand, due to the foreign investment regulations in the Philippine, foreign companies are not allowed to invest more than 40% of total capital of local public project companies. For example, in LRT1, a foreign company, Macquarie Infrastructure Holdings holds only 10% of Light Rail Manila Corporation (LRMC), the LRT1 concessionaire. On the other hand, its local counterpart Ayala Corporation and Metro Pacific Light Rail Corporation, holds 35% and 55% of LRMC respectively.

On top of the financing options above, private railway PPP concessionaires, whether train operator or maintenance service provider, may benefit from financing risk protection provided by public entities such as export credit agencies. For example, some risks beyond private concessionaire's control such as political risk and commercial risk can be mitigated through insurances provided by Nippon Export and Investment Insurance (NEXI). Similar undertaking is provided by the World Bank Group through its Multilateral Investment Guarantee Agency (MIGA). MIGA promotes foreign direct investment (FDI) into developing countries to help support economic growth, reduce poverty, and improve people's lives. All of these protections will benefit private concessionaire by providing access to funding, lowering borrowing costs and increasing tenor.

Table 7.4.22 Insurance Products to Mitigate Political Risk and Commercial Risk

Institution	Political / Country Risk	Commercial / Credit Risk
NEXI	Restriction/prohibition of exchange dealings, Raise in tariffs, Restriction/prohibition of imports, War, Revolution, Natural disasters, Inability of export due to political risks, Inability to collect export proceeds or prepaid money, Stocks acquired through overseas investment is confiscated due to political risks	Inability to collect export proceeds or loan due to counterparty bankrupt, Borrower repay default on the loan, Inability to export or import because the counterpart went bankrupt before exporting or importing
MIGA	Currency inconvertibility, Transfer restriction, Expropriation, War, Terrorism, Civil disturbance etc.	

Source: JICA Design Team based on NEXI and MIGA

In practice, in a 30-year UK railway franchise scheme, Hitachi, a Japanese rolling stock manufacturer and John Laing, a UK construction company set up a rolling stock maintenance company with financial support from NEXI and JBIC. The SPC of the 4.5 billion GBP investment project, 70% owned by Hitachi and the other 30% by John Laing, secured about 4.3 billion GBP debt financing including 1.8 billion GBP from JBIC. NEXI provided Overseas Untied Loan Insurance to cover the loans extended to the SPC by 5 Japanese banks. The insurance covers 97.5% of the Political / Country Risk and 90% of the Commercial / Credit Risk of the facility.

3) Market Sounding

In order to evaluate the PPP feasibility, it is essential to communicate with the potential investors and operators to confirm if the PPP option will be workable for them from both financial and technical perspectives.

4) Expected Financial Statements

Financial Statements, including profit and loss statements, balance sheet and cash flow statements, were prepared. At present, a pure publicly run, integrated project is assumed for analysis. Some highlights are shown below.

Table 7.4.23 Highlights of Income Statements (Million PhP)

FY	2022	2025	2035	2040
Revenue	8,282	27,885	36515	41,349
OPEX	9,305	13,105	13,105	16,466
Interest	4,446	5,446	4,244	2,946
Depreciation	11,964	16,569	16,569	1,6549
Net Income	-17,433	-7,235	2,597	5,368

Table 7.4.24 Highlights of Balance Sheets (Million PhP)

FY	2022	2025	2035	2040
Current Asset	-	26,208	23,851	-
Fixed Asset	6,46,271	687,929	522,239	439,393
Liabilities	533,669	633,522	503,771	370,844
Paid in Capital	139,558	141,941	141,941	156,024
Retained Earnings	-26,956	-61,325	-100,622	-92,842

Table 7.4.25 Highlights of Cashflow Statements (Million PhP)

FY	2022	2025	2035	2040
Operating Activities	-1,196	14,601	36,515	41,349
Investment Activities	-103,744	-18	-	-
Financing Activities	104,940	-	-26,937	-21,936

Table 7.4.26 Key Profitability and Financial Soundness Figures

Profitability	**Equity IRR (after tax)**	-4.7%
	Average EBITDA Margin	44.1%
	Timing of Surplus	FY2033
	Timing of Dividends	FY2056
Financial Soundness	**DSR (DSCR)**	1.05
	Average Equity Ratio	30%

This project is expected to turn into the black in 2033. However, due to the interest payment for the massive borrowings, financial soundness is quite low.

5) Sensitivity Analysis

In this section, revenue and O&M cost impact on Equity IRR is examined.

Table 7.4.27 Preconditions for the Sensitivity Analysis

Revenue				
90%	95%	100%	105%	110%
n/a	-9.0%	-4.7%	-1.8%	-0.2%

O&M costs				
90%	95%	100%	105%	110%
-7.3%	-6.0%	-4.7%	-3.6%	-2.5%

If revenue goes up by 10%, dividend payments will be generated in FY2045 and it will be possible to recover the invested capital. It is shown that operation of the railway system by an efficient operator is also desirable from the perspective of the Philippines public finance.

7.4.7 Main Points in Selecting O&M PPP Concessionaire

The current administration intends to adopt a "Hybrid PPP" scheme for this project. Considering the lessons from the previous railway PPP projects, this sub-section identifies the focal points in the selection of O&M PPP concessionaire as follows.

(1) Consistency with the infrastructure project Recent Trend

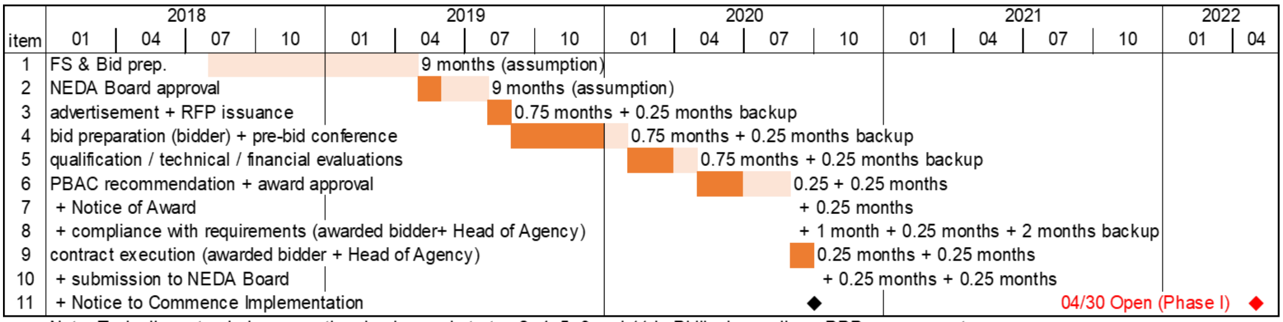
In conventional PPP contracts, the design, construction and O&M of the infrastructure are bundled. The bidder can freely propose the best infrastructure system satisfying the minimum service standards and output specifications set out by IAs. However, in the case of this project, the contractors that are responsible for the design and construction of the railway infrastructure may be different from the PPP O&M concessionaire. Therefore, at the bidding stage, it is important to set adequate evaluation criteria and desirable organizational structure and functions for railway operation to ensure that the bidders will be able to examine their capability to meet the minimum service and performance standards as well as output specifications.

(2) Risk Allocation

As for risk allocation of PPP projects, the PPP Center published the Generic Preferred Risk Allocation Matrix (GPRAM) that identifies list of risks, preferred allocation, and corresponding possible risk mitigation strategies. However, in the GPRAM, the private entities tend to be responsible for more risks than the public entities. Therefore, considering the characteristics of railway sector and the O&M aspects of the project, the risk allocation between public and private should be thoroughly examined; it is important to identify how much government support and subsidy is needed based on the concept of the GPRAM.

(3) Timeline

Considering Philippine Government plans to start the railway service by April 2022, it is ideal for the public entity and the concessionaire to enter into a contract by the beginning of 2021: a year before the start of operations. It should be considered that the procurement process of PPPs has specified durations of activities and can take a longer time than traditional public procurement. Moreover, in case of bid failure, the review of the project structure also requires longer time to undertake. Therefore, the Implementing Agencies need to carefully set the role of private entities and conditions for delivering tasks through PPPs which will be beneficial to both the public and private sides; taking into consideration the opinion and sentiments from potential private entities that may be involved in advance.



Note: Typically, extended process time is observed at step 2, 4, 5, 9 and 11 in Philippines railway PPP procurement.

Source: JICA Design Team

Figure 7.4.13 O&M PPP Procurement Schedule

CHAPTER 8 PROJECT IMPACT ANALYSIS

8.1 Operation and Effect Indicators

8.1.1 Purpose of Project Evaluation

In order to effectively monitor and evaluate this project, this section sets the project evaluation framework. The project is evaluated based on the "Handbook for JICA Project Evaluation (Ver1.1), JICA Evaluation Department, May 2016" (Handbook). As indicated by the "Guideline for JICA Project Evaluation (Ver. 2), JICA Evaluation Department, May 2014" (Guideline), the purposes of the project evaluation are to 1) improve projects thorough Plan-Do-Check-Act (PDCA) cycle and 2) secure accountability to the stakeholders including Japanese nationals and the recipient country.

1. Plan – Advance (Ex-ante evaluation)	Before the project implementation, examine project's appropriateness, planned contents, expected impacts, and indicators, and etc.
2. Do – Implementation Stage (Implementation)	Monitor periodically based on the contents of ex-ante evaluation
3. Check – Post Stage (Ex-post evaluation)	Post the project completion, examine effectiveness, impact, efficiency, sustainability of the project. Also, summarize the lesson learned and proposition from the project
4. Action (Feedback-Action)	Reflect the results of the evaluation to similar projects

Source: JICA Design Team as reconstructed from "JICA Operation Indicator and Effect Indicator Handbook (Ver. 1.1) in ODA Loan Projects, JICA Evaluation Department, May 2016."

Figure 8.1.1 PDCA Cycle

This project is at the stage where "1. Plan (Ex-ante evaluation)" is applicable. Evaluation criteria used at this stage – i.e., 1. Plan (Ex-ante evaluation) – will continue to be used to evaluate the progress of the project and evaluate the same ex-post.

8.1.2 Project Evaluation Method

The project evaluation method follows the procedures, intents and other elements detailed in the “JICA Operation Indicator and Effect Indicator Reference in ODA Loan Projects, JICA Evaluation Department, July 2014” (Reference), which is referenced under the chapter entitled “Reference for Project Evaluation, Examples of Standard Indicators, and etc.” in the Handbook. As mentioned, the purposes of the Project are to improve experience of passengers through the utilizations of existing urban transportation networks, in addition to improving the speed and convenience of the access to the airport, and as such, the following railway-related indicators suggested in the Reference have been adopted for project evaluation use. As the methods of calculation for these indicators suggest, railway operators collect the said information for self-monitoring purpose. Thus they will be able to provide the results upon request. In addition, the issues and lessons with the results of each indicator will be shared to responsible agencies, such as DOTr.

Table 8.1.1 Criteria Used for Project Evaluation

Indicator		Method of calculation
Operation Indicator	Number of Running Trains (number of trains/day)	Number of trains in operation / day
	Total Train Kilometer per Day (km/day)	Total kilometers a serviced train operated x Number of serviced train
	Operating Rate (%)	(365-(non-operated days))/365 where non-operated days are equal to the days required for heavy repair and those reserved for unscheduled repairs
Effect Indicator	Volume of Transportation (000 passenger-km)	Total number of passengers x distance each passenger traveled
	Travel Time between Station (minutes)	Time required to travel between stations

Source: JICA Design Team

8.1.3 Evaluation Results

The results of each indicator will be tallied as follows. As mentioned above, targets for 2027 will be evaluated based on the results provided by the railway operator.

Table 8.1.2 Operations and Effects Indicators – Outcomes

<table>
<tr><th colspan="3">Indicator</th><th>Baseline
(Actual Value in 2018)</th><th>Target
(2027)</th></tr>
<tr><td rowspan="6">Operation Indicator</td><td rowspan="2">Number of Running Trains (number of trains/day)</td><td>Limited Express</td><td>-</td><td>44
(CIA-Alabang)</td></tr>
<tr><td>Commuter Express and Commuter</td><td>-</td><td>261
(CIA-Calamba)</td></tr>
<tr><td rowspan="2">Total Train Kilometer per Day (km/day)</td><td>Limited Express</td><td>-</td><td>5,043
(CIA-Alabang)</td></tr>
<tr><td>Commuter Express and Commuter</td><td>-</td><td>32,249
(CIA-Calamba)</td></tr>
<tr><td rowspan="2">Operating Rate (%)</td><td>Limited Express</td><td>-</td><td>86%</td></tr>
<tr><td>Commuter Express and Commuter</td><td>-</td><td>87%</td></tr>
<tr><td rowspan="4">Effect Indicator</td><td colspan="2">Volume of Transportation
(000 passenger-km)</td><td>-</td><td>29,450
(CIA-Calamba)</td></tr>
<tr><td rowspan="3">Travel Time between Stations (minutes)</td><td>Limited Express</td><td rowspan="3">Approximately 5 hours
(Note)</td><td>75.75
(CIA-Alabang)</td></tr>
<tr><td>Commuter Express</td><td>111.75
(CIA-Calamba)</td></tr>
<tr><td>Commuter</td><td>141.00
(CIA-Calamba)</td></tr>
</table>

Note: Assuming use of road between CIA and Metro Manila (approximately two hours depending on congestion and choices of route) as well as railway between Tutuban-Mamatid (two and a half hours)

Source: JICA Design Team

8.2 Qualitative Impacts

In this section, the impacts from socio-economic and health/environmental standpoint are analyzed. These impacts are summarized as follows:

Table 8.2.1 Impacts from Socio-economic and Health/Environmental Standpoint

Perspectives	Items	Impacts
Socio-economic	**Population increase**: access to business and commercial areas will improve, and as a result, the population is expected to increase as the areas will become more attractive as residence areas	As detailed in Chapter 3.4.2 "Socio-economic Framework of the Study Area", the future population growth in adjoining provinces is estimated to be much higher than of Metro Manila (contribution of the railway development to population increase can be grasped to a certain extent by comparing populations increases between project area and Metro Manila, but, in order to understand population increase more comprehensively, considerations of other factors, such as the developments of road, medical and educational facility, will also be necessary.).
	Enterprise attraction: productivity increase as the result of access improvements is expected to attract enterprise in forms of new establishments or expansion	At this time, no railway exists in the north area of Metro Manila while residential areas continue to expand from central area to Malolos and further north. Also currently, Tutuban-Mamatid services are limited (two services each in the morning and evening) and requires more than two hours' travel time. The Project is expected to offer frequent service and faster connections. As analyzed in in Chapter 3.4.2 "Socio-economic Framework of the Study Area", the railway development is sought to contribute to the vitalization of local economy through the increase of number of workers in adjoining provinces[1].
		The project is sought to contribute to the socio-economic developments of localities through synergies with such development projects as below: • New Clark City: Development projects to become the Philippines' most modern and first technologically-integrated city with a mix of residential, commercial, agro-industrial, institutional, and information technology developments . • MCA Preliminary Master Development Plan: Development master plan setting Clark Freeport Zone (CFZ), Angeles City, San Fernando and Mabalacat as inner core • Central Luzon Regional Development Plan 2017-2022: Vision for the region to have globally competitive human resources, a highly productive and profitable agricultural sector, seamless and integrated physical access, and a transshipment and logistics hub
	Improved access: railway development will improve the access of the neighboring residents	The project is expected to result in one hour connection between Clark and Metro Manila (currently requiring approximately two hours using roads) and less than one hour connection between Solis and Calamba (currently Tutuban-Mamatid railway services are limited with two services each in the morning and evening, requiring more than two hours travel time.)

[1] If Transit Oriented Development (TOD) for the areas neighboring the station is promoted, there may be a need for comprehensive evaluation as to the impacts not only of the railway development but TOD onto enterprise attractions. Such evaluation may not be feasible for this study: the evaluation can possibly be led by LGUs and shared by the concerned institutions. Evaluation criteria can include such items as, working population, number of newly set-up enterprises and construction permits, etc.

Perspectives	Items	Impacts
Health/ Environmental	**Increased health of neighboring residents**: decrease in diseases resulting from air pollutions **Better environments**: reduction in greenhouse gas emission to which this project contributes will result in better environments	As the residents' transportation modality shifts from road vehicle to railway, road traffic volume and thereby the volume of CO2 emitted from road vehicles is expected to lessen. As a result, the incidence of diseases of the neighboring residents caused by air pollution etc., is expected to diminish. To be analyzed in the sub-sections "Road Traffic Impact during Construction", "Health Benefits" and "Mitigating the Impacts of Climate Change"

Source: JICA Design Team

8.2.1 Road Traffic Impact during Construction

This section analyses the economic losses brought about by traffic restriction during constriction. Below shows the estimated severe traffic congestion points during construction period. Closures of the construction sites and trunk roads, insufficient detour routes, and etc., are expected to result in the economic losses。

Table 8.2.2 Traffic Congestion Points during Construction Period

Area		Point	Description
MCRP	North Section	Bridges on Sacobia River	• Increasing construction vehicles for development in NCC • Two bridges, Mabalacat Bridge and Sacobia River Bridge, are close to construction site.
	Middle Section	Downtown of Angeles	• Construction site, Bus/ Jeepney terminals and trunk roads are close by. • Amusement center area are attractive for visitors even in night time.
	South Section	Malolos Station	• It will be crowded by feeder transportation for commuter/ student and construction vehicles.
NSRP-South	North Section	FTI	• Construction while operating PNR • Considering Subway Project is crucial, especially extension operation between South Line and the Subway. • Construction of transition section underground/ ground level will affect general traffic.
	Middle Section	Bicutan, Alabang	• Construction while operating PNR • Construction site, PNR and trunk roads are close. • Queuing length for level crossing is not enough.
	South Section	Mamatid, Calamba	• Poor road network around proposed depot site • Detour route is limited for lack of road network in the east side of PNR.

Source: JICA Design Team

8.2.2 Health Benefits

Railway developments can provide benefits that are often overlooked – i.e., health benefits. Below are 3 such health benefits identified in relation to the project being examined quantitatively:

- Reduction of respiratory disease caused by hazardous substances and particulate matter
- Reduction of fatalities and injuries
- Promotion of increased physical activities

Railway transport will help reduce health hazards: As the residents' transportation modality shifts from road vehicle to railway, road traffic volume and thereby the volume of hazardous substances emitted from road vehicles is expected to lessen. Thus, health benefit, or the decreased risk of health hazards – e.g., respiratory disease caused by hazardous substance – is expected.

Railway transport provides safer means of travel, reducing fatalities and injuries caused by road accidents: Train-related accidents happen at a lesser rate, and with much lower passenger fatality rates than vehicle travel does. Further, railway transit centers have higher levels of security monitoring and enforcement that can redound to reduced crime rates than other areas.

Railway transport promotes increased physical activities: Individuals using railway transport may experience increased physical activity level through walking to and from the identified access points to the train stations. Increased physical activity in turn may help lower the risk of many serious diseases, such as heart and vascular diseases, stroke, diabetes, and depression.

8.3 Project Evaluation Approach

The evaluation is based on the data available as of August 28, 2018.

This evaluation assumes the two requirements – i.e., 2022 opening of MCRP and one-hour connection between Clark and Metro Manila, both of which are the goals set by the Duterte Administration. As the technically feasible opening schedules that will meet the said requirements, Stage 1 opening between Malolos and CIA in May 2022, and Stage 2 opening between Clark and NCC in January 2025, are assumed in this evaluation, though the Stage 2 opening between Clark and NCC is not included in the target scope of this evaluation. As for the opening date of NSRP-South, whole line opening of NSRP-South in 2023 are assumed (staged opening in NSRP-South is not yet reflected in this project evaluation.) May 2022 opening is assumed for NSCR.Therefore, in this section, the scopes of the evaluation are two folds:

- Whole Network (thereafter referred to as Whole Network) – i.e., MCRP (Stage 1), NSRP-South and NSCR
- MCRP (Stage 1) and NSRP-South

The following parameters have been used to evaluate the impact of the projects.

Table 8.3.1 Parameters Used for Project Evaluation

Parameter	Figure Employed
PhP/Yen Exchange Rate	2.08
USD/Yen Exchange Rate	111
VAT	12% of total Construction Cost
Import Tax	3% of Construction Cost (other than Consulting Fee) as applied to International Portion only
Physical Contingency	5% of Civil Works, Depot, E&M, Rolling Stock (10% of Land Acquisition) and Price Contingency
Price Contingency (International Portion)	1.80%/year of Civil Works, Depot, E&M and Rolling Stock
Price Contingency (National Portion)	1.00%/year of Civil Works, Depot, E&M and Rolling Stock
Base Year/Month for Cost Estimation	2018/June
Administration Fee	3% of Construction Cost and 5% for Land Acquisition

Source: JICA Design Team

8.4 Project Evaluation of the Whole Network

In this section, the efficiency of economic resource allocations that the Whole Network is expected to deliver to the national economy is analyzed. “The Economic Internal Rate of Return (EIRR)”, “The Economic Net Present Value (ENPV)”, and “Benefit and Cost Ratio (B/C)”, are used as the evaluation indicators. In evaluating, literature such as “JICA Project Evaluation Handbook (Ver.1.1)” (2016/JICA), Evaluation Methodology Manuals for Railway Projects” (2012/MLIT), and “Guidelines for the Economic Analysis of Projects” (2017/ADB) are used as reference.

The economic benefits are estimated by comparing to “with project” case (a case wherein the project has been implemented), and “without project” case (a case wherein project implementation is forgone or not implemented). The evaluation period is assumed for 39 years, including the operation period of 35 years. The costs, revenues and benefits throughout the evaluation period are present-valued to 2018. In addition, the cash flow analysis that summarizes the cost, revenue and benefit is conducted.

8.4.1 Economic Cost

The economic cost is derived from the financial cost estimated in the financial analysis, as adjusted for items as transfer payment, land acquisition, land relocation compensation, and price contingency. The amounts in national price terms have been converted to international competitive market price terms using Standard Conversion Factor (SCF). O&M cost components have also been converted from financial costs to economic costs using SCF.

(1) Elimination of Transfer Payment

Such items as import tax and Value Added Tax (VAT) included in the financial costs are not the inputs of goods and services into the project, but the transfers of currencies from investors to government treasuries. Therefore, these taxes should be eliminated from the economic costs.

(2) Land Acquisition Cost and Relocation Cost

In principle, the economic value of land should reflect its opportunity cost and determined by what the land would have been used for without the project. In relation to the project being examined, the land to be acquired are assumed to be not utilized currently and therefore the opportunity cost is assumed to be 30% of the land acquisition costs.

Resettlement of the residents is assumed for the project, and the construction cost of the relocation facilities and houses are accounted for as part of economic cost as it is considered an opportunity cost.

On the other hand, cash assumed to be paid to the relocating residents as compensation is not counted as opportunity cost, and thus zero economic cost is assumed.

(3) No Price Contingency

In compliance with the previously referred Guideline, EIRR estimation does not include price contingencies.

(4) Conversion Factor

Since national price of goods and services is distorted by such factors as customs duty, subsidy and import restrictions, and thus not comparable to international price, in economic analysis, national price is adjusted using Standard Conversion Factor (SCF). SCF is assumed to be 0.83, derived as the inverse of 1.20 which is the shadow exchange rate currently adopted by NEDA as per “ICC Project Evaluation Procedures and Guidelines.”

As the labor cost includes shadow wage paid to unskilled labor, such cost is accounted for as the opportunity cost. Conversion factor of 0.6 is applied to unskilled labor portion of the labor to reflect its low productivity as compared to skilled labor.

The estimated economic cost including investment cost and O&M cost are as follows:

Table 8.4.1 Investment Cost (Economic Cost)

[redacted]

Source: JICA Design Team

Table 8.4.2 O&M Cost (Economic Cost)

(Mil. PhP)	2022	2025	2035	2040
Manpower	1,165	1,596	1,596	1,596
Power	3,954	5,436	5,436	5,436
Administration	2,995	4,416	4,416	4,416
O&M Cost Total	**8,114**	**11,448**	**11,448**	**11,448**

Source: JICA Design Team

Replacement costs for E&M and rolling stocks are considered in the evaluation. As for E&M, major components are assumed for replacement at the end of their economic lives. Minor replacements for rolling stocks are assumed to occur from the 15th and full replacement is implemented from 30th years after the opening of railway services, with each over a 5-year period.

As some infrastructure are thought to have longer economic lives than that of the evaluation period, the reasonable estimated residual values of such at the end of the project evaluation period will also be considered.

8.4.2 Economic Benefit

The economic benefit of Whole Network is calculated based on the methodology explained in this section.

In the process of calculating the core economic benefits of the Whole Network, Vehicles Operation Cost (VOC) and Travel Time Cost (TTC) are the two major components considered for inclusion into economic benefits. The construction of the railway network is expected to reduce traffic volume, which will then result in shorter travel times and faster vehicle operating velocity.

Greenhouse gas (hereinafter referred to as GHG) reduction which this project contributes is also considered for the inclusion into economic benefits.

(1) Vehicles Operation Cost (VOC)

VOC used for the EIRR estimations covers major transportation methods used in the Philippines. The economic benefit is expressed as the reduction in VOC “with” and “without” the Project. It is calculated by applying the following formula to each transportation method.

Unit VOC (PhP/passenger car unit (PCU)) x distance traveled x volume (PCU)

Unit VOC comprises of the eight elements; (1) fuel costs, (2) lubricant costs, (3) tire costs, (4) repair costs, (5) depreciation costs, (6) capacity opportunity (interest) costs, (7) crew costs and (8) overhead costs. Unit VOC is adopted from that under JICA report “The project for capacity development on transportation planning and database management in the Republic of the Philippines MMUTIS update and enhancement project (MUCEP)”

Table 8.4.3 show the adopted unit VOC.

Table 8.4.3 Unit VOC

Speed (km/hour)	VOC Unit (PhP per 1000 km)			
	Public	Motorcycle	Car	Truck
0	32,063	35,230	40,833	63,675
5	46,386	35,230	40,833	63,675
10	26,025	20,120	23,032	34,882
20	15,902	12,307	13,848	20,362
30	12,559	9,640	10,705	14,762
40	10,784	8,197	9,111	12,102
50	10,370	7,507	8,208	10,886
60	10,710	7,367	7,982	10,201
70	11,397	7,447	7,997	9,964
80	12,258	7,687	8,181	10,281
90	13,070	8,123	8,660	10,952
999	13,070	8,123	8,660	10,952

Source: JICA Design Team

(2) Travel Time Cost (TTC)

TTC is expressed as the reduction in the values of passenger's time between "with" and "without" the project. It represents the value of travel time to the economy. It is estimated using the following formula for each transportation method.

Unit TTC (PhP/PCU) x hours traveled (distance/speed) x volume (PCU)

Unit TTC represents the monetary value of time (VOT) per hour. It is based on the mode of transportation and household income, both of which are taken from MUCEP as adjusted for the time passage since the date of report as well as the escalation in line with the projected growth in the Gross Regional Domestic Product (GRDP) per capita[2].

Unit TTC, as shown on Table 8.4.4, is calculated for each transportation method as the value of travel time, derived based on the hourly wage in the survey conducted at the time of MUCEP. The Unit TTC (as often called VOT) is adjusted for the "gross up" to include the benefit component that is the cost directly associated with the employment of labor, but not accounted for in the household income - e.g., employer contribution to the social security system and fringe benefits. Such benefit component in the Philippines is estimated to be 20% of the hourly wage. Based on MUCEP, business trip is assumed to account for 43% of all trips whereas the rest or 57% is personal trips. Personal and business trips are assumed to have 70% and 100% value, respectively, of the unit TTC.

[2] GRDP per capita is estimated to be 6.0%. It is based on the average GRDP per capita for the year 2015/2016 and 2016/2017 for the three regions: NCR (National Capital Region), Region III (Central Luzon) and Region IV-A (Calabarzon), as weighted in proportion to the provincial population in each region wherein Whole Network is intended – i.e., Bulacan and Panpanga for Region III and Laguna for Region IV-A. GRDP per capita is assumed to grow at 6.0% per annum till 2034, at 3% from 2035 to 2039, and at zero (no growth) from 2040.

Table 8.4.4 Unit TTC

Unit TTC (PhP per hour)			
Public	**Motorcycle**	**Car**	**Truck**
770	324	208	75

Source: JICA Design Team

(3) Greenhouse Gas (GHG) Reduction

In sub-section, GHG emission reduction this project contributes is quantified. Such quantification is done based on the JICA Climate-FIT (Mitigation) (JICA Climate Finance Impact Tool / Mitigation) Draft Ver. 2.0 March 2014. GHG emission reduction quantified is shown on Table 8.4.5.

Table 8.4.5 GHG Emission Reduction

(tCO2/year)		
2025	**2035**	**2040**
207,273	685,477	924,579

Source: JICA Design Team

Table 8.4.6 shows the economic benefit of GHG emission reduction this project is expected to contribute. It is calculated using the following formula:

GHG emissions reduced (tCO_2) x price of carbon (PhP)

Price of carbon adopted is PhP 912/tCO_2, derived by multiplying 14.90 Euro/tCO_2, or the closing price of carbon of as of June 1, 2018 as quoted on the EU Emissions Trading System (EU ETC) and 61.227, the Euro/Philippine Peso exchange rate on the same day.

The economic benefits derived by following the aforementioned steps are as follow:

Table 8.4.6 Economic Benefit Results

(Mil. PhP)	2022	2025	2035	2040
VOC	14,616	30,799	33,878	46,046
TTC	13,989	32,161	51,882	87,291
CO_2	(72)	189	625	843
Economic Benefit Total	**28,533**	**63,149**	**86,385**	**134,181**

Source: JICA Design Team

8.4.3 Result of Economic Analysis

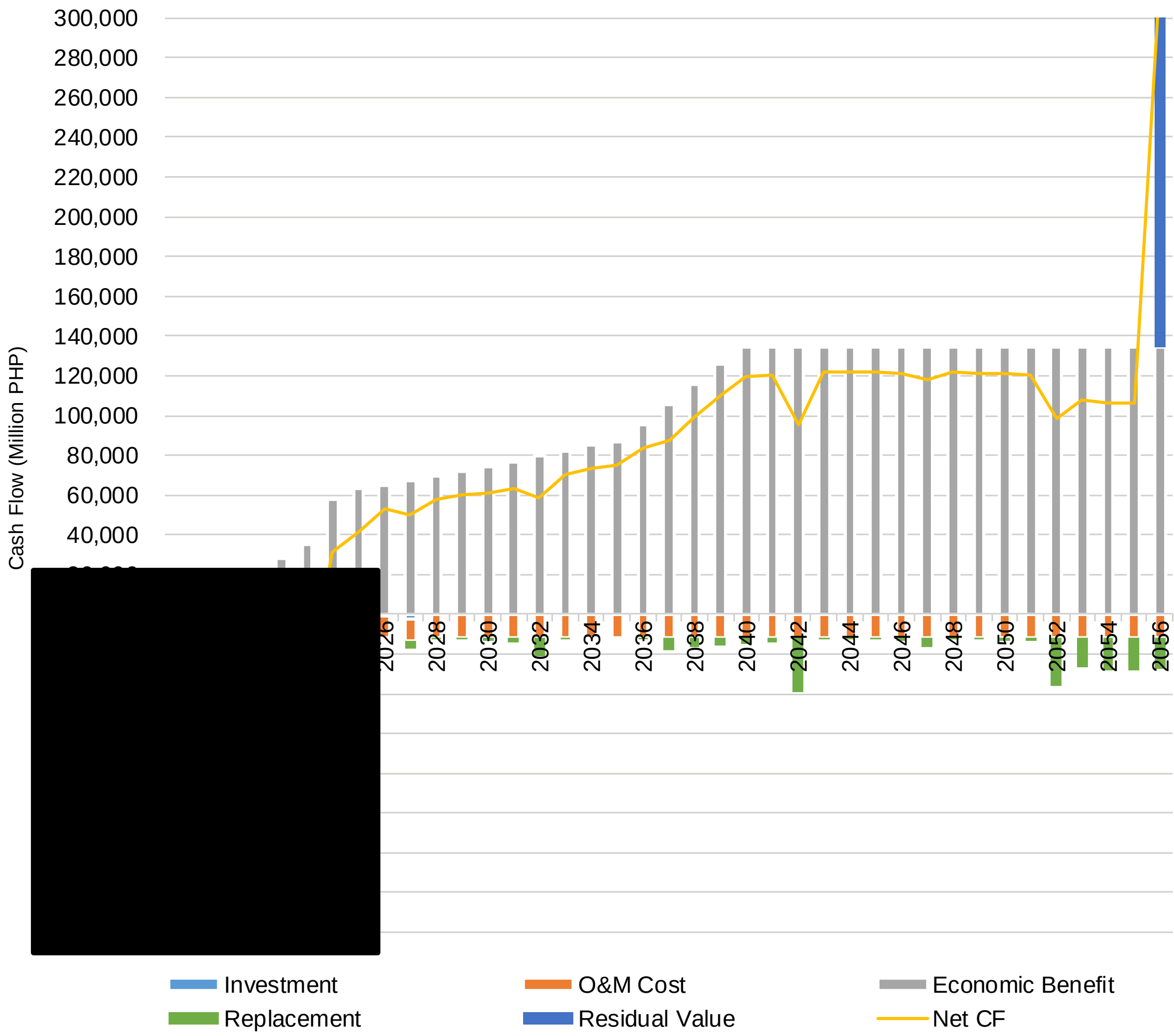
Using on the economic costs and benefits derived from above, economic cash flows of the project period are constructed as below, based on which EIRR, ENPV and B/C have been calculated. 10.4% is the evaluated EIRR, which is above the NEDA's hurdle rate or the NEDA Social Discount Rate of 10% as indicated in NEDA's guideline. By using the Social Discount Rate of 10%, ENPV is calculated at 17,515 million PhP, and B/C derived is 103.3%.

Table 8.4.7 Economic Analysis Results

EIRR	10.4%
ENPV	17,515
B/C	103.3%

	[redacted]	Replacement	O&M	Total Cost	Economic Benefit	Residual Value	Net Cash flow
2018	[redacted]	-	-	(6,474)	-		(6,474)
2019	[redacted]	-	-	(108,881)	-		(108,881)
2020	[redacted]	-	-	(139,037)	-		(139,037)
2021	[redacted]	-	(1,801)	(137,215)	-		(137,215)
2022	[redacted]	-	(8,114)	(97,244)	28,456		(68,788)
2023	[redacted]	-	(10,950)	(76,991)	35,489		(41,502)
2024	[redacted]	-	(11,448)	(26,536)	57,903		31,366
2025	[redacted]	-	(11,448)	(21,937)	63,149		41,212
2026	[redacted]	-	(11,448)	(12,106)	65,181		53,076
2027	-	(3,315)	(11,448)	(14,763)	67,300		52,537
2028	-	(169)	(11,448)	(11,617)	69,508		57,892
2029	-	(432)	(11,448)	(11,879)	71,811		59,932
2030	-	(2,079)	(11,448)	(13,526)	74,214		60,688
2031	-	(2,373)	(11,448)	(13,821)	76,721		62,900
2032	-	(9,473)	(11,448)	(20,921)	79,337		58,416
2033	-	(169)	(11,448)	(11,617)	82,068		70,451
2034	-	-	(11,448)	(11,448)	84,919		73,471
2035	-	-	(11,448)	(11,448)	86,385		74,937
2036	-	(432)	(11,448)	(11,879)	95,708		83,829
2037	-	(6,249)	(11,448)	(17,697)	105,395		87,698
2038	-	(4,750)	(11,448)	(16,197)	115,461		99,264
2039	-	(4,149)	(11,448)	(15,597)	125,924		110,327
2040	-	(3,419)	(11,448)	(14,867)	134,181		119,314
2041	-	(2,502)	(11,448)	(13,950)	134,181		120,231
2042	-	(27,740)	(11,448)	(39,187)	134,181		94,993
2043	-	(601)	(11,448)	(12,048)	134,181		122,133
2044	-	(432)	(11,448)	(11,879)	134,181		122,302
2045	-	(432)	(11,448)	(11,879)	134,181		122,302
2046	-	(1,647)	(11,448)	(13,095)	134,181		121,086
2047	-	(4,963)	(11,448)	(16,410)	134,181		117,771
2048	-	(792)	(11,448)	(12,240)	134,181		121,941
2049	-	(1,395)	(11,448)	(12,842)	134,181		121,338
2050	-	(1,924)	(11,448)	(13,371)	134,181		120,809
2051	-	(2,077)	(11,448)	(13,525)	134,181		120,656
2052	-	(24,294)	(11,448)	(35,742)	134,181		98,439
2053	-	(15,181)	(11,448)	(26,629)	134,181		107,552
2054	-	(16,659)	(11,448)	(28,107)	134,181		106,074
2055	-	(16,659)	(11,448)	(28,107)	134,181		106,074
2056	-	(15,635)	(11,448)	(27,083)	134,181	209,492	316,590

Source: JICA Design Team



Source: JICA Design Team

Figure 8.4.1 Cash Flow of Economic Cost and Benefit

8.4.4 Sensitivity Analysis

A sensitivity analysis considers the impacts of positive and negative changes to the project in various economic environments. To that end, the level of impacts from increasing or decreasing the economic cost and benefit to EIRR is analyzed.

Under the current assumptions, NEDA's hurdle rate of 10% is achievable unless 10% or more economic cost overrun or 5% or more decrease in benefits does not occur.

Table 8.4.8 Sensitivity Analysis of Economic Evaluation

		Investment								
		120%	115%	110%	105%	100%	95%	90%	85%	80%
	120%	8.7%	9.0%	9.4%	9.7%	10.1%	10.5%	11.0%	11.5%	12.0%
	115%	8.8%	9.1%	9.4%	9.8%	10.2%	10.6%	11.1%	11.5%	12.1%
	110%	8.9%	9.2%	9.5%	9.9%	10.3%	10.7%	11.1%	11.6%	12.2%
	105%	8.9%	9.2%	9.6%	9.9%	10.3%	10.8%	11.2%	11.7%	12.3%
O&M	100%	9.0%	9.3%	9.7%	10.0%	10.4%	10.8%	11.3%	11.8%	12.3%
	95%	9.1%	9.4%	9.7%	10.1%	10.5%	10.9%	11.4%	11.9%	12.4%
	90%	9.1%	9.4%	9.8%	10.2%	10.6%	11.0%	11.5%	12.0%	12.5%
	85%	9.2%	9.5%	9.9%	10.2%	10.6%	11.1%	11.5%	12.0%	12.6%
	80%	9.2%	9.6%	9.9%	10.3%	10.7%	11.1%	11.6%	12.1%	12.7%

		Economic Cost (Investment, O&M, Replacement)								
		120%	115%	110%	105%	100%	95%	90%	85%	80%
	120%	10.4%	10.8%	11.3%	11.8%	12.3%	12.9%	13.5%	14.1%	14.9%
	115%	10.0%	10.4%	10.9%	11.3%	11.8%	12.4%	13.0%	13.6%	14.3%
	110%	9.6%	10.0%	10.4%	10.9%	11.4%	11.9%	12.5%	13.1%	13.8%
	105%	9.1%	9.5%	10.0%	10.4%	10.9%	11.4%	12.0%	12.6%	13.3%
Benefit	100%	8.7%	9.1%	9.5%	9.9%	10.4%	10.9%	11.5%	12.1%	12.7%
	95%	8.2%	8.6%	9.0%	9.4%	9.9%	10.4%	11.0%	11.5%	12.2%
	90%	7.7%	8.1%	8.5%	8.9%	9.4%	9.9%	10.4%	11.0%	11.6%
	85%	7.2%	7.6%	8.0%	8.4%	8.9%	9.3%	9.9%	10.4%	11.0%
	80%	6.7%	7.1%	7.5%	7.9%	8.3%	8.8%	9.3%	9.8%	10.4%

Source: JICA Design Team

8.4.5 Financial Analysis

The main purpose of financial analysis is to analyze the financial feasibility of the project. Financial Internal Rate of Return (FIRR), Financial Net Present Value (FNPV), and Revenue and Cost Ratio (R/C) are used as the evaluation method.

Evaluation period is same as the economic analysis – i.e., 39 years including the operation period of 35 years.

8.4.6 Financial Cost

The project's financial costs are the initial investment costs – i.e., capital expenditures (CAPEX) – and operation and maintenance (O&M) costs – i.e., operational expenditures (OPEX)). The total financial costs will include physical contingencies and price contingencies (price escalation).

The financial investment cost, O&M costs and replacement costs are estimated as follows:

Table 8.4.9 Investment Cost (Financial Cost)

[redacted]

Source: JICA Design Team

Table 8.4.10 O&M Cost (Financial Cost)

(Mil. PhP)	2022	2025	2035	2040
Manpower	1,403	1,922	1,922	1,922
Power	4,764	6,549	6,549	6,549
Administration	3,134	4,621	4,621	4,621
O&M Cost Total	**9,301**	**13,092**	**13,092**	**13,092**

Source: JICA Design Team

Replacement costs for E&M and rolling stocks are considered in the evaluation. As for E&M, major components are assumed for replacement at the end of their economic lives. Major replacements for rolling stocks are assumed to occur from the 15^{th} and full replacement is implemented from 30^{th} years after the opening, with each over a 5-year period.

As some infrastructures are thought to have longer economic lives than that of the evaluation period, the reasonable estimated residual values of such infrastructures at the end of the project evaluation period will also be considered.

[3] Figures for Civil Works, Depot, E&M, Rolling Stock and Consulting are based on the information from DOTr and JICA report: "The Supplementary Survey on North-South Commuter Rail Project (phase II-A) in the Republic of the Philippines: Final Report" (November 2015)

8.4.7 Financial Revenue

Financial revenue comprises of two streams: 1) a fare revenue from railway operations and 2) a non-fare revenue consisting of advertising and space rentals around and within the railway station. Fare revenue is calculated as per the formula below.

Fare Revenue: Σ (Ridership x Train Fare)

Ridership: Number of Passengers (Annual)

Train Fare: Commuter Service: fixed fair of 22PhP + 2PhP/km x travelled distance (km)

Train Fare: Express Service: fixed fair of 22PhP + 4PhP/km x travelled distance (km)

As elaborated in Table 3.5.14 and Figure 3.5.10 of Chapter 3, the assumed fare setting is expected to provide the highest revenue.

Throughout the evaluation period, the non-fare revenue is assumed to be 10% to the fare revenue. A ridership projection used for the revenue is adopted from Chapter 3.

Table 8.4.11 Financial Revenue

(Mil. PhP)	2022	2025	2035	2040
Fare Revenue	7,529	25,350	33,195	37,590
Non-Fare Revenue	753	2,535	3,320	3,759
Revenue Total	**8,282**	**27,885**	**36,515**	**41,349**

Source: JICA Design Team

8.4.8 Financial Evaluation

The cash flow throughout the entire evaluation period is derived as the functions of the aforementioned financial costs and revenues, and utilizing the cash flow, FIRR, FNPV and R/C are calculated. FIRR is -0.5% and therefore the Whole Network is under NEDA's hurdle rate Weighted Average Cost of Capital (WACC.) WACC is estimated to be 4.3% (in calculating WACC, project cost is categorized by funding source – i.e.,, JICA, ADB and the government of the Philippines, then for each funding source, cost of funds in real term is estimated.)

FNPV is -401,595 Mil PhP and R/C is 56.0% using 4.885% as WACC.

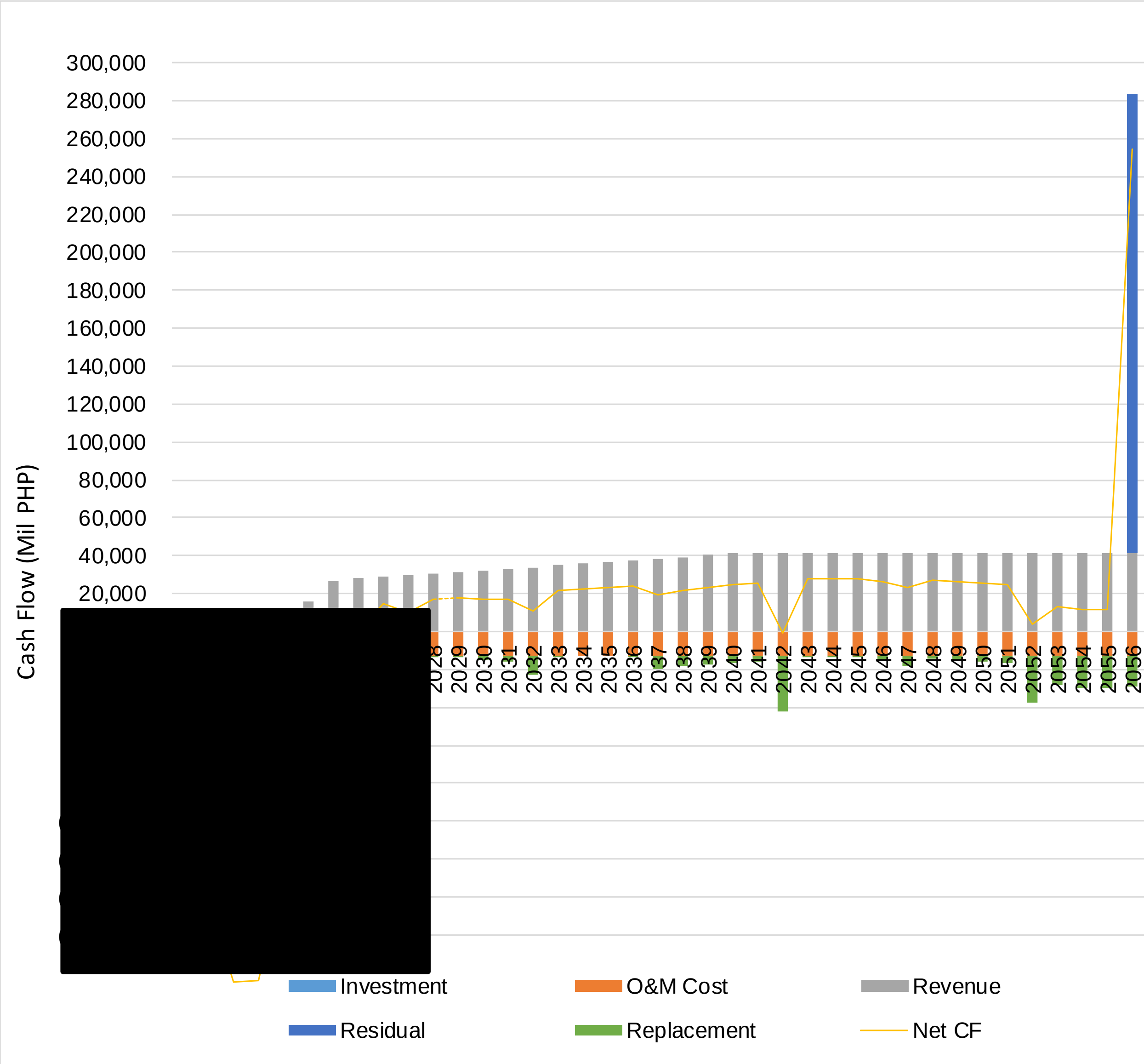
Relatively low demand in light of rather significant initial investment is the cause of the results above. The Government of the Philippines is considering the PPP modality wherein O&M of the Project is entrusted to a private sector operator. PPP may help improve the FIRR by reducing O&M costs through efficient operations and invoking more demands through marketing.

Table 8.4.12 Result of Financial Evaluation

FIRR	0.5%
FNPV	-401,595
R/C	56.0%

	[redacted]	Replacement	O&M	Total Cost	Revenue	Residual Value	Net Cash flow
2018	[redacted]	-	-	(12,272)	-	-	(12,272)
2019	[redacted]	-	-	(143,441)	-	-	(143,441)
2020	[redacted]	-	-	(184,679)	-	-	(184,679)
2021	[redacted]	-	(2,097)	(183,918)	-	-	(183,918)
2022	[redacted]	-	(9,301)	(132,823)	8,282	-	(124,541)
2023	[redacted]	-	(12,513)	(106,728)	15,531	-	(91,197)
2024	[redacted]	-	(13,092)	(33,064)	26,371	-	(6,694)
2025	[redacted]	-	(13,092)	(26,872)	27,885	-	1,013
2026	[redacted]	-	(13,092)	(13,971)	28,748	-	14,777
2027	-	(3,447)	(13,092)	(16,539)	29,611	-	13,071
2028	-	(279)	(13,092)	(13,371)	30,474	-	17,103
2029	-	(455)	(13,092)	(13,547)	31,337	-	17,789
2030	-	(2,261)	(13,092)	(15,353)	32,200	-	16,846
2031	-	(2,644)	(13,092)	(15,736)	33,063	-	17,326
2032	-	(9,734)	(13,092)	(22,827)	33,926	-	11,099
2033	-	(279)	(13,092)	(13,371)	34,789	-	21,418
2034	-	-	(13,092)	(13,092)	35,652	-	22,559
2035	-	-	(13,092)	(13,092)	36,515	-	23,422
2036	-	(455)	(13,092)	(13,547)	37,482	-	23,934
2037	-	(6,404)	(13,092)	(19,496)	38,448	-	18,952
2038	-	(5,042)	(13,092)	(18,134)	39,415	-	21,281
2039	-	(4,308)	(13,092)	(17,401)	40,382	-	22,982
2040	-	(3,599)	(13,092)	(16,692)	41,349	-	24,657
2041	-	(2,502)	(13,092)	(15,594)	41,349	-	25,754
2042	-	(29,367)	(13,092)	(42,459)	41,349	-	(1,110)
2043	-	(734)	(13,092)	(13,826)	41,349	-	27,523
2044	-	(455)	(13,092)	(13,547)	41,349	-	27,802
2045	-	(455)	(13,092)	(13,547)	41,349	-	27,802
2046	-	(1,806)	(13,092)	(14,899)	41,349	-	26,450
2047	-	(5,253)	(13,092)	(18,345)	41,349	-	23,003
2048	-	(993)	(13,092)	(14,085)	41,349	-	27,264
2049	-	(2,066)	(13,092)	(15,158)	41,349	-	26,191
2050	-	(2,779)	(13,092)	(15,871)	41,349	-	25,478
2051	-	(3,400)	(13,092)	(16,492)	41,349	-	24,857
2052	-	(24,487)	(13,092)	(37,580)	41,349	-	3,769
2053	-	(15,291)	(13,092)	(28,383)	41,349	-	12,966
2054	-	(16,818)	(13,092)	(29,911)	41,349	-	11,438
2055	-	(16,818)	(13,092)	(29,911)	41,349	-	11,438
2056	-	(15,726)	(13,092)	(28,818)	41,349	242,006	254,536

Source: JICA Design Team



Source: JICA Design Team

Figure 8.4.2 Cash Flow of Financial Cost and Revenue

8.4.9 Sensitivity Analysis

The sensitivity analysis considers the impacts of the changes in the financial environments to the Project. In line with this, the impacts of the changes in the financial costs and revenues to FIRR is analyzed.

Under the current assumptions, NEDA's hurdle rate will not be achievable even if revenue is 20% more from the currently projected level accompanied by the 20% reduction in investment cost.

Table 8.4.13 Financial Sensitivity Analysis

		Investment								
		120%	115%	110%	105%	100%	95%	90%	85%	80%
	120%	-0.7%	-0.6%	-0.4%	-0.2%	0.0%	0.2%	0.5%	0.7%	1.0%
	115%	-0.6%	-0.4%	-0.3%	-0.1%	0.1%	0.3%	0.6%	0.8%	1.1%
	110%	-0.5%	-0.3%	-0.1%	0.0%	0.3%	0.5%	0.7%	1.0%	1.2%
	105%	-0.4%	-0.2%	0.0%	0.2%	0.4%	0.6%	0.8%	1.1%	1.3%
O&M	100%	-0.3%	-0.1%	0.1%	0.3%	0.5%	0.7%	0.9%	1.2%	1.5%
	95%	-0.2%	0.0%	0.2%	0.4%	0.6%	0.8%	1.1%	1.3%	1.6%
	90%	-0.1%	0.1%	0.3%	0.5%	0.7%	0.9%	1.2%	1.5%	1.7%
	85%	0.0%	0.2%	0.4%	0.6%	0.8%	1.1%	1.3%	1.6%	1.9%
	80%	0.1%	0.3%	0.5%	0.7%	0.9%	1.2%	1.4%	1.7%	2.0%

		Financial Cost (Investment, O&M, Replacement)								
		120%	115%	110%	105%	100%	95%	90%	85%	80%
	120%	0.5%	0.8%	1.1%	1.5%	1.9%	2.2%	2.6%	3.1%	3.5%
	115%	0.2%	0.5%	0.8%	1.2%	1.5%	1.9%	2.3%	2.8%	3.2%
	110%	-0.2%	0.2%	0.5%	0.8%	1.2%	1.6%	2.0%	2.4%	2.9%
	105%	-0.5%	-0.2%	0.1%	0.5%	0.9%	1.2%	1.6%	2.1%	2.5%
Revenue	100%	-0.9%	-0.6%	-0.2%	0.1%	0.5%	0.9%	1.3%	1.7%	2.2%
	95%	-1.3%	-1.0%	-0.6%	-0.3%	0.1%	0.5%	0.9%	1.3%	1.8%
	90%	-1.7%	-1.4%	-1.1%	-0.7%	-0.3%	0.1%	0.5%	0.9%	1.4%
	85%	-2.2%	-1.9%	-1.5%	-1.1%	-0.8%	-0.4%	0.1%	0.5%	0.9%
	80%	-2.7%	-2.4%	-2.0%	-1.6%	-1.2%	-0.8%	-0.4%	0.0%	0.5%

Source: JICA Design Team

8.5 Project Evaluation of MCRP (Stage 1) and NSCR-South as One Railway Project

In this sub-section, the economic and financial feasibility of MCRP (Stage 1) and NSRP-South as one interrelated railway network is analyzed.

8.5.1 Economic Evaluation

The following investment cost, O&M cost, and benefits are used for economic analysis.

Table 8.5.1 Investment Cost (Economic Cost)

[redacted]

Source: JICA Design Team

Table 8.5.2 O&M Cost (Economic Cost)

(Mil. PhP)	2022	2025	2035	2040
O&M Cost	4,493	7,847	7,847	7,847

Source: JICA Design Team

Table 8.5.3 Economic Benefit

(Mil. PhP)	2022	2025	2035	2040
Economic Benefit	16,936	51,905	83,021	115,241

Source: JICA Design Team

Replacement costs for E&M and rolling stocks are considered in the evaluation. As for E&M, major components are assumed for replacement at the end of their economic lives. Major replacements for rolling stocks are assumed to occur from the 15th and full replacement is implemented from 30th years after the opening, with each over a 5-year period.

As some infrastructure are thought to have longer economic lives than that of the evaluation period, the reasonable estimated residual values of such at the end of the project evaluation period will also be considered.

Using the economic costs and benefits derived from above, economic cash flows of the project period are constructed below, based on which EIRR, ENPV and B/C have been calculated. 11.5% is the calculated EIRR, which is above the NEDA Social Discount Rate of 10%. Using the said figure, ENPV is calculated at 63,695 million PhP, and B/C derived is 115.5%.

Table 8.5.4 Result of Economic Evaluation

EIRR	11.5%
ENPV	63,659
B/C	115.5%

	[redacted]	Replacement	O&M	Total Cost	Economic Benefit	Residual Value	Net Cash flow
2018	[redacted]	-	-	(2,890)	-		(2,890)
2019	[redacted]	-	-	(72,999)	-		(72,999)
2020	[redacted]	-	-	(108,669)	-		(108,669)
2021	[redacted]	-	(1,088)	(104,543)	-		(104,543)
2022	[redacted]	-	(4,493)	(82,748)	16,936		(65,812)
2023	[redacted]	-	(7,348)	(69,866)	24,391		(45,476)
2024	[redacted]	-	(7,847)	(20,889)	48,125		27,235
2025	[redacted]	-	(7,847)	(18,336)	51,905		33,569
2026	[redacted]	-	(7,847)	(8,505)	54,380		45,875
2027	-	(2,649)	(7,847)	(10,495)	56,999		46,504
2028	-	(135)	(7,847)	(7,982)	59,774		51,792
2029	-	(345)	(7,847)	(8,191)	62,714		54,523
2030	-	(1,661)	(7,847)	(9,507)	65,833		56,325
2031	-	(1,896)	(7,847)	(9,742)	69,141		59,398
2032	-	(7,568)	(7,847)	(15,415)	72,652		57,238
2033	-	(135)	(7,847)	(7,982)	76,382		68,400
2034	-	-	(7,847)	(7,847)	80,343		72,497
2035	-	-	(7,847)	(7,847)	83,021		75,175
2036	-	(345)	(7,847)	(8,191)	89,429		81,237
2037	-	(5,239)	(7,847)	(13,086)	96,074		82,988
2038	-	(4,041)	(7,847)	(11,888)	102,967		91,079
2039	-	(3,562)	(7,847)	(11,408)	110,118		98,710
2040	-	(2,978)	(7,847)	(10,825)	115,241		104,416
2041	-	(2,246)	(7,847)	(10,092)	115,241		105,149
2042	-	(22,160)	(7,847)	(30,007)	115,241		85,234
2043	-	(480)	(7,847)	(8,327)	115,241		106,915
2044	-	(345)	(7,847)	(8,191)	115,241		107,050
2045	-	(345)	(7,847)	(8,191)	115,241		107,050
2046	-	(1,316)	(7,847)	(9,163)	115,241		106,079
2047	-	(3,964)	(7,847)	(11,811)	115,241		103,430
2048	-	(633)	(7,847)	(8,479)	115,241		106,762
2049	-	(1,114)	(7,847)	(8,961)	115,241		106,280
2050	-	(1,537)	(7,847)	(9,384)	115,241		105,858
2051	-	(1,659)	(7,847)	(9,506)	115,241		105,735
2052	-	(20,889)	(7,847)	(28,736)	115,241		86,506
2053	-	(13,609)	(7,847)	(21,456)	115,241		93,786
2054	-	(14,790)	(7,847)	(22,637)	115,241		92,605
2055	-	(14,790)	(7,847)	(22,637)	115,241		92,605
2056	-	(13,972)	(7,847)	(21,818)	115,241	176,066	269,489

Source: JICA Design Team

8.5.2 Financial Evaluation

The financial investment cost and O&M costs, as well as financial revenues are estimated as follows:

Table 8.5.5 Investment Cost (Financial Cost)

[redacted]

Source: JICA Design Team

Table 8.5.6 O&M Cost (Financial Cost)

(Mil. PhP)	2022	2025	2035	2040
O&M Cost	5,119	8,910	8,910	8,910

Source: JICA Design Team

Table 8.5.7 Financial Revenue

(Mil. PhP)	2022	2025	2035	2040
Revenue (Fare revenue and Non Fare revenue)	6,586	25,250	32,125	36,345

Source: JICA Design Team

Replacement costs for E&M and rolling stocks are considered in the evaluation. As for E&M, major components are assumed for replacement at the end of their economic lives. Major replacements for rolling stocks are assumed to occur from the 15th and full replacement is implemented from 30th years after the opening, with each over a 5-year period.

As some infrastructure are thought to have longer economic lives than that of the evaluation period, the reasonable estimated residual values of such at the end of the project evaluation period will also be considered.

The cash flow throughout the entire evaluation period is derived as the functions of the aforementioned financial costs and revenues, and utilizing the cash flow, FIRR, FNPV and R/C are calculated. FIRR is 1.5% and therefore the project is below NEDA’s hurdle rate – i.e., WACC. WACC is estimated to be 4.3% (in calculating WACC, project cost of MCRP and NSRP-South is categorized by funding source –

i.e., JICA, ADB and the Government of the Philippines, then for each funding source, cost of funds in real terms is estimated). FNPV is -251,708 Mil PhP and R/C is 64.6% under the WACC of 4.885%.

Table 8.5.8 Result of Financial Evaluation

FIRR	1.5%
FNPV	-251,708
R/C	64.6%

	[redacted]	Replacement	O&M	Total Cost	Revenue	Residual Value	Net Cash flow
2018	[redacted]	-	-	(4,434)	-	-	(4,434)
2019	[redacted]	-	-	(99,341)	-	-	(99,341)
2020	[redacted]	-	-	(147,461)	-	-	(147,461)
2021	[redacted]	-	(1,262)	(143,732)	-	-	(143,732)
2022	[redacted]	-	(5,119)	(114,852)	6,586	-	(108,267)
2023	[redacted]	-	(8,331)	(98,254)	22,977	-	(75,277)
2024	[redacted]	-	(8,910)	(26,340)	23,735	-	(2,605)
2025	[redacted]	-	(8,910)	(22,690)	25,250	-	2,560
2026	[redacted]	-	(8,910)	(9,789)	25,938	-	16,149
2027	-	(2,754)	(8,910)	(11,664)	26,625	-	14,961
2028	-	(223)	(8,910)	(9,133)	27,313	-	18,180
2029	-	(363)	(8,910)	(9,274)	28,000	-	18,727
2030	-	(1,806)	(8,910)	(10,717)	28,688	-	17,971
2031	-	(2,112)	(8,910)	(11,023)	29,375	-	18,353
2032	-	(7,776)	(8,910)	(16,687)	30,063	-	13,376
2033	-	(223)	(8,910)	(9,133)	30,750	-	21,617
2034	-	-	(8,910)	(8,910)	31,438	-	22,528
2035	-	-	(8,910)	(8,910)	32,125	-	23,215
2036	-	(363)	(8,910)	(9,274)	32,969	-	23,696
2037	-	(5,363)	(8,910)	(14,273)	33,813	-	19,540
2038	-	(4,275)	(8,910)	(13,185)	34,657	-	21,472
2039	-	(3,689)	(8,910)	(12,599)	35,501	-	22,902
2040	-	(3,122)	(8,910)	(12,033)	36,345	-	24,313
2041	-	(2,246)	(8,910)	(11,156)	36,345	-	25,189
2042	-	(23,460)	(8,910)	(32,370)	36,345	-	3,975
2043	-	(586)	(8,910)	(9,496)	36,345	-	26,849
2044	-	(363)	(8,910)	(9,274)	36,345	-	27,071
2045	-	(363)	(8,910)	(9,274)	36,345	-	27,071
2046	-	(1,443)	(8,910)	(10,353)	36,345	-	25,992
2047	-	(4,196)	(8,910)	(13,107)	36,345	-	23,238
2048	-	(793)	(8,910)	(9,703)	36,345	-	26,642
2049	-	(1,650)	(8,910)	(10,561)	36,345	-	25,785
2050	-	(2,220)	(8,910)	(11,130)	36,345	-	25,215
2051	-	(2,716)	(8,910)	(11,626)	36,345	-	24,719
2052	-	(21,043)	(8,910)	(29,954)	36,345	-	6,391
2053	-	(13,697)	(8,910)	(22,607)	36,345	-	13,738
2054	-	(14,917)	(8,910)	(23,827)	36,345	-	12,518
2055	-	(14,917)	(8,910)	(23,827)	36,345	-	12,518
2056	-	(14,044)	(8,910)	(22,955)	36,345	203,851	217,241

Source: JICA Design Team

CHAPTER 9 ENVIRONMENT AND SOCIAL CONSIDERATION

9.1 Assistance on Environmental Impact Assessment

9.1.1 Preparation of the Environmental Impact Statement

(1) Study Background

PNR currently operates the Solis-Calamba rail line. This commuter railway offers a more efficient alternative to road-based transport; however, the existing network needs to be significantly expanded in reach and capacity in order to meet increased daily passenger demand. To support the development of new urban centers and to meet increasing residential demands, a commuter railway service to connect Metro Manila with its adjacent northern and southern suburban areas is planned to be an important mass transit backbone. In addition, the railway will service the growth corridor of the Greater Capital Region (GCR); comprising of Region III, National Capital Region (NCR), and Region IV-A.

The NSRP-South will be constructed by utilizing the existing Right-of-Way (ROW) of the Philippine National Railways (PNR), while the PNR line will continue its operation for the freight and long-haul trains operation. In addition, NSRP -South plans to connect to the NSCR at Solis station and MMSP line at FTI station. After a discussion with DENR-EMB on December 5, 2017 about the above background, DENR-EMB classified the Project as a Category I New Project and thus required the preparation of an EIS and obtain ECC.

(2) Study Outline

In order to achieve the Environmental Compliance Certificate (ECC) for the NSRP-South, a draft Environmental Impact Statement (EIS) has been prepared following the JICA Guidelines for Environmental and Social Considerations 2010 (JICA Guidelines) and Asian Development Bank Safeguard Policy Statement 2009 (ADB SPS). The following activities were completed in the preparation of the EIS.

Table 9.1.1 Study Framework

	Items	Contents
1	Baseline condition of environmental & social consideration	Study initial environmental and social condition of project area
2	Review legal framework relevant to EIA	• Law and Regulation on EIA, Public Participation, Information Disclosure • Comparison of Philippines Policies and JICA Guidelines • Responsible Governmental Authorities
3	Impact Assessment and Analysis of Alternatives	Impact assessment including “without-project case”
4	Scoping	Clarification of items to consider and assessment methods. • Technical Scoping: February 9, 2018
5	Baseline Survey on environmental and social conditions	Land use, natural environment, socio economic condition etc. • Pedology: January 23 - February 22, 2018 • Terrestrial Ecology: February 9-24, 2018 • Hydrology/Hydrogeology: February 15, 2018 • Fresh / Ground water Quality: February 12-15, 2018 • Freshwater Ecology: February 8-9, 2018 • Air and Noise quality: January 18 – February 22, 2018 • Vibration: February 12 – 20, 2018 • Perception Survey: February 6 –28, 2018 • Soil sampling at Suckat Power Plant: August 20, 2018
6	Baseline condition of environmental & social consideration	Required Information for prediction, prediction methodology and results
7	Review legal framework relevant to EIA	Adequacy and Validation of mitigation measures and compensation
8	Impact Assessment and Analysis of Alternatives	Review of implementation arrangement, method and frequency
9	Scoping	Cost and budget for implementation of mitigation measures and monitoring plan
10	Baseline Survey on environmental and social conditions	Grievance Redress Mechanism, EMP & EMoP implementation mechanism
11	Predict environmental impacts	Disseminate project outline and gather stakeholder opinions and comments • IEC: December 2017 - January 2018 • Public Scoping: January 18, 19, 24, 2018 • Public Hearing: June 20, 21,22, 2018
12	Elaborate the feasible mitigation measures	Submit draft EIS to EMB for review and obtain ECC • Submission: 11 May, 2018 • Issuance of ECC: August, 2018
13	Develop Environmental Monitoring Plan	Conduct of west season sampling, analysis and report. • Air, water, noise, fauna and flora survey : July – August 2018

(3) Study Schedule

The schedule is as follows.

Table 9.1.2 EIA Schedule

Activity	2017	2018										
	12	1	2	3	4	5	6	7	8	9	10	11	12
Review of FS and previous projects													
Review of legal framework													
LGU and NGAs Meetings													
Public Scoping													
Technical Scoping													
Baseline Survey (Desktop)													
Baseline Survey (Field survey and analysis)													
Prepration of EIA rpeort													
ECC application and EIA review													
Public Hearing													
ECC Issurance													

Source: JICA Design Team

9.1.2 Project Outline

(1) Project Area

The NSRP-South will utilize the existing PNR ROW traversing 10 Local Government Units (LGUs), namely the cities of Manila, Makati, Taguig, Parañaque and Muntinlupa in NCR; and Cities of San Pedro, Biñan, Santa Rosa, Cabuyao and Calamba in the Province of Laguna. The length of the NSRP-South will be approximately 55.6 km from Solis Station to Calamba Station. Based on the preliminary design, 42.0 km section will be elevated, 12.6 km of the alignment will be at grade, and approximately 1 km underground. The line will have 21 stations, all of which, two of these stations planned to be at-grade, 18 on viaduct and one underground. The alignment of the proposed project showing the administrative boundaries is shown in Figure 9.1.1.

(2) Project Component

The NSRP will utilize the existing PNR ROW land acquisition over its length and will include the following components:

- Main Railway line
- Viaduct / bridges.
- Embankment
- Bridge crossings (rivers/highways)
- Tunnel
- Stations: All stations will be elevated and will have a ROW width of 60 m (including the tracks), and a length of around 250 m. The basic station layout is two separate platforms, serving two tracks except the station which will have a single platform at the center.
- Stations: Stations will be elevated, at grade and underground and will have a ROW width of 60 m (including the tracks), and a length of around 250 m. The basic station layout is two separate platforms, serving two tracks. Some stations will have a single platform at the center.
- Depot including Workshops and Operations Control Center, Maintenance and workshop buildings, Access tracks, Train storage tracks, Workshop for heavy rolling stock maintenance, Light repair shop, Catenary and track maintenance shops, repair shop, Wheel re-profiling Shop, Car washing track, Test track, Sub stations, Sewage treatment plant, storm water reservoir, emergency facility, Access road inside depot, car parking, light, fence etc.
- E&M System (Signal system, Over Head Contact System, Communication System, Substations, etc.)
- Drainage
- Maintenance Base
- Maintenance Access Roads
- Construction Yards: Office, Laboratory, Worker's quarter, warehouse, Fabrication Yard, Batching Plant, Segment Casting Yard
- Borrow Pit/Soil Disposal Areas

It should be noted that under the EIS, the construction yards are considered as a one of temporary facilities, however a separate ECC will be required and will be obtained by contractors.

(3) Impact Area

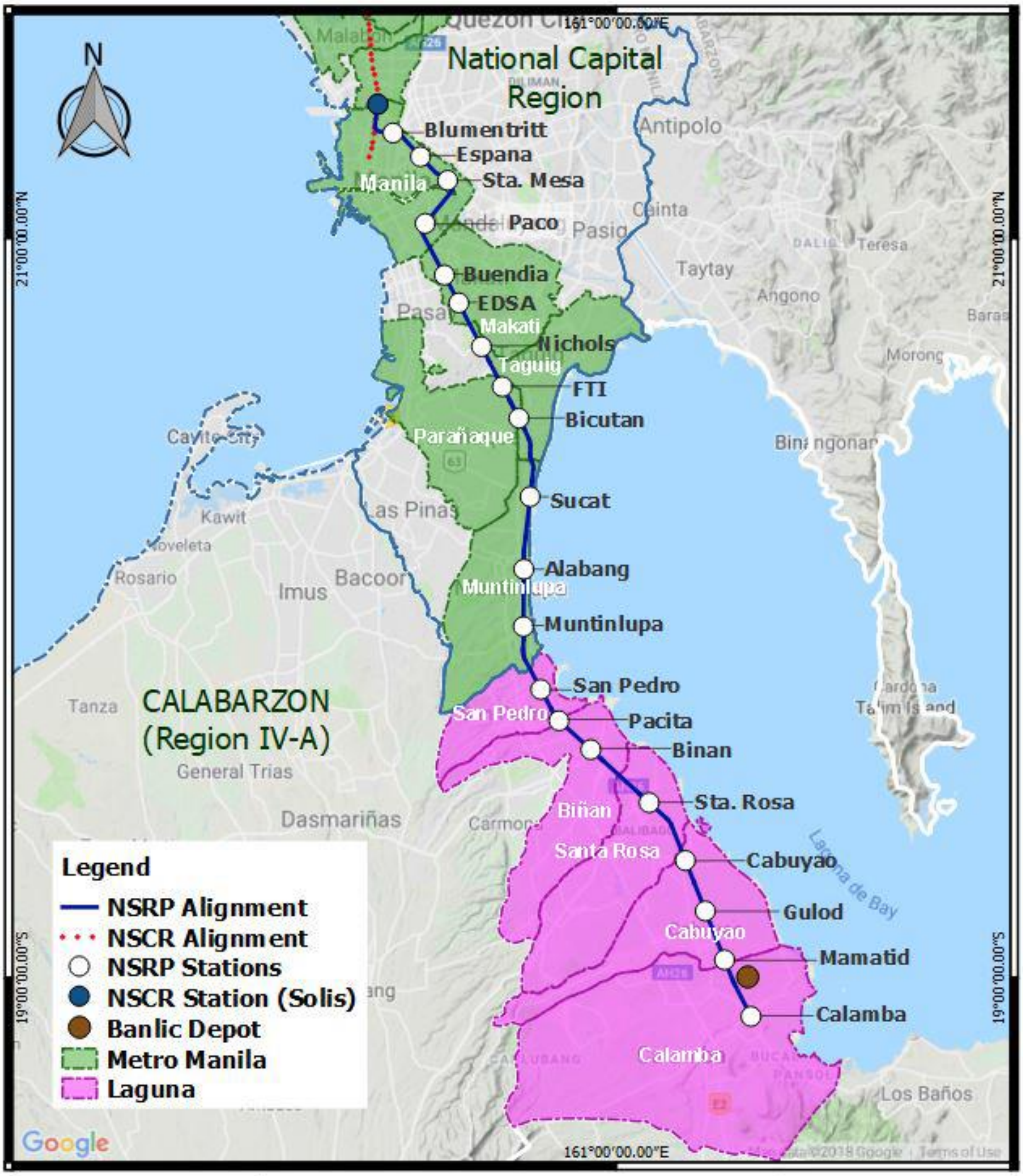
The NSRP-South alignment will run along the existing PNR ROW. Thus, the Direct Impact Areas (DIA) covers the existing PNR-ROW with an approximate width of 30 m with an estimated total length of 55.6 km. additionally, the DIA at the stations will be a width of 60 m with a length of approximately 250 m. Also, the location of the proposed Depot will be included in the DIA.

In terms of environmental effects, the DIA can also spread wider than the ROW where, for instance, noise, pollution, sediments travel further. Where this is the case the impact area is mentioned in the section. In terms of socio economic benefits, the DIA areas include the host LGUs which are the project beneficiaries for employment, business opportunities, and reduced road congestion. The indirect impact areas will cover the nearby LGUs who will benefit from the increased economic growth in the region and the entire country.

Table 9.1.3 Municipalities and Cities the Proposed Alignment traverses

Region	Province	Municipalities and Cities
National Capital Region	-	City of Manila
		City of Makati
		City of Taguig
		City of Parañaque
		City of Muntinlupa
Region IV (A) Calabarzon	Laguna	City of San Pedro
		City of Biñan
		City of Santa Rosa
		City of Cabuyao
		City of Calamba

Source: JICA Design Team



Source: GADM Global Administrative Areas Database (http://gadm.org/, Version 2, 2011) Prepared By: JICA Study Team	**Project Alignment Showing Administrative Boundaries** North South Railway Project	Scale: 0 2.5 5 7.5 km

Figure 9.1.1 Project Alignment Showing LGUs' Administrative Boundaries

9.1.3 Baseline Conditions on Environmental and Social Consideration

The initial conditions data and information here was collected from the secondary sources such as literature review and previous projects.

(1) Air Quality

Ambient air quality sampling was conducted under the JICA Preparatory Survey for Metro Manila Subway Project in Philippines (2017) (MMSP) which conducted sampling at FTI station. Results of the said samplings site is summarized in to Table 9.1.4. The results of FTI is high due to its close proximity to the expressway and a bus terminal, however it is still within the standard.

Table 9.1.4 Summary of Air Quality Survey Results under Previous Projects

Sampling Station	Sampling date	Ambient Air parameter						
		PM_{10} (µg/NCM)	TSP (µg/NCM)	Pb (µg/NCM)	CO (ppm)	NO_2 (µg/NCM)	SO_2 (µg/NCM)	O_3 (µg/NCM)
PNR FTI	2017.03.27-2017.05.02	8	204	ND	ND	37	ND	ND
	2017.07.10-27	34	209	ND	ND	27	2.0	ND
DENR Standard (NAAQS/NAAQGV)		150	230	1.5	30	150	180	140

Source: The Preparatory Survey for Metro Manila Subway Project in Philippines (2017), EIS Report

(2) Water Quality

A water quality survey was also conducted under MMSP. The results of the sampling sites of Pasig River, and San Juan River under the MMSP are summarized in Table 9.1.5. The results for the Pasig River and the San Juan River exceeded the DENR standard. A possible cause is untreated wastewater from industrial zones and untreated domestic wastewater.

Table 9.1.5 Summary of Surface Water Survey Results under Previous Projects

Parameter	Pasig river	San Juan river	DENR Class C Standard Waters
Sampling date	2017.03.01	2017.03.01	
pH	7.1	7.3	6.5 – 8.5
Temperature (ºC)	29	28	Not more than 3º C increase
Arsenic (As)	<0.01	<0.01	0.05 mg/L
Copper (Cu)	<0.01	<0.01	0.05 mg/L
Mercury (Hg)	<0.0002	<0.0002	0.002 mg/L
Free Cyanide	<0.02	<0.02	0.05 mg/L
Nitrate (NO_3)	1.2	0.2	10 mg/L
Cadmium (Cd)	<0.003	<0.003	0.01 mg/L
Lead (Pb)	<0.05	<0.05	0.05 mg/L
BOD 5-Day 20º C	4	50	7 mg/L
Chloride (Cl-)	141	37	350 mg/L
Chromium Hexavalent	<0.003	<0.003	0.05 mg/L
Dissolved Oxygen	5	<2	5.0 mg/L
Oil & Grease	3.7	3.9	2 mg/L

Parameter	Pasig river	San Juan river	DENR Class C Standard Waters
Sampling date	**2017.03.01**	**2017.03.01**	
Phosphate (as Phosphorous)	0.10	1.90	0.4 mg/L
Phenol	Not Detected	Not Detected	0.005 mg/L
MBAS	0.3	5.3	0.5 mg/L
TSS	86	66	Not more than 30 mg/L increase
Coliform	54,000	24,000,000	5,000 MPN/ 100 mL

Note: Shaded cells highlight non-conforming

Source: The Preparatory Survey for Metro Manila Subway Project in Philippines (2017), EIS Report

(3) Noise Level

A noise survey was also conducted under MMSP. The sampling point within the project area was FTI station. The survey results for this sampling site are summarized in to Table 9.1.6. The results for FTI is higher than the rest due to its close proximity to the expressway and a bus terminal. Noise generated by the passing vehicles and construction activities on the adjacent area likewise contributed to the intermittent noise recorded at the time of sampling.

Table 9.1.6 Summary of Noise Level Survey Results under Previous Projects

Sampling points	Sampling date	Mean Noise Level dBA			
		Morning (5 AM-9 AM)	**Day time (9 AM-6 PM)**	**Evening (6 PM-10 PM)**	**Night (10 PM-5 AM)**
PNR FTI	2017	80.0	77.0	74.0	76.0
DENR Noise Standard for Class B Areas (Commercial)		60.0	65.0	60.0	55.0

Note: Shaded cells highlight non-conforming

Source: The Preparatory Survey for Metro Manila Subway Project in Philippines (2017), EIS Report

(4) Topography and Geomorphology

1) Geology

Central Luzon Plain: The Central Plain of Luzon is characterized by its flat terrain, the largest in the island in terms of land area. The plain stretches over 200 km from Lingayen Gulf to Manila Bay and is 80 km wide. It is bounded by two major rivers; the Cagayan to the north, and the Pampanga to the south. In the middle of the plain rises the solitary volcanic cone of Mount Arayat. The western coasts of Central Luzon are typically flat extending east from the coastline to the Zambales Mountains, the site of Mount Pinatubo, renowned for its enormous 1991 eruption. The plain is composed of sediments from the Quaternary and Tertiary period, the volcanic sediment of the Quaternary period and after, and the layer of ash, rocks and silt by the recent the volcanic flow of Mount Pinatubo.

Marikina Plain: The Marikina plain, which is located between Sierra Madre mountain range and Central Luzon plan, is an alluvial plane formed by the sediment brought by Marikina River as it runs through Marikina Valley. The area is a flood plain whose elevation at the northern part is 15 m and becomes sea level around the Laguna Bay. The plain is formed with sediment of soft sand or a thick layer of silt and clay, mainly formed as alluvial deposits of the Quaternary period.

Laguna Low Plain (LLP): Laguna de Bay is a large shallow freshwater body in located in the south of the Central Luzon Plain with an aggregate area of about 900 km^2 which was the formed by two major volcanic eruptions. The East of the lake is Manila Bay lowland, the boundary to the Sierra Madre mountain range, and the north of the Lake is urbanized. Mount Banahaw is located at the boundary of Laguna and Quezon, whereas Laguna Volcanic Field is composed of over 200 dormant and monogenetic maars, crater lakes, scoria cones and stratovolcanoes, the tallest of which is Mount Makiling at 1,090 m (3,580 ft.) in elevation. The LLP is underlain by rocks of various origin and characteristics consisting primarily of agglomerates, pyroclastic, sandy tuff, and cinder beds. These occur in association with other properties in alluvial deposits, reworked tuff, and volcanic ash.

2) Active Faults

There is an active fault that will traverse the project alignment based on the Distribution Map of Active Faults in the Philippines (PHIVOLCS, 2000). The West Valley Fault runs through Bulacan, Metro Manila and Laguna. In the area of Muntinlupa City the proposed alignment will cross the fault line, and this earthquake generator could deliver a magnitude of 7.5[1]. If the West Valley Fault moves, the whole of Metro Manila will be affected in varying degrees include strong ground shaking, damaged infrastructure and utilities, and potentially a huge casualty count.

(5) Climatology and Meteorology

The Climate at the proposed NSRP area is described in Table 9.1.7 using the meteorological data from Ninoy Aquino International Airport (NAIA) the nearest PAGASA Synoptic Station located at 14°301’25.75” N and 121°00’15.90” E in Pasay City, Metro Manila with an elevation of 21 m.

Table 9.1.7 Meteorological Data Recorded at NAIA Synoptic Station (1981-2010)

Month	Rainfall Data		Temperature						Relative Humidity (%)	Wind Direction/velocity	
	Amount (mm)	No. of Rainy Days	Max (°C)	Min (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)		Wind Direction (16 points)	Wind Velocity (m/s)
January	6.8	2	30.2	22	26.1	26	22.6	21.2	75	E	3
February	4.2	1	31	22.5	26.7	26.6	22.7	21.1	72	E	3
March	4	1	32.5	23.6	28	27.9	23.4	21.7	68	E	4
April	16	1	34.1	25	29.5	29.4	24.5	22.7	67	ESE	4
May	70.4	10	33.8	25.5	29.7	29.4	25.3	23.9	72	W	3
June	265.2	14	32.5	25.1	28.8	28.5	25.3	24.2	77	W	3
July	316.7	16	31.3	24.6	28	27.7	25.1	24.2	81	W	3
August	418.4	19	30.8	24.6	27.7	27.4	25.1	24.3	83	W	3
September	255.2	16	31	24.6	27.8	27.5	25.2	24.4	83	W	2
October	283.4	14	31.1	24.3	27.7	27.5	24.8	23.8	80	E	2
November	99	8	31.1	23.7	27.4	27.2	24.2	23.1	78	E	2
December	28.6	3	30.2	22.7	26.5	26.3	23.1	21.9	76	E	2
Annual	1767.8	101	31.6	24.0	27.8	27.6	24.3	23.0	76	E	3

Source: Climatological Normals at NAIA Synoptic Station, PAGASA (1981-2010)

[1] Daligdig and Besana, 1993

1) Climate

Based on the Modified Coronas Climate Classification System, the Metro Manila and Laguna regions, where the proposed NSRP-South is to be located, fall under a Type I climate. A Type I climate is characterized by two pronounced seasons, dry season from November to April and wet season from May to October with maximum rain period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during the rainy season and get a large portion of rainfall from tropical cyclones occurring during the maximum rainy period.

2) Wind Regime

There are two seasonal wind regimes, the northeasterly winds and the southwesterly winds. From November to May, the wind blows on a northeasterly direction with an average wind velocity of 3.0 m/s. From June to October the southwesterly winds prevail with an average wind velocity of 2.6 m/s.

3) Rainfall

The monthly average rainfall at the Project site ranges from 4 mm to 418 mm (August), with an annual average of 1,768 mm. The least number of rainy days per month occurs in November to April; while the highest number or rainy days per month occurs in May to October which leads to flooding in low lying areas.

4) Temperature and Relative Humidity

The annual mean average temperature recorded at NAIA Station is 27.8 °C with January being the coldest month having an average temperature of 26.1 °C while the month of May is the warmest with an average temperature of 29.7 °C. The mean annual relative humidity recorded is 76%. The months of July to October are the most humid months recorded.

5) Frequency of Extreme Events

Climatological extreme values are from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed. The recorded annual extreme high and low temperature is 38.0 °C occurred in June 2, 1991 and 14.6 °C occurred in January 1, 1962, respectively. The amount of annual average extreme greatest rainfall is 472 mm occurred in July 20, 1972 while the annual average extreme highest wind is 56 meters per second westerly direction occurred in November 19, 1970.

6) Cyclone Frequency

The most number of cyclones occur during the months of June to December. These tropical cyclones are associated with the occurrence of low pressure areas (LPA) normally originating from the North Western Pacific Ocean of the Philippine Area of Responsibility (PAR) and generally moving northwestward. From 1948-2016 (period of 68 years) PAGASA determined an annual average of 20 tropical cyclones in the PAR with nine of these passing through the Philippine landmasses. PAGASA had tracked 28 tropical cyclones that crossed in the Province of Bulacan while 27 tropical cyclones that crossed the Province of Pampanga from 1948-2016. The month of October has the most number of tropical cyclones for both Bulacan and Pampanga.

(6) Hydrology

NSRP-South is located in the Pasig-Laguna de Bay River Basin and will be traversing 8 rivers including the Pasig River. According to the flood hazard map (25-year flood) of the project area by the University of the Philippines Nationwide Operational Assessment of Hazards (UP-NOAH), the project alignment lies on the Pasig-Laguna de Bay Basin, which makes the project area highly susceptible to flooding. The coastal area of Laguna de Bay Basin, where NSRP-South is located, especially in Calamba, where river water reaches to heights higher than the lake, causes the clogging of drainage and leads to flooding. The water level of Laguna and Manila Bay is almost the same, causing saline intrusion during the season that the water level of Laguna is low.

