Environmental Impact Assessment (Draft)

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Philippines: Laguna Lakeshore Road Network Project

Part 1

Prepared by the Department of Public Works and Highways for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS

(as of 15 May 2024)

Currency unit	–	peso/s (₱)
Php1.00	=	$0.018
$1.00	=	₱57.68

ABBREVIATIONS

AAQ	–	Ambient Air Quality
ADB	–	Asian Development Bank
AIP	–	Annual Investment Plan
AQI	–	Air Quality Index
A&D	–	Alienable and Disposable
ASEAN	–	Association of Southeast Asian Nations
BFAR	–	Bureau of Fisheries and Aquatic Resources
BMB	–	Biodiversity Management Bureau
BOD	–	Biological Oxygen Demand
BRGY	–	Barangay
BSWM	–	Bureau of Soils and Water Management
CCA	–	Climate Change Adaptation
CCC	–	Climate Change Commission
CDP	–	Comprehensive Development Plans
CE	–	Critically Endangered Species
CEMMAP	–	Contractor's Environmental Management Plan
CENRO	–	City Environment and Natural Resources Office
CHED	–	Commission on Higher Education
CLUP	–	Comprehensive Land Use Plan
CLUDP	–	Comprehensive Land Use and Development Plan
CMR	–	Compliance Monitoring Report
CMVR	–	Compliance Monitoring and Validation Report
CNC	–	Certificate of Non-Coverage
CNO	–	Certificate of Non-Overlap
CP	–	Contract Package
CPDO	–	City Planning and Development Office
CR	–	Critically Endangered
CS	–	Conservation Status
CSO	–	Civil Society Organizations
DA	–	Department of Agriculture
DAO	–	DENR Administrative Order
dB	–	Decibel
dBA	–	A-weighted decibels
DD / DED	–	Detailed Design/ Detailed Engineering Design
DENR	–	Department of Environment and Natural Resources
CENRO	–	Community Environment and Natural Resources Office
DENR-EMB-CO	–	Department of Environment and Natural Resources Environmental Management Bureau Central Office
DepEd	–	Department of Education
DIA	–	Direct Impact Areas

DILG	–	Department of Interior and Local Government
DO	–	Dissolved Oxygen
DOE	–	Department of Energy
DOH	–	Department of Health
DOLE	–	Department of Labor and Employment
DOST	–	Department of Science and Technology
DOTC	–	Department of Transportation and Communications
DOTr	–	Department of Transportation
DPWH	–	Department of Public Works and Highways
DRAM	–	DPWH ROW Acquisition Manual
DRR	–	Disaster Risk Reduction
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
EGGAR	–	Engineering Geological and Geohazard Report
EF	–	Emission Factor
EGF	–	Environmental Guarantee Fund
EIA	–	Environmental Impact Assessment
EIAMD	–	Environmental Impact Assessment and Management Division
EIARC	–	Environmental Impact Assessment Review Committee
EIS	–	Environmental Impact Statement
EISR	–	Environmental Impact Statement Report
EMB	–	Environmental Management Bureau
EMB-MC	–	Environmental Management Bureau Memorandum Circular
EMF	–	Environmental Monitoring Fund
EMoP	–	Environmental Monitoring Plan
EMP	–	Environmental Management Plan
EN	–	Endangered Species
ENRO	–	Environment and Natural Resources Officer
EO	–	Executive Order
EPA	–	Environmental Protection Agency
EPRMP	–	Environmental Performance Report and Management Plan
EQPL	–	Environmental Quality Performance Level
ERA	–	Environmental Risk Assessment
ERP	–	Emergency Response Plan
ESP	–	EIS Summary for the Public
FBI	–	Field Based Investigation
FGD	–	Focus Group Discussion
FMB	–	Forest Management Bureau
FS	–	Feasibility Study
FV	–	Field Validation
GAP	–	Gender Action Plan
GCM	–	Global Climate Models
GCR	–	Greater Capital Region
GESI	–	Gender Equality and Social Inclusion

GDP	–	Gross Domestic Product
GHG	–	Greenhouse Gas
GIS	–	Geographic Information System
GPS	–	Global Positioning System
GRM	–	Grievance Redress Mechanism
GVA	–	Gross Value Added
GW	–	Ground Water
HSE	–	Health, Safety, and Environment
IBA	–	Important Bird Area
IEC	–	Information and Education Campaign
IEE	–	Initial Environmental Examination
IFC	–	International Finance Corporation
IIA	–	Indirect Impact Areas
IPCC	–	Intergovernmental Panel on Climate Change
IPIF	–	Infrastructure Preparation and Innovation Facility
IRR	–	Implementing Rules and Regulations
ISF	–	Informal Settler Families
ITCZ	–	Intertropical Convergence Zone
IV	–	Importance Value
KBA	–	Key Biodiversity Area
LC	–	Least Concern
LDIP	–	Local Development Investment Program
LGU	–	Local Government Unit
LLDA	–	Laguna Lake Development Authority
LLRN	–	Laguna Lakeshore Road Network
LMO	–	Lake Management Office
LPPCHEA	–	Las Pinas-Paranaque Critical Habitat and Ecotourism Area
LTMO	–	Laguna Traffic Management Office
LTPBM	–	Long Term Performance Based Maintenance
MCX	–	Muntinlupa-Cavite Expressway
MENRO	–	Municipal Environment and Natural Resources Office
MFR	–	Makiling Forest Reservation
MGB	–	Mines and Geosciences Bureau
MH	–	Merchantable Height
MMDA	–	Metro Manila Development Authority
MMFR	–	Mount Makiling Forest Reserves
MMT	–	Multi-Partite Monitoring Team
MPSA	–	Mineral Production Sharing Agreement
MOA	–	Memorandum of Agreement
MRF	–	Materials Recovery Facility
MSL	–	Mean Sea Level
NAAQGV	–	National Ambient Air Quality Guideline Values
NAAQGS	–	National Ambient Air Quality Standards
NAIA	–	Ninoy Aquino International Airport
NAMRIA	–	National Mapping and Resource Information Agency
NAS	–	National Agrometeorological Station
NCCA	–	National Commission for Culture and the Arts
NCCAP	–	National Climate Change Action Plan
NCR	–	National Capital Region

NEDA	–	National Economic Development Authority
NFSCC	–	National Framework Strategy on Climate Change
NGA	–	National Government Agency
NGCP	–	National Gris Corporation of the Philippines
NGO	–	Non-Government Organization
NHA	–	National Housing Authority
NHCP	–	National Historical Commission of the Philippines
NHCS	–	Napindan Hydraulic Control System
NHS	–	National Health Service
NIPAS	–	National Integrated Protected Areas System
NLEX	–	North Luzon Expressway
NPCC	–	National Pollution Control Commission
NRS	–	National Road System
NTP	–	Notice to Proceed
OCC	–	Operation Control Center
OCD	–	Office of Civil Defense
ODA	–	Overseas Development Assistance
OGAC	–	Open-graded asphaltic concrete
O&G	–	Oil and Grease
OSHA	–	Occupational Safety and Health Association
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
PAWB	–	Protected Areas and Wildlife Bureau
PCCP	–	Portland Cement Concrete Pavement
PCG	–	Philippine Coast Guard
PCO	–	Pollution Control Officer
PD	–	Presidential Decree
PDR	–	Project Description Report
PEISS	–	Philippine EIS System
PEM	–	Philippine Earthquake Model
PEMAPS	–	Project Environmental Monitoring and Audit Prioritization Scheme
PENRO	–	Provincial Environment and Natural Resources Office
PEPRMP	–	Programmatic Environmental Performance Report and Management Plan
PHIVOLCS	–	Philippine Institute of Volcanology and Seismology
PMO	–	Project Management Office
PNP	–	Philippine National Police
PNR	–	Philippines National Railways
PNSDW	–	Philippine National Standard for Drinking Water
PO	–	People Organizations
PPE	–	Personal Protective Equipment
PRA	–	Philippine Reclamation Authority
PRECIS	–	Providing Regional Climates for Impact Studies

PSA	–	Philippines Statistics Authority
PSALM	–	Power Sector Assets and Liabilities Management
PSCCA	–	Philippine Strategy on Climate Change Adaptation
PSHA	–	Probabilistic Seismic Hazard Analysis
PWD	–	Persons with Disability
RA	–	Republic Act
RAP	–	Resettlement Action Plan
RCMs	–	Regional Climate Models
ROW	–	Right-of-Way
ROWARAP	–	Right-of-way Acquisition and Resettlement Action Plan
SAFDZ	–	Strategic Agriculture and Fisheries Development Zone
SCM	–	Stakeholders Consultation Meeting
SCTEX	–	Subic-Clark-Tarlac Expressway
SDP	–	Social Development Plan
SDMP	–	Spatial Development Master Plan
SLEX	–	South Luzon Expressway
SMR	–	Self-Monitoring Reports
STP	–	Sewage Treatment Plant
STPP	–	Sucat Thermal Power Plant
SPS	–	Safeguard Policy Statement
TD	–	Tropical Depression
TDS	–	Total Dissolved Solids
TESDA	–	Technical Education and Skills Development Authority
TH	–	Total Height
TIA	–	Traffic Impact Assessment
TNVIA	–	Transit Noise and Vibration Impact Assessment
TOR	–	Terms of Reference
TS	–	Tropical Storm
TSP	–	Total Suspended Particles
TSS	–	Total Suspended Solids
UNDP	–	United Nations Development Program
UNESCO	–	United Nations Educational, Scientific and Cultural Organization
USAID	–	United States Agency for International Development
USD	–	United States Dollar
VOCs	–	Vehicle Operating Costs
VU	–	Vulnerable Species
USEPA	–	United States Environmental Protection Agency
VFS	–	Valley Fault System
WHO	–	World Health Organization
WEF	–	World Economic Forum
WQG	–	Water Quality Guidelines
WSDI	–	Warm Spell Duration Index

NOTE

In this report, "$" refers to United States dollars.

EXECUTIVE SUMMARY

1.1 Project Overview

1. The Government of the Philippines (the Government) has been granted a loan by the Asian Development Bank (ADB), from which the Government will get support to meet its accelerated infrastructure development objectives. The loan — the Infrastructure Preparation and Innovation Facility (IPIF) — was approved in 2017. Additional financing was further granted in 2019. The IPIF is designed to achieve four outputs; the designs for each are designed per sub-sector. Under Output 1, where road and bridge projects are conceptualized – support is given to the Government in the preparation of design which includes, but is not limited to, detailed engineering design and the corresponding bid documents for flagship road and bridge projects. Among the many projects to be financed, the Laguna Lakeshore Road Network (LLRN) Project has been included as one of those to be prioritized. The Feasibility Study for it has been completed under the IPIF in 2020.

1.2 Project Need

2. The LLRN Project is designed to establish a permanent and vital linkage between the highly progressive but densely populated cities along both the western and eastern coastlines of Laguna Lake. The LLRN Project is structured into two distinct phases: Phase I and Phase II. Phase I of the Project will be constructed along the western side of Laguna Lake and Phase II of the Project will traverse the eastern side of Laguna Lake. Both phases are strategically designed to impact the broader regional boundaries, benefiting not only Metro Manila but also the Cavite-Laguna-Batangas-Rizal-Quezon (CALABARZON) region.

3. Upon the successful completion of Phase I, the LLRN Project will encompass a comprehensive network of viaducts, shoreline viaducts, and embankments, totaling approximately 37.5 kilometers (km) in length. This network will feature seven interchanges, enhancing accessibility and connectivity in key areas. These interchanges will be situated in Lower Bicutan (Taguig City); Sucat, Alabang, and Tunasan (Muntinlupa City); San Pedro City/Biñan City, Cabuyao City, and Calamba City (Laguna Province).

4. The LLRN Project – Phase I project is anticipated to address transportation challenges currently faced by the Manila South Road (MSR) and South Luzon Expressway (SLEX) highways. It is expected to play a key role in promoting economic development within the region by providing a safer, quicker, and more convenient travel option for motorists traveling between the northern and southern regions. Additionally, it will facilitate access to various tourist and business destinations, promoting overall regional growth and development.

5. The current transportation situation along the road networks connecting Manila to various localities leading up to the municipality of Los Baños, Laguna is characterized by significant congestion. This congestion leads to extended travel times for commuters, residents, and tourists alike. It also has a tangible impact on local businesses and the tourism industry in the wider Laguna, Rizal, Quezon, and Batangas provinces. One of the primary drivers of this congestion is the rapid population growth in the Philippines' capital city and its most densely populated region. This growth is pushing development further away from the urban core. As urban sprawl continues, the distance between places of employment and residential areas increases. Concurrently, the city continues to expand.

6. In this context, the role of transportation infrastructure becomes increasingly crucial. A key challenge posed by urban sprawl is ensuring that access to employment opportunities keeps pace with population growth. To mitigate the effects of this phenomenon, it is imperative to enhance the transport capacity in the region. The construction of the LLRN Project represents a strategic solution to alleviate the pressure on the existing road networks in the region. This new road network will play a vital role in mitigating traffic congestion and enhancing the overall performance of the transportation system. By establishing a direct and

efficient route between Manila and Laguna, the LLRN will lead to a reduction in traffic congestion and result in significant improvements in travel times for motorists.

7. The proposed scheme includes the construction of a 12.0 km viaduct and a 25.5km combination of shoreline viaduct and embankment. Additionally, it will connect local roads spanning approximately 5.4 km to the main alignment. Upon the successful implementation of the LLRN Project, travelers across all vehicle modes can expect substantial time savings, both for those traveling from Laguna in 2025 and for those commuting from Manila in 2035.

1.3 Project Description

8. The LLRN Project Phase I has a total mainline length of 37.5 km. The mainline and slip roads are classified as national primary road in accordance with the DPWH Design Guidelines, Criteria, and Standards (DGCS). It contains seven interchanges (IC), each in the areas of Lower Bicutan in Taguig; Sucat, Alabang, and Tunasan in Muntinlupa City; and San Pedro/Biñan, Cabuyao, and Calamba in Laguna Province. The first 12.0 km of the alignment is mostly straight and traverses about 500 m offshore between Lower Bicutan and Tunasan, while the succeeding 25.5 km runs along the onshore between Tunasan and Calamba composed of consecutive curves. The viaduct and embankment sections of the LLRN mainline divided per contract package is presented below:

Table 1. LLRN Contract Package

Contract Package		Embankment Length (km)	Viaduct/Bridge Length (km)
1	Lower Bicutan to Alabang	1.1	6.8
2	Alabang to San Pedro/Biñan	1.7	5.9
3	San Pedro/Biñan to Cabuyao	7.5	4.7
4	Cabuyao to Calamba	6.2	3.5
	Subtotal	**16.5**	**21.0**
	Total	**37.5 km**	

9. A typical road section of the mainline highway on embankment consists of a median, vehicular lanes, and shoulders. The LLRN main highway will have two lanes in each direction (dual 2-lane) except between Sucat and Sta. Rosa, with three lanes in each direction (dual 3-lane). The opposing lanes are separated by a median (New Jersey Type Barrier) which is 2.1m wide. The median width is inclusive of 0.6m marginal strips at each side of the barrier. The road is provided with a 3.35m wide vehicular lane and a shoulder 2.5m wide. The shoulder is provided with margins of 0.50m at each side. Guard rails are provided at the edge of the shoulder margins. The vehicular lanes are provided with a crossfall of 2.0% and the shoulder with 3.0% for embankment sections and 2.0% for viaduct sections. The embankment slopes will be in a ratio of 1V:2H and will be provided with structures for protection.

The Project Estimated Cost for all four contract packages stands at **PHP 181,024.61 Million**.

1.4 Baseline Condition of the Laguna Lakeshore Road Network (LLRN) Project

10. The project is classified based on ADB's Safeguard Policy Statement (2009) as Category A and likely have significant adverse environmental impacts that are irreversible, diverse or unprecedented. This is in consistent with EMB-DENR's project screening as per EMB Memorandum Circular 2014-005, Revised Guidelines for Coverage Screening and Standardized Requirements under Philippine EIS System. The project falls under Category A, Environmental Critical Project in Non-Environmental Critical Area (Non-ECA).

11. An ECC has been secured by the DPWH for the Project on 19 May 2022. Extensive studies and consultations have been conducted to include consultations with local government units (LGUs), socioeconomic and perception surveys, and public consultations as part of the environmental impact assessment (EIA). Extensive information and education communications (IEC) is currently being implemented. The environmental assessment for this project involved a thorough baseline sampling effort across various environmental components. This included air quality, surface water quality, groundwater, and sediment sampling. Additionally, ecological surveys, both terrestrial and aquatic, were conducted by experts to comprehensively understand the existing ecological conditions in the project area.

1.5 Physical Environment

1.5.1 Topography

12. The LLNR Project - Phase I is situated along the western coastline of Laguna Lake. This lake boasts an expansive area of approximately 911 km^2 and features a shoreline that spans 220 km (LLDA 1995 Laguna de Bay Masterplan). Laguna de Bay is geologically significant as it represents the largest volcano-tectonic depression in South Luzon, shaped by a combination of caldera eruptions and extension tectonics, as noted in a report by the Mines and Geosciences Bureau (MGB) in 2010.

13. The Taal-Makiling-Banahaw Volcanic Chain and the Sierra Madre Mountain range are the prominent geomorphological features near Laguna Lake. The Taal-Makiling-Banahaw corresponds to a west to east line of a group of volcanoes on the Macolod Volcanic Complex. The confines of the corridor can be traced from the easternmost coastline of Laguna de Bay in the north and from Batangas Bay to Mt Banahaw in the south (Förster, 1990). It serves as the western and southern boundary of Laguna de Bay. Other members of the Macolod Volcanic Complex are Mt. Macolod (Makulot), Mt. Malepunyo, and Laguna de Bay. The Sierra Madre range corresponds to an approximately 500km 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.

1.5.2 Geology

14. The geologic formations within the project alignment were identified using the available geologic maps from Mines and Geosciences Bureau. Three distinct geologic formations were identified namely Recent Alluvial Deposits, sedimentary rocks and pyroclastics and volcanic debris. From a viewpoint of tectonics, the Philippine Fault is a left-lateral strike-slip fault composed of different segments, about 1,250 km in total length, which is an active seismic source capable of producing earthquakes with magnitude greater than seven (7). The Infanta Segment is the segment of the Philippine Fault that is nearest the proposed road network. The active faults near the site are the West Valley Fault segment of the Marikina Valley Fault System which is very near at the west side of the proposed road network. The Infanta Segment of the Philippine Fault Zone is on the east side of the proposed road network.

15. The vicinity of the project may be susceptible to various natural hazards as with most of the Philippines, the project is also susceptible to seismic and volcanic hazards. Also, the project site is in an area affected by at least 2 to 3 typhoons annually.

1.5.3 Climate

16. The climate map of the country is based on the Modified Coronas classification. The road alignment, and other components of the LLRN project falls under Type I climate classification. Type I Climate is characterized by two 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 seasons and receive a fair share of rainfall as brought about by the tropical cyclones occurring during the maximum rainy period. The month of July is the wettest, with a monthly average rainfall of 329.6 mm. The month of February, on the other hand is the driest, with a mean monthly rainfall of 16.0 mm. The average annual rainfall recorded based on 30 years of data is 1767 mm.

1.5.4 Water Quality

17. Baseline survey assessed the water quality of Laguna Lake collected in San Pedro and Cabuyao, Laguna, and twenty (20) surface water stations. Results were compared to DENR Administrative Order No. 2016-08 and Administrative Order No. 2021-19, Class C. Limits and International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines (IFC), 30 April 2007. The test results showed majority of the survey sites did not conform to the guideline values for dissolved oxygen and BOD. The pH of the Laguna Lake water is neutral while nutrient content such as ammonia and phosphate did not conform to the DENR guideline standards at 0.06 and 0.025 mg/L, respectively. For fecal coliform bacteria, all stations failed to conform to the standard at 200 MPN/100ml.

1.5.5 Flooding

18. Based on the simulation results for the Laguna Lakeshore Road Network (LLRN) Phase 1 project, flooding conditions are primarily influenced by the rise in water level from the lake during extreme events. This rise in water level from the lake is typically more significant than the flooding caused by overland flow discharge from inland areas. For the 25-yr, 50-yr and 100-yr return period, respectively, the total increase in inundated area with the LLRN project is 2.06% under 25-yr return period, 2.05% for 50-yr return period, and 2.23% for 100-yr return period. These translates to an increase in flooded area by 19.13, 23.57, and 30.4 hectares for flood return periods of 25, 50, and 100 years. The values are all less than 5% which is considered minimal impact to the neighborhood.

1.5.6 Air Quality

19. Baseline air survey collected at least thirty-two (32) sampling sites at strategic locations of the proposed project. Total Suspended Particulates (TSP), particulate matter 10 and 2.5 microns (PM10 and PM2.5), nitrogen dioxide and sulfur dioxide were assessed. Results were compared to DENR and IFC EHS Guidelines. Results of dust and gaseous emissions were within the DENR standards. However, for $PM_{2.5}$ a number of stations exceeded IFC EHS Guidelines. All gaseous emissions were within the IFC requirement.

1.5.7 Noise Level

20. Noise monitoring has been conducted in thirty (30) background monitoring locations from 22 September to 30 November 2020. The common contributors of noise in these monitoring stations are vehicles and construction equipment. The 24-hour noise monitoring at 5 locations had median values that exceeded the NPCC standards for all time zones. Only 1 station had values below NPCC standards for all time stations, while all other locations exceeded standards for most of the time periods. To evaluate the results, the noise level guidelines are compared to the World Bank Group's WB Environment, Health and Safety (EHS) Guidelines of 2007 and the most of the results exceeded those standards.

21. During the LLRN Feasibility Study stage, the ambient noise for various points are measured. For LLRN DED stage, the measured values +3db are applied as the noise criteria following IFC standard. These standards are applied during construction and operation for all

project-affected areas. As the background noise measurement levels at all 30 stations are higher than the noise criteria of IFC for both daytime and night-time the project adopted the +3dB(A) from measured baseline.

22. The noise model ASJ RTN-Model 2008 using the typical cross-sections of LLRN are applied to calculate the noise level in the year of 2040, 2035, 2030, and 2025 during operational phase with projected traffic. Noise during the construction phase will mostly come from the operation of construction equipment and vehicle transport. Based on the construction plan for geotextile tube, soil Improvement, embankment, and pavement, the type and number of heavy machineries in operation for each CP and construction period was determined, and calculated the noise level if the construction machinery used in the same location would operate at the same time during the same period. The results show that the level exceed the noise standard for residential area as well as that for construction area stipulated in Philippines. Without sound barriers, it takes about 100m from the source to the area with noise level less than 75 dB, and therefore, the usage of sound barrier during the construction phase is essential especially in the area close to the sensitive receptors.

1.5.8 Ecological Environment

23. There are no declared protected area, national parks, watershed reserves nor wildlife preserves and sanctuaries within and in the vicinity of the project site. The nearest protected areas include Mount Makiling Forest Reserves (MMFR) located at Los Baños Laguna under 1910 Proclamation 106, which is approximately the 2.0 km south of the LLRN alignmentand the Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA), which is approximately 9 km from the alignment, under Presidential Proclamation 1412 issued on 22 April 2017.

24. The project is situated in Critical Habitat. The Project triggers Critical Habitat under IFC PS6 Criterion 1(a) Endangered Species, Criterion 1(b) Vulnerable Species and Criterion 2 Restricted Range:

- A fish species (*Neostethus ctenophorus)* under IFC PS6 Criterion 1(a) and Criterion 2
- A fish species (*Cephalocassis manillensis)* under IFC PS6 Criterion 1(a) and Criterion 2
- Silver Therapon (*Leiopotherapon plumbeus)* under IFC PS6 Criterion 1(b)
- A crab species (*Sundathelphusa subquadratus)* under IFC PS6 Criterion 2
- A damselfly species (*Paracercion pendulumunder)* under IFC PS6 Criterion 2

25. Most of the terrestrial land near the alignment is built up and modified, and most of the aquatic habitat is covered with water lilies (water hyacinths). There are no mangroves in the project site. The area is within the shoreline of freshwater Laguna Lake. The proposed project will require land to be cleared in all CPs, resulting in habitat loss. No threatened species are likely to be affected indirectly but the vegetation clearance must be planned and carefully managed as much vegetation as possible and avoid unnecessary loss. The habitat clearance will indirectly displace and disturb species present in the area. Species maybe killed, particularly birds during the nesting season. Associated risks include the increase of noise, movement, light and vibration near retained habitat and species. Such impacts will be temporary for the duration of the construction period but may displace species.

26. Pollution associated with site preparation and the construction phases has the potential to cause lasting damage to the retained vegetation and associated species. The main risks include oil, fuel, lubricants and solvents entering round water and the lake, dust deposition

and the combustion of fossil fuels. Further, the management and movement of soil and aggregate could introduce and spread invasive and non-native species.

27. The EMP includes measures to avoid, control and reduce these risks. Details related to the compensatory planting of habitats will be developed and documented in a Terrestrial Habitat Planting Plan.

28. There is a risk of pollution and disturbance from noise, light and movement during the operational phase of the project. As the terrestrial habitats are highly modified it is likely that the species present will habitualise to the change but the detailed design of the slip roads, traffic management and pollution controls must control these risks.

29. The lake is degraded and subject to continued pressure from water extraction, fishing, runoff, pollutants but it is still Critical Habitat and supports an important albeit degraded ecosystem.

30. Construction of the viaduct and embankment will result in permanent loss of lake habitat (sediment, water column, water surface, vegetation), as well as temporary loss of further areas of lake habitat that are required for construction only. The construction will also alter the flow of water near the outflow at Pasig river, which could result in changes in the draw down of water during and result in the exposure of sediments. This will indirectly affect some of the retained habitat, particularly areas that are likely to have different ecological characteristics to the majority of the waterbody e.g. the marginal habitats.

31. The removal and release of 7.795 millionm3 of sand, as per the Waste Mangement plan, will further adversely affect a large area of habitat beyond the immediately footprint of the viaducts, embankment and slip roads. Without careful pre-planning, including the surveying of the proposed receptor site(s) significant habitat could be lost.

32. The surface of the lake in the vicinity of the project is dominated by water hyacinth, an invasive species that spreads quickly. Section 6.4.6 Waste Management provides an estimate of off-site disposal of 76ha of water lily (assumed to be water hyacinth). This could be regarded as localized and short-term benefit, but it will not be sustained given rapid recolonization rate for the species and nor is it meaningful in the context of construction related disturbance and habitat loss. In addition, clearance and disposal of water hyacinth is likely to remove or reduce the extent of any remaining native aquatic plant communities.

33. Construction within the lake will inevitably kill the benthic macroinvertebrates, as well as any other species with limited capacity for dispersal in the project area. Loss of lake margin habitat along a significant proportion of the western shore could include removal of shallow water and seasonally exposed mud of potential value to aggregations of wetland birds, as well as other species that are adapted to utilize such habitats.

34. The Los Baños Laguna and the Las Pinas-Paranaque Critical Habitat and Ecotourism Area (LPPCHEA), a nationally important protected site for birds to the west in Manila Bay. It will not be directly affected but the mouth of the Pasig River is approximately 6km north of the protected area and indirectly connects the lake with the LPPCHEA. There is no available evidence to explain or justify if the fresh water from Laguna Lake contributes to the LPPCHEA and its important bird assemblages. It is not infeasible that the flow of water during the wet season or the flow of water plus the nutrients and deposits within the water contribute to the health and diversity of the mudflats within the LPPCHEA.

35. Pollution and siltation from various sources associated with site preparation and construction have the potential to have significant and long-lasting impact on the lake's habitats and species. They will exacerbate existing pressures on the lake ecosystem and increase the challenges faced in current and future actions for ecosystem restoration. They include pollution and siltation associated with land-based operations during site preparation and construction.

36. Construction of the embankment along a c.17km length of the western lake shore has the potential to isolate aquatic habitat by separating the area landward of the embankment from the wider lake ecosystem. There are gaps in the embankment that will provide connectivity between the two areas, but it is not known if normal exchange of sediment and water will continue. It is possible that the landward area will be subject to more rapid sedimentation, reduced water quality from the build-up of pollutants and organic material and changes in temperature range. Corresponding changes in plant and animal communities would be expected.

37. Pile driving may be required for the construction of piers and foundations that results in vibration of the pile in water and in the substrate, thereby generating sounds that potentially affect nearby animals. Increased levels of sound, particularly that from anthropogenic sources can affect fish in a variety of ways, at the extreme resulting in death or physical injury and physiological changes. Therefore, fish are at risk of being excluded from suitable habitat during parts of the construction period and the magnitude of the associated impact on them depends on the severity and duration of the effect, and the distribution of affected species and optimal habitat.

38. Further baseline surveys are required to better understand the extent and condition of the habitats present in and around the project area and the species they support. The detailed and multi-year surveys will inform the mitigation requirements and act as the baseline for long-term monitoring. The key biodiversity receptors, including zooplankton, phytoplankton, invertebrate assemblages, plants, fish and birds must be surveyed consistently during construction and for at least five years after construction.

