Environmental Impact Assessment

Project Number: 52310-001
July 2023
Draft

Philippines: Bataan-Cavite Interlink Bridge Project

Volume 1 Main Report

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

NOTES

Project Fact Sheet

Name of Project	Bataan – Cavite Interlink Bridge (BCIB) Project	
Project Location	Mariveles, Bataan: Barangays Mountain View and Alas Asin Naic, Cavite: Barangays Timalan Concepcion and Timalan Balsahan	
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	Bridge Monitoring and Maintenance Compound	Provide a base for bridge operations and maintenance
Project Cost	PHP 158.34 Billion (Civil Works) PHP 219.31 Billion (Total Project Cost)	
Project Construction	2024-2029	
Operation Date	2030	
Proponent Name	Department of Public Works and Highways (DPWH)	
Proponent Authorized Representative	Emil K. Sadain, CESO I Undersecretary for UPMO Operations and Technical Services Department of Public Works and Highways	
Proponent Address and Contact Details	Address: Bonifacio Drive Port Area, 652 Zone 068, Manila, 1018 Metro Manila, Philippines Contact Number: +63 2 5304 3805 / +63 2 5304 3681	
Updated EIA Preparer (Consultant)	T. Y. Lin International – Pyunghwa Engineering Consultants, Ltd. Joint Venture	
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EXHIBITS

ABBREVIATIONS

AADT	Average Annual Daily Traffic
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
AoA	Area of Analysis
BAP	Biodiversity Action Plan
BCIB	Bataan–Cavite Interlink Bridge Project
BCIB-PMT	BCIB Project Management Team
CALAX	Cavite–Laguna Expressway
CARI	Contractors' All-Risk Insurance
CAVITEX	Cavite Expressway
CEMMAP	Contractor Environmental Management and Monitoring Action Plan
CENRO	Community Environment and Natural Resources Office
CER	Compliance Evaluation Report
CGRC	Central Grievance Redress Committee
CHA	Critical Habitat Assessment
CIDH	Cast in Drilled Hole
CIMP	Corregidor Islands Marine Park
CITES	Convention on International Trade in Endangered Species
CLUP	Comprehensive Land Use Plan
CMR	ECC Compliance Report
CMVR	Compliance Monitoring and Validation Report
CR	Critically Endangered
CSC	Construction Supervision Consultant
DAO	Departmental Administrative Order
DED	Detailed Engineering Design
DENR	Department of Environment and Natural Resources
DENR-EMB	DENR Environmental Management Bureau
DENR-EMB CO	DENR-EMB Central Office
DENR-EMB RO	DENR-EMB Regional Office
DOH	Department of Health
DOLE	Department of Labor and Employment
DOST-PAGASA	Department of Science and Technology, PAGASA
DPWH	Department of Public Works and Highways
DPWH-BMU	DPWH Bridge Management Unit
DPWH-EHSO	DPWH Environment, Health and Safety Officer
DPWH-ESSD	DPWH Environmental and Social Safeguards Division
DPWH-EU	DPWH BCIB Environment Unit
DPWH-FMS	DPWH Field Monitoring Supervisor
EAAF	East Asian-Australasian Flyway
EBRD	European Bank for Reconstruction and Development
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate

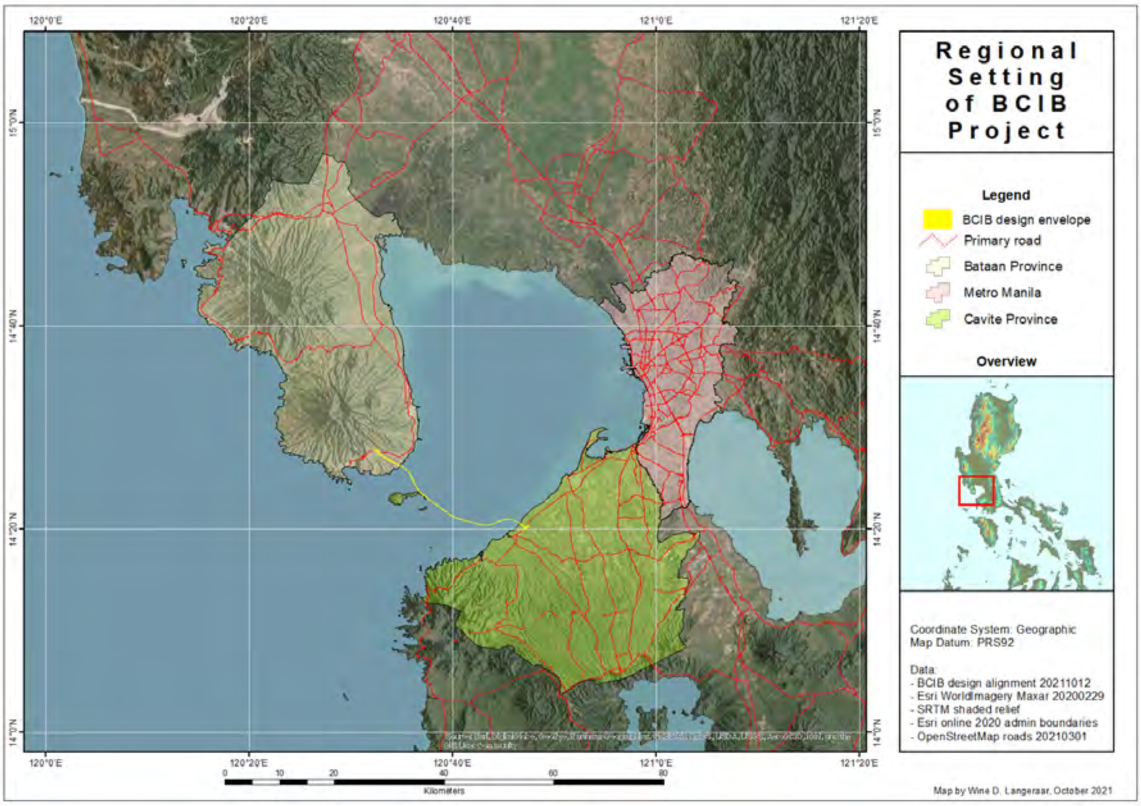
ECP	Environmentally Critical Project
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EIARC	Environmental Impact Assessment Review Committee
EIS	Environmental Impact Statement
EMA	External Monitoring Agent
EMF	Environmental Monitoring Fund
EMP	Environmental Management Plan
EN	Endangered
ENIPAS	Expanded National Integrated Protected Area System
EQPL	Environmental Quality Performance Level
ESA	Environmental Site Assessment
ESARD	DPWH Environmental & Social Assessment/Right-of-Way Division
FAB	Freeport Area of Bataan
GAP	Gender Action Plan
GHG	Greenhouse Gases
GN6	IFC Guidance Note 6
GRM	Grievance Redress Mechanism
GRO	Grievance Redress Officer
GRP	Grievance Reception Point
IBAT	Integrated Biodiversity Assessment Tool
IEC	Information, Education and Communication
IFC	International Finance Corporation
IRR	Implementing Rules and Regulations
IUCN	World Conservation Union
KBA	Key Biodiversity Area
LARP	Land Acquisition and Resettlement Plan
LGRC	Local Grievance Redress Committee
LGRO	Local Grievance Redress Officer
LGU	Local Government Unit
LGU	Local Government Unit
LMMPA	Locally-Managed Marine Protected Area
LOS	Level of Service
LPPCHEA	Las Piñas-Parañaque Critical Habitat and Ecotourism Area
MAO	Municipal Agriculture Office
MBSDMP	Manila Bay Sustainable Development Master Plan
MENRO	Municipal Environment and Natural Resources Office
MMT	Multi-Partite Monitoring Team
MOU	Memorandum of Understanding
MPDO	Municipal Planning and Development Office
NAMRIA	National Mapping and Resource Information Authority
NCB	North Channel Bridge
NIPAS	National Integrated Protected Area System
NOTAM	Notice to Mariners
NT	Near Threatened

PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PC	Primary Contractor
PC-EHSO	Primary Contractor Environment, Health and Safety Officer
PC-EHSR	Primary Contractor Environment, Health and Safety Representative
PEISS	Philippine Environmental Impact Statement System
PENRO	Provincial Environment and Natural Resources Office
PEO	Project Environment Officer
PHIVOLCS	Philippine Institute of Volcanism and Seismology
PSHA	Probabilistic Seismic Hazard Assessment
PPE	Personal Protective Equipment
PS6	IFC Performance Standard 6
PUD	Planned Use Development
RA	Republic Act
ROW	Right of Way
SCB	South Channel Bridge
SDP	Social Development Plan
SEMR	Semi-Annual Environmental Monitoring Report
SMR	Self-Monitoring Report
SPS	Safeguard Policy Statement
UBIV	Under-Bridge Inspection Vehicle
UBMT	Under-Bridge Maintenance Traveler
UPMO	Unified Project Management Office
UPMO RMC II	UPMO Roads Management Cluster II
US EPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
VIA	Visual Impact Assessment
VMS	Variable Message Sign
VU	Vulnerable
WDPA	World Database of Protected Areas
WHO	World Health Organization

EXECUTIVE SUMMARY

Basic Project Information

The proposed Bataan–Cavite Interlink Bridge (BCIB) project is a four-lane bi-directional road across the mouth of Manila Bay, which will create a direct ground transportation connection between the Philippine provinces of Bataan and Cavite. The project will be 32 km in length overall, including 26 km of marine viaducts and bridges over the waters of Manila Bay. The BCIB project is proposed to help alleviate road congestion in Metro Manila, manage projected population growth pressures in the National Capital Region, support development of additional port capacity for Manila and central Luzon Island, enhance tourism potential in western Bataan and historic Corregidor Island, and enable greater economic and social integration of the southern and northern parts of Luzon. The project proponent is the Department of Public Works and Highways (DPWH).



The proposed BCIB project has been developed by the Government of the Philippines with the financial and technical assistance of the Asian Development Bank (ADB), under the Infrastructure Preparation and Implementation Facility (IPIF), and will be implemented under the auspices of the Build, Build, Build program of the Government of the Philippines. Project preparatory activities began in 2018, and an initial Environmental Impact Assessment (EIA) was carried out from 2019–2021 in parallel with the feasibility study and preliminary design process. An Environmental Impact Statement (EIS) report was prepared in accordance with the requirements and procedures stipulated pursuant to Presidential Decree No. 1586, and submitted for consideration by the Department of Environment and Natural Resources–Environmental Management Bureau (DENR-EMB) in February 2021. DENR-EMB issued an Environmental Clearance Certificate (ECC) for the BCIB project in April 2021 (ECC-CO-2101-0011).

This EIA report is an updated and enriched version of the 2021 EIS, prepared in parallel with the Detailed Engineering Design (DED) to support consideration of the BCIB project for implementation financing by the Government of the Philippines, ADB and the Asian Infrastructure Investment Bank (AIIB). The updated EIA reflects the most recent information regarding the project's design, construction methods and construction logistics; newly acquired data regarding prevailing environmental conditions in the project area; expanded analysis of impact potentials and mitigation options, and findings from additional Information, Education and Consultation (IEC) activities. By agreement of ADB and AIIB, the safeguards framework of ADB, as reflected in its Safeguard Policy Statement 2009, is applied in the EIA, while maintaining conformance with Government of the Philippines requirements.

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Project Overview

Planned Infrastructure

The BCIB project will be a four-lane, dual carriageway road link spanning the 23 km-wide mouth of Manila Bay, consisting of 7.2 km of approach roads on land and 26 km of over-water infrastructure. The approach road on the Bataan side of the project will be 5.9 km long, and connect to the Roman Highway at a trumpet interchange positioned on the southeast edge of the urbanized area of Barangay Alas Asin, in the Municipality of Mariveles. The approach road will pass under the Roman Highway at the interchange. Two underpasses will be installed in the approach road to accommodate continued use of existing local roads, and a 100-m bridge will be built to span a wide gully. Approximately 200 m from the sea, the supporting embankment will end in an abutment, and the roadway will be carried on a raised viaduct out over the coastline to meet the marine crossing. Upon entering via the interchange, the remaining approach road will be restricted from public access. A Bridge Monitoring and Maintenance Compound (475 m^2) will be positioned on the west side of the approach road, and will be accessible only by management staff and maintenance crews from the roadway itself.

The over-water portion of the BCIB infrastructure will include two high cable-stayed navigation bridges (North Channel Bridge and South Channel Bridge) and 23.5 km of marine viaducts. There will be a mid-span turnaround interchange near where the alignment skirts Corregidor Island, and a minor nearshore navigation bridge off the Cavite shore. The North Channel Bridge will span the existing 300 m-wide shipping channel that runs between the southern coast of Bataan and Corregidor Island. The bridge will be supported on two 142 m-tall monopole towers and two anchor piers, and provide over-water clearance of 40.5 m. The bridge structure will be 736 m wide overall. No modification of the existing shipping channel will be necessary to accommodate the North Channel Bridge.

The South Channel Bridge will be of similar design to the North Channel Bridge, but considerably larger. This bridge will be supported on two 304 m-tall monopole towers and four anchor piers, and will accommodate the existing 750 m-wide deep-water shipping channel between Caballo Island and the Cavite nearshore. The South Channel Bridge structure will be 1,800 m long overall, with a 900-m clear span providing over-water clearance of 72.3 m. No modification of the existing shipping channel will be necessary to develop the South Channel Bridge.

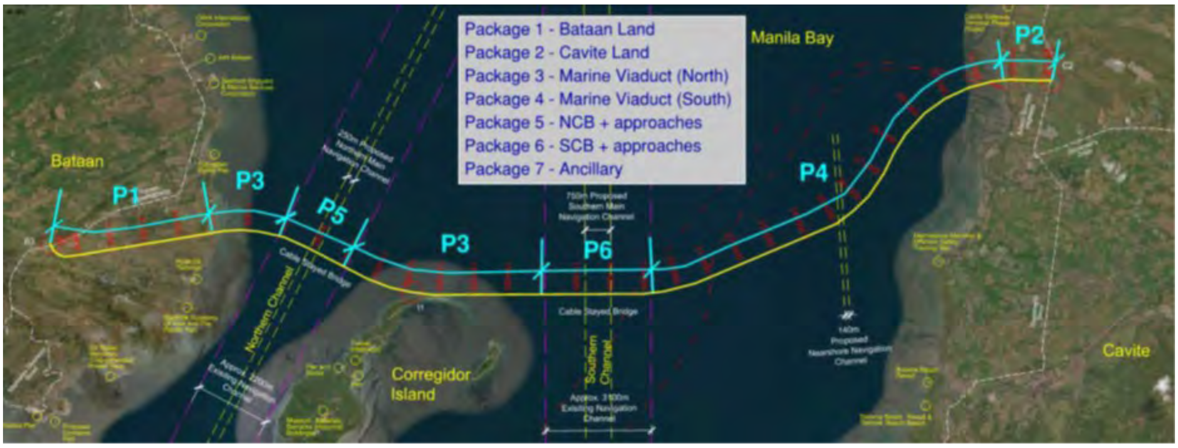
The long marine viaduct segments of the BCIB sea crossing will be 21 m above the water in most locations. The viaduct spans will be 100 m in deeper water, and 60 m in shallower areas, and will provide unconstrained passage for small vessels, including the light fishing craft favored by local fisherfolk. The nearshore navigation bridge near the Cavite coast will be of concrete box girder design, with overall length of 315 m. The bridge will provide 25 m vertical clearance, with a clear span of 150 m over a newly-established 90 m-wide navigation channel allowing passage of Philippine Coast Guard patrol boats and larger fishing boats transiting to the West Philippine Sea.

The turnaround interchange near Corregidor Island will be a pile-supported structure with ramps off the mainline providing access to the lower roundabout, and will permit motorists to return to their points of origin if desired, as well as enable adaptive management of traffic in emergency situations. The interchange has been designed to serve as the connection point for a possible future access road link to Corregidor Island, should a decision be taken at some point to pursue such a project; a link to Corregidor Island is not part of the BCIB project.

The approach road on the Cavite end of the BCIB project will be just 1.3 km long, and will be supported on embankments up to 6 m above grade. Two underpasses will be installed to permit continued use of existing local roads. The approach road will meet the Antero Soriano Highway at a partial cloverleaf interchange, with the mainline of the highway being raised over the incoming BCIB roadway. Slip roads will be provided to enable smooth flow on existing roadways around the interchange. The partial cloverleaf design of the interchange will permit possible future establishment of a direct link from the BCIB to the new Cavite–Laguna Expressway (CALAX), should this be pursued under a separate project at some future date.

Construction Methods and Process

Construction of the BCIB project will be completed under seven construction packages, so bidding entities are not limited to the small number of large international firms and joint ventures that will have the necessary capacity and expertise to take on the whole project as one piece.



The approach road in Bataan will be built at grade, with cutting and filling employed as necessary to account for uneven terrain; substantial earthworks will be necessary in some locations. Piling and concrete works will be necessary at the underpasses, interchange, gully bridge and viaduct near the shore. All piles for the approach road and interchange works in Bataan will be bored rather than driven.

The approach road in Cavite will transition from the marine viaduct with approximately 90 m of over-land viaduct, after which it will be supported on embankments. The embankments will be highest near the shore and gradually diminish over the 1.3-km distance to the Antero

Soriano Highway. To minimize land acquisition and materials, the embankment width will be narrowed in some segments by use of mechanically stabilized earth (MSE) construction. The partial cloverleaf interchange will include a new overhead viaduct for the mainline of the Antero Soriano Highway, as well as a four-lane replacement bridge over the west branch of the Timalan River. Piling will be necessary for the bridge, viaduct and culvert works; all piles will be bored rather than driven.

Most of the over-water infrastructure, including the North Channel Bridge and South Channel Bridge, the turnaround interchange, and northern and central segments of the viaducts, will be supported on arrays of steel tube piles set into the seafloor, excavated on the inside, and filled with steel-reinforced concrete. Approximately 2,300 piles will be installed, of which it is estimated that 45 to 66% (depending on contractor assessment of feasibility) will be driven into place with impact hammers; all other piles needed will be installed using the drilled method. Piling work will be on the critical path to project implementation, and will be carried out around the clock for an estimated 41 months, with multiple piling rigs working simultaneously for substantial portion of that time period. Material excavated from pile interiors prior to filling will be placed in barges and shipped by prior arrangement to fill customers.

The presence of competent rock at shallow depths on the nearshore shelf of the Cavite landmass will permit use of spread-foot foundations in lieu of driven or bored piles. Of the 312 total piers to be built, 104 will have spread-foot foundations. For each spread-foot foundation, the seabed will be excavated to the bedrock (removing approximately one meter of overburden on average), and a concrete foundation will be poured into formwork using attached tremie pipes. Excavated seabed material will be placed in barges and shipped by prior arrangement to fill customers.

The monopole towers be built up in-situ from caisson foundations that will be floated into place and lowered onto groupings of piles already placed in the seafloor, whereafter further piles will be driven and the caisson filled with concrete. The massive caissons will be constructed in a temporary drydock facility to be established specifically for the project on the south Bataan coast.

The viaducts will be built out from the Bataan and Cavite shores using overhead launching gantries to place concrete box girder sections. In deeper waters, full-span pre-cast concrete girders will be lifted into place by crane barges. The concrete slurry needed for in-situ casting in the marine works will be produced in floating batch plants; these will be kept supplied with raw materials by supply barges.

Three staging areas will be established to serve the BCIB project works. The first is a combined casting yard and drydock facility, where pre-cast components of the bridges and viaducts, as well as the caissons, will be manufactured. The site proposed for this facility is currently active quarry on the south Bataan shore, 7 km southwest of the BCIB landing point. Five temporary rock jetties averaging 400 m long will be set up to serve the casting yard and drydock, and approximately 1.8 ha of inshore seafloor will be dredged to a depth of at least 12 m to allow the caissons to be floated out upon completion. The second staging area is anticipated adjacent to the Bataan approach road alignment; this site will be used for storage and preparation of steel components needed in the marine construction, and will also have space for worker housing. A temporary rock jetty up to 400 m long, adjacent and parallel to the BCIB alignment, will be installed to serve this staging area.

The third staging area is proposed for the Cavite side, on a large site formerly subdivided for residential developments that has sat vacant for many years. This site will host a casting yard for making pre-cast components for the south viaduct, as well as steel storage and worker housing. The staging site in Cavite is located away from the shore and on the south side of the Antero Soriano Highway. The pre-cast components and raw materials for floating batch plants working offshore will be transported to the work front by way of the Antero Soriano Highway and the BCIB approach road right-of-way. The shallowness of inshore and nearshore waters off Cavite makes a loading facility impractical, so no temporary jetties will be established on the Cavite side; rather, pre-cast components and bulk materials will be delivered along the viaduct as it is constructed progressively outward from the shore.

The entire BCIB construction process is anticipated to require 69 months, and a workforce of 2,000 at the peak of works, distributed in approximately even proportions between Bataan and Cavite. Recruitment of local labor will be pursued in accordance with national law, but it is anticipated that worker accommodations will be required to house part of the workforce. These will be established within the staging areas.

Operations

The BCIB will be operated by a dedicated Bridge Management Unit, which will have responsibility for routine upkeep, periodic inspection of the infrastructure, monitoring traffic, enforcing traffic laws and weight restrictions, emergency preparedness and response, and managing works contracts for major maintenance and repair works. The BCIB management unit will conduct its operations from the Bridge Monitoring and Maintenance Compound on the Bataan side. No tolls will be charged for use of the BCIB. The BCIB infrastructure has been designed for a service life of 100 years.

EIA Process and Methods

As indicated above, the environmental assessment process for the BCIB project has been spread over more than four years, in two phases. The first EIA team began work in early 2019 and delivered the final draft EIS in April 2021, performing most field studies in early 2020. The second EIA team was constituted in December of 2020, and has worked up to the present, with most field studies conducted between September 2021 and June 2022. Assessment work at both stages has included wide-ranging desktop research and data sourcing; empirical field studies; and engagement with stakeholders in the project area.

Desktop Research

Both stages of the EIA study for the BCIB project have drawn on multiple types and sources of information, including:

- Project design information from the feasibility study, appended technical reports, preliminary design reports, updated preliminary design reports, and discussion with project engineering teams;
- Spatial data obtained from government agencies, project-related technical studies, and online databases and mapping tools provided by governmental, intergovernmental, non-governmental and private sector entities;
- Biodiversity screening reports generated using the Integrated Biodiversity Assessment Tool (IBAT);
- Statistical databases managed by the Philippine Statistical Authority, including data from the two iterations of the National Census of Population and Housing;

- Plan documents and periodic status reports issued by provincial and municipal governments, including physical framework plans, sustainable development and integrated coastal zone management plans, municipal comprehensive land use plans and associated zoning ordinances, snapshot reports such as 'state of the coast' reports, 'state of the province' reports;
- Technical analyses, resource assessments and plans produced under the auspices of national and regional planning initiatives such as the Manila Bay Environmental Management Project, Manila Bay Sustainable Development Master Plan, and National Biodiversity Strategy;
- Academic research reports on field studies related to environmental conditions and natural resource concerns in the Manila Bay area, sourced from national and international research publications;
- Fact-finding and consultation meetings held with municipal and provincial officials and other institutional stakeholders in the general project area; and
- EIA reports prepared for other undertakings in Manila Bay and surrounding area.

Empirical Studies

Field studies were conducted to provide up-to-date baseline data on social and environmental conditions specifically in the BCIB project area, including:

- Terrestrial biodiversity, including floral and faunal surveys;
- Marine biodiversity, including field surveys of plankton, infaunal organisms, coral reefs, reef fish, macroalgae and seagrass, and threatened marine vertebrate species;
- Freshwater and estuarine ecology;
- Water quality (marine, freshwater, groundwater);
- Ambient air quality;
- Ambient noise;
- Potentially contaminated sites;
- Physical cultural resources; and
- Landscape character and visual resources.

In addition to field surveys, modelling studies were conducted in the areas of air quality, traffic noise and vibration, and underwater noise from offshore piling works.

Stakeholder Engagement

The environmental assessment process was informed by two kinds of stakeholder engagement: formal consultation encounters with institutional stakeholders and members of the public, and a perception survey.

Scoping and coordination meetings were held with the concerned local governments, relevant governmental agencies and other entities in early 2019, to share information about the project proposal and the project development process; explain the environmental assessment requirements and process; identify issues of concern in relation to the conduct of environmental studies in the project area; and coordinate regarding permissions and communication. Subsequently, consultation meetings were convened with the municipal governments of Mariveles, Bataan and Naic, Cavite, as well as that of Cavite City, Cavite (which has jurisdiction over Corregidor Island). A second round of meetings was then held at the barangay level in each municipality.

During preparation of the updated EIA (2022), five public consultation meetings were held at the barangay level in Mariveles and Naic. Specialists on the EIA team also met for discussions with the municipal environmental agencies, fisherfolk representatives, and institutional entities involved in environmental conservation in the project area.

A perception survey was administered in community areas in the project area in 2022. The perception survey sought information regarding residents' impressions and concerns regarding existing environmental and social conditions, their comments and concerns about the BCIB project's implementation in their communities, their perceptions regarding possible benefits and drawbacks for themselves and the community at large, and their assessment of the aesthetic qualities of the project infrastructure based on artistic renderings.

EIA Study Teams

The first EIA study conducted from 2019–2021 was completed by Ove Arup & Partners Hong Kong, Ltd. in collaboration with Ecosys Corp. The present updated EIA study, carried out from 2021–2023, has been undertaken by T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd. Joint Venture, in association with DCCD Engineering Corporation and Renardet S.A.; technical studies were provided by sub-consultants including Ecosys Corp. (local baseline surveys) and Illingworth and Rodkin (underwater acoustic modeling). The project teams are shown in the table below.

Name	Role in the EIA Study	Qualification
Updated EIA Study (2021-2023)		
Jodi Ketelsen (T.Y. Lin International)	Senior Environment Specialist and EIA Team Lead	M.S. City Planning and M.S. Landscape Architecture, UC Berkeley, 1994
Simeon Stairs (Renardet SA)	Senior Environment Specialist	Ph.D. Environment and Resource Studies
Frederick Esternon (DCCD)	Environment Specialist	EIA Registration No. IPCO 311 B.S. Forestry and Natural Resources
Ian Borja (DCCD)	Environment Specialist	EIA Registration No. IPCO 424 B.S. Medical Technology
First EIA Study (2019–2021)		
David Rollinson	Environmental and Social Team Leader (Arup)	BSc (Hons) Environmental Biology MSc Environmental Management
Angel Salcedo	Environmental and Social Specialist (Arup)	EIA Registration No. IPCO 334 MSc Environmental Engineering B.S. Chemical Engineering
Maria Catherine Rontos	Environmental and Social Specialist (Arup)	EIA Registration No. IPCO 037 Diploma in Urban and Regional Planning B.S. Environmental Planning and Management
Frederick Esternon	Environmental and Social Specialist and EIA Head (Ecosys Corp)	EIA Registration No. IPCO 311 B.S. Forestry and Natural Resources
Elenor De Leon	Environmental and Social Specialist and EIA Deputy Lead (Ecosys Corp)	EIA Registration No. IPCO 425 Master in Development Management Master of Environment and Natural Resources Management (units earned)
Ruben Estudilo	Marine Ecology Specialist (Ecosys Corp)	PhD Marine Science (Units Earned) MSc Marine Science Ecology B.S. Marine Science
Armando Gillado Jr	Terrestrial Flora Specialist (Ecosys Corp Inc)	EIA Registration No. IPCO 312 B.S. Forestry and Natural Resouces

Name	Role in the EIA Study	Qualification
Russel Baniqued	Terrestrial Fauna Specialist (Ecosys Corp Inc)	EIA Registration No. IPCO 157 Environmental Science Specialist

Baseline Environmental Conditions

The BCIB project will span a wide area comprising three distinct terrestrial environments and aquatic environments including freshwater rivers and streams, minor estuaries, and the waters of Manila Bay. The following overview is organized in accordance with the standard broad categories applied in environmental impact assessment in the Philippines: Land, Water, Air and People.

Land

The entire Philippine archipelago is seismically active, and the BCIB project area is vulnerable to both earthquakes and tsunamis. The western part of Luzon Island, including the project area, was formed largely by volcanic activity, and continues to be shaped by it. Both Mt. Mariveles and the Corregidor volcanoes are still considered 'potentially active' by the Philippine Institute of Volcanology and Seismology (PHIVOLCS), although neither has shown signs of activity (Mt. Mariveles last erupted about 10,000 years ago, and Corregidor about 1,000,000 years ago); the more relevant volcanic potential during the lifespan of the BCIB project is ashfall from the Taal volcano, 43 km south-southwest of the Cavite terminus and one of the most active volcanoes in the country. The Bataan part of the BCIB project area is somewhat vulnerable to minor landslides, in gullies only; the Cavite portion is nearly flat and not at all susceptible to this hazard.

The BCIB project area in Bataan consists of a moderately sloped landscape, ranging from 0–250 meters above sea level, which forms part of the toe slope of the Mt. Mariveles volcano. The land is well-drained, underlain primarily by consolidated volcanic deposits including pyroclastic flows and ash deposits, with soils consisting mainly of Antipolo clays, and incised by numerous rivers and streams. Pre-industrial vegetation is considered to have been primarily grassland and scrubland, interspersed with riparian forest patches. Significant vestiges of this vegetative character are evident in the landscape today, despite long low-intensity agricultural use and the spread of built-up areas in the Roman Highway corridor, particularly the Alas Asin and Mt. View villages. Floral surveys indicate that native species still predominate, and that vegetative assemblages in some areas are probably broadly representative of pre-industrial land cover, in spite of significant degradation. Minor estuarine mangrove vegetation is present near the mouths of the Babuyan and San Jose Rivers. Based on the floral surveys, areas totaling roughly 300 ha in the general vicinity of the proposed BCIB alignment were categorized as Natural Habitat in accordance with the habitat classification guidelines of the International Finance Corporation (IFC); these areas are primarily in the downslope portion of the project area (from the shoreline to about 2.5 km inland), and to a lesser extent in the eastern part of the project area, on the steep lands along the edge of the Pangolisanin River valley. Terrestrial fauna in the area were found to be of generally low abundance and diversity, which is consistent with the proximity of human settlements and long-standing use of the land for pasture. Avian species associated with grassland and well-adapted to human-dominated landscapes predominate in the faunal species list.

Corregidor Island is of volcanic origin, with the present-day land masses of Corregidor itself and nearby Caballo Island being remnants of the rim of a caldera centered on San Jose Bay, to the immediate south of Corregidor. The floral and faunal assemblages of Corregidor

Island were not subjected to detailed survey for the EIA study, since the BCIB project will not occupy any part of the island. However, from secondary sources it could be established that the island is thickly vegetated with a mix of forest and grassland, and that the predominant upper canopy species is Ipil-ipil (*Leucaena leucocephalus*), an introduced leguminous species air-seeded on the island to encourage revegetation after the ecological devastation wrought by intense warfare during World War II. Avian species diversity is thought to be quite low, primarily due to the weak presence of fruiting tree species, and this was confirmed by a limited avian survey conducted for the present EIA study in the Tail End portion of the island, which is closest to the BCIB alignment.

The Cavite portion of the BCIB project area comprises a very lightly sloped landscape extending inland from Manila Bay, underlain by a mix of sedimentary formations of volcanic origin (primarily tuffs) and alluvial deposits. Predominant soils are dark vertisols, rich in clay and often poorly drained. Most of the land in the project area has been subject to intensive agricultural use (rice and row crops), as well as pasture and limited orchards and plantations, for many generations, and open space has been increasingly hemmed in over recent decades by strip development along local roads and in the Antero Soriano Highway corridor. The area is in the midst of an intensifying urbanization process, and a number of large rowhouse developments have been built in the last few years, with more in construction and planning stages. Pre-industrial land cover in the area is considered likely to have been a mix of grassland and lowland forest, but floral surveys indicate that native species are now in the minority. Faunal abundance and diversity are low, and faunal assemblages in most locations are dominated by species well-adapted to human-dominated habitats. Riparian zones are characterized by minor remnants of natural vegetative cover, including some mangrove thickets in the estuarine portions of the Timalan River, Labac River and Timbugan Creek, and faunal species less well-adapted to disturbance were noted at low levels of abundance in such out-of-the-way areas. The project area in Cavite was determined to be Modified Habitat per the IFC habitat classification guidance, due to the preponderance of non-native species and high level of prior land conversion and disturbance.

A survey undertaken to identify potential land contamination issues in the Bataan and Cavite portions of the BCIB project area identified a number of industrial sites within the broader project area where site activity might be expected to have some potential for generating localized land contamination issues, but most were well outside the project ROW and not coincident with any of the sites under consideration for use as construction staging areas. Two filling stations were found within the ROW.

No physical cultural heritage sites or objects have been identified within the proposed project ROW; the only items documented in a comprehensive survey carried out in the broader Bataan and Cavite portions of the project area are a series of roadside mile markers along the Roman Highway, commemorating the WWII Bataan Death March, which followed a route more or less aligned with the present-day highway. There are many sites of historical and cultural importance on Corregidor Island, but these were not surveyed for the EIA study, since the BCIB project will not involve construction or operation of any infrastructure on the island.

Significant visual resources are present in and around the BCIB project area, and these were catalogued in a visual impact assessment carried out as part of the EIA study. Key visual resources include the Mt. Mariveles volcano, the hills straddling the border between western Cavite and northern Batangas, Mt. San Miguel and the Five Fingers peninsula on either side of Mariveles Bay, the open seascape, and of course Corregidor and Caballo Islands. For the most part, these visual resources lie outside the project area, but are visible from within it and help to define the project's overall aesthetic context. Corregidor Island and Caballo Island can be considered to fall within the project's area of influence.

Protected Areas and Key Biodiversity Areas

There are no protected areas in the near vicinity of the proposed project footprint or anticipated staging area sites in Bataan; the nearest protected area designated as such under the Expanded National Integrated Protected Area System (ENIPAS) is the Watershed Purposes of Mariveles (Palanas) protected area, a 347-ha forest reserve located 5.8 km west of the Roman Highway interchange site. The Mariveles Mountains Key Biodiversity Area (KBA) encompasses 12,156 forest and grassland habitat on the summit and flanks of the Mt. Mariveles volcano; this non-statutory but internationally recognized conservation area extends close to the project area in Bataan; its southeast border lies approximately 1.3 km uphill from the Roman Highway interchange site.

Corregidor Island is a protected site (officially a national shrine), although not designated as such under ENIPAS, and not recognized for its biodiversity conservation values. The eastern Tail End portion of the island has been a restricted military zone for decades.

On the Cavite side, the nearest protected area to the project footprint or expected staging area site is the 3,975-ha Mts Palay-Palay Mataas-na-Gulod National Protected Landscape, whose eastern boundary lies approximately 12 km southwest of the proposed Antero Soriano Highway interchange. There is a KBA centered on the southwestern core area of the protected landscape, designated as the Mts. Palay-Palay and Mataas-na-Gulod National Park KBA; the closest part of the KBA is about 17 km from the Cavite ROW.

Endangered and Critically Endangered Terrestrial Species

Based on screening lists generated using the Integrated Biodiversity Assessment Tool (IBAT), analysis of range maps and habitat requirements, and field surveys conducted as part of the EIA study in 2020 and 2021/2022, a total of eight endangered terrestrial species (and no critically endangered species) are considered to have a non-trivial probability of being present in the BCIB project area. The two terrestrial portions of the project area offer only marginal habitat for all of these species, and only two were documented in field surveys: the exotic Java Sparrow (*Lonchura oryzivora*) in Cavite, and Burmese Rosewood (*Pterocarpus indicus*), for which the project area is out of range, but was found to be commonly planted as a living fence and fodder species in Bataan.

Draft Critical Habitat Assessment

A Draft Critical Habitat Assessment was prepared for terrestrial and marine species, following guidance provided by the International Finance Corporation (IFC) in relation to application of its Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012). Based on an earlier critical habitat screening report, an Area of Analysis was defined, encompassing all of Manila Bay and selected adjacent terrestrial land areas. Species appearing on the list of endangered and critically endangered species generated using the IBAT, as well as migratory species identified in a previous screening report as potentially having globally significant concentrations present in the Area of Analysis, were evaluated individually against Criteria 1–3 as specified under Performance Standard 6, to determine if any could be considered to qualify some part of the Area of Analysis as Critical Habitat. The Draft Critical Habitat Assessment also reviewed the history of institutional conservation attention and efforts at the regional and national level to determine if any part of the Area of Analysis met the thresholds under Criterion 4 of Performance Standard 6. The findings of the Draft Critical Habitat Assessment are considered provisional, and will be updated as data from pre-construction biodiversity surveys augments the baseline sufficiently to enable more fine-grained assessment based on definition of an ecologically appropriate area of analysis (EAAA) for each species of interest. Provision has been made in the environmental management plan for the longitudinal surveys necessary to arrive at final critical habitat determinations.

Seven avian species were provisionally found to meet relevant thresholds for Criteria 1–3 at the area-wide level of analysis, based on the percentages of their global populations documented in recent bird counts in Manila Bay. The endemic Philippine Duck (*Anas luzonica*) was considered a probable qualifying species under Criterion 1 (Critically Endangered and Endangered Species), while six migratory waterbird species were considered to found likely to qualify under Criterion 3 (Migratory and Congregatory Species); these are the Red-Necked Stint (*Calidris ruficollis*), Long-Toed Stint (*Calidris subminuta*), Kentish Plover (*Charadrius alexandrinus*), Whiskered Tern (*Chlidonius hybrida*), Black-Winged Stilt (*Himantopus himantopus*) and Pacific Golden Plover (*Pluvialis fulva*).

In addition, the Draft Critical Habitat Assessment indicated that several terrestrial conservation areas (protected areas and KBAs) and two habitat types (mangroves and mudflats) within the Area of Analysis may qualify as critical habitat elements under Criterion 4 (Highly Threatened and/or Unique Ecosystems), based on their meeting of the second threshold under this criterion (Other areas not yet assessed by IUCN but determined to be a high priority for regional or national systematic conservation planning). The identified terrestrial critical habitat elements of relevance to the BCIB project area are the Mariveles Mountains Key Biodiversity Area (KBA) on the Bataan side, and the Mts. Palay-Palay Mataas-na-Gulod National Protected Landscape on the Cavite side; the critical habitat category of mangroves is also relevant to the BCIB project area.

Water

The BCIB project area lies within the catchments of three rivers, these being the Pangolisanin, Babuyan, and San Jose. The Pangolisanin River is the largest and highest-energy of the three, and has its headwaters in the forested upper slopes of Mt. Mariveles. This river runs in a deep valley along the northeast edge of the project area, and enters Manila Bay at Barangay Cabcaben, about 2 km northeast of the BCIB alignment. Stream ecology surveys conducted for the EIA indicate that the river is in substantially natural condition in its upper reaches, but that water quality and ecological health decline as it proceeds through an intensively-farmed alluvial plain at lower elevations. The river encounters an urbanized environment from just upstream of the Roman Highway corridor to the mouth. The Babuyan River has a much smaller catchment than the Pangolisanin, with headwaters in the built-up areas of Barangay Mt. View and Alas Asin. The river's several tributaries drain a mix of peri-urban, agricultural and grassland areas, including substantial areas under mango cultivation. The lower portion of the river is estuarine, and is characterized by a pocket of mangrove vegetation. Stream ecology surveys indicate moderate degradation of water quality and ecological health, attributable to inputs of sewage, domestic waste and runoff from piggeries. The San Jose River also has a limited catchment, with upper tributaries rising within Alas Asin village, on the Roman Highway. The river's several minor branches are mostly intermittent, and course through a mix of residential built-up areas, industrial lands and pastured grassland. There is a minor estuarine segment near the mouth of the river where mangrove vegetation is present. Surveys indicate the water quality is significantly degraded, most likely by discharges of sewage from built-up areas, as well as runoff from industrial sites and pastures.

All of the rivers in the Bataan portion of the BCIB project area were deemed Modified Habitat per IFC classification guidelines, based on water quality degradation, land use in their catchments, and prevalence of non-native species. The upper reaches of the Pangolisanin River, which are outside the project area, were considered to qualify as Natural Habitat. All three rivers within the BCIB project area discharge to Manila Bay in areas characterized by coral and macroalgal benthic habitat.

The characteristics of watercourses on Corregidor Island were not assessed in the baseline study because the BCIB project will not impinge upon the island's land area, but the island is not known to have any significant streams. Minor seeps and intermittent brooks are likely to run in the island's many forested gullies during wetter times of the year.

The Cavite portion of the BCIB project area is within the catchments of the Timalan River and the lesser Timbugan Creek, and is bordered by the catchment of the Labac River (also known as the Bucalan River and Allemang River). All three of these watercourses are estuarine, up to about 2 km inland in the case of the Timalan and Labac Rivers, and support patches of mangrove vegetation. Aquatic surveys indicate quite substantial water quality degradation, apparently attributable to agricultural land use and discharge of raw and minimally treated sewage from both established built-up areas and new higher-density residential subdivisions. There is no sewerage or centralized wastewater treatment in the project area. Due to degraded water quality and a preponderance of exotic aquatic species, all three of the watercourses surveyed were deemed Modified Habitat per the IFC classification guidelines.

The marine environment in the BCIB project area represents a range of conditions, influenced by oceanographic factors, proximity to land, and both local and regional patterns of water quality degradation. The general bathymetric profile around the mouth of Manila Bay shows a moderately steep nearshore slope off southern Bataan, with depths reaching over 60 m in the middle of the 4 km-wide North Channel between Bataan and Corregidor Island. Similar slopes are found on the outer fringes of the Corregidor seamount, while more gentle bathymetry is observed within the caldera. The seafloor on the Bataan nearshore slope and Corregidor seamount are thought to be predominantly rocky, being composed of pyroclastic flows and boulder fields, while the depths of the North Channel are likely to have been subject to substantial sediment deposition through the ages, and characterized by soft bottom benthos. Southeast of Corregidor Island in the South Channel, depths of 40 m are attained, and the seafloor can again be considered to be predominantly soft sediments. A broad sedimentary terrace extends for 3–4 kilometers from the Cavite shore, on the south side of the South Channel; the seafloor in this area is composed predominantly of sands and muds.

Water quality is highly variable across Manila Bay, due to differential exposure to mixing by wind-driven and tidal currents, inputs from rivers, aquacultural activity, runoff from urban and agricultural areas, and discharges of sewage and industrial effluents. In general, the waters around the mouth of the bay are considerably less degraded than the waters further in, for example around the Metro Manila waterfront and near the mouths of major rivers including the Pasig River, the Marilao-Meycauayan-Obando system, Angat River and Pampanga River. Severe broad-scale events like hypoxia and harmful algal blooms have historically developed in the inner bay. This is not to imply, however, that the waters in the BCIB project area near the mouth of the bay are pristine. Water quality analysis carried out for this EIA study indicates that nutrification in particular is a problem even here, despite regular tidal flushing and considerable distance from the mouths of large, heavily polluted rivers. This is evidenced by depleted levels of dissolved oxygen, relatively high levels of ammonia, and elevated levels of fecal coliform in many samples. All samples exceeded the national standard maximum level for cyanide, which seems to indicate a broad background contamination rather than a specific local source. Contamination by heavy metals does not appear to be a significant threat in the waters of the project area, based on the limited baseline sampling conducted. This is supported by analysis of contaminant levels in marine sediment samples collected near the BCIB alignment, further corroborated by previous bay-wide sediment studies, which indicates levels of heavy metals and other contaminants mostly well below international benchmark concentrations (arsenic being a notable exception in two of 18 sampling locations).

Findings from surveys of plankton and bottom-dwelling invertebrates in the project area are broadly consistent with what has been discussed above in relation to marine water quality. Phytoplankton abundance was not found to be inordinately high, which supports the notion that the waters near the bay mouth are not as intensively nutrified as waters that are closer to river mouths and major centers of aquacultural production, although dominance of algal genera associated with eutrophic conditions was documented in some samples. Notably, numerous phytoplankton genera and species commonly implicated in harmful algal blooms were recorded in samples collected in the project area, but in very low concentrations; algal blooms resulting in poisonings, fish kills or aesthetic degradation appear not to have been recorded around the mouth of Manila Bay. Generally low abundance of zooplankton in survey findings from the BCIB project area may be at least partly indicative of water quality degradation. Both phytoplankton and zooplankton have been shown by previous work to be highly variable in space and time within Manila Bay. Data from surveys of infaunal invertebrates indicates generally low abundance and low to moderate diversity, and dominance in some locations by genera associated with nutrification and abundance of detritus.

The bay mouth is the only part of Manila Bay capable of supporting coral reef habitat, and this is just as much a function of natural background conditions as it is of water quality degradation. Hard substrates suitable for colonization by corals and other sessile animals are present mostly around the rocky nearshore slopes of southern Bataan, the Corregidor seamount, and the northern fringe of ancient flows from the Nasugbu volcanic complex on the coasts of far-western Cavite and northern Batangas. As is typical of estuaries, turbidity is naturally high (and salinity relatively low) in Manila Bay, especially during and after the rainy season, and this limits the range of coral species capable of thriving in locations close to major river mouths and away from tidal currents. Findings from several coral habitat surveys with sampling areas within the BCIB project area were considered in the baseline study. The coral reef habitats surveyed consist principally of fringing reefs characterized by colonized boulder fields and rocky slopes, rather than massive reef formations constituted by skeletons of reef-building species. Massive and encrusting coral forms predominate in many areas. Live benthic cover (including hard corals, soft corals, sponges, other sessile invertebrates, and macroalgae) tends to be quite low, which may be attributable to several factors (likely in combination), including patchiness of hard substrate, overfishing, use of dynamite fishing, water quality degradation, and naturally high turbidity. By the metric of hard coral cover, most reef areas sampled were considered to be in poor condition, although a minority were found to exceed the estimated national and Indo-Pacific averages. Notably, dead coral and dead coral colonized by algae were almost totally absent from the datasets of the three studies that recorded detailed breakdowns of benthic cover, which appears to suggest that the relatively low density of benthic cover observed may be a stable state, or at least not representative of active decline. Coral diversity was found to be variable across sites, but fairly low overall; a preponderance of coral genera thought to be tolerant of turbid conditions was noted in three of the studies reviewed.

Fisheries resources in Manila Bay are known to be in long-term decline, as documented by trawl surveys going back to the 1950s, and seen also in a generalized deterioration of fisherfolk livelihoods. The waters of the BCIB project area are an active year-round fishing zone plied primarily by local fisherfolk in small boats. Regulation of fishing is weak, dynamite fishing is reported to be common, and illegal bottom trawling by larger commercial boats is a known benthic degradation factor. A survey of reef fish conducted in the Bataan nearshore and Corregidor Island nearshore zones as part of the EIA study found that reef fish diversity, abundance and biomass are all low.

Despite the apparent presence of anthropogenic stressors and known degradation of marine resources indicated by baseline studies, the marine environment in the BCIB project area is appropriately categorized as Natural Habitat in accordance with the IFC habitat classification guidelines. Only one exotic species (the invasive mussel *Mytella strigata*) was recorded (but not found to be dominant) in any of the marine baseline surveys or earlier studies presenting data from the project area, and it is clear that benthic assemblages, while degraded in abundance and diversity, have not been replaced by something qualitatively different of anthropogenic origin.

The presence and distribution of marine mammals in Manila Bay have been subject to very little formal study, but data from an iterative longitudinal study of marine mammal strandings across the Philippines, as well as local media reports, do provide empirical evidence of at least intermittent presence of eight cetacean species, and review of range maps and habitat requirements suggests non-negligible probability of presence for an additional 13 cetaceans. A limited interview survey conducted as part of the EIA baseline study corroborated the presence of three species known from the stranding study and media reports. All of the marine mammal species confirmed within Manila Bay, and most of those suspected, are toothed whales. Dugongs were once known to use shallow areas of the bay, but have not been recorded since the 1970s.

Sharks, rays and other cartilaginous fish in Manila Bay have been studied even less than marine mammals, but numerous species are known or suspected to use the bay's waters. Participants in an interview survey conducted in the BCIB project area as part of the EIA baseline study identified nine shark species with reference to a visual identification key, as well as nine rays and two sawfish. Numerous others are suspected based on their appearance in screening lists and analysis of range maps and habitat requirements.

Marine turtles are a well-known presence during the winter nesting season on at least eight sandy beaches around the mouth of Manila Bay, and on at least five beaches further into the bay. Data from local turtle egg hatcheries run under municipal conservation programs indicate that the Olive Ridley (*Lepidochelys olivacea*) is the predominant nesting species on local beaches, although occasional presence of the Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys coriacea*) and Loggerhead Turtle (*Caretta Caretta*) is is reported by locals, and the Leatherback Turtle (*Dermochelys coriacea*) is suspected based on range mapping.

Marine Protected Areas

There are two locally-managed marine protected areas (LMMPAs) within the BCIB project area, and four others are found within 10 km of the proposed project alignment. The Corregidor Islands Marine Park (CIMP) is a 508-ha multi-use protected area consisting of a series of management zones, ranging in purpose from strict preservation to extractive uses, encompassing most of the nearshore zone around Corregidor Island. The BCIB alignment will cross one part of the CIMP, zoned as Artificial Reef Area. The CIMP was established in 2021 through a municipal ordinance of Cavite City (which has jurisdiction over the islands in the mouth of Manila Bay), but is conceived as a collaborative initiative involving numerous institutional stakeholders, and its planning and management is overseen by a multi-stakeholder management board, with a secretariat housed within the Cavite provincial office of DENR.

The other LMMPA in the project area is the Naic Fish Santuary (59 ha), which is situated about 800 m south of the BCIB alignment, in the Cavite nearshore zone. The sanctuary was designated through a 2003 ordinance of the Municipality of Naic, and is managed under a collaborative arrangement between the municipality and a local NGO.

Draft Critical Habitat Assessment

The Draft Critical Habitat Assessment prepared for the BCIB project evaluated each of 46 endangered and critically endangered marine species identified in IBAT screening and in baseline surveys (literature and interviews). No marine species were deemed eligible qualifying species for a critical habitat determination, based on consideration of information concerning habitat requirements, known extent of occurrence, estimated global populations where available, and probability of the Area of Analysis providing habitat to support local populations sufficient to meet critical thresholds specified in IFC PS6. However, marine protected areas designated for biodiversity conservation and two types of marine critical habitat (coral reefs and seagrass) were considered to meet the definition of qualifying critical habitat elements under Criterion 4, Threshold (b). The CIMP and its coral reefs were provisionally classified as Critical Habitat. There are no known seagrass beds in the project area. Critical habitat determinations for marine species and habitat elements will be finalized based on results of longitudinal surveys undertaken during the pre-construction and early construction phase.

Air

Climate

The climate of the Manila Bay region is classified as Type 1 under the Modified Coronas Classification System, and the BCIB project area can generally be expected to experience two pronounced seasons: dry from approximately October to April, and wet from approximately May to September. This precipitation pattern is driven by the monsoonal winds that prevail during different times of the year. The Manila Bay area is affected by the southwest monsoon (known locally as the *Habagat*) and the northeast monsoon (local name *Amihan*). In general, the southwest monsoon brings hot, humid conditions, with frequent development of cumulus cloud and heavy rainfall. By contrast, the northeast monsoon generally sweeps colder, drier air across the region, resulting in cold weather and a predominance of cirrus clouds bringing infrequent light rainfall.

In common with much of the Philippines, Manila Bay Luzon is vulnerable to tropical cyclones, which most often develop over the Western Pacific and track north-westwards across the archipelago. Much less frequently, cyclonic storms also form over the South China Sea and move eastwards to affect the country. Between 1948 and 2020, Bataan and

Cavite were traversed by 27 and 26 cyclones, respectively. More of these storms occurred in October than in any other month, in both provinces, but there is not a particularly strong modal distribution. Only January, February and March have been cyclone-free for both Bataan and Cavite. The Philippine Atmospheric, Geophysical and Astronomical Sciences Administration (PAGASA) categorizes cyclones based on their sustained wind speed, as follows: (1) tropical depressions (sustained winds 61 km/h or less); (2) tropical storms (62–88 km/h); (3) severe tropical storms (89–117 km/h); (4) typhoons (118–220 km/h); and (5) super typhoons (sustained winds greater than 220 km/h). The lion's share of cyclonic storms passing through Bataan and Cavite have consisted of tropical storms and typhoons; these two middle-of-range storm strength classes made up 89% of tracked storms in Bataan, and 88% in Cavite. No severe tropical storms have been recorded, and only one super typhoon (Rolly/Goni in 2020) has hit the area.

Climate Change

Downscaled climate change projections indicate that the project area is likely to see increases in the maximum daily temperature of 1.5°C by 2100 under the RCP4.5 scenario, and 3.2°C under the RPC8.5 scenario. The frequency of very hot days is expected to rise dramatically by 2100; the percentage of days exceeding the baseline 90th percentile threshold for high temperature (baseline 11.5% or 42 days) is projected to jump to above 60% (222 days for Bataan and 234 days for Cavite) under the RCP4.5 scenario, and to about 90% (331 days for Bataan and 334 days for Cavite) under RCP8.5.

The projected effects of climate change on rainfall in the BCIB project area are mixed. Bataan generally receives higher maximum daily rainfall now than Cavite, but the gap between them is projected to narrow somewhat under both emissions scenarios. For Cavite, maximum daily rainfall is projected to rise 8.2% above the baseline of 116.4 mm by 2100 under RCP4.5, and do the same by mid-century under the RCP8.5 scenario, while it is projected to settle close to the baseline in Bataan by 2100 under both scenarios. The 99th percentile for daily rainfall is projected to fall modestly for Bataan, for all time periods under both emissions scenarios, while in Cavite, the 99th percentile for daily rainfall is projected to rise for all time periods under both scenarios, with rises being a little stronger under the RCP4.5 scenario than under RCP8.5.

It can be considered likely that an increased incidence of landslides (Bataan only) will accompany the projected increases in maximum daily rainfall, since landslide risk is associated with soil saturation. Flooding that is derived from rainfall (as opposed to storm surge or sea level rise) can be expected to become more frequent, commensurate with increased maximum daily rainfall and rainfall on extremely wet days; this is a concern principally in Cavite, where flooding has been a problem historically, and is linked in substantial measure to rainfall events of sufficient volume and intensity to overwhelm local drainage channels and structures.

Tropical cyclones are expected to become somewhat stronger under the effects of climate change. The assumption adopted in the Climate Risk and Adaptation Assessment prepared for the BCIB project is that peak winds during cyclones visiting the project area may be stronger by a factor of 1.2–1.4 times by 2100, potentially reaching as high as 315 km/h. Potential for flooding associated with storm surge may increase more or less commensurately with storm strength. The Climate Risk and Adaptation Assessment report projects that sea level will rise 0.3 m to 0.7 m rise from present levels by 2130 under the RCP4.5 scenario, and 0.8 m to 1.6 m by 2130 under the RCP8.5 scenario.

Ambient Air Quality

The Bataan portion of the project area is mostly rural in character, but has seen the development of several industrial facilities in recent decades, and emissions from these facilities contribute to a generalized background degradation of air quality within the BCIB project area. Most notably, a pair of 316-MW coal fired power plants (GN Power) is located about 3 km east of the approach road alignment, and a major oil refinery (Philippine National Oil Corporation) stands 9 km to the northeast of the planned interchange. There are also other industrial facilities in the general vicinity, including two oil terminals, a plastics manufacturing complex, a cement terminal and at least one active quarry, and these may influence ambient air quality in the project area. Monsoonal shifts in the wind regime can be expected to help determine the relative importance of these air pollution sources at different times of year. In the direct vicinity of the BCIB approach road, agricultural burning, traffic in the Roman Highway corridor and dust from construction sites are thought to be the principal sources of air pollutants. Macro-scale transport of air pollutants in the Manila Bay area is not well understood, but it can be surmised that regional dispersion of emissions from Metro Manila and long-range transport from biomass burning in Malaysia and Indonesia exert some significant influence on air quality around the bay mouth. Despite the presence of the emissions sources mentioned, measurements of ambient air quality around the project sites and nearby community areas during the EIA baseline study do not indicate a heavily degraded airshed, at least not as measured at ground level. In sampling conducted in February of 2020 and October 2021, concentrations of particulate matter smaller than 2.5 microns ($PM_{2.5}$), particulate matter smaller than 10 microns (PM_{10}), total suspended particulates (TSP), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) were consistently below the maximum levels specified under the national standard, and only minor exceedances of the IFC standard for $PM_{2.5}$ were documented at a minority of sampling stations.

The Cavite side of the BCIB project area has few large local emitters; the nearest substantial point source is a diesel-powered power plant near Rosario, about 11 km northeast of the proposed Antero Soriano Highway interchange site. The principal sources of air pollutants in the Cavite project area are vehicles (especially in the Antero Soriano Highway corridor), dust from agriculture and construction, and burning of crop residues. The same regional influences as were mentioned for the Bataan (dispersion of emissions from Metro Manila and long-range transport from other Southeast Asian countries) can be expected to be relevant in Cavite as well. Ambient air quality as measured for the baseline survey in February 2020 and October 2021 was mostly within the national standard except for one exceedance for TSP. The IFC standard for $PM_{2.5}$ was exceeded slightly at one station and significantly at two others. Overall, the baseline sampling results are not suggestive of a significantly degraded airshed in the Cavite part of the project area.

Ambient Noise

The principal sources of ambient noise in the Bataan portion of the project area are traffic (particularly in the Roman Highway corridor), use of mechanized equipment in construction and agriculture, and household noise. Insects and amphibians are a dominant source of noise during the night and early morning. Ambient noise in the project area was found to be above both national and IFC standards for most stations and time periods, in some cases more than 10 dBA higher, during sampling conducted in February 2020 and October 2021.

Even more than on the Bataan side, ambient noise levels in the Cavite project area tend to exceed both national and IFC standards. During sampling in February 2020 and October 2021, almost no measurements met the national and IFC ambient noise standards, and exceeded them in some locations by over 15 dBA. The principal sources of ambient noise appear to be vehicles, motorized equipment used in agriculture and construction, household noise and insects (the latter even exceeding nighttime standards in some locations).

People

Bataan

The Bataan end of the BCIB project will be built entirely within the Municipality of Mariveles, in the two barangays of Alas Asin and Mountain View. Mariveles is the largest municipality in Bataan province by both area and population, and has undergone strong population growth in recent decades, with population more than doubling from 1990 to 2020. Population and built-up areas are concentrated near the coastline, particularly the south of the municipality (around Mariveles Bay) and east (along the Roman Highway corridor; this distribution can be explained partly by topography, as gentler slopes are found in the toe slope of the Mt. Mariveles volcano than higher up, and by the historical derivation of livelihood from the sea.

With the establishment of major industrial facilities along the coast and the expansion of the Freeport Area of Bataan, employment in the industrial sector accounts for the largest share of earned income in the project area. Light manufacturing enterprises within the FAB alone are estimated to provide employment to about 40,000 people, and significant expansion of the workforce is foreseen in the coming decade. Other industrial estates in Mariveles with significant workforces include the PNOC Industrial Estates in the northeast corner of the municipality (with enterprises engaged mainly in petrochemical products manufacturing) and the Basseco Compound in Mariveles Bay (brewery, shipyard, grain terminal and port facility). Major employers outside industrial estates include the GN Power coal-fired generating stations, as well as various oil terminals and shipyards along the coast. Significant employment is also to be found in the tertiary sector, mostly in small-to-medium sized enterprises in retail, business services, food services, real estate and transportation. Tourism is considered to have significant potential given the scenic and historic resources within the municipality, but is not yet a major employer. Agriculture employs only about 5% of the population of Mariveles, primarily due to relatively limited land suitability. There is little wet rice cultivation, with agricultural production consisting mostly of casava, corn, and tree fruits. Agricultural activity observed in the vicinity of the BCIB project footprint consists primarily of fruit orchards (principally mango and guava) and extensive grazing (principally cattle and sheep).

Despite the municipality's long coastline, fishing does not account for a significant share of employment or income in Mariveles. There were 3,126 registered municipal fisherfolk with 984 registered fishing boats across all barangays in the municipality in 2021. The largest numbers of fisherfolk are found in the barangays of Sisiman, Townsite, Lucanin, Alas Asin and Ipag. Several small fishing communities are found along the shore in the general vicinity of the BCIB project landing point, in Alas Asin, Mt. View and Cabcaben. Most fisherfolk in these areas use small (4–8 m) motorized outrigger canoes, and fish locally; the North Channel between Mariveles and Corregidor Island appears to be a particularly popular spot, which is reportedly due in part to the presence of a mixing zone where fisheries productivity is relatively high. Fishing is conducted year round, with peak seasons being March to May and June to August. A range of nets, traps and long-line technology is used by local fisherfolk.

The people and businesses of the project area in Bataan are linked to the national economy mainly by the Roman Highway, which offers the fastest route to Metro Manila, as well as to the nearest large commercial airport (Clark International). Numerous piers and port facilities in southern Mariveles serve industrial shipping needs. Private ferry companies offer regularly scheduled service between Mariveles Bay and the Manila waterfront (1 hr), and between Manila and Orion (1 hr), with land shuttle to Mariveles. Direct ferry service from Manila to the Camaya Coast Resort is also sometimes available. There is no ferry service between Bataan and Cavite.

The Roman Highway is being widened to six lanes as part of a multi-year project of DPWH Region III, but the highway remains a four lane road within built-up portions of the BCIB project area. The project area is connected to Mariveles town and the core development area of the Freeport Area of Bataan via a switch-backed segment of the Roman Highway that descends to the north part of the town and is open to passenger cars and other small vehicles only, and a bypass road that is designated for the use of truck and buses and enters the port area from the southeast. This bypass road follows a torturous route through a number of small settlements, and is beset with heavy congestion and numerous safety and environmental problems.

Cavite

The Cavite terminus of the project will be built entirely within the Municipality of Naic, and will impinge upon the two barangays of Timalan Balsahan and Timalan Concepcion. As an immediate neighbor of Metro Manila, Cavite province has experienced a surge of industrial and residential development, with the provincial population seeing a four-fold expansion between 1990 and 2020. Although Naic is positioned towards the western edge of the province, growth has increasingly spread to the municipality, whose population grew at an average rate of 6% from 2010 to 2020. Municipal officials indicate that developers' interest in pursuing projects in Naic is very strong, and numerous new row housing estates and industrial parks are noticeable features of the landscape.

Traditionally dominant sources of livelihood in Naic include agriculture (principally rice and vegetable cultivation), fishing and aquaculture, but the development of manufacturing and export processing capacity in municipalities to the northeast (e.g., Tanza, Rosario, Cavite City) and to a lesser extent within Naic itself has generated substantial new employment opportunities, even as agricultural land has increasingly transitioned to other uses (near the coast and transportation corridors) and Manila Bay-wide overfishing has led to the decline of fishing as a viable full-time livelihood. Growth in the coastal tourism sector (there are at least 15 small resorts in various stages of development along the Naic beachfront) is also notable. With strong recent expansion of residential and commercial development, employment in construction and related service provision is also likely to be a substantial source of livelihood.

Despite diversification of livelihoods, farming and fishing remain significant contributors to land use and employment. Around 60% of Naic's land area was still considered agricultural as of 2015, and approximately 2,300 people derived their income from farming of some kind in 2019. The leading agricultural product by both area cultivated and number of farmers involved is rice, followed by mango. Farming activity is increasingly constrained in the coastal and near-coastal parts of the municipality, due to conversion of land for residential, commercial and industrial uses.

Sources vary regarding the number of active fisherfolk in Naic, with many more apparently deriving a portion of their income from fishing than are actually formally registered as fisherfolk. Around Manila Bay generally, it is very common for fisherfolk to have other jobs and run small enterprises to supplement increasingly meager and unreliable fishing income. Officially registered fisherfolk across the nine coastal barangays of Naic numbered slightly over 400 in 2019. In common with their counterparts from other municipalities, the Naic fisherfolk are known to fish well beyond the boundaries of the official municipal fishing grounds, and commonly travel to the waters around Corregidor and Caballo Islands to fish. Fisherfolk in Timalan Balsahan and Timalan Concepcion report that they use mainly bottom-set gillnets and drift gillnets for fish, and crab gillnets to target Blue Swimming Crab (*Portunus pelagicus*) and Crucifix Crab (*Charybdis feriata*). About 20% of registered fisherfolk in Naic are involved in aquaculture; the primary concentration of aquacultural activity is within the Timalan River estuary, where oysters are the main harvest.

The principal link between the project area in Naic and Metro Manila is the Antero Soriano Highway, which connects to the Cavite Expressway near Cavite City. This road is nominally four lanes, but has numerous obstructions (utility poles, trees, informal parking areas) in the two outer lanes, which constrains traffic and creates safety concerns. There are a few minor local ports in river estuaries up and down the Cavite coast, but these mainly handle fishing traffic. A substantial new cargo wharf and terminal, the Cavite Gateway Terminal, was opened in 2018, about 2 km northeast of the proposed BCIB landing point in Tanza. This facility features roll-on-roll-off docks, a container yard and reefer accommodations, and is intended to provide a direct sea access point for the growing export processing and manufacturing sectors of Cavite and Laguna, bypassing the congested Port of Manila. There is no regular passenger ferry service from the Naic shore, either to Bataan or Metro Manila; the nearest ferry (with service to the Manila waterfront) is at Cavite City.

Anticipated Impacts and Prescribed Mitigation

The BCIB project will produce a range of positive and negative impacts, the former offering modest scope for enhancement, and the latter requiring careful management. Assessment of impacts in the EIA has followed the same organizing framework as was used in the previous baseline overview, with four thematic areas (Land, Water, Air, People) and three project phases (pre-construction, construction, operation).

Pre-Construction Phase Impacts

Pre-construction impacts are those impacts which, although they may be manifest during construction or operation, actually originate during planning, design and procurement, and can therefore be mitigated at least partially through decisions taken as part of these pre-construction activities. The pre-construction impacts identified for the BCIB project, as well as mitigation prescribed to address them, are summarized in the table below.

Pre-Construction Phase Impacts, Mitigation and Residuals

Impact Area	Pre-Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
LAND				
Land and environmental services	Loss of agricultural land to ROW (-)	• Judicious design of ROW	Medium	Significant residual
	Land use change (induced development) (+/-)	• None feasible within scope of EMP	High	-
Terrestrial biodiversity	Conversion of Natural Habitat (Bataan) (-)	• Judicious design of ROW	High	Significant residual
	Light pollution (-)	• Shielding and directionality specified in roadway lighting design	Low	Negligible

Impact Area	Pre-Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Avian mortality from vehicle collisions (perching birds) (-)	• Contingency for Installation of anti-perching devices if found significant during operations	Possibly significant	Negligible
	Avian mortality from bridge collisions (night migrants) (-)	• Adoption of bird-safe lighting scheme	Possibly significant	Possibly significant
	Enhanced long-term exploitation pressure on resources in Mariveles Mountains KBA (-)	• None feasible within scope of EMP	Possibly significant	Possibly significant
WATER				
Freshwater ecology	Contamination by roadway runoff (-)	• Design-driven mitigation foregone in favor of operation-phase mitigation	Low	-
Groundwater	Loss of recharge capacity (-)	• None feasible	Low	-
Marine water quality	Contamination by bridge deck runoff (-)	• Design-driven mitigation foregone in favor of operation-phase mitigation	Low	-
Marine biodiversity	Displacement of coral reef habitat (-)	• None feasible	High	-
	Displacement of soft bottom habitat (-)	• None feasible	Low	-
	Shading effects (+/-)	• None feasible	Low	-
	Ecological change due to light pollution (-)	• Shielding and directionality specified in roadway lighting design • Direct light emissions to water prioritized in decorative lighting design	Possibly significant	Possibly significant
	Loss of turtle nesting habitat at landing in Cavite (-)	• None possible	Low	Low
AIR				
Climate change	GHG emissions (-)	• LED lighting specified in designs • Low-carbon concrete specified	Uncertain	Uncertain
	Loss of sequestration capacity (-)	• Seedlings to be donated to DENR for use in offset plantings (100:1 ratio)	Medium	Low
Local air quality	Degradation of air quality in roadside areas (-)	• Unknown	Possibly significant	Possibly significant
Noise	Increased noise in roadside areas (-)	• Noise barriers to be incorporated in design as needed • Noise barriers infeasible on receiving roads due to gaps for ingress/egress	Medium	Significant residual in off-project areas
PEOPLE				
General livelihoods	General economic development and improved access to opportunity (+)	• Enhancement unnecessary	-	-
	Jobs in bridge operations (+)	• Job training and recruitment support	-	-
	Business opportunities in bridge maintenance and repair works (+)	• Marketplace connection support for local enterprises	-	-
Fisherfolk livelihoods	Probable increase in fish biomass from enhanced habitat diversity (+)	• Additional enhancement possible but effectiveness unknown	-	-
	Protective effect of no-dredge buffer (+)	• Enhance by establishing fish sanctuary along full length of alignment	-	-

Impact Area	Pre-Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
Public health and safety	Increased traffic and safety risks on receiving roads (-)	• Initiate multi-stakeholder planning process for safety and capacity improvements on EPZA Bypass (Bataan) and Antero Soriano Hwy and Governor's Dr (Cavite)	Medium	Residual unknown
Aesthetics	Impacts on static viewsheds (+/-)	• Design of infrastructure prioritizes positive visual impact	-	-
	Impacts on dynamic viewsheds (+)	• Design of infrastructure prioritizes positive visual impact	-	-
	Visual impact of roadside litter (-)	• Anti-littering signage incorporated in roadway design	Low	Low

[1] (+) = positive impact; (-) = negative impact; (+/-) = impact may be positive or negative, depending on the situation or receptor
[2] Pre- and post-mitigation significance not determined for positive impacts

Construction Phase Impacts

Construction impacts are those impacts which occur as a direct or indirect result of construction activity, and which are subject to mitigative actions that can be implemented by the contractors performing the construction work. Planning for mitigative action will typically and appropriately take place in the period immediately leading up to the start of construction, but mitigation will generally be implemented in parallel with construction activity.

As is typical for a project of this type and spatial scope, a large proportion of the impacts expected from the BCIB project will be related to the construction process, and most can be considered temporary. However, as the construction phase will be relatively long (upwards of five years) and some activities and site usages will endure for a substantial portion of that period, 'temporary' cannot always be equated with 'short-term'. The intensity of different construction activities will vary considerably, and while many impacts are expected at fairly low levels of severity, others will be felt strongly; those impacts generated at high intensity over long durations (such as marine pile driving and materials hauling) will have the greatest significance. Another driver of severity is the sensitivity of receptors, and this is especially relevant for the biodiversity dimensions of the BCIB project area, given that some components of the project environment are considered probable Critical Habitat, and some of the marine species known or suspected to be present in the project area are classified as endangered or critically endangered by IUCN. The construction phase impacts identified for the BCIB project, as well as mitigation prescribed to address them, are summarized in the table below.

Construction Phase Impacts, Mitigation and Residuals

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
LAND				
Environmental services	Degradation of habitat and ecosystem services on staging area sites (-)	• Contractors to optimize use of space and avoid vegetation removal to the extent possible • Contractors to prepare and implement site-specific Staging Area Rehabilitation Plans	Medium	Low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Degradation of habitat and ecosystem services outside ROW and staging areas (dust, boundary overflow) (-)	• Contractors to prepare and implement site-specific Dust Control Plans • Contractors to fence all work sites and prohibit boundary overflow	Low	Negligible
Soil	Contamination from spills and leaks (-)	• Require use of only newer-model equipment maintained in top condition • Contractors to prepare and implement site-specific Hazardous and Noxious Materials Management Plans	Low	Very low
	Spread of existing contamination during clearing and demolition (-)	• Contractors to arrange prior survey by DENR-recognized provider of testing and remediation services and implement abatement plans if needed	Low	Negligible
	Contamination from poor solid waste management (-)	• Contractors to prepare and implement site-specific Waste Management Plans	Low	Very low
Terrestrial biodiversity	Spread of invasive species (-)	• Contractors required to use only native species in reinstatement, slope stabilization and staging area rehabilitation	Medium	Negligible
	Depletion of local wildlife from worker hunting and gathering (-)	• Contractors to prohibit hunting and gathering by workers in time off	Low	Negligible
	Degradation of critical habitat (mangroves) and habitat of qualifying species (Philippine Duck) (-)	• Contractor responsible for Cavite station area to protect 30-m buffer along Timalan River frontage	Medium	Negligible
Physical cultural resources	Loss or damage of previously unknown physical cultural resources (-)	• Contractors required to develop chance find procedure and train workers in its use	Very low	Negligible
WATER				
Freshwater ecology	Siltation and sedimentation from erosion (-)	• Contractors to prepare and implement site-specific Soil Erosion Prevention and Runoff Management Plan • Contractors generating spoils to prepare and implement a site-specific Spoils Management Plans • Contractors to ensure that all runoff discharged from sites under their control is of sufficient quality to prevent violation of national water quality standard in receiving watercourse	High	Low
	Siltation and sedimentation from works conducted in watercourses at bridge and culvert works (-)	• Contractors to carry out in-water works in dry season if possible • Contractors to consistently deploy in-water silt curtains at bridge works	High	Low
	Contamination from spills and leaks (-)	• Contractors required to use only newer-model equipment maintained in top condition • Contractors to prepare and implement site-specific Hazardous Materials Management Plans	Low	Very low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Contamination from concrete washout (-)	• Contractors responsible for concrete batch plants to prepare and implement facility-specific Concrete Batch Plant Management Plans • Contractors operating concrete batch plants to ensure that washout water is recycled to the maximum extent possible to reduce water consumption	High	Very low
	Enrichment by human waste (-)	• Contractors to prepare and implement site-specific Human Waste and Sanitation Management Plans • Contractors to ensure that septic systems are designed and operated in accordance with Philippine National Plumbing Code	Medium	Very low
Groundwater	Contamination from spills and leaks (-)	• Contractors required to use only newer-model equipment maintained in top condition • Contractors to prepare and implement site-specific Hazardous Materials Management Plans	Low	Negligible
	Contribution to local scarcity (-)	• Contractors operating concrete batch plants to ensure that washout water is recycled to the maximum extent possible to reduce water consumption	Medium	Very low
Marine water quality	Siltation and sedimentation from land site erosion (-)	• Contractors to prepare and implement site-specific Soil Erosion Prevention and Runoff Management Plan • Contractors to ensure that all runoff discharged from sites under their control is of sufficient quality to prevent violation of national water quality standard in receiving watercourse	High	Low
	Siltation and sedimentation from marine works (-)	• Marine works contractors to consistently deploy surface-to-seabed silt curtains in a tight configuration around all works carried out in waters of depth 30 m or less • Marine works contractors to prepare and implement Marine Spoils Management Plan	High	Low
	Contamination from spills and leaks (-)	• Marine works contractors to prepare and implement Marine Spill Prevention and Response Plan	Medium	Very low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Enrichment by human waste (-)	• Marine works contractors to prepare and implement Marine Sanitation and Solid Waste Management Plans • Marine works contractors required to set up onshore septic systems to receive and treat waste collected from vessels and platforms, and operate them in accordance with Philippine National Plumbing Code	Medium	Very low
Marine biodiversity	Coral habitat loss from dredging and rock jetties (-)	• No mitigation possible	High	Significant residual
	Damage and disturbance of benthic habitat from anchoring and vessel activity (-)	• No mitigation feasible	High	Significant residual
	Injury and disturbance of marine mammals by pile-driving noise (-)	• Piling contractors to consistently deploy bubble curtains around piling rigs	High	Significant residual
	Injury and displacement of fish by pile-driving noise (-)	• Piling contractors to consistently deploy bubble curtains around piling rigs	High	Significant residual
	Ecological change in coral reef habitat due to extended pile-driving noise (-)	• Piling contractors to consistently deploy bubble curtains around piling rigs	High	Significant residual
	Degradation of marine habitat by solid waste disposal (-)	• Marine contractors to prepare and implement Marine Sanitation and Solid Waste Management Plan • Marine contractors to establish solid waste management facilities at shore sites	Low	Negligible
	Ecological change from use of work lighting for extended period (-)	• Contractors to deploy shielding on task lighting to limit direct light emissions to water	Medium	Low
	Injury and mortality of marine wildlife from vessel strikes (-)	• Marine contractors to enforce speed limits on all vessels • Marine contractors to implement Marine Wildlife Protection Protocol whenever megafauna are spotted	Low	Very low
	Ecological change due to temporary hydrodynamic modification (-)	• Contractors to install cross-circulation structure every 50 m in temporary rock jetties	Possibly significant	Possibly significant
AIR				
Climate change	GHG emissions from machinery used in works (-)	• Contractors to be required to use only newer-model equipment maintained in top condition	Medium	Low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
Local air quality	Dust from construction works and hauling (-)	• All contractors to prepare and implement approved site-specific Dust Control Plans • Contractors operating concrete batch plants to prepare and implement approved Concrete Batch Plant Management Plans including use of dust collection and suppression systems • Contractors to arrange layout of staging areas to ensure major dusty aggregates handling facilities are located at least 300 m from the nearest residence	High	Low
	Engine emissions from construction works and hauling (-)	• Require use of only newer-model equipment maintained in top condition • Contractors to arrange layout of staging areas to ensure major stationary equipment like concrete batch plants, asphalt batch plants and generators is located at least 300 m from the nearest residence • Contractors to prepare and implement approved Construction Traffic Management Plan to limit congestion • Construction Supervision Consultant to coordinate hauling of contractors to help limit undue congestion	Medium	Low
Noise	Noise from construction works and hauling (-)	• Contractors to arrange layout of staging areas to ensure major stationary equipment like concrete batch plants, asphalt batch plants and generators is located at least 300 m from the nearest residence • Contractors to deploy temporary noise barriers along Cavite approach road ROW, which will see heavy hauling throughout construction phase • Noisy on-land work activity to be strictly limited to daylight hours	Medium	Low
PEOPLE				
Disruption	Social conflict associated with influx of non-local workers (-)	• Implement recruitment and training programs to increase potential hiring of local workers, under the Social Development Plan • Ensure that contractors meet or exceed quotas for local workers under RA 6685 • Contractors responsible for construction camps to prepare and implement approved site-specific Construction Camp Management Plans including rules for resident conduct	Low	Very low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Congestion from construction traffic (-)	• Contractors to prepare and implement approved Construction Traffic Management Plans to limit congestion • Construction Supervision Consultant to coordinate hauling of contractors to help limit undue congestion	High	Medium
	Temporary access disruptions (-)	• Contractors to strictly limit blockage of access, and provide advance notice to residents and property owners of unavoidable access disruptions	Low	Very low
	Temporary utility disruptions (-)	• Contractors to coordinate closely with utility providers to manage planned disruptions • Contractors to provide training to operators of equipment capable of causing inadvertent damage to in-ground or overhead utility infrastructure	Low	Negligible
Livelihoods	Jobs in construction and related activity (+)	• Implement recruitment and training programs to increase potential hiring of local workers, under the Social Development Plan	-	-
	Opportunities to provide goods and services to project contractors (+)	• Implement marketplace connection support to facilitate procurement of goods and services from local enterprises by contractors, under Social Development Plan	-	-
	Temporary degradation of amenity values in Cavite coastal tourism zone due to noise, inshore siltation, and visual intrusion from nearshore marine works, leading to lost business (-)	• Marine works contractors to deploy shielding on work lighting to reduce glare • Marine works contractors to deploy surface-to-seabed silt curtains around nearshore marine foundation works to limit inshore siltation	Medium	Low
Fisherfolk livelihoods	Temporary restriction of access to fishing areas	• Marine contractors to provide safe access corridors for fisherfolk across project exclusion zone	Low	Low
	Reduced fish availability due to pile driving noise	• Piling contractors to consistently deploy bubble curtains around piling rigs	High	Significant residual
Public health and safety	Elevated safety risks due to construction traffic (-)	• Contractors working in the public way to prepare and implement approved Road Works Safety Management Plans • Contractors to prepare and implement approved Construction Traffic Management Plans	Medium	Low

Impact Area	Construction Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Elevated safety risks for fisherfolk active near marine works (-)	• Project exclusion zone to be demarcated • Informational events to be held with fisherfolk regarding rules for project exclusion zone, including operation of safe transit corridors	Low	Very low
Occupational health and safety	Hazards on job sites (-)	• All contractors to prepare and implement approved Occupational Health and Safety Plans • Marine works contractors to arrange for secure removal of any unexploded ordnance detected in seafloor prior to the start of any marine works	Medium	Low
	Hazards in construction camps (-)	• Contractors operating camps to prepare and implement approved Construction Camp Management Plans including facility standards and safety measures	Low	Negligible
	Geophysical hazards during construction (-)	• Each contractor to prepare Emergency Action Plan including preparedness and response capacity for earthquakes and tsunamis	Low	Very low
	Dehydration and heat exhaustion (-)	• Contractors to be required to provide unlimited supplies of clean drinking to workers at all times • Contractors to be required to provide shaded resting areas at all job sites, including marine work platforms	Low	Negligible

[1] (+) = positive impact; (-) = negative impact; (+/-) = impact may be positive or negative, depending on the situation or receptor

[2] Pre- and post-mitigation significance not determined for positive impacts

Operation Phase Impacts

Operation phase impacts are those impacts which occur as a direct or indirect result of the use of the completed infrastructure as well as its operation and maintenance (including scheduled and unforeseen repair works), and which are mitigated by the infrastructure owner or its designated operating entity, or by contractors engaged to carry out maintenance and repair activities. As is often appropriate, some significant operation-phase impacts of the BCIB project have been pre-mitigated during the design process. The construction phase impacts foreseen for the BCIB project, as well as mitigation prescribed to address them, are summarized in the table below.

Impact Area	Operation-Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
LAND				
Soil	Contamination from maintenance and repair works (-)	• Maintenance and repair contractors to be contractually required to prepare Hazardous Materials management Plans	Low	Very low

Impact Area	Operation-Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
	Contamination due to spills on roadway arising from accidents (-)	• Bridge Management Unit to strictly enforce speed limit • Bridge Management Unit to prepare and implement Emergency Action Plan including spill preparedness and response capacity	Low	Very low
	Contamination from litter buildup (-)	• Weekly mechanical sweeping of entire roadway including emergency pull-out lanes included in O&M plan • Bridge Management Unit to implement regular roadside litter removal	Low	Very low
WATER				
Freshwater ecology	Impaired water quality and contamination of biota from approach road surface runoff (-)	• Weekly sweeping of all four traffic lanes and both emergency lanes with a regenerative air sweeper included in O&M plan to remove particulate contaminants	Low	Negligible
	• Spill risk associated with accidents (-)	• Bridge Management Unit to strictly enforce speed limit • Bridge Management Unit to prepare and implement Emergency Action Plan including spill preparedness and response capacity	Low	Very low
	• Contamination from maintenance and repair works (-)	• Maintenance and repair contractors to be contractually required to prepare Hazardous Materials management Plans	Low	Very low
Marine ecology	Impaired water quality and contamination of benthic biota from bridge deck runoff (-)	• Weekly sweeping of all four traffic lanes and both emergency lanes with a regenerative air sweeper included in O&M plan to remove particulate contaminants	Low	Negligible
	Spill risk associated with accidents (-)	• Bridge Management Unit to strictly enforce speed limit • Bridge Management Unit to prepare and implement Emergency Action Plan including spill preparedness and response capacity	Low	Very low
	Contamination from maintenance and repair works (-)	• Maintenance and repair contractors to be contractually required to prepare Hazardous Materials Management Plans	Low	Very low
AIR				
Local air quality	Degradation of air quality in roadside areas from maintenance and repair works (-)	• Maintenance and repair contractors to be contractually required to prepare and implement Dust Control Plans	Medium	Low
PEOPLE				
Livelihoods	Jobs in bridge operations and maintenance (+)	• Bridge Management Unit to prioritize hiring of local people for jobs in infrastructure and ROW maintenance, administration, emergency response crews, security,	-	-

Impact Area	Operation-Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]
		equipment maintenance and groundskeeping at the BMMC, under auspices of SDP • Bridge Management Unit to require contractors engaged for major repair and replacement works to hire local labor in proportions at least meeting the minimum local labor requirement for construction projects as per RA 6685, under auspices of SDP		
	Business opportunities in maintenance and repair works (+)	• Bridge Management Unit to organize informational events to announce tenders to local contractors, to encourage local bids on maintenance and repair and replacement contracts, under auspices of SDP	-	-
Fisherfolk livelihoods	Fisheries-protective effect of BCIB against dredging (+)	• Bridge Management Unit to actively monitor dredging activity around bay mouth and strictly enforce 1-km no-dredge zone • Bridge Management Unit to actively monitor ECC applications for seabed mining near the bay mouth and participate in hearings as necessary to ensure permits are not granted within 1-km dredge zone	-	-
	Enhancement of fish stocks over the long term from increased structural diversity and protective effect of bridge presence (+)	• DPWH to collaborate with four municipalities whose waters are crossed by the alignment to establish fish sanctuaries along the entire alignment prior to start of operations, under the Social Development Plan	-	-
Public health and safety	Accident risks during infrastructure use (-)	• Bridge Management Unit to strictly enforce speed limit • Bridge Management Unit to institute spot safety checks to reduce frequency of unsafe vehicles • Bridge Management Unit to implement a conditions-based protocol for bridge closures, e.g., high winds, very heavy rain	Medium	Very low
Occupational health and safety	Accident risks during maintenance and repair works (-)	• Occupational health and safety measures applicable to regular maintenance teams included in O&M plan • Bridge Management Unit to contractually require contractors engaged for inspection, maintenance and repair works to prepare and implement Occupational Health and Safety Plan	Low	Very low
Aesthetics	Unsightly deposition of roadside solid waste (-)	• Bridge Management Unit to implement regular roadside litter removal	Low	Negligible

Impact Area	Operation-Phase Impacts[1]	Mitigation	Significance Before Mitigation[2]	Significance After Mitigation[2]

[1] (+) = positive impact; (-) = negative impact; (+/-) = impact may be positive or negative, depending on the situation or receptor
[2] Pre- and post-mitigation significance not determined for positive impacts

Overview of Key Residual Impacts

As can be seen from the tables above, almost all of the likely impacts identified are amenable to some degree of mitigation, and many are expected to drop off to low, very low or even negligible levels of significance if the prescribed mitigation is thoroughly and competently implemented. This is especially the case for impacts that are relatively minor to begin with (e.g., visual impacts of roadside litter, road surface runoff), and impacts that result from inadequate management systems (e.g., waste impacts, some contamination impacts, dust impacts, soil erosion, occupational health and safety impacts) and are therefore remedied by the making of good plans, backed up by good monitoring and enforcement.