(7) Protected area

1) International Protected Area

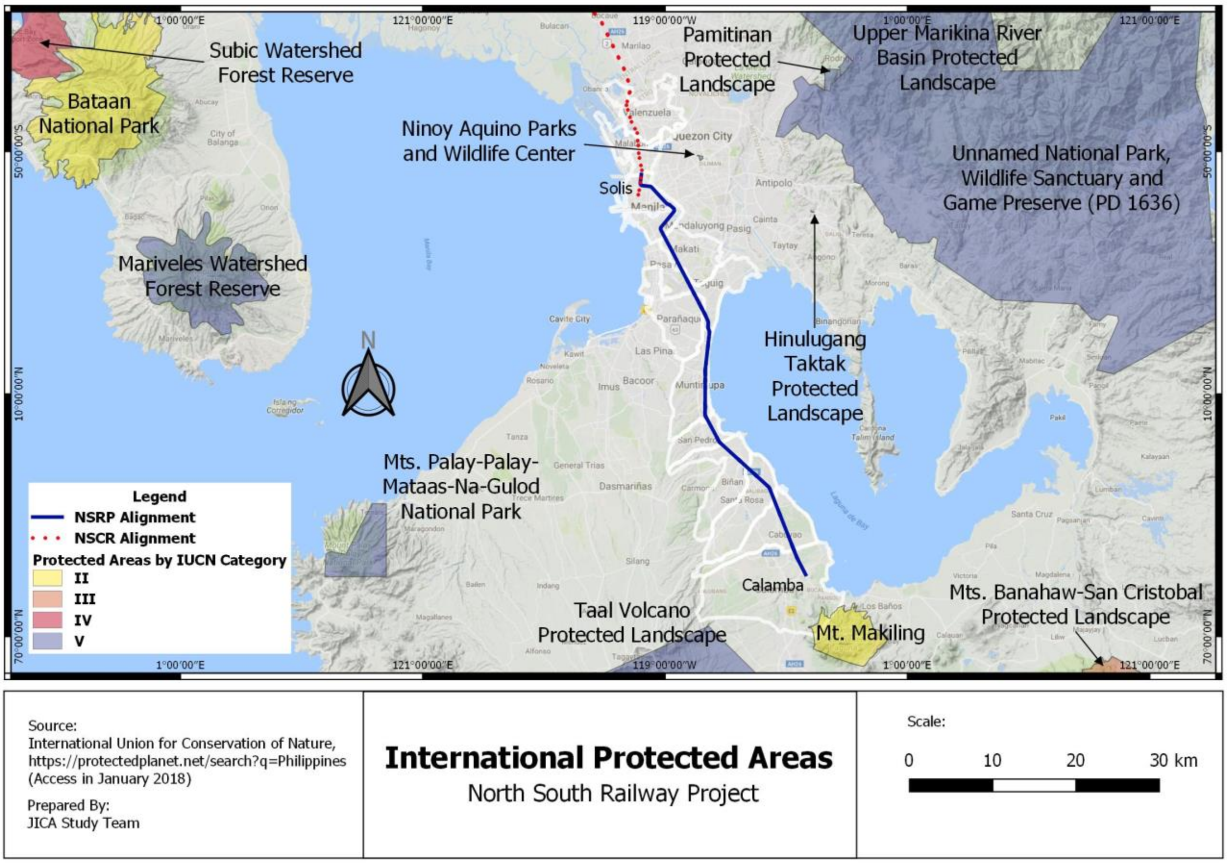
International Union for Conservation of Nature (IUCN) classifies protected areas according to their management objectives. The categories are recognized by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation. Based on the IUCN, Philippines has a total of 390 protected areas composed of category II: National Park (37), category III: Natural Monument or Feature (8), Category IV: Habitat/Species Management Area (17), Category V: Protected Landscape/ Seascape (145), and Category VI: Protected area with sustainable use of natural resources (183).

The protected areas located within 50 km of the project alignment is shown in Table 9.1.8 and Figure 9.1.2. The alignment of NSRP-South does not traverse the protected area, however, is located approx. 4 km from the Mount Makiling. The Mount Makiling was designated in 1933 under the Republic Act No. 552 as National park. However, it was decommissioned as a national park on June 20, 1963 by Republic Act no. 3523 when it was transferred to the University for use in forestry education and information. In 1990, Republic Act No. 6967, management was delegated as "Forest Reserve" in Mount Makiling to the University of the Philippine, was administrated and conserved primarily as a training laboratory for the advancement of scientific and technical knowledge particularly in the preservation, conservation and development of our forest, flora and fauna, and natural resources. Thus, currently there is a discrepancy in its designation category between IUCN and NIPAS. Mount Makiling is categorized as “National Park” under IUCN, however it is categorized as “Forest Reserve” in National Integrated Protected Areas System (NIPAS).

Table 9.1.8 International Protected area nearby Project area

Category	Protected area	Location	Area (ha)	Distance from the Project (km)
II	Mount. Makiling	Los Baños, Bay and Calamba City in the Province of Laguna and Santo Tomas, Batangas	4,244	4.0
III	Mts. Banahaw- San Cristobal Protected Landscape	Lucban, Tayabas, Sariaya, Candelaria & Dolores, Quezon Rizal, Nagcarlan, Liliw, Majayjay and San Pablo City, Laguna	10,900	29
V	Hinulugang Taktak protected landscape	Antipolo City, Rizal	3.2	17
V	Taal Volcano Protected Landscape	Taal, Batangas	62,000	27
V	Mts. Palay-palay-Mataas-na-Gulod National Park	Ternate and Maragondon Cavite & Nasugbu, Batangas	3,973	43
V	Pamitinan Protected Landscape	Antipolo and Rodriguez, Rizal	600	24
V	Upper Marikina River Basin Protected Landscape	Antipolo and Rodriguez, Rizal	26,125	25
V	Ninoy Aquino Parks and Wildlife Center	Quezon City, NCR	65	7
V	Unnamed National Park, Wildlife Sanctuary and Game Preserve (PD 1636)	Portion of Bulacan, Rizal, Laguna and Quezon Provinces	27,613	25

Source: IUCN, https://protectedplanet.net/search?q=Philippines (Access in January 2018)



Source: IUCN, https://protectedplanet.net/search?q=Philippines (Access in January 2018)

Figure 9.1.2 International Protected Area

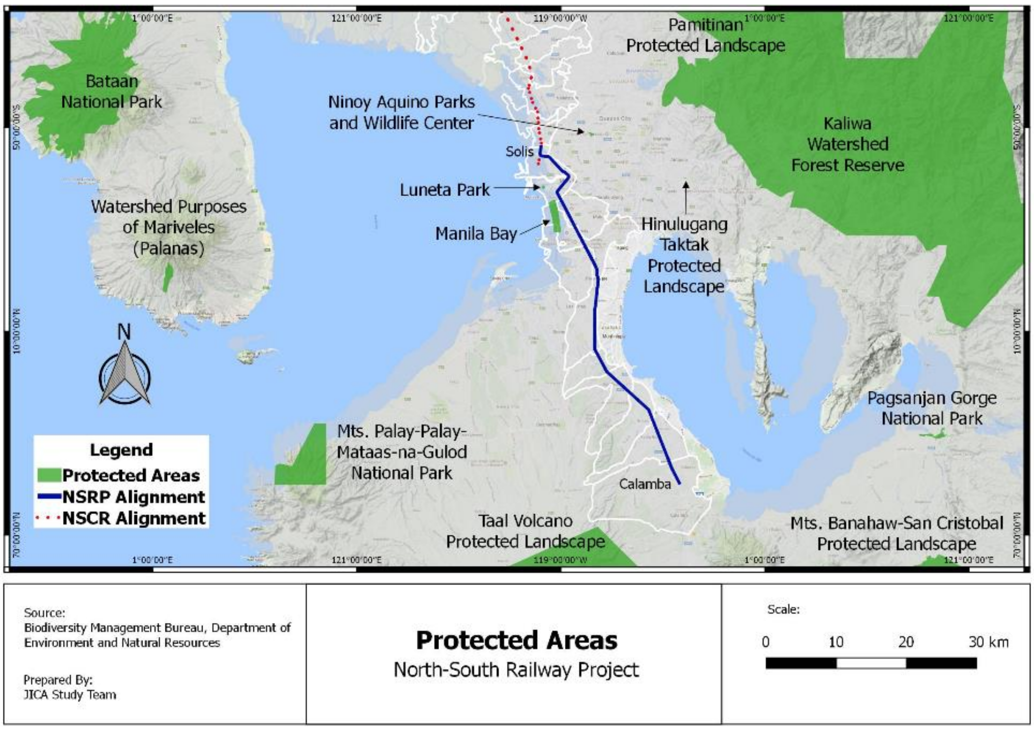
2) Protected area under the Philippine Law

The National Integrated Protected Areas System (NIPAS) Act of 1992 (Republic Act No. 7586) and its Implementing Rules and Regulations (DAO No. 92-25) as amended by DAO 2008-26 (2009) provides the legal framework for the establishment and management of protected areas in the Philippines. There are eight categories of protected areas under the NIPAS; Strict Nature Reserve, Natural Park, Natural Monument/Natural Landmark, Wildlife Sanctuary, Protected Landscape and Seascapes, Resource Reserve Natural Biotic Areas/ Anthropological Reserve, and Other. Protected areas located within 50 km from the project alignment is shown in Table 9.1.9 and Figure 9.1.3. The alignment of NSRP-South does not traverse the protected area under NIPAS.

Table 9.1.9 Protected Area nearby the Proposed NSRP-South

Category	Protected area	Location	Area (ha)	Distance from the Project (km)
Natural Park	Ninoy Aquino Parks and Wildlife Centre	Quezon Avenue Diliman, Quezon City	65	7
Protected Landscape and Seascapes	Hinulugang Taktak Protected Landscape	Antipolo, Rizal	3	17
	Taal Volcano Protected Landscape	Batangas	62,000	27
	Mts. Palay-palay-Mataas-na-Gulod	Ternate and Maragondon Cavite & Nasugbu, Batangas	3,973	43
	Mts. Banahaw- San Cristobal Protected Landscape	Lucban, Tayabas, Sariaya, Candelaria & Dolores, Quezon Rizal, Nagcarlan, Liliw, Majayjay and San Pablo City, Laguna	10,900	29
Other categories	Pamitinan Protected Landscape under Marikina Watershed Reservation	Antipolo and Rodriguez, Rizal	600	24
	Kaliwa Watershed Forest Reserve	Tanay, Rizal	35,150	25

Sources: Protected Areas and Wildlife Bureau, DENR

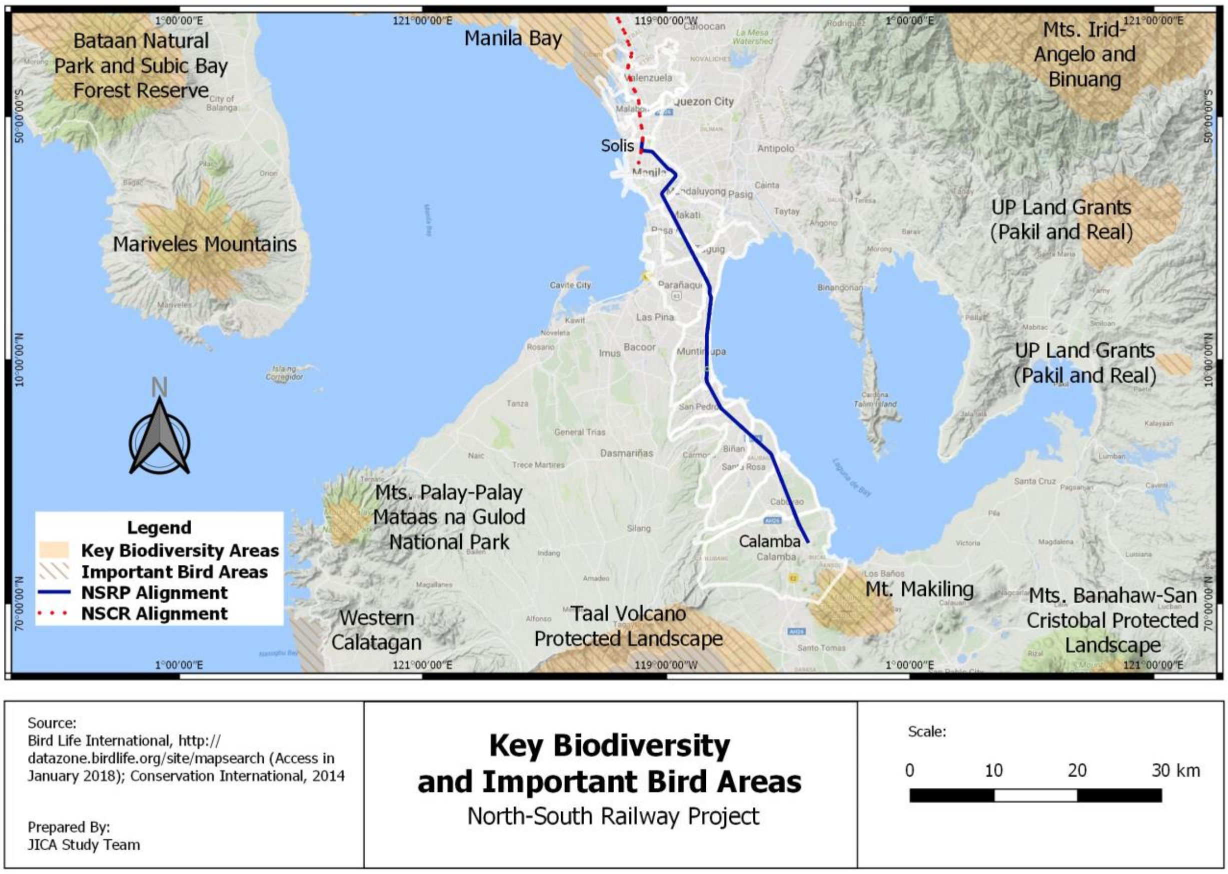


Source: Protected Areas and Wildlife Bureau, Department of Environment and Natural Resources (DENR)

Figure 9.1.3 Protected Area under NIPAS

3) Other important areas for biodiversity

In 2006, DENR developed the terrestrial Key Biodiversity Areas (KBAs) using data from the Important Bird Areas Program (IBAs), the 2004 IUCN Red List, as well as point locality data from published literature, experts and scientists, and museum collections. Based on the above-mentioned protected area and other important areas for biodiversity, it clarifies that the project is neither located within KBA/IBA. The closest IBAs/ KBAs is 4,244 ha of Mount Makiling (Los Baños, Bay and Calamba City in the Province of Laguna and Santo Tomas, Batangas), which is 4 km from the proposed alignment. The location map is shown in Figure 9.1.4.



Source: 1) Bird Life International (http://datazone.birdlife.org/site/mapsearch) (Access in January 2018),
2) Conservation International 2014

Figure 9.1.4 IBA and KBA location Map

(8) Endangered Species

The cities along the proposed alignment of NSRP-South, such as City of Manila, Makati, Pasig, Taguig, Parañaque are urbanized and are not suitable habitat for endangered species. In Laguna, the proposed alignment goes through agricultural land, and Mount Makiling is located in close proximity.

Many of the restricted-range birds of the Luzon Endemic Bird Area have been recorded on Mt Makiling, a few threatened species, including Philippine Eagle-owl which is defined under DAO 2007-1 and IUCN 1994. Threatened and poorly-studied endemic threatened mammals recorded in the area include Luzon

Broad-toothed Rat, *Abditomys latidens*, Lowland Striped Shrew-rat, *Chrotomys mindorensis*, Northern Luzon Giant Cloud Rat, *Phloeomys pallidus* and Luzon Short-nosed Rat, *Tryphomys adustus*. Large flying foxes *Pteropus spp.* and *Acerodon spp.* have been observed flying over the forest canopy. The endemic species include the recently described Luzon Forest Frog *Platymantis luzonensis* and Diminutive Forest Frog *Platymantis mimulus*, and the poorly-known ranid, *Limnonectes macrocephalus*. Reptiles recorded in this IBA include endemic and rare species, such as the White-Spotted Anglehead *Gonyocephalus semperi*, Jagor's Sphenomorphus *Sphenomorphus jagori*, Black-sided Sphenomorphus *Sphenomorphus decipiens* and Steere's Sphenomorphus *Sphenomorphus steerei*. A total of 2,038 species of flowering plants has been recorded on Mt Makiling.

(9) Historical and Cultural Heritage

In the Philippines, National Historical Commission of the Philippines (NHCP) declares the heritage in accordance with NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines (2011) under RA 10066 (2009). Structures and site that 1) Possess demonstrable historical significance, 2) are at least 50 years old, and 3) 70 % authentic are qualified for consideration.

Under the Project, there are two type of historical structures 1) historical and cultural heritage declared by NHCP, and 2) old PNR structures over 50 years. Table 9.1.10 and shows the list of historical and cultural heritage declared by NHCP located in close proximity to the proposed NSRP-South. Due to the proposed structure and alignment, distance to heritage is yet to be finalized. In addition, within the project area, old PNR stations and railway bridges are distributed along the proposed alignment. These structures are considered to meet the above-mentioned conditions. In case heritage sites are predicted to indirect impacts caused by the project, and the PNR structures are identified to be preserved by heritage authorities, the Project will prepare preservation measures together with NHCP, DOTr and the PNR

Table 9.1.10 Historical and Cultural Heritage accredited by NHCP in vicinity of NSRP-South

	Heritage	Location	Distance from the Project (km)
1	Lord Justo Ukon Takayama Monument	Plaza Dilao, Paco, Manila	0.08
2	Paciano Rizal House	Los Baños, Laguna	0.10

Source: NHCP

(10) Demography

The NSRP-South will traverse Manila, a city with more than 1.7 million inhabitants according to the 2015 Census of Population by the Philippine Statistics Authority (PSA). It is the most populous of the cities which will host the Project. Next most populous, is Taguig and Parañaque City with 804,915 and 665,822 inhabitants, respectively. However, in terms of density, Makati City is most densely populated with 27,000 persons per sq. km. From 2010-2015, Taguig City has the fastest average growth rate at 4.32% per annum, while the City of Manila experienced the lowest population growth at 1.43%.

In the Province of Laguna, the most populous city among the host LGU is Calamba City. In 2015, it had a population of 454,486. However, the most densely populated host city in Laguna is San Pedro City with 13,547 individuals per sq. km. The cities of Santa Rosa and Cabuyao are the fastest growing in terms of population, both had a population increase of 4.23% from 2010-2015.

Table 9.1.11 Population of Project area

City	Land Area (ha)	Population		Growth Rate 2010 - 2015 (%)*	Population Density (person/ km^2)	Household Population	No. of Households	House-hold Size
		2010	2015			2015		
Manila	7,596.65	1,652,171	1,780,148	22,425	1.43	1,763,348	435,154	4.05
Makati	2,735.57	529,039	582,602	27,000	1.85	579,433	154,095	3.76
Taguig	4,538.20	644,473	804,915	17,804	4.32	801,143	198,256	4.04
Parañaque	4,657.00	588,126	665,822	14,297	2.39	663,733	163,074	4.07
Muntinlupa	4,670.02	459,941	504,509	12,692	1.78	481,762	122,286	3.94
San Pedro	2,260.00	294,310	325,809	13,547	1.96	325,252	73,030	4.50
Biñan	4,350.00	283,396	333,028	8,270	3.12	332,170	86,752	3.12
Sta. Rosa	5,552.00	284,670	353,767	6,451	4.23	353,592	101,385	3.49
Cabuyao	4,291.56	282,436	308,745	7,130	4.23	307,998	81,573	3.78
Calamba	14,480.00	389,377	454,486	3,040	2.99	449,908	123,071	3.66

Notes: * excluding those situated on relocation sites

Source: 2010/2015 Census of Population and Housing, PSA

(11) Socio Economy

According to the World Economic Outlook Database prepared by the International Monetary Fund (IMF), the GDP per Capital of 2017 was USD 3,022, which shows the steady economic growth over the last 10 years except the year 2009 which impacted by the 2008 financial and economic crisis. In addition to the robust private consumption, growth in investment becomes prominent especially between 2014 and 2016. The contribution rate in 2014 was 0.9 which increased to 4.0 in 2015 and 5.7 in 2016. This shows that the leading factor of economic growth is shifting from private consumption to investment. By the type of industry, Agriculture, Forestry and Fisheries has dropped 1.3% from the previous year. The drought caused by the El Niño at early 2016 caused significant damage to these industries. On the other hand, mining has increased 8.4 % comparing to the previous year. Construction has increased considerably by 13.7 %. The rest of industry increased 7.4% in service, 8.9 % in Real Estate and BPO, and 7.6% in finance.

(12) Land use

The existing land use of the proposed alignment is summarized into the Table 9.1.12. The NSRP-South traverses mainly residential (58%) and commercial land (22%).

Table 9.1.12 Land use along the proposed alignment (km)

LGUs	Agricultural Land	Residential	Commercial	Industrial	Educational/ Religious/ Health	Green field/ waterbody	Others	Total
Manila		4.70	3.3		1.0	0.1		9.1
Makati		1.3	3.3		0.0			4.6
Taguig		1.4		2.3	1.8			5.5
Parañaque		0.8	0.9					1.7
Muntinlupa		5.2	4.3	0.2		0.1	0.9	10.6
San Pedro		1.7	0.4	0.3		0.8		3.2
Biñan		2.4	1.0		0.5	0.0		3.9
Santa Rosa	0.6	3.3	0.7			0.6		5.2
Cabuyao		5.5	0.7					6.2
Calamba	0.8	6.5	0.4	0.3	1.1	0.3		9.3
Total	**1.65**	**39.60**	**15.00**	**3.05**	**6.42**	**1.92**	**0.85**	**68.5**
	2%	**58%**	**22%**	**4%**	**9%**	**3%**	**1%**	**100%**

Source: JICA Design Team

9.1.4 Legal and Institutional Frameworks on Environmental Impact Assessment

9.1.4.1 Laws and Regulations of Environmental Impact Assessment (EIA)

Any private or public projects or activities which are likely to have foreseeable adverse effects on the natural and social environment are subject to the Philippine Environmental Impact Statement System (PEISS). Some of the most important laws and guidelines related to PEISS are shown in Table 9.1.13.

Table 9.1.13 Important Laws and Manuals of PEISS

Laws and manuals	Stipulation
Presidential Decree No. 1152 (1977)	Philippines' Environmental Code. Comprehensive environmental management with mitigation measures were addressed and concept of the environmental impact assessment was introduced for the first time.
Presidential Decree No. 1586 (1978)	PEISS was established to conduct EIA study for the environmentally critical projects and the projects in the environmentally critical areas.
Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	Proclaiming Environmentally Critical Areas and types of projects as Environmentally Critical Projects and within the scope of PEISS establish under PD No. 1586.
DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)	Providing the implementing rules and regulations for the Philippine Environmental Impact Statement (EIS) System of PD No. 1586.
DENR Administrative Order No. 2017-15	Guidelines on Public Participation under the Philippine Environment Impact Statement System
DENR Administrative Order No. 2018-18	Establishing a Centralized Management and Coordinative Mechanism at The Regional Offices of DENR, MGB and EMB, and Designating The DENR Regional Director as The Regional Executive Director Providing Overall Command of Regional Operations
EMB Memorandum Circular 2007-002	Revised Procedural Manual for DAO 03-30
DENR Memorandum Circular 2010-14	Standardization of Requirement and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
EMB Memorandum Circular 2010-002	Clarification to DENR Memorandum Circular No. 2010-14 and Other EIS System Policy Issuances
EMB Memorandum Circular 2010-004	Guideline for Use of Screening and Environmentally Critical Area (ECA) Mapping Systems

Laws and manuals	Stipulation
EMB Memorandum Circular 2011-005	Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
EMB Memorandum Circular 2014-005	Guidelines of Coverage Screening and Standardized Requirement under the PEISS amending relevant portions of EMB MC 2007-002

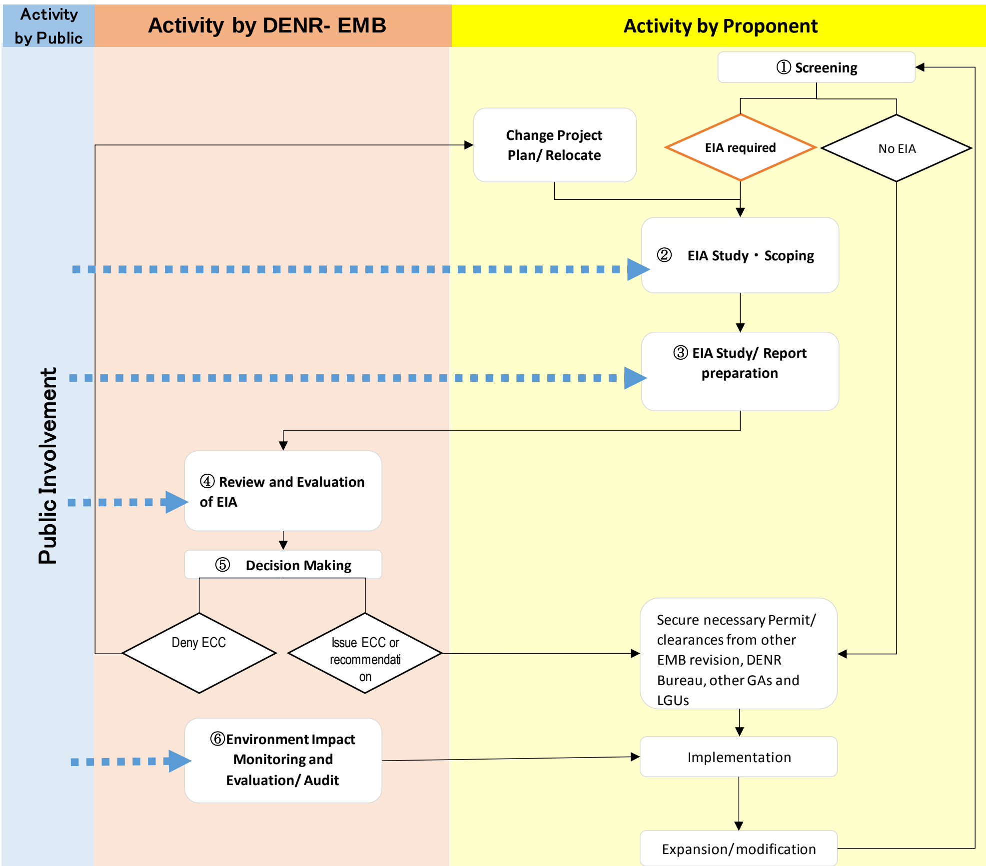
Source: JICA Design Team

9.1.4.2 Responsible Government Authorities

The Department of Environment and Natural Resources (DENR) is the government entity responsible for the environmental administration. The Environmental Management Bureau of DENR (DENR-EMB) is responsible for the issuance of decision making documents such as Environmental Compliance Certificate (ECC) and Certificate of Non-Coverage (CNC) for PEISS. EMB Regional Offices in respective regions are primarily responsible for the consultation and supervision of development projects.

9.1.4.3 Environmental Impact Assessment System in the Philippines (PEISS)

The Philippine EIA Process has six sequential stages 1) Screening, 2) Scoping, 3) EIA Study and Report Preparation, 4) EIA Review and Evaluation, 5) Decision Making, and 6) Post ECC Monitoring, Validation and Evaluation/Audit stage. A summary flowchart of the complete process is presented in Figure 9.1.5.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (2008)

Figure 9.1.5 Summary Flowchart of EIA Process

9.1.4.4 Projects requested to implement EIA

At the Screening stage, the project is assessed as to whether it should go through the EIA process or not. Projects which have been originally declared as Environmentally Critical Projects (ECPs) or projects in Environmentally Critical Areas (ECA) predicted to have significant impacts on the quality of the environment are subject to PEISS. The projects have been classified into four major groups; Category A: Environmentally Critical Projects, Category B: Non-Environmentally Critical Projects (NECP) Located in ECA, Category C: Environmental Enhancement or Direct Mitigation Project, and Category D: Non-Covered Project (Memorandum Circular No.2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements).

9.1.4.5 Types of reports required for granting of ECC

The EIA-covered projects will require the documents listed below, depending on project type, location, magnitude of potential impacts and project threshold, which differ according to the level of EIA and DENR EMB decision making process.

- Environmental Impact Statement (EIS);
- Programmatic Environmental Impact Statement (PEIS);
- Environmental Performance Report and Management Plan (EPRMP);
- Programmatic Environmental Performance Report and Management Plan (PEPRMP);
- Initial Environmental Examination (IEE) Checklist Report;
- Project Description Report (PDR)

All documents should be prepared by the project proponent and submitted to EMB Central Office or the Environmental Impact Assessment Division of the respective EMB Regional Offices. The outcome of the EIA Process is the issuance of decision documents, which can be an ECC, a CNC or a Denial Letter.

For Category A projects (new single project), ECC application documents (EIS) need to be submitted to EMB central office to have decisions made by EMB Director and/or DENR Secretary.

9.1.4.6 Scope of Items to be examined and Contents to be assessed in the EIA

The outline contents for an EIA Report for new, single project is defined in the Memorandum Circular No. 2010-14 “Standardization of Requirements and Enhancement of Public Participation in the Streamlined Implementation of the Philippine EIS System” by DENR (June 29, 2010).

9.1.4.7 Public Participation, Public Consultation and Information Disclosure need to take place

The PEISS places importance in public participation. According to DENR Administrative Order No. 2017 15, from the early stage of a project, the public for whom there is a potential to have direct or indirect impact, are provided accurate project information and involved in a series of public discussions. Public participation shall be demonstrated through the following activities:

- The Information, Education and Communication (IEC)
- Public Scoping
- Public Hearing
- Information Disclosure of EIA and Environmental Permissions
- Involvement of Indigenous Peoples in Decision-Making Process (If applicable)

9.1.4.8 An Environmental Monitoring and Management Plan needs to be formulated

(1) Objectives

Under the PEISS, the primary purpose of monitoring, validation and evaluation of a project is to ensure the implementation of sound environmental management within that project as stipulated in the ECC and other related documents. Specifically, it aims to ensure the following:

- Compliance with the conditions set in the ECC;
- Compliance with the Environmental Management Plan (EMP) commitments;
- Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis-a-vis the predicted impacts used as basis for the EMP design; and
- Continuous updating of the EMP for sustained responsiveness in addressing environmental impacts of the undertakings.

(2) Responsible organization

1) Project Proponent

The Proponent issued with an ECC is responsible for monitoring their projects. A proponent is required to submit an ECC Compliance Monitoring Report (CMR) on a semi- annual basis to the designated monitoring EMB office on a semiannual frequency. The detailed report on compliance to environmental standards specific to environmental laws will be submitted through the Self-Monitoring Report (SMR) on a quarterly basis to the concerned EMB office.

The Proponent will also establish Environmental Guarantee Funds (EGF) which is funds to pose a significant public risk or where the project requires rehabilitation or restoration, and Environmental Monitoring Fund (EMF) which is a fund to support the activities of MMT based on the Annual Work and Financial Plan approved by the EMB. The Proponent is to discuss and agree on the amount of EGF and EMP, and operation procedure, specifying in the MOA on MMT.

2) Multipartite Monitoring Team (MMT)

Based on DENR Administrative Order (DAO) No. 2017-15, the MMT will be set up by Proponents, composing representatives of relevant stakeholders including LGU, NGOs, community leaders, NGAs. As such, the EMB and the DOTr, being principal project parties, are no longer be members of the MMT. The MMT will be set up by Proponents, and will be primarily responsible of validating the proponent's environmental performance and submits findings/recommendations semi-annual as a

Compliance Monitoring and Validation Report (CMVR) to the concerned EMB office. The EMB provides oversight guidance to the MMT and consider its reports and recommendations in its impact and compliance evaluation. On the other hand, the DOTr will provide funds for the MMT activities.

3) Environmental Management Bureau (EMB)

The Environmental Management Bureau is primarily responsible for the over-all evaluation/audit of the Proponent's monitoring and the MMT's validation. EMB regional office will set up Taskforce comprising the Environment Impact Assessment Management Division (EIAMD) and Pollution Control Division (PCD) personnel jointly evaluate the effectiveness of environmental management measures being implemented by Proponent. The team will undertake hearing, field survey or sampling survey as necessary. The team will also document its evaluation findings as Compliance Evaluation Report which EMB Central Office will provide policy guidance and if necessary conduct monitoring and validation of performance audit. If EMB regional office / EMB central office found violation, fines and penalties will be imposed to the proponent, or may issue Cease and Desist Order.

(3) Disclosure of Monitoring Results

During the Operation, the Project Proponent is required to continue public participation, public consultation and information disclosure. CMR, SMR, MMT and CMVR are subject to public disclosure. The Project Proponent has full accountability to Stakeholders on the latest Environmental Management and Monitoring Plan and any modification of the project, any activities against the ECC.

9.1.4.9 Comparison of PEISS and JICA Guidelines/ADB SPS

Below are the results of a gap analysis between current relevant regulations in the Philippines and the JICA Guidelines and ADB SPS. Counter measures are also proposed to fill the gap.

Table 9.1.14 Gap between JICA Guidelines, ADB SPS and Relevant Regulations in the Philippines on EIA

Topic	JICA Guideline	ADB SPS	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
EIA	JICA supports and examines appropriate environmental and social considerations undertaken by project proponents etc. to avoid or minimize development projects' impacts on the environment and local communities, and to prevent the occurrence of unacceptable adverse impacts.	Set of specific safeguard requirements that borrowers/clients are expected to meet when addressing social and environmental impacts and risks. Through their due diligence, review, and supervision. ADB will ensure that borrowers/clients comply with these requirements during project preparation and implementation. Over time ADB may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs, and reflect evolving best practices.	EIA is a process that involves predicting and evaluating the likely impacts of a project (including cumulative impacts) on the environment during construction, commissioning, operation, and abandonment. It also includes designing appropriate preventive, mitigating, and enhancement measures addressing these consequences to protect the environment and the community's welfare". (Revised Procedural Manual for DAO 2003-30,1.0,2))	No significant gaps between harmonized policy and the Philippines law	Not Applicable
Compliance with National legislations and international treaties	• Projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities. • Projects do not deviate significantly from the World Bank's Safeguard Policies, and refers as a benchmark to the standards of international financial organizations; to internationally recognized standards, or international standards, treaties, and declarations, etc.; and to the good practices etc. of developed nations including Japan, when appropriate. (Sec.2/2.6/2, 3)	Apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines.	Proposal for activities which are outside the scope of the management plan for protected areas shall be subject to an environmental impact assessment as required by law before they are adopted, and the results thereof shall be taken into consideration in the decision-making process. No actual implementation of such activities shall be allowed without the required ECC under the Philippine EIA System. In instances where such activities are allowed to be undertaken, the proponent shall plan and carry them out in such manner as to minimize any adverse effects and take preventive and remedial action when appropriate. The proponent shall be liable for any damage due to lack of caution, on indiscretion. (NIPAS Act)	No significant gaps	Not Applicable
Impacts to be Assessed	• The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as	• Avoid, minimize, mitigate and/or offset for adverse impacts and enhancement of positive impacts through environmental planning and management • Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical,	• The country's statutory framework requiring Environmental Impact Assessment (EIA) for all projects that will affect environmental quality is embodied in Presidential Decree (PD) 1151 of 1977. • Under the EIA process, the proponent shall assess the direct and indirect impacts of a project on the biophysical and human environment and ensuring	No gap in the environment items and content. However, standards on soil, bottom sediment and vibration have not been	International standards such as WHO's, IFC's and developed countries' standards will be referred to in order to evaluate these items.

Topic	JICA Guideline	ADB SPS	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process. • In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational. The life cycle impact of a project period is also considered. • Various kinds of relevant information are needed in order to assess impacts on the environment and local communities. There are, however, uncertainties in predicting such impacts caused by the incomplete understanding of impact mechanisms and the limited information available. Therefore, if the scale of uncertainty is considered to be large, project proponents etc. provide environmental and social considerations that include preventive measures as much as possible.	biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate.	that these impacts are addressed by appropriate environmental protection and enhancement measures. (DAO 2003-30)	prepared yet	
Alternatives	Environmental impact must be assessed and examined from the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impact must be examined and incorporated into the project plan.	Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative	• The PEISS manual requires that the proponent should implement the alternative analysis and incorporate into EIS in the feasibility study stage. • PEISS process manual (2008) by DENR requires that the proponent should consider environmental social impacts of the project and implement the initial scoping in the pre-feasibility study stage.	No significant gaps	Not Applicable

Topic	JICA Guideline	ADB SPS	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
EMP	• Impact examination must include analysis of E&S costs and benefits in the most quantitative terms possible as well as qualitative analysis, and they must be conducted in close harmony with economic, financial, institutional, social, and technical analysis of projects. • The findings of the examination must include alternatives and mitigation measures, and be recorded as separate documents or include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. • EMP also provide for workers - safe and healthy working conditions, and prevent accidents, injury, and disease • Establish preventive and emergency preparedness and response measures to avoid, minimize the adverse impacts and risks to the health and safety of the local communities	• Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. • Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle.	The PEISS manual requires the EMP as a substantive content of an EIA report. The EMP should detail the impacts mitigation plan, areas of public information, education and communication, social development program proposal, environmental monitoring plans (with multi-sectoral public participation for EIS-based projects) and the corresponding institutional and financial requirements/ arrangements of proposed project or undertaking.	No significant gaps	Not Applicable
Consultation	• Project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration, the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. • Project proponents etc. to publicize in advance that they plan to consult with local stakeholders, with particular attention to directly affected people, in order to have meaningful meetings. • In the case of Category A projects, encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed. • Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation	• Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding	• As part of the social preparation process at pre-Scoping, Information, Education and Communication (IEC) is now explicitly required at the minimum of PEIS/EIS-based applications for which Public Scoping is a requirement. The IEC serves as a basis for preliminary identification of stakeholders and related issues in preparation for the Scoping proper. The conduct of the EIA Study shall include local stakeholders, who may serve as local expert sources, aides/guides, and resource persons in primary data collection to optimize access to indigenous knowledge of the environment. • As a form of disclosure of the EIA findings, Public Hearing is required for all new ECPs for which Public Scoping was undertaken and for	No significant gaps	Not Applicable

Topic	JICA Guideline	ADB SPS	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared. (Appendix 2)	the project's environmental performance. • For category-A projects, ADB ensures that the borrower or private sector sponsor carries out public consultation at least twice: (a) once during the early stages of EIA field work; and (b) once when the draft EIA report is available, and before loan appraisal by ADB.	PEIS-based applications. If necessary EMB should conduct Public Consultations.		
Information Disclosure	• In principle, project proponents etc. disclose information about the environmental and social considerations of their projects. • JICA encourages project proponents etc. to disclose and present information about environmental and social considerations to local stakeholders. (Sec.2/2.1/1, 6) • Project proponents etc. in the preparation of documents in an official or widely used language and in a form understandable by local people. (2.1/1, 6,7) • For Category A project, JICA publishes the status of host countries' submission of major documents on environmental and social considerations on its website. Prior to its environmental review, JICA also discloses EIA reports and environmental permit certifications 120 days prior to concluding agreement documents. JICA discloses a translated version of EIA reports, subject to approval by project proponents etc.	• Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. • Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders	• As a form of disclosure of the EIA findings, Public Hearing (PH) is required for all new ECPs for which public scoping was undertaken and for PEIS-based applications. Before the PH, relevant documents have to be opened to the public. • Full copies of the EIA Report are made accessible at the concerned EMB Offices, libraries/development council offices of the host cities. Concerned Barangays are also provided with the Executive Summary of the EIA Report. Copy of ECC is also submitted to other permitting agencies including funding institutions.	No significant gaps between Harmonized Policy and the Philippines' laws.	Not Applicable
Monitoring and Disclosure	• JICA confirms with project proponents etc. the results of monitoring the items that have significant environmental impacts. This is done in order to confirm that project proponents etc. are undertaking environmental and social considerations for projects that fall under Categories A, B, and FI. • Project proponents etc. must supply the information necessary for monitoring confirmation by JICA by appropriate means, including in writing. When necessary, JICA may	Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.	• The Proponents issued ECCs are primarily responsible for monitoring their projects. They are required to submit two kinds of monitoring reports, the ECC Compliance Monitoring Report (CMR) on semi-annual frequency and the Self-Monitoring Report (SMR) on a quarterly basis to the concerned EMB RO. • During project implementation, LGUs	No significant gaps between Harmonized Policy and the Philippines' laws	Not Applicable

Topic	JICA Guideline	ADB SPS	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	also conduct its own investigations. • JICA discloses the results of monitoring conducted by project proponents etc. on its website to the extent that they are made public in project proponents etc. (Sec.3/3.2/3.2.2/1, 7)		are represented in the Multipartite Monitoring Teams (MMTs), teams which are composed of various stakeholders which generally form the pillar for local vigilance to project performance. • Major features of the MMT are: 1. Provides appropriate checks and balances in monitoring of project implementation. 2. Validates the proponent's performance. 3. Recommends courses of action to EMB through the Compliance Monitoring and Validation Report (CMVR). • The EMB-DENR remains to be the primary actor for the overall evaluation of the proponents monitoring and the MMTs validation.		
Site selection	Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas. (Appendix 1. 4-2)	Do not implement project activities in areas of critical habitats, unless (I) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources.	All designated, critical habitats shall be protected, in coordination with the local government units and other concerned groups, from any form of exploitation or destruction which may be detrimental to the survival of the threatened species dependent therein. For such purpose, the Secretary may acquire, by purchase, donation or expropriation, lands, or interests therein, including the acquisition of usufruct, establishment of easements or other undertakings appropriate in protecting the critical habitat. (RA 9147)	No significant gaps	Not Applicable

Source: JICA Design Team

9.1.4.10 Environmental Standards

Presidential Decree 1152, otherwise known as the "Philippine Environment Code (1977)", establishes specific environment management policies and prescribes environmental quality standards. This is supplemented by Office of the President Executive Order 192 (1987) which mandates the EMB, among others, to; 1) formulate environmental quality standards such as the quality standards for water, air, land, noise and radiation, 2) recommend rules and regulations for environmental impact assessment and provide technical assistance for their implementation and monitoring, and 3) formulate rules and regulations for the proper disposition of solid wastes, toxic and hazardous substances.

JICA and ADB generally recognize national environmental standards for projects. If national environmental standards differ with international standards, the more stringent standards will be adopted. However, if sufficient justification exists, the country/national standards will apply.

Table 9.1.15 Environment Standards applied to the Project

item	National Standard	International Standard
Ambient Air Quality	• DAO No. 2000-81, Ambient Air Quality and Emission Standards • DAO No. 2013-13, Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 (PM2.5)	• World Health Organization Air Quality Guidelines for PM, O_3, NO_2 and SO_2
Surface water Quality	• DAO No. 2016-08, Water Quality Guidelines	• Environmental Quality Standards for Water Pollution of the Japan Ministry of Environment
Effluent	• DENR's General Effluent Standards of 2016	• IFC Indicative Guideline Values for Treated Sanitary Sewage Discharges (2007)
Groundwater Standards	• Department of Health Administrative Order No. 2017-0010, Philippine National Standards for Drinking Water (PNSDW) • DAO No. 2016-08, Water Quality Guidelines and General Effluent Standards	• WHO Guidelines for Drinking Water Quality (2011)
Ambient Noise Quality (*)	• National Pollution Control Commission Memorandum Circular No.002 Series of 1980, Section 78 (1980), Noise Environment Standards	• Noise guideline values for the new project and large-scale modification of the conventional railway in Japan Environmental Agency, 1995
Ambient Vibration Quality	-	• BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration, provides source data, prediction methodologies, mitigation measures and management • Technology and Laws Regulation for Pollution Control, 2000, Japan Environmental Management Association for Industry
Soil Quality	• The Bureau of Soils and Water Management Soil Fertility Rating • National DAO 2013-22	• Dutch Target and Intervention Values (2000)
Soil Contamination		• Dutch Target and Intervention Values (2000)

Note: * As of October 2018, noise and vibration standard to be applied during operation is under discussion with ADB, DOTr and EMB.

Source: JICA Design Team

9.1.4.11 Other Environmental Laws and Regulations

Major environmental laws and regulations, which may be relevant to the project, must be observed. The PEISS states obligations to strictly comply with the environmental laws, regulations and standards, which have been established by the Philippine government.

Table 9.1.16 Philippines Environmental Laws and Regulations

Items	Laws, Regulations and Environmental Quality Standards
Biodiversity	• Republic Act (RA) No.7586 (1992), National Integrated Protected Areas System (NIPAS) Act • RA No. 9147 (2001), Wildlife Resources Conservation and Protection Act • Executive Order (EO) No. 247, Prescribing Guidelines and Establishing a Regulatory Framework for the Prospecting of Biological and Genetic resources, there by-products and derivatives for Scientific Purposes and for other Purposes • DENR Administrative Order (DAO) No. 2004-15 Establishing the List of Terrestrial Threatened Species and their Categories and the List of other Wildlife species pursuant to RA 9147 otherwise known as the Wildlife Resources and Conservation Act of 2001 • DAO 2007-24, Establishing the National List of Threatened Plants and their categories and the List of other Wildlife Species
Forestry	• Presidential Decree (PD) No. 705 (1975), Forestry Reform Code • PD 953 (1976), Requiring the planting of trees in certain places and penalizing the unauthorized cutting, destruction, damaging and injury of certain trees, plants, and vegetation • EO No. 193 s. 2015, Expanding the Coverage of the National Greening Program (NGP)
Pollution Control (Water)	• PD No. 1067 (1976), Water Code • RA 9275 (2004), Clean Water Act • DAO No. 2005-10, IRR of the Clean Water Act
Pollution Control (Air)	• RA No. 8749 (1999), Clean Air Act
Pollution Control (Waste)	• RA No. 6969 (1990), Toxic Substances, Hazardous and Nuclear Wastes Control Act • PD No. 856, Sanitation Code • DAO 2006-10, Guidelines on the Categorized Final Disposal Facilities • DAO 2006-09, General Guidelines on the Closure and Rehabilitation of Open Dumpsites and Controlled Disposal Facilities • DAO 2013-22, IRR of RA 6969 • RA 9003, Ecological Solid Waste Management Act • DAO 1994-28, Interim Guidelines for the Importation of Recyclable Materials containing Hazardous Substances • DAO 1997-28, Amending Annex A of DAO 1994-28 • DAO 2001-34, IRR of RA 9003
Historical/ Cultural Heritage	• RA No. 10066 (2009), Providing for the Protection and Conservation of the National Cultural Heritage, Strengthening the National Commission for Culture and Arts (NCCA) and its Affiliated Cultural Agencies and for Other Purposes • RA No. 10086 (2010), Strengthening Peoples' Nationalism through Philippine History by changing the nomenclature of the National Historical Institute into the National Historical Commission of the Philippines (NHCP), Strengthening its powers and functions, and for other purposes
Ancestral Domain, Indigenous People	• RA No. 8371 (1997), Indigenous Peoples Rights Act • National Commission on Indigenous People (NCIP) Administrative Order (AO) No. 1 series of 1998, Rules and Regulations implementing RA 8371 otherwise known as “Indigenous Peoples Rights Act of 1997 • NCIP AO No. 1 series of 2004, Guidelines on the Formulation of the Ancestral Domain Sustainable Development and Protection Plan • NCIP AO No. 1 series of 2006, The Free and Prior Informed Consent Guidelines of 2006 • NCIP AO No. 3, series of 2012, Revised Guidelines on Free and Prior Informed Consent and related Processes
Climate Change and Disaster Risk Reduction	• RA 9729 (2009), Climate Change Act • Climate Change Commission (CCC) AO No. 2010-01, IRR of RA 9729 • EO No. 174, Institutionalizing Philippine Greenhouse Gas Inventory Management and Reporting System • RA 10121 (2010), Philippine Disaster Risk and Management Act • RA 10174 (2012), People’s Survival Fund • EMB Memorandum Circular (MC) 2011-005, EIA Technical Guidelines Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns

Source: JICA Design Team

9.1.5 Comparison of Alternatives

A comparison analysis of alternative options for structures and the depot was conducted to test the justification made for the final proposal, and this included the without project option. Analysis was made from the perspective of environment and social considerations, as well as engineering and construction cost etc. without weighting applied.

9.1.5.1 The "Without Project" Option

Access from the suburbs to Metro Manila using public transportation does not have sufficient capacity to meet demand. Exceeding road capacity is creating a bottleneck that is preventing further development in the northern and southern outskirts. The northern part of access to Metro Manila up to Malolos has no operating railway, and residential areas are expanding without sufficient public transportation. In the southern part of the city, PNR operates a limited number of non-electric trains up to Binan in Laguna Province. Urgent measures are needed to ensure public transportation linking the northern and southern parts to Metro Manila. Without a railway link north and south, sustainable growth of local industry will be hampered, traffic congestion will continue to waste the time of commuters and the environment of the area will deteriorate further by the traffic congestion and air pollution. Most of the route is on an existing railway right of way. The without project option has little merit.

9.1.5.2 ROW Alternative Option

An alternative ROW for NSRP was not initially considered because the use of existing PNR ROW is deemed to have the least land acquisition and involuntary resettlement. It was only during the stakeholder consultation meeting held in Manila, it was learned that the Department of Public Works and Highways (DPWH) has an ongoing project, the NLEX SLEX Connector Road Project (the "Connector") - an elevated expressway project under Public Private Partnership (PPP) that will utilize part of PNR ROW from Solis to Santa Mesa area in Manila. It was confirmed in a discussion meeting between DOTr and DPWH held last March 2018 that the Connector, which is already at the final stages of design, could not be changed anymore. Given this, the alignment of the NSRP would have to adjust westwards. This would entail additional land acquisition for NSRP to compensate for several meters of PNR ROW to be occupied by the Connector Road.

9.1.5.3 Structure Alternative Option

(1) Alternative Option

For railway structures for NSRP-South, three alternative types were considered.

- Option 1: Elevated structure (Viaduct)
- Option 2: Underground structure

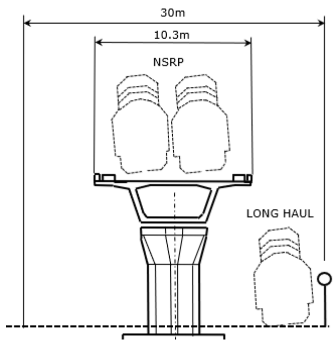
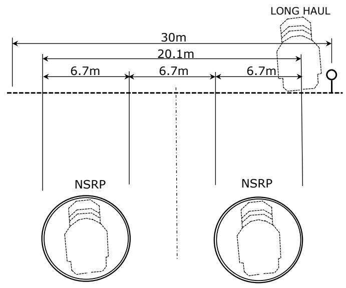
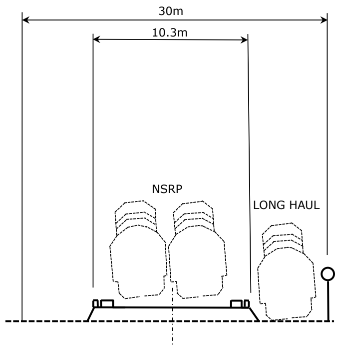
- Option 3: At Grade Structure (Including embankments)

(2) Result of Alternative Comparison

The result of comparison the above-mentioned alternatives are shown in Table 9.1.17. As the Solis-Calamba section passes through established urban areas, there are many continuous road crossings, and also flood prone areas. There are approximately 12,210 PAFs within the ROW.

At Grade structure is the lowest in cost and can be applied on sections where there are no road crossings and only a minor risk of flooding. On the other hand, where there is crossing with arterial roads or flood prone areas, a viaduct is recommended. An underground railway has less impact on environment and social consideration, and has few obstacles that cannot be avoided if using the existing PNR ROW, but is not preferred option due to lengthy construction period and high cost.

Table 9.1.17 Comparison of Structural Type of Structures NSRP-South

	Option 1 **Elevated Structure** (All line)	**Option 2** **Underground Structure** (All line)	**Option 3** Elevated Structure (+At Grade Structure)
Appearance			
Social Environment			
Land Acquisition	A: The require ROW is narrower than at grade structure	C: the required ROW is the widest	B: The required ROW is narrower than underground structure
Affected Households	C: Resettlement of PAPs and ISFs within the ROW is necessary	A: Resettlement of PAPs and ISFs is minimum	C: Resettlement of PAPs and ISFs within the ROW is necessary
ROW	A: The necessary ROW between stations is 30m, and 60m at station	A: The necessary ROW between stations is 30m, and 60m at station	A: The necessary ROW between stations is 30m, and 60m at station
Dividing of local community	B: Little impact of community division	A: No impact of community division	C: Significant impact of community division
Natural Environment			
Protected Area	B: Small impact is expected	A: Tunnel structure have very little impact on the ground	C: Significant impact is expected
Biodiversity	B: Small impact is expected	A: Tunnel structure have very little impact on the ground	C: Significant impact is expected
Flooding Risks	A: As it is an elevated structure, the tracks will not be submerged in case of flooding	B: Need to take measures to prevent submersion in the tunnel in case of flooding	B: Need measures to prevent flooding for at grade structure
Pollution Prevention			
Noise	B: Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.	A: There will be no noise along the railway	B: Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.

	Option 1 **Elevated Structure** (All line)	**Option 2** **Underground Structure** (All line)	**Option 3** Elevated Structure (+At Grade Structure)
Air Pollution	B: operation of construction machinery and vehicles during construction is expected to generate air pollution	B: During construction, transportation of excavated soil by vehicle is expected to generate air pollution	A: There will be relatively few vehicles loading embankment material during construction and air pollution risk is relatively low
Water Pollution	A: Little impact	C: Possible impact on underground water due to construction	A: Little impact
Ground Subsidence	A: No ground subsidence	A: Low risk of ground subsidence because of underground structure	B: There is risk of land subsidence in case of soft ground
Engineering			
Construction difficulty	B: Standard construction sequence and difficulty. More complex for long span river bridges.	C: Very complicate construction methodology of main alignment and stations.	A: Simple construction sequence for fully at-grade sections.
Construction Cost	B: Low cost than underground structure	C: Very high in cost	A: Same as elevated structure if soil improvement is necessary
Construction Time	B: Long	C: Longest	A: Long if soil improvement is necessary
Operation /Maintenance	A: Maintenance and cost is less than underground structure	C: Maintenance and cost is the highest	C: Maintenance and cost is the lowest, but in case of ground subsidence or condition change, reparation is very difficult
Disaster Prevention	B: Relatively safe and measures are easy compared to underground structure	C: If fire occurs in the tunnel, it will become a major disaster	A: Relatively safe and measures are easy compared to elevated structure
Earthquake	A: Structures are designed in consideration of earthquakes	A: Structures are designed in consideration of earthquakes	A: Elevated structures are designed in consideration of earthquakes. As at grade structures are low embankments, the impact of earthquake is limited
View from the Windows	A: Pleasant	C: No View	A: Pleasant
Landscape	B: Structure design needs to consider the impact on surrounding landscape	A: No impact on landscape because of underground structure	B: Structure design needs to consider the impact on surrounding landscape
Physical Conditions	A: Few impact on roads	A: No impact on roads	C: Significant impact on existing roads and there are risks of intrusion into railway crossings and rails
Evaluation	A: It has fewer advantages than underground option for social and environmental aspects but it is a good option for construction period and construction cost. Impact on roads is small and after overall evaluation, this option will be adopted for most sections.	C: It is a good option for social and environmental aspects, but it is not adopted as the construction period is long and the cost is expensive	B: It can be adopted in the sections where the impact on existing roads is small, and the lower cost.

Note: A: Excellent, B: Good, C: Poor

Source: JICA Design Team

9.1.5.4 Depot Site Alternative Options

For the required depot sites, three options were compared for NSRP-South.

Table 9.1.18 Alternative Comparison for NSRP-South Depot Site

	Option 1 Near Sucat	Option 2 Near Mamatid	Option 3 Near Los Baños
Picture			
Social Environment			
Land use	C: Old Power Plant: Stopped working in 2002: Approx. 13 ha Current owner is River Bend Consolidated Mining Corp. (Private Company)	B: Agricultural land with portion of built-up areas	B: Approx. 10 ha agricultural land （Rice field）
Land Acquisition	C: Need additional land acquisition for the depot site as well as access route to the Depot. (13 ha)	B: Need change of land class (irrigated agricultural land) and land acquisition. (33 ha)	C: Need additional land acquisition for the depot site from IRRI as well as access route to the Depot. (10 ha)
Resettlement	B: Resettlement of dozens of PAFs along the access line to the depot	B: PAFs within the area being considered. Risk of loss of income of farmers	C: Risk of loss of income of farmers as well as additional 10,000 PAPs along the access route to the Depot.
Natural Environment			
Protected Area	A: No protected area around the Project site	A: No encroachment to any protected area	C: Mount Mailing is located about 0.5 km from the site
Land Alteration	B: Loss of houses due to the access line	C: Loss of agricultural land. (33 ha)	B: Loss of agricultural land (Approx. 10 ha）
Vegetation	B: Some vegetation/grass, approx. 50 trees	B: Rice fields, approx. 30 coconut trees	C: Rice field (planted with crops). International Rice Research Institute
Pollution			
Noise and Vibrations	C: Concentrated residential area, potential impacts of noise and vibration	B: Adjacent to low-cost housing in the northwest and San Cristobal River to the south	B: Near residential area, risk of noise impact
Water	C: Risk of water pollution of Laguna de Bay due to sediment loaded water discharged during construction	C: Risk of water pollution to San Cristobal River due to sediment loaded water discharged during construction if not mitigated	C: Risk of water pollution of Molawin river due to sediment loaded water discharged during construction
Engineering			
Construction difficulty	C: Need to demolish existing structures prior to construction. The land is limited and constrains the facility layout	A: M The land is vast and little constraints in facility layout which settlement in the west and southeast	A: No existing structure, the work schedule until the start of construction can be shortened. The land is vast and little constraints in facility layout
Construction Cost	C: Most costly	A: Most economical	B: Higher cost than option 2

	Option 1 Near Sucat	Option 2 Near Mamatid	Option 3 Near Los Baños
Operation	A: Close to urban area and convenient for commuting to the depot site	B: Near to the proposed Mamatid station but accessibility might be an issue	C: Far from urban area and commuting to the depot site will have long time
Start in practice	A: Can be operated as soon as rails are laid to the depot	A: Can be operated as soon as rails are laid to the depot	C: At the southern end of the project, depot operation needs the laying of rails for the entire section
Evaluation	B: Considering the storage capacity of rolling stock, operation of carriage and maintenance, it is more difficult comparing to Option 2.	A: Considering the storage capacity of rolling stock, operation of carriage and maintenance, the option is preferred site for depot. However, the land class conversion is required.	C: Considering the proximity to the protected area and cause extra resettlement.

Note: **A**: Excellent, **B**: Good, **C**: Poor

Source: JICA Design Team

9.1.6 Scoping and TOR for the Survey on Environmental and Social Considerations

9.1.6.1 Scoping

Based on the preferred alternatives of ROW, structure type and depot location, the scoping of EIA was conducted. The draft scoping for NSRP-South is as shown in Table 9.1.19.

Table 9.1.19 Draft Scoping of NSRP-South

No	Items	Evaluation: Pre/ During construction	Evaluation: Operation	Reason of evaluation
Pollution Control				
1	Air Pollution	B-	B-	**Construction Phase:** Construction works and operation of construction equipment and machinery will generate air pollution. **Operation Phase:** Air pollution will be mitigated by reducing traffic congestion.
2	Water pollution	B-	C	**Construction Phase:** Soil runoff generated at the construction site might produce turbid water in local watercourses. **Operation Phase:** Non-treated water from stations and maintenance facilities might have an impact on water pollution.
3	Soil pollution	B-	C	**Construction Phase:** • Poor maintenance of construction equipment, machinery, and vehicles may cause soil contamination by leak of oil. • As the proposed depot site at Sucat was formerly a power plant station, there is a risk of soil contamination. **Operation Phase:** Maintenance facility of depot may cause soil contamination by leak of oil.
4	Waste	B-	C	**Construction Phase:** Construction work will generate a vast quantity of excavation soil. **Operation Phase:** Illegal dumping from stations and depot may cause impacts on the environment.

No	Items	Evaluation: Pre/ During construction	Evaluation: Operation	Reason of evaluation
5	Noise and Vibration	B-	C	**Construction Phase:** Pile driving works may cause noise and vibration to surrounding environment **Operation Phase:** Operation of trains may cause noise around viaduct sections. The impact of vibrations to the old PNR structures needs to be take in to account.
6	Ground subsidence	C	C	**Construction/Operation Phase:** In case of construction on soft ground, appropriate methods need to be adopted to avoid ground subsidence,
7	Odor	D	D	**Construction /Operation Phase:** No odor will be generated due to the project characteristics (Railway project).
8	Bottom sediment	B-	C	**Construction Phase:** Soil erosion generated at the construction site might impact on bottom sediment. Poor maintenance construction machinery and vehicles may cause bottom sediment contamination by leak of oil.
Natural Environment				
9	Protected Area	C	C	**Construction /Operation Phases:** Mount Makiling is located at about 4.0 km from the nearest alignment.
10	Ecosystem	B-	B-	**Construction Phase:** The construction might cut down trees. **Operation Phase:** The activity of the depot might have an impact on the ecosystem.
11	Hydrology	B-	B-	**Construction /Operation Phase:** Constructions of piers in the river might impact on hydrology.
12	Groundwater	C	C	**Construction Phase:** Underground excavation and installation of underground structures might impact the water level and quality of groundwater.
13	Geographical features	C	C	**Construction Phase:** Excavation and installation of structures might cause ground subsidence.
Social Environment				
14	Involuntary Resettlement	A-	A-	**Construction:** Approximately 12,210 PAFs need to be relocated due to this project, so there will be an impact on PAPs. **Operation Phase:** There might be an impact if appropriate measures are not taken.
15	Poor people	A-	A-	**Pre-Construction /Construction Phase:** Resettlement of the poor within the project site is expected. **Operation Phase:** Poverty might worsen if appropriate measures are not taken.
16	Ethnic minorities and indigenous peoples	D	D	**Pre-construction /Construction / Operation Phase** The alignment will not pass through an Ancestral Domain
17	Local economies, such as employment, livelihood, etc.	B-/+	C	**Construction Phase:** In case of resettlement, it might impact on transportation business such as taxi and jeepneys. On the other hand, construction will generate local employment. **Operation Phase:** It is highly possible that train will be used for long distance and taxi and jeepneys will be used for short to middle distance Para transit from the station.
18	Land use and utilization of local resources	B-/+	B+	**Construction Phase:** There will be a significant impact on land use due to the rails and depot. **Operation Phase:** The usage of vacant land in the outskirts will be stimulated by the operation.
19	Water usage	C	C	**Construction Phase/ Operation Phase** The impact is still unknown.

No	Items	Evaluation: Pre/ During construction	Evaluation: Operation	Reason of evaluation
20	Existing social infrastructures and services	C	C	**Pre-construction / Construction Phases/ Operation Phase** The scale of the impact cannot be assumed at this time.
21	Social structure such as social capital and local decision-making institutions	C	C	**Pre-construction / Construction Phases/ Operation Phase** The scale of the impact cannot be assumed at this time.
22	Misdistribution of benefits and damages	B-	B-	**Construction:** Misdistribution of benefits might arise conflict among the stakeholders. **Operation Phase:** Around the station is more convenient compared to the only rail section, both “benefits” and “damages” will occur.
23	Local conflicts of interest	B-	B-	**Construction Phase:** There might be local conflicts generated by land acquisition procedure and payment of compensation. **Operation Phase:** Around the station is more convenient compared to the rail only section, and business chances might create local conflicts.
24	Historical/Cultural heritage	C	C	**Construction Phase/ Operation Phase** In the Philippines, structures older than 50 years are classified as Historical/Cultural Heritage, so the preservation of old PNR stations and other structures need to be verified.
25	Landscape	B-	C	**Construction Phase:** There might be some impact during construction, but they will be small and short-term. **Operation Phase:** If viaducts will cross over other structures, the height might have an impact on landscape.
26	Gender	C	C	**Construction / Operation Phase** The impact cannot be determined at this time.
27	Children’s rights	C	C	**Construction / Operation Phase** The impact on school route is yet unknown.
28	Infectious diseases such as HIV/AIDS	B-	D	**Construction Phase** Risk to infectious diseases like HIV/AIDS may increase among construction workers. **Operation Phase:** Since the project aims improvement of urban transportation, the project will not directly concern on the spread of infection risks of HIV/AIDS.
29	Working conditions (including occupational safety)	B-	B-	**Construction Phase:** Inappropriate safety measures of contractor will deteriorate occupational safety. **Operation Phase:** Inappropriate safety measures of railway operator will deteriorate occupational safety.
Others				
30	Trans-boundary impacts or climate change	B-	B+/-	**Construction Phase:** Operation of construction machinery and vehicles will contribute to greenhouse gas (CO_2) emission. **Operation Phase:** Although electricity usage will generate greenhouse gas, modal shift from vehicles to railway that has a better energy efficiency will reduce greenhouse gas.

No	Items	Evaluation		Reason of evaluation
		Pre/ During construction	Operation	
31	Accidents	B-	B-	**Construction Phase:** There is a risk of accident on construction activity. **Operation Phase:** Viaducts are accident-prone areas.
32	Risk of flood	C	C	**Construction / Operation Phase:** Sections of the project alignment are flood-prone areas, verification that the project does not increase the risk of flooding needs to be done.

Note: Impact Items refer to "JICA Guidelines for Environmental and Social Considerations April 2010"
A+/- Significant positive/negative impact is expected,
B+/- Positive/negative impact is expected to some extent
C Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D No impact is expected

Source: JICA Design Team

9.1.6.2 TOR of Environment and Social Considerations

Following the draft scoping, the TOR for a survey including survey items, purposes, locations and methods, was prepared as show in Table 9.1.20.

Table 9.1.20 TOR for NSRP-South

	Items	Survey Items	Methodology
Pollution Control			
1	Air Pollution	• The national and international standards • Sensitive receptor in vicinity of the project area • Baseline condition of air quality along the project including sensitive receptors. • Impact of air pollution emitted by construction heavy machinery and vehicles, train operation and corresponding mitigation measures.	• Literature review/ Review existing survey results • Conduct bassline survey of air quality at 8 sampling points including sensitive receptors. • Study a construction plan, such as construction method, period, place, parameters, types of machinery and vehicles
2	Water pollution	• The national and international standards • River, creek and lake that might be affected by the project • Baseline condition of surface water quality of rivers and lakes along the project alignment • Baseline condition of groundwater around the project area. • Impact of surface /ground water quality during construction, operation, and corresponding mitigation measures.	• Review existing survey results conducted by EMB • Conduct baseline survey of surface water quality of rivers and lakes along the project alignment at 14 points. • Conduct baseline survey of groundwater level and quality around the project site at 8 sampling points evenly distributed within the stretch of the existing PNR ROW. • Predict and evaluate the impediments to meeting quality standards of DAO 2016-08
3	Soil pollution	• The national and international standards • Existing contaminated site/ potential site might be contaminated by the project • Baseline condition of soil quality and potential contaminated site • Impact of soil quality during construction/ operation and corresponding mitigation measures.	• Literature review and maps of the project area • Review existing survey results • Conduct baseline survey of soil quality at 10 soil sampling sites including stations, depot and other areas along the proposed alignment, and 1 sampling site for potential contaminated site. • Review the construction plan, such as construction method, period, place, parameters, types of heavy machinery and vehicles,

	Items	Survey Items	Methodology
4	Waste	• The estimated volume of excavated soil and construction waste • Disposal methodology of each LGUs • Impact of generated solid waste on the current waste treatment during construction/ operation and corresponding mitigation measures.	• Literature review • Data and information on waste consumption and issues gathering by each affected LGUs. • Review the construction plan, such as construction method, period, place, parameters, types of heavy machinery and vehicles
5	Noise and Vibration	• The national and international standards • Existing sensitive receptors in vicinity of project area and distance from alignment • Baseline condition of noise and vibration at project area including sensitive receptors. • Noise prediction for construction and operation activities at affected area, and corresponding mitigation measures.	• Review existing survey results • Conduct baseline survey of noise and vibration during morning, daytime, evening, and night-time at 15 sampling points including sensitive receptors and measure Equivalent Sound Level (L_{Aeq}) and Vibration acceleration level (L_{va}) of during construction and operation • Review construction plan including method, period, place, parameters, types of heavy machinery and vehicles at sensitive receptors.
6	Ground subsidence	• Baseline condition of soil type survey • Impact of project activities on ground subsidence and corresponding mitigation measures during construction and operation	• Review available reports, geologic literature and information from Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippine Atmospheric, Geophysical and Astronomical Services (PAGASA), and National Mapping and Resource Information Authority (NAMRIA) • Review the construction plan, such as construction method, period, place, parameters, types of heavy machinery and vehicles. • Conduct assessment by PHIVOLCS
7	Bottom sediment	• River, creek and lake might be affected by the project • Impact of potential construction activities on bottom sediment and corresponding mitigation measures during construction.	• Review construction plan including construction method, period, place, parameters, types of heavy machinery and vehicles, as well as similar projects, predict the generation of turbid water and oil leak.
Natural Environment			
8	Protected Area	• Verify the distance of Mount Makiling and project site, and predict the impact during and after construction. • In case of impacts are predicted, identify affected area and location, and prepare mitigation measures during construction and operation	• Literature review • Consult with relevant agencies and stakeholders. • Gather local resident's comments concerning worker's interaction with Mount Makiling.
9	Ecosystem	• Identify any fauna and flora listed in IUCN/ DAO 2007-11 • Baseline condition of terrestrial fauna and flora in/around the project site, and freshwater ecology • In the case that impacts are predicted, identify affected area and location, and prepare the effective and mitigation measures during construction and operation and long-term and monitoring to be implemented, as specified in the JICA guidelines FAQ.	• Literature review and review existing survey results • Interview and hearing in/around project area • Conduct baseline survey of terrestrial fauna and flora in/around the project site at 6 transect points. • Conduct freshwater ecology at the same 15 sampling point with surface water. • Review the construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles. • Confirm whether 1) the project will not cause any negative impact to the value of biodiversity and their supporting ecological process exist in the Area for Critical Natural Habitat, 2) the project will not cause any reduction in number of threatened species based on the species' listing on either the (global) IUCN Red List and/or on regional/national lists.
10	Hydrology	• Rivers, creeks and lakes might be affected by the project • Mitigation measures for river flow if structures are installed in rivers	• Review of CLUPs of the host LGUs and other secondary data such as existing literature and maps of MGB, NAMRIA, and PHIVOLCS. • Review construction plan and check structures installed at river crossing.

	Items	Survey Items	Methodology
11	Hydrogeology	• The national and international standards • Baseline condition of groundwater level around the project area. • Impact of potential construction and operation activities on groundwater and corresponding mitigation measures	• Review of CLUPs of the host LGUs and other secondary data such as existing literature and maps of MGB, NAMRIA, and PHIVOLCS. • Review existing survey results • Conduct baseline survey of groundwater level around the project site by existing geological survey and field survey at 8 sampling points evenly distributed within the stretch of the existing PNR ROW • Review the project operation plan such as construction method, period, place, parameters, types of heavy machinery and vehicles.
12	Geographical features	• Baseline condition of geographical features project area • Impact of potential construction and operation activities on geographical features and corresponding mitigation measures	• Review of available reports, geologic literature and information from MGB, PHIVOLCS, PAGASA, and NAMRIA. • Review the project operation plan such as construction method, period, place, parameters, types of heavy machinery and vehicles.
Social Environment			
13	Resettlement/ Land Acquisition	• National legal framework and international guidelines on RAP. • Baseline condition of Project Affected People (PAPs) based on the census and Social Economic Survey (SES). • Potential impacts to PAFs and affected area and location, and corresponding mitigation measures incorporated into the RAP.	• Literature review • Conduct census and socio-economic survey, resettlement and develop land acquisition policy. Livelihood and income program under RAP. • Clarify land tenure of affected area with relevant agencies • Gather opinions of PAPs through public scoping/hearing, perception survey, Stakeholder Consultation Meeting (SCM), focus group discussion (FGD) and interviews.,
14	Poor people	• The existence of the poor and vulnerable people in the project area • Potential impacts on poor and vulnerable people to be relocated based on the results of the SES and corresponding mitigation measures under RAP	• Conduct census and socio-economic survey, resettlement and Land acquisition policy. Livelihood and income program under RAP. • Conduct of public scoping/hearing, perception survey, SCM, and FGC for vulnerable group
15	Local economies, such as employment, livelihood, etc.	• Baseline condition of local economy, and livelihood of the project area. • Potential impact on employment and livelihood of PAFs and affected communities' due to resettlement, and corresponding mitigation measures. • Potential benefits to the local communities through the implementation of the project.	• Review of available secondary data, relevant studies, and other information from Philippine Statistics Authority (PSA), CLUP and Socio-economic Profile of the host LGUs • Conduct public scoping/hearing, perception survey/SES to verify the current income and livelihood of PAPs, and impact to local businesses. • Based on the results of the SES and SCMs, confirm the PAPs profile and prepare the compensation and livelihood restoration measures in the draft RAP. • Conduct SCM and FGD for transport operators and evaluate the impact on transport sector, and business owners
16	Land use and utilization of local resources	• Existing land use of the project area • Potential impacts on change of land use and corresponding mitigation measures	• Gather information and data on land use in and around the project area including Comprehensive Land Use Plan (CLUP), through existing information and data, and field reconnaissance • Consult to LGUs, relevant agencies
17	Water usage	• Baseline condition on water consumption, ground water usage around the project site and its capacity • Potential impact to water usage, and proposed mitigation measures.	• Literature review, Site survey, Interview and hearing to the relevant agencies • Conduct the survey on the use of ground water in the project area • Data and information on water consumption and issues gathering by each affected LGUs. • Conduct the supply of drinking water through SES. • Review the construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles.

	Items	Survey Items	Methodology
18	Existing social infrastructures and services	• Existing social infrastructures and services and its capacity in the project affected area • Potential impacts to existing social infrastructures and services, and proposed mitigation measures	• Literature review, Site survey, Interview and hearing with the relevant agencies • Review the construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles. • Verify the relocation sites and associated infrastructures (water, electricity, etc.).
19	Social structure such as social capital and local decision-making institutions	• Existing social structure such as social capital and local decision-making institutions • Potential impact of the project to the existing social structure and corresponding mitigation measures.	• Conduct census and socio-economic survey, resettlement and relocation site development under RAP, and identify the number of displaced person • Review the construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles.
20	Misdistribution of benefits and damages	• The project affected people and their profile through SES • Potential impact on the misdistribution of benefits and damages and corresponding mitigation measures under RAP	• Conduct census and socio-economic survey, resettlement and Land acquisition policy. Livelihood and income program under RAP. • Review the project operation plan such as construction method, period, place, parameters, types of heavy machinery and vehicles. • Conduct SCM and FGD.
21	Local conflicts of interest	• Existing economic status of PAPs by the RAP study, local conflicts of interest. • Potential gaps between PAPs and non PAPs and corresponding mitigation measure incorporated into the f draft RAP • Potential gap in PAPs income before/after resettlement	• Conduct census and socio-economic survey • Interview and hearing of PAPs • Conduct SCM and FGD for transport operators and evaluate the impact on transport sector, and business owners.
22	Historical/Cultural heritage	• Existing and potential historical/cultural heritage in the project site • Potential impacts of project design and activities to the existing and potential heritage, and corresponding mitigation measures.	• Literature review, interview and hearing to NHCP and concerned agencies • Review of maps and existing information and data, and field reconnaissance on potential heritage under the project • Field reconnaissance and interview to PNR on PNR stations and railway bridges within the project site, • Review the project design and construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles.
23	Landscape	• Exiting landscape value of the project area. • Proposed structures design • Potential impacts of project design and activities to the existing landscape value, and corresponding mitigation measures.	• Review of maps and existing information and data, and field reconnaissance • Conduct of public scoping/hearing, perception survey, SCM to present the proposed design and gather opinion
24	Gender	• The ratio of female and male PAFs, ratio of female headed households in vulnerable group • Potential impact on the female households, potential female train users, and the necessity of special assistance • Corresponding mitigation measure in facility design in attention to women and vulnerable.	• Review project design and the gender action plan developed in the project. • Identify the gender issues in the project area through reviewing the gender action plan and verify if the facility design is considerate of women and traffic disadvantaged. • Conduct FGD on vulnerable group including female head household
25	Children's rights	• Location of educational intuitions around the project site and school-commuting roads • Potential roads to be blocked during construction • Availability and distance to educational institution at relocation sites • Potential impacts on school roads by potential blocking, and mitigation measure	• Review of maps and existing information and data, and field reconnaissance • Conduct SES, to identify the impact to number of PAS under the school age • Review the construction plan such as construction method, period, and place. • Verify the relocation sites and associated infrastructures (school, etc.).
26	Infectious diseases such as HIV/AIDS	• Prevalence of infectious diseases such as HIV/AIDS in the project area. • Potential impact on the prevalence of HIV/AIDS during the construction	• Review existing information and data on trend of infectious disease in the project area through relevant agencies • Review similar projects on the prevalence of HIV/AIDS by influx of construction workers

	Items	Survey Items	Methodology
27	Working conditions	• National and international registration on work environments • Health and safety measures during construction in the light of other projects.	• Literature review and review of previous and similar projects • Review the construction plan such as construction method, period, place, parameters, types of heavy machinery and vehicles
Others			
28	Trans-boundary impacts or climate change	• Possibility of GHG reduction by the railway project • Reduction measures on GHG during construction and operation • Predict and evaluate impact of the project to the climate change and vies-versa.	• Review of previous and similar projects • Collect and review of existing studies on micro climate of the project area and its changes from PAGASA CIA Station • Predict effectiveness of GHG reduction by the project based on demand forecast data, and estimated electricity use. • Survey the construction equipment, machinery and vehicles which will emit GHG based on construction plan.
29	Accidents	• Applicable national and international registration • Trend of traffic accidents in the project area • Potential impact of the project on traffic volume in the area • Potential increase in traffic accidents, and corresponding mitigation measure. • the risk of occupational accidents during construction and operation based on other projects, and corresponding safety measures during construction and operation	• Collect existing trend on traffic accidents and occupational accidents at construction sits • Literature review on the potential impacts and risks of railway project on health of people living in surrounding communities, • Confirm established relationships between hazards of railway operations and health risks and effect to people • Review of previous and similar projects • Study the location of new stations, and potential increase in traffic volumes in surrounding area during operation linked to TOD.
30	Risk of flood	• The drainage morphology of the project area • The susceptibility and occurrence of flood around the project site • Potential impact on increase in the flood risk by the project and appropriate mitigation measures	• Collect and review existing study on Local climate of the project area in its trend on rainfall and extreme events such as typhoon • Study the flood prone area under the project area • Review the project operation plan.

Source: JICA Design Team

9.1.7 Results of the Survey on Environmental and Social Considerations

9.1.7.1 Pollution Control

(1) Air Pollution

The field survey was conducted from January 18 to February 8, 2018. The 24-hour ambient concentrations of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2, NO_2 and 1-hour ambient concentrations of O_3 and CO were recorded at eight pre-established sampling stations along the NSRP alignment. The results of sampling show that most of the stations are within the DENR limits, except for station AAQ3 (PNR Buendia) for TSP and PM_{10} levels and AAQ2 (PNR Sta. Mesa) for the $PM_{2.5}$ level. Comparing against WHO guideline values, sampling stations located at more urban environments have higher PM_{10} and $PM_{2.5}$ concentrations above the guideline values. Stations AAQ1 to AAQ5 have PM_{10} concentration levels above the guideline values, and Stations AAQ1 to AAQ4 have $PM_{2.5}$ concentration levels above the guideline values. The only other exceedance was SO_2 concentration level at station AAQ3 (PNR Buendia), which was located adjacent an intersection of Buendia Flyover corner Osmeña Highway and South Superhighway.

Table 9.1.21 Ambient Air Sampling Results

Parameter	Unit	Sampling Stations								Standards	
		AAQ1 PNR – Solis	**AAQ2: PNR - Sta. Mesa**	**AAQ3 PNR Buendia**	**AAQ4 PNR - FTI**	**AAQ5 PNR – Sucat**	**AAQ6 PNR – Binan**	**AAQ7: PNR – Calamba**	**AAQ8: Paciano Rizal Elementary School**	**DENR**	**WHO**
Date	-	Jan. 20 (1110 H) - Jan. 21 (1110 H)	Jan. 21 (1345 H) - Jan. 22 (1345 H	Jan. 18 (2000 H) - Jan. 19 (2000 H)	Feb. 07 (2148 H) - Feb. 08 (2148 H)	Feb. 20 (1350 H) - Feb. 21 (1350 H)	Jan. 23 (1026 H) - Jan. 24 (1026 H)	Jan. 24 (1356 H) - Jan. 25 (1356 H)	Jan. 25 (1716 H) - Jan. 26 (1716 H)		
Wind Direction	-	ENE	NE	ENE	N	ENE	NE	ENE	NE		
Highest Wind Speed	m/s	5.81	4.47	5.81	4.92	6.71	4.02	3.58	5.36		
Ave. Wind Speed	m/s	2.53	2.47	3.33	3.09	3.63	2.52	2.63	2.50		
Calm Winds	m/s	20	0	0	4	0	0	0	0		
Ave. Temp	C	27.8	28.3	27.4	25.0	29.2	27.1	26.6	26.1		
Ave. Barometric Pressure		29.80	29.81	29.87	29.82	29.85	29.78	29.78	29.79		
Ave. Relative Humidity	%	76	79	79	81	70	78	80	80		
TSP	$\mu g/m^3$	59.47	107.28	276.54	137.06	130.39	37.31	56.96	52.59	230	-
PM_{10}	ug/m^3	51.91	84.74	272.1	90.43	50.68	27.29	23.86	26.87	150	50
$PM_{2.5}$	ug/m^3	43.59	80.3	35.99	36.39	20.41	20.62	10.17	10.59	50	25
SO_2,	ug/m^3	6.06	7.65	62.79	ND	ND	57.3	10.98	6.2	180	20
NO_2	ug/m^3	15.56	7.02	0.34	52.98	3.28	12.3	2.9	3.05	150	-
Pb	ug/m^3	0.0024	0.0025	0.0007	ND	ND	0.0008	ND	ND	-	-
CO	ug/m^3	ND	ND	ND	ND	113.09	ND	ND	ND	35,000	30,000[2]
O_3	ug/m^3	ND	1.14	1.14	ND	0.05	1.14	ND	ND	140	-

Note: ND - less than method detection limit (MDL), Texts in colored boxes indicate values that exceeded the DENR standard

Source: Ambient Air Monitoring, GEOSPHERE Technologies 2018; 1As stated in Guideline Values of IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, Table 1.1.1: WHO Ambient Air Quality Guidelines, April

(2) Groundwater Quality

Samples were collected between February 12 and 14, 2018 from eight groundwater sampling stations. The wells were constructed between 100 and 8 years ago and depths range from 24 to 42 m. Usage varies from community drinking water supply, cooking, to bathing and washing. The wells in Buendia (GW-2), and Los Baños (GW-8) are not in regularly in use. The wells yielded clear water apart from Los Baños (GW-8). Some wells fail to meet the requirement for no odor. Bubbles, an indicator of water polluted by detergent substances appeared in the samples from Solis (GW-1) and Buendia (GW-2). Four groundwater wells fail the PNSDW standards for drinking water and all 8 fail the DENR Class A (Potable ground water) although for four wells this is only due to temperature. Results are shown in Table 9.1.22.

(3) Surface Water Quality

A freshwater quality survey was conducted on February 12, 14 and 22, 2018 to assess the physical-chemical properties from 14 surface water points identified along the proposed alignment. Samples were also taken for 12 rivers and creeks west to south of Laguna lake, plus 1 in Laguna Lake itself and 1 in Tadlac (Alligator) Lake. The results are shown in Table 9.1.23.

No river or lake met all standards for a DENR Class C River (Agricultural Use). The most significant failures were for Fecal Coliform which was well over the limit in all samples except in the relatively pristine Tadlac Lake. BOD exceeded limits in all sample points except SSW-8 which however failed the Japanese standard. Dissolved oxygen also failed to reach the standard in 9 out of the 14 sample sites. Nitrate and Chloride standards were met but two sample sites (SSW-11 and 13) failed to meet the phosphate standard signifying fertilizer or detergent run off.

