Environmental Impact Statement
for the
PNR South Commuter (North South Railway Project (NSRP) –South Line (Commuter))

VOLUME I: MAIN REPORT

(Draft Final Report)

May 2018

Department of Transportation (DOTr)

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
AAQ	Ambient Air Quality
AD	Ancestral Domain
ADB	Asian Development Bank
A&D	Alienable and Disposable
AFP	Armed Forces of the Philippines
AIDS	Acquired Immunodeficiency Syndrome
APG	Angiosperm Phylogeny Group
APS	Auxiliary Power Supply
APSI	Air Pollution Source Installation
AR5	IPPC's Fifth Assessment Report
As	Arsenic
ATP	Automatic Train Protection
AWARE	Airport Weather Advanced Readiness Toolkit
BAFs	Bureau of Agriculture and Fisheries Standards
BCDA	Bases Conversion Development Authority
BD	Basic Design
BFP-SRU	Bureau of Fire Protection – Special Rescue Unit
BMB	Biodiversity Management Bureau
BOD	Biochemical Oxygen Demand
BRGY	Barangay
BS	British Standard
BSWM	Bureau of Soils and Water Management
BT	Battery
Ca	Calcium
CADC	Certificate of Ancestral Domain Claim
CADT	Certificate of Ancestral Domain Title
CALC	Certificate of Land Claims
CALT	Certificate of Ancestral Land Title
CARI	Contractor's All Risk Insurance
CARP	Comprehensive Agrarian Reform Program
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
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
Cn	Cyanide
CNC	Certificate of Non-Coverage

CNO	Certificate of No Overlap
CO	Carbon Monoxide
CP	Compressor
CPDO	City Planning and Development Office
CPL	Central Plain of Luzon
Cr	Chromium
Cr^{+6}	Chromium Hexavalent
CR	Critically Endangered
CS	Conservation Status
CSEZ	Clark Special Economic Zone
CTC	Centralized Train Control
CWD	Civil Works Division
DA	Department of Agriculture
DAO	DENR Administrative Order
DAP	Development Academy of the Philippines
DAR	Department of Agrarian Reform
dB	Decibel
dBA	A-weighted decibels
DC	Direct Current
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
DIA	Direct Impact Area
DILG	Department of Interior and Local Government
DMU	Diesel Multiple Unit
DO	Dissolved Oxygen
DOH	Department of Health
DOST	Department of Science and Technology
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
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
ENRO	Environment and Natural Resources Officer
EO	Executive Order
EPRMP	Environmental Performance Report and Management Plan
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Engineering Support Division
ESRD	Environment, Social and ROW Division
EQPL	Environmental Quality Performance Level
FBI	Field Based Investigation
FMEA	Failure Modes and Effects Analysis
FMB	Forest Management Bureau
FPIC	Free, Prior and Informed Consent
FV	Field Validation
GAF	Grievance Action Form
GCR	Greater Capital Region
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPS	Global Positioning System
GRDA	General Residential Development Area
GRM	Grievance Redress Mechanism
GTI	Geosphere Technologies Inc.
GW	Ground Water
HCO_3	Bicarbonate
HIV	Human Immunodeficiency Virus
HG	Total Mercury
HSEC	Health, Safety and Environment Committee
Hz	Hertz
IBA	Important Bird Area
IC	Industrial, Commercial
ICC	Indigenous Cultural Communities
ICNIRP	International Commission on Non-Ionizing Radiation Protection
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
IP	Indigenous Peoples
IPC	Indigenous Peoples Communities
IPCC	Intergovernmental Panel on Climate Change
IPRA	Indigenous Peoples Rights Act
IRR	Implementing Rules and Regulations
IRRI	International Rice Research Institute
ISF	Informal Settler Families
IUCN	International Union for Conservation of Nature
IV	Importance Value
JICA	Japan International Cooperation Agency
K	Potassium
KBA	Key Biodiversity Area
KW/H	Kilowatt per hour
LAeq	Equivalent continuous sound pressure level

LC	Least Concern
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LGU	Local Government Unit
LIAC	Local Inter-Agency Committee
LLDA	Laguna Lake Development Authority
LPA	Low Pressure Area
LRT	Light Rail Transit
LRTA	Light Rail Transit Authority
MBAS	Methylene Blue Active Substances
MCLUPZO	Manila City Comprehensive Land Use Plan and Zoning Ordinance
MCRP	Malolos Clark Railway Project
Mg	Magnesium
MGB	Mines and Geosciences Bureau
MH	Merchantable Height
MMDA	Metro Manila Development Authority
MMFR	Mount Makiling Forest Reserve
MMSP	Metro Manila Subway Project
MMT	Multi-partite Monitoring Team
MMUTIS	Metro Manila Urban Transportation Integrated Study
MNTC	Manila North Tollways Corporation
MOA	Memorandum of Agreement
MPN	Most Probable Number
MRF	Materials Recovery Facility
MRT	Metro Rail Transit
MSWMB	Municipal Solid Waste Management Board
MT	Metric Ton
Na	Sodium
NAAQGV	National Ambient Air Quality Guideline Values
NAMRIA	National Mapping and Resource Information Authority
NBC	National Building Code
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
NFSCC	National Framework Strategy on Climate Change
NGO	Non-Government Organization
NHA	National Housing Authority
NHCP	National Historical Commission of the Philippines
NIPAS	National Integrated Protected Areas System
NLEX	North Luzon Expressway
NLRC	North Luzon Railways Corporation
NM	National Museum
NMTT	Navotas-Malabon-Tenejeros-Tullahan River
NO_2	Nitrogen Dioxide
NO_3-N	Nitrate
NPCC	National Pollution Control Commission
NSCR	North South Commuter Railway Project
NSRP	North South Railway Project – South Line (Commuter)
NTP	Notice to Proceed
O_3	Ozone

OCC	Operation Control Center
OCD	Office of Civil Defense
ODA	Overseas Development Assistance
O&G	Oil and Grease
OSH	Occupational Safety and Health
OTS	Other Threatened Species
OWS	Other Wildlife Species
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
PC	Pre-cast
PCSD	Project Control Support Division
PD	Presidential Decree
PDR	Project Description Report
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
PH	Public Hearing
pH	Potential of Hydrogen
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP	Philippine Peso
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
PO_4-P	Phosphate
PO	People Organizations
POP	Persistent Organic Pollutant
PPCC	Philippine Plant Conservation Committee
PPE	Personal Protective Equipment
PRI	Philippine Railway Institute
PSCCA	Philippine Strategy in Climate Change Adaption
PT	Pantograph
PTAC	Pilotage Trading and Construction
PUD	Planned Unit Development
PWU	Philippines Women's University
Qh	Recent deposits
QVP	Quaternary Volcanic Pyroclastic
RA	Republic Act
RAP	Resettlement Action Plan
REG	Region
RF	Rainfall

RHU	Rural Health Unit
RIC	RAP Implementation Committee
RIE	Residential, Institutional, Educational
ROW	Right-of-Way
RPM	Revised Procedural Manual
RS	Residency Status
RSD	Rolling Stock Division
SAFDZ	Strategic Agriculture and Fisheries Development Zone
SB	Sangguniang Bayan
SCPW	Society for the Conservation of Philippine Wetlands Inc.
SCTEX	Subic-Clark-Tarlac Expressway
SDP	Social Development Plan
SEMS	Social and Environmental Management Systems
SIC	Semi-conductor
SLEX	South Luzon Expressway
SMR	Self-Monitoring Report
SNC	Philippines Second National Communication on Climate Change
SO_2	Sulfur Dioxide
SO_4	Sulfate
SPS	Safeguard Policy Statement
SPT	Standard Penetration Test
SRTM	Shuttle Radar Topography Mission
STOA	Supplemental Toll Operating Agreement
STP	Sewage Treatment Plant
STPP	Sucat Thermal Power Plant
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
TDS	Total Dissolved Solids
TESDA	Technical Education and Skills Development Authority
TH	Total Height
TMS	Train Management System
TOR	Terms of Reference
TS	Tropical Storm
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
TY	Typhoon
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VL	Vibration Level
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

EXECUTIVE SUMMARY

1. This Executive Summary provides a general overview of the proposed PNR South Commuter (North South Railway Project (NSRP) – South Line (Commuter)) Project and its purpose and need; briefly describes the Project's Environmental Impact Assessment (EIA) Process; summarizes the major impacts for key resources and aspects associated with the proposed activities and corresponding preventive, mitigating and compensatory measures; and lists key consultation and coordination activities to include issues and concerns that emerged.

A. PROJECT FACT SHEET

<table>
<tr><td>Project Name</td><td colspan="2">PNR South Commuter (North South Railway Project (NSRP) – South Line (Commuter))</td></tr>
<tr><td>Project Location</td><td>Cities traversed by the alignment:
City of Manila
City of Makati
City of Taguig
City of Parañaque
City of Muntinlupa
City of San Pedro
City of Biñan
City of Sta. Rosa
City of Cabuyao
City of Calamba

Depot location: Banlic, Calamba, Laguna</td><td>Station location:
Blumentritt Station — Alabang Station
España Station — Muntinlupa Station
Sta. Mesa Station — San Pedro Station
Paco Station — Pacita Station
Buendia Station — Biñan Station
EDSA Station — Sta. Rosa Station
Nichols Station — Cabuyao Station
FTI Station — Gulod Station
Bicutan Station — Mamatid Station
Sucat Station — Calamba Station</td></tr>
<tr><td>Objective</td><td colspan="2">To expand the existing mass transport system connecting Metro Manila and adjacent areas</td></tr>
<tr><td>Project Type</td><td colspan="2">At-grade and Upgrade Railway System</td></tr>
<tr><td>Project Area</td><td colspan="2">Line: Length: 56.5 km, Width: 30 m
Station: 20 stations, Length: 180-220 m, Width: 60 m
Depot: Approximately 78 hectares</td></tr>
<tr><td>Project Capacity</td><td colspan="2">Two hundred (200) commuter trains having a capacity 2,200 passengers/train (seating + standing)</td></tr>
<tr><td>Major Components of the Project</td><td colspan="2">The components of the Project are: (1) Main Railway Line, (2) Stations, (3) Maintenance Depot, (4) E & M System and (5) Rolling Stock</td></tr>
<tr><td>Manpower</td><td colspan="2"><table>
<tr><th>Project Phase</th><th>Civil</th><th>E&M</th><th>Rolling Stock</th><th>Total</th></tr>
<tr><td>Pre-construction</td><td>100</td><td>60</td><td>40</td><td>200</td></tr>
<tr><td>Construction</td><td>11,000</td><td>1,500</td><td>500</td><td>13,000</td></tr>
<tr><td>Operation</td><td></td><td colspan="2">1,550</td><td>1400</td></tr>
</table></td></tr>
<tr><td>Project/Investment Cost</td><td colspan="2">PhP196.231 Billion</td></tr>
<tr><td>Project Duration</td><td colspan="2">The project is targeted to be operational by the 4th quarter of 2023 or approximately a period of five (5) years for pre-construction and construction activities</td></tr>
<tr><td>Profile of the Proponent</td><td colspan="2"></td></tr>
<tr><td>Name of Proponent</td><td colspan="2">Department of Transportation</td></tr>
<tr><td>Proponent's Address</td><td colspan="2">DOTr Head Office, Pinatubo Street corner Osmeña Street,
Clark Freeport Zone, Angeles City, Pampanga</td></tr>
<tr><td>Authorized Signatory/
Representative</td><td colspan="2">Atty. Timothy John R. Batan
Undersecretary for Railways</td></tr>
<tr><td>Contact Details</td><td colspan="2">Telephone No: (02)790-8300</td></tr>
<tr><td>Profile of the Preparer</td><td colspan="2"></td></tr>
<tr><td>EIA Preparer</td><td colspan="2">GEOSPHERE Technologies, Inc.</td></tr>
<tr><td>Consultant's Address</td><td colspan="2">19D Eisenhower Tower, Eisenhower St., Greenhills, San Juan, Metro Manila</td></tr>
<tr><td>Contact Person</td><td colspan="2">Engr. Ledicia T. Dela Cruz
Managing Director</td></tr>
<tr><td>Contact Details</td><td colspan="2">Landline: (+632) 724-5665; 724-5667
Fax Number: (+632) 723-4250
Email Address: gti0722@geospheretech.com</td></tr>
</table>

B. LEGAL AND INSTITUTIONAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT

2. Any private or public projects or activities which are likely to have foreseen adverse effects on the natural and social environment are subject to the Philippine Environmental Impact Statement System (**PEISS**). The list of laws and guidelines related to PEISS are shown in **Table ES-1**.

Table ES-1 Important Laws and Manuals of PEISS

Laws and Regulations of Environmental Impact Assessment (EIA)
• 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
• 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
• 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
Responsible Government Authorities
• DENR - government entity responsible for the environmental administration
• DENR-EMB - responsible for the issuance of decision making documents such ECC and Certificate of Non-Coverage (CNC) for PEISS
Environmental Impact Assessment System of JICA and ADB
• **JICA Guidelines for Social and Environmental Considerations (April 2010) -**
• ADB Safeguard Policy Statement (July 2009) – governs environment and social safeguards of ADB operations
Environmental Impact Assessment System in the Philippines
• The Philippine EIA Process has six (6) 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.
Environmental Standards
• Presidential Decree 1152, otherwise known as the "Philippine Environment Code (1977)": Recognizes the establishment of specific environment management policies and prescribing environmental quality standards
• Ambient Air Quality o Philippine Standards: – DENR Administrative Order (DAO) No. 2000-81: Implementing Rules and Regulations of RA No. 8749 which establishes the National Ambient Air Quality Standards for suspended particulate matters (TSP, PM10), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb) – DAO No. 2013-13: Establishes the provisional national ambient air quality guideline values for PM2.5 o International Standards: – World Health Organization Air Quality Guidelines for PM, O_3, NO_2 and SO_2 (2005)
• Surface Quality o Philippine Standards: – DENR Administrative Order (DAO) No. 2016-08 o International Standards: – Environmental water quality standards for protecting human health, Japan DENR Administrative Order (DAO) No. 2016-08
• Effluent Quality o Philippine Standards: – DENR Administrative Order (DAO) No. 2016-08 o International Standards: – IFC Indicative Guideline Values for Treated Sanitary Sewage Discharges (2007)DENR Administrative Order (DAO) No. 2016-08

– Japan National Effluent Standards (2015)
• Groundwater Quality o Philippine Standards: – DENR Administrative Order (DAO) No. 2016-08 – Department of Health (DOH) Administrative Order (DAO) No. 2017-0010 o International Standards: – WHO Guidelines for Drinking-Water Quality (2011)
• Noise o Philippine Standards: – National Pollution Control Commission (NPCC), Section 78, Table 1 – NPCC Memorandum Circular No. 1980-002 o International Standards: – Guidelines for Community Noise, World Health Organization (WHO), 1999.
• Vibration – British standards BS 5228-2:2009
• Soil Fertility o Philippine Standards: – Bureau of Soils and Water Management Soil Fertility Rating o International Standards: – Dutch Target and Intervention Values (2000)
• Soil Contamination – Dutch Target and Intervention Values (2000) – US EPA Regional Screening Levels (0.1)
Other Environmental Laws and Regulations Concerning the Project
• International treaties, agreements and related documents o Biodiversity – Convention on Biological Diversity, 1992 – Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 – Convention on Wetlands of International Importance, 1971 – Convention on the conservation of Migratory Species of Wild Animals, 1983 – Cartagena Protocol on Biosafety, 2000 (to the Convention on Biological Diversity) – Nagoya Protocol on Access to Genetic Resources & the Fair & Equitable Sharing of Benefits Arising from their Utilization-Supplementary Agreement to the Convention of Biological Diversity o Climate Change – Montreal Protocol on Substances that Deplete the Ozone Layer, 1987 – Vienna Convention for the Protection of the Ozone Layer, 1985 – London Amendment (to the Montreal Protocol), 1990 – United Nations Framework Convention on Climate Change, 1994 – Kyoto Protocol to the United Nations Convention on Climate Change 1998 – Paris Agreement Adopted in the 21st Session of the Conference of Parties to the United Nations Framework Convention on Climate Change, 2015 – United Nations Convention to Combat Desertification, 1994 o Pollution – Basel Convention on the Control of Transboundary Movements of Hazardous wastes and their Disposal, 1992 – Stockholm Convention on Persistent Organic Pollutants 2001 – Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 2004Montreal Protocol on Substances that Deplete the Ozone Layer, 1987 o Historical/Cultural Heritage – UNESCO Convention Concerning the Protection of the World Cultural and National Heritage, 1972 o Forestry – International Tropical Timber Agree, 1994 o Social – Convention on the Elimination of all Forms of Discrimination against Women, 1979 – International Convention on the Elimination of all forms of racial discrimination 1965 – International Covenant on Civil and Political Rights 1976 – International Covenant on Economic, Social and Cultural Rights 1976 – Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987 – Convention on the Rights of the Child 1990 – International Convention on the Protection of the Rights of all migrant Workers and members of their families, 1996 – International convention for protection of all persons from enforced Disappearance 2010 – Convention on the Rights of Persons with Disabilities 2008

- National Strategy and Plan relevant to Environment and Social Consideration
  - Biodiversity
    - Philippines: National Biodiversity Strategy and Action Plan (NBSAO) 1997
    - Philippine Biodiversity Conservation Priorities, 2002
    - A National Wetland Action Plan for Philippines 2011-2016
    - Philippine Plant Conservation Strategy and Action Plan 2003
  - Climate Change
    - Second National Communication Plan on Climate Change
    - Philippine Energy Plan 2009- 2030
    - Philippine Strategy on Climate Change Adaptation 2010-2022
    - National Framework strategy on Climate change 2010 - 2022
    - National Climate Change Action Plan, DILG Convention on the Elimination of all Forms of Discrimination against Women, 1979
  - Pollution
    - Philippine Development Plan 2017-2022
    - Philippine Environmental Partnership Program
    - Government Poverty Reduction Programs and Plans
    - Philippine Plan for Gender responsive Development Plan 1995-2025
    - National Plan of Action for Children 1991
    - 22-point platform and policy Pronouncements on Labor and employment 2010
  - Social
    - Second National Communication Plan on Climate Change
    - Philippine Energy Plan 2009- 2030
    - Philippine Strategy on Climate Change Adaptation 2010-2022
    - National Framework strategy on Climate change 2010 - 2022
    - National Climate Change Action Plan, DILG Convention on the Elimination of all Forms of Discrimination against Women, 1979

- Other related Laws and Regulations
  - 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
  - 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
  - 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 (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
  - 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)

o 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

- Permits to be Obtained for the Project Operation
  - NHCP Endorsement on Historical Structures (Old PNR structures)
  - Tree Cutting permit
  - Wastewater Discharge Permit
  - LLDA Clearance for Development Projects
  - Permit To Operate for Power Generator Sets (APSI)
  - ECC for Construction Work Areas/Batching Plants
  - Quarry Permit
  - Permit for structures over water bodies

C. PROCESS DOCUMENTATION

EIA Team

3. The EIA Study was conducted by a multidisciplinary team of specialists and consultants of the GEOSPHERE Technologies, Inc. (GTI) who have strong background in environmental assessments. The composition of the EIA Team is presented in **Table ES-1.**

Table ES-1 EIA Study Team Composition

Environmental Aspect/Task	Team Member	EMB Registry No.
Team Lead	Ledicia T. dela Cruz	IPCO-287
Peer Review	Noelina B. Miran	-
EIS Report Integration	Pearly Grace E. Resano	IPCO-115
Geology and Hydrology	Reynar Rollan	IPCO-294
Soils and Land Use	Marmelou Popes	-
Terrestrial Flora	Enrico Replan	IPCO-176
Terrestrial Fauna	Judeline Dimalibot	-
Water Quality	Vanderleaf Capalungan	-
Freshwater Ecology	Ma. Vivian Camacho	IPCO-213
Meteorology, Air Quality and Noise	Reynaldo S. Tejada	IPCO-036
Air Quality and Noise	Rogey A. Miedes	-
Vibration Survey and Assessment	Emmanuel G. Ramos	IPCO-117
Environmental and Social Safeguard (Socio-Cultural and Gender)	Felixberto Roquia, Jr.	IPCO-028

4. From the DOTr's side, the project management was spearheaded by Engr. Cristina Quinalayo, DOTr Environmental and Social Considerations Officer. The accountability statement of the proponent and the preparer is presented **Annex ES – 1**.

EIA Schedule

5. The EIA Study was conducted for a period of approximately six (6) months commencing from the conduct of Project Briefing for the EIA concerned personnel of the EMB to Information, Education, and Communication (IEC) activities. Technical Scoping was conducted with the EMB and EIA Review Committee (EIARC) members on February 9, 2018 and based on the agreed scope of work, the collection of primary data was conducted. Data collected were processed, analyzed and evaluated for impact assessment and formulation of Impact/Environmental Management Plan (EMP) and Environmental Monitoring Plan (**EMoP**). The data and information were written into an EISR and the final version of the EISR will be submitted to the EMB-Central Office for ECC application. The major activities undertaken to complete the EIA were listed in **Table ES-2**.

Table ES-2 EIA Study Schedule

Activity	Date
IEC Activities	With details presented in Table ES-4
Public Scoping	January 18, 2018, 1:00PM (Makati City) January 19, 2018, 1:00PM (Calamba City) January 24, 2018, 1:00PM (Taguig City)
Technical Scoping	February 9, 2018
Primary and Secondary Data Gathering	
Land Use	January-February 2018 – Desktop Review
Geology and Geological Hazards	February 15, 2018 – Site Investigation
Pedology	January 23, - February 22, 2018 – Site Investigation and collection of soil samples
Terrestrial Ecology	February 9-24, 2018
Hydrology/Hydrogeology	February 15, 2018 – Site Investigation
Water Quality	February 12-15, 2018 – Field survey and collection of water samples
Freshwater Ecology	February 8-9, 2018 – Field survey and collection of samples
Air Quality and Noise	January 18 – February 22, 2018 – Ambient Air Quality and Noise Sampling
Vibration	February 12-20, 2018
Socio-economic, Health and Perception Survey	February 6 - 28, 2018
Impact and Risk Evaluation	March 2018
Formulation of Impact/Environmental Management Plan (**EMP**) and Environmental Monitoring Plan (**EMoP**)	April 2018
Preparation of Draft EIS	January 2018 – May 2018
Submission of Draft EIS to EMB	May 2018
Public Consultation	June 2018

EIA Study Area

6. The EIA study area for the proposed NSRP covers ten (10) cities, namely, Cities of Manila, Makati, Taguig, Parañaque and Muntinlupa in National Capital Region (NCR); and Cities of San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba in Laguna Province, CALABARZON (Region IV-A).

EIA Methodologies

7. The EIA for the Project conforms to the Revised Procedural Manual for DAO 2003-30 and DAO 2017-15 in the conduct of the following activities, to wit: (i) IEC and Scoping, (ii) collection of primary and secondary data, (iii) identification/prediction/assessment of environmental impacts, (iv) formulation of EMP and the (v) development of EMoP. The baseline information are mainly primary and secondary data which were obtained from the local government units (LGUs) and other government agencies. Data collected were based from the approved EIA Scoping and Screening Form (**Annex ES-2**), which was finalized during the Technical Scoping Meeting conducted at the Environmental Management Bureau of the Department of Environmental and Natural Resources (EMB-DENR) Central Office, DENR Compound, Visayas Avenue, Diliman, Quezon City on February 9, 2018. **Table ES-3** shows the pertinent data, sources, and methodology used for the proposed NSRP.

Table ES-3 The EIA Methodology

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
LAND		
Land Use and Classification	• Review of Comprehensive Land Use Plan (CLUP) of Cities of Manila, Makati, Taguig, Parañaque and Muntinlupa in Metro Manila and Cities of San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba in the Province of Laguna	• Assessment of the compatibility of the proposed NSRP vis-à-vis approved land use plan and zoning classification.
Geology	• Conduct of field surveys • Review of available reports, geologic literature and information from Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Philippine Atmospheric, Geophysical and	• Assessment of construction and operation impacts based on the construction and operation activities of the proposed NSRP, and the susceptibility of the project area to natural hazards.

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
	Astronomical Services (PAGASA), National Mapping and Resource Information Authority (NAMRIA) and Proponent	
Pedology	• Review of existing literature and maps of the project alignment. • Conduct of field surveys and collection of soil samples	• Assessment of impacts based on the construction and operation activities of the proposed NSRP to the existing environment.
Terrestrial Ecology	• Conduct field surveys at the proposed Project alignment.	• Assessment of impacts based on the construction and operation activities of the proposed NSRP to the existing ecosystem
WATER		
Hydrology	• Review of CLUP of host LGUs • Conduct of field surveys	• Assessment of impacts based on the construction and operation activities of the proposed NSRP to the existing environment and the susceptibility of the project area to flooding.
Water Quality	• Collection of groundwater and surface water samples for analysis of physical, chemical, microbiological, micro-nutrient and heavy metal analyses at Mach Union Laboratory, Inc. in Las Piñas City. Levels of DO, salinity, conductivity, TDS and Temperature were measured on-site. • Assessment of groundwater quality and freshwater quality using the Philippine National Standards for Drinking Water of 2007 (PNSDW, 2017) and DAO 2016-08 (Water Quality Guidelines and General Effluent Standards of 2016), respectively.	• Assessment of impacts based on the construction and operation activities of the proposed NSRP to the existing environment.
Freshwater Ecology Ecology	• Characterization of trophic composition at 13 sampling stations in the rivers and creeks along the alignment. The phytoplankton samples were collected using 10μ-mesh plankton net and placed in clear plastic bottles preserved with Lugol's solution. The zooplankton samples, on the other hand, were collected using a 40μ-mesh net and placed in plastic bottles preserved with 7-10% formalin. Benthic organisms were collected from the sediments and strained using various mesh size sieves and preserved using alcohol.	• Assessment of impacts based on the construction and operation activities of the proposed NSRP to the existing ecosystem.
AIR		
Meteorology and Climatology	• Collection and review of existing literature and maps of the project area from PAGASA Science Garden Complex, Quezon City and NAS UPLB, Los Baños, Laguna	• Assessment of impacts based on the construction and operation activities. • Calculation of GHG emissions using emission factor-based estimation method prescribed in The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report. • Projection of monthly average temperature and rainfall and frequency of extreme events under medium range emission scenario using the data from PAGASA Climate Change in the Philippines, 2011
Air Quality and Noise Level	• Conduct of ambient air quality monitoring at the eight (8) established sampling stations to measure the Carbon Monoxide (CO), Ozone (O_3), Nitrogen Dioxide (NO_2), Sulfur Dioxide (SO_2), Total Suspended Particulates (TSP), Particulate Matter of less country presents than 10 μm (PM_{10}), Particulate Matter of less than 2.5 μm ($PM_{2.5}$) and Lead (Pb) concentration in the project area and its vicinity. • Conduct of Noise level measurement during morning, daytime, evening, and night time using Extech Noise Data Logger at the fifteen (15) established sampling stations. • Noise prediction for construction and operation activities	• Assessment of construction impacts on noise using the prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007). • Assessment of operation impacts on noise using the prediction model by Japanese Formula discussed in the "Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan" and "EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 1999, Osaka Prefecture".
Vibration	• Conduct of vibration measurement during morning, daytime, evening, and night time using Vibron Seismometer which is a seismic data recorder connected to geophones at the fifteen (15) established sampling	• Assessment of construction impacts on vibration using the prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007).

Environmental Components	Methodology and Approach on Baseline Survey	Methodology on Impact Assessment
	stations	• Assessment of operation impacts on vibration using the actual vibration measurements of similar project with the same train structure and operation (i.e. East-Osaka Urban Rapid Transit)
PEOPLE		
Socioeconomic and Public Health	• Conduct of IEC for the City LGUs • Conduct of Public Scoping • Conduct of Socio-economic, Public Health and Perception Survey at host barangays • Review of the CLUP and Socio-economic Profile of host cities and municipality • Review of available secondary data, relevant studies and other information from Philippine Statistics Authority (PSA). • Gathering and review of relevant primary data critical to the study; • Collected and evaluated recent trends of secondary data on health and injury profile from the City Health Office (CHO) for possible relationship to health impacts associated with the train operation. • Literature review on the potential impacts and risks of the railway on health of people living in surrounding communities, to confirm established relationships between hazards of railway and health risks and effect to people. • Review of CLUP of the host LGUs in the preparation of the Indicative SDP, and IEC Framework.	• Assessment of impacts based on the results of IEC, Public Scoping, FGD, survey of PAFs and construction and operation activities of the proposed NSRP.

Public Participation Activities

8. An extensive and comprehensive IEC campaign about the Project and the EIS System was conducted to ensure a meaningful and active participation of well-informed stakeholders – affected residents, host communities, LGUs, relevant agencies, the EMB and the local DENR in the EIA process.

IEC and Initial Perception Survey

9. The IEC Sessions presented in **Table ES-4** were conducted to provide updated information about the proposed Project and encourage the concerned stakeholders to participate in the EIA Study.

Table ES-4 IEC Conducted for the EIA Study of the Proposed Project

Date and Time	Venue	Main Participants	Number of Participants
December 13, 2017, 10:00AM	Provincial Government Extension Office, Calamba City	Representative from the Office of the Governor PUDHO Representative	Male: 2 Female 0 Total: 2
December 18, 2017, 10:00AM	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 Total: 9
December 18, 2017, 2:00PM	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
December 19, 2017, 10:00AM	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
December 20, 2017, 10:00AM	Conference Room, Parañaque City Hall	Parañaque City LGU Representatives (City Planning, UMADO, City Assessor, City ENRO, City Engineering and LHDO) Proponent - DOTr	Male: 3 Female: 6 Total: 9

Date and Time	Venue	Main Participants	Number of Participants
		JICA Design Team Ecosys Representative	
December 22, 2017, 10:00AM	Biñan City Hall	Parañaque City LGU Representatives (City Mayor, City Councilor, City ENRO and CPIO)	Male: 3 Female: 6 Total: 9
December 22, 2017, 2:00 PM	Makati City LGUs	Makati City Administrator's Office Representatives	Total: 8
December 22, 2017, 10:00AM	Calamba City	Representative of Calamba City LGU	Male: 1 Female: 0 Total: 1
December 27, 2017, 2:00 PM	Makati City Hall	Makati City Administrator's Office Representatives	Male: 4 Female: 1 Total: 5
January 10, 2018, 10:00 AM	Taguig City LGUs	City Hall, Taguig City	Total:: 15

10. The initial Perception Survey was conducted after the IEC in Manila City, Makati City, Taguig City, Parañaque City, Muntinlupa City, San Pedro City, Biñan City, Sta. Rosa City, Cabuyao City and Calamba City. Survey questionnaires were distributed to the participants after the IEC sessions. The survey covers the demographic characteristics, source of income, livelihood, health and sanitation, education, employment, their knowledge and attitude towards the proposed Project. The result of the survey showed that majority (80 of the 92) respondents were in favor of the project.

Public Scoping

11. The Public Scoping for the NSRP of the DOTr from Solis, Manila to Calamba, Laguna was conducted in three (3) cluster areas on January 18, 19 & 24, 2018 which details are presented in **Table ES-5**. The Public Scoping was facilitated by the representatives from the EIA Division of the EMB - Central Office to provide information about the Project and to collect site-specific issues, concerns, and inputs to the EIA Study.

Table ES-5. 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

Date and Time	Venue	Main Participants	Total No. of Participants
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

Perception survey

12. The Socio-Economic, Health and Perception Survey was conducted at the host barangays in the Cities of Manila, Makati, Taguig, Parañaque, Muntinlupa in Metro Manila and Cities of San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba using a survey questionnaire presented in **Annex ES-3**.

13. The respondents in the survey were the Barangay Council and Multi-sectoral Representatives (women representatives, men group representative, senior citizen, church group representative and other authority figures of the community). The total number of respondents per city is presented in **Table ES-6**.

Table ES-6. Perception Survey Respondents for the Proposed NSRP

Date	Host City	Respondents				
		Male		Female		TOTAL
		Sub-total	%	Sub-total	%	
February 6 – March 27, 2018	Metro Manila					
	Manila	486	52.31	443	47.69	**929**
	Makati	15	41.67	21	58.33	**36**
	Taguig	32	50.00	32	50.00	**64**
	Parañaque	4	50.00	4	50.00	**8**
	Muntinlupa	25	35.21	46	64.79	**71**
	Laguna					
	San Pedro	19	50.00	19	50.00	**38**
	Biñan	23	56.10	18	43.90	**41**
	Sta. Rosa	40	80.00	10	20.00	**50**
	Cabuyao	59	65.56	31	34.44	**90**
	Calamba	79	52.00	73	48.00	**152**
	TOTAL	782	-	697	-	**1,479**

Source: Geosphere 2018

14. The results of the survey showed that majority (73.67 %) of the respondents are in favor of the proposed NSRP.

D. EIA SUMMARY

Summary of Alternatives

Siting

15. The proposed NSRP will utilize the existing PNR-Right Of Way (**ROW**) and no other ROW alternative was considered because the area is highly developed.

16. For the location of Depot, the options being considered are 1) Old Sucat Power Plant and 2) agricultural land in Banlic, Calamba. Considering the storage of rolling stock, operation of

carriage and maintenance, the agricultural land in Banlic, Calamba was the preferred to be the Depot site.

Technology and Design

17. For the track structure, elevated structure option was considererd over the at-grade options after evaluation of impacts such as flooding and intersection with existing roads.

18. For the Rolling Stock Option, the DOTr will utilize an Electric Multiple Unit (EMU) Train for the Project, which runs quieter than diesel and locomotive-drawn multiple units.

Summary of Baseline Environmental Condition

19. Baseline conditions describe the state of the existing environment prior to project implementation. The summary of the baseline assessment is presented in **Table ES-7**.

Table ES-7 Summary of the Baseline Environmental Conditions

Component	Description
LAND	
Land Use and Classification	• The proposed NSRP will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR) except for the segment from Solis to Sta. Mesa Station. The alignment will traverse10 Local Government Units (LGUs), namely: City of Manila, City of Makati, City of Taguig, City of Parañaque and City of Muntinlupa in the National Capital Region (NCR); and City of San Pedro, City of Biñan, City of Santa Rosa, City of Cabuyao, and City of Calamba in the Province of Laguna. **Existing Land Use** • **Manila City**. Majority of the land in Manila City are used for commercial and residential. Predominantly, the lands adjacent to the PNR ROW are used for 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 City**. Based on the Makati Land Use Plan 2001-2011, residential areas accounted for the largest land use in the City of Makati. The major land uses adjacent to the project alignment within the city are residential and commercial. • **Taguig City.** General Residential Development Area – 1 (GRDA-1)[1] accounted for the largest land use in Taguig City, accounting for more than one third (40.4%) of the total land area. The major land uses adjacent to the project alignment are institutional, low density development, general residential development-1, low density development, open space, controlled growth corridor, and light industrial. • **Parañaque City.** As of the calendar year 2012, residential area 2 accounted for the largest land use in Parañaque City. The major land uses adjacent to the project alignment are mostly commercial 2 with patch of residential 3, commercial 1 and commercial 3. • **Muntinlupa City.** Majority of the total land area of Muntinlupa City is allocated for residential use followed by commercial use. Majority of the land use along the project alignment are residential with sections located in industrial and commercial areas. • **San Pedro City.** Majority of the land area of San Pedro City is built-up area composed of residential, commercial, institutional, industrial, tourism, agriculture, cemeteries, abattoirs, and infrastructure & utilities. The areas adjacent to the project alignment are being utilized as residential and commercial areas. • **Biñan City.** A large portion of the Biñan City's land area is dedicated for residential purposes. The areas adjacent to the project alignment are being utilized as residential and commercial areas. • **Sta. Rosa City.** Residential land use dominates the spatial extent of Sta. Rosa City. The areas adjacent to the project alignment are agricultural land, mostly rice fields, and residential areas. • **Cabuyao City.** A large portion of Cabuyao City's land area is dedicated for industrial purposes. The areas adjacent to the project alignment are residential, commercial, agricultural (ricefields), light industrial zone, Cabuyao Enterprise City 1 and institutional. • **Calamba City.** A large portion of Calamba City's land area is allocated as growth management area. Urban development, upland conseration, and agricultural development areas also represent a substantial space in the City. The areas adjacent to the project alignment are utilized for urban redevelopment and agricultural development areas. The land use at the proposed depot sit is agricultural.

[1] **General Residential Development Area** - 1 (GRDA-1) are neighbourhood-type communities that are evenly distributed throughout the city. These are mainly characterized by high-density mixed-use neighbourhoods that are closely compacted and pre-dominated by residences and small-scale neighbourhood 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.

Component	Description
	Environmentally Critical Area • The alignment of NSRP 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 Forest Reserve. • Within the vicinity of the NSRP alignment (80 m away), is the Lord Just Ukon Takayama Monument (Plaza Dilao, Paco, Manila) which was declared by the National Historical Commission (NHCP) of the Philippines as a national heritage site. There were also identified old PNR and other structures within the PNR ROW which are considered to meet the NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures. • The whole stretch of the alignment is prone to geologic (i.e. ground shaking) and typhoon hazards while only portions of the alignment located in Metro Manila are prone to periodic flooding during the rainy season. • Segment of NSRP Alignment passes through agricultural areas (i.e. rice field) in Sta. Rosa, Cabuyao, and Calamba. One of the sites being considered for the Depot is a 78-ha agricultural in Banlic, Calamba. • There are 35 water body crossings at NSRP alignment. These include Pasig River, Sucat River, Alabang River, Bayanan Creek, Poblacion River (Muntinlupa), Magdaong River (Muntinlupa), Tunasan River, San Isidro River (San Pedro River), Biñan River, San Cristobal River and Calamba River. **Land Tenure Issue/s** • NLEx/ SLEx Connector Road Project, being implemented by the Department of Public Works and Highways (DPWH), is 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 NLEx/ SLEx Connector Road Project will utilize the portions of PNR ROW for Solis to Pasig River which is in conflict with the proposed NSRP alignment. • Due to the NLEx/ SLEx Connector Road Project, the proposed NSRP alignment will run outside and in parallel to PNR ROW from Solis to Pasig River which will require acquisition of private land. • PNR ROW has been proliferated by Informal Settler Families (ISFs). ISFs and their structures can be found within the bounds of the proposed 30m ROW for NSRP. Most of the structures located at approximately 2 to 10 meters from the track are a mixture of concrete and light materials with 2 or more families sharing in a structure • The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area which is under the Power Sector Assests and Liabilities Management Corporation (PSALM). • 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. There is a possibility that the proposed NSRP might affect the ferry operation during its construction traversing Pasig River. **Visual Aesthetic** • 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 existing PNR lines being at grade structure are not visible from Laguna de Bay coast line however could be visible from Mount Makiling. **Land Value** • At present, Manila City has 100 % coverage of solid waste collection through a private contract with Leonel Waste Management. Makati City, on the other hand, has an overall collection efficiency of approximately 86% based on 1994 data. Taguig City uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependant on the satisfactory performance of the contractor. In Parañaque City, there is a daily collection of segregated wastes along the main thoroughfares and markets, weekly collection for households or residences and for stationary sources like government offices and other institutional entities, a three times a week collection are provided. Muntinlupa City also uses the services of a private contractor (REN Transport Corporation) for waste collection with 85% coverage. The wastes disposal site is in Rodriguez, Rizal and San Pedro, Laguna. • Garbage collection in San Pedro City is managed by a garbage contractor covering 20 barangays, catering to almost 65% of the total population. Garbage collected is currently being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio. At present, solid waste management in Biñan City can be considered inefficient. Pilotage Trading and Construction, is a private contractor, is in charge in the everyday garbage collection. On the other hand, solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba. In Calamba City, 81% of the wastes of the total population are collected and disposed daily in San Pedro, Laguna.
Geology/ Geomorphology	**Surface Landform/Geomorphology/Topography/Terrain/Slope** • The terrain class 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.

Component	Description
	Sub-surface Geology/Underground Conditions • **Lithology and Stratigraphy**. The geologic formations within a 10-km corridor which could potentially affect the proposed railway are Recent Deposits (Qh) and Tuff and Pyroclastic (N_3 + Q_1). In the project area, Qh are found in Solis Station to 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. Guadalupe Formation (Marl, Reworked Tuff, Pyroclastic) underlie the gently sloping segment from Pasay Road Station to Bicutan Station. • **Regional Tectonic Setting.** The major earthquake generators relevant to the proposed NSRP include the Philippine Trench, the Philippine Fault, West Marikina Valley Fault, Lubang-Verde Passage Fault, and the Manila Trench. **Geologic and other Natural Hazard** • The hazards which can potentially affect the NSRP include flooding and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. The segments from Solis Station to Nichols Station and from Muntinlupa Station to Banlic Depot are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking which could affect the stability of railway line and its stations. The segment the NSRP between the Muntinlupa and Alabang Stations is vulnerable to ground rupture where it is intersected by trace of the active West Marikina Valley Fault. Eruptions of Taal Volcano and Mt. Cristobal will bring about ground shaking and ash fall to the proposed NSRP alignment
Pedology	**Soil Types** • The project alignment will be traversing at least seven (7) types of soil. These soils are the: (1) Novaliches Clay Loam Adobe, (2) Guadalupe Clay, (3) Guadalupe Clay Adobe, (4) Quingua Silt Loam, (5) Carmona Sandy Clay Loam, (6) Lipa Loam, and (7) Macolod Clay Loam. **Soil Erosion/Loss of Topsoil/Overburden** • The baseline conditions for the erodibility of the soils along the NSRP alignment is generally little to no erosion due to land cover and water content of the soil. The topography also plays a part on the erodibility of the soils in the area. Since the area is generally flat, the erodibility of the soils would also be lesser **Soil Quality** • The results of the soil quality analysis in ten (10) stations showed that the pH level, organic matter, primary nutrients (P and K), magnesium and macronutrients (available iron, copper, manganese and zinc) were adequate based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy except for the pH level at Station S05 (FTI) and organic matter at Station S10 (Paciano Rizal Elementary School) which exceeded the adequate values of 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. The lowest calcium concentration level was in Station S10 at 1.02 cmol/kg while the highest calcium concentration level was in Station 01 (Solis) at 171.21 cmol/kg. • The levels of Lead in stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) exceeded the Target Value of the Dutch Standard but were way below the intervention values. The levels of Mercury, Arsenic, and Chromium in all sampling stations were well within the Target Values of the Dutch Standard. The levels of Mercury in six (6) stations (S01, S02, S04, S05, S06, and S07) were below the detectable limits of the method of analysis. Levels of Chromium hexavalent in stations S03, S04, S07, S08, S09, and S10 were also below the detectable limits of the analysis. Levels of Cadmium exceeded the Target Value of Dutch Standard but were below the Intervention Value. **Soil Contamination** • 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 and guideline values set in the US EPA Regional Screening Levels for Residential Area.
Terrestrial Ecology	**Terrestrial Flora** • Almost 60% of the surrounding area of the proposed project alignment comprised of dense residential areas and urbanized zones, consequently, small existing vegetation present in the study area are generally disturbed. Vegetation composition and structure covers only small patches/cover to domesticated trees, abandoned sites where weeds, grass and shrubs dominates smothered areas. • One hundred seven (107) morpho-species, 99 genera belonging to 42 families were documented in the six transect plots established within the NSRP alignment. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *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. • In terms of tree flora, a total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole proposed NSRP alignment. The average number of trees per quadrat (20m x 20m) is about 1 individual or an average density of 0.0025 tree/m^2 (1 tree for every 100 m^2).

Component	Description
	• A total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is slightly higher than that of trees, at 0.12 individual/m^2 or equivalent to 12 individuals for every 100m^2. • There are 51 ground cover species recorded from the all transect plots. • The diversity index of the project area ranged from low to moderately low, while evenness indices varied from very low to low. • Of the total 107 taxa identified to species level, five (5) species (5%) were found to be Philippine endemics or have natural habitat confined only in the country. Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and exhibits different economic and ecological importance. • Five (5) species recorded from NSRP alignment are listed under either the Philippine Red List or the IUCN Red List of Threatened Species. Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). **Terrestrial Fauna** • A total of sixty-four (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 lizards). • Out of the 55 species recorded in all the surveyed sites, nine endemic species of birds are recorded and thirty-nine or 69% of the total number of bird species are resident. • Among the captured and recorded species of mammals, 67% are native species, 16% endemic and 17% introduced species • No endemic species of amphibians and reptiles were recorded. Approximately 33% are introduced species and 67% are native species of amphibians and reptiles. • All or 100% of the species of birds, mammals and herpetofauna documented from the six survey sites are of Least Concern.
WATER	
Hydrology/ Hydrogeology	**Drainage Morphology / Inducement of Flooding / Reduction in Stream** • The main hydrologic feature which affects the NSRP alignment is the 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. Major rivers from Sierra Madre which feeds Laguna de Bay include Pagsanjan River, Santa Cruz River, Pangil River, Marikina River, Tanay River, Morong River and Siniloan River. Major rivers from the Taal-Makiling-Banahaw Volcanic chain include Tunasan River, San Pedro River, Cabuyao River, San Cristobal River and Calamba River. The main channels of these rivers and their tributaries are intersected by the NSRP Alignment from Bicutan to Calamba, Laguna in 35 locations. These river –railway intersections are found within the Laguna Lakeshore area which is usually affected by the rise in lake water levels during the rainy season and/or major storm events. • The Cities of Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao, and Calamba have drainage systems. However, most of the drainage structures in these LGUs are insufficient or clogged which cause flooding low lying areas. • The minor waterway crossings have estimated water depths of less than or equal to 30 centimeters (cm). The major crossings at Pasig, Biñan, Sta. Rosa, Cabuyao, San Cristobal and San Juan have inferred water depths greater than 30 cm. These conditions are expected to increase during the rainy season. The average depth of Laguna de Bay is 2.5 m. • 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. In general, the NSRP segment at the immediate banks of the main channel of the meandering Pasig River and segment from Taguig to San Pedro and from Solis Station to Bicutan are highly susceptible to flooding. . • 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.
Water Quality	**Groundwater Quality** • Known well depths of the tubes in Solis (GW-1), Alabang (GW-4), and Cabuyao (GW-6) range from 24-42 m. Known ages range from 8 to 100 years. Usage varies from community drinking water supply, cooking, bathing and washing. The wells in Buendia (GW-2), and Los Baños (GW-8) are not regularly in use. The wells yielded clear water (with persistent brown particles in Los Baños or GW-8). Odor ranged from no objectionable odor to objectionable odor. Bubbles, an indicator of significantly polluted water (from cleaning substances) appeared in the samples from Solis (GW-1) and Buendia (GW-2). Drinking water generally comes from the commercial "mineral" water or from the local water utility. Collectively, there was a high 84% conformance of the eight sampling sites with sixteen (16) parameters covered by PNSDW and DENR Class A guidelines. Out of 128 measurements, only twenty (20) or 14% cases of varying non-conformance by water sample were attributed to color, temperature, fecal coliform, total coliforms, TDS, Na, Cr+6, and CN. The groundwater qualities appeared to be within the current use. **Freshwater Quality** • The set of primary data obtained covered fourteen (14) sampling sites for twelve (12) rivers and creeks west to

Component	Description
	south of Laguna lake, plus one (1) in Laguna Lake and one (1) in Tadlac (Alligator) Lake. Temperature readings at these sampling stations ranged 25.7-31.1 ºC or within the DENR guideline. pH readings were within the guideline range of 6.5-8.5, except with the slightly lower value 6.4 in San Pedro River and Saran River. Color readings ranged <5-65 TCU. Values greater than guideline value of 5 TCU were found in Pasig River, Laguna Lake, Biñan River and Saran River. Fecal coliform and total coliform measured in thousands MPN/100 ml, except in Alligator Lake. BOD in the samples measured greater than the 7 mg/L minimum guideline limit, except in San Juan River (with 7 mg/L). The highest was 175 mg/L in Tunasan River. All the samples contained low or undetected nitrates, free cyanide (CN), arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), and organophosphates with the exception of Laguna Lake on Cd (0.010 mg/L vs 0.005 mg/L guideline limit), Bgy Bucal River on As (0.029 mg/L vs 0.02 mg/L guideline limit), and Saran River on Cd (0.011 mg/L vs 0.005 mg/L guideline limit.
Freshwater Ecology	• A total of thirteen (13) stations were surveyed at the project site. Overall conditions of freshwater bodies at the vicinity of the proposed site ranged from good to poor, which are reflective in the water quality and biological data. Bioindicator species of phytoplankton such as *Pediastrum, Melosira* and *Fragilaria*, and the occurrence of Rotifera species, such as *Brachionus urceolaris* are suggestive of these conditions. The dominance of Oligochaeta, *Melanoide*s and Chironomidae, which are known indicators of poor quality further corroborates with these observations. Also, low dissolved oxygen at several stations and high conductivity levels at all stations indicate poor water quality. Disturbances at aquatic bodies could be largely attributed to domestic and industrial activities.
AIR	
Climatology & Meteorology	• The climate at the proposed NSRP falls under the category of Type 1 based on the Modified Coronas Climate Classification of Philippine Climate. Type I climate is characterized by two (2) pronounced seasons, dry from November to April and wet from May to October with maximum period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon durin g rainy season and get a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period.
Air Quality	• The ambient air quality monitoring was conducted to measure 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 at eight (8) pre-established sampling stations along the NSRP alignment. • The results of sampling for ambient air quality showed that most of the stations are within the DENR standards, except for station AAQ3 (PNR Buendia) for TSP and PM10 concentration levels and AAQ2 (PNR Sta.Mesa) for PM2.5 concentration level. 24-hour concentration levels for Pb were relatively low, while CO and O3 concentrations were not detected at the majority of the stations. More than half of the stations (Stations AAQ1 to AAQ5) have PM_{10} concentration levels above the WHO guideline values, while half of the stations (Stations AAQ1 to AAQ4) have $PM_{2.5}$ concentration levels above the WHO guideline values. It was noted that these stations were located at more urban environments compared to those whose PM_{10} and $PM_{2.5}$ concentrations were within WHO guideline values.The only other exceedance was SO2 concentration level at station AAQ3 (PNR Buendia), which was located adjacent an intersection of Buendia Flyover corner Osmeña Highway and South Superhighway.
Noise Level	• Noise levels for the proposed NSRP were measured at fifteen (15) monitoring stations during morning (5:00 AM to 9:00 AM), daytime (9:00 AM to 6:00 PM), evening (6:00 to 10:00 PM) and nighttime (10:00 PM to 5:00AM). • Based on the results, the ambient noise levels observed in all stations were above the NPCC standard values and the WHO guideline values for their respective classifications.
Vibration Level	• Vibration levels were measured at fifteen (15) sampling stations established along the proposed NSRP alignment. • Observations of vibration at the areas along the proposed NSRP indicate that sites vary in levels of vibration from a low of 0.20 mm/s to a high of 31.5 mm/s. 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 walking pedestrians appear to dominate the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 10 mm/s which may be considered unpleasant by people when subjected to continuous vibration. The site with lowest level of vibration is in Divine Mercy Chapel, where vibration levels range only between 0.20 mm/s to 3.50 mm/s.
PEOPLE	
Demography	**<u>Population</u>** • The proposed NSRP will traverse through Manila 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 be host to the Project. Next most populous, is Taguig and Parañaque City with 804,915 and 665,822 inhabitants, respectively. However, the most densely populated is Makati City with 27,000 persons per square kilometer. 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 of the proposed NSRP is Calamba City.In 2015, it had a population of 454,486 (2015 Census of Population, PSA). However, the most densely populated host city in Laguna is San Pedro City with 13,547 individuals per square kilometer. The cities of Santa Rosa and Cabuyao are the fastest growing in terms of population, both had a population of 4.23% from 2010-2015. **<u>Gender and Age Profile</u>** • Generally, there is almost 1:1 proportion of male and female across Metro Manila and Laguna Province. The

Component	Description
	slight lead of female population accounted for 1% difference. Combined population of the host cities in Metro Manila and Laguna was largely composed of people in their productive age (15-64 years old) comprising 68% of the population, followed by the population of young dependents (children age 0-14 years old) making up the 28% of the population and, finally, the group of people in their retirement age (65 years old and above) accounting for 4% only of the population. • In 2015, there were more women (69.1%) than men (30.9%), with the proportion of women twice or more than twice of men in all PAPs. Majority of the PAPs belonged to the working age population, with 34.9% 21-40 years old. The proportion of dependents who are young (less than 12 years old) was approximately 27.9%, while those 61 years old and above were 4.5%, indicating that around 31% were dependents. The trend was similar for all affected LGUs, with majority having PAPs aged 21- 40 years old. **Literacy Rate, Profile of Educational Attainment** • Literary rate in the host LGUs of NSRP was high and higher compared to the national literacy rating in 2015. Females had a slightly higher literacy rate compared to the male population in the cities of Manila, Makati, Muntinlupa, San Pedro, Biñan, Sta. Rosa and Calamba. Males had higher literacy rate compared to the female population in City of Taguig. Males and Females had the same literacy rate in cities of Parañaque and Cabuyao. • In terms of educational attainment, the host LGUs' populace consisted largely of high school educated population, followed by elementary educated population except in cities of Makati and Parañaque wherein there were more academic degree holders than elementary educated population. • In general, the highest proportion of affected families were members who had reached high school (20.9%) and elementary (18%). Likewise, data indicates that a smaller proportion of PAPs had graduated elementary (5.3%) and had reached and graduated college (with 3% and 7.2%, respectively). In the city of Parañaque, San Pedro, Muntinlupa and Biñan, the highest proportion of families had reached elementary, with 32.6%, 23.5%, 19.4% and 19.6%, respectively. However, in the City of Manila and Taguig, the highest proportion of families belonged to those who had reached and graduated elementary – with 35.1%; and 40% of the families in Manila and Taguig had at least reached high school. In the cities of Santa Rosa and Biñan, the PAFs were distributed among those who had (1) reached elementary, (2) reached high school and (3) graduated high school, suggesting possible variations in the skill level of the PAPs.
Migration Profile	• Informal settlers were recorded in the host LGUs particularly in Manila City wherein 2.8 million ISFs were recorded in 2010. • Given that the Project will seek to utilize the existing PNR ROW, majority of the PAPs were ISFs who encroached on the existing ROW, with a few legal PAFs due to additional land acquisition required for the Project. PAPs are found mostly in the Cities of Calamba with 193 PAPs, Manila with 66 PAPs and Biñan with 27 PAPs. • Among the PAPs, there were members of households who were below the poverty line, and who may be elderly, persons with disabilities and/or needing special assistance, and solo parents. The SES also noted these PAPs who may be vulnerable or who may require additional compensation and/or other forms of assistance. • Among the vulnerable groups, majority were dependents – either as babies or toddlers (81.6%) or elderly (9%). There were also some PAPs who were pregnant (3.7%), had mental disorders (0.9%), were seriously ill (0.8%), blind (0.4%) or mute or deaf (0.3%).
Historical and Cultural Heritage	• Historical and cultural heritage declared by NHCP within the vicinity of the proposed NSRP includes Lord Justo Ukon Takayama Monument located in Plaza Dilao, Paco, Manila and Alberto Rizal House* in Biñan, Laguna. • There are also identified old PNR stations and railway bridge within the PNR ROW which are considered to meet the NHCP Guideline on the Identification, Classification, and Recognition of Historic Sites and Structures.
Existing Social Infrastructure and Services	**Power Supply** • Majority of the households in the host LGUs have electricity supplied primarily by 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% have no electricity connection, with the proportion of those with no electricity connection being highest in Cabuyao. **Water Rights/Supply** • Majority of the households in the host LGUs have access to safer water. Water is supplied primarily by Manila Water Company and Maynilad in Metro Manila while local water districts in the cities in Laguna **Pipeline** • The existing pipeline of First Philippine Corporation is located west of the proposed alignment. It runs along the National Highway in Muntinlupa City going north along the South Luzon Expressway (SLEx). The Black Oil Line has a branch going to the decommissioned STPP

Component	Description
	Open Space and Recreational Area • 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. **Education** • The educational facilities in the host cities include public and private day care centers, elementary schools, high schools and college facilities. **Communication** • Telecommunication services in the host LGUs of the proposed NSRP 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. **Peace and Order (Protective Services)** • Protective services in the host cities of proposed NSRP are rendered by Philippine National Police (**PNP**), Bureau of Fire Protection (**BFP**) and Bureau of Jail Management and Penology (**BJMP**) with augmentation from the Tanods. PNP manning in most of the host cities is below the PNP manning level standard of 1:500. **Solid Waste Management** • At present, Manila City has 100 % coverage of solid waste collection through a private contract with Leonel Waste Management. Makati City, on the other hand, has an overall collection efficiency of approximately 86% efficiency based on 1994 data. Taguig City uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependant on the satisfactory performance of the contractor. In Parañaque City, there is a daily collection of segregated wastes along the main thoroughfares and markets, weekly collection for households or residences and for stationary sources like government offices and other institutional entities, a three times a week collection are provided. Muntinlupa City also uses the services of a private contractor (REN Transport Corporation) for waste collection with 85% coverage. The wastes disposal sites are in Rodriguez, Rizal and San Pedro, Laguna. • Garbage collection in San Pedro City is managed by a garbage contractor covering 20 barangays, catering to almost 65% of the total population. Garbage collected is currently being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio. At present, solid waste management in Biñan City can be considered inefficient with two dump trucks. Pilotage Trading and Construction, is a private contractor, is in charge in the everyday garbage collection. On the other hand, solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba. In Calamba City, 81% of the wastes of the total population are collected and disposed daily in San Pedro, Laguna.
Public Services and Safety Profile	**Public Health Services** • Public health services in the host cities are provided through hospitals, health centers and clinics. The health personnel which include medical officers, dentists, medical technologists, nurses, nutritionist-dietician, nursing attendants, midwives, sanitary inspectors, barangay aides, dental aides, laboratory aides and administrative support staff. In 2000, the health center ratio in Manila City was below the DOH minimum standard. **Mortality and Morbidity Rates** • The Socioeconomic Survey (**SES**) also noted the PAPs with members who experienced health problem in the past year (morbidity) and the (2) causes of death for members of the family (mortality). Most of the PAPs had members who experienced flu (42.1%). This observation was applicable to all the affected cities. There was a low incidence of hypertension (6.3%), heart problems (2.3%), diarrhea (3.1%), dengue (1.4%) and typhoid fever (1.2%) among the PAPs during the time the survey was taken. • In terms of mortality, the main causes of death among members of PAFs were hypertension (18.1%), heart problems (14.1%), cancer (4.4%) and diabetes (3.9%) **Environmental Health and Sanitation Profile** • 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 tapped to community water system. Majority of the households disposed their garbage by having it picked up by garbage truck and majority also used toilet type water sealed sewer septic tank that is used exclusively by the household. • In general, most of the PAPs had access to water through deep well (35.3%). At least one (16%) out of 10 would had access to shared water connection, with a lower proportion (13.9%) having access to own water connection through Maynilad or MWSS. However, a per-LGU analysis indicates varying trends in water access. In the cities of Manila and Taguig, more families had access to water through Maynilad or MWSS – with 54.8% in Manila and 31.8% in Taguig. In Parañaque, however, at least 8 out of 10 families bought from water vendors, and the remaining proportion either had own connection (17.1%) or had access through deep wells (2.9%). In San Pedro, Biñan, Santa Rosa and Cabuyao, most families had access to water through deep wells. In Muntinlupa, majority also had access through deep wells, but at least 2 out of 10 families (23%) had access through Maynilad or MWSS. • In terms of access to sanitation, at least six (6) out of 10 PAPs had their own water-sealed toilets. The remaining had other sources of sanitation (20.7%), while at least 7.3% had communal or barangay toilet

Component	Description
	facilities. Among the PAPs, 301 PAFs had no access to sanitation. Among these, majority were in Calamba, Muntinlupa (97 families), Santa Rosa (52 families), Biñan (28 families), Taguig (21 families), and Manila (20 families). • Some community issues identified by the PAPs include flooding (19.3), drugs (16.7%), garbage collection (16.3%), and safety/security (13.2%). In Taguig, a high proportion of the PAPs stated that garbage collection was one of their main concerns, while in Manila, the main concern of the PAPs was safety and security, with 23.7% indicating it as one of the issues in their area. In Parañaque, garbage collection (33.9%) and water and sanitation (28.8%) pose as major issues. In the cities of San Pedro and Cabuyao, garbage collection and flooding were mentioned as the main concerns. However, in Biñan, most reported drugs (24.8%) as their main concern.
Socio-economic Profile	**Local Economy** • In 2016, he financial district of the country, Makati City had the most revenue of the host cities to the NSRP with revenue of nearly PhP 14.3 B. Manila City was next with PhP 12.8 B. Taguig City came in next with revenue of PhP 6.3 B (COA, Financial Profile, 2016). **Labor Force and Employment** • PAPs had varying income levels, with 20.8% having a monthly income of Php 12,000 to Php 15,999, 13% had an income of Php 9,000-9,999, and 11% an income of Php 16,000-19,999. In the Cities of Manila, Taguig, and Calamba, a higher proportion of PAPs earned from Php 12,000 to 15,999 monthly, with 22%, 25% and 19.7%, respectively. The same was observed in the city of Muntinlupa (24.6%), the city of San Pedro (16.4%) and the city of Biñan (21.3%). However, in the City of Santa Rosa and Cabuyao, the income level of the PAPs varied with higher proportions of PAPs with income belonging to (1) Php 12,000-15,999, (2) Php 8,000-9,999, and (3) Php 6,000-7,999. • In terms of occupation, at least four (4) out of 10 PAPs (28.6%) were unemployed, with at least 20% of the PAPs in all cities engaged in wage-based employment. At least 29.8% of the PAPs were employed and wage-based, while 9.4% were enterprise-based. This may pertain to PAPs who had their own businesses or were employed in business establishments.
Public Access	**Existing Transportation/Traffic Situation** • Host LGUs in Metro Manila particularly Cities of Manila, Makati and Taguig are known to be traffic-congested areas. • Major modes of land public transport in the host LGUs are bus, taxi, FX, jeepney, and tricycle. PNR operates from Manila City to Calamba City. **Access Points that may be Affected by the Project** • Based on the road maps of DPWH, there are several national roads that cross the proposed NSRP alignment. There are seven (7) primary, fourteen (14) secondary and nineteen (19) tertiary roads that cross the alignment. These include railroad crossing at grade level and railroad crossing over or under through bridge or tunnel. • 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. There is a possibility that the proposed NSRP might affect the ferry operation during its construction traversing Pasig River.

Summary of Key Environmental Impacts and Management Plan

20. The main impacts of the proposed NSRP are the relocation of the residents living along the right of way and the generation of dust, noise and vibration. More importantly, this project will help improve the condition of traffic by providing a faster and less polluting public mass transport. (Include impact assessment of associated project facilities (e.g. construction work areas, batching plants, raw material sources and the need for permits)

Table ES-8 Summary of the Environmental, Mitigating and Enhancement Measures, and Residual Impacts

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Impact
PRE-CONSTRUCTION			
LAND			
Land use and Classification	Conversion of at least 0.78 km^2 of agricultural land	• DOTr will coordinate with the lot owners, LGUs, other relevant agencies and concerned stakeholders in acquiring and/or securing the ROW	Change in land use of agricultural land utilized as part of ROW
	Conflict with the NLEx-SLEx Connector Road Project of DPWH	• DOTr will coordinate with DPWH (alignment from PNR Solis to Sta. Mesa Station) • Affected section of alignment to run parallel to existing PNR alignment and avoid overlap with the NLEx-SLEx Connector Road Project of DPWH	Acquisition of additional lots from Solis to Sta. Mesa Station.

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Impact
	Potential conflict on ROW, ferry operation and public access	• DOTr will coordinate closely with the MMDA and affected ferry companies to align and ensure that the proposed NSRP construction schedule and activities will be accommodated in their operation plan.	Minimal disruption on the ferry operation
PEOPLE			
People	Involuntary Resettlement of project affected persons (PAPs) (at least 7,692 households)	• DOTr will implement RAP in coordination with NHA, LGUs, and concerned stakeholders and relevant agencies that provide relocation site with complete facilities, amenities and basic services as well as livelihood for income restoration of head-of-household PAPs of ISFs and vulnerable groups.	Resettlement of project affected persons (PAPs) (at least 7,692 households); Enhanced living and livelihood conditions of resettled PAFs of ISFs and vulnerable groups
CONSTRUCTION			
LAND			
Land Use and Classification	Impairment of aesthetic view	• Maintain the construction site/ yards tidy and clean and rehabilitate after construction • Provide temporary screens/ walls to minimise the visual clatter. • Design the project facilities to harmonise with the surrounding environments (shape, colour, size, etc.)	Minimal impairment of aesthetic view
Geology/ Geomorphology	Inducement of subsidence, liquefaction, landslide, mud/debris flow	• Design and construct appropriate foundation and structures based on the 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.	None
Pedology	Degradation of soil quality (soil contamination)	• Prepare and implement solid waste management plan and proper disposal in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969.	None
Terrestrial Ecology	Loss of flora and fauna within ROW and Depot site	• Prior to any clearing activity, conduct 100% inventory of the affected trees along the alignment and secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. • Minimize vegetation clearing to areas to be developed only and implement the tree and vegetation management plan as part of the construction plan • Areas not part of the development within the ROW, around the stations and depot will be prioritized for replanting activity to create buffer zone to improve wildlife habitat. • Maintain other existing vegetation within the ROW that would serve as additional buffer and filter for wildlife and would serve either as temporary shelter or habitat during and after operation.	Minimal loss of flora and fauna within ROW and Depot site Buffer zones to be created will serve as favourable habitat for nurturing wildlife
WATER			
Hydrology	Inducement of flooding	• Design and install drainage to accommodate the surface water runoff from the project and avoid any flooding in the area caused by the project. • Regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.	Improved drainage system in areas along the NSRP alignment
Water Quality	Degradation of surface water quality	• Install wastewater treatment, portable sanitary facilities at construction sites/yards • Install temporary erosion ponds or silt traps around the major work areas. • Plan and implement construction activities in consideration to the water course, embankment, and wet/dry season.	Minimal surface water quality degradation
AIR			
Air Quality	Degradation of air quality	• Adjust construction activities in consideration to weather system, identifying periods of high winds and drought that aggravated dust transport. • Control vehicle movement maintaining the speed limit within the construction site to <10kph • Conduct regular cleaning and clearing of construction access / sites surfaces of spoils and debris from	Minimal degradation of air quality

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Impact
		construction equipment and vehicles and wetting of ground soil in the construction site when necessary.	
Acoustic Noise	Increase in ambient noise level	• Plan and 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. • Design and install effective noise barriers and absorbers along the alignment especially in areas with sensitive facilities and install noise control devices such as mufflers and noise suppressors to all construction equipment and machineries.	Minimal increase in ambient noise levels, confined to local construction sites away from noise-sensitive receptors and limited to daytime period and short duration
Ground vibration	Increase in ambient vibration level	• Plan and implement construction activities in consideration to time, duration, and scale to optimize the use construction equipment, machineries and vehicles. Schedule high vibration generating activities during daytime to reduce disturbance to nearby communities. • Select construction equipment and machineries matching the scale of the construction and with minimal vibration generation if possible	Minimal increase in vibration levels, confined to local construction sites away from sensitive receptors and limited to daytime period and short duration
PEOPLE			
People	Generation of Livelihood Opportunities and improvement of Safety	• Prioritize in hiring local qualified residents in coordination with the LGUs and employ workers in consideration to gender equality and to vulnerable group	Increased number of employed local residents with consideration to gender equality and vulnerable group
	Change/Conflict on ROW and Impact on Public Access	• Maintain the existing public access as much as possible. However, in case of closures/barriers, disseminate information to the public, barangay and LGUs on the potential impact to the existing public access and mitigation measure through the project activities. Provide 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, • Assign traffic guide to provide assistance to the road users.	Inconvenience to public's access to schools and other services, limited to duration of construction.
	Threat to public health and safety	• 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 mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites and access route in consideration to health and safety of local communities • Install fencing of the construction site, provision of signage and posters, and guarding of the access point to ensure that the public is prevented from entering unsafe areas.	Accidents may still occur, but the safety and health guidelines in place will significantly lower the exposure of workers and commuters to occupational and construction hazards, respectively.
	Traffic Congestion	• 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.	Minimal traffic congestion may still occur; Inconvenience to commuters. The residual impacts will be confined to construction phase only.
OPERATION			
LAND			
Land Use and Classification	Impairment of visual aesthetic	• Maintain tree planting to minimise the visual impact of the project	Trees planted along the alignment may create a positive visual impact
Geology/	Inducement of subsidence,	• Conduct proper inspection and prompt maintenance checks to every single installed structure and facility and	None

Environmental Component	Potential Impact	Prevention/Mitigation/ Enhancement Measures	Residual Impact
Geomorphology	Liquefaction, Landslide, Mud/Debris Flow, etc.	improve/ enhance capacity when possible • 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.	
Pedology (Soil Quality)	Degradation of soil quality (soil contamination)	• 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.	None
WATER			
Groundwater and Freshwater Quality	Deterioration of nearby groundwater and surface water due to discharge of untreated wastewater in stations and depot	• Each commuter station and depot will have a sewage treatment plant (**STP**) and a separate treatment facility for non-sewage waste waters such as from sinks, and washings to meet the applicable effluent standards. Handling of potential contaminants during operation phase shall be compliant with RA 6969.	None
AIR			
Acoustic Noise	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 reduce operational noise	Minimal increase in ambient noise levels confined to areas adjacent to alignment
Ground Vibration	Increase in ground vibration level	• 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	Minimal increase in vibration levels
PEOPLE			
People	Generation of estimated 1,550 job positions; opportunities for business	• Coordinate closely with the host LGUs, specifically at the barangay level regarding hiring of regular workers to ensure that the workers being considered are legitimate residents in the area in consideration to gender equality.	Higher employment rates in the host cities
	Influx of ISFs	• Install fencing and provide guards to prevent the settlement of ISFs along the ROW	None
	Threat to public health and safety	• Provide security guards in all stations to direct passengers on the safe zone • Provide sanitary facilities or utilities in all stations and depot. • Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work.	Accidents may still occur, but the safety and health guidelines in place will significantly lower the exposure of workers and commuters to occupational and operational hazards, respectively.
	Traffic Congestion in the areas adjacent to the proposed stations	• Establish a TOD Committee, which compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr • 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.	Minimal traffic build-up may still occur in areas adjacent to the proposed stations
	Reduced travel time by 45 mins for commuters	• Promote benefit of reduced travel time using NSRP mass transit over other modes of transportation	Increased number of commuters using the NSRP for transportation

Grievance Redress Mechanism

21. The Grievance Redress Mechanism (GRM) is an effective tool for early identification, assessment, and resolution of compliants on projects. The GRM for the proposed NSRP has the following objectives:

- To receive and facilitate the resolution of project stakeholders' concerns and grievances about environment related project impacts which cannot be settled during public consultations, paying particular attention to the impacts on vulnerable groups;
- To measure to the risks and adverse impacts of the project; and
- To address project stakeholders' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies.

The Grievance Procedure for the proposed NSRP is presented in **Table ES-9.**

Table ES-9. Grievance Procedure

Steps	By	Actions	
1	**Aggrieved Stakeholder**	Any aggrieved stakeholder will lodge his/her grievance in writing, verbally or electronically transmitted to the t DOTr Railway Office for immediate action.	
-	**Grievance officer (DOTr Railway Office)**	Receiving the written, verbal or electronically forwarded complaint from the aggrieved stakeholder and explaining the grievance redress process. Acknowledge receipt (and entering it into the grievance registry of the DOTr-Record Management System) of the complaint, provide copy 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.	
		a) If the complaint is project-related, the DOTr Railway Office will forward the complaint to the HSE Officer within the day from receipt of complaint.	b) If it is not project related, the DOTr Railway Office will assist the PAP by referring the complaint to the appropriate agency or LGU who may be able to act on the complaint.
3	**Aggrieved Stakeholder**		If the aggrieved stakeholder is not satisfied with the decision of the Grievance officer of DOTr Railway Office that the complaint is not project related, the aggrieved stakeholder may elevate his/her complaint to the HSE Officer.
-	Grievance officer (DOTr Railway Office)		Receive request from the aggrieved stakeholder to elevate his/her complaint to HSE Officer/ HSE Unit of contractor Record the status of the aggrieved stakeholder complaint.
-	**1st Level PMO HSE Officer**	Receives complaint from the Grievance officer. Act and decide on the complaint within 3 working days reckoning from the day it is received from Grievance officer (DOTr Railway Office), and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.	
-	Grievance officer (DOTr Railway Office)	Receive and record decision of **1st level decision maker** Inform to the aggrieved stakeholder.	
-	**Aggrieved Stakeholder**	Receives action of the **1st level** through the Grievance officer If satisfied, the complaint is resolved and recorded accordingly. If not satisfied with the decision of the **1st level** or if his/her complaint has not been acted upon within a period of 3 working days and has not received any response from the 1st level decision maker, the aggrieved stakeholder can forward the complaint, or file an appeal, to the **HSEC**.	
	Grievance officer (DOTr Railway Office)	Receive request from the aggrieved stakeholder to elevate his/her complaint to the **HSEC** Record the status of the aggrieved stakeholder complaint. Forward the complaint to the **2nd Level** within the day from receipt of complaint.	
-	**2nd Level HSEC**	Receives complaint from the Grievance officer. Act and decide on the complaint within 10 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.	
-	Grievance officer (DOTr Railway	Receive and record decision of **HSEC** Inform to the aggrieved stakeholder.	

	Office)	
-	**Aggrieved Stakeholder**	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 10 working days and has not received any response from **the 2nd Level,** the aggrieved stakeholder can forward the complaint, or file an appeal, to **the 3rd Level**.
-	Grievance officer (DOTr Railway Office)	Receive request from the aggrieved stakeholder to elevate his/her complaint to **the 3rd Level.** Record the status of the aggrieved stakeholder complaint. Forward the complaint to **the 3rd level** within the day from receipt of complaint.
-	**3rd Level MMT / PMO Board**	Receives complaint from the Grievance Officer. Act and decide on the complaint within 15 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.
-	Grievance officer (DOTr Railway Office)	Receive and record decision of **the 3rd Level** Inform to the aggrieved stakeholder.
-	**Aggrieved Stakeholder**	Receives action of **the 3rd Level** T through the Grievance officer If satisfied, the complaint is resolved and recorded accordingly. If not satisfied with the decision of the MMT or if his/her complaint has not been acted upon within a period of 15 working days and has not received any response from **the 3rd Level**, the aggrieved stakeholder can forward the complaint, or file an appeal, to the DENR
-	**4th Level DENR**	Receives complaint from aggrieved stakeholder. Once the complaint is filed in the DENR, technical conference will follow.

1. PROJECT DESCRIPTION

22. The Department of Transportation (DOTr) is the executive department of the Philippine Government responsible for the maintenance and expansion of viable, efficient, and dependable transportation systems as effective instruments for national recovery and economic progress through the country's land, air and sea transportation infrastructures.

23. President Duterte's administration released a 10-point Socio-economic Agenda and 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 pesos from 2017–2022.

24. The Build!Build!Build! Program is the administration's comprehensive infrastructure development program launched in April 2017. The program identified seventy (70) infrastructure flagship projects or high impact projects. Of these projects, ninteen (19) projects are located in Mega Manila. Besides the flagship projects, four (4) projects were also listed as key projects.

25. 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.

26. DOTr's thrust is to guide the development of new urban centers and to meet large residential demands; A commuter railway service to connect Metro Manila with its adjacent northern and southern suburban areas is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the Greater Capital Region (GCR), comprising of Region III, NCR and Region IV-A.

27. The Japanese Interational Cooperation Agency (JICA) and DOTr have agreed the conduct of Detailed Design Study (including supplementary F/S) of the Malolos-Clark Railway Project (MCRP) and the North South Railway Project (NSRP) – South Line (Commuter). The projects will be assisted by a grant within the framework of JICA and shall be co-financed by Asian Development Bank (ADB).

28. The target of this study is NSRP line extending NSCR line to the south. The NSCR Due Diligence (DD) study has already been accomplished and is now under consturction.

29. Currently, PNR regular route runs from Tutuban to Alabang and vice versa every hour starting at 5:00 in the morning up to 7:30 in the evening. During rush hour, a 30 minute interval is implemented. There are also Mamatid-Tutuban and Calamba-Tutuban daily trips. The trains leave Mamatid at 4:56 a.m. and in Calamba at 5:46 a.m. going to Tutuban. The trains depart Tutuban at 7:07 p.m. to Mamatid and 6:37 p.m. to Calamba.

30. The proposed NSRP will not share the tracks of the proposed freight and long-haul trains. PNR line will continue its operation while the NSRP is being constructed. Existing tracks will be reused for the freight and long-haul trains operation. In addition, NSRP plans to connect to the MMSP line at FTI station but needs further study.

1.1 PROJECT LOCATION AND AREA

1.1.1 Description of the Project Area

31. The NSRP will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (**PNR**) traversing the ten (10) Local Government Units (LGUs) of the Cities of Manila, Makati, Taguig, Parañaque and Muntinlupa in the National Capital Region (NCR); and Cities of San Pedro, Biñan, Santa Rosa, Cabuyao and Calamba in the Province of Laguna.

32. The length of the NSRP will be approximately 55.6 kilometer (km) from Solis Station to Calamba Station. Based on the preliminary design, 37.8 km section will be elevated, 4.0 km will be embankment and 13.8 km of the alignment will be at grade. The line will have twenty (20) stations which will all be elevated. The location map of the proposed NSRP is shown in **Figure 1.1.1**.

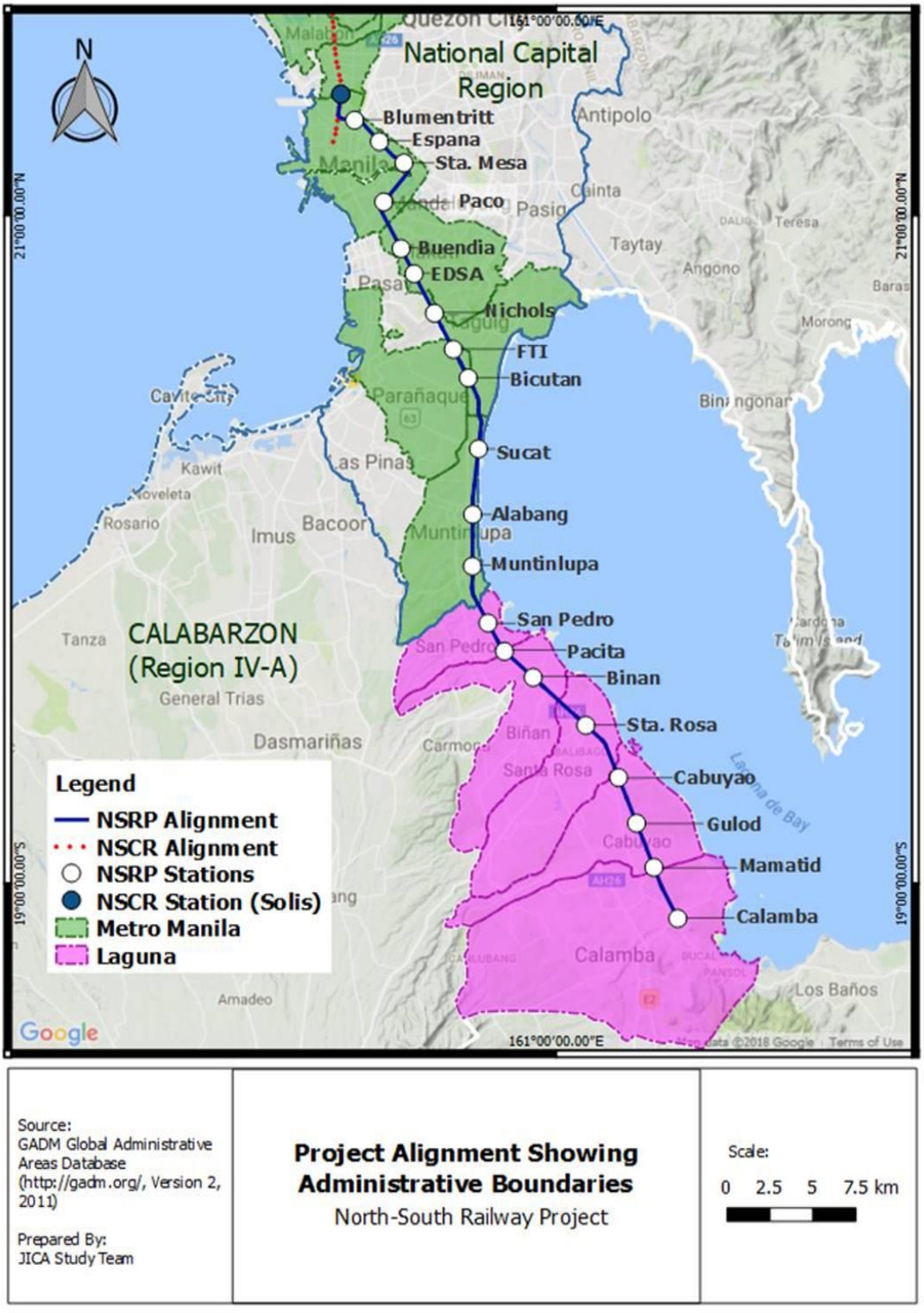


Figure 1.1.1 Project Alignment Showing LGUs' Political Boundaries

1.1.2 Impact Areas

33. The direct impact areas (DIA) cover the existing PNR-ROW with an approximate width of 30 meters (m) with an estimated total length of 55.6 km. Additionally, the DIA at the Commuter Station will be extended to a total width of 60 m with a span of approximately 180-220 m. The DIA also include the proposed Depot site. In terms of socio economic benefits, the DIA areas include the ten (10) host Local Government Units (LGUs) in NCR and Province of Laguna which are the project beneficiaries for employment, business opportunities, taxes and benefits from decongestion of road from vehicular traffic as well as expansion of economic opportunities in the Region.

34. The Indirect Impact Areas (IIA) will cover the other barangays within the host City, nearby LGUs who will benefit from the rapid economic growth in the region and the entire country. They will benefit from the stable and reliable means of transportation that can contribute further to the economic stability of the country. Error! Reference source not found. **Table 1.1.1** presents the impact areas. **Figure 1.1.2** to **Figure 1.1.11** show the direct impact barangays per city. **Table 1.1.2** presents the geographical location of the stations.

Table 1.1.1 Impact Areas of the Proposed NSRP

Host City	Direct Impact Barangays	Indirect Impact Barangays
Manila	Barangays 473, 472, 474, 483, 484, 485, 487, 443, 442, 444, 450, 351, 348, 349, 356, 359, 224, 227, 217, 621, 629, 628, 630, 165, 162, 161, 185, 186	Barangays 1 to 160,163,164, 166 to 184, 187 to 216, 218 to 223, 225 to 226, 228 to 347, 350, 352 to 358, 360 to 441, 445 to 449, 451 to 471, 475 to 482, 486, 488 to 620, 622 to 627, 631 to 905
Makati	San Antonio, Pio del Pilar, Bangkal, Magallanes	Bel-Air , Cembo b, Comembo b, Carmona, Dasmariñas, East Rembo b, Forbes Park, Guadalupe Nuevo, Guadalupe Viejo, Kasilawan, La Paz, Olympia, Palanan, Pembo b, Pinagkaisahan, Pitogo b, Poblacion, Post Proper Northside b, Post Proper Southside b, San Isidro, San Lorenzo, Santa Cruz, Singkamas, South Cembo b,Tejeros, Urdaneta,Valenzuela, West Rembo b, Rizal
Taguig	Fort Bonifacio, Western Bicutan, North Daang Hari, South Daang Hari, Bagumbayan, Tanyag	Bambang,Calzada,Hagonoy,Ibayo-Tipas,Ligid-Tipas,Lower, Bicutan,Maharlika, Village, Napindan, Palingon,Santa Ana, Central Signal Village (Signal Village) , Tuktukan, Upper Bicutan, Ususan,Wawa, Central Bicutan, Katuparan , New Lower Bicutan , North Signal Village , Pinagsama , San Miguel , South Signal Village
Parañaque	San Martin de Porres	Baclaran, Don Galo, La Huerta, San Dionisio, Santo Niño, Tambo, B. F. Homes, Don Bosco, Marcelo Green Village, Merville, Moonwalk, San Antonio, San Isidro, Sun Valley, Vitalez
Muntinlupa	Sucat, Buli, Cupang, Alabang, Bayanan, Putatan, Poblacion, Tunasan	New Alabang Village
San Pedro	San Antonio, San Vicente, Nueva	Bagong Silang, Cuyab, Estrella, G.S.I.S., Landayan, Langgam, Laram, Magsaysay, Poblacion, Riverside, San Roque, Santo Niño, United Bayanihan, United Better Living, Sampaguita Village, Calendola, Narra, Chrysanthemum , Fatima , Maharlika , Pacita 1, Pacita 2, Rosario , San Lorenzo Ruiz
Biñan	Canlalay, San Vicente , Sto Niño, San Antonio, Platero	Biñan (Poblacion), Bungahan, Santo Tomas (Calabuso), Casile, De La Paz, Ganado, San Francisco (Halang), Langkiwa, Loma, Malaban, Malamig, Mampalasan, Poblacion, San Jose, Soro-soro, Santo Domingo, Timbao, Tubigan, Zapote
Sta. Rosa	Tagapo, Labas, Pooc, Dila, Dita	Aplaya, Balibago, Caingin, Don Jose, Ibaba, Macabling, Malitlit, Malusak (Pob.), Market Area (Pob.), Kanluran (Pob.), Pulong Santa Cruz, Santo Domingo, Sinalhan
Cabuyao	Poblacion 1, Poblacion 2, Bigaa, Sala, Niugan, Banay-Banay, San Isidro, Pulo, Mamatid, Banlic (Cabuyao)	Baclaran, utong, Casile, Gulod, Marinig, Pittland, Diezmo, Barangay Tres (Pob.)
Calamba	San Cristobal, Parian, Poblacion I, Lecheria, Halang, Bucal, Pansol, Sucol, Masili, Banlic (Calmaba)	Bagong Kalsada, Banadero, Barandal, Bubuyan, Bucal, Bunggo, Burol, Camaligan, Canlubang, Hornalan, Kay-Anlog, Laguerta, La Mesa, Lawa, Lingga, Looc, Mabato, Makiling, Mapagong, Maunong, Mayapa, Paciano Rizal, Palingon, Palo-Alto, Barangay 2 (Pob.), Barangay 3 (Pob.), Barangay 4 (Pob.), Barangay 5 (Pob.), Barangay 6 (Pob.), Barangay 7 (Pob.), Prinza, Punta, Puting Lupa, Real, Saimsim, Sampiruhan,San Jose,San Juan, Sirang Lupa, Milagrosa (Tulo),Turbina,Ulango,Uwisan, Batino, Majada Labas

Source: JICA Study Team

Table 1.1.2 Station Location

Stations		Location	Geographical Coordinates		Distance to next station
			North Latitude	East Longitude	
1.	Solis (NSCR)[2]	Manila City	14°38'6.37"N	120°58'36.03"E	1.9 km
2.	Blumentritt	Manila City	14°37'20.54"N	120°59'3.08"E	1.9 km
3.	España	Manila City	14°36'40.36"N	120°59'51.30"E	1.8 km
4.	Santa Mesa	Manila City	14°36'0.28"N	121° 0'38.82"E	2.9 km
5.	Paco	Manila City	14°34'47.23"N	120°59'59.52"E	3.0 km
6.	Buendia	Makati City	14°33'19.89"N	121° 0'33.16"E	1.8 km
7.	EDSA	Makati City	14°32'32.75"N	121° 0'58.34"E	2.4 km
8.	Nichols	Taguig City	14°31'18.65"N	121° 1'37.94"E	2.2km
9.	FTI	Taguig City	14°30'17.57"N	121° 2'11.10"E	2.6 km
10.	Bicutan	Parañaque City	14°29'22.58"N	121° 2'42.27"E	4.1 km
11.	Sucat	Muntinlupa City	14°27'4.42"N	121° 3'2.79"E	4.0 km
12.	Alabang	Muntinlupa City	14°25'1.27"N	121° 2'52.11"E	301 km
13.	Muntinlupa	Muntinlupa City	14°23'24.69"N	121° 2'51.09"E	3.6 km
14.	San Pedro	San Pedro City	14°21'37.81"N	121° 3'22.01"E	1.9 km
15.	Pacita	San Pedro City	14°20'43.44"N	121° 3'54.78"E	2.4km
16.	Biñan	Biñan City	14°19'52.73"N	121° 4'52.40"E	4.1 km
17.	Santa Rosa	Santa Rosa City	14°18'24.89"N	121° 6'32.34"E	3.5 km
18.	Cabuyao	Cabuyao City	14°16'49.45"N	121° 7'34.21"E	2.9 km
19.	Gulod	Cabuyao City	14°15'20.61"N	121° 8'9.94"E	2.8 km
20.	Mamatid	Cabuyao City	14°13'58.86"N	121° 8'43.47"E	3.2 km
21.	Calamba	Calamba City	14°12'25.31"N	121° 9'28.53"E	
Total Length					55.6 km

Source: JICA Study Team

[2] NSCR station where NSRP will be interconnected

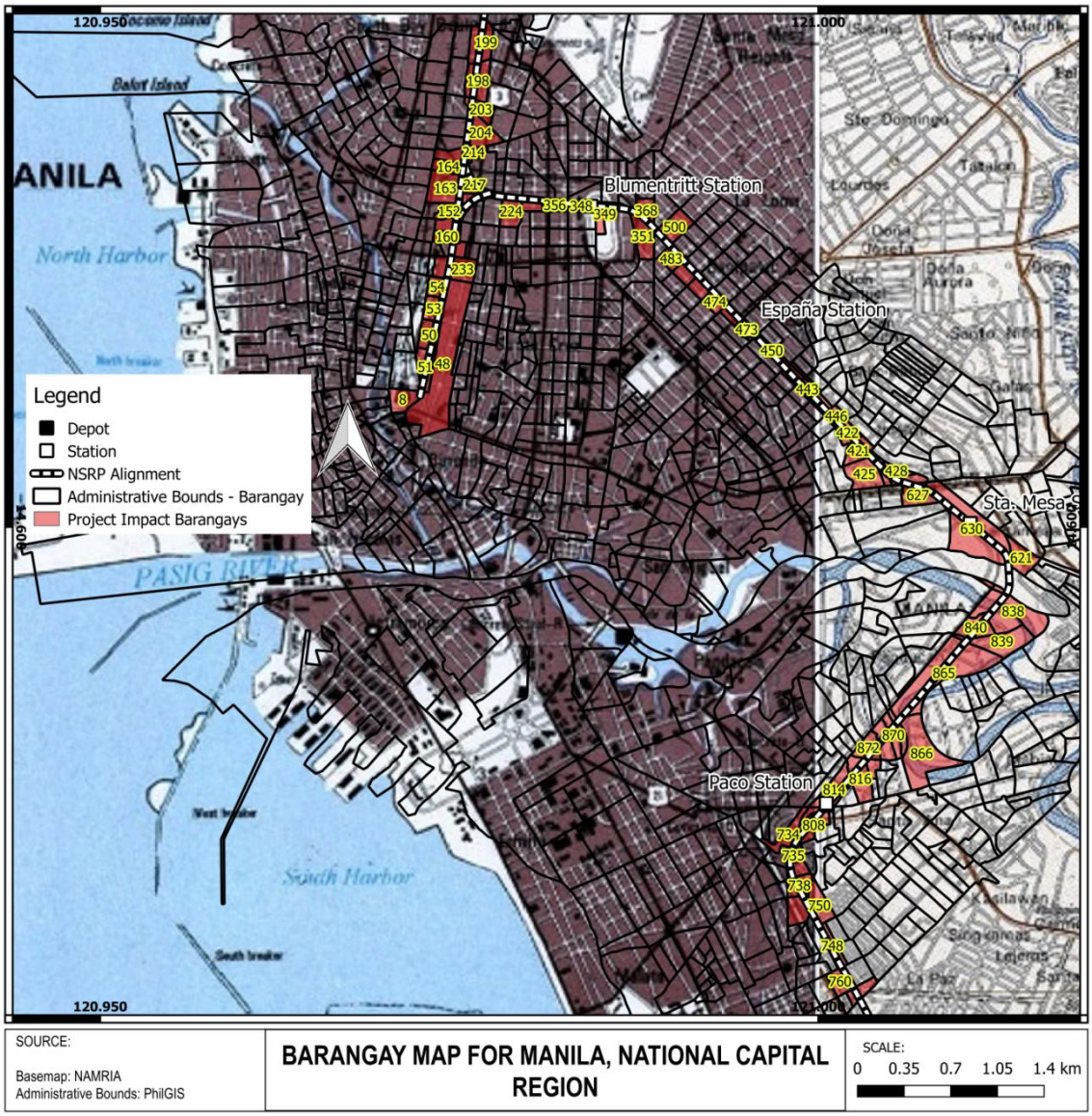


Figure 1.1.2. Direct Impact Barangays within Manila City

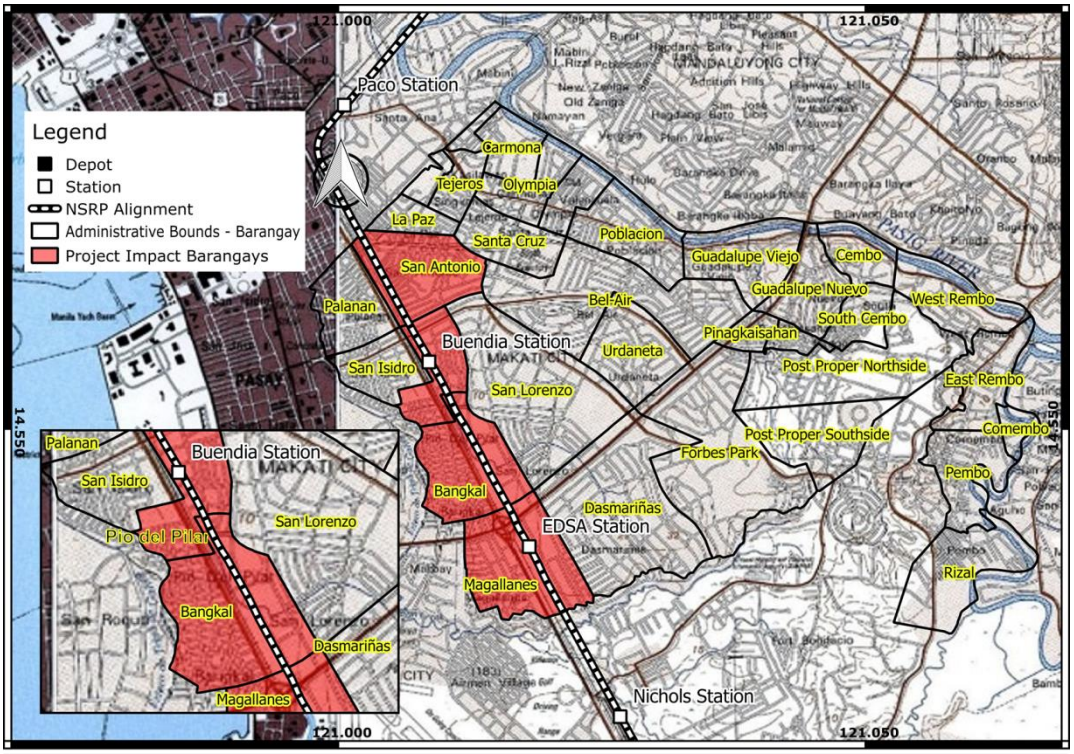


Figure 1.1.3 Direct Impact Barangays within Makati City

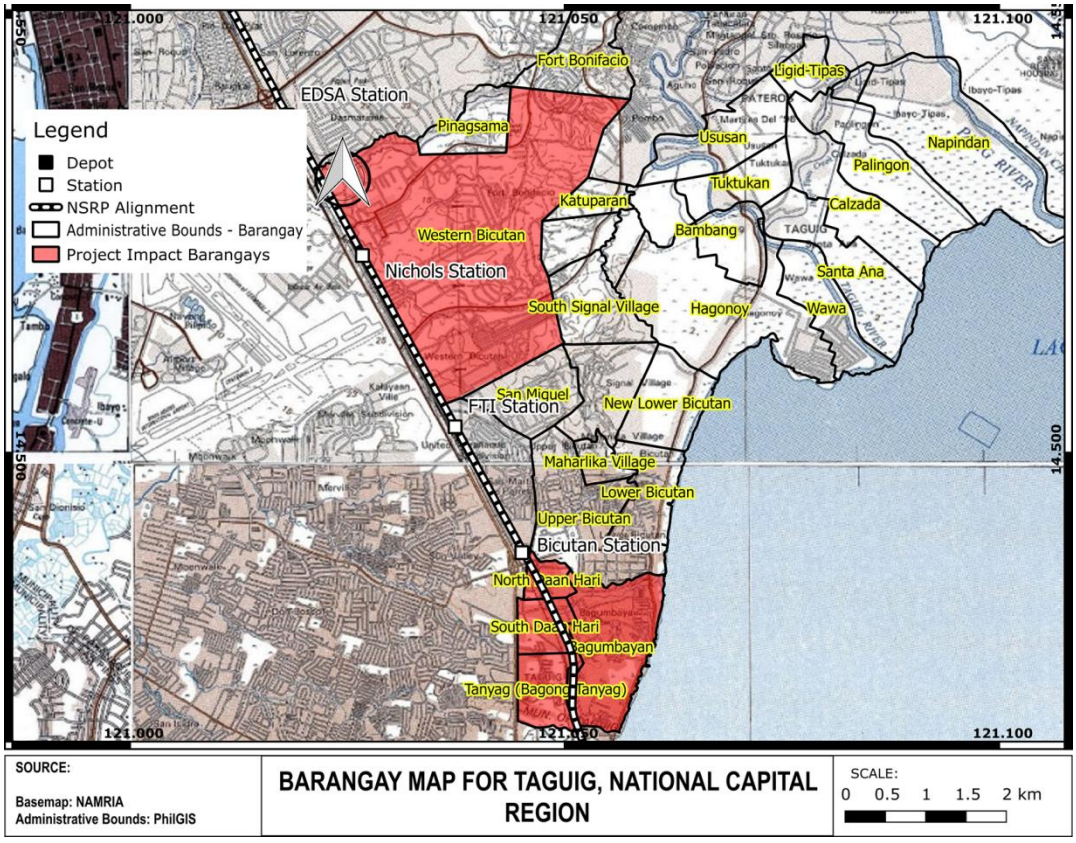


Figure 1.1.4 Direct Impact Barangays within Taguig City

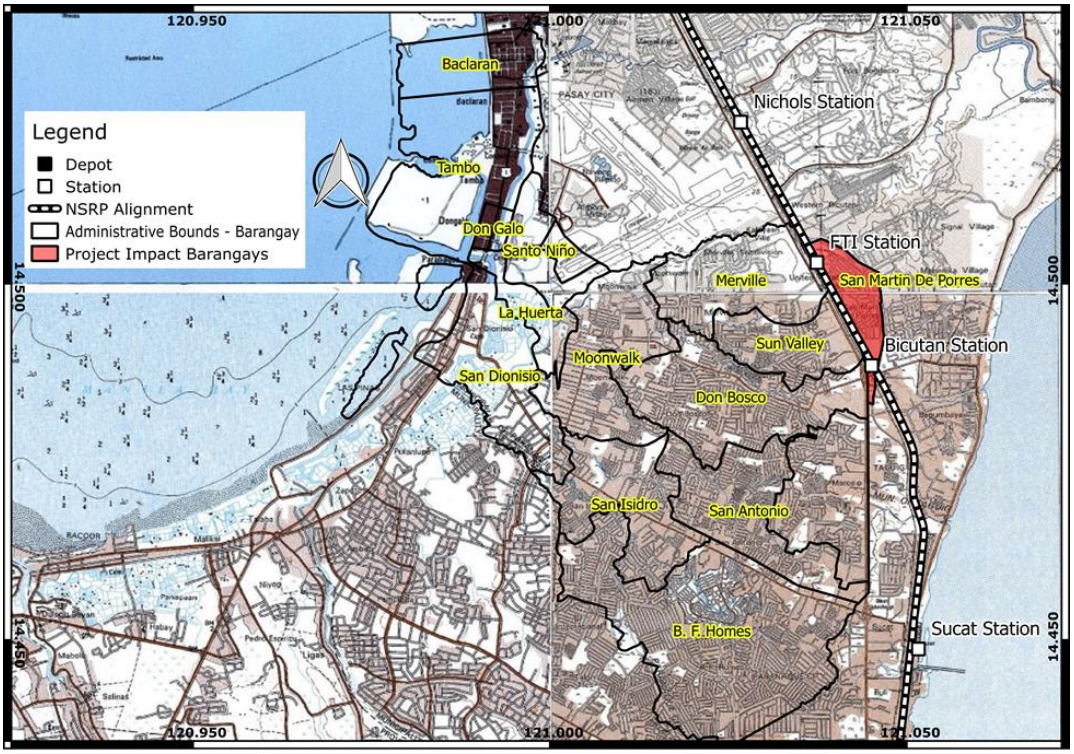


Figure 1.1.5 Direct Impact Barangays within Parañaque City

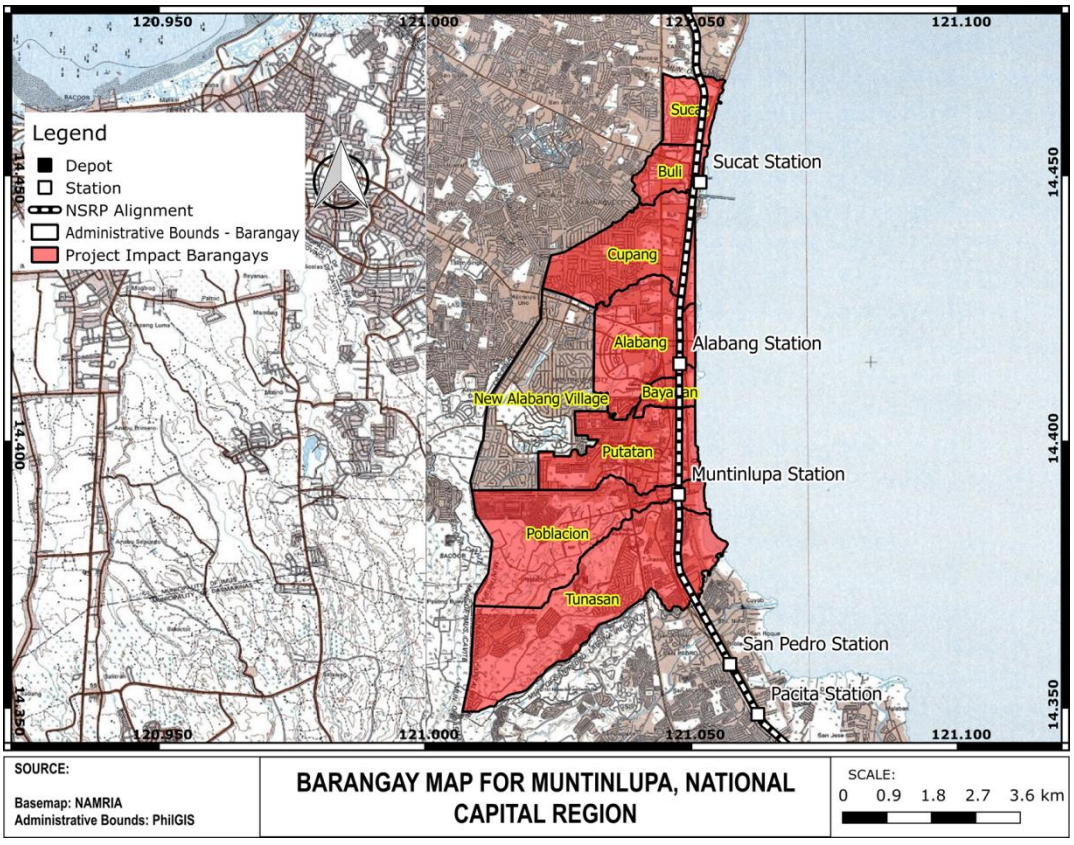


Figure 1.1.6 Direct Impact Barangays within Muntinlupa City

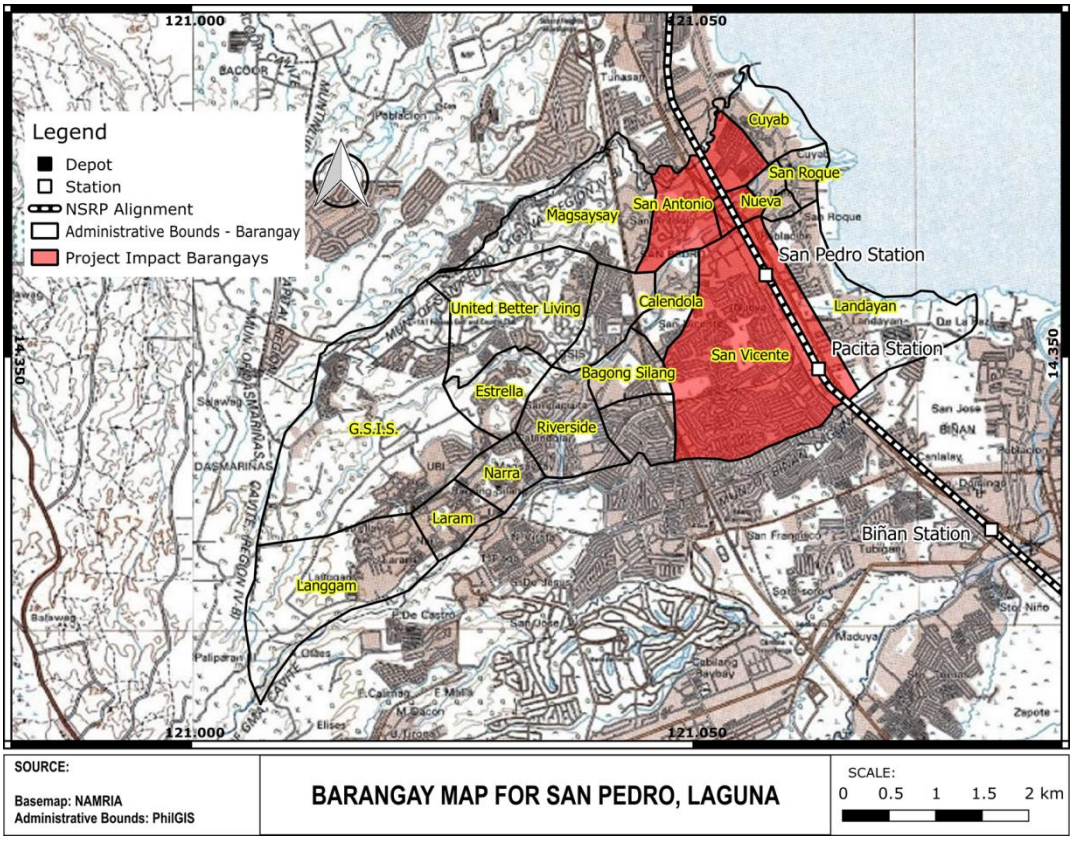


Figure 1.1.7 Direct Impact Barangays within San Pedro City

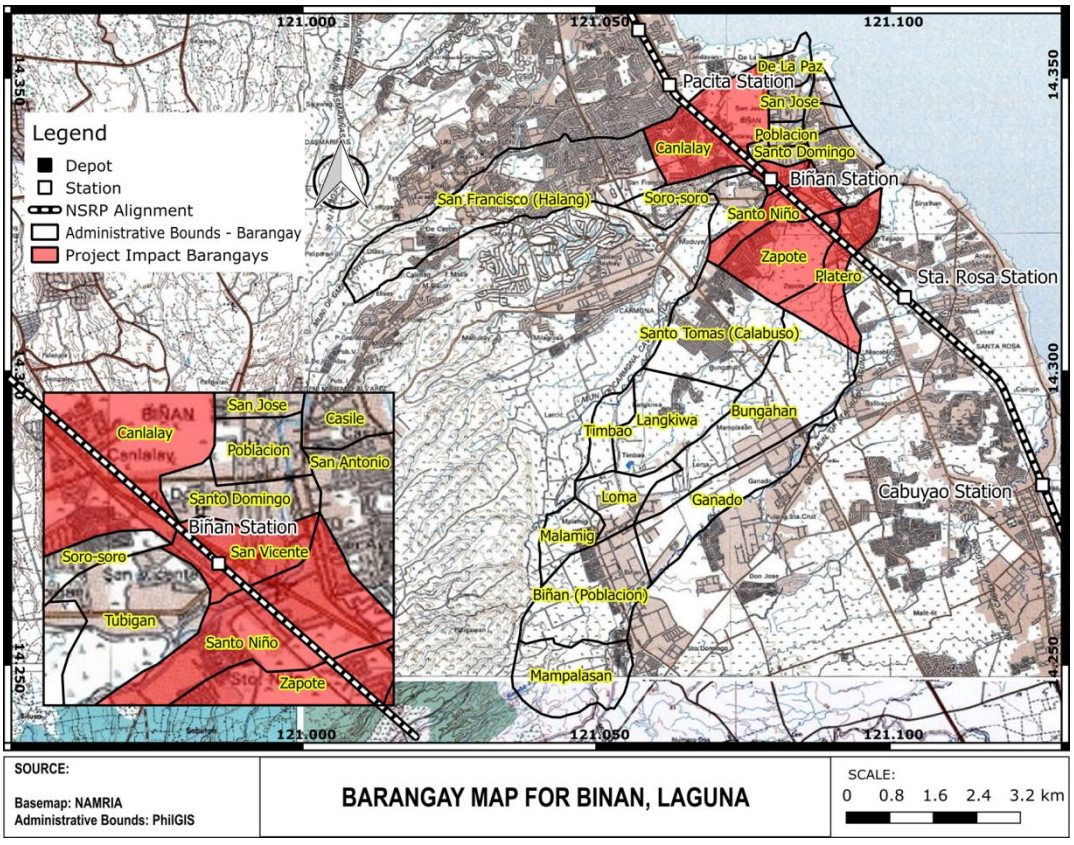


Figure 1.1.8 Direct Impact Barangays within Biñan City

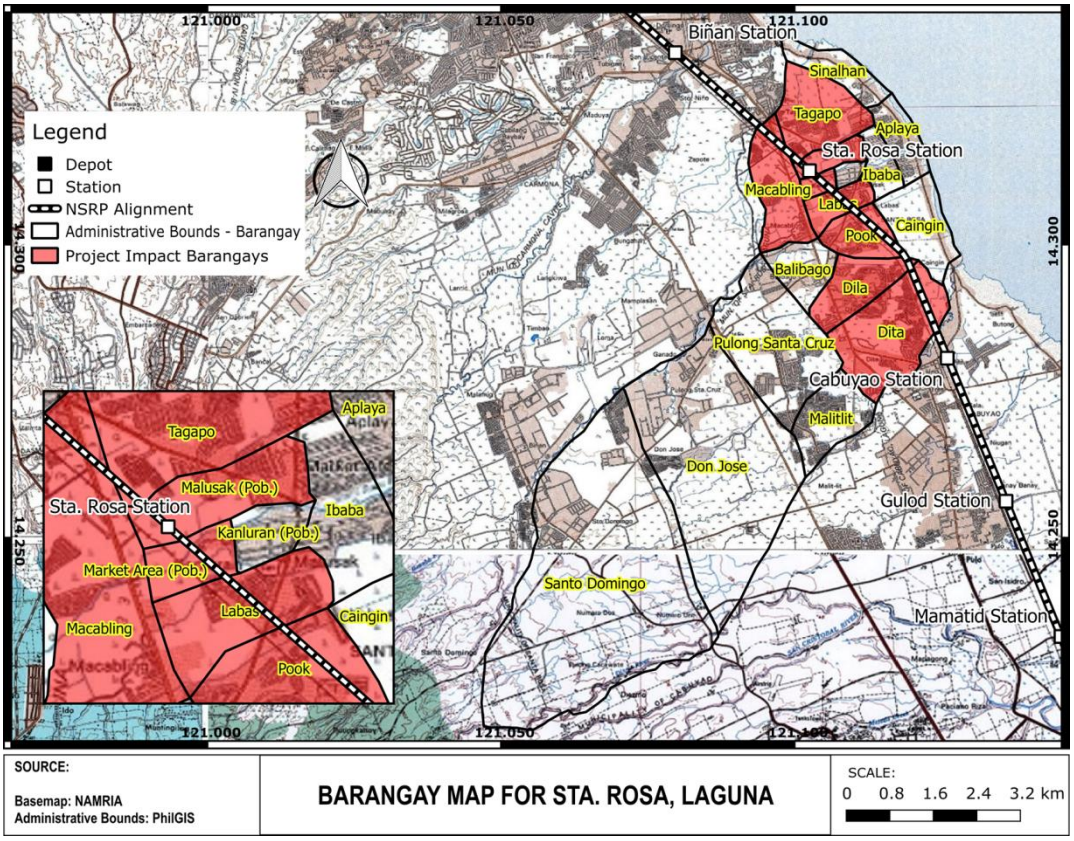


Figure 1.1.9 Direct Impact Barangays within Sta. Rosa City

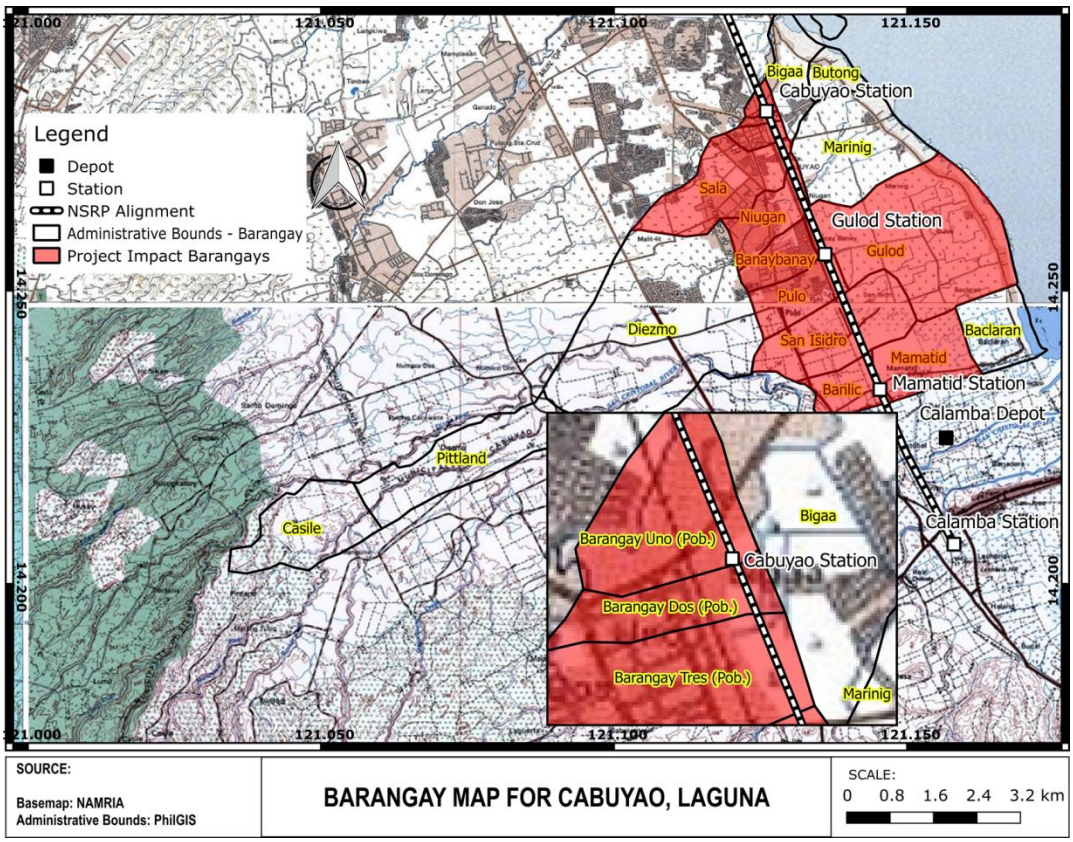


Figure 1.1.10 Direct Impact Barangays within Cabuyao City

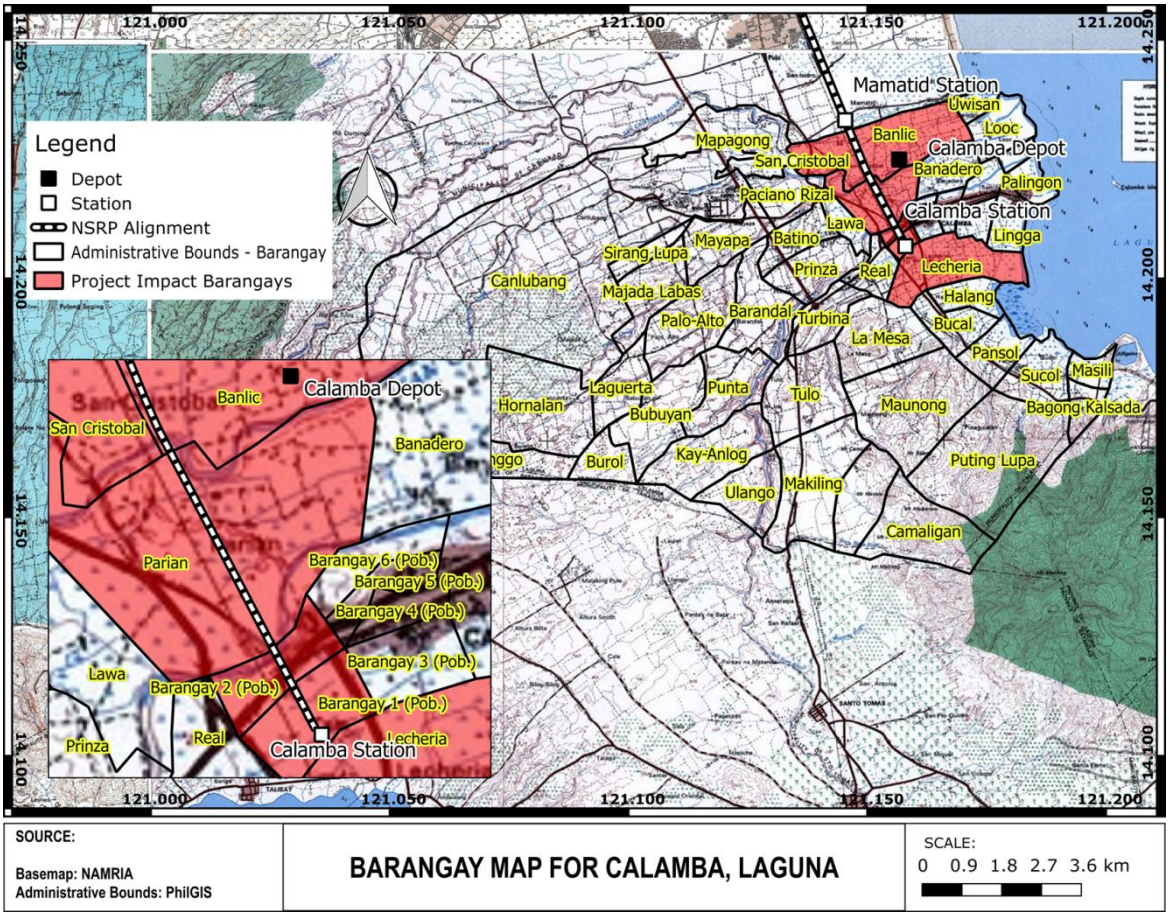


Figure 1.1.11 Direct Impact Barangays within Calamba City

1.2 PROJECT RATIONALE

35. The population of Metro Manila in the Philippines increased by 1.5 times from 8.0 million in 1990 to 12.0 million in 2010. With a population density of 20,000 per km², NCR is home to about 13% of the population of the Philippines and the main economic center accounting for 38% of the country's gross domestic product (GDP).

36. Severe traffic congestion and environmental degradation characterize Metro Manila particularly at city centers where high density development continues. 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.

37. Urban rail services including Metro Rail Transit (MRT), Light Rail Transit (LRT) and commuter rail offer 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 the increase daily passenger transit demand.

38. A mass transit service connecting Metro Manila with its adjacent areas is currently limited and as such, this presents a significant bottleneck to the further development of Metro Manila and its adjacent northern and southern suburban areas.

39. For this reason, the expansion of the existing mass transportation system has been identified by the Government as one of its highest priorities.

40. Based on the Metro Manila Urban Transportation Integrated Study (MMUTIS) formulated by the Philippine Government in 1996, with the technical and financial assistance from JICA, an

Urban Development Plan and Transportation Network Development Plan was established with 2015 as the target year.

41. Today, Manila is serviced by LRT1, LRT2, and MRT3, total length of 51.2km of railway services. However there is still a large demand for mass public transport to meet the transit need of the fast growing and highly dense metropolis.

42. While there is a rail commuter service by the PNR connecting the capital to the southern cities as far as Biñan in Laguna Province there is no such services to the north of Metro Manila area. Moreover, areas as far as Malolos to the north are rapidly developing into residential areas without the corresponding provision in public transport provision.

43. To guide the development of new urban centers and to meet large residential demands, a commuter railway service to connect Metro Manila with its adjacent northern and southern suburban areas is deemed to be an important mass transit backbone for Metro Manila as well as for the growth corridor of the GCR, comprising of Region III, Metro Manila and Region IV-A.

1.3 PROJECT ALTERNATIVES

1.3.1 ROW Alternative Options

44. The proposed Project will utilize the existing PNR-ROW and no other ROW alternative was considered because the area is highly developed.

1.3.2 Structure Alternative Options

45. As the Solis-Calamba section passes through established city areas, there are many continuous road crossings. There are also flood prone areas. There are around 10,000 Project Affected Families (**PAFs**) disregarding the hazard of living along the PNR ROW. Informal settler families and their structures can be found within the bounds of the proposed 30 m ROW for NSRP. Most of the structures located at approximately 2 to 10 meters from the track are a mixture of concrete and light materials with 2 or more families sharing in a structure. These affected families take the risk of living in what is considered as a danger area due to free or low rental cost and proximity to their livelihood and other services. **Table 1.3.1** presents the structural type options.

Table 1.3.1 Comparison of Structural Type of NSRP

	Elevated Structure Option	At Grade Structure	Embankment
Social Environment			
Land Acquisition	The necessary ROW is narrower than at grade structure	The necessary ROW is wider than elevated structure	The necessary ROW is the same with at grade structure
Affected Households	Resettlement of PAPs and ISFs within the ROW is necessary	Resettlement of PAPs and ISFs within the ROW is necessary	Resettlement of PAPs and ISFs within the ROW is necessary
ROW	The necessary ROW between stations is 30m, and 60m at station	The necessary ROW between stations is 30m, and 60m at station	The necessary ROW between stations is 30m, and 60m at station
Dividing of local community	Little impact of community division	Significant impact of community division	Significant impact of community division
Pollution Prevention			
Noise (Outside train)	Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.	Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.	Noise will be generated along the railway, but the impact can be mitigated by installing noise barriers.
Air Pollution	The operation of construction machinery and vehicles during construction is expected to generate air pollution	There will be relatively few vehicles loading embankment material during construction and air pollution risk is relatively low	The operation of construction machinery and vehicles during construction is expected to generate air pollution
Water Pollution	Little impact	Little impact	Little impact

	Elevated Structure Option	At Grade Structure	Embankment
Ground Subsidence	No ground subsidence	There is risk of land subsidence in case of soft ground	Possible in soft soil areas
Flooding Risks	As it is an elevated structure, the tracks will not be submerged in case of flooding	Need measures to prevent flooding for at grade structure	Need for additional drainage system to minimize flooding
Engineering			
Construction Time	Short construction period	Long if soil improvement is necessary	Shorter construction period than at grade structure
Operation /Maintenance	Easy due to access	Easy but in case of ground subsidence or condition change, reparation is very difficult	Easy due to access
Disaster Prevention	Relatively safe and measures are easy compared to underground structure	Relatively safe and measures are easy compared to elevated structure	Relatively safe and measures are easy compared to underground structure
Earthquake	Structures are designed in consideration of earthquakes	As at grade structures are low embankments, the impact of earthquake is limited	Embankment designed for earthquake loads
Landscape	The structure design needs to consider the impact on landscape	The structure design needs to consider the impact on landscape	The structure design needs to consider the impact on landscape
Physical Conditions	Few impacts on roads	Significant impact on existing roads and there are risks of intrusion into railway crossings and rails	Few impacts on roads if embankment provides openings
Overall Evaluation	After overall evaluation, it is the most suitable structure	There is a significant impact on existing roads and limited merits compared to the elevated structure	Low cost; recommended for non-flood prone areas and no crossings at main roads

Source : JICA Design Team

1.3.3 Vertical Alignment Alternative Options

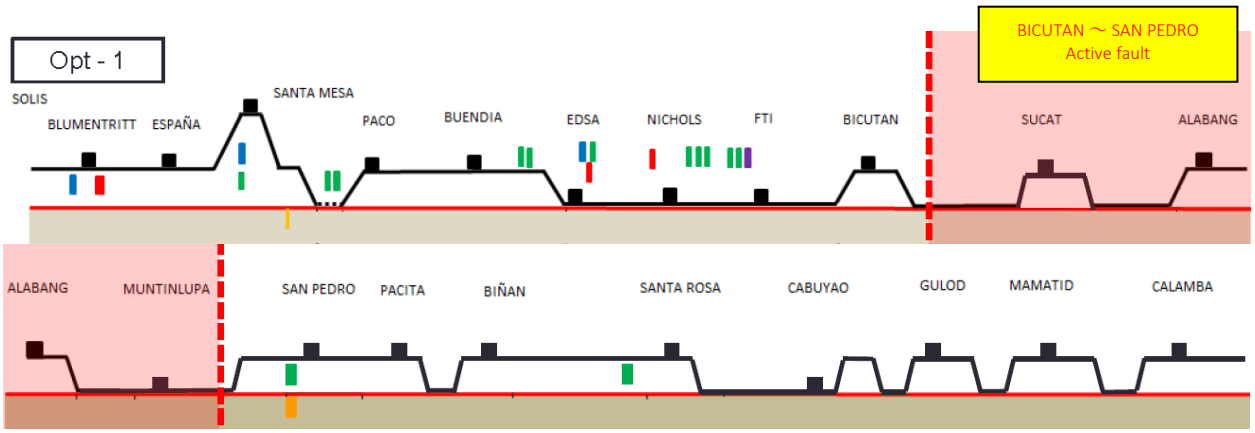
46. There are three (3) primary considerations to determine the vertical alignment option. These are:

1. Elevated assumption by traffic volume per day;
2. Critical points determined during the DED; and
3. Interference of active fault where safety and restorability or convenience will prevail.

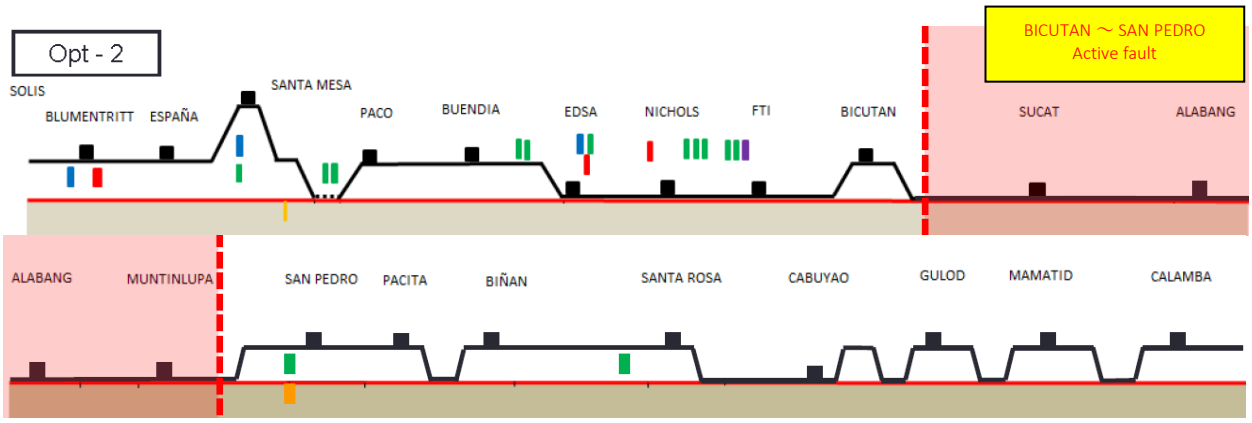
47. In addition, significant issues relative to railroad crossing will also be considered. These are:

1. Low service for transportation at the railroad crossing;
2. Bottleneck railroad crossing for transportation where traffic congestion often occurs;
3. Bottleneck railroad crossing for passenger/walker;
4. Narrow sidewalk at the railroad crossing;
5. Occurrence of many accidents at the railroad crossing (2 or more accidents in the last 5 years); and
6. School route at the railroad crossing.

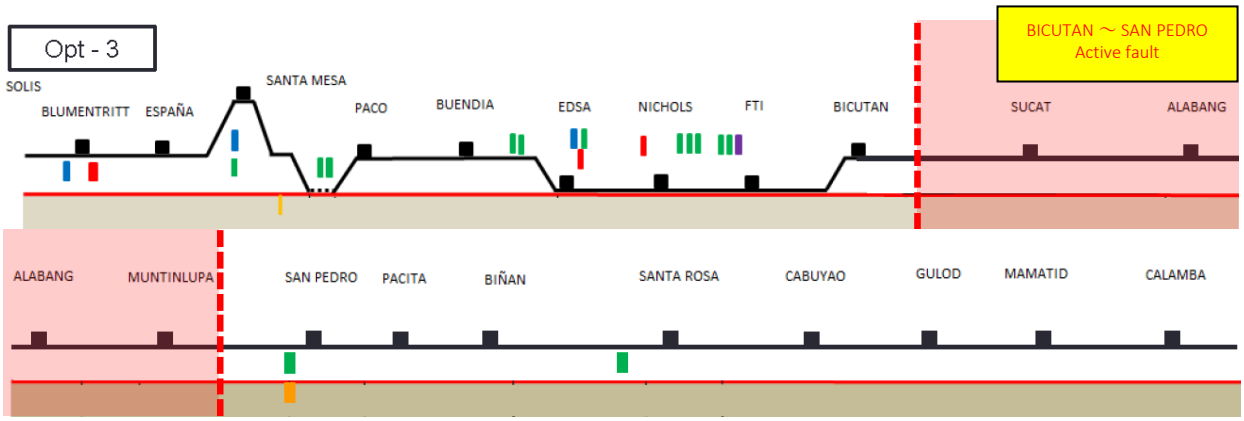
48. Additional consideration is the presence of active fault between Bicutan to San Pedro. Presented in **Figure 1.3.1** are the options for vertical alignment. Considering the structural types, the preferred vertical alignment for the proposed NSRP is Option 1.



Elevated assumption by traffic volume per day



Critical points determined during the DED



Interference of active fault where safety and restorability or convenience will prevail

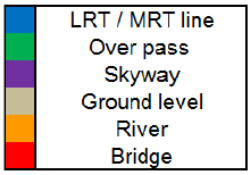


Figure 1.3.1 Option Description - Schematic Profile

1.3.4 Depot Alternative Options

49. For NSRP, there are two (2) sites being considered for the Depot. The required area of the depot is approximately 40 to 45 hectares (ha) including the space for the Training Center for railway personnel.

- Option 1: Sucat Power Plant: Old Power Plant with an approximate area of 0.13 km² (13 ha).
- Option 2: Between Mamatid and Calamba – Agricultural Land with an approximate area of 0.78 km² (78 ha).

Table 1.3.2 Alternative Comparison of Depot Site

	Option 1 Sucat Thermal Power Plant Area	Option 2 Between Mamatid and Calamba PNR Stations
Social Environment		
Land use	Old Power Plant: Stopped working in 2002 : Approximately 13 hectares. River Bend Consolidated Mining Corp. (Private Company) has an existing contract with Power Sector Assets and Liabilities Management Corporation (PSALM) for dismantling of movable equipment and its clean-up.	Agricultural land with portion of built-up areas
Land Acquisition	Limited area for land acquisition	The areas need acquisition of 78 ha. of agricultural land
Resettlement	Resettlement of dozens of PAFs along the access line to the depot	PAFs within the area being considered
Natural Environment		
Protected Area	No encroachment to any protected area	No encroachment to any protected area
Land Alteration	Loss of houses due to the access line	Loss of houses and agricultural land
Pollution		
Noise and Vibrations	Concentrated residential area, potential impacts of noise and vibration	Adjacent to low-cost housing in the northwest and San Cristobal River to the south
Water	Risk of water pollution of Laguna de Bay due to mud water discharged during construction if not mitigated	Risk of water pollution to San Cristobal River due to mud water discharged during construction if not mitigated
Engineering		
Construction	Need to demolish existing structures prior to construction and is not favorable cost wise The land is limited and constrains the facility layout	Most are open areas (agricultural) with settlement in the west and southeast
Operation	Close to urban area and convenient for commuting to the depot site	Near to the proposed Mamatid station but accessibility might be an issue
Start in practice	Can be operated as soon as rails are laid to the depot	Can be operated as soon as rails are laid to the depot
Evaluation	There is a need to demolish existing structures prior to construction and is not favorable cost wise. The land is also limited and constrains the facility layout.	Considering the storage of rolling stock, operation of carriage and maintenance, it is the preferred site for the depot.

Source: JICA Design Team

1.3.5 Technology Option

50. The DOTr will utilize an Electric Multiple Unit (EMU) Train for the Project. An EMU is a multiple unit train consisting of self-propelled carriages, using electricity as the motive power. An EMU requires no separate locomotive, as electric traction motors are incorporated within one or a number of carriages. An EMU is usually formed by two (2) or more semi-permanently coupled carriages, but electrically powered single-unit railcars are also generally classed as EMUs.

51. EMUs are popular on commuter and suburban rail networks around the world due to their fast acceleration and pollution-free operation. Being quieter than Diesel Multiple Units (DMU) and locomotive-drawn trains, EMUs can operate later at night and more frequently without disturbing nearby residents.

1.3.6 No Project Option

52. Public transportation access from the suburbs to Metro Manila is not sufficient, and it is a bottleneck for further development in northern and southern direction. The northern part of the metropole up to Malolos has no operating rail traffic, and residential areas are expanding without sufficient public transportation. In the southern part, very few non-electrical PNR trains are operating up to Calamba in Laguna Province. Urgent measures are needed to ensure public transportation linking the northern and southern parts to the metropole.

53. Therefore, if NSRP which is the railway traffic linking the southern part to Metro Manila stays undeveloped, sustainable growth of local industry will be hampered and the environment of the area will deteriorate further by the traffic congestion and air pollution, Therefore, not pursuing the Project is not an option.

1.4 PROJECT COMPONENTS

54. This section presents the main components, support facilities, pollution control devices and temporary facilities for the NSRP.

1.4.1 Main Components

55. Main components of the Project includes: Main Railway Line, Stations, Maintenance Depot, E & M System and Rolling Stock. Description of each component is described below.

1.4.1.1 Main Railway Line

(1) Track

56. The NSRP alignment is 55.6 km long from Solis, Manila to Calamba station. The track will consist of PC Sleeper and Ballast (Crushed stone). The required ROW width of the railway track is set 30 m all along the alignment (width of viaduct is 10.3 m).

(2) Sturcture Type

57. The proposed vertical alignment is taken at ground level as much as possible, when the vertical clearance is satisfied, otherwise the vertical alignment is designed elevated. The elevated section (viaduct) is planned over urban areas at a length of 37.8 km, with the embankment section planned for 4.0 km and on-grade section planned at 13.8 km. This lowers the construction costs or it will shorten the construction period.

1) Viaduct

58. PC segmental box girder has been planned with 40 m span as the optimal span based on ground condition study. The policy of the optimal span will be considered according to the ground conditions and construction assumption based on the previous plan. **Figure 1.4.1** shows the cross section of a typical viaduct.

Figure 1.4.1 PC segmental box girder

2) Embankment

59. Embankment will be adopted where it would not impact the regional split. The embankment will be planned in the suburbs areas and farmlands. The Embankment Profile Plan is

better to set a lower alignment and allow for the economical efficiency. **Figure 1.4.2** Cross-section of typical embankment shows the cross-section of typical embankment.

Figure 1.4.2 Cross-section of typical embankment

3) At Grade

60. At grade will be adopted where it would not impact to the regional split. The at grade section will be planned in the suburbs areas and farmlands where elevating the railway is not necessary for the economical efficiency. **Figure 1.4.3** shows the cross-section of typica At Grade structure.

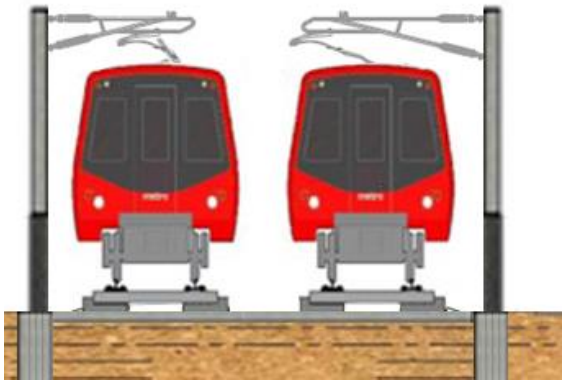


Figure 1.4.3 Cross-section of typical At Grade

1.4.1.2 Stations

61. There will be twenty (20) stations along the NSRP alignment. All stations will be elevated and will have a ROW width of 60 m (including the tracks). The station layout may either be two (2) separate platforms serving two (2) tracks or a single platform at the center.

62. The stations will also adopt a universal design which will incorporate barrier-free guidelines for elderly, chidren and persons with disabilities of both the Philippines and Japan. The proposed measure is to provide elevator and escalators, in addition to stairs for vertical movement of passengers from streets to stations' platforms. **Figure 1.4.4** shows a sample cross section of the alignment at the station and **Figure 1.4.5** shows the sample design of the station. **Figure 1.4.6** shows the typical layout of the proposed train stations.

63. The estimated required space and major dimensions the station are shown below. Final specifications will be determined in the DED phase.

Table 1.4.1 Daft Specification of Proposed Station

Items	Description
Total required width for station:	approx. 23 m for single platform, approx.40m for two platforms
Platform Length:	180 - 220 meters (platform length for 8 car train)
Platform width:	8 m
Structure Type:	2 to 4 storeys
Other facilities of the station are:	• Stairs, Elevators and Escalators • Restrooms/toilets • Automatic Fare Control systems consisting of Ticket Vending Machines, Automatic Gates, Automatic Fare Adjustment Machines, Data Collecting Machines and office booking machines • Information Counter and • Emergency exits.

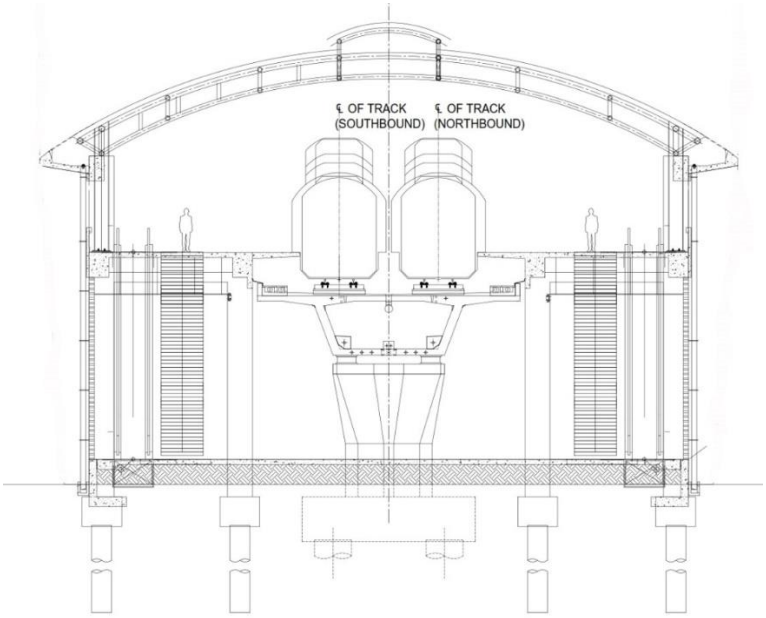


Figure 1.4.4 Sample Cross-section of Alignment at Stations

Figure 1.4.5 Sample Design of the Station

1.4.1.3 Depot

64. The depot will be located in Banlic, Calamba, Laguna with an area of approximately of 0.78 sq. km (78 hectares). The depot will include the following facilities:

- Operation 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
- Unscheduled Repair Shop
- Wheel Re-profiling Shop
- Car washing track
- Test track
- Sub-Stations
- Sewage treatment plant (STP),
- Storm water reservoir,
- Emergency facility
- Access Road inside depot, car parking, light, fence etc.

65. The depot will serve as an area for stabling, maintenance, inspection and train repair. Aside from these, the depot will function mainly as a central command office which conducts the operation control of the main line and the integrated management of electricity, facilities for the crew, and the maintenance base for track, power supply system, signalling, communication systems, and civil and architectural facilities. **Figure 1.4.7** shows the layout of the depot site.

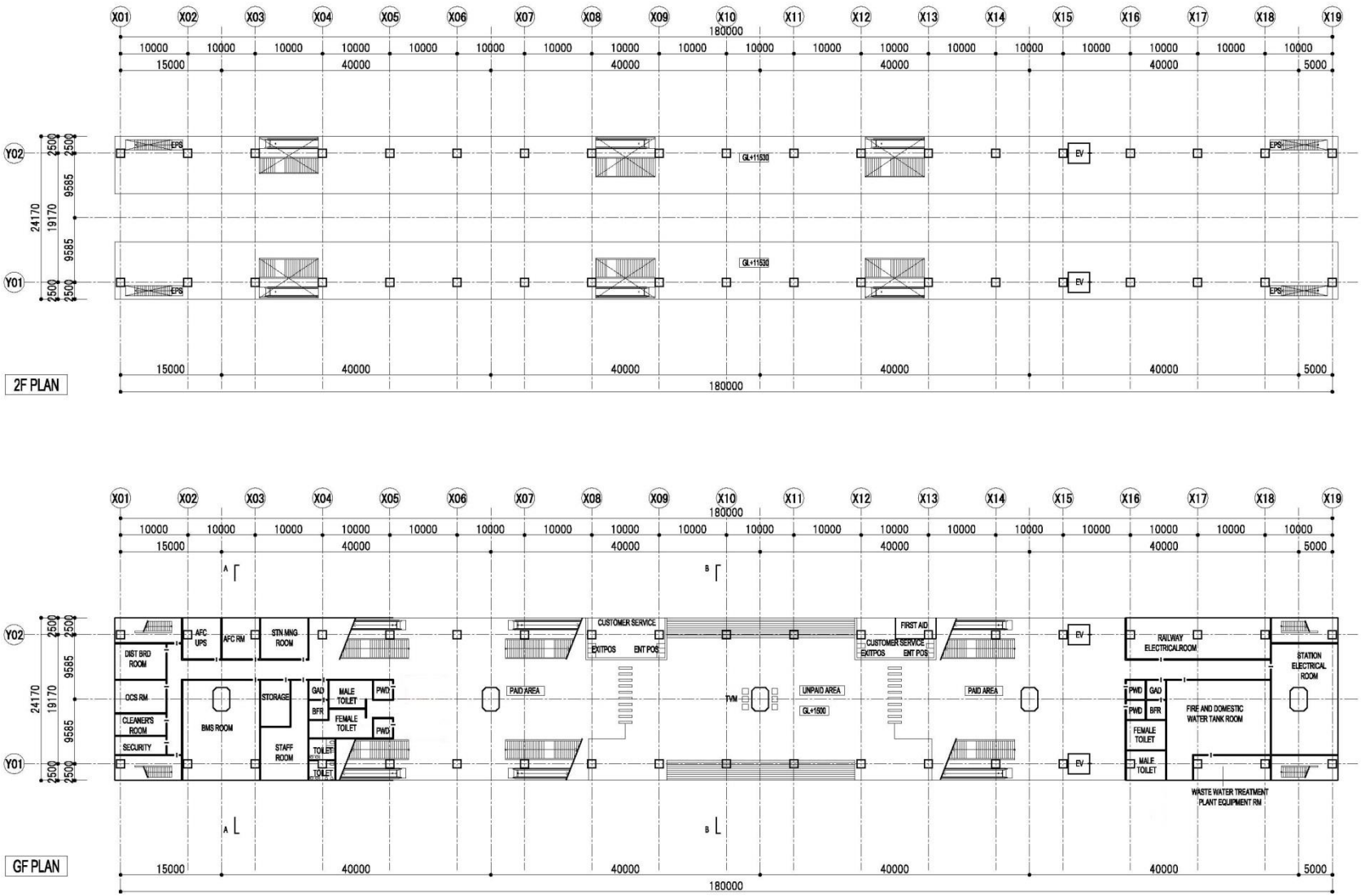
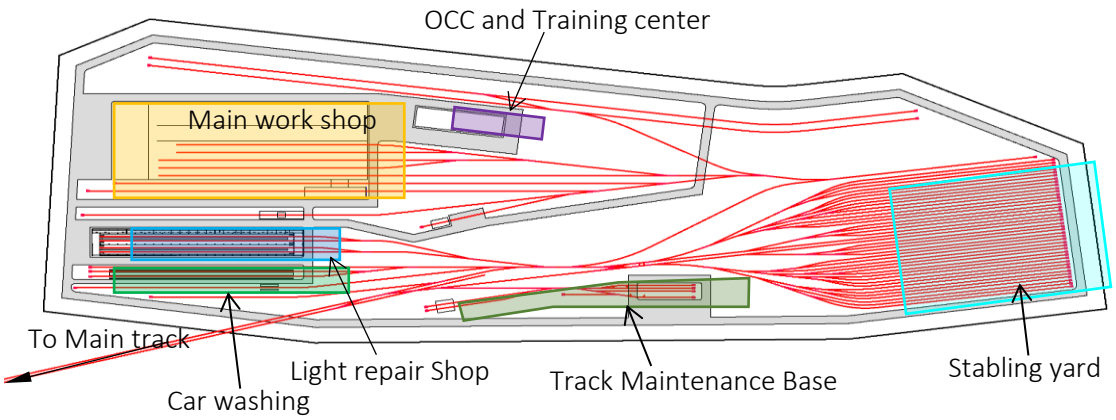


Figure 1.4.6. Typical Layout of Train Station



Source: JICA Study Team

Figure 1.4.7 Layout of the depot site

1.4.1.4 E & M System

66. E & M System refers to the electrical systems, mechanical systems, communication and automation systems, water services, fire detection and protection systems. This includes but not limited to the following:

- Railway operator: a single operator
- Communication system: Backbone System, Radio System, Voice and Data system, Closed Circuit Television System, Passenger Information Display System, Public Address System, Time Server and Master Clock System, Meteorological and Seismic Monitoring System, Railway Facility Monitoring System
- Signal System: Communication Based Train Control (**CBTC**)
- Power Supply: DC 1500V catenary system, substations are set every 3-5 km, power supplied by MERALCO
- Road Crossing: 10 trains / hour both direction at peak time
- Train Management System: 2 independent systems, a network of 100 Mbps,
- Brake system: Service brake, emergency brake and security brake
- Maintenance: Departure inspection, light maintenance, heavy maintenance, other maintenance
- Automatic Fare Collection System

1.4.1.5 Rolling Stock

67. The DOTr will utilize an EMU Train for the Project, which means that power supply system rolling stock is required for train operating electric power.

68. The DOTr has a plan to operate three (3) types of train service in this Project which are 1) a commuter train, 2) an express train. and 3) the airport limited express train which can connect CIA and the center of Manila within 1 hour.

69. An electric multiple unit or EMU is a multiple unit train consisting of self-propelled carriages, using electricity as the motive power. There will be total of 200 Rolling Stock (trains) having a capacity 2,200 passengers/train (seating + standing). The train's maximum speed is 120 km/hr and will be fully airconditioned. **Figure 1.4.8** shows the sample of an EMU train.

Figure 1.4.8 Sample of an EMU Train

1.4.2 Support Facilities

1.4.2.1 Sub-station Facilities

70. Sub-station will be equipped with supporting facilities of recieving facilites, and transformers and rectifiers and facitilies for supplying to railways.

1.4.2.2 Drainage Facilities

71. Drainage facilities will be installed to ensure that the Project structures (viaduct, embankment, at grade track) will minimize the adverse impacts of the Project by safely diverting runoff from the rail to the identified discharge points and introduce applicable improvement to rivers affected by the alignment. In other words, it is to ensure that the project will not impede any drainage channels and contribute to any flooding. Drainage system of station is considered a minor system while the drainage system of Depot is considered a major system.

72. Revetments or river bank protection and river bed protection will be provided at rivers and stream crossing wherever necessary. Bridge abutments and bridge pier foundation may also be provided with protection if warranted.

1.4.2.3 Administration and Operation Centre

73. Administration Building will be built for the PNR which will house the control rooms, office, security/first aid, kitchen/dining, toilet/locker, workshop and consumables.

1.4.2.4 Training Centre

74. DOTr considers to establish Philippine Railway Institute (PRI) as a governmental body attached to DOTr for promoting and executing a capacity build of railway matters. Driver's licenses and engineer's certifications will be issued by PRI. PRI also prepare the materials and knowledge base for training in each railway organization.

1.4.3 Pollution Control Devices

1.4.3.1 Air Pollution Control Facilities

75. The air pollution and noise levels which will be generated during construction are temporary in nature, but nonetheless these will be appropriately mitigated. During operation, the Project is not expected to generate air pollution. Noise from the operation of the EMUs is expected

to be within standard limits. However, at the stations, some buffer structures will be provided to reduce noise levels, particularly, in noise sensitive receptor areas.

1.4.3.2 Water Pollution Control System

76. Wastewater from the administration and Depot Facilities will be treated in a Sewage Treatment Plant (STP) prior to discharge into receiving body of water. Effluent from STP will be monitored to ensure that its quality meets the DENR standards.

1.4.3.3 Solid Waste Management System

77. Waste material generated will be classified as hazardous and non-hazardous wastes. Separate receptacles and storage areas will be established for each type of waste identified at the Project site. Non-hazardous solid waste will be classified as compostable, re-usable, recyclable, and residual. These will then be properly disposed of, based on their classification. DOTr will comply with disposal regulations as stipulated in the Ecological Solid Waste Management Act of 2000 or Republic Act 9003. Hazardous waste will be classified based on Republic Act 6969 or the Toxic Substances and Nuclear Wastes Control Act 1909. It will be handled, stored and transported according to Philippine standards and treated through DENR-accredited hazardous waste treaters. The following are the solid wastes generated from the proposed Project:

- Household waste consisting of compostable waste materials from food and recyclable or residual materials such as plastics, wrappers, crates or boxes for food supply of workers and/or employees.
- Debris and other materials removed from construction activities such as spoils or excavated materials
- Industrial solid wastes, such as damaged vehicle and equipment parts, etc.
- Hazardous wastes such as fuel/lube oil sludge, and bulbs.

1.4.4 Temporary Facilities

78. A temporary construction yard of approximately 48,000 m^2 will be located within the ROW. The temporary facilities will consist of the following, 1) Office (Contractor and Engineer), 2) Laboratory, 3) Labor Quarter (1,000 workers), 4) Warehouse, and 5) vehicle and heavy equipment maintenance/staging areas. Separate ECCs will be secured by the Contractor for the Rebar, Form Fabrication Yard, Batching Plant and Segment Fabrication Yard. Spoils and wastes disposal sites will be determined during DED stage.

1.4.5 Existing Utilities within the ROW

79. Existing Utilities within the ROW include 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.

1.4.6 Utility Requirements

80. Utility requirements during construction phase include fuel, power supply, and water supply and construction access. Discussion of detailed information for the construction and operation phases is discussed below.

1.4.6.1 Fuel Requirement

(1) During Construction

81. Fuel requirement for this phase involves the use of heavy equipment, transport and service vehicles. Based on the estimated number of heavy equipment, trucks and service vehicles to be used during the construction phase, the estimated fuel requirement is 256 m^3 of diesel.

(2) During Operation

82. Fuel requirement during operation is estimated at 20 m^3 of diesel for the use of back-up generators at stations during power interruption and for the service vehicles.

1.4.6.2 Power Requirement

(1) During Construction

83. Power supply will be sourced either by tapping at the nearest electricity source or through a generator set. Contractor will be required to submit an environmental and safety management plan for the use of generator sets. The estimated power requirement during the construction phase is 60,683,805 kWh/year.

(2) During Operation

84. To ensure high reliability of power supply during the operation, adequate redundancies in the transmission and distribution will be incorporated in the detail design stage. Power supply will be sourced out from MERALCO. The estimated power requirement during the operation phase is 303,419,025 kWh/year.

1.4.6.3 Water Supply

(1) During Construction

85. Water for construction of the Project will be taken from the nearest water source/ provider. In the absence of such water provider, water will be sourced from the ground water after obtaining necessary permit from the NWRB.

(2) During Operation

86. Water supply during operational phase will be sourced from the local water districts. Water usage will be minimal and limited to domestic use only (i.e., for usage in and maintenance of comfort rooms, etc.).

1.4.6.4 Construction Materials

87. The construction materials such as sand, steel, cement, etc. will be sourced locally. On the other hand, the railway tracks and the tension membrane for roofing will be sourced outside the Philippines.

1.4.6.5 Construction Access

88. All construction roads including roads which run through urban areas and narrow areas must be always maintained in good conditions. Especially water puddles embrittle the roads and affect the transport of equipment and materials. Thus, a drainage system must be carefully designed. At the planning stage, it is important to design durable roads which won't be damaged during the dry and rainy seasons

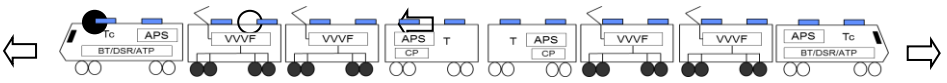
89. More than half of the construction sites are in urban areas, the access to the site will be through the public roads. Therefore, attention should be paid to general vehicles. Also consideration for the third parties, such as assigning security guards, providing vehicle washing facilities at entrances and exits to the site, etc. are necessary.

90. 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.

1.5 PROCESS/TECHNOLOGY

91. Trains to be used by the Project are electric operated. Specifications of the trains is presented in **Table 1.5.1.**

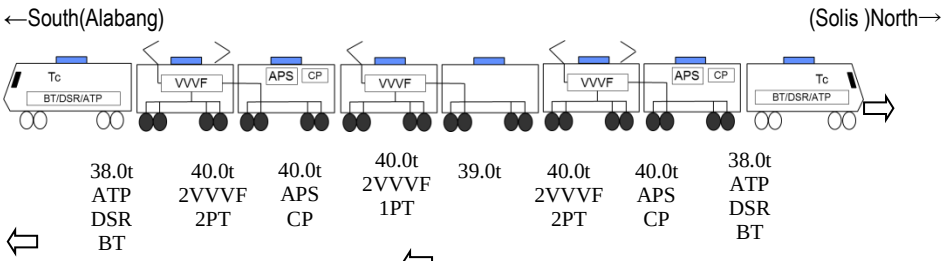
Table 1.5.1 Specification and Performance of Commuter Train (Draft)

No	Item	Specification, Performance
1	Basic	Commuter Train DC1,500V (Light weight stainless steel or Aluminum) Tc: Trailer Car with driver's cab M: Motor car T: Trailer car
2	Basic Configuration	In case of 4M4T (Tc+M+M+T+T+M+M+Tc) (Empty weight 264t) following is for reference ←South(Calamba) (Tutuban)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
3	Performance	Acceleration(Design):3.3km/h/s Deceleration(Design):4.2km/h/s (Max service brake, Instantaneous deceleration) 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 7person/m^2
7	Body	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
8	Bogie	Bolster less type, Max axle weight:16t
9	Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler Connectable with NSCR train without adapter
10	Current Collection	Single arm type 4 pantographs/1 train-set (No high voltage train line)
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 unit / 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 IGBT or Hybrid-SiC due to more energy saving.
14	Brake system	Electric command linked to ATP, combined type of electric and pneumatic, Security brake. Regenerative priority (Entire control, Rainy mode control)

No	Item	Specification, Performance
		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(self-cooling) 4 units/train-set DC1500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Electric (With adjacent door control backup function and door scissors control) 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
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 with redundancy
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 demand 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 gage, ammeter, powering and braking conditions etc. • Ethernet type・Control demand : duplex and loop system(redundancy)
30	Barrier free	• 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

Source: JICA Study Team

Table 1.5.2 Specification and Performance of Limited Express Train (Draft)

No	Item	Specification, Performance
1	Basic	Limited Express Train DC1,500V (Light weight stainless steel or Aluminum) Tc: Trailer Car with driver's cab M: Motor car
2	Basic Configuration	6M2T (Tc+M+M+M+M+M+M+Tc) (Empty weight 315t) following is for reference  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
3	Performance	Acceleration(Design, starting):3.0km/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:160km/h
4	Gauge	1,435mm(standard gauge)
5	Electric system	DC1,500V overhead catenary
6	Capacity	About 400(seats)
7	Body	MAX:19,500 mm (Length)×2,950 mm (Width)×3,655 mm (Height) Reading car length may be longer. MAX Height 4,150mm, when pantograph is folded, 1,130～1,150 mm(Height of floor) Under consideration
8	Bogie	Bolster less type, Max axle weight:16t
9	Coupler	Leading car: tight lock coupler Intermediate car: semi-permanent coupler Connectable with NSCR train without adapter
10	Current Collection	Single arm type
11	Traction Motor	3-phased totally enclosed high efficiency induction motor 4 unit / M car Non- disassembly bearing exchange type
12	Driving device	Parallel cardan
13	Propulsion system	VVVF inverter(Self cooling) 1C4M×6sets/train-set The device for VVVF inverter will be applied IGBT or Hybrid-SiC due to more energy saving.
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
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(self-cooling) 4 units/train-set DC1,500V→3-phase 440V・60Hz, single-phase AC220V・60Hz, DC100V
17	Battery	Sintered alkaline storage battery: DC100V 2 units/train-set
18	Door system	Electric (With adjacent door control backup function and door scissors control) or Pneumatic (With weakened function) , Airtight protecting mechanism
19	Lighting system	Crew cab, Saloon, Headlight, Tail light, Door・Emergency car side light: LED type
20	Fun	Under consideration
21	Air conditioner	ON/OFF type 3-phase 440V・60Hz Under consideration (including ventilation function)
22	Heater	Not mounted
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 with redundancy
25	ATP	CBTC

No	Item	Specification, Performance
26	Destination Display	Collective setting by TMS monitor, front and side display (with collar LED)
27	CCTV	Saloon security camera Aggregated each car HUB, displayed in TMS monitor and stored in memory in the cab via Ethernet
28	Saloon Display	Under consideration
29	Train Management System (TMS)	Control transmission for powering and service brake command, Monitor transmission for destination, guidance and air conditioner demand 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 gage, ammeter, powering and braking conditions etc. Ethernet type・Control demand : duplex and loop system(redundancy)
30	Barrier free	Identification band (cleat) on the floor just before the door Indicator light and chime (inside and outside) at opening and closing doors Wheel chair space
31	Toilet	1 or 2, One of them is a wheelchair accessible type Under consideration
32	Others	Under consideration about Wi-Fi, power supply and USB, etc.

Source: JICA Study Team

1.6 PROJECT SIZE

92. The Project is a linear infrastructure with a total length of 55.6 km stretch from Solis, Manila City going south to Calamba City utilizing the existing ROW of PNR. The required ROW width of the railway track is set 30 m all along the alignment. The stations will have a ROW of 60 m and length of 180-220 m. The proposed depot area will have a total land area of 0.78 square kilometer (km²) (78.0 ha) which is located in Barangay Banlic, Calamba City.

1.7 DEVELOPMENT PLAN, DESCRIPTION OF PROJECT PHASES AND CORRESPONDING TIMEFRAMES

1.7.1 Project Phases

93. This section describes the various activities to be undertaken during the Pre-Construction, Construction, and Operational Phases of the Project.

(1) Pre-Construction Phase

- Detailed Engineering Design and survey
- Planning and Utility Diversion specially in the open cut area and viaduct section if there any utility line
- Land acquisition for the depot area and project ROW
- Resettlement of Project affected people
- Bidding and selection of contractor
- Procurement of Rolling Stock and E&M
- Implement environment mitigation measures, monitoring of pre-construction activities.

(2) Construction Phase

- Preparation of construction site which include clearing existing vegetation, removal, and demolition of existing structures along the NSRP alignment and earth moving activities
- Protection measures for old PNR structures
- Implement Traffic Management Plan
- Transport of materials

- Construction of temporary facilities, Depot , Viaduct, Embankment and At Grade Structures, Station
- Manufacturing of girder for elevated section
- Implement environment mitigation measures, monitoring of construction activities.
- Implement Traffic Management Plan

(3) Post Construction Phase

- Demolition of all temporary structures/ facilities
- Decommissioning and removal of construction machinery and equipment from the site
- Clean-up activities will be undertaken
- Selection of Operator

(4) Operation Phase

- Test run of the NSRP trains
- Maintenance work of passenger facilities such as the station
- Maintenance of rolling stock
- Maintenance of E& M system including power supply system, Automatic ticketing system
- Implement the environmental management plan, monitoring of operation activities.
- Commercial operation (optional)

1.7.1.2 Abandonment Phase

94. In the unlikely event that the operation of NSRP is no longer deemed feasible to operate and maintain, a decommissioning or abandonment plan will be prepared by the proponent. The abandonment plan will specify the proposed studies to be conducted (e.g., site assessment) and what equipment can be recovered, relocated, or sold, and the area will be developed based on the next industrial use of the site. If soil contamination is present, the subject area will be decontaminated through the appropriate measures. The green buffer zone will have to be retained.

1.7.2 Project Schedule

95. The schedule of NSRP is presented in **Table 1.7.1** The construction will commence upon securing all the needed regulatory requirements.

Table 1.7.1 Proposed Timeline of NSRP

Project Phase	2018				2019				2020				2021				2022				2023			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Pre-construction																								
Construction																								
Trial Run																								
Operation																								

1.8 MANPOWER

96. Estimated manpower requirement during pre-construction, construction and operation phases is presented in **Table 1.8.1**.

Table 1.8.1 Manpower Requirement (Peak)

Project Phase	Civil	E&M	Rolling Stock	Total
Pre-construction	100	60	40	200
Construction	11,000	1,500	500	13,000
Operation		1,550		1550

97. A percentage of the technical personnel will be provided by Japanese consultants, since Japanese technology will most likely be employed for the NSRP. Most of the technical personnel will be hired by the Japanese consulting company, while for the construction works, manpower will be hired through the local construction company. Hiring of workers through agencies are discouraged. DOTr is committed to provide equal opportunities for employment of everyone, in compliance with the Labor Codes of the Philippines, Republic Act No. 10911 known as the Anti-Age Discrimination in Employment Act, and RA 7277 known as the Magna Carta for Disabled Person. DOTr will provide equal opportunities for employment of men and women, on the basis of their abilities, knowledge, skills and qualifications rather than on age or disability. Manpower will be sourced as much as possible from Metro Manila and Province of Laguna, while priority will be given to hiring employees from the areas where the NSRP alignment will be located. The policy on hiring including the treatment of statutory benefits of the workers will be stipulated in the TORs and contracts with the local contractors to ensure compliance.

1.9 INDICATIVE PROJECT INVESTMENT COST

98. The total capital cost of the proposed NSRP – South Line (Commuter) Project is estimated at One Hundred Ninety-Six Billion Two Hundred Thirty-One Million Pesos (PhP 196,231,000,000.00) @ 1 USD ≈ PhP 49.745 conversion rate.

2. LEGAL AND INSTITUTIONAL FRAMEWORK ON ENVIRONMENTAL IMPACT ASSESSMENT

2.1 LAWS AND REGULATIONS OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

99. Any private or public projects or activities which are likely to have foreseen adverse effects on the natural and social environment are subject to the Philippine Environmental Impact Statement System (**PEISS**). Among some of the most important laws and guidelines related PEISS are shown in **Table 2.1.1**.

Table 2.1.1 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
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
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 Study Team

2.2 RESPONSIBLE GOVERNMENT AUTHORITIES

100. The DENR is the government entity responsible for the environmental administration. The DENR-EMB is responsible for the issuance of decision making documents such 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.

2.3 ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM OF JICA AND ADB

(1) JICA Guidelines for Social and Environmental Considerations

101. As a matter of policy, the JICA, as an implementing agency for Japanese Official Development Assistance (**ODA**) adheres to the need to conduct environmental and social considerations for all forms of assistance; from technical cooperation to loan aid and grant aid projects. To complement this, JICA recognizes seven important Principles; a) that projects must address a wide range of environmental and social impacts, b) measures for environmental and social considerations must be implemented from project conceptualization to monitoring, c) ensure accountability when implementing cooperation projects, d) ensure stakeholder participation in decision-making processes, e) appropriate disclosure of information, f) enhance

organizational capacity of proponents, and g) promptness in project implementation. Their Guidelines for Social and Environmental Considerations (April 2010) were developed as far back as 2002 and have evolved over time with the latest version revised and published in 2010. Projects are screened, scoped and after proper information disclosure are categorized (Category A, B, C, and F1) based on, among others, the project scale, nature and degree of impact on the natural and social environment, the site or location, and the mitigation measures required. For this purpose, the railway projects are categorized as Category A.

102. JICA confirms compliance to the principles and procedures as contained in the Guidelines by a thorough review of the environmental reports and ensure that all project impacts on the natural and social environment are identified and proper mitigating measures are discussed. Further, JICA confirms that projects should conform to the environmental laws and standards of host countries or such other international financial organizations (such as the World Bank's Safeguard Policies) when appropriate. An independent Advisory Committee for Environmental and Social Considerations was established by JICA to provide expert advice in preparatory surveys, environmental review, and monitoring of projects under consideration. If appropriate environmental and social considerations are not undertaken or substantial compliance to established environmental laws and standards are not met after their review, JICA will not undertake Loan Aid, Grant Aid or Technical Cooperation projects.

(2) ADB Environment Safeguard

103. The ADB Safeguard Policy Statement (**SPS**) governing environment and social safeguards of ADB operations was approved by the ADB Board of Directors in July 2009 and became effective in January 2010. Its goal is to "promote the environmental and social sustainability of ADB supported projects by protecting people and their environment from potential adverse impacts and enhancing the benefits provided by such projects". The SPS applies to all ADB-financed sovereign and non-sovereign projects, and project components that are associated with ADB-supported projects, regardless of whether these are financed by ADB, the borrower/client, or co-financiers. As a matter of policy, ADB will not finance projects that do not comply with SPS requirements nor will it finance projects that do not comply with the host country's laws and regulations, including those where the implementing host country has obligations under International law/s.

104. SPS environmental safeguards requirements support the integration of environmental considerations into the project decision-making process and are triggered if a supposed project is likely to have environmental impacts and risks to the physical, biological, socioeconomic, and/or physical cultural resources in the project's area of influence. ADB borrowers/clients should be aware that compliance to the SPS requirements makes for (i) environmentally sustainable projects are primarily achieved through good design during project preparation and effective environmental management during project implementation; (ii) integrating environmental considerations into the project feasibility study and design calls for the incorporation of environmental assessment and management into the economic, financial, institutional, social and technical analysis of a project; and (iii) good environmental assessment and management enables the continued improvement of environmental performance throughout the life of a project, and can lead to enhanced economic, financial and social outcomes.

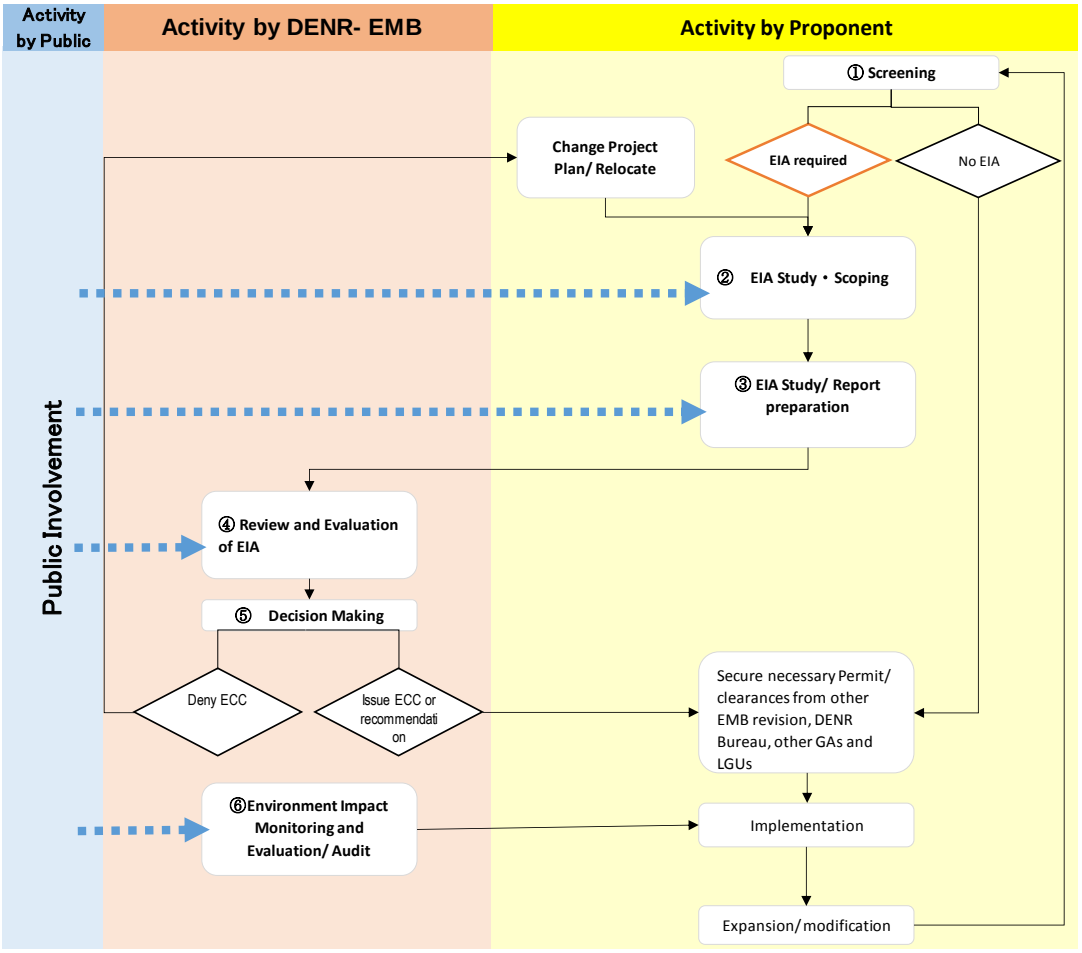
105. Standard Environmental Assessment procedures entail the following: a) environmental assessment throughout the Project cycle (from planning, feasibility study stage to operation management and decommissioning),b) Project screening, and Categorization (Cat. A= projects likely to have significant adverse impacts, Cat. B= potential impacts are less adverse than those in Cat A, Cat. C= where there are minimal or no adverse impacts, and Cat. F1=projects involving investment of ADB funds or through a financial intermediary), c) Scoping for Environmental Assessment, d) Analysis of Alternatives, e) Description of the Project, f) Applicable Policy, Legal and Administrative framework and Standards, g) Baseline environment and social conditions described, h) Impact and Risk analysis, i) development of an Environmental Management Plan, j)

Information disclosure, consultation and participation, and lastly, k) Grievance Redress Mechanism. Considering the impacts, the NSRP Project is classified as Category A under the ADB SPS system of project categorization.

106. Further, through the Sourcebook, ADB provides technical guidance on the four core environmental issues for environmental assessment and management such as, Health and Safety, Biodiversity Conservation and Sustainable Natural Resource Management, Pollution Prevention and Abatement, and Physical Cultural Resources.

2.4 ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM IN THE PHILIPPINES (PEISS)

107. The Philippine EIA Process has six (6) 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 2.4.1**.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (2008)

Figure 2.4.1 Summary Flowchart of EIA Process

2.4.1 Projects requested to implement EIA

108. At the Screening, the project is assessed whether it is subject to go through EIA process. Projects which have been originally declared as ECPs or projects in ECAs presumed to have significant impacts on the quality of the environment are subject to PEISS. The projects have been classified into four (4) major groups as shown in **Table 2.4.1**.

Table 2.4.1 Project Groups for EIA under PEISS

Category	Type and location of the project
Category A : Environmentally Critical Projects	Projects or undertakings which are classified as ECPs under Presidential Proclamation No. 2146 (1981) Proclamation No. 803 (1996) and any other projects that may later be declared as such by the President of the Philippines. Proponents of these projects implemented from 1982 onwards are required to secure an Environmental Compliance Certificate (ECC)
Category B : Non-Environmentally Critical Projects(NECP) but Located in ECA	Projects or undertakings which are not classified as ECP under Category A but which are likewise deemed to significantly affect the quality of the environment by virtue of being located in Environmentally Critical Area (ECA) as declared under Proclamation 2146 and according to the parameters set forth in the succeeding sections. Proponents of these project implemented from 1982 onwards are required to secure an ECC
Category C: Environmental Enhancement or Direct Mitigation Project	Projects or undertakings not falling under Category A or B which are intended to directly enhance the quality of the environment or directly address existing environmental problem
Category D: Non-Covered Project	Projects or undertakings that are deemed unlikely to cause significant adverse impact on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered by the Philippine EIS system and are not required to secure an ECC. However such non-coverage will not be construed as an exemption from compliance with other environmental laws and government permitting requirement

Source: Memorandum Circular No.2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements

2.4.2 Types of reports required for ECC

109. The EIA-covered projects will require the hereunder listed documents 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**).

110. All documents should be prepared by the project proponent to be submitted to EMB Central Office or the EIA Division of the respective EMB Regional Offices. The outcome of the EIA Process within PEISS administered by the EMB-DENR is the issuance of decision documents. Decision documents may either be an ECC, CNC, or a Denial Letter.

111. For Group A projects, ECC application documents need to be submitted to EMB central office to have decisions by EMB Director or DENR Secretary. While, ECC applications for Group B need to be submitted to EMB Regional Office for decision making by the EMB Regional Director. **Table 2.4.2** summarizes Project Groups, EIA Report Types, Decision Documents, Deciding Authorities, and Processing Duration.