39. New habitat will be created to compensate for and enhance the habitat that was lost or degraded. Wetland habitat is required on the lake landward of the embankment that, subject to confirmation through hydrological studies, to address the potential for ecosystem change from changes in water flow and quality and sedimentation in this area. Creation of habitat on the lake-facing side of the embankment and at intervals along the length of the viaduct, is required to help control future contaminants entering the lake and to provide native wetland vegetation to benefit wildlife. This could involve the use of the dredged material from within the construction footprint. Details will be developed and documented in a Freshwater Habitat Planting Plan.

40. A Biodiversity Action Plan has been developed to help achieve a net improvement in biodiversity for the lake. The actions include:

- The development and expansion of Green Filters around the lake. Green Filters are engineered and planted wetland habitats that trap, filter and clean effluent and contaminants to improve water quality and indirectly benefit biodiversity
- The expansion of biodiversity education and capacity building within the local communities around the lake, particularly the young
- Research into the potential to use water hycerith as a green source of fuel in the area and thus remove the invasive species, create a sustainable energy from waste project and create local jobs
- Write the framework for a Biodiversity Management Plan for lake.

41. It must be noted that the scope of the BAP will benefit biodiversity but will not offset the loss or degradation of habitats and species or provide confidence as to how best the project can simultaneously provide new habitats for wildlife and help reduce future contaminants entering the lake. Separate feasibility, assessment and offset assessments will be completed to inform the Freshwater Habitat Planting Plan.

1.6 Socio-economic Environment

1.6.1 Public Consultation Process

42. Stakeholder engagement started during the feasibility study preparation stage and is currently on-going at the time of report writing. Initial stakeholder identification and IEC meetings were completed as part of the government requirements on environmental scoping. Despite the COVID-19 pandemic that limited stakeholder engagement during the F/S stage, the project was able to adhere to meaningful consultations principle and PEISS through sectoral focus group discussions (FGDs) online channels such as video-conferencing and webinars. Official public scoping meetings were held on 10-11 November, 26 November 2020, and January 13, 2021. The DENR-EMB Central Office led another round of discussion in 17 June 2021. These scoping meetings were attended by representatives of local government units (LGUs), national government agencies (NGAs), fisherfolk organizations, and stakeholders in the corridor of the impact that will be affected by the project implementation, particularly the disadvantaged or vulnerable groups, the elderly, solo-parent, women and persons with disabilities (PWD).

1.7 Potential Major Impacts and Mitigation Measures

Table 3. Key Major Impacts and Mitigation Measures

Environmental Aspect	Potential Impact	Mitigation Measure/s
Pre-Construction/Construction Phase		
Fragmentation and habitat loss to fauna -Threat to abundance, frequency and distribution of species; abundance of ecologically and economically important species	Clearing areas intended for the project right of way which may include access roads, slip roads, temporary depot sites, and temporary basins, among others will require vegetation removal to give way for the development of the road project. In this connection, it is necessary to delineate areas that need to be remained vegetated as natural support and buffer systems, especially along the ROW, project boundaries, and or designated areas by DENR. Maintaining such vegetation cover may help sustain the stability of the soil and water recharge, and serve as a natural carbon sink, natural windbreak, gene pool, abode to remaining fauna species, and others.	-Land clearing should be confined to designated sites only. Vegetation to be cleared should be delineated to avoid unnecessary clearing. A 100% tree inventory should be conducted before tree cutting/earth balling is implemented, within the proposed development. By identifying the number of affected trees, it is easier to determine the number of seedlings for replacement, especially of similar species to be cut. Replacement and replanting should be conducted next to the project area or as per the advice of DENR. -Affected species along the alignment of the proposed road network could temporarily relocate in nearby, less affected parts of the Laguna Lake. Therefore, actual loss of any species is very unlikely. -Designate areas for vegetation enhancement as a natural buffer zone and fauna habitat to be maintained and protected in response to climate change mitigation and promotion of climate resiliency of the project. It is

Environmental Aspect	Potential Impact	Mitigation Measure/s
		important to get the support of LGU/DENR in the selection of appropriate rehabilitation areas. - During construction, it is necessary that the contractor shall prohibit its workers to engage in any mode of wildlife collection and/or hunting. It is also necessary for the contractor to participate in the conservation and protection of remaining wildlife species. Installation of warning signage in strategic areas for public information and warning is among the strategies.
Soil	-Significant change and alteration of the surface landform is expected during construction involving, cut & fill works (removal of topsoil, and scraping and grading of the ground), and slope modification to the ideal slope gradient. -soil disturbance due to transport of dredge materials to basins/disposal area -soil contamination caused by leaks and accidental spills of fuels and lubricants from construction vehicles, machineries and other construction equipment	-Identify a site for the disposal of demolition wastes away from sensitive receptors; -Provide barriers / security measures on temporary storage areas of demolition wastes to prevent scavenging activities which may compromise the safety of scavengers - land clearing shall be restricted to only what is necessary, - excavation on erodible soil surfaces be conducted during the dry season - excavated soil be collected and preserved for future reuse - soil erosion control be properly implemented - enhancing vegetation cover in appropriate areas to hold soil and minimize further erosion.
Water Quality	-Possibility of Water Quality Degradation by Temporal and Permanent Structures During the construction works of the project, water quality of receiving streams especially of Laguna Lake will be affected such as increase in TSS and TDS, color and turbidity. Hence, physical properties, such as pH, temperature and DO will also show alterations if significant contamination is present in the waters. This is primarily due to the disturbances during soil excavation activities.	-To prevent or minimize the water quality degradation by dredging and disposing used soils for temporally structures, the following methods is proposed to be implemented. First, soft soil of the surface later of the certain target area is cut out and bring on the top of neighboring site and then the layer will be filled in the area after dredging the sand of the target area. The same will be applied one after another to minimize the effects of dredging by preventing unnecessary stirring the surface layer which might contain pollutants while no heavy metals or any contaminants was detected

Environmental Aspect	Potential Impact	Mitigation Measure/s
	-Siltation, erosion and resuspension of particles in the water resulting from the construction works would negatively affect the water quality particularly in terms of increase in turbidity and TSS. This may aggravate during project land clearing, dredging, including the construction of temporary facilities, the embankment, and viaducts. Particles displaced from land may also lead towards sources of water via surface runoff and/ or excavation dewatering. -Spillages onsite if left unmanaged will also find its way in water streams, leading to possible increase in presence of heavy metal as well as excessive oil and grease and other particulate materials. In addition, increase in organic contaminants such as BOD, ammonia, phosphorus will be observed if domestic wastes from construction site is left unaccounted	from the samples in possible dredging sites. -Apply appropriate siltation control measures within the buffer of construction areas to prevent any pollution and silt disturbance due to construction activities near the lake; -The project shall be equipped with oil-water separator to remove oil from effluents prior to discharge to the water bodies; -Waste oils, oily water and other hazardous wastes will be collected and disposed offsite by an accredited third-party waste hauler and treater -The lake water trapped inside piles/ casing / cofferdam will be pumped out to sedimentation tank or settling devices before discharge to reduce the water quality impacts to the lake; - A closed sewage treatment system including soak pits and septic tank will be constructed to treat the effluent from the construction/labor camps -oil and grease traps, oil interceptors or equivalent and fuel platforms to be provided at maintenance, motorpool, refueling, washdown locations -Stockpiles should be distant from the waterways and covered in order to avoid contamination caused by rain washing the solids into the water body and increasing sedimentation
Flooding and climate change	An increase of about 19-30 hectares of land will flooded due to the embankment road.	Conduct of more robust hydrodynamic modeling to supplement the MIKE 2D overland flow with the intention of updating the drainage design to ensure no additional flooding will result from the project construction and operation. The assessment will include sea level rise in Manila Bay, 20% increase in annual maximum rainfall, and operation of the Paranaque Spillway.
Disposal of dredged materials	An estimated 7.795MCM of dredge materials will be generated to allow vessel navigation in the transportation of	Installation/implementation of silt control scheme that will include expansive silt screen

Environmental Aspect	Potential Impact	Mitigation Measure/s
	construction materials to the project site. Siltation, erosion, and resuspension of particles in the water resulting to water quality degradation. Significant habitat disturbance. The physical disturbance caused by dredging, including the movement of sediments and the operation of heavy machinery, can lead to the displacement of aquatic species. Disposal may destroy or modify benthic communities of the lake ecosystem in the areas affected by deposition of dredged material.	Site assessment of the receptor location or locations for this sand, to ensure no adverse impacts like habitat loss particularly if the area(s) comprises is comparatively healthy benthic communities.
Air Quality	-Construction of temporary facilities (construction camps, casting yard, laydown/storage areas, batching plants), hauling and transport of vehicles may result to short term air quality deterioration. At the construction yard, the dust levels are also expected to increase due to unloading of construction materials. It shall be ensured that most of the excavated material will be used within the project. -Large scale earthworks, transporting, dumping large quantities of dredge materials, demolition works etc. will generate and increase dust emissions in and around the construction zones. -Potential sources of particulate matter emission during pre and construction activities include earthworks (dirt or debris pushing and grading), exposed surfaces, exposed storage piles, truck dumping, hauling, vehicle movement on unpaved roads, combustion of liquid fuel in equipment and vehicles, land excavation, and concrete mixing and batching.	-Regular water sprinkling or spraying activity shall be done every three hours and at a higher frequency, if necessary, at all construction sites to minimize dust emissions. Good construction practices (such as keeping stock piles downwind and away from communities) shall be maintained. - Fuel-efficient and well-maintained haulage trucks/vehicles shall be employed to minimize exhaust gas emissions; periodic maintenance of all construction vehicles, machinery, generators, compressors and vehicles used during construction works -Transport, loading and unloading of loose and fill materials through covered vehicles with tarpaulin; -Provision of washing area for construction vehicles to remove mud and dirt from tires; wash down of construction vehicles before leaving the site

Environmental Aspect	Potential Impact	Mitigation Measure/s
Noise	The potential sources of noise during the preparation, construction, and worksite closure phases include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise. The construction works will use high volume of trucks, generators, excavators which may generate noise. The movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during the construction stage. However, these increased noise levels will prevail only for a short duration during the construction phase.	· Scheduling and limiting loud activities during construction and maintenance of the road at nearby settlements. Work that requires use of noisy machine/ equipment shall be at maximum of 2 hours per day (for 8-hour work, duty cycle should be 1:4); · Minimize schedule/activity during nighttime. Preferably during morning & day time only · Schedule the use of the roadway or alternative routes if the time is too late in the evening or outside the construction work hours to be agreed upon by the proponent, LGU, and contractor · Use of modern machines with acoustic designed technology that will generate low noise levels · A temporary noise barrier is also recommended to deflect and minimize noise impact to adjoining areas, when necessary.
Vibration	Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, should be controlled through choice of equipment, installation of vibration dampening pads or devices, and limiting the duration of exposure. Limits for vibration and action values. Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers	Other sources of vibration at construction site are rollers, compactors or any loose part of machinery exposure which may cause serious injury or workplace sickness. No equipment and machinery with loose or vibratory parts will be allowed to work. Such issues will be fixed through maintenance of the machinery on periodic basis. Use of rollers for land grading will be carried out during day times and with intermittent intervals to reduce the impacts of vibration on surrounding environment.
People · Land Acquisition and Resettlement Along the alignment	-Displacement of settlers, -Relocation of Project Affected Persons (PAPs) -Change/Conflict of land ownership (legal PAFs) -Agricultural lands in some identified areas that will be traversed by the mainline will potentially be affected.	-Preparation of DED Resettlement Plan (RP). The RP will be based on the final detailed design of the project to avoid involuntary resettlement; -Implementation of the approved RP of the Project in accordance with the applicable government process and directives; -Due payment to all land owners must be paid before mobilization of construction contractors; Compensation at replacement cost will be provided to all PAPs losing land/or assets due to land acquisition and ROW clearing of the project;

Environmental Aspect	Potential Impact	Mitigation Measure/s
		compensation will be accompanied with assistances as outlined in RP report.
· Disturbance of properties and loss of livelihood of PAPs		-Compensation Package, livelihood program and restoration for PAPs -Prepare and implement livelihood and income restoration for PAFs whose present means of livelihood is temporary, or permanent loss -Prepare and implement Social Development Program (SDP) including livelihood training for fisherfolks, business owners, vendors, agricultural landowners etc. affected by the project
Traffic	-Traffic congestion in barangay and main roads; - Increase in traffic due increase in vehicles; movement of trucks, vehicles to and from the project site especially in narrow roads; -Near-missed and road accidents -blocking of existing access roads	-Strategic traffic Management Plan based on results of Traffic Impace Assessment and Road safety shall be developed with LGUs; it shall be prepared in consultation with concerned traffic agencies, LGUs, local officials and general public.It shall include identification of traffic diversion, management, traffic schedules, traffic arrangements showing all detours, necessary barricades, warning/advisory signs and road signs. -Hire traffic aide/enforcer to ensure traffic management is implemented; -additional road safety signages especially in residential, school areas and other vulnerable areas; set and enforce speed limit along barangay roads -regular meeting, evaluation of actual traffic problems, revisit measures and possible doable solutions to ease the problem. -Provision of diversion route with appropriate health and safety measures; -In case of complete blockage of access due to project activities, without any alternate access to a business, compensation for lost income for the period of disrupted access will be provided -Assignment of traffic aide to provide assistance to the road users
Local Employment	Job opportunity to skilled and non-skilled workers within the project sites;	-Contractor should prioritize and hire local skilled and unskilled laborers within the cities affected

Environmental Aspect	Potential Impact	Mitigation Measure/s
	-hiring of local workers should be a priority	-Close coordination with host LGUs regarding hiring of temporary workers; -Provide skills training to PAFs under livelihood and income generation program based on RP
Gender (Vulnerable groups, women)	-Displacement of families/ individuals may disproportionately affect the women & vulnerable groups because of the greater responsibility that they have in looking after the needs and ensuring the welfare of household members. They may also have greater difficulty in coping with the disruption caused by the displacement compared to their male counterparts. -Construction activities are expected to cause disturbance to surrounding communities.	-Prepare and implement Gender Equality and Social Inclusion (GESI) Plan to ensure that gender equality and needs of vulnerable groups are addressed including gender sensitive livelihood and skills training program -Employ workers in consideration to gender equality.
Operation Phase		
Road Usage and Transport	-Increased fossil fuel emissions from the vehicles that utilize the highway -Frequent passge of transportation vehicles -increase probability of road accidents due to increased traffic and higher speed limit on the bridge/viaduct	Safety briefings, giving importance to personal and environmental implications. Ensure the proper use of personal protective equipment (PPE) based on Occupational Safety and Health Association (OSHA) guidelines -plant trees in between project site and local communities to reduce their exposure to these emissions as the vegetation act as a buffer -proper and efficient use of fuel powered equipment for air pollution reduction Road-safety signages should be installed and visible especially in areas where are there sensitive receptors (e.g., no blowing of horn signs) -secure CCTVs along the alignment with speed limit monitoring

1.8 Climate Change

43. The effect of climate change is an evolving study. Section 9.5.3 of the DPWH Design Guidelines, Criteria and Standards, Volume 3 provided some suggested allowances for climate changes for sea level rise and changes in rainfall, which will be considered in the design. The DED implemented an addition of 10% in the RIDF rainfall values to incorporate the effects of climate change in the road drainage design.

44. On GHG emissions, Carbon Dioxide emissions with LLRN and without LLRN Project projected in thirty (30) years from year 2026 to 2055 showed that CO_2 emissions will be reduced and it will generate less CO_2 due to the smooth traffic in and around Metro Manila

area around LLRN. It shows that the emission amount with LLRN Project is smaller than that of without LLRN Project.

45. For NO_2, the emission amount of NOx is also expected to be increased based on projected vehicles, while the magnitude of it is much smaller than that of CO_2 due to the emission factor. It is unlikely to have emission amount of NOx lead to exceed the standard value around LLRN alignment, monitoring should be conduct for observing the change of the NOx value such as sudden increase and exceeding the standard value.

46. Although, the emission source includes factories, contribution of Car emission is quite high. Therefore, as the increasing of the NOx monitoring value observed, the possibility of the Car around the monitoring station should be considered and evaluated.

1.9 Cumulative Impacts

47. During the pre-construction stage, some of the impacts are right-of-way acquisition which entails anxiety of affected families (including legal and informal settlers, however, this will be mitigated through the formulation of RP).

48. During construction, site clearing will affect the current biodiversity of the area, air quality deterioration within the locality due to the operation of heavy equipment, a decrease in water quality due to a potential increase in sediment load generated from backfilling of bridge approach and foundations, improper waste disposal, the potential proliferation of informal settlers, and other more.

49. Exposure of locals to noise levels, fugitive dust, and gaseous emissions will occur in proximity to project work sites during construction, due to their short-term, localized nature, these effects are expected to be minor. Though, these impacts can be mitigated to minimize if cannot be avoided thru the implementation of proposed mitigating measures. No adverse residual effects on human health will occur as a result of project construction or operation. Please note that the biodiversity of the area is low considering the presence of limited vegetation cover within the project area. This condition can be improved with the adoption of the proposed establishment of a plantation to serve as a natural buffer, carbon sink as well as habitat of remaining fauna species.

50. In the operation phase, the volume of traffic within the highly urbanized areas nearby will be decongested thru the utilization of the alternative road network. Travel time of the general public will be improved. Therefore, it is expected that the general economy of the locals will be improved due to ease in transport, reduction of fuel consumption, work efficiency, increase job opportunities, enhance local tourism activities, and other more which are long-term cumulative positive effects of the project.

1.10 Institutional Arrangements

51. DPWH through the Construction Supervision Consultant and contractor may designate a separate Health and Safety Officer and Pollution Control Officer (PCO) or may act concurrently as the Health & Safety Officer.

52. The Manager, PCO, Safety Officer, Community Relations Officer (Comrel) and Security Officer shall have appropriate educational background and/or experience and training on environmental, community organization and development, health and safety and security risk regulations and practices.

53. The PCO and Safety Officer shall report directly to the contractor's head, while the head shall coordinate with the DPWH-RMCII. The head shall be responsible for the overall environmental management program. The PCO should be given enough authority and competence on decision-making with reference to environmental management. The PCO shall be responsible for land, air, noise, water, solid and hazardous waste components. The Safety Officer shall be responsible for the health and safety component, while the Security Officer shall be in-charge of Peace and order to include security risk management and emergency

responses. The Community Relations Officer (Comrel) who will be designated from among the project engineers, shall handle the people and shall be responsible for plans and implementation of social development programs, IEC activities and implementation and monitoring of RP.

54. The first point of contact for any safety and environmental issues on site is the Health, Safety and Environmental (HSE) Manager and the Environmental Officer (EO). In the event that the HSE and EO are unavailable, all issues are referred to the Project Manager. He will then designate who among the remaining Safety Officers will take charge of the issues. Should there be environmental issues outside the control of the DPWH or in the event that the response or performance of DPWH is not considered appropriate, the Construction Management is to be contacted.

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CHAPTER 1. INTRODUCTION

1.1 Project Background

1. The Government of the Philippines (the Government) has been granted a loan by the Asian Development Bank (ADB), from which the Government will get support to meet its accelerated infrastructure development objectives. The loan – the Infrastructure Preparation and Innovation Facility (IPIF) - was approved in 2017. Additional financing was further granted in 2019.

2. The IPIF is designed to achieve four outputs; the designs for each are designed per sub-sector. Under Output 1, where road and bridge projects are conceptualized – support is given to the Government in the preparation of design which includes, but is not limited to, detailed engineering design and the corresponding bid documents for flagship road and bridge projects. Among the many projects to be financed, the Laguna Lakeshore Road Network (LLRN) Project has been included as one of those to be prioritized.

1.2 Project Overview

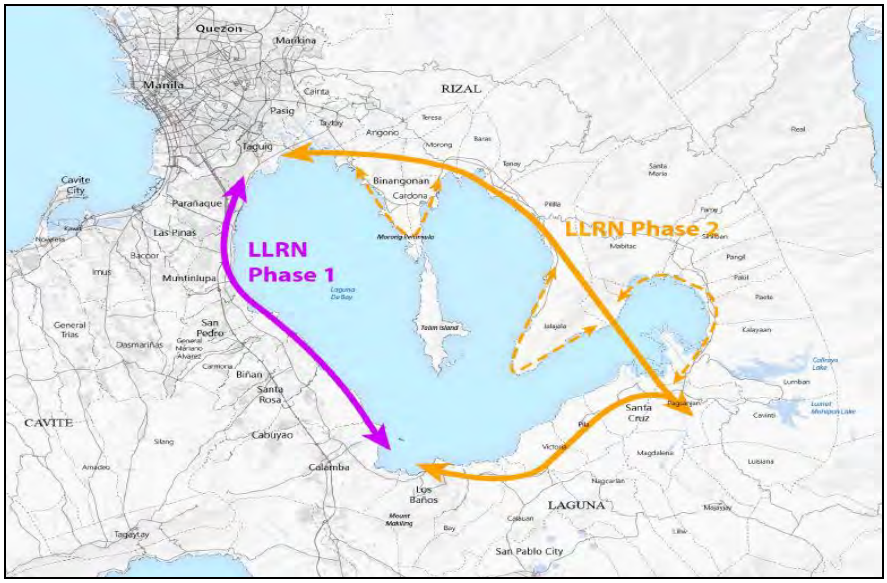
3. The **Laguna Lake** (or, **Laguna de Bay**) is the largest inland body of water in the Philippines and one of the largest lakes in Southeast Asia. It is bounded by the Sierra Madre Mountain ranges on the northeast, the Caliraya volcanic plateau on the east, mountains of Laguna and Batangas including Mt. Banahaw and Mt. Makiling on the south and southeast. The lake is divided into four (4) bays, namely West Bay, Central Bay, East Bay, and South Bay. It is on the southeast of the National Capital Region, about 25 km away from the Philippine capital, Manila.

4. National Capital Region **(**NCR) with its 16 cities and one municipality is the country's economic powerhouse, accounting for more than 31.8% of GDP. The population of NCR is 12.9 million and is expected to reach 14.0 million by 2030. Daytime population swells by an additional 3 million people from surrounding provinces and expected to further increase further by 2030. The diurnal traffic movement has resulted in heavy traffic congestion and substantial time and opportunity costs for commuters and businesses. The country loses ₱3.5 billion per day in 2017 due to traffic congestion in NCR and ₱2.5 billion in surrounding provinces. Such losses would rise to ₱5.4 billion per day in NCR and ₱5.9 billion per day in surrounding areas in 2035, if no action is taken.[6]

5. Among other areas, significant levels of congestion exist within NCR and along the national highway from NCR to Calamba in Laguna province. The situation is continuously worsening in the corridor from the NCR to from Calamba in Laguna province, where the relocation of industries outside the NCR since the 1970s has led to continuous growth in employment and population, making the NCR among the most dense and congested cities in Asia.[7] By 2025, it is estimated that this increase in vehicles will further slowdown traffic leading to average travel speeds for cars of only 16 km/h and 9 km/h in NCR and Laguna province, respectively. The ineffective and inefficient transportation network is causing a rise in transport time and cost which is preventing businesses to efficiently access markets and wider talent pools, and to attract tourists to the area.

6. The LLRN Project is proposed to be built along the shorelines of the Laguna Lake. Its Phase I is on the western shorelines of the lake and is the phase assessed by this EIA. Phase II stretches in the Northern to Southern coastline via an eastern route, but is not part of this assessment. **Error! Reference source not found.** shows the areas of the two phases

Figure 1-1: Phases of the LLRN Study



Source: LLRN Project Feasibility Study

7. Phase I - begins from the City of Taguig to the municipality of Calamba in Laguna. Currently, there are two (2) road networks existing in the area catering to motorists traveling from Metro Manila to the provinces in the Region IV-A or CALABARZON Region vice versa. These are the South Luzon Expressway or AH26 with its entry points in Taguig, Parañaque, Muntinlupa, and Laguna, and the Manila South Road starting at Muntinlupa City, passing through the cities of San Pedro, Biñan, Sta. Rosa, and Cabuyao and ends in Calamba in Laguna.

8. The proposed alignment is a combination of viaduct and embankment. The alignment starts at Brgy. Lower Bicutan in Taguig City and ends at Brgy. Bucal in Calamba City. It has seven (7) interchanges distributed along the course of the alignment and provides access to seven (7) cities/ municipalities in the western side of the lake and thirty-two (32) barangays. Table 1-1 presents the Cities and barangays that are traversed by the project.

Table 1-1: EIA Study Coverage

City/Municipality			Number of Barangays Covered
Metro Manila	1	Taguig	2
	2	Muntinlupa	8
Laguna	3	San Pedro	3
	4	Biñan	2
	5	Sta. Rosa	3
	6	Cabuyao	6
	7	Calamba	8
7 Cities			32

1.3 Project Rationale and Benefits

9. In 2014 and 2019, the government developed a roadmap for integrated urban development, coordinated with multisector transport infrastructure development in NCR and the surrounding provinces. The idea is to develop regional growth centers and link them by improved expressways, including the Laguna Lakeshore Road network, and railways. However, substantial underinvestment in infrastructure in the past has led to chronic capacity constraints, resulting in economic losses because of road congestion and significant air pollution. Under the Build Build Build (BBB) program, the government has strengthened investment for both rail and road transport infrastructure both rail system and roads. One of the focus of the BBB is the overburdened corridors that connects NCR and Laguna, the South Luzon Expressway and the Manila South road.

10. The overarching intent of the project is to provide a safer and faster alternative to the motorists traveling south / north to vitalize the economies for the surrounding areas including Laguna, Rizal, Quezon, and Batangas.

11. The Project will contribute to the access of economic opportunities for the growing population in the region. The Project will provide:

- A resilient, reliable transportation link for residents and commuters;
- Faster journey travel times;
- Ease of access to tourism activities, and
- Enhanced internal circulation, mobility, and external linkages to support the growth potential of the region.

12. Further the project will provide economic development opportunities for enhanced productivity due to better accessibility and savings in travel time and improved land mix resulting from reclamation activities. The economic outcomes from the project are as follows:

- **Cost**: Reducing the economic cost of transportation
- **Economic development and diversification**: Supporting economic development and diversification of the region.
- **Wider economic development**: Supporting integrated, equitable economic development of the region within the country

13. However, there are likely to be some adverse social impacts during construction because of property resumptions and short-term income impacts for fisherfolks and associated businesses at the lakeshore. These impacts and proposed mitigations will be detailed in the report.

14. In summary the LLRN scheme will provide congestion relief for the national highway from Metro Manila to Laguna. In doing so average journey times will be reduced for the workers, tourists and residents traveling in these provinces as well as for goods and services being transited domestically and internationally. This will have a beneficial effect on local industries including tourism, industries operating around the port and agriculture. The scheme will also help to protect the Laguna Lake shoreline from erosion, enhance transport network resilience from flooding and improve access for residents to local services.

Project Outputs

The projects outputs are:

- **Construction of the Laguna Lakeshore expressway from lower Bicutan in NCR to Calamba in Laguna Province will be constructed**. The expressway will be an access-controlled road with eight interchanges. The main alignment will be 37 km with an access road at each interchange to connect to the existing road networks. The northern section of the expressway from Lower Bicutan to Tunasan in NCR will be built as continuous viaduct off-shore over the lake, and the southern section from Tunasan to Calamba will be a combination of embankment and viaduct on the lakeshore[1]. The project will incorporate climate- and disaster-resilient features, such as increased height of viaducts and capacity of drainage to account for the projected increase in rainfall and lake-water levels during flood. The project includes access roads and community service roads which will be designed with gender-responsive features and meet international safety standards for pedestrians, including persons with disabilities, children, older people, and women. The project will improve the living conditions of the people in the lakeshore areas and create a more dynamic economy by providing better access to NCR.
- **Capacity of the Department of Public Works and Highways for bridge operation and maintenance strengthened.** The project will provide a capacity-building program to DPWH staff focused on improving the O&M of large-scale bridges. The program will include development of O&M manual, staff training and study on the institutional arrangement for O&M. The lessons learnt in the other countries will be incorporated. A separate mentoring program will be developed and implemented for all female technical staff across DPWH.

[1] Not part of the project but will be constricted from DPWH regular funds, community service roads with sidewalk and bike lane will be developed in the southern section to improve the accessibility and promote active transport in the community.

1.4 Executing and Implementing Agencies

15. The Department of Public Works and Highways (DPWH) is the executing agency while its Unified Project Management Office (UPMO)-Road Management Cluster (RMC) II is the implementing agency. The DPWH is the lead engineering and construction agency of the Government, tasked in ensuring and designing infrastructure developments such as national highways, bridges, flood control, and other related public works.

16. CTI Engineering International Co. Ltd. (Detailed Engineering Design), as the lead consultant for the Environmental and Social Impact Assessment of Laguna Lakeshore Road Network (LLRN) Project. KRC Environmental Services (DED) was hired as its sub-consultant to carry out the Environmental Impact Assessment (EIA) including the social aspects such as conduct of public consultation, Information and Education Campaign (IEC), perception surveys, focus group discussion (FGD), resettlement among others for the Project.