Table 9.1.22 Results of Analysis of Groundwater samples

Parameters	GW-1 Solis PNR Station	GW-2 Buendia PNR Station	GW-3 Sucat PNR Station	GW-4 Alabang PNR Station	GW-5 Biñan PNR Station	GW-6 Cabuyao PNR Station	GW-7 Calamba PNR Station	GW-8 Los Baños PNR Station	PNSDW 2017	DENR WQG			WHO
										Class A	Class B	Class C	
Use	for clothes washing	only when no water from local water utility	not for drinking	cooking, bathing, washing	for drinking, cooking, bathing, washing	for cooking, washing	not regularly in use	not regularly in use					-
Date of sampling	2/14/2018	2/14/2018	2/14/2018	2/13/2018	2/13/2018	2/13/2018	2/12/2018	2/12/2018					
Time of sampling (H)	0900	1225	1800	1700	1125	945	1605	1040					
Physical Characteristic													
pH	7.12	6.79	6.7	6.77	6.95	6.82	6.53	6.58	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.0	-
Color, TCU	10	40	10	<5	<5	<5	<5	5	10	50	50	75	-
Water temperature	29.4	31.2	30.5	30.1	30.8	29.8	31.1	30.8	-	26-30	26-30	25-31	-
Electric Conductivity	1,348	1,039	1,743	1,429	847	867	903	794	-	-	-	-	-
Total Dissolved Solids (TDS), mg/L	662	510	855	701	416	426	443	390	600	-	-	-	-
With objectionable odor	Yes	Yes	Yes	No	No	No	No	No	No				-
Captions and Anions													
Sodium (Na), mg/L	424	59	242	87	90	29	29	24	200	-	-	-	-
Potassium (K), mg/L	9.8	180	408	19	16	11	10	7.3	-	-	-	-	-
Calcium (Ca), mg/L	4.2	62	130	30	82	33	51	38	-	-	-	-	-
Magnesium (Mg), mg/L	4.4	106	132	16	37	21	23	12	-	-	-	-	-
Bicarbonate (HCO_3), mg/L	582	364	551	505	414	356	375	313	-	-	-	-	-
Chloride (Cl), mg/L	75	39	160	140	33	46	82	72	250	250	250	350	-
Sulfate (SO_4), mg/L	16	80	61	84	20	22	55	36	250	250	250	275	-
Nitrate (NO_3-N), mg/L	0.15	0.16	0.25	0.33	0.17	0.12	0.22	1.9	50	-	-	-	50
Toxic and Other Deleterious Substances													
Arsenic (As), mg/L	0.0069	0.0035	0.002	0.0016	0.0011	0.001	0.0017	0.0038	0.01	0.1	0.1	0.2	0.01
Cadmium (Cd), mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	0.003	0.003	0.005	0.003
Chromium Hexavalent (Cr+6), mg/L	<0.002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	0.05	0.01	0.01	0.01	0.05
Cyanide (CN), mg/L	0.0724	0.0369	0.0229	0.0045	0.0085	0.012	0.0115	0.0101	0.05	0.07	0.07	0.1	-
Lead (Pb), mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.01	0.01	0.01	0.05	0.01
Total Mercury (Hg), mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001	0.001	0.001	0.002	0.006
Microbes													
Fecal Coliforms, MPN/100 mL	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	-	<1.1	100	200	ND
Total Coliforms, MPN/100 mL	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	<1.1	-	-	-	ND

Note: Highlighted results do not conform with standard

Table 9.1.23 Results of Surface water Quality Sampling

Parameters	SSW-1 Pasig River	SSW-2 Laguna Lake	SSW-3 Buli River	SSW-4 Tunasan River	SSW-5 San Pedro River	SSW-6 Biñan River	SSW-7 San Cristobal River	SSW-8 San Juan River	SSW-9 Brgy Bucal River	SSW-10 Tadlac (Alligato r) Lake	SSW-11 Dampali t River	SSW-12 Saran River Brgy Malinta	SSW-13 Molawin River	SSW-14 Buot Creek	DENR Class C	Japan
Class (DENR 2016-08)	C	C	N/C	N/C	C	N/C	C	C	N/C	N/C	N/C	N/C	N/C	N/C		
Sampling Date	2/14/2018	2/14/2018	2/13/2018	2/13/2018	2/13/2018	2/13/2018	2/13/2018	2/12/2018	2/12/2018	2/12/2018	2/12/2018	2/12/2018	2/12/2018	2/22/2018	-	-
Sampling Time, H	1100	1720	1530	1450	1340	1100	825	1535	1435	1340	1220	1130	0925	0845	-	-
Flow Rate, m/s	0.3	Min. flow	Min. flow	0.4	0.4	-	1.2	0.5	0.1	Min. flow	0.4	0.0	0.3	0.3		
Depth, m	3.00	1.25	0.55	0.09	0.20	-	1.00	0.50	0.20	Deep	0.23	0.11	0.12	0.16		
Width, m	>100	_	5.4	7.7	4.0	10.0	6.0	16.0	3.5	_	3.3	3.3	7.1	4.5		
Color, TCU	65	28	5	5	5	10	5	<5	<5	5	5	10	5	40	75	-
Total Suspend Solids (TSS), mg/L	97	98	60	188	25	43	20	8.5	26	2.5	11	213	84	8.7	80	[50*; [15**
Temperature	28.4	28.4	29.4	30.6	30.3	28.5	27.2	30.1	31.3	29	27.2	29.9	25.7	28.8	25-31	-
pH	6.7	6.79	6.95	7.02	6.44	7.25	7.06	7.17	7.34	6.81	6.38	6.4	7.8	7.03	6.5 – 9.0	6.5-8.5*; 6.5-8.5**
Dissolved Oxygen (DO), mg/L	3.8	3.8	0.1	3.1	0.3	2.1	0.1	6.4	5.2	5.6	6.7	0.7	6.2	2.9	5	〈5*; 〈5**
Biochemical Oxygen Demand (BOD), mg/L	31	38	99	175	45	66	33	7	15	11	11	49	15	9	7	[5*; [5**
Fecal Coliform MPN/ 100m	460,000	4,900	700,000	2,400,000	7,900,000	9,200	9,200,000	160,000	1,300,000	22	24,000	5,400,000	54,000	540,000	200	-
Total Coliform, MPN/ 100 mL	460,000	35,000	700,000	2,400,000	24,000,000	9,200	16,000,000	160,000	2,400,000	49	24,000	5,400,000	54,000	540,000	-	-
Conductivity, µS/cm	547	580	1,097	1,637	1,325	1,200	982	738	1,355	829	228	674	346	518	-	-
Chloride (Cl), mg/L	81	68	96	220	63	120	98	50	250	120	8.2	32	15	29	350	-
Nitrate as N (NO_3-N), mg/L	0.4	0.4	0.48	0.13	0.13	0.11	0.13	1.24	0.43	0.84	0.14	0.1	0.38	0.22	7	[10
Phosphate as P (PO_4-P), mg/L	0.6	0.97	5.06	8.33	6.62	2.72	1.44	1.12	0.19	0.44	0.02	1.03	0.09	0.39	0.163 b	-
Copper (Cu), mg/L	<0.005	<0.005	0.028	0.021	0.031	0.369	0.021	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	0.02	-
Arsenic (As), mg/L	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	<0.0009	0.0048	0.0249	0.0094	0.0095	0.0108	0.0023	0.0024	0.02	[0.01
Cadmium (Cd), mg/L	<0.002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	0.002	0.011	<0.002	<0.002	0.005	[0.01
Chromium (Cr+6), mg/L	0.008	0.004	0.042	0.017	0.02	0.006	0.002	0.003	<0.002	0.002	0.004	0.005	0.005	0.014	0.01	[0.05
Lead (Pb), mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.02	0.05	[0.01
Mercury (Hg), mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002	[0.0005
Cyanide (CN) , mg/L	0.032	0.015	0.01	0.011	0.093	0.091	0.068	0.057	0.056	0.072	0.02	0.019	0.03	0.005	0.1	N/D
Oil and Grease (O&G)	1.5	1.5	3.2	5.3	6.7	2.4	1.3	<0.5	<0.5	<0.5	3.3	<0.5	<0.5	0.7	2	-
Organo-phosphates, mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.003	-
Phenols, mg/L	3.6	1.9	1.9	7.2	1.2	1.3	0.7	0.01	0.02	0.02	0.02	0.03	0.04	<0.01	0.05	-
Surfactants (MBAS), mg/L	<0.007	<0.007	2.19	0.388	4.81	0.373	0.204	<0.007	<0.007	<0.007	0.094	2.58	<0.007	0.0365	1.5	-

a Reference values are maximum allowable limits unless specified as range or minimum (min). b the reference values under the column of PO_4-P are conversions (0.3261) of the 0.5 mg/L and 5 mg/L PO_4 values in DAO 2016-08. . c. Highlighted results do not conform with standards

* Environmental Quality Standards for conservation of the Living Environment, Rivers, Class C

** Environmental Quality Standards for conservation of the Living Environment, Lakes, Class B, N/C: Not Classified, N/D: Not Detected

(4) Soil Fertility

To establish baseline levels of soil fertility, samples were collected between January 23 and February 2018 at 10 established sampling stations. All stations showed that the pH level, organic matter, primary nutrients (P and K), magnesium and macronutrients (available iron, copper, manganese and zinc) were adequate. However, the pH level at Station S05 and organic matter at Station S10 which exceeded the adequate values of pH 5.5-8.5 and 1.8% for pH and organic matter, respectively. The lowest nitrogen concentration level was in Station S06 (Sucat) at 250 mg/kg while the highest nitrogen concentration level was in Station S08 (Calamba) at 1,300 mg/kg. Levels of Cadmium exceeded the national Standard signifying unacceptably high levels for an agricultural use. Lead exceeded the national standard at five sample sites. Levels were moderately high at S03 and S08 signifying high levels for an agricultural use. S09 and S10 are high in arsenic.

Table 9.1.24 Results of Soil Fertility Quality

Parameters	**Sampling Stations**										**BSWM**[1]		
	S01	**S02**	**S03**	**S04**	**S05**	**S06**	**S07**	**S08**	**S09**	**S10**			
Surface Soil Analysis Pertaining to Soil Fertility Rating													
Soil Type	Filled-up Soil	Filled-up Soil	Filled-up Soil	Guadalupe Clay	Guadalupe Clay Adobe	Guadalupe Clay	Quiangua Silt Loam	Quiangua Silt Loam	Hydrosol	Lipa Loam	-		
pH	8.12	8.11	7.85	8.2	9.12	7.7	8.1	7.8	8.0	8.0	5.5-8.5		
Organic Matter, %	2.48	1.82	3.24	1.77	2.59	1.22	2.4	2.9	1.2	0.75	1-8; >3**		
Primary Nutrients													
Total Kjeldahl Nitrogen, mg/kg	260	280	1300	270	1300	250	970	1300	820	800	-		
Phosphorus, mg/kg	1135	4863	1913	6380	348	3873	2829	239	887	244	>10 ; >20**		
Potassium, cmol/kg	14.57	0.46	0.45	0.15	3.97	0.14	5.32	2.74	5.03	6.87	>0.25		
Secondary Nutrients													
Calcium, cmol/kg	171.21	22.245	110.445	10.315	110.445	35.59	19.18	5.11	14.6	1.02	-		
Magnesium, cmol/kg	154.47	12.01	79.15	2.44	79.15	4.54	59.69	66.76	227.05	52.80	>0.50		
Micronutrients													
Available Iron, mg/kg	42608	20393	42429	31941	18933	202214	76432	396112	25694	64802	>4.5		
Available Copper, mg/kg	459	63	104	971	65	399	189	168	90	126	>0.2		
Available Manganese, mg/kg	196	554	445	826	491	333	581	734	1394	3233	>1.0		
Available Zinc, mg/kg	391	239	1600	388	255	1062	434	369	130	82.6	>1.5; >1.0**		
Soil Analysis for Trace Metals											**PNS/ BAFS 40:2016**	**Dutch Standards**[2]	
												Target Values	**Intervention Values**
Lead, mg/kg	50	85.8	201	31	123	45	54.2	208	15.4	19	50	85	530
Mercury, mg/kg	20	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	0.09	0.04	0.04	20	0.3	10
Cadmium, mg/kg	2	2.90	2.87	3.93	2.50	4.17	3.55	5.11	3.65	3.78	2	0.8	12
Arsenic, mg/kg	5	1.62	2.32	1.37	1.57	2.15	1.88	3.55	9.76	10.0	5	29	55
Chromium Hexavalent, mg/kg	150	0.74	<0.2	<0.2	10.0	0.78	<0.2	<0.2	<0.2	<0.2	150	100	380

Note: 1) ** Limits applicable to dry land crops. Target Values of Dutch Standard (2000) – indicates the level at which there is a sustainable soil quality; Intervention Values of Dutch Standard (2000) – representative of the level of contamination above which there is a serious case of soil contamination. 2) Highlighted results do not conform with standard.

Sources: 1 The Bureau of Soils and Water Management Soil Fertility Rating
2 Dutch Target and Intervention Values (2000)

(5) Soil Contamination

Risk of soil contamination was identified at two sites; Sucat Thermal Power Plant (STPP), a proposed Sucat Station/ Depot) and Agricultural area in Banlic, Calamba City, another proposed depot. To obtain further understanding of soil contaminants soil samples were collected on March 23, 2018. Initially the survey at the Sucat Thermal Power was not permitted, because the government had an on-going contract with a private firm for its clean-up. The survey team was able survey the site in August 20, 2018. Soil was sampled at using the composite sample method. The results are shown below compared to the Dutch Intervention Values.

The results of the soil contamination analysis show that all measured parameters (pH, As, Ba, Cu, Zn, Fe, Cd, Cr, Pb, Mn, Hg, Se, Ni, O&G, and CN) are within the Dutch Intervention Values.

Table 9.1.25 Results of Soil Contamination Analyses

Parameters	Sampling Station		Dutch standard	REMARKS
	Sucat Site	Banlic Site	Intervention Values	
pH	8.20	7.0	2.0 < pH < 12.0 [1]	Passed
Arsenic, mg/kg	<0.4	<0.001	55 mg/kg	Passed
Barium, mg/kg	374	<0.04	625 mg/kg	Passed
Copper, mg/kg	34	<0.005	190 mg/kg	Passed
Zinc, mg/kg	225	0.922	720 mg/kg	Passed
Iron, mg/kg	35,254	0.389	3,000-100,000 [2]	Passed
Cadmium, mg/kg	2.92	0.0294	12 mg/kg	Passed
Chromium, mg/kg	23	0.054	380 mg/kg	Passed
Lead, mg/kg	37.4	<0.006	530 mg/kg	Passed
Manganese, mg/kg	770	4.04	30-5,000 [2]	Passed
Mercury, mg/kg	0.0582	<0.0001	10 mg/kg	Passed
Selenium, mg/kg	<0.4	<0.001	100 mg/kg	Passed
Nickel, mg/kg	47.5	0.48	210 mg/kg	Passed
Oil and Grease, mg/kg	2,671	78	-	N/A
Cyanide, mg/kg	0.0130	<0.0019	20 mg/kg	Passed

Source: Dutch Target and Intervention Values (2000), [1]DAO 2013-22, [2] Leeper, 1978

(6) Waste

The NCR generates the largest volume of waste material for the past five years due to its population size, number of establishments and modernized lifestyle. In 2016, an estimated population of 12 million people, Metropolitan Manila generated 9,213 tons per day of wastes and Region IV-A with 4,440.15 tons per day. The World Bank (2012)[2], estimates that solid waste being produced by Philippine cities will go up by 165 % as a consequence of a projected 47.3 % rise in urban population by 2025 and a projected doubling of municipal solid waste (MSW) generation per capita at 0.9 kg per day by 2025 from the current 0.5 kg, presenting a direct correlation between the per capita level of income in cities and the amount of waste

2 "What a Waste: A Global Review of Solid Waste Management" World Bank (2012)

per capita that is generated. Table 9.1.26 shows the waste volume in 2015 and predicted volume for 2016 to 2020 of solid waste generated by each host LGUs. Manila has significantly large volume of waste generated to compare the rest of host LGUs.

During the construction, in addition to the domestic solid waste, a total of 300,000 m^3 of soil will be disposal as result of soil excavation and backfilling operations for construction. Under the chapter 6, it has been confirmed that the existing soil disposal sites have sufficient capacity to take soil waste generated by the Project. The contractor will require to finalize the soil disposal site to be used in coordination with LGUs and contract with the operator prior to the construction.

Table 9.1.26 Predicted Waste Generation by LGU 2016-2020 (tons per year)

Municipalities	population	2015	2016	2017	2018	2019	2020
Manila	1,780,148	396,349.95	399,441.97	402,558.12	405698.57	408863.52	412053.16
Makati	582,602	174,654.06	177,095.50	179571.07	182081.24	184626.51	174,654.06
Taguig	804,915	205,655.78	213,113.74	220,842.16	228850.84	237149.96	245750.03
Parañaque	665,822	167,687.27	172,052.75	176,531.89	181127.63	185843.01	190681.15
Muntinlupa	504,509	99,438.72	101,314.83	103,226.32	105173.88	107158.19	109179.93
San Pedro	325,809	59,460.14	61,176.67	62,942.75	64759.81	66629.33	68552.82
Biñan	333,028	85,088.65	87,545.04	90,072.33	92672.58	95347.90	98100.45
Sta. Rosa	353,767	90,387.47	92,996.82	95,681.50	98443.68	101285.60	104209.57
Cabuyao	308,745	78,884.35	81,161.62	83,504.64	85915.29	88395.54	90947.38
Calamba	454,486	116,121.17	119,473.42	122,922.44	126471.02	130122.05	133878.48

Source: LGU-SWM-SCMAR revised March 2016

(7) Ambient Noise Level

1) Field Survey Results

In order to get a baseline for noise levels along the proposed NSRP-South were measured at 15 monitoring stations including potential sensitive receptors. All the sites showed levels exceeding standards. The noise levels obtained were characteristic of urban areas near roads or streets and with relatively dense population. The most frequently observed sources of noise were vehicles passing near the monitoring station, followed by voices of people nearby. The results were summarized in Table 9.1.27.

Table 9.1.27 Summary of Results for Manual Monitoring of Ambient Noise Levels

Station Number		Date	Time	Noise Levels, dBA (Slow Response)				DENR Standards	
				Min	***Max***	***Mean***	***Median***		
Station 1	*Morning*	21/01/2018	0648 H	52.9	80.7	64.9	76.9	Class AA	45 dBA
	Daytime	21/01/2018	1258 H	54.6	64.7	58.9	63.7	Class AA	50 dBA
	Evening	20/01/2018	1858 H	53.3	71.4	62.0	66.4	Class AA	45 dBA
	Nighttime	21/01/2018	2258 H	54.8	59.6	57.3	58.8	Class AA	40 dBA
Station 2	*Morning*	22/01/2018	0704 H	62.7	80.1	70.1	77.7	Class AA	45 dBA
	Daytime	22/01/2018	1338 H	59.1	78.5	79.5	73.1	Class AA	50 dBA
	Evening	21/01/2018	1858 H	59.3	78.3	65.9	76.8	Class AA	45 dBA
	Nighttime	21/01/2018	2247 H	7.3	78.5	63.7	74.2	Class AA	40 dBA
Station 3	*Morning*	31/01/2018	0634 H	59.5	77.0	64.0	70.2	Class A	50 dBA
	Daytime	30/01/2018	1655 H	64.0	78.1	79.5	71.8	Class A	55 dBA
	Evening	30/01/2018	1823 H	66.1	84.0	71.2	78.0	Class A	50 dBA
	Nighttime	30-31/01/2018	2208 H	58.1	71.0	63.1	67.7	Class A	45 dBA
Station 4	*Morning*	19/01/2018	0704 H	71.7	89.2	77.5	84.2	Class B*	70 dBA
	Daytime	19/01/2018	1301 H	71.5	82.8	76.6	80.4	Class B*	75 dBA
	Evening	18/01/2018	1900 H	70.8	81.6	73.9	76.4	Class B*	70 dBA
	Nighttime	19/01/2018	2303 H	68.5	76.9	71.7	75.1	Class B*	65 dBA
Station 5	*Morning*	08/02/2018	0720 H	70.9	79.4	75.4	78.0	Class B*	70 dBA
	Daytime	08/02/2018	1300 H	72.4	77.2	74.2	76.2	Class B*	75 dBA
	Evening	08/02/2018	1909 H	70.3	79.1	74.3	76.6	Class B*	70 dBA
	Nighttime	07/02/2018	2319 H	71.3	79.2	75.4	77.8	Class B*	65 dBA
Station 6	*Morning*	21/02/2018	0654 H	32.7	60.5	51.8	60.3	Class A	50 dBA
	Daytime	21/02/2018	1110 H	63.4	77.3	68.1	70.3	Class A	55 dBA
	Evening	20/02/2018	1825 H	54.1	84.4	67.5	78.4	Class A	50 dBA
	Nighttime	20/02/2018	2305 H	53.8	68.3	59.6	64.2	Class A	45 dBA
Station 7	*Morning*	23/03/2018	0748 H	63.8	83.6	68.9	78.8	Class A	50 dBA
	Daytime	24/03/2018	1650 H	63.7	80.9	65.6	66.6	Class A	55 dBA
	Evening	24/03/2018	1829 H	61.4	76.5	64.9	72.2	Class A	50 dBA
	Nighttime	25/03/2018	0215 H	58.0	60.8	58.6	59.0	Class A	45 dBA
Station 8	*Morning*	23/03/2018	0749 H	60.8	83.4	69.8	77.1	Class AA**	50 dBA
	Daytime	08/03/2018	1650 H	52.6	75.5	59.2	71.0	Class AA**	55 dBA
	Evening	08/03/2018	1830 H	54.1	66.8	60.6	65.2	Class AA**	50 dBA
	Nighttime	25/03/2018	0215 H	51.3	67.4	56.4	61.8	Class AA**	45 dBA

Station Number		Date	Time	Noise Levels, dBA (Slow Response)				DENR Standards	
				Min	*Max*	*Mean*	*Median*		
Station 9	*Morning*	24/03/2018	0755 H	62.80	76.20	65.67	69.30	Class AA	45 dBA
	Daytime	08/03/2018	1512 H	58.50	65.50	59.81	61.90	Class AA	50 dBA
	Evening	08/03/2018	2007 H	52.10	77.20	60.79	73.10	Class AA	45 dBA
	Nighttime	24/03/2018	0755 H	53.20	75.90	61.56	69.90	Class AA	40 dBA
Station 10	*Morning*	24/01/2018	0738 H	56.80	68.50	60.58	66.40	Class AA	45 dBA
	Daytime	23/01/2018	1259 H	42.10	63.80	54.42	61.70	Class AA	50 dBA
	Evening	23/01/2018	1858 H	56.70	63.60	58.98	62.00	Class AA	45 dBA
	Nighttime	24/01/2018	2308 H	62.80	67.20	63.47	64.50	Class AA	40 dBA
Station 11	*Morning*	24/03/2018	0630 H	60.50	76.70	64.62	69.50	Class AA	45 dBA
	Daytime	08/03/2018	1035 H	56.80	91.00	68.48	78.50	Class AA	50 dBA
	Evening	23/03/2018	1800 H	60.10	64.60	61.71	63.00	Class AA	45 dBA
	Nighttime	23/03/2018	2315 H	60.20	81.10	67.12	77.30	Class AA	40 dBA
Station 12	*Morning*	25/01/2018	0657 H	61.30	77.70	65.15	70.70	Class A	50 dBA
	Daytime	25/01/2018	1248 H	61.54	70.70	64.65	66.40	Class A	55 dBA
	Evening	24/01/2018	1908 H	63.20	77.80	67.83	73.80	Class A	50 dBA
	Nighttime	25/01/2018	2247 H	62.80	64.50	63.27	64.30	Class A	45 dBA
Station 13	*Morning*	08/03/2018	0750 H	55.4	86.7	63.1	72.5	Class AA	45 dBA
	Daytime	22/02/2018	1614 H	58.1	76.7	64.3	71.8	Class AA	50 dBA
	Evening	22/02/2018	1954 H	61.2	85.8	66.2	73.4	Class AA	45 dBA
	Nighttime	08/03/2018	2208 H	50.7	75.6	64.7	74.2	Class AA	40 dBA
Station 14	*Morning*	08/03/2018	0520 H	63.1	94.5	70.2	81.2	Class AA**	50 dBA
	Daytime	22/02/2018	1054 H	46.4	65.8	54.8	61.7	Class AA**	55 dBA
	Evening	22/02/2018	1825 H	58.1	77.7	67.1	74.8	Class AA**	50 dBA
	Nighttime	08/03/2018	0349 H	60.3	83.8	67.8	74.5	Class AA**	45 dBA
Station 15	*Morning*	26/01/2018	0655 H	59.9	76.1	61.9	63.8	Class AA	45 dBA
	Daytime	26/01/2018	1254 H	50.6	70.9	54.5	67.8	Class AA	50 dBA
	Evening	25/01/2018	1834 H	60.8	77.4	66.6	74.6	Class AA	45 dBA
	Nighttime	25-26/01/2018	2255 H	47.6	57.9	62.3	65.0	Class AA	40 dBA

Notes: * Areas directly fronting or facing a four-lane or wider road. A +10 dBA correction was applied to the NPCC Noise standards in these stations.
** Areas directly fronting or facing a four-lane road. A +5 dBA correction was applied to the NPCC Noise standards in these stations.

2) Prediction of Noise Level during Construction

The results of the prediction of noise from the construction are shown in Table 9.1.28. Without the acoustic barrier, the noise levels of a pile driver will exceed the maximum allowable level at 90 dB. The predicted noise levels of rock drilling, compressor slope surface spray and asphalt pavement mixing exceed maximum allowable level up to 10 m from the edge of the ROW.

With the 3 m high temporary wall, except the receiving point at the edge of ROW of pile driver works, the predicted noise levels of all types of construction work will be below the maximum allowable noise levels during the construction.

Table 9.1.28 Results of Prediction of Construction Noise

Construction Work		Distance from the Edge of the ROW to Receiving Point (m)					Maximum Allowable Noise Level [2] (dBA)	
Type [1]	Power Level (dB)	0	5	10	15	20		
Without temporary wall								
Pile drivers	135	111.4	106.2	102.9	100.6	98.7	90	Class 1
Rock drilling (soft rock)	119	95.4	90.2	86.9	84.6	82.7	85	Class 2
Slope surface spray	108	84.4	79.2	75.9	73.6	71.7	75	Class 3
Asphalt pavement	108	84.4	79.2	75.9	73.6	71.7	75	Class 4
With temporary wall (3.0 m)								
Pile drivers	135	90.4	89.2	88.9	86.6	84.7	90	Class 1
Rock drilling (soft rock)	119	74.4	73.2	72.9	70.6	68.7	85	Class 2
Slope surface spray	108	63.4	62.2	61.9	59.6	57.7	75	Class 3
Asphalt pavement	108	63.4	62.2	61.9	59.6	57.7	75	Class 4

Note 1): Technical Handbook for Environmental Impact Assessment of Roads, 2007

2): NPCC Memorandum Circular No. 002, May 12, 1980

Class 1 Work which requires pile drivers (excluding manual type), file extractors, riveting hammers or combination thereof. This classification does not include work in which pile drivers are used in combination with earth augers.

Class 2 Work which requires rock drills or similar equipment like jack hammers or pavement breakers

Class 3 Work which requires air compressor (limited to those compressors which use power other than electric motors with a rated output of 15 KW or more excludes air compressors powering rock drills, jack hammers and pavement breakers)

Class 4 Operation involving batching plant (limited to those with a mixer capacity of 0.5 or more cubic meters) and/or asphalt plants (limited to those with mixer capacity of 200 KG or more). Batching plants for the making or mortar are excluded.

3) : Highlighted results do not conform with standard.

3) Prediction of Noise Level during Operation

Noise level during operation is predicted based on the following assumption.

Table 9.1.29 Assumption applied for prediction

Items	Conditions
Prediction points	1.2 m height at 0, 10, 20, 30, 40, 50 m from the edge of railway ROW
Structural condition	Railway structure: Viaduct
	Truck structure: Slab track
	Installation of Ballast for noise reduction
	Rail type: Long rail
	Train length: 160 m (20 m x 8 cars)
Total Number of Operated Trains (one-way)	Day Time (7:00 ~ 22:00) : 150
	Night Time (22:00 ~ 24:00 & 6:00 ~ 7:00) : 55
	Train velocity :maximum 120 km/h

Source: JICA Design Team

The guideline values for noise levels are set to be 12.5 m from the center of the nearest track. The noise standard for train operation is adopted for “the new project and large-scale modification of the conventional railway in Japan Environmental Agency, 1995” due to the absence of standard in Philippines. The DENR environmental standards for noise is used as a reference only. The outline of results shows that the predicted noise levels will exceed the guideline values for night time. A noise barrier is one of the abatement measures to reduce the noise level Table 9.1.30 shows the predicted noise level at different height of theoretical noise barrier.

Table 9.1.30 Prediction of Noise Level during Train Operation

Mitigation measures	Day/ Night	Distance from ROW						Japanese Guideline values [1] (LAeq)
		0 m	10 m	20 m	30 m	40 m	50 m	
Barrier H=1.1 m	Day	58.1	58.6	58.3	59.0	59.5	59.0	60
	Night	56.0	56.5	56.2	56.9	57.3	56.8	55
Barrier H=1.5 m	Day	57.8	58.1	58.1	58.1	57.8	57.7	60
	Night	55.7	55.9	56.0	55.9	55.7	55.5	55
Barrier H=2.0 m	Day	57.6	57.1	57.1	56.6	55.7	55.5	60
	Night	55.4	55.0	55.0	54.4	53.6	53.4	55

Note: Noise guideline values for the new project and large-scale modification of the conventional railway in Japan Environmental Agency, 1995), 2) Day: 7am- 22pm/ Night: 22pm-7am. 3) Highlighted results do not conform with standard

Source: JICA Design Team

Further modelling was completed to assess the height of a noise barrier and its mitigating effects to bring the noise level to 50 dBA as a likely nighttime requirement (assuming optimization of train operation):

- A 1 m and 1.5 m height noise barrier or parapet: The noise level during the night is predicted to be above 55 dBA.
- A 2 m height noise barrier installed: The noise level at distance from 10m and more will be below 55 dBA.

Noise level should be further reduced in the noise sensitive areas (sensitive receptors).

(8) Ambient Vibration Level

1) Field Survey and Results

A vibration study for the proposed NSRP-South was conducted between February 22 and March 3, 2018 at 15 sampling stations established along the proposed NSRP-South. The sites were predominantly rural. The sites varied from residential areas to vacant areas near the roads in urbanized areas. The summary of observed peak values for velocities (mm/s) is shown in Table 9.1.31, while Table 9.1.32 shows the average vibration velocity (mm/s) for each of the stations during certain periods of the day.

The areas with the highest levels of vibration are in Tiyani Elementary School, Calamba PNR, Biñan PNR, Biñan Hospital, and Alabang PNR. Road traffic, passing trains, and pedestrians appear to be the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 10.0 mm/s which may be considered unpleasant by people if experienced continuously. The site with lowest level of vibration is in Divine Mercy Chapel, where vibration levels range only between 0.2 mm/s to 3.5 mm/s. Significant spikes in vibration levels reaching beyond 20.0 mm/s are notably observed in Tiyani Elementary School. Here, vibration level spiked to 31.5 mm/s corresponding to vibrations caused by trolleys along the PNR railway. In all sites, the source of spikes of high vibration is likely the passing of PNR trains, pedestrians, and vehicular traffic. The Tiyani Elementary School, Divine Mercy Viewing Chapel, Alabang PNR, Sta. Mesa PNR, and Solis PNR sites have the most pronounced changing pattern of vibration over the 24-hour period, and these are likely caused by the commercial activity and road traffic affecting these sites.

Table 9.1.31 Summary Peak Velocity (mm/s) for Each Station

Sampling Stations	Recorded Peak Velocity (mm/s)	Peak Time (Velocity & Vibration)	BS 5228-2:20093Tolerable Effect Threshold (10 mm/s)
Solis Station	6.7	6:30 AM	Below
PNR - Sta. Mesa	14.9	8:36 PM	Above
Old Paco Station	6.7	6:47 AM	Below
Buendia Station	8.2	7:55 PM	Below
PNR - FTI	9.5	3:20 AM	Below
Sucat Station	8.8	1:00 AM	Below
Alabang Station	11.9	8:45 PM	Above
Divine Mercy Viewing Chapel	7.9	1:50 AM	Below
Biñan Community Hospital	11.6	12:35 AM	Above
Biñan Station	12.9	6:20 AM	Above
Cabuyao Central School Complex	9.1	7:34 AM	Below
PNR - Calamba	12.1	4:23 PM	Above
Tiyani Elementary School	31.5	6:30 PM	Above
Los Baños Municipal Health Center	9.5	3:41 PM	Below
Paciano Rizal Elementary School	8.5	11:40 PM	Below

Note: The highlighted cells are the results that exceed the standard.

Table 9.1.32 Summary of Average Vibration (in mm/s) for Each Station

Sampling Stations		Vibration Level (mm/s) Morning (5 am – 9 am)	Day (9 am – 6 pm)	Evening (6 pm – 10 pm)	Night (10 pm – 5 am)
Solis Station	1	4.804574	3.84584	2.706666	4.219547
	2	3.61208	3.167262	2.034874	2.965853
	3	5.381366	4.416402	3.049602	4.656994
Sta. Mesa Station	1	6.699104	6.723175	5.751202	7.048378
	2	6.019561	6.132996	7.166664	7.025946
	3	4.962401	4.617808	4.023331	5.038009
Paco Station	1	4.804202	3.843632	2.578362	4.078523
	2	3.612084	3.166027	1.964708	2.875754
	3	5.380032	4.414312	2.92198	4.503895
Buendia Station	1	5.799935	5.267324	6.038076	3.677882
	2	3.988946	3.281307	3.782338	2.399669
	3	3.706094	3.918484	4.125332	2.398131
FTI Station	1	6.894695	7.425283	7.226608	7.158618
	2	6.798387	6.927447	7.486352	7.568949
	3	8.276234	8.486022	8.138997	7.969225
Sucat Station	1	5.810125	5.561146	6.104439	7.421675
	2	4.376947	4.2771	4.700475	5.475197
	3	5.401703	5.253573	5.862815	6.82444
Alabang Station	1	7.238837	9.415339	9.56349	7.572529
	2	7.046547	9.078545	9.173566	7.329653
	3	7.27355	9.812862	9.548126	8.418029
Divine Mercy Chapel	1	0.951025	0.469015	2.104008	2.786189
	2	0.896926	0.377208	1.448659	1.403356
	3	1.200671	0.512382	1.832799	2.410651
Biñan Community Hospital	1	8.799703	8.381251	7.710658	8.29635
	2	10.23671	9.360132	8.277106	9.697973
	3	8.657374	8.214162	7.714774	8.515975
Biñan Station	1	9.964394	9.991119	7.089233	7.923328
	2	7.250175	7.313021	5.067666	5.734504
	3	10.20451	10.41141	6.37212	8.047849
Cabuyao Central School Complex	1	7.26505	7.289751	6.586927	7.193468
	2	8.071952	7.833913	7.342302	8.005153
	3	8.125541	7.759358	7.517637	7.949129
PNR - Calamba	1	6.674839	7.482465	5.362865	7.102095
	2	5.35578	5.841612	4.48873	5.307428
	3	6.81639	7.858489	5.510633	6.847606
Tiyani Elementary School	1	15.92782	15.14351	27.11723	14.55272
	2	15.64853	13.39329	25.41079	15.31803
	3	14.15552	12.47576	23.99989	13.86218
Los Baños Health Center	1	5.850866	5.620557	6.414499	6.655665
	2	4.56283	3.33355	4.153701	5.006466
	3	5.984503	5.305565	5.806494	5.006488
Paciano Elementary School	1	4.261103	6.564245	6.93911	5.088264
	2	3.824671	4.919525	4.978999	4.102726
	3	4.908407	7.138621	7.708012	5.855774

Note: The highlighted cells are the results that exceed the standard.

2) Prediction of Vibration Level during Construction

Construction operations, such as a pile driving and rock drilling, cause ground vibrations that spread through the ground and diminishes in strength with distance. Ground vibrations from construction activities do not often reach the levels that can damage structures, but can achieve the audible and perceivable ranges for humans very near the construction site.

The Vibration Level on receiving points was calculated based on the prediction model developed in Technical Handbook for Environmental Impact Assessment of Roads, Japan (2007). The operations of a pile driver and rock drilling will affect the area around the Project site, including the old PNR stations, since the vibration is above the human perceptive threshold. Asphalt pavement will also affect the area within 10 m distance from the edge of the construction limit. Only the vibration of slope surface splay is below the human perceptive threshold. Pile drive work will reach to 55 dB at 83 m from the edge of ROW.

Table 9.1.33 Results of Prediction of Construction Vibration

Construction Work		Distance from the Edge of the ROW to Receiving Point (m)					Perceptive threshold of vibration for human (dB) [2]	BS 5228-2:2009 [3]
Type [1]	Vibration Level (dB)	0	5	10	15	20		
Pile drivers	81	79.7	75.3	72.5	70.3	68.4	55	10 mm/s (Converted to 136.9 VdB: ISO)
Rock drilling (soft rock)	64	62.8	58.8	56.3	54.5	53.1		
Slope surface spray	48	46.7	42.3	39.5	37.3	35.4		
Asphalt pavement	59	57.7	53.3	50.5	48.3	46.4		

Note:
1 Technical Handbook for Environmental Impact Assessment of Roads, 2007
2 Technology and Laws Regulation for Pollution Control, 2000, Japan Environmental Management Association for Industry
3 BS 5228-2:2009 (BSI British Standards: Code of practice for noise and vibration control on construction and open sites)
4 Highlighted results do not conform with standard

Source: JICA Design Team

3) Prediction of Vibration Level during Operation Phase

Vibration of buildings and houses near the NSRP-South alignment due to the train operation may affect people and quality of life and/or decrease working efficiency. There are no established prediction methods for vibration due to train operation since the mechanism of occurrence and transmission of train vibration is very complex. Therefore, the vibration levels are often predicted by using the regression equations based on the actual measurements of the similar cases of train operation and structures for reference. The NSRP-South will use the similar type of trains and structures as the existing railways in Japan, therefore, the model developed for the East-Osaka Urban Rapid Transit was used for the estimate of vibration level. The vibration level, VL is estimated in Table 9.1.34. In the case of the viaduct (slab), VL at the edge of the ROW is estimated 54.2 dB and is below the perceptible threshold of humans (55 dB). However, in the case of embankment (ballast), the estimated VL at distance from 0 m to 10 m will be over the perceptible threshold of human (55 dB).

Table 9.1.34 Estimated Vibration Level VL (dB)

Type of Structure	Distance from ROW					Threshold VL (dB)*
	0	5	10	15	20	
Viaduct (slab)	54.2	51.4	49.6	48.1	47.0	55
Embankment (Ballast)	61.2	58	55.8	54.2	52.9	

Note: 1) *Technology and Laws Regulation for Pollution Control, 2000, Japan Environmental Management Association for Industry. 2) Highlighted results do not conform with standard

Source: JICA Design Team

(9) Ground subsidence

Subsidence usually takes place in areas underlain by limestone and compressible materials like peat or clays. It can also take place when groundwater is excessively extracted from an area. Visually, the existing stations of NSRP-South have not exhibited indications of subsidence.

Seismic activity can lead to subsidence in certain soils. A study conducted by Thenhaus, Hanson and Algermissen of the United States Geological Survey and the Philippine Institute of Volcanology and Seismology (1995) estimated peak ground horizontal accelerations that have a 10% probability of being exceeded in 50 years for rock conditions, medium soil and soft soil conditions in the Philippines. In the case of the NSRP-South, the segments from Pasay Road Station to Alabang Station are underlain by weathered pyroclastic deposits which in the medium soil category. The segments from Solis Station to Buendia Station and from Muntinlupa Station to Banlic Depot are underlain by unconsolidated sediments which are in the soft soil category. A more detailed geotechnical assessment of the current NSRP-South alignment is ongoing to determine stability of the structures.

(10) Bottom sediment

Organisms that live in the bottom sediments of the rivers can be negatively affected by construction disturbance and by soil settling out from erosion caused elsewhere. The NSRP-South will build bridges at Pasig River, San Cristolbel River and Calamba River. The construction of piers in the rivers is very likely to cause local sediment disturbance around the pier and downstream for the duration of pile driving and pier construction. Scouring of the bottom sediment downstream of the finished piers can occur during strong flows. Hydrological studies will be used to determine the best design for the pier base to minimize this impact.

9.1.7.2 Natural Environment Condition

(1) Protected Area

The alignment of NSRP-South does not traverse any protected area, however at one section of NSRP-South is located approx. 4 km from the Mount Makiling.

(2) Ecosystem

1) Terrestrial Flora

The terrestrial flora survey was conducted on February 5-11, 2018 at six places along the project alignment. The survey was conducted using transect and quadrant methods, interviews with the local residents and records of flora and fauna collection from scientific literature.

a) Transect Plot Profiles

Table 9.1.35 and Figure 9.1.6 show the location and general vegetation condition of the different plots from the six transect plots established in the proposed NSRP-South alignment in consideration to the representative sample of different ecosystem along the alignment and ecologically sensitive area. The transects were identified and selected based on the presence of vegetation units across the proposed alignment, including the presence of major landscape features such as small ecological units (e.g. creek, rivers, etc.). Additionally, the presence of high value species such as those endemic, threatened plant and tree species located either on a patch of forest or aggregate within the proposed alignment also served as basis for selecting sampling sites. At each Transects, nine quadrants (20m x 20m) were laid out along a 2 km transect at every 250 m interval. Transect 4 is set at Tadlac Lake, whereas Transect 5 is set to be near the buffer zone of Mout. Makiling.

Table 9.1.35 Terrestrial Ecology Sampling Station

Sampling Station	Vegetation Type	Human Activity
Transect 1 – 204 (Dagupan Ext.), Tondo, Manila	Heavy built-up area, dense residential area along existing PNR RoW from Solis to Blumentritt-Monumento. Vegetation includes grasses, shrubs and few individual trees mostly horticultural and pioneer species found in a very disturbed environment.	Human settlements on the sides of the old railroad
Transect 2 - East Service Road , Taguig	Built-up area and heavy residential areas along FTI-Nichols existing railway. The alignment is adjacent to SLEX. Vegetation includes weeds, shrubs and few individual trees mostly horticultural species and pioneer trees found in a very disturbed environment	Mostly concrete business establishments; skyway, SLEX
Transect 3 – Niugan and Banay-Banay , Cabuyao, Laguna	Open and bare areas with spares tree vegetation near to residential areas and industrial zones.	Human settlement, Near Cabuyao Sanitary dump site
Transect 4 – Tadlac, Los Baños, Laguna	Dense vegetation of sparse tree individuals near Laguna de bay and residential areas, includes open spaces with dense grasses and weeds. “Cut” hill with dense tree vegetation.	Human settlement; resorts
Transect 5 – Baybayin and Timugan, Los Baños, Laguna	Dense vegetation of sparse tree individuals includes diverse floral species of ground, shrub and herbaceous layer. Sparse tree vegetation includes those located at trails and open spaces. Agroforestry farms and small vegetation near buffer zone of Mount Makiling.	Human settlement
Transect 6 – Sto. Nino Los, Baños, Laguna	Disturbed vegetation from the NSRP alignment going to IRRI-RoW with sparse tree vegetation that include those located near residential houses; encompassing Molawin creek with dense pioneer tree species; open and bare sections at IRRI-IPB section.	Close proximity to human habituation

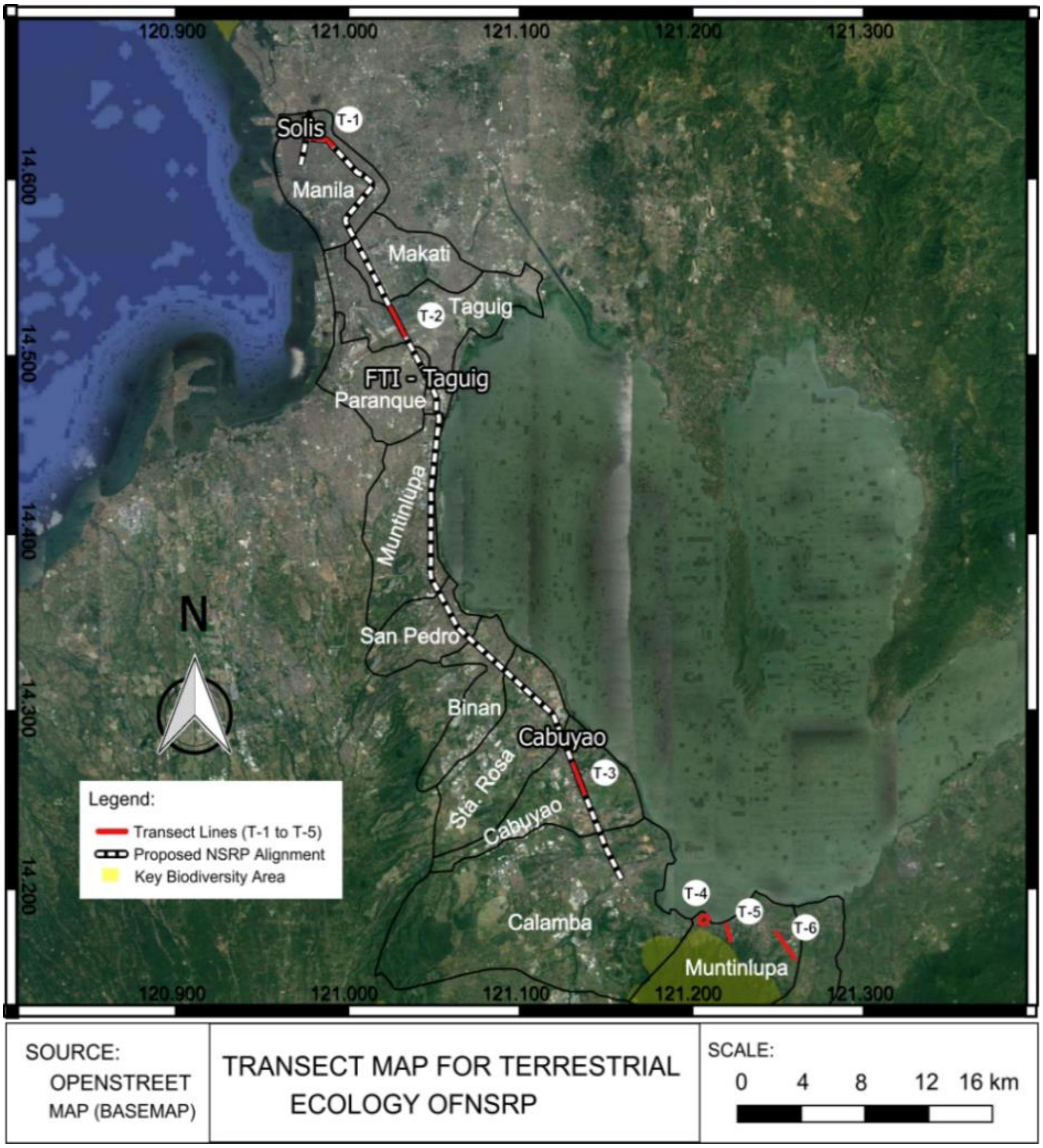


Figure 9.1.6 Location of Transects

b) General Vegetation

The proposed NSRP-South from Solis, Manila to Calamba, Laguna encompasses developed, disturbed, and maintained areas. Almost 60% of the surrounding area of the proposed project alignment comprised of dense residential areas and urbanized zones, consequently, the small existing vegetation present in the study area are generally disturbed. Two classification of vegetation were defined: (1) Small to medium sized trees sparsely arranged Is-Is (*Ficus ulmifolia*), Anabiong (*Trema orientalis*), Datiles (*Muntigia calabura*), Gmelina (*Gmelina arborea*) and Acacia (*Samanea saman*) forming patches of understorey species Hagonoy (*Chromolaena odorata*) and herbaceous layer of weeds and grasses within built-up and disturbed areas and across PNR properties; and (2) Variable vegetation on remnants of fruit tree species with genus *Mangifera, Artocarpus, Nephelium*. Pioneer tree species along alignment include genus *of Acacia, Leucaena, Trema* and *Muntigia* species).

c) Species Diversity

One hundred seven (107) morpho-species, 99 genera belonging to 42 families were documented in the six transect plots established within the NSRP–South. Transect 1 and Transect 5 have the highest number of species diversity.

Table 9.1.36 Species Diversity, Dominant Families and Abundance per Transect

Transect No.	No. of species	No. of Individuals	Dominant Plant Families
1	56	284	• Shrub species: *Chromolaena odorata* and *Stachytarpeta jamaicensis, etc.* • *Tree species: Ficus septica, Ficus umifolia, Premna odorata, Sweitenia macrophylla, Pterocarpus indicus, Artocarpus heterophyllus, Tamarindus indica, Psidium guajava, Muntigia calabura, Syzigium cuminii, Chrysophyllum cainito, Ficus balete, Ficus religiosa, etc.* • Herbaceous species: *Alternanthera sessilis, Xanthosoma violaceum, Synedrella nodiflora, Vernonia sp., Paspalum conjugatum, Mikania cordata, Heliotropium indicum* , etc.
2	32	244	• Herbaceous layer: *Ipomoea triloba, Tridax procumbens, Mikania cordata (Burm. f.) B.L. Rob.*, etc. • Shrub species: *Lantana camara L., Chromolaena odorata, Bridelia stipularis, Sida acuta and Sida rhomboidifolia*, etc. • Tree species: *Artocarpus altilis, Leucaena leucocephala, Trema orientalis (L.) Blume, Macaranga tanarius* (L.) Muell.-Arg., *Ficus ulmifolia, Ficus septica Burm. f. Melanolepis multiglandulosa, Gmelina arborea, etc*.
3	33	226	• Shrub species: *Lantana camara* L., *Chromolaena odorata, Solanum ferox, Ficus spp., Hedyotis sp., Borreira ocymoides*, etc. • Tree species: *Artocarpus ovatus, Ficus psuedopalma, Leucaena leucocephala, Garuga floribunda, Trema orientalis* (L.) *Blume, Macaranga tanarius* (L.) Muell.-Arg., *Ficus septica Burm. f., M. multiglandulosa, Munitigia calabura, Artocarpus blancoi*, etc. • Herbaceous layer: *Mimosa pudica L., Stachytarpeta jamaicensis, Mikania cordata (Burm. f.) B.L. Rob., Caesalpinia latisiliquum, Tridax procumbens*, etc.
4	41	312	• Shrub species: *Chromolaena odorata, Lantana camara L., Triumfetta rhomboidea*, etc. • Tree species: *Leucaena leucocephala, Trema orientalis (L.) Blume, Terminalia cattapa, Mangifera indica, Muntigia calabura*, etc. • Herbaceous layer: *Tridax procumbens Rolfe, Centrocema pubescens, Stachytarpeta jamaicensis, Mikania cordata (Burm. f.) B.L. Rob., Mimosa pudica*, etc.
5	52	806	• Tree species: *Leucaena leucocephala, Samanea saman, Pithecelobium dulce, Trema orientalis (L.) Blume, Macaranga tanarius (L.) Muell.-Arg., Ficus septica Burm. f., Gmelina arborea*, etc. • Herbaceous layer: *Zehneria indica (Lour.) Keraudren Centrosema pubescens, Ipomoea triloba, Mikania cordata (Burm. f.) B.L. Rob., Passiflora foetida, Tridax procumbens*, etc. • Grass species: T*hysanolaena latifolia, Sorghum halepense, Saccharum spontaenum*, etc.
6	47	307	• Shrub species: *Chromolaena odorata and Stachytarpeta jamaicensis*, etc. • Tree species: *Ficus septica, Ficus umifolia, Premna odorata, Sweitenia macrophylla, Pterocarpus indicus, Artocarpus heterophyllus, Tamarindus indica, Psidium guajava, Muntigia calabura, Syzigium cuminii, Chrysophyllum cainito, Ficus balete, Ficus religiosa* etc. • Herbaceous species: *Alternanthera sessilis, Xanthosoma violaceum, Synedrella nodiflora, Vernonia sp., Paspalum conjugatum, Mikania cordata, Heliotropium indicum* , etc.

Table 9.1.37 Species Diversity by Flora Type

Category	Species diversity	Dominant species
Tree Flora	• 107 morpho-species • 99 genera • 42 families	*Trema orientalis, Artocarpus altilis* (Park.) Fosb, *Ficus ulmifolia* Lamk, *Muntigia calabura* L., *Premna odorata Blanco, Leucaena leucocephala* (Lam.) de Wit, *Gmelina arborea* Roxb., and *Macaranga tanarius* (L.) Muell.-Arg. The aforementioned species were present in all transects except for *Artocarpus blancoi* (Elmer) Merr
Intermediate and Understory	• 13 morpho-species • 13 genera • 8 families	Hagonoy (*Chromolaena odorata*) and Coronitas (*Lantana camara*) / Dominant families: Asteraceae (mainly shrubs) and Verbenaceae (mainly herbaceous).
Ground Cover	51 ground cover specie	Bunga-Bunga (28.11%), Uuko (16.21%), Dagad (14.86%).

d) Biodiversity Value

<u>Endemic and Indigenous Species</u>

Of the total 107 taxa identified to species level, five species (5%) were found to be Philippine endemics or have natural habitat confined only in the country. Important among the list are those species that are also included in either the Philippine red list or in the International Union for Conservation of Nature (IUCN). These include Antipolo, Piling liitan, Niog-Niogan, and Anubing. These trees should be prioritized for conservation.

Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and have different economic and ecological importance. These species are represented by different general plant forms such as trees, vines, herb and shrub. The presence of endemic tree species within the railway tracks of PNR and the proposed alignment suggests that there are plant communities existing.

Table 9.1.38 List of Philippine endemic species recorded at established transects

Species	Common Name	Family Name	Endemism	Transect Plot(s) where Species Occurred	No. of trees found in transects
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	PE	T3 within plot**	34
Canarium luzonicum (Blume) A. Gray	Piling liitan	BURSERACEAE	PE	T5 and opportunistic survey within plot	1
Ficus pseudopalma Blanco	Niog-Niogan	MORACEAE	PE	T5	21
Ficus ulmifolia Lamk	Is-Is	MORACEAE	PE	T1, T3, T4, T5, T6	16
Ficus nota (Blanco) Merr	Tibig	MORACEAE	PE	T4, T5, T6	13

**PE: Philippine Endemic species

<u>Threatened Species</u>

Five species recorded from NSRP alignment are listed under either the Philippine Red List (DAO 2007-01) or the IUCN Red List of Threatened Species (2016.3). Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). Even if Narra is widely seen in the whole country, its basis of its conservation status is that its low population in the wild. Further, Narra is one of the notable tree species in the alignment, hence, appropriate management and monitoring strategies to ensure the continued survival of its population (as well as other threatened species) should be developed. Other threatened tree species which are also Philippine Endemic tree species such as Is-Is (*Ficus ulmifolia*), Piling liitan (*Canarium luzonicum*), and Antipolo (*Artocarpus blancoi*). These species are observed in mixed vegetation patches as sparsely arranged individual trees within the transect plots. These species are regarded as keystone species for fauna such as bats, birds and other frugivorous mammals and vertebrates. They are also widely dispersed by these animals through their droppings and pollination.

Table 9.1.39 List of threatened species

Species	Common Name	Family	IUCN 2016 ver. 3	DAO 2007-01	Transect plot(s) where species occurred	No. of trees found in transects
Artocarpus blancoi	Antipolo	MORACEAE	VU		T3 within plot**	34
Canarium luzonicum	Piling liitan	BURSERACEAE	VU		T5 and opportunistic survey within plot	1
Ficus ulmifolia	Is-is	MORACEAE	VU		T1, T3, T4, T5, T6	16
Pterocarpus indicus	Narra	FABACEAE	VU	CR	T1, T3, T4, T5, T6	32
Vitex parviflora	Molave	LAMIACEAE	VU	EN	2 and T3, T4, T5, T6	21
Sweitenia macrophylla	Mahogany	MELIACEAE	VU		-	48

Source: **DAO 2007-11 updated checklist (2011) pursuant to "Wildlife Resources Conservation and Protection Act 9147

2) Terrestrial Fauna

The terrestrial fauna survey was focused on the terrestrial vertebrate groups of Philippine wildlife; birds, mammals, amphibians and reptiles (herpetofauna).

a) Transect Profiles

The survey was conducted at the same six transects with Terrestrial Flora, on February 9-12 and 24, 2018 for the assessment of terrestrial vertebrate wildlife.

b) General Fauna

A total of 64 species of terrestrial vertebrate wildlife were observed and recorded during the survey conducted in 6 sites from Solis to Los Banos. These are 55 species of birds, 6 species of mammals (5 volant and 1 non-volant), and 3 species of amphibians and reptiles (2 species of frog and 1 species of lizard).

c) Species Diversity

Only two species of *Passer montanus* and *Pycnonotus goiavier* are common to all the site. The higher number of species recorded in T4 (Tadlac) may be due to the proximity of the site to bodies of water, i.e. the Laguna de Bay and the Tadlac Lake. Before the area was overwhelmed by the construction of resorts and houses, the part nearest Laguna de Bay was a habitat of large numbers of bee-eaters, *Merops sp.* The very few species of birds and individuals documented in transect T1 and T2 may accounted be to disturbed state of the sites. Informal settlers, waste and concrete walls all exclude wildlife.

More individuals were caught in the nets set up in the T6 and T5 since fruit trees, coconuts and other trees are present along the railroad and in the community near the site. These trees may be utilized as roosting or feeding sites by the birds. The mammals found are highly adaptable species that are commonly found in and around villages or human settlements and agricultural areas. The diversity at each surveyed site is very low and no direct conservation measures are needed for these common and adaptable species.

Table 9.1.40 Species Diversity by Transects

	Sampling Stations	Number of Species	Number of Individuals	Dominant Fauna
Birds	Transect 1	7	102	*Hirundo tahitica, Passer montanus*
	Transect 2	6	88	*Collocalia esculenta, Passer montanus*
	Transect 3	15	178	*Egretta garzettav, Hirundo rustica, Childonias hybrid, Passer montanus*
	Transect 4	35	288	*Nycticorax nycticorax, Hirundo tahitica, Hirundo rustica, Childonias hybrid, Passer montanus, Pycnonotus goiavier*
	Transect 5	17	106	*Hirundo rustica, Passer montanus, Pycnonotus goiavier*
	Transect 6	30	379	*Bubulcus coromandus, Lonchura atricapilla, Lonchura punctulatv, Passer montanus, Tringa nebularia*
Mammals	Transect 1	2	8	*Scotophilus kuhlii, Suncus murinus*
	Transect 2	0	0	
	Transect 3	2	6	*Cynopterus brachyotis, Rousettus amplexicaudatus*
	Transect 4	0	0	
	Transect 5	3	14	*Rousettus amplexicaudatus, Ptenochirus jagori*
	Transect 6	4	16	*Cynopterus brachyotis, Ptenochirus jagori*
Herpetofauna	Transect 1	3	18	*Hemidactylus frenatus, Occidozyga laevis, Rhinella marina*
	Transect 2	0	0	
	Transect 3	0	0	
	Transect 4	2	19	*Hemidactylus frenatus, Rhinella marina*
	Transect 5	1	4	*Hemidactylus frenatus*
	Transect 6	0	0	

Table 9.1.41 Species Diversity by Fauna Type

Type	Species Diversity	Frequently occurring species
Birds	55 species 26 families	*Passer montanus, Tachybaptus ruficollis, Sterna hirundo, Hirundo rustica, Egretta garzetta*
Mammals	5 species 3 families	*Cynopterus brachyotis, Ptenochirus jagori, Rousettus amplexicaudatus, and Macroglossus minimus, Scotophilus kuhlii, Suncus murinus*
herpetofauna	3 species	*Occidozyga laevis, Rhinella marina, Hemidactylus frenatus*

d) Biodiversity Values

The IUCN Red List of Threatened Species was consulted for a measure of the value and sensitivity to change of the species found in the survey. All of the species of birds documented from the six survey sites are of Least Concern. Out of the 55 species recorded in all the surveyed sites, nine endemic species of birds are recorded (*Collocalia troglodytes, Centropus viridis, Amaurornis olivacea, Dicaeum australe, Orthotomus derbianus, Rhipidura nigritorquis, Halcyon smyrnensis, Otus megalotis, and Rhabdornis mystacalis*), seven migratory birds (*Nycticorax nycticorax, Childonias hybrid, Egretta garzetta, Butorides striata, Egretta intermedia, Sterna hirundo, and Ixobrychus sinensi*s) and thirty-nine resident species or 69% of the total number of species of birds. All of the mammal species observed in all survey sites are of 'Least Concern' and are not threatened in their habitats and ranges. All of these are highly adapted to disturbed areas especially areas near human settlements. Some of the species recorded however forest dwellers are and depend on the forest for survival. All of the recorded species amphibians and reptiles are also categorized as 'Least Concern'. Consulting to the academic specilised in the field, it the ensured that the area does not have biodiversity value which requires regular monitoring.

3) Freshwater Ecology

The freshwater ecology along the alignment of the proposed NSRP were assessed by collecting biological samples at the same 13 stations established for surface water quality assessment. The survey was carried out on February 8-9, 2018.

a) Species Diversity

<u>Plankton Community</u>

Phytoplankton: Thirteen taxa of phytoplankton were found representing 3 algal divisions. These consisted of *Cyanophyta* (blue-green algae) which dominated with 68% of the counted organisms, Chlorophyta (green algae) were 18.3% and Bacillariophyta (diatoms) were 13.5%. In terms of taxa there were 3 blue-green algae, 5 green algae, and 5 diatoms.

Zooplankton: Fourteen 14 taxa of zooplankton were found representing 3 animal phyla. These consisted of *Arthropoda* (46.5% of the total number), followed by *Rotifera* (38.6%). *Protozoa* comprised 14.9% of the total count. Except at SW1 and SW2, numbers were low at the other stations and no zooplankton were found at three stations (SW8, SW9 and SW11).

Overall composition and mean abundances of zooplankton were low at majority of the surveyed stations except at SW1 and SW2, which indicate nutrient-enrichment. Sources of organic matter and/ nutrients as well as other pollutants may have a domestic source. Low zooplankton taxa richness and mean abundances in the majority of the sampling stations can be attributed to moderate to fast flowing water in most areas as well as disturbance from domestic outfalls.

Macrobenthos Community

At least 19 macrobenthos taxa representing 4 animal phyla were found. *Arthropoda* largely dominated comprising 50.4% of the total count, followed by *Mollusca* with 36.2% and *Annelida* at 13.2%.

None were observed at SW 3, but SW1, SW10, SW11 and SW13 showed the highest taxa richness observed at SW1, SW10, SW11 and SW13 (7-9 taxa) and the highest densities of macrobenthos were recorded at SW2, SW8, SW10 (36 to 76 ends.). /m^2).

The dominance of Oligochaeta, *Melanoides and* Chironomidae at most surveyed stations and the occurrence of leeches at a few stations are suggestive of polluted conditions. These taxa are known bio-indicators of eutrophic, nutrient-rich condition and poor water quality (Barbour et al., 1999). They frequent areas with high organic matter, since they are known to feed on detritus (organic matter, bacteria and protozoans). Domestic solid wastes, and sewage could serve as possible sources of organic matter and nutrients.

Fish and Other Aquatic Animals:

The presence of fish was determined by interviews with fishermen and locals. Despite the rivers being used as garbage and sewage disposal minor fishing activity was observed at SW2, SW7 and SW9, where fish are caught for domestic consumption.

Seven aquatic animals comprised of 5 fish species (tilapia, dalag, hito, kanduli, and janitor fish) and two reptiles (snakes and turtles) were reported by locals to have been caught at 5 out of the 13 stations. Taxa richness of fish and other aquatic animals was reported highest at SW7 (6 taxa), followed by that recorded at SW8 and SW12 (5 taxa each).

b) Biodiversity Values

Phytoplankton communities at SW1, SW2, and SW13 were relatively more diverse than that observed at SW7 and SW12. SW1 and SW2 had more diverse zooplankton communities compared with that recorded at SW9, SW12 and SW13. Overall diversity of macrobenthos communities were low at most stations except at SW9, SW10 and SW13, where a relatively higher index of diversity was recorded.

(3) Surface Hydrology

The main hydrologic feature which affects the NSRP alignment is Laguna de Bay. It is fed by 21 major rivers draining the western and southern slopes of Sierra Madre Range and the eastern and northern slopes of the Taal-Makiling- Banahaw Volcanic Chain. The main channels of many rivers and their tributaries intersect the NSRP alignment. These river–railway intersections are also located within the Laguna Lakeshore area which is usually affected by the rise in lake water levels during the rainy season and major storm events. The Hydrological study to determine flood level will be conducted for finalization of design.

(4) Underground Hydrology

The Groundwater Availability Map of the Philippines (1997) shows that the NSRP Line from Solis Station to Pasay Road Station will traverse over an area classified as "Local and Less Productive Aquifers". The segment from EDSA to Calamba City traverses a "Fairly Extensive and Productive Aquifer". Semi-confined aquifers are inferred to occur beneath the unconfined that underlies the entire NSRP Line. Wells drilled through these aquifers usually range in depth from 60 m to at least 200 m. The yields of these wells are used for domestic and industrial purposes.

(5) Geographical features

1) Geomorphology

Two terrain classes that can affect the proposed NSRP alignment are Cavite Manila Coastal Zone and Laguna Lakeshore. The Cavite Manila Coastal Zone corresponds to the southernmost extension of the Central Plain of Luzon. It receives eroded sediments from the rivers draining the long Cavite slope and from Pasig River. The segment from Solis Station to Nichols Station traverses this terrain unit. The Laguna Lakeshore corresponds to the gently sloping to flat area which serves as the immediate border of Laguna de Bay. The low elevation makes this area susceptible to flooding when the lake overflows. The segments from Sucat Station to Calamba Station and up to the location of the depot in Banlic, Calamba are located within this flood prone terrain unit.

2) Lithology and Stratigraphy

The geologic formations within a 10-km corridor which could potentially be affected by the proposed railway are Recent Deposits (Qh), Tuff (N_3) and Pyroclastic (Q_1). In the project area, Qh are found between Solis Station and Buendia Station, and Muntinlupa Station to Banlic, Calamba. Where the NSRP line passes through built up areas, these Quaternary deposits are locally covered by pavements, embankments or partially consolidated fill. The Guadalupe Formation (Marl, Reworked Tuff, and Pyroclastic) underlies the gently sloping segment from Pasay Road Station to Bicutan Station.

3) Regional Tectonic Setting

The Philippines is located in a tectonically active region near the boundary between the Philippine Sea Plate and the southeastern edge of the Eurasian Plate. The active zone of deformation is a complex system of subduction zones, collision zones and marginal sea basin. The major earthquake generators relevant to the proposed NSRP include the, the Philippine Fault, West Marikina Valley Fault, Lubang-Verde Passage Fault and the Manila Trench.

4) Geologic and other Natural Hazard

The natural hazards which can interact with the NSRP-South include flooding, landslides, typhoons and seismic and volcanic related hazards. The earthquake related hazards include ground rupture, ground shaking, and liquefaction. The volcanic related hazards include pyroclastic events, ash fall, and lahar flow along rivers. According to the Volcanic and Earthquake Hazard assessment conducted by

PHIlVOLCs in March 2018, volcanic hazards was assessed as safe. The site is outside Permanent Danger Zone of Taal Volcano, whereas Earthquake Hazard assessment that the project is 'partly moderately' and 'partly least susceptible' for ground shaking and liquefaction, and "safe" from ground rupture, earthquake induced landslide and tunami.

5) Pedology

a) Soil Types

The project alignment will traverse at least seven types of soil. These soils are the: Novaliches Clay Loam Adobe, Guadalupe Clay, Guadalupe Clay Adobe, Quingua Silt Loam, Carmona Sandy Clay Loam, Lipa Loam, and Macolod Clay Loam.

b) Soil Erodibility

The erodibility of the soils along the alignment is generally very low due to vegetation cover, flat topography and water content of the soil. The river bank soils along the alignment are generally stable because the soil types are mixed with clay particles aiding stability.

9.1.7.3 Social Environment

(1) Demography

The following study on demography is based on the 2015 census by Philippine Statistics Authority (PSA).

1) Population

The proposed NSRP will traverse through Manila which has more than 1.7 million inhabitants. It is the most populous of the cities through which the railway will pass. Next most populous, is Taguig and Parañaque with 804,915 and 665,822 inhabitants, respectively. However, in terms of density, the most densely populated is Makati City with 27,000 persons per sq.km. From 2010-2015, Taguig has the fastest average growth rate at 4.3 % per annum, while Manila experienced the lowest population growth at 1.4%. In the Province of Laguna, the most populous city through which the NSRP-South will run is Calamba. In 2015, it had a population of 454,486. However, the most densely populated host city in Laguna is San Pedro with 13,547 individuals per sq.km. The cities of Santa Rosa and Cabuyao are the fastest growing in terms of population, both had a population growth rate of 4.2% from 2010-2015.

2) Gender and Age Profile

According to PSA 2015, there is almost 1:1 proportion of male and female across Metro Manila and Laguna Province. The largest group in the combined population of Metro Manila and Laguna is of people in their productive age, (15-64 years old) being 68.0 % of the population This is followed by the population of young dependents (children age 0-14 years old) making up the 28.0 % of the population and, finally, the group of people in their retirement age (65 years old and above) accounting for 4.0 % of the population.

3) Literacy Rate, Profile of Educational Attainment

Literary rate in the LGUs that NSRP-South passes through was higher (99.7 %) than the national literacy rating (98.3%) according to PSA 2015. Male and female literacy rates vary slightly depending on the LGU most likely reflecting the job market and housing in the area. In terms of educational attainment, the host LGUs' populace consisted largely of high school educated population (41.2 %), followed by those only completing elementary schooling (20.1%). In cities of Makati and Parañaque the second highest group were degree holders rather than elementary educated population.

(2) Resettlement/Land Acquisition

The proposed NSRP-South will maximize the existing PNR ROW from the proposed Sta. Mesa station to Calamba station. Some portion will be outside the existing PNR ROW such as Solis to Sta. Mesa and Depot area. The Project will require land acquisition and resettlement of affected people in compliance to the RA 10752, JICA Guideline and ADB Safeguard Policy Statement.

1) Resettlement of Informal Settlers

Given that the Project will seek to utilize the existing PNR ROW, the majority of the PAPs were ISFs who encroached on the existing ROW, with a few legal PAPs due to additional land acquisition required for the Project. A large number of ISF will be Manila, Calamba, Binan and Mntinlupa.

Based on the census and social economic survey conducted under the RAP, the number of ISFs is approx.11,384 PAFs, which is 94 % of total affected families (12,210). This is approx. 14 times the number of legal PAFs (826). In all the LGUs, there are more ISFs than legal PAFs. The bulk of ISFs are in Manila with 4,964PAPs, Calamba with 2,334PAPs, and Biñan with 2,081PAP.

2) Land acquisition

The entire PNR alignment and ROW is the property of the Philippine National Railway, an agency of the Department of Transportation. Hence, there are no tenure issues with regard to ownership of the alignment. There are portions that still have encroachments by informal settlement, and these will be addressed in the RAP for land acquisition and relocation of informal settlers.

NLEx/ SLEx Connector Road Project: The Department of Public Works and Highways (DPWH) is implementing an 8 km all elevated 4-lane toll expressway extending the NLEx southward from the end of Segment 10 in C3 Road Caloocan City to PUP Sta. Mesa, Manila and connecting to the Skyway Stage 3, and mostly traversing the PNR rail track. The project includes two interchanges located at C3 Road, Caloocan and España, Manila. The project will be funded by the Manila North Tollways Corporation (MNTC) with an estimated project cost of PhP 23.302 Billion. Construction starts in May 2019 and expected to be completed by April 2021. The alignment of the proposed NSRP-South is in conflict with the road from Solis to Pasig River.

Private Land owners: Due to the NLEx/ SLEx Connector Road Project, the project alignment will run outside of PNR ROW from Solis to Pasig River and in parallel, which will require land acquisition. According to the census and SES under RAP, approx. 826PAFs own the land will be affected.

Sucat Thermal Power Plant: The government, under the Power Sector Assets and Liabilities Management Corporation (PSALM), has an existing contract with a private firm to dismantle, cleanup, and remediate the STPP site. The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area.

(3) Poor people

The average annual per capita poverty threshold of National Capital Region (NCR) and Region IV-A in 2015 was about PhP 25,007 and PhP 22,121 based on PSA. According to the census and SES, the majority of ISFs are also categorized into those vulnerable group 1,447 households are below poverty threshold, and the majority are dependents– either as babies/toddlers (4,232), or single parents (1,650 household), and elderly (1,430 household).

(4) Local economies, such as employment, livelihood, etc.

1) Local Economy

According to the Philippine Statistics Authority (PSA), the NCR accounts for 33% of the Philippines' Gross Domestic Product (GDP). Growth rates of Gross Regional Domestic Product (GRDP) of NCR and Region VI-A is as described in Table 9.1.42 in the absence of GDP data available at municipality/city level. In NCR, service sector is the major industry whereas agriculture is the main industry for Region VI-A.

Table 9.1.42 GRDP Growth Rates by Industrial Origin at Current Prices (%)

INDUSTRY/YEAR	13-14	14-15	15-16	16-17
NATIONAL CAPITAL REGION				
I. AGRICULTURE, HUNTING, FORESTRY & FISHING	20.2	20.2	-1.1	1.4
a. Agriculture and Forestry	20.6	20.4	-1.1	1.4
b. Fishing	(12.8)	-1.6	-1.6	3.7
II. INDUSTRY SECTOR	5.3	7.4	4	2.1
a. Mining and Quarrying	-	-	-	-
b. Manufacturing	7.8	6.2	6.8	5.7
c. Construction	(1.0)	5.6	-1.7	-13.9
d. Electricity, Gas and Water Supply	4.0	14.2	0.5	6.6
III. SERVICE SECTOR		7.8	10.8	10.2
a. Transportation, Storage & Communication	9.7	11.8	9.1	4.9
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	7.9	7.4	10.3	11.1
c. Financial Intermediation	8.7	6.7	9.7	11.2
d. Real Estate, Renting & Business Activities	10.3	10.0	14.2	10.3
e. Public Administration & Defense; Compulsory Social Security	16.1	2.3	13	13.6
f. Other Services	1.5	7.4	7.4	7.5

INDUSTRY/YEAR	13-14	14-15	15-16	16-17
GROSS DOMESTIC PRODUCT	6.9	7.8	9.6	8.9
REGION IV-A				
I. AGRICULTURE, HUNTING, FORESTRY & FISHING	8.1	-0.9	5.8	8.4
a. Agriculture and Forestry	13.4	0.1	7.7	8.9
b. Fishing	(10.1)	-5.2	-2.8	6.1
II. INDUSTRY SECTOR	8.1	-0.3	1.4	8
a. Mining and Quarrying	6.3	24.7	2.7	6.7
b. Manufacturing	8.9	-0.9	1.2	6.6
c. Construction	6.4	5.6	2.9	18.4
d. Electricity, Gas and Water Supply	(0.1)	-3.3	0.7	8.5
III. SERVICE SECTOR	6.3	7.4	8.3	8.3
a. Transportation, Storage & Communication	8.0	5.5	4.2	4.7
b. Trade and Repair of Motor Vehicles, Motorcycles, Personal and Household Goods	3.1	7.2	7.6	6.5
c. Financial Intermediation	13.2	6.2	9.5	10.2
d. Real Estate, Renting & Business Activities	7.0	8.2	8.8	9.1
e. Public Administration & Defense; Compulsory Social Security	5.5	-0.5	12.4	13
f. Other Services	2.9	12.3	11.3	10.5
GROSS DOMESTIC PRODUCT	7.5	2.2	4	8.1

Source: PSA

The Table 9.1.43 below summaries the classification of LGU income[3] and main economic activities. Under the project, Manila is classified into special and the remaining LGUs are classified into 1st Class. In 2016, the financial district of the country, Makati City had the most revenue of the host cities to the NSRP-South with revenue of nearly PhP 14.3 billion. Manila City was next with PhP 12.8 billion. Taguig City came in next with revenue of PhP 6.3 billion (COA, Financial Profile, 2016).

[3] DOF Department Order No. 23-08 : Income brackets for re-classification of Provinces, Cities and Municipalities in the Philippines

Classification based on Income	CITY	MUNICIPALITY
First Class (1st Class)	Php 400M or more	Php 55M or more
Second Class (2nd Class)	Php 320 or more but less than Php 400M	PhP 45M or more but less than PhP 55M
Third Class (3rd Class)	Php 240M or more but less than Php 320M	Php 35M or more but less than Php 45M
Fourth Class (4th Class)	Php 160M or more but less than Php 240M	Php 25M or more but less than Php 35M
Fifth Class (5th Class)	Php 80M or more but less than Php 160M	Php 15M or more but less than Php 25M
Sixth Class (6th Class)	Below Php 80M	Below Php 15M

Table 9.1.43 LGU Income and main economic activities

Municipality/ City	Class	Main economic activities
Manila	Special	Predominantly a service-oriented city. Leading industries, namely- textiles/garments, food, personal products, chemical/pharmaceutical, and rubber/plastic products, are generally light, labor-intensive activities.
Makati	1st Class	Country's premier financial, commercial and service center; commerce and service dominate the economic activities
Taguig	1st Class	Industry (manufacturing, cottage industries), commerce, service
Parañaque	1st Class	Commerce, industry (manufacturing), service
Muntinlupa	1st Class	Commerce and trade
San Pedro	1st Class	Agriculture (crop production (6.8% of total land area, mostly vegetables), commercial livestock and poultry (1.95%,)), fisheries (along Laguna de Bay), commerce and industry
Biñan	1st Class	Industry (driven by industrial establishments and small-medium enterprises (SME) industries), service, commerce (Poblacion)
Sta. Rosa	1st Class	Industry, trade and commerce
Cabuyao	1st Class	Manufacturing industries (food processing, textile, garments and electronics manufacturing), agricultural production (rice, squash, watermelon, garlic, upo, pineapple, coconut and coffee (rice, pineapple and coffee have decreased due to land conversion); livestock and poultry), fisheries
Calamba	1st Class	Industry, trade and commerce

2) Labor Force and Employment

In the absence of available data on employment at municipality/city level, the regional level data from the PSA were used in the study. Employment / Unemployment rate of NCR in Jan 2018 is 92.2 %, which get worse from 93.9% in Oct. 2017. Those of Region IV-A is 93.3% which also worsen from 94.3%. The total gainful workers (15-64 years old) of the host LGUs, as based on the 2015 Census of Population and Housing of the PSA, Manila is the highest as 1,110,381, followed by Taguig 554,185, Paranaque 471,360 and Makati 421,002 among the host LGU.

3) Income and Livelihood

In 2015, the average income of household in Region IV-A and NCR is PhP 22,121 and PhP 25,007 pa. According to the census and SES, average house income of PAFs below poverty is average monthly PhP 6,255.37, while those beyond the poverty threshold has an average monthly income of PhP 21,754.28. 25 % or 3,011 households have monthly incomes below PhP10,000, 40 % or 4,893 have monthly incomes above PhP10,000 but less than PhP20,000 and 35 % or 4,216 have monthly incomes above PhP20,000. According to the perception survey, majority (41.5%) of the respondents' husbands are the primary providers of income, although most of the households have multiple income providers, which 72.6% are earning from waged based job, while 21.7% is enterprise based. Also, small number of remittance based (2.3%) and land based (0.5 %).

(5) Land use and utilization of local resources

Main land use and adjacent to proposed aliment of host LGU is summarized below. Please note that the proposed depot site is considered as "irrigated and irrigable lands" which is "non- negotiable for conversion" under R.A.9700, section 22). Thus, DOTr is currently taking administrative procedure to obtain an exemption for development.

Table 9.1.44 Land use of host LGUs

Municipality/ City	Major land use	Land use adjacent to proposed aliment
Manila	commercial and residential	High and medium intensity commercial areas, university cluster zone and high density residential areas. The alignment also passes through the Pasig River between the districts of Sta. Mesa and Pandacan.
Makati	Residential	residential and commercial
Taguig	General Residential Development Area – 1 (GRDA-1)[4]	institutional, low density development, general residential development-1, low density development, open space, controlled growth corridor, and light industrial
Parañaque	residential area	commercial with patch of residential
Muntinlupa	Residential, commercial	residential with sections located in industrial and commercial areas
San Pedro	residential, commercial, institutional, industrial, tourism, agriculture, cemeteries, abattoirs, and infrastructure & utilities	residential and commercial areas
Biñan	residential	residential and commercial
Sta. Rosa	Residential	agricultural land, mostly rice fields, and residential areas
Cabuyao	industrial	residential, commercial, agricultural (rice fields), light industrial zone, Cabuyao Enterprise City 1 and institutional
Calamba	i growth management area, Urban development, upland conservation, and agricultural	urban redevelopment and agricultural

(6) Water usage

In the Philippines, 28.5 billion m^3 of water was withdrawn from various sources in 2000: 74% (21.1 billion m^3) was used for agricultural purposes, 9% (2.6 billion m^3) for industrial processes, and 17% (4.9 billion m^3) for domestic consumption. Under the NSRP-South host LGUs, in Manila city, average water consumption is for domestic; 28.0 m^3/month, commercial; 80-100 m^3/month and industrial; 100-111 m^3/month. Whereas in Cabuyao, average water consumption is for domestic and commercial; 18.5 m^3/month. Based on the field survey on ground water, the yields of wells are used for domestic (Community well, washing, cooking, bathing) and industrial purposes.

For the Project, the total water requirement for the estimated 30 months construction of viaducts, stations, piers, piles and pile caps is about 2,668m^3 per day. The estimated daily water consumption at the different stages of project development is presented in Table 9.1.45.

[4] **General Residential Development Area** - 1 (GRDA-1) are neighborhood-type communities that are evenly distributed throughout the city. These are mainly characterized by high-density mixed-use neighborhoods that are closely compacted and pre-dominated by residences and small-scale neighborhood service establishments and community facilities. Future development potentials in most parts of the GDA are limited due to the existence of heavily built-up areas and the presence of very narrow roads.

Table 9.1.45 Average Production and Consumption of NSRP

Project Stage	No. of Personnel	No. of Sites	Daily Consumption per Sites (m^3)	Total Daily Consumption (m^3)
Pre-construction	200	1	20	20
Construction	26,680	6	478	2,668
Operation	3,675	21	17.5	367.5

Note: per capita water consumption is 100 liters per day. During construction, 6 contract packages which translate to 4,780 persons per site. During Operation, 21 major sites which correspond to the stations and depot which translate to 175 persons per site.

(7) Existing social infrastructures and services

1) Power Supply

The majority of the households in the host LGUs have electricity supplied by Manila Electric Company (MERALCO). In terms of access to electricity, there are more PAPs who have access to electricity through shared connection (51.5%). This may refer to the ISFs who have shared electricity connection. Only 38% have their own electric meters. However, in Manila, the proportion of those with their own electricity connection (63.5%) is greater than those who have shared connection. In Taguig, Parañaque, Biñan and Calamba, the proportion of PAPs with shared connection is greater than those with their own individual meters. In some cases, such as Muntinlupa, the proportion of those with their own (40.6%) and shared (41.2%) are almost equal, but with at least 16.5% having no access to electricity. Only 8.5% of all PAFs, have no electricity connection, with the proportion of those with no electricity connection being highest in Cabuyao.

2) Water Supply

In line with the Clean Water Act, in Metro Manila, water is supplied primarily by the Metropolitan Waterworks and Sewerage System (MWSS), which splits the water concession into two; an east concession with Manila Water Company (MWC) and a west concession with Maynilad Water Services Inc. (MWSI). The main sources of Metro Manila's water supply are from the Angat, Ipo, and La Mesa Dams. The water from these dams are then processed by the La Mesa and Balara Treatment Plants, which converts it from a raw state to clean and potable water. Thus, majority of the households in the host LGUs have access to safer water from Metro Manila, whereas local water districts prevail in the cities in Laguna.

The results of the 2010 Census of Population and Housing showed that most households in Metro Manila (Manila, Makati, Taguig, Parañaque and Muntinlupa) and Laguna (San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba) used either their own faucet tapped to community water system or bottled water as water source for drinking. For cooking, laundry and bathing, most households used their own faucet connected to community water system.

3) Sewerage

Comparing to the water supply status, the sewage system is a long way behind. In 2015, EMB reports that in the Philippines, only 10.0 % of wastewater is treated while 58.0 % of the groundwater is contaminated. Only 5.0 % of the total population is connected to a sewer network while the vast majority use flush toilets connected to septic tanks. In 2013, the sewer connection coverage is limited in 12 .0% by MSW, whereas, 11.0 % in MWSI, targeted 100.0 % by the year 2028-2037. Under host LGUs, San Pedro and Sta. Rosa, Cabuyao does not have modern sewage system, whereas remaining host LGUs have some sewage system installed by MSWI, MWSI, LGUs and foreign funded projects.

The results of the 2010 Census of Population and Housing showed that most households in host LGUs, majority used toilet type water sealed sewer septic tank that is used exclusively by the household. According to perception survey that most respondents (86.0%) use either flush or water-sealed sanitary toilet facilities

4) Communication

Telecommunication services in the host LGUs include fixed landline telephone, cellular/mobile telephone and broadband carriers. Internet and courier services, national and local newspapers, satellite antenna are also present in the host cities.

5) Protective Services

Police Regional Offices (PRO) IV-A and Police Regional office NCR (NCRPO) manage and administer Police Stations in the region. At each LGU, police station and outputs are established. LGU and Barangay also provide the protective service to their communities which comprises with volunteer residents, such as Barangay Peacekeeping Operations and Barangay Peacekeeping Action Team.

The PRO 4a reports that for Jan-Mar. 2018, theft is the highest crime (29.0 %), followed by murder (23.0 %) and physical injuries (16.0 %). NCRPO data in 2017 showed almost 40 % reduction of crime incidents from 2016. A 23.4 % drop in murder cases from 1,976 to 1,514, Homicide cases also went down by 26.7 % from 577 to 423, physical injuries (down by 7.6 %, from 4,830 to 4,462), rape (17.5 % from 1,098 to 906); and robbery (16.0 %, from 3,603 to 3,025), theft by 19.9 %, from 8,059 to 6,454 incidents.

Fire protection is provided by BFP Region IV-A and NCR. Vehicles and equipment are owned by BFP but also LGUs. Businesses need to undergo regular inspections as a BFP clearance is needed for the application and the renewal of business permits, however not for residential. 60.0 -70.0 % of fires start from residences and majority are through electrical short circuits especially when households use appliances and wirings that are not ICC approved. BFP encourage every barangay to have their own fire brigade so they will have the necessary first responders during reported fire incidents in their barangays.

6) Solid Waste Management

Solid waste disposal is the responsibility of the LGU's in accordance to the RA 9003 or the Ecological Solid Waste Management Act has been in force since 2000. At present, most LGUs administer their own collection systems or contract out this service to private contractors. Nationwide, about 40.0 to 85.0 % of the solid wastes generated is collected. Uncollected waste ends up mostly in rivers, esteros and other water bodies, thus, polluting major water bodies and clogging the drainage systems, which results in flooding during heavy rains (NSWMC). Open dumping remains the general practice of waste disposal in the country as controlled dumpsites and sanitary landfills (SLFs) are very limited despite RA 9003 which requires LGUs to close their existing open dumpsites by year 2006 and to establish controlled disposal facilities or SLFs.

Some LGU's the requirements are not fully met, such as waste segregation at Materials Recovery Facilities (MRF), sanitary landfill, recycling etc. Manila City has 100.0 % coverage of solid waste collection through a private contract with Leonel Waste Management, on the other hand, the remaiing LGUs are yet to be improved. The wastes disposal sites used are in Rodriguez, Rizal and Pilotage Sanitary Landfill, San Pedro, Laguna.

7) Medical Service

Public health services in the host cities are provided through hospitals, health centers and clinics. NCR has hospital bed rate per 1000 population is 2.47, doctor/nurse/midwife per 100,000 is 5.1, 6.3 and 9.8. Whereas Region IV-A has hospital bed rate per 1000 population of 0.83, doctor/nurse/midwife per 100,000 of 2.0, 4.0 and 15.5 (DOH2008). In case of any emergency during the construction, each host LGUs has hospitals near the project site (within 1 km radius) except Paranaque.

8) Open Space and Recreational Area

Based on the standards for recreational facilities, a minimum of 500 sq.m. per 1,000 population for Municipal Park, Minimum of 0.5 hectare per 1000 population for playfield/athletic field is needed (Annex V of Volume V – Land Use of HLURB Guidelines). The host LGUs have designated open and recreational areas which are also incorporated in their Land Use Plan. Each LGU also have recreational facilities such as basketball courts and parks. There are no directly affected open spaces.