Table 2.4.2 Summary of Project Groups, EIA Report Types, Decision Documents, Deciding Authorities and Processing Duration

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Category A : Environmentally Critical Projects	A-1: New	Co-located	PEIS	ECC	EMB Central Office
		Single	EIS		
	A-2: Existing and to be expanded, modified and/or rehabilitated A-3: Operating without ECC	Co-located	PEPRMP in case programmatic monitoring data are available		
		Single	EPRMP in case monitoring data are available. EIS if no monitoring data are available.		
Category B : Non-Environmentally Critical Projects(NECP)	B-1: New	Co-located	PEIS	ECC	EMB regional office in the region where the project is located
		Single	EIS, IEEC	ECC	
	B-2: Existing and to be	Single	EPRMP, EPRMP Checklist	ECC	

Project Groups		Project	Documents Required For ECC/CNC Application	Decision Document	Deciding Authority
Located in ECA	expanded, modified and/or rehabilitated B-3: Operating without ECC	Co-located	PEPRMP	ECC	
Category C: Environmental Enhancement or Direct Mitigation Project		Co-located/ single	PDR (Part I and II)	CNC	EMB regional office in the region where the project is located
Category D: Non-Covered Project			PDR （Part 1 only)	CNC	EMB regional office in the region where the project is located

Note: () optional, subject to laws, rules, and regulations

Source: EMB Memorandum Circular No.2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements

2.4.3 Scope of Items to be examined and Contents to be assessed in the EIA

112. As previously discussed, depending on project type, location, magnitude of potential impacts and project threshold, EIS, PEIS, EPRMP, PEPRMP, IEE Checklist Report or PDR will be required. According to the DENR 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), the outline for EIA Reports for proposed new single projects is shown in **Table 2.4.3.**

Table 2.4.3 Outline of EIS for Proposed (New) Single Projects

EXECUTIVE SUMMARY
1) Project Fact Sheet
2) Process Documentation
3) EIA Summary
MAIN REPORT
1. PROJECT DESCRIPTION
1.1. Project Location and Area
1.2. Project Rationale
1.3. Project Alternatives
1.4. Project Components
1.5. Process / Technology
1.6. Project Size
1.7. Development Plan, Description of Project Phases and Corresponding Timeframes
1.8. Manpower
1.9. Indicative Project Investment Cost
2. ASSESSMENT OF ENVIRONMENTAL IMPACTS
2.1. The Land
2.1.1. Land Use And Classification
2.1.1.1. Impact in Terms of Compatibility With Existing Land Use
2.1.1.2. Impact on Compatibility With Classification as an Environmentally Critical Area (ECA)
2.1.1.3. Impact in Existing Land Tenure Issue/S
2.1.1.4. Impairment of Visual Aesthetics
2.1.1.5. Devaluation of Land Value As a Result of Improper Solid Waste Management and Other Related Impacts
2.1.2. Geology/ Geomorphology
2.1.2.1. Change in Surface Landform/ Geomorphology/ Topography/ Terrain/ Slope
2.1.2.2. Change in Subsurface Geology/ Underground Conditions
2.1.2.3. Inducement of Subsidence, Liquefaction, Landslide, Mud/ Debris Flow, Etc.
2.1.3. Pedology
2.1.3.1. Soil Erosion/ Loss of Topsoil/ Overburden
2.1.3.2. Change In Soil Quality/ Fertility
2.1.4. Terrestrial Ecology
2.1.4.1. Vegetation Removal and Loss Of Habitat
2.1.4.2. Threat to Existence and / or Loss Of Important Local Species
2.1.4.3. Threat to Abundance, Frequency and Distribution of Important Species
2.2. The Water
2.2.1. Hydrology/ Hydrogeology
2.2.1.1. Change in Drainage Morphology/ Inducement of Flooding/ Reduction In Stream Volumetric Flow
2.2.1.2. Change in Stream, Lake Water Depth
2.2.1.3. Depletion of Water Resources/ Competition In Water Use

2.2.2.	Oceanography
2.2.2.1.	Change/ Disruption In Water Circulation Pattern, Littoral Current, and Coastal Erosion And Deposition
2.2.2.2.	Change In Bathymetry
2.2.3.	Water Quality
2.2.3.1.	Degradation of Groundwater Quality
2.2.3.2.	Degradation of Surface Water Quality
2.2.3.3.	Degradation of Coastal/ Marine Water Quality
2.2.4.	Freshwater Ecology
2.2.4.1.	Threat to Existence and/ or Loss of Important Local Species and Habitat
2.2.4.2.	Threat to Abundance, Frequency and Distribution of Species
2.2.5.	Marine Ecology
2.2.5.1.	Threat to Existence and/ or Loss of Important Local Species and Habitat
2.2.5.2.	Threat to Abundance, Frequency and Distribution of Species
2.3.	The Air
2.3.1.	Meteorology / Climatology
2.3.1.1.	Change In The Local Micro-Climate E.G. Local Temperature
2.3.1.2.	Contribution in Terms of Greenhouse Gas Emissions (or GHG Mitigation Potential)
2.3.2.	Air Quality (Noise/Vibration)
2.3.2.1.	Degradation of Air Quality
2.3.2.2.	Increase in Ambient Noise Level
2.3.2.3	Vibration
2.4.	People
2.4.1.	Displacement of Settler/S
2.4.2.	In-Migration
2.4.3.	Cultural/ Lifestyle Change (Especially on Indigenous People, If Any)
2.4.4.	Impacts on Physical Cultural Resources
2.4.5.	Threat to Delivery Of Basic Services/ Resources Competition
2.4.6.	Threat to Public Health And Safety
2.4.7.	Generation of Local Benefits From The Project
2.4.8.	Traffic Congestion
3.	ENVIRONMENTAL MANAGEMENT PLAN
4.	ENVIRONMENTAL RISK ASSESSMENT (ERA) AND EMERGENCY RESPONSE POLICY AND GUIDELINES
5.	SOCIAL DEVELOPMENT PLAN (SPD) FRAMEWORK AND INFORMATION, EDUCATION AND COMMUNICATION (IEC) FRAMEWORK
5.1.	Social Development Plan (SDP)
5.2.	Information, Education And Communication (IEC) Campaign
6.	ENVIRONMENTAL COMPLIANCE MONITORING
6.1.	Self-Monitoring Plan
6.2.	Multi-Sectoral Monitoring Framework
6.3.	Environmental Guarantee And Monitoring Fund Commitments
7.	ABANDONMENT / DECOMMISSIONING / REHABILITATION POLICIES AND GENERIC GUIDELINES
8.	INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION FOR THE ENTIRE OPERATION
9.	ANNEXES

Source: DENR Memorandum Circular NO. 2010-14, Annex 1-A, June 2010

2.4.4 Public Participation, Public Consultation and Information Disclosure

113. The PEISS stresses importance in public participation. According to DENR Administrative Order No. 2017 15, from the early stage of project, the public who have potential to have direct/ indirect impacts are provided accurate project information and involved in a series of public discussion. Public participation will be demonstrated through the following activities:

- IEC
- Public Scoping
- Public Hearing
- Information Disclosure of EIA and Environmental Permissions
- Involvement of Indigenous Peoples in Decision-Making Process

2.4.5 Environmental Monitoring and Management Plan needs to be formulated

(1) Objectives

114. Under the Philippine EIS System, the primary purpose of monitoring, validation and evaluation/audit is to monitor the short-term and long-term changes in the environment and ensure

the judicious implementation of sound environmental management within a company/corporation and its areas of operation as stipulated in the ECC and other related documents. Specifically, it aims to ensure the following:

- Monitor environmental changes in the environment;
- 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 undertakings.

(2) Responsible organization

1) Monitoring by Project Proponent

115. The Proponents with issued ECCs are primarily responsible for monitoring their projects. A proponent is required to submit an ECC Compliance Monitoring Report (CMR) to the designated monitoring EMB office on a semi-annual 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.

2) Multi-partite Monitoring Team (MMT)

116. The MMT is primarily responsible of validating the proponent's environmental performance and submits findings/recommendations as a Compliance Monitoring and Validation Report (CMVR) to the concerned EMB office.

3) Environmental Management Bureau（EMB）

117. The Environmental Management Bureau is primarily responsible for the over-all evaluation/audit of the Proponent's monitoring and the MMT's validation.

(3) Disclosure of Monitoring Results

118. 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 and any activities against the ECC conditions.

2.5 COMPARISON OF PEISS AND JICA GUIDELINES/WORLD BANK (WB) /ADB SAFEGUARD POLICIES

119. The results of gap analysis between current relevant regulations in the Philippines to the JICA Guidelines, and World Bank Operational Policy 4. Counter measures are also proposed to fill the gap.

Table 2.5.1 Gap between JICA Environmental Guidelines and Relevant Regulations in the Philippines on EIA

Topic	JICA Environmental Guideline,	ADB	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 include 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))	Basically, there is no gap 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 will be subject to an environmental impact assessment as required by law before they are adopted, and the results thereof will be taken into consideration in the decision-making process. No actual implementation of such activities will be allowed without the required ECC under the Philippine EIA System. In instances where such activities are allowed to be undertaken, the proponent will plan and carry them out in such manner as to minimize any adverse effects and take preventive and remedial action when appropriate. The proponent will be liable for any damage due to lack of caution, on indiscretion. (NIPAS Act)	Gap is insignificant	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 employment and livelihood, utilization of land and local	• 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, biological, socioeconomic (including impacts on livelihood through environmental media,	• 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 will assess the direct and indirect impacts of a project on the biophysical and human environment and ensuring that these impacts are addressed by appropriate environmental	No gap in the environment items and content. However, standards on soil, bottom sediment and vibration have not been prepared yet	International standards such as WHO's, IFC's and developed countries' standards will be referred to in order to evaluate these

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	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.	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.	protection and enhancement measures. (DAO 2003-30)		items.
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.	Basically there are no gaps	Not Applicable
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,	• Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and			

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	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	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.			
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 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)	• 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 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.	• 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 will 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 PEIS-based applications. If necessary EMB should conduct Public Consultations.	Basically there are no gaps	Not Applicable
Information Disclosure	• In principle, project proponents etc. disclose information about the environmental and social	• Disclose a draft environmental assessment (including the EMP) in a timely manner,	• As a form of disclosure of the EIA findings, Public Hearing (PH) is required for all new	Basically there are no gaps between	Not Applicable

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	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.	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	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.	Harmonized Policy and the Philippines' laws.	
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. • The information necessary for monitoring confirmation by JICA must be supplied by project proponents etc. by appropriate means, including in writing. When necessary, JICA may 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)	• 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 are represented in the Multi-partite 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.	Basically there are no gaps between Harmonized Policy and the Philippines' laws	Not Applicable
Site selection	Projects must, in principle, be undertaken outside of	• Do not implement project activities in areas	All designated, critical habitats will be protected,	Gap is insignificant	Not Applicable

Topic	JICA Environmental Guideline,	ADB	Relevant Regulations in the Philippines	Main Gap	Countermeasures for Filling Gaps
	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)	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.	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)		

Source: JICA Study Team

2.6 ENVIRONMENTAL STANDARDS

2.6.1 Approach

120. Presidential Decree 1152, otherwise known as the "Philippine Environment Code (1977)", recognizes the establishment of specific environment management policies and prescribing 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.

121. JICA and ADB generally recognizes national environmental standards for projects. If national environmental standards do not exist or are considered inappropriate, internationally recognized standards will be used for reference purposes. Moreover, 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.

2.6.2 Ambient Air Quality

122. The Department of Environment and Natural Resources (DENR) Administrative Order (DAO) No. 2000-81 otherwise known as the Implementing Rules and Regulations of Republic Act No. 8749, Clean Air Act of 1999, establishes the national ambient air quality standards for suspended particulate matters (TSP, PM10), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and lead (Pb) while DAO No. 2013-13 establishes the provisional national ambient air quality guideline values for PM2.5. **Table 2.6.1** shows the comparison of applicable national and international standards to on ambient air quality. The international standard used in comparison with the Philippine standards is World Health Organization (WHO) Air Quality Guidelines for PM, O_3, NO_2 and SO_2 (2005) , which IFC Environmental, Health, and Safety General Guidelines (April 30, 2007) also refers.

Table 2.6.1 National Ambient Air Quality Standards

Parameter	Averaging Time	Philippines DAO 2000-81, DAO 2013-13	WHO
TSP	24 Hours	230 µg/NCM	
PM10	24 Hours	150 µg/NCM	50 µg/ m3
PM2.5	24 Hours	50 µg/NCM	25 µg/ m3
SO2	24 Hours	180 µg/NCM	20 µg/ m3
NO2	24 Hours	150 µg/NCM	200 µg/m3 (1-hour mean)
CO	1 Hour	35 mg/NCM	35 mg/ m3 (Indoor *1)
O3	1 Hour	140 µg/NCM	100 µg/ m3 (8 hour mean)
Lead (Pb)	24 Hours	1.5 µg/NCM	0.5- 1.0 µg/m3 (annual*2l)

Sources: DAO 2000-81, DAO 2013-13, WHO Air Quality Guidelines for PM, O3, NO2 and SO2 (2005),
*1: WHO Guidelines for Indoor Air Quality (2009)
*2: WHO air quality guidelines for Europe (1987)

2.6.3 Surface Water Quality

123. The DENR Administrative Order (DAO) No. 2016-08 provides water usage and classification as well as water quality guidelines and general effluent standards. **Table 2.6.2** shows the water quality criteria by class. **Table 2.6.3** and **Table 2.6.4** presents the comparison of applicable national and international standards on surface water quality.

Table 2.6.2 Water Body Classification

Classes	Description
Class AA	Public Water Supply Class I – Intended primarily for waters having watersheds, which are uninhabited and/or otherwise declared as protected areas, and which require only approved disinfection to meet the latest Philippine National Standards for Drinking Water (PNSDW)
Class A	Public Water Supply Class II – Intended as sources of water supply requiring conventional treatment (coagulation, sedimentation, filtration and disinfection) to meet the PNSDW
Class B	Recreational Water Class I – Intended for primary contact recreation (bathing, swimming, etc.)
Class C	1) Fishery Water for the propagation and growth of fish and other aquatic resources; 2) Recreational Water Class II – for boating, fishing, or similar activities 3) For agriculture, irrigation, and livestock watering
Class D	Navigable waters

Source: DAO No. 2016-08

Table 2.6.3 Surface Water Quality Guidelines

Parameter	DAO 2016-08			Japan (Class C)
	Class A	Class B	Class C	
Color	50	50	75 TCU	-
Temperature	26-30°C	26-30°C	25-31°C	-
pH (Range)	6.5-8.5	6.5-8.5	6.5-9.0	6.5-8.5
Dissolved Oxygen (DO)	5 mg/L	5 mg/L	5 mg/L	≥5 mg/L
Biochemical Oxygen Demand (BOD)	3	5 mg/L	7 mg/L	≤5 mg/L
Total Suspended Solids (TSS)	50 mg/L	65 mg/L	80 mg/L	≤50 mg/L
Surfactants (MBAS)	0.2 mg/L	0.3 mg/L	1.5 mg/L	-
Oil and Grease (Petroleum Ether Extracts)	1 mg/L	1 mg/L	2 mg/L	-
Nitrate as Nitrogen	7 mg/L	7 mg/L	7 mg/L	≥10 mg/L
Phosphate as Phosphorus	0.5 mg/L	0.5 mg/L	0.5 mg/L	≤0.1 mg/L
Phenolic Substances and Phenols	<0.001 mg/L	<0.001 mg/L	0.05 mg/L	-
Total Coliforms				≤100 MPN/100mL
Fecal Coliforms	1.1 MPN/100mL	100 MPN/100mL	200 MPN/100mL	-
Chloride as Cl	250	250	350 mg/L	-
Copper (Dissolved Copper)	0.02 mg/L	0.02 mg/L	0.02 mg/L	-
Arsenic (As)	0.01 mg/L	0.01 mg/L	0.02 mg/L	≤0.01 mg/L
Cadmium (Cd)	0.003 mg/L	0.003 mg/L	0.005 mg/L	≤0.01 mg/L
Chromium (Hexavalent)	0.01 mg/L	0.01 mg/L	0.01 mg/L	≤0.05 mg/L
Cyanide (CN-)	0.07 mg/L	0.07 mg/L	0.1 mg/L	Not detectable
Lead (Pb)	0.01 mg/L	0.01 mg/L	0.05 mg/L	≤0.01 mg/L
Total Mercury (Hg)	0.001 mg/L	0.001 mg/L	0.002 mg/L	≤0.005 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	-

Sources: DAO No. 2016-08, Environmental water quality standards for protecting human health, Japan

Table 2.6.4 General Effluent Standards

Parameter	DAO 2016-08				IFC	Japan
	Class A	Class B	Class C	Class D		
Color	100 TCU	100 TCU	150 TCU	300 TCU	-	-
Temperature	3 ºC change	3 ºC change	3 ºC change	3 ºC change	-	-
pH (Range)	[illegible]	6.0-9.0	6.0-9.5	5.5-9.5	6.0-9.0	-
Dissolved Oxygen (DO)	-	-	-	-	-	-
Biochemical Oxygen Demand (BOD)	2	2 mg/L	3 mg/L	12 mg/L	30 mg/L	160 mg/L (daily ave. 120 mg/L)
Total Suspended Solids (TSS)	70 mg/L	85 mg/L	100 mg/L	150 mg/L	50 mg/L	200 mg/L (daily ave. 150 mg/L)
Surfactants (MBAS)	2 mg/L	3 mg/L	15 mg/L	30 mg/L	-	-
Oil and Grease (Petroleum Ether Extracts)	5 mg/L	5 mg/L	5 mg/L	15 mg/L	10 mg/L	-
Nitrate as Nitrogen	14 mg/L	14 mg/L	14 mg/L	30 mg/L	10 mg/L	120 mg/L (daily ave. 60 mg/L)
Phosphate as Phosphorus	1 mg/L	1 mg/L	1 mg/L	10 mg/L	2 mg/L	16 mg/L (daily ave. 8 mg/L)
Phenolic Substances and Phenols	0. 01 mg/L	0.01 mg/L	0.5 mg/L	5 mg/L	-	5 mg/L

Parameter	DAO 2016-08				IFC	Japan
	Class A	Class B	Class C	Class D		
Total Coliforms	3,000 MPN/100mL	3,000 MPN/100mL	10,000 MPN/100mL	15,000 MPN/100mL	400 MPN/100mL	daily ave. 3,000 cm^3
Fecal Coliforms	4 MPN/100mL	200 MPN/100mL	400 MPN/100mL	800 MPN/100mL	-	-
Chloride as Cl	350	350	450 mg/L	500 mg/L	-	-
Copper (Dissolved Copper)	0.04 mg/L	0.04 mg/L	0.04 mg/L	0.08 mg/L	-	0.3 mg/L
Arsenic (As)	0.02 mg/L	0.02 mg/L	0.04 mg/L	0.08 mg/L	-	0.1 mg/L
Cadmium (Cd)	0.006 mg/L	0.006 mg/L	0.01 mg/L	0.02 mg/L	-	0.03 mg/L
Chromium (Hexavalent)	0.02 mg/L	0.02 mg/L	0.02 mg/L	0.04 mg/L	-	0.5 mg/L
Cyanide (CN-)	0.14 mg/L	0.14 mg/L	0.2 mg/L	0.4 mg/L	-	1 mg/L
Lead (Pb)	0.02 mg/L	0.02 mg/L	0.1 mg/L	0.2 mg/L	-	0.1 mg/L
Total Mercury (Hg)	0.002 mg/L	0.002 mg/L	0.004 mg/L	0.008 mg/L	-	0.0005 mg/L
Organophosphate as Malathion	1 µg/L	1 µg/L	3 µg/L	6 µg/L	-	-

Sources: DAO No. 2016-08, IFC Indicative Guideline Values for Treated Sanitary Sewage Discharges (2007), Japan National Effluent Standards (2015)

2.6.4 Groundwater Standards

124. The Department of Health (DOH) Administrative Order (DAO) No. 2017-0010 otherwise known as Philippine National Standards for Drinking Water (PNSDW) of 2017 establishes the criteria for drinking water quality. In cases where the criteria for certain parameters are not available in PNSDW, the guideline values from DAO 2016-08 Water Quality Guidelines (WQG) for Class AA Waters will be used. **Table 2.6.5** shows the comparison of applicable national and international standards on groundwater quality. The international standards used in comparison with Philippine standards are the WHO Guidelines for Drinking-Water Quality (2011).

Table 2.6.5 Ground Water Quality Standards

Parameter	Holding Time	PNSDW	WHO Guidelines for Drinking-Water Quality
Physical Characteristics			
pH	Not to exceed 6 hours	6.5-8.5	Not of health concern at levels found in drinking-water
Color	24 hours	10 CU	No health-based guideline value is proposed for colour in drinking-water. Drinking-water should ideally have no visible color but most people can only detect color above 15 TCU in a glass of water. Levels of color below 15 TCU are often acceptable to consumers. High color from natural organic carbon (e.g. humics) could also indicate a high propensity to produce by-products from disinfection processes.
Temperature	-	26-30°C	Cool water is generally more palatable than warm water, and temperature will have an impact on the acceptability of a number of other inorganic constituents and chemical contaminants that may affect taste. High water temperature enhances the growth of microorganisms and may increase problems related to taste, odor, color, and corrosion.
Cations and Anions			
Sodium (Na)	28 days	200 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Potassium (K)	-	-	Occurs in drinking-water at concentrations well below those of health concern but may affect acceptability of drinking water
Calcium (Ca)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Magnesium (Mg)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Bicarbonate (HCO3-)	-	-	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Chloride (Cl-)	28 days	250 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Sulphate (SO-2)	28 days	250 mg/L	Not of health concern at levels found in drinking-water but may affect acceptability of drinking water
Nitrate (NO3-)	24 hours	50.00 mg/L	50 mg/L as nitrate ion (or 11 mg/L as nitrate-nitrogen)
Toxic and Other Deleterious Substances			

Parameter	Holding Time	PNSDW	WHO Guidelines for Drinking-Water Quality
Arsenic (As)	28 days	0.05 mg/L	0.01 mg/L
Cadmium (Cd)	28 days	0.003 mg/L	0.003 mg/L
Chromium (Cr)	28 days	0.05 mg/L	0.05 mg/L
Cyanide (CN-)	24 hours	0.07 mg/L	Occurs in drinking-water at concentrations well below those of health concern, except in emergency situations following a spill to a water source
Lead (Pb)	28 days	0.01 mg/L	0.01 mg/l
Mercury, Total (Hg)	28 days	0.001 mg/L	0.006 mg/l (for inorganic)
Microbiological Quality			
Total Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL	Must not be detectable in any 100 ml sample
Fecal Coliforms	<1.1 MPN/100mL	<1.1 MPN/100mL	Must not be detectable in any 100 ml sample

Source: DAO 2007-012, DAO 2016-08, WHO Guidelines for Drinking-Water Quality (2011)

2.6.5 Noise and Vibration

(1) Noise Standard

125. The measured noise levels were compared to the noise standard under the Rules and Regulations of the National Pollution Control Commission (NPCC), Section 78, Table 1, Environmental Quality Standards for Noise in General Areas, the NPCC Memorandum Circular No. 1980-002, Standards in Areas Directly Fronting/Facing Roads with Four (4) or more Lanes (**Table 2.6.7**) and the Guidelines for Community Noise of World Health Organization (WHO), 1999 (**Table 2.6.8**).

Table 2.6.6. NPCC Standards for Noise in General Areas

Class	Maximum Allowable Noise Level (dBA)		
	Daytime (9AM - 6PM)	Morning (5AM-9AM)/ Evening (6PM – 10PM)	Nighttime (10PM – 5AM)
AA	50	45	40
A	55	50	45
B	65	60	55
C	70	65	60
D	75	70	65

Notes:
AA - a section or contiguous area which requires quietness, such areas within 100m from school sites, nursery schools, hospitals and special homes for the aged.
A - a section or contiguous areas which is primarily used for residential purposes
B - a section or contiguous areas which is primarily a commercial area
C - a section primarily reserved as light industrial area
D - a section which is primarily reserved as heavy industrial area

126. For areas directly facing a public transportation route or an urban traffic artery, the foregoing standards plus a correction factor equivalent to the following will apply:

i – Areas directly fronting or facing a four-lane road …….. + 5 dBA

ii – Areas directly fronting or facing a four-lane or wider road …….. + 10 dBA

Table 2.6.7 NPCC Noise Standards in Areas Directly Fronting/Facing Roads with Four (4) or more Lanes

Class	Maximum Allowable Noise Level (dBA)		
	Daytime (9AM - 6PM)	Morning (5AM-9AM)/ Evening (6PM – 10PM)	Nighttime (10PM – 5AM)
AA	60	55	40
A	65	60	45
B	75	70	55
C	80	85	60
D	85	80	65

Table 2.6.8. Guidelines for Community Noise of WHO, 1999

Receptor	One Hour LA_{eq} (dBA)[1]	
	Daytime 0700H – 2200H	Nighttime 2200H – 0700H
Residential; institutional; educational2	55	45
Industrial; commercial	70	70

Notes: [1] Guideline values are for noise levels measured out of doors
[2] For acceptable indoor noise levels for residential, institutional and educational settings refer to WHO (1999).

Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.

127. Comparing the NPCC standards and WHO guidelines, the NPCC classes AA and A correspond to WHO category RIE (Residential, institutional, educational), while NPCC classes B, C and D correspond to WHO category IC (Industrial, commercial). Also, the WHO definition of daytime period encompasses the second half (0700H – 0900H) of morning period and the whole daytime and evening periods according to NPCC, while the WHO night-time period encompasses the night time period and the first half (0500H – 0700H) of morning period according to NPCC.

(2) Vibration Standard

128. National standard for vibration is absent in the Philippines at the same time there are limited standards available under International Standards. Under such situation, British standards 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. Additionally, the Standard includes guidance on the levels of vibration that cause varying degrees of human response and damage to buildings or services. These are specified in terms of a component peak particle velocity (ppv).

Table 2.6.9 Guidance on Effects of Vibration Levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: BS 5228-2:2009

129. The standard for the building damage caused by the vibration energy are described in both British standard BS 7385-2:1993 Evaluation and measurement for vibration in buildings.

Table 2.6.10 Transient Vibration Guide Values for Cosmetic Damage

Place and time	Peak components particle velocity in frequency range of predominant pulse (mm/s)	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4Hz and above	
Unreinforced or light framed structure. residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50mm/s at 40Hz and above

Source: BS 7385-2:1993

2.6.6 Soil Fertility and Contamination

(1) Soil Fertility

130. The Bureau of Soils and Water Management (**BSWM**) provides a standard soil fertility rating for certain parameters such as levels of pH, organic matter, primary nutrients (Nitrogen, Phosphorus, Potassium), secondary nutrients (Calcium, Manganese), micronutrients (Copper, Zinc, Iron, Manganese) and trace metals (Lead, Arsenic, Mercury, Cadmium, Chromium Hexavalent).

Table 2.6.11 Soil Fertility/Quality Standards

Parameter	Philippines	International		
	PNS/ BAFS 40:2016 (Organic Soil Amendments)	General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy (adopted by BSWM)	Dutch Target and Intervention Values, 2000	
			Target Values	Intervention Values
pH	-	5.5-8.5	-	-
Organic Matter	≥ 20%	1-8; >3**	-	-
Primary Nutrients				
Total Kjeldahl Nitrogen	-	-	-	-
Phosphorus	-	>10 >20**	-	-
Potassium	-	>0.25	-	-
Total NPK (N, P, K were analyzed separately)	5-10%	-	-	-
Secondary Nutrients				
Calcium	-	-	-	-
Magnesium	-	>0.50	-	-
Micronutrients				
Available Iron	-	>4.5	-	-
Available Copper	300 mg/kg	>0.2	-	-
Available Manganese	-	>1.0	-	-
Available Zinc	5 mg/kg	>1.5; >1.0**	-	-
Trace Metals				
Lead	50 mg/kg	-	85 mg/kg	530 mg/kg
Arsenic	20 mg/kg	-	29 mg/kg	55 mg/kg
Mercury	2 mg/kg	-	0.3 mg/kg	10 mg/kg
Cadmium	5 mg/kg	-	0.8 mg/kg	12 mg/kg
Chromium Hexavalent	150 mg/kg	-	100 mg/kg	380 mg/kg

*Indicative levels for serious soil contamination
** Limits applicable to dry land crops

Source: BSWM, Dutch Target and Intervention Values (2000)

Table 2.6.12 Soil Fertility Evaluation Criteria Standard

Parameter	High/ Adequate	Medium/ Moderate	Low/ Deficient
pH	5.6-6.7	5.6-4.6	>6.8* <4.5*
Organic matter	>4.6%	2.1-4.5%	<2
Available Phosphorus	>10	2.1-9.9	<2
Extractable Potassium	>151	76-150	<75

*pH 4.5 and 6.8 is considered problem soils for rice

(2) Soil Contamination

131. The TCLP limits prescribed in Table 2.1 Classification of Hazardous Wastes of the DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36) were adopted in determining whether the soil samples collected in Stations CS1 and CS2 are contaminated with Acid wastes, Alkali wastes, waste with Cyanide and/or waste with Inorganic Chemicals.

Table 2.6.13. TCLP Limits

Parameters	TCLP Limits (based on Table 2.1 Classification of Hazardous Wastes of DAO 2013-22)
pH	≤2 Acid ≥12.5 Alkali
Arsenic, mg/L	>1
Barium, mg/L	>70
Copper, mg/L	-
Zinc, mg/L	-
Iron, mg/L	-
Cadmium, mg/L	>0.3
Chromium, mg/L	>5
Lead, mg/L	>1
Manganese, mg/L	-
Mercury, mg/L	>0.1
Selenium, mg/L	>1
Nickel, mg/L	-
Oil and Grease, mg/L	-
Cyanide, mg/L	>70

Source: DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

2.7 OTHER ENVIRONMENTAL LAWS AND REGULATIONS CONCERNING THE PROJECT

2.7.1 International treaties, agreements and related documents

132. Following Table 2.7.1 shows the list of international regulations/agreements that the Philippines has ratified.

Table 2.7.1 Ratified International Treaties/Agreements in the Philippines

Category	Name of treaty	Year ratified
Biodiversity	Convention on Biological Diversity, 1992	1992 June
	Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973	1981, November
	Convention on Wetlands of International Importance, 1971	1994, November
	Convention on the conservation of Migratory Species of Wild Animals, 1983	1994, February
	Cartagena Protocol on Biosafety, 2000 (to the Convention on Biological Diversity)	2006 October
	Nagoya Protocol on Access to Genetic Resources & the Fair & Equitable Sharing of Benefits Arising from their Utilization-Supplementary Agreement to the Convention of Biological Diversity	2015 September

Category	Name of treaty	Year ratified
Climate Change	Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	1991, July
	Vienna Convention for the Protection of the Ozone Layer, 1985	1991, July
	London Amendment (to the Montreal Protocol), 1990	1993, August
	United Nations Framework Convention on Climate Change, 1994	2003 November
	Kyoto Protocol to the United Nations Convention on Climate Change 1998	2003
	Paris Agreement Adopted in the 21st Session of the Conference of Parties to the United Nations Framework Convention on Climate Change, 2015	2017 December RP Accession
	United Nations Convention to Combat Desertification, 1994	2000, February
Pollution	Basel Convention on the Control of Transboundary Movements of Hazardous wastes and their Disposal, 1992	1993, October
	Stockholm Convention on Persistent Organic Pollutants 2001	2004 May
	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 2004	2006 July
Historical/ Cultural Heritage	UNESCO Convention Concerning the Protection of the World Cultural and National Heritage, 1972	1985, May
Forestry	International Tropical Timber Agree, 1994	1983, November
Social	Convention on the Elimination of all Forms of Discrimination against Women, 1979	1981
	International Convention on the Elimination of all forms of racial discrimination 1965	1967 September
	International Covenant on Civil and Political Rights 1976	1986
	International Covenant on Economic, Social and Cultural Rights 1976	1974 June
	Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment 1987	1986 June
	Convention on the Rights of the Child 1990	1990 July
	International Convention on the Protection of the Rights of all migrant Workers and members of their families, 1996	1995 July
	International convention for protection of all persons from enforced Disappearance 2010	
	Convention on the Rights of Persons with Disabilities 2008	2008 April

Source: www.ohchr.org/EN/ProfessionalInterest/Pages/CMW.aspx

2.7.2 National Strategy and Plan relevant to Environment and Social Consideration

133. Following are national level Action Plans and Strategies (including systems) on various Natural Resources components and Environmental Management which impact on projects and activities. These are implemented by national government agencies and instrumentalities in coordination with appropriate stakeholders and partners. This reflects the cross sectoral approach to environmental management concerns.

Table 2.7.2 National Strategy and Plan relevant to Environment and Social Consideration

Category	Name
Biodiversity	Philippines: National Biodiversity Strategy and Action Plan (NBSAO) 1997
	Philippine Biodiversity Conservation Priorities, 2002
	A National Wetland Action Plan for Philippines 2011-2016
	Philippine Plant Conservation Strategy and Action Plan 2003
Pollution	DAO 2007-22 Guidelines on the requirements for Continuous Emission Monitoring System
	DAO 2000-82 Integrated Air Quality Improvement Framework-Air Quality Control Action Plan
	Adopt an Estero/Waterbody Program, 2010
	DAO's Implementing Sec. 5 of RA 9275,on the Designation of Certain Areas as Water quality Management Areas
	Integrated Persistent Organic Pollutants Management Project
	Adoption of a National Strategy for the Management of POP's Contaminated Sites in the Philippines, EMB Memorandum February 2016
	National Solid Waste Management Framework, 2004

Category	Name
Social	Philippine Development Plan 2017-2022
	Philippine Environmental Partnership Program
	Government Poverty Reduction Programs and Plans
	Philippine Plan for Gender responsive Development Plan 1995-2025
	National Plan of Action for Children 1991
	22 point platform and policy Pronouncements on Labor and employment 2010
Climate Change	Second National Communication Plan on Climate Change
	Philippine Energy Plan 2009- 2030
	Philippine Strategy on Climate Change Adaptation 2010-2022
	National Framework strategy on Climate change 2010 - 2022
	National Climate Change Action Plan, DILG

Source: JICA Study Team

2.7.3 Other related Laws and Regulations

134. Major environmental laws and regulations, which may be relevant to the infrastructure/interchange projects, 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 2.7.3 Philippines Environmental Laws, Regulations, and Environmental Quality Standards

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
	DAO No. 2016-08, Water Quality Guidelines (WQG) and General Effluent Standards (GES)
	RA 9275 (2004), Clean Water Act
	DAO No. 2005-10, IRR of the Clean Water Act
	Department of Health (DOH) Administrative Order (AO) No. 2017-0010, Philippine National Standards for Drinking Water (PNSDW)
Pollution Control (Air)	RA No. 8749 (1999), Clean Air Act
	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 ($PM_{2.5}$)
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

Items	Laws, Regulations and Environmental Quality Standards
	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
Pollution Control (Noise)	National Pollution Control Commission (NPCC) Memorandum Circular (MC) No.002 Series of 1980, Section 78 (1980), Noise Environment Standards
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 Study Team

2.7.4 Permits to be Obtained for the Project Operation

135. Prior to the project implementation, following permits have to be obtained.

Table 2.7.4 Permits Required for the Project

Permit	Authority Involved
NHCP Endorsement on Historical Structures (Old PNR structures)	NHCP, NCCA, NM
Free and Prior Informed Consent documentation (FPIC), Certificate of No Overlap (CNO)	NCIP
Tree Cutting permit	DENR –NCR. DENR-Reg3, Region IV-A
Wastewater Discharge Permit	Laguna Lake Development Authority (LLDA) for Manila EMB-NCR for Makati, Pasay, Parañaque, EMB-Reg 4A for Laguna EMB-Reg3 for Bulacan, Pampanga, Tarlac
LLDA Clearance for Development Projects	LLDA for Manila and Laguna
Permit To Operate for Power Generator Sets (APSI)	EMB-NCR for Metro Manila, EMB-Reg3 for Bulacan, Pampanga, Tarlac EMB-Reg4A for Laguna
ECC for Construction Work Areas/Batching Plants	EMB-NCR for Metro Manila EMB-Reg3 for Bulacan, Pampanga, Tarlac EMB-Reg4A for Laguna
Quarry Permit	LGU where quarry is located
Permit for structures over water bodies	DPWH (as mandated by the Water Code)

Source: JICA Study Team

136. Some of permits required prior to implementation are further detailed below:

(1) Tree Cutting permit

137. Following shows the detail guideline and procedure to obtain the permit.

Table 2.7.5 Tree Cutting Permit Guidelines

Relevant Policies/Guidelines	
1	DENR Memorandum on Guidelines and Procedures on the Planting, Maintenance, and Removal of Trees in Urban Areas and in Areas Affected by Government Infrastructure Projects (2009)
2	DENR Memorandum Order (DMO) No. 2012-02, Uniform Replacement Ratio for Cut or Relocated Trees
3	DENR Memorandum Circular (DMC) No. 2011-01, Guidelines, and Procedures in the implementation of the NGP
4	DAO NO. 2016-20, IRR of EO 193
5	Forest Management Bureau (FMB) Technical Bulletin No. 3 (2014), Measurement Standards, and Procedures in the conduct of inventory for standing trees

138. The application procedure for the issuance of tree cutting permit is shown in the table below. On the average, the duration of the processing of application takes minimum about two (2) months from the day application made, due to a number of government entities involved in the procedure.

139. If in case coconut trees are affected, tree cutting guidelines of the Philippines Coconut Authority (PCA), pursuant to Republic Act No. 10593, will apply.

Table 2.7.6 Procedure to obtain Tree Cut Permit

Procedure		Responsible Entity
1	Submit application documents to the concerned CENRO: - Application Letter - LGU Endorsement/ Certificate of No Objection - Copy of the Land Title for Private Property - Photographs of trees to be removed - Site Development Plan and ECC	DOTr
2	Review the submitted requirements, assign inspecting officer and issue order of payment	CENRO
3	Receive the OP and pay tree inventory fee but no payment required for less than 20 trees	DOTr
4	Conduct 100% inventory or inspection of the area and prepare Inspection Report with geotagged photos	CENRO (Inspection Personnel)
5	a. Review and approve inspection report b. Sign endorsement to PENRO	CENRO
6	a. Review, and approve CENRO recommendation b. Sign endorsement to RD	PENRO
7	a. Review and approve endorsement to FMB b. Furnish a copy to the USEC for Field Operations c. Release endorsement to FMB	DENR Regional Office / Regional Director
8	a. Review, evaluate and conduct data analysis b. Prepare Memorandum of Endorsement to USEC for Field Operations c. Draft clearance for the issuance of tree cutting permit d. Review and Sign Memorandum of Endorsement to USEC for Staff Bureaus	FMB
9	Review and forward to USEC for Field Operations	USEC for Staff Bureaus
10	Review and approve/sign Clearance to Issue Permit to Cut	USEC for Field Operations
11	a. Receive Clearance to Issue Permit to Cut b. Transmit to concerned Regional Office	FMB
12.	Prepare and Sign Tree Cutting Permit	DENR Regional Office/ RD
13	Receive Tree Cutting Permit	DOTr

Source: DENR Citizen's Charter Process No. 10 (Processing of Application for Issuance of Tree Cutting Permits)

(2) NHCP Endorsement on Historical Structures (Old PNR structures)

140. Following shows the detail guideline and procedure to obtain the NHCP endorsement.

Table 2.7.7. NHCP Guidelines

Relevant Policies/Guidelines	
1	NHCP Guidelines on the Identification, Classification, and Recognition of Historic Sites and Structures in the Philippines. (2011)
2	NHCP Universal Guidelines of the Restoration and Preservation of Monuments and Historic Sites
3	NHCP Process of Architectural Restoration
4	NHCP Techniques involved in the Restoration of Historic Structures
5	NHCP Standards and Guidelines in Maintaining Historic Sites and Structures. (2010)
6	Republic Act No. 10066, An Act 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
7	Republic Act No. 6541, National Building Code of the Philippines

141. The process of architectural restoration by the NHCP is summarized into seven (7) steps as shown in the table below.

Table 2.7.8 Procedure to obtain NHCP endorsement

Procedure		Responsible Entity
1	Inventory of Historical Structures	DOTr, PNR, NHCP
2	Identification of Necessity of Restoration	DOTr
3	Declaration as Monument	NHCP
4	Planning for Preservation Scheme	DOTr, PNR
5	Approval of Scheme	NHCP
6	Implementation	DOTr, PNR
7	Re-use and Maintenance	DOTr, PNR

Source: NHCP Techniques involved in the Restoration of Historic Structures

142. To obtain the NHCP endorsement, Protection and Conservation Plans for historical structures will be prepared by the DOTr and PNR. The Protection Plan will cover the measures for the protection of historical structures during project construction while the Conservation Plan provides a program for the preservation of sites and structures during operation. The plans will be submitted to and deliberated on by the three agencies concerned on historical, cultural heritage such as the NHCP, the National Museum (NM), and the National Commission on Culture and the Arts (NCCA).

3. ANALYSIS OF KEY ENVIRONMENTAL IMPACTS

143. To obtain the NHCP endorsement, Protection and Conservation Plans for historical structures will be prepared by the DOTr and PNR. The Protection Plan will cover the measures for the protection of historical structures during project construction while the Conservation Plan provides a program for the preservation of sites and structures during operation. The plans will be submitted to and deliberated on by the three agencies concerned on historical, cultural heritage such as the NHCP, the National Museum (NM), and the National Commission on Culture and the Arts (NCCA).

144. This chapter discusses the state of the existing environment before the onset of the proposed NSRP. The baseline data presented in this section are based on primary and secondary data collection. Primary data were obtained through field surveys, consultation meeting, interviews with key stakeholders, and sampling and analyses of environmental parameters. For this study, the field surveys were conducted during the dry season only. Secondary data were collected from the Comprehensive Land Use Plan (CLUP) of the affected LGUs and relevant data sources from different government authorities (e.g. MGB, PHIVOLCS, PAGASA, DENR, etc.).

145. At the end of each section, impact indetification, prediction, assessment, and mitigation are summarized in **Table 3.1.30**, **Table 3.2.20**, **Table 3.3.30** and **Table 3.4.54** respectively.

3.1 LAND

3.1.1 Land Use and Classification

146. The proposed NSRP will utilize the existing Right-of-Way (ROW) of the Philippine National Railways (PNR) for the majority of the project traversing 10 cities including Manila, Makati, Taguig, Parañaque and Muntinlupa in the National Capital Region (NCR); and San Pedro, Biñan, Santa Rosa, Cabuyao, and Calamba in the Province of Laguna. For the segment from Solis Station to Sta. Mesa Station, DOTr will acquire a private land adjacent to PNR ROW since the NLEx-SLEx Connector Road Project of the DPWH was designed to utilize the existing PNR ROW. Additionally, approximately 78 ha of agricultural land in Banlic, Calamba will be acquired for the Depot.

3.1.1.1 Existing Land Use

147. The NSRP will utilize the existing PNR ROW except for the alignment from Solis Station to Sta. Mesa Station and the depot site in Banlic, Calamba. Additionally, the 20 stations of NSRP will be extended to 30 m from the existing width of the PNR ROW of 30 m or a total of 60 m at a length of 180 m to 220 m. The land use within the vicinity of the PNR ROW includes commercial, agricultural, industrial, institutional, residential, etc. and the areas become more densely built-up within urban centers of the host cities. Hence, land uses and development conditions within the vicinity of NSRP are predominantly built-up areas.

Summary of the existing land uses by host LGU is presented below.

Manila City

148. Based on the 2005-2050 Manila City Comprehensive Land Use Plan and Zoning Ordinance (MCLUPZO), the City has six (6) major land use allocations, namely: residential (20.7%), commercial (41.0%), institutional (2.3%), industrial (18.6%), public open space (6.2%) and transport / utilities and unclassified lands (11.2%). The land use and zoning map of the City of Manila is provided in **Figure 3.1.1.** From this map, it may be gleaned that the City is already congested with commercial and business-related developments.

149. The NLEx-SLEx Connector Road Project of the DPWH was designed to utilize the PNR ROW from Solis Station to Sta. Mesa Station. Based on this the NSRP alignment in this area will utilize a private land adjacent to PNR ROW which will be acquired by DOTr.

150. Five (5) NSRP Stations will be located in the City of Manila including Solis, Blumentritt, Espana, Sta. Mesa and Paco. From the existing PNR Solis Station, the NSRP alignment will utilize a private land of about 8.0 km in length up to Zobel Roxas Street. Predominantly, the land uses adjacent to the PNR ROW are high and medium intensity commercial areas, university cluster zone and high density residential areas. The land use within the proposed Blumentritt and España Stations is a high intensity commercial area while the proposed Sta. Mesa Station will be located adjacent to the university cluster zone and high density residential area. The land use at the immediate vicinity of the proposed Paco Station is a high density residential area. The alignment will pass through the Pasig River between the districts of Sta. Mesa and Pandacan going to Paco Station.

Makati City

151. Based on the Makati Land Use Plan 2001-2011 (adopted in 2001), residential areas accounted for the largest land use in the City of Makati at 35.0% of its total land area. Special mixed-use and commercial uses ranked next at 14.6% and 14.8%, respectively. The rest of Makati's land area is shared by institutional, recreational, parks and open spaces, cemetery, government center, and riverside development. Roads comprised 23.6% of the total land area. Figure 3.1.2 shows the existing land use map of the City of Makati.

152. The NSRP alignment will utilize approximately 4.4 km of the PNR ROW passing through Barangays San Antonio, Pio del Pilar, Bangkal and Magallanes. The major land uses adjacent to the project alignment are residential and commercial. The land uses at the immediate vicinity of the proposed Buendia Station are intended for commercial and residential uses. For the EDSA Station the immediate land use of the area is for commercial use. The NLEx-SLEx Connector Road Project of the DPWH is parallel to the proposed NSRP alignment in Makati City.

Taguig City

153. Based on the Taguig Land Use Plan 2000-2020, an area classified as General Residential Development Area – 1 (GRDA-1)[3] accounted for the largest land use in Taguig City, accounting for more than one third (40.4%) of the total land area. The institutional zone and urban core zone rank next at 9.6% and 7.6%, respectively. The rest of Taguig's land area is shared by General Residential Development Area – 2 (GRDA-2)[4], light industrial zone, socialized housing zone, low density residential development zone, tourism development zone, entertainment zone, military zone and open space zone. The creek, and easement land uses comprise 9.3% of the total land area. Figure 3.1.3 shows the existing zoning map of the City of Taguig.

154. The NSRP alignment will utilize approximately 5.8 km of the PNR ROW passing through Barangays of Fort Bonifacio, Western Bicutan, North Daang Hari, South Daang Hari, Bagumbayan and Bagong Tanyag. The major land uses adjacent to the project alignment are institutional, low density development, general residential development-1, low density development, open space, controlled growth corridor, and light industrial. The land uses at the immediate vicinity of the proposed stations are: (1) Nichols Station at Low Density Development and Institutional; (2) FTI Station at light industrial; and (3) Bicutan Station at GRDA-1.

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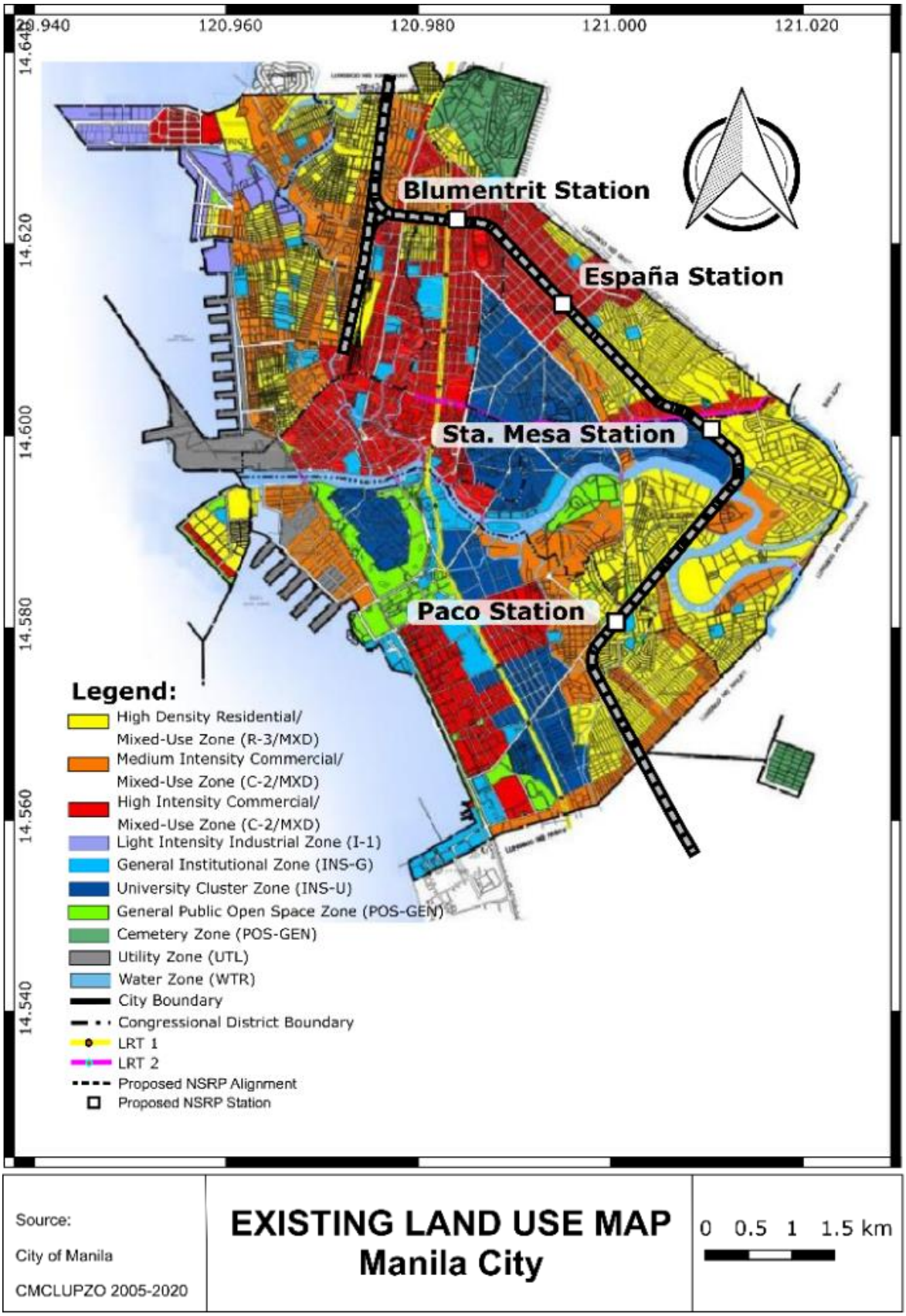
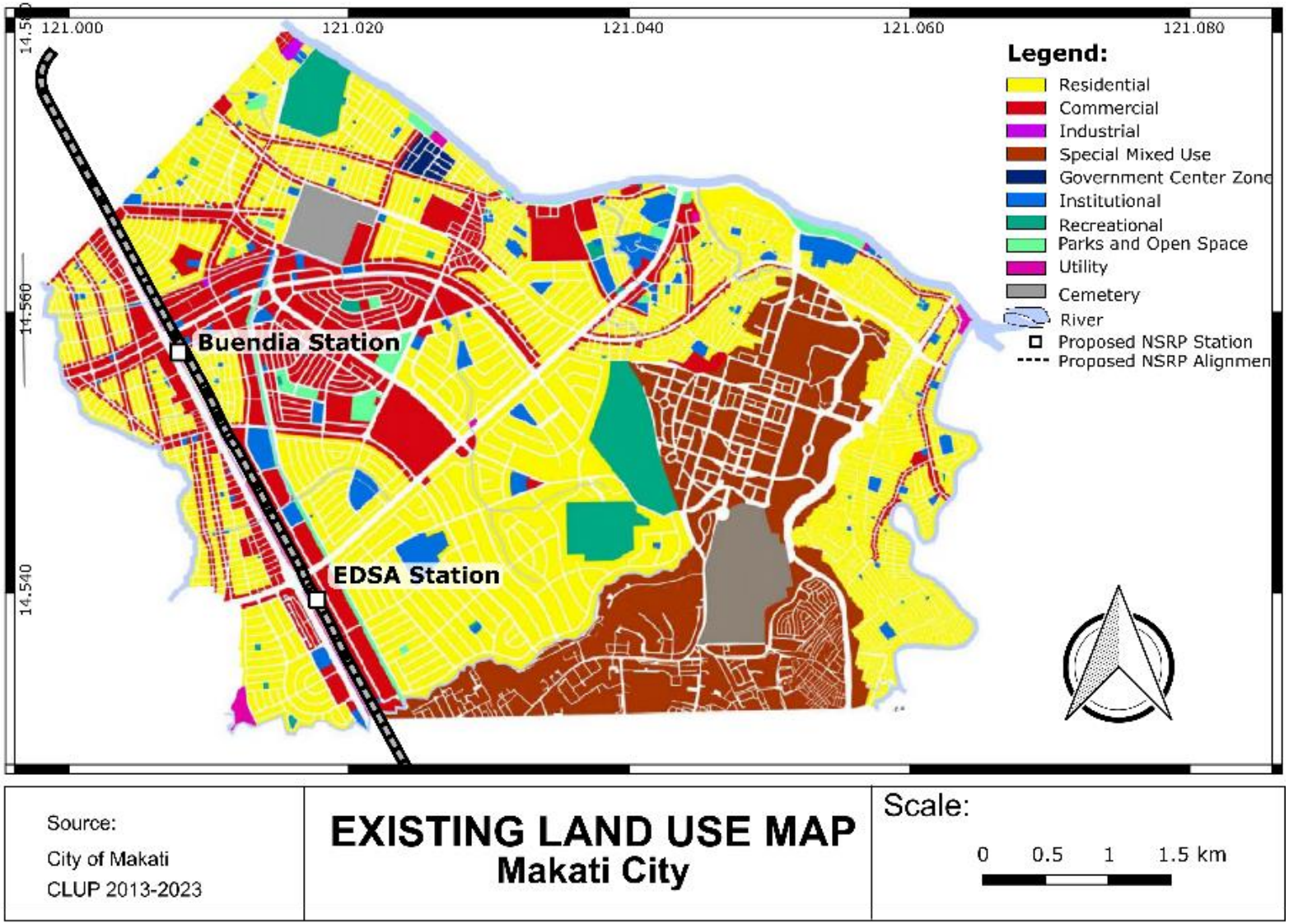
[3] **General Residential Development Area** - 1 (GRDA-1) are neighbourhood-type communities that are evenly distributed throughout the city. These are mainly characterized by high-density mixed-use neighbourhoods that are closely compacted and pre-dominated by residences and small-scale neighbourhood 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.

[4] **General Residential Development Area** - 2 (GRDA - 2) includes the areas presently occupied by the Bonifacio Naval Station, Marines Corps, Navy Officers Village, Philippine Army (PA) Support Command, PA Dental Dispensary and JUSMAG. This area is being earmarked for re-development as a master-planned medium density residential area. It shall complement the predominantly commercial and business developments in the Global City by accommodating the increasing demands for residential spaces in the city.



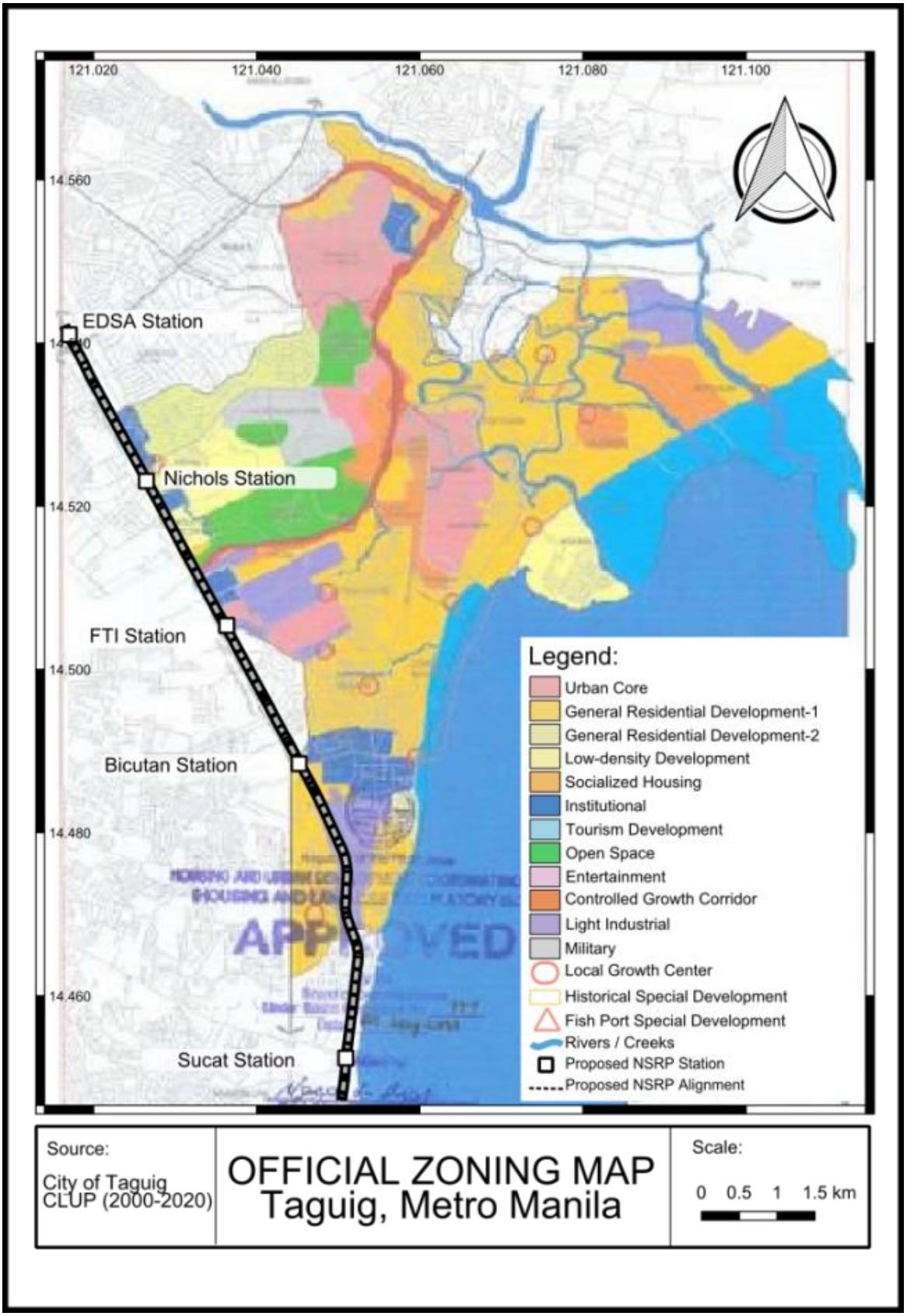
Source: Land Use and Zoning Map, 2005-2020 Manila CLUPZO

Figure 3.1.1 Land Use Map of the City of Manila showing Project Alignment



Source: Existing Land Use Map, The New Makati CLUP (2013-2023) Volume 1 Part 1

Figure 3.1.2 Makati City Existing Land Use Map



Source: Zoning Map, The Taguig CLUP (2000-2020) Volume II

Figure 3.1.3 3 Zoning Map of the City of Taguig showing Project Alignment

Parañaque City

155. The total land area of Paranaque City is 46.6 km^2 (4,660 hectares). As of the calendar year 2012, residential area 2 accounted for the largest land use in Parañaque City at 44.5% of the total land area. This was followed by Planned Unit Development (PUD), commercial 3 and industrial 2 at 17.8 %, 8.4 % and 8.0 %, respectively. The rest of Parañaque's land area is shared by residential 1, 3 & 4, commercial 1 & 2, industrial 1, institutional, parks & playground, cemetery and utilities. About 0.8% of the land area of Parañaque is comprise of creeks and rivers. Figure 3.1.4 shows the 2007 land use map of the City of Parañaque.

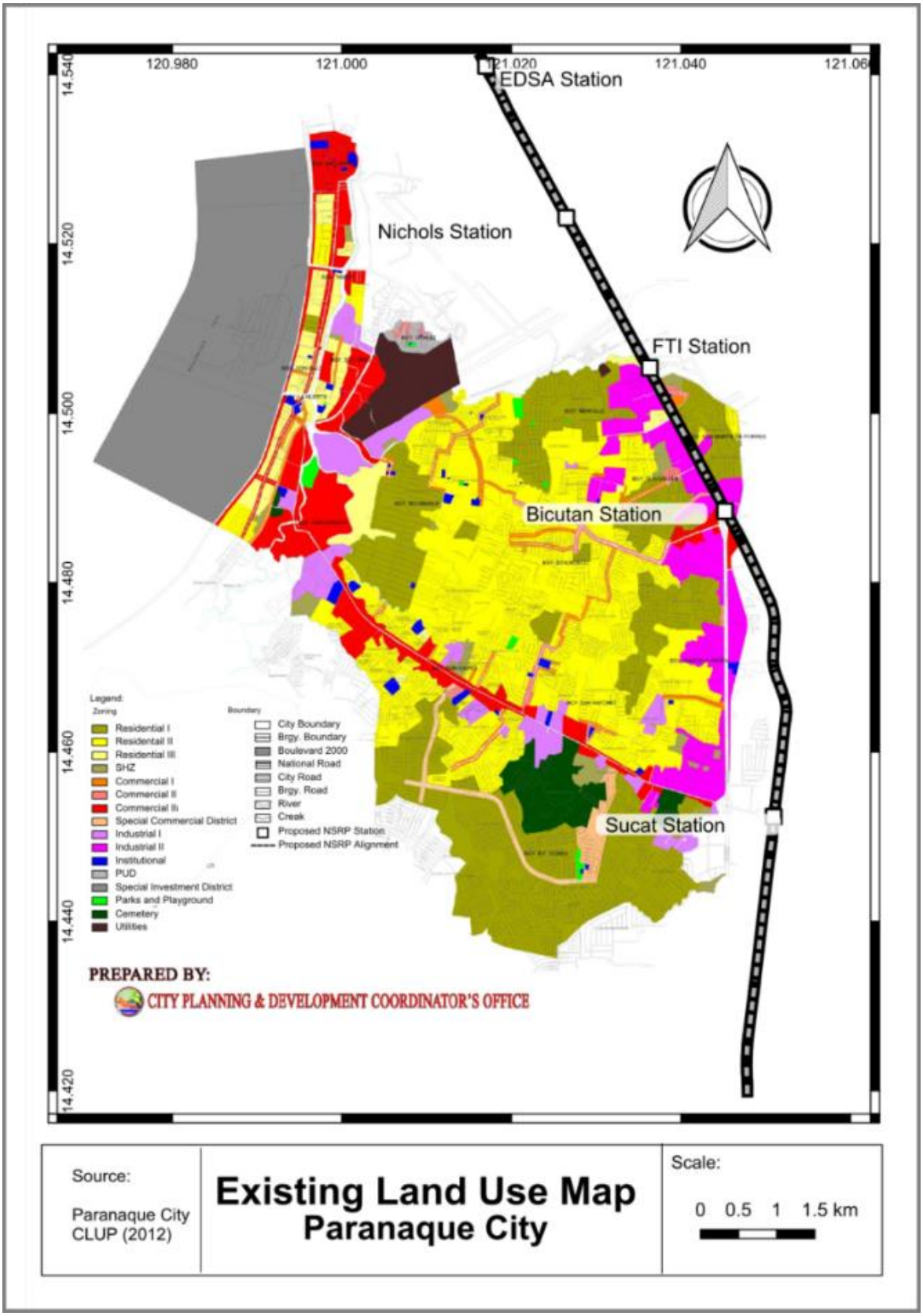
156. The NSRP alignment will utilize approximately 2.1 km of the existing PNR ROW passing though Barangay San Martin de Porres. Majority of the land us adjacent to the project alignment are commercial 2 with patch of residential 3, commercial 1 and commercial 3. The land uses at the immediate vicinity of the proposed Bicutan Station are commercial 3 and industrial 2.

Muntinlupa City

157. Based on the Land Use Plan 2001-2011, about 56.4 % of the total land area of Muntinlupa City is allocated for residential use and about 22.5 % is allocated for commercial use. The rest of Muntinlupa's land area is allocated for industrial, institution, parks and recreation, utilities, open spaces, urban corridor, tourism zone, specialized housing site and cemetery uses. Figure 3.1.5 shows the existing land use map of the City of Muntinlupa.

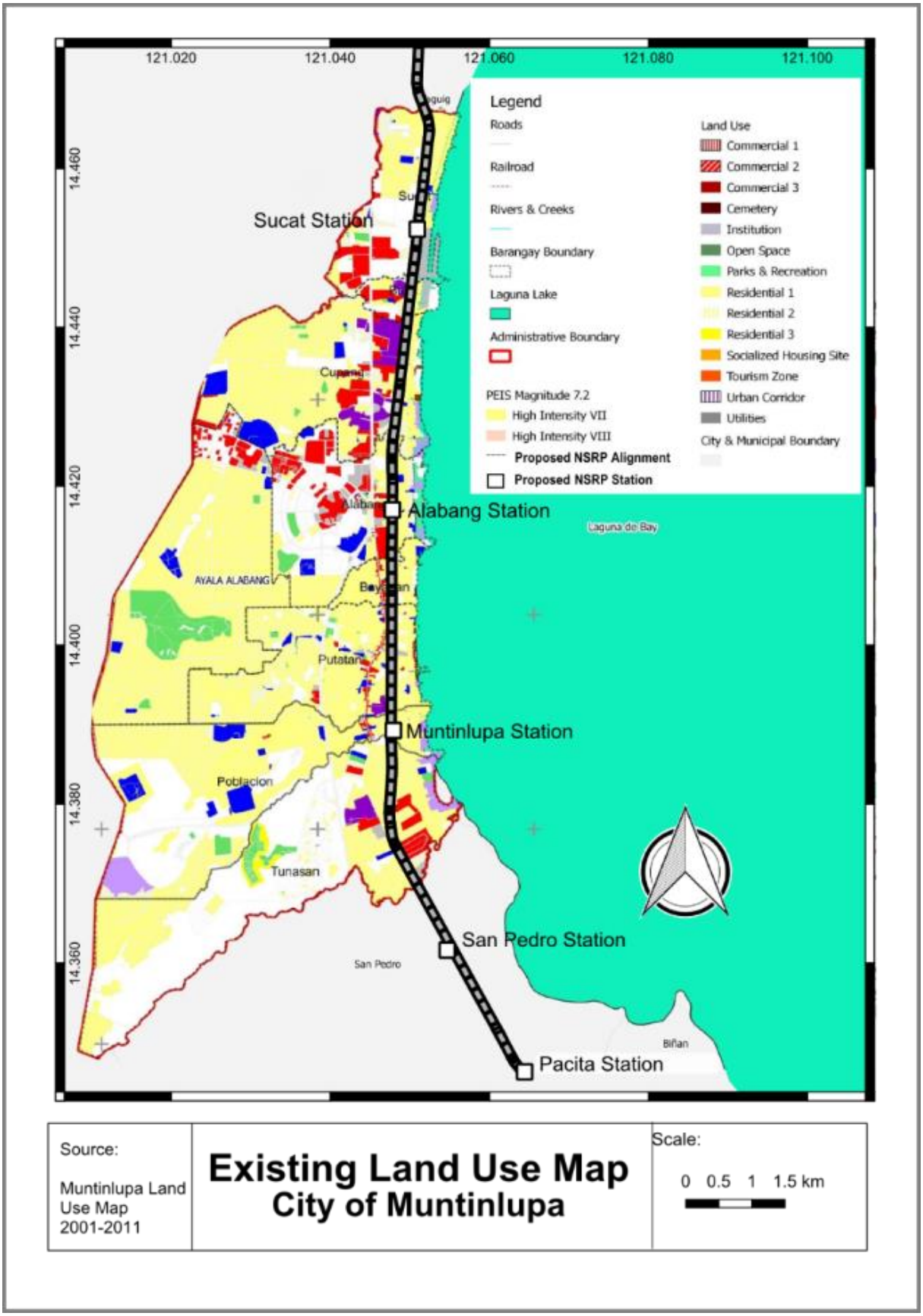
158. The NSRP alignment will utilize approximately 11.1 km of the PNR ROW passing through Barangays of Sucat, Buli, Cupang, Alabang, Bayanan, Putatan, Poblacion and Tunasan. Majority of the land use along the project alignment are residential with sections located in industrial and commercial areas. Notable institutional structures situated in the vicinity of the proposed railway are: Miraculous Medal School in Sucat; San Roque Catholic School and San Roque Parish Church in Alabang; Department of Education ALS Center and Library Hub, Mary Mother of God Parish Church and The Church of Jesus Christ of Latter-day Saints in Bayanan; Christ the King College of Science and Technology in Putatan and Divine Mercy Viewing Chapel in Tunasan.

159. The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area. STPP site is also being considered as depot for minor maintenance works. Presently, the government, under the Power Sector Assests ans Liabilities Management Corporation (PSALM), has an existing contract with a private firm to dismantle, clean-up and remediate the STPP site. According to the existing land use map of Parañaque, the project is located in a utility type of land use. The proposed Alabang Station will be located adjacent to the Starmall Alabang which is designated as a commercial area with residential areas at the east. The immediate vicinity of the proposed Muntinlupa Station is residential area.



Source: Land Use and Zoning Map, Parañaque City Socioeconomic Profile (2012)

Figure 3.1.4 Land Use and Zoning Map of the City of Parañaque showing Project Alignment



Source: Existing Land Use Map, Muntinlupa City CLUP (2001-2011)

Figure 3.1.5 Existing Land Use Map of the City of Muntinlupa showing Project Alignment

San Pedro City

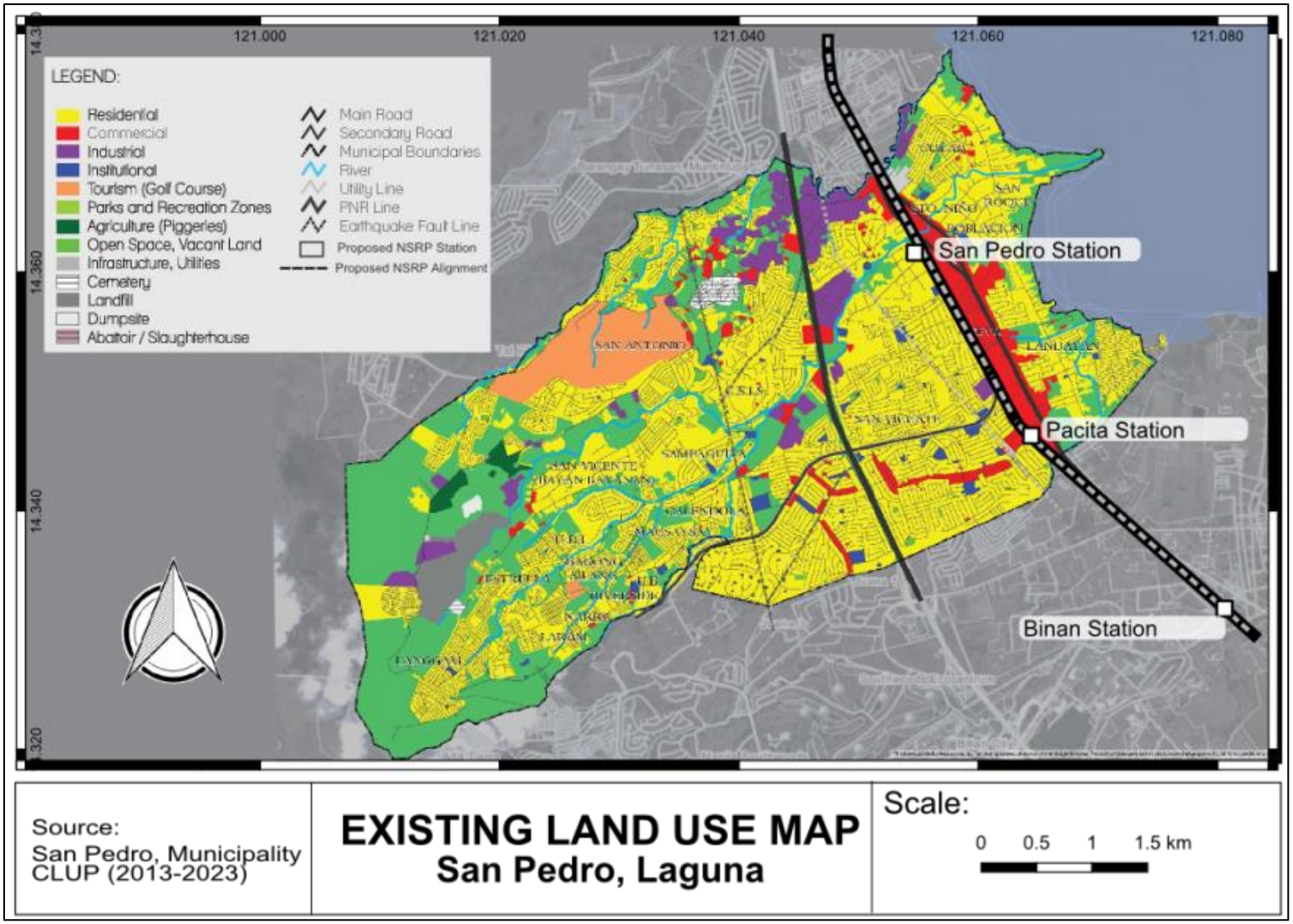
160. The Municipality of San Pedro has a total land area of 22.6 km² where it is following land uses: residential, commercial, institutional, industrial, tourism, agriculture, cemeteries, abattoirs, and infrastructure & utilities. Non-built up areas are 8.3 km² (825.3 hectares) or 36.5 % of total land area, composed of open spaces & idle lands, roads, landfill, dumpsite, water zone, and parks & recreation. Figure 3.1.6 shows the existing land use map of the City of San Pedro.

161. The project alignment will utilize approximately 3.2 km of the PNR ROW passing the Barangays of San Antonio, San Vicente and Nueva. The areas adjacent to the project alignment are being utilized as residential and commercial areas. The land uses at the vicinity of the proposed San Pedro and Pacita Stations are residential and commercial.

Biñan City

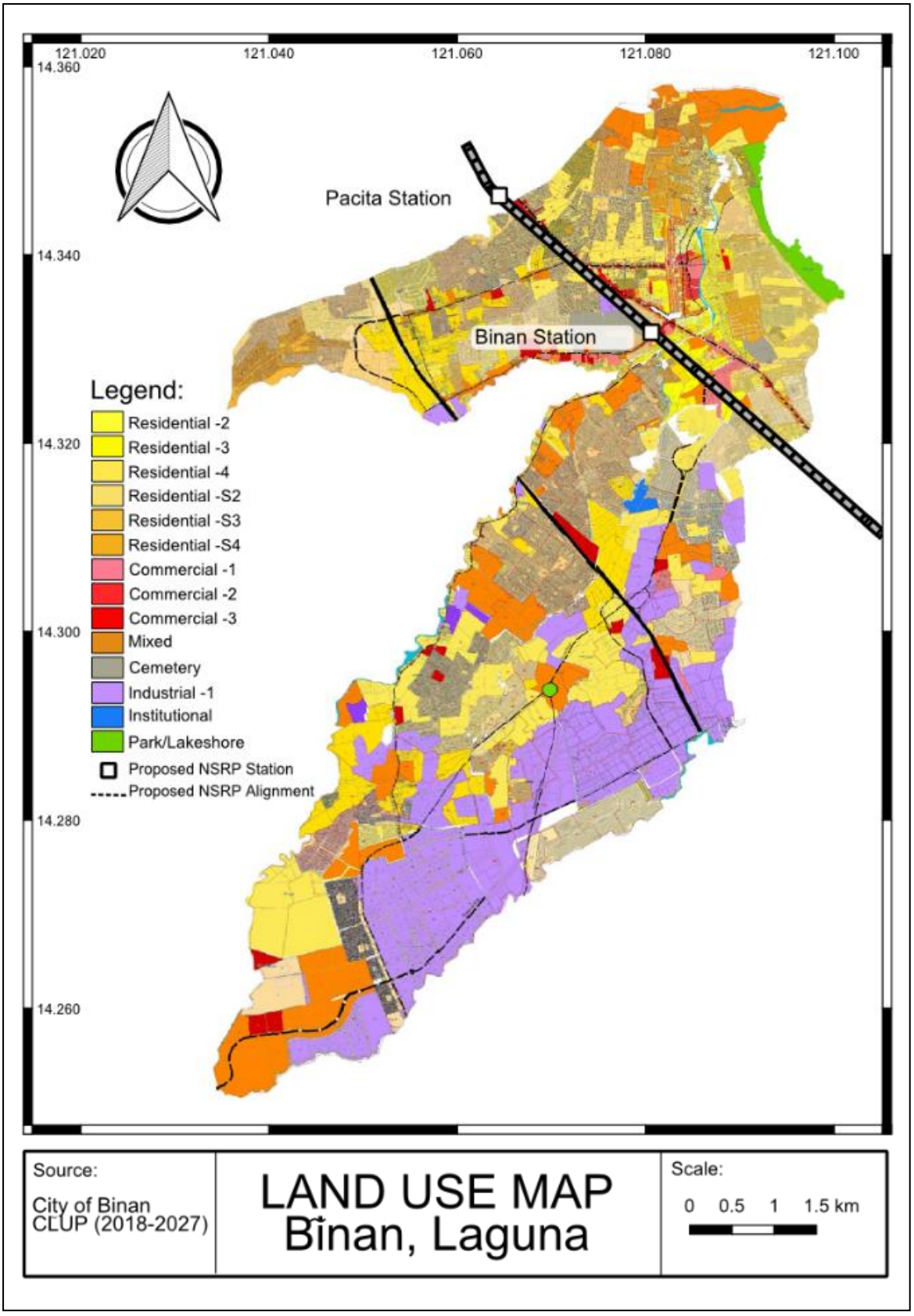
162. Biñan City has a total land area of 43.5 km², which represents 2.5 % of the entire Laguna area. Of the 11 land use classifications illustrated in Figure 3.1.7, a large portion of the city's land area is dedicated for residential purposes. Open grasslands with scattered trees also represent a substantial space in the city. The remaining portions of the city are subdivided to other uses such as commercial, institutional, industrial, mixed-use, recreational, infrastructure, utilities and cemetery.

163. The project alignment will utilize approximately 4.2 km of the PNR ROW passing the Barangays of Canlalay, San Vicente, Sto. Niño and Platero. The areas adjacent to the project alignment are being utilized as residential and commercial areas. The land uses at the vicinity of the proposed Biñan Station are residential and commercial.



Source: Existing Land Use Map 2012, San Pedro City CLUP Volume 1 (2013-2023)

Figure 3.1.6 Existing Land Use Map of the City of San Pedro showing Project Alignment



Source: Land Use Map, Biñan City CLUDP (2018-2027)

Figure 3.1.7 Land Use Map of the City of Biñan showing Project Alignment

Sta. Rosa City

164. The area distribution of land uses of Santa Rosa City's total land area of 55.52 km² are as follows: residential (40.5 %), idle (24.5 %), agricultural (12.0 %), industrial (10.2 %), tourism (4.0 %), infrastructure (3.8 %), commercial (2.7 %), institutional (0.9 %), cemetery (0.5 %), waterways (0.5 %), and pond (0.3 %). Thus, it is seen that residential land use dominates the spatial extent of the city, i.e., with two-fifths of the city being devoted to high, medium-and low-density housing establishments. Significantly, around one-fourth of the city is indicated as idle in its relatively less accessible southern section. A tenth of the city is still holding out as agricultural ricelands in its northern half. The industrial land use category is also significant, i.e., occupying around one-tenth of the city's areal extent. The industrial district has establishments ranging from light to medium and heavy industries. Figure 3.1.8 shows the land use map of Sta. Rosa City.

165. The project alignment will utilize approximately 5.1 km of the PNR ROW passing the Barangays of Tagapo, Labas Pooc, Dila and Dita. The areas adjacent to the project alignment are agricultural land, mostly rice fields, and residential areas. The notable institutions within the vicinity of the project alignment are New Sinai MDI Hospital and Cañosa School in Brgy. Tagapo, Labas Elementary School and Colegio de Sta. Rosa de Lima, Inc. in Brgy. Labas and Queen Ann School of Sta. Rosa Inc. in Brgy. Dita. The land uses at the vicinity of the proposed Sta. Rosa Station are residential and agricultural.

Cabuyao City

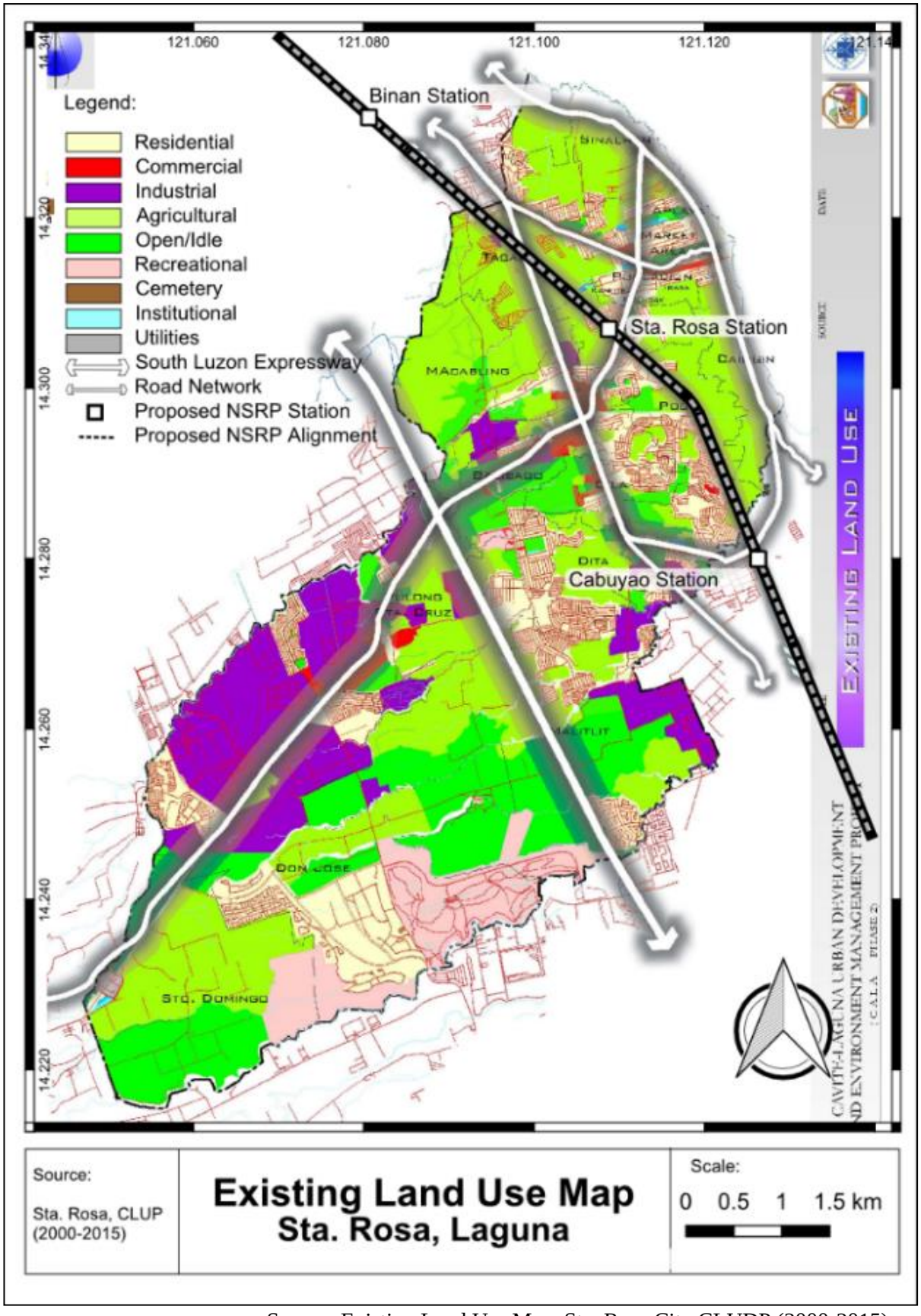
166. Cabuyao City has a total land area of 43.30 km². A large portion of the city's land area is dedicated for industrial purposes. Agricultural lands also represent a substantial space in the city. The remaining portions of the city are subdivided to other utilizations such residential, commercial, special development, Cabuyao Investment and Development Authority Growth Centers, and other zones. Figure 3.1.9 shows the land use map of Cabuyao City.

167. The project alignment will extend approximately 6.5 km of the PNR ROW passing the Barangays of Poblacion 1 and 2, Bigaa, Sala, Niugan, Banay-Banay, San Isidro, Pulo and Mamatid. The areas adjacent to the project alignment are residential, commercial, agricultural (ricefields), light industrial zone, Cabuyao Enterprise City 1 and institutional. Notable institutions at the project vicinity are Cabuyao Central School, MCGI Ang Dating Daan Cabuyao and University of Cabuyao. The land uses at the vicinity of the proposed Cabuyao Station are light to medium density residential and high density commercial areas. For the proposed Gulod Station, the land uses employed around its vicinity are medium density residential, mixed-used, and authority growth areas. The proposed Mamatid Station is to be located between a medium density residental area and a medium density commercial zone.

Calamba City

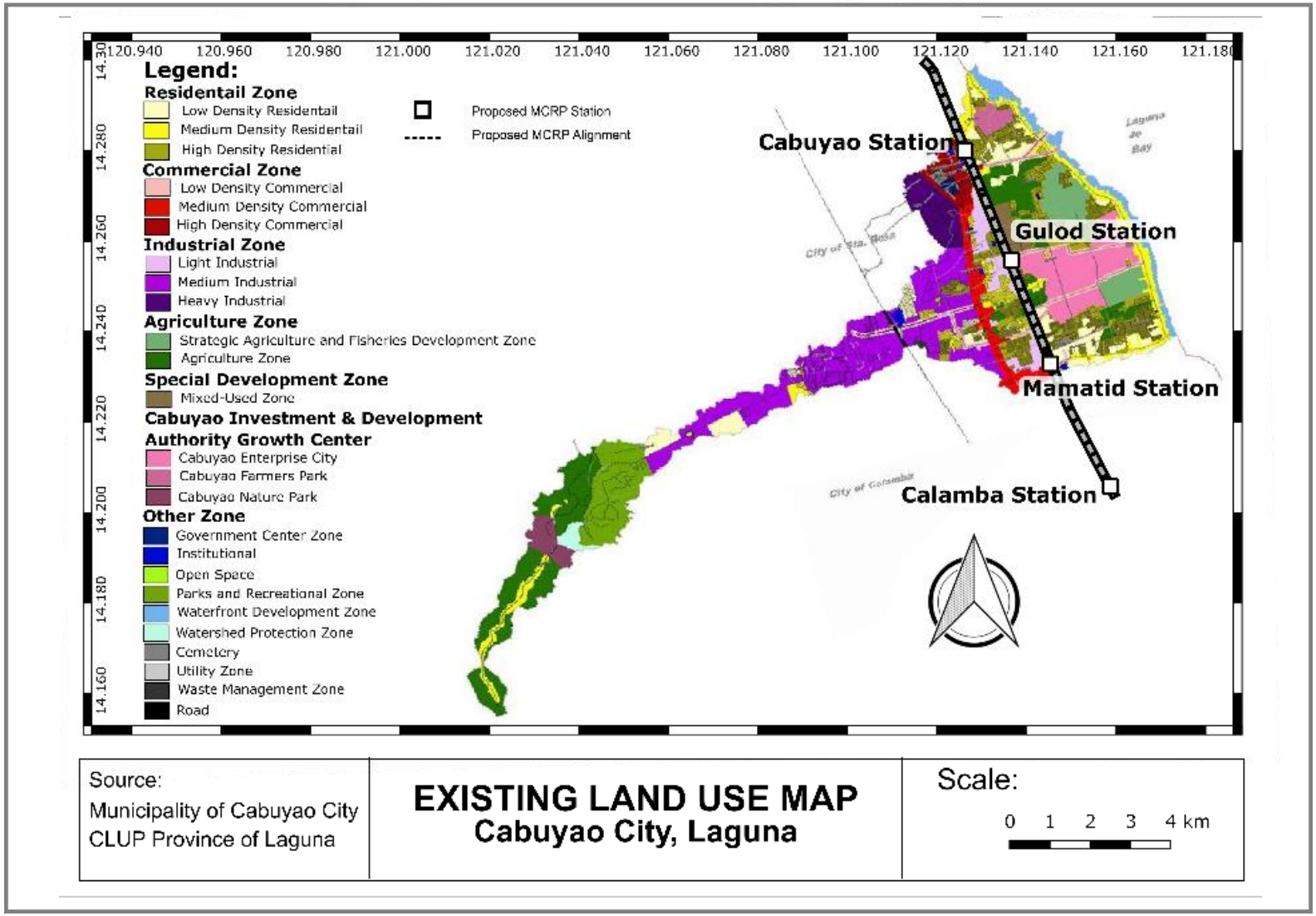
168. Calamba City has a total land area of 144.8 km². A large portion of the City's land area is allocated as growth management area. Urban development, upland conseration, and agricultural development areas also represent a substantial space in the City. The remaining portions of the City are subdivided to other utilizations such forest buffer and Makiling Forest Reservation. Figure 3.1.10 shows the zoning map of Calamba City.

169. The project alignment will utilize approximately 3.2 km of the PNR ROW passing the Barangays of San Cristobal, Parian, Poblacion 1, Lecheria, Halang, Bucal, Pansol, Sucol, Masili, Banlic, Real and La Mesa. The areas adjacent to the project alignment are utilized for urban redevelopment and agricultural development areas. The land use at the vicinity of the proposed Calamba Station is urban redevelopment area. The proposed depot will be constructed on agricultural land in Banlic, Calamba.



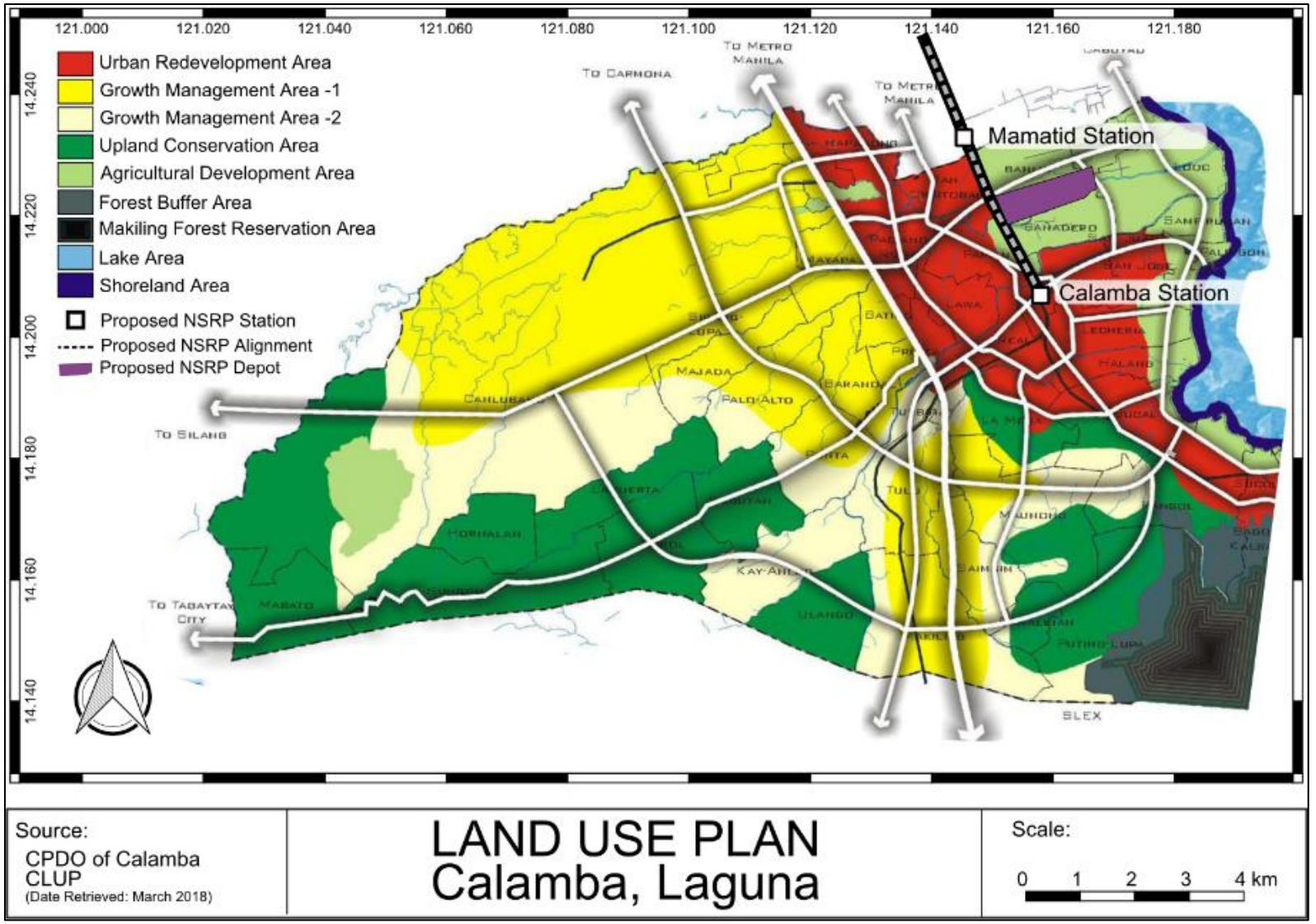
Source: Existing Land Use Map, Sta. Rosa City CLUDP (2000-2015)

Figure 3.1.8 Sta. Rosa City Land Use Map



Source: Zoning Map, Cabuyao City CLUP

Figure 3.1.9 Zoning Map of the City of Cabuyao showing Project Alignment



Source: Land Use Map, Calamba City CLUP

Figure 3.1.10 Land Use Map of the City of Calamba showing Project Alignment

3.1.1.2 Environmentally Critical Area

170. Environmentally Critical Areas (ECAs) are environmentally sensitive areas declared under Presidential Proclamation No. 2146 of 1981 where significant environmental impacts are expected if certain types/ thresholds of project are located, developed, or implemented within these areas. Table 3.1.1 presents the list of ECAs and its relevance to the project site.

Table 3.1.1 List of ECA and relevance to the Project Site

Environmentally Critical Areas		Relevance to the Proposed Project Site
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	The proposed NSRP will not traverse any national parks, watershed reserves, wildlife preserves and sanctuaries. Identified nearest protected area is the Mount Makiling Forest Reserve (MMFR) approximately 4 km away.
2	Areas set aside as aesthetic, potential tourist spots.	No identified nearby areas set aside for aesthetic, potential tourist spot.
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	The proposed NSRP will not traverse any habitat of endangered or threatened species of Indigenous Philippine wildlife. Identified nearest protected area is the Mount Makiling Forest Reserve (MMFR) (4 km from alignment).
4	Areas of unique historic, archaeological, geological, or scientific interests	Identified old PNR structures to be maintained will be conserved in accordance with the guidelines of the National Historical Commission of the Philippines (NHCP)
5	Areas which are traditionally occupied by cultural communities or tribes	The proposed NSRP alignment will not traverse CADT/CADC.
6	Areas frequently visited and or hard hit by natural calamities (geologic hazards, floods, typhoons, volcanic activity, etc.)	The proposed NSRO will traverse an area with High Risk to typhoon passage and geologic hazard. Segments from Manila City to San Pedro City have high susceptibility to flooding.
7	Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	The proposed NSRP project area is generally flat and will not traverse areas with critical slope.
8	Areas classified as prime agricultural lands	The proposed NSRP will traverse agricultural areas in Sta. Rosa, Cabuyao, and Calamba Cities. The proposed Depot will be located in an agricultural land in Calamba City.
9	Recharge areas of aquifers	No identified recharge areas of aquifers along the NSRP alignment.
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.	This type of ECA is not relevant for the proposed NSRP. Although there are fishery activities in Laguna and Tadlac Lakes, these lakes will not be encroached by the proposed NSRP.
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	This type of ECA is not relevant for the proposed NSRP.
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines.	This type of ECA is not relevant for the proposed NSRP.

Source: Presidential Proclamation No. 2146 (1982)

(1) Areas Declared by Law as National Parks, Watershed Reserves, Wildlife Preserves and Sanctuaries

171. The alignment of NSRP 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 Forest Reserve. The reserve was designated in 1993 under the Republic Act No. 552 as a National park, which in 1963 under Republic Act No. 3523 and Republic Act No. 6967, management was delegated to the University of the Philippines, to administer and conserve the area primarily as a training laboratory for the advancement of scientific and technical knowledge particularly in the preservation, conservation and development of the country's forest, flora and fauna, and natural resources.

1) Protected Areas based on International Laws

172. International Union for Conservation of Nature (IUCN) protected area management categories classify protected areas according to their management objectives (**Table 3.1.2**). 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.

173. Based on the IUCN, Philippines has a total of 390 protected areas composed of National Park (37), Natural Monument or Feature (8), Habitat/Species Management Area (17), Protected Landscape/ Seascape (145), and Protected area with sustainable use of natural resources (183).

Table 3.1.2 Classification of IUCN Protected Area

	Classification	Feature	Number of Protected Area in Philippines
I	Strict Nature Reserve/ Wilderness Area	Areas set aside to protect biodiversity and also possibly geological/geomorphic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values / protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition	0
II	National Park	To protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities	37
III	Natural Monument or Feature	To protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove	8
IV	Habitat/Species Management Area	To protect particular species or habitats and management reflects this priority	17
V	Protected Landscape/ Seascape	Area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values	145
VI	Protected area with sustainable use of natural resources	Areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems	183

Source: IUCN（http://www.iucn.jp/park/protection/reserve/reserve (Access in January 2018)

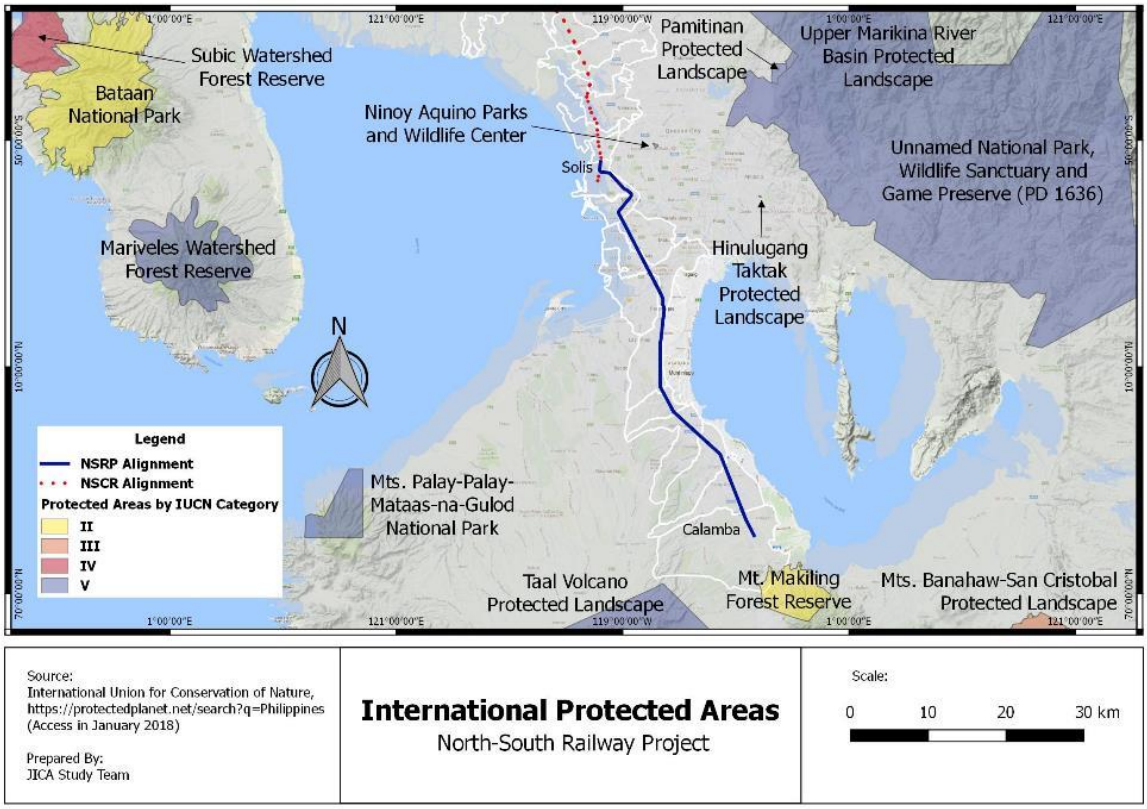
174. Listed in **Table 3.1.3** are the protected areas within the 50-km from the project alignment. The closest protected area is Mount Makiling National Park which is approx. 4 km from the project alignment.

Table 3.1.3 International Protected Area nearby Project Area

Category	Protected area	Location	Area (ha)	Distance from the Project Alignment (km)
II	Mount Makiling National Park	Los Baños, Bay and Calamba City in the Province of Laguna and Santo Tomas, Batangas	4,244	4
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

Category	Protected area	Location	Area (ha)	Distance from the Project Alignment (km)
V	Upper Marikina River Basin Protected Landscape	Antipolo and Rodriguez, Rizal	26,125	25
V	Ninoy Aquino Parks and Wilidlife Centre	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: International Protected Area: IUCN, https://protectedplanet.net/search?q=Philippines (Access in January 2018)

Figure 3.1.11 International Protected Area (IUCN)

2) Protected Area under the Philippine Law

175. 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 (8) 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 categories (**Table 3.1.4**).

Table 3.1.4. Classification of NIPAS

	Category	Features	Number of Protected Area in Philippines*
1	Strict Nature Reserve	SNR is an area possessing some outstanding ecosystem, features, and/or species of flora and fauna of national scientific importance, maintained to protect nature and maintain processes in an undisturbed state in order to have ecologically representative examples of the natural environmental monitoring, education and for maintenance of genetic resources in a dynamic and evolutionary state.	0
2	Natural Park	NP is a relatively large area not materially altered by human activity where extractive resource uses are not allowed and which are maintained to protect outstanding natural and scenic areas of national or international significance for scientific, educational, and recreational use.	27
3	Natural Monument/Natural Landmark	NM/NL is a relatively small area focused on protection of small features to preserve nationally significant natural features on account of their special interest or unique characteristics.	4
4	Wildlife Sanctuary	WS comprises an area which assures the natural conditions necessary to protect nationally significant species, groups of species, biotic communities, or physical features of the environment where these may require specific human manipulation for their perpetuation.	10
5	Protected Landscape and Seascapes	PL/S are areas of national significance which are characterized by the harmonious interaction of man and land while providing opportunities for public enjoyment through recreation and tourism within the normal lifestyles and economic activity of these areas.	57
6	Resource Reserve	RS is an extensive and relatively isolated and uninhabited area normally with difficult access designated as such to protect natural resources of the area for future use and prevent or contain development activities that could affect the resources pending the establishment of objectives which are based upon appropriate knowledge and planning.	5
7	Natural Biotic Areas/ Anthropological Reserve	Natural Biotic Areas/Anthropological Reserve is an area set aside to allow the way of life of societies living in harmony with the environment to adopt to modern technology at their pace.	4
8	Other categories	This refers to those areas established by law, conventions, or international agreements which the Philippine Government is a signatory.	-

Note: *As of December 2008

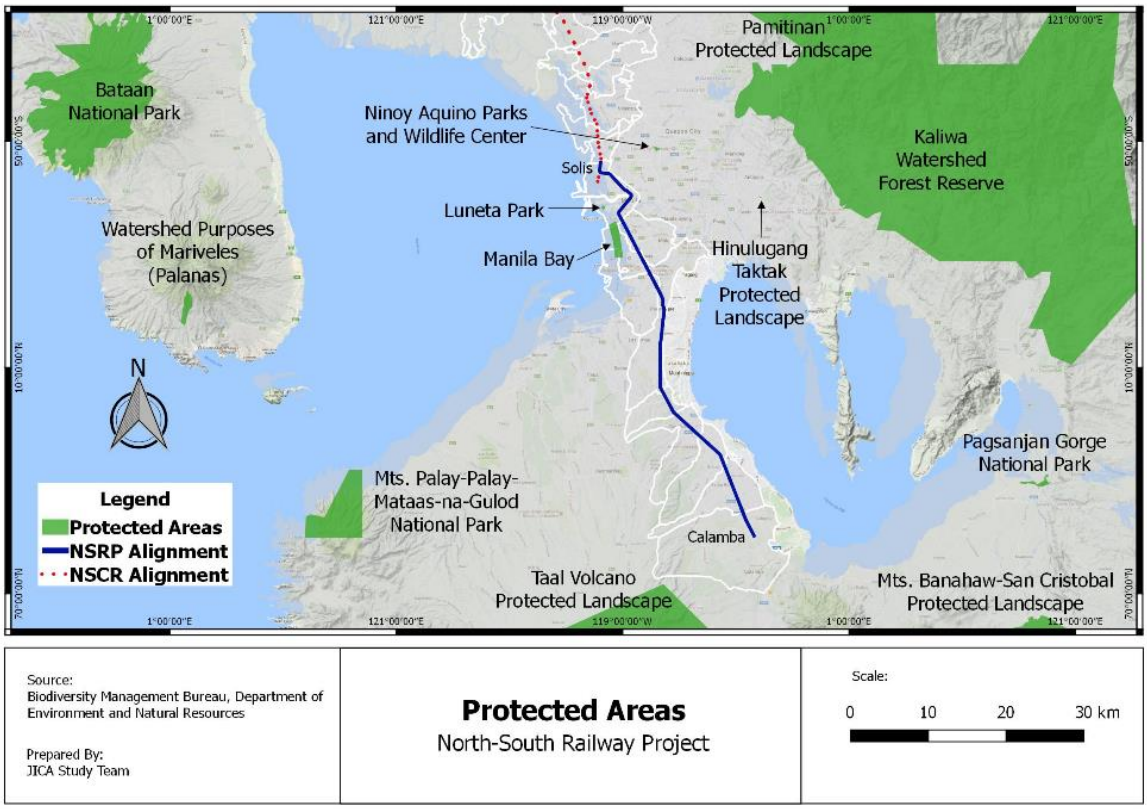
Source: A. La Viña, et al., Legal Framework for Protected Areas: Philippines (2010)

176. Protected areas located within 50 km from the project alignment are shown in Table 3.1.5 and Figure 3.1.12. The alignment of NSRP does not traverse any protected area.

Table 3.1.5 Protected Area nearby the Proposed NSRP

Category	Protected area	Location	Area (ha)	Distance from the Project Alignment (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



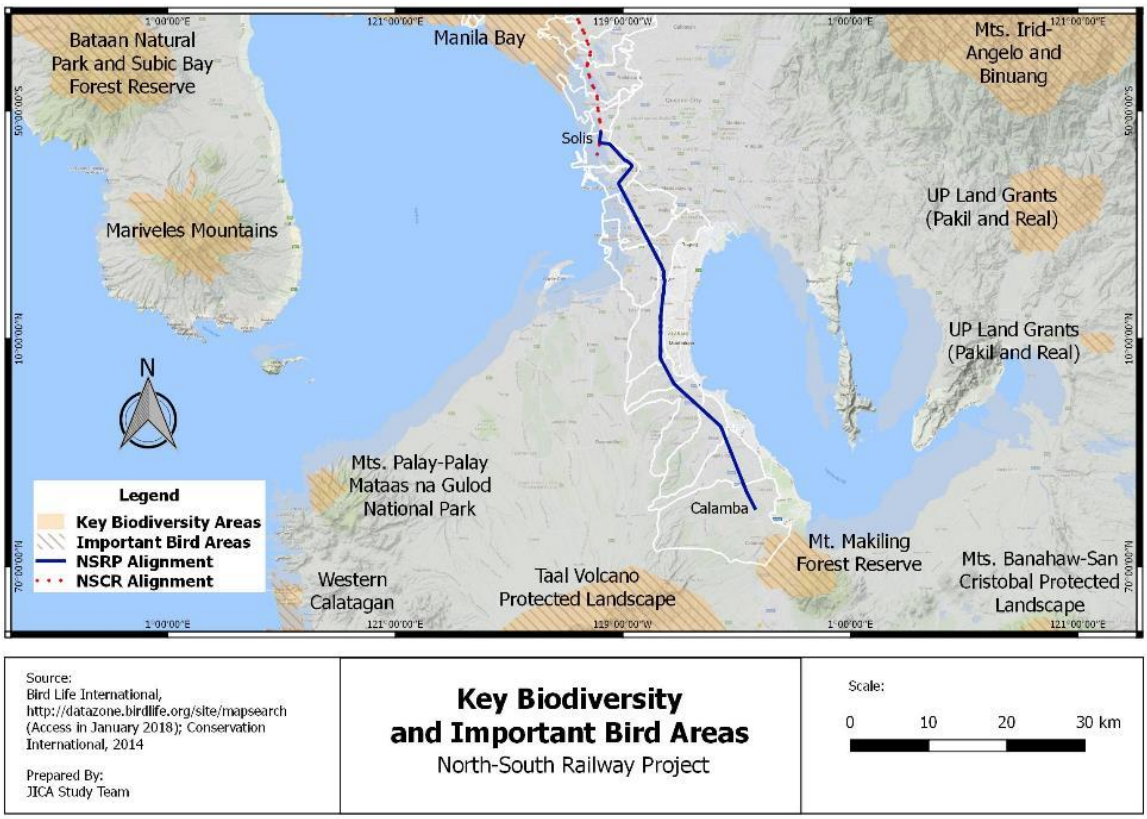
Source: Protected Areas and Wildlife Bureau, DENR

Figure 3.1.12 Protected Area under NIPAS

3) Important Bird Areas and Key Biodiversity Areas

177. In 2006, DENR defensed 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 the international nor national protected area. The closet IBAs/ KBAs is 4,244 ha of Mount Makiling National Park (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 3.1.13**.

178. Although it is not under IBAs/ KBAs, Tadlac Lake (also known as Alligator Lake) was also included in the area of study to assess the biodiversity in its sorrounding. The lake which is approximately 5.5 km from the proposed NSRP alignment is located in Barangay Tadlac, Los Baños near the border of Calamba City in the province of Laguna. The lake is contained in a piece of land jutting out to the Laguna de Bay that was known as Malilimbas Point and is directly situated below the northeastern slope of Mount Makiling, the highest mountain in the Laguna Volcanic Field. Because of its origin, the lake has no outlet and is replenished only by rainfall.



Source:1) Bird Life International (http://datazone.birdlife.org/site/mapsearch) (Access in January 2018)
2) Conservation International 2014

Figure 3.1.13 IBAs and KBAs Location Map

(2) Areas of Unique Historic, Archaeological, or Scientific Interests

179. 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 sites which: 1) Possess demonstrable historical significance; 2) be at least fifty (50) years old; and 3) seventy (70) percent authentic, are qualified for consideration.

180. Within the vicinity of the NSRP alignment (80 m away) is the Lord Just Ukon Takayama Monument (Plaza Dilao, Paco, Manila) which was declared as National Monument by NHCP in 1992.

181. Within the proposed project alignment, old PNR and other structures were also identified. These structures are considered to meet the above-mentioned conditions for recognition of historic sites and structures. DOTr will consult to National Commission for Culture and the Art (NCCA), National Museum, and National Historical Commission of the Philippines (NHCP) and PNR for the qualification of those structures and provide necessary protection measure during construction.

(3) Areas frequently visited and or hard hit by natural calamities

182. Philippines is prone to natural hazards such as typhoons, earthquakes, volcanic eruptions, landslides and tsunamis. The whole stretch of the alignment is prone to geologic (i.e. ground shaking) and typhoon hazards while only portions of the alignment located in Metro Manila are prone to periodic flooding during the rainy season. The alignment is not prone to volcanic activity. The geologic hazards, floods, typhoons, and volcanic activity are discussed in Section 3.1.2.3.

(4) Areas classified as prime agricultural land

183. Prime agricultural land refers to the land that can be used for various or specific agricultural activities and can provide optimum and suitable yield with minimum inputs and development costs as determined by the Department of Agriculture (DAR AO No. 01 Series of 2002). Portion of NSRP alignment will pass through agricultural areas (i.e. rice field) in Sta. Rosa, Cabuyao, and Calamba. The site being considered for the Depot is a 78-ha agricultural lot in Banlic, Calamba.

184. Except for the 30 m extension of the proposed stations, the agricultural land in Sta. Rosa and Cabuyao will not be affected since the project will utilize the existing PNR ROW. Addionally, the agricultural land in Banlic, Calamba needs to be converted into an Infrastructure/ Utilities, Transportation and Services land use for the construction of the Depot.

(5) Water Bodies

185. Laguna de Bay is the main hydrologic feature which affects the NSRP alignment. It is a fresh water lake with a surface area ranging from 911 to 949 km^2 and a watershed area of 3,820 km^2. The lake is currently used for fisheries, as a source for domestic water supplies, and industrial cooling, as a transport route, as a source for power generation and irrigation, and as a place for recreation[5]. With its many uses, the lake is facing environment issues that are being addressed up to the present. Data shows that 60 % of the estimated 8.4 million people staying around the Laguna de Bay dumped their solid and liquid wastes indirectly to the lake through its 21 tributaries. Of the total wastes going into the lake, 40 % comes from agricultural wastes, 30 % from domestic wastes, and 30 % from industrial wastes[6].

186. There are 35 water ways crossing at NSRP alignment. These include Pasig River, Sucat River, Alabang River, Bayanan Creek, Poblacion River (Muntinlupa), Magdaong River (Muntinlupa), Tunasan River, San Isidro River (San Pedro River), Biñan River, San Cristobal River and Calamba River. However, none of these rivers is being utilized for drinking water. The pollution in these rivers are *extreme* and will be subjected to regular water quality monitoring at identified monitoring stations during project implementation. Discussion of the rivers is presented in the hydrology section of this report.

187. Table 3.1.6 shows the summary list of ECAs per City that will be traversed or within the proximity of the NSRP alignment.

[5] http://www.greenpeace.org/seasia/ph/What-we-do/Toxics/Water-Patrol/The-problem/Laguna-Lake/
[6] http://fmds.upou.edu.ph/index.php/27-fmds-community/178-lagunalake

Table 3.1.6 ECA Traversed by NSRP Alignment

Environmentally Critical Areas		Manila	Makati	Taguig	Parañaque	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
1	All areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries	None	None	None	None	None	None	None	None	None	None
2	Areas set aside as aesthetic, potential tourist spots	None	None	None	None	None	None	None	None	None	None
3	Areas which constitute the habitat for any endangered or threatened species of Indigenous Philippine wildlife (Flora and Fauna)	None	None	None	None	None	None	None	None	None	None
4	Areas of unique historic, archaeological, geological, or scientific interests	Yes	Yes	None	None	Yes	Yes	Yes	None	Yes	None
5	Areas which are traditionally occupied by cultural communities or tribes	None	None	None	None	None	None	None	None	None	None
6	Areas frequently visited and or hard hit by natural calamities										
	- geologic hazard	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	- floods	Yes	Yes	Yes	Yes	Yes	Yes	None	None	None	None
	- typhoons	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	- volcanic activity	None	None	None	None	None	None	None	None	None	None
7	Areas with critical slope: All lands with slope of 50% or more classified as geohazard by MGB	None	None	None	None	None	None	None	None	None	None
8	Areas classified as prime agricultural lands	None	None	None	None	None	None	None	Yes	Yes	Yes
9	Recharge areas of aquifers	None	None	None	None	None	None	None	None	None	None
10	Water bodies characterized by one or any combination of the following conditions: tapped for domestic purposes; within the controlled and/or protected areas declared by appropriate authorities; which support wildlife and fishery activities.	None	None	None	None	Yes	None	None	None	None	None
11	Mangrove areas characterized by one or any combination of the following conditions: with primary pristine and dense young growth; adjoining mouth or major river systems; near or adjacent to traditional productive fry or fishing grounds; areas which act as natural buffers against shore erosion, strong winds and storm floods; areas on which people are dependent for their livelihood.	None	None	None	None	None	None	None	None	None	None
12	Coral reefs characterized by one or any combination of the following conditions: With 50% and above live coralline cover; Spawning and nursery grounds for fish; Act as natural breakwater of coastlines.	None	None	None	None	None	None	None	None	None	None

3.1.1.3 Land Tenure Issue/s

188. The entire PNR alignment and ROW is the property of the Philippine National Railway, an attached agency of the DOTr. Hence, there are no tenurial issues (i.e. CARP or with CADC/ CADT/ CALC/ CALT) with regards to ownership of the alignment. However, there are portions of the alignment that are still encroached by informal settlers and these will be addressed in the Resettlement Action Plan.

(1) PNR Operation

189. PNR operation will not be affected by the project during its implementation. The proposed NSRP will not share the tracks of the proposed freight and long-haul trains. PNR line will continue its operation while the proposed NSRP is being constructed. Existing tracks will be reused for the freight and long-haul trains operation. In addition, the proposed NSRP plans to connect to the MMSP line at FTI station but needs further study.

(2) NLEx/ SLEx Connector Road Project

190. NLEx/ SLEx Connector Road Project, being implemented by the Department of Public Works and Highways (DPWH), is an 8 km all elevated 4-lane toll expressway which will extend the NLEx southward from the end of Segment 10 in C3 Road Caloocan City to PUP Sta. Mesa, Manila and will connect to the Skyway Stage 3, and traverse mainly the PNR rail track. The project includes two (2) 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.

191. The alignment of the proposed NSRP from Solis Station to Sta. Mesa Station will utilize a private land adjacent to the PNR ROW which will be acquired by DOTr. This is because the NLEx/SLEx Connector Road Project of the DPWH from Solis to Sta. Mesa has been designed to utilize the PNR ROW.

(3) Private Land owners

192. The DOTr will acquire the private land for NSRP alignment from Solis Station to Sta. Mesa Station; the 30 m extension for each station and the depot site in Banlic, Calamba.

(4) Informal Settlers

193. PNR ROW has been proliferated by Informal Settler Families (ISFs) disregarding the hazard of living along the PNR ROW. Informal settler families and their structures can be found within the bounds of the proposed 30m ROW for NSRP. Most of the structures located at approximately 2 to 10 meters from the track are a mixture of concrete and light materials with 2 or more families sharing in a structure. These families take the risk of living in what is considered as a danger area due to free or low rental cost and proximity to their livelihood and other services.

(5) Sucat Thermal Power Plant

194. The government, under the Power Sector Assests ans Liabilities Management Corporation (PSALM), has an existing contract with a private firm to dismantle, clean-up, and remediate the STPP site. The proposed Sucat Station will be located at the decommissioned Sucat Thermal Power Plant (STPP) area. The DOTr is also considering the STPP as a depot for minor maintenance works.

(6) Pasig River Ferry Service

195. 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. Although commonly referred to as a ferry, it is more similar to a water bus.

196. The latest Pasig Ferry Service, operated by Nautical Transport Services Incorporated, was reactivated on April 28, 2014 to alleviate the traffic situation in Metro Manila in light of the infrastructure projects being constructed simultaneously. The ferry service is operated by Metro Manila Development Authority until a private investor takes over.

197. There is a possibility that the proposed NSRP might affect the ferry operation during its construction traversing Pasig River. Appropriate measures will be done by DOTr including coordination with the concerned parties.

3.1.1.4 Visual Aesthetics

198. 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.

199. 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.

200. The lake is also part of the flyway for migratory birds. Mount Makiling National Park is located south of the lake. The mountain is ideal for hiking, camping, trekking, mountain biking, and bird watching. The Mount Makiling Forest Reserve has a total of 2,048 plant species, many of which are exotic flowers.

201. The existing PNR lines being at grade structure are not visible from Laguna de Bay coast line however could be visible from Mount Makiling.

3.1.1.5 Land Value

202. Discussed in this section are the solid waste management information's and schemes of each LGUs traversed by the proposed project.

City of Manila

203. Based on the Manila Comprehensive Land Use plan and Zoning Ordinance (Book 1, 2005-2020), the total volume of garbage generated per day in Manila City is approximately 6,498.94 cubic meters for the year 2000. This includes wet and dry household waste, industrial waste, commercial waste, and some hospital waste. The highest percentage of the solid waste generated is of food waste contributing to 45 % of the total solid waste generated. The second and third type of solid waste are dry paper/cardboard and plastic/Styrofoam/rubber which contribute 19 % and 16 % to the total generation, respectively. On the other hand, the total volume of garbage collected per day within the city is approximately 6,409.15 cubic meters. This consisted of 46 % food waste, 12 % dry paper/cardboard, and 12% plastic/Styrofoam/rubber. The total waste collected consisted mostly of food waste amounting to 46% and fine and inert contribute the least amount.

204. At present, the LGUs collect city/municipal solid waste in Metro Manila either through private contracts or through the LGU's own sanitation services departments. Manila City has 100 % coverage of solid waste collection through a private contract with Leonel Waste Management wherein 250 compactors and heavy equipment are used for collection on a daily basis.

205. Waste collection is done through house-to-house or via curb side wherein wastes are placed in plastic bags, rattan baskets, or in various types of bins usually provided by the residents

themselves. These are loaded onto a garbage truck. Since the city has no final disposal facility, waste collected is brought to a transfer station (Vitas Transfer Station, 10-hectare facility) situated at Pier 18, NHA Compound, Tondo. Waste is brought to either the Tanza Facility located in Tanza, Navotas or the Rodriguez Facility located in Marikina Valley.

City of Makati

206. Based on the CLUP of Makati City (2013-2023), the estimated total solid waste generation of Makati in 1994 was 502.78 tons per day or 2,654.2 m³ per day. Generated wastes account 45.0 % from residential, 12.2 % from market, 13.5 % from commercial, 0.7 % from construction and demolition, 12.5 % from roads and streets, 8.3 % from institutional, and 8.0 % from other sources.

207. The city's Solid Waste Management Division handles solid waste collection. Five garbage collection service providers have been contracted by the city to collect and haul off wastes. The contractors are required to make about 153 trips daily throughout 27 barangays of the city. Each collection truck is required to make two daily trips. Overall collection efficiency has been estimated at 86% efficiency, based on 1994 data.

208. Solid waste collection in the CBD and in six residential villages surrounding the business district is handled by the private sector.

209. Solid waste is collected through a cell system. One cell is estimated to contain from 12 to 15 m³ of waste. These are collected along the road/street at curb side. Residents and owners of establishments are required to discharge wastes in plastic bags or trash receptacles prior to the arrival of the collection trucks.

210. Three types of collection trucks are used: 10-wheeler, 6-wheeler, and compactors, with 15, 10, and 8 m³ minimum capacity, respectively. Handcarts are utilized where narrow streets do not allow the access of collection trucks, and collection points are designated for systematic collection.

City of Taguig

211. For solid waste disposal in City of Taguig, the assumed unit is taken as 0.5 kg. per capita per day[7]. For the predicted population, total solid waste is estimated to be 1009 ton/day. The volume of solid waste generated per day is 149.1 tons per day (MMDA). The collection rate is at 56.79 %.

212. Localized collection of solid waste could be provided by the city or a private service contractor may be employed. Collected waste would be carried to a waste would be compacted and loaded into containers for transfer to sanitary landfill sites.

213. The Solid Waste Management Office (7 staff), together with the Clean and Green Office (324 staff, including 262 street sweepers), the Agriculture Office (7 staff), and the General Services Office (50 staff), are all under the Environment Maintenance Group headed by the Environment and Natural Resources Officer (ENRO).

214. The city uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependant on the satisfactory performance of the contractor. The 'Clean and Green' area checkers (lead persons of street sweepers) seek to enforce requirements that no waste is left uncollected within their respective areas of jurisdiction. Uncollected waste is reported to the Office who, in turn, notifies the contractor.

215. The Waste Management Division mainly performs monitoring functions with "one-stop outposts" manned by personnel on a 24-hour basis, serving as multi-purpose monitors. Illegal disposal from other LGUs, by either contractors or residents, is prevalent in Taguig due to the availability of vacant land.

[7] Source: Metro Manila Solid Waste Management Project (TA 3848-PHI) Final Report, Report No.1, Summary Report (September 2003)

216. The LGU collects non-medical waste from hospitals but does not monitor if hospitals comply with the proper handling and disposal of medical waste. Regulation of handling, collection, and disposal of medical waste from other establishments such as funeral parlours and private clinics is the responsibility of the City Health Office through their sanitary inspectors.

City of Parañaque

217. Based on the 2012 Socioeconomic Profile of Parañaque, the projected waste diversion and disposal targets of the City of Parañaque in 2021 is 51 % and 432.9 tons/day, respectively. The solid waste management of the City of Parañaque is described below.

218. The segregation of wastes will primarily be conducted at source to include residential households, industrial, commercial, institutions, and agricultural sources. Barangays will provide a schedule on the collection of biodegradables and non- biodegradable waste to impose the segregated collection scheme. All waste that will not be collected by the barangays will be regarded as residual wastes.

219. The different types of vehicles, ranging from 10-wheeler dump truck to smaller ones will be utilized depending on the area of collection. There will be daily collection of segregated wastes along the main thoroughfares and markets. A weekly collection will be instituted for households or residences. For stationary sources like government offices and other institutional entities, a three times a week collection will be provided. Further, for bulky and yard wastes generated within the barangay, collection will be upon request.

220. Door to door collection of solid waste will be utilized in accessible areas. However, for inaccessible areas, push carts will be used.

221. The recyclables and compostable will be collected by the barangay eco-aides. This is in compliance with Section 6 Rule VI of the Implementing Rules and Regulations of RA 9003. These collected recyclables and compostable will be brought to the MRF for further segregation and composting. The residuals will be collected by the City Private Hauler and brought to a sanitary landfill identified by MMDA.

City of Muntinlupa[8]

222. The City of Muntinlupa generates a total of 80,400 tonnes/year of wastes. It is composed of paper (10.2 %), glass (3.1 %), metals (3.9 %), plastic (28.1 %), and kitchen/food waste (29.1 %), other organic (20.4 %), other inorganic (5.0 %), and hazardous/special (0.2 %) (Spring 2003).

223. The City uses the services of a private contractor (REN Transport Corporation) for waste collection with 85% coverage. The wastes disposal sites are in Rodriguez, Rizal and San Pedro, Laguna.

City of San Pedro

224. Based on the 2013-2023 City CLUP, San Pedro generates 238,609.67 kg or 263.02 tons of solid waste per day in 2007. Garbage collection is managed by a garbage contractor covering 20 barangays, catering to almost 65% of the total population. Garbage is currently being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio.

225. There is also a two-hectare materials recovery facility in the area, the only MRF in the city. Additional MRFs should be established per barangay in order to comply with the Ecological Solid Waste Management Act of 2000 (RA 9003).

[8] Source: Metro Manila Solid Waste Management Project (TA 3848-PHI) Final Report, Report No.1, Summary Report (September 2003)

City of Biñan[9]

226. Solid waste remains a problem for Biñan City due to increasing urbanization. The 1992 projection of solid waste generation for the year 2000 stands at 124,538 kg/day. At present, two dump trucks service the market area while three Isuzu Elf trucks service 13 barangays. The remaining barangays resort to open burning, dumping, burying, and disposing into waterways. Solid waste management in the city can be considered inefficient.

City of Sta. Rosa[10]

227. The estimated volume of waste generated in the city in 2015 is about 246,570 kgs per day. An estimated 62% of the total wastes generated are biodegradable, 20% are residual wastes, 17% are recyclable wastes, and about 1% is special or hazardous waste.

228. Household waste contributes to about 65% of the solid waste generation in the City, while 35% of the wastes come from non-household sources.

229. The City Government, through the supervision of the City ENRO, is providing daily garbage collection to the 18 barangays, including almost all private subdivisions. It is spending Php 54 million per year for the collection and hauling of garbage (City ENRO, 2008).

230. Pilotage Trading and Construction (PTAC) is a private contractor that owns a sanitary landfill located in San Pedro, Laguna is in charge in the everyday garbage collection of the city. PTAC is using 29 dump trucks tracking different routes per day. (Excerpt from the 10-Year City Solid Waste Management Plan)

City of Cabuyao[11]

231. Solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba.

City of Calamba[12]

232. In the City of Calamba, solid wastes are usually generated by 80,661 households, about 289 industrial firms, more than 6,000 commercial establishments and a number of institutional houses scattered in the entire area.

233. It is estimated that the 387,876 projected population in the year 2006 generate as much as 232 tons of garbage per day (computed at 0.6 kg/day/capita). Of this figure, the city government of Calamba was collecting 67 % in 2004 from only 37 % in 2001. This is supported by barangay owned garbage trucks that collect 14 % of the consolidated wastes. The remaining 19% on the other hand left uncollected and excluded in the 81 % total wastes being disposed daily in San Pedro, Laguna.

234. Remarkably, collection via garbage trucks increased significantly between 1990 & 2000. This posted an annual average increase of 55%. This development is caused by the efforts of local authorities in expanding the garbage collection scheme to completely eradicate erroneous manner of wastes disposals, thus freeing rivers and streets of dumped materials.

235. For the collection, generators are advised to bring out their garbage at the designated schedules. Included in the rounds are several subdivisions, commercial areas, markets, hospitals and institutions. Main roads and parks are maintained by the street cleaners.

236. In parallel, barangays such as San Cristobal, Paciano Rizal, Parian, Barandal, Real, Lawa, Pansol, Canlubang and Villa de Calamba in Barangay Lamesa had acquired their own garbage

[9] Source: 2018 Biñan Eco Profile and Sectoral Situational Analysis Volume 2
[10] Source: http://santarosacity.gov.ph/about-sta-rosa/waste-management/ (Date Retrieved: April 6, 2018)
[11] Source: Cabuyao City Socioeconomic, CLUP (2000-2010)
[12] Source: Calamba City Socioeconomic Profile (2007)

trucks, thus the load was lessened and attention of the City ENRO for garbage collections was diverted to more barangays in need of the service.

3.1.1.6 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-Construction and Construction Phase

1) Impact in terms of Compatibility with Existing Land Use

237. Along the PNR ROW from Paco Station to Calamba Station, the impact of the proposed NSRP on the land use is not significant during the pre-construction and construction phases. However, the NSRP alignment from Solis Station to Sta. Mesa Station will be located outside the existing PNR ROW to give way to the NLEx/SLEx Connector Road Project of the DPWH which has been designed to utilize the existing PNR ROW. Based on this, about 8 km of land parallel to the PNR ROW will be aquired by DOTr for the NSRP alignment for these stations which is predominantly built-up area. This means that the land use of about 8.0 km x 30 m (24 ha) private land will be permanently changed for the ROW of NSRP thereby, resulting to a permanent loss of various commercial, residential and other establishments and other uses of the area. Similalry, the existing land use of the 78 ha depot in Banlic, Calamba and the area for the 30 m extension at 20 stations will be changed permanently from its existing land use for utilization by NSRP. Whenever finalized, the land use for the depot site at Banlic, Calamba will likewise be changed.

238. Accordingly, food production from the 78-hectare agricultural lot will be permanently lost.

239. The direct impact on land use and development would be a function of the plans, zoning ordinances, and economic development programs of the affected LGUs. Overall, the proposed railway project is compatible with local government plans that support rail systems and transit-oriented development. Existing land use policies and zoning ordinances support the development of the proposed railway.

240. Information on the proposed NSRP will be shared with the affected LGUs from time to time. Majority of the affected municipalities/cities will soon have to adopt the proposed NSRP in their CLUP to accommodate its implementation. DOTr will regularly communicate with the LGUs so that the proposed NSRP will be in accordance with the future land use plans. DOTr will cooperate with the urban planners of LGUs to identify their future land use of surrounding areas that will result to a significant increase of transportation oriented developments. DOTr will also consider the station recommendations of the LGUs and coordinate with DAR for the conversion of the agricultural land for the proposed depot.

2) Impact on Compatibility with Classification as an ECA

241. Impacts on compatibility with ECA are expected to be less significant for DOTr will plan, design and construct the NSRP in consideration to the ECA such as: 1) areas of unique historic, archaeological, geological of scientific interest; 2) areas frequently visited by and/or hardhit by natural calamities (geologic hazards, floods and typhoons); and 3) areas classified as prime agricultural lands.

242. As stated, DOTr will plan and design the project, construction yards and related access considering the location of ECA to ensure sufficient distance, etc.

a. Areas of unique historic, archaeological, geological or scientific interest

243. The NSRP is expected to enhance the existing old PNR structures of over 50 years that are located close to the proposed NSRP. The DOTr will coordinate with the NHCP, National Museum, National Commission for the Culture and the Arts (NCCA), PNR and LGUs for its qualification as an historical site. DOTr will prepare a protection and conservation plan to maintain the structures, to provide necessary protection measures during construction. This also includes the protection of identified heritage sites which have great potential as tourist spots.

b. Areas frequently visited and/or hard hit by natural calamities

244. The impacts to NSRP of geologic hazards such as ground shaking and ground rupture; and typhoon hazards and flooding for the alignment from Sta. Mesa Station to Paco Station and FTI Station to San Pedro Station which have high susceptibility to inundation during heavy rains will be addressed by the following measures: a) Ground shaking can be mitigated through appropriate foundation design based on a combination of geotechnical and seismicity studies and coordination with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during earthquake events so that adjustment on construction schedule can be instituted; b) Risk to ground rupture which applies to the alignment from Taguig to Muntinlupa as traversed by the active West Marikina Valley Fault can be managed thru conduct of detailed seismological and geotechnical study and gather data needed to formulate design measures which will mitigate the likelihood of ground rupture; c)Typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of construction schedules in relation to bulletins issued; d) Drainage systems will be installed in accordance to the comprehensive hydrological study to address flooding; and e) implementation of an Emergency Response Plan for the construction phase.

c. Areas classified as prime agricultural lands

245. The significant impact of the NSRP depot is the loss of about 78 ha agricultural land. Accordingly, food production from this land will be permanently lost. However, DOTr has been coordinating with lot owners and other concerned stakeholders for its intent of just compensation in acquiring the land and/or securing the ROW.

3) Impact in Existing Land Tenure Issue/s

246. The impact of the proposed NSRP to the existing land tenure is significant in areas outside the PNR ROW particulary from the Solis Station up to the east of PNR Santa Mesa Station wherein about 8.0 km of built-up area (residential, commercial, etc.) parallel to the PNR ROW will be acquired since NLEx-SLEx Connector Road Project of the DPWH will utilize the PNR ROW. The DOTr will, however, coordinate with DPWH to optimize the utilization of existing PNR ROW so as to minimize land acquisition.

247. DOTr will coordinate with PSALM for Sucat Thermal Power Plant, LGUs, lot owners and other concerned stakeholders on its intent for a just compensation in acquiring the land and/or securing ROW for the alignment outside the PNR ROW, the depot and the 30 m extension for the stations.

248. There is also a possibility that during construction, the NSRP will affect the ferry operation particularly for the alignment that traverses Pasig River. The DOTr will, however, coordinate with the concerned agencies and other stakeholders to minimize the disruption of the ferry operation and ensure safety of both the commuters and workers of NSRP. This impact is expected to be temporary and moderately significant.

249. There are portions of the alignment that still have encroachments by informal settlements, and these will be addressed in the Resettlement Action Plan for land acquisition and relocation of informal settlers.

4) Impairment of visual aesthetics

250. The impact on visual aesthetics during construction of NSRP at grade structures of about 13.8 km will not be significant since there are already existing at grade PNR structures. However, the elevated structures of about 37.8 km will have a significant impact on aesthetics particularly in the Province of Laguna where only few high rise structures are present. This, however, is temporary and structures will be designed in consideration of size, shape and color to mitigate the visual impact from local community and viewpoints. In addition, tree planting along the alignment will mitigate the visual impact of the hard structure and provide natural screening.

251. Areas within the ROW that will not be covered by the development will be planted with trees to act as a buffer zone, green corridor and to lessen the aesthetic sore brought about by construction activities.

252. During construction, improper handling and disposal of construction and domestic wastes may result in visual pollution and will have an aesthetic impact on the landscape. In order to reduce, if not eliminate, the environmental impacts of the solid wastes, the construction plans, operating instructions and solid waste management plan will be strictly implemented. DOTr will ensure that the contractors maintain the construction site tidy and clean and that temporary screens/walls are provided to minimize visual clatter. During the demobilization of construction activities, construction yards will be rehabilitated to its previous condition.

5) Devaluation of land value as a result of improper solid waste management

253. Waste generation and improper waste disposal during pre-construction and construction phases may affect the soil quality, which will result to the devaluation of land value. The proposed NSRP will generate domestic wastes such as papers, cartons, plastics, bottles, food leftovers, etc. Municipal solid waste generation during construction period is estimated at 7.8 tons per day assuming a per capita generation of 0.6 kg/person. Some hazardous solid wastes that will be generated include busted fluorescent lamps and spent batteries. Residual construction materials such as aggregates, sand, cement, steel materials, timber, precast components, among others will be procured according to the schedule of the construction progress. Since the proposed NSRP requires a huge quantity of materials, it is expected that residual construction materials may inevitably be left over. Permeation of lime or cement into the ground with water will result in soil hardening, higher pH value and groundwater pollution and in the end the polluted land will lose productivity and the valuable land resources will be wasted.

254. The DOTr will formulate and implement a Solid and Hazardous Waste Management Plan which which include the following: (1) Acquisition of adequate quantities of construction materials to avoid wastage; (2) Reuse of excess construction materials for road and other infrastructure projects of the host LGUs; (3) provision of adequately sized waste bins for recycle, biodegradable and hazardous waste; (4) strict implementation of waste segregation by the construction personnel; (5) coordination with the LGUs for the regular monitoring of project generated waste for eventual disposal to the LGUs' designated disposal facility. Hazardous wastes will be stored properly and will be treated and disposed by a DENR accredited transporter and treater in accordance with RA 6969.

255. Emergency Response Plan and a Health and Safety Management Plan will likewise be implemented in case of accidental spills. Also, regular training of workers on environment and workplace management will be provided.

(2) Operation

1) Impact in terms of compatibility with existing land use

256. The proposed NSRP will have no impact on the compatibility with the land use during the operation phase. Affected LGUs will adopt the proposed NSRP in their CLUPs. Moreover, the proposed NSRP is anticipated to provide a more efficient and safer transportation facility due to reduced travel time, traffic congestion, safety concerns, and energy consumption. As a result of this improvement, land development would be expected to increase along or near the corridor through conversion of low density residential areas to higher density residential and commercial uses.

1) Impact on compatibility with classification as an ECA

257. During operation phase, typhoon impacts may be mitigated through regular coordination with PAGASA and adjustment of train schedules in relation to bulletins issued by the said weather agency. Drainage systems will be properly inspected and maintained to address flooding. An Emergency Response Plan for the operation phase will be prepared and implemented

258. Although only low ground shaking impact is expected of the project, maintaining close coordination with the Philippine Institute of Volcanology and Seismology (PHIVOLCS) during earthquake events to make necessary adjustments on its operation will be required, as the project will be connected to a network of transit developments.

259. DOTr will also coordinate with NHCP, PNR, LGU and relevant authorities for the continuous conservation of identified old PNR structures.

2) Impact in existing land tenure issue/s

260. The proposed NSRP will have no impact on the existing land tenure issue during the operation phase.

3) Impairment of visual aesthetics

261. The proposed NSRP will have no impact on the visual aesthetic during operation, yet it will be different from the occurring landscape along the alignment. The structures (viaducts and stations) will be well designed (size, shape and colour). The architecture of the structures will be complimentary to the urban landscape and will not be unpleasing to the visual aesthetics of the natural urban and rural landscape.

262. Continuous tree planting activities and maintenance within the ROW, depot and around the stations will minimize the visual impact of the railway structures and harmonize with the surrounding environments by creating green corridors. This will be also beneficial to the local community and will reduce GHG emission.

4) Devaluation of land value as a result of improper solid waste management

263. The proposed NSRP will generate domestic wastes such as papers, cartons, plastics, bottles, food leftovers, etc. Assuming a per capita waste generation of 0.6 kg per day, the proposed project will generate an estimated of 0.93 ton of solid waste per day during operation. Some hazardous wastes that will also be generated include busted fluorescent lamps, spent batteries, used oils, etc. Improper disposal of generated solid and hazardous wastes particularly at the stations and depot could pose health and sanitation hazards to the operations personnel and railway passengers and may affect the soil quality at the area which will result to the devaluation of land value.

264. A Solid Waste Management Plan will be implemented in accordance with RA 9003 at the stations and depot of the proposed NSRP. This includes waste minimization, segregation, and proper disposal. Properly sized bins will be provided for recyclable, biodegradable and hazardous waste. The NSRP management will coordinate with the host LGUs for the regular collection of the waste and their disposal to the DENR designated site. Bulk hazardous wastes will be stored in impermeable area and with appropriate secondary containment. Hazardous wastes will be stored properly and will be transported, treated and disposed of by a DENR Accredited transporter and treater in accordance with RA 6969.

265. An Emergency Response Plan and a Health and Safety Management Plan will be implemented in case of accidental spills. Regular training of employees will also be provided in regards to keeping the workplace and surrounding environment in good condition.

3.1.2 Geology/Geomorphology

266. Primary geologic data were gathered and analyzed though inspection of the major stations and key segments of the NSRP route. The field surveys and analysis were guided through the use of Google images, topographic maps and Shuttle Radar Topography Mission (SRTM) digital elevation data of Southern Luzon**.**

267. Topographic, geologic and seismologic data were respectively accessed from the National Mapping and Resource Information Authority (NAMRIA), Mines and Geosciences Bureau (MGB) and Philippine Institute of Volcanology and Seismology (PHIVOLCS). **Table 3.1.7** presents the data accessed and gathered from these agencies.

Table 3.1.7 Secondary Data Gathered from NAMRIA, MGB and PHIVOLCS

Data Source	Nature of Data
National Mapping and Resource Information Authority	1:50,000 scale topographic maps
Mines and Geosciences Bureau	2010 edition of the Geologic and Tectonic Map of the Philippines
	1980 and 2010 editions of the Geology and Mineral Resources of the Philippines
	Landslide and Flood Susceptibility Map of Parts of Region 4
Philippine Institute of Volcanology and Seismology	Earthquake Data
	Map of Major Earthquake Generators
	Liquefaction Potential Map
	Map of Active and Potentially Active Volcanoes
	Map of the Intersection of the WMV Fault with NSRP Alignment
Philippine Institute of Volcanology and Seismology and US Geological Survey	Peak Ground Acceleration Maps

Source: Geosphere 2018

3.1.2.1 Surface Landform/Geomorphology/Topography/Terrain/Slope

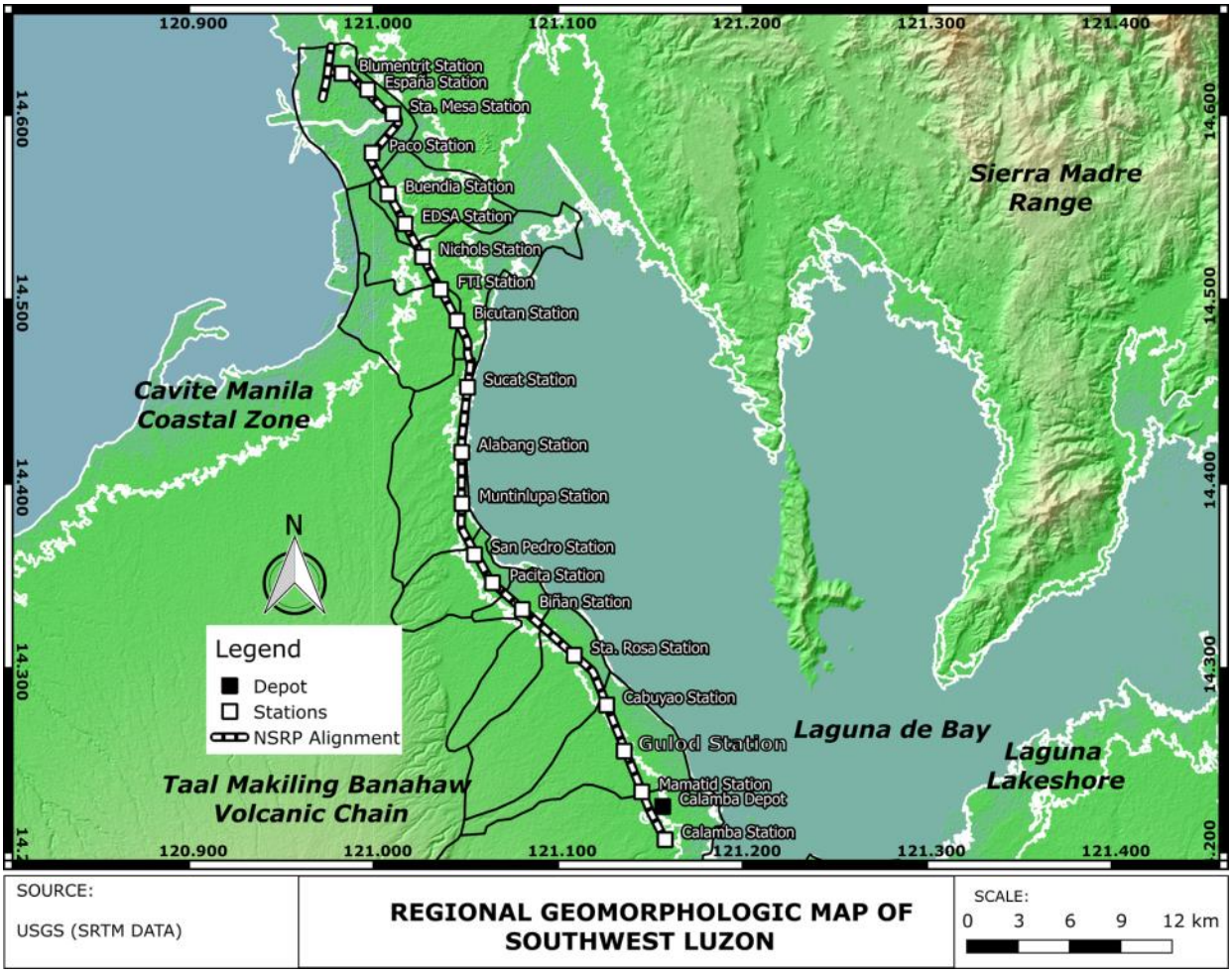
268. **Figure 3.1.14** shows the regional geomorphologic map of Southwest Luzon and the location of the NSRP with respect to the mapped terrain units. The Sierra Madre range corresponds to a long mountain chain which extends from Cagayan in the north to the Bicol Region in the south. In the SW Luzon Area, it is characterized by steep and dissected slopes which serves as the eastern border of Laguna de Bay. The steep slopes favour erosion and dissection by west flowing rivers and streams. The eroded sediments are subsequently deposited into the adjacent lake.

269. The Taal-Makiling-Banahaw Volcanic Chain corresponds to a west to east line of volcanoes. It serves as the western and southern boundary of Laguna de Bay. The terrain is characterized by a radial drainage system flowing southward to Laguna de Bay in the case of Mt. Makiling and Mt. Banahaw and to Manila Bay in the case of Cavite.

270. 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.

271. 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.

272. **Figure 3.1.14** enumerates the features of the intersected terrain units and links the geology, hydrology, and hazards prevailing within the individual or combination of the route segments.



Source: USGS (SRTM Data)

Figure 3.1.14 Regional Geomorphologic Map of Southwest Luzon

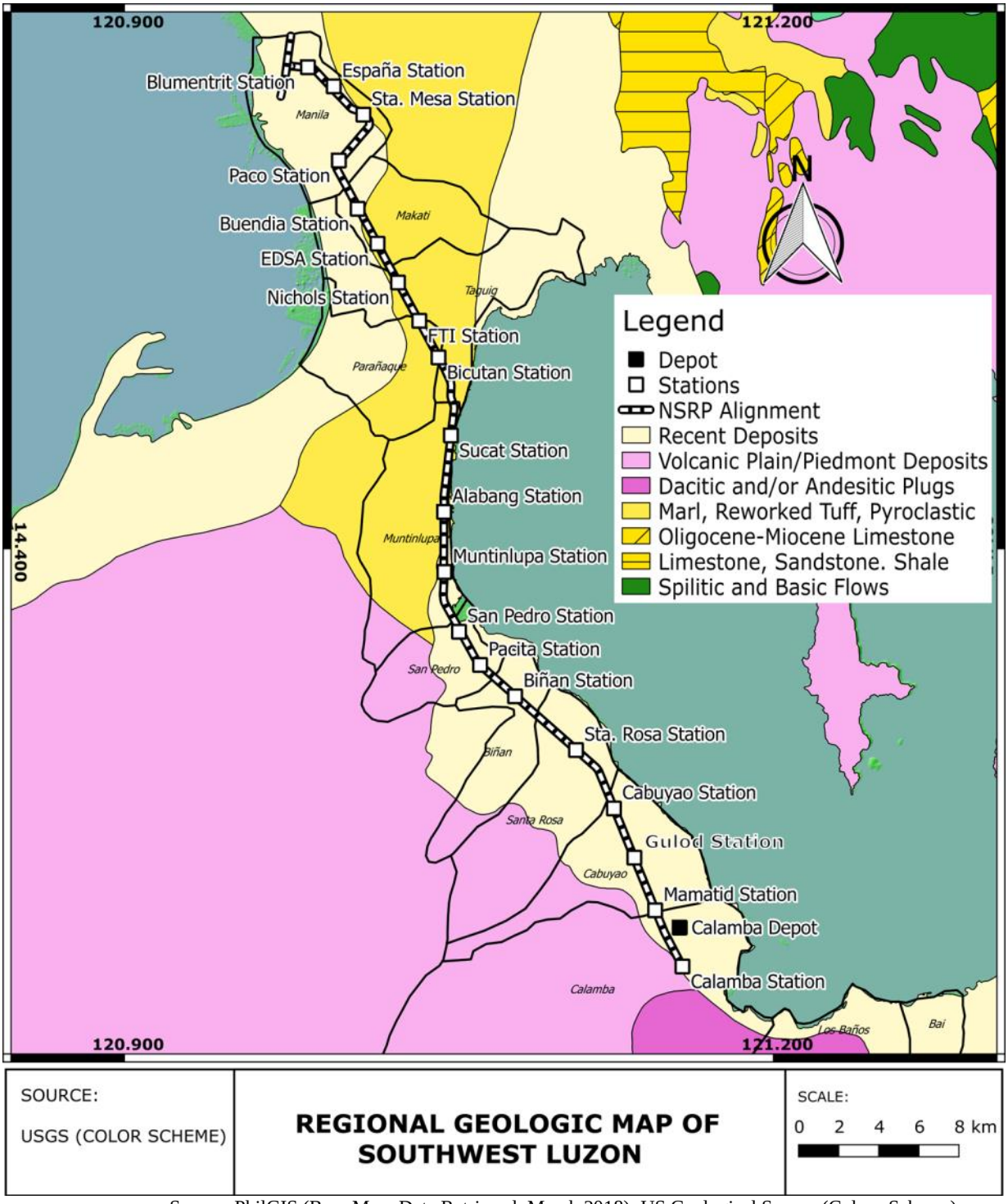
Table 3.1.8 Features of Terrain Units which can Affect the Proposed NSRP Alignment

Terrain Class	SLRP Segments	Features
Cavite Manila Coastal Zone	Solis Station to Bicutan Station	Flat to gently sloping; vulnerable to flooding due and storm surges near the coastal edge; swampy conditions present; main river channel correspond to the meandering Pasig River and the lower reaches of rivers draining the long slopes of Cavite.
Laguna Lakeshore	Sucat Station to Bai Depot	Flat to gently sloping; abuts against Laguna de Bay; vulnerable to flooding

3.1.2.2 Sub-surface Geology/Underground Conditions

(1) Lithology and Stratigraphy

273. The geologic formations within a 10-km corridor which could potentially affect the proposed railway were identified and delineated using available geologic and topographic maps (Figure 3.1.15). Within this corridor, two (2) geologic formations were identified namely the Recent Deposits (Qh) and Tuff and Pyroclastic ($N_3 + Q_1$).



Source: PhilGIS (Base Map; Date Retrieved: March 2018); US Geological Survey (Colour Scheme)

Figure 3.1.15 Regional Geologic Map of Southwest Luzon showing the NSRP Line

274. Qh refers to the heterogeneous mixture of sands, clays, silts and gravels of varying degrees of consolidation. This kind of deposit is greatly affected by the provenance of the sediments. Occurrence of these deposits is usually found on the end slopes of the terrain. The deposits within the Cavite – Manila Coastal Zone represent the mixture of alluvial and marine environment. The deposits within the Laguna Lakeshore area represent the mixture of alluvial and lacustrine environment. In the project area, these deposits area found in Solis Station to Buendia Station, and Muntinlupa Station to Banlic Depot.

275. Where the NSRP line passes through built up areas, these Quaternary deposits are locally covered by pavements, embankments or partially consolidated fill.

276. Guadalupe Formation (Marl, Reworked Tuff, Pyroclastic), dated Pliocene to Pleistocene, refers to the tuff sequence that is found cropping along Pasig River in Guadalupe, Makati, Metro Manila (Peña, 2008). It was formally named by Teves and Gonzales in 1950 as Guadalupe Formation which consists of two stratigraphical members. These members are the Alat Conglomerate and the Diliman Tuff. The Alat Conglomerate is predominantly sedimentary, while the Diliman Tuff is made up of consolidated pyroclastic ejecta. These materials and their weathered derivatives underlie the gently sloping segment from Pasay Road Station to Bicutan Station.

277. **Table 3.1.9** shows the stratigraphic succession of these formations as mapped by the Mines and Geosciences Bureau (MGB) including the general lithologic descriptions and their distribution within the route traversed by the NSRP Line.

Table 3.1.9 Stratigraphic Succession of the Rock Formations Traversed by the NSRP Line

Epoch	Geologic Formation	Formation Name	General Lithology	Distribution
Holocene	Recent Deposits (Qh)	Quaternary Alluvium	Unconsolidated, heterogeneous aggregate of gravels, boulders, sands, silts and clays	Solis Station to Buendia Station; Muntinlupa Station to Banlic Depot
Pliocene - Pleistocene	Tuf and Pyroclastic (N3 + Q1)	Guadalupe Formation	Tuffs and tuffaceuous sedimentary rocks	Pasay Road Station to Bicutan Station

Source: Geosphere 2018

(2) Regional Tectonic Setting

278. The Philippines is located in a tectonically active region near the boundary between the Philippine Sea Plate and the south-eastern edge of the Eurasian Plate. The active zone of deformation between these two (2) plates is referred to as the Philippine Mobile Belt (Gervasio, 1966) and is characterized by a complex system of subduction zones, collision zones and marginal sea basin openings (Geology of the Philippines, 2002). The island of Luzon where the NSRP is located occupies the northern section of the Philippine Mobile Belt.

279. The major earthquake generators relevant to the proposed NSRP include the Philippine Trench, the Philippine Fault, West Marikina Valley Fault, Lubang-Verde Passage Fault, and the Manila Trench.

Philippine Trench

280. The Philippine Trench corresponds to the morphological expression of the subduction of the Philippine Sea Plate beneath the eastern Philippine Arc (Geology of the Philippines, 2002; Cardwell and others, 1980; Fitch, 1970; Hamburger and others, 1983).

Manila Trench

281. The Manila Trench is a broadly arcuate geological structure located west of the island of Luzon and spans the length from 13° north to 22° north latitude. This earthquake generator is located approximately 202 km west of the San Pedro Station.

Philippine Fault

282. The Philippine Fault is a left lateral fault which transects the Philippine Mobile Belt from Luzon though the Visayas to Mindanao over a length of more than 1,200 km. PHIVOLCS attributed the occurrence of earthquakes in Ragay (1973, M 7.0), Northern Luzon (1990, M 7.7)

and Masbate (2003, M6.2) to movement along segments of the Philippine Fault[13]. The projected trace of the fault in Luzon in Quezon is approximately 60 km east of the Sta. Rosa Station.

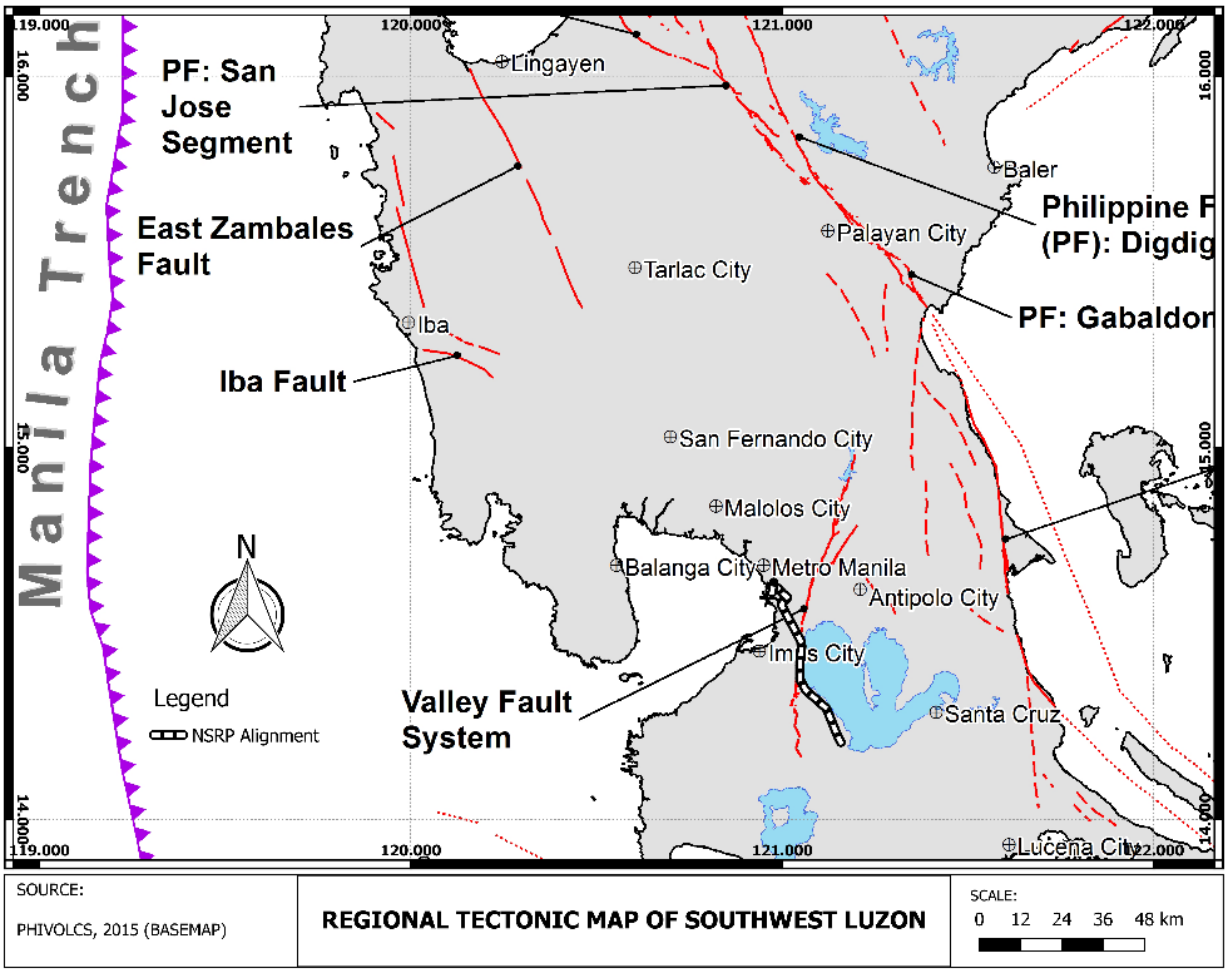
West Marikina Valley Fault

283. The West Marikina Valley Fault is a right lateral geological structure which traverses a distance of about 135 km from Bulacan in the north to as far south as Tagaytay area. Its trace intersects the NSRP between the Muntinlupa and Alabang Stations.

Lubang-Verde Passage Fault

284. The Lubang-Verde Passage Fault System is located offshore between Batangas peninsula and Mindoro Island. It is a strike-slip (left-lateral) fault with has a northwest-southeast alignment.

The tectonic and structural features which can potentially affect the NSRP are presented in Figure 3.1.16.



Source: PHIVOLCS 2015

Figure 3.1.16 Tectonic Map of Central Luzon

3.1.2.3 Geologic and other Natural Hazard

285. The hazards which can potentially affect the NSRP include flooding, landslides and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. The proposed NSRP route has been assessed by PHILVOLCS Earthquake and

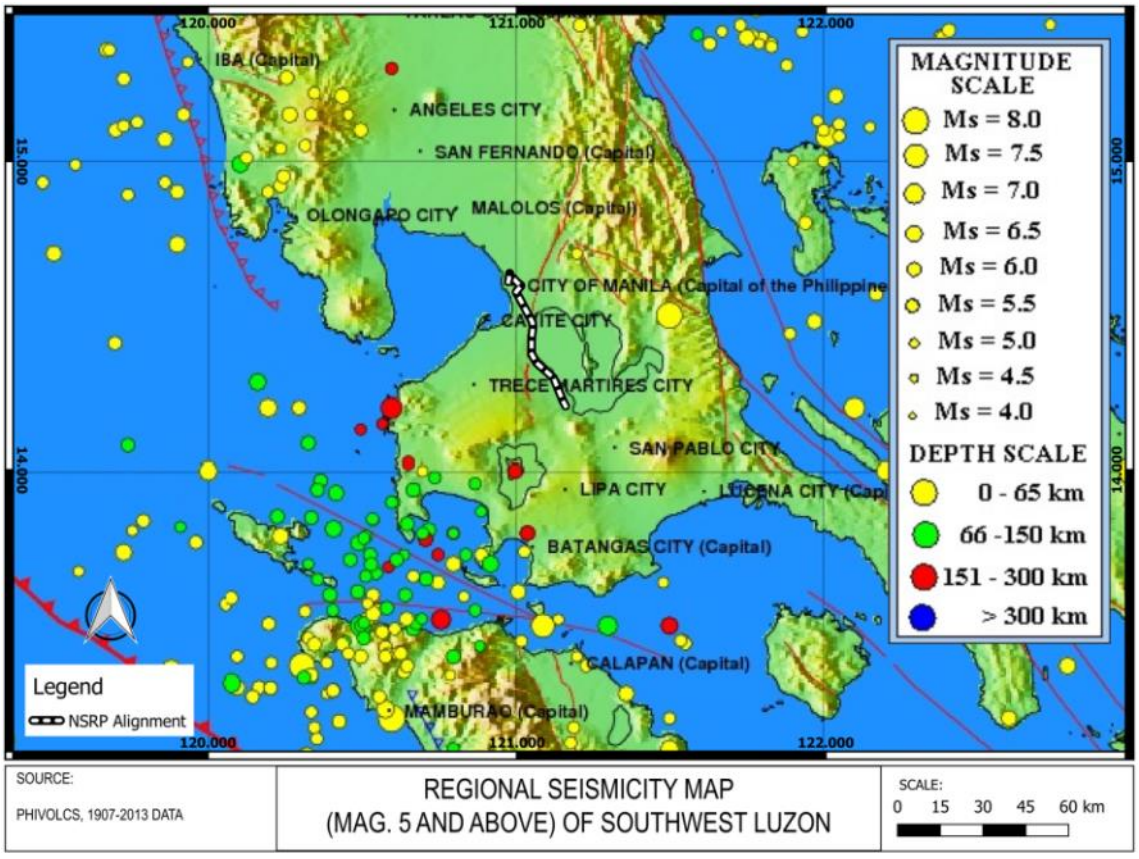
[13] http://www.phivolcs.dost.gov.ph/index.php?option=com_content&view=article&id=379&Itemid=500023

Volcanic Hazard Assessment for Ground Rupture, Liquefaction, Landslide, Tsunami, nearest volcano, and pyroclastic flow/ base surge.

(1) Seismicity

286. **Figure 3.1.17** shows the plot of earthquakes with magnitude's greater than 5 within a 300 km radius from the center of the NSRP Line in Muntinlupa Station. The clusters of earthquakes are found to the northeast offshore of Baler, Quezon and southwest offshore between Mindoro and Batangas.

287. Table 3.1.11 **Table 3.1.10** lists the major seismic events (M ≥ 6.5) within 100 km from the centre of the NSRP Line from 1907 to 2013. The strongest recorded quake within 74 km southwest of the Banlic Depot corresponds to a Magnitude 7.1 event, which was recorded on November 14, 1994.



Source: PHIVOLCS, 2015

Figure 3.1.17 Plot of earthquakes with magnitude's greater than 5

Table 3.1.10 Major Seismic Events within 100 km from NSRP Alignment

Year	Month	Day	Hour	Min	Sec	North	East	Depth	Ml	Mb	Ms	Distance from nearest NSRP Segment	Direction from NSRP
1994	11	14	19	15	27.8	13.50	121.09	7		6.1	7.1	74	Southwest
1940	3	28	15	48	50.0	14.20	120.60	#			6.8	58	West
1939	5	6	17	0	7.0	13.50	121.30	#			6.5	77	South
1937	8	20	11	59	16.0	14.50	121.50	#			7.5	46	East

Source: PHIVOLCS

(2) Ground Subsidence and Settlement

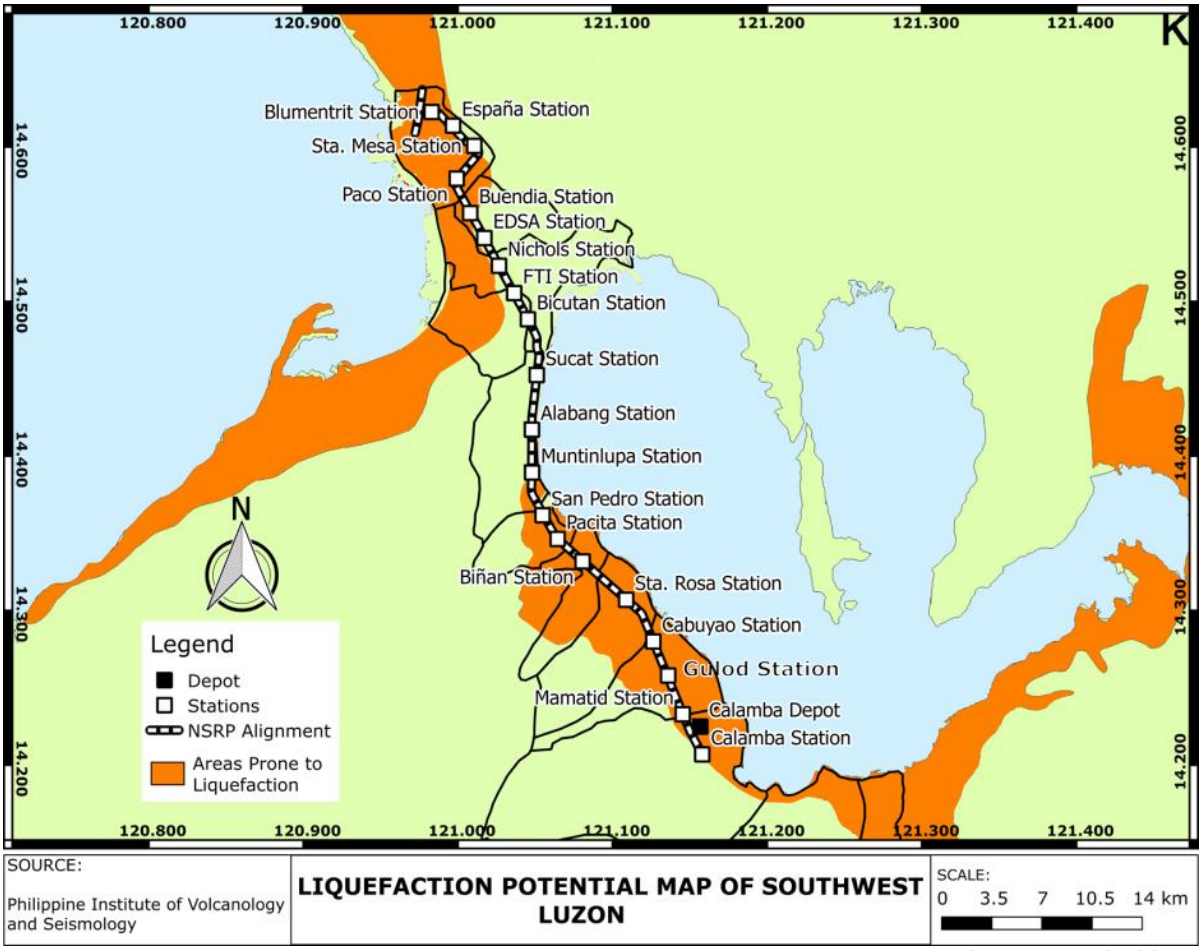
288. Settlement due to loading of the proposed engineering structures such as stations and equipment depot can potentially take place on sections of the NSRP line which will traverse the area underlain by Recent Deposits. Potential settlement will depend on the design load and the geotechnical properties of the foundation materials. Such properties can only be determined during the design stage when drilling, in-situ tests and laboratory tests will be conducted.

289. 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 have not exhibited indications of subsidence. A more detailed geotechnical assessment of the current NSRP stations is needed to determine stability of the structures.

290. Reports of subsidence due to excessive groundwater extraction are currently not available. Most of the production wells of the water providers and establishments which use groundwater are located farther west of the existing railway station. Extraction of groundwater via shallow tube wells of the settlements along the line is deemed low to bring about settlement of the ground near or beneath the stations and railway.

(3) Liquefaction

291. The areas underlain by the Recent Deposits where groundwater is deemed shallow are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. The segments from Solis Station to Nichols Station and from Muntinlupa Station to Banlic Depot fall under such a classification (Figure 3.1.18). This preliminary assessment needs to be validated by geotechnical investigation particularly at the locations of the train stations. The investigation should include drilling with Standard Penetration Tests (SPT), water level measurements, grain size analysis of recovered soil samples and calculation of liquefaction potential.

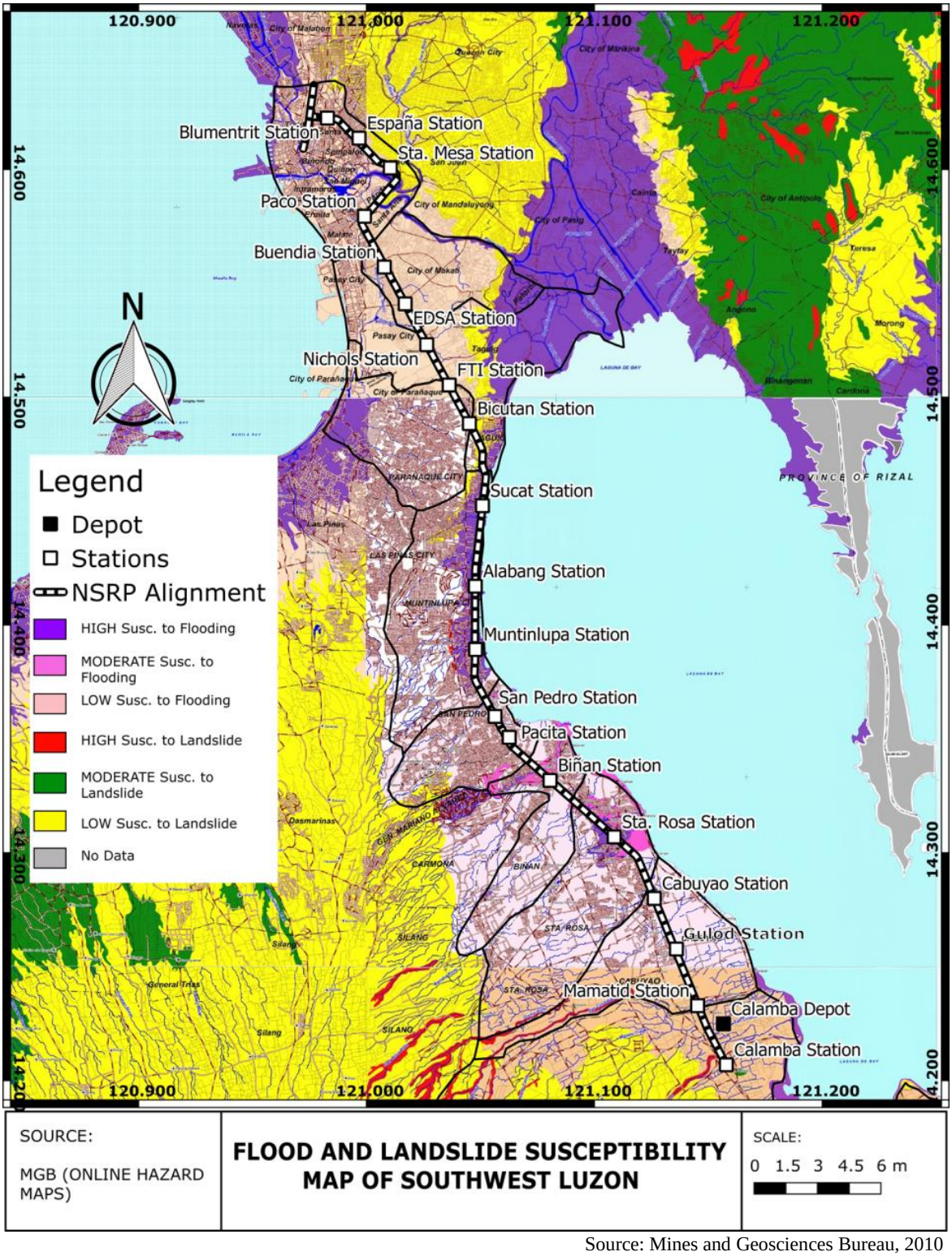


Source: PHIVOLCS

Figure 3.1.18 NSRP Line plotted on the Liquefaction Potential Map

(4) Landslides

292. Due to its flat to gentle slope, the entire NSRP Line has low susceptibility to landslides. Figure 3.1.19 shows the flood and landslide hazard map of the NSRP alignment.