Table 1-2: Proponent Profile

Proponent Name	Department of Public Works and Highways (DPWH)
Address	Bonifacio Drive Port Area, 652 Zone 068, Manila, 1018 Metro Manila, Philippines
Authorized signatory/ representative to apply for ECC	Emil K. Sadain, CESO I Senior Undersecretary Department of Public Works and Highways Room 211, 2nd Floor, DPWH Main Office, Bonifacio Drive, Port Area Manila, Philippines
Recommending Approvals	Sharif Madsmo H. Hasim Project Director Department of Public Works and Highways Roads Management Cluster II (Multilateral) Unified Project Management Office (UPMO)
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1.5 Purpose of the EIA

17. This Environmental Impact Assessment (EIA) is a compliance requirement as provided in the ADB Safeguard Policy Statement (2009). The conduct of an EIA is a requirement to ensure the sustainability of the project outcomes by protecting the environment and people from the potential adverse impacts attributable to the LLRN project. The objectives of the EIA are: (i) avoid adverse impacts of projects on the environment and affected people, where possible; (ii) minimize, mitigate, and/or compensate for adverse project impacts on the environment and affected people when avoidance is not possible; and (iii) help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

18. This report is prepared by the DPWH and documented the EIA approach, assessment, consultations, and mitigation and monitoring measures to ensure residual significant adverse environmental impacts and risks are managed. More specifically, this report provides:

- Description the existing socio-environmental conditions within the Project area;

- Description of the project design, construction activities and operational parameters;
- Description the extent, duration and severity of potential impacts;
- Analysis of all significant impacts; and
- Mitigation actions and monitoring program and presents it all in the form of an Environmental Management Plan (EMP).

1.6 Environmental Category of Project

19. Based on the ADB's rapid environmental assessment (REA) screening, the LLRN Project falls under Category A of the ADB SPS guidelines (2009) due to the anticipated adverse environmental and social impacts from the project design and location. More specifically, impacts on the lake flood detention function, biodiversity, water quality, noise and vibration, occupational and community health and safety, and vehicular traffic.

20. Similarly, the Philippine Government's Department of Environment and Natural Resources (DENR), more specifically the Environmental Management Bureau (EMB) determined the LLRN Project – Phase I is an Environmentally Critical Project (ECP) and also classified as environmental Category A based on the Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippine EIS System as the Project traverses both land and water bodies, specifically the Laguna Lake.[2] With this, an Environmental Impact Statement (EIS) Report has been prepared for the environmental compliance certificate (ECC) application of the Project.

21. EMB-MC 2014-005 states that infrastructure, more specifically roads and bridges, must secure an Environmental Compliance Certificate (ECC), through conduct of full-blown Environmental Impact Assessment (EIA) as the project poses significant environmental impacts. The DPWH secured the ECC for the Project on May 19, 2022.

1.7 Approaches and Methodology of EIA Study

22. The area of study for the EIA was determined as the vicinity of the road alignment which focusing on the Laguna Lake and the influence area along the slip and connecting roads. Although the primary impact zone is confined within the road right-of-way (ROW) a wider impact screening area was adopted for the noise and vibration (100m from the edge of the ROW) with the widest involved biodiversity impact screening reaching 50-km corridor from the road center line.

23. This report has been prepared in accordance with ADB's SPS (2009), and the guidelines and requirements of the Philippine's DENR Administrative Order 2003-30 (DAO 2003-30) – Implementing Rules and Regulations of Presidential Decree 1586 Establishing Environmental Impact Statement System, including Environmental Management Bureau Memorandum Circular 2014-005 (EMB-MC 2014-005) – Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippines EIS System (PEISS) under DENR Administrative Order No. 2019-16.

24. EIA based on feasibility study was approved by Philippine Government. Environmental Compliance Certificate (ECC) was issued in May 2022.

[2] Based on the Revised Procedural Manual of the Department of Environment and Natural Resources (DENR) Administrative Order No. 30 Series of 2003 (DAO 2003-30), major roads and bridges are categorized as Environmental Critical Project (ECP) under Category A and within the scope of the EIS System based on Proclamation No. 2146 (1981) and Proclamation No. 803 (1996). Environmental Management Bureau (EMB) Memorandum Circular 005 of 2014 (EMB MC 2014-005) or the Revised Guidelines for Coverage Screening and Standardized Requirements under the Philippine EIS System states that infrastructure, more specifically roads and bridges, must secure an Environmental Compliance Certificate (ECC) through conduct of full-blown Environmental Impact Assessment (EIA) as the project poses significant environmental impacts

25. This report documents the results of the EIA prepared based on the detailed engineering design (DED) prepared by the CTI Consultants for the DPWH. Based on alignment and construction methods alternatives assessed during the feasibility study stage, primary and secondary data were collected on the preferred alternative followed by an assessment of potential environmental and social impacts and the design of mitigation and monitoring measures were presented to public/stakeholders' consultations. Details of the assessment methodology is provided below.

- **Review of Secondary Data**. The EIA study has drawn on multiple types and sources of information, including:
  - official government/non-governmental, and private entities publications including statistical handbooks, national and local plans, projections, on-line data bases, and maps.
  - Project design information from the feasibility study, appended technical reports,
  - preliminary design reports, updated preliminary design reports, and discussion with project engineering teams;
  - intergovernmental, non-governmental and private sector entities;
  - Biodiversity screening reports generated using the Integrated Biodiversity Assessment Tool (IBAT);
  - various Laguna Lake Development Plans
  - land use plans and associated zoning ordinances, Laguna Lake report cards
- **Field Studies.** Field studies were conducted to supplement and update the compiled baseline from secondary sources which includes:
  - environmental conditions specifically in the BCIB project area, including
  - Soil quality
  - Lake Water quality
  - Surface/River water quality
  - Ground water quality
  - Lake sediment quality
  - Potential dredge quality
  - Noise
  - Flora and fauna survey
  - Fresh water ecology survey
- **Stakeholder Engagement.** To inform and solicit inputs to the project design engagement was accomplished through the following: formal consultation encounters with institutional stakeholders and members of the public, and a perception survey. In accordance with ADB's Safeguard Policy Statement (SPS) 2009 requirements that consultations will be continued throughout the project planning, design, and implementation phases and in line with DENR Administrative Order (DAO) No. 2017-15 that provides guidelines on meaningful public participation under the Philippine EIS system, a series of consultations were held during the Feasibility Study and Detailed Engineering Design stages. series of consultations were conducted through various methods including Information Education Communication (IECs), Focus Group Discussions (FGDs), Stakeholders' Consultation Meetings (SCM), public scoping, and public hearing. They were represented by Local Government Units (LGUs), National Government Agencies (NGAs), Fisherfolk Organizations, and stakeholders in the corridor of the impact that will be affected by the project implementation, particularly the disadvantaged or vulnerable groups, especially those below the poverty line, the elderly, solo-parent, women, and persons with disabilities (PWD).

Table 1-3: Summary of Assessment Methodologies Adopted by the Project

EIA Key Components	Methods
Land	
Land Use and Classification	Review of secondary data from comprehensive land use plans
Geology/Geomorphology	Interpretation of existing mappings, including topographic, geologic, flood maps, landslide susceptibility maps, and existing ground investigation information. Technical reports regarding the geologic conditions of the project area, other geology-related resources; and results of field inspection
Geohazard Assessment	
Pedology	
Soil Quality	Soil sampling and analysis
Lake sediments	Sediment sampling and analysis of leachates Dredge material characterizations
Critical Habitat Assessment	Primary and Secondary collection
Biodiversity Habitat	Secondary data collection on Protected Areas
Terrestrial Ecology Flora Assessment	Transect survey • Use of quadrat sampling plots • Documentation of tracts and coordinates of sampling stations using GPS
Terrestrial Ecology Fauna Assessment	Transect survey • Netting • Trapping • Night sampling
Water	
Hydrology/Hydrogeology	Review of secondary data: • Comprehensive land use plans, • Integrated Water Resource Management Master Plan by the Provincial Government of Laguna, • Related hydrologic studies, and • Historic flood levels • Hydrodynamic Assessment
Water Quality	Surface water, and ground sampling and analysis
Freshwater (Lake) Ecology	• Review of secondary data from comprehensive land use plans • Primary collection on Phytoplankton & Zooplankton - Plankton net vertical haul (water column sampling) from near the bottom to the surface and laboratory microscopic analysis • Primary Productivity (Chlorophyll-a) - Surface water sampling and laboratory analysis • Ichthtyoplankton (Fish Eggs & Fish Larvae) - Bongo net surface tow for 10 minutes and laboratory analysis • Soft Bottom Infaunal Benthos - Ekman bottom grab sampling and laboratory microscopic analysis - Fish and Aquatic Invertebrates - Actual observations of fishing activities - Informal interviews - Visit to fish landing and fish market - Secondary data gathering from internet search, survey reports, scientific publications, and published and unpublished literature • Aquatic Macrophytes/Plants - Field observations and interviews - Secondary data gathering from internet search, reports, scientific

EIA Key Components	Methods
	publications, and published and unpublished literature Fisheries (Fish Capture and Aquaculture) - Field observations and informal interviews - Secondary data gathering from internet search, scientific publications, field survey reports, and published and unpublished literature
Air	
Meteorology	•Climate •Secondary data on rainfall, humidity and temperature
Ambient Air	Ambient air sampling and analysis • Air dispersion modelling
Noise	Noise sampling • Noise modelling
Traffic Impact Assessment	Vehicle – classified count surveys • Secondary data review • Travel time savings analysis
People	
Public Participation and Scoping	Preliminary desk research • Site visits • Initial consultations • Stakeholder mapping • Key informant interviews • Consultations • Household survey
Socio-Economic	Socio-Economic Survey and Profile
Gender Assessment	Gender Survey and Profile

- **Temporal Scope of Impact Assessment.** The identification and evaluation of impacts including the formulation of appropriate mitigation and enhancement measures cover all project development phases from pre-construction, construction, and operational phases. Although decommission phase is included, this type of project is not expected to be abandoned after its economic life but expanded or rebuilt. Impacts from typical road projects were applied will typically arise obviously and visibly during construction, but the impacts of design and alignment made in the pre-construction phase are crucial determinants of impacts anticipated during construction and operation, and substantial attention and effort were directed at identifying opportunities for pre-emptive mitigation.

- **Significance of Impacts.** The identification of environmental and social impacts from infrastructure development is a function of the activities that take place during construction and operation of the infrastructure, and the environmental and social attributes of the local setting on the other. The people, communities and ecosystems that may be affected by a project (receptors) are variable in terms of their proximity to the infrastructure; their sensitivity to influences such as noise, disturbance and emissions; and their ability to adapt to change.

Risk is assessed as the likelihood that the activity will influence the environment as well as the consequence of the effect occurring. Risk significance is function of likelihood and consequence. This study adopted a 5-point ordinal scoring system. Any medium to significant risk requires an environmental management measure to manage the potential environmental risk. In contrast, professional judgement was required concerning the application of an environmental measure to mitigate low risk situations.

1.8 Structure of the Report

26. The report is structured as follows:

- **Section 1: Introduction –** The section in hand provides the introductory information.
- **Section 2: Legal, Policy and Administrative Framework –** This section presents an overview of the policy/legislative framework as well as the environmental assessment guidelines of the Philippines that apply to the proposed project.
- **Section 3: Description of the Project –** Section 3 describes the Project need and its environmental setting. A scope of works is also provided indicating the type of construction works required.
- **Section 4: Assessment of Alternatives** – This section presents a summary of the 'options analysis' undertaken by ADB in November 2019 along with an analysis of the 'no project' alternative.
- **Section 5: Description of the Environment –** This section of the report discusses the country, regional and local environmental baseline conditions. This section is divided into subsections relating to:
    - Physical: geology and soils; topography; climate and air quality; hydrology and geohazards.
    - Biological: flora and fauna (including Red List species) and nationally and internationally designated sites.
    - Social: population; communities; demographics; employment and socioeconomics; land use; infrastructure (including local access roads); public health and safety; physical cultural heritage; waste management and noise.
    - Surveys have been conducted to address important gaps in the existing data and to collect up-to-date information on topics and areas where potentially significant negative impacts may occur, specifically biodiversity.
- **Section 6: Environmental Impacts and Mitigation Measures –** Section 8 outlines the potential environmental impacts and proposes mitigation measures to manage the impacts. The residual impacts of the Project are also presented. This portion of the report also discusses cumulative impacts of the proposed project and other planned or on-going projects in the region as well as any potential induced impacts of the Project. No specific transboundary impacts have been identified.
- **Section 7: Public Consultation, Information Disclosure –** Section 10 provides a summary of all of the stakeholder consultation activities undertaken and includes the Projects grievance mechanism.
- **Section 8: Grievance Redress Mechanism –** provides a systematic approach and procedure on grievance redress mechanism (GRM) to respond to the potential valid concerns of the project affected persons. This method will resolve the grievances of project affected persons for the satisfactory implementation of the project.

- **Section 9: Environmental Management Plan –** This section of the EIA comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan.
    - Clearly identifies what specific potential impacts various types of works may have on the sensitive receptors;
    - Provides concrete actions prescribed for managing these impacts, including location and timing of these actions;

- Provides cost estimates for the main discrete mitigation measures (those that are unlikely to be part of a construction company' corporate policy and will not necessarily be included into general pricing of the contract); and
- Specifies responsibility for the implementation of each mitigation activity.
- Lists all prescribed mitigation measures by types of construction activities;
- Provides selected criteria of monitoring implementation of mitigation measures;
- Specifies methods for measuring outcomes of applied mitigation measures (visual, instrumental, survey, etc.);
- Identifies location and timing/frequency of monitoring mitigation measures by the prescribed criteria;
- Gives cost estimates of monitoring mitigation measures by the prescribed criteria; and
- Specifies responsibility for tracking each monitoring criterion.

- **Section 10: Conclusions and Recommendations –** The final section of the EIA provides the report conclusions and recommendations, including a description of any residual impacts.

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CHAPTER 2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

27. This chapter discusses the national and local policy, legal and administrative framework within which the environmental assessment of the project is carried out. Relevant international environmental agreements to which the Philippines is a party is also be included. Also discussed is the procedural requirements and scope of impact assessment, as specified under both the Philippine Environmental Impact Statement System (PEISS) and ADB's Safeguard Policy Statement, 2009.

2.1 Government Agencies Involved in the Implementation of the Environmental Laws

28. The following Philippine government agencies have relevant participation in the implementation of the environmental management of any project, particularly for the Laguna Lakeshore Road Network (LLRN) Project:

- Department of Environment and Natural Resources (DENR), the main government agency responsible for environmental protection and management in the Philippines. The DENR has several bureaus dedicated to environment management oversight in different thematic areas, particularly:
  - Environmental Management Bureau (EMB
  - Forest Management Bureau
  - Biodiversity Management Bureau
  - Protected Areas and Wildlife Bureau (PAWB)
- Laguna Lake Development Authority (LLDA)
- Department of Public Works and Highways (DPWH)
- Department of Agriculture – Bureau of Fisheries and Aquatic Resources (DA-BFAR)
- Local Water Utilities Administration (LWUA)
- Metro Manila Development Authority (MMDA)
- Local government units (LGUs) – Taguig, Muntinlupa, San Pedro City, Biñan City, Santa Rosa City, Cabuyao City, and Calamba City

2.2 Relevant National Laws, Regulations and Standards

29. A number of national laws have direct or indirect concern on the development of major infrastructures in the Philippines. These laws cover environment, occupational safety and health standards concerns that need to be complied with by the proponent, whether government or private entities. These laws also include international conventions and agreements signed by the Philippines, which may have direct or indirect impacty on planning and development of public infrastructures. These key legal instruments potentially relevant to development of the projects are listed below.

Table 2-1: Relevant Laws and Regulations

Laws and Implementing Regulations	Stipulation
Laws	
Republic Act 4850 (1966) as amended by PD 813 (1975) Creating the Laguna Lake Development Authority as amended by	Promote, and accelerate the development and balanced growth of the Laguna Lake area and the surrounding provinces, cities and towns within the context of the national and regional plans and policies for social and economic development and to carry out the development of the Laguna Lake region with due regard and adequate provisions for

Laws and Implementing Regulations	Stipulation
	environmental management and control, preservation of the quality of human life and ecological systems, and the prevention of undue ecological disturbances, deterioration and pollution
Presidential Decree (PD) No. 1152 (1977); Philippine Environment Code	Comprehensive environmental management including mitigation measures was addressed and the concept of the environmental impact assessment was introduced for the first time.
PD No. 1586 (1978); Establishing an Environmental Impact Statement System	This law aims to protect the environment despite the increasing demand on use of natural resources and socio-economic development to attain sustainability. It provides the legal and procedural framework for conducting Environmental Impact Assessments (EIAs) for projects likely to have significant environmental impacts
Presidential Proclamation No.2146 (1981) and No. 803 (1996)	Proclamation of Environmentally Critical Areas (ECAs) and types of Environmentally Critical Projects (ECPs) within the scope of the PEISS
Republic Act (RA) 6969 (1990) Toxic Substances, Hazardous and Nuclear Waste Control Act	Covers the importation, manufacture, processing, handling, storage,transportation, sale, distribution, use and disposal of chemical substances and mixtures, including the storage and disposal of hazardous wastes.
RA 8371 (1997) Indigenous Peoples Rights Act	Recognizes and aims to protect and promote the rights of indigenous cultural communities, including by establishment and operation of a National Commission on Indigenous Peoples (NCIP)
RA 8550 (1998, amended 2013) Fisheries Code	Concerned with the regulation of fishing and aquaculture; provides penalties for causing aquatic pollution, which may include a number of activities that could occur in the context of infrastructure development, such as discharge of oils and other hazardous substances, and wetland conversion
RA No. 8749 (1999) Clean Air Act of 1999	Aims an effective prevention, control and abatement of air pollution, and provides the basis for promulgation and enforcement of air quality and emissions standards
RA No. 9003 (2001) Ecological Solid Waste Management Act	Provides for a rational and organized waste management systems, primarily at the local government level, through establishment of standards, institutional forms, inventories, funding mechanisms and support programs
RA No. 9147 (2001) Wildlife Resources Conservation and Protection Act.	Aims at the conservation, preservation and protection of wildlife species and their habitats, in order to preserve and encourage ecological balance and biological diversity.
RA No. 9275 (2004) Philippine Clean Water Act	Aims for an effective abatement and control of surface and ground water pollution from land-based sources, and provides for specification of water quality standards.
RA No. 9729 (2009) Climate Change Act.	The law mainstreams climate change mitigation and adaptation into government policy formulation, establishing a framework strategy and program on climate change
RA No. 10066 (2009). National Cultural Heritage Act.	Aims to protect, preserve, conserve and promote the nation's cultural heritage, its property and histories, and the ethnicity of communities; establish and strengthen cultural institutions; and protect cultural workers and ensure their professional development and well-being.

Laws and Implementing Regulations	Stipulation
RA No. 10121 (2010) Philippine Disaster Risk and Management Act	Mainstreams disaster risk reduction and climate change adaptation and mitigation in development processes, including public infrastructure.
RA No. 11058 (2017) Occupational Safety and Health Act	Ensures a safe and healthful workplace for all working people by ensuring that the provisions of the Labor Code of the Philippines, all domestic laws, and internationally recognized standards on occupational health and safety are fully enforced and complied with by employers
Selected Implementing Regulations	
DENR Administrative Order (DAO) 2003-30	Implementing rules and regulations for the PEISS of Presidential Decree (PD) No. 1586
EMB Memorandum Circular (MC) 2007-002	Revised procedural manual for DAO 2003-30.
DENR MC 2010-14	Standardization of requirement and enhancement of public participation in the streamlined implementation of the PEISS.
EMB MC 2010-002	Clarification to the Department of Environment and Natural Resources (DENR) memorandum circular No. 2010-14 and other environmental impact statement (EIS) system policy issuances.
EMB MC 2010-004	Guideline for use of screening and ECA Mapping Systems.
EMB MC 2011-005	Incorporating disaster risk reduction (DRR) and climate change adaptation (CCA) concerns in the PEISS.
EMB MC 2014-005	Guidelines of coverage screening and standardized requirement under the PEISS amending relevant portions of Environmental Management Bureau (EMB) MC 2007-002.
Memorandum Circular No. 01, Series of 2014	Guidelines for the Implementation of the DPWH-DENR-DSWD Partnership on the Tree Replacement Project
DAO 2017-15	Guidelines on public participation under the PEISS.
DAO 2018-18	Establishing a centralized management and coordinative mechanism at the regional offices of the DENR, the Mines and Geosciences Bureau (MGB) and the EMB and designating the DENR regional director as the regional executive director providing overall command of regional operations.
DPWH Department Order No. 57, Series of 2016	Environmental Impact Assessment (EIA) for DPWH Infrastructure Projects and Tree Cutting Permit Application
EMB Memorandum Circular No. 31 Series of 2020	Guidelines on the Five (5) year validity of Environmental Compliance Certificate (ECC) pursuant to DENR Administrative Order No. 30 Series of 2003
DENR Administrative Order No. 02, Series of 2022	Guidelines for Public Participation under the Philippine Environmental Impact Statement System (PEISS) for Proposed River Restoration Project Through Dredging Activities pursuant to Section 5.4 of DENR-DPWH-DILG-DOTR Joint Memorandum Circular 2019-01

Source: LLRN Project DED Study, compiled/expanded

2.2.1 Relevant National Standards on Environment and Occupational Health and Safety for Infrastructure Projects

30. National standards have been specified for a number of environmental and occupational health and safety parameters, including ambient air quality, noise, surface water, groundwater, and workplace conditions. In some substantive areas, national standards have not yet been developed. Existing national standards relevant to infrastructure development are identified in the following table.

Table 2-2 National Standards Relevant to Infrastructure Projects

Area/Concern	Applicable Standards
Ambient air quality	National Ambient Air Quality Guideline Values (specified in RA-8749-IRR-DAO-2000-81) Provisional National Ambient Air Quality Guideline for PM2.5 (specified in RA-8749-IRR-DAO-2013-13)
Water quality (surface water, groundwater, effluents)	Water Quality Guidelines and General Effluent Standards of 2016 (specified in RA-9275-DAO-2016-08 and DAO-2021-19)
Water quality (drinking water)	Philippine National Standards for Drinking Water of 2017 (specified in Department of Health (DOH) Administrative Order No. 2017-10)
Noise	Amendments to Article 1 (Noise Control Regulations), Chapter IV (Miscellaneous Regulations), Rules and Regulations of the National Pollution Control Commission,1978 (in NCCC Memorandum Circular No. 002 , Series of 1980)
Occupational safety and health	Occupational Safety and Health Standards (as amended 1989). Department of Labor and Employment, Bureau of Working Conditions.

2.2.2 International Commitments

31. The Philippines is a party to several international conventions and other agreements. In general, national law and policy are made consistent with these international agreements. Thus, it is expected that actions on meeting these commitments are integrated in the overall implementation and management of the infrastructure development projects. Among these international commitments are listed below

Table 2-3 Relevant International Conventions and Agreements Joined by the Philippines

Relevant International Commitments
UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972 1985
Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973 1981
Convention on the Conservation of Migratory Species of Wild Animals, 1983 1994
Vienna Convention for the Protection of the Ozone Layer, 1985 1991
Montreal Protocol on Substances that Deplete the Ozone Layer, 1987 1991
London Amendment (to the Montreal Protocol), 1990 1993

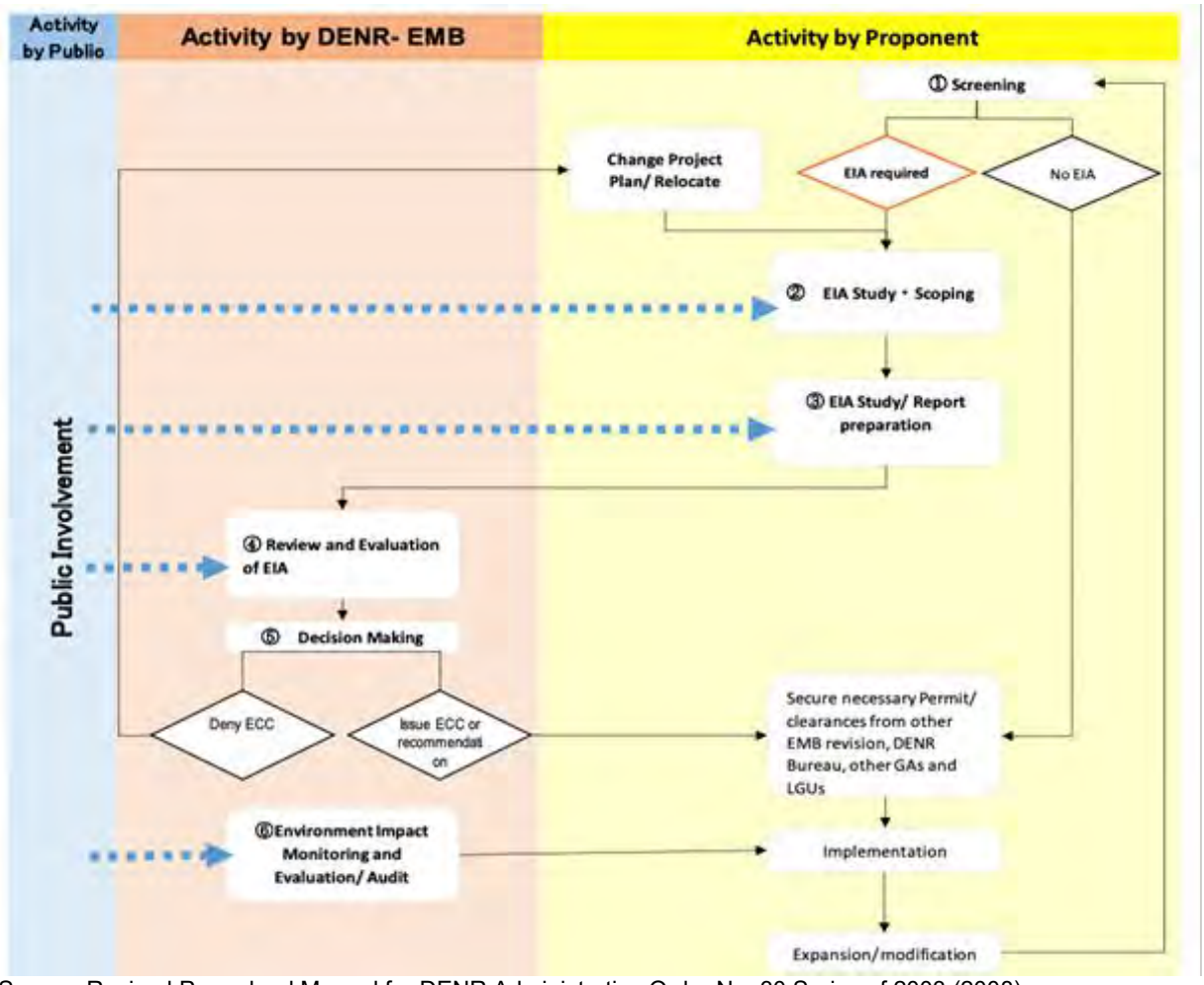
Convention on Biological Diversity, 1992 1992
United Nations Framework Convention on Climate Change, 1994 2003
Kyoto Protocol to the United Nations Convention on Climate Change, 1998 2003
Stockholm Convention on Persistent Organic Pollutants, 2001 2004
Paris Agreement (pursuant to United Nations Framework Convention on Climate Change), 2015 2017

2.3 Philippine Environmental Impact Assessment System Process

32. The PEISS 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. A summary flowchart of the process is presented in

33. Figure 2-1.

Figure 2-1: Summary Flowchart of EIA Process Projects Requested to Implement EIA



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

34. During screening, the project is assessed whether it is subject to go through EIA process or exempted from the process. Projects are classified into four (4) major groups as shown in the following table.

Table 2-4 : Project Groups for EIA under the PEISS

Category	Type and Location of the Project
Category A: Environmentally Critical Project (ECP)	Projects or undertakings which are classified as Environmentally Critical Projects (ECPs) under Presidential Proclamation No. 2146 (1981) and Proclamation No. 803 (1996), and any projects that are later be declared as such by the President of the Philippines. These types of projects include heavy industries; resource extractive industries; major infrastructure projects; golf courses and other major tourism projects; cut flower industry projects; telecommunication projects; energy exploration projects; small business development project facilities; array of cottage industries and service industries
Category B: Non-environmentally Critical Project	Projects or undertakings which are not classified as ECPs under Category A,but which are likewise deemed to significantly affect the quality of the environment by virtue of being located in an Environmentally Critical Area (ECA) as declared under Proclamation 2146.
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 addressing existing environmental problems.
Category D: Non-Covered Project	Projects or undertakings that are deemed unlikely to cause significant adverse impacts on the quality of the environment according to the parameters set forth in the Screening Guidelines. These projects are not covered by the PEISS and are not required to secure an ECC. However, such non-coverage is not construed as an exemption from compliance with other environmental laws and government-permitting requirements.