9) Public Transport

Major modes of land public transport in the host LGUs are bus, taxi, FX, jeepneys, and tricycle. PNR operates from Manila City to Calamba City.

PNR: The proposed NSRP-South will not share the tracks of the proposed freight and long-haul trains. PNR line will continue its operation while the NSRP - South is being constructed. Existing tracks will be reused for the freight and long-haul trains operation. In addition, NSRP-South plans to connect to the MMSP line at FTI station but needs further study.

Pasig River Ferry Service: The Pasig River Ferry Service is the only water-based transportation in Metro Manila that cruises the Pasig River from Pinagbuhatan in Pasig to Intramuros in the City of Manila. The system is owned and operated by a private company, SCC Nautical Transport Services Incorporated.

(8) Social structure such as social capital and local decision-making institutions

There is a high amount of internal migration and this stresses basic services in cities. Many barangays are experiencing high population growth from migration including ISFs. LGUs receiving informal settlement have responsibilities to allocate land and integrate migrants into welfare systems. Some LGUs are refusing to take any PAFs from other LGUs. The main destination for long-distance movers was CALABARZON (Region IV-A), which absorbed 27.7% of them, followed by Metro Manila (19.7%) and Central Luzon (13.0 %) (Philippines Statistics Authority 2012). The high volume of migrants to cities had strained housing, infrastructure, and basic services in major cities. As a result, informal settlements had proliferated: the number of informal settlers in the Philippines had increased from 4.1% of total urban population in 2003 to 5.4% in 2012; and out of the 2.2 million that lived in informal settlements, 1.3 million were in Metro Manila alone (World Bank 2017). Accordingly, the Department of the Interior and Local Government, in 2012, almost a half of the informal settlers in Metro Manila was in Manila City.

Based on the census and social economic survey conducted by the RAP. The project is expected to displace approximately 12,210 PAFs. Relocation sites for displaced PAFs will be also identified and coordinated with LGUs in accordance to in city relocations, and where basic and social infrastructure can be provided. Financial assistance by the proponent will be also provided to the receiving LGUs to cover all operation expense for social infrastructure such as health, education, transport, waste management, etc.

(9) Misdistribution of benefits and damages

The project will cause negative impacts on those affected persons required to relocate. Based on the census and SES conducted under the RAP, the total number affected is approsimaely 12,210 PAFs, 826 legal landowners and 6,333 structure owners. In addition, during construction, some local businesses might have a temporary disturbance. On the other hand, through the development of NSRP-South, the land development is expected to increase along or near the corridor and station area, which will boost local economy. Those affected directly as well as indirectly will be compensated fairly through RAP and at relocated site, they have to have same or better living condition than currently existing, with basic infrastructure, livelihood and income basis.

(10) Local conflicts of interest

Local conflicts of interest could come from the effects falling unequally on one group over others. If negative affects impact predominantly one group then conflict may arise, particularly if there is existing rivalry. Pre-construction and construction there may be a conflict among community and LGUs who have to be displaced and temporary affected and among communities’ migrants arriving and locals. Based on the census and social economic survey conducted by the RAP. The project separately preparing RAP to provide fare compensation for those affected by the project to ensure that their livelihood and income stay same or better than prior to the project. Relocation sites for displaced PAFs will be also identified and coordinated with LGUs in accordance to in city relocations, and where basic and social infrastructure can be provided. As mentioned above, financial assistance by the proponent will be also provided to the receiving LGUs.

(11) Historical/Cultural heritage

Historical and cultural heritage declared by NHCP within the vicinity (within 0.5 km) of the proposed NSRP-South includes Lord Justo Ukon Takayama Monument located in Plaza Dilao, Paco, Manila and Alberto Rizal House in Biñan, Laguna. In accordance with the Republic Act No.10066, Section 18, the project is required to detail the possible impacts in the EIA report. The project will avoid any direct negative impacts to the above existing heritage by ensuring the propose alignment to have sufficient distance from the heritage structures and providing design in consideration to the location of pier foundation, The project will also develop appropriate mitigation measure against indirect impact such as vibration during the construction, if any predicted. The Project will consult the proposal with NHCP, National Museum and National Commission for Culture and the Arts prior to the implementation.

Besides the above, a total of 51 PNR structures were identified to meet the condition of structures “over 50 years” during the site investigations with JICA Design Team and PNR in March 2018. The JICA Design Team and PNR Proposal have developed their proposal and will present to NHCP, National Museum and National Commission for Culture and the Arts (NCCA) for further discussion on requirements for preservation of listed item. For those identified to be conserved, the project will conduct a measurement survey and develop sufficient protection measure against direct and indirect impact such as vibration during the construction. Building condition survey will be also conducted by DOTr prior to construction and mitigation measure will be updated as required. Project will seek for approval on the proposed protection measures from NHCP, National Museum and NCCA prior to the implementation.

Table 9.1.46 Old PNR Stations and Bridges within the Project Alignment

No.	Category	Heritage	Year	Location	Coordinate
*	Signal Tower	Abad Santos Signal Tower (Casitas)	1891	Abad Santos corner Old Antipolo St., Manila City, NCR,	14°37'23.25" N, 120°58'40.63" E
1	Bridge	Carriedo Bridge	1931	Manila City, NCR, 32 km PNR Kilometerage	
2	Signal Tower	Abad Santos Signal Tower (Casitas)	1916	Abad Santos corner Old Antipolo St., Manila City, NCR,	14°37'23.25" N, 120°58'40.63" E
3	Bridge	No Name Bridge	1913	Alegeciras St. cor. Antipolo St., Blumentritt, Manila, NCR,	14°36'52.95" N, 120°59'40.23" E
4	Bridge	No Name Bridge	1913	Sampaloc, Arevalo St. Manila, NCR	14°36'19.29" N, 121° 0'12.56" E
5	Bridge	Pandacan Bridge	1938	Pasig River, Pandacan, Boundary of Sta. Mesa and Pandacan, Manila City, NCR	14°35'39.86" N, 121° 0'43.96" E
6	Bridge	Beata Bridge	1913	Estero de Pandacan – Beata St., Manila City, NCR	14°35'27.33" N, 121° 0'33.54" E
7	Bridge	Kahilum Bridge	1913	Balagtas – Beata St., Along Francisco Balagtas St. Manila City, NCR	14°35'8.58" N, 121° 0'17.46" E

No.	Category	Heritage	Year	Location	Coordinate
8	Bridge	Concordia Bridge	1913	Estero de Pandacan – Quirino, Along Quirino Avenue, Manila City, NCR	14°34'56.44" N, 121° 0'7.18" E
9	Station	Paco Station	1913	Quirino Avenue, Paco, Manila City, NCR	14°34'48.70" N, 20°59'59.80" E
10	Bridge	Paco Bridge	1940's	Estero de Paco, Quirino Avenue, Paco, Manila City, NCR,	14°34'33.48" N, 120°59'53.13" E
11	Bridge	Paco Creek Bridge	1940's	Estero de Pandacan –Perlita, Along Perlita St., Manila City, NCR	14°34'26.09" N, 120°59'56.78" E
12	Station	Vito Cruz Station	1931	Barangay 759, Manila City, NCR	14°34'0.21" N, 121° 0'11.18" E
13	Station	Buendia Station	1931	Dela Rosa St. corner Osmeña Highway, Makati City, NCR	14°33'27.48" N, 121° 0'28.02" E
14	Bridge	No Name Bridge	1940's	Tripa de Galiena Creek, Pasay, Manila City, NCR	14°32'41.96" N, 14°32'41.96" N
15	Bridge	No Name Bridge	1940's	Vilamor Air Base, Magallanes, Manila City, NCR	14°31'50.55" N, 121° 1'20.69" E
16	Bridge	No Name Bridge	1940's	Fort Bonifacio, PSCA College, Manila City, NCR	14°31'40.91" N, 121° 1'25.86" E
17	Bridge	Conception Bridge	1940's	Sucat River, Parañaque City, NCR	14°26'46.75" N, 121° 3'0.75" E
18	Bridge	Buli Bridge	1940's	Barangay Buli @ Muntinlupa Business School, Muntinlupa City, NCR,	14°26'27.02" N, 121° 2'58.48" E
19	Bridge	Cupang Bridge	1940's	Vinalon St., Muntinlupa City, NCR	14°25'52.01" N, 121° 2'54.44" E
20	Bridge	Alabang Bridge	1940's	Alabang-Mangangate River, Muntinlupa City, NCR	14°25'36.37" N, 121° 2'52.69" E
21	Station	Alabang Station	1959	Alabang, Muntinlupa City, NCR	14°25'10.41" N, 121° 2'52.02" E
22	Bridge	Banayan Bridge	1940's	Bayanan Creek, Muntinlupa City, NCR	14°24'39.65" N, 121° 2'51.55" E
23	Bridge	Bucal Bridge	1940's	Poblacion River, Muntinlupa City, NCR	14°23'28.89" N, 121° 2'51.38" E
24	Bridge	Prinza Bridge	1940's	Magdaong River, Muntinlupa City, NCR	14°23'18.39" N, 121° 2'51.33" E
25	Bridge	Tunasa Bridge	1940's	RMT Crossing, Tunasan River, Muntinlupa City, NCR	14°22'26.32" N, 121° 2'54.74" E
26	Bridge	Pacwood Bridge	1940's	Tunasan River, Muntinlupa City, NCR	14°22'10.22" N, 121° 3'3.82" E
27	Bridge	San Pedro Bridge	1940's	San Isidro River, San Pedro, Laguna	14°21'50.71" N, 121° 3'14.43" E
28	Station	San Pedro Station	1970's	San Pedro, Laguna	14°21'35.91" N, 121° 3'22.15" E
29	Office	PNR Office, San Pedro	1970's	San Pedro, Laguna	14°21'36.23" N, 121° 3'22.96" E
30	Bridge	SPACBA Bridge	1940's	Begonia St., San Pedro, Laguna	14°21'19.40" N, 121° 3'31.77" E
31	Station	Pacita Station	1949	San Pedro, Laguna	14°20'48.07" N, 121° 3'50.10" E
32	Bridge	Canlalan 1 Bridge	1940's	Barangay Nueva, San Pedro, Laguna	14°20'41.57" N, 121° 3'57.08" E
33	Station	Biñan Station	1948	Biñan, Laguna	14°19'52.26" N, 121° 4'53.51" E
34	Bridge	Biñan Bridge	1948	Biñan, Laguna	14°19'49.82" N, 121° 4'55.93" E
35	Bridge	Puntod Bridge	1940's	Florenceville sub-division, Sta. Rosa, Laguna	14°19'0.06" N, 121° 5'52.37" E

No.	Category	Heritage	Year	Location	Coordinate
36	Bridge	Tagapo Bridge	1940's	SM Sta. Rosa, Laguna	14°18'48.86" N, 121° 6'5.11" E
37	Bridge	Putol Bridge	1940's	Silang – Santa Rosa River, Sta. Rosa, Lagun	14°18'38.69" N, 121° 6'16.50" E
38	Bridge	Bayan Bridge	1940's	North Pearl Drive, Sta. Rosa, Laguna	14°18'36.28" N, 121° 6'19.31" E
39	Bridge	No Name Bridge	1940's	Orient Drive, Sta. Rosa, Laguna	14°18'34.04" N, 121° 6'21.82" E
40	Bridge	Ilayang Bulo Bridge	1940's	Barangay Dila / Pooc, Sta. Rosa, Laguna	14°17'40.17" N, 121° 7'13.35" E
41	Bridge	Pook Bridge	1940's	Captain Perlas St., Sta. Rosa, Laguna	14°18'3.53" N, 121° 6'56.54" E
42	Bridge	No Name Bridge	1940's	South Ville IV, Sta. Rosa, Laguna	14°17'51.03" N, 121° 7'8.83" E
43	Bridge	Bamban Mayor Bridge	1940's	NIA Road, Sta. Rosa, Laguna	14°17'40.17" N, 121° 7'13.35" E
44	Bridge	Kamada Bridge	1940's	Golden City, Sta. Rosa, Laguna	14°17'40.17" N, 121° 7'13.35" E
45	Bridge	Mayora Bridge	1940's	Barangay Dila, Sta. Rosa, Laguna	14°17'18.21" N, 121° 7'22.31" E
46	Bridge	No Name Bridge	1940's	Apple St., Sta. Rosa, Laguna	14°17'10.66" N, 121° 7'25.34" E
47	Bridge	Cabuyao Bridge	1949	Barangay Uno (Poblacion), Cabuyao, Laguna	14°17'0.87" N, 121° 7'29.37" E
48	Station	Cabuyao Station	1949	Cabuyao, Laguna	14°16'46.00" N, 121° 7'35.06" E
49	Bridge	Southville Bridge	1940's	Maring Creek, Cabuyao, Laguna	14°16'40.22" N, 121° 7'37.74" E
50	Bridge	No Name Bridge	1940's	Cabuyao, Laguna	14°16'20.65" N, 121° 7'45.74" E
51	Bridge	No Name Bridge	1940's	Tarican Road, Cabuyao, Laguna	14°16'4.45" N, 121° 7'52.31" E
52	Bridge	No Name Bridge	1940's	Cabuyao River tributary, Laguna	14°15'57.27" N, 121° 7'55.23" E
53	Bridge	Sala-Langka Bridge	1940's	Cabuyao, Laguna	14°15'46.56" N, 121° 7'59.58" E
54	Bridge	No Name Bridge	1940's	Burmingham Village Rd., Cabuyao, Laguna	14°14'48.55" N, 121° 8'23.27" E
55	Station	Mamatid Station	1942	Mamatid, Cabuyao, Laguna	14°13'58.90" N, 121° 8'43.80" E
56	Bridge	Mamatid Bridge	1940's	Cabuyao, Laguna	14°13'50.14" N, 121° 8'46.97" E
57	Bridge	San Cristobal Bridge	1940's	San Cristobal, Calamba, Laguna	14°13'11.70" N, 121° 9'4.18" E
58	Bridge	San Juan River Bridge	1940's	Calamba, Laguna	14°12'32.17" N, 121° 9'24.83" E
59	Dormitory	Calamba Dormitory House (Train conductor)	1909	Calamba, Laguna	14°12'25.55" N, 121° 9'27.38" E
60	Dormitory	Calamba Dormitory House (Train driver)	1909	Calamba, Laguna	14°12'25.04" N, 121° 9'27.66" E
61	Train Shed	Calamba Station Shed and Yard	1909	Calamba, Laguna	14°12'21.81" N, 121° 9'29.48" E

Note: The list is based on visual validation conducted in March 2018

Source: JICA Design Team

(12) Landscape

The existing PNR operates along the Laguna de bay which is the largest fresh water lake in the Philippines, and the third largest in South East Asia.

The Laguna de Bay region is rich in history, natural beauty, and biodiversity. The Laguna de Bay lakeshore has been inhabited for many thousands of years, which can be seen in the Angono petroglyphs in the lakeshore town of Binangonan, Rizal. Due to the many years of Spanish influence, there are several old churches around the region.

The lake is also part of the flyway for migratory birds. Mount Makiling is located south of the lake. The mountain is ideal for hiking, camping, trekking, mountain biking, and bird watching.

The existing PNR lines being at grade structure are not visible from Laguna de Bay coast line however could be visible from Mount Makiling.

(13) Gender

Under the RAP, a Gender Impact Assessment has been conducted to Project Affected household, with reports indicating a lack of awareness on the issue of gender and vulnerable groups among the infrastructure projects. The results likewise indicate that some gender and development activities are not related to gender, therefore, not addressing the needs of the PAPs. Based on SES, male-headed households is 57.5 % while 42.5 % are female-headed households.Based on FGD targeted female PAFs, it is articulated is that majority of females walk and some uses jeepneys and tricycle to make their trips to markets, school, and health center, which walking is the first and fast means and save cost. It is also stressed that their regular trips won’t require railway and they preferred to use jeepneys and tricycle because they can bring their children without any additional fare. In term of concern and issue of the project, common answers are losing their homes and livelihood, being moved away from work and children’s school, and uncertainty of the life at the relocation site.

(14) Children’s rights

In the Philippines, children at 5 years old start schooling. The public school term start from June and finish in April. According to HLURB, the maximum distance for a pupil or student to walk from residence to school site is three km, while the maximum time from residence to school aboard public conveyance is 30 minutes. The educational facilities in the host cities include public and private day care centers, elementary schools, high schools and college facilities.

Table 9.1.47 Educational Institutions in host LGUs

City	Elementary School		High School		College/ Universities		Educational institution within 50m from alignment
	Public	Private	Public	Private	Public	Private	
Manila	68	41	32	29	7	67	Manuel L. Quezon High School, Dr. Benigno Aldana Elementary School, Polytechnic University of the Philippines - Institute of Science and Technology, Concordia College, Pedro Gil High School, St. Claires College of Nursing, San Antonio National High School
Makati	28	15	5	12	2	18	Makati Hope Christian School, Manila Contemporary Art Gallery
Taguig	69 [a]	89 [a]	9	15	2 [b]	5 [b]	Mababang Paaralan ng Sucat
Parañaque	22	66	11	33	1	14	No affected schools within 50 meters
Muntinlupa	19	64	11 [c]	53 [c]	2	14	Muntinlupa Business School, St. Bernadette College, DepEd ALS Center, Christ the King, College of Science and Technology (2 structures) Muntinlupa Institute of Technology, Muntinlupa National High School, Santo Niño School of Muntinlupa
San Pedro	20	81 [d]	7	81 [d]	1	13	San Vicente Elementary School, Little Explorer Montessori School
Biñan	26		8		8		Springtime County Learning Center
Sta. Rosa	18	86	7	86	1		No affected schools within 50 meters
Cabuyao	19	91	7	43	1	4	Cabuyao Central School Complex, Pamantasan ng Cabuyao
Calamba	51	82	16	42	1	16	PMMC Maranatha Christian Academy STI College, Calamba

Note: a daycare centers/kinder/elementary; b college/university/vocational; c including junior and senior high school; d elementary and high school

Sources: CLUP and SEP of Manila, Makati, Taguig, Parañaque, untinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba City

(15) Infectious diseases such as HIV/AIDS and Community health

Prevalent diseases along the route of the railway are malaria and dengue fever and sexual diseases. HIV/AIDS cases have increased to 10,500 in 2016 and the Philippines has become the country with the fastest growing HIV/AIDS epidemic in Asia and the Pacific, and has become one of eight countries that account for more than 90% of new HIV/AIDS infections in the region. (Joint United Nations Program on HIV/AIDS). As of 2017, NCR (309 cases /32%), Region IV-A (135 cases /14%) and Region III (107 cases /11%) are the top 3 regions with reported cases of HIV/AIDS. According to 2015 annual report of Department of Health Regional Office NCR, the Number of HIV/AIDS including asymptomatic recorded in 2017 from 1984 are 3583 in Manila, 2021 in Makati, 1037 in Taguig, 879 in Paranaque, 872 in Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao, and Calamba respectively.

According to the study of Firled Health Service Information System (FHSIS) (2016), the Top 10 diseases in the NCR is Acute Respiratory Infection (number of case: 717,356), ALTRI & Pneumonia (161,689), and Hypertension (128,825), whereas in Region 4-A, Acute Respiratory Infection (515,691), Hypertension (116,004), and ALTRI & Pneumonia (105,022).

According to the perception survey, the majority of the respondents (64.69%) have been ill at least three times in the last year. Fever is the most common (34.75%) cause of illness among the respondents, followed by upper respiratory diseases (27.51%). And 30.02% get medical treatment at barangay health centers, slightly more than those that get treatment at hospitals (28.51%). This may be due to more costly treatment at hospitals. A significant percentage also opt for treatment at private clinics (16.95%), while a few still gets treated by herbalists, or simply gets treated at home (self-treatment).

(16) Working conditions

1) Occupational Injuries and Diseases

According to PSA, the number of occupational accidents in the Philippines reached a total of 44,739 in 2015, a decline of 5.7 % from 2013. Despite this reduction, the resulting occupational injuries in 2015 grew by 3.8 % from 49,118 in 2013 to 50,961, cross industries, manufacturing accounted for the highest shares of total occupational injuries in 2015 and 2013 at 50.4 %. (25,667) and 48.1 %. (23,641), respectively. Construction industry share of accidents in 2013 was 4.3%, which increased in 2015 to 10.1%. In 2013, more than half (58.3% or 306) of the 525 cases of occupational injuries with workdays lost in the construction industry were caused by superficial injuries and open wounds. Other types of injuries include foreign body in the eye (12.4%); fractures (10.1%); and dislocations, sprains and strains (7.2 %). Laborers and unskilled workers were the mostly injured in the construction industry posting the highest share at 70.1 %. The rest of the occupations showed comparatively lower shares of injuries which include craft and related trade workers (10.5 %); plant and machine operator s and assemblers (7.4 %); and technicians and associate professionals (5.9 %). Total of 4,175 cases of occupational diseases were recorded in the construction industry in 2013. By type of disease, 5 in every 8 occupational diseases (62.5 % or 2,610), were caused by other work related musculoskeletal diseases. This was followed by other diseases with relatively fewer cases namely: back pains (5.6 %); occupational dermatitis (4.9 %) and essential hypertension (4.4 %).

2) Occupational Safety and Health Practices

The Occupational Safety and Health (OSH) Standards is set as mandatory by the Department of Labor and Employment. It aims to protect every working man and woman against the dangers of injury, sickness or death through safe and healthful working conditions. Employers are required to submit a Summary Report including; Work Accident/Illness Report, Annual Exposure Data Report, Report of Safety Organization, Minutes of the Meetings of Health and Safety Committee, Annual Medical Report.

The seven out of every 10 establishments in construction industry implemented the following OSH policies/programs: accident prevention program (78.9%); accident investigation program (70.5%); and drug free workplace policy program (68.1%); DOLE-approved construction safety and health (67.5%); and monitoring/surveillance of occupational and work - related injuries and illnesses (67.2%).

As preventive and control measures against work safety and health hazard, almost all of the establishments in construction had posted safety signage or warnings (98.3%) and provided workers orientation on safety and health hazards at work (98.2%) as part of its preventive and control measures against work safety and health hazards in the workplace.

In addition, a total of 921 establishments in construction had availed of various work safety and health related trainings/seminars for their employees: 40 hour construction safety training (90.4%); fire safety training (67.4%); and 1 - Day occupational safety and health Orientation (64.7%) etc.

(17) Trans-boundary impacts or climate change

1) CO_2 Emissions

a) CO_2 Emissions during construction

The fuel consumption for the use of construction equipment, service vehicles as well as transport of construction materials were estimated. The total CO_2 emissions during construction are estimated at 691.5 MT CO_2/yr.

b) CO_2 Emissions during Operation

The electricity consumption during project operation is estimated to be at 303.4 million kWh /yr (72,500 MWh/yr.). The assumption is based on the daily power requirements for the operation of the train, stations, and facility depot. GHG Protocol's Purchased Electricity Calculation Tool with emission factor from the GWP values of the 2014 IPCC Fifth Assessment Report was utilized to automatically calculate the total CO_2 emissions. The total CO_2 emissions during operation are estimated at 36,422.1 MT CO_2 /yr. The Philippines Second National Communication (**SNC**) on Climate Change has projected 100,402,000 MT of CO_2 for 2020. Using the projection of SNC, the Project is expected to contribute approximately 0.00069% during the construction phase and approximately 0.036% during the operation phase.

2) Climate Risk/ Climate Change

The climate change scenario for the Philippines as published by PAGASA in February 2011 indicates that Metro Manila and Laguna will receive the impact of Climate change.

The Climatic Risk and Vulnerability Assessment was also conducted to meet ADB requirements following the ADB the Climate Risk Management Framework[5]. The detail report is enclosed in to ANNEX 9.1.1.

a) Rainfall and Temperature

The projected seasonal rainfall and temperature change for the period of 2006-2050 in Metro Manila and Laguna are as follows.

[5] Guidelines for Climate Proofing Investment in the Transport Sector, ADB, 2011

Table 9.1.48 Projected seasonal change for the period of 2006-2050 (%)

	2006-2035				2036-2050			
	Dec. - Feb.	Mar. - May	Jun. - Aug.	Sep. - Nov.	Dec. - Feb.	Mar. - May	Jun. - Aug.	Sep. - Nov.
Rainfall (%)								
Metro Manila	-12.8	-33.3	8.5	8.5	-17.3	-38.5	21.3	3.7
Laguna	-20.2	-31.5	2.9	2.9	0.1	-34.8	6.8	0.4
Temperature (°C)								
Metro Manila	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9
Laguna	0.9	1.1	1.0	0.9	1.8	2.1	1.9	1.9

b) Frequency of Extreme Events

Based from the climate change scenario for the Philippines as published by PAGASA in February 2011, Metro Manila will have 1,176 days with maximum temperature of above 35 °C during the 2006-2035 period and 2,118 days during the 2036-2050 period; 6,445 dry days during the 2006-2035 period and 6,382 dry days during the 2036-2050 period; and 12 days with rainfall above 200 mm during the 2006-2035 period and 13 days during the 2036-2050 period.

Moreover, the Province of Laguna will have 8,010 days with maximum temperature of above 35 °C during the 2006-2035 period and 8,016 days during the 2036-2050 period; 8,226 dry days during the 2006-2035 period and 6,081 dry days during the 2036-2050 period; and 14 days with rainfall above 200 mm during the 2006-2035 period and 9 days during the 2036-2050 period.

(18) Accidents

An annual report from the Metro Manila Development Authority (MMDA) showed that the number of vehicular accidents in the National Capital Region in 2017 is 13,707. In all LGUs, the traffic accidents are increasing as shown on Table 9.1.49. The results show that the number is very high in Manila and Makati, known to be traffic-congested areas. Predicted traffic volume is currently under study.

Table 9.1.49 Distribution of Traffic Accidents by Affected City/ Municipality in Metro Manila

City	Year	Fatal	Non-Fatal Injury	Damage	Grand Total
Manila	2012	53	901	7,331	8,285
	2017	53	1,263	9,999	11,315
Makati	2012	26	1,115	6,498	7,639
	2017	18	727	10,680	11,425
Taguig	2012	18	841	3,370	4,229
	2017	15	626	5,116	5,757
Paranaque	2012	20	901	2,942	3,863
	2017	41	992	4,149	5,182
Muntinlupa	2012	13	952	2,431	3,396
	2017	13	800	3,316	4,129

Source: Metro Manila Development Authority

Based on the road maps of DPWH, there are several national roads that cross the proposed NSRP-South. There are 7 primary, 14 secondary and 19 tertiary roads that cross the alignment. These include railroad crossing at grade level and railroad crossing over or under through bridge or tunnel. During the construction, the linear development of the project will potentially disturb existing roads/streets it crosses as well as will impact to the main roads in the vicinity. During the operation, the project will lead to greater traffic in the area of the station with consequent risks. Transport Led Development projects will seek to re-order local road network to reduce road conflicts and accidents. Predicted traffic volume is currently under study.

(19) Flood Risks

Metro Manila suffered from serious flood damage in 1948, 1966, 1967, 1970, 1972, 1977, 1986, 1988, 1995, 1998, 1999, 2000, 2002, 2004, and 2009. Floods were caused by overflow of Pasig-Marikina—Napindan-San Juan River as well as inland drainage. Once this type of flooding occurs, low-lying areas in Metro Manila along the Manila Bay and the Laguna Lake are totally submerged. In additional to this type of flooding, local inundation takes place at a number of low-lying spots during heavy rain.

According to the 1:50,000 geo-hazard maps prepared by the MGB classify, the segments from Solis Station to Bicutan Station: Low susceptibility to flooding with the exception of the immediate banks of the main channel of the meandering Pasig River which has high susceptibility. This high susceptibility affects the segment from Paco Station to Sta. Mesa Station. The segment from Taguig to San Pedro: High susceptibility to flooding. This area falls within the Laguna Lakeshore which is affected by the rise in lake levels during major rain events. The segment from San Pedro Station to Biñan Station: Low susceptibility to flooding. The immediate bank of San Pedro River has high susceptibility to flooding. The segment from Biñan Station to Sta. Rosa Station has moderate susceptibility to flooding. The segment from Sta. Rosa Station to Calamba: Low susceptibility to flooding.

9.1.8 Identification, Prediction and Assessment of Environment Impact

Based on the results of the survey, the potential impact of the project is assessed.

Table 9.1.50 Impact Assessment based on the Survey

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
Pollution Control						
1	Air Pollution	B-	B-	B-	B+/ -	**[Construction Phase]** (-) Generation of dusts and particulate matter, and gas emissions due to earthworks, demolition and site clearance including removal of topsoil, moving of excavated material and transporting, and operation of equipment, machineries and service vehicles. The effect of the identified impacts is low and short-term. **[Operation Phase]** (+) Operation of railway will contribute to the ease of traffic congestion and decrease of air polluting emissions. (-) Vehicle exhaust emissions and dust could increase in the vicinity of stations due to increased traffic. Activities at the depot might also aggravate the quality of air within its vicinity.
2	Surface Water pollution	B-	C	B-	B-	**[Construction Phase]** (-) Excavation, levelling, stock piling and dewatering of pier excavation within or near the river banks would cause short term slight increase in sediments and turbidity of rivers and/or streams along the proposed railway. (-) Improper handling of stockpiles of excavated soil could be exposed to erosion especially during rainy season and may be discharged to water bodies through run-off which will contribute to the siltation / sedimentation of nearby drainage systems or natural waterways. (-) Wastewater from temporary facilities area, improper handling of solid waste generated by workforce, and fuel, lubricant and hydraulic oil discharges from poorly maintained construction equipment, machineries and heavy vehicles would cause short-term deterioration of nearby water body. **[Operation Phase]** (-) The long-term uncontrolled discharge of wastewaters from commuter station and depot may cause deterioration in nearby surface water.
	Ground Water pollution	B-	C	B-	B-	**[Construction Phase** (-) Construction activities might change in the direction of groundwater flow. (-) Risk of groundwater contamination may come from accidental spillage of oil and fuel from storage tanks, poor disposal of other chemicals, chemicals used in pile driving. **[Operation Phase** (-) the long-term overland discharge of untreated wastewaters from the train stations and depot may cause degradation of quality of nearby groundwater
3	Soil pollution	B-	C	B-	B-	**[Construction Phase]** (-) Improper management of solid waste generated from the demolition of existing structures, clearing of ROW, and construction workforce may cause land contamination. (-) untreated wastewater from temporary facilities might contaminate nearby soil. (-) Soils may become contaminated in the event leaks and accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. **[Operation Phase]** (-) Improper management of solid wastes and wastewater generated by railway users/ employees at station and depot may result to land contamination. (-) Leaks of detergents, lubricants agents and used oil at the depot may contaminate soil.

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Items</th><th colspan="2">Assessment in Scoping</th><th colspan="2">Assessment based on Survey results</th><th rowspan="2">Assessment of Impact</th></tr>
<tr><th>Pre/During construction</th><th>Operation</th><th>Pre/During construction</th><th>Operation</th></tr>
<tr><td>4</td><td>Waste</td><td>B-</td><td>C</td><td>B-</td><td>B-</td><td>[Construction Phase]
(-) Improper management of domestic wastes by construction workforce, hazardous solid wastes, and residual construction materials will cause problems of disposal.
(-) Poor management of disposal of excess soil as a result of soil excavation and backfilling operations may end up be discharged to water bodies through run-off and could cause increased sedimentation in nearby rivers.
[Operation Phase]
(-) Improper management of domestic wastes, hazardous solid wastes, will cause problems of disposal at LGUs</td></tr>
<tr><td rowspan="2">5</td><td>Noise</td><td>B-</td><td>C</td><td>A-</td><td>A-</td><td>Construction Phase]
(-) Increase in noise level due to earthmoving, demolition and earth balling, and operation of equipment, machineries, and service vehicles. The noise levels of pile driver and rock drilling will exceed the maximum allowable noise levels of construction work (90 dBA).
[Operation Phase]
(-) The predicted noise level of train operation will exceed the guideline values for Night (55 dBA) even at the edge of the ROW.</td></tr>
<tr><td>Vibration</td><td>B-</td><td>C</td><td>A-</td><td>B-</td><td>[Construction Phase]
(-) The operations of pile driver and rock drilling will affect the area around the project site including NHCP heritage site and old PNR structures, since the vibration level (VL) is above the human perceptive threshold (55 dB).
[Operation Phase]
(-) Vibration is not expected to affect humans or buildings in case of viaduct, however in case of embankment, it will exceed for the building within 10m of the track.</td></tr>
<tr><td>6</td><td>Ground subsidence</td><td>C</td><td>C</td><td>B-</td><td>B-</td><td>[Construction / Operation Phase]
(-) The soft soil particularly in the segment from Solis station to Buendia station/ Muntinlupa station to Banlic Depot area may be at risk during a strong earthquake that makes construction structures unstable.</td></tr>
<tr><td>7</td><td>Bottom sediment</td><td>B-</td><td>C</td><td>B-</td><td>C</td><td>[Construction Phase]
(-) Piling works of viaduct/bridges piers in the rivers, will cause short term adverse impact on bottom sediment quality in and out of the rivers, especially during rainy season.
(-) Solid wastes or contaminants such as fuel, lubricant and hydraulic oil discharges from poorly maintained construction equipment, machineries and heavy vehicles generated during construction, as well as domestic wastes generated may adversely affect water and sediment quality.
[Operation Phase]
(-) Slight change to downstream sediments due to bridge piers in river.</td></tr>
<tr><td colspan="7">Natural Environment</td></tr>
<tr><td>8</td><td>Protected Area</td><td>C</td><td>C</td><td>D</td><td>D</td><td>The alignment of NSRP-South does not traverse any international/local protected areas, important bird areas or key biodiversity areas, however, it is located approximately 4 km from the Mount Makiling.</td></tr>
<tr><td>9</td><td>Ecosystem (terrestrial flora)</td><td>B-</td><td>B-</td><td>B-</td><td>D</td><td>[Construction Phase]
(-) Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing populations of introduced flora along the length of the proposed rail alignment.
(-) Loss of the critically endangered, endangered, and vulnerable species namely: Antipolo, Piling liitan, Is-is, Narra and Molave in the project area through vegetation removal and land clearance.
[Operation Phase]
During the operation phase, no vegetation removal and clearing are expected, so that there would be no threat to the existence and/or loss of important local flora species.</td></tr>
</table>

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
	Ecosystem (terrestrial fauna)	B-	B-	B-	B-	**[Construction Phase]** (-) Removal of vegetation, generation of noise, vibration, illumination, and vehicular movement which can disrupt animal activities. **[Operation Phase]** (-) Generation of noise, vibration, illumination, and vehicular movement which can disrupt animal activities.
	Ecosystem (Freshwater Ecology)	B-	B-	B-	B-	**[Construction Phase]** Little or minimal impacts on aquatic bodies as most sampling stations are already heavily polluted as a result of domestic and industrial activities in the area except those less affected by human activities, such Masaluso River and Cutcut River Tributary. (-) Disruption of water flow by earth-moving activities may affect nearby aquatic habitats which serve as shelter, spawning and nursery grounds for aquatic animals. (-) Erosion of sediments through land clearing and stockpiles of sediment may end up as runoff to nearby sections especially during storm and heavy rains. These may adversely affect plankton and macrobenthos fauna. (-) Water pollution from spills of vehicles, domestic sewage of workers may give rise to eutrophication, changes in composition of aquatic fauna and mortality of highly sensitive species of fish and aquatic insects. (-) loss of fish by illegal fishing by workers. **[Operation Phase]** (-) Spills from train during normal operations and occasionally due to accidental spills from train and at depot will cause negative impacts on aquatic animals. (-) An increase of the local population induced by the railroad could result in an undesirable increase of domestic wastes which may pollute freshwater bodies and adversely affect aquatic organisms
10	Hydrology	C	C	A-	B-	**[Construction Phase]** (-) construction of stations and viaduct pier may clog existing drainage systems and block creeks, canals and other waterways, may cause sedimentation and flooding in the surrounding areas during heavy rainfall. **[Operation Phase]** (-) The proposed NSRP-South embankments may induce flooding and inundation due to drainage overflows, surface run-off and siltation. (-) Viaduct pier insulated in rivers may impact to the exiting water flow and may induce local flooding.
11	Ground Hydrology	C	C	D	D	**[Construction Phase]** Concreting works at the stations and depot will bring about increase in water consumption. However, the amount is not significant and will not affect the water supply needs of the host LGUs. **[Operation Phase]** Railway operations will not contribute to the depletion of the local groundwater resources or compete in water use with local residents and establishments.
12	Geographical features	C	C	B-	B-	**[Construction Phase]** (-) Ground rupture can affect the segment between Muntinlupa and Alabang stations. (-) the operation of heavy equipment for transporting, hauling and excavated materials from one area to another so as to avoid spills into drainage systems or nearby waterways. The stockpiles of excavated materials if not properly managed could be exposed to erosion especially during rains and will contribute to the siltation of nearby drainage systems or natural waterways. **[Operation Phase]** (-) Landslide and lahar flows can block the railway route or hit the moving train and damage the railway cars. Ground shaking can bring about liquefaction and settlement of the track and stations foundation and can also damage bridge crossings.

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
Social Environment						
13	Resettlement/ Land Acquisition	A-	A-	A-	A-	**[Construction Phase]** (-) Resettlement and disturbance to properties are unavoidable along the proposed railway alignment, station, and depot. The total of approx. 12,210 Project Affected Families (PAFs) will be displaced due to the loss of their dwellings (Refer to Draft RAP). (-) The acquisition of additional land for the project ROW for the proposed stations and curved alignment, displacement of households, businesses and commercial establishments, and displacement from the source of livelihood are unavoidable. **[Operation Phase]** (-) Payment of compensation, preparation of relocation sites might be delay and insufficient livelihood and income restoration program are provided. This will delay restoration of livelihood and income of PAFs and worse the living standard prior to the construction.
14	Poor people	A-	A-	A-	A-	**[Pre-Construction / Construction Phase]** (-) Most of the affected approx. 11,384 ISFs are regarded as the poor. Issues of vulnerable group are not take into account and the resettlement of ISFs might worsen their livelihood by loss of income etc. **[Operation Phase]** (-) Improvement of their economic situation and relocation sites might take a longer and livelihood make get worse comparing to prior construction.
15	Ethnic minorities and indigenous peoples	C	C	D	D	The Project will have no direct impacts to the indigenous peoples near the Project site since there are no recorded indigenous tribes or groups near the impact areas
16	Local economies, such as employment, livelihood, etc.	B-/+	C	B-/+	B-/+	**[Pre-Construction / Construction Phase]** (-) The project may lead to a decline or eventual loss of business in affected areas. Land acquisition will force commercial establishments and farmers may need to move out and might cause income loss and unemployment. Livelihood of the local community such as commercial establishments, vendors and tenants, may experience temporary disturbance during construction. (+) The construction activities will create temporary employment of about 13,000 workers skilled and unskilled laborers. (+) the demand for retail and other services by the manpower influx may increase economic activities and benefits for some local businesses. **[Operation Phase]** (+) the operation of the NSRP-South will provide employment to approx. 1,550 employees for manning the stations, operations and maintenance of trains at the depot. (+) The NSRP-South will boost regional economic activities at the stations attracting future commercial development as well as along the route through provision of an efficient mass transit system and promotes urban and economic development by enhancing workforce mobility between the industrial zones. (-) Influx of migrant workers during operation of the proposed NSRP-South will intensify the competition for jobs of locals.
17	Land use and utilization of local resources	B-/+	B+	B-	B+	**[Construction Phase]** (-) Plans, zoning ordinances, and economic development programs of the affected LGUs and national government agencies with similar road and infrastructure projects in the vicinity of the alignment might be affected. **[Operation Phase]** (+) The proposed NSRP-South will provide a more efficient and safer transportation facility. As a result, land development is expected to increase along or near the corridor through conversion of low density residential areas to higher density residential and commercial uses. (+) the proposed NSRP-South may enhance the access to tourist destinations in the host LGUs because of shorter time and the easy access

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
18	Water usage	C	C	B-	D	**[Construction Phase]** (-) There are small creeks in agricultural area might be temporary blocked due to civil works. (-) During construction, concreting works will bring about increase in water consumption about 10 m^3 per day. However not significant and will not affect the water supply needs of the host LGUs. **[Operation Phase]** Not be significant and essentially limited to the drinking water requirement of the operations staff, maintenance of comfort rooms and the regular cleaning of the stations, depot and cars (in total 252 m^3 per day).
19	Existing social infrastructures and services	C	C	B-	B-	**[Construction Phase]** (-) Temporarily interruption of utility services relocation may inconvenience the communities. (-) Increase in demand for resources such as power and water supply, additional schools, markets and community service facilities, etc. in the resettlement areas is expected. (-) Solid waste or soil generated by the construction activities may overload the local disposal site. **[Operation Phase]** (-) Development of infrastructure such as power and water supply, additional schools, markets and community service facilities, etc. might take longer at the resettlement areas as well as take longer to integrate into each host LGU and provider.
20	Social structure such as social capital and local decision-making institutions	C	C	B-	B-	**[Pre- Construction/ Construction Phase]** (-) The total of approx. 11.384 ISFs will be relocated to the existing/newly developed relocation sites. (-) Fair compensation are not paid to those affected people. (-) The influx of ISF due to the delay in construction. **[Operation Phase]** (-) Integration of existing residents and new settlers might take longer at the relocation sites. The impacts to barangay's/ residents' societies might continue.
21	Misdistribution of benefits and damages	B-	B-	B-	B-	**[Pre- Construction/ Construction Phase]** (-) The total of approx.12, 210 PAFs will be displaced due to the loss of their dwellings. (-) Some commercial and business establishment and farmers along the proposed alignment will be displaced and will lose income. (-) Fair compensation are not paid to those affected people. **[Operation Phase]** (-) Provision of compensation and restoration of livelihood of PAFs might take a longer period of time.
22	Local conflicts of interest	B-	B-	B-	B-	**[Pre- Construction/ Construction Phase]** (-) The total of approx.11.384 ISFs will be displaced, which might cause a conflict between existing residents and new settlers at the relocation sites. (-) Migrant workers may also bring in cultures and views not acceptable to the locals and other social ills **[Operation Phase]** (-) Conflict resolution between existing residents and new settlers might take longer at the relocation sites.
23	Historical/Cultural heritage	C	C	B-	B-	**[Pre- Construction/ Construction Phase]** (-) The old PNR Structures in will be affected by the proposed NSRP-South. Design might require to remove or relocated. During construction, vibration might cause the negative impact to the state of structure. (-) NHCP heritage of Lord Justo Ukon Takayama Monument, Alberto Rizal House might be impacted by vehicle access and vibration generating construction activities. **[Operation Phase]** (-) In sufficient provision of mitigation measure on the old PNR Structures and existing NHCP heritage will deteriorate the value.

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
24	Landscape	B-	C	B-	B-	**[Construction Phase]** (-) Improper handling and disposal of construction and domestic wastes may result in visual pollution and will have an aesthetic impact on the landscape, but temporary. **[Operation Phase]** (-) The existing surrounding landscape value might be disturbed by the proposed vertical structures interrupting views across landscape.
25	Gender	C	C	B-	B-	**[Pre- Construction/ Construction Phase]** (-) Lack of awareness on the issue of gender and vulnerable groups will results the project not sufficiently addressing the needs of female and vulnerable groups. **[Operation Phase]** (-) Train system might lack in needs of gender-sensitive facilities and furnishings. (-) Poor access of solo parents to employment and other livelihood opportunities.
26	Children's rights	C	C	B-	B-	**[Construction Phase]** (-) The blocking of access roads will lead to possible disruption for access to school. (-) Involuntary resettlement might affect school activities in case relocation would be conducted during the school year. (-) Relocation site might lack in educational institutions or cause difficult to access. (-) Potential risks of displacement and loss of livelihood may increase threats of increased poverty to households already living below poverty threshold. Loss of income will cause them potential exclusion and difficulty in their access to basic social services compromising the well-being of the household members specially children and women. **[Operation Phase]** (-) development of social infrastructure including school, and improvement of the economic situation of vulnerable group might take longer.
27	Infectious diseases such as HIV/AIDS	B-	D	B-	B-	**Construction Phase]** (-) potential air and water pollutants generated by the construction activities may have adverse impacts on the health and safety of residents of nearby communities, specifically those along the project boundary (-) Most construction workers will be hired locally. However, infectious diseases such as HIV/AIDS might be spread due to workers from outside. (-) The workers and the local community also run the risk of exposure and spread of contagious/ infectious diseases due to unsanitary condition at the project site. **[Operation Phase]** (-) The health of employees working at the stations and depot may be affected from exposure to unsanitary conditions.
28	Working conditions (including occupational safety)	B-	B-	B-	B-	**[[Construction Phase]** (-) there are potential construction activities such as site preparation, excavation work which will involve excavation of previously contaminated area. (-) Workers may be exposed to ergonomic stress and increased levels of noise, air and water pollutants, and heat, as well as physical hazards associated with heavy lifting, moving heavy equipment, etc. (-) Increased risk of construction-related accidents due to improper work ethic and requirement to construct quickly. **[Operation Phase]** (-) Improper work ethics might threat health and safety of workers and passenger at the stations and depot. (-) The health of employees working at the stations and depot may be affected from exposure to unsanitary conditions.

No	Items	Assessment in Scoping		Assessment based on Survey results		Assessment of Impact
		Pre/During construction	Operation	Pre/During construction	Operation	
Others						
29	Trans-boundary impacts or climate change	B-	B+/-	B-	B+/-	**[Construction Phase]** (-) The operation of construction machines and vehicles will emit CO_2 temporarily but the impact on global warming will be slight. (-) Intense rainfall would potentially cause damage to embankment and earthwork due to soil erosion, landslides, and flooding. High temperature and heat waves would potentially cause heat stress to workers. **[Operation Phase]** (+) The emission of GHG will decrease due to the modal shift, "electrification" of passenger railway systems and increase of vehicle travel speeds. (-) Climate change will impact to the operation of railway. Extreme events may disrupt operations and add costs to operation.
30	Accidents	B-	B-	B-	B-	**Construction Phase]** (-) Traffic accidents are likely to occur due to the increase of construction vehicles, unmanaged temporary access, and change in traffic pattern. **[Operation Phase]** (-) There may be increased vehicular flow in areas adjacent to stations and depot that may cause traffic accidents.
31	Risk of flood	C	C	B-	B-	**[Construction Phase]** (-) The NSRP-south goes through the flood prone zone of Metro Manila and Laguna area. Segment from Taguig to San Pedro has high susceptibility to flooding. (-) The improper handling, storage, and hauling of stockpiles of excavated materials/spoils, the proposed NSRP-South may potentially induce flooding and cause inundation due to sediment run-off, siltation and drainage overflow. (-) Due to the construction of impervious structures such as the viaducts, storm water run-off may increase that would change the flood storage capacity of waterways and its floodplains **[Operation Phase]** (-) Embankment may act as a dam to cause flooding and inundation in upstream areas.

Note: Impact Items refer to "JICA Guidelines for Environmental and Social Considerations April 2010"
A+/- Significant positive/negative impact is expected,
B+/- Positive/negative impact is expected to some extent
C Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D No impact is expected

Source: JICA Design Team

9.1.9 Environmental Management Plan and its Implementation Cost

The Environmental Management Plan (EMP) as shown on Table 9.1.51, presents the mitigation/enhance measures for the impacts that may arise during the Pre-Construction, Construction, and Operational Phases of the proposed Project.

9.1.10 Environment Monitoring Plan

The Environment Monitoring Plan (EMoP) as shown on Table 9.1.52 will be prepared to monitor the environment impact and effectiveness of measures during the construction and operation. The EMoP will also include the items to be monitored, monitoring methodology, time and frequency, monitoring points, and cost and implementation intuition.

Table 9.1.51 Environment Management Plan for the Proposed NSRP-South

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
General				
Pre-construction, Construction and Operation activities		Comply with the relevant laws: • RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - Secure hazardous waste generator's ID from DENR-EMB; - Provision of hazardous materials storage area; - Hazardous materials/ wastes will be stored in appropriate container properly sealed and labelled; - Hazardous waste will be hauled by an accredited transporter; - Hazardous waste will be treatment by a registered treater (TSD Facility). • RA 9003: management and disposal of solid wastes - Waste segregation, recycling, provision of waste color coded bins, etc.; - Provision of Material Recovery Facility (MRF); - Regular hauling of solid wastes through the LGU or private contractor. • RA 8749: comprehensive air pollution control policy - Secure permit to operate for all air pollution source installations (i.e generator set); - Regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; - Regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary; - Control vehicle movement maintaining the speed limit within the construction site to <10 kph and provide cover to loaded trucks. • RA 9275: comprehensive water quality management and for other purpose - Secure discharge permit; - Provision of Wastewater Treatment Facility at the depot; - Provision of three-chambered septic tank at each station. • PD 442: Labour Code of the Philippines, as amended (including Occupational Safety and Health Standards) - Gender equality will be considered in hiring of workers; - Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. - Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. - Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies.;	• DOTr PMO • Contractors • Operator • LGUs • MMT	Included in the contractor and operator's service fee on health, safety and environmental management • RA 6969: PhP 100,000/yr • RA 9003: PhP 400,000 /yr • RA 8749: PhP 400,000/yr • RA 9275: PhP 400,000/yr • PD 442: PhP 6,000 / worker • PD 856: PhP 50,000/yr • Sanitary facility: PhP 200,000 / per site • Emergency Response Plan and Health and Safety Management Plan: Php 300,000 • Health and Safety Desk or Medical Station: Php 200,000/per site • PhP 1,500 / man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
		- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient; • PD 856: Sanitation Code of the Philippines - Provide safe and clean water for drinking; - Provision of appropriate sanitary facilities such as portable toilets and waste bins. • Implementation of Emergency Response Plan and Health and Safety Management Plan to include but not limited to: - Distribution of manual/guideline for workers/employee on health and safety, environment management; - Orientation and continuous training of qualified workers/ employee/ operator on Environment Management, Basic and Construction Occupational Safety and Health, Scaffolding Safety, Fire Safety and Safe Use of Chemicals at Work; - Provision of earthquake, fire drills for workers; - Provision of appropriate PPE for workers; - Provision of security personnel. - Regular monitoring of site condition		
Pollution Control				
Air Pollution	• Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction activities • Degradation of air quality due to gaseous emissions from machineries and service vehicles	**[Construction]** • Minimize the removal of vegetation and alteration of topography if possible. • Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Conduct prompt inspection and regular maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards • Control vehicle movement maintaining the speed limit within the construction site to <10 kph and minimize vehicle transport by maximizing the use of site generated materials • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from construction equipment and vehicles and wetting of ground soil in the construction site when necessary. Stock pile and trucks loaded with spoils will be covered. • Implement materials handling program or a site protection and rehabilitation program. • Monitor air quality at identified nearby sensitive receptors regularly and evaluate effectiveness of the air pollution reduction measures provided. • Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED • PhP 1,500 / man-hour • Monitoring: PhP 30,000 to 80,000 / per sampling station depending on the parameter/s to be monitored
Water Pollution.	• Degradation of surface water quality • Threat to abundance, frequency and distribution of species	**[Pre-Construction/ Construction]** • Design and implement the temporary drainage of waste water from construction yard/ facilities/ camp, surface water runoff drainage systems to minimize discharge. • Design and install sewage treatment facility and separate non-sewage wastewater for stations and Depot in compliance to the Sanitation Code of the Philippines. In addition, depot will have interceptor tank to remove oil and fuel from surface water.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED • Php 50,000/per discharge permit • Treatment facility: Php

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
		• Compliance with RA 9275, secure discharge permit. **[Construction]** • Install wastewater treatment, portable sanitary facilities at construction sites/yards • Conduct proper inspection and regular maintenance of construction machineries, equipment, vehicles and wastewater treatment equipment and facilities with appropriate measure to collect any leakage • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal including the temporary storage by contractor in accordance with RA 9003. • Implement material handling program or a site protection program. • Conduct of effluent quality monitoring at discharge point		5,000,000/site • Php 1,500/man-hour • Php 100,000/yr for Hazard waste disposal. • Php 400,000 /yr for Solid waste disposal • Php 25,000/per sampling station
	Degradation of groundwater quality	**Pre-Construction]** • Plan and Implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations. • Install sedimentation / filtration pond at tunnel construction area. **[Construction]** • Comply with environmental permitting requirements for the storage, transport, handling, treatment, and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969, and solid waste / soil management plan, in accordance to RA 9003.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED
Soil Pollution	Degradation of soil quality (soil contamination)	**[Construction]** • Proper inspection and maintenance of machines and equipment. • Strictly implement solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Conduct soil quality monitoring in case of any possible contamination events occur.	• DOTr • Contractor	Construction cost to be finalized during the DED • Php 1,500/man-hour • Php 25,000/ per sampling station
	Exposure to contaminated soil	**[Pre-Construction/ Construction]** • Identify a potential contaminated site and conduct of soil sampling survey at potential contained site, if necessary. Conduct Environmental Site Assessment if there is suspected contamination on the proposed location of facilities (e.g. depot). In case traces are detected, construction activities on site shall be paused until a soil management plan is developed and implemented in consultation to the DENR – EMB. • Storage, handling, transport, treatment and disposal of contaminated soil will be in accordance with RA 6969 **[Construction]** • Conduct continuous monitoring of toxic level to ensure that contaminants will not pose hazards.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED: • Php 25,000/ per sampling station • ESA Phase I Php 150,000 /site • ESA Phase II Php 1,000,000/site • ESA Phase III depends on extent of contamination. • Php 1,500/man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Waste	• Devaluation of land value • Increased demand on waste disposal	**[Construction]** • Disposal of solid waste, excavated soil, hazardous waste at the identified disposal sites in each LGUs. • Strictly implement solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003. • Conduct Social Development Plan (SDP) including waste management to the communities.	• DOTr • Contractors • LGU • MMT	To be included in the contractor's Service Cost: • Php 1,500/man-hour • SDP: Php 15,000 /per person
	• Improper handling of excavated soil	**[Pre-Construction/Construction]** • Plan and implement recycling and reuse of excavated soil to be utilized for the project/ other project as much as possible. In case of excessive soil to be generated, identify the capacity of existing soil dump site and the final spoil disposal site. **[Construction]** • Place excavated materials on appropriate dump sites or spoils area and with adequate containment. • Strictly implement construction plan, soil management plan, and proper disposal by contractor in accordance to RA 9003, minimization of waste, segregation.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 3,000 /haul per track • Php 400,000 /yr for Solid waste disposal
Noise and Vibration	• Increase in ambient noise level • Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	**[Pre-Construction/ Construction]** • Select sites (i.e. construction yard, temporary facilities, access route) in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected • Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities. • Design and adopt long rails and ballast-less track with elastic and absorbent sleeper support to minimize noise generation from train operation **[Construction]** • Implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries, and vehicles in accordance to the noise emission standard. • Minimize alteration of topography and removal of vegetation. • Install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries. Use of electric instead of diesel powered equipment, hydraulic tools instead of pneumatic tools. • Conduct regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard • Provide appropriate PPE to construction workers • Monitor noise levels at identified nearby sensitive receptors (residential, school and hospital areas) including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED • Php 1,500 /man-hour • PPE: Php 8,000 /personnel • Php 25,000/per sampling station • Php 30,000/ per meter noise barrier
	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors	**[Pre-Construction / Construction]** • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED • Php 1,500 /man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
	• Threat to existence and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species	to provide proper protection provision measures and continuous monitoring from the impact of vibration. **[Construction]** • Implement construction activities in consideration of time, duration, and scale of construction to optimize the use construction equipment, machineries, and vehicles with minimal vibration generation. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible • Provide training on vibration mitigation and provide appropriate PPE to construction workers; • Monitor vibration levels including identified nearby sensitive receptors, old PNR structures including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided.	• LGUs	• Php 25,000 /per sampling station • Php 15,000/ per training
Ground subsidence, Natural Hazard	Loss of soil strength, settlement of soil, lateral spreading, bearing failure, floatation of embedded structures, damage to overlaying structures, in the event of natural disaster Damage to railway infrastructure and risk to the life of construction workers	**[Pre-Construction/Construction]** • Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. • Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. **[Construction]** • Install sufficient protection measure such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. • Proper inspection of all installed and constructed / ongoing construction structures and facilities.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED • Php 1,500/ man-hour • Soil Improvement: PhP 30,000 / m^2
Bottom sediment	• Disturbance on bottom sediment and degradation of surface water • Siltation • Induce of turbidity	**[Pre-Construction]** • Based on the hydrological and geodetic surveys, design bridge piers that will minimize installation within the rivers and select appropriate construction materials to be used. • Minimize the removal of vegetation cover, alternation of topography as much as possible. • Plan and implement construction activities in consideration to the water course, embankment, and dry season. • Coordinate with NWRB, DPWH and LGUs for necessary permit **[Construction]** • Install protection measures for soil erosion and bottom sediment around the bridge piers if necessary. • Place excavated material in temporary staging area with provision for silt traps/ siltation pond to avoid silt draining to waterways, degradation of surface water quality and clogging of waterways, if necessary. • Conduct regular surface water quality monitoring.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED • Php 1,500/ man-hour • Soil erosion control: Php 30,000 / m^2 • Php 25,000 /per sampling station

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Natural Environment				
Ecosystem (Flora)	• Loss of Habitat • Removal of vegetation along the proposed NSRP particularly the planted trees at FTI, Solis and other areas along the ROW	**[Pre-Construction]** • Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary clearance of tree cutting. • Conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimize removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/endemic/ indigenous species of trees, shrubs and grasses shall be specified for replacement trees. • Wildlings of the endangered and threatened species, if any, will be collected before construction, placed in the nursery, and give priority during nursery operation to be used for rehabilitation of areas that will be affected by project. • For tree replanting, areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone and to improve habitat for wildlife. For those that cannot be replanted within the project area, coordination with the DENR and LGUs on the identification of area for the potential trees that will be relocated. • Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. **[Construction]** • Conduct tree planting activities to compensate site clearing activities. • Conduct regular monitoring on survival of replanted trees and replant if necessary.	• DOTr PMO • Contractors • LGUs	Construction cost to be finalized during the DED • PhP 1,000,000 for the 100% tree inventory • PhP 100/ sapling • Php 1,500/ man-hour
Ecosystem (Fauna)	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	**[Pre-Construction/ Construction]** • Design, plan and implement the project that will minimize vegetation clearing, alteration of landform, generation of noise, vibration, illumination, and vehicular movement particularly in areas adjacent to flora of higher conservation significance (i.e. Antipolo, Is-is, Narra) and in the vicinity of ecological significant areas. • Prepare and implement a tree and vegetation management plan as part of the construction plan considering the significance to fauna (local bird species) such as installing buffer zone, minimizing the use of herbicide and machinery as much as possible. • If any concern arises, consult to stakeholders including DENR, University of Philippines, and concerned NGOs. If required	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED • Php 1,500/man-hour
Hydrology	Impact to water flow	**[Pre-Construction /Construction]** • Design and install sufficient drainage system including temporary drainage system during construction to accommodate the surface water runoff from the project and avoid any flooding in the rea caused by the project in consideration to the existing drainage system and flood storage capacity • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system in robust to flood and related extreme events including temporary construction drainage, train structure to be above the flood level, installation of drainage pumping system, etc. • Based on the hydrological, design and install viaduct piers.	• DOTr • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 1,500/man-hour • Drainage: Php 15,000/m

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
		• Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. **[Construction]** • Minimize removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt trap to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste/ soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal by contractor in accordance to RA9003. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.		
Ground Hydrology	Depletion of water resource/ competition in water use	**[Construction]** • Will utilize surface water from the local water service provider/s • Conduct regular monitoring of water consumption • Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp.	• DOTr PMO • Contractors • LGU • MMT	To be included in the contractor's Service Cost: • Php 1,500/man-hour • water conservation program: PhP 300,000 / per site
Geographical Features	Permanent and major modification of the terrain and alteration of landform	**[Pre-Construction /Construction]** • Formulate appropriate design measures for the protection on slopes and banks, soil improvement / ground reinforcement to minimize ground failure during construction based on the results of the geological survey and geotechnical investigations.	• DOTr • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 1,500/man-hour • Soil erosion control: Php 30,000 / m^2
	Soil erosion	**[Pre-Construction/ Construction]** • Design and install of appropriate mitigating measures to prevent or minimize slope failure during construction based on the results of the geo hazard assessment and geotechnical investigations. **[Construction]** • Minimize the removal of vegetation cover as much as possible, provision of slope stabilization measure/s, when necessary. • Install surface water runoff drainages system, protection of slope and bank as required. • Implement appropriate materials handling program or a site protection and rehabilitation program including but not limited to the following; - Scheduling of clearing and excavation activities in speedy manner during dry season if possible. - Installation of temporary erosion ponds or silt traps around the major work areas. - Placement of excavated materials on appropriate staging site or spoils area and with adequate containment. Limit stock pile height up to 2 m high only. - Installation of fence at the stockpiles of sand and gravel to reduce sediment transport during heavy rains including reduction of storage time in the work areas.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 1,500/man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
		• Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system		
	Loss of soil strength, settlement of soil, lateral spreading, bearing failure, floatation of embedded structures, damage to overlaying structures, in the event of natural disaster Damage to railway infrastructure and risk to the life of construction workers	**[Pre-Construction/Construction]** • Design and implement appropriate foundation and structures based on combination of geotechnical, geodetic and hydrologic study, and seismicity studies, and in compliance with the National Building Code and the Structural Code of the Philippines and internationally accepted guideline. • Design and install emergency escape route, early warning (alarm) system, emergency power supplies in the design of the structure particularly in the viaduct. • Plan and implement appropriate construction method, schedule, and activities based on combination of geotechnical and geological investigations, and seismicity studies in coordination with the PHIVOLCS. **[Construction]** • Install sufficient protection measure such as soil improvements during excavation activities and implement appropriate materials handling program or a site protection and rehabilitation program. • Proper inspection of all installed and constructed / ongoing construction structures and facilities. • Coordinate with the PHIVOLCS during earthquake and volcanic events to adjust construction schedule. Conduct earthquake drills for workers.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 1,500/man-hour • Soil improvement: Php 30,000 / m^2
Social Environment				
Resettlement/ Land Acquisition	Displacement of Residents and commercial establishments along the project alignment	**[Pre-Construction]** • Design train system maximizing the existing PNR ROW and minimizing additional land acquisition. • Conduct sufficient stakeholder consultation meetings to disclose the project, affected area, timeline, compensation package, grievance redress mechanism etc. • Implement RAP in coordination with LGUs, lot owners and other concerned stakeholders and agencies in acquiring the land and/or securing ROW, and justly compensated prior to displacement. • Prepared and Implement RAP in coordination with KSAs/NHA, LGUs, lot owners and other concerned stakeholders and agencies in acquiring the land and/or securing ROW, relocation of ISFs and justly compensated prior to displacement. **[Pre-Construction/ Construction]** • Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established Grievance Redress Mechanism (GRM)	• DED consultants • DOTr PMO • LGUs	DED cost / To be included in RAP Budget

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Poor people	• Displacement of ISFs • Disturbance of livelihood • Loss of income	**[Pre-Construction]** • Prepare and implement RAP to ensure that ISFs are provided with proper relocation sites and/or justly compensated and Livelihood and income restoration. • Prior to displacement, secure and/or develop relocation sites in coordination with the concerned LGUs, Key Shelter Agencies, and other concerned stakeholders with conducive living condition and basic utilities, services and amenities. • Conduct sufficient stakeholder consultation meetings to disclose the project, affected area, timeline, compensation package, grievance redress mechanism etc. **[Pre-Construction/ Construction]** • Conduct external and internal monitoring to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established Grievance Redress Mechanism (GRM)	• DOTr PMO • DED consultants • LGUs • SHFC	DED cost / To be included in RAP Budget
Local economies, such as employment, livelihood, etc.	Generation of Local Employment	**[Pre-Construction /Construction]** • Close coordination with the host LGUs (barangay level) regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Those affected by the Project will be prioritized for employment in consideration to gender equality. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP	• DOTr PMO • Contractors • LGUs	RAP cost/ To be included in the Construction Cost • IEC: Php 50,000/ per meeting with Barangay /LGU • Training: Php 15,000/ per PAFs
	Loss/ disturbance of local commercial establishments, vendors, agricultural land	**[Pre-Construction]** • Conduct sufficient stakeholder consultation meetings to disclose the project, affected area, timeline, compensation package, grievance redress mechanism etc. • Prepare and Implement RAP in coordination with LGUs, business owners and vendors, employers and agricultural landowners and justly compensated for their income loss prior to displacement. **[Pre-Construction/ Construction]** • Prepare and implement livelihood and income restoration for PAPs whose present means of livelihood is no longer viable and will have to engage in a new income activity. • Conduct Social Development Plan (SDP) including livelihood training include business owners and vendors, employers and agricultural land owners affected by the project including venders • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • If PAFs raise an issue, ensure prompt response and resolution per established GRM	• DOTr PMO • DED consultants • LGUs • , SHFC	DED cost / To be included in RAP Budget
Land use and utilization of local resources	Incompatibility with the Existing Land Use	**[Pre-Construction]** • Information sharing to the affected LGU to align and ensure that proposed NSRP shall be accommodated in their future land use plan • Identification of future land use of surrounding areas that will result to a significant increase of transportation-oriented developments in cooperation with urban planners of LGUs to adopt in the future developments.	• DOTr PMO • LGUs	N/A

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Water usage	Depletion of water resource/ competition in water use	**[Construction]** • Utilize surface water from the local water service provider/s • Conduct regular monitoring of water consumption • Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp.	• DOTr PMO • Contractors • LGU • MMT	To be included in the contractor's Service Cost: • Php 1,500/man-hour • water conservation program: PhP 300,000/per site
Existing social infrastructures and services	Increased demand on public infrastructure	**[Pre-Construction / Construction]** • Prepare and implement RAP in consideration of relocation site to be sufficiently covered the expected demand of basic services and resource and social programs at relocation sites in coordination with LGUs.	• DOTr PMO • LGUs • NHA, KSAs	To be included in RAP Budget /
	Disturbance on utility	**[Pre-Construction]** • Prepare and implement utility relocation plan in coordination with utility companies such as water, electricity, telephone, gas and oil, • Prepare and implement protection plan during relocation activities	• DOTr PMO • Contractors • LGU	To be included in the contractor's Service Cost: • Php 1,500/man-hour
	Potential conflict with ferry operation	**[Pre-Construction]** • Close coordination with the MMDA and affected ferry companies to align and ensure that the proposed NSRP construction schedule and activities shall be accommodated in their operation plan • Plan appropriate method and schedule of construction to minimize the impact to existing ferry operation **[Construction]** • Strictly implement construction plan	• DOTr PMO	N/A
	Impact on Public Access	**[Pre-Construction/ Construction]** • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary disclosure during construction, minimize the impact to the daily life of affected communities such as access to social infrastructure in coordination with host LGUs for the schedule of construction activities. • Disseminate information to the public, barangay, and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. • Provision of diversion route with appropriate health and safety measures. In case of any changes, prompt update on the diverted routes to the concerned communities and LGUs, • Assignment of traffic guide to provide assistance to the road users.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost/ To be included in the Construction Cost: • Php 1,500/man-hour • IEC: Php 50,000/ per meeting with Barangay /LGU
Social structure such as social capital and local decision-making institutions	Conflict between existing residents and new relocates	**[Pre-Construction / Construction]** • Prepare and implement Social Development Plan (SDP) in coordination with the host LGUs to align projects or programs to their development plans	• DOTr PMO • LGUs • NHA, KSAs	To be included in RAP Budget / the DOTr's service fee: SDP: Php 15,000/ per person

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
	In-migration to the project area	**[Pre-Construction / Construction]** • Plan and implement construction schedule to shorten time between the pre-construction and construction as much as possible. • Install fencing and guarding of the proposed project to restrict the public from entering the ROW.	• DOTr PMO • Contractors • LGUs	To be included in the contractor's Service Cost: • Php 10,000/per meter of fence
Misdistribution of benefits and damages	• Displacement/ Disturbance of Properties • Change/Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)	**[Pre-Construction]** • Prepare and implement RAP to ensure that PAFs are justly compensated for the loss of income by the project. • Payment of compensation prior to displacement. • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • Implement RAP in coordination with KSAs/ NHA, LGUs, lot owners and other concerned stakeholders and agencies to address the issue on land acquisition and relocation of informal settlers. **[Construction]** • If PAFs raise an issue, ensure prompt response and resolution per established GRM	• DOTr PMO • LGUs • KSAs	To be included in RAP Budget
Local conflicts of interest	Potential conflict among PAFs, LGUs and other government infrastructure projects	**[Pre-Construction]** • Close coordination with DPWH, PSALM and other relevant agencies. • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are justly compensated for the loss of income by the project prior to displacement. • Conduct external and internal monitoring agencies to ensure that displacement activities are conducted in compliance to the RAP. • Prepare and implement arrangement on financial assistant to the receiving LGUs of PAFs. **[Construction]** • If PAFs raise an issue, ensure prompt response and resolution per established GRM	• DOTr PMO	
Historical/Cultural heritage	Impacts on /Cultural Historical resources	**[Pre-Construction /Construction]** • Conduct literature review and site validation of the potential historic structures in coordination with PNR and NHCP; • Perform measured survey of the identified historic structures including its foundation and building condition. • Coordinate closely with the NCCA, National Museum, NHCP, concerned LGUs, and PNR for verifying the qualification of those structures and provide necessary protection measures. • Prepare and implement a protection plan for those identified PNR structures which shall be maintained **[Construction]** • Close coordination with the National Museum on the appropriate course of action in case of any archaeological finds.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED • Php 1,500/man-hour • Php 100,000 / per m^2

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Landscape	Degradation of aesthetic view	**[Pre-Construction/ Construction]** • Design and install facilities to harmonies with the surrounding environments (shape, color, size, etc.) • Identify and plant trees within the ROW that will not be covered by development to act as buffer zone, green corridor and to lessen aesthetic sore brought by construction and railway structures **[Construction]** • Maintain the construction site/ yards tidy and clean and rehabilitate after construction. • Provision for temporary screens/ walls to minimize the visual clatter.	• DOTr PMO • DED Consultant • Contractors	DED cost / construction cost to be finalized during the DED • Php 1,500/man-hour • Php 10,000/ per meter of screen
Gender	Degradation of Livelihood Opportunities and improvement of Safety by lack of consideration	**[Pre-Construction/ construction]** • Prepare and implement RAP to ensure that gender equality and needs of vulnerable group are well addressed • Design and install train system in consideration to the following: - Strategic placement of security and lighting within the vicinity of the stations; - Adopt universal design • Employ workers in consideration to gender equality. • Include gender sensitive livelihood and skills training program in the SDP with due consideration to vulnerable group	• DOTr • DED consultants • Contractors • LGUs	DED cost / To be included in the Construction Cost: • Php 1,500/man-hour • SDP: PhP 15,000/per person
Children's rights	Impact to School Access	**[Pre-Construction/ Construction]** • Prepare and implement RAP in consideration of relocation site to be sufficiently covered the expected demand on access to educational institution in coordination with LGUs. • Based on the study on public access at affected barangay, maintain the existing public access as much as possible. • In case of any temporary disclosure during construction, minimize the impact to the daily life of affected communities such as access to social infrastructure in coordination with the DepEd and host LGUs for the schedule of construction activities. • Disseminate information to the public, barangay, and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. • Relocation activities to be conducted in consideration to school term.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost/ To be included in the Construction Cost: • Php 1,500/man-hour • IEC: Php 50,000/ per meeting with Barangay /LGU
Infectious disease / community health and safety	Degradation of public health	**[Pre-Construction / Construction]** • Formulation and implementation of IEC Plan to inform the affected LGU and local communities and the general public about 1) the project, project activities, duration, possible project impacts and incorporate their comments and inputs in the design, 2) the potential impact of project activities to air quality, noise, vibration, and climate change, and corresponding health and safety mitigation measures, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites/facilities/yard and access route in consideration to health and safety of local communities. • Plan and implement social development plan including health and safety of local community **[Construction]** • Provide safety officers to monitor the health and safety of the local community. If any complains	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED: PhP 1,500/man-hour • IEC: Php 50,000/ per meeting with Barangay /LGU • Php 10,000/ per meter of screen

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
		rises, immediately identify the causes and evaluate built-in measures. • Install fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that the area is not accessible to the public. • Implement Emergency Response Plan and Health and Safety Management Plan.		
	Increase risk of infectious disease of workers	**[Pre-Construction / Construction]** • Include medical certificate in the requirements for hiring of workers to ensure that they are fit to work. Ensure that they are provided with proper training on construction, occupational health and safety, and emergency response procedure. • Provide safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins. • Prepare and implement occupational Health and Safety Management Plan	• DOTr PMO • Contractors • LGU	Included in the contractor's service fee on health, safety and environmental management: • Php 50,000/month for clean drinking water
Working conditions (including occupational safety)	Increase risk of accidents at construction sites	**[Pre-Construction / Construction]** • Prepare and implement occupational Health and Safety Management Plan • Plan of construction including storage of equipment and machinery, and access route of heavy vehicle considering health and safety of workers • Provide appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment. • Establish Health and Safety Desk or Medical Station at the active construction sites to monitor and safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies. • Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.	• DOTr PMO • Contractors • LGUs	Included in the contractor's service fee on health, safety and environmental management • PhP 4,000/ personnel for PPE • Php 1,500/man-hour • Health and Safety Desk or Medical Station: Php 200,000/ site
Others				
Trans-boundary impacts or climate change	• Exhaust emission from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders	**[Pre-Construction]** • Minimize the removal of vegetation and alteration of topography if possible. **[Construction]** • Conduct proper inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard **Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible**	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED: • Php 1,500/man-hour
	• Restrictions/ disruption of construction due to soil erosion/landslides/ and flooding. • Slower drainage, soil erosion, disruption in construction by increased rainfall • Overheating of	**[Pre-Construction]** • Take account of change in local micro climate such as rainfall, temperature pattern for 2020 and 2050 in project design criteria and schedule of construction works. • Based on the hydrological and geodetic study, design and install train system which is robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct and embankment) i.e. train facilities to be above the flood level, installation of drainage pumping system. **[Construction]** • Adjust construction activities in consideration to local climate / extreme events such as extreme	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED • Php 1,500/man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
	construction equipment, vehicles / heat stress by high temperature and heat waves	heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.		
Accidents	Increase on traffic accidents	**[Pre-Construction/ Construction]** • Conduct Traffic Impact Assessment (TIA) and based on the results of TIA, prepare and implement Traffic Management Plan (TMP), coordinate to the concerned LGUs and transport operator/s and get their inputs and approval • Schedule transport of heavy structures during period when there are fewer vehicles on the road and posting of appropriate traffic signage and warnings. • Disseminate information to the general public, host barangays, and LGUs on the potential impact of the project to the existing access and provide mitigating measures. • Implement Emergency Response Plan and Health and Safety Management Plan.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED • Php 10,300,000 for TIA
Risk of Flood	Flooding and inundation by sediment run off, siltation, drainage overflow, clogging	**[Pre-Construction/ Construction]** • Design and install sufficient drainage system including temporary drainage system during construction to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project, in consideration to the existing drainage system and flood storage capacity. • Based on the hydrological, geological study and local climate change data from PAGASA, design and install train system in robust to flood and related extreme events including temporary construction drainage, train structure to be above the flood level, installation of drainage pumping system, etc. • Coordinate with DPWH and LGUs on the integration of proposed drainage plan to the project area. **[Construction]** • Minimize the removal of vegetation and alteration of topography as much as possible. • Install soil erosion control such as protection of slope and bank silt traps to minimize siltation of waterways as required. • Strictly implement construction plan, operating instructions and solid waste / soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal by contractor in accordance to RA 9003 • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible~~.~~	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED • Php 1,500/man-hour • Soil Erosion Control: Php 30,000/m^2 • Drainage: Php 15,000/m
Operation				
Pollution Control				
Air Quality	• Degradation of air quality in the vicinity of the station and in depot area • Increase in Vehicle Exhaust	• Select appropriate operation and maintenance equipment that are fuel efficient to reduce emission. • Conduct regular inspection and maintenance of heavy equipment, machineries, facilities and service vehicles and facilities such as generator etc. to meet the DENR Emission Standard	• DOTr • Operator • LGUs	Included in the operation and maintenance cost: • Php 1,500/man-hour • Php 25,000/per

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
	emission and entrained dust due of increased movement of people	• Regular cleaning and clearing of road from spoils and debris and wetting of ground in the periphery of the depot when necessary. • Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969 at depot area, and provide appropriate PPE for the concerned personnel • Control service vehicle movement by maintaining the speed limit to <10 kph within the construction site. Minimize vehicle transport by maximizing the use of site generated materials. • Monitor air quality at the identified sampling stations considering to possible impact in vicinity to stations and evaluate effectiveness of the air quality reduction measures provided.		sampling station
Water Quality	• Degradation of groundwater quality • Degradation of surface water quality • Threat to abundance, frequency and distribution of species	• Comply with environmental permitting requirements for the storage, transport, handling, and treatment and disposal of hazardous material/ wastes and contaminated soil in accordance with RA 6969. • Conduct proper inspection and prompt maintenance of the installed wastewater treatment facilities. • Compliance to RA 9275 including but not limited to securing of discharge permit. • Conduct proper inspection and regular maintenance of drainage system and treatment facility. • Conduct of regular effluent quality monitoring	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost • Php 1,500/man-hour, • Php 25,000/per sampling station
Soil Quality	• Change in soil quality/fertility	• Strict implementation of solid waste management plan and proper disposal by an accredited contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969. • Implement Emergency Response Plan for accidental oil and chemical spills at the depot site • Conduct of soil quality monitoring at the depot site	• DOTr • Operator	Included in the operation and maintenance cost: • Php 1,500/man-hour, • Php 25,000/per sampling station
Noise Quality	Reduction of noise due to decrease in traffic volumes	• Provide incentives to and information dissemination activities to encourage commuters to use rail transit over other modes of transport	• DOTr • Operator • LGUs	Included in the operation and maintenance cost: • Php 1,500/man-hour, • Php 25,000/ per sampling station • Php 30,000/ per meter noise barrier
	Increase in ambient noise level	• Optimize the number of train operation at night time to reduce generated noise • Provision of effective height of noise barriers on each side of the track especially on areas with sensitive receptors such as school, hospital, residential area • Provision of noise control device such as muffler to all stationary sources (i.e. generator set) • Regular inspection and proper maintenance of trains and tracks to ensure its optimal operation and functionality • Monitor noise levels including identified nearby sensitive receptors including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the noise reduction measures provided.		
Vibration Quality	Increase in ground vibration level	• Monitor vibration levels including identified nearby sensitive receptors, old PNR structures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provided. • Regular inspection, proper maintenance and reconditioning of trains and tracks such as rail grinding, slip-slide detectors and maintenance or replacement of suspension system, brakes and wheels	• DOTr • Operator • LGUs	Included in the operation and maintenance cost: • Php 25,000/ per sampling station • Php 1,500/man-hour

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Waste	• Degradation of land value • Change in soil quality	• Conduct proper inspection and prompt maintenance of machines and equipment, and facilities • Strictly implement solid waste management plan in accordance to RA 9003, and treatment of hazardous chemicals and contaminated soil in accordance with RA 6969. • Conduct of soil quality monitoring when necessary. Conduct soil quality monitoring when necessary.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost: • PhP 1,500/man-hour
Natural Environment				
Ecosystem	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Hindrance to Wildlife Access	• Minimized noise, vibration, illumination, and vehicular movement in significant fauna area • Continuous planting of replacement tress if any. • Conduct monitoring on survival of replanted trees and replant if required. • Implement vegetation management plan considering significant fauna (local bird species) to minimize the use of herbicide and machinery as much as possible.	• DOTr PMO • Operator	Included in the operation and maintenance cost • Php 1,500/man-hour
Hydrology	• Increase of flood occurrence and worse the impact	• Conduct Proper Inspection and prompt maintenance of the installed drainage system and improve/enhance capacity when possible.	• DOTr PMO • Operator • LGU	Included in the operation and maintenance cost: PhP 1,500/man-hour
Geographical Features (Natural Hazard)	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities.	• Conduct inspection in the event of natural hazard occurrence to assess damage of structures • Regular Coordination with the PHIVOLCS for earthquake and volcanic events to adjust the train schedule as necessary. • Conduct earthquake drills for train users are also advised • Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and improve/ enhance capacity when possible • Upgrades or install new technological advances when available are also encouraged for the continued operation of NSRP	• DOTr PMO • Operator	Included in the operation and maintenance cost: • Php 1,500/man-hour
Social Environment				
Local Economy such as employment and livelihood etc./ gender	Local employment	• Coordinate closely with the host LGUs, specifically at the barangay level regarding the hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality.	• DOTr • Operator • LGUs	Included in the operation cost • Php 1,500/man-hour
Social structure such as social capital and local decision-making institutions	Influx of ISFs	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW	• DOTr • Operator • LGUs	Included in the maintenance cost • Php 10,000/meter of fence
Historical/Cultural heritage	• Conservation of old PNR structure and parks • Improve access to tourist destination	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs	• DOTr • Operator • LGUs	Included in the budget of proponent • Php 100,000/ per m^2

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
Landscape	Impairment of visual aesthetic	• Maintain tree planting to minimize the visual impact by the project and harmonies to the surrounding environments in open areas within the ROW, depot and around the stations, to create green corridor.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost • Php 1500/man-hour • PhP 100 / sapling
Infectious disease of workers	Increase risk of infectious disease of employee	• Implement the Occupational Health and Safety Management Plan. • Provide sanitary facilities or utilities in all stations and depot.	• DOTr • Operator • LGUs	Included in the health and safety and environmental management plan: • Occupational Health and Safety Management Plan: Php 300,000 • Sanitary facilities Php 200,000 /location
Work Environments		• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan	• DOTr • Operator • LGUs	Included in the health and safety and environmental management plan: • Occupational Health and Safety Management Plan: Php 300,000 • PPE: PhP 4,000/ per personnel (safety shoes, hard hat, reflector vest, gloves and ear plug)
Others				
Climate Change	• Restrictions/ disruption of railway operation due to soil erosion/landslides/ and flooding. • Slower drainage, soil erosion, disruption in construction by increased rainfall • Overheating of construction equipment and vehicles and overheating of track buckling and signaling problems	• Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition; • When necessary, install improvement of railway system to make it more resilient to temperature and rainfall increase; • Planting of vegetation as much as possible in open areas at the depot, around the stations and along the railway track; • Implementation of an Emergency Response Plan;	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost • Php 1,500 /man-hour • Php 100/per sapling • Emergency Response Plan: Php 300,000

Items	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)
	Reduction of Greenhouse Gases	• Provide incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift) • Plant and manage vegetation as much as possible to open areas at the depot, around the stations and along the railway track • Conduct energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring • Conduct regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost: • Php 1,500 /man-hour, • Php 100/per sapling • Energy/ water conservation program: Php 300,000
Accident	Increase risk of accidents	• Provide security guards in all stations to direct passengers on the safe zone. • Establish a TOD Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan and implement TOD in consideration to the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station	• DOTr • Operator • LGUs	Included in the operation and maintenance cost
Flood risk	Increase of flood occurrence and worse the impact	• Coordinate with PAGASA / PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.	• DOTr • Operator • LGUs	Included in the operation and maintenance cost: • Php 1,500 /man-hour

Table 9.1.52 Environment Monitoring Plan for the Proposed NSRP-South

Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
PRE-CONSTRUCTION PHASE						
Natural Environment						
Ecosystem	• Number of trees cut/ transplanted • Number of trees replaced	Inventory	Monthly until ROW is cleared prior to construction	Project ROW/ nurseries	• DOTr PMO • Contractor–	Part of pre-construction cost • PhP 10,000,000
Social Environment						
Resettlement/ Land Acquisition	Compensation for affected land, structures and improvements	Consultation Meeting and Survey with PAPs	Monthly until ROW is fully acquired	Affected barangays	DOTr-PMO	Included in the RAP cost • PhP 50,000/ meeting Barangay Level
	Resettlement of PAPs to the relocation sites	Consultation Meeting and/or Survey with the PAPs	Monthly until ISFs are all relocated	Affected barangays	• DOTr- PMO • SHFC • LIAC	Included in the RAP cost • PhP 50,000/ meeting Barangay Level
	• Livelihood program • No. of Participants	• Consultation Meeting and/or Survey with the PAPs • Livelihood Trainings & Seminars	Quarterly until the end of livelihood restoration program	Affected barangays	• DOTr- PMO • LGUs	Included in the RAP cost • PhP 50,000/ meeting Barangay Level • Training: PhP 15,000 / pert PAPs
CONSTRUCTION PHASE						
Pollution Control						
Air Quality	Dust level	• Ocular observation • Interview to residents of affected barangay	Daily observation Monthly interview	In and around construction sites Affected Barangay	• DOTr PMO • Contractor	Included in the construction cost: • Php 1,500 /man-hour
	TSP (µg/NCM), PM_{10} (µg/NCM) $PM_{2.5}$ (µg/NCM), SO_2 (µg/NCM), NO_2 (µg/NCM), Pb (µg/NCM), CO (mg/NCM), O_3 (µg/NCM)	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2, CO, O_3: grab sampling; absorbing solution	• Quarterly (24-hr Sampling except for CO and O_3 which is 1-hr sampling) Immediately based on complaints	Established 9 monitoring stations near active construction sites	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF: • PhP 800,000/ quarter • PhP 25,000.00/ per sampling station

Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
Water pollution	Color (TCU), TSS, pH, Temp (°C), DO (mg/L), BOD5 (mg/L), Fecal Coliform (MPN/100 mL), Total Coliform (MPN/100 mL), Conductivity, Chloride (mg/L), Nitrate as N (mg/L), Phosphate as P (mg/L), Copper (mg/L), Arsenic (mg/L), Cadmium (mg/L), Chromium (mg/L), Lead (mg/L), Mercury (mg/L), Cyanide (mg/L), O&G (mg/L) Organo-phosphates (µg/L), Phenols (mg/L), Surfactants (mg/L)	• Ocular inspection • Grab sampling DAO 2016-08 Approved method	• Daily inspection • Quarterly sampling	14 sampling points: 1) Pasig River, 2) Laguna Lake, 3) Buli River, 4) Tunasan River, 5) San Pedro River, 6) Biñan River, 7) San Cristobal River, 8) San Juan River, 9) Bgy Bucal River, 10) Alligator Lake, 11) Dampalit River, 12) Saran River (Bgy Anos), 13) Molawin River, 14) Buot Creek	• DOTr PMO • Contractor • Third party sampling firm • MMT	Included in the EMF: • PhP 25,000.00/ per sampling station
Water pollution	Ph, Temp, DO, mg/L(min) Color, TCU, BOD5, mg/L(max) Fecal Coliform, MPN/100 mL O&G, mg/L	• Grab sampling (In situ for pH and T Using pH meter and temperature probe) DAO 2016-08 Approved methods	Quarterly	Surface water established sampling stations near active construction sites; temporary facility and depot discharge points	• DOTr PMO • Contractor • Third Party Sampling Firm • MMT	Included in the EMF • PhP 25,000.00/ per sampling station
Soil pollution	• Quantity • Occurrence of accidental spills • Condition of equipment and machinery	• Ocular inspection, • Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting, in case of spill, immediate action is required	Area of construction and temporary facilities	DOTr Contractor	Included in the engineering cost • Php 1,500 /man-hour
	Trace metals: Pb, Hg, Cd, As, Cr^{+6} (mg/kg), Proper removal of contaminated soil, Substance/s that spill (e.g. Oil, diesel and Grease)	• Soil sampling as necessary; • Monitoring of handling of hazardous chemical against RA6969.	As needed	Contaminated site, if any	DOTr Contractor	Included in the Construction cost: • PhP 25,000.00/ per sampling station
Waste (excavated Soil)	• Volume disposed • Disposal method • Management of soil against soil	• Ocular inspection, • Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting, Immediately in case of spill	Area of construction	• DOTr PMO • Contractor	Included in the engineering cost: • Php 1,500 /man-hour
Waste (Solid Waste)	• Volume • Disposal method • Management of against solid waste management plan	• Ocular inspection, • Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting,	Area of construction and temporary facilities and disposal site	• DOTr PMO • Contractor	Included in the engineering cost • PhP 3,000 / per haul per track

Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
	Soil fertility level (if necessary), pH, N, P, K, micronutrients, and heavy metals	Soil sampling and analyses for fertility	As required		• DOTr PMO • Contractor	PhP 25,000.00/ per sampling station
Noise	Noise Level	• Ocular observation • Direct Reading/ Sound Level Meter • Interview to residents of affected barangay	• Daily observation • Monthly interview • Noise level measurement when necessary	In and around construction sites, Affected Barangay	• DOTr PMO • Contractor	Included in the Construction cost: • PhP 30,000/unit of noise meter (price base on Extech 407760 with data logger)
	Noise Level (dBA)	Direct Reading/ Sound Level Meter	Monthly (morning, daytime, evening and nighttime when applicable), Immediately based on complaints	Established monitoring stations including sensitive receptor (within 50 m from alignment)	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF: • PhP 30,000/unit of noise meter (price base on Extech 407760 sound level data logger)
Vibration	Vibration Level	• Ocular observation • Interview to residents of affected barangay	Daily observation Monthly interview	• In and around construction sites • Affected Barangay	• DOTr PMO • Contractor • MMT	Included in the Construction cost: • Php 1,500 /man-hour
	Vibration Level (dBA)	Vibrometer	Monthly during pile driving Quarterly Monitoring	• Nearest receptor at the active construction area • Established monitoring stations including sensitive receptor (within 50 m from alignment) • Old PNR structure / NHCP accredited cultural / historical structures (within 50 m from alignment) • Buildings adjacent to the project area.	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF • PhP 25,000/ per sampling station
Ground subsidence	Level of ground subsidence	Visual observation/ Measurement of level	Monthly or as needed	• Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in the Construction cost: • Php 1,500 /man-hour

Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
Natural Environment						
Ecosystem	• Number of trees cut • Provision of required number of tree seedling • Survival rate of the species introduced	• Ocular inspection of replacement stock at nurseries, receiving area before and after planting; • Counting/ estimating numbers	• Quarterly during the Construction Phase • Until planting complete (+1 to 2 years)	Designated tree planting Site/receiving area (LGU/ DENR designated site/s), buffer area/nurseries.	• DOTr PMO • Contractor	Included in the Construction cost • Php 1,500 /man-hour
Hydrology	Occurrence of flooding	• Ocular inspection and observation of choke points • Check PAGASA bulletin	Daily during rainy season	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in engineering cost: PhP 1,500 /man-hour
Geographical features	Occurrence of erosion of slopes, stockpile, etc.	Ocular inspection of site/s	Daily	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in the Construction cost • Php 1,500 /man-hour
Social Environment						
Local economy/ Gender	Number of PAFs, locals, females hired	Survey status of employment	Throughout construction phase	Project Sites	• DOTr • Contractor	Included in the Construction cost • Php 1,500 /man-hour
Livelihood	SDP implementation Record IEC implementation Record Participants list	Interview with residents of affected barangay, relocatees	Throughout construction phase	• Affected Barangay • Barangay with relocated sites	• DOTr PMO • Contractor	Included in the Construction cost • Php 1,500 /man-hour
Infectious diseases such as HIV/AIDS	• Infectious disease • Degradation of health condition of workers/ communities	• Survey trend of epidemic disease • Health Check-up of workers	Monthly throughout construction phase	Construction yard/ affected barangays	• DOTr PMO • Contractor	Included in the Construction cost: • Php 1,500 /man-hour
Work Environment	Working Environment Measurement (WEM)	• BWC-OSHC/NIOSH method	Quarterly Throughout construction phase	Project Site	• Third party sampling firm • DOTr • Contractor	Part of construction cost: • PhP 10,000/ station
	Number of Accident	Occurrence of accidents related construction work	Weekly, In case of accidents, immediately	Project Site	• DOTr PMO • Contractor	Included in the Construction cost: • Php 1,500 /man-hour
Others						
Accidents	• Number of accident involving communities	• Survey occurrence of accidents with local communities • Interview to affected communities	Regular monitoring throughout construction phase, In case of accidents, immediately	Affected Barangay	DOTr Contractor	Included in the Construction cost: • Php 1,500 /man-hour
	• Traffic congestion • Traffic volume	Survey traffic volume	Weekly monitoring of traffic condition	Main intersection near construction area	• DOTr PMO • Contractor	Included in the Construction cost: • Php 1,500 /man-hour

Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
Flood risk (during rainy season)	Occurrence of flooding	• Ocular inspection and observation of choke points • Check PAGASA bulletin	• Daily during rainy season	Area of construction and temporary facilities	• DOTr PMO • Contractor	Included in engineering cost: • Php 1,500 /man-hour
OPERATIONAL PHASE						
Pollution Control						
Air Pollution	TSP (ug/NCM), PM_{10} (ug/NCM), $PM_{2.5}$ (ug/NCM). SO_2 (ug/NCM), NO_2 (ug/NCM), Pb (ug/NCM), CO (mg/NCM), O_3 (ug/NCM)	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2: grab sampling; absorbing solution	• Annually (24-hr Sampling except for CO and O_3 which is 1-hr sampling, • Immediately based on the complaints	Stations and Depot	• DOTr PMO • Operator • MMT	Included in the EMF • PhP 800,000/ quarter • PhP 25,000 / per sampling station
Water Quality	Ph, Temp, DO, mg/L (min), Color, TCU, BOD5, mg/L (max) Fecal Coliform, MPN/100 mL, O&G, mg/L	• Grab sampling • In situ for pH and Temp using pH meter and temperature probe) • DAO 2016-08 approved methods	Quarterly	discharge points	• DOTr PMO • Operator • Third party sampling firm • MMT	Included in the EMF • PhP 25,000/ per sampling station
Waste	• Volume • Disposal method • Management of against solid waste management plan	• Ocular inspection, • Regular reporting	• Daily visual inspection, • Monthly reporting	• Passenger facility • depot	• DOTr PMO • Operator	Included in the Operation & Maintenance cost: • Php 1,500 /man-hour
	Soil fertility level, pH, N, P, K, micronutrients, and heavy metals	Soil sampling and analyses	As necessary	• Depot	• DOTr PMO • Operator • Third Party Sampling Firm	Included in the EMF: • PhP 25,000/ per sampling station
Soil Pollution	• Quantity • Occurrence of accidental spills • Condition of equipment and machinery	• Ocular inspection, • Regular reporting, meeting • Monitoring of handling of hazardous chemical against RA6969.	Daily visual inspection, • Monthly reporting and meeting, in case of spill, immediate action is required	• Depot	• DOTr PMO • Operator • Third Party Sampling Firm	Included in the EMF • Php 1,500 /man-hour
	Trace metals: Pb, Hg, Cd, As, $Cr+^6$ (mg/kg), Proper removal of contaminated soil, Substance/s that spill (e.g. Oil, diesel and Grease)	• Soil sampling as necessary;	As needed	Contaminated site, if any	DOTr PMO Operator • Third Party Sampling Firm	Included in the Operation & Maintenance cost: • PhP 25,000/ per sampling station
Noise and Vibration	Noise levels	Direct Reading/ Sound Level Meter	• Semi Annually (daytime and night time) • Immediately based on the complaints	Established monitoring stations at sensitive receptor (within 50 m from alignment)	• DOTr PMO • Operator • Third party sampling firm	Included in the EMF: • PhP 25,000/ per sampling station

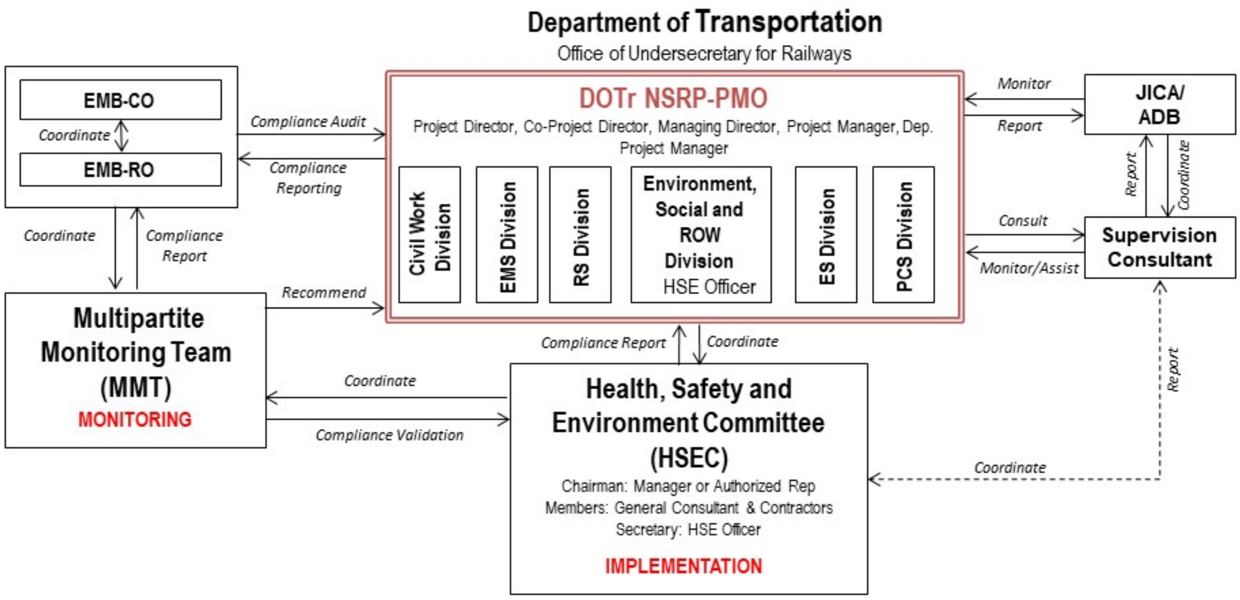
Environmental Item	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost
		Method	Frequency	Location		
	Vibration Level (dBA)	Vibrometer	• Immediately based on the complaints	• Complained area	• DOTr PMO • Operator • Third party sampling firm	Included in the EMF • PhP 25,000/ per sampling station
Ground subsidence	Level of ground subsidence	• Visual observation; • Level measurement	• Visual observation: daily • Measurement: monthly		• DOTr PMO • Operator	Included in the Operation & Maintenance cost • Php 1,500 /man-hour
Natural Environment						
Ecosystem	Number of trees surviving	Ocular inspection of health and vigor	Quarterly	Transplanted areas	• DOTr PMO • Operator	Part of Operation & Maintenance cost: • Php 1,500 /man-hour
Social Environment						
Work Environment	Occurrence of accident/s	• Monitoring of work environments • Regular Meeting	Monthly	Project Sites	• DOTr PMO • Operator	Part of Operation & Maintenance cost: • Php 1,500 /man-hour
Others						
Accident	• Number of Accident • Increase in accident involving communities	• Help desk • Monitoring • Documentation	• Regular monitoring • In case of accidents, immediately	Project Sites Area with stations and Depot	• DOTr • Operator	Part of Operation & Maintenance cost: • Php 1,500 /man-hour
	• Traffic congestion • Traffic volume	• Survey traffic volume • Actual traffic observation and documentation • Help Desk	Regular monitoring throughout operation phase	Project Site	• DOTr • Operator	Part of Operation & Maintenance cost: • Php 1,500 /man-hour
Flood risk	Occurrence of flooding	Ocular inspection and observation	Daily during rainy season	Project alignment, train stations and depot facility	• DOTr PMO • Operator	Included in the Operation & Maintenance cost: • Php 1,500 /man-hour

9.1.11 Institutional Plan for EMP Implementation

The Institutional Plan is a plan for the creation of a body that will be responsible for the effective implementation of the proposed Environmental Management Plan (EMP) whose main thrust is to ensure that environmental, socio-economic, political and public health issues are properly addressed in a timely manner. It provides the necessary mechanisms that will strengthen the relationship of the proponent with the host community, the concerned government agencies and other stakeholders.

9.1.11.1 Institutional Structure

The organizational structure for the EMP constitutes the DOTr PMO and its Environment, Social and ROW Division (ESRD); Health, Safety and Environment Committee (HSEC), Supervision Consultant, Contractor (including Sub-Contractor) and MMT as key entities for its effective implementation. Figure 9.1.7 presents the simplified institutional diagram for the EMP implementation, showing the management/ relationship line among these entities.



Source: JICA Design Team

Figure 9.1.7 Simplified Institutional Plan for Implementing the EMP

DOTr will create a new office or designate one of the railway attached agencies to serve as PMO. Under the PMO, HSEC will be created to implement the EMP during pre-construction and operational phase of the project. The Contractors for the Works will be tasked to implement the EMP for the construction phase. Environmental compliance monitoring will be undertaken by the MMT which will monitor compliance of the contractors and the PMO with the ECC conditions and the EMP in accordance with the guidelines of DAO 2003-30, DAO 2017-15 and DAO 2018-18.

9.1.11.2 DEPARTMENT OF TRANSPORTATION

The DOTr as the Implementing Agency will be responsible for providing overall policy and guidance with regards to implementation of the proposed NSRP-South. DOTr will ensure that all the necessary provisions for implementing the EMP and EMoP, including budgets and agreements with other concerned national and local government agencies are included in all contracts, and in accordance with JICA Guideline and ADB SPS.

(1) DOTr NSRP-SOUTH Project Management Office (NSRP-South PMO)

The NSRP-South PMO will be established as the representative of the Department in all activities pertaining to the planning, design review, and implementation of the project, which will be guided by the Operational Procedures. Project Director, Co-Project Director and Management Director of the NSRP-South PMO will be responsible for the decision-making, planning and implementation of the overall project activities, whereas a Project Manager and Deputy Project Manager will be acting management of the NSRP-South. Besides, The Proponent will, by specifying in the MOA, establishes EGF and EMF in consultation with EMB.

(2) Environment Social and ROW Division of NSRP-South - PMO

Under the NSRP-South PMO, the Environment Social and ROW division (ESR Division) is created and staffed with Health, Safety and Environment Officer (HSEO), Environmental Engineers and other specialists, including environmental consultants who will provide the necessary guidance and technical assistance, and at the same time, together with the office staff, implement the conditions of the ECC and the activities laid out in the EMP and EMoP, and in line with JICA guideline and ADB safeguard Policy agreed.

(3) Health, Safety and Environment Officer (HSEO)

The Health, Safety and Environment Officer / Pollution Control Officer, will provide appropriate action on complaints brought before the ESRD-MCRP PMO for resolution. Further, he/she will closely coordinate with the Health, Safety and Environment Unit of the Contractor on matters of mutual concern during Construction Phase. The officer is required to take the compulsory trainings prior to construction starts.

9.1.11.3 Health, Safety and Environment Committee

The HSE Committee will be under the PMO which will also comprise representatives from the DOTr, general consultant and contractors on-site. Their main role and responsibilities are to ensure the compliance to the EMP and EMoP and other conditions stipulated under ECC and act on grievance if any arises during construction.

9.1.11.4 Multipartite Monitoring Team (MMT)

The Multipartite Monitoring Team (MMT) is an independent third-party entity formed after the issuance of the ECC to encourage participation of the project's various stakeholders and to monitor the project's compliance with ECC conditions as well as the EMP and EMoP during the pre-construction, construction and operation phases of the proposed project.

The formation of the MMT will be initiated by the NSRP- PMO through a Memorandum of Agreement (MOA) between the EMB-CO and the NSRP-South- PMO with conformity of the identified MMT members, in accordance to the DENR Administrative Order (DAO) No. 2017-15 and DAO 2018-18.

9.1.11.5 The Contractor

The Contractor will be jointly responsible for implementing the EMP, and liable to sanctions and penalties to be incurred by DOTr in relation to non-compliance to conditions set in the ECC. It will provide the necessary funds for implementing the EMP, as will be stipulated in the "DOTr Environmental Protection Clauses" of the Bid Documents. As previously stated it shall be jointly (with DOTr) responsible for ensuring that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the TOR.

9.1.11.6 Monitoring and Reporting

In order to ensure the compliance to ECC, EMP and EMoP, NSPR PMO will submit semi- annual Compliance monitoring report and Quarterly Self-Monitoring Report to EMB, JICA and ADB until project completion report is issued. Prior to start monitoring activities, NSRP PMO is to prepare a checklist and monitoring form to ensure the compliance to EMP and EMoP as per requirements of JICA and ADB. The result of public consultation information disclosure will be also submitted together with monitoring reports.

9.1.12 Public Participation, Public Consultation and Information Disclosure

During the study and in accordance to the PEISS (DAO 2017-15), JICA guidelines and ADB SPS, assists JICA Design Team assisted DOTr to hold: 1) Information, Education and Communication (IEC) of Stakeholders; 2) Public Scoping; 3) Stakeholder Consultation Meetings (SCM) and Focus Group Discussions (FGD), and 4) Public hearing. Public scoping and Public hearing were conducted under the facilitation by EMB, whereas IEC and SCM were led by DOTr.

9.1.12.1 Information, Education and Communication

The IEC was conducted to provide updated information about the proposed Project and encourage the concerned stakeholders to participate in the EIA study.

Table 9.1.53 IEC Conducted for the EIA Study of the Proposed Project

Date and Time	Venue	Main Participants	Total No. of Participants
2017/12/13, 10:00 AM	Provincial Government Extension Office, Calamba City	• Representative from the Office of the Governor • PUDHO Representative	Male: 2 Female: 0 Total: 2
2017/12/18, 10:00 AM	Office of the City Administrator, Conference Room, Muntinlupa City	• Muntinlupa City LGUs (UPAO Representative, CPDO Representative, City Engineering Representative, Records and Assets Representative, Representatives of Barangays)	Male: 2 Female: 7 Total: 9
2017/12/18, 2:00 PM	Manila City Engineer's Office Conference Room, Manila City Hall	• Manila City LGUs (Representatives from the Office of the City Administrator, City Engineer's Office and DEPW)	Male: 5 Female: 8 Total: 13
2017/12/19, 10:00 AM	The Workshop Room, 3rd Floor, Los Baños Municipal Hall	• San Pedro City LGU Representatives • Santa Rosa City LGU Representatives • Vice Mayor of Cabuyao City • Los Baños LGU Representatives	Male: 20 Female: 4 Total: 24
2017/12/20, 10:00 AM	Conference Room, Parañaque City Hall	• Parañaque City LGU Representatives (City Planning, UMADO, City Assessor, City ENRO, City Engineering and LHDO) • Proponent - DOTr • JICA Design Team • Ecosys Representative	Male: 3 Female: 6 Total: 9
2017/12/22, 10:00 AM	Biñan City Hall	• Parañaque City LGU Representatives (City Mayor, City Councilor, City ENRO and CPIO)	Male: 3 Female: 6 Total: 9
2017/12/22, 2:00 PM	Makati City LGUs	• Makati City Administrator's Office Representatives	Total: 8
2017/12/22, 2:00 PM	Calamba City	• Representative of Calamba City LGU	Male: 1 Female: 0 Total: 1
2017/12/27, 2:00 PM	Makati City Hall	• Makati City Administrator's Office Representatives	Male: 4 Female: 1 Total: 5
2018/01/10, 10:00 AM	Taguig City LGUs	• City Hall, Taguig City	Total: 15

Source: JICA Design Team

9.1.12.2 PUBLIC SCOPING

The Public Scoping for the NSRP-South was conducted in three cluster areas on January 18, 19 & 24, 2018 which details are presented in

Table 9.1.54. The Public Scoping was facilitated by the EIA Division of the EMB-CO to provide information about the Project and to collect site-specific issues, concerns and inputs to the EIA Study.

Table 9.1.54 Schedule, Venue, and Participants of the Public Scoping

Date and Time	Venue	Main Participants	Total No. of Participants
January 18, 2018; 1:00 PM	Barangay Carmona Covered Court, Barangay Carmona, Makati City, Metro Manila	• EIAMD Case Handlers, DENR - EMB Central Office • PNR Representative • DPWH Representatives • MMDA Representatives • MGB Representatives • Manila City LGUs (City Councilors, Representative from the Office of the Mayor and Vice Mayor, Department Heads and concerned Barangay Chairmen and Councilors) • Residents from the different barangays along the PNR alignment • Makati City LGUs (City Councilors, Representative from the Office of the Vice Mayor, Department Heads and concerned Barangay Chairmen and Councilors) • Parañaque City LGUs • Muntinlupa City LGUs	Male: 67 Female: 75 Total: 142
January 19, 2018; 1:00 PM	LLC Auditorium in Calamba Elementary School Central 2, Calamba City, Laguna	• EIAMD Case Handlers, DENR - EMB Central Office • Calamba City LGUs (City Councilors, Representative from the Office of the Mayor and Vice Mayor, Department Heads and concerned Barangay Chairmen and Councilors) • Biñan City LGUs • Los Baños LGUs • Residents from the different barangays along the PNR alignment	Male: 44 Female: 20 Total: 64
January 24, 2018; 1:00 PM	Taguig City Satellite Office, Kalayaan Hall, 10th floor, SM Aura, Taguig City, Metro Manila	• EIAMD Case Handlers, DENR - EMB Central Office • MMDA Representative • Taguig City Department Heads/ Representatives {City Legal Office (CLO), Barangay Affairs Office (BAO), LBO, Urban Poor Affairs Office (UPAO), City Planning Development Office (CPDO), Low-cost Housing Office (LHO), City Engineer's Office} • Chairman, Barangay South Daang Hari and Staff • Councilor, Barangay Tanyag • Chairman, Barangay Fort Bonifacio • Councilor, Barangay Bagumbayan • Chairman, Barangay North Daang Hari • Chairman, Barangay Western Bicutan	Male: 13 Female: 5 Total: 18

Source: JICA Design Team

Table 9.1.55 Issues / Concerns during Public Scoping (January 18, 2018)

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
1. Project Description	**Engr. Ma. Teresa Quiogue, Sr. EMS, CENRO, Parañaque City:** In Parañaque City, what areas will be affected?	**L. dela Cruz (Geosphere):** Based on the inputs from Paranaque City LGU, Barangay San Martin in Paranaque will be affected by the proposed PNR Los Banos Project.
	For Sucat, will you utilize the existing PNR Station?	**N. Tatualia (DOTr):** For Sucat, we have two (2) plans. One is to locate the depot in Sucat and the other is the station. Whether to utilize the existing or construct a new one, we are not yet sure. Again, these are still plans and can still change.
	Hon. Jun Panganiban, Barangay Councilor, Barangay Buli, Muntinlupa City: Will you fence the railroad?	**N. Tatualia (DOTr):** For safety, yes and that is the plan.
	If you will fence the railroad, how about the roads that we used to cross from one side to the other side of the railway? There will be no right-of-way (ROW) for the people?	**N. Tatualia (DOTr):** We understand your concern, Sir. We also don't want to close the roads, particularly those that are Public Roads or those that were constructed by LGUs for passage of its

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
		constituents to the other side of the railroad. We don't want to divide your barangay, municipality or city into two because we fenced the railway. Whether we close the road permanently or elevate our structure and provide access, it will be included in our study and design. As much as possible, we would like to avoid permanent closing of roads.
	Hon. Marilyn Telles, Barangay Councilor, Barangay 348, Manila City: We are near the Blumentritt Station. What is your plan with the station? Are you going to widen it? There are residential areas near the station	**N. Tatualia (DOTr):** Again, the required area for the station is 60 meters in width and 250 meters for the length. One issue with the Blumentritt Station is that there is LRT 1 station right above it. We are coordinating with the Light Rail Manila Corporation to make the Blumentritt Station as an integrated transport terminal for LRT 1 and SNRP. Most likely, the NSRP will be elevated. We would know the structures that may be affected once our Resettlement Action Plant (RAP) Team has completed their survey.
5. People	**Hon. Alnardo Rotap, Chairman, Barangay 507, Manila City:** I would like to ask the PNR and DOTr representatives if they consider the NLEX-SLEX Connector Project. We already had two (2) meetings with them but there's no DOTr or DENR representative during those meetings. Our barangay, along with other barangays in District 6, will be affected by the Skyway Project (NLEX-SLEX Connector Project). According to their engineer, the area that would be affected is on the left side of the railway, 60 meters from the centerline. Within that 60-meter area, there are privately-owned buildings. According to their engineer, they will have separate consultation with them while the informal settlers will be relocated. From your presentation a while ago, you said that your right of way is 30 meters and 60 meters (for the station). We are confused. Who would be responsible for the relocation of our affected constituents?	**N. Tatualia (DOTr)**: This is a separate project. The proponent for the NLEX-SLEX Connector Project is DPWH. It is true that DPWH will also use the existing ROW of PNR. We already had several coordination meetings with them since we need to discuss the sharing of the ROW. Based on our meetings, DPWH is ahead of us in terms of project timeline. They are already conducting their survey and tagging and they already have drawings of their structures. While, the DOTr, on the other hand is still on the design process. Since we are a little behind with them, we will be the one to adjust. Our design team is studying and will incorporate or take into consideration the design of the project of DPWH. As mentioned a while ago, DPWH will have relocation. In this project, we will also have relocation. So far, we only have the 1st consultation meeting. After the third meeting, we can identify the households that will be affected by the NSRP.
	Hon. Rowena Cruz, Chairman, Barangay 811, Manila City: To be specific, how many meters is the ROW of PNR? It couldn't be 30 m because there would be lots of houses and infrastructures that would be affected, including our house. We have land title so that would be impossible.	**N. Tatualia (DOTr)**: Ma'am, historically, the ROW of PNR is 30 meters. That would be 15 meters from the center line to one side of railway and another 15 meters from the center line to the other side. We are still on the design stage. Our design team is asking for 30 meters ROW because, historically, that is the ROW of PNR. As for those that will be affected, particularly landowners, within the 30 meters ROW, rest assured that your rights will not be violated. We have another sub-contractor that is preparing the resettlement action plan in accordance to RA 7279 and JICA Standards.
	I think we have a law that the condominiums and housing projects of the presidents couldn't be displaced. So, how about the housing projects of President Ramos and Marcos that were located near the railroad, what would happen to them?	**N. Tatualia (DOTr)**: We are still on the design process. Eventually, we will have a ground survey to determine who would really be affected.
	Hon. Connie Moya, Barangay 484, Manila City I hope you could coordinate with the City of Manila. There are lots of Projects such as the NLEX SLEX Connector Project. Please coordinate with the City so we will be informed and not confused, particularly in the ROW. We do	**N. Tatualia (DOTr)**: Yes, Ma'am. We are coordinating with the City of Manila.

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
	understand that you have ROW. There are informal settlers in the area but if you are within your ROW, then I guess there's no problem with that. There would only be a problem it you will go beyond your right of way.	
	Hon. Remigio Udsig, Barangay Councilor, Barangay 576, Manila City My concern is on the resettlement. What is your plan? Where would you relocate the ISF? Is the relocation site provided with facilities or utilities that are needed by the relocatees?	**N. Tatualia (DOTr):** Sir, I would like to invite you to the Public Consultation Meeting on January 22 at Manila City Hall. We would answer all your concern regarding the resettlement there. As of the moment, we are still on the planning stage. We are not yet implementing our resettlement action plan. Regarding your concern about the relocation site, recently we had our agreement with SHFC. They will be responsible for the relocation site and make sure that it is livable. And we have PCUP. They will make sure and check that the social economic status of the relocates will not be lower than their previous status.
	Hon. Pio Morabe, Chairman, Barangay 348, Manila City: You have mentioned a while ago that the ISF will be resettled. How about the private individuals? Will you compensate them?	N. Tatualia (DOTr): As of now, our ideal ROW is 30 meters. Under RA 10752, the "Right-of-Way-Act", the affected formal or informal, settlers have their rights. Under this Act, we have what we call negotiate sale wherein the current market value is used to compensate the owners of the properties/structures that will be affected. We have SHFC and PCUP to ensure that the affected families will be compensated accordingly.
	Who will do the appraisal? The Municipal Assessor?	**N. Tatualia (DOTr)**: We have government financial institution, accredited by the Bangko Sentral ng Pilipinas.
		Engr. Arida (EMB-CO): All questions regarding the resettlement will be answered in the public consultation for the resettlement action plan. Though resettlement is part of the EIA Study, this is only a framework. The details and other concerns will be answered in the resettlement action plan.

Source: JICA Design Team

Table 9.1.56 Issues / Concerns during Public Scoping (January 19, 2018)

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
1. Project Description	**Hon. Jose Ricomedes, Barangay Councilor, Barangay Uno, Calamba City:** Is it true that the JP Rizal will be fenced? Would it be possible for the station to have an area of 20 x 20 meters only?	**A. Narvaez (DOTr):** Sir, the ROW is 30 meters for the track and 60 meters for the station, those are non-negotiable. The negotiable is the location of the stations and the alignment. Regarding the fencing, we are not fencing yet since we are still in the study stage.
	Hon. Marcelino Ameglio, Barangay Councilor, Barangay Pansol, Calamba : The proposed project will have 22 stations. Is there a chance that one of the stations will be located in Barangay Pansol? Before, there's a station in Pansol. However, it's no longer operational. We already wrote a letter to PNR to operate the station in Pansol, however, there's no action on our request.	**A. Narvaez (DOTr):** The stations are not yet final. The stations in some areas may be transferred to another if it would come out in the study that it is not feasible. We are welcome for that proposal if you think that it is feasible and viable to construct and operate a station in your barangay. You can write a letter. We can include that in our study.
	Hon. Florencio Atienza, Chairman, Barangay Bucal, Calamba City: Will the project push through?	A. Narvaez (DOTr): I wanted to say, Sir, yes. But, we can only say that it is 100% sure when our loan will be granted by Japan. That's

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
		why we are conducting this public consultation because this is a part of the process to acquire ECC. ECC along with the RAP is a requirement of Japan before they grant us our loan.
	Mr. Rodulph Salar, Barangay Admin, Barangay Lalakay, Los Banos: How high would the railway be elevated? And how high is the fence?	A. Narvaez (DOTr): We don't have those technical details yet. But, the railway will be elevated including the at-grade. There would be embankment just like in the MRT.
	The speed of the train is 120 kph. That's fast. If someone will cross there, he would really endanger his self.	**A. Narvaez (DOTr):** Sir, the 120 kph is the maximum speed. The railway will be elevated, there would be embankments and viaducts and it would be fenced to avoid accidents.
	If it would be elevated and fenced, how about the road crossings?	**A. Narvaez (DOTr):** We are still studying those details. As much as I want to answer your question, we don't have it yet. We'll know it when we have the final design. One thing is for sure, we will not close public roads.
	Hon. Antonio Kalaw, Municipal Councilor, Los Baños : Are you conducting feasibility study? What is the timeline of the feasibility study?	**A. Narvaez (DOTr):** Yes, Sir. This public consultation is already part of the feasibility study. For the timeline, it is 2022 po.
	Hon. Benedicto Albonida, Municipal Councilor, Los Baños Do you have the exact location of station and depot in Los Baños?	**A. Narvaez (DOTr):** Sir, there's no final location yet for the stations, depot and other facilities. The finalization of design is not yet starting. We are still on the feasibility stage. But, once we have the final design, we will consult with the LGUs. But, just to give you an idea, we've met with IRRI. We're considering the option to utilize the lot that they are leasing from UP LB for the depot. But, that's not yet final.
3. Water	**Hon. Alvin Garcia, City Councilor, City of Biñan:** Our problem is with the post of the PNR in our barangay, San Vicente. During heavy rains, our area is easily flooded because the post blocks the waterway. We already brought this to PNR about two (2) years ago. Until now, there's no action. It's now one of the problems in our barangay. The post blocks the waterway so there's deposition of sediments and our river depth is getting shallow, which is also one of our problems right now. We hope that you can bring this up with PNR.	**A. Narvaez (DOTr):** Thank you po, Sir. Yes, well consider your sentiments in our study. That's why we have these consultations. Actually, this is just a start of series of consultations so we can also gather inputs from you. We hope that by the time that we will go to your barangays or community, you would accommodate us so we can consider you input, such as this one, in our study. The alignment is not yet final and our principle here is that, as much as possible, we don't want to affect critical structures such as those with cultural heritage, churches and schools. Regarding your concern, we need to formalize it. You can write a request letter to PNR so they can take action.
	Hon. Jaime Salandanan, City Councilor, City of Biñan: Regarding the PNR post that obstructs the waterway in Barangay San Vicente, we already wrote a letter to the PNR. They responded that they will fix it but until now, there's no action.	**A. Narvaez (DOTr):** Thank you, councilor. As what I've told to Councilor Alvin, we are still on the design stage. We do consider in our design those concerns such as obstruction. But, if it's causing problem now, I'm not sure if it's the same GM that you wrote before but if it's not that inconvenient, you can always write a letter to GM Magno. I think he is very open to such request.
3. People	**Mr. Rodulph Salar, Barangay Admin, Barangay Lalakay, Los Baños:** Who will finance the relocation of the informal settlers? Is it the national or the local government?	**A. Narvaez (DOTr):** Just to give everyone a background, this public scoping is being held for the environmental impact. We have other ongoing consultations right now, in Los Baños and in other LGUs which focus on resettlement only. All your concerns regarding resettlement will be answered there. To your question po, we (DOTr) have a budget for the resettlement. We will have three (3) consultation meetings. At the moment, we are still at the 1st consultation meeting. In the 2nd consultation meeting,

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
		there we will discuss details about the resettlement and entitlement packages.
	Hon. Jaime Salandanan, City Councilor, City of Biñan : We already relocated some informal settlers. However, since the project is being implemented and the area is not guarded, they kept on coming back. Then, we will clear the area again. The PNR and the City of Biñan are spending and re-spending for the resettlement	**A. Narvaez (DOTr):** Regarding the relocatees that keep on coming back, that's not only in Biñan. There are really some resettlement plans that were not implemented properly. But as what I've mentioned earlier, we are conducting consultation meetings. As of the moment, we can't give you yet the details but for this project, we will offer more options. We are considering more options for the resettlement and entitlement packages for the potential affected families. We are pushing for peoples' plan. We will engage the affected families or persons. They will be involved so we will be ensured that they would patronize the relocation.
	Mr. Rodulph Salar, Barangay Admin, Barangay Lalakay, Los Baños: How about terrorists? Have you considered the security issues?	**A. Narvaez (DOTr):** Yes, Sir. This project is Japanese funded. So, we are following not only local and national policies but as well as international standards. Rest assured po, security issue is being considered in our study.
	Ms. Raovez Claudio, Representative, Office of the Vice Mayor, Calamba City: Aside from the informal settlers, there are also vendors near the PNR property. Would they be resettled also?	**A. Narvaez (DOTr):** The PNR has an existing ROW that is 30 meters. If they encroached within the 30 meters, they will be resettled. We are conducting consultation meetings for our resettlement action plan. We will have dialogues with the affected person/family so that we can implement the RAP properly.
	Hon. Antonino Trinidad, Chairman, Barangay Banlik, Calamba: Are you connected with those conducting surveys for the families that will be resettled? They have these forms that need to be signed by affected resident. Also, if there would be relocation, I suggest that you look into the source of income of those that will be resettled. You should also consider the accessibility of the relocation site from the place of employment of the relocatees so they would not come back to the PNR properties.	**A. Narvaez (DOTr):** Thank you po, Sir. We are not connected with the group that's conducting the survey. Again, we are on the consultation stage only. Our surveys have not yet started. Regarding the relocation, yes, there would be relocation site. But, the resettlement and entitlement packages will be discussed during the 2nd consultation. We are trying to come up with packages that will be patronized by the relocatees so they will not keep on coming back to PNR properties.

Source: JICA Design Team

Table 9.1.57 Issues / Concerns during Public Scoping (January 24, 2018)

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
5. People	**Hon. Peter Garcia, Barangay Councilor, Barangay Tanyag, Taguig City I:** 'm concern with our urban road. We don't have problem with our proper road. However, the temporary road that connects Purok 5 to the proper is within the 30 meters ROW of PNR. We don't have ROW from the Perpetual Health that's why that temporary road was constructed.	**Atty. Enciso (DOTr):** Sir, clarification, where is the temporary road? It is the road connecting from the proper road to Purok 5, right? How long is it? If going to Los Baños, where is it located?
	It is approximately 100 meters. Going to Los Baños, it is on the right side of the track. Based on the survey of the PNR personnel when they did the clearing, the road is within the ROW of PNR. That is the access road from Proper to Puroks 6 and 5.	**Atty. Enciso (DOTr):** Sir, even without this Project, the PNR has already ROW. So, why was that road constructed when the land was owned by the PNR?

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
	When the railroad was transferred on the left, the old railroad was vacated. That vacant lot was then bought by our constituents. They constructed their houses there and later on, it became Purok 5. The same is true with Purok 6. As I've said a while ago, we don't have ROW from Perpetual Health Village, that's why the road was constructed.	**Atty. Enciso (DOTr):** Sir, is it approved by the City LGU?
	No, it was not approved. But, the PNR also failed to fence their property so the residents of the barangay continued the construction of the road. When your engineers will survey the site, you would see that the whole stretch of the road will be affected.	If it was not approved by the LGU, then it was not included in the plan of the existing roads. Right now, JICA is requesting the plans of the existing roads per City/Municipality. If that road is temporary and was not approved, then more likely, it was no reflected in the plans. You should coordinate, Sir, with your LGU so it would be recognized. For the existing roads, our engineers would base only the documents that they got from the LGUs. We will conduct census and tagging but that would be for the ISFs only. You should have a document that shows that there is an existing temporary road that will be affected by the project so that it would be considered by our engineers in the design. So, please coordinate with your LGU and we need documents. **Hon. Nicky Supan (Barangay Chairman, Barangay Western Bicutan):** May I advise that you make a resolution or ordinance and bring it to our mayor and PNR so that they can support you.
	Hon. Nicky Supan, Barangay Chairman, Barangay Western Bicutan: From Tutuban to Los Baños, there are lots of structures that would be affected in that 15-15 meters ROW of PNR. In Brgy. Tanyag, there are manufacturing plants that would be affected. My question is, for those structures that would be affected by the project, would there be compensation, relocation and livelihood?	**Atty. Enciso (DOTr):** Sir, for the legal owners, we have RA 10752 'the ROW Act' which states that there should be compensation. Also, we are complying with the JICA Standards which is very strict when it comes to compensation. That's why the DOTr is thinking of other packages, not just what was stated in RA 10752, so we can comply with JICA Standards. As to how much, that would be discussed in our next consultation in RAP. Also, if based on the assessment of our design team, the area would be negatively affected, there's a possibility that we will move the alignment. Our alignment is not yet final. If it would cost more because there's a lot that would be affected, we could move the alignment.
	Also, you have mentioned that you would hire from the host barangays? That never happens. The contractors bring in their personnel. How sure are you that our affected residents "kabarangay" would be employed in the project?	**Atty. Gwen Enciso (DOTr):** Sir, we have a coordination meeting always. I will raise your concern so we could think of ways to address such. **L. dela Cruz (Geosphere):** Actually Sir, this will be included in the EIA requiring the proponent to hire workers from the host LGUs. The DOTr, can include this in their contract with their contractors requiring the latter to hire locals from the barangay, city or municipality. The Barangay may also include a condition in the Barangay Permit for Contractors to secure clearance from the barangay for all their workers to ensure that they hire local workers. If it's not followed, you can raise this issue to the MMT for the DENR can issue a notice of violation if they will not comply.

EIA Module	Issues/Suggestions Raised by Stakeholder	Proponent's Response
	Mr. Henry Tetalvero, Representative, UPAO We would like to request that all affected barangays will have consultations. As of the moment, only two (2) barangays were consulted. It would be better if you would have consultations in the affected area because the affected residents are there.	**Atty. Enciso (DOTr):** Sir, that is the real the process. I will check with JICA why some of the barangays were not yet consulted. I will ask. **L. dela Cruz (Geosphere):** As explained before, this consultation is not for the resettlement action plan. This is for the ECC. The consultations for the resettlement of those that will be affected including, houses and other assets are handled by the RAP Team. They are conducting separate consultations per barangay. As what I've known, they will conduct three (3) consultations, not just one. Don't worry Sir, there will be consultation for the resettlement.
	Hon. Lourdes Pagsisihan, Barangay Chairman, Barangay South Daang Hari They already conducted a consultation in our barangay. It so happened that I was not available. The residents were confused on how wide is the ROW of PNR. The consultation should be conducted per barangay and should be clarified up to where is the ROW of PNR because there are 2 and 3-storey buildings that would be affected.	**Atty. Enciso (DOTr):** Ma'am, those that are within the 30 meters ROW of PNR will be removed. In the first place, they should not have constructed within that 30-meters because that is owned by PNR. There are just lapses on the part of PNR for not taking care of its properties, but eventually, the 30-m ROW will be cleared. How would they know if they will be affected or not? Again, there's another group that's preparing the resettlement action plan. They will conduct the census and tagging.
	Hon. Lorenzo Fortuno, Barangay Chairman, Barangay North Daang Hari: I think you should invite also in the consultation the Barangay San Martin in City of Parañaque. I think they have about 200 ISFs that encroached in the ROW of PNR.	**Atty. Enciso (DOTr):** We'll check Sir if when is the consultation in their barangay. Thank you. **L. dela Cruz (Geosphere):** Actually, they already attended our Public Scoping which was held in Makati last January 18.
	Mr. Leodolpo Quinteza, Representative, LHO: The issues regarding the resettlement will be discussed in the RAP. On the side of the local, there are series of consultations. They (DOTr) will secure a Certificate of Compliance (COC) from us. Before they clear the area, they will secure COC from us. The City is making sure that they are following the procedures especially if there would be affected residents. As we can remember, the ROW of PNR was already cleared before. If there are some ISFs in the area at the present, those are returnees only. If the ROW will be expanded, there would be affected structures. Before they clear that, they will secure a COC. Before they can secure COC, the LIAC will be convened. There would be more consultations, minimum of 3. And the LGU is making sure the procedures are followed.	**L. dela Cruz (Geosphere):** Thank you Sir for the clarification.

Source: JICA Design Team

9.1.12.3 Public Hearing

Three sessions of clustered Public Hearing were conducted on 20, 21 and 22 June 2018. These were presided by the EMB-Central Office and the EIARC. The additional issues that were raised during the Public Hearing will be incorporated into the EISR and will be submitted to EMB-Central Office for review by the EIARC.

Table 9.1.58 Public Scoping conducted during Feasibility Study

Date and Time	Venue	Target Affected LGU	Main Participants	No. of Participants
2018/06/20 9:00 am	Brgy. Carmona Covered Court, A.P. Reyes Street, Makati City	• Manila City • Makati City • DENR-EMB NCR • MGB Central • DPWH NCR • MMDA • PCUP • PUP • DepEd • DSWD	• EIAMD Public Hearing Officers, DENR-EMB Central Office • EIA Review Committee, DENR-EMB Central Office • DepEd Manila • PCUP Representatives • PUP Representatives • MMDA Representative • DPWH NCR Representative • Manila City LGUs (Department Heads, Councilors, concerned Barangay Chairmen and Kagawad) • Makati City LGUs (Department Heads, concerned Barangay Chairmen and Kagawad) • Residents	Male: 48 Female: 44 Total*: 92
2018/06/21 9:00 am	The Lakeshore Tent, C6, Lower Bicutan, Taguig City	• Taguig City • Muntinlupa City • Parañaque City • DENR-EMB NCR • MGB Central • DPWH NCR • MMDA • PCUP • DepEd • DSWD • HUDCC	• EIAMD Public Hearing Officers, DENR-EMB Central Office • EIA Review Committee, DENR-EMB Central Office • HUDCC Representatives • MMDA Representative • DPWH NCR Representative • Taguig City LGUs (Department Heads, concerned Barangay Chairmen and Kagawad) • Muntinlupa City LGUs (Department Heads, Councilors, concerned Barangay Chairmen and Kagawad) • Parañaque City LGUs (Department Heads, concerned Barangay Chairmen • Residents	Male: 75 Female: 101 Total*: 176
2018/06/22 9:00 am	Sta. Rosa Auditorium, Rizal Boulevard, Sta. Rosa City	• San Pedro City • Biñan City • Sta. Rosa City • Cabuyao City • Calamba City • DENR-EMB Region IV-A • MGB Region IV-A • DPWH Region IV-A • PCUP • DepEd • DSWD	• EIAMD Public Hearing Officers, DENR-EMB Central Office • EIA Review Committee, DENR-EMB Central Office • CENRO Sta. Rosa • PCUP Representative • DepEd Biñan • DepEd Cabuyao • San Pedro LGUs (concerned Barangay Chairmen) • Biñan LGUs (Department Heads, concerned Barangay Chairmen and Kagawad) • Ospital ng Biňan • Sta. Rosa LGUs (Department Heads, Councilors, and concerned Barangay Chairmen) • Cabuyao LGUs (Department Heads, Councilors, concerned Barangay Chairmen and Kagawad) • Calamba LGUs (Department Heads, Councilors, concerned Barangay Chairmen and Kagawad) • Residents	Male: 68 Female: 102 Total*: 170

Source: JICA Design Team

Table 9.1.59 Issues / Concerns during Public Scoping (June 20, 2018)

EIA Module	Issues/Concerns Raised	Proponent's Response
Project Description	**Ms. Susana Milan, Celadon Residences:** We wrote a letter to Atty. Matias, Chief EIA Division, EMB-DENR, clarifying if Celadon Residences will be affected by the project. Our barangay, Brgy. 350, is not included in the impact statement. We hope that you can respond to our letter, in writing, so we will be guided.	**Engr. Lenon Ramboyong, EMB DENR:** We acknowledge the receipt of your letter to EMB. We will respond to your letter, but in the meantime, DOTr and Geosphere is here to answer directly if your residence will be affected. **Ms. Ally Narvaez, DOTr:** We at DOTr have ongoing talks with the property manager of Celadon Residences. We will be conducting Stakeholder Consultation Meeting specifically with Celadon residents. The property manager is just asking for formal letter from DOTr and project design details, which at this stage, might not yet be final. What we want at this time is initial dialogue.
	Mr. Benigno Masangcay, Brgy. 473 Resident: When you called for a meeting in Brgy. 473, you explained this project to the constituents. They were saying that you will occupy 60 m x 70 m, that's about half a hectare. A lot of civilians, living there for a long time, were told by the representatives that the affected residents will have to vacate the area. We were instant squatters. They told us to vacate the area; they will pay us. But, we are residing there for 60 years and then all of the sudden, you will tell us to leave? What happened to my suggestion if you can reduce the area, 60 m x 70 m, that you will get? This time you showed us that the cross-section of the train will almost occupy the Algeciras and Prudencio Streets.	**Ms. Nathalie Tatualia, DOTr:** We want to clarify that the correct information, based on the presentations we have done, is 30 m from the center of alignment, not 60 x 70m.
	Ms. Lydia Masangcay, Brgy. 473 Resident: On the first meeting held in Brgy. 473, I was not present. There is Algeciras St, Prudencio St. and then the railroad. Based on the presentation, my question is that 60-meter width on the midline of the railroad? It means from the right side is 30 meters?	**Ms. Nathalie Tatualia, DOTr:** While the final centerline of the track is not yet finalized, the total width of the track itself is 30m, which means 15 m from each side of the centerline. **Mr. Rupert Cruz, JDT:** • The 60m is determined for study purposes only, to find out the most feasible location for the stations, which will minimize the effect of the project to the residents near the proposed railway. • We will have many scheduled public meetings and consultations, from this stage up to the final design stage, when more substantial and finalized information is available. **Ms. Nathalie Tatualia, DOTr:** To clarify sir Rupert's statement, since I said the alignment is 30m and now he is saying it is 60m. The 60m is for the stations, while the rest of the track will be 30m wide. Now the measurement is made 60m, because as he was saying, we are still finding out where to best locate the stations.
	Ms. Susana Milan, Celadon Residences: There's a need for a thorough clarification because the people are confused. From the midpoint of the railway track, can you draw (the ROW) so we would understand and it would not cause undue stress?	**Ms. Nathalie Tatualia, DOTr:** (Showing cross-section of alignment) For alignment, 15 m both sides from the centerline. (Showing cross-section of station) For stations, 30m both sides from the centerline
	How about the area that will be affected by the North-South Connector Road Project of DPWH? What is the distance of the project from the mid-track, is it still 15 meters?	**Ms. Nathalie Tatualia, DOTr:** For sections where DPWH has used the current PNR alignment, the alignment will move to the side, while maintaining the 30m alignment width. There is

EIA Module	Issues/Concerns Raised	Proponent's Response
		currently close coordination with DPWH regarding final design for these sections.
	The DPWH (Project) will be on the left side (of the ROW), and then this project will be on the right side? How would that be? You will get 30 meters from the midline?	**Ms. Nathalie Tatualia, DOTr:** The midline/centerline will move, and the alignment will move with it. We will maintain the 30m train alignment for safety reasons.
	Is it possible that you coordinate with the DPWH to have joint venture on ROW by any ways? Would it be possible that the DPWH (Project) will be at the top and you will be underneath or vice versa? You can help a lot of people if you can do that.	**Ms. Nathalie Tatualia, DOTr:** Yes, that is one of the items in the ongoing talks with DPWH. We will maximize the use of the right-of-way without compromising safety of operations, both of the Connector Road and PNR.
	Brgy. Chairman Pio Murabe, Brgy. ampalok: The PNR ROW is 30 m so, you will move 15 m outward. This will cover the road, approximately 9 m, the sidewalk, approx. 2 m, therefore, you will get approx. 4 meters from our property line. There's already a tagging in our area. Would there still be a road and sidewalk at the front of the houses or that would be totally covered by the PNR?	**Ms. Nathalie Tatualia, DOTr:** At this point, we are only at the preliminary stage so the tagging is only initial count of potential affected structures. We will get to the next phase where the final affected structures will be identified.
	Ms. Lydia Masangcay, Brgy. 473: Is your perspective drawing of station already the final design?	**Ms. Nathalie Tatualia DOTr:** We only have typical station types. The technical design is not yet final.
	Ms. Myrna Rodriguez, DPWH: The PNR ROW of 30 m. For stations, you will extend another 15 m. Here in Manila, we have a lot of roads. If you will get more ROW, the width of our existing roads would be narrower.	**Ms. Ally Narvaez, DOTr:** We have three structures to build, and some of that are elevated, so it may provide solution to roads that will be within alignment. We continue to coordinate with DPWH and local government units regarding possible effects of the railway to the existing road network, but our goal is to minimize the number of roads that will be affected by this project.
	Ms. Susana Milan, Celadon Residences: How about the easements? Would that be included in the 30 m ROW? Would the freight line use the same line (with this project) and included in the 30 m?	**Ms. Ally Narvaez, DOTr:** Yes, the easement is included in the 30m width.
	Mr. Jun Navalez, City of Manila: When will be the final design ready? We will be expecting a presentation from DOTr on Feb 2019?	**Ms. Ally Narvaez, DOTr:** The next phase will be finished by February 2019, but as early as August and September, we are looking to finalize the alignment in order to also finalize the Resettlement Plan.
People	**Ms. Susana Milan, Celadon Residences:** Will you conduct stakeholder's consultation meeting there (Celadon Residences)? We only have limited information to know what will happen. So, there are still many individuals who were not yet informed.	**Ms. Ally Narvaez, DOTr:** Yes, actually we are planning to do a stakeholders' meeting especially for the Celadon residents.
	Mr. Ivan Cruz, Property Manager of Celadon: We are coordinating with Ecosys Corp. We are actually waiting for the response of our letter. We are waiting for the schedule of the consultation meeting.	**Ms. Ally Narvaez, DOTr:** The papers are being processed. We have an initial schedule on June 25. We want to formally respond to your letter.
	Brgy. Chairman Pio Murabe, Brgy. Sampalok: We are talking about urban area. The owners of the lots are already spending for facilitating the papers of the lands. Others were already looking at another place to transfer. We hope that you will not back-out from this or else all the money that these residents spent will go to waste.	**Mr. Rupert Cruz, JDT:** What we are saying to private, especially legal, PAPs, you will know the cut-off if we will serve the notice of taking. Our time frame will be known by the end of the year. It will be our choice to improve your property or not before that cut-off.
	Mr. Jose Bistag, Celadon Residences: If the final tagging is already finished and the affected residents were already identified, what is the methodology of transferring to the resettlement or	**Ms. Christina Fernandez, DOTr:** We follow the RA 10752 "Right of Way Act", so we will appraise a property based on its current market value. DOTr will request the services of an appraiser

EIA Module	Issues/Concerns Raised	Proponent's Response
	relocation site and would there be compensation?	preferably of government financing institutions usually Landbank or the Development Bank of the Philippines. For affected structures, improvements, crops and trees we will get the IPA or accommodator landbank for replacement cost.
	Mr. Jose Bistag, Celadon Residences: How to determine market value and what if the owner would not agree (with the market value)?	**Ms. Christina Fernandez, DOTr:** We have nationally agreed standards that are used by our appraisers. If the owner does not agree with the appraisal, the law states that the process is a negotiated sale but only a one-time offer. Other venues maybe to expropriate, get a court to decide the just compensation.
	Mr. Jun Navalez, City of Manila: This project will result to traffic. No one is updating us on the alternatives (routes). It is already traffic even if there's no construction yet.	**Ms. Ally Narvaez, DOTr:** We have a Traffic Impact Assessment, but the Traffic Management Plan will be delegated to the bidding construction contractor. Part of the bidding process will be to evaluate their traffic management plan
	Mr. Jose Bistag, Celadon Residences: We have a self-generating power station. If that would be affected through expropriation, what would happen? What is your definition of stakeholders since it (power generating facility) supplies power to approx. 300 houses in our community? If we will call for SCM, all of our community will be invited since they will also be affected?	**Ms. Christina Fernandez, DOTr:** • We have a technical team dedicated to studying the relocation of utilities. As of this time, everything is in feasibility study, and not yet finalized. • Separate talks between DOTr technical team and utility providers will be made. • Any interested member of the public is invited to attend our consultation meetings.
	Ms. Susana Milan, Celadon Residences: How would you secure the area in case there will be expropriation process going on? How about the location, how it will be secured by you? We, in Celadon Residences, we have perimeter walls. Will the walls be open in case there will be expropriation process ongoing? What will happen to the security of our area? Are you going to provide extra security? This is a big concern in our community.	**Ms. Ally Narvaez, DOTr:** We will schedule our 3rd stakeholders' consultation meeting, where we will discuss more thoroughly matters like this and more.
Others	**Mr. Jose Bistag, Celadon Residences:** What are the grounds/concerns for the ECC not to be issued?	**Engr. Lenon Ramboyong, EMB DENR:** The ECC issuance may be denied if there are requirements not met as per EIA. Regarding compliance, we can issue fines for violations or noncompliance to technical and social requirements of the project. This is in force for the whole life span of the project.
	Mr. Jose Bistag, Celadon Residences: Do you have a hotline where we can call?	**Ms. Ally Narvaez, DOTr:** We are finalizing our mechanism regarding grievance redress, and as soon as we have assigned our point persons and made the GRM structure final, we will disclose the details to you in one of our upcoming consultation meetings.

Source: JICA Design Team

Table 9.1.60 Issues / Concerns during Public Scoping (June 21, 2018)

EIA Module	Issues/Concerns Raised	Proponent's Response
Project Description	**Hon. Dante Umario, Former Councilor of Muntinlupa:** You mentioned that you will utilize the ROW of the existing railway, right? Why there is a need for tagging since the 15-15 m is already 30 m. That is already your property. Why there is still a tagging? What for?	**Ms. Klarize Evangelista, DOTr:** The first tagging is for potentially affected structures and/or residences. Not finalized yet, but only for study purposes. The second tagging will be conducted for the final structures that will be affected. The tagging process identifies who will be included in the budget allocated for compensation during relocation.
	Hon. Luisito Arciaga, Councilor of Muntinlupa: Approximately 10 m from the centerline of the railway, there is a national power. It encroached in your right of way by about 5 meters. What would you do with that? Would you demolish it and transfer it farther from the railway? Would you relocate the posts?	**Ms. Rae Cecille Palma, DOTr** We will relocate the utilities that are within the final alignment.
	Mr. Petes Aguilera, Muntinlupa City Planning: If you're saying that you have not yet identified the centerline, what was the basis of the demolition that happened before? The ISF were demolished and were resettled in Southville 3. Why don't you use the centerline that the PNR used before so that there would be no further discussion of demolition, especially in Muntinlupa.	**Ms. Rae Cecille Palma, DOTr:** This is a new project of DOTr. The demolition that happened before is not part of this project. We are yet to finalize the centerline of the new project.
	Ms. Mary Ann Policarpio, HUDCC: When would the construction start? May 2019? When you say construction that means that the area is already cleared? We need to know so we could count backward when should be the start of clearing for relocation.	**Ms. Klarize Evangelista, DOTr:** Yes, the target date is May 2019 for construction, which will also mark the start for clearing operations.
	Hon. Mamerto Sevilla, Jr. Chairman, Sucat, Muntinlupa: In your presentation, majority of the south portion of the tracks will be elevated? The 38 km will be elevated. Does that mean that the whole stretch of the railway in Metro Manila will be elevated?	**Ms. Rae Cecille Palma, DOTr:** There will be an elevated portion from Bicutan down to south portion of Metro Manila.
	Hon. Mamerto Sevilla, Jr. Chairman, Sucat, Muntinlupa: The most common complaint of the residents is the noise from the train horns. There is a suggestion to close the unrecognized crossings to limit the noise from train horns. Here in Muntinlupa, there are a lot of unrecognized crossings, even in subdivisions. What is your plan with the criss-cross in the railway? It would be good if the railway will be elevated so there would be no need to close the roads.	**Ms. Rae Cecille Palma, DOTr:** The new trains will not be noisy, unlike the present design. Since the present design allows for crossings, warning signals are in place for safety purposes. Crossings are one of the considerations in the present feasibility study.
	Mr. Nordy Pimentel, MMDA: Do you have a waste disposal plan per station and would there be intermodal from the stations to the terminals?	**Ms. Rae Cecille Palma, DOTr:** There will be waste disposal plan per station, and the station is designed to integrate a transport terminal, so that commuters do not have to walk far.
People	**Hon. Dante Umario, Former Councilor of Muntinlupa:** A company called, Ecosys Corp, called for a meeting in barangay hall (Sucat). They explained the project. However, since then, the meeting caused fear, worry and doubts in our area. They were talking about demolition. The project is still under study, why are they talking about demolition. In our area, we have (land) titles. Those that they identified that will be affected were subdivisions. We are residing there for hundreds of years already. They are also conducting	**Ms. Klarize Evangelista, DOTr:** What we are doing now are initial talks. We wanted you to be informed as early into the project as possible, so that later, you will not be surprised. This is an important part of the feasibility study.

EIA Module	Issues/Concerns Raised	Proponent's Response
	tagging. The project is still under study. The term "demolition" caused fear on our residents. Is it possible for the tagging to be stopped? The residents were afraid. If you will continue, we could not assure that nothing would happen since many of the residents are afraid of their situation. Since it would still take a long time before the project implementation, is it possible to stop the tagging?	
	Dr. Rudy Sabio, Paranaque: We all know that the relocation site should have water, lighting and electricity. If the target start of construction is May 2019, where is the relocation site? And, what is the process of their transfer to the relocation area.	**Ms. Klarize Evangelista, DOTr:** We are talking with LGU and SHFC for the possible relocation sites, as early as now. We propose them to be located in cities or near cities, and ensure that these sites will have utilities, school, market and livelihood opportunities.
Others	**Mr. Bonifacio Ungdicio Jr. Purok 5, Tanyag:** Not all can attend in this kind of hearing. Can you post on the internet or any website regarding the progress of the project? We will just monitor it from there so it would just be very simple.	**Ms. Rae Cecille Palma, DOTr:** The project updates are posted in DOTr website and FB account. **Lenon Ramboyong, EMB-DENR:** The project is posted also in the EMB website: www.emb.gov.ph. The draft EIS is posted there, and also proponent details. **Ms. Rae Cecille Palma, DOTr** We will also have Grievance Redress Mechanism hotline so that you can ask information regarding this project.

Source: JICA Design Team

Table 9.1.61 Issues / Concerns during Public Scoping (June 22, 2018)

EIA Module	Issues/Concerns Raised	Proponent's Response
Project Description	**Hon. Alexis Desuasido, City Councilor of Binan:** Before, a Local Inter-Agency Committee (LIAC) was already formed. However, the project did not push through. How many percent that this project will be implemented? Would the resettlement action plan be implemented?	**Monica Francisco, DOTr:** We expect this project to push through since this is aligned with the president's targets/vision.
	Sally dela Cruz, former chairman ng Brgy Pansol: Pansol is the hot spring capital of the Philippines. If there is no Pansol, there is no traffic in Calamba. I would like to push our request to revive the station in Pansol. This project and the revival of the station in Pansol would be a big help to solve the problem in traffic.	No answer from DOTr
	Atty. Anastacio P. Mejorada, SP Secretary, San Pedro: The City of San Pedro has a San Pedro Urban Renewal. The plan on the environment is good. Have you coordinated with the Office of the Mayor? If you have a project, you should consult with the City.	**Monica Francisco, DOTr:** The master plan of San Pedro was considered at the start of the project. The station planning is coordinated with City Planning Office of every city hall concerned.
	Hon. Ramon Fernandez, Chairman, Platero, Biñan: In Muntinlupa, the railway has drainage. Would that extend up to here in Laguna? It would be better if there's drainage to avoid flooding.	**Monica Francisco, DOTr:** The design of the drainage system is currently studied, but its design will depend on the final alignment.
	Loida Humarang, Calamba City ENRO: The questions that were previously raised were good. We hope that the resource person that we could talk to	**Lenon Ramboyong, EMB Case Handler:** Our goal for public hearings like this is to answer your queries as technically sound as possible. There will be

EIA Module	Issues/Concerns Raised	Proponent's Response
	is accountable enough to answer our questions. We hope that you can send answers to our questions. I am also concerned with the noise pollution, the impact of the project on the traffic, how often the train would run. In Calamba, not only families, but industries, tourism industry. Our market at the crossing will also be affected.	more stakeholders' consultation meetings to address all the concerns raised. **Monica Francisco, DOTr:** Also, we do not want to cause undue stress by presenting information as 'final', and then revise them later. This project will undergo a thorough study before it will be finalized. Rest assured, the additional information will be disseminated to our stakeholders.
Air	**Mrs. Teresa Madriaga, Cabuyao Central School:** Cabuyao Central School is very near to the railway. Would it be affected by the project? The noise of the train and from the construction, would it affect the students? Also, since our 3-storey building is made of steel and screws, wouldn't it be affected when the train operates? We just want to ensure the safety of our students.	**Monica Francisco, DOTr:** We will conduct surveys for the alignment, and identify affected structures. We will include your concerns and get back to you for the responses. Thank you.
People	**Arnold Paralegal, President, BUCCNAI, Calamba:** We had already a 1st stakeholder's consultation meeting last January and followed by another in April. They explained to us the Peoples Plan. We called our members. The problem, however, is that they don't have yet a coordination with our Mayor. We hope that they will coordinate first with the Mayor and talked about the ISFs since project including the laws that they presented is good.	**Monica Francisco, DOTr:** I will get the details of what happened and relay it to our consultant. Thank you.
	Mr. Agaton Villamor, Vice President, SAMBARIL, Calamba City: Would it be possible to have relocation in each barangay? The relocation site before was far from hospital, market and school. The transportation is also difficult and there's no livelihood in the area. That's why most of the relocatees returned to the 'riles'. So, if it's only possible that we will be relocated in our own barangay, we would be happy.	**Monica Francisco, DOTr:** Our ideal target is for the relocation sites to be as near as possible to your original locations, preferably within the barangay. Worst-case scenario is if we won't find suitable location nearby. May consultation meetings will follow this one to discuss this issue further.
	Ma. Lea Madrid, Social Worker: Why is it that the affected residents don't know who is the particular person that they can talk to? What office and where? This is a big project. The public don't need to wait for a public hearing or stakeholders meeting for their concerns to be addressed. Do you have already an assigned or accredited mobilizer to do the documentation for them? I heard last year, the PCUP is doing the accreditation of mobilizers.	**Monica Francisco, DOTr:** Our contractor for conducting consultation meetings is Ecosys, and there is ongoing coordination with potential affected barangays.
	Mr. Rico Mac, Barangay Kagawad, Barangay Poblacion Calamba City: Do you have an established contractor for the development? Because there are those who went to our barangay and showed presentations about housing. That, they can finish the housing project within 6 months. They are giving us forms. We want to know if they are telling the truth.	**Atty. Lucille Moreno, EMB-Central Office:** They are not from our team, so we cannot verify their statement.
	Ernesto Peralta, Pari-an: When would the housing project start? They are saying that the railway is until 2020? Is that true?	**Monica Francisco, DOTr Representative:** In terms of relocation, before the construction starts, the affected stakeholders will be fully relocated. That is stated in the guidelines we follow. Before any infrastructure is built, the relocation should be finished.
	Anastacia Viron, Barangay Bucal: What we are asking is just quality (for the relocation). Even if there is payment from us as long as it has	**Ledicia dela Cruz, GEOSPHERE:** The DOTr will follow the standards set by JICA and ADB, so it will meet stringent requirements regarding

EIA Module	Issues/Concerns Raised	Proponent's Response
	quality and complete with facilities, school, health center, hospital, with livelihood, near to transport facilities and far from dumpsite.	basic facilities needed in a good relocation site.
	Ma. Lea Madrid, Social Worker: Would there be a separate body coming from JICA for the relocation site? Does this mean that the budget for relocation is the disturbance compensation or all the housing project? There would be a separate budget that will be funneled out to the SHFC for this PNR Project?	**Monica Francisco, DOTr Representative:** The budget will come from DOTr, with SHCF as our Social Key Housing Agency.
	Ma. Lea Madrid, Social Worker: They mentioned that 50% (will be given) if we will sign that we will leave. However, we couldn't understand the remaining 50%. Is this after I leave the 'riles'? Before, it was 70-30 but based on our last meeting, it was already 50-50.	**Monica Francisco, DOTr Representative:** The details will be coming from our ECOSYS consultant, to be further addressed during the third stakeholders' consultation meeting, but as far as I know, the compensation will be given 100%.
Others	**Atty. Noel M. Villanueva, SP Secretary of Calamba:** We can't deny that the affected residents go to the elected official since they don't have any other access to the government. Their access is their elected officials. So, to reduce the pressure to our elected officials, we hope that there would be a separate consultation meeting with the Sangguniang Panglungsod.	**Monica Francisco, DOTr Representative:** Thank you, sir. We will note your statement.

Source: JICA Design Team

9.1.12.4 Stakeholder Consultation Meetings

Three round of Stakeholder Consultation Meeting (SCM) will be held under the RAP with the disclosure of the Project in terms of (i) areas that the Project will traverse, (ii) its components such as the stations, depot, and (iii) other features such as envisioned width of the Right-Of-Way (ROW). This was followed by a description of the RAP Study, with particular focus on the following topics: (i) Basic principles of resettlement; (ii) Socio-economic survey activities, and (iii) RAP schedule of activities. At the end of each meeting, the invited PAPs were encouraged to participate in the open forum to express their views/opinions. A summary of participants, the main concerns/issues raised during the SCMs is provided in **the section 9.2. RAP.**

9.1.12.5 Focus Group Discussion

This Focus Group Discussion (FGD) was conducted targeting business sector, valuables, transport, and vendors as part of the consultation with the affected households in all Cities of the proposed NSRP. Results from the FGDs will be consolidated to substantiate the data gathered from the Socio-Economic Survey and will be analyzed as inputs in the preparation of the Livelihood Restoration and Improvement Program which will be included in the RAP. A summary of participants, the main concerns/issues raised is provided in **the section 9.2. RAP.**

9.2 Land Acquisition and Involuntary Resettlement

Though the Project, the NSRP-SC, will utilize the existing PNR ROW to minimize the size of the land acquisition and magnitude of the displacement associated with it, 12,210 affected households or 45,388 people are assumed to be displaced in the Feasibility Study（FS） stage. The estimated land for the acquisition is 86.42 ha.

The Project will fall in "Category A" of "JICA Guidelines for Environmental and Social Considerations" (2010) (hereinafter referred to as "JICA Guidelines (2010)") due to its nature: (i) Sensitive Sector: Railway, and (ii) Sensitive Characteristic: Large Scale Involuntary Resettlement.

9.2.1 Preparation of Resettlement Action Plan

The Resettlement Action Plan (RAP) of the Project specifies the guidelines and procedures necessary for DOTr to conduct resettlement of Project Affected Persons (PAPs) properly. It ensures that the livelihood and living standards of the PAPs prior to the displacement would be maintained or improved as a result of the Project, in accordance with the legal framework of the Philippines, the JICA Guidelines (2010) and ADB Safeguard Policy Statement 2009 (hereinafter referred to as "ADB SPS (2009)").

(1) Framework of the RAP Study

The framework of RAP Study and associated surveys, their Objectives and Outcomes are shown in Table 9.2.1.

Table 9.2.1 Framework of RAP Associated Surveys

	Activity	Objective	Outcome
1	Conduct Information, Education and Communication (IEC)	Gather basic data, decide on RAP preparation timeline and Scope of Work.	
2	Conduct Detailed Measurement Survey (DMS) and Socio-Economic Survey (SES)	• Conduct a ground survey on the PAPs assets that would be lost and make its list. • Finalize statistical data of the PAPs. • Confirm the assets to be lost and the qualification of the PAPs for the livelihood restoration measures.	• DMS Report • List of PAPs and affected assets (structures, land, crops etc)
3	Conduct Replacement Cost Survey (RCS)	Determine the real market value of structure to be affected by the usage and location of the structures and land, and crops in order to decide the compensation amount.	List of compensation amount for PAPs and affected assets (structures, land, crops, etc.)
4	Conduct Focus Group Discussions (FGD) and Livelihood Restoration Measures	Gather the needs of the Socially Vulnerable and prepare Livelihood Restoration Measures for them.	• Livelihood Restoration Program • Minutes of Meeting (MOM)
5	Identify Relocation Sites	Coordinate with NHA, LGUs and other Government Agencies to select relocation sites.	• List of Relocation Sites • Draft MOU with NHA/LGU
6	Conduct Stakeholder Consultation Meeting (SCM)	Provide information about the Project to the PAPs and collect their views and opinions.	• MOM • Attendance list • Pictures
7	Coordinate with related agencies	Coordinate with concerned Government Agencies for the land acquisition and the implementation of livelihood restoration measures.	MOM

	Activity	Objective	Outcome
8	Prepare RAP	Finalize RAP based on the results of the above-mentioned surveys.	RAP
9	Conduct Due Diligence	Verify that resettlement of PAPs relocated before the commencement of this study and that just compensation and livelihood restoration has been implemented in case of relocation conducted for the Project prior the Loan Agreement.	Due Diligence Report (DDR)
10	Conduct Gender Impact Assessment (GIA)	Conduct interview with and survey to female PAPs to understand their issues and confirm the necessary assistance.	GIA Report

Source: JICA Study Team

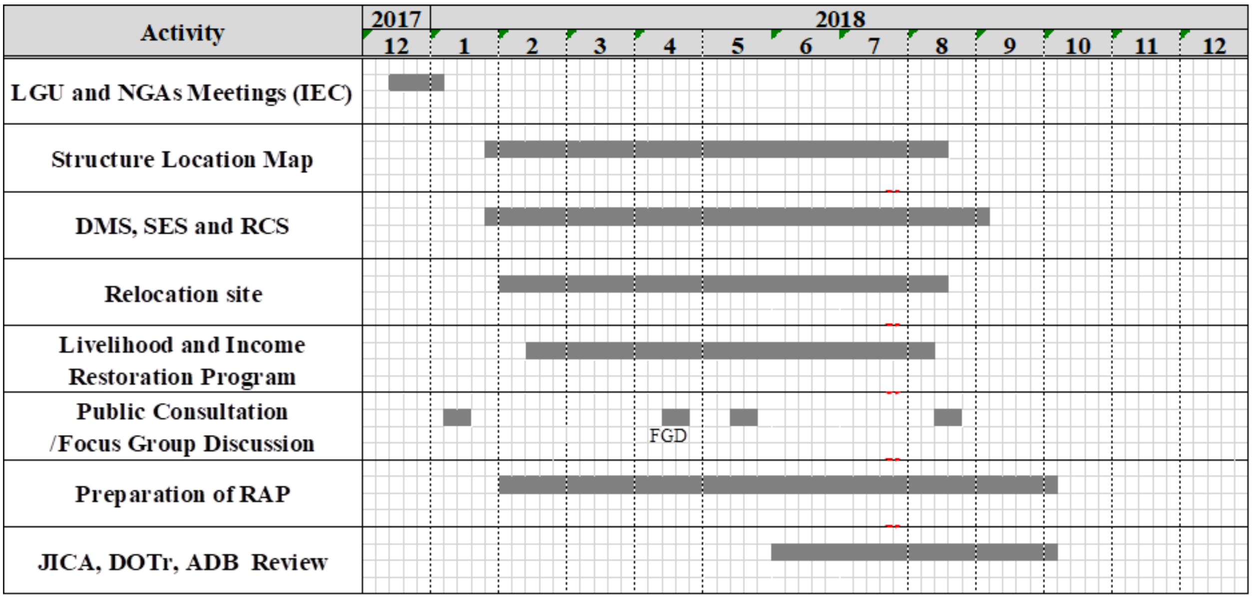
(2) RAP Process

For resettlement, A Draft RAP will be prepared for the Project. The progress of the RAP activities is shown in Table 9.2.2 and the schedule for the Draft RAP is indicated in Table 9.2.3.

Table 9.2.2 Status of RAP Activities

Activity	Status
Review of the planned activities and existing documents	December 2017: Completed
Education and Communication (IEC) Meetings	December 2017- January 2018: Completed
1st Stakeholder Consultation Meeting (SCM)	January 2018: Completed
Socio-economic Survey	January 2018 – August 2018: Completed
Replacement Cost Survey	February 2018 – August 2018: Completed
Focus Group Discussion (FGD)	April - May 2018: Completed
2nd SCM	May -July 2018: Completed
3rd SCM	August 2018: Completed
Preparation of Draft RAP	Planned from February to October 2018
Review of Draft RAP by JICA, DOTr and ADB	June 2018 - October 2018

Table 9.2.3 RAP Schedule



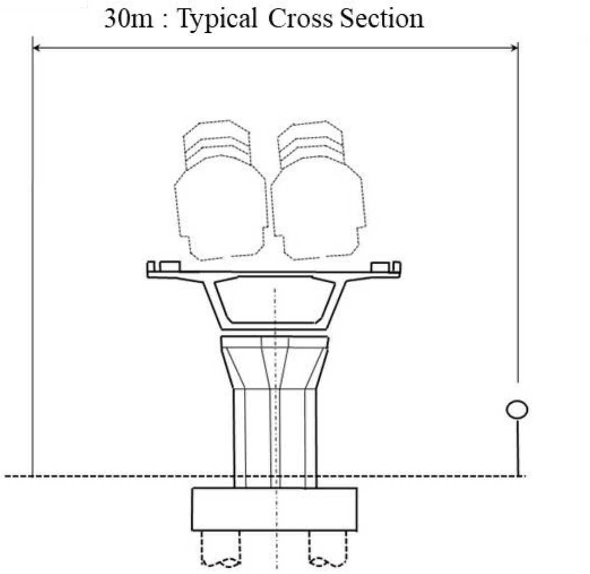
Source: JICA Study Team

9.2.2 Necessity of the Land Acquisition

This Project will maximize the utilization of PNR ROW in order to minimize the additional ROW acquisition. Nonetheless, the Project will result in physical displacement of the PAPs, including Informal Settler Families (ISFs) living within the existing PNR ROW. Additionally, it will affect access roads located parallel to or across the railway track, particularly in City of Manila, Muntinlupa in Metro Manila and some parts of Calamba in Laguna province.

9.2.2.1 Additional ROW for the Railway

On DOTr’s request, the FS RAP ROW for the Project is set at 30m:15m to the left and15m to the right from the assumed center of existing tracks. The Project ROW acquisition might have some impact not only on residential but also on industrial facilities. If the structures of Project Affected Households (PAHs) are severity affected, they will need to be relocated. Typical cross-section of viaducts is presented in Figure 9.2.1.

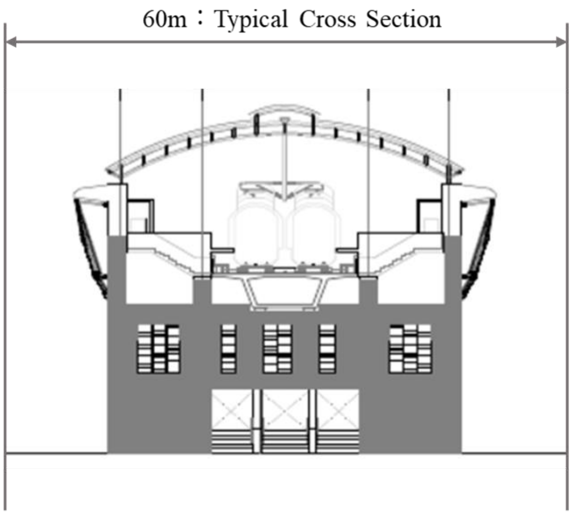


Source: JICA Study Team

Figure 9.2.1 Typical Cross Section for Viaducts

9.2.2.2 ROW for the Stations

Construction of new stations will necessitate additional land acquisition. The ROW width for the stations is set as 60m (30m to the left and 30m to the right from the assumed center of the existing tracks) Typical cross-section of the stations is shown in Figure 9.2.2.

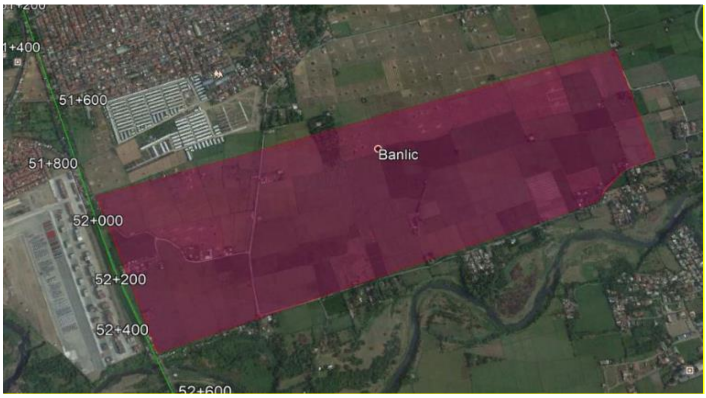


Source: JICA Study Team

Figure 9.2.2 Typical cross section for Stations

9.2.2.3 ROW for Depot Site

The proposed depot site for the NSRP-SC is in Barangay Banlic, Calamba Laguna province. It is located between the proposed Mamatid Station and Calamba Station. The exact boundary of the depot is being determined and the total area is expected to be around 30 hectares. The site is largely used for agricultural activities with patches of residential structures owned by private individuals.



Source: JICA Study Team

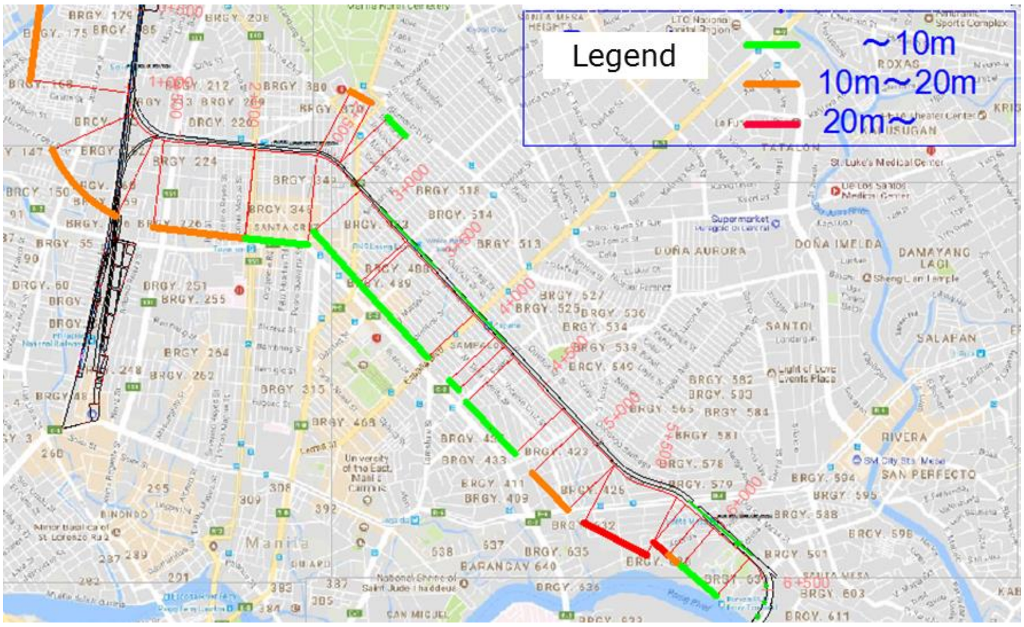
Figure 9.2.3 Proposed Depot Site in Banlic

9.2.2.4 Additional Land Acquisition due to Overlap with NLEX - SLEX Connector

As shown in Figure 9.2.4, the NLEX – SLEX Connector Road (white line) is planned to run parallel to Solis - Santa Mesa section of the proposed NSRP-SC (red line). At several sections, structures of the NLEX - SLEX Connector Road are planned to be built inside the PNR ROW, overlapping with the proposed NSRP-SC alignment. Therefore, the additional land acquisition will be needed to compensate the ROW occupied by the structures of NLEX – SLEX Connector Road in such overlapped section. (Figure 9.2.5)

Source: JICA Study Team

Figure 9.2.4 NLEX –SLEX Connector Road, Skyway Stage 3 and NSRP-SC alignments



Source: JICA Study Team

Figure 9.2.5 Additional land acquisition along NLEX – SLEX Connector Road

9.2.2.5 Connection with Metro Manila Railway Project

Direct train operation between NSRP-SC and the Metro Manila Subway Project (MMSP) is being considered since August 2018. The connection of the two Projects will result in some design modification to 3 stations, Bicutan, San Pedro and Gulod, with changes in track layout and station configuration. The design modification is being planned within the Project ROW, but finalization will be done during Detailed Engineering Design. If additional land acquisition and/or resettlement become necessary, these additional land acquisition and/or resettlement will be undertaken following the principles of this RAP.

9.2.3 Legal Framework

9.2.3.1 Philippine's legal framework for Land Acquisition and Involuntary Resettlement

Table 9.2.4 summarizes the main requirements of laws and regulations of the Philippines concerning land acquisition and involuntary resettlement.