For a subset of impacts, mitigation by prevention and minimization is either not physically possible (e.g., habitat displaced by infrastructure); infeasible due to excessive cost or technical limitations; of dubious feasibility due to high uncertainty; or not anticipated to be effective enough to meet the expectations of relevant stakeholders. Such impacts will be residuals that have to be dealt with in one (or more) of three ways: (1) develop compensatory measures to offset the damage incurred in a way acceptable to stakeholders; (2) put in place an adaptive management plan to further assess the significance of the impact as it unfolds, and develop appropriate mitigation if needed; or (3) consider the residual an acceptable tradeoff against the positive impacts of the project. The impacts that are anticipated to have residual impacts of sufficient significance to require considered adoption of one or more of the approaches mentioned are shown in the table below.

Impact	Characterization of Residual	Residual Management Approach	Mechanism for Residual Management
Loss of land (productive capacity and environmental services)	• High certainty • Wholly attributable to BCIB • Quantified	Consider acceptable tradeoff against project benefits (implicit in higher-order development plans)	-
Land use change (induced development)	• High certainty • Attribution to BCIB partial (other drivers significant) • Difficult to quantify	Consider acceptable tradeoff against project benefits (implicit in higher-order development plans)	-
Conversion of Natural Habitat (Bataan ROW)	• High certainty • Wholly attributable to BCIB • Quantified	Restoration offset on remnant parcels to achieve 'no net loss'	Action program in Biodiversity Action Plan
Enhanced long-term exploitation risk to Mariveles Mountains KBA	• Low certainty • Attribution to BCIB strongly plausible but unproven • Difficult to quantify	Adaptive management of risk	Action program in Biodiversity Action Plan
Avian collision risk	• Low certainty (lack of data) • Wholly attributable to BCIB • Difficult to quantify	Adaptive management of risk	Action program in Biodiversity Action Plan
Marine benthic habitat loss (some Critical Habitat)	• High certainty • Wholly attributable to BCIB • Quantified	Conservation offset in nearby comparable area to achieve 'net gain'	Action program in Biodiversity Action Plan

Impact	Characterization of Residual	Residual Management Approach	Mechanism for Residual Management
Marine benthic habitat degradation	• Medium certainty • Attributable to project but other factors relevant • Difficult to quantify	Conservation offset in nearby comparable area to achieve 'net gain'	Action program in Biodiversity Action Plan
Effects on marine mammals (injury, disturbance)	• Low certainty • Attribution to BCIB strongly plausible but unproven • Difficult to quantify	Adaptive management of risk	Action program in Biodiversity Action Plan
Effects on marine turtles	• Medium certainty • Attribution to BCIB strongly plausible but unproven • Difficult to quantify	Conservation offset	Action program in Biodiversity Action Plan
Effects on fisherfolk livelihoods	• Medium certainty • Attribution to BCIB strongly plausible but unproven • Difficult to quantify	Compensatory enhancement of fisheries resources protection and management for benefit of local fisherfolk, and livelihood restoration program	Action programs in Social Development Plan
Increased traffic on receiving roads (noise, emissions, public safety, inconvenience)	• High certainty • Attribution to project partial (other factors significant)	Consider acceptable tradeoff against project benefits	-

Most of the significant residual impacts relate to biodiversity, and are appropriately addressed through a Biodiversity Action Plan in conformance with IFC Performance Standard 6, as is required by ADB. The Biodiversity Action Plan is outside of the Environmental Action Plan but is cross-referenced therein. An additional residual impact to local livelihood is addressed through the Social Development Plan, which is embedded in the Environmental Management Plan.

The Environmental Management Plan

The EMP is the primary vehicle for ensuring that implementation of the proposed infrastructure complies with national laws and ADB safeguards requirements. The core function of the EMP is to translate environmental analysis and prescriptions for mitigation and enhancement, as laid out in the EIA report, into enforceable requirements for action, oversight and follow-up. Once the project is approved for implementation, the EMP will be made part of the bidding packages for civil works, and implementation of relevant provisions will become contractual obligations under each of the primary construction contracts.

The heart of the EMP is the Impacts Management Plan Responsibility Matrix, which specifies actionable mitigation and enhancement prescriptions for each significant impact identified, and assigns responsibility for implementation. The responsibility matrix covers all phases of project development after approval, including several ECC compliance matters that must be addressed in the pre-construction phase. Performance indicators are specified as the basis for monitoring of compliance with each measure. A key pre-construction requirement specified in the Impacts Management Plan Responsibility Matrix is the preparation of a Contractor Environmental Management and Monitoring Action Plan (CEMMAP) by each of the primary contractors, as well as subsidiary specialized management plans for each of several aspects of the works; sample outlines for the CEMMAPs and subsidiary plans are provided in an Appendix to the EMP.

An Environmental Monitoring Plan is embedded within the EMP. The monitoring plan is essential to EMP implementation, as it is the basis for (1) ensuring that each entity is fulfilling its prescribed role; (2) identifying emerging compliance problems and deleterious environmental effects before they can become more serious and difficult to correct; and (3) giving regulatory agencies, ADB, concerned government entities and the affected public some reassurance that all appropriate steps are being taken to manage the project works and facilities to a high standard for safety and environmental responsibility.

The monitoring plan lists monitoring actions for each prescribed measure in the Impacts Management Plan Responsibility Matrix, as well as the performance indicators, applicable parameters and methods, timing of monitoring, applicable standards and action to take in the event of non-compliance. Each monitoring action is assigned to a specific entity. Prescribed monitoring actions target both EMP implementation (deployment of mitigation and enhancement measures) and the degree of success in preventing and minimizing adverse environmental effects from project activities (by measuring environmental parameters such as air quality and noise). Reporting requirements are also detailed.

Also embedded in the EMP is a Social Development Plan (SDP), which is formulated to address implementation of mitigation and enhancement measures that pertain to local livelihoods. Programs to help ensure that local people and enterprises benefit to the maximum extent possible from the BCIB project, in the form of direct jobs and business opportunities, are included in the plan, as are measures to help ensure that local fisherfolk, who will have a major construction project take place in the midst of their fishing grounds, do not suffer significant loss of livelihood due to the project works, and indeed come to benefit from long-term fisheries-related outcomes. The largest allocation under the SDP is for a fisherfolk livelihood restoration program comprising a combination of fisheries enhancement projects and a monetary compensation mechanism for the most heavily affected fishers.

The EMP will serve as the principal tool for integrating and coordinating the actions of entities with an essential role in ensuring that the project is delivered in an environmentally and socially responsible manner, across the pre-construction, construction and operation phases. It is critical for the EMP to go beyond specifying the mitigation and monitoring activities required, and ensure that the various entities assigned responsibilities have the necessary capacities to fulfil them. Accordingly, the EMP identifies each of the entities to be involved, reviews the expected work flows of EMP implementation in relation to existing capacities, and identifies needs with respect to both capacity-building and training. Capacity-building needs are outlined for the BCIB project's Environment Unit, and special staffing needs linked to the particular oversight demands of the project are specified for the Construction Supervision Consultant. A training program encompassing training for the Environment Unit, Multi-Partite Monitoring Teams, local sub-contractors, and construction workers is specified and costed. Training will be the responsibility of the Construction Supervision Consultant, and will be delivered prior to and during the construction phase.

It will be necessary for DPWH to continue to engage with project stakeholders throughout the project cycle. Consultation is typically appropriate whenever a new project phase is imminent (e.g., start of construction, onset of new construction activity, start of operations), a major change is made to the design or construction methods, and after significant events like natural disasters or accidents. The EMP contains an itemized and costed Stakeholder Engagement Plan to facilitate such periodic interaction. Also related to stakeholder interaction, a Grievance Redress Mechanism is proposed in the EMP. The Grievance Redress Mechanism is proposed to comprise separate grievance reception points and resolution processes for complainants in Bataan and Cavite, to maximize accessibility and appropriateness, and will give people who feel they have been wronged in some way by the project's implementation to have their grievance received and addressed in a fair and transparent way.

Preliminary Biodiversity Action Plan

Several of the more significant residual impacts of the BCIB project will require management actions that are beyond the scope of the EMP, in that they will necessitate partnerships and support agreements with entities not involved in the project's implementation, and will in some cases involve medium- and long-term implementation that will endure well past the end of the construction period. Management programs for residual biodiversity impacts have been collected together in a Preliminary Biodiversity Action Plan (BAP). The Preliminary BAP presently comprises six proposed action programs, each designed to address a residual biodiversity impact (or impacts) through partnership between DPWH and one or more qualified entities; these are outlined in the table below. The Preliminary BAP is appropriately understood as a living document, and will be refined in consultation with stakeholders and in accordance with anticipated updating of the Draft Critical Habitat Assessment based on longitudinal biodiversity baseline work.

Preliminary BAP Action Program	Possible Partners
Action Program A – Adaptive Management of Exploitation Risk in Mariveles Mountains KBA	DPWH; Mariveles LGU; Limay LGU; Ayta Magbukún indigenous community, DENR-BMB; biodiversity-focused NGOs
Action Program B – Restoration Set-Aside for Natural Grassland Habitat of Alas-Asin	DPWH; Mariveles Municipal Environment and Natural Resources Office (MENRO); DENR-BMB; biodiversity-focused NGOs
Action Program C – Offset of Residual Effects on Coral Habitat Through Enhancement of Corregidor Islands Marine Park Management Programs	DPWH; Bureau of Fisheries and Aquatic Resources; Corregidor Islands Marine Park Management Board; academe
Action Program D – Offset of Residual Effects on Marine Turtles Through Support of Municipal Hatchery and Outreach Programs	DPWH; Mariveles MENRO; Naic MENRO; NGOs
Action Plan E – Adaptive Management of Avian Collision Risk	DPWH; DENR-BMB; bird-focused NGOs
Action Plan F – Monitoring and Offset for Expected Impacts on Marine Mammals from Project-Produced Underwater Noise	DPWH; Bureau of Fisheries and Aquatic Resources; marine-focused NGOs; academe

Establishment of the BAP action programs will appropriately begin during the pre-construction phase, so that prescribed measures can be operational and financially supported by the end of works, when the project management team and ADB will wind down their involvement. ADB will provide oversight and guidance in the early implementation of the BAP, and the Construction Supervision Consultant (which will be required to engage the necessary biodiversity expertise) will be responsible, in collaboration with the DPWH project management team, for facilitating and driving forward the process of partnership formation and action program setup. It is proposed that a dedicated replenishable fund be established to support long-term implementation of the BAP, under a trusteeship approved by ADB.

Estimated Cost of EMP and BAP Implementation

Most of the mitigation, enhancement and monitoring actions listed in the EMP are appropriately considered a routine and expected part of regular operations for the implementing parties, and it is impractical to attempt a segregation and numerical determination of the cost of these measures. For a subset of the prescribed measures, which may fall outside the scope of normal operating procedure or 'business as usual' for the national context and involve hiring specialized personnel, using non-standard materials, outsourcing things like laboratory analysis to technical providers, and providing training and capacity-building, segregated costs can be estimated. The costs associated with implementing the BAP are estimated separately.

Taken together, cost estimates for implementation of the EMP (including the Social Development Plan as well as training and capacity-building) and the BAP represent the incremental expenditure attributable to efforts to mainstream environmental and social sustainability in the BCIB project's implementation. The cost estimate for EMP and BAP implementation is summarized in the table below.

Cost Category	Estimated Cost - Low End (PHP)	Estimated Cost - High End (PHP)
DPWH		
Capacity building for DPWH-EU	168,000,000	168,000,000
Consultations	2,100,000	4,700,000
Environmental Monitoring Fund (operation of MMTs)	TBD	TBD
Social Development Plan	1,210,725,000	1,210,725,000
Biodiversity Action Plan	1,000,000,000	3,000,000,000
Specialized Biodiversity Management Plans	300,000,000	800,000,000
Carbon Sink Program	TBD	TBD
Environmental mitigation measures	3,100,000	6,100,000
Construction phase confirmatory monitoring	15,365,000	15,365,000
External Monitoring Agent	TBD	TBD
Subtotal DPWH	2,720,290,000	5,222,890,000
CONSTRUCTION SUPERVISION CONSULTANT		
Training programs	1,035,000	1,035,000
Specialist positions	190,000,000	190,000,000
Longitudinal studies and management plans	235,000,000	235,000,000
Subtotal CSC	426,035,000	426,035,000
PRIMARY CONTRACTORS (PCs)		
CEMMAP and specialized sub-plan development	25,000,000	25,000,000
Construction phase mitigation	5,554,695,000	5,554,695,000
Construction phase monitoring	153,645,000	153,645,000
Subtotal PCs	5,733,340,000	5,733,340,000
Estimated EMP Implementation Expenditures (quantifiable incremental)	8,883,665,000	11,386,265,000

1.

1 INTRODUCTION

1.1 Background

The subject of this environmental impact assessment (EIA) report is the Bataan–Cavite Interlink Bridge (BCIB) project, a major infrastructure proposal put forward by the Department of Public Works and Highways under the Build, Build, Build Program of the Government of the Philippines. The project is under consideration for financing by the Asian Development Bank (ADB) and the Asian Infrastructure Investment Bank (AIIB). By agreement of these two lending institutions, the safeguards framework of the ADB is applied for the purposes of the EIA.

Project preparatory activities began in 2018, and an environmental assessment was carried out from 2019–2021 in parallel with the feasibility study and preliminary design process. An Environmental Impact Statement (EIS) report was prepared in accordance with the requirements and procedures stipulated pursuant to Presidential Decree No. 1586, and submitted for consideration by the Department of Environment and Natural Resources–Environmental Management Bureau (DENR-EMB) in February 2021. DENR-EMB issued an Environmental Clearance Certificate (ECC) for the BCIB project in April 2021 (ECC-CO-2101-0011).

This EIA report is an updated and enriched version of the 2021 EIS report, and has been prepared in parallel with the Detailed Engineering Design (DED) to support consideration of the BCIB project for implementation financing by the Government of the Philippines, ADB and AIIB. The updated EIA reflects the most recent information regarding the project's design, construction methods and construction logistics; newly acquired data regarding prevailing environmental conditions in the project area; enriched analysis of impact potentials and mitigation options, and findings from additional Information, Education and Consultation (IEC) activities.

1.2 Summary of EIA Process and Methodology

1.2.1 EIA Study Teams

The first EIA study conducted from 2019–2021 was completed by Ove Arup & Partners Hong Kong, Ltd. in collaboration with Ecosys Corp (as sub-contractor). The present updated EIA study, carried out from 2021–2023, has been undertaken by T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd. Joint Venture, in association with DCCD Engineering Corporation and Renardet S.A.; technical studies were provided by sub-consultants including Ecosys Corp. (local baseline surveys) and Illingworth and Rodkin (underwater acoustic modeling). The project teams are shown in Exhibit 1-1.

Exhibit 1-1 EIA Study Teams

Name	Role in the EIA Study	Qualification
Updated EIA Study (2021-2023)		
Jodi Ketelsen (T.Y. Lin International)	Senior Environment Specialist and EIA Team Lead	M.S, City Planning and M.S. Landscape Architecture, UC Berkeley 1994
Simeon Stairs (Renardet SA)	Senior Environment Specialist	Ph.D. Environment and Resource Studies
Frederick Esternon (DCCD)	Environment Specialist	EIA Registration No. IPCO 311 B.S. Forestry and Natural Resources
Ian Borja (DCCD)	Environment Specialist	B.S. Medical Technology
First EIA Study (2019–2021)		
David Rollinson	Environmental and Social Team Leader (Arup)	BSc (Hons) Environmental Biology MSc Environmental Management
Angel Salcedo	Environmental and Social Specialist (Arup)	EIA Registration No. IPCO 334 MSc Environmental Engineering B.S. Chemical Engineering
Maria Catherine Rontos	Environmental and Social Specialist (Arup)	EIA Registration No. IPCO 037 Diploma in Urban and Regional Planning B.S. Environmental Planning and Management
Frederick Esternon	Environmental and Social Specialist and EIA Head (Ecosys Corp)	EIA Registration No. IPCO 311 B.S. Forestry and Natural Resources
Elenor De Leon	Environmental and Social Specialist and EIA Deputy Lead (Ecosys Corp)	EIA Registration No. IPCO 425 Master in Development Management Master of Environment and Natural Resources Management (units earned)
Ruben Estudilo	Marine Ecology Specialist (Ecosys Corp)	PhD Marine Science (Units Earned) MSc Marine Science Ecology B.S. Marine Science
Armando Gillado Jr	Terrestrial Flora Specialist (Ecosys Corp Inc)	EIA Registration No. IPCO 312 B.S. Forestry and Natural Resouces
Russel Baniqued	Terrestrial Fauna Specialist (Ecosys Corp Inc)	EIA Registration No. IPCO 157 Environmental Science Specialist

1.2.2 EIA Study Timeline

The EIA study conducted by Ove Arup & Partners Hong Kong began with background research and stakeholder engagement in early 2019, and proceeded through early 2021. Most baseline ecological surveys and consultation activities were carried out in early 2020.

The present EIA study update was initiated in March of 2021, with initial desktop review of available information, and formulation of additional field survey work needed to update and expand the understanding of baseline conditions and impact potentials. Field surveys were initiated in September of 2021, and carried out mainly over the ensuing 5–6 months. Progress on field studies was significantly constrained by bad weather in October 2021, and by slowdowns related to the Enhanced Community Quarantine put in place by the

Government of the Philippines to address the ongoing COVID-19 pandemic. Uncertainty regarding the availability of land in Bataan and Cavite for construction staging delayed some field study activity, and follow-up field surveys were required in 2022 to account for selection of new staging areas. Adjustment of assumptions for analysis of some impacts had to be made quite late into the EIA study process. In addition, numerous delays in the design process, most notably in the conduct of prerequisite marine geotechnical survey work, meant that important details of pier design and construction methods—key determinants of the scope and severity of construction-phase impacts—also became available only in late 2022. The EIA study timeline was thus substantially elongated relative to initial expectations.

1.2.3 EIA Study Area

The area of study for the EIA was defined as the vicinity of the planned BCIB infrastructure, focusing on the mouth of Manila Bay and encompassing southern Bataan Province; a broad zone roughly 5 km wide along the marine alignment that included Corregidor Island and associated islands and shoals; and the western part of Cavite Province. The spatial scope of analysis varied according to the phenomenon of interest; most field studies appropriately focused on the immediate project vicinity and even strictly to the project footprint itself, but analysis of some topics (e.g., critical habitat assessment) necessarily considered regionally-scaled information pertaining to the entire Manila Bay ecosystem.

1.2.4 Study Methods and Information Sources

Assessment work at both the initial and update stages of the EIA involved wide-ranging desktop research and data sourcing; empirical field studies; and engagement with stakeholders in the project area.

1.2.4.1 Desktop Research

The EIA study has drawn on multiple types and sources of information, including:

- Project design information from the feasibility study, appended technical reports, preliminary design reports, updated preliminary design reports, and discussion with project engineering teams;
- Spatial data obtained from government agencies, project-related technical studies, and online databases and mapping tools provided by governmental, intergovernmental, non-governmental and private sector entities;
- Biodiversity screening reports generated using the Integrated Biodiversity Assessment Tool (IBAT);
- Statistical databases managed by the Philippine Statistical Authority, including data from the two iterations of the National Census of Population and Housing;
- Plan documents and periodic status reports issued by provincial and municipal governments, including physical framework plans, sustainable development and integrated coastal zone management plans, municipal comprehensive land use plans and associated zoning ordinances, snapshot reports such as 'state of the coast' reports, 'state of the province' reports;
- Technical analyses, resource assessments and plans produced under the auspices of national and regional planning initiatives such as the Manila Bay Environmental Management Project, Manila Bay Sustainable Development Master Plan, and National Biodiversity Strategy;

- Academic research reports on field studies related to environmental conditions and natural resource concerns in the Manila Bay area, sourced from national and international research publications;
- Fact-finding and consultation meetings held with municipal and provincial officials and other institutional stakeholders in the general project area; and
- EIA reports prepared for other undertakings in Manila Bay and surrounding area.

1.2.4.2 Empirical Studies

Field studies were conducted to provide up-to-date baseline data on social and environmental conditions specifically in the BCIB project area, including:

- Terrestrial biodiversity, including floral and faunal surveys;
- Marine biodiversity, including field surveys of plankton, infaunal organisms, coral reefs, reef fish, macroalgae and seagrass, and threatened marine vertebrate species;
- Freshwater and estuarine ecology;
- Marine water quality;
- Freshwater quality;
- Groundwater quality;
- Ambient air quality;
- Ambient noise;
- Potentially contaminated sites;
- Physical cultural resources; and
- Landscape character and visual resources.

In addition to field surveys, modelling studies were conducted in the areas of air quality, traffic noise and vibration, and underwater noise from offshore piling works.

1.2.4.3 Stakeholder Engagement

The environmental assessment process was informed by two kinds of stakeholder engagement: formal consultation encounters with institutional stakeholders and members of the public, and a perception survey.

Consultations

Scoping and coordination meetings were held with the concerned local governments, relevant governmental agencies including the Philippine Coast Guard and Philippine Navy, and Corregidor Foundation, Inc. (responsible for management of Corregidor Island) in early 2019, to share information about the project proposal and the project development process; explain the environmental assessment requirements and process; identify issues of concern in relation to the conduct of environmental studies in the project area; and coordinate regarding permissions and communication.

Subsequently, consultation meetings were convened with the municipal governments of Mariveles, Bataan and Naic, Cavite, as well as that of Cavite City, Cavite (which has jurisdiction over Corregidor Island). With elected leadership and personnel from a range of municipal offices present, the BCIB project was formally introduced, and numerous questions and concerns were raised and discussed. A second round of meetings was held at the barangay level in each municipality, with barangay leaders, representatives of a range of social sectors and interested community members. Interviews were also conducted with several people working for Corregidor Foundation, Inc. and various tourism operators on Corregidor Island.

During preparation of the updated EIA (2022), five public consultation meetings were held at the barangay level in Mariveles (2) and Naic (3). Specialists on the EIA team also met to discuss with the municipal environmental agencies of Mariveles and Naic regarding existing programs and issues, as well as with fisherfolk representatives in both municipalities, and institutional entities involved in environmental conservation in the project area. Meetings were also held with the District Engineering Offices for both Bataan 2nd District and Cavite 1st District to discuss safety and capacity concerns regarding local roadways.

Perception Survey

An 18-question in-person perception survey was administered in community areas within and close by the project alignments in Mariveles and Naic in 2022. The perception survey sought information regarding residents' impressions and concerns regarding existing environmental and social conditions, their comments and concerns about the BCIB project's implementation in their communities, their perceptions regarding possible benefits and drawbacks for themselves and the community at large, and their assessment of the aesthetic qualities of the project infrastructure based on artistic renderings. A total of 650 people participated in the perception survey, of whom 350 were interviewed in Mariveles, and 300 in Naic.

1.2.4.4 Impact Characterization

Temporal Scope of Impact Assessment

Analysis of impacts and definition of suitable mitigation measures encompassed all phases of the project infrastructure's development, including the pre-construction phase, construction phase, and operation phase. Impacts from transportation projects typically arise most obviously and visibly during construction, but the impacts of design and siting decisions made in the pre-construction phase are often crucial determinants of impacts manifest during construction and operation, and substantial attention and effort were directed at identifying opportunities for pre-emptive mitigation.

Significance of Impacts

Generation of environmental and social impacts from infrastructure development is a function of the activities that take place during construction and operation of the infrastructure, on the one hand, and the particular 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. The activities involved in construction and operation of infrastructure also vary based on the nature of the project, the noisiness and dirtiness of the construction works required, and how long different activities are carried out in one place. The significance of impacts depends on the particular juxtaposition of activities and receptors in specific locations (see Exhibit 1-2). Determination of impact significance and prioritization of corresponding mitigative effort ultimately relies on the professional judgement and experience of the EIA practitioner, with inputs gathered from baseline research and stakeholders.

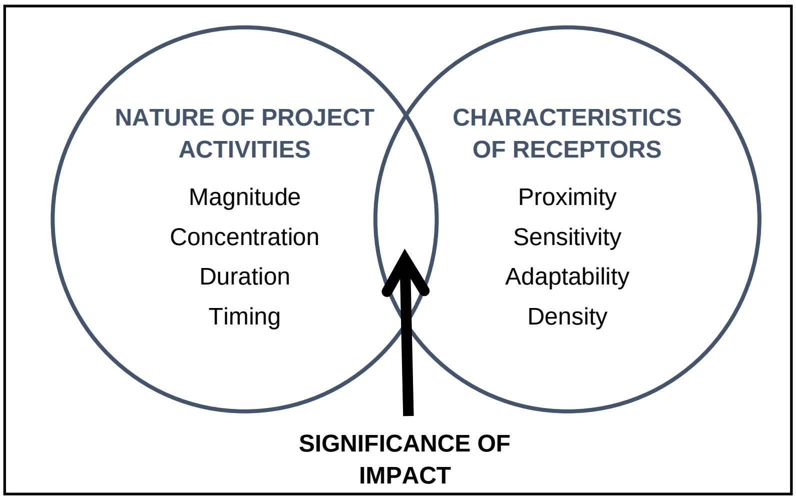


Exhibit 1-2: Activities and Receptors as Determinants of Impact Significance

Typology of Impacts

The impacts that arise from particular configurations of infrastructure development activities and landscape features may emerge in different forms and through various pathways. Exhibit 1-3 shows the dualistic typology of impacts that has underlain the impact assessment process.

Exhibit 1-3: Typology of Impacts Used in Assessment

Impact parameter	Types of impact	
Direction of change relative to baseline conditions	POSITIVE	NEGATIVE
Magnitude of impact in relation to ability of people and ecosystem to cope with change	MINOR	SEVERE
Spatial extent of effects	LOCALIZED	WIDESPREAD
Duration of effects experienced	TEMPORARY	PERSISTENT
Timing of effects experienced	INTERMITTENT	CONTINUOUS
Nature of cause-and-effect linkage between project activity and impact experienced by receptors	DIRECT	INDIRECT
Relationship of project activities to impacts from other sources in landscape	ISOLATED	CUMULATIVE
Relationship of project development to future developments in the landscape and their impacts	INDUCED	INDEPENDENT

1.2.4.5 Identification of Mitigation and Enhancement Measures

Objectives of Mitigation

The central goal of impact assessment is to determine how best to avoid and/or mitigate (make less serious, severe, or damaging) potential negative effects before they arise, and to identify opportunities for enhancing potential positive impacts, which may or may not be part of the project rationale. The EIA considers the specific activities that implementation will involve, from site selection through to operation, and defines the impacts that can be expected to arise in view of the particular features of the receiving environment. The analysis and discussion of impacts uses an integrated approach, in which environmental and social impacts are considered together in relation to each set of infrastructure development activities. The mitigation strategies prescribed in the EIA are aligned with international best practice, and aim to ensure that have the project's infrastructure development activities meet all relevant national standards for environmental quality and workplace health and safety.

Mitigation Hierarchy

Identification of an appropriate proactive approach for each expected impact in this EIA makes use of the standard mitigation hierarchy concept applied in impact assessment worldwide. In the mitigation hierarchy, top priority is given to measures that enable outright prevention or avoidance of impacts. Where prevention or avoidance is not possible, the next most preferred option is to minimize impacts to the greatest extent possible, within reasonable limits of feasibility. Finally, and only once it has been confirmed that there is no feasible way to reduce an impact below a reasonable threshold of social acceptability, it is appropriate to consider measures to compensate for the loss or damage caused to people and nature through reimbursement, replacement, or offsetting. For positive impacts, there is no hierarchy as for mitigation, only one objective: to adopt measures to enhance or reinforce positive effects whenever possible, through thoughtful adaptation during site selection, design and implementation.

1.3 Structure of EIA Report

The updated EIA study report broadly follows the structure of the report prepared by Ove Arup Partners and Ecosys Corp., with additions to reflect ADB content expectations and organizational adaptations to enhance clarity for the reader. A brief guide to the report is provided here.

The first report chapter following this Introduction (Chapter 2: Legal and Administrative Context) details the national institutions, laws and regulations; international commitments; and ADB requirements that help to structure the EIA study itself and its prescriptions for impact management. The chapter compares the requirements for EIA under the Philippine Environmental Impact Statement System and ADB's safeguards framework, and identifies broad concordance, while also highlighting the ADB expectations that go beyond what is required by the Philippine system, with respect to the selection of appropriate environmental standards, as well as adherence to the guidelines developed by the International Finance Corporation (IFC) with regards to assessment and mitigation of biodiversity impacts.

Chapter 3 of the EIA provides a concise overview of the BCIB project as conceived by DPWH and engineering and construction planning teams. The description encompasses the rationale and objectives driving the project's formulation, the infrastructure components, construction methods, staging sites, workforce, worker camps and materials estimates, preliminary construction schedule, and operations and maintenance, all as known at the time of writing. Notably, the project's design, construction methods and choice of staging areas already reflects significant environmental inputs, developed through discussion between the EIA team and the engineering and construction planning teams.

The fourth chapter (Analysis of Alternatives) details the process by which the Preferred Alternative presently under development was selected from amongst a field of 12 originally proposed alternatives for achieving the project's goal of providing a road link joining Bataan and Cavite across Manila Bay. The chapter examines the criteria applied, and considers the favorability of the Preferred Alternative relative to other alternatives such as tunnel-viaduct causeways, as well as to the No Project Alternative. In addition, Chapter 4 reviews several design changes that were made over the course of the detailed design process, and evaluates their environmental implications.

Chapters 5 through 8 form the analytical core of the EIA report, where baseline environmental and social conditions are described in detail before placing the project infrastructure plan and anticipated construction methods into the physical context of their implementation to draw out informed conclusions about probable effects and how to address them. These chapters are arranged according to the standard thematic framework used for environmental assessment under the Philippines Environmental Impact Statement System (Land, Water, Air, People). Impact potential is evaluated in turn for or the Pre-Construction, Construction and Operation phases in each of Chapters 5 through 8. The principal output of the four baseline-impacts-mitigation chapters is a series of context-specific prescriptions for mitigation and enhancement measures, which are carried forward to the Environmental Management Plan.

Chapter 9 summarizes the steps taken to engage with project stakeholders, as a means of (1) gathering insights and local knowledge that could inform understanding of baseline conditions and shape the lines of inquiry pursued in the environmental assessment; (2) providing stakeholders with sufficient information about the project to appreciate how its implementation may affect their lives, communities and living environments; and (3) hearing from stakeholders about their expectations and concerns regarding project impacts, as possible inputs to the shaping of mitigation and enhancement proposals. The chapter details the consultation encounters arranged by the EIA teams between 2019 and 2022, including meetings, key informant interviews, and a perception survey.

The EIA report culminates in Chapter 10 with the Environmental Management Plan (EMP), a comprehensive guide to everything that needs to happen in order for the mitigation and enhancement prescriptions developed in Chapters 5 through 8 to be implemented successfully. The EMP lays out the institutional framework for implementation, assigns responsibilities for mitigation, monitoring, ongoing stakeholder engagement, capacity-building and training, and estimates costs for these activities. The EMP includes a Social Development Plan, Stakeholder Engagement Plan, and a Training Plan, as well as Grievance Redress Mechanism. Although it is produced as a chapter in the EIA report, the EMP will be included as essential reference material in the bidding packages for the civil works, and is designed to stand alone as needed for this purpose, with its own Appendices containing sample outlines for the Contractor Environmental Management and Monitoring Action Plans (CEMMAPs) and specialized sub-plans that will be required of each primary contractor on the project. Cost estimates for construction-phase mitigation and monitoring are disaggregated by construction package to the extent possible, to help prospective contractors scope the financial implications of their obligations under the EMP. Other entities involved in EMP implementation, most notably DPWH and the Construction Supervision Consultant, may rely on the segregated cost estimates as inputs to their planning and budgeting for effective discharge of their responsibilities.

2 LEGAL AND ADMINISTRATIVE CONTEXT

The implementation of the BCIB project must be in conformance with all relevant national laws, regulations and standards, as well as the country's international commitments, and a key objective of environmental impact assessment is to ensure that this imperative is realized. This section of the EIA report considers the national legal instruments pertaining to environment, health and safety that may reasonably be expected to come into play as this particular project is implemented, and also 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 National Institutional Context Relevant to EIA

Department of Environment and Natural Resources. Governmental responsibility for environmental protection in the Philippines rests mainly with the Department of Natural Resources (DENR). The DENR has several bureaus dedicated to environmental oversight in different thematic areas; the Environmental Management Bureau (DENR-EMB), specifically its Environmental Impact Assessment and Management Division, has oversight responsibility for the environmental assessment of infrastructure projects. Regional offices of the DENR-EMB oversee public scoping of impacts at the early stages of the EIA process, as well as monitoring during project implementation.

Department of Labor and Employment. Oversight of occupational health and safety in the Philippines is the responsibility of the Department of Labor and Employment (DOLE), specifically its Bureau of Working Conditions (DOLE-BWC). The DOLE-BWC develops and promotes labor standards, and enforces them through workplace inspections carried out by its regional offices. Construction sites on infrastructure projects are subject to inspection in relation to a range of parameters, including safety measures and safety training, sanitation, worker amenities, and compliance with rules regarding pay, working hours, overtime, and employment of young workers.

National Commission for Culture and the Arts. Protection and management of physical cultural resources in the Philippines is overseen by the National Commission for Culture and the Arts, which delegates responsibility for this aspect of its much broader remit mainly to the National Museum. A number of other cultural agencies support protection of archival and intangible components of the country's cultural and historical heritage. Agencies without any inherent cultural or historical mission, including DENR and DPWH, may be called upon in particular circumstances to play a role in protection of physical cultural heritage, such as may exist in protected areas, or be affected by infrastructure projects.

Local Government. A number of environment, health and safety oversight and regulatory functions have been delegated to the local level, including some in relation to such matters as solid waste management, environmental performance of small and medium-sized enterprises, establishment and protection of greenbelts and parks, and small-scale extraction of sand, gravel and stone. Local government units (LGUs) are the permitting authorities with respect to many aspects of infrastructure preparation and operation. With respect to the marine environment, LGUs have jurisdiction over municipal fisheries and fishing grounds, and over enforcement of fisheries laws within municipal territorial waters (within 15 km of the shore) through community-based patrol forces called Bantay Dagats.

Special Context of Manila Bay. In addition to the roles outlined above, which are generally applicable everywhere in the country, a special layer of institutional responsibility applies to Manila Bay. In the context of rising public concern regarding the apparent decline of the Manila Bay environment, legal action was brought by a coalition of concerned citizens, seeking to force the governmental sector to take decisive action to reverse the trend. The case was heard by the country's Supreme Court in 2008, and a landmark decision known as the Writ of Continuing Mandamus was handed down, requiring 13 different federal agencies to act individually and in concert to clean up, rehabilitate and preserve Manila Bay, and restore its waters to a state fit for swimming, skin diving and other forms of contact recreation.[1] These agencies, commonly referred to as the 'Mandamus agencies' are the

1. Department of Natural Resources;
2. Department of Agriculture - Bureau of Fisheries and Aquatic Resources;
3. Department of Education;
4. Department of Health;
5. Department of Public Works and Highways;
6. Department of Budget and Management;
7. Department of the Interior and Local Government;
8. Metro Manila Development Authority;
9. Metropolitan Waterworks and Sewerage System;
10. Philippine Coast Guard;
11. Philippine National Police - Maritime Group;
12. Philippine Ports Authority; and
13. Local Water Utilities Administration.

Each of the agencies named in the writ is required to develop and implement action plans within areas subject to its remit, and report progress to the Supreme Court on a quarterly basis until such time as the Supreme Court determines that the condition of Manila Bay meets the stated quality benchmarks. A Manila Bay Coordinating Office situated within DENR serves as the liaison amongst the 13 Mandamus agencies, and between the agencies and the Supreme Court.

2.2 Relevant National Laws, Regulations and Standards

Several national laws and presidential decrees, and their supporting implementing regulations, have direct or indirect bearing on the development of major infrastructure in the Philippines. The environmental and occupational safety and health standards provided for under some of these instruments structure compliance by project proponents and contractors. In addition, the Philippines has signed on to a number of international conventions and agreements, and the provisions of some of these instruments bear directly or indirectly on planning and development of public infrastructure. The key legal instruments with potential relevance to development of the BCIB are identified and briefly discussed below, in order of their enactment, promulgation or entry into force.

[1] Supreme Court Order G.R. No. 171947-48

2.2.1 Legislation and Supporting Regulations

Presidential Decree No. 856 (1975) Philippine Code of Sanitation. Administered by the Department of Health (DOH), the code applies to all enterprises, establishments, premises and projects that may generate pollutants that could adversely affect public health. Key sections of the decree are applicable to large infrastructure projects like the BCIB, covering such matters as water supply; food establishments; sanitary permit requirements; industrial hygiene; collection, drainage and disposal of sewage; and refuse disposal.

Presidential Decree No. 979 (1976) Marine Pollution Decree of 1976. This decree proclaims prohibitions on the dumping or discharge of solid waste, oil, noxious gaseous substances and other harmful materials into the sea from ships, barges and other vessels, and also makes it illegal to place or allow the placement of such wastes and materials on the shore of marine water bodies or their tributaries, such that they may be washed into the sea during high tides, floods and storms. Given the intensive use of barges and support vessels anticipated during BCIB implementation, in addition to the expected positioning of work sites at and near the shoreline, these prohibitions are of heightened relevance.

Presidential Decree No. 1067 (1976) Water Code of the Philippines. This decree establishes the basis for regulation of access to, utilization and conservation of surface water and groundwater. The decree requires prior issuance of a water permit for most uses of water, and specifies penalties for those who obstruct natural flows, block access to water bodies, pollute water through harmful discharges, and cause or allow groundwater wastage, among other offences.

Presidential Decree No. 1152 (1977) Philippine Environment Code. The Environment Code provides the basis for comprehensive development of environmental law and policy in the country. The decree calls for the promulgation of environmental standards for air quality, noise, and water quality, and for development of management policies for various areas of natural resource management, including wildlife, forests, soils, fisheries and aquatic resources. Rational policies for waste management are also urged.

Presidential Decree No. 1586 Establishing an Environmental Impact Statement System Including Other Environmental Management Related Measures and for Other Purposes (1978). As its name indicates, this decree is the central basis for environmental impact assessment in the Philippines. Its implementation is supported by a variety of administrative orders issued over the years by DENR. The Philippines Environmental Impact Statement System (PEISS) defined by the decree is described in more detail later on. All proposed infrastructure projects must at least undergo screening to determine whether they are covered under the system, and the depth and extent of assessment and reporting procedures required are determined by the particular characteristics of the proposed project and its environs.

Republic Act (RA) No. 6969 (1990) Toxic Substances, Hazardous and Nuclear Wastes Control Act. This law 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. The act is implemented through DENR Administrative Order No. 1992-29, which establishes mechanisms for inspection of premises where hazardous substances are used and stored; assigns responsibility for safe recycling and disposal of hazardous wastes to the waste generating entity; and stipulates procedures for registration and reporting by waste generators and transporters. Waste oils, typically a voluminous waste product of major construction works, are among the

Prescribed Hazardous Wastes listed in the order, as are asbestos-containing materials, which are sometimes encountered during pre-construction demolition of existing structures.

RA No. 8371 (1997) Indigenous Peoples Rights Act. This law 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. In the context of environmental impact assessment of proposed infrastructure projects, the key relevance of the law is its requirement that no government license or concession may be granted for a public or private project that may impinge upon or affect any ancestral domain without the Free, Prior and Informed Consent of the indigenous community involved. The nearest ancestral lands to the proposed BCIB alignment are several kilometers away and will not be affected, but the law may come into play if quarries are established in close proximity to such lands.

RA No. 8550 (1998) Fisheries Code (amended 2013). This law is concerned mainly with the regulation of fishing and aquaculture, but also provides for penalties for causing aquatic pollution, which is defined broadly and 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. The act is implemented through Department of Agriculture Administrative Order No. 1998-03.

RA No. 8749 (1999) Clean Air Act of 1999. This law seeks effective prevention, control and abatement of air pollution, and provides the basis for promulgation and enforcement of air quality and emissions standards. The law is supported by DENR Administrative Order No. 2000-81, which specifies standards for a wide range of air pollutants and emissions sources, and defines mechanisms for inspection, enforcement and penalties for non-compliance. The order specifically requires mitigation of dust from construction and maintenance activities, and provides the basis for a periodic testing regime for emissions from motorized and fuel-burning equipment.

RA No. 9003 (2001) Ecological Solid Waste Management Act. This law aims to institute rational and organized waste management systems, primarily at the local government level, through establishment of standards, institutional forms, inventories, funding mechanisms and support programs. The law places a high priority on waste reduction and waste segregation at source for effective recycling and composting. Section 48 of the law lists a number of Prohibited Acts that will result in legal sanction; these apply to everyone, including operators of construction sites and public infrastructure. The Act is implemented through DENR Administrative Order No. 2001-34.

RA No. 9147 (2001) Wildlife Resources Conservation and Protection Act. This act provides for the conservation, preservation and protection of wildlife species and their habitats, in order to preserve and encourage ecological balance and biological diversity. Among the key provisions of the law are procedures for designation of threatened species and critical habitats, both within and outside of protected areas that form part of the National Integrated Protected Areas System (NIPAS). The law is implemented through Joint DENR-DA-PCSD Administrative Order No. 2004-01 in relation to terrestrial wildlife, and Fisheries Administrative Order No. 2010-233 for aquatic wildlife. Under the PEISS, environmental impact assessments of proposed infrastructure projects must take account of the possible presence of threatened species and critical habitats as designated under the Wildlife Resources Conservation and Protection Act, and prescribe appropriate mitigation for any foreseen impacts.

RA No. 9275 (2004) Philippine Clean Water Act. This law pursues effective abatement and control of surface and ground water pollution from land-based sources, and provides for specification of water quality standards. The law establishes a permit system for discharges to surface waters, and assigns responsibility to the polluter for containment, clean-up and remediation of releases found to have caused receiving waters not to meet national surface water quality standards. Under the PEISS, proposed projects are required to meet national water quality standards for both permitted discharges and receiving waters. The act is implemented through DENR Administrative Order No. 2005-10.

RA No. 9729 (2009) Climate Change Act. This law attempts to mainstream climate change mitigation and adaptation into government policy formulation, establishing a framework strategy and program on climate change, and creating a Climate Change Commission. Neither the act nor its implementing regulation imposes any direct requirement on planning, environmental assessment, construction or operation of public infrastructure like the BCIB, but it is to be expected that infrastructure design should in general seek to align with and support the broad aims of reducing greenhouse gas emissions and incorporating adaptations to enhance resilience in the face of projected climate change effects, and also that infrastructure planning should be carried out in accordance with local and national climate resilience planning processes institutionalized under the act.

RA No. 10066 (2009). National Cultural Heritage Act. This act seeks 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. The law stipulates that environmental impact assessment of public and private infrastructure development projects must take account of anthropological, archaeological and historical heritage sites, and assigns DPWH responsibility for taking into account the potential impacts of planning, design, construction and maintenance of national roads and bridges on heritage structures or aspects of heritage conservation. The act applies to historic and culturally significant sites and features, both on land and under water.

RA No. 10121 (2010) Philippine Disaster Risk and Management Act. This law aims to mainstream disaster risk reduction and climate change adaptation and mitigation in development processes, including public infrastructure. Neither the act nor its supporting regulation imposes direct requirements relating to the environmental assessment, construction or operation of infrastructure projects, although it is to be expected that the operator of a major transport link such as the BCIB would be an integral participant in local and regional disaster response efforts institutionalized under the law. Infrastructure planning and design should aim to enhance resilience, and the Emergency Response Plan embedded within the Environmental Management Plan produced for the construction and operation phases of the infrastructure should take account of potential disaster scenarios, including necessary coordination with disaster response bodies established by this law.

RA No. 11058 (2017) Occupational Safety and Health Act. This law aims to ensure 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. The law applies to all establishments, projects and sites, and requires all workplaces to have in place a safety and health program comprising such elements as provision of occupational health and safety personnel and facilities; safety and health promotion, training and education; provision and use of personal protective equipment (PPE); provision of safety signage; systems and practices for dust control and management; waste management systems, and emergency preparedness and response plans. The Act is implemented through DOLE Department Order 2018-198.

RA No. 11038 (2018). Expanded National Integrated Protected Areas System (ENIPAS) Act. An updated and amended version of the 1992 National Integrated Protected Areas System (NIPAS) Act (RA No. 7586), the ENIPAS Act provides for the establishment and management of a national integrated protected areas system encompassing "outstandingly remarkable areas and biologically important public lands that are habitats of rare and endangered species of plants and animals, biographic zones and related ecosystems, whether terrestrial, wetland, or marine." Section 11 of the act stipulates that an environmental impact assessment must be carried out for any proposed undertaking that would be inconsistent with the management plan for a protected area designated as part of the NIPAS, and that no such activity can be commenced without the proponent having received an Environmental Compliance Certificate under the PEISS. Screening of projects like the BCIB must consider at an early stage whether any NIPAS protected areas will be impinged upon or affected (none have been identified in the zone of influence of the BCIB project).

2.2.2 Standards

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 Exhibit 2-1.

Exhibit 2-1 National Standards Relevant to Infrastructure Projects

Substantive area	Relevant standard
Ambient air quality	• National Ambient Air Quality Guideline Values (specified in RA-8749-IRR-DAO-2000-81) • Provisional National Ambient Air Quality Guideline for $PM_{2.5}$ (specified in RA-8749-IRR-DAO-2013-13)
Water quality (surface water, ground water, 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 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 N0. 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.

2.3 International Commitments

The Philippines has joined many international conventions and other agreements. In general, national law and policy are to be made consistent with such international agreements, and infrastructure development actions are to be implemented in such a way as to contribute to the country’s meeting of its commitments. The conventions and agreements to which the Philippines is a party are identified in Exhibit 2-2.

Exhibit 2-2 International Conventions and Agreements Joined by the Philippines

International Commitment (in order of adoption date)	Philippines ratification or accession
International Convention on the Elimination of All Forms of Racial Discrimination, 1965	1967
Convention on Wetlands of International Importance, 1971	1994
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
International Covenant on Civil and Political Rights, 1976	1986
International Covenant on Economic, Social and Cultural Rights, 1976	1974
Convention on the Elimination of All Forms of Discrimination Against Women, 1979	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 the Rights of the Child, 1990	1990
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1992	1993
Convention on Biological Diversity, 1992	1992
International Tropical Timber Agreement, 1994	1983
United Nations Convention to Combat Desertification, 1994	2000
United Nations Framework Convention on Climate Change, 1994	2003
International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families, 1996	1995
Kyoto Protocol to the United Nations Convention on Climate Change, 1998	2003
Cartagena Protocol on Biosafety (pursuant to Convention on Biological Diversity), 2000	2006
Stockholm Convention on Persistent Organic Pollutants, 2001	2004
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 2004	2006
Convention on the Rights of Persons with Disabilities 2008	2008
International Convention for Protection of All Persons From Enforced Disappearance 2010	2010
Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (pursuant to Convention on Biological Diversity), 2010	2015
Paris Agreement (pursuant to United Nations Framework Convention on Climate Change), 2015	2017

Of the international commitments listed in Exhibit 2-2, only a subset has direct relevance to development of infrastructure such as the BCIB. The most pertinent international instruments are discussed briefly below.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973). Although the connection between transport infrastructure and trade in endangered species is rather indirect, this Convention (best known by its acronym CITES) plays a role in screening of proposed infrastructure projects, as project proponents are required under national legal instruments to check if any species listed under the Convention—or habitat of such species—may be affected directly or indirectly by construction or operation of the infrastructure.

Convention on the Conservation of Migratory Species of Wild Animals (1983). Under this convention, groups of signatory countries with an interest in the conservation of a migratory species that uses parts of their national territories come together to develop multilateral species-specific conservation and management agreements and memoranda of understanding (MOUs). The Philippines is a party to three such agreements under the Convention: (i) the MOU on the Conservation and Management of Dugongs and Their

Habitats Throughout Their Range; (ii) the MOU on the Conservation of Migratory Sharks; and (iii) the MOU on the Conservation and Management of Marine Turtles and Their Habitats of the Indian Ocean and South-East Asia. Signatories of these sub-agreements are bound to shape national policy and local practice in order to further the conservation of the target species, including by avoiding development activities that could generate harmful effects on habitat or individuals.

Convention on Biological Diversity (1992). The primary mechanism for implementation of the aims of this Convention at the national level is the formulation of national biodiversity conservation strategies, which are typically centered on designation and effective management of comprehensive networks of protected areas of various management categories along a spectrum from strict preservation to sustainable utilization. Infrastructure developments that run counter to the aims of protected areas designated in whole or in part for their biodiversity values contravene the country's commitments under the Convention. Under the PEISS, proposed infrastructure projects that would impinge upon or significantly affect a protected area are automatically subject to the highest level of scrutiny in the environmental assessment process.

United Nations Framework Convention on Climate Change (1994). Under this convention and its supporting Kyoto Protocol (1998) and Paris Agreement (2015), the parties commit to measuring, reporting and reducing national emissions of greenhouse gases (GHGs). Development of transport infrastructure—including both construction and operation—may make a significant contribution to the country's overall GHG emissions, and is subject to study, measurement and reporting, as well as emissions reduction efforts through necessity analysis, design measures, innovative construction practices, and modification of operational and maintenance procedures. The environmental assessment process is the time for estimation of the GHG emissions that will be generated during construction and operation, and of the potential emissions savings from implementation of mitigative measures in design, construction and operation.

Convention on the Rights of Persons with Disabilities (2008). One of the guiding principles of this convention is accessibility, which encompasses access to opportunities, to services and to physical facilities. New infrastructure that does not include reasonable provisions for safe and convenient access and use (including for employment) by people with disabilities contravenes the country's commitments under this convention.

2.4 Philippines Environmental Impact Assessment Requirements

2.4.1 Philippines Environmental Impact Statement System (PEISS)

The Philippines Environmental Impact Statement System (PEISS) is a well-defined set of procedural requirements established to guide the consistent, thorough and defensible conduct of environmental assessments in relation to public-sector and private-sector development projects. The foundation of the PEISS is elaborated by the following key instruments:

1. Presidential Decree No. 1586: Establishing an Environmental Impact Statement System Including Other Environmental Management Related Measures and for Other Purposes (issued 1978);

2. DENR Administrative Order 2003-30: Implementing Rules and Regulations (IRR) for the Philippine Environmental Impact Statement System (issued 2003); and
3. Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (issued 2007).

The PEISS is administered by DENR-EMB, through its Environmental Impact Assessment and Management Division. DENR-EMB follows the classification rules defined in the Revised Procedural Manual (and in a number of administrative orders and memorandum circulars that have amended particular portions of it since its issuance) in (i) determining which proposed projects are covered under the system; (ii) specifying environmental assessment and reporting requirements based on attributes of proposed projects and their settings; and (iii) reviewing proponents' applications for the appropriate environmental certification.

A key element of the PEISS is the categorization of proposed undertakings, such that assessment procedures appropriate to the scale, complexity, probability and severity of negative environmental and social impacts can be identified. Proposed projects are considered in terms of both the project characteristics (scale, industrial sector, class of infrastructure) and the characteristics of the environment (interpreted broadly to include both biophysical and social parameters) in which the project will be implemented. Four project categories are defined, as follows:

Category A – Projects or undertakings which are classified as Environmentally Critical Projects (ECPs) under Presidential Proclamation No. 2146 (1981), Proclamation No. 803 (1996), and any projects that may later be declared as such by the President of the Philippines.

Category B – 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 – Projects or undertakings not falling under Category A or B which are intended to directly enhance the quality of the environment or directly address existing environmental problems.

Category D – Projects or undertakings that are deemed unlikely to cause significant adverse impacts on the quality of the environment according to parameters set forth in the Screening Guidelines.[2]

As can be seen from the list above, the definition of Environmentally Critical Projects (ECPs) and Environmentally Critical Areas (ECAs) is central to categorization of undertakings for environmental assessment purposes.

Environmentally Critical Projects. Five broad classes of undertakings, each comprising at least several sub-classes, have been defined under EMB Memorandum Circular 2014-005; these are summarized in Exhibit 2-3. Projects falling within these classes are further delineated based on specific scalar thresholds. Any project that surpasses the highest threshold for its sub-class is considered an Environmentally Critical Project (ECP) for assessment purposes. For bridges, projects of length 10.0 km or more are automatically

[2] DENR-EMB. 2003. Revised Procedural Manual DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), p.4.

classified as ECPs, and are therefore assigned to Category A. The BCIB project exceeds the 10 km threshold by a large margin. Because the project will consist of new construction as opposed to upgrading existing infrastructure, it is further classified as Category A-1.

Exhibit 2-3 Classes of Undertaking Under PEISS

Class	Type of proposed undertaking
1	Heavy Industries – Non-ferrous metal industries; iron and steel mills; smelting plants; chemical industries; agri-food processing industries; other processing and manufacturing industries
2	Resource Extractive Industries – Mining and quarrying projects including oil and gas extraction; forestry and agricultural projects; and fisheries and aquaculture projects
3	Infrastructure Projects – Dams, water supply and flood control projects; power plants of all types; reclamation and other land restoration projects; roads and bridges; other transport facilities including airports and ports; buildings including housing, storage facilities and other structures; pipeline and cable projects; waste management projects
4	Golf Course and Other Tourism Projects – Golf course projects; resorts and other tourism/leisure projects (all)
5	Other Projects – Cut flower industry projects; telecommunication projects; energy exploration projects; small business development project facilities; array of cottage industries and service industries

Source: DENR-EMB. 2014. Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System. EMB Memorandum Circular 005, July 2014.

Environmentally Critical Areas. Twelve categories of sensitive settings and features, or Environmentally Critical Areas (ECAs), have been delineated to guide application of the PEISS; these are listed in Exhibit 2-4. Projects whose footprints will impinge upon, or whose activities will significantly affect, an area or feature in one of the ECA categories are assigned to Category B (unless they are also classified as ECPs, in which case they will be in Category A). If there is any significant doubt as to whether an ECA category is applicable to an undertaking, the category is deemed to apply unless the project proponent can present credible evidence (based on field study, desktop research or formal confirmation by the relevant government agency) to support an argument that the category should be ruled out.[3]

Exhibit 2-4 Categories of Environmentally Critical Areas (ECAs)

Category	Type of sensitive area or feature
1	Areas declared by law as national parks, watershed reserves, wildlife preserves and sanctuaries
2	Areas set aside as aesthetic and potential tourist spots, including certain classes of caves
3	Areas which constitute the habitat of any endangered or threatened species of Philippine wildlife (flora or fauna)
4	Areas of unique historic, archaeological, geological or scientific interest
5	Areas which are traditionally occupied by cultural communities or tribes
6	Areas frequently visited and/or hard-hit by natural calamities (geologic hazards, floods, typhoons, volcanic and seismic activity, etc.)
7	Areas with critical slopes
8	Areas classified as prime agricultural lands
9	Recharge areas of aquifers
10	Water bodies (all natural water bodies regardless of classification)
11	Mangrove areas as mapped or identified by DENR
12	Coral reefs as mapped or identified by DENR and/or Department of Agriculture-Bureau of Fisheries and Aquatic Resources (DA-BFA)

Source: DENR-EMB. 2014. Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System. EMB Memorandum Circular 005, July 2014.

The BCIB project falls within, or has significant potential to affect, landscape elements in five of the ECA categories, including Category 2 (Corregidor Island is an aesthetically endowed potential tourist spot, as are the northern beaches of Cavite Province); Category 3

[3] DENR-EMB. 2003. Revised Procedural Manual DENR Administrative Order No. 30 Series of 2003 (DAO 03-30), p.4.

(Manila Bay is known to be used by a number of endangered marine species); Category 4 (Corregidor Island is a protected historic site); Category 10 (given the project's placement in Manila Bay); and Category 12 (there are known coral reefs in the vicinity of Corregidor and Caballo Islands, as well as the nearshore zone of southern Bataan).

Coverage under PEISS. A proposed project's assigned category determines whether it is covered under the PEISS. Category A and Category B projects are automatically covered, and Category D projects are automatically not covered. Undertakings initially assigned to Category C are evaluated by DENR-EMB on the basis of project information provided by the proponent on a standard screening form, and then assigned to one of the other categories. The proponent of any project deemed covered under the PEISS is required to apply to DENR-EMB for an Environmental Compliance Certificate (ECC). Proponents of projects judged not to be covered under the PEISS are not required to apply for an ECC, but may optionally apply for a Certificate of Non-Coverage (CNC), should such proof of non-coverage be needed for any purpose, such as due diligence for financing or risk management. As a Category A undertaking, the BCIB is covered under the PEISS, and DPWH, as the proponent, has been required to apply for an ECC.

Environmental Compliance Certificate. The decision by DENR-EMB about whether to grant an ECC is the central—but not final—outcome of the environmental assessment process. The ECC is not in itself a clearance or permit to proceed with construction of project infrastructure, but rather is an assurance that the project as formulated is in a position to secure all necessary permissions from the relevant authorities before proceeding, by virtue of having adequately considered all potential negative impacts, and incorporated measures of sufficient strength and relevance in its Environmental Management Plan (EMP) to ensure the project's implementation will not violate the country's applicable laws and standards. An ECC is to be treated by all the responsible oversight agencies, and by the Local Government Units (LGUs) with spatial jurisdiction, as a prerequisite of the project proponent's applications for the required permits for construction and operation. The final decision as to whether a project will be permitted to proceed to implementation rests either with the local government units (LGUs) in whose territory the project is to be built and operated, or with the government agency whose remit includes promotion of a sectoral program that includes the proposed project, not DENR-EMB.

The ECC document, if 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.

Scope of Study and Report Requirements. In order to obtain an ECC, the project proponent must prepare and submit an environmental assessment report that meets DENR-EMB requirements for the appropriate project category. For new individual projects, one of three environmental assessment report types is required: (i) an Environmental Impact Statement (EIS); (iii) an Initial Environmental Examination Checklist (IEEC); or (iii) a Project Description (PD). The report requirements for different project categories are shown in Exhibit 2-5.

Exhibit 2-5 Environmental Assessment Report Requirements for Single New Projects

Project category	Covered under PEISS (ECC required)	EA report type required
Category A	YES	EIS
Category B (greater scale/impact potential)	YES	EIS
Category B (lesser scale/impact potential)	YES	IEEC
Category C	Determined by re-categorization as A, B or D based on evaluation of preliminary project information submitted	PD (Parts I and II)
Category D	NO	PD (optional, Part I only)

Source: DENR-EMB Memorandum Circular No. 2014-005. Revised Guidelines for Coverage Screening and Standardized Requirements Under the Philippine EIS System. July 2014.

Of the report types specified under the PEISS for individual projects, the EIS is the most comprehensive and rigorous. EIS reports must include, at a minimum:

1. a detailed project description;
2. a description of the environmental and social baseline conditions;
3. systematic analysis and discussion of impacts on the environment, broadly conceived to encompass the Land, Water, Air and People in the project area;
4. an Environmental Management Plan (EMP) to be funded and implemented by the proponent to manage the anticipated impacts through the project cycle; and
5. corollary plans for monitoring of EMP implementation.

Regardless of the type of environmental assessment report required for a particular project, report preparation is the sole responsibility of the project proponent, and should normally be undertaken during the preliminary design phase.

The ECC application, including all required reports, 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 in question. The review is to be guided by three general criteria:

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

To support faster approval of priority infrastructure projects coming under the umbrella of the Build Build Build Program, DENR issued an administrative order in 2019 (DAO 2019-16). The order lays out a streamlined process for consideration of ECC applications pertaining to such projects. According to the streamlined process, a decision on a complete and correctly submitted ECC application will be issued within 20 working days of receipt. The BCIB has been put forward as part of the Build Build Build Program.

The BCIB, as a large-scale Category A project with significant potential for environment, health and safety impacts and an expansive zone of influence, was determined by DENR-EMB to require a full EIS to support the application by DPWH for an ECC. Such a report was prepared in 2020 on behalf of DPWH during the preliminary design phase.[4] An ECC was issued for the project in April 2021 by DENR-EMB. The present EIA is a revised and updated version of the earlier report, prepared concurrently with the detailed design phase; it reflects all design changes, new information on the expected construction methods and locations of ancillary work sites, and results from additional baseline studies. The updated EIA report also includes content additions to more effectively meet ADB expectations; this is discussed further later on in this section.

2.4.2 Stakeholder Participation in the Environmental Assessment Process

As indicated above, 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:

1. **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.
2. **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.
3. **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.
4. **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.
5. **Monitoring of EMP Implementation –** A Multi-Partite Monitoring Team (MMT) will be 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.[5]

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[4] Department of Public Works and Highways. 2021. Infrastructure Preparation and Innovation Facility – Output 1 – Roads and Bridges, Bataan–Cavite Interlink Bridge (BCIB) Project – Environmental Impact Assessment Report. Third Issue, 11 February 2021. Ove Arup and Partners Hong Kong, Ltd.

[5] (1) DENR-EMB. 2003. Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (DAO 03-30); (2) DENR-EMB. 2017. Guidelines on Public Participation Under the Philippine Environmental Impact Statement (EIS) System. DENR Administrative Order No. 2017-15.

Disclosure. Effective stakeholder participation is enabled by disclosure of information about the project and the steps in its assessment. 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 is subject to specific time-bound disclosure requirements under the PEISS; these are summarized in Exhibit 2-6.

Exhibit 2-6 Disclosure Requirements Under PEISS

Information/item for disclosure	Method	Timing
Notice of Completion of Public Scoping and Start of EIA Study including: • Project description presented in public scoping • Schedule of project scoping • Public Scoping Report (PSR)	Posted on DENR-EMB website	Upon approval of PSR
Draft EIS report	Posted on DENR-EMB website	At least 20 days before public hearing
EIS Summary for the Public (ESP) in English and Filipino including: • Basic project information • Concise integrated summary of major impacts and residual effects after mitigation • Proponent's statement of commitment and capability to implement mitigation to prevent negative impacts • Information on where to get a copy of the draft EIS	Posted on DENR-EMB website	At least 20 days before public hearing
Notice of Public Hearing (NPH) including: • Objectives of the hearing • Necessity for project • Project goals and objectives • Brief description of scale, location and major components of the project • Project proponent • Date and venue of hearing • Instructions and deadline for registration of intent to attend and/or submit comments and position papers • Instructions and deadline for submission of written comments and position papers • Contact information for further inquiries	Posted on the DENR-EMB website Published in newspaper Posted in conspicuous public spaces in affected barangays	At least 20 days before public hearing (website) Once per week for 2 consecutive weeks, with second notice at least 7 days prior to public hearing (newspaper) At least 15 days prior to public hearing (posters)
IEC materials including information on: • Purpose of EIA • Necessity for project • Project goals and objectives • Project alternatives • Proposed locations of infrastructure components and alternatives • Project proponent • Projected implementation timeframe • Preliminary expectations on potential impacts for each alternative	Newspaper announcements Flyers Non-written means (radio, public address system)	At least 7 days before public hearing Non-written communications to be disseminated on at least 2 consecutive days)

Information/item for disclosure	Method	Timing
Revised EIS report, with invitation for further comment	Posted on DENR-EMB website	Posting for 7 days
ECC EMP including impact management plan and environmental monitoring plan Documentation of Public Participation	Posted on DENR-EMB website	Upon granting of ECC

Source: DENR Administrative Order No. 2017-15, Guidelines on Public Participation Under the Philippine Environmental Impact Statement System.

2.4.3 Monitoring and Reporting Requirements

The focus of environmental monitoring is defined under the PEISS to include four specific matters of interest: (i) the project's compliance with the conditions specified in the ECC; (ii) the project's compliance with the EMP; (iii) the effectiveness of the EMP-prescribed measures in preventing or mitigating the project impacts anticipated in the EMP's formulation; and (iv) continual updating of the EMP for sustained responsiveness to evolving project activities and impacts.

Monitoring of project implementation takes three forms for projects requiring an EIS: (i) self-monitoring by the project proponent of operations and sites; (ii) monitoring and validation carried out by a Multi-Partite Monitoring Team (MMT) set up specifically for the project; and (iii) audit/evaluation of the proponent's self-monitoring and the operation of the MMT by DENR-EMB.

Proponent. The proponent, or an entity working on its behalf, is required to monitor project implementation against all parameters identified in the EMP, and submit quarterly Self-Monitoring Reports (SMRs) to DENR-EMB. In addition, the proponent will conduct monitoring of the project's ECC compliance, and prepare semi-annual Compliance Monitoring Reports (CMRs); each of these is to be embedded within the concurrently-submitted quarterly SMR.

Multi-Partite Monitoring Team. A MMT is formed by the project proponent after issuance of the ECC, in consultation with DENR-EMB. The MMT should be broadly representative of the range of stakeholder groups identified for the project. The monitoring function of the MMT is to scrutinize 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 people, 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 work of the MMT is supported by a dedicated monitoring fund set up by the proponent.

DENR-EMB. 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.

2.4.4 Permitting and Clearance Requirements

Infrastructure projects, especially large ones like the BCIB, typically trigger a need for clearances by relevant government agencies and LGUs, as well as environmental permits which have to be applied for in advance of the commencement of works, and kept current for the duration of construction activity. An indicative list of clearances and permits expected to be required for the BCIB is presented in Exhibit 2-7.

Exhibit 2-7 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 from barangays	Leadership of each directly affected barangay
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
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
Navigational clearance	Philippine Coast Guard
Coast Guard clearance	Philipine Coast Guard
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	DOLE (Bureau of Workforce Conditions)
Environmental registration of project managers	DENR (Environmental Management Bureau)
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 ADB Environmental Impact Assessment Requirements

2.5.1 Safeguard Policy Statement, 2009

The Safeguard Policy Statement, 2009 (SPS) is the principal source of the mandate to conduct environmental impact assessment on undertakings proposed for financing by ADB.[6] The SPS establishes an environmental review process to ensure that projects and programs are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and are not likely to cause significant environmental, health, or safety hazards. The SPS is one of the key Bank Policies collected in the ADB Operations Manual. The policy promotes good practice as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. The core directives provided in the SPS are reinforced by related practical guidance

[6] ADB. 2009. *Safeguard Policy Statement*. June 2009. Manila.

materials produced by ADB, including Environment Safeguards: A Good Practice Sourcebook (2012) and the older Environmental Assessment Guidelines (2003).[7]

Appendix 1 of the SPS provides a framework of expectations for environmental analysis, engagement with stakeholders and communities potentially affected by projects, reporting, and follow-up implementation. Key prescriptions include the following:

1. Early scoping and screening of potential impacts by the project proponent, in consultation with a range of stakeholders, including project-affected people and concerned non-governmental organizations;
2. Consideration of possible alternatives to the project's location, design, technology, and components that could help avoid or minimize negative environmental impacts and risks;
3. Definition of substantive focus to encompass potential direct, indirect, cumulative and induced environmental impacts and risks to physical, biological, socioeconomic and cultural resources;
4. Definition of spatial focus based on an understanding of the realistic area of influence of project-related activities;
5. Definition of temporal focus to encompass as stages of project implementation, including preconstruction, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration;
6. Preparation of an environmental impact assessment based on an accurate description of the proposed undertaking and appropriate environmental and social baseline description of the environment in which the undertaking would be implemented; and
7. Definition and prescription of siting, design, construction and operation measures to ensure—in order of priority—avoidance of, minimization of, or compensation for anticipated adverse impacts.

2.5.2 Screening and Categorization

Each project or program considered for ADB financing is subject to screening for potential social and environmental impacts. Preliminary project concepts and sites are typically evaluated using a standard checklist, and assigned to one of four categories, defined in the SPS (p. 19) as follows:

1. **Category A.** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment is required.
2. **Category B.** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An Initial Environmental Examination is required.

[7] (1) ADB. 2012. *Environment Safeguards: A Good Practice Sourcebook (Draft Working Document).* December 2012. Manila.; (2) ADB. 2003. *Environmental Assessment Guidelines.* Manila.

3. **Category C.** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required, although environmental implications need to be reviewed.
4. **Category FI.** A proposed project is classified as category FI if it involves investment of ADB funds to or through a financial intermediary.

The BCIB project has been the subject of a prior full EIA conducted in accordance with the requirements of the PEISS, following a screening process that assigned the project to the highest assessment category under the national environmental impact assessment system. A separate screening conducted on behalf of ADB supports the same categorization under the ADB framework. The BCIB project is a large-scale and complex undertaking, spanning 32 km over terrestrial and marine environments, and implemented through seven major work packages. The project will produce a diverse set of impacts, some of which can be considered irreversible, and some of which will require specialized, purpose-built mitigation strategies. Several key impacts will be experienced or have ramifications at some distance beyond the actual infrastructure footprint. Previous screening also indicated that a Critical Habitat determination may be appropriate for a number of threatened wildlife species thought to occur in or near the project area, which introduces significant complexity in both assessment and mitigation. Based on the scale of the proposed infrastructure and finding of significant impact potential by the prior study and screenings, there can be little question that the project should be assigned to Category A for Environment under the ADB classification scheme. Accordingly, a full Environmental Impact Assessment (EIA) is the appropriate mode of assessment.

2.5.3 Key Elements of EIA for Category A Projects

The SPS prescribes a standard set of content expectations for an EIA study and report, as follows:

1. **Legal and Administrative Context –** An overview of the relevant legal instruments and administrative structures that will determine the project's requirements for environmental assessment and compliance, including both national legal and process requirements, and those of ADB.
2. **Description of Project –** A concise yet comprehensive outline of the proposed project, including its location, rationale, objectives, policy and infrastructure components, expected project implementation activities encompassing all project phases and sites (including the permanent project footprint, temporary construction support sites, and associated facilities), planned implementation timeline and expected cost.[8]
3. **Description of the Environment (Baseline Conditions) –** A comprehensive survey of the biophysical, socio-economic and cultural attributes of the environment in which the project is to be established, based on desktop and field study.
4. **Analysis of Alternatives –** A discussion of the alternative options (including the 'no project' alternative) explored for the project, including the environmental ramifications of each, and the process used to decide on a preferred alternative.

[8] Associated facilities are defined in the SPS as facilities that are necessary for a proposed project's implementation, and which would not be set up or operated in the absence of the need presented by the proposed project. Common examples are electrical substations and supply lines, water and sewer system extensions, access roads, and quarries and borrow pits established specifically to provide building materials for a project.

5. **Anticipated Impacts and Mitigation Measures –** A systematic analysis and accounting of the positive and negative impacts that can be anticipated, encompassing the pre-construction, construction and operation phases and considering physical, biological, social, economic and cultural dimensions, accompanied by prescriptions for measures to mitigate (prevent, minimize or compensate) or enhance each impact identified, as appropriate.

6. **Information Disclosure and Consultation –** A description and documentation of the steps taken during EIA preparation to inform stakeholders and others of the proposed project, and to ensure meaningful consultation with stakeholders, including project-affected communities and civil society, thereby facilitating their informed participation in the project's implementation.

7. **Grievance Redress Mechanism –** A description of the institutional structure to be set up by the project proponent to receive, investigate, evaluate and resolve instances of hardship or harm experienced by any person as a result of any aspect of the project's implementation, in a manner that is transparent, accessible, culturally and socially appropriate, and fair.

8. **Environmental Management Plan –** A comprehensive plan listing the anticipated impacts and measures prescribed to mitigate them; delineating the roles of the institutional actors involved in the plan's implementation; assigning responsibility for implementation of each prescribed measure; specifying a monitoring plan covering construction and operation phases; assessing institutional capacity building and training needs to ensure plan effective plan implementation; and providing an estimated cost for EMP implementation.

9. **Environmental Monitoring Plan –** A plan embedded within the EMP to help ensure that each item prescribed in the EMP is implemented effectively and in a timely manner by the assigned actors, and that semi-annual environmental monitoring reports covering compliance monitoring, effects monitoring and operation of the grievance redress mechanism are prepared and submitted to ADB for the duration of the project's construction phase.

2.5.4 Environmental Standards Application

In general, ADB and other multilateral donors support the application of national environment, health and safety standards in environmental impact assessment, where these are found to be sufficiently developed to address the particular areas of risk presented by an undertaking, and of at least equivalent stringency to standards specified or commonly referred to by relevant international entities. Where a national standard applicable to project risks does not exist, is insufficiently comprehensive to address the full range of relevant parameters, or is significantly less stringent than standards operational elsewhere, an appropriate stand-in is identified from the selection of known international standards. Standards referenced in the World Bank Group's IFC Performance Standards and Environmental, Health and Safety (EHS) Guidelines are a preferred source of guidance, although in some cases standards developed by agencies in jurisdictions with advanced regulatory frameworks such as the United States and European Union may be most useful. The national and international standards relevant to the BCIB project are compared in a later section of this chapter.

2.5.5 Public Participation in the Environmental Assessment Process

Information disclosure. Public disclosure is a fundamental mechanism for enabling participation in a project by stakeholders, beneficiaries and other project-affected people and communities. ADB requires the borrower (proponent) to submit the following documents for disclosure on ADB's website: (i) a draft full EIA at least 120 days prior to ADB Board consideration; ii) the final EIA; (iii) a new or updated EIA and corrective action plan prepared during project implementation, if any; and (iv) the semi-annual environmental monitoring reports. The proponent is also required to provide relevant environmental information, including from the draft and final EIA and monitoring reports, in a timely manner, in an accessible place and in a form and language(s) understandable to affected people, including those with limited literacy.

Consultation. For all ADB-supported projects, the proponent is required to carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. For Category A projects, at least two rounds of consultation are required, at a depth and spatial distribution commensurate with the scale of the project, number of people and communities potentially affected, and the salience, severity and magnitude of anticipated impacts. The first round should normally take place during the feasibility or preliminary design phase, and provides the opportunity for two-way communication between the project proponent (and study team working on its behalf) and affected stakeholders and communities, such that stakeholders can learn about the project, and the proponent and study team can learn from stakeholders about the project's environment and about stakeholders' perspectives and opinions regarding the project's implementation as proposed. A second round is required after the draft EIA report has been prepared, so stakeholders can learn what impacts are anticipated and how they will be mitigated, and provide their input to the further evolution of the proposed project as it moves toward approval and implementation. In the case of linear infrastructure, each round of consultation (including any additional rounds that may be deemed appropriate to capture seasonal dimensions or facilitate engagement with the full range of stakeholders) should normally be carried out in multiple community locations along the alignment.

2.5.6 Monitoring and Reporting Requirements

ADB requires the proponents of the projects it supports to monitor the progress of EMP implementation, to a depth and extent commensurate with the scope and severity of the project's anticipated impacts. Monitoring reports are to be submitted to ADB on a semi-annual basis for most projects, and quarterly for particularly complex or sensitive projects. Monitoring reports should document monitoring methods and results, identify any corrective actions necessary to address poor compliance or adverse effects, and specify a plan for implementation of such corrective actions. The proponent is required to submit semi-annual monitoring reports for the duration of the project's construction phase. For projects expected to have significant potential for adverse impacts during the operation phase, submission of monitoring reports may, at the discretion of ADB, be required on at least an annual basis for the duration of the operation phase.

2.6 Comparison and Reconciliation of PEISS and ADB Requirements

The expectations for the substantive content, analytical scope, and depth of environmental assessment for a major project such as the BCIB under the PEISS and ADB frameworks are broadly concurrent. The BCIB project is appropriately placed in the top assessment category by each framework, in both cases requiring preparation of the most rigorous assessment study, which is an EIS or EIA. The two frameworks require a similar degree of stakeholder engagement, and the expectations for the EMP and monitoring of its implementation are roughly the same. Key differences include the expected structure and content of EIA reports, the environmental standards that are to be applied to prevention and monitoring of project impacts, and the level of rigor concerning assessment and management of risks to biodiversity.

2.6.1 Report Structure and Content

PEISS and ADB expectations regarding the structure and content of the environmental assessment report differ modestly. This can be seen in the side-by-side comparison of standard tables of contents for reports prepared to PEISS and ADB specifications, in Exhibit 2-8.

The differences detailed in Exhibit 2-8 are mainly structural (a matter of organization), and to a lesser extent substantive (a matter of content elements). The former are of less consequence than the latter. For this updated environmental assessment report for the BCIB project, the differences have been reconciled by adoption of a hybrid report structure, which follows the PEISS format to the extent possible, while adding typical ADB-mandated features as appropriate. This should enable the EIA report to simultaneously serve the needs and meet the expectations of (i) DENR-EMB (which will use the report to confirm the validity of the ECC granted on the basis of the earlier EIS report); (ii) ADB (which will use the report in its safeguards due diligence related to loan processing and implementation); and (iii) DPWH (which will be largely responsible for implementing the EMP).

Exhibit 2-8 Comparison of Report Structures for Philippines EIS and ADB EIA

EIS Outline (PEISS standard)[1]	EIA Outline (ADB standard)[2]
Project Fact Sheet Executive Summary 1. Basic Project Information 2. Description of the Project's EIA Process 2.1 Terms of Reference of the EIA Study 2.2 EIA Team 2.3 EIA Study Schedule 2.4 EIA Study Area 2.5 EIA Methodology 2.6 Public Participation 3. Project Description 3.1 Project Location and Area 3.2 Project Rationale 3.3 Project Alternatives 3.4 Project Development Plan, Process/Technology Options and Project Components 3.5 Description of Project Phases 3.6 Manpower Requirements 3.7 Project Cost 3.8 Project Duration and Schedule 4. Baseline Environmental Conditions, Impact Assessment and Mitigation 4.1 The Land 4.2 The Water 4.3 The Air 4.4 The People 5. Environmental Risk Assessment (when applicable) 6. Environmental Management Plan 6.1 Impacts Management Plan 6.2 Social Development Framework 6.3 IEC Framework 6.4 Emergency Response Policy and Generic Guidelines 6.5 Abandonment/Decommissioning/Rehabilitation Policies and Generic Guidelines 6.6 Environmental Monitoring Plan 6.7 Institutional Plan for EMP Implementation 7. Bibliography/References 8. Annexes	Executive Summary I. Legal and Administrative Framework A. National laws, regulation and standards B. National environmental assessment requirements C. ADB environmental assessment requirements II. Project Description A. Project Location B. Project Rationale C. Proposed Infrastructure Components D. Ancillary Sites and Facilities E. Expected Project Implementation Activities F. Project Implementation Schedule G. Project Cost III. Description of Project Environment A. Biophysical Environment B. Socioeconomic Environment IV. Analysis of Alternatives V. Anticipated Impacts and Mitigation Measures A. Biophysical Environment B. Socioeconomic Environment VI. Information Disclosure and Consultations A. Rationale B. Stakeholder Identification C. Disclosure Activity to Date D. Consultation Activity to Date E. Future Disclosure and Consultation Activity VII. Grievance Redress Mechanism VIII. Environmental Management Plan (EMP) A. Objectives of EMP B. Roles and Responsibilities in EMP Implementation C. Anticipated Impacts and Mitigation Measures D. Environmental Monitoring Plan E. Reporting Requirements F. Capacity Building and Training Needs G. Cost Estimate IX. Conclusions and Recommendations

[1] As indicated in Annex 2-12 of Revised Procedural Manual (DENR Administrative Order No. 30 Series of 2003)
[2] As indicated in Annex to Appendix 1 of Safeguard Policy Statement, 2009

2.6.2 Environmental Standards

As indicated above, ADB supports the application of national standards to supported infrastructure development projects, but requires the use of international standards when national standards do not exist for parameters relevant to likely project risks, and when existing national standards are less stringent than comparable standards used elsewhere. Exhibit 2-9 lists and evaluates the available national standards relevant to the BCIB project, and indicates an appropriate international stand-in for each substantive area for which a national standard is lacking or deemed insufficiently applicable or stringent to address project risks.

Exhibit 2-9 Determination of Applicable National and International Standards

Substantive Area	Relevant National Standard	Applicable Standard/Benchmarks for BCIB
Ambient air quality	• National Ambient Air Quality Guideline Values (specified in RA-8749-IRR-DAO-2000-81) • Provisional National Ambient Air Quality Guideline for $PM_{2.5}$ (specified in RA-8749-IRR-DAO-2013-13) • Evaluation: Less stringent than applicable international standards	• World Bank Group Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality (2007)
Water quality (surface water, ground water, effluent)	• Water Quality Guidelines and General Effluent Standards of 2016 (specified in RA-9275-DAO-2016-08 and updated by DAO-2021-19) • Evaluation: Comparable to international standards and most appropriate to national context	• Water Quality Guidelines and General Effluent Standards of 2016 (specified in RA-9275-DAO-2016-08 and updated by DAO-2021-19)
Water quality (drinking water)	• Philippine National Standards for Drinking Water of 2017 (specified in Department of Health Administrative Order No. 2017-10) • Evaluation: Comparable to World Health Organization standards	• Philippine National Standards for Drinking Water of 2017 (specified in Department of Health 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 N0. 002 , Series of 1980) • Evaluation: Less stringent than similar international standards	• World Bank Group Environmental, Health and Safety Guidelines: Environmental Noise Management (2007)
Underwater noise	• No national standards for underwater noise	• US National Marine Fisheries Service (National Oceanic and Atmospheric Administration) Underwater Acoustic Thresholds. NOAA Technical Memorandum NMFS-OPR-55 (2016)
Vibration	• No national standards for vibration	• US Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06, May 2006)
Soil quality	• No national standards for soil contamination	• Dutch Target and Intervention Values, 2000. Circular on Target Values and Intervention Values for Soil Remediation, February 4, 2000. Ministry of Housing, Spatial Planning and Environmental Management.
Sediment quality	• No national standards for freshwater or marine sediment quality	• United States National Oceanic and Atmospheric Administration (NOAA) Sediment Quality Guideline screening benchmark values
Occupational safety and health	• Occupational Safety and Health Standards (as amended 1989). Department of Labor and Employment, Bureau of Working Conditions. • Evaluation: Comparable to World Bank Group Environmental Health and Safety Guidelines, and familiar to Philippine regulators, contractors and workers. Do not cover worker accommodations.	• Occupational Safety and Health Standards (as amended 1989). Department of Labor and Employment, Bureau of Working Conditions. • International Finance Corporation/European Bank for Reconstruction and Development Workers' Accommodation Processes and Standards (2009)

2.6.3 Biodiversity Assessment and Management

With respect to the risks that a project's development may pose to biodiversity, ADB requires application of the World Bank Group's IFC Performance Standard 6: Biodiversity

Conservation and Sustainable Management of Living Natural Resources (2012), which entails a more structured and rigorous assessment than is stipulated under the PEISS. Habitats present within and near the project's area of influence are expected to be classified in accordance with the definitions, criteria and process steps specified in Performance Standard 6 and its supporting Guidance Note 6 (2019), and project modifications and/or specialized biodiversity management plans must be developed to manage the project's implementation in a manner commensurate with the magnitude of risks posed to biodiversity values. The procedures required under Performance Standard 6 and Guidance Note 6 have been followed in the preparation of this updated EIA for the BCIB project.

3 PROJECT DESCRIPTION

3.1 Project Purpose

The proposed Bataan–Cavite Interlink Bridge Project (BCIB) will entail the construction and operation of a new direct road linkage between Bataan and Cavite Provinces by way of an over- sea crossing of Manila Bay, as shown in Exhibit 3-1. The project is being implemented by the Department of Public Works and Highways (DPWH) and is under consideration for financing by the Asian Development Bank (ADB).

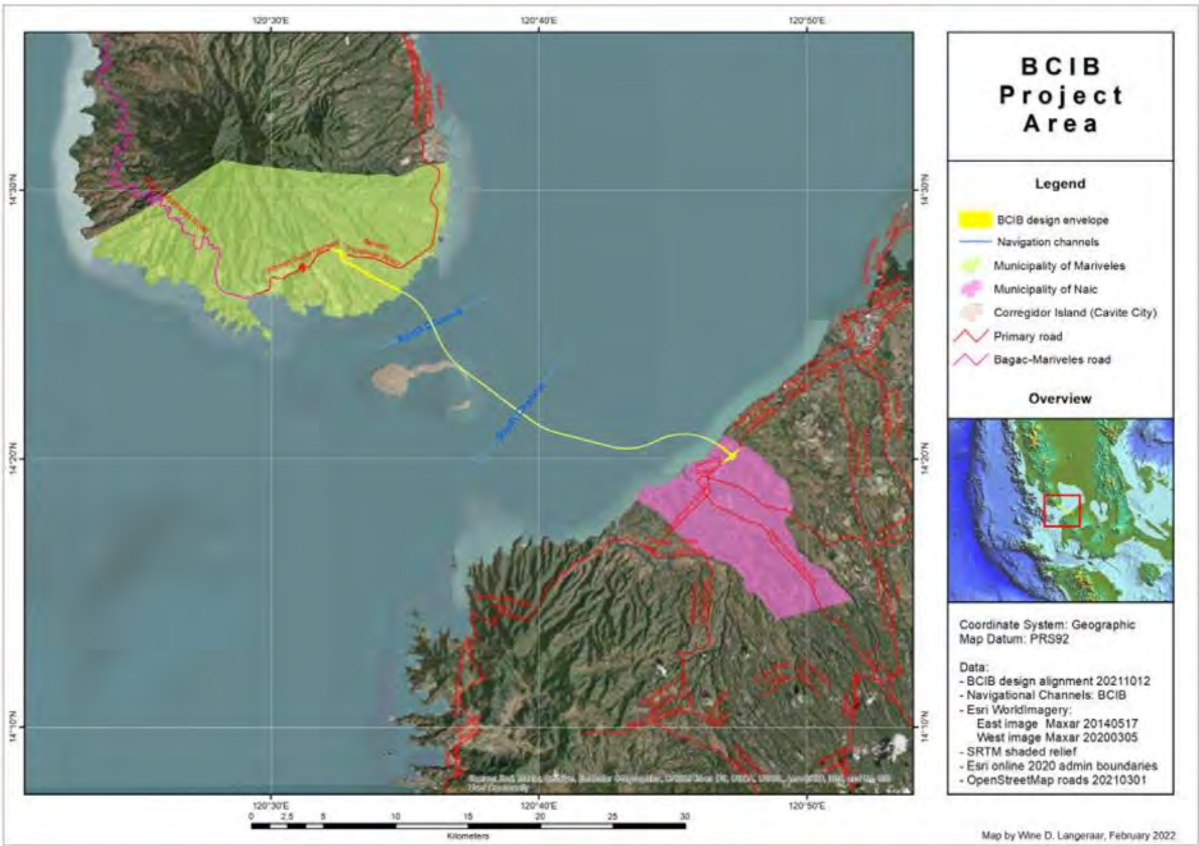


Exhibit 3-1 Location of Proposed Bataan-Cavite Interlink Bridge Project

The proposed establishment of a direct road link between Bataan and Cavite supports goals articulated in national and regional development plans, including the Philippine Development Plan 2017–2022, CALABARZON Regional Development Plan 2017–2022, Central Luzon Development Plan 2017–2022, and National Capital Region Development Plan 2017–2022. Major focal points in these plans include accommodating planned growth, amelioration of road traffic congestion, and ensuring the ability of Manila to serve as the country's premier shipping hub over the long term. As elaborated below, the BCIB is designed to address these objectives.