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

35. The LLRN project is a road network with two lanes on each direction along the mainline, except for certain sections. The total main length is 37.6 km which is divided into two sections. Section 1 has a viaduct of about 11.8 km while Section 2 has a shoreline viaduct and embankment of about 25.8 km. The road network will require a total land area of 210,994.38 m^2 and will affect a total fish cage area of 837,400 m^2.

36. Considering its size, location, and the potentially affected areas and community, the LLRN Project is classified as a Category A project by virtue of it being a major infrastructure project and is located within an environmentally critical area (ECA). The Project will need to undergo a detailed environrmental impact assessment (EIA) and apply for an Environmental Compliance Certificate (ECC) from the DENR.

2.3.1 Environmental Impact Assessment (EIA) Process

37. The LLRN, as a Category A Project will need to have a detailed Environmental Impact Statement (EIS) Report following the EMB requirements based on DENR-EMB Memorandum Circular No. 2014-005. Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System

38. All required documents should be prepared and submitted by the project proponent, in this case, the DPWH, to EMB Central Office (CO).

39. The ECC application, which is the comprehensive EIA Report, including all required documents, is reviewed by an Environmental Impact Assessment Review Committee (EIARC) convened by DENR-EMB and composed of specialists and representatives of agencies with substantive relevance to the project under evaluation. The review is to be guided by three general criteria:

a. Environmental considerations are suitably integrated into overall project planning;
b. The assessment is technically sound and the proposed environmental mitigation measures are considered likely to be effective; and
c. The assessment is based on timely, informed and meaningful public participation by potentially affected communities.

40. The EIA Report contains detailed information on key environmental impacts on land, water, air, and people, the impact assessment and mitigation measures, Environmental Management Plan, Environmental Risk Assessment Policies and Guidelines, Social Development Plan & IEC Framework, Environmental Compliance Monitoring Plan, Decommissioning/Abandonment/Rehabilitation Plan, Institutional Plan for EMP Implementation, and Health & Safety Plan.

41. The outcome of the EIA process within the PEISS administered by the EMB-DENR is the issuance of a decision document, the Environmental Compliance Certificate (ECC), signed by the DENR Secretary.

2.3.2 Stakeholder Participation and Consultation

42. The PEISS places importance on public participation. According to DAO 2017-15, from the early stage of project, the public who can potentially be affected with direct/indirect impacts is provided with accurate project information and are involved in a series of public discussions.

43. Stakeholder participation in the environmental assessment process is one of the main criteria against which ECC applications are considered. There are several mechanisms for participation, deployed at different points in the process where the involvement of stakeholders is appropriate and desirable. These are as follows for projects requiring an EIS:

a. **Information, Education and Communication (IEC) activities –** The proponent is required to carry out a systematic effort to disclose the project's preparation to leaders and members of the public in the LGUs that will be affected by the project. The IEC is an opportunity for preliminary identification of institutional stakeholders and stakeholder groups. IEC methods may include small- and large-format meetings, publicly distributed materials and other methods.
b. **Public Scoping –** Public meetings with invited stakeholders, DENR-EMB and members of the EIARC are required to define the substantive and spatial scope of the environmental assessment study. The key output of public scoping is typically a list of concerns and issues that the participants have indicated should be given particular attention in the environmental assessment study.
c. **Environmental Assessment Study –** Stakeholders can and should be given the opportunity to provide local knowledge and expertise to the study, as key informants, focus group participants, guides, and so on. Local knowledge is often critical to baseline development and impact analysis.
d. **Public Hearings –** The findings of the environmental assessment study must be publicly presented in a format accessible to all interested people, with the study report disclosed in advance to the relevant municipalities, so participants can prepare

statements about issues of concern for presentation in the hearings. The key output of public hearings in each affected municipality is typically a list of concerns that may be reflected in revisions to the EMP, as appropriate.

e. **Monitoring of EMP Implementation –** A Multi-Partite Monitoring Team (MMT) is set up to provide oversight of the proponent's self-monitoring with respect to implementation of the project's EMP. Local stakeholders are entitled to participate through their LGU representatives on the MMT, and through community members appointed to the MMT to represent vulnerable sectors of the local population.

2.3.3 Information Disclosure

44. Disclosure of information about the project begins with the early IEC activities and continues through the public scoping and preparation of the draft EIS. Following production of the draft EIS, the project proponent will need to comply with specific time-bound disclosure requirements under the PEISS; these are summarized below

Table 2-5: Information Disclosure Requirements under PEISS

Document	Information for Disclosure	Activity	Duration
Draft EIS for Review and an Executive Summary for the Public (ESP) in English and Filipino Versions	• Project description* • Proposed location • Project proponent • Projected timeframe of the project implementation • Concise integrated summary of the major impacts and residual effects after mitigation • Identified stakeholders • Proponent's statement of commitment and capability to implement necessary measures to prevent negative adverse impacts • Information on where to get a copy of the EIS for further information	Posting on the EMB website along with the NPH	At least 20 days before the public hearing
Notice of Public Hearing (NPH)	• Objectives of the public hearing • Necessity of the Project and its goals and objectives • Brief description of the Project's components and size and its proposed location • A Project proponent • A date and venue of a public hearing • Instructions and a deadline for the registration of intent to attend the public hearing and/pr give comment(s) or position papers • Instructions and a deadline for submitting comments or position papers • Contact person(s) for further inquiries	• Issued by the EMB • Posting on the EMB website along with the draft EIS and ESP • Publish the NPH in a newspaper for general circulation upon EMB's approval	At least 20 days before the public hearing Once a week for 2 consecutive weeks (publication of 2nd NPH at least 7 days before the scheduled public hearing) At least 15 days prior to the scheduled hearing

Document	Information for Disclosure	Activity	Duration
IEC Materials	• Purpose of EIA as stipulated in PD 1151 and 1586 • Necessity of the Project and its goals and objectives • Project alternatives • Proposed locations of project facilities/components and alternatives considered prior to the selection • Project proponent (indicating incorporators and subsidiaries) • Projected timeframe of the project phases • Preliminary identified environmental aspects for each alternative	Distribute flyers in places where reading newspapers is not a common practice Disseminate information through non-written means such as radio, public address system, or other similar means if there are identified primary stakeholders who have no access to written means of information	2 consecutive days, at least 7 days before the public hearing
Revised EIS	Incorporated with key aspects of the public hearing documentation	Posting on the EMB website for further public comments	7 days (comments received after the 7-day period are no longer considered in the review of the ECC application)
Copies of the ECC, the EMP (IMP & EMoP) and the Documentation of Public Participation	• Chronology of public participation (PP) activities conducted • Key issues raised and how these were responded by the project proponent and considered in the review of the ECC application indicating the stage of the EIA process when these issues were raised • Related issues that were raised but are beyond the mandate of the EMB-DENR	Posting on the EMB website	

EMoP=environmental monitoring plan, IMP=impact mitigation plan
Note: It should include discussion on the process and criteria for choosing from alternatives including how the public/stakeholders influence the selection.
Source: DAO 2017-15

2.3.4 Gender Equity and Social Inclusion (GESI) and other Social Dimensions

45. The GESI aims to develop Gender Plans that are relevant to and appropriate for the socio-economic conditions of the affected communities, especially the directly affected households to be traversed by LLRN's final road alignment. Since the LLRN will not directly benefit the PAPs as direct users of the road network, the focus of the GESI Analysis and Action Plan is how the Project will impact on the women and men PAPs belonging to the vulnerable groups in the covered areas in terms of physical, economic, and socio-cultural displacement. Thus, the GESI analysis process started during pre-construction phase to adapt and harmonize the Project's GESI component with the existing GAD plans and programs and mainstream best practice strategies and programs being implemented by host LGUs that are relevant to the Contract Package (CP) or segment.

2.3.5 Environmental Compliance Certificate

46. An Environmental Compliance Certificate (ECC) is the document issued by the DENR after a positive review of the EIA Report, certifying that based on the representations of the proponent, the proposed project or undertaking has complied with all the requirements of the EIS System and has committed to implement its approved Environmental Management Plan (EMP). The EMP details the prevention, mitigation, compensation, contingency, and monitoring measures needed to enhance positive impacts and minimize negative impacts and risks of a proposed project or undertaking.

47. The ECC document, when issued, normally includes legally binding conditions of approval, as well as recommendations, regarding selected aspects of project implementation. The ECC is valid for the full life cycle of the project, without any requirement of renewal. If project implementation does not begin within five years of issuance, if major design or technology changes are introduced, or if environmental conditions in the project area change in such a way as to reduce the applicability of the measures comprising the EMP, an application for a new or amended ECC may be required by DENR-EMB.

2.4 Monitoring and Reporting Requirements

48. Under the PEISS, the primary purpose of monitoring, validation and evaluation/auditing is to ensure 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:

- Compliance with the conditions set in the ECC;
- Compliance with the EMP commitments;
- Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis-a-vis the predicted impacts used as the basis for the EMP design; and
- Continuous updating of the EMP for sustained responsiveness in addressing environmental impacts of undertakings.

2.4.1 Responsible Parties for Conducting Monitoring and Reporting

Project proponent

49. The Proponent (DPWH) is primarily responsible for monitoring the project. DPWH is required to submit an ECC compliance monitoring report (CMR) to the designated monitoring EMB office on a semi-annual basis. The detailed report on the compliance to environmental standards specific to environmental laws is submitted through a self-monitoring report (SMR) on a quarterly basis to the concerned EMB office.

Multi-partite Monitoring Team

50. The MMT is primarily responsible for validating the proponent's environmental performance and submits findings/recommendations through a compliance monitoring and validation report (CMVR) to the concerned EMB office semi-annually. The MMT is formed by the Proponent in consultation with the DENR-EMB. The functions of the MMT are to monitor the proponent's compliance with the ECC conditions and EMP, and to validate the proponent's monitoring, reporting and environmental performance. The MMT also receives and reviews complaints brought forward by affected persons or communities, and investigates any reports or evidence of suspected violations of any national standard. The MMT is expected to submit Compliance Monitoring and Validation Reports (CMVRs) to DENR-EMB on a semi-annual basis. The Proponent provides a monitoring fund for the works of the MMT.

Environmental Management Bureau

51. Based on the reporting of the proponent and MMT, the relevant DENR-EMB regional office conducts audits of the project's environmental performance, and may carry out field investigations and sampling as needed to investigate and address particular concerns arising from its evaluations. The DENR-EMB regional office prepares semi-annual Compliance Evaluation Reports (CERs) for submission to the DENR-EMB central office.

2.4.2 Other Permitting and Clearance Requirements

52. Aside from the ECC, typical permits required for infrastructure projects like the LLRN coming from various government agencies and LGUs are listed below. These will have to be applied for in advance of the commencement of works and should be kept current for the duration of construction activity.

Table 2-6. Clearances and Permits Required

Clearance	Permit Issuing Authority
Municipal endorsement/Certificate of No Objection	LGU of each directly affected municipality
Endorsement/Certificate of No Objection	Directly-affected Barangay/s
Dumping permit	Directly affected LGUs
Building permits	LGU Office of the Building Official
Fire safety evaluation clearance	Bureau of Fire Protection
Occupancy permit	LGU Office of the Building Official
Electrical connection agreement	LGUs; Meralco; Electric Cooperatives
Certificate of zoning compliance	LGU Zoning Divisions
Land use conversion/reclassification, if relevant	LGU Planning Divisions
Tree-cutting permit	DENR (Biodiversity Management Bureau)
Water use permit	National Water Resources Board
Certificate of Non-Overlap	National Commission on Indigenous Peoples
Civil aviation clearance	Civil Aviation Authority of the Philippines
Fisheries clearance	Bureau of Fisheries and Aquatic Resources (Department of Agriculture)
Registration of Safety Officer	Bureau of Workforce Conditions, DOLE
Registration of Pollution Control Officer	DENR (Environmental Management Bureau)
Hazardous waste generator ID	DENR(Environmental Management Bureau)
Permit to transport hazardous waste	DENR (Environmental Management Bureau)
Wastewater discharge permit	DENR (Environmental Management Bureau)
Permit to operate generator sets	DENR (Environmental Management Bureau)

2.5 Asian Development Bank Safeguard Policy Statement 2009

53. ADB is committed to ensuring the environmental sustainability of the projects it supports. Its 2009 Safeguards Policy Statement (SPS) has three safeguard requirements (SR): SR1 on Environment, outlines the requirements that borrowers/clients are required to meet when delivering environmental safeguards for projects supported by the ADB; SR2 on Involuntary Resettlement, outlines the requirements that borrowers/clients are required to meet in delivering involuntary resettlement safeguards to projects supported by ADB; and SR3 on Indigenous Peoples, outlines the requirements that borrowers/clients are required to meet in delivering indigenous peoples safeguards to projects supported by ADB. ADB SR3 does not apply to MRT4.

54. **Information Disclosure.** In line with ADB's Public Communications Policy, ADB is committed to working with the borrower/client to ensure that relevant information (whether

positive or negative) about social and environmental safeguard issues is made available in a timely manner, in an accessible place, and in a form and language(s) understandable to affected people and to other stakeholders, including the general public, so they can provide meaningful inputs into project design and implementation.

55. For this Project, which is classified as environment category A project, the following will need to be submitted: 1) draft environmental impact assessment reports at least 120 days before Board consideration; 2) draft environmental assessment and review framework, and draft resettlement frameworks and/or plans before project appraisal; 3) final or updated environmental impact assessments and resettlement plans; and 4) environmental and involuntary resettlement monitoring reports submitted by borrowers/clients during project implementation.

56. **Consultation and Participation**. ADB is committed to working with borrowers/clients to put meaningful consultation processes into practice. For policy application, meaningful consultation is a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. ADB requires borrowers/clients to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities. For projects with significant adverse environmental, involuntary resettlement, or Indigenous Peoples impacts, ADB project teams will participate in consultation activities to understand the concerns of affected people and ensure that such concerns are addressed in project design and safeguard plans.

57. **Local Grievance Redress Mechanism (GRM).** ADB requires that the borrower/client establish and maintain a GRM to receive and facilitate resolution of affected peoples' concerns and grievances about the borrower's/client's social and environmental performance at project level. The GRM should be scaled to the risks and impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process that is gender responsive, culturally appropriate, and readily accessible to all segments of the affected people.

58. **Climate Risk and Vulnerability Assessment.** The ADB also requires the identification of climate change risks to specific sub-project early in the project cycle. Preliminary climate risk screening initially assesses the sensitivity of the project components to climate conditions, i.e., how climate parameters and projected sea level rise will have impacts on project design, design, construction materials to be used, construction schedules, and possible adaptation strategies. Technical notes and information resources have been developed by ADB to guide project proponents in the climate risk and vulnerability assessment.

2.5.1 Comparison of the PEISS and ADB Safeguard Policy Statement

59. An analysis of the current relevant regulations in the Philippines and the ADB Safeguard Policy Statement (SPS) has been carried out. The results of the gap analysis including recommended countermeasures to fill the gaps are summarized in table below.

Table 2-7: Gaps between ADB SPS 2009 and Relevant Regulations in the Philippines on EIA

Topic	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter measures for Filling Gaps
EIA	A 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 ensures that borrowers/clients comply with these requirements during project preparation and implementation. Over time, ADB may adopt additional safeguard requirements or update existing requirements to enhance effectiveness, respond to changing needs and reflect evolving best practices.	EIA is a process that involves predicting and evaluating the likely impacts of a project (including cumulative impacts) on the environment during construction, commissioning, operation and abandonment. It also includes designing appropriate preventive, mitigating and enhancement measures addressing these consequences to protect the environment and the community's welfare (Revised Procedural Manual for DAO 2003-30,1.0,2).	There is no gap between harmonized policies and the Philippines' laws.	Not applicable
Compliance with National Legislations and International Treaties	Apply pollution prevention and control technologies and practices consistent with international good practices, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety (EHS) Guidelines. When host country regulations differ from these levels and measures, the borrower will achieve whichever is more stringent.	Proposals for activities which are outside the scope of the management plan for protected areas are subject to environmental impact assessment as required by law before they are adopted, and the results thereof are taken into consideration in the decision-making process. No actual implementation of such activities is allowed without the required ECC under the PEISS. In instances where such activities are allowed to be undertaken, the proponent carries them out in such a manner as to minimize any adverse effects and take preventive and remedial actions when appropriate. The proponent is liable for any damage due to lack of caution or indiscretion.	No significant gap.	Not applicable
Impacts to be Assessed	Avoid, minimize, mitigate and/or offset adverse impacts and enhance positive impacts through environmental planning and management. Conduct environmental assessment for each proposed project to	The country's statutory framework requiring EIA for all projects that affect environmental quality is embodied in PD 1151 of 1977. Under the EIA process, the proponent assesses direct and indirect impacts of a project on biophysical and	No gap In environment items and contents. However, standards on soil, bottom sediment and vibration	International standards such as WB-IFC's and developed countries standards are referred to in order to

Topic	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter measures for Filling Gaps
	identify potential direct, indirect, cumulative and induced impacts and risks to physical, biological, socioeconomic (including impacts on the livelihood through environmental media, health and safety, vulnerable groups and gender issues), physical and cultural resources in the content of the project's area of influence. Assess potential transboundary and global impacts including climate change.	human environments, ensuring that these impacts are addressed by appropriate environmental protection and enhancement measures (DAO 2003- 30).	have yet to be prepared.	evaluate these items.
Alternatives	Examine alternatives depending on the project's location, design, technology and components and their potential environmental and social impacts Document the rationale for selecting the particular alternative proposed. Consider the "no project" alternative.	The PEISS manual requires that the proponent should implement the alternative analysis and incorporate it into EIS at the feasibility study stage. The PEISS process manual (2008) by the DENR requires that the proponent should consider environmental and social impacts of the project and implement the initial scoping at the pre- feasibility study stage.	No gap identified	Not applicable
EMP	Avoid, where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an 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	Specifying an impact mitigation plan, areas of public information, education and communication, a social development program proposal, an environmental monitoring plan (with multi-sectoral public participation for EIS-based projects) and the corresponding institutional and financial requirements/arrangements.	No gap identified	Not applicable

Topic	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter measures for Filling Gaps
	preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties and the polluter pays principle.			
Consultation	Carry out meaningful consultations 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 a resolution of the affected people's concerns and grievances regarding the project's environmental performance. For Category A projects, ADB ensures that the borrower carries out public consultation at least twice: (a) once during the early stages of EIA's field works and once when a draft EIA report is available and before loan appraisal by ADB.	As part of the social preparation process at pre-scoping, the IEC is now explicitly required at the minimum of PEIS/EIS- based applications for which public scoping is a requirement. The IEC serves as the basis for preliminary identification of stakeholders and related issues in preparation for proper scoping. The conduct of the EIA study engages local stakeholders who may serve as local expert sources, aides/guides and resource persons for primary data collection to optimize the access to indigenous knowledge of the environment. As a form of disclosure of the EIA findings, a public hearing is required for all new ECPs for which public scoping was undertaken and for PEIS-based applications. If necessary, the EMB should conduct public consultations.	No gap identified	Not applicable
Information Disclosure	Disclose a draft environmental assessment (including	As a form of disclosure of the EIA findings, a public hearing is required for all new ECPs	There is no gap between harmonized	Not applicable

Topic	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter measures for Filling Gaps
	the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment and its updates if any, to affected people and other stakeholders.	for which public scoping was undertaken and for PEIS-based applications. Before the PH, relevant documents have to be opened to the public. A full copy of the EIA report is made accessible at the concerned EMB offices, libraries/development council offices of host municipalities. Concerned barangays are also provided with the executive summary of the EIA report. A copy of the ECC is also submitted to other permitting agencies including funding institutions.	policies and the Philippines' laws.	
Monitoring and Disclosure	Implement the EMP and monitor its effectiveness. Document monitoring results including the development and implementation of corrective actions and disclose monitoring reports.	The proponents with issued ECCs are primarily responsible for monitoring their projects. They are required to submit two kinds of monitoring reports, the ECC CMR on a semi-annual basis and the SMR on a quarterly basis to the concerned EMB RO. During project implementation, LGUs are represented in the MMT, or the team consisting of various stakeholders who generally form the pillar for local vigilance to project performance. Major features of the MMT are the following: (i) providing appropriate checks and balances in monitoring of project implementation; (ii) validating the proponent's performance; (iii) recommending courses of action to the EMB through the CMVR. The EMB-DENR remains to be the primary actor for the overall evaluation of the proponents' monitoring and the validation.	There is no gap between harmonized policies and the Philippines' laws.	Not applicable
Site Selection	Do not implement project activities in areas of critical habitats unless (i) there are no measurable adverse impact on the critical habitat that could	All designated and critical habitats are protected in coordination with local government units and other concerned groups from any form of exploitation or	No gap identified	Not applicable

Topic	ADB SPS 2009	Relevant Regulations in the Philippines	Main Gap	Counter measures for Filling Gaps
	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 environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach for the use, development and management of renewable natural resources.	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).		

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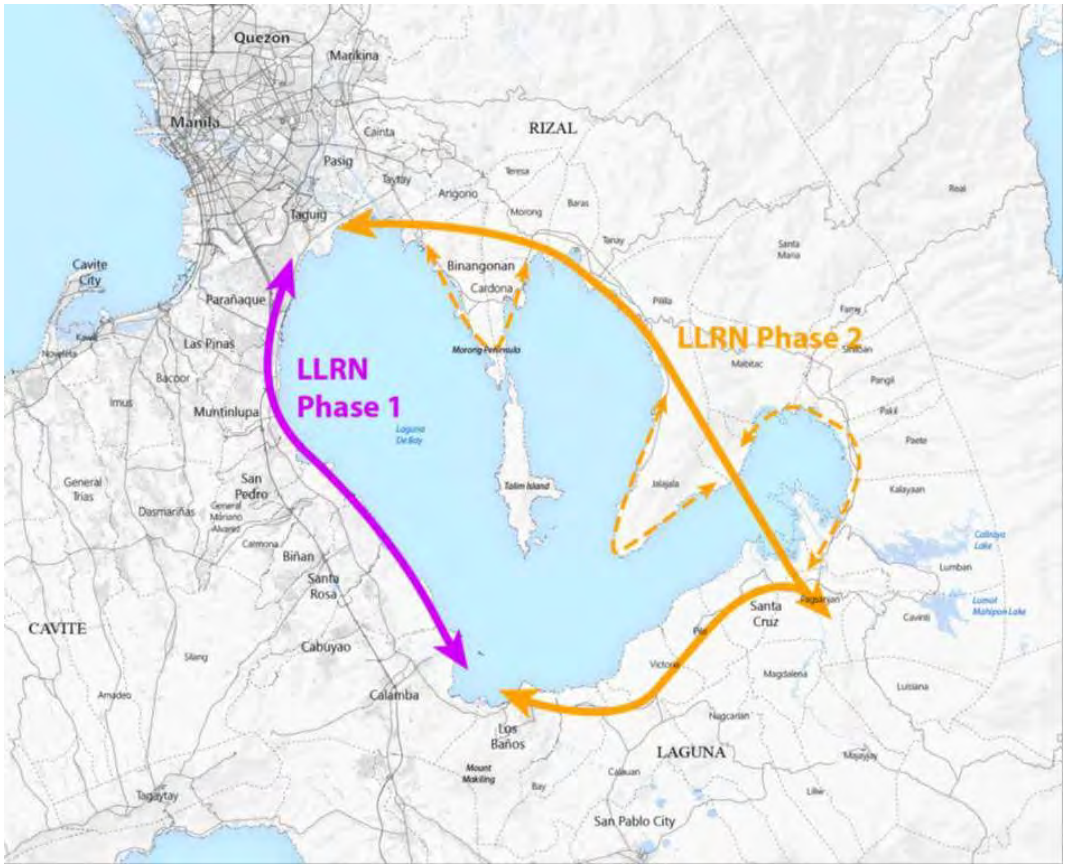
CHAPTER 3. PROJECT DESCRIPTION

60. The Laguna Lakeshore Road Network (LLRN) Project is one of the seven projects under the Infrastructure Preparation and Innovation Facility (IPIF), which aims to support the Department of Public Works and Highways (DPWH) in delivering more effective, efficient, and innovative infrastructure projects nationwide.

61. The LLRN Project caters to the area around Laguna de Bay, with a road network scheme divided into two phases. Phase I runs along the western coastline of the Lake, while Phase II stretches from the northern to the southern coast via an eastern route. The current study is for Phase I of the Project.

Figure 3-1: Project Location of the LLRN Project



Source: LLRN Project – Feasibility Study

3.1 Project Location

62. The LLRN Project is proposed to be built along the shorelines of the Laguna Lake. The subject of this report – Phase I – will begin from Brgy. Lower Bicutan in the City of Taguig (E506618.207, N1601893.661) and end at Brgy. Bucal in the City of Calamba, Laguna (E519002.096, N1569447.584). Currently, there are two (2) road networks existing in the area catering to motorists traveling from Metro Manila to the provinces in the Region IV-A or CALABARZON Region and vice versa. These are the SLEX or AH26 with its entry points in Taguig, Paranaque, Muntinlupa, and Laguna; and the MSR starting at Muntinlupa City, passing through the cities of San Pedro, Biñan, Santa Rosa, and Cabuyao and ends in Calamba in Laguna.

63. Interchanges are distributed along the alignment and will provide access along seven cities on the western side of Laguna Lake. One interchange in Taguig at Barangay Lower Bicutan; three interchanges in Muntinlupa at Barangays Sucat, Alabang, and Tunasan; three interchanges in Laguna at the cities of San Pedro/Biñan, Cabuyao, and Calamba. These interchanges are proposed to connect to city boundaries at the nearest national road and/or Manila South Road. Figure 3-2 presents the proposed mainline alignment and interchanges of the LLRN Project.

Figure 3-2: Proposed Alignment and Interchanges of the LLRN Project

Source: LLRN Project – Phase I DED

64. The LLRN Project is composed of four contract packages: Contract Package 1 is for the main viaduct from Lower Bicutan to Alabang; Contract Package 2 with the shoreline embankment plus viaduct from Alabang to San Pedro/Binan; Contract Package 3 shall comprise the shoreline embankment plus viaduct/bridges from San Pedro/Binan to Cabuyao; and Contract Package 4 with shoreline embankment plus viaduct/bridges from Cabuyao to Calamba.

Table 3-1: Length of Embankment and Viaduct/Bridge per Contract Package (in km)

	Embankment	Viaduct/Bridge	Total
Contract Package 1			
• Mainline	1.13	6.81	7.94
• Sucat Slip Road	0.526	0.488	1.01
• Alabang Slip Road	0.906	-	0.91
Contract Package 2			
• Mainline	1.72	5.91	7.63
• Tunasan Slip Road	0.745	0.201	0.95
• Tunasan Connecting Road	0.581	-	0.58
Contract Package 3			
• Mainline	7.50	4.73	12.23
• San Pedro/Binan Slip Road	0.65	-	0.65
• San Pedro/Binan Connecting Road	1.191	-	1.19
Contract Package 4			
• Mainline	6.17	3.53	9.70
• Cabuyao Slip Road	0.277	-	0.28
• Cabuyao Connecting Road	2.896	0.792	2.98
• Calamba Slip Road	2.761	0.296	3.06

Source: LLRN Project – Phase I DED

Contract Package 1

65. Figure 3-3 presents Contract Package 1. It comprises a 7.942km mainline length from Lower Bicutan to Alabang Interchange, consisting of 1,132m of Embankment and 6,810m of Bridges/Viaducts combined with a flyover. Sucat Interchange comprises a 3,003m total length of Slip Road, Ramps, and a trumpet-type interchange, while Alabang Interchange comprises a 3,126m total length of Slip Road, Ramps, and Roundabout.

66. In Taguig City, the alignment starts at Lower Bicutan with an entry/exit point as a T-intersection with the C6 Extension, approximately 480 meters (m) from the existing C6 Road and General Santos Avenue connecting points. In Barangay Sucat, a proposed trumpet-type interchange is connected to a 1,015m slip road linking the mainline up to Dir. A. Bunye Street. In Barangay Alabang, a roundabout interchange is proposed with a 906m slip road to connect to the intersection of Montillano Street, Manuel Quezon at the north and Ilaya Road at the south. Several residential and commercial structures are noted at this junction including the Alabang Medical Clinic and Iglesia Ni Cristo.

Figure 3-3: Contract Package 1

Source: LLRN Project – Phase I DED

Contract Package 2

67. Figure 3-4 shows the Contract Package 2. It comprises a 7.626km mainline length from Alabang to San Pedro Interchange consisting of 5,890m of Bridges/Viaducts combined with flyovers, 1,717m of Embankment, and 30m of Discharge Opening. Tunasan Interchange comprises a 3,328m total length of Slip Road, Ramps, and Roundabout.

68. An interchange has been considered in Barangay Tunasan, as requested by the City Government of Muntinlupa, with a 947-meter slip road connecting to the nearest local road. To increase the LLRN Project's accessibility to the motoring public, a connecting road will be included in Tunasan, connecting the end of the slip road to the existing Manila South Road (MSR). The alignment of the connecting highway follows an existing road with an approximate length of 580m. A 157-meter pedestrian walkway is also included in the scope of the project to reroute foot traffic away from the corner of the connecting road and the Manila South Road considering that a portion of the connecting road is designed without a sidewalk.