Table 9.2.4 Philippine Legislation, Guidelines and Policies

Law and Regulations	Requirements
The Philippine Constitution of 1987	• Private property shall not be taken for public use without just compensation. (Article III, Bill of Rights, Section 9) • Urban or rural poor dwellers shall not be evicted nor their dwelling demolished, except in accordance with law and a just and humane manner. No resettlement of urban or rural dwellers shall be undertaken without adequate consultation with them and the communities where they are to be relocated. (Article XIII, Urban Land Reform and Housing, Section 10)

Law and Regulations	Requirements
Republic Act No. 10752 (An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and other purposes of 2016)	• This law, enacted on March 7, 2016, repeals Republic Act (RA) No. 8974 (An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and other purposes). Both laws (RA 8974 and RA 10752) are based on the premise that private property shall not be taken for public use without just compensation (Article III, Section 9 of the 1987 Constitution). RA 10752 was enacted to further strengthen the said constitutional provision and ensure that property owners and project-affected properties in areas where national government infrastructure projects would be given just compensation. Implementing Rules and Regulations (IRR) of RA 10752 is promulgated on May 25, 2016, to carry out the provisions of the said Act. • Main provisions in RA 10752 sought to expedite the implementation of infrastructure projects while ensuring that just and equitable compensation be provided to the project-affected persons. The pertinent revisions in RA 10752 include: (1) expansion in scope of national government projects, (2) refining the modes of acquisition, (3) compensation based on replacement cost for land, structures and improvements, (4) changes in guidelines for expropriation proceedings, (5) payment terms and (6) appropriation.
Republic Act No.7279 (Urban Development and Housing Act : UDHA of 1992)	• The mandate of this Act is to uplift the conditions of the underprivileged and homeless citizens in urban areas and resettlement areas by making available to them decent housing at affordable cost, basic services and employment opportunities. • Defines the equitable land tenure system, defines compensation measures for leasehold rights and ensure compensation payment to small property owners. • Eviction and demolition may be allowed (a) for government infrastructure projects with available funding, (b) for persons within danger areas such as *esteros* and railroad tracks and (c) for cases with a court order for eviction and demolition. • Socialized housing or resettlement areas shall be provided by the LGUs or the National Housing Authority (NHA) in cooperation with the private developers and concerned agencies with the basic services and facilities.
Republic Act No.7160 (Local Government Code of 1991)	• The power of eminent domain by the local government unit may not be exercised unless a valid and definite offer has been previously made to the owner, and such offer was not accepted. • Allows LGUs to adopt the provisions in the ROW acquisitions, LGU can possess land immediately after court application for land acquisition by pre-supporting 15% of the fair land price calculated based on tax payment. The remaining amount is determined by the court based on the market price at the time of land acquisition.
Republic Act No. 6389 (Agricultural Land Reform Code of 1971)	Agricultural lessees are entitled to receive disturbance compensation equivalent to five times the average gross harvests on his/her landholding during the last five preceding calendar years.
Republic Act No. 6685 (December 1988)	National and local public works projects funded by either the national government or local government, including foreign-assisted projects must hire at least 50% of the unskilled and 30% of the skilled labor requirements from bona fide and actual residents in the province, city and municipality who are ready, willing and able, as determined by the governor, city mayor, or municipal mayor concerned.
Republic Act No. 9679 (Home Development Mutual Fund Law of 2009)	The Pag-IBIG Fund is a mutual provident savings system which is primarily intended for shelter financing among its members. Section 10 states that the Fund shall be private, owned wholly by the members, administered in trust and applied exclusively for their benefit. Section 6 of the Act provides that membership in the Fund shall be mandatory upon all employees covered by the Social Security System (SSS) and the Government Service Insurance System (GSIS) and their respective employers.
Executive Order (EO) No. 1035, Series of 1985	This EO provides the procedures and guidelines for the expeditious acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects.
Executive Order (EO) No. 48, Series of 2001	This EO declared non-core properties of PNR (i.e., those outside the boundaries of railroad tracks and not utilized for railroad purposes) as socialized housing sites and provided for the disposition of the same to bonafide occupants, through the Housing and Urban Development Coordinating Council (HUDCC)
Executive Order (EO) No. 272, Series of 2004	EO 272 created the Social Housing Finance Corporation (SHFC) . This E.O. also assigned SHFC as the lead government agency for undertaking socialized housing programs that will cater to the formal and informal sectors in the low-income bracket and shall take charge of developing and administering social housing program schemes, particularly the CMP and the Abot-Kaya Pabahay Fund (AKPF) Program (amortization support program and development financing program)

Law and Regulations	Requirements
DOTr Department Order No. 2013-05	• The Department Order specifies the composition of the Technical Working Committee for the Acquisition of Sites/Rights-Of-Way for the department's Infrastructure Projects. It states that no infrastructure project shall be bid out and/or shall commence unless the acquisition of the site and/or ROW of lots affected by the project are determined/settled as certified by the Committee. • Under the Guidelines on ROW Acquisition, properties may be acquired through the following modes: donation, quit claim, exchange or barter, negotiated sale or purchase, expropriation or other modes as authorized by law. The Guidelines specify that an ocular of the property to be acquired must be conducted.
HLURB Memorandum Circular No. 13, Series of 2017	The Housing and Land Use Regulatory Board (HLURB) Memo sets the price ceiling for Economic Housing at above PhP450,000 to PhP1,700,000 while a Medium-Cost Housing is above PhP1,700,000 to PhP4,000,000.
DOTr Right-of-Way and Site Acquisition Manual (ROWSAM)	The ROWSAM was developed to provide clear and specific operational guidelines on ROWA. It aims to guide DOTr staff on the legal processes and procedures necessary to acquire and clear private and public land required for the construction and operation of public transport infrastructure regardless of the funding source(s).
DPWH Right-of-Way Acquisition Manual (DRAM)	The DRAM was developed in compliance with Section 18 of the Implementing Rules and Regulations (RR), of R.A. 10752, which prescribes that, to provide clear, specific and operational guidelines for the efficient acquisition of ROW for its infrastructure projects, each IA (i.e., Implementing Agency) shall prepare and implement its own "Manual of Procedures for ROW Acquisition." The DRAM covers the entire ROW acquisition process
Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP), 2007	The LARRRIP indicates that social impacts of infrastructure projects should be avoided, minimized and/or mitigated. PAPs should be provided with sufficient compensation to ensure that their standard of living prior to the project should be maintained or improved. Project stakeholders should also be consulted regarding the project's design, implementation and operation.

Source: JICA Study Team

9.2.3.2 JICA's Policies on Involuntary Resettlement

Key principles of JICA policies on involuntary resettlement are summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.

II. When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.

III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.

IV. Compensation must be based on the full replacement cost as much as possible.

V. Compensation and other kinds of assistance must be provided prior to displacement.

VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.

VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.

IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

The above principles are complemented by the World Bank OP 4.12, since it is stated in the JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies." Additional key principles based on the World Bank OP 4.12 are as follows:

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers who wish to take advantage of such benefits.

XI. Eligibility of Benefits include the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets, and the PAPs who have no recognizable legal right to the land they are occupying.

XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.

XIII. Provide support for the transition period (between displacement and livelihood restoration).

XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc.,

XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people. An abbreviated resettlement plan is to be prepared. In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plans institutional framework for implementation; monitoring and evaluation mechanism: time schedule for implementation: and, Detailed Financial Plan etc.

9.2.3.3 Gap Analysis between Legal Framework of the Philippine, the JICA Guidelines and ADB Safeguard Policies

A comparison of legal framework of the Philippine’s, the JICA Guidelines (2010) and ADB SPS (2009) was undertaken. The gaps and the Project Policy to bridge the Gaps are as indicated in Table 9.2.5.

Table 9.2.5 Comparison between the JICA Guidelines, ADB Safeguard Policy and Legal Framework on Involuntary Resettlement

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
1	Compensation for non-land assets for those without recognized legal rights to affected land.	PAPs who have neither formal legal rights nor recognizable claims to affected land they occupy is to be compensated for the loss of assets other than land and for other improvements to the land, at full replacement cost, provided they occupied the project area prior to the project cut-off date.	PAPs without legal entitlement to affected land will be eligible for compensation for structures and improvements with the following criteria: a. Must be a Filipino citizen; b. Must not own any real property or any other housing facility, whether in an urban or rural area; c. Must not be a professional squatter or a member of a squatting syndicate, as defined in R.A No. 7279, otherwise known as the "Urban Development and Housing Act of 1992"; (Section 5(b) of RA 10752)[1] "Squatting syndicates" as defined in section 3 of RA 7279[2] will not be eligible for compensation or assistance. Under Section 15 of IRR of RA 10752, the government shall provide adequate appropriations including the cost of development and implementation of resettlement projects, including planning, social preparation, provision of basic services, community facilities, livelihood restoration and improvement and other activities in the resettlement action plan.	PAPs without legal rights to affected land are potentially ineligible for compensation for non-land losses if they are classified as professional squatters or members of squatting syndicates.	PAPs who do not have legally recognized right to the affected land but who occupy the project affected area prior to the cut-off date are eligible for compensation for all losses, other than land, at full replacement cost. "Squatting syndicates" as defined in section 3 of RA 7279 and who are certified by HUDCC and or other Government Agency (PNR, LGU among others) as such will not be eligible for compensation or assistance. Presence in the project affected area at the project cut-off date to be validated through census and validated by the Local Inter-Agency Committee.
2	Eligibility for resettlement assistance	Physically displaced persons will be provided with relocation assistance, transitional support and development assistance. Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards and provide them with appropriate income	Socialized Housing: Under Section 16 of RA 7279, informal settlers: To qualify for the socialized housing program, a beneficiary: a. Must be a Filipino citizen; b. Must be an underprivileged and homeless citizen c. Must not own any real property whether in the urban or rural areas; and	Restrictions on eligibility for resettlement assistance for those who have previously availed of socialized housing or have real property elsewhere.	All relocating PAPs will be eligible for: - relocation assistance, including transportation allowances plus food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). AND one of the two following option: (i) Provision of economic and socialized housing[3] or other forms of government assisted housing will be offered to all PAPs who are physically

[1] Section 6.6 of IRR of RA 10752 includes additional criterion that PAPs must not occupy an existing government ROW. However, this criterion is not supported in RA 10752 itself.

[2] "Squatting syndicates" refers to groups of persons engaged in the business of squatter housing for profit or gain

3 As defined in Section 2, Batas Pambansa (BP) 220, "economic and socialized housing" refers to housing units which are within the affordability level of the average and low-income earners

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
		sources and legal and affordable access to adequate housing.	d. Must not be a professional squatter or a member of squatting syndicates.		displaced. However, the forms of government assisted housing may vary according to PAPs' degree of vulnerability and affordability level[4]. HLURB Classification and Price Ceiling[5] for government housing projects: Socialized housing (PhP450,000) Economic or Low-Cost Housing (Above PhP450,000 to 1,700,000 Medium Cost Housing Above PhP1,700,000 to 4,000,000 Open Market – Above PhP4,000,000 OR (ii) Those relocating PAPs who are not eligible for socialized housing or who do not avail of it will be entitled to: - cash allowance for rental assistance for 5 months; - Cash compensation to cover the cost of reconnecting facilities such as water and power. - Transportation to be provided inclusive of transportation of materials, as well as food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). "Squatting syndicates" as defined in section 3 of RA 7279 and who are certified by HUDCC as such will not be eligible for resettlement assistance. Members of squatting syndicates who do not actually occupy project-affected structures and are residing elsewhere will not be physically displaced and as such will not be eligible for relocation assistance and transitional support.
3	Payment of capital gains tax on land acquired through expropriation.	The rate of compensation for acquired housing, land and other assets will be calculated at full replacement costs. The calculation of full replacement cost will be based on the following elements: (i) fair market value; (ii)	RA 10752 requires for the property owner to pay the capital gains tax in expropriation proceedings in order to incentivize and promote the negotiated sale. Under the negotiated sale, the IA shall pay for the account of the seller, the capital gains tax, as well as the documentary stamp	Payment of capital gains tax by PAP if the land expropriated is inconsistent with the principle of replacement cost.	Payment of CGT will be paid by the IA after the ruling by the court in expropriation cases when a PAP is unable to accept the negotiated sale as they lack the paperwork and are required to undergo Extra Judicial Settlement before being recognized as the property owner (for example, in deceased estates that have not been settled).

[4] Affordability level is equivalent to 30% of the gross family income as determined by the National Economic Development Authority (NEDA) from time to time (Section 2, BP 220)

[5] HLURB memorandum Circular No. 13 Series of 2017

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
		transaction costs; (iii) interest accrued, (iv) transitional and restoration costs; and (v) other applicable payments, if any.	tax, transfer tax and registration fees. The property owner will pay any unpaid real property tax. Under expropriation proceedings, the IA shall pay the documentary stamp tax, transfer tax and registration fees, while the owner will pay the capital gains tax and any unpaid real property tax.		Prompt and complete disclosure of the advantages of Negotiated Sale over Expropriation Proceedings (As provided for by R.A. 10752) shall be made during the conduct of the 2nd Stakeholder Consultation Meeting (SCM) to wit: Negotiated Sale Incentives: (i) Outright offer for the land price will be based on fair market value) (ii) Payment of CGT shouldered by Implementing Agency (DOTr) (iii) Shorter process (2-6 months if all required documents are complete) Expropriation Proceeding Disadvantages: Initial payment for land based on BIR zonal value and owner needs to present documentary evidence during court hearings to prove that value should be higher (i) the Owner needs to hire a lawyer (ii) Longer process (may take a year to several years before the decision of court for payment of just compensation in favor of the owner becomes final and executory) and orders DOTr to pay the owner the difference. PAPs may still revert from expropriation to negotiation at any point in time before the last day of filing for Motion of the expropriation case. In case the Expropriation Case has been filed in Court: The plaintiff (DOTr) can withdraw the case any time before the filing of the answer by the defendant (PAPs) (Section 1(h) Rule 16 of the 1997 Rules of Court on Civil Procedures) If the answer has been filed, there has to be a joint filing by DOTr and owner to withdraw the case (Section 2, Rule 17 of the 1997 Rules of Court on Civil Procedures) In both cases, the acquisition mode would revert back to the Negotiated Sale, which will entitle the owner to pay at current market value of the land (as indicated in DOTr's letter offer), free of taxes, including CGT and registration fees in accordance with Section 5(c) R.A. 10752, replacement cost for structures and improvements and market value for crops and trees under Section 5(a) R.A. 10752.

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
4	Scope of application of the RAP	Scope to cover direct impacts of land acquisition and restricted land use for the project, including any land acquired for development of resettlement sites specifically for the project.	Unless specifically included in the RAP, Government standards only would be applied.	The potential gap with respect to the application of entitlements under RAP to those who are affected by land acquisition to develop resettlement sites for the project.	Any land acquired for resettlement site, development specifically for the needs of the project will be included in the scope of RAPs. DOTr will oblige any agency responsible for land acquisition for resettlement sites, such as NHA, to apply the same standards and entitlements as set out in the framework.
5	Payment of compensation and assistance prior to displacement	All compensation and assistance should be provided prior to displacement.	Under R.A. 10752, PAPs will be paid in two installments for their affected properties. The balance in compensation for the land will only be paid after the deed of sale has been completed. The balance of payment for improvements will be paid to the PAPs only after the acquired lands have been cleared of all improvements (i.e., structures, trees and crops).	Gap on timing for payment	The PAPs will not be displaced until after they have been paid in full the compensation and applicable allowances due to them. For negotiated sale the following arrangements will be applied: For structures: DOTr to pay 100% prior to being displaced, unless the PAP is participating in a government housing project, in which case housing will be provided within the program and amortizations offset by the value of the structure. For land: 1st installment of 50% by DOTr remaining 50% is paid to PAPs when land is officially transferred, but no displacement nor civil works to commence until this transfer is effective and balance paid.
6	Severity of impact on productive resources after which rehabilitation assistance is required.	Loss of 10% or more of productive or income sources (e.g. farmland, business/ shop)	For agricultural tenants and sharecroppers: Financial assistance equivalent to the average gross harvest for the last three (3) years and not less than P15,000 per hectare (E.O. 1035). For agricultural lessees: Entitled to disturbance compensation equivalent to five times the average gross harvests on his/her landholding during the last five preceding calendar years (R.A. 6389)	Gap with respect to threshold and requirement for livelihood restoration assistance for all cases experiencing loss of productive resources.	Provision of supplementary support for livelihood and income restoration for those whose productive resources permanently affected by 10% or more.
7	Severity of loss of property after which	If the residual portion is 20% or less[6] or if the residual portion is	No specific law prescribes acquisition of remaining unviable portion of the acquired	No current Government policy on this issue.	If the residual portion is 20% or less, or if the residual portion is no longer viable for use

[6] Based on the World Bank Involuntary Resettlement Sourcebook which, JICA applies in its policy, provides that if more than 80% of holdings is acquired, or if residual holdings no longer economically viable, owner shall have the option to sell the residual land

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
	the entire property will be acquired.	no longer viable for use according to the original purpose, the entire property will be acquired.	property. [7]		according to the original purpose, the entire property will be acquired taking also the wishes of the PAP into consideration.
8	Income restoration and livelihood improvement	The borrower/client will include detailed measures for income restoration and livelihood improvement of displaced persons in the resettlement plan. Income sources and livelihoods affected by project activities will be restored to pre-project levels, and the borrower/client will make every attempt to improve the incomes of displaced persons so that they can benefit from the project. For vulnerable persons and households affected, the resettlement plan will include measures to provide extra assistance so that they can improve their incomes in comparison with pre-project levels. The resettlement plan will specify the income and livelihoods restoration strategy, the institutional arrangements, the monitoring and reporting framework, the budget and the time-bound implementation schedule.	Requirements for supplementary assistance or training to certain categories of PAPs. However, the requirements do not have specific objectives to restore income earning capacity and are limited in scope and application. Nonetheless, IRR of R.A.10752 states that government appropriations should be available to implement the cost of development and implementation of resettlement projects, and may include livelihood restoration and improvement activities.	ADB/JICA guidelines are more specific regarding objectives of restoring income earning capacity and include those whose income generation resources are severely affected.	Income restoration and livelihood improvement measures need to be designed in consultation with PAPs and be adequately resourced to restore income earning capacity of all PAPs whose livelihoods are affected and improve income earning capacity of vulnerable PAPs. The effectiveness of the income restoration and livelihood improvement activities will be monitored and reviewed.
9	Transitional assistance and compensation for lost income.	In the case of physically displaced persons, provide transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities; and	Section 10(c) of R.A. 10752 provides that the cost of development and implementation of resettlement projects covered by the Act, including planning, social preparation and other activities under the resettlement action plan shall be provided an adequate appropriation to	Although there are no specific laws and guidelines which mention the transition period, entitlements relating to this may be lumped under "*livelihood restoration and improvement and other*	Transitional support during the period while PAPs are resettling and re-establishing their livelihoods will be provided aimed at stabilizing their living standards. Compensation to be provided for lost income for businesses affected by this project

[7] The DPWH Land Acquisition Resettlement Rehabilitation and Indigenous Peoples Policy (LARRIPP) 3rd Ed. Series 0f 2007 provides that if portion of the property to be affected is more than 20% of the total land area or even less than 20% if the remaining portion is no longer economically viable or it will no longer function as intended. The owner of this property (land or structures, etc.) shall be entitled to full compensation in accordance to RA 8974. The DPWH LARRIPP 2007 is dated, being based on RA 8974, which has been superseded by R.A. 10752.

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
		opportunities to derive appropriate development benefits from the project. In cases where land acquisition affects commercial structures, affected business owners are entitled to (i) the costs of re-establishing commercial activities elsewhere; (ii) the net income lost during the transition period; and (iii) the costs of transferring and reinstalling plant, machinery, or other equipment.	cover the funds needed for such. Section 15 of the IRR of R.A. 10752 further states that when necessary the development cost described above may include land development and housing construction, provision of basic services and community facilities, livelihood restoration and improvement and other activities under the resettlement action plan in coordination with concerned government agencies. Executive Order No. 1035 provides for (1) financial assistance to displaced tenants, cultural minorities and settlers equivalent to the average annual gross harvest for the last 3 years and not less than P15,000 per hectare and (2) disturbance compensation to agricultural lessees equivalent to 5 times the average gross harvest during the last 5 years. Section 7 of R.A. 6389 provides for disturbance compensation for agricultural lessees equivalent to 5 times the average gross harvest in the last 5 years. For PAFs whose structures are severely affected and business/income will be affected, the DPWH LARRIP (2003) provides for rehabilitation assistance with an amount not more than P15,000 (based on the tax record for the business activities)	*activities under the resettlement action plan*" as provided by the latest ROW law and its IRR. In the Philippine laws, there is no provision for compensation for loss of income for medium to large businesses.	For PAPs who are owners of medium to large commercial establishments built inside own affected property: Acquire the property but allow the owner of the structure and business use of the land for a defined period to give the owner time to transfer, subject to agreement on a case to case basis; Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business; Assistance in securing a soft loan to enable self-rehabilitation for those restarting business elsewhere; PAPs who are owners of commercial establishments and are leasing space from property owners For those who will continue with their commercial activities elsewhere, rental subsidy for three (3) months based on prevailing average monthly rental for a similar structure of equal type and dimension to the property being leased. Not applicable to lease contracts that will expire within three (3) months at the time of taking; Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business elsewhere; PAPs who are owners of micro commercial establishments built inside own affected property: Cash compensation to cover income losses during the transition period corresponding to stoppage of business activities, but not exceeding six-month period; Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the industry elsewhere; Assistance in securing a soft loan to enable self-rehabilitation for those restarting business elsewhere.
10	Disclosure of the RAP	JICA Policy is to make the RAP accessible to the Public through its website before Loan Agreement	The NEDA ICC does not require the RAP to be made available to the public.		The RAP shall be prepared and accessible to the public through the JICA, ADB and DOTr websites. Salient information from the RAP will be disclosed to PAPs prior to and following finalization.
11	Grievance redress mechanism	Appropriate and accessible grievance mechanisms must be	Republic Act 9285 (Alternative Dispute Resolution (ADR) Act of 2004) was meant	ADR system is promoted by RA 9285, but it does not	An effective and accessible grievance redress mechanism will be established to resolve disputes

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
		established for the affected people and their communities.	to promote alternative mechanisms to resolve disputes outside of judicial litigation and to provide the means for using ADR as an effective tool. ADR system adopts such measures as mediation, conciliation, arbitration, or any combination of it to achieve speedy and efficient means of resolving cases pending before all courts.	stipulate the grievance redress mechanism. There are no specific laws that stipulate the grievance redress mechanisms in the Philippines.[8]	outside the judicial system. Prior to the start of ROW acquisition[9] (ROWA), DOTr will establish a help desk at each city/ municipality to address the concerns of PAPs pertaining to RAP and ROWA. Each help desk must be established immediately before the sending of the Notice of Taking to PAPs by DOTr. A database of PAPs' concerns, actions taken, referrals made and resolution status of said concerns shall be developed and maintained by DOTr. Once the ROWA commences, GRM is triggered and the help desk shall serve as recipient and database manager of grievances filed.
12	Census, inventory of losses and establishment of a cut-off date for eligibility to entitlements.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census, asset inventory and socioeconomic survey). The borrower/client will establish a cut-off date for eligibility. Information regarding the cutoff date will be documented and disseminated throughout the project area.	Requirement under RA 7279 and its IRR for LGUs is to conduct inventory of their ISFs. The conduct of survey and tagging are established a practice by the Urban Poor Affairs Office (UPAO). Section 4 of the IRR for Registration of Socialized Housing Beneficiaries states that the city/municipal government shall be primarily responsible for carrying out the registration of underprivileged and homeless families within their respective jurisdictions.	No specific requirement for the cut-off date.	A census and socioeconomic survey are conducted for the affected areas to prepare the RAP. For informal settlers, the cut-off date is set on the beginning date of the census and tagging. The cut-off date is publicly disclosed during the 1st stakeholder consultation meeting in the project affected areas. Date of Notice of Taking will be the cut-off date for formal property owners.
13	External monitoring	For projects with significant involuntary resettlement impacts, the borrower/client will retain qualified and experienced experts to conduct external monitoring.	Not required	Requirement for external monitoring of projects with significant impacts.	The IA will engage qualified experts to conduct an external monitor of implementation of the RAP.
14	Voluntary land donation	Voluntary land donation is not specifically covered under the ADB and JICA policy frameworks.	Voluntary land donations are permitted.	Voluntary land donations are a mode of land acquisition for the project.	Voluntary donation will be an act of informed consent and APs/IPs will not be forced to donate land or other assets with coercion or under duress. Any voluntary donation will follow international best practices and be confirmed through written records and verified by an independent third

[8] In terms of guidelines, Section 3.4 Tracking and Monitoring Implementation of Grievance procedures of the DPWH LAPRAP Tracking Manual of 2003 may be used as reference.

[9] Onset is marked by the sending of the Notice of Taking by DOTr

	Issue	ADB/JICA	Laws of the Philippines	Gap	Gap Filling Measure
					party.

Source: JICA Study Team

9.2.4 Resettlement Policy of the NSRP-SC Project

9.2.4.1 Basic Resettlement Policy

The Government of the Philippines will adopt a Project Resettlement Policy (the Project Policy) for the NSRP Project because existing national laws and regulations have gaps with the international standards including JICA’s policy. The Project Policy is aimed at filling any gaps in order to help ensuring that PAPs including Informal Settlers Families (ISFs) are able to rehabilitate themselves to at least their pre-project conditions, at the earliest possible time.

This section discusses the principles of the said Project Policy and the entitlements of the PAPs based on the types and degrees of their losses. The NSRP-SC Project Policy is presented below:

I. Land acquisition and involuntary resettlement will be avoided where feasible or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

II. Where displacement of households is unavoidable, all PAPs losing assets, livelihood, or resources will be fully compensated and assisted so that they can improve, or at least restore, their former socio-economic and conditions.

III. Where displacement of business enterprises is unavoidable, all PAPs losing livelihoods will be fully assisted so that they can improve, or at least restore, their former economic conditions.

IV. Rehabilitation assistance will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have their:

- Standard of living adversely affected:
- Right, title or interest in any house, interest in, right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or movable assets, acquired or possessed, temporarily or permanently;
- Income earning opportunities in business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; and
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

V. All affected people shall be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected, nor tenure status and social or economic status, will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and socio-economic survey shall be entitled to compensation for their lost assets at replacement cost as well as restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

VI. PAPs that lose only part of their physical assets but would be left with a portion that will be inadequate to sustain their current standard of living shall be fully compensated. PAPs whose structures are marginally affected shall not be required to relocate or move out, but will be consulted if they intend to reside in the remaining portion of their property.

VII. People temporarily affected shall be considered PAPs. Contractors shall secure the necessary ECCs for temporary facilities such as workers camps, warehouses for materials, stockpiling areas etc. from the appropriate DENR-EMB offices where they are located. Where these facilities are located in public or private lands, the Contractor shall enter into Lease Agreements and should there be a need for temporary displacement or compensation for affected structures and improvements, the Contractor shall comply with the provisions of R.A. 10752 and the Resettlement Action Plan for NSRP-SC Project.

VIII. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.

IX. The resettlement plans will be designed in accordance with the Project Resettlement Policy.

X. The Resettlement Action Plan (RAP) as approved by JICA will be disclosed by DOTr to the public through the following means: posting of approved RAP on DOTr website and distribution to concerned LGUs.

XI. Payment for land and/or non-land assets will be based on the principle of full replacement cost.

XII. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include the provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skills development, wage employment, or self-employment, including access to credit. Cash compensation alone will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

XIII. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, and transitional allowance.

XIV. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly, and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

XV. PAPs will be involved in the process of developing and implementing resettlement plans.

XVI. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

XVII. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation, other entitlements and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Philippine government.

XVIII. Displacement must not take place before provision of compensation and other assistance required for relocation. Sufficient social infrastructure and basic services must be provided in the resettlement site prior to relocation. Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be on-going activities.

XIX. Implementation arrangements for the implementation of the RAP will be in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

XX. Appropriate reporting (including auditing and redress functions) monitoring and evaluation mechanism, shall be in place as part of the resettlement management system. An external monitoring agent or group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified resettlement experts, NGOs, research institutions or universities.

9.2.4.2 Cut-off Date of Eligibility

The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, the cut-off date was declared for the informal settlers only.[10] No cut-off date was declared with regards to formal settlers (i.e., property owners) as this will be reckoned from the issuance of the Notice of Taking (NoT) by the DOTr in accordance with laws (Section 11 of R.A. 10752 and Section 16 of its Implementing Rules and Regulations or IRR). Based on these statutes, any new

[10] Informal settling is an unlawful act after 1992 in accordance with Section 30 of R.A. 7279

structure or improvement to an existing one on the land covered by the ROW acquisition will not be compensated after the issuance of the NoT.

The indicative dates for the conduct of the census survey and tagging were announced to PAPs through the conduct of the 1st Stakeholder Consultation Meeting as shown in Table 9.2.6. For each city/municipality, dates were assigned to prevent the influx of ineligible non-residents who might take advantage of the project entitlements.

Table 9.2.6 Cut-Off Dates of Eligibility

PROVINCE/CITY/MUNICIPALITY	BARANGAY	CUT-OFF DATE (First day of the tagging)
LAGUNA		
CABUYAO	POBLACION 1	January 24, 2018
	POBLACION 2	January 24, 2018
	BIGAA	January 24, 2018
	SALA	January 24, 2018
	NIUGAN	January 24, 2018
	BANAY-BANAY	January 24, 2018
	SAN ISIDRO	January 24, 2018
	BANLIC	January 24, 2018
	PULO	January 23, 2018
	MAMATID	January 23, 2018
LOS BAÑOS	TADLAC	January 26, 2018
	LALAKAY	January 26, 2018
	BAMBANG	January 26, 2018
	MALINTA	January 31, 2018
	BATONG MALAKE	January 25, 2018
	MAYONDON	January 31, 2018
	BAYBAYIN	January 25, 2018
	ANOS	January 25, 2018
	TIMUGAN	January 26, 2018
	MAAHAS	January 29, 2018
	TUNTUNGIN-PUTHO	January 29, 2018
	SAN ANTONIO	January 31, 2018
BAY	PACIANO RIZAL	February 05, 2018
CALAMBA	BANLIC	February 13, 2018
	SAN CRISTOBAL	February 13, 2018
	PARIAN	February 12, 2018
	POBLACION 1	February 07, 2018
	LECHERIA	February 07, 2018
	HALANG	March 15, 2018
	BUCAL	March 12, 2018
STA ROSA	TAGAPO	February 15, 2018

PROVINCE/CITY/MUNICIPALITY	BARANGAY	CUT-OFF DATE (First day of the tagging)
	LABAS	February 15, 2018
	POOC	February 15, 2018
	DILA	February 19, 2018
	DITA	February 19, 2018
BIÑAN CITY	CANLALAY	February 24, 2018
	SAN VICENTE	February 20, 2018
	STO NINO	February 20, 2018
	SAN ANTONIO	February 19, 2018
	PLATERO	February 19, 2018
SAN PEDRO	SAN ANTONIO	February 28, 2018
	SAN VICENTE	February 26, 2018
	NUEVA	February 26, 2018
METRO MANILA		
MUNTINLUPA CITY	TUNASAN	February 27, 2018
	POBLACION	February 28, 2018
	PUTATAN	March 19, 2018
	BAYANAN	March 05, 2018
	ALABANG	March 06, 2017
	CUPANG	March 06, 2017
	BULI	March 06, 2017
	SUCAT	March 12, 2018
PARAÑAQUE CITY	SAN MARTIN DE PORRES	March 21, 2018
TAGUIG CITY	FORT BONIFACIO	March 22, 2018
	WESTERN BICUTAN	March 22, 2018
	NORTH DAANG HARI	March 23, 2018
	SOUTH DAANG HARI	March 23, 2018
	BAGUMBAYAN	March 23, 2018
	TANYAG	March 23, 2018
MAKATI CITY	SAN ANTONIO	March 21, 2018
	PIO DEL PILAR	March 21, 2018
	BANGKAL	March 21, 2018
	MAGALLANES	March 21, 2018
CITY OF MANILA	807	March 26, 2018
	769	March 26, 2018
	800	March 27, 2018
	803	March 27, 2018
	811	March 28, 2018
	868	March 28, 2018
	865	March 28, 2018
	835	March 28, 2018

PROVINCE/CITY/MUNICIPALITY	BARANGAY	CUT-OFF DATE (First day of the tagging)
	836	March 28, 2018
	815	March 28, 2018
	426	April 03, 2018
	428	April 03, 2018
	629	April 03, 2018
	422	April 04, 2018
	473	April 04, 2018
	472	April 04, 2018
	474	April 04, 2018
	483	April 04, 2018
	484	April 04, 2018
	349	April 04, 2018
	368	April 04, 2018
	356	April 06, 2018
	630	April 11, 2018
	628	April 11, 2018
	446	April 13, 2018
	444	April 13, 2018
	443	April 13, 2018
	442	April 13, 2018
	450	April 13, 2018
	487	April 16, 2018
	485	April 16, 2018
	351	April 16, 2018
	348	April 17, 2018
	359	April 18, 2018
	224	April 18, 2018
	227	April 18, 2018
	218	April 19, 2018
	217	April 19, 2018
	186	May 24, 2018
	185	May 24, 2018
	161	May 24, 2018
	162	May 24, 2018
	165	May 24, 2018

Source: JICA Study Team

9.2.4.3 Principle of Replacement Cost

All land and non-land assets owned by households/shop owners who meet the cut-off date will be compensated based on the principle of replacement cost. The replacement cost is the amount calculated before displacement which is needed to replace affected asset without depreciation and deduction for taxes and/or costs of the transaction.

9.2.5 Socioeconomic Characteristics of PAPs

The socio-economic survey was carried out to identify all PAPs and their assets to be affected (land, structures, improvements and crops) as well as establish a baseline of their social and economic conditions. It is comprised of three main components namely the: (i) Census survey, (ii) Asset and land survey, (iii) Livelihood and living survey. Further, questions seeking to the following information from the PAPs were made: project awareness, perceptions, issues and concerns, suggested livelihood rehabilitation measures, information on railway access/use, previous relocations and relocation preferences. All these information are essential inputs to the development of a robust RAP.

The coverage of the socio-economic survey includes all communities located within the final route of the NSRP-SC and the required ROW of the railway and stations (entrances/exits, vent shaft/ventilation system). Municipalities/cities in Metro Manila covered by the survey are as follows:

- In Metro Manila: Manila, Taguig, Parañaque and Muntinlupa
- In Laguna: San Pedro, Biñan, Sta. Rosa, Calamba and Cabuyao.

The locations were confirmed using KML files prepared by the JICA Study Team (JST). Identification of affected areas was made using available software such as Google Earth, Maps.ME and Open Street Maps (OSM). With the help of the respective Local Government Units (LGUs,) lots and structures that would be displaced were identified.

9.2.5.1 The Census Survey

The main purpose for conducting the census survey and tagging are:

- To determine the number of households and persons (including landowners, tenants, business owners, employees and informal settlers) and those more vulnerable among them that would be affected by the project;
- To determine the profile of the PAPs including their socio-demographic profile, livelihood sources, economic status and/or living standards and their access to basic services and facilities which are essential to meet compensation and resettlement assistance requirements;
- To gauge PAPs' perceptions about the Project, anticipated project benefits, concerns, issues, recommendations for addressing these issues and suggested livelihood rehabilitation measures;
- To quantify all affected assets (land, structures, improvements, crops, etc.) within the project area as input to establishing full and fair compensation; and,

- To provide a baseline for measuring the impact and social performance of the Project.

9.2.5.2 Profile of the Households to be Affected

Households occupying structures to be affected by the Project were categorized by the use of the structures, namely residential or residential/commercial purposes and surveyed to establish their number, profiles and socio-economic conditions which are vital inputs to this RAP. The Household for this plan, is defined as "*…one or more people who live in the same dwelling and also share meals or living accommodation and may consist of a single family or some other grouping of people. A single dwelling will be considered to contain multiple households if either meals or living space are not shared".*

A total of 12,210 potentially affected households were surveyed as shown in Table 9.2.7, with the gender distribution of household heads summarized in Table 9.2.8.

Table 9.2.7 Number of Affected Households

City/Municipality	Formal Settler Families/ Households	Informal Settler Families/ Households	Total No of Affected Households	%
Manila	465	4,499	4,964	40.66
Makati	21	140	161	1.32
Taguig	17	361	378	3.10
Parañaque	0	38	38	0.31
Muntinlupa	132	1,166	1,298	10.63
San Pedro	24	277	301	2.47
Biñan	37	2,044	2,081	17.04
Sta. Rosa	11	424	435	3.56
Cabuyao	5	101	106	0.87
Calamba	114	2,334	2,448	20.05
Total	826	11,384	12,210	100.00
Note: Informal Settler Families -Includes the renters, sharers, rent-free occupants and structures owners who do not have legally recognizable right to the land they occupy.				

Source: JICA Study Team

Table 9.2.8 Gender Distribution of Household Heads

City/ Municipality	Male		Female		Total	
	No.	%	No.	%	No.	%
Manila	9,493	49.85	9,549	50.15	19,042	100.00
Makati	299	49.8	301	50.17	600	100.00
Taguig	668	52.02	616	47.98	1,284	100.00
Parañaque	85	56.29	66	43.71	151	100.00
Muntinlupa	2,437	51.12	2,330	48.88	4,767	100.00
San Pedro	588	51.67	550	48.33	1,138	100.00
Biñan	3,677	51.63	3,445	48.37	7,122	100.00
Sta. Rosa	795	52.27	726	47.73	1,521	100.00
Cabuyao	195	53.42	170	46.58	365	100.00

City/ Municipality	Male		Female		Total	
	No.	%	No.	%	No.	%
Calamba	4,673	49.72	4,725	50.28%	9,398	100.00
Total	22,910	50.48%	22,478	49.52%	45,388	100.00

Source: JICA Study Team

(1) Type of Residence

Residential structures are considered as *primary residences* if the occupant households regard it as their permanent living accommodation. Some residential structures are considered as *secondary residence* if the household occupants have a primary residence elsewhere. Secondary residences serve as temporary accommodations for individuals or households who want to be near schools or workplace during weekdays or for an extended period with the intention to return to their primary residence during weekends, school/work holidays/vacations and or during school breaks in most cases.

Table 9.2.9 Type of Residence

City/ Municipality	Primary Residence		Secondary Residence		N/R		N/A		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Manila	4816	97.02	133	2.68	15	0.30	0	0.00	4,964	100.00
Makati	141	88.13	19	11.88	0	0.00	1	0.26	161	100.00
Taguig	367	97.09	10	2.65	0	0.00	1	0.26	378	100.00
Parañaque	38	100.00	0	0.00	0	0.00	0	0.00	38	100.00
Muntinlupa	1270	97.77	22	1.69	6	0.54	0	0.00	1,298	100.00
San Pedro	298	99.00	3	1.00	0	0.00	0	0.00	301	100.00
Biñan	2033	97.69	38	1.83	7	0.34	3	0.14	2,081	100.00
Sta. Rosa	416	95.63	10	2.30	2	0.46	7	1.61	435	100.00
Cabuyao	95	89.62	8	7.55	3	2.83	0	0.00	106	100.00
Calamba	2,377	97.14	56	2.29	14	0.53	1	0.04	2,448	100.00
Total	11,851	97.06	299	2.45	47	0.38	13	0.11	12,210	100.00
Note: N/R-The household respondents did not specify either primary or secondary.										

Source: JICA Study Team

(2) Reason for Establishing Residence in Present Location

Multiple responses were generated from potentially affected households when asked about the reasons for choosing to reside in their present location. The results are summarized in Table 9.2.10.

Table 9.2.10 Reasons for Establishing Residence in the Current Location

City/ Municipality	A	B	C	D	E	F	G	Total
Manila	3,023	627	215	3,184	352	457	107	7,965
Makati	109	32	2	75	25	12	5	260
Taguig	216	65	26	221	8	35	12	583
Parañaque	16	15	6	19	7	8	1	72
Muntinlupa	603	234	106	629	76	116	38	1,802
San Pedro	140	68	30	156	18	24	21	457
Biñan	880	486	143	935	96	232	132	2,904

City/ Municipality	A	B	C	D	E	F	G	Total
Sta. Rosa	148	127	49	171	37	40	21	593
Cabuyao	46	34	6	53	12	9	11	171
Calamba	1,087	511	207	1,151	144	337	115	3,552
Total	6,268	2,199	790	6,594	775	1,270	463	18,359
%	34.14	11.98	4.30	35.92	4.22	6.92	2.52	100.00
Note: A - Proximity to livelihood, B – Rent Free/Affordable Rental Rate, C – Other economic reasons, D – Near family ties, E – Near school, F – Got married, G – other social reasons								

Source: JICA Study Team

(3) Household Size or Number of Household Members

The average household size is summarized in Table 9.2.11

Table 9.2.11 Household Size

City/ Municipality	1-2	3-4	5-6	7-8	9-10	10<	N/R	Total	Ave.
Manila	1,218	2,231	1137	276	76	26	0	4,964	4
Makati	62	54	23	8	7	6	1	161	4
Taguig	129	164	69	13	2	1	0	378	3
Parañaque	11	12	9	5	1	0	0	38	5
Muntinlupa	377	556	277	62	22	2	2	1,298	4
San Pedro	82	127	67	18	6	1	0	301	4
Biñan	742	830	372	111	19	5	2	2,081	4
Sta. Rosa	145	177	71	25	6	3	8	435	4
Cabuyao	37	47	13	7	2	0	0	106	3
Calamba	663	998	553	164	54	10	5	2447	4
Total	3,467	5,197	2,591	689	195	54	17	12,210	4
%	28.39	42.56	21.22	5.64	1.60	0.44	0.14	100.00	

Source: JICA Study Team

(4) Educational Attainment of Household Members

The educational attainment of the surveyed household members is summarized in Table 9.2.12.

Table 9.2.12 Educational Achievement of Household Members

City/ Municipality	A	B	C	D	E	F	G	H	I	Total
Education, FEMALE										
Manila	292	1,208	360	1,610	1,700	220	1,342	1,900	55	8,687
Makati	5	28	12	41	57	11	48	83	1	286
Taguig	25	113	29	134	148	15	48	44	0	556
Parañaque	3	20	3	16	8	0	4	1	0	55
Muntinlupa	70	382	132	404	562	67	195	247	2	2,061
San Pedro	15	111	38	98	97	11	46	49	4	469
Biñan	138	642	207	678	780	82	188	110	2	2,827
Sta. Rosa	29	147	61	136	134	13	26	27	0	573
Cabuyao	3	38	15	26	32	4	16	10	0	144
Calamba	168	840	255	819	1214	115	343	239	1	3,994

City/ Municipality	A	B	C	D	E	F	G	H	I	Total
Sub-Total	748	3529	1112	3962	4732	538	2256	2710	65	19,652
%	3.81	17.96	5.66	20.16	24.08	2.74	11.48	13.79	0.33	100.00
Education, MALE										
Manila	302	1,318	330	1,607	1,704	347	1,351	1,483	47	8,489
Makati	8	29	9	37	49	24	62	59	1	278
Taguig	21	129	34	138	137	26	49	32	0	566
Parañaque	6	30	4	14	7	0	1	1	0	63
Muntinlupa	89	484	116	440	520	102	183	194	2	2130
San Pedro	12	122	34	111	92	17	63	39	3	493
Biñan	108	775	266	701	719	121	154	97	2	2,943
Sta. Rosa	23	204	81	128	123	16	34	10	0	619
Cabuyao	5	52	23	29	43	7	6	6	0	171
Calamba	167	893	230	836	1117	210	275	163	3	3894
Sub-Total	741	4036	1,127	4,041	4,511	870	2,178	2,084	58	19,646
%	3.77	20.54	5.74	20.57	22.96	4.43	11.09	10.61	0.30	100.00
Grand Total	1,489	7,565	2,239	8,003	9,243	1,408	4,434	4,794	123	39,298
%	3.79	19.25	5.70	20.36	23.52	3.58	11.28	12.20	0.31	100.00
Note: A-Preschool, B-Elementary Level, C-Elementary Graduate, D-Highschool Level, E-Highschool Graduate, F-College Level, G-College Graduate, H-Vocational/Technical, I-Advance Degree										

Source: JICA Study Team

9.2.5.3 Assets and Land Survey

Assets can be classified as either fixed and movable. Fixed assets refer to structures and perennial crops which are attached to the ground while movable assets are those that PAPs can still bring with them when relocated. The asset survey focused on the fixed structures since these will be impacted by the Project. Asset and land surveys involved gathering information on their ownership status and type of the use.

Table 9.2.13 Number of Affected Residential Structures and Survey Respondents

City/ Municipality	Affected Occupied Structures		No. of Surveyed Persons		
	No.	%	Formal Settler Families/ Households	Informal Settler Families/ Households	Total
Manila	2,090	29.74	465	4,499	4,964
Makati	50	0.71	21	140	161
Taguig	159	2.26	17	361	378
Parañaque	30	0.43	0	38	38
Muntinlupa	678	9.65	132	1,166	1,298
San Pedro	194	2.76	24	277	301
Biñan	1,605	22.84	37	2,044	2,081
Sta. Rosa	321	4.57	11	424	435
Cabuyao	89	1.27	5	101	106
Calamba	1,812	25.78	114	2,334	2,448
Total	7,028	100.00	826	11,384	12,210

Notes:
1. Number of surveyed PAPs respondents is based on the tagging and census activity after the conduct of stakeholder consultation meetings,
2. Number of structures and respondents do not match because: There are structures with more than one

occupant/household (e.g., renters of residential units, as well as lessees of commercial establishments); There are respondents who own more than one (1) affected structure

Source: JICA Study Team

Table 9.2.14 Number of Structures by Type of Use

City/ Municipality	Total No. of Structures		Structure Usage							
	No.	%	Residential	Commercial	Commercial-Residential	Industrial	Industrial-Residential	Institutional	Residential/ Institutional	Others
Manila	2,090	29.74	1,787	54	222	0	2	20	2	3
Makati	50	0.71	23	16	10	0	0	1	0	0
Taguig	159	2.26	105	21	33	0	0	0	0	0
Parañaque	30	0.43	23	4	2	0	0	1	0	0
Muntinlupa	678	9.65	492	95	85	0	0	3	0	3
San Pedro	194	2.76	157	18	19	0	0	0	0	0
Biñan	1,605	22.84	1,188	221	172	1	0	3	0	20
Sta. Rosa	321	4.57	274	28	12	0	0	1	0	6
Cabuyao	89	1.27	75	7	5	0	0	1	1	0
Calamba	1,812	25.78	1,687	92	13	1	1	1	0	17
Total	7,028	100.00	5,811	556	573	2	3	31	3	49
%	100.00		82.68	7.91	8.15	0.03	0.04	0.44	0.04	0.70

Source: JICA Study Team

(1) Land Ownership Status

Land ownership can be a form of economic security among the affected households, business owners and landowner/claimants. As part of the census survey, respondents were asked whether they own the lands they occupy and/or claim. The results are summarized in Table 9.2.15.

Table 9.2.15 Ownership of Lands

City/Municipality	Yes			No			N/R			Total		
	M	F	ST	M	F	ST	M	F	ST	M	F	ST
Manila	210	255	465	2,014	2,467	4,481	9	9	18	2,233	2,731	4,964
Makati	11	11	22	71	68	139	-	-	-	82	79	161
Taguig	3	14	17	166	194	360	1	-	1	170	208	378
Parañaque	-	-	-	11	27	38	-	-	-	11	27	38
Muntinlupa	46	85	131	530	624	1,154	5	8	13	581	717	1,298
San Pedro	12	12	24	116	156	272	1	4	5	129	172	301
Biñan	18	19	37	947	1,064	2,011	14	19	33	979	1,102	2,081
Sta. Rosa	8	3	11	230	190	420	2	2	4	240	195	435
Cabuyao	3	2	5	46	55	101	-	-	-	49	57	106
Calamba	78	36	114	1416	908	2,324	4	6	10	1498	950	2,448
Total	389	437	826	5,547	5,753	11,300	36	48	84	5,972	6,238	12,210
%	6.51	7.01	6.76	92.88	92.23	92.55	0.60	0.77	0.69	100.00	100.00	100.00

Source: JICA Study Team

(2) Structure Ownership and Occupancy

Potentially affected residential or business structure occupants were asked if they own the structures they occupy. Survey responses as presented in Table 9.2.16.

Table 9.2.16 Ownership of Structures

City/ Municipality	Structure Ownership			Male Owners		Female Owners	
	Yes	No	N/R	No.	%	No	%
Manila	1,967	2,995	2	863	43.87	1,104	56.13
Makati	31	130	0	15	48.39	16	51.61
Taguig	190	188	0	81	42.63	109	57.37
Parañaque	33	5	0	9	27.27	24	72.73
Muntinlupa	710	585	3	294	41.41	416	58.59
San Pedro	203	98	0	95	46.80	108	53.20
Biñan	1,331	742	8	617	46.36	714	53.64
Sta. Rosa	337	94	4	192	56.97	145	43.03
Cabuyao	88	18	0	44	50.00	44	50.00
Calamba	1,443	1,001	4	869	60.22	574	39.78
TOTAL	6,333	5,856	21	3,079	48.62	3,254	51.38

Source: JICA Study Team

9.2.5.4 Livelihood and Living Survey

This section provides details necessary to understand the affected households' livelihoods and living standards as well as vulnerabilities.

(1) Sources of Household Income

The survey also sought information on the households' primary sources of income by categorizing either as land-based, wage-based, enterprise-based and remittance based. The land-based sources are those income generating activities largely dependent on the productive potential of land such as crop production, fish or aquaculture, livestock raising/production etc. The wage-based incomes are cash payments paid to individuals in return for services rendered while the enterprise-based sources are those income-earning activities that the household or household members engage that is not land-based nor wage-based. The remittance based sources are those incomes sent to the household or household member/s from another location as a means to support household needs or expenses. The result of the survey is summarized in Table 9.2.17.

Table 9.2.17 Primary Source of Household Income

City/	Land-Based			Wage-Based			Enterprise-Based			Remittance-Based			No Occupation		
Municipality	M	F	ST	M	F	ST	M	F	ST	M	F	ST	M	F	ST
Manila	18	14	32	3,865	2,457	6,322	742	918	1,660	85	166	251	4,272	5,473	9,745
Makati	-	-	-	138	102	240	38	39	77	3	3	6	105	137	242
Taguig	1	1	2	289	132	421	58	58	116	5	9	14	282	402	684
Parañaque	-	-	-	22	11	33	10	11	21	-	-	-	42	43	85
Muntinlupa	2	3	5	962	567	1,529	242	237	479	11	22	33	1,114	1,381	2,495
San Pedro	2	-	2	210	130	340	68	64	132	3	5	8	281	328	609
Biñan	6	1	7	1,586	728	2,314	303	437	740	19	24	43	1,487	2,000	3,487
Sta. Rosa	3	5	8	329	138	467	81	82	163	5	1	6	272	405	677
Cabuyao	5	1	6	91	37	128	20	24	44	-	1	1	63	79	142
Calamba	18	5	23	1,994	1,192	3186	474	555	1029	34	33	67	2,180	2,517	4697
Total	55	30	85	9,486	5,494	14,980	2,036	2,425	4,461	165	264	429	10,098	12,765	22,863
%	0.24	0.13	0.19	41.73	24.25	33.00	8.96	10.70	9.83	0.73	1.17	0.95	44.43	56.34	50.37

City/	Others			N/R			N/A			Total		
Municipality	M	F	ST	M	F	ST	M	F	ST	M	F	ST
Manila	200	228	428	21	16	37	326	221	547	9,529	9,493	19,022
Makati	6	11	17	-	-	-	11	7	18	301	299	600
Taguig	6	2	8	2	1	3	-	63	63	643	668	1,311
Parañaque	-	-	-	8	-	8	-	20	20	82	85	167
Muntinlupa	25	25	50	10	7	17	-	195	195	2,366	2,437	4,803
San Pedro	5	8	13	-	-	-	-	53	53	569	588	1,157
Biñan	15	10	25	48	42	90	-	435	435	3,464	3,677	7,141
Sta. Rosa	5	3	8	17	11	28	14	150	164	726	795	1,521
Cabuyao	1	4	5	-	-	-	-	49	49	180	195	375
Calamba	32	31	63	33	36	69	105	52	157	4,870	4,421	9291
Total	295	322	617	139	113	252	456	1,245	1,701	22,730	22,658	45,388
%	1.30	1.42	1.36	0.61	0.50	0.56	2.01	5.49	3.75	100.00	100.00	100.00

Source: JICA Study Team

The location of the primary source of income is summarized in Table 9.2.18.

Table 9.2.18 Location of Primary Source of Income

City/Municipality	Total PAPs with Primary Occupation	Own Residence/ House	Within Neighborhood or Barangay	Near Barangay	Other City/ Municipality	Overseas	No Definite Area	Others	N/R
Female									
Manila	3,799	678	509	875	1225	197	202	14	99
Makati	155	27	34	48	27	4	14	1	0
Taguig	203	51	54	34	42	10	7	0	5
Parañaque	22	7	10	0	4	0	1	0	0
Muntinlupa	861	168	234	192	178	40	14	6	29
San Pedro	207	35	60	49	44	6	11	0	2
Biñan	1,242	300	349	238	230	31	31	10	53
Sta. Rosa	240	42	73	64	33	3	6	5	14
Cabuyao	67	15	26	16	5	1	2	0	2
Calamba	1852	372	529	449	334	69	38	4	57
Sub Total	8,648	1,695	1,878	1,965	2,122	361	326	40	261
%	100.00	19.60	21.72	22.72	24.54	4.17	3.77	0.46	3.02
Male									
Manila	4,931	380	639	1209	1867	230	513	13	80
Makati	185	13	34	53	43	10	30	1	1
Taguig	361	16	124	81	102	5	27	0	6
Parañaque	40	5	7	10	4	0	6	0	8
Muntinlupa	1,252	92	370	268	363	34	101	2	22
San Pedro	288	19	101	71	67	9	20	1	0
Biñan	1,977	113	599	536	469	16	173	13	58
Sta. Rosa	440	30	135	102	113	7	33	2	18
Cabuyao	117	15	42	29	21	4	3	1	2
Calamba	2585	217	869	725	516	29	161	12	56
Sub Total	12,176	900	2,920	3,084	3,565	344	1,067	45	251
%	100.00	7.39	23.98	25.33	29.28	2.83	8.76	0.37	2.06
Total	20,824	2,595	4,798	5,049	5,687	705	1,393	85	512
%	100.00	12.46	23.04	24.25	27.31	3.39	6.69	0.41	2.46

Source: JICA Study Team

Table 9.2.19 presents the different types of enterprises found in the locations surveyed.

Table 9.2.19 Types of Enterprise-Based Livelihoods

City/Municipality	Sari-Sari Store	Food/ Catering	Hair/ Nails/ Beauty Salon	Tailoring/ Dress-making	Transportation	Construction	Vulcanizing Shop	Vending	Others	N/R	Total

City/Municipality	Sari-Sari Store	Food/ Catering	Hair/ Nails/ Beauty Salon	Tailoring/ Dress-making	Transportation	Construction	Vulcanizing Shop	Vending	Others	N/R	Total
Manila	275	189	40	30	245	25	2	405	412	37	1,660
Makati	14	16	1	0	16	0	0	17	9	4	77
Taguig	21	4	4	1	13	2	0	25	44	2	116
Parañaque	1	1	0	0	1	0	0	7	11	0	21
Muntinlupa	108	48	10	3	57	7	0	93	139	14	479
San Pedro	17	15	2	0	21	1	0	38	34	4	132
Biñan	151	68	22	24	71	11	5	166	206	16	740
Sta. Rosa	24	19	3	5	36	4	0	46	19	7	163
Cabuyao	6	2	1	1	6	0	0	11	17	0	44
Calamba	177	70	21	12	152	1	5	276	187	128	1,029
Total	794	432	104	76	618	51	12	1,084	1,078	212	4,461
%	17.80	9.68	2.33	1.70	13.85	1.14	0.27	24.30	24.16	4.75	100.00

Source: JICA Study Team

(2) Monthly Household Income

The survey results for monthly household income is summarized in Table 9.2.20.

Table 9.2.20 Monthly Household Income (All Sources)

Income Bracket	Total	%
PhP 0-999	20	0.16
PhP 999-1,999	70	0.57
PhP 2,000-PhP3,999	328	2.69
PhP4,000- PhP5,999	536	4.39
PhP 6,000-PhP7,999	846	6.93
PhP8,000-PhP 9,999	1,301	10.66
PhP 10,000-PhP11,999	1,029	8.43
PhP12,000-PhP 15,999	2,559	20.96
PhP 16,000-PhP 19,999	1,305	10.69
PhP 20,000-PhP24,999	1,248	10.22
PhP25,000-PhP29,999	729	5.97
PhP30,000 -PhP 49,999	1,351	11.06
PhP50,000-& Above	674	5.52
No answer	214	1.75
Total	12,210	100.00

Source: JICA Study Team

(3) Monthly Expenditures

The average monthly expense among the affected households is summarized in Table 9.2.21.

Table 9.2.21 Monthly Household Expenditures

Average Monthly Expense	No. of Resp. Reporting	Monthly Average Expense	%
Rent (Land)	154	1,135	4.40
Rent (House/Room)	2,738	3,100	12.02
Tax	361	1,462	5.67
Food	11,033	7,147	27.72
Light	9,772	1,097	4.26
Water	9,083	467	1.81
Education	4,624	2,302	8.93
Communications (Telephone, CP, etc.)	8,646	519	2.01
Transportation	7,602	1,439	5.58
Recreation	2,640	1,435	5.56
Gas/groceries/medicine, etc.	10,140	1,723	6.68
Average, Total Expense	-	25,784	100.00
Savings	885	3,958	15.35
Note: Percent against average monthly household income of PhP14,887 (Detailed Census and Survey 2018)			

Source: JICA Study Team

(4) Vulnerability

Vulnerable persons will most likely experience more difficulty when physically or economically displaced and coping with transition at relocation site without appropriate support and assistance. The census survey recorded the following vulnerabilities:

Table 9.2.22 Summary of Vulnerabilities among PAPs

Vulnerabilities	Male		Female		Total	
	No.	%	No.	%	No.	%
Baby/Toddler	2,191	51.77	2,041	48.23	4,232	87.24
Pregnant	N/R	0.00	238	100	238	4.91
Mental Disorder	39	60	26	40	65	1.34
Needs Assistance in Walking/ Cannot Walk	56	57.73	41	42.27	97	2
Seriously Ill	28	56	22	44	50	1.03
Blind	11	42.31	15	57.69	26	0.54
Mute/Deaf	24	53.33	21	46.67	45	0.93
Others	65	66.33	33	33.67	98	2.02
Total (Individual)	2,414	49.76	2,437	50.24	4,851	100
Elderly Headed Household	651	45.52	779	54.48	1,430	31.59
Single Parent (Separated + Widow)	453	27.45	1,197	72.55	1,650	36.45
HH Below Poverty Threshold	N/R	0.00	N/R	0.00	1,447	31.96
Total (Household)	1,104	24.39	1,976	43.65	4,527	100.00

Source: JICA Study Team

9.2.5.5 Profile of Affected Businesses

(1) Type of Business Ownership

The type of business ownership is summarized in Table 9.2.23.

Table 9.2.23 Type of Business Ownership

City/ Municipality	Single Proprietorship			Partnership			Corporation			Cooperative			Others			Total			
	M	F	N/R	M	F	N/R	M	F	N/R	M	F	N/R	M	F	N/R	M	F	N/R	Total
Manila	85	105	10	0	3	3	2	0	8	0	0	0	3	3	14	90	111	35	236
Makati	9	6	0	0	0	0	5	3	6	0	0	0	0	0	0	14	9	6	29
Taguig	23	31	0	1	0	0	0	0	0	0	0	0	0	0	0	24	31	0	55
Parañaque	6	4	1	0	0	0	0	0	3	0	0	0	0	0	0	6	4	4	14
Muntinlupa	56	124	1	0	2	1	0	0	2	0	0	0	0	1	1	56	127	5	188
San Pedro	11	27	0	0	0	0	0	0	0	0	0	0	0	0	0	11	27	0	38
Biñan	150	249	4	1	1	0	1	0	0	0	0	0	1	0	5	153	250	9	412
Sta. Rosa	15	29	0	0	0	0	0	0	0	0	0	0	1	0	1	16	29	1	46
Cabuyao	8	6	0	0	0	0	0	0	1	0	0	0	2	0	0	10	6	1	17
Calamba	189	330	3	2	5	0	1	0	0	0	0	0	1	0	15	193	335	18	546
Total	552	911	19	4	11	4	9	3	20	0	0	0	8	4	36	573	929	79	1,581
%	96.34	98.06	24.05	0.70	1.18	5.06	1.57	0.32	25.32	0.00	0.00	0.00	1.40	0.43	45.57	100.00	100.00	100.00	

Source: JICA Study Team

(2) Average income of Employees

The average income of employees is summarized in Table 9.2.24.

Table 9.2.24 Average Monthly Income – Employee

City/Municipality	Average Income (Monthly)			Average Income (Monthly)	No. of Businesses Disclosing
	Rank and File	Mid-Level Management	Senior Management		
Manila	94,777	57,702	80,690	197,801	116
Makati	66,060	51,800	79,333	166,493	114
Taguig	66,011	51,790	71,333	160,761	21
Parañaque	10,810	11,200	12,600	10,810	10
Muntinlupa	12,900	0	0	12,900	5
San Pedro	27,352	4,160	6,500	26,887	26
Biñan	11,433	375	1,000	8,308	4
Sta. Rosa	17,626	16,550	15,000	49,176	60
Cabuyao	7,538	0	21,375	9,100	8
Calamba	11,435	14,845	11,008	9,988	8
Total	32,594	26,053	33,204	65,222	372

Source: JICA Study Team

9.2.5.6 Project Awareness

The awareness about the Project is summarized in Table 9.2.25 for Land Owners/Claimants, and in Table 9.2.26 for Affected Households.

Table 9.2.25 Project Awareness among Land Owners/Claimants

City/ Municipality	Yes		No		N/R		Total	
	No.	%	No.	%	No.	%	No.	%
Manila	36	92.31	3	7.69	0	2.33	39	100.00
Makati	-		-		-		-	
Taguig	-		-		-		-	
Parañaque	-		-		-		-	
Muntinlupa	5	100	0	0	0	0	5	100.00
San Pedro	-		-		-		-	
Biñan	1	100	-	0	-	0	1	100.00
Sta. Rosa	-		-		-		-	
Cabuyao	1	100	-	0	-	0	1	100.00
Calamba	3	100	-	0	-	0	3	100.00
Total	46	93.88	3	6.12	0	0	49	100.00

Source: JICA Study Team

Table 9.2.26 Project Awareness Among Households

City/ Municipality	Yes		No		N/R		Total	
	No.	%	No.	%	No.	%	No.	%
Manila	4,297	86.56	643	12.95	24	0.48	4,964	100.00
Makati	85	53.13	75	46.88	1	0.00	161	100.00

City/ Municipality	Yes		No		N/R		Total	
	No.	%	No.	%	No.	%	No.	%
Taguig	364	96.30	14	3.70	0	0.00	378	100.00
Parañaque	35	92.11	3	7.89	0	0.00	38	100.00
Muntinlupa	1,216	93.75	72	5.55	10	0.69	1,298	100.00
San Pedro	251	83.39	48	15.95	2	0.66	301	100.00
Biñan	1,910	91.78	155	7.45	16	0.77	2,081	100.00
Sta. Rosa	419	96.32	12	2.76	4	0.92	435	100.00
Cabuyao	95	89.62	11	10.38	0	0.00	106	100.00
Calamba	2,306	94.20	118	4.82	24	0.98	2,448	100.00
Total	10,978	90.2	1,151	9.18	81	0.62	12,210	100.00

Source: JICA Study Team

9.2.5.7 Issues and Concerns

The issues and concerns about the project are summarized in Table 9.2.27 for Land Owners/Claimants, and in Table 9.2.28 for Affected Households.

Table 9.2.27 Issues and Concerns Among Land Owners/Claimants

City/ Municipality	A	B	C	Others	Total
Manila	30	17	16	3	66
Makati	0	0	0	0	0
Taguig	0	0	0	0	0
Parañaque	0	0	0	0	0
Muntinlupa	5	3	2	0	10
San Pedro	0	0	0	0	0
Biñan	1	0	0	0	1
Sta. Rosa	0	0	0	0	0
Cabuyao	1	1	0	0	2
Calamba	3	1	1	0	5
Total	40	22	19	3	84
%	47.62	26.19	22.62	3.57	100.00

Note: A-May not get the fair market price of the land, B- Payment may be delayed, knowing government procedures, C-Only asset I have, may not be able to buy the same quality and location at the price paid

Source: JICA Study Team

Table 9.2.28 Issues and Concerns Among Affected Households

City/ Municipality	A	B	C	D	E	Others	N/R	Total
Manila	4,010	52	201	139	51	233	428	5,114
Makati	84	0	5	1	0	25	35	150
Taguig	354	1	7	12	1	10	6	391
Parañaque	35	0	1	0	0	1	0	37
Muntinlupa	1,177	8	29	54	10	111	12	1,401
San Pedro	262	6	11	4	4	34	2	323
Biñan	1929	28	47	38	4	103	40	2,189
Sta. Rosa	404	3	9	5	1	23	4	449
Cabuyao	88	1	4	2	1	8	2	106

City/ Municipality	A	B	C	D	E	Others	N/R	Total
Calamba	2306	33	84	30	8	131	30	2,622
Total	10,649	132	398	285	80	679	559	12,782
%	83.31	1.03	3.11	2.23	0.63	5.31	4.37	100.00
Note: A- My house will be demolished/we will be relocated to another area, B- My shop will be relocated, C- My business/livelihood will be negatively affected, D-Living environment in the area will get worse because of noise and vibration, E. Value of commercial and residential properties will be decreased.								

Source: JICA Study Team

9.2.5.8 Recommendations to Address Issues and Concerns

As part of the survey, respondents were asked of their thoughts on how they think the issues and concerns they have raised can be addressed. The recommendations/suggestions generated from the respondents are summarized in Table 9.2.29 .

Table 9.2.29 Recommendations/suggestions generated from the respondents

Households	Business	Land Owners/Claimants
Provide permanent relocation sites where we can live permanently	Provision of alternative business structure within the same barangay or nearby where the economic center is/are	Fair compensation for affected land without delay prior to utilization
Relocation with−n barangay/City/ Municipality	Financial support to restart business elsewhere	Provide alternative livelihood opportunity for those whose source of income is rental of land.
Compensation for housing structure and assistance to relocate in our chosen province	Financial compensation for the lost business structure at a fair market value that will enable business owners to reestablish the same	Integrate safety measures in the project design to secure nearby communities
Provision of replacement housing that is made of sturdy materials, with access to electricity and water,	Opportunity to put up the same business at the relocation site	Ensure that the trains will not cause noise pollution
The same neighborhood at the relocation site	Provide alternative access for marginally affected businesses	Provide alternative access for the remaining communities
Relocation site must be safe and secured, near schools, hospitals, market, main roads	Provide information ahead of project start	
Financial assistance to reestablish livelihoods or start new livelihoods	Allow us to demolish our own structures so we can still use salvaged materials	
Provision of free housing at the relocation site	Assistance in relocating the business	
Provision of space to continue our livelihoods at relocation site (i.e,. sari-sari store, eatery, livestock raising etc.) and space for the garage (tricycle, jeepney etc.)		
Affordable housing program		
Proper information dissemination before any demolition		

Source: JICA Study Team

9.2.5.9 Proposed Livelihood Restoration and Improvement Measures

The respondents from the affected household and business owners indicated various types of livelihood assistance when asked what they think would be the appropriate livelihood assistance in case they lose their livelihoods, jobs or businesses. The results are summarized in Table 9.2.30.

Table 9.2.30 Types of Proposed Livelihood Assistance Among Affected Household

City/ Municipality	A	B	C	D	E	F	G	Others	Total
Manila	12	10	12	9	101	86	7	9	246
Makati	1	1	0	2	13	6	0	4	27
Taguig	0	0	4	2	33	20	1	3	63
Parañaque	0	0	0	0	4	0	0	2	6
Muntinlupa	5	5	12	4	108	73	8	22	237
San Pedro	1	0	2	0	21	11	0	4	39
Biñan	25	19	33	20	235	185	31	36	584
Sta. Rosa	0	3	3	0	23	22	4	5	60
Cabuyao	6	1	0	1	7	6	0	0	21
Calamba	39	13	35	10	328	247	28	30	730
Total	89	52	101	48	873	656	79	115	2,013
%	4.42	2.58	5.02	2.38	43.37	32.59	3.92	5.71	100.00

Note: A-Job/Employment within the current sector and within the same Barangay, B- Any job/employment within the same Barangay, C- Any job/employment near the potential relocation site, D-Job/Employment with the same occupation in the same city, E- Business capital/funds to re-start the same business, F-Business capital/funds to set-up new business, G- Vocational training/other livelihood skills

Source: JICA Study Team

9.2.6 Compensation and Entitlement

The PAPs' eligibility for compensation and entitlements is in accordance with the policy and legal framework for the land acquisition and resettlement policy of the Project. Identification of PAPs' eligibility was carried through the socio-economic survey.

For areas requiring land acquisition, the negotiated sale will be the preferred mode of acquisition. Compensation for the structures and improvements will be based on full replacement cost.

9.2.6.1 Eligibility Criteria

The PAPs are eligible for the compensation of their affected assets in accordance to Section 5 of R.A. 10752. There are two main modes of acquisition prescribed by law namely, (i) Negotiated Sale and (ii) Expropriation.

(1) Negotiated Sale

Under the negotiated sale, the following two eligibility criteria will be observed.

a. PAPs who meet the following criteria will be entitled to cash compensation for the loss of land, crops and trees (if any) based on the current market value and full replacement cost for structures and improvements, free from taxes, including capital gains tax, documentary stamp tax, transfer tax and registration fees, except Real Property Tax (RPT) arrears and estate tax in case of Extra-Judicial Settlement (EJS).

PAPs who have full titles, such as Original Certificate of Title (OCT) or Transfer Certificate of Title (TCT) or Emancipation Patents (EP) or Certificate of Land Ownership Award (CLOA)

PAPs who are not original patent holders of lands granted under C.A. 141 and where any previous acquisition is not through a gratuitous title (e.g., donation, succession)

PAPs who can present (i) a Tax Declaration showing his/ her and his/her predecessors' open and continuous possession of the property for at least 30 years, (ii) a certification from the Department of Environment and Natural Resources (DENR) that the land is alienable and disposable, or (iii) other documents that may show proof of ownership;

PAPs who are holders of (i) Emancipation Patent (EP) granted under Presidential Decree No. 27 or (ii) CLOA granted under the Comprehensive Agrarian Reform Act (R.A. 6657)

PAPs who were former ISFs but who now hold a title of land as beneficiaries of government socialized housing programs. In addition, they will be eligible to become beneficiary of other CMP programs in accordance with the Social Housing Finance Corporation (SHFC) Board Resolution No. 528 and Corporate Circular 16-047 Series of 2016.

If losing 10% or more of agricultural land, PAPs are entitled to participate in the Livelihood Restoration and Improvement Program.

b. PAPs who are original patent holders of lands granted under CA 141 and whose land has not been subjected to previous government exercise of its lien will not receive compensation for land but will be provided with:

Cash compensation for structure, improvements, crops and trees, computed at full replacement cost;

No compensation for land up to 20 m width if the patent was granted prior to 1975, and up to 60m width for patents granted thereafter. More than government lien, follow other entitlements for PAPs who have a full title or if feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAP;

For PAPs directly engaged in farming, a disturbance compensation equivalent to five times of the average gross harvest for the last five years on the principal and secondary crops of the area acquired (as adopted from RA 6389);

If losing 10% or more of agricultural land, PAPs are entitled to participate in the Livelihood Restoration and Improvement Program; and

Financial assistance, particularly to displaced tenants/occupants of agricultural lands, cultural minorities and settlers who are duly accredited by the Ministry of Agrarian Reform/Bureau of Forest Development/Office of Muslim Affairs and Cultural Communities in accordance with Section 18 of EO No.1035 series of 1985.

The PAPs who own the structures but do not own the land are entitled to the following:

- Cash compensation for the entire or, affected portion of the structure or improvement without depreciation, upon presentation of proof of ownership (e.g., certification from the concerned barangay in accordance with the IRR for R.A. 10752);
- If low income and homeless, the option to avail of tenured land, or socialized housing package either through the LGUs or CMP through the SHFC; and
- Have the option to keep salvaged materials from demolished structures without deduction from compensation due him.

c. PAHs who will incur temporary impacts during construction (for use as an access road, for soil dumping, borrow sites and contractor's camps, etc.) and who have legal rights to the land will be entitled to the following from the construction Contractor:

- Lease amount equivalent to prevailing rental rates in the location of the property
- Compensation for affected non-land assets based on replacement cost and
- Restoration of land to pre-construction state

(2) Expropriation Proceedings

In the event that a PAP refuses or fails to accept the compensation in the negotiated sale, or fails or refuses to submit the documents necessary for the payment, DOTr will initiate expropriation proceedings.

For expropriation cases, a check will be deposited to the court upon the filing of a complaint by the DOTr through the Office of the Solicitor General (OSG). For land, the amount of compensation will be computed based on the latest Bureau of Internal Revenue (BIR) Zonal value. For structures and improvements, the basis of computation will be in terms of full replacement cost as defined in R.A. 10752 and its IRR. Crops and trees will be compensated based on its current market value.

The court will immediately issue an order to take possession of the property and start implementation of the project as provided in Section 6(a) of R.A. 10752. While the court adjudicates the compensation to be paid, the PAP may, at any time request the court to release such deposit upon presentation of proof of ownership (Section 6(a) R.A. 10752).

After the case has been heard by the court, the court will order DOTr to pay the difference, if any, between the initial compensation and the just compensation as determined by the Commissioners assigned by the said court. DOTr will pay the necessary documentary stamp tax and registration fee.

Based on Rule 16 Section 1(h) of the 1997 Rules of Court on Civil Procedures, the plaintiff (DOTr in this Project) can withdraw the case any time before the filing of the answer by the defendant (PAPs). If the answer has been filed there has to be a joint filing by DOTr and the owner to withdraw the case (Section 2, Rule 17 of the 1997 Rules of Court on Civil Procedures).

In both cases, the acquisition mode would revert back to negotiated sale, which will entitle the owner to pay at current market value for land (as indicated in DOTr's letter offer), free of taxes, including CGT and registration fees, replacement cost for structures and improvements and market value for crops and trees.

If no motion to dismiss as above described is filed, expropriation proceeding will continue. Once the court decision becomes final , executory acquisition mode (expropriation) cannot revert back to any other mode.

Where the PAP agreed to the negotiated sale, but was unable to gain the necessary documents to show proof of the ownership, DOTr may pursue a joint motion in the court for a compromised judgment reflecting the agreed amount - on a case-by-case basis and in good faith. DOTr will provide assistance to PAPs whose lands will be subjected to EJS. This will be done through the Help Desk that will be established at each LGU prior to the issuance of the NoT. Early issuance of the NoT is highly recommended for PAPs to have enough time to complete/progress EJS process prior to the issuance of the Letter Offer to Buy, which only gives them 30 days to accept the offer, after which the expropriation proceedings can commence.

9.2.6.2 Special Assistance for Vulnerable Groups

PAPs who belong to any of the following vulnerable groups will be regarded as vulnerable.

- Poor based on the poverty threshold
- Elderly
- Persons with disabilities (PWDs)
- Single women-headed households

Those may be worsened off after the displacement will be provided with:

- Inconvenience allowance in the amount of PhP 10,000 per household;
- Rehabilitation assistance in the form of skills training and other development activities with the value of up to PhP 15,000 per household in coordination with other government agencies;
- Support to access/maintain government welfare programs;
- Inclusion in the Livelihood Restoration and Improvement Program as prescribed in the RAP.

For families with persons needing special assistance and/or medical care, respective LGUs will provide nurses or social workers to help them before and during the resettlement activities.

9.2.6.3 Severity of the Project Impacts

PAPs will be compensated in accordance with the severity of the impact (severe or marginal) on the affected properties, as defined in the ADB SPS (2009).

There are two levels of impacts that are expected from the ROW acquisition:

1. **Severe** (severely-affected) – for properties (land and structures / improvements) that are acquired for the Project covering more than 20% (for residential land) or 10% (for agricultural land); or if less than 20% (for residential land) or 10% (for agricultural land) but the remaining area is no longer economically viable or will no longer serve intended function.

2. **Marginal** (marginally-affected) – for properties (land and structures/improvements) that are acquired for the Project covering less than 20% (for residential land) or 10% (for agricultural land) and the remaining area is still viable for continued use.

Properties to be acquired may include the entire area or a portion of the properties. For severely affected properties, the entire land and or structure including improvements, crops and trees will be compensated at replacement cost. Whereas for marginally affected properties, only the portion affected, including the improvements, crops and trees contained in the affected portions will be compensated at replacement cost.

9.2.6.4 Payment Schedule

The mode of the payment to the PAPs is summarized in Table 9.2.31.

Table 9.2.31 Payment Arrangements for Legal Property Owners

PAP Category	Estimated time for validation and overall land acquisition	Remaining payment
Case 1. PAPs with complete documents which have been verified by DOTr and authenticated by authorized agencies	15 to 30 working days	DOTr to pay 100% of compensation prior to issuance of a new title in favor of DOTr and before relocation/construction can begin. DOTr to notify property owners early to enable time to gather necessary paperwork as proof of ownership.
Case 2. PAPs with complete documents except for Tax Clearance (due to the landowner's incapacity to pay their RPT arrears)	30 to 45 days	DOTr to pay 100% of compensation prior to issuance of a new title in favor of DOTr and before relocation/construction can begin. DOTr to notify property owners early to enable time to gather necessary paperwork as proof of ownership.
Case 3. PAPs would require extra-judicial settlements (i.e. missing documents due to the death of land owner, etc.)	6 months-1 year	An initial compensation at an amount computed at 100% of lot price based on latest Bureau of Internal Revenue (BIR) zonal value for the land, replacement cost for structure and improvements and market value for crops and trees. A check will be deposited to the court in favor of the owner upon the filing of expropriation case by DOTr. While the court adjudicates the compensation to be paid, the PAPs may, at any time request the court to release such deposit upon presentation of proof of

PAP Category	Estimated time for validation and overall land acquisition	Remaining payment
		ownership; After the case has been heard by the court, the Court will order DOTr to pay the difference, if any, between initial compensation and the just compensation as determined by the court.

Source: JICA Study Team

9.2.6.5 Entitlement Matrix

The Entitlement Matrix of the Project describes the compensation and entitlements for the PAPs as shown in Table 9.2.32.

Table 9.2.32 Entitlement Matrix for NSRP-SC

Type of Impact		Loss of Land	
Entitled Person		(Severe/Full)	(Marginal/Partial)
1a	PAPs who have full title being Original Certificate of Title (OCT) or Transfer Certificate of Title (TCT) or emancipation patents (EP) or Certificates of Land Ownership Award (CLOA).	Entitlements: Cash compensation for loss of land at full replacement cost computed at current market value, free of taxes, including capital gains tax (CGT), documentary stamps tax (DST), transfer tax and registration fees, except Real Property Tax (RPT) arrears. OR If feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAPs.	Entitlements: Cash compensation for portion of land at full replacement cost computed at current market value, free of taxes, including CGT, DST, transfer tax and registration fees, except RPT arrears. Easement Agreement: If the portion of a lot required for a ROW is minimal, such that the expenses for surveying or segregating that portion from the main lot would be more than the value of the part of the lot needed, the DOTr may, if the owner agrees, resort to the mode of easement of ROW (Title VII, Chapters 1 and 2 Civil Code of the Philippines). In this case, cash compensation for the value of the portion of the land subjected to easement agreement computed at latest BIR zonal value, with owner retaining ownership of said portion of land (Article 630, Chapter 1, R.A. 386/ Civil Code of the Philippines).
1b	PAPs who are not original patent holders of lands granted through C.A. 141 (i.e. those who have bought the patent for the land previously granted through C.A. 141) and where any previous acquisition is not through a gratuitous title (e.g., donation or succession) (C.A. 141, Chapter 7).		
1c	For untitled land, PAPs who can present: (a) Tax Declaration showing his and his predecessors' open and continuous possession of the property for at least 30 years, (b) a certification from the DENR that the land is alienable and disposable and (c) other documents that may show proof of ownership (RA 10752).		
1d	PAPs who were former ISFs but now hold title of land as a result of a government socialized housing program.		
1e	PAPs who were former ISFs and government socialized housing program beneficiaries whose titles are still under the name of the organization.	Entitlements: Same as above, with less any amount still owing to the title.	Entitlements: Same as above.
1f	PAPs who are original patent holders of lands granted through Commonwealth Act (C.A.) No. 141 and the land has not been subjected to previous government	Entitlements: No compensation for land up to 20 meters width if patent was granted prior to 1975 and up to 60 meters width for patents granted thereafter.[11] In excess of government lien, follow other	Entitlements: No compensation for the affected portion of land within 20 meters width if patent was granted prior to 1975 and up to 60 meters width for patents granted thereafter. In excess of

[11] For example, if the affected land was granted through CA 141 prior to 1975 and the land to be acquired for the right of way was a strip of land up to 20m then the PAP would not be entitled to compensation for the land. If, however, the land to be acquired from the same land was wider than 20m (say 50m) then the PAP would be entitled to compensation for any area over the 20m width (in this case 30m) provided other required

Type of Impact		Loss of Land	
Entitled Person		(Severe/Full)	(Marginal/Partial)
	exercise of its lien.	entitlements for 1a.	government lien, follow other entitlements for marginal/partial impacted 1a PAPs.
1g	PAPs whose properties are mortgaged	Entitlements: Same as above, but check payment will be split into as follows: 1. For mortgagee PAPs – Full replacement cost as defined above, less remaining amortization; 2. For Mortgagor – Remaining amortization amount, computed based on original amount of principal, less interests for remaining amortization period	Entitlements: DOTr to request Mortgagor to segregate the portion of the property to be acquired for ROW from the rest of the property. 1. Full replacement cost for portion of the mortgaged property to be acquired, less remaining amortization; 2. Pay Mortgagee the remaining amortization amount needed to release portion of mortgaged property
Implementation Considerations: DOTr to pay 50% of compensation upon execution of the Deed of absolute Sale and the remaining 50% at the time of issuance of a new title in favor of DOTr but before displacement/clearing can begin. DOTr to notify property owners early to enable time to gather necessary paperwork as proof of ownership. If the original patent granted under CA 141 has been subject to Government exercise or lien, it cannot be subject to lien a subsequent time. PAPs can request DOTr to pay the RPT arrears in advance to the LGU. This amount will be deducted from the compensation payment, except when the arrears is higher than the total compensation amount. The land for land option will be considered on a case by case basis considering the potential complexities in transferring titles, in order to ensure that there is not a large gap between acquisitions of land and providing the new parcel of land to the PAP.			

conditions are met. For land granted through CA 141 from 1975, then the any land acquired up to a width of 60m would not be compensated and same principle would apply as to the 20m example.

<table>
<tr><th colspan="2">Type of Impact</th><th colspan="2">Loss of Structure</th></tr>
<tr><th colspan="2">Entitled Person</th><th>(Severe/Full)</th><th>(Marginal/Partial)</th></tr>
<tr><td>2a</td><td>PAPs who own structures and also own the land where the structure is located.</td><td rowspan="2">Entitlements:
Cash compensation for entire structure equivalent to full replacement cost without deduction for depreciation or salvaged materials.

In cases where the affected structure are being used as a dwelling by the structure owner and their family residing there, self-relocation or assisted resettlement as follows:

1. Self-relocation assistance:
(i) Rental subsidy equivalent to 5 months of rental payment for an alternative dwelling;
(ii) Cash compensation to cover the cost of reconnecting utilities such as water and power;
(iii) Transportation to new dwelling inclusive of transportation of materials; and
(iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr).

OR

2. Assisted-resettlement:
(i) Option to avail of government economic and medium cost housing program under the Home Development Mutual Fund otherwise known as Pag-IBIG Fund. The Pag-IBIG housing loan may be used to finance any one or a combination of the following:
- Purchase of a fully-developed residential lot or adjoining residential lots not exceeding 1,000 m^2;
- Purchase of a residential house and lot, townhouse or condominium unit;
- Construction or completion of a residential unit on a residential lot owned by the member;
- Home Improvement; and/or
- Refinancing of an existing housing loan.
(ii) Cash compensation to cover the cost of reconnecting utilities such as water and power;
(iii) Transportation to new dwelling inclusive of transportation of materials; and
(iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr).</td><td rowspan="2">Entitlements:
Cash compensation for the affected portion of the structure to full replacement cost without deduction for depreciation or salvaged materials.</td></tr>
<tr><td>2b</td><td>PAPs who own structures but do not own the land where the structure is located on and are not a low-income household and/or they own a dwelling elsewhere.</td></tr>
</table>

Type of Impact		Loss of Structure	
Entitled Person		(Severe/Full)	(Marginal/Partial)
Implementation Considerations: The amount of the rental subsidy by locality will be determined by DOTr through the replacement cost study. The DOTr will enter into an agreement with Pag-IBIG so that available housing programs can be made accessible to eligible PAPs through their respective LGUs. PAPs that do not meet Pag-IBIG program eligibility criteria, such as the elderly, may have the option to avail of affordable public rental accommodation in socialized housing arranged by DOTr. Rental allowance subsidy equivalent to five (5) months will be provided while awaiting availability of public rental accommodation. PAPs may be allowed to self-demolish their structures to enable them to preserve materials that still have salvage value. In such cases PAPs will be entitled to keep salvageable materials without deduction from compensation. Eligibility requirements for Pag-IBIG Loan: (i) active member of Pag-IBIG Fund; (ii) have made at least 24 monthly savings (the lump sum payment of the required 24 monthly savings is allowed); (iii) have the legal capacity to acquire and encumber real property; (iv) have passed satisfactorily background credit/ and employment/business checks of Pag-IBIG Fund; (v) have no outstanding Pag-IBIG short-term loan in arrears at the time of loan application; (vi) have no Pag-IBIG housing loan that was foreclosed, cancelled, bought back due to default, or subjected to dacion en pago; and (vii) if with existing Pag-IBIG housing loan, either as principal or co-buyer/borrower, it must be updated. The maximum loanable amount is PhP6M based on the lowest of the following: (i) member's actual need; (ii) desired loan amount (iii) loan entitlement based on capacity to pay; and (iv) loan-to-appraised value ratio. Loan term or maximum repayment period is 30 years. Normal loan application may either be through on-line scheduling of appointment or walk-in at any Pag-IBIG branches. In the case of PAPs, DOTr will make necessary agreement with the Housing and Urban Development Coordinating Council (HUDCC) so that the PAPs can be assigned a priority lane or similar arrangement for faster processing of their loan. With regards to marginally/partially affected structures, if the affected portion results in the structure no longer being suitable for a dwelling for the structure owner and residents, then self-relocation or assisted resettlement options apply.			
2c	PAPs who are renting, leasing or sharing the structure and do not have a low-income.[12]	Entitlements: No compensation for land or structures. In cases where the structures are being used as residential dwellings, self-relocation or assisted resettlement as follows: 1. Self-relocation assistance: (i) Rental subsidy equivalent to 5 months of rental payment for an alternative dwelling; (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power; (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). OR 2. Assisted resettlement:	No compensation. In the case of residential dwellings, if the affected portion results in the structure no longer being suitable for a dwelling, then self-relocation or assisted resettlement options apply.

[12] Refer to footnote 5.