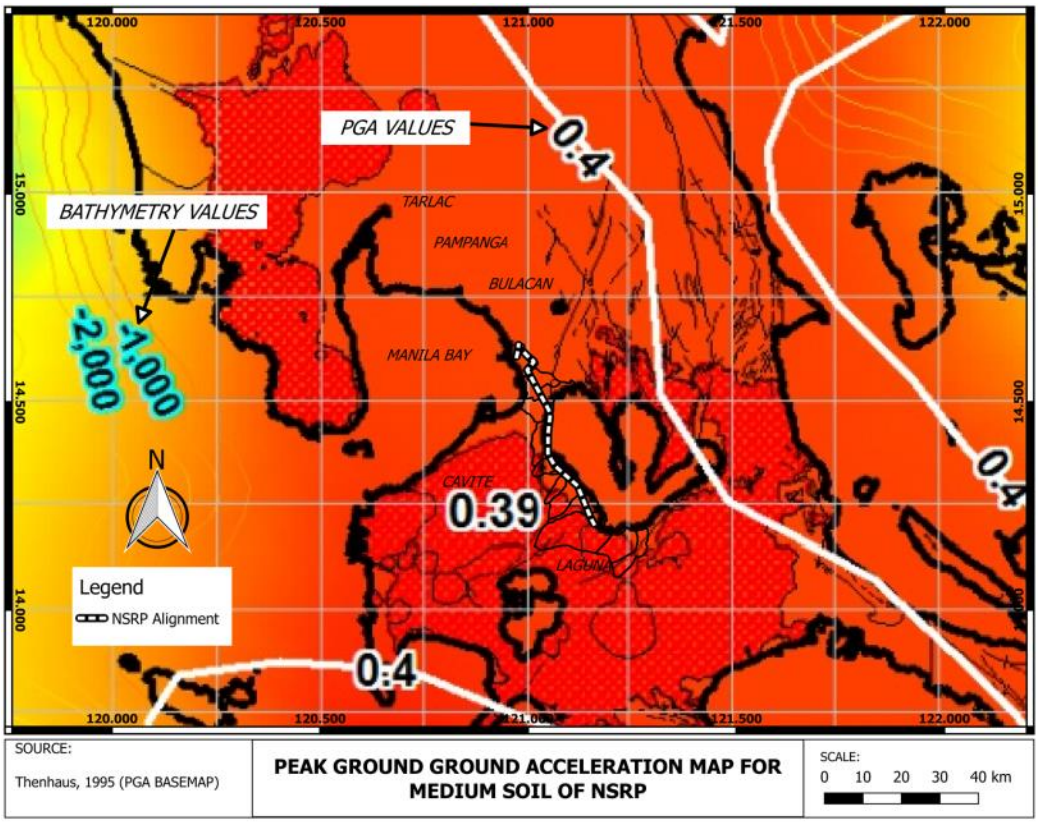
Source: Mines and Geosciences Bureau, 2010

Figure 3.1.19 Flood and Landslide Hazard Map of the NSRP Alignment

(5) Ground Shaking

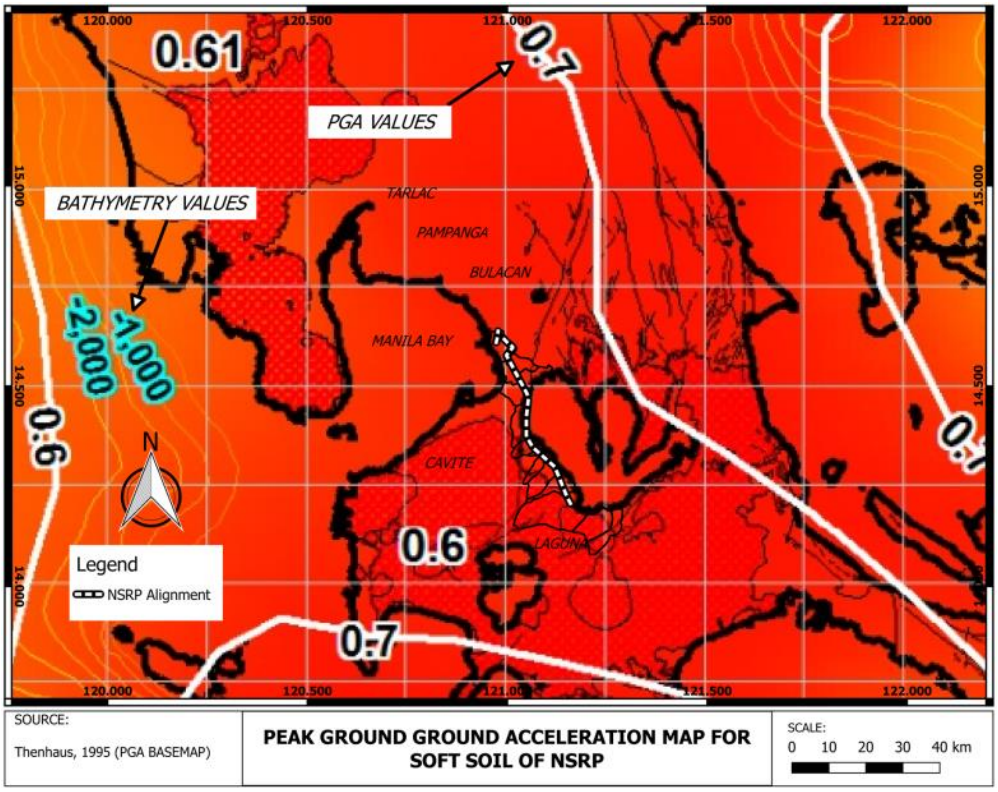
293. Earthquakes that can be generated by the major geological and tectonic structures in the region could bring about ground shaking which could affect the stability of railway line and its stations. A study conducted by Thenhaus, Hanson and Algermissen of the United States

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 Line, the segments from Pasay Road Station to Alabang Station are underlain by weathered pyroclastic deposits which are deemed to fall under medium soil category (Figure 3.1.20). The segments from Solis Station to Buendia Station and from Muntinlupa Station to Banlic Depot are underlain by unconsolidated sediments which are deemed to fall under the soft soil category (Figure 3.1.21). Accordingly, the peak ground accelerations correspond to 0.4 *g* and 0.7 *g*, respectively. These regional values though need to be validated through more detailed seismological studies as part of due diligence of the currently established stations and for the still unconstructed Gulod Station.



Source: Thenhaus, 1995

Figure 3.1.20 PGA Map for Medium Soils of NSRP Line

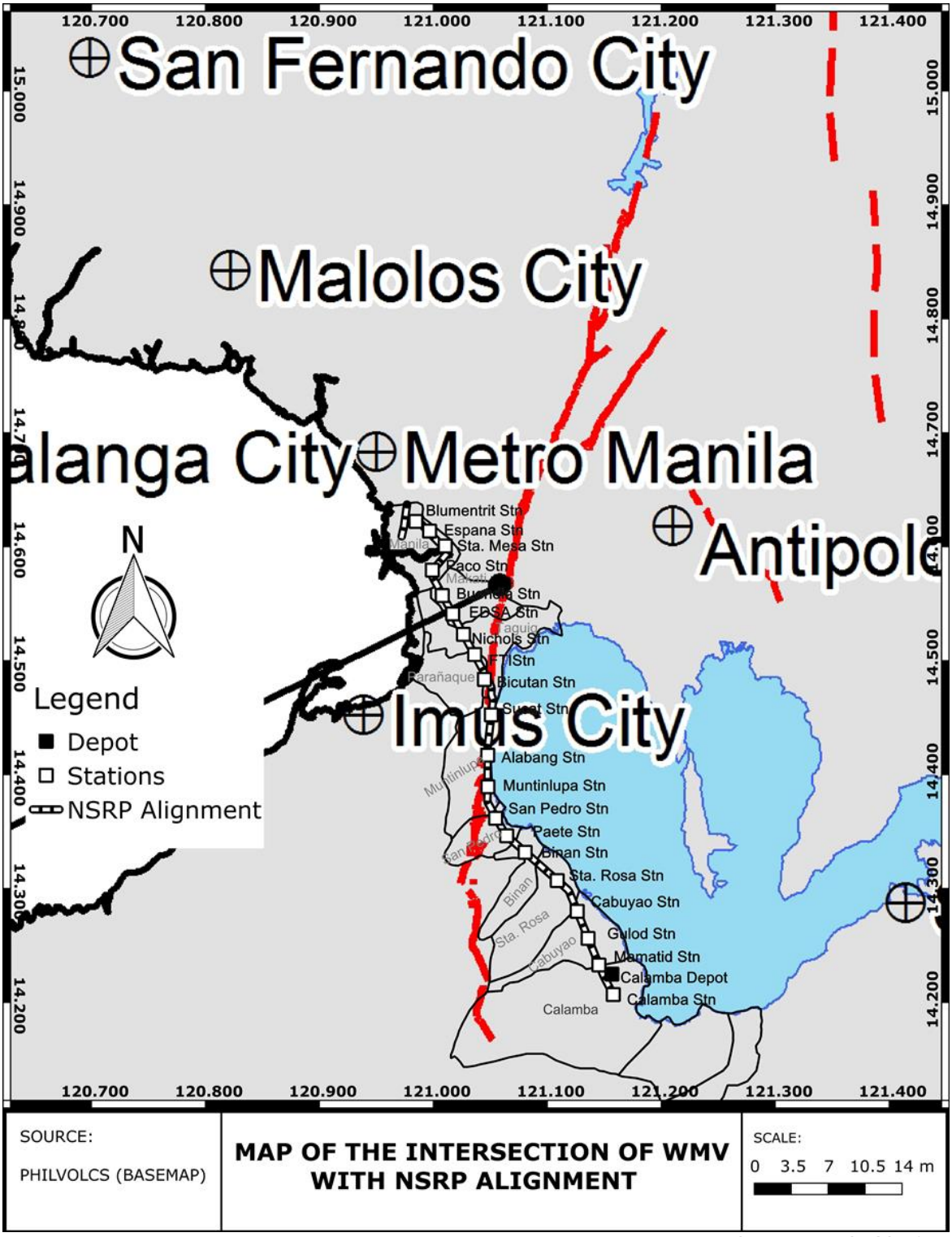


Source: Thenhaus, 1995

Figure 3.1.21 PGA Map for Soft Soils of NSRP Line

(6) Ground Rupture

294. Ground rupture occurs when a new rupture is created or when renewed movement of old fractures takes place (Punongbayan, 1994). PHIVOLCS is recommending a buffer zone at least 5 m on both sides of a fault trace or from the edge of deformation zone. The segment the NSRP between the Muntinlupa and Alabang Stations is vulnerable to ground rupture where it is intersected by trace of the active West Marikina Valley Fault. The location of the fault rupture can be seen in Figure 3.1.22.

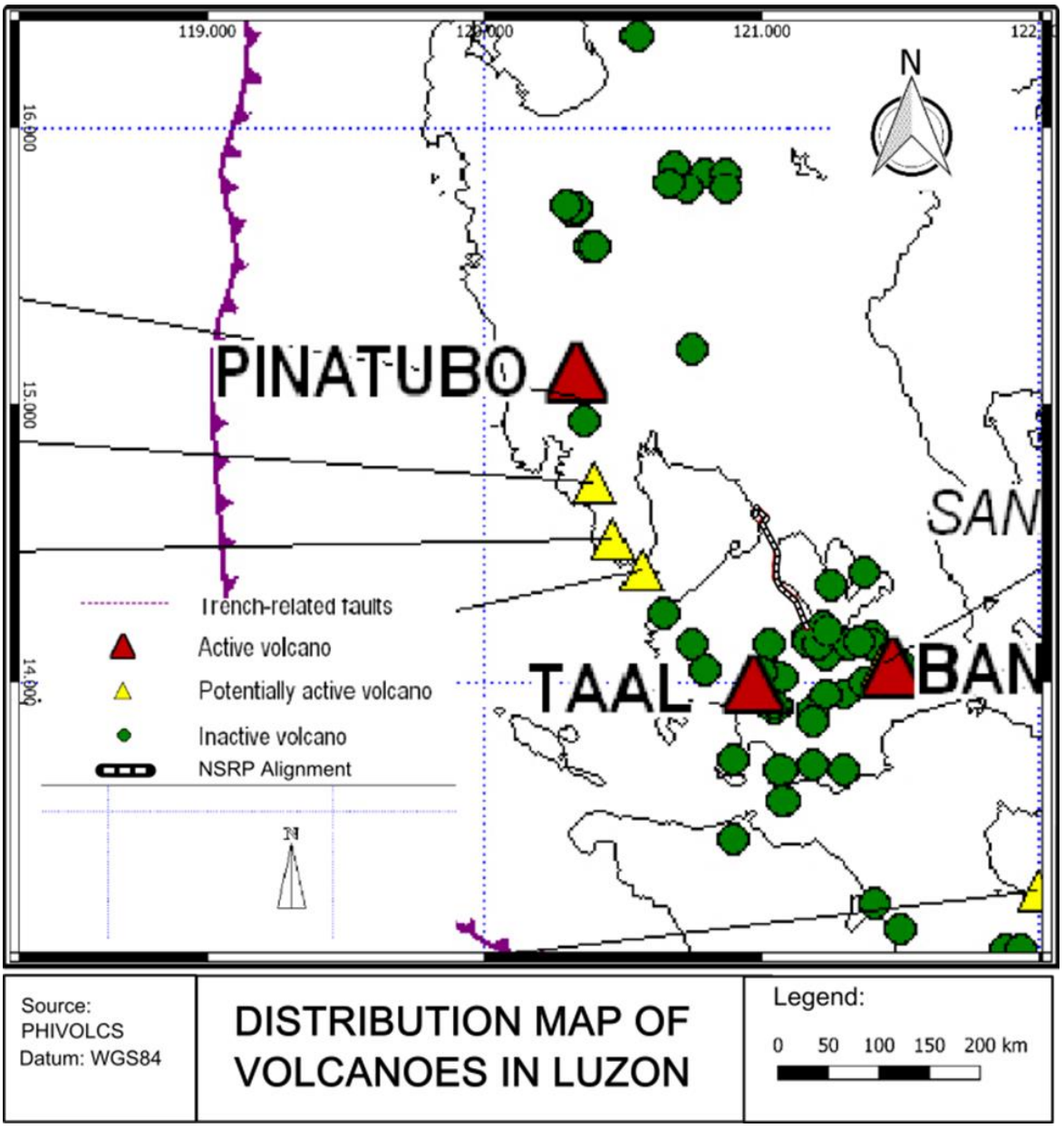


Source: PHIVOLCS, 2015

Figure 3.1.22 Map showing the intersection of the project alignment and the West Valley Fault System

(7) Volcanic Hazards

295. As shown in Figure 3.1.23, the nearest active volcano from the proposed NSRP is Taal Volcano. The crater of this volcano is approximately 28 km southwest of the Calamba Station. Due to its low elevation compared to the NSRP route, the only hazards which can potentially affect the project are ground shaking and ash fall. Mt. San Cristobal, located beside Mt. Banahao has been deemed potentially active by PHIVOLCS. Eruption of this volcano will bring about ground shaking and ash fall to the NSRP.



Source: Philippine Institute of Volcanology and Seismology

Figure 3.1.23 Distribution of Volcanoes in the Philippines

3.1.2.4 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

296. Pre-construction activities for the proposed NSRP would not entail significant terrain alteration. These will only involve surveys, foundation/geotechnical exploration and detailed engineering design, most of which will involve minimal land alteration, clearing and removal of vegetation cover at the selected sections of the railway route and therefore will not result in any significant terrain alteration.

297. 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.

298. 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.

299. Construction of embankment for the proposed NSRP will change the present topographic condition. But this change will be minimal for the total length of the embankment is only 4.0 km as compared to the total length of 55.6 km.

2) Change in Sub-surface Geology/Underground Conditions

300. The NSRP construction will entail the excavation of necessary overburden or weathered rocks to facilitate the placement of required engineering structures. However, the extent of this impact may only be determined during the Detailed Engineering Design Phase.

3) Inducement of Subsidence, Liquefaction, Landslides, Mud/Debris Flow, etc.

301. The hazards which can potentially affect the NSRP include flooding, landslides and earthquake related hazards. The seismic related hazards include ground rupture, ground shaking, and liquefaction. The proposed NSRP route has been assessed by PHILVOLCS Earthquake and Volcanic Hazard Assessment for Ground Rupture, Liquefaction, Landslide, Tsunami, nearest volcano, and pyroclastic flow/ base surge

302. The areas underlain by the Recent Deposits where groundwater is deemed shallow are potentially vulnerable to liquefaction in the event of a major earthquake occurrence. The segments from Solis Station to Nichols Station and from Muntinlupa Station to Banlic Depot fall under the area which are vulnerable to liquefaction in the event of a major earthquake occurrence. This preliminary assessment needs to be validated by geotechnical investigation particularly at the locations of the train stations.

303. Due to its flat to gentle slope, the entire NSRP Line has low susceptibility to landslides

304. The segment the NSRP between the Muntinlupa and Alabang Stations is vulnerable to ground rupture where it is intersected by trace of the active West Marikina Valley Fault

305. The nearest active volcano from the proposed NSRP is Taal Volcano. The crater of this volcano is approximately 28 km southwest of the Calamba Station. Due to its low elevation compared to the NSRP route, the only hazards which can potentially affect the project are ground shaking and ash fall.

306. The design and construction of the structures and foundation of the proposed NSRP will comply with the provisions of the National Building Code and the Structural Code of the Philippines, and international standards based on the geotechnical and seismicity studies to eliminate/minimized impacts of liquefaction, ground shaking and ground rupture hazards. Especially the fault segment will require a comprehensive study.

307. Coordination with the PHIVOLCS during earthquake events will be made in order to make adjustments including assessment of possible damages to the structures being constructed. Sufficient protection measures such as soil improvements will be provided during excavation works.

308. In case of the emergency, emergency escape route, early warning system, as well as emergency power supplies for the NSRP are also advised to be installed to ensure continued operation of vital services during emergencies. Earthquake drills will also be conducted annualy. Emergency Response Plan is also established and implemented.

309. It is also strongly advised that the site is regularly inspected for structures constructed and under construction to detect any defects to minimise the potential accidents incurred by natural hazard. In addition, appropriate materials handling program or a site protection and rehabilitation program will be implemented.

(2) Operation Phase

1) Change in Surface Landform/Geomorphology/Topography/Terrain/Slope

The operation of the proposed NSRP will not bring about changes in topography and geomorphology.

2) Change in Subsurface Geology/Underground Condition

310. Changes in subsurface geology and underground condition are not expected during the operation of the proposed NSRP.

3) Inducement of Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc.

311. During operation phase, ground shaking can bring about liquefaction and settlement of the track and station foundation. Bridge crossings can also be damaged. Ground rupture can affect the segment between Muntinlupa and Alabang stations. Possible impacts include but not limited to loss of soil strength, settlement of soil, lateral spreading, bearing failure, floatation of embedded structures and damage to overlaying structures.

312. The basic mitigation measure for the hazards that can potentially affect the NSRP Line is to undertake the appropriate studies which will generate information that can be used to assess damages to the structures.

313. Impacts of ground shaking can be mitigated through appropriate foundation design based on combination of geotechnical and seismicity studies. Coordination with the PHIVOLCS during earthquake events will be made in order to make operational adjustments. Earthquake resistance of the NSRP will rely on the constructed protective measures and its maintenance.

314. Proper and prompt maintenance checks are very important to every installed structure and facility. Upgrades or installation of new technological advances when available are also encouraged for the continued operation of NSRP. Regular earthquake drills also advised to be put in place to prevent loss of life and possibly the trains itself.

3.1.2 Pedology

3.1.2.1 Soil Types

315. The project alignment will be traversing at least seven (7) types of soil. These soils are the: (1) Novaliches Clay Loam Adobe, (2) Guadalupe Clay, (3) Guadalupe Clay Adobe, (4) Quingua Silt Loam, (5) Carmona Sandy Clay Loam, (6) Lipa Loam, and (7) Macolod Clay Loam.

Novaliches Clay Loam Adobe

316. This soil type is part of the Novaliches Soil Series which can be found on moderately sloping to rolling volcanic foothills. The soil type contains Fe-Mn concretions with irregular

gravels and partially weathered tuffaceous rock fragments. The water retention for this soil type is high and the permeability is moderate. This soil type is towards the development of a mature soil formed from other alluvial deposits.

Guadalupe Clay

317. This soil type is defined to be coarse and granular when moisture is absent but plastic and sticky when moisture is present. This soil type is part of the Guadalupe soil series which came from the weathering of the tuff deposit found in the area. The first 30 cm of the series is defined to be moist clay loam and the next 28 cm is defined with presence of soft weathered saprolytes.

Guadalupe Clay Adobe

318. Compared to Guadalupe Clay, Guadalupe Clay Adobe is hard and compact, and difficult to cultivate. This makes this soil type unsuitable for cropping. This soil type is part of the Guadalupe soil series which came from the weathering of the tuff deposit found in the area. The first 30 cm of the series is defined to be moist clay loam and the next 28 cm is defined with presence of soft weathered saprolytes.

Quingua Silt Loam

319. This type of soil covers 208,500,000 m² in the province of Bulacan, and 215,690,000 m² of land cover in the province of Pampanga. The mineralogy of this type of soil is generally mixed. The parent materials are recent alluvium, and recent coastal deposits. Soil thickness is found to be ranging from 100-150 cm. Fertility ranges from moderate to very high fertility.

Carmona Sandy Clay Loam

320. This soil type is part of the Carmona Series which is derived from the weathered product of volcanic tuff material. The Carmona Sandy Clay Loam is pale brown to grey sandy clay with abundant concretions as seen on the topmost layer of the soil. In subsoil, it is coloured pale brown to yellowish grey plastic when wet, with abundant dark brown and reddish brown concretions. When moisture is absent, it is hard and compact. In the substratum, the weathered tuffaceous material can be seen.

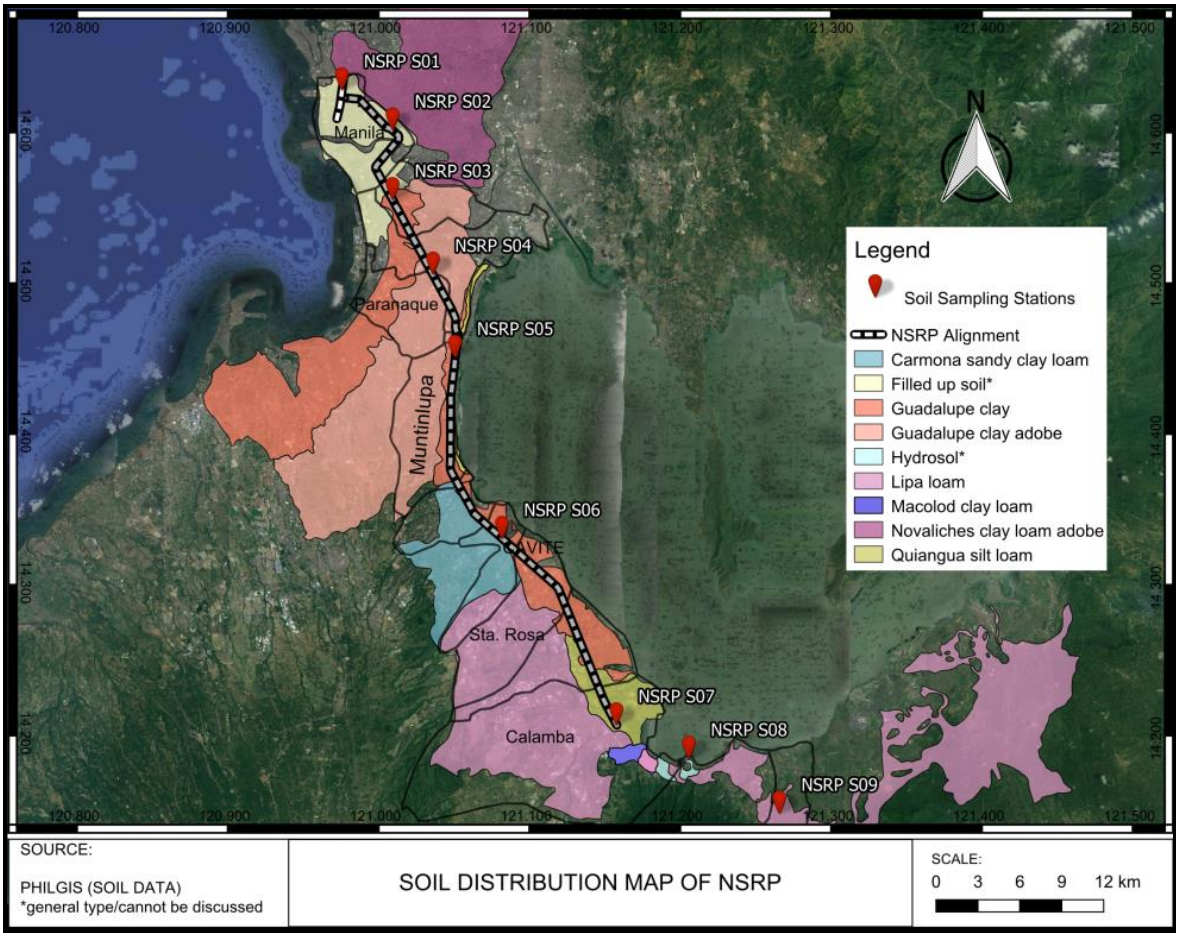
Lipa Loam

321. The Lipa Loam is part of the Lipa Series. These soils span deep as it gives moderately well to well drainage capabilities. The Lipa Series can be found on undulating to rolling terrains. Lipa Loam has a subsurface characteristic that is brown to dark-brown in appearance. Other characteristics signify it as a mallow, loose and very friable fine granular loam. The subsoil is defined as dark brown clay of a friable fine granular tuffaceous material with concretions and an irregular and abrupt boundary. The substratum is made up of highly weathered tuff mixed with tuffaceous gravels and concretions.

Macolod Clay Loam

322. This soil type is part of the Macolod Series. The Macolod Clay Loam is hard, fine and gravelly in texture on the surface. It is generally sticky when wet and granular when dry from 30-60 cm. Substratum is composed of highly weathered rock and sticky when moisture is abundant. The soils permeability is medium to poor.

323. The distribution of these soil types along the project alignment can be found on **Figure 3.1.24**.



Source: PhilGIS, March 2018

Figure 3.1.24 Soil Map showing the Soil Types found along the NSRP Alignment

3.1.2.2 Soil Erosion/Loss of Topsoil/Overburden

324. The baseline conditions for the erodibility of the soils along the NSRP alignment is generally little to no erosion due to land cover and water content of the soil. The topography also plays a part on the erodibility of the soils in the area. Since the area is generally flat, the erodibility of the soils would also be lesser. The river bank stability for the soils along the alignment is generally stable because the soil types are mixed with clay particles. The clay particles will add stability to the riverbanks through flocculation.

3.1.2.3 Soil Quality

(1) Soil Fertility

1) Field Survey

325. Soil samples were collected at ten (10) established sampling stations (Table 3.1.11 and Figure 3.1.25) for physicochemical analyses such as such as pH, N, P, K, micronutrients, and heavy metals. Soil samples were collected from two (2) horizons per sampling station. Surface/disturbed soil samples were taken at 0-25 cm depth using soil auger and were analysed for pH, N, P, K, and micronutrients. The subsurface/undisturbed soil samples were taken at 25-50 cm and were analysed for heavy metals.

326. The limits used for assessment of trace metals are the Target and Intervention Values of Dutch Standards. USEPA 2010 Standard and Leeper, 1978 were used as reference for the assessment of parameters that are not found in the Dutch Standards. The Dutch Standards are

environmental pollutant reference values used in environmental remediation, investigation, and clean-up.

Table 3.1.11 Sampling Stations for Soil Quality Testing

Sampling Stations	Description	Date of Sampling
S01	PNR – Solis Station Coordinates: 14°37'41.65"N; 120°58'32.40"E	February 14, 2018
S02	Area near Pandacan Depot Coordinates: 14°35'36.65"N; 121° 0'41.87"E	February 15, 2018
S03	PNR - Sta. Mesa Coordinates: 14°35'54.27"N; 121° 0'46.14"E	February 13, 2018
S04	PNR – Buendia Coordinates: 14°33'17.27"N; 121° 0'33.81"E	February 14, 2018
S05	PNR – FTI Coordinates: 14°30'22.55"N; 121° 2'9.58"E	February 8, 2018
S06	PNR – Sucat Coordinates: 14°27'4.63"N; 121° 3'2.59"E	February 20, 2018
S07	PNR – Biñan Coordinates: 14°19'52.00"N; 121° 4'51.00"E	January 23, 2018
S08	PNR – Calamba Coordinates: 14°12'23.54"N; 121° 9'28.66"E	January 24, 2018
S09	Alligator Lake Area Coordinates: 14°10'47.90"N; 121°12'25.82"E	January 26, 2018
S10	Paciano Rizal Elementary School Coordinates: 14° 8'56.27"N; 121°16'4.30"E	January 25, 2018

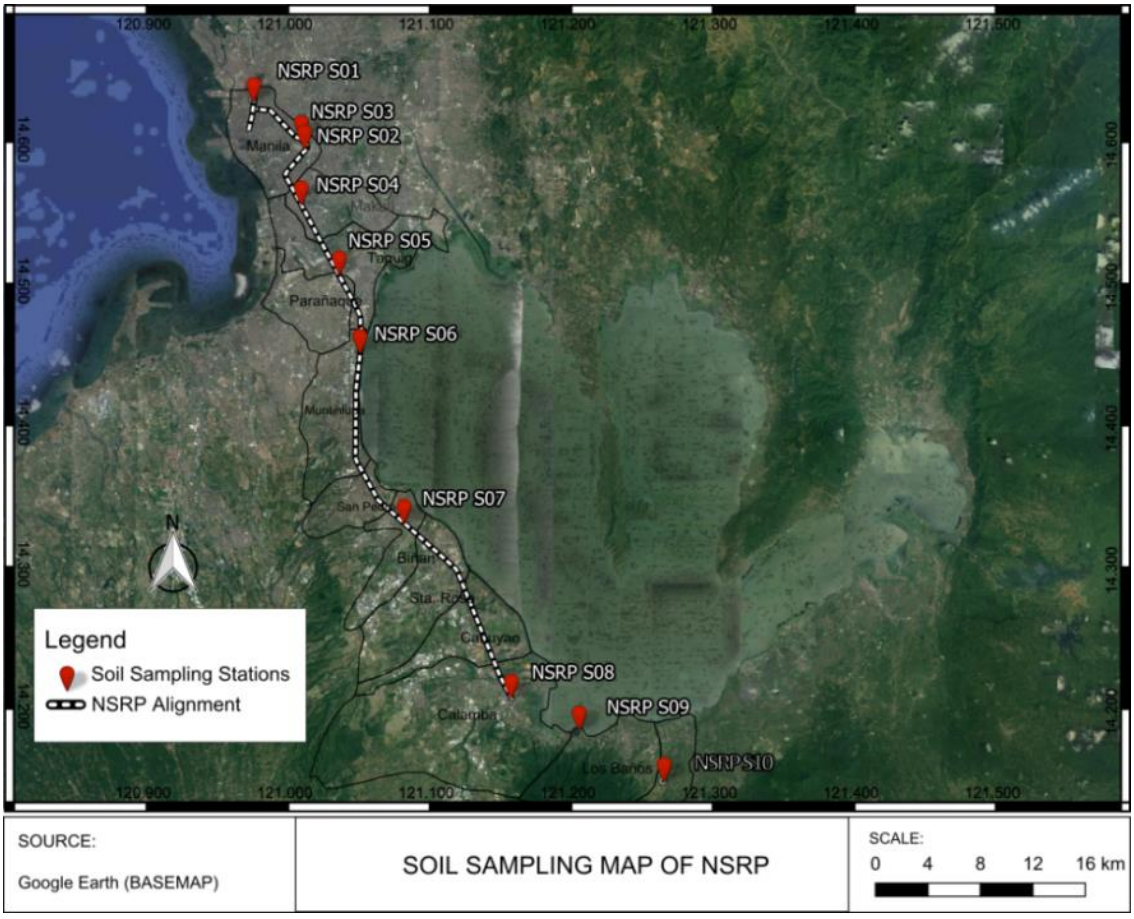


Figure 3.1.25 Soil Sampling Station Map

2) Applied Standard

327. The Adequate Values for parameters such pH, Organic Matter, primary nutrients (Phosphorus, Potassium), secondary nutrient (Magnesium), micronutrients (Iron, Copper, Manganese, and Zinc), as set the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy, which were adopted by BSWM, were used to determine the fertility of the collected soil samples. Dutch Target and Intervention Values (2000) were adopted for trace metals such as Lead, Arsenic, Mercury, Cadmium, and Chromium Hexavalent.

3) Results and Analysis

328. Table 3.1.12 shows the results of the surface soil quality analysis pertaining to soil fertility rating and Trace Metals.

329. The soil samples collected at Stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa) and S09 (Alligator Lake) belongs to Hydrosol, Guadalupe Clay in Stations S04 (Buendia) and S06 (Sucat); Guadalupe Clay Adobe in Station S05 (FTI), Quingua Silt Loam in Stations S07 (Biñan) and S08 (Calamba); and Lipa Loam in Station S10 (Paciano Rizal Elementary School).

330. The results of the soil quality analysis in 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 based on the general guideline values for the fertility rating of soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy except for the pH level at Station S05 (FTI) and organic matter at Station S10 (Paciano Rizal Elementary School) which exceeded the adequate values of 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. The lowest calcium concentration level was in Station S10 at 1.02 cmol/kg while the highest calcium concentration level was in Station 01 (Solis) at 171.21 cmol/kg.

331. The levels of Lead in stations S01 (Solis), S02 (Pandacan), S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) exceeded the Target Value of the Dutch Standard but were way below the intervention values. The levels of Mercury, Arsenic, and Chromium in all sampling stations were well within the Target Values of the Dutch Standard. The levels of Mercury in six (6) stations (S01, S02, S04, S05, S06, and S07) were below the detectable limits of the method of analysis. Levels of Chromium hexavalent in stations S03, S04, S07, S08, S09, and S10 were also below the detectable limits of the analysis. Levels of Cadmium exceeded the Target Value of Dutch Standard but were below the Intervention Value.

a. Results by Sampling Stations

Station S01 (PNR Solis Station)

332. The soil sample collected at Station S01 (Solis) is a filled-up soil. The result of soil quality analysis (Table 3.1.12) shows that levels of pH, organic matter, primary nutrients (P and K), magnesium and micronutrients (available iron, copper, manganese and zinc) at this site are adequate based on the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The level of Nitrogen is 260 mg/kg while level of calcium is 171.21 cmol/kg.

333. The levels of mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The levels of lead and cadmium do not conform to the Dutch Target Values but are within the Intervention Values.

Station S02 (Area near the Pandacan Depot)

334. The soil sample collected at Station S02 (Pandacan) is a filled-up soil. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) at this site are adequate based on the General Guidelines for the

Fertility Rating of Soils[14] (Table 3.1.12). The levels of Nitrogen and calcium are 280 mg/kg and 22.245 cmol/kg, respectively.

335. The levels of mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The levels of lead and cadmium do not conform to the Dutch Target Values but are within the Intervention Values.

Station S03 (PNR Sta. Mesa)

336. The soil sample collected at Station S03 (Sta. Mesa) is also a filled-up soil. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) at this site are adequate (Table 3.1.12). The levels of Nitrogen and Calcium are 1,300 mg/kg and 110.445 cmol/kg, respectively.

337. The same with Station S01 (Solis) and Station S02 (Pandacan), the levels of mercury, arsenic and chromium hexavalent are within the Dutch Target Values (2000). The levels of lead and cadmium do not conform to the Dutch Target Values but are within the Intervention Values.

Station S04 (PNR Buendia)

338. The soil sample collected at Station S04 (Buendia) is classified as Guadalupe clay. Levels of pH, organic matter, phosphorus, magnesium, and micronutrients (available iron, copper, manganese, and zinc) at this site are adequate (Table 3.1.12). Level of potassium recorded at 0.15 cmol/kg is inadequate. The level of Nitrogen and Calcium are 270 mg/kg and 10.315 cmol/kg, respectively.

339. The levels of lead, mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S05 (PNR FTI)

340. The soil sample collected at Station S05 (FTI) is classified as Guadalupe clay adobe. Levels of organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate (Table 3.1.12). On the other hand, the pH level at this station is high. The levels of Nitrogen and Calcium are 1,300 mg/kg and 110.445 cmol/kg, respectively.

341. The levels of mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The levels of lead and cadmium do not conform to the Dutch Target Values but is within the Intervention Values.

Station S06 (PNR Sucat)

342. The soil sample collected at Station S06 (Sucat) was classified as Guadalupe clay. Levels of pH, organic matter, phosphorus, magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate. Level of potassium recorded at 0.14 cmol/kg is inadequate. The levels of Nitrogen and Calcium are 250 mg/kg and 35.59 cmol/kg, respectively.

343. The levels of lead, mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S07 (PNR Biñan)

344. The soil sample collected at Station S07 (Biñan) was classified as Quingua Silt Loam. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate. The levels of Nitrogen and Calcium are 970 mg/kg and 19.18 cmol/kg, respectively.

[14] General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy

345. The levels of lead, mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S08 (PNR Calamba)

346. The soil sample collected at Station S08 (Calamba) is classified as Quingua Silt Loam. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate[15]. Levels of Nitrogen and Calcium are 1,300 mg/kg and 5.11 cmol/kg, respectively.

347. The levels of mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The levels of lead and cadmium do not conform to the Dutch Target Values but is within the Intervention Values.

Station S09 (Alligator Lake Area)

348. The soil sample collected at Station S09 (Alligator Lake) was classified as Hydrosol. Levels of pH, organic matter, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate. The levels of Nitrogen and Calcium are 820 mg/kg and 14.6 cmol/kg, respectively.

349. The levels of lead, mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

Station S10 (Paciano Rizal Elementary School)

350. The soil sample collected at Station S09 (Alligator Lake) was classified as Hydrosol. Levels of pH, primary nutrients (P and K), magnesium, and micronutrients (available iron, copper, manganese, and zinc) in this site are adequate. Level of organic matter measured at 0.75 is low. The levels of Nitrogen and Calcium are 800 mg/kg and 1.02 cmol/kg, respectively.

351. The levels of lead, mercury, arsenic, and chromium hexavalent are within the Dutch Target Values (2000). The level of cadmium does not conform to the Dutch Target Values but is within the Intervention Values.

[15] Based on the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy

Table 3.1.12 Results of Surface Soil Analysis Pertaining to Soil Fertility Rating and Trace Metals

Parameters	Sampling Stations										Adequate Values[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											Dutch Standards[2]	
											Target Values	Intervention Values
Lead, mg/kg	142	85.8	201	31	123	45	54.2	208	15.4	19	85	530
Mercury, mg/kg	<0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	0.09	0.04	0.04	0.3	10
Cadmium, mg/kg	7.43	2.90	2.87	3.93	2.50	4.17	3.55	5.11	3.65	3.78	0.8	12
Arsenic, mg/kg	2.93	1.62	2.32	1.37	1.57	2.15	1.88	3.55	9.76	10.0	29	55
Chromium Hexavalent, mg/kg	5.4	0.74	<0.2	<0.2	10.0	0.78	<0.2	<0.2	<0.2	<0.2	100	380

Note: ** 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

Sources:
1 Adequate Values are based on General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy (adopted by BSWM)
2 Dutch Target and Intervention Values (2000)

b. Results by Parameters

352. Results of analysis for each parameter were graphed showing its relative concentration levels at the ten (10) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant General Guidelines for the Fertility Rating of Soils and Dutch Target and Intervention Values.

pH Level

353. Extreme levels of alkalinity or acidity greatly impacts the absorption of certain nutrients by plants. Though there are nutrients that can be absorbed by plants through a broad spectrum of pH levels, there are some nutrients that are sensitive to pH levels. Measurement of pH also plays a great role in determining what type of plants will grow on a pH-specific type of soil.

354. Figure 3.1.26 shows the graphical presentation of the levels of pH in ten (10) sampling stations. As shown, pH levels in all stations are adequate except for pH level in Station S05 (Sucat) which exceeded the maximum guideline value set in the General Guidelines for the Fertility Rating of Soils provided in the Interpretation of Chemical and Physical Soil Data for the USDA Soil Taxonomy. The lowest pH level was recorded in Station S06 (Sucat) at 7.7.

355. There are many factors that affect the levels of pH in soil. Usually the pH of the soil is controlled by the provenance of the sediments or the bedrock which the soil came from. For stations 4 and 5, the alkalinity of the soil can be attributed to the bedrock where the soil came from. The bedrock for these stations is tuff. Weathering of silica produces a basic environment. For the other stations, the general acidity or alkalinity of the soil can be attributed to the amount of organic matter present in the area or the mineralogy of the soil. Decomposition of organic matter has been linked to a decrease in pH due to production of carbonic acid.

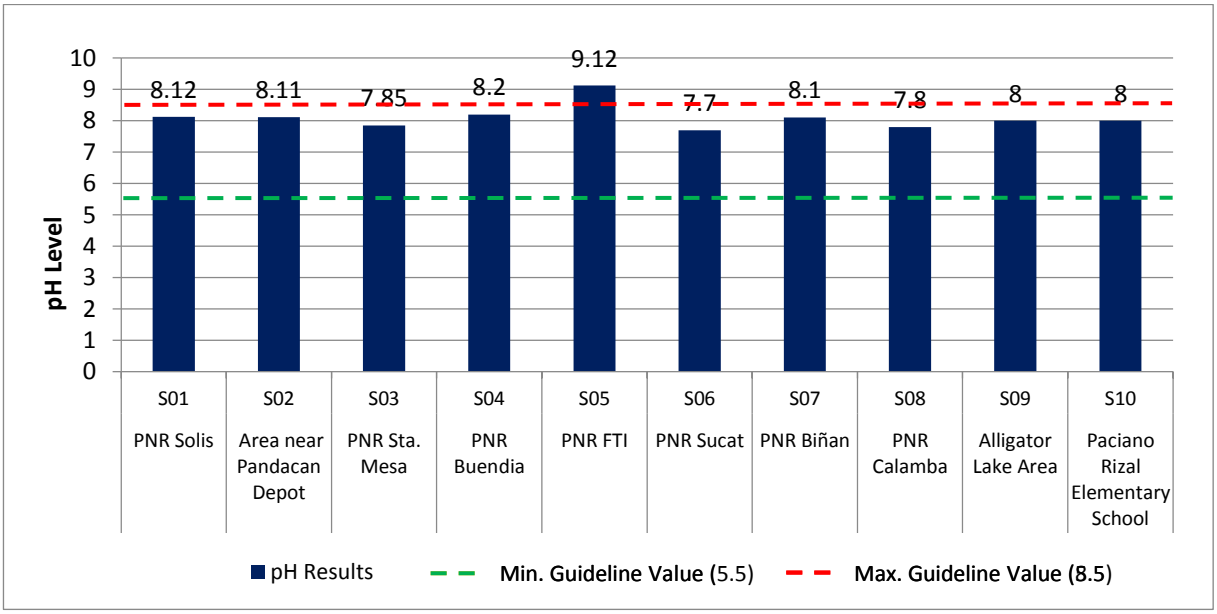


Figure 3.1.26 Result of pH Level Measurement of Soil Samples

Organic Matter

356. The amount of organic matter present in a given soil ecosystem is influenced by a variety of other soil properties such as soil texture, soil pH, soil temperature, moisture content, aeration, clay mineralogy and biological activities. It is important to take note that some of these soil properties, in turn, are being influenced by the amount of organic matter present in a given soil ecosystem. Organic matter serves as a "revolving nutrient fund" for plants by facilititating nutrient availability for plants and as an agent.

357. Figure 3.1.27 shows the graphical presentation of the levels of organic matter in ten (10) sampling stations. As shown, levels of organic matter in all stations are adequate except for the organic matter in Station S10 (Paciano Rizal Elementary School) which is below the minimum guideline value set in the General Guidelines for the Fertility Rating of Soils. The highest level of organic matter was recorded in Station S03 (Sta. Mesa) at 3.24%.

358. There are a lot of factors to consider for the attribution to soil organic matter content. The survey showed that the organic matter content of the stations surveyed were close to the minimum guideline value. The generally low amount of organic matter present in the soil samples can be attributed to the climate the Philippines is experiencing. Higher temperatures are attributed to higher decomposition rates, which is experienced normally by tropical countries like the Philippines.

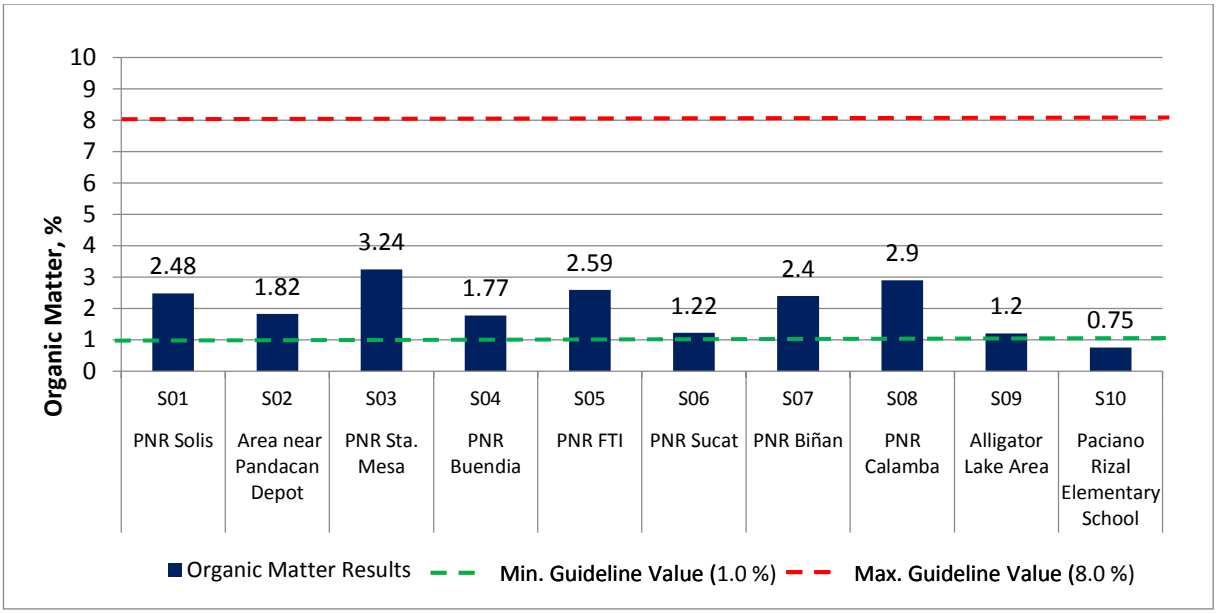


Figure 3.1.27 Result of Organic Matter Measurement of Soil Samples

Total Kjeldahl Nitrogen

359. Total Kjeldahl Nitrogen (TKN), unlike total Nitrogen is the sum of all plant-bound nitrogen including ammonia. Nitrogen are building blocks of plants for growth. High Nitrogen content in soil would be beneficial for plants but Nitrogen in excess will result to low-yield for agricultural plants. There are also cases where the plants get deformations due to excess Nitrogen in soil. High concentration levels of Nitrogen can also be damaging to water quality and might be a signal for possible groundwater contamination.

360. Figure 3.1.28 shows the graphical presentation of the levels of total Kjeldahl Nitrogen in ten (10) sampling stations. As shown, the highest level of total Kjeldahl Nitrogen was recorded in Stations S03 (Sta. Mesa), S05 (FTI) and S08 (Calamba) at 1,300 mg/kg while the lowest nitrogen level was recorded in Station S06 at 250 mg/kg.

361. There are six stations (stations 3,5,7,8,9, and 10) that yielded exceptionally high TKN content in soil. These can be attributed to high activity of nitrogen-fixing bacteria during the first phases of decomposition (ammonia production) or nitrogen residue from recent animal manure decomposition.

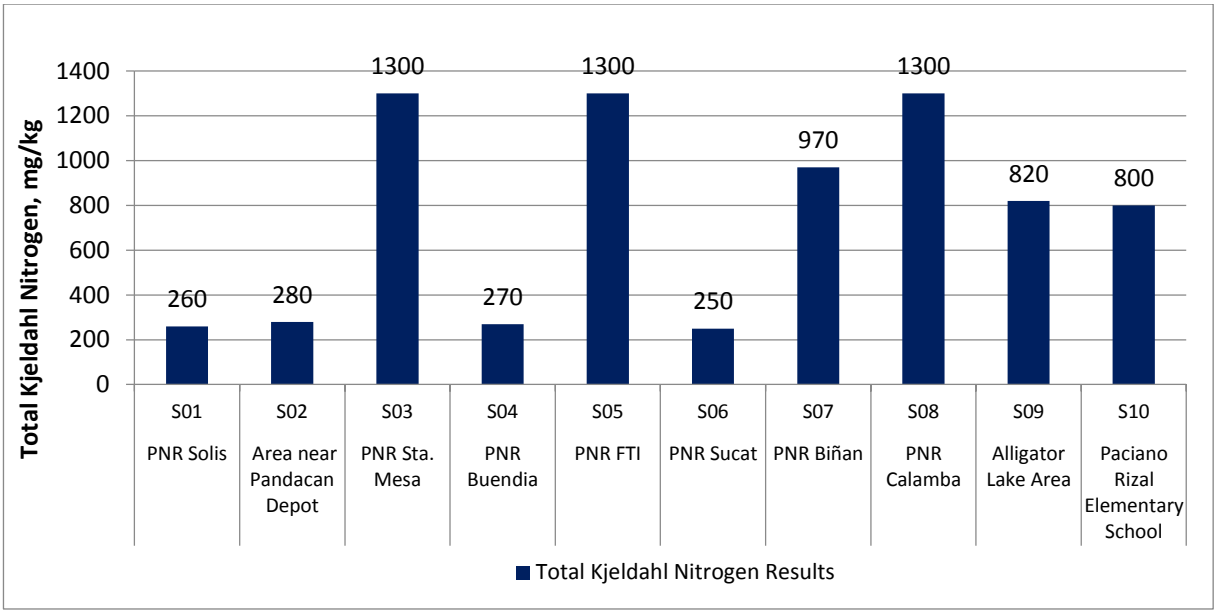


Figure 3.1.28 . Result of Total Kjeldahl Nitrogen Measurement of Soil Samples

Phosphorus

362. Phosphorous in soils serve as energy source for cellular reactions of plants. They can hasten the maturity of a plant or stimulate the stages of early development of a plant. Phosphorous is one of the three vital ingredients of commercial fertilizers together with Nitrogen and Potassium. Phosphorous in soils comes in two forms, the plant-ready inorganic Phosphorous and the organic Phosphorous. There is a natural fixation of these organic phosphorous that converts it into the inorganic type. There are several factors that increase the concentration of phosphorous in soils. They can be added through the use of fertilization, leaching from rocks, etc. Phosphorous in excess is harmful to water resources. They might cause unwanted eutrophication events since they hasten cellular activity.

363. Figure 3.1.29 shows the graphical presentation of the levels of phosphorus in ten (10) sampling stations. As shown, levels of phosphorus in all station are adequate (>10.0 mg/kg). The highest level of phosphorus was recorded in Stations S04 (Buendia) at 6,300 mg/kg while the lowest phosphorus level was recorded in Station S08 at 239 mg/kg.

364. Since phosphorous is a highly soluble substance, the high amounts of phosphorous in some stations can be attributed to residual phosphorous that has been carried through water runoffs. Elevated amounts of phosphorous can also be an indication of a possible groundwater pollution.

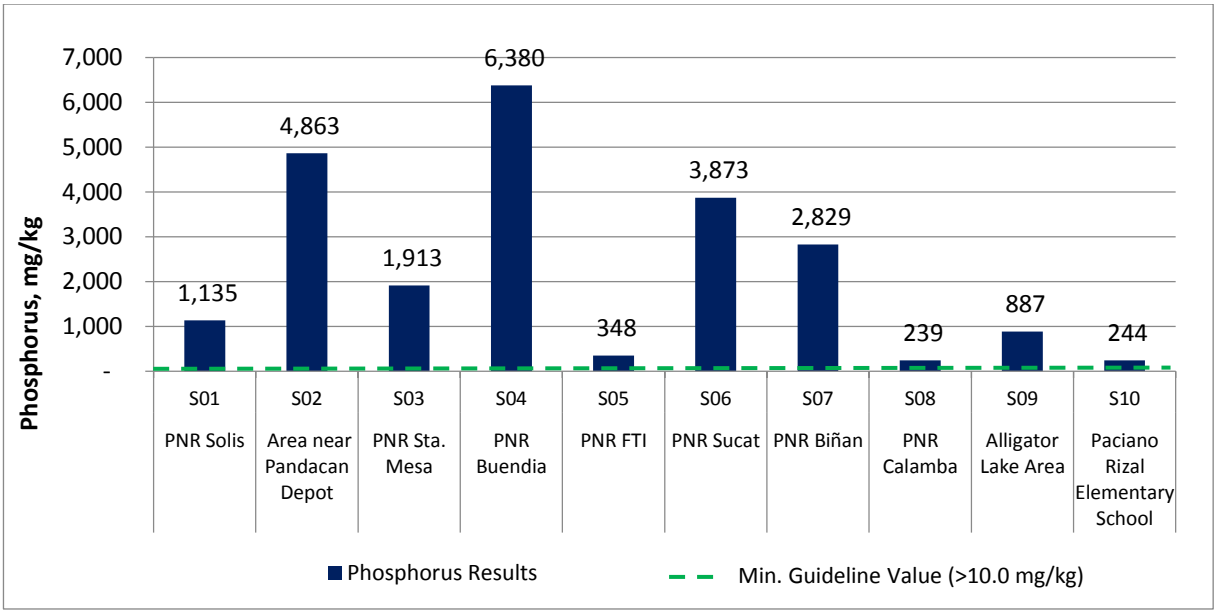


Figure 3.1.29 Result of Phosphorus Measurement of Soil Samples

Potassium

365. Potassium is responsible for the movement of water, nutrients, and carbohydrates through plants. It is also utilized by plants for manufacturing Adenosine Tri-Phosphate (ATP) which drives processes in the cells of plants. Potassium concentrations in soils are generally high (20,000 ppm). Plants usually develop specific symptoms if experiencing deficiency with potassium. They usually develop discoloration along the margins of the leaves and during maturation will continue the process of "necrosis". Problems arising from potassium deficiency can be addressed by the use of fertilizers.

366. Figure 3.1.30 shows the graphical presentation of the levels of potassium in ten (10) sampling stations. As shown, levels of potassium in Stations S04 (Buendia) and S06 (Sucat) are not adequate while in other stations (i.e. S01, S02, S03, S05, S07, S08, S09 and S10), potassium level are adequate. The highest level of potassium was recorded in Station S01 (Solis) at 14.57 cmol/kg while the lowest potassium level was recorded in Station S06 at 0.14 cmol/kg.

367. Potassium levels is greatly affected by the moisture content of the soil and mineralogy. For station 1, it is difficult to pinpoint the factor that affected the elevated concentration of potassium in the soil because the soil in the area is transported and is not in situ.

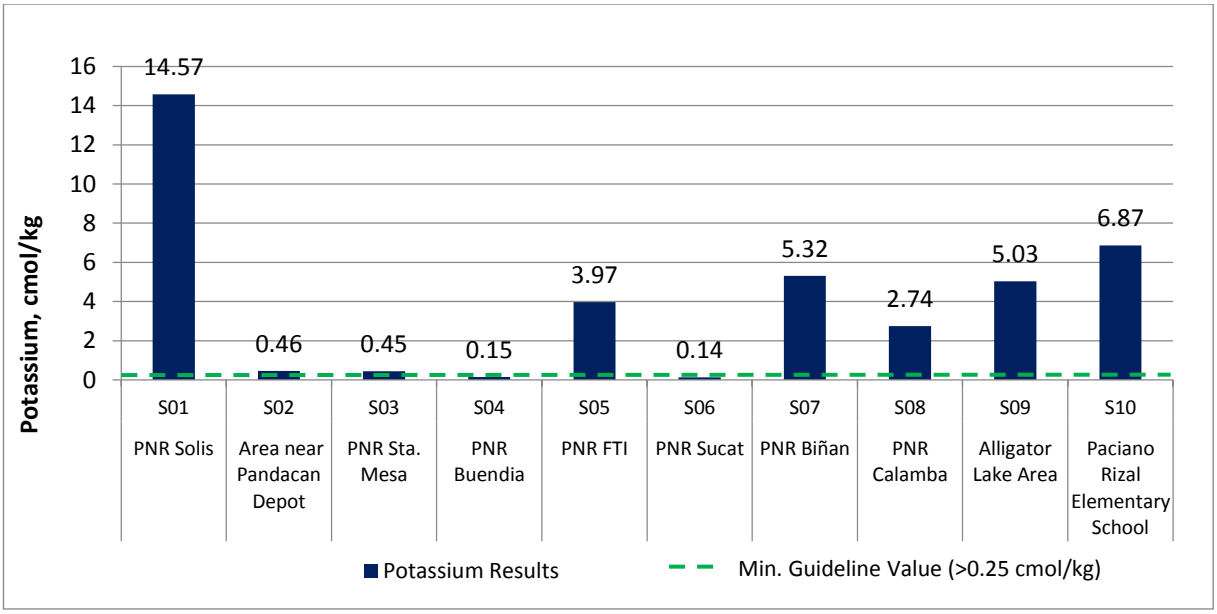


Figure 3.1.30 . Result of Potassium Measurement of Soil Samples

Calcium

368. Presence of calcium in soil ensures proper soil porosity through flocculation of clay and organic matter. It is also important for proper tissue growth of plants. Calcium also helps in the metabolism of starch. It also has the ability to neutralize excess acid or alkalinity in soil.

369. Figure 3.1.31 shows the graphical presentation of the levels of calcium in ten (10) sampling stations. As shown, the highest level of calcium was recorded in Station S01 (Solis) at 171.21 cmol/kg while the lowest potassium level was recorded in Station S06 (Sucat) at 1.02 cmol/kg.

370. Calcium is known to pose no toxicity for the plants but it is known that excess calcium reduces the uptake of nutrients of plants. Though it is known that calcium is known to neutralize the alkalinity or acidity of soil, it is still a common mistake to assume that when the soil pH is high it is correlated to elevated levels of calcium in soil.

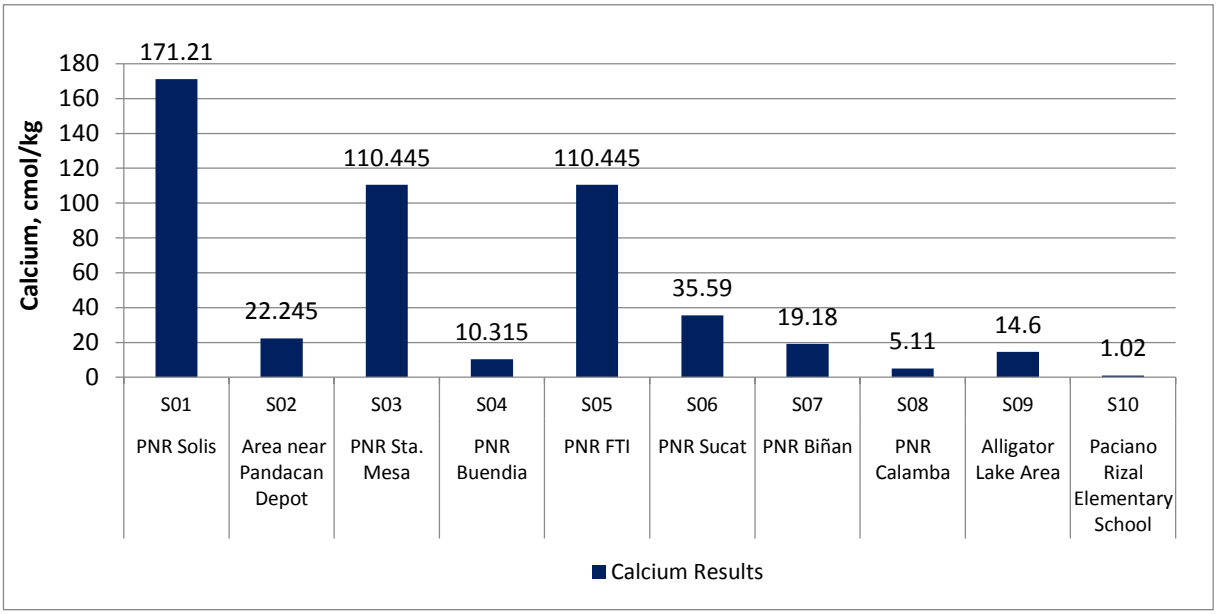


Figure 3.1.31 Results of Calcium Measurement of Soil Samples

Magnesium

371. Magnesium is an important component of chlorophyll in plant tissues. Insufficient amount of magnesium in soil will result to stunted growth of the plant. Magnesium also helps in activating specific enzyme systems. Enzymes are complex substances that affect heavily the metabolism of plants. Insufficient amount of magnesium in soil develops magnesium-deficient plants which in turn pose harm to the livestock that intakes these magnesium-deficient plants. The animals that intake these magnesium deficient plants suffer from grass tetany.

372. Figure 3.1.32 shows the graphical presentation of the levels of magnesium in ten (10) sampling stations. As shown, levels of magnesium in all stations are adequate (>0.50 cmol/kg). The highest level of magnesium was recorded in Station S09 (Alligator Lake) at 227.05 cmol/kg while the lowest magnesium level was recorded in Station S04 (Buendia) at 2.44 cmol/kg.

373. The source of natural magnesium is very reliant to the mineralogy of the soil. It is therefore difficult to pinpoint the reason that attributed to the high or low soil concentration findings for the survey stations since the majority of the alignment is supposedly covered with Recent deposits.

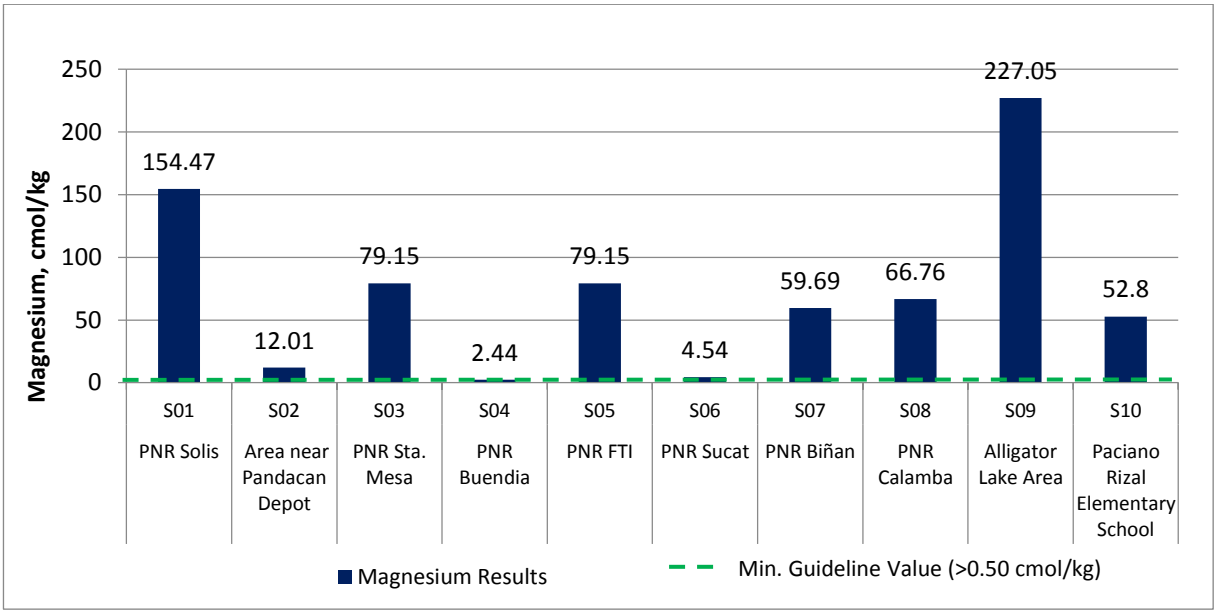


Figure 3.1.32 Results of Magnesium Measurement of Soil Samples

Available Iron

374. Iron is important for development and function of chlorophyll in plants. It is also important for respiration, nitrogen fixation, energy transfer, and metabolism. Excess concentration of iron in soil is commonly linked to problems with the uptake of other nutrients rather than producing toxicity impacts.

375. Figure 3.1.33 shows the graphical presentation of the levels of available iron in ten (10) sampling stations. As shown, levels of available iron in all stations are adequate (>4.5 mg/kg). The highest level of available iron was recorded in Station S08 (Calamba) at 396,112 mg/kg while the lowest available iron was recorded in Station S05 (Sucat) at 18,933 mg/kg.

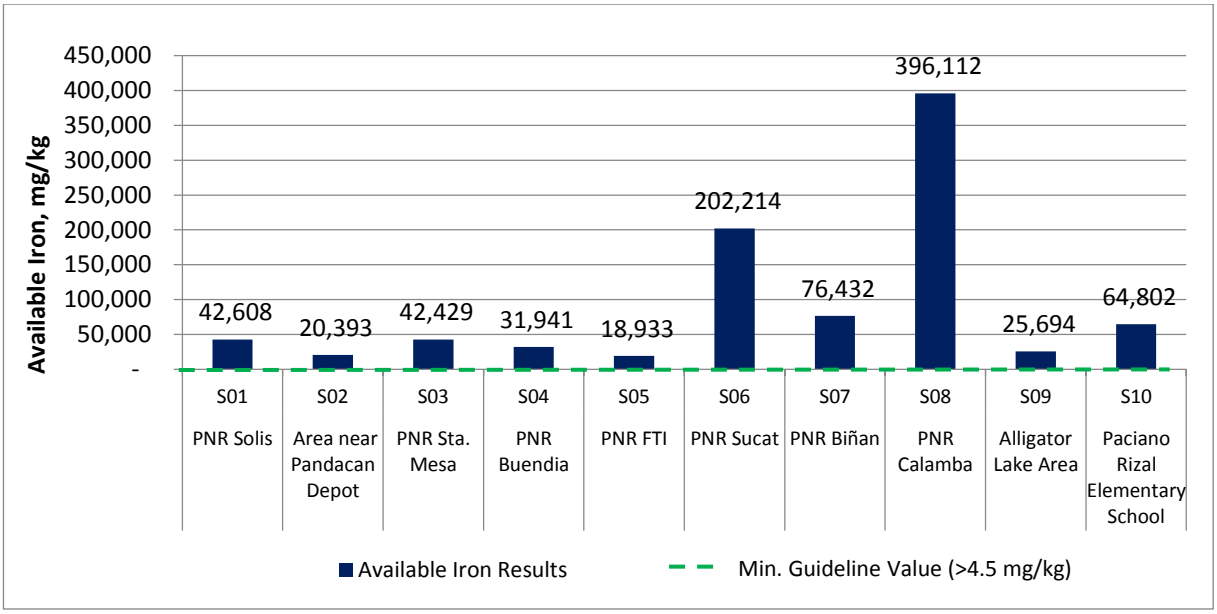


Figure 3.1.33 Results of Available Iron Measurement of Soil Samples

Available Copper

376. Copper, like iron facilitates respiration, and photosynthesis. It is also important for the metabolism of plants. Copper in plants also affects the flavor, sugar content and storage life of fruits. Increased concentration of copper is considered to pose no toxicity problems for the plant. Elevated concentrations just prevent other nutrients from being taken in by plants.

377. Figure 3.1.34 shows the graphical presentation of the levels of available copper in ten (10) sampling stations. As shown, levels of available copper in all stations are adequate (>0.2 mg/kg). The highest level of available copper was recorded in Station S04 (Buendia) at 971 mg/kg while the lowest available copper was recorded in Station S02 (Pandacan) at 63 mg/kg.

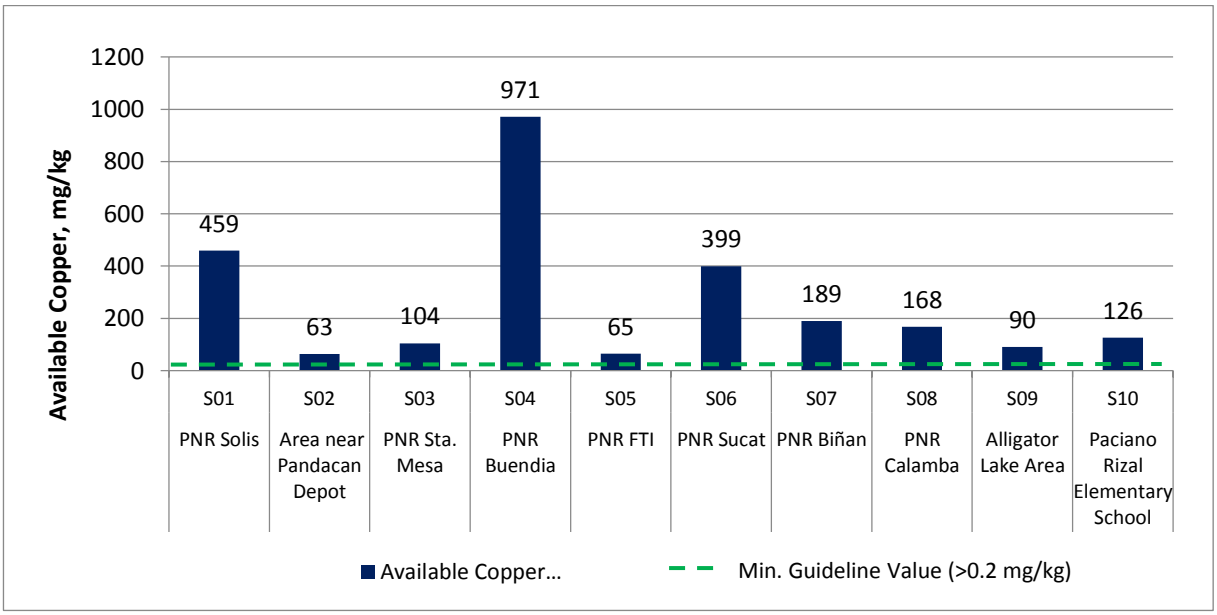


Figure 3.1.34 Results of Available Copper Measurement of Soil Samples

Available Manganese

378. Manganese is important for photosynthesis, production of chlorophyll and nitrogen. It is also responsible for the production of ascorbic acid, riboflavin, and carotene. A variety of factors affects the availability of manganese in soil, following are some: pH, Organic matter, Moisture, and other nutrients. There are no direct links to toxicity due to excessive manganese concentration. But like other nutrients, excess manganese is correlated to decrease in uptake of other nutrients.

379. Figure 3.1.35 shows the graphical presentation of the levels of available manganese in ten (10) sampling stations. As shown, levels of available manganese in all stations are adequate (>10 mg/kg). The highest level of available manganese was recorded in Station S10 (Paciano Rizal Elementary School) at 3,233 mg/kg while the lowest available manganese was recorded in Station S01 (Solis) at 196 mg/kg.

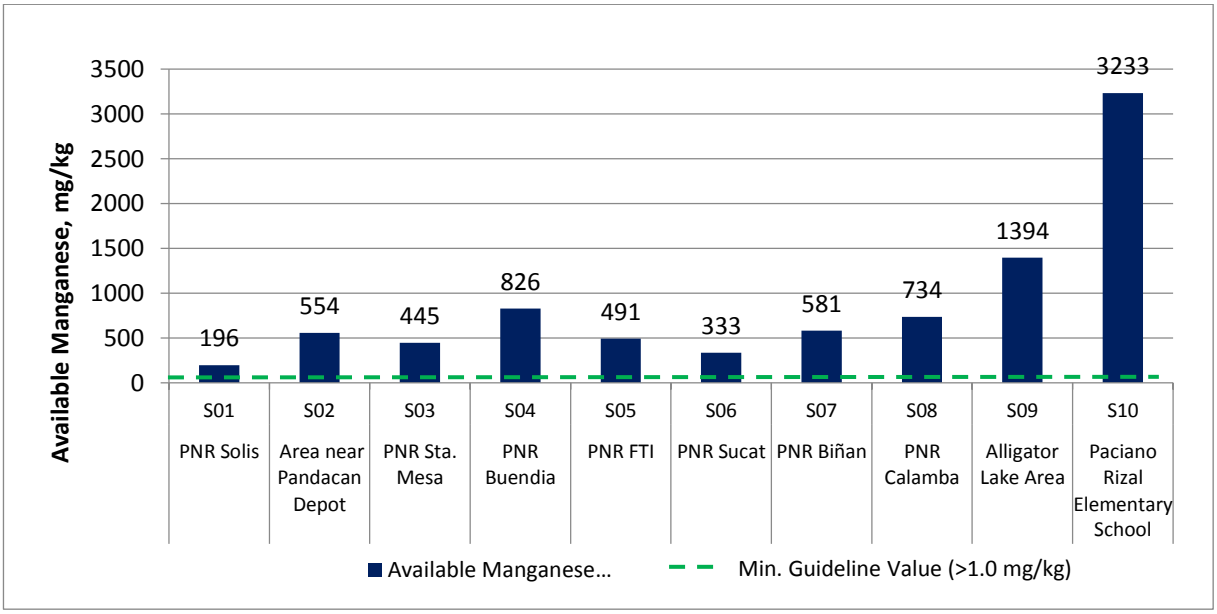


Figure 3.1.35 Results of Availalable Manganese Measurement of Soil Samples

Available Zinc

380. Zinc is responsible for the production of plant growth hormones and proteins. The development of roots, and as well as carbohydrate and chlorophyll production are also dependent on the intake of zinc. There are several factors that affect the availability of zinc in soil, following are some: pH, Organic Matter, Moisture, and other nutrients. Toxicity with zinc is difficult to detect because the normal symptoms are just darker than normal leaves.

381. Figure 3.1.36 shows the graphical presentation of the levels of available zinc in ten (10) sampling stations. As shown, levels of available zinc in all stations are adequate (>1.5 mg/kg). The highest level of available zinc was recorded in Station S03 (Sta. Mesa) at 1,600 mg/kg while the lowest available zinc was recorded in Station S10 (Paciano Rizal Elementary School) at 83 mg/kg.

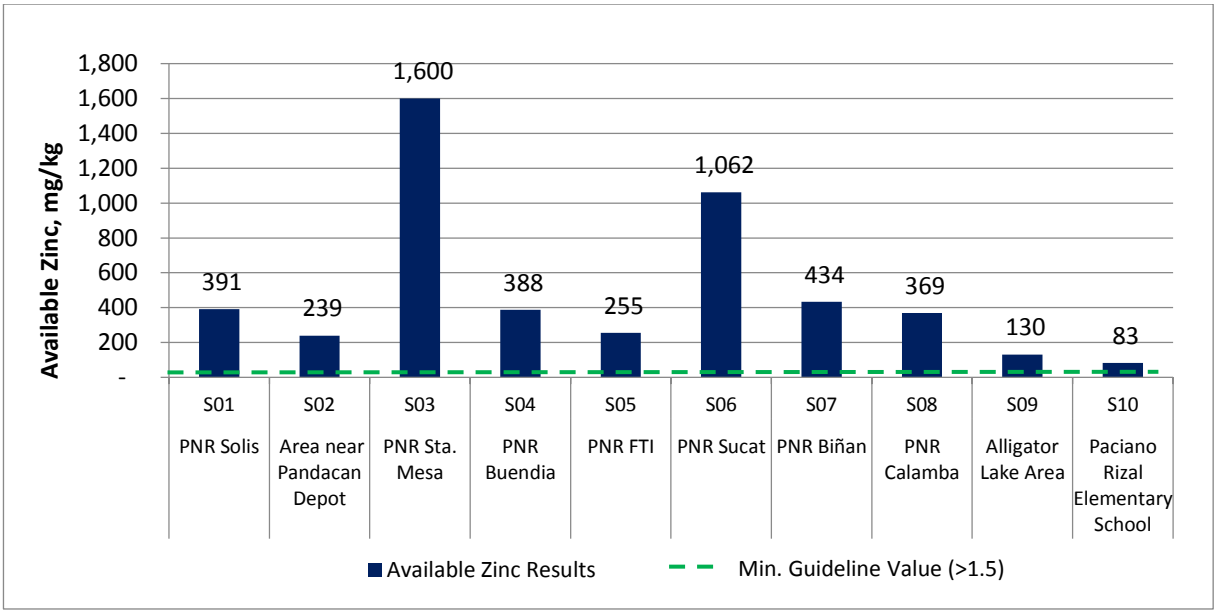


Figure 3.1.36 Results of Available Zinc Measurement of Soil Samples

Lead

382. Lead is a naturally occurring heavy metal. In high concentrations, it is considered toxic and is linked to a plethora of medical problems. Lead contamination is common in highly industrialized areas. The major 2 major sources of lead are old paints and auto emissions.

383. Figure 3.1.37 shows the graphical presentation of the levels of lead in ten (10) sampling stations. As shown, levels of lead in Stations S04, S06, S07, S09, and S10 are within the Dutch target value while levels of lead in Stations S01, S02, S03, S05, and S08 do not conform to the Dutch target value but are within the intervention value. The highest level of lead was recorded in Station S08 (Calamba) at 208 mg/kg while the lowest lead was recorded in Station S09 (Alligator Lake) at 15.4 mg/kg.

384. Lead can be carried to other places by runoff but it is observed that soils sampled near old buldings yield high lead content in soil.

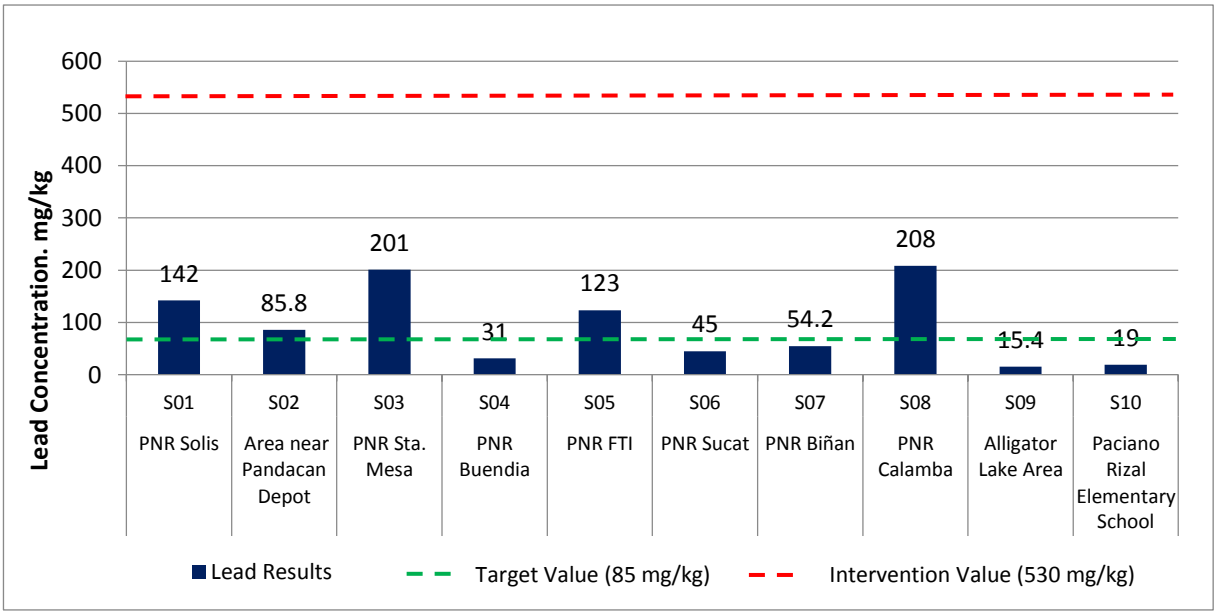


Figure 3.1.37 Results of Lead Measurement of Soil Samples

Mercury

385. Mercury is a toxic compound that is present naturally and can be introduced also to the environment through anthropogenic activities. Mercury is able to bioaccumulate through the food chain, that is why soil and water contaminated with mercury has the highest potential to contaminate the whole food chain with mercury. Mercury has adverse effects on nearly all the systems of the human body. The top contributor of mercury to the environment are industrial activities (cement kiln, gold mining, coal power plants, etc.).

386. Figure 3.1.38 shows the graphical presentation of the levels of mercury in ten (10) sampling stations. As shown, levels of mercury were not detected in stations S01, S02, S04, S05, S06, and S07. In Stations S03, S08, S09 and S10, levels of mercury were detected but are within Dutch target value. The highest level of mercury was recorded in Station S08 (Calamba) at 0.09 mg/kg.

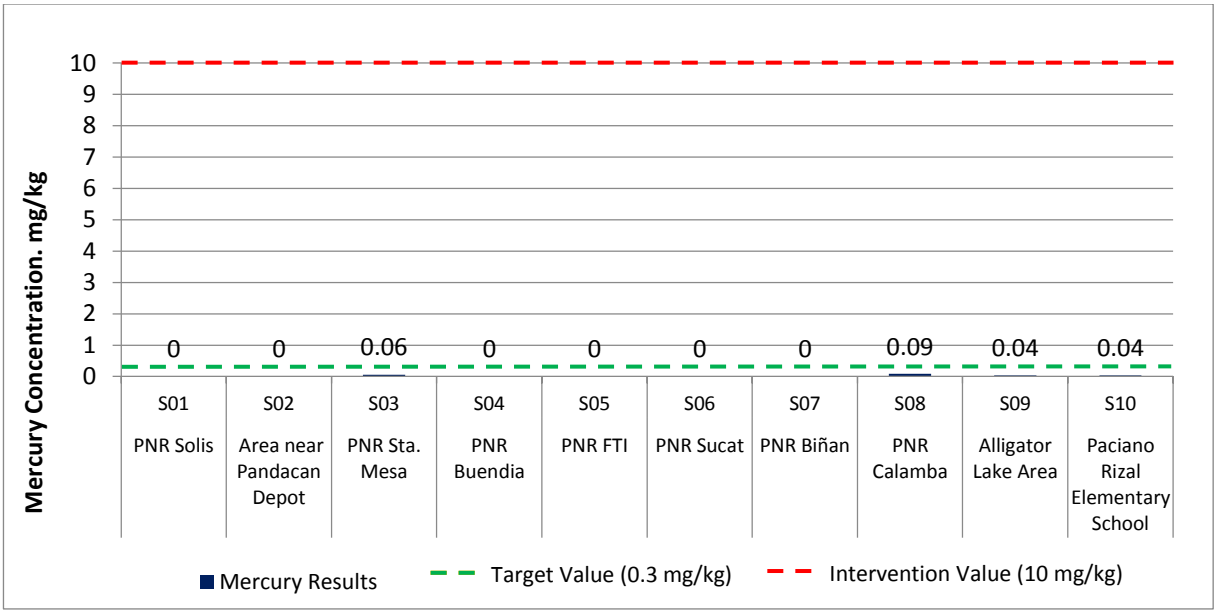


Figure 3.1.38 Results of Mercury Measurement of Soil Samples

Cadmium

387. Cadmium is a toxic element that is used in manufacturing of batteries, paints, and soil fertilizers. Just like lead, cadmium contamination is also linked to industrialization. Like lead, cadmium also poses a lot of medical problems due to cadmium ingestion or inhalation.

388. Figure 3.1.39 shows the graphical presentation of the levels of cadmium in ten (10) sampling stations. As shown, levels of cadmium in all stations do not conform to the Dutch target value but are within the Intervention Value. The highest level of cadmium was recorded in Station S01 (Solis) at 7.43 mg/kg while the lowest cadmium level was recorded in Station S05 (FTI) at 2.5 mg/kg.

389. The high concentrations of cadmium observed in the survey stations might have been brought by industrial activities present in the area.

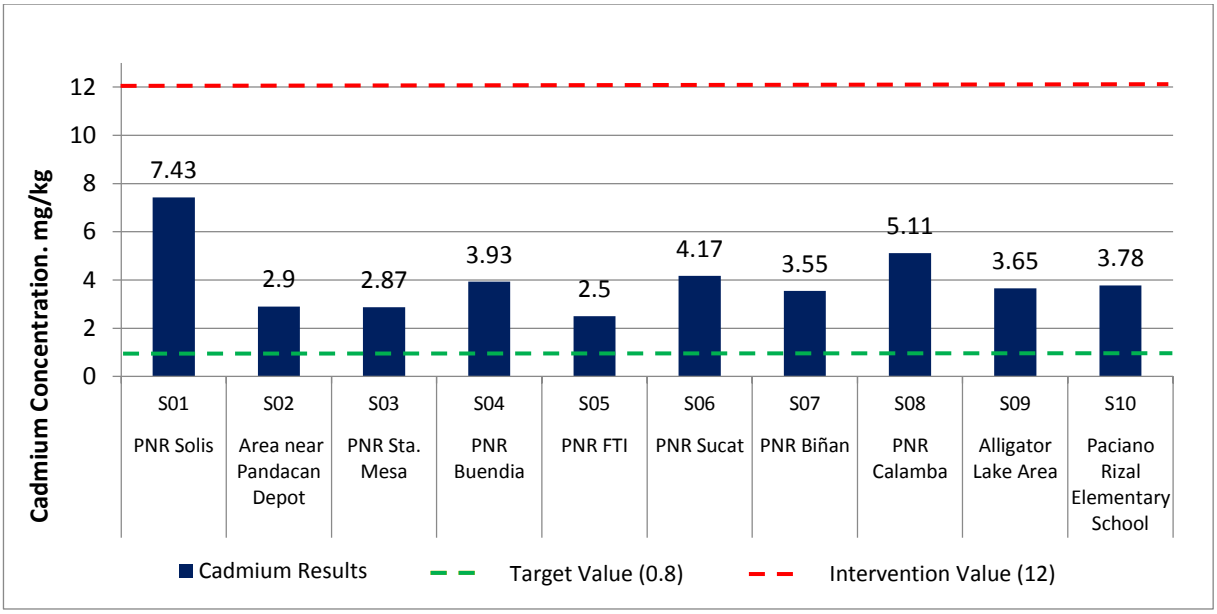


Figure 3.1.39 Results of Cadmium Measurement of Soil Samples

Arsenic

390. Arsenic is another type of toxic compound that is most toxic in its inorganic form. Long-term exposure to arsenic from drinking water has been proven to cause cancer and skin lesions. There are other diseases that have been proven to be caused by arsenic exposure, including cardiovascular diseases, and diabetes. The common sources of arsenic other than industrial activities are the following: Chromated Copper Arsenate (CCA) treated timber, termite control products and some herbicides.

391. Figure 3.1.40 shows the graphical presentation of the levels of cadmium in ten (10) sampling stations. As shown, levels of arsenic in all stations conform to the Dutch target value. The highest level of arsenic was recorded in Station S10 (Paciano Rizal Elementary School) at 10.0 mg/kg while the lowest concentration was recorded in Station S04 at 1.37 mg/kg.

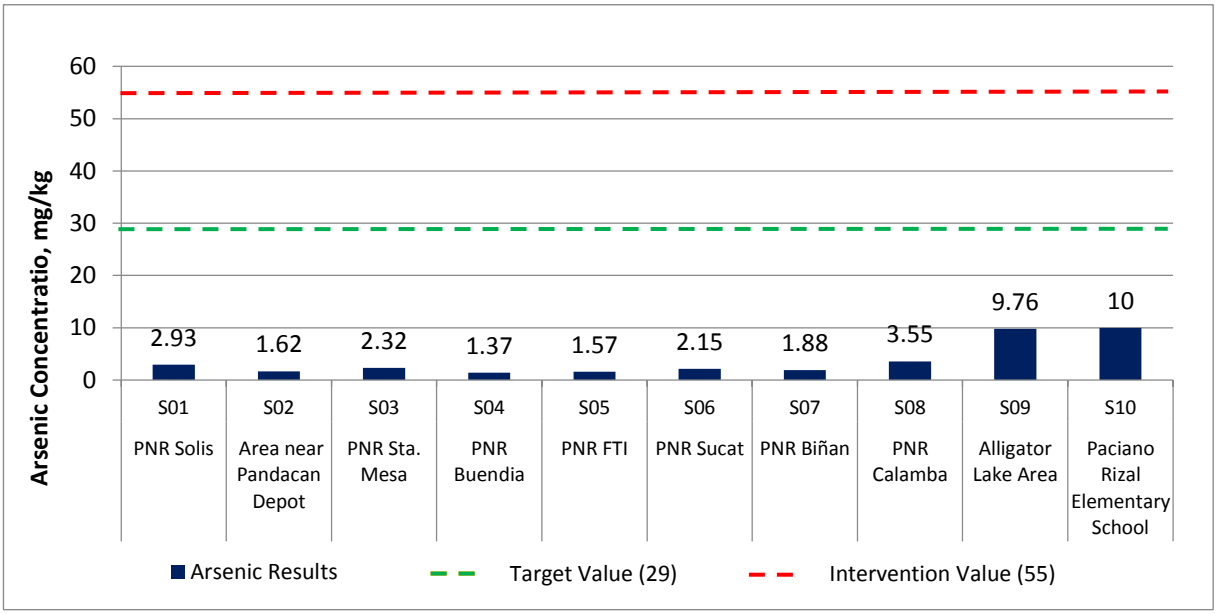


Figure 3.1.40 Results of Arsenic Measurement of Soil Samples

Chromium Hexavalent

392. Chromium can exist in different valencies including its ground state but it is the hexavalent chromium that is substantially more toxic. Chromium, once taken up by plants, affect the germination, plant growth, photosynthesis, and the uptake of a variety of nutrients. For humans, chromium is actually benefitial in small amounts. Ingestion of chromium in high amounts can cause organ damage, stomach ulcers, vomiting, and heart problems.

393. Figure 3.1.41 shows the graphical presentation of the levels of chromium hexavalent in ten (10) sampling stations. As shown, levels of chromium hexavalent were not detected in stations S03, S04, S07, S09, and S10. In Stations S01, S02, S05, S06, levels of chromium hexavalent were detected and are within the Dutch target value. The highest level of chromium hexavalent was detected in Station S05 (Sucat) at 10 mg/kg.

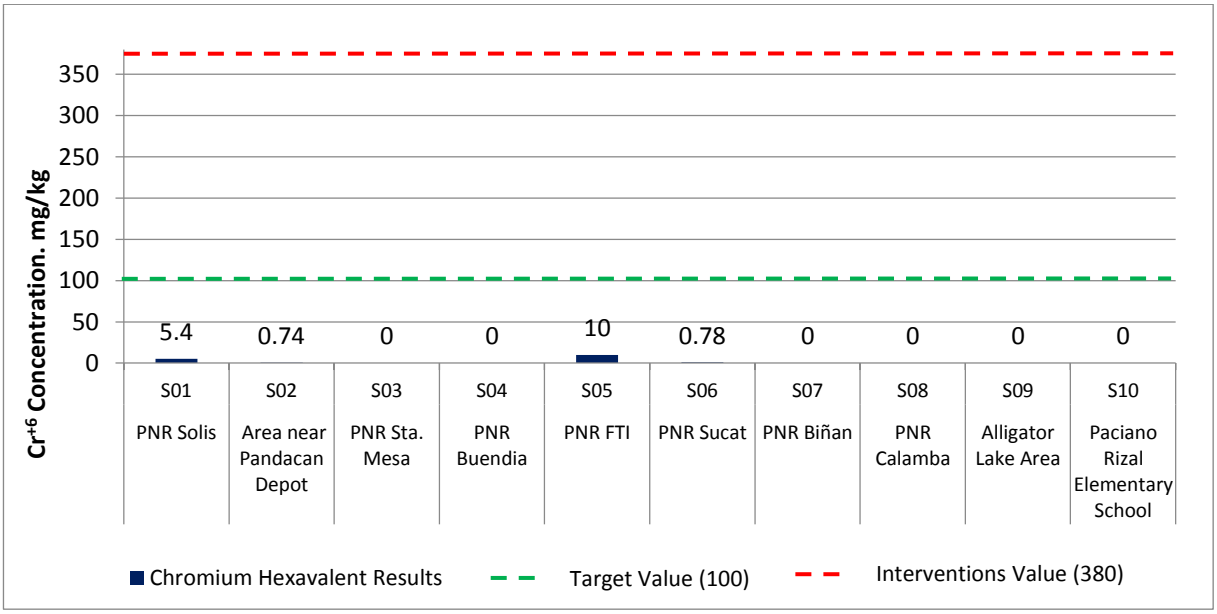


Figure 3.1.41 Results of Chromium Hexavalent Measurement of Soil Samples

(2) Soil Contamination

394. Soil contamination or soil pollution as part of land degradation is caused by the presence of manmade chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. Two (2) sites were being considered to conduct soil contamination sampling – Sucat Thermal Power Plant (STPP) area (Proposed Sucat Station/ Depot) and Agricultural area in Banlic, Calamba City (propose Depot). At STPP site, the study team was not permitted to enter its vicinity thus the field survey was not conducted under this study. The government has an on-going contract with a private firm for its clean-up.

1) Field Survey

395. Soil sample was collected at the proposed depot site in Banlic, Calamba City (Table 3.1.13 and Figure 3.1.42) using composite sampling to determine if the site is contaminated. The collected sample was submitted to Mach Union Laboratory, Inc. for the analysis of pH, Arsenic (As), Barium (Ba), Copper (Cu), Zinc (Zn), Iron (Fe), Cadmium (Cd), Chromium (Cr), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Nickel (Ni), Oil and Grease (O&G) and Cyanide (CN) using Toxicity Leaching Procedure (TCLP) analysis.

Table 3.1.13 Location of Soil Sampling Station for Suspected Contaminated Site

Sampling Location		Date of Sampling
SC01	Depot Site in Banlic, Calamba, Laguna Coordinates: 14°13'38.48"N; 121° 9'31.55"E	March 23, 2018

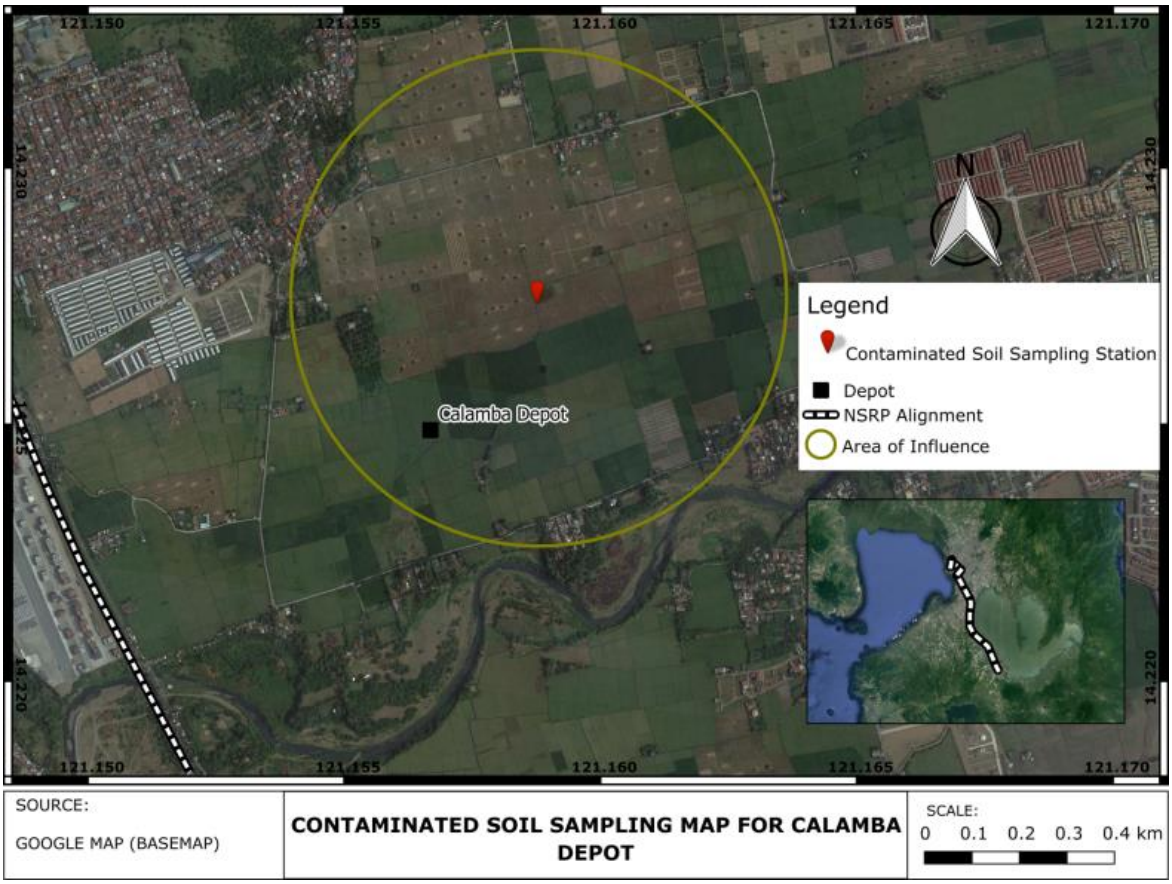


Figure 3.1.42 Soil Sampling Station Map for Potentially Contaminated Site

2) Applied Standard

396. The TCLP limits prescribed in Table 2.1 Classification of Hazardous Wastes of the DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36) were adopted in determining whether the soil samples collected in Stations CS1 and CS2 are contaminated with Acid wastes, Alkali wastes, waste with Cyanide and/or waste with Inorganic Chemicals.

3) Results and Analysis

397. The soil samples collected at the proposed depot site belongs to Quiangua Silt Loam. Table 3.1.14 shows the results of the soil contamination analysis. As shown, all measured parameters (pH, As, Ba, Cu, Zn, Fe, Cd, Cr, Pb, Mn, Hg, Se, Ni, O&G, and CN) are within the TCLP limits.

Table 3.1.14 Results of TCLP Analysis for Potentially Contaminated Soil Samples

Parameters	Sampling Station	TCLP Limits (based on Table 2.1 Classification of Hazardous Wastes of DAO 2013-22)
	Depot Site	
pH	7.0	≤2 Acid ≥12.5 Alkali
Arsenic, mg/kg	<0.001	>1
Barium, mg/kg	<0.04	>70
Copper, mg/kg	<0.005	-
Zinc, mg/kg	0.922	-
Iron, mg/kg	0.389	-
Cadmium, mg/kg	0.0294	>0.3
Chromium, mg/kg	0.054	>5
Lead, mg/kg	<0.006	>1
Manganese, mg/kg	4.04	-
Mercury, mg/kg	<0.0001	>0.1
Selenium, mg/kg	<0.001	>1
Nickel, mg/kg	0.48	-
Oil and Grease, mg/kg	78	-
Cyanide, mg/kg	<0.0019	>70

Source: DAO 2013-22, Revised Procedures and Standards for the Management of Hazardous Wastes (Revising DAO 2004-36)

3.1.2.4 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction phase

1) Soil Erosion/Loss of Topsoil/Overburden

Soil Erosion

398. During construction, earthmoving activities will be carried out along the alignment, stations and depot. These areas will be subjected to clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments. These activities will generate stockpiles of excavated materials within the project area. 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.

399. Temporary siltation ponds with silt traps will be provided within the work areas so as not to contaminate the the water ways in the area. Also, care must be observed in the operation of heavy equipment for transporting and handling excavated materials from one area to another so as to avoid spills into drainage systems or nearby waterways.

400. As part of the detailed design stage, DOTr through its contractor will formulate designed measures to minimize if not prevent slope failure during construction. The measures will be based on the findings and recommendation of the geohazard assessment and geotechnical investigations.

401. The time scale for the erosion of exposed surfaces and materials stockpiles is deemed short-term as this process would likely take place only during the rainy season of the construction period.

402. The construction contractor will be required to submit and implement appropriate materials handling program or a site protection and rehabilitation program that will be monitored regularly by DOTr.

2) Change in Soil Quality

Degradation of Soil Fertility

403. The soil quality survey conducted at selected sampling sites shows that lead and cadmium does not conform to the international standards. Whenever possible, DOTr will collect soil

samples prior to start of construction activities to validate the baseline levels preferably during the wet season.

404. Pre-construction activities that will result in solid waste generation include the demolition of existing structures and clearing and securing of ROW. Recycling of wastes will be implemented, as much as possible, through sorting, stockpiling, and containing recyclable wastes. If appropriate, leftover concrete and metals will be used for suitable alternative projects. If waste is inevitable, it will be sorted in the designated temporary storage area prior to disposal and temporary storage area will be designated. Non-recyclable wastes will be disposed of by an accredited contractor to a designated landfill.

405. During construction works, 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. These may result in relatively insignificant amount of contaminants in the soil. Hazardous Waste Management Plan will be strictly enforced and soil quality will be continuously monitored to maintain the quality and early detection contamination. Oil spills could be prevented requiring the Contractors to undertake the following:

- Conduct proper inspection and maintenance of machines and equipment;
- Store bulk hazardous chemicals in impermeable areas and with appropriate secondary containment;
- Comply with environmental permitting requirements for the storage, transport, treatment and handling of hazardous substances and wastes in accordance with RA 6969;
- Implementation of manual for workers to prevent oil and chemical spills and also provide regular training to workers on environment management and working environments; and
- Implement an Emergency Response Plan and a Health and Safety Management Plan in case of spills.

406. The construction workforce, will likewise, generate solid wastes such as industrial waste packaging materials from construction materials and general wastes from workers such as food scraps, putrescible wastes, toiletries and recyclable and non-recyclable packaging materials. If such wastes will not be handled properly, these would cause land and potential surface water contamination and negative impacts to aesthetics. Mitigation measures to address solid waste impacts include:

- Submission and implementation of Solid Waste Management Plan as part of contractors' engagement in accordance to RA 9003;
- Placement of waste bins to avoid dispersal of litter and regular site maintenance duties; and
- Regular collection, transportation, and disposal of wastes to minimize the attraction of vermin, insects and pests.

Excavated Soil Disposal

407. During construction phase, excess soil from earthwork activities such as excavation, backfilling, and embankment may be generated. If not managed properly, soil wastes may be discharged to water bodies through run-off and could cause increased sedimentation in nearby rivers. Based on the construction plan, a total of around 300 km^3 of soil will be for disposal as a result of soil excavation and backfilling operations for the construction of stations, elevated structures, earthworks for construction workability and drainage and box culvert at the Depot.

408. As a measure, as much as possible, excavated soil will be recycled and reused for utilization in the project or other project/s. For the handling of excavated soil, placement of excavated materials on appropriate disposal sites or spoils area and with adequate containment. In addition, implementation of construction plan and soil management plan will be strictly enforced.

Proper disposal of solid waste by contractor in accordance to RA 9003 will also be at hand including waste minimization and segregation.

Exposure to Contaminated Soil

409. The proposed Sucat station is planned to be located at the Sucat Thermal Power Plant (STPP) site and when possible a depot for minor repair works will be also sited in this station. The assessment for possible contamination at the STPP has not been done due to restrictions onsite. Instead, the assessment was done at Banlic, Calamba depot site and results showed that no presence contamination was detected.

410. The DOTr intends to conduct the Environmental Site Assessment at the STPP site prior to construction NSRP to assess the possible presence of contamination and determine the appropriate remediation if necessary.

411. During construction, there are potential construction activities such as site preparation, excavation work which will involve excavation of previously contaminated area and in case that toxic substances are found within the project area and/or adjacent sites, site activities will be put on hold until Environmental Site Assessment is conducted and contaminated soil management plan is prepared to implement necessary remediation measures in consultation with the DENR - EMB. The site will be continuously monitored for toxic level to ensure that contaminant will not pose hazard.

412. Workers will be provided training on the handling of contaminated soil and provided with appropriate PPE. Implementation of an Emergency Response Plan and a Health and Safety Management Plan in case of spills.

(2) Operation phase

1) Soil Erosion/Loss of Topsoil/Overburden

413. Since the railway is located in a relatively flat terrain, soil erosion during operation of the proposed NSRP is not likely to occur.

2) Change in Soil Quality

Degradation of Soil Fertility

414. The potential impact on soil quality degradation during operation phase of NSRP will be significant at the Depot particularly if handling of chemicals, fuel oil, lubricants, wastes and used oils is not properly implemented. Improper management of chemicals for the NSRP operation, solid wastes and wastewater may result to land contamination as well as aesthetic impacts. Management measures will include proper chemical storage and handling; segregation of wastes; provision of waste bins that will allow proper waste segregation; use of sealable waste bins to avoid attraction of vermin, insects and pests, regular collection and transportation of wastes for recycling or disposal at licensed facilities; and formulation and implementation of policies on solid waste minimization and solid waste management for patrons and staff.

415. Hazardous solid wastes to be generated, as part of general maintenance works, such as lead acid batteries, air filters, busted fluorescent, used oil, etc. will be disposed of in accordance with the provisions of R.A. 6969 "*The Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990* as well as R.A. 9003, *The Ecological Solid Waste Management Act*. Wastes of these kinds will be properly inventoried, labelled, and stored prior to proper disposal through DENR-accredited transporters and treaters.

416. Soil contamination during operation phase could result from leaks of lubricants agents and used oil. Releases of such chemicals will be of more concern in the proposed Banlic Depot stockyard, where train maintenance activities will take place:

- Provide proper inspection and maintain of machines and equipment;

- Implementation of manual for workers to prevent oil and chemical spills and provide regular training to workers on environment management and working environments;
- Implement an Emergency Response Plan and a Health and Safety Management Plan must be in place in case of spills; and
- Continuous monitoring of toxic level to ensure that contaminant will not pose hazard. In case traces of trace contaminants are detected, consult with the DENR – EMB and develop a soil management plan.

Exposure of Contaminated Soil

417. Should contaminated soil be present, continuous monitoring of toxic level will be conducted in the vicinity of the contaminated site to ensure that contaminant will not pose hazard. In case traces of contaminants are detected, consult with the DENR – EMB and develop a soil management plan.

3.1.3 Terrestrial Ecology

418. The Philippines is one of the mega diversity countries due to its diverse habitats and high rates of endemism. However, on the other hand, it is also one of the world's hotspots, with a large number of endangered and threatened species.

419. The proposed alignment of NSRP will traverse the high density residential and commercial areas in Metropolitan Manila and Province of Laguna.

420. The most notable ecological area near the proposed NSRP alignment are the Mount Makiling Forest Reserve (MMFR) which is approximately 4 km away, the Laguna de Bay and the Tadlac Lake (also known as Alligator Lake).

421. MMFR is 4,244 hectare nature reserve 65 km southeast of Metro Manila. Mt. Makiling contains diverse flora from a large number of endemic families, genera and species that include many interesting forms. There are also some species introduced from several parts of the world, some of which are already naturalized after long years of existence in the area. There are also threatened species based on International Union for Conservation of Nature (IUCN) and Department of Environment and Natural Resources Administrative Order 2007-01 found inside the reserve. Aphanamixis polystachya, Artocarpus rubrovenius, Balakata luzonica, Cinnamomum mercadoi, Dillenia reifferscheidia, and Myristica philippinensis are among the species listed as vulnerable in both the DENR's Department Administrative Order (DAO 2007-1) and the IUCN Redlist.

422. Laguna de Bay is the largest lake in the Philippines located east of Metro Manila between the provinces of Laguna to the south and Rizal to the north. Its dominant use at present is for fishery, both open water fishing and aquaculture. It is also part of the flyway of migratory birds for shelter and foods.

423. Tadlac Lake is also included in the area of study to check the biodiversity in its surrounding. The lake is located in Barangay Tadlac, Los Baños near the border of Calamba City in the province of Laguna. The lake is contained in a piece of land jutting out to the Laguna de Bay that was known as Malilimbas Point and is directly situated below the northeastern slope of Mount Makiling, the highest mountain in the Laguna Volcanic Field. Because of its origin, the lake has no outlet and is replenished only by rainfall.

424. Tadlac Lake is also notable for its history of annual Lake overturns, locally called *langal.* This phenomenon, rare elsewhere but usually occurring in Tadlac lake during the cold months of December to February, is the result of trapped carbon dioxide (CO2) erupting from the deep layers of the lake towards the surface, leading to fish kills due to low levels of dissolved oxygen[16]. This

[16] Santos-Borja, Adelina C. (2008). "Multi-Stakeholders" Efforts for the Sustainable Management of Tadlac Lake, The

phenomenon was greatly heightened by the introduction of aquaculture to the lake in the mid-1980s, eventually leading to a massive and costly fishkill in 1999, which in turn led to the cessation of aquaculture activities on the lake.

3.1.3.1 Terrestrial Flora

425. Some of the most marked temporal fluctuations in species abundances are linked to seasons. In theory, multispecies assemblages can persist if species use shared resources at different times, thereby minimizing interspecific competition. Philippines have only two (2) seasons: the wet and dry season. The dry season starts in late November and ends in May while wet or rainy seasons starts in June and lasts till October.

426. The proposed NSRP alignment encompasses large amounts of developed, disturbed and maintained areas. It is surrounded by heavy industrial facilities, residential areas and infrastructures. Hence, no actual or significant difference is expected in terms of data gathering during dry or wet season. Also, species composition from plant diversity assessment does not solely rely on physical factors specifically climate or weather data, or does not arrest the fact that there is more diverse species during wet season only.

427. For this study, the terrestrial flora survey was conducted during the dry season.

(1) Field Survey

428. The terrestrial flora survey was conducted on February 5-11, 2018 at six (6) sites/transects along the project alignment. Individual trees, with a diameter at breast height (dbh) of 10 cm or more, were geo-tagged and measured through their biometrics.

429. During the terrestrial flora survey, modified belt transect method wherein nine (9) quadrats (20 m x 20 m) were laid out along a 2-km transect at every 250 m interval. Nested quadrat sampling technique was used to assess and characterize the structure and species composition of the different plant communities. For large woody plants whose diameter is equal or greater than 10 cm, measurements of diameter at breast-height (dBH), merchantable height (MH), and total height (TH) were done inside the 20 m x 20 m quadrat. Frequency of shrubs, poles, and saplings inside the 5 m x 5 m quadrat was counted to account for the intermediate species, while percentage cover of understorey species (grasses and other plants below 1 m in height) inside the 1 m x 1 m quadrat was determined.

430. Information gathered in the field were tabulated and analysed to characterize floral composition within the study area. The relative density, relative dominance, and relative frequency values for each tree species were determined to obtain their Importance Value (IV), which is the standard measurement in forest ecology to determine the rank relationships of species. Also, the relative frequency, relative density, and relative dominance indicate different aspects of the species importance in a community. Importance values were determined using the following formula:

$$\text{Density} = \frac{\text{number of individuals}}{\text{area sampled}}$$

$$\text{Relative Density} = \frac{\text{density for a species}}{\text{total density for all species}} \times 100$$

$$\text{Frequency} = \frac{\text{number of plots in which species occur}}{\text{total number of plots sampled}}$$

$$\text{Relative Frequency} = \frac{\text{frequency value for a species}}{\text{total frequency for all species}} \times 100$$

Philippines". Research Center for Sustainability and Environment, Shiga University.

Dominance = basal area or volume for a species / area sampled

Relative Dominance = dominance for a species / total dominance for all species x 100

Importance Value = Relative Density + Relative Frequency + Relative Dominance

431. Diversity indices (Shannon, Simpson's and Evenness) for each sampling quadrats were generated using Paleontological Statistical software package for education and data analysis (PAST version 3.12). Moreover, endemism and ecological status of the different species were assessed to determine the ecological importance of the vegetation in the area. Plant classification followed the latest Angiosperm Phylogeny Group classification (APG IV, 2016) while the common names adapted that of Rojo (1998).

Table 3.1.15 Terrestrial Ecology Sampling Station

Sampling Station	GPS Coordinates	Profile/Dominant Species**	Vegetation Type	Human Activity
Transect 1 – 204 (Dagupan Ext.), Tondo, Manila	N 14°37'37.15" E120°58'32.10"	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 and ,* etc. Herbaceous species: *Alternanthera sessilis, Xanthosoma violaceum, Synedrella nodiflora, Vernonia sp., Paspalum conjugatum, Mikania cordata, Heliotropium indicum , etc.*	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	N 14°31'39.53" E121°01'26.72"	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.	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 establishmen ts; skyway, SLEX
Transect 3 – Niugan and Banay-Banay , Cabuyao, Laguna	N 14°16'46.32" E121°07'48.95"	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.	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 Banos, Laguna	N 14°10'52.28" E121°12'15.09"	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.	Dense vegetation of sparse tree individuals near Laguna de bay and residential areas, includes open spaces with dense grasses and weeds. "Cut" hill with	Human settlement; resorts

Sampling Station	GPS Coordinates	Profile/Dominant Species**	Vegetation Type	Human Activity
		Herbaceous layer: *Tridax procumbens* Rolfe, *Centrocema pubescens, Stachytarpeta jamaicensis, Mikania cordata* (Burm. f.) B.L. Rob., *Mimosa pudica,* etc.	dense tree vegetation.	
Transect 5 – Baybayin and Timugan, Los Banos, Laguna	N 14°10'47.06" E121°13'10.04"	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: *Thysanolaena latifolia*, *Sorghum halepense, Saccharum spontaenum*, etc.	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 MMFR.	Human settlement
Transect 6 – Sto. Nino Los, Banos, Laguna	N 14°10'32.08" E121°14'54.76"	Shrub species: *Solanum torvum*, *Sida acuta*, *Chromolaena odorata*, etc. Tree species: *Gmelina arborea*, *Trema orientalis* (L.) Blume, *Macaranga tanarius* (L.) Muell.-Arg. *Morinda citrifolia* L., *Ficus septica* Burm. f. *Melanolepis multiglandulosa,* etc. Herbaceous layer: *Coccinea grandis* (L.) Voigt, *Centrosema pubescens*, *Passiflora foetida, Mikania cordata* (Burm. f.) B.L. Rob., *Caesalpinia latisiliquum, Tridax procumbens,* etc. Grass species: *Imperata cylindrica, Thysanolaena latifolia*, *Sorghum halepense, Saccharum spontaenum*, etc.	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

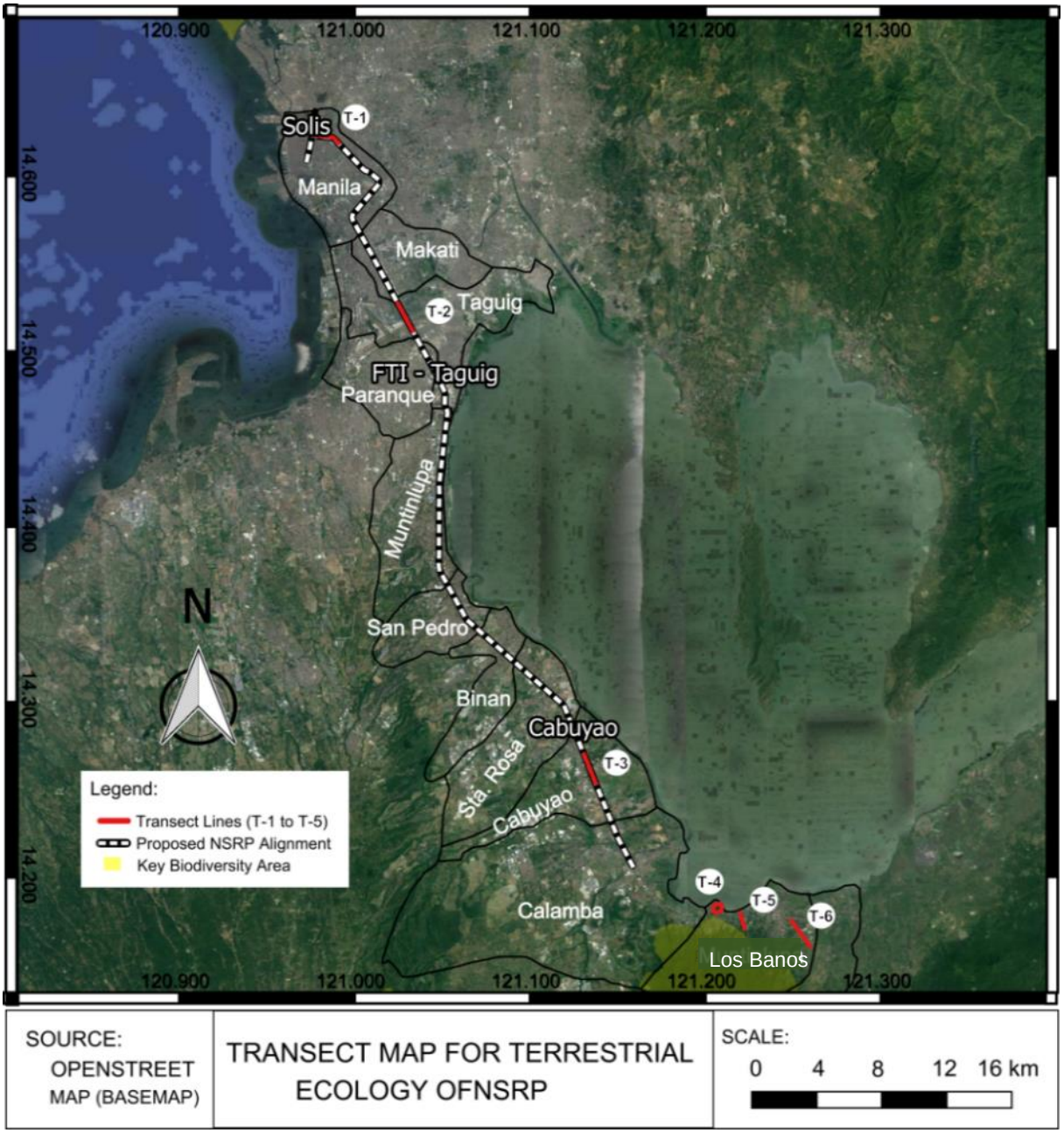


Figure 3.1.43 Location of Transect Plot for Terrestrial Ecology

(2) Results and Analysis

432. The proposed NSRP does not pass through any protected area, reserved forest area, or natural forest area. The most notable ecological area near the proposed NSRP alignment is the MMFR which is is approximately 4 km away. The proposed project alignment encompasses large amounts of developed, disturbed, and maintained areas. It is surrounded by heavy industrial facilities, residential areas, and infrastructures.

433. Majority of plants recorded at the NSRP site are weeds species common to disturbed and degraded areas. Few number of both endemic tree species were encountered in the transect plots. There are no threatened species recorded to all transect plots. Majority of plants recorded are weeds species common to disturbed and degraded areas. Dominant families include *Cannabaceae*, *Fabaceae*, *Verbenaceae*, *Anacardiaceae*, *Lamiaceae*, *Asteraceae* and *Moraceae*. Majority of plants recorded are weeds species common to disturbed and degraded areas.

1) Associated Vegetation/Significant Landscapes

Internal environment

434. Associated vegetation or landscapes are important in assessing terrestrial ecology assessment since these areas can serve as either viable alternative shelter or entrance site for new plant or animal species recruits from the main ecosystems or an area affected by any development or disturbance. Based from the site survey, there are no observed associated vegetation in the project area as it was already surrounded by heavy industrial facilities, residential areas and infrastructures except for areas located in Los Baños, Laguna. Additionally, areas within the existing PNR alignment from Manila to Calamba are smothered with weeds and other invasive species. Sparse tree vegetation are notable within houses and squatter areas that build temporary houses within the PNR rails.

435. A small creek (Molawin creek) was observed near the alignment that joins other minor creek lines that runs parallel to International Rice Research Institute (IRRI). The creek host a number of tree species and patches of vegetation such as bamboos, pioneer tree species, and herbaceous plants. On the other hand, Brgy. Tadlak and Alligator Lake host tree species of pioneer and common planted trees. The area provides good quality habitat for endemic flora species, including Is-Is (Ficus ulmifolia) and Niog-Niogan (Ficus psuedopalma). Consequently, these small units of ecological area will provide the best habitat in the proposed alignment for fauna such as birds and bat species that do not rely on hollows.

External environment

436. External environment focus on other significant landscapes that are outside or not located within the project area but relatively adjacent to it. This includes protected areas designated by the Philippine's laws or international treaties and conventions in the vicinity of the project sites and determine the distance between protected area and the railway track. Additionally, other proclaimed/declared biodiversity, wetlands, and protected areas that are near to the identified sampling station where there are notable ecosystems were accounted. Associated vegetation or landscapes located externally are important in assessing terrestrial ecology assessment since these areas can serve as final sanctuary or viable alternative shelter or entrance site for new plant or animal species recruits from the main ecosystems or an area that had been totally disturbed and affected by any development or disturbance.

437. Notable ecological area near to the proposed NSRP alignment and depot site is the Mount Makiling Forest Reserve (MMFR) located at Los Banos, Laguna. A number of significant endangered and endemic wildlife species especially floral species are present in MMFR.

2) General Vegetation

438. The proposed NSRP alignment from Solis, Manila to Calamba, Laguna encompasses mostly 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, small existing vegetation present in the study area are generally disturbed. Tree vegetation are generally spares. Two (2) classification of vegetation were defined for the proposed NSRP railway alignment, representing few structural and floristic composition of general plant form such as trees, shrubs, grasses, and herbaceous species. These are mainly comprised of: (1) Small to medium sized individuals of sparse trees of 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).

3) Transect Plot Profiles

439. Figure 3.1.44 show the location and general vegetation condition of the different plots from the six (6) transect plots established in the proposed NSRP alignment.

Transect 1 (Solis Station)

440. Transect 1 is located at Tondo, Manila encompassing high built-up area. The area is almost devoid of vegetation and only patches of disturbed grasses and weeds growing along the alignment can be observed along with few trees. This vegetation occurred on low density near smothered places and residential areas. In terms of understorey and ground cover, shrubs are represented by Hagonoi (*Chromolaena odorata*), *Cleome rutidosperma*, *Blumea lacera*, *Urena lobata* and *Stachytarpeta jamaicensis.* The most dominant ground cover is Bunga-Bunga (*Alternathera sessilis*) and Tuhod manok (*Synedrella nodiflora*) which are common species of open and disturbed area. The area is already disturbed and no notable plant species of ecological significance are found in the plot.

441. In terms of other tree species present in the plot, pioneers are represented by few individuals of forest trees such as Hauili (*Ficus septica*), Narra (*Pterocarpus indicus*), Anabiong (*Trema orientalis*) and an endemic species of Is-Is (*Ficus ulmifolia*). On the other hand, other exotic trees and horticultural species are represented by *Muntigia calabura*, *Samanea saman*, *Sweitenia macrophylla*, *Artocarpus heterophyllus*, *Psidium guajava*, *Syzigium cuminii* and *Chrysophyllum cainito*, Fig trees are also prominent in the area. **Figure 3.1.44** shows the transect map in Solis Station (T1).

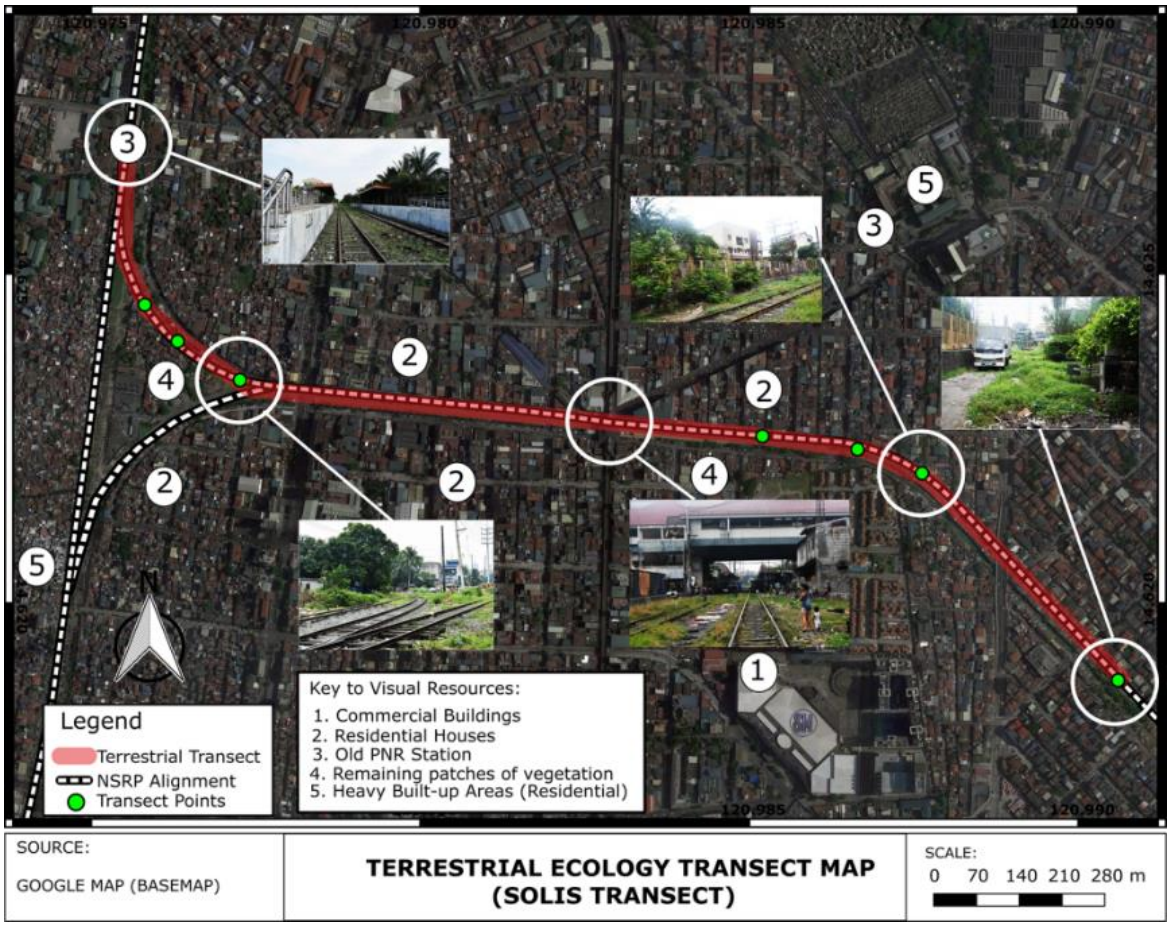


Figure 3.1.44 Map showing Transect 1 established at Solis station, Tondo, Manila

Transect 2 (FTI-Nichols)

442. Transect 2 (FTI-Nichols) is located at Taguig-Bicutan area. The transect plot is characterized with heavy built-up environments and surrounded by skyway roads and residential areas (**Figure 3.1.45**). The vegetation in this area is very minimal similar to T1 plot in terms of trees but more on ground and shrub layer. On the mid-point section, sparse tree individuals of Anabiong (*T. orientalis*) can be observed along with Datiles (*M. calabura*), Mahogany (*S. macrophylla*), and Rain tree (*S. saman*). Other sparse tree species include Mangga (*Mangifera indica*) and Sampaloc (*Tamarindus indicus*) covered by creeping vines within the alignment. Sparse tree vegetation and bare areas with the presence of very scattered shrubs and trees are notable in sections approaching the main station. These areas are well maintained and growth of plant species is regulated. Understorey shrubs species are represented by Hagonoi (*Chromolaena odorata*), *Cleome rutidosperma*, *Blumea lacera*, *Urena lobata* and *Stachytarpeta jamaicensis.* Grasses are represented by *S. halepense*, *I. cylindrica and S. spontaenum*. Ground cover species include Bunga-Bunga (*Alternathera sessilis*), Gatas-gatas (*Euphorbia hirta*), Botonesan (*Borreira ocymoides*), Tuhod manok (*Synedrella nodiflora*) and Alikbangon lalaki (*Commelina diffusa*).

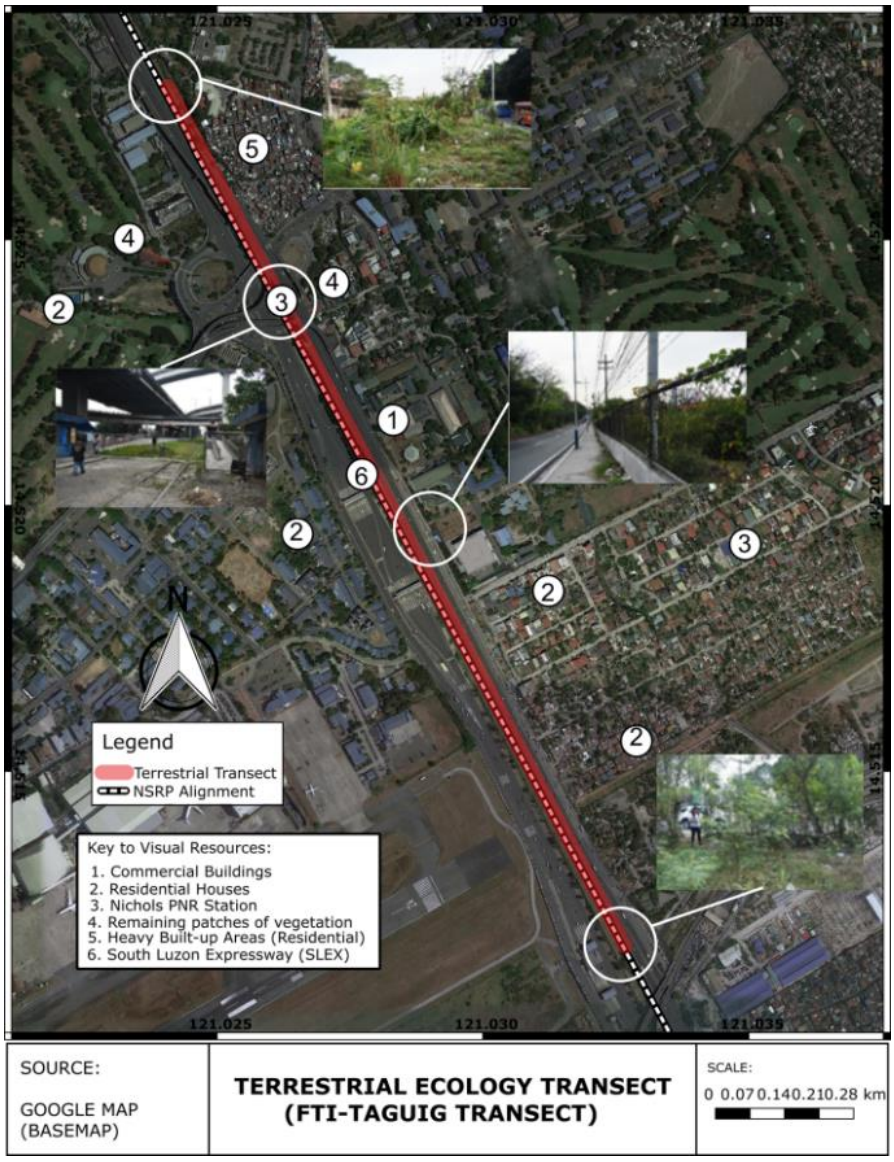


Figure 3.1.45 Map showing Transect 2 established at FTI-Nichols station

Transect 3 (Cabuyao)

443. Transect 3 is located at Brgy. Banay-Banay and Niugan at the municipality of Cabuyao. The transect plot is surrounded by agricultural farms (Figure 3.1.46). The vegetation in this area is moderately thicker than T1 and T2 in terms of trees, ground cover, grasses and shrub layer. On the mid-point section, sparse tree individuals of Rain tree (*Samanea saman*) and Gmelina (*Gmelina arborea*) can be observed along with native tree species of Rimas (*Artocarpus altilis*), Is-Is (*Ficus ulmifolia*) and Niog-Niogan (*Ficus psuedopalma*), Alagau (*Premna odorata*), Datiles (Muntigia calabura) and Anabiong (*Trema orientalis*). In terms of understorey and intermediate species layer, several individuals of Ligas (*Semecarpus cuneiformis*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and Mahogany (*S. macrophylla*) were observed.

444. Ground cover species typically include dense vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp.* Other invasive or exotic ground cover species include legume Dilang butiki (*Centrocema pubescens*), Bunga-Bunga (*Alternanthera sessilis*) and Dagad (*Tridax procumbens*). Medium sized diameter trees were represented by Rimas (*A. altilis*), Anubing (*A. ovatus*) and Acacia (*S. saman*).

445. Two (2) tree species of Antipolo (*Artocarpus blancoi*) which is endemic to the country and listed in IUCN and DENR Redlist is present in the area. Other sections of the transect plot are dominated by bamboo species Kawayan tinik (*Bambusa blumea*) near minor creek lines. Ipil-Ipil (*Leucaena leucocephala*) and Mahogany (*Sweitenia macrophylla*) can also be observed in shaded areas as sparse trees along with banana plantation.

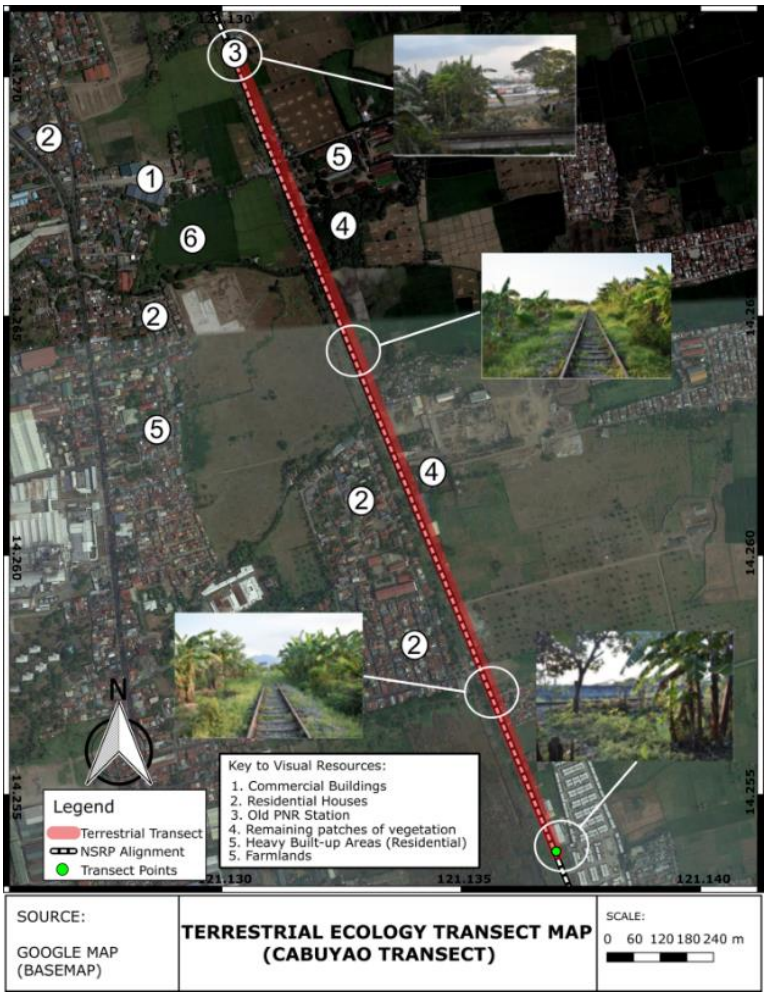


Figure 3.1.46 Map showing Transect 3 established at Brgy. Banay-Banay and Niugan

Transect 4 (Tadlac Lake)

446. Transect 4 is located at Brgy. Tadlac, Los Banos, Laguna as shown in Figure 3.1.47. Based from the survey, there are no endangered plant or tree species in the area. Only common tree species were recorded near the lake and the hilly slopes within the periphery of the area. Tree species include big diameter Rain tree (*Samanea saman*), Smooth Narra (*Pterocarpus indicus*), Gmelina (*Gmelina arborea*), Kamachile (*Pithecelobium dulce*) and Ipil-Ipil (*Leucaena leucocephala*) are present within the periphery of the lake and on top of the hill. Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Talisai (*Terminalia cattapa*), Ipil-Ipil (*Leucaena leucocephala*) and Datiles (*Muntingia calabura*) were documented at the sides encircling the outline of the lake. In terms of understorey and intermediate species layer, several individuals of Ligas (*Semecarpus cuneiformis*), Binunga (*Macaranga tanarius*), Sablot (*Litsea glutinosa*) and some bamboo species such as Kawayan killing (*Bambusa vulgaris*) were observed.

447. In terms of ground cover, several species were abundant and recorded in the "cut" hill. Hagonoi (*Chromolaena odorata*) and Cogon (*Imperata cylindrica*) occupies ridges and trails near open spaces.

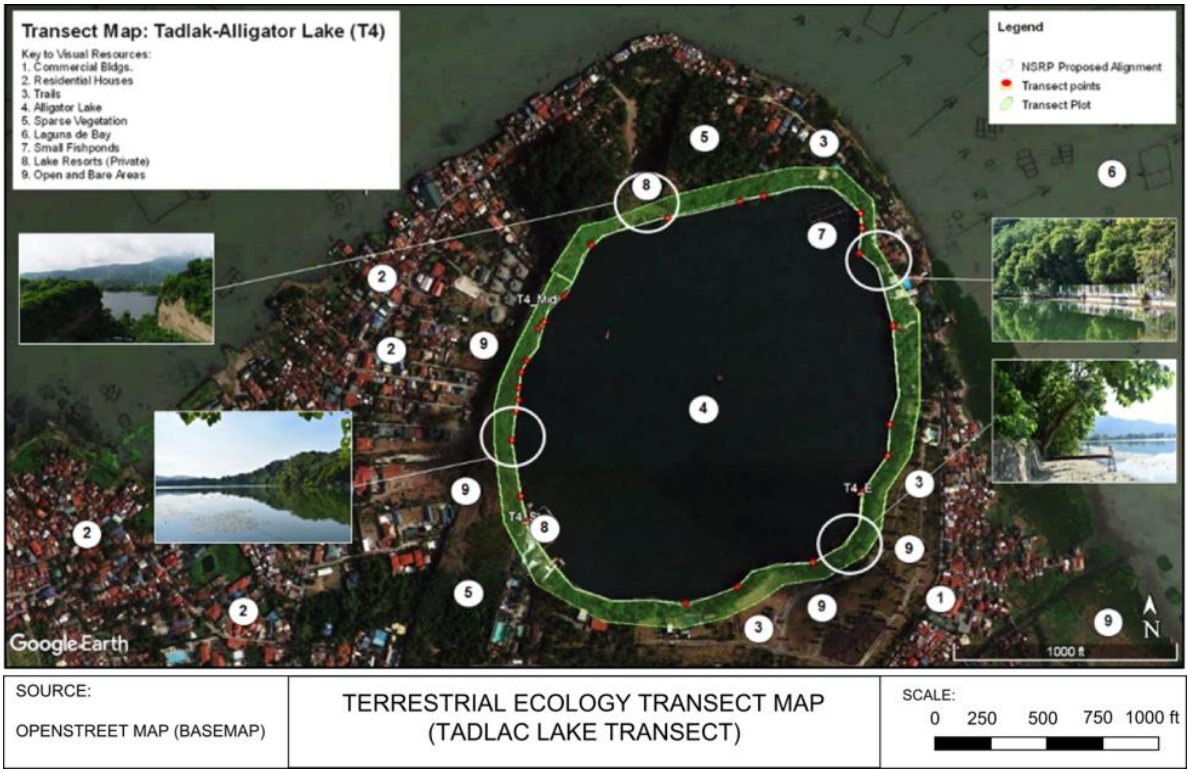


Figure 3.1.47 Map showing Transect 4 established at Brgy. Tadlac, Los Banos, Laguna.

Transect 5 (Timugan)

448. Transect 5 is located at two (2) barangays in Los Banos, consisting of Brgy. Timugan and Brgy. Baybayin which covers the starting point near to Laguna de Bay (Figure 3.1.48). Brgy. Timugan is part of the buffer zone of Mt. Makiling Forest Reserve (MMFR). The landscape resources within the forest reserve are surrounded by a buffer zone delineated by law for the purpose of providing protection to the reserve and the resources therein. Prior to the declaration of the buffer zone in 1998 however, the fringes of the forest reserve have already been either farmed or made part of residential areas. The landscape of the forest reserve shows that in most part of its boundary, grassland and agroforestry farms with huts or houses are common. Based from the site

survey, there are established agroforestry farms within the transect plot and include mature trees of Mangga, Santol and Lanzones. On the mid-point section, sparse tree individuals of Ipil-Ipil (*Leucaena leucocephala*), Datiles (*Muntigia calabura*), Rain tree (*Samanea saman*) and Kamachile (*Pithecelobium dulce*) can be observed within the private area. In terms of understorey and intermediate species layer, the same species were observed. Further inland some remnants of planted bananas (*Musa sp.*) which were abandoned because the existing condition of the area, according to the officials present during the survey. Ground cover species includes thick vegetation of grass species such as Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*) and *Penissetum sp.* There are no significant vegetation neither endangered species of plants and trees recorded within the survey plot even though it is located within the buffer zone.

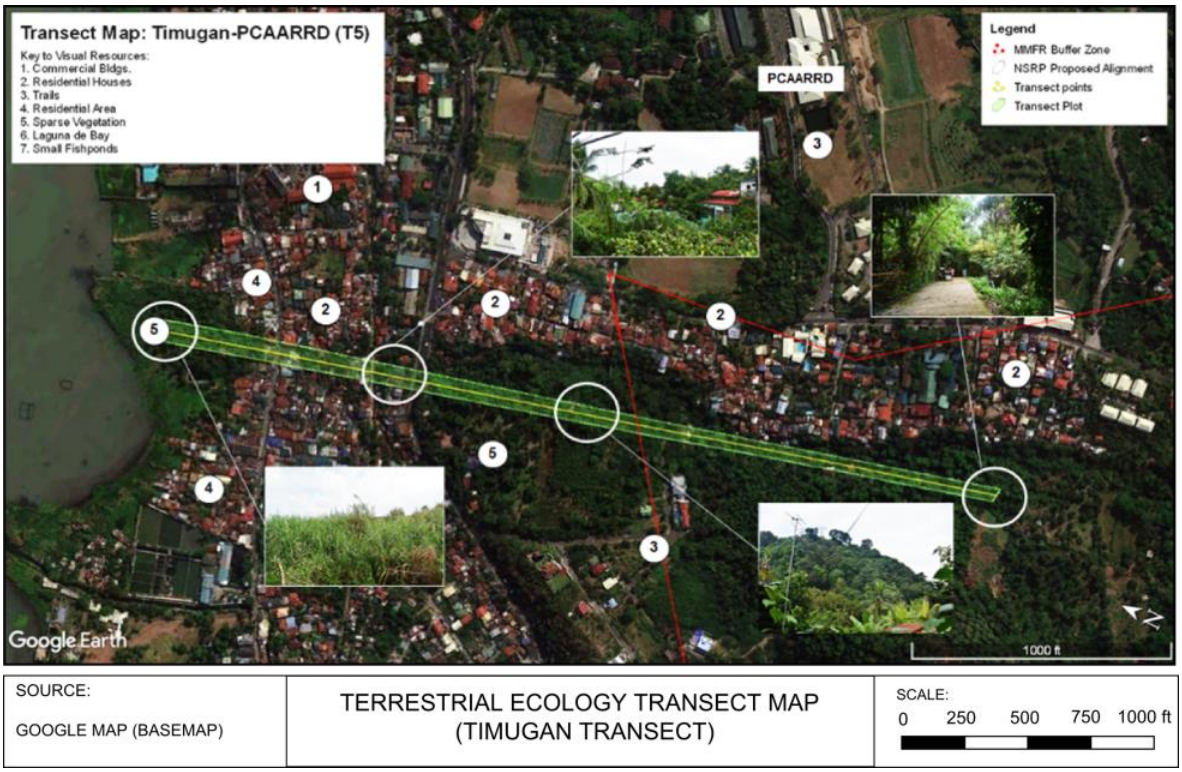


Figure 3.1.48 Map showing Transect 5 established at Brgy. Timugan (Incl. Baybayin), Los Banos, Laguna.

Transect 6 (San Antonio - IRRI-IPB section)

449. Transect 6 is located at Brgy. Sto. Nino, Los Banos, Laguna. Shanties' residential areas are the first to be seen along railway tracks from the starting point located at the center of the barangay. The transect plot is characterized by abandoned fishponds and vast areas of wetlands or inundated area smothered by different plant species (Figure 3.1.49). The vegetation in the transect plot are very disturbed. Walking through the plots are residential houses inside vegetated areas, some of which are planted and domesticated tree species of Santol (*S. koetjape*), Lanzones (*L. domesticum*) and some small back yard garden. Near to mid-plot is a small creek called, Molawin creek. The creek actually host diverse species of trees and dense cover of bamboo poles. These species includes Tangisang bayawak (*F. variegata*), Tibig (*Ficus nota*) and an endemic species of Moraceae, Antipolo (*Artocarpus blancoi*). On the mid-point section, the area is already devoid of canopy trees which are actually open and bared areas passing through front gate of IRRI. Weeds and some small shrubs and herbaceous vines dominates the railway tracks such as Bunga-bunga (*Alternathera sessilis*), Kuliot (*Sida rombhoidifolia*), Melon daga (*Zherenia indica*) and Dilang butiki (*Centrocema pubescens*).

450. Other ground cover species includes Talahib (*Sacharrum spontaenum*), Cogon (*Imperata cylindrica*), Dagad (*Tridax procumbens*). Sparse trees can be observed at the end of the plot dominated by an exotic and invasive species of Paper Mulberry (*Broussonetia papyrifera* (L.) Vent.)

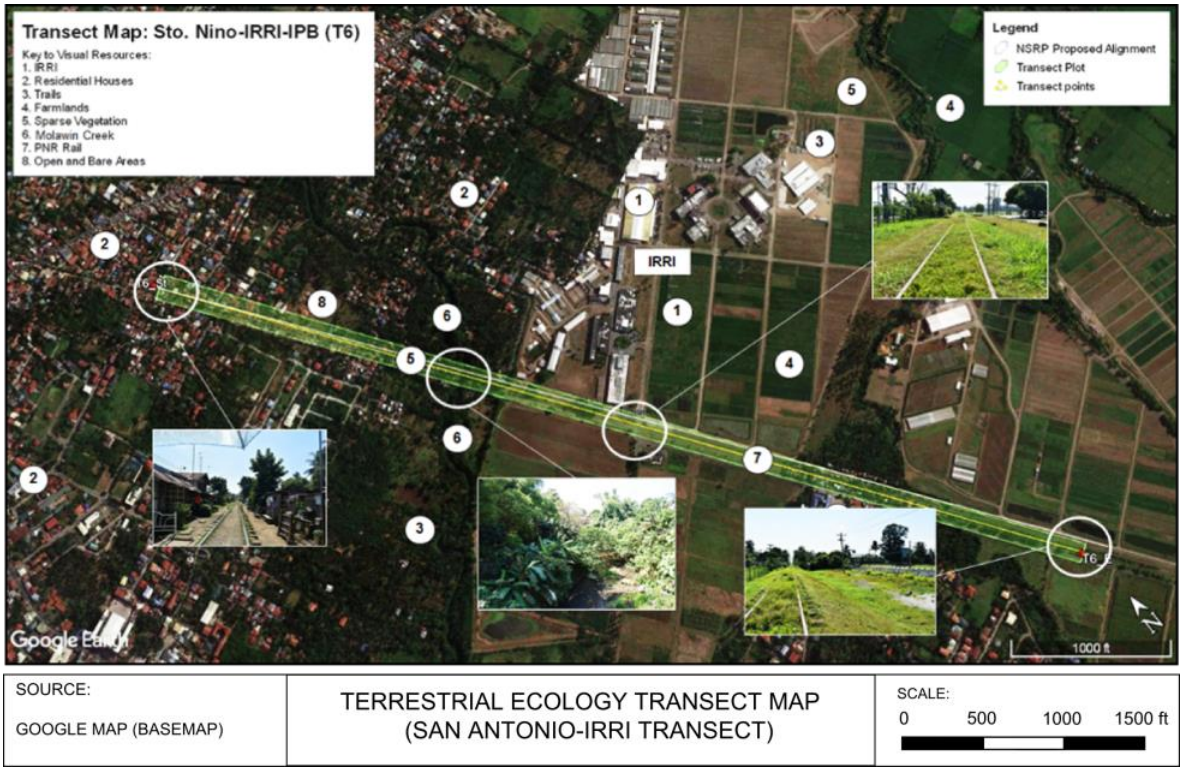


Figure 3.1.49 Map showing Transect 6 established at Brgy. Sto.Nino (IRRI-IPB section) Los Banos, Laguna.

451. The list of all plant and tree species recorded in per transect plot are listed in Table 1 in **Annex 3-1**.

4) Species Diversity

a. Species Composition, Density and Abundance

452. One hundred seven (107) morpho-species, 99 genera belonging to 42 families were documented in the six transect plots established within the NSRP alignment. Dominant families in the said transect plots were Fabacae, Moraceae, Anacardiaceae, Lamiaceae, Euphorbiaceae, Annonaceae, Malvaceae, Poaceae, Convulvolaceae and Asteraceae. The most frequently occurring tree species were *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., which were recorded in Transect 3 only with 2 individual trees.

453. Apart from the species recorded from the quadrat sampling, additional 5 species (not resent in the quadrats) were recorded from the opportunistic survey. Hence, a total of 112 morpho-species of plants were encountered in the whole proposed NSRP Railway alignment. **Annex 3-1 Table 2** presents the taxonomic list of all plant and tree species recorded in NSRP Alignment.

Tree Flora

454. A total of 42 morpho-species with 40 genera belonging to 18 families were recorded in the whole proposed NSRP alignment. The average number of trees per quadrat (20m x 20m) is about 1 individual or an average density of 0.0025 tree/m^2 (1 tree for every 100 m^2). This is understandable since the area is very disturbed and generally dominated by invasive shrubs and grasses which compete with relatively few individual trees as "weeds". Additionally, since the transect plots are located in a very disturbed environment and built-up areas, it is expected that tree or plant cover would be very minimal as these areas are very well maintained, hence, the lower tree density of the transect plots can be attributed to the general land use and condition of the area.

455. On the other hand, sparse tree vegetation are characterized by the dominance of small-sized pioneer trees similar in abandoned (e.g. inactive) or idle areas of PNR. The trees with the largest diameter include both fruit and forest trees which are represented by Rimas (*Artocarpus altilis*), Anabiong (*Trema orientalis*), Duhat (Syzigium cuminii), Mangga (*Mangifera indica*), Kamachile (*Pithecelobium dulce*), Rain tree (*Samanea saman*), Alagau (*Premna odorata*), Santol (*Sandoricum koetjape*) and Antipolo (Artocarpus blancoi). These tree species are present in all transect plots except for the species of *A. blancoi* which is only documented in Brgy. Banay-Banay (T3) near the PNR railway track mixed with abandoned banana stands.

456. The relative density, relative dominance and relative frequency values for each tree species in all the transect plots were determined to obtain their Importance Value (IV), a standard measure in ecology that determines the rank relationships of species. Based on the computed IV (**Table 3.1.16**) the three most important species (with the highest IV) are Langka (19.24), Ipil-Ipil (18.52), and Santol (17.83). Most of the tree species documented in the project alignment are agroforestry species planted in the remaining patches of vegetation in the area. This imply low conservation value of the area particularly in areas that are highly disturbed.

Table 3.1.16 Top 10 Tree Species with the Highest Importance Value (IV)

Scientific Name	Common nane	Family Name	IV
Artocarpus heterophyllus Lamk.	Nangka	MORACEAE	19.24
Leucaena leucocephala (Lam.) de Wit	Ipil-Ipil	FABACEAE	18.52
Sandoricum koetjape (Burm. f.) Merr	Santol	MELIACEAE	17.83
Broussonetia papyrifera (L.) Vent.	Paper mulberry	MORACEAE	12.81
*Mangifera indica L.	Mangga	ANACARDIACEAE	12.73
Ficus ulmifolia Lamk	Is-Is	MORACEAE	12.05
*Muntigia calabura L.	Datiles	MUNTIGIACEAE	8.30
Premna odorata Blanco	Alagau	LAMIACEAE	6.73
*Pithecellobium dulce (Roxb) Benth.	Kamachile	FABACEAE	6.03
Artocarpus altilis (Park.) Fosb.	Rimas	MORACEAE	5.46

Note: IV- Importance Value

Intermediate and Understorey

457. A total of 13 morpho-species with unique 13 genera belonging to 8 families were recorded for understorey layer. The average density is slightly higher than that of trees, at 0.12 individual/m^2 or equivalent to 12 individuals for every 100m^2. The two most abundant understorey species are Hagonoy (*Chromolaena odorata*) and Coronitas (*Lantana camara*) with 23 and 17, respectively. The most dominant families at the understorey are Asteraceae with 23 individuals and Verbenaceae with 17 individuals (Table 3.1.6). The representative species of family Asteraceae are predominantly shrubs (9 species), while those representing family Malvaceae are herbaceous plants (4 species). A total of 93 individual species were recorded in the area. The list of all the understorey plant species recorded in the whole NSRP proposed alignment are presented in Table 3.1.17

Table 3.1.17

Table 3.1.17 Top 10 Most Abundant Understorey Species

Scientific Name	Common name	Family Name	Total Count
Chromolaena odorata (L.) R.M. King & H. Rob.	Hagonoy	ASTERACEAE	23
Lantana camara L.	Coronitas	VERBENACEAE	17
**Urena lobata* L.	Kulot-Kulotan	MALVACEAE	13
Tabernaemontana pandacaqui Poir.	Pandakaki	APOCYNACEAE	9
Stachytarpheta jamacensis (L.) Vahl	Kandikandilaan	VERBENACEAE	9
**Sida acuta* Burm. f.	Walis-walisan	MALVACEAE	8
**Sida javensis* Cav.	Igat-Igat	MALVACEAE	6
Cassia alata Linn.	Akapulko	FABACEAE	5
*Sida rhombifolia L.	Takling baka	MALVACEAE	4
Ficus ulmifolia Lamk.	Is-Is	MORACEAE	4

** Invasive species

Ground Cover

458. There are 51 ground cover species recorded from the all transect plots (**Annex 3-1 Table 4**). It must be noted that the ground cover species referred in this survey are all species (crawling or erect) inside the 1m x 1m quadrat with height of less than 1 meter. Hence, seedlings of different tree species are included as ground cover. Based on the survey, ground cover occupies more than 80% of the ground layer leaving less growing spaces for the other recruits of seedlings of other tree species, hence, low species diversity. Based on site survey and measurements, the most dominant species that occupy the highest relative cover are Bunga-Bunga (28.11%), Uuko (16.21%), and a species of runner weed, Dagad (14.86%) (Table 3.1.18). Photo 3.1.1 shows some of the documented ground cover species in the NSRP alignment.

Table 3.1.18 Top 10 Most Dominant Ground Cover Species

Scientific Name	Common Name	Family Name	Relative % Cover
Alternanthera sessilis (L.) R.Br. ex DC.	Bunga-Bunga	AMARANTHACEAE	28.11
Mikania cordata (Burm. f.) B.L. Rob.	Kulitis	ASTERACEAE	16.21
Tridax procumbens Linn.	Dagad	ASTERACEAE	14.86
*Centrosema pubescens Benth.	Dilang Butiki	FABACEAE	10.56
Synedrella nodiflora	Tuhod manok	ASTERACEAE	8.15
Coccinea grandis (L.) Voigt	Tamling	CUCURBITACEAE	7.15
Zehneria indica (Lour.) Keraudren	Melon Daga	CUCURBITACEAE	4.25
*Sida rhombifolia L.	Takling baka	MALVACEAE	3.45
*Urena lobata L.	Kulot-Kulotan	MALVACEAE	2.34
Sorghum halepense (L.) Pers.	Johnson grass	POACEAE	2.73

* Invasive species

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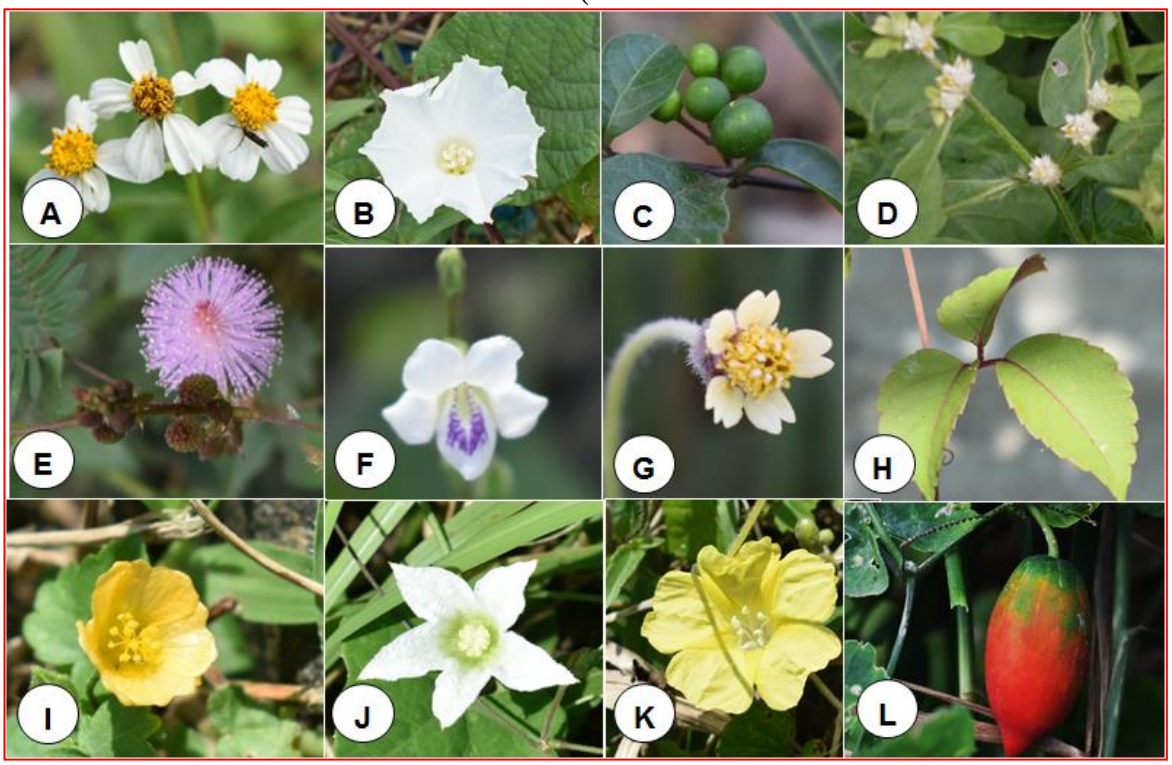


Note: (a) Dadayem (*Bidens alba* (L.) DC.), ASTERACEAE; (b) Aurorang gubat (*Ipomea triloba* L.); (c) Bagan-Bagan (*Lycianthes biflora* (Lour.) Bitter), SOLANACEAE; (d) Bunga-Bunga (*Alternanthera sessilis* (L.) R.Br. ex DC., AMARANTHACEAE; (e) Makahiya (**Mimosa pudica L.*), FABACEAE; (f) *Asystasia gangetica*, ACANTHACEAE; (g) Dagad (*Tridax procumbens* Linn.), ASTERACEAE; (h) Alangingi (*Cayratia trifolia* (L.) Quis.), VITACEAE; (i) Igat-Igat (**Sida javensis* Cav.), MALVACEAE; (j) Melon daga (*Zehneria indica* (Lour.) Keraudren), CUCURBITACEAE; (k) Aurora (Ipomea sp.), CONVULVOLACEAE; (l) Tamling (*Coccinea grandis* (L.) Voigt), CUCURBITACEAE.

Photo 3.1.1 Some of the photographed and recorded dominant ground cover species at different transect plots

b. Species Diversity Indices

459. The diversity index of the project area ranged from low to moderately low, while evenness indices varied from very low to low (**Table 3.1.19** and **Figure 3.1.50**). Diversity indices were highest in the understorey and herbaceous layer. The vegetation in some of the transect plots (e.g. T1, T2, T3) is considered as disturbed vegetation, though sparse and very minimal, these areas where trees are not that dominant can be regarded as vegetation patches or formations.

460. Most of the sampling plots has low diversity (Table 3.1.19). Transect plots 1, 2, 3 and 4 are considered to be low in diversity primarily because the condition of the plots are extremely disturbed. Transect plot 5 obtained the highest value (2.559) while Transect 1 (*H'*=2.163) got the lowest Shannon index (2.163). The number of species present in each transect plot was primarily the reason for very low/low value of Shannon index, which is also influenced by the number of individuals which concentrated much on the ground cover species.

461. Transect 1 obtained the highest value of Simpson index (0.971) while Transect 3 had the lowest value of Simpson index (0.950). In terms of Evenness index, plot 4 had the highest value of close to 1.0 understandably because it contains a relatively more species primarily ground cover species.

Table 3.1.19 Diversity indices and number of species and individuals for each plot

Transect No.	No. of species	No. of Individuals	Diversity Indices		
			H'	D'	J'
1	56	284	2.163	0.971	0.934
2	32	244	2.186	0.954	0.919
3	33	226	2.170	0.950	0.906
4	41	312	2.349	0.963	0.958
5	52	806	2.559	0.965	0.901
6	47	307	2.467	0.958	0.906

Note: H' – Shannon index; D = Simpson's index; J – Evenness index
Diversity Index: vh – very high (3.50 above), h – high (3.00 – 3.49), m – moderate (2.50 – 2.99), l – low (2.00 – 2.49), vl – very low (1.99 – below); Evenness Index: vh – very high (0.75 – 1.00), h – high (0.50 – 0.74), m – moderate (0.25 – 0.49), l – low (0.15 – 0.24), vl – very low (0.05 – 0.14).

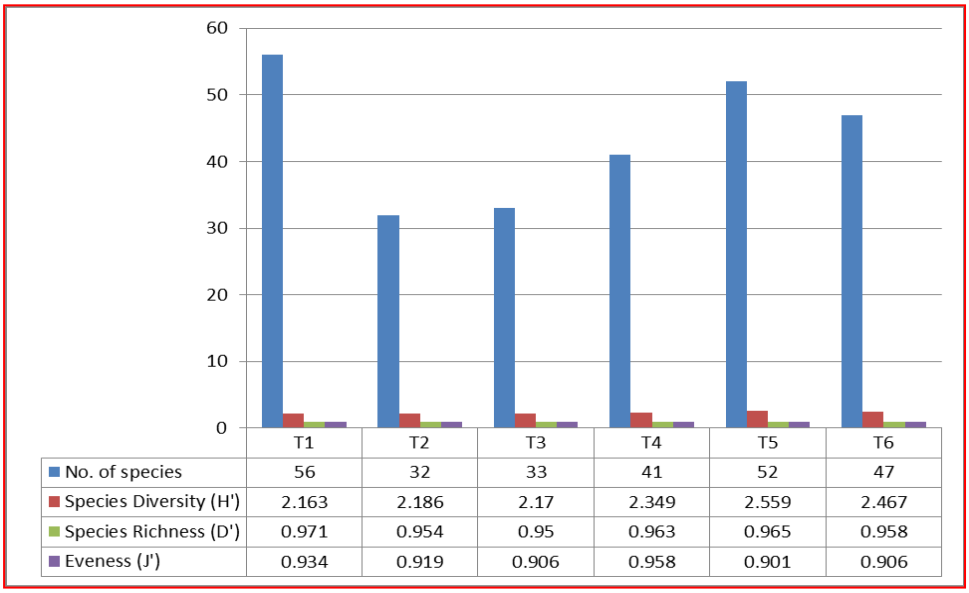


Figure 3.1.50 Diversity indices and number of species for each plot

5) Biodiversity Value

a. Ecologically Important Species

462. The ecological or biodiversity value of an area is always measured in terms of species richness and in the number of endemic and threatened species present. Species that are of botanical importance (endemic, threatened, and new record) are listed below.

Endemic and Indigenous Species

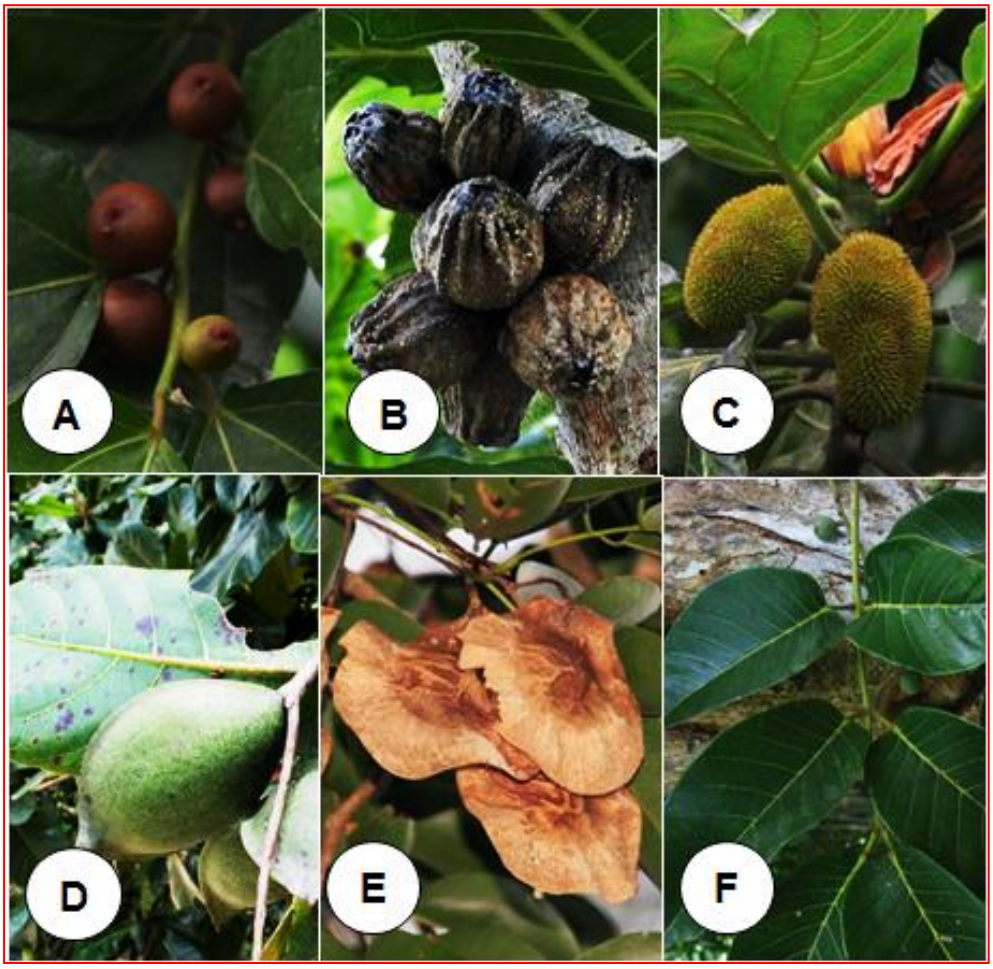
463. Of the total 107 taxa identified to species level, five (5) species (5%) were found to be Philippine endemics or have natural habitat confined only in the country (Table 3.1.20). Noteworthy among the list are those species that are also included in either the Philippine red list or in the International Union for Conservation of Nature (IUCN). These include Antipolo, Piling liitan, Niog-Niogan, and Anubing. These trees should be prioritize for species conservation.

464. Eighty four percent (84%) of the total number of species recorded in the area are indigenous to the Philippines and exhibits different economic and ecological importance. These species are represented by different general plant forms such as trees, vines, herb and shrub (Annex 3-1, Table 5**).** The presence of endemic tree species within the railway tracks of PNR and the proposed alignment suggests that there are plant communities that still host for endemic tree species and other native flora documented in the sites.

Table 3.1.20 List of Philippine endemic species recorded in the proposed NSRP Railway Alignment

SPECIES	Common Name	Family Name	Endemism
Artocarpus blancoi (Elmer) Merr.	Antipolo	MORACEAE	PE
Canarium luzonicum (Blume) A. Gray	Piling liitan	BURSERACEAE	PE
Ficus pseudopalma Blanco	Niog-Niogan	MORACEAE	PE
Ficus ulmifolia Lamk	Is-Is	MORACEAE	PE
Ficus nota (Blanco) Merr	Tibig	MORACEAE	PE

**PE: Philippine Endemic species



Note: (a) Is-Is (*Ficus ulmifolia* Lamk.), MORACEAE; (b) Niog-Niogan (*Ficus pseudopalma* Blanco), MORACEAE; (c) Antipolo (*Artocarpus blancoi* (Elmer) Merr., MORACEAE; (d) Talisai (*Terminalia catappa* L., COMBRETACEAE; (e) Smooth Narra (*Pterocarpus indicus* Willd. forma *indicus*, FABACEAE; (f) *Piling liitan* (Canarium luzonicum (Blume) A. Gray, BURSERACEAE).

Photo 3.1.2 Some of the photographed and recorded indigenous and endemic tree species at different transect plots established within the proposed NSRP railway alignment.

Threatened Species

465. Five (5) 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) (Table 3.1.21). Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*)

(IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01).

Table 3.1.21 List of threatened species recorded from the NSRP Railway alignment.

Species	Common name	Family	IUCN 2016 ver.3	DAO 2007-01
Artocarpus blancoi	Antipolo	MORACEAE	VU	
Canarium luzonicum	Piling liitan	BURSERACEAE	VU	
Ficus ulmifolia	Is-is	MORACEAE	VU	
Pterocarpus indicus	Narra	FABACEAE	VU	CR
Vitex parviflora	Molave	LAMIACEAE	VU	EN
Sweitenia macrophylla	Mahogany	MELIACEAE	VU	

Source: **DAO 2007-11 updated checklist (2011) pursuant to "Wildlife Resources Conservation and Protection Act 9147

466. Other threatened tree species includes 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 sparse individual trees within transect plots. Others are also documented during opportunistic survey present near farms and small creeks surrounded by thick vegetation of grass and bamboo species such as Kawayan tinik (*Bambusa blumeana*) (Table 3.1.22).

Table 3.1.22 List of some indigenous and endemic tree species and the transect plots where they are recorded.

Species	Local Name	Family Name	Transect plot(s) where species occurred
Artocarpus blancoi	Antipolo	MORACEAE	T3 within plot**
Canarium luzonicum	Piling liitan	BURSERACEAE	T5 and opportunistic survey within plot
Ficus ulmifolia	Is-is	MORACEAE	T1, T3, T4, T5, T6
Pterocarpus indicus	Narra	FABACEAE	T1, T3, T4, T5, T6
Vitex parviflora	Molave	LAMIACEAE	T2 and T3, T4, T5, T6
Mallotus philippinensis	Banato	EUPHORBIACEAE	T5

**along alignment mixed with other vegetation of invasive and exotic plants.

b. Economic Uses

467. List of some significant flora species documented in NSRP alignment and their economic use and importance are presented in Table 3.1.23. Majority of the species have medicinal use. Some species are source of food and timber.

Table 3.1.23 List of some significant flora species documented in NSRP alignment and their economic use and importance

Local Name	Species	Family Name	Economic Importance/Uses
Alibangbang	Bauhinia malabarica	Fabaceae	Timber; Medicinal Use
Alim	Melanolepis multiglandulosa (Reinw. Ex Blume) Reichb. f. & Zoll.	Euphorbiaceae	Medicinal Use
Tangisang bayawak	Ficus variegata Blume		Source of Food
Anabiong	Trema orientalis (L.) Blume	Cannabaceae	Medicinal use
Antipolo	Artocarpus blancoi (Elmer) Merr.	Moraceae	Paper production. Seeds and fruits are edible.
Anubing	Artocarpus ovatus Blanco	Moraceae	Timber
Balinghasai	Buchanania arborescens (Blume) Blume	Anacardiaceae	Timber; medicinal use
Banato	Mallotus philippensis (Lamk) Muell.-Arg.	Euphorbiaceae	Medicinal Use, Timber source
Bangkoro	Morinda citrifolia L.	Rubiaceae	Medicinal Use

Local Name	Species	Family Name	Economic Importance/Uses
Bayag Usa	Voacanga globosa (Blanco) Merr.	Apocynaceae	Medicinal Use
Bayok	Pterospermum diversifolium Blume	Malvaceae	Medicinal Use
Binayuyu	Antidesma ghaesembilla	Phyllanthaceae	Fruits are eaten raw and prepared into jams, etc.
Binunga	Macaranga tanarius (L.) Muell.-Arg.	Euphorbiaceae	Medicinal Use; Timber source.
Dalunot	Pipturus arborescens (Link) C.B. Rob.	Urticaceae	Food, medicine and a source of fibre and dyes
Datiles	Muntingia calabura	Muntigiaceae	Firewood, fruits are edible;medicinal value
Hauili	Ficus septica Burm. f.	Moraceae	Medicinal Use
Igyo	Dysoxylum gaudichaudianum (A. Juss.) Miq.	Meliaceae	Timber and local medicinal use
Ipil-Ipil	Leucaena leucocephala (Lam.) de Wit	Fabaceae	Medicinal Use; Forage and Fodder, Timber source, Firewood, etc.
Is-Is	Ficus ulmifolia	Moraceae	Food, the hard and rough leaves are used to clean household materials.
Kalalaknit	Merremia vitifolia (Burm. f.) Hall. f.	Convolvulaceae	Medicinal plants as herbal remedy; erosion control
Kaliantan	Leea philippinensis Merr.	Vitaceae	Medicinal use
Kawayan tinik	Bambusa blumeana	Poaceae	Medicinal Use
Lamingo	Euphorbia atoto G. Forst.	Euphorbiaceae	Medicinal Use
Ligas	Semecarpus cuneiformis Blanco	Anacardiaceae	Medicinal Use
Matanghipon	Breynia vitis-idaea	Phyllantaceae	Medicinal Use
Molave	Vitex parviflora Juss.	Lamiaceae	Timber; Medicinal Use
Niyog-Niyogan	Ficus pseudopalma Blanco	Moraceae	Medicinal Use
Pakiling	Ficus odorata (Blanco) Merr.	Moraceae	Medicinal Use; timber.
Pili	Canarium ovatum Engl.	Burseraceae	Food
Piling liitan	Canarium luzonicum	Burseraceae	Food
Sablot	Litsea glutinosa (Lour.)C.B. Rob.	Lauraceae	Food, medicine
Saging matsing	Musa acuminata Colla	Musaceae	Medicinal value.
Santol	Sandoricum koetjape (Burm. f.) Merr.	Meliaceae	Fruits, Timber source, Medicinal Use
Takipan	Caryota rumphiana Mart. var. philippinensis Becc.	Arecaceae	Source of food and materials. A highly ornamental palm tree.
Tambabasi	Callicarpa formosana Rolfe	Lamiaceae	Food, Medicinal use
Tangisang-bayawak	Ficus variegata Blume	Moraceae	food, medicine and source of wood and wax
Tibatib	Rhaphidophora pinnata (L.) Schott	Araceae	Medicinal use, ornamental.
Tulibas tilos	Micromelum minutum (J.G. Forster) Wight & Arn	Rutaceae	Medicinal Use, Used for handles of bolos and making furniture.
Tibig	Ficus nota	Moraceae	Medicinal uses, Fruits are edible.
Yautia	Xanthosoma violaceum Schott	Araceae	Medicinal Use

3.1.3.2 Terrestrial Fauna

468. Birds are good indicators as it responds fast to threats and changing environmental conditions. Species composition and diversity of birds may differ between seasons and between sampling sites. Conduct of another survey for the rainy/wet season is needed to check if the same species are present in the sites surveyed. For the proposed NSRP alignment, however, most of the survey sites were in built up areas which no longer harbor important species of wildlife.

For this study, the terrestrial flora survey was conducted during the dry season.

(1) Field Survey

469. The terrestrial fauna survey was focused on the terrestrial vertebrate groups of Philippine wildlife; birds, mammals, amphibians and reptiles (herpetofauna). Standard field methods and

procedures were used for each taxa during the survey. Direct and indirect transect identification such as tracks, signs and auditory cues, trapping and mist-netting were used. Microhabitat searches were also done in the immediate vicinities of the transect line, 10 meters to the left and 10 meters to the right, to ascertain the presence of small and/or cryptic species of wildlife.

1) Birds

470. Transect walks were done along 2-kilometer pre-established transect lines. Direct observations were done on or along (Solis, San Antonio-IRRI), near (FTI-Taguig, Cabuyao), perpendicular (Timugan), and a few km away from (Crocodile/Alligator Lake) the existing railroad. The pace of walking varies in order to detect different species. Where and when possible, observers walked across different habitat types and spent time searching in habitat breaks. Searches were conducted from 5:30-9:00 in the morning, and in the afternoon at 3:30-6:00 or before sunset. Observers were equipped with binoculars and a camera. Birds flying and perched over the area were counted individually.