Figure 3-4: Contract Package 2

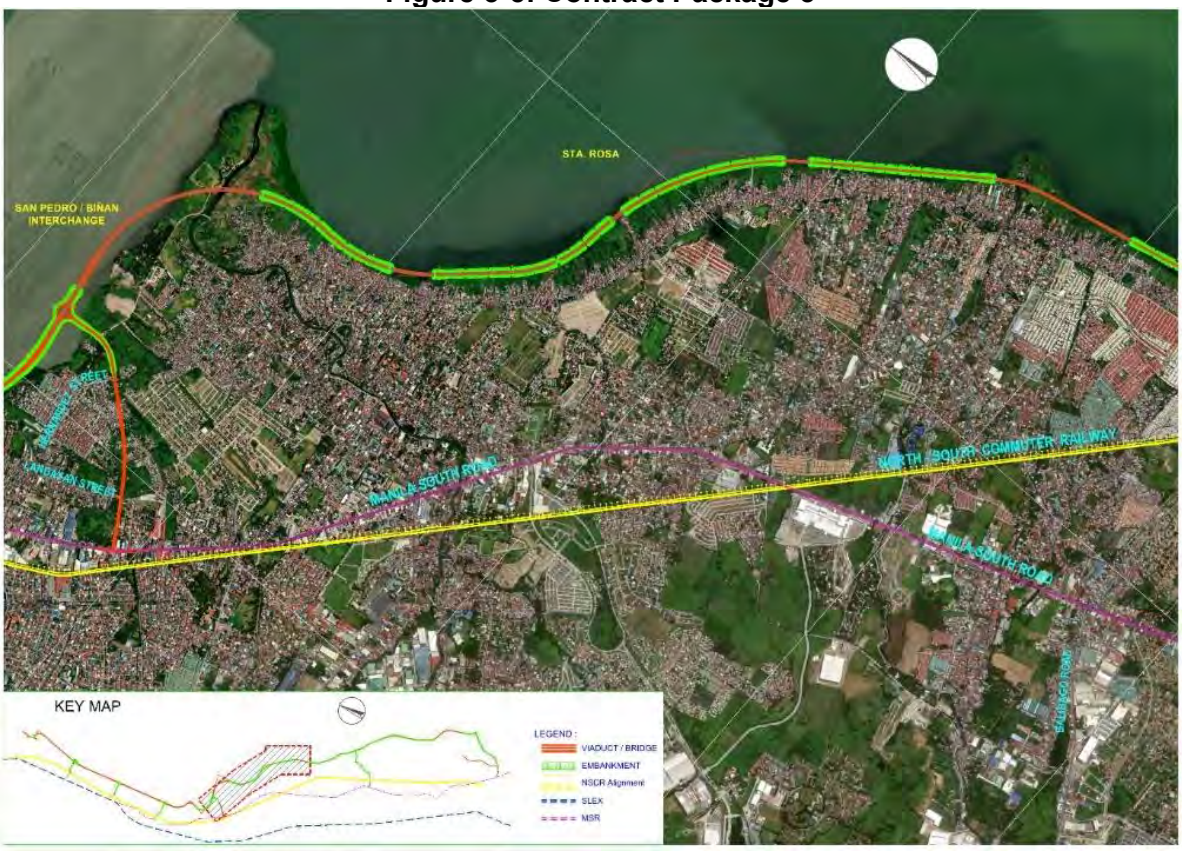
Source: LLRN Project – Phase I DED

Contract Package 3

69. Figure 3-5 presents the Contract Package 3. It comprises of 12.23km mainline length from San Pedro to Cabuyao Interchange consisting of 7,507m of embankment, 4,395m viaducts/bridges combined with flyovers, and 332m of discharge openings while the San Pedro / Biñan Interchange comprises a 2,946m total length of Slip Road, Ramps and Roundabout.

70. Near the border of Barangays Landayan and De La Paz in the cities of San Pedro and Biñan, respectively, in Laguna is another interchange that connects to the mainline with a 650 m slip road that mostly traverses vacant lands, an unnamed road, and a few residential structures with landing point located at the end of Hernandez St. The slip road links to the MSR by a 1.19 km long connecting road which traverses swampy lands and runs almost parallel with the existing waterway (Little Creek). A two (2) 3.0m x 3.0m reinforced concrete box culvert (RCBC) will be constructed where the alignment crosses the creek.

Figure 3-5: Contract Package 3



Source: LLRN Project – Phase I DED

Contract Package 4

71. Figure 3-6 presents the Contract Package 4. It comprises of 9.70km mainline length from Cabuyao to Calamba Interchange consisting of 6,172m of Embankment, 3,545m of viaducts/bridges, and 12m of discharge opening. The Cabuyao Interchange comprises a total length of 567m of Slip Road and Roundabout while Calamba Interchange comprising total length of 3,346m of Slip Road and Roundabout.

72. In Barangay Marinig in Cabuyao, from the at-grade roundabout of the mainline at the shoreline, a 277.5-meter slip road connects to Brgy. Marinig Road traverses a heavily vegetated area and low-rise residential structures. Both sides of this road are occupied by residential houses and compounds: 300 m north of this landing point is the University of Perpetual Help System Maritime Training Center and Cabuyao River, while 300 m south is the intersection of Marinig Road and Southville Road, where the Cabuyao Fish Port and North Marinig Elementary School are located nearby. The slip road at Cabuyao is linked to MSR by a 2.98km connecting road and will include the construction of two (2) bridges crossing the Niugan River and will pass under the structures of the North-South Commuter Railway Extension (NSCR-Ex) Project.

73. Lastly, the at-grade roundabout in Calamba is located at Barangay Palingon. A 3,057-meter slip road connects with the Parian-San Jose-Bucal Bypass Road Project from the roundabout with a T-junction. The Bypass Road Project starts at the MSR, thus providing the connection for the LLRN Project.

Figure 3-6: Contract Package 4

Source: LLRN Project – Phase I DED

3.2 Development Plan, Description of Project Phases, and Corresponding Timeframes

74. The project components will be implemented according to the Department of Public Works and Highways (DPWH) Standard Specifications, Volume II: Highways, Bridges, and Airport, 2013 and Volume III: Flood Control and Drainage Structures and Water Supply Systems, 2019, supplemented with various issuances and additional project-specific specifications where necessary.

3.2.1 Project Phases

Pre-construction/Pre-operational Phase

75. The pre-construction phase involves planning and conducting the detailed engineering design for the project components, obtaining ROW and necessary clearances and local permits, procuring contractors and awarding contracts, and mobilizing for construction.

76. During the pre-constructional phase, the contractor(s) will mobilize equipment and supplies to the project site and erect temporary facilities for workers and field office, storage sheds, and workshops required for the management and supervision of the project—construction management staff and workers, including local labor, which will include women. The casting yard, which will also serve as a dry dock, will be set up where precast concrete elements such as rafters and beams will be cast.

77. Road users near the project site need to be considered during pre-construction. Access roads may need to be opened before construction-related activities commence. Any required road closures or detours will be marked to ensure no safety risks for road users and

minimize possible distribution. A Traffic Management Plan will be prepared within 30 days of issuing the Contractor the Notice-to-Proceed (NTP).

Construction/Development Phase

78. The construction methods presented are commonly adopted worldwide. While the contractors will refer to them, these methods are subject to changes depending on the contractor's preference based on the availability of construction vessels, plants, and resources. In general, the construction or development phase of the LLRN will involve the following activities:

- Dredging for barge access
- Construction of temporary steel deck and piling platform
- Construction of temporary dry working platform
- Installation of pile foundation
- Excavation activities
- Superstructure construction
- Formation of road embankment and slope protection
- Construction of drainage structures
- Installation of ancillary road works

Operational Phase

79. The possibility of a hybrid public-private partnership (PPP) was among the implementation scheme options raised by the National Economic and Development Authority (NEDA) - Investment Coordination Committee - Cabinet Committee (ICC-CC), where the government will undertake the core civil works, while the operations and maintenance (O&M) will be through PPP.

80. The design of the structures will follow the Design Standard guidelines of DPWH, Minimum Performance Standards, and Climate Change Adaptation Resilient infrastructure as prescribed by the Toll Regulatory Board (TRB) and other project specifications, where necessary. These design standards contain principles and requirements for safety, serviceability, and durability. It assumes that the Private Concessionaire will perform maintenance activities during the working life of the structures to enable them to fulfill the requirements for reliability.

81. The PPP O&M is planned to be undertaken by the O&M concessionaire as a separate contract package (i.e., Contract Package 5). To preserve the intended reliability of the structures, there is an absolute requirement for ongoing inspection and maintenance as part of the requirements imposed by the selected private concessionaire, which would take effect after the one (1) year Defects Liability Period (DLP). Replacement or repair of specific components shall be carried out as necessary to ensure that the reliability of the structures is maintained during the intended service life.

82. Depending on the frequency of the scheduled maintenance activities to be imposed on the private concessionaire for the O&M, they may be classified as routine, periodic, or annual maintenance activities.

Decommissioning Phase after Construction

83. The decommissioning phase will be after the project has ended its construction. This will include demobilizing temporary facilities and structures, such as accommodation for work, and removing all equipment. Construction areas will be cleared and cleaned of any construction waste or debris. Demobilization and restoration work will comply with the accepted procedures and standards prescribed in the approved civil works contract, per DPWH standards. The contractor shall prepare a separate comprehensive decommissioning plan and/or rehabilitation management plan (RMP) to address specific issues concerning the project's abandonment. During construction, the contractor shall secure clearance from the lot

owner that they utilize as Temporary Camp/Ancillary/Depot. This shall be prepared by the contractor, approved by DPWH, submitted to DENR, and shared with ADB for review and subsequent approval before project decommissioning.

3.2.2 Project Schedule

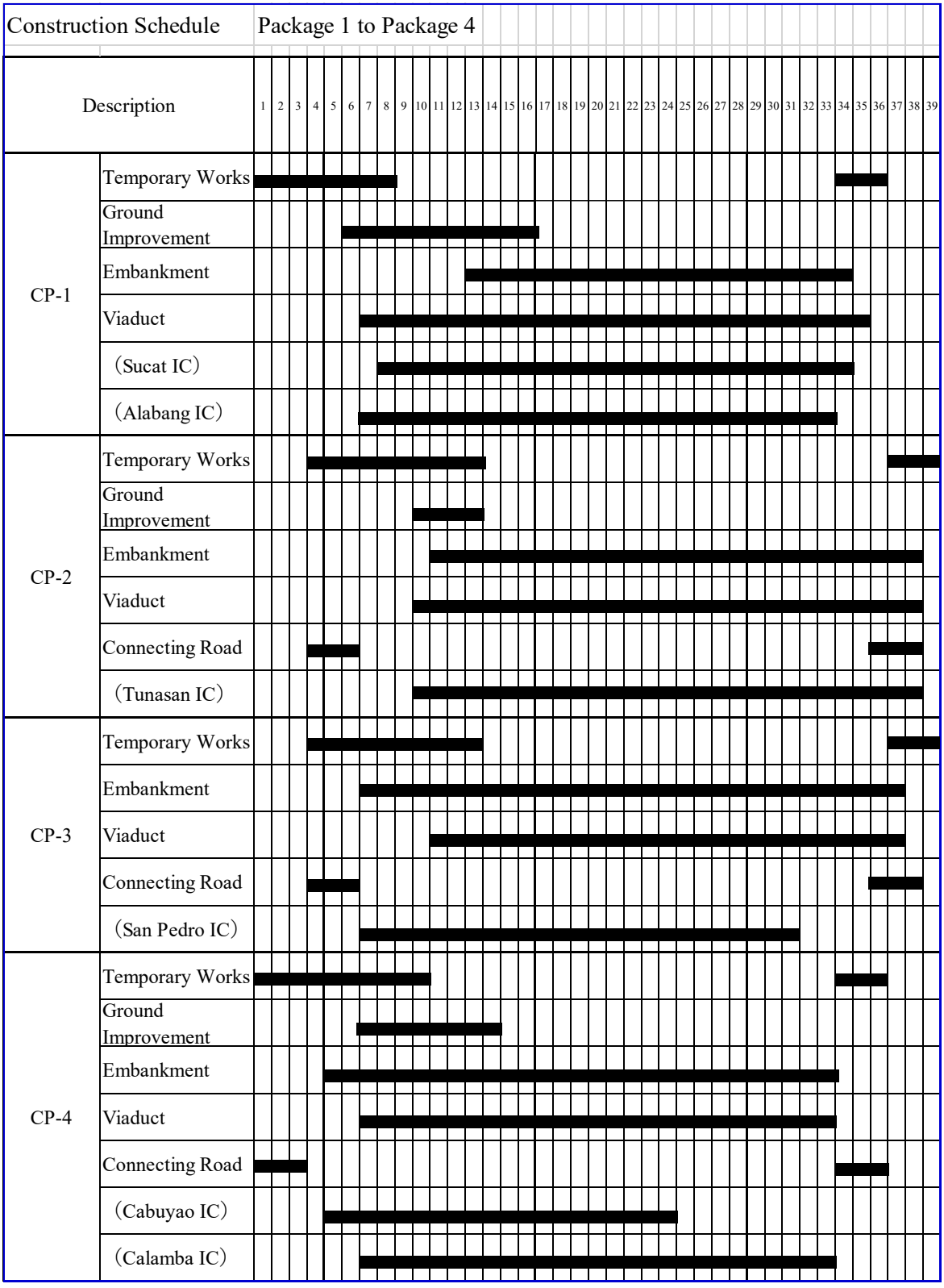
84. Project preparation and identification started in 2018, while the Detailed Engineering Design of Phase I commenced in 2021. Construction is expected to begin in Q4 2024 and end in Q4 2027. The schedule of procurement and implementation is as follows:

- Procurement of Civil Works: 7 months
- Civil Works Construction: 36 months
- Defects Liability Period: 12 months

3.2.3 Construction Schedule

85. **Table 3-2** shows the construction schedule of all packages.

Table 3-2: Construction Schedule of All Packages



Source: LLRN Project – Phase I DED

3.2.4 Indicative Project Investment Cost

86. The Project Cost Estimate, amounting to PHP 181,024.61 Million, consists of costs for civil works, consultancy services for construction supervision, physical contingency, administrative overhead, land acquisition and resettlement, price contingency, and taxes. The table below presents the indicative cost per package.

Table 3-3: Indicative Cost Per Package

Item	Unit	Package 1	Package 2	Package 3	Package 4	Total	Remarks
1. Civil Work (A)	**Million PhP**	**42,189.49**	**39,706.24**	**25,612.91**	**22,471.32**	**129,979.95**	
1-1 Direct Cost	Million PhP	36,564.69	34,229.52	22,431.24	19,549.35	112,774.80	
1-2 Indirect Cost	Million PhP	5,624.80	5,476.72	3,181.67	2,921.97	17,205.15	
2. Engineering and Administration	**Million PhP**	**500.00**				**500.00**	
3. Construction Supervision Management	**Million PhP**	**3,500.00**				**3,500.00**	
4. Land Acquisition	**Million PhP**	**4,589.64**				**4,589.64**	
5. Physical Contingency	**Million PhP**	**2,176.97**	**2,017.04**	**1,301.04**	**1,178.95**	**6,674.00**	
6. Price Contingency	**Million PhP**	**6,370.40**	**5,796.62**	**3,804.27**	**3,266.89**	**19,238.19**	
7. Tax and Duties	**Million PhP**	**5,424.55**	**4,941.41**	**3,187.15**	**2,989.72**	**16,542.83**	
Project Cost	**Million PhP**	**181,024.61**				**181,024.61**	Total (1+2+3+4+5+6+7)

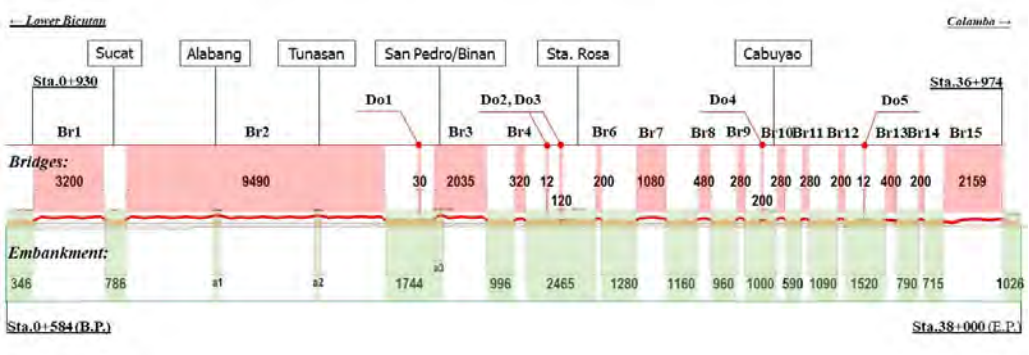
Source: LLRN Project – Phase I DED

3.3 Project Components

87. The project is a road network with dual two lanes along the mainline, except for the section between Sucat and Sta. Rosa, which has three lanes in each direction. The opposing lanes are separated by a median (New Jersey-Type Barrier) with a base width of 0.90m. and 0.6m marginal strips at each side of the barrier. For road embankment, it has a 3.35m wide vehicular lane and a shoulder 2.5m wide. The shoulder has a shoulder margin of 0.50m on each side. Guard rails are provided at the edge of the shoulder margins. The vehicular lanes have a crossfall of 2.0%, and the shoulder is 3.0% for embankment sections and for viaduct/bridges, the crossfall is 2.0% with 1.5m wide shoulder and concrete barrier at edge. Layby are provided in the viaduct at every 1.5km.

88. The LLRN is characterized by a viaduct/bridge and embankment formation. Figure 3-7 shows a line diagram of the viaduct/bridges, discharge openings with types of superstructure, and embankment sections of the LLRN alignment from Lower Bicutan to Calamba.

Figure 3-7: Line Diagram of the LLRN (Viaduct/Bridge and Embankment)



Source: LLRN Project – Phase I DED

3.3.1 Viaduct/Bridge

89. The viaduct portions of the alignment have a vertical clearance of at least a 5.6m from MSL for non-navigable portion, 7.6m from MSL for fishing boats and 8.6m from MSL for passenger boats from the design flood level to allow fisherfolk to pass beneath the viaduct portions. The viaducts would be supported on piles embedded in the lakebed. Major rivers and smaller tributaries would have viaduct or bridge to allow the continuous flow of water into the lake. The identified significant rivers include the San Isidro, Biñan, Cabuyao, San Cristobal, and San Juan Rivers. Figure 3-8 shows the considerations in defining the vertical clearances for the viaducts/bridges.

Viaduct and Bridges

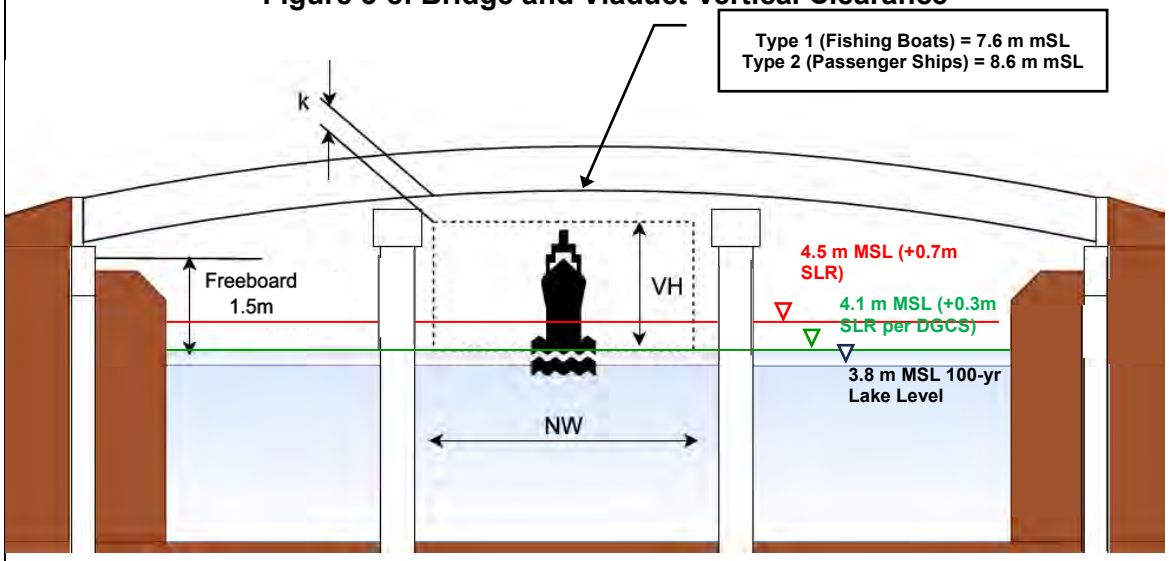
Vertical Clearance (Type I – Fishing Boats) = HWL + HV + K + CC
= 3.8 + 2.5 + 1.0 + 0.3
= 7.6 m MSL

Vertical Clearance (Type II – Passenger Ships) = HWL + HV + K+ CC
= 3.8 + 3.5 + 1.0 + 0.3
= 8.6 m MSL

Where,

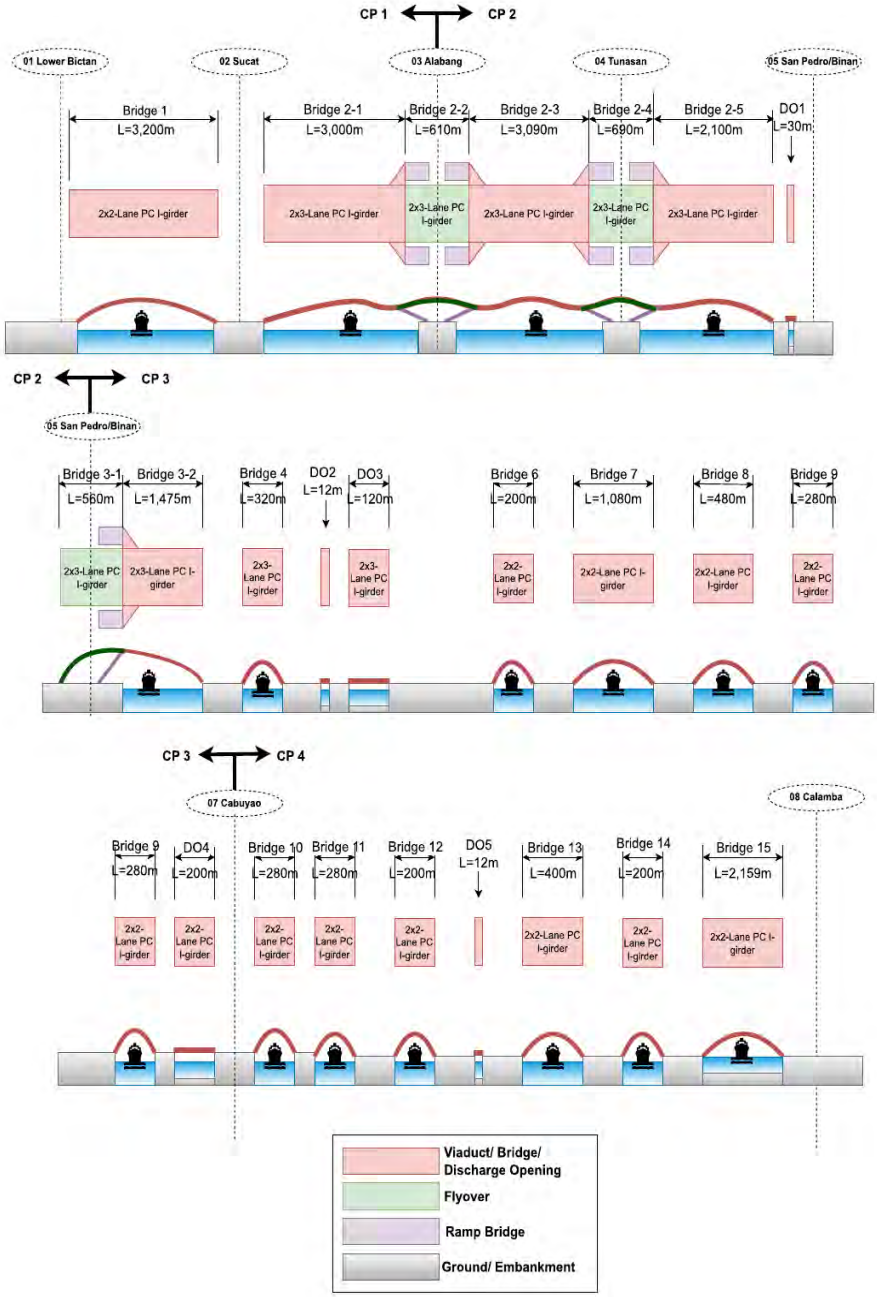
MSL	:	Mean sea level
SLR	:	Sea level rise
HWL	:	Highest Water Level recorded within the AOR (Area of Responsibility)
HV	:	Height of Vessel
K	:	Constant of 1.0-meter allowance that would allow safe passage of vessels or watercrafts or 1.5 meters for rivers carrying debris
CC	:	Water level rise due to Climate Change (0.3 meter: DPWH Design Guidelines, Criteria and Standards, Volume 3, Water Engineering Projects, 2015" Section 9.5.3)
NW	:	Navigation Width (= minimum bridge span length)

Figure 3-8: Bridge and Viaduct Vertical Clearance



Source: LLRN Project – Phase I DED

Figure 3-9: Line Diagram of the Viaduct/Bridges and Discharge Opening with Type of Superstructure per Contract Package

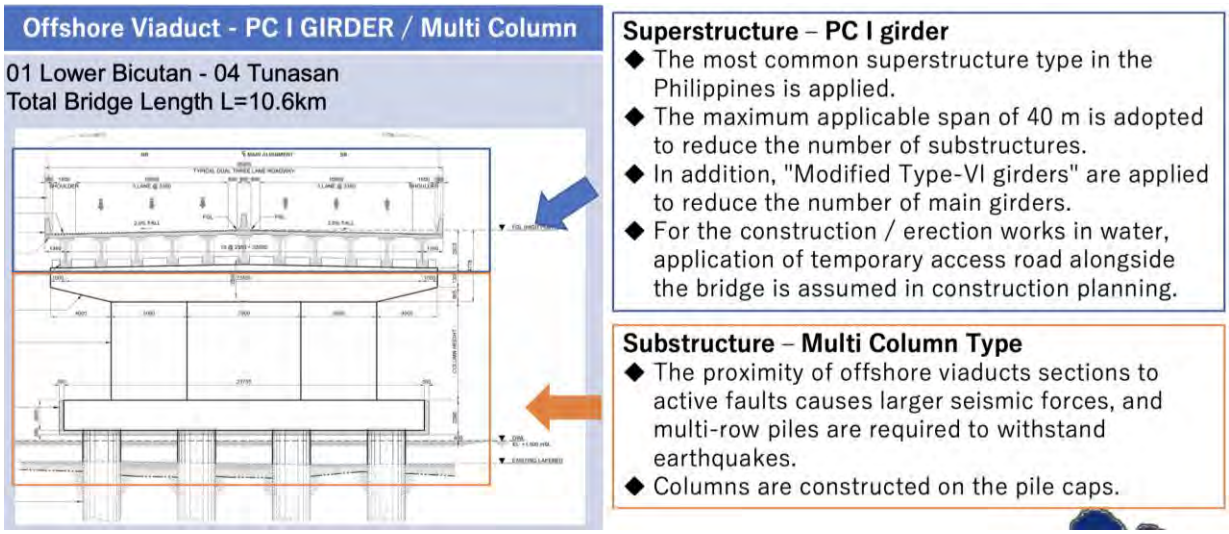


Source: LLRN Project – Phase I DED

90. There are two (2) types of viaducts/bridge construction in the LLRN Project. The first type is the offshore viaduct, which will commence from Lower Bicutan to Tunasan Interchange characterized mainly by straight alignment, away from land, and near an active fault. This type of viaduct is the most commons superstructure in the Philippines with a maximum applicable span of 40m is adopted to reduce the number of superstructures. Due to the proximity to active faults exposed to large seismic forces, multi-row piles will be installed and columns are constructed over pile caps. A temporary access road will be constructed alongside the bridge to allow equipment and material transport. This access road are relatively short and will be removed upon section completion.