3.2 Accommodating Planned Growth

The metropolitan area of Manila (Metro Manila) has long been the dominant growth pole of both Luzon and the Philippines as a whole, and today, it accounts for 12.4 percent of the national population (Census 2020) and 36.4 percent of the national Gross Domestic Product

(GDP) (2017).[9] Services and economic opportunity are heavily concentrated in Metro Manila and surrounding urbanized jurisdictions; this perpetuates the attractiveness of the megacity as a destination for temporary and permanent in-migration. However, the density of Metro Manila makes it difficult for migrants to afford housing within easy reach of Manila’s economic opportunities. Regional and national development plans recognize a need to improve access to services and economic opportunity in other parts of Central Luzon (Region III) and CALABARZON (Region IV-A), including in Bataan. The Philippine Development Plan envisions decentralizing shipping and commercial activity within Luzon to alleviate both vehicular and marine congestion, thus providing economic opportunities for a broader range of the island’s population.

3.3 Traffic Congestion

As Metro Manila is hemmed in on the east by mountainous terrain and on the west by Manila Bay, there are few alternative routes for traffic between the northern half of Luzon and the industrializing CALABARZON region to the south. At present, majority of north-south traffic travels through the city, and although there are two north-south expressways in operation, these are frequently overburdened by through and local traffic. Traversing Metro Manila can add hours to a trip, imposing inconvenience, losses of work time, increased fuel costs, and overall lower productivity. A new regional transportation corridor could improve the movement and efficiency of commercial and routine commutes and reduce barriers to productivity. A direct connection between Bataan and CALABARZON would enhance regional economic integration. Exhibit 3-2 illustrates how an alternative route could connect major industrial areas and nearby port options to improve distribution and access to broader markets without diluting the Metro Manila’s significance as the economic center.

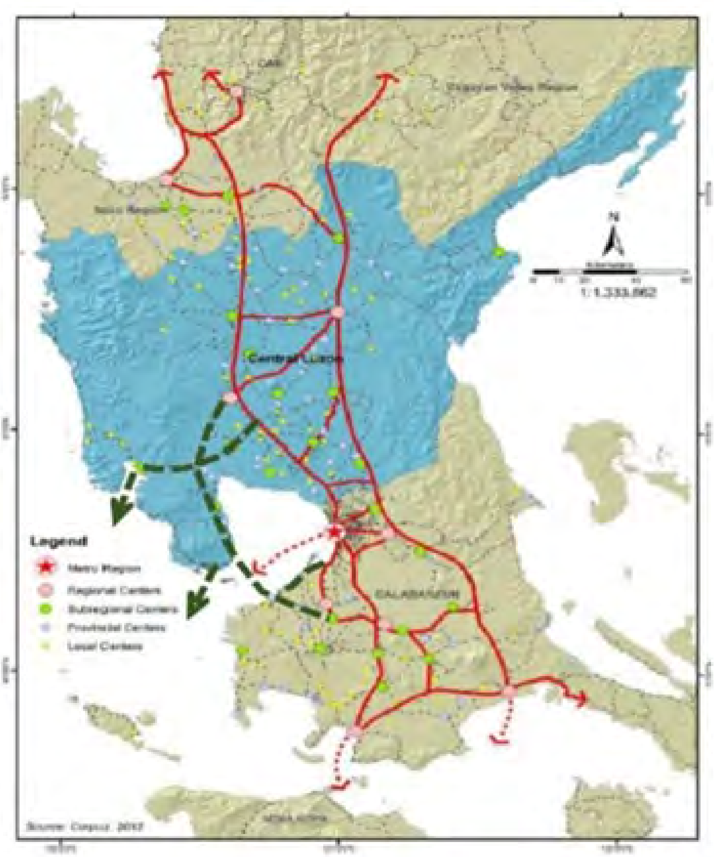


Exhibit 3-2 Potential New Regional Transportation Corridor

3.4 Marine Shipping

The Port of Manila is and will continue to serve as the predominant maritime shipping hub in the country, but the port facilities and landside infrastructure are surrounded by dense development that limits future expansion in the immediate vicinity. Development of other

[9] Philippines Statistical Authority, 2020 Census of Population and Housing; (2) Metropolitan Manila Development Authority (MMDA). 2018. National Capital Region Development Plan 2017-2022.
[Land Use Plan | Authority of the Freeport Area of Bataan (afab.gov.ph)]

complementary port facilities around Manila Bay offers a strategy for ensuring that the long-term demand for shipping services around the Manila market can be met efficiently despite the land constraints. The existing Port of Mariveles, which serves the Freeport Area of Bataan (FAB) on the south end of the Bataan peninsula, is well positioned to relieve pressure on the Port of Manila and enhance Manila Bay's overall port capacity. However, the potential of this port to absorb substantial traffic from the Port of Manila is constrained by the difficulty of land access from the major markets of Metro Manila and CALABARZON. The fastest route from the Port of Mariveles to the industrial and export processing center of Cavite and Laguna –the immediate southern provinces of Metro Manila, for example, involves driving north and east for approximately 95 kilometers (km) and then south another 100 km, with travel time upwards of four hours. A direct road link across the bay would cut the journey between the same points to less than 20 percent of the normal route travel time and avoid the delays involved in passing through Metro Manila.

3.5 Project Objectives

The BCIB project was formulated to respond to regional road transport and economic development needs articulated in regional development plans through establishment of a road link across Manila Bay. An overview of the project's corresponding results chain, as defined in the 2020 Feasibility Study[10], is presented in Exhibit 3-3.

[10] DPWH. 2020. Bataan-Cavite Interlink Bridge Project - Feasibility Study. Prepared for Department of Public Work and Highways by ARUP. February 2020

OBJECTIVES

Reduce transportation constraints on existing roads, facilitating local economic development
Ease traffic congestion in Metro Manila while linking South Luzon and North Luzon
Support development of seaports of Bataan and Cavite as premier international shipping gateways to the country

OUTPUTS

A long sea crossing bridge across Manila Bay, linking Bataan and Cavite and incorporating long-span navigation bridges to maintain ease of shipping in and out of the bay.

OUTCOMES

Reduced congestion and improved network reliability, supporting reduction in travel costs
Improved connectivity between Metro Manila and Bataan
Greatly reduced travel time between Bataan and Cavite
Improved mobility and accessibility to services, employment and markets
Enhanced ability to accommodate projected population growth in central Luzon
Expansion of capacity for international and domestic maritime trade enabled
Opportunities for tourism development on Corregidor Island and Bataan west coast expanded

IMPACTS

Productive capacity of national economy expanded
Jobs created and incomes increased
Benefits of central polar economic growth shared more widely
Greater integration of marginalized sectors in regional economy
Improved investment climate

Source: Adapted from BCIB Project Final Feasibility Study Report, 28 February 2020 (Ove Arup & Partners Hong Kong Ltd.)

Exhibit 3-3 Anticipated BCIB Results Chain

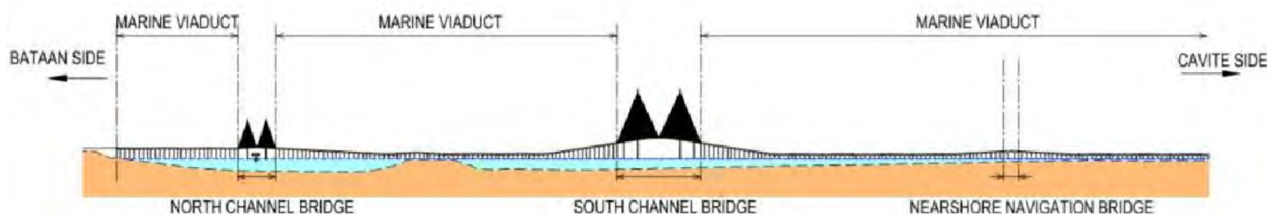
3.6 PROJECT DESCRIPTION

3.6.1 Bataan-Cavite Interlink Bridge Components

The proposed BCIB will be a four-lane, median-separated roadway with total length of 32 km, of which 26 km will be over the waters of Manila Bay (Exhibit 3-4). The BCIB will connect to the Roman Superhighway at an interchange in Mariveles, Bataan, and to the Antero Soriano Highway at an interchange in Naic, Cavite.

Exhibit 3-4 Plan View of BCIB Showing Navigation Channels

The profile in Exhibit 3-5 illustrates the key project features, from left to right. The dominant features are the North Channel Bridge, which will provide for a 300-meter navigation channel, and the South Channel Bridge, which will span a 650-meter channel accommodating two-way passing for even the largest ocean-going vessels. Near the Cavite shore, the marine viaduct will include a third navigation bridge for smaller commercial and service vessels to use. The high- clearance viaducts between these bridges permit easy passage of local fishing and recreational boats. The BCIB roadway will provide a vehicular turnaround in a shallow portion of the Manila Bay east of Corregidor Island, which is between the north and south channel bridges. This vehicular turnaround has been designed to accommodate a potential future access road to the island.



Source: BCIB Project Final Feasibility Study Report, 28 February 2020 (Ove Arup & Partners Hong Kong Ltd.)

Exhibit 3-5 BCIB Project Profile

The BCIB access from Bataan is proposed as a trumpet interchange with the Roman Superhighway and then will descend approximately 220 meters (m) in elevation over a distance of 5 km to meet the marine viaduct crossing. The interchange will require the relocation of 28 businesses and 33 residents near the Roman Superhighway and along the BCIB alignment[11]. Exhibit 3-6 shows the setting of the northwest (Bataan) terminus of the BCIB in the municipality of Mariveles.

Exhibit 3-6 Overview of BCIB Looking Northwest over Bataan

At the south end of the BCIB, the on-land roadway will extend just 1.3 km from the shore to where it will join with the Antero Soriano Highway (Route 1), which in turn links to the Manila–Cavite Expressway (Expressway 3) near Naic, Cavite. Frontage roads will direct local traffic onto the Antero Soriano Highway around the perimeter of the interchange. This terminus is also identified as the starting point of a possible future connection to the Cavite–Laguna Expressway (CALAX), which is operational for the most part of Laguna segments but is still under-construction in the Cavite side. A link to CALAX is not part of the BCIB project, but a partial cloverleaf design has been chosen for the BCIB–Antero Soriano Highway interchange to enable development of a full cloverleaf interchange in the event that this connection is built in the future. The permanent footprint will require the relocation of 54 businesses and 67 residential units[12]. Exhibit 3-7 shows the setting of the southeast (Cavite) terminus of the BCIB in the municipality of Naic.

[11] Draft Updated Social Safeguards Report and Land Acquisition and Resettlement Plan, November 2022
[12] Draft Updated Social Safeguards Report and Land Acquisition and Resettlement Plan, November 2022

Exhibit 3-7 Overview of BCIB looking over proposed Antero Soriano Highway northbound

The BCIB roadway is planned to consist of four travel lanes, two in each direction, with shoulders to the outside and a barrier or separation in the median, for a total width of 20.9 m at bridge sections. Theon-land portion will be mostly built upon embankments to provide resilience to projected sea level rise over the project's 100-year design life. The embankment will be composed of both cut and compacted engineered soil, upon which aggregate subbase will be laid, followed by crushed aggregate subbase, and topped with a polymer modified stone mastic asphalt[13] as the final roadbed. Right-of-way has been minimized by narrowing the embankments with retaining walls. To maintain local roads as well as large gullies and riverine areas, bridges and reinforced box culvert structures are proposed as appropriate. The embankments transition to land viaducts which connect with the marine viaduct. Marine viaducts are designed as precast concrete box girders supported by seismically resilient concrete piers. A turnaround is planned to be located between the two navigation bridges positioned just east of Corregidor Island. Ramps will extend from either direction, descending down to a platform located under the BCIB mainline where vehicles can return up ramps in the opposite direction. The turnaround platform uses I-beam straddled between piers to be cast on the mainline pile cap with one additional pier in the center Exhibit 3-8. Turnaround platform supporting beams will be set 11 meters above mean sea level, which considers projected sea level rise. All concrete structural elements are designed with steel reinforcement and post-tensioning to satisfy service, strength and extreme event loading such as vessel collision and earthquakes. The marine concrete box girder deck on the approaches splits into a dual-box

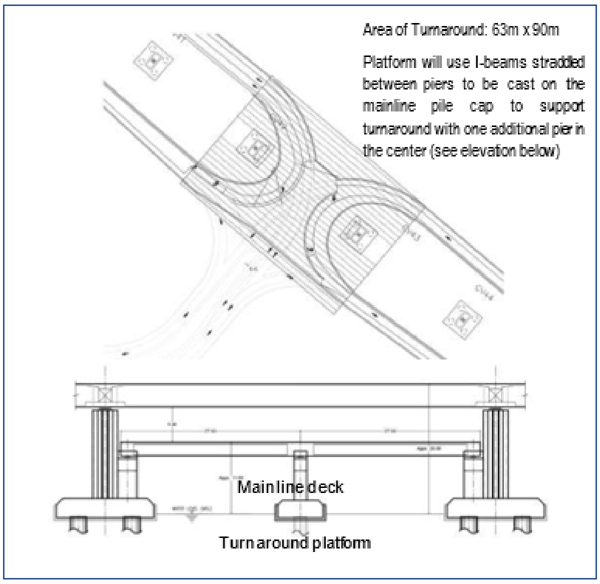


Exhibit 3-8 Plan View and Elevation of Turnaround Platform at Corregidor Island

[13] Polymer modified stone mastic asphalt is a with stone-on-stone structure bonded with polymer-modified mastic that reduces the amount and severity of distresses, improve thermal properties, and to extend pavement service life.

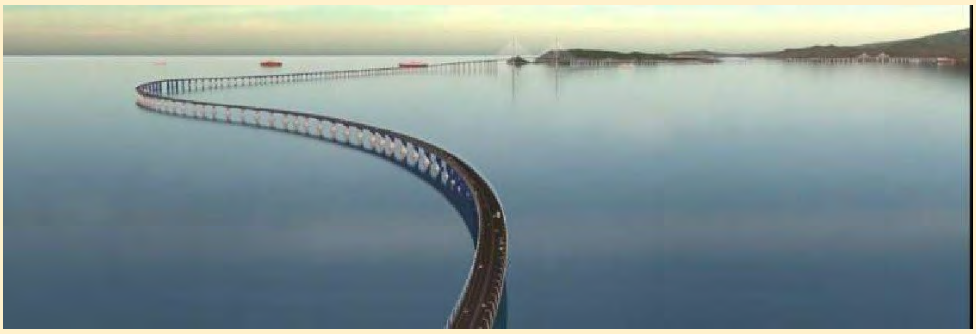
girder to transition to the cable-stayed bridges. The North Channel Bridge is comprised of steel I-beam supported decks, while the South Channel Bridge uses twin-barrel orthotropic steel box girders. For safety purposes, DPWH will enforce a weight limit on commercial trucks prior to entering the BCIB alignment, and tricycles, bicycles, and pedestrians will not be allowed. Exhibit 3-9 provides an overview of the key BCIB features.

Exhibit 3-9 Project Description By Project Feature

<table>
<tr><th>BCIB Project Feature</th><th>Description</th></tr>
<tr><td>Land Approach - Bataan</td><td>5.4-km roadway supported primarily on embankment from Roman Highway to marine viaduct, with six structures to maintain local circulation, including:

Interchange bridge at Roman Highway
Alas-Asin Viaduct
Alas-Asin Road Overpass Bridge
Mt. View Road Overpass Bridge
Mt. View Waterway Bridge
Bataan land viaduct from road to marine viaduct, consisting of five 40-meter spans

</td></tr>
</table>

BCIB Project Feature	Description
Land Approach – Cavite	1.38-km roadway supported primarily on embankment from south marine viaduct to the interchange with Antero Soriano Highway, with five structures to maintain current circulation, including: • Antero Soriano Interchange Bridge (partial clover-leaf interchange) ➢ The interchange bridge raises the Soriano highway over the BCIB, consisting of two 25-m spans supported on steel I-beams straddling the roadway from abutments on eitherside. • Tramo Underpasses 1 & 2 – reinforced box culvert • Timalan-Balsahan Underpass – reinforced box culvert • Cavite land viaduct from road to marine viaduct, consisting of three 40-m spans 
Marine Viaducts & High-Level Approaches	The Marine Viaducts are comprised of northern, central and southern segments comprised of a series of 100-m spans where water depths exceed 10m, and 60-m spans in shallow waters under 10 m. Including the High-Level Approaches on either side of the Cable-Stayed Bridges, the overall extent is 23.5 km. The height of the deck above the sea surface will vary from approximately 21 m for most of the marine viaduct length, to over 80 m at the south navigation channel. Most superstructure elements will be massively precast, place on support piers, and stitched together at mid-span. 

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BCIB Project Feature	Description
Vehicle Turnaround	Four ramps will descend to a roundabout for vehicles to turn around and return, proposed as a pier-supported platform located east of Corregidor Island narrow tail. 
North Channel Bridge	A 736 m-long Cable-Stayed Bridge consisting of: • 400-m bridge center span and two 168-m back spans ➢ Spanning over 300 m-wide navigation channel ➢ 40.5 m vertical clearance beneath the bridge deck • Two 142-m above-water monopole towers with 128 stay cables to support the bridge deck • Two anchor piers 

1

BCIB Project Feature	Description
South Channel Bridge	An 1,800 m-long Cable-Stayed Bridge consisting of: • 900-m bridge center span and two 168-m long back spans ➢ Spanning over 750 m-wide navigation channel ➢ 72.3-m vertical clearance beneath the bridge deck • Two 304-m above-water monopole towers with 216 stay cables to support the bridge deck • Four anchor piers 
Nearshore Navigation Bridge	A 315 m-long navigation bridge is located within the marine viaduct south of the South Channel Bridge consisting of: • 150-m clear span and 82.5-m side spans using concrete box girders ➢ Spanning over 90 m-wide navigation channel ➢ 25-m vertical clearance beneath the bridge deck 

BCIB Project Feature	Description
Associated Facilities	Bridge Monitoring and Maintenance Compound (BMMC) on a 0.5-hectare site on the Bataan side, featuring a 2-story, 475-m^2 maintenance building; electrical service building; technical shelter; emergency response office; guard outposts; utilities, fuel pump shed, water tank, portable sewage treatment plant; and fenced open areas for parking and yard. Bridge  Other associated facilities include identified sites for a future border control site and future maintenance center on the Bataan side

3.7 Traffic During Operations

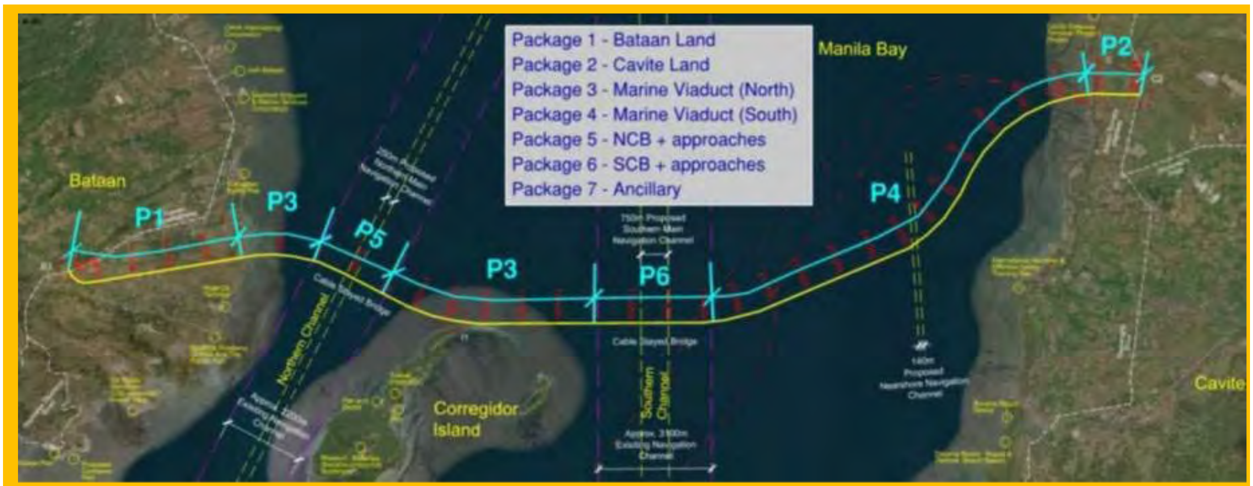
During operation, traffic patterns are anticipated to change affecting the primary highways in both Bataan and Cavite. The objective of BCIB is to ease the traffic pressures on Manila road network by diverting traffic, thereby reducing congestion, providing enhanced access to broader markets and port facilities. Exhibit 3-10 demonstrates how annual average daily traffic (AADT) volumes will change from reviewing volumes without and then with the BCIB. The traffic volumes are projected for both 2030 and 2050. The level of service (LOS) is qualitative measure that refers to the speed, convenience, comfort and security of transportation facilities and services as experienced by road users. The computation considers both the speed of the roadway and the number of travel lanes to determine how many vehicles can pass through the roadway. Full capacity of the roadway is equivalent to a LOS of 1.00. A measure of less than one (<1.00) allows moving traffic whereas higher than one (>1.00) indicates potential congestion and travel speeds are slower than the roadway was designed. The level of service alphabet of A, B, C, D or F is an assigned grade indicating the degree of congestion, where F indicates saturated condition. DPWH is planning to increase the capacity of connecting highways by adding lanes in each direction which will improve the reported LOS. The BCIB will bring more traffic to the Bataan and Cavite Province highways but improvements these facilities are underway. The LOS reported in Exhibit 3-10 does not reflect these plans.

Exhibit 3-10 Projected AADT Traffic and Level of Service for 2030 and 2050

Roadway Facility	Volumes of Vehicles without Project (PCU)	Volumes of Vehicles with Project (PCU)	Percent Change	Total Lane Capacity (PCU/HR)	Projected Level of Service without/ with project	Projected Level of service without/ with Project
	2030					
Roman Highway (northbound)	10,114	11,311	208%	2200	0.4/ 1.2	LOS B/ F
Roman Highway (southbound)	47,960	68,639	99%	2200	0.3/ 0.7	LOS B/ C
Antero Soriano Highway (northbound)	71,462	70,111	131%	1800	0.97/ 1.7	LOS D/ F
Antero Soriano Highway (southbound)	47,423	47,423	58%	1800	0.7/ 1.1	LOS C/ F
BCIB (Eastbound)		18,159				
BCIB (Westbound)		17,563				
	2050					
Roman Highway (northbound)	15,251	16,636	291%	2200	0.5/ 1.7	LOS B/ F
Roman Highway (southbound)	89,299	124,985	139%	2200	0.4/ 1.0	LOS B/ E
Antero Soriano Highway (northbound)	112,758	111,976	183%	1800	0.9/ 2.5	LOS E/ F
Antero Soriano Highway (southbound)	89,399	116,022	81%	1800	0.9/ 1.5	LOS D/ F
BCIB (Eastbound)		30,215				
BCIB (Westbound)		29,372				
Source: BCIB Project, January 2023 (DCCD)						

3.8 Construction

Construction will take place over five years and require temporary use of large areas outside of the permanent right-of-way for staging materials and equipment, and operation of worker camps. The BCIB construction work will be divided into several work packages, so bidding entities are not limited to the small number of large international firms and joint ventures that will have the necessary capacity and expertise to take on the whole project as one piece. The expected breakdown of contracts is delineated as Packages 1 through 7 in Exhibit 3-11.



Construction Package	Works	Approximate length of works (km)
Package 1	Land approach, including interchange (Bataan)	5.0
Package 2	Land approach, including interchange (Cavite)	1.3
Package 3	Marine viaduct (North)	8.0
Package 4	Marine viaduct (South)	12.6
Package 5	North Channel Bridge and approaches	2.1
Package 6	South Channel Bridge and approaches	3.1
Package 7	Ancillary facilities	-

Exhibit 3-11 Planned Construction Packages

Execution of each package will adhere to a Contractor Environmental Management and Monitoring Action Plan (CEMMAP), which anticipates and plans for traffic management, public information dissemination, and environmental mitigation and ongoing stewardship. The CEMMAP will apply best management practices for avoiding and minimizing negative effects during construction, to the extent possible. The construction will begin first on the two on-land packages, and within one-year, multiple packages will be under construction concurrently (see Section 3.8.3, Preliminary Construction Schedule for more detail on schedule).

3.8.1 Construction Phasing

Generalized construction phases are described below. While the phases are described in a linear fashion, the scale of the BCIB project dictates that phases are likely to continue for extended periods and overlap with other phases.

Pre-construction actions. Pre-construction activities are prerequisites of the main construction activity. These include finalizing property acquisition, obtaining environmental permits, establishing environmental management protocols, obtaining approvals for the CEMMAPs and transportation management plans, drafting and disseminating public information, establishing communication protocols with utilities and emergency service agencies, identifying a workforce, collecting large machinery, and ordering and scheduling construction material deliveries from local and distant locations.

Mobilization activities. Mobilization includes assembling skilled crews, clearing and grubbing landside portions of the project footprint and staging areas to allow stockpiling materials, storing equipment (see inset box for equipment needed), and developing the concrete casting works. For maximum efficiency, a substantial portion of the staging areas will be dedicated to casting yards, where bridge components such as concrete box girders will be made to specifications. Staging areas, including casting yards and worker crew camps are described in Section 3.8.2, Temporary Staging Areas.

Initial estimates of Construction Equipment needed:

8 - Excavators/ dozers
1 - Compactor/Roller
2 - Wheel Loaders
7- Rubber Tire Loaders
3 - Motor Graders
13 - Forklifts
40 - Trucks
4 - Lifting Frame w/ Hoists
65 - Cranes
2 - Boom Trucks (Neck breakers)
20 - Generator Engines
57 - Hoist on Cranes
25 - Hydraulic Pile Hammers
86 - Welding machines
41 - compressors
89 - generators
6 - Mechanic Boats
6 - Survey Boats
6 - Superintendent Boats
14 - Tugboats
4 - Elevators
24 - 3-Axle Trucks
23 – 6-kW Light Plants
7 - Concrete Pumps
12 - 100-Ton Straddle Lifts
9 - Steam Generators
12 - Air Tugger for Cart Systems
3 - Overhead Gantries
3 - Transporters
2 - Slip Form Paving Machines
4 - Ready Mix Trucks
2 - Bidwells for Overlay

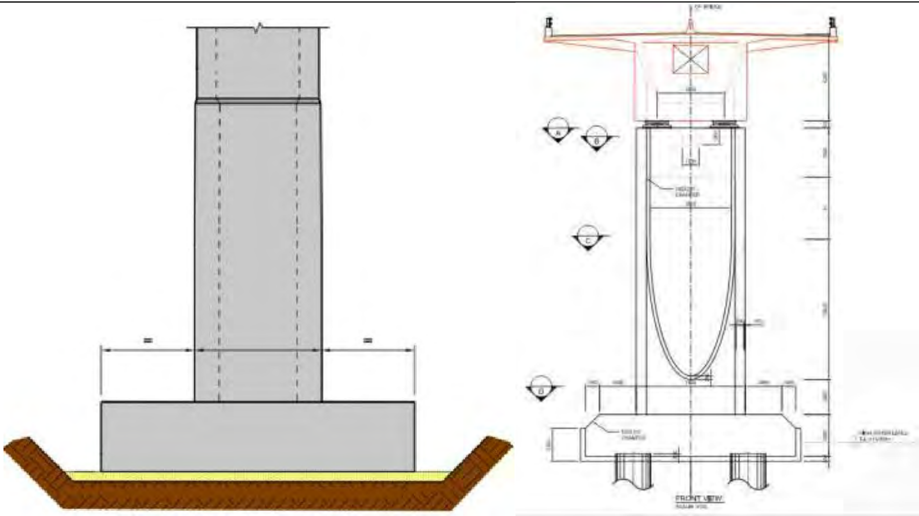
Construction site limits on land will be delineated with fencing, and sensitive resources will be protected with exclusion fencing (brightly colored fence material). Clearing and grubbing in Cavite will begin by removing residential and business structures, farmlands and some trees. Similarly, clearing on the Bataan side will consist of removing structures, removing vegetation and then cutting and filling the terrain to designed slope specifications. Building demolition waste will be hauled to landfills, whereas soils will be piled for reuse in designated staging areas or hauled for use by others, and vegetation will be composted for later use in landscaping. Relocation of existing utilities will begin in this phase. For instance, 200 Volt lines cross the BCIB alignment in Bataan and Cavite and may have to be relocated and raised higher. Additionally, public water lines and 69 V distribution lines and poles will need to be relocated.

Hauling materials on and off site will begin during mobilization and will be sustained for most of the construction phase. Material hauling will occur mostly on local highways, although barge delivery is foreseen for some bulk materials needed at shore-proximate work sites. The primary road hauling routes will be the Roman Highway (Bataan side) and Antero Soriano Highway and Govenors Drive (Cavite side). These roads are four-lane concrete roads and considered to have sufficient durability to support the hauling traffic associated with the BCIB construction works. However, some bridges on the Antero Soriano Highway may have to be reinforced to support the hauling heavy equipment through different project actions. Temporary traffic controls will be established in cooperation with local officials and emergency service agencies.

Floating batch plants are large integrated units with materials. Supplies are fed from barges rotating in and out. Waste waters pulled out of the piles are pumped to settling tanks for process water management. It is anticipated that there will be five floating batch plants needed for the peak construction period.

Photo source: tappanseesales.com

Substructure construction. The foundations for bridges, viaducts, and interchanges are referred to as substructure elements consisting of pier columns, anchor piers, pier caps, and abutments. The marine viaduct was divided by shallow water areas (less than 10m) and deep-water areas. The shallow water areas are located in three separate zones, specifically: nearshore Bataan (0.88km), Corregidor Island (1.09km), and Cavite (6.48km). In these areas, span length of 60m is proposed instead of the original 100m spans to facilitate using a girder erection equipment not requiring deep draft. Substructure construction in deep waters will be built from anchored barges. Two construction methods are proposed to establish the pier foundation at the sea floor depending on geotechnical conditions present: spread footing and pile supported. Exhibit 3-12 illustrates the comparative foundation types. The pile foundations include large diameter steel tubes (2.8 to 3m) which, when embedded deeply into the seafloor, will be excavated on the inside. Rebar cages will be inserted, and concrete slurry will be poured into the piles from floating batch plants (see inset box to right).



Spread Footing-supported Pier

Pile-supported Pier

Exhibit 3-12 Comparison View of Spread Footing Supported Pier and Pile-Supported Pier

Outside of the shallow areas, all vertical structures, including the four monopole towers for the cable-stayed bridges and support columns for viaduct and bridge piers, will be cast in situ, using moving formwork travelers.

The general sequence of pile installation is to prepare the template for piles based on the design drawings, and then drive the steel pipe pile into the seabed. For approximately 25 percent of the marine piers, the foundation will be built by driving piles into the sea floor with impact hammers or vibratory hammers. The other pile supported piers method is referred to as the Cast in Drilled Hole (CIDH = drilled shafts) method. CIDH sets a permanent steel casing and augers within the casing, thus progressively lowering the casing deeper into the sea floor. The drilled material is extruded by the drill onto the barge and collected in a sealed container where the material is dewatered and carried away. To reach desired depth, steel casings are extended by joining another to the top through welding or bolting. Upon reaching desired depth, a series of rebar cages are formed. These are connected to the next rebar cage prior to placing in the bottom of the emptied casing. Finally, the casing is filled with concrete using a tremie process. Tremie concrete refers to pouring concrete from a hopper through a vertical pipe extending from above the surface to bottom of the casing where there may still be water. As concrete flows from the bottom of the pipe, more is added to the hopper so that the tremie pipe is continuously charged with fresh mix. As the mix flows, fills the pipe and pushes the remaining water above the concrete.

The number of piers per bridge segment is outlined in Exhibit 3-13. This table also demonstrates the number of piers per BCIB package that would require pile driving which is considerably noisier than bored piles or installing spread footing foundations. The number of total piles per construction area are indicated in Exhibit 3-14. Following installation of each grouping of piles, a prefabricated cofferdam in the shape of the pile-cap will be positioned over the driven piles and the bottom seal slab will be cast in place. The form will be de-watered and braced once the seal slab concrete achieves the design strength. Then rebar cages will be placed inside the forms and concrete poured. Finally, on top of the pile caps, falsework, formwork, and rebar cages will be placed to cast the support columns, on top of which the superstructure will be supported.

In the shallow areas, a spread footing will be precast with pre-installed tremie pipes and jacks. This spread footing is set on a cleanly scraped seafloor with a shallow draft catamaran barge catamaran barge with strand jacks or cables for hoisting and a winch as the hoist. Once set in correct and level position, concrete is poured through the tremie pipes to bond the footing to the sea floor. The spread footings are designed 15 meters square and will have rebar extruding through the top to which the remaining portion of the pier and pier cap can be cast in-situ.

Exhibit 3-13 Number of Pier and Foundation Construction Methods for Each Bridge Segment

Bridge Segment	Total Number of Piers in Manila Bay	Number of Piers Supported via Pile Driving	Number of Piers Supported via Augered piles or Spread-footing Foundation
North Viaduct	35	0	35
North Channel Bridge	4	0	4
Central Viaduct	87	12	75
South Channel Bridge	6	6	0
South Viaduct	180	45	135
TOTAL	312	63	249

Exhibit 3-14 Estimated Number of Steel Piles for Each Bridge Segment

Estimated Number of Steel Piles by Project Area by Diameter (CISS & CIDH pile foundations)			
		2.8m	3m
Landside over/underpasses - Bataan	N/A (Concrete Drilled Shafts)		
Landside over/underpasses - Cavite	N/A (Concrete Drilled Shafts)		
Marine Viaduct - north			112
Marine Viaduct - central			292
Marine Viaduct – south, including nearshore bridge			692
North Channel Bridge High-Level Approaches		216	
South Channel Bridge High-Level Approaches		216	
North Channel Bridge		402	
South Channel Bridge		320	
Subtotal		1,154	1,096
Total Piles			2,250

The cable-stay bridge towers are founded on submerged precast caissons and pier base. First, the supporting seabed will be reinforced with driven inclusion piles, and then a precast caisson built at dry dock will be floated to its final location and lowered into place. The caissons will act as gravity base structures which are free to slide during seismic events, providing isolation of seismic forces. Above the pier base, each tower shaft will be entirely cast in place with jump forms broken into multiple segments (lifts); each lift will be 4 m to 6 m high. The monopole towers for the North Channel Bridge will be 142 m tall, and the South Channel towers will be 304 m tall as shown in Exhibit 3-15.

Superstructure construction. The superstructure is the portion of the bridge that provides the horizontal span, including the box girders, I-beams, and bridge deck. The superstructure for the majority of the viaducts will use precast, post-tensioned concrete box girders, which will be on cast on land and then floated out on barges and lifted into place with crane barges. The land viaducts will have 40-m spans with AASHTO type girders; the shallow marine areas will have 60-m spans and the remainder of the marine viaduct will use 100-m spans.

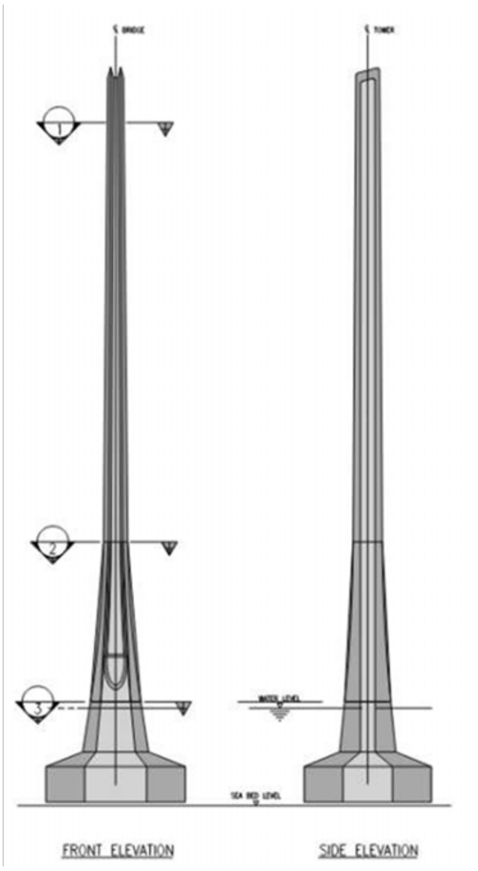


Exhibit 3-15 Bridge Tower for South Channel Bridge

Over deep waters, full span lifts will be performed with floating cranes, balancing the extended cantilevers on piers, and interlocked with the next span with closure pours (Exhibit 3-16). Over shallow waters, a launching gantry will be positioned and secured on the first land viaduct girder and the gantry arms extended to the front pier, and the legs of the launching gantry moved sequentially towards the front pier to establish stability. When the entire system is secured in its position, the precast box girder will be placed at the end of launching gantry via the transporter (Exhibit 3-17). The winch trolleys will fasten the girder and lift it towards the final location to complete the process. When all segments of a new cantilever have been erected and post-tensioning tendons[14] stressed, a closure joint is made at midspan called a stitch. Afterwards, continuity post-tensioning tendons are installed and stressed between the piers for span continuity. These same steps will be repeated for the succeeding spans.

Exhibit 3-16 Full Span Heavy Lift

For the cable-stayed bridges, the superstructures will be different for the North and South Channel Bridges. The superstructure of the North Channel Bridge will be a composite deck with steel edge girders running longitudinally, connected by regularly spaced steel floor beams held up by stay cables. The roadway deck will use precast slabs integrated with cast-in-place stiches to form a continuous concrete deck.

Exhibit 3-17 Launching Gantry Installing Precast Concrete Box Girder Segments

The South Channel Bridge will be a combination of two continuous steel box girders running longitudinally, connected by regularly spaced steel cross beams formed as a rectangular box (Exhibit 3-18). To erect, a segmental construction procedure using deck module lifters to lift each preassembled steel section is used. The modules bolt to the previous sections using temporary alignment brackets, and the cantilevers are stabilized by the stressing of stay cable to the designed tension. Each section will be welded prior to adding the next segment. When erection reaches the intermediate and anchor piers, the permanent bearings are installed to connect the superstructure to the piers.

Exhibit 3-18 South Navigation Chanel Bridge Deck showing Steel Box Girders with Cross-struts

[14] Tendons: high-strength steel post-tensioning in the precast box girders which connect adjacent segments together.

The two large vessel navigation channels will remain open for majority of the construction period, but one of the two navigation channels will be open at all times. The south navigation channel will only be closed for very short periods when the South Channel Bridge deck modules are being lifted into place. DPWH will work through the Philippine Coast

Guard through issuance of "Notice to Mariners" (NOTAM) for a routinely updated designation of a 100-to-150m marine project exclusion zone (PEZ) restricting mooring and anchoring of vessels not directly involved in the construction along the bridge alignment. Similarly, private vessels (smaller boats) will be prevented from traveling through portions of the marine construction limits of active construction zones for safety precautions. No long-term PEZ will be established along the navigational channels so as maintain safe navigation of ships entering Manila Bay.

Roadway and associated fixtures. The landside roadway will not be finished until most of the marine work and interchange work are finished to reduce wear on the new roadway from hauling materials and large equipment to and from the marine-side construction areas. However, building the roadway embankment and installing the structural elements, such as the culverts, over- and under-crossings and portions of the interchanges, will begin early to minimize bifurcation of local roadway circulation and to facilitate construction equipment hauling within the roadway alignment. The final phase of roadway construction will involve installing utilities and drainage facilities, laying the finer aggregate roadbed, and casting the concrete roadway on the landside.

Finish work will include final roadway concrete bed, installing lighting, signage and railing barriers, and striping the roadway lanes. Light- weight, durable, low candle, programmable LED lighting will project seasonal colors onto the cable-stay bridges and towers, and roadway-directed shielded white lighting is designed to prevent light leakage into waters or adjacent land areas (Exhibit 3-19.

Exhibit 3-19 Example of LED Night Lighting Scheme

Ancillary facilities. Construction of the maintenance buildings and substations and installation of overhead monitoring structures will proceed in parallel with construction of the bridges, viaducts, and on-land roadways. The work sequence will begin with grading the overall pad, trenching for utilities, installing building foundations, and digging for in-ground fuel tanks. The second phase will include raising building walls, installing roofs, and adding pavement and yard landscaping. These elements are likely to be developed by specialized contractors separate from the roadway/bridge contractors.

Demobilization. Depending on workflow, demobilization of the staging areas and removal of equipment and materials may overlap with opening the roadway to users. Demobilization involves finalizing landscaping, restoring staging areas, and meeting final contractor obligations on environmental management mitigation measures. Hydroseeding or seed-embedded blankets will be placed of remaining exposed soil areas to prevent erosion and restore vegetative cover quickly. Seed mix will reflect native plant species. All temporary staging areas will be restored and become available for redevelopment upon completion of the BCIB.

3.8.2 Temporary Staging Areas

Both Bataan and Cavite will host temporary construction sites to house the concrete casting yards, material and equipment storage, and temporary housing areas for non-local labor. Casting yards will be set up to manufacture pre-cast concrete components of the bridges and viaducts prior to transport to the installation locations. Casting yards are best located close to the bay shore to facilitate direct transfer to barges without the extra cost, complexity, and traffic disruption associated with road transport. The casting yards will hold the cement, aggregate, reinforcing steel, equipment, and large laydown areas for bridge elements to cure.

Storage areas will be designed to protect stockpiles of dry materials from spreading dust to nearby waterways, natural areas and sensitive land uses. Laydown areas will be designated to receive ongoing deliveries of steel pipes, I-beams and rebar with adjacent lands for building rebar cages. Formwork materials and special equipment will be contained onsite in close proximity to Project limits. Demolition materials will be hauled offsite to permitted landfills; vegetation will be hauled to predetermined compose sites; and, soil and/or dredged material will be offered to developers. Therefore, storage for spoils materials should not be necessary.

Some temporary grounds will be designated for worker camps. The necessary construction workforce will vary during the construction phase, ranging from about 500 workers for initial mobilization and demobilization to nearly 2,000 workers at peak activity, when multiple packages will be under construction at the same time. A sizable percentage of total workers will be skilled tradespeople. While Philippine regulations require the contractor to use and train local interested labor force, it is anticipated that many workers will require temporary housing nearby the construction site to limit commuting difficulties. In line with standards developed by the International Finance Corporation and European Bank for Reconstruction and Development, an estimated 2,500 to 3,000 m^2 is needed for every 100 workers to accommodate living areas, sanitary facilities, eating area, an infirmary, a management office, waste management, access, and parking and recreational areas. The estimated construction camp size assumes that 20 percent of workers will live in neighboring communities and not need housing at the project site.

Exhibit 3-20 summarizes the various types of construction staging areas and estimated land needs for both the Bataan and Cavite sides.

Exhibit 3-20 Approximate Construction Staging Areas for Bataan and Cavite

Construction Staging Area	Contents and Descriptions	Bataan Side Approximate Area (hectare)	Cavite Side Approximate Area (hectare)
Casting Yard	Contain delivery and storage areas, concrete batching plants, steel fabrication shops and equipment maintenance and repair shops, kitchens and mess halls, and sanitary facilities. Located adjacent to or very nearby the shore to allow direct transfer of pre-cast and fabricated components to barges. Bataan side will include a drydock and temporary piers.	60	25
Staging/ Laydown Area	Contractor offices, equipment storage, materials receiving, repair shops, warehouses, and general staging of the construction equipment. Space for worker parking, motor pool parking, worker buses, and turnarounds will be needed.	50	25
Worker Camp	Worker camp will include living areas, sanitary facilities, an eating area, an infirmary, a management office, a waste management system, points of access, parking areas and recreational areas.	35–40	20–25
Marine-side staging	Barges carrying marine equipment will be moored near construction site locations via four anchors. Material carrying barges will be moored with piles nearshore when not in use. A temporary pier built as part of the casting yard in Bataan will allow an estimated 40 boats to dock for easy crew access (crew shuttle boats, mechanical boats, tugboats, and inspector and superintendent boats).	TBD	TBD
TOTAL		290	90

Exhibit 3-21 delineates staging areas in yellow and labels primary material access routes for the Bataan construction area. The staging area labeled as #1 (southwest corner) will contain a dry dock, boat piers and concrete box girder casting yard. The staging area centered on the alignment will contain a worker's camp and additional material storage and laydown areas. In Bataan, two primary trucking routes, Roman Highway and the Kamaya Point Road, would be used to transport materials via land to these sites. The current property owner of staging area #1 has the necessary permits to build an improved two-lane roadway between Kamaya Point Road to the Dry Dock and Pre-casting yard. The BCIB right-of-way would be cleared, grubbed and initial cut-and-fill would be compacted to the shore before construction materials would be trucked to the staging area #2 that straddles the BCIB alignment.

Exhibit 3-21 Bataan Staging Areas and Material Delivery Routes

Exhibit 3-22 and Exhibit 3-23 provide a conceptual layout for each staging area identified in Bataan.

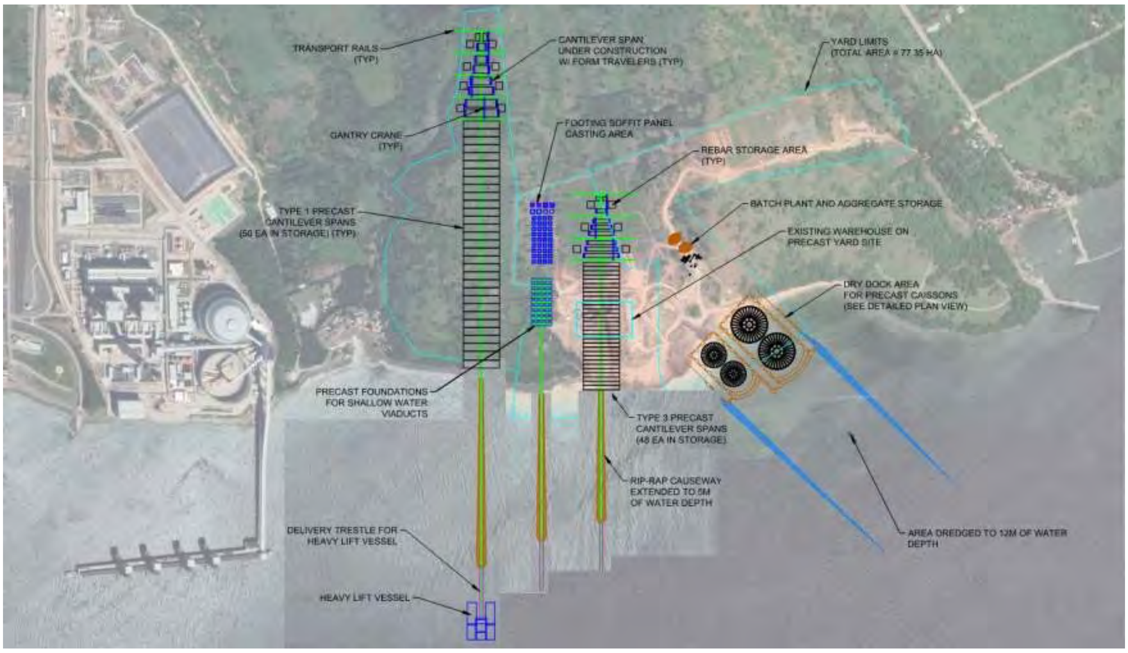


Exhibit 3-22 Casting yard and Dry Dock in Bataan Using Previously Disturbed Site

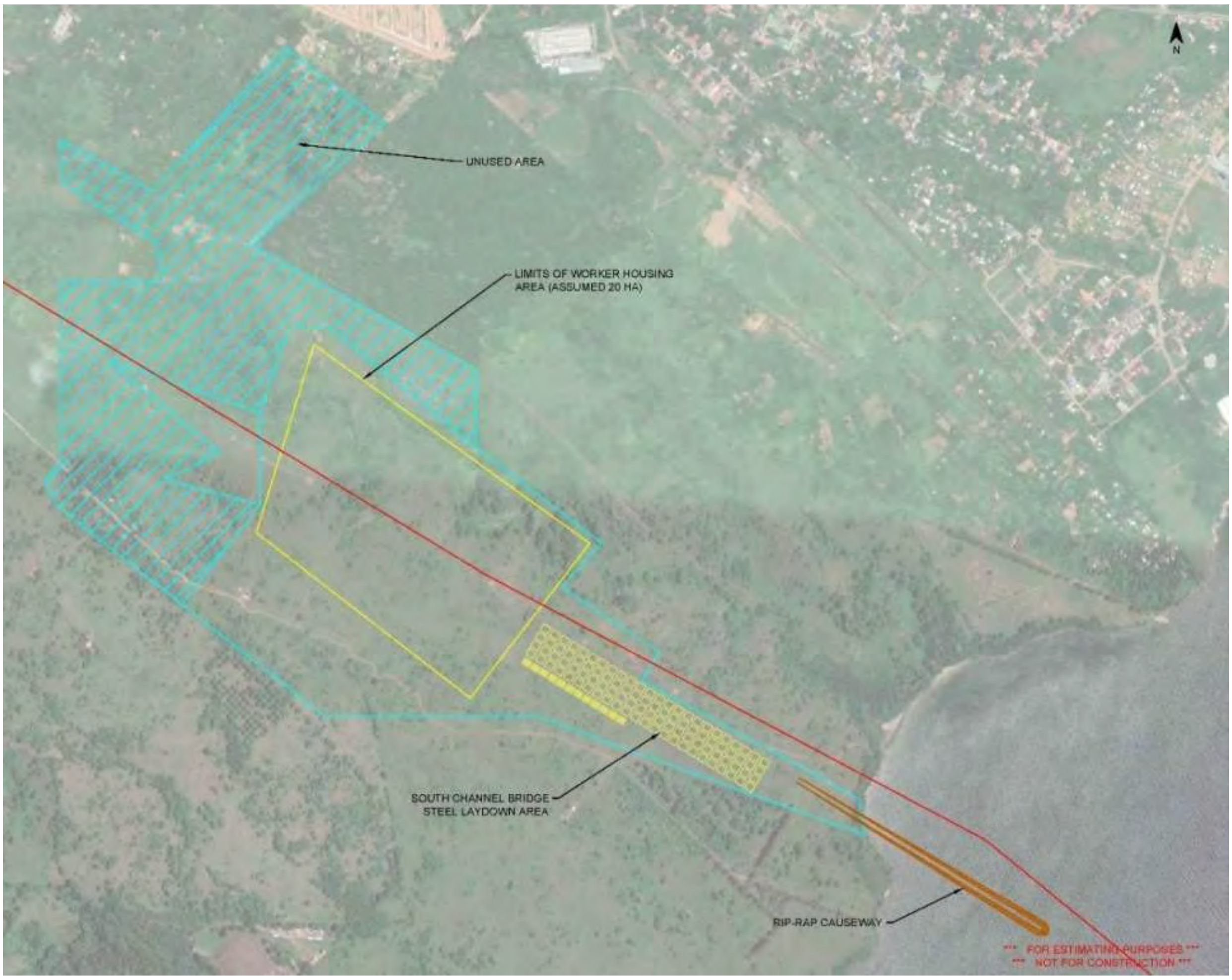


Exhibit 3-23 Worker Housing and Construction Laydown Area centered on BCIB Alignment in Bataan

On the Bataan side, the casting yard will include a temporary dry dock at the shoreline. The dry dock will be excavated from the land side but also require dredging the shore to a minimum of 12 meters depth to launch and float the large caisson elements to the bridge. The site will include one of two on land concrete batch plants to serve the casting yards. Temporary platforms will extend from shore to achieve a minimum 15m draft access point for barges to receive bridge components, equipment, and concrete mixing supplies and transfer to marine site locations. A dock for shuttle boats, mechanical boats, tugboats, and inspector and superintendent boats is needed in Bataan at either or both staging areas. The identified site for the casting yard and dry dock property has been partially cleared by current owner, who has also begun building an improved access road to the site from Kayama Point Road.

In Cavite, only one staging area has been identified using a 174-hectare site with access directly onto Antero Soriano Highway and less than a kilometer north of the BCIB mainline alignment (Exhibit 3-25).

Exhibit 3-25 Cavite Staging Areas and Material Delivery Routes

The conceptual staging plan includes several laydown areas for piles, rebar, and smaller casting yard for smaller bridge components (Exhibit 3-24). It will also house the second landside concrete batch plant located strategically distant from the Cavite workers' camp.

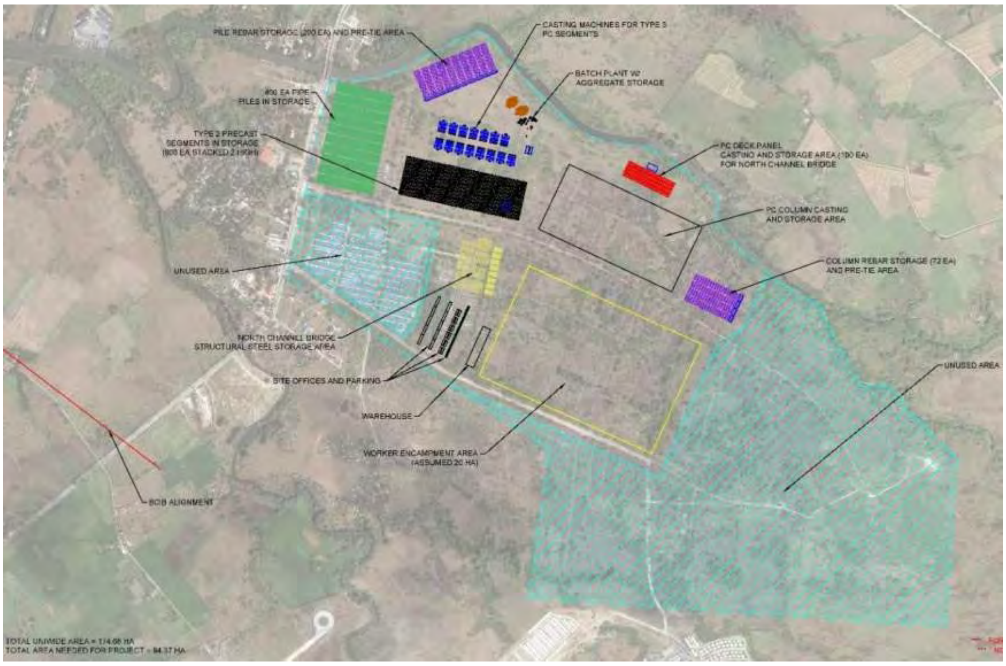


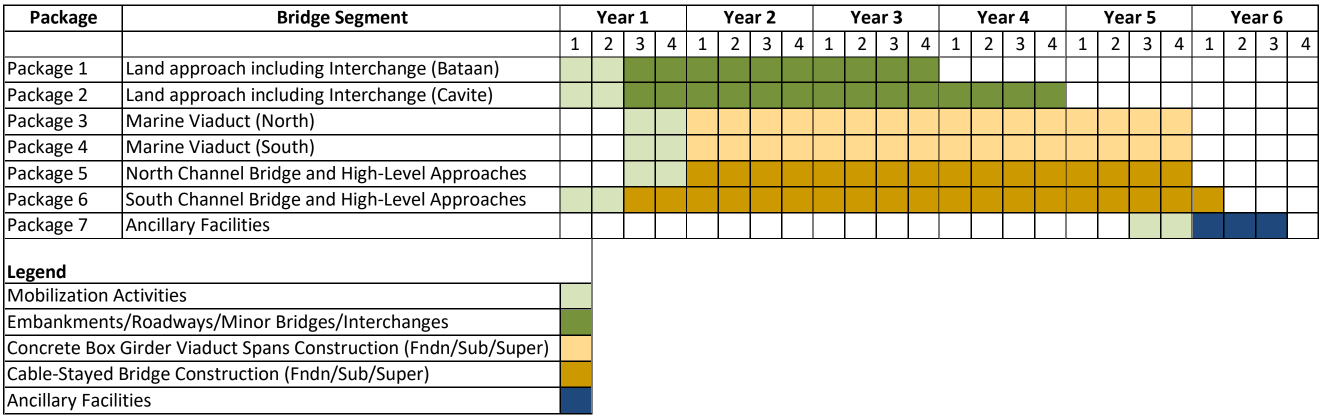
Exhibit 3-24 Cavite Staging Areas Using the Uniwide Development Site

In addition to landside staging areas, marine mooring will align the BCIB alignment throughout construction, and near the staging areas at shore. The mooring areas will house barges containing equipment such as cranes and concrete batch plants or otherwise awaiting transport of materials from shore. The mooring will depend on placed sea anchors or weights set in a pattern to void colliding. Barges will vary from 20-30 meters wide and up to 40 m long.

3.8.3 Preliminary Construction Schedule

The BCIB construction phase is currently expected to begin in Q1/Q2 of 2023 and last for approximately 69 months. To maintain this schedule expectation, work may occur 24 hours a day for 7 days a week on many sites. Severe weather conditions, such as typhoons and hurricanes will require team and equipment to take safe harbor. A Safe Harbor Plan will be submitted prior to construction. Safe harbor locations need to be reserved in advance of construction. Safe Harbor can include relocating or at minimum tying ships together to reduce impact. The preliminary construction schedule assumes 1-to-2-week loss per year due to inclement weather conditions. Exhibit 3-26 provides a generalized project schedule from the start of mobilization to the end of the construction phase.

Exhibit 3-26 Preliminary Construction Schedule



3.8.4 Construction Material Sources

A materials source study is still under development at the time of preparing this environmental evaluation, however the local aggregates used for ready-mix and asphalt mixing plants have been reviewed. Aggregates, sands and a portion of the raw cement for the BCIB are found in Provinces lying east and north of Manila (Bulacan, Rizal, Pampanga, Zambales and Pangasinan). These areas are identified as major aggregate suppliers for the Metro Manila and surrounding zones, where there is substantial demand for aggregates used in construction of various structures. These raw material locations are over 2 and 3 hours away from either side of the BCIB, as shown in Exhibit 3-27. Majority of the identified sites are north of the Project, although this study is not complete.

The quarries operating in Angat (Bulacan) exploit the alluvial deposits in the Angat River area north of Bataan. They originated from porphyritic basalt and fine to coarse-grained sandstone with veinlets of silica and carbonate.

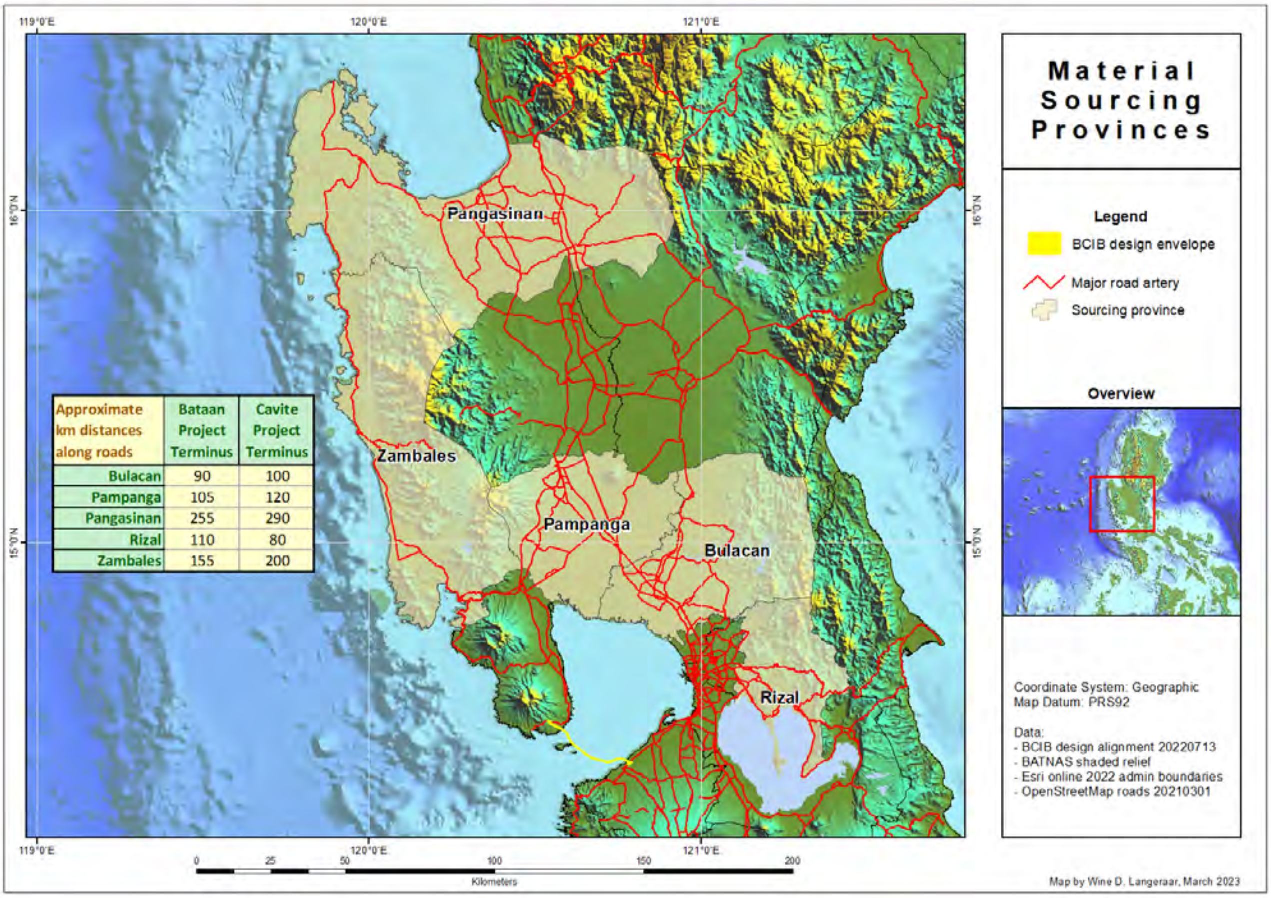


Exhibit 3-27 Provinces where Raw Material May be Sought for BCIB and Average Kilometers Distance

In Rizal Province the aggregates coming from Antipolo, Angono and Montalban are composed chiefly of chloritized basalts and andesites with minor clastic rocks and tuffs.

The aggregates from Zambales are products of erosion of the Zambales Ophiolite, mixed with the lahar deposits from the Pinatubo eruption. The kind of rocks exploited is silicified basalt.

The Province of Pampanga represents the principal supply source for fine aggregates (sand). The aggregates are mostly lahar deposits, containing pumice. In Porac the aggregates are pyroclastic rocks, with gabbro, andesite, basalt and pumice clasts.

For the most part, the remaining array of materials are planned to be shipped from outside the Luzon Island. The manufacturers of Steel Products (Reinforcing Steel Bars, Metal Decking, Wide Flanges, Plates, Sheet Piles) import the raw material and to the extent possible, pre-manufactured steel members from China and Vietnam. Cement is planned to be imported from Vietnam, and in lesser percentage produced locally. The cement manufacturing plants visited are located in Bataan and Batangas Provinces, and Metro Manila (Pasig). The dealer and installer of Geosynthetics reports that his raw materials are imported from China, Europe, Malaysia and Taiwan.

The identified asphalt plants are located in Rizal Province (Taytay) and Metro Manila (Pasig City). These are located approximately over 3 hours away from Cavite staging areas and almost 4 hours away from the Bataan staging areas. The plan is to truck the bituminous asphalt from these plants rather than create asphalt batch plants in the staging areas.

The high volume of cement, aggregates, sand and bituminous needed for the BCIB will require extensive travel throughout the island. The steel products will be shipped in and barged to jetties in Bataan where equipment can lift the material onto Staging areas for use in forms and cast as needed. However, the steel products needed for the Cavite Uniwide site are likely to be trucked from the Manila port Using primarily the Antero Soriano Highway.

3.9 Operations and Maintenance

3.9.1 Expected Traffic Volume and Composition

The BCIB would be accessible to trucks, buses, private cars, jeepneys and motorcycles, but not non-motorized vehicles, bicycles or pedestrians. There would not be a sidewalk, and pick- up/drop-off and vending activity on the shoulders would be prohibited. Pursuant to Section 7C of the IRR of RA 8794 Motor Vehicle User's Charge (MVUC), overloaded trucks and trailers that either exceed 150 percent of the maximum allowable gross vehicle weight (GVW) and/or load of 13,500kgs per axle are penalized and not allowed to proceed along the roadway.

Currently available future traffic forecasts suggest that the bridge would see over 25,000 passenger car units (PCU) of usage per day in its first year of operation including trips in both directions, and that this would grow to about 37,400 PCU per day by the tenth year of operation (approximately 50% increase over 10 years). While motorcycles are higher in numbers initially, crossing in cars are expected to grow rapidly, while Jeepney vehicles are expected to decline by 2035. **Error! Reference source not found.** provides a summary breakdown of average automobile daily traffic forecast use of the BCIB over the first 10 years of operation.**Error! Not a valid link.***Source: Package 2: Updated Preliminary Design Report, T.Y.Lin International, PEC. January 2023.*

3.9.2 Schedule of Inspections

The design life of the marine components (Cable-stayed bridges and marine viaducts) of the BCIB is 100 years. Within that time span, wear and tear and normal deterioration of minor components (road wearing course, painted surfaces, safety barriers, electrical fixtures, etc.) is to be expected, and the need for replacement and upgrading of such components is foreseen and subject to predictive scheduling. The need for unanticipated repair works may also arise. Exhibit 3-28 provides an indicative schedule of major inspection. All inspections responsibilities and qualifications shall follow DPWH guidelines and manuals.

Exhibit 3-28 Planned Schedule of Inspections

Name	Frequency	Method
Routine	Quarterly	Visual inspection from ground and bridge deck level
Condition	Annually – every three years	Close visual inspection by boat (if required) and bridge inspection vehicle every three years
Engineering	Annually	Detailed inspection for bridge repair
Emergency	As required	Emergency inspection
Inventory	Once after construction and after every modification	Data collection from AS Built drawing and construction documents
Geometrical	Once every three years and as needed (after earthquake, typhoon, etc.)	Measurement by survey instrument

Source: DPWH Cable Stayed Bridge Inspection Manual, 2014

Maintenance and safety are critical for infrastructure of this magnitude and location confronting numerous forceful natural elements. Methods and access to facilitate routine inspections are designed into the BCIB. These involve designing so that special equipment can be mounted, personnel-access points into the vaults of the structure, ladders and elevators. In addition to visual inspections, the bridge includes monitoring tools, In some situations, drone inspections may help provide convenient routine inspection to determine when more advanced inspections are necessary. The BCIB design does designated maintenance crew access points from the bridge deck to allow access to the piers (expansion joints in the Marine Viaducts) and towers (NCB & SCB). There may be pick-up and drop-off of inspection/maintenance personnel at these access points.

3.9.3 Inspections of the North & South Channel Bridges

Stay Cables: Stay cables will be accessed using unmanned inspection vehicles (UIV) for routine inspection. When closer, manned inspection is needed a stay cable gantry (SCG) will be employed, pulled along a stay cable by means of a line installed along the cables, allowing personnel to travel from lower to upper stay limits.

Towers: The exteriors of the main cable bridge towers will be accessible by inspection cradles lowered from davit cranes at the tower top for the superstructure. Tower interiors will be equipped with an elevator and a full height ladder system with safety landings at intervals along the height. The tower top's exterior platform will store instruments for structural health monitoring, electrical service for the aviation lighting, and equipment to deploy the davit cranes for operating the tower inspection cradles. The pier portion of the towers would be accessible via boat and/or a rope system.

Superstructure: The exteriors of superstructures will be accessed by Under Bridge Inspection Vehicle (UBIV) on the approaches and by Under Bridge Maintenance Traveler (UBMT) on the main cable structures. Interiors will have access by walkways and electric-powered shuttle vehicles.

Piers: Exterior surfaces of the pier will be accessible by using the UBIV and the rope access system, consisting of rope anchors attached to the pier surface and ropes. Access to a pier top will be provided by UBIV or UBMT for inspection and routine maintenance as well as through access hatches in the superstructure soffit and the top of the pier. The interior surfaces of the pier leg including cable tie-down anchorage will be accessible through the provision of a full- height staggered ladders and access platforms.

3.9.4 Inspections of the Marine and Land Viaducts

Superstructure and Piers will be accessed similarly to the main cable bridges.

3.9.5 Schedule of Maintenance Works

To effectively manage the maintenance of the BCIB, a maintenance team shall be established. The crew will be housed in the Operations and Maintenance facility in Bataan and transported as needed throughout the bridge. During bridge routine and condition inspections, the team shall coordinate with the accredited bridge inspectors that are dedicated to the BCIB. The maintenance crew will consist of a chief maintenance engineer, assistant maintenance engineer(s), foremen, operation leads, drivers, mechanics and a support crew for a minimum of 20 qualified public works staff.

Maintenance will involve routine cleaning and inspections as well as conducting preventative repairs.

To prevent deterioration of the bridge structure, cleaning works will include removing accumulated foreign materials from the entire bridge such as its deck, curbs, top of pier, trusses and its web members, top and lower flanges and webs of beams or girders, expansion joints, bearings, wind bracing and drains. Areas which have been cleaned shall be ensured free from accumulated sand, gravel, dirt, and other foreign materials. Routine cleaning will also provide secondary benefits, such as less pollutants entering the Manila Bay and continued safety for travelers using the facility. Exhibit 3-29 below outlines the major categories of maintenance and repairs planned. A detailed annual inspection shall be undertaken to detect defects in the bridge deck, superstructure, substructure, bridge accessories and protection works (abutments, piers/ batter). For portions of the BCIB that are within 1 km of the Manila Bay, a protective mortar made of lithium nitrate polymer cement mortar will be applied. Further than 1 km, a protective acryl urethane-based coating is applied to protect BCIB features (over-/ undercrossings, roadway) from carbonation, weather, UV rays, chemical and oil damage.

Exhibit 3-29 Maintenance and Routine Repairs Planned

	Routine Maintenance	Routine/ Preventative Repairs
Steel Superstructure	Pressure washing, removing dirt and salts	-Removing rust with grinders and apply touch-up paint and anti-corrosion paint during dry season
Concrete (superstructure, substructure, abutments)	Routine washing, high-pressure water jets and inspections throughout for small or expanding cracks, spalling and scaling of concrete, with detailed notes and photos	- Minor patching of concrete - High-strength epoxy in cracks - Removing debris and cleaning bearing Concrete repair
Roadway	Sweeping, routine washing, high-pressure water jets to remove mud, sand, and debris on roadway, curbs, drain pits and railing. Culvert cleaning to removing sediment, sand and debris using manual labor.	-Cleaning expansion joints, filling cracks with liquid asphalt, and filling if needed with bituminous premix. -Vegetation control involves cutting low plants to 0.3 m and clearing brush and tree limbs to remove visual and physical hazards. -Replace erosion-resistant materials at back-slopes, including drainage ditch areas. -Periodic replacing concrete/bituminous.
Bridge accessories and signage	Inspecting signs, batter of piers, lighting, guardrails for alignment, strength, visibility.	-Replacing as needed.

The following list of equipment shall be used for day-to-day maintenance work of bridges and roads.

- Bridge inspection vehicle
- Air Compressor with attachments
- Asphalt kettle
- Asphalt distributor
- Concrete mixer
- Pay Loader
- Backhoe with breaker
- Generator
- Jack hammer/ pneumatic breaker
- Kneading Machine and applicator
- Power sprayer (2)
- Pruning saw (2)

- Road grinder
- Service vehicles (2)
- Plate compactor
- Road Roller
- Dump truck
- Stake Truck
- Water truck
- Regenerative air sweeper/vacuum
- Chainsaw (2)
- Grass cutter (4)
- Extension ladder
- Minor tools, (chisel, grinder, shovels, picks, crowbar, power drill, flashlight, etc.)
- Personnel Safety Equipment (enough to for entire staff and surplus)

3.9.6 Safety Program

The Philippines is vulnerable to earthquakes, strong weather patterns including typhoons and high wind speeds. All of these conditions can affect driving conditions on the BCIB. While opposing travel lanes are separated for the entire length of the bridge, this does not eliminate the potential for vehicular accidents or breakdowns to occur along the overwater viaduct and navigational bridges. The potential for incidents to occur and be stranded will require a security and monitoring systems to summon an emergency response team and/ or alert the commuters, vehicles, and cargo trucks of obstacles or weather conditions that may require closing crossings to avoid unsafe roadway conditions.

The BCIB Project requires a video surveillance system, access control for bridge critical portals and the operational crew to detect, assess, and respond to possible issues or events on the bridge to ensure the security and safety of travelers and the bridge itself. The BCIB security system and design team will develop:

1. Security zone protection including video surveillance coverage criteria, performance criteria, and integration criteria with direct lines of communication with emergency response team.

2. Surveillance camera equipment mounted and electronically connected at intervals throughout the bridge. The systems will be connected to monitoring workstations located in a secured area such as control center, data center or main equipment room in the Operation and Maintenance yard buildings located on the Bataan side of the bridge.

3. Variable Message Signs (VMS) will be mounted on gantries to be installed at approaches to the BCIB on the Roman Highway and the Antero Soriano Highway on both approaches to the BCIB interchange to inform travelers before entering the BCIB. There will also be VMS near the turnaround to provide travelers in-route information in case bridge operations need to inform travelers to return to their origin.

4. Guidelines on the minimal number of BCIB-dedicated emergency response personnel and equipment will be established in coordination with DPWH office of emergency service for police, fire and ambulance response. For instance, a minimum of two tow-trucks to be in working operation at all times – one located at either end at all times; and there will be 24-hour surveillance crew required.

5. 24-hour trained response personnel will be required to have connectivity through field equipment on person at all times. To ensure proper response time, trained personnel will be positioned on either side of the BCIB in Bataan and Cavite. In

Bataan, the crew may be able to share the Operations and Maintenance facility, but appropriate location for emergency response and equipment is Cavite will be sought through leasing or purchase.

6. Back-up systems will operate on off-grid power sources as solar or battery-operated systems in case of power outage issues.

7. VMS and patrol units will close off access to the BCIB when conditions for crossing the BCIB are unsafe.

4 ANALYSIS OF PROJECT ALTERNATIVES

This chapter of the EIA report outlines the evolution of the BCIB project design process, from initial identification of possible alignments through to the current formulation as described in Chapter 3. The process through which formal project alternatives were identified and weighed against each other is described, and the environmental implications of both the eventual Preferred Project Alternative and the No Project Alternative are discussed. In addition, a number of specific project options (i.e., components of the Preferred Project Alternative) that have been identified and adopted during the detailed design process—some of which may have significant environmental benefits—are detailed.

4.1 Selection of Preferred Project Alternative

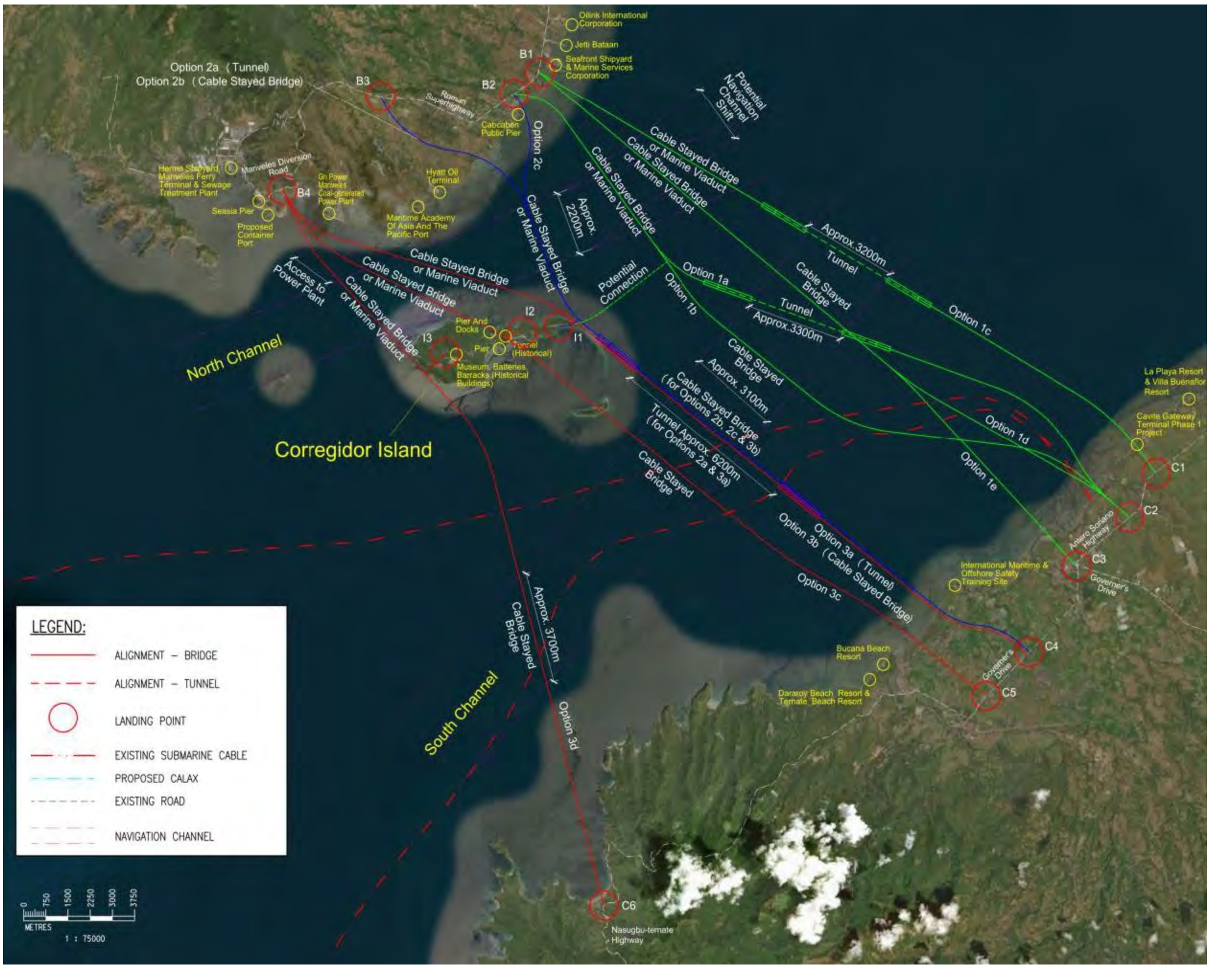
4.1.1 Early Consideration of Project Alternatives

A Project Options Study was conducted in 2019 to review possible alternative alignments and infrastructure configurations capable of achieving the project objectives, as part of Stage 1 of the feasibility study process. Four potentially feasible points of connection to the existing road network were identified on the Bataan side (B1, B2, B3, B4), and six (C1, C2, C3, C4, C5, C6) on the Cavite side. In addition, three possible connection points on Corregidor Island were proposed (I1, I2, I3). A total of 12 project alternatives based around three general corridors were developed to conceptual design stage. Each alternative included a combination of land approaches, marine viaducts, and high-clearance long-span bridges to preserve established ship channels. Some alternatives included tunnels as well. All project alternatives considered in the initial option screening are indicated on the map in Exhibit 4-1. [15]

The initial list of project alternatives was narrowed from 12 to five. The narrowing process was influenced by the results of a concurrent navigation study, which found that the area off the coast of Barangay Cabcaben in Bataan was a favored ship anchoring ground. Alignment alternatives using the B1 and B2 connection points were considered to entail excessive vessel collision risk for this reason, and were excluded or modified to make use of a different connection point. The navigation study also found that some proposed alignment and infrastructure options would require modifying existing navigation channels. Considering the importance of these long-established shipping channels, project alternatives that would entail substantial channel adjustments were eliminated.

Another factor in the initial narrowing of the field of alternatives was the presence of two undersea communications cables extending out to sea from the Cavite shore. This consideration effectively ruled out some alternatives that would include tunnels as a means of crossing the south navigation channel, since re-routing communications cables to accommodate a tunnel would add excessive cost, complexity and potential for disruption of communications.

[1] Details of the project option selection process reported and discussed here are based on the Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.).



Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

Exhibit 4-1 Project Alternatives Given Initial Consideration

Finally, topographical considerations led to exclusion of alignment alternatives that would have connected to the Bataan road network at the westernmost proposed connection point (B4). This connection point was found to be in a particularly hilly area that would have required a steep approach road gradient and substantial engineering works.

During the narrowing process, an additional alignment alternative and road network connection point in Cavite were added to the analysis, to evaluate the possibility of connecting directly to the Cavite Expressway (CAVITEX) from a shore approach off Cavite City. The justification for this was the anticipation that it might reduce land acquisition needs, as well as on-land construction and operation impacts.

Five alternatives were shortlisted for more detailed consideration. These options are listed in Exhibit 4-2 and shown on the map in Exhibit 4-3.

Exhibit 4-2 Shortlisted Project Alternatives

Project Alternative	Road Network Connection	South Channel Infrastructure	North Channel Infrastructure	Corregidor Island Connection
Option 2a	B3 Bataan (Roman Hwy) C4 Cavite (CALAX)	Tunnel	Cable-stayed bridge	Possible at I1

Project Alternative	Road Network Connection	South Channel Infrastructure	North Channel Infrastructure	Corregidor Island Connection
Option 2b	B3 Bataan (Roman Hwy) C4 Cavite (CALAX)	Cable-stayed bridge	Cable-stayed bridge	Possible at I1
Option 4a	B3 Bataan (Roman Hwy) C2 Cavite (R1, CALAX)	Tunnel	Cable-stayed bridge	Possible at I1
Option 4b	B3 Bataan (Roman Hwy) C2 Cavite (R1, CALAX)	Cable-stayed bridge	Cable-stayed bridge	Possible at I1
Option 5	B3 Bataan (Roman Highway) CAVITEX	Cable-stayed bridge	Cable-stayed bridge	Possible at I1

Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

Exhibit 4-3 Project Alternatives Taken Forward After Initial Screening

4.1.2 Selection and Scoring of Project Alternatives

A workshop was held on 19 February 2019 to compare the advantages and disadvantages of the five short-listed project alternatives, with the aim of selecting one to advance into Stage 2 of the Feasibility Study. A broad group of stakeholders was assembled to review the alignment route, conceptual design, implementation duration and cost estimate for each alternative.

The short-listed alternatives were evaluated using a multi-criteria selection methodology, whereby a score was assigned to each alternative for each of 30 criteria. The criteria were grouped under five categories: Technical, Financial, Economic, Environmental, and Social.

Each of the criteria results were ranked and weighted in accordance to their importance in the success of the project. The criterion groups were assigned weights as indicated in Exhibit 4-4.

Exhibit 4-4 Weighting of Criterion Categories

Criterion Category	Weight
Technical	30%
Financial	25%
Economic	25%
Environmental	10%
Social	10%
Total	100%

Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

For each criterion, each project alternative was scored on a performance scale of Excellent to Very Poor, based on discussion and consensus reached by stakeholders participating in the workshop, and on the expert knowledge and insights of the participants. Qualitative and quantitative performance judgements were translated to numerical scores; the scoring scheme is shown in Exhibit 4-5.

Exhibit 4-5 Project Option Scoring Scheme

Performance Assessment	Numerical Score
Excellent	9–10
Good	7–8
Acceptable	5–6
Poor	3–4
Very poor	1–2

Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

Under the scoring system, a score of 1 was considered highly undesirable, and indicative of a potentially insurmountable problem. A score of 0 on any particular criterion would indicate absolute infeasibility for the alternative in question, regardless of other scores. Having a 0 score option was considered necessary to weed out alternatives for which information sufficient for credible evaluation was unlikely to be available until a very late stage in the analysis.

Once scoring had been completed for each alternative in relation to all criteria, weighted scores were calculated and the summary of results was presented. The stakeholders in the workshop were then given the opportunity to comment, and discuss the scores and any other pertinent issues, and consensus was sought on the preferred alternative alignment. The full list of criteria, and a summary of the data points and insights that went into applying them to the shortlisted alignments, are detailed in Exhibit 4-6.

The top-scoring alternative based on the multi-criteria analysis carried out by the workshop group was Option 2b (two cable-stayed bridges, connecting to Bataan at B3 and to Cavite at C4), followed closely by Option 4b (two cable-stayed bridges, connecting to Bataan at B3 and to Cavite at C2).