471. Mist netting was employed to confirm species occurrence and distribution as well as identification of cryptic species of birds. Mist nets were hoisted along possible flight paths of birds, e.g., in between trees, just above the ground with clearance of at least 15 cm to 1 m. Net locations were recorded using a handheld GPS unit. The nets were set in the afternoon and checked in the morning of the next day. For each site, three sets of nets with two nets each were set serially along the transect line. These nets were also used to catch Volant mammals during the night. Nets were checked before noon and at 5:00 pm or an hour before dusk.

2) Mammals

472. Mist nets used for birds were also emloyed for catching bats. Mist netting were done in most of the study areas except in FTI-Taguig where there was no site where the nets can be set. Mist nets were set and positioned in strategic points of the sampling sites (e.g., flyways, across established trails near a river or stream, forest edges, openings and forest interior) but away from human habitations. Since the sites are in close proximity to human settlements adjustments were made. The nets were set and opened at 6:00 pm and removed the following morning at 6:00 am in the Los Baños sites (Tadlac, Timugan and San Antonio-IRRI) while in Solis and Cabuyao, it was set at 5:30-9:00pm because of security reasons. Net watching for insectivores was done at 6:00-9:00pm. Numbers of individuals caught were counted. Photographs of captured species were taken, these were set free after photo documentation. Net watching was not done in the FTI-Taguig site because there was no area along the site where the nets could be set.

473. Live trapping was conducted from 1800H-0600H to catch small non-volant mammals. Twenty live traps were set in each site. Roasted coconut meat mixed with peanut butter, bread, and fried dried fish were used as baits for live traps. The traps were placed along possible runways, near holes or among root tangles and fallen logs, where small non-volant mammals might be present. Checking of traps was performed early in the morning of the next day. Introduced/invasive species of rodents are killed through drowning while other species are set free after photodocumentation. Live trapping was not done in FTI-Taguig and Cabuyao because there was no area where we can set the traps along SLEx and in Cabuyao, there was a problem with the security.

474. Identification, nomenclature, classification and conservation status were determined based on Heaney et al. (1998), Fieldiana (Peterson et al., 2008), published taxonomic keys, and IUCN.

3) Reptiles and Amphibians (Herps)

475. Reptiles and amphibians (herps) survey were conducted using the Visual Encounter Survey and hand-grabbing technique (Heyer et al., 1994; Matsui, 2006) while doing the transect walks. The Visual Encounter Survey was used in the sampling to conduct searches in high potential areas throughout the sampling sites. These methods were supplemented with acoustic

searching for frogs, turning of rocks and logs, peeling bark, digging through leaf litter, and excavating burrows and termite mounds.

476. Purposive time-constrained herpetofaunal survey was conducted at 6:00-9:00 in the morning and 19:00-21:00 hours in the evening. Any amphibian or reptile seen and captured were identified, recorded, and released in the same habitat after being measured and photographed.

477. Identification, nomenclature, classification and conservation status were determined based on Brown and Alcala (1978, 1980), published taxonomic keys, IUCN, AmphibiaWeb, Frost et al. (2006), Frost (2007), and other available field guides.

(2) Results and Analysis

1) General Fauna

478. A total of sixty-four (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 lizards).

2) Transect Profiles

479. Six (6) transects were established along the proposed NSRP alignment on February 9-12 and 24, 2018 for the assessment of terrestrial vertebrate wildlife. Table 3.1.24 shows the six transect lines, Solis, FTI-Taguig, Cabuyao, Tadlac, Timugan, and San Antonio –IRR, along the NSRP alignment.

480. The transects are very close to human habitation and located mostly along the existing PNR railroad from wherein it is largely distinct from the surrounding environment. Two of the transect lines, T1 (Solis) and T2 (FTI-Taguig), are located in Metro Manila while four (4) transect lines, T3 (Cabuyao), T4 (Tadlac Lake), T5 (Timugan) and T6 (San Antonio-IRRI), are locate in Laguna. Transects T1 and T2 are located primarily in built up areas and are very near to human habitations. The two sites are highly disturbed by varied human activities. Transect T3 was located along the railroad adjacent to the ricefields, vegetable gardens and walled properties in Cabuyao City. Transect T4 is surrounded by houses and resorts and with barely any trees or natural vegetation. Transect T5 is located near in human settlements and resorts at the edge of Laguna Lake to a human settlements in Timugan wherein a number of fruit trees and ornamental trees are present. Transect T6 is located the railway, more than a hundred meters from the national highway in San Antonio. There are houses on both sides of the existing railroad. Portion of the railroad near the International Rice Research Institute (IRRI) was cleared of vegetation. Table 3.1.24 presents the habitat type and human activities at each survey site.

Table 3.1.24 Location and Description of the Transects Lines of Terrestrial Fauna

Station ID	Description	Start	End	Habitat Type
T1	Solis	N120.97551 E14.62707	N120.62253 E14.62253	Typical “Home along the Riles” site Undergrowth vegetation (weeds,and grass), cultivated leafy vegetables
T2	FTI Taguig	N121.02402 E14.52773	N121.2485 E14.17535	No vegetation National Road/Highway
T3	Cabuyao	N121.13026 E14.2706	N121.13701 E14.25377	Rice field, Less vegetation, more of roads, resorts, privately owned land, ipil-ipil, banana trees, ricefields, vegetable gardens
T4	Tadlac	N121.20363 E14.17944	N121.20565 E14.18486	Lakes, fragmented forest/forest patch, stream bank
T5	Timugan	N121.21944 E14.17976	121.22236 E14.16560	Agro-forest, secondary growth forest, Cultivated land
T6	San Antonio-IRRI	N121.2485 E14.17599	N121.2592 E14.16084	Rice fields, Undergrowth vegetation (sedges, weeds,grasses), cultivated areas

3) Species Diversity

Birds

481. Fifty-five (55) species of birds belonging to 26 families were recorded during the survey of terrestrial vertebrates. The highest number of species was recorded in T4 (Tadlac) with 35, followed by T6 (30), T5 (17), T3 (15), T1 (7) and T2 with only six (6) species. Only two (2) species are common to all the sites, the Eurasian Tree Sparrow *Passer montanus* and the Yellow-vented Bulbul *Pycnonotus goiaver*. The list of bird species documented from each site and the number of individuals counted are shown in. Table 3.1.25.

482. 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 (Crocodile/Alligator Lake). Before the area was besieged by the construction of resorts and houses, the part nearest Laguna de Bay was a habitat of hundreds of bee eaters, *Merops sp.*

483. Table 3.1.25 shows that T6 (San Antonio-IRRI) has the highest number of individuals recorded at 33.22% (379) of the total number of individuals of birds from all sampled sites. It is followed by T4 (Tadlac) with 25.24% (288), 15.6% (178) for T3 (Cabuyao), 9.29% (106) for T5 (Timugan), 8.9% (102) for T1 (Solis) and the least from T2 (FTI-Taguig) with 7.7 % (88).

484. The very few species of birds and individuals documented in transect T1 and T2 may accounted be to disturbed state of the sites. The area adjacent to the railroad tracks in Solis is occupied by informal settlers and there is very little vegetation where birds or any wildlife can thrive. It also teems with garbage and waste materials including human excreta. Transect T2 is mostly concrete walls which protect buildings from dust and noise pollution brought about by the constant flow of traffic along the South Luzon Expressway (SLEx). Few trees were found near Gate 3 of Fort Bonifacio within the PNR ROW which may not be enough to sustain or be a habitat for birds and volant mammals.

Table 3.1.25 List of Bird Species Documented from Six (6) Transect Line

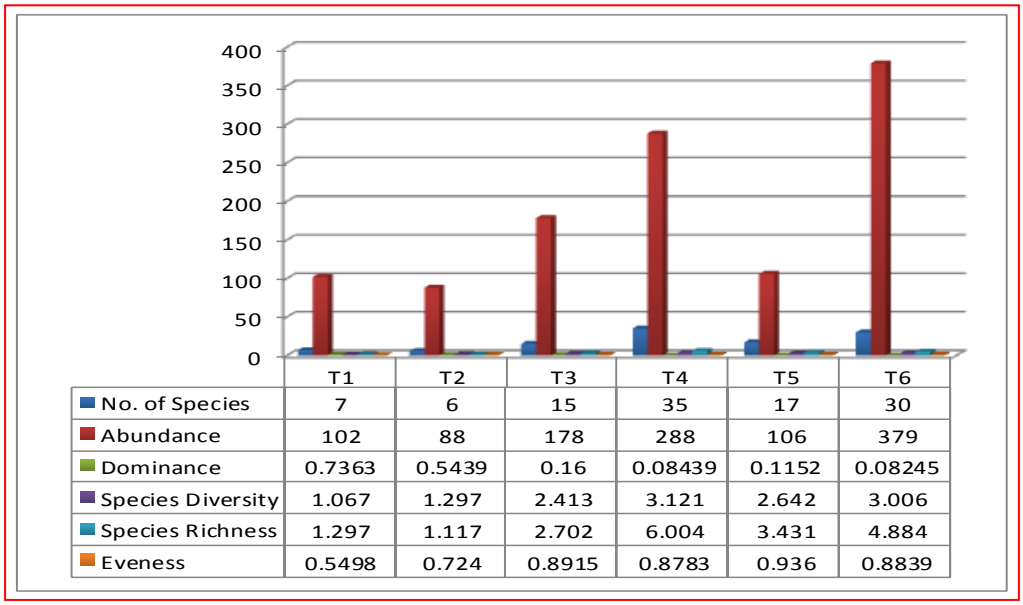
FAMILY	SCIENTIFIC NAME	COMMON NAME	SURVEY SITES					
			T1	T2	T3	T4	T5	T6
Alcedinidae	*Alcedo atthis*	Common Kingfisher				3		
Alcedinidae	*Todiramphus chloris*	White-collared Kingfisher			5	3		1
Alcedinidae	*Halcyon smyrnensis*	White-throated Kingfiher					2	1
Apodidae	*Collocalia esculenta*	Glossy Swiftlet		19	3	14		13
Apodidae	*Collocalia troglodytes*	Pygmy swiftlet				7		4
Ardeidae	*Egretta garzetta*	Little Egret	2		10	11	2	13
Ardeidae	*Butorides striata*	Little Heron				4		
Ardeidae	*Egretta intermedia*	Intermediate Egret				8	3	
Ardeidae	*Bubulcus coromandus*	Cattle Egret				10		31
Ardeidae	*Ixobrychus sinensis*	Yellow Bittern				5		
Ardeidae	*Bubulcus ibis*	Cattle Egret					2	
Ardeidae	*Nycticorax nycticorax*	Black-crowned Night Heron				33		
Artamidae	*Artamus leucorynchus*	White-breasted Wood-swallow				4		7
Cisticolidae	*Orthotomus derbianus*	Grey-backed Tailorbird				1		
Cisticolidae	*Cisticola juncidis*	Zitting Cisticola			3			2
Columbibae	*Phapitreron leucotis*	White-eared Brown Dove				2		
Columbibae	*Spilopelia chinensis*	Spotted Dove						6
Columbibae	*Geopelia striata*	Zebra Dove	1	1	4		5	13
Columbibae	*Streptopelia tranquebarica*	Red-turtle Dove						7
Corvidae	*Corvus macrorhynchos*	Large-billed Crow				4		5

FAMILY	SCIENTIFIC NAME	COMMON NAME	SURVEY SITES					
			T1	T2	T3	T4	T5	T6
Corvidae	*Corvus enca*	Slender-billed Crow					6	
Cuculidae	*Centropus viridis*	Philippine Coucal				2		
Dicaeidae	*Dicaem australe*	Red-keeled Flowerpecker				2	6	
Dicaeidae	*Dicaeum trigonostigma*	Orange-bellied Flowerpecker					6	
Estrildidae	*Lonchura atricapilla*	Chestnut Munia			17			28
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia						38
Hirundinidae	*Hirundo tahitica*	Pacific Swallow	9	2		16		2
Hirundinidae	*Hirundo rustica*	Barn Swallow			22	14	12	8
Laniidae	*Lanius cristatus*	Brown Shrike	1		5	7		19
Laniidae	*Lanius schach*	Long-tailed Shrike				1		2
Laridae	*Childonias hybrida*	Whiskered Tern			45	24	8	11
Laridae	*Sterna hirundo*	Common Tern			6	2		0
Locustellidae	*Megalurus palustris*	Striated Grassbird			8	3		16
Locustellidae	*Megalurus timoriensis*	Tawny Grassbird			4			13
Megalaimidae	*Megalaima haemacephala*	Coppersmith Barbet			0	1		
Megalaimidae	*Megalaima haemacephala*	Coppersmith Barbet					3	
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater						3
Motacillidae	*Anthus richardi*	Richard's Pipit						4
Nectriniidae	*Cinnyris jugularis*	Olive-backed Sunbird				7	8	4
Passeridae	*Passer montanus*	Eurasian Tree sparrow	80	54	27	47	15	60
Podicipedidae	*Tachybaptus ruficollis*	Little Grebe				12		
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	6	4	15	16	15	12
Pycnonotidae	*Ixos philippinus*	Philippine Bulbul					10	
Rallidae	*Gallirallus torquatus*	Barred Rail				2		2
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen				2		
Rallidae	*Porzana cinerea*	White-browed Crake				11		
Rallidae	*Gallinula chloropus*	Common Moorhen				4		
Rallidae	*Amaurornis olivacea*	Plain Bush-hen				3		
Rallidae	*Gallirallus philippensis*	Buff-banded Rail						2
Rhipiduridae	*Rhipidura nigritorquis*	Pied Fantail				2		
Scolopacidae	*Tringa nebularia*	Common Greenshank						35
Strigidae	*Otus megalotis*	Philippine Scops Owl					1	
Sturnidae	*Acridotheres cristatellus*	Crested Myna		8		1		17
Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	3		4			
Sturnidae	*Rhabdornis mystacalis*	Stripe-headed Rhabdornis					2	
TOTAL			**102**	**88**	**178**	**288**	**106**	**379**

485. Figure 3.1.51 shows that based on the number of species the T4 (Tadlac) site has the highest number with 35 species. It is followed by T6 (San Antonio-IRRI) with 30, T5 (Timugan) with 17, T3 (Cabuyao) with 15, T1 (Solis) with 7, and the least T2 (FTI-Taguig) with only six species recorded.

486. Transect T6 (San Antonio-IRRI) has the highest number of individuals counted with 379 which is 33,22% of the total number of individuals (1141) observed and recorded. Birds are abundant in T6 because of the presence of ricefields which are good feeding grounds for insectivores. Next is T4 (Tadlac) with 288 individuals or 25.24%, followed by T3 (Cabuyao) with

178 (15.6%), T5 (Timugan) with 106 (9.29%), T1 (Solis) with 102 (8.95), and the barangay with the least counted individuals of birds is T2 (FTI-Taguig) with only 88 (7.71%)



	T1	T2	T3	T4	T5	T6
No. of Species	7	6	15	35	17	30
Abundance	102	88	178	288	106	379
Dominance	0.7363	0.5439	0.16	0.08439	0.1152	0.08245
Species Diversity	1.067	1.297	2.413	3.121	2.642	3.006
Species Richness	1.297	1.117	2.702	6.004	3.431	4.884
Eveness	0.5498	0.724	0.8915	0.8783	0.936	0.8839

Figure 3.1.51 Diversity Indices of Bird Species

487. Dominance of a species could be associated to the highest number of individuals recorded in each site. Transect T1 has the highest dominance value (0.6278) compared to T2 (0.4341), T3 (0.1284), T5 (0.08811), T4 (0.0679), and T6 has the least dominance value of 0.0708. The high dominance value of T1 and T2 may possibly be the effect of the presence of built up areas and close proximity of the area to human habitation that causes high disturbance. Since the area is near human habitation and highly exposed to urbanization, the development that took place and will take place in the area can cause rapid changes to the environment. With continuous development, the environment becomes homogenous which causes high species dominance. High homogeneity in the environment will cause high competition of existing natural resources which will later result to the fittest individual ruling the environment. Hence, as the environment undergoes changes, species composition might dwindle allowing one species to become dominant. Figure 3.1.51 shows that with high dominance value, there is less diversity and evenness as observed in T1 (Solis).

488. Transect T4 is the most diverse in terms of species composition compared to other sampling sites. It has a species diversity index value of 3.121. This was followed by T6 with 3.006. The high species diversity value does not necessarily mean that the equality of the distribution of species in a certain area are normally distributed. It is shown in Figure 3.1.51 that despite high species diversity index value in T4, the evenness of species is highest in T5 (0.936). This was followed by T3 (0.0.8915) and T6 (0.6312), and T4 with an evenness value 0.8783.

489. A tool to determine the degree of disturbance of a certain habitat or site, is the determination of the percentage of species belonging to different feeding guilds. The increase/decrease in the number of species of a certain feeding guild will determine the effects of disturbance, natural or anthropogenic. Table 3.1.26 shows the species of birds with the respective habitats, feeding guilds, residency, and distribution, and IUCN conservation status of each species.

Table 3.1.26 Feeding guild, Residency Status (RS), Conservation Status (CS) and Abundance of Bird Species

FAMILY	SCIENTIFIC NAME	Feeding Guild	Residency/ Distribution Status	Conservation Status
Ardeidae	Nycticorax nycticorax	C	Migratory	LC
Laniidae	Lanius cristatus	C,I	Resident	LC
Laridae	Childonias hybrida	C.I	Migratory	LC
Passeridae	Passer montanus	G,I	Resident	LC
Pycnonotidae	Pycnonotus goiavier	F,I	Resident	LC
Ardeidae	Egretta garzetta	C	Migratory	LC
Ardeidae	Butorides striata	P,I	Migratory	LC
Ardeidae	Egretta intermedia	C	Migratory	LC
Ardeidae	Bubulcus coromandus	C,I	Resident	LC
Apodidae	Collocalia esculenta	I	Resident	LC
Hirundinidae	Hirundo tahitica	I	Resident	LC
Podicipedidae	Tachybaptus ruficollis	I	Resident	LC
Rallidae	Gallirallus torquatus	O	Resident	LC
Rallidae	Amaurornis phoenicurus	O	Resident	LC
Laridae	Sterna hirundo	C	Migratory	LC
Apodidae	Collocalia troglodytes	C,I	Endemic	LC
Laniidae	Lanius schach	C,I	Resident	LC
Cuculidae	Centropus viridis	I	Endemic	LC
Megalaimidae	Megalaima haemacephala	F,I	Resident	LC
Ardeidae	Ixobrychus sinensis	C,I	Migratory	LC
Columbibae	Phapitreron leucotis	F	Resident	LC
Alcedinidae	Alcedo atthis	P,I	Resident	LC
Alcedinidae	Todiramphus chloris	C	Resident	LC
Nectriniidae	Cinnyris jugularis	F,I	Resident	LC
Artamidae	Artamus leucorynchus	I	Resident	LC
Rallidae	Amaurornis cinerea	O	Resident	LC
Hirundinidae	Hirundo rustica	I	Resident	LC
Rallidae	Gallinula chloropus	O	Resident	LC
Locustellidae	Megalurus palustris	I	Resident	LC
Rallidae	Amaurornis olivacea	O	Endemic	LC
Dicaeidae	Dicaem australe	F	Endemic	LC
Sturnidae	Acridotheres cristatellus	I	Resident	LC
Cisticolidae	Orthotomus derbianus	I	Endemic	LC
Corvidae	Corvus macrorhynchos	O	Resident	LC
Rhipiduridae	Rhipidura nigritorquis	I	Endemic	LC
Alcedinidae	Halcyon smyrnensis	P,I	Endemic	LC
Motacillidae	Anthus richardi	I	Resident	LC
Locustellidae	Megalurus timoriensis	I	Resident	LC
Rallidae	Gallirallus philippensis	O	Resident	LC
Estrildidae	Lonchura atricapilla	G	Resident	LC
Estrildidae	Lonchura punctulata	G	Resident	LC
Columbibae	Spilopelia chinensis	G	Resident	LC
Columbibae	Geopelia striata	G	Resident	LC
Meropidae	Merops philippinus	I	Resident	LC

FAMILY	SCIENTIFIC NAME	Feeding Guild	Residency/ Distribution Status	Conservation Status
Columbibae	Streptopelia tranquebarica	G	Resident	LC
Scolopacidae	Tringa nebularia	C,I	Resident	LC
Cisticolidae	Cisticola juncidis	I	Resident	LC
Sturnidae	Aplonis panayensis	F	Resident	LC
Ardeidae	Bubulcus ibis	C,I	Resident	LC
Corvidae	Corvus enca	C	Resident	LC
Dicaeidae	Dicaeum trigonostigma	F	Resident	LC
Pycnonotidae	Ixos philippinus	C,I	Resident	LC
Megalaimidae	Megalaima haemacephala	F,I	Resident	LC
Strigidae	Otus megalotis	C	Endemic	LC
Sturnidae	Rhabdornis mystacalis	F,I	Endemic	LC

490. There are nine types of feeding guilds observed and recorded for all bird species identified in six selected sites (Figure 3.1.52). Insectivory is the dominant feeding guild and comprises 24% (14) of the total number of species. This is followed by mixed feeders such as carnivores-insectivores with 21% (12), carnivores-omnivores (12%) (7), granivores (9%) (5), frugivores-insectivores (8%) (5), frugivores (7%) (4), piscivores- insectivores (5%) (3), and the least number of species were granivores-insectivores has the lowest value of 2% (1).

491. Percentage distribution patterns of bird's species based on residency status showed that most of the species of birds present in the six established transects during the 2018 terrestrial vertebrate survey are residents (69%), sixteen percent (16%) are endemic, and 15% are migrants (Figure 3.1.53).

492. 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 sinensis*) and thirty-nine resident species or 69% of the total number of species of birds.

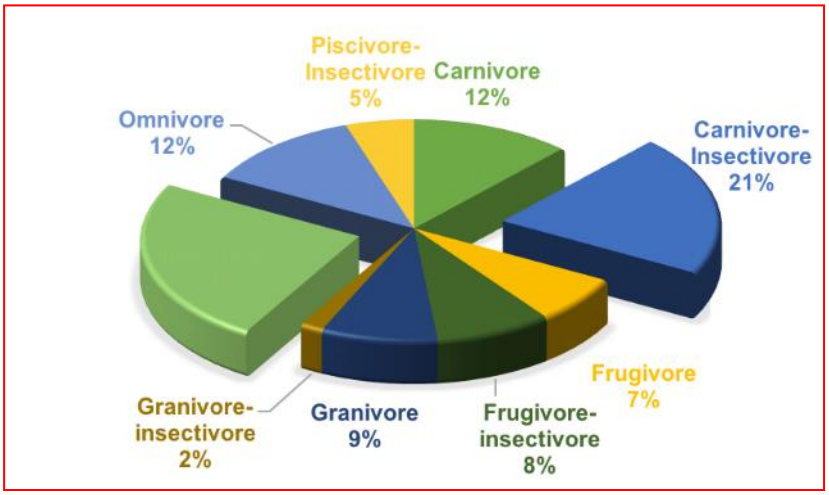


Figure 3.1.52 Percentage of Species Belonging to Different Feeding Guilds

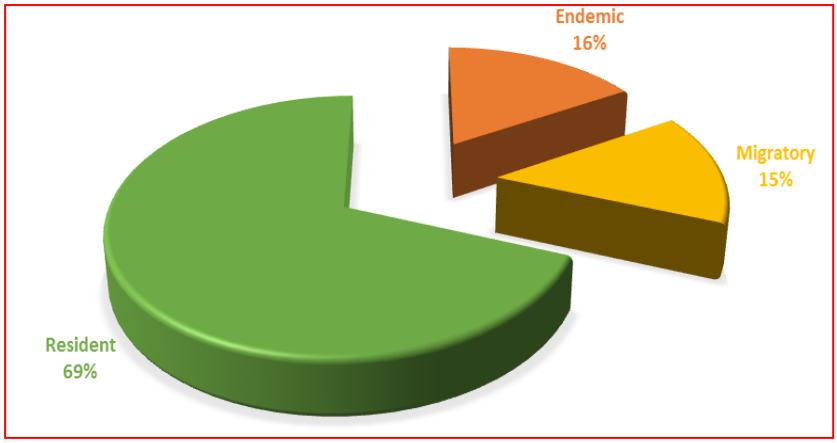


Figure 3.1.53 Percentage Distribution Patterns of Bird Species

MAMMALS

493. A total of five (5) species belonging to three (3) families were recorded from the six (6) established survey sites for mammals (**Table 3.1.27).** The species of mammals documented from the six (6) transects are composed of five (5) volant - four (4) fruit bats (*Cynopterus brachyotis, Ptenochirus jagori, Rousettus amplexicaudatus, and Macroglossus minimus)* and one (1) species of insect bat belonging to family Vespertilionidae, *Scotophilus kuhlii* and one (1) non-volant species which is an introduced species belonging to Family Soricidae, *Suncus murinus.*

494. The highest number of species was observed from the T6 where four of the volant species were captured and recorded, followed by T5 with 3, T1 and T3 with 2 species each. Non-volant species was only documented in T1 and not in any other site. There were no captured and recorded individuals from T2 since no nocturnal survey was done. This was due to the very close proximity to the national highway and there was no possible area to set-up the nets. No bats or rodents were caught in the nets and traps in Tadlac.

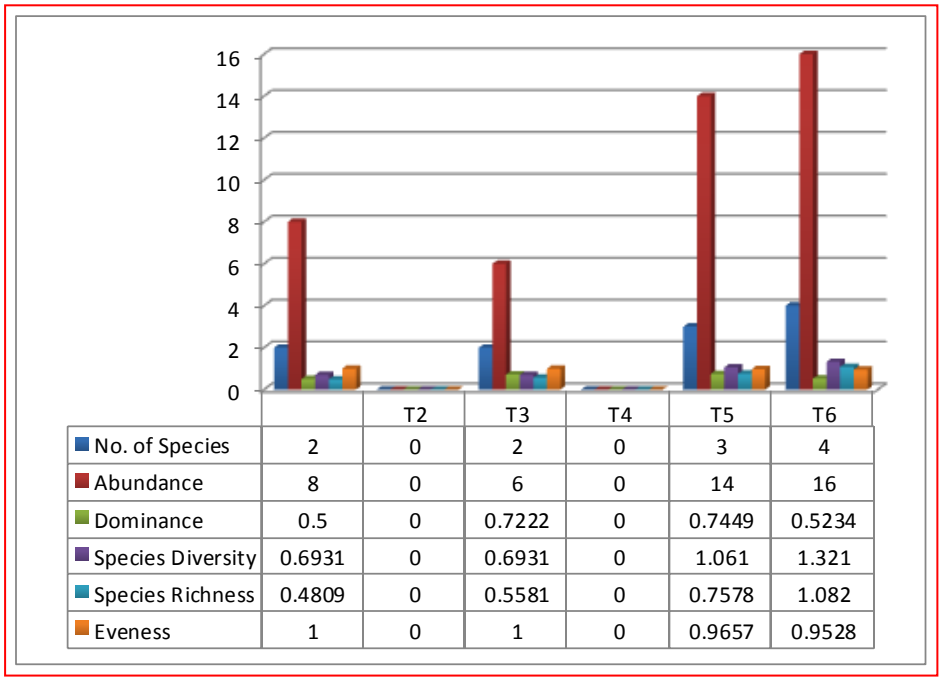
Table 3.1.27 List of Volant and Non-volant Species of Mammals

FAMILY	SCIENTIFIC NAME	COMMON NAME	SURVEY SITES					
			T1	T2*	T3	T4	T5	T6
VOLANT								
Pteropididae	Cynopterus brachyotis	Lesser Dog-faced Fruit Bat			3		1	7
Pteropididae	Ptenochirus jagori	Greater Musky Fruit Bat					4	6
Pteropididae	Macroglossus minimus	Dagger-toothed Long-nosed Fruit Bat						1
Pteropodidae	Rousettus amplexicaudatus	Geoffroy's Rousette					9	2
Vespertilionidae	Scotophilus kuhlii	Asiatic Lesser Yellow House Bat	5		3			
NON-VOLANT								
Soricidae	Suncus murinus	Asian House Shrew	3					
TOTAL			8	-	6	-	14	16

495. Forty-four (44) individuals of combined Volant and non-volant mammals were recorded in all sites. Abundance is highest in the T6 site wherein a total of 16 individuals were caught in the nets. Fourteen (14) individuals were also caught in T5 while there were 8 caught in T1 and 6 in T3. 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.

496. Another reason for the high and low abundance in the different sites may be because of the varied composition of habitats that can be found or cannot be found in each site.

497. There is not much difference in species dominance among the sites wherein the higher value is observed to be similar in T3 and T5 (0.7222 and 0.7449, respectively) and lower in T1 and T6 (both rounded off at 0.5).



	T2	T3	T4	T5	T6
No. of Species	0	2	0	3	4
Abundance	0	6	0	14	16
Dominance	0	0.7222	0	0.7449	0.5234
Species Diversity	0	0.6931	0	1.061	1.321
Species Richness	0	0.5581	0	0.7578	1.082
Eveness	0	1	0	0.9657	0.9528

Figure 3.1.54 Diversity Indices of Species of Mammals

498. The habitat, population status, distribution and conservation status of mammals observed during the survey of terrestrial vertebrates are presented in Table 3.1.28.

499. The documented species of volant and non-volant mammal are highly adaptable species that are commonly found in and around villages or human settlements and agricultural areas. And no direct conservation measures are needed for these common and adaptable species.

500. Based on data gathered, out of the six (6) sites, it showed that *Suncus murinus* is the only species of non-volant mammals sampled. It is an introduced species that can highly adapt to vast range and type of habitat.

501. All of these are highly adapted to disturbed areas especially areas near human settlements. Some of the species recorded are forest dwellers and depend on the forest for survival except *Macroglossus minimus, Rousettus amplexicaudatus*, and *Suncus murinus* which thrive in all habitats.

502. There is no much variation in species observed in all survey sites. Among the captured and recorded species, 67% are native species, 16% endemic and 17% introduced species (Figure 3.1.55).

Table 3.1.28 Habitats, Population and Conservation Status and Distribution of Mammals

Species	Habitat	Population Status	Residency Status	Conservation Status
BATS				
Cynopterus brachyotis	Lower montane forests, dipterocarp forests, gardens, mangrove and strand vegetation	Abundant and widespread; populations stable and increasing	Native	LC
Ptenochirus jagori	Primary and secondary forest; agricultural areas	Population are large and generally stable	Endemic	LC
Macroglossus minimus	Found in disturbed and	Abundant and widespread;	Native	LC

Species	Habitat	Population Status	Residency Status	Conservation Status
	agricultural areas	populations stable and increasing		
Rousettus amplexicaudatus	Roosts in caves, crevices; found in a variety of habitat	Abundant and widespread	Native	LC
Scotophilus Kuhlii	Roosts in caves, crevices, ceiling of the house	Abundant and widespread; populations stable and increasing	Native	LC
RODENTS				
Suncus murinus	Abundant in all habitats	Non-native pest; abundant	Introduced	LC

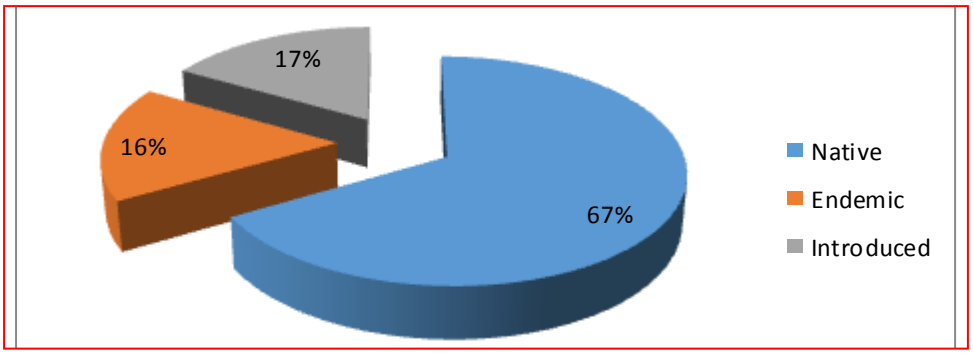


Figure 3.1.55 Percentage Distribution Patterns of Mammal Species

Herpetofauna

503. Three (3) species of herpetofauna comprised of two (2) amphibians and one (1) lizard were recorded. The two (2) species of amphibians belong to two families namely Dicroglossidae (*Occidozyga laevis*) and Bufonidae (*Rhinella marina*); while the lizard belongs to family Gekkonidae (*Hemidactylus frenatus*).

504. Based on the result, there is no much of a difference with the species recorded in the six selected surveyed sites. Thirty-hree (33) individuals of species of frogs and lizards are recorded. T1 has the highest number of individuals recorded with 18, next is T4 with 19, and T5 with 4 individuals of lizard.

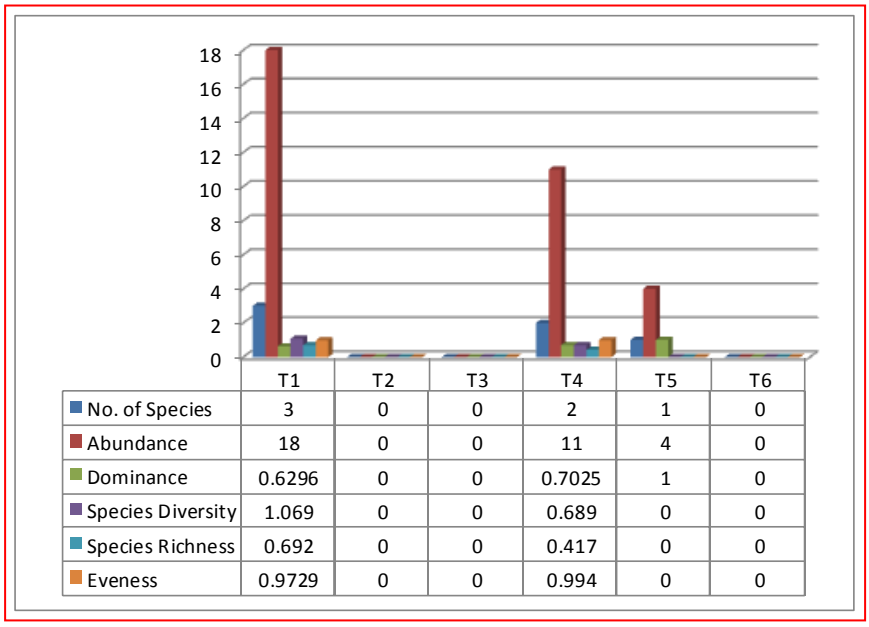
Table 3.1.29 List of Species of Amphibians and Reptiles Observed and Recorded

FAMILY	SCIENTIFIC NAME	COMMON NAME	SURVEY SITES					
			T1	T2	T3	T4	T5	T6
ANURANS								
Dicroglossidae	Occidozyga laevis	Puddle frog	2	0	0	0	0	0
Bufonidae	Rhinella marina	Cane toad	6	0	0	6	0	0
REPTILES								
		Lizard						
Gekkonidae	Hemidactylus frenatus	Common House Gecko	10	0	0	5	4	0

505. The herpetofauna documented during the survey are highly adapted to degraded and man-made environments. Most of them are introduced that can thrive in a wide variety of habitats. Some of the species are considered invasive. These species kill native and endemic species of frogs like the *Rhinella marina* commonly known as “Bullfrog” which is noted to be the most abundant species in T1 and T4. *Hemidactylus frenatus* (Common House Gecko) was recorded with close proximity to human habituation or inside the houses.

506. Diversity indices can only be compared in three transects: T1, T4 and T5. **Figure** 3.1.56 showed that values of diversity indices for herpetofauna in all the sites were very low in areas where the taxon is documented. Most of the sites are dominated by the invasive species *Rhinella marina* which is more terrestrial than aquatic and the common house lizard, *Hemidactylus frenatus*. The puddle frog was documented in Solis where there was a canal at the side of the railroad. The comparison of values of diversity indices between sites is presented in Figure 3.1.56.

507. All values of diversity indices in the surveyed sites are very low. Species dominance is highest in T5 (Timugan) while it is lowest in T1 (Solis). Species diversity and richness in Solis are higher because it is where all 3 species of herpetofauna were recorded while evenness is higher in T5.



	T1	T2	T3	T4	T5	T6
No. of Species	3	0	0	2	1	0
Abundance	18	0	0	11	4	0
Dominance	0.6296	0	0	0.7025	1	0
Species Diversity	1.069	0	0	0.689	0	0
Species Richness	0.692	0	0	0.417	0	0
Eveness	0.9729	0	0	0.994	0	0

Figure 3.1.56 Diversity Indices of Species of Herpetofauna

508. The distribution and conservation status of amphibians and reptiles observed and recorded in the surveyed areas are mostly species that inhabit varied habitat types and appears to thrive even in degraded and man-made environments. Amphibians and reptiles were found in or near streams and pools, trees within agricultural areas or near settlements. Most of the recorded species are found in disturbed habitats (Table 3.1.30).

509. The recorded species of amphibians and reptiles in the surveyed sites needs less conservation management since most of the species observed are species that occur in a diverse range of habitats that can be classified as areas of high disturbance.

Table 3.1.30 Habitat, distribution and conservation status of amphibians and reptiles observed and recorded from three survey areas.

Species	Habitat	Residency Status	Conservation Status
Occidozyga laevis	Aquatic habitat type;puddle	Native	LC
Rhinella marina	All habitat types	Introduced	Invasive
Hemidactylus frenatus	Diverse Habitat range	Native	LC

510. No endemic species of amphibians and reptiles were recorded. There are only two residency status noted during the survey (Native and Introduced). Approximately 33% are introduced species and 67% are native species of amphibians and reptiles (Figure 3.1.57).

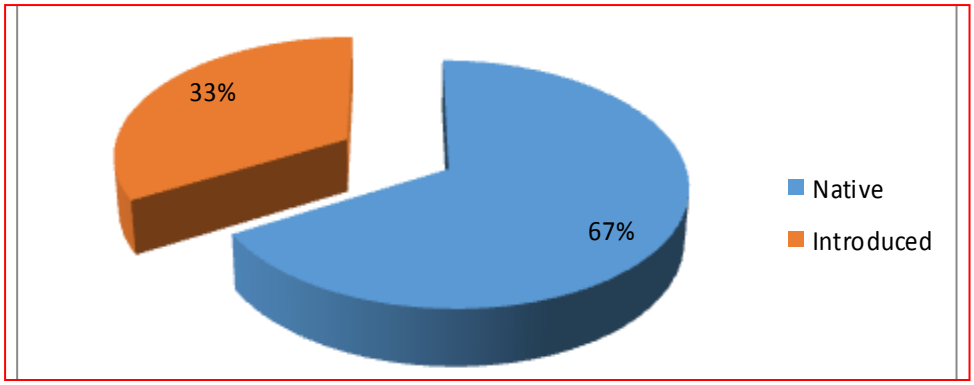


Figure 3.1.57 Herpetofauna Percentage Residency Status

4) Biodiversity Values

Birds

511. All or 100% of the species of birds documented from the six survey sites are of Least Concern (LC) (Table 3.1.30). LC is a category on the IUCN Red List of Threatened Species which indicates that a taxon is widespread and abundant or that birds in the area are not in any danger of becoming extinct and maybe they have already adapted to the conditions in the area.

Mammals

512. 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 are forest dwellers and depend on the forest for survival except *Macroglossus minimus, Rousettus amplexicaudatus*, and *Suncus murinus* which thrive in all habitats.

Herpetofauna

513. All of the recorded species amphibians and reptiles are categorized as Least Concern based on IUCN like the recorded mammals and bird species (**Table 3.1.30**).

3.1.3.3 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction phase

1) Vegetation Removal and Loss of Habitat

514. The proposed NSRP will not pass through any protected area, reserved forest area, or natural forest area. The NSRP alignment will traverse a highly built-up area, disturbed, and maintained areas and it is within the vicinity of heavy industrial facilities, residential areas, commercial establishments and infrastructures. The most notable ecological area is the Mount Makiling Forest Reserve (MMFR) which is is approximately 4 km from Calamba Station of NSRP.

515. While the NSRP will utilize the existing PNR ROW for its alignment from Paco Station to Calamba and along built-up areas from Solis station to Sta. Mesa station, removal of vegetation cover along the route is minimal. However, the removal of vegetation cover in a 78 ha depot will be significant for this is an agricultural area.

516. Although clearing of vegetation will be required along the railway, and for establishment of infrastructure such as borrow pits, laydown areas/construction yard, water bores, and access tracks, majority of plants recorded at the NSRP site are weeds species common to disturbed and degraded areas.

517. Few number of both endemic tree species were encountered in the transect plots. There are no threatened species recorded in all transect plots. Dominant families include *Cannabaceae, Fabaceae, Verbenaceae, Anacardiaceae, Lamiaceae, Asteraceae* and *Moraceae*.

518. Vegetation clearing and other site preparation activities will also destroy grasslands/marshland and some tree patches which serve as shelter and food for existing wildlife species. This will lead to loss of habitats particularly for birds especially those which are migratory. The effects during pre-construction will increase or magnify during the construction period. This may result to the disappearance of some species which will not be able to withstand the perturbations brought about by the entry of equipment added by people trampling over the habitats of wildlife. Other disturbances which will affect species are dust and noise pollution which may drive fauna away from their habitats.

519. Earthworks, disturbance to vegetation, vehicle movement and other factors have the potential to introduce additional weeds to the area and to spread existing population of introduced flora along the length of the proposed rail alignment.

520. A complete census of flora along the alignment will be conducted to determine the total counts of trees and other arborescent taxa will potentially be affected during pre-construction and construction activities.

521. Vegetation clearing will be kept to the minimum necessary for safe construction and operation of the railway, particularly in areas adjacent to vegetation of higher conservation significance. The design of the rail alignment will be refined, taking into account the locations of significant vegetation types and populations of significant flora, with the objective of avoiding these through final design.

522. Prior to clearing activities, a tree cutting permit will be acquired from the DENR. A detailed plan for the management of affected flora will be prepared by DOTr. Proper assessment of the matured trees will be conducted to determine appropriate method of removal, if it will be transferred/earth balled or cut.

523. Matured trees will be transferred carefully to designated receiving areas. A detailed plan for transfer/earth balling of matured trees will be prepared prior to removal. The detailed plan should include proper handling of the uprooted tree and preparation of the recipient site to ensure high survival rate of the trees. A system to periodically monitor and maintain survival of these species should be set in place to assure high survival rate. DOTr will coordinate with the DENR and LGUs for the identification of relocation area for the potential trees that will be relocated.

524. Tree planting activities will be also conducted to replace trees and vegetation that will be removed and affected by site clearing. Native/endemic/indigenous species of trees, shrubs, and grasses should be cultivated/grown in nurseries. These will be used to restore habitats of wildlife at the buffer zone which will be established at the side of the railway. Buffer areas near or adjacent to the construction sites should be established where wildlife can flee or find shelter. Survival rate will also be monitored and replacement as necessary.

525. During construction, tree planting activities can be conducted where possible and regular monitoring of replanted trees will be conducted to check survival. Any of failed trees will be replanted as necessary.

2) Threat to Existence And / Or Loss of Important Local Species

526. Vegetation clearing is inevitable during pre-construction and construction phase. This may affect the existence of the five (5) flora species that were found to be Philippine endemics or have natural habitat confined only in the country. Noteworthy among the list are the critically endangered (CR) Smooth Narra (*Pterocarpus indicus*) (IUCN), and a premium tree species which is specifically used in railroad ties, Molave (*Vitex parviflora*) (DAO 2007-01). Consequently, vegetation clearing may also affect the fauna species in the area including the nine (9) bird species and one (1) mammal which are endemic.

527. To mitigate impacts to the existence of important local species, indigenous and native plant and tree species naturally growing in the project site will be emphasized for conservation and protection planning in response to the conservation status reported in this report. Wildlings of the endangered and threatened species, if any, will be collected before construction and placed in the nursery and will be given priority during nursery operation to be used for rehabilitation of areas that will be affected by project.

3) Threat to Abundance, Frequency and Distribution of Important Species

528. The construction of the railway will result in the clearing of vegetation in the depot site which is about 78 ha and along the existing PNR ROW which is characterized as predominantly built-up area. Moreover, there could be adverse effects on the insects, wildlife or other organisms that depend on the vegetation as a source of food for insects, wildlife, or other organisms.

529. Results of the plant diversity assessment revealed that the project area has low to moderately low biodiversity index value while evenness indices varied from very low to low.

530. Loss of habitat during land and site preparations prior to construction will result to the decrease in abundance and frequency of observed wildlife. Endemic species which may not be able to withstand disturbances (e.g. construction of structures, depots) may not thrive in the area.

531. To mitigate the impacts of the project, wildlings of the endangered and threatened species will be collected before construction and placed in the nursery and will be given priority during nursery operation to be used for rehabilitation of areas that will not be affected by project. Buffer areas near or adjacent to the construction sites should be established where wildlife can flee or find shelter.

4) Hindrance to Wildlife Access

532. The amphibians will be mostly affected during pre-construction and construction phase. If the grassland/marshland is cleared, the area will dry up and access routes will be closed to these taxa. This may result to disappearance of some species from the affected areas. Alternate access routes or corridors for amphibians and mammals may be set aside inside work sites to allow wildlife to traverse.

533. As for mammals, five (5) volant species consisting of four (4) fruit bats and one (1) species of insect bat and one (1) non-volant species which is an introduced species. The bats may have just been flying through from their feeding area returning to their roosts when caught in the nets. There were no trees which were suitable for roosting or feeding of bats along the proposed NSRP alignment

534. The only natural habitat that could be considered significant to fauna is the open shrub to wooded land in the transect plots established in the proposed railway alignment which are being visited by local bird species in the area. Most of the areas are either intentionally cleared or occupied for residential purposes.

(2) Operation phase

1) Vegetation Removal and Loss of Habitat

535. During the operation phase, no vegetation removal and clearing are expected. Tree planting activities will be conducted to replace trees and vegetation that were removed and affected by site clearing. Also, a regular monitoring of flora and fauna at sensitive area and survival of replanted trees will be conducted.

2) Threat to Existence and/or Loss of Important Local Species

536. During the operation phase, no vegetation removal and clearing are expected so there would be no threat to the existence and/or loss of important local flora species. As an additional consideration, implementation of vegetation management plan will be enforced including but not limited to the minimal use of herbicide and machineries.

537. Regular maintenance of ROW to control vegetation may involve the use of mechanical methods, such as mowing or pruning machinery, in addition to manual hand clearing and herbicide use, all of which can disrupt wildlife and their habitats. Noise, vibration, illumination, and vehicular movement can disrupt animal activities. Workers are provided training on ecological impact of construction activities.

3) Threat to Abundance, Frequency and Distribution of Important Species

538. As previously mentioned, no vegetation removal and clearing are expected during operation phase. For landscaping of open areas, use local or endemic species as much as possible.

4) Hindrance to Wildlife Access

539. The open and disturbed areas will be re-vegetated to allow wildlife to traverse. Additional measures include minimize noise, vibration, illumination and vehicular movement in consideration to the existing fauna at significant area/s.

Table 3.1.31 Summary of Impact Identification, Prediction, Assessment and Mitigation for LAND

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: - RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - RA 9003: management and disposal of solid wastes - RA 8749: comprehensive air pollution control policy - RA 9275: comprehensive water quality management and for other purpose • 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
Construction of the proposed NSRP at Manila City Area and depot facility	Land use and Classification	Incompatibility with the Existing Land Use.	C-	[Pre-Construction] • Information sharing to the affected LGU to align and ensure that proposed NSRP will 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.
Construction of the proposed NSRP at the following: • Areas with the existing old PNR structures • Areas with high risk to typhoon passage, high susceptibility to flooding. • Prime agricultural areas in Depot	ECA	Incompatibility with Classification as an ECA	B-	[Pre-Construction] • Plan and design the site, structure foundation, and structure including construction activities in consideration to the ECAs. • Coordinate with relevant government agencies and stakeholders as required
Portions of the alignment encroached	Land Tenure	Land Acquisition	B-	[Pre-Construction] • Implement Resettlement Action Plan in coordination with NCIP, LGUs, lot owners and other concerned stakeholders

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
by informal settlements, outside the existing PNR ROW between Solis to Sta. Mesa and an agricultural area at Depot, and other government project sites				and agencies to address the issue on land acquisition and relocation of informal settlers.
		Potential conflict with other government infrastructure projects	B-	[Pre-Construction] • Close coordination with DPWH, PSALM and other relevant agencies
		Potential conflict with ferry operation	B-	[Pre-Construction] • Close coordination with the affected ferry companies to align and ensure that the proposed NSRP construction schedule and activities will be accommodated in their operation plan • Plan appropriate method and schedule of construction to minimise the impact to existing ferry operation [Construction] • Strictly implement construction plan
Existence of ongoing construction activities	Visual aesthetic	Degradation of aesthetic view	B-	[Pre-Construction/ Construction] • Design and install facilities to harmonise with the surrounding environments (shape, colour, 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 minimise the visual clatter.
Generation and improper handling and disposal of domestic and hazardous solid waste.	Land Value	Devaluation of land value as a result of improper solid waste management	B-	[Construction] • Strictly implement solid waste management plan and proper disposal by contractor in accordance with RA 9003, hazardous waste disposal in accordance with RA 6969
Permanent and major modification of the terrain at embankment section	Topography	Alteration of landform	C-	[Pre-Construction /Construction] • Formulate appropriate design measures for the protection on slopes and banks, soil improvement/ ground reinforcement go minimise ground failure during construction based on the results of the geological survey and geotechnical investigations.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
Earthworks, (excavation, backfilling, stockpiling) and natural hazards • Likely seismic events around NSRP line • Potential liquefaction between Solis to Nichols station and Muntinglupa to Banlic Depot. • Potential ground rupture between Muntinlupa to Alabang station. • Potential eruption of Taal Volcano will bring ground shaking and ash fall,	Ground Subsidence Liquefaction Landslide, Mud/ Debris Flow, etc.	• 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	B-	**[Pre-Construction/Construction]** • Design and implement appropriate foundation and structures based on combination of geotechnical, geotechnical 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.
Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments.	Pedology	Soil erosion	B-	[Pre-Construction/ Construction] • Design and install of appropriate designed measures to prevent or minimize slope failure during construction based on the results of the geohazard assessment and geotechnical investigations. [Construction] • Minimise 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. • Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system
Generation and improper handling and	Pedology	Soil erosion	B-	[Pre-Construction/Construction] • Plan and implement recycling and reuse of excavated soil to be utilised for the project/ other project as much as

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
disposal of excavated soil, leftover concrete by excavation activities (Excavated Soil)				possible. In case of excessive soil to be generated, identify 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.
• Accidental spills of fuels /lubricants from construction vehicles & machineries/ hazardous chemicals. • Generation and improper handling/disposal of construction/domestic /hazardous wastes.	Pedology	Degradation of soil quality (soil contamination)	B-	[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 fertility monitoring in case of any possible contamination events occur.
Damage of subsurface structures during drilling and excavation at previously contaminated site (land fill site)	Pedology	Exposure to contaminated soil	C	[Pre-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 toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures. • 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. In case trace are detected, construction activities on site will be paused until a soil management plan is developed in consultation to the DENR – EMB and implemented.
Removal of vegetation along the proposed NSRP particularly at Bamban and Capas.	Terrestrial Ecology	Loss of Habitat	B-	[Pre-Construction] • Prior to any clearing activity, conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimise removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/endemic/ indigenous species of trees, shrubs and grasses will be specified. • For tree replanting, areas not part of the development within the ROW, around the stations and depot will be prioritize for replanting activity to create buffer zone to improve wildlife. For those that cannot be replanted within the project area, coordination with the DENR and LGUs on the identification of relocation area for the potential trees that will be relocated. • Secure tree cutting permit in compliance with DENR Memorandum Order No. 2012-02. [Construction]

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
				• Conduct tree planting activities to compensate site clearing activities. Conduct regular monitoring on survival of replanted trees and replant if necessary.
• Removal of vegetation along the proposed NSRP particularly at Bamban and Capas. • Earthworks and vehicle movement. • Generation of dust and noise, vibration, and illumination pollution.	Terrestrial Ecology	• Threat to Existence and/or Loss of Important Local Species • Threat to Abundance, Frequency and Distribution of Important Species • Hindrance to Wildlife Access	B-	[Pre-Construction/ Construction] • Design, plan and implement that will minimise 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. • 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. • Prepare and implement a tree and vegetation management ~~plan~~ as part of the construction plan considering the significance to fauna (local bird species) and minimising the use of herbicide and machinery as much as possible. • Coordinate with DENR–Biodiversity Management Bureau and SCPW for the conservation of migratory birds if required.
Operation and maintenance of the proposed NSRP	ECA	Incompatibility with the area hard hit by natural calamities.	B-	• Coordinate with PAGASA / PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.
Presence of the proposed NSRP structures (railway, passenger facilities, depot etc.)	Visual aesthetics	Visual impact	C-	• Maintain tree planting to minimise the visual impact by the project and harmonise to the surrounding environments in open areas within the ROW, depot and around the stations, to create green corridor.
Generation and improper handling of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), depot.	Land value	• Degradation of land value • Change in soil quality	C-	• 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.
Occurrence of landslides, volcanic hazards, ground shaking and liquefaction • Likely seismic events around NSRP line • Potential liquefaction between Solis to Nichols station and	Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities. • Risk to the life of	B-	• 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

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
Muntinglupa to Banlic Depot. • Potential ground rupture between Muntinlupa to Alabang station. • Potential eruption of Taal Volcano will bring ground shaking and ash fall.		passengers and workers.		
Operation of the proposed NSRP and passenger facility, Depot, Operation of service vehicle, Passenger movement	Terrestrial Ecology	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Hindrance to Wildlife Access	C-	• 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 minimise the use of herbicide and machinery as much as possible. • Minimised noise, vibration, illumination, and vehicular movement in significant fauna area (alignment sections in Malolos to Minalin under Manila Bay Biodiversity Area).

Note;
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor positive/negative impact is expected to some extent
D: Extent of impact is unknown

3.2 WATER

3.2.1 Hydrology/Hydrogeology

3.2.1.1 Drainage Morphology / Inducement of Flooding / Reduction in Stream

(1) Drainage Morphology

1) Natural Drainage System

540. The main hydrologic feature which affects the NSRP alignment is the Laguna de Bay. It is a freshwater lake with a surface area ranging from 911 to 949 km^2 and a watershed area of 3,820 km^2. 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, as can be gleaned in **Figure 3.2.1**.

541. Major rivers from Sierra Madre which feeds Laguna de Bay include Pagsanjan River, Santa Cruz River, Pangil River, Marikina River, Tanay River, Morong River and Siniloan River.

542. Major rivers from the Taal-Makiling-Banahaw Volcanic chain include Tunasan River, San Pedro River, Cabuyao River, San Cristobal River and Calamba River. The main channels of these rivers and their tributaries are intersected by the NSRP Alignment from Bicutan to Bay, Laguna in 50 locations. These river –railway intersections are found within the Laguna Lakeshore area which is usually affected by the rise in lake water levels during the rainy season and/or major storm events.

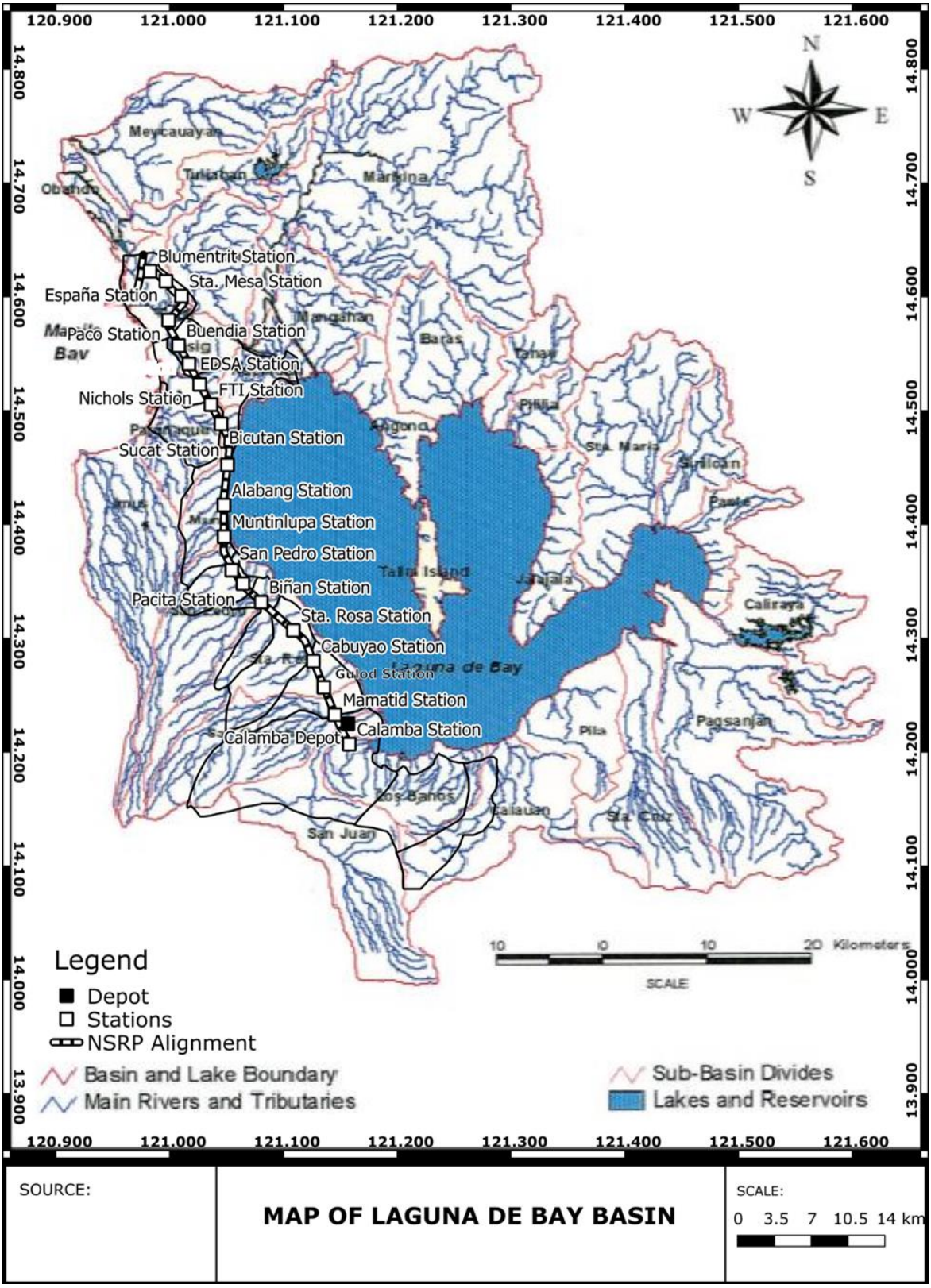
543. The Laguna Lake's only outlet is the Napindan Channel which is connected to Manila Bay via the Pasig River.

544. The exit of Pasig River into Manila Bay resulted in the formation of a triangular sedimentary flood deposit known as the Manila Delta. The NSRP segments starting from Solis Station to Buendia Station traverse this delta and crossed the meandering Pasig River at three (3) locations near Paco Station and Sta. Mesa Station. The combination of these conditions makes these segments of NSRP vulnerable to flooding during major rain events and high tides.

545. Overall, the NSRP Alignment was intersected by rivers and streams at 35 locations as set out in Table 3.2.1.

546. The NSRP Alignment from Mamatid Station to Gulod Station runs parallel to a major irrigation canal.

547. Figure 3.2.2 shows the plot of the 35 river or drainage crossings. The large scale topographic maps showing the position of the river or stream crossings and the trace of the particular drainage system which will be intersected are found in **Annex 3-2.**

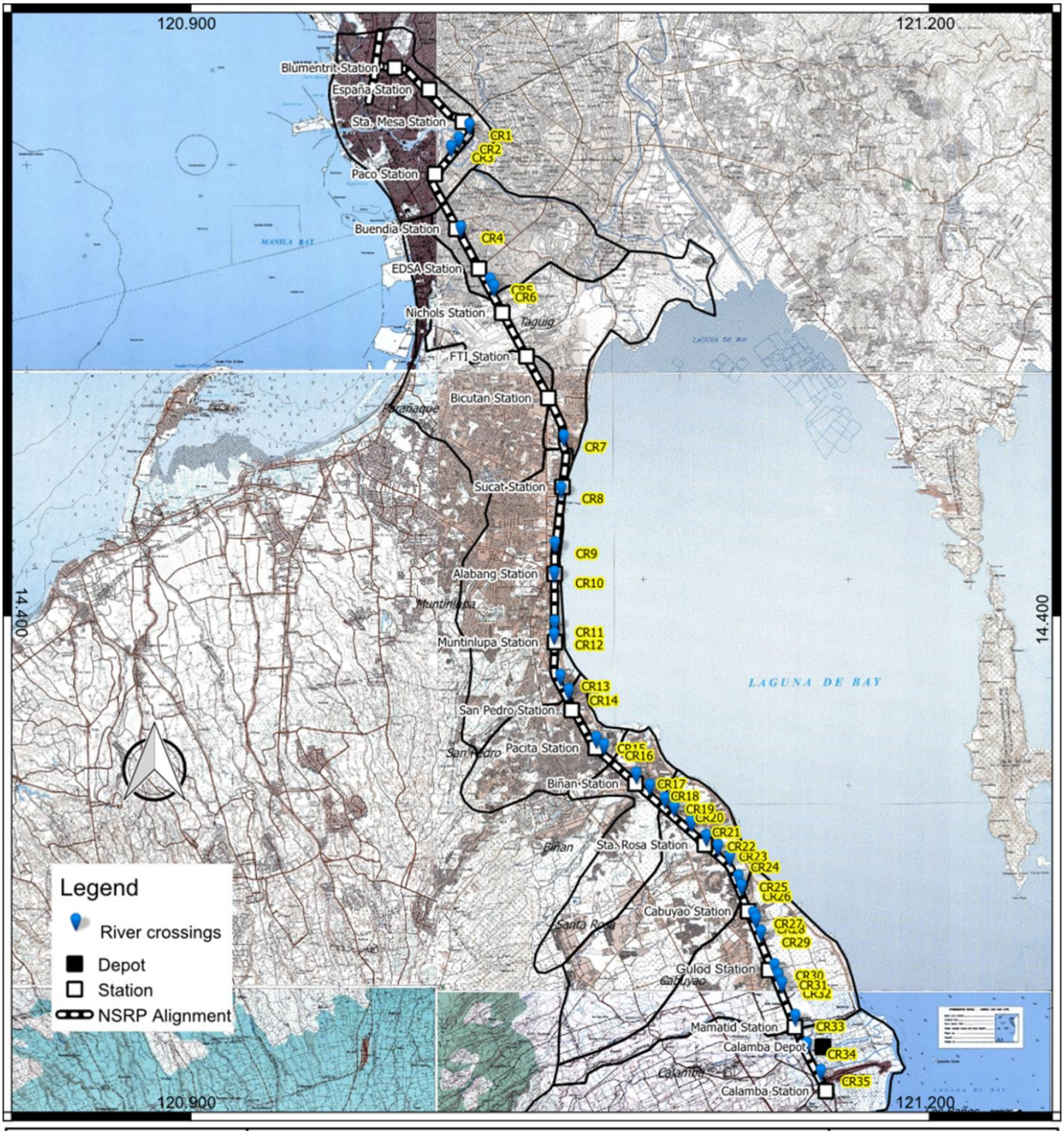


Source: http://hywr.kuciv.kyoto-u.ac.jp/ihp/riverCatalogue/Vol_05/9_Philippines-4.pdf
(Date retrieved: April 11, 2018)

Figure 3.2.1 Pasig-Marikina-Laguna de Bay Rivers and Sub-basins

Table 3.2.1 NSRP Alignment and Corresponding River/Stream Crossings

Segment	No. of River/Stream Crossings	Designation	River/Stream Name	Latitude	Longitude
Solis to Blumentritt	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Blumentritt to Espana	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Espana to Sta. Mesa	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Sta. Mesa to Paco	3	CR1	Pasig River	14° 35' 42.1764"	121° 0' 47.232"
		CR2	Pasig River	14° 35' 21.9516"	121° 0' 31.4964"
		CR3	Pasig River	14° 35' 10.1256"	121° 0' 20.4948"
Paco to Buendia	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Buendia to Pasay Road	1	CR4	No Name	14° 33' 12.3264"	121° 0' 34.5168"
Pasay Road to Edsa	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Edsa to Nichols	2	CR5	No Name	14° 31' 56.2476"	121° 1' 17.7132"
		CR6	No Name	14° 31' 46.0128"	121° 1' 23.2248"
Nichols to FTI	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
FTI to Bicutan	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Bicutan to Sucat	1	CR7	No Name	14° 28' 6.7692"	121° 3' 5.3172"
Sucat to Alabang	2	CR8	No Name	14° 26' 51.1692"	121° 3' 1.3644"
		CR9	Mangangate River	14° 25' 30.7128"	121° 2' 52.1052"
Alabang to Muntinlupa	2	CR10	Bagonan River	14° 24' 47.6928"	121° 2' 51.4536"
		CR11	No Name	14° 23' 35.7144"	121° 2' 51.7452"
Muntinlupa to San Pedro	3	CR12	Magdaong River	14° 23' 17.3616"	121° 2' 51.0432"
		CR13	No Name	14° 22' 16.7232"	121° 3' 0.3672"
		CR14	San Pedro River	14° 21' 55.8504"	121° 3' 12.2796"
San Pedro to Pacita	None	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Pacita to Biñan	2	CR15	No Name	14° 20' 45.5784"	121° 3' 52.758"
		CR16	No Name	14° 20' 35.3472"	121° 4' 3.9684"
Biñan to Sta. Rosa	6	CR17	Biñan River	14° 19' 53.7888"	121° 4' 51.2364"
		CR18	No Name	14° 19' 36.1128"	121° 5' 11.0112"
		CR19	No Name	14° 19' 17.0904"	121° 5' 33.2196"
		CR20	No Name	14° 19' 4.7892"	121° 5' 46.752"
		CR21	Sta. Rosa River	14° 18' 43.2864"	121° 6' 11.6064"
		CR22	No Name	14° 18' 22.4064"	121° 6' 33.5952"
Sta. Rosa to Cabuyao	4	CR23	No Name	14° 18' 7.7256"	121° 6' 50.6232"
		CR24	No Name	14° 17' 52.3248"	121° 7' 7.9644"
		CR25	No Name	14° 17' 22.9776"	121° 7' 20.4816"
		CR26	Cabuyao River	14° 17' 9.6504"	121° 7' 25.1004"
Cabuyao to Gulod	3	CR27	No Name	14° 16' 29.352"	121° 7' 42.2436"
		CR28	No Name	14° 16' 21.7056"	121° 7' 45.93"
		CR29	No Name	14° 16' 2.2836"	121° 7' 53.4972"
Gulod to Mamatid	4	CR30	No Name	14° 15' 13.5144"	121° 8' 13.2612"
		CR31	No Name	14° 14' 59.7732"	121° 8' 18.726"
		CR32	No Name	14° 14' 47.4756"	121° 8' 24.0936"
		CR33	No Name	14° 13' 59.2248"	121° 8' 43.5408"
Mamatid to Calamba	2	CR34	San Cristobal River	14° 13' 18.5124"	121° 9' 0.3636"
		CR35	San Juan River	14° 12' 38.8332"	121° 9' 21.0132"



Source: Geosphere 2018

Figure 3.2.2 Plot of the Major River or Stream Crossings with Respect to NSRP Alignment

(2) Drainage System

Manila City

548. Manila and suburbs is divided into two (2) areas by the Pasig River; namely, North Manila and its suburbs and South Manila and its suburbs. With a total length of about 25 km, the river provides the main drainage that links the Manila Bay with Laguna Lake.

549. The drainage and flood control system in the city is made up of the drainage main and laterals. The drainage is made of concrete pipes and culverts. The average size of concrete pipes for the drainage main in 30 inches in diameter and the culverts are from a minimum size of 1 m x 1 m to a maximum size of 1.60 m x 1 m. The laterals, on the other hand, are made of concrete pipes with an average diameter of 18 inches.

550. There are thirteen (13) existing pumping stations with flood gates, two (2) independent flood gates and thirteen (13) major esteros as listed in Table 3.2.2. Table 3.2.3 shows the inventory of flood control structures and related facilities.

Table 3.2.2 Pumping Stations (PS) and Independent Floodgates (IF), 1997

Name of Pumping Station Independent Flood Gate	Total Pump Capacity (cms)	Fuel Storage Capacity (L)	Gate Width	Drainage Area (ha.)	Locations (Mouth of Esteros/Mains)
Aviles PS	14.1	55,000		365	Esteros de Sampaloc
Quiapo PS	9.5	52,700		225	Elizondo St., Quaipo
Valencia PS	10.5	50,400		246	Estero de Valencia, Sta. Mesa
Binondo PS	11.6	40,900		279	Estero de Bonondo
Paco PS	7.59	29,900		182	Estero de Paco
Pandacan PS	4.4	24,600		180	Estero de Pandacan
Sta. Clara PS	5.3	25,600		133	Estero de Sta.Clara, Sta. Ana
Tripa de Galina PS	56	95,000		1,769	Estero dele Tripa de Galina
Balete PS	2.5			52	Romualdes St., Ermita
Escolta PS	1.5	9,500		Included with Binondo PS	Estero dela Reina, Sta. Cruz
Vitas PS	32			578	Estero de Vitas, Tondo
Balut PS	2			49	Rodriguez St., Tondo
San Andres PS	19			365	Inviernes St., Sta. Ana
Padacan IF			4	37	Beata S., Pandacan
Sante Banez IZ			10	30	Cristobal St., Paco

Source: MCLUPZO (2005-2020), Manila City

Table 3.2.3 Inventory of Flood Control Structures and Related Facilities

Area	Drainage Pipe (lm)	Box Culvert	Lined/Open Earth Canal	Manhole	Inlet	Catch Basin
North Manila	115,594.70	9,428.40	4,369	6,938	1,634	2,614,1,026
South Manila	73,666.21		25,696	3,042	2,867	
Total	**189,260.91**	**9,428.40**	**30,065**	**9,980**	**4,501**	**3,640**

Area	Mains		Outfall		Interceptor	
	Number	Length (lm)	Number	Length (lm)	Number	Length (lm)
North Manila	15	12,874.80	1	866	1	2,943
South Manila	7	6,440.10				
Total	**22**	**19,314.90**	**1**	**866**	**1**	**2,943**

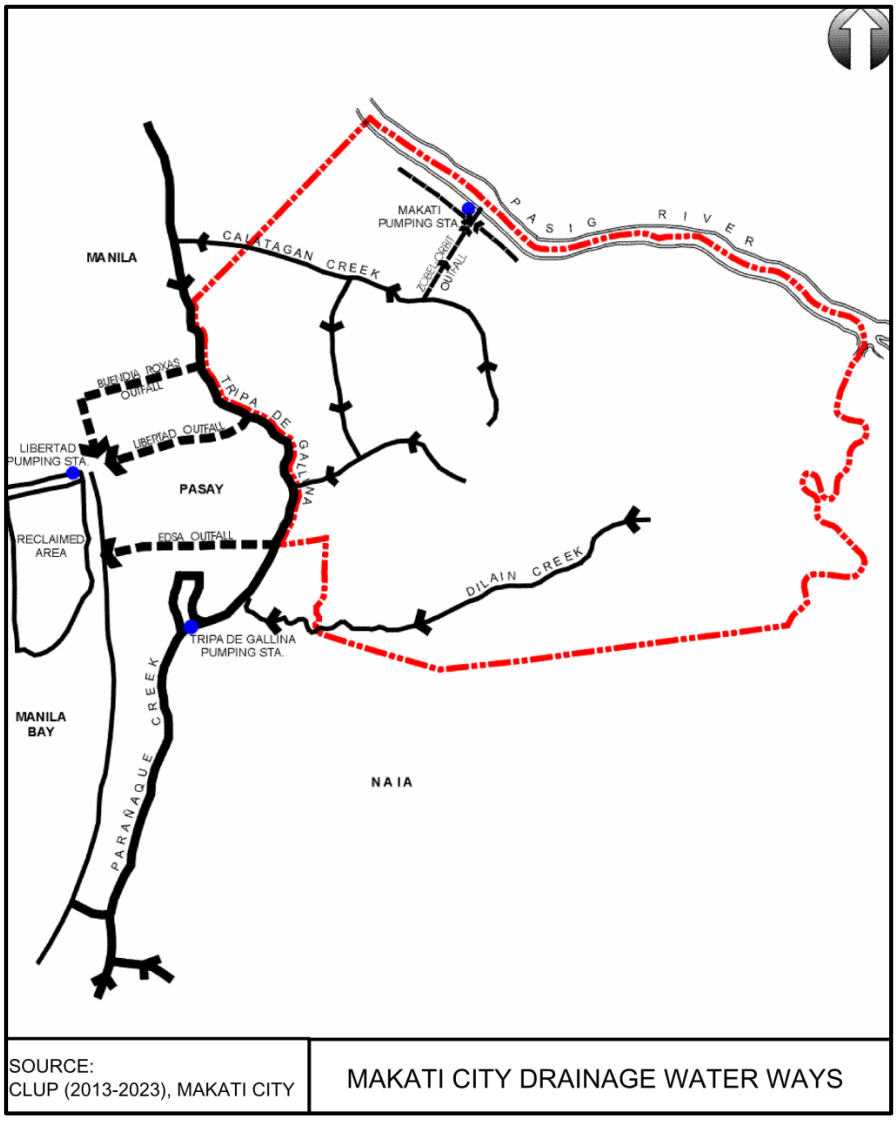
Source: MCLUPZO (2005-2020), Manila City

Makati City

551. There are seven low-lying barangays in Western Makati that are flood-prone: Singkamas, Tejeros, La Paz, San Antonio, Palanan, San Isidro, and Pio del Pilar. Insufficient drainage infrastructure connections and indiscriminate dumping of garbage on waterways cause flooding in these areas.

552. The city has four (4) types of drainage systems. These include open canal, covered open canal made of concrete, concrete hollow block walling, reinforced concrete covered pipe, and box culvert. Domestic and industrial wastes are discharged into storm drains and ultimately into the nine (9) rivers and creeks that extend from Del Pan Street to San Jose, Guadalupe as shwn in Figure 3.2.3.

553. Among the flood-prevention measures being taken in Makati is the operation of the Makati Pumping Station. This station serves the barangays of Poblacion, Valenzuela, and Bel-Air. It operates by collecting storm water and sewage through three (3) main channels: (a) the Makati Headrace I which serves barangay Olympia from the north, (b) the Makati Headrace II from the south serving barangay Poblacion in the southeast, and (c) the Zobel-Orbit main which serves Bel-Air in the southwest. The Zobel-Orbit main also diverts floodwater and sewage from Santa Clara Creek to the retaining pond, from which these are pumped into Pasig River.



Source: CLUP (2013-2023), Makati City

Figure 3.2.3 Makati City Drainage Water Ways Map

Taguig

554. As of 2016, Taguig pumping station, located along C-6 at Taguig-Pateros drainage channel, has eight (8) units of submersible axial flow pumps that siphon 24 cubic meters of water per second. It covers about 1,423 ha drainage area and serves approximately 8,700 m of estero.

555. Labasan drainage area is also located in Taguig. The drainage area served by the pumping station is 594 ha. The total installed pumping capacity is 9 m3/sec. The pumped water is drained into Laguna de Bay. The current pumping capacity is not sufficient to prevent flooding during a two day design rainstorm with a return time of 10 year, when about 25% of the drainage area gets flooded. It is proposed during PY1 to increase the pumping capacity to 32 m3 /sec.

Parañaque City

556. According to 2012 CLUP of Parañaque, several areas are considered flood-prone due to clogged drainage. These are: a portion of F.B. Harrison cor. Aguarra St. and Redemptorist Road Quirino Ave. in Baclaran and Monte Carlo (Fatima St.) in San Antonio. It was noted that these areas are not considered as impact areas in the NSRP.

Muntinlupa City

557. According to the 2016 Ecological Profile of the City of Muntinlupa, rivers and other tributaries collectively drain water into Laguna De Bay. Most of these river ways mark the natural boundary of the separation of each barangay. Like any continually developing areas, some river ways have already been covered by developments, which in turn is the reason why there is evident flooding on some parts of the city. This is aside from the fact that most of these river ways are already polluted and clogged.

558. The drainage system of the city includes the ditch/culvert along the national road from Tunasan to Sucat and Arandia St. and Rodriguez St. in Tunasan.

San Pedro City

559. The primary drainage system is the San Pedro River. The direction of flow is from higher elevation areas in the west to lower elevation areas in the east towards Laguna de Bay.

560. The River System is not enough to effectively drain the large urban area of the municipality. Flooding occurs due to inadequate drainage facilities. Inundation is a common occurrence in the lower elevation areas most notably in the easternmost part of San Pedro near Laguna de Bay. These are barangays Cuyab, San Roque, and Landayan. The low-lying characteristic of this area makes it vulnerable to inundation due to the rise of water levels. Other factors such as the presence of structures along the waterways contribute to the flooding problem. Areas of higher elevation generally have no problem with flooding.

561. Private subdivisions are required to have their own drainage systems. However, this has not been confirmed and location of drainage outfalls is not determined.

562. Past irrigation systems for agricultural use may have been used for drainage upon land conversion.

Biñan City

563. A combination of circular and rectangular channels is the existing drainage system in the entire City of Biñan. Most of the system is closed and entirely of pipe. Flooding in low-lying areas are caused by insufficiency of drainage structures, while some others are damaged. Informal settlers have also encroached river banks (2018-2027 CLUP Volume II, Biñan City).

Sta. Rosa City

564. Santa Rosa River at the western boundary, the Diezmo and Cabuyao Rivers at the eastern side, and the Laguna de Bay serve as receiving water bodies for storm water runoff. A system of storm drainage systems in the urban areas, residential areas and industrial estates convey runoff to these natural water bodies. These consist of reinforced-concrete pipes, open canals (either lined or unlined), and reinforced-concrete rectangular culverts. Flooding is limited to tidal flooding in the lakeshore areas and river overflows. An area of around 50 ha within the Diezmo River Irrigation System is prone to flooding (2000-2015 CLUP, Sta. Rosa City).

Cabuyao City

565. Drainage and Sewerage. The absence of a modern sewerage system suggests that the creeks and rivers leading to Laguna de Bay receive all liquid wastes. Provided there are no hazardous effluents, the lake can still digest domestic wastes given primary treatment through individual septic tanks (Ecological Profile of Cabuyao City).

Calamba City

566. Based on the result of public-access flood hazard mapping, 59.07% (228.2 has) of Brgy. Pansol, Calamba area was determined to have high hazard to flooding, while 10.30% (37.39 has) and 23% (88.5 has) have moderate and low hazard to flooding, respectively. The remaining 7.63 % (24.49 has) was not prone to flooding. Interviews with residents, resort owners, business establishment owners and barangay officials were done to identify the social perspective as to why flooding occurs in their locality, typhoons and rainfall events which caused flooding and specific areas which are most affected by flood. Findings suggest poor drainage system as one of the contributing factors to flooding aside from low elevation.

(3) Stream and Lake Water Depth

567. The minor waterway crossings have estimated water depths of less than or equal to 30 centimeters (**cm**). The major crossings at Pasig, Biñan, Sta. Rosa, Cabuyao, San Cristobal and San Juan have inferred water depths greater than 30 cm. These conditions are expected to increase during the rainy season. The average depth of Laguna de Bay is 2.5 m[17].

(4) Flooding

568. 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.

569. **Table 3.2.4** shows the summary of the situation and damage of major recent floods which occurred in Metro Manila.

Table 3.2.4 Summary of the Situation and Damage of Major Recent Floods Occurred in Metro Manila

Typhoon Name/ Date	Situation and Damage
Typhoon 'Rosing' November 1995	Typhoon 'Rosing' brought strong winds and heavy rainfall that flooded the Marikina Valley and the low-lying shoreline areas of Laguna Lake because of the overflowing of the Marikina River and the high Laguna Lake water stage. The flood killed 21 persons and injured 253. Affected families were 109,254 or 519,030 persons. Damage for infrastructure was estimated at 71 million pesos.
Typhoon 'Loleng' October 1998	More than 900 families living along the Pasig River, Pateros Creek, Marikina River and Napindan River were swamped by flood caused by Typhoon 'Loleng', measuring 1 to 2 m. At least eighteen (18) low-lying barangays on or near the Pasig River and its tributaries were submerged under waist- and knee-high floodwaters.
Typhoon 'Seniang' November 2000.	The extensive flood was brought about by Typhoon 'Seniang' in early November 2000. The depth of inundation ranged from 0.2 m to 6 m. The highest flood levels in the following municipalities were Marikina City where flood waters ranged from 1 m to 5.5 m, Quezon City where sixteen (16) barangays were suffered from floods of more than 1 m with the highest at 6 m, San Juan City where the flood waters were ranged from 1 m to 3 m, Rodriguez where five (5) of eight (8) barangays are under 1.5 m deep of water level at the deepest of 6 m. The flood affected total of 22,174 families or 93,961 persons with ten (10) people confirmed dead and trn (10) injured. Number of evacuated families was 10,055 (53,310 persons). Total damage was estimated at 129 million pesos.

[17] http://www.llda.gov.ph/index.php?option=com_content&view=article&id=74&Itemid=475

Typhoon Name/ Date	Situation and Damage
Typhoon 'Aere' and Typhoon 'Chaba' August 25, 2004	Massive floods and landslides occurred on August 25, 2004 resulted from the continuous heavy rains accompanying typhoon 'Aere' and typhoon 'Chaba' affected thirteen (13) cities and two (2) towns in Metro Manila, mostly in Quezon City, in addition to nearby provinces. The flood affected total of 4,392 families or 24,108 persons with eight (8) people confirmed dead and three (3) injured. For two consecutive days, Metro Manila experienced moderate to heavy rains that caused the submergence of lowland areas.
Tropical Storm 'Ondoy' September 26, 2009	damages Tropical Storm 'Ondoy' brought a heavy rain and caused devastating flood disasters in Regions I, II, III, IV-A, IV-B, V, VI, IX, XII, ARMM, CAR and NCR (Metro Manila) on September 26, 2009. The heavy rainfall of 455 mm/day observed at Science Garden in Quezon City brought a huge volume of flood discharge along the Pasig-Marikina River, resulting in the death/missing of about 500 people and causing massive

Source: JICA, The Preparatory Study for Pasig-Marikina River Channel Improvement Project (Phase III) Final Report Vol. 3 (October 2011)

570. The 1:50,000 geohazard maps prepared by the MGB classifies susceptibility to flooding into three (3). "Areas with Low Susceptibility to Flooding experience floods with heights less than or equal to 0.5 m. Areas with Moderate Susceptibility to Flooding attain flood heights from 0.5 to one (1) m. Areas with High Susceptibility to Flooding attain flood heights greater than one (1) m."[18]

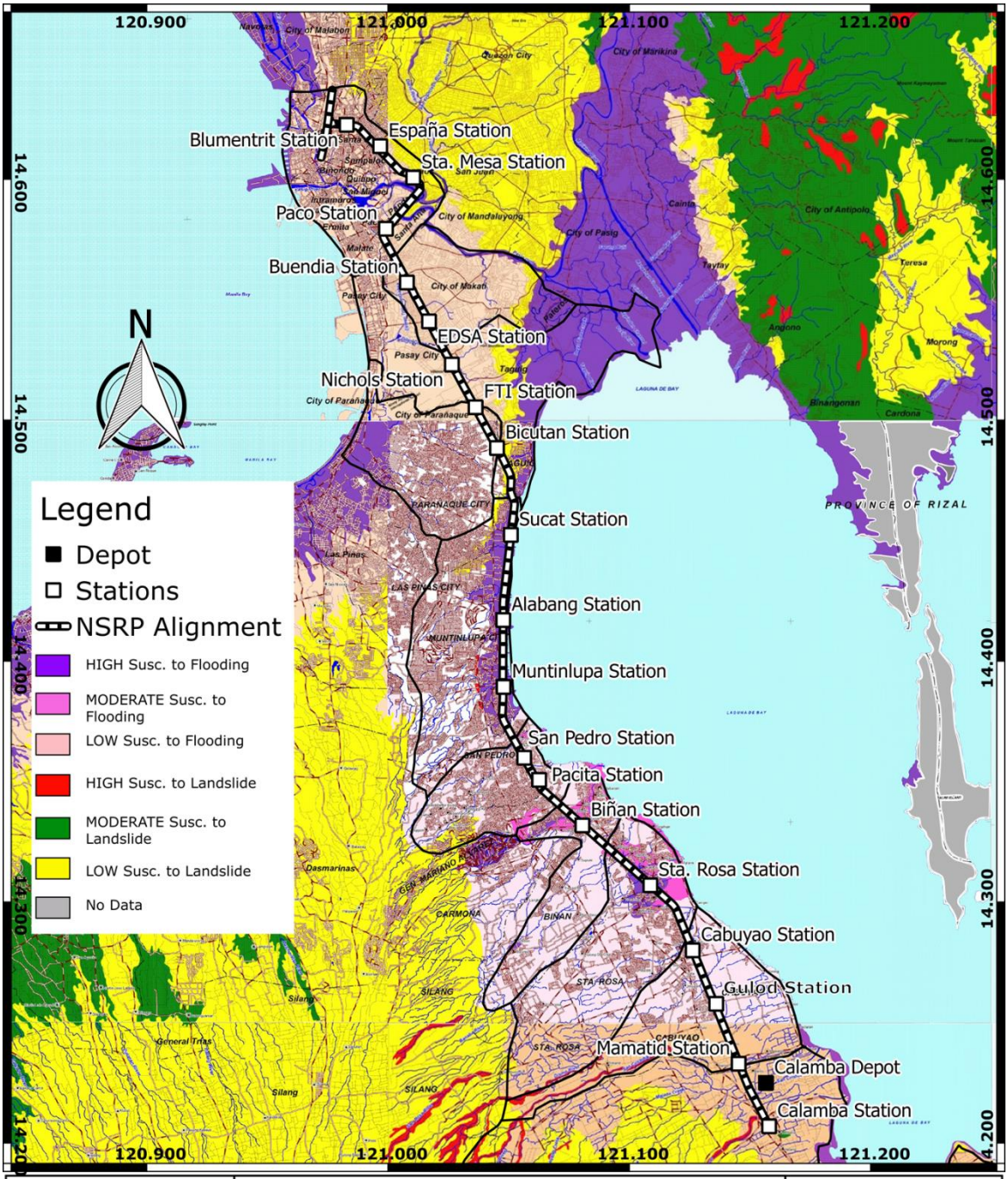
571. In general, the NSRP segments from Solis Station to Bicutan Station have low susceptibility to flooding with the exception of the immediate banks of the main channel of the meandering Pasig River which has high susceptibility. This high susceptibility affects the segment from Paco Station to Sta. Mesa Station.

572. The NSRP segment from Taguig to San Pedro has high susceptibility to flooding. This area falls within the Laguna Lakeshore which is affected by the rise in lake levels during major rain events.

573. The segment from San Pedro Station to Biñan Station has 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.

574. The segment from Sta. Rosa Station to Calamba has low susceptibility to flooding. The coastal area of Calamba from Baclaran to Bucal has high susceptibility to flooding. The railway segment in these areas is located above these flood prone sections of the LGU. Figure 3.2.4 shows the NSRP line with respect to the Flood and Landslide Susceptibility map of the MGB for Southwest Luzon (NCR, Region IV-A).

[18] As described in the legend of the Landslide and Flood Susceptibility Maps published by MGB.



Source: Mines and Geosciences Bureau, 2010

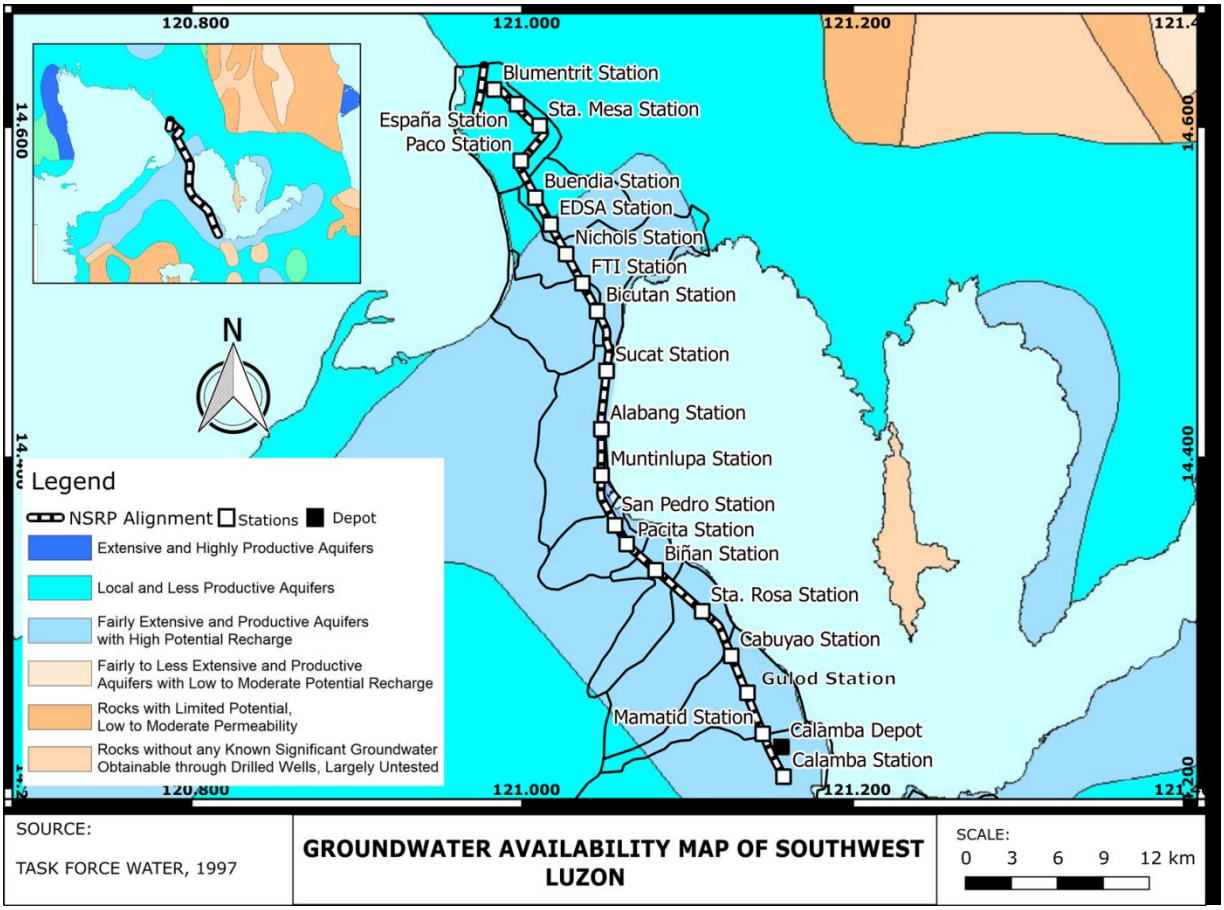
Figure 3.2.4 Flood Susceptibility Map of Southwest Luzon (NCR, Region IV-A)

3.2.1.2 Hydrogeology

575. The 1997 Groundwater Availability Map of the Philippines shows that the NSRP Line from Solis Station to Pasay Road Station will traverse an area classified under "Local and Less Productive Aquifers". The segment from EDSA to Calamba City falls under "Fairly Extensive and

Productive Aquifers" as can be reflected in Figure 3.2.5. Groundwater occurs under unconfined conditions within the interstices of the two (2) cited classifications. In both cases, water table could be intersected from about 3 to 18 m below the ground surface. Water is extracted through shallow tube wells which are pumped manually or with the aid of low capacity centrifugal pumps. Yield from these shallow wells are used mainly for washing.

576. 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.



Source: Task Force Water, 1997

Figure 3.2.5 The NSRP Alignment as situated in the Groundwater Availability of Luzon

3.2.1.3 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Drainage Morphology / Inducement of Flooding/Reduction in Stream / Volumetric Flow

The NSRP alignment goes through the flood prone zone of Metro Manila and Laguna area.

577. In addition to the flood history in the NSRP alignment area, flood projections of PAGASA for 2020 and 2050 will have to be considered. This has predicted that rainfall increase is likely during the southwest monsoon (June-July-August) season until the transition (September-October-November) season in most areas of Luzon and Visayas, and also, during the northeast monsoon

(December-January-February) season, particularly, in provinces/areas characterized as Type II climate in 2020 and 2050.

578. Extreme rainfall events (heavy daily rainfall) will continue to become more frequent, extreme rainfall is projected to increase in Luzon and Visayas only, in 2020 and 2050. The projected seasonal rainfall change in 2020 and 2050 under the medium-range emission scenario in NCR and Laguna is presented in Table 3.2.5.

Table 3.2.5 Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7
Laguna	629.2	386.8	845.0	1066.5	-20.2	-31.5	2.9	2.9	0.1	-34.8	6.8	0.4

Source: Climate Change in the Philippines, 2011 PAGASA

The NSRP Project will not bring about any change in the flow of the intersected rivers.

579. Pre-construction and construction activities may temporarily aggravate the flooding problem if not implemented properly. Improper handling, storage and hauling of demolition debris/excavated materials and solid wastes, particularly along station locations may clog existing drainage systems and block creeks, canals and other waterways. Due to the construction of impervious structures such as the viaducts and bridge piers, stormwater run-off may increase that would change the flood storage capacity of waterways and its floodplains. A proper temporary drainage system shall be installed for the Project in order to address the issue on flooding. Minimizing the removal of vegetation and alternation of topography during pre-construction would alleviate the problem as this would preserve the natural drainage system of the area.

580. Given that flooding is an existing environmental problem in the project area, the proponent will ensure that appropriate measures are put in place and strictly complied with. The proponent will prepare and implement a Construction Management Plan indicating the contractor's commitment to proper disposal of demolition debris, construction spoils and solid wastes. These materials will not be put anywhere near watercourses and areas where it could be carried away into low-lying areas of the Project or into the drainage system. Solid wastes will be collected and disposed in accordance with RA 9003.

581. Erosion controls such as vegetation on slope and silt traps will be implemented to address the issue. Upon the completion of the Project, the contractor will take care of the disposal of all debris and waste materials into an appropriate designated area. The contractor will initiate erosion control measures before major earthmoving works begin.

582. Aside from being a geomorphologically catch basin, another reason that aggravated the existing flooding problem of the affected areas is the blockage of natural waterways. Such a case was raised during public scoping in Calamba, Laguna. The existing pier of PNR blocks the waterway which causes sedimentation and flooding in the surrounding areas during heavy rainfall. To address this, NSRP structures will be designed to have a clearance of above established flood level and discharges and to reduce bridge piers when possible, which will be established and included in the detailed design. When necessary, sump pumps will be installed at the lowest points to pump out accumulated floodwater along the railway track. Construction of new sufficient and effective drainage system will also be incorporated. The proponent will also coordinate with DPWH how to integrate both parties' drainage plans along the project area. It is also important to share information to LGUs and incorporate their comments and inputs in the design to harmonize with existing drainage systems.

2) Change in Stream or Lake Water Depth

583. While the Project will pass through the rivers mentioned above, it will not pass through Laguna Lake. The elevation of the structures as viaducts will not in any way change the flows of water bodies like streams and rivers, nor affect the depth of these water bodies. One of the proposed sites for the NSRP station is the Sucat Thermal Power Plant (**STPP**) area which is located next to Laguna de Bay. The construction of the said station is not expected to affect the depth of the lake.

3) Depletion of Water Resources / Competition in Water Use

584. Concreting works at the stations and depot will bring about increase in water consumption. The following assumptions were made in estimating the amoint of water to be used for construction:

- 1 cubic meter of concrete will require 180 liters of water
- The 20 stations will require a concrete volume[19] of 35,200 m^3
- 30% of the depot will be paved
- 12 buildings of assumed 100 m^2 area will be constructed

585. The estimated concreting water requirement for the project during 1-year civil works aspect of construction is presented below:

- 20 stations: 6,336 m^3
- Depot: 1,922 m^3

586. The total water requirement for the estimated 1-year civil works phase of construction is about 10,310 m^3 or 28 m^3 per day spread over the 20 stations and depot. This amount is not significant and will not affect the water supply needs of the host LGUs. The domestic water consumption during construction and operation were estimated using the following:

- Pre-construction, construction and operation personnel of 200, 13,00 and 1550, respectively.
- Per capita water consumption of 100 liters per day[20]
- 22 major construction sites corresponding to the stations, depot and construction yard which translates to 619 persons per site
- 21 major operation sites corresponding to the stations and depot which translates to 120 persons per site

587. The estimated daily water consumption at the different stages of project development are presented in **Table 3.2.6**.

Table 3.2.6 Estimated Domestic Water Consumption of NSRP

Project Stage	No. of Personnel	No. of Sites	Daily consumption per site (m^3)	Total Daily Consumption (m^3)
Pre-Construction	200	1	20	20
Construction	13,000	22	59	1,300
Operation	1550	21	12	252

588. As shown, the amount of water that will be consumed during construction of NSRP is considerable which can be sourced from existing water sources of the LGUs or through drilling of 1 to 2 wells along the PNR ROW.

[19] 20 stations with platform area of 220 m x 40 m and a thickness of 0.5 m
[20] Consumption will be essentially limited to drinking and flushing of toilet and cleaning of cars

589. The water consumption during operation is not significant. In practice, the drinking water supply at each train station is bought from commercial water providers within the LGUs. Water to be used for cleaning and toilet use come from the Level III system of the LGUs.

590. Overall, the impact of the project on the water sources of the host LGUs is rated as low and not significant and will persist only during the period of construction. The mitigating measures identified include the implementation of a Water Conservation Program for the project and regular monitoring of water consumption for domestic and construction purposes.

(2) Operation phase

1) Change in Drainage Morphology / Inducement of Flooding / Reduction in Stream

591. The operation of the NSRP railway will not affect the intersected rivers and waterways. It will not contribute to the increase in the current vulnerability of the route to flooding. The NSRP will not result in the reduction of the flow of the intersected waterways. The drainage system of the Project will be properly designed and constructed. The climate change projections will be incorporated in the design of the drainage system. Regular inspection and prompt maintenance of drainage system will be implemented and when necessary, improvement and enhance of capacity will be done.

2) Change in Stream and Lake Water Depth

592. The operation of the NSRP will not affect the water depths of the intersected rivers and the nearby Laguna de Bay.

3) Depletion of Water Resources / Competition in Water Use

593. Water requirements of the NSRP will 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.

594. Drinking water of the staff/personnel will be purchased from local water providers. The stations and depot will be linked to the Level III System of the nearby water districts.

595. Accordingly, railway operations will not contribute to the depletion of the local groundwater resources or compete in water use with local residents and establishments. A water conservation management plan will be implemented. This will include utilization of recycled water and rainwater.

3.2.2 Water Quality

3.2.2.1 Groundwater Quality

596. Uncontrolled discharge of waste water or water-borne contaminants from NSRP operation may percolate into ground and deteriorate the quality of the local groundwater, limiting the use of the local groundwater. The construction of the railway columns down to the bedrock for elevated viaducts and bridges may encounter groundwater at shallow depths. The groundwater in column holes may be pumped out and may affect the nearby surface water. In addition, the quality of groundwater may influence the choice of material quality of the columns. These situations make the assessment of the existing or baseline groundwater quality relevant in this study.

(1) Field Survey

597. Groundwater samples were collected on February 12-14, 2018 to assess the physico-chemical properties of the groundwater within the vicinity of the Project site. Eight (8) groundwater sampling stations were established for the proposed NSRP: four (4) in Metro Manila and four (4) in Laguna. The groundwater samples were collected at eight (8) tube wells as shown in Table 3.2.7 and Figure 3.2.6.

598. Primary data on groundwater quality in the various locations along the prospect alignment were generated from eight (8) groundwater sampling sites near the PNR stations in Solis, Buendia, Sucat, Alabang, Biñan, Cabuyao and Calamba. It was in the presumption that groundwater occurs in a great span at varying quality along the proposed 70-km alignment; hence, the results of groundwater sampling from the different sources are taken as examples of the groundwater quality along that alignment. More sampling sites may be established depending on the need for the proposed physical development. Locating the sources of groundwater at shallow depths was one constraint because the use of the shallow tube wells is no longer popular in highly developed areas relying on local water utilities.

599. The water samples were collected after sufficient purging of wells. The samples for the analysis of microbes were collected into sterilized small glass bottles and wrapped with aluminum foil. The samples for the analyses of organics were collected into amber glass bottle. The samples for the analysis of other parameters were collected into Polyethylene Terephthalate (**PET**) bottles. The collected groundwater samples were labeled, stored in ice-chest and submitted to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City, Metro Manila to measure the levels of 21 water quality indicators as follows:

- Primary Parameters: Color, Chloride (**Cl**), Nitrate as Nitrogen (**NO3-N**), Fecal Coliform
- Secondary Parameters: Inorganics: Sulfate (**SO4**), Metals: Arsenic (**As**), Cadmium (**Cd**), Chromium Hexavalent (**Cr+6**), Lead (Pb), Total Mercury (**Hg**), Organics: Cyanide (**CN**)
- Others: Total Coliform, Calcium (**Ca**), Magnesium (**Mg**), Sodium (**Na**), Potassium (**K**), Bicarbonate (**HCO3**)

600. The Temperature, pH, Conductivity, Total Dissolved Solids (**TDS**) were measured on-site using a calibrated Thermo Scientific Orion Star A329 Water Quality Meter. Out of the 21 parameters measured, sixteen (16) are covered by PNSDW and DAO 2016-08. These are color, temperature, pH, Fecal Coliform, Total Coliforms, TDS, Na, Cl, SO4, and NO3-N, As, Cd, Cr +6, Pb, Hg, and CN.

Table 3.2.7 Groundwater Quality Sampling Stations

Water Source Code	Description	Geographic Coordinates	Depth	Well Age or Year Installed	Water Usage
GW-1	Hand pump tube well in front of 742E Interior 7, Benita St. Zone 16, Barangay 185, Gagalangin Tondo, Manila City (near Solis PNR Station)	14° 37' 47.00" N, 120° 58' 33.10" E	10 pipes (120 ft., 36.4 m)	2009 or 2010 (8 years)	Community well, for clothes washing
GW-2	Hand pump tube well in front of 6857 Washington St., Barangay Pio del Pilar, Makati City (near Buendia PNR Station)	14° 33' 10.02" N, 121° 00' 41.45"E	No data	1998 or 1999 (20 years)	Community, used only when there is no water from local water utility
GW-3	Hand pump tube well in front of 6857 Washington St., Barangay Pio del Pilar, Makati City (Sucat PNR Station)	14° 27' 04.38" N, 121° 03' 05.83"E	No data	No data	Not for drinking
GW-4	Hand pump tube well inside a house in Montillano St. Purok 4, Alabang, Muntinlupa City (near Alabang PNR Station)	14° 25' 12.59" N, 121° 02' 52.55"E	7 pipes (140 ft., 42.5 m)	2005 (13 years)	Cooking, bathing, washing
GW-5	Hand pump tube well in front of 186 Barangay. San Vicente, Biñan Laguna (near Biñan PNR Station)	14° 19' 51.68" N, 121° 04' 54.80"E	No data	Over 100 years	Drinking when boiled, cooking, bathing, washing
GW-6	Hand pump tube well in front of a house in Alipit St., Purok Uno, Bgy. Bigaa Cabuyao City (near Cabuyao PNR Station)	14° 16' 50.36" N, 121° 07' 34.69"E	4 pipes (80 ft, 24.3 m)	No data	Community well, For cooking, washing
GW-7	Hand pump tube well in front of a house in Criscor Homes, Bgy. Uno, Calamba Laguna (near Calamba PNR Station)	14° 12' 28.89" N, 121° 09' 30.14"E	No data	No data	Community well, not regularly in use
GW-8	Hand pump tube well at an apartment back (north) of the PNR Station office, Barangay Mayondon, Los Baños, Laguna (near Los Baños PNR Station)	14° 10' 55.30" N, 121° 14' 24.95"E	No data	No data	Not in use

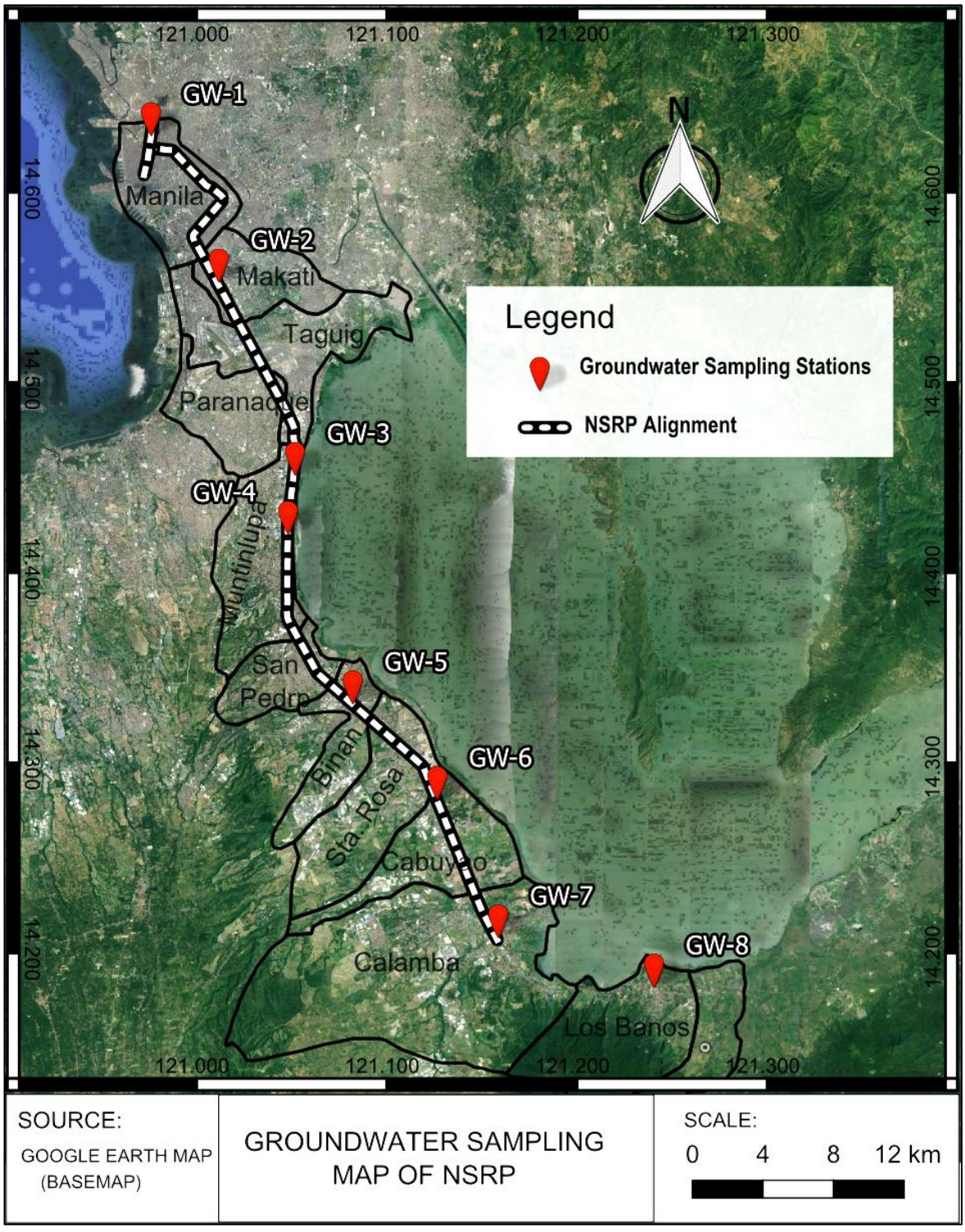


Figure 3.2.6 Groundwater Quality Sampling Stations

(2) Applied Standard

601. The DOH Administrative Order (**DAO**) No. 2017-0010 otherwise known as Philippine National Standards for Drinking Water (**PNSDW**) of 2017 was adopted, as well as the DAO 2016-08, which adopts the water quality guidelines for surface water, with modification, based on intended beneficial use, as follows:

- Class A for source of potable water and other domestic use;
- Class B for bathing and other primary contact recreation; and
- Class C for irrigation, fish culture and livestock watering.

602. Table 3.2.7 shows the comparison of applicable national and international standards on groundwater quality. The international standards used in comparison with Philippine standards are the WHO Guidelines for Drinking-Water Quality (2011). For Further detail criteria to be referred to Chapter 2, 2.6.4 Groundwater.

(3) Results and Analysis

603. Known well depths of the tubes in Solis (GW-1), Alabang (GW-4), and Cabuyao (GW-6) range from 24-42 m. Known ages range from 8 to 100 years. Usage varies from community drinking water supply, cooking, bathing and washing. The wells in Buendia (GW-2), and Los Baños (GW-8) are not regularly in use. The wells yielded clear water (with persistent brown particles in Los Baños or GW-8). Odor ranged from no objectionable odor to objectionable odor. Bubbles, an indicator of significantly polluted water (from cleaning substances) appeared in the samples from Solis (GW-1) and Buendia (GW-2). Drinking water generally comes from the commercial "mineral" water or from the local water utility

604. Collectively, there was a high 84% conformance of the eight sampling sites with sixteen (16) parameters covered by PNSDW and DENR Class A guidelines. Out of 128 measurements, only twenty (20) or 14% cases of varying non-conformance by water sample were attributed to color, temperature, fecal coliform, total coliforms, TDS, Na, Cr+6, and CN. The groundwater qualities appeared to be within the current use. Similarities and trends in the major cations were also noted.

1) Results by Sampling Stations

GW-1 PNR Solis Station

605. Measured levels of pH, color, TDS, Cl, SO4, NO3-N, As, Cr, Cr+6, Pb, Hg and total coliform at Station GW-1 (PNR Solis Station) were within the PNSDW, DENR Guideline Values for Class A freshwater and World Health Organization (WHO) Guideline Values for drinking water. The level of CN, however, did not conform to the PNSDW and DENR guideline values for Class A freshwater. Also, measured level of Na was not within the PNSDW standard value of 200 mg/L for drinking waters. No objectionable odor was observed in the water samples.

GW-2 PNR Buendia Station

606. During sampling at GW-2 (PNR Buendia Station), the water temperature was not within the DENR guideline values of 26ºC - 30ºC for Class A freshwater. The color of the water showed non-conformance compared with the maximum allowable limit of 10 TCU of PNSDW but conformed to the DENR Class A guideline value of 50 TCU. The measured levels of pH, conductivity, TDS, Na, Cl, SO4, NO3-N, heavy metals (As, Cd, Cr+6, Pb and Hg) and CN were within the PNSDW, DENR guideline values and WHO guideline values for water. The levels of fecal and total coliforms showed non-conformance with DENR Class A freshwater guideline value of <1.1 MPN/100 mL for fecal coliforms and PNSDW standard value of <1.1 MPN/100 mL for total coliforms. This indicates that water is not safe for drinking unless appropriate water treatment is administered.

GW-3 PNR Sucat Station

607. The result of the water quality measurement at GW-3 (PNR Sucat Station) showed conformance with the PNSDW, DENR Guideline Values for Class A freshwater and WHO guideline values for drinking water except for the water temperature level. The water temperature measured at 30.5 ºC was not within the DENR guideline values of 26 ºC-30 ºC for Class A freshwater.

GW-4 PNR Alabang Station

608. The result of the water quality measurement at GW-4 (PNR Alabang Station) also showed conformance with the PNSDW, DENR Guideline Values for Class A freshwater and WHO Guideline Values for drinking water except for the water temperature level. The water temperature at 30.1 ºC was not within the DENR guideline values of 26 ºC-30 ºC for Class A freshwater.

GW-5 PNR Biñan Station

609. The same with stations GW-3 and GW-4, the result of the water quality measurement at GW-5 (PNR Biñan Station) also showed conformance with the PNSDW, DENR Guideline Value for Class A freshwater and WHO guideline value for drinking water except for the water temperature level. The water temperature level recorded at 30.8 ºC was not within the DENR guideline values of 26ºC-30ºC for Class A freshwater.

GW-6 PNR Cabuyao Station

610. Measured levels of pH, color, temperature, conductivity, TDS, Cations and Anions (Na, Cl, SO4 and NO3-N) and toxic and other deleterious substances (As, Cd, Cr+6, Pb, Hg and CN) showed conformance with the PNSDW, DENR Guideline Value for Class A freshwater and WHO guideline values for drinking water. The bacteriological analysis of the water, however, showed that fecal coliform is present at >8.0 MPN/100 mL which does not conform with the <1.1MPN/100 mL guideline value of DENR. The total coliform at >8.0 MPN/100 was not within the <1.1 MPN/100 mL criteria of PNSDW.

GW-7 PNR Calamba Station

611. The water quality measurement at GW-7 (PNR Calamba Station) showed conformance with the PNSDW, DENR Guideline Value for Class A freshwater and WHO guideline value for drinking water except for the water temperature level. The water temperature level recorded at 31.1 ºC during the sampling was not within the DENR guideline values of 26 ºC-30 ºC for Class A freshwater.

Groundwater Station 8

612. Measured levels of pH, color, conductivity, TDS, Cations and Anions (Na, Cl, SO4 and NO3-N) and toxic and other deleterious substances (As, Cd, Cr+6, Pb, Hg and CN) showed conformance with the PNSDW, DENR Guideline Values for Class A freshwater and WHO guideline values for drinking water. The bacteriological analysis of the water, however, showed that fecal coliform is present at >8.0 MPN/100 mL which does not conform with the <1.1MPN/100 mL guideline value set by DENR. The total coliform count at >8.0 MPN/100 did not also conform to the PNSDW. Also, the water temperature level recorded at 31.1 ºC was not within the DENR guideline values of 26 ºC-30 ºC.

Table 3.2.8 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	Domestic Use	Domestic Use	Domestic Use	Domestic Use	Domestic Use	Domestic Use	Domestic Use	Domestic 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									No				
Cations 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 (HCO3), 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 (SO4), mg/L	16	80	61	84	20	22	55	36	250	250	250	275	
Nitrate (NO3-N), mg/L	0.15	0.16	0.25	0.33	0.17	0.12	0.22	1.9	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	1
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	03
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	5
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	1
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	06
Microbes													
Fecal Coliforms, MPN/100mL	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	-	<1.1	100	200	
Total Coliforms, MPN/100mL	<1.1	17	<1.1	<1.1	<1.1	>8.0	<1.1	>8.0	<1.1	-	-	-	

Note: Highlighted results does not conform with standard

Color

613. The color ranged from <5 to 40 TCU with one case of non-conformance (40 TCU of GW-2 Buendia) compared with the maximum allowable limit of 10 CU of PNSDW, but conforming with the 50 TCU of DENR Class A guideline (Figure 3.2.7).

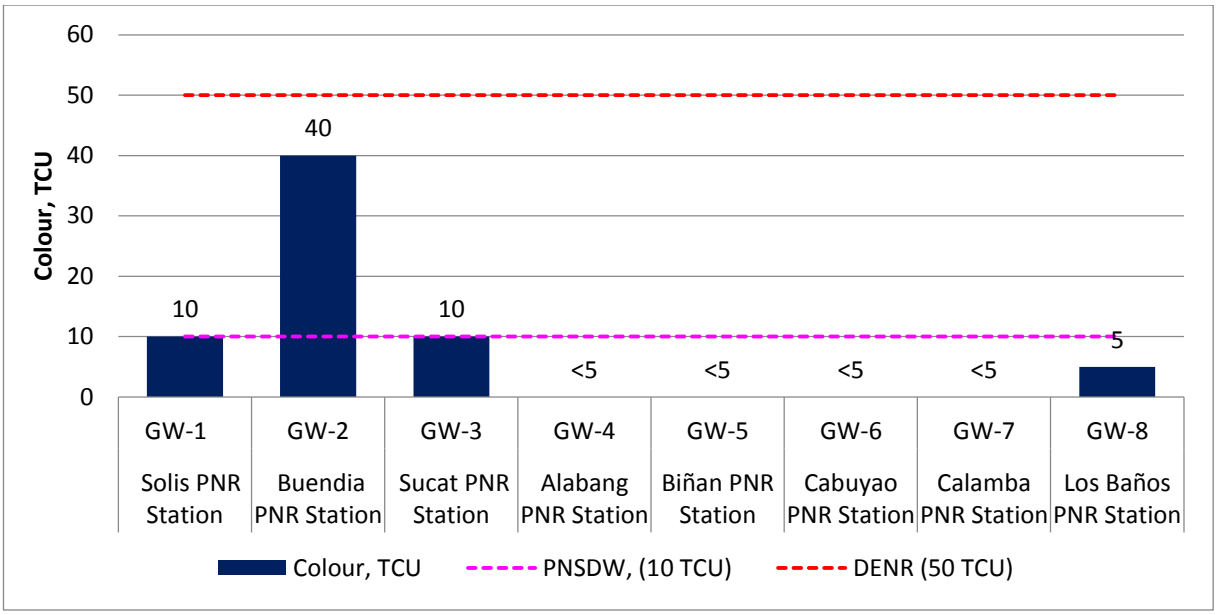


Figure 3.2.7 Results of Color Measurement of Groundwater Samples

Temperature

614. Temperature ranged from 29.4 to 31.2 ºC with five (5) cases of non-conformance with the DENR Class A 26 ºC -30 ºC guideline range. However, the values may be taken as natural levels. (Figure 3.2.8)

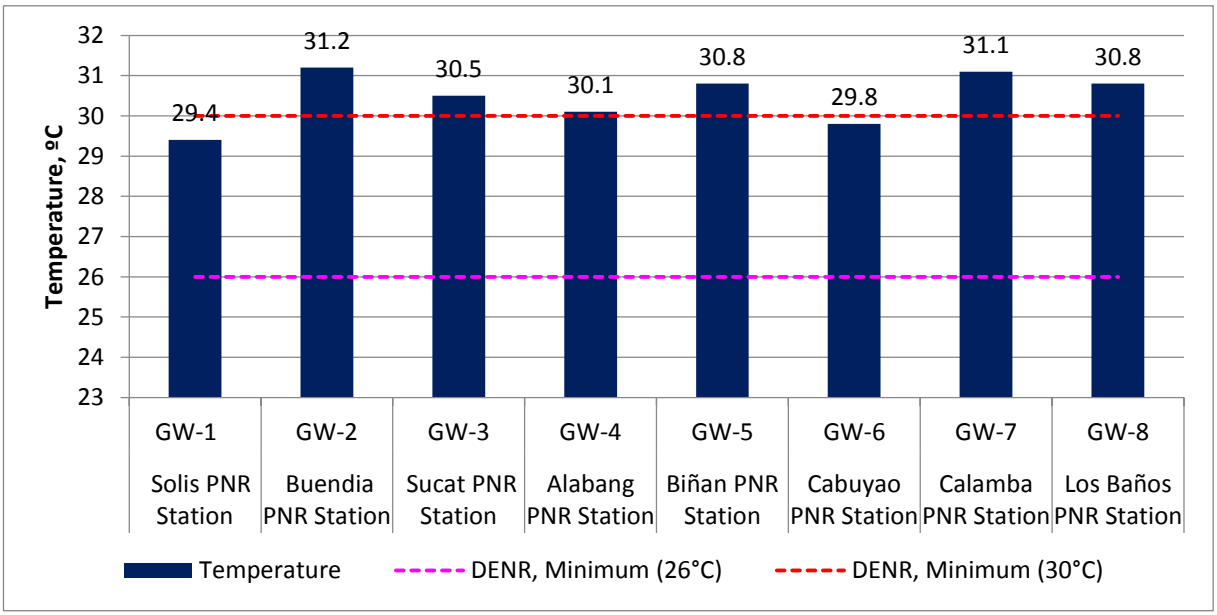


Figure 3.2.8 Results of Temperature Measurement of Groundwater Samples

pH Level

615. The pH ranged from 6.53 to 7.12 within the 6.5 - 8.5 ranged of PNSDW and DENR Class A guideline (Figure 3.2.9)

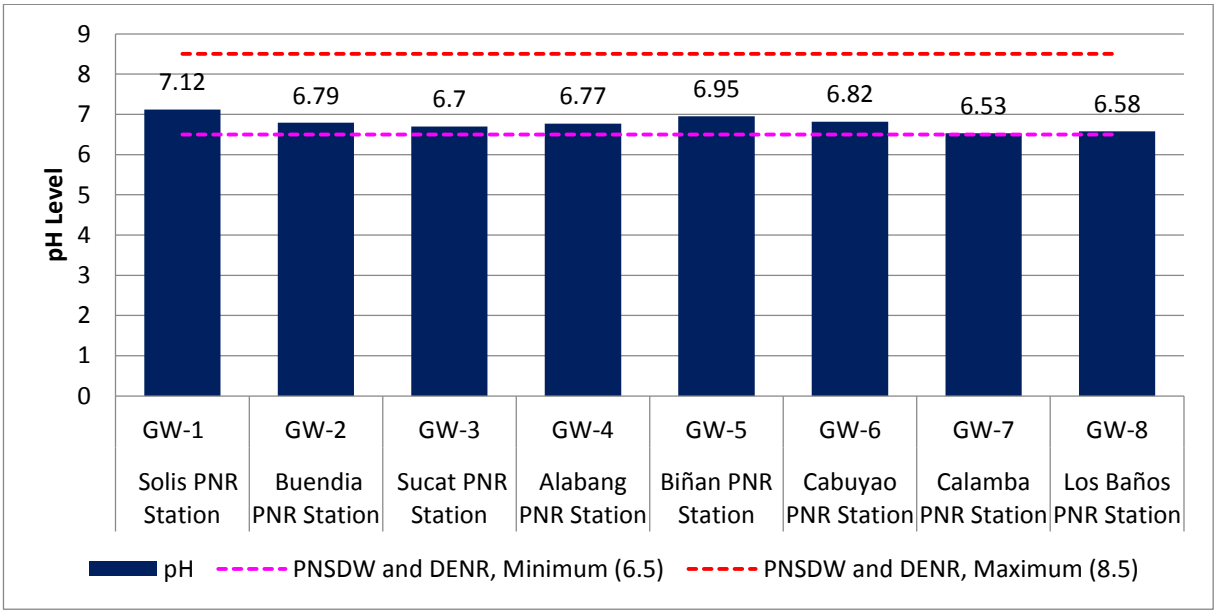


Figure 3.2.9 Results of pH Measurement of Groundwater Samples

Conductivity

616. The electric conductivity of the groundwater in the eight (8) stations ranged from 794 to 1,743 uS/cm. The highest was recorded in Sucat PNR Station (GW-3) with 1,743 uS and the lowest was in Los Baños PNR Station (GW-8) with 794 uS (Figure 3.2.10)

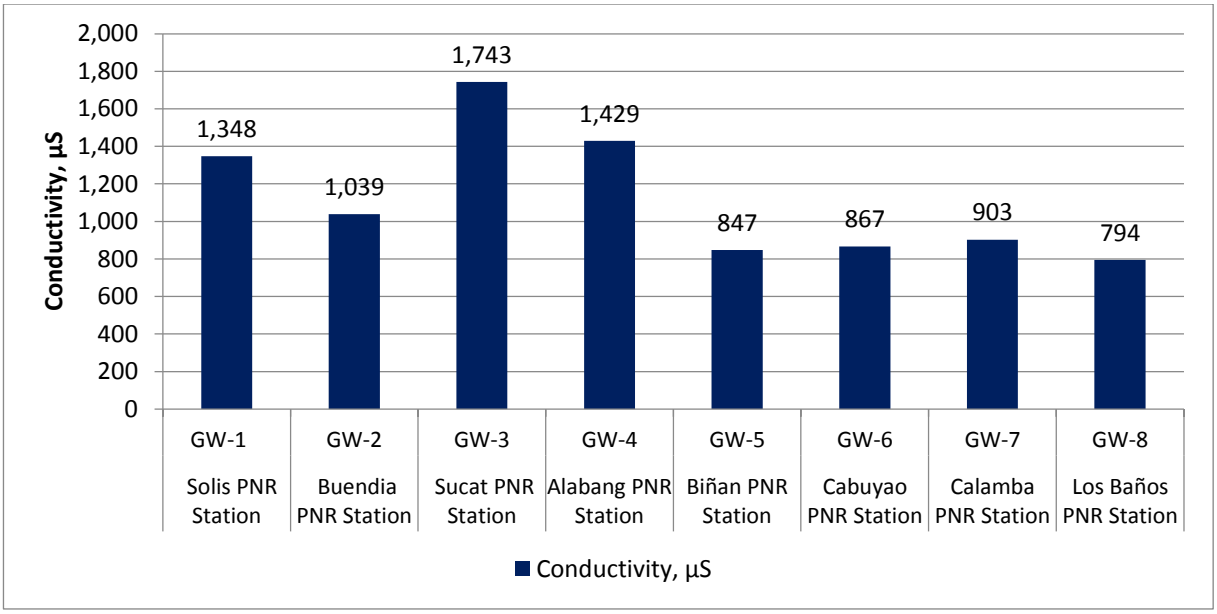


Figure 3.2.10 Results of Electrical Conductivity Measurement of Groundwater Samples

Total Dissolved Solids

617. The equivalent TDS of the eight (8) stations ranged from 390 to 701 mg/L, with the highest one recorded in Sucat PNR Station (GW-3) and the lowest in Los Baños Station (GW-8). Overall, there were three (3) cases of non-conformance with the 600 mg/L PNSW maximum allowable limit; those are the Solis, Sucat and Alabang PNR Stations as shown in Figure 3.2.11.

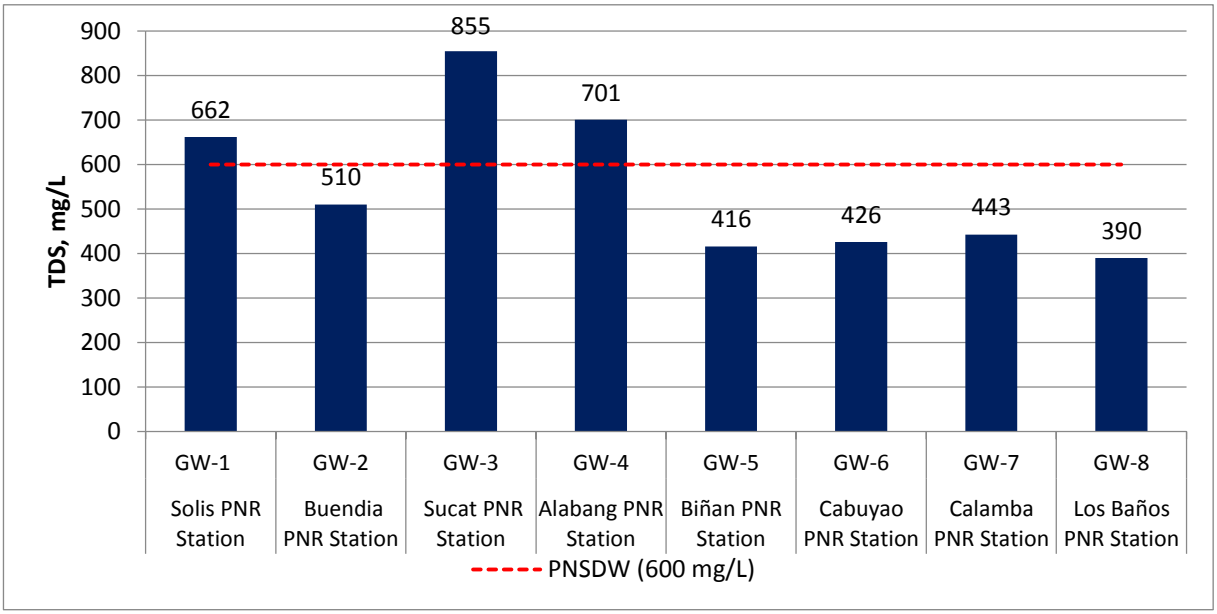


Figure 3.2.11 Results of Total Dissolved Solids Measurement of Groundwater Samples

Sodium

618. The Na concentrations of the stations ranged from 24 to 424 mg/L with two cases of non-conformance (GW-1 Solis and GW-3 Buendia_ with the PNSDW maximum allowable limit of 200 mg/L. The highest one was recorded in Solis PNR Station (GW-1) with sodium concentration of 424 mg/L and the lowest in Los Baños PNR Station with 24 mg/L (Figure 3.2.12).

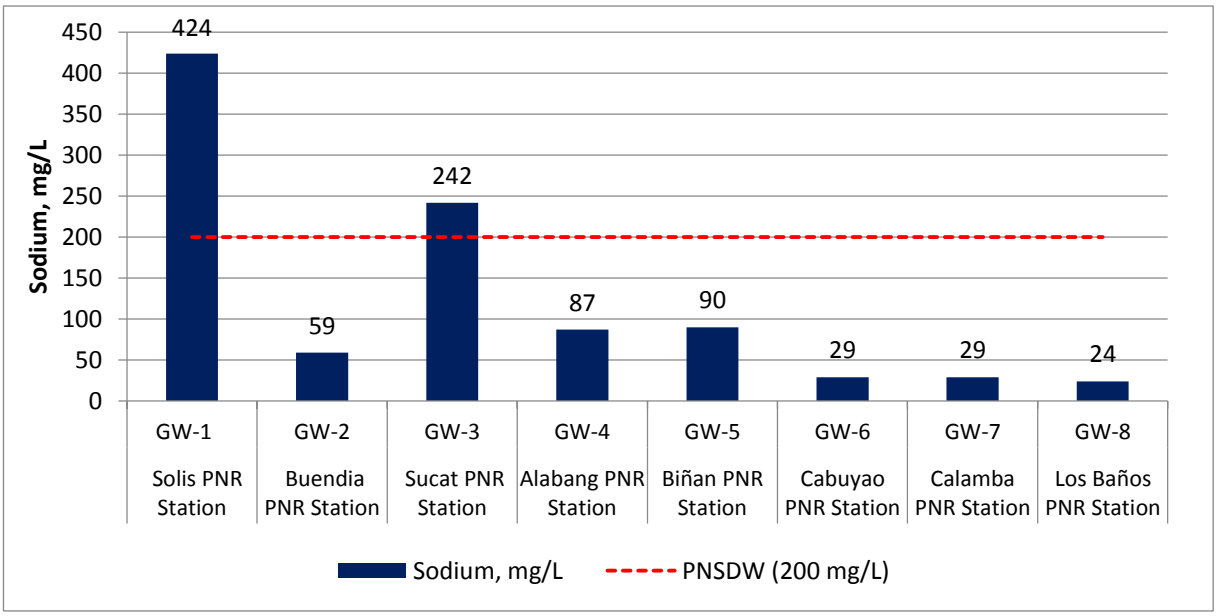


Figure 3.2.12 Results of the Sodium Measurement of Groundwater Samples

Calcium

619. The Ca concentrations of the groundwater in the stations ranged from 4.2 to 130 mg/L. The highest concentration was recorded in Sucat PNR Station (GW-3) and the lowest was in Solis PNR Station (GW-1) (Figure 3.2.13).

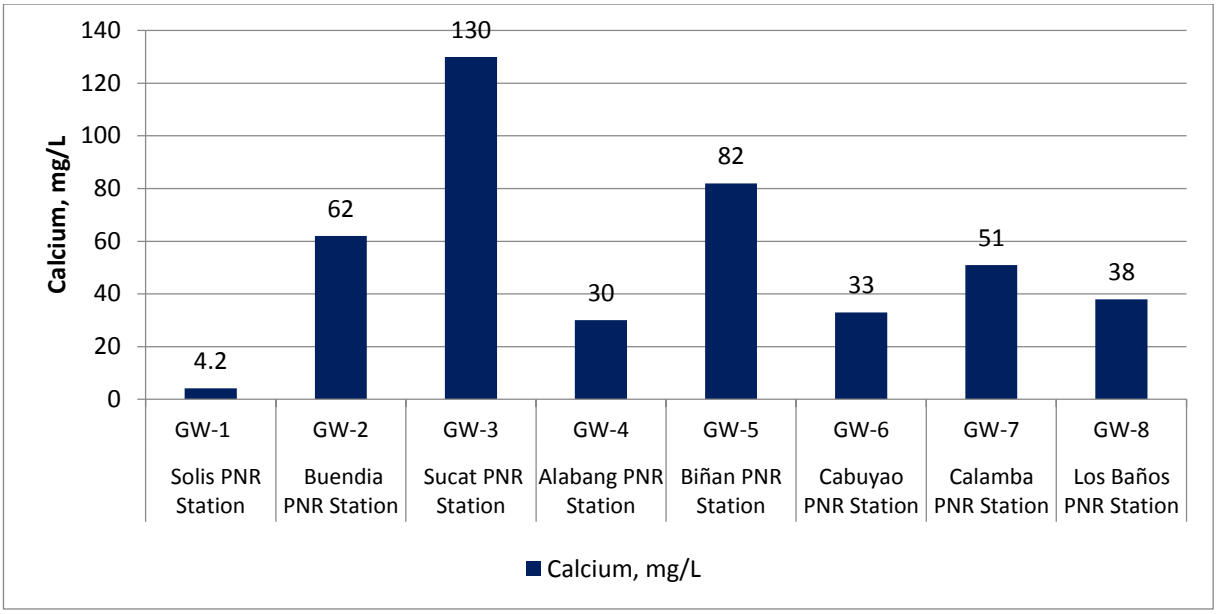


Figure 3.2.13 Results of Calcium Measurement of Groundwater Samples

Chloride

620. The Cl concentrations for the eight (8) stations ranged from 33 to 160 mg/L and were all within the maximum allowable limit. The highest was recorded in Sucat PNR Station (GW-3) and the lowest was in Biñan PNR Station (Figure 3.2.15).

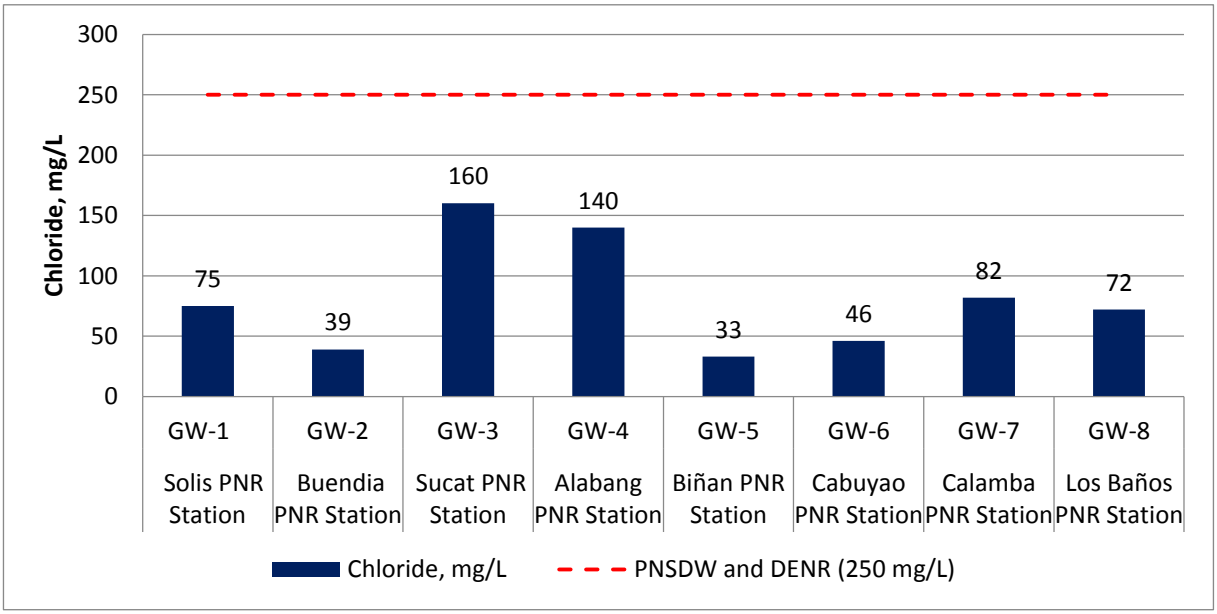


Figure 3.2.14 Results of Chloride Measurement of Groundwater Samples

Sulfate

621. SO4 concentrations in all PNR stations were within the standard. The sulfate concentrations in all stations ranged from 16 to 84 mg/L. The highest was recorded in Alabang PNR Station (GW-4) and the lowest was in Solis PNR Station (GW-1) (Figure 3.2.15).

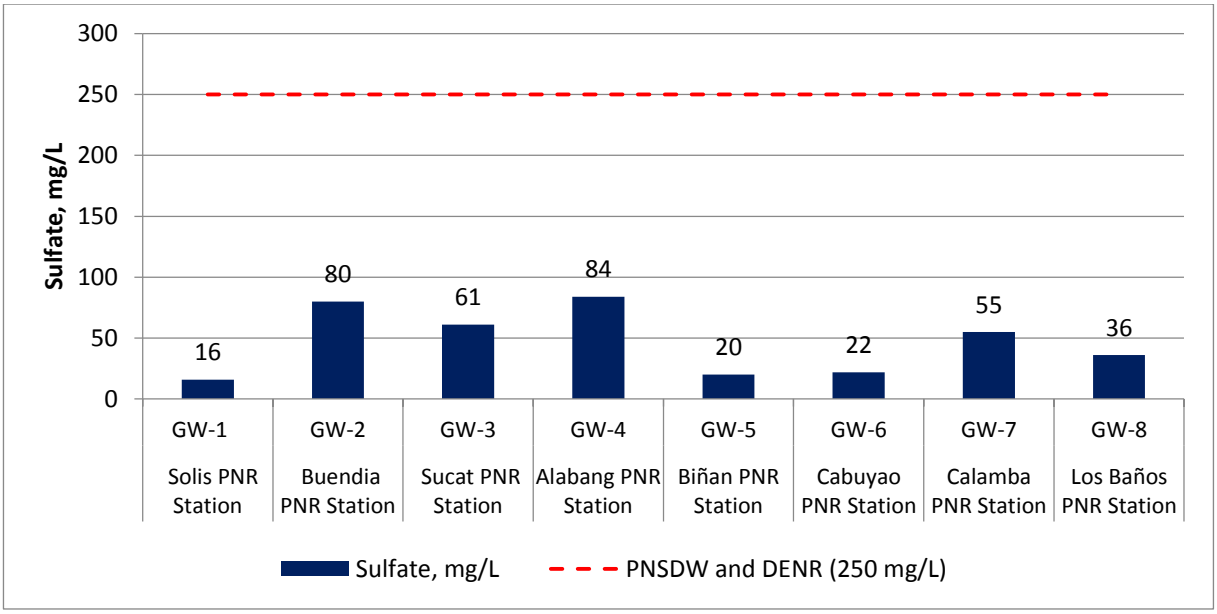


Figure 3.2.15 Results of Sulfate Measurement of Groundwater Samples

Nitrate

622. The PNR stations' NO3-N concentrations ranged from 0.12 to 1.9 mg/L and were all below the maximum allowable limit. The highest concentration was recorded in Los Baños PNR Station (GW-8) and the lowest was in Cabuyao PNR Station (GW-6) (Figure 3.2.16).

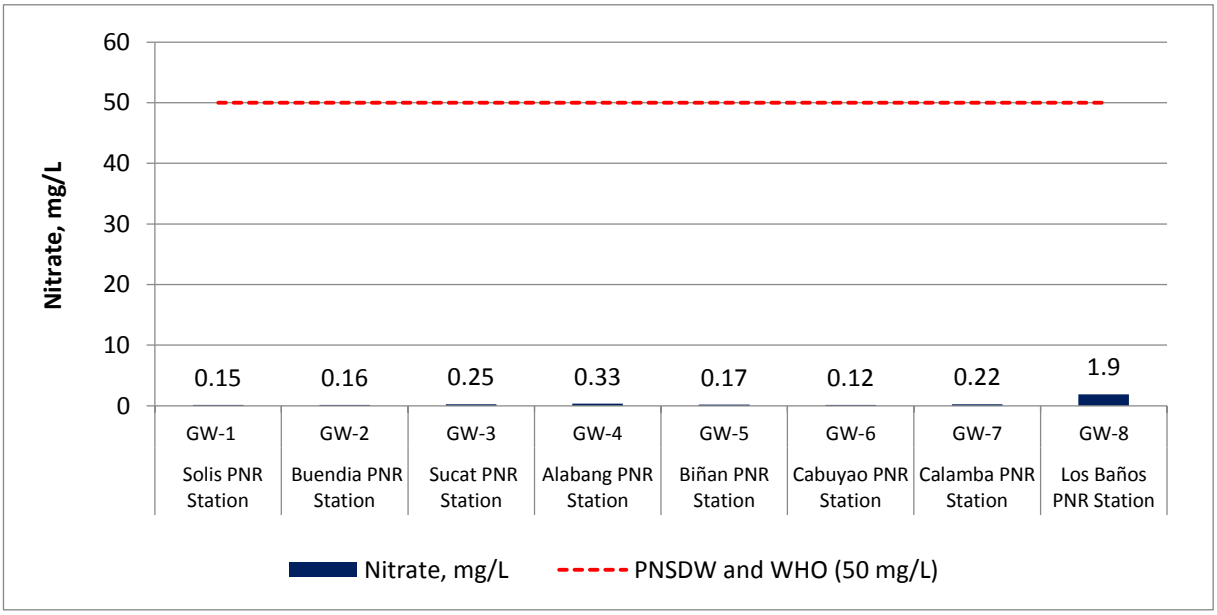
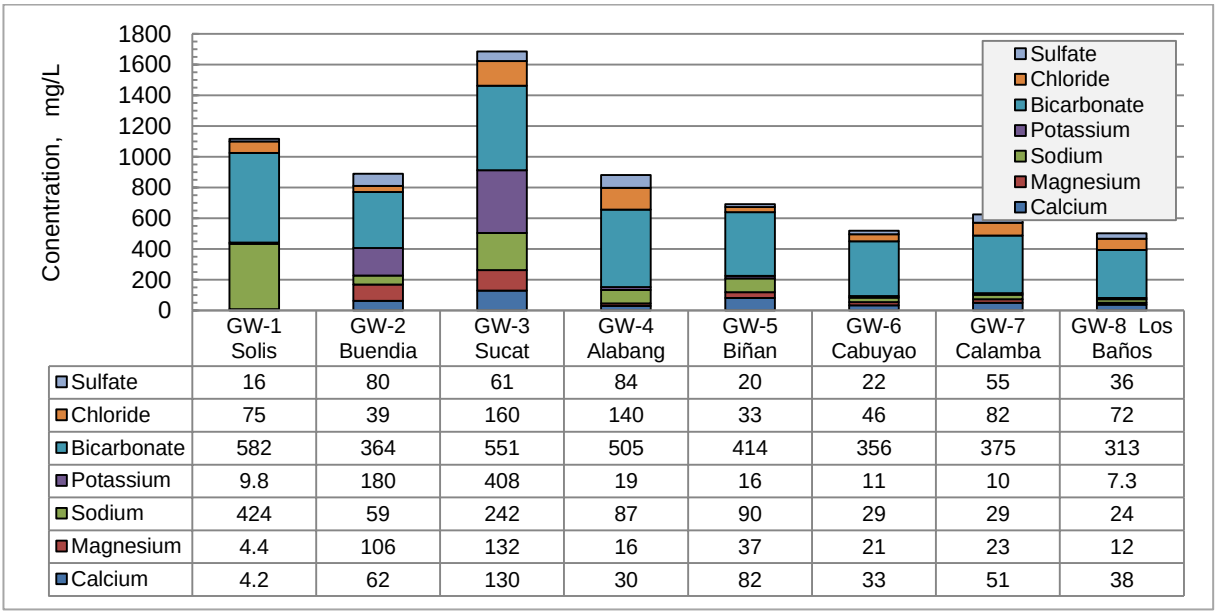


Figure 3.2.16 Results of Nitrate Measurement of Groundwater Samples

Concentrations of Major Ions

623. In all PNR stations, Bicarbonate (HCO3-2) ranged 313-582 mg/L dominating the major ions (Ca, Mg, Na, K, Cl, HCO3, SO4) in the samples. The concentrations for rest of the ions were generally less than 100 mg/L. Cases of concentrations greater than 100 mg/L were Ca, Mg, Na, K and Cl in GW-3 (Sucat); Na in GW-1 (Solis), Mg in GW-2 (Buendia) and Cl in GW-4 (Alabang) as shown in Figure 3.2.17.



	GW-1 Solis	GW-2 Buendia	GW-3 Sucat	GW-4 Alabang	GW-5 Biñan	GW-6 Cabuyao	GW-7 Calamba	GW-8 Los Baños
Sulfate	16	80	61	84	20	22	55	36
Chloride	75	39	160	140	33	46	82	72
Bicarbonate	582	364	551	505	414	356	375	313
Potassium	9.8	180	408	19	16	11	10	7.3
Sodium	424	59	242	87	90	29	29	24
Magnesium	4.4	106	132	16	37	21	23	12
Calcium	4.2	62	130	30	82	33	51	38

Figure 3.2.17 Results of Concentrations of Major Ions in the Groundwater Samples

Trace Metals

624. Deleterious constituents like Cd, Pb and Hg were not detected in all eight (8) sampling sites. Concentration levels of As and Cr+6 were present in all sampling sites and were within PNSDW and DENR and WHO guideline values as shown in Figure 3.2.18.

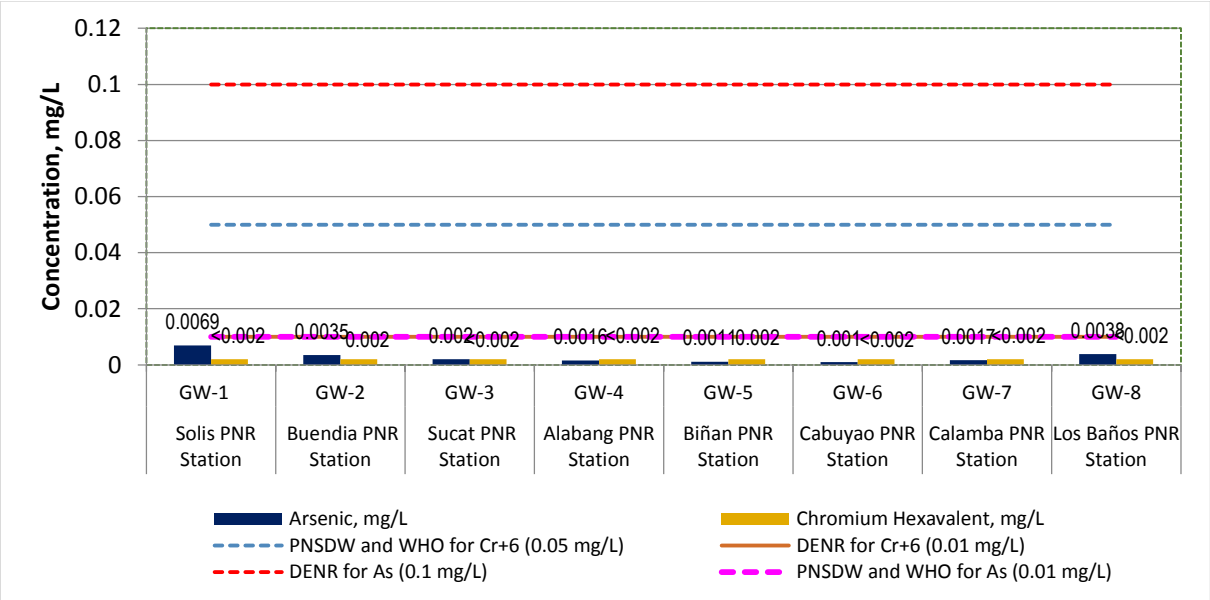


Figure 3.2.18 Results of Concentrations of Toxic Elements by Groundwater Sample

Free Cyanide

625. All stations' concentrations were in conformance to the standards except for the Solis PNR Station which exceeded both. The station with the highest concentration is the Solis PNR Station (GW-1) and the lowest is the Alabang PNR Station (GW-4) as shown in Figure 3.2.19.

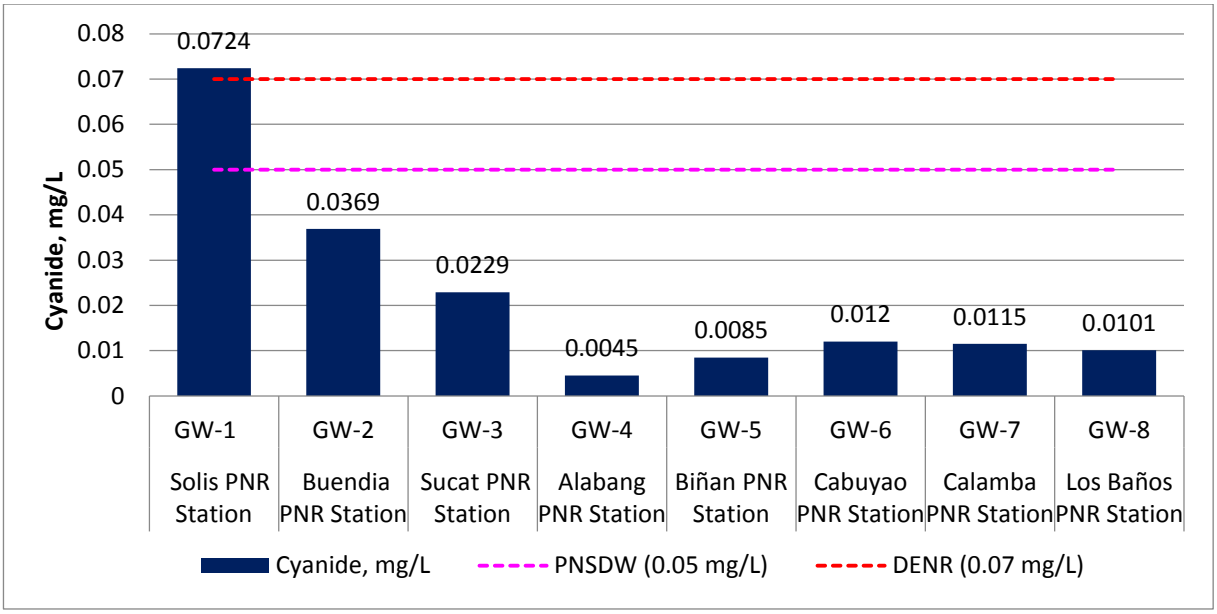


Figure 3.2.19 Results of Free Cyanide Measurement of Groundwater Samples

Fecal Coliforms and Total Coliforms

626. Fecal coliforms and total coliforms ranged from <1 to > 8 MPN/100 ml. Three (3) cases of detection, which did not pass the PNSDW and WHO Guidelines were noted in Station GW-2, GW-6, and GW-8.

3.2.2.2 Surface Water / Freshwater Quality

627. The NSRP alignment was intersected by rivers and streams at 35 locations. The major rivers that intersect the alignment include Pasig River, Tunasan River, San Pedro River, Cabuyao River, San Cristobal River and Calamba River.

628. Massive population growth, infrastructure development and increased economic activities led to the deterioration of water bodies in Metro Manila. In 1990, the Pasig River was pronounced as dead and incapable of sustaining marine life. As of 2003, the DENR formally declared four (4) more rivers as biologically dead; the Navotas-Malabon-Tenejeros-Tullahan (**NMTT**) River, Paranaque River, Marikina River and San Juan River.

629. The proposed NSRP alignment will cross rivers and streams which are potential impact areas of project construction and operations. The natural waterways covered in this study were aimed at obtaining a general picture of the range of quality of surface water bodies, through various parameters, as a guide in the detailed water pollution prevention planning and implementation. For the selected sites, the data gathered would serve as part of baseline data for dry season. Surface water quality data at these sites during wet season would be collected prior to and during project implementation.

(1) Field Survey

630. Freshwater quality survey was conducted on February 12-14 & 22, 2018 to assess the physical-chemical properties of rivers and creeks along the proposed NSRP. The freshwater

samples were collected at fourteen (14) surface water sampling sites identified along the proposed alignment, representing small to large flow river systems, generally in highly urbanized and industrialized areas in Metro Manila segment down to Laguna segment with agricultural areas. Table 3.2.9 and Figure 3.2.20 present the description of the freshwater quality sampling stations.

631. Each freshwater sampling site was characterized for 23 parameters, with reference to DAO 20016-08 Water Quality Guidelines and General Effluent Stations of 2016:

- Primary Parameters temperature, pH, DO, colour, BOD, TSS, Cl, NO3-N, PO4-P, fecal coliforms
- Secondary Parameters Metals: As, Cu, Cd, Cr+6, Pb, Hg

Organics: CN, oil/grease (Petroleum Ether Extracts)**,** organophosphate, phenolic substances as phenols, MBAS

- Others Conductivity, total coliforms

632. In-situ measurements include temperature, pH, and conductivity using Thermo Scientific Orion Start A329. DO was also measured using Trans Instruments DO meter. The water samples for microbes analysis were collected into sterilized small glass bottles and wrapped with aluminum foil; for oil and grease into wide-mouth bottles, organics into amber glass bottle; and the rest of the parameters into PET bottles. The labeled samples were stored in ice-chest and brought for laboratory analyses with a Chain-of-Custody Form within 24 hours to Mach Union Laboratory, Inc., a DENR recognized laboratory in Las Piñas City.

Table 3.2.9 Surface Water / Freshwater Quality Sampling Stations

Sampling Point	Description	Coordinates	Sampling Date
SW-1	Pasig River, Manila City	14° 35' 39.69"N 121° 00' 44.28"E	02/14/2018
SW-2	Laguna Lake, Muntinlupa City	14° 27' 07.20"N 121° 03' 14.95"E	02/14/2018
SW-3	Buli River, Muntinlupa City	14° 26' 46.96"N 121° 03' 00.82"E	02/13/2018
SW-4	Tunasan River, Muntinlupa City	14° 22' 10.33"N 121° 03' 03.81"E	02/13/2018
SW-5	San Pedro River, San Pedro City	14° 21' 50.99"N 121° 03' 14.92"E	02/13/2018
SW-6	Biñan River, Biñan City	14° 19' 49.74"N 121° 04' 56.04"E	02/13/2018
SW-7	San Cristobal River, Calamba City	14° 13' 12.47"N 121° 09' 04.78"E	02/13/2018
SW-8	San Juan River, Calamba City	14° 12' 31.98"N 121° 09' 25.14"E	02/12/2018
SW-9	Bgy Bucal River, Calamba City	14° 11' 02.19"N 121°10' 30.46"E	02/12/2018
SW-10	Alligator Lake, Los Baños	14° 10' 51.04"N 121°12' 28.44"E	02/12/2018
SW-11	Dampalit River, Los Baños	14° 10' 34.23"N 121°12' 58.29"E	02/12/2018
SW-12	Saran River (Bgy Anos), Los Baños	14° 10' 55.16"N 121°13' 51.76"E	02/12/2018
SW-13	Molawin River, Los Baños	14° 10' 13.23"N 121°15' 08.34"E	02/12/2018
SW-14	Buot Creek, Los Baños	14° 9'53.83"N 121°15'22.86"E	02/22/2018

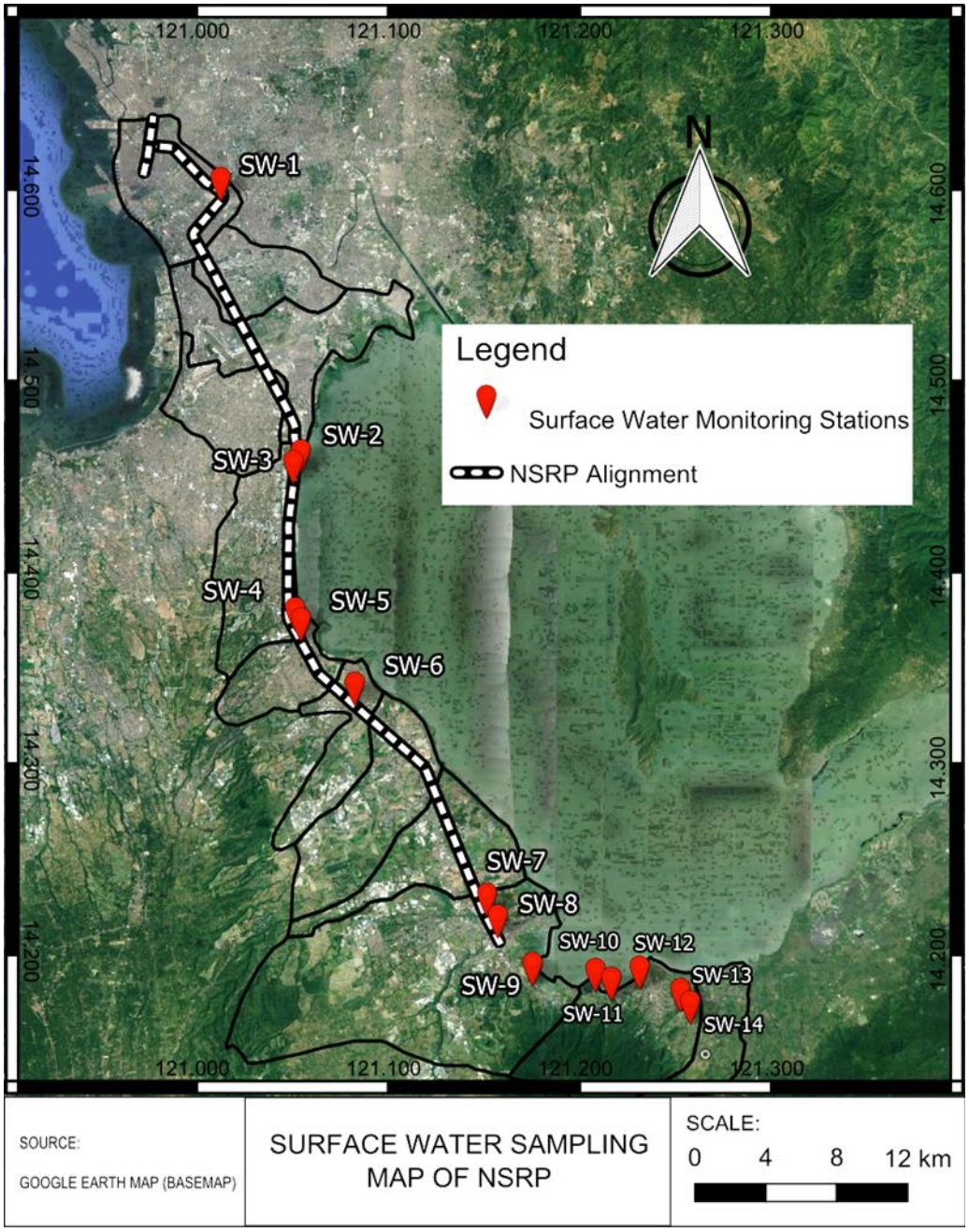


Figure 3.2.20 Map of the Surface Water Quality Monitoring Stations

(2) Quality of Laguna Lake Survey

633. The primary data obtained was supplemented by secondary data from DENR publication, and LLDA publications and electronic files provided.

634. LLDA covers a total of eighteen (18) sampling stations twelve (12) for Laguna Lake tributaries and six (6) within Laguna Lake to accurately assess the suitability of the lake for all its present and intended beneficial use as shown in Table 3.2.10 and Figure 3.2.21.

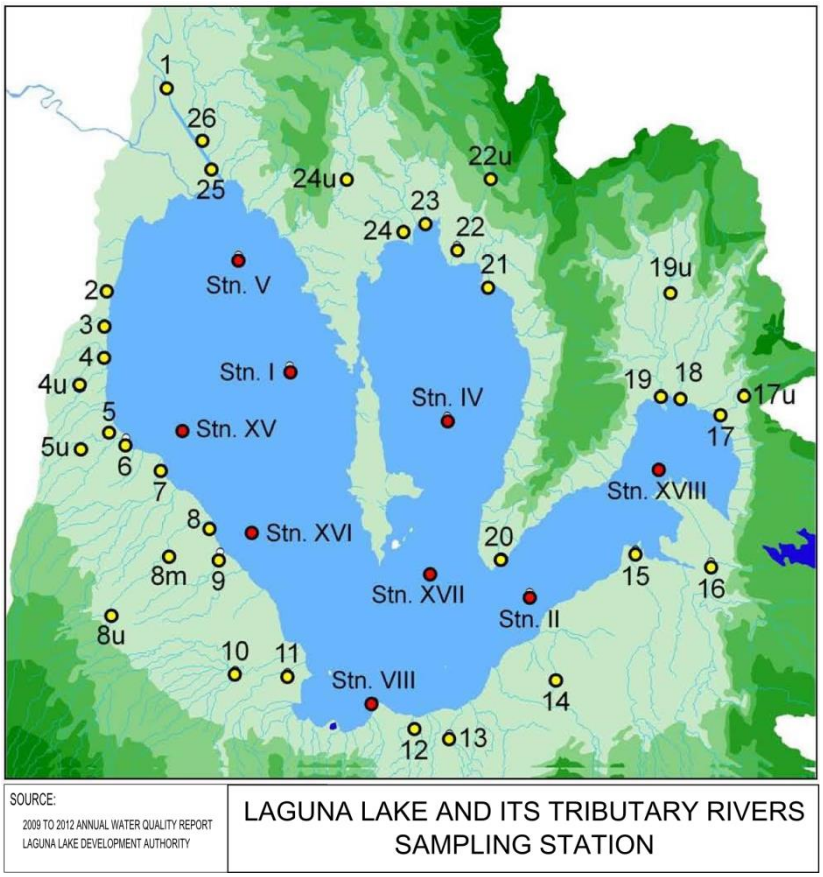
635. The secondary data were grouped into primary and secondary parameters. The values for primary parameters were annual averages of at least ten (10) data sets except for coliform which is the geometric mean of at least data sets per quarter and twice WQG for maximum allowable limit; for secondary inorganic parameters, annual average of four (4) data sets; for secondary metals and

organics parameters, as maximum allowable limit; and for natural occurrence higher than WQG, as maximum 10% increase of the natural level.

Table 3.2.10 LLDA Data Sampling Sites

LLDA Data Sampling Sites			
Stn XV -	San Pedro	6	San Pedro River
Stn XVI -	Sta. Rosa	7	Biñan River
Stn VIII -	Los Baños	8u	Sta. Rosa River - Upstream
2	Bagumbayan River (Taguig)	8m	Sta. Rosa River - Midstream
3	Buli Creek (Taguig)	8	Sta. Rosa River - Downstream
4u	Mangangate River – Upstream (Muntinlupa)	9	Cabuyao River
4	Mangangate River – Downstream (Muntinlupa)	10	San Cristobal River
5u	Tunasan River – Upstream (Muntinlupa)	11	San Juan River
5	Tunasan River – Downstream (Muntinlupa)	12	Molawin River (Los Baños)

Source: Annual Water Quality Report on the Laguna de Bay and its Tributary Rivers, LLDA, 2009-2012



Source: Annual Water Quality Report on the Laguna de Bay and its Tributary Rivers, LLDA, 2009-2012

Figure 3.2.21 Laguna Lake and Its Tributary Rivers Sampling Station

(3) Applied standard

636. The DENR Administrative Order (DAO) No. 2016-08 provides water usage and classification, and quality criteria of fresh surface waters. Table 3.2.11 shows the comparison of applicable national and international standards (Environmental Water Quality Standards for Protecting Human Health, Japan) on surface water quality. For further detail criteria to be referred to Chapter 2, 2.6.3 Surface Water Quality.

(4) Results and Analysis

637. Table 3.2.11 contains the results of the surface water quality sampling. Table 3.2.12 and Table 3.2.13 presents the range and average of 2009-2017 annualized monthly DO, BOD, total coliform, NO3-N, and PO4-P measured by LLDA in Laguna Lake tributaries and the 2012-217 data within the lake, respectively. Table 3.2.14 presents the DENR compliance rating of Pasig River.

638. The set of primary data obtained covered fourteen (14) sampling sites for twelve (12) rivers and creeks west to south of Laguna lake, plus one (1) in Laguna Lake and one (1) in Tadlac (Alligator) Lake. The secondary data from LLDA covered eighteen (18) sampling stations for twelve (12) Laguna Lake tributaries and within Laguna Lake. There are three (3) river systems with the upstream and downstream monitoring stations by LLDA. Available data for these tributaries are annualized monthly measurements of DO, BOD, total coliform, NO3-N, and PO4-P for each station for the years 2009-2017. The LLDA data also include the annualized monthly averages of turbidity, BOD, total coliform, NO3-N, and PO4-P for the three Laguna Lake bays fronting San Pedro, Sta. Rosa and Los Baños.

639. The results of measurements in the fourteen (14) surface water sampling sites for the 23 parameters were taken as baseline and examples of surface water quality along the proposed alignment. The sampling sites represented different natural features, landuse and flowrates which are factors of water quality.

1) Results by Sampling Stations

The following is a discussion of the results by sampling site:

SW-1 Pasig River

640. The sampling site is located just downstream (west) of Paco-Sta. Mesa Bridge or Pandacan Bridge, City of Manila or just upstream of the existing railway alignment. The river water flowed towards Manila Bay. The river is deep with a width of about 100 m at the sampling site. The river is about 25 km long connecting Laguna Lake and Manila Bay, and is technically a tidal estuary with flow direction reversals depending on the water levels of Manila Bay and Laguna Lake. The river is classified as Class C water. The result of water testing showed that fifteen (15) parameters were conformant to DENR guidelines for Class C waters. The six (6) non-conforming parameters were TSS, DO, BOD, Fecal coliform, PO_4-P and phenols. A DENR Report covering the years 2006-2013 indicate Pasig River showed low compliance rating in DO, BOD and PO4-P, but relatively high for NO3-N.

641. Of the 23 parameters measured, eleven (11) were covered under the Japan standards for Class C River. Of the eleven (11) parameters, seven (7) were conformant to the standard. These include pH, NO3-N, Cu, As, Cd, Pb and Hg. The four (4) non-conforming parameters were TSS, DO, BOD and CN.

SW-2 Laguna Lake

642. The sampling site is located about 120 m east of the large fuel tanks of the decommissioned Sucat Thermal Plant. The lake is classified as Class C water. Fifteen (15) parameters were in conformance with Class C guidelines. The six (6) non-conforming parameters were TSS, DO, BOD, fecal coliform, PO4-P and phenols. Results of LLDA monitoring of BOD, NO3-N, PO4-P, total coliform and turbidity fronting San Pedro, Sta. Rosa and Los Baños are shown in *Table 3.2.12*. In general, the concentrations of BOD, NO3-N and PO4-P remained within their respective Class C guidelines, of not more than 7 mg/L, 7mg/L, and 0.5 mg/L, respectively. Total coliform range 37-1,373 MPN/100 ml. Cases of less than the200 MPN/100 ml maximum guideline occurred in 2016. There is no temporal trend in the concentrations. Turbidity though apparently increased in monitoring sites in 2013-2016 based on the decreasing depth of visibility Secchi disc from the surface, roughly about 40 cm to 70 cm.

643. Among the 23 parameters measured at Laguna Lake, seven (7) parameters were conformant to the Japan standards for Class B Lake. The four (4) non-conforming parameters include TSS, DO, BOD and Cyanide.

SW-3 Buli River

644. The sampling site is located just downstream (east) of the railway bridge in Buli River, Muntinlupa City. It is a small river with 5.4 m width slowly moving. The river is not yet classified. Only twelve (12) parameters were in conformance with Class C guidelines. The nine (9) non-conforming parameters were DO, BOD, fecal coliform, PO4-P, Cu, Cr+6, O&G, phenols, and surfactants. The levels indicate serious water pollution. Floating garbage piles were observed just upstream. The 2009-2017 LLDA data shows similar non-conformance cases in DO, BOD, coliform, and PO4-P.

645. Among the 23 parameters measured at Buli River, six (6) parameters were conformant to the Japan standards for Class C River. The five (5) non-conforming parameters include TSS, DO, BOD, Hg and Cyanide.

SW-4 Tunasan River

646. The sampling site is located just downstream (east) of the railway bridge in Tunasan River, San Pedro Laguna. It is a small river with shallow depth along 3.9 m wide flowing water. The water sample contained mosquito wrigglers and characterized a milky brownish, greenish brownish, greenish, and had aromatic smell. The river is not yet classified. Only twelve (12) parameters were in conformance with Class C guidelines. The nine (9) non-conforming parameters were TSS, DO, BOD, fecal coliform, PO4-P, Cu, Cr+6, O&G, and phenols. The levels indicate serious water pollution. The 2009-2017 LLDA data shows similar non-conformance cases in DO, BOD, coliform, and PO4-P.

647. Among the 23 parameters measured at Tunasan River, seven (7) parameters were conformant to the Japan standards for Class C River. The four (4) non-conforming parameters include TSS, DO, BOD and CN.

SW-5 San Pedro River

648. The sampling site is located just downstream (east) of the railway bridge in San Pedro River, San Pedro Laguna. It is a small murky river. The sampling site about 4 m wide and 20 cm deep. The river is classified as Class C water. Only eleven (11) parameters were in conformance with Class C guidelines. The ten (10) non-conforming parameters were pH, DO, BOD, fecal coliform, PO4-P, Cu, Cr+6, O&G, phenols, and surfactants. The levels do indicate serious water pollution. The 2009-2017 LLDA data shows similar non-conformance cases in DO, BOD, coliform, and PO4-P.

649. Among the 23 parameters measured at San Pedro River, eight (8) parameters were conformant to Japan standards for Class C River. The three (3) non-conforming parameters include DO, BOD and Cyanide.

SW-6 Biñan River

650. The sampling site is just downstream (east) of the railway bridge in Biñan River, Biñan, Laguna, shallow, about 10 m wide. The river is not yet classified. Only 14 parameters were in conformance with Class C guidelines. The seven non-conforming parameters were DO, BOD, fecal coliform, PO4-P, Cu, O&G, and phenols. The levels indicate serious water pollution. The 2009-2017 LLDA data shows similar non-conformance cases in DO, BOD, coliform, and PO4-P.

651. Among the 23 parameters measured at Biñan River, eight (8) parameters were conformant to Japan standards for Class C River. The three (3) non-conforming parameters include DO, BOD and Cyanide.

SW-7 San Cristobal River

652. The sampling site is just downstream (east) of the railway bridge in San Cristobal River, Calamba City. It is a small river, shallow and about 6 m wide. Water appeared turbid and greenish. Per interview, the river is used for swimming by children downstream. A pig carcass was seen along the channel. The river is classified as Class C water. Fifteen (15) parameters were in conformance with Class C guidelines. The five (5) non-conforming parameters were DO, BOD, fecal coliform, PO4-P, Cu and phenols. The 2009-2017 LLDA data shows similar non-conformance cases in DO, BOD, coliform, and PO4-P.

653. Among the 23 parameters measured at San Cristobal River, eight (8) parameters were conformant to Japan standards for Class C River. The three (3) non-conforming parameters include DO, BOD and Cyanide.

SW-8 San Juan River

654. The sampling site is located just downstream (east) of the railway bridge in San Juan River, Calamba City. The river is about 16 m wide and 0.5 deep, clear with children found swimming upstream. The river is classified as Class C water. Nineteen (19) parameters were in conformance with Class C guidelines. The two (2) non-conforming parameters were fecal coliform, and PO4-P. The 2009-2017 LLDA data shows similar non-conformance cases in coliform, and PO4-P.

655. Among the 23 parameters measured at San Juan River, eight (8) parameters were conformant to Japan standards for Class C River. The two (2) non-conforming parameters were BOD and CN.

SW-9 Bgy Bucal River

656. The sampling site is located about 50 m downstream (north) of Bucal Bridge in Southspring Villa Subdivision, Barangay Bucal, Los Baños, Laguna. It is a small river, 3.5 m wide and 20 cm deep. It is not yet a classified river. Sixteen (16) parameters were in conformance with Class C guidelines. The five (5) non-conforming parameters were temperature, DO, BOD, fecal coliform, and PO_4-P.

657. Among the 23 parameters measured at Brgy Bucal River, eight (8) parameters were conformant to Japan standards for Class C River. The two (2) non-conforming parameters were BOD and CN.

SW-10 Tadlac (Alligator Lake)

658. The sampling site is southeast of Tadlac (Alligator) Lake, about 40 m NNW of Balai Inday in Lakewood Subdivision, Barangay Tadlac, Los Baños, Laguna. It is not yet a classified water body. Nineteen (19) parameters were in conformance with Class C guidelines. The two (2) non-conforming parameters were BOD, and PO4-P. The Tadlac (Alligator) Lake, as a reference water body which is far from the alignment, meets the Class B (recreational) guidelines for the various parameters except for BOD.

659. Among the 23 parameters measured at Tadlac Lake, eight (8) parameters were conformant to Japan standards for Class B Lake. The two (2) non-conforming parameters were BOD and Cyanide.

SW-11 Dampalit River

660. The sampling site is located just downstream (north side) of the railway bridge in Dampalit River, Barangay Bambang, Los Baños, Laguna. It is a small fast flowing river about1.5 m wide and 15 cm at the sampling site. It is not yet a classified river. Sixteen (16) parameters were in-conformance with Class C guidelines. The five (5) non-conforming parameters were Temp, DO, BOD, fecal coliform, and O&G.

661. Among the 23 parameters measured at Dampalit River, nine (9) parameters were conformant to Japan standards for Class C River. The two (2) non-conforming parameters were BOD and CN.

SW-12 Saran River

662. The sampling site is just downstream (north side) of railway bridge of Saran River in Barangay Malinta, and 105 m NW of Anos Bridge, Los Baños, Laguna. It is a small river with water about 2 m wide and 15 cm deep at the sampling site. Domestic wastes were seen along the black muddy river bed. It is unclassified. Results of sampling showed only thirteen (13) parameters were in conformance with Class C guidelines. Eight (8) non-conforming parameters were TSS, pH, DO, BOD, fecal coliform, PO4-P, Cd and surfactants.

663. Among the 23 parameters measured at Saran River, four (4) parameters were conformant to Japan standards for Class C River. The seven (7) non-conforming parameters were TSS, pH, DO, BOD, As, Cd and CN.

SW- 13 Molawin River

664. The sampling site is located just downstream (eastside) of the railway bridge in Molawin (Maulauen) River, west of the International Rice Research Institute (IRRI) Los Baños, Laguna. The river crisscrosses the campus of the University of the Philippines Los Baños and some areas of the town of Los Baños. It is a small river, with water about 4.5 m wide and 13 cm deep. It is not yet a classified river. Eighteen (18) parameters were in conformance with Class C guidelines. Three (3) non-conforming parameters with Class C guidelines were TSS, BOD, and fecal coliform. The 2009-2017 LLDA data shows non-conformance cases in DO, coliform, and PO_4-P.