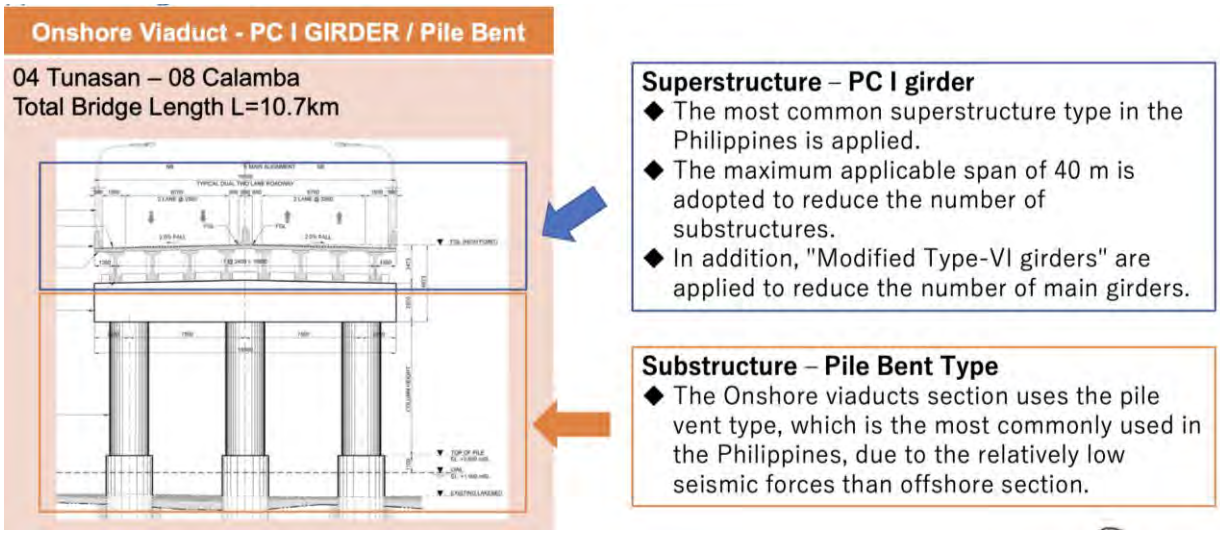
91. The second type is onshore viaduct/bridges from Tunasan Interchange to Calamba Interchange with frequent curves with access from land.

Figure 3-10: Offshore Viaduct



Source: LLRN Project – Phase I DED

Figure 3-11: Onshore Viaduct

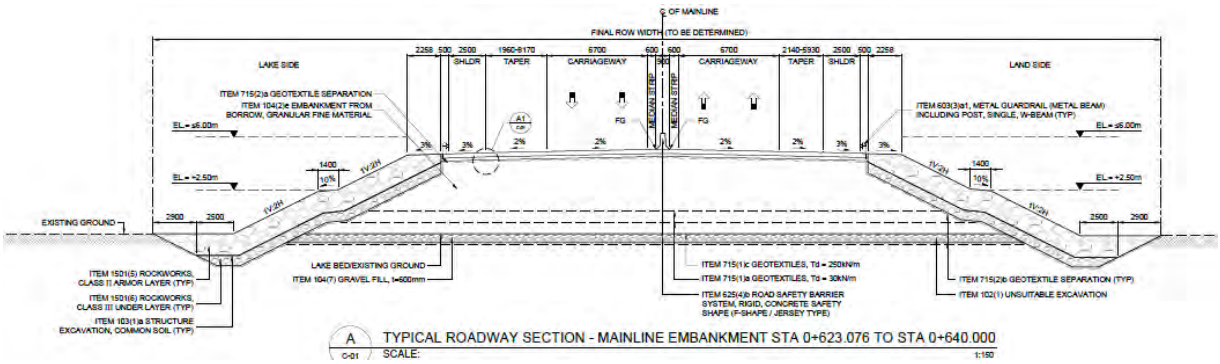


Source: LLRN Project – Phase I DED

3.3.2 Embankment

92. The embankment section of the LLRN Project is set above elevation 6.0m MSL. Embankments will be constructed at the beginning, viaduct approaches, ramp sections, and roundabouts. The fill material for the embankments is designed with geotextile layers and the slope of the embankment is protected by armor rock layers and underlayer, as shown in succeeding Figure. The embankment formation will be provided with equalizing culverts and discharge culverts at an approximate interval of 150m to 250m. This will permit water flow from the shoreline to the lakeside.

Figure 3-12: Typical Slope Protection for Embankment Section

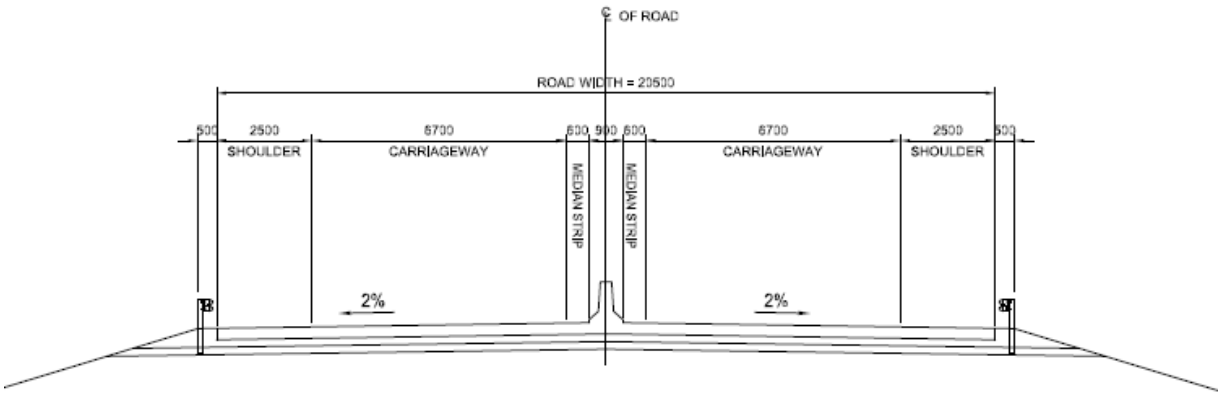


Source: LLRN Project – Phase I DED

3.3.3 Slip Road

93. A slip road, as referred to in the Project, is an embankment formation with slope protection and ditches for drainage. Slip roads connect the LLRN central alignment to the existing road network (near the city boundary at the shoreline) from beyond the roundabout. The slip road is a dual 2-lane road with a 2.10m wide median (Jersey Type barrier and marginal strips) and a 2.50m wide shoulder. The shoulder is changed into a combination curb/gutter and sidewalk where the slip road approaches the residential area. The typical section of a slip road is shown in the following Figure.

Figure 3-13: Typical Section of Slip Road

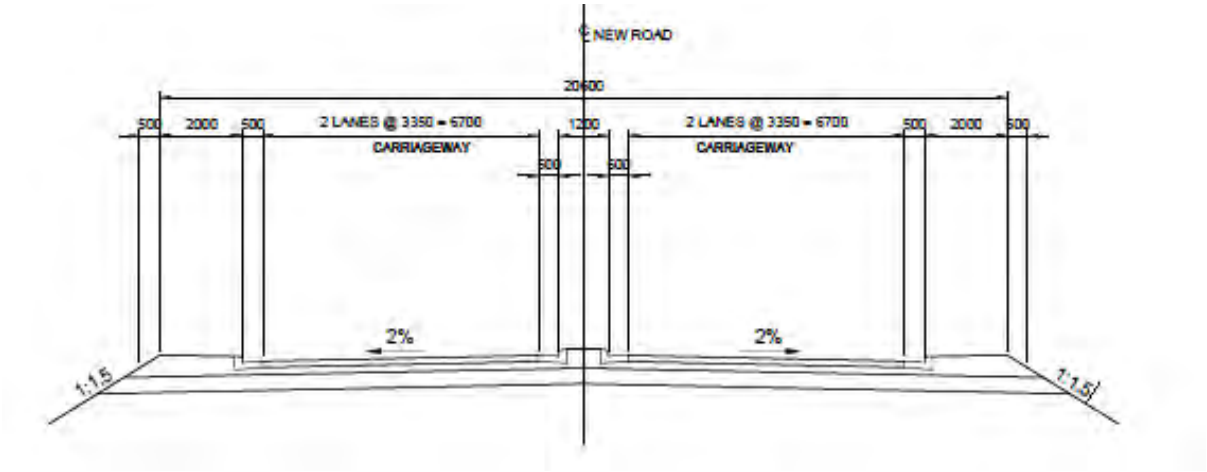


Source: LLRN Project – Phase I DED

3.3.4 Connecting Roads

94. Connecting Roads links slip roads to the Manila South Road (national highway). Connecting roads will be constructed in Tunasan, San Pedro/Biñan, and Cabuyao. The connecting road is a dual-two-lane road with a 2.200m raised median, including marginal strips and a 2.50m combination curb/gutter and sidewalk, as shown below. These connecting roads will also be used to haul materials and equipment to the project site,

Figure 3-14: Typical Section of Connecting Road



Source: LLRN Project – Phase I DED

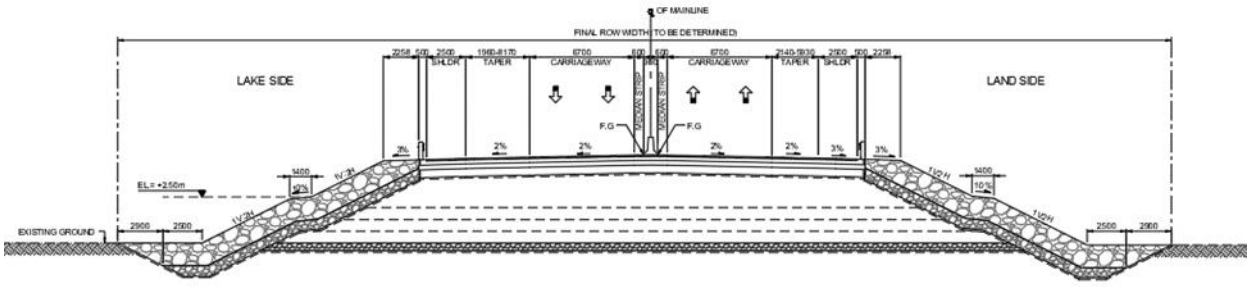
3.3.5 Road Right-of-Way

95. The minimum road right-of-way width for the LLRN Project is 30m. However, this is often exceeded due to the footprint of the embankment slope.

3.3.6 Drainage System

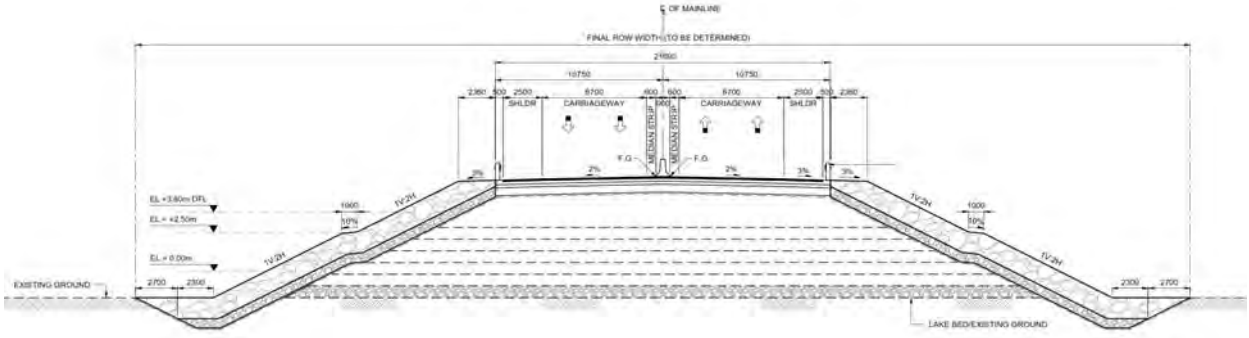
96. For road embankment on the lake, the stormwater runoff within the road drain to the side of the embankment. This design is consistent for the embankment along the mainline and the slip roads. For the sections where the embankment is in the developed areas with existing drainage structures, curb-inlet maintenance holes, and reinforced concrete pipe culverts (RCPC) are considered in the design. The proposed RCPC will connect to an existing drainage system. Drainage opening along the median barriers is provided in horizontal curves with associated superelevation. For viaducts/bridges located directly on the lake and/or waterways, bridge deck drains are provided that drain directly into the lake. Where the viaducts/bridges are located in developed areas or above roads, collecting pipes will be installed that connect to existing drainage structures on the ground.

Figure 3-15: Typical Section for Road Drainage (Mainline)



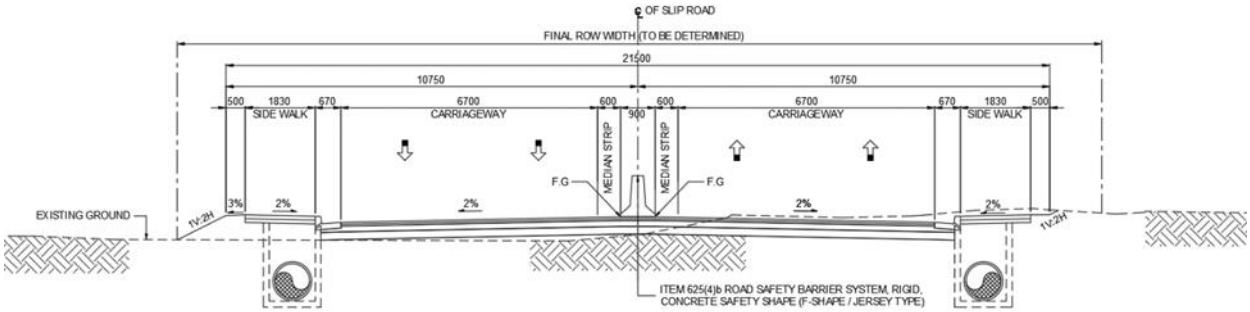
Source: LLRN Project – Phase I DED

Figure 3-16: Typical Section for Road Drainage (Slip Road)



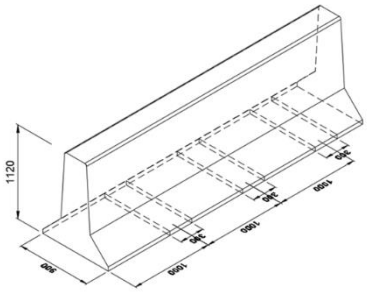
Source: LLRN Project – Phase I DED

Figure 3-17: Typical Section for Road Drainage (Slip Road/Connecting Road)



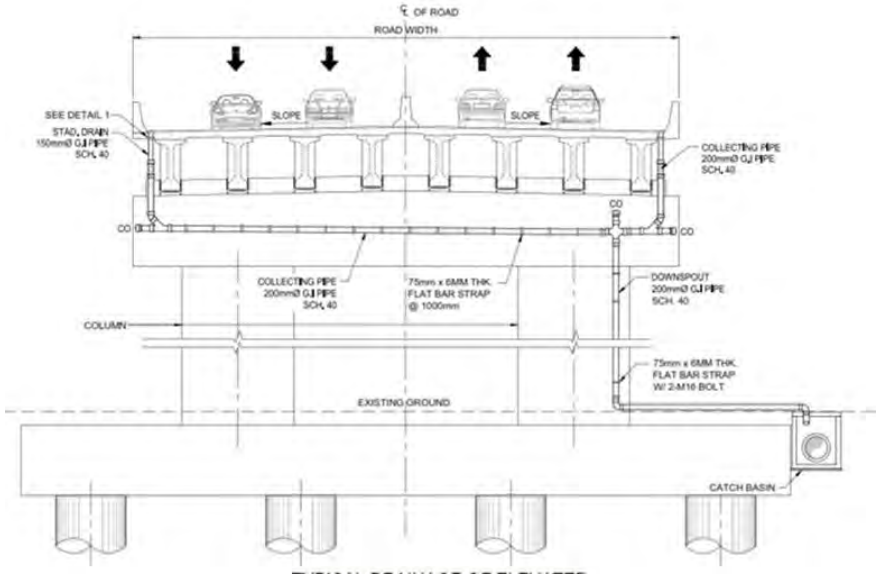
Source: LLRN Project – Phase I DED

Figure 3-18: Typical Median Barrier Drains



Source: LLRN Project – Phase I DED

Figure 3-19: Typical Drainage System for Viaduct/Bridge over Road



Source: LLRN Project – Phase I DED

3.3.7 Road Ancillary Facilities

97. The LLRN Project is designed with streetlights, pavement markings, and road signs. A traffic signal system is provided at selected intersections were warranted. Accessibility ramps are also provided at intersections or cross-points. Emergency median openings are strategically located along the viaduct/bridges and embankment. The LLRN network is illuminated by double-arm solar streetlights on the mainline, slip roads, and connecting roads at the median. Single-arm solar streetlights are provided for the ramps and roundabouts of the interchanges. The LLRN network has reflectorized pavement markings indicating the edge of lanes, chevron markings for islands and ramps' nosing, crosswalks, lane arrows, stop lines, etc. Appropriate regulatory warnings and guide signs are provided. Traffic signal systems are provided at selected intersections – at Lower Bicutan, Sucat slip road/Bunye St., Alabang slip road/Montillano St., Cabuyao slip road/Brgy. Marining Road, Calamba slip road/Bucal Bypass Road and at intersections of the connecting road with MSR (Tunasan, San Pedro/Binan & Cabuyao). Median opening and emergency exits are provided at locations shown in **Table 3-4**.

Table 3-4: Location of Median Openings and Emergency Exits

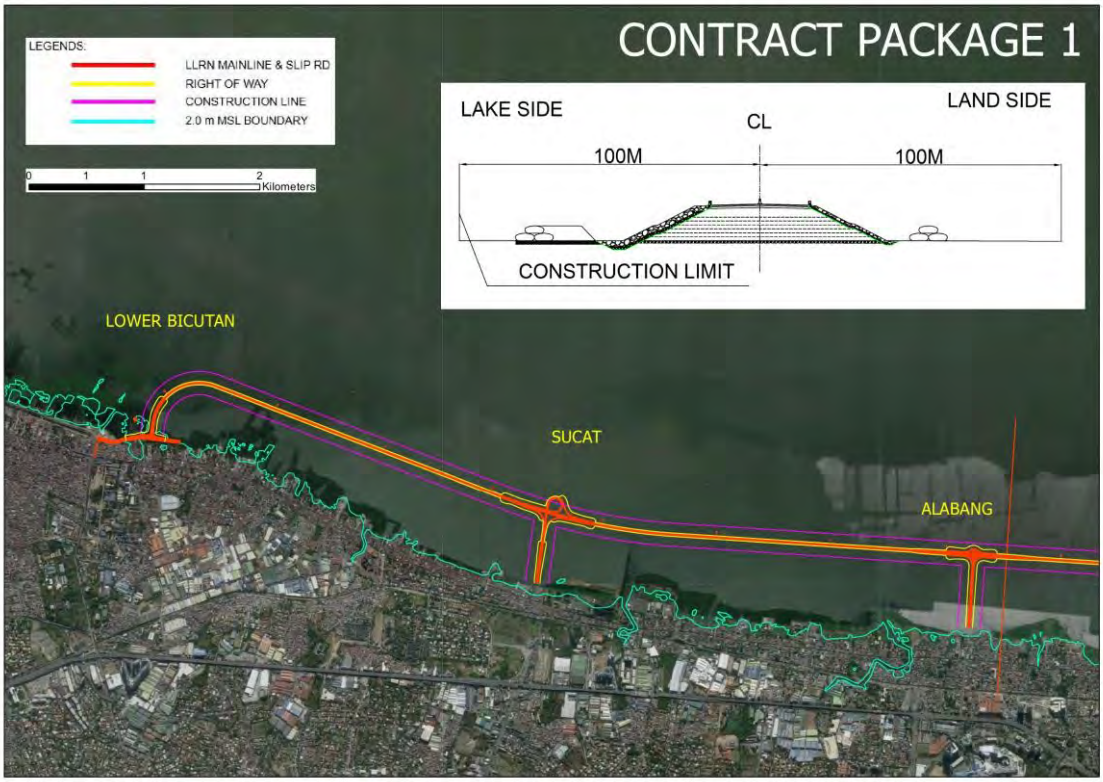
STATION		LENGTH	CONTRACT	DISTANCE BETWEEN	REMARKS
FROM	TO	(m)	PACKAGE	OPENING/EXIT (m)	
00+620.000			CP1		Lower Bicutan Intersection, exit point from LLRN, North Bound.
03+210.000	03+250.000	40	CP1	2590.000	Median Opening - Viaduct
04+180.882			CP1	930.882	Sucat Ramp exit, South Bound
04+525.000	04+555.000	30	CP1	344.118	Median Opening - Embankment
04+936.409			CP1	381.409	Sucat Ramp exit, North Bound
05+795.530	05+835.530	40	CP1	859.121	Median Opening - Viaduct
06+995.530	07+035.530	40	CP1	1160.000	Median Opening - Viaduct
07+711.566			CP1	676.036	Alabang Ramp exit, South Bound
08+730.530			CP2	1018.964	Alabang Ramp exit, North Bound
09+350.265	09+390.265	40	CP2	619.735	Median Opening - Viaduct
10+550.265	10+590.265	40	CP2	1160.000	Median Opening - Viaduct
11+410.000			CP2	819.735	Tunasan Ramp exit, South Bound
12+510.000			CP2	1100.000	Tunasan Ramp exit, North Bound
13+185.000	13+225.000	40	CP2	675.000	Median Opening - Viaduct
14+485.000	14+515.000	30	CP2	1260.000	Median Opening - Embankment
15+860.000			CP2	1345.000	Sn Pedro/Binan Ramp exit, South Bound
16+880.000			CP3	1020.000	Sn Pedro/Binan Ramp exit, North Bound
18+920.000	18+950.000	30	CP3	2040.000	Median Opening - Embankment
23+485.500	23+515.500	30	CP3	4535.500	Median Opening - Embankment
26+485.000	26+515.000	30	CP3	2969.500	Median Opening - Embankment
28+538.370			CP4	2023.370	Cabuyao Roundabout
31+580.000	31+610.000	30	CP4	3041.630	Median Opening - Embankment
34+480.000	34+510.000	30	CP4	2870.000	Median Opening - Embankment
35+815.000	35+855.000	40	CP4	1305.000	Median Opening - Viaduct
37+999.934			CP4	2144.934	Calamba Roundabout

Source: LLRN Project – Phase I DED

3.3.8 Temporary Construction ROW and Facilities

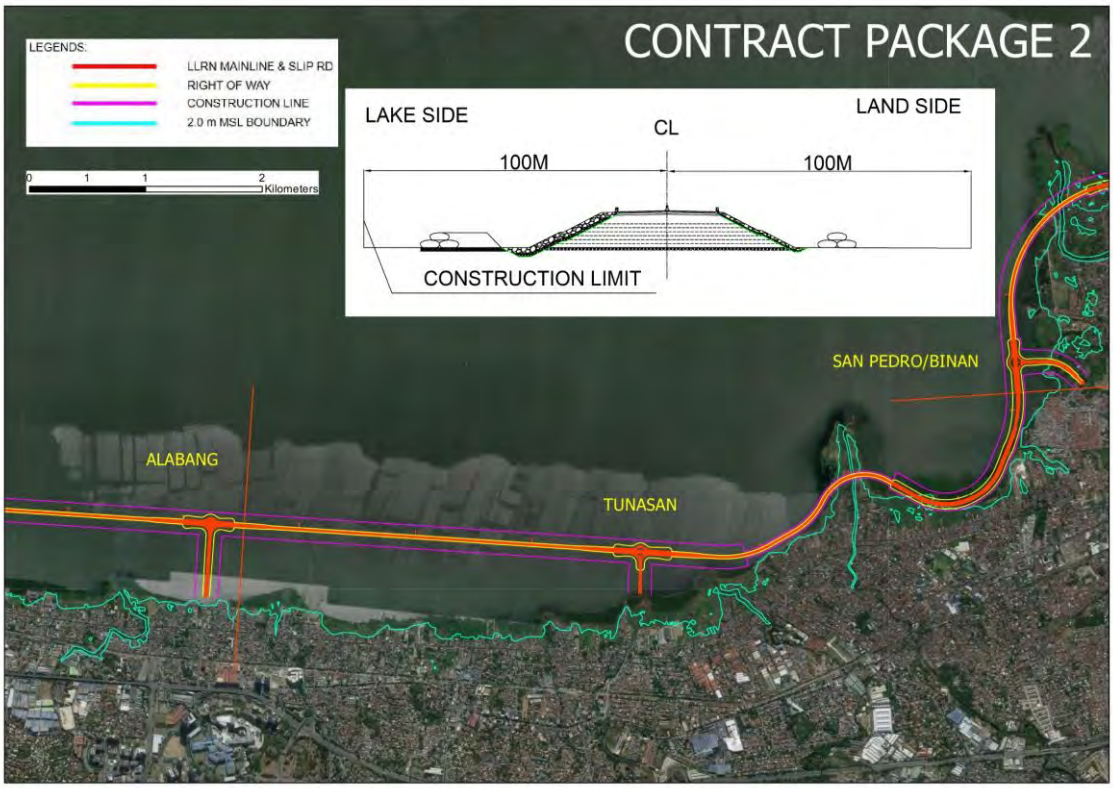
98. Temporary construction areas may impact people. This project's construction limit has been identified as at least 100 meters onshore. In the lakeshore area, distance is adjusted to evade the extent of the impact of construction activities. The construction limits of the four (4) packages are presented in Figure 3-20 to Figure 3-23.

Figure 3-20: Construction Limit in CP1



Source: LLRN Project – Phase I DED

Figure 3-21: Construction Limit in CP2

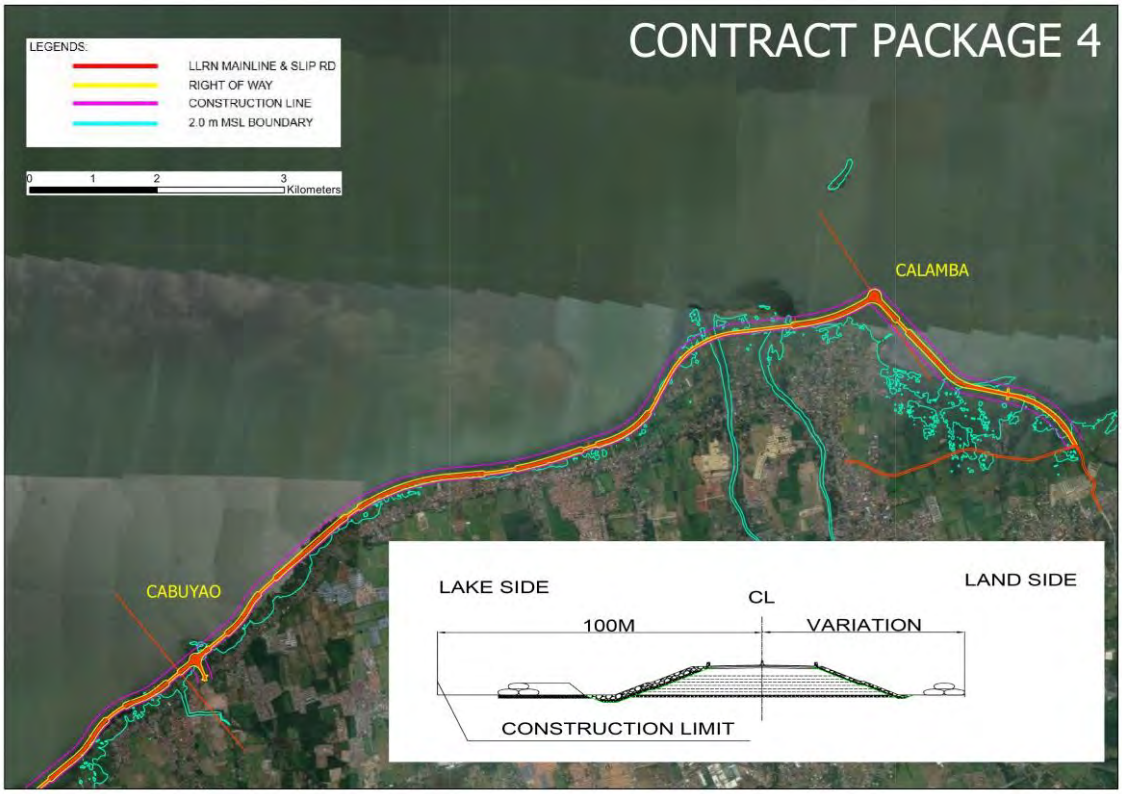


Source: LLRN Project – Phase I DED

Figure 3-22: Construction Limit in CP3

Source: LLRN Project – Phase I DED

Figure 3-23: Construction Limit in CP4



Source: LLRN Project DED Study

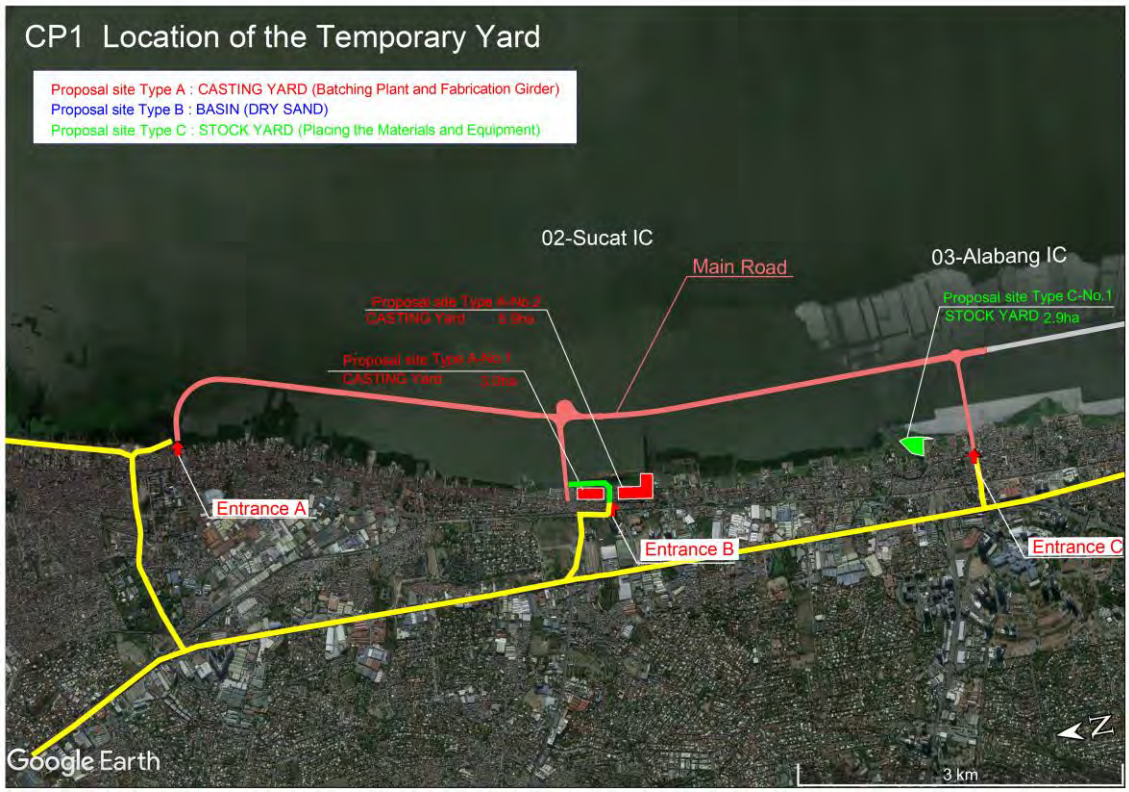
Temporary Construction Facility areas

99. Potential construction yards have been identified, impacting people and the environment. Several options are presented in the Figure below. The provisions included in the Entitlement Matrix will be applied to address any potential resettlement implications. The construction yards will consist of the following facilities: (i) Office (Contractor & Engineer); (ii) Worker's Quarters; (iii) Warehouse; (iv) Rebar, Formwork Fabrication Yard; (v) Batching Plant; and (vi) Casting Yard.