Exhibit 4-6 Summary of Evaluation Considerations by Criterion

Criteria	Option 2A	Option 2B	Option 4A	Option 4B	Option 5
Technical					
Efficiency of Road Traffic Movement	• Speed reduction - 6% upgrade at tunnel approaches • Local area improvement required at interchange with Governor's Drive"	• Local area improvement required at interchange with Governor's Drive	• Speed reduction - 6% upgrade at tunnel approaches • Local area improvement required at interchange with Antero Soriano Highway"	• Local area improvement required at interchange with Antero Soriano Highway	• Landing point closer to dense population centre but less efficient to overall transport network • Potential issue at connection to Toll Plaza of Cavitex
Impact on Marine Traffic	• South Channel Tunnel with less restriction	• South Channel Bridge with a narrower navigation channel	• South Channel Tunnel with less restriction • Adverse impact to vessels from South Channel towards Bataan	• South Channel Bridge with a narrower navigation channel • Adverse impact to vessels from South Channel towards Bataan	• South Channel Bridge with a narrower navigation channel • Some impact to vessels near Cavite shore • Adverse impact to vessels from South Channel towards Bataan
Pedestrian/Cyclist Friendliness	Not applicable for BCIB and not considered in the scoring				
Implementation Schedule	~110 months (critical path - IMT, longer than the IMT in Option 4a)	~72 months (critical path - navigation bridge)	~86 months (critical path - IMT)	~72 months (critical path - navigation bridge)	~72 months (critical path - navigation bridge)
Constraints and Risks to Implementation	• 26km road requires land resumption in Cavite • Tunnel and artificial island have higher construction risks • Tunnel clash with submarine telecom cables, diversion required	• 26km road requires land resumption in Cavite	• 14.3km road requires land resumption in Cavite • Tunnel and artificial island have higher construction risks • Adverse impact to vessels from South Channel towards Bataan during construction	• 14.3km road requires land resumption in Cavite • Adverse impact to vessels from South Channel towards Bataan during construction	• Short length of land resumption at Sangley • Uncertain development plan and schedule of the proposed Sangley Airport • Adverse impact to vessels from South Channel towards Bataan during construction

Criteria	Option 2A	Option 2B	Option 4A	Option 4B	Option 5
Operations & Maintenance Considerations	Tunnel requires more onerous O&M arrangement and special arrangement for hazardous vehicles.	Typical O&M procedures for concrete and cable supported bridges	Tunnel requires more onerous O&M arrangement and special arrangement for hazardous vehicles.	Typical O&M procedures for concrete and cable supported bridges	Typical O&M procedures for concrete and cable supported bridges
Financial					
Construction Cost	Construction cost = PHP286 bn	Construction cost = PHP168 bn	Construction cost = PHP281 bn	Construction cost = PHP178 bn	Construction cost = PHP300 bn
Clearance, Compensation and Resettlement Cost	Land acquisition cost = PHP2.2bn	Land acquisition cost = PHP2.2bn	Land acquisition cost = PHP1.5bn	Land acquisition cost = PHP1.5bn	Land acquisition cost = PHP2.3bn
Risk and Uncertainty to Cost	• Tunnel and artificial island higher risk and uncertainty to ground condition • Some uncertainty in land resumption for connection to CALAX • Tunnel clash with marine cable - diversion required	• Some uncertainty in land resumption for connection to CALAX	• Tunnel and artificial island higher risk and uncertainty to ground condition • Some uncertainty in land resumption for connection to CALAX	• Some uncertainty in land resumption for connection to CALAX • Higher marine risk during construction	• Airport development plan and require further liaison (more uncertainty) • Land resumption uncertain at this stage
Operations & Maintenance Cost	Maintenance cost per year = 3.8bn PHP	Maintenance cost per year = 1.7bn PHP	Maintenance cost per year = 3.6bn PHP	Maintenance cost per year = 1.8bn PHP	Maintenance cost per year = 3.0bn PHP
Economic					
Ability to Improve Existing Transport Networks	• Could add to congestion on Governors Drive and Antero Soriano Highway. • Resilience to overall road network	• Could add to congestion on Governors Drive and Antero Soriano Highway • Resilience to overall road network	• Could add to congestion on Antero Soriano Hwy. • Resilience to overall road network	• Could add to congestion on Antero Soriano Hwy. • Resilience to overall road network	• Fast and direct route to Metro Manila • Less additional traffic on Antero Soriano Highway. • Resilience to overall road network (less than others)
Growth Opportunities of the Surrounding Area and its Supply Chains	• More dispersed development • Could support tourism development along Manila Bay	• More dispersed development • Could support tourism development along Manila Bay	• Would support more concentrated urban development • Would support industry development	• Would support more concentrated urban development • Would support industry	• Would support more concentrated urban development • Would support industry • Would support connectivity to airport and ports in Metro Manila

Criteria	Option 2A	Option 2B	Option 4A	Option 4B	Option 5
Accessibility Impacts on Labour Market, Employment and Productivity	• Some agglomeration benefits. • Does not connect into existing employment areas on the Cavite side	• Some agglomeration benefits. • Does not connect into existing employment areas on the Cavite side	• Some agglomeration benefits. • Connects into existing employment areas on the Cavite side	• Some agglomeration benefits. • Connects into existing employment areas on the Cavite side	• Greatest agglomeration benefits. • Better connects into Metro Manila • Reduces urban sprawl
Impact on Land Use Capacity and Development	• Could create more urban sprawl • Transport infrastructure for future development of Cavite	• Could create more urban sprawl • Transport infrastructure for future development of Cavite	• Avoids excessive urban sprawl • Transport infrastructure for future development of Cavite	• Avoids excessive urban sprawl • Transport infrastructure for future development of Cavite	• Supports connection to the proposed Sangley airport. • Fully avoids urban sprawl
Environmental					
Encroachment in Environmental Critical Areas (ECAs)	• Tunnel construction near Corregidor- more adverse impact to tourist spot	• Similar route as Option 2A but bridge construction is anticipated lesser impact	• Tunnel construction- more extensive impact to water bodies	• Similar route as Option 4A but bridge construction is anticipated lesser impact	• Similar to Option 4B but more extensive impact due to longer viaduct in water
	• No known ECAs within the alignment corridor, except that all will traverse Manila Bay				
Impacts on Cultural Heritage	• The alignment does not traverse any known areas of cultural heritage value, pending detailed investigation.				
Vegetation Removal	• Most extensive impact at Cavite due to longest length from C4 to CALAX		• Extensive impact at Cavite due to long length from C2 to CALAX		• Least extensive impact at Cavite- only small area affected
Loss of Habitat, Threat to Species, and Hindrance to Biological Access	• Tunnel and artificial island cause more threat • Longer connection to CALAX	• Bridge construction less significant impact • Longer connection to CALAX	• Tunnel and artificial island cause more threat	• Bridge construction less significant impact	• Bridge construction less significant impact • Alignment longer than Option 2 and 4
Impact on Marine and Freshwater	• More extensive impact from tunnel and artificial island construction	• Less impact for navigation bridge construction	• More extensive impact from tunnel and artificial island construction	• Less impact for navigation bridge construction	• Less impact for navigation bridge construction but more than Option 2B/4B due to longer alignment
Air Pollution and Increase in Noise Levels	Options 2A, 2B, 4A and 4B are far away from population centers compared with Option 5, which has significantly long length of viaduct along the coast and closer to the population enters causing air and increasing noise levels.				• Viaduct running in parallel with Cavite coast - closer to population centers

Criteria	Option 2A	Option 2B	Option 4A	Option 4B	Option 5
Existing Soil Contamination	• Tunnel construction require more soil removal	• Lesser impact compared with Option 2A	• Tunnel construction require more soil removal	• Lesser impact compared with Option 4A	• Slightly more impact on the seabed compared to Options 2B and 4B due to construction of longer of marine viaduct
Waste Generation	• Tunnel construction will have more soil removal	• Lesser waste generation compared with Option 2A	• Tunnel construction will have more soil removal	• Lesser waste generation compared with Option 4A	• Similar to Option 2B and 4B, lesser waste generation compared with Option 2A and 4A
Quality of Visual Experience	• Tunnel - less visual than navigation bridge	• Long span navigation bridge - attractive	• Tunnel - less visual than navigation bridge	• Long span navigation bridge - attractive	• Long span navigation bridge – attractive • Long stretch of viaduct parallel to Cavite Coast - adverse impact of sea view from Cavite land
Social					
Displacement of Informal Settlers	• High at Cavite alignment; • 21km road alignment connection to CALAX, higher possibilities on displacement		• High at Cavite alignment; • 13km road alignment connection to CALAX, high possibilities on displacement		• Least effect on informal settlers since little land acquisition required
Indigenous People	• No known records of Indigenous Peoples at both sides. Hence possible migration is not discounted.				
Right of Way Conflict	• Highest on connection to CALAX		• High on connection to CALAX		• Assumed to be minimal (shortest length)
Traffic Congestion During Construction	• Impact to existing roads at Cavite - longer extent		• Impact to existing roads at Cavite • Lesser impact compared to Option 2		• Little impact to Cavite
Resettlement Impact	• Highest impact - 21km connection to CALAX		• High impact - 13km connection to CALAX		• Less impact due to short length on Cavite land
Economic Displacement	Some impact to existing livelihood (fisheries and agriculture)				
FINAL RANK:	5	1	4	2	3

1 *Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)*

4.1.3 Further Development of Alternatives

Given the close similarity in both scores and conceptual designs for Option 2b and Option 4b, the design team conducted further comparison work to refine the evaluation in relation to key criteria. A brief summary of this further comparison is shown in Exhibit 4-7.

Exhibit 4-7 Comparison of the Two Top-Scoring Project Alternatives

Criterion Category	Key Considerations
Technical feasibility	Option 2b scored highest technically. The Navigation Clearance Study (WP5-1) showed that tankers using the Southern Navigation Channel mostly turn northwest towards Bataan after crossing Corregidor Island. Option 4b would cut across this typical navigation path and would thus be a greater obstacle to safe shipping.
Financial feasibility	Option 2b would be slightly cheaper to implement than Option 4b due to shorter over-water length. The alignment would also pass closer to Corregidor Island, making a possible future connection to the island cheaper to implement.
Economic feasibility	Option 4b received better scores on economic criteria because its Cavite connection was at C2, as opposed to C4, where 2b would connect. The C2 connection would be an interchange with the existing Antero Soriano Highway that connects to the southern end of CAVITEX at the Binakayan-Kawit Toll Plaza. Drivers from Metro Manila wishing to use the new bridge would be able to drive from the Toll Plaza to C2 along the Antero Soriano Highway. By contrast, the C4 connection would be an interchange on Governor's Drive. The distance to this interchange from the CAVITEX Binakayan-Kawit Toll Plaza is longer and there would be a major traffic bottleneck at the existing junction at Naic where the two arms of Governor's Drive and Antero Soriano Highway meet.
Environmental and social feasibility	Connection at C2 would enable an at-grade road of approximately 13 km in length to be built in the future to connect to CALAX, as opposed to approximately 21 km for a similar link to CALAX from C4. The significantly shorter CALAX link would not only be cheaper and quicker to implement, but would generate fewer land acquisition, environmental and social concerns.

Source: Options Study Report for Feasibility Study for Bataan–Cavite Interlink Bridge (BCIB) Project, November 2019 (Ove Arup & Partners Hong Kong, Ltd.)

Based on the head-to-head comparison of Option 2b and Option 4b, a new project alternative (Option 2c) was developed by incorporating the most advantageous characteristics of Option 2b and Option 4b. The Option 2c alternative would connect to Bataan at B3 and follow the route and bridge positioning of Option 2b in the northern section, but adopt the 4b landing point and connection at C2 (Antero Soriano Hwy).

Another scoring exercise was carried out on the new Option 2c alternative, using the same criteria and weighting scoring method. The results indicated that Option 2c scored highest amongst all the options (see Exhibit 4-8).

Exhibit 4-8 Comparison of Option 2c Against Previously Considered Project Alternatives

	Technical	Financial	Economic	Environmental	Social	Total (10.0 max)	Rank
Weighting	30%	25%	25%	10%	10%		
Option 2a	1.44	1.23	1.75	0.49	0.48	5.38	5
Option 2b	2.30	2.33	1.75	0.63	0.48	7.47	1
Option 4a	1.49	1.45	2.00	0.52	0.56	6.02	4
Option 4b	2.06	2.18	2.00	0.65	0.56	7.44	2
Option 5	1.94	1.53	2.18	0.57	0.71	6.91	3
Option 2c	2.40	2.19	2.00	0.67	0.58	7.72	Best

Subsequently, Option 2c was put through a sensitivity analysis using five cases. Option 2c again came out on top, besting the previous highest-scoring options (Options 2b and 4b) across all cases (see Exhibit 4-9). Option 2c was, accordingly, selected as the Preferred Project Alternative to be taken forward to Stage II of the Feasibility Study. The Preferred Project Alternative has already been thoroughly described in Chapter 3, so no further description is necessary here.

Exhibit 4-9 Comparison of Scores on Sensitivity Analysis

	Option 2c	Option 2b	Option 4b
Base Case	7.72	7.47	7.44
Case A	7.74	7.51	7.31
Case B	7.88	7.78	7.65
Case C	7.77	7.39	7.53
Case D	7.65	7.40	7.38
Case E	7.60	7.32	7.33

4.1.4 Environmental Evaluation of the Preferred Project Alternative

The BCIB project as reflected in the Preferred Project Alternative is an enormous physical undertaking that will inevitably generate potential significant negative environmental and social impacts, which will require mitigation. This does not differentiate the Preferred Project Alternative from any of the other alternatives considered. All would have involved construction of an extended sea crossing, with implications of of marine and on-land construction impacts.

As documented in Exhibit 4-6 and Exhibit 4-7, the relative merits of the alternatives with respect to marine and on-land impacts were weighed. Significantly, it was noted that the alternatives that involved only over-water infrastructure (i.e., no tunnels) were considered likely to generate less severe construction impacts on the marine environment, as the proposed tunnel options involved placement of pre-cast tunnel sections into channels excavated into the seafloor, as opposed to boring beneath the seafloor. The Preferred Project Alternative was thus grouped among the more favorable alternatives in relation to marine impacts. Total over-water alignment length—a significant determinant of impact potential—of the Preferred Project Alternative is comparable to most of the other proposed alternatives, being slightly longer than some, and much shorter than the longest alternative considered (Option 5).

With respect to potential for on-land impacts, the Preferred Project Alternative was also among the most favorable alternatives considered, partly because of the quite short approach road length it would require on the Cavite side. The Preferred Project Alternative would also not involve any construction on Corregidor Island, which some alternative alignments would have required. Finally, the amount of work required to adapt and expand local road networks to serve the BCIB on the Cavite side (including possible future construction of a BCIB-CALAX link) was relatively low for the Preferred Project Alternative, as compared to alternatives with more westerly landing points.

4.1.5 Environmental Evaluation of the No Project Alternative

The No Project Alternative was not explicitly integrated into the multi-criteria scoring exercise detailed above, but this was acknowledged as a possible course of action, and can be compared post-hoc to the other project alternatives. The No Project Alternative would of course have a construction cost of zero, and no technical design challenges to overcome, or effects on marine navigation. Without any BCIB project being built, there would be no impact on the marine or terrestrial environment from construction works, and no land acquisition or disruption of people's lives would be required. The No Project Alternative would thus have scored favorably on many of the criteria in the analysis, particularly financial, environmental and social ones. However, it would not result in any economic, social and transportation benefits, and in fact could be expected to receive a score of 0 on the following criteria from the scoring matrix:

- Ability to improve existing transport networks;
- Growth opportunity of the surrounding area and its supply chains;
- Accessibility impacts on labor market, employment and productivity; and
- Impact on land use capacity and development.

As a score of 0 on any criterion was to be indicative of absolute infeasibility, it is clear that the No Project alternative, with four 0 scores, would have been ruled out very early in the multi-criteria selection process, despite high scores on financial, technical, environmental and some social criteria. The No Project Alternative would not address the regional needs at the center of the project's rationale, and therefore could not be considered a viable project alternative.

In terms of actual environmental and social consequences, outside the context of the scoring framework, the potential effects of a No Project alternative could be expected to include the continued worsening over time of significant problems, including (1) negative externalities resulting from worsening traffic congestion, including noise, air quality and safety impacts, as well as impaired emergency response and extreme event evacuation capacity; and (2) continuing regional disparities in economic opportunity and access to quality services, which are acknowledged as a significant driver of in-migration to Metro Manila, a city already struggling to provide adequate basic services, affordable housing, and a healthy living environment for its existing residents. The No Project Alternative would engender a missed opportunity to address such problems, and this is not to be dismissed out of hand. While the BCIB project alone would not be expected to resolve congestion and regional disparities, which are complex and enormous problems, it is appropriately understood as a potentially significant contributor to a multi-component solution set.

4.2 Project Options Developed

The alignment, land sites and connection points of the Preferred Project Alternative did not evolve significantly during either preliminary design or detailed design. Nevertheless, a number of design options were developed and adopted during the detailed design process, and all of these have environmental implications. These project options are identified and discussed briefly below.

4.2.1 Removal of Land Viaduct (Bataan)

The preliminary design produced in 2020 included 2 km of viaduct (concrete superstructure) to support the BCIB roadway on the Bataan side. This was included to permit a high connection with the marine viaduct at the shoreline, thereby reducing the slope of the marine viaduct deck between the shore and the North Channel Bridge. During detailed design, the engineering team lowered the marine viaduct near the shore, resulting in an at-grade approach road instead of an extended viaduct. In addition to reducing design complexity, construction time and cost, a shorter length of concrete viaduct also results in a modest reduction in construction-derived greenhouse gas emissions.

4.2.2 Repurposing of Toll Plaza (Bataan)

BCIB was anticipated to be a toll road, and a toll plaza was included in the preliminary design for the approach road on the Bataan side. During the detailed design process, tolls were ruled out and the toll plaza was removed from the designs. The space reserved for the toll plaza was kept in the detailed design, to be developed as an inter-provincial border control point to be developed as a separate project at a later date. The removal of the toll plaza infrastructure from the BCIB project represents a favorable change in environmental impacts, principally reduced greenhouse gas emissions during construction, and also entails a social equity enhancement.

4.2.3 Removal of Weigh Stations

The preliminary design assumed that weigh stations would be integral to the BCIB project, and incorporated them into the land approach alignments, with substantial overhead turnaround ramps to permit overweight vehicles to return to their origins via the opposite side of the divided roadway. During detailed design, it was decided that weigh stations would be removed from the BCIB project, and implemented separately by DPWH at locations on the Roman Highway and Antero Soriano Highway, on either side of the respective BCIB interchanges. The off-project weigh stations have yet to be designed or sited, but it is anticipated that placing them on the sides of existing highways will require less physical infrastructure than would have been the case if they were integrated into the approach roads (i.e., no overhead turnaround ramps), and this will ultimately represent a reduction in greenhouse gas emissions from their construction.

4.2.4 Alignment Adjustment (Bataan)

Only one alignment change was made during detailed design; this entailed shifting the landing point on the Bataan side approximately 50 m to the southwest from its original position. The aim of this change was to increase the distance between the immediately upslope section of the land approach and a number of steep-sided gullies associated with the Babuyan River, thereby reducing lengths of bridges, fill requirements and slope protection works. The change is environmentally beneficial, as the risk of erosion and water quality impacts for the Babuyan River and Manila Bay during construction is reduced.

4.2.5 Redesign of Interchange (Cavite)

The preliminary design produced in 2020 indicated that the interchange at the Antero Soriano Highway in Cavite would be a modified T-junction. Early in the detailed design work, this interchange design option was recognized as a likely source of congestion and safety problems, and a partial cloverleaf interchange was developed to take its place. The partial cloverleaf will certainly be more energy-intensive to build than the much simpler T-junction, but the increased greenhouse gas emissions derived from construction should be far outweighed by emissions savings associated with smoother traffic flow (on both the BCIB approach road and the Antero Soriano Highway) over the lifespan of the BCIB. Public safety should also be significantly enhanced by adoption of the partial cloverleaf design.

5 BASELINE CONDITIONS, ANTICIPATED IMPACTS AND PRESCRIBED MITIGATION (LAND)

This chapter of the EIA report considers the existing conditions in the three land areas within the BCIB project area, assesses the likelihood and significance of impacts on the environmental attributes of those land areas in light of the expected project activities as outlined earlier in the Project Description and defines mitigation measures appropriate to the identified risks. The focus of the chapter is on Mariveles and Naic, as this is where the BCIB project will have direct physical impacts; Corregidor Island is included in the analysis although to a limited extent, because the project will not physically impinge upon the island. The BCIB does maintain an option for a future connection to the island via a turnaround positioned nearby the island. Assessment of impacts and development of mitigation prescriptions takes in the pre-construction phase, construction phase and operation phase, in that order.

5.1 Baseline Conditions

5.1.1 Geology and Geomorphology

5.1.1.1 Tectonic Setting

The Philippine archipelago is located in a complex convergence zone between a number of major and minor tectonic plates. Most of the country sits atop the Philippine Mobile Belt, which is a dynamic 'in-between' crustal element—sometimes called a microplate—with subduction fronts on both the east and west. To the east, the Philippine Sea Plate is subducting westward beneath the archipelago, along the East Luzon Trench and Philippine Trench. To the west, the Sunda Plate (associated with and sometimes considered part of the Eurasian Plate) is subducting eastward beneath the Philippine Mobile Belt, along the Manila, Negros, Sulu and Cotabato Trenches. As the motion of the subducting Philippine Sea Plate along the Philippines Trench is oblique, the convergence is partitioned into trench-normal and trench-parallel motion. The trench-normal motion is mainly accommodated by subduction along the Philippine Trench itself, while the trench-parallel motion is given expression in the Philippine Fault System running along the north–south axis of the archipelago's major land masses, as well as other active crustal faults.[16]

The tectonic context just described has produced the Philippine islands' volcanic orogeny and a system of faults. Crustal deformations and the movement of various pieces of crust broken off from the adjacent plates further add to the islands' overall geological and geomorphological complexity and dynamism.[17] Exhibit 5-1 illustrates the relative positioning of trenches and troughs where subduction occurs, major volcanic zones including currently active volcanoes and some of the many faults that crisscross the country.

[16] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition. Quezon City.
[17] (1) Yumul, G.P., Jr., C.B. Dimalanta and V.B. Maglambaya. 2008. Tectonic setting of a composite terrane: A review of the Philippine island arc system. Geosciences Journal 12(1): 7-17.; (2) Doo, W., S. Hsu and L. Armada. 2015. Philippine island arc system tectonic features inferred from magnetic data analysis. Terr. Atmos. Ocean. Sci. 26: 679-686.

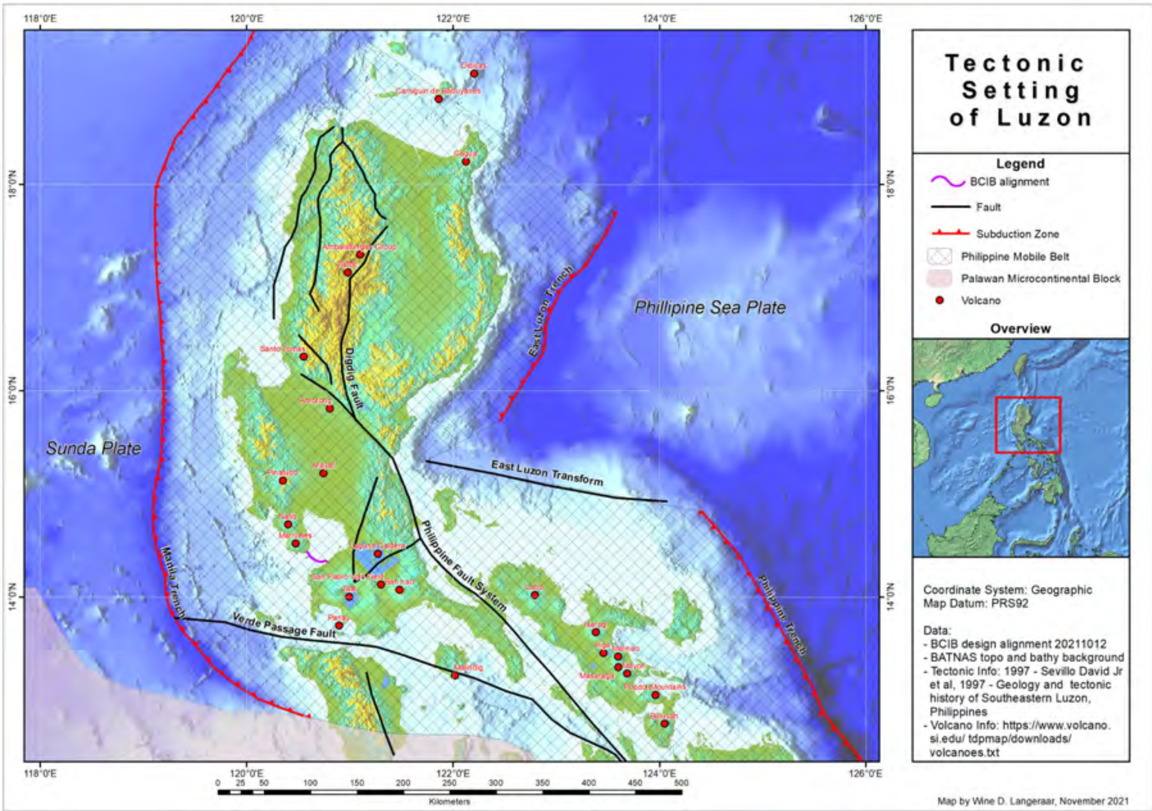


Exhibit 5-1 Regional Tectonic Setting of BCIB Project

5.1.1.2 Trenches and Fault systems

As shown in in Exhibit 5-1, Luzon is bracketed by oceanic trenches on the west (Manila Trench) and on the east (Philippine Trench and East Luzon Trench). Major faults in the central part of Luzon include the Valley Fault System, which runs in a northeast–southwest direction through the central part of Metro Manila, the Lubang-Verde Passage Fault System offshore to the south and the Philippine Fault Zone further away along the east coast of Luzon. Activity along these major faults is driven mainly by the opposing subduction dynamics to the east and west of the archipelago.

Manila Trench. Located on the western side of the Philippine archipelago, the Manila Trench is a deep ocean trough that represents the surface expression of the eastward-dipping subduction of the Sunda Plate. The Manila Trench follows a gentle reverse-curved course northwards from its southern terminus on the west coast of Mindoro Island, to an area near the southwest tip of Taiwan (sources differ as to definition of its northern terminus). The Manila Trench is located about 150 km southwest of the BCIB project alignment at its closest point. Subduction along the southern portion of the Manila Trench has produced an accretionary prism composed of sediments, which is thought to contributed to formation of the Lubang group of islands just 70 km southwest of the mouth of Manila Bay.[18] The convergence of the Eurasian and Philippine plates in the region between northern Luzon and southwest Taiwan is more collisional than subductional and is subject to deposition of sediments from the continental portion of the Eurasian Plate, so the seafloor topography is less sharply defined than in the southern portion. The Manila Trench is associated with the active Luzon Volcanic Arc, which includes several prominent volcanoes spread along the

[18] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition. Quezon City.

western side of Luzon. The trench is also associated with seismic risk, particularly its forearc portion, which is east of the trench itself. [19]

Philippine Trench. The Philippine Trench is a major structural feature extending along the eastern edge of the archipelago and accommodates the westward-dipping subduction of the Philippine Sea Plate.[20] The trench stretches approximately 1,300 km in a general northwest–southeasterly orientation, from a point 250 km off the north-central part of Luzon to near the Talaud Islands off northwest Sulawesi, Indonesia. The Philippine Trench has an associated volcanic arc extending along the western islands in the southern part of the country but this does not extend as far north as Luzon. The inferred trace of the Philippine Trench is nearly 400 km east-northeast of the BCIB project area at its nearest point.

East Luzon Trench. The East Luzon Trench is an extension of the Philippine Trench that curves around the eastern coast of northern Luzon and similarly reflects the westward-dipping subduction of the Philippine Sea Plate below the inter-plate terrane that supports the Philippine archipelago. The East Luzon Trench extends in a generally northeasterly direction for about 300 km from its southern terminus in a transform zone separating it from the Philippine Trench off the Polillo Islands, before losing clear definition. The southern end of the East Luzon Trench is approximately 150 km northeast of the BCIB project area. The history and character of the East Luzon Trench are poorly understood, including the cause of its offset transform from the Philippine Trench and the nature and precise path of its northern reaches but it is not thought to be associated with any volcanic arc.[21]

Philippine Fault Zone. The Philippine Fault Zone is a major left-lateral strike-slip fault zone with a mapped length of about 1,250 km, running from northern Luzon to southern Mindanao. Movement in the Philippine Fault Zone accommodates part of the oblique convergence between the Philippine Sea Pate and the Sunda Plate and hence the fault is a major source of earthquakes across the archipelago. The fault zone is relatively active and there have been seven large earthquakes recorded along its northern part since the mid-17th century, including the 1990 Luzon earthquake with moment magnitude (M_w) of 7.7.[22]

The Philippine fault system is generally split into the Northern Segment (northwest Luzon to Lamon Bay), Central Segment (Bondoc Peninsula to Leyte) and Southern Segment (Mindanao and the Moluccas). The BCIB project alignment is situated approximately 100 km west of the fault system between the Northern Segment and Central Segment near Lamon Bay, where there is a transition from north-trending branches of strike-slip faults in the Northern Segment to a relatively simple, well-defined fault pattern in the Central Segment.[23]

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[19] (1) Hsiung, K., C. Su, H. Yu and J. Chang. 2015. Morphology, seismic characteristics and development of the sediment dispersal system along the Taiwan–Luzon convergent margin. Mar. Geophys. Res. 36:293-308.; (2) Hirtzel, J., W. Chi, D. Reed, L. Chen, C. Liu and N. Lundberg. 2009. Destruction of Luzon forearc basin from subduction to Taiwan arc-continent collision. Tectonophysics (2009), doi:10.1016/j.tecto.2009.01.032.; (3) Yumul, G.P., Jr., C.B. Dimalanta and V.B. Maglambaya. 2008. Tectonic setting of a composite terrane: A review of the Philippine island arc system. Geosciences Journal 12(1): 7-17.; Doo, W., S. Hsu and L. Armada. 2015. Philippine island arc system tectonic features inferred from magnetic data analysis. Terr. Atmos. Ocean. Sci. 26: 679-686.; (4) Su, S.S. 1988. Seismic hazard analysis for the Philippines. Natural Hazards 1:22-44.

[20] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition. Quezon City.

[21] Ibid.

[22] Bataan–Cavite Interlink Bridge Seismic Hazard Analyses Report (T.Y. Lin International – Pyunghwa Engineering Consultants JV). September 27, 2021.

[23] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

Valley Fault System. Previously known as the Marikina Fault System, the Valley Fault System comprises a series of active, predominantly right-lateral strike-slip faults and extends approximately 110 km from northeast of Metro Manila in Bucalan Province to southwest of the capital in Laguna Province. The fault system has two main subsystems, the West Valley Fault and East Valley Fault. The West Valley Fault occupies the entire length of the system, while the East Valley Fault is much shorter, running nearly parallel to its western counterpart over a distance of just 30 km, on the eastern edge of Metro Manila in Riaz Province. The Valley Fault System is capable of producing periodic significant earthquakes (M_w 7 or higher), having experienced three or possibly four major slip events over the past 1,400 years.[24] This fault is considered to have been in a locked position for some time and is thus assumed to be building up pressure that could be released in a significant seismic event. The recurrence interval for major events along the Valley Fault has been variously estimated at 200–400 years and 300–1,000 years and no such event are known to have occurred since the 17th century, so it is suspected that a period of activity may be approaching.[25] At its nearest point, the West Valley Fault lies about 30 km east of the proposed BCIB alignment's Cavite terminus.

Lubang-Verde Passage Fault System. Also known as the Sibuyan Sea Fault, this fault is a northwest–southeast trending strike-slip fault of left-lateral orientation, located offshore in the Verde Island Passage between the Batangas Peninsula and Mindoro Island. This active fault, which is considered a branch of the Philippine Fault running up the spine of Luzon, lies approximately 95 km to the southwest of the BCIB project alignment. The fault transforms into a thrust/left-lateral transpressional fault in its westernmost extension, where it cuts through the southern portion of the Manila Trench accretionary prism.[26] A branch of the Lubang-Verde Passage Fault extends northward along the eastern side of the Lubang Islands, placing it approximately 65 km southwest of the project area.[27]

Western Boundary Fault. It is suspected that there may be a shallow fault running in a north–south direction, approximately 5–25 km off the west coast of Luzon, in the forearc region of the Manila Trench subduction zone. The existence of the fault is inferred based on analysis of bathymetric features but this finding has not been confirmed by geological evidence or imaging. Preliminary mapping suggests the southern end of the fault would be approximately 40 km northwest of the BCIB project area.[28]

5.1.1.3 Volcanism

The Philippine Mobile Belt, which underlies most of the landmass in the Philippine Archipelago, is a geological amalgamation of ancient and young volcanic island arcs originating from the tectonic movement of adjacent crustal plates. Being at the major plate boundary between the Philippine Sea Plate and Eurasian (Sunda) Plate, this constitutes a segment of the Pacific Ring of Fire. Volcanic activity has been the dominant influence on

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[24] Selda, P.A.Y., R.A.C. Luna, R.D. Quebral, J.M.B. Gargullo, K.J.R. Leobrera, E.D. Marasigan, M.J.P. Armario, and M/P. Baniquett. 2019. Seismic hazard analysis for public infrastructure in Metro Manila. Proceedings of the 16th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, October 14–18, 2019, Taipei, Taiwan.

[25] (1) Bataan–Cavite Interlink Bridge Seismic Hazard Analyses Report (T.Y. Lin International – Pyunghwa Engineering Consultants JV). September 27, 2021.; (2) Selda, P.A.Y., R.A.C. Luna, R.D. Quebral, J.M.B. Gargullo, K.J.R. Leobrera, E.D. Marasigan, M.J.P. Armario, and M/P. Baniquett. 2019. Seismic hazard analysis for public infrastructure in Metro Manila. Proceedings of the 16th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, October 14–18, 2019, Taipei, Taiwan.

[26] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

[27] Bataan–Cavite Interlink Bridge Seismic Hazard Analyses Report (T.Y. Lin International – Pyunghwa Engineering Consultants JV). September 27, 2021.

[28] Ibid.

landforms across the archipelago through the ages and continues to shape the landscape through new eruptions from active volcanoes around the country. Because of the prevalence of volcanic activity, the country is very susceptible to volcanic hazards such as pyroclastic flows and associated pyroclastic gas clouds, lahar flows, ashfall, tsunamis and volcanically-triggered earthquakes. The BCIB project area is bracketed by a number of active and potentially active volcanoes.

Mount Mariveles. Mt. Mariveles is a massive stratovolcano whose forested summit (elevation 1,388 masl) stands just eight kilometers to the northwest of the BCIB alignment's terminus on the Bataan side; much of the land on which the approach road and associated viaducts, interchange and buildings are to be constructed is part of this volcano's past depositions (this can be seen in Exhibit 5-2). Mt. Mariveles last erupted about 4,000 years ago and is classified by the Philippine Institute of Volcanism and Seismology (PHIVOLCS) as 'potentially active'. This volcano has two prominent flank cones on its northeast and east flanks, Mt. Samat and Mt. Limay.[29]

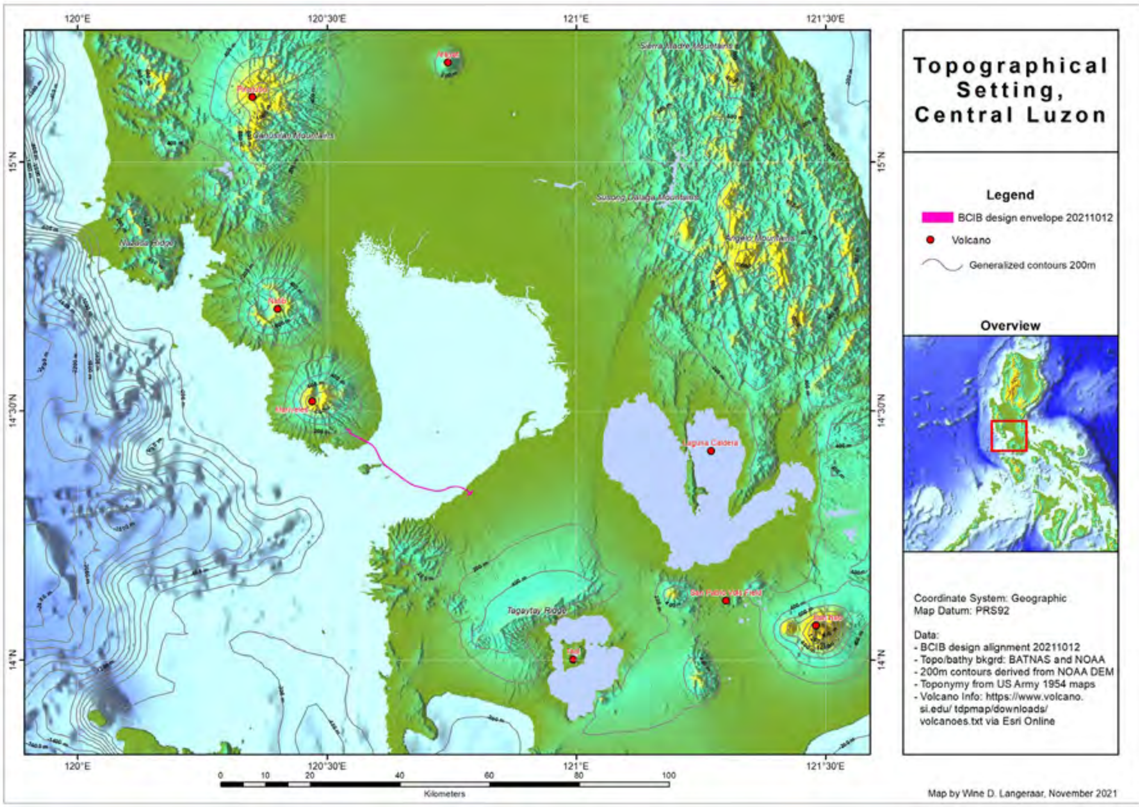


Exhibit 5-2 Volcanic Features in Regional Topography of Central Part of Luzon

Mount Natib. The second of two massive stratovolcanoes on the Bataan Peninsula, Mt. Natib (elevation 1,253 m) is located 25 km northeast of Mt. Mariveles. This volcano's eruptive history is not well understood but it is thought that the most recent eruption probably dates from the early Holocene, i.e., around 11,000 years ago. PHIVOLCS considers Mt. Natib to be 'potentially active'.[30]

[29] Information sourced from the Smithsonian Institution's Global Volcanism Program website (https://volcano.si.edu) and PHIVOLCS' interactive volcano database (https://wovodat.phivolcs.dost.gov.ph/volcano/ph-volcanoes).
[30] Ibid.

Mount Pinatubo. World-renowned since its dramatic 1991 eruption, which caused widespread damage via pyroclastic falls, heavy lahar flows and ash deposition—and even had a significant effect on the global climate due to its inputs of aerosols to the stratosphere—Mt. Pinatubo (elevation 1,486 masl) remains active. The volcano, which has erupted an estimated eight times in the last 10,000 years, is located 80 km north-northwest of the BCIB alignment.[31]

Corregidor. The sickle-shaped Corregidor Island and nearby Caballo Island are remnants of the rim of the ancient Corregidor volcano's caldera. Based on sedimentary evidence, the most recent eruption of Corregidor is thought to have occurred about 1 million years ago. PHIVOLCS lists Corregidor as 'potentially active', although it is unclear on what evidentiary basis this classification has been made.[32]

Taal Volcano. Thought to have been at one time a towering mega-volcano that collapsed in a major eruptive event, Taal Volcano has a low physical profile (summit elevation just 311 masl) but remains one of the most active volcanoes in the Philippines. Taal Volcano has erupted dozens of times in recorded history, including a January 2020 event which spread large amounts of ash over the central portion of Luzon, including parts of Metro Manila. A series of minor eruptions with only local effects occurred in July 2021 and another minor eruption was recorded in April 2022. The Taal Volcano is located approximately 43 km south-southeast of the BCIB alignment's terminus in Cavite. The upper bedrock layers and soils of Cavite Province, including the BCIB project area, are derived from direct deposits of pyroclastic material and ash from this volcano through the ages, as well as erosional deposition by watercourses flowing off its northern flanks. A number of lesser volcanoes are spaced out to the northwest of Taal, including Mt. Batulao, Mt. Talamitam, and Mt. Palay-Palay (Mt. Mataas-na-Gulod); these are all considered extinct.[33]

5.1.1.4 Topography

The topography of the BCIB project area is varied and determined by volcanic orogeny and erosional and depositional processes. The differences in topography across the project area can be traced to the broader regional geology and its mix of volcanic highland formations and intervening broad alluvial and sedimentary basins (refer to Exhibit 5-3).

Bataan

The Bataan portion of the project area is situated on the lower slopes of Mt. Mariveles, a stratovolcano whose summit caldera rim stands at 1,200 masl, just 13 km from the southern shore. The steepest slopes are to be found on the upper slopes of the volcano's cone, while more moderately sloped land made up of material from ash falls, lava flows, lahar flows and alluvium lies in an 8–9 km-wide strip along the coast. Numerous streams run off the forested upper slopes of the volcano, creating frequent incised valleys and making for a complex topographical profile at the local scale. The Bataan portion of the BCIB alignment runs mostly along a ridge, roughly parallel to steep-walled valleys carved out by streams

[31] Ibid.
[32] Ibid.
[33] Ibid.

(see Exhibit 5-3). Typical slopes range from 3–8% in the general vicinity of the proposed alignment on the Bataan side.[34]

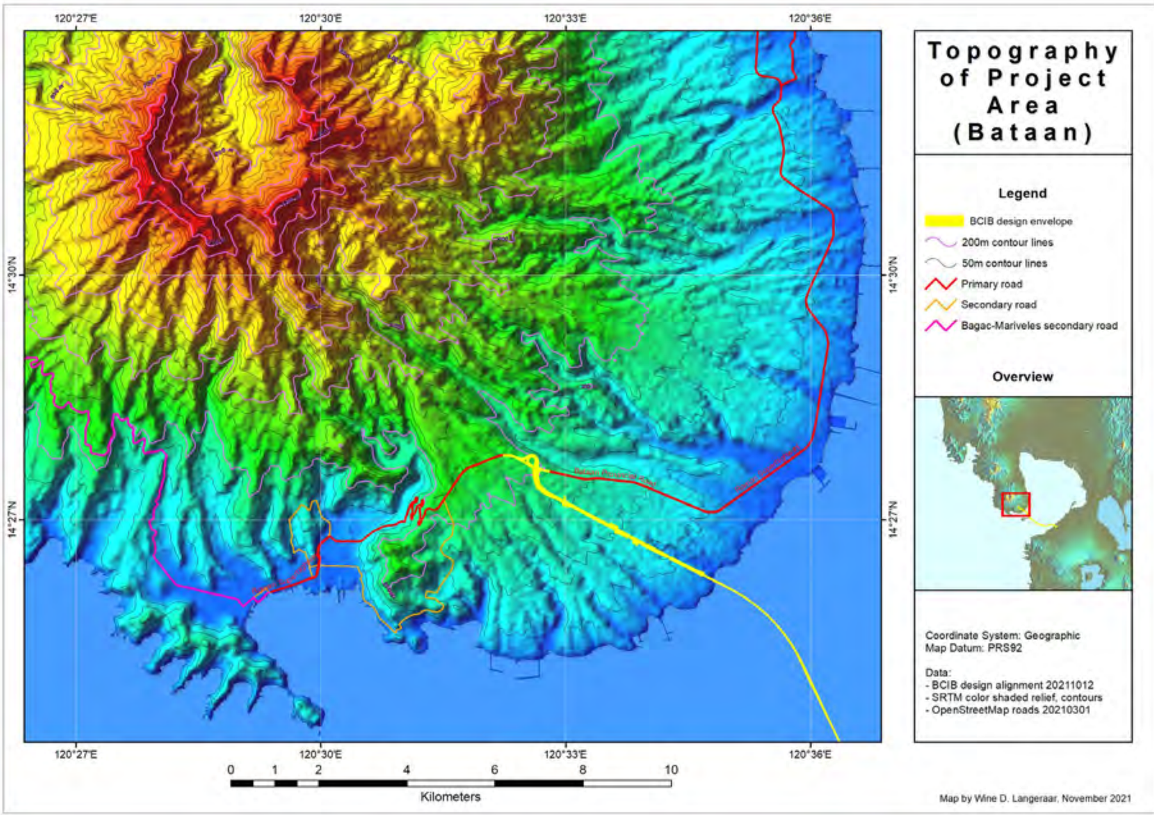


Exhibit 5-3 Topography of Project Area (Bataan)

Corregidor Island

The landmass of Corregidor Island consists mostly of remnants of the caldera rim of the Corregidor volcano. Along much of its coastline, the tadpole-shaped island rises sharply from the sea, with slopes up to 35% and cliffs and rocky headlands in some places. There is a low saddle area near the western start of the island's Tail End portion. The Tail End is generally of lower elevation than the main body of the island, tapering off to just a few meters above sea level at the far southeast tip. As would be typical of a small land mass, there are few sizable streams to carve significant valleys, although minor gullies and ravines are prevalent (see Exhibit 5-4).

Cavite

The project area in Cavite is at the northwestern edge of a long, gently sloping outflow plain of the Taal Volcano, approximately 35 km to the southeast. Slopes in this area are rarely greater than 1% and rivers are relatively low energy and not deeply incised. The land is not flat (the proposed site for the BCIB interchange, 1.3 km inland, lies at 14 masl) but the terrain is a marked contrast to that found across the water in Bataan (see Exhibit 5-5).

[34] Bataan–Cavite Interlink Bridge Project, Package 1: Preliminary Engineering Design Report. 3 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.

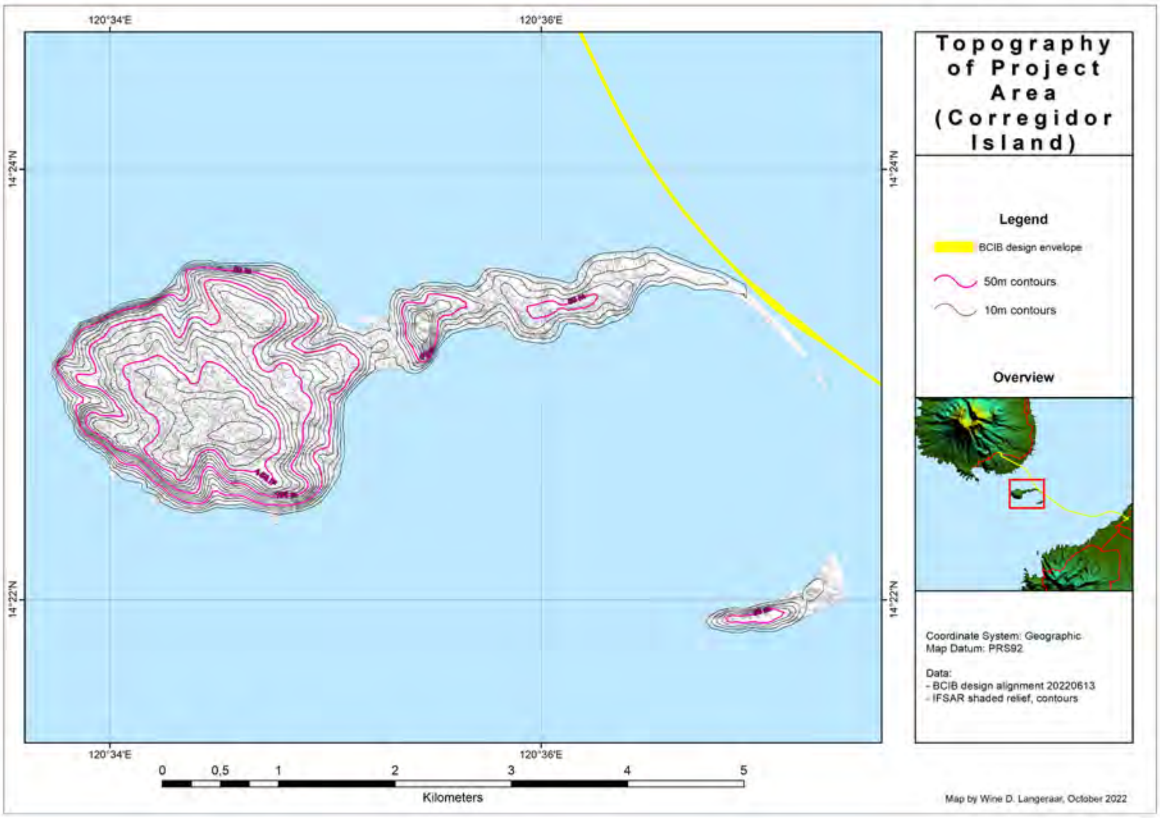


Exhibit 5-4 Topography of Project Area (Corregidor Island)

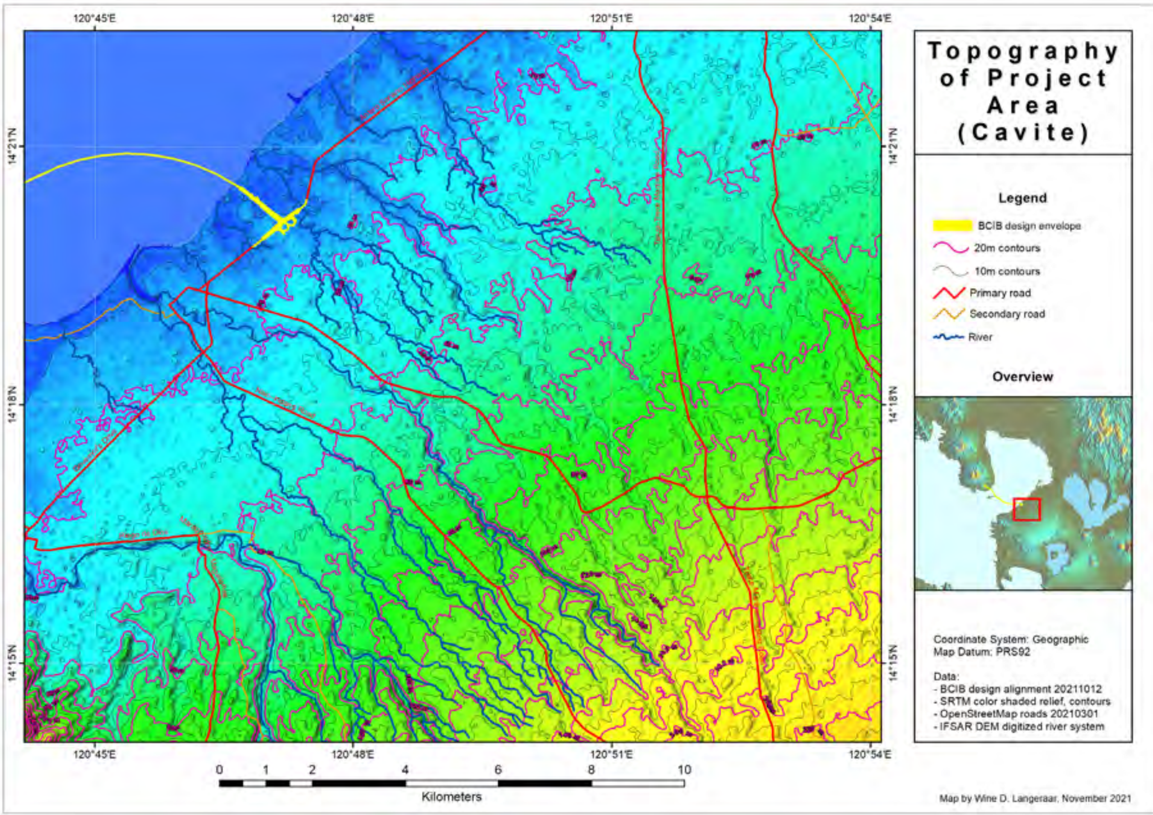


Exhibit 5-5 Topography of Project Area (Cavite)

5.1.1.5 Stratigraphy and Petrology

The geological formations underlying the project area are volcanic and sedimentary in origin. As can be seen in the map in Exhibit 5-6, the formations in the Manila Bay region are relatively young, having all been laid down since the Oligocene-Miocene.

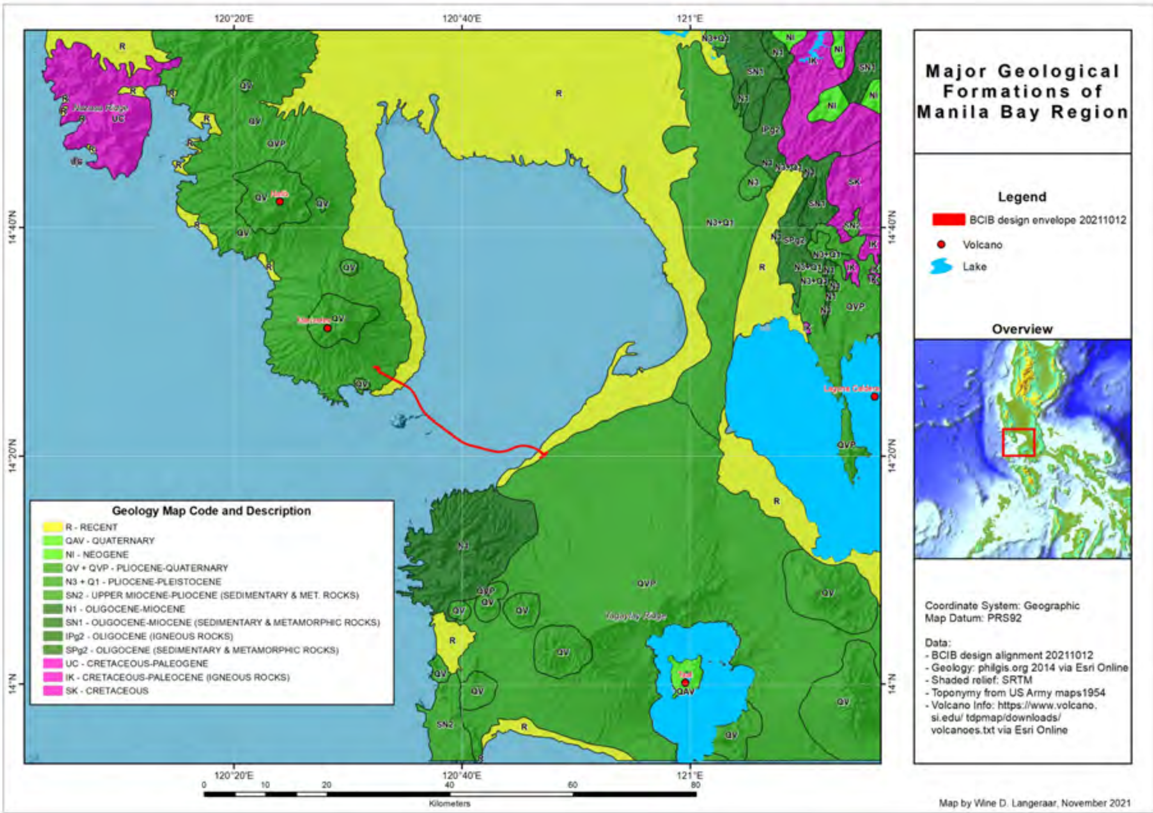


Exhibit 5-6 Geological Formations Underlying the BCIB Project Area

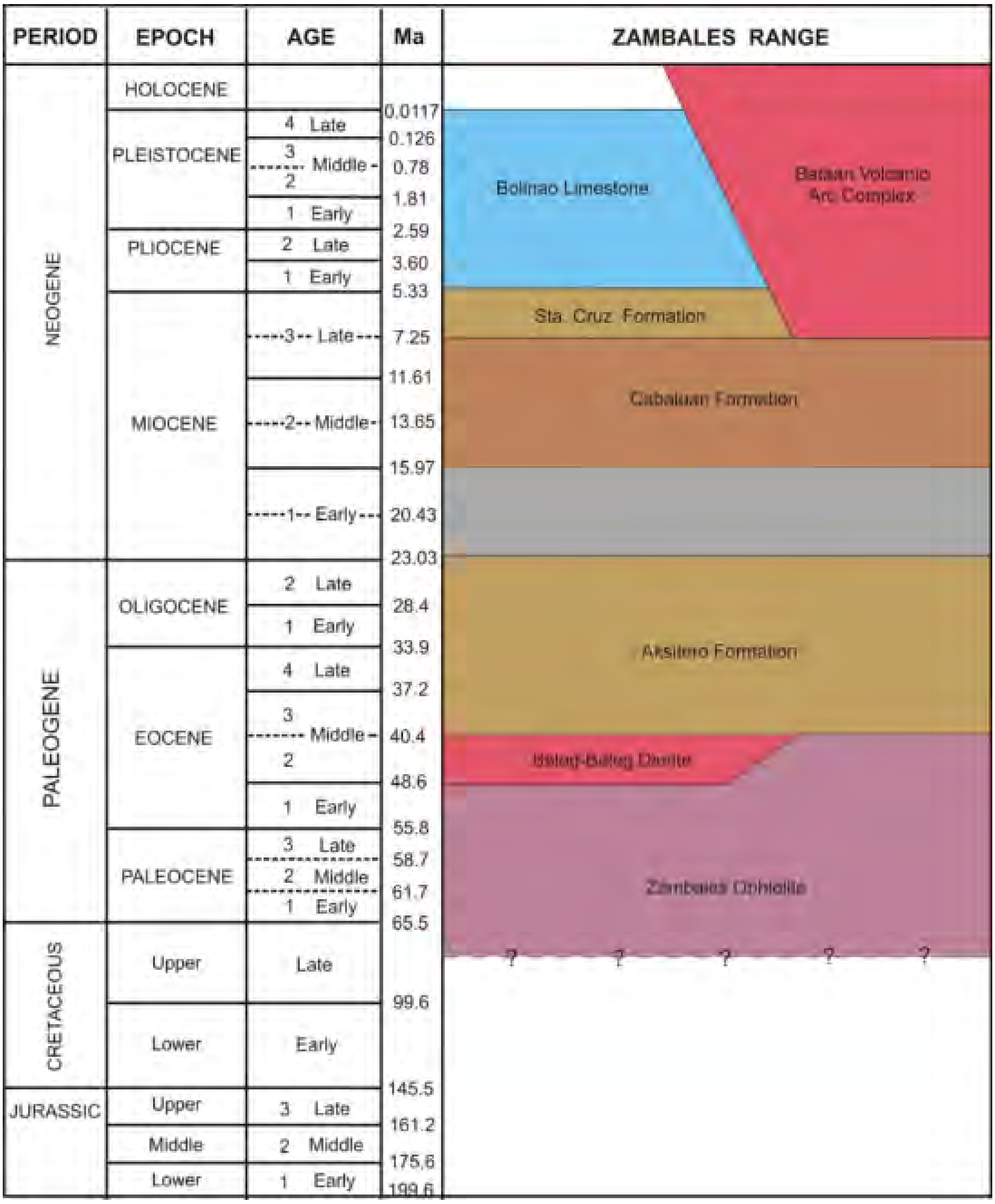
The BCIB project area is considered by the Mines and Geosciences Bureau to fall within two geological provinces defined by stratigraphic commonalities, or 'stratigraphic groupings'; the Zambales Range (Stratigraphic Grouping 5, or SG5) and Southwest Luzon Uplands (Stratigraphic Grouping 7, or SG7). The Zambales Range (SG5) includes the major portion of the Western Volcanic Belt on Luzon, associated with subduction along the Manila Trench. The Bataan Peninsula falls within this stratigraphic grouping. The Southwest Luzon Uplands (SG7) is a broad swath extending across all of Batangas and Cavite Provinces and western parts of Laguna Province on Luzon, as well as the Verde Island Passage and the northern half of Mindanao. All of western Manila Bay and the landmass that defines its southern shore are included in SG7.[35]

Zambales Range. The basement formation in the SG5 is the Zambales Ophiolite Complex, made up of oceanic crust and mantle material thought to date to the Paleocene–Eocene or perhaps earlier (see Exhibit 5-7). The Bataan Peninsula is within the Coto Block, the more southern of two major blocks in the complex. The Zambales Ophiolite Complex comprises metamorphic harzburgite, dunite, troctolite, allivalite, olivine gabbro and a plutonic-volcanic suite of diorite, diabase and basalt. The predominant formations visible on the Bataan Peninsula today are the Late Miocene–Recent volcanoes of the Bataan Volcanic Arc

[35] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

Complex, which have extruded through the Ophiolite Complex; these include Mt. Pinatubo, Mt. Natib and Mt. Mariveles, amongst others.[36]

Mt. Mariveles is a stratovolcano that consists of lava flows, pyroclastic flows, ashfall deposits, pyroclastic fans and related epiclastic derivatives. The composition of rocks found in the volcanic formation include basalts, basaltic andecites and andecites.[37]



Source: Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

Exhibit 5-7 Stratigraphic Column for Zambales Range (SG5)

Geotechnical surveys conducted during the detailed design work revealed the bedrock to be a structurally strong volcanic breccia, characterized as a lithified ignimbrite pyroclastic

[36] Ibid.
[37] Ibid.

deposit (breccias are a class of rock composed of small angular stones cemented together by an intervening matrix of fine material), with light to moderate weathering. A highly weathered lithic tuff (formed by consolidation of volcanic ash deposits) of very weak structural strength was found to overlie the breccia bedrock. Deposits from lahar flows were also noted in some locations.[38] The formations just mentioned are incised by the numerous rivers and streams that drain the slopes of Mt. Mariveles and are overlain by quaternary alluvial deposits in the resulting valleys, particularly closer to the coast and in nearshore shelf areas.

Exhibit 5-8 Decomposed Pyroclastic Flow at Manila Bay Coastline, Mariveles

Southwest Luzon Uplands. The basement formation in the western part of the Manila Bay region is the San Juan Formation, an Oligocene metamorphic structure of volcanic origin that is composed principally of basalt andecite, greywacke, shale, slate, paraschist, marble and hornfel (see Exhibit 5-10). The San Juan Formation is overlain by the Nasugbu Volcanic Complex, which is exposed along the western coast of Batangas Province. The Nasugbu Complex, which is estimated to be approximately 500 m thick, was formed by pyroclastic flows and is made up principally of agglomerate, tuff andesite and dacite. Lying on top of the Nasugbu Volcanic Complex is the sedimentary Corregidor Formation, which is thought to extend from the southern tip of the Bataan Peninsula to the west coast of Batangas Province and thus likely underlies most or all of the BCIB project area. The Corregidor Formation, which is exposed at Corregidor and Limbones Islands and constitutes the bedrock underlying Naic and Ternate, is composed mainly of cobble to boulder agglomerates, interbedded with sandstone and shale deposited in a littoral context. The sandstones exhibit cross-bedding and the shale is silty and tuffaceous, while the agglomerate in some locations grades into tuff, indicating the volcanic origin of the source materials.[39]

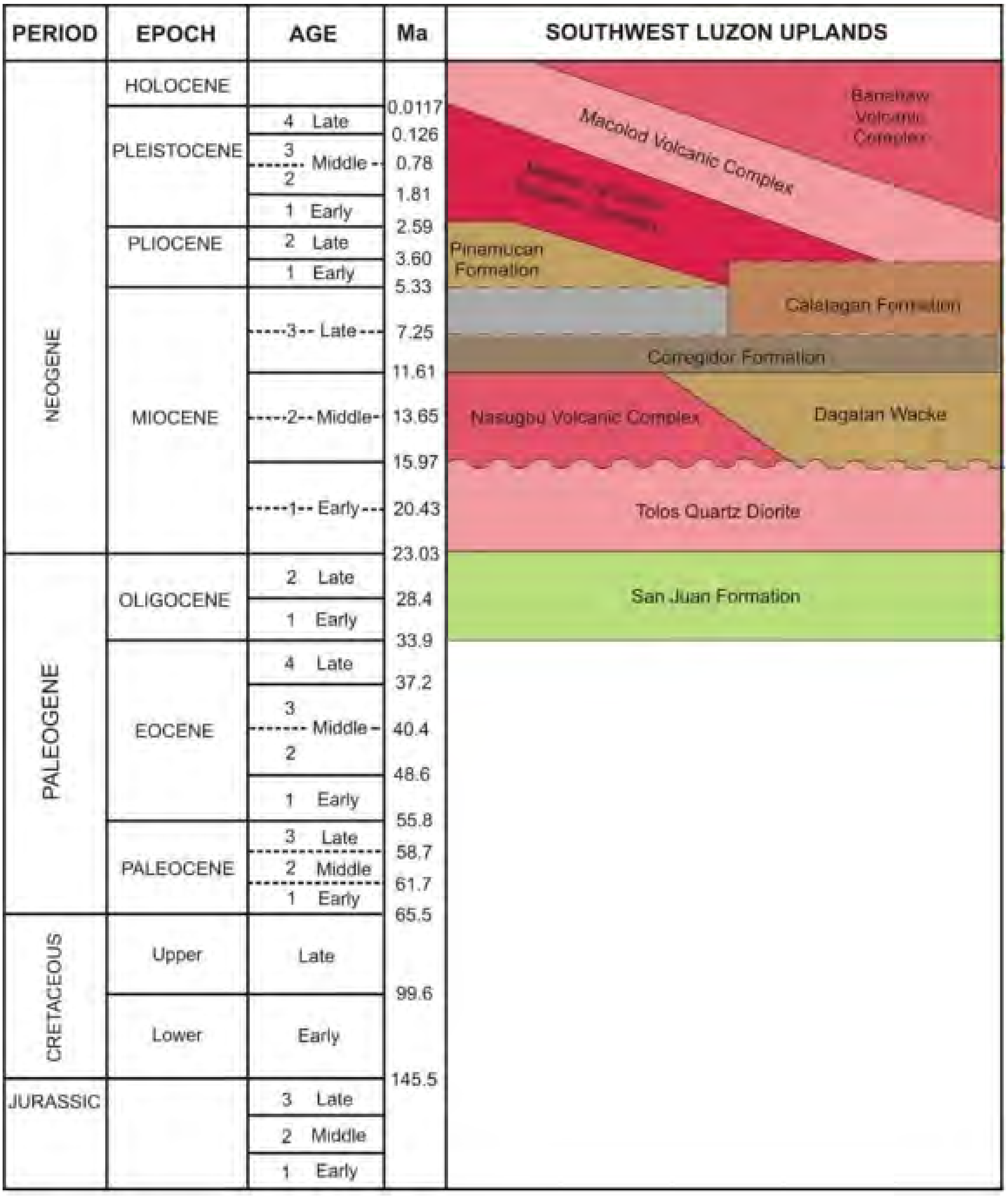
[38] Bataan–Cavite Interlink Bridge Project, Package 1: Preliminary Engineering Design Report. 3 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.
[39] Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

Exhibit 5-9 Lahar Flow Overlying Pyroclastic Flow, Mariveles

Younger volcanic formations that have built upon the earlier strata and contributed to the surface and near-surface geology of the BCIB project area are the Mataas-na-Gulod Volcanic Complex (now extinct) in the western part of Cavite and northern Batangas and the Macolod Volcanic Complex, which is a transverse east–west band of volcanic features that covers much of southern Cavite, eastern Batangas and Laguna and includes a number of active and potentially active volcanoes, including the Taal Volcano. This volcano, with its massive low caldera of over 300 km^2 formed through a lively history of explosions and collapses, has spread large volumes of material in base surges and pyroclastic flows over an area of more than 2,000 km^2, including north across the Tagtatay Ridge towards Manila Bay.[40]

Geotechnical surveys carried out in support of the BCIB detailed design work found that the bedrock in the Cavite section of the project area consist of (in order of increasing depth) sandstones, polymict congloemerate, tuffaceous sandstones and lithic tuff.[41] These materials are consistent with the Corregidor Formation, which is known to be present near the surface along the Cavite shore. Given the known outflows from the Taal volcano in this direction, it is possible that they also made some contribution to the makeup of the bedrock in this area. The bedrock formations described above are overlain by significant quaternary alluvial deposits of eroded volcanic materials from upper catchment areas, which reach as far as Tagtatay Ridge, on the northern edge of the Taal volcano caldera.

[40] Ibid.
[41] Bataan–Cavite Interlink Bridge Project, Draft Preliminary Design Report – Package 2. 28 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.



Source: Mines and Geosciences Bureau. 2010. Geology of the Philippines, 2nd Edition.

Exhibit 5-10 Stratigraphic Column for Southwest Luzon Uplands (SG7)

5.1.1.6 Soils

The soils found in the Bataan portion of the project area are primarily andosols and nitisols, as classified by the Food and Agriculture Organization (FAO). Andosols are associated with glass-rich volcanic ejecta, mainly ash but also tuff and pumice and are found in Bataan on the upper slopes of Mt. Mariveles (see Exhibit 5-11). These soils are typically dark in color and are generally fertile and considered to have high agricultural potential.[42]

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[42] IUSS Working Group WRB. 2015. World Reference Base for Soil Resources 2014, Update 2015. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome.

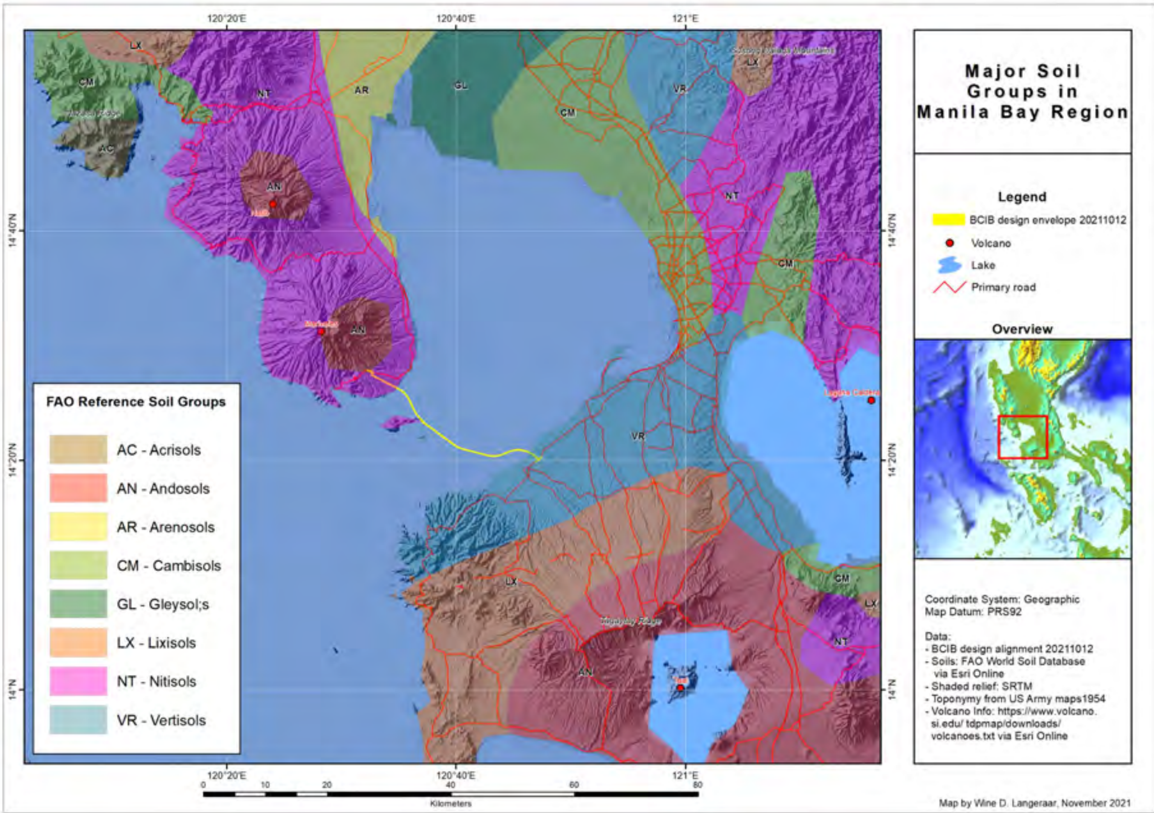


Exhibit 5-11 FAO Soil Groups in BCIB Project Area

The andosols found on Mt. Mariveles are classified under the Philippine soil classification system as Antipolo.[43] Formed from weathering of basalt and other volcanic rocks, Antipolo soils are expected in upland areas of volcanic origin. These soils are described as being fine, well-mixed and well-drained with moderate permeability and reddish brown to red in color in the upper horizon. Spherical tuffaceous concretions are typical components of the soil profile. The subsoil is usually reddish brown and granular, with friable clays, while the lower subsoil is typically weathered tuffaceous material. The substratum is reddish brown to light reddish brown, with frequent iron concretions and coarse brown granular clay. Antipolo soils are considered suitable for upland rice where slope permits and only for perennial cropping systems such as tree crops and grass pasture in steeper areas.[44]

Nitisols are typically deep, well-drained red tropical soils with a clay-rich subsurface horizon and a moderate to strong angular blocky structure that permits deep penetration by plant roots and consequent resistance to erosion. Nitisols occur predominantly on level to hilly terrain and are generally very productive relative to other red tropical soils, due to high content of weathering minerals, high organic matter and good internal drainage. Their parent materials are usually intermediate to basic rock, supplemented in volcanic regions by deposits of ash.[45] The nitisols occurring on the lower slopes of Mt. Mariveles are designated under the Philippine soil classification system as Antipolo Clays.[46] Antipolo Clays are

[43] Based on soil mapping carried out by the Bureau of Soil and Water Management and presented on the Philippines Geoportal (geoportal.gov.ph)
[44] Cavating, R.B., R.G. Galavita and C.D. Bacatio. 2014. The Soils of the Philippines. Springer: Dordrecht.
[45] IUSS Working Group WRB. 2015. World Reference Base for Soil Resources 2014, Update 2015. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome.
[46] Based on soil mapping carried out by the Bureau of Soil and Water Management and presented on the Philippines Geoportal (geoportal.gov.ph)

assigned to the Typic Dystropepts group of soils, which are formed from volcanic material and are typically brownish to reddish in color, moderately deep to deep, well drained and with a clayey texture.[47] Exhibit 5-12 shows a test pit dug as part of the geotechnical survey along the proposed BCIB alignment in Bataan, which illustrates the reddish color and good drainage typical of nitisols.

Exhibit 5-12 Test Pit in Nitisol (Antipolo Clay) in Mariveles

The soils on the Cavite side of the BCIB project area are considered vertisols under the FAO classification system. Vertisols are dark, heavy clay soils typically found in depressions and lightly undulating topographical environments. These soils generally have a high proportion of swelling clays, which produce deep, wide cracks during dry periods, enabling robust self-mixing or churning of the soil material (the name vertisol is from the Latin *vertere*, to turn). From an agricultural perspective, vertisols are challenging, because their heavy texture makes cultivation laborious and because the constant shrinking and swelling action is injurious to the roots of many plants. The soils tend to be fertile and can be productive with careful water management to avoid the extremes of waterlogging and cracking. Under the Philippine soil classification system, the vertisols found in the Cavite portion of the BCIB project area are considered Guadalupe Clays. Guadalupe Clays are known as shallow, plastic, sticky soils, gray in color and with poor drainage and slow permeability. These soils are considered to be among the best for growing wet rice.[48] The Guadalupe Clays found in the coastal and near-coastal parts of Cavite are assigned to the sub-classes Aquic Ustipsamments (along the coast) and Typic Pellusterts (in the low-lying alluvial plains). Aquic Ustipsamments are young and show weak formation of weathering-derived horizons and are typically dark to very dark greyish brown, poorly to well drained and have low water-holding capacity. Typic Pellusterts are typically fine-grained, poorly drained soils derived from weathering of volcanic tuffs and old alluvial deposits.[49] A soil test pit dug along the proposed alignment in Naic during the geotechnical survey shows a reasonably well-drained vertisol, which nevertheless exhibits strong clay clodding in the excavated material (see Exhibit 5-13).

[47] Bureau of Soils and Water Management. 2003. Soil Survey Report of Bataan Province. Quezon City.
[48] Cavating, R.B., R.G. Galavita and C.D. Bacatio. 2014. The Soils of the Philippines. Springer: Dordrecht.
[49] Bureau of Soils and Water Management. 2002. Soil Survey Report of Cavite Province. Quezon City.

20		Date	10/1/2021	Sheet	
Onshore GI Works for Bataan-Cavite Interlink Bridge				1 of	1
Naic, Cavite	Weather:	Fair			
	Coordinates	Northing:	1585899.9	Pit Dimension:	[illegible]
TY LIN/PEC Joint Venture		Easting:	476252.97	Elevation:	3.554 m

Layer Code	Depth (m) To	Depth (m) From	Sample Type/No	Description
L1	0.3	0	top soil (loamy)	dark gray; clayey silt material; with organic remains
L2	0.7	0.3	transition zone	Silty clay; tuffaceous material, with some finegravel (~15%); coarse sand; brown to light gray
L3	1.00	0.7	Clayey Silt	Clayey Silt; brown to dark gray; with traces of sand and fine gravels (~5 to 10%)
L4	2.0	1.0	silty sand	Clayey silty sand; with fine to coarse gravels; dark gray; with coarse sands; with mottled reddish brown tuffaceous clay

Exhibit 5-13 Test Pit in Vertisol (Guadalupe Clay) in Naic

5.1.1.7 Geohazards

Seismic hazards. Earthquakes are a regular occurrence in the central part of Luzon; this can be readily inferred from the map in Exhibit 5-14, which shows the epicenters of all earthquakes above 3.0 magnitude recorded between 1900 and 2021. Significant clusters are visible along the branches of the Lubang-Verde Passage Fault to the south of the project area and across the northern Bataan Peninsula for this particular time period but there are many potential sources of seismic energy in the region and also numerous factors influencing the practical effects of particular seismic events in a given place. The design of the BCIB has prepared for seimic events and therefore the risk profile for the BCIB project is low. The map nevertheless is indicative of an active, complex seismic landscape.

Buildings and infrastructure are vulnerable to five main effects of earthquakes: ground shaking, ground rupture, liquefaction, tsunamis and landslides. Each of these effects and their relevance to the BCIB project area is discussed briefly below.

Ground shaking. A probabilistic seismic hazard assessment (PSHA) conducted for the BCIB project site generated ground motion estimates for 100-, 1,000- and 2,500-year shaking levels for V_{s30} of 760m/s, 450 m/s and 220 m/s, respectively, for each of 11 locations along the proposed alignment.[50,51] V_{s30} refers to shear wave velocity to 30 m ground depth, a measure of stiffness of ground materials, measured in m/s. 760 m/s, 450 m/s and 220 m/s are shear wave velocity values chosen to represent less stiff, moderately stiff and more stiff ground materials, respectively. These mid-range representative values are a commonly used stand-in for empirically measured Vs data when modeling is conducted with incomplete geotechnical field data. Geotechnical investigations were still ongoing at the time the PSHA was carried out and the assumptions and findings will be subject to refinement and validation when all geotechnical test data are available.

[50] Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.
[51] The analysis was conducted before empirical shear wave velocity measurements were available for all 11 sites used in the model; then-available data for three sites on the Bataan end of the alignment indicated that 220 m/s would not be a relevant shear wave velocity for this area, so those three sites were only modeled at V_{s30} = 450 m/s and V_{s30} = 760 m/s.

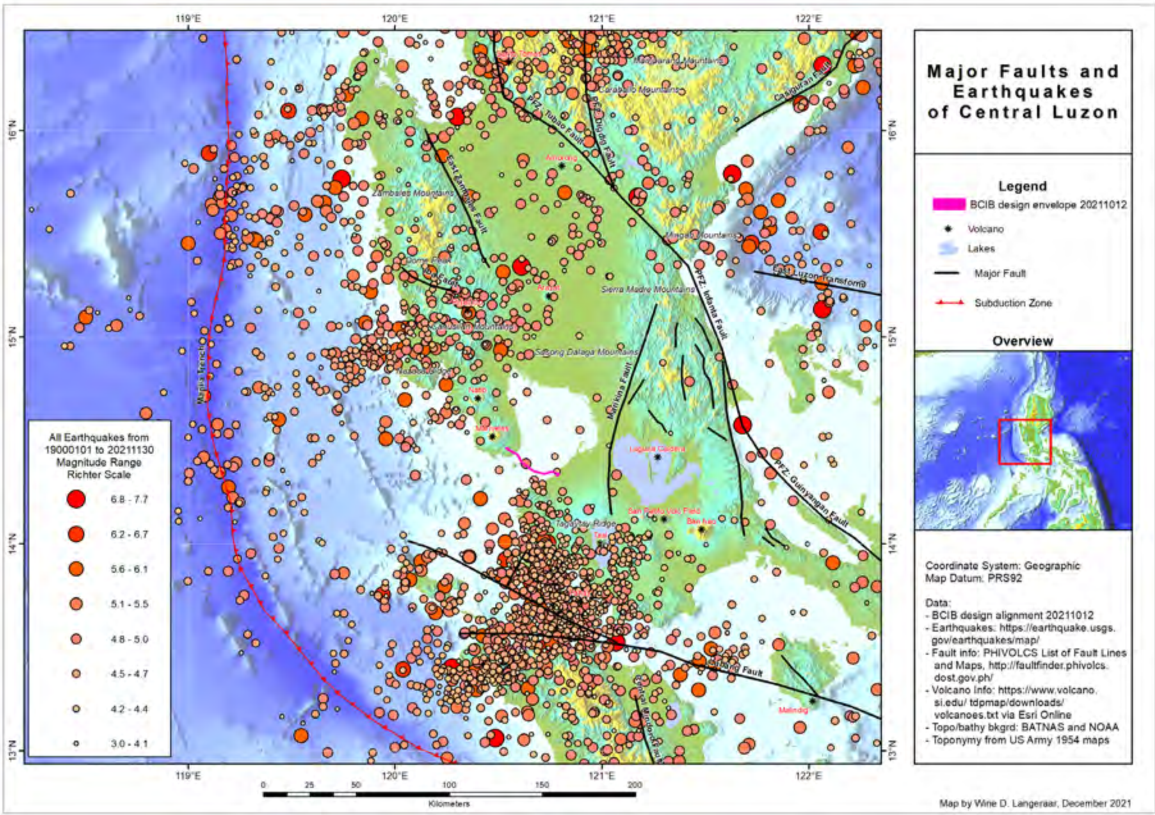
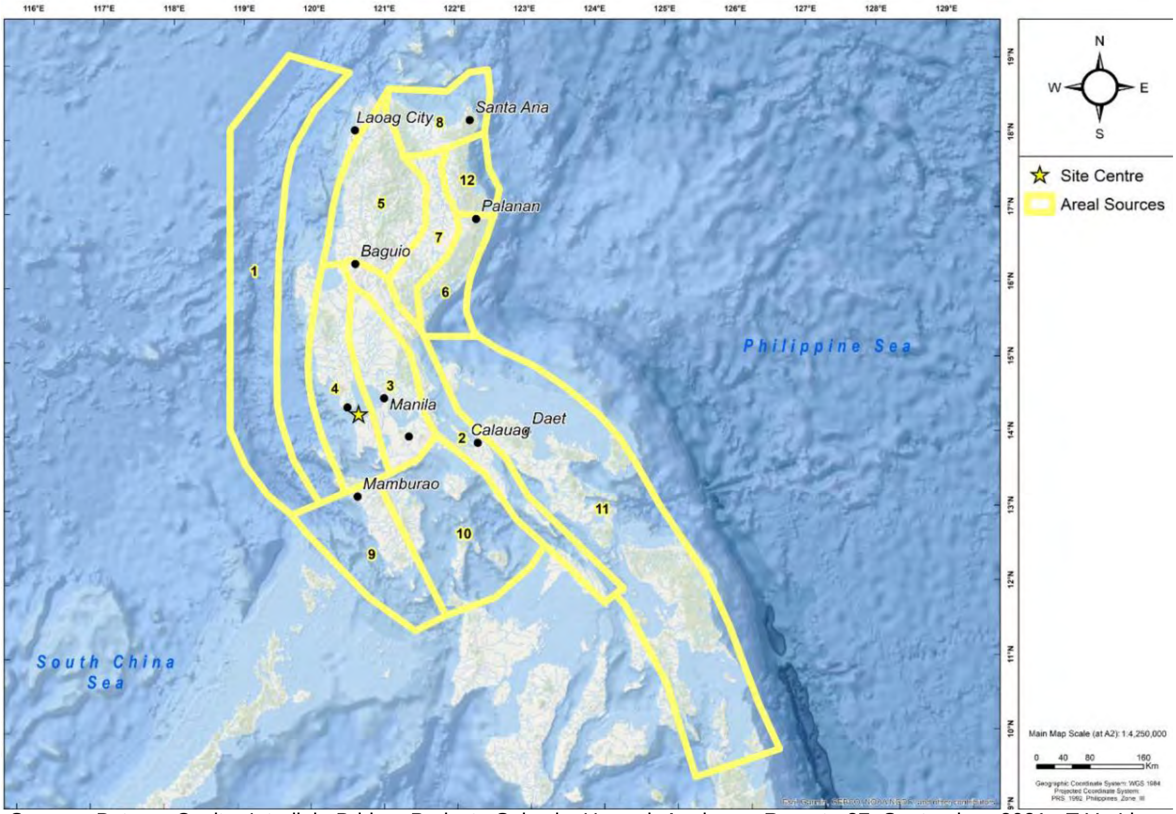


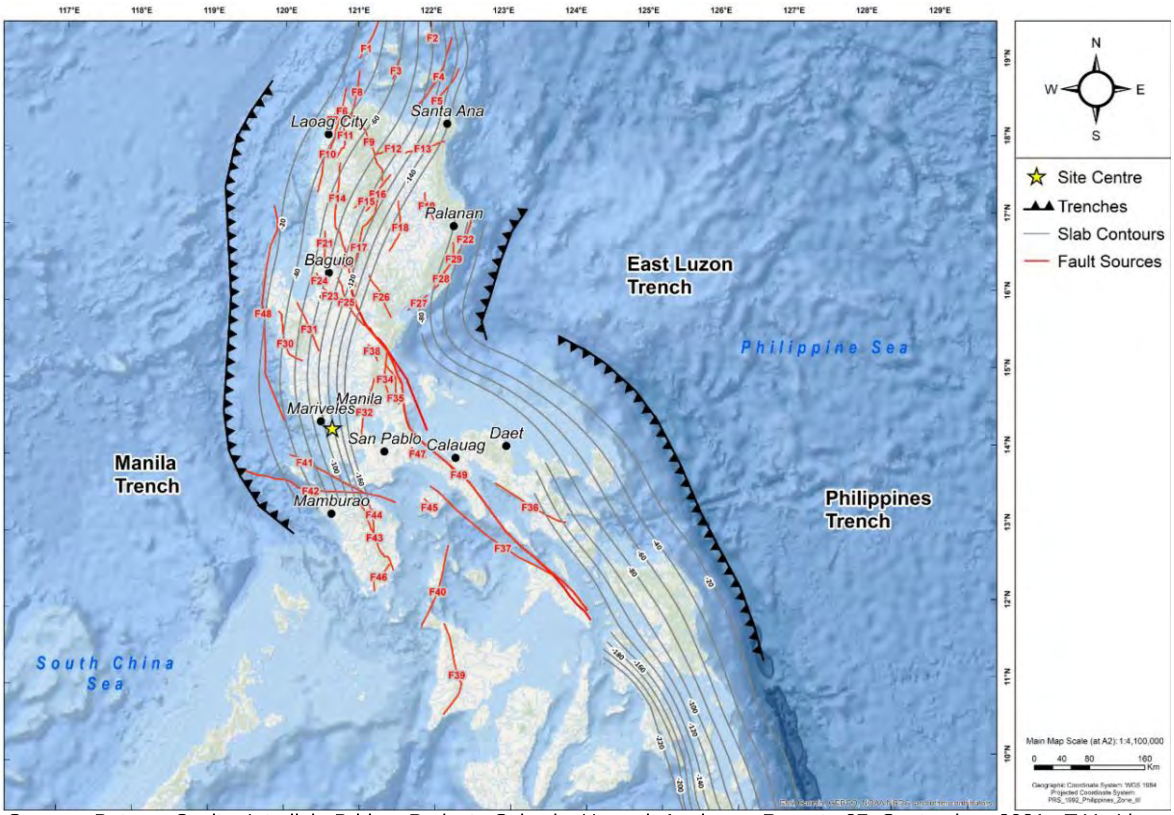
Exhibit 5-14 Earthquake Occurrence in Central Part of Luzon, 1900-2021

The PSHA developed a regional seismotectonic model based on an analysis of the geometry and historical seismicity of all potential seismogenic sources within 300 km of the proposed BCIB project site. The model incorporated 12 shallow areal zones, 49 shallow crustal fault sources, 3 intraplate subduction sources, 3 interface subduction sources, 3 deep areal sources below the interface subduction sources and 8 deep areal sources below the shallow crustal sources. Shallow areal source zones are regions of the shallow crust (defined as less than 40 km deep) in which a uniform style of faulting, earthquake magnitude and earthquake recurrence characteristics but for which there is insufficient data to model specific faults; these are mapped in Exhibit 5-15. Shallow crustal fault sources are specific active faults for which data are sufficient to estimate magnitude and recurrence values for representative events (see Exhibit 5-16). Subduction source zones include the plate interfaces of the subduction zones, as well as the intraplate portions of these zones (Exhibit 5-17). Deep areal sources are volumes of the lower crust that are considered seismogenic and extend from the base of the shallow crust (40 km below the surface) to 200 km below the surface; these are shown in Exhibit 5-18.