665. Among the 23 parameters measured at Molawin River, seven (7) parameters were conformant to Japan standards for Class C River. The four (4) non-conforming parameters were TSS, pH, BOD and CN.

SW-14 Buot Creek

666. The sampling site is located just downstream (eastside) of the Railway Bridge in Buot Creek, south of the International Rice Research Institute (IRRI) Los Baños, Laguna. It is small unclassified river. Seventeen (17) parameters were in conformance with Class C guidelines. Four (4) non-conforming parameters with Class C guidelines were DO, BOD, fecal coliform, and PO4-P.

667. Among the 23 parameters measured at Buot Creek, seven (7) parameters were conformant to Japan standards for Class C River. The four (4) non-conforming parameters were DO, BOD, Pb and CN.

Table 3.2.11 Results of Freshwater 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 Bgy Bucal River	SSW-10 Tadlac (Alligator) Lake	SSW-11 Dampalit River	SSW-12 Saran River (Bgy Malinta)	SSW-13 Molawin River	SSW-14 Buot Creek	Reference Values DENR AO 2016-08 Class C	Japan Standards
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	minimal flow	minimal flow	0.4	0.4	-	1.2	0.5	0.1	minimal 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/ 100mL	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, uS/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 (NO3-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 (PO4-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**	Not detectable

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 Bgy Bucal River	SSW-10 Tadlac (Alligator) Lake	SSW-11 Dampalit River	SSW-12 Saran River (Bgy Malinta)	SSW-13 Molawin River	SSW-14 Buot Creek	Reference Values DENR AO 2016-08 Class C	Japan Standards
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
* Environmental Quality Standards for conservation of the Living Environment, Rivers, Class C
** Environmental Quality Standards for conservation of the Living Environment, Lakes, Class B

Table 3.2.12 Range and Average of 2009-2017 Annualized Monthly DO, BOD, Total Coliform, Nitrate and Phosphate Measured by LLDA in Laguna Lake Tributaries.

Monitoring Station		DO, mg/L		BOD, mg/L		Total Coliform, MPN/100 ml		NO_3-N, mg/L		PO_4-P, mg/L	
		Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
3	Buli Creek	0.1 - 1.7	0.4	72 - 489	184	3.50 E+06 - 8.15 E+11	1.02E+11	0.05 - 2.57	0.41	1.40 - 7.95	2.45
5u	Tunasan River - Upstream	1.7 - 4.9	3.6	5 - 38	15	1.95 E+05 -6.03 E+06	2.18E+06	0.35 - 1.30	0.76	0.70 - 1.48	1.15
5	Tunasan River - Downstream	0.1 - 0.9	0.2	129 - 426	240	7.00 E+06 - 4.67 E+10	5.88E+09	0.05 - 2.45	0.42	1.24 - 17.43	4.04
6	San Pedro River	0.2 - 2.7	1.3	11 - 24	17	6.40 E+05 - 1.19 E+08	1.71E+07	0.06 - 0.91	0.47	0.95 - 8.56	2.49
7	Biñan River	0.5 - 1.6	0.9	21 - 45	27	6.73 E+05 - 4.70 E+06	3.10E+06	0.04 - 0.34	0.20	0.61 - 1.39	1.05
9	Cabuyao River	0.6 - 3.5	1.1	11 - 30	20	1.44 E+06 - 1.02 E+07	4.84E+06	0.05 - 0.43	0.16	0.53 - 3.78	1.36
10	San Cristobal River	0.3 - 4.3	1.6	33 - 99	56	3.54 E+06 - 7.54 E+07	2.16E+07	0.06 - 0.79	0.24	0.43 - 1.58	0.65
11	San Juan River	2.8 - 6.0	4.4	4 - 9	5	1.29 E+05 - 8.65 E+06	1.62E+06	3.20 - 6.82	4.66	0.54 - 2.19	0.91
12	Molawin River	3.1 - 4.4	3.7	3 - 4	4	6.17 E+04 - 4.50 E+05	1.83E+05	0.54 - 1.02	0.70	0.29 - 0.49	0.41
	Range		0.2 – 6.4		4 - 240		1.83E+05 - 1.19E+11		0.13 – 4.66		0.66 – 4.04
	Class C Guideline		5 min		7		200		7		0.163

Note: The monitoring stations are located downstream unless specified.

Source: LLDA

Table 3.2.13 Range and Average of 2012-2017 Annualized Monthly Turbidity, BOD, Total Coliform, Nitrate & Phosphate Measured by LLDA in Laguna Lake Bay Stations

Monitoring Station	Turbidity, cm		BOD, mg/L		Total Coliform, MPMN/100 ml		NO_3-N, mg/L		PO_4-P, mg/L	
	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
1. Stn XV - San Pedro	37 - 65	53	1.8 - 5.0	2.8	37- 938	362	0.04 - 0.45	0.19	0.05 - 0.14	0.10
2. Stn XVI -Sta. Rosa	40 - 72	54	1.6 - 7.5	3.5	40 - 892	381	0.04 - 0.56	0.20	0.04 - 0.14	0.09
3. Stn VIII - Los Baños	44 - 73	56	1.4 - 4.0	2.3	47 - 1373	510	0.13 - 0.70	0.28	0.06 - 0.11	0.09

Note1: Turbidity is the depth of the visibility of the standard white secchi disc lowered from the surface water of Laguna Lake. No turbidity data in 2017.

Source: LLDA

Table 3.2.14 DENR Compliance rating of Pasig River to Class C waters

Parameter	Compliance Rating No. of Compliance / No. of Observations	Reference value DAO 1990-34, Class C mg/L
DO,mg/L	3 / 68	5
BOD, mg/L	1 / 68	7
Phosphate, mg/L	3 / 433	0.4
Nitrates, mg/l	388 / 433	10

Source: DENR

2) Results by Parameter

Colour

668. True colour measured from fourteen (14) sampling sites ranged from <5 to 65 TCU or within the DENR Class C guideline of not more than 75 TCU. The highest was measured in Pasig River (SW1) and the lowest were in San Juan (SW-8) and Brgy. Bucal Rivers (SW-9) as shown in Figure 3.2.22.

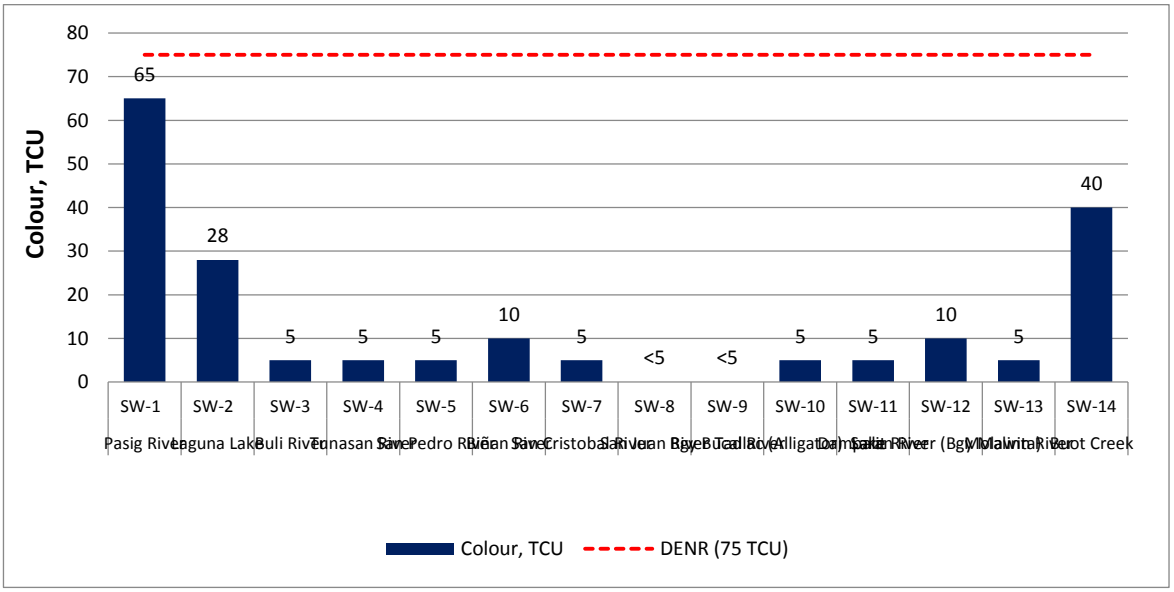


Figure 3.2.22 Results of Color Measurement of Surface Water Samples

Total Suspended Solids

669. TSS concentrations ranged from 2.5 to 213 mg/L. Cases of levels greater than the 80 mg/L DENR Class C maximum allowable limit were noted in Pasig River (SW-1), Laguna Lake (SW-2), Tunasan River (SW-4), Saran River (SW-12), and Molawin River (SW-13).Cases of levels greater than the Japan Standard (50 mg/L) were noted Pasig River (SW-1), Laguna Lake (SW-2), Buli River (SW-3), Tunasan River (SW-4), Saran River (SW-12), and Molawin River (SW-13) as shown in Figure 3.2.23.

670. Supplementary to 98 mg/L TSS of Laguna Lake (SW-2) is the set of turbidity annual average from LLDA using the depth at which a Secchi Disc is visible from the surface. In the three (3) monitoring stations San Pedro, Sta. Rosa, and Los Baños bays in the lake, turbidity (disc visibility) measured only 37-73 cm deep in 2012-2016, with decreasing visibility depth of around 70 cm to 40 cm since 2013, an indication of increasing turbidity (Figure 3.2.23)

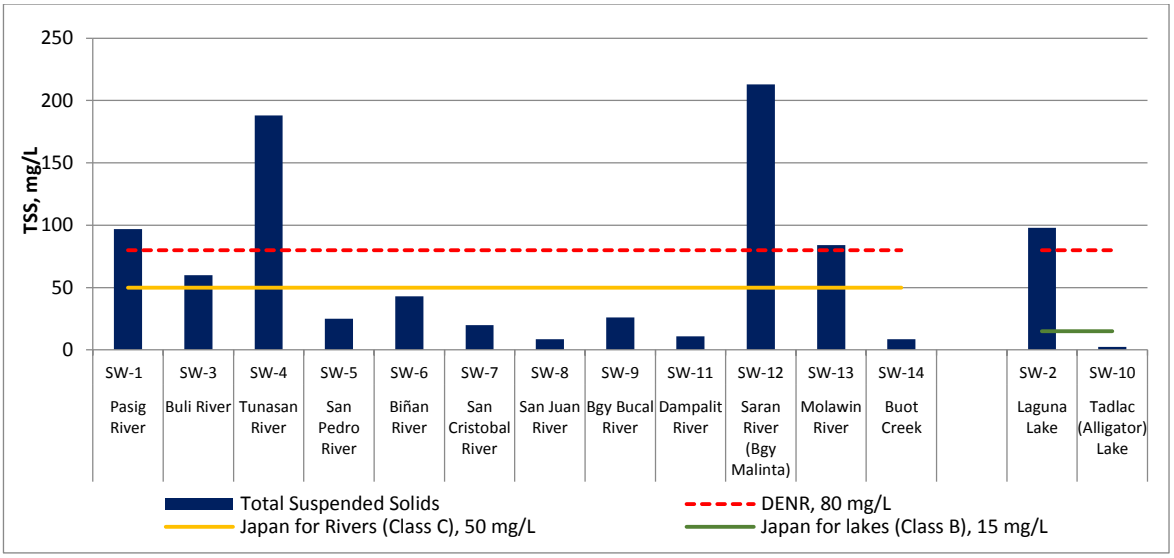


Figure 3.2.23 Results of Total Suspended Solids Measurement of Surface Water Samples

Temperature

671. Temperatures of all stations ranged from 25.7 to 31.3 °C. The maximum was observed in Brgy. Bucal River (SW-9) exceeding the 31 ºC upper limit of DENR Class C water. All the rest were within the upper and lower limits set by DENR for Class C water (Figure 3.2.24).

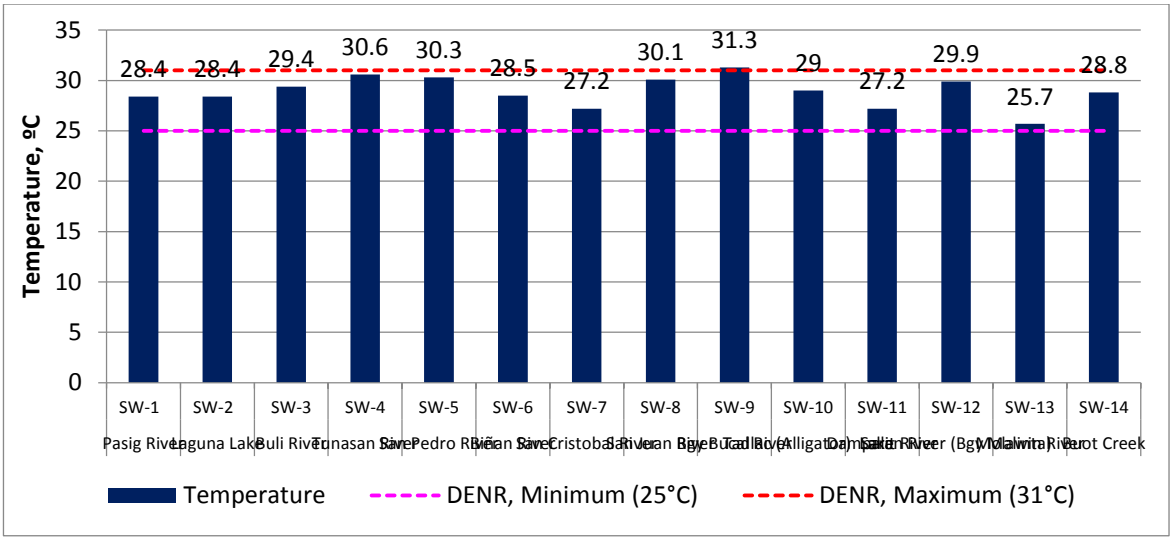


Figure 3.2.24 Results of Temperature Measurement of Surface Water Samples

pH Level

672. The pH ranged from 6.38 to 7.80. pH values less than the minimum requirement of 6.5 was observed in San Pedro River (SW-5), Dampalit River (SW-11), and Saran River (SW-12). No stations exceeded the maximum allowable limit of DENR and Japan which are 9.0 and 8.5 respectively (Figure 3.2.25).

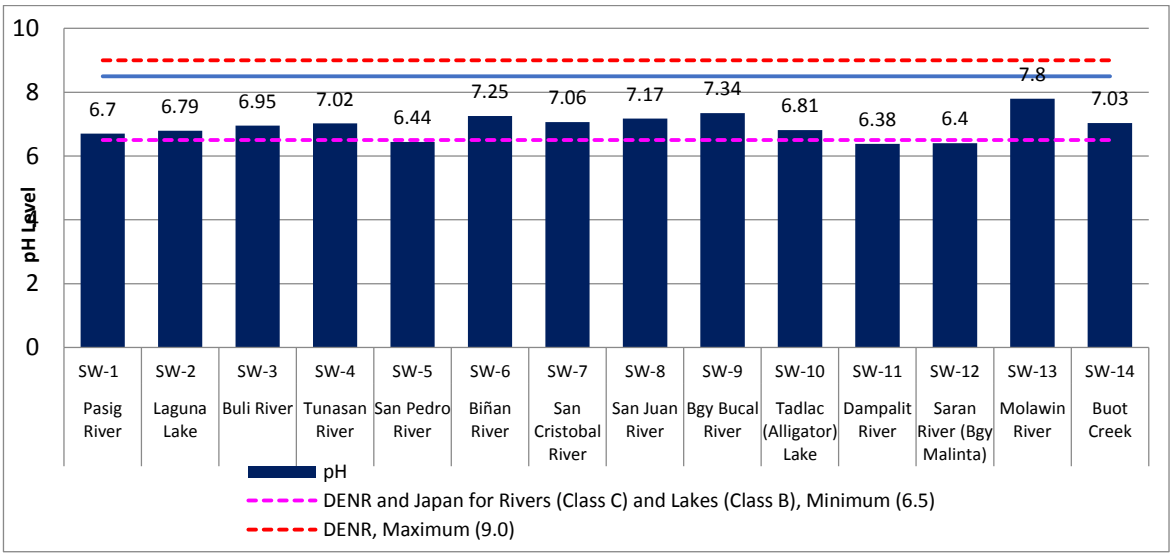


Figure 3.2.25 Results of pH Measurement of Surface Water Samples

Dissolved Oxygen

673. DO concentrations ranged from 0.1 to 6.7 mg/L. Pasig River (SW-1), Laguna River (SW-2), Buli River (SW-3), Tunasan River (SW-4), San Pedro River (SW-5), Biñan River (SW-6), San Cristobal River (SW-7), Saran River (SW-12) and Buot River (SW-14) conformed within the 5 mg/L Class C minimum requirement of DENR and Japan Standard as shown in Figure 3.2.26.

674. In the LLDA river monitoring stations, the average of the annualized monthly DO measurements per tributary station in 2009-2017 ranged 0.2-6.4 mg/L (Table 3.2.12). Cases of conformance with the minimum 5 mg/L were noted in the upstream station in Sta. Rosa River (in all cases), and in San Juan River.

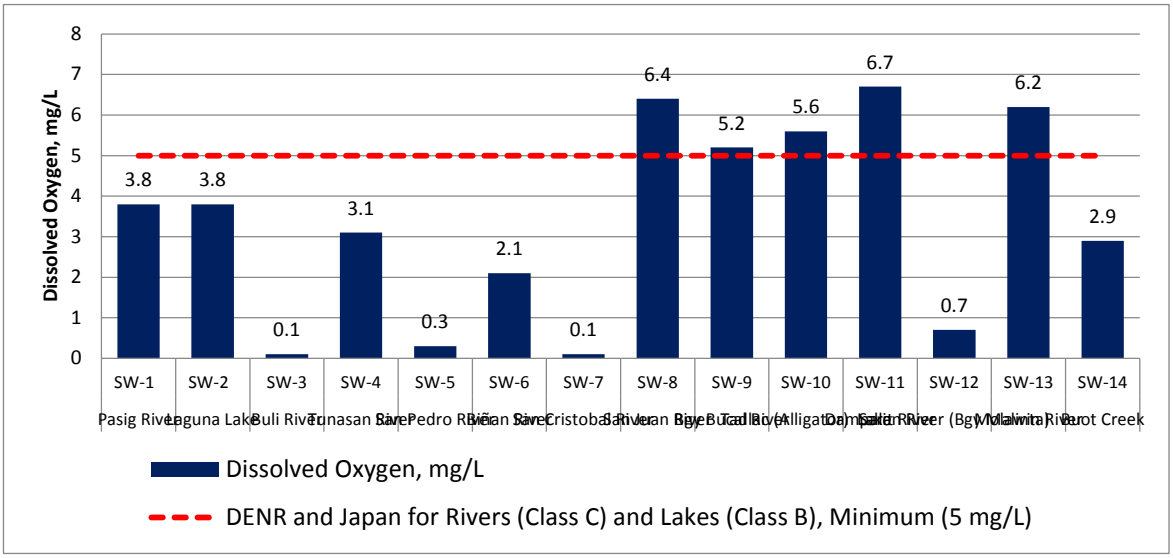


Figure 3.2.26 Results of Dissolved Oxygen Measurement of Surface Water Samples

Biochemical Oxygen Demand

675. BOD concentrations ranged from 7 to 175 mg/L. Only San Juan River (SW-8) conformed to the 7 mg/L for Class C maximum allowable limit, and the highest BOD recorded was in Tunasan River (SW-4) with 175 mg/L as shown in Figure 3.2.27.

676. In the LLDA river monitoring stations, the average of the annualized monthly BOD measurements per tributary station in 2009-2017 ranged 4-240 mg/L as shown in Table 3.2.12. Cases of conformance with the minimum 7 mg/L were noted in the San Juan River and Molawin River. Annual BOD measurement within Laguna Lake remained less than 7 mg/L except the 7.5 mg/L in Sta Rosa bay station in 2017 as presented in Table 3.2.13.

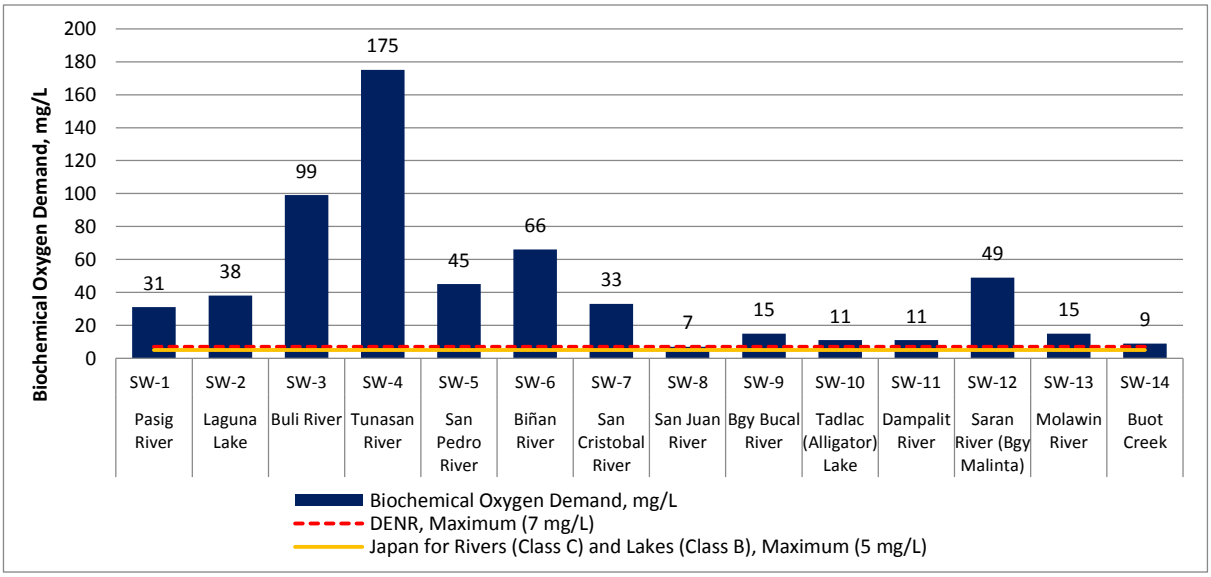


Figure 3.2.27 Results of Biochemical Oxygen Demand Measurement of Surface Water Samples

Fecal Coliform

677. Fecal coliform counts ranged from 22 to 9,200,000 MPN/100 ml. Only Tadlac Lake (SW-10) conformed to the 200 MPN/100 ml Class C maximum allowable limit. All the rest exceeded with the DENR guideline with highest fecal coliform count in San Cristobal River (SW-7) as shown in Figure 3.2.28.

678. In the LLDA river monitoring stations, the average of the annualized monthly total coliform measurements per tributary station in 2009-2017 ranged very high at 183, 000 – 1.1E+11 MPN/100 ml as given in Table 3.2.12. The total coliform annual geometric means within Laguna Lake ranged at lower values of 37-1,373 MPN/100 ml as shown in Table 3.2.13.

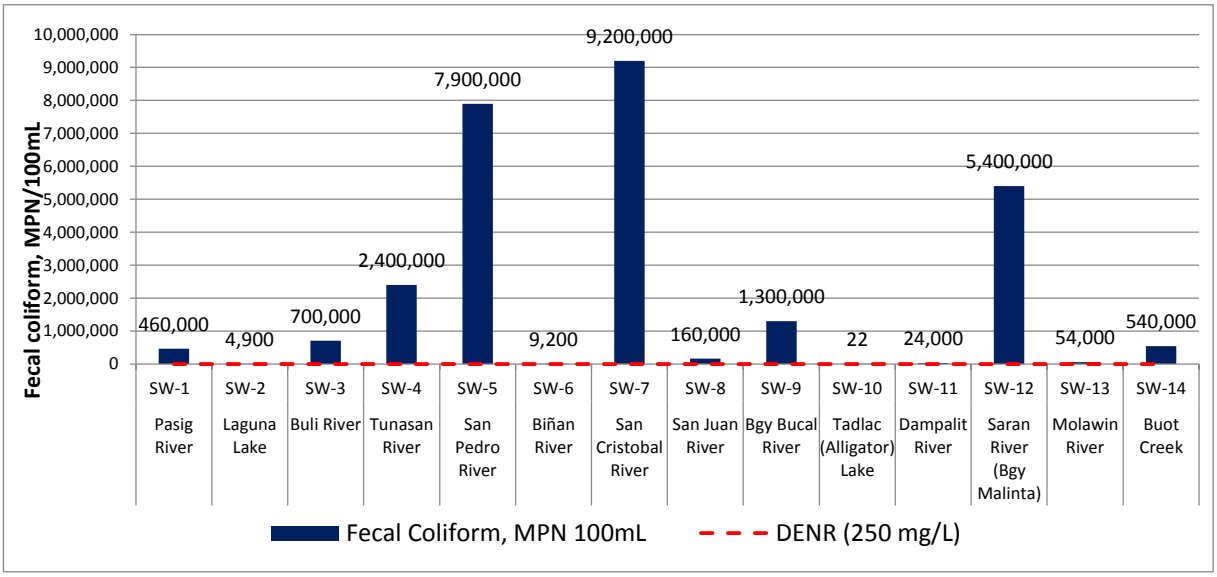


Figure 3.2.28 Results of Bar Graph of Fecal Coliform by Surface Water Samples

Total Coliform

679. Total coliform ranged from 49 to 24,000,000 MPN/100 ml. Only Tadlac River (SW-10) conformed to the 100 mg/L maximum allowable limit of Japan standards. All the other stations exceeded the Japan standard with the highest total coliform count in San Pedro River (SW-5) at 24,000,000 MPN/100 ml (Figure 3.2.29).

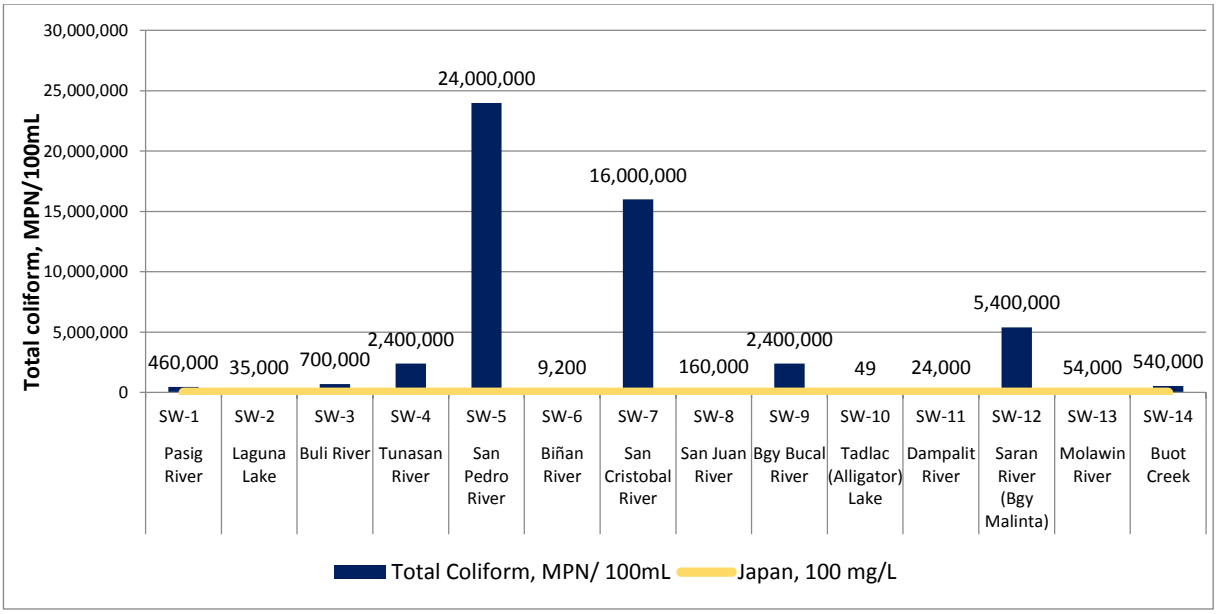


Figure 3.2.29 Results of Bar Graph of Total Coliform by Surface Water Samples

Conductivity

680. Conductivity measurements ranged from 228 to 1,637 uS/cm. The highest conductivity was measured in Tunasan River (SW-4) at 1,637 uS while the lowest was measured in Dampalit River with 228 uS as shown in Figure 3.2.30.

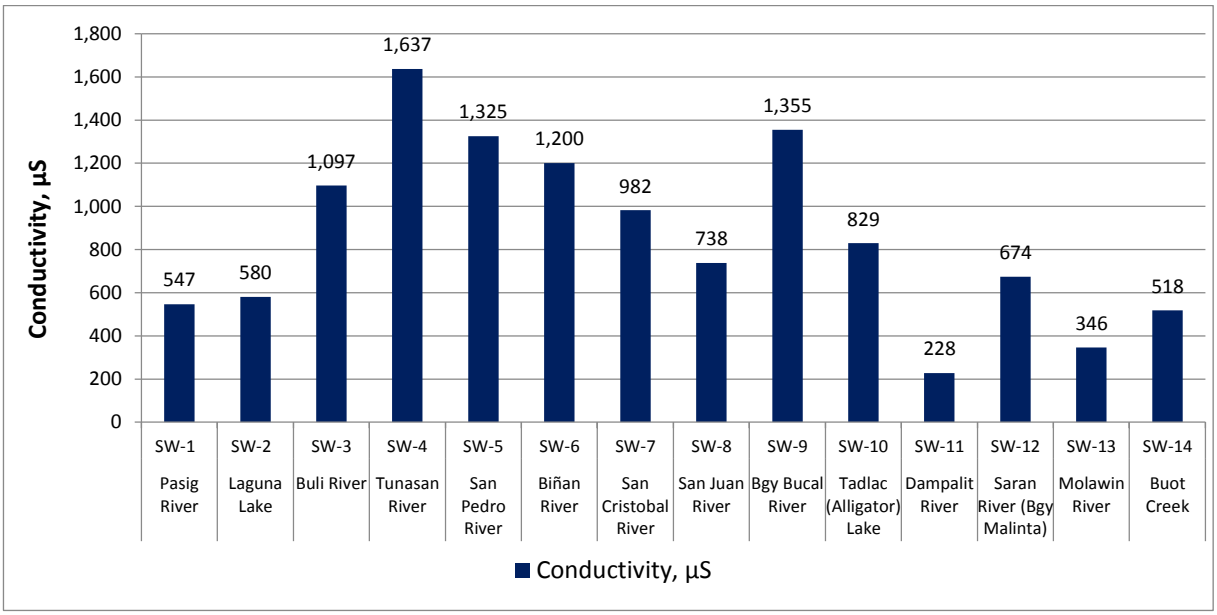


Figure 3.2.30 Results of Conductivity Measurement of Surface Water Samples

Chloride

681. Cl concentrations ranged from 8.2 to 250 mg/L or within DENR Class C guideline of not more than 350 mg/L. The highest chloride concentration was measured in Brgy. Bucal River (SW-9) while the lowest was measured in Dampalit River (SW-11) as shown in Figure 3.2.31.

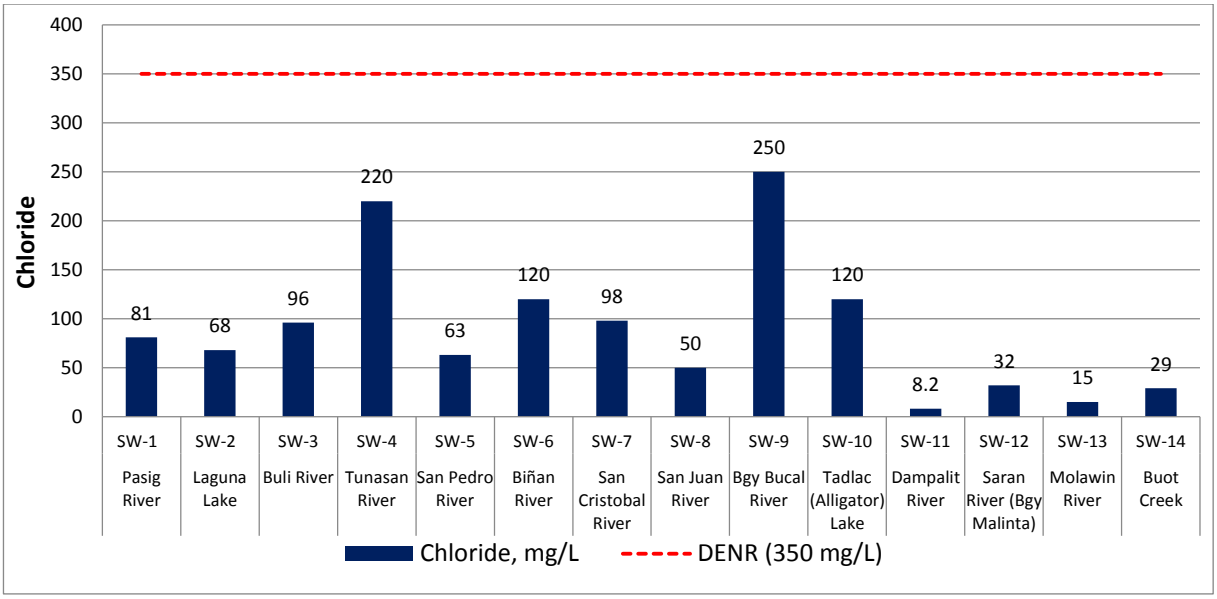


Figure 3.2.31 Results of Chloride Measurement of Surface Water Samples

Nitrate

682. NO3-N concentrations ranged from 0.10 to 1.24 mg/L which is within DENR Class C guideline of not more than 7 mg/L and Japan standard of more than 10 mg/L. The 1.24 mg/L came from San Juan River (SW-8) which prominently had higher nitrate concentration as shown in Figure 3.2.32.

683. From the LLDA monitoring data, the average of the annualized monthly NO3-N measurements per tributary station in 2009-2017 ranged from 0.13 to 4.66 mg/L., or within Class C guideline. Elevated nitrate concentrations were also observed in Molawin River as set out in Table 3.2.12. NO3-N concentration within the Laguna Lake stations were less than 1 mg/L as presented in Table 3.2.13.

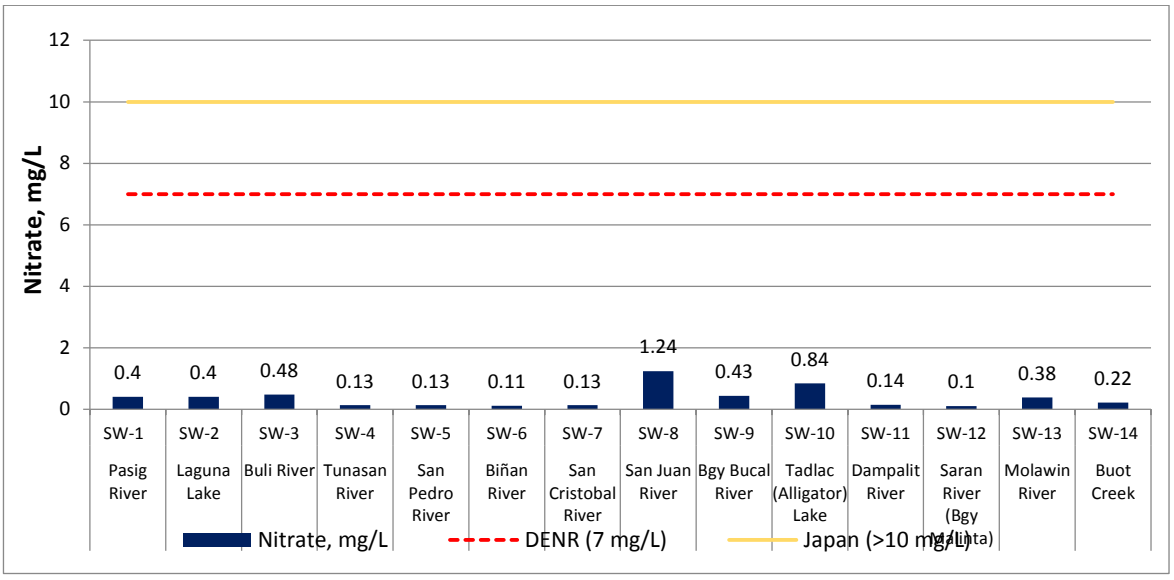


Figure 3.2.32 Results of Nitrate Measurement of Surface Water Samples

Phosphate

684. PO4-P concentrations ranged from 0.02 to 8.33 mg/L. Only Dampalit River (SW-11) and Molawin River conformed to the DENR Class C guideline of not greater than 0.163 mg/L. High concentrations were measured at Buli River, Tunasan River, San Pedro River, and Biñan River (Figure 3.2.33).

685. In comparison, LLDA data have a range of 0.66 to 4.04 mg/L on average annual monthly concentrations of PO4-P in 2009-2017 in the tributaries of Laguna Lake or more than the Class C limits as given in Table 3.2.12. PO4-P concentrations were within the Class C guideline as shown in Table 3.2.13.

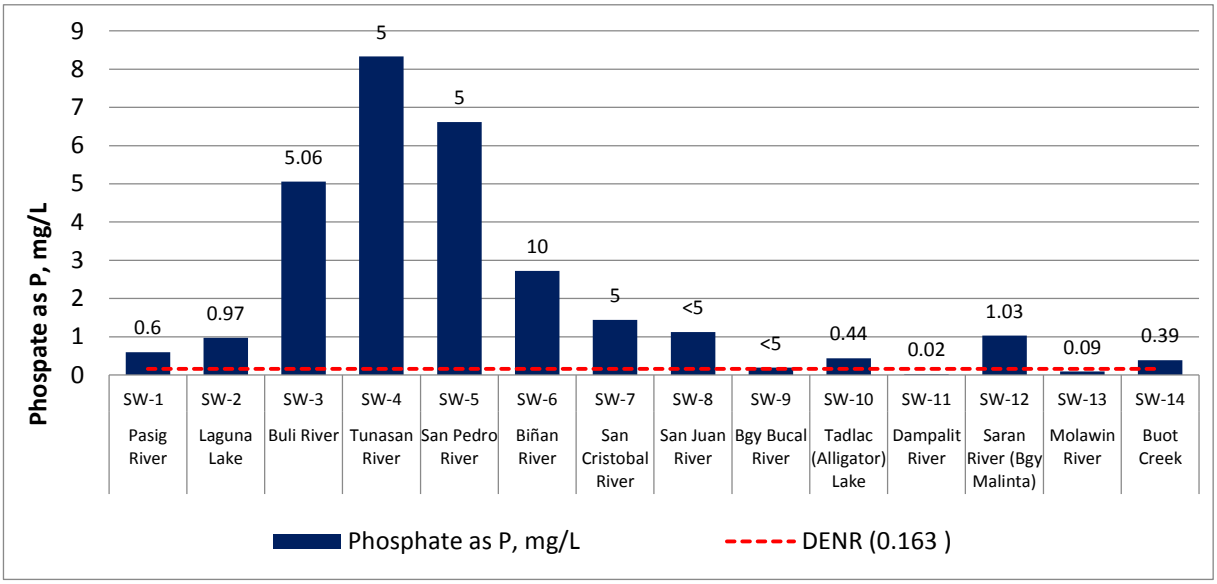


Figure 3.2.33 Results of Phosphate Measurement of Surface Water Samples

Organo-phosphates

686. The maximum allowable Ogano-Phosphate concentration based from the DENR standards is 0.003 mg/L. For the fourteen (14) stations surveyed, the results gathered showed that the stations contained insignificant amounts of Organo-Phosphate as can be reflected in Figure 3.2.35.

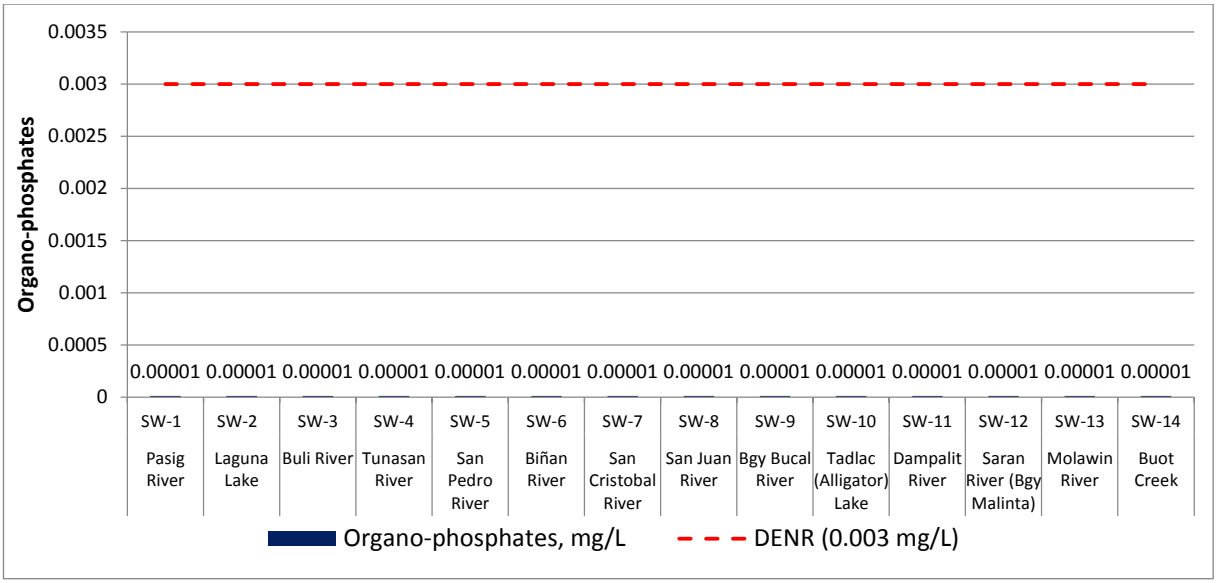


Figure 3.2.34 Results of Organo-Phosphate Measurement of Surface Water Samples

Copper

687. Cu concentrations ranged from 0.005 to 0.369 mg/L. Levels greater than 0.02 mg/L DENT Class C ceiling were noted in four samples: Buli River (SW-3), Tunasan River (SW-4), San Pedro River (SW-5), and Biñan River (SW-6) as shown in Figure 3.2.35.

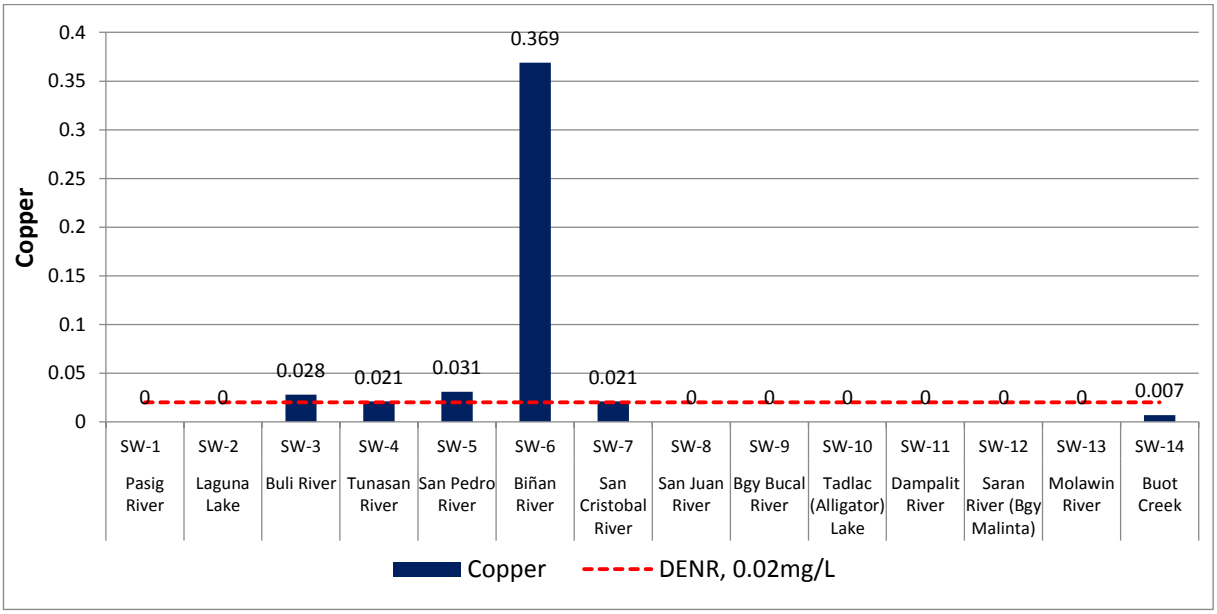


Figure 3.2.35 Results of Copper Measurement of Surface Water Samples

Arsenic

688. The concentration of As observed from the fourteen (14) surface water sampling stations ranged from <0.0009 to 0.0249 mg/L. Barangay Bucal River failed to conform with the DENR Class C guideline and Japan Standard. Saran River was in conformance with the DENR guideline value but not with the Japan standard. All other stations were in conformance to the DENR guideline and Japan standard as can be gleaned from Figure 3.2.36.

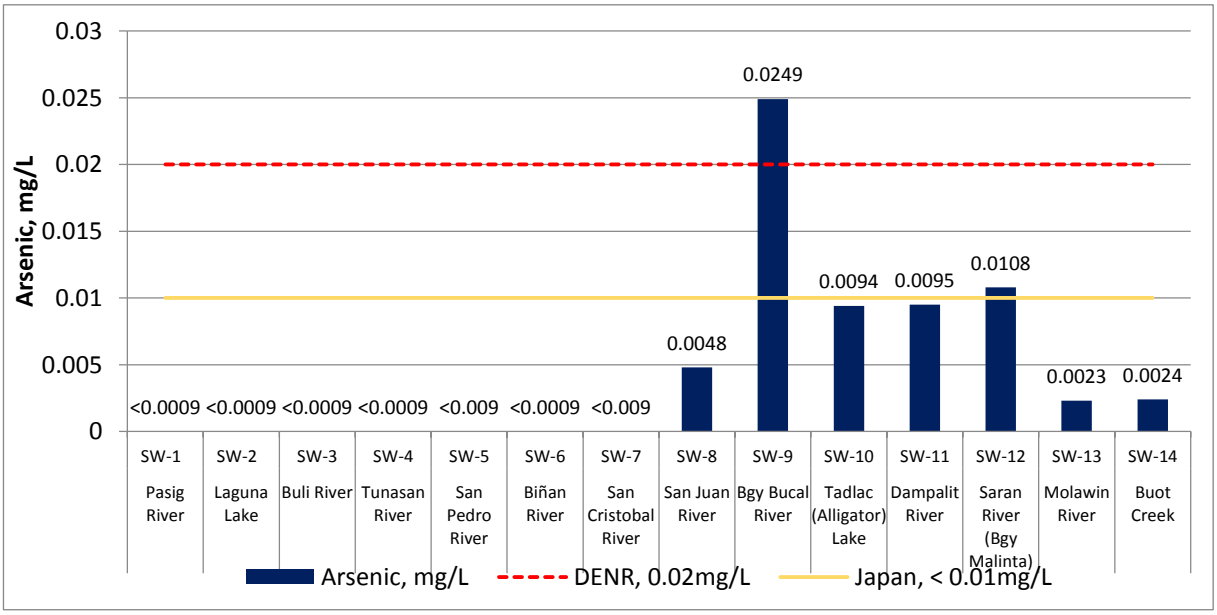


Figure 3.2.36 Results of Arsenic Measurement of Surface Water Samples

Cadmium

689. Of the fourteen (14) stations sampled for Cd content, four (4) stations were found to contain Cd. Of these four (4), three (3) sampling sites (Laguna Lake, Brgy. Bucal and Dampalit Rivers) were in conformance with the Japan standard. Brgy. Bucal and Dampalit Rivers were also in conformance with the DENR guideline. Saran River was non-conformant with both DENR guideline and Japan standard as shown in Figure 3.2.37.

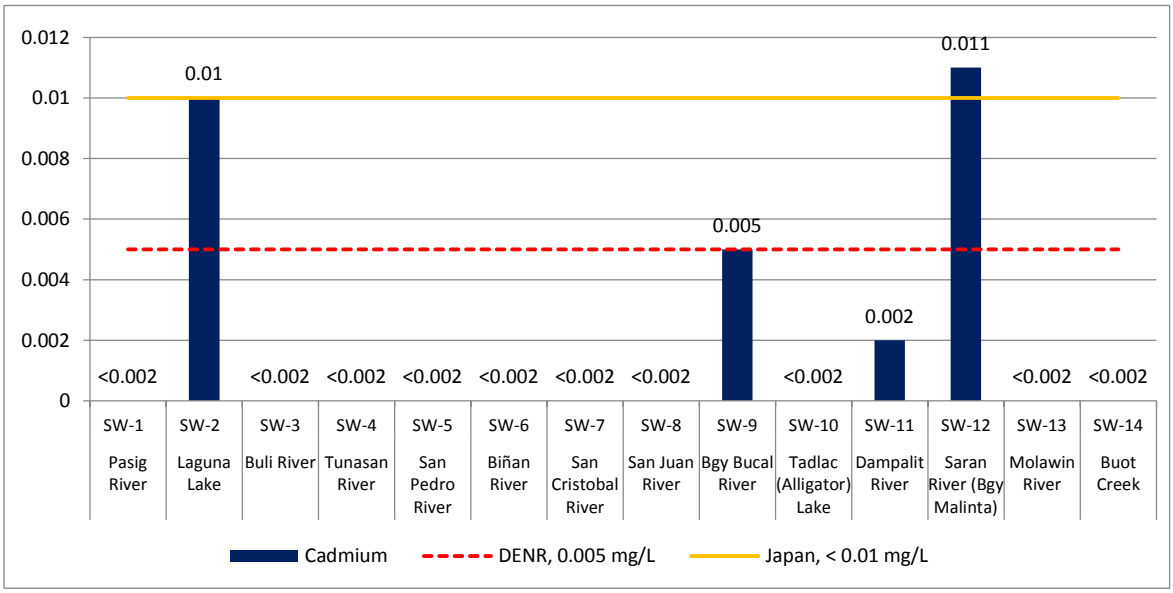


Figure 3.2.37 Results of Cadmium Measurement of Surface Water Samples

Chromium Hexavalent

690. From the fourteen (14) surface water sampling stations studied, four (4) stations (Buli, Tunasan, San Pedro Rivers and Buot Creek) were non-conformant with both DENR guideline and Japan standard for chromium hexavalent. Pasig and Biñan Rivers were compliant with the DENR guideline but not on the Japan standard.

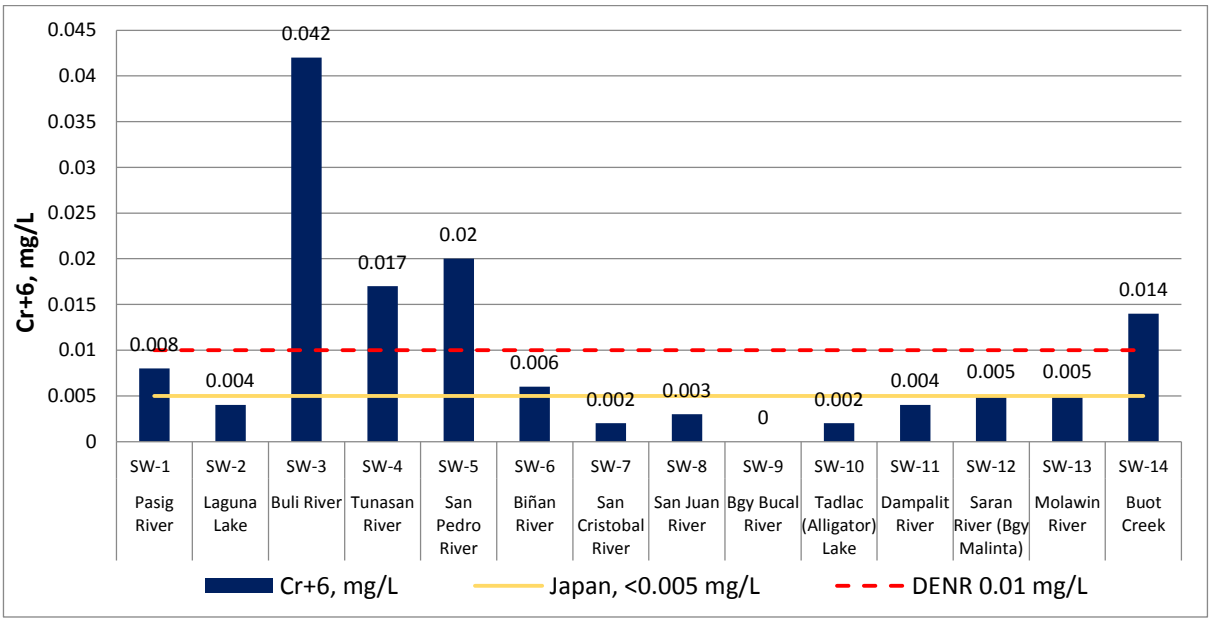


Figure 3.2.38 Results of Chromium Measurement of Surface Water Samples

Lead

691. Among the fourteen (14) surface water sampling stations sampled for Pb content, only Buod Creek was confirmed to have a presence of Pb. The said sampling was non-conformant with failed the Japan standards for exceeding the uppermost limit of the standard as can be reflected in Figure 3.2.39.

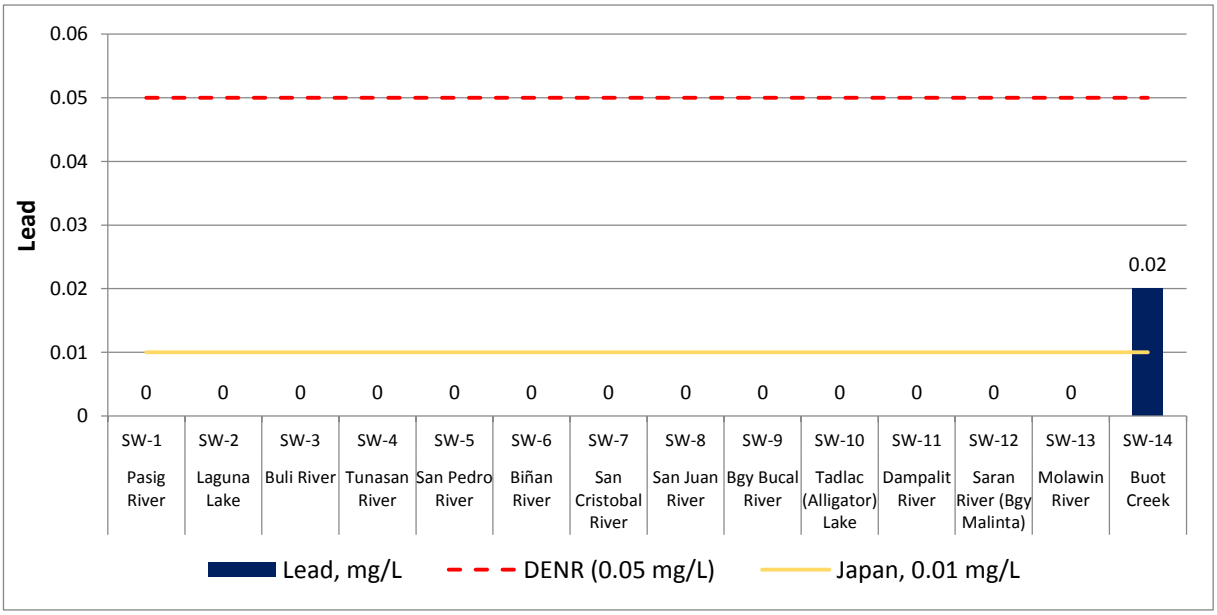


Figure 3.2.39 Results of Lead Measurement of Surface Water Samples

Mercury

692. The results showed that levels of Hg in all fourteen (14) stations were in compliance with the DENR guideline for Class C and Japan standard.

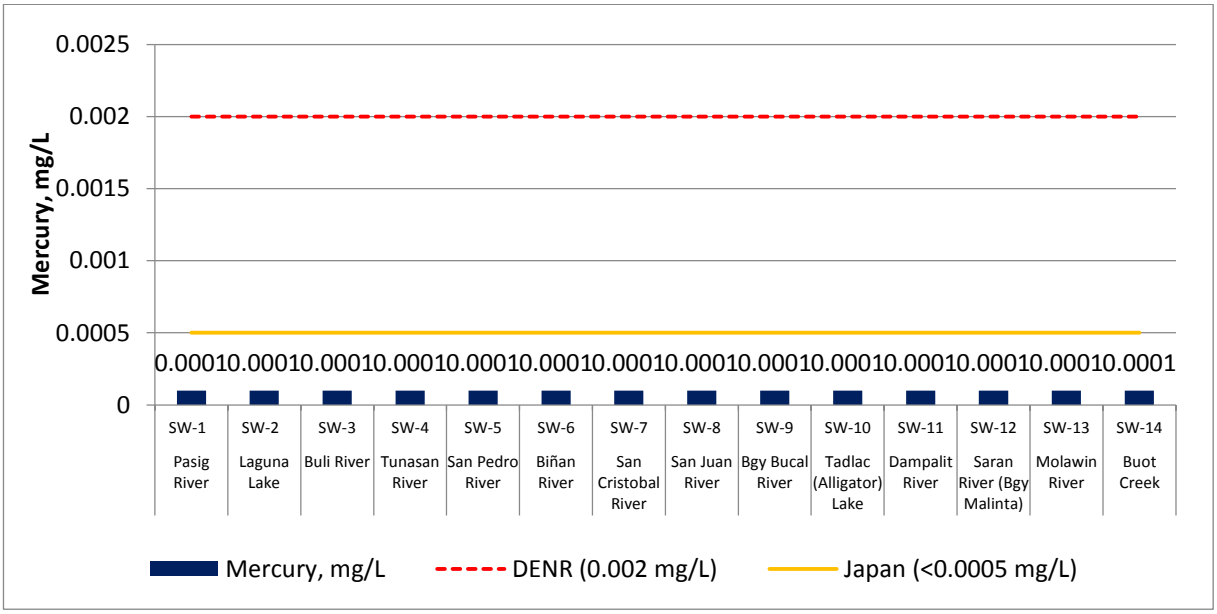


Figure 3.2.39 Results of Mercury Measurement of Surface Water Samples

Cyanide

693. Considering this standard, all the stations considered for CN content determination passed. But the highest concentration of CN in surface waters was observed in San Pedro River.

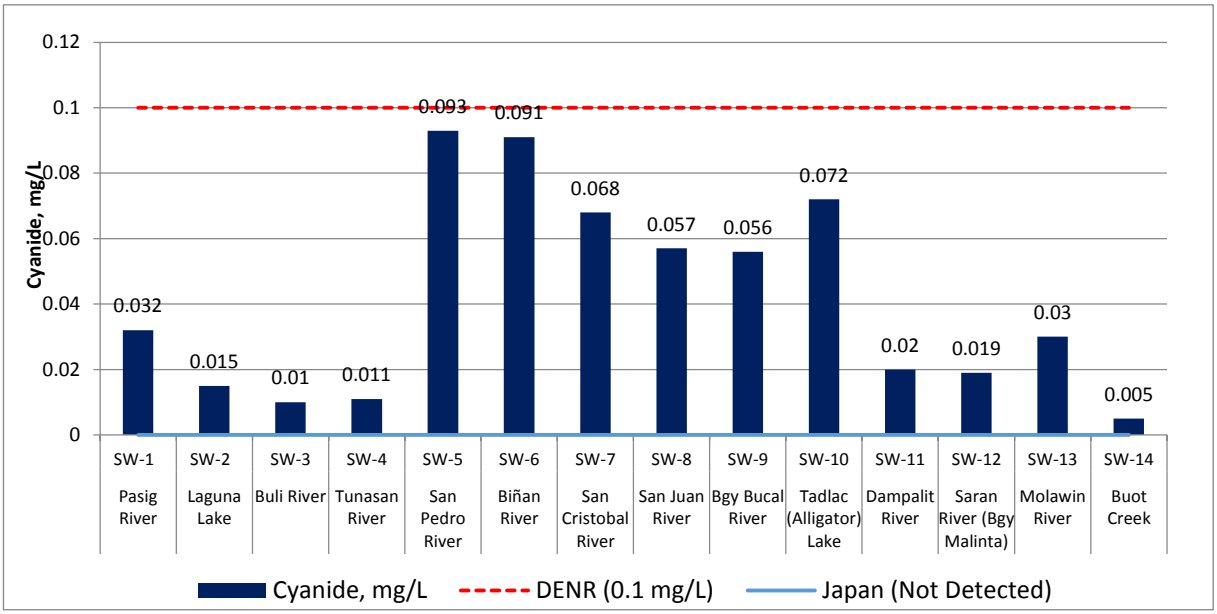


Figure 3.2.40 Results of Free Cyanide Measurement of Surface Water Samples

Oil and Grease

694. The concentration of O&G in all fourteen (14) stations ranged from 0.5 to 6.7 mg/L. level of O&G in Buli, Tunasan, San Pedro, Biñan, and Dampalit Rivers were non compliant with the DENR guideline for Class C water. The highest concentration of O&G was recorded in San Pedro River as shown in Figure 3.2.41

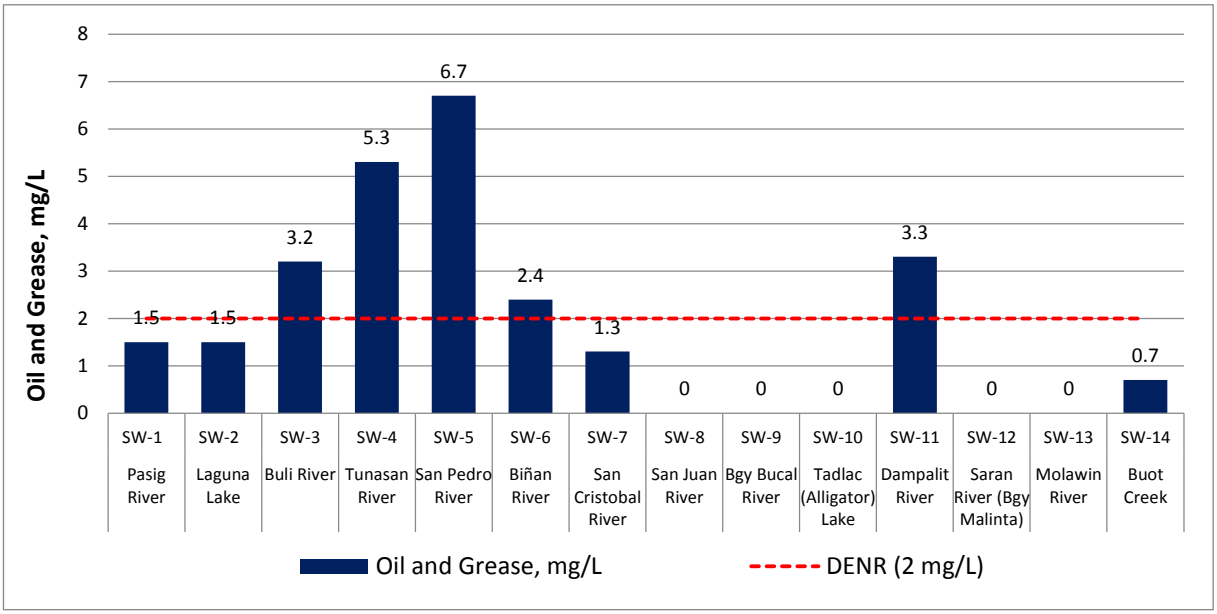


Figure 3.2.41 Results of Oil and Grease Measurement of Surface Water Samples

Phenols

695. The concentration of phenol in all fourteen (14) stations ranged from <0.01 to 7.20 mg/L. Levels of phenol in Pasig, Laguna Buli, Tunasan, San Pedro, Biñan, and San Cristobal Rivers were non-conformant with the DENR guideline for Class C water. The highest phenol level was recorded in Tunasan River at 7.2 mg/L as shown in Figure 3.2.42.

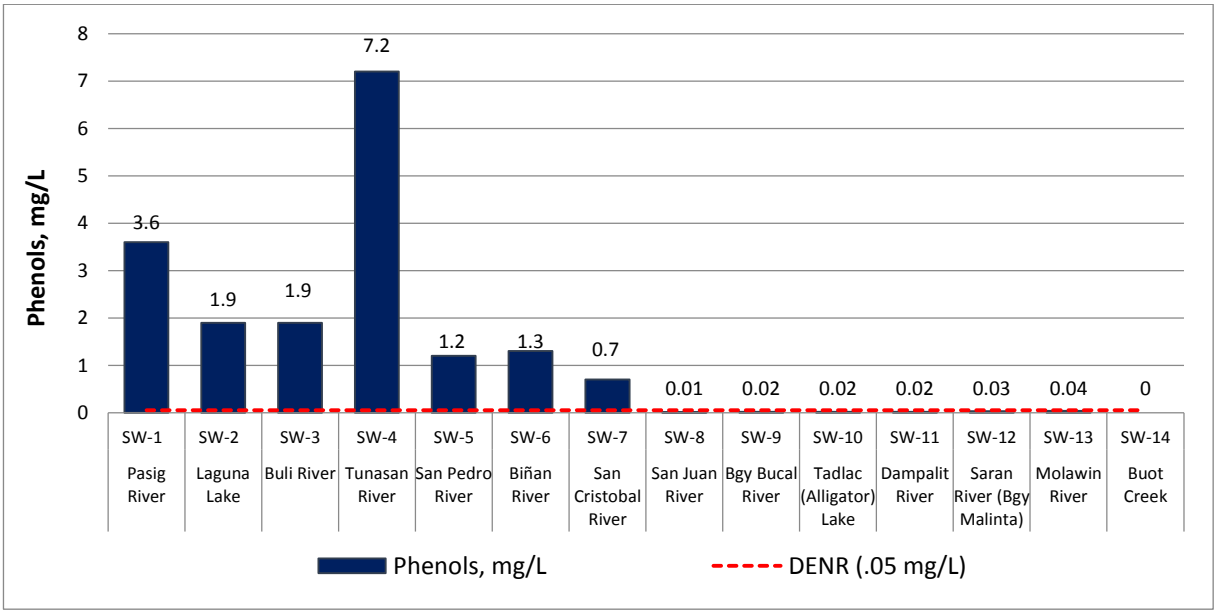


Figure 3.2.42 Results of Phenols Measurement of Surface Water Samples

Surfactants

696. Concentration of MBAS in fourteen (14) stations ranged from 0.007 to 4.810 mg/L. Of the fourteen (14) stations studied, three (3) stations were non-conformant with the DENR guideline for Class C waters. These are Buli, San Pedro, and Saran Rivers.

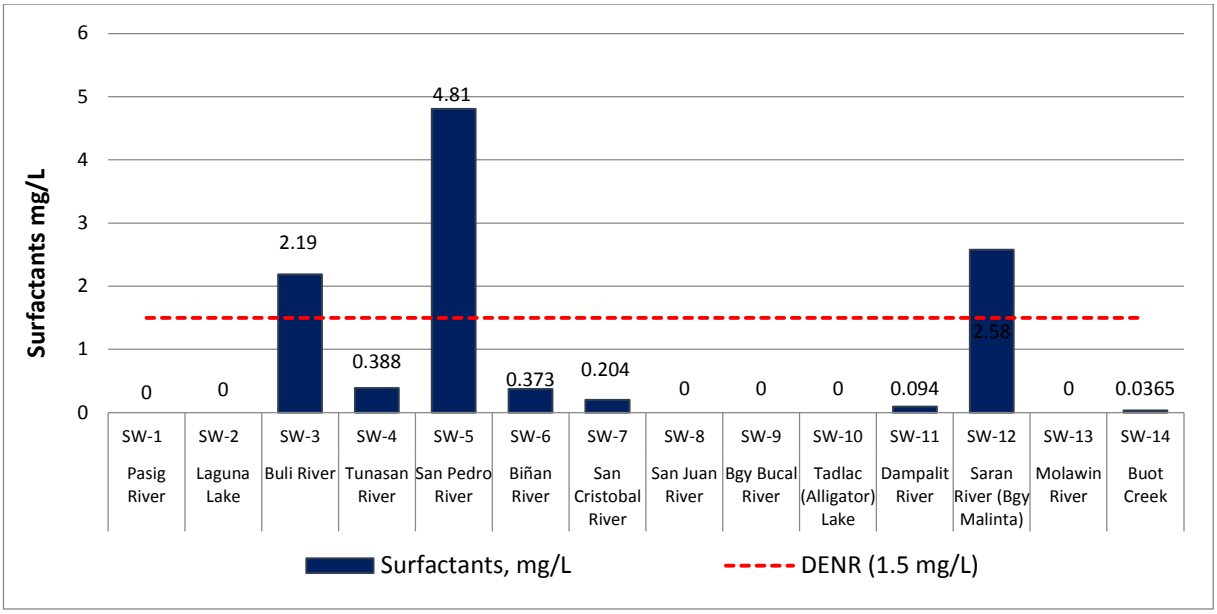


Figure 3.2.43 Results of Surfactants Measurement of Surface Water Samples

3.2.2.3 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Degradation of Groundwater Quality

697. During construction, there will be no significant impact or change in the quality of groundwater along the NSRP alignment, train stations and depot. No toxic chemicals will be introduced into railway under surface columns that will go deep to the bedrock. Risk of groundwater contamination may come from accidental spillage of oil and fuel from storage tanks. This can be addressed by having proper storage, handling and use of substances that can potentially harm the groundwater resource, in accordance with the requirements RA 6969 and its implementing rules and regulations. Inventory of chemicals to be used and site-specific layout of work areas and measures will be laid down during the mobilization phase. The workers will also have proper training on proper waste disposal and will have sufficient knowledge on the handling of potential groundwater-contaminating substances.

2) Degradation of Surface Water Quality

698. Construction works like ground excavations, leveling, stockpiling, and dewatering of railway column holes within or near the river banks would cause observable but short-term increase of total suspended solids of surface water, more pronounced during rainy season. This can be addressed by scheduling the construction period on a dry season and having erosion controls. Erosion controls which shall be implemented for the Project are the following: siltation ponds with silt traps, silt curtains, geo-membranes, avoidance of side tipping of earth spoils into water bodies, construction of silt barriers immediate compacting, hauling of excess spoil to designated spoil disposal areas located away from water bodies. Fencing, prior to major earthworks in Banlic depot, would be a significant measure.

699. The spoils will be hauled into pre-designated disposal areas where soil erosion control measures will be applied such limiting the height of storage, compacting, and maintenance of vegetative cover. Water in spoils will be drained on-site to avoid spillages along the hauling routes. Prior to leaving hauling trucks will be covered and dirt on the side and tires will be removed. During rainy periods, tire trucks with mud will be washed in on-site temporary wash area using high pressure pipe-water.

700. The concentration of total suspended solids (TSS) in the receiving water body is a relevant parameter in assessing the performance of erosion control. Water quality guideline for total suspended solids in the Laguna Lake Region (Class C) is set at 80 mg/L according to LLDA Board Resolution 523 series of 2017 which adopted DAO 2016-08. LLDA has jurisdiction over the NSRP area by virtue of RA 4850 (1966), as amended. which is "An Act Creating The Laguna Development Authority, Prescribing its Powers, Functions and Duties, Providing Fund Therefor, and for other Purposes." RA 4850 is supplemented by EO 927 (1983), "Further Defining Certain Functions and Powers of the Laguna Lake Development Authority."

701. In the construction of railway bridges and piers in waterways, the DOTr will coordinate with and/or secure necessary permits from NWRB, DPWH, LLDA, and concerned LGUs. At this stage, water quality management protocols will be implemented to minimize water quality degradation based on applicable freshwater quality standards.

702. Wastewater from construction support temporary facilities like toilets, canteens, and wash area would cause short-term deterioration of nearby water bodies. Such facilities will be located away from water bodies and will be provided with waste water containment structure for treatment or delivery to waste water treatment facility. Other possible surface water contaminating substances should be handled properly by having proper storage for each substance.

703. Risk of surface water contamination in depot area, may come from accidental spillage of oil and fuel from storage tanks. The risk can be addressed by having proper storage, handling and use of substances that can potentially harm surface water, in accordance with the requirements RA 6969 and its implementing rules and regulations. Inventory of chemicals to be used and site-specific layout of work areas and measures will be laid down during the mobilization phase. The workers will also have proper training on proper waste disposal and will have sufficient knowledge on the handling potential groundwater-contaminating substances

A surface water and effluent quality monitoring will be conducted.

(2) Operation Phase

1) Degradation of Groundwater Quality

704. During project implementation, long term overland discharge of untreated wastewaters from commuter station and depot may cause deterioration in nearby groundwater. Wastewater would typically contain wash water and used oil. Each commuter station and depot will have a sewage treatment plant (**STP**) such as septic tank and a separate treatment facility for non-sewage waste waters that meets the applicable effluent standards. Handling of potential contaminants during operation phase will be compliant with RA 6969.

2) Degradation of Surface Water Quality

705. During project implementation, long term overland discharge of untreated wastewaters from commuter station and depot may cause deterioration in nearby surface water. Wastewater would typically contain washwater and used oil. Each commuter station and depot will have a sewage treatment facility and a separate treatment facility for non-sewage wastewaters to meet the applicable effluent standards.

706. Service areas are the most likely locations where such contamination occurs because of the concentration of parked vehicles and fuel stands. Depot will therefore be equipped with an interceptor tank to remove oil and fuel grease from surface water before discharge. A wastewater

treatment facility with oil removal will be constructed at the Depot. Treatment facilities such as septic tanks designed to appropriate standards will be installed from every station to treat domestic sewage. All kinds of wastewater with oil will be stored and treated at Depot's WTF. The DOTr will conduct regular surface water quality monitoring activities in order to check the quality of the surface water from time to time. DOTr will also secure a DP from DENR for the disposal of treated wastewater to the waterbodies.

An effluent quality monitoring will be conducted as required.

3.2.3 Freshwater Ecology

707. Aquatic biodiversity is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and means of coping with any environmental change. Phytoplankton plays the role of primary producer in the rivers food chain while zooplankton organisms occupy a central position in the food webs of aquatic ecosystem. The importance of zooplankton is well recognized as these have vital part in food chain and play key role in cycling of organic matter in an aquatic ecosystem. Similarly, the macro-invertebrates act as the secondary producers in the aquatic ecosystem. They are an important link in the food web of aquatic ecosystem.

A field survey was conducted to determine the existing aquatic biodiversity at major river crossings at the proposed NSRP alignment.

(1) Field Survey

708. The freshwater ecology along the alignment of the proposed NSRP were assessed by collecting biological samples at the same stations established for surface water quality assessment on February 8-9, 2018.

709. A total of thirteen (13) stations were surveyed at the Project site which are presented in Photos 3-15 and Figure 3.2.44. The coordinates of the sampling stations were determined using GPS and their relative locations are presented in **Table 3.2.15** and **Figure 3.2.44**.

710. At each station, physical features were characterized including general land use, bank conditions, general riparian vegetation features and type of sediment. Instream variables such as average width and depth (Barbour et al. 1999) were also measured. Water quality meters were used to obtain on-site measurements of basic limnological variables such as DO, conductivity, pH and temperature. The average depths and widths of freshwater stations were measured using a meter stick and transect tape.

711. Plankton sampling was conducted at a total of thirteen (13) stations in reaches with open or partly open canopies (>50%); riffles not pools, with moderate water velocity (between 10 and 60 cm/sec). Plankton samples were obtained by passing a total volume of 100 l water through a plankton net, with a mesh size of 64 μ and a mouth diameter of 0.3 m (Photo 1). Three replicate samples of zooplankton and of phytoplankton were collected from each station. Samples were placed in properly- labelled, 500-ml capacity plastic containers, immediately fixed in formalin (5% by volume) and brought to the laboratory for processing and further analysis. Plankton enumeration was done using the Sedgewick counting chamber observed under a binocular microscope. Plankton were identified to the lowest possible taxa using taxonomic keys such as those of Mamaril et al. (1986), Segers (2004; 2007) and Bellinger and Sigee (2010).

712. A total of 39 sediment samples were collected for the macrobenthos study. Collections were undertaken at three (3) replicate zones at each station. For each station, ten (10) trowelful of sediments were obtained from each replicate zone, which covered an area of about 1 m2. The underside of rocks and stones were also checked for the presence of macrobenthos, and when present were hand-picked. Collected macrobenthos and sediment samples were placed in properly-labeled Ziploc plastic bags and preserved in 5% formalin. Samples were brought to the laboratory for further processing. In the laboratory, sediment samples were passed through a 1-mm mesh-sized sieve and all animals retained in the sieve were collected and sorted. Macrobenthos were transferred in plastic containers and preserved with 5% formalin and identified to the lowest

possible taxa using Haynes (2001) and Gapud and Raros (1986). Their abundances were recorded and expressed as number of animals/ m2. Methods of macrobenthos collection, preservation, and processing generally followed Barbour et al. (1999).

713. Locals were interviewed regarding the general river-use and types of fishes and other aquatic animals caught in the area.

Table 3.2.15 Coordinates and Elevation of Surveyed Stations

Sampling Stations	Sampling Station Description	Northing Coordinates	Sampling date
SW1	**Pasig River, Manila City** Open canopy, wide and deep river channel; turbid water; near bridge; concrete pathway at the right bank and buildings at the left bank; densely- populated area; receives domestic and industrial sewage and other effluents from buildings, industrial areas and houses; water hyacinth floating instream	14° 35' 39.69"N 121° 00' 44.28"E	February 8, 2018
SW2	**Laguna Lake, Muntinlupa City** Near slum area and oil depot with huge amounts of garbage/ waste along the lakeshore; turbid water, relatively deep; dense cover of water hyacinth near shore; with minor fishing activity	14° 27' 07.20"N 121° 03' 14.95"E	February 8, 2018
SW3	**Buli River, Muntinlupa City** Near slum area; heavily polluted; foul smell; muddy silty substrate; repository of domestic wastes, all types of garbage observed instream; shallow, narrow river with open canopy	14° 26' 46.96"N 121° 03' 00.82"E	February 8, 2018
SW4	**Tunasan River, Muntinlupa City** Shallow, narrow river with open canopy; highly turbid, polluted river with numerous houses along banks; concrete banks; solid wastes instream	14° 22' 10.33"N 121° 03' 03.81"E	February 8, 2018
SW5	**San Pedro River, San Pedro City** Polluted waters with garbage instream; turbid waters; several houses along banks; open canopy; shallow, narrow river; concrete and sandy banks	14° 21' 50.99"N 121° 03' 14.92"E	February 8, 2018
SW6	**San Cristobal River, Calamba City** Shallow river with concrete, sloping right bank, and sandy, grassland area at the left bank; open canopy; garbage observed at the instream area as well as banks	14° 13' 12.47"N 121° 09' 04.78"E	February 8, 2018
SW7	**San Juan River, Calamba City** Clear shallow waters with garbage instream; sloping concrete right bank and sandy area at left bank; with minor fishing activity	14° 12' 31.98"N 121° 09' 25.14"E	February 9, 2018
SW8	**Bgy Bucal River, Calamba City** Open canopy; shallow, narrow river channel; huge amounts of garbage instream; highly populated (slum area)	14° 11' 02.19"N 121°10' 30.46"E	February 9, 2018
SW9	**Alligator Lake, Los Baños** Clear, deep lake; La Resio Resort and houses along lakeshore; trees, grasses and shrubs along lake margin	14° 10' 51.04"N 121°12' 28.44"E	February 9, 2018
SW10	**Dampalit River, Los Baños** Shallow, narrow stream with several houses along banks; concrete sloping, steep banks; domestic sewage and effluents directly discharged into the stream; serve as dumping grounds of wastes (garbage observed instream and along banks)	14° 10' 34.23"N 121°12' 58.29"E	February 9, 2018
SW11	**Saran River (Bgy Anos), Los Baños** Shallow, narrow stream; receives effluents from houses; sewage directly discharged into the river; concrete right bank; few trees and shrubs at left bank; white, opaque water; garbage instream	14° 10' 55.16"N 121°13' 51.76"E	February 9, 2018
SW12	**Maulauen River, Los Baños** Clear, shallow stream with trees and grass along banks; 25% overhanging vegetation; with rocks and pebbles instream and few boulders at banks	14° 10' 13.23" 121°15' 08.34"	February 9, 2018
SW13	**Buot Creek, Los Baños** Clear, shallow but dirty water with solid wastes instream and along banks; banks with several houses; receives all types of domestic wastes; few trees and shrubs along banks	14° 9'53.83"N 121°15'22.86"E	February 22, 2018

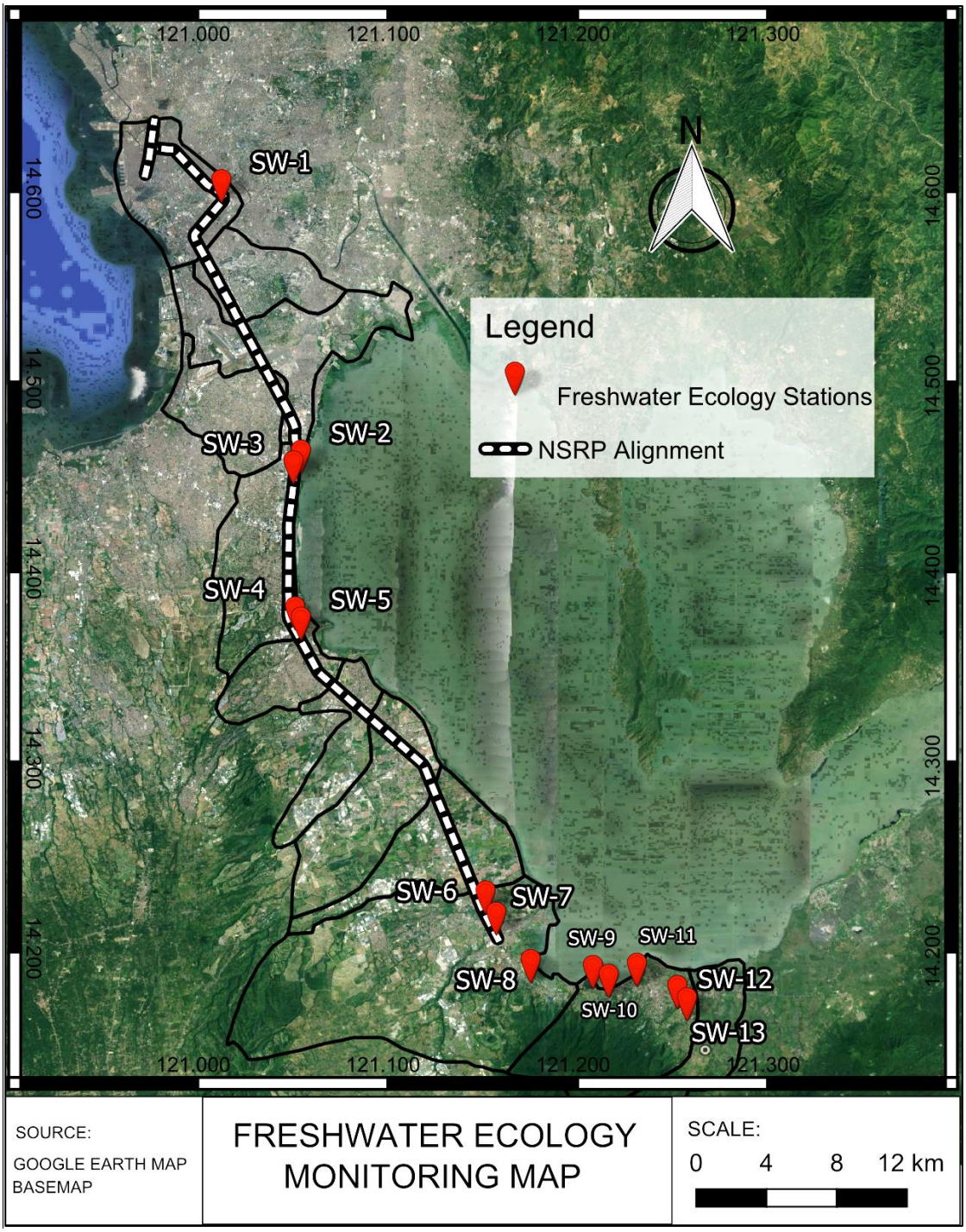


Figure 3.2.44 Freshwater Ecology Monitoring Stations

(2) Survey Result and Analysis

714. The conditions of freshwater bodies at the vicinity of the proposed site of the PNR Los Baños (North-South Railway) NSRP ranged from good to poor, which are reflective in the water quality and biological data. Bioindicator species of phytoplankton such as *Pediastrum*, *Melosira* and *Fragilaria*, and the occurrence of Rotifera species, such as *Brachionus urceolaris* are suggestive of these conditions. The dominance of Oligochaeta, *Melanoide*s and Chironomidae, which are known indicators of poor quality further corroborates with these observations. Also, low DO at several stations and high conductivity levels at all stations indicate poor water quality. Disturbances at aquatic bodies could be largely attributed to domestic and industrial activities.

1) Species Diversity

a. Plankton Community

Phytoplankton

715. The phytoplankton community at thirteen (13) stations combined at the vicinity of the proposed PNR-South Project comprised at least thirteen (13) taxa representing three (3) algal divisions. Cyanophyta (blue-green algae) largely dominated the phytoplankton community comprising 68.2% of the total count. Relatively lower proportions were recorded for Chlorophyta (green algae) and Bacillariophyta (diatoms), representing 18.3% and 13.5%, respectively, of the total phytoplankton. Five (5) diatom taxa, five (5) green algal taxa and three (3) blue-green algal taxa were recorded at the study site as presented in Table 3.2.16.

716. Phytoplankton mean abundances varied among sampling stations, ranging from 1 cell/l to 873 cells/l. SW4 had the highest mean algal density (873 cells/l), followed by those recorded at SW3 (277 cells/l), SW7 (207 cells/l), SW9 (199 cells/l) and at SW13 (186 cells/l)/. Moderate algal abundances were observed at WSS2, SW6 and SW12 with values ranging from 42 cells/l to 84 cells/l. Meanwhile, low algal densities were recorded at three remaining stations (SW8, SW10 and SW11), with average phytoplankton abundances ranging from 1 cell/l to 18 cells/l as shown in Table 3.2.16.

717. *Pediastrum* dominated at SW1 (84 cells/l), followed by *Ulothrix* (34 cells/l), while *Fragilaria* (32 cells/l) was the most abundant taxon at SW2. High mean densities of *Microcystis* were observed SW3 (250 cells/l), SW4 (545 cells/l) and SW5 (140 cells/l), consistently dominating these stations. *Aphanocoapsa* was also recorded at high density at SW4 (328 cells/l), and this taxon dominated at SW9 (199 cells/l), sw10 (3 cells/l) and at SW11 (18 cells/l). Stations SW6 and SW7 were dominated by *Ulothrix* (56 cells/l and 98 cells/l, respectively), while high densities of this taxon were observed at SW1 (34 cells/l) and at SW13 (50 cells/l). Meanwhile, *Melosira* was the most abundant taxon at SW12 and SW13 (18 cells/l and 56 cells/l, respectively) as indicated in Table 3.2.16.

718. The dominance of *Pediastrum, Fragilaria and Melosira*, as well as the occurrence of *Microcystis* at high densities at majority of the surveyed stations are suggestive of eutrophic (nutrient-rich) waters. These taxa are known bioindicators of such condition (Bellinger and Sigee, 2010). *Microcystis* is also known to produce toxin and impart foul smell and unwanted taste in water systems (Bellinger and Sigee, 2010).

Table 3.2.16 Mean (No. of Units/ l) and Relative Mean Density (%) of Algae Recorded at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Overall Mean Density	Relative Mean Density
Bacillariophyta	45	32	27	0	13	2	77	1	0	0	0	18	91	23	13.5
Fragilaria	29	32	23	0	3	0	27	0	0	0	0	0	25	11	6.2
Melosira	0	0	5	0	0	0	39	0	0	0	0	18	56	9	5.2
Navicula	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0.0
Surirella	11	0	0	0	10	2	11	0	0	0	0	0	10	3	2.0
Synedra	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Chlorophyta	97	43	0	0	0	60	118	0	0	1	0	17	77	32	18.3
Cladophora	0	0	0	0	0	0	20	0	0	0	0	11	28	5	2.6
Pediastrum	48	10	0	0	0	4	0	0	0	1	0	5	0	5	3.0
Scenedesmus	11	15	0	0	0	0	0	0	0	0	0	0	0	2	1.2
Spirogyra	5	14	0	0	0	0	0	0	0	0	0	0	0	1	0.8
Ulothrix	34	4	0	0	0	56	98	0	0	0	0	0	50	18	10.7
Cyanophyta	0	9	250	873	140	7	12	0	199	3	18	8	17	118	68.2
Aphanocapsa	0	0	0	328	0	0	0	0	199	3	18	8	0	43	24.7
Microcystis	0	0	250	545	140	0	0	0	0	0	0	0	0	72	41.5
Spirulina	0	9		0	0	7	12	0	0	0	0	0	17	3	2.0
Mean Density	142	84	277	873	153	68	207	1	199	4	18	42	186	173	100.0
SD	4	10	23	166	18	11	1	0	37	5	8	14	13		
Number of Taxa	7	6	3	2	3	4	6	2	1	2	1	4	6	13	

Zooplankton

719. At least fourteen (14) zooplankton taxa representing three (3) animal phyla were recorded at ten (10) surveyed stations combined at the vicinity of the proposed location of NSRP. Arthropoda was the most abundant phylum representing 46.5% of the total zooplankton, followed by Rotifera with an overall relative density of 38.6%. Relatively lower proportion was recorded for Protozoa comprising 14.9% of the total count. Meanwhile, none was recorded at three remaining stations (SW8, SW9 and SW11). Rotifera had the highest number of zooplankton taxa (8 taxa) followed by Arthropoda (5 taxa), while a single taxon was observed for Protozoa as shown in Table 3.2.17.

720. Moderate zooplankton densities were recorded at SW1 and SW2 with values of 49 inds. /l and 33 inds. /l, respectively. These two (2) stations also had relatively higher number of taxa ranging from 9-10 taxa, compared with that recorded at (8) eight remaining stations. Low zooplankton taxa richness was observed at the rest of the sampling stations with values ranging from 1-5 taxa, as indicated in Table 3.2.17.

721. Copepoda nauplius dominated at SW1 (15 inds. /l), followed by *Filinia* (10 inds. /l). Copepoda nauplius and *Brachionus urceolaris* co-dominated at SW2 each having a mean density of 9 inds. /l. Copepoda nauplius dominated at SW12 (4 inds. /l), and *Centropyxis* at SW13 (5 inds. /l) as shown in Table 3.2.17.

722. Overall composition and mean abundances of zooplankton were low at majority of the surveyed stations except at SW1 and SW2 (Table 3.2.17).

723. The presence of *Filinia* and *Brachionus urceolaris* at moderate densities and the occurrence of protozoan Genus *Centropyxis*, may indicate nutrient-enrichment in some surveyed stations, since these taxa are known bioindicators of such condition (Lampert and Sommers, 2007; Hra, 2011; Marneffe et al., 1998). Sources of organic matter/ nutrients as well as other pollutants may possibly be domestic as well as industrial activities, particularly at sites SW1 and SW2. Low zooplankton taxa richness and mean abundances in majority of the sampling stations can be attributed to moderate to fast water flow in most areas as well as domestic disturbances.

Table 3.2.17 Mean (No. of Units/ l) and Relative Mean Density (%) of Algae Recorded at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Overall Mean Density	Relative Mean Density
Arthropoda	23	16	0	0	0		0	0	3	0	0	4	3	5	46.5
Calanoida copepodite	4	5	0	0	0	0	0	0	1	0	0	0	1	1	9.6
Calanoida female	4	2	0	0	0	0	0	0	0	0	0	0	0	1	6.3
Copepoda nauplius	15	9	0	0	0	0	0	0	2	0	0	4	2	3	30.4
Isopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Bosmina	5	1	0	0	0	0	0	0	0	0	0	0	0	1	5.8
Protozoa	4	3	1	0	0	0	1	0	1	0	0	1	3	2	14.9
Centropyxis	4	3	1	0	0	0	1	0	1	0	0	1	5	2	14.9
Rotifera	22	15	0	0	0	2	0	0	0	0	0	1	3	4	38.6
Brachionus calyciflorus	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
Brachionus leydigi	0	1	0	0	0	2	0	0	0	0	0	0	0	0	2.9
Brachionus urceolaris	0	9	0	0	0	0	0	0	0	0	0	0	0	1	8.2
Filinia	10	2	0	0	0	0	0	0	0	0	0	0	0	1	10.6
Hexarthra	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1.0
Keratella tropica	5	0	0	0	0	0	0	0	0	0	0	0	0	0	4.6
Lecane	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1.2
Polyarthra	6	3	0	0	0	0	0	0	0	0	0	0	0	1	8.4
Mean Density	49	33	2	0	0	2	1	0	4	0	0	5	8	10	100.0
SD	15	2	1	0	0		1	0	1	0	0	4	2		
Number of Taxa	9	10	3	1	1	1	1	0	4	0	0	5	4	14	

b. Macrobenthos Community

724. A total of nineteen (19) macrobenthos taxa representing four (4) animal phyla were recorded at thirteen (13) stations combined at the proposed site of PNR NSR Project, while none was observed at SW3. Arthropoda largely dominated the macrobenthos community comprising 50.4% of the total count, followed by Mollusca with 36.2%. Annelida was recorded at relatively low proportion (13.2%) as shown in Table 3.2.18.

725. Macrobenthos taxa richness was relatively low at surveyed stations, ranging from 1-9 taxa, with relatively higher taxa richness observed at SW1, SW10, SW11 and SW13 (7-9 taxa), compared with that recorded at eight (8) remaining stations (1-4 taxa). High densities of macrobenthos were recorded at SW2, SW8, SW10 (104 to 179 inds. /m2), while moderate densities at SW1, SW9, SW11, SW12 (36 to 76 inds. /m2). Meanwhile low densities were recorded at five (5) remaining stations (1-16 inds. /m2) as presented in Table 3.2.18.

726. Oligochaeta was the most abundant taxon at SW1 (30 inds. /m2), and *Melanoides* at SW2, SW9, SW10 and SW13 (23-95 inds. /m2. Chironomidae of Order Diptera dominated at four (SW7, SW8, SW11, and SW12) of the thirteen (13) surveyed stations. This taxon was recorded at high density at SW8 (178 inds. /m2). Chironomidae was also recorded at high densities at SW9 and SW10 (16 and 44 inds. /m2). Class Hirudinea (leeches) was recorded at moderate density at SW10, as given in Table 3.2.18.

Table 3.2.18 Mean (No. of Animals/ m^2) and Relative Mean Density (%) of Macrobenthos at Thirteen (13) Sampling Stations

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Total Mean Density	Relative Mean Density
ANNELIDA	30	0	0	4	0	1	1	0	11	11	23	1	6	88	13.2
Hirudinea	0	0	0	0	0	0	0	0	0	10	0	0	4	15	2.2
Oligochaeta	30	0	0	4	0	1	1	0	11	1	23	0	2	72	10.9
Polychaeta	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
Nereididae	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0.1
ARTHROPODA	0	0	0	0	4	0	14	178	16	45	53	7	17	334	50.4
Decapoda (crabs)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Insecta	0	0	0	0	4	0	14	178	16	44	53	7	17	334	50.4
Order Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1
Elmidae	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0.1
Order Diptera	0	0	0	0	4	0	14	178	16	44	53	6	1	317	47.8
Chironomidae	0	0	0	0	4	0	14	178	16	44	53	6	1	317	47.7
Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Order Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	13	13	2.0
Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0.5
Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	10	10	1.4
Order Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0.5
Hydropsychidae	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0.5
MOLLUSCA	6	113	0	0	1	0	1	1	25	48	0	1	45	240	36.2
Bivalvia	1	10	0	0	0	0	0	0	0	0	0	0	2	13	2.0
Corbicula	0	10	0	0	0	0	0	0	0	0	0	0	2	13	1.9
Tellinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Gastropoda	5	102	0	0	1	0	1	1	25	48	0	1	43	227	34.2
Acmaeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Acmaea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Ampullaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Pomacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
Physidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2
Thiaridae	4	96	0	0	0	0	1	1	25	48	0	1	43	219	33.0
Melanoides	4	95	0	0	0	0	1	1	23	47	0	1	43	215	32.4
Thiara scabra	1	1	0	0	0	0	0	0	2	0	0	0	0	4	0.6
Viviparidae	0	6	0	0	0	0	0	0	0	0	0	0	0	6	1.0
Viviparus	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.3
PLATYHELMINTHES	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2
Turbellaria	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2

Taxa	SW-1 Pasig River	SW-2 Laguna Lake	SW-3 Buli River	SW-4 Tunasan River	SW-5 San Pedro River	SW-6 San Cristobal River	SW-7 San Juan River	SW-8 Bgy Bucal River	SW-9 Tadlac (Alligator) Lake	SW-10 Dampalit River	SW-11 Saran River (Bgy Malinta)	SW-12 Molawin River	SW-13 Buot Creek	Total Mean Density	Relative Mean Density
Dugesia	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0.2
Mean Density	36	113	0	4	5	1	16	179	52	104	76	9	68	663	100.0
SD	37	143	0	6	2	2	6	69	31	60	24	2	21		
Number of Taxa	8	4	0	2	3	1	4	2	4	9	4	7	9	19	

727. The dominance of Oligochaeta **(**Photo 3.2.1**),** *Melanoides and* Chironomidae **(**Photo 3.2.2**)** at most surveyed stations and the occurrence of leeches (Photo 3.2.3) at few stations are suggestive of polluted conditions. These taxa are known bioindicators of eutrophic, nutrient-rich condition/ 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 wastes such as solid wastes, and sewage could serve as possible sources of organic matter and nutrients.

Photo 3.2.1 Oligochaeta the Dominant Taxon at WSS1

Photo 3.2.2 Chironomidae (Midge Larvae), the Dominant Taxon at Majority of the Surveyed Stations

Photo 3.2.3 Hirudinea (Leech) Observed at Moderate Density at WSS10

c. Fish and Other Aquatic Animals

728. Majority of the sampling stations serve as repository for all types of wastes/ garbage and pollutants from domestic and industrial activities. Minor fishing activity was observed at SW2, SW7 and SW9, but fish caught are used for domestic consumption, as shown in **Photo 3.2.4**, **Photo 3.2.5** and **Photo 3.2.6**.

729. A total of seven (7) aquatic animals comprised of five (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 five (5) stations as shown in Table 3.2.19. 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) (Table 3.2.19).

Table 3.2.19 Fish and Other Aquatic Animals Reportedly Caught at Five (5) Stations

Stations	Fish and other aquatic animals
SW2	Oreochromis niloticus (tilapia)
SW6	Hypostomus plecostomus (janitor fish), Oreochromis niloticus (tilapia), Clarias sp. (hito), Channa sp.(dalag), turtle (pawikan)
SW7	Hypostomus plecostomus (janitor fish), Oreochromis niloticus (tilapia), Clarias sp. (hito), Channa sp.(dalag), turtle (pawikan), Arius (kanduli)
SW9	Oreochromis niloticus (tilapia), Channa sp.(dalag)
SW12	Hypostomus plecostomus (janitor fish), Oreochromis niloticus (tilapia), Channa sp.(dalag), snake, turtle

Photo 3.2.4 Local Catching Fish at SW2 Using Fish Net

Photo 3.2.5 Catching Fish Using Hook and Line at SW7

Photo 3.2.6 Fisherfolk Catching Fish Using Fish Net at SW9 Tadlak Lake

2) Biodiversity Values

730. Phytoplankton communities at SW1, SW2, and SW13 were relatively more diverse (diversity values ranging from 1.61 to 1.66) than that observed at SW7 and SW12 (diversity values of 1.48 and 1.28, respectively). Meanwhile, low diversity values were recorded for phytoplankton communities at the remaining sampling stations (0.34 to 0.67). SW1 and SW2 had more diverse zooplankton communities (2.0 diversity values) 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 relatively higher index of diversity values were recorded (diversity index values ranged from 1.08 to 1.36) as shown in Table 3.2.20.

Table 3.2.20 Shannon's Diversity Index Values of Freshwater Communities at Thirteen (13) Surveyed Stations at PNR Los Bańos-NSR Project Site

Freshwater Communities	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11	SW12	SW13
Phytoplankton	1.66	1.61	0.37	0.66	0.34	0.67	1.48	0.00	0.00	0.56	0.00	1.28	1.65
Zooplankton	2.03	2.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04	0.00	0.00	0.87	1.15
Macrobenthos	0.48	0.45	0.00	0.00	0.00	0.00	0.46	0.03	1.18	1.08	0.61	0.74	1.36

3.2.3.2 Impact Identification, Prediction and Assessment and Mitigation

(1) Pre-construction and Construction Phase

1) Threat to Existence and/or Loss of Species of Important Local and Habitat

731. The Project will have little or minimal impacts on aquatic ecology as almost all stations are already heavily polluted as a result of domestic and industrial activities.

2) Threat to Abundance, Frequency and Distribution

732. Construction activities along a railway alignment may adversely affect aquatic species, particularly in rivers and streams where individuals of Insect Orders Ephemeroptera (mayflies) and Trichoptera (caddisflies), which are known indicators of good water quality, were observed (such as at WSS 14 or Buot Creek which few kilometers from Calamba Station). Project activities may also have negative impacts on fish communities, particularly reported at several sites (WSS2- Laguna Lake, WSS7- San Cristobal River, WSS8- San Juan River, WSS10- Alligator Lake and WSS13- Maulauen River), where commercially important fishes such as *Oreochromis niloticus* (tilapia), *Channa* (dalag) and *Arius* (kanduli) have been reported. For aquatic species, the adverse effects which would contribute to a decrease in freshwater biota which may be attributed to the NSPR construction works within the vicinity of rivers and streams include:

- Disruption of water flow in waterways for the construction of drainage structures and earth-moving activities related to NSRP construction (such as excavation and backfilling) may destroy aquatic habitats which serve as shelter, spawning and nursery grounds for aquatic animals such as fishes and macroinvertebrates.
- Increase in turbidity of surface water and disruption of the waterbed by deposition of sediments from soil erosion due to construction works and storm water runoff. Turbidity may clog gills of fishes and affect their respiration and may also result in localized mortality of macroinvertebrates such as larval forms of aquatic insects, annelids (segmented worms) and molluscs (shelled animals), which serve as prey items for fishes and other aquatic animals. This may also impair feeding apparatus of macroinvertebrates. Increased turbidity may also limit light penetration, which may result in decreased primary productivity of phytoplankton and other algae. Consequently, zooplankters which rely on phytoplankton for food may potentially decrease in type and number. If this would persist, an overall decrease in both primary and secondary productivity may occur in the area.
- Water pollution from oil/fuel spills of vehicles.
- Water pollution from domestic sewage effluents of workers may give rise to eutrophication, changes in composition of aquatic fauna (such as increase in abundances of pollution-tolerant aquatic species), and mortality of highly sensitive species of fish and aquatic insects.
- Possible illegal fishing of workers.

733. The overall magnitude of the impact decrease in abundances of aquatic organisms during construction is considered low since these are not expected to adversely affect their integrity.

These impacts will occur for a short period and aquatic populations will have the capability to recover their numbers once the construction phase ends.

734. Dust accumulation in freshwater bodies during transport of materials would increase turbidity or levels of suspended particles in water, resulting in decreased light penetration. This would decrease photosynthesis of phytoplankton and benthic algae and consequently decrease diversity of zooplankton and other invertebrates, and fish which rely on them for food. To minimize or prevent this, vehicles carrying construction materials will be covered and speed limits will be implemented.

735. The main mitigation measures during the construction phase to prevent soil erosion and contamination of water bodies which may directly or indirectly affect aquatic organisms will be the implementation of DOTr's Sedimentation and Erosion Control Plan; Plan for the safe management of hazardous materials and Spill Prevention Program, including emergency response measures in case of accidental spills; and a Waste Management Plan.

736. Whenever possible, construction activities at the vicinity of water bodies will be carried out during the dry season.

737. Limit the extent of construction area next to water courses. No occupation of the stream bed or the banks will be allowed, unless there is no other reasonable alternative to carry out the construction work. Stockpiles will be covered to prevent sediment from being washed into nearby rivers and creeks. The construction drainage will be directed to retention basins or grassed filter zones to trap sediments and other contaminants, rather than discharging directly to the water courses. These sediment and contaminant retention structures will be constructed in the areas where habitats of very high or high sensitivity are located along the alignment or in a close location downstream of the effluent discharge point. Domestic wastewater generated in the construction camps will not be allowed to be discharged untreated into natural water courses. The camps will be provided with STP to treat effluents to admissible levels for discharge in the water body. The construction sites will be provided with chemical portable toilets and the waste adequately managed.

(2) Operation Phase

1) Threat to Existence and/or Loss of Species of Important Local and Habitat and threat to Abundance, Frequency and Distribution

738. During operation phase, negative impacts on aquatic animals could be attributed to spills from washings of trucks and vehicles during normal operation and occasionally due to accidental spills of chemicals and fuel at the depot. Degradation of habitat quality due to storm water discharges and alterations in stream hydrology can degrade habitats ranging up to several hundred meters from railways. Finally, an increase of the local population induced by the railroad could result in an undesirable increase of illegal fishing as well as domestic wastes which may pollute freshwater bodies and adversely affect aquatic organisms.

739. Regular control and maintenance of drainage structures and retention basins will be conducted to ensure removal of clogged debris or sediments. Domestic wastewater generated at the stations will be treated according to the relevant national legislation and standards. Untreated wastewater will not be allowed to be discharged into natural water courses. In the event that connection of the sewage system at the station to the municipal collector are unfeasible, the station shall be provided with a STP to treat effluents to admissible levels prior to discharge in the water body. The cleaning water generated by the washing of the trucks and vehicles will be treated as well unless it can be discharged under permit issued by the local government unit (municipal/city office or the LLDA/DENR).

Additional measures are as follows:

- Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969;
- Strictly implement solid waste/soil management plan, which include minimization of waste/soil generation, segregation, and proper disposal in accordance to RA 9003;
- Comply with RA 9275 including but not limited to securing of DP;
- Proper inspection and regular maintenance of drainage system and treatment facility.

Table 3.2.21 Summary of Impact Identification, Prediction, Assessment and Mitigation for Water

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Water	Contamination of water resources Depletion of water resources	**C-** **C-**	- Comply with the relevant laws: – RA 6969: storage, transport, handling, treatment and disposal of hazardous waste – RA 9003: management and disposal of solid wastes – RA 8749: comprehensive air pollution control policy – RA 9275: comprehensive water quality management and for other purpose
PRE-CONSTRUCTION / CONSTRUCTION				
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	Hydrology	Flooding and inundation by sediment run off, siltation , drainage overflow, clogging	B-	**[Pre-Construction/ Construction]** Design and install sufficient drainage capacity 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, geodetic 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]** Minimise 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 Conduct regular inspection and prompt maintenance of the drainage system, all installed structures and facilities and improve/ enhance capacity when possible.
	Hydrogeology	Depletion of water resource/ competition in water use	C-	**[Construction]** Conduct regular monitoring of water consumption Implement water conservation program such as use of rain harvested/ recycled water at construction yard/ camp.
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	Degradation of groundwater quality	C-	**[Pre-Construction/ Construction]** Plan and Implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/Enhancement Measures
				geotechnical investigations. **[Construction]** Limit the use of toxic chemicals for construction of viaduct pier. 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.
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water • Induce of turbidity	B-	**[Pre-Construction]** Based on the hydrological and geodetic surveys, design bridge piers that will minimise 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. The extent of 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 degradation of surface water quality and clogging of waterways, if necessary. Conduct regular surface water quality sampling.
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	
• Discharge of water, from construction sites/ yards • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic and hazardous wastes.	Water Quality	Degradation of surface water quality	B-	**[Pre-Construction/ Construction]** Design and implement the temporary drainage of construction water, surface water runoff drainage systems to minimise discharge and implement the following measures: 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. Comply 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, re-use, recycle and proper disposal including the temporary storage by contractor in accordance with RA 9003 Implement material handling program or a site protection program. Conduct effluent quality sampling at discharge point
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	
OPERATION				

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/Enhancement Measures
Operation o train	Hydrology	Increase of flood occurrence and worse the impact	C-	Conduct proper inspection and prompt maintenance of the installed drainage system, and improve/ enhance capacity when possible
Operation of passenger facilities, depot.	Hydrogeology	Degradation of groundwater quality	C-	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.
• Discharge of waste water, from passenger facilities, depot. • Accidental spills of fuels and lubricants from service vehicles and machineries, at depot • Generation and improper handling and disposal of domestic and hazardous wastes.	Water Quality	Degradation of surface water quality	B-	Comply with environmental permitting requirements for the storage, transport, handling, and treatment of hazardous material/ wastes and contaminated soil in accordance with RA 6969. Strictly implement solid waste / soil management plan, which include minimization of waste/soil generation, segregation, re-use, recycle and proper disposal in accordance to RA 9003 Comply with RA 9275 including but not limited to securing of Discharge Permit. Conduct proper inspection and regular maintenance of drainage system and treatment facility. Conduct regular effluent quality monitoring
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor positive/negative impact is expected to some extent
D: Extent of impact is unknown

3.3 AIR

3.3.1 Climatology and Meteorology

740. The Climate at the proposed NSRP area is described in Table 3.3.1. based on Climate Map of the Philippines while the meteorological considerations at the Project site are described using the meteorological data from Ninoy Aquino International Airport (**NAIA**) 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 3.3.1 Meteorological Data Recorded at NAIA Synoptic Station (1981-2010)

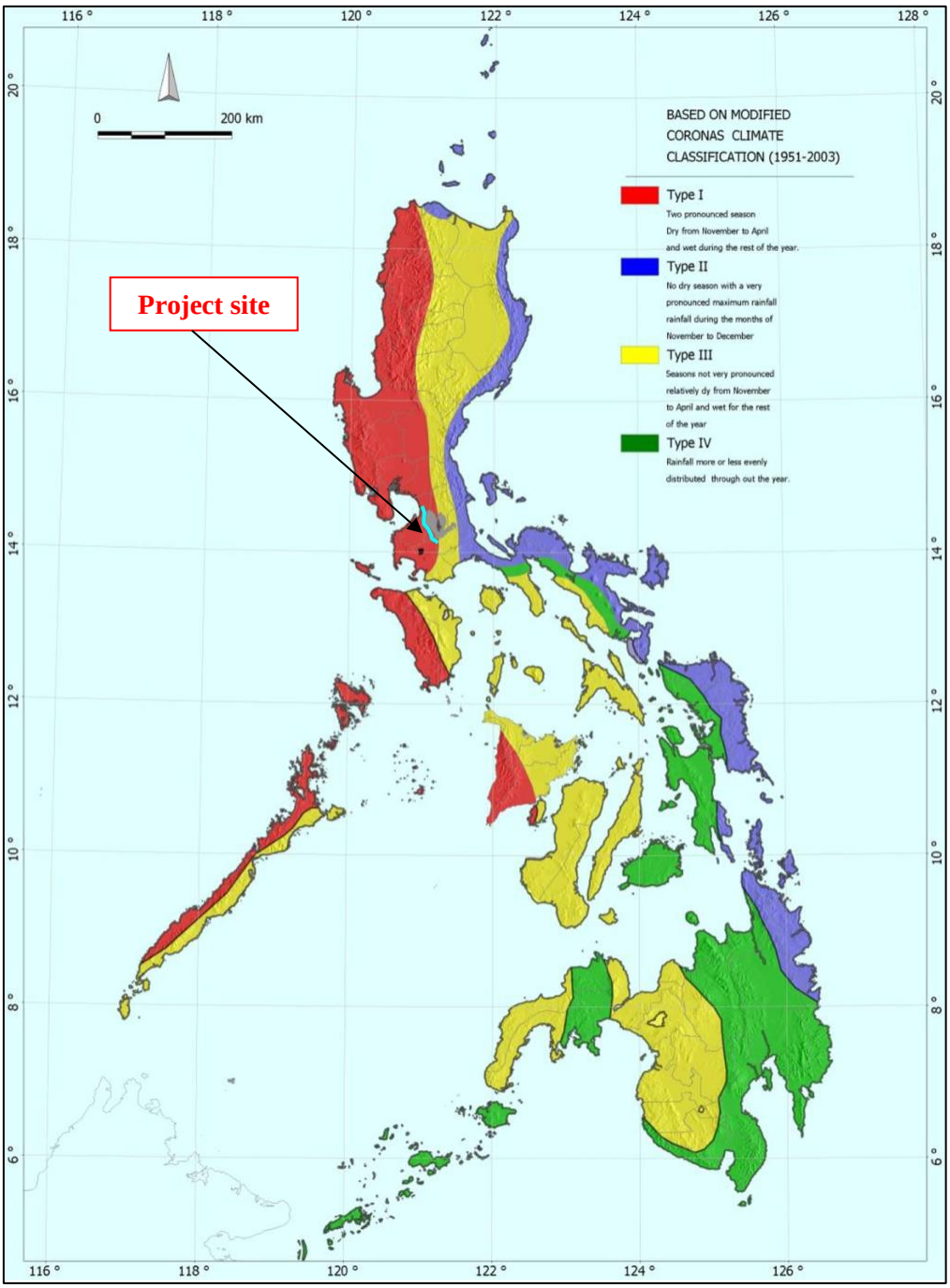
Month	Rainfall Data		Temperature						Relative Humidity (%)	Wind Direction/velocity	
	Amount (mm)	No. of Rainy Days	Max (°C)	Min (°C)	Mean (°C)	Dry Bulb (°C)	Wet Bulb (°C)	Dew Point (°C)		Wind Direction (16 pt)	Wind Velocity (m/s)
January	6.8	2	30.2	22	26.1	26	22.6	21.2	75	E	3
February	4.2	1	31	22.5	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)

3.3.1.1 Local Micro-Climate

741. Based on the Modified Coronas Climate Classification System, the area that will be traversed by NSRP in Metro Manila and Laguna Province fall under Type I climate classification as indicated in the Climate Map of the Philippines in Figure 3.3.1. Type I Climate is characterized by two (2) pronounced seasons, dry season from November to April and wet season from May to October with a maximum rainy period from June to September. Areas under this type of climate are generally exposed to the southwest monsoon during rainy season and receive a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period.

Classification	Description
Type I	Dry from November to April and wet during the rest of the year. The highest rainfall are from June to September.
Type II	No dry season with a pronounced rainfall from November to February. March to May has the lowest rainfall.
Type III	Seasons are not very pronounced, relatively dry from November to April, and wet during the rest of the year.
Type IV	Rainfall is more or less evenly distributed throughout the year

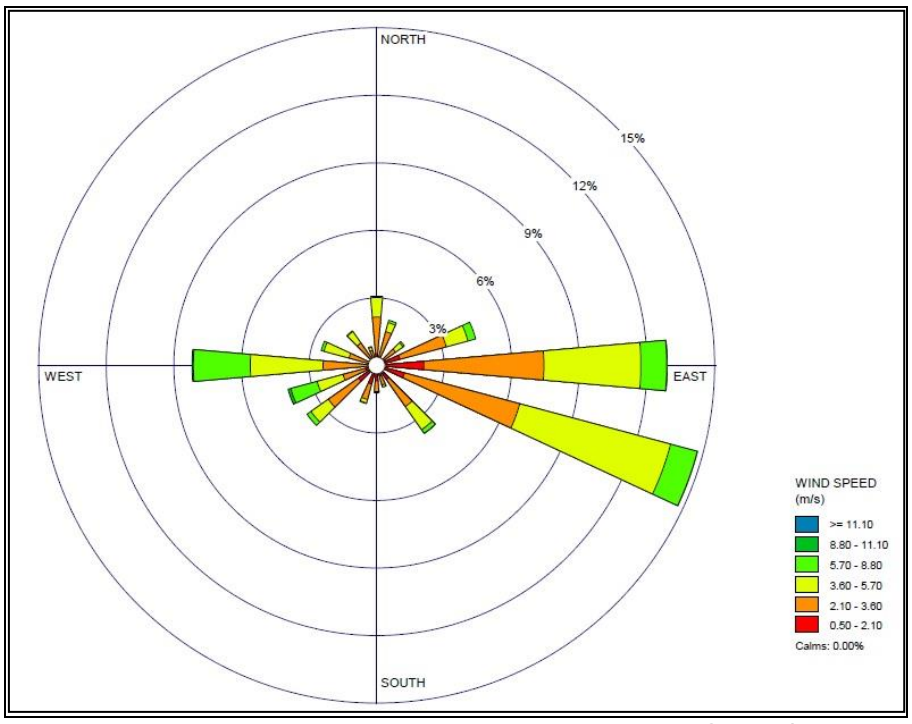


Source: PAGASA

Figure 3.3.1. The Philippine Climate Map

(1) Wind Regime

742. The meteorological data recorded at NAIA Station from January 1 to December 31, 2017 show that the prevailing wind at the Project site is from east-southeast and east which comprise about 15% and 13%, respectively and is reflected in Figure 3.3.2. The average hourly wind speed is 3.42 meters per second (m/s), few winds exceed 11.1 m/s and winds less than 2.10 m/s occur from all directions. Strongest wind comes from west followed by west-southwest.



Source: AERMET View Version 9.5.0

Figure 3.3.2. Windrose Diagram PAGASA NAIA Station

743. The tropical condition can be attributed to the location of the NSRP Project, which is between 14 to 16 degrees North of Equator. The monsoonal condition, on the other hand, refers to two (2) 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 3.08 m/s. From June to October the southwesterly winds prevail with an average wind velocity of 1.96 m/s.

(2) Relative Humidity

744. Relative humidity refers to the amount of water vapor in the air, expressed as a percentage of the maximum amount that air could hold at the given temperature. The mean annual relative humidity recorded at PAGASA NAIA Station is 76% as presented in Table 3.3.1. The months of July to October are the most humid months. Factors affecting humidity are changes in temperature and atmospheric circulation. The air is said to be saturated when it contains the maximum amount of water vapor possible at a given temperature. When the temperature of the air falls below the dew point, some of the water vapor contained in the air condenses, clouds form, and precipitation can result in the form of rain.

(3) Rainfall

745. The monthly average rainfall at the NSRP area ranges from 4 mm to 418.4 mm, with an annual average of 1,767.8 mm (Table 3.3.2). 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 caused flooding in low lying areas. The heaviest precipitation occurred in August with an average rainfall of 418.4 mm.

(4) Temperature

746. The annual mean average temperature recorded at PAGASA 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 highest and lowest temperatures occured in the months of April and January, respectively. The mean maximum and minimum temperatures were 34.1 °C and 22 °C, as presented in Table 3.3.2**.**

(5) Frequency of Extreme Events

747. Climatological extreme values are from the 30-year monthly and annual summaries of temperature, rainfall, and wind speed in Table 3.3.2. The recorded annual extreme high and low temperature was 38.0 °C which occurred in June 2, 1991 and 14.6 °C in January 1, 1962, respectively. The amount of annual average extreme greatest rainfall was 472.4 mm which occurred in July 20, 1972 while the annual average extreme highest wind was 56 m/s from westerly direction which occurred in November 19, 1970.

Table 3.3.2 Climatological Extreme Recorded at NAIA Synoptic Station as of 2016

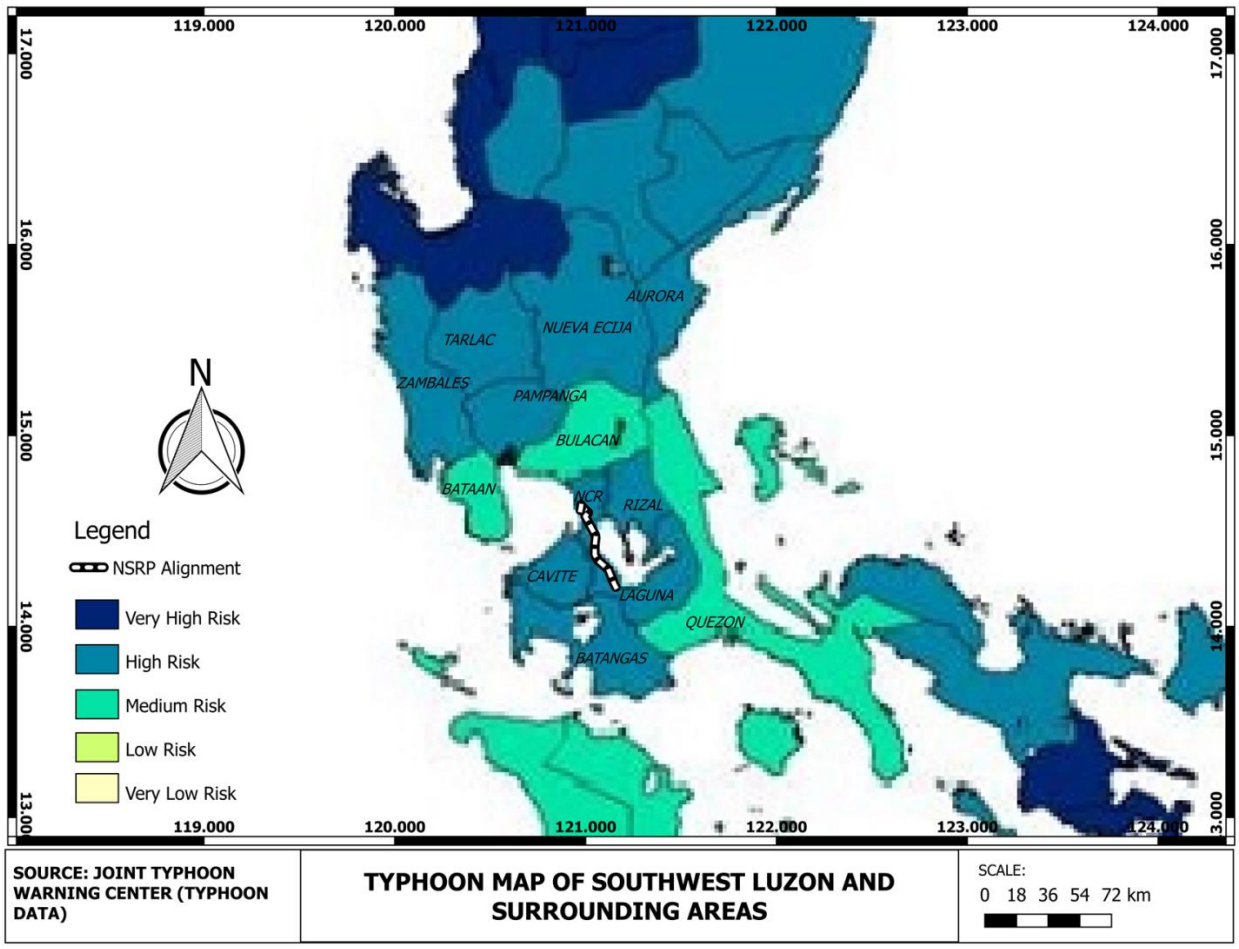
Month	Temperature (°C)				Greatest Daily RF (mm)		Strongest Winds (m/s)		
	High	Date	Low	Date	Amount	Date	Speed	Dir	Date
Jan	35.8	01-07-1989	14.8	01-18-1961	55.3	01-03-1970	20	ENE	01-12-1986
Feb	35.1	02-21-1998	14.6	01-01-1962	16.5	02-27-1950	20	E	02-28-1988
Mar	36.5	03-30-1978	16.0	03-03-1963	36.0	03-07-2011	26	E	03-29-1992
Apr	37.8	04-23-1948	18.7	04-01-1994	63.0	04-04-1992	22	ESE	04-06-1986
May	38.2	05-18-2014	19.1	05-11-1950	229.1	05-27-1960	31	SW	05-22-1976
Jun	38.0	06-02-1991	20.0	06-22-1954	353.8	06-01-1958	36	S	06-29-1964
Jul	36.4	07-26-2016	18.3	07-28-1948	472.4	07-20-1972	36	W	07-08-1986
Aug	35.2	08-29-1989	17.4	08-09-1949	401.8	08-10-1947	30	WSW	08-16-1984
Sep	35.2	09-02-2013	19.1	09-15-1950	228.9	09-08-1963	40	NNW	09-28-2006
Oct	36.0	10-24-1976	18.0	10-23-1981	274.5	10-09-1978	27	W	10-18-1985
Nov	35.8	11-17-1972	17.2	11-26-1949	121.7	11-14-1977	56	W	11-19-1970
Dec	34.2	12-29-1978	16.3	12-18-1955	125.5	12-15-2015	25	NW	12-30-1950
Annual	38.2	05-18-1969	14.6	02-01-1962	472.4	07-20-1972	56	W	11-19-1970

Source: PAGASA, Climatological Extremes at NAIA Synoptic Station as of 2016

(6) Cyclone Frequency

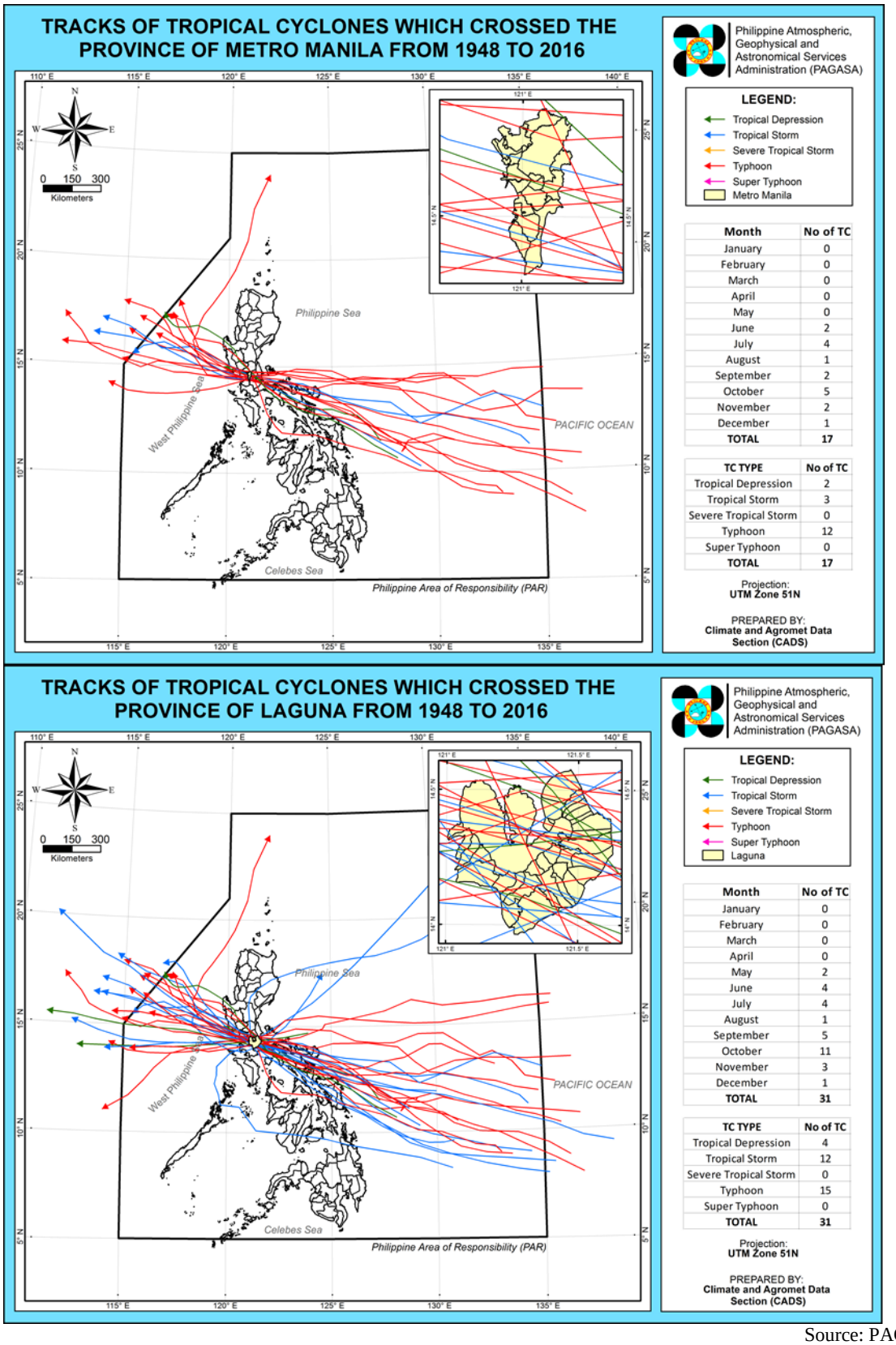
748. The most number of cyclones occur during the months of June to December. These tropical cyclones are associated with the occurrence of low pressure areas (**LPA**) normally originating over the North Western Pacific Ocean side of the Philippine Area of Responsibility (**PAR**) and generally moving northwestward. Tropical cyclones also originate in the South China Sea or at the western part of the country, having unusual motions, and quite rare with 52 occurrences in fifty (50) years (Perez, 2001). PAGASA categorized these cyclones as tropical depressions (**TD**), with wind speeds up to 63 kph; tropical storm (**TS**) with wind speeds from 64-117 kph, and tropical typhoon (**TY**), with wind speeds over 117 kph. Figure 3.3.3 shows that the proposed NSRP site is within high typhoon risk area.

749. 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. Overall, PAGASA tracked 17 tropical cyclones that crossed in Metro Manila while 31 tropical cyclones crossed the Province of Laguna from 1948-2016 as shown in Figure 3.3.4. The month of October has the most number of tropical cyclones for both Metro Manila and the Province of Laguna.



Source: Manila Observatory, 2005

Figure 3.3.3 Philippine Typhoon Map



Source: PAGASA

Figure 3.3.4. Tracks of Tropical Cyclones which Crossed the Province of Metro Manila and Laguna from 1948 to 2016

3.3.1.2 Contribution in Terms of Greenhouse Gas Emissions

750. Majority of greenhouse gas (**GHG**) emissions that may be generated by the proposed NSRP are expected to come from activities associated with the construction (fuel/ electricity use for the operation of construction vehicles and equipment), operation and maintenance (fuel use for maintenance activities) of the Project. These fuel combustion and electricity consumption activities release three (3) out of seven (7) GHGs, namely: carbon dioxide (**CO_2**), methane (**CH_4**) and nitrous oxide (**N_2O**). Of these gases, the major gas emitted is CO_2 and the bulk of the GHG emissions calculations involve determining the amount of CO_2 emissions as CH_4 and N_2O emissions have a very low share in terms of emissions. As such, this report only focused on CO_2 emissions.

(1) Methodology

751. The CO_2 were calculated using emission factor-based estimation method. The methodology estimates the CO_2 emissions by multiplying a level of activity data (**AD**) by an emission factor (**EF**). Activity data is a quantified measure of activity resulting in emissions during a given period of time (e.g. data on fuel consumption (liters/km) and purchased electricity (kWh reading)) while emission factor is the average emission rate of a given GHG for a given source, relative to units of activity. The general equation is shown below. This is based on The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard, Revised Edition, World Business Council for Sustainable Development (**WBCSD**) and the World Resources Institute (**WRI**), 2006 Intergovernmental Panel on Climate Change (**IPCC**) Guidelines for National GHG Inventories and 2014 IPCC Assessment Report.

Equation: GHG Emissions = AD x EF

(2) Results and analysis

752. The emissions associated with the Project are categorized into direct and indirect emissions. Direct GHG emissions of Scope 1 are from sources that are owned and/or controlled by the proponent. This is usually applicable during the operational phase (e.g. use of generator set and equipment owned by the proponent). Indirect emissions, on the other hand, are further categorized into Scope 2 and Scope 3. Scope 2 emissions are a consequence of the project's operations at sources owned and/or controlled by another entity which include purchased electricity consumption. Scope 3 emissions are a consequence of the proponent's activities but to which the proponent has no direct control over which include tailpipe emissions from contracted equipment/ vehicles during construction. In the case of this Project, the type of emissions are Scope 2 and Scope 3.

Table 3.3.3 Items to Consider for Each Scope

Scope	Construction	Operation
1	**1. Stationary combustion** Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. standby genset) **2. Mobile combustion** Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)	**1. Ptationary combustion** Emissions from fuel use of entity-owned/ controlled stationary equipment (e.g. genset) **2. Mobile combustion** Tailpipe emissions from entity-owned/ controlled vehicles (e.g. service van)
2	**1. Stationary combustion** Emissions from the consumption of purchased electricity for construction works	**1. Stationary combustion** Emissions from the use of purchased electricity for train, stations and depot operations
3	**1. Stationary combustion** Emissions from fuel use of contracted construction equipment (e.g. standby genset) **2. Mobile combustion** Emissions from transportation of purchase d construction materials/ construction wastes using contracted vehicles (e.g. trucks, pickup)	**1. Mobile combustion** Emissions from fuel use of contracted vehicles (e.g. service vans)

1) CO_2 Emissions during construction

753. In calculating Scope 3 emissions, fuel consumption for the use of construction equipment, service vehicles as well as transport of construction materials were estimated as presented in Table 3.3.4. Since these construction equipment/ vehicles are diesel-powered, the emission factor for diesel will be based from the US EPA Emission Factors for Greenhouse Gas Inventories, which was last modified on November 19, 2015. Presented below are the activity data, emission factor as well as the results of the computation. The total CO_2 emissions during construction are estimated at 691.5 MT CO_2/yr.

Table 3.3.4 CO_2 Emission by Source

Emission Sources	No. of Units	Fuel Type	Fuel Consumption (L/100km)[1]	Assumed distance travelled (km/yr)	Fuel Consumption (L/yr)	Emission Factor (kg CO_2/L)[2]	Calculated CO_2 Emission (MT CO_2/yr)
Heavy Equipment	20	Diesel	31.6	5,000	31,600	2.7	85.3
30-tonner Truck	50	Diesel	20.9	15,000	156,750	2.7	423.2
Pick-up	30	Diesel	12.1	12,000	43,560	2.7	117.6
Service Van	20	Diesel	12.1	10,000	24,200	2.7	65.3
						Total CO_2 Emission	**691.5**

Source: 2017 Fuel Consumption Guide, Natural Resources Canada
[2] Source: Emission Factors for Greenhouse Gas Inventories (last modified: 11-19-2015), US EPA

2) CO_2 Emissions during Operation

754. In calculating Scope 2 emissions, the electricity consumption during project operation was estimated at 303.4 million kWh per year (303,419 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. Presented below are the activity data as well as the results of the computation. The total CO_2 emissions during operation are estimated at 152,429.7 MT CO_2/yr.

Table 3.3.5 CO_2 Emission by Railway Operation

Emission Sources	Annual Electricity Consumption (MWh)	Calculated CO_2 Emission (MT/yr)
Railway Operation (train, stations and depot)	303,419	152,429.7

755. 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 0.15% during the operation phase. As presented, NSRP will only generate a small amount of CO_2 to the total anthropogenic CO_2 load of the country. If this total load is a measure of responsibility for global warming on an absolute magnitude, the NSRP can still be considered to be on the low-end greenhouse gas emitters.

3.3.1.3 Climate Risk/ Climate Change

(1) Climate Change Policy in the Philippines

756. According to PAGASA, future climate changes in the Philippines are likely in terms of trends in seasonal values of temperature, rainfall and extreme events. Climate data shows an increasing trend in the number of hot days and warm nights but a decreasing trend in the number of cold days and cool nights. Both maximum and minimum temperatures are generally getting warmer. From 1951 to 2010, there was a 0.65°C increase in the mean temperature.

757. In terms of rainfall, it is becoming more frequent and its intensity is increasing based on trend comparisons of extreme daily rainfall intensity and frequency between 1951-2010 and 1961-1990 mean values. 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 causes flooding in low-lying areas.

758. On the average, twenty (20) tropical cyclones visit the PAR with nine (9) of these passing through the Philippine landmasses every year based on 1948-2016 data. The location of the project is situated on a path where at least one (1) tropical cyclone annually frequents.

759. Relative to this, there is an increasing trend in the annual total cost of damage due to the occurrence of tropical cyclones based on 1970-2012 data. The damage cost during this period amounted to PhP 337.67 Billion in 43 years according to the Office of Civil Defense (**OCD**). The last five (5) years (2008-2012) of the OCD data indicated an exponential trend which has taken a considerable toll in the economic outlook of the country.

760. These trends and scenarios, which are further discussed below, indicate that the country will not be spared by the impacts of climate change given its geographical location, archipelagic formation, biophysical characteristics and population distribution. Additionally, even if GHG emissions are drastically reduced, the magnitude of their presence in the atmosphere is irreversible. Stabilizing these GHGs will take time and climate change impacts will continue for the years to come.

761. In the urgency for local climate action, the Climate Change Act (Republic Act 9729) was passed in 2009 which creates the Climate Change Commission (**CCC**), mainstreaming climate change into government policy formulations and establishes framework strategies and actions towards adaptation and mitigation. In 2010, the National Framework Strategy on Climate Change (**NFSCC**) was adopted to serve as reference point to steer national mitigation and adaptation strategies. In line with the NFSCC, the Philippine Strategy on Climate Change Adaptation (**PSCCA**) was prepared to guide the country's climate change adaptation actions. In 2011, the National Climate Change Action Plan (**NCCAP**) was prepared which outlines the priority areas for adaptation and mitigation. In 2012, the People's Survival Fund (RA 10174) was passed for financing adaptation programs and projects based on the NFSCC. Other key policies on climate change are presented in Chapter 2, Section 2.7.3.

(2) Change in Local Micro-climate

1) Rainfall

762. The climate change scenario projected a rainfall decrease and increase in 2020 and 2050 for both Metro Manila and Province of Laguna. Metro Manila in the year 2020 will have an increase of 8.5% for the months of July to August and a decrease of 12.8% to 33.3% for the months of December to May. For Laguna Province, the year 2020 will have an increase of 2.9% from July to November and a decrease of 20.2 to 31.5% from December to May. Similarly, the 2050 projection shows an increase of 3.7% to 21.3% for the months of July to November and a decrease of 17.3% to 38.5% for the months of December May in Metro Manila while an increase of 0.1 to 6.8% for the months July to February and a decrease of 34.8% for the months of March to May in the Province of Laguna.

763. Table 3.58 and Table 3.3.7 present the projected monthly average rainfall with climate change scenario for 2006-2035 and the monthly average rainfall with climate change scenario for 2036-2065 in Metro Manila and Laguna. Figure 3.3.5 shows the projected seasonal mean rainfall in 2020 and 2050 in Metro Manila and Laguna Province.

Table 3.3.6 Seasonal Rainfall Change (in %) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000) mm				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	107.5	198.5	1170.2	758.7	-12.8	-33.3	8.5	0.0	-17.3	-38.5	21.3	3.7
Laguna	629.2	386.8	845.0	1066.5	-20.2	-31.5	2.9	2.9	0.1	-34.8	6.8	0.4

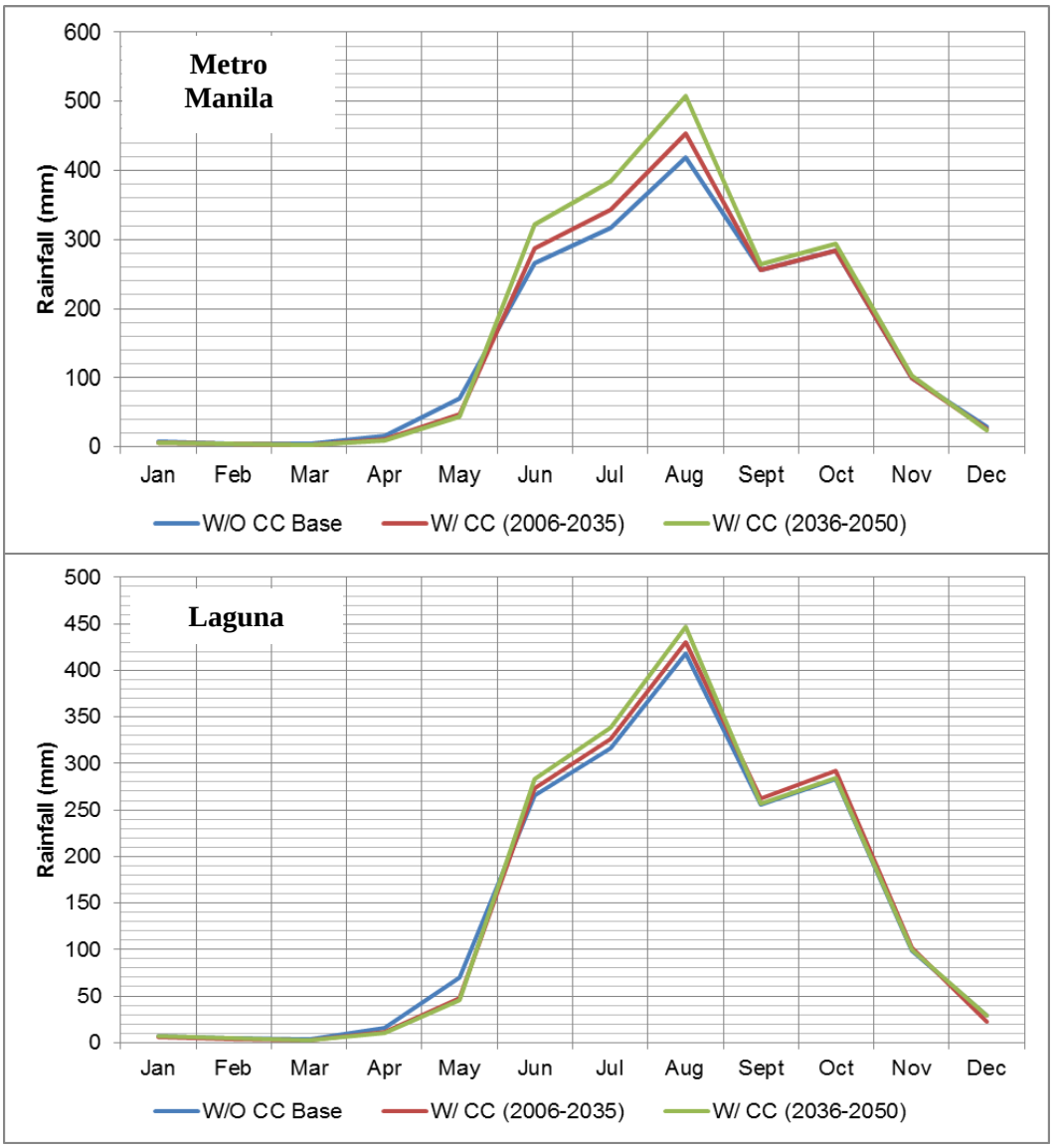
Source: Climate Change in the Philippines, 2011 PAGASA

Table 3.3.7 Projected Seasonal Mean Rainfall in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

	Projected Monthly Average Rainfall (mm)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1981-2010)												
Ave	6.8	4.2	4	16	70.4	265.2	316.7	418.4	255.2	283.4	99	28.6
Manila												
With Climate Change Scenario (2006-2035)												
Ave	5.93	3.66	2.67	10.67	46.96	287.74	343.62	453.96	255.20	283.40	99.00	24.94
With Climate Change Scenario (2036-2065)												
Ave	5.62	3.47	2.46	9.84	43.30	321.69	384.16	507.52	264.64	293.89	102.66	23.65
Laguna												
With Climate Change Scenario (2006-2035)												
Ave	5.43	3.35	2.74	10.96	48.22	272.89	325.88	430.53	262.60	291.62	101.87	22.82
With Climate Change Scenario (2036-2065)												
Ave	6.81	4.20	2.61	10.43	45.90	283.23	338.24	446.85	256.22	284.53	99.40	28.63

Note: Calculated based on the PAGASA Climate Change in the Philippines, 2011

Source: Climate Change in the Philippines, 2011 PAGASA



Source: Climate Change in the Philippines, 2011 PAGASA

Figure 3.3.5 Projected Seasonal Mean Rainfall in 2020 and 2050 in Metro Manila and Laguna Province

2) Temperature

764. The climate change scenario for the Philippines published by PAGASA in February 2011 indicated that the Provinces of Metro Manila and Laguna where the alignment of NSRP will be located will have an increase in temperature in 2020 and 2050. The projected temperature increase in Metro Manila is 0.9 to 1.1°C in the average temperature baseline data in 2020 and an increase of 1.8 to 2.1°C in 2050. Moreover, in the Province of Laguna, the projected temperature increase is 0.9 to 1.1°C in the average temperature baseline data in 2020 and an increase of 1.8 to 2.1°C in 2050. Table 3.3.8 and Table 3.3.9 show the seasonal temperature increase and projected seasonal mean temperature in 2020 and 2050 under medium range emission scenario in Metro Manila and Province of Laguna. Figure 3.3.6 and Figure 3.3.7 show the graphical presentation of the monthly average temperature change from 2006 to 2035 and from 2036-2050, respectively.

Table 3.3.8 Seasonal Temperature Increase (in ºC) in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

Province	Observed Baseline (1971-2000)				Change in 2020 (2006-2035)				Change in 2050 (2036-2065)			
	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
Metro Manila	26.1	28.8	28.0	27.4	1.0	1.1	0.9	1.0	2.0	2.1	1.8	1.9
Laguna	25.0	27.5	27.5	26.7	0.9	1.1	1.0	0.9	1.8	2.1	1.9	1.9

Source: Climate Change in the Philippines, 2011 PAGASA

Table 3.3.9 Projected Seasonal Mean Temperature in 2020 and 2050 under Medium Range Emission Scenario in Metro Manila and Province of Laguna

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Baseline/Without Climate Change Scenario (1997-2010)												
Max	30.2	31	32.5	34.1	33.8	32.5	31.3	30.8	31	31.1	31.1	30.2
Min	22	22.5	23.6	25	25.5	25.1	24.6	24.6	24.6	24.3	23.7	22.7
Ave	26.1	26.7	28	29.5	29.7	28.8	28	27.7	27.8	27.7	27.4	26.5
With Climate Change Scenario (2006-2035)												
Metro Manila												
Max	31.2	32	33.6	35.2	34.9	33.4	32.2	31.7	32	32.1	32.1	31.2
Min	23	23.5	24.7	26.1	26.6	26	25.5	25.5	25.6	25.3	24.7	23.7
Ave	27.1	27.7	29.1	30.6	30.8	29.7	28.9	28.6	28.8	28.7	28.4	27.5
Laguna												
Max	31.1	31.9	33.6	35.2	34.9	33.5	32.3	31.8	31.9	32	32	31.1
Min	22.9	23.4	24.7	26.1	26.6	26.1	25.6	25.6	25.5	25.2	24.6	23.6
Ave	27	27.6	29.1	30.6	30.8	29.8	29	28.7	28.7	28.6	28.3	27.4
With Climate Change Scenario (2006-2065)												
Metro Manila												
Max	32.2	33	34.6	36.2	35.9	34.3	33.1	32.6	32.9	33	33	32.2
Min	24	24.5	25.7	27.1	27.6	26.9	26.4	26.4	26.5	26.2	25.6	24.7
Ave	28.1	28.7	30.1	31.6	31.8	30.6	29.8	29.5	29.7	29.6	29.3	28.5
Laguna												
Max	32	32.8	34.6	36.2	35.9	34.4	33.2	32.7	32.9	33	33	32
Min	23.8	24.3	25.7	27.1	27.6	27	26.5	26.5	26.5	26.2	25.6	24.5
Ave	27.9	28.5	30.1	31.6	31.8	30.7	29.9	29.6	29.7	29.6	29.3	28.3

Source: Climate Change in the Philippines, 2011 PAGASA

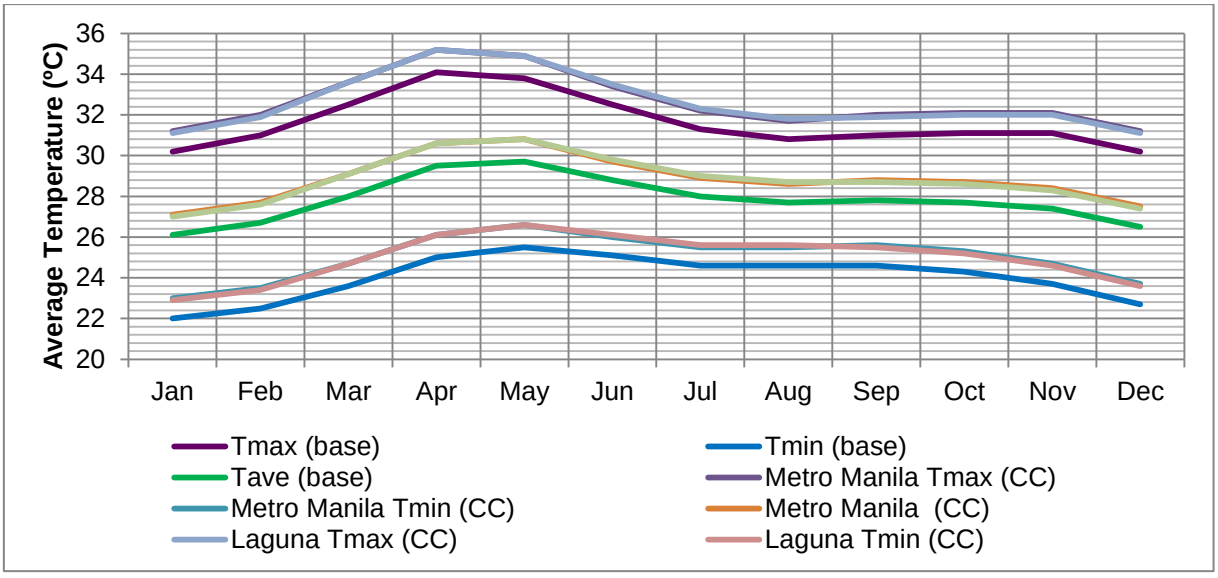


Figure 3.3.6 Change in Monthly Average Temperature for the Period of 2006-2035

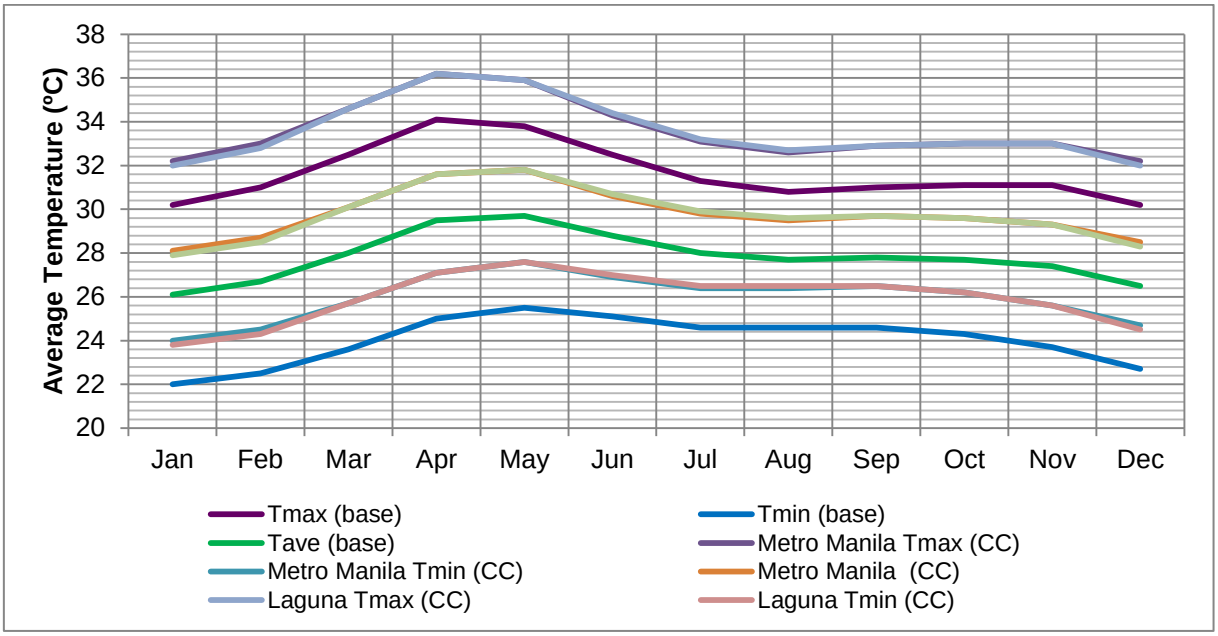


Figure 3.3.7 Change in Monthly Average Temperature for the Period of 2036-2065

3) Frequency of Extreme Events

765. 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 >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 >200 mm during the 2006-2035 period and 13 days during the 2036-2050 period. Data are presented in Table 3.3.10.

766. Moreover, the Province of Laguna will have 8,010 days with maximum temperature of >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 >200 mm during the 2006-2035 period and 9 days during the 2036-2050 period.

Table 3.3.10 Frequency of Extreme Events in 2020 and 2050 under Medium Range Emission Scenario

Province	No. of Days w/ T_{max} >35°C			No. of Dry Days			No. of Days w/ Rainfall >200mm		
	OBS (1971-2000)	2020	2050	OBS	2020	2050	OBS	2020	2050
Metro Manila*	299	1176	2118	7380	6445	6382	12	12	13
Laguna**	928	8010	8016	8226	6081	6049	6	14	9

Note: * Using values of Port Area, ** Using values of Ambulong

Source: Climate Change in the Philippines, 2011 PAGASA

3.3.1.4 Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

1) Change in Local Micro-climate

767. During construction, variations in micro-climate will affect the schedule of construction works, potentially delaying the progress of construction.

768. The changes in rainfall pattern and significant local temperature changes will be included in the design criteria of the Project. Material selection and technologies to be used in the Project will take into consideration the effects of micro-climate variations and the effects of extreme temperature changes to operating conditions of project components. Passenger facilities will incorporate renewable energy, energy efficient technologies and maximize the natural environment as much as possible.

769. Clearing of trees and other vegetation cover in some portions of NSRP alignment will reduce evapo-transpiration rate and area shaded by vegetation, which will lead to higher ambient temperatures in local environment. However, DOTr will only cut trees when necessary and with permit from DENR. To avoid destruction of vegetation cover, construction temporary facilities and staging areas for equipment and construction materials will be located in non-vegetated areas of the PNR ROW. Areas where vegetation was removed during construction phase will be restored and developed as much as possible during post-construction. This will reduce the impact of vegetation removal and limit its effects to construction phase only. The restoration and development of vegetated areas may even enhance the micro-climate along the alignment after construction phase is completed.

770. Workers' exposure to extreme local micro-climate conditions may have negative effects to their health and compromise their safety and productivity. Micro-climate variations will have to be integrated to designing work policies, proper work clothing, equipment safety features, provision of temporary shade areas for workers, drinking water supply, etc. to minimize health effects and work hazards for the workers.

2) Contribution in Terms of Greenhouse Gas Emissions

771. The construction of the Project is expected to contribute an approximately 0.00069% of the total CO_2 emission, which is a small contribution to the total anthropogenic CO_2 load.

772. However, in order to minimize unnecessary CO_2 generation from construction activities, the following measures will be implemented:

- Minimize vegetation removal and alteration of topography if possible;
- Implement regular inspection and preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standard; and
- Use electric or fuel-efficient equipment, machineries and vehicles and maximize its operation if possible.

3) Impact of Climate Change to Project

773. The Project is generally at high risk to the effects of climate change based on the AWARE climate risk screening report (ADB, 2018) for the Project. It determined the level of climate risk of the proposed Project to flooding, landslide, typhoons, precipitation increase, temperature increase and precipitation decrease. Among the climate risk topics analyzed, precipitation increase registered at medium level while temperature increase and precipitation decrease registered at low level. The rest, including flooding, landslide and typhoons are identified to cause high risk to the proposed Project.

High Risk

774. The level of climate risk for the Project due to flooding, landslides and typhoons is high. Among the geographical factors considered are proximity to waterbodies, topography, land use characteristics (including land use in upstream catchment areas), design and maintenance level of drainage infrastructure, and vulnerability of exposed assets. Flooding may cause overflow of drainage systems and restrictions/disruption during construction phase. Relative to flooding, many cities/ municipalities are prone to liquefaction. In terms of increase in frequency and severity of typhoons, the potentials impacts are restrictions/ disruption of railway construction.

Medium Risk

775. The level of climate risk for the Project due to increase in precipitation is medium. The design of certain project components may have to be slightly modified to cope with its potential impacts. Intense rainfall would potentially cause damage to embankment and earthwork due to soil erosion, landslides and flooding. Extended rain periods would potentially cause slower drainage, soil erosion of infrastructure assets as well as disruption in construction.

776. During pre-construction phase, design consideration will be based on the results of the geohazard assessment and geotechnical investigation to prevent or minimize slope failure.

Low Risk

777. The level of climate risk for the Project due to increase in temperature, resulting to longer periods of warm temperature/drought as well as warm days and nights is low. It is further characterized by high temperature and heat waves, sudden temperature changes and intense sunlight. High temperature and heat waves would potentially cause overheating of construction equipment and service vehicles and cause heat stress to workers. In order to mitigate this, construction activities will be adjusted as needed.

778. In consideration to the above climate risk, train system will be designed to robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct, embankment, tunnels) based on the hydrological and geodetic study. Additional measures include: installation of bridge within the rivers will be minimized; design train facilities above the flood level; and provision of drainage pumping systems to drain runoff water (rainwater, etc.) and divert to the sewer if required. It is also essential to prepare and an Emergency Response Plan in cased of potential extreme events.

(2) Operation Phase

1) Change in Local Micro-climate

779. Maintenance and development of buffer zones/vegetated areas will enhance the micro-climate along the NSRP ROW and its local environment by reducing the ambient temperature. As previously discussed, the changes in the rainfall pattern and local temperature will be included in the design criteria of the Project based on the PAGASA Projection for 2020 and 2050.

780. Regular inspection of NSRP structures and facilities will be conducted and perform necessary maintenance when needed. Improvement of internal drainage system will also be considered to accommodate water run-off as needed and improvement of railway system considering possible temperature rise as necessary.

781. Thermal threats are due to the susceptibility of tracks to damage during periods of elevated temperatures that exceed the operating conditions. When this temperature is exceeded, the ability of the steel rails to support rail traffic begins to degrade. At extreme heat conditions, the continuously welded rail tracks that make up the modern rail system will buckle due to expanding metal. Regular inspection of railway structures and facilities will be conducted in order to identify possible buckling and conduct maintenance as necessary.

2) Contribution in Terms of Greenhouse Gas Emissions

782. Project can be considered to be on the low-end greenhouse gas emitters based on its estimated CO_2 contribution. However, necessary measures will be enforced to further minimize its possible impact. In addition, essential enhancement will be implemented to lessen impact of climate change to the Project.

783. Global passenger and freight activity is increasing as economies grow. In the Philippines, majority of existing transport systems are conventional buses, passenger cars, taxies, and jeepneys that heavily rely on petroleum, which supplies 95% of the total energy used by world transport. In 2010, the transport sector accounted for 27% of final energy use and 6.7 $GtCO_2$ direct emissions based on IPCC's Fifth

Assessment Report (**AR5**). With the increasing need for transport activities, baseline CO_2 emissions are projected to approximately double by 2050 if not mitigated.

784. Relative to this, the Project intends to reduce GHG emissions by realizing a "modal shift" from existing Passenger Transport Systems to Passenger Railway Systems. In addition, "electrification" of Passenger Railway Systems will reduce GHG emissions. In comparison with other transport modes, collective modes of transport, such as the NSRP, use less energy and generate less GHGs. Furthermore, Mass Transit Systems provide more capacity at less marginal cost. The reduced CO_2 emissions represent only one of benefit of the improved Mass Transit System. Besides, planting and energy efficient products will also contribute to minimize the GHG emission. Majority of the benefits for the populace and the economy are due to substantially improved accessibility.

785. To maintain and/or further reduce its minimal contribution, necessary measures during operation will be enforced including tree planting, energy/water conservation program implementation as well as:

- Provision of incentives and information dissemination activities to encourage commuters to use rail transit and its benefits over other modes of transport (Modal Shift)
- Planting of vegetation as much as possible to open areas at the depot, around the stations and along the railway track
- Energy/water conservation program such as use energy efficient products (i.e. LED lights) and monitor carbon footprint monitoring
- Regular inspection and proper maintenance of railway systems and facilities, and equipment and machinery

3) Impact of Climate Change to Project

786. As described in the pre-construction and construction phase, precipitation increase registered at medium level while temperature increase and precipitation decrease registered at low level, and flooding, landslide and typhoons, are identified to cause high risk to the proposed Project.

787. Flooding, landslides and typhoons will cause damage to catenary as well as restrictions/disruption of railway operation. Increase in precipitation would potentially cause damage to embankment due to landslides and flooding. Extended rain periods would potentially cause slower drainage and disruption in operations. Increase in temperature and heat would potentially cause overheating of infrastructure and rolling stock equipment; while, sudden temperature changes and intense sunlight would cause tension/overheating of track buckling and signaling problems. Decrease in precipitation is characterized by droughts, which has potential impact to earthworks desiccation.

788. Mitigation measures and enhancement to address the impact of the Project to climate change and vice versa are as follows;

- Regular inspection and preventive maintenance of railway structures and facilities to ensure optimum working condition;
- When necessary, installation improvement of railway system to make it more resilient to temperature and railfall increase;
- Planting of vegetation as much as possible in open areas at the depot, around the stations and along the railway track;
- Establishment and implementation of an Emergency Response Plan.

3.3.2 Air Quality

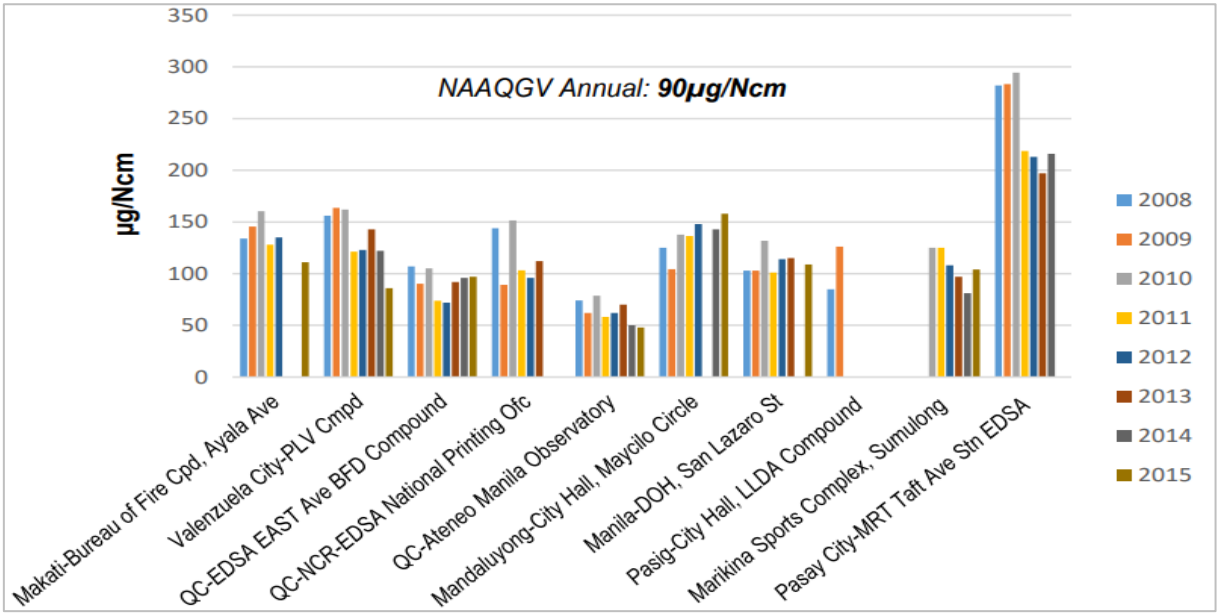
3.3.2.1 Ambient Air Quality

789. Ambient Air Quality is defined by RA 8749 as the general amount of pollution present in a broad area and refers to the atmosphere's average purity as distinguished from discharge measurements taken at the source of pollution. In order to monitor the ambient air quality of the country, EMB regional monitoring stations routinely take measurements of criteria air pollutants, namely: Total Suspended Particulates (**TSP**), Particulate Matter less than 10 microns (**PM_{10}**), (**$PM_{2.5}$**), Lead (**Pb**), Sulfur Dioxide (**SO_2**), Nitrogen Dioxide (**NO_2**), Ozone (**O_3**) and Carbon Monoxide (**CO**).

790. The National Air Quality Status Report for 2008-2015 of EMB showed that the average annual TSP values recorded in all monitoring stations in NCR exceeded the National Ambient Air Quality Guideline Valued (**NAAQGV**) of ug/ncm except for the Ateneo Station. **Figure 3.3.8** shows the annual TSP trends in NCR from 2008 to 2015.

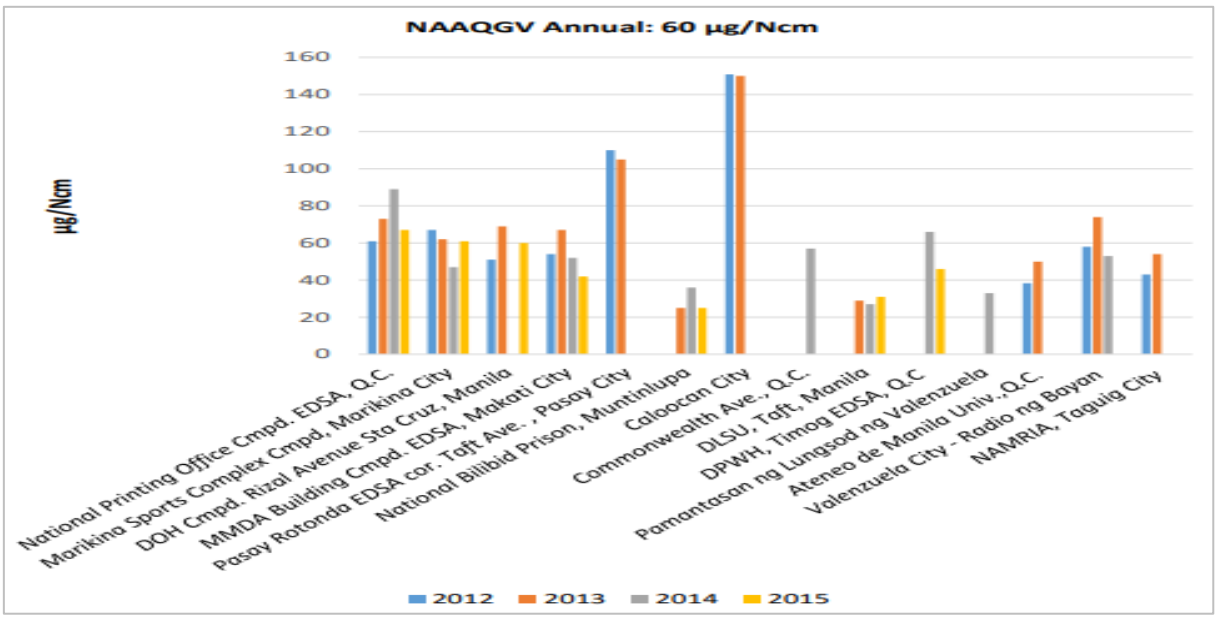
791. The PM_{10} levels in NCR were also monitored by the EMB. **Figure 3.3.9** shows the PM_{10} levels in the NCR during the period 2012-2015. It is notable that there were fewer stations that registered measurements exceeding the guideline value of 60 µg/Ncm in 2012 and 2014. The majority of stations, however, had measurements that exceeded the guideline value in 2013.

792. The exceedances and high values of TSP and PM_{10} levels from the annual ambient air quality guideline values show the poor or deriorating quality of air in National Capital Region.



Source: https://emb.gov.ph/wp-content/uploads/2015/09/1-Air-Quality-1.8-National-Air-Quality-Status-Report-2008-2015.pdf
(Date retrieved: April 10, 2018)

Figure 3.3.8 TSP Annual Mean Values in NCR, 2008-2015



Source: https://emb.gov.ph/wp-content/uploads/2015/09/1-Air-Quality-1.8-National-Air-Quality-Status-Report-2008-2015.pdf
(Date retrieved: April 10, 2018)

Figure 3.3.9 PM_{10} Annual Levels in the National Capital Region 2012-2015

(1) Field Survey

793. The ambient air quality monitoring was conducted on January 18 – February 8, 2018, as detailed in Table 3.3.11 and Figure 3.3.10**,** to measure 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 at eight (8) pre-established sampling stations along the NSRP alignment. The monitoring was conducted in accordance to the standard methods of the DENR as prescribed in its AO No. 2000-81, the Implementing Rules and Regulations (**IRR**) of the Philippine Clean Act of 1999 and the Presidential Decree No. 984 (National Pollution Control Decree of 1976), as amended by NPCC MC No. 1980-002.

794. The collected samples were brought to Mach Union Water Laboratory, Inc., a DENR recognized laboratory in Las Piñas City and to EMB Central Office Laboratory for analysis.

795. Temperature, wind direction and other relevant parameters which describe the weather condition in the area were also recorded at each station during sampling.

Table 3.3.11 Date and Time of Air Quality Sampling Per Station

Sampling Station		Description	Coordinates	Coordinates	
				24-Hour Monitoring	1-Hour Monitoring
AAQ1	PNR – Solis	Adjacent to Bliss residential area, approximately 150 meters from PNR Solis station	14°37'42.17" N; 120°58'32.88" E	Jan 20-21, 2018 1110H-1110H	Jan 20, 2018 1305H-1305H
AAQ2	PNR - Sta. Mesa	Near Barangay 630 barangay hall approximately 100 meters from PUP main gate	14°35'54.27" N; 121°0'46.14" E	Jan 21-22, 2018 1345H-1345H	Jan 22, 2018 0830H-0930H
AAQ3	PNR Buendia	Buendia Flyover corner Osmeña Highway and South Superhighway	14°33'29" N; 121°0'27" E	Jan 18-19, 2018 2000H-2000H	Jan 20, 2018 1500H-1500H
AAQ4	PNR - FTI	Along East Service Road, approximately 70m from FTI station entrance and 30 m south of Bagong Lipunan Condominium	14°30'24.86"N; 121°2'7.64" E	Feb 7-8, 2018 2148H-2148H	Feb 8, 2018 1215H-1315H
AAQ5	PNR – Sucat	Near residential and Sucat Thermal PP	14°27'8.01" N; 121°3'3.04" E	Feb 20-21, 2018 1350H-1350H	Feb 21, 2018 1405H-1505H
AAQ6	PNR – Binan	Basketball Court near new PNR Biñan	14°19'52.11" N;	Jan 23-24, 2018	Jan 24, 2018

Sampling Station		Description	Coordinates	Coordinates	
				24-Hour Monitoring	1-Hour Monitoring
		Station, 200 m from San Vicente Ferrer Parish Church	121°4'51.08" E	1026H-10263H	1705H-1805H
AAQ7	PNR – Calamba	Basketball Court near PNR Calamba Station, 200 m from Maranatha Christian Academy	14°12'26.05" N; 121°9'28.13" E	Jan 24-25, 2018 1356H-1356H	Jan 25, 2018 1645H-1745H
AAQ8	Paciano Rizal Elementary School	Paciano Rizal Elementary School Bay, Laguna	14°8'57.04" N; 121°16'5.08" E	Jan 25-26, 2018 1716H-1716H	Jan 26, 2018 1020H-1020H

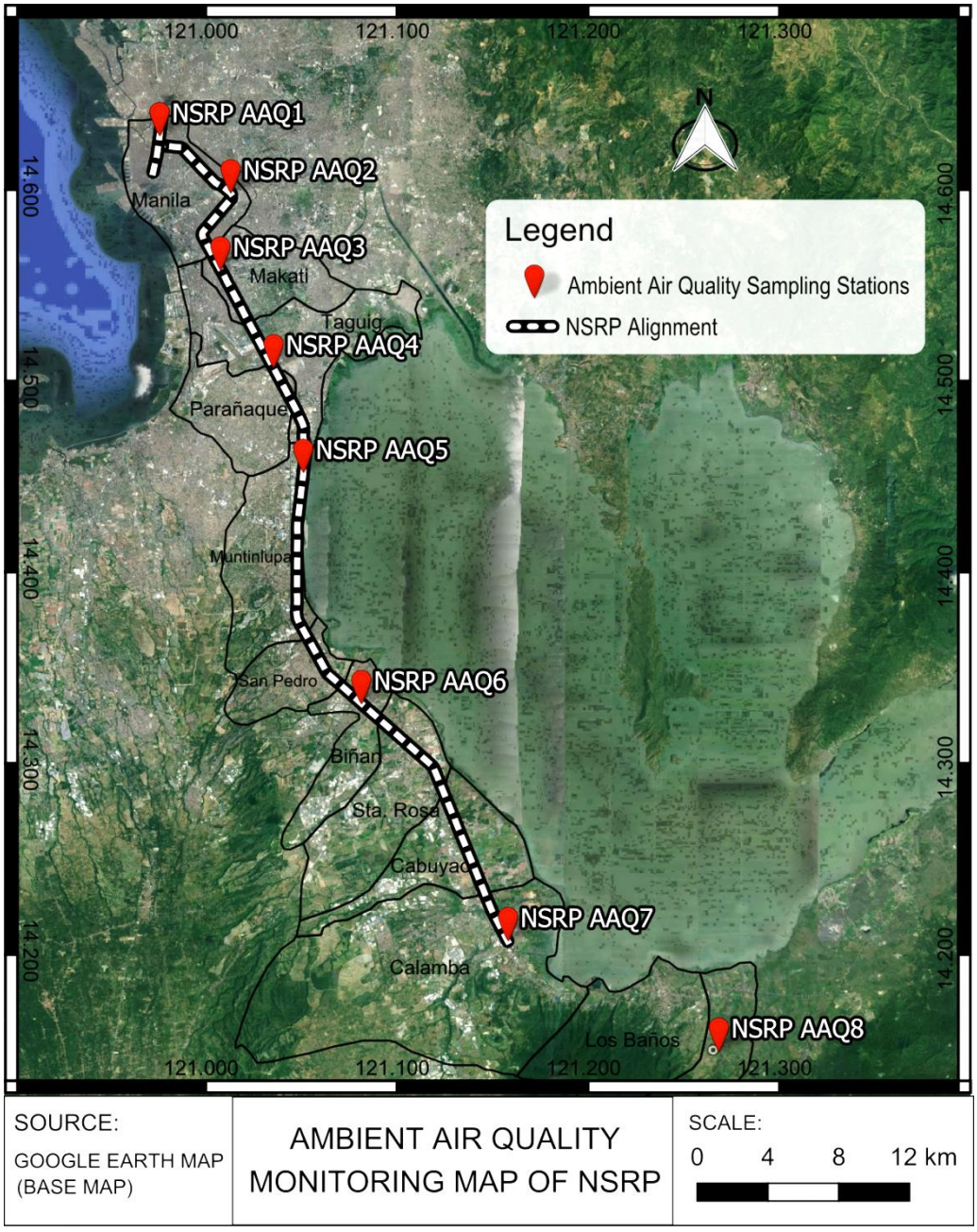


Figure 3.3.10 Air Quality Sampling Station Map

(2) Criteria for Assessment of Ambient Air Quality

796. The results of ambient air quality monitoring for NSRP were compared to the standard levels of the DENR set forth in the Philippine Clean Air Act of 1999, DENR Administrative Order No. 2013-13 and the International Finance Corporation (**IFC**) Standards ($PM_{2.5}$ Guideline Value) which adopted the relevant standards and guidelines of the World Bank (**WB**) and the World Health Organization (**WHO**) as presented in Table 3.3.12. It must be noted that for Pb, the DENR and WHO have no relevant standard for 24-hour averaging time. Likewise, for NO_2 and O_3, the IFC standards are for 1-hour and 8-hour means, respectively. WHO has replaced TSP in favor of PM_{10} and $PM_{2.5}$ for determining the exposure-response relationship of particulate matter and health effects.