100. For CP1, the proposed construction yard and facilities will be located at a former power plant in Sucat, Muntinlupa, approximately 8 hectares, as shown in Figure 3-24. Three (3) hectares will be allotted to the casting yard, and approximately five (5) hectares will be allotted to the casting yard and batching plant. This property is owned by the Department of Transportation (DOTr) as future resettlement site of affected people from their commuter projects.

101. The proposed transport routes to the temporary construction facility are either by barge to Laguna Lake or by land where the transport route will be from SLEX to General Santos Ave., Lower Bicutan, Taguig, ending at C6 road. Another option is SLEX Sucat, which will go to Meralco Road.

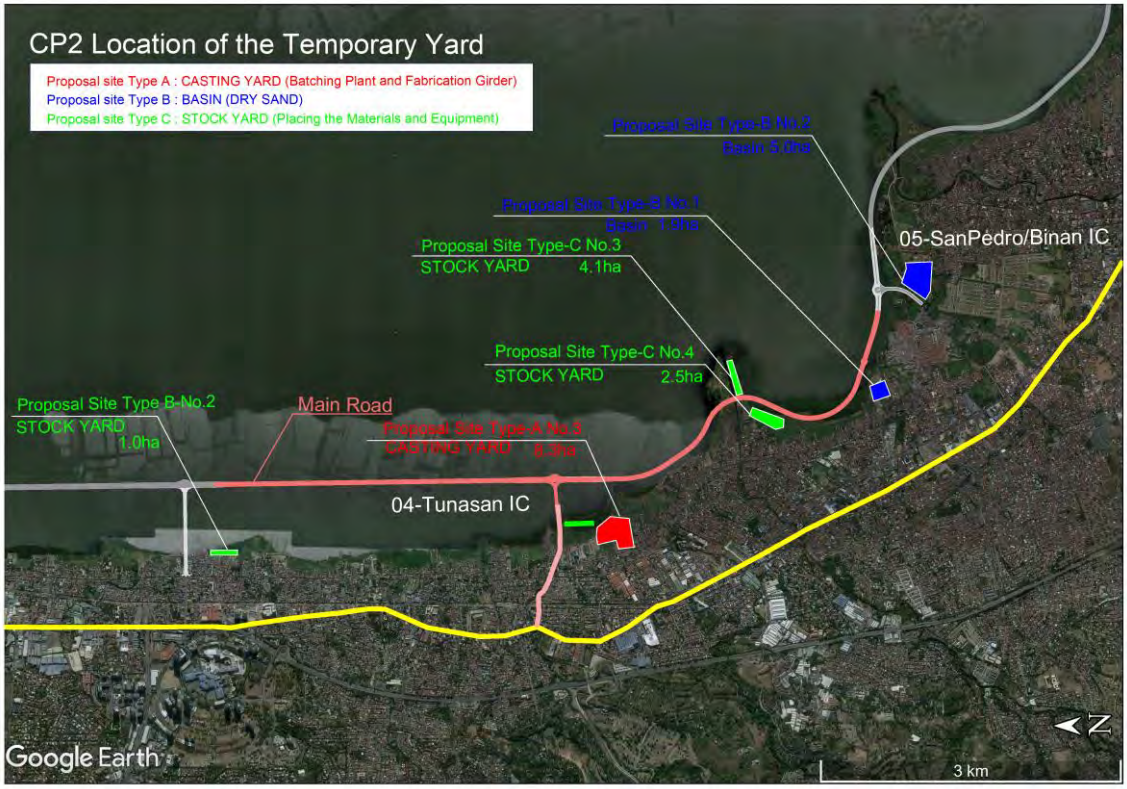
Figure 3-24: Temporary Construction Facility areas in CP1



Source: LLRN Project – Phase I DED

102. For CP2, the proposed construction yard and facilities will be at Brgy. Tunasan, Muntinlupa and San Pedro, Laguna, approximately fifteen (15) hectares, as shown in Figure 3-25. Eight (8) hectares cover the proposed casting yard and batching plant, and seven (7) hectares will be intended for the drying area in San Pedro/Biñan, Laguna. The proposed connecting road will be the access road to the proposed temporary construction facility. MSR to the proposed connecting road will be used as a transport route to the construction facility.

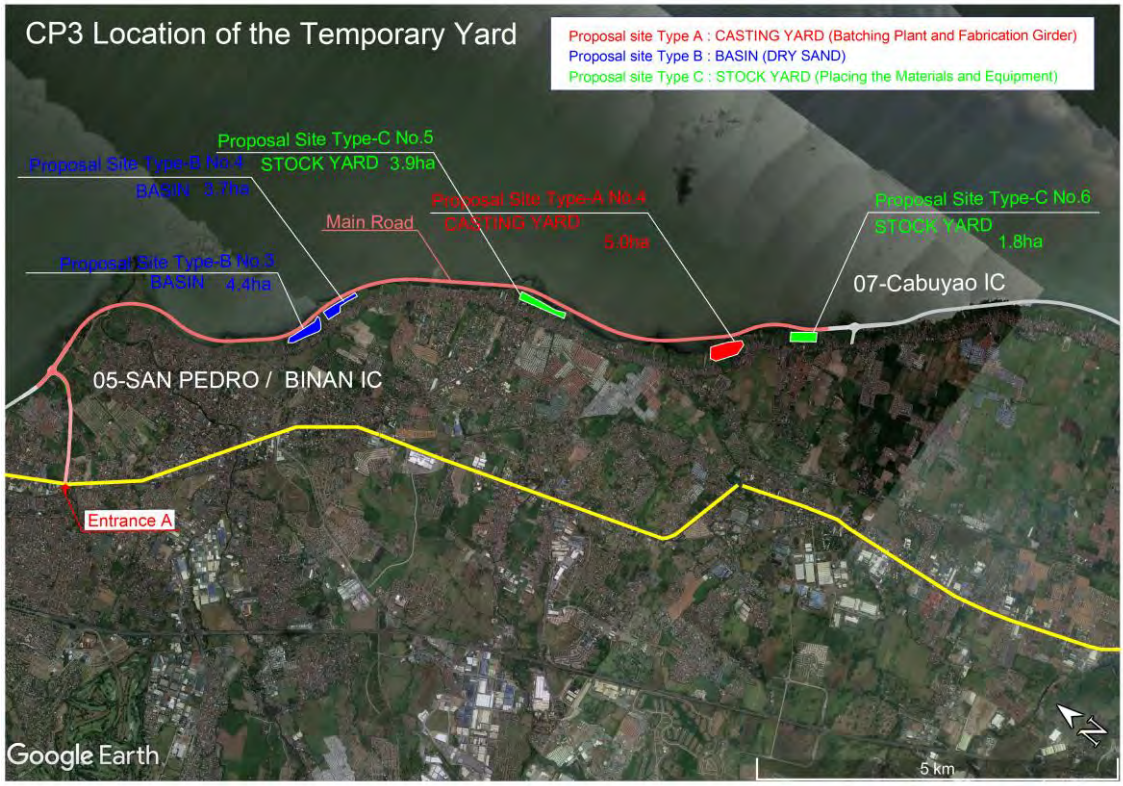
Figure 3-25. Temporary Construction Facility areas in CP2



Source: LLRN Project – Phase I DED

103. For CP3, the proposed construction yard and facilities will be at Brgy. Sinalhan, Sta. Rosa to Brgy. Butong, Cabuyao, Laguna, has approximately nineteen (19) hectares, as shown in Figure 3-26. Five (5) hectares cover the casting yard and batching plant located at Sta. 27+000. There are 2 locations for the basin, four (4) hectares each for the drying area located at Sta. 20+300 and Sta. 27+000. The stockyard (Sta. 24+100 and Sta. 27+900) covers around 6 ha. The proposed connecting road will be the access road to the proposed temporary construction facility. The transport route starts at Brgy. Landayan, San Pedro, Laguna are going to the site. MSR to the proposed connecting road will be used as a transport route to the construction facility.

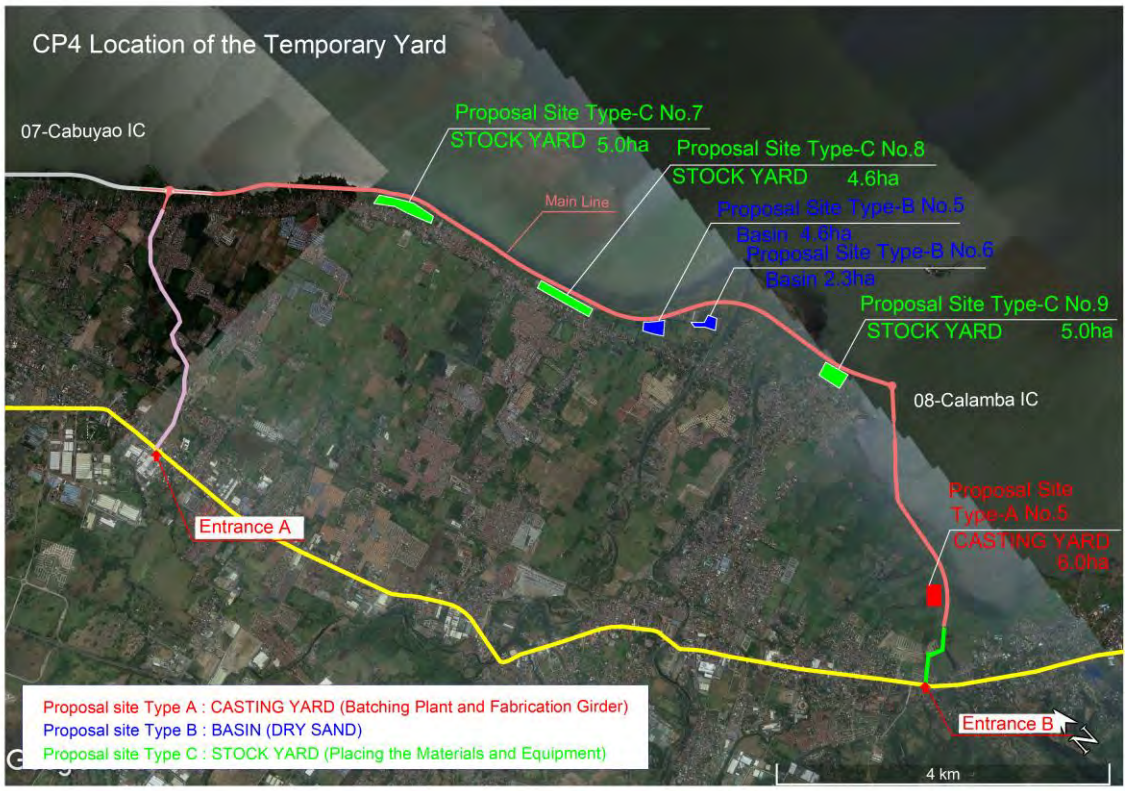
Figure 3-26. Temporary Construction Facility areas in CP3



Source: LLRN Project – Phase I DED

104. For CP4, the proposed construction yard and facilities will be located at Brgy. Marinig, Cabuyao to Brgy. Bucal, Calamba, Laguna, approximately twenty-seven (27) hectares, as shown in Figure 3-27. Six (6) hectares cover the casting yard and batching plant at Sta. 2+600. There are 2 locations for the basin; four (4) and two (2) hectares will be intended for drying area located at Sta. 34+900 and Sta. 35+700 respectively. The stockyard (Sta. 31+700, Sta. 33+900, and Sta. 37+400) covers around 15 hectares. The connecting road will be the access road to the proposed temporary construction facility. The transport route starts at Brgy. Landayan, San Pedro, Laguna going to the site. Another alternate route will start at MSR, going to Bucal Bypass Road. MSR to the proposed connecting road will be used as a transport route to the construction facility.

Figure 3-27. Temporary Construction Facility areas in CP4

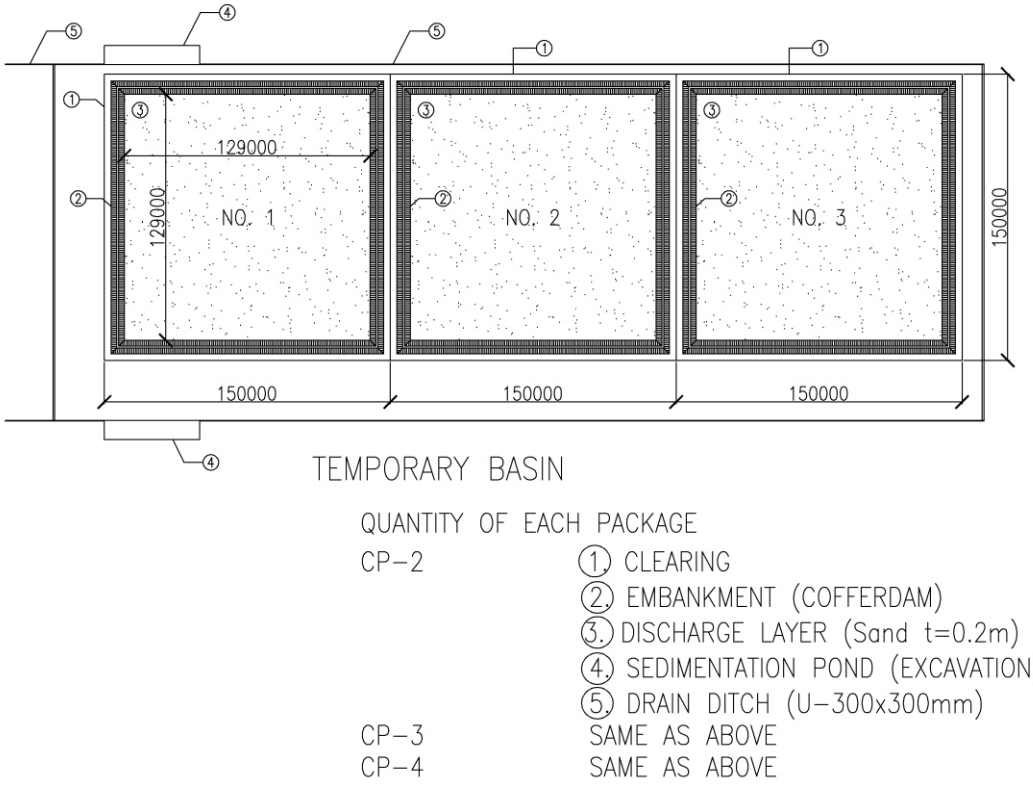


Source: LLRN Project – Phase I DED

Basin Yard

105. CP2 to CP4 will construct a basin. The dredged sand will use a cutter suction dredger connected to the pipeline to the drying basin. Once dry, the dredge material will be used as a material source for embankment if the dredge material conforms with the quality control test for embankment criteria. The plan for the basin yard is shown in **Figure 3-28**. The basin yard is surrounded by a canal that will flow to the sedimentation pond.

Figure 3-28: Plan of Basin Yard



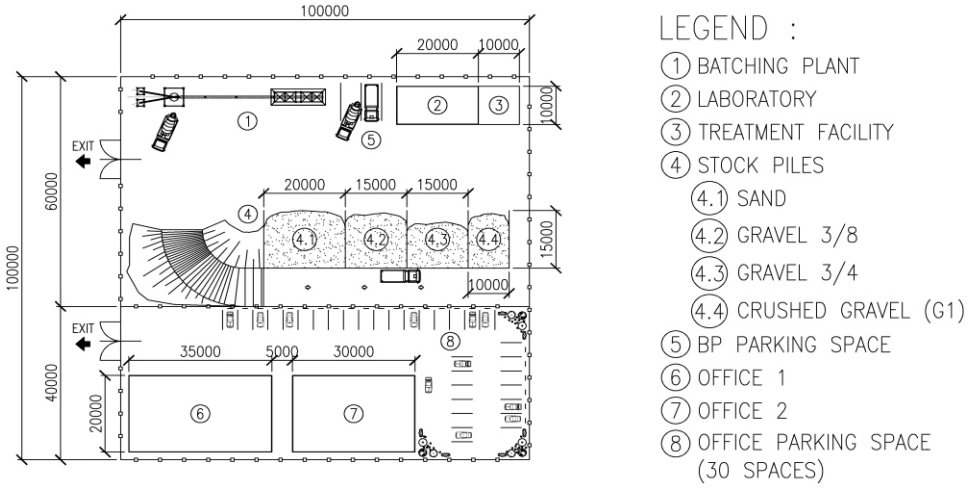
Source: LLRN Project – Phase I DED

Batching Plant

106. The Concrete Batching Plant will be installed on the site of each package to ensure the supply of large amount of concrete quantity required, support the continuous and stable fabrications of girders, and reduce environmental impact (noise, vibration, and traffic congestion). The specification of the batching plant is as follow:

- Rated Productivity: 90 m^3/hour
- Production Capacity per batch: 1.5 m^3
- Mixing motor power: 2 × 30 kw
- Aggregate Batching Machine: 4 bins
- Cement Silo: 2 × 100 T
- Total Weight: 40 T
- Total Power: 160 kw

107. Figure 3-29 shows the plan for the Batching Yard while the succeeding Figures provide the locations of construction yards for CP1 to CP4.



Source: LLRN Project – Phase I DED

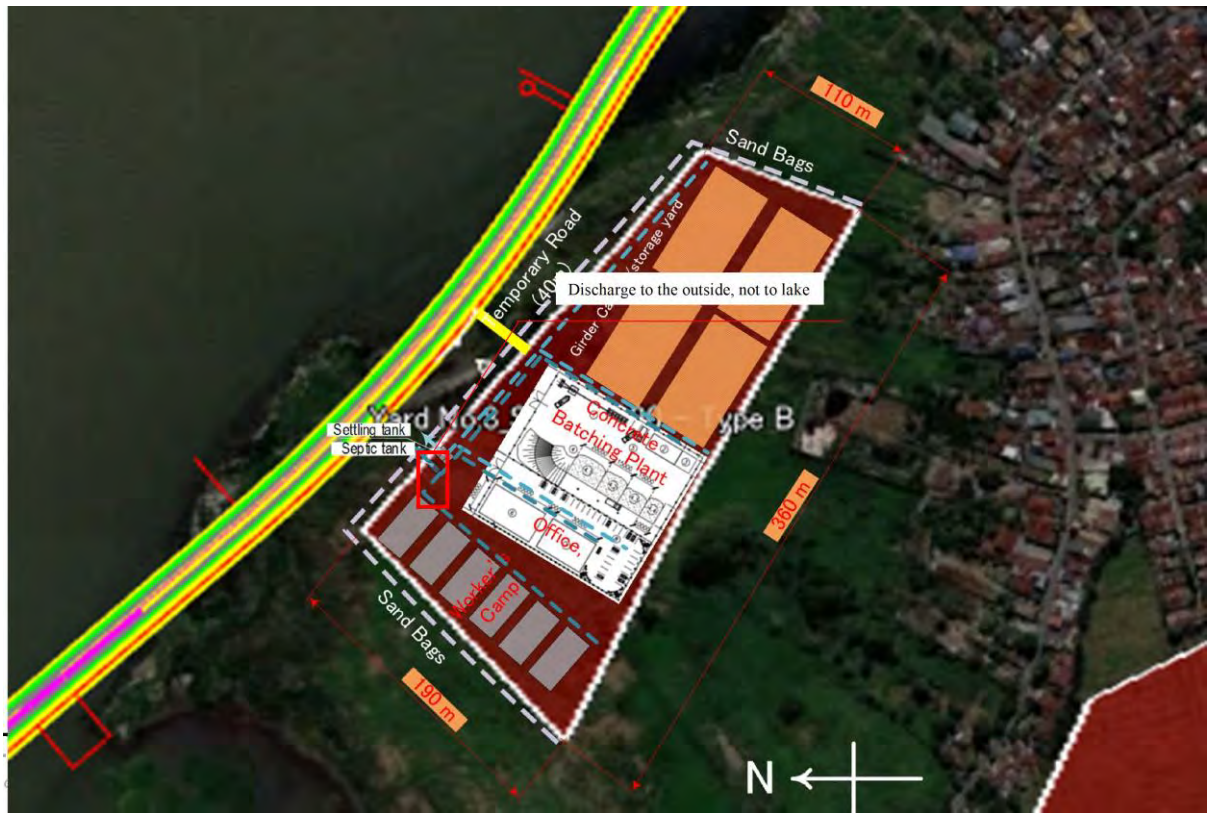
Figure 3-30: Construction Yard for CP1

Source: LLRN Project – Phase I DED

Figure 3-31: Construction Yard for CP2

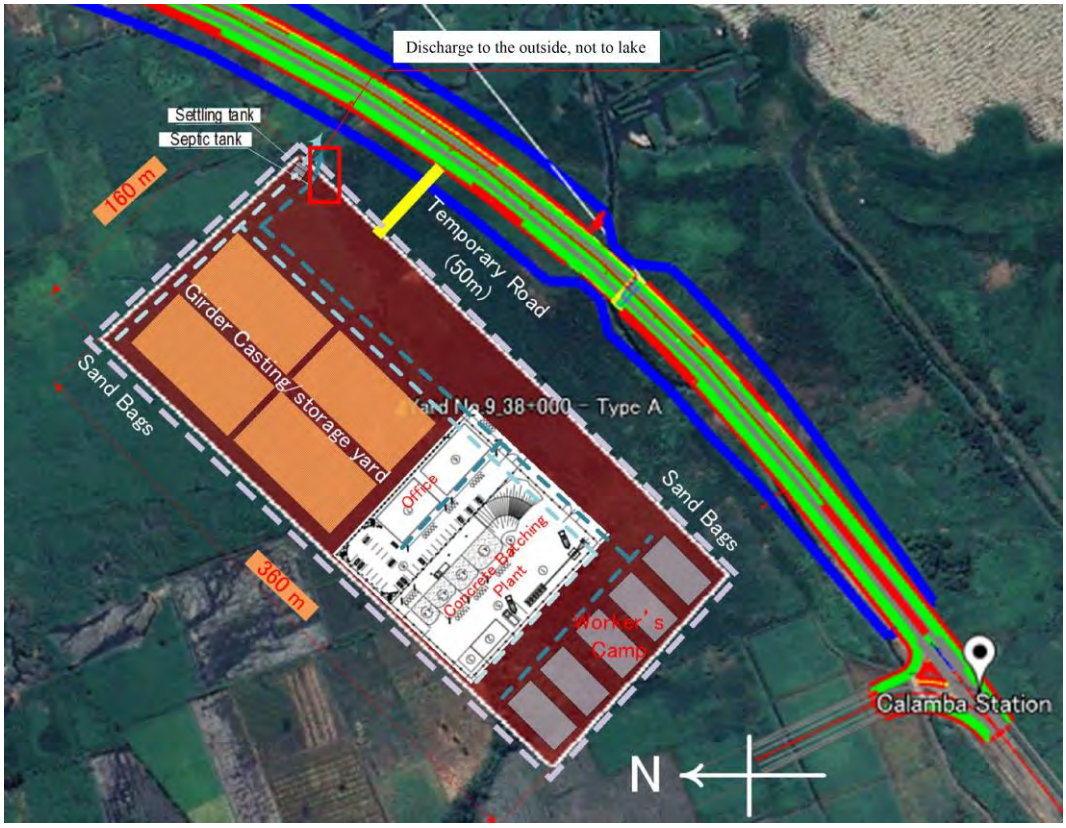
Source: LLRN Project – Phase I DED

Figure 3-32: Construction Yard for CP3



Source: LLRN Project – Phase I DED

Figure 3-33: Construction Yard for CP4



Source: LLRN Project – Phase I DED

3.3.9 Construction Methodology

Embankment

a) Temporary Embankment

108. Temporary embankment will be required in CP1, CP2, CP3 and CP4 for all viaduct areas. The temporary embankment will be used as access road to the construction areas and removed after the construction works. Gaps will be provided to allow continuous flow of water to the lake. For CP1, there will be an opening of at least 500m; while for CP2, CP3, and CP4, temporary bridges shall be constructed at the location of the viaduct. The construction schedule for the viaduct section of each contract package will be shown in the succeeding sections.

109. Figure 3-34 shows that using the geotextile tube enclosing several piers for cofferdam (Method 1). The purposes of the coffer damming are to keep the offshore embankment area dry and to maintain the work area for viaduct erection and the temporary road. The crest of the cofferdam will be at least above EL2.0 m.

110. During the cofferdam installation fine sand, with particle size distribution from 0.1-0.5mm, will be used as filling material to ensure impermeability and stability. This sand will be sourced generally outside the project area as the soft soil in-situ is not appropriate for filling the Geotextile Tube. Sand will be dredged and for log distance hauling, hopper barges will be used. Temporary embankments will be removed, transported, and disposed of at the disposal site.

Figure 3-34: Cofferdam of Geotextile Tube

Source: LLRN Project – Phase I DED

b) Permanent Embankment

111. Similar method for cofferdam construction using a geotextile tube will be used. However, the dredge materials will be via cutter suction dredger to the dry basin. The dried suitable dredge materials will be used for embankment. Specific preparation of ground improvement for soft soil treatment and stabilization will be made. Embankments will be installed in by layers using geotextile reinforcement and separation.

Viaduct

112. Figure 3-35 to Figure 3-38 present the construction schedule for the viaduct to ensure the passage of fisherfolks accessing the lake throughout the construction period. As explained above, for CP1, there will be an opening of at least 500m; while for CP2, CP3, and CP4, temporary bridges shall be constructed at the location of the viaduct.