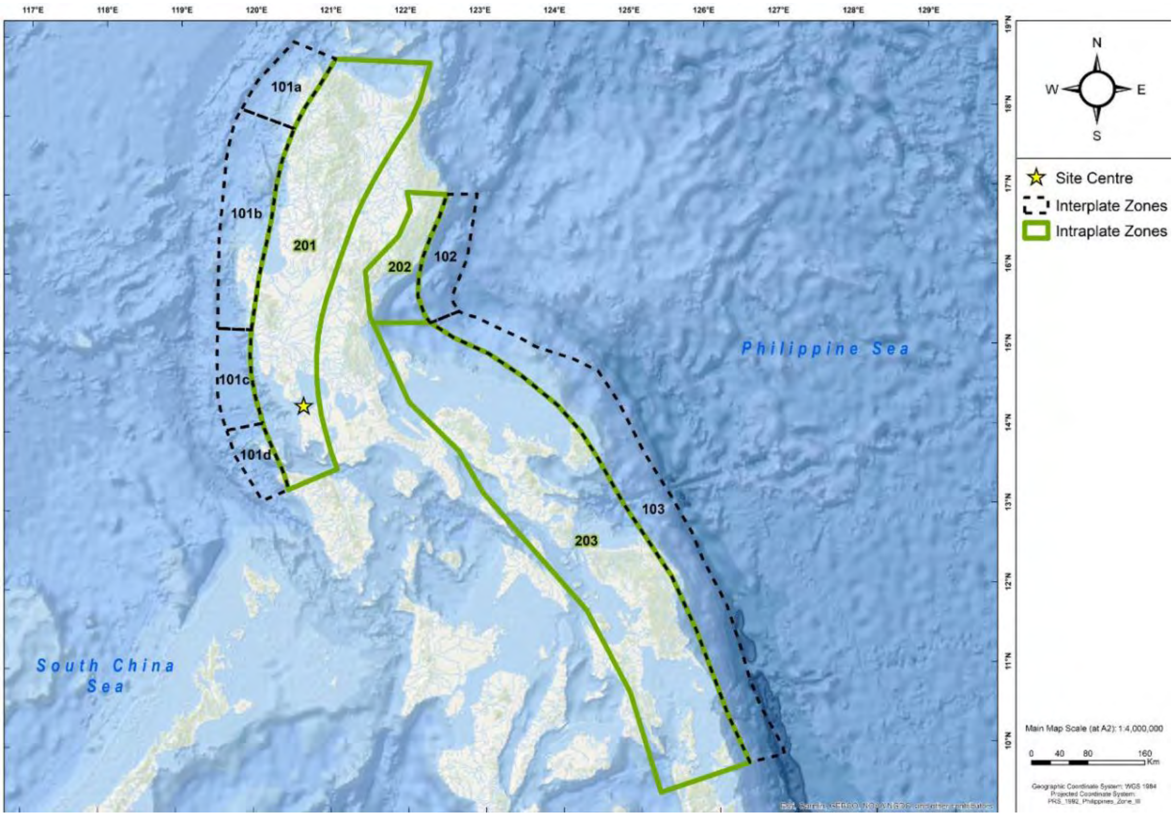
Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-15 Shallow Areal Seismic Source Zones



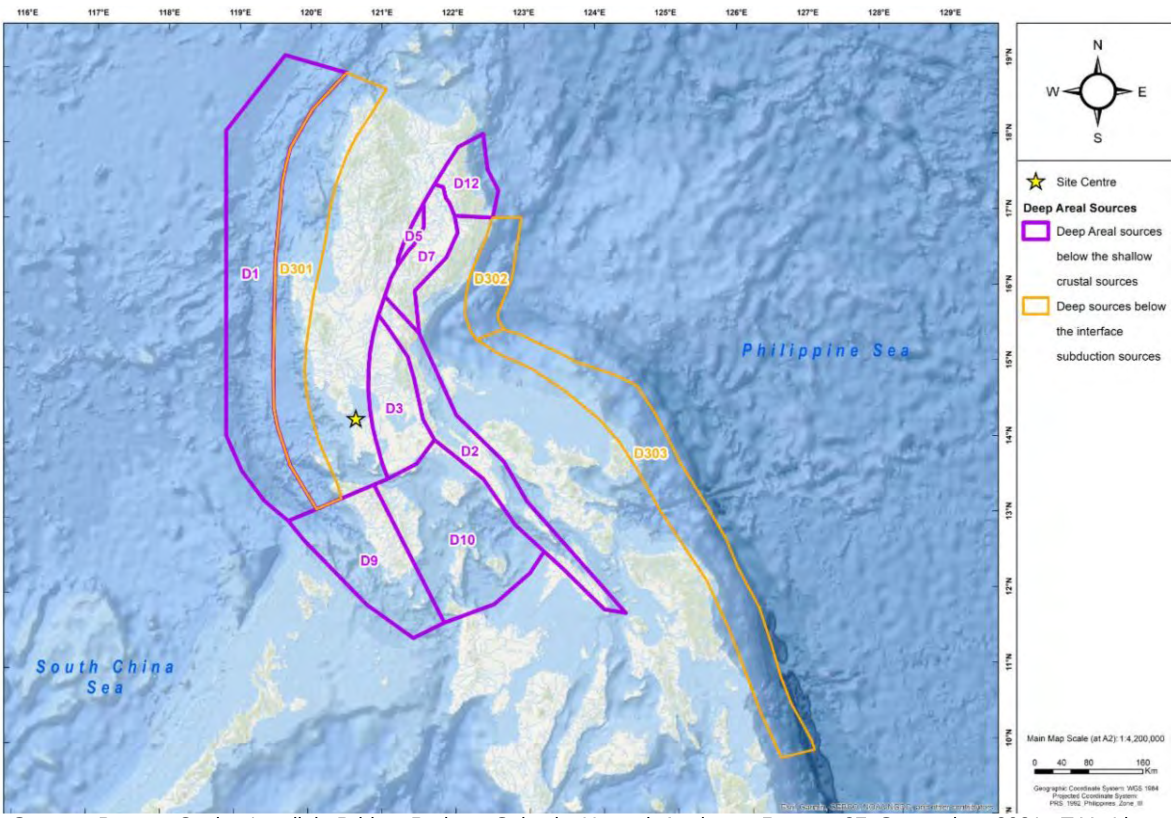
Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-16 Shallow Crustal Faults



Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-17 Subduction Source Zones



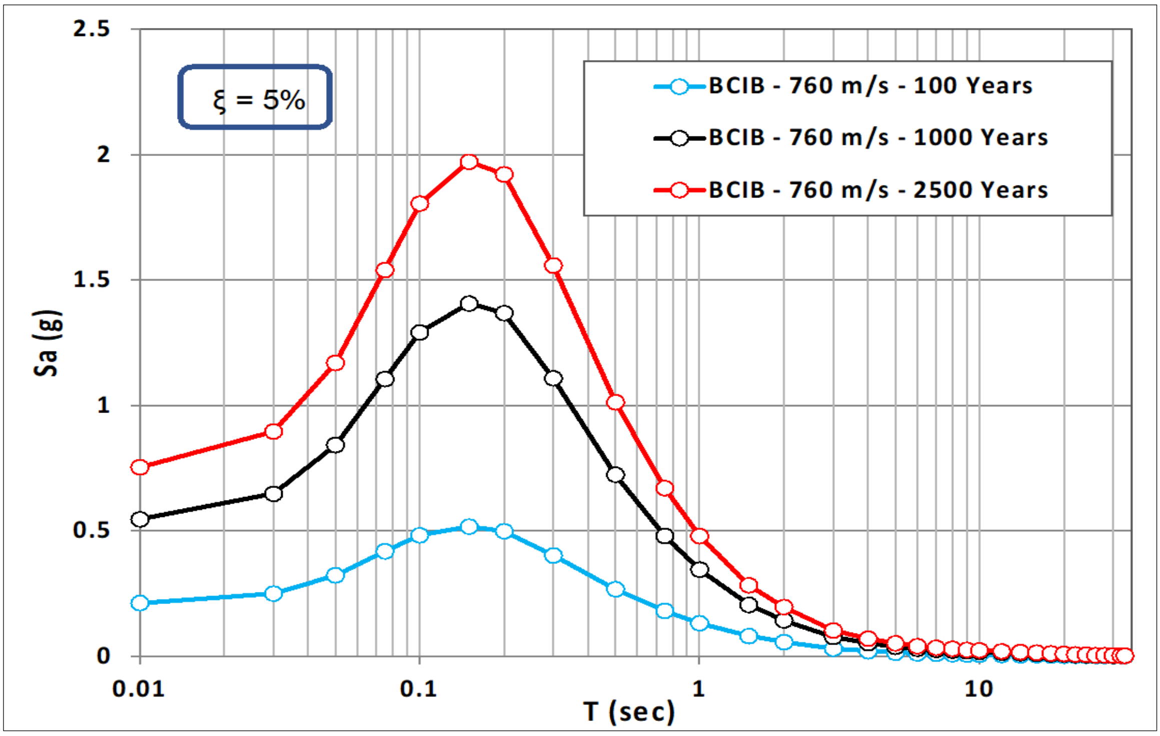
Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-18 Deep Areal Seismic Source Zones

The modeled seismic hazard for the proposed BCIB project site was disaggregated to identify the most significant contributing sources. For V_{s30} of 760 m/s at short oscillator periods, the primary contributors to ground motion hazard for all shaking levels were found to be intraplate subduction source 201 – Manila Intraplate and shallow areal source A4 Zambales, within which the BCIB project site is located. Other important contributors were Interface 101 – Manila Interface and deep areal source D3 – Central Valley, whose significance is greatest towards the Cavite side of the project area. At long oscillator periods (1 second and 5 seconds) and V_{s30} of 760 m/s, the most important contributor to seismic hazard at the BCIB site was found to be fault F49 – Philippine Fault, with significant contributions also coming from interface subduction source 101 – Manila Interface, intraplate subduction source 201 – Manila Intraplate and fault F32 – West Valley Fault; the latter source has its greatest significance towards the Cavite end of the project alignment. For long structural periods, the contribution from 101 – Manila Interface was found to be higher on the Bataan side and lower on the Cavite side. Similar shaking hazards were modeled for V_{s30} of 450 m/s and 220 m/s, with the main difference being that the contribution from subduction structure sources was found to decrease somewhat at these lower shear wave velocities, while the significance of shallow crustal sources increased.

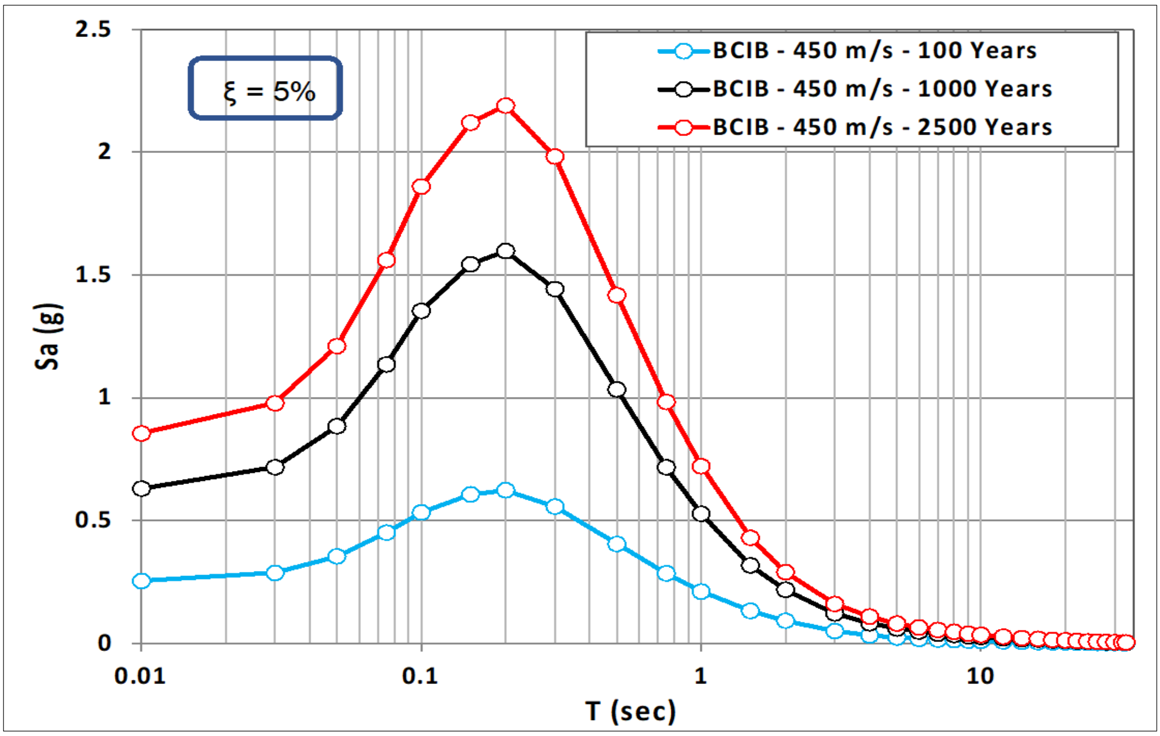
Further disaggregation of the seismic hazard by event magnitude and distance indicated that the short-period hazard for all shaking levels (100 year, 1,000 year, 2,500 year) is primarily associated with earthquakes of M_w 7.0–8.5 occurring within 50–150 km from the BCIB site; this distance range includes the two subduction zone sources mentioned above, 101 – Manila Interface and 102 – Manila Intraplate. A significant contribution to the hazard was also foreseen from M_w 5.0–7.0 events occurring within the 0–50 km range, which corresponds to the shallow crust areal source A4 – Zambales; this applies especially to the 100-year shaking level. With respect to longer oscillator periods, i.e., 5 seconds, the primary contributors to seismic hazard at the BCIB location were identified, for all shaking levels, as M_w 7.0–8.5 quakes taking place at a distance of 50–150 km, specifically the sources F49 – Philippine Fault and to a lesser extent, the interface subduction zones 101 - Manila Interface and 102 – Manila Intraplate and the planar source F32 – West Valley Fault.

Horizontal acceleration response spectra (indicating the intensity of shaking) are shown for V_{s30} = 760 m/s, V_{s30} = 450 m/s and V_{s30} = 220 m/s (all shaking levels) in Exhibit 5-19, Exhibit 5-20 and Exhibit 5-21, respectively. The data presented indicate that for all shear velocities and shaking levels, the greatest spectral acceleration would be expected for oscillator periods in the range of 1.1–1.4 seconds. Maximum spectral acceleration (2,500 year shaking level) would be on the order of 1.9 g for V_{s30} = 760 m/s and marginally higher at approximately 2.2 g for both and V_{s30} = 450 m/s and V_{s30} = 220 m/s.



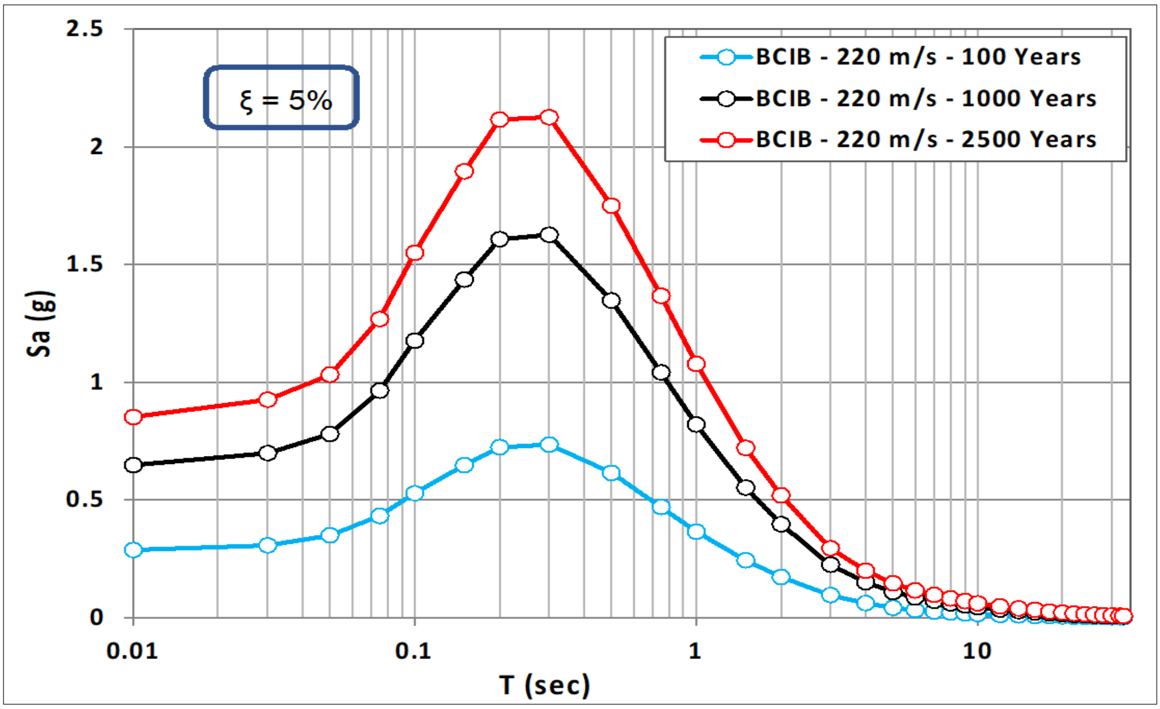
Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-19 Horizontal Acceleration Response Spectra, V_{s30} = 760 m/s



Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

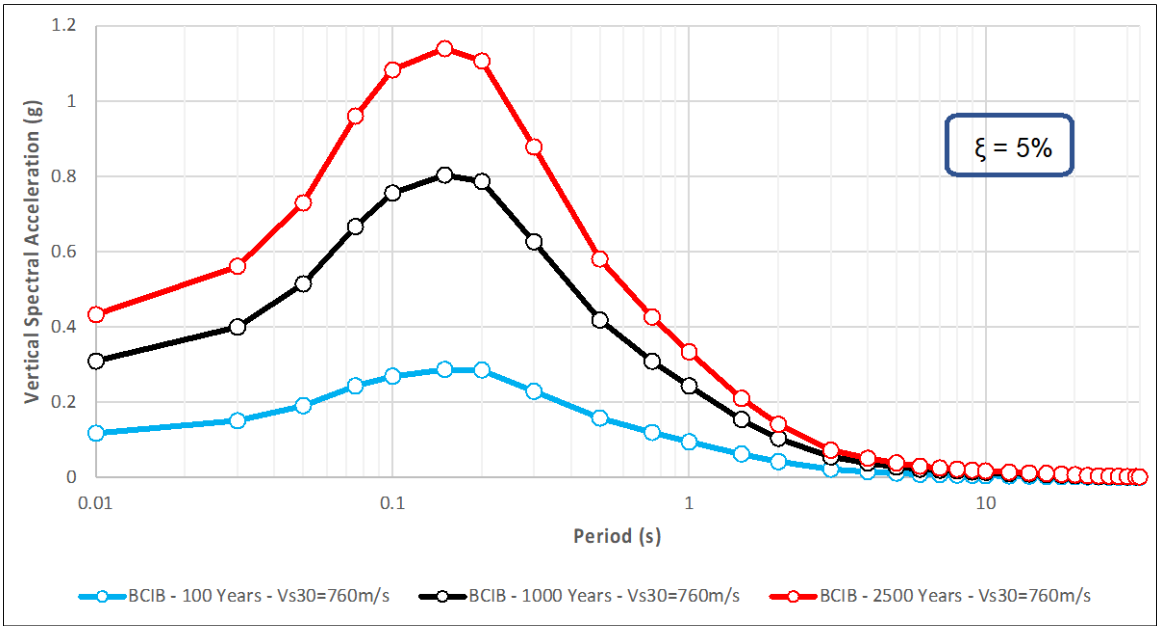
Exhibit 5-20 Horizontal Acceleration Response Spectra, V_{s30} = 450 m/s



Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

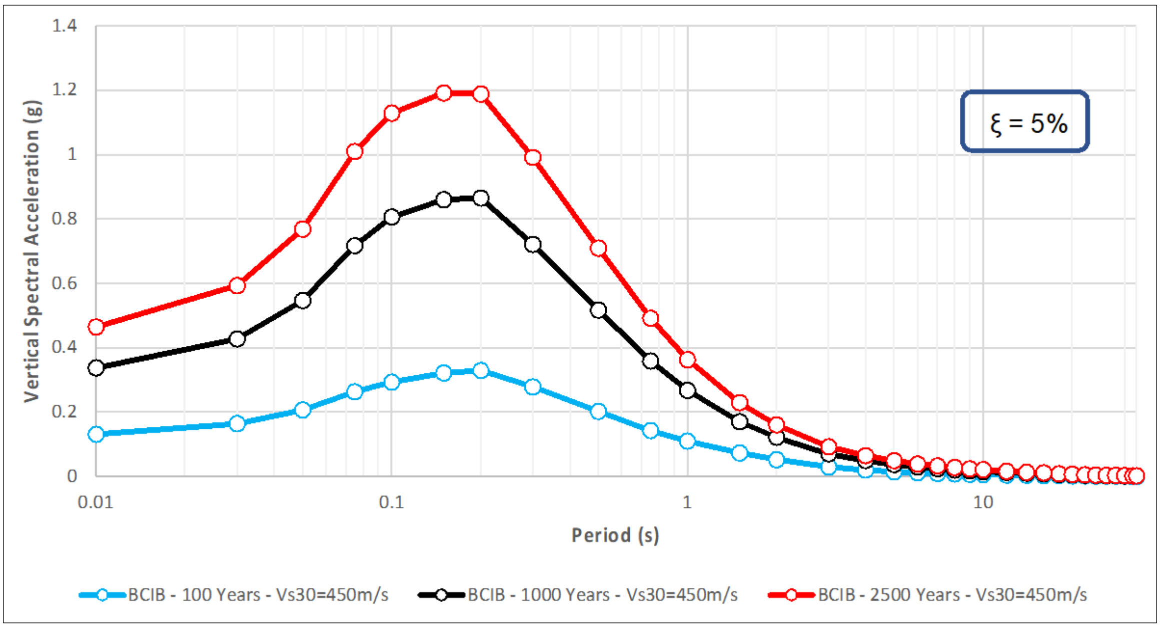
Exhibit 5-21 Horizontal Acceleration Response Spectra, V_{s30} = 220 m/s

The vertical component of seismic shaking hazard at the BCIB project area was also modeled. Vertical uniform hazard spectra were developed (for 100 year, 1,000 year and 2,500 year shaking levels) from vertical–horizontal (V/H) ratios estimated for the horizontal response spectra at V_{s30} of 760 m/s, 450 m/s and 220 m/s. The vertical acceleration spectra for these three shear wave velocities are presented in Exhibit 5-22, Exhibit 5-23 and Exhibit 5-24. The vertical shaking component would be expected to be substantially weaker than the horizontal component, with maximum acceleration values (2,500 year shaking) reaching just over 1.1 g for V_{s30} = 760 m/s and V_{s30} = 220 m/s and 1.2 g for V_{s30} = 450 m/s.



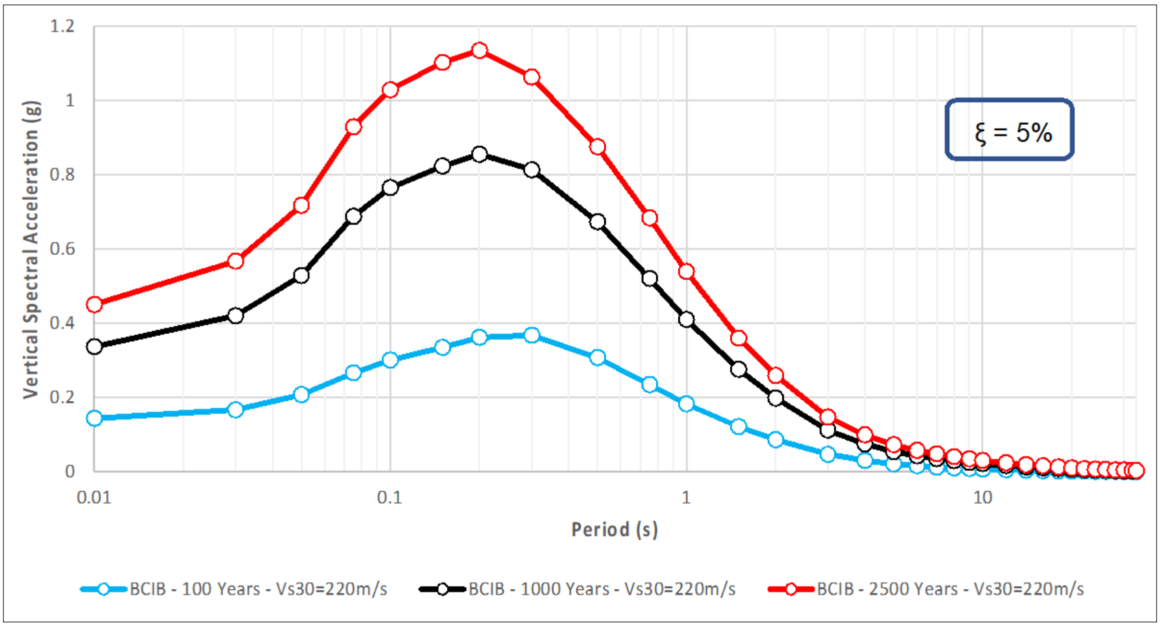
Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-22 Vertical Acceleration Response Spectra, V_{s30} = 760 m/s



Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-23 Vertical Acceleration Response Spectra, V_{s30} = 450 m/s



Source: Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.

Exhibit 5-24 Vertical Acceleration Response Spectra, V_{S30} = 22 m/s

Ground rupture. In the case of surface-expressed faults, seismic events may involve longitudinal shearing, differential uplift, buckling or opening of minor chasms along the fault, causing catastrophic damage to structures built in close proximity. This is of great concern with respect to the Valley Fault where it runs through Metro Manila, as the fault is overlain by a high density of buildings, industrial facilities and linear infrastructure. Analysis of subsurface relationships observable in test trenches along the Valley Fault suggest lateral slips of 1–2 m and vertical displacements of 20–40 cm during past earthquakes; even larger displacements (up to 6 m lateral strike slip displacement) in events on the Philippine Fault.[52] There are no known surface-expressed faults within the BCIB project area, so ground rupture is not of any concern there.

Liquefaction. The cause of significant and widespread structural damage to buildings and infrastructure during earthquakes in zones with loose, saturated and low-cohesion soils, liquefaction is characterized by sudden fluid behavior and near zero shear resistance in ground that may seem solid under normal circumstances. Substantial portions of the Manila Bay region are underlain by relatively young, weakly cohered sedimentary formations considered susceptible to liquefaction (see Exhibit 5-25). The vulnerable area includes a large portion of Metro Manila and extends southwest along the south shore of Manila Bay, including all coastal and near-coastal portions of Cavite. PHIVOLCS mapping indicates that the liquefaction potential in Naic is highest in a narrow band (approximately 200–300 m wide) along the coast and decreases with increasing distance from the shore.[53] The southern Bataan Peninsula is mostly considered not to be susceptible to liquefaction, except in the case of alluvial deposits that occur in limited areas along the coast; such deposits are found around Mariveles Bay and also beneath the coastal built-up areas of Cabcaben and Townsite, a few kilometers from the proposed BCIB alignment.

[52] Bataan–Cavite Interlink Bridge Project, Seismic Hazard Analyses Report. 27 September 2021. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd JV.
[53] PHIVOLCS. Ready for GMAA Project: Liquefaction Hazard Map of Naic. December 2014.

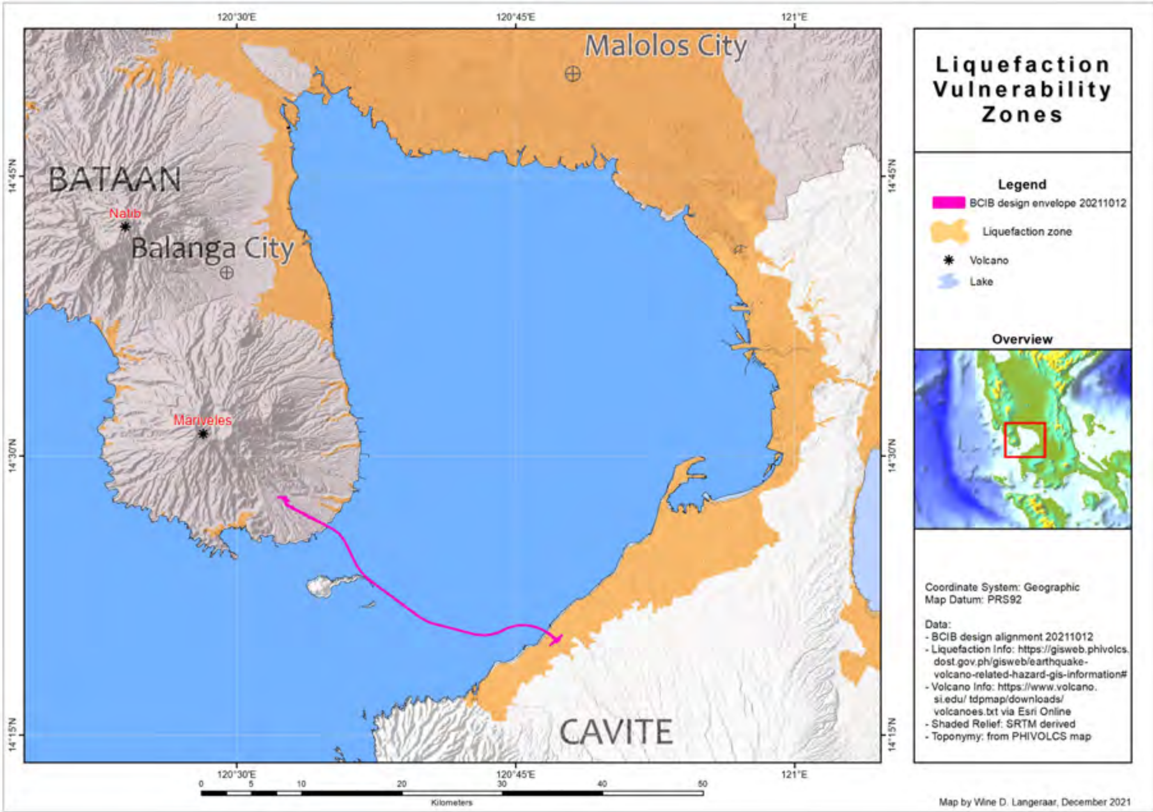


Exhibit 5-25 Land Areas Prone to Liquefaction in Manila Bay Region

Tsunamis. Due to its positioning near a major active oceanic trench, with unobstructed open water in the intervening space, the BCIB project area can be said to have high vulnerability to tsunamis. Tsunami risk modeling carried out by PHIVOLCS suggests that tsunami waves up to 5.5 m may be a predictable scenario in the event of a shallow 8.3 magnitude earthquake occurring along the Manila Trench anywhere between 14° N and 16° N, translating into at-shore surges of lesser or greater depth, depending on local bathymetry.[54] The maps in Exhibit 5-26 and Exhibit 5-27 show the approximate expected direct impact zone of a tsunami wave of this magnitude in the BCIB project area. The maps adopt an indicative scenario of 7 m at-shore wave height, based on the PHIVOLCS 5.5 m tsunami wave height assumption and allowing for a 25% hypothetical magnification effect from local bathymetry. The greatest impact in the Bataan side of the project area would be experienced in the built-up areas of Barangays Cabcaben and Mountain View, as well as the industrial and residential areas around Mariveles Bay. On the Cavite side, the effects would be heavier, due to the preponderance of low-lying land along the coast. Here, significant areas of land would be affected, including some areas of relatively high population density along the coastline, e.g., Barangays Munting Mapino and Timalan Concepcion.

[54] (1) NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.; (2) PHIVOLCS. Ready for GMAA Project: Tsunami Hazard Map of Naic. December 2014.

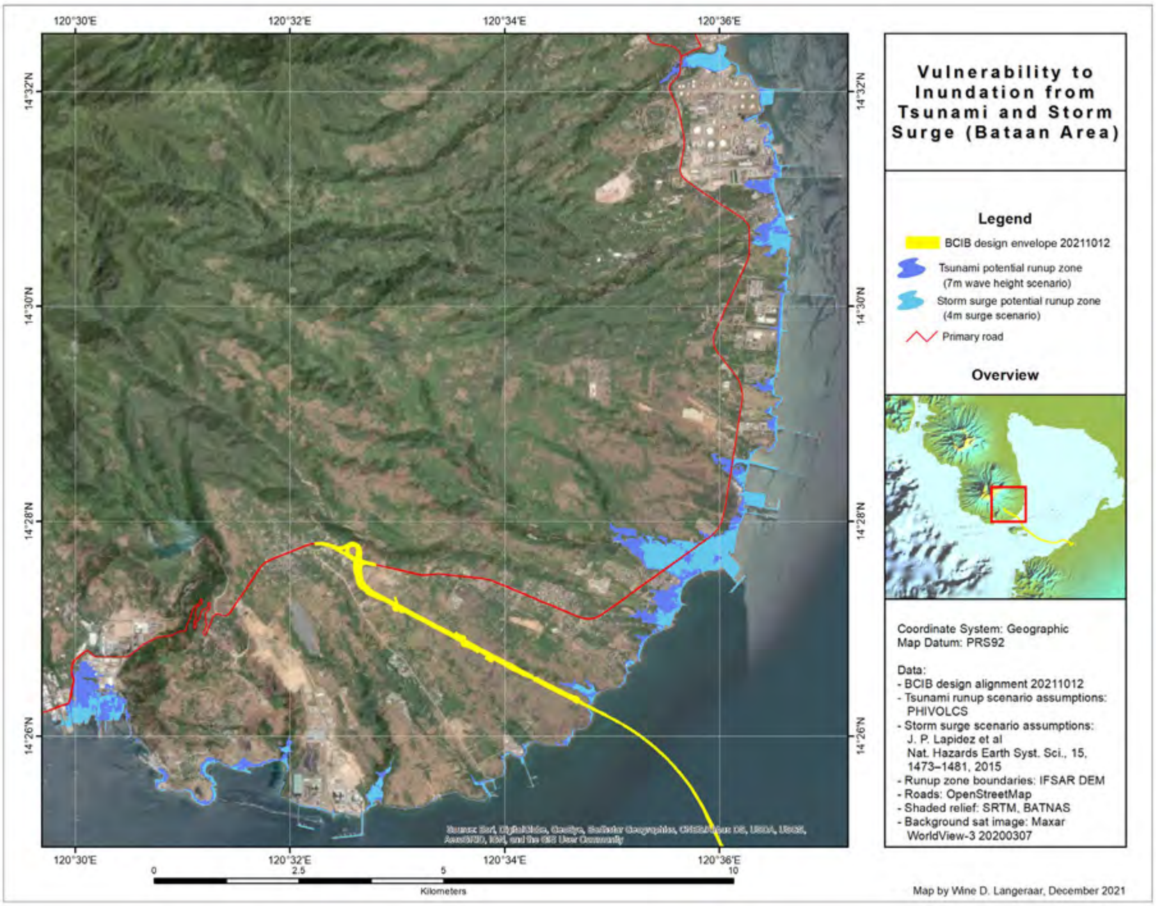


Exhibit 5-26 Coastal Vulnerability to Tsunamis in BCIB Project Area (Bataan)

Landslides. In many parts of the Philippines, landslides are a significant local geohazard and may be triggered by seismic events but also by volcanic eruptions, high slope saturation, slope disturbance by human activity. Usually, two or more factors combine to produce landslides. The Bataan portion of the BCIB project area has low vulnerability to large landslides, because of the generally quite moderate slopes that characterize the topography near the coast, although some potential for localized exists on steeper slopes of river valleys and ravines, including some nearby the proposed BCIB footprint (notably the west side of Pangosalanin River and Babuyan River valleys). Landslide vulnerability is greater higher up on the slopes of the Mt. Mariveles, particularly where forest clearance for agricultural use has occurred. The Cavite portion of the BCIB project area is not at all vulnerable to landslides, even in earthquakes, due to the absence of significant slopes.

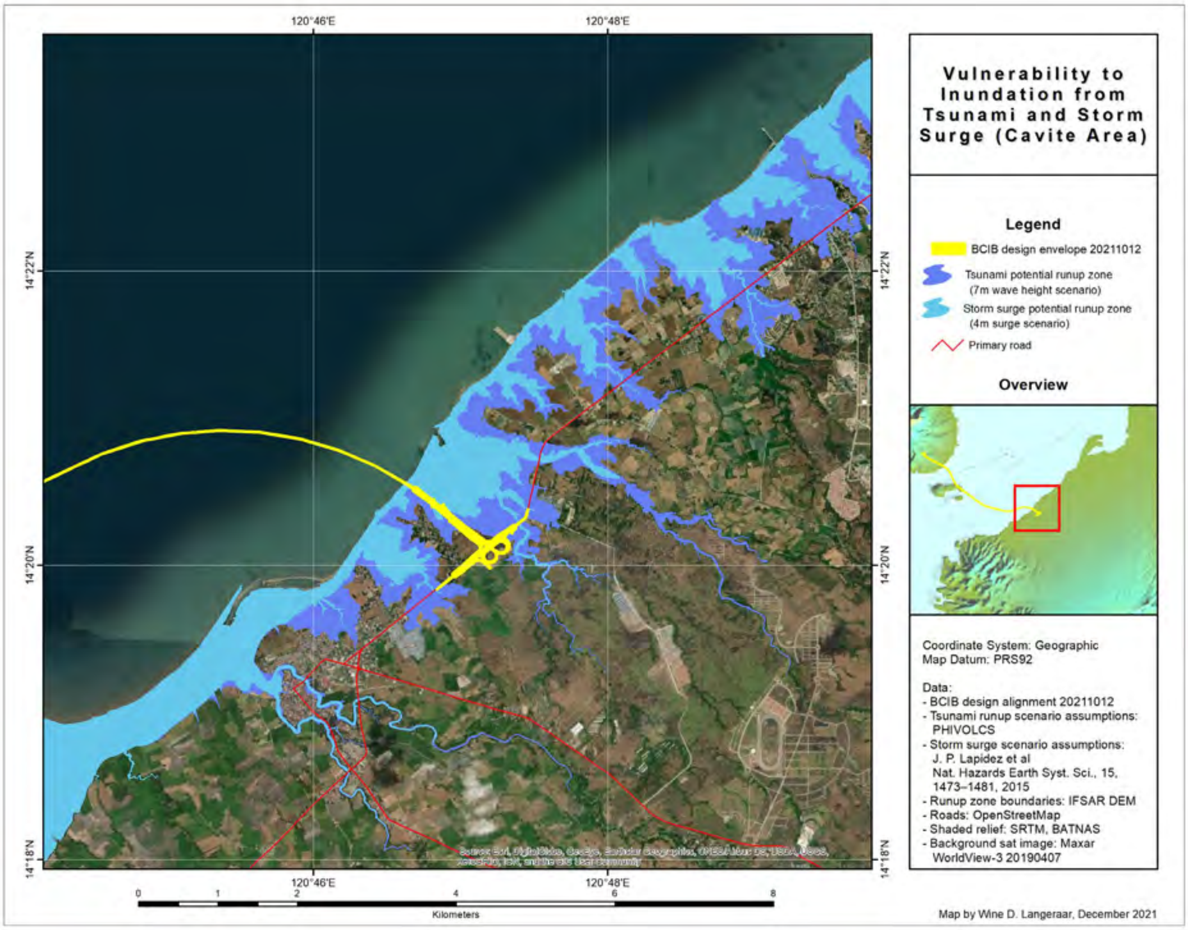


Exhibit 5-27 Coastal Vulnerability to Tsunamis in BCIB Project Area (Cavite)

Volcanic hazards. Being nearby a number of active and potentially active volcanos, the BCIB project area is at some risk of being affected by volcanic eruptions, with the severity of effects being dependent on various factors, including distance from the erupting volcano; nature, volume and duration of volcanic emissions; wind direction; topography; and rainfall and prior soil saturation levels at the time of the eruption. The primary volcanic hazards are pyroclastic flows, lahar flows and ash fall.

Pyroclastic flows. The most dangerous volcanic phenomenon, pyroclastic flows are very fast-moving torrents of lava, rock fragments, gases and ash. Pyroclastic flows may descend the slope of a volcano at speeds up to 160 km per hour, engulfing everything in their path in material up to 375°C. The heavier solids that flow along the ground surface typically burn, crush, displace and bury ground features, while the lighter gases and ash burn and suffocate every living thing in the path of the flow. Evidence of past pyroclastic flows is abundant in the bedrock of the BCIB project area, especially in the Bataan portion area, where coastal erosion and road cuts have exposed substantial pyroclastic members (refer to Exhibit 5-8).

Lahar flows. Lahar flows are large-volume, fast-moving rivers of slurry composed of pyroclastic material, debris and water. Often having the consistency of cement and carrying boulders of various sizes as well as trees and other debris gathered upslope, lahar flows may be up to tens of meters deep and travel at speeds in the tens of meters per second. A substantial water source is necessary for a lahar flow to occur and this may be supplied by a crater lake, heavy rain during or following an eruption, or glaciers and snowpack melted by the sudden influx of hot pyroclastic material. Massive lahar flows occurred when Mt. Pinatubo erupted in 1991, just as a major cyclone dumped heavy rains on northern Luzon; the resulting transformation of the downslope landscape is readily seen on satellite imagery of the area. There is some evidence of past lahar flows on the lower slopes of Mt. Mariveles, including within the BCIB project area (refer to Exhibit 5-9).

Ash fall. Outputs of ash (actually fine particles of rock material) from volcanic eruptions can be voluminous and may seriously impair air quality, disrupt ground and air transportation, limit crop growth or bury crops completely, clog drainage channels and air handling systems and even cause the collapse of poorly constructed roof structures. Impact zones for ash falls are difficult to model, as wind direction and wind speed (at multiple atmospheric levels) at the time of ash-producing eruptions strongly influence the area subject to deposition. Past eruptions of volcanos near the BCIB project area have involved significant ash emissions, as recorded in recent events and evidenced by a preponderance of tuffs (a kind of rock formed from ash depositions) in local strata, particularly in Cavite.

5.1.2 Land Use and Land Use Trends

5.1.2.1 Land Cover

Bataan

Land cover in and around the Bataan portion of the BCIB project area consists of a semi-rural patchwork of pasture, orchards, grassy fallow, grassland, scrubland, plantations, secondary forest, industrial sites and built-up areas. In general, forest cover and plantations, as well as some natural grassland, prevail on the higher and steeper slopes of Mt. Mariveles, while cultivated land, orchards, grassy fallow, grassland, scrubland, industrial sites and residential-commercial areas predominate on the lower slopes closer to Manila Bay. The distribution of built-up areas is concentrated along the Roman Highway and along the coastline. Land cover as of 2020 is shown in Exhibit 5-28.

A breakdown of land uses by area and percentage area for all of Mariveles (as of 2017) is provided in Exhibit 5-29. Over 90% of the municipality is comprised of open space and 77% of the open space consists of treed land, including forest, plantations and coconut groves. The BCIB project area is considerably less endowed with trees than the municipality as a whole, with scrubland being the dominant land cover along most of the alignment. Limited cropping areas are present towards the north end of the alignment, near Alas Asin village. The northern end of the alignment, including the interchange, are situated within the built-up area along the Roman Highway.

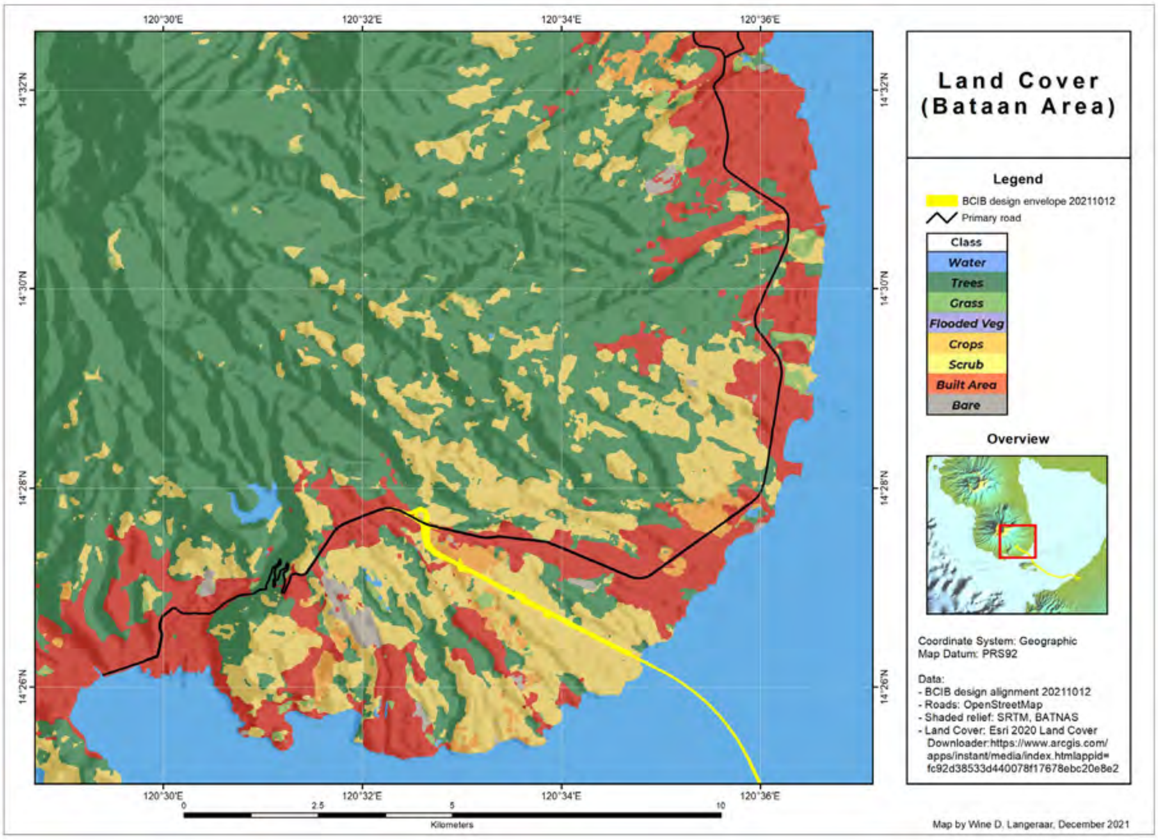


Exhibit 5-28 Land Cover in BCIB Project Area (Bataan), 2020

Exhibit 5-29 Breakdown of Land Use, Mariveles (2017)

Land Cover Type	Land Area	% of Total
Built-up area	1,459.81	9.17
Open space	14,460.19	90.83
Total land area	15,920.00	100.00
Open Space Categories		
Agro-forestry	4,507.42	31.17
Closed forest	3,464.70	23.96
Coconut	3,176.50	21.97
Fishpond	917.42	6.34
Fruit trees	511.34	3.54
Grassland	504.62	3.49
Idle land	390.60	2.70
Inland water	353.45	2.44
Mango	327.23	2.26
Open forest	108.12	0.75
Open/barren	79.96	0.55
Paddy rice	42.97	0.30

Land Cover Type	Land Area	% of Total
Pastureland	37.99	0.26
Shrubs	25.91	0.18
Vegetable	6.55	0.05
Wooded grassland	5.41	0.04
Total	14,460.19	100.00

Source: Municipality of Mariveles. 2017. Comprehensive Land Use Plan, Mariveles, Bataan (2017–2026), Volume I. Prepared by UP PLANADES, Quezon City.

Corregidor Island

Land cover on Corregidor Island consists mostly of secondary growth of forest and scrub, as well as substantial grassland areas (see Exhibit 5-30). The island's present vegetative cover represents a substantial recovery since the island's days as a military base, which ended soon after WWII. The ruggedness of the terrain in some parts of the island is suggestive of a possibility that remnants of primary forest and scrub may persist in inaccessible spots like gullies and along coastal cliffs, although intensive use and bombardment during WWII are reported to have essentially razed the entire island. No detailed botanical surveys are known to have been carried out on the island. Tree seeds were spread over the island from airplanes after WWII in an attempt to jumpstart revegetation; the favored species used in the seeding was Ipil-ipil (*Leucaena leucocephala*), a leguminous tree native to Central America which has become naturalized throughout Asia through its widespread adoption in agroforestry, reforestation and afforestation efforts. As a result, ipil-ipil is the dominant species in the island's forests. The predominance of ipil-ipil has been linked to relatively low avian diversity on the island, as bird species that feed on native fruit-bearing trees are mostly absent.[55] A minor portion (less than 5%) of the island's area is occupied by roadways, an airstrip, public sites and buildings. Most of the long thin Tail End portion of the island has been a restricted military area for decades and has become thickly vegetated.

[55] Personal communication, Mr. Jerry Rollin, Consultant, Corregidor Foundation Inc., 28 March 2022.

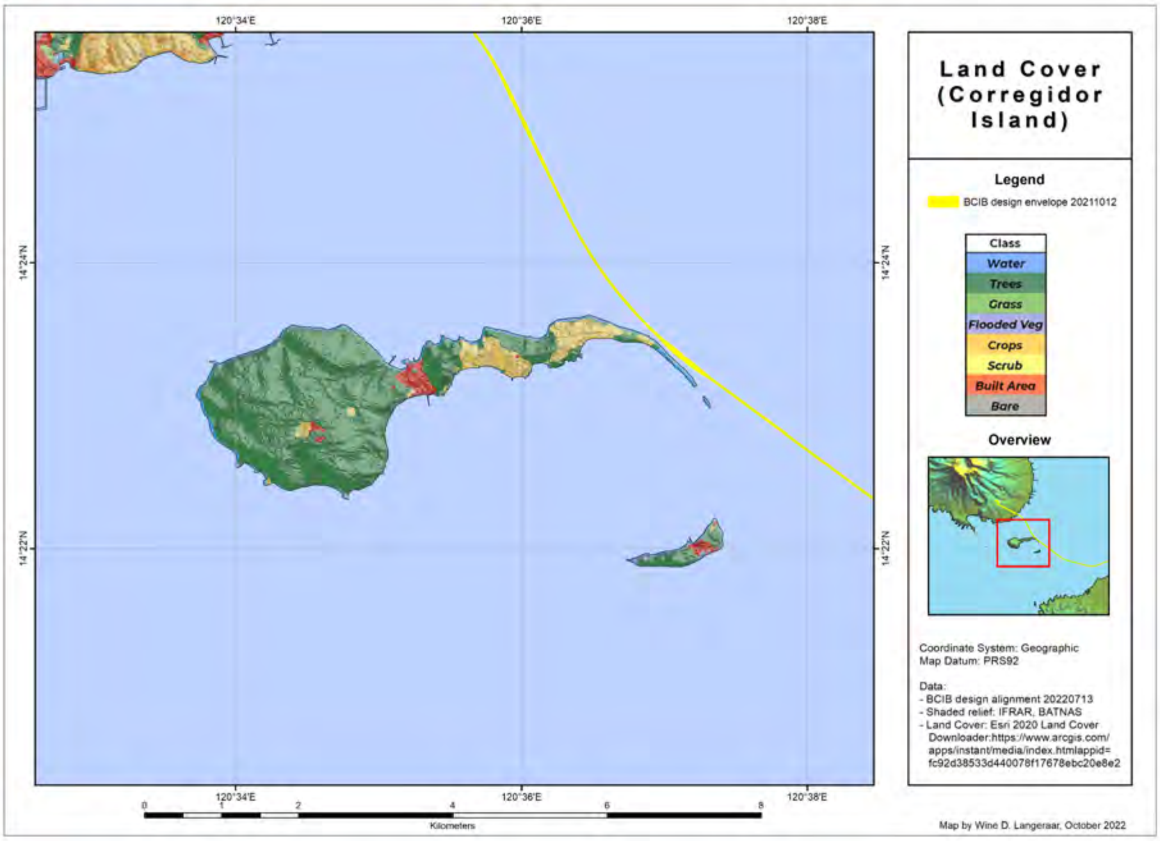


Exhibit 5-30 Land Cover on Corregidor Island, 2020

Cavite

The landscape in the project area on the Cavite side is a mosaic of fields, rice paddies, small plantations and residential-commercial built-up areas. Established development can be found along the coast in most places, although the coastal area nearest the proposed BCIB alignment's landing point remains partly open space. Virtually all road segments in the area exhibit dense strip development, with roadsides occupied by commercial establishments, residences and institutional compounds. There are several recently developed low-rise residential subdivisions in the area. Farmland, mostly used for growing rice or left fallow, occupies the spaces in the matrix of developed strips. There are also some minor areas given over to household gardens and plantations and minor fragments of secondary riparian woodland and mangroves can be found along the area's rivers.

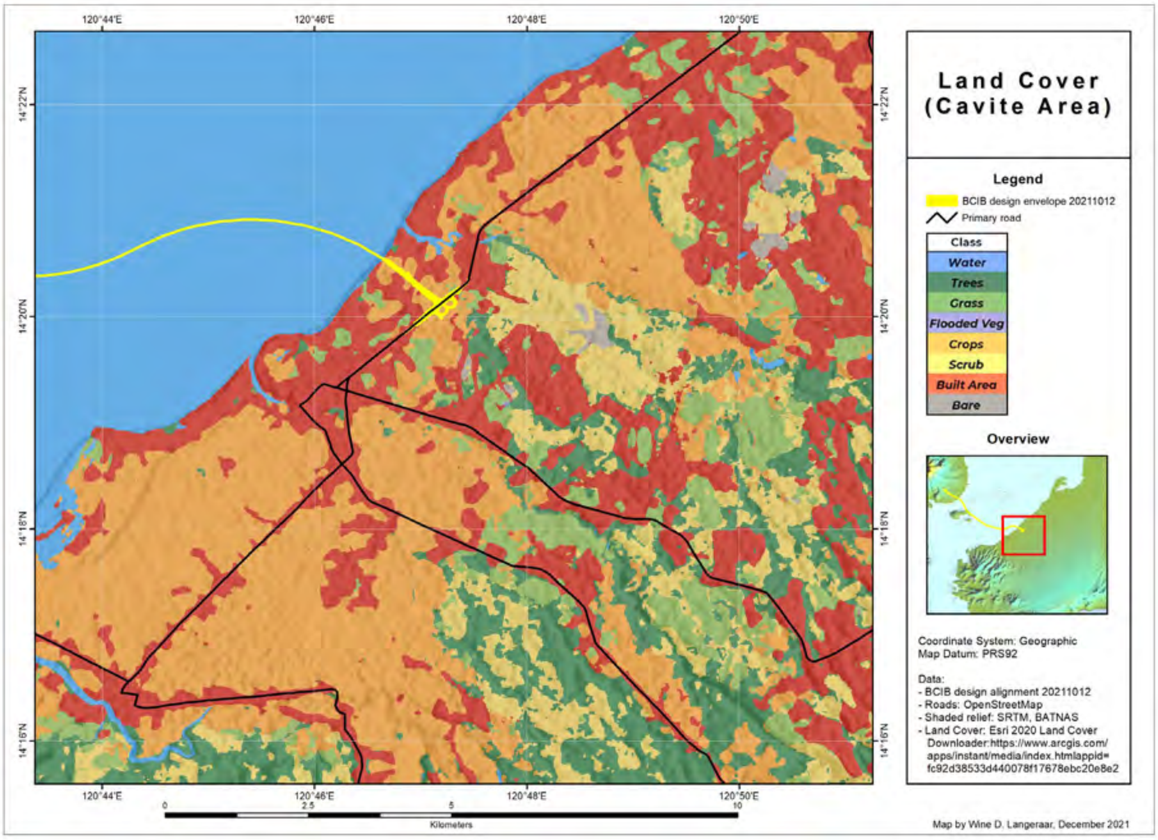


Exhibit 5-31 Land Cover in BCIB Project Area (Cavite), 2020

5.1.2.2 Land Use Change

Bataan

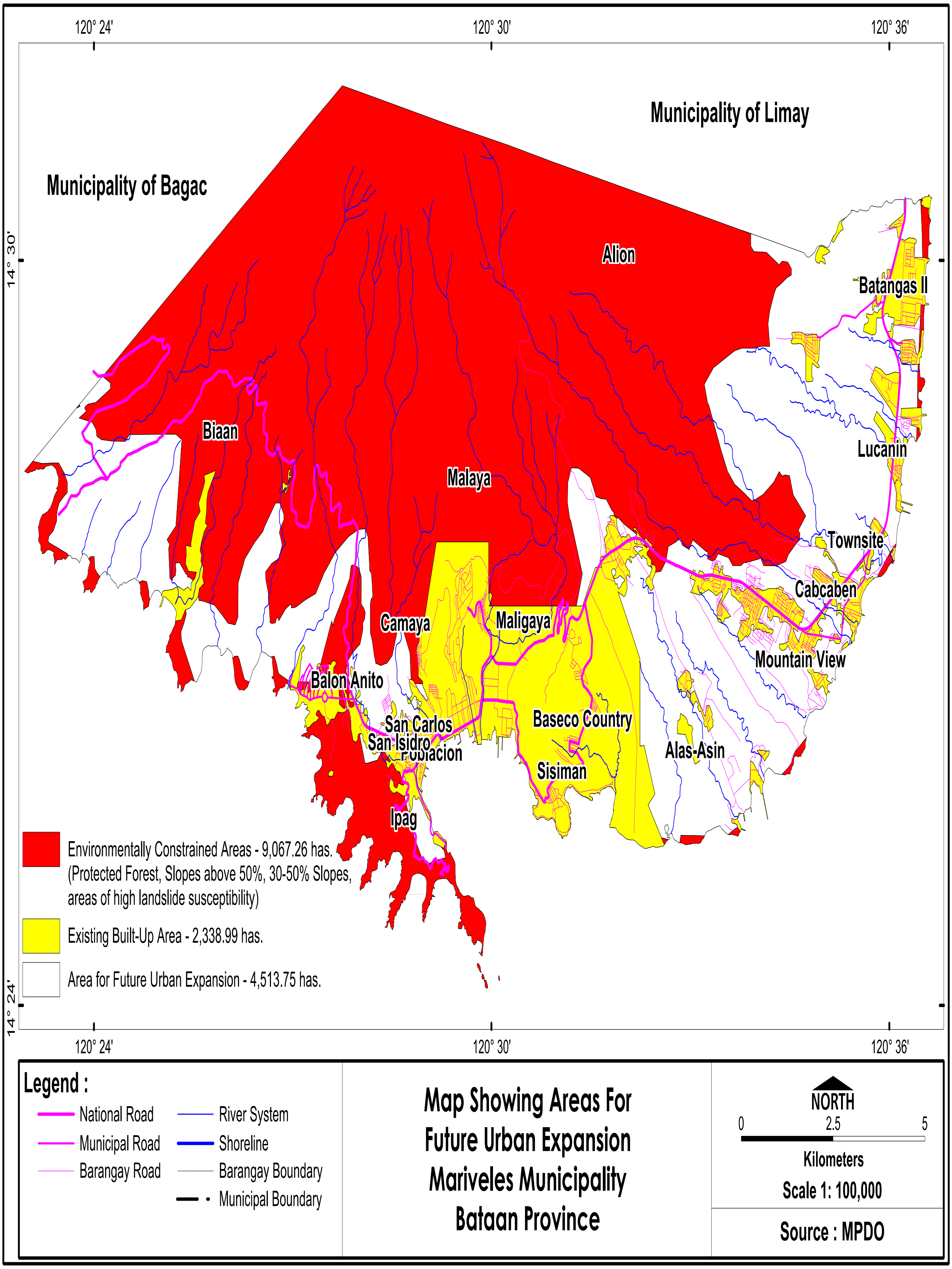
Although population and economic activity in Mariveles have grown appreciably over the last three decades (with population more than doubling and steady addition of enterprises to the FAB), land use change in the general vicinity of the BCIB project alignment, as observed from historical satellite imagery, has been gradual. The area is mostly semi-rural at present but cannot be expected to remain that way over the long term. The southern portion of Mariveles is targeted in both provincial and municipal development plans for industrial development and tourism development and the lands in the vicinity of the BCIB are expected to come under increasing pressure for conversion to new uses.

The Bataan Provincial Development and Physical Framework Plan, 2019–2025 (BPDPFP) designates Mariveles for both industrial development and tourism development, while recognizing the importance of also protecting forest and agricultural land within the context of regional land use priorities. Mariveles town itself is categorized as a Primary Urban Center and is understood as the dominant focal point of industrial development. The proposed emphasis of industrial development is on small and medium-sized enterprises and manufacturing outside the FAB and for light to heavy industries to be concentrated within the FAB. Tourism development is expected to focus on coastal areas. The BPDPFP proposes that a buffer zone approach be developed to constrain conversion of agricultural and especially forest land.[56]

The 2017-2026 Comprehensive Land Use Plan (CLUP) for the Municipality of Mariveles also foresees and promotes continued industrial development and tourism development and aims to manage expected growth by designating planned use development (PUD) areas, expanding road and utility networks to connect growth areas, shifting some municipal government functions and facilities to Alas-Asin from the already congested center of Mariveles town and pursuing urban renewal in Mariveles town. The plan recognizes the constraints placed on expansion of built-up areas by topography, as much of the municipality's area consists of steeply sloped lands on the southern flanks of Mt. Mariveles and also highlights the importance of reserving forest-capable lands for forest production, in line with high-level land use priorities expressed at the regional and provincial levels. The plan proposes delineation of protected forest areas and production forest areas and also enforcement of water resource protection easements as per the Philippine Water Code, as mechanisms for limiting conversion of lands not suitable for development. The slopes and peaks of Mt. Mariveles, as well as the Five Fingers coastal area and the Camaya Coast further west, are highlighted in the CLUP as having high potential for tourism development. The CLUP projects the demand for additional urban land to be 1,761 ha by 2026; of this amount, 1,018 ha are estimated to be needed for additional residential development, 322 ha for infrastructure, 255 ha for industry, 85 ha for commercial development, 73 ha for institutional facilities and 8 ha for recreational open space. The remaining buildable land area (total area minus environmentally constrained land and already built-up areas) is estimated at 4,264 ha.[57] The barangays along the Roman Highway corridor, including Alas Asin and Mt. View, are named as primary target spaces to accommodate projected land development needs.

The zoning plan adopted under the Mariveles CLUP designates the entire area on both sides of the Roman Highway Corridor, including all land between the highway and the coastline, as a future development zone; this can be seen in the map in Exhibit 5-32, which appears in the CLUP.

[56] Contents of the Bataan PDPFP presented here are as reported in T.Y. Lin International/Pyunghwa Engineering Consultants Joint Venture. 2022. Land Use Study and Future Development Plan Study Report (7 July 2022 Draft).
[57] Municipality of Mariveles. 2017. Comprehensive Land Use Plan, Mariveles, Bataan (2017–2026), Volume I. Prepared by UP PLANADES, Quezon City



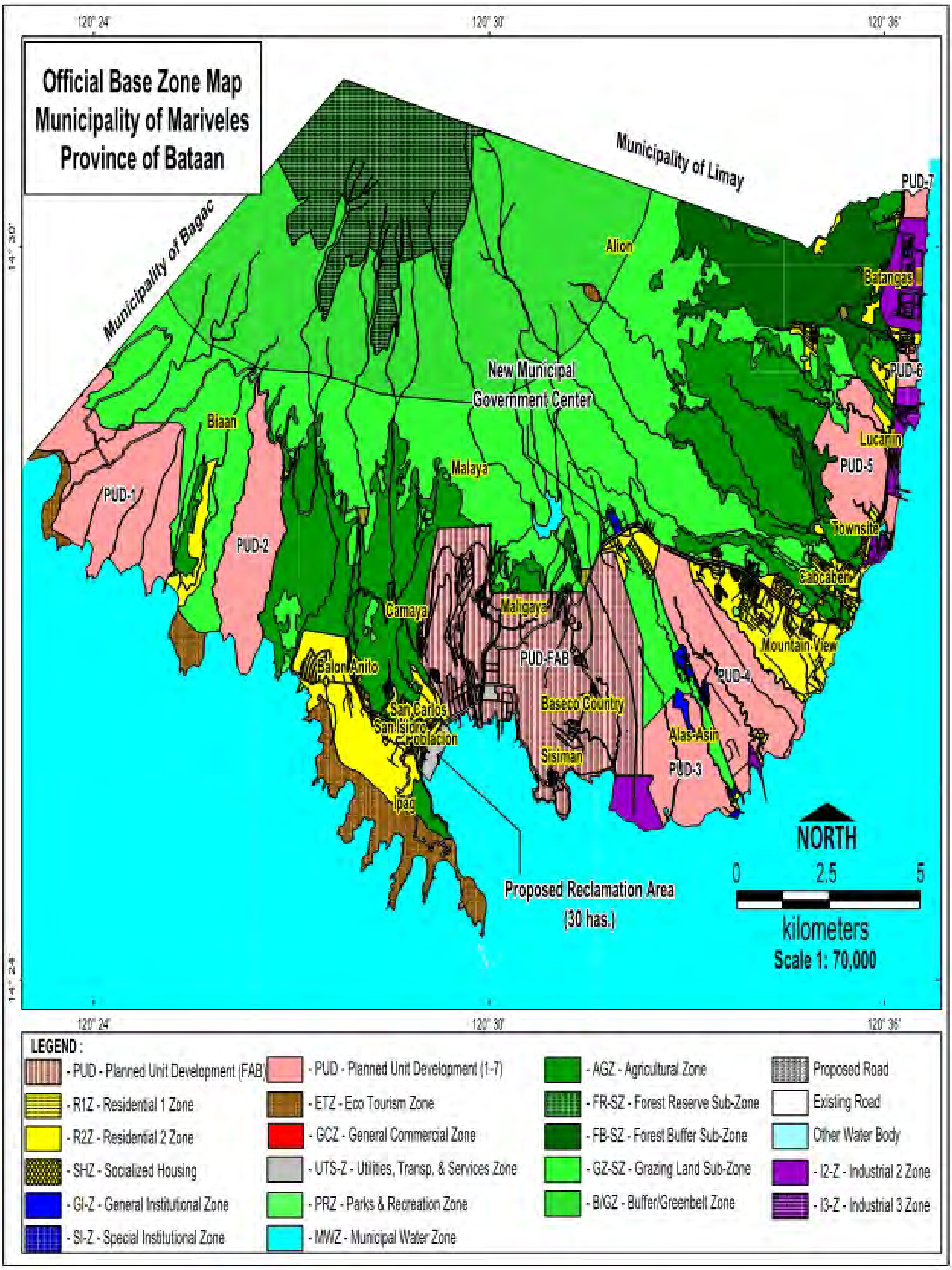
1
2 *Source: Municipality of Mariveles. 2017. Comprehensive Land Use Plan, Mariveles Bataan (2017-2026), Volume I.*
3 *Prepared by UP PLANADES, Quezon City.*

4 Exhibit 5-32 Land Areas Designated for Future Development, Mariveles CLUP 2017–2026

5 The current municipal zoning ordinance for Mariveles indicates that much of Alas Asin and
6 several other areas along the Roman Highway corridor are designated for PUDs. PUDs are
7 a tool used by municipalities to direct development to areas considered locationally

advantageous and also lacking in major physical and environmental constraints. They are defined in the Mariveles zoning ordinance as "a land development scheme wherein the project site is comprehensively planned as an entity via unitary site plan which permits flexibility in planning/design, building siting, complementarity of building types and land uses, usable open spaces and the preservation of significant natural land features."[58] PUDs may accommodate planned commercial/industrial estates and residential estates, or a combination of these. The BCIB alignment falls within PUD-4, which is not given any additional designation as to the particular uses that may be favored by the municipality (see Exhibit 5-33). The area to the east of the alignment is zoned as Residential 2, which is intended, as per the zoning ordinance, to promote medium density residential use, characterized mainly by low-rise single-attached, duplex or multi-level structures and other residential buildings for exclusive use as multi-family dwellings.[59] Eventual full build-out of the PUD-4 and Mt. View Residential 2 areas along the alignment, if indeed it adheres to the zoning ordinance, would not be expected to leave substantial open space or agricultural land, although the municipality would have the option of imposing open space requirements in development plans approved for PUD-4.

[58] Municipality of Mariveles. 2017. Comprehensive Land Use Plan, Mariveles, Bataan (2017–2026). Volume II, Zoning Ordinance. Prepared by UP PLANADES, Quezon City. (p.16)
[59] Ibid.



Source: Municipality of Mariveles. 2017. Comprehensive Land Use Plan, Mariveles, Bataan (2017-2026), Volume II. Prepared by UP PLANADES, Quezon City.

Exhibit 5-33 Current Zoning Plan, Municipality of Mariveles (2017)

In addition to municipal planning and control tools, land use in Mariveles is significantly shaped by the FAB. Special economic zones such as the FAB have some latitude to expand the lands under their jurisdictions as may be needed to enable synergies and enhanced function and to better pursue their core objectives. The FAB has been in the process of developing selected expansion areas, including in Alas Asin, Mt. View and Cabcaben, where interest is strong on the part of potential co-locator enterprises. This has included the recent construction of a substantial port and warehousing facility built on reclaimed land northeast of the Cabcaben waterfront and may also draw in a number of potential new facilities in the western part of Alas Asin.[60]

A number of specific public- and private-sector developments that are likely to affect land use in the vicinity of the BCIB project in Mariveles have been identified in discussions with municipal planning and development personnel and others. On the public sector side, the municipality is planning to shift some of its functions and facilities out of the congested center of Mariveles town to Alas Asin; a government service center is planned for a site along the Kamaya Point Road and a municipal market facility is to be built somewhere in or around Alas Asin village.[61] Several private sector initiatives are reportedly being discussed. The owner of a glass products factory in Pasig (Pioneer Float Glass Manufacturing, Inc) is proposing to relocate to a site immediately to the northeast of the BCIB alignment; the new plant would be a major industrial facility, with a blast furnace and tall stack, two 1 km-long assembly lines and a PANAMAX-capable pier and wharf extending 1 km from the shore (It is unknown if the facility would be approved for this location). A substantial solar farm is also reportedly under consideration for the area directly along the alignment, to be developed by Aboitiz Renewables, Inc.; details of scale, generating capacity and precise location are not well understood at the time of writing.[62]

Corregidor Island

Land use on Corregidor Island has remained stable since the end of WWII. Roads connecting former military installations (many now tourist sites) were rehabilitated and a small number of commemorative spaces and viewpoints were built from the 1950s onwards but these are of a modest scale. Tourist accommodations are very limited and confined to the so-called 'Bottomside' part of the island, which is a low saddle at the base of the island's long 'tail'. There are two ferry docks, on the north and south sides of the Bottomside area, respectively, as well as a 31-room mid-range hotel, a smaller budget inn, two restaurants, a handful of small gift shops and a staff accommodations compound.[63] Support infrastructure is very limited; a water supply system built by the United States military comprising wells, enormous cisterns and extensive piping is still in place but dilapidated and mostly non-functional. Electricity comes almost exclusively from diesel generators, as there is no undersea cable to Bataan. Basic septic vaults are the only means of sewage treatment and solid waste is dumped in a ravine.[64]

Plans to develop the island as a tourist destination are being formulated at the initiative of the Tourism Infrastructure and Enterprise Zone Authority (TIEZA), a government-owned and -controlled corporation attached to the Department of Tourism. A master planning process has been underway since 2018, the main objective of which is to make Corregidor

[60] Personal communication, Engr. Hazel de Guzman, Head of Infrastructure and Facilities, Freeport Area of Bataan (24 March 2022).
[61] T.Y. Lin International/Pyunghwa Engineering Consultants Joint Venture. 2022. Land Use Study and Future Development Plan Study Report (7 July 2022 Draft).
[62] Ibid.
[63] TIEZA. 2019. Corregidor Tourism Master Plan – Final Situational Analysis Report (May 2019). Prepared by Palafox Associates, Makati City.
[64] Personal communication, Mr. Jerry Rollin, Consultant, Corregidor Foundation Inc., 28 March 2022.

a major tourist attraction while maintaining its historical value. The eventual outcome of the effort is stated as follows: "Corregidor will become a sustainable premier war memorial and socio-cultural island destination in Asia Pacific that continuously offers the experience of its rich cultural and biodiverse heritage, to global and local visitors with affordable comfortable state-of-the-art facilities and services."[65] As of the time of writing, a Tourism Master Plan has reportedly been prepared but has not yet been publicly released; the underlying objective and vision are suggestive of substantial investment in tourist infrastructure. The Tail End portion of the island, which is closest to the BCIB alignment, is particularly rugged and much of its limited buildable land area is occupied by a military airstrip. Accordingly, development of tourist facilities such as accommodations is likely to be quite limited in this part of the island.[66]

Cavite

The eastern part of Cavite has undergone rapid urban development in recent decades, as one of the principal peripheral growth areas of Metro Manila. Growth pressures have spread steadily westward and it is clear from both present land use and evidence of property development plans that this part of the province is already in the midst of a substantial wave of land use change. Officials of both the Provincial Environment and Natural Resources Office (PENRO) and Naic's Municipal Environment and Natural Resources Office (MENRO) indicated in discussions with the EIA team in March 2022 that there is intense interest from land developers in properties in Naic, with many development proposals under review and in process.

The CALABARZON Regional Development Plan 2017–2022 adopts a Centers, Corridors and Wedges (CCW) approach to spatial organization and development in the region. Within this rubric, wedges are understood as areas peripheral to the main centers of population density and economic activity and within the interstices of the major transportation and industrial exchange corridors. Wedges are designated as places where development emphasis should be on agri-modernization and residential development. Naic is considered a wedge in the 2017-2022 plan but borders two corridor municipalities (Tanza and Trece Martires) and seems certain to be re-classified as a corridor itself when the BCIB is completed.[67]

The Cavite Provincial Development and Physical Framework Plan 2021–2030 includes the near-coastal portion of Naic, which will host the BCIB landing and interchange, within the southwestern end of the province's preeminent growth triangle known as 'La Llave de Manila'. The Llave de Manila is designated as the provincial hub for trade, commerce and industry and areas on its extremity such as Maragondon, Naic and Tanza are understood as urban settlement corridors whose development can help reduce pressure on the already dense municipalities closer to Cavite City. Densification, infilling of vacant lots and redevelopment are the priority modes of development, reflecting the relative scarcity of open land and desire not to feed sprawl. Development of industrial capacity, such as in export processing and manufacturing, is to be directed to the neighboring 'Cavite Nuevo'

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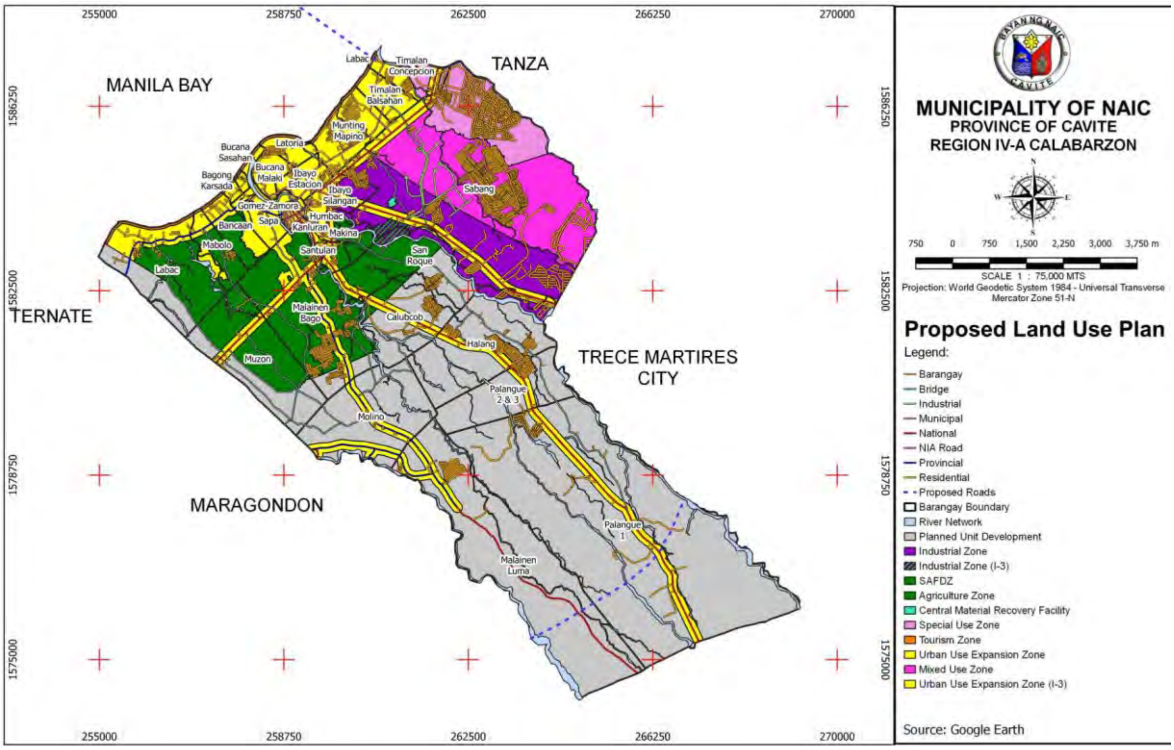
[65] TIEZA. 2019. Corregidor Tourism Master Plan – Final Situational Analysis Report (May 2019). Prepared by Palafox Associates, Makati City.
[66] Personal communication, Mr. Jerry Rollin, Consultant, Corregidor Foundation Inc., 28 March 2022.
[67] Elements of the CALABARZON Regional Development Plan presented here are as reported in T.Y. Lin International/Pyunghwa Engineering Consultants Joint Venture. 2022. Land Use Study and Future Development Plan Study Report (7 July 2022 Draft).

growth triangle, which has more available open land. The Cavite Nuevo triangle includes the southern half of Naic, not far from the BCIB interchange.[68]

The Municipality of Naic's Comprehensive Land Use Plan (2022–2032), as approved by the municipality and still under review at the provincial level, has as its central thrust the promotion of mixed-use development that doesn't come at the cost of agricultural viability.[69] The CLUP seeks to maximize livability for its current and future residents and focuses on improving transport and communications links, augmenting social services and enhancing commercial and retail activity and on promoting amenity-based economic development linked primarily to the beaches of the Manila Bay coastline. Naic is recognized as one of three tourism nodes in the province because of its beaches and this coastal resource is considered something of an untapped source of economic potential for the municipality.

The current municipal zoning ordinance for the Municipality of Naic designates most of the land around the BCIB alignment, from near the shoreline to the Antero Soriano Highway, as Urban Use Expansion Zone and in practice this area is predominantly residential, with older settled strips found along roads and newer medium-density low-rise housing estates being built over the last few years. There is also some agricultural land left in this area but it is not zoned as such and it is highly probable that it will be taken up by residential development before very long. The area to the southwest of the BCIB interchange site is variously zoned as Industrial, Mixed Use and Special Use. A 100 m-wide strip along the entire length of the Naic coastline is designated as Tourism Zone, for the purposes of promoting development of the beach tourism industry. This coastal strip is mostly built up already, primarily with low-key beach resorts and restaurants, although some non-conforming uses (e.g., informal shipyards in at least two places) are evident. Many of the resorts appear to be in an early or partial stage of development. Fisherfolk communities are also found in some locations along the shore.

[68] Key concepts of the Cavite Provincial Development and Physical Framework Plan presented here are as reported in T.Y. Lin International/Pyunghwa Engineering Consultants Joint Venture. 2022. Land Use Study and Future Development Plan Study Report (7 July 2022 Draft).
[69] Municipality of Naic. 2022. Comprehensive Land Use Plan 2022-2032. Unofficial draft CLUP.



Source: Municipality of Naic. 2022. Comprehensive Land Use Plan 2022-2032. Unofficial draft CLUP.

Exhibit 5-34 Zoning as Indicated in Naic CLUP 2022–2032

5.1.3 Floral Biodiversity

A desktop review of available documents was completed using published Environmental Impact Statements, local Comprehensive Land Use Plans, National Mapping and Resource Information Authority (NAMRIA) maps, available survey data and reports, and Google Earth imagery. The desk-based data was validated with field surveys in February 2020, between October and November 2021, and in April 2022. Together the desktop and field assessments characterized the makeup and significance of extant floral assemblages. The sampling methods and analytical applications employed were used consistently during the three years of surveys, unless otherwise stated.

With the exception of limited sampling of coastal vegetation on the east coast of the Tail End portion of Corregidor Island, which is close to the BCIB alignment, the flora of the island was not surveyed for this EIA study. Should a link be developed from the BCIB to the island under any future project, it will be appropriate for vegetation surveys to be conducted at that time, under the auspices of a project-specific EIA or IEE.

5.1.3.1 Sampling Methods

The floral sampling employed the transect with nested quadrats method to assess and characterize the structure and species composition of plant communities in multiple locations within the project area. The number and extent of the transects increased over time as the footprint of the project developed and the possible impacts were better understood. Three transects were initially established in Bataan during 2020 and increased to five in 2021 resulting in a total of eight transects in Bataan. Two transects were initially established in Cavite during 2020 and increased to five in 2021. One point sampling site was also assessed in Tanza, Cavite in November 2021. A further three transects were completed in 2022, resulting in a total of ten transects in Cavite. Each transect was approximately 1 km long and each had at least three nested quadrat sampling plots. Each primary sampling quadrat consisted of a 20 m x 20 m (400 m^2) plot, marked off by laying length of tape on the ground. A 5 m x 5 m (25 m^2) nested plot was established within the 400 m^2 plot and a second nested plot of size 3 m x 3 m (9 m^2) was marked off within it. Quadrats were spaced evenly along their respective transects. Positioning of nested 5 m x 5 m plots within the 20 m x 20 m primary quadrats was randomized, as was placement of 3 m x 3 m nested plots within the intermediate plots. The locations of transects and quadrats are shown on the maps accompanying the data presentation below.

To assess the canopy layer, all trees greater than or equal to 10 cm diameter at breast height (DBH) standing within each 20 m × 20 m primary quadrat were measured, identified to the species level and characterized. The intermediate canopy was assessed by doing the same for all plants more than 1 m in height and stem diameter between 5 cm and 9 cm found standing inside the 5 m × 5 m plot. For the understory layer, all plant specimens with stem diameter less than 5 cm and height less than 1 m growing within each 3 m × 3 m plot were identified, counted and characterized. This included wildlings, herbs, vines, grasses and shrubs. Percent cover of each species in the understory was estimated and recorded. Floral species growing outside the established plots were noted to help characterize the vegetation type of the sampling areas but were not included in the dataset or used in computation of ecological indices.

Data were recorded directly in Excel spreadsheets during sampling using tablet computers. Photographs were taken whenever possible to support later data interpretation; these were geo-tagged using smartphone applications (e.g., GeoCam and NoteCam). A handheld GPS unit (Garmin etrex20) was also used to validate the GPS reading of smartphone applications and to record transect tracks and plot coordinates.

5.1.3.2 Data Analysis

Plants found in each sampling plot were identified and classified at the time of sampling. Species that could not be identified onsite were documented in detail and identified later using available published taxonomic literature, the National Herbarium images and online resources including Co's Digital Flora of the Philippines (https://philippineplants.org/), World Flora Online (https://www.worldfloraonline.org/), International Plant Names Index (https://www.ipni.org/) and Plants of the World Online (https://powo.science.kew.org/).

After species identification, the conservation status of each species was checked using the DENR Department Administrative Order (DAO) 2017-11 Red List and the latest IUCN Red List of Threatened Species data (www.iucnredlist.org). Each species was classified according to its status in relation to native floral assemblages for the relevant biogeographic provinces (i.e., endemic, indigenous, introduced), using published literature and online sources. Each non-indigenous species was checked against the Global Invasive Species Database (www.iucngisd.org) and classified invasive or non-invasive.

Biodiversity indices. Biodiversity indices are mathematical measures of species diversity in a community or ecosystem. They are used to develop insights into the condition, resilience and conservation value of floral communities, by integrating numerical observations gathered from surveys (e.g., number of species, abundance, frequency, etc.). Calculation of biodiversity indices also provides useful additional points of comparison between habitat areas. Three indices were used in the floral baseline survey: a basic species richness index, the commonly used Shannon Diversity Index and Pielou's Evenness Index.

The Fernando Biodiversity Scale for tropical ecosystems was used to aid in interpretation of computed index values. The indices used are specified in turn below.

Species richness (n) is simply the number of plant species in a given area:

$$\text{Species richness (n)} = \frac{number\ of\ species}{transect}$$

Shannon Diversity Index (H') values represent the amount of diversity in the sampled ecological unit, based on the total number of species and the number of individuals of each species. High values for H' may be indicative of favorable ecosystem conditions, including low levels of disturbance and degradation and robust resilience. The index formula is:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

where: p_i represents the proportion or relative abundance of each individual species to the total abundance (measured from 0 to 1); and

$\ln p_i$ represents the natural logarithm of p_i

Pielou's Evenness Index (J') yields a measure of the distribution of species abundances within the overall composition of a community, derived based on species richness and H'. Low values for J' reflect a distribution in which small numbers of species account for large proportions of total abundance, possibly indicating prevalence of disturbance or degradation and vulnerability to pests. By contrast, high values for J' indicate a community in which a greater breadth of species accounts for the majority of overall abundance, which may suggest greater resilience and higher value as habitat for a greater number of faunal species. The index formula is:

$$J' = \frac{H'}{ln\ (S)}$$

where: H' is the value computed using the Shannon Diversity Index; and

S is the number of species in the community, across all samples in a dataset

Values calculated for H' and J' were compared to Fernando's Biodiversity Scale, a metric commonly cited in the Philippines; the scale is shown in Exhibit 5-35.

Exhibit 5-35 Fernando Biodiversity Scale

Relative values	Species diversity (H')	Evenness index (J')
Very high	3.500 – 4.000	0.750 - 1.000
High	3.000 – 3.499	0.500 – 0.740
Moderate	2.500 – 2.999	0.250 – 0.490
Low	2.000 – 2.499	0.150 – 0.240
Very low	1.999 and below	0.140 and below

Source: Ecosys Corp.