Table 3.3.12 Relevant Guideline Values for Ambient Air Quality

Parameter	Averaging Time	DENR Standards (µg/Ncm) (1)	WHO Ambient Air Quality Guidelines (2)
TSP	24 Hours	230	-
PM_{10}	24 Hours	150	50 µg/ m^3
$PM_{2.5}$	24 Hours	50 (3)	25 µg/ m^3
Lead (Pb)	24 Hours	1.5 µg/NCM (3 mos.) 1.0 µg/NCM (annual)	0.5 µg/m3 (annual)(4)
Sulfur dioxide (SO_2)	24 Hours	180	20 µg/ m^3
Nitrogen dioxide (NO_2)	24 Hours	150	200 µg/m^3 (1-hour mean)
Ozone (O_3)	1 Hour	140	100 µg/ m^3 (8-hour mean)
Carbon monoxide (CO)	1 Hour	35,000	30 mg/m^3 (4)

Sources:
(1) National Ambient Air Quality Guideline for Criteria Pollutants of the Philippine Clean Air Act of 1999
(2) IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, Table 1.1.1: WHO Ambient Air Quality Guidelines, April 30, 2007
(3) DENR Administrative Order No. 2013-13
(4) WHO Air Quality Guidelines for Europe (2000)

(3) Results and Analysis

797. The results of sampling for ambient air quality showed that most of the stations are within the DENR standards, except for station AAQ3 (PNR Buendia) for TSP and PM_{10} concentration levels and AAQ2 (PNR Sta.Mesa) for $PM_{2.5}$ concentration level. 24-hour concentration levels for Pb were relatively low, while CO and O_3 concentrations were not detected at the majority of the stations.

798. More than half of the stations (Stations AAQ1 to AAQ5) have PM_{10} concentration levels above the WHO guideline values, while half of the stations (Stations AAQ1 to AAQ4) have $PM_{2.5}$ concentration levels above the WHO guideline values. It was noted that these stations were located at more urban environments compared to those whose PM_{10} and $PM_{2.5}$ concentrations were within WHO guideline values.

799. 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.

1) Results by Sampling Stations

The results of monitoring for each station are briefly described below.

Station AAQ1 (PNR Solis)

800. During testing, the prevailing winds were coming from east-northeast direction, with average winds speeds at 2.53 m/s. Average temperature was 27.8^{0}C, while barometric pressure was 29.80 inHg and relative humidity at 76%. Table 3.3.13.

801. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, Pb, SO_2 and NO_2 measured in station AAQ1 (PNR Solis) were below the DENR Standards. All parameters are below the WHO AAQ Guideline Values except for PM_{10} and $PM_{2.5}$. CO and O_3 were not detected at this station.

Station AAQ2 (PNR Sta. Mesa)

802. During testing, the prevailing winds were coming from northeast direction, with average winds speeds at 2.47 m/s. Average temperature was 28.3^{0}C, while barometric pressure was 29.81 inHg and relative humidity at 79%.

803. The concentration level of TSP, SO_2, NO_2, Pb and O_3 in station AAQ2 (PNR Sta. Mesa) were below the standard values. PM_{10} was not within the WHO AAQ Guideline Value while $PM_{2.5}$ was not within both DENR Standard and WHO AAQ Guideline Values. CO was not detected at station at this station.

Station AAQ3 (PNR Buendia)

804. During testing, the prevailing winds were coming from east-northeast direction, with average winds speeds at 3.33 m/s. Average temperature was 27.4^{0}C, while barometric pressure was 29.87 inHg and relative humidity at 79%.

805. For station AAQ3 (PNR Buendia), $PM_{2.5}$, SO_2, NO_2, Pb and O_3 were below the DENR standards. TSP and PM_{10} were not within the DENR Standards and WHO AAQ Guideline values, while $PM_{2.5}$ and SO_2 was not within the WHO AAQ Guideline values. The CO was not also detected at station at this station. Exceedances may be attributed to the emission of the vehicles passing near the sampling station. Station AAQ3 was located at Buendia Flyover corner Osmeña Highway and South Superhighway wherein high volume of vehicles was observed throughout the sampling period.

Station AAQ4 (PNR FTI)

806. During testing, the prevailing winds were coming from the north direction, with average winds speeds at 3.09 m/s. Average temperature was 25.0^{0}C, while barometric pressure was 29.82 inHg and relative humidity at 81%.

807. For station AAQ4 (PNR FTI), the concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2 and Pb were below the DENR Standard values while SO_2, Pb, CO and O_3 were not detected. PM_{10} and $PM2_{.5}$ exceeded the WHO AAQ Guideline values.

Station AAQ5 (PNR Sucat)

808. During testing, the prevailing winds were coming from the east-northeast direction, with average winds speeds at 3.63 m/s. Average temperature was 29.2^{0}C, while barometric pressure was 29.85 inHg and relative humidity at 70%.

809. The concentration levels of TSP, PM_{10}, $PM_{2.5}$, NO_2, CO and O_3 in station AAQ5 (PNR Sucat) were also below the standard values DENR Standard values. SO_2 and Pb were not detected in this station. PM_{10} exceeded the WHO AAQ Guideline values.

Station AAQ6 (PNR Biñan)

810. During testing, the prevailing winds were coming from the northeast direction, with average winds speeds at 2.52 m/s. Average temperature was 27.1^{0}C, while barometric pressure was 29.78 inHg and relative humidity at 78%.

811. The concentration levels of all parameters tested in station AAQ6 (PNR Biñan) were below the DENR standard values. CO was not detected, while SO_2 exceeded the WHO AAQ Guideline values.

Station AAQ7 (PNR Calamba)

812. During testing, the prevailing winds were coming from the east-northeast direction, with average winds speeds at 2.63 m/s. Average temperature was 26.6^{0}C, while barometric pressure was 29.78 inHg and relative humidity at 80%.

813. Concentration levels of TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2 in station AAQ7 (PNR Calamba) were below the standard values while Pb, CO and O_3 were not detected.

Station AAQ8 (Paciano Rizal Elementary School)

814. During testing, the prevailing winds were coming from the northeast direction, with average winds speeds at 2.50 m/s. Average temperature was 26.1^{0}C, while barometric pressure was 29.79 inHg and relative humidity at 80%.

815. Concentration levels of TSP, PM_{10}, $PM_{2.5}$, SO_2, and NO_2 in station AAQ8 (Paciano Rizal Elementary School) were below the standard values while Pb, CO and O_3 were not detected.

816. The meteorological data recorded during sampling at each sampling were used to compute the concentrations of TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, O_3 and Pb in standard condition on each sampling station.

Table 3.3.13 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 (1110H) - Jan. 21 (1110H)	Jan. 21 (1345H) - Jan. 22 (1345H	Jan. 18 (2000H) - Jan. 19 (2000H)	Feb. 07 (2148H) - Feb. 08 (2148H)	Feb. 20 (1350H) - Feb. 21 (1350H)	Jan. 23 (1026H) - Jan. 24 (1026H)	Jan. 24 (1356H) - Jan. 25 (1356H)	Jan. 25 (1716H) - Jan. 26 (1716H)		
Prevailing 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	ug/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;
[1]As 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 30, 2007
[2]WHO Air Quality Guidelines for Europe (2000)

2) Results by Parameters

817. Results of analysis for each parameter were graphed showing its relative concentration levels at the eight (8) sampling stations. Brief discussions were made comparing the results across the sampling stations and against relevant DENR standards and WHO guideline values.

Total Suspended Particulates (TSP)

818. Figure 3.3.11 shows the graphical presentation of the concentration levels of TSP in eight (8) sampling stations. As shown, concentration level of TSP exceeded the DENR Standard of 230 ug/m^3 in Station AAQ3 (PNR Buendia) at 276.54 ug/m^3. The lowest concentration was recorded in station AAQ6 (PNR Biñan) at 37.31 ug/m^3. WHO has no 24-hour guideline value for TSP.

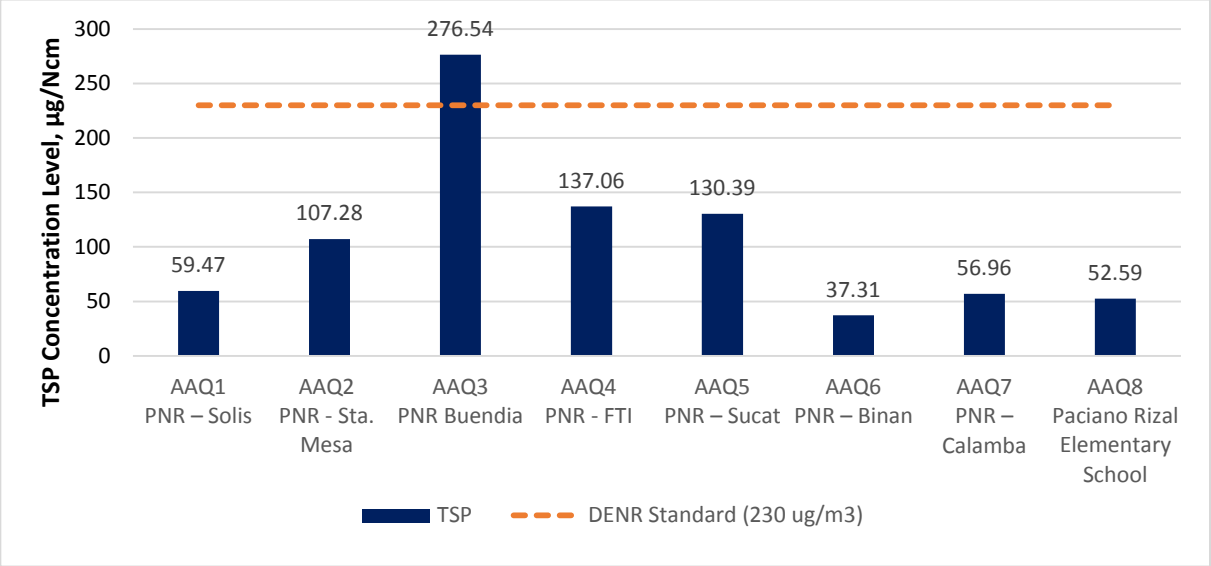


Figure 3.3.11 Concentration Levels of TSP (µg/m^3) at Eight (8) Sampling Stations

Particulate Matter up to 10 microns (PM_{10})

819. Figure 3.3.12 shows the graphical presentation of the concentration levels of PM_{10} in eight (8) sampling stations. Concentration level of PM_{10} exceeded the DENR Standard in Station AAQ3 (PNR Buendia) at 272.1 ug/m3. The lowest concentration of PM_{10} was recorded in station AAQ7 (PNR Calamba) at 23.86 ug/m3. Concentration level of PM_{10} exceeded the WHO AAQ Guideline Value at stations AAQ1, AAQ2, AAQ3, AAQ4 and AAQ5.

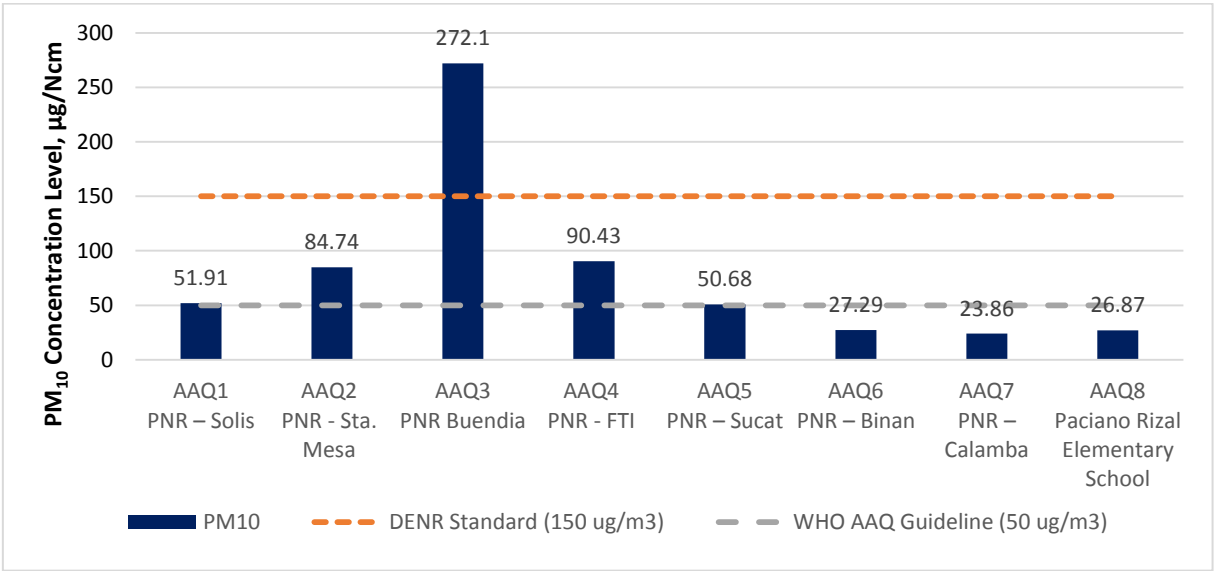


Figure 3.3.12 Concentration Levels of PM_{10} (µg/m^3) at Eight (8) Sampling Stations

Particulate Matter up to 2.5 microns ($PM_{2.5}$)

820. Figure 3.3.13 shows the graphical presentation of the concentration levels of $PM_{2.5}$ in eight (8) sampling stations. As shown, concentration level of $PM_{2.5}$ in Station AAQ2 (PNR Sta. Mesa) exceeded the DENR Standard at 80.3 ug/m3. The lowest concentration was recorded in station AAQ7 (PNR Calamba) at 10.17 ug/m3. Concentration level of $PM_{2.5}$ exceeded the WHO AAQ Guideline Value at stations AAQ1, AAQ2, AAQ3 and AAQ4.

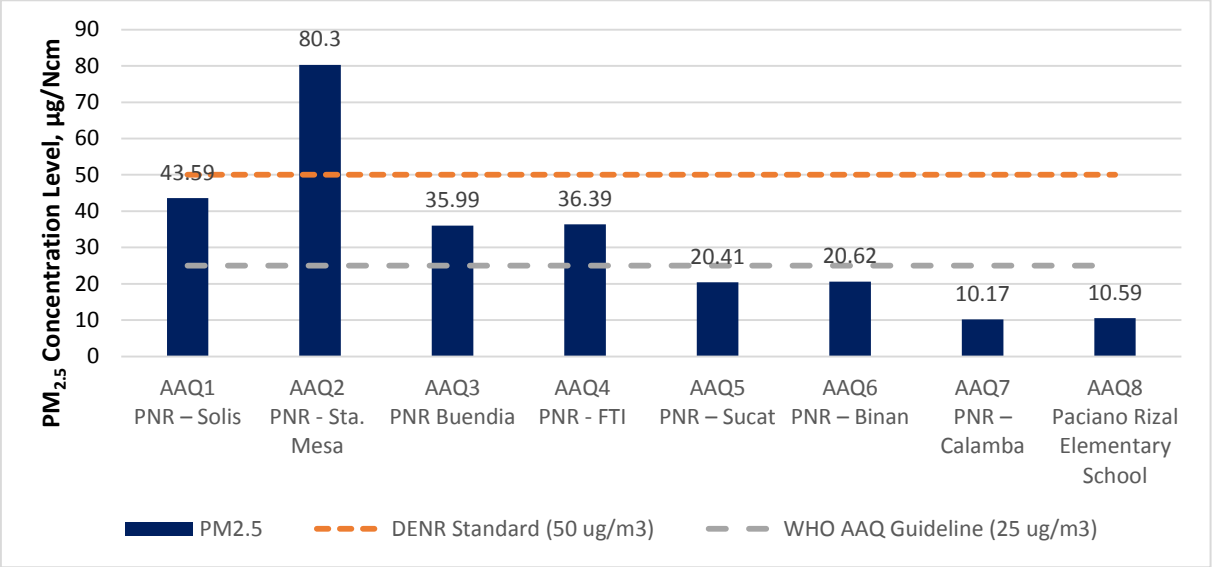


Figure 3.3.13 Concentration Levels of $PM_{2.5}$ (µg/m^3) at Eight (8) Sampling Stations

Sulfur Dioxide (SO_2)

821. Figure 3.3.14 shows the graphical presentation of the concentration levels of SO_2 in eight (8) sampling stations. As shown, concentration levels of SO_2 in all sampling stations were within the DENR Standard. The highest concentration was recorded in station AAQ3 (PNR Buendia) at 62.79 ug/m3. SO_2 was not detected in stations AAQ4 and AAQ5. Concentration level of SO_2 exceeded the WHO AAQ Guideline Value at stations AAQ3 and AAQ6.

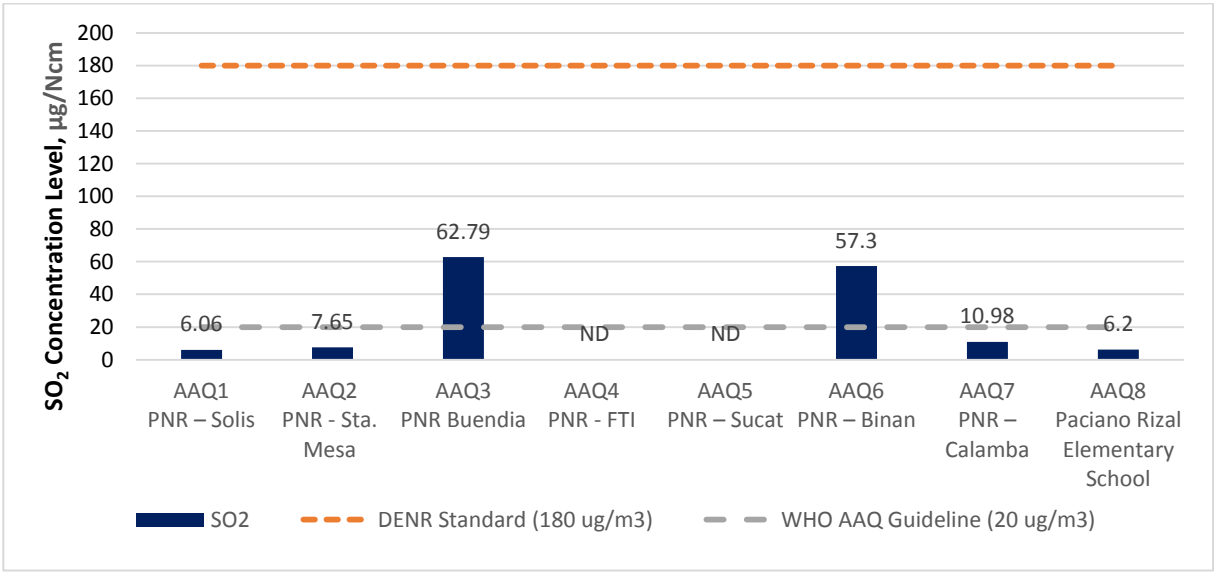


Figure 3.3.14 Concentration Levels of SO_2 (µg/m^3) at Eight (8) Sampling Stations

Nitrogen Dioxide (NO_2)

822. Figure 3.3.15 shows the graphical presentation of the concentration levels of NO2 in eight (8) sampling stations. As shown, concentration levels of NO2 in all sampling stations were within the DENR Standard. The highest concentration was recorded in station AAQ4 (PNR Buendia) at 52.98 ug/m^3 while the lowest concentration was recorded in station AAQ3 (PNR Buendia) at 0.34 ug/m3. WHO has no 24-hour guideline value for NO_2.

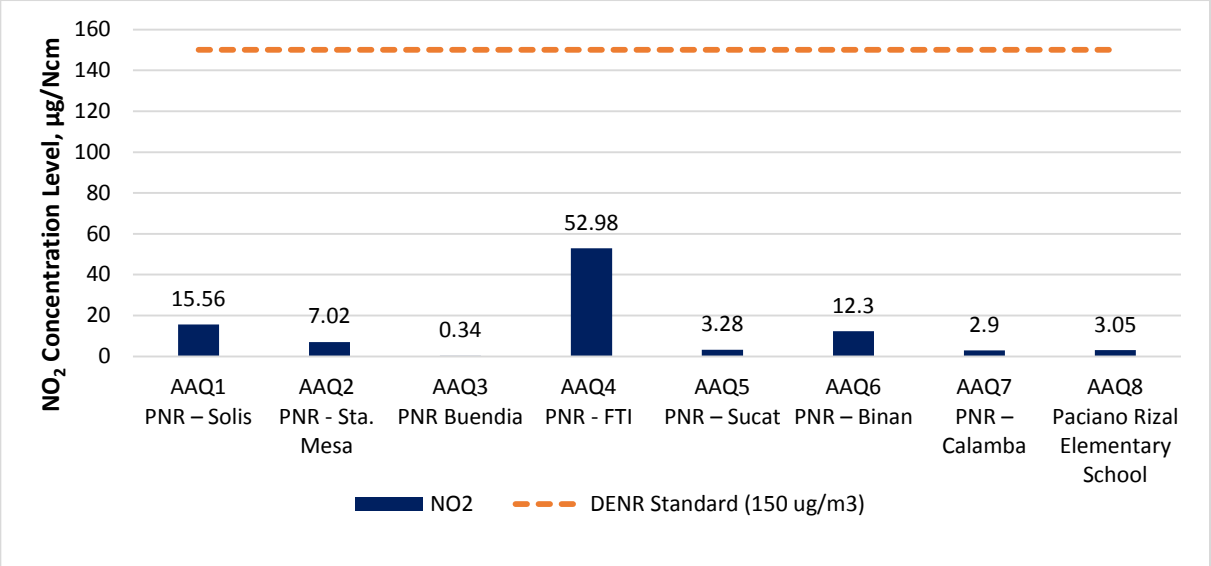


Figure 3.3.15 Concentration Levels of NO_2 (µg/m^3) at Eight (8) Sampling Stations

Lead (Pb)

823. **Figure 3.3.16** shows the graphical presentation of the concentration levels of Pb in eight (8) sampling stations. The highest Pb concentration was recorded in AAQ2 (PNR Sta. Mesa). Pb was not detected at stations AAQ4 (PNR FTI), AAQ5 (PNR Sucat), AAQ7 (PNR Calamba) and AAQ8 (Paciano Rizal Elementary School). Both the DENR and WHO have no 24-hour standard for Pb.

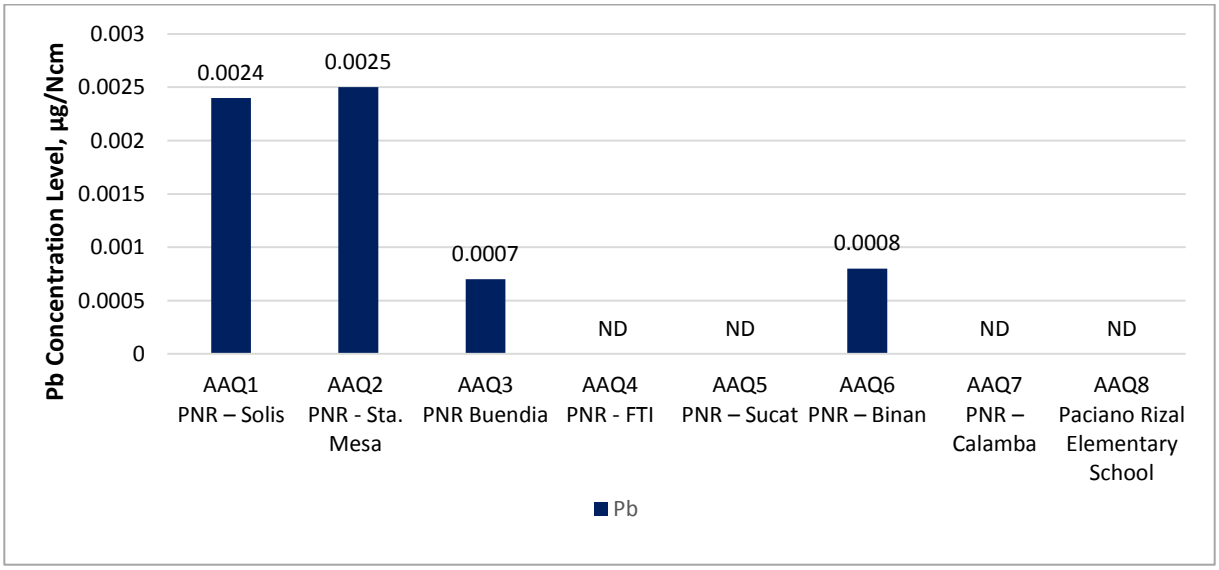


Figure 3.3.16 Concentration Levels of Pb (µg/m^3) at Eight (8) Sampling Stations

Carbon Monoxide (CO)

824. **Figure 3.3.17** shows the graphical presentation of the concentration levels of CO in eight (8) sampling stations. CO was not detected in all stations except in station AAQ5 (PNR Sucat).

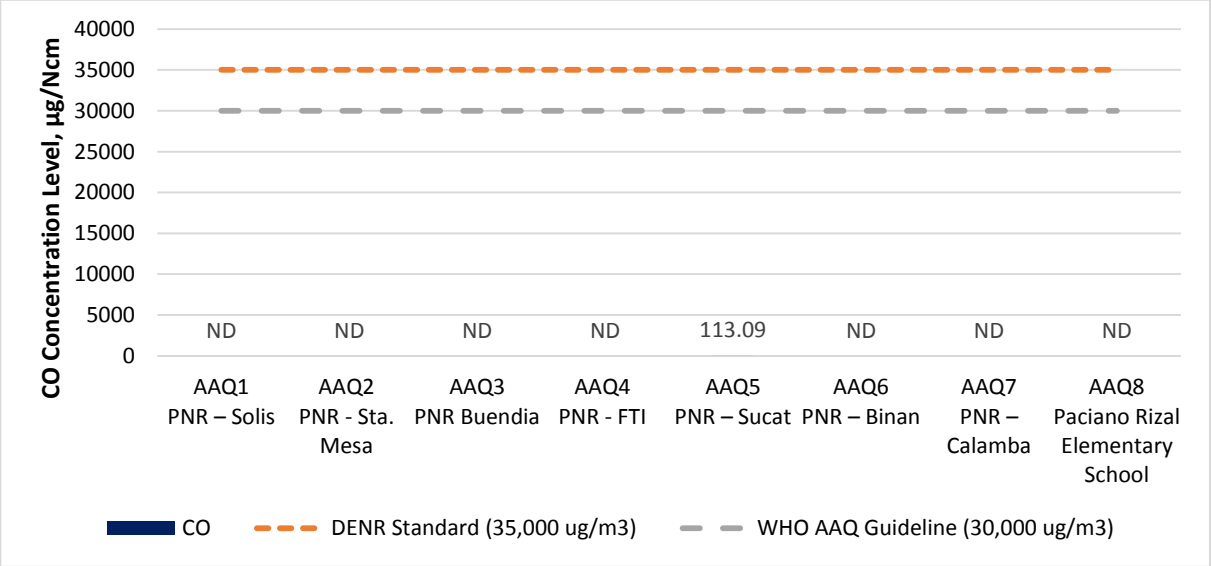


Figure 3.3.17 Concentration Levels of CO (µg/m^3) at Eight (8) Sampling Stations

Ozone (O_3)

825. **Figure 3.3.18** shows the graphical presentation of the concentration levels of O_3 in eight (8) sampling stations. As shown, concentration levels of O_3 in all sampling stations were way below the DENR standard value of 140 ug/m^3. O_3 was not detected at stations AAQ1 (PNR-Solis), AAQ4 (PNR-FTI), AAQ7 (PNR-Calamba) and AAQ8 (Paciano Rizal Elementary School). WHO has no 24-hour guideline value for O_3.

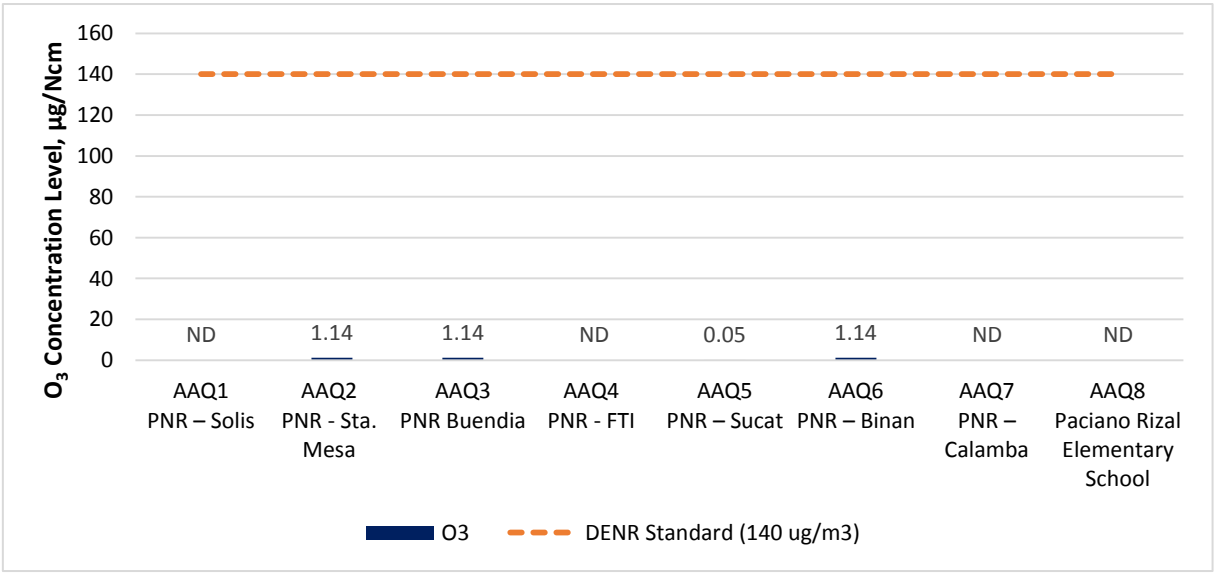


Figure 3.3.18. Concentration Levels of O_3 (µg/m^3) at Eight (8) Sampling Stations

3.3.2.2 Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

826. Due to the nature of construction process, emissions will not be constant and will fluctuate based on operating periods and the combination equipment to be used at any one time. The location of emission sources will also change as the construction activity progresses along the alignment. Intensive construction activities will not be generally carried out at night time. Potential receptors such as residents will not be continually exposed during construction for extended period and limited daily exposure. The major impacts on air quality by the Project in the construction phases are as follows:

Dust Generation

827. Earthworks like excavation for structure foundations, removal of topsoil, ground leveling, earthfill for embankments generate dust and can cause significant deterioration of air quality at the areas surrounding active construction sites. This may be mitigated by the following measures:

- Minimise alteration of topography and removal of vegetation to minimise earthworks and retain natural dust barriers.
- Limiting earthworks during periods of calm winds as much as possible, using daily weather forecast information;
- Wetting of ground soil in the construction site when necessary, especially during dry and windy periods;
- Regular clean-up of paved areas inside construction sites by spraying with water or other wet methods to minimize fugitive dusts;
- Stockpiles of excavated materials exposed to winds will be covered or surrounded with temporary fences or wind barriers. The surrounding areas will be shielded from dust from construction sites by erecting temporary walls/fences to act as wind barriers.
- Grievance Redress Mechanism will be in place to receive and respond to possible complaints.

828. By implementing these mitigating measures, the dust generated will be minimized to levels within standards and contained within specific areas within the construction sites. Dust transported by the winds to surrounding areas will also be reduced. These impacts will cease to be significant after the earthworks are completed.

829. Transportation of excavated soil will generate additional dust during loading/unloading into transport vehicles, soil falling from vehicles during transport and dust from soil sticking to vehicle body and wheels. These activities may cause minor impacts at areas surrounding loading/unloading areas and along transport paths. The impact may be reduced by the following measures:

- Minimize transport of excavated materials as much as possible. Reuse soil as backfill wherever possible. Locate a stockpile area as near as possible to the excavation site.
- Require transport vehicles carrying soil to be covered. Vehicles transporting soil will not be overfilled, to prevent soil from spilling from the vehicle.
- Control vehicle movement maintaining the speed limit within the construction site to <10kph; Enforcing a speed limit during transport from one site to another will also prevent spillage.
- Provide wash area for vehicles before they leave the construction site and transport excavated soil.

830. By applying these mitigating measures, dust generated by transport of excavated material (soil) will be reduced to insignificant levels and contained areas. These impacts will cease after all the excavated soil are backfilled or disposed of.

831. Concreting and cementing of structures and facilities like viaducts, piers, depot, etc., particularly activities like removing forms, casts and frames and sanding excess concrete off newly-constructed structures will generate minor to moderate amounts of fine dusts at active construction sites and their surrounding areas during the concreting part of construction phase. The dust generated may be reduced to acceptable levels by making use of pre-fabricated structures as much as possible, and isolating construction areas by putting up temporary fences/walls. Wetting the structure before removing casts and frames will prevent dusting off of cement. The impact will last only until the concreting and cementing activities are done.

832. Removal of existing structures prior to construction and clean-up activities including demolition of temporary facilities after construction will generate minor to moderate amounts of dust at the areas surrounding the demolition sites, temporary facilities and other clean-up sites (staging areas and material stockpiles, for example). Careful handling of scrap materials and using wet methods to collect residual soils and earth will minimize the dust generated from the clean-up activities to insignificant levels. The impact will cease after the clean-up activities are done.

Exhaust Generation

833. Equipment and vehicles that are diesel- or gasoline- operated and used extensively during the construction activities will cause exhaust gas emissions that can potentially reduce the air quality of the areas surrounding active construction sites. Maximizing use of electrically-powerd equipment and undertaking regular preventive maintenance of heavy equipment, machineries and service vehicles to meet the DENR Emission Standards will reduce the emissions to levels within standards, especially at nearby sensitive receptors.

834. Air quality will be monitored at identified baseline sampling points including 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 air pollution reduction measures provide. Update and improve these measures as necessary. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

(2) Operation Phase

835. During the operation phase, entrained dust due to increased traffic of people at the vicinity of the stations and ingress and egress of vehicles at the depot. This minor impact will occur only between the start and end of daily train operations and limited to within the vicinities of the stations and depot. Mitigation measures that will reduce dust entrainment to insignificant levels are as follows:

- Conduct regular cleaning and clearing of road from spoils and debris, and wetting of soil in the periphery of the depot when necessary;
- Control service vehicle movement within the depot maintaining the speed limit to <10kph.
- Development and management of buffer areas vegetation around the stations and depot.

836. Operation of back-up generator sets may slightly increase the levels of pollutants like NO_x and CO at the areas surrounding the generator set during events of power interruptions. Selecting appropriate operation and maintenance equipment that are fuel efficient to reduce emission and undertaking regular inspection and proper preventive maintenance of the equipment will ensure the emissions are within DENR source emission standards.

3.3.3 Noise

3.3.3.1 Ambient Noise Level

837. As of the 2010 data of Philippine Statistics Authority, 100% of Metro Manila and 71.9% of Laguna are urban areas. It is then expected that the noise levels in these stations will reflect the general conditions of urban areas, namely, dense populations and moderate to heavy traffic conditions.

838. For example, in a survey conducted by DPWH in May 2000, reported in Metro Manila Road Pavement Rehabilitation Project by JICA, noise levels obtained at Kalayaan Avenue Intersection of the C-5 road in Metro Manila were reported to range from 75 - 77 dBA, higher than the DENR Standard of 75 dBA for commercial areas fronting 4-lane or wider roads. The same report also indicated that 80% of road users who were interviewed said the noise levels were worse than before.

839. A paper by Fajardo presented at the International Association for Impact Assessment (**IAIA**) 2007 conference reports the data presented in Error! Not a valid bookmark self-reference..

Table 3.3.14 Noise Levels in Taft Avenue, Quezon Avenue and EDSA

Study Area	Noise Ranges, dBA	DENR Standard (Class B facing 4-lane or wider roads), Daytime
Taft Avenue, Manila	75 - 79	75
Quezon Avenue	75 - 80	75
EDSA (Camp Crame)	86 - 89	75

Source: Fajardo, Belinda, "A Study on Individual Perceptions of Road Traffic Noise" 2007

840. The Environmental Impact Assessment Report for Laguna Section of Cavite-Laguna Expressway (**CALAx**) Project showed the noise levels at the three (3) stations located within Laguna exceeded the NPCC standards for Class B category 75 % of the sampling periods, with noise ranging from 49.6 dBA to 70.6 dBA.

(1) Field Survey

841. Noise levels for the proposed NSRP were measured at fifteen (15) monitoring stations during morning (5:00 AM to 9:00 AM), daytime (9:00 AM to 6:00 PM), evening (6:00 to 10:00 PM) and nighttime (10:00 PM to 5:00AM) using an Extech® noise level meter and data logger. The data logger was set to record A-weighted noise data at 10-minute intervals using slow response mode. One-hour samples were recorded for each of the four periods and the equivalent energy level (LAeq) computed according to the following formula:

$$LA_{eq} = 10 \times log_{10}\{(10^{1/10} + 10^{2/10} + \cdots + 10^{n/10})/n\}$$

$$where: n = number\ of\ samples$$

Table 3.3.15. describes the location of the noise sampling stations and their categories according to applied standards.

Table 3.3.15. Station Description for Ambient Noise Levels Monitoring

Station ID	Station	Description	NPCC Area Class	WHO Category[1]
N01	**PNR – Solis** 14°37'42.17" N; 120°58'32.88" E	Adjacent to BLISS residential area, approximately 150m from PNR Solis station and 25m north of Gregoria de Jesus Elementary School	AA	RIE
N02	**PNR - Sta. Mesa** 14°35'54" N; 121°00'46" E	Near Brgy. 630 barangay hall approximately 100m from PUP main gate	AA	RIE
N03	**PNR Old Paco Station** 14°34'46.79" N; 120°59'59.27" E	Near PNR Paco at Brgy. 815 residential area, approx. 250m west of Concordia College and 250m southeast of Manuel Roxas High School	A	RIE
N04	**PNR Buendia** 14°33'29" N; 121°00'27" E	Buendia Flyover corner Osmeña Highway and South Superhighway. Adjacent areas occupied by business establishments	B*	IC
N05	**PNR FTI** 14°30'24.86" N; 121°02'07.64" E	Along East Service Road, approximately 70m from FTI station entrance and 30m south of Bagong Lipunan Condominium	B*	IC
N06	**PNR Sucat** 14°27'08" N; 121°03'03" E	Approx. 20m east of Escalades South Metro residences, and 40m west of Purok II residential area. Near Sucat Thermal Power Plant.	A	RIE
N07	**PNR Alabang**	Residential area near PNR Alabang Station, approx.	A	RIE

Station ID	Station	Description	NPCC Area Class	WHO Category[1]
	14°25'02.12" N; 121°02'51.78" E	150m northwest of West Bay College and 120m west of St. Peter's School		
N08	**Divine Mercy Memorial Chapel** 14°22'14.9" N; 121°03'01.1" E	Front of Divine Mercy Memorial Chapel, about 90m south of Sikatville RMT Tunasan residential area	AA**	RIE
N09	**Biñan Community Hospital** 14°20'12.7" N; 121°04'28.6" E	Parking area in front of the Emergency Section of Biñan Community Hospital	AA	RIE
N10	**PNR Biñan** 14°19'52" N; 121°04'51" E	Basketball Court near new PNR Biñan Station, 100m northeast of San Vicente Ferrer Parish Church	AA	RIE
N11	**Cabuyao Central School** 14°16'35.7" N; 121°07'35.2" E	Front of Sergio Osmeña St. about 25m across Cabuyao Central School. The station is adjacent to residential area of Poblacion II.	AA	RIE
N12	**PNR Calamba** 14°12'26.1" N; 121°09'28.7" E	Vacant lot near PNR Calamba Station, 20m west of Criscor Homes, 200m northwest of Maranatha Christian Academy	A	RIE
N13	**Tiyani Elementary School** 14°10'44.1" N; 121°11'58.5" E	Approx. 20m north of Tiyani Elementary School	AA	RIE
N14	**Los Baños Municipal Health Center** 14°10'52.8" N; 121°13'34.7" E	Approx. 10m south of Los Baños Municipal Health Center, adjacent to a 2-way Manila East Road	AA**	RIE
N15	**Paciano Rizal Elementary School** 14°08'57" N; 121°16'05" E	Approx. 60m south of Paciano Rizal Elementary School in Bay, Laguna	AA	RIE

Notes: *Areas directly fronting or facing a four-lane or wider road. A +10 dBA correction will be applied to the NPCC Noise standards in these stations.
**Areas directly fronting or facing a four-lane road. A +5 dBA correction will be applied to the NPCC Noise standards in these stations.
1RIE – Residential; Institutional; Educational; IC – Industrial; Commercial

Figure 3.3.19 Noise Sampling Station Map

(2) Applied Standard

842. The measured noise levels were compared to the NPCC Memorandum Circular, Section 78, Table 1, Environmental Quality Standards for Noise in General Areas, the NPCC Memorandum Circular No. 1980-002, Standards in Areas Directly Fronting/Facing Roads with Four (4) or more Lanes and the Guidelines for Community Noise of WHO, 1999. Detail criteria are given in Chapter 2. 2.6.5.

(3) Results and Analysis

843. Based on the results, the ambient noise levels observed in all stations were above the NPCC standard values and the WHO guideline values for their respective classifications.

844. The lowest 1-Hour LAeq obtained was 57.9 dBA at Station N01 (PNR – Solis) during daytime, while the highest 1-Hour LAeq obtained was 79.2 dBA at Station N04 (PNR Buendia) during morning and evening. 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.

845. Brief discussion of noise levels as compared to NPCC standards and WHO guideline values were made. The results were summarized in **Table 3.3.16**.

1) Results by Sampling Stations

N01 – PNR Solis

846. Station N01 was located within 100 meters of Gregoria de Jesus Elementary School, and thus was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

847. Station N01 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N02 – PNR Sta. Mesa

848. Station N02 was located within 100 meters of Polytechnic University of the Philippines (**PUP**), and therefore was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

849. Station N02 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N03 - PNR Old Paco Station

850. Station N03 was located in a residential area at Brgy. 815 and, therefore, was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

851. Station N03 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N04 - PNR Buendia

852. Station N04 was located in a commercial area and, therefore, was categorized as an B Class area according to NPCC classification. Furthermore, it was located adjacent to Buendia Flyover corner Osmeña Highway and South Superhighway, increasing its acceptable maximum noise levels by 10 dBA. Nevertheless, noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 75 dBA for daytime, 70 dBA for morning and evening, and 65 dBA for nighttime.

853. Station N04 was categorized under Industrial and Commercial areas based on WHO Guidelines. Noise levels measured during daytime and nighttime were higher than the 1-hour LAeq noise levels set by WHO for its category, which is 70 dBA for both monitoring periods.

N05 - PNR FTI

854. Station N05 was located in a commercial area and, therefore, was categorized as an B Class area according to NPCC classification. Furthermore, it was located adjacent to the east service road near where the Metro Manila Skyway converges to South Luzon Expressway, increasing its acceptable maximum noise levels by 10 dBA. Nevertheless, noise levels measured in all monitoring periods were higher than

maximum noise levels set for its classification, which are 75 dBA for daytime, 70 dBA for morning and evening, and 65 dBA for nighttime.

855. Station N05 was categorized under Industrial and Commercial areas based on WHO Guidelines. Noise levels measured during daytime and nighttime were higher than the 1-hour LAeq noise levels set by WHO for its category, which is 70 dBA for both monitoring periods.

N06 - PNR Sucat

856. Station N06 was located in a residential area at Purok 4 and Escalades South Metro residences and, therefore, was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

857. Station N06 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N07 - PNR Alabang

858. Station N07 was located in a residential area near PNR Alabang Station and, therefore, was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

859. Station N07 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N08 - Divine Mercy Memorial Chapel

860. Station N08 was located in front of Divine Mercy Memorial Chapel and, therefore, was categorized as an AA Class area according to NPCC classification. Furthermore, it is located adjacent a 4-lane street, increasing its acceptable maximum noise levels by 5 dBA. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

861. Station N08 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N09 - Biñan Community Hospital

862. Station N09 was located adjacent of the Biñan Community Hospital and, therefore, was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

863. Station N09 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N10 - PNR Biñan

864. Station N10 was located within 100 meters of San Vicente Ferrer Parish Church and, therefore, was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

865. Station N10 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N11 - Cabuyao Central School

866. Station N11 was located across Cabuyao Central School and, therefore, was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

867. Station N11 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N12 - PNR Calamba

868. Station N12 was located near Criscor Homes residential area and, therefore, was categorized as an A Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

869. Station N12 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N13 - Tiyani Elementary School

870. Station N13 was located within 100 meters of Tiyani Elementary School and, therefore, was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

871. Station N13 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N14 - Los Baños Municipal Health Center

872. Station N14 was located near Los Baños Municipal Health Center and, therefore, was categorized as an AA Class area according to NPCC classification. Furthermore, it is located adjacent a 4-lane street, increasing its acceptable maximum noise levels by 5 dBA. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 55 dBA for daytime, 50 dBA for morning and evening, and 45 dBA for nighttime.

873. Station N014 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

N15 - Paciano Rizal Elementary School

874. Station N15 was located within 100 meters of Paciano Rizal Elementary School and, therefore, was categorized as an AA Class area according to NPCC classification. Noise levels measured in all monitoring periods were higher than maximum noise levels set for its classification, which are 50 dBA for daytime, 45 dBA for morning and evening, and 40 dBA for nighttime.

875. Station N15 was categorized under Residential, Institutional and Educational areas based on WHO Guidelines. Noise levels measured during daytime and nighttime sampling were higher than the 1-hour LAeq noise levels set by WHO for its category, which are 55 dBA and 45 dBA, respectively.

876. Figure 3.3.19 to Figure 3.3.22 present the noise levels according to NPCC area classification together with the applicable standards for every monitoring period, while Figure 3.3.23 and Figure 3.3.24 show the daytime and nighttime noise levels for the ambient noise stations classified according to WHO category compared with the applicable standard per category.

Table 3.3.16 Summary of Results for Manual Monitoring of Ambient Noise Levels

Station Number	Date	Time	Noise Levels, dBA (Slow Response)	DENR Standard			WHO Guidelines		Sources of Noise
				Area Class	Monitoring Period	Noise Level (dBA)	Monitoring Period	Noise Level (dBA)	
N01	Jan 21, 2018	0654H-0754H	65.4	AA	Morning	45 dBA	Daytime	55	Vehicles passing by nearby road, people talking, chickens crowing; birds chirping
	Jan21, 2018	1304H-1404H	57.9		Daytime	50 dBA	Daytime	55	Vehicles passing by nearby road, people talking; dogs barking
	Jan 20, 2018	1904H-2004H	62.4		Evening	45 dBA	Daytime	55	Vehicles passing by nearby road; chirping of nocturnal insects
	Jan21, 2018	2304H-0004H	60.1		Nighttime	40 dBA	Nighttime	45	Chirping of nocturnal insects
N02	Jan 22, 2018	0709H-0809H	63.7	AA	Morning	45 dBA	Daytime	55	Light vehicles and tricycles passing
	Jan 22, 2018	1343H-1443H	66.3		Daytime	50 dBA	Daytime	55	Dogs barking; passing light vehicles and tricycles
	Jan 21, 2018	1903H-2003H	65.8		Evening	45 dBA	Daytime	55	People talking nearby; tricycle passing
	Jan 21, 2018	2303H-0003H	68.4		Nighttime	40 dBA	Nighttime	45	Tricycles passing nearby
N03	Feb 3, 2018	0640H-0740H	67.6	A	Morning	50 dBA	Daytime	55	Vehicles; people talking nearby; dogs barking; chicken clucking
	Feb 2, 2018	1700H-1800H	69.4		Daytime	55 dBA	Daytime	55	Vehicles passing; people talking nearby; dogs barking, chicken clucking
	Feb 2, 2018	1828H-1928H	67.9		Evening	50 dBA	Daytime	55	Vehicles passing nearby
	Feb 2, 2018	2214H-2314H	68.3		Nighttime	45 dBA	Nighttime	45	Dogs barking; vehicles passing nearby
N04	Jan 19, 2018	0709H-0809H	79.2	B*	Morning	70 dBA	Daytime	70	Light vehicles passing; blowing of horns
	Jan 19, 2018	1306H-1406H	77.2		Daytime	75 dBA	Daytime	70	Light vehicles passing; blowing of horns
	Jan 18, 2018	1906H-2006H	79.2		Evening	70 dBA	Daytime	70	Bus and light vehicles passing; nearby fountain
	Jan 19, 2018	2309H-0009H	76.5		Nighttime	65 dBA	Nighttime	70	Light vehicles passing
N05	Feb 8, 2018	0725H-0825H	75.5	B*	Morning	70 dBA	Daytime	70	Vehicles passing through access road; blowing of horns
	Feb 8, 2018	1305H-1405H	75.7		Daytime	75 dBA	Daytime	70	Vehicles passing through access road; pedestrians talking nearby
	Feb 8, 2018	1915H-2015H	74.9		Evening	70 dBA	Daytime	70	Vehicles passing through access road
	Feb 7, 2018	2325H-0025H	75.0		Nighttime	65 dBA	Nighttime	70	Vehicles passing through access road
N06	Feb 21, 2018	0700H-0800H	73.6	A	Morning	50 dBA	Daytime	55	Vehicles; people taling; blowing of horns and loud mufflers
	Feb 21, 2018	1115H-1215H	75.0		Daytime	55 dBA	Daytime	55	Vehicles; sound system nearby; people talking; blowing of horns
	Feb 20, 2018	1831H-1931H	74.2		Evening	50 dBA	Daytime	55	Vehicles with loud mufflers
	Feb 20, 2018	2310H-0010H	69.3		Nighttime	45 dBA	Nighttime	45	Vehicles with loud mufflers
N07	Mar 23, 2018	0754H-0854H	70.4	A	Morning	50 dBA	Daytime	55	Vehicles passing nearby; tricycles; motorcycles
	Mar 24, 2018	1655H-1755H	61.7		Daytime	55 dBA	Daytime	55	Sound system from nearby commercial building; tricycles; motorcycles; construction activities; people talking nearby
	Mar 24, 2018	1835H-1935H	61.4		Evening	50 dBA	Daytime	55	Vehicles; sound system in operation nearby; dogs barking; noise

Station Number	Date	Time	Noise Levels, dBA (Slow Response)	DENR Standard			WHO Guidelines		Sources of Noise
				Area Class	Monitoring Period	Noise Level (dBA)	Monitoring Period	Noise Level (dBA)	
									from a commercial building; loudspeakers nearby
	Mar 25, 2018	0220H-0320H	62.9		Nighttime	45 dBA	Nighttime	45	Passing of motorcycles and tricycles; dogs barking; people passing nearby
N08	Mar 23, 2018	0754H-0854H	70.4	AA**	Morning	50 dBA	Daytime	55	Vehicles passing in and out of nearby establishment
	Mar 8, 2018	1655H-1755H	61.7		Daytime	55 dBA	Daytime	55	Cars passing nearby
	Mar 8, 2018	1835H-1935H	61.4		Evening	50 dBA	Daytime	55	Birds chirping nearby; cars passing nearby; crowing of roosters; vendor selling rice cakes
	Mar 25, 2018	0220H-0320H	62.9		Nighttime	45 dBA	Nighttime	45	Dogs barking; vehicles passing nearby highway
N09	Mar 24, 2018	0800H-0900H	68.0	AA	Morning	45 dBA	Daytime	55	Vehicles passing nearby; people talking
	Mar 8, 2018	1518H-1618H	68.0		Daytime	50 dBA	Daytime	55	Tricycles and motorcycles passing nearby; pedestrian hailing a tricycle; vendors peddling their goods
	Mar 8, 2018	2012H-2112H	63.1		Evening	45 dBA	Daytime	55	Vendor pedding her goods; passing of tricycles; children playing nearby
	Mar 24, 2018	0800H-0900H	68.0		Nighttime	40 dBA	Nighttime	45	Tricycles; people talking outside the Emergency Room; barking dogs
N10	Jan 24, 2018	0744H-0844H	67.2	AA	Morning	45 dBA	Daytime	55	Crowing chickens; people talking
	Jan 23, 2018	1304H-1404H	64.1		Daytime	50 dBA	Daytime	55	Children playing and shouting; people talking; boys playing basketball nearby
	Jan 23, 2018	1904H-2004H	63.6		Evening	45 dBA	Daytime	55	People talking nearby; chirping of nocturnal insects
	Jan 24, 2018	2314H-0014H	63.8		Nighttime	40 dBA	Nighttime	45	Dogs barking; chirping of nocturnal insects
N11	Mar 24, 2018	0635H-0735H	63.8	AA	Morning	45 dBA	Daytime	55	Sound system from Zumba activity; tricycles and motorcycles
	Mar 8, 2018	1041H-1141H	71.5		Daytime	50 dBA	Daytime	55	Passing of vehicles nearby; students reciting inside classrooms; students having school activities
	Mar 23, 2018	1805H-1905H	61.8		Evening	45 dBA	Daytime	55	Motor vehicles (tricycles, motorcycles) passing nearby
	Mar 23, 2018	2320H-0020H	65.0		Nighttime	40 dBA	Nighttime	45	Tricycles and motorcycles passing nearby; videoke machine in operation; dogs barking
N12	Jan 25, 2018	0703H-0803H	63.3	A	Morning	50 dBA	Daytime	55	Tricycles passing by nearby road; people talking
	Jan 25, 2018	1253H-1353H	64.3		Daytime	55 dBA	Daytime	55	People talking nearby; tricycles passing by nearby road
	Jan 24, 2018	1913H-2013H	65.2		Evening	50 dBA	Daytime	55	People talking nearby; children shouting; tricycles passing by nearby road
	Jan 25, 2018	2253H-2353H	63.4		Nighttime	45 dBA	Nighttime	45	Chirping of nocturnal insects
N13	Mar 8, 2018	0755H-0855H	66.7	AA	Morning	45 dBA	Daytime	55	Crowing of rooster; barking of dogs; chirping birds nearby; people talking nearby; students' voices
	Feb 22, 2018	1620H-1720H	70.3		Daytime	50 dBA	Daytime	55	Light vehicles and motorcycles passing nearby road; children

Station Number	Date	Time	Noise Levels, dBA (Slow Response)	DENR Standard			WHO Guidelines		Sources of Noise
				Area Class	Monitoring Period	Noise Level (dBA)	Monitoring Period	Noise Level (dBA)	
									playing nearby
	Feb 22, 2018	1959H-2059H	67.8		Evening	45 dBA	Daytime	55	Light vehicles and motorcycles passing nearby road
	Mar 8, 2018	2214H-2314H	58.3		Nighttime	40 dBA	Nighttime	45	Karaoke music nearby; barking of dogs; people talking nearby; tricycles passing nearby
N14	Mar 8, 2018	0525H-0625H	68.6	AA**	Morning	50 dBA	Daytime	55	Vehicles passing nearby road
	Feb 22, 2018	1100H-1200H	71.2		Daytime	55 dBA	Daytime	55	Buses, trucks and other light vehicles passing nearby road
	Feb 22, 2018	1830H-1930H	68.1		Evening	50 dBA	Daytime	55	Buses, trucks and other vehicles passing nearby road; blowing of horns
	Mar 8, 2018	0355H-0455H	72.7		Nighttime	45 dBA	Nighttime	45	Ambulance siren arriving; birds chirping nearby; horns of jeepneys passing nearby
N15	Jan 26, 2018	0700H-0800H	61.8	AA	Morning	45 dBA	Daytime	55	Light vehicles passing; students playing and shouting
	Jan 26, 2018	1300H-1400H	67.8		Daytime	50 dBA	Daytime	55	Light vehicles passing
	Jan 25, 2018	1840H-1940H	59.3		Evening	45 dBA	Daytime	55	Light vehicles passing; chirping of nocturnal insects
	Jan 25-26, 2018	2300H-000H	61.6		Nighttime	40 dBA	Nighttime	45	Light vehicles passing; chirping of nocturnal insects

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.
Values in red indicates exceedance

2) Results by Time

Noise Levels During Morning

877. As shown in **Figure 3.3.20**, noise levels in all stations exceeded the NPCC standards during the morning period. The highest noise level of 79.2 dBA was measured at station N04 – PNR Buendia while the lowest noise level of 61.8 dBA was measured at station N13 – Paciano Rizal Elementary School. The morning period covers the time between 5:00 AM to 9:00 AM.

878. The noise levels in thirteen (13) stations categorized as Residential, Institutional and Educational exceeded the WHO guideline values of 55 dBA for daytime and 45 dBA for nighttime, while the noise levels in two (2) stations categorized as Industrial/Commercial exceeded the WHO guideline values of 70 dBA for both daytime and nighttime.

879. The first half of this period (5:00 AM to 7:00 AM) is covered by the WHO nighttime period, while the second half (7:00 AM to 9:00 AM) is covered by the WHO daytime period.

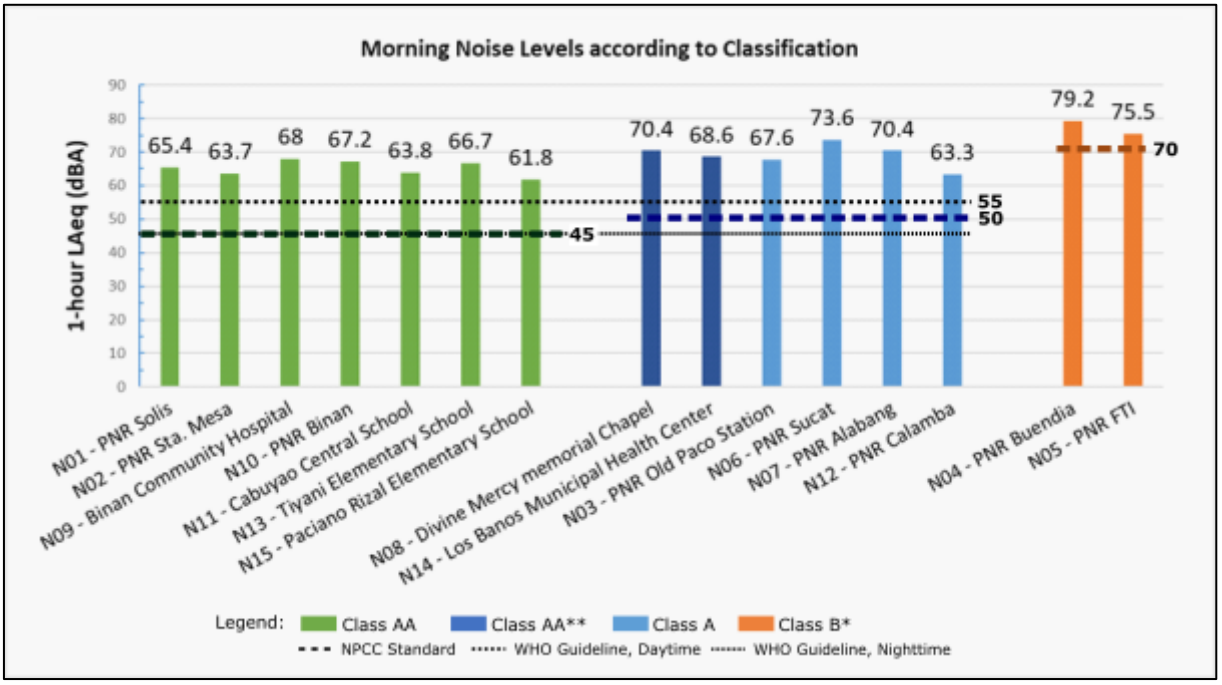


Figure 3.3.20 Morning Ambient Noise Levels According to NPCC Classification

Noise Levels During Daytime

880. As shown in **Figure 3.3.21**, noise levels in all stations exceeded the NPCC standards during the daytime period. The highest noise level of 77.2 dBA was measured at station N04 – PNR Buendia while the lowest noise level of 57.9 dBA was measured at station N01 – PNR Solis. The daytime period covers the time between 9:00 AM to 6:00 PM.

881. The noise levels in thirteen (13) stations categorized as Residential, Institutional and Educational exceeded the WHO guideline values of 55 dBA for daytime and 45 dBA for nighttime, while the noise levels in two (2) stations categorized as Industrial/Commercial exceeded the WHO guideline values of 70 dBA for both daytime and nighttime.

882. The noise levels in thirteen (13) stations categorized as Residential, Institutional and Educational exceeded the WHO guideline values of 55 dBA for daytime, while the noise levels in two (2) stations categorized as Industrial/Commercial exceeded the WHO guideline values of 70 dBA for daytime. It was also noted that stations N06 – PNR Sucat, N11 – Cabuyao Central School, N13 – Tiyani Elementary

School and N14 – Los Baños Municipal Health Center exceeded the WHO standard for Industrial and Commercial category, even though they are categorized under Residential, Institutional and Educational Category.

The daytime period as set by WHO covers the time between 7:00 AM to 10:00 PM.

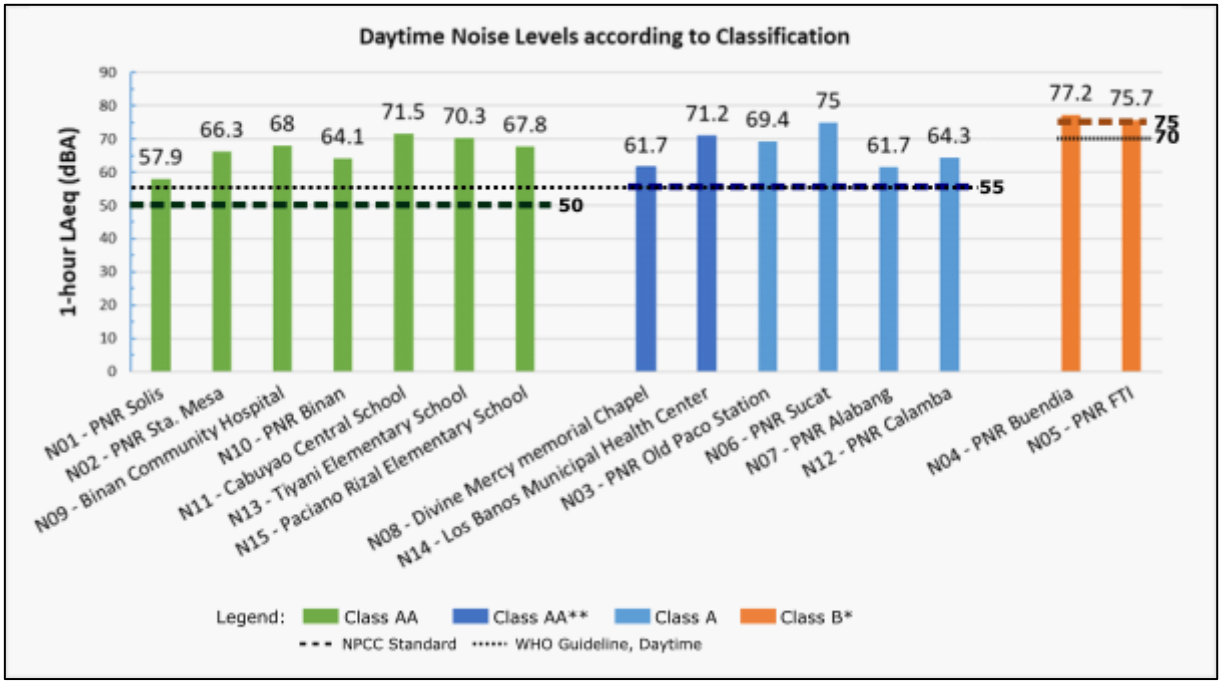


Figure 3.3.21. Daytime Ambient Noise Levels According to NPCC Classification

Noise Levels during Evening

883. As shown in **Figure 3.3.22**, noise levels in all stations exceeded the NPCC standards during the evening period. The highest noise level of 79.2 dBA was measured at station N04 – PNR Buendia while the lowest noise level of 59.3 dBA was measured at station N15 – Paciano Rizal Elementary School. The evening period covers the time between 6:00 PM to 10:00 PM.

884. The noise levels in thirteen (13) stations categorized as Residential, Institutional and Educational exceeded the WHO guideline values of 55 dBA for daytime, while the noise levels in two (2) stations categorized as Industrial/Commercial exceeded the WHO guideline values of 70 dBA for daytime. It was also noted that station N06 – PNR Sucat exceeded the WHO standard for Industrial and Commercial category, even though it is categorized under Residential, Institutional and Educational Category.

The daytime period as set by WHO covers the time between 7:00 AM to 10:00 PM.

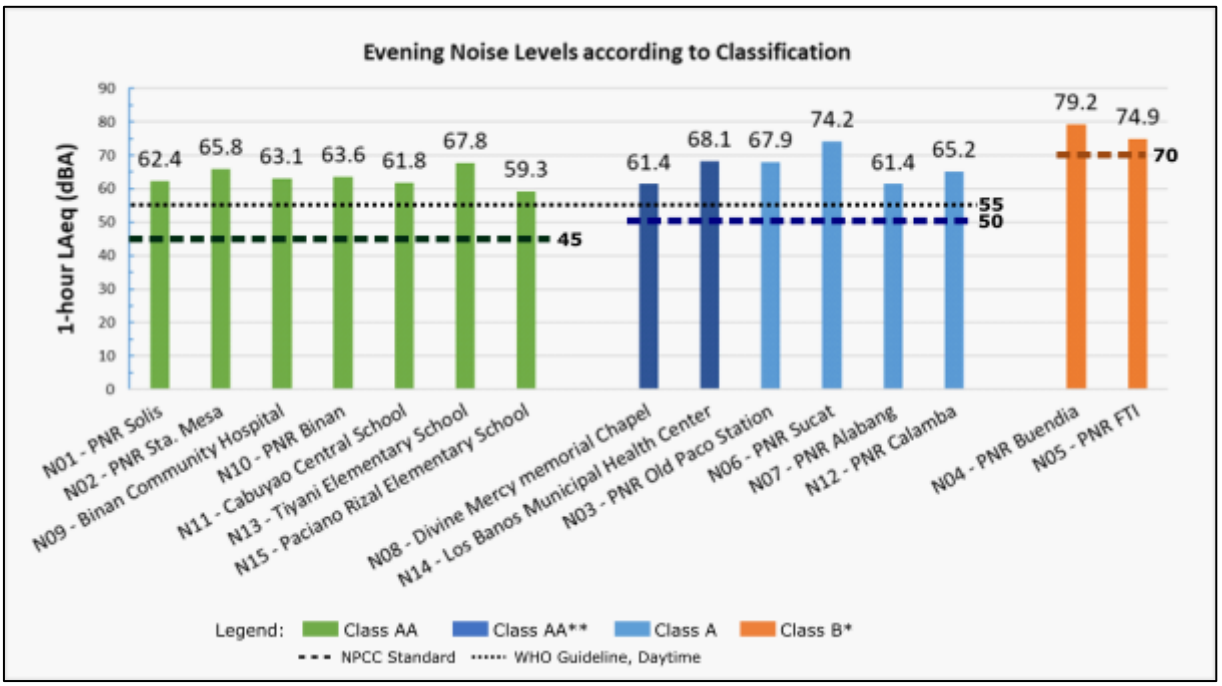


Figure 3.3.22 Evening Ambient Noise Levels According to NPCC Classification

Noise Levels during Nighttime

885. As shown in Figure 3.3.23 , noise levels in all stations exceeded the NPCC standards during the nighttime period. The highest noise level of 76.5 dBA was measured at station N04 – PNR Buendia while the lowest noise level of 58.3 dBA was measured at station N13 – Tiyani Elementary School. The nighttime period covers the time between 10:00 PM to 5:00 AM.

886. The noise levels in thirteen (13) stations categorized as Residential, Institutional and Educational exceeded the WHO guideline values of 45 dBA for nighttime, while the noise levels in two (2) stations categorized as Industrial/Commercial exceeded the WHO guideline values of 70 dBA for nighttime. It was also noted that station N14 – Los Baños Municipal Health Center exceeded the WHO standard for Industrial and Commercial category, even though it is categorized under Residential, Institutional and Educational Category.

The daytime period as set by WHO covers the time between 10:00 PM to 7:00 AM.

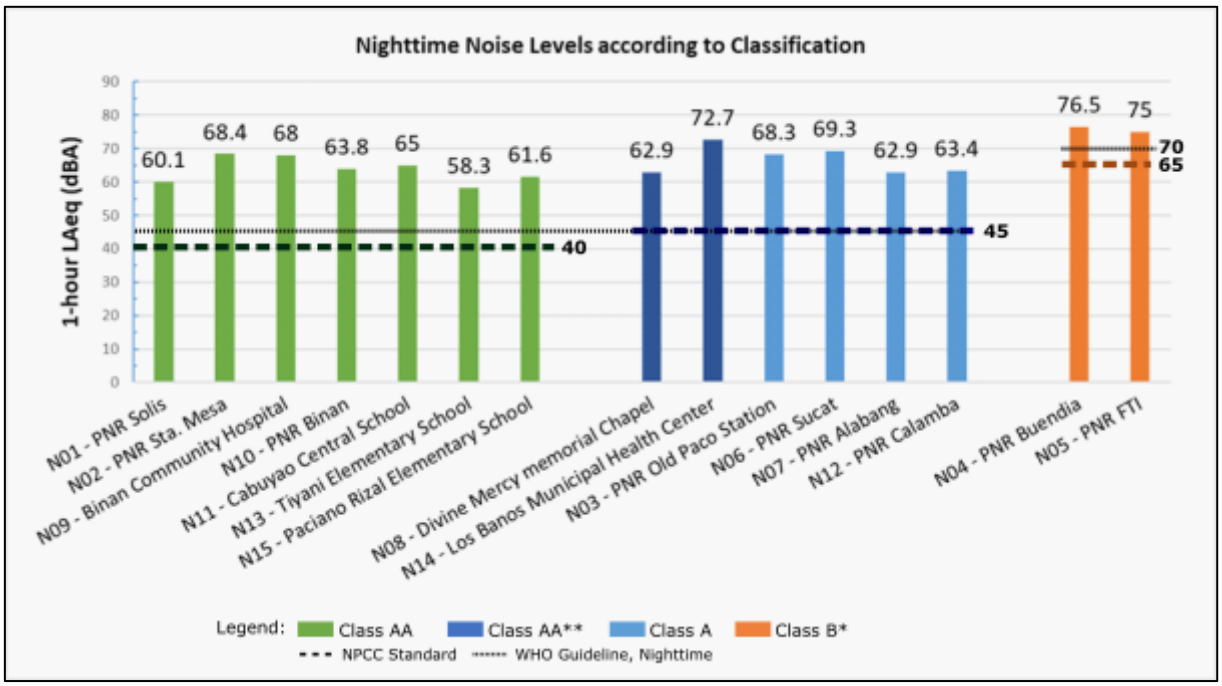


Figure 3.3.23 Nighttime Ambient Noise Levels According to NPCC Classification

3.3.3.2 Impact Identification, Prediction and Assessment, and Mitigation

(1) Pre-construction and Construction Phase

887. Ambient noise levels will definitely increase because of construction activities and operation of heavy equipment and machineries, the generator set, and noise from vehicles coming in and out of the Project site.

888. All the sampling sites surveyed under the Project shows that the noise level is already above the NPCC and WHO standards. However, it is important that the project activities do not worsen the existing condition.

889. Some areas along the NSRP alignment are near institutions that will definitely be affected by the noise generated during the pre-construction and construction phases of the Project. It is important to identify these institutions to be able to provide appropriate measures during the Detailed Design Phase of the Project.

890. Workers at construction sites and operators of noise-generating equipment are directly exposed to high noise levels.

1) Prediction method

891. The prediction model developed in the Technical Handbook for Environmental Impact Assessment of Roads (2007) is applied.

a. **Prediction model**

892. The noise level at receiving points is calculated by the following formula of sound propagation.

$$L_p = L_w + 10log\left\{\frac{Q}{4\pi r^2}\right\} = L_w - 20logr - 8$$

Where,L_p: Noise level at Receiving Point (dB)

L_w: Power Level of noise source (dB)

r: Distance between noise source and receiving point (m)

Q: Constant on sound radiation (in case of hemisphere radiation: =2)

b. Power level of construction machinery

The power levels of main construction machinery are shown in **Error! Not a valid bookmark self-reference.**

Table 3.3.17. Weighted Power Level of Construction Type

Construction Type	A weighted power level (dB)
Pile drivers (hydraulic pile hammer)	135
Rock drilling (soft rock)	119
Slope surface splay	108
Asphalt pavement	108

Source: Technical Handbook for Environmental Impact Assessment of Roads (2007)

c. Location of noise source and receiving point

893. The construction machinery, i.e., noise emission source is assumed to be set on the center of the track. During the construction, temporary walls (3.0 m) will be set at the edge of the ROW (construction limit). The height of the receiving point is 1.2 m.

2) Results of the prediction and evaluation

894. The results of the prediction of noise from the construction are shown in Error! Not a valid bookmark self-reference.. Without the temporary wall, the noise levels of pile driver will exceed the maximum allowable level at 90 dB. The predicted noise levels of rock drilling will exceed maximum allowable level of 85 dB up to 10 m from the edge of the ROW. In case of the slope surface spray and asphalt pavement, the predicted noise level will exceed just at the edge of the ROW.

895. With the 3 m high temporary wall, the predicted noise levels of all types of construction work will be below the maximum allowable noise levels during the construction. The noise levels will be further dampened as it propagates to greater distances.

Table 3.3.18 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	113.0	107.0	103.5	101.0	99.0	90	Class 1
Rock drilling (soft rock)	119	69.6	70.0	70.3	70.5	70.7	85	Class 2
Slope surface splay	108	62.5	62.5	62.5	62.4	62.4	75	Class 3
Asphalt pavement	108	63.4	63.4	63.4	63.4	63.4	75	Class 4
With temporary wall (3.0m)								
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 splay	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 in 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.

Source: JICA Study Team

3) Mitigation Measures

896. The unmitigated noise generated by the pile drivers is estimated to reach up to 99 dBA at 20 meters away from the edge of the ROW, impacting the areas near the vicinity of pile driving activities. Prediction showed that using a 3-meter temporary wall as a mitigating measure reduced the noise levels to 84.7 dBA, which is within acceptable levels during construction.

897. Further reduction of impacts brought about by pile drivers and other construction equipments may be obtained by the following mitigation measures:

- Locate noise-intensive sites as far as possible from the sensitive receptors including ecologically significant areas (if any) likely to be affected. Based on the predicted noise levels, pile driving activities will be located so that the nearest sensitive noise receivers are farther than at least 5 meters from the edge of ROW nearest to the activity.

- Plan construction activities considering the time and scale to minimize nuisance noise; for example, operation of pile drivers and other noisy equipment will be limited to daytime only.

- Undertake information dissemination to the public to raise the awareness to the impact of noise from the project activities and establish Grievance Redress Mechanism to handle any complaint if any.

- Provide noise control devices such as mufflers and noise suppressors to all construction equipment and machineries to help minimize noise they generate. Electric-powered equipment will be used as much as possible instead of diesel-powered equipment.

- Provide temporary noise barriers such as acoustic curtains, particularly in noise-sensitive areas such as churches, schools, and hospitals in the immediate vicinity of the construction area.

- Monitor noise levels at identified sampling points including 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 provide and modify as needed. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

898. Implementing the mitigation measures will ensure that the noise levels generated by construction equipments will be minimized to within acceptable levels. The extent will be reduced to areas within the sound barriers and will be limited to daytime periods only.

899. Construction of facilities and structures will expose workers, especially equipment and machine operators, directly to high noise levels generated by these equipment and machines while they are in operation. The following measures will mitigate the health impact of noise generated by construction equipment:

- Provide training on noise mitigation and provide appropriate PPE, e.g. earmuffs, to construction workers. A combination of earmuffs and earplugs, for example, can reduce noise by as much as 14.5 dBA.

- Duration of workers' exposure to noise will be reduced by effective shift rotation schemes. Standard practice limits workers' exposure to 90 dBA to 8 hours, reducing it by half for every 5 dBA increase in their noise level exposures.

- Provide clear and visible warning signs at areas where high noise levels are expected to occur.

- Medical check-ups among workers will be provided to ensure auditory health and to prevent hearing loss.

900. Implementation of these mitigating measures will ensure that the workers are properly protected from the impacts of exposure to high levels of noise during construction. Exposure magnitude will be reduced by appropriate PPEs, and duration of exposure will be reduced to acceptable working hours.

(2) Operation Phase

901. The noise by train operation was examined with reference to "Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan" and "EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 1999, Osaka Prefecture".

1) Prediction method

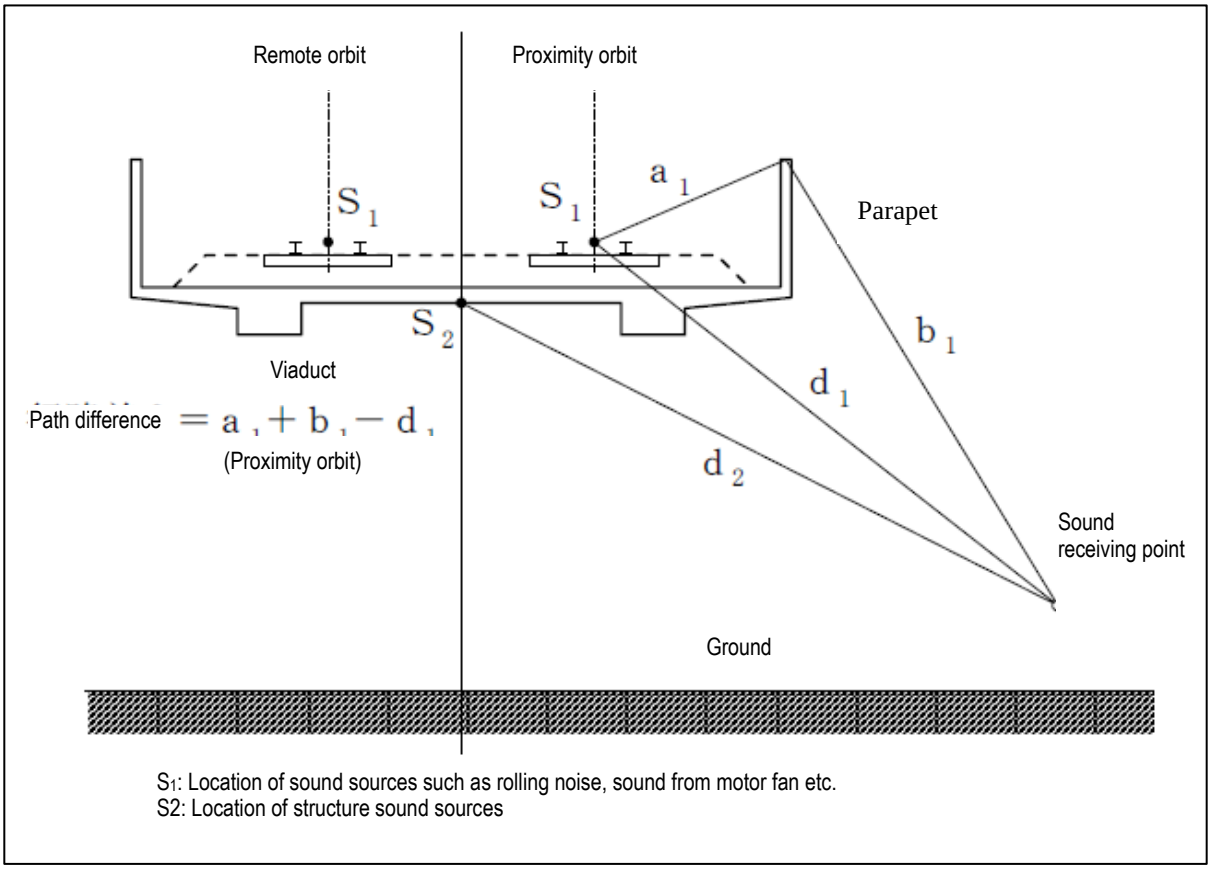
902. Based on section structure and train velocity, the maximum of the noise level at the time of the run of 1 train (L_{Amax}) is initially estimated. Moreover, single event sound exposure level (L_{AE}) is estimated from train transit time. Finally, equivalent continuous sound pressure level (L_{Aeq}) by train number every train type of time zone is calculated.

2) Prediction model

903. The prediction model by Japanese formula is applied. The noise by train operation compounds 3 main sound sources such as rolling noise of running train, structure sound from vibration of slab on concrete viaduct, and railway vehicle sound. The formula is calculated by combining these sound sources.

a. Estimation of maximum value of noise level (L_{Amax})

904. The prediction formula for train length *l* m and train velocity *V* km/h indicates Formula 1 - 4 by definition of each variable shown in **Figure 3.3.24**



Source: Proposal of a Prediction Model for Noise of Conventional Railway, Noise Control Engineering 20(3), 1996, Institute of Noise Control Engineering, Japan

Figure 3.3.24 Arrangement of Sound Source, Sound Receiving Point and Explanation of Path Difference

(a.1) Rolling noise

$$L_{Amax}(R) = PWL_R - 5 - 10log_{10}d_1 + 10log_{10}\left(\frac{\left(\frac{l}{2d_1}\right)}{1+\left(\frac{l}{2d_1}\right)^2} + \tan^{-1}\left(\frac{l}{2d_1}\right)\right) + \alpha_1 \quad --- \text{Fomula 1}$$

Where, $L_{Amax}(R)$: maximum value of noise level (decibel)
PWL_R : Sound source power level (decibel)
$PWL_R = 30.0 \log_{10}(V) + 42.6$
D_1 : Distance between center of run orbit and sound receiving point (m)
l : Train length (m)
V : Train velocity (km/h)
α_1 : damping effect by balustrade (decibel)

(a.2) Structure sound

$$L_{Amax}(C) = PWL_C - 5 - 10log_{10}d_2 + 10log_{10}\left(\frac{\left(\frac{l}{2d_2}\right)}{1+\left(\frac{l}{2d_2}\right)^2} + \tan^{-1}\left(\frac{l}{2d_2}\right)\right) + \Delta L_C \quad --- \text{Formula 2}$$

Where, $L_{Amax}(C)$: Maximum value of noise level (decibel)
PWL_C : Sound power level of structure sound (decibel)
$PWL_C = 72$
d_2 : Distance between center of structure underside and sound receiving point (m)
ΔL_C : Correction value
$r < 4h$: $\Delta L_C = 0$
$r > 4h$: $\Delta L_C = -10 \log_{10}(r/4h)$
r: Horizontal distance between center of viaduct and sound receiving point (m)
h: Height of viaduct underside from ground (m)

(a.3) Maximum value of noise level (L_{Amax})

905. The maximum value of noise level for one (1) train formation is calculated by combining noise levels calculated by Formula 1 - 2.

$$L_{Amax} = 10log_{10}\left(10^{\frac{L_{Amax}(R)}{10}} + 10^{\frac{L_{Amax}(C)}{10}}\right) --- \text{Formula 3}$$

906. Relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE})

907. The relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE}) is calculated by using Formula 4.

$$L_{AE} = L_{Amax} + 10log_{10}(l/(1000V/3600)) --- \text{Formula 4}$$

Calculation of equivalent continuous sound pressure level (LAeq)

$$L_{Aeq} = 10log_{10}\left(\frac{1}{T}\sum_{i=1}^{n} 10^{L_{AEi}/10}\right) --- \text{Formula 5}$$

Where, L_{AEi} : Single event sound exposure level by direction and train type (decibel)
N : Number of trains
T : Time for L_{Aeq} (second)

908. The maximum value of noise level for one (1) train formation is calculated by combining noise levels calculated by Formula 1 - 2.

$$L_{Amax} = 10log_{10}\left(10^{\frac{L_{Amax}(R)}{10}} + 10^{\frac{L_{Amax}(C)}{10}}\right) - - - \text{Formula 3}$$

909. Relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE})

910. The relation between estimation of maximum value of noise level (L_{Amax}) and single event sound exposure level (L_{AE}) is calculated by using Formula 4.

$$L_{AE} = L_{Amax} + 10log_{10}(l/(1000V/3600)) - - - \text{Formula 4}$$

Calculation of equivalent continuous sound pressure level (LAeq)

$$L_{Aeq} = 10log_{10}\left(\frac{1}{T}\sum_{i=1}^{n} 10^{L_{AEi}/10}\right) - - - \text{Formula 5}$$

Where, L_{AEi} : Single event sound exposure level by direction and train type (decibel)
N : Number of trains
T : Time for L_{Aeq} (second)

3) Predictive condition

a. Prediction points

The prediction points are 1.2 m height at 0, 10, 20, 30, 40, 50 m from the edge of railway.

b. Structural condition

The structural conditions are as follows:

- 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)

c. Operation condition

911. The number of operated trains is shown in Table 3.3.19 based on the train operation condition. The train velocity is maximum 120 km/h.

Table 3.3.19 Total Number of Operated Trains (one-way)

Day Time (7:00 ~ 22:00)	Night Time (22:00 ~ 24:00 & 6:00 ~ 7:00)	Total
150	55	205

Source: JICA Study Team

4) Prediction results

912. The results of prediction on railway noise of the equivalent continuous sound pressure level (LAeq) (dBA) are shown on the following tables.

913. The guideline values are set at the distance of 12.5 m from the center of the nearest track. The predicted noise levels caused by the train operation cannot be directly compared to the DENR environmental standards for noise. WHO is used instead as reference.

914. The outline of results shows that the predicted noise levels will exceed the guideline values for all day and night even at the edge of the ROW. Noise barrier is one of the abatement measures to reduce the noise level. Table 3.3.20 shows the predicted noise level at different heights of noise barrier.

Table 3.3.20 Prediction of Noise Level During Train Operation

Mitigation measures	Day/ Night	Distance from ROW						Guideline values[1] (LAeq)	WHO Guidelines [2]	
		0 m	10 m	20 m	30 m	40 m	50 m		RIE	IC
Barrier H=1.1 m	Day	58.1	58.6	58.3	59.0	59.5	59.0	60	55	70
	Night	56.0	56.5	56.2	56.9	57.3	56.8	55	45	70
Barrier H=1.5 m	Day	57.8	58.1	58.1	58.1	57.8	57.7	60	55	70
	Night	55.7	55.9	56.0	55.9	55.7	55.5	55	45	70
Barrier H=2.0 m	Day	57.6	57.1	57.1	56.6	55.7	55.5	60	55	70
	Night	55.4	55.0	55.0	54.4	53.6	53.4	55	45	70

Note:
1 Noise guideline values for the new project and large-scale modification of the conventional railway in Japan Environmental Agency, 1995)
2 RIE – Residential, Institutional, Educational; IC – Industrial, Commercial
Source: JICA Study Team

The following findings are drawn from the resulting data:

- In order to decrease the noise level below 50 dBA during the night, (5dBA less than the guideline value of 55dBA during the night because the allowable level of noise sensitive area is often set at 5dBA below), the effective height of noise barrier is considered.

- Based on the optimization of train operation, at 1 m height noise barrier or parapet installed, the noise level during the night is under 50 dBA for the year 2020. Noise level generated by the train operation for years 2025 to 2040 still exceeds 50 dBA during the night operation, at distances from 0m to 30 m, due to the increase of trains.

- With a 2 m height noise barrier installed, the noise level for years 2020 to 2040 is way below 50 dBA.

915. The predicted noise levels satisfy the noise guideline values for the areas directly facing the railway. However, according to the guidelines, noise level will be further reduced in the noise sensitive areas. The adequate measurements are recommended for noise sensitive receptors of Class AA within 50m of the alignment.

916. The impact to the noise sensitive receptors within 50 m distance from the alignment is also examined as shown in **Error! Not a valid bookmark self-reference.**. The noise level shows that with 2 m height noise barrier will meet Japanese standard, however, it does not conform with the NPCC and WHO standards. It is highly recommended that with the appropriate height of noise barrier, additional mitigation measures will be provided.

Table 3.3.21. Prediction of Noise Level at Sensitive Receptors During Train Operation

No.	Critical Structures	Approx. Distance from Alignment centerline (meters)	Noise from train with 2.0m H barrier dBA	Japanese Standard (1)	NPCC standard Night time (10 pm- 5 am) dBA	WHO Standard
City of Manila, NCR						
1	Trinity Baptist Church	10	55.0	55	40 (AA)	45
2	Manuel L. Quezon High School	50	53.4	55	40 (AA)	45
3	Maria Clara Health Center	15	55.0	55	40 (AA)	45
4	Barangay Hall 483, Zone	10	55.0	55	40 (AA)	45
5	Kingdom Light Congretation Hall	20	55.0	55	40 (AA)	45
6	Grotto sa Antipolo Church	40	53.6	55	40 (AA)	45
7	First Core Medical Clinic	50	53.4	55	40 (AA)	45
8	Benco Bldg. Medium-rise Residential	5	55.2	55	45 (A)	45
9	MPD Sampaloc Police Station (PS-4)	0	55.4	55	40 (AA)	45
10	Dr. Benigno Aldana Elementary School	35	54.0	55	40 (AA)	45
11	Iglesia ni Cristo Church, G. Tuazon	50	53.4	55	40 (AA)	45
12	Iglesia ni Cristo, Sampaloc	50	53.4	55	40 (AA)	45
13	Brgy Hall 428, Zone 43	0	55.4	55	40 (AA)	45
14	Brgy Hall Structure, Sta. Mesa	5	55.2	55	40 (AA)	45
15	Polytechnic University of the Philippines - Institute of Science and Technology	10	55.0	55	40 (AA)	45
16	Brgy Hall 630, Zone 63	15	55.0	55	40 (AA)	45
17	Concordia College	15	55.0	55	40 (AA)	45
18	S.A.P.A.R.I. Tenement Housing Structures	10	55.0	55	45 (A)	45
19	Pedro Gil High School	30	54.4	55	40 (AA)	45
20	San Antonio Health Center	10	55.0	55	40 (AA)	45
21	St. Claires College of Nursing	10	55.0	55	40 (AA)	45
22	San Antonio National High School	10	55.0	55	40 (AA)	45
City of Makati, NCR						
23	The Linear Buildings, Makati	20	55.0	55	45 (A)	45
24	Cityland Bldgs. Pasong Tamo	20	55.0	55	45 (A)	45
25	Yulo Plaza	15	55.0	55	45 (A)	45
26	PDIC Warehouse	15	55.0	55	40 (AA)	45
27	Makati Hope Christian School	20	55.0	55	40 (AA)	45
28	Manila Contemporary Art Gallery	20	55.0	55	40 (AA)	45
29	Church of Nazarene	30	54.4	55	40 (AA)	45
30	Jesus is Lord Church	30	54.4	55	40 (AA)	45
31	Jehova's Witness Kingdom Hall Church	30	54.4	55	40 (AA)	45
City of Taguig, NCR						
32	Village Baptist Church	25	54.7	55	40 (AA)	45
33	PNCC Government Bldgs., Bicutan	15	55.0	55	40 (AA)	45
34	NDH / San Isidro Labrador Chapel	40	53.6	55	40 (AA)	45
35	Mababang Paaralan ng Sucat	50	53.4	55	40 (AA)	45
36	UCCP Sucat Evangelical Church	10	55.0	55	40 (AA)	45
City of Muntinlupa, NCR						
37	Escalades South Metro - Robinsons Development (Tower 3-4)	30	54.4	55	45 (A)	45
38	Muntinlupa Business School	15	55.0	55	40 (AA)	45
39	St. Bernadette College	40	53.6	55	40 (AA)	45
40	Kalintong Mosque	30	54.4	55	40 (AA)	45
41	IEMELIF Church	30	54.4	55	40 (AA)	45
42	DepEd ALS Center	10	55.0	55	40 (AA)	45
43	Parokya ni Maria Ina ng Dyos	15	55.0	55	40 (AA)	45

No.	Critical Structures	Approx. Distance from Alignment centerline (meters)	Noise from train with 2.0m H barrier dBA	Japanese Standard (1)	NPCC standard Night time (10 pm- 5 am) dBA	WHO Standard
44	Church of Jesus Christ of Latter-Day Saints	15	55.0	55	40 (AA)	45
45	Christ the King, College of Science and Technology	15	55.0	55	40 (AA)	45
46	Muntinlupa Institute of Technology	20	55.0	55	40 (AA)	45
47	Muntinlupa National High School	15	55.0	55	40 (AA)	45
48	Santo Niño School of Muntinlupa	20	55.0	55	40 (AA)	45
49	El Rancho Hotel	10	55.0	55	45 (A)	45
50	Rhema Full Gospel Church Inc.	15	55.0	55	40 (AA)	45
51	MCGI Church (Dating Daan) Tunasan	10	55.0	55	40 (AA)	45
52	Faithful Jesus Church	10	55.0	55	40 (AA)	45
53	Divine Mercy Viewing Chapel	15	55.0	55	40 (AA)	45
City of San Pedro, Laguna						
54	San Vicente Elementary School	30	54.4	55	40 (AA)	45
55	Little Explorer Montessori School	40	53.6	55	40 (AA)	45
56	Church of Jesus of Latter-day Saints	45	53.5	55	40 (AA)	45
City of Biñan Laguna						
57	Biñan Community Hospital	20	55.0	55	40 (AA)	45
58	University of Perpetual Health	15	55.0	55	40 (AA)	45
59	Heaven's Park - Memorial Garden	25	54.7	55	40 (AA)	45
60	Springtime County Learning Center	15	55.0	55	40 (AA)	45
61	Santa Rosa Mutli-purpose Arena	30	54.4	55	40 (AA)	45
62	Santa Rosa Arena Proposed Parking Area	30	54.4	55	40 (AA)	45
63	Bueno Perlas Subdivision Row-houses	15	55.0	55	45 (A)	45
64	West Drive Subdivision	30	54.4	55	45 (A)	45
65	Grace in Christ Baptist Church	30	54.4	55	40 (AA)	45
City of Cabuyao, Laguna						
66	Sta. Rosa Homes Subdivision Row-houses	15	55.0	55	45 (A)	45
67	Cabuyao Central School Complex	15	55.0	55	40 (AA)	45
68	Jesus is Lord Church	50	53.4	55	40 (AA)	45
69	MCGI Church	25	54.7	55	40 (AA)	45
70	Pamantasan ng Cabuyao	40	53.6	55	40 (AA)	45
City of Calamba, Laguna						
71	PMMC Maranatha Christian Academy	25	54.7	55	40 (AA)	45
72	Sun Miles Condo	40	53.6	55	45 (A)	45
73	STI College, Calamba	30	54.4	55	40 (AA)	45
74	Halang Elementary School	20	55.0	55	40 (AA)	45
75	DepEd Bldgs.	20	55.0	55	40 (AA)	45
76	Cannosa Academy	50	53.4	55	40 (AA)	45
77	Collegio de San Juan de Letran, Calamba	20	55.0	55	40 (AA)	45
78	Bucal Elementary School	20	55.0	55	40 (AA)	45
79	E. Baretto Sr. Elementary School	35	54.0	55	40 (AA)	45
80	Tiyani Elementary School	15	55.0	55	40 (AA)	45
81	United Church of Christ	20	55.0	55	40 (AA)	45
82	Boy Scouts of the Philippines	40	53.6	55	40 (AA)	45
83	Morning Star Montessori	10	55.0	55	40 (AA)	45
84	Los Baños Central E.S.	40	53.6	55	40 (AA)	45
85	Immaculate Conception Church	20	55.0	55	40 (AA)	45
86	TESDA	40	53.6	55	40 (AA)	45
Municipality of Los Baños Laguna						
87	Kingdom Hall Jehovah's Witness	25	54.7	55	40 (AA)	45
88	Los Baños Municipal Health Center	25	54.7	55	40 (AA)	45

Note 1) noise guideline values for the new project and large-scale modification of the conventional railway in Japan (Environmental Agency, 1995)

5) Mitigation Measures

917. Without the train operation, the baseline noise levels observed range from 57.9 to 79.2 dBA. The generated noise of the train operations based on prediction model will create additional noise of at range 56.0 to 58.1 dBA at the centerline of the alignment when a 1.1-meter barrier is constructed. Using the dBA 'Addition Rule'[21], the expected noise levels will then be at the range of 60.9 to 79.2 dBA. With the construction of a 2-meter barrier, the predicted additional noise will be 55.4 to 57.6 dBA, and the expected noise levels will be 59.9 dBA to 79.2 dBA. It means that the mitigating measure of creating noise barriers will have minimal effect on the existing baseline noise levels, since the higher baseline noise levels effectively mask the noise created by the train operations. The impacts of the train operation will also be limited to the operating hours of the NSRP.

918. On the other hand, for the operation of the NSRP, it is expected that traffic volume will be reduced. A 50% reduction of the traffic volume may theoretically result in a 3 dB reduction in noise levels, regardless of the absolute number of vehicles, while 10% reduction in traffic volume will decrease noise by 0.5 dB.

919. Based on the results of predicted noise levels, mitigation and enhancement measures are as follows:

- Use of long rails and ballast-less track with elastic and absorbent sleeper supports to minimize noise generation from train operation;
- Optimization of the number of train operation at night time to reduce generated noise;
- Provision of effective height of noise barriers ideally site specific, especially at 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;
- Monitoring of noise levels at identified sampling points including 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 provide if complaints regarding noise from train operations arise. Monitor actions on complaints, if any, based on Grievance Redress Mechanism.

3.3.4 Vibration

920. Vibration introduced by a Rail Transport System is composed of the vibration energy transmitted through the supporting structure under the tracks and into the ground. Once the vibration gets into the ground, it propagates through the various soil and rock strata, creating a path into the nearby buildings and facilities. The level of vibration is reduced by distance from the source, according to the local geological conditions. Relevant receptors can be the vibration-sensitive buildings (e.g., residences, hospitals, or schools). Vibrations at high levels may cause perceptible shaking of the structures and create disturbing sound inside the rooms. Vibration sensitive instruments (microscopes, medical test instruments, radio transmission facilities, etc.) can be adversely affected if these are located within a short distance (e.g., a few tens of meters) away from the rail tracks.

921. The tolerance of humans to vibration is wide ranged, since people have become accustomed to the large movements while riding vehicles in motion. Many people have even learned to take a rest and sleep even while inside moving and vibrating cars, trains and airplanes. As such, people have therefore adjusted to various levels of vibration and their tolerance level have also become variable, being sensitive during

[21] https://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/polguide/polguide02.cfm. Retrieved May 25, 2018.

nighttime and while at home or in buildings, and very insensitive while inside moving vehicles and when awake or during daytime. Therefore, not all receivers have the same vibration-sensitivity. People outdoors are usually very tolerant to vibration, while those indoors are annoyed when vibration is perceptible and sustained, or when these suddenly occur while at rest.

922. The Philippines does not have any environmental criteria for vibration. This report uses as reference the vibration standards for environmental assessment in Britain which describe vibration criteria for various types of receivers. Ground borne vibration can be described in terms of displacement, velocity, or acceleration. In evaluating impacts from this transit Project, we consider the adverse levels of vibration according to certain levels that can cause damage to buildings and, therefore, as compared to seismic/earthquake shaking. The levels of vibration that disrupt sensitive receptors (equipment, structures) and can cause annoyance to humans inside buildings are also used as criteria in this report.

3.3.4.1 Ambient Vibration Level

(1) Field Survey

923. Vibration study for the proposed NSRP was conducted on February 22 - March 3, 2018. Vibration levels were measured at fifteen (15) sampling stations established along the proposed NSRP alignment. The sites varied from residential areas to vacant areas near the roads in urbanized areas. The descriptions of the sampling stations and the schedule of sampling are presented in Table 3.3.22 and Figure 3.3.25.

924. The approach used in the vibration study follows the prescription of the British Standard 7385 (1993). The Philippines' EMB has not defined any vibration standards or procedures of investigation in the Philippines.

925. At each site, 24-hour sampling was undertaken where vibration was recorded using Vibron Seismometer which is a seismic data recorder connected to geophones. Three (3) sets of vertical sensors and three (3) additional sets of triaxial sensors created the four (4) sets of sensors that are spread one (1) meter apart around each observation area. The uniaxial sensors have a natural frequency of 4.5 Hz and a sampling frequency of 147 samples per second. Each seismic sensor was deployed in pre-identified sites, on grade of concrete or asphalt pavement or on barren surface road side or grounds of the facility.

Table 3.3.22 Vibration Monitoring Stations

Station ID	Description	Coordinates		Date of Sampling
V01	Solis Station	14°37'37.35"N	120°58'32.27"E	March 2-3, 2018
V02	PNR - Sta. Mesa	14°36'1.48"N	121° 0'38.39"E	March 1-2, 2018
V03	Old Paco Station	14°34'43.86"N	120°59'56.76"E	March 1-2, 2018
V04	Sta. Mesa Station	14°33'24.27"N	121° 0'30.35"E	February 27-28, 2018
V05	PNR - FTI	14°30'24.02"N	121° 2'7.74"E	February 27-28, 2018
V06	Sucat Station	14°27'8.64"N	121° 3'3.07"E	February 26-27, 2018
V07	Paco Station	14°25'0.91"N	121° 2'51.23"E	February 26-27, 2018
V08	Divine Mercy Viewing Chapel	14°22'15.09"N	121° 3'1.35"E	February 25-26, 2018
V09	Biñan Community Hospital	14°20'13.14"N	121° 4'27.12"E	February 25-26, 2018
V10	Buendia Station	14°19'53.90"N	121° 4'50.70"E	February 24-25, 2018
V11	Cabuyao Central School Complex	14°16'36.96"N	121° 7'37.63"E	February 24-25, 2018
V12	PNR - Calamba	14°12'25.69"N	121° 9'28.80"E	February 23-24, 2018
V13	FTI Station	14°10'43.87"N	121°11'58.96"E	February 23-24, 2018
V14	Los Baños Municipal Health Center	14°10'53.12"N	121°13'35.37"E	February 22-23, 2018
V15	Paciano Rizal Elementary Schoo	14° 8'59.04"N	121°16'5.29"E	February 22-23, 218

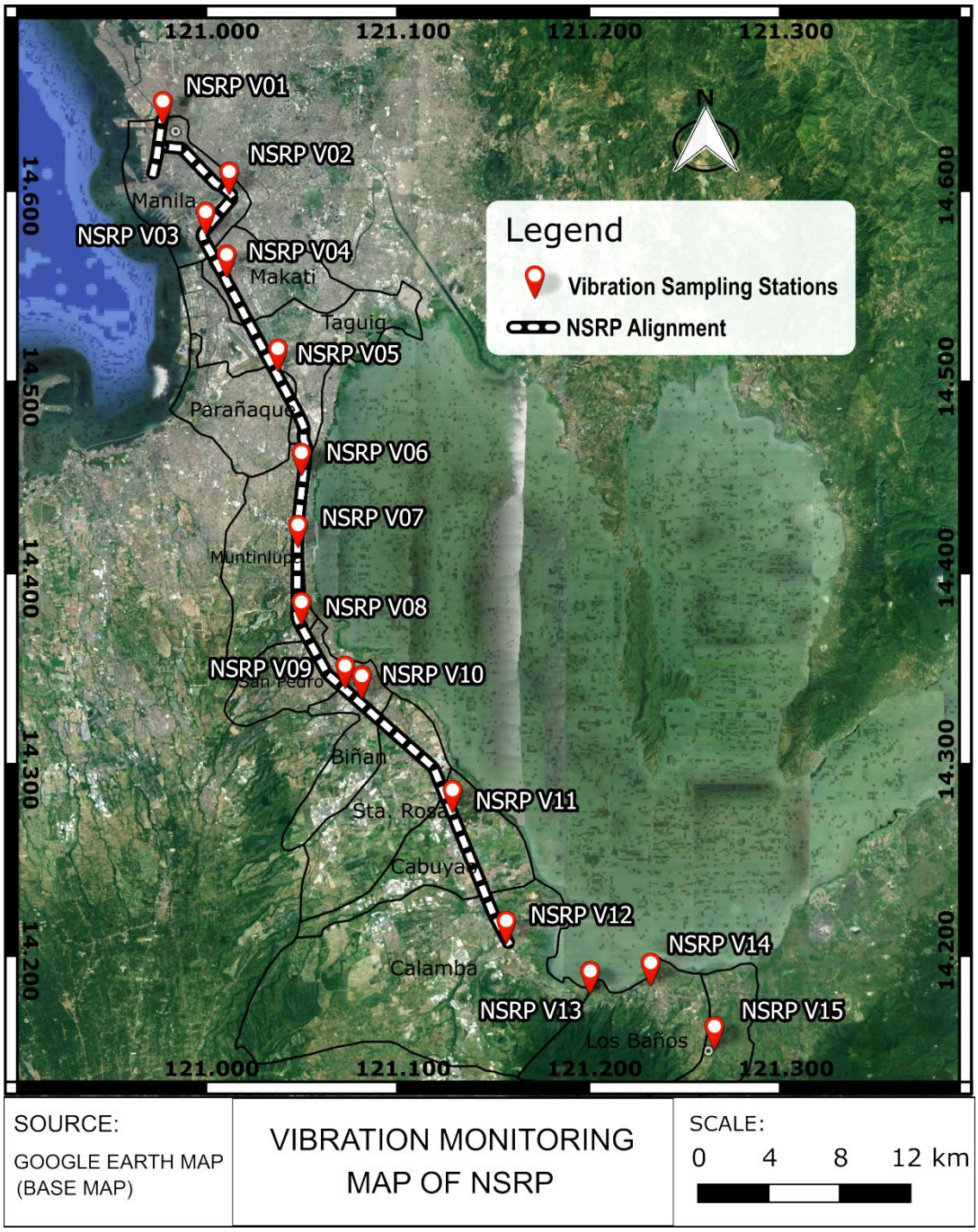


Figure 3.3.25 Vibration Sampling Station Map

(2) Applied standard

926. **Table 3.3.23** presents the effects of vibration levels in terms of human perception and disturbance. Vibration levels were compared to the threshold of tolerance set at 10 mm/s.

Table 3.3.23 Guidance on Effects of Vibration Levels

Vibration Level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.

Vibration Level	Effect
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

Source: BS 5228-2:2009 (BSI British Standards: Code of practice for noise and vibration control on construction and open sites)

(3) Results and Analysis

927. Observations of vibration at the areas along the proposed NSRP indicate that sites vary in levels of vibration from a low of 0.20 mm/s to a high of 31.5 mm/s. 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 walking pedestrians appear to dominate the cause of high levels of vibration. At these areas, the range of vibration levels may reach beyond 10 mm/s which may be considered unpleasant by people when subjected to continuous vibration. The site with lowest level of vibration is in Divine Mercy Chapel, where vibration levels range only between 0.20 mm/s to 3.50 mm/s.

928. Significant spikes in vibration levels reaching beyond 20 mm/s are notably observed in Tiyani Elementary School. Here, vibration level spiked to 32.0 mm/s corresponding to vibrations caused by trolleys along the old PNR railway. Nocturnal activity of animals like cats wandering around the instrument also caused some vibrations. In all sites, the source of impulsive and short duration vibration is likely the passing of PNR trains, pedestrians, and vehicular traffic.

929. 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.

930. The summary of observed peak values for velocities (mm/s) is shown in Table 3.3.24 while Table 3.3.25 shows the average vibration velocity (mm/s) for each of the stations during certain periods of the day.

Table 3.3.24 Summary Peak Velocity (mm/s) for Each Station

Sampling Stations	Recorded Peak Velocity (mm/s)	Peak Time (Velocity & Vibration)	Tolerable 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

Table 3.3.25 Summary of Average Vibration (in mm/s) for Each Station

Sampling Stations		Vibration Level (mm/s)			
		Morning	Day	Evening	Night
		(5 am – 9 am)	(9 am – 6 pm)	(6 pm – 10 pm)	(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

V01 Solis PNR Station

931. The Solis PNR observation site was located in a residential area and PNR railway is not operational in this site. The minimum background vibration is 2.2 mm/s and most vibrations are caused by small road vehicles and pedestrians (**Figure 3.3.26**). The background vibration peak level is at 5.5 mm/s in which vibrations are annoying to people in buildings. The recorded peak velocity for this station is 6.7 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents.

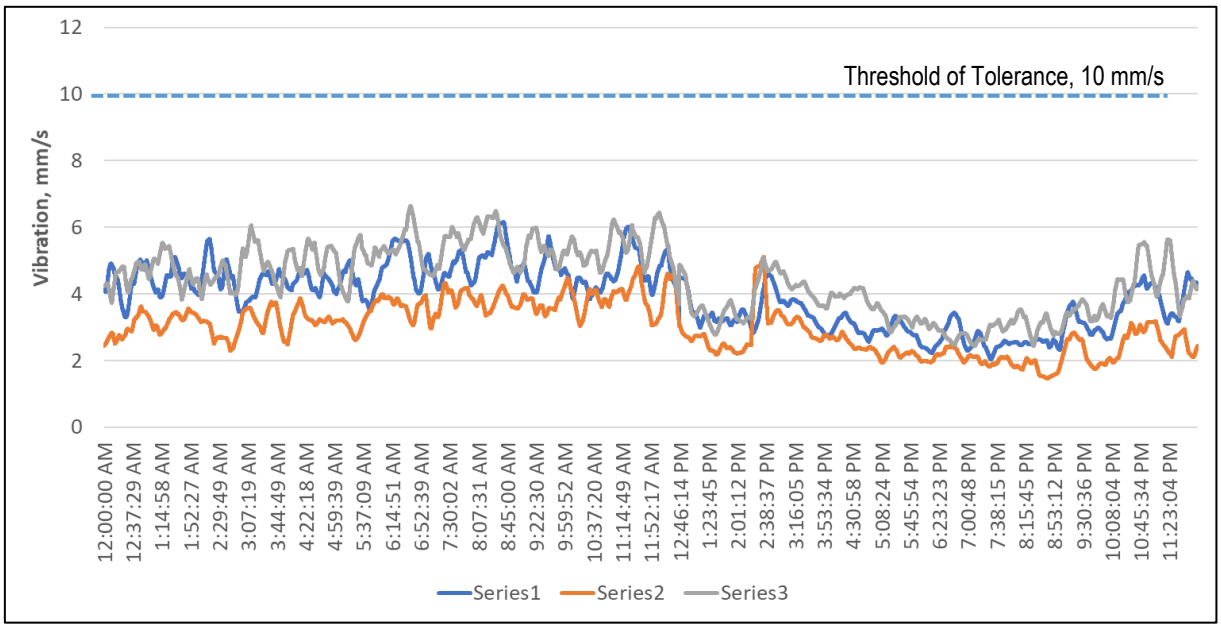


Figure 3.3.26 Solis PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V02 Sta. Mesa PNR Station

932. The Sta. Mesa PNR observation site is located in a residential area and near a university. This is one of the busiest stations of the PNR railway system. The minimum background vibration is 3.0 mm/s and the peaks in vibration are caused by the arrivals and departures of the PNR train (**Figure 3.3.27**). The background vibration peak level is at 9.0 mm/s in which vibrations are annoying to people in buildings. The recorded peak velocity for this station is 14.9 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

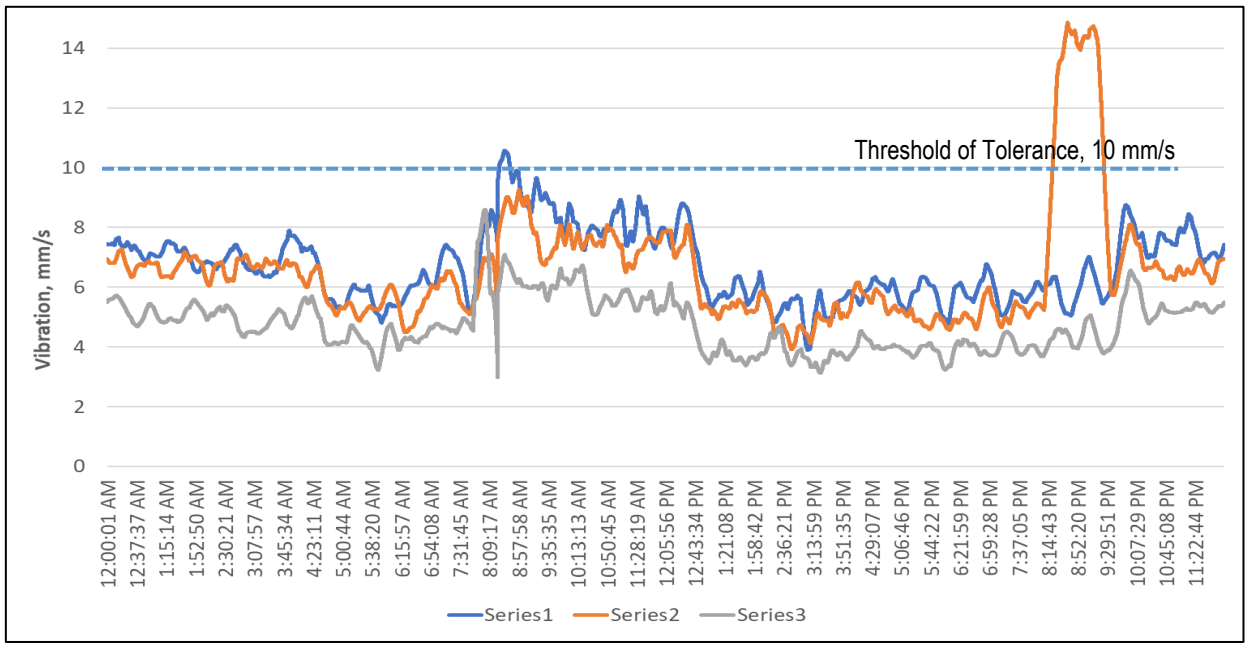


Figure 3.3.27 Sta. Mesa PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V03 Paco PNR Station

933. The Paco PNR observation site is located near a busy highway and the PNR railway in this site is operational. The minimum background vibration is 2.5 mm/s and most vibrations are caused by arrivals and departures of the PNR train (Figure 3.3.28). The background vibration peak level is at 5.5 mm/s in which can be annoying to people in buildings. The recorded peak velocity for this station is 6.7 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents.

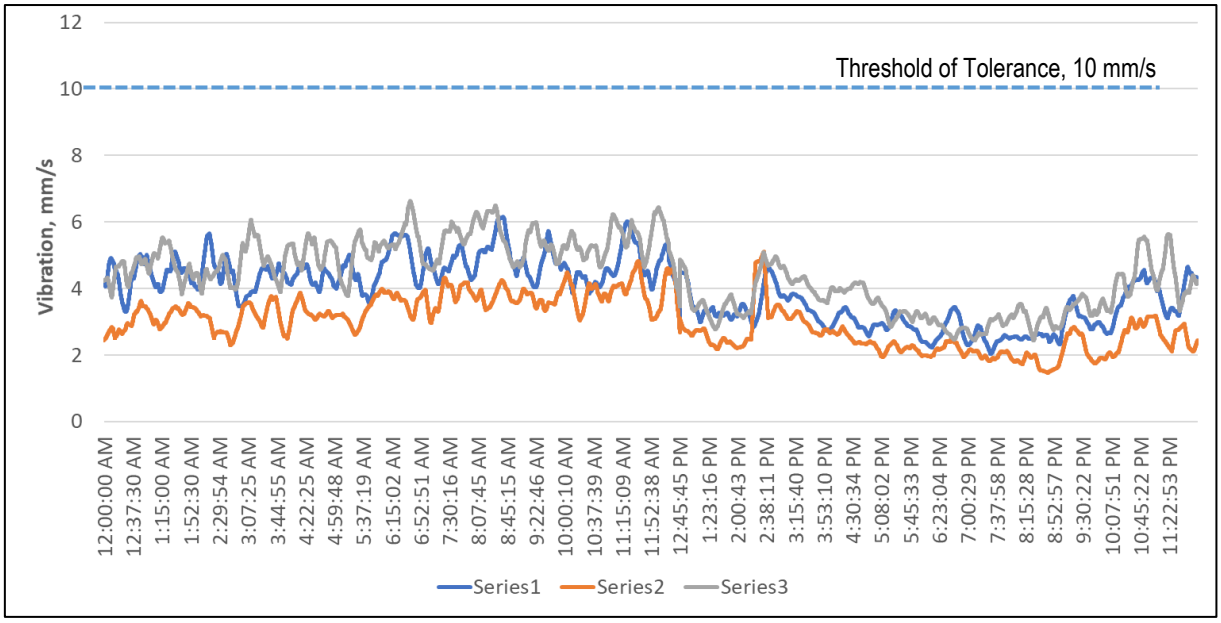


Figure 3.3.28 Paco PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V04 Buendia PNR Station

934. The Buendia PNR observation site is located near a major expressway and the PNR railroad passing by this site is operational. The minimum background vibration is 6.5 mm/s and most vibrations are caused by the arrivals and departures of the PNR train as can be gleaned from Figure 3.3.29 . The background vibration peak level is at 9.0 mm/s in which vibrations are annoying to people in buildings. The recorded peak velocity for this station is 8.2 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is also close to threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

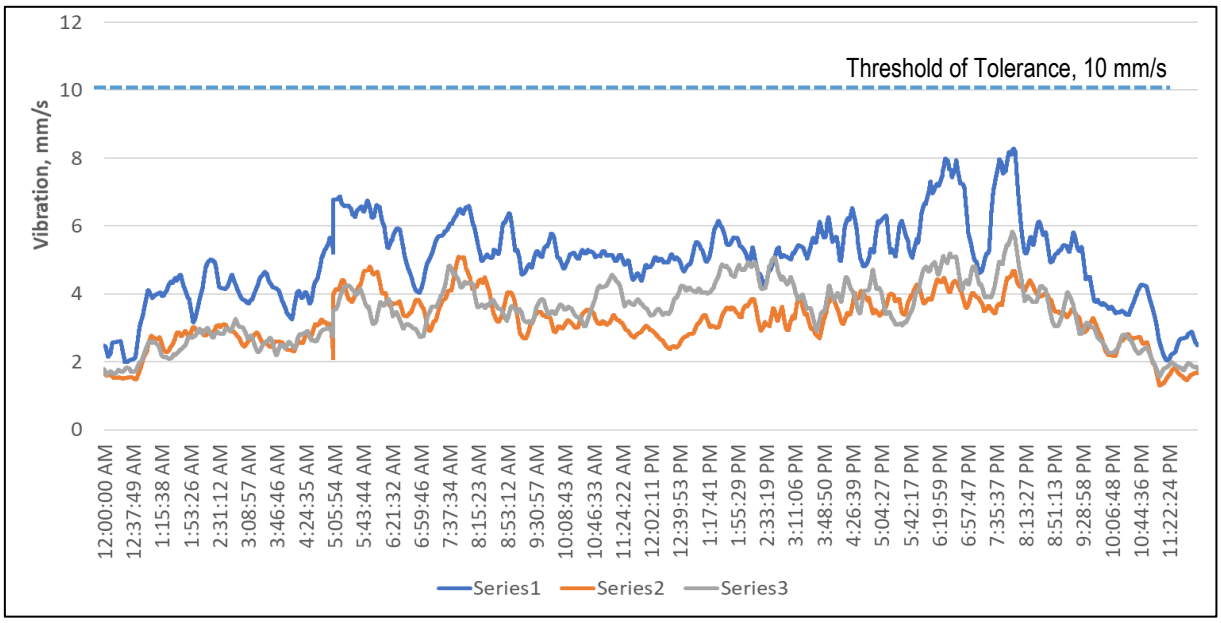


Figure 3.3.29 Buendia PNR Site Vibration Peak Level in mm/s at 4.5Hz.

V05 FTI PNR Station

935. The FTI PNR observation site is located near a major expressway and near the Sucat PNR railway station which is operational. The minimum background vibration is 6.5 mm/s and most vibrations are caused by arrivals and departures of the PNR train (Figure 3.3.30). The background vibration peaks at 9.0 mm/s which can be annoying to people in buildings. The recorded peak velocity for this station is 9.5 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is also close to threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

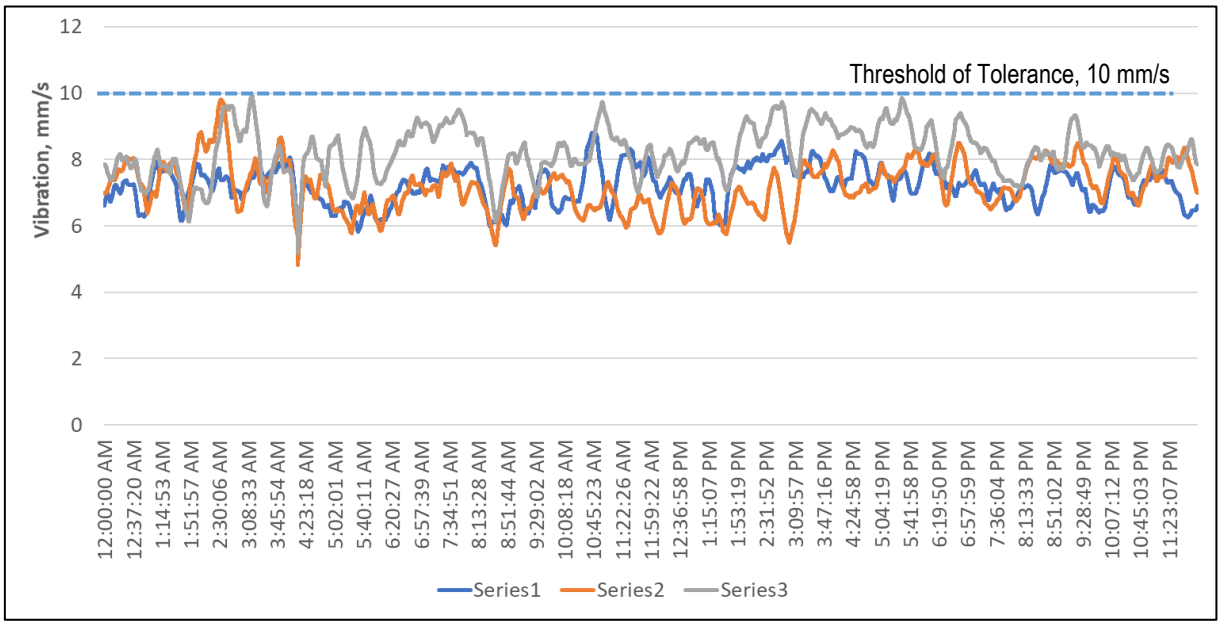


Figure 3.3.30 FTI PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V06 Sucat Station

936. The Sucat PNR observation site is located in a residential area and the PNR railway in this site is operational. The minimum background vibration is 4.5 mm/s and most vibrations are caused by the arrival and departure of the PNR train (Figure 3.3.31). The background vibration peak level is at 7.5 mm/s, a level which can be annoying to people in buildings. The recorded peak velocity for this station is 8.8 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is also close to threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

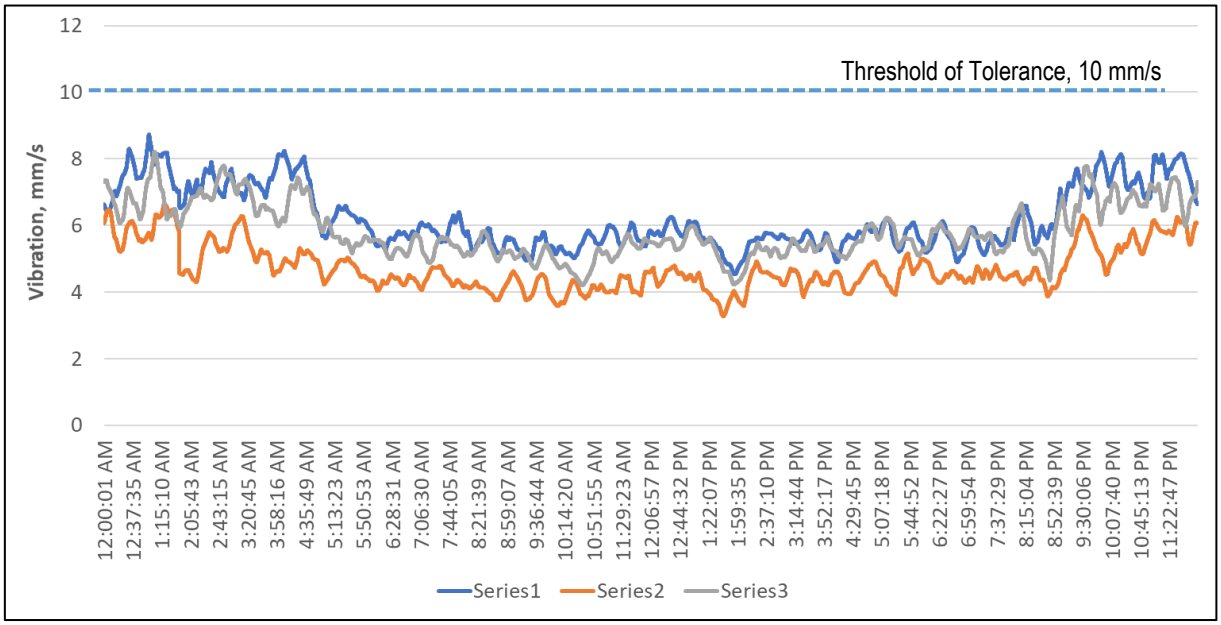


Figure 3.3.31 Sucat PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V07 Alabang PNR Station

937. The Alabang PNR observation site is located near a mall parking area. The nearby PNR railway station in this site is also operational. The minimum background vibration is 6.0 mm/s and most vibrations are caused by the arrival and departure of the PNR train (Figure 3.3.32.). The background vibration peak level is at 11.0 mm/s. The recorded peak velocity for this station is 11.9 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

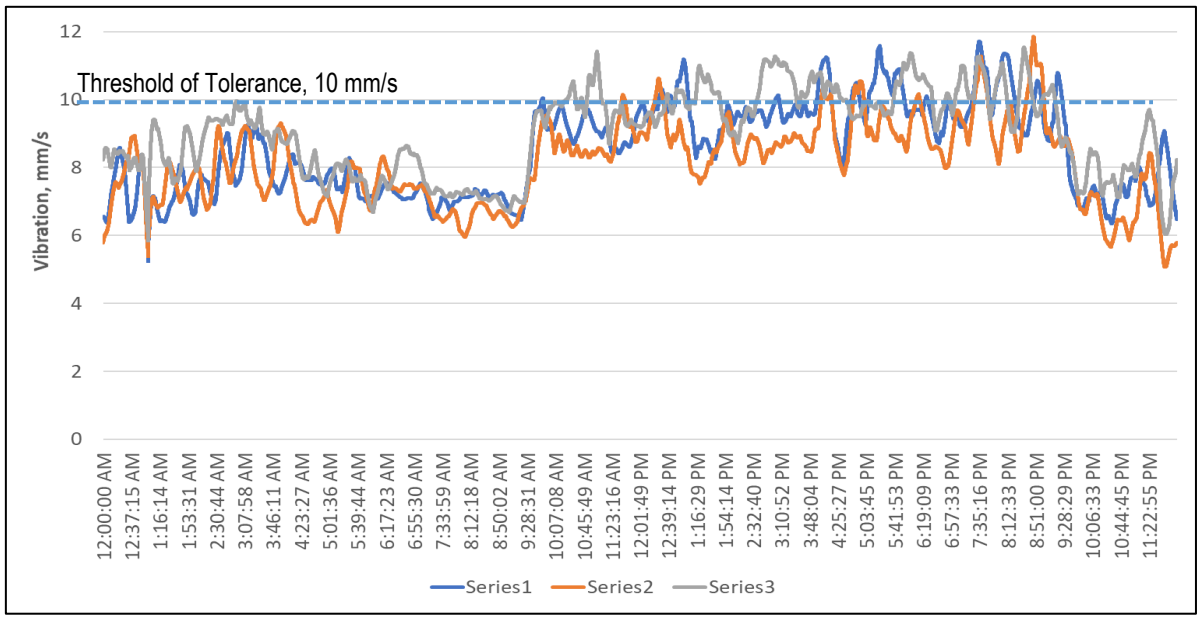


Figure 3.3.32. Alabang PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V08 Divine Mercy Viewing Chapel

938. The Divine Mercy Viewing Chapel observation site is located at a residential area near an LTO vehicle impounding area. Most of the vibrations observed are caused by pedestrians and the PNR train passing by. The minimum background vibration is at 0.0 mm/s and has a peak background vibration level at 3.5 mm/s. (Figure 3.3.33). The recorded peak velocity for this station is 7.9 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents.

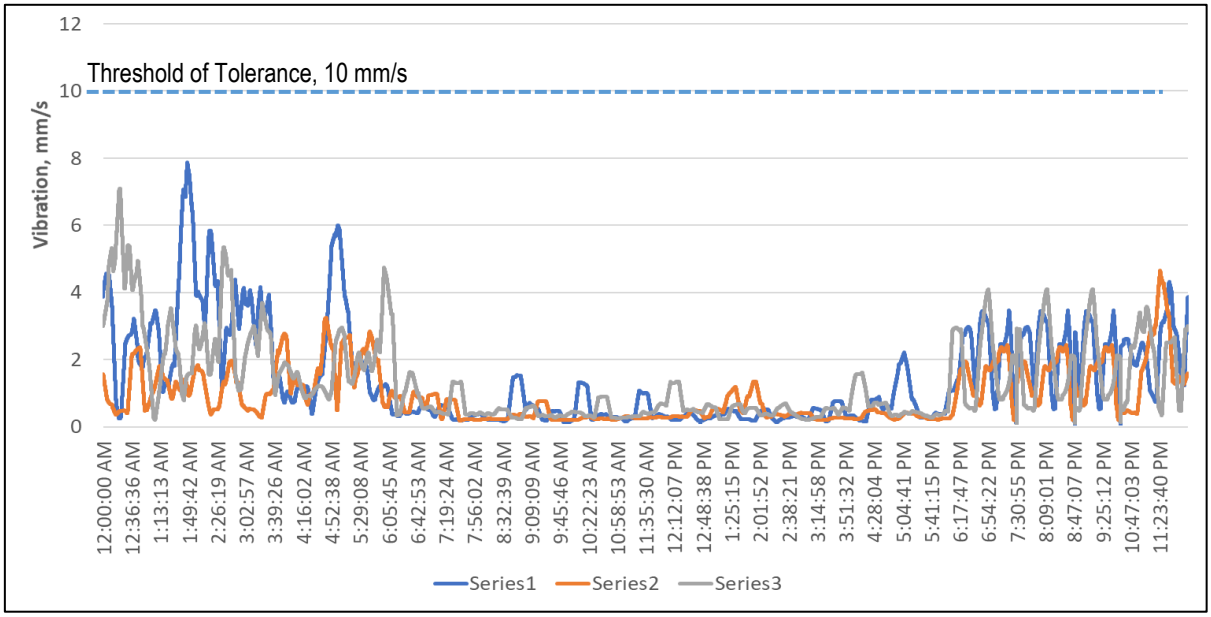


Figure 3.3.33 Divine Mercy Viewing Chapel Site Peak Vibration Level in mm/s at 4.5Hz.

V09 Biñan Hospital

939. The Biñan Hospital observation site is located at a residential area inside the Community Hospital. Most of the vibrations are caused by pedestrians, small vehicles and the PNR train passing by. The minimum background vibration is at 7.0 mm/s and peaks at 11 mm/s, as shown in Figure 3.3.34 This level is considered unpleasant by people subjected to continuous vibrations. The recorded peak velocity for this station is 11.6 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

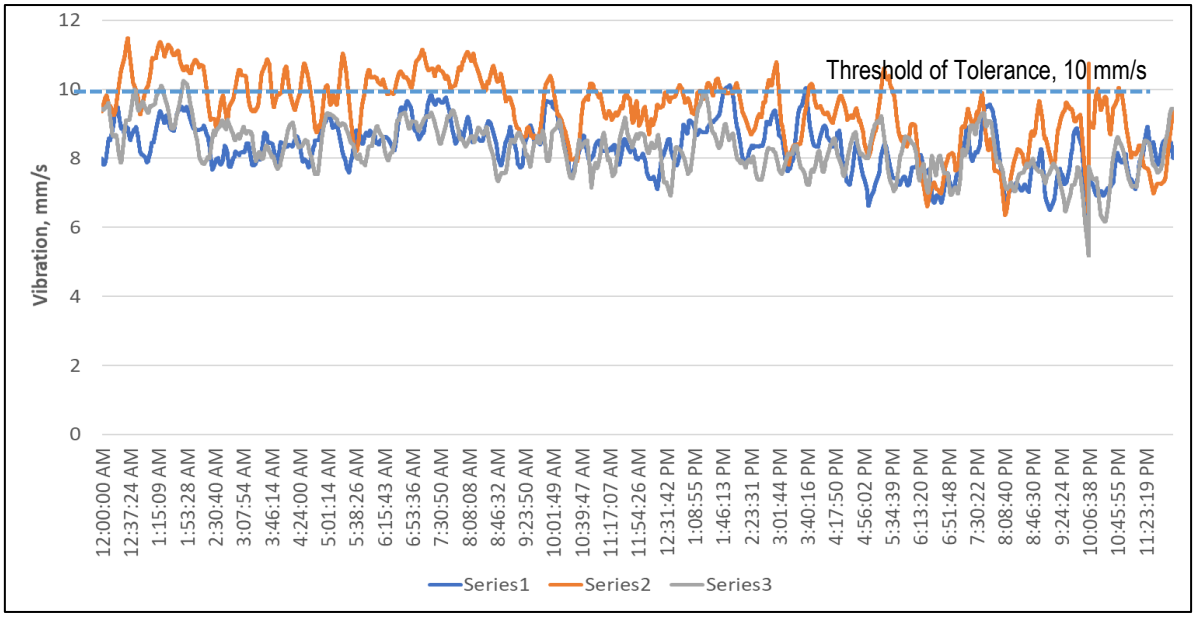


Figure 3.3.34 Biñan Hospital Peak Vibration Level in mm/s at 4.5Hz

V10 Biñan PNR Station

940. The Biñan PNR observation site is located near the market place and the PNR railway in this site is operational. The minimum background vibration is 6.0 mm/s and most vibrations are caused by the arrival and departure of the PNR train (Figure 3.3.35). The background vibration level is at 11 mm/s, a level that can be considered unpleasant by people subjected to continuous vibrations. The recorded peak velocity for this station is 12.9 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

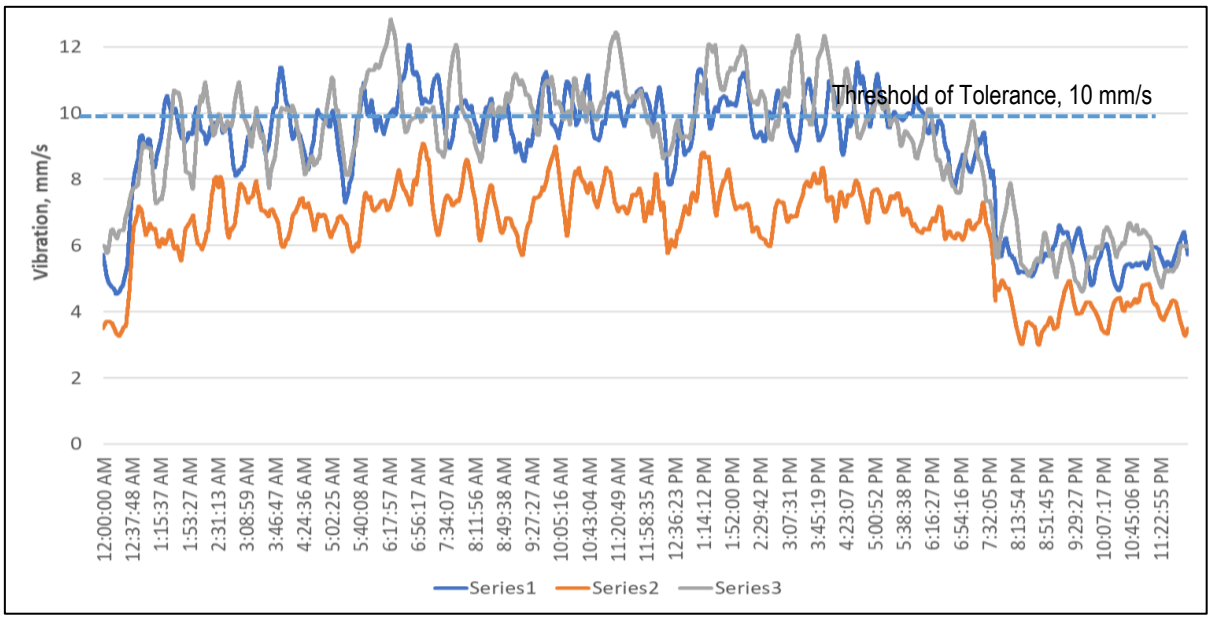


Figure 3.3.35 Biñan PNR Site Peak Vibration Level in mm/s at 4.5Hz.

V11 Cabuyao Central School

941. The Cabuyao observation site is located at a residential area inside the Central School. Most of the vibrations recorded by the instrument are caused by pedestrians and the passing of PNR trains. The minimum background vibration is at 6.2 mm/s and a peak level at 8.5 mm/s was observed as shown in Figure 3.3.36 . This level can be annoying to people in buildings. The recorded peak velocity for this station is 9.1 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is close to the threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

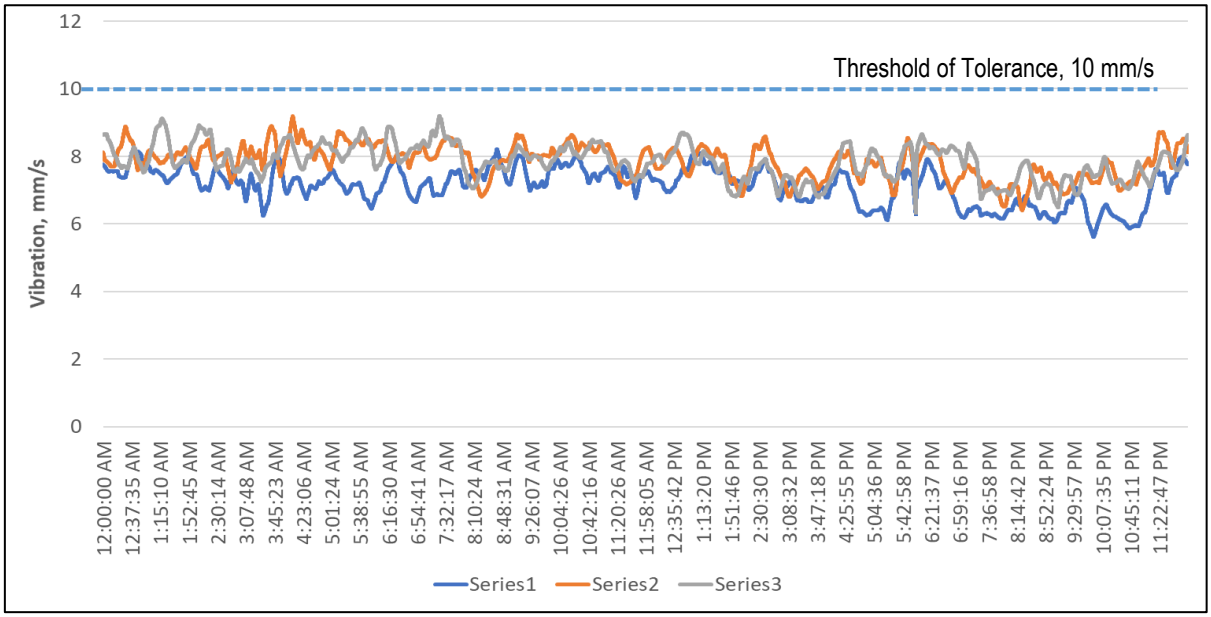


Figure 3.3.36 Cabuyao Site Peak Vibration Level in mm/s at 4.5Hz.

V12 Calamba PNR Station

942. The Calamba PNR observation site is located in the near the market place. The PNR station in this site is still operational and may have influenced the background level of ground motion. The minimum background vibration is 4.0 mm/s and most movements are caused by the arrival and departure of PNR trains, as shown in Figure 3.3.37 . Likewise, an on-going repair of an electric post in the nearby lot used heavy equipment which cased temporary elevated levels of ground shaking. The background vibration level is at 9.0 mm/s, a level that may be annoying to people in buildings. The recorded peak velocity for this station is 12.1 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

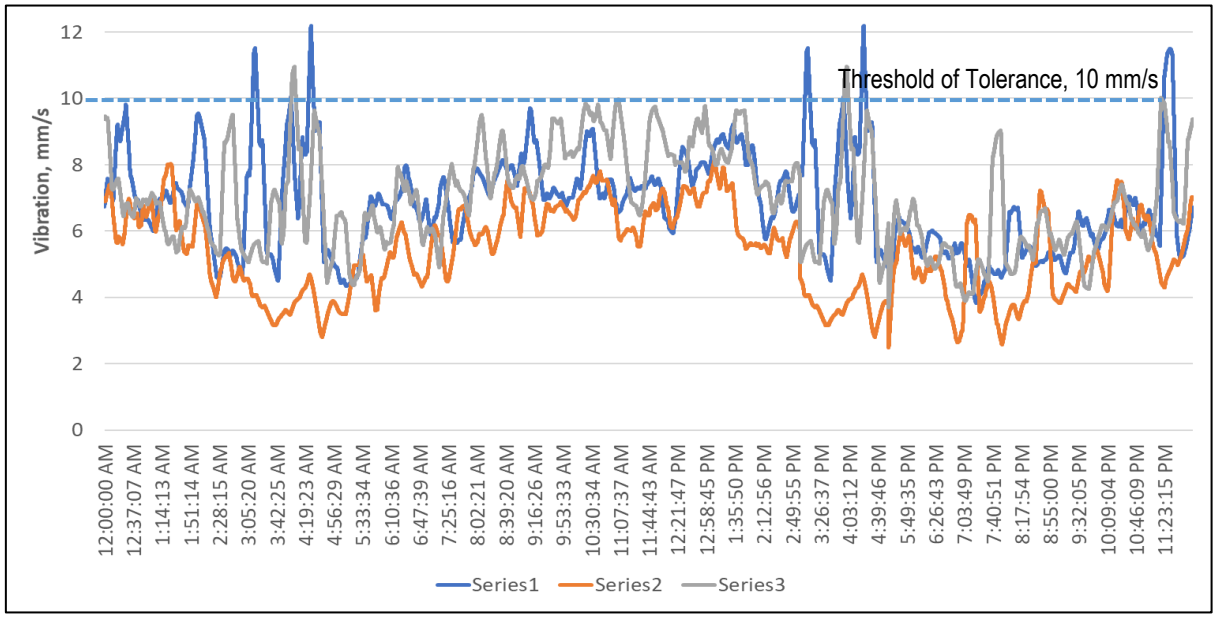


Figure 3.3.37 Calamba PNR Vibration Peak Level in mm/s at 4.5Hz.

V13 Tiyani Elementary school

943. The Tiyani Elementary school is a residential area where most vibrations are caused by wooden carts or trolleys with metal ball bearing as wheels (or locally called “skates”). These makeshift passenger vehicles that use the steel rails for transport, and the passing of students walking to and from school cause much of the vibration at the site. Located near the old PNR railway, it has a minimum background vibration of 6.0 mm/s as shown in Figure 3.3.38. During the observation period, the daytime vibration level was caused mainly by students walking to a school event. The night time vibrations were caused by motorcycles, although some cats roaming around the instrument in their nocturnal foray, reaching a peak of 27.0 mm/s. This level can be considered unpleasant by people experiencing continuous vibrations. The recorded peak velocity for this station is 31.5 mm/s. Based on the British Standard Guidance, vibration is likely to be intolerable for any more than a very brief exposure to this level.

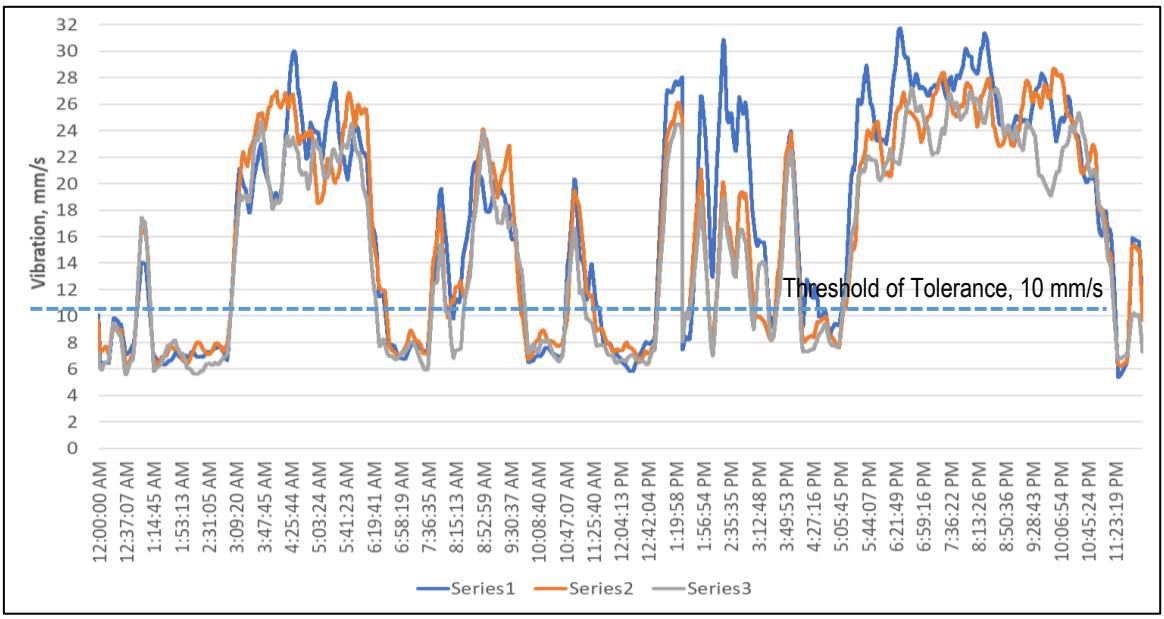


Figure 3.3.38. Tiyani Elementary School Vibration Peak Level in mm/s at 4.5Hz.

V14 Los Baños Health Center

944. The Los Baños Health Center observation site is a residential area along a major highway where most of the vibrations are caused by pedestrians and vehicles. The site has a low level of background vibration with minimum levels at 3.2 mm/s as shown in Figure 3.3.39. Background vibration is high in the afternoon which was caused by children playing around the site. The level increased during night time up to dawn which may be caused by road traffic of heavy trucks in the highway, reaching a peak of 6.8 mm/s which can be annoying to people in buildings. The recorded peak velocity for this station is 9.5 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is also close to the threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

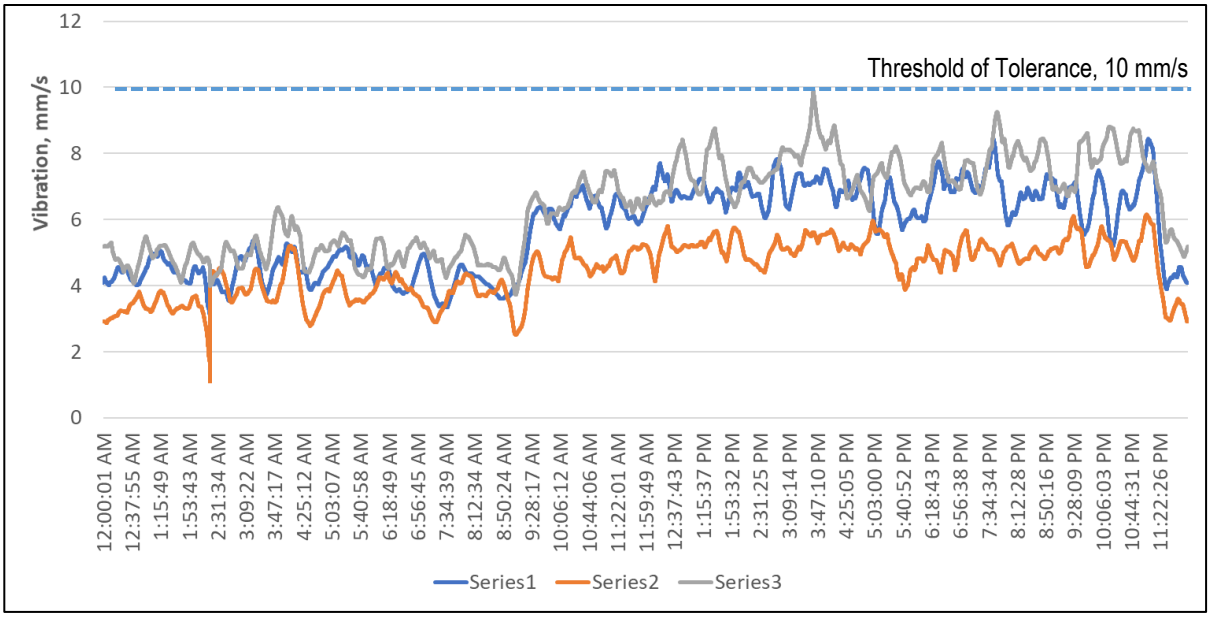


Figure 3.3.39 Los Baños Health Center Vibration Peak Level in mm/s at 4.5Hz.

V15 Paciano Rizal Elementary School

945. The Paciano Rizal Elementary School observation site is a residential area and most of the vibrations are caused by students and small vehicles. The site is located along the old PNR railway and has a minimum background vibration of 3.8 mm/s as shown in Figure 3.3.40. Background vibration remained constant during the day and increased during night time which may be caused by road traffic of small vehicles in the nearby highway, reaching a peak of 7.8 mm/s in which the vibrations are annoying to people inside buildings. The recorded peak velocity for this station is 8.5 mm/s. Based on the British Standard Guidance, this level of vibration in residential environments will likely cause complaint but can be tolerated if prior warning and explanation has been given to residents. This is also close to the threshold of intolerable vibration, set at 10 mm/s by British Standard Guidance.

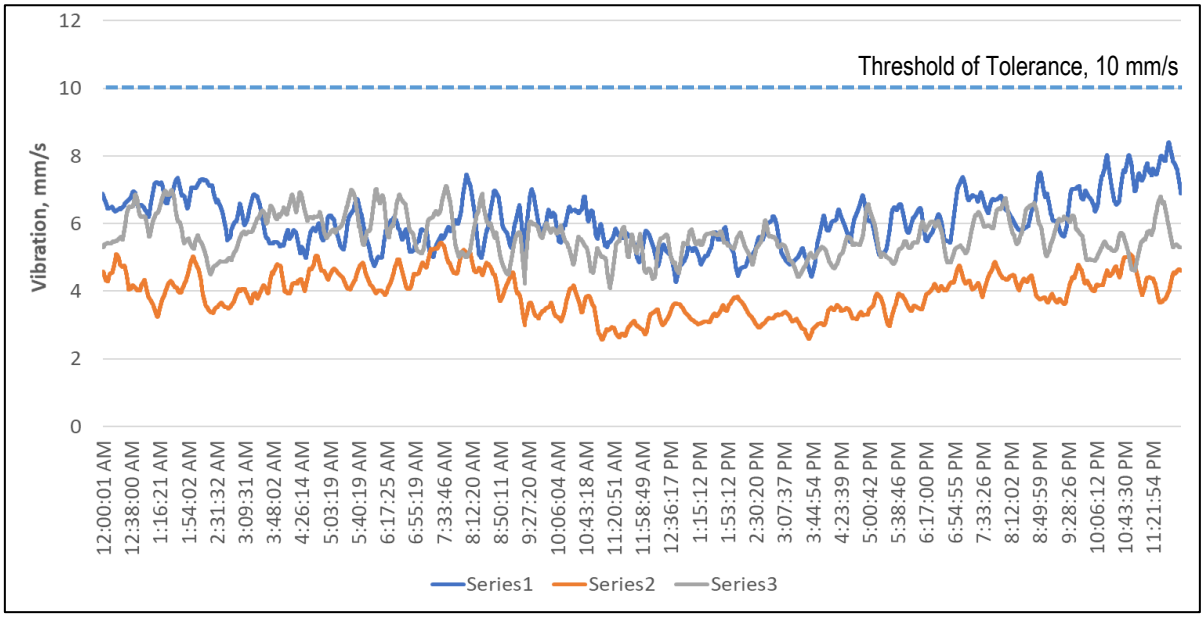


Figure 3.3.40 Paciano Rizal Elementary School Vibration Peak Level in mm/s at 4.5Hz.

3.3.4.2 Impact Identification, Prediction, Assessment and Mitigation

(1) Pre-construction and Construction Phase

946. Operation of construction machinery, such as pile driver and rock drilling, causes 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 feelable ranges for human very near the construction site.

1) Prediction method

a. Prediction model

947. The prediction model developed in Technical Handbook for Environmental Impact Assessment of Roads (2007) is applied. Vibration transmits from a source to a receiving point according to the following formula.

$$L_{(r)} = L_{r_0} - 15log_{10}\frac{r}{r_0} - 8.68\alpha(r - r_0)$$

Where, $L_{(r)}$: Vibration level (VL) at receiving point (dB)

$L_{(r_0)}$: Vibration level at reference point (dB)
r : Distance from a source (construction machinery) to receiving point (m)
r_0: Distance of reference point (= 5m)
α: Internal damping ratio

b. Vibration level on reference point

The power levels of main construction machinery are shown in **Table 3.3.26**.

Table 3.3.26 Vibration Level of Construction Machinery and Damping Ratio

Construction machinery	Vibration Level at Reference Point (dB)	Internal Damping Ratio
Pile drivers (hydraulic pile hammer)	81	0.01
Rock drilling (soft rock)	64	0.001
Slope surface splay	48	0.01
Asphalt pavement	59	0.01

Source: Technical Handbook for Environmental Impact Assessment of Roads (2007)

c. Location of vibration source and receiving point

948. The construction machinery, i.e., noise emission source is assumed to be set on the center of the track. During the construction, temporary walls (3.0m) will be set at the edge of the ROW (construction limit). The height of the receiving point is 1.2m.

2) Results of the prediction and evaluation

949. The VL on receiving points was calculated based on the said prediction model. The results of the prediction of the construction noise are shown in Table 3.3.27.

Table 3.3.27 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
Rock drilling (soft rock)	64	62.8	58.8	56.3	54.5	53.1		
Slope surface splay	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)

Source: JICA Study Team

950. The operations of pile driver and rock drilling will affect the area around the Project site, including the old PNR stations, since the vibration is beyond the human perceptive threshold. Asphalt pavement will also affect the area within 10m distance from the edge of the construction limit. Only the vibration of slope surface splay is below the human perceptive threshold.

3) Mitigation Measures

951. Pile driving for piers and tunnel driving generate vibrations which may affect the area around the NSRP site particularly when vibration level is beyond the human perceptive threshold. Vibration is more pronounced in sections with hard rock. Tunnel boring machines (TBM) operation generates vibrations, which are transmitted in all directions.

952. The identified impacts will have a high adverse effect to humans, thus, mitigating measures must still be implemented to alleviate the impacts.

953. To reduce generation of vibration and its impact to direct recipients, such as the workers, nearby residents and structures along the NSRP alignment, the following measures will be implemented:

- Select sites considering the sensitive receptors in the selection of temporary construction yard;
- Minimize alteration of topography and removal of vegetation;
- Plan construction activities considering time, duration and scale of construction to optimize the use construction equipment, machineries, and vehicles. Schedule high vibration generating activities during daytime to reduce disturbance to nearby communities;
- Conduct building condition survey of old PNR structures apart and buildings adjacent to the alignment to determines extent of damage to such buildings due to vibration and provide proper protection provision measures and continuous monitoring from the impact of vibration;
- Undertake information dissemination to the public to raise the awareness to the impact of vibration from the project activities and establish Grievance Redress Mechanism to handle any complaint if any;
- Identify nearby sensitive receptors and ecologically significant areas (if any) likely to be affected and conduct vibration levels survey; and
- Conduct vibration sampling at identified sensitive receptors.
- During construction, proposed measures are as follows:
- 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 PPE to construction workers; and
- Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), old PNR strctures, historical heritages including ecologically significant area/s (if any) likely to be affected by the operation and evaluate effectiveness of the vibration reduction measures provide.

(2) Operation Phase

954. Structural vibration of buildings and houses near the NSRP alignment due to train operation may affect people in many ways, such as deterioration of quality of life or decrease of working efficiency.

955. There are no established prediction methods for vibration due to train operation since the mechanism of occurrence and transmission of train vibration is very complicated. 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 model below is developed for the East-Osaka Urban Rapid Transit by using the vibration data of the similar type of trains and structures at the existing railways. The NSRP will use the similar type of trains and structures as the existing railways in Japan, therefore, the following model is used for the estimate of vibration level.

1) Prediction method

The prediction model is proposed for several types of trains and structures as shown in Table 3.80.

Table 3.3.28 Prediction Model of Vibration Levels

Type	Structure	Model Equations
Train	At-grade (Ballast)	VL= 21.3 log10V - 13.9 log10R + 30.9
	Embankment (Ballast)	VL=42.4 log10V -15.4 log10R - 13.0
	Viaduct (Slab)	VL=12.9log10V -13.2log10R+ 39.3

Type	Structure	Model Equations
	Viaduct (Ballast)	VL=18.5 log10V -21.0 log10R+ 44.0
Freight	At-grade (Ballast)	VL=15.3 log10V -20.7log10R+ 54.7
	Embankment (Ballast)	VL=18.6 log10V - 8.2log10R+ 31.4
	Viaduct (Ballast)	VL=10.4 log10V -20.8 log10R+ 66.7

Note. VL: Vibration Level (dB), V: Velocity (km/h), R: Distance from the center of railway track (m)

Source: EIA report for Osaka Outer Ring for East-Osaka Urban Rapid Transit, 2006, Osaka Prefecture

2) Structures

The types of structure of the NSRP are viaduct (slab) and embankment (ballast).

Parameter

According to the operation plan, the train velocity is 120km/h.

Prediction

956. The vibration level VL is estimated in Table 3.3.29. In the case of the viaduct (slab), VL at the edge of the ROW is estimated 54.6 dB and below the perceptible threshold of humans (55dB). 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 (55dB).

Table 3.3.29 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

Source: JICA Study Team

3) Mitigation Measures

957. In the case of the viaduct (slab), mitigation measures will not be needed to be implemented. On the other hand, the embankment will be used for the section where the alignment goes through the rural areas and no flood-prone area. However, the following measures will be taken to abate the vibration level where the residences are located within 15 m distance from the ROW.

- Undertake 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; and

- Monitor vibration levels at identified nearby sensitive receptors (residential, school and hospital areas), 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. Monitor actions on complaints, if any, and attend to unresolved cases based on Grievance Redress Mechanism.

3.3.5 Electric Magnetic Compatibility

958. The Railway Project and its operating systems have been so designed to address concerns on Electro Magnetic Compatibility (**EMC**) and Electro Magnetic Interference (**EMI**). EMC is an issue that is mitigated through the application of EMC industry accepted practice during design and installation of the system. These conform to the limits provided by the International Commission on Non-Ionizing Radiation Protection (ICNIRP 1998 guidelines). This limits the minimal effects of EMI to the environment.

Table 3.3.30 Summary of Impact Identification, Prediction, Assessment and Mitigation for Air

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: - RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - RA 9003: management and disposal of solid wastes - RA 8749: comprehensive air pollution control policy - RA 9275: comprehensive water quality management and for other purpose • 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
PRE-CONSTRUCTION / CONSTRUCTION				
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate Change	Exhaust emission from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders.	C-	**[Pre-Construction]** • Plan and design structures that will minimise 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
Climate Risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion/landslides/and flooding.	A-	**[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 robust to climate change and related extreme events including drainage, passenger facilities and structures (viaduct, embankment, and tunnels) 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 heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.
		slower drainage, soil erosion, disruption in construction by increased rainfall	B-	
		overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-	

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
• Earthworks including excavation activities • Site clearance including removal of topsoil at the depot site	Air Quality	Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction activities	B-	**[Pre-Construction]** • Design to minimise alteration of topography and removal of vegetation. **[Construction]** • 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 <10kph and minimise vehicle transport by maximising 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. • 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.
• Operation of construction machinery, equipment and vehicles	Air Quality	• Degradation of air quality due to gaseous emissions from machineries and service vehicles	C-	
• Operation of construction machinery, equipment and vehicles • Earthworks	Acoustic Noise	• 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	B-	**[Pre-Construction /Construction]** • Select sites (i.e. construction yard, temporary facilities, access routes) in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected • Plan and 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. • Design to minimise alteration of topography and removal of vegetation. • 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]** • 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. • 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.
• Conduct of geotechnical investigation • Operation of construction machinery, equipment and vehicles • Pile driving for piers	Ground vibration	• Increase in ambient vibration level • Threat to existence and/or loss of important local species and habitat	C-	**[Pre-Construction / Construction]** • Select sites in consideration to sensitive receptors including ecologically significant areas (if any) likely to be affected. • Plan and 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. • Conduct building condition survey of old PNR structures and buildings adjacent to the alignment 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

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
		• Threat to abundance, frequency and distribution of species		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.
OPERATION				
Climate Risk • changes in the rainfall pattern and local temperature	Meteorology/ Climatology	Restrictions/ disruption of construction due to soil erosion/landslides/and flooding.	A-	• 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;
		slower drainage, soil erosion, disruption in construction by increased rainfall	B-	
		overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-	
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Climate Change	Reduction of Greenhouse Gases	B+	• 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
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Air Quality	• Degradation of air quality in the vicinity of the station and in depot area • Increase in Vehicle Exhaust emission and entrained dust	C-	• 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 • 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

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
		due of increased movement of people		• Control service vehicle movement maintaining the speed limit to <10kph. Minimise vehicle transport by maximising 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.
Operation of trains	Acoustic Noise	Reduction of noise due to decrease in traffic volumes	B+	• Provide incentives to and information dissemination activities to encourage commuters to use rail transit over other modes of transport
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Acoustic Noise	Increase in ambient noise level	C-	• 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.
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Ground Vibration	Increase in ground vibration level	C-	• 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

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

3.4 PEOPLE

959. Baseline data are presented at city level where such data are available. Where data is not available, provincial data is used. The data also sometimes differ in reference years, and this is always reflected in the text and tables so as to enable the reader to distinguish the timelines of the data. All information are secondary data, except for the data on PAPs which were derived from the primary socio-economic surveys conducted during the data gathering phase as of April 25th, 2018.

960. The baseline data covers the impact areas in Metro Manila and the Province of Laguna. In Metro Manila, the NSRP will traverse through host cities namely: Manila City, Makati City, Taguig City, Parañaque City, and Muntinlupa City. In Laguna, NSRP will pass through San Pedro City, Biñan City, Sta. Rosa City, Cabuyao City, and Calamba City. Shown in the table below are the host LGUs for the Project.

3.4.1 Demography

3.4.1.1 Population

961. The NSRP will traverse through Manila 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 be host to the Project. Next most populous, is Taguig and Parañaque City with 804,915 and 665,822 inhabitants, respectively. However, the most densely populated is Makati City with 27,000 persons per square kilometer. 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%.

962. In the Province of Laguna, the most populous city among the host LGU of the proposed NSRP is Calamba City.In 2015, it had a population of 454,486 (2015 Census of Population, PSA). However, the most densely populated host city in Laguna is San Pedro City with 13,547 individuals per square kilometer. The cities of Santa Rosa and Cabuyao are the fastest growing in terms of population, both had a population of 4.23% from 2010-2015.

Table 3.4.1 Demographic Data of Cities and Municipalities Hosting the NSRP

City	Land Area (ha.)	Population		Growth Rate *	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: *2010-2015; [a] Excluding those situated on relocation sites,

Source: 2015 Census of Population and Housing, PSA

3.4.1.2 Gender and Age Profile

(1) Gender and Age Profile of Host LGUs

963. Table 3.4.2 shows that generally, there is almost 1:1 proportion of male and female across Metro Manila and Laguna Province. The slight lead of female population accounted for 1% difference. On the other hand, Table 3.4.3 and

964.

965. **Table 3.4.4** show that the combined population of the host cities in Metro Manila and Laguna was largely composed of people in their productive age (15-64 years old) comprising 68% of the population, followed by the population of young dependents (children age 0-14 years old) making up the 28% of the population and, finally, the group of people in their retirement age (65 years old and above) accounting for 4% only of the population.

Table 3.4.2 Gender Distribution by City (2015)

City	GENDER DISTRIBUTION				
	Males		Females		TOTAL
	Frequency	%	Frequency	%	
Manila	876,687	49.24%	903,461	50.75%	1,780,148
Makati	276,269	47.42%	306,332	52.58%	582,602
Taguig	403,861	50.17%	401,054	49.83%	804,915
Parañaque	325,043	48.81%	340,779	51.18%	665,822
Muntinlupa	259,116	51.36%	245,393	48.64%	504,509
San Pedro	161,614	49.60%	164,195	50.40%	325,809
Biñan	166,039	49.86%	166,989	50.14%	333,028
Sta. Rosa	173,912	49.16%	179,855	50.84%	353,767
Cabuyao	153,748	49.80%	154,997	50.20%	308,745
Calamba	226,683	49.88%	227,803	50.12%	454,486
TOTAL	3,022,972	49.53%	3,090,874	50.47%	5,939,934

Source: Philippine Statistics Authority (2015)

Table 3.4.3 Age Distribution per City (2015)

City	AGE GROUP						
	0-14 years old		15-64 years old		65 years old and above		TOTAL
	Frequency	%	Frequency	%	Frequency	%	
Manila	598,272	28.6%	1,110,381	67.4%	71,495	4.0%	1,780,148
Makati	132,882	22.8%	421,002	72.3%	28,718	4.9%	582,602
Taguig	228,744	28.4%	554,185	68.9%	21,986	2.7%	804,915
Parañaque	167,349	25.1%	471,360	70.8%	27,113	4.1%	665,822
Muntinlupa	129,645	36.5%	355,507	58.1%	19,357	5.4%	504,509
San Pedro	89,705	27.5%	221,494	68.0%	14,610	4.5%	325,809
Biñan	92,862	27.9%	230,065	69.1%	10,101	3.0%	333,028
Sta. Rosa	91,676	25.9%	251,555	71.1%	10,536	3.0%	353,767
Cabuyao	91,008	29.5%	208,983	67.7%	8,754	2.8%	308,745
Calamba	129,318	28.5%	310,421	68.3%	14,747	3.2%	454,486
Total	**1,751,461**	**28.07%**	**3,924,953**	**68.17%**	**227,417**	**4.76%**	**6,113,831**

Source: Philippine Statistics Authority (2015)

966. Gender and Age Profile of PAFs by LGUs

967.

968. **Table 3.4.4** indicates that in 2015, there were more women (69.1%) than men (30.9%), with the proportion of women twice or more than twice of men in all PAPs. Table 3.4.5 indicates that majority of the PAPs belonged to the working age population, with 34.9% 21-40 years old. The proportion of dependents who are young (less than 12 years old) was approximately 27.9%, while

those 61 years old and above were 4.5%, indicating that around 31% were dependents. The trend was similar for all affected LGUs, with majority having PAPs aged 21- 40 years old.

Table 3.4.4 Gender of PAPs

Municipality	Gender					
	Male	%	Female	%	Total	%
City of Manila	517	33.5%	1024	66.5%	1541	100.0%
Taguig	64	29.1%	156	70.9%	220	100.0%
Parañaque	7	20.0%	28	80.0%	35	100.0%
Muntinlupa	258	28.6%	643	71.4%	901	100.0%
San Pedro	71	30.6%	161	69.4%	232	100.0%
Biñan	584	30.6%	1323	69.4%	1907	100.0%
Sta. Rosa	152	35.1%	281	64.9%	433	100.0%
Cabuyao	26	33.3%	52	66.7%	78	100.0%
Calamba	1260	29.4%	3031	70.6%	4291	100.0%
NSRP Total	3775	30.9%	8423	69.1%	12198	100.0%

Source: JICA Study Team

Table 3.4.5 Age Distribution of PAPs

City	Age								
	6 YO or Less	7-12 YO	13-16 YO	17-20 YO	21-40 YO	41-60 YO	61 Above	N/R	Total
City of Manila	778	671	412	471	2211	1079	369	108	**6099**
%	12.8%	11.0%	6.8%	7.7%	36.3%	17.7%	6.1%	1.8%	100.0%
Taguig	128	103	50	55	265	144	31	30	**806**
%	15.9%	12.8%	6.2%	6.8%	32.9%	17.9%	3.8%	3.7%	100.0%
Parañaque	30	24	10	8	45	24	0	0	**141**
%	21.3%	17.0%	7.1%	5.7%	31.9%	17.0%	0.0%	0.0%	100.0%
Muntinlupa	524	448	237	259	1235	641	149	85	**3578**
%	14.6%	12.5%	6.6%	7.2%	34.5%	17.9%	4.2%	2.4%	100.0%
San Pedro	178	127	58	56	304	124	49	12	**908**
%	19.6%	14.0%	6.4%	6.2%	33.5%	13.7%	5.4%	1.3%	100.0%
Biñan	1234	787	387	468	2379	927	218	226	**6626**
%	18.6%	11.9%	5.8%	7.1%	35.9%	14.0%	3.3%	3.4%	100.0%
Sta. Rosa	254	162	93	118	467	211	50	56	**1411**
%	18.0%	11.5%	6.6%	8.4%	33.1%	15.0%	3.5%	4.0%	100.0%
Cabuyao	43	37	15	16	112	64	11	15	**313**
%	13.7%	11.8%	4.8%	5.1%	35.8%	20.4%	3.5%	4.8%	100.0%
Calamba	2674	2245	1193	1390	6067	2898	812	342	**17621**
%	15.2%	12.7%	6.8%	7.9%	34.4%	16.4%	4.6%	1.9%	100.0%
NSRP Total	**5843**	**4604**	**2455**	**2841**	**13085**	**6112**	**1689**	**874**	**37503**
%	15.6%	12.3%	6.5%	7.6%	34.9%	16.3%	4.5%	2.3%	100.0%

Source: JICA Study Team

3.4.1.3 Literacy Rate, Profile of Educational Attainment

(1) Literacy Rate and Educational Attainment Profile of LGUs

969. Results from the PSA 2015 Census of Population and Housing (**CPH**) show that 98.30% of the 78.9 million individuals who are 10 years old and older were literate or could read and write. Table 3.4.6 shows that the literary rate in the host LGUs was high and higher compared to the national literacy rating. Females had a slightly higher literacy rate compared to the male population in the cities of Manila, Makati, Muntinlupa, San Pedro, Biñan, Sta. Rosa and Calamba. Males had higher literacy rate compared to the female population in City of Taguig. Males and Females had the same literacy rate in cities of Parañaque and Cabuyao.

970. In terms of educational attainment, the host LGUs' populace consisted largely of high school educated population, followed by elementary educated population except in cities of Makati and Parañaque wherein there were more academic degree holders than elementary educated population. Table 3.4.7 shows the Highest Grade/Year Completed of Total Population 5 Years Old and Over.

Table 3.4.6 Literacy of the Household Population 10 Years Old and Over

City	Household Population 10 years old and over			Literate					
	Both Sexes	Male	Female	Both Sexes		Male		Female	
				f	%	F	%	f	%
Manila	1,412,632	684,683	727,949	1,410,170	99.83%	683,427	99.82%	726,743	99.83%
Makati	490,104	228,487	261,617	489,487	99.87%	228,160	99.86%	261,327	99.89%
Taguig	643,476	319,059	324,417	642,107	99.79%	318,406	99.80%	323,701	99.78%
Parañaque	549,659	264,948	284,711	548,788	99.84%	264,524	99.84%	284,264	99.84%
Muntinlupa	394,155	191,993	202,162	393,607	99.86%	191,706	99.85%	201,901	99.87%
San Pedro	265,518	130,121	135,397	264,751	99.71%	129,687	99.67%	135,064	99.75%
Biñan	268,607	132,802	135,805	267,753	99.68%	132,360	99.67%	135,393	99.70%
Sta. Rosa	291,396	141,816	149,580	290,956	99.85%	141,596	99.84%	149,360	99.85%
Cabuyao	246,400	121,470	124,930	245,988	99.83%	121,269	99.83%	124,719	99.83%
Calamba	360,163	176,639	183,524	359,093	99.70%	176,089	99.69%	183,004	99.72%

Note: Literacy of the Household Population 10 Years Old and Over

Source: Philippine Statistics Authority (2015)

Table 3.4.7 Highest Grade/Year Completed of Total Population 5 Years Old and Over

City	Highest Grade/Year Completed											
	Pre-School		Elementary		High School		Post-Secondary		College Undergraduate		Academic Degree Holder	
	f	%	f	%	f	%	f	%	f	%	f	%
Manila	34,132	2%	318,354	20%	609,088	38%	28,476	2%	274,021	17%	288,127	18%
Makati	11,117	2%	76,732	14%	169,294	32%	16,050	3%	97,148	18%	155,913	29%
Taguig	18,242	3%	140,303	19%	287,659	40%	12,530	2%	120,763	17%	118,621	16%
Parañaque	13,586	2%	114,806	19%	231,492	38%	11,125	2%	87,707	14%	134,327	22%
Muntinlupa	10,059	2%	87,839	19%	187,285	41%	6,986	2%	61,034	13%	79,787	17%
San Pedro	6,633	2%	59,607	20%	120,198	41%	6,325	2%	41,694	14%	55,107	19%
Biñan	6,985	2%	71,146	24%	132,994	44%	3,900	1%	36,727	12%	41,782	14%
Sta. Rosa	7,038	2%	64,903	20%	144,375	45%	6,824	2%	43,132	13%	50,769	16%
Cabuyao	7,087	3%	60,462	22%	131,407	47%	6,304	2%	34,486	12%	32,873	12%
Calamba	9,815	2%	87,638	21%	190,790	47%	6,416	2%	48,566	12%	55,781	14%

Note: Total Population 5 Years Old and Over by Highest Grade/Year Completed

Source: Philippine Statistics Authority (2015)

(2) Educational Attainment of PAFs

971. Table 3.4.8 shows varied patterns of educational attainment among the affected families. However, in general, the highest proportion of families were members who had reached high school

(20.9%) and elementary (18%). Likewise, data indicates that a smaller proportion of PAPs had graduated elementary (5.3%) and had reached and graduated college (with 3% and 7.2%, respectively). In the city of Parañaque, San Pedro, Muntinlupa and Biñan, the highest proportion of families had reached elementary, with 32.6%, 23.5%, 19.4% and 19.6%, respectively. However, in the City of Manila and Taguig, the highest proportion of families belonged to those who had reached and graduated elementary – with 35.1%; and 40% of the families in Manila and Taguig had at least reached high school. In the cities of Santa Rosa and Biñan, the PAFs were distributed among those who had (1) reached elementary, (2) reached high school and (3) graduated high school, suggesting possible variations in the skill level of the PAPs.