Figure 3-35: Viaduct Construction Schedule for CP1


Legend
Embankment
VIADUCT
Temporary Embankment :
Step 3
31MONTH
01-Lower Bicutan
02-Sucat
03-Alabang
OPENING
Google Earth
3 km


Legend
Embankment
VIADUCT
Temporary Embankment :
Step 4
36MONTH
01-Lower Bicutan
02-Sucat
03-Alabang
Google Earth
3 km

Figure 3-36: Viaduct Construction Schedule for CP2

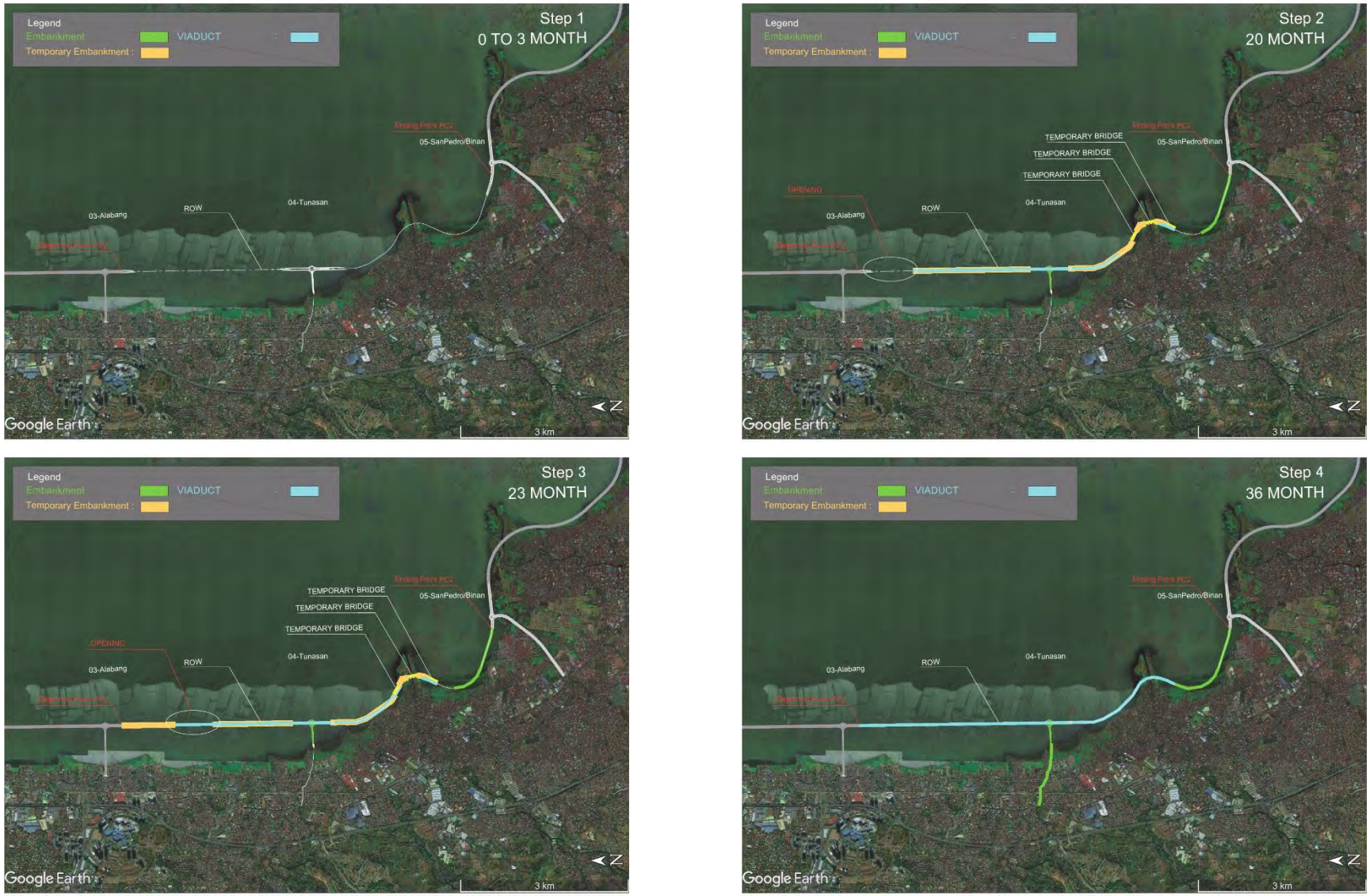
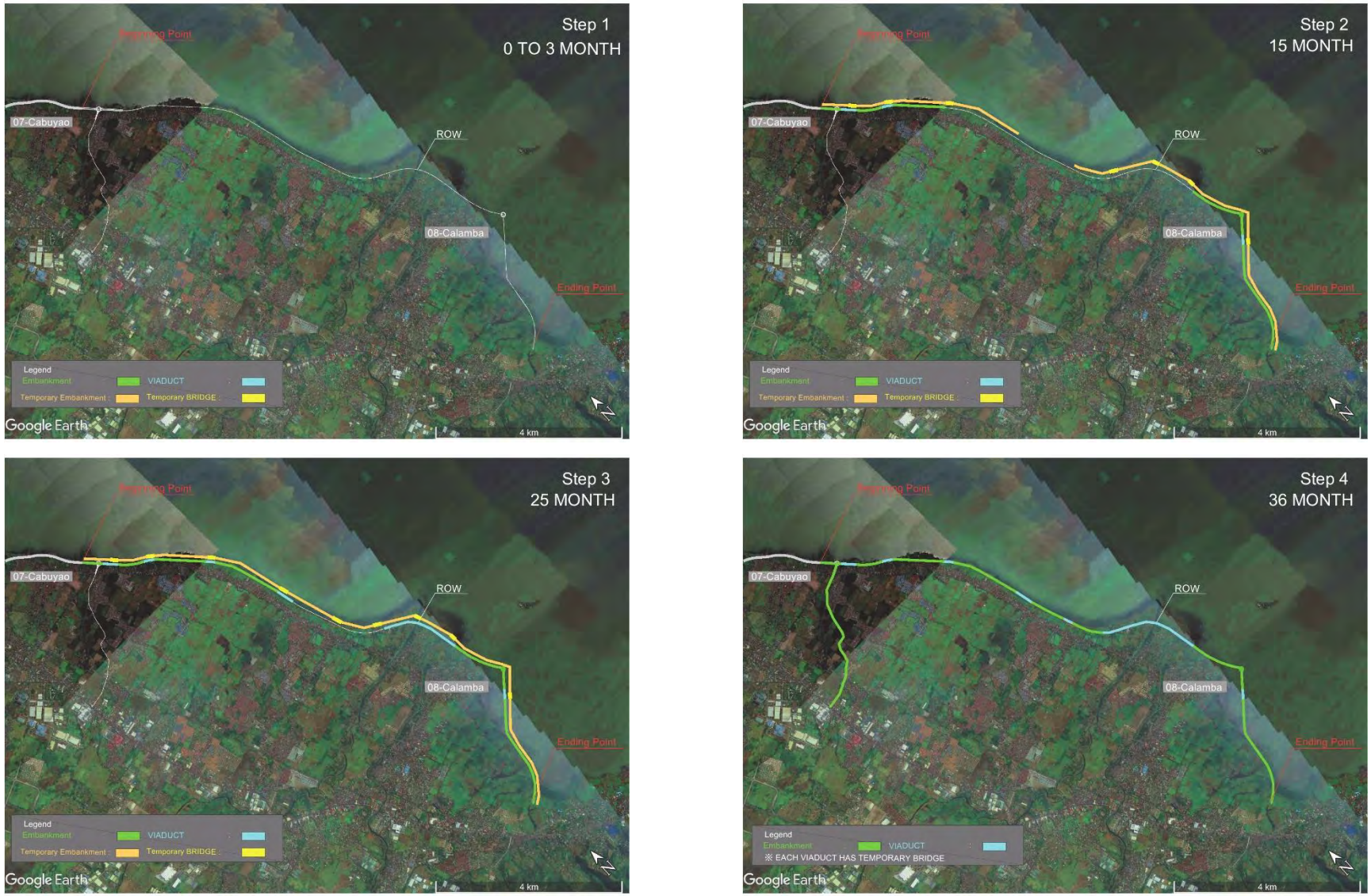


Figure 3-37: Viaduct Construction Schedule for CP3

Figure 3-38: Viaduct Construction Schedule for CP4



Pile Foundations

113. Bridge construction shall be done on the temporary work area and road above lake level. Heavy equipment, rebar, ready-mix concrete, and other construction materials shall be transported via temporary road and piled in the respective stockpile area. The bored piles shall be cast in place. The diameter of the cast-in-place piles ranges from 1.0 m to 3.0 m, and the earth auger method is recommended for installation. Procedures for preparation works, drilling, and casting for pile foundations have been established.

Superstructure Construction

114. Girders will be launched using two cranes and transported to the site through the temporary construction road on the geotextile tube. This is followed by deck slab construction made of reinforcing bars that are assembled on-site and the concrete floor slabs cast. After the floor slabs are cast, the barrier is installed to complete the construction. Details are discussed in Annex B.

Sources of Construction Material

115. Substantial amounts of construction materials are available within the Laguan Lake watershed. The PEA 1991 Feasibility Study of the Laguna De Bay Reclamation Project, it was estimated that around 220 million cubic meters of sand and fill materials exist along the identified area. In contrast, the LLRN Project will require a total earth fill material embankment is around of 16 million cubic meters. Porac, Pampanga can provide sand for embankment and concrete production, which is about 103 km via NLEX. Montalban, Rizal can supply aggregate (fine and coarse) for pavement and concrete production, about 50 km via C6 road. Angono, Binangonan can provide aggregates (fine and coarse) for pavement and concrete production, which is about 19 km. Finally, Taysan in Batangas can supply additional aggregates for pavement and concrete production and armor rock, which is about 75 km via at-grade SLEX.

Table 3-5. List of Quarries

Nos	COMPANY	LOCATION OF QUARRY			COMMODITY	PRODUCTION CAPACITY (CY 2022)		OUTPUT	APPROXIMATE HAULING DISTANCE (km.)	DELIVERED TO	
		ESTIMATED AREA OF QUARRY (ha.)	BARANGAY	MUNICIPALITY, PROVINCE		ESTIMATED QTY	UNIT	cu.m/hour		STATION	PACKAGE
1	**DMM PORAC QUARRY**	16.0	Calzadang Bayu	Porac Pampanga	Fine Aggregates (Vibro Sand)	75,000.00	cu.m/month	375	108	Lower Bicutan	CP-1 & CP-2
					Coarse Aggregates (G1, ¾", 3/8")						
					Fine Aggregates						
					Base Coarse (Class A)						
					Sub-base Coarse						
2	**ATN HOLDINGS INC.**	256.0	Macabud	Montalban Rizal	Coarse Aggregates (G1, ¾", 3/8")	35,200	cu.m/month	176	45	Lower Bicutan	CP-1 & CP-2
					Fine Aggregates						
					Armour Rocks (500-1,000kgs.)	1,760		9			
3	**RODROCKS & AGGREGATES CORP.**		San Isidro	Montalban Rizal	Coarse Aggregates (G1, ¾", 3/8")	79,230	cu.m/month	396	44	Lower Bicutan	CP-1 & CP-2
					Fine Aggregates						
					Base Coarse (Class A)						
					Sub-base Coarse						
					Armour Rocks	4,170		21			
					Boulders						
4	**MONTALBAN MILLEX AGGREGATES CORP.**		San Rafael	Rodriguez Rizal	Coarse Aggregates (G1, ¾", 3/8")				44	Sucat	CP-1 & CP-2
					Fine Aggregates						
					Base Coarse						

Nos	COMPANY	LOCATION OF QUARRY			COMMODITY	PRODUCTION CAPACITY (CY 2022)		OUTPUT	APPROXIMATE HAULING DISTANCE (km.)	DELIVERED TO	
		ESTIMATED AREA OF QUARRY (ha.)	BARANGAY	MUNICIPALITY, PROVINCE		ESTIMATED QTY	UNIT	cu.m/hour		STATION	PACKAGE
5	**SOLID INTEGRATED CO. INC.**		Payatas Road	Rodriguez Rizal	Coarse Aggregates (G1, ¾", 3/8")	Unlimited	cu.m/month		43	Sucat	CP-1
					Fine Aggregates						
					Base Coarse						
6	**HARDROCK AGGREGATES CORP.**	45.0	Cupang	Antipolo Rizal	Coarse Aggregates (G1, ¾", 3/8")	80,000	cu.m/month	400	31	Sucat	CP-1 & CP-2
					Fine Aggregates						
					Base Coarse (Premium)						
					Crushed Rock						
					Filling Materials						
					Armour Rocks	8,350		42			
					Boulders						
7	**RAPID CITY AGGREGATES INC.**	4.0	Inarawan	Antipolo Rizal	Coarse Aggregates (G1, ¾", 3/8")	40,000	cu.m/month	200	27	Lower Bicutan	CP-1 & CP-2
					Fine Aggregates						
					Base Coarse (Premium)						
					Armour Rocks	4,170		21			
					Boulders						
8	**LAFARGE AGGREGATES CORP.**	3.9	Bato	Antipolo Rizal	Coarse Aggregates (G1, ¾", 3/8")	31,670	cu.m/month	158	22	Sucat	CP-1 & CP-2
					Fine Aggregates						
					Base Coarse (Premium)						

Nos	COMPANY	LOCATION OF QUARRY			COMMODITY	PRODUCTION CAPACITY (CY 2022)		OUTPUT	APPROXIMATE HAULING DISTANCE (km.)	DELIVERED TO	
		ESTIMATED AREA OF QUARRY (ha.)	BARANGAY	MUNICIPALITY, PROVINCE		ESTIMATED QTY	UNIT	cu.m/hour		STATION	PACKAGE
					Armour Rocks	1,670		8			
					Boulders						
9	**MADLANGBAYAN QUARRY**	20.0	Pinagsanhan	Maragondon, Cavite	Coarse Aggregates (G1, ¾", 3/8")	142,500	cu.m/month	713	55	San Pedro	CP-1 & CP-2
					Fine Aggregates						
					Embankment Materials						
					Armour Rocks	7,500		38			
					Boulders						
10	**ACG QUARRYING SERVICES**	5.0	Sapang II	Ternate, Cavite	Lastillas	10,000	cu.m/month	50	54	Tunasan	CP-1 & CP-2
11	**CORNERSTONE AGGREGATES INC.**	4.0	Lucsuhin	Calatagan, Batangas	Coarse Aggregates (G1, ¾", 3/8")	40,000	cu.m/month	200	112	Cabuyao	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Boulders	10,000		50			
12	**MONTEVIL TRADERS CORP.**	5.0	San Marcelino	Taysan, Batangas	Coarse Aggregates (G1, ¾", 3/8")	25,000	cu.m/month	125	72	Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						

Nos	COMPANY	LOCATION OF QUARRY			COMMODITY	PRODUCTION CAPACITY (CY 2022)		OUTPUT	APPROXIMATE HAULING DISTANCE (km.)	DELIVERED TO	
		ESTIMATED AREA OF QUARRY (ha.)	BARANGAY	MUNICIPALITY, PROVINCE		ESTIMATED QTY	UNIT	cu.m/hour		STATION	PACKAGE
					Base Coarse (Premium)						
13	TERAVERA CORP.	10.0	San Agustin	Alaminos, Laguna	Coarse Aggregates (G1, ¾")	16,000	cu.m/month	80	28	Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse (Premium)						
					Armour Rocks	2,000		10			
					Boulders	2,000		10			
14	NACINO GRAVEL AND SAND TRADING AND TRUCKING SERVICES	5.5	Sampaloc II	Sariaya, Quezon Province	Coarse Aggregates (G1, ¾", 3/8")	42,500		213	66	Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Armour Rocks	7,500		38			
					Boulders						
15	TANTUCO QUARRY & NEARBY QUARRY	5.5	Isabang	Sariaya, Quezon Province	Coarse Aggregates (G1, ¾", 3/8")	40,000	cu.m/month	200	73	Cabuyao	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Armour Rocks	150,000		750			
					Boulders						

Nos	COMPANY	LOCATION OF QUARRY			COMMODITY	PRODUCTION CAPACITY (CY 2022)		OUTPUT	APPROXIMATE HAULING DISTANCE (km.)	DELIVERED TO	
		ESTIMATED AREA OF QUARRY (ha.)	BARANGAY	MUNICIPALITY, PROVINCE		ESTIMATED QTY	UNIT	cu.m/hour		STATION	PACKAGE
16	**SARIAYA QUARRY & NEARBY QUARRY (C/O Erwin)**	12.0	River Control St, Sampaloc II	Sariaya, Quezon Province	Coarse Aggregates (G1, ¾", 3/8")		cu.m/month		65.1	Cabuyao & Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Armour Rocks						
					Boulders	50,000		250			
17	**RRA23 QUARRY / GOLDER 23 QUARRY**	14.0	Ibabang Atingay	Magdalena, Laguna	Coarse Aggregates (G1, ¾", 3/8")	316,730	cu.m/month	1,584	47	Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Armour Rocks	16,670		83			
					Boulders						
18	**DCL BUILDERS SUPPPLY AND TRADING/**	5.0	Ibabang Atingay	Magdalena, Laguna	Coarse Aggregates (G1, ¾", 3/8")	475,190	cu.m/month	2,376	46	Calamba	CP-3 & CP-4
					Fine Aggregates						
					Sub-base Coarse						
					Base Coarse						
					Armour Rocks	8,340		42			
					Boulders	16,670		83			

Source: LLRN Project DED Study

Dredging Area

116. Four (4) locations were identified as possible dredging areas as the possible source of construction materials as shown in Figure 3-39.

117. The embankment material for CP1 will be sourced from mountain quarries, whereas other Construction Packages will mainly be sourced through dredging in Laguna Lake. Because of the large embankment, sand materials shall be sourced from quarries in Antipolo and Montalban in Rizal and Porac in Pampanga. The hauling distance from the material source to the site is approximately 40 km.

Figure 3-39: Dredging Area

Source: LLRN Project – Phase I DED

Disposal

118. The Laguna Lake Development Authority allowed the use of the disposal site of the temporary sand (dredged material) in Laguna Lake.

119. Figure 3-40 shows the location of the Disposal Site at Lumban, Laguna with an area of 32 hectares. The hauling distance is 50 km for land transportation and 38 km for lake transportation.

Figure 3-40: Disposal Site Location

Source: LLRN Project – Phase I DED

120. The proposed disposal site of dredged materials was surveyed on 26 October 2022. The land property, which is located in Lumban, Laguna, is owned by LLDA. Barge will be used to transport dredge materials from the LLRN construction site via Laguna Lake.

Waste

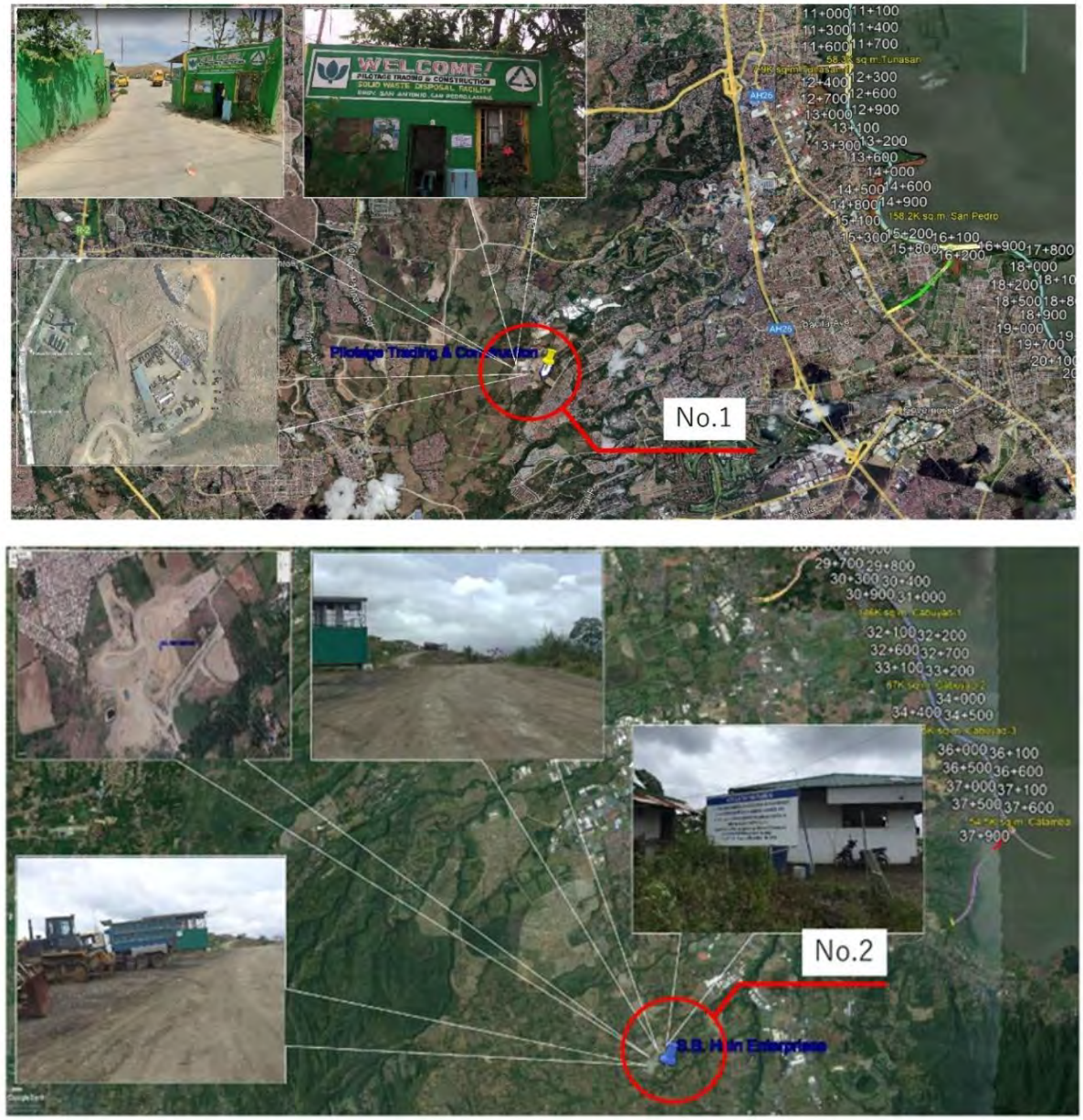
121. Waste generated from the site was planned for disposal at the locations shown in Table 3-6 and Figure 3-41.

Table 3-6: List of Disposal Sites for Waste

No.	Location	Station	Area	Remarks
1	San Pedro	15+300	-	22 km from CP1
2	Calamba	38+000	-	12 km from CP4

Source: LLRN Project – Phase I DED

Figure 3-41: Locations of Disposal Sites for Waste at San Pedro and Calamba, Laguna



Source: LLRN Project – Phase I DED

a) Estimated Quantity of Dredged Sand

122. Table 3-7 presents the estimated quantity of dredged sand materials for four (4) contract packages. The dredged material for the temporary embankment for CP1 and CP2 are proposed to be returned to the dredging location while the dredged material for the temporary embankment for CP3 and CP4 are proposed to be disposed to the disposal site as requested by LLDA.

Table 3-7: Estimated Quantity of Dredged Sand Materials from CP1 to CP4

		Unit	CP1	CP2	CP3	CP4	Total	Note
Quantity of Dredged Sand Materials	Temporary Embankment	m^3	1,449,271	771,710	425,560	337,850	2,984,391	
	Permanent Embankment	m^3	0	862,100	2,037,250	1,912,000	4,811,350	CP-1: from quarry (V=808,000m^3)
	(Total)	**m^3**	**1,449,271**	**1,633,810**	**2,462,810**	**2,249,850**	**7,795,741**	

Source: LLRN Project – Phase I DED

123. Estimation of Quantity for Waste Material. Table 3-8 presents the quantity of waste materials. An accredited and registered disposal company will haul these materials.

Table 3-8: Quantity of Waste Material

Item	Final Disposal Site	Unit	CP1	CP2	CP3	CP4	Total	Remark
Bored Pile Sand	Private Disposal Company	m3	310,833	247,887	113,253	75,606	747,578	
Concrete Mass for Pile Head	Private Disposal Company	m3	5,832	5,233	3,358	2,106	16,529	
Dredging Sand	Laguna Lake	m3	1,449,271	771,710	425,560	337,850	2,984,391	
Concrete Waste	Private Disposal Company	m3	7,857	7,803	3,016	1,048	19,724	
Geotextile Tube	Private Disposal Company	m3	4,361	1,883	2,043	1,588	9,875	
Tree	Private Disposal Company	ea.	34	100	24	29	187	Dia. 150 to 900
0.28m thick, PCCP (Unreinforced)	Private Disposal Company	m2	600	860	300	1000	2,760	
Existing Riprap	Private Disposal Company	m3				810	810	
0.10m thick Sidewalk	Private Disposal Company	m2	10	261			271	
610mm dia. RCPC	Private Disposal Company	l m	300				300	
1520mm dia. RCPC	Private Disposal Company	l m				10	10	
1830mm dia. RCPC	Private Disposal Company	l m	400				400	
Cyclone Fences	Private Disposal Company	l m			280		280	
Concrete Fences	Private Disposal Company	l m			131		131	
Fences	Private Disposal Company	l m				500	500	
Curb and Gutter	Private Disposal Company	l m	20	240			260	
Steel	Private Disposal Company	kg				14400	14,400	
Water Lilies	Private Disposal Company	ha			16	22	38	
Removal of Concrete	Private Disposal Company	m3	500			200	700	

Source: LLRN Project – Phase I DED

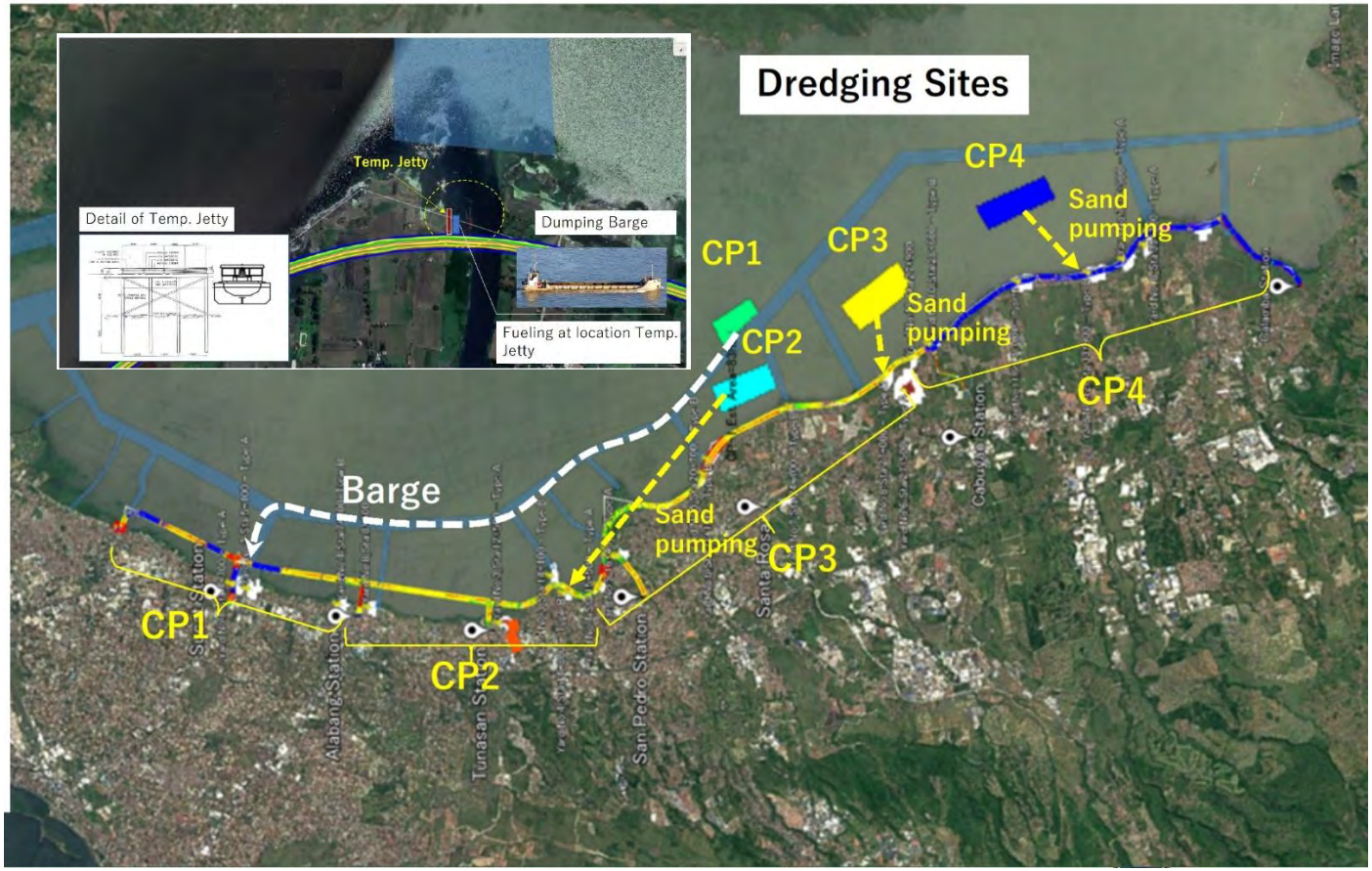
Vessel Navigation during construction

124. Figure 3-42 shows a temporary work plan, including a navigation route, for the project site in Laguna Lake during construction. The CP1 transport route will be mainly via navigation.

125. Work vessels should be able to deploy and operate across the many work fronts within the project site. During this stage, vessels may be heavily laden with dredged soils or construction fill materials for transport across the site. Further dredging may be needed to maintain a navigation channel for these vessels with sufficient depth clearance. Alternatively, the laden draft of boats may be tightly controlled to avoid additional dredging.

126. Given the constraints for mobilizing and operating in Laguna Lake, it is recommended that non-specialized, shallow-drafted, or draft-controlled work vessels should be procured to carry out the construction of the LLRN Project. Specialized plants may be brought via overland routes and loaded onto general work barges; supporting infrastructure, such as a temporary causeway, may need to be constructed. Loaded vessels may also need to limit quantities of cargo in their holds to successfully navigate through un-dredged shallow water areas and maintain stability during construction, particularly with lifting works.

Figure 3-42: Temporary Work Plan



Source: LLRN Project – Phase I DED