Importance Value. Relative density, relative dominance and relative frequency values were calculated for each floral species and used to confirm the importance value (IV) for a species. The IV is a measure of how dominant a species is in a given community. It is a statistical term and should not be mistaken for the ecological importance of a species in its environment. The formulae used are shown in turn below.

$$\textbf{Density (De)} = \frac{\textbf{No. of individuals of species}}{\textbf{Area of plot}}$$

$$\textbf{Dominance (Do)} = \frac{\textit{Basal area of species}}{\textit{Area of plot}}$$

$$\textbf{Frequency (F)} = \frac{\textit{No. of quadrats in which species occurs}}{\textit{Total no. of quadrats}}$$

$$\textbf{Relative density (RDe)} = \frac{\textit{Density of species}}{\textit{Total density of all species}} \, x\, 100$$

$$\textbf{Relative dominance (RDo)} = \frac{\textit{Dominance of species}}{\textit{Total dominance of all species}} \, x\, 100$$

$$\textbf{Relative frequency (RF)} = \frac{\textit{Frequency of species}}{\textit{Total frequency of all species}} \, x\, 100$$

$$\textbf{Importance value (IV)} = RDe + RDo + RF$$

5.1.3.3 Consultation

Good practice requires projects to consult and develop partnerships with recognized and credible conservation organizations and academic institutes. Consultation helps provide supplementary data, validate other sources or data, confirm current and likely threats to habitats and species, and inform potential conservation activities and offset sites within the landscape that could benefit biodiversity receptors potentially impacted by the project. Consultation for this project prioritized marine receptors but all consultation included a degree of terrestrial data identification and discussion. Key consultation comprised:

Date and location	Event type	Entities/Individuals Consulted	Key Topics of Discussion Relevant to Assessment
21 October 2021	Group consultation (online)	Corregidor Islands Marine Park Technical Committee (multi-stakeholder entity)	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones
22 March 2022	Group consultation	Municipal Environment and Natural Resources Office, Mariveles	• Active coastal conservation programs, including marine turtle hatchery • Potential long-term effects of BCIB project on forests of Mt. Mariveles
22 March 2022	Group consultation	Alas-Asin Fisherfolk Barangay Alas-Asin	• Locations of fishing activity around Mariveles shore and Corregidor Island • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
28 March 2022	Individual interview	Corregidor Foundation, Inc. (Mr. Jerry Rollin, Consultant)	• Ecology of Corregidor Island and surrounding waters • Existing threats to marine ecosystem around Corregidor Island • Planned environmental management activities for Corregidor Islands Marine Park

Date and location	Event type	Entities/Individuals Consulted	Key Topics of Discussion Relevant to Assessment
29 March 2022	Group consultation	Provincial Environment and Natural Resources Office, Cavite	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones • Threats to marine ecology of BCIB project area • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
29 March 2022	Group consultation	Municipal Environment and Natural Resources Office, Naic Municipal Agriculture Office, Naic	• Active coastal conservation programs, including marine turtle hatchery • Naic Fish Sanctuary
30 March 2022	Group consultation	Corregidor Islands Marine Park Technical Committee	• Proximity of proposed BCIB alignment to Corregidor Islands Marine Park management zones • Threats to marine ecology of BCIB project area • Scoping of possible benthic restoration in context of environmental mitigation related to the BCIB project
12 May 2022	Small-group interview	Ms. Eva Pangilinan Municipal Environment and Natural Resources Office, Naic Mr. John Nepomuceno, Dean Cavite State University	• Naic marine turtle hatchery program • History and management of Naic Fish Sanctuary
2022	Individual interview	Dr. Lemuel Aragones Institute of Environmental Science and Meteorology, University of the Philippines	• State of knowledge regarding presence, distribution and abundance of cetaceans in Manila Bay
2022	Individual interview	Dr. Yaptinchay, Executive Director Marine Wildlife Watch of the Philippines	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay
2022	Individual interview	Kester Yu, Marine conservationist and previous officer of National Environmental Protection Council of the Philippines	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay
2022	Individual interview	Oceana (Diovanie de Jesus, Campaign and Science Specialist)	• State of knowledge regarding presence, distribution and abundance of marine wildlife in Manila Bay

5.1.3.4 Limitations

As with any project of this scale and complexity, limitations with data collection have been identified. Where possible, the limitations were controlled as the data was collected, e.g repeat surveys across multiple years, but where this has not been possible, measures have been put in place to control the limitations. Examples of controls include the use of management plans to rectify gaps in baseline data; the use of the precautionary principle, and where a gap or issue is perceived not to be important, a statement of justification. The following limitations and controls are acknowledged:

- Field surveys prioritized point sampling within the proposed area of land take and therefore did not comprehensively cover the entire project area or an area of influence surrounding the sites. Where relevant and necessary, further annual field surveys, including additional survey locations, are included in the relevant Management Plans;
- Some field surveys were completed in one year only. Although these surveys will be replicated in future years as part of the Management Plans and Biodiversity

Action Plan, it does mean that some data presented in the EIA represents a single month or season, rather than multiple months, seasons or years. Where justified, the precautionary approach has been adopted, and field surveys are committed to in a relevant Management Plan;

- Some surveys were limited in frequency and extent, e.g. mammal surveys. In order to enrich the baseline, a continuation of surveys and an expansion of the survey locations is included in the Biodiversity Management Plan (BMP);
- Consultation largely focused on marine receptors. Terrestrial consultation will be prioritized during the development and finalization of the BMP and the Biodiversity Action Plan (BAP) to address this;
- Where weak baseline data limits the certainty of impact assessment, the precautionary approach has been used to inform a likely 'worst case' impact conclusion, and further surveys have been recommended. The surveys are committed to within a Management Plan, which will include a mechanism for re-assessing the EIA, CHA or BAP.

5.1.3.5 Floral Survey Findings (Bataan)

The floral assemblages of the Bataan portion of the BCIB project area were sampled along a total of eight transects. The initial three transects were surveyed in February 2020, and a further five in late October 2021. As described earlier, the landscape in this part of Mariveles is predominantly open, consisting mostly of grassland, much of it pastured, with infrequent orchards, plantations, household gardens, hedgerows, riparian vegetation and built-up areas. The locations of the 2021 transects and plots sampled are shown on the map in Exhibit 5-36.

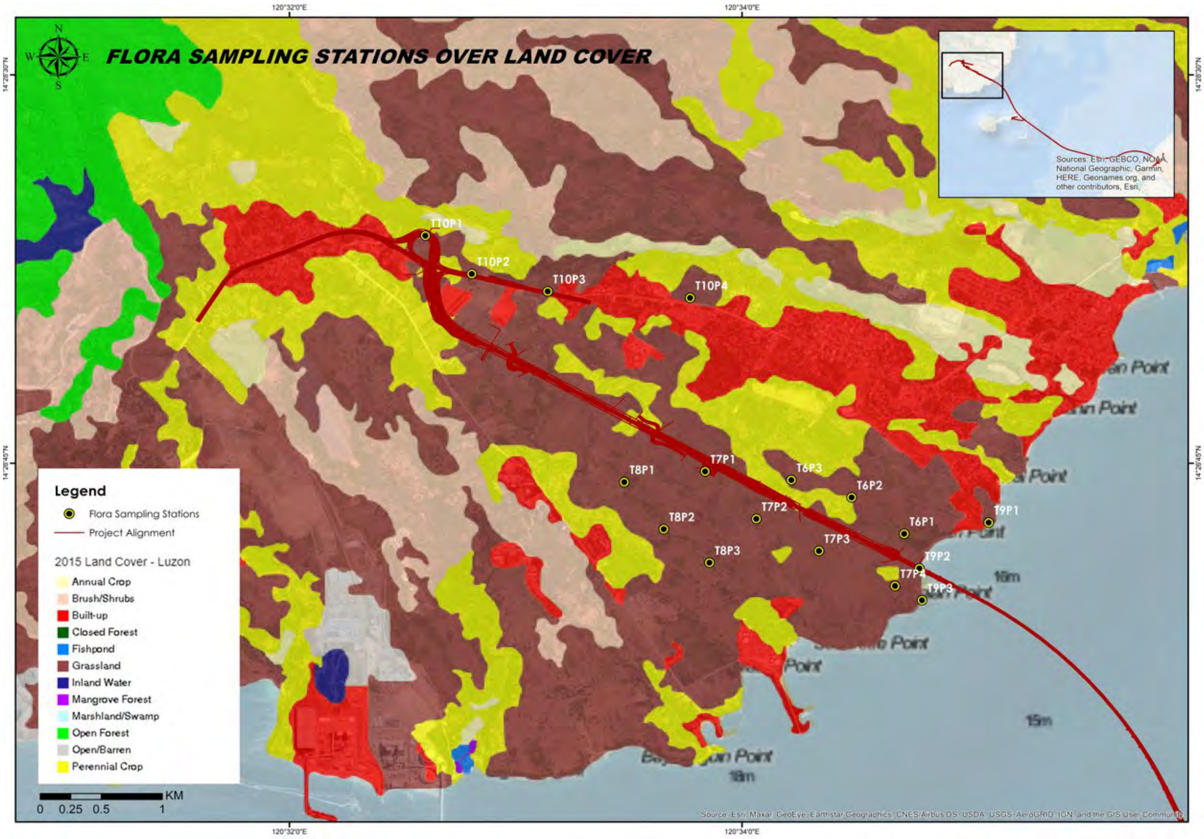


Exhibit 5-36 Floral Survey Transects, Bataan

In all, sampling along the eight floral transects recorded 58 species belonging to 29 families, the most heavily represented family was Fabaceae, which comprised 16% of species. The full species list is shown in Exhibit 5-37.

Exhibit 5-37 Comprehensive List of Species Documented in Floral Sampling (Bataan)

Common Name	Scientific Name	Family	Distribution	Habit
Earpod wattle, auri	*Acacia auriculiformis A. Cunn. ex Benth.*	Fabaceae	Exotic	Tree
Thornless mimosa	*Aeschymone americana L.*	Fabaceae	Exotic	Herb
Badyang	*Alocasia macrorrhizos*	Araceae	Indigenous	Herb
Kasui	*Anacardium occidentale L.*	Anacardiceae	Exotic	Tree
Binayuyu	*Antidesma ghaesembilla Gaertn.*	Phyllanthaceae	Indigenous	Tree
Dumayaka	*Arenga tremula (Blco.) Merr*	Arecaceae	Endemic	Palm
Antipolo	*Artocarpus blancoi (Elm.) Merr.*	Moraceae	Endemic	Tree
Neem	*Azadirachta indica A. Juss.*	Meliaceae	Exotic	Tree
Bayog	*Bambusa merrilliana (Elm.) Rojo & Roxas comb.nov.*	Poaceae	Endemic	Grass
Kalambuaia/ Putat	*Barringtonia acutangula (L.) Gaertn.*	Lecythidaceae	Indigenous	Tree
-	*Callerya sp*	Fabaceae		Shrub
Bitaog	*Calophyllum inophyllum L.*	Calophyllaceae	Indigenous	Tree

Common Name	Scientific Name	Family	Distribution	Habit
Gonoy	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Asteraceae	Exotic	Herb
Palala	*Cnestis palala (Lour.) Merr.*	Connaraceae	Indigenous	Vine
Niog/Coconut	*Cocos nucifera L.*	Arecaceae	Indigenous	Palm
Bikal babui	*Dinochloa luconiae*	Poaceae	Indigenous	Grass
River red gum	*Eucalyptus camaldulensis Dehnh*	Myrtaceae	Exotic	Tree
Tibig	*Ficus nota*	Moraceae	Indigenous	Tree
Hauili	*Ficus septica Burm.f.*	Moraceae	Indigenous	Tree
Wild hops	*Flemingia strobilifera (L.) W.T. Aiton*	Asteraceae	Indigenous	Shrub
Madre-cacao	*Gliricidia sepium (Jacq.) HBK.*	Fabaceae	Exotic	Tree
Melina	*Gmelina arborea Roxb.*	Lamiaceae	Exotic	Tree
Cogon	*Imperata cylindrica (L.) Raeusch.*	Poaceae	Exotic	Grass
Tan-ag	*Kleinhovia hospita*	Bryttneriaceae	Exotic	Tree
Banaba	*Lagerstroemia speciosa (L.) Pers.*	Lythraceae	Indigenous	Tree
Coronitas	*Lantana camara L.*	Lamiaceae	Exotic	Shrub
Ipil-ipil	*Leucaena leucocephala (Lamk) de Wit*	Fabaceae	Exotic	Tree
Nitong-puti	*Lygodium circinnatum (Burm.f.) Sw.*	Schizaeaceae	Exotic	Vine
Binunga	*Macaranga tanarius (L.) Müll. Arg.*	Euphorbiaceae	Indigenous	Tree
Mangga	*Mangifera indica L.*	Anacardiaceae	Exotic	Tree
Alim	*Melanolepis multiglandulosa (Reinw. ex Blume) Reichb. & Zoll.*	Euphorbiaceae	Indigenous	Tree
Uoko	*Mikania cordata (Burm.f.) B.L. Rob.*	Asteraceae	Exotic	Vine
Makahiya	*Mimosa pudica L.*	Fabaceae	Exotic	Herb
Wild ampalaya	*Momordica charantia*	Cucurbitaceae	Indigenous	Vine
Bangkoro	*Morinda citrifolia L.*	Rubiaceae	Indigenous	Tree
Pandan	*Pandanus dubius*	Pandanaceae	Indigenous	Herb
Kupang	*Parkia timoriana (DC.) Merr.*	Fabaceae	Exotic	Tree
Carabao grass	*Paspalum conjugatum*	Panicoideae	Exotic	Grass
Pasyonaryang mabaho	*Passiflora foetida L.*	Passifloraceae	Exotic	Vine
Avocado	*Persea americana Mill.*	Lauraceae	Exotic	Tree
Kamachile	*Pithecellobium dulce (Roxb.) Benth.*	Fabaceae	Exotic	Tree
Alagau	*Premna odorata*	Lamiaceae	Indigenous	Tree
Aroma	*Prosopis juliflora (Sw.) DC.*	Fabaceae	Exotic	Shrub
Bayabas/ guava	*Psidium guajava L.*	Myrtaceae	Exotic	Tree
Narra	*Pterocarpus indicus Willd.*	Fabaceae	Indigenous	Tree

Common Name	Scientific Name	Family	Distribution	Habit
Bayok	*Pterospermum diversifolium Blume*	Dombeyaceae	Indigenous	Tree
Talahib	*Saccharum spontaneum L.*	Poaceae	Indigenous	Grass
Santol	*Sandoricum koetjape (Burm.f.) Merr.*	Meliaceae	Indigenous	Tree
Ligas	*Semecarpus cuneiformis Blanco*	Anacardiaceae	Indigenous	Tree
Kalumpang	*Sterculia foetida L.*	Sterculiaceae	Indigenous	Tree
Kalios	*Streblus asper Lour.*	Moraceae	Indigenous	Tree
Mahogany	*Swietenia macrophylla King*	Meliaceae	Exotic	Tree
Duhat	*Syzygium cumini (L.) Skeels*	Myrtaceae	Exotic	Tree
Pandakaki	*Tabernaemontana pandacaqui Poir.*	Apocynaceae	Indigenous	Shrub
Talisai	*Terminalia catappa L.*	Combretaceae	Indigenous	Tree
Anabiong	*Trema tomentosa (Roxb.) Hara*	Cannabaceae	Indigenous	Tree
Molave	*Vitex parviflora A. Juss.*	Lamiaceae	Indigenous	Tree
Lanete	*Wrigthia pubescens R.Br. ssp. laniti (Blco.) Ngan.*	Apocynaceae	Indigenous	Tree
Maladuklap	*Ziziphus cumingiana Merr.*	Rhamnaceae	Indigenous	Tree

Although grassland with scrub was the dominant habitat in the project area, over 60% of the plant species recorded in the sample plots consisted of tree species; many of the tree specimens documented were saplings and were frequent in the intermediate canopy. Shrubs were also prominently represented. A breakdown of vegetation by plant form is shown in Exhibit 5-38.

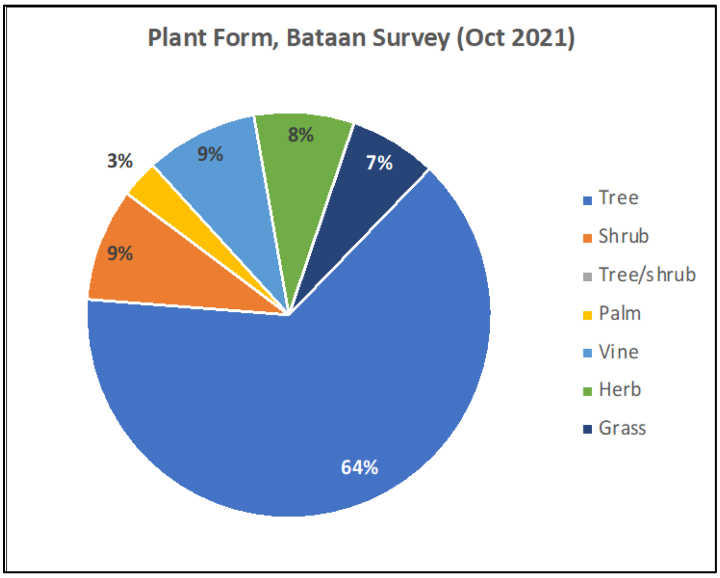


Exhibit 5-38: Breakdown of Vegetation by Plant Form, Bataan

Close to 60% of species documented across all transects were indigenous species, with 5% being species that are endemic to the Philippines (see Exhibit 5-39). Endemic species found in the sampling plots were Antipolo (*Artocarpus blancoi*), Dumayaka (*Arenga tremula*) and Bayog (*Bambuna merrilliana*). Only one species found in the survey in Mariveles is listed as a threatened floral species in DAO 2017-11; this is Narra (*Pterocarpus indicus*), which is also known as Burmese Rosewood.[70] Narra is listed as vulnerable (VU) in DAO 2017-11 and as endangered (EN) in the IUCN Red List. This species is commonly planted to create living fences.

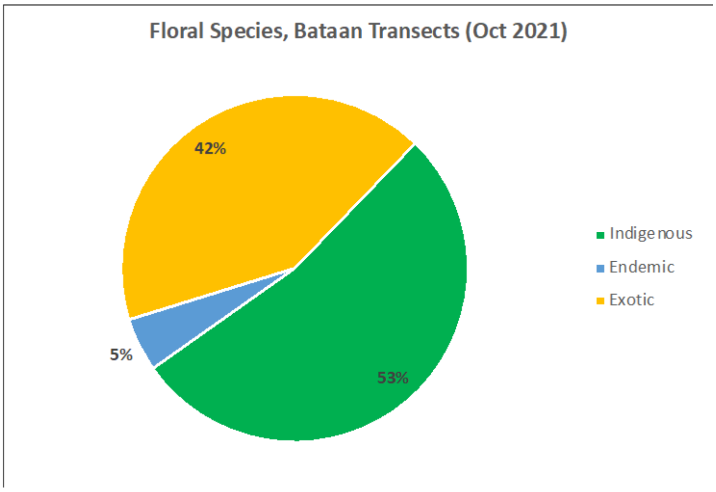


Exhibit 5-39 Native and Introduced Species, Bataan Survey

Nine invasive plant species were identified at least once in the sampling plots surveyed in Mariveles; these are listed in Exhibit 5-40. It is not known to what extent the specimens identified may represent invasions currently causing significant ecological harm at the local scale, but the evenness of species composition (discussed below) is certainly not suggestive of dominance, at least not by a single invasive species.

Exhibit 5-40 Invasive Species Documented in Bataan Floral Survey

Common Name	Species	Family	Habit
Aroma	*Acacia farnesiana*	Fabaceae	Tree
Coronitas	*Lantana camara*	Lamiaceae	Shrub
Hagonoi	*Chromolaena odorata*	Asteraceae	Herb
Ipil-Ipil	*Leucaena leucocephala*	Fabaceae	Tree
Talisai	*Terminalia catappa*	Combretaceae	Tree
Cogon	*Imperata cylindrica*	Poaceae	Grass
Duhat	*Syzygium cumini*	Myrtaceae	Tree
Mangium	*Acacia mangium*	Fabaceae	Tree
Sablot	*Litsea glutinosa*	Lauraceae	Tree

Floral diversity as measured by the Shannon-Weiner Diversity Index was found to be generally low across all of the transects, with a high of H'=2.6, low of H'=1.7 and mean H'=2.1. Across the eight transects in Bataan, three scored below 2.0 and fell into the 'very low' diversity category on the Fernando scale, four were in the 'low' category and just one in the 'medium' category. By contrast, scores on the evenness of species composition, as measured using Pielou's Evenness Index, were in the 'very high' category per the Fernando Scale. This is sometimes considered a favorable indicator of ecosystem resilience and, as mentioned above, seems likely to rule out an out-of-control invasion by any species, at least in the locations sampled.

[70] DENR Administrative Order 2017-11, Updated National List of Threatened Philippine Plants and Their Categories

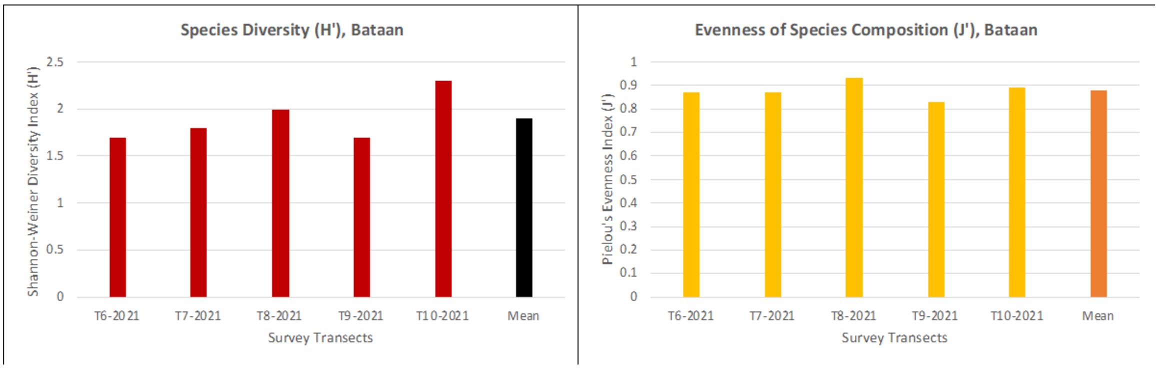


Exhibit 5-41 Floral Species Diversity and Evenness, Bataan (Transects No. 6 –10 from 2021)

The importance values (IV), which illustrates the dominant species, do not indicate an invasion by any invasive species in the upper, intermediate or lower understory layers (see Exhibit 5-42). Only two of the listed invasives, (Ipil-ipil and Gonoy) were found among the most dominant (IV) species for each transect. Ipil-ipil is a species widely planted throughout the tropics, often selected for reforestation, afforestation and agroforestry projects for its fast growth and leguminous nature, which allows it to fix nitrogen in the soil and provide protein-rich fodder for livestock; this species was the most dominant (IV) in three of the transects, in the immediate canopy layer for all of them and also the overstory in one. The importance of this species in the intermediate canopy but rarely the upper canopy may be indicative of the species' use for live fencing and livestock fodder. The other invasive, Gonoy, makes an appearance as the dominant species (IV) in two transects (T8 and T10), in the understory in both cases. This flowering shrub is considered very invasive in many places across the tropics where it has been inadvertently introduced.

The presence of Cogon grass is also acknowledged. This species is particularly invasive in the Philippines, and frequently dominants or outcompetes native grasses, where present. It was recorded infrequently throughout the survey area, but was only dominant in the understory along one transect (T3).

The foregoing seems reasonably favorable regarding the status of invasives but most of the species with highest IV are not indigenous species. Of the 15 species listed in Exhibit 5-42, only five are native to the Philippines. Of course, lists of top species by dominance (IV) do not provide a full picture of the overall balance of indigenous and exotic flora as measured in the survey plots; as indicated in Exhibit 5-39, the majority of species represented in the sampling data are indigenous. The strong showing of exotic species in terms of dominance (IV) does, however, suggest substantial anthropogenic influence in the floral composition of the area. This is consistent with a multi-decade history of agricultural use.

Exhibit 5-42 Floral Species With Highest Importance Values by Canopy Layer, Bataan

Transect	Layer	Scientific Name	Common Name	IV (Dominance)
T1-2020	Overstory	*Pterocarpus indicus*	Narra	94.9
	Intermediate	*Pterocarpus indicus*	Narra	36.5
	Understory	*Paspalum conjugatum*	Carabao grass	60.5
T2-2020	Overstory	*Cocos nucifera*	Coconut	123.2
	Intermediate	*Gliricidia sepium*	Kakauate	58.3
	Understory	*Paspalum conjugatum*	Carabao grass	67.4
T3-2020	Overstory	*Artocarpus blancoi*	Antipolo	64.2
	Intermediate	*Leucaena leucocephala*	Ipil-ipil	86.7

Transect	Layer	Scientific Name	Common Name	IV (Dominance)
	Understory	*Imperata cylindrica*	Cogon	60.5
T6-2021	Overstory	*Anacardium occidentale L.*	Kasui	50.6
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	74.9
	Understory	*Mimosa pudica L.*	Makahiya	129.8
T7-2021	Overstory	*Eucalyptus camaldulensis Dehnh*	River red gum	84.7
	Intermediate	*Gliricidia sepium (Jacq.) HBK.*	Madre-cacao	94.9
	Understory	*Saccharum spontaneum L.*	Talahib	85.3
T8-2021	Overstory	*Gmelina arborea Roxb.*	Melina	79.2
	Intermediate	*Semecarpus cuneiformis Blanco*	Ligas	56.7
	Understory	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Gonoy	64.1
T9-2021	Overstory	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	48.0
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	103.1
	Understory	*Mikania cordata (Burm.f.) B.L. Rob.*	Uoko	123.0
T10-2021	Overstory	*Pterocarpus indicus Willd.*	Narra	52.7
	Intermediate	*Gliricidia sepium (Jacq.) HBK.*	Madre-cacao	73.5
	Understory	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Gonoy	70.1

5.1.3.6 Floral Survey Findings (Cavite)

The floral assemblages of the Cavite portion of the BCIB project area were sampled along a total of ten transects, two of which were surveyed in February 2020, five in November 2021 and three in early 2022. As has been described earlier, the landscape in this part of Naic is mostly open fields, rice paddies and some pastured grassland, with a few small household banana plantations; there is also significant riparian vegetation along watercourses. Many areas of vegetation are hemmed in by strip development along roads, as well as some quite large rowhouse-style residential subdivisions built in the last 5 to 10 years. The locations of the 2021 and 2022 transects and plots sampled are shown on the map in Exhibit 5-43.

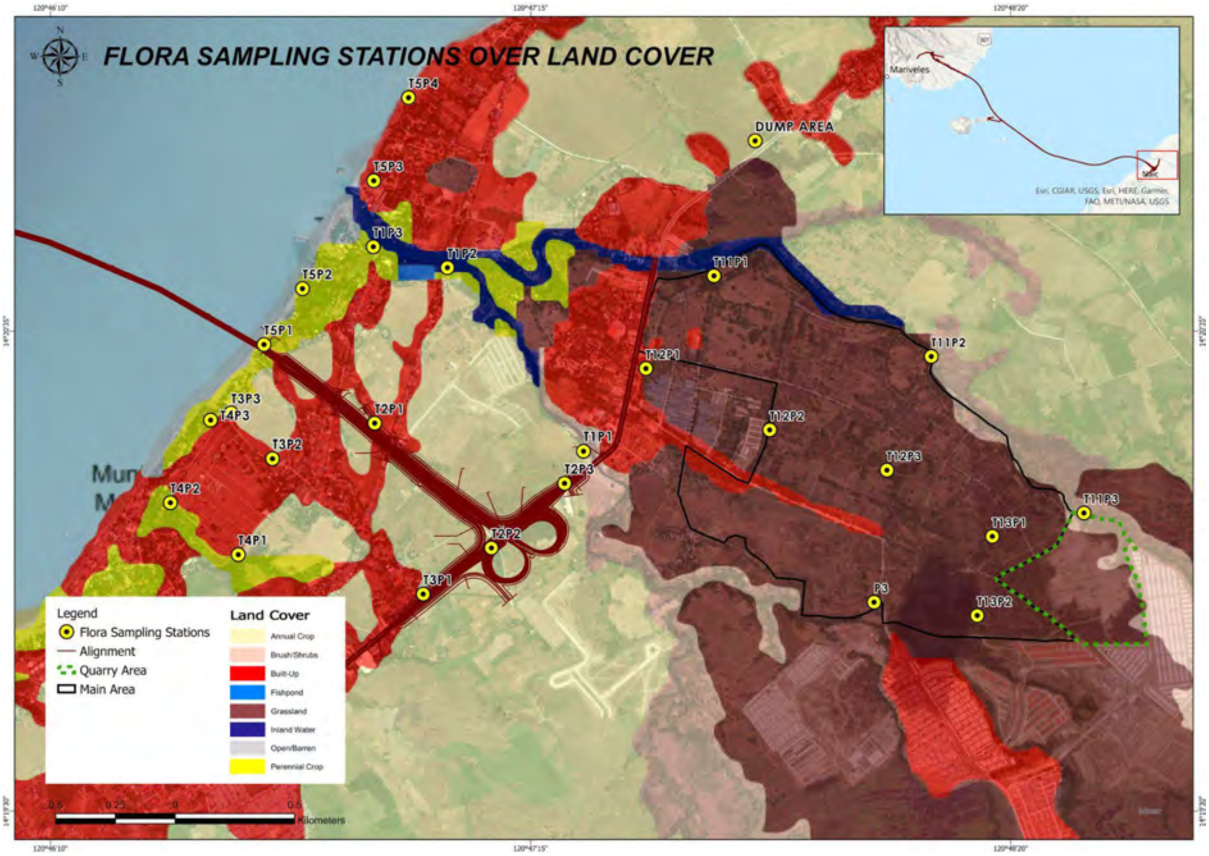


Exhibit 5-43 Floral Survey Transects, Cavite

Sampling along the 2021 and 2022 floral transects identified 73 species belonging to 29 families, the most frequently recorded family was Fabaceae, which comprised 22% of species. The full species list is shown in Exhibit 5-44, for reference.

Exhibit 5-44 Comprehensive List of Species Documented in Floral Sampling (Cavite)

Common Name	Scientific name	Family	Distribution	Habit
Sea holly	*Acanthus ebracteatus Vahl.*	Acanthaceae	Indigenous	Shrub
Dokot-dakot	*Achyranthes aspera*	Amaranthaceae	Exotic	Herb
Manila palm	*Adonidia merrillii*	Arecaceae	Indigenous	Palm
Malalagundi	*Allophyllus cobbe (L.) Raeusch.*	Sapindaceae	Indigenous	Shrub
Guyabano	*Annona muricata L.*	Annonaceae	Exotic	Tree
Ornamental Palm	*Arecaceae sp*	Arecaceae		Palm
Api-api	*Avicennia officinalis L.*	Verbenaceae	Indigenous	Tree
Neem	*Azadirachta indica A. Juss.*	Meliaceae	Exotic	Tree
Matang-hipon	*Breynia rhamnoides*	Euphorbiaceae	Indigenous	Tree
Himbabao	*Broussonetia luzonica (Blco.) Bur.*	Moraceae	Indigenous	Tree
Balinghasai	*Buchariania arboressens*	Anacardiaceae	Indigenous	Tree
Beautyberry	*Callicarpa formosana*	Lamiaceae	Indigenous	Herb
Wild Ground Nut	*Calopogonium muconioides*	Fabaceae	Exotic	Vine

Common Name	Scientific name	Family	Distribution	Habit
papaya	*Carica papaya L.*	Caricaceae	Exotic	Herb
Yellow oleander	*Cascabela thevetia (L.) Lippold*	Apocynaceae	Exotic	Shrub
Agoho	*Casuarina equisetifolia L.*	Casuarinaceae	Indigenous	Tree
-	*Cayratia sp.*	Vitaceae		Vine
Dilang Butiki	*Centrosema pubescens*	Fabaceae	Exotic	Vine
Gonoy	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Asteraceae	Exotic	Herb
Niog, Coconut	*Cocos nucifera L.*	Arecaceae	Indigenous	Palm
Fire tree	*Delonix regia (Hook) Raf.*	Fabaceae	Indigenous	Tree
Dapdap	*Erythrina orientalis (L.) Murr.*	Fabaceae	Indigenous	Tree
Buta-buta	*Excoecaria agallocha L.*	Euphorbiaceae	Indigenous	Tree
Tibig	*Ficus nota (Blco.) Merr.*	Moraceae	Indigenous	Tree
Payangpayang	*Flemingia strobilifera*	Fabaceae	Indigenous	Shrub
Madre-cacao	*Gliricidia sepium (Jacq.) HBK.*	Fabaceae	Exotic	Tree
Melina	*Gmelina arborea Roxb.*	Lamiaceae	Exotic	Tree
Zebra wood	*Guettarda speciosa L.*	Rubiaceae	Indigenous	Tree
Cogon	*Imperata cylindrica*	Poaceae	Exotic	Grass
Beach morning glory	*Ipomoea pes-caprae (L.) R.Br.*	Convolvulaceae	Indigenous	Vine
Kayomyom	*Ixora philippinensis Merr.*	Rubiaceae	Indigenous	Tree
Ipil-ipil	*Leucaena leucocephala (Lamk) de Wit*	Fabaceae	Exotic	Tree
Bangkal	*Nauclea orientalis*	Rubiaceae	Indigenous	Tree
Binunga	*Macaranga tanarius*	Euphorbiaceae	Indigenous	Tree
Paang-baliwis	*Malachra capitata (L.) L.*	Malvaceae	Exotic	Herb
Alai	*Mallotus tiliifolius (Blume) Müll. Arg.*	Euphorbiaceae	Indigenous	Tree
Mangga	*Mangifera indica L.*	Anacardiaceae	Exotic	Tree
Cassava	*Manihot esculenta*	Euphorbiaceae	Exotic	Shrub
Alim	*Melanolepis multiglandolosa*	Euphorbiaceae	Indigenous	Tree
Uoko	*Mikania cordata (Burm.f.) B.L. Rob.*	Asteraceae	Exotic	Vine
Bani	*Milletia pinnata (L.) Panigrahl.*	Fabaceae	Indigenous	Tree
makahiya	*Mimosa pudica L.*	Fabaceae	Exotic	Herb
Bangkoro	*Morinda citrifolia L.*	Rubiaceae	Indigenous	Tree
Datilies	*Muntingia calabura*	Tiliaceae	Exotic	Tree
Banana	*Musa sp.*	Musaceae		Herb
Nipa, Sasa	*Nypa fruticans Wurmb.*	Arecaceae	Indigenous	Palm
Carabao grass	*Paspalum conjugatum (Berg.)*	Fabaceae	Exotic	Grass

Common Name	Scientific name	Family	Distribution	Habit
Avocado	*Persea americana Mill.*	Lauraceae	Exotic	Tree
Kamachile	*Pithecellobium dulce (Roxb.) Benth.*	Fabaceae	Exotic	Tree
Kalachuche	*Plumeria acuminata Ait.*	Apocynaceae	Exotic	Tree
Indian Lanutan	*Polyalthia ongifolia*	Annonaceae	Exotic	Tree
Alagau	*Premna odorata Blanco*	Lamiaceae	Indigenous	Tree
Aroma	*Prosopis juliflora (Sw.) DC.*	Fabaceae	Exotic	Shrub
Bayabas	*Psidium guajava L.*	Myrtaceae	Exotic	Tree
Narra	*Pterocarpus indicus.*	Fabaceae	Indigenous	Tree
Bakauan	*Rhizophora apiculata Blume*	Rhizophoraceae	Indigenous	Tree
Bakauan-bato	*Rhizophora stylosa Griff.*	Rhizophoraceae	Indigenous	Tree
Talahib	*Saccharum spontaneum L.*	Poaceae	Indigenous	Grass
Santol	*Sandoricum koetjape Burm.f.) Merr.*	Meliaceae	Indigenous	Tree
Rain Tree	*Samanea saman*	Fabaceae	Exotic	Tree
Yellow casia	*Senna spectabilis*	Fabaceae	Exotic	Tree
Pagatpat	*Sonneratia alba J. Sm.*	Lythraceae	Indigenous	Tree
Sineguelas	*Spondias purpurea L.*	Anacardiaceae	Exotic	Tree
Kalios	*Streblus asper Lour.*	Moraceae	Indigenous	Tree
Mahogany	*Swietenia macrophylla King*	Meliaceae	Exotic	Tree
Duhat	*Syzygium cumini (L.) Skeels*	Myrtaceae	Exotic	Tree
Pandakaki	*Tabernaemontana pandacaqui Poir.*	Apocynaceae	Indigenous	Shrub
Sampaloc	*Tamarindus indica*	Fabaceae	Exotic	Tree
Talisai	*Terminalia catappa L.*	Combretaceae	Indigenous	Tree
Anabiong	*Trema orientalis*	Cannabaceae	Indigenous	Tree
Mangkit	*Urena lobata L.*	Malvaceae	Indigenous	Shrub
Lagundi	*Vitex negundo L.*	Lamiaceae	Exotic	Shrub
Molave	*Vitex parviflora Juss.*	Lamiaceae	Indigenous	Tree
Lanite	*Wrightia pubescens*	Apocynaceae	Indigenous	Tree
Mansanitas	*Ziziphus cumingiana Merr.*	Rhamnaceae	Indigenous	Tree

Despite the dominance of grassland and agriculture throughout the Cavite survey area, the majority of the vegetation sampled comprised trees similar to those recorded in Bataan. Further, many of the trees were saplings. Tree species were also frequent in the intermediate canopy. Shrubs, herbs and vines were also well represented. The composition of surveyed vegetation by plant form is shown in Exhibit 5-45.

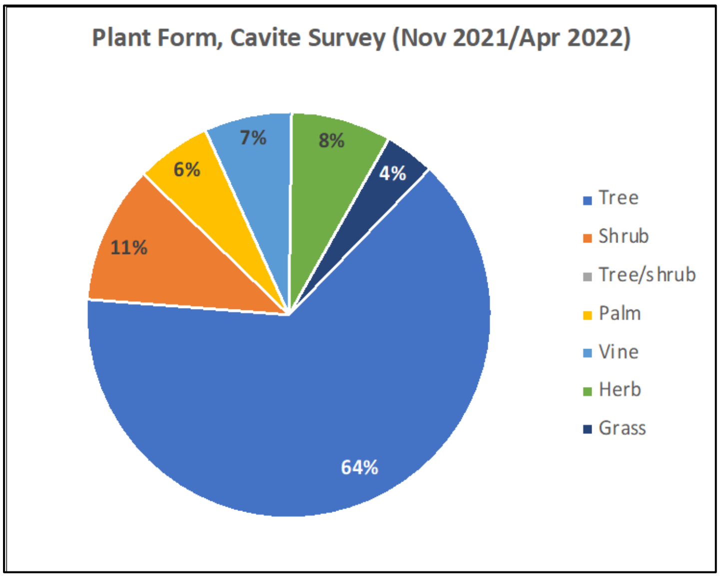


Exhibit 5-45 Breakdown of Vegetation by Plant Form, Cavite (2021/22 data)

Approximately half the species documented across all transects were indigenous (see Exhibit 5-39). None of the species identified were endemic to the Philippines. As was the case in Bataan, only one species found in the survey in Naic is listed as a threatened floral species in DAO 2017-11: Narra.[71] Narra is listed as vulnerable (VU) in DAO 2017-11 and as endangered (EN) in the IUCN Red List.

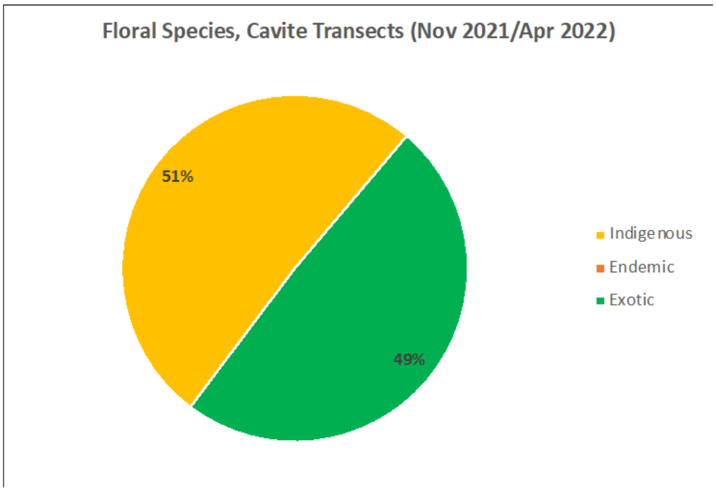


Exhibit 5-46 Native and Introduced Species, Cavite (2021/22 data)

Seven invasive plant species were identified in the sampling plots surveyed in Cavite; these are listed in Exhibit 5-47. Levels of evenness in the overall species composition (as discussed below) do not suggest any of the species are spreading uncontrollably or dominating. All the invasive species found in Cavite were also found in Bataan and it is assumed that they are also widespread in settled areas across Luzon.

[71] DENR Administrative Order 2017-11, Updated National List of Threatened Philippine Plants and Their Categories

Exhibit 5-47 Invasive Species Documented in Cavite Floral Survey

Common Name	Species	Family	Habit
Aroma	*Acacia farnesiana*	Fabaceae	Tree
Coronitas	*Lantana camara*	Lamiaceae	Shrub
Hagonoi	*Chromolaena odorata*	Asteraceae	Herb
Ipil-Ipil	*Leucaena leucocephala*	Fabaceae	Tree
Talisai	*Terminalia catappa*	Combretaceae	Tree
Cogon	*Imperata cylindrica*	Poaceae	Grass
Duhat	*Syzygium cumini*	Myrtaceae	Tree

Floral diversity as measured by the Shannon-Weiner Diversity Index was found to be more varied across transects and somewhat lower overall for the Cavite transects than for those in Bataan. The Cavite transects had a high of H'=2.8, low of H'=1.2 and mean H'=1.8. Seven of the transects scored below H'=2.0, putting them into the 'very low' diversity category on the Fernando scale. Of the remainder, two fell into the 'low' category and just one exceeded the threshold of H'=2.5 necessary to qualify as 'medium'. Scores on the evenness of species composition, as measured using Pielou's Evenness Index, were in the 'very high' category across the board, per the Fernando Scale. As mentioned above, these very strong evenness values are probably inconsistent with a strong takeover by invasive species and may indicate a relatively high level of ecosystem resilience.

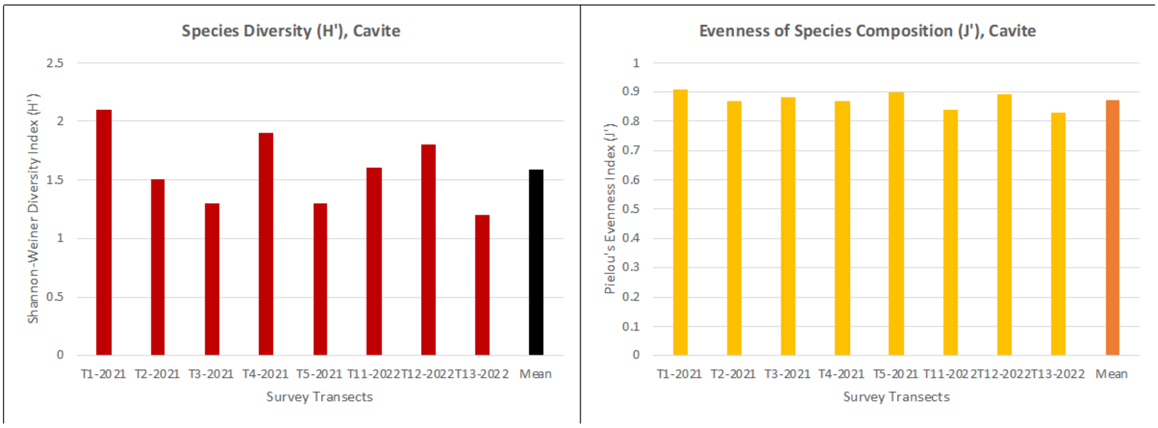


Exhibit 5-48 Floral Species Diversity and Evenness, Naic (Transects 1–5 and 11–13)

The same two invasives as were found amongst the top species in terms of importance value in the Bataan floral survey were similarly represented in the importance value data for the transects in Cavite: Ipil-ipil and Gonoy; this can be seen in Exhibit 5-49. Ipil-ipil had the highest importance value at five of 10 transects, all in relation to the intermediate canopy (and additionally in the upper canopy at one of the five). Once again, this would appear to be indicative of use of Ipil-ipil as live fencing and/or livestock fodder, as this species can get quite tall if left to grow freely. Gonoy was dominant in the understory at four of the 10 transects.

As mentioned above, over half of the species represented in the Cavite floral survey are indigenous, although this was not strongly reflected in the list of species with the highest IV (dominance) per transect. Of the 18 species with the highest IV (dominance), as listed in Exhibit 5-49, eleven are exotic and seven are native to the Philippines. The strong representation of exotic species in Exhibit 5-49 is partly a reflection of long-standing agricultural use of the landscape in the Cavite part of the project area and several of the species shown are commonly cultivated species.

Exhibit 5-49 Floral Species With Highest Importance Values by Canopy Layer, Cavite

Transect	Canopy Layer	Scientific Name	Common Name	IV (Dominance)
T1-2020	Overstory	*Musa sp.*	Banana	90.9
	Intermediate	*Manihot esculenta*	Cassava	71.2
	Understory	*Mikania cordata*	Uoko	29.7
T2-2020	Overstory	*Cocos nucifera*	Coconut	147.1
	Intermediate	*Azadirachta indica*	Neem tree	83.3
	Understory	*Achyranthes aspera*	Dokot-dakot	64.3
T1-2021	Overstory	*Mangifera indica L.*	Mango	85.2
	Intermediate	*Rhizophora stylosa Griff.*	Bakauan-bato	58.2
	Understory	*Mikania cordata (Burm.f.) B.L. Rob.*	Uoko	51.0
T2-2021	Overstory	*Delonix regia (Hook) Raf.*	Fire tree	128.0
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	120.2
	Understory	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Gonoi	81.5
T3-2021	Overstory	*Mangifera indica L.*	Mango	101.7
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	108.5
		Prosopis juliflora (Sw.) DC.	Aroma	108.5
	Understory	*Malachra capitata (L.) L.*	Paang-baliwis	84.6
T4-2021	Overstory	*Delonix regia (Hook) Raf.*	Fire tree	76.1
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	93.3
	Understory	*Chromolaena odorata (L.) R.M. King & H. Rob.*	Gonoi	106.5
T5-2021	Overstory	*Cocos nucifera L.*	Niog, Coconut	85.7
	Intermediate	*Casuarina equisetifolia*	Agoho	124.4
	Understory	*Ipomoea pes-caprae (L.) R.Br.*	Beach morning glory	300.0
T11-2022	Overstory	*Samanea saman*	Rain Tree	95.6
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	132.3
	Understory	*Chromolaena odorata*	Gonoi	108.6
T12-2022	Overstory	*Samanea saman*	Rain Tree	68.1
	Intermediate	*Swietenia macrophylla*	Mahogany	85.5
	Understory	*Urena lobata*	Kulotan	98.1
T13-2022	Overstory	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	167.5
	Intermediate	*Leucaena leucocephala (Lamk) de Wit*	Ipil-ipil	111.4
	Understory	*Chromolaena odorata*	Gonoi	100.9

5.1.4 Mangroves and Coastal Vegetation

Mangroves are highly threatened globally and throughout the Philippines, and their extent in Manila Bay is known to have reduced greatly compared to historical coverage. Coastal resource mapping conducted by the National Mapping and Resource Information Agency (NAMRIA), as presented in the Coastal Resource Map 2021 – Central Luzon, does not show any significant mangrove patches near the mouth of the bay. From local reconnaissance, however, it was evident that some remnants of mangrove exist in and around the BCIB project area, primarily along the banks of the estuaries that extend inland from the coast in Cavite and to a lesser extent in Bataan.

5.1.4.1 Survey Methods

A survey of coastal and estuarine vegetation was conducted in 2020 to assess the presence, extent and characteristics of likely mangrove habitat in the BCIB project area. Floral assessment was done using the point sampling method. A total of eight stations were sampled in Mariveles, three stations on Corregidor Island and 15 stations in Naic. A sample plot of area 20 m x 20 m was established in each sampling station to assess the characteristics of the upper canopy. In each sample plot, heights of all species with 15 cm in trunk diameter and above were identified, counted and measured. A 5 m x 5 m subplot to assess the middle canopy was located inside one corner of each upper canopy plot. In this smaller plot, all trees and saplings of diameter 15 cm and less were identified, counted and recorded. Finally, a 1 m x 1 m plot was established in one corner of each 5 m x 5 m plot to assess the composition of the lower canopy. All wildlings and other smaller plants (stem diameter 1 cm and below) within the 1m x 1m plot were identified, recorded and counted.

Key measures and indices reflective of various aspects of species diversity and community structure were calculated based on the floral sampling data collected. Base measures calculated for each species were density, relative density, dominance, relative dominance, frequency and relative frequency. Indices calculated from these base measures were Importance Value (IV), Shannon-Weiner Species Diversity Index (H') and Evenness Index (e'). Biodiversity indices can yield useful insights into community composition and dynamics that simple measures of species richness, i.e., the number of species present, cannot. Formulae used are as follows:

$$\boldsymbol{Density\ (De)} = \frac{\boldsymbol{No. of\ individuals\ of species}}{\boldsymbol{Area\ of\ plot}}$$

$$Dominance\ (Do) = \frac{Basal\ area\ of species}{Area\ of\ plot}$$

$$Frequency\ (F) = \frac{No. of\ quadrats\ in\ which\ species\ occurs}{Total\ no. of\ quadrats}$$

$$Relative\ density\ (RDe) = \frac{Density\ of species}{Total\ density\ of\ all\ species} x\ 100$$

$$Relative\ dominance\ (RDo) = \frac{Dominance\ of species}{Total\ dominance\ of all\ species}\ x\ 100$$

$$Relative\ frequency\ (RF) = \frac{Frequency\ of species}{Total\ frequency\ of all\ species}\ x\ 100$$

$$Importance\ value\ (IV) = RDe + RDo + RF$$

$$Shannon - Weiner\ Species\ Diversity\ Index\ (H') = -\sum_{i=1}^{s} p_i\ ln\ p_i$$

where s = Nunber of species; p_i = Proportion of each species belonging to the ith species of the total number of individuals

Shannon's Evenness Index (e) = H' / H_{max}

where H_{max} = ln (S)

Values obtained for the Shannon-Weiner Index and Shannon's Evenness Index were interpreted with reference to the Fernando Biodiversity Scale, as follows:

Relative Interpretation	Shannon-Weiner Index	Shannon Evenness Index
Very High	≥ 3.5	≥0.75
High	3.0 - 3.49	0.50 – 0.74
Moderate	2.5 – 2.99	0.25 – 0.49
Low	2.0 – 2.49	0.15 – 0.24
Very Low	≤ 1.99	≤0.14

5.1.4.2 Findings of Coastal Vegetation Sampling (Bataan)

A total of eight sampling stations were established in the coastal area nearby the BCIB landing site, of which five were on the coastline itself and three were in the estuary of the Babuyan River (see Exhibit 5-50). Six of the eight stations were found to support mangrove species, or closely allied species. The sampled locations are described briefly below.

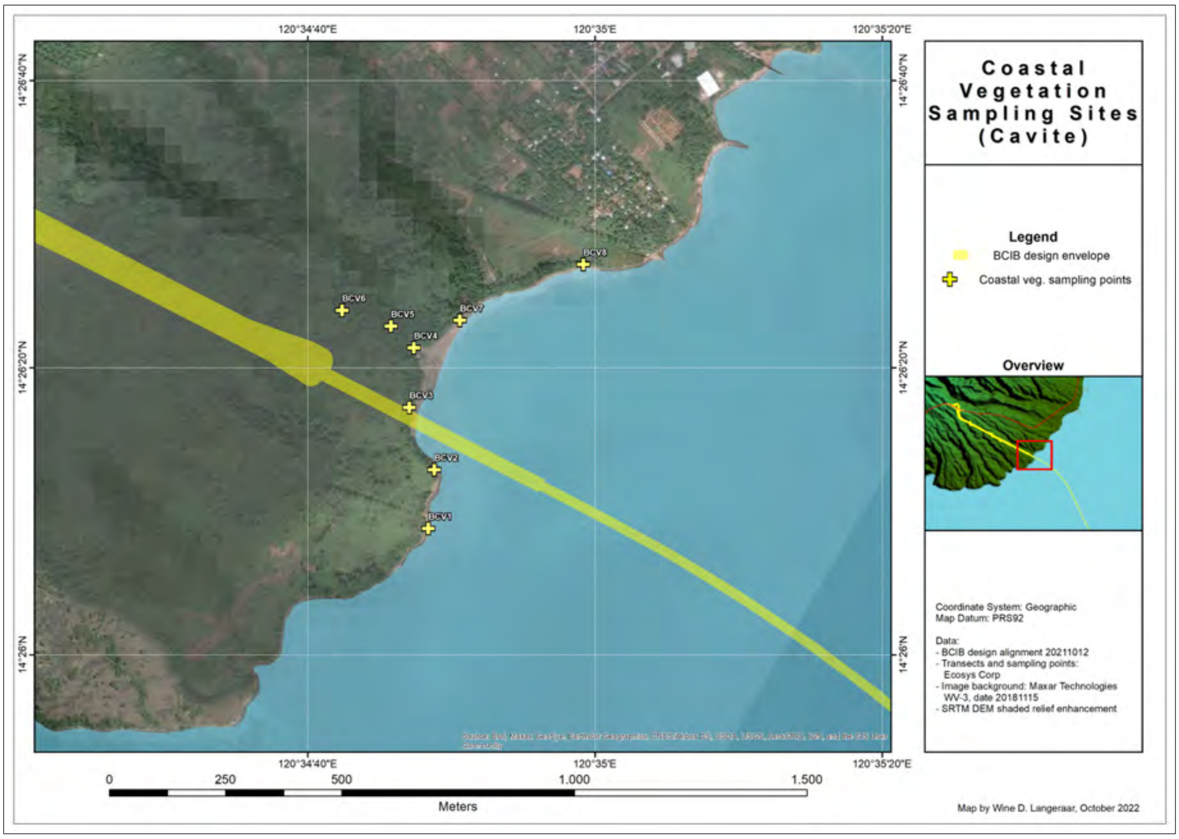


Exhibit 5-50 Coastal Vegetation Sampling Stations, Mariveles

Station 1 was established in a small mangrove patch approximately 100 m^2 in area, on the shoreline about 190 m southwest of the BCIB centerline (260 m linear distance along the shore to the landing site). Young regeneration of the mangrove species Bungalon (*Avicennia marina*) and Pagatpat (*Sonneratia alba*), with an average diameter of 3.55 cm, were found thriving at this rocky, exposed location. These two species are known as 'front liners' for their ability to tolerate high salinity and withstand strong wave action.

Exhibit 5-51 Small Stand of *Avicennia marina* and *Sonneratia alba* at Station 1

Station 2 was approximately 160 m southwest of the BCIB centerline. Two individual Bungalon plants, a mangrove species, measuring 2.5 cm diameter were recorded on the rocky part of the beach, while the palm genus *Arenga* was well represented in upslope areas. Few other plants were observed, possibly due to the steepness of the land next to the beach.

Station 3 was located directly under the BCIB centerline. The land slopes up steeply from a mixed sandy-rocky beach at this location and there was very little backshore. Large diameter specimens of Boto (*Scaevola taccada*) and Taluto (*Pterocymbium tinctorium*) were conspicuous on the coastal slope. No mangrove species were observed.

Station 4 was located 145 m northeast of the center line, 50 m upstream from the mouth of the Babuyan River, a minor estuary with predominant mangroves. Putat (*Barringtonia racemosa*) was the most common mangrove species although Pagatpat, Nipa (*Nypa fruticans*) and Tui (*Dolichandron espathacea*), all mangrove species, also appeared to be abundant and thriving.

Exhibit 5-52 Station 4 (Stand of *Nypa fruticans* at Left)

Station 5 was located in the middle part of the lower Babuyan River, 115 m upstream from the mouth and 155 m northeast of the BCIB centerline. Nipa and Tui were the dominant mangrove species, although mature stands of Putat were also present. These species are all mangrove species. Ipil-ipil and Duhat trees were observed growing on the slopes above the creek.

Station 6 was located in the uppermost part of the Babuyan River mangrove zone, 220 upstream from the river's mouth and 90 m northeast of the edge of the BCIB (145 m northeast of the centerline). Nipa and Tui, both mangrove species, were recorded frequently.

Exhibit 5-53 Station 6 at Uppermost Part of Babuyan River Mangrove Zone

Station 7 was located 235 m northeast of the BCIB centerline, near the northeast end of the sandy beach that marks the mouth of the Babuyan River. The area's vegetation was dominated by Aroma trees (*Acacia farnesiana*), with some Coconut (*Coco nucifera*) and large diameter Kalumpang trees (*Sterculia foetida*). No mangrove species were recorded at this sampling station.

Station 8 was the most distant station from the BCIB alignment, 460 m northeast of the centerline (515 m linear distance along the shoreline). Prominent species at this station included Pandan Dagat (*Pandanus tectorius*), a mangrove species, on the beach edge and Ipil-ipil on the coastal slope.

Exhibit 5-54 *Pandanus tectorius* on Beach at Station 8

A total of 28 species, 25 genera and 19 families were recorded during the survey across the eight sites in Mariveles. Three exotic or introduced species (*Acacia auriculiformis*, *Acacia farnesiana* and *Puteria rivicoa*) were among them. The overall species diversity value computed for the sampled plots fell within the 'moderate' range (H' = 2.50–2.99). With respect to evenness, the sampled areas also showed 'moderate' (e' = 0.250–0.499) levels.

Across all sampling stations, Nipa was by far the most dominant species in the upper canopy with 135.99 IV. Nipa was the most frequently recorded species with 105 individuals and highest relative dominance (64.81). For the middle canopy, species in the genus *Arenga* were most dominant, with 26.70 IV, followed by Pandan Dagat with 25.87 IV and Ipil-ipil at 20.00 IV. For the lower canopy, Ipil-ipil was the most dominant species with 65.54 IV, followed by Putat and Pagatpat with 41.22 IV and 34.12 IV, respectively. Ipil-ipil was the most common species (relative dominance 40.54). Putat and Ipil-ipil were widely distributed in the sampled plots, each with relative frequency of 25.0.

The findings of the survey of coastal vegetation in Mariveles confirm the presence of mangrove species at five of the eight stations. The Babuyan River estuary appears also to represent a more substantial agglomeration of mangrove habitat compared to the sparse, patchy distribution of mangrove species along the exposed coast. The Babuyan River mangrove zone was quite close to the BCIB project footprint, about 90 m at the closest point, and some tributaries of the river directly drain land within and around the footprint.

5.1.4.3 Findings of Coastal Vegetation Sampling (Corregidor Island)

Three coastal vegetation sampling stations were established along the eastern coast of Corregidor Island, as shown in Exhibit 5-55.

Station 1 was 1.2 km southwest of the BCIB centerline, on the north side of the Tail End portion of Corregidor Island. The site was characterized by large diameter specimens of Bitaog (*Calophyllum inophyllum*), as well as Kalumpang and Ipil-ipil. The beach was very rocky and backed by a steep coastal slope, with little in the way of backshore zone. No mangrove species were recorded.

Station 2 was on a pebbly beach 260 m southwest of the BCIB centerline. Vegetation was dominated by grasses, which grew down to the high-water mark. Pandan Dagat, a mangrove species and Talisay (*Terminalia catappa*) were recorded along the lower coastal slope but the distribution of these was sparse.

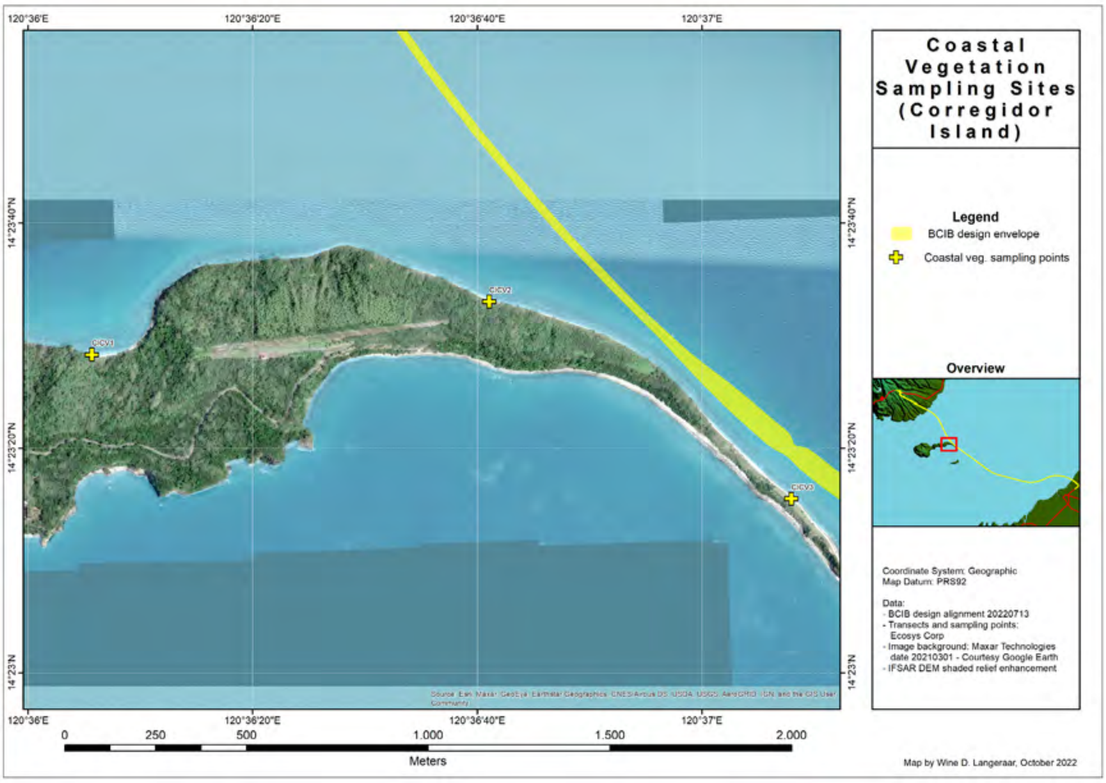


Exhibit 5-55 Coastal Vegetation Sampling Stations, Corregidor Island

Station 3 was situated almost at the tip of the island, 100 m southwest of the centerline. Grasses were the dominant vegetation, although several coconut trees, which appeared to have been planted, were observed. No mangrove species were documented.

Exhibit 5-56 Bitaog (*Calophyllum inophyllum*) at Station 1 (Corregidor Island)

Exhibit 5-57 Grassland with *Pandanus tectorius* and *Terminalia catappa* in the background at Station 2 (Corregidor Island)

Exhibit 5-58 Grassland Above Beach at Station 3 (Corregidor Island)

Across all three sites sampled on Corregidor Island, Coconut was the most dominant species in the upper canopy, with 106.44 IV. It was followed by Bitaog at 63.42 IV, Kalumpang at 41.83 IV and Ipil 36.65 IV. In the middle canopy, Pandan Dagat was the most dominant species with 161.53 IV, followed by *Arenga sp*. at 39.98 IV and Bangkoro (*Morinda citrifolia*) with 26.94 IV.

Botong (*Barringtonia asiatica*) and Talisay (*Terminalia catappa*) were the only species that are generally associated with beaches that were recorded in the lower canopy, with 110 IV and 90 IV, respectively. The small number of beach species growing in the area was likely due to the narrowness of the beaches, with little to no backshore space available. These sites are frequently hit by strong waves during stormy weather.

A total of 11 species, 11 genera and 11 families were recorded during the assessment at Corregidor Island. No exotic species were recorded. The overall species diversity value computed for the sampled plots fell within the 'low' range (H' = 2.00–2.49). With respect to evenness, the sampled areas showed 'moderate' (e' = 0.250–0.499) levels. Although the survey confirmed the presence of one species commonly associated with mangrove areas (*Pandanus tectorius*), the findings strongly suggest a general absence of mangrove habitat along this part of the Corregidor Island coast.

5.1.4.4 Findings of Coastal Vegetation Sampling (Cavite)

A total of 15 sampling stations were established along the Naic coast in the general vicinity of the BCIB project site, of which seven were in beach locations and eight in estuarine locations associated with the Timalan River, Timbugan Creek and Labac River. The sampling station locations are shown in Exhibit 5-59.

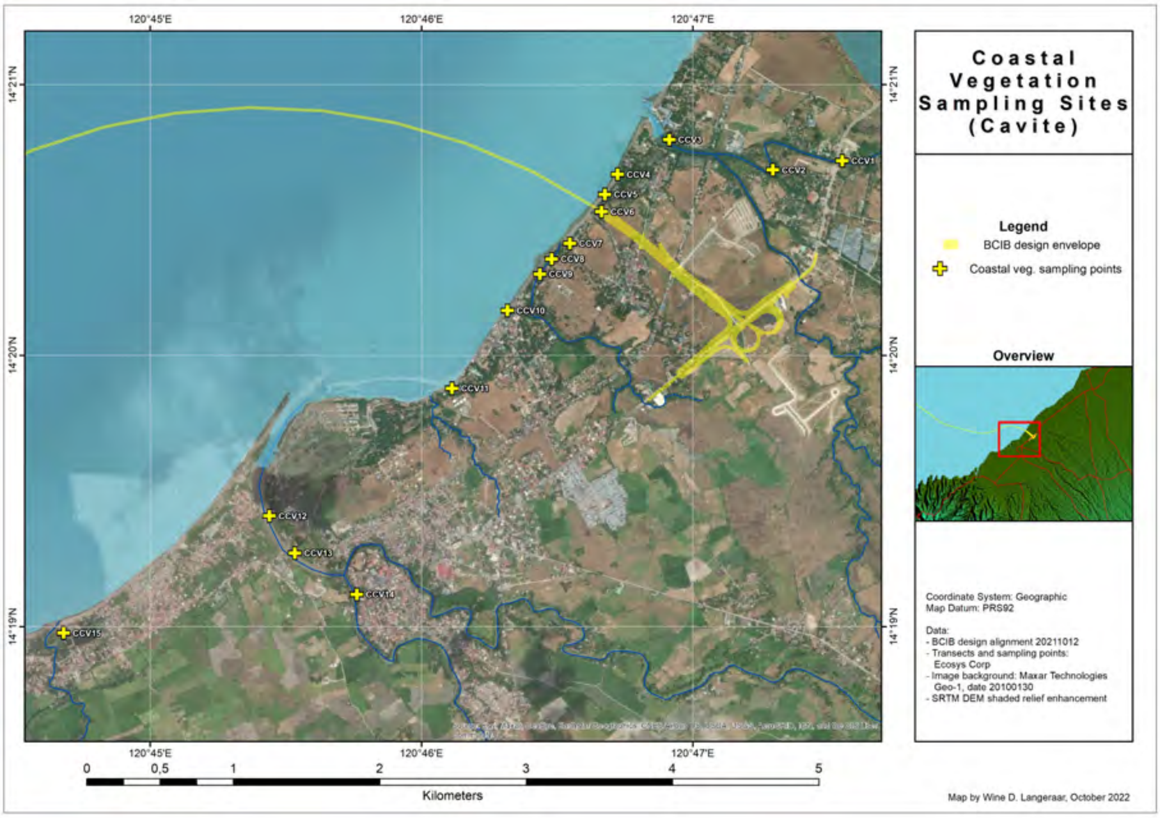


Exhibit 5-59 Coastal Vegetation Sampling Stations, Naic

Stations 1–3 were established in an estuarine mangrove area located at Barangay Timalan Balsahan. Station 1 was located along the Timalan River near the Antero Soriano Highway crossing, about 1.6 km linear distance along the river from Manila Bay and 1.2 km across land to the centerline of the BCIB. Station 2 was positioned at a prominent bend in the river, 950 m from the mouth. And Station 3 was set up on the east side of the river 250 m upstream from the bay and about 670 m northeast of the BCIB centerline. These estuarine areas are full of oyster farms and riverside communities. Mangroves present in this area were observed to be small but thriving. Nipa, Bungalon, Pagatpat, Tabigi (*Xylocarpus granatum*) and Bakauan Babae (*Rhizophora mucronata*) were the common species recorded at these three stations. Some of the mangrove stands were found to be the result of reforestation efforts.

Exhibit 5-60 Bakauan Babae (*Rhizophora mucronata*) Planted Along Timalan River at Station 2 (Cavite)

Exhibit 5-61 Wildings and Pheumatophore Roots of *Avicennia sp*. at Station 3 (Cavite)

Stations 4 and 5 were located along the beach of Barangay Timalan. Large diameter specimens of Talisay, Kamachile (*Pithecellobium dulce*), Coconut and Aroma were the most common species found at these two stations. No mangrove species were recorded.

Station 6 was positioned near the BCIB landing point. This station had several houses around which were found large diameter specimens of Kamachile and Malunggay (*Moringa oleifera*), as well as fruit trees like Guava (*Psidium guajava*), Santol (*Sandoricum koetjape*), Mango (*Mangifera indica*) and Atis (*Annona squamosal*). Clumps of Kawayan Tinik (*Bambusa blumeana*) were also seen growing sparsely outside the plot. The beach was wide and sandy and did not offer suitable mangrove habitat. No mangroves were recorded.

Exhibit 5-62 Talisay, Bani and Kamachile at Station 4, Tiamalan Balsahan (Cavite)

Station 7 and Station 8 were inside a private beach resort. Big specimens of Mango, Sampaloc (*Tamarindus indica*), Kamachile, Coconut, Talisay and Bani (*Pongamia pinnata*) were recorded. Aside from these trees, which are maintained principally for shade, there was very little other vegetation present due to intensive use and landscape maintenance activity.

Station 9 was established in a small mangrove patch located upstream from the mouth of the Timbugan Creek, which meets Manila Bay at Aroma Beach. Mangrove species such as Bungalon, Buta-buta (*Excoecaria agallocha*) and Pototan lalaki (*Bruguiera sexangula*) were recorded. This mangrove patch was 600 m southwest of the BCIB centerline.

Exhibit 5-63 Mangrove Species on the Bank of Timbugan Creek at Station 9 (Cavite)

Station 10 was located at Barangay Munting Mapino. Coconut, Mango, Duhat (*Syzygium cumini*) and Nangka (*Artocarpus heterophyllus*) were the common fruit trees recorded. One mangrove species, Botong (*Barringtonia asiatica*), was observed in its flowering stage. However, this was a built-up beachfront and was not considered suitable mangrove habitat.

The situation was similar at Station 11, which was established at Naic Healing Beach Resort. Coconut and Talisay with an average diameter of 35 cm were the predominant species.

Station 12 was located at the Bukanang Maliit mangrove area, on the east bank of the Labac River, 1.4 km from Manila Bay and 2.9 km from the BCIB landing point. Bakauan Babae, Buta-buta and Nipa were the common mangrove species, while Talisay and Alagaw Dagat (*Premna serratifolia*) were the principal non-mangrove species growing in the vicinity. Bakauan babae was recorded in its flowering stage.

Stations 13 and 14 were situated at Barangay Sapa, along the Labac River, 1.9 km and 2.5 km upstream from the river mouth. Stands of Bakauan Babae, which had been planted in 2007 along the riverbank, were observed to be fruiting here. The planting of mangrove propagules here was reportedly initiated by the Cavite College of Fisheries. Nipa was also common around these sites.

Exhibit 5-64 Planted Stand of Bakauan Babae (*Rhizophora mucronata*) at Station 13 (Cavite)

Exhibit 5-65 Nipa (*Nypa fruticans*) with Fruits at Station 14 (Cavite)

Station 15 was the most distant sampling station from the BCIB project location, at 4.5 km from the centerline. This station was located at Barangay Mabolo, in a mangrove area that was estimated at approximately 1,000 m^2 in extent. The area was planted with Bakauan Babae. The planting activity was reportedly initiated by BFAR CALABARZON in 2019. Approximately 3,000 propagules were planted. Nipa, Bakauan Babae, *Sonneratia sp*. buta-buta and Pototan Lalaki were the most common species in the area. Aroma, Coconut and Ipil-ipil were also recorded in the sampling plot.

Exhibit 5-66 Propagules of Bakauan Babae Planted at Station 15

Across all sites sampled in Naic, Nipa was the most dominant species in the upper canopy, with 86.56 IV, followed by Coconut with 56.04 IV and Talisay with 24.36 IV. Nipa and Coconut were found to have the highest relative dominance, at 39.32 and 22.75, respectively. Coconut and Talisay were the widely distributed amongst the sampled plots. Twenty-six species were recorded in the upper canopy samples, of which six were true mangrove species, eight were beach or associated species and 12 were non-mangrove species that usually grow in upland sites.

With regards to the middle canopy, Bakauan Babae was the most dominant species with 41.87 IV, followed by Aroma at 28.30 IV and Ipil-ipil 26.97 IV. Bakauan Babae had the highest relative dominance value of 26.4, followed by Aroma at 11.2. For the lower canopy, Bungalon was the most dominant species, with 46.69 IV, followed by Bani (*Millettia pinnata*) at 38.52 IV and Bakauan Babae with 28.58 IV.

A total of 41 species, 27 genera and 21 families were recorded during the coastal vegetation survey in Naic. Fifteen exotic or introduced species were also recorded in the area. Some of these species were planted long ago by the communities for subsistence or shade.

The overall species diversity value computed for the sampled plots in Naic fell within the 'moderate' range (H' = 2.50–2.99). With respect to evenness, the sampled areas showed 'moderate' (e' = 0.250–0.499) levels.

The findings of the survey of coastal vegetation in Naic indicate substantial presence of mangrove species in estuarine localities, specifically the estuaries of the Timalan River, Timbugan Creek and the Labac River. It is very likely that the observed mangrove habitat are remnants of a formerly more extensive network of estuarine mangroves. None of the estuarine mangrove areas in Naic are particularly close to the BCIB project; the closest the stands are in the Timalan River, whose lower reaches are roughly parallel with the BCIB approach road, 600–800 m distant. Fewer but larger patches were present in the Timbugan Creek, which is also 600-800 distant.

5.1.5 Faunal Biodiversity

A desktop review of available documents was completed using published field data and ecological reports, Environmental Impact Statements, local Comprehensive Land Use Plans, National Mapping and Resource Information Authority (NAMRIA), and Google earth. The desk-based data was validated with field surveys in February 2020, in late 2021 and early 2022. Together the surveys confirmed the presence or likely absence of notable species throughout the BCIB area. The sampling methods and analytical applications employed were used consistently during the three years of surveys and where surveys were, unless otherwise stated.

5.1.5.1 Sampling Methods

The overall approach to sampling was purposive, rather than random, which is generally considered appropriate for general baseline surveys. The principal objective was to generate a reasonably comprehensive ecological profile of a landscape, including the range of habitats and major ecological features present. This was based on the trained analyst's interpretation of available secondary information such as satellite imagery and thematic mapping and subsequent targeted field surveys. Several methods were employed to survey faunal assemblages, including line transect surveys, mist netting, live cage trapping, cruise surveys, opportunistic observation and interviews with local people encountered during sampling. Each is described briefly in turn below.

Line transect surveys. The line transect method is most useful for surveying avian species and assemblages. Three transects were surveyed in Bataan in 2020 and five different transects in 2021. In Cavite one transect was surveyed in 2020, six in 2021 and two in 2022. Transect selection took account of habitat availability, composition, continuity, accessibility and noteworthy features, e.g., sites potentially used for breeding, foraging, roosting, etc. Once features of interest were identified, suitable access points, such as existing trails, roads, passable streams, dry riverbeds and so forth were located and necessary permissions obtained. The surveyors walked slowly (about 250 m per 15 minutes) along the access transect from 6 am to 9 am and again the same day from 3 pm to 6 pm. Where feeding, breeding or roosting areas were encountered, the traverse was paused as needed for additional observation, to optimize faunal data collection. During each slow traverse, all birds and other fauna seen (with the aid of binoculars as needed) and heard were identified up to the species level, counted, recorded and photographed.

Mist netting. Mist nets consist of lightweight, minimally visible nylon or polyester mesh panels suspended between two poles, somewhat resembling a volleyball net and are used to capture nocturnal flying species (e.g., bats and some birds) that are difficult to see and identify. Mist nets are typically set up in suspected flyways, near feeding trees and gardens, beside watercourses and dry riverbeds and at any naturally tunnel-like formations of vegetation and topography. Five mist net sites were surveyed in 2021 in Bataan and eight in Cavite. Mist nets were checked for trapped animals about every two hours from dawn to dusk, to prevent animal fatalities from exhaustion, dehydration and predation. Trapped animals were removed from the nets and placed in breathable cloth bags to await identification and documentation. Specimens were identified down to the species level, counted, recorded and photographed before being released near the point of capture.

Live cage trapping. Forty cage traps were baited with dried fish or roasted coconut with peanut butter and installed in locations where nonvolant mammals such as rodents were considered likely to pass, such as dry riversides, along game trails and near possible feeding trees, burrow openings, gardens, orchards, coconut/bamboo groves and settlements. Traps were installed in late afternoon, left overnight and retrieved in early morning. Trapped animals were identified up to species level, counted, recorded and photographed before being released near the point of capture.

Cruising. The cruise method was used to survey nocturnal species, especially amphibians and reptiles. Three surveys were completed in Bataan and five in Cavite during 2021. Reconnaissance of areas suitable for night cruising and the identification of nocturnal species was undertaken during daytime. Selected sites included watercourses and streambeds, where amphibians and reptiles can usually be found. Field samplers equipped with headlamps cruised selected sites from 7 pm to 9 pm, following an imaginary straight line for a minimum of 100 m from a start point, for at least one hour. All amphibians and reptiles seen or heard during cruising were captured where possible and placed in resealable bags or breathable cloth bags. Collected animals were identified to species level, counted, recorded and photographed prior to release.

Opportunistic observation. Numerous incidental identifications of wildlife species were made while proceeding with other sampling methods, during rest breaks and while in transit to and from sampling areas.

Interviews. Informal interviews were conducted with locals during the sampling period, incidental to other activity; this enabled the capture and use of local knowledge regarding possibly favorable sampling sites, as well as supplementary information about presence and abundance of various species during different times of the year.

5.1.5.2 Data Analysis

Information to support species identification, interpretation of field data and specification of species conservation status was gathered from sources including:

- Allen, D. (2020). Birds of the Philippines. Lynx and BirdLife International Field Guides. Lynx Editions, Barcelona
- Kennedy, et al. (2000). A Guide to the Birds of the Philippines. Oxford University Press, New York.
- IUCN. (2021). The IUCN Red List of Threatened Species. Version 2021-3. https://www.iucnredlist.org. Accessed first on January 2022.
- Department of Environment and Natural Resources. (2019). DENR Administrative Order No. 2019-09: Updated National List of Threatened Philippine fauna and their Categories. Office of the National Administrative Register, UP Law Center.
- IUCN. (2021). The IUCN Red List of Threatened Species. Version 2021-3. https://www.iucnredlist.org. Accessed first on January 2022.
- CITES. (2021). CITES Appendices I, II and III (22/06/2021). https://cites.org/eng/app/appendices.php. Accessed first on January 2022.

Biodiversity indices were calculated to develop insights into the condition and conservation value of the sampled faunal assemblages, using the formulae listed below:

Species Richness Index (S) = the number of species for a given area

Shannon-Weiner Diversity Index (H') = $-\sum [n_i/N \ln n_i/N]$

where n_i = number individuals of a species; N = total number of individuals of all species

Simpson's Dominance Index (C) = $\sum(n_i/N)^2$

where n_i = number individuals of a species; N = total number of individuals of all species

Shannon's Evenness Index (e) = H' / H_{max}

where $H_{max} = \ln(S)$

The Fernando Biodiversity Scale was used to support interpretation of values calculated for the Shannon-Weiner Index and Shannon Evenness Index, as follows:

Relative Interpretation	Shannon-Weiner Index	Shannon Evenness Index
Very High	≥ 3.5	≥0.75
High	3.0 - 3.49	0.50 – 0.74
Moderate	2.5 – 2.99	0.25 – 0.49
Low	2.0 – 2.49	0.15 – 0.24
Very Low	≤ 1.99	≤0.14

5.1.5.3 Faunal Survey Findings (Bataan)

Faunal sampling was carried out along three transects in Mariveles in early 2020 and five line transects in late October 2021. As indicated above, line transects are useful principally for surveying avian communities. In addition, three cruise transects were surveyed at night to detect and characterize assemblages of nocturnal animals, especially amphibians and reptiles. Five trapping sites comprising mist nets and cage traps were also sampled, aimed at small ground mammals, bats and nocturnal birds. The locations of the transects and trapping sites are shown on the map in Exhibit 5-67.

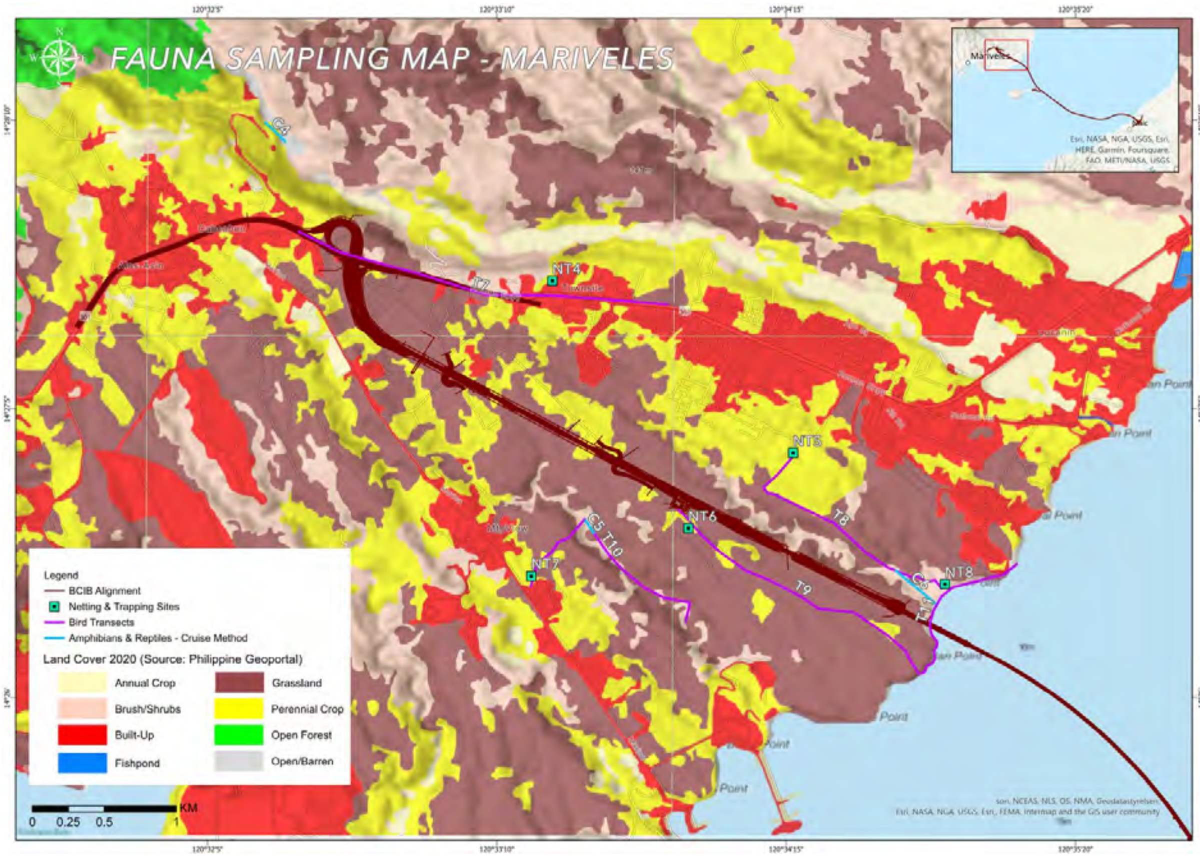


Exhibit 5-67 Faunal Survey Locations, Bataan

In all, 70 faunal species were observed during sampling in the Bataan portion of the BCIB project area. Three quarters of these (53 species) were birds. Four amphibian species (three frogs and one toad) were documented, as were nine reptile species (mostly snakes). The mammals were represented by just four species, all bats. A comprehensive species list is provided in Exhibit 5-68.