Table 3.4.8 Educational Attainment of PAPs

City	Pre-school	Elementary		High School		College		Vocational/ technical	Advance degree	Post-baccalaureate	NA	NR	Total
		level	graduate	level	graduate	level	graduate						
City of Manila	199	837	236	1046	1089	198	797	846	29	468	44	310	**6099**
%	3.3%	13.7%	3.9%	17.2%	17.9%	3.2%	13.1%	13.9%	0.5%	7.7%	0.7%	5.1%	100.0%
Taguig	26	149	40	151	172	14	44	35	0	86	9	80	**806**
%	3.2%	18.5%	5.0%	18.7%	21.3%	1.7%	5.5%	4.3%	0.0%	10.7%	1.1%	9.9%	100.0%
Parañaque	8	46	7	27	12	0	4	0	0	19	1	17	**141**
%	5.7%	32.6%	5.0%	19.1%	8.5%	0.0%	2.8%	0.0%	0.0%	13.5%	0.7%	12.1%	100.0%
Muntinlupa	108	695	201	628	778	101	227	210	2	343	81	204	**3578**
%	3.0%	19.4%	5.6%	17.6%	21.7%	2.8%	6.3%	5.9%	0.1%	9.6%	2.3%	5.7%	100.0%
San Pedro	24	213	66	167	151	14	52	30	0	120	31	40	**908**
%	2.6%	23.5%	7.3%	18.4%	16.6%	1.5%	5.7%	3.3%	0.0%	13.2%	3.4%	4.4%	100.0%
Biñan	218	1299	416	1207	1284	174	288	157	3	816	169	595	**6626**
%	3.3%	19.6%	6.3%	18.2%	19.4%	2.6%	4.3%	2.4%	0.0%	12.3%	2.6%	9.0%	100.0%
Sta. Rosa	43	307	121	231	219	25	53	37	0	160	38	177	**1411**
%	3.0%	21.8%	8.6%	16.4%	15.5%	1.8%	3.8%	2.6%	0.0%	11.3%	2.7%	12.5%	100.0%
Cabuyao	7	78	31	40	50	6	10	6	0	36	5	44	**313**
%	2.2%	24.9%	9.9%	12.8%	16.0%	1.9%	3.2%	1.9%	0.0%	11.5%	1.6%	14.1%	100.0%
Calamba	591	3115	866	2969	4065	577	1221	832	5	1663	314	1403	**17621**
%	3.4%	17.7%	4.9%	16.8%	23.1%	3.3%	6.9%	4.7%	0.0%	9.4%	1.8%	8.0%	100.0%
NSRP Total	**1224**	**6739**	**1984**	**6466**	**7820**	**1109**	**2696**	**2153**	**39**	**3711**	**692**	**2870**	**37503**
%	3.3%	18.0%	5.3%	17.2%	20.9%	3.0%	7.2%	5.7%	0.1%	9.9%	1.8%	7.7%	100.0%

Source: JICA Study Team

3.4.2 Migration Profile

3.4.2.1 In-Migration

972. In-migration or Internal Migration, according to the PSA, is a form of geographic spatial mobility of people involving a change in usual residence within a country (region, province, city/municipality) during a specified period of observation for a reason such as economic, social, political and cultural (Siegel and Swanson, 2004 *localized to the Philippine setting*). 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%) (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), (UNESCO, UNDP, IOM, and UN-Habitat, 2018).

3.4.2.2 Profile of Informal Settlers

(1) ISFs Profile of Host LGUs

Manila

973. Among the regions, Metro Manila continues to host the largest slum population, even if it has the lowest poverty of incidence. In the City of Manila, almost one of three persons (31%) is a squatter or illegal settler as established by the survey done by the Manila Social Welfare Department in 1999. On the whole, the number of squatters in Manila has been increasing over the years. It is generally accepted that the growth of the squatters is inversely proportional to the country's economic performance. In 1999, Districts I and II (Tondo I and Tondo II) had 74% of the total squatter population. The Tondo area was usually the first settlement site for migrants to Manila. Many newcomers chose to stay in Tondo as squatters because they had no other option and because Tondo offered many opportunities for informal occupations, particularly those areas near the ports.

974. From 2013 to date 7,403 ISFs have been relocated to relocation sites in Bulacan, Cavite, and Laguna. Under the Land for the Landless Program of the Manila City Government 257 families have been given lots, while 32 families both house and lot in Sitio Dubai at the Baseco Compound, Metro Manila. In 2010, almost half of the informal settlers in Metro Manila was in Manila City. The population of informal settlers then was 2.8 million (556,526 informal settler families); and that 104,000 families lived in danger zones according to the Department of the Interior and Local Government (**DILG**). In Manila, ISFs were clumped together in the 107 barangays traversed by waterways like Pasig River, San Juan River, Estero de Maypajo and Estero de Sunog.22

Makati

975. A large majority of the household population five years old and over (80.43%) resided in the same place of residence that they resided five years ago. The rest changed their place of residence five years ago as follows: 2.23% in another city or municipality of Metro Manila, 15.04% in other provinces, and 0.88% in foreign countries (Makati City CLUP, 2013-2023).

976. In 2011, the city had a total of 7,675 informal settlers which was 9.5% more than the 2010 figure of 7,009 informal settlers. This increase can be attributed to at least two (2) factors: i) the establishment of new households by members of informal settler families, and ii) the influx of new informal settlers.

Taguig

977. According to the Housing and Urban Development Coordinating Council (HUDCC) in 2000, the number of households of informal settler living in Taguig City constituted 33.7% of the total number of households. The number of informal settler households living in danger areas was 2,869 (HUDCC, 2000). As an official reception point for immigrants to the Metropolitan area, Taguig's already insufficient infrastructure has been burdened by an even greater demand for basic needs. Foremost among these is housing along with associated social services (Taguig City, Comprehensive Land-Use and Zoning Plan).

Parañaque

[22] *Erap gets NHA's commitment to help informal settlers living in danger zones*, Politics.com.ph| December 04, 2016; http://manila.gov.ph/erap-gets-nhas-commitment-to-help-informal-settlers-living-in-danger-zones/

978. There are approximately 343 areas occupying the City of Parañaque, which are considered Urban Mission Areas. Sixteen (16) areas are considered Areas for Priority Development (**APD**) and twelve (12) others are undergoing Community Mortgage Program (**CMP**).

979. Barangay Moonwalk had the most number of informal settlers, 35 followed by Barangay San Antonio ith 33, Barangay Don Bosco with 22 and Barangay Sto. Nino with 22 clustered settlements. Household population in each settlement ranged from 50 to 1,700 families.

980. The city was home to 25,073 informal settler families, covering an estimated 45.131 hectares land area. Informal settlers in danger areas were approximately 3,320 families, in government lands 3,763 families, in areas declared APD 2,460 families and those located in private lands 15,428 families. Majority of informal settler dwellings weere made of light materials; only a few were made of concrete and semi-concrete materials. Monthly income of these families was below the minimum wage (Socioeconomic Profile of Parañaque, 2012).

Muntinlupa

981. In 2017, a paper presented by Ayson, et. al. presented to the World Bank Conference on Land and Property noted that a survey conducted by the local government of Muntinlupa identified 83 informal settlements in four (4) barangays: 31 were located in Sucat, 29 in Alabang, nineteen (19) in Cupang and four 94 in Buli. There was a total of 72,384 informal settlers in Muntinlupa: 50% of which is located in Sucat, and the rest in the other three (3) barangays. This informal settler population accounted 14 % of Muntinlupa's total population of 504,509 as of 2015. According to Ayson, et. al. a total of 16,908 ISFs were identified from the four (4) barangays mentioned. From which, a total of 17,038 occupants were identified: 56% classified as owners, 24% renters and 20% sharers. A total of 9.575 structures were identified in these barangays. This translates to eight (8) informal settlers living under one structure. The occupancy types were as follows: 87% residential, 3% commercial, and 10% mixed-used occupancy.

San Pedro

982. One concern in the housing sector is the presence of informal settlers. As of August 2012, a total of 8,507 informal settler families were recorded in San Pedro, where 44% percent were residing in danger areas such as creeks, railways, and under the NAPOCOR line.

Biñan

983. The NHA estimated that the number of informal settler families in the Laguna de Bay shoreland was 82,040. The largest informal settler community was in Lupang Arenda in Barangay Sta. Ana, Taytay, Rizal with 60,000 families.

984. Two (2) other large informal settler communities were found in the Province of Laguna: Barangay Malaban in Biñan with 6,800 informal settler families and Barangay Sinalhan in Sta. Rosa with 4,800 families. The remaining 10,440 informal settler families were in clusters of informal settlements located in 29 shoreland municipalities (188 lakeshore barangays) around the lake.

Santa Rosa

985. The City Urban Development and Housing Office recorded a total of 8,093 families lived in 6,217 structures along the slums of Santa Rosa. Bgry. Pulong Santa Cruz hosted the most number of informal settler families surveyed to be around 2,305.[23]

Cabuyao

986. In 2011, the water quality monitoring team from the LLDA noticed informal settlers living at the banks of Cabuyao River, at Sitio Bulihan, Brgy. Sala fronting Purefoods Villa Susana Subdivision.[24]

[23] 2014-2015 Socioeconomic Profile of Sta. Rosa City
[24] Water Quality report on Cabuyao River, Laguna Lake Development Authority. © 2011. URL: http://www.llda.gov.ph/dox/waterqualityrpt/rivers/cabuyao.pdf

Calamba

987. The City Housing Department has identified more than 2000 informal settler families in Calamba. Some were living in permanent danger zones: flood prone villages, and shoreline areas in the Laguna Bay (Calamba City CLUP).

(2) ISFs under the Project by LGUs

Given that the Project will seek to utilize the existing PNR ROW, majority of the PAPs were ISFs who encroached on the existing ROW, with a few legal PAFs due to additional land acquisition required for the Project. Table 3.4.9 indicates that 92.8% of the PAFs were ISF, with the few legal PAFs distributed among the LGUs – and found mostly in the Cities of Calamba with 193 PAFs, Manila with 66 PAFs and Biñan with 27 PAFs.

Table 3.4.9 Number of PAFs

City	Project Affected Structures	PAPs			
		Legal PAPs	ISFs	No Response	Total
City of Manila	2,059*	66	1444	31	**1541**
%	-	4.3%	93.7%	2.0%	100.0%
Taguig	116	11	206	3	**220**
%	-	5.0%	93.6%	1.4%	100.0%
Parañaque	24	0	34	1	**35**
%	-	0.0%	97.1%	2.9%	100.0%
Muntinlupa	646	69	791	41	**901**
%	-	7.7%	87.8%	4.6%	100.0%
San Pedro	183	13	212	7	**232**
%	-	5.6%	91.4%	3.0%	100.0%
Biñan	351	27	1809	71	**1907**
%	-	1.4%	94.9%	3.7%	100.0%
Sta. Rosa	1,568	11	411	11	**433**
%	-	2.5%	94.9%	2.5%	100.0%
Cabuyao	70	3	75	0	**78**
%	-	3.8%	96.2%	0.0%	100.0%
Calamba	3,578	193	3961	137	**4291**
%	-	4.5%	92.3%	3.2%	100.0%
NSRP Total	**8,595**	**393**	**8943**	**302**	**9638**
%	-	4.1%	92.8%	3.1%	100.0%

Source: JICA Study Team

988. Among the PAFs, there were members of households who were below the poverty line, and who may be elderly, persons with disabilities and/or needing special assistance, and solo parents. The SES also noted these PAPs who may be vulnerable or who may require additional compensation and/or other forms of assistance, as indicated in Table 3.4.10.

989. Among the vulnerable groups, majority were dependents – either as babies or toddlers (81.6%) or elderly (9%). There were also some PAPs who were pregnant (3.7%), had mental disorders (0.9%), were seriously ill (0.8%), blind (0.4%) or mute or deaf (0.3%)

Table 3.4.10 Vulnerability of PAFs

City/	Vulnerability Count

Municipality	Baby/Toddler	Pregnant	Elderly	Mental Disorder	Needs Assistance Walking/Cannot Walk	Seriously Ill	Blind	Mute/Deaf	Others	Total
City of Manila	415	24	150	10	12	7	6	9	17	**650**
%	63.8%	3.7%	23.1%	1.5%	1.8%	1.1%	0.9%	1.4%	2.6%	100.0%
Taguig	71	6	6	0	0	0	0	0	0	**83**
%	85.5%	7.2%	7.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Parañaque	26	2	0	0	0	0	0	0	1	**29**
%	89.7%	6.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.4%	100.0%
Muntinlupa	404	18	38	6	14	5	2	1	10	**498**
%	81.1%	3.6%	7.6%	1.2%	2.8%	1.0%	0.4%	0.2%	2.0%	100.0%
San Pedro	126	6	13	0	1	0	1	4	7	**158**
%	79.7%	3.8%	8.2%	0.0%	0.6%	0.0%	0.6%	2.5%	4.4%	100.0%
Biñan	994	46	60	4	8	5	6	8	10	**1141**
%	87.1%	4.0%	5.3%	0.4%	0.7%	0.4%	0.5%	0.7%	0.9%	100.0%
Sta. Rosa	208	7	14	0	2	1	2	0	3	**237**
%	87.8%	3.0%	5.9%	0.0%	0.8%	0.4%	0.8%	0.0%	1.3%	100.0%
Cabuyao	39	3	0	1	0	1	0	0	5	**49**
%	79.6%	6.1%	0.0%	2.0%	0.0%	2.0%	0.0%	0.0%	10.2%	100.0%
Calamba	2131	87	206	27	42	23	11	8	31	**2566**
%	83.0%	3.4%	8.0%	1.1%	1.6%	0.9%	0.4%	0.3%	1.2%	100.0%
NSRP Total	**4414**	**199**	**487**	**48**	**79**	**42**	**28**	**30**	**84**	**5411**
%	81.6%	3.7%	9.0%	0.9%	1.5%	0.8%	0.5%	0.6%	1.6%	100.0%

Source: JICA Study Team

3.4.2.3 Housing Availability and Programs

Manila

990. The present need of the City of Manila centers on the provision of housing units for relocated informal settlers and the upgrading of housing on site. In addition, the total housing need covers the housing of employees, as well as policemen, teachers, and other public employees those without their own homes.

991. There is a need for some 49,000 units for families to be relocated and 21,500 units to be upgraded on site, totaling to 70,500 housing needs for the informal settlers. Some 16,800 housing units will have to be provided to city employees, policemen, and teachers (Urban Settlements Office, Manila City CLUP and Zoning Ordinance, 2005-2020).

992. There is a housing backlog for the City of Manila based on the recorded number of upgraded and constructed housing units as of 2000. The Housing Program for informal settlers was only 5% accomplished, while the accomplishment for the Housing Program for government employees did not even reach 1%.

993. The relocation of informal settlers had mostly been off-city. Agencies such as the NHA and the DPWH, hadcollaborated with the city government in the relocation of these families. The City Government had initiated housing projects such as site upgrading for 1,145 families and the construction of new housing units for 1,705 families.

994. From the 2017 Commission on Audit (**COA**) Report25 the NHA 5-Year Plan (2011-2016) based on budget allocation indicated that the NHA had allocated for the construction of in-city housing for 970 priority informal settler families.

Makati

995. On the whole, Makati recorded a ratio of 105 households per 100 occupied housing units. This implies a backlog of five (5) housing units per 100 households in the City if the Housing Program goal is one house for each household (Makati City CLUP, 2013-2023).

996. One of the priority objectives of the City is to achieve zero informal settlers. It was for this reason that the City had purchased two (2) properties; one in San Jose Del Monte City, Bulacan (3.2 hectares) and another in Calauan, Laguna (40 hectares) and developed these into subdivisions where the informal settlers would be relocated. The relocation site in Bulacan is called "Dreamland Ville" while the one in Laguna is called "Makati Home Ville." Makati has Gawad Kalinga (**GK**) as its partner in this Relocation Program. The City purchased and developed the relocation site, GK, on the other hand, is responsible for the construction of houses and Community Development. The City also helps raise funds for the construction of the GK houses (Makati City CLUP, 2013-2023).

Taguig

997. Homeownership in Taguig was high (76%) but lot ownership was comparatively low (58%). 28% of residents were occupying, land for free, reflecting the occurrence of squatting. Single-detached homes comprised 69% of the housing supply (Taguig City, Comprehensive Land-Use and Zoning Plan).

998. The Socialized Housing Areas (**SHA**) are located in portions of Calzada, Napindan, Ibayo Tipas, Ligid Tipas, Bagong Tanyag, Western Bicutan, signal Village and Palingon. The SHA in Palingon is located in a still undeveloped area. On the other hand, undeveloped areas at the back of the residential and neighborhood facilities are along the Maestrang Pinang. The allocation for Socialized Housing Zone is 253 ha. or 5.58% of the total land area of Taguig (Taguig City, Comprehensive Land-Use and Zoning Plan). The 2017 COA Audit Report on the Housing Program of the NHA's 5-Year Plan (2011-2016), based on budget allocation, 720 priority ISFs were allocated budget for in-city housing[1].

Parañaque

999. Parañaque City utilizes the "pipeline housing projects," and "socialized housing" projects. In 2010, there were four (4) pipelined housing projects and ten (10) socialized housing projects in the city. There were two (2) NGOs who assisted the housing of informal settlers, the GK Kalinga and Habitat for Humanity with nine (9) and four (4) housing projects, respectively (*Source: Socioeconomic Profile of Parañaque, 2012)*

Muntinlupa

1000. The 2010 projection of the housing gap, or the discrepancy between the projected demand and the projected supply in housing, was 81,248 households with a projected household size of 3.74 individuals per household.

The land use allocation for Socialized Housing Site by the City Government was 111.81 ha. or 2.3941% of the total area of Muntinlupa (Muntinlupa City, CLUP 2001-2011)

San Pedro

1001. The City Urban Development and Housing Office (**CUDHO**) of San Pedro reported that the total housing units for 2010 was 61,284, which were all occupied. San Pedro is touted as a dormitory town for having more than a hundred subdivisions scattered in its 2,260-hectare area.

[1] Project Work Plan, Supra, p. 6, note 37. IN-CITY RESETTLEMENT HOUSING PROGRAM. Performance Audit Report, Commission on Audit (2017).
http://www.hudcc.gov.ph/sites/default/files/styles/large/public/document/NISUS%20Final%20Report_July2014.pdf

1002. There are two (2) resettlement areas in the city at Barangays San Antonio and San Vicente. Brgy. San Antonio caters to 2,574 housing units and families under the administration of the NHA and the LGU. Barangay San Vicente comprised of 137 housing units and families under the administration of the LGU, GK and Alaska Milk Corporation. To address the need for available land, the CUDHO identified potential land for housing in San Pedro. One site is owned by the local government located in Brgy. San Vicente in Bayan Bayanan which is classified for residential use. Another potential land for housing is an undeveloped and vacant land located in Brgy. San Antonio but privately owned. Homes in these potential lands for housing may be built with the help of the NHA (San Pedro City, Comprehensive Land Use Plan and Zoning Ordinance, 2013-2023)

Biñan

1003. Biñan has many housing subdivisions for low and middle-income families in many barangays done by real estate developers. Socialized housing like the Southville Housing Project provided by the NHA as in other places in San Pedro, Santa Rosa and Cabuyao proved to be difficult to implement in terms of adequate sites and services.

1004. The Southville resettlement site– a Mass Housing Project of the National Government for informal settlers in Metro Manila was established in Barangay Langkiwa with thousands of family beneficiaries. It has an area of fourteen (14) hectares.

Santa Rosa

1005. The population boom in the City is explained by the establishment of Southville Subdivision (Phase 1-9) – the Mass Housing Project of the National Government for informal settlers in Metro Manila. In the year 2014-2016 the City Government estimated 6,173 housing units (*City Urban Development and Housing Office, City of Santa Rosa*).

1006. As of 2013 through the efforts of the National Government, local government and some NGOs, 8,525 ISFs were given 8,517 housing units in resettlement areas in Barangays Caingin, Pooc, Pulong Santa Cruz. In Barangay Caingin, the National Government, through the NHA, provided 2,178 housing units to 2,178 families. In Brgy. Pooc 5,337 families were with 5,335 housing units through the combined effort of the NHA and the local government. In Brgy. Pulong Santa Cruz, a total of 1,010 family were provided with the same number housing units (*NHA/Civic Organization/Cooperative, City Planning and Development Office/Local and Urban Poor Affairs Office).*

Cabuyao

1007. According the Census of Population and Housing done by the PSA, the Occupied Housing units were 78,730 while the accompanying number of households was 81,573, excluding those in housing areas. There are many private subdivisions in Cabuyao offering house and lot (rowhouses, duplexes and single attached) thru Pag-ibig, SSS, GSIS and other financing loans. One of the biggest subdivision is the Mabuhay City in Brgy. Mamatid, Cabuyao, Laguna.

1008. The households living along the railroad considered to be within the danger zones were relocated to the NHA Housing Project, Southville Subdivision, a Relocation Project of the National Government about 55 hectares in Brgy. Niugan, Marinig and Banaybanay intended for households living along Cabuyao PNR and others from Makati area).

1009. Another survey conducted by the CPDO in 1999 estimated the potential socialized housing beneficiaries to be 2,072 families. The biggest number of beneficiaries came from Sala – 352 (16.99%); San Isidro – 344; Niugan – 339; and Banaybanay – 224 with a total of 1,259 families or a combined 60.76% of the total number of 2,072 beneficiaries. The beneficiaries of socialized housing were families living in danger zones and did not own houses nor lots. At present, there is no existing Housing Project for these potential beneficiaries (Cabuyao, CLUP and Zoning Ordinance, 2000-2010).

Calamba

1010. Some 76 informal settlers-families, who were relocated to safer grounds in the City's Banlic Suburb, were up for the "BagongBahay, BagongBuhay" Resettlement Program of the city government to start life anew and engage in a "cleaner, safer and homey" residential village. The chief of the Public Affairs Office of the Mayor stated that they will provide more than 100 more housing units to accommodate the transfer of priority ISFs from danger areas in the City.[26]

1011. The City Government is now sprucing up some 1,000 row-house units turned over by the NHA through its socialized housing scheme for poor households and informal settlers in Southville VI Housing, Brgy. Kay Anlog.[27]

3.4.3 Indigenous People Profile

1012. There are no indigenous peoples living within the vicinity of the NSRP. Most of the impact areas are fully industrialized. In NCR, no community of ndigenous peoples (**IPs**) is present. Based on NCIPCensus in year 2000IPs called the Dumagat/Remontado Tribe in the Laguna de Bay Region are present only in the Province of Rizal.[28] The Rizal Province is on the Northern and Eastern shores of Laguna Lake (Laguna de Bay), the NSRP will traverse along the Western and Southern shores of the Laguna Lake.

3.4.4 Historical and Cultural Heritage

1013. Table 3.4.11 shows the list of historical and cultural heritage declared by NHCP located in close proximity to the Project proposed alignment. In case heritage sites are predicted to have indirect impact by the project, DOTr will prepare preservation measures together with NHCP and the PNR.

Table 3.4.11 Historical and Cultural Heritage accredited by NHCP

No.	Heritage	Location	Distance from the Project (km)
1	Lord Justo Ukon Takayama Monument	Plaza Dilao, Paco, Manila	0.10
2	Alberto Rizal House*	Biñan, Laguna	0.85

Source: NHCP
*Locally declared by Biñan as a heritage site, house of Rizal's mother

1014. Within the project area, old PNR stations and railway bridge dotted along the proposed alignment. These structures are considered to meet the above-mentioned conditions and need for preservation. DOTr will consult NCCA, NHCP, NM and PNR for the qualification of those structures and provide necessary protection measure during construction. The structures over 50 years within the Project area are listed in Table 3.4.12**.**

Table 3.4.12 Old PNR Stations and Bridges within the Project Alignment

No.	Heritage	Location	Description
1	Solis Signal Tower (1916)	Solis St., Manila City, NCR	Structure is in good condition and maintained by PNR.
2	Abad Santos Signal Tower (1916)	Abad Santos corner Old Antipolo St., Manila City, NCR	Structure is in good condition and maintained by PNR.
3	Magsaysay Bridge (1960)	Ramon Magsaysay Blvd – Service Road cor PNR alignment, Sta. Mesa	Bridge shows art deco design. Parts of the bridge affected by LRT construction.
4	Pandacan Bridge (1938)	Boundary of Sta. Mesa and Pandacan, Manila City, NCR	Old Swing-over bridge gears to be excavated.
5	Paco Station (1913)	Quirino Avenue, Paco, Manila City, NCR	Structure is derelict with no roof. Parts of the structure have been demolished.
6	Vito Cruz Station (1931)	Malate, Manila City, NCR	Structure is in good condition and maintained by PNR.

[26] Jan. 10, 2018. Philippine News Agency. http://www.pna.gov.ph/articles/1021113
[27] SOCA 2014, August 28, 2014. http://www.calambacity.gov.ph/index.php/soca
[28] *Indigenous People (IP) Plan for the PhilWAVES Project in the Laguna de Bay Region.* Laguna Lake Development Authority (LLDA). URL: http://www.llda.gov.ph/dox/philwaves/ip-plan.pdf

No.	Heritage	Location	Description
7	Buendia Station (1931)	Santo Tomas, NCR	Structure is in good condition and maintained by PNR.
8	Alabang Station with auxiliary restroom (1959)	Alabang, Muntinlupa City, NCR	Structure is in good condition and maintained by PNR.
9	San Pedro Bridge (1940)	San Pedro, Laguna	Old Baily bridge to be excavated.
10	San Pedro Station and auxiliary bldgs. (1965)	San Pedro, Laguna	Structure is in good condition and maintained by PNR.
11	Pacita Station (1949)	San Pedro, Laguna	Structure is in good condition and maintained by PNR.
12	Biñan Station (1948)	Biñan, Laguna	Structure is in good condition and maintained by PNR.
13	Cabuyao Station (1949)	Cabuyao, Laguna	Structure is derelict, roof partially damaged.
14	Mamatid Station (1942)	Mamatid, Cabuyao, Laguna	Structure is in good condition and maintained by PNR.
15	Calamba Dormitories (1909)	Calamba, Laguna	Structure is in good condition and maintained by PNR.

Note: The list is based on visual validation conducted in March 2018

Source: JICA Study Team

3.4.5 Existing Social Infrastructure and Services

3.4.5.1 Power Supply

(1) Power Supply by Host LGUs

Manila

1015. As of 1995, the percentage of households connected to the distribution lines of the MERALCO is already more than 95% and has continued to increase.

The nerve center of the power supply of Manila is located at Solis Street, Tondo, which receives power from five (5) main sources – Caloocan, Navotas, Balintawak, Sta. Mesa and Tegen. The power requirement of the city stands at about 540 MW and is projected to increase in line with the increase in population.

Makati

1016. Electric power supply connections in all barangays of the city are provided by the MERALCO, which is the sole electric distributor for Metro Manila. MERALCO gets its bulk supply from the state-owned National Power Corporation (**NPC**). Electric power in Makati City is provided by the Luzon Grid of the NPC through five (5) Meralco sub-stations. These sub-stations are Forbes Park, Kamagong, Rockwell, Malibay, and Makati. Residential uses account for 87% of total Meralco connections in the city; commercial and industrial uses account for the 13% balance. In as much as all of the city's barangays have access to electricity, existing distribution lines and facilities must be closely monitored to maintain reliability of service.

Taguig

1017. Power upgrading and development of the Taguig Power System by Meralco will be made tandem to the development of Bonifacio Global City part of Taguig. Existing overhead power lines of Napocor and Meralco will be changed to underground system in the Taguig area. New and upgraded main power lines (high voltage and medium voltage) will be run underground) along the new C5 and C6 highway that run across Taguig. New sub-stations will be provided and existing substation will be upgraded to meet the power demands of Taguig as a City.

Parañaque

1018. MERALCO supplies the power needs of Parañaque. Power service is distributed to the following types of consumers: residential, commercial, and industrial purposes.

Muntinlupa

1019. MERALCO supplies the power needs of Muntinlupa. It supplies to an estimated 100,642 residential units, 9,774 commercial units, 74 industrial units and 114 streetlights. In 2016, an

estimated of 98.56% households have electric power supply. The existing power sub-stations in the city are Ayala-Alabang Substation located in Alabang, Muntinlupa -Filinvest Substation located in also in Alabang and Gardner Substation in Sucat.

San Pedro

1020. The sole electricity distributor of San Pedro is MERALCO. In 2010, 98% of households were well served with electricity. Only 2% of households remain unserved. The capacity and efficiency of the electric power supply system is good. Electricity is available 24 hours a day with no shortages. MERALCO upgrades its equipment and facilities as the need arises to provide San Pedro with adequate electricity.

1021. According to the MERALCO, the most number of connections in San Pedro are residential with 61,726 connections, followed by commercial types with 5,956 connections, public streetlights with 136 connections and, lastly, industrial with only 71 connections.

Biñan

1022. All barangays are presently energized. As of 1998, there were about 39,902 house connections. NPC generates power and feeds/transmits this to the MERALCO's Power Distribution System. MERALCO estimates that they service at least 96% of the population. MERALCO commercial and industrial connections/customers as of 1998 are placed at 3,200 and 115, respectively (2018 Biñan Eco Profile and Sectoral Situational Analysis).

1023. The Power Supply System of the City of Biñan is generated by power plants operated by the National Grid Corporation of the Philippines (**NGCP**) and by independent power producers (**IPPs**) which are in strategic parts of Luzon (Biñan City CLUP, 2018-2027).

Sta. Rosa

1024. Power Supply in South Luzon Region including Santa Rosa City is generated by power plants operated by the NPC and by IPPs located in strategic parts of Luzon and supplied to the Luzon Grid attaining a capacity of 9,158 megawatts. Some power plants are located in the region, especially in the Province of Laguna (Makiling Banahaw Geothermal Power Plant), Batangas (Calaca Coal Fired Power Plant) and Quezon (Pagbilao and Hopewell Coal Fired Power Plant). Power is distributed by MERALCO(Socioeconomic and Physical Profile of Santa Rosa, 2013).

Cabuyao

1025. All barangays except some part of Brgy. Casile have electricity. Cabuyao is being served by MERALCO.

Calamba

1026. In 2007, the entire City of Calamba is fully equipped with electricity through the MERALCO and NPC. Meralco’s two sub-stations facilitate the flow of electricity in the locality. These are located in Barangay Mayapa while its administration building is located at the Crossing area of Barangay 1. NAPOCOR’s power supply is provided by various power plants including the Makban Geothermal Power Plant (2007 Socio-economic Profile of Calamba City).

The number of MERALCO’s customers for 2001 totaled to 65,739 from 55,481 in 1998. Connections are categorized as: residential, commercial, industrial and streetlights.

(2) Power Supply of PAFs

925. 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% have no electricity connection, with the proportion of those with no electricity connection being highest in Cabuyao.

Table 3.4.13 Access to Electricity per LGU

City	Access to Electricity						
	Own Electric Meter for Power Connection	Shared Connection	No Connection	Others	N/A	N/R	Total
City of Manila	978	492	24	40	0	7	**1,541**
%	63.5%	31.9%	1.6%	2.6%	0.0%	0.5%	100.0%
Taguig	53	140	23	3	0	1	**220**
%	24.1%	63.6%	10.5%	1.4%	0.0%	0.5%	100.0%
Parañaque	1	30	2	2	0	0	**35**
%	2.9%	85.7%	5.7%	5.7%	0.0%	0.0%	100.0%
Muntinlupa	366	371	149	13	0	2	**901**
%	40.6%	41.2%	16.5%	1.4%	0.0%	0.2%	100.0%
San Pedro	57	91	79	4	1	0	**232**
%	24.6%	39.2%	34.1%	1.7%	0.4%	0.0%	100.0%
Biñan	437	1,257	188	11	5	9	**1,907**
%	22.9%	65.9%	9.9%	0.6%	0.3%	0.5%	100.0%
Sta. Rosa	77	249	88	8	5	6	**433**
%	17.8%	57.5%	20.3%	1.8%	1.2%	1.4%	100.0%
Cabuyao	9	28	39	1	1	0	**78**
%	11.5%	35.9%	50.0%	1.3%	1.3%	0.0%	100.0%
Calamba	1,685	2,308	229	41	9	19	**4,291**
%	39.3%	53.8%	5.3%	1.0%	0.2%	0.4%	100.0%
NSRP Total	**3,663**	**4,966**	**821**	**123**	**21**	**44**	**9,638**
%	38.0%	51.5%	8.5%	1.3%	0.2%	0.5%	100.0%

Source: JICA Study Team

3.4.5.2 Water Rights/Supply

Manila

1027. The City is being served by two (2) concessionaires in the distribution of its water supply namely: Maynilad Water Services Inc. (**MWSI**) and Manila Water Company (**MWC**). The coverage service area of MWSI includes Tondo, Sta. Cruz, Quiapo, Sampaloc, Sta. Mesa, Pandacan, Binondo, San Miguel, Ermita, Malate, Intramuros, and part of Singalong. MWC on the other hand covers Sta. Ana, and part of Singalong. As of 2002 the average monthly consumption in million cubic meters in Manila was about 3.12 for residential areas, 0.26 for residential households with business, about 1.7 for commercial areas and about 0.29 for industrial areas.

Makati

1028. Manila Water Company and Maynilad provide water service in Makati City through several primary distribution mains. Domestic use accounts for 93% of the total water consumption in the city; commercial use accounts for 5% while industrial and government uses account for the remaining 2%. As of 1995, 91.5% of households had direct water access (through household/ communal water faucets). About 5.8% sourced their water from public faucets while 1.2% of households buy water from water peddlers. Other sources of water include deepwells, dug wells, rain and water bodies. In 2011, 97.50% of households in Makati were considered to have access to safe drinking water. Data from the Makati Health Department from 2009-2011, however, indicated a decrease in the total number of households served from 2010 to 2011.

Taguig

1029. Metropolitan Water Works and Sewerage System (**MWSS**) provide water service in Taguig City. There are one (1) MWSS Installed Deepwell in the city, three (3) public artesian wells, 50 commercial (private) deepwells and four (4) shallow deepwells used by plant growers[29].

Parañaque

1030. Much of the water supply of City of Parañaque comes from Maynilad Water whereas a number of pumps and artesian wells especially those in the mission areas are still in used. Water supply is no longer the major problem of the residents (Parañaque Socioeconomic Profile, 2012).

Muntinlupa

1031. At present, Maynilad is the main water supplier of the city besides Prime Water who got a license to extract groundwater for its Camella Properties. In 2016, there were 78,440 household (97.92) with access to safe water (Muntinlupa City Ecological Profile 2016).

San Pedro

1032. The San Pedro Water District is the sole distributor of potable water supply in San Pedro. It has a total of 24,769 service connections with residences having the most number of connections, followed by commercial and government connections. In 2011, the San Pedro Water District supplied 623,729 cubic meters of water per month: 547,101 cubic meter /month for residential, 26,900 cubic meter/month for commercial and 49,728 cubic meter/month government use. Private subdivisions have their own water distribution systems. Both source their water from groundwater.

1033. Despite the presence of a local waterworks system, of the total household population of San Pedro in year 2009, 11,473 households or 18% got their water from level I sources or point sources such as rain collectors, wells, and springs. Another 2,549 households or 4% got their water from level II sources such as communal faucet systems. 49,728 households or 78% got their water from level III source or a local waterworks system (Municipal Health Office, 2009).

Biñan

1034. The City of Biñan sources its water from Laguna Water. Some barangays utilize deep wells as their source of water supply.

Sta. Rosa

1035. As of 2013, a total of 65,807 households (94% of total households) in Santa Rosa City hah access to safer water. Of those who had access, 65% were served by Level I and 35% by Level III Systems. There were no households with access to Level II access to water. Level III system is operated by the Laguna Water Management Services Corporation, a subsidiary of the MWCI. The Laguna Water sourced the water supply from the Matangtubig Springs in Cabuyao. The rest of the individual households relied on groundwater for drinking and domestic uses through water wells (Level I). The Level III Water System had poor level of service characterized by low to zero pressure during peak demand, high non-revenue water due to presence of leaks in pipes, and old and undersized pipes (Santa Rosa City, Socio-economic and Environmental Profile, 2014-2015).

1036. On the other hand, Level I Systems were not monitored and this can lead to groundwater exploitation. Based on the available 1998 data, groundwater extraction had already reached 60% of the safe groundwater yield. Santa Rosa had 110 groundwater permits (domestic, commercial, industrial, and irrigation, municipal) with a total extraction of 1,431.616 liters per second (**lps**). The specific capacity of the wells within the vicinity of Santa Rosa ranged from 1 to 30 liter per second per meter (l/s/m). Of these 35 water rights/permits for domestic water supply, all of which were sourced from groundwater, have been issued by the National Water Resources Board (**NWRB**).

[29] Source: Taguig City Comprehensive Land Use Program

Cabuyao

1037. Generally, water for domestic use in Cabuyao is taken from deep and shallow wells except in the Poblacion areas. Laguna Water formerly Triple A (formerly Provincial Waterworks System) manages the water supply for the urban area of Cabuyao, whose source is the Matang Tubig Spring, located some 11 km. away from the Poblacion. It services not only Cabuyao but also the cities of Sta. Rosa and Biñan. Aside from it, there is also Cabuyao Water District, wherein the office is located at Katapatan Subd., Banaybanay, Cabuyao, Laguna. It serves the Katapatan Subdivision and a portion of Mabuhay City Subdivision in Brgy. Mamatid, Cabuyao, Laguna.

1038. The remaining households in Cabuyao depend on other sources of water as Level I (spring development) and Level II (communal faucet).

1039. The heavy concentration of deep wells is found in the barangays located in the eastern part of the town near the lake. These barangays include Baclaran, Banaybanay, Butong, Gulod, Marinig, Pulo, Niugan, San Isidro, Banlic and Diezmo.

Calamba

1040. Calamba Water District maintains the Water Piped System in the city through the spring and well sources located in Barangays Bucal and Barangay 1 (Crossing). These are considered main water sources of the company with four (4) pumping units in its Bucal Spring Source area.

1041. Households not connected to the Piped Water System depend on deep wells and shallow wells. Many use a combination of sources for their supply. Based on the 1990 DILG Inventory, at least 800 Levels 1 & 2 water systems were in Calamba.

3.4.5.3 Pipeline

1042. The existing pipeline of First Philippine Corporation is located west of the proposed alignment. It runs along the National Highway in Muntinlupa City going north along the South Luzon Expressway (**SLEx**). The Black Oil Line has a branch going to the decommissioned STPP. **Figure 3.4.1** and **Figure 3.4.2** show the location of the oil pipe line and the PNR ROW which is the proposed alignment of NSRP.

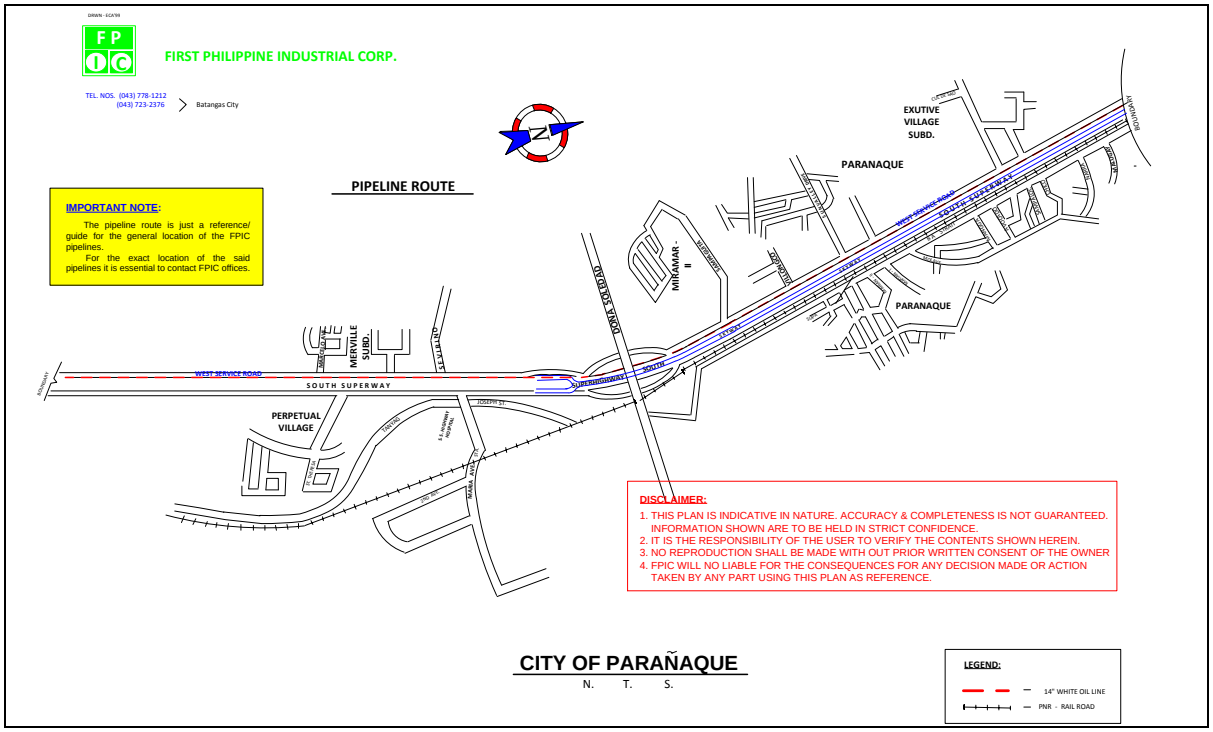


Figure 3.4.1 Pipeline Location at City of Parañaque

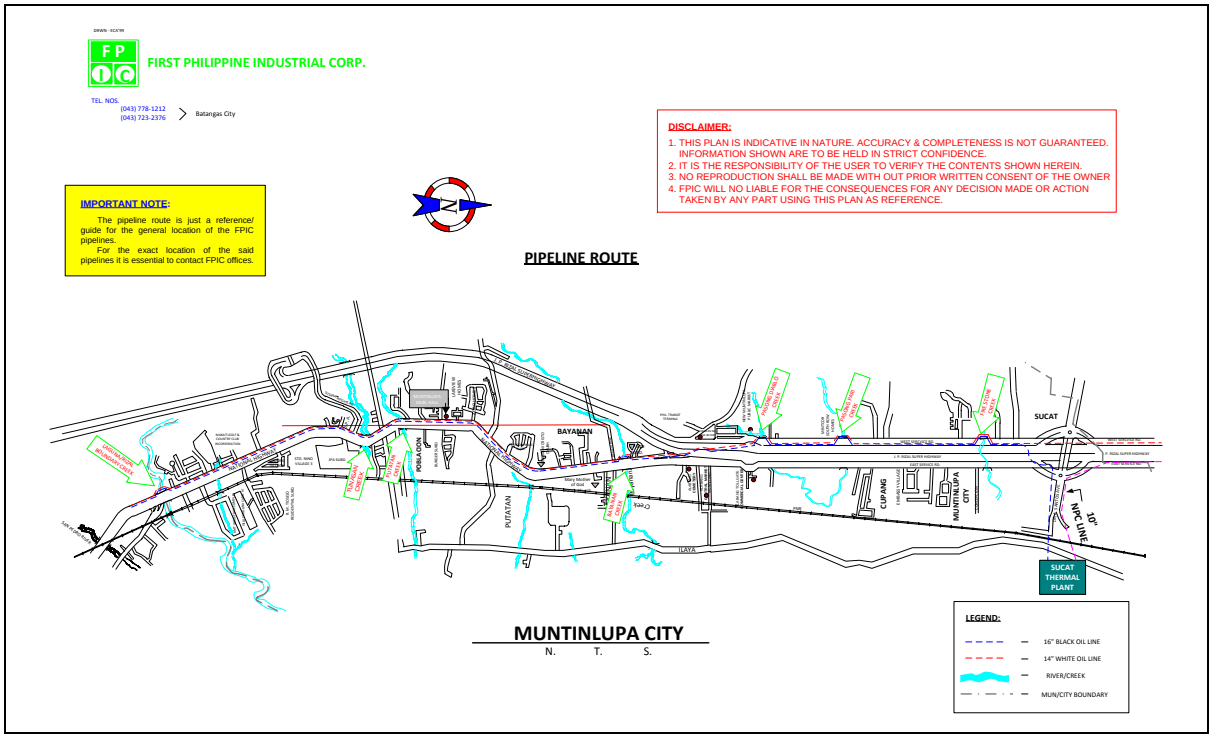


Figure 3.4.2 Pipeline Location at Muntinlupa City

3.4.5.4 Open Space and Recreational Area

Manila City

1043. As of year 2000, there are 53 public plazas in the City of Manila maintained by the Parks Development Office, occupying a total land area of 119, 120 square meters. This translates to a plaza-population ratio of 75 square meters per 1,000 population, which is inadequate, reflecting the scarcity of open space in the city. Figure 3.4.3 shows the existing open spaces and recreational areas in Manila City. The open spaces and recreational areas near or within the vicinity of the proposed NSRP alignment are listed below.

Source: MCLUPZO (2005-2020), Manila City

Figure 3.4.3 Existing Open Spaces and Recreational Areas in Manila City

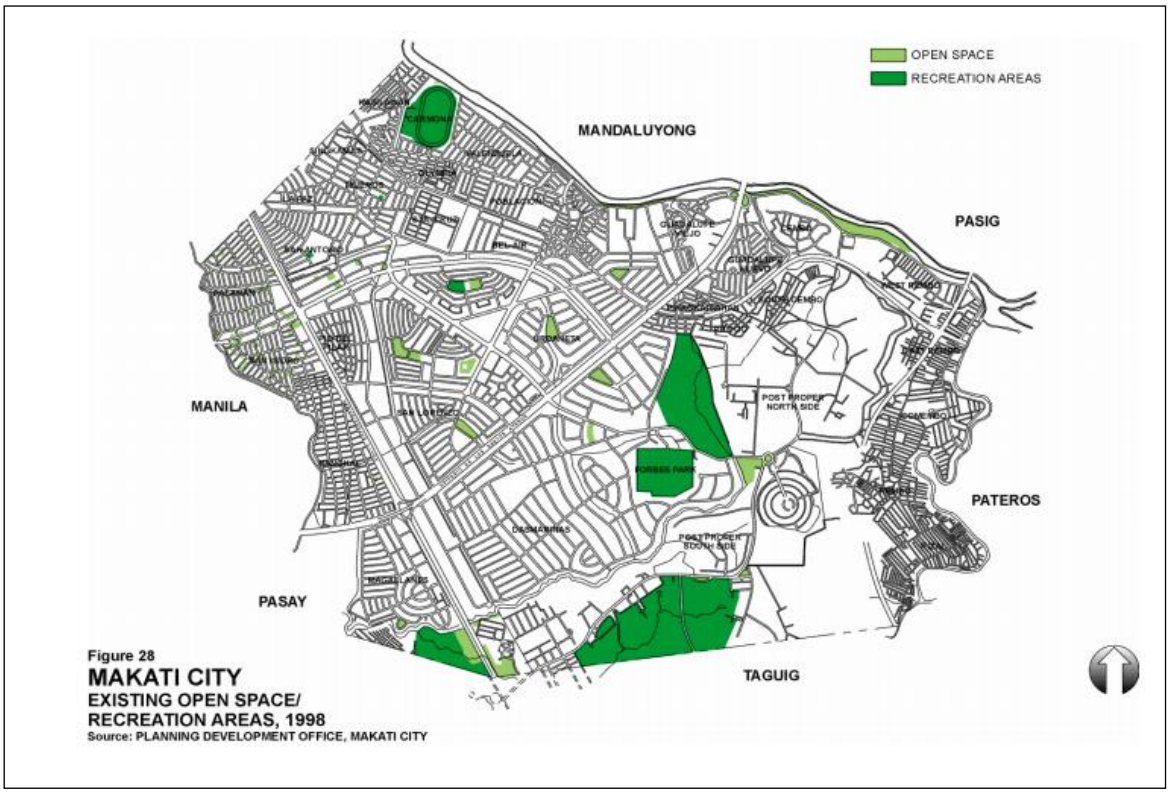
Table 3.4.14 Open Spaces and Recreational Areas in Manila City

Open Spaces And Recreational Areas	
Public Plaza	a. Plaza Dilao b. Plaza Lawton
Basketball Court	
Distric II	c. Almeda-Laguna Basketball Court d. Cavite Basketball Court e. Maria Guizon Basketball Court f. Solis-Dagupan Basketball Court g. T. Bugallon Basketball Court
District IV	h. Craig Basketball Court
District V	i. A. Borja Playground j. F. Munoz Basketball Court k. Gutierrez Basketball Court
District VI	l. Punta Tenement Basketball Court m. Ricasa Playground

Makati City

1044. As of 1998, approximately 7% of the city's total land area functioned as open/recreational space, excluding memorial parks (classified as institutional space), sidewalks, center islands, and roads/streets.

1045. The major parks or green spaces (whether officially designated or functioning as part of commercial developments) in the city are: Libingan ng Bayani and American Cemetery in Fort Bonifacio, Greenbelt in the CBD, Guadalupe Nuevo and Guadalupe Viejo Cloverleaf parks along Edsa, the Magallanes Interchange Park, the Poblacion Park along JP RizalAvenue, and Liwasang Makati along the Pasig River frontage.



Source: CLUP (2013-2023), Makati City

Figure 3.4.4 Existing Open Space/Recreation Areas in Makati City

Taguig City

1046. The Open Space Areas (**OSA**) in Taguig City include the American Memorial, Libingan ng mga Bayani, Heritage Park and Philippine Navy Golf Club and a 20-meter strip to the west of C-5 from the East Service Road to the Libingan ng mga Bayani. These also include the mandated 10-meter easement along Pasig River and its tributaries as mandated by MMDA Ordinance No. 81-01 and the easement provisions of the Philippine Water Code. The OSA shall be maintained as functional open spaces with proper landscaping and park amenities and facilities.

1047. Parks and recreational facilities in the city include Lakeshore Dike--Ilog Labasan/Laguna Lake and Brgy. Hall Children Playground. Basketball courts include one (1) covered court, two (2) open courts and two (2) half courts. The covered court is located in SEPVHOA Compound while the open courts are located in Ayo Compound and Daang Manunuso and the half courts are located Cruz Compound and BPTHAI Multi Purpose Hall.

Parañaque City

1048. According to the 2012 Socio-Economic Profile of Parañaque City, about 114,929 hectares of the total land area of the city were parks and playgrounds.

1049. The Palasan Area in Barangay San Dionisio and the Tropical Funland area in Barangay BF Homes are two (2) of the recreational zones in Parañaque. The remaining largest portions of the marine ponds are located along Ninoy Aquino Avenue and Dr. A. Santos Avenue from La Huerta to SM City-Sucat of San Dionisio extending west to Las Piñas boundary and scattered small portions of open spaces within the subdivisions of Barangay Merville, Don Bosco, Marcelo Green, San Dionisio, San Isidro and BF.

Muntinlupa City

1050. Open spaces in Brgy. Putatan include areas within Camella Homes I bounded by Camella Drive, Jasmine, and Iris. In Brgy Tunasan, selected areas within Susana Heights. Listed below are the parks and recreational areas within Muntinlupa.

Table 3.4.15 Open Spaces and Recreational Areas in Muntinlupa City

Barangay	Parks and Recreation
Alabang	n. Liwasan ng mga Bayani
Ayala Alabang	o. Specified areas in Madrigal Business Park p. Tanauan Park q. Ma. Cristina Park r. Polilio Park s. Palawan Park t. San Jose Park u. San Juanico Park v. Guava Park w. Makiling Park x. Mabolo Park y. Alabang Country Club
Sucat	z. Area in Posadas Village bounded by Our Lady of Miraculous Medal, Peridot St., Emerald St., and Diamond St. aa. Area bounded on the East by railroad tract and on the South by Sucat Avenue
Cupang	bb. Area located in Pacific Village bounded by Habeneria St., Vanda St., Aeridis St., and A. Roxas Chua Circle cc. Area located in Alabang 400 bounded by a horseshoe shaped inner road next to Belmont drive dd. Area located in Alabang Hills, Phase 1 bounded by Tagaytay St., Tagbilaran St., and Tangub St.
Tunasan	ee. Joseph Marello Park

San Pedro City

1051. The most visited destinations in San Pedro are Santo Sepulcro Shrine and TAT Pilipinas Golf Course. TAT Pilipinas Golf Course makes up the bulk of the total land area allotted for tourism at 86.01 hectares or 3.80% of total land area.

1052. There are a total of 68 covered and open basketball and volleyball courts in the municipality. Most of them (26) are located in Brgy. San Vicente. There are no sports facilities located in Brgy. Laram.

Sports and Recreational Facilities in San Pedro City in 2011 are listed below.

Table 3.4.16 Open Spaces and Recreational Areas in San Pedro City

Sports and Recreational Facility	Owned by Barangay/ City Government	Owned by Home Owners Assoc	Total
Covered Basketball/Volleyball Court	10	18	28
Open Basketball/Volleyball Court	9	31	40
Tennis Court	0	12	12

Playground	2	25	27
Park	2	0	2
Swimming Pool	0	2	2

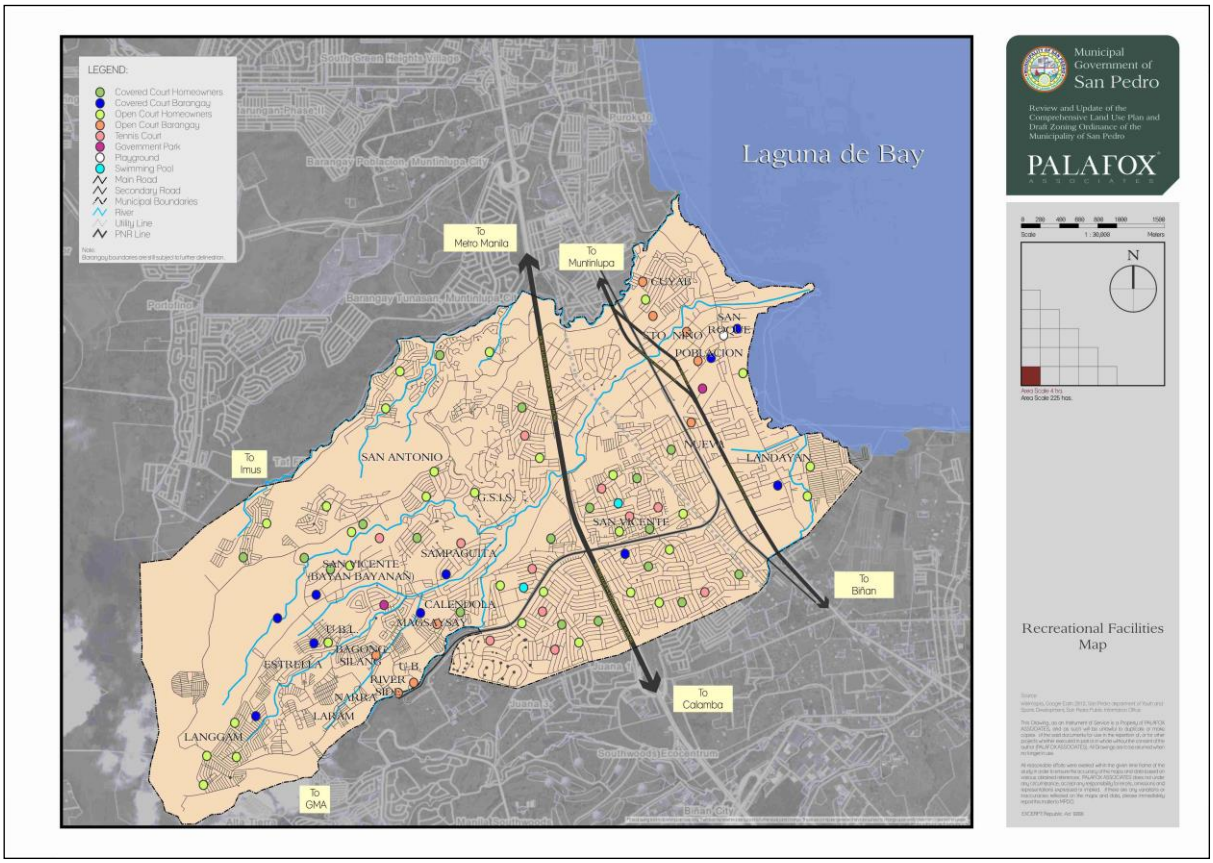


Figure 3.4.5 Existing Open Space/Recreation Areas in San Pedro City

Biñan City

1053. The Recreational Development Zones of the city are located in Southwoods Golf Course, Splash Island in Barangay San Francisco, the Alonte Sports Arena, Track and Field in Barangay Zapote, and small private resorts, tennis and badminton courts scattered around the city. Barangays have covered courts used for basketball tournaments. The zone should also include hotels, mini parks, green areas, jogging areas, and swimming pools, others consistent with live, work and play lifestyle.

Table 3.4.17 Open Spaces and Recreational Areas in Binan City

Recreational and Sports Development Zone	Land Area		% Share
1. Southwoods	15		0.34
2. Splash Island	10		0.23
3. Alonte Sports Arena	3		0.07
4. Track and Field	5		0.11
5. Small Private Resorts/Sports Centers	50	1.15	

Sta. Rosa City

1054. Catering to the municipal residents and guests is a host of privately-operated recreation facilities (e.g. bowling alleys, tennis courts, movie houses, swimming pools and the popular theme

park, Enchanted Kingdom). Of the eighteen (18) barangays, fifteen (15) have public basketball courts and six (6) have private basketball courts. Refer to Table 3.4.18**.**

Table 3.4.18 Location and Number of Sports/ Recreation Facilities, 1990

Name of Brgy. and Location	Private	Public	General Condition
Basketball Courts:			
Brgy. Aplaya (Elem. School)	1	-	good condition
Brgy. Caingin (Elem. School)	1	-	good condition
Brgy. Balibago	5	4	good condition
Brgy. Dila	2	2	good condition
Brgy. Dita	7	-	good condition
Brgy. Don Jose	1	4	
Brgy. Ibaba (St. John Subd.)	2	-	good condition
Brgy. Labas (Olympia Subd.	1	-	good condition
Brgy. Macabling	1	-	good condition
Brgy. Malitlit	1	1	good condition
Brgy. Malusak	-	1	good condition
Brgy. Market Area	2	-	good condition
Brgy. Pooc	-	1	good condition
Brgy. Pulong Sta. Cruz	1	-	
Brgy. Sinalhan	1	-	good condition
Brgy. Sto. Domingo	1	-	
Brgy. Tagapo Elem. School	4	-	good condition
Tennis Courts / Pelota Courts			
Brgy. Kanluran	X	-	
Brgy. Pooc	X	-	
Brgy. Tagapo	X	-	
Table Tennis			
Brgy. Ibaba (ROLAS)	X	-	
Swimming Pool		-	
Adanas	X	-	

Source: MDPC, Santa Rosa

Cabuyao City

1055. Of all the sports facilities present in this municipality, basketball courts ranked number one, with eighteen (18) courts in fourteen (14) barangays. This stems from the fact that Filipinos are basketball aficionados. This is followed by table tennis with ten (10) facilities in five (5) barangays.

1056. There are two (2) movie houses located at Barangay Dos. For golf enthusiasts, the municipality has a golf course open to the public at Barangay Pittland.

Table 3.4.19 Sports and Recreational Facilities, Cabuyao

Facility	Location	No.
1. Basketball Court	Gulod, Banaybanay, Pulo, Marinig, Banlic, Bigaa, Niugan, Pittland, Mamatid, Sala, Brgy. Uno, San Isidro, Casile, Baclaran	18
2. Volleyball Court	Gulod, Marinig, San Isidro	4
3. Softball Court	Banaybanay, Pulo, Pittland	3
4. Tennis Court	Barangay Uno, Baclaran	2
5. Billiard Table	Marinig	3
6. Table Tennis	Banlic, Bigaa, Mamatid, Brgy. Dos, San Isidro	10
7. Swimming Pool	Mamatid, Sala, Baclaran	4
8. Gymnasium/Plaza	Brgy. Uno	1/1
9. Golf Course	Pittland	1
10. Mini-Resort	Sala, Mamatid	2
11. Moviehouse	Brgy. Dos	2

Source: MPDC Office**,** Cabuyao, Laguna

Calamba City

1057. Calamba City, now considered the "Hot Spring Capital of the Country", offers the best resort accommodations with modern facilities and amenities. It is known as a good hideaway for pleasure and relaxation for people wanting to put hold or escape their present pressure. Most of the resorts are located in Barangays Pansol, Bagong Kalsada and Bucal, all adjacent to Los Baños where Mt. Makiling silently resides.

1058. There were only three (3) listed recreational facilities in the Calamba City website (www.calambacity.gov.ph).

3.4.5.5 Education

1059. Table 3.4.20 shows the number of public and private elementary, high school and college/universities in the host LGU of the proposed NSRP.

Table 3.4.20 Educational Facilities per LGU

City	Year	Elementary School		High School		College/ Universities	
		Public	Private	Public	Private	Public	Private
Manila	1999	68	41	32	29	7	67
Makati	1996	28	15	5	12	2	18
Taguig	2005-2006	69[a]	89[a]	9	15	2[b]	5[b]
Parañaque	-	22	66	11	33	1	14
Muntinlupa	2015-2016	19	64	11[c]	53[c]	2	14
San Pedro	2011-2012	20	81[d]	7	81[d]	1	13
Biñan	2016	26		8		8	
Sta. Rosa	2014-2015	18	86	7	86	1	
Cabuyao	2013	19	91	7	43	1	4
Calamba	2008	51	82	16	42	1	16

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, Muntinlupa, San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba City

Manila

1060. As of 1999, there were 109 elementary schools including day centers and kindergartens in the City of Manila. Sixty eight (68) of which were public and 41 were private. There were 32 public and 29 private highschools in the city. There were 74 collegiate institutions; seven (7) were public and 67 were privately-owned. As of school year 2003-2004, there were 74 pre-elementary school in Manila City. There were alsoone (1) public and eight (8) privately-owned vocational schools in the city.

Makati

1061. In 1996, the city had 28 public elementary schools and five (5) public secondary schools. The Pamantasan ng Makati is the only public higher education institution owned and operated by the city. Private schools included six (6) elementary, three (3) secondary and nine (9) schools offering prep, elementary and secondary levels of education. The city also had 33 vocational, technical, and special schools and eighteen (18) private higher learning institutions such as Ateneo de Manila University and the Asian Institute of Management.

Taguig

1062. As of S.Y.2005-2006, there were 158 elementary schools in Taguig City. Sixty nine (69) of which were public and 41 were private. There were nine (9) public and fifteen (15) private high schools in the city. There were seven (7) college/university/vocational institutions; two (2) were public and five (5) were privately=owned.

Parañaque

1063. There were (22 public elementary schools and 66 private schools that cater to the formal education of children from six to twelve years old in the City of Parañaque. There were eleven (11) public high schools and 33 private high schools. There is a total of fifteen (15) collegiate institutions; one (1) is public and fourteen (14) are privately owned. Also, the city has 128 pre-elementary school.

Muntinlupa

1064. In 2015-2016, there were nineteen (19) public elementary schools and 64 private schools cater the formal education of children from six to twelve years old in the City of Muntinlupa. There were eleven (11) public high schools and 53 private high schools including the institutions which offer junior and senior high school. There weresixteen (16) collegiate institutions; two (2) were public and 14 were privately- owned.

San Pedro

1065. In 2011-2012, there were twenty (20) public elementary schools and seven (7) private secondary schools in the City of Parañaque. There were 81 private elementary and high schools in the city. There were also fourteen (14) collegiate institutions; one (1) was public and thirteen (13) were privately-owned (San Pedro CLUP, 2013-2023).

Biñan

1066. In 2016, the City of Biñan had 26 elementary schools, eight (8) high schools and eight (8) colleges (Biñan City, CLUP).

Sta. Rosa

1067. In 2013, there were eighteen (18) public elementary schools in Sta. Rosa (DepEd, City of Sta. Rosa). There were seven (7) public secondary schools in Sta. Rosa City. For the School Year 2014-2015, there were 86 private elementary and secondary schools operating in the City of Santa Rosa. Polytechnic University of the Philippines – Santa Rosa Campus is a state university located at the New Santa Rosa Village, Brgy.Tagapo, City of Santa Rosa, Laguna.

Cabuyao

1068. Cabuyao City hosts one (1) public university (University of Cabuyao) and four (4) pivate institutions for tertiary education. It also has seven (7) public high schools and forty-three (43) private high schools. The City has ninetee (19) public elementary schools and 91 private elementary schools. The public pre-elementary schools were recorded to be nineteen (19) public and 97 private establishments. There is one (1) school for special education. The City has an Alternative Learning System (**ALS**) in eight (8) of its barangays (Cabuyao Ecological Profile, 2013).

Calamba

1069. In School Year 2007-2008, there were a total of 425 schools in the city. There were 208 pre-elementary schools; 105 of which were public and 103 were private[30]. There were a total of 133 elementary schools, 51 of which were public and 82 were public elementary schools. There were sixteen (16) public and 42 private highschools in the city. There were seventeen (17) collegiate institutions; one (1) public and sixteen (16) privately-owned. For vocational schools, there was one (1) public and eight (8) privately-owned.

[30] As of School Year 2003-2004

3.4.5.6 Communication

Manila

1070. The Philippine Long Distance and Telephone Company (**PLDT**) monopolizes the telephone system in the City of Manila. PLDT's microwave network linked its various exchanges with those owned by another telecommunications network. Other telecommunication systems available in the city consist of mobile phones. Major service providers include Globe Telecom and Smart Communications.

Makati

1071. The Philippine Long-Distance Telephone (**PLDT**) and Globe Telecom are the major providers of land-based telephone services in the City. Smart Communications, Globe Telecom, and Sun Cellular are the major mobile phone service providers operating in the city.

1072. There are four (4) international record carriers and stations in the city, which includes Eastern Telecommunications Philippines, Inc., Globe Telecom, Philippine Global Communications, and Capitol Wireless, Inc. Postal services are provided primarily through four (4) postal offices: a central postal office in Sen. Gil Puyat Avenue and three (3) other postal offices located in Districts I and II.

1073. There are five (5) FM radio stations, three (3) AM radio stations; two (2) cable operators and two (2) satellite television providers in Metro Manila servicing the city. There are also two (2) television stations and six (6) publishing houses based in the city. Existing telecommunication facilities meet the standards set by the HLURB and show that the city's communication level is adequate.

Taguig

1074. PLDT and new telecommunication companies like SMART are starting to provide Taguig with new telephone lines. New telecom centers, fiber optics communication networks, and satellite links are provided to meet the communication requirements of Taguig. (Taguig City, CLUP)

Parañaque

1075. Four (4) telecommunication companies serves Parañaque namely: Globe, Smart, PLDT, and Sun Cellular. Parañaque Central Post Office and an annex in the City Hall serves the postal system.

Muntinlupa

1076. In 2016, there were seven (7) telecommunication companies that served Muntinlupa namely: Globe, PLDT, Sun Cellular, JFM Installation & Telecom Services Inc., APN Philippines, Inc.,PHILIPPINES, INC., INNOVE Communications Inc., and Universal Storefront Services Corp.

San Pedro

1077. There are two (2) telephone companies that operate in San Pedro: PLDT and Digitel. They provide local, long distance, domestic, and international communication services. There are two (2)cellular sites in San Pedro. These are owned by Smart Communication, Inc. located at Fr. Masi St., Barangay San Antonio and Globe Telecom located at the back of Jo Commercial, National Highway, Barangay Nueva. Services provided by mobile telephone companies include voice calls, text messaging (**SMS**) and internet access.

1078. There are no broadcasting services in San Pedro. television cable services are provided by Sky Cable. postal services are provided through the PhilPost Office located in Pacita Complex, Barangay San Vicente. Internet service providers include PLDT, SKY, Globe, Sun Cellular and Smart (City Government of San Pedro, CLUP and Zoning Ordinance 2013-2023).

Biñan

1079. Telecommunication giants Smart Communications and Globe Telecom service the cellular/mobile telephone needs of Biñan while fixed landline telephone services are provided by PLDT and Intelco.

Sta. Rosa

1080. Telecommunication services in Sta. Rosa include fixed landline telephone (by PLDT, DIGITEL), cellular/mobile telephone (Smart, Globe and Sun Cellular) and broadband carriers (Globe, Smart, PLDT, Bayantel). Internet Service Providers (**ISP**) is powered by fiber optic cable network infrastructure and wireless technology. Courier services are provided by private entities like DHL, FEDEX and LBCAIR. National and local newspapers and broadsheets circulate regularly. Satellite antenna - based cable TV stations – Royal Cable, SkyCable and Cignal Cable operate in all areas. (Socio-economic and Physical Profile of Sta. Rosa, 2013)

Cabuyao

1081. A public post office and telegraph is found in the city compound of Cabuyao. The Cabuyao Post Office has fourteen (14) staff and one (1) staff for telegraph office.

1082. Two (2) telephone companies (PLDT and DIGITEL) and a number of sites for cellular phones (Smart, Globe Digitel) are present in Cabuyao. These serve the telecommunication needs of the residents as well as businesses in the town. There are 32 cellsite towers in Cabuyao to provide better telecommunication in the area. (Cabuyao MPDC 2009)

Calamba

1083. The telecommuncitions company present in Laguna include: The Sunshop (Suncellular-Digitel); Smart Communications (Smart Communications, Incorporated); Globe (Globe Telecom, Incorporated); andPLDT.

3.4.5.7 Peace and Order (Protective Services)

Manila

1084. In 2005 the city had eleven (11) Police Stations and 40 Police Sub-stations with 2,984 uniformed personnel of which 441 accounted for the traffic police of the 170 outposts. At that time, there was one policeman per 622 populations (short of 619 policemen that are needed to meet the PNP manning level standard of 1 policeman per 500 populations). In addition, there was one (1) traffic police per 3,585 (short of 86 traffic police personnel needed to meet the standard of 1 traffic police per 3000 population). To date, it cannot be determined yet whether these were met until the city completes its latest SEP.

1085. Theft and robbery are the two (2) most common crimes in the City of Manila which account for 39% each of the recorded cases of crime. This is followed by physical injury (10%). The City of Manila has fifteen (15) fire stations manned by 335 personnel. There are also several volunteer fire brigades such as the Association of the Philippine Volunteer Fire Brigade (Source: Manila City CLUP 2005-2020).

Makati

1086. Makati has a total of nine (9) police precincts scattered in different locations within the city, a police headquarters (main) and a traffic management group, with a total of 489 personnel, 57 vehicles and 33 motorcycles. In 2011, there were a total of 1,112 crimes; a crime solution efficiency of 76%. Fire protection facilities and equipment include a fire station (main) and ten (10) sub-stations with 119 fire protection personnel, eleven (11) fire trucks and one (1) ambulance (Makati City CLUP, 2013-2023).

Taguig

1087. Taguig City is home to the Philippine National Police-National Capital Region Police Headquarters, the PNP Special Action Force, as well as the army, navy, and marine camps. It is also near an air-support security facility, the Villamor Air Base.[31]

[31] Taguig City Official Website: Security and Transportation; url: http://www.taguig.gov.ph/our-city/peace-and-order/

Parañaque

1088. In 2011, the City of Parañaque had one (1) police headquarters in its own building near Kaybuboy Bridge in San Dionisio. It had a total strength of 356 policemen with a ratio of one (1) policeman for every 1,990 inhabitants (1: 1,990). Parañaque had a total crime volume of 1,346 and 731 total crime-solved and a crime solution efficiency of 54.31% (Parañaque City Socio-economic Profile 2012).

Muntinlupa

1089. In 2016, the City of Muntinlupa had six (6) police stations. It had a total strength of 529 policemen with a ratio of one (1) policeman for 953 inhabitants. The city had a total crime volume of 1,956 (Muntinlupa Ecological Profile, 2016).

San Pedro

1090. For the year 2012, the San Pedro Police reported that there were 119 Protective Service Personnel in the city giving a ratio of 1:2,640 which is below the standard of 1:500. Their equipment included six (6) vehicles or mobile cars, 58 different firearms, fifteen (15) handcuffs, thirteen (13) base radios, thirty (30) handheld radios, and one (1) finger print kit (San Pedro CLUP, 2013-2023).

Biñan

1091. Protective services are rendered by Philippine National Police (**PNP**), Bureau of Fire Protection (**BFP**) and Bureau of Jail Management and Penology (**BJMP**) with augmentation from the Tanods of the 24 Barangays as force multiplier. Central Police Headquarter is located in the new City Hall Compound, police outposts in the 24 barangays, fire stations and jail temporarily housed at the old City Hall in the Poblacion. The City Disaster Risk Reduction Management Office (**CDRRMO**) is located in the City Hall Compound with rescue vehicles and equipment in case of emergency. Evacuation Centers are scattered in many barangays.

1092. The BJMP needs jails to accommodate increasing number of detainees for rehabilitation. The BFP fire-fighting services are complemented by barangays with fire trucks and auxiliary personnel. The occurrence of disasters may threaten peace and security due to climate change with the severity and scale of disasters (Biñan City CLUP, 2018-2027).

Sta. Rosa

1093. As of 2014, Santa Rosa City Police Station had a total strength of 162 police personnel: 139 policemen and 23 policewomen . The police to population ratio based on the National Statistics Office 2014 estimate of the Santa Rosa City population was 1:2,013. Four (4) police assistance centers and ten (10) police outposts were maintained by the PNP – Santa Rosa (Philippine National Police (PNP), City of Sta. Rosa Police Station, 2013).

1094. The main station of the Bureau of Fire Protection Santa Rosa is located on J.P. Rizal Blvd., Brgy. Tagapo, City of Santa Rosa. In 2013, there were 35 BFP personnel in Sta. Rosa. The city had four (4) servceable firetrucks (Sta. Rosa City Socioeconomic Profile, 2014-2015).

Cabuyao

1095. The Philippine National Police (**PNP**) maintains its headquarters within the city hall compound. In 2009, the total police force consisted of 76 members, including the chief of police. The police to population ratio was 1:3,237 compared to the prescribed ratio of 1:1,000. In 2008, there were 3,083 interpersonal disputes resolved through Lupong Tagapamayapa out of 3,714 interpersonal disputes reported in Cabuyao. The local police force of Cabuyao had the following police equipment at its disposal: three (3) patrol cars, two (2) motorcycle, three (3) radio receiver and one (1) fax machine (PNP Headquarters, Cabuyao, 2013).

1096. In2009, firemen in the city totaled 24. The firemen to population ratio was 1:10,252 compared to the prescribed ratio of 1:10,000, which means that the firemen are slightly enough in the locality. The firemen of Cabuyao had two (2) firetrucks at its disposal. It is augmented by three (3) firetrucks owned by Asia Brewery and the Light Industry and Science Park of the Philippines

(**LISPP**) and Brgy. Pulo. There were 58 reported fire incidents in 2009 (BFP, Cabuyao, Laguna, 2009).

Calamba

1097. The City of Calamba has twelve (12) police outposts. It has a total strength of 105 policemen with a ratio of one (1) policeman for every 3,318 inhabitants (1:3,318). In 2006, the City had a total crime volume of 162. As support team, the 1,410 barangay tanods in 54 barangays work hand in hand with the authorities. Their presence decreases the volume of cases in the central office since petty crimes are usually handled at the barangay level. Likewise, the 44 security agencies serve the growing needs for security personnel of various business establishments in the city. The presence of ninety (90) traffic enforcers is vital in the maintenance of peace and order.

1098. In 2004, firemen of the city totaled 27. The firemen to population ratio was 1:12,905 compared to the prescribed ratio of 1:10,000. The firemen of Calamba had three (3) firetrucks at its disposal. There were 79 reported fire incidents in 2004.

3.4.5.8 Sewage

The following paragraphs describe the sewerage system of the host LGUs.

Manila

1099. The Manila Sewerage System was constructed in 1909 with the original overload capacity to serve 450,000 people. The system covers 1,850 hectares, serving 530,000 people with the total length of 240 km.

1100. Sewage is collected by lateral interceptor pipes of 15cm. to 150cm. in diameter from the various districts of the city. It is conveyed to the Tondo main sewage pumping station through seven (7) pumping stations. Sta. Ana, a sub-district of Manila, has a separate system and has its wastes discharging directly to the Pasig River. However, the construction of a sewer main line is presently on-going to interconnect the system in Sta Ana to the Paco Sewage Station.

1101. According to the Manila Second Sewerage Project (World bank-JGA TF 2252-3PH), the estimated number of septic tanks in the year 2000 was about 125, 279 with a population septic tanks ratio of 13:6. There are no records of de-sludging of tank nor the in use of packaged-type waste water treatment plants but their use may be seen in high-rise commercial-residential buildings in Central Manila.

Makati

1102. Makati is prone to flooding because of its topographic and hydrological conditions characterized by low-level areas and the low gradient of the Pasig River combined with the prevalence of heavy rainfalls associated with tropical cyclones. The city has three (3) types of drainage channels: open canals, reinforced concrete covered pipes, and improved box culverts.

1103. Domestic and industrial wastes are discharged into storm drains and into the nine (9) rivers and creeks that extend from Del Pan Street to San Jose, Guadalupe. During the period 2009 to 2011, improvements were made to the city's drainage system. Open canals were converted to improved box culverts and Reinforced Circular Concrete Pipes (RCCP). By 2011, 419.238 km. or 66.07% of city streets had improved Box Culvert Systems, 208.54 km. or 32.87% were lined with RCCP drainage while only 6.75 km. or 1.06% remained as open canals.

Taguig

1104. Taguig in the 21st Century will be served with Sewage Treatment Plant (**STP**) for recycling waste water/sewage. The total discharge is estimated to be 2,660L/s and would be pumped to the proposed STP for conversion into recycled water. Wastewater and sewage would be collected by sewers and flow by gravity to pumping stations located at strategic points to suit the general contour of the land. The lift stations would be integrated into designated utility centers and each would be provided with emergency power.

1105. The expected wastewater to be produced by the population for the year 2020 is taken as 75% of the water consumption (306,000 cu.m./day) and the required capacity of the proposed STP is 229,500 cu.m.per day.

1106. The Recycled Delivery System will consist of a storage tank and a pump station at the STP. Recycled water is pumped from sewage treatment via a force main to the recycled water reservoir. The Recycled Water System will operate as a pumped system with the pump station drawing from the recycled water reservoir and feeding supply into the distribution system. Under normal conditions all storm water drainage would be in underground pipes and culverts. (Source: Taguig City, CLUP)

Parañaque

1107. The West Zone concessionaire Maynilad has fast-tracked the Parañaque Sewer Network Project that will benefit 516,000 people in 9 of 16 barangays in the city.

1108. Mayor Edwin Olivarez disclosed that 95 subdivisions in the city will also benefit with the completion of the multimillion-peso project funded by the DBP and JICA. The Project involves laying 65 kilometers of sewer pipes, with diameter sizes ranging from 200 mm to 1,500 mm. Olivarez said the city's sewer network will collect wastewater generated by households in Barangays La Huerta, San Dionisio, BF Homes, Don Bosco, Marcelo Green Village, Moonwalk, San Antonio, and San Isidro to Maynilad's STP.

1109. The P1.7-billion Maynilad Parañaque STP has a treatment capacity of 76 MLD (million liters per day) and will serve some 287,000 customers in Barangays San Dionisio, Sto. Niño, San Isidro, part of Moonwalk, San Antonio, Marcelo Green, La Huerta, and Don Bosco in Parañaque City.

Muntinlupa

1110. Water coming into the Laguna Lake from Muntinlupa directly affects the water quality of the lake, as noted by the LLDA. According to the LLDA based on their 2013 water quality monitoring data, they concluded that the water quality falling below even class C (for fisheries).

1111. (MAYNILAD proposes to construct a 20-MLD STP, conveyance system, pump stations and other appurtenances to handle wastewater flows into the Laguna Lake. The proposed STP will serve a hydrological catchment area of 2,550 ha. The project will be referred to as the "Tunasan Sewage Treatment Plant" Project.

1112. Local Government of Muntinlupa (Metro Manila), with the assistance of USAID, installed a low-cost Wastewater Treatment Plant (**WTP**) in the public market.

San Pedro

1113. San Pedro has no sewerage system. Residential households are required to have their own septic tanks. A late 1990s study from the University of the Philippines-Los Baños concluded that the San Pedro River and Tunasan River are virtually dead, based on dissolved oxygen (**DO**) and biochemical oxygen demand (**BOD**) levels. This is a result of high discharge of domestic and industrial waste from communities and industrial sites. Informal settlers residing along the rivers is a contributing factor to water pollution of San Pedro and will need to be relocated to more suitable living areas. Industrial establishments will need to be regulated more strictly regarding effluents. (Source: San Pedro City, CLUP 2013-2023)

Biñan

1114. The City uses a combination of circular and rectangular channels as the existing drainage system in the entire City of Biñan. Most of the system is closed and entirely of pipe. Flooding in low-lying areas are caused by insufficiency of drainage structures, while some others are damaged. Informal settlers have also encroached river banks.

Sta. Rosa

1115. It is estimated that about 64,775 households (93% of total) have private sanitary toilets and complete sanitation facilities. However, with the exception of industrial estates, there is no sewerage system in Santa Rosa City. Direct disposal of domestic wastewater through soil percolation or through drainage canals or directly to surface water bodies can contribute to the deterioration of creeks, rivers and the Laguna Lake.

1116. A special concern for this infrastructure sub-sector is the lack of sanitation and toilet facilities during disaster response as identified during the 2012 Sectoral Analysis Workshop. It was noted that there is an increase in the number families getting sick while in evacuation centers.

Cabuyao

1117. The absence of a modern sewerage system suggests that the creeks and rivers leading to Laguna de Bay receive all liquid wastes. Provided there are no hazardous effluents, the lake can still digest domestic wastes given primary treatment through individual septic tanks.

Calamba

1118. The recent survey regularly conducted by the NSO on sanitation facilities, in the span of 10 years (1990-2000), additional 21% have afforded to have their own septic tanks installed in their respective places, therefore, shared facilities dropped by 9%. As a whole, 95% of city households are already equipped with toilet facilities.

1119. LLDA introduced the concept of natural Wastewater Treatment Systems through a partnership with the USAID Environmental Cooperation-Asia (**ECO-Asia**) in collaboration with Chia Nan University of Taiwan (**CNU**) and Calamba Water District as means to solve the growing wastewater problem in the region at the least cost but most effective and efficient way.

1120. The Municipalities of Angono, Rizal and Lucban, Quezon as well as the City of Calamba, Laguna will be among the firsts in the Laguna de Bay Region to develop a Wastewater Treatment Facility (**WTF**) using natural systems such as constructed wetlands to serve community residents within their respective jurisdiction.

3.4.5.9 Solid Waste Management

1121. The following paragraph briefly describes the solid waste management of the host LGUs. The solid waste management of the host LGUs was discussed in *Section 3.1.1.5. Land Value* of this report.

Manila

1122. Based on the Manila Comprehensive Land Use plan and Zoning Ordinance (Book 1, 2005-2020), In 2000, the total volume of garbage generated per day in Manila City was approximately 6,498.94 cubic meters. Manila City had 100% coverage of solid waste collection through a private contract with Leonel Waste Management wherein 250 compactors and heavy equipment were used for collection on a daily basis. Waste collection is done through house-to-house or via curbside wherein wastes are placed in plastic bags, rattan baskets, or in various types of bins. Since the city has no final disposal facility, wastes collected in garbage trucks are brought to a transfer station (Vitas Transfer Station, 10-hectare facility). Waste is brought to either the Tanza Facility located in Tanza, Navotas or the Rodriguez Facility located in Marikina Valley.

Makati

1123. In 1994, the estimated total solid waste generation in Makati was 502.78 tons per day or 2,654.16 cubic meters per day. The city's Solid Waste Management Division handles solid waste collection. Five (5) garbage contractors had been contracted by the city to collect and haul off wastes. The contractors were required to make about 153 trips daily throughout 27 barangays of the city. Solid waste was collected through a cell system. One cell is estimated to contain from 12 to 15 cubic meters of waste. These are collected along the road/street at curbside. Residents and owners of

establishments are required to discharge wastes in plastic bags or trash receptacles prior to the arrival of the collection trucks.

Taguig

1124. For solid waste disposal in City of Taguig, the assumed unit is taken as 0.5 kg. capita per day. For the predicted population, total solid waste is estimated to be 1009 ton/day. The volume of solid waste generated per day is 149.1 tons per day (MMDA). The collection rate is at 56.79%. The city uses the services of a private contractor (IPM Construction) for waste collection with the contract renewed every six months dependant on the satisfactory performance of the contractor.

Parañaque

1125. The projected waste diversion and disposal targets of the City of Parañaque by 2021 are 51% and 432.89 tons/day, respectively. Presently, there are daily collection of segregated wastes along the main thoroughfares and markets. A weekly collection is instituted for households or residences. For stationary sources, a three-time a week collection are provided. For bulky and yard wastes generated within the barangay, collection are upon request. The recyclables and compostables are collected by the barangay eco-aides in compliance with Section 6 Rule VI of the Implementing Rules and Regulations of RA 9003. These collected recyclables and compostables are brought to the Material Recovery Facility (**MRF**) for further segregation and composting. The residuals are collected by the City Private Hauler and brought to a sanitary landfill identified by MMDA.

Muntinlupa

1126. The City of Muntinlupa generates a total of 80,400 tonnes/year of waste. The City uses the services of a private contractor, REN Transport Corporation, for waste collection with 85% coverage. The wastes disposal collection is in Rodriguez, San Pedro, and Laguna.

San Pedro

1127. In 2007, San Pedro generated 238,609.67 kg or 263.02 tons of solid waste per day. Garbage collection was managed by a garbage contractor covering twenty (20) barangays, catering to almost 65% of the total population. Currently, garbage is being disposed in Pilotage Sanitary Landfill, a 32-hectare facility found in Narra Road, Barangay San Antonio. There is also a two-hectare MRF in the area, the only one in the city.

Biñan

1128. Solid waste remains a problem for Biñan City due to increasing urbanization. The 1992 projection of solid waste generation for the year 2000 stoodat 124,538 kg/day. At present, two (2) dump trucks service the market area while three (3) Isuzu Elf trucks service thirteen (13) barangays. The remaining barangays resort to open burning, dumping, burying, and disposing into waterways. Solid waste management in the city can be considered inefficient.

Sta. Rosa

1129. Household waste contributes to about 65% of the solid waste generation in the city, while 35% of the wastes come from non-household sources. The City Government is providing daily garbage collection to the eighteen (18) barangays, including almost all private subdivisions. It is spending Php 54 million per year for the collection and hauling of garbage. Pilotage Trading and Construction (**PTAC**) is a private contractor that owns a sanitary landfill located in San Pedro, Laguna and is in charge in the everyday garbage collection of the city. PTAC is using 29 dump trucks tracking different routes per day.

Cabuyao

1130. Solid waste disposal of the City of Cabuyao is done at the sanitary landfill operated by the City of Calamba.

Calamba

1131. In City of Calamba, solid wastes are usually generated by 80,661 households, about 289 industrial firms, more than 6,000 commercial establishments and a number of institutional houses scattered in the entire area. In 2006, it was estimated that the 387,876 projected population generates as much as 232 tons of garbage per day (computed at 0.6 kg/day/capita). The barangay-owned garbage trucks collect 14% of the consolidated wastes. The remaining 19% on the other hand is left uncollected and excluded in the 81% total wastes being disposed daily in San Pedro, Laguna.

3.4.6 Public Health and Safety Profile

3.4.6.1 Public Health Services

1132. The following discussions summarize the available data on health facilities and personnel for each city affected by the NSRP.

Manila

1133. The City of Manila has twenty-three (23) private hospitals, six (6) national government hospitals, and four (4) city government hospitals. The distribution of health facilities shows that District IV has eight (8) of the 23 private hospitals in Manila, while District II has one private hospital. District III has three (3) national hospitals.

1134. In 2000, the health center ratio was 1:32,267 and the DOH minimum standard is 1:20,000, which means thirty (30) additional health centers were needed in the city.

Makati

1135. In 2011, the city's public health facilities includedd two (2) public hospitals (including the Acute Care Center), 27 public health centers/social hygiene clinic and four (4) public lying-in clinics. Private health facilities, on the other hand, include three (3) hospitals, 173 medical clinics and 82 dental clinics.

Taguig

1136. According to DOH-NCR 2003 data, the City of Taguig had one (1) government hospital and four (4) private hospitals. There were 137 hospital beds and the Bed-to-Population Ratio of both government and private hospitals is 1:4,175.

Parañaque

1137. The Parañaque City Health Office has six (6) private and one (1) public hospital, sixteen (16) health centers, five (5) barangay stations and seven (7) lying –in clinics.

1138. The total health personnel comprise the following: twenty (20) medical officers, 23 dentists, fifteen (15) medical technologists, 67 nurses, five (5) nutritionist-dietician, 32 nursing attendants, 45 midwives, thirty (30) sanitary inspectors, 23 barangay aides, eleven (11) dental aides, four (4) laboratory aides and thirty (30) administrative support staff.

Muntinlupa

1139. According to the City Health Office, in 2016, there were fifteen (15) public health centers and eight (8) private-owned hospitals in Muntinlupa.

1140. The Health Personnel to Population Ratio of the city included the following: Barangay Health Worker (**BHW**) to Population Ratio was 1:1,152 while the Barangay Nutrition Scholars (**BNS**) to Population Ratio was 1: 48,149. Doctor to Population Ratio was 1:626 while Nurse to Population Ratio was 1:573 and Midwives to Population Ratio was 1:4,767. Medical Technologist to Population Ratio was 1:3,752, while Dentists to Population Ratio was 1:22,928 and Nutritionists/Dietitian to Population Ratio was 1:96,267.

1141. For the hospital bed capacity, Muntinlupa had a total of 424 beds in the Payward and three (3) hospitals in the Charity Ward with most (207 beds) coming from Ospital ng Muntinlupa.

1142. The city had sufficient number of health centers for its population. However, two (2) of the barangays (i.e., Alabang and Poblacion) did not meet the national standard ratio for health center to population ratio.

San Pedro

1143. According to the San Pedro City Health Office, in 2012, the government health facilities in San Pedro comprised of two (2) hospitals, one (1) Lying-in Clinic, two (2) health centers and seven (7) Barangay Health Stations. In addition, there were four (4) private health facilities in San Pedro.

1144. There were a total of 120 government health personnel in San Pedro. San Pedro had one (1) City Health Officer, two (2) medical officers, 16 public health nurses, 10 nursing aides, 25 midwives, two (2) sanitary inspectors, four (4) dentists, three (3) dentist aides, 36 Barangay Health Workers, 20 Barangay Nutrition Scholars and one (1) nutritionist.

Biñan

1145. Biñan has a 100-bed community hospital in Canlalay providing emergency health and outpatient services with laboratory services. There are two (2) Rural Health Units (**RHUs**) in Biñan, one (1) covering ten (10) barangays and RHU in San Antonio covering the other fourteen (14) barangays. Perpetual Health Hospital, Unihealth-Southwoods Hospital and Medical Center and Biñan Doctor's Hospital are three (3) big hospitals. There are 25 private medical clinics offering primary, secondary and tertiary level health services. Several dental clinics, eye clinics, skin clinics and lying in clinics. There are Barangay Health Stations housed within barangay multi-purpose halls.

Sta. Rosa

1146. Health Care Facilities (**HCFs**) comprise hospitals, lying-in clinics, medical and dental clinics, optical centers, medical laboratories, and pharmacies. In the City of Santa Rosa, almost all HCFs are privately owned (99%) and only 1% is owned by the government.

1147. In 2013, these HCFs in the city employed an estimated 2,603 employees, both medical and non-medical staff. Santa Rosa had a total of seven (7) hospitals with a hospital bed-population ratio of 2 beds for every 1,000 population. In the eight (8) lying-In clinics, the bed-population ratio of one (1) is to one (1) was recorded. There is a total of 168 health facilities in the city with only two (2) are publicly owned.

1148. Majority (57%) of these hospitals are categorized as Level III, which means these are departmentalized hospitals. The remaining hospitals (43%) are categorized as Level II or non-departmentalized hospitals.

Cabuyao

1149. The health facilities of Cabuyao include one (1) hospital which serves eighteen (18) barangays, seventeen (17) Barangay Health Centers covering fifteen (15) barangays, and two (2) Satellite Hospitals serving emergency and consultation.

1150. In 2008, the health manpower in Cabuyao consisted of field workers as well as hospital-based medical practitioners. The public health workers in Cabuyao included nineteen (19) public health doctors, sixty (60) public health nurses, four (4) rural sanitary inspectors, two (2) dentists, thirty (30) midwives, six (4) medical technologists, four (4) X-ray technicians, and two (2) physical therapists.

1151. According to the 2008 CLUP of the City, the recorded ratio to Public Health Workers to population of Cabuyao were the following: ratio of public doctors to population was 1:11,832; ratio of public nurses to population was 1:3,747; ratio of public dentists to population was 1:112,404; and ratio of public midwives to population is 1:7,494.

Calamba

1152. According to the latest record obtained from the City Health Office, the City of Calamba had a total of eight (8) hospitals, four (4) lying-in cClinics and 54 barangay health stations. Two (2) are categorized as government hospital and the rest are privately-owned.

1153. In 2006, the following were the health workers to population ratio of the City , the number to standard ratio of the doctors ws 1:20,000; nurses, 1:15,000; midwives, 1:5,000, and barangay health workers, 1:5,000.

3.4.6.2 Mortality and Morbidity Rates

(1) Morbidity and Mortality by LGUs

1154. The following discussions summarizes the available data on vital health indicators for each city affected by the NSRP. Crude Birth Rate (**CBR**), Crude Death Rate (**CDR**), Maternal Mortality Rate (**MRR**), Infant Mortality Rates (**IMR**) and Child Mortality Rates (**CMR**) are a few indicators briefly reviewed.

Manila

1155. The causes of mortality and morbidity in the City of Manila are typical of those in an urban area of a developing country.

1156. From 1997 to 2001, the CBR of Manila showed a gradual decrease, from 25 to 17 per 1,000 population from 1997 to 2001, while the CDR had increased from 6 to 7 per 1,000 population.

1157. According to the CLUP 2005-2020 of Manila Health Department, the leading causes of morbidity in the year 2000 were the following: diarrhea, bronchitis, pneumonia, TB respiratory, influenza, diseases of the heart, measles, dengue fever, mumps and chickenpox while the recorded leading causes of mortality were the following: pneumonia, diseases of the heart, malignancies, HPN cerebrovascular diseases, prematurity, TB respiratory, sepsis, utero placental insufficiency and homicide.

Makati

1158. In 2011, the CDR was at 5.33 per 1,000 population, decreasing by 0.14 compared to 2010.Makati's CBR was at 18.0 per 1,000 population, decreasing by 1.63 compared to 2010. The declining trend began from 2007, probably related to increased contraceptive prevalence rate, from 27.0% in 2007 to 32.5% in 2009.

1159. MMR increased in 2011 at 1.1 from 0.39 per 1000 live births in 2010, while the city's IMR slightly increased from 11.31 to 11.7 per 1000 live births during the same period.

Taguig

1160. According to the DOH-NCR, in 2003, the MMR of Taguig was 1.04 . On the other hand, the IDR was 20.56. The 2003 DOH Survey for malnutrition rate showed malnutrition rates of 2.14%, that is, for those who were considered to be below-normal and a 0.26% for below normal-very low. Insame year, the average reported cases of tuberculosis was 104.7, cases of diarrhea 534.7, cases of dengue fever 4.2, cases of bronchitis/bronchiolitis 1,223.7 and cases of pneumonia 495.3.

Parañaque

1161. In 2011, the city had recorded 8,151 live births by a CBR of 13.13 per thousand live births. For the morbidity rate, a total of 26,896 patients were seen and examined by the different health centers. Upper Respiratory Tract Infection with a rate of 175.97/ 10, 000 population remained the leading cause of morbidity in Parañaque.

1162. For the 2011 mortality rate, there were 2,362 deaths from all causes with the CDR of 3.81 per 1000 population. Highest number of deaths was reported in Barangay BF with 294 deaths, followed by Barangay San Dionisio with 252 and Barangay Moonwalk with 207 deaths.

1163. In 2011, highest number of deaths (416) was due to coronary artery diseases. In same year, there were 114 infant deaths from all causes with a CDR of 13.99 per 1000 livebirths.

Muntinlupa

1164. In 2016, according to the City Health Office of Muntinlupa, different general health situation indicators were increasing for the last five years. CBR increased to 18.6% from 13.23%; CDRincreased to 5.07% from 13.23%. The IMR decreased from 12.17% in 2012 down to 2.8% in 2016; the Under Five Mortality Rate also decreased from 18.95% to 4.58% in 2016 and the MMR declined 50% from 64% to 33.5%.

San Pedro

1165. In 2011, there were 6,864 live births in San Pedro with a CBR of 23.61%. The leading causes of morbidity or sickness according to the 2011 record of San Pedro City Health Office were the following: influenza with 948 cases; diarrhea with 847 cases; urinary tract infection with 836 cases; upper respiratory tract infection with 672 cases; dengue with 496 cases; allergy, 457 cases; hypertension, 376 cases; asthma, 304 cases, bronchitis, 286 cases and parasitism with 91 cases.

1166. For the mortality rate, it was reported by the San Pedro City Health Office in 2011 that cardiopulmonary arrest was the leading cause of death at 431 cases.

Biñan

1167. The ten (10) leading causes of morbidity for the past five years (2010-2015) name: unspecified acute lower respiratory infection (11,278), essential primary hypertension (3,3345), influenza (2,005), infectious gastroenteritis and colitis (1,459), exposure to unspecified factor (1,585), disorders of urinary system (1,218), rash and non-specific skin eruption (1,448), asthma (1,103) and vitamin deficiency (1,186), among others. On one hand, the ten (10) leading causes of mortality were as follows: cardiac arrest, senility, pneumonia, pulmonary disease, renal failure, among others. There were deaths such as infant, maternal and neo natal.

Sta. Rosa

1168. In 2012, the city recorded a total of 6,570 new births, which was 16.76% higher than the 2012 total number of live births of 5,627 babies. The CBR in 2011 of CHO 1 and CHO 2 was recorded at 22 and 14 live births for every 1,000 population, respectively.

1169. The CDR in the City of Santa Rosa increased from 2013 to 2014. The CDR in 2014 was about six (6) deaths per 1,000 population, higher than the CDR of three (3) per 1,000 population in 2013.

1170. Morbidity is the frequency of disease and illness, injuries, and disabilities in a population. In the City of Santa Rosa, the top leading cause of morbidity was the Acute Upper Respiratory Tract Infection (**AURTI**) with 40,763 cases. Other leading causes of morbidity were acute viral infection, iron deficiency, urinary tract infection, hypertension, tonsillitis, asthma, gastroenteritis, and bronchitis. The leading cause of mortality in Santa Rosa was pneumonia followed by multiple organ failure, ischemic heart disease, type II diabetes, septicemia, and hypertensive heart disease.

Cabuyao

1171. In 2008, Cabuyao exhibited a CBR of 24% and CDR of 2.27%. Insame year, Cabuyao showed an IMR of 0.41%, or a total of 23 infant death among children below one year old out of 5,611 livebirths. In terms of maternal mortality rate, Cabuyao had a rate of 0.22%.

1172. There is no known epidemic in Cabuyao. In 2008, the ten (10) leading causes of mortality which are cardiovascular diseases, stroke, cancer (all forms), diabetes, hypertension, pneumonia, congestive heart failure, senility, renal failure, and heart diseases indicated the absence of an imminent health risk. For the same year, the top risk killers in all ages were hypertension, pneumonia, and cancer. As to the leading causes of illness, diarrhea, hypertension and TB respiratory diseases top the list.

Calamba

1173. The City Health Office reported that in 2006, there were a total of 5,883 live births in the city which was 3.6% higher than the figure last year. The number of birth implies that there were around 490 newborn babies every month or about sixteen (16) every day.

1174. Given the total number of births from 1998-2006, there were about fifteen (15) births for every 1,000 population which was comparably lower than the 19.7 per 1,000 population obtained in 2005. CBR is estimated at about nineteen (19) per 1,000 population.

1175. According to the 2005-2006 CLUP of Calamba, the leading causes of mortality were: PTB (all forms), myocardial infarction, diabetis mellitus, cancer (all forms), cardio vascular accident/stroke, hypertensive heart disease, chronic obstructive pulmonary disease, congestive heart failure, diarrheal diseases/ electrolyte imbalance, pneumonia, acute hypertensive renal failure and senility.

1176. Although Acute Respiratory Infection that involves cold and cough has always been the leading causes of medical consultations for over nine years.

1177. The following are the leading causes of morbidity for 2005 and 2006, ARI (Cold, Coryza, Cough), influenza, HPN, skin problem/ allergic contact dermatitis, musculoskeletal diseases (arthritis), urinary tract infection, PTB, asthma, tonsillitis, diarrhea, heart diseases/ cardio vascular diseases, gastrointestinal diseases and bronchitis.

(2) Morbidity and Mortality of PAFs by LGUs

1178. The Socioeconomic Survey (**SES**) also noted the PAPs with members who experienced health problem in the past year (morbidity) and the (2) causes of death for members of the family (mortality). Table 3.4.21 indicates that most of the PAPs had members who experienced flu (42.1%). This observation was applicable to all the affected cities. There was a low incidence of hypertension (6.3%), heart problems (2.3%), diarrhea (3.1%), dengue (1.4%) and typhoid fever (1.2%) among the PAPs during the time the survey was taken.

1179. In terms of mortality, the main causes of death among members of PAFs were hypertension (18.1%), heart problems (14.1%), cancer (4.4%) and diabetes (3.9%), as indicated in Table 3.4.22.

Table 3.4.21 Morbidity of PAFs by LGUs

City	Morbidity														
	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrhea	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hypertension	Diabetes	None	Others	Total
City of Manila	0	1	20	2	17	17	37	529	9	43	194	56	524	74	**1523**
%	0.0%	0.1%	1.3%	0.1%	1.1%	1.1%	2.4%	34.7%	0.6%	2.8%	12.7%	3.7%	34.4%	4.9%	100.0%
Taguig	0	0	3	3	6	2	7	127	1	7	18	3	40	35	**252**
%	0.0%	0.0%	1.2%	1.2%	2.4%	0.8%	2.8%	50.4%	0.4%	2.8%	7.1%	1.2%	15.9%	13.9%	100.0%
Parañaque	0	0	0	1	3	0	3	16	1	0	0	0	10	7	**41**
%	0.0%	0.0%	0.0%	2.4%	7.3%	0.0%	7.3%	39.0%	2.4%	0.0%	0.0%	0.0%	24.4%	17.1%	100.0%
Muntinlupa	0	0	9	28	37	10	29	422	3	28	51	19	236	151	**1023**
%	0.0%	0.0%	0.9%	2.7%	3.6%	1.0%	2.8%	41.3%	0.3%	2.7%	5.0%	1.9%	23.1%	14.8%	100.0%
San Pedro	0	0	2	0	13	3	5	134	1	5	19	1	45	38	**266**
%	0.0%	0.0%	0.8%	0.0%	4.9%	1.1%	1.9%	50.4%	0.4%	1.9%	7.1%	0.4%	16.9%	14.3%	100.0%
Biñan	0	0	26	22	71	16	43	749	3	34	69	26	513	320	**1892**
%	0.0%	0.0%	1.4%	1.2%	3.8%	0.8%	2.3%	39.6%	0.2%	1.8%	3.6%	1.4%	27.1%	16.9%	100.0%
Sta. Rosa	1	0	7	3	14	9	20	226	3	3	20	6	98	89	**498**
%	0.2%	0.0%	1.4%	0.6%	2.8%	1.8%	4.0%	45.4%	0.6%	0.6%	4.0%	1.2%	19.7%	17.9%	100.0%
Cabuyao	0	0	1	1	10	0	6	36	0	3	8	1	23	11	**100**
%	0.0%	0.0%	1.0%	1.0%	10.0%	0.0%	6.0%	36.0%	0.0%	3.0%	8.0%	1.0%	23.0%	11.0%	100.0%
Calamba	0	1	81	67	156	50	133	2248	17	120	291	122	1076	713	**5075**
%	0.0%	0.0%	1.6%	1.3%	3.1%	1.0%	2.6%	44.3%	0.3%	2.4%	5.7%	2.4%	21.2%	14.0%	100.0%
NSRP Total	**1**	**2**	**149**	**127**	**327**	**107**	**283**	**4487**	**38**	**243**	**670**	**234**	**2565**	**1438**	**10670**
%	0.0%	0.0%	1.4%	1.2%	3.1%	1.0%	2.7%	42.1%	0.4%	2.3%	6.3%	2.2%	24.0%	13.5%	100.0%

Source: JICA Study Team

Table 3.4.22 Mortality of PAFs by LGUs

City	Mortality														
	HIV/AIDS	Malaria	Dengue	Typhoid fever	Diarrheal	Skin diseases	Pneumonia	Flu	Cancer	Heart problems	Hypertension	Diabetes	None	Others	Total
City of Manila	1	2	39	3	10	2	44	17	39	170	345	71	655	81	**1479**
%	0.1%	0.1%	2.6%	0.2%	0.7%	0.1%	3.0%	1.1%	2.6%	11.5%	23.3%	4.8%	44.3%	5.5%	100.0%
Taguig	0	1	3	0	3	0	4	0	3	71	83	11	48	67	**294**
%	0.0%	0.3%	1.0%	0.0%	1.0%	0.0%	1.4%	0.0%	1.0%	24.1%	28.2%	3.7%	16.3%	22.8%	100.0%
Parañaque	0	0	2	0	1	0	3	0	7	5	6	3	11	9	**47**
%	0.0%	0.0%	4.3%	0.0%	2.1%	0.0%	6.4%	0.0%	14.9%	10.6%	12.8%	6.4%	23.4%	19.1%	100.0%
Muntinlupa	0	0	68	6	8	3	13	9	57	149	242	46	274	224	**1099**
%	0.0%	0.0%	6.2%	0.5%	0.7%	0.3%	1.2%	0.8%	5.2%	13.6%	22.0%	4.2%	24.9%	20.4%	100.0%
San Pedro	0	0	8	0	6	0	10	2	7	37	52	7	63	70	**262**
%	0.0%	0.0%	3.1%	0.0%	2.3%	0.0%	3.8%	0.8%	2.7%	14.1%	19.8%	2.7%	24.0%	26.7%	100.0%
Biñan	1	3	134	6	80	17	33	49	35	281	341	45	446	546	**2017**
%	0.0%	0.1%	6.6%	0.3%	4.0%	0.8%	1.6%	2.4%	1.7%	13.9%	16.9%	2.2%	22.1%	27.1%	100.0%
Sta. Rosa	0	0	98	1	16	6	17	12	20	65	76	10	114	112	**547**
%	0.0%	0.0%	17.9%	0.2%	2.9%	1.1%	3.1%	2.2%	3.7%	11.9%	13.9%	1.8%	20.8%	20.5%	100.0%
Cabuyao	0	0	5	0	1	0	6	5	3	10	13	3	37	5	**88**
%	0.0%	0.0%	5.7%	0.0%	1.1%	0.0%	6.8%	5.7%	3.4%	11.4%	14.8%	3.4%	42.0%	5.7%	100.0%
Calamba	2	7	480	81	119	31	114	92	331	799	1017	247	1239	972	**5531**
%	0.0%	0.1%	8.7%	1.5%	2.2%	0.6%	2.1%	1.7%	6.0%	14.4%	18.4%	4.5%	22.4%	17.6%	100.0%
NSRP Total	**4**	**13**	**837**	**97**	**244**	**59**	**244**	**186**	**502**	**1587**	**2175**	**443**	**2887**	**2086**	**11364**
%	0.0%	0.1%	7.4%	0.9%	2.1%	0.5%	2.1%	1.6%	4.4%	14.0%	19.1%	3.9%	25.4%	18.4%	100.0%

Source: JICA Study Team

3.4.6.3 Environmental Health and Sanitation Profile

(1) Health and Sanitation per LGU

1180. The results of the 2010 Census of Population and Housing in Table 3.4.23 showed that most households in Metro Manila (Manila, Makati, Taguig, Parañaque and Muntinlupa) and Laguna (San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba) usedeither 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 tapped to community water system. Majority of the households disposed their garbage by having it picked up by garbage truck as shown in Table 3.4.24) and majority also used toilet type water sealed sewer septic tank that is used exclusively by the household as indicated in Table 3.4.25

Table 3.4.23 Main Source of Water Supply for Drinking, Cooking, Laundry/Bathing of Households per City (2010)

Water Source	Manila	Makati	Taguig	Paraña-que	Muntinlupa	San Pedro	Biñan	Sta. Rosa	Cabuyao	Calamba
	%	%	%	%	%	%	%	%	%	%
Water Source for Drinking										
Own use faucet community water system	41.6	52.5	58.2	33.8	15.8	36.8	12.0	18.9	27.4	50.9
Shared faucet community water system	13.6	5.7	7.7	7.5	6.5	6.8	4.2	4.5	2.9	8.9
Own use tubed/piped deep well	0.2	0.4	0.7	0.8	3.2	1.8	3.5	4.7	3.6	5.6
Shared tubed/piped deep well	0.4	0.5	1.1	1.5	6.8	2.5	9.3	6.3	3.5	9.0
Tubed/piped shallow well	0.14	0.04	0.47	0.75	0.87	0.31	1.01	0.73	1.05	3.07
Dug well	0.02	0.00	0.15	0.28	-	0.05	0.62	0.87	0.71	0.87
Protected spring	0.6	-	-	-	-	0.6	1.0	1.0	1.1	1.0
Unprotected spring	0.05	-	-	-	-	0.01	0.03	0.03	0.04	0.37
Lake river rain and others	0.02	-	-	-	0.01	-	0.02	-	0.02	0.21
Peddler	0.9	0.4	0.7	1.7	2.3	2.3	0.2	0.2	0.2	0.1
Bottled water	41.6	39.1	29.1	51.6	62.5	48.3	67.8	62.5	59.1	19.8
Others	1.0	1.4	1.8	2.1	2.0	0.6	0.3	0.3	0.4	0.2
Water Source for Cooking										
Own use faucet community water system	77.96	89.86	84.19	74.70	42.45	76.6	41.5	54.8	67.5	64.8
Shared faucet community water system	18.56	7.15	9.96	12.44	15.51	9.9	11.8	10.9	8.3	9.7
Own use tubed/piped deep well	0.51	0.61	1.19	2.08	10.29	3.3	13.1	12.6	8.4	7.6
Shared tubed/piped deep well	0.64	0.67	1.42	3.40	18.61	4.8	25.0	13.7	8.3	11.2
Tubed/piped shallow well	0.23	0.03	0.88	1.11	2.60	0.68	3.29	2.90	2.31	4.00
Dug well	0.04	0.10	0.27	0.88	-	0.17	1.84	2.11	1.31	0.98
Protected spring	0.20	-	-	-	-	0.42	0.14	0.17	0.83	0.67
Unprotected spring	0.13	-	-	-	-	0.01	0.09	0.02	0.17	0.42
Lake river rain and others	0.02	-	-	-	0.01	0.01	0.01	0.01	0.03	0.21
Peddler	0.49	0.23	0.53	1.93	2.41	1.88	0.05	0.10	0.14	0.06
Bottled water	0.93	1.15	0.58	2.08	6.57	2.00	3.19	2.76	2.52	0.35
Others	0.29	0.20	0.96	1.38	1.54	0.15	0.04	0.02	0.12	0.10
Water Source for Laundry/Bathing										
Own use faucet community water system	78.0	89.9	42.5	74.7	84.2	41.5	67.5	64.8	76.6	54.8
Shared faucet community water system	18.6	7.1	15.5	12.4	10.0	11.75	8.32	9.72	9.92	10.90
Own use tubed/piped deep well	0.5	0.6	10.3	2.1	1.2	13.07	8.44	7.55	3.26	12.55
Shared tubed/piped deep well	0.6	0.7	18.6	3.4	1.4	25.01	8.29	11.15	4.85	13.67
Tubed/piped shallow well	0.2	0.0	2.6	1.1	0.9	3.29	2.31	4.00	0.68	2.90
Dug well	0.0	0.1	-	0.9	0.3	1.84	1.31	0.98	0.17	2.11
Protected spring	0.2	-	-	-	-	0.14	0.83	0.67	0.42	0.17
Unprotected spring	0.1	-	-	-	-	0.09	0.17	0.42	0.01	0.02
Lake river rain and others	0.0	-	0.0	-	-	0.01	0.03	0.21	0.01	0.01
Peddler	0.5	0.2	2.4	1.9	0.5	0.05	0.14	0.06	1.88	0.10
Bottled water	0.9	1.2	6.6	2.1	0.6	3.19	2.52	0.35	2.00	2.76
Others	0.3	0.2	1.5	1.4	1.0	0.04	0.12	0.10	0.15	0.02

Source: CPH 2010, PSA

Table 3.4.24 Manner of Garbage Disposal of Households per City (2010)

Manner of Garbage Disposal	Manila	Makati	Taguig	Paraña-que	Muntin-lupa	San Pedro	Biñan	Sta. Rosa	Cabu-yao	Calamba
	%	%	%	%	%	%	%	%	%	%
Picked up by garbage truck	96.58	98.44	95.02	95.60	94.63	93.82	90.97	94.95	96.34	87.41
Dumping in individual pit (not burned)	2.04	1.03	3.33	2.67	2.55	0.95	2.25	2.23	0.59	2.17
Burning	0.21	0.37	1.31	0.89	2.46	4.41	5.75	2.60	2.62	9.22
Composting	0.08	0.03	0.13	0.11	0.06	0.18	0.28	0.05	0.35	0.20
Burying	0.11	0.01	0.10	0.12	0.10	0.32	0.42	0.12	0.08	0.75
Feeding to animals	0.24	0.01	0.01	0.36	0.01	0.28	0.04	0.04	0.03	0.02
Others	0.73	0.10	0.08	0.25	0.19	0.04	0.29	0.01	-	0.24

Source: CPH 2010, PSA

Table 3.4.25 Toilet Facility of Households per City (2010)

Toilet Facility	Manila	Makati	Taguig	Paraña-que	Muntin-lupa	San Pedro	Biñan	Sta. Rosa	Cabu-yao	Calamba
	%	%	%	%	%	%	%	%	%	%
Water-sealed sewer septic tank used exclusively by household	71.73	84.71	84.86	84.65	76.68	88.77	74.08	84.04	89.16	81.83
Water-sealed sewer septic tank shared with other households	17.02	11.10	8.67	8.10	11.95	4.50	10.92	7.13	3.79	6.22
Water-sealed, other depository used exclusively by household	3.26	1.27	3.07	1.99	4.15	2.94	8.36	4.57	3.57	4.81
Water-sealed other depository shared with other households	3.07	2.03	2.02	1.54	4.04	0.95	3.77	2.13	1.91	3.10
Closed Pit	0.79	0.02	0.47	2.34	0.98	1.31	1.33	1.34	1.01	2.00
Open Pit	0.74	0.05	0.39	0.45	0.31	0.46	0.28	0.20	0.23	1.03
Others (pail system and others)	1.95	0.45	0.43	0.79	1.22	0.79	0.98	0.43	0.29	0.70
None	1.44	0.37	0.09	0.15	0.67	0.27	0.29	0.16	0.03	0.31

Source: CPH 2010, PSA

(2) Water and Sanitation Access of PAFs per LGU

1181. Table 3.4.26 indicates the status of PAPs' access to water per LGU. In general, most of the PAPs had access to water through deep well (35.3%). At least one (16%) out of 10 would had access to shared water connection, with a lower proportion (13.9%) having access to own water connection through Maynilad or MWSS.

1182. However, a per-LGU analysis indicates varying trends in water access. In the cities of Manila and Taguig, more families had access to water through Maynilad or MWSS – with 54.8% in Manila and 31.8% in Taguig. In Parañaque, however, at least 8 out of 10 families bought from water vendors, and the remaining proportion either had own connection (17.1%) or had access through deep wells (2.9%). In San Pedro, Biñan, Santa Rosa and Cabuyao, most families had access to water through deep wells. In Muntinlupa, majority also had access through deep wells, but at least 2 out of 10 families (23%) had access through Maynilad or MWSS.

Table 3.4.26 Access to water by PAFs

City	Access to Water								
	Maynilad Manila Water (Piped Connection)	Shared with Neighbour (Community Faucet)	Deep well	Shallow Well	Buy from Water Vendors	Others	N/A	N/R	Total
City of Manila	844	503	4	1	68	108	2	11	**1541**
%	54.8%	32.6%	0.3%	0.1%	4.4%	7.0%	0.1%	0.7%	100.0%
Taguig	70	45	26	0	16	62	0	1	**220**
%	31.8%	20.5%	11.8%	0.0%	7.3%	28.2%	0.0%	0.5%	100.0%

City	Access to Water								
	Maynilad Manila Water (Piped Connection)	Shared with Neighbour (Community Faucet)	Deep well	Shallow Well	Buy from Water Vendors	Others	N/A	N/R	Total
Parañaque	6	0	1	0	28	0	0	0	**35**
%	17.1%	0.0%	2.9%	0.0%	80.0%	0.0%	0.0%	0.0%	100.0%
Muntinlupa	207	94	330	3	196	67	1	3	**901**
%	23.0%	10.4%	36.6%	0.3%	21.8%	7.4%	0.1%	0.3%	100.0%
San Pedro	3	19	149	2	25	34	0	0	**232**
%	1.3%	8.2%	64.2%	0.9%	10.8%	14.7%	0.0%	0.0%	100.0%
Biñan	12	97	1448	48	146	143	5	8	**1907**
%	0.6%	5.1%	75.9%	2.5%	7.7%	7.5%	0.3%	0.4%	100.0%
Sta. Rosa	12	25	238	62	24	60	5	7	**433**
%	2.8%	5.8%	55.0%	14.3%	5.5%	13.9%	1.2%	1.6%	100.0%
Cabuyao	4	4	40	13	11	5	0	1	**78**
%	5.1%	5.1%	51.3%	16.7%	14.1%	6.4%	0.0%	1.3%	100.0%
Calamba	177	811	1167	27	181	1888	18	22	**4291**
%	4.1%	18.9%	27.2%	0.6%	4.2%	44.0%	0.4%	0.5%	100.0%
NSRP Total	**1335**	**1598**	**3403**	**156**	**695**	**2367**	**31**	**53**	**9638**
%	13.9%	16.6%	35.3%	1.6%	7.2%	24.6%	0.3%	0.5%	100.0%

Source: JICA Study Team

1183. In terms of access to sanitation, at least six (6) out of 10 PAPs had their own water-sealed toilets, as indicated in Table 3.4.27. The remaining had other sources of sanitation (20.7%), while at least 7.3% had communal or barangay toilet facilities. Among the PAPs, 301 PAFs had no access to sanitation. Among these, majority were in Calamba, Muntinlupa (97 families), Santa Rosa (52 families), Biñan (28 families), Taguig (21 families), and Manila (20 families).

Table 3.4.27 Access to Sanitation of PAFs per LGU

City	Access to Sanitation							
	Own Water Sealed Toilets	Open Pit	Communal /Barangay Toilet	No Toilet	Others	N/A	N/R	Total
City of Manila	1334	10	149	20	22	1	5	**1541**
%	86.60%	0.60%	9.70%	1.30%	1.40%	0.10%	0.30%	100.00%
Taguig	83	1	23	21	91	0	1	**220**
%	37.70%	0.50%	10.50%	9.50%	41.40%	0.00%	0.50%	100.00%
Parañaque	1	0	16	6	12	0	0	**35**
%	2.90%	0.00%	45.70%	17.10%	34.30%	0.00%	0.00%	100.00%
Muntinlupa	551	7	64	56	214	2	7	**901**
%	61.20%	0.80%	7.10%	6.20%	23.80%	0.20%	0.80%	100.00%
San Pedro	100	2	35	14	79	0	2	**232**
%	43.10%	0.90%	15.10%	6.00%	34.10%	0.00%	0.90%	100.00%
Biñan	1010	3	170	28	678	7	11	**1907**
%	53.00%	0.20%	8.90%	1.50%	35.60%	0.40%	0.60%	100.00%
Sta. Rosa	168	7	29	52	163	7	7	**433**
%	38.80%	1.60%	6.70%	12.00%	37.60%	1.60%	1.60%	100.00%
Cabuyao	21	12	26	7	12	0	0	**78**
%	26.90%	15.40%	33.30%	9.00%	15.40%	0.00%	0.00%	100.00%
Calamba	3226	17	190	97	720	16	25	**4291**
%	75.20%	0.40%	4.40%	2.30%	16.80%	0.40%	0.60%	100.00%
NSRP Total	**6,494**	**59**	**702**	**301**	**1,991**	**33**	**58**	**9638**

City	Access to Sanitation							
	Own Water Sealed Toilets	Open Pit	Communal /Barangay Toilet	No Toilet	Others	N/A	N/R	Total
%	67.40%	0.60%	7.30%	3.10%	20.70%	0.30%	0.60%	100.00%

Source: JICA Study Team

3.4.6.4 Community issues among PAFs per LGU

1184. Table 3.4.28 highlights some community issues identified by the PAPs – flooding (19.3), drugs (16.7%), garbage collection (16.3%), and safety/security (13.2%). In Taguig, a high proportion of the PAPs stated that garbage collection was one of their main concerns, while in Manila, the main concern of the PAPs was safety and security, with 23.7% indicating it as one of the issues in their area. In Parañaque, garbage collection (33.9%) and water and sanitation (28.8%) pose as major issues. In the cities of San Pedro and Cabuyao, garbage collection and flooding were mentioned as the main concerns. However, in Biñan, most reported drugs (24.8%) as their main concern.

Table 3.4.28 Community issues among PAFs per LGU

City	Community Issues									
	Health	Water/Sanitation	Flooding	Safety/Security	Drugs	Job/Employment	Garbage Collection	Others	N/R	Total
City of Manila	104	298	94	442	164	69	335	217	142	**1,865**
%	5.6%	16.0%	5.0%	23.7%	8.8%	3.7%	18.0%	11.6%	7.6%	100.0%
Taguig	8	10	40	34	53	16	75	17	35	**288**
%	2.8%	3.5%	13.9%	11.8%	18.4%	5.6%	26.0%	5.9%	12.2%	100.0%
Parañaque	5	17	0	1	1	6	20	7	2	**59**
%	8.5%	28.8%	0.0%	1.7%	1.7%	10.2%	33.9%	11.9%	3.4%	100.0%
Muntinlupa	23	108	167	131	201	99	135	134	101	**1,099**
%	2.1%	9.8%	15.2%	11.9%	18.3%	9.0%	12.3%	12.2%	9.2%	100.0%
San Pedro	9	27	49	32	32	40	53	42	21	**305**
%	3.0%	8.9%	16.1%	10.5%	10.5%	13.1%	17.4%	13.8%	6.9%	100.0%
Biñan	31	125	460	332	573	184	321	167	118	**2,311**
%	1.3%	5.4%	19.9%	14.4%	24.8%	8.0%	13.9%	7.2%	5.1%	100.0%
Sta. Rosa	19	48	187	57	77	89	101	42	26	**646**
%	2.9%	7.4%	28.9%	8.8%	11.9%	13.8%	15.6%	6.5%	4.0%	100.0%
Cabuyao	11	20	25	9	13	14	6	9	2	**109**
%	10.1%	18.3%	22.9%	8.3%	11.9%	12.8%	5.5%	8.3%	1.8%	100.0%
Calamba	180	191	1331	575	924	417	940	536	398	**5,492**
%	3.3%	3.5%	24.2%	10.5%	16.8%	7.6%	17.1%	9.8%	7.2%	100.0%
NSRP Total	**390**	**844**	**2,353**	**1,613**	**2,038**	**934**	**1,986**	**1,171**	**845**	**12,174**
%	3.2%	6.9%	19.3%	13.2%	16.7%	7.7%	16.3%	9.6%	6.9%	100.0%

Source: JICA Study Team

3.4.7 Socio-economic Profile

3.4.7.1 Local Economy

1185. In 2016, he financial district of the country, Makati City had the most revenue of the host cities to the NSRP with revenue of nearly PhP 14.3 B. Manila City was next with PhP 12.8 B. Taguig City came in

next with revenue of PhP 6.3 B (COA, Financial Profile, 2016). Table 3.4.29 shows the financial profile of each host LGU.

Table 3.4.29 Financial Profile, Calendar Year 2016

Impact Area (City)	Revenue (PhP)
Manila City	12,832,646,000.00
Makati City	14,266,491,000.00
Taguig City	6,318,460,000.00
Parañaque City	4,819,981,000.00
Muntinlupa City	4,553,378,000.00
San Pedro City	1,105,909,000.00
Biñan City	1,798,628,000.00
Sta. Rosa City	2,930,873,000.00
Cabuyao City	1,664,572,000.00
Calamba City	3,170,264,000.00
Municipality of Los Baños	272,921,000.00

Source: Republic of the Philippines, Commission on Audit, Financial Profile Calendar Year 2016, 2016 Annual Financial Report

3.4.7.2 Labor Force and Employment

(1) Labor Force and Employment Profile by Host LGUs

Manila

1186. The City is predominantly a service-oriented city. Therefore, very little agriculture, forestry, mining and quarrying were undertaken. The leading industries were- textiles/garments, food, personal products, chemical/pharmaceutical, and rubber/plastic products. Theseare generally light, labor-intensive activities. They take advantage of the city's substantial labor and the labor supply from the rest of the metropolis. The rest were employed in the industry sector with a miniscule number in agriculture. (Manila, Comprehensive Land Use Plan and Zoning Ordinance, 2005-2020).

1187. Like major cities, Manila has become less of a center of manufacturing and more of a center of services, amenities, and leisure. Given the centrality of the city in the NCR, it provides employment, services, amenities and facilities for a large floating population that does not reside in the city.

Makati

1188. Makati gives priority to providing employment opportunities to its residents. Currently, the city has several employment assistance programs such as job placement/referral; job fairs; government internship program, employment of students, senior citizens, persons with disability, and differently-abled persons; emergency employment; and career development programs. In 2011, 7,053 out of 22,033 registered applicants (32.0%) were hired under the City's employment programs (Makati Public Employment Service Office (PESO), 2009-2011). The number of unemployed person in Makati was 15,650 individuals (Makati City, PESO, 2011).

Taguig

1189. In 2012, unemployment was low (9%), gainful employment was high (80%), and the jobs breakdown indicated a high concentration of craft-oriented and plant/machine operations work. It is notable that the only 1% of the total work force in Taguig is engaged in farming and fishing. (Taguig City CLUP, 2012).

Parañaque

1190. In 2012, he total population of 15 years old and over in Parañaque was estimated at 430,378 persons but only 62.5 % or 268,986 were in the labor force or economically active persons and those not economically active persons (house-keepers, students, aged and others) were 37.5 % or 161,392 persons.

1191. Employment rate among the economically active persons was estimated at 88.4% or 237,780 employed persons and the unemployment rate was 11.6 % or 31,202 unemployed persons. The employed labor force was composed of 55.9 % or 132,360 males and 44.1 % or 105,420 females (Source: Parañaque City Socio-economic Profile, 2012).

Muntinlupa

1192. The city envisions itself to become one of the leading investment hubs in the country, serious efforts are being made to indeed attract local and international businesses to the city. Data on Commerce and Trade attest to this pursuit. In 2016, the City's total recorded business registration was 13,761, with total declared employment of 114,780 individuals. (Muntinlupa City, Ecological Profile 2016)

San Pedro

1193. Occupations and groups in the city comprise of several factory workers and those involved in agriculture. Major and minor agricultural occupations include: fishing, farming, duck, poultry, swine and goat raising and fighting cock raising. The potential working population (15-64 yrs. old) of San Pedro was 221,494 as of 2015 PSA Census of the Population, 62.4% of which were gainful workers or 138,305 individuals. (Census of Population, PSA 2015).

1194. In 2011, those involved in the livesstock and poultry numbered 1,273 individuals (City Agriculture Office, 2011).

Biñan

1195. The working age population (15-64 age group) was 230,065, labor force (15 years and above) was 153,343, school-going population (1-24 years) was 155,659 and dependent population (young 0-4/old 65 over) was 102,963. Employment was 153,343 (63.8%) and unemployment 86,823 (36.2%) (Biñan City, CLUP 2018-2027).

Sta. Rosa

1196. The businesses in Sta. Rosa generated a combined employment of 100,000 persons and contributing almost eight billion dollars to the country's export earnings. The city is the host to four car manufacturers and two bus assemblers with a combined manpower of almost 3,000 persons and a total production output of 698,859 units. There are 830 fishermen who utilize the fishing territories in three barangays – Caingin (86.0 has.), Aplaya (153.0 has.) and Sinalhan (60.0 has.) (Sta. Rosa City Socio-economic profile 2014-2015).

Cabuyao

1197. For the period 1996 to 1999, the number of employed persons in Cabuyao increased by 72.6% - from 27,669 to 47,775. This is also true for the Province of Laguna which increased by 280% from 117,200 to 446,531 in 1999. It may be noted that increase in the city's share of employment in the industry sector coincided with the uptrend of the manufacturing sector for the years 1996 to 1999. Increase also in the city's employment share in the services sector, implied that some service-oriented firms opened their business in the area. As of 1996, there were 27,669 employed in Cabuyao and 117,200 in the entire province of Laguna. (Cabuyao CLUP, 2000-2010).

Calamba

1198. The potential working population (aged: 15-64 yrs. old) of Calamba City numbered 230,065 individuals about 68.3% of the total population according to the 2015 PSA Census of Population. The gainful workers numbered 202,352 individuals about 89.27% of the potential labor force (according to PSA[32], a gainful occupation is a permanent and fultime job lasting for one year or longer or expected to last for one year of longer).

[32] Philippine Labor Force Survey Jan. 2007, 1st Quarter. Philippine Statistics Authority. URL: http://psa.gov.ph/psada/index.php/catalog/5/datafile/F3/V132

(2) Income of PAFs by LGUs

1199. Table 3.4.30 indicates that the PAPs had varying income levels, with 20.8% having a monthly income of Php 12,000 to Php 15,999, 13% had an income of Php 9,000-9,999, and 11% an income of Php 16,000-19,999. In the Cities of Manila, Taguig, and Calamba, a higher proportion of PAPs earned from Php 12,000 to 15,999 monthly, with 22%, 25% and 19.7%, respectively. The same was observed in the city of Muntinlupa (24.6%), the city of San Pedro (16.4%) and the city of Biñan (21.3%). However, in the City of Santa Rosa and Cabuyao, the income level of the PAPs varied with higher proportions of PAPs with income belonging to (1) Php 12,000-15,999, (2) Php 8,000-9,999, and (3) Php 6,000-7,999.

Table 3.4.30 Income Bracket of PAFs

City	Income Bracket (Php)													
	Below 2k	2k-3.9k	4k-5.9k	6k-7.9k	8k-9.9k	10k-11.9k	12k-15.9k	16k-19.9k	20k-24.9k	25k-29.9k	30k-49.9k	50k above	N/R	Total
City of Manila	7	24	45	74	107	95	339	204	179	109	246	97	15	**1541**
%	0.5%	1.6%	2.9%	4.8%	6.9%	6.2%	22.0%	13.2%	11.6%	7.1%	16.0%	6.3%	1.0%	100.0%
Taguig	2	12	15	14	27	18	55	25	23	10	13	4	2	**220**
%	0.9%	5.5%	6.8%	6.4%	12.3%	8.2%	25.0%	11.4%	10.5%	4.5%	5.9%	1.8%	0.9%	100.0%
Parañaque	0	6	8	5	6	3	4	1	1	0	0	0	1	**35**
%	0.0%	17.1%	22.9%	14.3%	17.1%	8.6%	11.4%	2.9%	2.9%	0.0%	0.0%	0.0%	2.9%	100.0%
Muntinlupa	12	34	43	69	97	67	222	93	98	45	76	28	17	**901**
%	1.3%	3.8%	4.8%	7.7%	10.8%	7.4%	24.6%	10.3%	10.9%	5.0%	8.4%	3.1%	1.9%	100.0%
San Pedro	4	16	26	28	38	16	38	26	12	11	10	2	5	**232**
%	1.7%	6.9%	11.2%	12.1%	16.4%	6.9%	16.4%	11.2%	5.2%	4.7%	4.3%	0.9%	2.2%	100.0%
Biñan	22	89	126	211	315	226	406	176	117	70	98	22	29	**1,907**
%	1.2%	4.7%	6.6%	11.1%	16.5%	11.9%	21.3%	9.2%	6.1%	3.7%	5.1%	1.2%	1.5%	100.0%
Sta. Rosa	14	19	35	53	72	37	80	29	41	9	12	7	25	**433**
%	3.2%	4.4%	8.1%	12.2%	16.6%	8.5%	18.5%	6.7%	9.5%	2.1%	2.8%	1.6%	5.8%	100.0%
Cabuyao	2	7	8	11	14	5	15	7	2	2	5	0	0	**78**
%	2.6%	9.0%	10.3%	14.1%	17.9%	6.4%	19.2%	9.0%	2.6%	2.6%	6.4%	0.0%	0.0%	100.0%
Calamba	49	120	200	341	579	439	844	505	460	198	367	118	71	**4,291**
%	1.1%	2.8%	4.7%	7.9%	13.5%	10.2%	19.7%	11.8%	10.7%	4.6%	8.6%	2.7%	1.7%	100.0%
NSRP Total	**112**	**327**	**506**	**806**	**1,255**	**906**	**2,003**	**1,066**	**933**	**454**	**827**	**278**	**165**	**9638**
%	1.2%	3.4%	5.3%	8.4%	13.0%	9.4%	20.8%	11.1%	9.7%	4.7%	8.6%	2.9%	1.7%	100.0%

Source: JICA Study Team

1200. In terms of occupation, at least four (4) out of 10 PAPs (28.6%) were unemployed, with at least 20% of the PAPs in all cities engaged in wage-based employment, as indicated in Table 3.4.31. At least 29.8% of the PAPs were employed and wage-based, while 9.4% were enterprise-based. This may pertain to PAPs who had their own businesses or were employed in business establishments.

Table 3.4.31 Main Occupation of PAFs

City	Main Occupation								
	Land Based	Wage Based	Enterprise Based	Remittance Based	No Occupation	Others	N/A	N/R	Total
City of Manila	28	1,908	492	86	3115	95	58	318	**6,100**
%	0.5%	31.3%	8.1%	1.4%	51.1%	1.6%	1.0%	5.2%	100.0%
Taguig	2	220	83	10	405	5	8	73	**806**
%	0.2%	27.3%	10.3%	1.2%	50.2%	0.6%	1.0%	9.1%	100.0%
Parañaque	0	28	21	0	69	0	6	17	**141**
%	0.0%	19.9%	14.9%	0.0%	48.9%	0.0%	4.3%	12.1%	100.0%
Muntinlupa	3	1,036	341	28	1910	29	59	172	**3,578**
%	0.1%	29.0%	9.5%	0.8%	53.4%	0.8%	1.6%	4.8%	100.0%
San Pedro	2	237	102	4	490	8	12	53	**908**
%	0.2%	26.1%	11.2%	0.4%	54.0%	0.9%	1.3%	5.8%	100.0%

City	Main Occupation								
	Land Based	Wage Based	Enterprise Based	Remittance Based	No Occupation	Others	N/A	N/R	Total
Biñan	8	2,016	639	45	3211	28	170	509	**6,626**
%	0.1%	30.4%	9.6%	0.7%	48.5%	0.4%	2.6%	7.7%	100.0%
Cabuyao	5	94	31	1	121	4	11	46	**313**
%	1.6%	30.0%	9.9%	0.3%	38.7%	1.3%	3.5%	14.7%	100.0%
Calamba	36	5,223	1,669	148	8272	126	745	1403	**17,622**
%	0.2%	29.6%	9.5%	0.8%	46.9%	0.7%	4.2%	8.0%	100.0%
NSRP Total	**92**	**11,169**	**3,524**	**328**	**18,209**	**303**	**1,153**	**2,727**	**37,505**
%	0.2%	29.8%	9.4%	0.9%	48.6%	0.8%	3.1%	7.3%	100.0%

Source: JICA Study Team

3.4.8 Public Access

3.4.8.1 Existing Transportation/Traffic Situation

Manila

1201. The entire road network in Manila City is composed of about 770 km of roads, less than 3% of which remains unpaved. Roads and street are administratively classified as national and local. The total number of city streets in Manila is 1,580 with a total length of 553.07 km and occupying a total area of 3,644,000 square meters. The total number of national roads is 258 with a total length of 240.5 km and occupying a total area of 3,162,000 square meters.

1202. Major modes of land public transport in Manila are bus, taxi, FX, jeepney, and tricycle while informal land transport systems are kalesa, pedicab and kuliglig. The PNR and the LRTA operate the railway systems in Manila. The PNR has six (6) terminals or stations within Manila, which includes Blumentritt, España, Laong Laan, Pandacan, Pedro Gil, and Tutuban. The LRT-1 (Yellow Line) that runs along the length of Taft Avenue (R-2) and Rizal Avenue (R-9), and the LRT-2 (Purple Line) that runs along Ramon Magsaysay Blvd (R-6) are the only mass rail rapid transit lines traversing Manila. As the chief seaport of the Philippines, the Port of Manila along Manila Bay served as the city's main entry/exit point accessible via passenger/ cruise ships, while the Pasig River can be traversed via ferry service.

1203. According to Origin Destination Matrix (O-D), Manila ranks second to the top generators of trips, accounting for about 11% of the total Trip Origins and about 12% of Trip Destinations within the sixteen (16) zones considered.

Makati

1204. Makati is a major traffic generator for the greater Metropolitan Manila Area because it is the primary Central Business District (**CBD**) of the country. The city attracts a large amount of vehicle traffic due to its relatively large resident population and its predominantly service-oriented economy. Therefore, the city regulates the in-bound and out-bound traffic during the morning and afternoon peak hours, respectively. Mobility and accessibility, is one of Makati's most important requirements. However, continuing population growth, economic development, and corresponding increases in vehicular trips that are internally generated or passing through the city have constrained regional accessibility and local circulation. It is, therefore, a great concern that any further development in the city must be sustainable in terms of its traffic carrying capacity, or programs are identified to mitigate potential severe congestion.

1205. The city's road network is part of a system of circumferential and radial roads of Metro Manila. Traffic congestion within Makati is compounded by the fact that major expressways exist in north and south of Metro Manila but they are not interconnected. As a result, north and south through traffic is fed to major roads that are at the same time the major gateways to Makati.

1206. These gateways are Roxas Boulevard, Osmeña Highway, EDSA, and C5. Among these roads, EDSA is the busiest with 170,000 vehicles per day along the stretch from Guadalupe Bridge to Sen. Gil Puyat Avenue. Next is C5 with 136,000 vehicles per day within the vicinity of Kalayaan Avenue and Fort

Bonifacio. Osmeña Highway has 115,000 vehicles per day within the Don Bosco area, while Roxas Boulevard has 75,000 vehicles per day within the segment south of Sen. Gil Puyat Avenue.

1207. The transit systems in the city are road-based (jeepneys and buses) and rail-based (rail). For road-based transit, jeepneys are taken mainly for local circulation while buses, with the exception of Fort Bus, are regional in scope and service. Rail-based transit lines that serve Makati are all part of the regional system. This includes the LRT 1, MRT 3, and the PNR.

1208. The PNR is a railway company owned by the Philippine Government that operates a commuter line service in Metro Manila and another line to the Bicol Region. The PNR stations that service the city are located along Osmeña Highway with stations at Sen. Gil Puyat Avenue, Pasay Road, EDSA, and Nichols. In 2010, PNR carries 8,000 passengers daily through its commuter line service.

1209. Light Rail Transit Line 1 (**LRT1**) originally operates from Taft Avenue to Monumento with eighteen (18) stations. In October 2010, its north extension project began commercial operations up to Roosevelt with two (2) additional stations. Soon, LRT 1 will connect with the EDSA MRT 3 at North Avenue. In 2011, LRT 1 has an average total daily passenger boarding of 435,121. The Sen. Gil Puyat Station of LRT 1 directly serves Makati commuters. Mass Rail Transit 3 (**MRT 3**) is also known as EDSA MRT because it runs almost the entire stretch of EDSA. This is thus far the most important rail system that serves Makati since four (4) of its stations are located inside the city. With estimated peak-hour passenger volume in 2011, these stations include Guadalupe (5,463 passengers); Sen. Gil Puyat (3,499 passengers); Ayala (6,247 passengers) and, Magallanes (5,130 passengers) (Makati City, CLUP 2013-2023).

Taguig

1210. At present, Taguig is served only by South Super Highway to the west and R4 to the north with C5 in-between. There is limited access to all three (3) from the most populated regions of the city. Given Taguig's large area and population, these few links to regional travel routes are far from sufficient. Within Taguig, only one (1) sub-standard roadway connects most of the barangays, and most streets are too narrow to handle the current traffic load.

1211. Transportation is already a problem within Taguig, with narrow streets, a lack of through-roads, and heavy traffic loads. The growing population and new development will only further burden and an already inadequate system. The Strategic Concept Plan recommends a series of improvements, both long term and short term, with the goal of having a well-integrated and hierarchally differentiated road network. Better public transportation systems with connections to other parts of the metropolitan region are also proposed.

Parañaque

1212. Public Transportation vehicles plying along the main thoroughfares within the city are the taxis and jeepneys. Public buses are plying along the South Super Highway, Coastal Road and the norhern part of the city. In residential areas, tricycles and the pedicabs are the most common means of transporting passengers and their stuff. The present number of public utility vehicles is reasonable enough to acccommodate the demand of the population.

1213. The overall raod network of the city is 358.186 km. The road network in general is better condition and very passable.

1214. The southern segment of C-5 is a component of the major road system of Metro Manila that will connect Radial Road in Parañaque to Radial Road-4 in Makati, traversing along NAIA, crossing the South Luzon Tollways (**SLT**) by ovepass/flyover and leading to the southern portion of Fort Bonifacio Military Reservation.

1215. The fastest alternative from Alabang to Buendia during rush hours is the Metro Manila Skyway. The Skyway is a "package system": the elevated highway plus the South Luzon Tollways which will be upgraded. Motorists choosing the Skyway will enjoy a smooth uniterrupted drive from Alabang all the

way the to Makati. On the other hand, motorists who choose the South Luzon Tollway will find traffic flow faster since other motorists will opt for the Skyway.

1216. The City Government of Parañaque has already addressed the perennial traffic problem along the corner of Dr. A. Santos Avenue and the East Service Road by implementing a strict no parking rule for public utility vehicles within that area. Along Bicutan Interchange, it has successfully devised a re-routing scheme in the area and traffic has been contained to a manageable level. With coordination with other government agencies, most notably the MMDA, it hopes to find better solutions to other congested areas of the city.

1217. Areas identified as traffic-congested are entry/exits of municipalities namely: Bicutan (Brgy. San Martin de Porres), Sucat Interchange (Brgy. BF), Canaynay Avenue/Evacon (Brgy. San Dionisio along DASA), Kabihasnan Road (Brgy. San Dionisio along Quirino Ave.), MIA Road (Brgy. Tambo along Quirino Ave. and along Coastal Road), and Baclaran Rotonda (Brgy. Baclaran).

Muntinlupa

1218. Buses have stations in Starmall Alabang and South Station Alabang which have routes passing through EDSA to Quezon City, Navotas or Valenzuela. Provincial buses are found in South Station Alabang which have routes to Batangas City, Lucena, Quezon, and even to Bicol Region. Buses also pass through the Alabang viaduct from EDSA to Pacita Station.[33] Jeepneys have stations in Starmall Alabang and South Station Alabang which have routes to General Mariano Alvarez, Calamba and Pasay going through Metro Manila Skyway, Alabang-Zapote Road, or National Road (Maharlika Highway). Tricycles and pedicabs serve the interior of barangays and residential areas.

1219. The city is traversed by the PNR. PNR Terminals in Muntinlupa City include Sucat Station (along Meralco Road), Alabang Station (along T. Molina Street at the back of Starmall), and Muntinlupa Station (Rizal Street).

1220. Traffic in Cavite, Las Piñas, especially in the City of Muntinlupa has been decongested with the aid of the Muntinlupa-Cavite Expressway (**MCX**), which connects the SLEx and the Daang Hari Road, has recently been completed. It is a sample of a successful Private-Public Partnership (**PPP**) between Ayala Corporation and DPWH. It involved the construction of a 4-kilometer, 4-lane paved toll road, passing through the NBP reservation that connects Bacoor, Cavite to SLEx. Travel time from Daang Hari to Alabang interchange is reduced by an average of 45 minutes.

1221. The proposed Laguna Lake Expressway Dike (**LLEd**) Project is currently on the process of consultation evaluation and preparation for bidding. The project will provide a high standard highway cum dike that will facilitate traffic flow and mitigate flooding in the western coastal communities along Laguna Lake, from Bicutan/Taguig in Metro Manila through Calamba to Los Baños in Laguna. The proposed alignment runs 500 meters away but following the shoreline of the Laguna Lake.

San Pedro

1222. Buses with lines from Metro Manila serve the city. Jeepneys provides service between the city and nearby areas and the city's barangays. Tricycles and pedicabs serves the barangays and subdivisions (gated communities). The existing PNR railroad lines traversing the city also provide mobility for the San Pedro populace. The PNR has two stations in San Pedro; namely: San Pedro Station and Pacita MG Station.

1223. San Pedro City is accessible by land from its adjoining municipalities. It is aproximately 29 kilometers from Manila via South Superhighway and 61 kilometers from Sta. Cruz, the provincial Capitol. The City's circulation system is made up of a network of radial and circumferential roads, which link the city. The major arterial road, which traverses through the central business district of the town, is the National Highway connecting the Municipalities of Biñan and Muntinlupa City.

[33] Muntinlupa. Wikipedia. URL: https://en.wikipedia.org/wiki/Muntinlupa#Public_utility_vehicles

1224. In addition to the arterial road, the city is also served by a single loop of collector road around the town, which is being maintained by the national government. At present, this road links most of the barangays of San Pedro including those in the Resettlement Area and the villages/subdivisions as well. As designed, these roads start from the major urban road, Mabini Street, and then pass through Magsaysay Road upwards to Narra Road, Holiday Hills, then to the Resettlement Area to Calendola Village to Barangay San Vicente and back to A. Mabini.

1225. Meanwhile, service roads, which branch out of this collector road, serve as the access of the population from the majority of the neighbourhood nits as well as from the existing industrial establishments to the other portions of the city.

1226. Finally, on the western middle part of San Pedro is the South Expressway, which runs from Magallanes to Calamba. This extension does not, however, have an interchange exclusively to and from San Pedro passing through South Expressway. From the North, the nearest entry is the Susana Heights interchange and from the South, the nearest entry is the Southwoods inter-change and vice-versa.

Biñan

1227. Public transportation within the city is facilitated mostly by jeepneys. Tricycles and the motor-driven three-wheeled pedicabs are used for short trips or distances. Subdivisions may either be accessed via multicab shuttles and tricycles. The PNR currently operates a commuter line from Tutuban, Manila to Cabuyao, Laguna.

1228. The City of Biñan can be accessed through these main roads: 1 National road (South Luzon Expressway) which serves Northern and Southern Luzon; two (2) regional/provincial roads (Old National Highway serving the Province of Laguna and CALAX Expressway serving Cavite and Laguna); and three (3) SLEx junctions (San Francisco/Southwoods Exit, Carmona Exit, and Mamplasan Exit.

1229. Access/ circulation limitations are presented by narrow roads, traffic congestion in and around the poblacion, and right-of-way problems. Traffic on the Old National Road on the southeast of the intersection is due to the crossing of traffic on the P. Burgos Street, Gen. Capinpin Street and San Vicente Road/J. Gonzales Street. Traffic is heavy in front of the University of Perpetual during traffic hour due to the private cars and public vehicles waiting for the students to come out. Main traffic at Southwoods Ave. occurs at Rotonda and Rosario Complex road towards the City of San Pedro.

Sta. Rosa

1230. A grid network of roads, a railway and a ferry system define the movement systems in Santa Rosa. These systems shall be closely inter-connected and provided with adequate transition (such as enhanced accessibility to PNR terminals and the proposed ferry station) in order to maximise their service potentials.

1231. Santa Rosa may be seen as being divided into three major sectors: eastern, central and western. These divisions are defined by existing major roads and development patterns. The eastern sector is defined by areas east of the Manila South Road. The city center has since been expanding along the Manila South Road. This sector is also the site of the city hall, the central business district and is where most of the old residential areas of Santa Rosa may be found. The area is traversed by the Philippine National Railway's (PNR) south line with an inactive passenger station located near the Poblacion.

1232. The central sector is wedged in between the SLEx and the Manila South Road. This is a relatively new development area and may be characterized by the presence of idle lands, sporadic agricultural areas, sprawling subdivisions, commercial and industrial establishments as well as the Enchanted Kingdom.

1233. The western sector is between the city of Silang and the SLEx. It is a fast urbanizing area and is characterized by sprawling industrial estates and residential subdivisions as well as vast idle lands (most of which are reportedly held in Land Bank). At the westernmost part is found a military camp. The western sector has been earmarked as the location of a major town center by one of the leading property developers in the country. Of significance in this sector is the development of universities near the

sector's boundary with Silang which will undoubtedly attract a large volume of pedestrian and vehicular traffic.

1234. Significant stretches of the National Road perpendicular to the SLEx (from Brgy. Balibago to the boundary of Silang) is already experiencing heavy vehicular traffic. Future projects are expected to further depend on this road and will definitely add to its present level of congestion. The Manila South Road (from Biñan to Cabuyao) is also heavily congested. Given the situation that the private sector controls huge land banks (a good deal of which are still undeveloped/idle) the opening of new roads to alleviate present and expected conditions has become difficult. (Sta. Rosa CLUDP, 2000-2015)

Cabuyao

1235. Public conveyances are available in Cabuyao City. The main mode of land transportation is the jeepney, which has the highest number of registered vehicles in the city. Barangays are served either by jeepneys or tricycles, which have regular trips. In Brgy. Casile however, trips are quite irregular. Added to this is the absence of access road linking the upland barangays to the Poblacion. People have to go to Canlubang and use it as entry and exit access.

1236. In 2009, the city government of Cabuyao has a total of 53 vehicles (different kinds of vehicles). Aside from these vehicles, the eighteen (18) barangays also have public vehicles to serve its constituents, like barangay patrol, ambulance and others. There were eighteen (18) Tricycle Operators Drivers Association (**TODA**) in Cabuyao with a total of 3,644 members.

1237. In terms of access, a network of city roads adequately serves the town center and lowland barangays. Cabuyao has a total road length of 40.58 kms., spread circumferentially in the poblacion and in the other barangays except for the three (3) upland barangays which are not accessible through Cabuyao but through Canlubang.

1238. The 7-km. railway of the PNR was not operating in Cabuyao before 2001-2010. Its road signs and rail were not in good condition and needed total rehabilitation.

1239. The present road system in Cabuyao can still handle the volume of traffic. At certain point in time, however, especially during peak hours (7-9 AM and 4-7 PM), vehicular traffic is quite congested at certain choke points such as the National Highway – Pulo-Diezmo Road intersection, San Isidro-Pulo Diversion Road, Banlic and at the CBD of the city.

1240. Traffic incidence recorded was 536 for year 2009. This incidence as well as traffic congestion could be due to traffic management (e.g. traffic signs, road signs, traffic rules implementation) and the size of the roads, as well as human factors as driver's attitudes and behavior.

Calamba

1241. Tricycles, buses, and jeepneys, are popular modes of transportation in Calamba. There is also a PNR station in the city. Calamba is bounded on the east by Laguna de Bay. It is demarcated by Cabuyao on the northern part. It is adjacent to Los Baños on the southern portion. The western part brings the city near to the towns of Tanauan and Sto. Tomas in Batangas.

3.4.8.2 Access Points that may be Affected by the Project

(1) Road Network

1242. The DPWH classified the national road into three (3), namely: Primary, Secondary and Tertiary. National Primary Roads include roads that directly connect major cities (at least around 100,000 people). National Secondary Roads include roads that directly connect cities to national primary roads, except in metropolitan area and road that directly connects major ports and ferry terminals to national primary road, among others. National Tertiary Roads are the existing roads under DPWH which perform a local function.

Table 3.4.32 presents the national road classification.

1243. There are several national roads that cross the proposed NSRP alignment as reflected in Table 3.4.33 and Figure 3.4.6 to Figure 3.4.11. Figure 3.4.11 shows the national roads that cross the NSRP alignment. As shown, there are seven (7) primary, fourteen (14) secondary and nineteen (19) tertiary roads that cross the alignment. These include railroad crossing at grade level and railroad crossing over or under through bridge or tunnel. An on-site survey will be conducted to determine the actual number of railroad crossing.

Table 3.4.32 National Primary, Secondary and Tertiary Road Classification

National Primary: a. Directly connects Major Cities (at least around 100,000 people) Cities within Metropolitan Areas are not covered by the criteria
National Secondary: a. Directly connects Cities to National Primary Roads, except in Metropolitan Area b. Directly connects Major Ports and Ferry Terminals to National Primary Road c. Directly connects Major Airports to National Primary Road d. Directly connects Tourist Service Centers to National Primary Roads or other- e. Directly connects Cities (not included in the category of Major Cities) f. Directly connects Provincial Capitals within the same Region g. Directly connects to Major National Government Infrastructure to National Primary h. Roads or Other National Secondary Roads
National Tertiary: a. Other existing roads under DPWH which perform a local function

Source: https://psa.gov.ph/content/road-classification (Date Retrieved: 04/26/18)

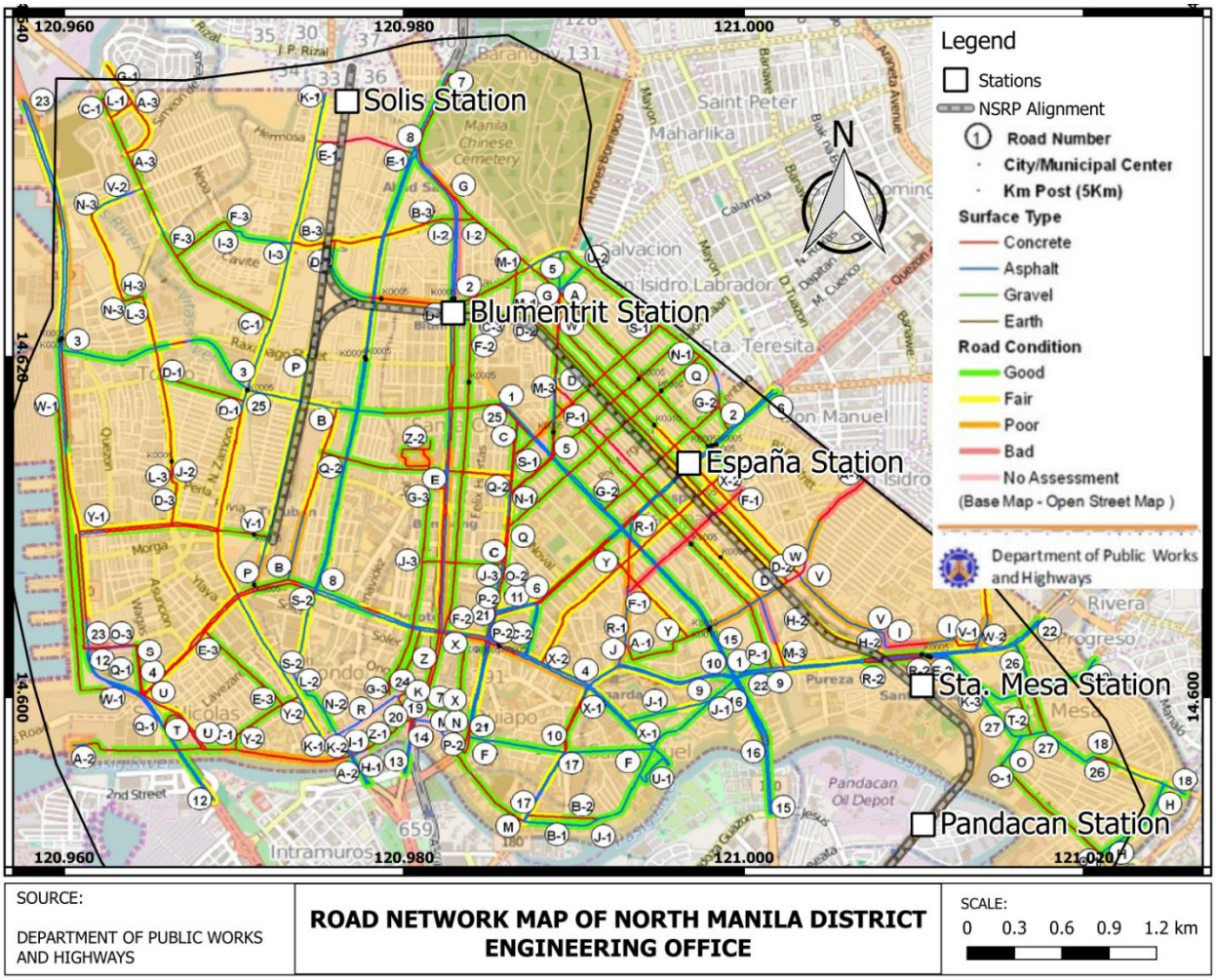
Table 3.4.33 List of Road Crossing the NSRP[34]

DEO / Functional Classification / Road Name / Road Number		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total
North Metro Manila							
	Secondary Roads						
5-5	Dimasalang St	1.08	0.47	0.78	-	0.08	2.41
6-6	España Blvd	1.61	2.33	-	0.14	-	4.08
7-7	J Rizal Ave	4.67	1.49	1.34	0.74	0.20	8.44
8-8	JA Santos Ave	3.95	1.93	-	-	-	5.88
22-22	R Magsaysay Blvd	0.86	2.77	0.21	0.12	0.10	4.06
25-25	Tayuman	1.03	0.58	-	-	0.01	1.62
	Tertiary Roads						
A-1	G Tuazon St	0.43	-	0.83	0.39	0.20	1.84
E-1	Hermosa St	-	-	-	-	0.64	0.64
F-1	J Fajardo St	-	-	-	0.97	0.01	0.99
N-1	Laon-Laan St	1.83	-	-	-	-	1.83
Q-1	M Roxas Service Rd	0.22	-	0.22	-	0.44	0.88
S-1	Ma. Clara	0.91	-	0.34	-	-	1.25
D-2	North Antipolo St	2.90	0.07	0.52	-	0.02	3.51
G-2	P Florentino	0.98	-	-	-	0.02	1.00
R-2	Ramon Magsaysay Blvd Service Rd	0.66	-	0.20	-	-	0.86
X-2	SH Loyola	-	1.77	-	-	-	1.77
B-3	Solis	-	0.90	-	-	-	0.90
South Metro Manila							
	Secondary Roads						
15-15	Nagtahan Link Rd 2	1.31	-	-	-	0.82	2.14
14-14	Nagtahan Link Rd 1	1.31	0.25	-	-	0.60	2.16
19-19	Plaza Dilao	0.11	0.09	-	-	-	0.20
29-29	South Super H-way	2.83	-	-	-	0.11	2.94

[34] The list includes roads crossing the railway at grade level and roads crossing over or under using a bridge or tunnel.

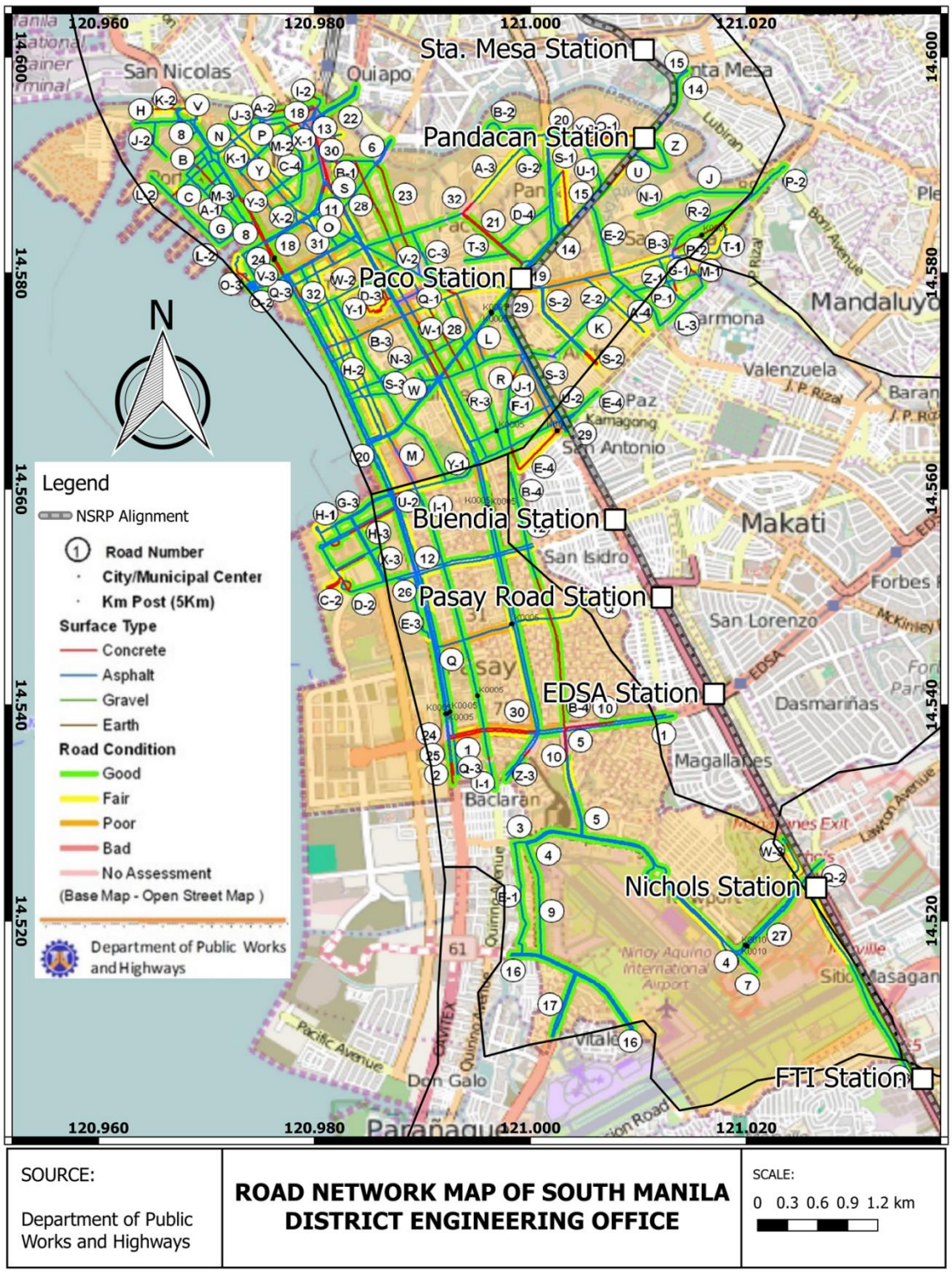
DEO / Functional Classification / Road Name / Road Number		Condition Rating					
		Good	Fair	Poor	Bad	No Assessment	Total
	Tertiary Road						
U	Beata St	0.81	-	-	-	-	0.81
S-3	Sn Andres St	2.11	-	-	-	0.01	2.12
U-2	P Ocampo Sr	1.55	0.51	-	-	0.02	2.07
E-4	Zobel Roxas St	0.48	0.63	-	-	-	1.11
Second District of Manila							
	Primary Roads						
11-11	Epifanio Delos Santos Ave (EDSA)	8.09	1.02	-	-	0.81	9.92
16-16	South Super Highway SB (Magallanes Flyover)	0.37	-	-	-	0.19	0.55
	Secondary Roads						
23-23	Gil Puyat Ave	8.33	-	-	-	-	8.
	Tertiary Road						
A	Antonio Arnaiz Ave	2.22	-	-	-	0.01	2.23
First District of Manila							
	Primary Roads						
4-4	C-5 Road	-	-	-	-	16.70	16.70
	Secondary Roads						
16-16	Gen Santos Ave	2.58	0.47	-	-	0.01	3.06
	Tertiary Road						
O	Fort Bonifacio-Nichols Field Rd	3.54	-	-	-	-	3.54
Las Piñas Muntinlupa District							
	Primary Roads						
1-1	Daang Maharlika (LZ)	5.46	0.30	-	-	0.05	5.81
	Secondary Roads						
4-4	Parañaque-Sucat Rd	0.88	-	-	-	-	0.88
5-5	PPTA Rd	5.58	0.15	-	-	0.15	5.88
	Tertiary Road						
H	South Super H-way East Service Rd	4.46	-	-	-	0.15	4.60
F	Muntinlupa-Railroad Station Rd	1.35	0.05	-	-	0.06	1.46
Second District of Laguna							
	Primary Roads						
1-1	Biñan-Cavite Rd	0.74	0.69	-	0.23	-	1.67
2-2	Calamba-Sta Cruz-Famy Jct Rd	0.66	5.17	5.49	6.74	0.13	18.19
4-4	Manila South Rd	7.16	8.82	6.08	1.45	1.03	24.55

Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/roads%201.htm(Date Retrieved: 04/18/2018)



Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.6 Road Network Map of North Manila District

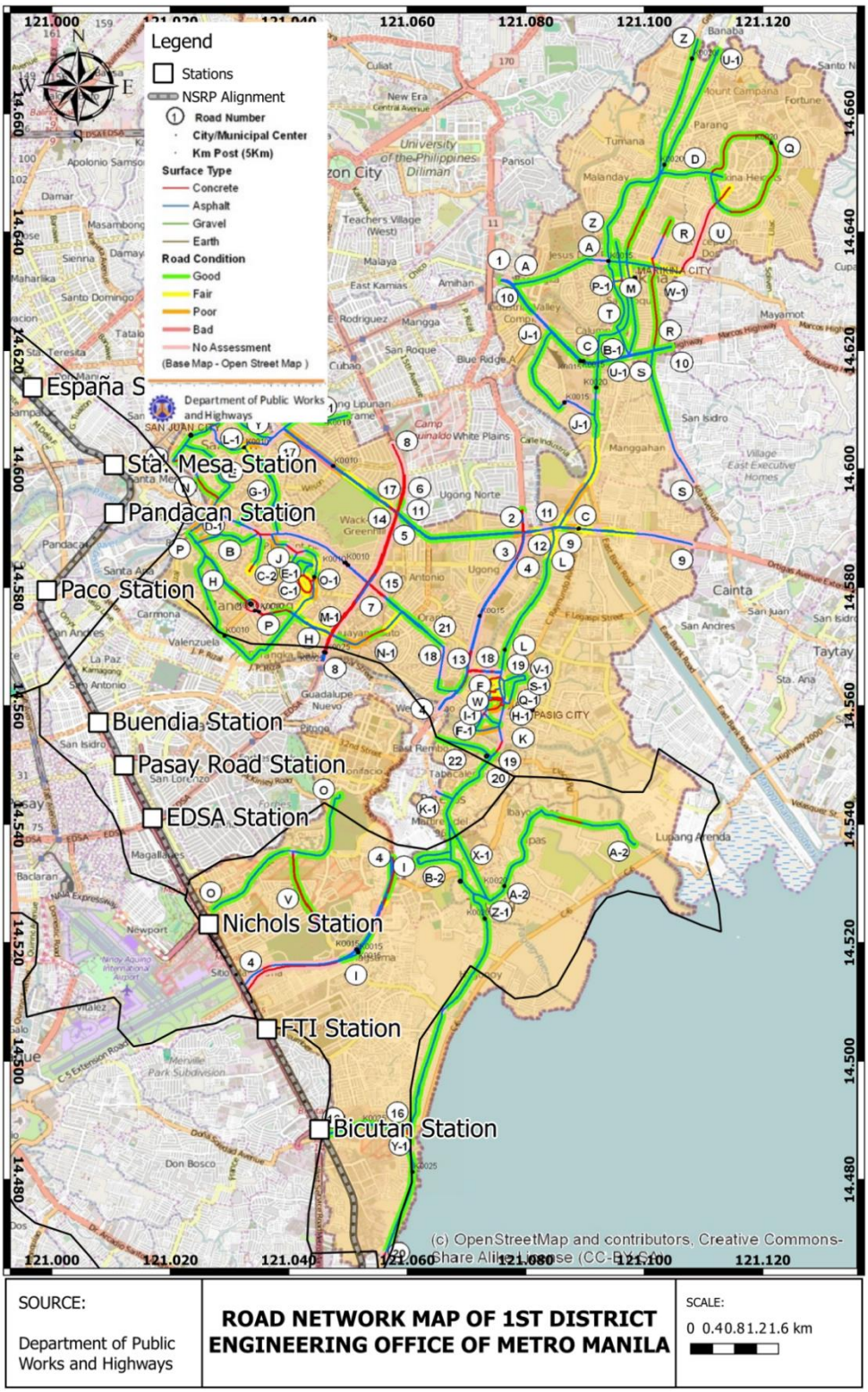


Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.7 Road Network Map of South Manila District

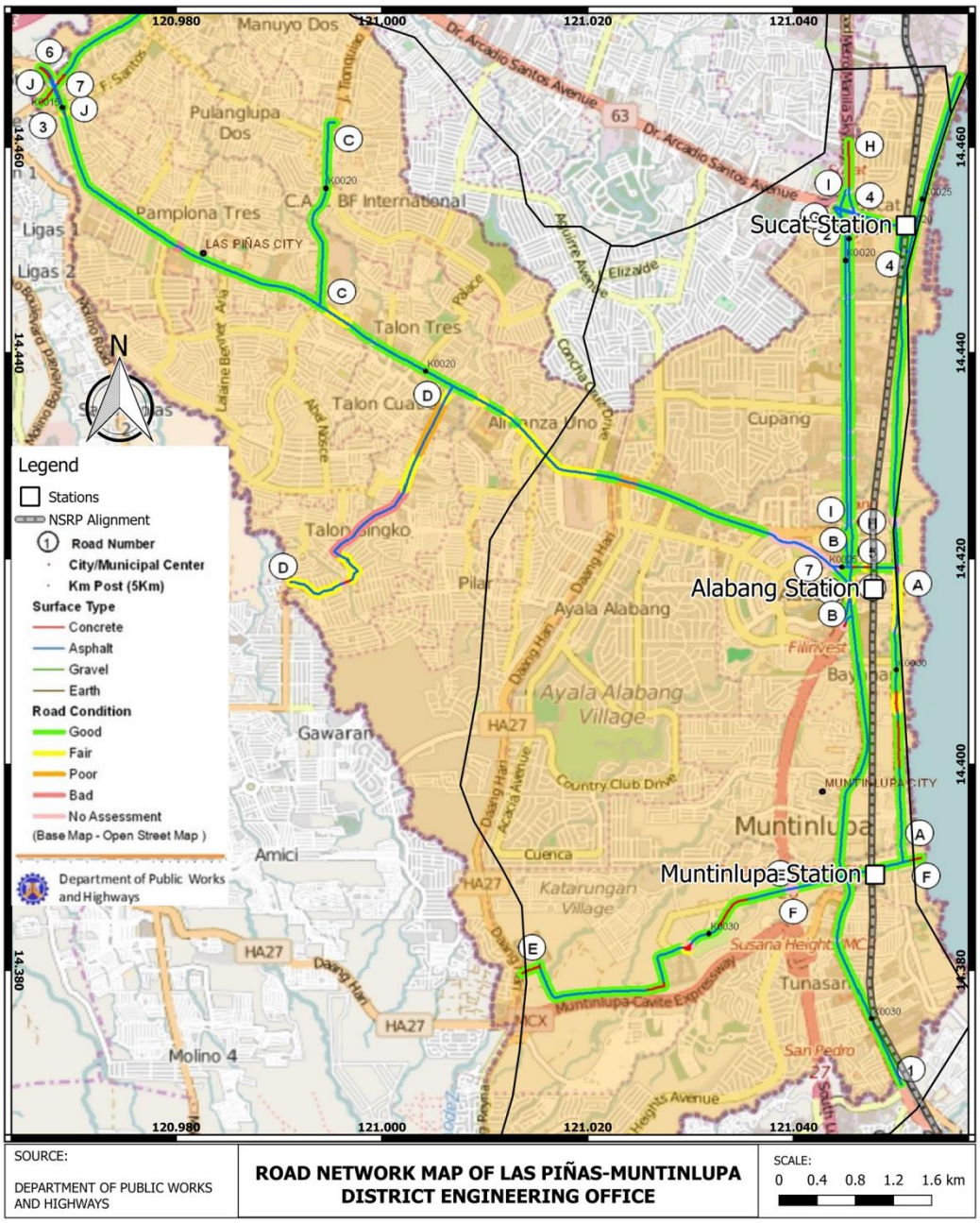
Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.8 Road Network Map of Second District of Manila



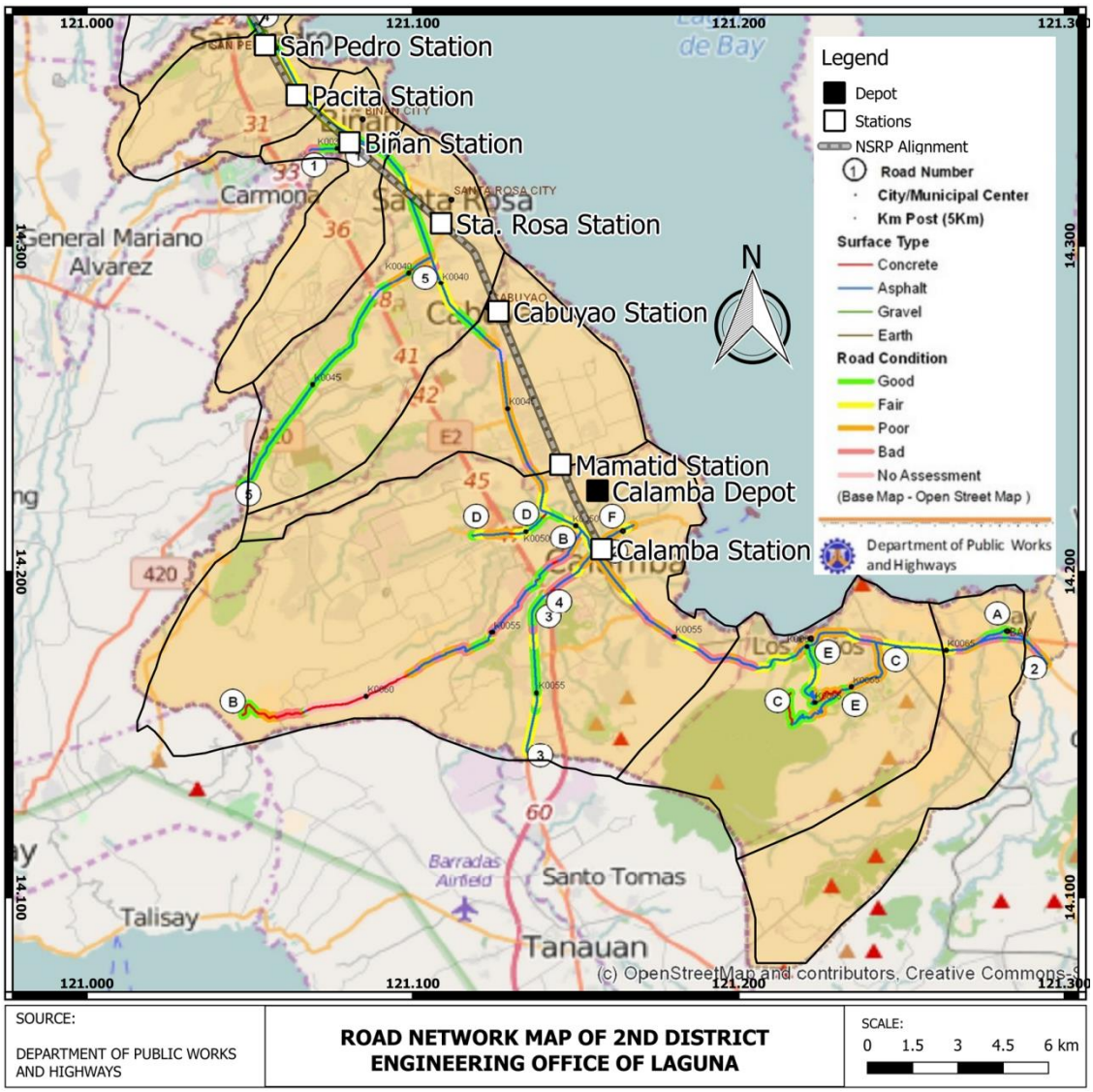
Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.9 Road Network Map of First District of Manila



Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.10 Road Network Map of Las Piñas Muntinlupa District



Source: http://www.dpwh.gov.ph/dpwh/atlas/2015%20DPWH%20Road%20Data/Road%20Data%202015/north_manila.htm (04/24/18)

Figure 3.4.11 Road Network Map of Second District of Laguna

(2) Ferry Service at Pasig River

1244. 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. Although commonly referred to as a ferry, it is more similar to a water bus.