Type of Impact		Loss of Structure	
Entitled Person		(Severe/Full)	(Marginal/Partial)
		(i) Option to avail of government economic and medium cost housing program under the Home Development Mutual Fund otherwise known as Pag-IBIG Fund. The Pag-IBIG housing loan may be used to finance any one or a combination of the following: - Purchase of a fully-developed residential lot or adjoining residential lots not exceeding 1,000 m^2; - Purchase of a residential house and lot, townhouse or condominium unit; - Construction or completion of a residential unit on a residential lot owned by the member; - Home improvement; and/or - Refinancing of an existing housing loan. (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power; (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr).	
2d	PAPs who own structures but do not own the land where the structure is located on, and are a low-income household.[13]	Entitlements: Cash compensation for entire structure equivalent to full replacement cost without deduction for depreciation or salvaged materials. In cases where the structures are being used as dwellings, self-relocation or assisted resettlement as follows: 1. Self-relocation assistance: (i) If PAP opts to move to an existing property (verified by the receiving LGU), transportation to be provided (e.g. bus tickets) inclusive of transportation of belongings; and (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power; (iii) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). OR 2. Assisted resettlement:	Entitlements: Cash compensation for affected portion of the structure equivalent to full replacement cost without deduction for depreciation or salvaged materials.
2e	PAPs who own structures and were former ISFs but now hold title of land through government socialized housing programs.		

[13] Includes PAPs who previously participated in a government socialized housing program but who no longer have it, but did not sell it or rent it out (e.g. those who abandoned the housing unit).

Type of Impact		Loss of Structure	
Entitled Person		(Severe/Full)	(Marginal/Partial)
		(i) Option to avail of government socialized housing program of a partner government key shelter agency (KSA) (if qualified); (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power (if not provided by KSA/LGU); (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). If completion of the socialized housing accommodation will not be ready in time, temporary accommodation or a rental allowance will be provided.	
2f	PAPs who were former ISFs and CMP/NHA beneficiaries whose titles are still under the name of the organization.	Same as above minus any amount still owed to the housing agency.	
2g	PAPs who own structures but do not own the land where the structure is located and who have previously availed of government socialized housing program (returnees) and are deemed ineligible by the key shelter agency (KSA) to participate in the socialized housing program	Entitlements: Cash compensation for entire structure equivalent to full replacement cost without deduction for depreciation or salvaged materials. In cases where the structures are being used as dwellings by the structure owner and their family residing there, self-relocation or assisted resettlement as follows: 1. Self-relocation assistance: (i) If PAP opts to move to an existing property (verified by the receiving LGU), transportation to be provided (e.g. bus tickets) inclusive of transportation of belongings; (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power; and (iii) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). OR 2. Assisted resettlement: (i) Option to avail of affordable public rental housing accommodation by DOTr in partnership with KSA or LGUs;	

Type of Impact		Loss of Structure	
Entitled Person		(Severe/Full)	(Marginal/Partial)
		(ii) Cash compensation to cover the cost of reconnecting utilities such as water and power (if not provided by KSA/LGU); (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). If completion of the public rental housing accommodation will not be ready in time, temporary accommodation or a rental allowance will be provided.	
Implementation Considerations: PAPs will not be responsible for demolition of structures. PAPs are entitled to salvageable materials. Payment of compensation for structures and improvements may be held in abeyance or used as an advance payment on their amortizations at the PAPs request until the relocation site and socialized housing accommodation becomes available. For PAPs who own untitled condominium units, DOTr shall oblige developers, particularly if these were engaged by key shelter agencies, to make the necessary arrangements to effect release of Certificate of Condominium Title to PAPs who have duly paid full amount in consideration. Any fees required to be paid to community organizers to set up communities to borrow for socialized housing will be paid by DOTr.			
2h	PAPs who occupy temporary dwellings.	Provision of Assisted Resettlement options as detailed for 2d provided that they present a Certification from their respective Barangay Captains and Head of LGU's Urban Poor Affairs Office stating that they are bona fide residents and have occupied the project affected-area prior to the applicable cut-off date. PAPs that do not meet the socialized housing program eligibility criteria but are able to present Certification may have the option to avail of affordable public rental housing accommodation through partnership with KSA and LGUs. If completion of the public rental housing accommodation will not be ready in time, temporary accommodation or a rental allowance will be provided.	No compensation for structure.
2i	PAPs who are renting, leasing or sharing the structure and have a low-income.[14]	No compensation for land or structures. In cases where the structures are being used as residential dwellings, self-relocation or assisted resettlement as follows:	

14 Refer to footnote 5.

Type of Impact		Loss of Structure	
Entitled Person		(Severe/Full)	(Marginal/Partial)
		1. Self-relocation assistance: (i) Rental subsidy equivalent to 5 months of rental payment for an alternative dwelling; (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power; (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). OR 2. Assisted resettlement: (i) Option to avail of government socialized housing (if qualified); (ii) Cash compensation to cover the cost of reconnecting utilities such as water and power (if not provided by KSA/LGU); (iii) Transportation to new dwelling inclusive of transportation of materials; and (iv) Food allowance of 150p per person relocated or a food parcel of equal or greater amount (as determined by DOTr). If completion of the socialized housing at the relocation site will not be ready in time, temporary accommodation or a rental allowance will be provided.	
Implementation Considerations: Any fees required to be paid to community organizers to set up communities to borrow for socialized housing will be paid by DOTr. The amount of the rental subsidy by locality will be determined by DOTr through the replacement cost study.			

Entitled Person		Loss of income/Livelihood
3a	PAPs who own fixed micro businesses (e.g. small shops, sari-sari store, carinderia, food stand, repair shop, etc.) with or without permits from the LGU concerned.	Entitlements: Cash compensation for income losses during transition period corresponding to stoppage of business activities, not to exceed six months.[15] Cash compensation to cover transactional (e.g., permitting) cost of re-establishing the business elsewhere. Assistance in securing soft loan to enable self-rehabilitation for those restarting business elsewhere. Participation in the Livelihood Restoration and Improvement Program. For PAPs who are leasing space from property owners:

[15] Preferred mode of business transition is to help set up affected persons with an alternative but similar business with minimal transition period. Options have to be considered by the PAPs with no delay.

<table>
<tr><th colspan="2">Entitled Person</th><th>Loss of income/Livelihood</th></tr>
<tr><td></td><td></td><td>(i) For those who will continue with their micro-small business activities elsewhere, rental subsidy for three (3) months based on prevailing average monthly rental for a similar structure of equal type and dimension to the property being leased. Not applicable to lease contracts that will expire at the time of taking.</td></tr>
<tr><td>3b</td><td>PAPs who own small, medium and large business establishments[16] and own the affected property.</td><td rowspan="2">Entitlements:
Cash compensation for income losses during transition period corresponding to stoppage of business activities, not to exceed six months.[17]
Cash compensation to cover transactional (e.g., permitting) cost of re-establishing the business elsewhere.
Assistance in securing soft loan to enable self-rehabilitation for those restarting business elsewhere.

For PAPs who are owners of medium to large commercial establishments built inside own affected property:
(i) Acquire the property but allow the owner of the structure and business use of the land for a defined period to give the owner time to transfer, subject to agreement on a case to case basis;

For PAPs who are owners of commercial/business entities and are leasing affected space/property:
(i) For those who will continue with their commercial and business activities elsewhere, rental subsidy for three (3) months based on prevailing average monthly rental for a similar structure of equal type and dimension to the property being leased. Not applicable to lease contracts that will expire at the time of taking.</td></tr>
<tr><td>3c</td><td>PAPs who own medium and large business establishments and are leasing/renting space from property owners.</td></tr>
<tr><td>3d</td><td>Vendors with no stalls / ambulant vendors/ hawkers.[18]</td><td>Assistance in identification of and transportation to, an alternative site to continue economic activity, e.g. assistance in (a) shifting to areas within the same LGU where there is no construction and/or (b) identify alternative sites to sell.</td></tr>
<tr><td>3e</td><td>PAPs who are employed in a displaced commercial or industrial establishment and lose their job due to closure of business or laying off as a result of minimized operation.</td><td rowspan="2">Entitlements:
Cash compensation for net salary for two (2) months based on minimum wage.
Participation in the Livelihood Restoration and Improvement Program.
Provision of skills training in anticipation of available job positions during construction and operation of the project.
Priority in employment during construction and operation stage of the project.</td></tr>
<tr><td>3f</td><td>PAPs who permanently relocate to a place that makes former wage-based livelihood opportunities inaccessible and as a result need to find new employment or source of livelihood.</td></tr>
<tr><td>3g</td><td>PAPs who permanently relocate to a place that makes it more expensive to commute to their place of work and they</td><td>Commuting allowance of an amount based on additional costs, but not exceeding Php 5,000 per household per month for three months (not entitled to 3e or 3f).</td></tr>
</table>

[16] Categories of businesses are based on capitalization and number of employees, with (1) Php 15,000,000-100,000,000 capitalization and 100-199 employees for medium businesses, and (2) More than PhP 100,000,000 capitalization and over 200 employees for large businesses. In this project, affected enterprises are expected to be only micro and small as defined under Small and Medium Enterprise Development (SMED) Council Resolution No. 01 Series of 2003 dated 16 January 2003.

[17] Preferred mode of business transition is to help set up affected persons with an alternative but similar business with minimal transition period. Options have to be considered by the PAPs with no delay.

[18] Pertains to itinerant vendors who move from place to place to sell goods/services.

Entitled Person		Loss of income/Livelihood
	retain their employment.	
3h	PAPs who are agricultural tenants and sharecroppers.	Entitlements: Financial assistance equivalent to the average gross harvest for the last three (3) years and not less than P 15,000 per hectare (EO 1035). Crop compensation will be made between the owner and sharecropper as per terms of the sharecropper in case of privately-owned land / publicly-owned land. In case of dispute over verbal agreement with sharecropper, certification from elected representatives will be considered as legal document. Participation in the Livelihood Restoration and Improvement Program.
3i	PAPs who are landowners or lessee who are directly engaged in farming.	A disturbance compensation equivalent to five times the average gross harvest for the last five years on the principal and secondary crops of the area acquired (as adopted from RA.6389). Participation in the Livelihood Restoration and Improvement Program.
Implementation Considerations: Income losses as based on evidence such as tax receipts or otherwise as per estimated values of monthly income losses for various categories of micro-businesses to be determined by replacement cost study.		

Entitled Person		Loss of Public Land and Structure (Severe/Full)
4a	Government Agency/ Local Government Unit (LGU) owners of affected public structures and areas on public land.	Entitlements: Compensation between agencies based on mutual agreement.
4b	Government Agency/ Local Government Unit (LGU) owners of affected public structures and areas on private land.	Entitlements: Cash compensation for structures at full replacement cost. Reconstruction of the social infrastructure within easy reach of all users. Transportation to be provided inclusive of transportation of materials.

Entitled Person		Loss of Non-Land Assets and Improvements
5a	Owners of fruit and timber trees (regardless of ownership status of affected land).	Entitlements: Cash compensation at replacement cost for affected fruit and timber trees.
5b	Owners of crops (regardless of ownership status of affected land).	Entitlements: Compensation for the affected crop at market value of the crop at full-term harvest time.
5c	Owners of aquaculture produce (regardless of ownership status of affected land).	Entitlements: Allowance for costs associated with moving aquaculture stock[19]
5d	Owners of other affected non-land assets	Entitlements:

[19] PAPs will receive compensation for land and compensation for improvements. If the remaining area (remaining fish pond area) is no longer viable, PAPs will be compensated for entire area.

	and improvements (not mentioned in 5a, 5b or 5c).	Compensation at replacement cost for affected non-land assets and improvements (not mentioned in 5a, 5b, 5c).

Implementation Considerations:
Determination of replacement cost of trees will take in to account age and productivity of the tree.
Compensation rates determined by the replacement cost study and informed by values prescribed by the Department of Agriculture (for fruit trees) or Department of Environment and Natural Resources (DENR) for timber trees.
Coordination with land owners and/or fishpond operators to advise them regarding the schedule of clearing.

Entitled Person		Additional Hardship Due to Vulnerability
6a	PAPs who are classified as any of the following vulnerable groups: poor (based on the poverty income threshold), elderly and single women-headed households and persons with disabilities.	Entitlements: In addition to applicable compensation: Inconvenience allowance in the amount equivalent to Php 10,000 per household. For the families with persons who need special assistance and/or medical care, respective LGUs to provide nurses or social workers to help them before and during the resettlement activity. Rehabilitation assistance in the form of skills training and other development activities with the value of up to Php 15,000 will be provided in coordination with other government agencies. Support and/or maintain access to government welfare programs. Inclusion in the Livelihood Restoration and Improvement Program.

Entitled Person		Temporary Impacts due to Construction
7a	PAPs who have legal rights to the land.	Entitlements: Restoration of land within 3 months of completion of use. Compensation for affected non-land assets at full replacement cost. Cash payment for rent of the affected land at prevailing rental rates in the location of the property until the property is restored.
7b	PAPs without legal rights to affected land but owners of affected non-land assets.	
7c	Severance impacts/ barrier effect during construction disrupting lateral movement (access).	The project will provide for crossings and continued access.
Implementation Considerations: Contractors will be responsible for the arrangement and payment of land rent, restoration of land and compensation for non-land assets. Contractors will also be responsible for restoration of land and compensation for non-land assets.		
Entitled Person		**Unanticipated Involuntary Resettlement Impacts**
8a	Eligible affected persons.	Entitlements will be prepared in accordance with the ADB Safeguard Policy Statement and applicable national laws and regulations (including requirements for preparation of corrective action plan and other related documents for ADB and JICA to review and approve).
Implementation Considerations: Entitlements to be prepared in such circumstances are subject to approval of the DOTr and concurrence by ADB and JICA.		

Expropriation Proceeding
1. An initial compensation at an amount computed at 100% of lot price based on latest Bureau of Internal Revenue (BIR) zonal value for land, replacement cost for structures and improvements and market value for crops and trees in the form of a check will be deposited to the court in favor of the owner upon filing of expropriation case by DOTr. The Court will immediately issue an order to take possession of the property and start implementation of the project (Section 6(a) R.A. 10752). 2. While the court adjudicates the compensation to be paid, the PAPs may, at any time request the court to release such deposit upon presentation of proof of ownership (Section 6(a) R.A. 10752). 3. After the case has been heard by the court, the Court will order DOTr to pay the difference, if any, between initial compensation and the just compensation as determined by the court. 4. At this time, DOTr will also pay any required taxes with the exception of CGT (as detailed in RA10752) and any unpaid RPT.
Implementation Considerations: Based on Rule 16 Section 1(h) of the 1997 Rules of Court on Civil Procedures, the plaintiff (DOTr) can withdraw the case any time before the filing of the answer by the defendant (owners). If the answer has been filed there has to be a joint filing by DOTr and owner to withdraw the case (Section 2, Rule 17 of the 1997 Rules of Court on Civil Procedures). In both cases, the acquisition mode would revert back to negotiated sale, which will entitle the owner to payment at current market value for land (as indicated in DOTr's letter offer), free of taxes, including CGT and registration fees, replacement cost for structures and improvements and market value for crops and trees. If no motion to dismiss as above described is filed, expropriation proceeding will continue. Once the court decision becomes final and executory acquisition mode (expropriation) cannot revert back to any other mode. Where the PAP agreed to the negotiated sale, but was unable to gain the necessary documents to show proof of ownership, DOTr may pursue a joint motion in the court for a compromised judgement reflecting the agreed amount – on a case-by-case basis and in good faith. DOTr will provide assistance to PAPs whose lands will be subjected to Extra Judicial Settlement (EJS). This will be done through the Help Desk that will be established at each LGU prior to the issuance of the Notice of Taking (NoT). Early issuance of the NoT is highly recommended for PAPs to have enough time to complete/progress EJS process prior to issuance of the Letter Offer to Buy, which only gives them 30 days to accept offer, after which expropriation proceedings can commence. If PAPs are unable to complete the EJS before the expropriation proceedings are heard by a court, DOTr will pay the just compensation as determined by the court, as well as any required taxes including CGT, except for any unpaid RPT.

9.2.7 Relocation Sites

As part of the project policy, resettlement assistance will be provided for immediate loss (i.e., for a transition period needed to restore the livelihood and standards of living of PAH and for permanent loss of structure for ISFs. In particular, ISFs, as defined under R.A. 7279 and in accordance with the IRR of R.A. 10752, are entitled to relocation.

Prior to the relocation, ample consultations will be provided to the PAHs to ensure that their needs are addressed and relocation site options to be presented. In coordination with the key shelter agencies, host and sending LGUs and the PAPs, DOTr as the implementing agency, is tasked to ensure that no PAH will be forcibly evicted or a structure demolished without prior notice and consultation.

In-city relocation should be prioritized as much as possible to ensure minimal displacement of PAHs from their source of livelihood. During Detailed Engineering Design Stage, the PAPs will be asked to select their preferred relocation site, based on the information on available relocation sites.

The comparison of the housing packages is summarized in Table 9.2.33. Each housing modality has different options and package inclusions.

Table 9.2.33 Housing Packages Available to PAPs

Options	Housing Modality		
	LGU/SHFC Socialized Housing Program	**Pag-IBIG Housing Loan**	**Public Rental**
Housing Package inclusions	• House and lot package (inclusive of cost for land acquisition, site development and housing construction); • Community organizing (inclusive of social preparation, mobilization, documentation, registration and community development and planning workshops); • Community facilities, open spaces and facilities for PWDs; • Livelihood development and implementation;	Any or a combination of the following: • Purchase of a fully-developed residential lot or adjoining residential lots not exceeding 1,000 m^2 • Purchase of a residential house and lot, townhouse or condominium unit; • Construction or completion of a residential unit on a residential lot owned by the member • Home Improvement; • Refinancing of an existing housing loan	• For those who do not qualify for socialized housing program or housing loans, Public Rental option at an affordable rate shall be provided through DOTr.

Source: JICA Study Team

The specific arrangements for the PAHs for each relocation site option would be discussed in detail in a Memorandum of Agreement (MOA) between DOTr and the key shelter agencies.

9.2.7.1 Identification of Relocation Sites for ISFs

Social Housing Finance Corporation (SHFC) organize the PAHs into Community Associations (CA) with 200 member-family as the largest to ensure manageability through their accredited mobilizers (partner NGOs). These CAs will identify their preferred site, provide input to the site development plan and agree on the type and floor plan of their housing unit. They will be involved in all aspects of the planning – thus the term is called as *People's Plan*. These CAs will undergo capacity building as part of community organizing and will be trained to run their association, to implement livelihood projects and to manage their estate.

The Minutes of Agreement (MOA) stipulates responsibility of the SHFC as summarized below:

- Identify, develop and construct relocation sites for the affected ISFs;
- Conduct community organizing and other social preparation works;
- Assist the LGUs in the dissemination of information to project beneficiaries on the proposed projects to be implemented;
- Undertake the relocation and resettlement of ISFs affected by the Project;
- Lead the development and implementation of livelihood programs for the ISFs;
- Submit a periodic report to DOTr on accomplishments with evidence document of the relocation and financial statement reviewed by a pre-agreed designated auditor

9.2.7.2 Candidate Relocation Sites for the Project

There are some potential candidate relocation sites selected based on the initial consultations and meetings with the LGUs, the PAPs and key shelter agencies such as SHFC, as well as information from land use plan of LGUs in case the PAPs cannot identify a relocation site. The summary of the candidate relocation sites for NSRP-SC is indicated in Table 9.2.34. The suitability of the candidates is to be verified by SHFC.

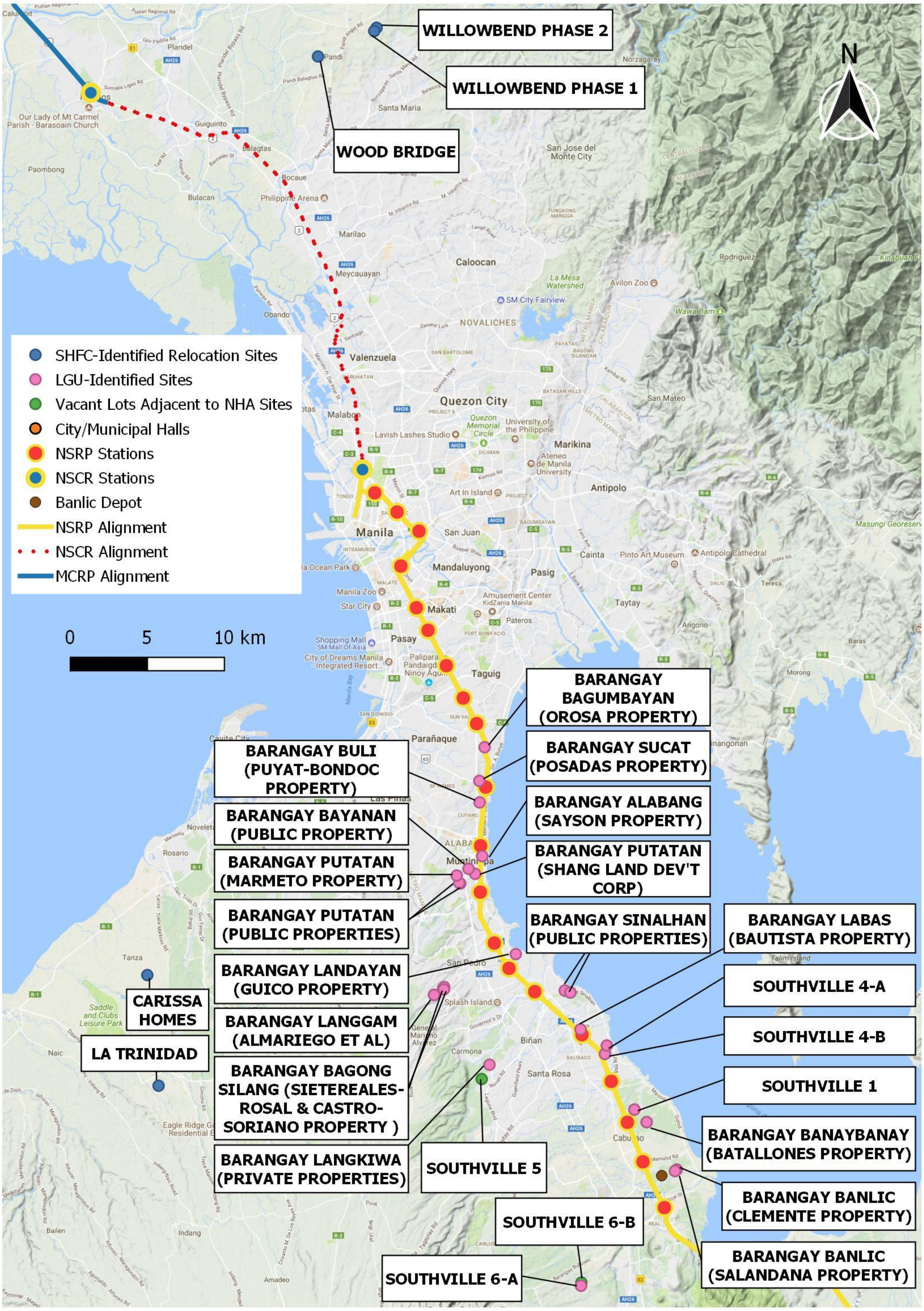
Table 9.2.34 Candidate sites for relocation Source: JICA Study Team

No.	LGU	Number of ISFs	Location of Proposed Relocation Site	Distance from alignment	Total Area	Ave lot. Size	Site selection criteria							
								Willingness of LGU / Host community		Accessibility of road networks and other facilities			Utilities	Site suitability
							Availability of lots/units	LGU willingness to accommodate ISFs within LGU	Willingness of Host LGU to accommodate ISFs from other LGUs	Accessibility of road networks	Access to health and sanitation facilities (Indicate available facilities)	Access to community service facilities(Indicate available facilities)	Water and Electric Power Connection	Not flood-prone / landslide prone / earthquake prone
1	Manila	4,499	(1) Wood Bridge, Pandi Bulacan	28.2 km	To be determined	32 – 96 m^2	326	No more available area	X	✓	To be confirmed	To be confirmed	✓	Passed SHFC site suitability inspection
			(2) Willowbend, Pandi Bulacana	28.4 km	To be determined	32 – 96 m^2	1,661		X	✓	To be confirmed	To be confirmed	✓	Passed SHFC site suitability inspection
			(3) Carissa Homes, Tanza Cavite	22.0 km	21.44 ha	32 – 96 m^2	3,000		To be confirmed	✓	Within 5km radius	Schools & market	✓	Passed SHFC site suitability inspection
2	Makati	140						No more available area						
3	Taguig	361	(1)Carissa Homes, Tanza Cavite	22.0 km	21.44 ha	32 – 96 m^2	250	No more available area	To be confirmed	✓	Within 5km radius	Schools & market	✓	Passed SHFC site suitability inspection
			(1)Orosa Property (Daang Hari)	adjacent	1,98 ha	30 m^2	500	To be accommodated	X	✓	Within 5km radius	Schools & market	✓	To be confirmed
4	Paranaque	38	(1)Carissa Homes, Tanza Cavite	22.0 km	21.44 ha	32 – 96 m^2	50	No more available area	To be confirmed	✓	Within 5km radius	Schools & market	✓	Passed SHFC site suitability inspection
5	Muntinlupa	1,166	(1)Carissa Homes, Tanza Cavite	22.0 km	21.44 ha	32 – 96 m^2	1,200	No more available area	To be confirmed	✓	Within 5km radius	Schools & market	✓	Passed SHFC site suitability inspection
			(1)Brgy Alabang	0.20 km	0.72 ha	30 m^2	185	✓	X	X	Within 5km radius	Schools & market	X	To be confirmed
			(2)Brgy Putatan (Govt. Lot)	0.80 km	0.53 ha	30 m^2	136	✓		X	Within 5km radius	Schools & market	X	To be confirmed
			(3)Brgy Buli	0.10 km	2.44 ha	30 m^2	625	✓		✓	Within 5km radius	Schools & market	X	To be confirmed
			(4)Brgy Putatan	0.20 km	1.21 ha	30 m^2	310	✓		✓	Within 5km radius	Schools & market	X	To be confirmed
			(5)Brgy Putatan	1.50 km	1.14 ha	30 m^2	293	✓		✓	Within 5km radius	Schools & market	X	To be confirmed
			(6)Brgy Putatan (Govt. Lot)	1.35 km	0.6 ha	30 m^2	153	✓		✓	Within 5km radius	Schools & market	X	To be confirmed
			(7)Brgy Sucat(Posadas Property)	adjacent	19.85	30 m^2	-	✓		✓	Within 5km radius	Schools & market	X	To be confirmed

No.	LGU	Number of ISFs	Location of Proposed Relocation Site	Distance from alignment	Total Area	Ave lot. Size	Site selection criteria							
								Willingness of LGU / Host community		Accessibility of road networks and other facilities			Utilities	Site suitability
							Availability of lots/units	LGU willingness to accommodate ISFs within LGU	Willingness of Host LGU to accommodate ISFs from other LGUs	Accessibility of road networks	Access to health and sanitation facilities (Indicate available facilities)	Access to community service facilities(Indicate available facilities)	Water and Electric Power Connection	Not flood-prone / landslide prone / earthquake prone
6	San Pedro	277	(1) Brgy. Langgam San Pedro	4.9 km	1.7 ha	30 m^2	435	✓	X	✓	Within 5km radius	Schools & market	X	Not flood prone
			(2) Brgy. Bagong Silang, San Pedro	4.2 km	1.3 ha	30 m^2	718	✓		✓	Within 5km radius	Schools & market	X	Not flood prone
			(3) Brgy Landayan	0.50 km	0.715	30 m^2	183	✓		✓	Within 5km radius	Schools & market	X	To be confirmed
7	Binan	2,044	(1) Carissa Homes, Tanza Cavite	22.0 km	21.44 ha	32 – 96 m^2	718		To be confirmed	✓	Within 5km radius	Schools & market	✓	Passed SHFC site suitability inspection
			(2) La Trinidad Subdivision, Trece Martires	23.0 km	4.07 ha	32 – 96 m^2	165		To be confirmed	✓	Within 5km radius	Within 5km radius	✓	Passed SHFC site suitability inspection
			(1) Adjacent lot to Southville 5	6.0 km	8.00 ha	40 m^2	1,200		To be confirmed	✓	Within 5km radius	Within 5km radius	✓	To be confirmed
			(1) Barangay Langkiwa	5.00 km	8.80 ha	30 m^2	2,256	✓	X	✓	Within 5km radius	Within 2km radius	✓	Not flood prone
8	Sta. Rosa	424	(1) Brgy Labas	0.1 km	2.94 ha	40 m^2	754	✓	X	✓	Within 2 km radius	Within 2km radius	✓	To be confirmed
			(2) Brgy Sinalhan	3.0 km	4.10 ha	40 m^2	1,051	✓		✓	Within 3km radius	Within 2km radius	✓	Flood Prone Area
			(3) Brgy Balibago	2.0 km	3.47 ha	30 m2	890	✓		✓	Within 3km radius	Within 2km radius	✓	To be confirmed
			(4) Brgy Caingin	0.40 km	8.85 ha	30 m2	2,270	✓		✓	Within 3km radius	Within 2km radius	✓	To be confirmed
9	Cabuyao	101	Brgy Banay Banay	0.50 km	11 ha	40 m^2	2,115	✓	To be confirmed	✓	Within 2 km radius	Within 2km radius	✓	To be confirmed
10	Calamba	2,334	(1) Salandana Property Brgy Banlic Calamba	1.7 km	3 ha	40 m^2	770	✓	X	✓	To be confirmed	To be confirmed	X	To be confirmed
			(2) Clemente Property,	1.8 km	5 ha	40 m^2	1,282	✓		✓	To be confirmed	To be confirmed	X	To be confirmed
			(3) Lot 3080 and 1245 Barangay Banlic	1.0 km	5 ha	30 m2	1,282	✓		✓	Within 5km radius	Within 2km radius	✓	To be confirmed
			(1) Southville 6	6.8 km	2 ha	24 m^2	300	✓	X	✓	To be confirmed	To be confirmed	✓	Not prone to flooding
			(2) Adjacent lot to Southville 6	6.8 km	20 ha	40 m^2	2,800	✓	X	✓	To be confirmed	To be confirmed	✓	Not prone to flooding
TOTAL		**11,384**					**27,878**							

NOTE:Pink: identified by the LGU; for consultation to PAPs and technical assessment of SHFC   Grey: identified by SHFC   Green: adjacent lots to NHA

Source: JICA Study Team



Source: JICA Study Team

Figure 9.2.6 Location Map of Relocation Sites for NSRP

9.2.7.3 Amortization

As in all other government socialized housing projects, the relocated PAHs will also be required to pay monthly amortization costs. Based on the discussion with DOTr and SHFC, it is agreed that the affordable rate will be set as a flat rate for maximum 30 years loan based on the income of PAHs, government policies and in line with the housing package, minus compensation for affected assets as indicated in the Entitlement Matrix.

9.2.7.4 Rental Subsidy

Rental subsidies will be paid directly to the PAPs on a monthly basis. DOTr will provide support to PAHs to set up a bank account with Landbank, so that monthly rental subsidies will be paid. The initial payment of the rental subsidy will also include a deposit amount of two months. This will facilitate financial literacy and can be support by financial literacy training under the Livelihood Restoration and Improvement Program (LRIP).

Due to the number of the PAPs, rather than organizing transport from existing structures to the temporary rental accommodation and then later to the resettlement sites, DOTr may transfer funds instead to the PAP’s Landbank accounts.

9.2.7.5 Temporary Shelter

In case the Resettlement site construction are not yet ready in time for the clearing of ROW, the first priority is rental subsidy as relocation option to PAHs. However, provision of temporary shelter will be also considered. Standards and conditions will be set to minimize the extra inconvenience that this may bring to the already affected families.

9.2.8 Livelihood Restoration and Improvement Plan

The objective of the Livelihood Restoration and Improvement Program (LRIP) is to assist the PAPs whose livelihoods are directly adversely affected by the Project for restoring their income generating capacity to at least pre-project levels. For vulnerable PAPs including ISFs, the LRIP is also aimed at improving their living standards. The livelihood restoration measures are to be planned to take account of each situation. Sufficient time for planning and substantial interaction with the PAPs is deemed essential requisites to developing a more robust plan that will promote both immediate and long-term self-sufficiency.

As such, while this plan outlines the necessary livelihood restoration measures, further consultations with the PAPs to plan specific livelihood restoration and improvement measures in accordance with the following hierarchy of preference:

Preference 1 Restoration of current livelihoods:

Where the PAPs have existing viable livelihoods, the preferred approach is to restore these livelihoods where feasible. This is considered a lower-risk approach considering that the likelihood of success is high if the PAPs will be able to continue doing what they know best and what is proven to workable in the local situations. While opportunities for the livelihood improvement may be introduced, the emphasis should be on replacing enabling conditions and livelihood assets with new assets of at least equal quality and quantity. This represents a lower risk of failure due to technical, economic, or social factors. The many PAPs with affected livelihoods are expected to be able to restore their income generating capacity with transitional assistance without additional Livelihood Restoration and Improvement Program (LRIP) interventions. However, some will require additional support to enable them to readjust their existing livelihood to a new operating environment, more particularly if their previous livelihood involves engaging in service activities. This finds more applicability to women as engagement in service activities ranked 3rd among the major industries participated by them.[20]

<u>Preference 2 Introduction of Alternative Livelihoods.:</u>

Opportunities for alternative livelihoods will be provided to the PAPs when the restoration of their previous livelihood is not feasible or preferred by the PAP, or as a means to improve the households' income earning capacity. The promotion of alternative livelihoods should be geared towards providing the PAPs opportunity for diversifying livelihoods and improving household incomes (e.g. seasonal workers, minimum wage-earning households) interest of the based-on PAP current skills set and/or capacities and taking account of market needs/demands. Livelihood activities traditionally engaged in by women should be supported; but at the same time, livelihood programs that encourage men and women's participation in non-traditional undertakings should likewise be promoted. Moreover, care should be taken that unpaid care and domestic work are equally redistributed within the household, especially between the husband and wife, to avoid exacerbating women's burden of unpaid work as a result of additional hours spent on alternative livelihoods.

9.2.8.1 Livelihood Restoration for the Affected Businesses

In the Philippines'' legal framework, compensation for income losses is not provided except for agricultural tenants, lessees and free patent holders. While JICA Guidelines (2010)[21] and ADB SPS

[20] 2016 Gender Statistics

[21] In reference to World Bank's O.P. 4.12

(2009) prescribe payment for loss of income, it would render the Project financially unviable if the acquisition of the ROW becomes very expensive. Thus, a combination of assistance in various forms isare carefully crafted to assist the PAPs based on their (i) tenurial status and (ii) size of their business.

(1) Tenurial Status of the Business Owner

The set of the assistance has been formed according to the tenurial status of the business owner as presented in Table 9.2.35.

Table 9.2.35 Assistance by Tenurial Status of the Business Owner

Tenurial Status	Assistance
PAPs who Own the Land on which their Business Operated	• Assistance in seeking replacement land, of the same size or of a size that permits relocation of the affected business, possibly within the same barangay or City/Municipality; • Cash compensation to cover transactional (e.g., permitting) cost of re-establishing the business in the replacement land; • Assistance in securing government soft loans that offer lower transaction costs and interest rates and long-term and flexible payment schedules, to enable self-rehabilitation; • Project benefit-sharing agreement with DOTr such as, but not limited to Right of First Offer (RFO) or Right of First Refusal (RFR) in locating at commercially developed areas during the project operation. This option is deemed more practical for commercial rather than industrial establishments.
PAPs who Lease Land and/or Structures for Operating Their Businesses	• Assistance in seeking alternative rental space to reestablish business, preferably within the same barangay or City/Municipality; • Rental subsidy for three months based on the prevailing average monthly rental for a similar structure of equal type and dimension to the property being leased. Not applicable to lease contracts that will expire within three months at the time of taking; • Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business elsewhere.
PAPs whose Affected Businesses are within the PNR Row and are not Paying Any Rent	• Assistance in securing government soft loans that offer lower transaction costs and interest rates and long-term and flexible payment schedules, to enable self-rehabilitation; • Assistance in seeking alternative rental space to reestablish business, preferably within the same barangay or City/Municipality; • Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business elsewhere.

Source: JICA Study Team

In any case, the affected businesses should be given preference for availing of rental commercial spaces that may be established at the railway stations on a first-come-first-serve basis subject to screening procedures aimed at ensuring business appropriateness.

(2) Size of the Business

The set of the assistance has been formed according to the Size of the Business as presented in Table 9.2.36.

Table 9.2.36 Assistance by Tenurial Status of Size of the Business

Tenurial Status	Assistance

Tenurial Status	Assistance
PAPs who own fixed micro businesses regardless of tenurial status and with or without permits from the LGU concerned (e.g. Small shops, sari-sari store, carinderia, food stand, repair shop, etc.)	• Cash compensation for income losses during the transition period corresponding to stoppage of business activities, not to exceed six months.[22] • Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business elsewhere: • Assistance in securing soft loan that offer lower transaction costs and interest rates and long-term and flexible payment schedules to enable self-rehabilitation for those restarting business elsewhere.
Vendors with no stalls/ ambulant vendors/ hawkers	• Assistance in identification of alternative temporary sites to continue the economic activity. (e.g. assistance in (a) shifting to areas within the same LGU where there is no construction and/or (b) identify alternative sites to sell). LGU assistance will be sought to reorganize their places operating outside the acquired areas.
PAPs who own medium and large business establishments (including apartments for rent and those who own the land)	• Cash compensation for income losses during the transition period corresponding to stoppage of business activities, not to exceed six months.[23] • For PAPs who are owners of medium to large commercial establishments built inside own affected property - Acquire the property but allow the owner of the structure and business use of the land for a defined period to give the owner time to transfer, subject to agreement on a case to case basis; - Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business; - Assistance in securing soft loan that offers lower transaction costs and interest rates and long-term and flexible payment schedules to enable self-rehabilitation for those restarting business elsewhere. Transitional support during the period while PAPs are resettling and re-establishing their livelihoods will be provided aimed at stabilizing their living standards.
PAPs who are owners of medium to large commercial establishments built inside own affected property:	• Acquire the property but allow the owner of the structure and business use of the land for a defined period to give the owner time to transfer, subject to agreement on a case to case basis; • Cash compensation to cover transactional (e.g., permitting) cost of reestablishing the business • Assistance in securing soft loan to enable self-rehabilitation for those restarting business elsewhere. Transitional support during the period while PAPs are resettling and re-establishing their livelihoods will be provided aimed at stabilizing their living standards.

Source: JICA Study Team

Income losses to be paid shall be based on evidence such as tax receipts or otherwise as per estimated values of monthly income losses for various categories of microbusinesses as determined by the SES and validated by DOTr during RAP implementation.

(3) Livelihood Restoration for Affected Employees and/or Wage-Based Earners

For Affected Employees and/or Wage-Based Earners, the assistance is described in Table 9.2.37.

Table 9.2.37 Assistance by Tenurial Status of the Affected Employees and/or Wage-Based Earners

Tenurial Status	Assistance

[22] Preferred mode of business transition is to set up affected persons with an alternative but similar business. Options have to be considered by the APs with no delay.

[23] Preferred mode of business transition is to set up affected persons with an alternative but similar business. Options have to be considered by the PAPs with no delay.

Tenurial Status	Assistance
For employees of commercial and industrial enterprises who will lose their jobs either due to closure or minimized operations	• Cash compensation for net salary for two months based on minimum wage • Provision of skills training in anticipation of available job positions during construction and operation • Priority in employment during construction and operation stage of the project or provision of alternative livelihood opportunity as outlined in this chapter.
PAPs who are relocated in an off-city site and continue working in the same company/location after being relocated	• Commuting allowance going to the original place of work with an amount not exceeding Php 5,000 per household/ per month for three months • Provision of skills training to qualify for job/livelihood opportunities near the relocation site • Endorsement to the receiving LGU to be prioritized for employment opportunities of equal salary or to be provided initial inputs to start a business, including the provision of commercial space/stalls to be rented/owned, capitalization and access to soft loan and assistance in marketing their products. As women build on their existing traditional skills, LGUs must ensure that business skills training on non-traditional skills shall also be provided to them to prevent over competition and market saturation within communities
PAPs who permanently relocate to a place that makes former wage-based livelihood opportunities inaccessible and as a result need to find new employment or source of livelihood	• Cash compensation for net salary for 2 months based on minimum wage AND • Provision of skills training in anticipation of available job positions during construction and operation, and • Priority in employment during construction and operation stage of the project OR • Provision of skills training to qualify for job/livelihood opportunities near the relocation site; and • Endorsement to the receiving LGU to be prioritized for employment opportunities of equal salary or to be provided initial inputs to start a business, including provision of commercial space/stalls to be rented/owned, capitalization and access to soft loan and assistance in marketing their products, taking into account the prevention of over competition and market saturation in communities, particularly in the business enterprises participated by women.

Source: JICA Study Team

9.2.8.2 Livelihood Restoration for Land-Based Income Earners (Replacement Farm Land)

It is recommended that privately owned farms be assisted in finding replacement farmlands where possible. For farming households within PNR ROW, replacement land at resettlement sites is also suggested, however, the viability of this option needs to be studied further during the detailed planning stage. Through an appropriate government program outlined in the subsequent section, technical support to assist farmers adapt their farming practices to the changed conditions should be extended. Technical support should include women-friendly and sustainable agriculture technology designed based on accessibility and viability, in consultation with women's organizations (Sec. 21, Republic Act 9710). Inputs (fertilizer, chemicals and crop varieties) should also be provided to bring the land into full productive potential.

Alternative non-land-based livelihood opportunities should be extended where sufficient replacement land is not available. This will include skills training and consideration for the project employment to assist PAPs depending on the land-based income supplement their livelihoods at resettlement sites.

Additionally, immediate traditional support shall be provided as described in Table 9.2.38.

Table 9.2.38 Assistance by Tenurial Status of the Land Based Income Earners

Tenurial Status	Assistance

Tenurial Status	Assistance
Agricultural land owners who are directly engaged in farming	• If feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAPs; Consultations with both women and men shall be held to guarantee same rights to both spouses or common−law spouses in respect to resources and property ownership and management, whether titled or not (Sec. 19(f), RA 9710) • A disturbance compensation equivalent to five times the average gross harvest for the last five years on the principal and secondary crops of the area acquired. (as adopted from RA 6389)
Agricultural lessee	• Entitled to disturbance compensation equivalent to five times the average gross harvests on his/her landholding during the last five preceding calendar years
Agricultural tenants and sharecroppers	• Financial assistance equivalent to the average gross harvest for the last three (3) years and not less than P15,000 per hectare (EO 1035); • Rehabilitation assistance in the form of skills training and other development activities to be provided in coordination with other government agencies to be designed in consultation with eligible PAPs, including and women's organizations groups to ensure the development of women-friendly and sustainable agriculture technologies; and • Assistance in securing soft loan to enable self-rehabilitation.

Source: JICA Study Team

Crop compensation will be made between the owner and sharecropper as per terms of the sharecropper in case of privately-owned land/publicly-owned land. In case of a dispute over the verbal agreement with sharecropper, certification from elected representatives will be considered as legal document.

9.2.8.3 Programs and Services

The Livelihood Restoration and Improvement Program (LRIP) activities to improve livelihoods will be based primarily on existing relevant programs at the national, regional, provincial and LGU levels with the last being an active partner in program implementation in order to ensure maximum project benefits. This approach ensures the LRIP alignment to broader community investment programs, synergies in achieving cost efficiencies and development outcomes and sustained LGU support once the LRIP ends. To ensure social inclusion, development outcomes should consider the integration of the different needs and concerns of women and men, people with disability and the elderly people as agents and beneficiaries of programs and services, in all local plans and agenda including the LGUs investment plan and programs. This will guarantee the gender responsiveness and sustainability of the livelihood programs to be accessed by the PAPs (Sec 36(a)(3), RA 9710).

(1) Vocational Training

Usually, vocational training will be provided by the Technical Education and Skill Development Authority (TESDA). TESDA is the government agency tasked to manage and supervise technical education and skills development in the Philippines. Training activities will be delivered through the following three modes.

TESDA run training centers: TESDA provides certificates of completion after each training course. The certificates of the completion are presented to would-be employers who will provide permanent employment and a regular stream of income. Trainings cost an average of Php 10,000/course, but may be as high as Php 15,000. TESDA, in collaboration with various LGUs, industries/sectors who provide funds, implement the Training for Work Scholarship Program (TWSP) where successful scholars are chosen to undergo training based on industry requirements. The scholars, before being chosen, undergo a rigid selection process. PAFs and/or vulnerable groups may avail of this program, after they pass the tests or assessments provided. Centres in the project areas are located in Culumpit, Bulacan and San Luis, Pampanga.

Private – run: private institutions/schools: Vouchers are allocated by TESDA at least 3-4 times a year to accredited training centers. The number of vouchers is demand-based; it is usually determined through surveys on the training courses needed per barangay.

Community Based Programs: Community-based Training for Enterprise Development Program is primarily addressed to the poor and marginal groups, those who cannot access, or are not accessible by formal training provisions. They may have low skills, limited management abilities, and have few economic options. They may have no access to capital – most of them are unqualified for formal credit programs. The program goes further than just mere skills training provision. It is purposively designed to catalyze the creation of livelihood enterprises that shall be implemented by the trainees, immediately after the training. Likewise, it is designed to assist partner agencies such as LGUs, NGOs, people organizations and other agencies and organizations with a mission to help the poor get into productive undertakings to help themselves and their communities.

Vocational Training(s), in particular, those provided by TESDA, should ensure enrollment of women in non-traditional skills training (e.g. welding, carpentry, plumbing) as it offers higher income compared to engagement in traditional livelihood activities (Sec. 13, RA 9710). TESDA should ensure the full implementation of the gender-sensitive TVET curriculum in all training courses, regardless of the mode of delivery of these trainings.

(2) Mainstream Employment Information and Referral

Mainstream employment opportunities will be explored and interventions carried out to assist the PAPs for potential employment. A labor market assessment will be carried out in areas groups of PAHs are relocated for program implementers to understand the dynamic market conditions (i.e. available jobs, the volume of human resource demand, skills required, job hiring seasons/cycles etc.) and sources of potential employment and entrepreneurship opportunities among the PAPs. Labor market assessment should consider the gender needs of women and men, as gender segregation characterizes employment in the Country (WEDGE Plan). By Looking into the type of employment women and men are traditionally engaged in, a gender-responsive employment plan could be devised by the project implementers and improve chances of women to better jobs, with higher income. The result of the assessment will help define specific interventions to improve chances of PAPs for employment.

(3) Project Employment Opportunities

Based on the outcomes of the survey and FGDs, there are wage-based earning PAPs who expressed that they are given opportunity to be employed near resettlement sites while enterprise-based earning PAPs saw employment opportunities as an alternative to their lost enterprises. Additionally, there are a number of PAPs who are in their working age but are currently unemployed due to a lack of opportunities. Other PAPs stressed that being directly impacted by the project, they should be given priority in availing job opportunities during construction and operations.

(4) Financial Management and Entrepreneurial Training

Resettlement processes are complex, particularly as they relate to valuation, compensation and assistance packages. Limited exposure to the cash economy and low levels of financial literacy, in light of future payment of compensation funds, highlights the need to provide PAPs with access to financial advice, as part of this program. Financial advice will help to improve their capabilities on money management matters, including financial planning; investment options; training, employment and business development. The nature of financial advice varies and will have to be undertaken at different stages to coincide with the various financial activities during the RAP implementation (i.e. compensation payment, the release of livelihood support, livelihood implementation/enterprise operations etc.).

(5) Additional Support for Vulnerable Persons

The detailed Livelihood Restoration and Improvement Program (LRIP) will identify to November 2018 by HUDCC, SHFC and DOTr PMO, the need to provide additional support to vulnerable persons, including extremely underprivileged persons, Persons with Disabilities (PWD), elderly people. Depending on the number of vulnerable persons, DOTr will engage special interest Civil Society Organizations (CSOs) or Non-Government Organizations (NGOs) to provide support to each vulnerable group.

9.2.9 Grievance Redress Mechanism

Grievance refers to any concern, issue or conflict resulting from the varying interpretations of involuntary resettlement and implementation of the RAP for the NSRP-SC. This may include issues on the compensation for various types of PAPs, application of the eligibility criteria, relocation of the informal settlers, reduced income and the quality of services.

9.2.9.1 Levels of Grievance Redress Mechanism

There are four levels of Grievance Redress Mechanism (GRM), while an assigned Grievance Officer from Office of the Undersecretary for Railways, the DOTr serves as the first contact point for PAPs. Table 9.2.39 summarizes the levels of grievances for ISFs and legal PAFs.

Table 9.2.39 Levels of Grievance Redress Mechanism

	For Legal Project-Affected Families	For Informal Settler Families (ISFs)
1st Level	Help Desk/Grievance Desk	
2nd Level	RAP Implementation and Management Committee (RIMC) • To be headed by the NSRP-SC Project Management Office (NSRP-SC PMO) • Will convene once the ROW Acquisition (ROWA) starts	Local Housing Office (LHO) / Local Inter-Agency Committee (LIAC)

3rd Level	Project Inter-Agency Committee (PIAC)
4th Level	Court

Source: JICA Study Team

9.2.9.2 Roles and Responsibilities of Officers and Offices concerning the GRM

(1) Help Desk/Grievance Desk

The Help Desk/Grievance Desk is the first contact point for legal PAPs and ISFs in the GRM. It will receive all complaints and determine whether such complaints are project related or not. The Help Desk/Grievance Desk will be established in each LGU and in the DOTr Railway Office. The following are outline of the roles and responsibilities of the Help Desk/Grievance Desk under the abovementioned office:

- Acknowledge receipt of the complaint either the written or verbal complaint from the PAPs and explaining the grievance redress process including contact details where complaint will be forwarded and who is responsible for acting complaint to PAP. If it is a verbal complaint, the NSRP-SC PMO will write down the complaint for the PAP and ask him/her to sign the complaint.
- Assign a coded reference number for all complaints received via phone call, text message, letter, or verbal that will be easily identified and traced for follow up purposes.
- Clarify the nature of the complaint whether it is project related or not.
- If the concern is beyond the Grievance Desk Officers' capacity to decide, forward the complaint to the respective LHO/LIAC designated office for ISFs or RIMC for legal PAHs if it is project related.
- Advise the complainant if the complaint is not project-related and assists him/her by forwarding the complaint to the appropriate agency or LGUs who could act on the complaint.
- Follow up with the LHO/LIAC/RIMC on their action on the complaint.
- Provide feedback to the PAP on the status of complaint - and the decision of the LHO/ LIAC/RIMC.
- Maintain a database for all complaints and the corresponding actions and decisions on the complaints received. Prepare quarterly Monitoring Reports on Grievance Redress with accomplishments and status of unresolved grievance to the PIAC and semi-annual monitoring reports to JICA and ADB.

(2) RAP Implementation and Management Team (RIMC) / NSRP-SC Project Management Office (NSRP-SC PMO)

Grievances unresolved under the Help deck/Grievance Desk at the first level of GRM will be turned over to the RAP Implementation and Management Committee (RIMC) / NSRP-SC PMO. They will receive the complaints made by a legal PAHs and seek to resolve it.

As the second level of grievance, the RIMC will have the following roles and responsibilities:

- Act and decide on each complaint within 15 working days on the complaint filed by PAP
- Provide feedback to the PAP on the status of complaint - and the decision of the RIMC through the NSRP-SC PMO.

(3) Local Housing Office (LHO) or Local Inter-Agency Committee (LIAC)

As the second level of GRM for the ISFs, they will decide on the merits of the complaints elevated or forwarded by the Help/Grievance Desk. In particular, the LIAC/LHB will:

- Supervise and coordinate all concerns in relation to relocation;
- Facilitate and expedite activities of the beneficiary validation committee in the stages;
- Act and decide on the complaint within 15 working days from receipt of a complaint from the Help Desk and informing the PAP on the action and decision;
- Inform the NSRP-SC PMO of the action and decision on the PAP's complaint; and
- Create subcommittees to support various activities identified, such as: pre-relocation stage, actual relocation stage and post-relocation.

(4) Project Inter-Agency Committee (PIAC)

The PIAC will serve as the third level of GRM for legal PAFs and ISFs. The PIAC will receive all complaints and determine complaints forwarded from the LHO/LIAC, or the RIMC.

As the third level, the PIAC will have the following roles and responsibilities:

- Act and decide on each complaint within 15 working days on the complaint filed to the PIAC by NSRP-SC PMO or the LHO/LIAC.
- Provide feedback to the PAP on the status of complaint - and the decision of the PIAC through the NSRP-SC PMO or the LHO/LIAC.

9.2.9.3 Grievance Redress Mechanism Procedures

Grievances from the PAPs related to the resettlement implementation or any related issues with regards to the project will be handled, free of monetary charge, through a process of negotiations aimed at arriving at a consensus decision. The procedures for ISFs and legal PAP are described in Table 9.2.40.

Table 9.2.40 Grievance Redress Mechanism Procedure

<table>
<tr><th>Steps</th><th>By</th><th colspan="2">Actions</th></tr>
<tr><td>1</td><td>Aggrieved Stakeholder</td><td colspan="2">Any aggrieved stakeholder will lodge his/her grievance in person to the Help/Grievance Desk, or in writing, verbally or electronically transmitted to the Grievance Officers within the NSRP-SC PMO for immediate action.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">1st Level
Help Desk established at each LGU</td><td colspan="2">• When received in person, the grievance may be written down by the staff of the Help/Grievance Desk on behalf of the aggrieved stakeholder, who will sign the written complaint for official submission.
• Explain process to the aggrieved stakeholder and give contact details of where the complaint will be forwarded and who is responsible for acting on complaint.
• Review the complaint to determine whether it is project related or not.
• If the concern is beyond the Grievance Desk Officers' capacity to decide, forward the complaint to the 2nd level.</td></tr>
<tr><td>a) If the complaint is project- related, the Help/Grievance Desk will forward the complaint to the ROW-PMO/RIMC for concerns pertaining to legal PAPs and LHO/LIAC for ISFs' within 15 working days from receipt of complaint.</td><td>b) If it is not project related, the Help/Grievance Desk will assist the PAP by referring the complaint to the appropriate agency or LGU who may be able to act on the complaint.</td></tr>
<tr><td>3</td><td>Aggrieved Stakeholder</td><td rowspan="2"></td><td>If the aggrieved stakeholder is not satisfied with the decision of the Help/Grievance Desk that the complaint is not project related, the aggrieved stakeholder may elevate his/her complaint to the RIMC or LHO/LIAC</td></tr>
<tr><td>4</td><td>Help/Grievance Desk</td><td>• Receive request from the aggrieved stakeholder to elevate his/her complaint to PIAC
• Record the status of the aggrieved stakeholder complaint.</td></tr>
<tr><td>5</td><td>2nd Level
RIMC (Legal PAPs) or LHO /LIAC (ISFs)</td><td colspan="2">• Receives complaint from the Help/Grievance Desk.
• Act and decide on the complaint within 15 working days reckoning from the day it is received from Help/Grievance Desk
• Inform the Help/Grievance Desk the action and/or decision on the aggrieved stakeholder's complaint.</td></tr>
<tr><td>6</td><td>Help/Grievance Desk</td><td colspan="2">• Receive and record decision of 2nd level decision maker.
• Inform to the aggrieved stakeholder.</td></tr>
<tr><td>7</td><td>Aggrieved Stakeholder</td><td colspan="2">• Receives action of the 2nd level through the Grievance officer
• If satisfied, the complaint is resolved and recorded accordingly.
• If not satisfied with the decision of the 2nd level or if his/her complaint has not been acted upon within a period of 15 working day and has not received any response from the 2nd level decision maker, the aggrieved stakeholder can forward the complaint, or file an appeal, to the PIAC.</td></tr>
<tr><td>8</td><td>Help/Grievance Desk</td><td colspan="2">• Receive request from the aggrieved stakeholder to elevate his/her complaint to the PIAC
• Record the status of the aggrieved stakeholder complaint.
Forward the complaint to the 3rd Level within 15 working days from receipt of complaint.</td></tr>
<tr><td>9</td><td>3rd Level
PIAC</td><td colspan="2">• Receives complaint from the Help/Grievance Desk
• Act and decide on the complaint within 15 working days and inform the decision to the aggrieved stakeholder on the decision accordingly.
• Inform the Help/Grievance Desk the action and/or decision on the aggrieved stakeholder's complaint.</td></tr>
<tr><td>10</td><td>Help/Grievance Desk</td><td colspan="2">• Receive and record decision of PIAC
• Inform to the aggrieved stakeholder.</td></tr>
</table>

Steps	By	Actions
11	Aggrieved Stakeholder	• Receives action of the 3rd Level through the Help/Grievance Desk • If satisfied, the complaint is resolved and recorded accordingly. • If not satisfied with the decision of the 3rd Level or if his/her complaint has not been acted upon within a period of 15 working day and has not received any response from the 3rd Level, the aggrieved stakeholder can forward the complaint, or file an appeal, to the 4th Level (Court).
12	Help/Grievance Desk	• Receive request from the aggrieved stakeholder to elevate his/her complaint to the 4th Level. • Record the status of the aggrieved stakeholder complaint. • Forward the complaint to the 4th Level within 15 working days from receipt of complaint.
13	4th Level Court	• Receives complaint from aggrieved stakeholder. • Once the complaint is filed in the Court, the judicial procedures for the trial on the case will be followed.

Source: JICA Study Team

9.2.10 RAP Implementation Institution

DOTr is the Implementing Agency (IA) of the Project. It is headed by the Department Secretary to whom several Undersecretaries report directly. For this Project, the Undersecretary for Railways will directly supervise the implementation of the project through the Project Management Office (PMO).

9.2.10.1 The DOTr Technical Working Committee for the Acquisition of Sites/Rights-of-Way for the Department's Infrastructure Projects (DOTr TWC)

The Department Order No. 2013-05 specifies the composition of the TWC for the acquisition of sites/ROW. "The DOTr Technical Working Committee for the Acquisition of Sites/ROW for the Department's Infrastructure Projects" (DOTr TWC) will provide support to all project management office under DOTr including NSRP-SC PMO.

The following are the roles and responsibilities of the DOTr TWC:

- Provide overall supervision and coordination in the planning, implementation, monitoring and evaluation of land/site acquisition activities;
- Evaluate and examine all documents pertaining to the property to be acquired;
- Certify that at least 50% of required ROW had been acquired on the date of bidding in case a project would take more than one year to complete before the same is advertised and bid out, or the necessary complaint for expropriation had been filed and the corresponding writ of possession had been issued by the court;
- Study and approve the acquisition price of the real property to be acquired, including improvements thereon, as recommended by an Independent Property Appraiser (IPA)/Government Financing Institution (GFI), in accordance with R.A. 10752 and its IRR;
- Approve payment of resettlement benefits to project affected property owners.

9.2.10.2 Right of Way Project Management Office (ROW PMO)

While the NSRP-SC PMO will be exclusive for the Project, the ROW-PMO will be responsible for all railway projects under the support of the TWC. The ROW PMO is focused on the ROW acquisition, relocation of PAPs including the ISFs and indigenous people, in compliance with laws on environmental protection and preservation with an effective performance monitoring and auditing mechanism. The ROW PMO is responsible for the following tasks:

- Execute DOTr's duties and responsibilities in ROW acquisitions;
- Read, know and understand the provisions of this RAP particularly the Entitlement Matrix;
- Ensure timely procurement of GFI services and monitor appraisal of affected properties, thereafter;
- Issue Notice of Taking (NoT) and Letter Offer (LO) duly approved and signed by proper authorities;
- Offer step-by-step guide to PAPs in securing required documents, particularly in extra-judicial settlement (EJS) cases;
- Carry-out timely payment of compensation to PAPs; and
- Monitor and ensure timely clearing of the ROW and relocation of PAPs.

9.2.10.3 NSRP-SC Project Management Office (NSRP-SC PMO)

The NSRP-SC PMO will be the implementing office of the NSRP-SC Project in accordance with JICA and ADB policies on involuntary resettlement.

- Provide technical assistance on day-to-day activities and management monitoring of the Project;
- Secure necessary approval and permit from concerned government agencies, LGUs and other stakeholders, including the relocation of utilities;
- Supervise the general consultant undertaking the detailed engineering design review, tendering and construction;
- Monitor the progress of the Project to ensure that compliance with the conditions of the contract are carried out by the general consultant and general contractor;
- Conduct internal monitoring of RAP implementation; and
- Submit periodically (monthly basis) all necessary reports to DOTr and act under the overall direction of the Undersecretary for Railways.

9.2.10.4 The Project Inter-Agency Committee (PIAC)

The Project Inter-Agency Committee (PIAC) will be responsible in creating inter-agency policies or agreements regarding sharing of resources, exchange of information and linking of programs for the effective and unhampered implementation of the RAP, in accordance with the laws of the Philippines, the JICA Guidelines (2010) and ADB SPS (2009). It will provide high-level coordination to make resources, programs and information available and accessible to the lower level units of each Department and LGUs where the actual work of RAP implementation happens.

The following are the roles and responsibilities of the PIAC:

- Craft and approve project specific policies that are not contrary to, and may have not been covered by the provisions of the approved RAP;
- Perform oversight function in the planning, implementation, monitoring and evaluation of the resettlement activities including site selection, site development, actual relocation and integration of the PAPs to the host community;
- Establish and maintain high-level coordination to support the TWG and NSRP-SC PMO in the actual execution of plans and programs for the resettlement, livelihood restoration and provision of social safety nets;
- Consolidate and mobilize resources to hasten the efficient implementation of the RAP; and
- Review, deliberate and provide resolution/action on the grievance complaints elevated at their level.

9.2.10.5 The Technical Working Group (TWG)

Under PIAC is a Technical Working Group (TWG) composed of representatives from the concerned division and attached agencies of partner Departments and representatives from the LGUs for housing and livelihood. The TWG will be responsible in implementing all the programs related to livelihood and relocation envisioned in this RAP from the community down to the household level.

9.2.10.6 RAP Implementation and Management Committee (RIMC)

The RAP Implementation and Management Committee (RIMC) will be created through a Memorandum of Understanding between the NSRP-SC PMO and the concerned LGUs. Its main role, as its name connotes, is to implement the RAP. Other important functions include:

- Participate in the conduct of information education and communication (IEC) with PAPs, throughout the RAP implementation;
- Assist DOTr in validating the eligibility of PAPs in relation to their corresponding entitlements; and

- Receive grievances during RAP implementation, related but not limited to project design, parcellary survey, appraisal, compensation, extra-judicial settlement (EJS), etc.

The RIMC will be established after the creation of the NSRP-SC PMO.

9.2.10.7 Philippine National Railways (PNR)

The Philippine National Railways (PNR), as one of the attached agencies of DOTr, owns the legacy of the PNR ROW, and acts as the co-project director. It will be represented in the NSRP-SC PMO**.**

9.2.10.8 Local Government Units (LGUs)

As stipulated in RA 7279, LGUs, in coordination with the National Housing Authority (NHA), “shall provide relocation and resettlement sites with basic services and facilities and access to employment and livelihood opportunities sufficient to meet the basic needs of the affected families”.

9.2.10.9 Local Housing Office (LHO) or Local Inter-Agency Committee (LIAC)

The Local Housing Board (LHB) or Local Inter-Agency Committee (LIAC) is the central decision-making, coordinating and consultative body, a pool of manpower, resources and expertise of concerned local government units and national government agencies, as well as the working group that implements and/or causes the carrying out of the various activities, plans, programs and projects regarding resettlement of ISFs. LIAC members gather as required, attend all open dialogues and observe all demolition works to secure the rights of the affected families/persons as well as to prevent conflicts.

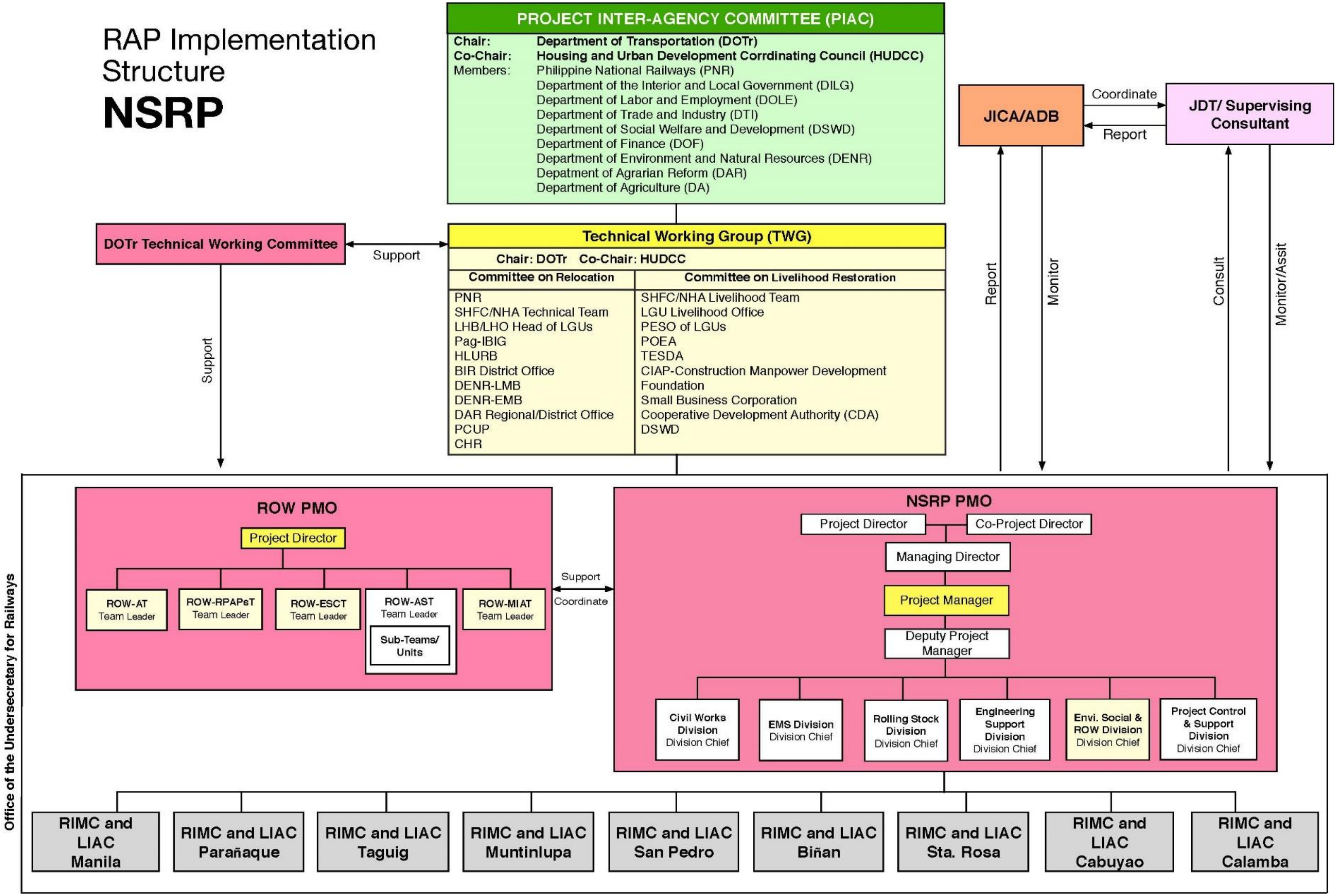
9.2.10.10 Housing and Urban Development Coordinating Council (HUDCC)

The Housing and Urban Development Coordinating Council (HUDCC), under the immediate control and supervision of the President of the Philippines, is charged with てえ main function of coordinating the activities of the government housing agencies (i.e. NHA and SHFC) to ensure the accomplishment of the National Shelter Program. Based on Section 3 of Executive Order No. 90 Series of 1986.

9.2.10.11 Social Housing Finance Corporation (SHFC)

Executive Order No. 272 s. 2004 stipulates that Social Housing Finance Corporation (SHFC) is the lead government agency to “undertake social housing programs that will cater to the formal and informal sectors in the low-income bracket and will take charge of developing and administering social housing program schemes, particularly the Community Mortgage Program (CMP) and Abot Kaya Pabahay Fund (AKPF) Program (amortization support and developmental financing program)” (*Section 2).* These programs are community driven and requires an organized community association for a housing loan assistance to be processed.

The role and Coordination of NSRP-SC RAP Implementation Institutions / Agencies is as shown in Figure 9.2.7 .



Source: JICA Study Team

Figure 9.2.7 Role and Coordination of NSRP-SC RAP Implementation Institutions / Agencies

9.2.11 Implementation Schedule

The construction of the NSRP-SC will be implemented in two phases. The Phase1 is to cover between Solis-Blumentritt starting from June 2019. Phase2 is to cover between Blumentritt-Calamba. The general implementation schedule for the RAP is shown on Table 9.2.41 and Table 9.2.42.

Table 9.2.41 RAP Implementation Schedule of NSRP-SC (Solis – Blumentritt)(Tentative)

	Activity	Responsible Agency	Period (Duration)
A. Project Implementation			
1	Start of Construction	Contractor	Jun. '19 - May.'22
B. Preparation of RAP Implementation			
1	RAP field surveys (Parcellary, DMS, SES, RCS)	JDT	Oct.'18 - Feb.'19
2	Finalization of Master list of PAFs	DOTr/PNR/JDT/LIAC	Feb.'19 - Mar.'19
3	Finalization of RAP Report	DOTr/ADB/JDT	Sep.'18- Mar.'19
4	JICA and ADB Review and concurrence of RAP	JICA/JDT	Mar. '19
C. RAP Implementing Institution			
1	Creation o DOTr PMO, RIMC, PIAC, LIAC, etc.	DOTr/PNR	Sep. '18 - Oct. '18 (2M)
2	Mobilization of PIAC (National level)	DOTr (Chair) HUDCC (Co-chair)	Sep. '18 - Oct. '18 (2M)
3	Mobilization of LIAC at Manila (LGU level)	LGU(Chair) DOTr (Co-chair)	Sep. '18 - Oct. '18 (2M)
4	Coordination of sending LGUs, LIAC members regarding resettlement scope and schedule	DOTr/PNR/LIAC	Sept. '18 - Jan. '19 (5M)
5	Appointment of PAPs representatives to LIAC (after LIAC created)	LIAC/PMO/RIMC/LGUs/ NGOs	Nov. '18 (1M)
6	Set up and Operation of Grievance Redress Mechanism	LIAC/PMO/RIC	Sep. '18 -
D. Land Acquisition (Depends on schedule of DOTr validation of data)			
1	Validation of RAP survey	DOTr PMO/PNR/LIAC	Feb. '19 - Mar.'19 (2M)
2	Issuance of Notice of Taking	DOTr PMO	Feb. '19 (1M)
3	Procurement/ Appraisal of Affected Properties	GFI/IPAs	Feb. '19 - Apr. '19 (3M)
4	Issuance of Letter of Offer	DOTr PMO	Apr. '19 (1M)
5	Payment of Compensation and other forms of assistance	DOTr PMO	May. '19 (1M)
6	Expropriation Proceedings	DOTr PMO	May. '19 -
7	Clearance of ROW by PAPs	Structure owners/PMO/ LGUs	May. '19 (1M)
E. Relocation of Informal settlers (developing community identified site)			
1	Verification / Validtation of affected ISFs	SHFC/LIAC	Oct. '18 - Apr.'19 (7M)
2	Validation of structure compensation	DOTr	Feb. '19 - Apr.'19 (3M)
3	Community Organizing (including identification of relocation site)	PAPs/SHFC	Nov. '18 - Apr.'19 (6M)
4A	**Relocation to SHFC identified relocation site**		
	4A-1. Land Acquisition of Relocation Sites	SHFC/DOTr	Jan.'19 (1M)
	4A-2. Obtaining of Required Permits for Relocation Sites	SHFC/DOTr	Feb.'19 (1M)
	4A-3. Development of Relocation Sites (Clearing, construction of housing, community facilities, connecting utilities etc.)	SHFC	Apr. '19 - Aug.'19 (5 M)
	4A-4. Payment of Compensation and other forms of assistance	SHFC	Apr. '19 - May.'19 (2M)
	4A-5. Provision of Rental Subsidy if the housing is not ready	DOTr	Apr. '19 - Jul.'19 (4M)
	4A-6. Relocation (ISFs) to rental property	DOTr	Apr. '19 - Jun.'19 (3M)
	4A-7. Clearing of ROW	DOTr/PIAC	Apr. '19 - Jun.'19 (3M)
	4A-8. Relocation (ISFs) to Permanent Social Housing	SHFC	Aug. '19 - Oct. '19 (3M)
4B	**Relocation to Community identified relocation site**		
	4B-1. Validation of Relocation site (Community)(documentary required is covered)	PAPs/SHFC	Apr. '19 - Jun.'19 (3M)
	4B-2. Land Acquisition of Relocation Sites	SHFC/DOTr	Jul. '19 - Oct.'19 (4M)
	4B-3. Obtaining of Required Permits for Relocation Sites	SHFC/DOTr	Nov. '19 - Apr.'20 (6M)
	4B-4. Development of Relocation Sites (Clearing, construction of housing, community facilities, connecting utilities etc.)	SHFC	May. '20 - Apr.'21 (12 M)
	4B-5, Payment of Compensation and other forms of assistance	SHFC	Apr. '19 - May.'19 (2M)
	4B-6. Provision of Rental Subsidy	DOTr	May. '19 - Jul.'20 (24 -25M)
	4B-7. Relocation (ISFs) to rental property	DOTr	Apr. '19 - Jun.'19 (3M)
	4B-8. Clearing of ROW	DOTr/PIAC	Apr. '19 - Jun.'19 (3M)
	4B-9. Relocation (ISFs) to Permanent Social Housing	SHFC	May. '21 - Jul. '21 (3M)
F. Provision of Livelihood restoration Program			
1	Formation of Sub Committee on Livelihood with receiving LGUs	LIAC/DOTr PMO	Sep.'18 - Oct. '18 (2M)
2	Coordination and MOA with relevant agencies on provision of Livelihood	HUDCC/LIAC/DOTr PMO	Oct.'18 -Nov. '18 (2M)
3	Implementation of Livelihood and Income Restoration Program	HUDCC/SHFC/DOTr	Jan.'19 - May. '19 (5M)
4	Provision of Livelihood and Income Improvement Program	HUDCC/SHFC/DOTr	Apr. '19 -Mar '22 (24M)
5	Monitoring of Livelihood and Income Improvement Program	HUDCC/SHFC/DOTr	1 yr from relocated
G. Monitoring of RAP Implementation			
1	Set up Monitoring Agents	DOTr PMO	Oct '18 - Nov. '19 (2M)
2	Internal Monitoring	DOTr PMO	Dec '18 - Up to Project Completion
3	External Monitoring	EMO	Dec '18 - Up to Project Completion

Source: JICA Study Team

	Activity	Responsible Agency	Period (Duration)
A. Project Implementation			
1	Start of Construction	Contractor	Apr. '20 - Sep. '23
B. Preparation of RAP Implementation			
1	RAP field surveys (Parcellary, DMS, SES, RCS)	JDT	Nov.'18 - Apr.'19 (6M)
2	Finalization of Master list of PAFs	DOTr/PNR/JDT/LIAC	Apr.'19 - May.'19 (2M)
3	Finalization of RAP Report	DOTr/ADB/JDT	Sep.'18- May.'19 (9M)
4	JICA and ADB Review and concurrence of RAP	JICA/JDT	May. '19 (1M)
C. RAP Implementing Institution			
1	Creation o DOTr PMO, RIMT, PIAC, LIAC, etc.	DOTr/PNR	Sep. '18 - Oct. '18 (2M)
2	Mobilization of PIAC (National level)	DOTr (Chair) HUDCC (Co-chair)	Sep. '18 - Oct. '18 (2M)
3	Mobilization of LIAC (LGU level)	LGU(Chair) DOTr (Co-chair)	Sep. '18 - Oct. '18 (2M)
4	Coordination of sending LGUs, LIAC members regarding resettlement scope and schedule	DOTr/PNR/LIAC	Sept. '18 - Jan. '19 (5M)
5	Appointment of PAPs representatives to LIAC (after LIAC created)	LIAC/PMO/RIMT/LGUs/NGOs	Nov. '18 (1M)
6	Set up and Operation of Grievance Redress Mechanism	LIAC/PMO/RIC	Sep. '18 -
D. Land Acquisition (Depends on schedule of DOTr validation of data)			
1	Validation of RAP survey	DOTr PMO/PNR/LIAC	Apr. '19 - Jul.'19 (4M)
2	Issuance of Notice of Taking	DOTr PMO	May. '19 - Jun.'19 (2M)
3	Appraisal of Affected Properties	GFI/IPAs	Jun. '19 - Oct. '19 (5M)
4	Issuance of Letter of Offer	DOTr PMO	Jul.'19 - Nov.'19 (5M)
5	Payment of Compensation and other forms of assistance	DOTr PMO	Aug.'19 - Dec.'19 (5M)
6	Expropriation Proceedings	DOTr PMO	Aug. '19 --
7	Clearance of ROW by PAPs	Structure owners/PMO/	Jan.'20 - Mar. '20 (3M)
E.Relocation of Informal settlers (Depends on schedule of DOTr validation of data)			
1	Verification of affected ISFs	SHFC/LIAC	Jan. '19 - Jul.'19 (7M)
2	Validation of structure compensation	DOTr	Apr. '19 - Jul.'19 (4M)
3	Community Organizing (including idenrification of reloation site,)	PAPs/SHFC	Apr. '19 - Jun.'19 (3M)
4A	**Relocation to LGU identified Incity Relocation Site**		
	4A-1. Validation of LGU Incity Relocation Sites	SHFC	Sep. '18 - Nov.'18 (3M)
	4A-2. Land Acquisition of Relocation Sites	SHFC/DOTr	Dec. '18 - Mar.'19 (4M)
	4A-3. Obtaining of Required Permits for Relocation Sites	SHFC/DOTr	Apr. '18 - Sep.'19 (6M)
	4A-4. Development of Relocation Sites (Clearing, construction of housing, community facilitis, connecting utilities etc.)	SHFC	Oct. '19 - Sep.'20 (12 M)
	4A-5.Payment of Compensation and other forms of assistance	SHFC	Oct.'19 - Dec.'19 (3 M)
	4A-6. Provision of Rental Subsidy if the housing is not ready	DOTr	Jan. '20 - Sept.'20 (9 M)
	4A-7. Relocation (ISFs) to rental property	DOTr	Jan. '20 - Sept.'20 (9M)
	4A-8. Clearing of ROW	DOTr/PIAC	Jan. '20 - Mar.'20 (3M)
	4A-9. Relocation (ISFs) to Permanent Social Housing	SHFC	Oct.'20 - Dec.'20 (3M)
4B	**Reloation to SHFC Identified Relocation Site**		
	4B-1. Land Acquisition of Relocation Sites	SHFC/DOTr	Aug.'19 (1M)
	4B-2. Obtaining of Required Permits for Relocation Sites	SHFC/DOTr	Sep.'19 (1M)
	4B-3. Development of Relocation Sites (Clearing, construction of housing, community facilities, connecting utilities etc.)	SHFC	Oct. '19 - Feb.'20 (5 M)
	4B-4. Payment of Compensation and other forms of assistance	SHFC	Jan. '20 - Feb.'20 (2M)
	4B-5. Provision of Rental Subsidy if the housing is not ready	DOTr	Jan. '20 - Mar.'20 (3M)
	4B-6. Relocation (ISFs) to rental property	DOTr	Jan. '20 - Mar.'20 (3M)
	4B-7. Clearing of ROW	DOTr/PIAC	Jan. '20 - Mar.'20 (3M)
	4B-8. Relocation (ISFs) to Permanent Social Housing	SHFC	Mar. '20 - May. '20 (3M)
4C	**Development of Community Identified Relocation Site**		
	4C-1. Validation of Relocation site (Community)(documentary required is covered)	PAPs/SHFC	Aug. '19 - Oct.'19 (3M)
	4C-2. Land Acquisition of Relocation Sites	SHFC/DOTr	Nov. '19 - Feb.'20 (4M)
	4C-3. Obtaining of Required Permits for Relocation Sites	SHFC/DOTr	Mar'20 - Aug.'20 (6M)
	4C-4. Development of Relocation Sites (Clearing, construction of housing, community facilities, connecting utilities etc.)	SHFC	Sep. '20 - Aug.'21 (12 M)
	4C-5, Payment of Compensation and other forms of assistance	SHFC	Oct. '19 - Dec.'19 (3M)
	4C-6. Provision of Rental Subsidy	DOTr	Jan.'20 - Aug.'21 (20 M)
	4C-7. Relocation (ISFs) to rental property	DOTr	Jan. '20 - Mar.'20 (3M)
	4C-8. Clearing of ROW	SHFC	Sep.'21 - Nov.'21 (3M)
	4C-9. Relocation (ISFs) to Permanent Social Housing	DOTr/PIAC	Sep '21 -Nov.'21 (3M)
F. Provision of Livlihood Program			
1	Formation of Sub Committee on Livelihood with receiving LGUs	LIAC/DOTr PMO	Sep.'18 - Oct. '18 (2M)
2	Coordination and MOA with relevant agencies on provision of Livelihood	HUDCC/LIAC/DOTr PMO	Oct.'18 -Nov. '18 (2M)
3	Implementation of Livelihood and Income Restoration Program	HUDCC/SHFC/DOTr	Oct.'19 - Mar. '20 (6M)
4	Provision of Livelihood and Income Improvement Program	HUDCC/SHFC/DOTr	Jan.'20 -Dec '21 (24M)
5	Monitoring of Livelihood and Income Improvement Program	HUDCC/SHFC/DOTr	1 yr from relocated
G. Monitoring of RAP Implementation			
1	Set up Monitoring Agents	DOTr PMO	Nov. '18 -Dec. '18 (2M)
2	Internal Monitoring	DOTr PMO	Jan.'19 - Up to Project Completion
3	External Monitoring	EMO	Jan. '19 - Up to Project Completion

Table 9.2.42 Implementation Schedule of NSRP-SC (Blumentritt- Calamba)(Tentative)

Source: JICA Study Team

9.2.12 Costs and Budget

The cost for implementing the RAP for the NSRP-SC is presented in Table 9.2.43.

Table 9.2.43 Estimated RAP Implementation Cost

Activity		Cost Item	Amount	Remarks
A. Land and Structures Acquisition		Land	20,325,303,258	Based on IPA appraisal
		Structures	6,058,164,000	Estimated based on replacement cost as defined in R.A. 10752
		Subtotal for (A)	26,383,467,258	
B. Resettlement Assistance		Livelihood rehabilitation assistance	218,022,000	Maximum amount PhP15,000 per PAP
		Rental Subsidy	98,294,060	Renters of residential structures based on highest average current rental fee x 5 months
		Temporary Shelter	2,219,880,000	Estimated based on prevailing local price of prefabricated temporary shelters plus 30% associated cost.
		Rental Subsidy for Temporary Property for Solis - Blumentritt	214,707,600	For rental property until permanent Social Housing is ready.
		Income Loss (business)	852,641,664	Compensation for income loss for CIBE declared incomes
		Income Loss (employee)	398,812,676	Compensation for income loss for employees/workers
		Special Assistance for vulnerable groups	45,270,000	Special Assistance for vulnerable persons such as medical care due to the implementation of the relocation
		Transportation Assistance	69,220,000	For transporting PAPs to the relocation site
		Food assistance	31,149,000	For relocating PAPs during relocation schedule (3 days)
		Subtotal for (B)	4,147,997,000	
C. Development of Relocation Sites		Horizontal/vertical development	5,122,800,000	Using SHFC ceiling price for horizontal and vertical development
		Subtotal for (C)	5,122,800,000	
D. Crops and Trees		Compensation for Crops and trees	858,000	The market value of potentially affected crops and trees.
		Subtotal for (D)	858,000	
E. RAP Implementation and monitoring		LIAC coordination	10,000,000	Organizing and make LIAC functioning through meetings and other related activities
		Internal monitoring cost	12,750,000	RAP Internal monitoring cost for 2019 to 2023
		External monitoring cost	4,200,000	RAP external monitoring cost for 2020 to 2023
		Subtotal for (E)	26,950,000	
Total (A+B+C+D+E)			35,682,072,258	
F.	Administrative Cost	1,784,103,473	1,784,103,613	5% of Total (A+B+C+D+E)
	Contingency	3,568,206,946	3,568,207,226	10% of Total (A+B+C+D+E)
Total (A+B+C+D+E+F)			41,034,383,097	41,034,383,000 Round off

Source: JICA Study Team

9.2.13 Monitoring and Evaluation

The DOTr will put in place a monitoring system that will track whether the: (i) planned resettlement activities for PAHs was delivered (i.e., whether compensation for the lost assets was promptly paid); and (ii) planned activities contained in the RAP, such as relocation and livelihood restoration are producing the desired outcomes. Internal monitoring will track the progress in the delivery of physical and financial targets, resettlement assistance and other entitlements, while external monitoring will assess the effects and impact of the RAP implementation.

9.2.13.1 Internal Monitoring

The tasks and obligations of the NSRP-SC PMO on internal monitoring are to:

a. Supervise and monitor the implementation of the RAP, on a regular basis. The findings will be documented in the monthly report to be submitted to the Project Director of NSRP-SC PMO, for subsequent submittal to JICA/ADB.
b. Review if the RAP is implemented as designed and planned and report on any gaps.
c. Verify that funds are released in a timely and the amount is sufficient for each activity and purpose.
d. Validation of compensation paid and verification that 100% compensation was paid prior to relocation;
e. Review how grievances are recorded and addressed.
f. Prepare required monitoring reports based on format prescribed in the RAP.

9.2.13.2 External Monitoring

DOTr will mobilize an External Monitoring Agent (EMA) to undertake independent external monitoring and evaluation to ensure that DOTr is properly implementing the RAP, such that it meets the JICA/ADB policies. The EMA can either be a qualified individual or a consultancy firm with qualified and experienced staff.

The methodology of external monitoring will be of two types namely: 1) random observation visits; and 2) consultation with PAHs, both at their current residence area and at their relocation site. The tasks of the EMA will be the following:

a. Verify results of internal monitoring;
b. Assess the extent to which consultation and disclosure activities are inclusive, accessible and effective in conveying key information from the RAP as well as providing conditions for PAPs to contribute to decision making which affects them such resettlement and livelihood restoration.
c. Verify that compensation and assistance has been provided in accordance with the requirements of the RAP;
d. Assess whether resettlement objectives are likely to be achieved; specifically, whether livelihood and living standards have been restored or enhanced
e. Ascertain whether the social safeguards document/plan entitlements were appropriate to meet the objectives, and whether the objectives were suited to AP conditions;

f. Suggest modification in the implementation procedures of the social safeguard document/plan, if necessary, to achieve the principles and objectives of the Resettlement and Indigenous Peoples Framework (RIPF);

g. Review how compensation rates were evaluated; and

h. Validation of compensation paid and verification that 100% compensation was paid prior to relocation; and

i. Review the effectiveness of the grievance redress mechanism, it's accessibility and responsiveness to resolving complaints.