Exhibit 5-68 Comprehensive List of Species Documented in Faunal Surveys, Bataan

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
Birds						
1	Accipiter gularis	*Japanese Sparrowhawk*	Migrant	LC	Appendix II	EN
2	Acridotheres cristalellus	*Crested Myna*	Introduced	LC		
3	Actitis hypoleucos	*Common Sandpiper*	Migrant	LC		
4	Alcedo atthis	*Common Kingfisher*	Migrant	LC		
5	Anthus rufulus	*Paddyfield Pipit*	Resident	LC		
6	Ardea intermedia	*Intermediate Egret*	Resident/Migrant	LC		
7	Artamus leucoryn	*White-breasted Woodswallow*	Resident	LC		

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
8	Bolbopsittacus lunulatus	*Guaiabero*	Endemic	LC	Appendix II	EN
9	Bubulcus ibis	*Cattle Egret*	Resident/Migrant	LC		
10	Calidris ruficollis	*Red-necked Stint*	Migrant	NT		
11	Centropus viridis	*Philippine Coucal*	Endemic	LC		
12	Chalcophaps indica	*Common Emerald Dove*	Resident	LC		
13	Cincloramphus timoriensis	*Tawny Grassbird*	Resident	LC		
14	Cinnyris jugularis	*Olive-backed Sunbird*	Resident	LC		
15	Collocalia esculenta	*Grey-rumped Swiftlet*	Endemic	LC		
16	Collocalia troglodytes	*Pygmy Swiftlet*	Endemic	LC		
17	Corvus enca	*Slender-billed Crow*	Resident	LC		
18	Corvus macrorhyncos	*Large-billed Crow*	Resident	LC		
19	Cuculus saturatus	*Himalayan Cuckoo*	Migrant	LC		
20	Dicaeum australe	*Red-keeled Flowerpecker*	Endemic	LC		
21	Egretta garzetta	*Little Egret*	Resident/Migrant	LC		
22	Egretta sacra	*Eastern Reef Egret*	Resident/Migrant	LC		
23	Hypotaenidia torquata	*Barred Rail*	Resident	LC		
24	Gallus gallus	*Red Junglefowl*	Resident	LC		
25	Geopelia striata	*Zebra Dove*	Resident	LC		
26	Gerygone sulphurea	*Golden-bellied Gerygone*	Resident	LC		
27	Haliastur indus	*Brahminy Kite*	Resident	LC	Appendix II	EN
28	Hirundo rustica	*Barn Swallow*	Migrant	LC		
29	Hirundo javanica	*House Swallow*	Resident	LC		
30	Lalage nigra	*Pied Triller*	Resident	LC		
31	Lanius cristatus	*Brown Shrike*	Migrant	LC		
32	Lanius schach	*Long-tailed Shrike*	Resident	LC		
33	Lonchura atricapilla	*Chestnut Munia*	Resident	LC		
34	Lonchura leucogastra	*White-bellied Munia*	Resident	LC		

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
35	Lonchura punctulata	*Scaly-breasted Munia*	Resident	LC		
36	Megalurus palustris	*Striated Grassbird*	Resident	LC		
37	Merops philippinus	*Blue-tailed Bee-eater*	Resident	LC		
38	Monticola solitarius	*Blue Rock Thrush*	Resident/Migrant	LC		
39	Nycticorax nycticorax	*Black-crowned Night Heron*	Resident	LC		
40	Oriolus chinensis	*Black-naped Oriole*	Resident	LC		
41	Orthotomus derbianus	*Grey-backed Tailorbird*	Endemic	LC		
42	Passer montanus	*Eurasian Tree Sparrow*	Introduced	LC		
43	Pernis steerei	*Philippine Honey Buzzard*	Endemic	LC	Appendix II	EN
44	Psilopogon haemacephalus	*Coppersmith Barbet*	Resident	LC		
45	Pycnonotus goiavier	*Yellow-vented Bulbul*	Resident	LC		
46	Rhipidura nigritoquis	*Philippine Pied Fantail*	Endemic	LC		
47	Saxicola caprata	*Pied Bush Chat*	Resident	LC		
48	Spilopelia chinensis	*Spotted Dove*	Resident	LC		
49	Sterna hirundo	*Common Tern*	Resident	LC		
50	Todiramphus chloris	*Collared Kingfisher*	Resident	LC		
51	Tringa brevipes	*Grey-tailed Tattler*	Migrant	NT		
52	Turnix suscitator	*Barred Buttonquail*	Resident	LC		
53	Zosterops meyeni	*Lowland White-eye*	Near Endemic	LC		
Amphibians						
54	Hylarana erythraea	*Common Green Frog*	Introduced	LC		
55	Kaloula pulchra	*Banded Bullfrog*	Introduced	LC		
56	Limnonectes macrocephalus	*Luzon Fanged Frog*	Endemic	NT		OTS[2]
57	Rhinella marina	*Cane Toad*	Introduced	LC		
Reptiles						
58	Ahaetulla prasina	*Gunther's Whip Snake*	Resident	LC		
59	Chelonid	*Marine Turtle*	Migrant	VU/EN/CR[1]	Appendix I	EN / CR

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
60	Coelognathus erythrurus	*Philippine Trinket Snake*	Resident	LC		
61	Gekko gecko	*Tokay Gecko*	Resident	LC	Appendix II	OTS
62	Hemidactylus frenatus	*Common House Gecko*	Resident	LC		
63	Lycodon sp.	*Wolf Snake (exact species unknown)*	unknown	unknown	unknown	unknown
64	Malayopython reticulatus	*Reticulated Python*	Resident	LC	Appendix II	OTS
65	Naja philippinensis	*Philippine Cobra*	Endemic	NT	Appendix II	OTS
66	Varanus marmoratus	*Marbled Monitor Lizard*	Endemic	LC	Appendix II	OTS
Mammals						
67	Cynopterus brachyotis	*Short-nosed Fruit Bat*	Resident	LC		
68	Ptenochirus jagori	*Greater Musky Fruit Bat*	Endemic	LC		
69	Pteropus hypomelanus	*Island Flying Fox*	Resident	NT	Appendix II	EN
70	Rousettus amplexicaudatus	*Common Rousette*	Resident	LC		

Notes
[1] The identity of the chelonid turtle could not be ascertained and since four species are likely to occur in the area, the threatened categories of all are indicated.
[2] OTS = Other Threatened Species (category used in DAO 2019-09 for species one threat level below VU)

Out of the 70 faunal species recorded during the survey, 13 are considered threatened by one or more of the three key sources: the IUCN Red List, CITES Appendices and DENR DAO 2019-09. These species are listed in Exhibit 5-69). The identity of the chelonid turtle species reported by locals to use the beach by the mouth of the Babuyan River as a nesting site could not be definitively determined, so the conservation status is given for all the marine turtle species known to frequent Manila Bay. It is highly probable that the species in question is the Olive Ridley (*Lepidochelys olivacea*), as this is the most frequent nester on local beaches. The Olive Ridley is considered VU by IUCN and EN under DAO 2019-09.

Exhibit 5-69 List of Threatened Species Documented in Faunal Survey, Bataan

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
Birds						
1	*Accipiter gularis*	Japanese Sparrowhawk	Migrant	LC	Appendix II	EN
2	*Bolbopsittacus lunulatus*	Guaiabero	Endemic	LC	Appendix II	EN
3	*Calidris ruficollis*	Red-necked Stint	Migrant	NT		
4	*Haliastur indus*	Brahminy Kite	Resident	LC	Appendix II	EN

	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
5	*Pernis steerei*	Philippine Honey Buzzard	Endemic	LC	Appendix II	EN
6	*Tringa brevipes*	Grey-tailed Tattler	Migrant	NT		
Amphibians						
7	*Limnonectes macrocephalus*	Luzon Fanged Frog	Endemic	NT		OTS[2]
Reptiles						
8	*Chelonid turtle*	Marine Turtle	Migrant	VU/EN/CR[1]	Appendix I	EN / CR[1]
9	*Gekko gecko*	Tokay Gecko	Resident	LC	Appendix II	OTS
10	*Malayopython reticulatus*	Reticulated Python	Resident	LC	Appendix II	OTS
11	*Naja philippinensis*	Philippine Cobra	Endemic	NT	Appendix II	OTS
12	*Varanus marmoratus*	Marbled Monitor Lizard	Endemic	LC	Appendix II	OTS
Mammals						
13	*Pteropus hypomelanus*	Island Flying Fox	Resident	NT	Appendix II	EN

Avian diversity

In all, 838 individual birds representing 53 species were counted in Mariveles during the 2021 surveys. No significant differences in species richness were documented between transects (see Exhibit 5-70). Differences in avian abundance between transects were attributed by the surveyors to favorable topography offering good vantage points for bird observation along some transects, and the presence of relatively large flocks of the cosmopolitan Eurasian Tree Sparrow (*Passer Montanus*), Yellow-Vented Bulbul (*Pycnonotus goiavier*) and White-breasted Woodswallow (*Artamus leucoryn*), all common and widespread species, along the T7-2021 transect. A mass nesting site used by various egret species, dominated by the Cattle Egret (*Bubulcus ibis*), contributed to elevated abundance at T10-2021. Many species observed are commonly associated with grassland habitat and human-dominated areas.

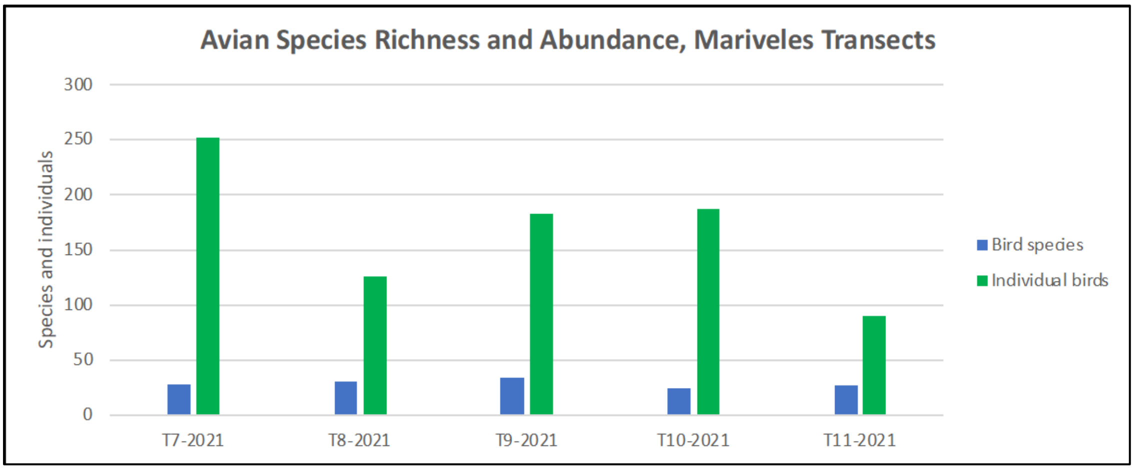


Exhibit 5-70: Avian Species Richness and Abundance, Bataan (2021)

Bird diversity in the Bataan portion of the project area was found to be quite high in general, with three of eight transects in the 'high' category on the Fernando Scale and three others in the 'moderate' category (see Exhibit 5-71). Only one transect had diversity below H'=2.0, placing it in the 'low' diversity category. Evenness, as calculated using Shannon's Evenness Index, was found to be mostly in the 'very high' range (e=0.75 or greater). Dominance scores were favorably low. Overall, the Bataan project area's moderate to high diversity and high evenness yield quite a good diversity profile for an area that has been subject to substantial human modification for several decades.

Amphibian diversity

The survey data suggest that amphibian diversity is quite low in the Bataan portion of the BCIB project area. Only four amphibian species were recorded: the Common Green Frog (*Hylarana erythraea*), Banded Bullfrog (*Kaloula pulchra*), Luzon Fanged Frog (*Limnonectes macrocephalus*) and Cane Toad (*Rhinella marina*). The Luzon Fanged Frog is an indigenous and endemic species but the other three are introduced and commonly considered indicators of anthropogenic impact on local biodiversity. The Luzon Fanged Frog was only recorded along the Alas-Asin River and nearby stream. The three introduced species were recorded along the watercourses closer to the BCIB alignment (San Jose River and Babuyan River). Cane Toad was recorded throughout the general vicinity of the project area, across various habitats including grassland, commercial areas and coastal areas.

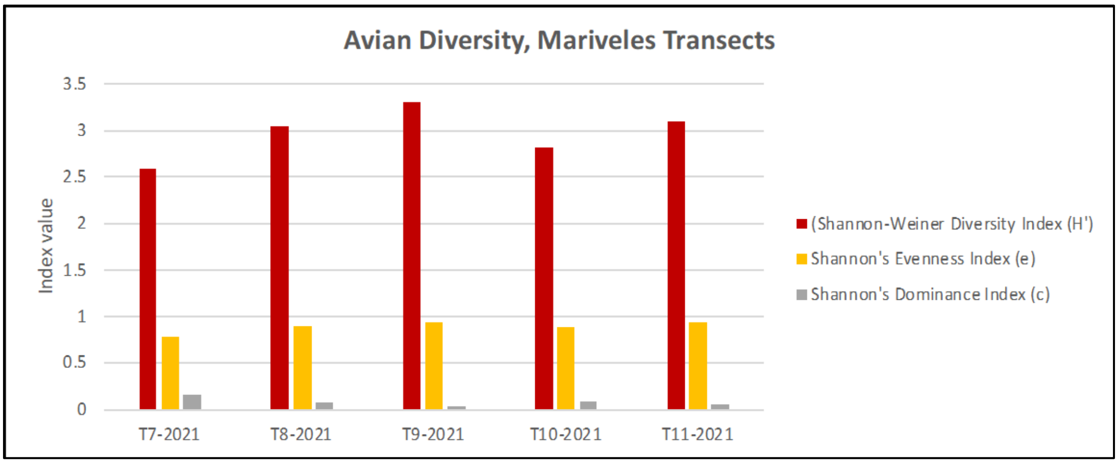


Exhibit 5-71 Avian Diversity, Bataan Project Area (2021)

Reptilian diversity

Reptiles are challenging to survey because they are naturally cryptic and intensive field study is required to achieve comprehensive representation of species. Nine reptile species were recorded through the cruise method and interviews, which potentially indicates a low diversity for the wider landscape. The reptile species documented included five snakes, three lizards and one marine turtle. All of the reptiles recorded are native to the Philippines; the Philippine Cobra (*Naja philipinnensis*) and the Marbled Water Monitor (*Varanus marmoratus*) are endemic. Monitor lizard traps were also recorded throughout the area during the flora and fauna surveys.

Mammalian diversity

Only four mammal species were recorded during the survey, which is probably indicative of low mammalian diversity, although the limited frequency and extent of the surveys may be a contributing factor. All mammals documented were frugivorous bats: the Short-nosed Fruit Bat (*Cynopterus brachyotis*), Greater Musky Fruit Bat (*Ptenochirus jagori*), Island Flying Fox (*Pteropus hypomelanus*) and Common Rousette (*Rousettus amplexicaudatus*). These species were captured in mist nets. All four of these species are adaptable and capable of occupying a wide range of habitats, including forest, ecotones, agroforestry zones, orchards, plantations and even urban areas. No insectivorous bats were captured but some unknown bat species were observed flying at dusk. Live cage traps failed to capture nonvolant mammals such as rodents, which was surprising, as it is very likely that rodents including rats, mice and shrews do inhabit the landscape, given the presence of human habitation and agricultural activity. The apparent absence of larger mammals was, by contrast, not surprising, as most larger Philippine mammals are associated with less disturbed habitat than that present.

5.1.5.4 Faunal Survey Findings (Corregidor Island)

A survey of avian species was conducted in and around the Tail End portion of Corregidor Island in February 2022. Unlike terrestrial flora and non-volant terrestrial fauna, birds that use habitat along the Tail End may be exposed to direct impacts from the development of the BCIB project; the assemblages of avian life are therefore relevant to the baseline and are scoped into the impact assessment.

Two survey transects were established on the Tail End, the first (Transect 12) along the beach on the eastern side of the land ridge, near where the BCIB marine viaduct will pass and the second (Transect 13) along the beach on the eastern flank, facing San Jose Bay. Both transects surveyed represented rocky beach and adjacent brushland and grassland habitats. Brushland was predominant along much of the transects' lengths, with grassland becoming more prevalent only towards the extreme southeastern tip of the island. The two transects have different exposures to wind and waves. Transect 12 is exposed to robust wave action generated by the strong northeasterlies that predominate during the northeast monsoon and is generally a harsher environment than Transect 12, which is somewhat more sheltered and has a slightly wider beach with modest stretches of sand amongst the rocks. Anthropogenic activities recorded in the vicinity include the docking of small fishing vessels and the scavenging of solid wastes washed ashore, for sale in junkshops on the mainland. Fisherfolk are known to use the shores of the island for resting or for refuge when sea conditions are unfavorable. Although Corregidor Island is a recognized tourist site, most of the Tail End portion remains a restricted military area, so tourist presence would not be expected to have any effect on bird life in the surveyed area. The military airstrip in the Tail End is not currently used.

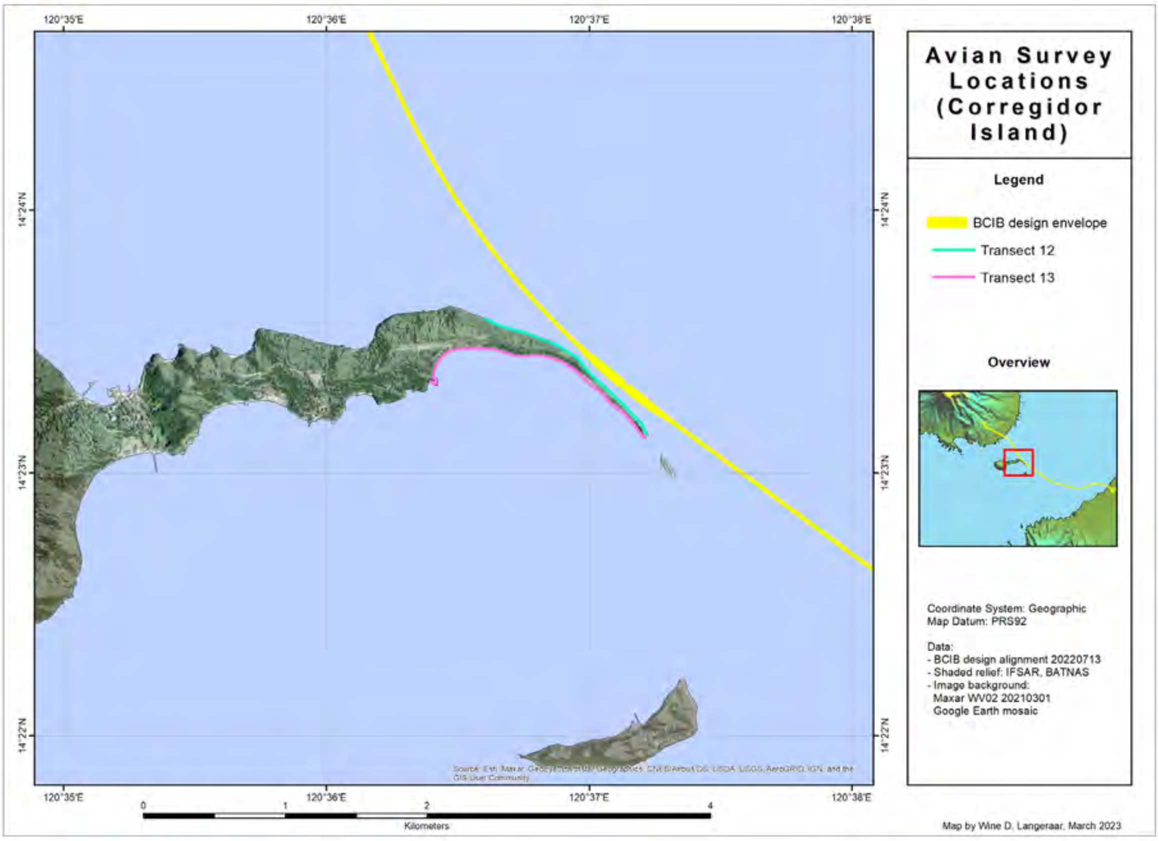


Exhibit 5-72 Avian Survey Transects on Tail End of Corregidor Island (2022)

A total of 18 avian species were recorded during the survey; 17 species were observed along Transect 12 and 14 were seen along Transect 13. As both transects were in the same general area and both were characterized by similar grassland and brushland habitat, the lack of a significant difference in species composition was unsurprising.

Species diversity was found to be low to moderate, with H'=2.61 for Transect 12 and H'=2.36 for Transect 13. This level of diversity is reflective of the existing conditions, notably the island setting and types of habitat present (brushland, grassland and open forest). Corregidor Island is not known for high avian diversity in general, as the island's flora is deficient in fruiting tree and shrub species, itself a legacy of an aerial seeding program implemented after the forest-destructive years of WWII, which led to the introduced, leguminous tree Ipil-ipil becoming the dominant forest species.

Evenness index values calculated for the two transects were e=0.92 for Transect 12 and e=0.90 for Transect 13; these are considered very high values by the Fernando Biodiversity Scale and indicate an absence of especially dominant species. This was corroborated by dominance indices of c=0.09 and c=0.10 for Transect 12 and Transect 13, respectively. The full list of avian species recorded along the two transects is presented in Exhibit 5-73.

The avian species list is dominated by resident species, including three that are endemic to the Philippines. All of the species recorded are classified as LC by IUCN, while three are designated as EN under DAO 2019-09, by virtue of their being listed in the CITES appendices.

Exhibit 5-73 Avian Species Recorded on Corregidor Island (Tail End)

Taxa	Species	Common Name	Residency	IUCN status	DENR-DAO 2019-09 status
1	*Artamus leucoryn*	White-breasted Woodswallow	Resident	LC	
2	*Cinnyris jugularis*	Olive-backed Sunbird	Resident	LC	
3	*Collocalia troglodytes*	Pygmy Swiftlet	Endemic	LC	
4	*Cypsiurus balasiensis*	Asian Palm Swift	Resident	LC	
5	*Halcyon smyrnensis*	White-throated Kingfisher	Resident	LC	
6	*Haliaeetus leucogaster*	White-bellied Sea-eagle	Resident	LC	Endangered
7	*Haliastur indus*	Brahminy Kite	Resident	LC	Endangered
8	*Hirundo rustica*	Barn Swallow	Migrant	LC	
9	*Lanius cristatus*	Brown Shrike	Migrant	LC	
10	*Megalurus palustris*	Striated Grassbird	Resident	LC	
11	*Merops philippinus*	Blue-tailed Bee-eater	Resident	LC	
12	*Monticola solitarius*	Blue Rock Thrush	Migrant/ Resident	LC	
13	*Oriolus chinensis*	Black-naped Oriole	Resident	LC	
14	*Pandion haliaetus*	Western Osprey	Migrant/ Resident	LC	Endangered
15	*Phapitreron leucotis*	White-eared Brown Dove	Endemic	LC	
16	*Pycnonotus goiavier*	Yellow-Vented Bulbul	Resident	LC	
17	*Rhipidura nigritorquis*	Philippine Pied Fantail	Endemic	LC	
18	*Todiramphus chloris*	Collared Kingfisher	Resident	LC	

5.1.5.5 Faunal Survey Findings (Cavite)

Faunal sampling was carried out along eight line transects in Naic, of which one was initially surveyed in early 2020, six were surveyed in early November 2021 (including the duplication of the 2020 survey), and two more in May 2022. In addition, nine cruise transects were surveyed at night to detect and characterize assemblages of nocturnal animals, especially amphibians and reptiles. Eight netting and/or trapping sites were also sampled, aimed at small ground mammals, bats and nocturnal birds. The locations of the transects and trapping sites are shown on the map in Exhibit 5-74.

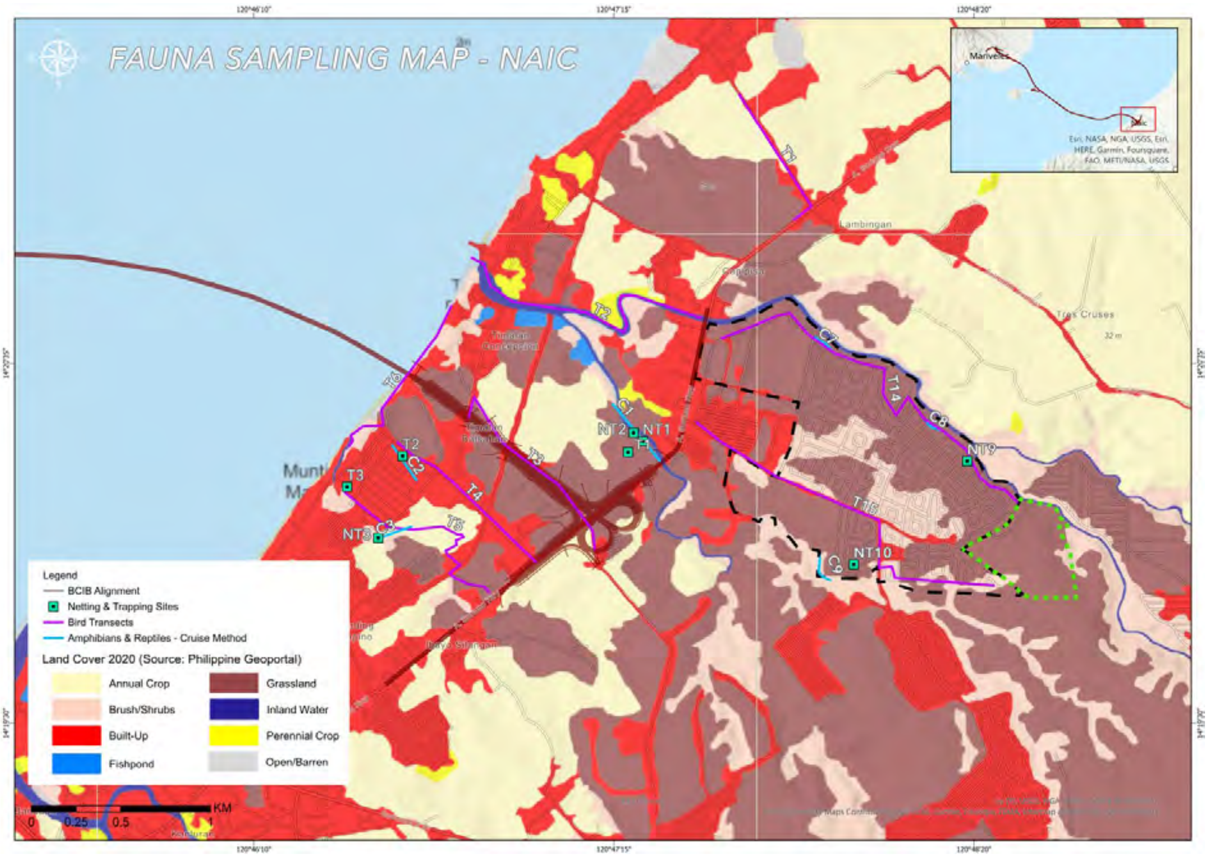


Exhibit 5-74 Faunal Survey Locations, Cavite

A total of 78 faunal species were documented during the sampling in Cavite. Of these, 74% (58 species) were birds, while five mammal species, four amphibian species and 11 reptile species were recorded. A comprehensive species list is provided in Exhibit 5-75.

Exhibit 5-75 Comprehensive List of Species Documented in Faunal Surveys, Cavite (2021/22)

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
Birds						
1	*Acridotheres cristatellus*	Crested Myna	Introduced	LC		
2	*Actitis hypoleucos*	Common Sandpiper	Migrant	LC		
3	*Aerodramus mearnsi*	Philippine Swiftlet	Endemic	LC		
4	*Alcedo atthis*	Common Kingfisher	Migrant	LC		
5	*Amaurornis phoenicurus*	White-breasted waterhen	Resident	LC		
6	*Anas luzonica*	Philippine duck	Endemic	VU		EN
7	*Anthus rufulus*	Paddyfield Pipit	Resident	LC		
8	*Ardea alba*	Great Egret	Resident/ Migrant	LC		
9	*Ardea intermedia*	Intermediate Egret	Resident/ Migrant	LC		
10	*Ardea purpurea*	Purple Heron	Resident	LC		

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
11	*Artamus leucoryn*	White-breasted Woodswallow	Resident	LC		
12	*Bubulcus ibis*	Eastern Cattle Egret	Resident/ Migrant	LC		
13	*Butorides striata*	Striated Heron	Resident/ Migrant	LC		
14	*Calliope calliope*	Siberian rubythroat	Migrant	LC		
15	*Cecropis daurica*	Red-rumped swallow	Resident	LC		
16	*Centropus bengalensis*	Lesser coucal	Resident	LC		
17	*Centropus viridis*	Philippine coucal	Endemic	LC		
18	*Chalcophaps indica*	Common Emerald Dove	Resident	LC		
19	*Chlidonias hybrida*	Whiskered Tern	Migrant	LC		
20	*Cincloramphus timoriensis*	Tawny Grassbird	Resident	LC		
21	*Cinnyris jugularis*	Olive-backed Sunbird	Resident	LC		
22	*Cisticola exilis*	Golden-headed cisticola				
23	*Collocalia esculenta*	Grey-rumped Swiftlet	Resident	LC		
24	*Copsychus mindanensis*	Philippine Magpie-robin	Endemic	LC		
25	*Corvius macrorhynchos*	Large-billed crow	Resident	LC		
26	*Dicaeum australe*	Red-keeled Flowerpecker	Endemic	LC		
27	*Egretta garzetta*	Little Egret	Resident/ Migrant	LC		
28	*Geopelia striata*	Zebra Dove	Resident	LC		
29	*Gerygone sulphurea*	Golden-bellied Gerygone	Resident	LC		
30	*Haliastur indus*	Brahminy Kite	Resident	LC	Appendix II	EN
31	*Hirundo rustica*	Barn Swallow	Migrant	LC		
32	*Hirundo javanica*	House Swallow	Resident	LC		
33	*Hypotaenidia philippensis*	Buff-banded Rail	Resident	LC		
34	*Hypotaenidia torquate*	Barred Rail	Resident	LC		
35	*Ixobrychus cinnamomeus*	Cinnamon Bittern	Resident	LC		
36	*Ixobrychus sinensis*	Yelow bittern	Migrant	LC		
37	*Lalage nigra*	Pied Triller	Resident	LC		
38	*Lanius cristatus*	Brown Shrike	Migrant	LC		
39	*Lanius schach*	Long-tailed Shrike	Resident	LC		
40	*Lonchura atricapilla*	Chestnut Munia	Resident	LC		

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
41	*Lonchura oryzivora*	Java Sparrow	Introduced	EN		
42	*Lonchura punctulata*	Scaly-breasted Munia	Resident	LC		
43	*Megalurus palustris*	Striated Grassbird	Resident	LC		
44	*Merops philippinus*	Blue-tailed Bee-eater	Resident	LC		
45	*Nycticorax caledonicus*	Rufous Night-heron	Resident	LC		
46	*Nycticorax nycticorax*	Black-crowned Night Heron	Resident	LC		
47	*Oriolus chinensis*	Black-naped Oriole	Resident	LC		
48	*Passer montanus*	Eurasian Tree sparrow	Introduced	LC		
49	*Phapitreron leucotis*	White-eared Brown Dove	Endemic	LC		
50	*Psilopogon haemacephalus*	Coppersmith barbet	Resident	LC		
51	*Pycnonotus goiavier*	Yellow-vented Bulbul	Resident	LC		
52	*Rhipidura nigritorquis*	Philippine Pied Fantail	Endemic	LC		
53	*Saxicola caprata*	Pied Bush Chat	Resident	LC		
54	*Spilopelia chinensis*	Spotted Dove	Resident	LC		
55	*Streptopelia dusumieri*	Island Collared dove	Resident	VU		EN
56	*Todiramphus chloris*	Collared Kingfisher	Resident	LC		
57	*Turnix ocellatus*	Spotted buttonquail	Endemic	LC		
58	*Turnix suscitator*	Barred buttonquail	Resident	LC		
Amphibians						
59	*Fejervarya cancrivora*	Mangrove frog	Resident	LC		
60	*Polypedates leucomystax*	Common Tree Frog	Resident	LC		
61	*Kaloula pulchra*	Banded bullfrog	Introduced	LC		
62	*Rhinella marina*	Cane toad	Introduced	LC		
Reptiles						
63	*Chelonid*	Marine Turtle	Migrant	VU / EN / CR[1]	Appendix I	EN / CR
64	*Chrysopelea paradisi*	Paradise Tree snake	Resident	LC		
65	*Dendrelaphis sp.*	Bronzeback Tree Snake	Resident	LC		
66	*Eutropis multifasciata*	Common Mabuya	Resident	LC		
67	*Gekko gecko*	Tokay gecko	Resident	LC	Appendix II	OTS[2]
68	*Hemidactylus frenatus*	Common house gecko	Resident	LC		
69	*Lamprolepis smaragdina*	Emerald skink	Resident	LC		

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
70	*Malayopython reticulatus*	Reticulated Python	Resident	LC	Appendix II	OTS
71	*Naja philippinensis*	Philippine Cobra	Endemic	NT	Appendix II	OTS
72	*Oligodon ancorus*	Northern Short-headed snake	Endemic	NT		
73	*Varanus marmoratus*	Luzon Monitor Lizard	Endemic	LC	Appendix II	OTS
Mammals						
74	*Cynopterus brachyotis*	Short-nosed Fruit Bat	Resident	LC		
75	*Ptenochirus jagori*	Musky Fruit Bat	Endemic	LC		
76	*Rousettus amplexicaudatus*	Common Rousette	Resident	LC		
77	*Rattus tanezumi*	Oriental House Rat	Introduced	LC		
78	*Scotophilus kuhlii*	Lesser Asiatic Yellow Bat	Resident	LC		

Notes

[1] The identity of the chelonid turtle could not be ascertained and since four species are likely to occur in the area, the threatened categories of all are indicated.

[2] OTS = Other Threatened Species (category used in DAO 2019-09 for species one threat level below VU)

Out of the 78 faunal species recorded during the survey in Cavite, nine are listed with a threatened status in the IUCN Red List, CITES Appendices, or DENR DAO 2019-09. These species are shown in Exhibit 5-76 . The identity of the chelonid turtle species reported to use the beaches of Barangays Timalan Balsahan and Timalan Concepcion could not be definitively determined during the survey, so the conservation status is given for all of the marine turtle species known to frequent Manila Bay. It is highly probable that the species in question is the Olive Ridley, as this is known to be the most frequent nester on local beaches. The Olive Ridley is considered VU by IUCN and EN under DAO 2019-09.

Exhibit 5-76 Threatened Species Identified During Faunal Survey in Cavite (2021/22)

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
Birds						
1	*Anas luzonica*	Philippine Duck	Endemic	VU		EN
2	*Haliastur indus*	Brahminy Kite	Resident	LC	Appendix II	EN
3	*Lonchura oryzivora*	Java Sparrow	Introduced	EN		
4	*Streptopelia dusumieri*	Island collared dove	Resident	VU		EN
Reptiles						
5	*Chelonid (undetermined)*	Marine Turtle	Migrant	VU/EN/CR	Appendix I	EN/CR
6	*Gekko gecko*	Tokay gecko	Resident	LC	Appendix II	OTS
7	*Malayopython reticulatus*	Reticulated Python	Resident	LC	Appendix II	OTS

No.	Species	Common Name	Residency	IUCN Status	CITES	DENR DAO 2019-09
8	*Naja philippinensis*	Philippine Cobra	Endemic	NT	Appendix II	OTS
9	*Varanus marmoratus*	Luzon Monitor Lizard	Endemic	LC	Appendix II	OTS

Avian diversity

The faunal survey in Cavite observed a total of 875 individual birds representing 58 species. The most abundant species recorded were the Eurasian Tree Sparrow with 75 individuals, Eastern Cattle Egret (*Bubulcus ibis*) with 72, Scaly-breasted Munia (*Lonchura punctulata*) with 63 individuals and Grey-Rumped Swiftlet (*Collocalia esculenta*) with 54 individuals. These frequent species were mainly recorded within the open grasslands and pastures, brushlands and rice fields. The observed species are well-adapted to urban and peri-urban settings. A substantial subset of species is more suited to natural habitats and their presence is linked to the scattered patches of riparian and mangrove vegetation that remain along the Timalan River.

Significant differences in species richness were documented between the eight transects and abundance varied more widely (see Exhibit 5-77). The differences are likely to be associated with the habitat characteristics within which the species were recorded. In particular, the four transects with the highest species richness (T2, T5, T14 and T15) were located along or adjacent to riparian/mangrove zones or brushland with relatively lightly disturbed conditions. There were generally low levels of human activity at these locations, enabling the presence of disturbance-intolerant species and boosting species richness compared to more disturbed locations. By contrast, T1 and T6, which had the lowest species richness, were in areas of high human activity and low-quality habitat, the former being along a road passing though pasture surrounded by commercial establishments and a new housing development under construction, and the latter being on a busy beachfront.

Similar to species richness, the differences in abundance across transects were dependent on the degree of anthropogenic activity in areas traversed by the respective transects. Avian abundance was highest in three transects located in lightly disturbed areas (T2, T5 and T15).

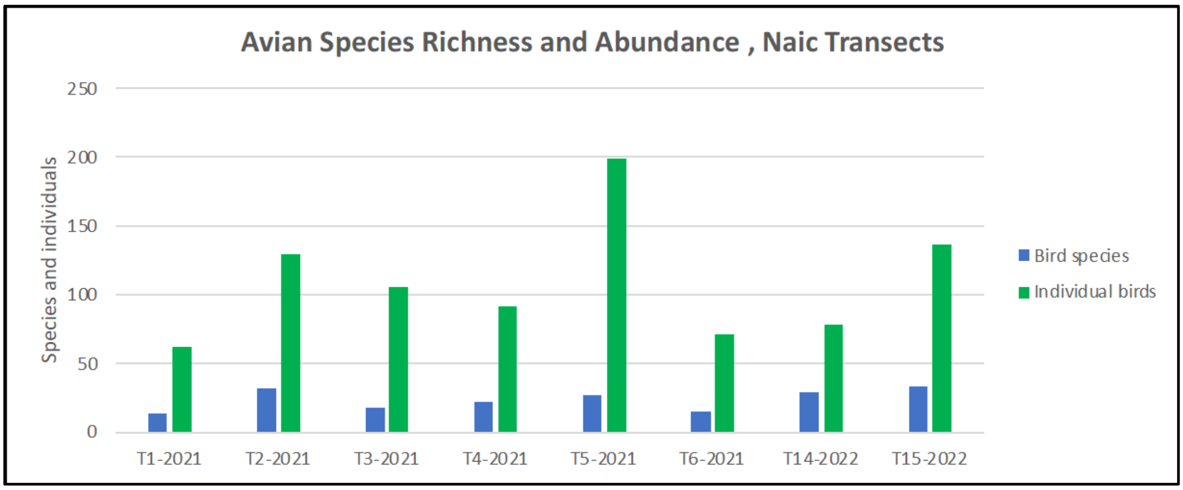


Exhibit 5-77 Avian Species Richness and Abundance, Cavite (2021/22)

Avian diversity, as measured using the Shannon-Weiner Diversity Index, was found to be moderate to high, with five of the eight transects in the H'=2.5 to H'=3.0 range, which is considered 'moderate' on the Fernando Biodiversity Scale and the remaining three transects above H'=3.0 and classified as 'high' (see Exhibit 5-78). The evenness of species representation in the faunal assemblage, as measured using Simpson's Evenness Index, was very high, with the lowest score being e=0.90 and the highest e=0.98, as compared to the maximum of e=1.0.

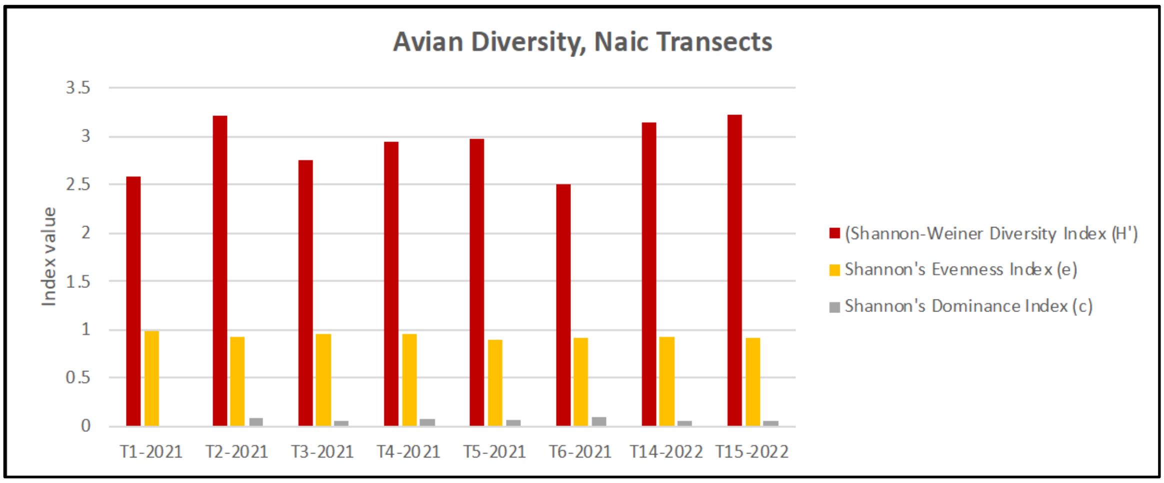


Exhibit 5-78 Avian Diversity, Cavite Project Area

Amphibian diversity

Only four amphibian species were recorded during the survey, indicating low diversity. The four species found are the Mangrove Frog (*Fejervarya cancrivora*), Banded Bullfrog, Common Tree Frog and the Cane Toad. The Mangrove Frog, Banded Bull Frog and the Common Tree Frog seemed to have a limited distribution in the area, as they were only recorded in the riparian zone of a tributary of the Timalan River. The very adaptable Cane Toad was observed in all the sites surveyed, indicating wide distribution and probable dominance of local amphibian assemblages. Both the Cane Toad and Banded Bullfrog are introduced species.

Reptilian diversity

Diversity of reptiles as recorded in the survey appears to be low, with 11 species observed, but it is acknowledged that reptile species are cryptic and difficult to find, and the survey may therefore understate diversity. Noteworthy species are the endemic Philippine Cobra, Northern Short-Headed Snake (*Oligodon ancorus*), Marbled Water Monitor and a chelonid marine turtle with historical observations of irregular nesting along the Naic coast. It is probable that the marine turtle is the Olive Ridley, as this is reported to nest more frequently on local beaches than any of the other three marine turtle species know to enter Manila Bay.

Mammalian diversity

Just five mammal species were documented during the survey in Cavite, indicating low mammalian diversity in the area. Generally low mammalian abundance and diversity were expected, given the peri-urban setting and high degree of human activity in most of the locations surveyed. The five species recorded were Short-nosed Fruit Bat, Common Rousette, Greater Musky Fruit Bat, Lesser Asiatic Yellow Bat (*Scotophilus kuhlii*) and Oriental House Rat (*Rattus tanezumi*). These species are common, widespread and known to inhabit disturbed areas even in urban landscapes, provided there are available food sources (e.g., orchards, gardens, fruiting figs, mangroves). The Greater Musky Fruit Bat is an endemic species recorded across various elevation and disturbance gradients indicating high tolerance and adaptability to wide range of habitats. The Oriental House Rat is an introduced species commonly recorded in areas with human presence (e.g., human settlements, agricultural areas, agroforestry zones, forest clearings, edge habitats).

5.1.6 Habitat Classification

The ecological character of each of the terrestrial portions of the BCIB project area was considered in relation to the habitat classification criteria stipulated in IFC Performance Standard 6 (PS6).[72] The key operational definitions specified in PS6 and in the supporting Guidance Note 6 (GN6) as follows:

Habitat. Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. For the purposes of implementation of this Performance Standard, habitats are divided into modified, natural and critical. Critical habitats are a subset of modified or natural habitats. (PS6, Para. 9)

Modified Habitat. Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones and reclaimed wetlands. (PS6, Para. 11)

Human activity may modify the structure and composition of natural habitats to the degree that nonnative species become dominant and/or the natural ecological functions of the habitat fundamentally change. At the extreme, this takes the form of urbanized areas. However, there is a wide spectrum of modified habitats that includes agricultural areas, plantation forestry and lands partially degraded by a range of other human interventions. The landscape context (for example, fragmentation of surrounding natural habitat, if any) will also influence the degree to which a project site is considered modified. (GN6, Para. 35)

Natural Habitat. Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin and/or where human activity has not essentially modified an area's primary ecological function and species composition. (PS6, Para. 13)

Natural habitats are not to be interpreted as untouched or pristine habitats. It is likely that the majority of habitats designated as natural will have undergone some degree of historical or recent anthropogenic impact. The question is the degree of impact. If, in the judgement of a competent professional, the habitat still largely contains the principal characteristics and functions of a native ecosystem(s), it should be considered a natural habitat regardless of some degree of degradation and/or the presence of some invasive alien species, secondary forest, human habitation, or other human-induced alteration. (GN6, Para. 39)

5.1.6.1 Habitat Classification (Bataan)

The terrestrial portion the BCIB project area in Mariveles has a long history of human use, principally for agriculture and forestry but also settlement and industry. The vegetative assemblages found in the areas along the BCIB alignment today are somewhat reminiscent of probable pre-industrial communities, in that the latter are likely to have featured a

[72] International Finance Corporation – World Bank Group. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Natural Resources. January 1, 2012.

relatively low-density canopy, with significant expanses dominated by grasses. Modification of the habitat in the vicinity of the project ROW has progressed to varying degrees, with the most intense change being evident around the northern end of the alignment, within and near Alas Asin village. Here, the extent of residential development and intensity of farming activity and other land uses has been such that native species and pre-industrial assemblages are only weakly evidenced; the most appropriate classification for these areas is modified habitat. The area of modified habitat within the ROW is 23.3 ha.

The area along the downslope portion of the alignment is predominantly scrubby grassland. Although significantly influenced by human uses such as pastures, occasional minor mango orchards, a few rustic homesteads and periodic burning to bring on new growth for grazing, the species assemblages found during the survey are associated with grasslands and adjacent habitats (e.g., riparian and coastal) and the majority of species recorded are indigenous. The grassland found in the area today, despite degradation by human use, likely resembles the habitat that would have been found in the area 50 or more years ago. Historical satellite imagery dating back to as early as 1985 shows grassland in the area. In view of these findings, the half of the project area closest to Manila Bay is appropriately classified as natural (though somewhat degraded) habitat (see the area marked as 1 in Exhibit 5-79 and photograph in Exhibit 5-80). This area of natural habitat is 11.7 ha in extent.

There is also an area on the northeast side of the Roman Highway in the vicinity of the proposed interchange site where the land slopes fairly steeply towards the alluvial plain of the Pangolisanin River and grassland species assemblages prevail. Much of this area appears to be minimally disturbed, probably due to the steepness of the terrain and is appropriately classified as natural habitat (see the area marked as 2 in Exhibit 5-79 and photograph in Exhibit 5-81). This area of natural habitat is 0.6 ha in extent.

Exhibit 5-79 Inferred Area of Natural Habitat (Grassland)

Exhibit 5-80 Grassland Near Lower End of Bataan Approach Road Alignment

Exhibit 5-81 Grassland Near Interchange Site, Looking Northeast to Pangolisanin River

5.1.6.2 Habitat Classification (Corregidor Island)

The vegetation of Corregidor Island was not surveyed in detail as part of this EIA study, as the BCIB project as proposed will not directly impinge upon any part of the island. For the same reason, no classification as per PS6 was carried out. Although heavily vegetated now, the entire island was reportedly mostly denuded during WWII and was aerially seeded with the non-native Ipil-ipil tree; numerous ornamental tree species have also been introduced to the island. No detailed habitat or flora survey work is known to have been carried out on the island. It is probable that some remnants of original species assemblages survived the intensive use and bombardment of WWII in gullies and along cliffs and play a part in the island's ecology today but this is a matter for investigation in the context of future development proposals for the island.

5.1.6.3 Habitat Classification (Cavite)

Much of the terrestrial portion of the BCIB project area in Naic has been intensively cultivated for generations, including for wet rice. A handful of small orchards are found and some areas are subject to extensive grazing. The landscape has been undergoing a process of urbanization for some years and some of the remaining open areas have been significantly cleared and reshaped in preparation for planned development. Riparian vegetation of substantially natural character (including some mangrove species) does remain along minor portions of the principal waterways (especially the Timalan River) and such patches offer support to edge-adapted faunal species still thriving in the area. The floral and faunal surveys found that certain areas continue to exhibit high species richness but native species are in the minority and consist mostly of species adapted to life in developed areas or at least tolerant of disturbed habitats and high human activity. In view of this, the BCIB project within Naic is appropriately classified as modified habitat.

5.1.7 Critical Habitat Determinations

An initial critical habitat screening was conducted for the BCIB project area by a consultant engaged by ADB in 2020 and this was followed up with a comprehensive critical habitat assessment carried out by the present EIA team in 2021-2022.[73]

The critical habitat assessment was developed in accordance with concepts and procedures specified by IFC in its Performance Standard 6 (IFC PS6).[74]

Typically for a critical habitat assessment a candidate long list of species is initially generated based on species that could potentially be present within a wider area of analysis (AoA). IFC PS6 then requires that for each biodiversity feature or species that regularly occurs in the project's area of influence, and could potentially meet IFC PS6 criteria, an ecologically appropriate area of analysis (EAAA) is defined. The boundaries of the EAAAs should be defined based on the ecological patterns and processes that are necessary to maintain that species. The local population supported within the EAAA is what is used to determine if IFC PS6 critical habitat thresholds have been met.

At the time of writing the Critical Habitat Assessment, insufficient data was available to define species level EAAAs. As such an area of analysis (AoA) encompassing all of Manila Bay and a reasonable buffer of land area around the proposed BCIB project in Bataan and Cavite was defined and evaluated against the five standard criteria of the IFC assessment framework. The selected AoA is shown in Exhibit 5-82 and the IFC assessment criteria are presented in Exhibit 5-83.

This approach is in line with the precautionary approach, and as the project improves its biodiversity baseline over time, the critical habitat assessment will be revisited and updated. In the interim a precautionary approach has been taken to the assessment.

[73] SC Environment, Ltd (SCE). 2020. Critical Habitat Screening, Nelex–Manila Bay Bridge. Report prepared for the Asian Development Bank. 7 May 2020.
[74] (1) International Finance Corporation. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012.

Exhibit 5-82 Area of Analysis for Critical Habitat Assessment

Exhibit 5-83 IFC Criteria and Thresholds for Critical Habitat Assessment

Criterion	Thresholds
Criterion 1 – Critically Endangered and Endangered Species	
	Threshold (a) – Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).
	Threshold (b) – Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in (a).
	Threshold (c) – As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species
Criterion 2 – Endemic and Restricted-Range Species	
	Threshold (a) – Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.
Criterion 3 – Migratory and Congregatory Species	
	Threshold (a) – Areas known to sustain, on a cyclical or otherwise regular basis, ≥1% of the global population of a migratory or congregatory species at any point of the species' lifecycle.
	Threshold (b) – Areas that predictably support ≥10% of the global population of a species during periods of environmental stress.
Criterion 4 – Highly Threatened and/or Unique Ecosystems	
	Threshold (a) – Areas representing ≥5% of the global extent of an ecosystem meeting the criteria for IUCN status of CR or EN under the IUCN's Red List of Ecosystems.
	Threshold (b) – Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.
Criterion 5 – Areas Associated With Key Evolutionary Processes	
	Presence or absence of idiosyncratic landscape features that catalyze and support evolutionary processes

Source: International Finance Corporation – World Bank Group. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Natural Resources. January 1, 2012.

A screening based on the BCIB project's location, carried out by ADB in September 2021 using the Integrated Biodiversity Assessment Tool (IBAT), generated lists of critically endangered and endangered species that have some documented evidence of presence within 50 km of the BCIB project alignment. These lists were adopted as the primary basis for assessment in relation to Criteria 1–3, supplemented with local species presence information gathered through field studies and desktop research. Each species was evaluated in relation to habitat requirements, distribution mapping and global population estimates (when available) to determine both whether each species regularly occurs in the AoA and if it meets the IFC thresholds. Ultimately the assessment sought to confirm if any part of the AoA could be considered Critical Habitat. As introduced previously, this is a precautionary approach to a Critical Habitat Assessment given the extent of the project and the limited available data.

For Criterion 4, Threshold (a) was found not applicable, as the Manila Bay area has not yet been assessed by IUCN for possible inclusion in the Red List of Ecosystems but a historical analysis of conservation policies, plans, programs and on-the-ground initiatives developed by local, regional and national institutions was undertaken to evaluate the applicability of Threshold (b). Criterion 5 had been judged by a previous screening to be not applicable to the Manila Bay region, but it was reassessed on a precautionary basis. The findings from the critical habitat assessment are summarized in turn for Criteria 1–4 below. The full critical habitat assessment report, which encompasses both terrestrial and marine species, is in the report Annexes.

Criterion 1 – Critically Endangered and Endangered Species. With regards to Criterion 1, the Critical Habitat Assessment found that the AoA could not be considered critical habitat for any critically endangered or endangered species, as none of the identified species could regularly occur and be expected to be present in numbers sufficient to meet the associated percentage thresholds for qualification. However, the assessment did find that the Philippine Duck (*Anas luzonica*) triggers Critical Habitat Criterion 1(b) in line with the precautionary principle. The estimated local population of this endemic species constitutes a considerable proportion of the estimated global population (6.3–12.5%). Although *Anas luzonica* is presently classified as Vulnerable (VU) by IUCN, the species population is in severe decline and therefore it is possible that the loss of this population could result in a change of the IUNC status from VU to Endangered (EN). The potential for the BCIB project to generate significant impacts on this species is considered later in this chapter.

Criterion 2– Endemic and Restricted-Range Species. The critical habitat assessment did not find that any terrestrial species could be considered likely to meet the thresholds under Criterion 2.

Criterion 3 - Migratory and Congregatory Species. Six migratory waterbird species were found to be qualifying species under Criterion 3, as comparison of their local estimated populations against estimated global populations indicated proportions in excess of 1% of the global population (Threshold 3(a)).

These six qualifying species are:

- Red-Necked Stint (*Calidris* ruficollis; 1.5% of global population);
- Long-Toed Stint (*Calidris subminuta*; 2.2%);
- Kentish Plover (*Charadrius alexandrinus*; 1.0–5.2%)

- Whiskered Tern (*Chlidonius hybrida*; 3.6–17.9%);
- Black-Winged Stilt (*Himantopus himantopus;* 0.9–1.5%); and
- Pacific Golden Plover (*Pluvialis fulva*; 7.7–10.1%).

The potential for the BCIB project to generate significant impacts on each of these species is considered later in this chapter.

Criterion 4 – Highly Threatened and/or Unique Ecosystems. Detailed historical review of conservation status assessments, conservation policy documents and plans and programs proposed or put in place indicates that there has been substantial institutional recognition of the biodiversity values of Manila Bay ecosystem and selected nearby terrestrial habitat areas and sustained interest on protecting biodiversity values, principally through establishment and competent management of protected areas. In accordance with the precautionary principle small portions of two Key Biodiversity Areas (KBAs), all of one protected area and part of a second fall within the AoA adopted for the Critical Habitat Assessment and can therefore be considered as qualifying habitat under Criterion 4(b). These are:

- Mariveles Mountains KBA (southern edge);
- Manila Bay KBA (shore-proximate areas);
- Mts. Palay-Palay Mataas na Gulod Protected Landscape (northern section near the Cavite shore); and
- Las Piñas-Parañaque Critical Habitat and Ecotourism Area (entire protected area).

The locations and key characteristics of these KBAs and protected areas and their proximity to the BCIB project area, are detailed below. The potential for the BCIB project to lead to significant impacts on these critical habitat elements is considered in later in this chapter.

In addition to designated conservation areas, mangroves and mudflats have been identified in major conservation planning documents such as the Manila Bay Sustainable Development Master Plan as habitat types of critical importance to the health of the Manila Bay ecosystem. As such, mangrove and mudflat areas are deemed critical habitat wherever they occur in the AoA, in accordance with the precautionary principle and Criterion 4 (b). The distribution of mudflats and mangroves in relation to the BCIB project area is outlined below and the potential for the project to negatively affect these particular habitat types is considered later in this chapter.

5.1.7.1 Key Biodiversity Areas

There are a number of Key Biodiversity Areas (KBAs) around the Manila Bay area and two of these are nearby the project area. KBAs are areas recognized by the Key Biodiversity Areas Partnership as possessing high biodiversity values and are recommended as priority areas for conservation action, including establishment of protected areas and implementation of other biodiversity-protective land management programs and tools.[75] Although not statutorily established entities, KBAs are recognized as having significant biodiversity values by international and multilateral organizations including ADB and are understood by most national governments as priority components of efforts to meet international commitments under the Convention on Biological Diversity. The map in

[75] The KBA Partnership is a global initiative formed by 13 of the most prominent international conservation organizations to enhance global conservation efforts by systematically mapping internationally important sites for biodiversity conservation and advocating for allocation of resources to ensuring their long-term protection.

Exhibit 5-84 shows the KBAs around the Manilla Bay area with details of those in close proximity to the project described thereafter.

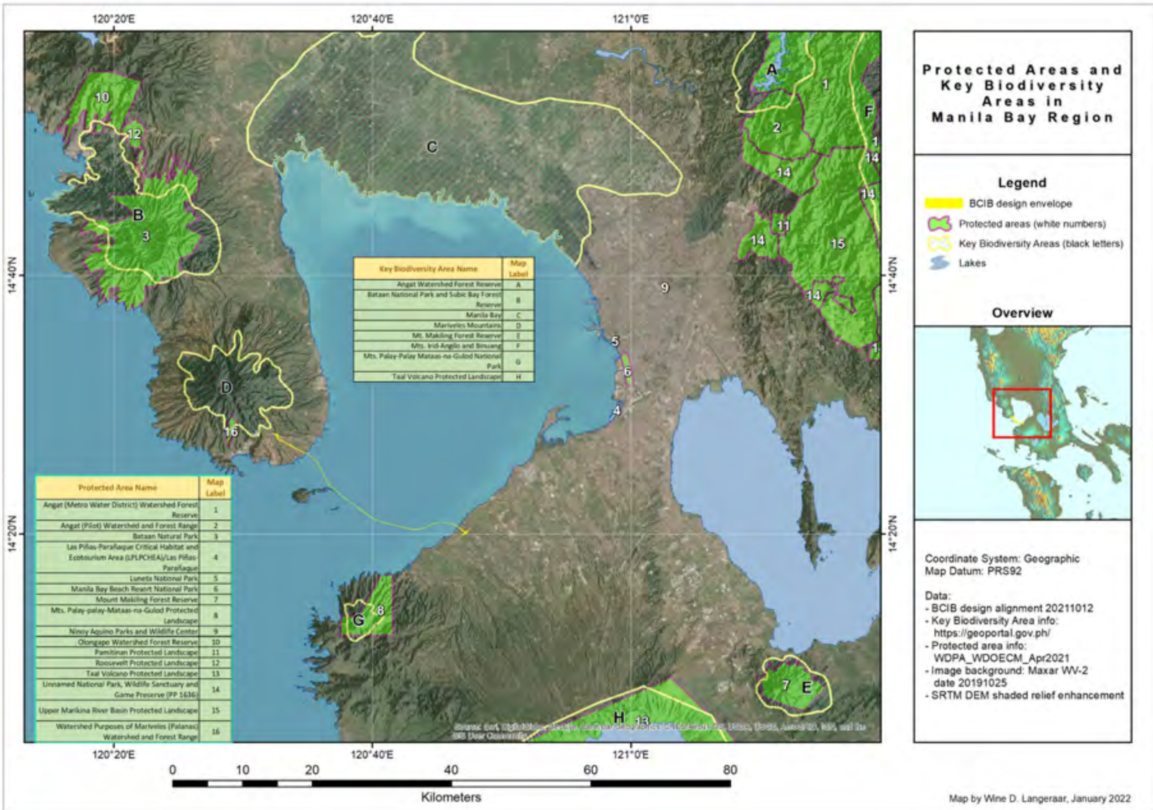


Exhibit 5-84 Protected Areas and Key Biodiversity Areas in Central Part of Luzon

Mariveles Mountains KBA. The KBA of greatest relevance to the BCIB project is the Mariveles Mountains KBA, which is defined largely by the extent of forest and other tree-dominant land cover on Mt. Mariveles. The KBA has a total area of 12,156 ha and partly surrounds the Mt. Mariveles Watershed Forest Preserve, which is an 'initial component' of the Expanded National Integrated Protected Area System (E-NIPAS). The Mariveles Mountains KBA has an altitudinal range of 1,200 m, extending from about 200 masl to the summit of Mt. Mariveles and encompasses areas of lowland and montane forest, including mossy forest. Forest cover includes old plantations, as well as some old growth forest on the high slopes of the mountain. The KBA is known or suspected to harbor populations of 2 critically endangered and endangered species, Philippine cockatoo (*Cacatua haematuropygia*) and Isabela oriole (*Oriolus isabellae*), and 19, vulnerable, migratory and restricted range bird species, of which 17 are birds and four are plants. The principal threat to the integrity of ecosystems within the Mariveles Mountains KBA is thought to be mining, as a number of applications for commercial extraction permits have been under consideration.[76] It is also likely that the southern and eastern fringes of the KBA will come under conversion pressure over the long term as population density and economic development increase along the Roman Highway corridor (as is foreseen in municipal and provincial development plans). The southeastern boundary of the Mariveles Mountains

[76] Key Biodiversity Areas Partnership (2020) *Key Biodiversity Areas factsheet: Mariveles Mountains*. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership. Downloaded from http://www.keybiodiversityareas.org/ on 17/12/2021.

KBA is approximately 1.3 km uphill from the proposed BCIB terminal interchange in Barangay Alas Asin (see Exhibit 5-85).

Mts. Palay-Palay and Mataas Na Gulod National Park KBA. Partially overlapping with the larger Mts. Palay-Palay and Mataas na Gulod Protected Landscape, a statutorily designated component of the NIPAS, the Mts. Palay-Palay and Mataas Na Gulod National Park KBA has an area of 1,830 ha and an altitudinal range of 50–648 masl. The KBA spreads over a hilly area formed by now-extinct volcanoes along the present-day border of Cavite and Batangas Provinces and features three prominent peaks (Palay-Palay, Pico de Loro and Mataas na Gulod). The area encompassed by the KBA remains mostly forested and the northern section around Mt. Palay-Palay has the last remaining lowland evergreen rainforest in Cavite province. Small areas of arable land and settlements with gardens, as well as some shifting cultivation, are found within the KBA and expansion of agricultural activity is viewed as the main threat to biodiversity here (unsustainable collection of forest products and infrastructure development are considered secondary threats). The Mts. Palay-Palay and Mataas Na Gulod KBA is home to four species classified as Vulnerable by IUCN; these are the Philippine Duck, Philippine Eagle-owl (*Bubo philippensis*), Ashy Thrush (*Zoothera cinerea*) and Southern Luzon Phloeomys (*Phloeomys cumingi*).[77] The eastern boundary of the Mts. Palay-Palay and Mataas Na Gulod KBA is approximately 17 km west-southwest of the proposed BCIB interchange at the Antero Soriano Highway.

Manila Bay KBA. While further away from the BCIB project area than the two KBAs already mentioned, the Manila Bay KBA is of potential relevance to biodiversity values in the project area because it is an important node of habitat for migratory waterbird species, some of which may also be expected to use other parts of the greater Manila Bay ecosystem, including the footprint of the proposed project. The Manila Bay KBA encompasses 96,338 ha of mudflats, mangrove swamps and brackish channels across the head of Manila Bay. Although subject to widespread use and conversion for aquaculture and salt production, the lands within the KBA remain a prominent wintering and stopover site along the East Asian-Australasian Flyway, a major long-distance avian migration corridor. The BCIB project area is about 39 km southwest of the nearest part of the Manila Bay KBA.

5.1.7.2 Protected Areas

There are two protected natural areas nearby the project area, both recognized under the E-NIPAS; these are the Watershed Purposes of Mariveles (Palanas) protected area and the Mts. Palay-Palay and Mataas na Gulod Protected Landscape. Corregidor Island is also protected primarily albeit for its significant historical values and as a restricted military area It is not designated as a protected area as part of the E-NIPAS but is likely to have significant biodiversity values as a result of its isolation and protection.

Watershed Purposes of Mariveles (Palanas). Also known as the Mariveles Watershed Forest Preserve, the Watershed Purposes of Mariveles (Palanas) protected area is a forested tract of 347 ha on the southern slope of Mt. Mariveles, uphill from the built-up residential and industrial barangays around Mariveles Bay. First established by an Executive Order in 1919 and ostensibly managed by a Protected Areas Management Board sanctioned by DENR, the Mariveles Watershed Forest Preserve serves to protect lands in the catchment

[77] Key Biodiversity Areas Partnership (2020) *Key Biodiversity Areas factsheet: Mounts Palay-Palay-Mataas Na Gulod National Park*. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership. Downloaded from http://www.keybiodiversityareas.org/ on 17/12/2021.

of the Santol River, which originates near the rim of Mt Mariveles and empties into Mariveles Bay. The site has not been assigned a classification in the World Database of Protected Areas (WDPA). Based on analysis of satellite imagery from 1987–2021, it appears that the preserve has had fairly stable tree cover, particularly in the higher elevation portions but infrequent clearings are evident both along the river and on ridges and the vegetation pattern in lower reaches is indicative of plantations rather than natural forest. The preserve is listed as an 'initial component' protected area under the E-NIPAS. This means that its suitability for continued inclusion in the E-NIPAS is under review following the 2018 passage of RA 11038. The review aims to rationalize a national protected area system composed of a wide variety of disparate protected areas accumulated via presidential decrees, executive order and acts of congress over many decades, some of dubious conservation value. If Mariveles Watershed Forest Preserve is deemed worthy of permanent inclusion in the system following a process of information-gathering, suitability analysis and public consultations, it will be made a permanent component of the system by an act of congress. Exhibit 5-85 shows this protected area's location, as well as the boundary of the much broader KBA that partially encompasses it. The eastern boundary of Mariveles Watershed Forest Preserve is located approximately 5.8 km west of the proposed BCIB interchange at the Roman Highway.

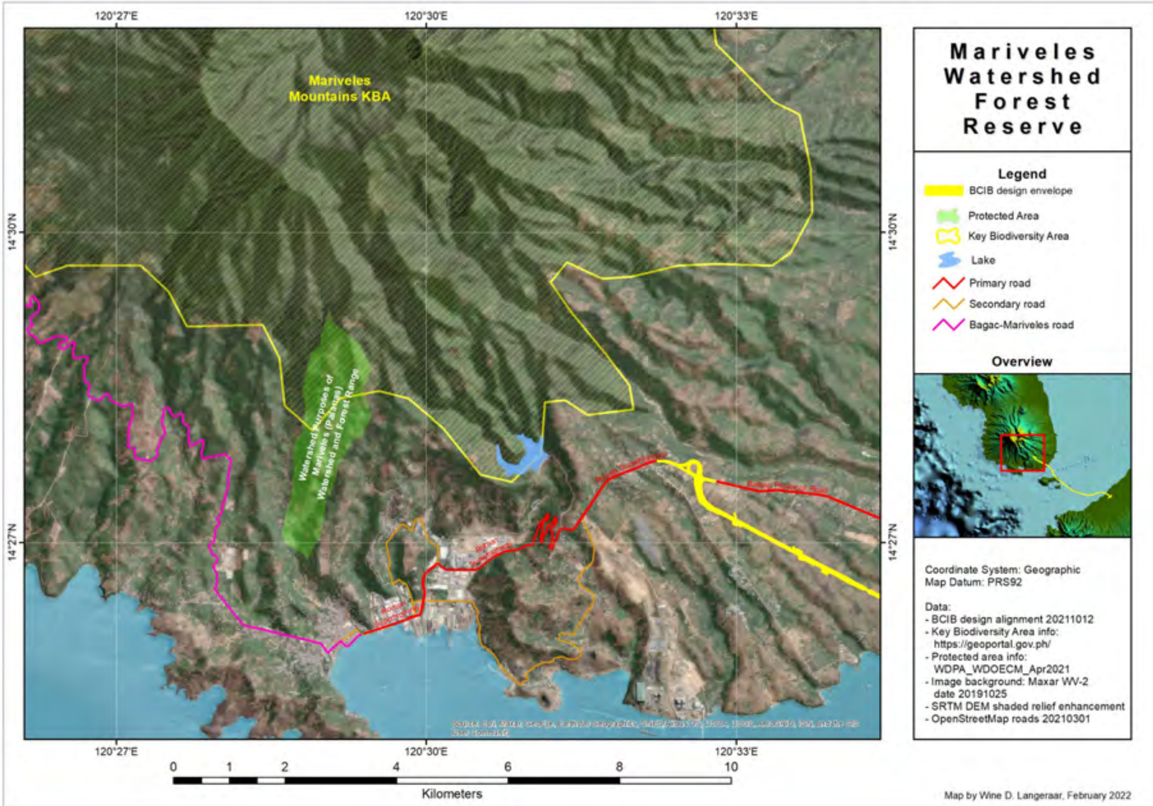


Exhibit 5-85 Protected Areas and KBAs in the BCIB Project Area (Bataan)

Mts. Palay-Palay and Mataas na Gulod Protected Landscape. Located about 12 km west-southwest of the proposed BCIB-Antero Soriano Highway interchange, the Mts. Palay-Palay Mataas na Gulod Protected Landscape is listed as a permanent component of the E-NIPAS. The protected area is classified in the WDPA as Category V and is managed by a multi-stakeholder protected area management board constituted under DENR leadership. The area was originally set aside as a national park centered on Mt. Palay-Palay and Mt. Mataas na Gulod, via a 1976 presidential proclamation but was substantially re-shaped and re-designated as a protected landscape by another presidential proclamation in 2007.[78]

The present protected landscape occupies a mostly forested hilly area along the Cavite-Batangas provincial border, which owes its topography to an extinct volcanic complex. A number of popular hiking trails provide access to the higher peaks. The protected area is 3,975 ha in area and includes small portions of coastline both inside Manila Bay (in Ternate, Cavite) and outside the bay near Limbones Cove. The Nasubgu–Ternate Highway traverses parts of the protected landscape (see Exhibit 5-86). The protected landscape is divided into 10 management zones, of which the largest is a Sustainable Use Zone (1,995 ha, about half of the total protected area), in which only low-impact biodiversity extraction activities are permitted. Strict Protection Zones cover just 250 ha of the protected landscape.[79] The biodiversity resources of the protected landscape have not been subject to substantial study but the northern part of the strict protection zone (situated in the southwestern corner of the protected landscape) is considered to represent the last remaining area of lowland evergreen rainforest in Cavite.[80]

Las Piñas-Parañaque Critical Habitat and Ecotourism Area. The Las Piñas–Parañaque Critical Habitat and Ecotourism Area, also known as the Las Piñas–Parañaque Wetland Park, is a protected area to the east of Manila Bay near Metro Center. The entire wetland is a declared Ramsar site. There are at least 41 recorded migratory birds coming from as far as China, Japan, and Siberia. The migration season is between August to April and the site can support up to 5,000 individual birds each day. Among these birds are the little egret, black-crowned night heron, and the common moorhen. Among the endemic species are the Philippine duck, which is the only known breeding ground for the ducks in Metro Manila. During the low tide, small invertebrates and macrobenthic species are exposed to the air which are consumed by birds and other small animals in the area. The area is also a spawning ground, nursery and sanctuary for fish.

Corregidor Island. Although not designated as a protected area under E-NIPAS, Corregidor Island is a government-protected site (officially a national shrine) whose primary management objective is ensuring the preservation and interpretation of the island's nationally and internationally significant history as a military bastion. As the natural resources on the island have rebounded following cessation of military use and bombardment after WWII, conservation of scenic and natural resource values has also emerged as a key management objective. Current management proposals for Corregidor Island foresee development as both a historical tourism attraction and eco-tourism destination. The area of Corregidor Island is approximately 5.5 km^2. The proposed BCIB alignment will pass within 100 m of the eastern edge of the island but will not directly impinge upon the beach or intertidal zone. A marine park has been established for portions of the nearshore waters around Corregidor Island; this is discussed in the next chapter (Water).

[78] Manalili, M. A. Undated. Mounts Palay-Palay Mataas na Gulod Protected Landscape Forest Assessment and Geospatial Analysis Technical Report. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, De La Salle University Dasmariñas, Department of Natural Resources.
[79] Province of Cavite. 2015. Socio-Economic and Physical Profile (SEPP) 2015.
[80] BirdLife International (2022) Important Bird Areas factsheet: Mounts Palay-Palay-Mataas Na Gulod National Park. Downloaded from http://www.birdlife.org on 27/06/2022.

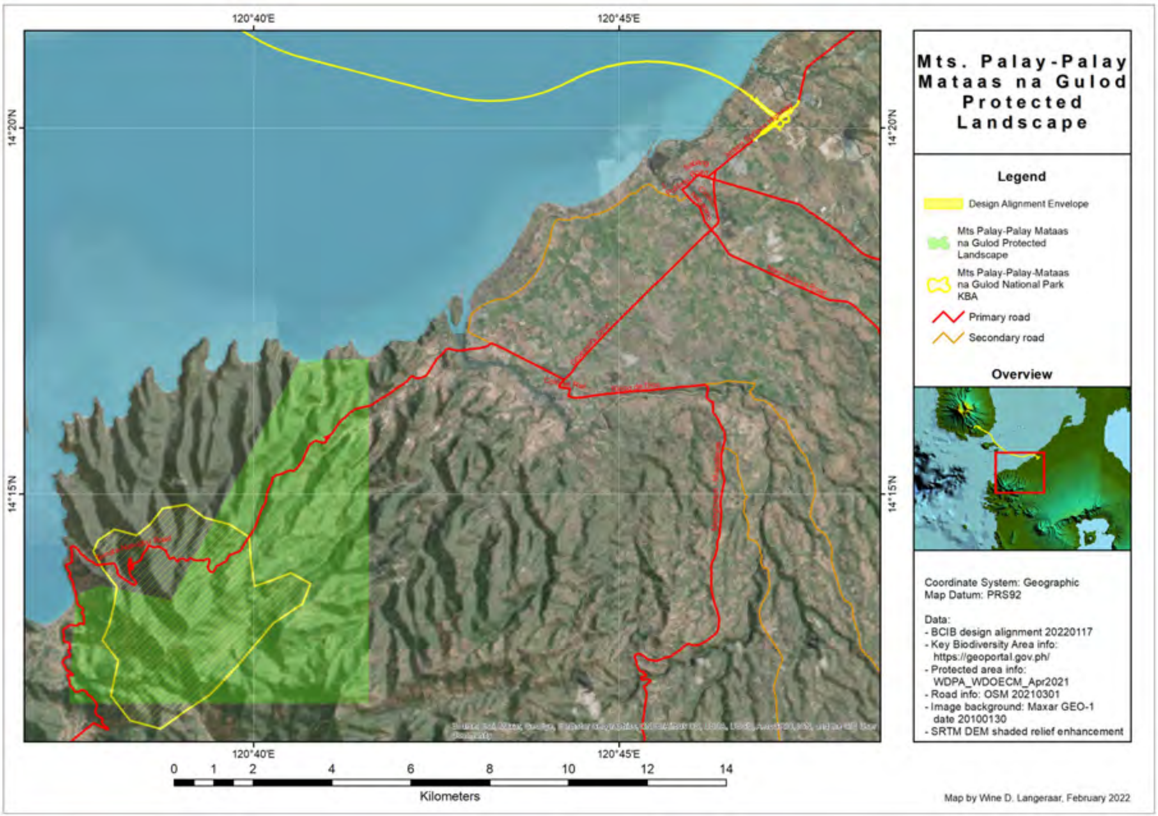
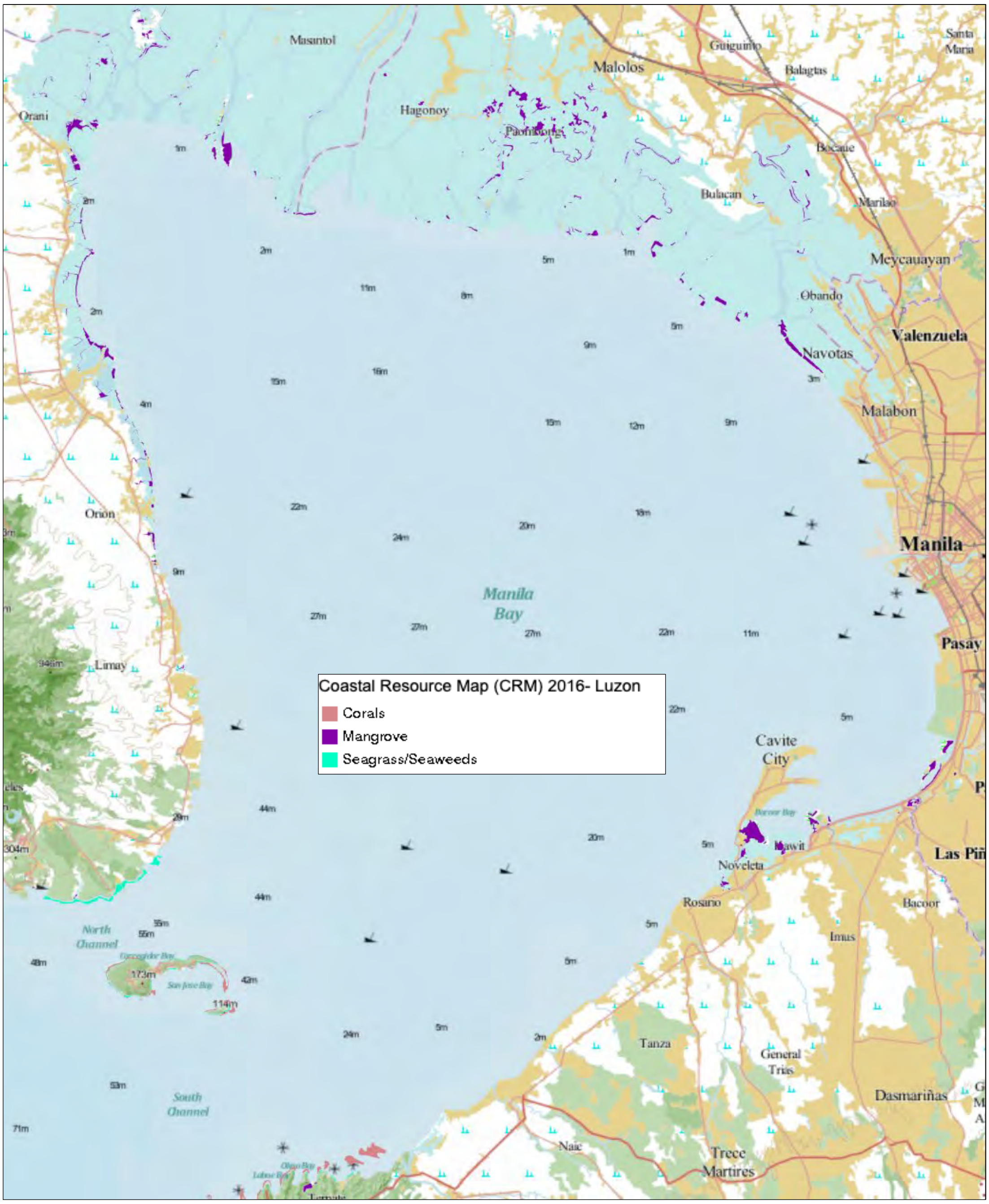


Exhibit 5-86 Protected Areas and KBAs in the BCIB Project Area (Cavite)

5.1.7.3 Mangroves

NAMRIA mapping (Coastal Resource Map 2016) indicates a spotty distribution of mangroves in Manila Bay (see Exhibit 5-87) and does not show any mangrove areas within the BCIB project area. However, the presence of mangrove species was detected through coastal vegetation surveys in 2020, 2021 and 2022. The entire distribution of mangrove vegetation near the BCIB project area is not precisely known but can be inferred from the survey data, incidental field observations, tidal range and topography and interpretation of satellite imagery.



Source: NAMRIA. 2015. Coastal Resource Map 2016 – Luzon. geoportal.gov.ph.

Exhibit 5-87 Mangrove Distribution in Manila Bay (NAMRIA)

Predicted distribution of mangroves for the Bataan portion of the BCIB project area is shown in Exhibit 5-88 and for the Cavite portion in Exhibit 5-89. It is to be emphasized here that the distributions shown on these two maps is precautionary and predictive, and assumed only at the time of writing; the areas marked should be understood as areas where riparian and seafront vegetation is more likely than not to include arboreal mangrove species. Distribution within estuaries is known to be patchy due to past clearance and mangrove species occurrence along rocky beaches in Mariveles is thought to be quite sparse.

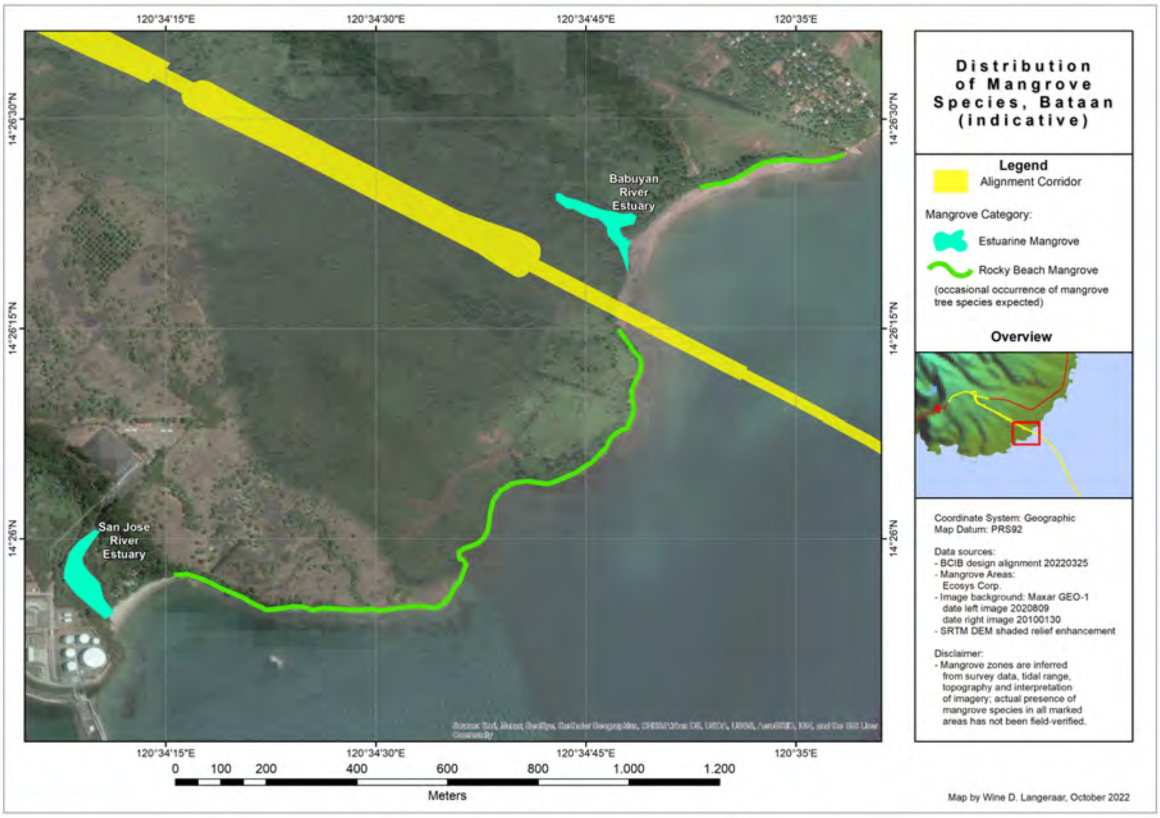


Exhibit 5-88 Predicted Distribution of Mangroves in BCIB Project Area (Bataan)

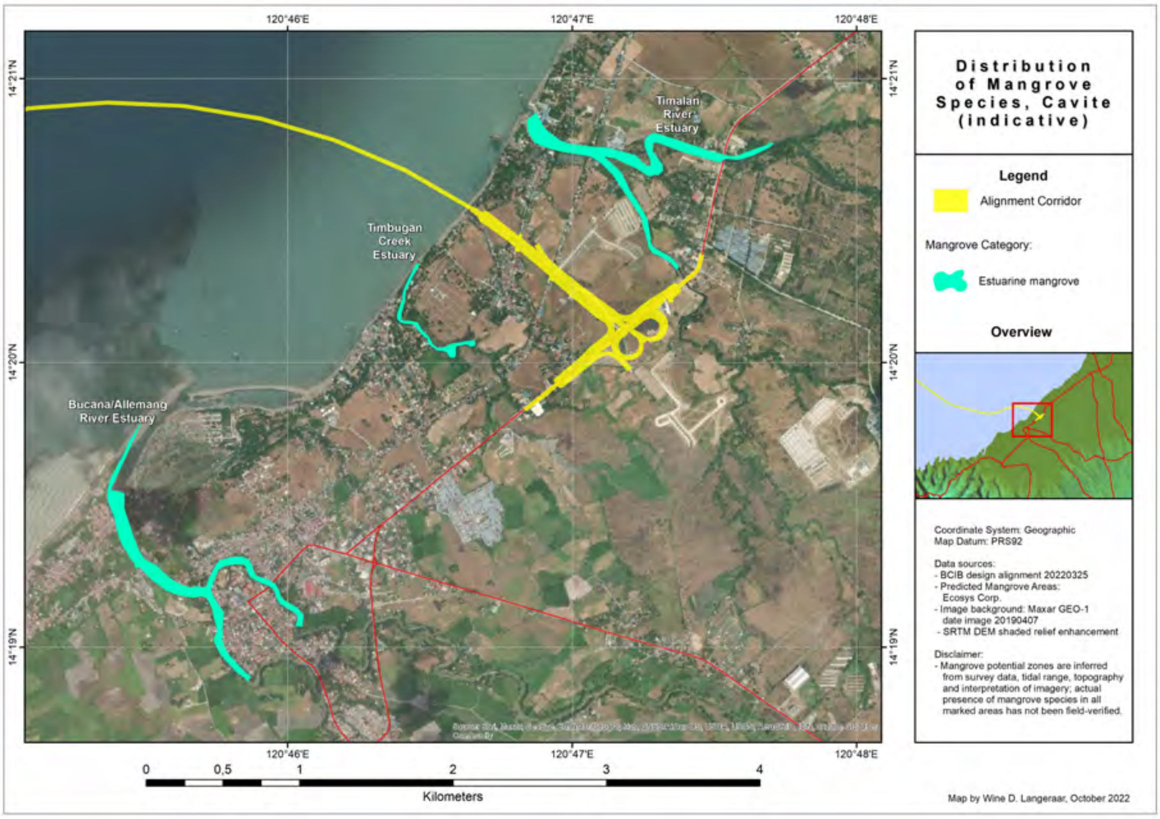
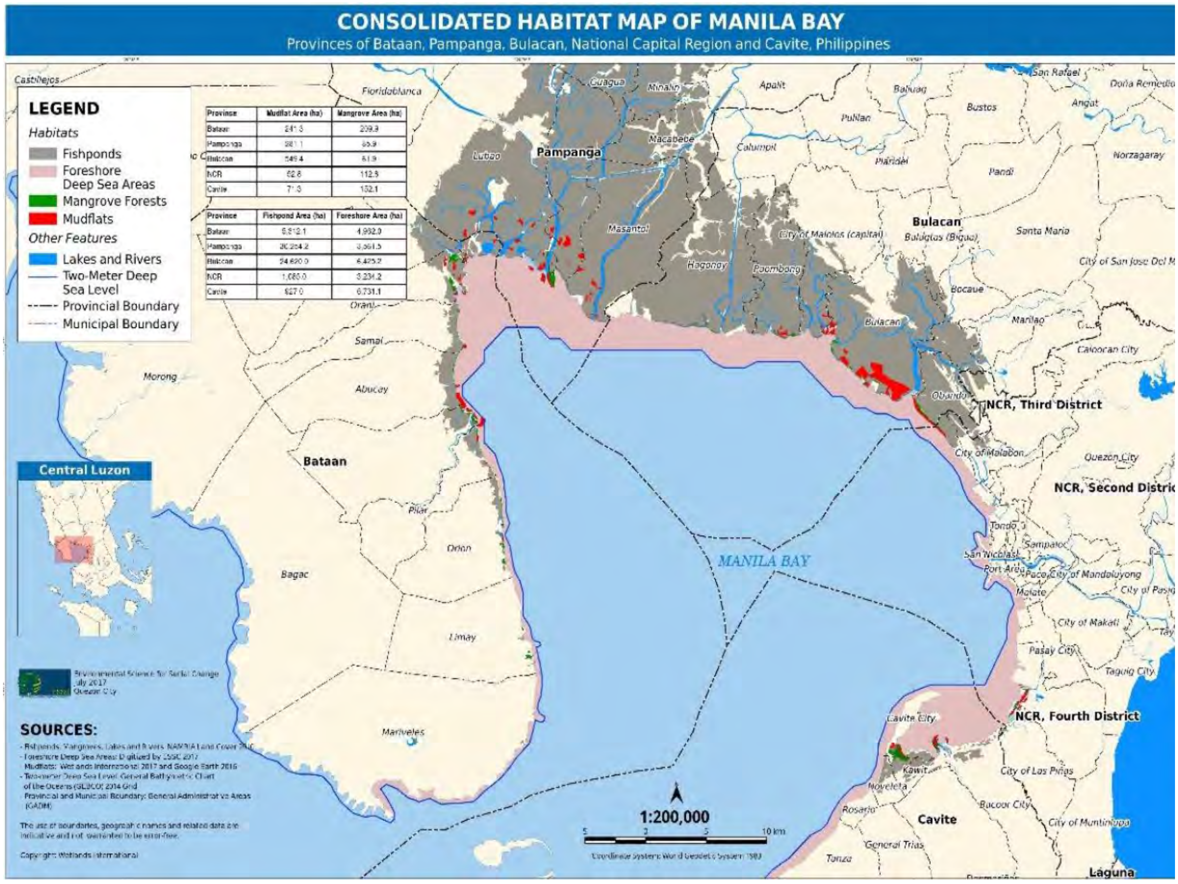


Exhibit 5-89 Predicted Distribution of Mangroves in BCIB Project Area (Cavite)

5.1.7.4 Mudflats

The topography and bathymetry of the areas around the mouth of Manila Bay are not conducive to formation of this habitat type to any significant extent. Most mudflats are located in the deltaic lands around the northern end of Manila Bay and to a lesser extent in the eastern part of the bay (see Exhibit 5-90). The nearest significant mudflats to the BCIB project area are in Bacoor Bay, approximately 21 km northeast of the BCIB's Cavite landing point.