1245. The latest Pasig Ferry Service, operated by Nautical Transport Services Incorporated, was re-activated on April 28, 2014 to alleviate the traffic situation in Metro Manila in light of the infrastructure projects being constructed simultaneously. The ferry service is operated by MMDA until a private investor takes over.

1246. There is a possibility that the proposed NSRP might affect the ferry operation during its construction traversing Pasig River. Appropriate measures will be done by DOTr including coordination with the concerned parties. As of 12 April 2017, there are twelve (12) operational ferry stations as presented in **Table 3.1.7**.

Table 3.1.7. Station of Pasig Ferry Service

#	Station	Location	Notes
1	Plaza de Mexico (Manila)	Intramuros, Manila	near Bureau of Immigration (Philippines), Manila Cathedral and Manila Central Post Office
2	Escolta Street	Binondo, Manila	near Jones Bridge
3	Liwasang Bonifacio	Liwasang Bonifacio, Ermita, Manila	near Quezon Bridge, Liwasang Bonifacio and Manila Central Post Office
4	Polytechnic University of the Philippines	Santa Mesa, Manila	near Philippine Coast Guard Station
5	Santa Ana	Santa Ana, Manila	Santa Ana Public Market and Savemore
6	Lambingan	Punta, Santa Ana, Manila	Bautista Street, Brgy. 897, Zone 99
7	Valenzuela	Valenzuela, Makati	near Bonaventure Garden Homes, Riverside Studios Manila and LTO Makati District Office
8	Hulo	Hulo, Mandaluyong	near Parish of Our Lady of the Abandoned Church
9	Guadalupe	Guadalupe Nuevo, Makati	near Guadalupe MRT Station and Commercial Mall
10	Maybunga	Maybunga, Pasig	beside Maybunga Barangay Hall
11	San Joaquin	San Joaquin, Pasig	near Sumilan and Bambang Bridge
12	Pinagbuhatan - Acacia	Pinagbuhatan, Pasig	near C6 Bridge Philippine Coast Guard Station

Source: MMDA Website, accessed April 13, 2018

3.4.9 Perception Survey

1247. The Socio-Economic, Health and Perception Survey was conducted at the host barangays in the Cities of Manila, Makati, Taguig, Parañaque, Muntinlupa in Metro Manila and Cities of San Pedro, Biñan, Sta. Rosa, Cabuyao and Calamba using a survey questionnaire presented in **Annex 3-3**.

1248. The respondents in the survey were the Barangay Council and Multi-sectoral Representatives (women representatives, men group representative, senior citizen, church group representative and other authority figures of the community). The total number of respondents per city is presented in **Table 3.4.34**.

Table 3.4.34 Perception Survey Respondents for the Proposed NSRP

Host City	Respondents				
	Male		Female		TOTAL
	Sub-total	%	Sub-total	%	
Metro Manila					
Manila	486	52.31	443	47.69	**929**
Makati	15	41.67	21	58.33	**36**
Taguig	32	50.00	32	50.00	**64**
Parañaque	4	50.00	4	50.00	**8**
Muntinlupa	25	35.21	46	64.79	**71**
Laguna					
San Pedro	19	50.00	19	50.00	**38**
Biñan	23	56.10	18	43.90	**41**
Sta. Rosa	40	80.00	10	20.00	**50**
Cabuyao	59	65.56	31	34.44	**90**
Calamba	79	52.00	73	48.00	**152**
TOTAL	782	-	697	-	**1,479**

Source: Geosphere 2018

Results of the Socio-economic, Health and Perception Survey are tabulated and briefly discussed.

3.4.9.1 Data on Respondents

1249. Table 3.4.35 shows that more than half (52.8%) of the respondents are male while 47.20% are female. Manila, Biñan, Sta. Rosa, Cabuyao and Calamba have more male than female respondents, while Makati and Muntinlupa have more female respondents. Taguig, Parañaque and San Pedro have equal male-female respondents ratio.

Table 3.4.35 Total Number of Respondents

Sex	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	No.	%	No.	%	No.	%	No	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	485	52	16	42	32	50	4	50	25	35	19	50	23	56	40	80	59	66	79	52	**782**	**52.80**
Female	444	48	22	58	32	50	4	50	46	65	19	50	18	44	10	20	31	34	73	48	**699**	**47.20**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

Table 3.4.36 shows that a majority of the respondents (67.93%) were born in the city where they currently reside, most of them residing in the barangays where they were born. Other respondents were from other cities/municipalities (9.32%), while a notable number of respondents came from other provinces (22.75%). The largest percentage of respondents that are born in their city are from Cabuyao (74%) and Biñan (63%), while largest percentage of respondents that are born from other provinces are in Taguig and Makati, each with 34%.

Table 3.4.36 Respondents' Place of Birth

Place of Birth	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
In this Barangay	510	55	16	42	21	33	2	25	38	54	22	58	26	63	25	50	67	74	80	53	**807**	**54.49**
Other Barangay	146	16	7	18	8	13	1	13	6	8	6	16	7	17	5	10	5	6	8	5	**199**	**13.44**
Other Municipality/ City	43	5	2	5	13	20	4	50	16	23	2	5	5	12	10	20	12	13	31	20	**138**	**9.32**
Other Province	230	25	13	34	22	34	1	13	11	15	8	21	3	7	10	20	6	7	33	22	**337**	**22.75**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1250. Table 3.4.37 shows that a little more than half (54.01%) of the respondents were in the 41-60 years old, and respondents within working age bracket account for a little over 83.46% of the total. Table 3.4.38 shows that almost all (94.19%) of the respondents are Tagalog.

Table 3.4.37 Respondents' Profile According to Age

Age	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
15-20	12	1	1	3	5	8	0	0	1	1	0	0	0	0	0	0	2	2	2	1	**23**	**1.55**
21-30	79	9	3	8	14	22	1	13	5	7	1	3	4	10	3	6	9	10	14	9	**133**	**8.98**
31-40	181	19	5	13	15	23	4	50	11	15	7	18	5	12	11	22	24	27	17	11	**280**	**18.91**
41-50	233	25	12	32	15	23	1	13	21	30	6	16	13	32	15	30	30	33	40	26	**386**	**26.06**
51-60	244	26	12	32	12	19	2	25	22	31	22	58	16	39	12	24	16	18	56	37	**414**	**27.95**
61-70	143	15	5	13	3	5	0	0	11	15	2	5	2	5	4	8	9	10	22	14	**201**	**13.57**
71-above	37	4	0	0	0	0	0	0	0	0	0	0	1	2	5	10	0	0	1	1	**44**	**2.97**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

Table 3.4.38 Respondents' Ethnicity Profile

Ethnicity	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Tagalog	865	93	33	87	62	97	7	88	70	99	37	97	41	100	50	100	88	98	142	93	**1395**	**94.19**

Ethnicity	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Ilokano	2	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2	1	**5**	**0.34**
Kapangpangan	1	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**	**0.14**
Others	61	7	4	11	1	2	1	13	1	1	1	3	0	0	0	0	2	2	8	5	**79**	**5.33**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1251. Table 3.4.39 shows that the respondents are mostly Roman Catholic (91.02%), while only a few are either Protestant, Aglipayan or INC.

Table 3.4.39 Respondents' Religion Profile

Religion	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Catholic	837	90	35	92	61	95	6	75	61	86	37	97	39	95	48	96	88	98	136	89	**1348**	**91.02**
Protestant	20	2	0	0	0	0	1	13	0	0	1	3	0	0	0	0	0	0	4	3	**26**	**1.76**
Aglipayan	10	1	0	0	2	3	0	0	3	4	0	0	0	0	0	0	0	0	0	0	**15**	**1.01**
INC	16	2	3	8	0	0	0	0	2	3	0	0	1	2	0	0	0	0	2	1	**24**	**1.62**
Others	46	5	0	0	1	2	1	13	5	7	0	0	1	2	2	4	2	2	10	7	**68**	**4.59**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1252. Table 3.4.40 shows that most of the respondents had formal education they acquired from community schools, and majority (47.1%) of them attended college. This is higher than the 32.8% who had secondary education. Comprising 13.7% of the total respondents were those who were able to attend technical-vocational courses.

Table 3.4.40 Educational Attainment Profile

Highest Level of Education	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
None	1	0	0	0	0	0	0	0	0	0	5	13	0	0	9	18	0	0	0	0	**15**	**1.01**
Elementary	46	5	0	0	0	0	0	0	1	1	10	26	1	2	12	24	2	2	8	5	**80**	**5.40**
High School	313	34	9	24	12	19	2	25	23	32	1	3	18	44	21	42	25	28	62	41	**486**	**32.82**
Vocational	120	13	6	16	5	8	0	0	14	20	17	45	2	5	0	0	14	16	25	16	**203**	**13.71**
College	449	48	23	61	47	73	6	75	33	46	5	13	20	49	8	16	49	54	57	38	**697**	**47.06**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1253. Table 3.4.41 shows that about 58.6% of the respondents confirmed that they are married, while 26.33% are single. The remaining percentage are either widowed or separated. This only shows that marriage remains an important social institution in the cities surveyed.

Table 3.4.41 Civil Status

Civil Status	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Single	217	23	5	13	20	31	4	50	18	25	30	79	13	32	41	82	16	18	26	17	**390**	**26.33**
Married	572	62	23	61	39	61	3	38	41	58	3	8	21	51	4	8	61	68	101	66	**868**	**58.61**
Widow	79	9	6	16	2	3	1	13	9	13	3	8	4	10	3	6	9	10	16	11	**132**	**8.91**
Separated	61	7	4	11	3	5	0	0	3	4	2	5	3	7	2	4	4	4	9	6	**91**	**6.14**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1254. Table 3.4.42 shows that majority (50.7%) of the respondents have 1 to 3 children, and almost all have up to 6 children only.

Table 3.4.42 Number of Children

Number of Children	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
None	184	20	8	21	20	31	4	50	17	24	6	16	15	37	10	20	15	17	22	14	**301**	**20.32**
1 to 3	454	49	23	61	28	44	2	25	37	52	25	66	17	41	23	46	51	57	91	60	**751**	**50.71**
4 to 6	248	27	6	16	14	22	2	25	13	18	7	18	9	22	16	32	21	23	31	20	**367**	**24.78**
7 to 10	34	4	1	3	2	3	0	0	3	4	0	0	0	0	1	2	3	3	8	5	**52**	**3.51**
10-above	9	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	**10**	**0.68**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1255. Table 3.4.43 shows that more than half (53.81%) of the respondents have been residents of their respective municipalities for 21 to 50 years. Only 5.87% have been residents of their city for 10 years or less.

Table 3.4.43 Number of Years of Residency

Years of Residency	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
1-10	62	7	4	11	4	6	0	0	1	1	0	0	0	0	1	2	6	7	9	6	87	**5.87**
11-20	108	12	2	5	7	11	1	13	4	6	1	3	2	5	4	8	12	13	11	7	152	**10.26**
21-30	116	12	7	18	18	28	5	63	6	8	9	24	7	17	6	12	10	11	31	20	215	**14.52**
31-40	204	22	7	18	21	33	0	0	19	27	5	13	6	15	13	26	21	23	25	16	321	**21.67**
41-50	156	17	7	18	6	9	0	0	17	24	13	34	5	12	9	18	18	20	30	20	261	**17.62**
51-60	128	14	8	21	3	5	0	0	7	10	3	8	8	20	8	16	11	12	31	20	207	**13.98**
61-Above	127	14	2	5	3	5	2	25	6	8	5	13	8	20	4	8	7	8	15	10	179	**12.09**
N/A	28	3	1	3	2	3	0	0	11	15	2	5	5	12	5	10	5	6	0	0	59	**3.98**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1256. **Table 3.4.44** shows that majority (41.5%) of the respondents belong to traditional families where husbands are the primary providers of income, although most of the households have multiple income providers, which 60.0% are earning from their regular salaried jobs, while the rest have either contractual jobs (11.2%) or other sources of income (10.2%).

1257. Most of the respondents (46.6%) earn at least Php 10,000 or higher in a month, near to or higher than the minimum wage rate of approximately Php 11,300. This percentage is lower than the percentage of respondents having regular salaried jobs, which means some of them earn below the minimum wage. There are a few respondents who earn less than Php 1,000 in a month, while 14.1% earn more than Php 20,000 per month.

Table 3.4.44 Household's Employment and Income

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Provider in the Family																						
Husband	460	42	16	32	33	40	4	36	36	40	20	37	18	35	34	40	47	42	90	47	758	**41.49**
Wife	206	19	15	30	26	31	2	18	23	26	16	30	12	24	21	25	24	21	54	28	399	**21.84**
Son	155	14	10	20	5	6	2	18	9	10	9	17	7	14	11	13	12	11	25	13	245	**13.41**

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Daughter	124	11	5	10	7	8	1	9	7	8	3	6	11	22	9	11	10	9	24	12	201	**11.00**
No answer	153	14	4	8	12	14	2	18	14	16	6	11	3	6	10	12	20	18	0	0	224	**12.26**
Total	**1098**	**100**	**50**	**100**	**83**	**100**	**11**	**100**	**89**	**100**	**54**	**100**	**51**	**100**	**85**	**100**	**113**	**100**	**193**	**100**	**1827**	**100.0**
Source of Income																						
Salary	480	52	36	95	47	71	6	67	53	75	32	84	30	73	39	78	71	77	98	64	892	**60.03**
Contractual Job	131	14	1	3	3	5	0	0	9	13	1	3	2	5	3	6	2	2	14	9	166	**11.17**
Farming	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	9	6	15	**1.01**
Selling	93	10	0	0	3	5	1	11	3	4	3	8	5	12	3	6	4	4	15	10	130	**8.75**
Others	116	12	1	3	7	11	0	0	1	1	0	0	2	5	2	4	6	7	16	11	151	**10.16**
No answer	105	11	0	0	6	9	2	22	5	7	2	5	2	5	3	6	7	8	0	0	132	**8.88**
Total	**929**	**100**	**38**	**100**	**66**	**100**	**9**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**92**	**100**	**152**	**100**	**1486**	**100.00**
Earning in a month																						
Less than 1,000	50	5	2	5	3	5	0	0	8	11	0	0	0	0	2	4	3	3	7	5	75	**5.06**
P1,000 - 4,999	176	19	3	8	7	11	0	0	12	17	6	16	8	20	5	10	4	4	19	13	240	**16.21**
P5,000 - 9,999	250	27	11	29	9	14	2	25	27	38	13	34	8	20	2	4	27	30	30	20	379	**25.59**
P10,000 - 14,999	165	18	10	26	8	13	0	0	6	8	6	16	14	34	10	20	12	13	45	30	276	**18.64**
P15,000 - 20,000	98	11	5	13	16	25	2	25	4	6	6	16	4	10	19	38	19	21	32	21	205	**13.84**
More than 20,000	114	12	5	13	19	30	4	50	4	6	5	13	6	15	12	24	21	23	19	13	209	**14.11**
No answer	76	8	2	5	2	3	0	0	10	14	2	5	1	2	0	0	4	4	0	0	97	**6.55**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1258. Table **3.4.45** shows that with regard to problems in the community, the prevalence of illegal drugs (14.65%), traffic congestion (11.28%) and problems concerning wastes (i.e. garbage) (11.22%) are the most common concerns among respondents. This might have resulted from the current government's campaign on drugs, therefore, raising the importance of solving the problem on illegal drugs, while sentiment on traffic congestion and waste management may likely come from the respondents' daily experience. Respondents in each city differ in the problems they think should be prioritized. For example, in Muntinlupa, poor local government service ranks on top, while flooding ranks on top for respondents from Sta. Rosa.

1259. While, 16.81% of the respondents want to implement curfew hours to curb local disturbance, and 13.21% expressed daily collection of wastes/garbage as important solutions that need to be implemented in their respective cities. The percentages per city show that the respondents differ in giving importance to the solutions needed in their community. In Parañaque and Cabuyao, for example, road widening is paramount, while respondents from San Pedro desire more regular collection of wastes and garbage.

Table 3.4.45 Problems in the Community

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Problem in the Community																						
Traffic congestion	111	12	16	29	17	12	6	32	4	4	0	0	2	4	20	28	6	6	6	4	188	**11.28**
Drugs	112	12	0	0	27	20	1	5	9	9	7	17	10	22	4	6	34	31	40	26	244	**14.65**
Fire	21	2	2	4	0	0	1	5	0	0	0	0	1	2	1	1	12	11	0	0	38	**2.28**
Wastes	89	10	0	0	11	8	0	0	5	5	9	22	6	13	11	15	0	0	56	36	187	**11.22**
Flood	45	5	1	2	3	2	0	0	0	0	7	17	0	0	22	31	4	4	11	7	93	**5.58**
Lack of street lights	13	1	0	0	16	12	0	0	5	5	0	0	7	15	1	1	1	1	0	0	43	**2.58**
Public Service	41	4	6	11	23	17	1	5	30	29	0	0	0	0	0	0	3	3	0	0	104	**6.24**
Drainage	13	1	3	5	7	5	4	21	0	0	1	2	1	2	3	4	11	10	0	0	43	**2.58**
Lack of Livelihood	88	9	4	7	3	2	2	11	4	4	1	2	0	0	2	3	0	0	25	16	129	**7.74**

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
No permanent homes	33	4	0	0	7	5	2	11	3	3	0	0	4	9	0	0	1	1	14	9	64	**3.84**
Lack of housing program	26	3	0	0	6	4	0	0	13	13	0	0	1	2	0	0	9	8	0	0	55	**3.30**
Stubborn Citizens	58	6	2	4	0	0	0	0	3	3	1	2	3	7	2	3	5	5	3	2	77	**4.62**
Lack of education	0	0	8	15	14	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	**1.32**
No answer	279	30	13	24	4	3	2	11	26	25	15	37	11	24	6	8	23	21	0	0	379	**22.75**
Total	**929**	**100**	**55**	**100**	**138**	**100**	**19**	**100**	**102**	**100**	**41**	**100**	**46**	**100**	**72**	**100**	**109**	**100**	**155**	**100**	**1666**	**100.00**
Possible Solutions to Community Problems																						
Smooth Traffic flow	47	5	8	23	18	14	1	11	4	4	6	15	19	42	9	12	11	11	0	0	123	**8.04**
road widening	64	7	7	20	4	3	4	44	1	1	0	0	0	0	0	0	40	38	0	0	120	**7.85**
"tokhang" Program against illegal drugs	100	11	0	0	12	9	2	22	0	0	0	0	5	11	0	0	0	0	0	0	119	**7.78**
Daily collection of wastes/garbage	161	17	0	0	7	5	0	0	5	5	20	51	1	2	5	6	3	3	0	0	202	**13.21**
Rehabilitation program	55	6	0	0	13	10	0	0	5	5	2	5	1	2	3	4	0	0	0	0	79	**5.17**
Street Lights	62	7	0	0	27	20	0	0	5	5	7	18	6	13	14	18	2	2	0	0	123	**8.04**
Housing Program	0	0	3	9	22	17	0	0	5	5	0	0	5	11	0	0	7	7	8	17	50	**3.27**
proper drainage system	26	3	4	11	17	13	0	0	31	29	0	0	0	0	0	0	8	8	3	7	89	**5.82**
Enhanced employment	12	1	2	6	2	2	0	0	9	8	0	0	6	13	0	0	2	2	13	28	46	**3.01**
Implement curfew hours	223	24	0	0	8	6	0	0	0	0	4	10	0	0	22	29	0	0	0	0	257	**16.81**
strict implementation of laws	45	5	0	0	2	2	0	0	3	3	0	0	1	2	0	0	7	7	22	48	80	**5.23**
Housing Program	80	9	2	6	0	0	0	0	12	11	0	0	0	0	1	1	7	7	0	0	102	**6.67**
No answer	61	7	9	26	0	0	2	22	26	25	0	0	1	2	23	30	17	16	0	0	139	**9.09**
Total	**936**	**100**	**35**	**100**	**132**	**100**	**9**	**100**	**106**	**100**	**39**	**100**	**45**	**100**	**77**	**100**	**104**	**100**	**46**	**100**	**1529**	**100.00**

3.4.9.2 Land Resource

1260. Table 3.4.46 shows that the majority of the respondents either own (40.72%) or rent (22.21%) the property where they reside. In Manila and Makati, respondents who rent are slightly more than those who own their property.

Table 3.4.46 Land Ownership

Land Ownership	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Owner	239	26	16	42	51	80	3	38	48	68	21	55	27	66	38	76	66	73	94	62	603	**40.72**
Tenant	166	18	1	3	3	5	0	0	4	6	1	3	1	2	2	4	5	6	13	9	196	**13.23**
Renting	254	27	18	47	0	0	2	25	13	18	5	13	7	17	1	2	5	6	24	16	329	**22.21**
Others	168	18	3	8	7	11	3	38	2	3	10	26	5	12	2	4	5	6	21	14	226	**15.26**
No answer	102	11	0	0	3	5	0	0	4	6	1	3	1	2	7	14	9	10	0	0	127	**8.58**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1261. Table 3.4.47 shows that the majority (72.40%) of the respondents do not cultivate crops, and the rest cultivates common crops such as vegetables and sweet potato. Rice is still cultivated but owing to the urban environment of the impact areas, the percentages are low.

Table 3.4.47 Cultivated Crops

Crops	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Rice Plant	27	3	0	0	1	2	0	0	1	1	0	0	3	7	0	0	6	6	6	4	44	**2.92**
Corn	28	3	0	0	0	0	0	0	1	1	3	7	1	2	1	2	0	0	3	2	37	**2.46**

Vegetables	18	2	1	3	1	2	0	0	2	2	0	0	3	7	3	6	11	12	23	15	62	**4.11**
Banana	7	1	0	0	0	0	0	0	1	1	0	0	2	5	1	2	1	1	14	9	26	**1.73**
Sweet potato	72	8	0	0	0	0	0	0	8	10	6	15	2	5	0	0	1	1	12	8	101	**6.70**
Others	60	6	3	8	4	6	8	100	20	24	32	78	2	5	4	8	3	3	10	7	146	**9.69**
None	719	77	34	89	59	91	0	0	50	60	0	0	29	69	44	83	72	77	84	55	1091	**72.40**
Total	**931**	**100**	**38**	**100**	**65**	**100**	**8**	**100**	**83**	**100**	**41**	**100**	**42**	**100**	**53**	**100**	**94**	**100**	**152**	**100**	**1507**	**100.00**

3.4.9.3 Health Situation

1262. Table 3.4.48 shows that the majority of the respondents (64.69%) have been ill at least three (3) times in the last year.

Table 3.4.48 Frequency of Being Sick in the Past Year

Frequency of Being Sick in the Past Year	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
1	293	32	13	34	33	52	3	38	25	35	12	32	15	37	19	38	29	32	64	42	506	**34.17**
2	182	20	7	18	11	17	1	13	15	21	9	24	6	15	14	28	15	17	39	26	299	**20.19**
3	106	11	5	13	6	9	0	0	5	7	5	13	3	7	1	2	8	9	14	9	153	**10.33**
4	32	3	4	11	0	0	0	0	3	4	3	8	8	20	4	8	4	4	8	5	66	**4.46**
5	17	2	2	5	0	0	0	0	0	0	1	3	0	0	0	0	1	1	5	3	26	**1.76**
6 or more	44	5	4	11	4	6	1	13	3	4	0	0	0	0	1	2	5	6	3	2	65	**4.39**
No answer	255	27	3	8	10	16	3	38	20	28	8	21	9	22	11	22	28	31	19	13	366	**24.71**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1263. Table 3.4.49 shows that 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 opts for treatment at private clinics (16.95%), while a few still gets treated by herbalists, or simply gets treated at home (self-treatment).

Table 3.4.49 Health Situation of the Respondents

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Kind of illness																						
Diarrhea	145	11	7	13	10	9	0	0	10	11	13	23	9	21	0	0	5	5	18	11	217	**10.99**
Upper Respiratory	344	27	18	33	29	25	2	25	26	29	12	21	10	23	16	26	27	25	59	37	543	**27.51**
Fever	439	34	16	29	35	30	2	25	26	29	23	40	13	30	21	34	49	46	62	39	686	**34.75**
Others	161	13	8	15	22	19	0	0	13	14	5	9	4	9	7	11	9	8	22	14	251	**12.72**
No answer	185	15	6	11	21	18	4	50	15	17	4	7	7	16	18	29	17	16	0	0	277	**14.03**
Total	**1274**	**100**	**55**	**100**	**117**	**100**	**8**	**100**	**90**	**100**	**57**	**100**	**43**	**100**	**62**	**100**	**107**	**100**	**161**	**100**	**1974**	**100.00**
Place where they are treated																						
House	100	9	5	11	3	3	0	0	7	9	1	3	3	7	3	5	1	1	17	11	140	**8.10**
Health center	349	32	23	49	18	19	2	22	29	37	19	49	13	31	8	14	23	23	35	22	519	**30.02**
Barangay Health Worker	19	2	0	0	0	0	1	11	3	4	0	0	2	5	1	2	4	4	8	5	38	**2.20**
Private clinic	154	14	10	21	25	27	1	11	13	17	8	21	6	14	9	16	26	26	41	26	293	**16.95**
Herbalist	8	1	0	0	0	0	0	0	2	3	0	0	1	2	0	0	2	2	4	3	17	**0.98**
Hospital	318	29	5	11	34	36	2	22	14	18	6	15	12	29	19	33	32	32	51	33	493	**28.51**
No answer	158	14	4	9	14	15	3	33	10	13	5	13	5	12	17	30	13	13	0	0	229	**13.24**
Total	**1106**	**100**	**47**	**100**	**94**	**100**	**9**	**100**	**78**	**100**	**39**	**100**	**42**	**100**	**57**	**100**	**101**	**100**	**156**	**100**	**1729**	**100.00**

1264. Table 3.4.50 shows that most respondents rely on community water system for their drinking water supply (64.21%) and for their household chores like laundry and washing (65.29%)

Table 3.4.50 Sources of Water for Drinking and Household Chores

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Source of drinking water																						
Spring	21	2	0	0	1	2	0	0	0	0	0	0	0	0	1	2	1	1	7	5	31	**2.09**
Deep well	21	2	0	0	0	0	0	0	23	32	2	5	9	22	6	12	19	21	25	16	105	**7.09**
River	11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	12	**0.81**
Water system	617	66	35	92	55	86	7	88	39	55	31	82	16	39	26	52	43	48	82	54	951	**64.21**
Others	200	22	1	3	6	9	1	13	6	8	2	5	13	32	11	22	23	26	38	25	301	**20.32**
No answer	59	6	2	5	2	3	0	0	3	4	3	8	3	7	6	12	3	3	0	0	81	**5.47**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**
Water source for household chores																						
Spring	20	2	1	3	1	2	0	0	0	0	0	0	0	0	2	4	2	2	9	6	35	**2.36**
Deep well	38	4	1	3	0	0	0	0	26	37	2	5	19	46	11	22	28	31	41	27	166	**11.21**
River	1	0	0	0	6	9	7	88	0	0	0	0	0	0	0	0	6	7	2	1	22	**1.49**
Water system	636	68	36	95	54	84	1	13	40	56	32	84	16	39	28	56	46	51	78	51	967	**65.29**
Others	168	18	0	0	3	5	0	0	2	3	2	5	4	10	5	10	8	9	22	14	214	**14.45**
No answer	66	7	0	0	0	0	0	0	3	4	2	5	2	5	4	8	0	0	0	0	77	**5.20**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

1265. Table 3.4.51 shows that most respondents (85.96%) use either flush or water-sealed sanitary toilet facilities, and the rest are either utilizing hole on the ground or none at all.

Table 3.4.51 Toilet Facility

Toilet Facility	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
None	24	3	1	3	18	28	6	75	0	0	0	0	0	0	0	0	10	11	2	1	61	**4.12**
Flush	322	35	23	61	16	25	2	25	27	38	13	34	16	39	32	64	5	6	53	35	509	**34.37**
Water sealed	499	54	13	34	28	44	0	0	39	55	23	61	24	59	12	24	35	39	91	60	764	**51.59**
House hole on the ground	17	2	0	0	1	2	0	0	1	1	0	0	0	0	0	0	3	3	3	2	25	**1.69**
Hole on the ground	9	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	3	2	14	**0.95**
Anywhere	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	16	0	0	23	**1.55**
No answer	49	5	1	3	1	2	0	0	3	4	2	5	1	2	6	12	22	24	0	0	85	**5.74**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**

3.4.9.4 Perception Survey Results

1266. Majority (83.05%) of the respondents are aware of the project through various means. About 62.81% of the respondents were made aware of the project through information disseminated in the barangays (**Table 3.4.52**). Majority (73.67%) of the respondents were in favor of the proposed project. Most respondents in the host cities were in favor of the project.

Table 3.4.52 Awareness on the Project

Awareness on the Project	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Awareness on the Project																						
Yes	796	86	26	68	53	83	6	75	49	69	30	79	29	71	41	82	65	72	135	89	1230	**83.05**
No	102	11	12	32	11	17	1	13	15	21	5	13	6	15	6	12	19	21	17	11	194	**13.10**
No answer	31	3		0	0	0	1	13	7	10	3	8	6	15	3	6	6	7	0	0	57	**3.85**
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100.00**
Source of Information																						
Neighbor	56	6	1	3	4	6	0	0	2	3	4	11	2	5	0	0	5	5	4	3	78	**5.25**
Barangay	621	67	15	39	33	51	3	38	40	56	20	53	26	63	34	68	35	38	107	69	934	**62.81**
Other person	41	4	2	5	2	3	0	0	0	0	0	0	0	0	2	4	8	9	10	6	65	**4.37**
IEC/Public Scoping	117	13	8	21	21	32	3	38	19	27	10	26	2	5	5	10	25	27	33	21	243	**16.34**
No answer	94	10	12	32	5	8	2	25	10	14	4	11	11	27	9	18	20	22	0	0	167	**11.23**
Total	**929**	**100**	**38**	**100**	**65**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**93**	**100**	**154**	**100**	**1487**	**100.00**

Awareness on the Project	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao,		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Acceptance of the Proposed Project																						
Yes	623	67	38	100	53	83	7	88	59	83	28	74	32	78	44	88	77	86	130	86	1091	**73.67**
No	229	25	0	0	10	16	0	0	3	4	8	21	8	20	1	2	0	0	22	14	281	**18.97**
No answer	77	8	0	0	1	2	1	13	9	13	2	5	1	2	5	10	13	14	0	0	109	7.36
Total	**929**	**100**	**38**	**100**	**64**	**100**	**8**	**100**	**71**	**100**	**38**	**100**	**41**	**100**	**50**	**100**	**90**	**100**	**152**	**100**	**1481**	**100**

1267. Table 3.4.53 shows that 38.27% of the respondents were anticipating that the Project will provide a much faster commute from Metro Manila to Laguna, and 31.43% believes the Project will result to less traffic congestion.

1268. About 45.39% of the respondents were concerned that the Project will demolish the houses near the railway. The largest percentage came from Biñan with 53% of the respondents expressing concern over the impact of the Project on the settlers near the railway.

Table 3.4.53 Possible Impacts of the Project Listed by the Respondents

Particular	Manila		Makati		Taguig		Parañaque		Muntinlupa		San Pedro		Biñan		Sta. Rosa		Cabuyao		Calamba		TOTAL	
	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	ST	%	Total	%
Benefits of the Project																						
Express transport from Metro Manila to Laguna	525	38	32	41	46	39	6	35	37	32	22	42	22	38	27	38	58	39	104	40	879	**38.27**
Less traffic congestion	431	31	24	30	34	29	5	29	31	27	17	33	14	24	23	32	41	28	102	39	722	**31.43**
Less air pollution and noise from the vehicles	222	16	13	16	28	24	4	24	18	16	8	15	20	34	13	18	28	19	50	19	404	**17.59**
Others	71	5	9	11	8	7	1	6	9	8	1	2	0	0	6	8	7	5	5	2	117	**5.09**
No answer	128	9	1	1	3	3	1	6	19	17	4	8	2	3	3	4	14	9		0	175	**7.62**
Total	**1377**	**100**	**79**	**100**	**119**	**100**	**17**	**100**	**114**	**100**	**52**	**100**	**58**	**100**	**72**	**100**	**148**	**100**	**261**	**100**	**2297**	**100.00**
Negative Impacts of the Project																						
Demolition of houses near the railway	571	47	13	31	40	46	3	30	22	24	18	42	23	53	23	37	35	31	109	61	857	**45.39**
Closure of the roads that traverse the railway	262	22	10	24	20	23	2	20	27	29	15	35	12	28	19	31	22	20	42	23	431	**22.83**
Noise during construction	176	14	9	21	17	20	0	0	12	13	3	7	4	9	11	18	19	17	23	13	274	**14.51**
Others	77	6	2	5	5	6	2	20	5	5	0	0	0	0	4	6	3	3	5	3	103	**5.46**
No answer	132	11	8	19	5	6	3	30	26	28	7	16	4	9	5	8	33	29	0	0	223	**11.81**
Total	**1218**	**100**	**42**	**100**	**87**	**100**	**10**	**100**	**92**	**100**	**43**	**100**	**43**	**100**	**62**	**100**	**112**	**100**	**179**	**100**	**1888**	**100.00**

3.4.10 Impact Identification, Prediction, Assessment and mitigation

(1) Pre-Construction and Construction Phase

1) Displacement of Settlers

Displacement/Disturbance of Properties

1269. One of the significant impacts of the NSRP is the displacement/disturbance of properties. Based on the latest census, tagging and socio-economic survey conducted by the RAP Team from Calamba City to Manila City within the PNR ROW, an estimated of 9,638 families will be displaced. Though NSRP alignment will maximize the use of PNR ROW to minimize land acquisition, it has been however proliferated by ISFs disregarding the hazard of living along the PNR ROW.

1270. Moreover, the PNR ROW from Solis Station to Sta. Mesa Station in Manila City is already committed for the NLEx/SLEx Connector Road project of the DPWH which will start construction in 2019. Hence, DOTr will acquire land or secure a ROW parallel to PNR ROW from Solis Station to Sta. Mesa Station with a total length of about 10.9 km up to Zobel Roxas Street. This segment will likewise displace affected families and properties, businesses and commercial establishments along this proposed ROW. Additional displacement of properties, business establishments, families and others within the 30 m extension at each of the 20 stations will be also a significant imppact including the 78 ha depot in an agricultural areas in Banlic, Laguna.

1271. Social Development Plan Framework presented in Chapter 6 of this report will address, among others, the displacements involving resettlement of the PAFs. It is further elaborated in the RAP for the NSRP, which is a separate document. RAP is being prepared to ensure that affected families and establishments will be provided with an acceptable relocation area and/or just compensation. The measures of compensation and assistance to all PAFs in the RAP will be based on the JICA Guidelines for Environmental and Social Considerations (2010) and ADB Safeguard Policy Statement (2009), the Republic Act No. 10752, and other applicable Philippine Laws and Regulations. Just compensation will be paid in full prior to any displacement activity. Internal and external monitoring of RAP activities will be conducted in accordance with ADB and JICA guidelines.

1272. Relocation sites will be secured/developed prior to displacement in coordination with LGUs, SHFC and other key shelter agencies with basic utilities such as power and water and health and educational facilities. A noted positive impact of the Project is that the affected families (i.e. informal settler families) may eventually be provided with secure tenure through housing units with basic amenities. NSRP will also lead to improving the living conditions of the PAFs as provided in the relocation sites.

1273. Livelihood of the local community from commercial establishments, small vendors, and farmers may experience temporary disturbance during construction. The Project may also lead to a decline or eventual loss of business in affected areas. In consideration of affected groups, construction activities will be undertaken at the shortest possible time to restore normal business operations immediately. Alternative livelihood programs in coordination with the LGUs and other government agencies will also be taken in to consideration. For business establishments that will be permanently removed, fair compensation measures will be provided to ensure continued economic activity and/or the restoration and/or improvement of livelihood.

Impact on Privately-Owned Land

1274. For sections wherein private lands may be affected by the NSRP alignment such as the 10.9 km ROW parallel to the PNR ROW from Solis Station to Sta. Mesa Station; 30-meter ROW extension at 20 stations, depot areas (Sucat Thermal Power Plant or Banlic, Laguna), land acquisition and or securing ROW is being considered. To avoid conflict, RAP and Land Acquisition Plan (**LAP**) is being prepared, in accordance with ADB and JICA Guidelines and applicable Philippine Laws and Regulations, for this Project to address in detail the compensation for land and structures, resettlement of displaced persons (**DPs**), and loss of livelihood opportunities.

1275. DOTr will coordinate with DPWH, PSALM, LGUs, lot owners and other concerned stakeholders in acquiring the land and/or securing ROW.

1276. There will be a provision for external and internal monitoring agencies to ensure that the displacement activities are conducted in compliance to the RAP.

Change/Conflict on Right of Way and Impact on Public Access

1277. Among the immediate impacts identified, the blocking of access roads of the PAFs, as well as possible disruption of school activities of students (in case relocation would be conducted during the school year), pose major concerns during the construction phase.

1278. The Project will study the current use of public access in local affected communities and mitigate the closure of existing access as much as possible. In case any diversion will be required, the project-

affected communities and LGUs will be well-informed on the Project activities including constructions schedule and possible impact to the existing public access (pedestrian, cyclist and vehicles). The RAP to be prepared will also include recommendations in coordination with the DepEd and the host LGUs for the schedule of construction activities to ensure that the transition and adjustment of PAFs would have minimal disruptions and would ensure that the PAFs' conditions would be maintained, if not improved.

1279. During the construction, diversion roads and alternative access routes will be provided with appropriate protection measures, which will minimize the disruption of dailylife of local communites. Traffic aides will be also assigned on site to guide road users ensuring their safety and to monitor the site condition. Diversion access are likely to change as the construction progresses. The contractor will keep the public informed on any changes in diversion route through notices, posters, signages, etc.

Vulnerable Groups: People under poverty line, solo parents, women, children, elderly and persons with disabilities

1280. Under the RAP, A Gender Impact Assessment has been conducted, 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 (**GAD**) activities are not related to gender, therefore, not addressing the needs of the PAPs. Some identified issues among LGUs include: (1) lack of specialized gender-sensitive facilities and furnishings, (2) poor access of solo parents to employment and other livelihood opportunities, and (3) improved access to safe and potable water supply among indigenous communities, among others. In addition, the absence of a GAD database sets limitations on the capacity of LGUs to plan for their needs.

1281. Vulnerable Persons such as solo parents elderly, persons with disabilities, and those living below the poverty line will also benefit from the Livelihood and Income Restoration Program, which specific details will be explained in the Resettlement Action Plan (RAP) for the Project. In addition, gender sensitive livelihood and skills training program will also be included in the SDP Framework presented in Chapter 6 with due consideration to solo parents and women-headed families.

1282. The Project's design of train system will also account for the needs of the vulnerable groups through the provision of gender-sensitive facilities for women, allocation of trains for women (especially those pregnant), including allocation of security officers for each station. In addition, the station design will ensure that the PAPs are provided with sufficient lighting to ensure their safety and security.

2) In-Migration

1283. Once the ROW had been cleared during the pre-construction stage, informal settlers can potentially occupy or resettle in the area. In order to avoid this, the time between the pre-construction and construction will be shortened as much as possible. Moreover, the project area will be fenced and guarded with security personnel to limit access or entry at the ROW.

1284. Qualified project-affected persons (**PAPs**) who own structures but do not own the land may also be relocated to existing resettlement sites or new construction sites near the proposed NSRP Alignment. DOTr will coordinate with the receiving LGUs for the development of sites and provision of basic services and facilities, as well as for ensuring the integration of the PAPs into the host community. This will be included in the SDP programs.

1285. The impact of in-migration of workers during construction may not be also significant because DOTr and its contractors will employ qualified local residents for the NSRP.

3) Cultural/Lifestyle Change

1286. 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.

1287. Some residents may increase the pace of their lifestyle to keep up the demand of employment and livelihood opportunities. Amenities including water, food supply, and temporary housing will be provided

for them during construction so as not only to improve their living but also to change their perception on values of these conveniences.

1288. The living condition of the ISFs will be improved because they will be provided with secure tenure through housing units with basic amenities. Utilities including water and electric supply will be provided to resettlement areas.

4) Impacts on Physical/Cultural Resources

1289. The NSRP may affect the Old PNR structures specified in **Table 3.4.12** which are over 50 years. These structures are within the Project alignment and can be considered as historic sites/structures. There are also identified heritage sites declared by the National Historical Commission of the Philippines (**NHCP**) that have a close proximity to the alignment.

1290. For the old PNR structures, DOTr will conduct literature review and site validation of the potential historic structures in coordination with PNR and NHCP and perform measured survey of the identified historic structures including its foundation and building condition. DOTr will prepare a Protection and Conservation Plan to maintain the structures and to provide necessary protection measures during construction. It will also include the protection of identified heritage sites which have great potential as tourist spots.

1291. In the event that an archaeological asset is discovered during the course of construction period, the following procedure will be implemented:

- DOTr must preserve the potential archaeological finds and report it immediately to the National Museum.
- Closely coordinate with the National Museum on the appropriate course of action in protecting the archaeological finds.
- Cease immediately all construction activities in the vicinity of the find/feature/site;
- Hire an archaeologist, recognized by the National Museum, to ensure the following are carried out:
- Implement the following process for conservation a) Hire a conservator, if required, b) The consulting archaeologist completes a report on the findings and submits to the National Museum, and c) National Museum reviews the report and informs when works can resume.

5) Threats to Delivery of Basic Services/Increase in Demand for Resources

1292. Prior to construction of, there are existing infrastructure (e.g. water and fuel pipelines, electric and telephone posts and cables, etc.) within the vicinity of the NSRP alignment need to be relocated/transferred or moved to give way for the construction of the NSRP. The constuction will affect the utilities and may cause disruption of delivery of basic services. Also, concreting works at the stations and depot will bring about increase in water consumption. The amount of water will depend on the size of the structure that will require concreting. The impacts, however, are rated as low and not significant and will persist only during the pre-construction and construction period. The project will also generate solid waste including construction. Solid wastes will be handled and disposed by a private waste collector commissioned by the contractor.

1293. To avoid disruption of delivery of basic services to the community, a utility and relocation plan will be prepared in coordination with utility companies such as water, electricity, telephone, gas and oil. A protection plan will also be prepared for the relocation activities. A water conservation program and regular monitoring of water consumption for domestic and construction purposes will be implemented. Also, the DOTr's contractor will identify the final disposal sites for each LGUs. Solid wastes will be handled and disposed in accordance with RA 9003.

1294. On the other hand, 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. Provision of these resources will be included in the RAP.

6) Threats to Public Health and Safety

1295. The potential air and water pollutants generated during pre-construction and construction phases of the proposed NSRP may have adverse impacts on the health and safety of the workers and residents of nearby communities, specifically, those along the project boundary. Workers may be exposed to ergonomic stress and increased levels of noise, dust, and heat, as well as physical hazards associated with heavy lifting, moving heavy equipment, etc. The workers and local residents may also expose to or spread contagious/infectious diseases due to unsanitary condition at the project area.

The following measures will be implemented to reduce risks of threats to human health and safety:

Public health and safety (accidents involving local communities)

Pre-construction phase

- 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 mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any;
- Planning for construction yard and access route in consideration to health and safety of local communities;
- Consideration of safety measures will also be considered in the design of the train such as emergency brake and exit; and
- Close coordination with the nearest hospitals in the active construction site for possible emergencies.

Construction phase

- Provision of safety officer to monitor the health and safety of the local community; and
- 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.

Occupational Safety and Health (Accidents and infectious disease)

Pre-construction phase

- Preparation of Occupational Safety and Health Management Plan.
- Inclusion of medical certificate in the requirements for hiring of workers to ensure that they are fit to work.
- Ensure that the construction workers are provided with proper training on construction operating procedures, occupational health and safety procedures and emergency preparedness and response procedure.
- Preparation of Construction Management Plan including storage of equipment and machinery, and access route of heavy vehicles considering health and safety of workers; and
- Close coordination with the nearest hospitals in the active construction site for immediate transfer and/or further evaluation and medical management of the patient.

Construction phase

- Provision of safe and clean water for drinking, appropriate sanitary facilities such as portable toilets and waste bins.
- Provision of appropriate personal protective equipment (PPE) to all construction workers, particularly to the personnel working on heights, heavy and electrical equipment, and tunneling activities.

- Provision of medical/first aid kits at the construction area. Establishment of Health and Safety Desk or Medical Station at the active construction sites to safeguard the health of the workers and local residents and to provide immediate response during unexpected incidents/emergencies.

7) Generation of Local Benefits

1296. The direct benefits resulting from the proposed NSRP during pre-construction and construction include the creation of temporary employment for both local and non-local manpower. During construction of the proposed NSRP, DOTr will require about 13,000 workers. The exact number of workers and operators will depend on the construction duration and number of equipment that will be used.

1297. To enhance the employment opportunities brought by the proposed NSRP, DOTr will regularly coordinate with the host LGUs and barangays regarding the hiring of temporary workers to ensure that the workers being considered are legitimate residents in the area. Moreover, by hiring local residents, some of the social conflicts associated with uncontrolled in-migration can be minimized. The priority of employment will be provided to project-affected people and gender equality will be also well considered. Through livelihood and income generation program prepared under RAP, the skill training will be provided to those PAFs underprivileged so that they have sufficient skills to work at construction phase.

1298. The respective contractor will be responsible to provide accommodation for their workers and equipped with the necessary social infrastructure. Non-local skilled and non-skilled workers will stay in temporary accommodation. After construction activities, the contractor will ensure that workers leave the area to prevent the formation of informal settlements.

1299. Potential positive effects of the manpower influx will include demand for retail and other services. This may increase economic activities and benefits for some local businesses including food suppliers and other retailers that are not included in affected structures that will be displaced. It is expected also to increase business opportunities in terms of the project needs for construction materials, supplies, concrete aggregates, and social services.

8) Traffic Congestion

1300. An increase in vehicular traffic will be expected during pre-construction and construction of the proposed NSRP due to the movement of construction equipment; delivery of construction materials; and additional commuters – construction workforce.

1301. Because of the mobilization of heavy vehicles and equipment, construction activities and staging of works, restriction/blockage of some roadways/access roads will be unavoidable. This will lead to increased traffic congestion and changes in traffic patterns. Motorists, cyclists, and pedestrians might alter their trip routes to their inconvenience in order to avoid heavy traffic in the construction areas.

1302. Traffic Impact Assessment (**TIA**) will be prepared and base on its findings, a Traffic Management Plan (**TMP**) that details the activities to adequately manage traffic flow will be prepared and strictly implemented. The TMP will be properly coordinated with concerned LGUs, transport operators and approved by the LGUs concerned. Some measures that will be included in the plan are rerouting of traffic, proper scheduling of transport of heavy structures during period when there are less vehicles on the road and posting of appropriate traffic sign and warning. Also, the general public, host barangays and LGUs are well informed on the potential impact of the project to the exiting access and provide mitigating measures.

(2) Operation Phase

1) Displacement of Settlers

1303. No displacement of households and business establishment is expected during operation of the proposed NSRP.

2) In-Migration

1304. Influx of migrant workers during operation of the proposed NSRP will intensify the competition for jobs of locals. Migrant workers may also bring in cultures and views not acceptable to the locals. Sometimes, the presence of migrants is associated with increased crime rate, sprouting of informal settlers and other social ills. Locals who are qualified will be given the opportunity and priority to seek employment from the proposed NSRP. DOTr will maximize the use of local labor as possible. Moreover, the project area will be fenced to prevent the settlement of ISFs along the ROW.

3) Cultural/Lifestyle Change

1305. 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.

1306. With the operation of the proposed NSRP, it is anticipated that the host barangays, the surrounding barangays and the entire cities will be undergoing transformation bringing about by the influx of new industries and expansion of existing industries, which will further increase opportunities for local employment, increase in-migration and the need of increasing goods, commodities and social services. Moreover, the shorter travel time from Metro Manila to the host cities in Laguna will also give convenience to the commuters. Some residents may increase the pace of their lifestyle to keep up with development in the area and the convenience of the mass transport may improve their living as well as their perception on values of these conveniences.

4) Impacts on Physical/Cultural Resources and Common Property Resources

Old PNR Stations may be preserved, demolished and/or relocated depending on the decision of the National Museum, NCCA, PNR, LGUs and DOTr. Similarly, plans for areas currently used as parks will be coordinated with LGUs. Thus, preservation measures will ensure minimal impact on the structures. Measures will also be in place to ensure minimal disruption of nearby agricultural areas during operation phase.

1307. In addition, the proposed NSRP may enhance the access to tourist destinations in the host LGUs because of shorter time and the easy access.

5) Threat to Delivery of Basic Services/Increase in Demand for Resources

The operation of the proposed NSRP is not expected to have significant impact on the basic services of the host cities. The power, water, and other utilities requirement of the proposed NSRP will be integrated into the service areas of the existing public utilities and would not deprive the public access to such utilities.

6) Threat to Public Health and Safety

1308. There may be risk of accidents due to improper work ethics, which may threaten health and safety of workers and passengers at the stations and depot. An Occupational Health and Safety Management Plan will be implemented by DOTr during the operations stage. This will be aligned with the policy of the DOTr mandating the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient and reliable transportation services. Appropriate PPE must be provided to all personnel undertaking maintenance work. Security guards will be deployed in all stations to direct passengers on the

safe zone. An Emergency Response Plan will also be established by the proponent in order to define actions in preventing the occurrence of accidents and response procedure in case of accidents, fire and natural hazards.

1309. The health of employees working at the stations and depot may be affected from exposure to unsanitary conditions. Sanitary facilities or utilities to maintain sanitary and healthy conditions will be made available in all stations and depot.

7) Generation of Local Benefits

1310. Employment for skilled personnel to operate and maintain the railway system will be available during operation. It is estimated that the operation of the proposed NSRP will provide employment to approximately 1,550 employees for manning the stations, operations and maintenance of trains at the depot. DOTr will regularly coordinate 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.

1311. The proposed NSRP will boost regional economic activities along the route through provision of an efficient mass transit system and promotes urban and economic development by enhancing workforce mobility between cities. This fast and continuous means of transportation gives the labor force in Southern Luzon more chances of getting available jobs without having to consider the distance between their home and their place of work. Shorter and more comfortable travel time will also bring workers better physical and psychological state resulting to work productivity. The presence of the stations will also attract future commercial development around the area.

8) Traffic Congestion

1312. The NSRP will generally improve the traffic situation within the project area due to expected shift of commuters from road-based to rail-based transport system. The project will also result to a shorter travel time and convenience for commuters from Metro Manila to Calamba, Laguna.

1313. At present, travel time from Solis, Manila to Calamba, Laguna through public bus will take more 2.0 hours and through PNR will take approximately 1 hour 45 minutes. Using the commuter train, travel time from Solis to Calamba will only take about 50 minutes 50 seconds. Hence, travel time will be shortened by more than 45 min/passenger.

1314. On the contrary, there may also be increased vehicular flow in areas adjacent to stations that may cause traffic congestion. This could be addressed by providing loading and unloading and or park and ride areas per station. DOTr will form a Transit Oriented Development (TOD) Committee, which will compose of the Traffic Management of LGUs, Planning Office, PNR, DPWH, and DOTr to plan the loading and unloading area and the circulation of the traffic as well as the integration of transport facility within the station.

Table 3.4.54 Summary of Impact Identification, Prediction, Assessment, and Mitigation for People

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
GENERAL				
Pre-construction, Construction and Operation activities	Land, Water, Air and People			• Comply with the relevant laws: - RA 6969: storage, transport, handling, treatment and disposal of hazardous waste - RA 9003: management and disposal of solid wastes - RA 8749: comprehensive air pollution control policy - RA 9275: comprehensive water quality management and for other purpose • 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
PRE-CONSTRUCTION / CONSTRUCTION				
Land acquisition for ROW and involuntary Resettlement for Project Affected Families (PAFs)	• Informal Settler Families (ISFs) • Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)	• Displacement of ISFs • Disturbance of livelihood • Loss of income	A-	**[Pre-Construction]** • Design train system maximising the exiting PNR ROW and minimising additional land acquisition. • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are provided a proper relocation area and/or justly compensated. The RAP will include the following: - Provision of relocation sites for ISFs - Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons. • 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 external and internal monitoring to ensure that displacement activities is conducted in compliance to the RAP. **[Construction]** • If PAFs raise an issue, ensure prompt response and resolution per established GRM
	Legal PAFs	• Displacement/ Disturbance of Properties	A-	**[Pre-Construction]** • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are justly compensated the loss of income by the project.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
		• Change/Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)		• Payment of compensation prior to displacement. • Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW • Conduct external and internal monitoring agencies to ensure that displacement activities is conducted in compliance to the RAP. **[Construction]** • If PAFs raise an issue, ensure prompt response and resolution per established GRM。
Employment and Livelihood	Gender and children	Generation of Livelihood Opportunities and improvement of Safety	C-	**[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
• Clearing of the proposed project area • Resettlement	In Migration	In-migration to the project area	C-	**[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.
In migration to new relocation site	Basic Services/ Resources	Increased demand on public infrastructure, Degradation on livelihood	C-	**[Pre-Construction / Construction]** • Prepare and implement Resettlement Action Plan (RAP) in consideration of relocation site to be sufficiently cover the expected demand of basic services and resource and social programs at relocation sites in coordination with LGUs. • Prepare and implement Social Development Plan (SDP) in coordination with the host LGUs to align projects or programs to their development plans
• Encroachment of the proposed NSRP to historical sites, tourist spots, etc. • Excavation activities • Construction of the proposed project	Historical Sites, artefacts and archaeological remains	Impacts on /Cultural Historical resources	B-	**[Pre-Construction]** • 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 will be maintained **[Construction]** • Close coordination with the National Museum on the appropriate course of action in cased of any archaeological finds.
Generation of solid waste, excavated soil and hazardous	Basic Services/	Increased demand on	B-	**[Pre-Construction / Construction]** • Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
material	Resources	waste disposal		• Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003.
• Mitigation /Generation of potential air and water pollutants • Heavy lifting and movement of heavy equipment • Construction of the proposed project	Public Health and Safety	• Degradation of public health • Increase in accident involving local communities	B-	**[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 mitigation, and safety aspects like areas that are restricted for the public, and 3) the Grievance Redress Mechanism to handle complaint/s if any. • Plan for construction sites and access route in consideration to health and safety of local communities. **[Construction]** • Provide safety officers to monitor the health and safety of the local community. If any complains 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.
	Occupational Health and Safety	• Increase risk of accidents at construction sites • infectious disease of workers	B-	**[Pre-Construction / Construction]** • Prepare and implement occupational Health and Safety Management Plan • 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. • Plan of construction plan 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.
Employment of workers	Local Economy	Generation of Local Employment	B+	**[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. • Provide skill trainings to PAFs under livelihood and income generation program developed by RAP

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
Blocking of existing access roads	Public Access	• Impact on Public Access • Impact to School Access • Increase in accidents	B-	**[Pre-Construction/ Construction]** • Based on the study on public access at affected barangay, maintain the exiting public access as much as possible. • In case of any temporary disclosure during construction, minimise 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 LGU on the potential impact to the exiting 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.
• Movement of construction equipment; • Delivery of construction materials • Additional commuters due to construction workforce • Blocking of access roads	Traffic Management	Traffic Congestion	B-	**[Pre-Construction/ Construction]** • Based on Traffic Impact Assessment (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 less 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 exiting access and provide mitigating measures.
OPERATION				
• Operation of train • Hiring of workers	Local Economy In Migration	• Generation of Local Benefits • Business opportunities • Influx of ISFs	C+	• 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. • Install fencing and guard to prevent the settlement of ISFs along the ROW
Operation of train	Physical/ Cultural resource	• Conservation of old PNR structure and parks • Improve access to tourist destination	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs
• Operation of train and station	Public Health and Safety	Increase risk of accidents	B-	• Provide security guards in all stations to direct passengers on the safe zone.

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures
• Maintenance work at Depot	Occupational Health and Safety	Increase risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan • Provide sanitary facilities or utilities in all stations and depot.
Operation of train	Traffic Management	Traffic Congestion in the areas adjacent to the proposed stations	B-	• 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.

Note:
A+/-: Significant positive/negative impact is expected.
B+/-: Moderate positive/negative impact is expected to some extent.
C+/-: Minor / Negligible positive/negative impact is expected to some extent.
D: Extent of impact is unknown.

4. ENVIRONMENTAL MANAGEMENT PLAN

1315. The DOTr is committed to minimize any adverse impacts, which could arise from the construction, operation, and abandonment of the proposed NSRP. It will do so by formulating an EMP to manage the Project's impacts and risks, adopt the best available proven control technologies and procedures, undergo a continuing process of review and positive action in the light of available monitoring results and continuing consultation with the local communities.

1316. Basically, the EMP will aim to achieve an exemplary environmental performance in the pre-construction, construction, and operation of the proposed NSRP. In order to meet this goal, the following activities/measures / programs will have to be implemented:

- Environmental Policy;
- Application of Mitigation/Management Measures;
- Environmental Monitoring Program;
- Resettlement Action Plan;
- Social Development Program;
- Emergency and Contingency Plan;
- Information, Education and Communication Plan;
- Construction Contractor's Program; and
- Institutional Plan and Hiring of an Environmental/Safety Officer.

Table 3.4.1 presents the EMP for the proposed NSRP.

Table 3.4.1 Environment Management Plan for the Proposed NSRP

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
GENERAL								
Pre-construction, Construction and Operation activities	Land, Water, Air and People			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 genset); 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 <10kph 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: Labor Code of the Philippines, as amended (including Occupational Safety and Health Standards) Gender equality will be considered in hiring of workers;	• DOTr PMO • Contractors • Operator • LGUs • MMT	Included in the contractor and operator's service fee on health, safety and environmental management	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2018 onwards

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				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.; 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				
PRE-CONSTRUCTION / CONSTRUCTION								
LAND								
Land acquisition for the NSRP ROW	Land use and Classification	Incompatibility with the Existing Land Use	C-	**[Pre-Construction]** • Maximise the use of existing PNR ROW. • Information sharing to the affected LGU to align and ensure that proposed NSRP will be accommodated in their future land use plan • Identification of future land use of surrounding areas that will result to a	• DOTr PMO • LGUs	N/A	N/A	3rd quarter of 2018 to 2nd quarter of 2019

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				significant increase of transportation-oriented developments in cooperation with urban planners of LGUs to adopt in the future developments.				
Construction of the proposed NSRP at the following: • Areas with the existing old PNR structures • Areas with high risk to typhoon passage, high susceptibility to flooding • Prime agricultural areas in depot site	ECA	Incompatibility with Classification as an ECA	B-	**[Pre-Construction]** • Plan and design the site, structure foundation, and structure including construction activities in consideration to the ECAs. • Coordinate with relevant government agencies and stakeholders as required	• DOTr PMO • DED Consultant • LGU	To be included in the DED cost	EGF	3rd quarter of 2018 to 2nd quarter of 2019
Land acquisition for the NSRP ROW	Land Tenure	Involuntary resettlement of informal settlers who had encroached portion of the existing PNR ROW; settlements outside the existing PNR ROW between Solis to Sta. Mesa; agricultural area at Depot; and other government project sites	B-	**[Pre-Construction]** • Implement Resettlement Action Plan 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.	• DOTr PMO • LGUs • NHA, KSAs	To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 2nd quarter of 2019
		Potential conflict with other government infrastructure projects	B-	**[Pre-Construction]** • Close coordination with DPWH, PSALM and other relevant agencies	• DOTr PMO	N/A	N/A	3rd quarter of 2018 to 2nd quarter of 2019
		Potential conflict with ferry operation	B-	**[Pre-Construction]** • Close coordination with the MMDA and affected ferry companies to align and ensure that the proposed NSRP construction schedule and activities will be accommodated in their operation plan • Plan appropriate method and schedule of construction to minimise the impact to existing ferry operation	• DOTr PMO	N/A	N/A	3rd quarter of 2018 to 2nd quarter of 2019
				[Construction] Strictly implement construction plan	DOTr PMO	N/A	N/A	3rd quarter of 2019 to 3rd

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
								quarter of 2023
Construction activities	Visual aesthetic	Degradation of aesthetic view	B-	**[Pre-Construction/ Construction]** • Design and install facilities to harmonise with the surrounding environments (shape, colour, size, etc.) • Identify planting area 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, and plant trees	• DOTr PMO • DED Consultant • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[Construction] • Maintain the construction site/ yards tidy and clean and rehabilitate after construction. • Provision for temporary screens/ walls to minimise the visual clatter.	• DOTr PMO • DED Consultant • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Generation and improper handling and disposal of domestic and hazardous solid waste.	Land Value	Devaluation of land value as a result of improper solid waste management	B-	**[Pre-Construction]** • Identify the final disposal site for solid waste, excavated soil and hazard waste at each LGUs.	• DOTr • Contractors • LGU • MMT	To be included in the contractor's Service Cost	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[Construction] • 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 Social Development Plan (SDP) including waste management to the communities	• DOTr • Contractors • LGU • MMT	To be included in the contractor's Service Cost	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Generation and improper handling and disposal of excavated soil, leftover concrete by excavation activities (Excavated Soil)	Land Value	Devaluation of land value as a result of improper handling of excavated soil	B-	**[Pre-Construction/Construction]** • Plan and implement recycling and reuse of excavated soil to be utilised for the project/ other project as much as possible. In case of excessive soil to be generated, identify the final spoil disposal site.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Construction of embankment	Topography	Permanent and major modification of the	C-	**[Pre-Construction /Construction]** • Formulate appropriate design measures for the protection on slopes and	• DOTr • DED	DED cost / construction	Bid Documents/ Contract	3rd quarter of 2018 to 3rd

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
		terrain and alteration of landform		banks, soil improvement / ground reinforcement to minimise ground failure during construction based on the results of the geological survey and geotechnical investigations.	consultants • Contractors	cost to be finalized during the DED	Agreement	quarter of 2023
Earthworks, (excavation, backfilling, stockpiling) and natural hazards	Geology/Geomorphology	Ground Subsidence Liquefaction Landslide, Mud/ Debris Flow, etc.	B-	[**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.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Clearing and removal of vegetation, stripping of soil cover, excavation of underlying rock, grading or construction of embankments.	Pedology	Soil erosion/loss of top soil	B-	**[Pre-Construction/ Construction]** • Design and install of appropriate mitigating measures to prevent or minimize slope failure during construction based on the results of the geohazard assessment and geotechnical investigations.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				[Construction] • Minimise 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. • Utilize heavy equipment for transporting, hauling and excavating material from one area to another so as to avoid spills into drainage system	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
• Accidental spills of fuels /lubricants from construction vehicles & machineries/ hazardous chemicals. • Generation and improper handling/disposal of construction/domestic /hazardous wastes.	Pedology	Degradation of soil quality (soil contamination)	B-	**[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Drilling and excavation at previously contaminated site (e.g. Sucat Thermal Power Plant)	Pedology	Exposure to contaminated soil	C	**[Pre-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 that toxic substances are found within the project area and/or adjacent sites, prepare contaminated soil management plan and implement necessary remediation measures. • Storage, handling, transport, treatment and disposal of contaminated soil	• DOTr Contractor	Construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				will be in accordance with RA 6969				
				[Construction] • Conduct continuous monitoring of toxic level to ensure that contaminants will not pose hazards. In case traces are detected, construction activities on site will be paused until a soil management plan is developed and implemented in consultation to the DENR – EMB.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	EGF/Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Removal of vegetation along the proposed NSRP particularly the planted trees at FTI, Solis and other areas along the ROW	Terrestrial Ecology (Flora)	• 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	B-	**[Pre-Construction]** • Design, plan and implement the project that will minimise 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.. • Conduct 100% inventory of the affected trees along the alignment to determine the total counts, category, and characteristics of affected trees and minimise removal particularly in areas adjacent to vegetation of higher conservation significance as much as possible. Native/endemic/ indigenous species of trees, shrubs and grasses will be specified. • 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.	• DOTr PMO • Contractors • LGUs	Construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[Construction] • Prior to any clearing activity, clearly mark the ROW to avoid the unnecessary clearance of tree cutting. • 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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
• Earthworks and vehicle movement. • Generation of dust and noise, vibration, and illumination pollution.	Terrestrial Ecology (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	B-	**[Pre-Construction/ Construction]** • Design, plan and implement the project that will minimise 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, minimising the use of herbicide and machinery as much as possible.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
WATER								
• Site preparation, land clearing, removal of vegetation • Excavation • Construction activities	Hydrology	Flooding and inundation by sediment run off, siltation, drainage overflow, clogging	B-	**[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.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				[Construction] • Minimise 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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
	Hydrogeology	Depletion of water resource/ competition in water use	C-	**[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	Degradation of groundwater quality	C-	**[Pre-Construction/ Construction]** • Plan and Implement appropriate construction methods (i.e. excavation, backfilling, stockpiling) based on geological and geotechnical investigations.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Earthworks, (excavation, backfilling, stockpiling)	Water Quality	• Disturbance on bottom sediment and degradation of surface water • Siltation • Induce of turbidity	B-	**[Pre-Construction]** • Based on the hydrological and geodetic surveys, design bridge piers that will minimise 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.	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				• 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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	**[Pre-Construction]** • Based on the hydrological and geodetic surveys, design bridge piers that will minimise 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	• DOTr PMO • DED consultants • Contractors • LGUs • MMT	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
• Discharge of wastewater, from construction sites/ yards • Accidental spills of fuels and lubricants from construction vehicles and machineries, as well	Water Quality	Degradation of surface water quality	B-	**[Pre-Construction/ Construction]** • Design and implement the temporary drainage of waste water from construction yard/ facilities/ camp, surface water runoff drainage systems to minimise 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. • Compliance with RA 9275, secure discharge permit.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
as other hazardous chemicals like paints and solvents. • Generation and improper handling and disposal of construction, domestic and hazardous wastes.				**[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	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-	**[Pre-Construction/ Construction]** • Design and implement the temporary drainage of waste water from construction yard/ facilities/ camp, surface water runoff drainage systems to minimise 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. • Compliance with RA 9275, secure discharge permit.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[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	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
AIR								
• Operation of construction machinery, equipment and vehicles • Removal of trees and other vegetation	Climate Change	Exhaust emissions from movement of equipment and vehicles, excavated soil carried by vehicles and other heavy loaders.	C-	**[Pre-Construction]** • Plan and design structures that will minimise the removal of vegetation and alteration of topography if possible.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Climate Risk	Meteorology/ climatology	Restrictions/ disruption of construction due to soil erosion/landslides/ and flooding.	A-	**[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.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[Construction] • Adjust construction activities in consideration to local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-	**[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.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				[Construction] • Adjust construction activities in consideration to local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
		Overheating of construction equipment, vehicles / heat stress by high temperature and heat waves	C-	**[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.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[Construction] • Adjust construction activities in consideration to local climate / extreme events such as extreme heat to avoid overheating of construction equipment and service vehicles and cause heat stress to workers. • Implement Emergency Response Plan.	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	EGF/ Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
• Earthworks including excavation activities • Site clearance including removal of topsoil at the depot site	Air Quality	Degradation of air quality due to dust generation from transportation of excessive soil / spoil to fill area construction activities	B-	**[Construction]** • Minimise alteration of topography and removal of vegetation. • 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 <10kph and minimise vehicle transport by maximising 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.	• DOTr PMO • Contractors	construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
• Operation of construction machinery, equipment and vehicles		Degradation of air quality due to gaseous emissions from machineries and service vehicles	C-					

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
• Operation of construction machinery, equipment and vehicles • Earthworks	Acoustic Noise	• 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	B-	**[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	• DOTr PMO • DED consultants • Contractors	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
				[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. • Minimise 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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
• Conduct of geotechnical investigation • Operation of construction machinery, equipment	Ground vibration	• Increase in ambient vibration level and threat to the health and safety of sensitive receptors • Threat to existence	C-	**[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 to provide proper protection provision measures and continuous monitoring from the impact of vibration.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
and vehicles • Pile driving for piers		and/or loss of important local species and habitat • Threat to abundance, frequency and distribution of species		**[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.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
PEOPLE								
Land acquisition for ROW and involuntary Resettlement for Project Affected Families (PAFs)	• Informal Settler Families (ISFs) • Vulnerable persons (Women-headed households, elderly, persons with disabilities and the poor)	• Displacement of ISFs • Disturbance of livelihood • Loss of income	A-	**[Pre-Construction]** • Design train system maximising the existing PNR ROW and minimising additional land acquisition. • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are provided with proper relocation area and/or justly compensated. The RAP will include the following: - Provision of relocation sites for ISFs - Livelihood and income restoration for head-of-household PAPs of ISFs and vulnerable persons. • 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.	• DOTr PMO • DED consultants • LGUs • NHA, KSAs	DED cost / To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 2nd quarter of 2019
				[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 • NHA, KSAs	DED cost / To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
	Legal PAFs	• Displacement/ Disturbance of Properties • Change/Conflict in Land Ownership • Impact on Livelihood and Income (i.e. farming, business)	A-	**[Pre-Construction]** • Prepare and implement Resettlement Action Plan (RAP) to ensure that PAFs are justly compensated for the loss of income by the project. • Payment of compensation prior to displacement. • Coordination with the LGUs, land owners and other concerned stakeholders in acquiring the land and/or securing ROW	• DOTr PMO • LGUs • KSAs	To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 2nd quarter of 2019
				[Pre-Construction/ construction] • 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 • LGUs • KSAs	To be included in RAP Budget	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 3rd quarter of 2023
Employment and Livelihood	Gender and children	Generation of Livelihood Opportunities and improvement of Safety	C-	**[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	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
• Clearing of the proposed project area • Resettlement	In Migration	In-migration to the project area	C-	**[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	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
In migration to new relocation site	Basic Services/ Resources	Increased demand on public infrastructure, Degradation on livelihood	C-	**[Pre-Construction / Construction]** • Prepare and implement Resettlement Action Plan (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. • 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 on	RAP Budget to be adjusted after DED	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
• Encroachment of the proposed NSRP to historical sites, tourist spots, etc. • Excavation activities • Construction of the proposed project	Historical Sites, artefacts and archaeological remains	Impacts on /Cultural Historical resources	B-	**[Pre-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 will be maintained	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 2nd quarter of 2019
				[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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
Generation of solid waste, excavated soil and hazardous material	Basic Services/ Resources	Increased demand on waste disposal	B-	**[Pre-Construction / Construction]** • Identification of final disposal site for solid waste, excavated soil, hazardous waste at each LGUs. • Conduct regular monitoring of disposal status in compliance to RA 9003 and RA 6003.	• DOTr PMO • Contractor • LGUs	To be included in the construction cost	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
• Mitigation /Generation of potential air and water pollutants • Heavy lifting and movement of heavy equipment • Construction of the proposed project	Public Health and Safety	• Degradation of public health • Increase in accident involving local communities	B-	**[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.	• DOTr PMO • DED consultants • Contractors • LGUs	DED cost / construction cost to be finalized during the DED	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				[Construction] • Provide safety officers to monitor the health and safety of the local community. If any complains 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. • Plan and implement social development plan including health and safety of local community. • 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	Bid Documents/ Contract Agreement	3rd quarter of 2019 to 3rd quarter of 2023
	Occupational Health and Safety	• Increase risk of accidents at construction sites • infectious disease of workers	B-	**[Pre-Construction / Construction]** • Prepare and implement occupational Health and Safety Management Plan • 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. • 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	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
Employment of workers	Local Economy	Generation of Local Employment	B+	**[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. • Provide skill trainings to PAFs under livelihood and income generation	• DOTr PMO • Contractors • LGUs	RAP cost/ To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				program developed by RAP				
Blocking of existing access roads	Public Access	• Impact on Public Access • Impact to School Access • Increase in accidents	B-	**[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, minimise 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. • 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	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
• Movement of construction equipment; • Delivery of construction materials • Additional commuters due to construction workforce • Blocking of access roads	Traffic Management	Traffic Congestion	B-	**[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.	• DOTr PMO • Contractors • LGUs	To be included in the Construction Cost	Bid Documents/ Contract Agreement	3rd quarter of 2018 to 3rd quarter of 2023
OPERATION								
LAND								
Operation and maintenance of the proposed NSRP	ECA	Incompatibility with the area that will be hardly hit by natural calamities.	B-	• Coordinate with PAGASA / PHIVOLCS and adjustment of train schedules. • Implement proper inspection and prompt maintenance of drainage systems.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF	3rd quarter of 2023 onwards
Presence of the proposed NSRP structures (railway, passenger facilities, depot etc.)	Visual aesthetics	Impairment of visual aesthetic	C-	• Maintain tree planting to minimise the visual impact by the project and harmonise 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	EGF	3rd quarter of 2023 onwards

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
Generation and improper handling of domestic and hazardous wastes including accidental oil and lubricant spills from passenger facilities (station), depot.	Land value	• Degradation of land value • Change in soil quality	C-	• 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.	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	EGF	3rd quarter of 2023 onwards
Occurrence of landslides, volcanic hazards, ground shaking and liquefaction • Likely seismic events around NSRP line • Potential liquefaction between Solis to Nichols station and Muntinlupa to Banlic Depot. • Potential ground rupture between Muntinlupa to Alabang station. • Potential eruption of Taal Volcano will bring ground shaking and ash fall.	Subsidence, Liquefaction, Landslide, Mud/Debris Flow, etc	• Damage to tracks • Risk to the life of passengers and workers • Damage to passenger facilities.	B-	• 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	EGF	3rd quarter of 2023 onwards
Operation of the proposed NSRP and passenger facility, Depot, service vehicle, Passenger movement	Terrestrial Ecology	• Loss of Habitat • Threat to Existence and/or Loss of Important Local Species • Hindrance to Wildlife Access	C-	• Minimised 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 minimise the use of herbicide and machinery as much as possible.	• DOTr PMO • Operator	Included in the operation and maintenance cost	EGF	3rd quarter of 2023 onwards
WATER								
Operation of train	Hydrology	Increase of flood occurrence and worse the impact	C-	Conduct proper inspection and prompt maintenance of the installed drainage system, and improve/ enhance capacity when possible	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	3rd quarter of 2023 onwards

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
Operation of passenger facilities, depot. • Discharge of waste water, from passenger facilities, depot. • Accidental spills of fuels and lubricants from service vehicles and machineries, at depot • Generation and improper handling and disposal of domestic and hazardous wastes.	Water Quality	Degradation of groundwater quality	C-	• 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	EGF/ Contract agreement	
		Degradation of surface water quality	B-					
	Freshwater Ecology	Threat to abundance, frequency and distribution of species	C-					
AIR								
Climate Change	Meteorology/ Climatology	Restrictions/ disruption of railway operation due to soil erosion/landslides/ and flooding.	A-	• 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	EGF/ Contract agreement	3rd quarter of 2023 onwards
		Slower drainage, soil erosion, disruption in construction by increased rainfall	B-					
		Overheating of construction equipment and vehicles and overheating of track buckling and signalling problems	C-					
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Meteorology/ Climatology	Reduction of Greenhouse Gases	B+	• 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	• DOTr PMO • Operator • LGUs	Included in the operation and maintenance cost	Contract agreement	3rd quarter of 2023 onwards

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				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				
	Air Quality	• Degradation of air quality in the vicinity of the station and in depot area • Increase in Vehicle Exhaust emission and entrained dust due of increased movement of people	C-	• 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 • 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 <10kph within the construction site. Minimise vehicle transport by maximising the use of site generated materials. • Monitor air quality at the identified sampling stations	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	3rd quarter of 2023 onwards
Operation of trains	Acoustic Noise	Reduction of noise due to decrease in traffic volumes	B+	• 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	N/A	3rd quarter of 2023 onwards
Operation of trains, depot, passenger facilities (stations), service vehicles, etc.	Acoustic Noise	Increase in ambient noise level	C-	• 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.			EGF/ Contract agreement	3rd quarter of 2023 onwards
	Ground Vibration	Increase in ground vibration level	C-	• 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.	• DOTr • Operator • LGUs	Included in the operation and maintenance cost	EGF/ Contract agreement	3rd quarter of 2023 onwards

Environmental Aspect	Environmental Component	Potential Impact	Level of significance	Prevention/Mitigation/ Enhancement Measures	Responsible Institution	Estimated Cost (PhP)	Guarantee/ Financial Arrangement	Schedule of Implementation
				• .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				
PEOPLE								
• Operation of train • Hiring of workers	Local Economy In Migration	• Generation of Local Benefits • Business opportunities • Influx of ISFs	C+	• 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. • Install fencing and provide guards to prevent the settlement of ISFs along the ROW	• DOTr • Operator • LGUs	Included in the maintenance cost	Contract agreement	3rd quarter of 2023 onwards
Operation of train	Physical/ Cultural resource	• Conservation of old PNR structure and parks • Improve access to tourist destination	C+	• Continuous conservation activities of old PNR structures in coordination with PNR and LGUs	• DOTr • Operator • LGUs	Included in the budget of proponent	EGF/ Contract agreement	3rd quarter of 2023 onwards
• Operation of train and station • Maintenance work at Depot	Public Health and Safety	Increase risk of accidents	B-	• Provide security guards in all stations to direct passengers on the safe zone.	• DOTr • Operator • LGUs	Included in the health and safety and environmental management plan of proponent budget	EGF/ Contract agreement	3rd quarter of 2023 onwards
	Occupational Health and Safety	Increase risk of accidents and infectious disease of employee	B-	• Implement the Occupational Health and Safety Management Plan. • Provide appropriate PPE to all personnel undertaking maintenance work. • Implement the Emergency Response Plan • Provide sanitary facilities or utilities in all stations and depot.				
• Operation of train	Traffic Management	Traffic Congestion in the areas adjacent to the proposed stations	B-	• 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	EGF/ Contract agreement	3rd quarter of 2023 onwards

Note:
A+/-: Significant positive/negative impact is expected
B+/-: Moderate positive/negative impact is expected to some extent
C+/-: Minor/Negligible positive/negative impact is expected to some extent
D+/-: Extent of impact is unknown

5. ENVIRONMENTAL RISK ASSESSMENT

5.1 OBJECTIVES

1317. The primary objective of the Environmental Risk Assessment (**ERA**) is to identify the risks to the environment, health and safety aspects associated with NSRP activities. ERA aims to manage unforeseen events and potential hazards that may have adverse impacts to the environment and the people. It aims to provide information for making informed decisions and mechanisms to communicate forecasted risks such that stakeholders and the public are informed of the implications of identified risks.

5.2 METHODOLOGY

1318. The risk characterization and assessments can be done using either a qualitative or quantitative approach. Descriptive assessments and systematic characterization form the basis of the qualitative assessment. This is best applied to accidents or events with little or no data pertaining to frequencies of occurrence or ecosystem and health impacts. There are limited data available for the Philippines that can be used for statistical analysis

1319. The assessment method is generally defined as an engineering reliability method known as Failure Modes and Effects Analysis (**FMEA**). This approach is a systematic characterization and evaluation of sources of risks to the environment. It can be considered as a qualitative approach based on expert opinions. The primary objective of this approach is to identify the risks, prioritize those risks, identify risk tradeoffs, and identify means and methods to reduce the risks. Four questions must generally be answered to fully satisfy the process:

- What can go wrong?
- What is the range of severity of the adverse consequences?
- How likely are those adverse consequences to occur?
- What can be done to reduce risks that are unacceptable?

The assessment is conducted through following steps:

- Hazard identification: Identification of materials to be stored and used within the site
- Environmental Pathway Identification: Cataloguing pathways and migration routes for transport of chemical or biological agents, and the spread of physical stressors
- Accident Scenario: Identification of scenario that allow the introduction of materials to the environment, focusing on the scenarios of "what can go wrong" that have the potential to adversely affect the environment and human health so that the full range of potential consequences must be considered at this stage
- Risk Characterization and Assessment: Estimation of the incidence and severity of the effects likelihood to occur in an environmental compartment due to actual or predicted exposure to a hazard

5.3 HAZARD IDENTIFICATION

1320. Hazards associated with the Project were identified during construction and operation phases under the eleven (11) categories below. It should be noted that hazards caused by noise and vibration are not included in this section as these are already discussed in the previous sections. Hazards identified below are focused more on the health and safety impacts to the people.

- Rail system failure
- Structural failure
- Construction-related accidents
- Exposure to the toxic chemicals / hazardous substances at contaminated site during construction and operation

- A breach or release of toxic chemicals / hazardous substances at maintenance depot
- A breach or release of toxic chemicals / hazardous substances during transport
- Fire
- Natural Disasters (Earthquake, Flood etc.)
- Terrorism attacks
- Security and violent incidents
- Transmission of infectious diseases

1321. Additional information relative to the specific hazards and risks associated with those hazards is presented below:

(1) Railway System Failure

1322. This includes failure of rail equipment particularly rail track, signalling/ communication systems and rolling stock. Failure of these devices due to natural hazards (flood, earthquake, volcanic eruption, and the like), natural wear and tear of rail parts, terrorist attacks or other forms of accidents may result to derailment.

(2) Structural Failure

1323. Structural failure as a hazard is related to buildings at the Depot and stations as well as all infrastructures where the rail tracks are laid. Failure of these structures due to natural or man-made hazards may result to damage of property and/or loss of human life

1324. DOTr and the Contractor will comply with the necessary codes and standards (i.e. the Philippine National Structural Code and National Building Code) in order to obtain the required permits. This will serve as an assurance that the facilities are structurally sound.

(3) Exposure to the toxic chemicals / hazardous substances at previous contaminated site

1325. In case contaminated sites exist in the project area, exposure to the toxic substance may occur during the detoxification process, excavation of the site during the construction, and also to the neighbouring communities. DOTr and the Contractor will ensure that site remediation and/or clean-up, if appropriate, follows national government regulations and procedures on health, safety, and environment.

(4) A Breach or Release of toxic chemicals / hazardous substances at Maintenance Depot

1326. The chemicals used for maintenance activities at depot are not harmful when handled properly. However, if accidental spills during their usage or a breach in containment unit occur, these chemicals may cause hazard to air and surface water. Even on storage, breach in containment unit may accidentally happen allowing the chemicals to diffuse into the air or be spilled on soil and surface/groundwater.

1327. The fuel / chemical containers will be properly designed to ensure its safety and durability during storage. Personnel who will be assigned at the depot will be trained on occupational safety and health standards to ensure safety during handling of chemicals and other hazardous substances for maintenance activities.

(5) A Breach or Release of toxic chemicals / hazardous substances during Transport

1328. This can be due to accidental spills or breach in containment unit of toxic chemicals and hazardous substances while in transport.

1329. Freight service will be introduced into the rail system or when the system has been developed to warrant the introduction of this service. However, since this Project is a transportation facility, some

passengers may opt to carry with them "dangerous" goods that they need to transport. These goods may be accidentally spilled or released from its containers during transport and may cause fire, damage to property and / or loss of human life.

1330. The design of rail facilities to handle storage of toxic chemicals / hazardous substances during freight service will be in accordance with applicable local and international codes and standards. Inspection of containment units of toxic chemicals / hazardous substances for transport will be handled by qualified DOTr personnel and/or the railway operator.

(6) Fire

1331. Fire may occur due to excessive heat, failure of equipment and other accidents. Fire may result to damage of property and/or loss of human life.

1332. DOTr will comply with the Bureau of Fire Protection (**BFP**) requirements as part of its application for building permits. Firefighting equipment (fire hydrants, fire extinguishers) will be placed at strategic locations within the project site. The Emergency Response Plan (**ERP**) will ensure timely and proper response to emergency situations caused by fire.

(7) Natural Disaster (Earthquake, Flood, landslides, cyclones etc.)

1333. Some part of project area is prone to the natural disaster such as Flood and earthquake. The railway structures are designed taking into account those events, however there might be extreme cases beyond prediction which will cause damage to railway facilities and system, human injuries and accidents.

1334. The DOTr / Contractor will ensure adequate coordination with Disaster and Risk Reduction Management agencies, (Philippine National Red Cross etc.) on appropriate protocols to address such incidents including the response mechanism.

(8) Terrorism Attack

1335. Terrorism attacks are prevalent in mass transport systems these days. Tight security measures (including coordination with law enforcement agencies) will be implemented during construction and operation phases to avoid occurrence of this risk.

(9) Security and Violent Incidents

1336. The structural environment of railway systems may present opportunities for security incidents, crime and violence to occur. These include numerous unobserved niches and empty spaces, poorly lit stations, constricted platforms and crowded facilities.

(10) Transmission of Infectious Diseases

1337. Transmission of infectious diseases through close person-to-person contact or indirect contact is a potential health hazard related to subways, where spaces could be confined. Rodents may also be a problem in subway systems. Hence, it is important to consider diseases that maybe spread by these rodents and their health awareness measures.

(11) Construction Related Accident

1338. During construction, all personnel assigned at the Project site may be subject to accidents if Health and Safety Management Plans are not properly carried out. Similar to other construction activities, risk may occur due to construction related accidents such as:

- Collapse of scaffolding;
- Falling of construction materials while being lifted by a crane boom;

- Fire or electrocution from welding and use of other electrical equipment;
- Personnel being run over by heavy equipment;
- Accidental fall of workers while in elevated location; and
- Injury from construction debris and materials.

1339. Health and Safety Management Plans required for the Works will be set up by the Prime Contractor. As a matter of policy, Occupational Safety and Health regulations should be followed by all personnel.

5.4 ENVIRONMENTAL PATHWAYS

1340. Ground can be considered as an environmental pathway when liquid substances travel through it by seepage or surface runoff.

1341. Water is one of the fastest and the most short-term pathway for potential pollutant impact. In many cases, this pathway is also a combination of surface water runoff and groundwater. The physical and chemical processes that affect migration of contaminants with both surface water and groundwater pathways are similar. Additionally, topographic and geomorphologic conditions also influence this pathway.

1342. Air can only become an environmental pathway when substances are in gaseous state. Vapors from hazardous chemicals and other substances are volatile. If these substances are released, they may diffuse into the air.

1343. To avoid deleterious effects of the various potential contaminants/pollutants on humans via the enumerated pathways all possible mitigating measures will be made available by the Proponent/Contractor.

5.5 FAILURE MODE AND EFFECT ANALYSIS

1344. Based on the previous discussions of hazard identification, environmental pathways, and accident scenarios, a Failure Mode and Effect Analysis (**FMEA**) was performed. This is primarily a qualitative assessment approach but does provide a systematic characterization and evaluation of the risks. The analyses combine subjective ratings or categories of likelihood and consequences of various events, which are identified in Table 5.5.1 and Table 5.5.2 .

(1) Likelihood and Consequence Rating

1345. The identified hazards will be assessed in terms of the relationship between the level of likelihood to exposure and the severity of effect / consequence of losses to the people, financial, public and environment. The table below shows the relationship of exposure and severity of effects. Ratings or categories of livelihood and consequences of various events, which are identified in the following tables.

Table 5.5.1 Likelihood Categories for Risk Assessment

Subjective Category	Likelihood Occurrence	Likelihood Occurrence
Negligible	<10-6	Less than 1:1,000,000
Very low	10-6 to 10-4	1:1,000,000 to 1:10,000
Low	10-4 to 10-2	1:10,000 to 1:100
Moderate	10-2 to 10-1	1:100 to 1:10
Significant	>10-1	Greater than 1:10

Source: JICA Study Team

Table 5.5.2. Environmental and Health Consequence Categories for Risk Assessment

Subjective Category	Environmental and Health Consequences
Safe	Negligible effect on environment and human health
Marginal	Failure will cause some environmental degradation but no major or long term damage. Minor injury or illness.
Moderate	Failure will cause significant environmental degradation but no long term damage. Major injury or illness.
Critical	Failure will degrade environment, and if not mitigated will cause significant and permanent damage. Permanent disability.
Severe	Failure will cause major and irrevocable environmental damage. Fatalities

Source: JICA Study Team

(2) Risk Assessment Conclusion

1346. As indicated in the FMEA analysis, a number of individual events would need to occur in near simultaneous fashion to result in potential occurrence of these risks. Individually, each event has a low probability of occurrence. When taken as a joint occurrence the probabilities are even lower. As such, only a catastrophic event would present a potential environmental hazard.

1347. A summary of these analyses using these categories as applied to the eleven (11) accident scenarios is presented in Table 5.5.3.

Table 5.5.3 Summary of Failure Modes and Effects Analysis

	Description of Failure Mode	Project Phase	Effects	Consequences		Likelihood		Preventive measure
				Category	Confidence	Category	Confidence	
	Failure of rail component may result to derailment	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Design of rail system should conform with known standards
2	Structural failure of encapsulation facility by seismic events	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to marginal (environmental degradation)	High	Very low	High	Structural design follows or exceeds Code requirements
3	Exposure to the toxic chemicals and hazardous substances at previous contaminated site	Construction phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very Low	High	Adherence and training on Occupational Safety and Health Environmental guidelines/procedures
4	Release of toxic chemicals and hazardous substances during maintenance activities	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Safety training for depot personnel and proper design of depot facilities
5	Release of toxic chemicals and hazardous substances during transport of dangerous goods	Operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Inspection of goods for transport by qualified personnel and design of rail facility to handle transport of dangerous goods
6	Fire	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Installation of firefighting facilities
7	Natural Disaster	Construction and Operational Phase	Possible damage to property and injury/loss to human life	Minimal to moderate (Environmental degradation)	High	Very low	High	Design of rail structure/system should conform to international standards. Adequate response mechanism
8	Terrorist attacks	Construction and operational phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Tight security measures within the project site
9	Construction related accidents	Construction phase	Possible damage to property and injury/loss of human life	Minimal to moderate (environmental degradation)	High	Very low	High	Follow Occupational Safety and Health regulations
10	Security and violent incidents	Operational phase	Possible damage to property and injury/loss to human life	Minimal to marginal (environmental degradation)	High	Very low	High	Tight security measures at the Railway facilities (Station, Sub-station, Depot)
11	Transmission of infectious diseases	Construction and operational phase	Possible injury/loss to human life	Minimal to marginal (Health consequences)	High	Low	High	Health awareness measures and sanitary practices.

Source: JICA Study Team

5.6 EMERGENCY RESPONSE POLICY AND GENERIC GUIDELINES

5.6.1 Objectives

1348. During the Detailed Engineering Design Stage (DED), the DOTr will organize a Project Management Office (**PMO**) which will develop an ERP in order to define actions in preventing the occurrence of accidents and response procedure in case of accidents, fire, and natural hazards. For the construction phase, the contractor will be required to prepare the ERP.

1349. During the operation phase, the DOTr and PMO operator of the proposed NSRP will also prepare a specific ERP for its operations.

1350. This will be aligned with the policy of the DOTr on the strict implementation of precautionary, safety and security measures to ensure safe, fast, efficient, and reliable transportation services.

5.6.2 Concept

1351. Possible causes of emergency situations due to man-made and natural hazards should be considered in the DED to reduce the chance of their occurrence. There are a number of design standards and codes that DOTr PMO will have to comply with and incorporate in its performance specifications. These standards are part of the requirements of the local agencies concerned in order to grant permits and licenses to DOTr.

1352. Procedures for each of several emergency categories will be established. The procedures will specify necessary actions to be performed by appropriate personnel within a time or event sequence. The emergency response plan will as a minimum address, but not limited to the following categories:

- Construction-related accidents (including spills during excavation works)
- Fire
- Bomb Threat
- Total Power Failure
- Structure Failure
- Train Derailment or Collision
- Transport of Dangerous Goods
- Suicide/Railway Injuries or Fatalities
- Criminal Acts
- Natural disasters (High Winds, Flood, Earthquake, etc.)

1353. The plan will establish what constitutes an emergency and the procedure will be developed for the following:

- Emergency Reporting
- Notification of Emergency Response Personnel
- Dispatching of Emergency Response Personnel and Equipment to the Site
- Coordination of all Emergency Response activities
- Protection of passengers/personnel, and equipment at the emergency site
- Evacuation of passengers/personnel
- Communication to all passengers, employees, emergency response personnel
- Restoration of normal operations
- Containment procedures for hazardous chemicals and dangerous goods

1354. Training of contractors, employees, and emergency response team will also be undertaken. Education of the riding public with regard to emergency procedures and equipment as well as required

passenger emergency response will also be included. Facilities, equipment, and vehicles needed to cope effectively with emergency situations will also be required.

5.6.3 Emergency Response Program

1355. The proponent through its vision will adopt an active program of pursuing a healthy, safe, and environment-friendly operation. DOTr/Operator guidelines on health and safety will be made clear to contractors and all employees during construction and operations. An orientation briefing for contractors and training for employees will be implemented.

(1) Construction Phase

1356. Emergency situations that may occur during construction are construction-related accidents and fire. The Prime Contractor will set up safety measures required for the Works as follows:

- Upon issuance of Notice of Award, prepare, as part of the Contractor's Environmental Management Plan (**CEMAP**), an Emergency Response and Contingency Plan, as well as an Occupational Safety and Health Management Plan that illustrate measures to be undertaken during emergency cases including spills, fire, structural failure, and other construction-related accidents. As previously mentioned, approval of the CEMMAP (including plans mentioned above) will be a prerequisite for issuance of Notice to Proceed;
- Provide and enforce wearing of PPE such as: efficient helmets, and where necessary, eye goggles, ear protection, safety harnesses, and other personal protection equipment for all the personnel;
- Submit for the approval of DOTr detailed proposals for safety regulations and emergency procedures;
- Produce approved copies of above plans, regulations and emergency procedures and distribute and display at each place of work, together with any other documents, posters, notices boards, or the like which are required by law. The Prime Contractor will revise, replace, maintain, or remove the notices, regulations and the like as required by legislation;
- Provide adequate warning signs, barricades, and warning lights at all times during construction;
- Ensure that all equipment are in good working condition;
- Provide at designated stations within the site emergency telephones, suitable accommodation, and transport and first aid equipment including stretchers; and
- Provide adequate service for the protection against fire at the site in accordance with the local fire regulations.

(2) Operation Phase

1357. For the operation stage, emergency situations that could occur are as presented in Table 5.6.1.

Table 5.6.1 Preventive Maintenance during Emergency Situations

Emergency Situation	Preventive Measures
Derailment	Railway Operator will procure emergency re-railing and rescue equipment. These should be part of the depot equipment. Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment. Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. There will be inspections for: Track geometry and ride quality Turnouts (which may be combined with regular lubrication and cleaning) Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results.
Fire	The Fire Safety Enforcement Manual of the Bureau of Fire Protection Philippine Standards will be principally used as the design criteria of this project as imposed by the laws of the Philippines to be complied with.

Emergency Situation	Preventive Measures
Typhoon	Regulations to follow for each typhoon signal no.: 1 – speed restriction for trains (60 kph max) 2 – speed restriction for trains (30 kph max) 3 – speed restriction for trains (30 kph max) 4 – suspend operation
Flood	The bridge design will be carried out for a 50 and/or 100 yr return period high water level with a minimum safety margin clearance of 1 m and/or 0.5 m, respectively whichever is the greater. In addition, all drainage will be replaced, and in most cases by a better system. Railway Operator will conduct periodic maintenance or when necessary for its drainage and water systems.
Earthquake, Ground Setting and Liquefaction	[Guideway Structures] Railway Operator will perform regular inspections by routine patrol of all subway and depot structures and perform maintenance and repairs. A detailed structure inspection will be performed at least once per year. The general condition of the structure as viewed from the track will be included in the item list of all route patrols, which are carried out on a regular basis. All structures will be catalogued and numbered in a register of structures that records the conditions, inspection requirements, results and any corrective actions. Main structures will be the subject to periodic structural inspections. These inspections will be designed and performed according to general practice according to the structure types, materials (steel or concrete), foundations, and any specific examination of components such as bearing and expansion joints. Stations and Depot buildings will also be inspected using route patrolling and general route inspections. The inspections will be supplemented with fault reports made by the operational staff. Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably. [Tracks] Railway Operator will inspect, maintain adjust and replace defective, excessively worn or broken running rails, cross ties, special track work components, ballast, direct fixation fasteners, and other track materials, related hardware and support equipment. Railway Operator will also inspect and adjust the smoothness of the alignment and levels of the track geometry. In addition to the patrols described above, there will be inspections for: Track geometry and ride quality Turnouts (which may be combined with regular lubrication and cleaning) Ultra-sonic testing of rail joints and turnout components. These tests will be based on an annual test in each of the first two years and then scheduled as necessary according to the initial results. Should periodic inspection detect signs of ground movement, services will be suspended or be run at reduced speed. If services are allowed to continue, detailed monitoring of the site would be instigated. If services will be suspended, passengers would be de-trained at the next available station stop. Detailed investigation into the improvements required would be undertaken before services are recommenced or speed restrictions be lifted and such works would be put in hand as soon as reasonably.
Failure of Structure	DOTr PMO will comply with international and national standards to ensure that the structures are designed and built in accordance with these safety standards.
Transport of Dangerous Goods	DOTr PMO has no immediate plans for the transport of dangerous goods. However, DOTr PMO and Railway Operator train crew and emergency re-rail and rescue crews would receive specific training on emergency procedures associated with the specific types of goods carried.
Medical attention required by passengers	For every station, security guards will be equipped with first aid kits. During extreme emergency cases, medical services including ambulance would be summoned to the nearest station by the central supervising station.
Criminal Acts	Railway Operator will provide security services to ensure the safety of passengers, crew and office workers.

1358. DOTr PMO will produce an Emergency Procedural Plan, which will include, but not limited to, the following:

- Policy, purpose, scope and definitions
- List of participating agencies and names of executives responsible for each agency
- Safety procedures during emergency situations
- Purpose and operation of Centralized Train Control (**CTC**) System and alternate CTC
- Purpose and operation of command post and auxiliary command post

- Communication facilities available for use during emergency cases
- Operating manuals of all specialized rescue equipment
- Maps and plans of complex areas of the system
- Any additional information and data that the particular agencies require to have in the plan.

1359. LGUs and other participating agencies within the locality will be coordinated with by DOTr PMO to cooperate and assist depending on the nature of an emergency, which will include the following:

- Medical services
- Building department
- Fire department
- Police department
- Utility companies
- Other transportation agencies

1360. Training for emergency response crew for the operation stage will be programmed to include the following:

- Sponsored by equipment suppliers for the rescue equipment, firefighting equipment and the like
- Courses being offered by some government agencies and entities such as DSWD, Bureau of Fire Protection Special Rescue Unit (**BFP-SRU**), Philippine National Red Cross, DENR-EMB, Disaster and Risk Reduction Management offices etc.
- Evacuation of passengers from train, to a point of safety along the guideway
- Evacuation of passengers from stations (surface and underground)

1361. Emergency procedures to be controlled from the CTC within the Depot Control Center, including coordination of participating agencies such as fire service, police, ambulance, public works and utility companies, etc.

6. SOCIAL DEVELOPMENT PLAN/FRAMEWORK AND IEC FRAMEWORK

6.1 SOCIAL DEVELOPMENT PLAN/FRAMEWORK

(1) Objective

1362. The SDP/ Framework is formulated in coordination with the Planning and Development Officers of the cities where NSRP will pass through, in order to derive from the respective local SDPs of the LGUs, their programs and projects for people's livelihood, health and environment. This would enable them to enhance their self-reliance in the context of the proposed NSRP.

(2) Responsible parties

1363. The LGU will implement SDP for potential projects as stated in Table 6.2.1. The formulation of the SDP will involve also those government agencies with mandates to deliver services in social development such as Department of Health (**DOH**), DENR, Department of Education (**DepEd**), DSWD, Department of Trade and Industry (**DTI**), Philippine National Police (PNP), etc. It should also include civil society such as NGOs and People Organizations (**PO**).

(3) Social Development Framework

1364. SDP for the proposed NSRP will be prepared based on the data/information collected from CLUP of the host LGUs and based on the discussions during the Pre-IEC, Public Scoping. The information collected from perception survey will also form part of the SDP that mainly addresses the perceived fears of environmental degradation due to pollution on land, water, air and health risks. Table 6.2.1 presents the indicative SDP for the proposed NSRP. Further, it is necessary that re-assessment of SDP be regularly done to identify and monitor the following:

- High investments which may have savings and income for the LGU/s and proponent;
- More social development projects for direct and indirect affected communities; and
- Need for a unified grievance mechanism to address complaints effectively and timely.

1365. The cost estimates will be prepared once the specific projects have been identified and processed in consultation with the LGUs and sectors concerned.

6.2 IEC FRAMEWORK

1366. The IEC) Plan/ Framework will be undertaken to encourage the participation and cooperation not only of the affected households but a broader sector of stakeholders and facilitate the establishment of support linkages throughout the implementation and operation of the project.

1367. The IEC will also inform the stakeholders about the progress of the project and provide feedback to the proponent regarding the concerns and issues raised by the stakeholders as the project progress.

Table 6.2.2 presents the IEC Framework for the proposed NSRP.

(1) Target Sector

1368. The IEC will be provided targeting project affected barangay and public as well as general public who will be indirectly affected.

1369. During the detailed design and engineering works, which will be undertaken post ECC, the proponent will consider consultations as maybe necessary and feasible with independent professionals, individuals, members of the academe, concerned governmental entities (e.g. the DOST

PAGASA/PHIVOLCS) and of the civil societies concerning the application of technical/scientific/engineering knowledge and methodologies to address various perceived and real concerns on natural risks and hazards at the project site environs.

(2) IEC Scheme/ Strategy Methods and Information Medium

1370. The IEC methods will include individual methods (key informant interviews), group methods (focus group discussions), community open forum, and multi-media (print and social media). The IEC will provide information about the project details such as benefits and risks that will result from its implementation and should also inculcate value formation by making members of the community aware of their responsibilities as stakeholders.

1371. The IEC program will be implemented in close coordination with concerned LGUs, NGOs, and stakeholders. DOTr will also engage the services of local teachers and community organizers in planning, implementing, and conducting the IEC.

(3) Timeframes / Frequency and Funding Support

1372. Presented in Table 6.2.1 and Table 6.2.2 the SDP and IEC Frameworks, respectively. Schedule of activities varies per target sector. Included in the matrix is the source of fund for each activity for the proposed SDP activities. IEC activities on the other hand will be funded by DOTr.

Table 6.2.1 SDP Framework for the Proposed NSRP

Concern		Responsible Community Member/ Beneficiary	Government Agency/ Non-Government Agency and Services	Proponent	Indicative Timeline	Source of Fund
	Livelihood					
	1-A Preparation of Resettlement Action Plan (RAP)	• Barangay Chairman; and • Presidents of Homeowners Association	• DOTr • NHA • LGU	DOTr – PMO	DED Stage (i.e., After conduct of Parcellary Survey)	• Part of DED Consultancy budget
	1-B Relocation of informal settlers	• Barangay Chairman; and • Presidents of Homeowners Association	• DOTr • NHA • LGU Housing Office • DSWD • DPWH	DOTr – PMO	Pre-Construction Stage	• DOTr • Site development cost and other basic facilities can be included in DED budget
	1-C Gender Responsive Livelihood Training Program (for women) Skills training for construction work Skills training for handicraft making Skills training for food preparation, etc.	• Barangay Chairman; • Barangay Kagawad for Livelihood; • Presidents of Homeowners Association; and • Officers of Women's organizations	• LGU Livelihood Office • DSWD • TESDA	DOTr – PMO	After ECC Issuance	• LGU Livelihood Office • TESDA
	1-D Formation of/ Support to Vendors Organizations	• Barangay Chairman; and • Leaders of Vendors Organizations	• DOTr • DTI • LGU	DOTr – PMO	Prior to RAP Implementation	• LGU Livelihood Office
2	Health and Safety	• Barangay Chairman; and • Barangay Kagawad for Health and Safety	• City Health Office; • DSWD; and • Barangay Health Centres	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU Health Office
3	Education	• Barangay Chairman; • Barangay Kagawad for Education • Teacher and/or Principal; and • Qualified Students of Barangays	• Department of Education • Barangay		Pre-Construction, Construction, Operation Stage	• LGU
4	Sports	• Barangay Chairman; and • Barangay Kagawad for Sports	• City Sports Commission • Barangays		Pre-Construction, Construction, Operation Stage	• LGU
5	Environment and Sanitation	• Barangay Chairman; and • Barangay Kagawad for Environment and Sanitation	• LGU and CENRO; and • DENR Region 3	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU CENRO
6	Peace and Order	• Barangay Chairman; • Barangay Kagawad for Peace and	• LGU	DOTr – PMO	Pre-Construction, Construction,	• LGU and PNP

Concern		Responsible Community Member/ Beneficiary	Government Agency/ Non-Government Agency and Services	Proponent	Indicative Timeline	Source of Fund
		Order; • Homeowners Association Sergeant-at-Arms	• PNP		Operation Stage	
7	Spiritual	• Barangay Chairman; • Parish Pastoral Council; • President Homeowners Association; • Leaders of other religious groups	• Parish Priests • LGU	DOTr – PMO	Pre-Construction, Construction, Operation Stage	• LGU

Table 6.2.2 IEC Framework for the Proposed NSRP

Target Sector	Major Topic/s of Concern in Relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
LGUs along Railway Alignment	Project Status	Group Meeting	Slide Presentation Focus Group Discussion	• Once on Pre-construction (DED Stage) • Quarterly during Construction Phase • As required during Operation Phase	P20,000.00 per meeting
	Work Progress	Group Meeting	Slide Presentation Focus Group Discussion	• Monthly during Construction Phase	P20,000.00 per meeting
Concerned Government Agencies (e.g. DPWH, BCDA)	DED issues	Group Meeting	Focus Group Discussion	• As needed on Pre-construction (DED Stage) • As required during Construction and Operation Phases	P15,000.00 per meeting
Professional society and Individuals	Continuing consultation	Group Meeting	Multi-sectoral Cluster Meeting Focus Group Discussion	• Once on Pre-construction (DED Stage) • As required during Construction and Operation Phases	P15,000.00 per meeting
Barangay Chairman of Project-affected barangays	• Project Status • Socio-Economic impacts and benefits to existing establishments, health and safety • Resettlement Action Plan	Group Meeting	• Audio-Visual Presentation • Slide Presentation • Authority figures and Key Informant Interviews	• Once on Pre-construction (DED Stage) • Monthly during the entire period of ROW Acquisition • As required during Construction and Operation Phases	P30,000.00 per meeting
Local Inter-Agency Committees (LIACs)	• Presentation of Project Status; and • Presentation of valuation methodology and next steps for ROW Acquisition	Group Meeting	• Slide Presentation • Multi-sectoral Cluster meetings	• Once on Pre-construction (DED Stage) • Monthly during the entire period of ROW Acquisition • As required during Construction and Operation Phases	P30,000.00 per meeting
Land and Structure	• Project Status	Group Methods	• Slide Presentation	• Before construction Phase	P30,000.00 per

Target Sector	Major Topic/s of Concern in Relation to Project	IEC Scheme/ Strategy/ Methods	Information Medium	Indicative Timelines and Frequency	Indicative Cost
Owners	• Valuation methodology and next steps for ROW Acquisition		• Focus Group Discussion • Printed Materials	• As necessary until completion of ROW Acquisition	meeting
Senior Citizen	• Project Status • Health and Safety	Group Methods	• Slide Presentation • Printed Materials	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
Female residents	• Project Status • Health and Safety	Group Methods	• Slide Presentation • Printed Materials • Focus Group Discussion	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
Vendors	• Project Status • Health and Safety	Group Methods	• Slide Presentation • Multi-sectoral Cluster meetings	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
Informal Settlers	• Project Status • Relocation site • Health and Safety	Group Meeting	• Slide Presentation • Multi-sectoral Cluster meetings	• Before construction Phase • As necessary until completion of ROW Acquisition	Will be determined during DED
General Public (Indirect)	• General project information and updates	Multi-media	• Media releases • Slide Presentation • Printed Materials	• Before construction Phase up to the completion of the project.	Will be determined prior to construction
MMT Members	• Project Details • Status of Implementation • Impact Management and Monitoring Plans • Quality Management	Group Method	• Slide Presentation • Printed Materials	• Upon formation of MMT composition	P15,000.00

7. GRIEVANCE REDRESS MECHANISM

7.1 OBJECTIVES OF GRIEVANCE REDRESS MECHANISM

1373. Grievance Redress Mechanism (GRMs) is an effective tool for early identification, assessment, and resolution of complaints on projects. GRM will serve as a venue for receiving aggrieved stakeholders' concerns and acting on the concerns but it does not hinder them from their right to judicial action if the decision is unacceptable. The NSRP will establish a mechanism for following objectives:

- Receive and facilitate the resolution of project stakeholders' concerns and grievances about environment related project impacts which cannot be settled during public consultations, paying particular attention to the impacts on vulnerable groups;
- Measure to the risks and adverse impacts of the project; and
- Address project stakeholders' concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to the country's judicial or administrative remedies.

7.2 INFORMATION DISSEMINATION

1374. During the Feasibility Study Stage, NSRP – PMO will set-up a helpdesk to initially handle complaints. GRM will be established during the Detailed Engineering and Design Stage. NSRP – PMO will consult the affected people through their representative and make necessary revision in this GRM to make this more effective. This will ensure the stakeholders are aware of the existence of this GRM. The consultation includes providing the contact information of the NSRP – PMO (hotlines, email, etc.)

7.3 LEVELS OF GRIEVANCE REDRESS MECHANISM

1375. The GRM is composed of four (4) levels. The Grievance officer of DOTr Railway Office will be the contact point for receiving the grievances/complaints from the stakeholders.

1376. As part of the basic policies for the GRM, a grievance should be resolved in a timely manner at the lowest level possible. However, (a) if not settled at the lowest level, (b) if the aggrieved stakeholders are not satisfied with the action taken, or (c) the case is not acted upon the prescribed timeline, the issue or concern will be taken to the next level.

1377. The DENR and the Court of Justice will be the final decision maker for the complaint and grievance. All cases elevated to the 4th level will be outside the jurisdiction and control of this GRM.

	Environment Issue	Health and Safety Issue	Timeline
Contact Point	Grievance Officer of DOTr Railway Offices		Same day
1st Level	HSE Officer of NSRP – PMO		3 days
2nd Level	Health, Safety and Environment Committee (HSEC)		10 days
3rd Level	Multipartite Monitoring Team (MMT)	DOTr Management Level	15 days
4th Level	DENR EMB	the Court of Justice	

7.4 ROLES AND RESPONSIBILITIES

7.4.1 The Grievance officer of DOTr Railway Offices

1378. The Grievance officer will be appointed as a complaints contact point of DOTr Railway Offices to receive all complaints regard's to the Project. The DOTr Railway office is to prepare a procedural manual / operations manual on the Project GRM mechanism to include, but not limited to, the nature of complaints which should be handled by the HSE Officer of the PMO, HSEC, MMT, DOTr board

Management level. The manual will also include a GRM Frequently Asked Questions Sheet to be circulated to all DOTr offices. The Grievance Officers are provided sufficient training prior to deployment. The following are the roles and responsibilities of the Grievance officer of DOTr Railway Offices:

- Screening of complaint if it is project related or not. If the complaint is project related (health, safety and environment issue), forward the complaint to the HSE officer, HSEC or MMT. If the complaint is not project-related, assist the aggrieved stakeholder by forwarding the complaint to the appropriate agency or LGUs who will act on the complaint.;
- Receiving the written, verbal or electronically forwarded complaint from the aggrieved stakeholder and explaining the grievance redress process. Acknowledge receipt (and entering it into the grievance registry of the DOTr-Record Management System) of the complaint and provide copy of the complaint including contact details where the complaint will be forwarded and who will act on it within the day of receipt;
- Constant communication with the aggrieve stakeholder to the whereabouts and status of his/ her concerns;
- Following up with the HSE officer, HSEC, and MMT on their action on the complaint;
- Providing feedback to the PMO on the status of complaint and subsequent action/decision of the HSE Officer, HSEC, and MMT; and
- Maintaining a database for all complaints and the corresponding actions and decisions on the complaints received. Prepare Quarterly Report on Grievance Redress to include accomplishments and status of unresolved grievance to the higher level and JICA/ ADB.

7.4.2 1st Level: Health, Safety and Environment (HSE) Officer of NSRP- PMO

1379. The NSRP – PMO will designate a HSE Officer. He/ She will be responsible to receive, assess/evaluate and provide finding/ recommendation/ decision on all complaints from the Grievance Officer. The following are the roles and responsibilities of the HSE officer:

- Act and decide within 3 working days on the complaint received from Grievance Officer of DOTr Railway Office. Timeline starts upon receipt of the complaint; and
- Provide feedback to the aggrieved stakeholder on the status and/or the decision on the complaint through the Grievance Officer of DOTr Railway Office.

7.4.3 2nd Level: Health, Safety and Environment Committee (HSEC) of NSRP - PMO

1380. The NSRP – PMO will form a HSEC to receive all complaints forwarded by the Grievance Officer of DOTr Railway Office. Its composition includes HSE Officers of NSRP – PMO, General Contractor and Contractor. The following are the roles and responsibilities of the HSEC:

- Discuss forwarded grievances on the regular weekly meeting;
- Act and decide within 10 working days on the complaint received from the Grievance officer of DOTr Railway Office;
- Provide feedback to the aggrieved stakeholder on the status and/or the decision on the complaint through the Grievance officer of DOTr Railway Office; and
- Hold public consultation within the area of complaint to consult the community.

7.4.4 3rd Level: Multipartite Monitoring Team (MMT) / DOTr Management level

1381. The NSRP – PMO will initiate the formation of Multipartite Monitoring Team (MMT) compliant to Section 18 of DENR Administrative Order No. 2017-15. MMT will be responsible for handling environmental issues whereas health and safety related issues will be handled by the DOTr Management Level. Its roles and responsibilities relative to grievances are the following:

- Convene immediately once a complaint forwarded by the Grievance Officer has not been resolved in the 1st and 2nd level;
- Act and decide within 15 working days on the complaint filed by aggrieved stakeholder who is not satisfied with the action or decision of HSEC; and
- Inform the aggrieved stakeholder and MMT/ DOTr Management level of the actions and decisions regarding the filed complaints through the Grievance officer of DOTr Railway Office.
- Conduct monthly meetings to discuss complaints and grievances; and
- Update the status of the project in the FAQ sheet to be disseminated to Grievance officers

7.4.5 4th Level: DENR

1382. Issues related to environment, not addressed in the third level will be elevated to the DENR - Environmental Management Bureau.

7.5 GRIEVANCE REDRESS MECHANISM PROCEDURES

1383. Grievances from the aggrieved stakeholders related to environment issues with regard to the project will be handled, free of monetary charge, through a process of negotiations aimed at arriving at a consensus decision. The procedures are described below:

Table 7.5.1 Grievance Procedure

Steps	By	Actions
1	**Aggrieved Stakeholder**	Any aggrieved stakeholder will lodge his/her grievance in writing, verbally or electronically transmitted to the t DOTr Railway Office for immediate action.
-	**Grievance officer (DOTr Railway Office)**	Receiving the written, verbal or electronically forwarded complaint from the aggrieved stakeholder and explaining the grievance redress process. Acknowledge receipt (and entering it into the grievance registry of the DOTr-Record Management System) of the complaint, provide copy 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. a) If the complaint is project-related, the DOTr Railway Office will forward the complaint to the HSE Officer within the day from receipt of complaint. b) If it is not project related, the DOTr Railway Office will assist the PAP by referring the complaint to the appropriate agency or LGU who may be able to act on the complaint.
3	**Aggrieved Stakeholder**	If the aggrieved stakeholder is not satisfied with the decision of the Grievance officer of DOTr Railway Office that the complaint is not project related, the aggrieved stakeholder may elevate his/her complaint to the HSE Officer.
-	Grievance officer (DOTr Railway Office)	Receive request from the aggrieved stakeholder to elevate his/her complaint to HSE Officer/ HSE Unit of contractor Record the status of the aggrieved stakeholder complaint.
-	**1st Level PMO HSE Officer**	Receives complaint from the Grievance officer. Act and decide on the complaint within 3 working days reckoning from the day it is received from Grievance officer (DOTr Railway Office), and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.
-	Grievance officer (DOTr Railway Office)	Receive and record decision of **1st level decision maker** Inform to the aggrieved stakeholder.

-	**Aggrieved Stakeholder**	Receives action of the **1st level** through the Grievance officer If satisfied, the complaint is resolved and recorded accordingly. If not satisfied with the decision of the **1st level** or if his/her complaint has not been acted upon within a period of 3 working days and has not received any response from the 1st level decision maker, the aggrieved stakeholder can forward the complaint, or file an appeal, to the **HSEC**.
	Grievance officer (DOTr Railway Office)	Receive request from the aggrieved stakeholder to elevate his/her complaint to the **HSEC** Record the status of the aggrieved stakeholder complaint. Forward the complaint to the **2nd Level** within the day from receipt of complaint.
-	**2nd Level HSEC**	Receives complaint from the Grievance officer**.** Act and decide on the complaint within 10 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.
-	Grievance officer (DOTr Railway Office)	Receive and record decision of **HSEC** Inform to the aggrieved stakeholder.
-	**Aggrieved Stakeholder**	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 10 working days and has not received any response from **the 2nd Level,** the aggrieved stakeholder can forward the complaint, or file an appeal, to **the 3rd Level**.
-	Grievance officer (DOTr Railway Office)	Receive request from the aggrieved stakeholder to elevate his/her complaint to **the 3rd Level.** Record the status of the aggrieved stakeholder complaint. Forward the complaint to **the 3rd level** within the day from receipt of complaint.
-	**3rd Level MMT / PMO Board**	Receives complaint from the Grievance Officer. Act and decide on the complaint within 15 working days and inform the decision to the aggrieved stakeholder on the decision accordingly. Inform the Grievance officer the action and/or decision on the aggrieved stakeholder's complaint.
-	Grievance officer (DOTr Railway Office)	Receive and record decision of **the 3rd Level** Inform to the aggrieved stakeholder.
-	**Aggrieved Stakeholder**	Receives action of **the 3rd Level** T through the Grievance officer If satisfied, the complaint is resolved and recorded accordingly. If not satisfied with the decision of the MMT or if his/her complaint has not been acted upon within a period of 15 working days and has not received any response from **the 3rd Level**, the aggrieved stakeholder can forward the complaint, or file an appeal, to the DENR
-	**4th Level DENR**	Receives complaint from aggrieved stakeholder. Once the complaint is filed in the DENR, technical conference will follow.

7.6 GRIEVANCE REDRESS MECHANISM GUIDELINES

The guidelines for GRM are as follows:

- All complaints received in writing, verbally or transmitted electronically will be documented and filed. Upon receiving a complaint from the aggrieved stakeholder, the Grievance Officer of DOTr Railway Office will accomplish the Grievance Action Form (see Appendix 1).
- Aggrieved stakeholder will not be charged of any fees (administrative and legal fees) in filing of their grievance.
- The Grievance Action Form (GAF) will be stamped with a "Received" mark with corresponding control no., date of receipt and signature of the persons who received the said letter.

- Actions and decisions made with the received complaints/grievances/appeals by the HSEC, MMT and DENR – EMB will be reported and discussed by the Grievance Officer of DOTr Railway Office during weekly meetings.
- If the grievance indicated in the letter cannot be readily addressed, the aggrieved stakeholder will be referred to the appropriate authority. The following will be indicated in the GAF: name of the authority to look for, date when the aggrieved stakeholder can meet with the said authority, and the venue for the meeting.
- In addition, the Grievance Officer of DOTr Railway Office will publicize the grievance redress process in the form of handouts such as pamphlets, brochures or leaflets that are written in Filipino. All concerned institutions, including Barangays, LGUs, and the NSRP – PMO, will use the same handouts in explaining the grievance redress procedures to the aggrieved stakeholder who will come to them to raise their issue or concern. The handout will be disseminated through LGUs and Barangays as well as DOTr, also the mechanism to be publicized at the website of DOTr and LGUs.

7.7 GRIEVANCE ACTION FORM

1384. A Grievance Action Form (GAF), attached as **Figure 7.8.1** in this GRM, will be adopted. At all levels, a grievance registry is maintained to keep track and document the number and type of complaints and grievances that have been raised, as well as their status and action/s taken. The grievance registry will be part of an online record management system (RMS). Updating of the online RMS regarding the status of grievances will be allowed only for select DOTr officers. The GAF will, as a minimum, contain the following:

- Basic information of the aggrieved stakeholder (Name, Address, Contact Number);
- Date of last disclosure meeting;
- Category of grievance filed (environment related issue or not); and
- Type of action taken (resolved at the HSEC level or referred to higher authorities).

7.8 MONITORING REPORTS ON GRIEVANCE REDRESS

1385. The NSRP – PMO will prepare Quarterly Reports on Grievance Redress. Accomplishments and status of unresolved grievance of each agency to the higher level and JICA/ADB will be reflected. This report will be a part of internal and external monitoring.

Grievance Action Form

Note: Shaded portions to be filled up by the Grievance Officer only	Control No.
PROJECT INFORMATION Name of Project:	Date Received:
Implementing Officer:	Received by: Designation: Signature over printed name

PAP's PERSONAL INFORMATION

Name		Date of Birth (MM-DD-YYYY)	
Spouse		Date of Birth (MM-DD-YYYY)	
Address			
Occupation			
Contact Number			

DETAILS ON GRIEVANCE FILED

CATEGORY (Encircle appropriate letter)

A Environmental Related

B Health and Safety Related

C RAP Related

D Not Environment/RAP Related

TYPE OF ACTION (Encircle appropriate letter)

Environmental	RAP
A Resolved at HSE Officer Level	**A Resolved at LIAC / DOTr per PMO**
B Resolved at HSEC Level	**B Resolved at RIC**
C Resolved at MMT Level	**C Referred to Court**
D Referred to DENR – EMB	

DETAILS OF GRIEVANCE

Date: _____

Details: _____

_____

_____

_____

_____

_____

_____

REFERRAL DETAILS

Name of Authority _____

_____

Position _____

Date of Meeting _____

Venue _____

Referred by: _____
(Printed Name and Signature of Grievance Officer)

Concurred: _____
(Printed Name and Signature of PAP)

Date: _____

Figure 7.8.1 Grievance Action Form (draft)

8. ENVIRONMENTAL COMPLIANCE MONITORING

1386. The Environmental Compliance Monitoring presents the DOTr's commitment to conduct a self-monitoring activity wherein various measures are proposed in order to ensure that the impacts which will be caused by the proposed project are minimized and properly managed. This Environmental Compliance Monitoring takes reference to the provision of DAO 2017-15, which requires the establishment of the MMT for Environmentally Critical Projects (ECPs), the Environmental Monitoring Fund (EMF) and the Environmental Guarantee Fund (EGF).

8.1 SELF-MONITORING PLAN

1387. DOTr will conduct a self-monitoring activity of its environmental operations, and will regularly submit its Self-Monitoring Report (**SMR**) to the DENR. The initial EMoP will follow Annex 2-20 of the DAO 2003-30. The plan is largely indicative and will be refined during project implementation.

1388. Environmental monitoring will involve all Project phases; namely, construction, commissioning, operations and abandonment to determine and find explanation on any changes in the baseline data. This includes inventory of opened up areas, removal of structures and vegetation, volume of spoils, spaces opened up, built up structures, changes in land use, increase in real estate developments within the influence area of the Project, influx of workers, water consumption, jetty operations, waste generation, disposal of hazardous wastes, operating and maintenance of equipment, fuel and chemical storage and dismantling and removal of facilities and removal and disposal of demolition wastes.

An initial EMoP is presented in Table 8.1.1.

Table 8.1.1 Environment Monitoring Plan for the Proposed NSRP

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
PRE-CONSTRUCTION PHASE													
LAND													
Terrestrial Flora: Clearing existing vegetation along the ROW	Removal/ Transfer of trees and other vegetation	• 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	Post ECC Agreement between DOTr, contractor, and DENR – EMB			85-90% survival rate of the trees/ vegetation planted/ transplanted Obtain tree-cutting/ balling permit prior to removal of any trees		
PEOPLE													
Land Acquisition	Displacement of residents and few commercial establishments along the proposed alignment	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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	100% compensation prior to displacement
Involuntary Resettlement for PAPs	Improvement of living Conditions through Relocation	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 • NHA/ SHFC • LIAC	Included in the RAP cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM Improvement of living conditions through Relocation	100% Resettlement of PAPs to the relocation sites
		• Livelihood program • No. of Participants	• Consultation Meeting and/or Survey with the PAPs • Livelihood Trainings and Seminars	Quarterly until the end of livelihood restoration program	Affected barangays	• DOTr- PMO • LGUs	Included in the RAP cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Livelihood trainings and program will consider gender equality
CONSTRUCTION PHASE													
LAND													
Earthworks	Generation of	• Volume	• Ocular	Daily visual	Area of	• DOTr PMO	Included in the	Post ECC Agreement between DOTr,			Post ECC Agreement between DOTr,		

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
including excavation activities and embankment construction	excavated soil for disposal, storage or moving	disposed • Disposal method • Management of soil against soil management plan	inspection, • Regular reporting, meeting	inspection, Monthly reporting and meeting, Immediately in case of spill	construction	• Contractor	engineering cost	contractor, and DENR – EMB			contractor, and DENR – EMB		
Overall construction activities: Generation of solid waste	Soil pollution and aesthetic view	• 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	Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
		Soil fertility level (if necessary) pH, N, P, K, micronutrients, and heavy metals	Soil sampling and analyses for fertility	As required		• DOTr PMO • Contractor		Post ECC Agreement between DOTr, contractor, and DENR – EMB			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Operation and Maintenance of construction machineries, equipment and vehicles	Generation and accidental spills of hazardous wastes (i.e. oil, grease, etc.)	• Quantity • Occurrence of accidental spills • Condition of equipment and machinery	• Ocular inspection, • Regular reporting, meeting	Daily visual inspection, Monthly reporting and meeting,	Area of construction and temporary facilities	DOTr Contractor	Included in the engineering cost	Complaints	Resolve complaints based on GRM	Compliance with RA 6969	Complaints	Resolve complaints based on GRM	Compliance with RA 6969
Earthwork activities	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	N/A	N/A	N/A	Visually observed subsidence	Implement corrective actions as necessary	If the observed subsidence will pose hazard to the workers and community
• Clearing and removal of	Soil Erosion	Occurrence of erosion of slopes,	Ocular inspection of site/s	Daily	Area of construction and	• DOTr PMO • Contractor	Included in the Construction	N/A	N/A	N/A	Visually observed	Implement corrective	If the observed

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
vegetation • Earthwork activities		stockpile, etc.			temporary facilities		cost				erosion	actions as necessary	erosion will pose hazard to the workers and community
Clearing existing vegetation	Loss of Flora	• 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	POST-ECC Agreement between DOTr, Contractor and EMB			Terrestrial Flora: • Clearing of existing vegetation • Number of trees transplanted/ replaced • Survival rate of the species introduced	Transfer of trees and other vegetation Provision of corresponding number of tree seedling	85-90% survival rate of the trees/ vegetation planted/ transplanted
WATER													
Increase demand on the drainage	Flooding (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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
• Excavation, piling work • Construction of piers in rivers	Increase in suspended sediments in receiving water	• TSS	Ocular inspection Grab sampling DAO 2016-08 Approved method	Daily inspection Quarterly sampling	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	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Class C • TSS: 80 mg/L	Post ECC Agreement between DOTr, contractor, and DENR – EMB		

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
• Wastewater generation • Fuel and oil leaks from construction equipment • Fuel and oil leaks from storage	Degradation of Surface Water Quality; Quality of effluent discharge	• pH • Temp • DO • Color • BOD_5 • Fecal Coliform • O&G	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	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Class C: • pH: 6.5-8.5 • Temp: 25 – 31 °C • DO: 5.0 mg/L (min) • Color: 75 TCU • BOD_5: 7 mg/L (max) • Fecal Coliform: 200MPN/100mL • O&G: 2 mg/L	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
AIR													
Air Quality: Construction works; Movement of vehicles and equipment	Degradation of Air Quality; Generation of dust; Exhaust emissions from equipment	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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
		• TSP • PM10 • PM2.5 • SO2 • NO2	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2: grab sampling; absorbing solution	24-hr Sampling (quarterly) Immediately based on complaints	Established 8 monitoring stations near active construction sites	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Earthmoving, Operation of	Increase in Noise Levels	Noise Level	• Ocular observation	Daily observation	In and around construction sites	• DOTr PMO • Contractor	Included in the Construction	N/A	N/A	N/A	Complaints	Resolve complaints	Implement corrective

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
equipment and machinery			• Direct Reading/ Sound Level Meter • Interview to residents of affected barangay	Monthly interview Noise level measurement when necessary	Affected Barangay		cost					based on GRM	actions as necessary
	Increase in Noise Levels	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	Post ECC Agreement between DOTr, contractor, and DENR – EMB		Environmental Quality Standards for Noise in General Areas (NPCC Memorandum Circular No. 1980-02)	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Earthmoving, Operation of equipment and machinery	Increase in Vibration Levels	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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
		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 recognized	• DOTr PMO • Contractor • MMT • Third Party Sampling Firm	Included in the EMF	N/A	N/A	N/A	Post ECC Agreement between DOTr, contractor, and DENR – EMB		

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
					cultural/ historic structures (within 50 m from alignment) • Buildings adjacent to the project area.								
PEOPLE													
• Construction activities • Vehicle access around construction sites	Threat to Health and safety of the community	• Number of accident involving communities • Degradation of livelihood of local 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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Construction Activities	Occupational health	Working Environment Measurement (WEM)	• BWC-OSHC/NIOSH method	Quarterly Throughout construction phase	Project Site	• Third party sampling firm • DOTr • Contractor	Part of construction cost	Exceeding: • Philippine OSH Standard • NIOSH Standard	Strictly adhere to Occupational Safety and Health Standard	• Philippine OSH Standard • NIOSH Standard	• Complaints on workers' health and safety • Complaints on workers' health and safety	Investigate on workers' health and safety issue and conduct measurement if necessary	• Philippine OSH Standard • Regular check-up
		• Infectious disease • Degradation of health condition of workers	• Survey trend of epidemic disease • Health Check-up of workers	Monthly throughout construction phase	Construction yard	• DOTr PMO • Contractor	Included in the Construction cost	N/A	Strictly adhere to Occupational Safety and Health Standard	• Philippine OSH Standard • NIOSH Standard	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
		Number of Accident	Occurrence of accidents related construction work	Weekly, In case of accidents,	Project Site	• DOTr PMO • Contractor	Included in the Construction cost	N/A	Strictly adhere to Occupationa	• Philippine OSH Standard	Occurrence of accident	• Provide appropriate PPE	Coordinate with the nearest

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
				immediately					I Safety and Health Standard	• NIOSH Standard		• Conduct supplementary training on safety as necessary	medical facility
Employment of PAFs and locals		Number of PAFs, locals, females hired	Survey status of employment	Quarterly	Project Sites	• DOTr • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Resettlement, Construction activities	Social conflicts Degradation of livelihood	SDP implementation Record IEC implementation Record Participants list	Interview with residents of affected barangay, relocatees	Quarterly	Affected Barangay Barangay with relocated sites	• DOTr PMO • Contractor	Included in the Construction cost	N/A	N/A	N/A	Complaints	• Resolve complaints based on GRM • Coordinate with LGUs	Implement corrective actions as necessary
• Blocking of access roads, • Increase in construction vehicles on roads	Increase in traffic volume	• 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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
OPERATIONAL PHASE													
LAND													
Train operation	Ground subsidence	Level of ground subsidence	• Visual observation; • Level measurement	• Visual observation: daily • Measurement : monthly		• DOTr PMO • Operator	Included in the Operation & Maintenance cost	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Train operation • Depot • Passenger facilities	Generation of domestic / Solid wastes by passengers and	• Volume • Disposal method	• Ocular inspection, • Regular reporting	• Daily visual inspection, • Monthly reporting	• Passenger facility • depot	• DOTr PMO • Operator	Included in the Operation & Maintenance cost	N/A	N/A	Compliance with RA 9003	Complaints	Resolve complaints based on GRM	• Compliance with RA 9003 • Coordinate

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
			Method	Frequency	Location			EQPL Range			Management Measure		
								Alert	Action	Limit	Alert	Action	Limit
	personnel												with the host LGU/s
		• Soil fertility level	Soil sampling and analyses	As necessary	• Depot	• DOTr PMO • Operator • Third Party Sampling Firm	Included in the EMF	N/A	N/A	PNS/ BASF 40:2016 • Organic Matter • Total NPK • Trace Metals	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
Maintenance works • Depot facility	Spill of oil and other similar substances	Substance/s that spilled (e.g. oil, diesel, grease)	• Ocular inspection • Soil sampling survey • Check against RA6969	• Weekly ocular inspection, • In case of spill, immediate action is required.	• Depot	• DOTr PMO • Operator • Third Party Sampling Firm	Included in the Operation & Maintenance cost	N/A	N/A	N/A	Incident of spillage	Compliance with RA 6969 Initiate Clean-up	Limit indicated in dutch Standards (e.g. Pb: 85 mg/ kg Hg: 0.3mg/kg Cd: 0.8 mg/kg As: 3 mg/kg Cr+6: 100 mg/kg)
Survival of transplanted trees/ vegetation	Survival rate of transplanted trees/ vegetation	Number of trees surviving	Ocular inspection of health and vigor	Quarterly	Transplanted areas	• DOTr PMO • Operator	Included in the Operation & Maintenance cost	N/A	N/A	N/A	70% survival rate	Replacement of non-surviving tree/s	85-90% survival rate of the trees/ vegetation planted/ transplanted
WATER													
Increase demand on the drainage	Flooding (during rainy season)	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	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
• Wastewater generation • Fuel and oil leaks from construction	• Degradation, Quality of effluent discharge	• BOD • COD • Color • TSS • O&G	• Grab sampling • In situ for pH and Temp using pH meter and	Quarterly	discharge points	• DOTr PMO • Operator • Third party sampling firm • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		pH: 6.5-9.0 Temp: 25 - 31 O&G: 2 DO: 5.0 (min)	Post ECC Agreement between DOTr, contractor, and DENR – EMB		

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
equipment		• Coliform • pH	temperature probe) • DAO 2016-08 approved methods							Color: 75 BOD5: 7(max) TSS: 80 Fecal Coliform: 200 Implement corrective actions as necessary			
AIR													
Train operation, Depot, passenger facilities, service vehicles	Degradation of Air Quality; Generation of dust; Exhaust emissions from equipment	TSP, PM_{10}, $PM_{2.5}$, SO_2, NO_2	• TSP, PM_{10}: High Volume; Gravimetric method • $PM_{2.5}$: e-sampler, gravimetric • SO_2, NO_2: grab sampling; absorbing solution	• 24-hr Sampling, Annually • Immediately based on the complaints	Stations and Depot	• DOTr PMO • Operator • MMT	Included in the EMF	Post ECC Agreement between DOTr, contractor, and DENR – EMB		TSP: 230 ug/NCM; PM_{10}: 150 ug/NCM; $PM_{2.5}$: 50 ug/NCM; SO_2: 180 ug/NCM; NO_2: 150 ug/NCM Implement corrective actions as necessary	Post ECC Agreement between DOTr, contractor, and DENR – EMB		
	Increase in Noise levels	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	Environmental Quality Standards for Noise in General Areas (NPCC Memorandum Circular No. 1980-02)			Post ECC Agreement between DOTr, contractor, and DENR – EMB		
	Increase in Vibration Levels	Vibration Level (dBA)	Vibrometer	• Immediately based on the complaints	• Complained area	• DOTr PMO • Operator • Third party sampling firm	Included in the EMF	N/A	N/A	N/A	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
PEOPLE													
Operation of train	Health and safety issues of the	• Increase in accident	• Monitoring • Documentation	• Regular monitoring	Area with stations and Depot	• DOTr PMO • Operator	Part of Operation &	Complaints	Resolve complaints	Implement corrective	Complaints	• Resolve complain	• Implement corrective

Key Environmental Aspect per Project Phase	Potential Impacts per Environmental Sector	Parameters	Sampling and Measurement Plan			Lead Person	Estimated Cost	Environment Quality Performance Level Management (EQPL) Scheme					
								EQPL Range			Management Measure		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
	community	involving communities • Degradation of livelihood of local communities		• In case of accidents, immediately			Maintenance cost		based on GRM	actions as necessary		ts based on GRM • Coordinate with LGUs	actions as necessary • Coordinate with the nearest medical facility
	Safety Issues on employee	Occurrence of accident/s	• Monitoring of work environments • Regular Meeting	Monthly	Project Sites	• DOTr PMO • Operator	Part of Operation & Maintenance cost	Complaints on workers safety	Investigate on workers safety issue and conduct measurement if necessary	Philippine OSH Standard NIOSH Standard	Exceeding: Philippine OSH Standard NIOSH Standard	Strictly adhere to Occupational Safety and Health Standard	Philippine OSH Standard
	Increase in accident	Number of Accident	Help desk	• Regular monitoring • In case of accidents, immediately	Project Sites	• DOTr • Operator	Part of Operation & Maintenance cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary
Traffic management	Increase in traffic volume	Traffic congestion	Help desk	Throughout operation phase	Project Site	• DOTr • Operator	Part of Operation & Maintenance cost	Complaints	Resolve complaints based on GRM	Implement corrective actions as necessary	Complaints	• Resolve complaints based on GRM • Provision for traffic signage and personnel	Implement corrective actions as necessary

8.2 MULTI-PARTITE MONITORING TEAM

1389. Pursuant to DAO 2017-15, the law mandates that after issuance of the ECC, a Multi-Partite Monitoring Team (**MMT**) will be formed for ECPs. The MMT is tasked to monitor the compliance of the Project as stated in the ECC conditions, EMP and other related policy. Furthermore, the MMT will gather information and data relating to complaints and impacts of the project to environment and society. Other tasks of the members of the MMT are the following:

- Prepare and submit Compliance Monitoring Validation Report (**CMVR**) quarterly
- Review all monitoring reports
- Disseminate information to the affected households/individuals
- Submit recommendations to EMB-DENR

1390. The EMB-DENR will provide oversight guidance to the MMT and consider its reports and recommendations regarding project impacts and compliance evaluation.

1391. The composition of the MMT will be representative of relevant stakeholders groups. The following are recommended members of the MMT:

- Representative from the LGUs along the NSRP alignment
  - Manila City
  - Makati City
  - Taguig City
  - Parañaque City
  - Muntinlupa City
  - San Pedro City
  - Biñan City
  - Santa Rosa City
  - Cabuyao City
  - Calamba City
- Representative from the LGU-accredited local NGOs with mission/s specifically related to environmental management. Representative from an academic institution may be included in absence of a local NGO
- Representative from locally recognized community leaders who can represent vulnerable sectors such as women and senior citizen
- Concerned Government Agencies
  - Department of Public Works and Highways
  - Metro Manila Development Authority (**MMDA**)
- Members of MMT will elect among themselves the Chairman and Vice Chairman.
- The members of MMT will elect among themselves the Chairman and Vice Chairman.

8.3 ENVIRONMENTAL MONITORING AND ENVIRONMENTAL GUARANTEE FUND COMMITMENTS

(1) The Purpose of EMF and EGF

1392. The DOTr commits to establish an EMF and EGF. The EMF will be exclusively utilized to cover all costs attendant to the operation of the MMT. Whereas, the EGF will be used exclusively for the following purposes:

- Immediate rehabilitation of areas affected by damages to the environment and the resulting deterioration of environmental quality as a direct consequence of the proposed NSRP construction, operation and abandonment;
- Just compensation of parties and communities affected by the negative impacts of the proposed NSRP;
- Conduct of scientific or research studies related to the proposed NSRP that will aid in the prevention or rehabilitation of accidents and/or environmental damages; and
- For contingency and clean-up activities, environmental enhancement measures, damage prevention programs and social equity measures including the necessary IEC and capability building activities related to the Project.

(2) Basis of the Cost

1393. The EGF Trust Fund and EGF Cash Fund will be replenished to its original amount annually or whenever the amount goes below 50% of the original amount. The EGF Trust Fund will be renewed upon every expiration. The amount of EGF Trust Fund and EGF Cash Fund are typical figures of EGF. **Table 8.3.1** shows the EMF, EGF Trust Fund and EGF Cash Fund for the proposed NSRP

Table 8.3.1 EMF, EGF Trust Fund and EGF Cash Fund for the Proposed NSRP

Type of Fund	Amount (PhP)
EMF (PhP)	250,000.00
EGF Trust Fund (PhP)	250,000.00
EGF Cash Fund (PhP)	250,000.00

1394. At the end of the project life, a sufficient amount will be reserved from the EGF to ensure that rehabilitation, restoration, decommissioning, or abandonment will be adequately financed. Such amount may be increased during the project life span to ensure that the balance will be sufficient for the abandonment phase. In such case, the EGF Committee may require an adjustment of such amount to cover inflation and other factors. The required submission to the EMB-DENR of the Abandonment/ Decommissioning Plan for the proposed NSRP will have a corresponding fund commitment subject to the approval of the DENR or the lead government agency with direct approving authority on the Abandonment/Decommissioning Plan.

9. DECOMMISSIONING/ABANDONMENT/REHABILITATION POLICY

9.1 POLICY

1395. In the unlikely event that the proposed NSRP becomes uneconomically viable or if by *force majeure* or acts of God, it will have to be terminated and/or decommissioned. A detailed abandonment/decommissioning plan will be developed prior to the closure of the facilities and within the timeframe that will be specified in the ECC. The Abandonment and Decommissioning Plan will be prepared in accordance to DENR requirements and will address the following:

- Proposed abandonment/decommissioning measures for the facilities constructed as part of the project;
- Removal of any existing hazardous and non-hazardous wastes;
- Site restoration where appropriate;
- Cost associated with the proposed abandonment/decommissioning activities and source of funds for the implementation of the activities; and
- Conformance to the requirements of the PNR (as owner of the ROW), the local government, the DENR and other relevant agencies.

9.2 PROCEDURE AND RESPONSIBLE PARTIES

(1) Pre-Abandonment/Decommissioning Activities

1396. The DOTr/PMO will further develop the appropriate protocols to address the Abandonment/Decommissioning Plan. The plan will be submitted to the DENR for review and approval prior to the commencement of abandonment/decommissioning activities. DOTr concerned Staff/Workers will be informed six (6) months prior to abandonment/decommissioning of the proposed NSRP. All affected communities and stakeholders will also be properly informed of the abandonment/decommissioning activities.

(2) Abandonment/Decommissioning Activities

1397. The DOTr/PMO will oversee the performance of identified activities in the Abandonment/Decommissioning Plan by their Contractor for all temporary structures, work areas related to the Project. In the case of the railway operation, the DOTr/PMO will oversee the performance of all appropriate activities by the Railway Operator, as contained in the Abandonment/Decommissioning Plan, including the provision of security within the premises. Appropriate documentation will be conducted during the abandonment procedures including photographs of the work areas/operational areas, by the DOTr/PMO. This documentation will be made available to the proper agencies, upon request and for monitoring purposes.

(3) Post-Abandonment/Decommissioning Activities

1398. Upon review of the submitted Plan, the DENR-EMB will notify the Proponent/DOTr of its findings and may, as a consequence of the review process, conduct inspections, other related activities, and actual site observations. Should inspections be necessary, the DENR will form a team composed of, among others, DOTr/PMO, PNR, EMB, concerned LGU's, and such other entities who are affected by the abandonment procedures.

1399. If during site inspection irreversible damages to the environment are discovered, the extent of such damage will be investigated and reported to the DENR-EMB. If the findings show that said damages were caused by construction-related activities, the Contractor's All Risk Insurance (**CARI**) will be tapped

for compensation of damages. In the event such findings show that the damages were caused by train maintenance and operations procedures, the EGF will be tapped.

10. INSTITUTIONAL PLAN FOR EMP IMPLEMENTATION

1400. The Institutional Plan is the inception of a body that will implement the proposed Environmental 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 necessary mechanism that will strengthen the organizational relationship of the proponent with the host community, concerned government agencies, and other stakeholders.

1401. The proposed Project will be primarily implemented by the DOTr. The PNR, being the owner of the ROW will be involved during the pre-construction phase. However, the PNR will not be necessarily a part of the Management and Operation Agreement since private operators may be involved.

10.1 DEPARTMENT OF TRANSPORTATION

1402. The DOTr as the proponent for the proposed NSRP, is the primary policy, planning, programming, coordinating, implementing and administrative entity of the executive branch of the government on the promotion, development, and regulation of a dependable and coordinated network of transportation system, as well as in the fast, safe, efficient and reliable transportation.

1403. The DOTr plays a crucial role in accelerating the country's economic development. It provides the backbone for growth and enhances the country's competitive edge by providing effective and efficient transportation infrastructure systems that narrow the geographical and physical divide, connecting the country, its islands, and its people to the rest of the world.

(1) Vision

1404. By 2030, DOTr is a world class organization, providing integrated transport, connecting people, islands, families, communities and the nation with the rest of the world, and constantly responding for environmentally sustainable and globally competitive transport system.

(2) Mission

1405. To provide the country with efficient, effective, and secure transportation systems those are globally competitive, compliant with international standards, and responsive to the changing times.

(3) Sectorial and Attached Agencies

1406. The DOTr has three (3) Sectoral Offices and sixteen (16) Attached Agencies. The sectorial offices include the Maritime, Road, and Rail Transport Offices. The latter includes the MRT 3 which is a Project Management Office (PMO) of the Department.

1407. Among the attached agencies are three (3) Railway agencies namely: Philippine National Railways (PNR), Light Rail Transit Authority (LRTA), and North Luzon Railways Corporation (NLRC or Northrail).

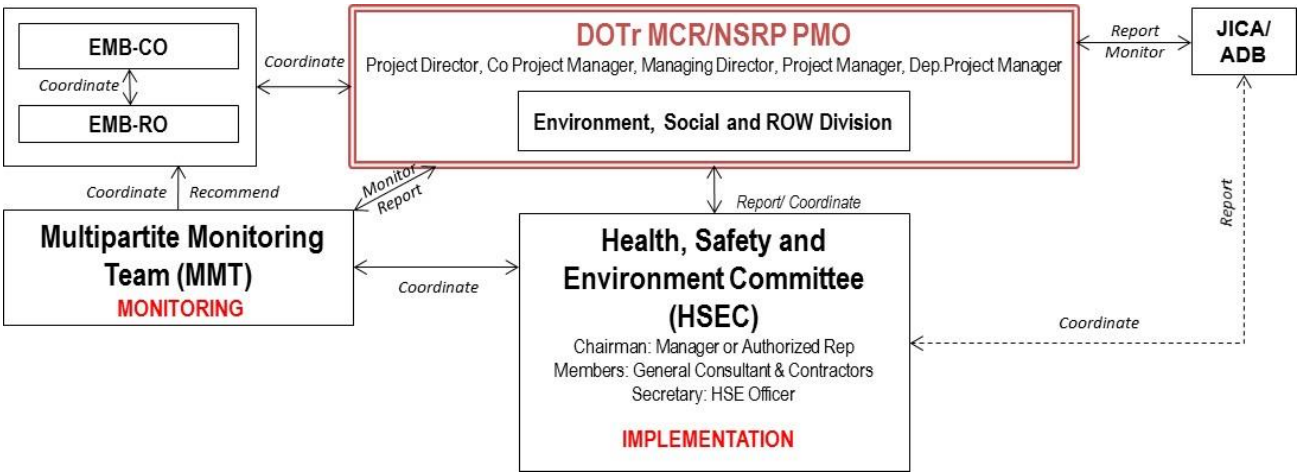
(4) DOTr Roles of the EMP

1408. The DOTr as the Implementing Agency will be responsible for providing overall policy and guidance with regards to implementation of the Project. It will ensure that all the necessary provisions for implementing the EMP and the Environmental Monitoring Plan (EMoP), including budgets and agreements with other concerned national and local government agencies are included in all contracts. In accordance with D.O. 245 Series of 2003 and the Updated Social and Environmental Management System (SEMS) Operation Manual of 2014, DPWH is not authorized to set aside an Environmental Management Fund (EMF) from which honoraria for Multi-Partite Monitoring Team (MMT) Members may be drawn from, but the Department will shoulder the costs of travel, food, and other monitoring expenses.

10.2 IMPLEMENTATION OF THE EMP

(1) Institutional Structure

1409. The organizational structure for the EMP constitutes the DOTr PMO and its Environment, Social and ROW Division (**ESRD**); Health, Safety and Environment Committee (HSEC), General Consultant, Contractor (including Sub-Contractor) and MMT as key entities for its effective implementation. Figure 10.2.1 presents the simplified institutional diagram for the EMP implementation, showing the management/ relationship line among these entities.



Source: JICA Study Team

Figure 10.2.1 Simplified Institutional Plan for Implementing the EMP

1410. DOTr will create a new office or designate one of the railway attached agencies to serve as PMO. Under the PMO, The Health, Safety and Environment Committee (**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 and DAO 2017-15.

1411. The HSEC and the Contractor's implementation of the EMP will be in coordination with the following entities:

- EMB-CO
- EMB-R4A
- EMB-NCR
- DENR Forest Management Bureau (FMB) and BMB
- DOTr Attached Agencies – PNR
- Other Relevant NGAs – National Commission for Culture and the Arts (NCCA), NHCP, NM, DPWH, Laguna Lake Development Authority (LLDA), National Housing Agency (NHA)
- LGUs of Manila, Makati, Taguig, Parañaque, Muntinlupa, San Pedro, Biñan, Santa Rosa, Cabuyao, and Calamba
- MMDA

(2) DOTr NSRP Project Management Office (NSRP PMO)

1412. The NSRP PMO will be established as the representative of the Department in all activities pertaining to the planning, design review, and implementation of the project. It will be guided by the Operational Procedures.

1413. The following will be responsible for the decision-making, planning and implementation of the overall project activities: Project Director, Co-Project Director and Management Director (**Table 10.2.2**) whereas a Project Manager and Deputy Project Manager will be acting management of the NSRP.

Table 10.2.2 Composition of NSRP PMO (Provisional)

	Position	Member
1	Oversight Functions	Project Director: Assistant Secretary for Railways Co-Project Director: PNR General Manager Managing Director: Representative from DOTr
2	Manager	Project Manager: Representative from DOTr/PNR Deputy Project Manager: Representative from DOTr/PNR
3	Division	Six (6) Divisions headed by a Division Chiefs. Civil Works Division Electricity and Mechanical System Division (EMS Division) Rolling Stock Division (RS Division) Engineering Support Division (ES Division) Environment Social and ROW division (ESR Division) Project Control and Support Division (PCS Division)

(3) Environment Social and ROW Division of NSRP - PMO

1414. Under the NSRP PMO, the Environment Social and ROW Division (ESR Division) is created and staffed with Health, Safety and Environment Officer (HSEO) Officer, 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 which is an integral part of this EISR.

- Prior to bidding process, prepare the "DOTr Environmental Protection Clauses" of the Bid Documents to apply to the project based on the EMP and the ECC for the project;
- Discuss contract environmental clauses with bidders to allow the latter to include realistic costs of complying with contract provisions in their bids;
- Ensure that compliance to all conditions stipulated in the ECC are included as provisions in the Bid Documents to be issued to prospective Contractors; and
- Ensure that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the TOR of the Detailed Engineering Design.

1415. A Training Program for capacity building of the PMO-ESR will be designed by professional training institution offering environmental courses like the Pollution Control Association of the Philippines (**PCAPI**) Manila Observatory, Miriam College, UP Los Baños IESAM, or PWU. The Training Course will be conducted through any of these training institutions, or through the Development Academy of the Philippines (**DAP**) to help build the capability of the environmental staff for environmental management and monitoring. It will be required that the hiring of environmental unit staff will be those who are graduates of environmental management courses, or have at least 5 to 10-year experience in the environmental management field.

(4) Health, Safety and Environment Officer (HSEO)

1416. The Health, Safety and Environment Officer (HSEO), will provide appropriate action on complaints brought before the ESRD-NSRP 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. Among others, the HSEO will:

- Guide the PMO-ESRD engineers and technical personnel in the implementation of the conditions of the ECC and such other activities laid out in the EMP and EMoP both of which are integral parts of this EIS report;
- prepare environment monitoring reports including Compliance Monitoring Report, as well as reporting to JICA and ADB;
- assist in preparing the "DOTr Environment Protection Clauses" of the Bid Documents,
- Review contract environmental clauses (such as inclusion of ECC conditionalities, required engineering interventions in approved EMP/EMoP, etc.) with bidders to ensure proper understanding and compliance.

(5) Health, Safety and Environment Committee

1417. The HSE Committee will be under the PMO which will also comprise representatives from the DOTr, general consultant and contractors on-site. Their role and responsibilities area as follows:

- Conduct weekly meetings to discuss issues and complaints as well as resolve them;
- Forward Issues that are not resolved to the MMT. If the MMT cannot resolve the critical issue, it will be referred to the DOTr Secretary or Undersecretary for resolution;
- Monitor compliance of contractors' implementation of the EMP;
- Identify sources of pollution issues;
- Monitor the effectiveness of mitigating/enhancement measures;
- Based on monitoring results, find solutions/alternatives to enhance the EMP;
- Coordinate with EMB and other relevant oversight agencies and other stakeholders;
- Regularly report compliance to the ECC and its Conditionalities;
- Submit quarterly SMR detailing status of compliance with ECC and bi-annually the Compliance Monitoring Report (**CMR**) and other required environmental reports to DENR – EMB.

(6) Multi-Partite Monitoring Team (MMT)

1418. The MMT is an independent third-party entity formed after the issuance of the ECC to encourage participation of the Project's various stakeholders and 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.

1419. The formation of the MMT will be initiated by the DOTr (PMO) through a Memorandum of Agreement (**MOA**) between the EMB-CO and the DOTr (PMO) with conformity of the identified MMT members.

1420. Based on DENR Administrative Order (DAO) No. 2017-15, the MMT will be composed of representatives of relevant stakeholders. As such, the EMB and the proponent (DOTr), being principal project parties, will no longer be members of the MMT. Instead, the EMB will provide oversight guidance to the MMT and consider its reports and recommendations in its impact and compliance evaluation. On the other hand, the proponent (DOTr) will provide funds for the MMT activities based on the AWFP approved by the EMB. The specific functions of the MMT will include the following:

- Conduct quarterly ocular site visit to validate the proponent's compliance with the ECC conditions and the Environmental Management and Monitoring Plan including the requirement to conduct self-monitoring and submit corresponding reports regularly;
- Observe sampling activities conducted by the project proponent;
- Prepare and submit its report to EMB-CO and EMB-R3 concerned using EMB-prescribed format at least semi-annually not later than July 30 for the first semester report and January 30 for the 2nd semester report; and

- Institute an environmental emergency and complaints receiving and management mechanism which will include systems for transmitting recommendations for necessary regulatory action to EMB in a timely manner to prevent adverse environmental impacts.

1421. The key stakeholder members of the MMT are enumerated below as stipulated in DAO 2017-15.

1. LGUs

- One (1) Provincial Environment and Natural Resources Office (PENRO) representative from each affected province
- In case there is no PENRO, 1 representative each from the City Environmental and Natural Resources Office (CENRO), City Planning and Development Office (CPDO) or the Sangguniang Barangay (SB) Environment Committee Chairman
- Rural Health Unit (RHU) Chiefs
- Concerned Barangay Captains

2. NGO / PO

- One (1) environmental NGO representative
- In case there is no environmental NGO, one (1) representative from other NGOs
- Maximum of two (2) from locally-recognized community leaders representing vulnerable sectors such as IPs, women, senior citizen, etc.

3. Academe

- Maximum of two (2) representatives from the academe

4. Relevant NGAs

- Maximum of three (3) representatives with related mandate on the proposed Project
- On special environmental concerns (e.g. biodiversity), DENR membership will be endorsed by concerned Bureau Director

(7) The Contractor

1422. The Contractor will be jointly responsible for implementing the EMP, and liable to any and all 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 will be jointly (with DOTr) responsible for ensuring that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the TOR of the Detailed Engineering Design.

10.3 INFORMATION DISCLOSURE

1423. DOTr will disclose relevant information on the project and its potential impacts to the stakeholders in line with JICA guideline and ADB Safeguard Policy Statement. Information Disclosure aims to achieve the following objectives:

- Enhance the sustainability of projects by ensuring that interventions are relevant to the people of the area.
- Learn from the various social groups living in a project area how they perceive the existing situation, recent trends, existing problems, and potential solutions;
- Collect local knowledge, information, and ideas about the technical implications and impacts of project design;

- Determine potential social, economic, and cultural impacts not always foreseen in survey based socio-economic studies;

- DOTr will provide following documents to JICA and ADB to disclose on their website as well as on their website.

- A draft EIS to be disclosed at least 120 days in advance of JICA and ADB review
- The final EIS
- A new / updated EIS and corrective action plan prepared during project implementation if any,
- Environment monitoring reports

1424. In addition, DOTr will disclose key information to the affected people and other stakeholders in plain and understandable Philippine language and suitable communication methods.

1425. Key Information includes; Project outlines and activities, implementation schedule, project location, duration and potential impact/risks to be affected and corresponding mitigation measures, consultation process and grievance mechanism.

1426. Media to be used: public consultations, brochures, leaflet, booklet, poster, radio, web-site, info-graphics etc.

10.4 REPORTING

1427. The HSE officer of MCR PMO will submit quarterly monitoring reports to JICA and ADB during construction until the project completion report is issued. In addition, the results of public consultation and information disclosure will be also submitted to JICA and ADB. The report is also to be disclosed to the public.

11. PUBLIC CONSULTATION DOCUMENTATION

11.1 INFORMATION, EDUCATION AND COMMUNICATION AND INITIAL PERCEPTION SURVEY

1428. The IEC was conducted to provide updated information about the proposed Project and encourage the concerned stakeholders to participate in the EIA study. The IEC sessions are shown in Table 11.1.1 with the summary of major issues and concerns in Table 11.1.2.

Table 11.1.1 IEC Conducted for the EIA Study of the Proposed Project

Date and Time	Venue	Main Participants	Total No. of Participants
December 13, 2017 10:00 AM	Provincial Government Extension Office, Calamba City	Representative from the Office of the Governor PUDHO Representative	Male: 2 Female: 0 Total: 2
December 18, 2017 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 Total: 9
December 18, 2017 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
December 19, 2017 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
December 20, 2017 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
December 22, 2017 10:00 AM	Biñan City Hall	Parañaque City LGU Representatives (City Mayor, City Councilor, City ENRO and CPIO)	Male: 3 Female: 6 Total: 9
December 22, 2017, 2:00 PM	Makati City LGUs	Makati City Administrator's Office Representatives	Total: 8
December 22, 2017 2:00 PM	Calamba City	Representative of Calamba City LGU	Male: 1 Female: 0 Total: 1
December 27, 2017 2:00 PM	Makati City Hall	Makati City Administrator's Office Representatives	Male: 4 Female: 1 Total: 5
January 10, 2018, 10:00 AM	Taguig City LGUs	City Hall, Taguig City	Total: 15

Source: JICA Study Team

Table 11.1.2 Summary of Major Issues and Concerns during IEC

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 me 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	JICA Study Team will organize a coordination meeting with NHA.

LGU	Concerns		Answers
	EIA	RAP	
		Los Baños? Local election might cause delay in resettlement (LGU wants to conduct resettlement after the elections)	
			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, and seismicity.		JICA Study Team will coordinate with PHIVOLCS and gather information concerning procedures.
		There is an ongoing construction of road along the alignment which is a project of Congress Biazon.	JICA Study Team requested LGU to provide data on on-going projects
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

1429. The initial Perception Survey was conducted after the IEC activity. Survey questionnaires were distributed to the participants after the IEC sessions. The survey covers the demographic characteristics, source of income, livelihood, health and sanitation, education, employment, their knowledge and attitude towards the proposed Project.

1430. IEC documents such as attendance, issues raised, and photos taken during the IEC are presented **Annex 11-1**.

11.2 STAKEHOLDER CONSULTATION MEETINGS

11.2.1 First Round of the Stakeholder Consultation Meetings (SCM)

1431. The 1st round of Stakeholder Consultation Meeting (PCM) was in each LGU as shown in **Table 11.2.1.** The 1st PSCM started 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 the main concerns/issues raised during the first SCMs is provided in **Table 11.2.2**.

Table 11.2.1 Stakeholder Consultation Meetings (SCMs)

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
Makati City	Multi-Purpose Room, 7th Floor, Makati City Hall Building 2	09:00 A.M. 18 December 2017	PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	4	2	6

Table 11.2.1 Stakeholder Consultation Meetings (SCMs)

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
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, BLGUs, 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	LGU, PAPs, 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	LGU, PAPs, 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. 01 February	PAPs, BLGUs, DOTr Representatives, JICA	57	152	209

Table 11.2.1 Stakeholder Consultation Meetings (SCMs)

LGUs	Venue	Date & Time	Main Participants	Number of Participants		
	Pansol	2018	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
Municipality of Los Baños	Covered Court, Old Municipal Hall Compund, Brgy. Baybayin	2:00 P.M. 19 January 2018	LGU, PAPs, BLGUs, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.			1889
Municipality of Bay	Covered Court, Brgy. Paciano Rizal	08:30 A.M. 27 January 2018	LGU, BLGU, DOTr Representatives, JICA Design Team Representatives, EcosysCorp, Inc.	51	74	125

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during 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 SCM
• 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	• A more detailed explanation regarding the concern will be discussed during the 2nd SCM; • 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.

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
and returned to informal settling along the tracks could still qualify to the relocation program for the project	• 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; • 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 SCM
• 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 SCM; • 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,	• Permission will be requested from the structure owners

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
census and survey due to work schedule, particularly during weekdays	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	
• 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;

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
	• 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
• 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 SCM 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;

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
	• 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	
• 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; • The Detailed Design Phase will start from August 2018 until May 2019; • Construction is scheduled to start by 2019 • The target opening of the NSRP commuter is by 2022,

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
	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 South Line 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 SCM
• 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;

Table 11.2.2 Summary of Issues and Comments at the 1st PCM

Summary of Issues, Concerns, Comments, and Suggestions Raised during the 1st SCM	
Queries/Concerns/Suggestions/ Comments	**- Responses To Queries**
	• 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

11.2.2 Focus Group Discussions

11.2.2.1 Focus Group Discussion with Affected Business Sector

This Focus Group Discussion (FGD) was conducted 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 Resettlement Action Plan (RAP).

The general objective of the FGD is to obtain inputs in the formulation of the Livelihood Restoration and Improvement Program directly from the Project Affected Persons (PAPs). The specific objectives are as follows:

- To determine PAPs' apprehensions/concerns regarding acquisition of properties in relation to their respective businesses;
- To understand PAPs' concept of livelihood restoration and improvement;
- To determine possible project benefit-sharing schemes that will be acceptable to PAPs; and
- Based on output of the FGD, recommend mitigation measures to be included in the Compensation and Entitlement Matrix of the RAP

The FGDs were conducted in the Cities of Calamba, Cabuyao, Biñan, Sta. Rosa, San Pedro, Muntinlupa, Parañaque, and Taguig. **Table 11.2.3** below indicates the dates and locations of the FGDs for each City.

Table 11.2.3 Focus Group Discussions with Affected Business Sector

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					

11.2.2.2 Focus Group Discussion with Affected Vulnerable Sector

1432. This Focus Group Discussion (FGD) was conducted as part of the consultation with the vulnerable sectors affected by the proposed NSRP. The vulnerable sectors covered by 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).

1433. 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. Topics for the FGDs will focus mainly on Livelihood and Relocation with the following objectives:

The general objectives of this FGD are as follows:

(i) To obtain inputs in the formulation of the Livelihood Restoration and Improvement Program directly from the Project Affected Persons (PAPs); and

(ii) To discuss possible relocation options.

The specific objectives are as follows:

(i) To determine PAPs' apprehensions/concerns regarding displacement of communities in relation to their respective sources of livelihood;

(ii) To understand PAPs' concept of livelihood restoration and improvement;

(iii) To identify other possible entitlements that will be acceptable to PAPs;

(iv) To identify relocation preferences among the PAPs; and

(v) Based on output of the FGD, recommend mitigation measures to be included in the Compensation and Entitlement Matrix of the RAP.

1434. The FGDs were conducted in the Cities Calamba, Cabuyao, Biñan, Sta. Rosa, San Pedro, Muntinlupa, Parañaque, and Taguig. The table below indicates the dates and locations of the FGDs for each City/Municipality.

11.3 PUBLIC SCOPING

1435. The Public Scoping for the NSRP South Line Commuter (PNR Los Baños) (the 'Project') of Department of DOTr from Solis, Manila to Los Baños, Laguna was conducted in three (3) cluster areas on January 18, 19 & 24, 2018 which details are presented in Table 11.3.1.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 11.3.1 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	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)	Male: 44 Female: 20 Total: 64

Date and Time	Venue	Main Participants	Total No. of Participants
	School Central 2, Calamba City, Laguna	Biñan City LGUs Los Baños LGUs Residents from the different barangays along the PNR alignment	
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

1436. The agenda for the Public Scoping started with a prayer followed by the national anthem. The welcome remarks were given by the respective LGUs and followed by the introduction of participants prior to the presentation of the EIA Process and Project Description. A two-hour open forum was allotted to the participants to raise their issues, concerns, and inputs to the EIA Study.

1437. The overview of the EIA Study and the objectives of Public Scoping were presented by the representative from the EMB EIA - CO. The description and benefits of the Project were presented by the Proponent, DOTr, while the Potential Impacts and Mitigating Measures as well as the benefits of the Project were discussed by Engr. Ledicia T. dela Cruz of Geosphere. After the presentations, an open forum was held, which was facilitated by the representatives from EMB EIA-Central Office, to solicit inputs to the EIA study of the project from the stakeholders. After the open forum, the issues, comments, suggestions, inputs to the EIA Study was summarized by Engr. dela Cruz and advised the participants to contact the EMB, Proponent, and Geosphere for additional issues, concerns and inputs that they may want to raise after the Public Scoping. Public Scoping was then adjourned after the closing remarks from Proponent, DOTr.

1438. The receipt copy of the invitation letters, attendance sheets, photos taken during Public Scoping and the accomplished Annex 2-7c (Proforma Public Scoping List of Issues) are presented in **Annex 11-2**.

11.4 PUBLIC HEARING

1439. Three (3) sessions of clustered Public Hearing will be conducted, two (2) in NCR and one (1) Laguna. For NCR, the public hearing sessions will be held in Makati City on June 20, 2018 and the another one Taguig City on June 21, 2018. For Laguna, the public hearing session will be held in Sta. Rosa City on June 22, 2018. The public hearing will be presided by the EMB-Central Office and the EIARC. The additional issues that will be raised during the Public Hearing will be incorporated into the EISR and will be submitted to EMB-Central Office for review by the EIARC.

11.5 INFORMATION DISCLOSURE

1440. The following information were presented to the public during IEC, FGD and Public Scoping:

- Project Description
- Possible impacts of the proposed NSRP
- Proposed mitigating measures

1441. Prior to Public Scoping, the Project Description and the proof for the conduct of IEC such as attendance sheets, photos, received invitation lettes and list of issues raised by the participants were posted in the EMB Website. The hard copies of the above-mentioned documents were also distributed to the invited participant as attachment of the invitation letters.

1442. The draft Environmental Impact Statement Report (EISR) and the EIS Summary for the Public (ESP) will be posted in the EMB website (www.emb.gov.ph) at least 20 days before the public hearing. After the review process, the final EISR of the proposed NSRP will be distributed to the following:

Metro Manila	**Province of Laguna**
City Government of Manila Manila City Hall Padre Burgos Ave, Ermita, Manila, 1000 Metro Manila Contact No. 527-0907	**City Government of San Pedro** San Pedro City Hall San Pedro City, Laguna Contact No. 808-2020
City Government of Makati Makati City Hall 1339 Angono, Manila, Metro Manila Contact No. 0977 359 5796	**City Government of Sta. Rosa** Sta. Rosa City Hall J.P Rizal BLVD. Brgy. Malusak , City of Santa Rosa Laguna , Philippines 4026 Contact No. (049)530-0015/ (02) 998-4206
City Government of Taguig Taguig City Hall Gen. A Luna St, Taguig, 1637 Metro Manila Contact No. 0921 722 1972	**City Government of Cabuyao** Cabuyao City Hall Barangay Sala, Cabuyao Laguna 4025 Contact No. (049) 502-6760
City Government of Parañaque Parañaque City Hall San Antonio Ave, San Antonio Parañaque, Metro Manila Contact No. 820-7783	**City Government of Calamba** Calamba City Hall New City Hall Complex, Chipeco Ave Ext, Brgy. Real, Calamba, Laguna Contact No. (049) 545 6789
City Government of Muntinlupa Muntinlupa City Hall Manila S Rd, Putatan, Muntinlupa 1772 Metro Manila Contact No. 0946 512 2334	**City Government of San Pedro** San Pedro City Hall San Pedro City, Laguna Contact No. 808-2020
Environmental Management Bureau DENR Compound, Visayas Ave, Diliman, Quezon City, 1116 Metro Manila Contact No: (02)920-2240	**Provincial Government of Laguna** Laguna Provincial Capitol Pedro Guevara Ave, Santa Cruz, Laguna Contact No: (049) 808 1105

12. CONCLUSIONS AND RECOMMENDATIONS

1443. The proposed NSRP will have both positive and negative impacts due to the construction of a 56.5 km railway and other associated components such as stations and depot.

1444. The significant negative environmental impacts of the proposed NSRP are land acquisition of about 24 ha of built-up areas and 78 ha of agricultural land and resettlement of about 10,000 PAPs (this includes residential, business and other structure households); blocking of roads, traffic havoc and road safety; and health, hygiene and sanitation of construction workers and public. The medium impacts of the Project are changes in land use; generation of excess materials; blocking of flood water flows and natural drainage; air, noise and vibration pollution due to construction activities and operation of the Project; and soil erosion.

1445. The significant positive environmental impacts of the Project in terms of environmental enhancements and compensation measures are the, regional development through connection of the southern region with the northern region of the country; development of resettlement sites with all necessary infrastructure facilities; and huge potential for employment during construction and operation stages as well as from induced economic growth and activities and reduced traffic congestion.

1446. An EMP has been formulated to mitigate the negative impacts during various phases (preconstruction, construction and operation) of the Project to acceptable levels. Detailed plans such as resettlement action plan, traffic management plan, SDP and IEC Framework emergency preparedness and response plan are prepared to address key impacts/risks of the Project. Environmental Protection Clauses (EPC) is prepared prior to bidding process to address all general construction related and common environmental impacts and will be included in all construction contracts of the Project. Environmental enhancement plans and compensation measures such as tree plantation/green area development plan are recommended to improve the environmental conditions in the Project area. To ensure that these enhancement and compensation measures are implemented correctly and negative impacts avoided, the EMP along with adequate budget is included in the contract documents of the Project. A successful tool for the EMP is the environmental monitoring during various stages of the Project, which has been provided in the EMoP. The main monitoring parameters include environmental quality monitoring (air, noise, surface water, groundwater), ecological monitoring, wastes, drainage congestion, tree plantation, road accident, health and safety etc.

1447. An environmental enhancement fund is proposed to be established. This fund will be utilized for operation and maintenance of all environmental enhancement facilities proposed in the Project and to fund any additional environmental enhancement project proposals.

1448. The key Institutions responsible for the successful implementation of the EMP and EMoP of the project are DOTr PMO, contractors, Operator, LGUs and MMT. Institutional strengthening and capacity building of DOTr PMO have been proposed for strengthening their capacity in the implementation of EMP and EMoP. The proposed programs are (a) capacity building initiatives involving oriented trainings for the DOTr PMO staff and on the job training for the contractors; (b) third party engagements for independent reviews; and (c) establishment of an Environmental Management System in DOTr PMO.

1449. The total environmental management and monitoring budget for the Project is included in the contract of the contractors. An EMF amounting to P250,000 will be exclusively utilized to cover all costs attendant to the operation of the MMT .

1450. The Project will have overall positive impacts and some negative impacts. Most of these negative impacts are mainly construction related and can be mitigated by the successful implementation of the EMP. There will be some residual impact for significant negative impacts, which will be compensated by environmental enhancement measures recommended in the EMP.

1451. Two public scoping sessions and ten (10) information education and communication were completed and all issues raised that suggested mitigative actions were implemented and integrated into the EMP and EMoP

1452. DOTr concludes that this EIA is complete and addresses all relevant likely impacts and proposes a full set of time-bounded mitigative and monitoring actions, including the assignment of responsibilities. The application of the detailed EMP will ensure that the nature and sociocultural environmental are not unduly affected by the work or the operation of the proposed project.

1453. Finally DOTr will complete a contractor briefing and training session prior to contractor field mobilization, to ensure that the EMP is understood by the contractor and all responsibilities are clear and will be undertaken as defined in the EMP.

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