The detailed monitoring indicators for the IMA and EMA are shown in Table 9.2.44.

Table 9.2.44 Monitoring Indicators for the NSRP-SC RAP

Monitoring Indicators	Basis for Indicators/Check List
For the IMA	
1. Budget and timeframe	• Have all land acquisition and resettlement staff been appointed and mobilized for the field and office work on schedule? • Have capacity building and training activities been completed on schedule? • Are settlement implementation activities being achieved against the agreed implementation plan? • Are funds for resettlement being allocated to resettlement agencies on time? • Have resettlement offices received the scheduled funds? • Have funds been disbursed according to the RAP? • Has the social preparation phase taken place as scheduled? • Have all land been acquired and occupied in time for project implementation?
2. Delivery of Compensation and Entitlements	• Have all PAFs received entitlements according to amounts and categories of loss set out in the entitlement matrix? • Have PAFs received payments for affected structures on time? • Have all received the agreed transport costs, relocation costs, income substitution support and any resettlement allowances, according to schedule? • Have all replacement land plots or contracts been provided? Was the land developed as specified? Are measures in train to provide land titles to PAFs? • How many PAFs resorted to expropriation? • How many PAF households have received land titles? • How many PAFs have received housing as per relocation options in the RAP? • Does house quality meet the standards agreed? • Have relocation sites been selected and developed as per agreed standards? • Are the PAFs occupying the new houses? • Are assistance measures being implemented as planned for host communities? • Is restoration proceeding for social infrastructure and services? • Are the PAFs able to access schools, health services, cultural sites and activities at the level of accessibility prior to resettlement? • Are income and livelihood restoration activities being implemented as set out in income restoration plan? For example, utilizing replacement land, commencement of production, numbers of PAFs trained and provided with jobs, micro-credit disbursed, number of income generating activities assisted? • Have affected businesses received entitlements including transfer and payments for net losses resulting from lost business and stoppage of production?
3. Public Participation and Consultation	• Have consultations taken place as scheduled including meetings, groups and community activities? Have appropriate resettlement leaflets been prepared and distributed? • How many PAFs know their entitlements? How many know if they have been received? • Have any PAFs used the grievance redress procedures? What were the outcomes? • Have conflicts been resolved? • Was the social preparation phase implemented?
4. Benefit monitoring	• What changes have occurred in patterns of occupation, production and resources use compared to the pre-project situation? • What changes have occurred in income and expenditure patterns compared to pre-project situation? What have been the changes in cost of living compared to pre-project situation?

Monitoring Indicators	Basis for Indicators/Check List
	Have PAFs' incomes kept pace with these changes? • What changes have taken place in key social and cultural parameters relating Monitoring Indicators Basis for Indicators / Check List to living standards? • What changes have occurred for vulnerable groups?
For the EMA	
5. Delivery of Entitlements	• Entitlements disbursed, compared with number and category of losses set out in the entitlement matrix. • Disbursements against timelines. • Identification of the displaced persons losing land temporarily, e.g. through soil disposal, borrow pits, contractors' camps, been included. • Timely disbursements of the agreed transport costs, relocation costs, income substitution support and any resettlement allowances, according to schedule. • Provision of replacement land plots. • Quality of new plots and issue of land titles. • Restoration of social infrastructure and services. • Progress on income and livelihood restoration activities being implemented as set out in the income restoration plan, for example, utilizing replacement land, commencement of production, the number of the displaced persons trained in employment with jobs, microcredit disbursed, number of income-generating activities assisted. • Affected businesses receiving entitlements, including transfer and payments for net losses resulting from lost business.
6. Consultation and Grievances	• Consultations organized as scheduled including meetings, groups and community activities. • Knowledge of entitlements by the displaced persons. • Use of the grievance redress mechanism by the displaced persons. • Information on the resolution of the grievances. • Information on the implementation of the social preparation phase. • Implementation of special measures for Indigenous Peoples.
7. Communications and Participation	• Number of general meetings (for both men and women). • Percentage of women out of total participants. • Number of meetings exclusively with women. • Number of meetings exclusively with vulnerable groups. • Number of meetings at new sites. • Number of meetings between hosts and the displaced persons. • Level of participation in meetings (of women, men and vulnerable groups). • Level of information communicated—adequate or inadequate. • Information disclosure. • Translation of information disclosure in the local languages.
8. Budget and Time Frame	• Land acquisition and resettlement staff appointed and mobilized on schedule for the field and office work. • Capacity building and training activities completed on schedule. • Achieving resettlement implementation activities against the agreed implementation plan. • Funds allocation for resettlement to resettlement agencies on time. • Receipt of scheduled funds by resettlement offices. • Funds disbursement according to the resettlement action plan. • Social preparation phase as per schedule. • Land acquisition and occupation in time for implementation.
9. Resettlement and Relocation	• ISFs provided adequate information, consulted on preferences and guided on procedures to avail of social housing. • ISFs participation in selection and design of social housing locations and options. • Number and percentage of ISFs provided availing of social housing programs. • Timeliness of provision of social housing to relocating ISFs • Quality of social housing provided to ISFs (suitability of location, utilities, access to social services). • Transitional assistance, such as transportation allowances, provided. • Rental assistance provided until social housing is available for eligible ISFs. • Percentage of relocating ISFs able to service financial obligations • Percentage of relocating ISFs satisfied with social housing and remaining in social housing. • Adequate management on the part of NHA.
10. Livelihood and Income Restoration	• Number of displaced persons under the rehabilitation programs (women, men and vulnerable groups).

Monitoring Indicators	Basis for Indicators/Check List
	• Number of displaced persons who received vocational training (women, men and vulnerable groups). • Types of training and number of participants in each. • Number and percentage of displaced persons covered under livelihood programs (women, men and vulnerable groups). • Number of displaced persons who have restored their income and livelihood patterns (women, men and vulnerable groups). • Number of new employment activities. • Extent of participation in rehabilitation programs. • Extent of participation in vocational training programs. • Degree of satisfaction with support received for livelihood programs. • Percentage of successful enterprises breaking even (women, men and vulnerable groups). • Percentage of displaced persons who improved their income (women, men and vulnerable groups) • Percentage of displaced persons who improved their standard of living (women, men and vulnerable groups) • Number of displaced persons with replacement agriculture land (women, men and vulnerable groups) • Quantity of land owned/contracted by displaced persons (women, men and vulnerable groups) • Number. of households with agricultural equipment • Number of households with livestock

Source: JICA Study Team

9.2.13.3 Type of Reports

The monitoring reports to be prepared are summarized in Table 9.2.45.

Table 9.2.45 Monitoring Reports

Type of report	Internal/ External	Frequency	Who to prepare	Submit to whom
Inception and Compliance Report	External Monitoring	1 month after mobilization	EMA	EMA ⇒DOTr, JICA and ADB
Initial Evaluation Report	Internal Monitoring	3 months after the completion of payments of compensation to PAPs	PMO	Project Manager ⇒ JICA and ADB
Quarterly monitoring Report	Internal Monitoring	Quarterly submission	PMO	Project Manager ⇒ JICA and ADB
Semi-Annual Monitoring and Evaluation Report	Internal/ External Monitoring	Every 6 months until the construction works end	PMO/EMA	Project Manager ⇒ JICA and ADB EMA ⇒DOTr, JICA and ADB
Final Report/Resettlement audit Report	Internal/External Monitoring	Upon loan closing	PMO/EMA	Project Manager ⇒ JICA and ADB EMA ⇒DOTr, JICA and ADB

Source: JICA Study Team

9.2.14 Public Consultations

Information, Education and Communication (IEC) with LGUs was organized to inform the Project, which was based on the project affected area as of December 2017. After the IEC, consultatin meeting with the PAPs and FGD for the PAPs with specific characters were carried out. The schedule of those meeting is shown in Table 9.2.46.

Table 9.2.46 Meeting's Schedule, Participants and Topics

Date	Participants	Topics of the discussion and contents
Information, Education and Communication: IEC (Dec. 2017~Jan. 2018)	LGU (City/ Municipalities along the alignment)	• Project outline • Gathering the concerns of the LGUs
1st Stakeholder Consultation Meeting (Jan. 2018)	LGU (City/ Municipalities along the alignment) Stakeholders including the Barangays Captains	• Project Outline • Outline of RAP surveys • Project timeline and Cut -off dates • Collecting PAPs opinion
2nd Stakeholder Consultation Meeting (March 2018)	LGU (City/ Municipalities along the alignment) Stakeholders including the Barangays Captains	• Legal Framework for land acquisition and resettlement • Collecting PAPs opinion
3rd Stakeholder Consultation Meeting (August 2018)	LGU (City/ Municipalities along the alignment) PAPs determined through census survey Barangays Captains	• Results of the SES • Relocation sites and Entitlements • Collecting PAPs opinion
FGD (March 2018)	Vulnerable People (Women, Poor people etc.)	• Collecting PAPs opinion • Consideration of Gender and Poor • Livelihood Improvement Measures

Source: JICA Study Team

9.2.14.1 Information, Education and Communication (IEC)

The Outline of the conducted IEC are shown in Table 9.2.47, the opinion collected from the LGUs and the countermeasures are shown in Table 9.2.48**.**

Table 9.2.47 IEC dates, Targets and Participants

Date and Time	Venue	Main Participants	No. of Participants
2017/12/13, 10:00 am~00:20	Extension Office of the Governor of Laguna	Representative from the Office of the Governor PUDHO Representative	Male: 4 Female: 4 Total: 8
2017/12/18, 10:00~12:00	Conference Room, Office of the City Administrator, Muntinlupa City Hall	Muntinlupa City LGU Representative	Male: 8 Female: 7 Total: 15
2017/12/18, 10:00~12:00	The Workshop Room, Office of the Municipal Mayor, 3rd Floor, Los Baños Municipal Hall	San Pedro City LGU Representatives Santa Rosa City LGU Representatives Vice Mayor of Cabuyao City Los Baños LGU Representatives	Male: 21 Female: 10 Total: 31
2017/12/18, 02:00~04:00	Conference Room, Office of the City Engineer, 3rd Floor, Manila City Hall	Manila City LGUs (Representatives from the Office of the City Administrator, City Engineer's Office and DEPW)	Male: 5 Female: 8 Total: 13
2017/12/20, 10:00 ~12:00	Conference Room, Parañaque City Hall	Parañaque City LGU Representatives (City Planning, UMADO, City Assessor, City ENRO, City Engineering and LHDO)	Male: 7 Female: 6 Total: 13
2017/12/22, 10:00 ~12:00	Conference Room, Office of the Mayor, Binan City Hall	Binan City LGU Representatives (City Mayor, City Councilor, City ENRO and CPIO)	Male: 3 Female: 7 Total: 10
2017/12/22, 02:00 ~04:00	Conference Room, Office of the Mayor, 3rd Floor, Calamba City Hall	Calamba City LGU Representative	Male: 2 Female: 3 Total: 5
2017/12/22, 02:00 ~03:00	Conference Room, Office of the City Engineer, 8th Floor, Makati City Hall	Makati City Administrator's Office Representatives	Male: 4 Female: 5 Total: 9
2018/01/10,	Conference Room 1, Taguig City Hall	Taguig City LGU Representative	Male: 6

Date and Time	Venue	Main Participants	No. of Participants
10:00~11:30			Female: 1 Total: 7
2018/01/19, 02:00~03:00	MPD Conference Room, Bay Municipal Hall	Bay Municipality LGU Representative	Male: 4 Female: 0 Total: 4
2018/3/2 10:00~12:00	BTTC Center, Meeting Room	BCDA Representative	Male: 0 Female: 5 Total: 5
2018/3/28	SHFC Board Room	SHFC Representative HUDCC Representative	Male: 5 Female: 10 Total: 15
2018/5/28, 10:00~11:30	NHA Conference Room	NHA Representatives DOTr Representative	Male: 5 Female: 3 Total: 8
2018/6/6 10:00~12:00	SHFC Board Room	SHFC Representative DOTr Representative	Male: Female: Total:

Source: JICA Study Team

Table 9.2.48 Summary of Major Issues and Concerns during IEC for the NSRP-SC

LGU	Concerns		Answers
	EIA	RAP	
Office of the Governor, Laguna	Trees will need to be cut down during clearing of ROW		JICA Study Team will check for permission to cut
	There is a fault line near the alignment		An Engineering Geological and Geohazard Assessment (EGGA) will made during design.
	Will the PNR Old station be preserved?		JICA Study Team will discuss the preservation of old PNR stations with NHCP and DOT
		• Convening of LIAC at an early stage. • There are large number of ISFs at Calamba and Los Baños • Where is the resettlement site for Los Baños? • Local election might cause delay in resettlement (LGU wants to conduct resettlement after the elections)	JICA Study Team will organize a coordination meeting with NHA.
			The Public roads will not be blocked. If passing through private road, a MOA will be made between PNR and LGU.
Muntinlupa City	• There is a local ordinance declaring the areas along the fault line (west valley fault) a “no build zone”. This is supported by a zoning ordinance and is also incorporated in their CLUP • Identified geo-hazards are flood, liquefaction, seismic.		JICA Study Team will coordinate with PHIVOLCS and gather information concerning procedures.
		There is an ongoing construction of road along the alignment which	JICA Study Team requested LGU to provide data on ongoing projects

LGU	Concerns		Answers
		is a project of Congress Biazon.	
Los Baños, Laguna		There are at least 3500 ISFs along the PNR alignment	DOTr to write a letter of request to LGUs to halt issuance of building permit within the 30-m PNR ROW
Paranaque City		A legal PAP is set to construct an 8-level building near the alignment.	JICA Study Team will prioritize some sections for parcellary survey particularly in the proposed station location。
Taguig City	A fault line traverses PNR alignment between Tanyag and Daang Hari.		JICA Study Team will coordinate with PHIVOLCS and gather information concerning procedures.
		• Tanyag area has many ISFs	• Sub-contractors to meet with LGU officials prior to actual survey and stakeholder consultation meetings • DOTr to endorse sub-contractors to the LGU

Source: JICA Study Team

Source JICA Study Team

Photo 9.2.1 IEC in Makati (left) and Muntinlupa (right)

9.2.14.2 The Stakeholder Consultation Meetings

After the IEC, the Stakeholder Consultation Meetings (SCM) was carried out for total three times. The SCM shall be held considering working hours maximize the participation of PAPs. During the SCM, explanation of the outline of the Project, proposed alignment and station location, tentative implementation schedule, outline of surveys were conducted in Tagalog to enable all the participants to understand the discussion. To facilitate the participation of poor or vulnerable PAPs, the venue location was selected in the proximity to the PAPs, so they could attend the meeting by walking. For PAPs who need assistance for transportation, respective Barangay Offices were requested, and agreed to provide service vehicles.

(1) 1st Stakeholder Consultation Meeting

The 1st SCM was conducted at the cities with expected PAPs from January 2018 as shown in Table 9.2.49. At the end of each meeting, the PAPs were invited to participate in the open forum to express their views/opinions freely.

Table 9.2.49 1st Round of SCM for NSRP-SC

LGUs	Venue	Date & Time	Main Participants	Number of Participants

				Male	**Female**	**Total**
Manila City	Dapitan Sports Complex	09:00 A.M. 22 January 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	94	80	174
	Covered Court, Brgy. 811	2:00 P.M. 22 January 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	114	208	322
	Sases Covered Court, Brgy. 803	08:30 A.M. 02 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	125	268	393
	Sarmiento Community Center, Brgy. 592	08:30 A.M. 02 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	62	96	152
	Jacinto Ciria Cruz Covered Court, Brgy. 860	2:00 P.M. 02 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	189	374	563
	Basketball Court, Brgy. 511	2:00 P.M. 02 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	97	214	311
	Basketball Court, Brgy. 503	08:30 A.M. 03 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	21	38	59
	Barangay Hall, Brgy. 368	08:30 A.M. 03 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	101	220	321
	Covered Court, Brgy. 224	2:00 P.M. 03 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	13	12	25
	Domingo Santiago Covered Court, Brgy. 576	2:00 P.M. 03 February 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	204	361	565
	Brgy. 629 Covered Court	9:00 A.M. 11 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	42	68	110
	Aldana Elementary School, Brgy. 422	2:00 P.M. 11 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	82	145	227
	Brgy. 473, Algeciras Cor. Florentino Sts.	09:00 A.M. 12 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	96	156	252
	Brgy. 483, Algeciras Cor. Maria Clara Sts.	02:00 P.M. 12 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	67	206	273
	Brgy. 443, Algeciras Cor. Firmeza Sts.	04:00 P.M. 12 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives,	47	75	122

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
				Male	Female	Total
			EcosysCorp, Inc.			
	Brgy. 348, Old Antipolo cor. Oroquieta Sts. (Blumentritt Station)	09:00 A.M. 13 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	126	176	302
	Brgy. 224 Covered Court	02:00 P.M. 13 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	20	26	46
Makati City	Multi-Purpose Room, 7th Floor, Makati City Hall Building 2	09:00 A.M. 17 January 2017	LGU, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	4	2	6
Taguig City	Covered Court, Brgy. Fort Bonifacio	09:00 A.M. 19 January 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	14	34	48
	Covered Court, Brgy. South Daang-Hari	2:00 P.M. 19 January 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	39	52	91
Parañaque City	Brgy, Hall, San Martin De Porres	2:00 P.M. 17 January 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	3	2	5
Muntinlupa City	Baywalk Covered Court, Brgy. Bayanan	2:00 P.M. 18 January 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	39	81	120
	Barangay Hall, Brgy. Alabang	08:30 A.M. 31 January 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	48	87	135
	Brgy. Hall Covered Court, Brgy. Poblacion	2:00 P.M. 31 January 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	40	74	114
San Pedro City	Pavillion Hall, 5th Floor, San Pedro City Hall	08:30 A.M. 18 January 2018	LGU, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	28	66	94
Biñan City	Biñan People’s Center	2:00 P.M. 18 January 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	55	204	259
Sta. Rosa City	West Drive Covered Court, Brgy. Labas	08:30 A.M. 19 January 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	44	97	141
Cabuyao City	AVR, Cabuyao City Hall	2:00 P.M. 18 January 2018	LGU, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	89	53	142
Calamba City	LLC Auditorium, Central 2	2:00 P.M. 19 January 2018	LGU, BLGUs, PAPs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	71	127	198
	Covered Court, Brgy.	09:00 A.M.	PAPs, BLGUs, DOTr	57	152	209

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
				Male	Female	Total
	Pansol	01 February 2018	Representatives, JICA Design Team Representatives, EcosysCorp, Inc.			
	Covered Court, Brgy. Parian	2:00 P.M. 01 February 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	13	61	74

Source JICA Study Team

Source JICA Study Team

Photo 9.2.2 1st SCM in Manila

Table 9.2.50 Main Topics at the 1st SCM

Queries/Concerns/Suggestions/Comments	Responses to Queries
Entitlements and Rights of ISFs	
• Qualifications for relocation program; • If unit owners in the residential buildings within the PNR ROW (Brgy. 811) be qualified in the relocation program for the project as they do not own the land	• The law gives priority to homeless and underprivileged citizens who cannot afford to have their own house and lot; • Beneficiaries of previous relocation programs who sold their units and returned to informal settling are not qualified to avail or be a beneficiary of any government housing project for 10 years; • Clarified that eligibility of the PAPs to the relocation program for the project will be determined by the partner housing agency of the DOTr; • A more detailed explanation on the qualifications of the PAPs to the relocation program will be discussed in the 2nd meeting
• Entitlements of structure owners	• The type of land ownership must be established first to determine the entitlements of the structure owner; • The owner will be compensated for the structure, if the land is outside the PNR ROW; • During tagging, the structure owner will be the one to be photographed and not the renter
• If awardees of previous NHA housing program are still qualified to avail another relocation of the project; • If recipients of a relocation program through a PNR project who sold their units and returned to informal settling along the PNR tracks be a beneficiary of the housing program for this project; • If awardees of a housing program who abandoned their units due to the poor living conditions in the relocation site and returned to informal settling along the tracks could still qualify to the relocation program for the project	• A more detailed explanation regarding the concern will be discussed during the 2nd meeting; • Based on RA 7279, it depends on the reason of the awardee for leaving the unit; • It is specified in the law that awardees who sold their relocation units and returned to informal settling are not qualified to avail any another NHA housing program for 10 years. • All ISFs within the 30-m PNR ROW will be included in the survey, even the returnees, but their qualification for another relocation will be decided by the partner housing agency of DOTr; • The survey results will show the length of stay of the awardee in the unit and if the unit was put up for rent or for sale, or just plainly abandoned; • If the case is abandonment, it will be very different from the case where the owner sold the unit;

Queries/Concerns/Suggestions/Comments	Responses to Queries
	• Since availing of a relocation has become a business, a stricter inquiry on the true reason for abandoning the housing unit is being carried out by NHA; • If the awardee could prove through documentation that he/she is not a professional squatter based on NHA standards, then qualification for another relocation program will be considered; • The People's Plan will be based on the plan made by the people, with the assistance from the partner housing agency of the DOTr, like in this case the Socialized Housing and Finance Corporation or SHFC
• If all the families living in one structure will be included in the relocation program	• Relocation will be per household; • One household is defined by a separate kitchen and food budget
• If financial assistance will be accorded to PAPs unqualified for relocation	• The legal framework of the RAP will be discussed during the 2nd meeting;
• Basis of compensation for the structures	• Affected structures will be compensated at replacement cost, without depreciation
Entitlements and Rights of Renters	
• Qualifications of renters to the relocation program	• Qualification of the renters to the relocation program is dependent on the current economic status; • A separate interview will be conducted for the renters, and if established that they are qualified, they will be included in the relocation program; • Emphasized that the Consultant can only recommend who are qualified, but the partner housing agency of DOTr will decide who are qualified and who are not; • The renters may have a higher possibility of being a beneficiary of a relocation program
• Compensation for renters	• A renter has its own entitlements which are separated from the owner; • A detailed explanation on the compensation for renters will be discussed during the 2nd meeting; • The compensation for the renter will not be subtracted from the compensation for the structure owner
Issues and Concerns on the Tagging and Survey	
• Suggested that a coordination meeting with the barangay units be carried out by the Teams during the conduct of the survey and tagging to facilitate the activities	• Informed the stakeholders that it is the standard operating procedure of the census and survey teams to coordinate with the office of the barangay chairpersons; • Requested the BLGUs to provide assistance during the conduct of the tagging, census and survey activities
• Structure owners may not be present during the tagging, census and survey due to work schedule, particularly during weekdays	• Permission will be requested from the structure owners prior to tagging; • Suggested to the PAPs to authorize their neighbors to permit the tagging in case the owners are not present; • Schedule of the interview could be arranged with Team on weekends as the enumerators are staying in the area, to accommodate PAPs who are working during weekdays
• If tagging of structures depends on the number of families living in the house	• Clarified that the tagging will be per structure, not per household or per family; • Explained that structures tagged at this stage are considered potentially affected only; • There may be additional structures to be tagged once the parcellary survey is completed; • After the tagging, the enumerators/interviewers will start the survey and census
Alternative Livelihood and Restoration Program	

Queries/Concerns/Suggestions/Comments	Responses to Queries
• If there will be alternative livelihood for PAPs who will lose their main source of income, like the trolley operators	• Informed the PAPs that there will be a livelihood restoration and improvement program to be included in the RAP Report, with considerations to the skills of every individual; • Urged the PAPs to provide accurate and correct information, especially the questions regarding present livelihood for the inputs would be the basis of the preparation of the livelihood restoration program; • Temporary employment during implementation of the project is also being considered as another livelihood program. Trainings will be conducted by construction engineers to qualify for the job; • Informed the PAPs that there is an existing law that that states that a large percentage of the workforce should come from the directly affected area
Issues on the Relocation Site	
• Possibility of an in-city relocation, and should not be far from the present work places of PAPs to avoid returning to the tracks	• In-city relocation is the priority; • Option for in-city relocation will be discussed with the concerned LGUs to determine the availability of potential relocation sites within the city/municipality; • If there are there are no available public lands within the city/municipality, potential sites in neighboring areas will be considered; • Emphasized the resettlement for the project is a People's Plan, wherein a relocation plan will be presented to the PAPs for discussion to ensure that the relocation site is acceptable to the relocatees to achieve the "no worse-off" policy of JICA; • The PAPs will be involved in the planning of the relocation program; • JICA will be monitoring the living conditions of the relocatees to ensure that the no-worse off policy is achieved
• Basic social service facilities such as water and power supply, health center and educational and sanitation facilities must be provided at the relocation site	• Explained that JICA is aware of the circumstances surrounding the failure of some relocation programs and the negative experiences of the relocatees; • Related that the DOTr has already coordinated with the Socialized Housing and Finance Corporation (SHFC), the housing agency that will partner with DOTr in the implementation of the relocation program for the project; • As stipulated in RA 7279, the relocation site must have water and power supply, educational facilities and access; • The RAP Study as well as the agreement with SHFC will include the budgeting for the utilities; • Explained that not only the Philippine Laws will safeguard their rights but also the JICA standards, which must be complied by DOTr to be able to secure the loan for the project; • Reiterated that JICA will conduct a monitoring on the living conditions of the relocatees to ensure that the JICA guidelines are complied with; • JICA will not allow the PAPs to be relocated in a site where the basic social service facilities are not provided; • The JICA guidelines will bridge the gap between the Philippine Law and the International Standards to ensure that the PAPs' rights are protected during implementation of the project; • Explained JICA will not approve the loan if the guidelines of the RAP are not followed; Assured the PAPs that the DOTR will not relocate the PAPs in an area where the basic social service facilities are not provided
• Housing units in the relocation areas must be decent and not sub-standard	• Emphasized that DOTr's direction is towards building a standard housing for the PAPs; • Assured the PAPs that a thorough study will be undertaken to ensure that all aspects are carefully considered; • Clarified that the primary objective of the consultation meeting is to involve the PAPs in the planning of the relocation program that will best correspond to their needs

Queries/Concerns/Suggestions/Comments	Responses to Queries
• If compensation for structures dependent on the size	• The compensation for every structure varies depending on the size and type; • A more detailed explanation regarding the compensation of structures will be discussed during the 2nd meeting; in March
• If the relocation unit is free or to be amortized by the awardees	• Our law and even JICA and the World Bank do not recommend providing the housing program for free to encourage the beneficiaries to give value to the relocation unit received; • The law promotes affordable housing, meaning the recipients will be asked to pay the minimum monthly amortization that they can afford for a certain period
Right-Of-Way Issues	
• Reckoning point of the 30-meter PNR ROW	• Explained that the surveyors are still locating the boundary of the 30 m ROW, and it will be marked once the parcellary survey is completed by March; • Informed the participants that there are areas, where the tracks are not in the middle of the ROW; • In areas where the tracks are in the middle of the ROW, it will be 15 m to the left and 15 m to the right; • Clarified that for tagging, census and survey, measurement of the 30-m ROW will be from the centerline of the existing tracks, 15-15 m left and right
• Basis of compensation for private lands	• A more detailed explanation on compensation of private lands will be discussed in the 2nd SCM; • The latest ROW law, R.A. 10752 will be implemented for the compensation of affected private properties
• Residential buildings (with 50 units per building) in Brgy. 811, Manila City are located within the PNR ROW	• The 30-m ROW of the PNR is still being established by the JICA Design Team; • A coordination with the PNR and SGC will be undertaken to determine the status of the residential building
• Possibility that the areas below the elevated railway could be utilized as alternative roads	• The matter will be referred to DOTr as the agency may have other plans for the areas underneath the elevated guideway
Concern on Access	
• Raised concern on the access of residents during construction	• Provision of alternative access to affected access roads and crossings are being considered in the design; • The PNR ROW will be secured and fenced after clearing to ensure safety of public
• Provision of access for residents crossing the tracks	• Clarified that unauthorized access to public will no longer be allowed once operational; • The survey will include questionnaire regarding access, to understand the need of the residents for access to cross over to the other side of the tracks and the importance of the access that will be lost; • The RAP Preparer could recommend the provision of the access to the other side of the tracks if the purpose for crossing over is valid, such as going to a day care or school
• Concern on the possible closure of existing road crossings and public access points	• All existing legal roads crossed by the alignment such as National Roads, City Roads and Barangay Roads will be maintained and not closed/blocked; • Provision of alternative access to affected access roads and crossings are being considered in the design; • Assured that the concern is being carefully studied by the traffic engineering design team
Timeline of the Project	

Queries/Concerns/Suggestions/Comments	Responses to Queries
• Timeline of the project	• Stressed that the timeline of the project is tentative; • The feasibility and basic design stages are simultaneously undertaken, which started last November 2017 and re expected to be completed by August 2018; • It is expected that the loan agreement will be signed by December 2018; • Construction is scheduled to start by 2019 • The target opening of the NSRP-SC is by 2022, and is expected to have the connection with the on-going NCSR (Tutuban-Malolos) Project (partial operation of the is expected, The expected
• Concern regarding the timing of the project's implementation date which might disrupt the education of the affected students	• The timing of the relocation will be part of the RAP report; • Students must be given consideration and timing of the relocation should not be scheduled in the middle of the school year; • If unavoidable, there should be an arrangement between the concerned school and the students, that the affected students can come in and go on with their studies; • The issue will be included recommendation in the RAP study
• Certainty that the project will be implemented	• Explained that by 2020, the President expects that the train is already operational; • The government has already allotted funds and exerted efforts in the project, so implementation is certain; • There will be no issue even if the administration changes, for as long as the new administration will pursue the implementation of the project
• Transition period allowed by the DOTr for the PAPs to fully vacate the structures	• Assured the PAPs that they will have enough time to prepare before the actual relocation is implemented, as they will be involved in the planning period
• Exact date that the affected area will be determined	• Based on the project's tentative timeline, the DED will be undertaken by August 2018; • The specific areas to be affected will be determined during the DED stage
Engineering Design	
• If the 30-m PNR ROW will be fenced once the railway is operational	• Yes, the ROW will be fenced to limit access to the public to ensure safety; • Unauthorized access to the ROW will be limited
• If the railway project is elevated	• Yes, and there are also some sections on embankment
• Height of the elevation	• The NSRP-SC is still in the design stage and the structure design is not yet final, so the height of elevation is not yet determined
Other Issues and Concerns and Suggestions	
• Policy on salvaged materials	• Salvaged materials will be given to the structure owners; • Further explanation regarding salvaged materials will be discussed in the next meeting;
• Temporary shelters (tents) along the tracks should not be included in the census and tagging	• Clarified that there are different categories of PAPs such as the land owners, structure owners, owners of temporary shelters and terminals and all these are classified as project affected persons; • All PAPs will be interviewed; • Explained that the PAPs will have different types of compensations and entitlements depending on their classification
• Concern on the possible invasion of illegal settlers from neighboring areas due to speculation on potential relocation	• Explained that the RAP Team will not undertake the census and tagging without the permission of the LGUs and BLGUs and without consultation with the stakeholders first; • Urged the stakeholders to be vigilant and discourage would be settlers to construct new structures in the area; • Reminded the stakeholders that if the number of the ISFs increased, the initial budget allotted for them would be shared with the new ISFs which were not included in the original financial plan

Source: JICA Study Team

(2) 2nd Stakeholder Consultation Meeting

The 2nd SCM involved the (i) presentation of the legal framework that will be the basis for compensation and entitlements along with the corresponding eligibility requisites. As in the 1st Meeting, the invited PAPs were encouraged to participate in the Open Forum at the end of each meeting. The dates and participants number are summarized in Table 9.2.51.

The issues, concerns, comments and suggestions raised during the 2nd Meeting are summarized in Table 9.2.52.

Table 9.2.51 Outline of the 2nd SCM

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
				Male	Female	Total
Manila City	Brgy. 811 Covered Court	9:00 A.M. 27 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc. PNR Representative	228	556	784
	Brgy. 629 Covered Court	2:00 P.M. 27 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc. PNR Representative	39	93	132
	Brgy. 443, Algeciras cor. Firmeza Sts.	3:00 P.M. 30 April 2018	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc. PNR Representative	34	68	102
	Aldana Elementary School, Brgy. 422	8:00 A.M. 31 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.; SHFC Representatives	39	93	132
	484 Brgy. Hall, Algeciras St., Brgy. 484	2:00 P.M. 31 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	71	232	303
	Brgy. 485, Algeciras St.	2:00 P.M. 06 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	34	56	90
	Brgy. 224 Covered Court	8:00 A.M. 07 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	15	7	22
	Brgy. 348, Old Antipolo cor. Oroquieta Sts. (Blumentritt Station)	2:00 P.M. 07 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	66	140	206
Taguig City	Brgy. Fort Bonifacio Covered Court	8:00 A.M. 01 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	21	50	71
	Cayetano Sports Complex, Brgy. Bagumbayan	8:00 A.M. 08 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	9	31	40
Parañaque City	Brgy, Hall, San Martin De Porres	2:00 P.M. 01 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	8	25	33

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
Muntinlupa City	Muntinlupa Sports Complex	9:00 A.M. 28 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	179	382	561
San Pedro City	Biñan People's Center	2:00 P.M. 28 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	26	46	72
Biñan City	Biñan People's Center	2:00 P.M. 28 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	288	571	859
Sta. Rosa City	Santa Rosa Auditorium	2:00 P.M. 25 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	106	199	305
Cabuyao City	Santa Rosa Auditorium	2:00 P.M. 25 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	45	21	66
Calamba City	LLC Auditorium, Central 2	09:00 AM 25 April 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative; SHFC Representative	266	652	918

Source JICA Study Team

Table 9.2.52 Main Topis of the 2nd SCM

Queries/Concerns/Suggestions/Comments	Responses to Queries
Entitlements and Rights of ISFs	
• If the recipient of previous housing program who never occupied the unit due to its distant location from the children's school still qualified to avail the relocation program	• It can be considered if the recipient will return the awarded unit; • Even if NHA is not the housing agency who will facilitate the relocation program, the data will still be included for validation • The concern will be referred to the top management of SHFC as the reason for not occupying the unit is valid
• Emphasized Section 28 of RA. 7279 which states that there should be no demolition without a proper relocation	• Explained that the law dictates that no demolition could be executed if the affected persons have not been informed 30 days prior the demolition. However, the project has been disclosed last January, meaning more than the minimum of 30 days
• Asked for assurance regarding the 30-day rule of notice before demolition	• The law will protect the PAPs (Section 28 of RA 7279) and the JICA and ADB guidelines
Compensation and Entitlements of Private Property Owners	
• If when will the initial 70% payment for the structures be accorded to the owners; • If when the 30% balance will be paid	• The initial 70% will be paid upon the execution of the agreement of the negotiated sale; • The remaining 30% will be paid once the structure is completely demolished
Entitlements and Rights of Renters & Tenants	
• If tenants are also qualified to avail a relocation program	• If the tenants passed the criteria for qualification, then they are entitled to avail the relocation program for the project
Compensation and Entitlements	
• The structure is divided into three rooms between the siblings; • Each room has its own kitchen; • The other rooms are being rented out	• Sharing of the compensation for the structure will be internal between the siblings; • Household heads of each room will be interviewed as there are three separate kitchens, which qualify to the definition of one (1) household;

Queries/Concerns/Suggestions/Comments	Responses to Queries
• If the crops will be compensated	• Yes, crops are included in the items to be compensated
• Schedule of compensation of the 70% payment for the structures; • If when the 30% balance will be paid	• The initial is 70% of the agreement of the negotiated sale; • The remaining 30% will be paid once the structure is demolished
• If the PAPs will be compensated or relocated	• Clarified that compensation is paid for the affected lands and structures, while relocation will be given to qualified PAPs
Issues and Concerns on the Tagging and Survey	
• If the validation, tagging and survey undertaken last 07 February 2017 official	• Yes. February 7, 2018 was the start of the tagging and census survey in the Poblacion 1
• Asked for clarification why the name of the structure is written on the sticker, but the renter's name was recorded on the interview sheet	• Explained that the tag or sticker is for the structures only to determine the number of affected structures for budgetary purpose; • Both the structure owner and the renter will be interviewed; • The renter will be interviewed as he/she may qualify to the relocation program for the project
• The structure was not tagged because the owner is not present; • If owners of structures that were not tagged be qualified to the relocation program	• Explained that the structures are not tagged if there is no consent from the owner; • There is a reserved control number for the structure that was not tagged; • Informed the PAPs that there will be a second round of tagging; • Clarified that if the structure owner is qualified to avail a relocation based on SHFC's guidelines, then he/she will be included in the awardees; • Assured that the Team will return to the area to complete the tagging activity
• Schedule of the second tagging	• The second tagging will be undertaken during the DED when the design is final. It will be coordinated with the barangay
Issues on the Relocation Program and Relocation/Resettlement Site	
• Asked for confirmation regarding the news going around that Brgy. Banlic, Calamba is being considered as the relocation site; • Confirmation on the information that the area has already been acquired by JICA	• Disclosed that SHFC and JICA Study Team visited the City Government of Calamba and conducted ocular inspections on potential relocation sites in the city; • Clarified that it is not confirmed if the areas visited were already purchased by the LGU; • Clarified that JICA will only fund the civil works or construction cost for the project. The Government of the Philippines will take care of have no chance to avail the ROW compensation as well as the provision of the relocation site/s for the PAPS
• Requested that the PAPs be relocated in an area that is not flood-prone	• Explained that in the People's Plan (PP) and Community Mortgage Program (CMP), the PAPs are involved in the planning and selection of the relocation site, thus, they get to pick the best relocation site
• Possibility that individual families could apply for a loan from SHFC; • If PAPs not associated with any homeowners' association here is no chance to avail the relocation program	• There is a chance but not through CMP as it is the relocation program chosen by DOTr for this specific project
• If the community mortgage program (CMP) under SHFC is covered by any law	• Yes. The CMP is under Section 31 of RA 7279; • CMP is in section 31
• Requested that the legal heirs of the beneficiary be allowed to continue payment of the relocation unit in case the awardee passes away	• Continuation of the mortgage will be offered first to the legal heirs. If the heirs declined the offer the unit will be returned to the government and the payments made will be forfeited •
Right-Of-Way Issues	
• Disclosed that a clearing operation along the in Brgy. Poblacion 1, Calamba City is on-going	• Asked if the PAPs were informed of the clearing operation; • Mr. Jojo Valenciano assured the PAPs that the clearing operation will be verified with the Engineering team at once
• Clarifications on the measurement of the ROW	• Explained that the 15 m on both sides from the centerline of the existing tracks was measured for the purpose of Feasibility Study (FS); • Added that the 30-m ROW will fit two (2) tracks as compared to the existing single track
Concern on Access	
• The 30-m ROW will affect the access of the residents	• Provision of alternatives to affected access roads and crossings are being considered in the design

Queries/Concerns/Suggestions/Comments	Responses to Queries
Timeline of the Project	
• Target date of project implementation to enable the owners to decide whether to make improvements to their structures; • Asked for confirmation if demolition of structures will be carried out by May 2019	• The project is still in the FS stage; • Target start of construction is May 2019; • Improvements on the structures are allowed, like additional protection for the rainy season; • The area should be cleared by May 2019; • Stressed that the timeline of the project is still tentative
Other Issues and Concerns and Suggestions	
• Disclosed that a certain a group called Mayor Rodrigo Roa Duterte (MRRD) headed by Mr. Bobby Diesta from the DILG Central Office distributed forms from the Finance Shelter Foundation (FSF) in Brgy. Parian; • FSF has an office in Brgy. Parian; • The PAPs from Brgy. Parian were forced to fill out the said application forms, but did not conform as the group did not inform the LGU of such activity; • Disclosed that FSF said that it has an available relocation site for the PAPs; • Clarified if FSF is related to the Social Housing Finance Corporation (SHFC)	• SHFC has not yet undertaken any coordination activities with the LGUs, so community mobilizers have not been sent to the ground; • Emphasized that SHFC has not distributed any application forms; • When the SHF representatives touched based with the community, they are easily identifiable as they are wearing official SHFC shirts with logo; • Validation of the tagging and census survey conducted by EcosysCorp, Inc. will be undertaken before SHFC initiates its activities on the ground

Source JICA Study Team

(3) Combined 1st and 2nd Stakeholder Consultation Meeting

Aside from the 1st and 2nd SCM presented above, additional series of combined 1st and 2nd SCM were conducted in areas with proposed station locations, depot and the NSRP-SC Connection to the North-South Commuter Railway (NSCR). The combined Meeting started with the disclosure of the proposed project details such as (i) the area and width traversed by the alignment (ii) location and preliminary design of stations and (iii) timeline of the project. The RAP activities including the (i) census tagging of potentially affected structures, (ii) Socio-Economic Survey of households and (iii) cut-off date for eligibility were soon discussed.

The legal framework of the RAP was discussed starting off with the (i) international standards of ADB and JICA and then followed by (ii) R.A. 10752 and R.A. 7279 of the Philippine legislation.

At the end of each meeting, the invited PAPs were encouraged to participate in the open forum to express their views/opinions. A summary of the main concerns/issues raised during the combined Meeting is provided in Table 9.2.54.

Table 9.2.53 Outline of the Combined SCM

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
				Male	Female	Total
Manila City	Brgy. 629 Covered Court (Sta. Mesa and Paco Stations)	2:00 P.M. 17 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative, SHFC Representative	39	46	85
	Brgy. 185 Covered	8:30 A.M.	PAPs, BLGU, DOTr	136	238	374

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
	Court (NSRP-SC Connection to NSCR)	23 May 2018	Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representatives			
	Brgy. 473, Algeciras cor. Florentino Sts. (España Station)	2:00 P.M. 23 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	87	184	271
	Celadon Residences Clubhouse, Brgy. 350	5:00 P.M. 21 July 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representatives, ADB Representative	46	16	62
Makati City	Facundo St. cor. Medina St. Brgy. Pio del Pilar (Buendia Station)	8:00 A.M. 25 June 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	34	28	62
	Magallanes Brgy. Hall (EDSA Station)	2:00 P.M. 22 June 2018	LGU, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	23	10	33
Taguig City	Villamin Compound, Brgy. Western Bicutan (Nichols Station)	2:00 P.M. 09 July 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	40	46	86
Parañaque City	Brgy, Hall, San Martin De Porres (FTI Station)	2:00 P.M. 02 July 2018	LGU, PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	17	9	26
Muntinlupa City	Alabang Barangay Hall (Alabang and Muntinlupa Sta.)	8:30 A.M. 22 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	28	29	57
	Sucat Barangay Hall (Sucat Station)	2:00 PM 22 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	32	56	88
San Pedro City	San Pedro Pavilion (San Pedro and Pacita Stations)	2:00 P.M. 16 May 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representatives, PNR Representatives	7	11	18
Biñan City	San Pedro Pavillion (Biñan Station)	2:00 P.M. 16 May 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representatives, PNR Representatives	22	88	110
Sta. Rosa City	San Pedro Pavillion (Santa Rosa Station)	2:00 P.M. 16 May 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representatives, PNR Representatives	26	70	96
Cabuyao City	LLC Auditorium, Central School (Cabuyao, Gulod	8:00 A.M. 16 May 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives,	4	26	30

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
	and Mamatid Stations)		EcosysCorp, Inc., SHFC Representatives, PNR Representatives			
Calamba City	LLC Auditorium, Central School (Calamba Station)	8:00 A.M. 16 May 2018	PAPs, LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representatives, PNR Representatives	11	13	24
	Brgy. Banlic Covered Court (Banlic Depot)	8:00 A.M. 25 May 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	54	229	283
	Brgy. Banlic Covered Court (Banlic Depot)	9:00 A.M. 13 June 2018	PAPs, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	25	35	60

Source: JICA Study Team

Table 9.2.54 Main Topics the combined SCM

Queries/Concerns/Suggestions/Comments	Responses to Queries
Issues and Concerns on RAP activities	
• Schedule for the census tagging and socio-economic survey (SES)	• The census tagging schedule will be coordinated with the barangay chairman; • The socio-economic survey will be conducted immediately after the census tagging
• Concern on the PAPs who were not present during census tagging and/or SES	• The PAPs may inform the barangay that they permit the census tagging to proceed, or they could give consent to their neighbors to allow tagging of their structure; • The PAPs could set a schedule of the SES with the enumerator in instances that they are not available during the scheduled interview
• Concern on cut-off date	• The cut-off date is only applicable to informal settler families; • Assigned date will be on the first day of the conduct of the census tagging; • All structures constructed after the cut-off date will not be included in the compensation; • Persons not residing in the direct impact area at the time of the census tagging and SES will not be included in the master list of the PAPs
• Treatment for multiple households residing in one structure	• Number of interviews will be based on the number of households in the structure; • A household is defined by a separate kitchen and budget for food for each family
• Schedule of the second interview	• There will only be one interview for NSRP-SC
• Schedule of the second tagging	• Explained that the second tag is an indication that the structure is certainly affected by the project; • Added that the sticker of the second tagging will not have a white background (like the first tag); • Second tagging will commence during the Detailed Engineering Design (DED); • PAPs will be notified ahead of time before the tagging
• Schedule of the next meeting	• The barangay heads will be notified at least a week ahead; • PAPs who indicated their contact details in the attendance sheet will be notified through SMS
On Project Coordination	
• If the project has been approved by NEDA	• DOTr confirmed that the project has been approved by NEDA and is included in the Philippine Development Plan (2017-2022)
• If the LGU is consulted about the project	• Information Education Communication (IEC) Meetings have been

Queries/Concerns/Suggestions/Comments	Responses to Queries
	arranged before going in the barangay level; • The concerned LGU is also aware of the SCMs being conducted on-ground, especially concerned departments such the planning office and the local housing office, as they are also invited to the meetings; • The LGU is also extending its assistance to the project through identification of possible relocation sites
On the Timetable of the Project	
• Possible length of remaining stay in the current location of ISFs	• Construction is scheduled to start on May 2019
• The remaining time for the property owners to prepare the necessary documents required may not be enough, particularly for properties with tax issues and ownership concerns	• The issues and concerns are noted; • The property owners will be given adequate time to prepare the necessary documents required to facilitate the payment
On Relocation	
• Possible length of remaining stay in the current location of ISFs	• Construction is scheduled to start on May 2019
• The housing partner of the Department of Transportation (DOTr) for NSRP-SC	• The housing partner of DOTr for the NSRP-SC is the Social Housing Finance Corporation (SHFC)
• Possibility of in-city relocation	• In-city relocation is priority. However, if there is no available land in the area, vertical relocation (medium-rise building) may be considered; • If horizontal relocation is preferred, available lands in the nearby areas could be considered
• If renters could avail the relocation program	• Renters could avail the relocation program if they qualify the criteria from RA 7279 Section 16. Their qualification will be evaluated by SHFC
• If the association will construct their own relocation (ISF)	• Not necessarily but they have the option. Details like this will be planned by the association with SHFC; • They will be consulted for the interior arrangements of the relocation unit
• If those residing in relocation sites who are affected by the project will be recognized as private owners, renters, or ISFs	• If the PAP has the title of the unit, they will be considered as private owners; • The issue will be referred to DOTr
• Asked for assurance that they will receive relocation	• Answered that the loan for the project will not be signed if the relocation for the affected persons will not be executed properly; • Demolition will not be permitted unless the relocation site is ready for occupancy; • JICA and ADB will be actively monitoring the relocation so the PAPs shouldn’t worry
• If they are not qualified for the relocation	• They could apply for the next bracket of housing assistance (via Pag-IBIG or SSS)
• Age restriction of Pag-IBIG	• There is a proposal to remove the Pag-IBIG age restriction—giving the option to the child/children of the owner to continue paying if ever the original awardee is unable to continue the payment
• Transfer of business and business equipment	• The government will provide assistance for the transfer, as well as provide a list of options
• Private property owners requesting for assistance in the relocation since ISF will receive assistance	• The list of available properties in the city or in the neighboring cities will be given to private owners to assist in relocating
On Engineering Design	
• Width of the alignment; • Centerline and exact boundaries of the PNR ROW	• For the purpose of the FS RAP, the main tracks will be 30 meters wide; • The 15 m-15 m (30 m) on both sides will be reckoned from the centerline of the existing tracks in the absence of an established ROW and centerline of the PNR; • The relocation survey is currently being conducted to determine the centerline and the boundaries of the PNR ROW
• If there is a possibility that the 30-m and the 60-m ROW for the main tracks and the stations, respectively be extended	• 30 meters will be the maximum ROW for the main tracks, as well as 60 meters will be the maximum for the stations

Queries/Concerns/Suggestions/Comments	Responses to Queries
due to unexpected design changes	
• Size of the station	• Standard stations will measure 60 m x 250 m
• If the current station will be used as the new station	• Most of the stations will be elevated; • The stations will be in the same areas as the current stations but not limited in the same location
• If there are future development plans given the enormity of the of the required ROW for the stations	• DOTr has disclosed that the stations are planned to be intermodal transportation terminals for easy transfer of commuters; • Other stations are also seen as connections to different government projects such as the North South Commuter Railway (NSCR) and the Metro Manila Subway Project (MMSP); • A larger station is also needed to accommodate the expected high volume of ridership
• Plans on the area beneath the guideway	• DOTr is planning to develop the area below (current PNR) to be a transportation line for freight
• Elevation of the guideway from the ground	• As the project is still in the feasibility stage, the height of guideway is not determined yet
• Length of the train	• Eight to ten cars are planned to operate per train with provision for additional cars in the future;
• Station utilities and features; • Requested to consider the safety access and mobility of the persons with disabilities (PWDs) especially those with sensory disability to the stations	• DOTr assured the stakeholders that all the considerations for the safe access and mobility of the PWDs are included in the design as it is guided by international standards; • Added that gender-segregated comfort rooms will also be provided
• Possibility of relocating the station/alignment to other areas (this concern is raised during the SCMs for all stations, as the private property owners are strongly opposing the location of the station in their area)	• Informed the stakeholders that the size of the station may still be reduced as the design is not finalized yet; • The proposed alignment maximizes the current PNR ROW. Going farther than the PNR ROW will result to a larger ROW acquisition; • There are possibilities in moving the stations but only by a few meters. Moving the proposed station locations will be based on the results of the feasibility study; • The depot in Brgy. Sucat is proposed to support the future long-haul train. Brgy. Sucat is the most optimal location according to previous studies
Issues and Concern on the Compensations and Entitlements	
• If it's possible to claim the compensation for the land property and structure even if nobody is currently residing in the property	• Yes, occupancy on the property will not affect the claiming of compensation; • As long as the property has a clean title, the owner of the property could claim the compensation
• Asked if when will the compensation amount for the property be disclosed Disclosure date of the	• A letter offer from the DOTr will be sent to the owners as the information is confidential; • Explained that the owners will be given thirty (30) days to indicate their response to the offer; • The letter offer will be sent during the DED stage
• Schedule of the release of initial payment	• For land property, the initial payment will be 50% of the negotiated amount Once the title is transferred under the name of the government or the Implementing Agency (IA), the 50% balance will be paid to the property owner; • The structure will be paid with 70% of the total estimated amount based on replacement cost; • The remaining 30% balance will be paid once the area is cleared and structure is completely demolished
• Entitlements of those who will not qualify on the relocation	• Entitlements will be discussed during the third stakeholder consultation meeting
• If the business owners will be compensated for income loss	• At present, there is no law that will provide for the compensation of income loss; • Since the project is internationally funded (JICA & ADB), additional compensations and entitlements not provided by the national law may be considered and accorded to the PAPs; • Entitlements and compensation packages will be discussed during the third stakeholder consultation meeting

Queries/Concerns/Suggestions/Comments	Responses to Queries
Issues and concerns regarding the homeowner's association (HOA) to be formed for community mortgage program (CMP)	
• If the PAPs will organize the HOA by themselves	• Community organizers from Social Housing Finance Corporation (SHFC) will go on-ground to assist the community in forming the homeowners' association
• If the PAPs can organize ahead	• Yes, but it will be better to wait for the community organizers of SHFC
• If organizing a HOA is compulsory	• Only organized communities or homeowners' associations will be allowed to apply for the CMP. No individuals or individual families will be accepted for a loan
• Maximum number of members	• SHFC has answered that current ceiling for membership per association is two hundred (200). However, there is a proposal to increase the ceiling to accommodate the large number of PAPs of the NSRP-SC
• If their current HOA could be recognized by SHFC	• Yes, but the community organizers of SHFC will still have to meet with them
Environmental Issues and Concerns	
• Raised concern on the flooding problem in the location of proposed EDSA Station in Brgy. Magallanes, Makati City	• Assured that the flooding concern in the area will be considered in the in the final design of the project
• Informed that MERALCO pays PHP10,000 every month to the property owner as rent for the location of the post	• DOTr responded that a meeting with Meralco has decided that Meralco will be the one to move the electric post
Extrajudicial Settlements	
• Owner of land is deceased	• The legal heirs will have to process the transfer of title through extrajudicial settlement; • This is required as the government will only transact and compensate the property owner
• If the transfer of title will be covered by the government	• The transfer of title to the government will be covered by DOTr. Transfer from deceased owner to the legal heirs will be covered by the PAPs
Land Property and Structure Issues	
• Stated strong opposition to the location of the Sucat Station in the old Sucat Thermal Power Plant that would result to the realignment of the rail tracks and entail extensive displacement of residential houses and private properties in Brgy. Sucat and Buli, Muntinlupa City; • Suggested that the Posadas Property be considered for the location of the station	• It is not publicized but the plan is to use the area for the South Long Haul (Bicol bound) interchange, not for the NSRP-SC; • Clarified that the original proposal was to put the depot in Laguna; • The feasibility study (FS) found out that it will be better to have a stop in Sucat since the next depot will be in Valenzuela City; • The project is still in the FS stage and the design is not yet final; • The suggestion is noted and will be related to DOTr for consideration
• Expressed strong opposition to the location of the proposed España Station in Brgys. 472 & 473, Manila City; • Suggested that the station be located in areas where less properties and structures will be affected	• The location of the proposed España Station in the area is not yet final as the project is still I the FS stage; • The final location of the station shall be determined during the DED
• The areas to be affected by the NSRP-SC alignment in Brgy. 186 is owned by the Manotoc's and is now subject to expropriation by the Manila City LGU; • Disclosed that property will be utilized for socialized housing project, in which the beneficiaries are the residents in the area	• The concern will be related to DOTr for further verification
• Disclosed that most of the residents in Bogy. 348 & 349 do not have legal rights to the land; • The property is previously part of owned by the PNR but the ownership was later transferred to the Manila City LGU. The Manila City LGU allowed	• The concerns are noted and will be related to DOTr; • DOTr will closely coordinate with the Manila City LGU to resolve the issues and concerns surrounding the ownership of the property in question

Queries/Concerns/Suggestions/Comments	Responses to Queries
occupancy of the residents	
• If owners would be allowed to develop the remaining part of the of the property after the acquisition	• If the owner chose not to sell the whole land property to the government, they have the freedom to develop the remaining portion of the property
• If the households of subdivided structures could avail the relocation program for the project	• They could avail the relocation as long as they were interviewed in the SES and they qualify the criteria for relocation; • Compensation for subdivided structures will be accorded to the owners
• The owner of the property is abroad (OFW)	• The owners abroad could issue a special power of attorney to the person who will be handling the acquisition
• The proof of ownership is the deed of sale only, not the title	• Advised to keep the deed of sale; • The title should be transferred under their name for them to receive the compensation, especially since the direct person DOTr will transact with is the one listed in the tax declaration from the City Assessor
• Only a small portion will be affected by the project	• The small portion could be acquired through easement of ROW agreement; • In the easement agreement, the owner will grant perpetual use of the strip of land as ROW to the IA and the owner will keep ownership of the land; • The strip of land acquired will be compensated based on BIR Zonal Valuation. The title will be annotated, defining the part of the property used as ROW; • All structures and improvements affected within the strip of land acquired will be compensated based on replacement cost • The owner has the option to keep the remaining land especially if it is still economically viable; • If more than eighty percent (80%) will be acquired, the owner has the option to sell the whole property
Issues concerning project affected persons	
• Consideration for the NHA-MRB unit owners in Brgy. 185, 162, & 161 who are paying monthly amortization	• If the land is part of the ownership, compensation will be accorded to the individual owners, by unit; • Fully paid unit owners will be compensated for the unit; • Advised the owners who have little amortizations left, to pay the remaining amortizations to claim ownership to the unit. Compensation would be based on replacement cost of the units, so the owners can recover the payment made; • For those who still have a huge sum to pay, the total amortization amount paid will be reimbursed and the rest will be accorded to the NHA, as the agency still possess ownership to the unit; • DOTr will be coordinating with NHA to discuss the arrangements and resolve the concerns; • The consultations will be continuous, so the stakeholders will be updated on the discussions between the DOTr and NHA
• Expressed concern on the possibility that their established residence in the NHA MRBs will again be subjected to displacement	• The concern is noted • Admitted the challenge posed by the housing buildings of NHA to the project; • Reiterated that the relocation survey is currently undertaken and the alignment and its ROW are not yet final
• If awardees whose structures will be affected by the project be considered private owners or ISFs	• The concern will be referred to JICA and DOTr

Source: JICA Study Team

(4) 3rd Stakeholder Consultation Meeting

The 3rd SCM was conducted from August 21-28, 2018. During it, DOTr presented some project updates, explained the Entitlement Matrix and discussed the Livelihood Restoration and Improvement Program

(LRIP), while SHFC presented the relocation process and options. Below are the outline and summary of issues and concerns gathered from the 3rd SCM.

Table 9.2.55 Outline of the 3rd SCM

LGUs	Venue	Date & Time	Participants	Number of Participants		
				Male	Female	Total
San Pedro City, Santa Rosa City, Biñan City, Cabuyao City Calamba City	Santa Rosa Auditorium	8:00 A.M. August 18, 2018	Legal PAPs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative, ADB Representative	42	72	114
Santa Rosa City	Santa Rosa Auditorium	13:00 P.M. August 18, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representative, PNR Representative, ADB Representative	87	269	356
Manila City	Dapitan Sports Complex	8:00 A.M. August 20, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	285	511	796
	Dapitan Sports Complex	13:00 P.M. August 20, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	137	303	440
Taguig City, Paranaque City, Muntinlupa City	Cayetano Sports Complex, Brgy. Bagumbayan, Taguig City	8:00 A.M. August 21, 2018	Legal PAPs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative, ADB Representative	50	68	118
Taguig City, Paranaque City	Cayetano Sports Complex, Brgy. Bagumbayan, Taguig City	13:00 P.M. August 21, 2018	ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	88	157	245
Manila City	Dapitan Sports Complex, Instruccion St, Sampaloc, Manila	8:00 A.M. August 22, 2018	ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	422	771	1193
	Dapitan Sports Complex, Instruccion St, Sampaloc, Manila	13:00 P.M. August 22, 2018	ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	169	308	477
	Dapitan Sports Complex, Instruccion St, Sampaloc, Manila	8:00 A.M. August 23, 2018	Legal PAPs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative, ADB Representative	157	271	428
	Carmona Sports Complex, Arpilleda, Makati City	13:00 P.M. August 23, 2018	Legal PAPs and ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	53	56	109
Calamba City	Don Jose Homes Project Covered Court,	8:00 A.M. August 24, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives,	197	473	670

LGUs	Venue	Date & Time	Participants	Number of Participants		
				Male	Female	Total
	Brgy. Banlic, Calamba City		EcosysCorp, Inc.,			
	Don Jose Homes Project Covered Court, Brgy. Banlic, Calamba City	13:00 P.M. August 24, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.,	186	382	568
Biñan City	Alonte Sports Arena, Zapote Street, Biñan City	8:00 A.M. August 27, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representative, PNR Representative,	266	645	911
Muntinlupa City	Brgy. Sucat Covered Court, Muntinlupa	13:00 P.M. August 27, 2018	Legal PAPs and ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representative, PNR Representative,	350	567	917
San Pedro City, Muntinlupa City	Pacita Astrodome, San Pedro City	8:00 A.M. August 28, 2018	ISFs DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., SHFC Representative, PNR Representative,	91	225	316
Cabuyao City	Cabuyao City Hall AVR	14:00 P.M. August 28, 2018	ISFs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc., PNR Representative,	50	70	120

Source: JICA Study Team

Table 9.2.56 Main Topics at the 3rd SCM

Queries/Concerns/Suggestions/Comments	Responses to Queries
Inquiries on the project details	
• The timetable of the project	• Relocation will start processing on April 2019. The construction will be on May 2020; • Advised to process the documents needed to fast track the payment on the compensation
• If the 30m will extend	• There will be no additional measurements beyond 30 meters except for the stations which are 60 meters
Concerns on the RAP Activities	
• Structure was tagged but they were not interviewed for the socio-economic survey (SES)	• The household head might have been unavailable when the census team conducted the survey in their area; • The master list is not final and not all in the master list will be given a relocation unit
• Requested free transportation for the next stakeholder consultation meetings	• Transportation will be provided for barangays far from the venue
• The possibility of being interviewed after the cut-off date since they just moved in	• There will be no entitlements since they moved in after the cut-off date
Questions regarding the relocation and the socialized housing program	
• If two households under one structure were interviewed, will both of them get a relocation program	• Availing the socialized housing depends if the household will qualify the criteria of Socialized Housing and Finance Corporation (SHFC)
• If the relocation will be given for free	• The funding organizations would like to give a sense of value to the housing awards;

Queries/Concerns/Suggestions/Comments	Responses to Queries
	• The beneficiaries will still have to pay the monthly;
• If the home owner's association is mandatory	• SHFC's mobilizers will go on ground to help the community be organized. SHFC will only grant the loan to organized communities.
• Maximum loanable amount	• Maximum loanable amount is ₱450,000.
• How to be a member of Pag-IBIG	• They will have to pay the two years' worth of membership to become a new member
• Asked about the monthly amortization of the relocation	• Still in discussion with the concerned agencies
• How many square meters will the relocation be	• The size of their relocation depends on the decision and the plan of the HOA
• If they could still be beneficiaries of the socialized housing if their structure will be paid for compensation	• Yes, but they will have structure they own is more than the loanable amount of SHFC (₱450,000), they could be assisted to apply a loan to Pag-IBIG
• Available in-city relocations	• Most feasible in-city relocation are in the form of medium rise buildings
• If those who occupied a structure illegally could qualify for the socialized housing	• They will also have their own entitlements. If they are interviewed, they will be included in the master list to be validated by SHFC
• Requirements and deadline of application to SHFC	• The beneficiary should be a Filipino Citizen, Informal Settler & belonging to low-income bracket, 18 to below 60 years of age, has not availed of any government housing program and not a "professional squatter" • Emphasized that awardees of previous government housing projects cannot avail of the project's housing program anymore. No double availment • The CMP will not entertain individual applications; • They could file for the claiming the compensation once they receive the letter offer
• If those who availed through Pag-IBIG before can avail again	• As long as they are in good standing;
Concerns on the possible monetary compensations	
• Compensation for crops and livestock	• All crops with commercial value will be compensated. The livestock will be relocated with the owner
• Asked if there will be a financial assistance for those who will self-relocate	• The expenses during self-relocation will be shouldered by the government; • Those who will self-relocate are required to have secured shelter
• Soft-loan	• They will be given the list of those who are offering soft loans—from the LGU and from small corporations, etc.
• If it's alright to use the compensation for rent only and not avail a new shelter since she's old already	• As long as the shelter is secured before moving in

Source: JICA Study Team

Table 9.2.57 Summary of Issues and Concern of Legal PAPs during the 3rd SCM

Queries/Concerns/Suggestions/Comments	Responses to Queries
On project specifics and project updates	
• Start of construction	• Construction starts on the 2nd quarter of 2020.
• Start of processing the relocation	• Relocation starts one year ahead of the construction (2nd quarter of 2019)
• If the 30m alignment is final	• The 30m alignment is the proposed study area for the project. The final measurement of the alignment will be finalized after conducting the parcellary survey
Concerns regarding RAP activities	
• The structure wasn't tagged	• Their structure might not be tagged because 1) they were unavailable during the tagging, 2) they refused to the tagging of their structure or 3) they are not included in the

Queries/Concerns/Suggestions/Comments	Responses to Queries
	potentially affected structures; • A control number was reserved for them;
• Households who were not interviewed	• If they were not interviewed because they were not available when the enumerators went on ground, the household head could go to the barangay and get a certificate of residency; • When the second tagging comes and their structure will surely be affected by the project, they will be interviewed so that they can be included in the SES master list and the database of the project
Monetary Compensation	
• Price range of market value	• Market value will differ from property to property as it will be appraised according to its development and characteristics; • The appraisal will be done by licensed independent property appraisers (IPA)
• The compensation for the structure and the land might not be enough to buy a replacement property	• The IPAs will appraise the affected structures during the Detailed Engineering Design considering that the owner needs to buy a replacement for their property
• How to avail the rental subsidy	• The rental subsidy will only be applicable to those who will
Entitlements of businesses	
• Premature effect of the project disclosure to their businesses (e.g. renters leaving due to uncertainty brought about by the project)	• Owners could convince renters attempting to leave that they have a separate entitlement from the owner; • The income loss brought about the project disclosure will not be covered or replaced by the project
• Their structure is their only source of income	• Income loss will be compensated for a maximum of six months during transition
• Possible business and job opportunities	• The project affected persons have the right to first offer—if there are business spaces and opportunities or job openings within the project, its alignment and its stations, the PAPs will be enquired first
• Business permit is denied due to the project	• Since the project measurements are not yet final, some LGUs have taken the liberty to pause any developments in the area near the PNR
Entitlements of residential private property owners	
• Possibility of replacing their property with another property instead of monetary compensation	• DOTr will assist the owners and present them the available properties within or near their city
• Land owner but not interviewed for the Socio-Economic Survey	• It is alright if the owner was not interviewed; • The owner's details will be taken from the LGU since they are the registered owner
• Why there is a Pag-IBIG option for legal owners	• The national law will only compensate the property to the owner. But since the foreign funders have social safeguards, the private property owners will still be being assisted if they will avail through Pag-IBIG; • They could avail through Pag-IBIG if the PAP chose assisted relocation rather than self-relocation; • Legal owners could choose to apply for Pag-IBIG if for example, they want a bigger property and that the compensation for their property is not enough to pay for the new property
• Who reconstructs the part of their structure which will be affected partially	• Since the owner will be compensated for the affected area, they owner will shoulder the reconstruction
• On implementation of the entitlement matrix	
• Doubts the capacity of the government to deliver the promises in the entitlement matrix	• Assured the PAPs that the foreign funding agencies of the project will actively monitor the implementation of the project; • The proper implementation of the relocation of the PAPs is part of the conditions for the loan agreement that will be

Queries/Concerns/Suggestions/Comments	Responses to Queries
	signed on December 2018
Concerns regarding the property titles	
• Subdivision of the mother title of community mortgage programs	• Reminded the PAPs that the title is needed to be compensated for the land; • The subdivision of the mother title of CMPs will only be done after all members have paid their loaned amount; • The developer should process the transfer of titles; • For the case concerning the Home Guarantee Corporation and San Jose Builders in Manila: The concerns agencies and organizations will discuss the issue on the ownership of units in the medium-rise buildings
• Have purchased land/property and the title of the property hasn't been transferred yet	• Advised that the new owner should process the transfer of title early on since the compensation will only be paid to the person whose name is indicated in the title; • Reminded the PAPs to keep all transactions and agreements between them and the seller
Questions on the housing program	
• If structure owners could be included in the socialized housing program	• They can be included if they will qualify in the criteria of the project's housing partner—Socialized Housing and Finance Corporation; • SHFC will be validating the master list compiled for the North-South Railway Project—South Line (Commuter)
• Suggestions on information dissemination	
• Notice for the upcoming meetings did not reach them	• Aside from the letters sent to the barangay chairmen, text message reminders were also sent to the PAPs; • Those who have not received the text reminder could leave their mobile numbers to the attendance sheet. This is so the team could inform them of the upcoming meetings
• Requests on providing pamphlets, information materials, or handouts that the PAPs can take home so that they could review the entitlement matrix	• The suggestion is noted; • The entitlement matrix will be uploaded together with the Resettlement Action Plan (RAP) to the websites of JICA and ADB

Source: JICA Study Team

(5) Focus Group Discussion with Affected Vulnerable Sector

This Focus Group Discussion (FGD) was conducted as part of the consultation with the vulnerable sectors affected by the NSRP-SC. The vulnerable sectors in this FGDs will only be limited to the poor, the underprivileged and the homeless, including socialized housing beneficiaries. Separate FGDs have been designed and conducted for other vulnerable groups such as women, elderly and children under the Gender Impact Assessment component of the Resettlement Action Plan (RAP).

Table 9.2.58 indicates the dates, venues and breakdown of participants for each City/Municipality.

Table 9.2.58 Date, Venue and Participants, by City

LGU	Date	Venue	Male	Female	Total
City of Calamba	04/12/2018	Barangay Pansol Quadrangle	4	5	9
City of Cabuyao	04/24/2018	Cabuyao Central School	1	9	10
City of Biñan	04/10/2018	2 Conference Rooms: Office of the Mayor, City Hall	6	15	21
City of Santa Rosa		Function Room, 4th Floor, Building A, Santa Rosa City Hall	11	52	63
City of San Pedro	04/11/2018	1) Ceremonial Hall, 2) Mountain View Conference Room	10	22	32
City of Muntinlupa		2nd Floor, Resiliency Building, Hall of Justice Compound, Brg. Tunasan	11	13	24

City of Parañaque City of Taguig	04/13/2018	Conference Room 3-4, Legislative Building, Parañaque City Hall	7	10	17
City of Manila	05/15/2018	SACES Covered Court, Brgy. 803, Manila	2	11	13

Source: JICA Study Team

The results of the FGDs are summarized in Table 9.2.59 to identify common themes across the project areas.

Table 9.2.59 Summary of FGD Results for the Vulnerable

Guide Questions	Responses
1. What are your apprehensions /concerns regarding the potential impact of resettlement on your livelihoods?	• Re-establishing and ensuring that current business will continue to provide income when relocated • Finding space to re-establish business • Possibility of losing or being far from customers and/ product source/market for products • Possibility of losing or being away from work/business • Decrease in income from business • More time and cost for travel if relocated far from work/business or away from city center • No livelihood program in resettlement area • What will happen to livelihood? (i.e. trolley, construction work, vendors, farmers) • Might become difficult to earn a living • Possibility of not having a land to plant (backyard gardening) • Losing social network (e.g. drivers association)
2. What support programs do you think are necessary to help you cope up with the possible impacts on your livelihoods?	• Provision of loan/capital to establish or re-establish business • Assistance in relocating business • Provision of livelihood programs that would enable them to earn for their daily subsistence • Allocation of store space to re-establish business • Opportunity to start business or livelihood that would provide a stable source of income • Skills training • Provision of land to plant vegetables for selling • Supply of products for selling • Opportunity to land a job (e.g. permanent government post, street sweeper, factory, carpenter, domestic helper, janitor, etc.) • Assistance in forming/joining an association (Tricycle Operators & Drivers Association) • Financial support/transition allowance while looking for new work (to spend for job application requirements) • Opportunity to own a tricycle as income source
3. If livelihood restoration is not possible, what alternative livelihood programs can you suggest?	• Provision of jobs (e.g. mechanic, health worker) • Cottage industry (e.g. broom-making for export, soap making, embroidery, sewing) • Food processing (e.g. *Tocino, longanisa*, hotdog) • Putting up business (e.g. repair shop, loading station, frozen foods, native delicacies, motor parts, meat products, viand, livestock and poultry raising, food cart, fish balls, clothes, mini grocery, junkshop, buy and sell) • Capital for business
4. What other programs can you suggest to help improve existing livelihoods and consequently help improve household income?	• Skills training for construction workers, furniture makers, carpenters, janitors, etc. • Establishing a cooperative that would provide training on how to run a business (e.g. online selling, food processing, etc.) • Financial assistance/loan from government for additional business capital • Provision of materials/equipment to earn a living (e.g. manicure-pedicure set, sewing, tricycle or side car) • Provision/opportunity to land a job

Guide Questions	Responses
	• Market linking/access to product source
5. How do you think the project can help you cope better with the livelihood impacts?	
a. During Construction?	• Source out construction materials from affected people (e.g. hollow blocks, hardware materials, etc.) • Priority in hiring skilled workers from affected communities (e.g. steel man, mason, carpenters, welders, labor, painter, etc.) to work in the construction site • Opportunity and financial assistance in putting up food cart/eatery/sari-sari store near construction site
b. During Operation?	• Allocation of space for selling in the stations • Free skills training to land a job during operation Provision of permanent jobs (e.g. guard, janitor, assisting passengers) • Allow existing tricycle operators and drivers association to operate in the area
6. What is your relocation preference?	• Accessible location (near or within the city) with good roads, proper drainage and free from flood and landslide • Accessible by public transportation • Having a sturdy, proper and permanent housing with complete facilities and utilities (light and water) • Opportunity to own a sturdy house (free or with affordable monthly housing amortization) • Availability of basic social services (market, school, clinic, church, hospital, community center) • Availability of livelihood and work opportunities and space to put up store/business • Availability of land for backyard gardening • Peaceful, orderly, united and drug-free community with a homeowner's association to look after community welfare • Equal and fair provision of benefits to affected persons/households • Immediate relocation to be administered by PNR • No NHA involvement
7. What are the factors influencing your relocation preference?	• To be able to live in a safe, peaceful and orderly community that is free from flood, landslide, drugs and crime • Basic necessities (light and water), as well as the availability of social services are essential for daily living • To ensure that the affected persons will truly benefit from the relocation • Housing units provided by other housing programs (e.g. NHA) are substandard and easily deteriorate
8. Other suggested resettlement support/assistance	• Advance notice prior to relocation • Provision of government truck for hauling • Financial assistance for relocation, to be given directly to the affected households, if possible to pay for transportation for hauling household stuff, food allowance for daily subsistence while re-establishing source of income • Well-organized relocation process

Source: JICA Study Team

Source: JICA Study Team

Photo 9.2.3 FGD in Binan (left) and in Paranaque (right)

(6) Focus Group Discussion with Affected Business Sector

Besides the FGD for the affected vulnerable sector, FGD for the Affected Business Sector was held. women and the vulnerable was also conducted as part of the consultation with the affected households in all Cities/Municipalities of the NSRP-SC. The notification to the stakeholders was conducted through the sub-consultants who noticed the Barangays, who in turn noticed the concerned stakeholders through phone calls or person to person information. During hearing and collect comments from PAPs, gender balance and gender difference were considered. To encourage and have at least 40% women participation, child-minding services and breastfeeding area were arranged.

Results from the FGDs will be consolidated to substantiate the data gathered from the Socio-Economic Survey and will be analyzed as inputs in the preparation of the LRIP which will be included in the RAP.

Table 9.2.60 indicates the dates, venues and breakdown of participants for each LGU.

Table 9.2.60 Dates and Locations of FGDs

LGU	Date	Venue	Male	Female	Total
City of Calamba	04/24/2018	DILG Multipurpose Hall, New City Hall	3	3	6
City of Cabuyao		Cabuyao Central School	5	9	14
City of Biñan	04/23/2018	2 Conference Rooms: Office of the Mayor, City Hall	2	8	10
City of Santa Rosa		Rooftop, Labas Barangay Hall	3	8	11
City of San Pedro	04/26/2018	Mountview Hall, San Pedro City Hall	0	3	3
City of Muntinlupa		Tunasan Bulilit Center	5	4	9
City of Parañaque	04/25/2018	Conference Hall, 7th Flr, SM Aura	0	1	1
City of Taguig					
City of Manila	05/15/2018	SACES Covered Court, Brgy. 803, Manila	1	5	6

Source: JICA Study Team

The results of FGDs is summarized in Table 9.2.61.

Table 9.2.61 Summary of FGD Results for the Business Sector

Guide Questions	Responses
1. On the business side - What are your apprehensions/concerns regarding acquisition of your property?	• Might lose business/income source • How to replace/re-establish business • No other source of income

Guide Questions	Responses
	• What portion of the property will be affected? • Disturbance to our newly built business • Financial burden to rebuild portion of our business structure • Loss of regular clients/customers • Where to relocate and what is the situation in the new area • Too expensive to rent space • How it would affect the business and their lives
2. What are your expectations regarding livelihood restoration and improvement?	• Capital to look for/buy/rent space for business and rebuild workspace • Cash compensation for affected land and structure • Transitional allowance while re-establishing business • Assistance in establishing alternate business • Skills training (e.g. how to operate business, learning new skills/new business, product diversification) • Provision of alternative space to re-establish our shop preferably in populated areas. If we are qualified to be relocated this would be better.
3. What possible project benefit sharing schemes can you suggest? During Construction?	• Opportunity to put up canteen/eatery in the construction site • Opportunity to apply for jobs/become sub-contractor/bid for projects
During Operation?	• Opportunity to rent commercial space at train station • Opportunity to enter into business contracts with the project implementer to supply materials (i.e. hardware)
4. What is your expected timeline for this? During Construction?	• When construction commences
During Operation?	• When operations start
5. What do you consider as "deal breakers" for the schemes presented?	• If the project doesn't proceed • Government's inability to pay on time (difficult to conduct business with government) • No consultations with the affected communities in whatever project-related decisions the government makes • Corruption- cash compensation/ financial support doesn't reach affected business owners • Too many affected people and businesses for the government to support. Just compensate us for the loss of business structure along with financial support so we can re- establish on our own.

Source: JICA Study Team

9.3 Gender Impact Assessment

A Gender Impact Assessment has been conducted as a component of the Resettlement Action Plan (RAP) in order to anticipate or identify the livelihood of the project effecting negative consequences for either women or men, which bear on the degree of equality between them.

9.3.1 Legal Framework

The Legal Framework for Gender Consideration is summarized in Table 9.3.1.

Table 9.3.1 Regal Framework for Gender Considerations

Law and Regulations	Contents
RA 9710, Magna Carta of Women of 2009	Addresses the gender gaps favoring men, thus paving the way to gender equality and women empowerment. The law recognizes the economic, political and sociocultural realities affecting women's current condition. The equality of men and women entails the abolition of the unequal structures and practices that perpetuate discrimination and inequality.
Harmonized Gender and Development Guidelines	Provides Philippine government agencies (including LGUs), ODA donors

Law and Regulations	Contents
for Project Development, Implementation, Monitoring and Evaluation (2007)	and development practitioners with a common set of analytical concepts and tools for integrating gender concerns into development programs and projects. The uniform guidelines are supposed to help users in evaluating projects proposed for funding, designing projects and implementing them – including managing, monitoring and evaluating performance.
DOTr Department Order No. 2012-05	Requires that "Specific analysis/evaluation and recommendations on gender-related issued shall be incorporated in the locally- and foreign funded transport development studies (master plan studies and feasibility studies), to include service level standards in service-oriented industry."

Source: JICA Study Team

9.3.2 Focus Group Discussion

The FGDs were conducted from April 10, 2018 for each of the host LGUs. For each FGD, fifteen participants were randomly selected from the list of female respondents and female household heads.

9.3.2.1 Issues on access for potential female users in terms of: travel patterns, modes of transportation and access to resources for travel

In order to determine the participants' travel patterns, modes of transportation and resources for transportation fare, they were asked the following questions:

a. What regular trips do you take and for what purpose?

b. What is your regular mode of transportation?

c. What is your reason/consideration in choosing this mode?

Majority of the participants are full time housewives with some having homebased livelihood like sari-sari store or carinderia. The very few participants are having regular work outside of the house.

As for the question (a), a regular trip and its purpose, major answers are as follows: (i) Market for daily food consumption, (ii) Market weekly for goods and merchandise for their sari-sari store or carinderia, (ii) Bring and fetch their children to and from school, (iv) Pay the bills, (v) Visit the health center for the vaccination of their children and for free contraceptives, and, (vi) Go to church. All are response form the housewives, which reveals the major role they play are caring for the family and managing the household. The respondents who have regular work take trips to the mall for recreation and eating out during Sundays after church.

As for the question (b) common modes of transportation are jeepney and tricycle.

However, related to the question (c) majority of the respondents choose to walk whenever possible to save on transportation fare.

9.3.2.2 Perceived Threats and Potential Benefits of the Project

The second set of questions were to collect the participants' perception on the Project in terms of perceived threats and potential benefits. The questions are:

a. As a woman, what are your apprehensions and concerns about the project?
b. As a woman, what other negative effects do you feel will result from this project?
c. What potential benefits do you think will result from the project for you, your family and the community?

Answers to the question (a) and (b)s are shared as follows: losing their homes, losing their livelihood, being moved away from work, being moved away from their children’s school and the uncertainty of the kind of life that they will have in the relocation site.

Responses on potential benefits of the Project, the question (c), were few. The participants emphasized that although the railway project will bring development to their city/municipality, it will not benefit them directly because their regular trips do not require the services of a train.

9.3.2.3 Livelihood Opportunities

In order to help the participants identifying livelihood opportunities that the project will open for them; the following questions were asked:

a. What type of job or work do you think you can perform during construction and operation?
b. What other livelihood opportunities do you think will stem from the project?
c. In the light of a possible relocation and loss of livelihood, what types of assistance can help you restore and improve your livelihood?

The participants gave very few answers to the questions above. Most of them held the common conception that jobs especially during construction are mostly for men. The jobs that they identified were related to the work that they currently do as housewives: cooking and selling food, food vending and jobs related to cleaning (utility worker, janitress).

9.3.3 Recommendations

Based on the Gender Analysis of the NSRP-SC, a Gender Action Plan (GAP) was developed to recommend and propose measures to address gender-specific needs of potential female users of the NSRP-SC integrating gender considerations in all the project phases. This GAP was shared within the Study Team for considerations, and gender considerations are applied in the design of stations and train. Even in the preparation of this RAP, child-friendly corners were provided during the SCMs to ensure women’s the participation in the planning stage. This GAP will also be applied to the Livelihood Restoration and Improvement Program (LRIP), to ensure that women are given opportunities to improve their economic status.

Table 9.3.2 Gender Action Plan for NSRP-SC

Components and Outputs	Proposed Gender Mainstreaming Activities	Primary Responsibility
Output 1. Integrate gender-sensitive physical design features		
1.1 Integrate railway safety and accessibility-related physical design features that	Priority seating, handrails and waiting spaces for women, elderly and people with disability in all trains and train stations Ensure that handlebars are suited to average height of Filipino	DOTr Project Team, JICA Design Team, Local Consultant

Components and Outputs	Proposed Gender Mainstreaming Activities	Primary Responsibility
effectively protect and address specific needs of women	women Ensure that all road safety and IEC materials developed are gender-sensitive and do not promote gender stereotypes (e.g. use appropriate gender sensitive language)	
1.2 Reduce gender inequalities and social risks at Railway Stations	Installation of sufficient lighting and CCTVs especially in dark areas, around basic facilities in the stations e.g. walkways, stairs and platforms Provide separate male/female toilets and larger capacity female toilets at railway stations and on trains Increased visibility of security personnel to prevent the occurrence gender-related violence (e.g. sexual harassment) Set up a Complaints Desk for violations to personal safety Train public transport staff and local railway security personnel on proper response, handling and management of sexual harassment cases	DOTr Project Team, JICA Design Team, Local Consultant
Output 2. Increase women's participation in all Project Stages: Planning, Design, Construction, Operation and Maintenance		
2.1 Ensure participation of Women in project-related consultations	Ensure participation of women in all public consultations and consultative meetings and conduct these in vernacular languages Provide for a Child-friendly Corner (child-minding/babysitting services, breastfeeding area) during public consultations and meetings to encourage women to attend and participate Encourage women participation in Grievance Redress Mechanisms (GRM) Committee (at least 1 woman in addition to all members) Encourage female representation in all committees established for the project	DOTr Project Team, JICA Design Team, Local Consultant
Output 3. Improve economic opportunities for women		
3.1 Ensure that construction activities abide by labor standards, such as equal opportunities and equal wages of men and women for work of equal value, prohibition of child labor, etc.	Bidding documents and contracts contain provisions on core labor standards Incidents of non-compliance reported Where possible, include provisions in bidding documents to encourage women's participation in labor-based work during the construction, including female hiring to comprise 20% of the total workforce in skilled and unskilled position Ensure equal pay for equal work between male and female workers and payment for women should be given directly to them	DOTr Project Team, JICA Design Team, Contractors
3.2 Promote women's livelihood and entrepreneurship in railway stations	Allocation of reserved shop spaces for women's businesses inside the railway stations	DOTr Project Team, JICA Design Team, Local Consultant
3.3 Ensure that resettlement activities will deal with both men and women including equal compensation for both	If land is acquired and/or livelihood is affected, ensure that affected females are compensated at the same rate of payment as affected males, and provided with adequate arrangements to restore/maintain livelihoods (replacement of land, financing for micro business opportunities, skills training for income generation	DOTr Project Team, JICA Design Team, Local Consultant

Components and Outputs	**Proposed Gender Mainstreaming Activities**	**Primary Responsibility**
	projects, cash transfers, etc.)	
3.4 Reduce gender inequalities and social risks	Provide separate sanitary facilities and changing rooms and lockers for men and women Organize bi-annual training for railway workers and community members on gender issues and HIV/AIDS awareness Provide Gender-sensitivity trainings for all construction workers and affected community members. 100% of women employed in the NSRP-SC trained in train safety	DOTr Project Team, JICA Design Team, Local Consultant
Output 4. Institutional Strengthening and Capacity Building for Better Project Management		
4.1 Enhanced gender-responsiveness of transport authorities and project management	Recruitment of at least 20% women staff for its project management unit Recruitment of a Gender Specialist to assess, consult, train and help manage the implementation of GAP Inclusion of indicators that measures the implementation of the GAP in the NSRP-SC project monitoring framework Collection, analysis and maintenance of sex-disaggregated data in the baseline, progress and monitoring and evaluation reports	DOTr Project Management Unit
4.2 Capacity building for gender mainstreaming	Develop a gender strategy to recruit female staff in various positions and additional capacity building and training for female staff Conduct gender-sensitivity trainings and HIV/AIDS awareness for NSRP-SC project management staff	DOTr Project Management Unit
Implementation Arrangements: The GAP implementation shall be the primary responsibility of the Gender Specialist under the DOTr Project Management Unit. Likewise, GAP implementation progress reports are to be prepared and submitted bi-annually by the PMU Gender Specialist.		

Source: JICA Study Team