Source: Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

Exhibit 5-90 Distribution of Mudflats and Other Key Waterbird Habitats in Manila Bay

5.1.8 Physical Cultural Resources

A comprehensive survey was conducted in the vicinity of the BCIB project sites and along the principal associated road corridors to identify and characterize any significant physical cultural heritage sites that might be within 100 m of any project site or within 100 m roads expected to receive significant construction traffic or increased traffic volume during the project's operation (first five kilometers from the BCIB interchange sites). The survey methodology included ocular inspection, consultation with the LGU and confirmation with the Philippine Registry of Cultural Property (PRECUP) database.

5.1.8.1 Bataan

The principal heritage element identified in the Bataan portion of the BCIB project area is a series of roadside markers that commemorate the Bataan Death March, a forced mass movement of tens of thousands of Filipino and American prisoners of war and local civilians from Mariveles and Bagac to San Fernando, Pampanga, following the surrender of Bataan to Japanese forces in April 1942. There are some 100 such markers along the Bataan portion of route, which largely coincides with the present-day Roman Highway. Each marker is a simple 1.5 m-high concrete obelisk (see Exhibit 5-91). Some are situated within the road's ROW; none are within the BCIB project's future footprint.

Exhibit 5-91 Example of Bataan Death March Roadside Marker, Alas Asin

5.1.8.2 Corregidor Island

There are numerous historic and commemorative sites on Corregidor Island and these are considered a highly significant part of the nation's military history and cultural heritage. Military installations preserved and operated as tourist venues on the island include the Malinta Tunnel, Navy Radio Intercept Tunnel; the enormous Middleside Barracks and Topside Barracks, a hospital, parage ground, 18 gun batteries, the Kindley Airfield and many other lesser sites. Major commemorative sites include the Filipino Heroes Memorial, Pacific War Memorial, Mindanao Memorial and Japanese Memorial Garden. These historic and commemorative sites are spread all around the island; sites found in the parts of the Tail End nearest the BCIB alignment include the Kindley Airfield and Navy Radio Intercept Tunnel. There is also a civilian cemetery at the far end of the Tail End, off the southern end of the airstrip.[81]

5.1.8.3 Cavite

The survey did not identify any physical cultural heritage objects or sites within the BCIB project footprint in Naic, or anywhere in the vicinity.

5.1.9 Aesthetic Qualities of the Project Area

The BCIB project area is set amongst a variety of landscape features, encompassing both land and sea areas. A full landscape analysis is included in the visual impact assessment (VIA) prepared based on field reconnaissance in 2022; this is included in the report Annexes. A brief summary of key aesthetic qualities is presented below.

[81] TIEZA. 2019. Corregidor Tourism Master Plan – Final Situational Analysis Report (May 2019). Prepared by Palafox Associates, Makati City.

5.1.9.1 Bataan

The portion of Mariveles that will host the interchange and approach road for the BCIB is a varied landscape with a southerly and southwesterly overall slope aspect, being part of the toe slope of the Mt. Mariveles volcano. The land mass is composed primarily of volcanic materials and alluvial deposits and has been incised over time by numerous streams running southward off the higher slopes of the mountain. Gullies and ravines, some with significant patches of riparian growth, are prominent features that lend visual variety to the landscape.

Present land use is characterized mainly by agricultural activities; there are numerous orchards, mixed homestead plantations and hedgerows and expanses of grassy and scrub land that are periodically burned as part of a swidden-fallow rotation. Significant areas are used for pasture. The area can be said to have a generally pleasing rural character, though not classically picturesque.

Non-agricultural uses have assumed increasing importance in the local landscape in recent decades, with growth in residential and commercial development in the barangays of Alas-Asin, Mountain View, Cabcaben, Townsite and Basseco Country. Major industrial facilities, including oil terminals, a pair of large coal-fired power plants, a solar farm and a cement plant have been developed, mostly near the shore. To the west, numerous manufacturing and import-export processing facilities have been established within the Freeport Area of Bataan, clustered around the north side of Mariveles Bay. Residential and commercial developments in the area are generally unremarkable from an aesthetic standpoint. Industrial facilities can sometimes have a certain austere beauty and may lend interest to a landscape but the suite of industrial facilities in the Mariveles portion of the project area are more likely to be perceived by most viewers as rather incongruous additions to the rural coastal landscape, most notably the tall red and white stacks, substations and overhead transmission lines of the GN Power coal-fired power plants, which are visible from many vantage points.

Many locations within the project area in Mariveles have views over Manila Bay, including the North Channel and Corregidor Island; the sloping topography of the area enables such views even from some locations that are well away from the shore. Shipping activity in the North Channel is a significant component of visual interest in the area. Mt. Mariveles is another dominant feature of the visual landscape, visible from many points within this part of the project area.

5.1.9.2 Corregidor Island

Seen from the water and from elevated vantage points around southern Mariveles, Corregidor Island appears as a place of hills and forests, with the limited modern infrastructure and much more diverse and extensive military ruins almost entirely hidden from view. The cliff-ringed shores of the western part of the island reinforce the sense of Corregidor Island as a wild and perhaps also mysterious place. Corregidor Island and Caballo Island together constitute a significant visual resource that enhances the aesthetic and touristic appeal of the entire North Channel area.

Visitors to Corregidor Island are driven around in open-sided trolley buses, along narrow, twisting and switch-backing roads beneath a dense forest canopy, with occasional glimpses out to the sea. The landscape of the island is imbued with a sense of dark history, with hulking and unrestored remains of former military installations, replete with bullet holes and bomb craters, to be seen here and there amongst the tangled growth of forest. Remarkable views are to be had from memorial sites around the island, variously taking in

Mt. Mariveles to the north, Manila Bay to the east, the South China Sea and the rugged Five Fingers coastal area to the west and Caballo Island and the hills of western Cavite and northern Batangas to the south.

5.1.9.3 Cavite

The Cavite portion of the BCIB project area is much less visually remarkable than Bataan and Corregidor Island, not being similarly blessed with varied topography. Visitors to Naic encounter bustling road corridors passing through a mosaic of flattish agricultural lands, low-rise residential areas and commercial and industrial facilities. There are few sweeping views to be had away from the coast. The primary visual resource in Naic is the coastline, with its sandy beaches and low-key resorts and the views that can be had from there. Mt. Mariveles makes a pleasant prospect across the bay's mouth and the hills of western Cavite and northern Batangas rise up to the west. Corregidor and Caballo Islands are visible, though distantly so and the open expanses of both Manila Bay and the South China Sea can be appreciated.

5.1.10 Potentially Contaminated Sites

A survey comprising desktop research, interviews and consultations with local key informants and field reconnaissance was conducted in late 2021 and early 2022 to identify and characterize sites within the BCIB project area that may have been significantly contaminated by previous land uses. The survey was conducted in line with US EPA guidance for Phase I Environmental Site Assessments. The Phase I ESA covered both the on-land portions of the project area and the seabed along the BCIB project alignment, taking into account both the planned infrastructure footprint and areas under consideration for use as possible construction support sites. Information sources included interviews with municipal officials; documentation of industrial and commercial sites and facilities registered with DENR and municipalities; records pertaining to ECCs held and applied for by industrial entities; map analysis; on-site reconnaissance; review of specialized reports and academic literature; and review of groundwater and surface water quality data assembled by Ecosys Corp. A brief synopsis and presentation of findings in relation to on-land portions of the BCIB project area is provided below. Findings regarding possible marine contamination are detailed in the Chapter 6.

5.1.10.1 Bataan

The contaminated sites survey identified numerous industrial sites around southern Mariveles with significant potential for generating outputs of environmental contaminants, including coal-fired power plants, oil and gas terminals, concrete plants and other major facilities. All of these were determined to be located at some distance from the project alignment and possible construction staging sites. Only one site of potential concern within or very nearby the project alignment was identified: a filling station (Shell Oil) that lies within the project ROW in Alas Asin village (see Exhibit 5-92). The filling station will be demolished as part of site clearing. Underground tanks are present on the site and the possibility of past leakage (common with underground storage tanks in general) is assumed to present a non-negligible risk of contaminated soil and groundwater being present. Accordingly, a Phase II ESA including soil and groundwater testing was recommended.

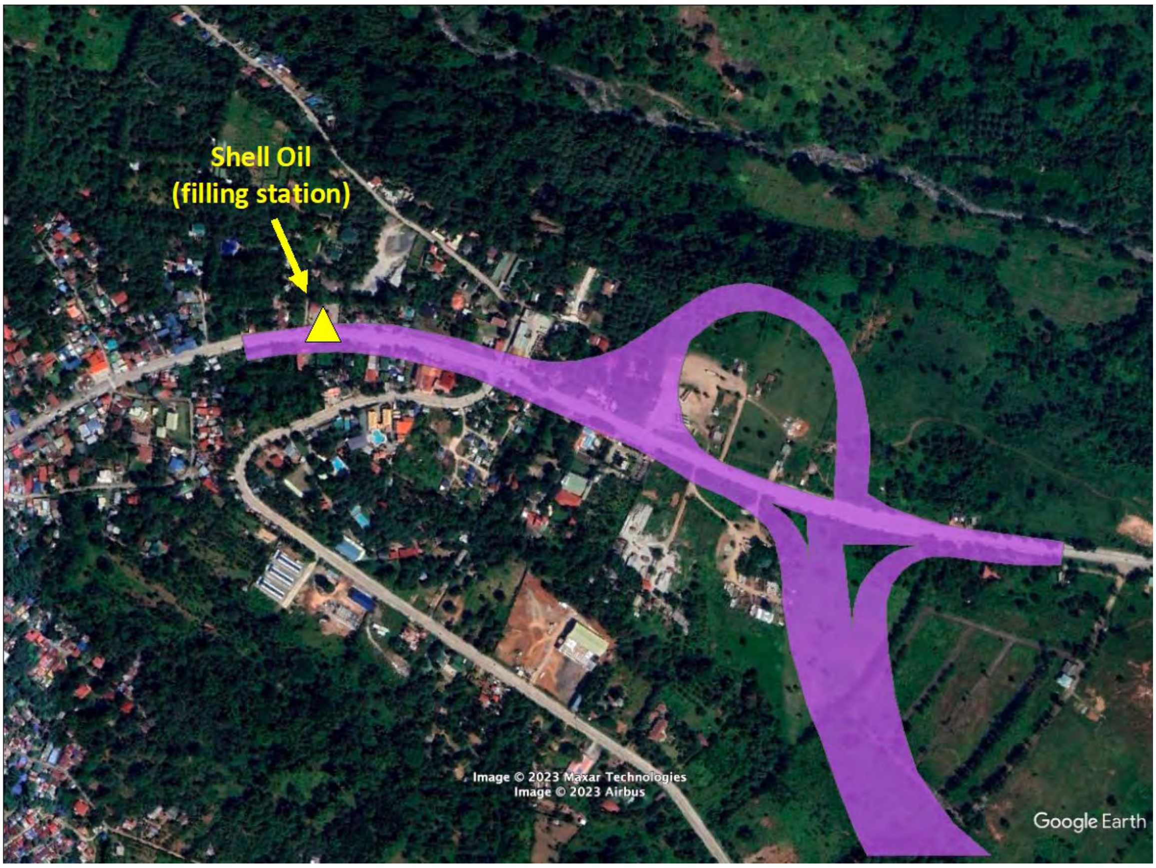


Exhibit 5-92 Shell Oil Filling Station, Within Project Footprint in Alas Asin

5.1.10.2 Corregidor Island

The contaminated sites survey did not include Corregidor Island, as no part of the BCIB project will impinge upon any part of the island.

5.1.10.3 Cavite

The contaminated sites survey identified a limited number of industrial facilities that could be considered likely to generate environmental contaminants in near the Cavite approach road footprint, principally small shipyards found along the shoreline nearby the landing site, as well as two filling stations along the Antero Soriano Highway in the vicinity of the BCIB interchange site. Only one site, the PTT filling station, was found to fall within the project ROW or any of the areas under consideration as possible construction staging areas. The filling station is expected to be demolished as part of site clearing and underground storage tanks are present on the site. A Phase II ESA including soil and groundwater testing was recommended for this site.

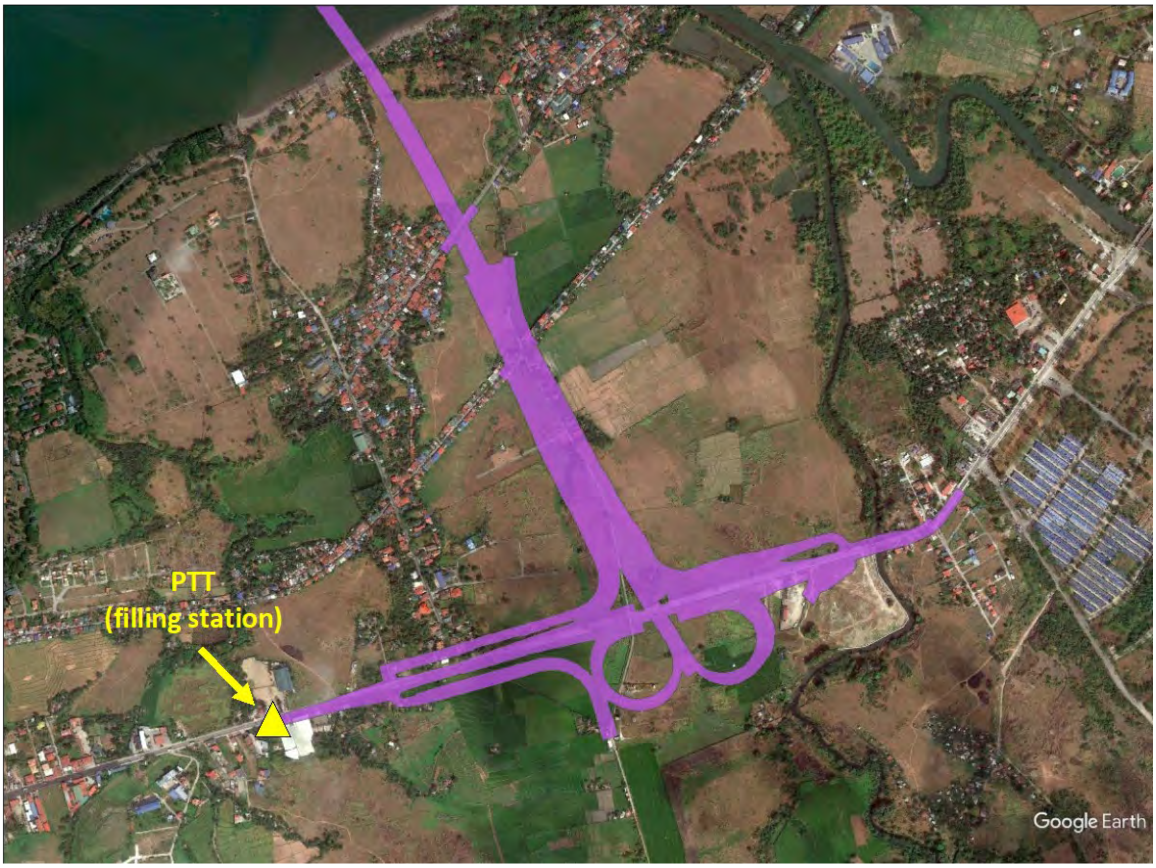


Exhibit 5-93 PTT Filling Station, Within Project Footprint in Naic

5.2 Anticipated Impacts and Prescribed Mitigation

5.2.1 Pre-Construction Phase Impacts and Mitigation

Pre-construction impacts are those impacts which, although they may be manifest during construction or operation, actually originate during planning, design and procurement and can therefore be mitigated at least partially through decisions taken as part of these pre-construction activities. Examples include the change of land use, loss of habitat or degradation of habitat, which is a consequence of the design process. In many cases it makes sense to re-visit these impacts in relation to the construction and/or operation phase, as a residual component of impact may remain to be addressed closer to the time of impact occurrence.

5.2.1.1 Loss of Productive Land

Anticipated Impact. Conversion of agricultural land to build infrastructure inevitably results in a loss of agricultural potential at the local scale, which ultimately contributes to erosion of the country's overall food production capacity. Most of the land that will come under the BCIB project footprint in both Bataan and Cavite is presently used for some kind of agricultural purpose. On the Bataan side, agricultural uses include mainly mango orchards, household gardens and extensive grazing by cattle, sheep and goats. The infrastructure footprint on the Bataan side is 44.46 ha and an estimated 80% of this is subject to an agricultural use; thus the loss to agriculture is roughly 36 ha of mostly low-productivity land. Agricultural uses on the Cavite side include wet rice, small low-input plantations of banana and coconut, household gardens and some pasture. The footprint on the Cavite side is 21.22 ha and an estimated 60% of this is presently used for some form of agriculture; the loss to agriculture on the Cavite side is therefore about 13 ha of moderately productive land.

Prescribed Mitigation. The anticipated loss of agricultural potential needs to be put into context. The BCIB project is being implemented to facilitate multiple development aims, including improving livelihood prospects for large numbers of people who should be expected to benefit from decentralized growth and expansion of employment and business opportunities outside of Metro Manila. The higher-order regional development thrust into which the BCIB project's formulation fits makes an implicit trade-off between present uses (mainly agricultural) and future uses (industrial, commercial and urban residential) and it is assumed that the loss of present land use values to society will be compensated many times over by the expected economic and social benefits of the project. In some contexts, it may make some sense to make compensatory investments in increasing agricultural productivity on neighboring lands to mitigate losses to conversion but scope for this would be very limited for lands near the project footprint, as conversion for other uses is already expected. Therefore, no mitigation is proposed. The loss of agricultural potential will be a residual impact.

IMPACT SUMMARY					
Impact:	Loss of agricultural potential				
Direction:	Negative	Type:	Direct, cumulative	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Moderate
Mitigation:	• None prescribed				
Residual:	Expected, moderate (about 36 ha lost in Mariveles; 13 ha lost in Naic)				

5.2.1.2 Land Use Change (Induced Development)

Anticipated Impact. Transport infrastructure can almost always be expected to drive land use change in nearby areas and indeed this is among the desired outcomes of many road projects. Induced development potential is considered below for each of Bataan, Corregidor Island and Cavite.

Bataan. It is very likely that development of the BCIB project will spur increased land development in southern Bataan, particularly by supporting growth in FAB-linked enterprises and by improving access to the area by developers and would-be residents. Loss of agricultural potential and ecosystem services, initially confined to the sites occupied by the new infrastructure, will grow in scope over time.

The development of southern Bataan, including the Roman Highway corridor, is foreseen in national and regional development plans that call for shifting growth from Metro Manila.[82] Facilitating this decentralization goal is a key objective of the BCIB project. In this context, the urbanization that will foreseeably take place in southern Bataan as a result of the BCIB project's development as a planned outcome.

Corregidor Island. A road link to Corregidor Island is not included in the infrastructure plan for the BCIB project, although the emergency turnaround structure near the island's Tail End has been designed to accommodate later establishment of such a link under some

[82] Including the Philippine Development Plan 2017–2022, Central Luzon Development Plan 2017–2022, CALABARZON Region Development Plan 2017–2022, and the National Capital Region Development Plan 2017–2022.

future initiative, should that be pursued. A separate environmental impact assessment will be required to evaluate the environmental implications for the island, including induced development impacts, in the event that such a link project is proposed. Nevertheless, as the BCIB project is a logical prerequisite for a secondary road link project, it is appropriate to provide some hypothetical comment here on the potential for induced development on the island. It bears emphasis that key stakeholders in the island's present management and future development strongly welcome the prospect of an induced development effect from a road link, anticipating not only much easier access for tourists, but also opportunities to remove some key constraints on realization of the historical tourism model expected to guide the island's future development.[83] Provision of tourism services and operation of historic sites on the island is presently hampered by limited groundwater resources, reliance on diesel generators for all electricity supply, difficult provisioning logistics, and solid waste management challenges (most waste is disposed of in a ravine on the island, as this is easier and less expensive that transporting it to a proper landfill on the mainland).[84] The BCIB is understood as a potential conduit for reliable electricity and potable water supply, as well as provisioning and responsible waste disposal.

It is important to acknowledge two checks on potentially unfavorable induced development on Corregidor Island from a road link to the BCIB. First, while stakeholders may have differing ideas of future tourist numbers and carrying capacity, there appears to be broad agreement that private cars should not be allowed onto the island. It is recognized that enabling motorists to access the island directly BCIB would require substantial parking infrastructure and expansion of the island's road system, provision of which would detract from the island's present character. Emissions, noise and traffic run counter to the overarching themes of solemn remembrance and historical appreciation that animate stakeholders' development visions for the island. Instead, it is anticipated that shuttle buses from Bataan and Cavite would be the sole means by which tourists could access the island. With control over shuttle bus allocation, island management authorities would have an effective means of limiting tourist numbers as necessary to prevent unfavorable land use change and remain within carrying capacity.

The second check on induced development effects on Corregidor Island is land tenure. The entire island is the property of the state, having been a military installation and subsequently designated a national shrine. Portions of the island (including most of the Tail End) are still operated and enforced as restricted military zones. The absence of private land (existing businesses and facilities are operated by lessees and concessionaires, not landowners) provides a substantial measure of governmental control over future land use. While the island's institutional stakeholders may or may not arrive at a carrying capacity determination that is truly sustainable, the free market will not drive land use to the extent that it would in contexts where private land ownership predominates.

Cavite. The land-use context in Cavite is somewhat different than in Bataan, in that the remaining rural land there is already under intense pressure for residential and industrial development. The BCIB project will be just one of many drivers of land use change in Cavite and can be considered minor when compared to the development pressures derived from Cavite's position as a leading growth pole on the southwestern edge of Metro Manila.

[83] Based on conversations with Mr. Jerry Rollin, Consultant, Corregidor Foundation Inc., 28 March 2022 and Engr. Aldrin Malabad and other representatives of the Philippine Veterans' Affairs Office, 30 March 2022.
[84] (1) TIEZA. 2019. Corregidor Tourism Master Plan – Final Situational Analysis Report (May 2019). Prepared by Palafox Associates, Makati City; (2) Personal communication, Mr. Jerry Rollin, Consultant, Corregidor Foundation Inc., 28 March 2022.

Many of the remaining open spaces around the BCIB project area in Cavite have been previously subdivided for residential estates and it can be considered quite probable that many of these lands will have been converted before the BCIB crossing opens.

Prescribed Mitigation. Given the intentionality (in Bataan) and inevitability (in Cavite) of induced land use change, prevention is not an appropriate approach to mitigation of induced development impacts in those project locations. Ecosystem service losses attributable to urbanization can be minimized through sensible design of urban and industrial developments, with measures such as aggressive enhancement of stormwater infiltration, rainwater harvesting, balancing development space with open space, designing around pre-existing streams and wildlife corridors, setbacks and so on. However, instituting such measures as standard practice in new developments around the BCIB project area is well beyond the scope of the EMP for the BCIB project. Mitigation of the impacts of intentionally induced growth is more appropriately pursued in the context of strategic environmental assessment of the national and regional policies that seek to decentralize urban growth. That said, some mitigation measures proposed below in relation to terrestrial biodiversity impacts may help to maintain a certain amount of ecological function within the landscape in spite of anticipated future land development, and help to protect valued biodiversity resources from induced development beyond the immediate vicinity of the project footprint.

With respect to Corregidor Island, the discussion above has emphasized that the island's management authorities will have some strong built-in advantages in shaping development and land use in the event that a link to the BCIB is developed in the future. Deployment of these advantages will appropriately be a focus of project planning and ultimately the environmental impact assessment and EMP for any future link project, but are beyond the practical reach of the EMP for the BCIB.

IMPACT SUMMARY					
Impact:	Land use change (induced development)				
Direction:	Neutral	Type:	Indirect, cumulative	Probability:	High
Duration:	Permanent	Scope:	Widespread	Significance:	High
Mitigation:	• None prescribed				
Residual:	None expected from BCIB project specifically				

5.2.1.3 Loss of Habitat

Anticipated Impact. The BCIB ROW will occupy 44.46 ha in Bataan, of which an estimated 80% (35.6 ha) is grassland, scrub or trees, some of which comprises notable habitat and may be valuable for wildlife. The ROW on the Cavite side will occupy 21.22 ha, of which roughly 60% (13.3 ha) is grassland, scrub or agricultural land and likely to provide some foraging and refugia opportunities for wildlife. This habitat will be cleared and permanently lost, a direct and irreversible impact.

The significance of habitat loss is largely dependent on the quality of the habitat converted, with losses of habitat classified as natural (in accordance with IFC PS6) being generally more consequential than losses of modified habitat. Approximately 12.3 ha of grassland within the BCIB ROW in Bataan, primarily in the portion of the approach nearest Manila Bay (11.7 ha) but also around the Roman Highway interchange (0.6 ha), is natural habitat (though degraded). The magnitude of this permanent loss is high as it is likely to be one of the last remaining expanses of natural habitat on the shores of Manila Bay. The remaining habitat in Bataan that is due for clearance, 23.3 ha, is modified habitat. All of the habitat that will be converted on the Cavite side, 21.22 ha, is modified habitat. In total, 12.3 ha of natural habitat and 44.5 ha of modified habitat will be permanently lost.

Land conversion caused by the project has been minimized to the extent feasible during the design process, to limit habitat degradation, species loss and associated costs. The design is such that no other viable alternatives within the region exist. This will result in an adverse, significant impact on natural habitat, grassland. As such, losses from the conversion of this natural habitat will need to be compensated to meet the biodiversity target of 'no net loss', as required under IFC PS6 and net gain where they also quality as Critical Habitat. Despite the extent of the modified habitat due to be lost, 44.5 ha, it does not support significant biodiversity value and as such will result in a permanent adverse impact that is not subject to the no net loss requirements, as natural habitat is.

Habitat clearance in the approach road ROWs will require the removal of an estimated 1,454 trees of greater than 15 cm diameter at breast height (1,120 in the Bataan ROW and 334 in Cavite). This will result in a permanent but reversible adverse impact on flora through the loss of roosting, refugia and foraging opportunities. These removals are subject to replacement requirements under national law.

Prescribed Mitigation. Under IFC PS6 the loss of natural habitat must be avoided, and where this is not possible it must be compensated to achieve no net loss. Measures must therefore be put in place to ensure the conservation value of the grassland is successfully replaced for the duration of the BCIB project. There is at least 12.3 ha of remnant land, equal to the extent of natural grassland that will be lost within the land parcels acquired for the ROW. The creation of grassland on this land will maintain natural grassland in-situ that is well connected to the surrounding retained natural grassland, but it is unlikely to achieve no net loss, let alone achieve any possible net gains. The land available for planting post-construction comprises remnant parcels of land that will be located adjacent to the new road (**Error! Reference source not found.**). The use of disparate and fragmented parcels of land will be of less ecological value than the original, well-connected and contiguous pre-construction grassland. Further, the grassland will be removed and temporarily lost for the time it takes for the new grassland to be planted and to mature. The soil profile will also likely change resulting in a change to the seedbank and probably therefore the species composition. It is likely that it will take at least ten years to reestablish the same quality of species composition as that lost.

Detailed field surveys of the grassland to be lost must be completed before any vegetation clearance can start. Surveys must be completed by professional botanists with at least 15 years' experience and preferably experience surveying the local species. Soil sampling must be undertaken by professional soil scientists to confirm the soil structure and its chemistry. Comparable soil sampling surveys must also be completed at all proposed receptor sites to ensure they are suitable. These surveys will confirm the baseline conditions and inform the objectives for the Natural Grassland Restoration Plan, which must be developed by professional ecological professionals with at least 15 years' experience with grassland translocation and management. It will be approved by the CSC when the project starts and implemented throughout the construction phase and prior to site abandonment. A sample outline for a Natural Grassland Restoration Plan is included in Appendix B of the EMP. The principles guiding this plan include:

- the protection of topsoil and restoration of vegetation cover as quickly as possible after construction or disturbance;
- the reestablishment of original habitat to its pre-construction conditions;
- minimization measures including the management controls and workforce education; and
- the prioritization of endemic species and the possible translocation of use of cuttings and local seed-resources where necessary.

The Plan will therefore detail the plan's objectives, inclusive of how the grassland's soil and its seedbank will be stripped, transported and when. It will detail how the soil will be stored, how high the soil bunds will be, how they will be protected from the wind, rain and heat, and how and when they will be restored to ensure the regeneration of the natural grassland is given the best chance of success. It must confirm exactly where the new 12.3ha (minimum) of grassland will be created, which will ideally be adjacent to other areas of existing grassland. The new grassland will need to be established as early as possible and preferably during first two years of construction to give it the best possible opportunity of re-establishing quickly and sufficient time for the Contractors to monitor and manage the grassland before works finish. The management plan will include a three-year monitoring program (minimum) with adaptive management measures to ensure actions can be implemented should the re-establishment not succeed in the first two years. Effective long-term protection and restoration of the compensatory set-asides will require cooperation and a partnership arrangement with the Municipality of Mariveles, covering long-term site management and monitoring. The plan must be completed in consultation with the local authority and experts.

Despite the above efforts to replace like for like, the successful re-establishment of natural grassland is extremely complex, difficult and is unlikely to be perfectly successful. Residual adverse impacts are therefore likely, albeit minor. Further assessment of available receptor land must be completed prior to construction starting, to ideally identify and help secure another 12 ha (24 ha in total) of contiguous, suitable receptor land. If at least another 12 ha of another possible grassland receptor site close to the existing grassland cannot be identified, secured and managed in perpetuity, additional conservation actions will be required to ensure no net loss of natural grassland. These may include the protection or enhancement of existing and local natural grassland habitat in the landscape. Measures will be detailed, committed and implemented under the auspices of the project's Biodiversity Action Plan (provided in report Annexes) to facilitate formulation and implementation.

DPWH will be required to apply for a tree-cutting permit from the local-level DENR offices (CENROs) of Mariveles and Naic for the expected removal of trees from within the respective ROWs. Appropriate locations for compensatory tree-planting will be determined through discussion between DPWH and the CENROs, in consultation with community stakeholders as needed.

IMPACT SUMMARY					
Impact:	Loss of terrestrial natural habitat				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Moderate

Mitigation:	• Restore at least 12.3ha of permanent natural grassland on remnant parcels along the Bataan alignment to work towards no net loss of biodiversity values under the Natural Grassland Management Plan (Appendix B) • Identification of another 12 ha of potential receptor land that would be planted and managed as natural grassland. If this is not possible: • Establishment of additional conservation actions to protect or enhance the adjacent and retrained natural grassland under auspices of Biodiversity Action Plan • Apply for tree-cutting permit and implement compensatory plantings as stipulated by DENR under the conditions of permit approval
Residual:	Loss of modified habitat (Bataan 23.3 ha; Cavite 13.3 ha) Loss of natural habitat (Bataan 12.3 ha), to be addressed under the Biodiversity Action Plan

5.2.1.4 Habitat Fragmentation

Anticipated Impact. New roads in non-urban environments create discontinuities that divide blocks of contiguous habitat into smaller functional units, with effects that vary significantly based on the characteristics of the habitats and species present. Some habitats can experience dramatic ecological change that extend beyond the boundary of the cleared ROW, as edge-adapted species take over and interior-specialized species retreat to the remaining habitat, potentially ending genetic interchange with others of their species on the other side of the road. More open, heterogeneous habitat, including previously fragmented habitat, in which edge-adapted species prevail, may not see much or any change in floral or faunal species composition, although isolation of sub-populations of small faunal species that have difficulty crossing roads may eventually lead to reduced genetic diversity at the sub-population level.[85]

The landscape of the project area in Bataan is mostly open and already quite fragmented. Grassland determined to be natural habitat nearer the coast may be subject to minor diminishment of their biodiversity values over time due to reduced opportunities for interchange between species but most species depend on invertebrates or the wind for dispersal or pollination. The width of the ROW is not considered sufficient to adversely affect dispersal of the grassland or scrub species, but it will likely result in the increase in edge effect. The diversity of the grassland species is likely to change at the edge of each new, smaller grassland compartment. This is, however, not expected to adversely change the conservation status of the habitat. All other habitats in Bataan are already considered to be fragmented and disturbed, including the modified grassland around the upslope of the alignment.

The project will also disturb the movement of local species through increased fragmentation of their habitat. The BCIB alignment will bisect suitable habitat for numerous species, particularly those less mobile, reptiles, amphibians, small mammals and invertebrates. Notable species including the Luzon Fanged Frog and Philippine Cobra, both Near-Threatened endemic species, are particularly likely to be affected. Fragmentation could isolate viable breeding populations in habitat too small to sustain them or with a genetic pool too small to maintain a healthy, viable population. Unmitigated, the local impacts will be of moderate significance to the local notable reptile and amphibian species populations. The impacts will, however, not adversely affect the conservation status of the species as the extent of the fragmentation is restricted to a few kilometers in Bataan and the local species ranges are much larger. Remaining habitat in Cavite is already heavily modified and fragmentation effects are not of any concern.

[85] Fahrig, L. 2003. Effects of Habitat Fragmentation on Biodiversity. Annual Review of Ecology, Evolution and Systematics. Vol 34 (2003): 487–515.

The effects of the loss and fragmentation of habitat on certain notable species present in Bataan will be somewhat minimized by three crossing points inherent to the road's design: (1) the Alas Asin Underpass (2.4 km uphill from the shoreline); (2) the Alas Asin Waterway Bridge spanning a wide gully and an intermittent tributary of the Babuyan River (1.1 km from the shoreline); and (3) a 200-m strip of land between the end of the embankment and the shoreline, where the roadway will be supported on a raised viaduct. Together, these significant gaps in the embankment, each offering opportunities for free movement of even very small species across the alignment, can be considered to minimize fragmentation effects to a very low level of significance.

The habitats in Cavite are already fragmented by roads, housing, and agriculture. The fragmentation caused by the construction of the proposed BCIB will not adversely affect the conservation status of any habitats present.

Prescribed Mitigation. As discussed above, the adverse effects associated with fragmenting the habitat of notable species in Bataan will be partially mitigated by gaps in the road embankment. This mitigative potential can be augmented by enhancing habitat in the vicinity of each gap to attract and provide cover to animals that may benefit from having access to the crossings. The sites should be planted with shade tolerant, endemic species and some dead-plants (e.g. dead hedges or trees) should also be added to provide structure for other flora to utilize and colonize. This will be the responsibility of the PC1 contractor.

IMPACT SUMMARY					
Impact:	Habitat fragmentation				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• PC1 to enhance habitat in the vicinity of designed gaps in the Bataan approach road embankment to facilitate safe crossing by wildlife, with sensitive planting of shade tolerant, endemic species				
Residual:	Expected but low				

5.2.1.5 Wildlife Disturbance

Anticipated Impact. Disturbance related impacts are by nature localized and unlikely to be severe in the case of the BCIB approach roads because of likely absence of rare or endangered species and the low levels of wildlife density. There are no known roosting sites, high value feeding sites or any other sites of particularly concentrated wildlife use close by the alignment in either Bataan or Cavite. Further, some species, particularly many bird species, are known to readily habituate to changes in noise, light and movement.

Prescribed Mitigation. In view of the low significance of expected impacts, no mitigation is prescribed.

IMPACT SUMMARY					
Impact:	Wildlife mortality, disturbance and fragmentation from habitat clearance				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Long-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• None prescribed				
Residual:	Expected but low				

5.2.1.6 Light Pollution

Anticipated Impact. Increases in road and vehicle lighting may affect wildlife in roadside areas. Potential effects on faunal species include altered hunting and foraging behavior of nocturnal and diurnal animals; changes to predator-prey relationships; unbalanced competitive dynamics between species; onset of migration and mating at inopportune times; and bird collisions with structures due to disorientation. For floral species, effects may include reduced pollination success for night-pollinated flowering species and out-of-season flowering, fruiting and leaf-drop in photoperiod-sensitive species.[86] These impacts are unlikely to be of any material magnitude in the case of the BCIB, given low wildlife density and habitats present.

Increased lighting will contribute to a more generalized form of light pollution known as 'atmospheric glow', whose primary effect on wildlife is to confuse and redirect noctural avian migrants, and potentially also bats. Urban glow is known to alter foraging, commuting and migration patterns, in some cases bringing them into greater proximity to the lights (e.g. tall buildings and infrastructure) and increasing the risk of collisions, as well as drawing them away from more favorable habitat.[87] It would be very difficult to quantify these effects for the BCIB as they will be a minor incremental addition to a broader lighting problem but the effects are unlikely to be greater than a low significance due to the species present and the proximity of existing lit urbanized areas. Best practice design and construction measures still recommend the minimization and control of lighting, particularly in justifying the reducing contribution to a cumulative impact.

Prescribed Mitigation. Roadway lighting specifications incorporated in the infrastructure designs will indicate universal use of luminaries with shielding and directionality sufficient to largely eliminate lateral and upward light leakage and this is expected to sharply limit the potential for light pollution impacts along the approach roads.

IMPACT SUMMARY					
Impact:	Light pollution				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Permanent	Scope:	Localized	Significance:	Very low
Mitigation:	• None prescribed, beyond measures already reflected in designs				
Residual:	No significant residual is expected				

5.2.1.7 Wildlife Road Mortality (On-land Roadways)

Anticipated Impact. Roads can cause significant wildlife mortality, particularly when they are built across pre-existing wildlife movement corridors. Slow-moving faunal species such as turtles and tortoises, snakes and amphibians are particularly vulnerable due to the length of time it takes them to cross the entire road surface but mortality can also be high for more mobile species (even airborne ones), as disorientation and misperception are important factors in collisions with vehicles. Mitigation is sometimes justified on the basis of significant predictable road mortality, or where frequent wildlife-vehicle collisions are deemed to pose significant road safety risks. Wildlife mortality is not expected to be significant for either of the BCIB approach roads, given the generally low density of wildlife

[86] Longcore, T. and C. Rich. 2004. Ecological light pollution. Frontiers in Ecology and the Environment 2004; 2(4):191-198.
[87] Adams, C.A., E. Fernández-Juricic, E.M. Bayne and C.C. St. Clair. 2021. Effects of artificial light on bird movement and distribution: A systematic map. Environmental Evidence 10:37.

in the areas traversed and the preponderance of small species not well adapted to climbing high embankments. The ROW will be fenced, and this will also impede entry of wildlife onto the roadway.

Prescribed Mitigation. In view of the discussion above, no specific mitigation is prescribed but the underpasses detailed earlier, the steepness of the embankments and the proposed fencing will all work to avoid and reduce the likelihood of any mortality.

IMPACT SUMMARY					
Impact:	Wildlife mortality on approach roads				
Direction:	Negative	Type:	Direct	Probability:	Moderate
Duration:	Long-term	Scope:	Localized	Significance:	Very low
Mitigation:	• Enhancement of habitat in the vicinity of designed gaps in the Bataan approach road embankment to facilitate safe crossing by wildlife, with sensitive planting of shade tolerant, endemic species				
Residual:	Expected but very unlikely to be significant				

5.2.1.8 Wildlife Road Mortality (on the Bridge)

Anticipated Impact. Bridge and viaduct railings may be attractive roosting and perching sites for some bird species, particularly seabirds and the proximity to fast-moving traffic entails elevated risk of collisions with vehicles. It is difficult to predict whether this might be a significant problem with the BCIB. Somewhat analogous infrastructure close to shore, including loading ship loading piers at the Hyatt Oil Terminal and at the foot of Kamaya Pt. Road, does not appear to attract large numbers of seabirds but the situation may be different further from land. The significance of the impact is not clear and further monitoring is required to inform any potential mitigation.

Prescribed Mitigation. Given uncertainty as to the probability of seabird roosting and perching becoming a problem on the BCIB, including which particular areas might be trouble spots, preventive measures such as anti-roosting devices installed on bridge railings may not be justified. Instead, a Bird Management Plan will be implemented.

Birds regularly using the land and air space close to the BCIB will be surveyed quarterly by professional consultants and the data will inform an adaptive management approach. Therefore, monitoring during the construction phase and early operational phase will confirm bird species' local presence and abundance, how these change across the year, and also how different species interact with the bridge, if at all. The incidence of vehicle strikes will also be monitored for the first three years of bridge operations. Any emerging problems identified in the course of monitoring shall be assessed by independent experts and the requisite mitigation will be proposed. The Plan will confirm what actions will be required in the event that adverse impacts on birds are recorded. The Plan will proactively detail who will be responsible and accountable, when actions must be reviewed and whether any changes to the monitoring plan are required. Measures will include bird deterrents, including anti-roosting devices that could be installed retroactively. Monitoring for the emergence of bird strike concerns due to excessive roosting and perching is appropriately carried out as part of bridge safety monitoring and will be discussed later, in relation to the operation phase.

IMPACT SUMMARY					
Impact:	Bird mortality from collisions with vehicles on bridges and viaducts				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Long-term	Scope:	Localized	Significance:	Unknown
Mitigation:	• Development and implementation of a Bird Management Plan				
Residual:	Unknown and to be determined				

5.2.1.9 Avian Bridge Collision Mortality

Anticipated Impact. Tall bridges are known to result in a certain incidence of bird mortality, due to collisions with various components of the infrastructure. Collision risk is highly context-specific and situational; key factors are the frequency and severity of atmospheric conditions that restrict visibility; the physical nature of the bridge components; lighting of the bridge structure; the biophysical parameters of the landscape in which the bridge is situated; and the density, frequency and timing of avian movements through the landscape.[88] Each of these factors is discussed below in relation to the BCIB.

The current state of knowledge regarding bird movements in and around the BCIB project area is very weak; systematic avian research in the region has been limited to general and species-focused bird surveys designed to confirm presence and annual bird counts focused on waterbirds in the northern and eastern fringes of Manila Bay, where habitat supports large concentrations of migratory waterbirds. This paucity of movement data makes it impossible to quantify bird collision risk to any meaningful degree; it is nevertheless possible to conceptualize the risks, reflect on their probable significance and develop both precautionary and adaptive mitigation options.

Atmospheric conditions limiting visibility. Most birds are thought to avoid tall infrastructure, provided they are able to perceive its presence; indeed, one concern raised about the effects of large projects on migrating birds is that the long routes birds take for the purpose of avoidance may add to the energetic cost of migration.[89] When birds cannot perceive tall infrastructure due to unfavorable weather, deliberate avoidance is not possible. The principal conditions of concern for bird strikes are fog, low cloud cover and rain, particularly when they occur at night.

Most birds are diurnal but many of those that migrate do so at night. The means by which nocturnal migrants orient themselves are not well understood but it is generally thought that most species probably rely on a combination of the earth's magnetic field and visual cues such as the stars, moon, sunset and sunrise, horizon, coastlines and silhouettes of high landforms.[90] When visibility is poor due to fog, cloud or rain, most of these cues become unavailable and birds may essentially 'fly blind', guided only in a very general sense by the earth's magnetic field. Blind flight is not likely to have been very consequential in a time before humans began building structures tall enough to impinge on the free air space transited by avian night migrants but is obviously very risky in the vicinity of

[88] Kahlert, J., K. Hüppop and O. Hüppop. 2005. Construction of a fixed link across Fehmarnbelt: Preliminary risk assessment on birds. National Environmental Research Institute (Ministry of the Environment, Denmark).
[89] Ibid.
[90] (1) Adams, C.A., E. Fernández-Juricic, E.M. Bayne and C.C. St. Clair. 2021. Effects of artificial light on bird movement and distribution: A systematic map. Environmental Evidence 10:37.; (2) Ogden, L. J. E. (1996) Collision course: the hazards of lighted structures and windows to migrating birds. Toronto, Canada: World Wildlife Fund Canada and the Fatal Light Awareness Program.;

communications towers, high bridges, skyscrapers and other very tall structures.[91] Rates of bird collisions with tall infrastructure are known to be dramatically lower in clear weather, when the stars and moon are visible and available for use in navigation.[92] Although the loss of visual cues guiding daytime flight may not be as extreme without the addition of darkness as a factor, it may be presumed that birds flying in very low visibility conditions during the day are likely to also have to 'fly blind' on occasion, relying mostly on the earth's magnetic field for orientation and lacking advance warning of the proximity of tall infrastructure.

The area around the mouth of Manila Bay reportedly sometimes experiences fog during the pre-dawn hours during the northern hemisphere winter months, which is the peak migration period for most bird species that pass through the Manila Bay area. Storms and fronts yielding low cloud and heavy rain pass through mainly during the southwest monsoon, from May to October. Visibility is also sometimes limited by smog. Avian collision risk from the BCIB infrastructure may thus be elevated to some extent at almost any time of the year, although the heavier presence of birds during the winter migration would tend to indicate higher probability of collisions then.

Physical nature of bridge components. Cable-stayed and suspension bridges are particularly problematic for birds because the cables are difficult to perceive compared with more substantial structural members, especially in low-visibility conditions. Theoretically, the heavy cables of a large cable-stayed bridge should entail somewhat lower risk in this regard than the smaller-diameter vertical suspenders of a suspension bridge, the guy wires of a communications tower, or conductors of a transmission line. Nevertheless, the diagonal cable sprays of a cable-stayed bridge present a complex landscape of obstacles for transiting birds and diurnal birds migrating at night are thought not to have fine-grained perceptive abilities.[93] It is noted that the range of cable diameters for the BCIB range from 200 mm for the 38 strand system to 315 mm for 109 strands cables. These are substantial cables that will be easy to see in good weather, either alone or in combination with the other cables. Taller communication towers (305 m and higher) are known to have several times higher bird mortality rates than shorter ones in the 116–146 m range, presumably because they intrude further into the available air space and have a greater number of support guys for birds to collide with.[94] A similar relationship may reasonably be assumed to hold true for cable-stayed bridges; the SCB, at 305 m, is likely to present a substantially greater risk to migrating birds than the 152 m-high NCB.

In contrast to the high towers and cable sprays of the NCB and SCB, the long marine viaducts of the BCIB are not likely to pose a significant risk to migrating birds, primarily because of their low height off the water. Although there is substantial variability in preferred flying altitude by species and in accordance with weather conditions, virtually no species fly at very low altitudes during nocturnal migrations.[95] For resident species,

[91] Ogden, L. J. E. (1996) Collision course: the hazards of lighted structures and windows to migrating birds. Toronto, Canada: World Wildlife Fund Canada and the Fatal Light Awareness Program.
[92] (1) Kahlert, J., K. Hüppop and O. Hüppop. 2005. Construction of a fixed link across Fehmarnbelt: Preliminary risk assessment on birds. National Environmental Research Institute (Ministry of the Environment, Denmark).; (2) Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand and J.M. Marquenie. 2008. Green Light for Nocturnally Migrating Birds. Ecology and Society 13(2):47.
[93] Ogden, L. J. E. (1996) Collision course: the hazards of lighted structures and windows to migrating birds. Toronto, Canada: World Wildlife Fund Canada and the Fatal Light Awareness Program.
[94] Gehring, J., P. Kerlinger and A.M. Manville II. 2009. Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. Ecological Applications 19(2): 505-514.;
[95] Ogden, L. J. E. (1996) Collision course: the hazards of lighted structures and windows to migrating birds. Toronto, Canada: World Wildlife Fund Canada and the Fatal Light Awareness Program.

especially seabirds that make low-altitude daily flights out to sea to feed and return in the same manner to roost, the viaduct superstructure may present a collision risk in extreme fog but this risk could be expected to be moderated by the birds' familiarity with the local environment, including the bridge. The risk of collision with the viaducts for locally circulating birds may be elevated during construction, when the obstacle is first introduced but can likely be expected to drop off with time.

Lighting of the bridge structure. Three kinds of lighting are planned for the over-water components of the BCIB infrastructure: roadway lighting, aviation warning beacons and decorative floodlighting. Each of these may influence avian collision risk.

Roadway lighting on the BCIB crossing is expected to be of significance to birds primarily as a source of generalized light pollution, rather than a contributor to collision risk, although significant upward light leakage may contribute to birds' confusion and difficulty in orientation. Roadway lighting is probably the least consequential of the three forms of bridge lighting for nocturnally-migrating birds.

Aviation warning lights will be strategically positioned at height in accordance with national air transportation safety requirements. The principal problem for birds with warning lights on tall structures is that they appear to have a 'trapping' effect, whereby passing birds adopt the artificial light as a dominant visual orienting cue and begin to curve their course until they are, in effect, circling or otherwise maintaining close proximity to the light source. This circling brings birds into proximity with cables and antennae attached to the lighted structures, increasing the risk of collisions and may explain why bird kills on transmission lines tend to be more frequent around tower locations than they are in the intervening spaces.[96] Although the trapping effect has often been conceptualized as a matter of 'attraction', there appears to be a consensus in the literature that the tendency to approach artificial light sources may be more a matter of confused navigation than straight-line attraction in the sense of a magnet. The effect is termed 'trapping' or 'capture' because, once in the orbit of an artificial light source, birds seem to have difficulty breaking away to continue on their journeys; this may be because they are unable to perceive less bright visual cues in the broader landscape, or because artificial light in some wavelengths interferes with their ability to self-orient using the earth's magnetic field.[97] Birds circling an isolated light source in such a state of confusion have been known to die of exhaustion. Others are rescued by the arrival of dawn, assuming they don't die from a collision with some part of the infrastructure.[98] There is solid evidence that strobes are considerably less apt to lead to bird mortality around tall structures than are continuously lit lights (perhaps because the trapping effect is disrupted) and also that continuously illuminated red warning lights are the most problematic of all, including when used in combination with flashing lights and lights of

[96] Kahlert, J., K. Hüppop and O. Hüppop. 2005. Construction of a fixed link across Fehmarnbelt: Preliminary risk assessment on birds. National Environmental Research Institute (Ministry of the Environment, Denmark).
[97] (1) Adams, C.A., E. Fernández-Juricic, E.M. Bayne and C.C. St. Clair. 2021. Effects of artificial light on bird movement and distribution: A systematic map. Environmental Evidence 10:37.; (2) Ogden, L. J. E. (1996) Collision course: the hazards of lighted structures and windows to migrating birds. Toronto, Canada: World Wildlife Fund Canada and the Fatal Light Awareness Program.
[98] Van Doren, M.B., K.G. Horton, A.M. Dokter, H. Klinck, S.B. Elbin and A. Farnsworth. 2017. High-intensity urban light installation dramatically alters bird migration. Proceedings of the National Academy of Sciences direct submission, www.pnas.org/cgi/doi/10.1073.

other colors. One study of collision risk at tall communications towers found that removal of continuously lit red lights from the lighting scheme reduced bird mortality by over 50%.[99]

Floodlighting tall infrastructure elements for decorative (and sometimes navigational) purposes has a similar trapping effect to continuously lit aviation warning lights.[100] In the case of a cable-stayed bridge, the entire vertical length of the tower is typically lit and birds circling at multiple elevations have to repeatedly navigate through both cable sprays. Decorative floodlighting is generally not amenable to use of flashing patterns. Artificial light emitted at long wavelengths (e.g., red) or with a heavy long-wave component (white) has a much stronger effect on bird navigational behavior than light with short (green) or very short (blue) wavelengths.[101] Decorative floodlighting that relies heavily on blues and greens may reasonably be expected to lead to a lower incidence of collisions with an illuminated bridge tower than lighting schemes employing white or hues of red, pink and orange.

Biophysical parameters of the landscape. The spatial configuration of ecological resources favorable to avian wildlife, such as river valleys, wetland complexes, sheltered bays and grain-growing areas, is a strong determinant of particularly concentrated migration pathways and of bird distribution in general. Some landscapes also possess physical characteristics that serve to concentrate wildlife movements, including those of birds. Mountain passes may be taken as the path of least effort by lower-flying migrants, for example and narrow stretches of open water positioned between areas of higher ground may be favored by waterfowl and seabirds, at least for short, low-altitude movements.

The north and east sides of Manila Bay are known to host a substantial concentration of waterbird species during the winter months, both transient migrants and overwintering residents. The shallow foreshore, mudflats, ponds, mangroves and brackish backwaters of northeastern Bataan, Pampanga and Bulacan, as well as smaller patches of mangrove and mudflat habitat around Parañaque in Metro Manila and Bacoor Bay in western Cavite, still support major feeding activity, despite long-term patterns of habitat conversion and degradation caused by aquaculture, agriculture and urban development. Manila Bay is considered a significant component site of the East Asian-Australasian Flyway (EAAF) for this reason. The relative proximity of concentrated waterbird feeding zones to the BCIB project area may potentially contribute to bird mortality risk, although this should perhaps not be overstated, in light of the distances involved and the height at which the birds will be flying. Exhibit 5-94 shows the straight-line distances from the NCB and SCB sites to each of several major waterbird-supporting areas in the northern and eastern margins of the bay. The data shown are not indicative of major impact potential. The nearest site of waterbird concentration is Bacoor Bay, at 29 km from the SCB and 33 km from the NCB; geometry would tend to suggest that movements of waterbirds associated with these agglomeration sites should be flying higher than the BCIB and potentially be diffused at such distances. There are no significant areas of mudflat, mangrove or brackish backwater capable of supporting large concentrations of waterbirds in parts of Manila Bay closer to the mouth and the BCIB project area. Despite this, is noted that the northern reaches of the Bay do

[99] (1) Gehring, J., P. Kerlinger and A.M. Manville II. 2009. Communication towers, lights, and birds: successful methods of reducing the frequency of avian collisions. Ecological Applications 19(2): 505-514.
[100] Van Doren, M.B., K.G. Horton, A.M. Dokter, H. Klinck, S.B. Elbin and A. Farnsworth. 2017. High-intensity urban light installation dramatically alters bird migration. Proceedings of the National Academy of Sciences direct submission, www.pnas.org/cgi/doi/10.1073.
[101] Poot, H., B.J. Ens, H. de Vries, M.A.H. Donners, M.R. Wernand and J.M. Marquenie. 2008. Green Light for Nocturnally Migrating Birds. Ecology and Society 13(2):47.

support significant numbers of wading and shore birds including globally significant concentrations of Red-Necked Stint (*Calidris ruficollis*), Red-Necked Stint (*Calidris ruficollis*), Kentish Plover (*Charadrius alexandrines*), Whiskered Tern (*Chlidonius hybrida*), Black-Winged Stilt (*Himantopus Himantopus*) and Pacific Golden Plover (*Pluvialis fulva*), all species that trigger Critical habitat.

Exhibit 5-94 Proximity of BCIB to Major Waterbird Concentration Zones in Manila Bay

Major waterbird habitat areas	Distance from NCB (km)	Distance from SCB (km)
Pampanga Bay (Southern Pampanga/Northeast Bataan)	46	52
Western Bulacan	42	46
Eastern Bulacan	45	47
Parañaque	41	37
Bacoor Bay	33	29

Source: Consultant's analysis derived from Google Earth and Jensen, A.E. 2018. Internationally Important Waterbird Sites in Manila Bay, Philippines, October 2018. Technical Report. Wetlands International and IUCN National Committee of the Netherlands.

There is little known about the movements of waterbirds around the Manila Bay ecosystem. But as a matter of geography, there does not appear to be a strong case to be made for the mouth of Manila Bay as a major flight path in relation to the macroscale migration of waterbirds. Virtually all other major nodes of waterbird habitat used as wintering grounds and stopovers in the Philippines are located in a southeasterly or northerly direction from Manila Bay (see Exhibit 5-95) and to the extent that waterbirds can be expected to move principally between such nodes, it would not appear advantageous for migrating waterbirds to expend energy on westward movement out the bay mouth (except perhaps for flocks heading directly for Palawan). There are also few significant wetland areas along the western coast of Luzon that might be accessed via the mouth of Manila Bay. Accordingly, it may reasonably be surmised that the BCIB's cable-stayed bridges are unlikely to function as hazardous screens across the path of large numbers of migrating waterbirds. It should also be acknowledged here that the two cable-stayed bridges, at 800 m (NCB) and 1,800 m (SCB) in length, will occupy a small portion of the total cross-section of the 23 km-wide bay mouth.

Waterbirds are not the only avian migrants to frequent the Manila Bay region; numerous passerine species also travel along the EAAF. Significant areas of forest on the Bataan Peninsula around Mt. Mariveles and Mt. Natib and across the water in the hills straddling the border between Cavite and Batangas and around the Taal Volcano, offer wintering and stopover habitat for passerine migrants. No evidence has been found to suggest mass movements of passerines through the BCIB project area as a result of movement between these nodes of forest habitat and there is no basis for quantification of through-passage or attendant exposure to collision risk. But for practical purposes, it can be considered probable that there is an elevated incidence of passerine migrants in the general vicinity of the BCIB project site, including the two tall cable-stayed bridges, during the northern hemisphere winter months.

Apart from migrants, many resident bird species are found in the immediate vicinity of the BCIB project area. Some of these species may fly over the waters of the bay in the vicinity of the NCB and SCB in the course of daily movement between roosting and feeding areas but these will primarily be daytime flights and habituation to the bridges as part of the local environment can be expected to moderate collision risk. The risk to resident birds can therefore be considered low.

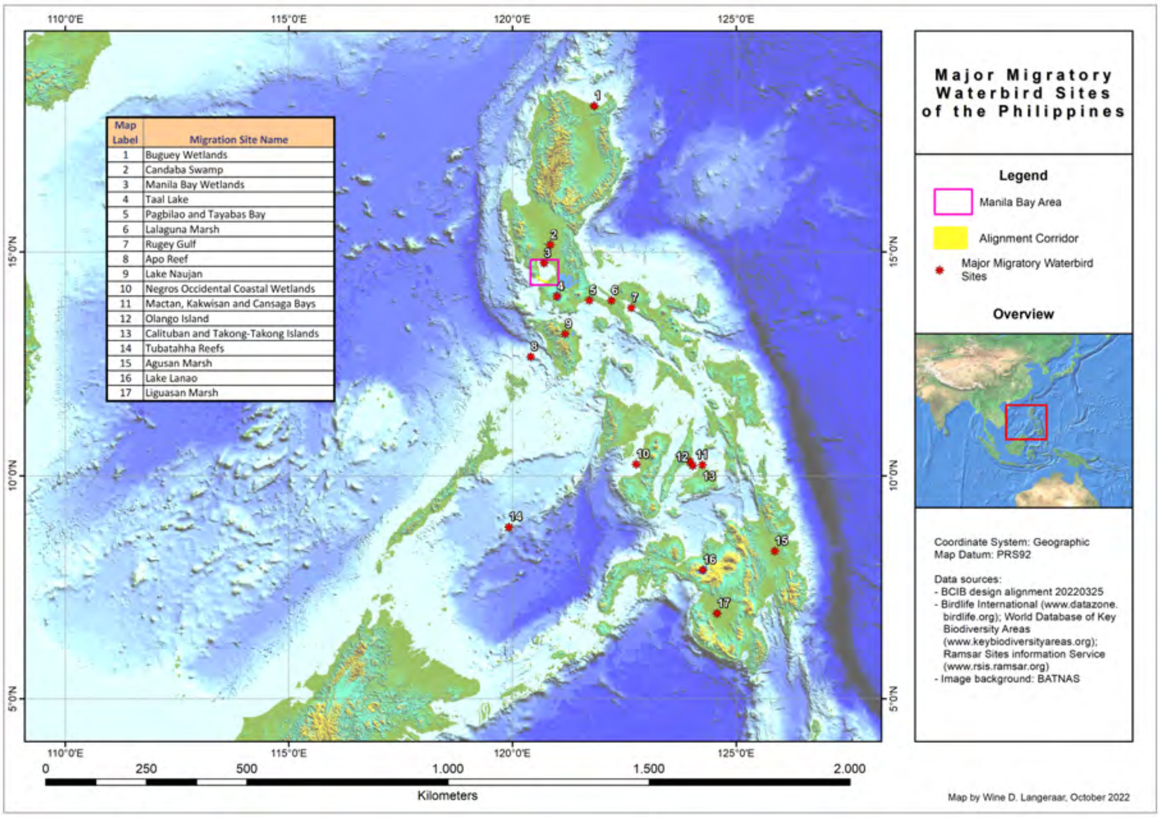


Exhibit 5-95 Distribution of Prominent Waterbird Habitat Sites in the Philippines

Prescribed Mitigation. Despite the lack of a basis for quantification of the collision risk for migrant birds, it is anticipated that the NCB and SCB may result in at least some bird mortality and mitigation is justified by the precautionary principle. Given the very high uncertainty surrounding bird numbers and movements, major structural options to reduce the exposure of birds to the structures, such as making the bridge towers shorter and reducing the number of cable stays, cannot realistically be advised. Fortunately, there are relatively low-cost options that can be implemented at the design and operation phases to mitigate bird collision risk; all involve lighting.

One design-driven mitigation option is to minimize light emissions from roadway lighting, to lessen effects on birds' navigational and visual-perceptual abilities. Careful orientation and shielding of roadway light fixtures can eliminate direct upward emissions. The roadway lighting design specification for the entire BCIB project indicates exclusive use of luminaries with shielding and directionality sufficient to eliminate direct lateral and upward light emissions. Reflected light is impossible to control completely but should be of much lower intensity and produce no consistent glare, so this can be considered an insignificant residual.

A second design measure is to make the aviation warning lights installed on the NCB and SCB bridge towers as bird-friendly as possible. The aviation lighting design scheme for the bridges follows the navigation lighting guidelines of the Federal Aviation Administration (US Department of Transportation) obstruction lighting guidelines, which specify dual red/white flashing lights (high-intensity flashing white during the day and medium-intensity flashing white during twilight and red flashing at night).[102] As mentioned above, flashing lights are much less likely to generate a trapping effect than solid ones, especially solid red; the adopted scheme is therefore considered likely to be effective mitigation.

The third avenue for risk reduction is to modify the use of floodlighting. It is understood that nighttime illumination is a powerful tool for enhancing the aesthetic appeal of the cable-stayed bridges and that removal of floodlighting from the design altogether to protect birds is not a realistic mitigation option. However, turning the floodlighting off during peak bird migration season (and perhaps only during times of poor visibility even then) may be a reasonable and easily implemented compromise if bird mortality proves to be a significant problem. In addition, altering the color scheme of decorative floodlighting to eliminate or reduce long-wave emissions (by using only hues of green and blue) during the avian migration season is likely to significantly reduce the trapping effect. The decorative lighting system for the two BCIB bridges will be controlled by a modular automated system with multiple standard program settings, including a 'bird-safe' regimen favoring blues and greens that can be switched on during migration season, or any time low-visibility conditions are expected.

Bird deterrent ball markers, large discs or spheres that are frequently used to deter birds from colliding with overhead powerlines are not considered necessary as the cables themselves are so wide. The cables will vary between 200 mm and 350 mm and given their density will form a screen that will be easily seen in good weather.

The measures outlined above are expected to help reduce the risk of avian collision. However, as indicated at the outset of this discussion, collision risk is highly context-specific and there is no guarantee that a generic 'bird-safe' lighting program will be effective in all situations. For this reason, a Bird Management Plan is required. Bird monitoring must commence before construction to confirm the species that fly close to the proposed BCIB area, their abundance and their behavior, including the height of flight, flying speed and likely purpose (e.g., foraging or migrating). Monitoring must begin before construction and continue for the duration of the construction works. The surveys will comprise vantage point surveys, and will be completed from Bataan, Corregidor Island and Cavite four times a year. Surveys must be undertaken by professional bird surveyors with relevant experience.

Bird monitoring data will inform the baseline and enable decisions regarding possible changes to the lighting regime to be professionally informed. The management plan will help inform when the floodlights should be shut off or switched to 'bird-safe' or some other perhaps more effective custom scheme. The adaptive management program would require a limited-term partnership between DPWH and a local NGO with strong avian expertise and technical capacity, and is proposed as an action program under the auspices of the project's Biodiversity Action Plan (BAP).

[102] Federal Aviation Administration. Advisory Circular AC70/7460-1M – Obstruction Marking and Lighting. Effective 11/16/2020.

IMPACT SUMMARY						
Impact:	Bird mortality due to collisions with BCIB bridges					
Direction:	Negative	Type:	Direct	Probability:	High	
Duration:	Permanent	Scope:	Localized	Significance:	Unknown	
Mitigation:	• Develop and implement a Bird Management Plan to confirm the baseline of species and abundance that use the air space close to the BCIB and to inform a protocol for bird-friendly application of decorative flood lighting in local context, under auspices of the BAP					
Residual:	Expected, significance unknown					

5.2.1.10 Impacts of Habitat Loss on Threatened Species

Anticipated Impact. Eleven threatened terrestrial species were identified and likely to be present in the wider landscape; these include species classified as EN, CR or VU by the IUCN and/or by DENR-BMB through DAO 2019-09. The threatened species are listed in Exhibit 5-96 with relevant information regarding the potential impacts associated with the loss of habitat.

Exhibit 5-96 Potential Habitat Loss Impacts on Threatened Species

Species	Notes on Habitat Loss Impact Potential
Anas luzonica Philippine Duck IUCN status: VU National status: EN	*Anas luzonica* uses a range of coastal, riverine and wetland habitats, including mangroves, watercourses inside forests, ponds including fishponds and coastal lagoons. Its diet consists of fish, shrimps, insects, rice and young vegetation. Given its habitat requirements, *Anas luzonica* is very unlikely to be significantly affected by the development of the BCIB. Suitable habitat is limited, particularly in Bataan. Cavite offers better opportunities, particularly along the Timalan River and Timbugan Creek, which retain some mangroves and other riparian arboreal vegetation and offer potential feeding and nesting sites. There are also some inland fishponds along the lower reaches of the Timalan River and near the mouth of the Labac River which may be used by individuals of the species. Three individuals of *Anas luzonica* were observed feeding along the Timalan River near the Antero Soriano Highway crossing in 2022. Only one aquatic habitat feature will be impinged upon by the BCIB ROW in Cavite, where the northeast ramp extension of the Antero Soriano Highway interchange crosses the west branch of the Timalan River. This is an existing crossing which will be widened as part of the project; the widening would constitute a negligible loss of aquatic habitat potentially used by *Anas luzonica,* especially compared with the suitable habitat available elsewhere in the Bay. Since rice is known to feature in the diet of *Anas luzonica*, it bears mentioning that some rice paddies lie within the Cavite ROW and will be converted as part of the project's development. However, the loss of sub-optimum habitat has to be understood in the context of already-ongoing land use change in this area. All areas along the alignment are zoned for non-agricultural uses in the Naic CLUP and there are numerous residential and commercial development proposals already in process. Even if the BCIB were not built, the rice paddy area would be very unlikely to persist for long. Impacts through habitat loss are expected but the magnitude of the impacts is likely to be very low or negligible. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Anas luzonica*. The IUCN Red List of Threatened Species 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 19 September 2022.
Accipiter gularis Japanese Sparrowhawk IUCN status: LC National status: EN	This species is listed as EN because of its inclusion in CITES Appendix II. The species is a migrant raptor that does not breed locally and feeds on passerine birds, as well as bats, insects and rodents. The BCIB project will not affect the hawk's breeding sites and it is unlikely to regularly use the grassland scrub or agricultural land for roosting. There is a wide expanse of suitable foraging habitat in the wider landscape, the species is highly mobile and it's diet is varied and distributed. As such it is exceedingly unlikely to be adversely affected by the loss of habitat. No significant impacts are expected. Source: BirdLife International (2022) Species factsheet: *Accipiter gularis*. Downloaded from http://www.birdlife.org on 19/09/2022.
Bolbopsittacus lunulatus Guaiabero	This parrot species is listed as EN because of its inclusion in CITES Appendix II. It inhabits lowland forest and nearby cultivated areas and its diet consists primarily of fruit; guava orchards are favored anthropogenic habitats. The global population is considered stable. No lowland forest will be converted or degraded to allow

Species	Notes on Habitat Loss Impact Potential
IUCN status: LC National status: EN	development of the BCIB project but small portions of a number mango and guava orchards (total area approximately 3.5 ha) will fall within the Bataan ROW and a further 1.9 ha is considered a possible staging area. These areas constitute a minor proportion of orchard in the wider landscape. Only a small number of fruit trees would be affected by the project's development in Cavite. Overall, the BCIB project can be expected to have a very low or negligible affect on *Bolbopsittacus lunulatus*. No significant impacts are anticipated. Source: BirdLife International. 2016. *Bolbopsittacus lunulatus*. The IUCN Red List of Threatened Species 2016: e.T22684914A93051249. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684914A93051249.en. Accessed on 19 September 2022.
Haliaeetus leucogaster White-Bellied Sea Eagle IUCN status: LC National status: EN	This resident raptor is listed as EN because of its inclusion in CITES Appendix II. It is typically found along coasts and around islands and may be observed over open water, in estuaries and mangroves and in in woodlands close to the sea. It may also use terrestrial wetlands. *Haliaeetus leucogaster* nests in trees and on rocky outcroppings and feeds on a wide range of prey, including fish, reptiles, other birds and small mammals, as well as carrion. The species is known to be fairly tolerant of proximity to people and to use resources associated with human activity, including fish pens and garbage dumps. It was recorded flying along the Tail End of Corregidor Island during faunal surveys in 2022. The rugged wooded coastline of Corregidor Island and to a much lesser extent parts of the south Mariveles Coast (such as the lower reaches of the Babuyan River valley) would appear to offer the most favorable habitat in the BCIB project area. There is no evidence to suggest that the species is nesting on Corregidor Island or in close proximity to the BCIB so the project's affects are likely to be limited to indirect effects, including increased noise, light and movement disturbance. These are assessed in the Construction Phase impact assessment. As the bird is highly mobile and is very unlikely to nest in the ROW or standing areas and the there is significant open water available for foraging in the wider landscape, no significant impacts are anticipated. Source: BirdLife International. 2020. *Haliaeetus leucogaster* (errata version published in 2022). The IUCN Red List of Threatened Species 2020: e.T22695097A216253643. Accessed on 20 September 2022.
Haliastur indus Brahminy Kite IUCN status: LC National status: EN	This resident raptor species is listed as EN because of its inclusion in CITES Appendix II. Generally associated with coasts and inland wetlands, the bird feeds largely on carrion, particularly dead fish and crabs but also hunts, fish and steals from other predators. A common and adaptable bird, *Haliastur indus* is found throughout the BCIB project area (individuals were recorded in baseline faunal surveys in Mariveles, Naic and Corregidor Island). There is no evidence to suggest that the species is nesting with the ROW or near the BCIB so the project's affects are likely to be limited to indirect effects, including increased noise, light and movement disturbance (which area assessed later). As the bird is highly mobile any such affects are unlikely to adversely affect the species conservation status so no significant impacts are anticipated. Source: BirdLife International. 2016. Haliastur indus. The IUCN Red List of Threatened Species 2016: e.T22695094A93489054. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695094A93489054.en. Accessed on 20 September 2022.
Lonchura oryzivora Java Sparrow IUCN status: EN National status: EN	*Lonchura oryzivora* is not native to the Philippines and local populations derive from introductions, as in many other locations around the tropics. It is listed as EN under national law because it appears in CITES Appendix II. This highly adaptable species is favored by the songbird trade, and is endangered in its native range in Indonesia due to intensive collecting. An urban population of the species is known from Metro Manila. *Lonchura oryzivora* was recorded in Naic during faunal surveys conducted in the BCIB project area in 2021/2022. Given this bird's introduced status and adaptability to human-dominated environments and ready availability of suitable habitat in the vicinity, conversion of green space potentially used by it for the BCIB approach roads is extremely unlikely to constitute an impact that would adversely affect the species' conservation status. Habitat of equal quality or better is abundance throughout the wider landscape and significant impacts are not expected. Source: BirdLife International. 2021. *Lonchura oryzivora*. The IUCN Red List of Threatened Species 2021: e.T22719912A183133210. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22719912A183133210.en. Accessed on 21 September 2022.
Pandion haliaetus Western Osprey IUCN status: LC National status: EN	This resident raptor species is listed as EN because of its inclusion in CITES Appendix II. It is found around shallow waters, from which it derives its main diet of live fish. Nests are typically found in tall exposed trees near water. The species is tolerant of human proximity and is sometimes found in water-proximate suburban and urban environments. *Pandion haliaetus* was recorded along the east coast of Corregidor Island during faunal surveys conducted in the BCIB project area in 2022. Given a known adaptability to the built environment, it can be considered highly unlikely that *Pandion haliaetus* will experience significant negative effects as a result of the BCIB project's development. It is probable that individuals of this species will use parts of the marine viaduct as a perching spot during fishing

Species	Notes on Habitat Loss Impact Potential
	activity and thus may even derive very small benefits from its presence. It is not anticipated that any nesting sites would be damaged or degraded to make way for the approach roads, as the on-land alignments are not particularly close to water bodies. No significant effects are expected. Source: BirdLife International. 2021. *Pandion haliaetus*. The IUCN Red List of Threatened Species 2021: e.T22694938A206628879. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22694938A206628879.en. Accessed on 21 September 2022.
Pernis steerei Philippine Honey Buzzard IUCN status: LC National status: EN	This common endemic raptor species is listed as EN because of its inclusion in CITES Appendix II. It inhabits moist lowland and montane forest, with the latter considered of primary importance. An individual of this species was observed in Mariveles during faunal surveys carried out in the BCIB project area in 2021. Development of the BCIB project infrastructure will not require conversion of any lowland or montane forest and the risk to this species can accordingly be considered very low. No significant impacts are expected. Source: BirdLife International. 2016. *Pernis steerei*. The IUCN Red List of Threatened Species 2016: e.T22735356A95108828. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22735356A95108828.en. Accessed on 21 September 2022.
Pterocarpus indicus Narra (Burmese Rosewood) IUCN status: EN National status: VU	*Pterocarpus indicus* is a tropical hardwood whose native habitat is tropical montane forest and its success in the wild is threatened by logging. The species is widely planted as a live fence in the Philippines, well outside its native forest context and altitudinal range. Numerous instances of such plantings were recorded in Mariveles and Naic during floral surveys carried out in the project area in 2021/2022 and the tree in planted form was actually the dominant canopy species in some floral sampling plots. Given the absence of wild-grown *Pterocarpus indicus* in the immediate vicinity of the BCIB approach road sites, the risk to the species from the project can be considered very low. Some planted specimens may be removed to make way for the infrastructure but given that these are in effect an introduced species in the sites where they occur in the project area, the biodiversity significance of this loss can be considered negligible. Source: Barstow, M. 2018. Pterocarpus indicus. The IUCN Red List of Threatened Species 2018: e.T33241A2835450. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T33241A2835450.en. Accessed on 21 September 2022.
Pteropus hypomelanus Island Flying Fox IUCN status: NT National status: EN	This common fruit bat species is listed as EN under national legislation because of its inclusion in CITES Appendix II. Tolerant of human activity, *Pteropus hypomelanus*, in most parts of its range in the Philippines, roosts on small offshore islands and near coastlines but forages in agricultural areas on the mainland, particularly where orchards are found. The species was observed in Mariveles during faunal surveys in the BCIB project area in 2021. No roosting sites were noted anywhere in the vicinity of the alignment. Small portions of a number of mango and guava orchards (total area approximately 3.5 ha) will fall within the Bataan ROW and a further 1.9 ha is considered a possible staging area. These areas constitute a minor proportion of orchard area in the general landscape. However, it is acknowledged that the ecology of large fruit bats in the BCIB is poorly understood. Their roosting sites, commuting corridors, foraging sites and any migration patterns are not understood. Further, large bats may move large distances in a single evening and could easily cross the mouth of the Bay or fly across the alignment of the BCIB. Possible risks associated with direct mortality if bats fly close to the bridge or disturbance from increased light and noise could also affect the species local behaviors. Available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bat Management Plan. Tsang, S.M. 2020. *Pteropus hypomelanus*. The IUCN Red List of Threatened Species 2020: e.T18729A22081642. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T18729A22081642.en. Accessed on 21 September 2022.
Streptopelia dusumieri Philippine Collared Dove IUCN status: VU National status: EN	*Streptopelia dusumieri* is a species of open country, including grassland and agricultural land with trees and scrub. Introduced populations are found in urban areas, indicating high adaptability to dense human presence and activity. Individuals of this species were recorded in Naic during baseline faunal surveys in 2021/2022; although not recorded in Mariveles during the surveys, there is substantial suitable habitat there and presence would not be unexpected. Given the adaptability of this species and the abundance of suitable habitat in the wider landscape, development of the BCIB project area is unlikely to generate significant impacts but available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2018. *Streptopelia dusumieri*. The IUCN Red List of Threatened Species 2018: e.T22727533A132177741. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22727533A132177741.en. Accessed on 21 September 2022.

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Prescribed Mitigation. Significant adverse impacts are not expected for most species, primarily because most of the threatened species known to be present in the BCIB are highly mobile. Available data to inform this assessment is, however, limited and more information on the species' nesting sites, abundance, foraging sites, movement and vulnerability is required. This is particularly relevant to the Philippine Duck, the Philippine Collared Dove and the Island Flying Fox. These species will be subject to further consideration prior to construction as part of the Bird Management Plan and Bat Management Plan, respectively. An outline of the Management Plans' scope and contents is presented in the Appendices.

Bird monitoring must commence before construction starts to confirm which species fly close to the proposed BCIB area, their abundance and behavior, including any that may nest on Corregidor Island. Monitoring must begin before construction and continue for the duration of the construction works. The surveys will comprise vantage point and transect surveys, and will be completed at Bataan, Corregidor Island and Cavite four times a year. Surveys must be undertaken by professional bird surveyors with relevant experience.

Bat monitoring must commence before construction and continue for at least three years during construction to confirm the presence of bats that fly close to the proposed BCIB area, their abundance and behavior. Surveys will comprise vantage point surveys and potentially also thermal imaging surveys, and will be undertaken at Bataan, Corregidor Island and Cavite four times a year. Surveys must be undertaken by professional bat specialist with relevant experience.

Bird and bat monitoring data will inform the baseline and enable decisions regarding possible changes to the habitat planting and restoration plans (and relevant to construction impacts, lighting regime and working hours, program etc.). The management plans will help ensure that impacts to threatened species are avoided where possible and minimized where not to ensure that there are no significant impacts. The plans will confirm what actions will be required in the event that adverse impacts on any threatened species are recorded. The plans will proactively detail who will be responsible and accountable, when actions must be reviewed and whether any changes to the monitoring plan are required. The adaptive management program for birds will likely require a limited-term partnership between DPWH and a local NGO with strong avian expertise and technical capacity.

IMPACT SUMMARY					
Impact:	Impacts on threatened terrestrial species				
Direction:	Negative	Type:	Direct	Probability:	Likely
Duration:	Permanent	Scope:	Localized	Significance:	Unknown (likely to be low)
Mitigation:	• Development and implementation of a Bird Management Plan • Development and implementation of a Bat Management Plan				
Residual:	None expected				

5.2.1.11 Habitat Loss Impacts on Critical Habitat-Qualifying Species

Anticipated Impact. Seven terrestrial species, all birds, were identified as part of the Critical Habitat Assessment to trigger Critical Habitat thresholds (see report Annexes). The Critical Habitat Assessment used a precautionary approach given the poor availability of data and the scale and magnitude of the project’s potential effects on species. The assessment precautionarily used AoA instead of EAAA to determine regular occurrence and may therefore have included some species that would not usually trigger critical habitat. All species are relevant to the impact assessment but further data is required to confirm if they regularly occur in the Area of Influence and to refine the assessment and its conclusions. These species are listed in Exhibit 5-97, along with relevant information regarding their habitat requirements, probability of presence in the BCIB project area and the potential for the development of the project to result in losses of habitat necessary to their well-being. The Philippine Duck is both threatened and a critical habitat-qualifying species and thus makes a repeat appearance in Exhibit 5-97.

Exhibit 5-97 Potential for Habitat Loss Impacts on Critical Habitat-Qualifying Species

Species	Notes on Habitat Loss Impact Potential
Anas luzonica Philippine Duck IUCN status: VU National status: VU	*Anas luzonica* uses a range of coastal, riverine and wetland habitats, including mangroves, watercourses inside forests, ponds including fishponds and coastal lagoons. Its diet consists of fish, shrimps, insects, rice and young vegetation. Given its habitat requirements, *Anas luzonica* is very unlikely to be significantly affected by the development of the BCIB. Suitable habitat is limited, particularly in Bataan. Cavite offers better opportunities, particularly along the Timalan River and Timbugan Creek, which retain some mangroves and other riparian arboreal vegetation and offer potential feeding and nesting sites. There are also some inland fishponds along the lower reaches of the Timalan River and near the mouth of the Labac River which may be used by individuals of the species. Three individuals of *Anas luzonica* were observed feeding along the Timalan River near the Antero Soriano Highway crossing in 2022. Only one aquatic habitat feature will be impinged upon by the BCIB ROW in Cavite, where the northeast ramp extension of the Antero Soriano Highway interchange crosses the west branch of the Timalan River. This is an existing crossing which will be widened as part of the project; the widening would constitute a negligible loss of aquatic habitat potentially used by *Anas luzonica,* especially compared with the suitable habitat available elsewhere in the Bay. Since rice is known to feature in the diet of *Anas luzonica*, it bears mentioning that some rice paddies lie within the Cavite ROW and will be converted as part of the project's development. However, the loss of sub-optimum habitat has to be understood in the context of already-ongoing land use change in this area. All areas along the alignment are zoned for non-agricultural uses in the Naic CLUP and there are numerous residential and commercial development proposals already in process. Even if the BCIB were not built, the rice paddy area would be very unlikely to persist for long. Impacts through habitat loss and disturbance are expected but the magnitude of the impacts is likely to be very low or negligible. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Anas luzonica*. The IUCN Red List of Threatened Species 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 19 September 2022.
Calidris ruficollis Red-Necked Stint IUCN status: NT National status: -	A small migrant wading waterbird species that breeds in northern and northeastern Russia and winters in Southeast Asia and Australasia, *Calidris rufucollis* prefers coastal and intertidal mudflats, sheltered inlets, bays and lagoons across its winter range. It may also be found in freshwater, brackish and saltwater wetlands and is reported to use sandy beaches and rocky shorelines occasionally. Its main diet consists of insects, small invertebrates, molluscs, gastropods and crustaceans, plucked from exposed mud surfaces and very shallow water during low water. When feeding in saltmarshes, seeds and other plant material may also be included in the diet. Calidris ruficollis was found to be a critical habitat-qualifying species for Manila Bay as a whole, based on the numerical significance of the estimated wintering population in relation to estimated global population. Given this species' reliance on mudflats and other environments featuring sheltered, low gradient, periodically exposed aquatic substrate, it would not be expected as a frequent or numerous occupant of the BCIB project area and indeed was not documented in baseline faunal surveys conducted in 2021/2022. There are no mudflats in the immediate vicinity of the bridge landing sites. The shoreline in Mariveles and along Corregidor Island is predominantly rocky and the sandy beaches along the Naic shore are steep enough that only a relatively narrow band of sand is exposed during low tide. The shore habitats most likely to attract *Calidris ruficollis* and other small waders are the sandy bars around the mouths of minor local river estuaries (the Babuyan River in Mariveles and the Timalan River, Timbugan Creek and and Labac River in Naic) and muddy areas within these estuaries. None of these estuaries are expected to suffer modification as a result of the project's construction. The potential for the BCIB project to generate negative impacts on this species is therefore very low. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction.

Species	Notes on Habitat Loss Impact Potential
	Sources: (1) BirdLife International. 2016. *Calidris ruficollis*. The IUCN Red List of Threatened Species 2016: e.T22693383A93401907. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693383A93401907.en. Accessed on 19 September 2022.; (2) Source: Birdlife Australia. 2022. Red-necked Stint. https://birdlife.org.au/bird-profile/red-necked-stint. Accessed 19 September 2022.
Calidris subminuta Long-Toed Stint IUCN status: LC National status: -	This species is a small migrant wading waterbird which breeds in Russia and Mongolia and spends winters in Southeast Asia, Australasia and parts of South Asia. It is deemed a critical habitat-qualifying species for Manila Bay as a whole, based on the numerical significance of the estimated wintering population in relation to estimated global population. In its winter range, *Calidris subminuta* is typically found in shallow inland wetlands, around the edges of permanent and temporary lakes, ponds, reservoirs, lagoons, swamps, streams, river floodplains, marshes, rice paddies, sewage ponds and saltpans and less frequently around tidal estuaries and mudflats. Within any of these habitats, it requires soft, muddy shorelines and short grass, sedges, floating aquatic vegetation, reeds and rushes. The bird's diet consists of insects (notably carabid beetles), small gastropod molluscs, crustaceans, small amphibians and seeds. The exposed beaches within the BCIB project area do not offer suitable habitat for *Calidris subminuta* and indeed the species was not recorded in faunal surveys conducted along the shore (or anywhere else in the project area) in 2021/2022. The most likely candidate habitat areas nearby the BCIB alignment and works sites would be the assortment of fish ponds along the lower Timalan River and near the mouth of the Labac River in Cavite and possibly some limited sites within the estuaries of these rivers and nearby Timbugan Creek. As the BCIB infrastructure footprint will not impinge upon any of these locations, it is considered that the project is extremely unlikely to have any effect on *Calidris subminuta*. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction. Source: BirdLife International (2022) Species factsheet: *Calidris subminuta*. Downloaded from http://www.birdlife.org on 19/09/2022.
Charadrius alexandrinus Kentish Plover IUCN status: LC National status: -	A small migratory shorebird found mostly in coastal rather than inland environments, *Charadrius alexandrinus* tends to frequent sand, silt or dry mud surfaces and generally avoids exposed oceanic coastlines and rocky or broken ground. Typical habitats include sandy, pebbly or muddy shores, dunes, lagoons, marshes, coral limestone shores, estuaries and tidal mudflats. It may also use near-coastal sandy areas by brackish water bodies but does not commonly associate with freshwater. The species' diet consists mainly of insects and their larvae, spiders, gammarids, crabs and other crustaceans, brine shrimp, molluscs, polychaete worms and small pieces of seaweed. *Charadrius alexandrinus* was not recorded during faunal surveys carried out in the BCIB project area in 2021/2022. With their exposed rocky shores and paucity of inland brackish waters, the Mariveles and Corregidor Island portions of the project offer no suitable habitat for this species. The Cavite shore, which is sandy but exposed and without any mudflats, provides possible habitat that can be considered marginal at best. The most likely habitat for this species within the BCIB project area would be around the bars and inland shores of the estuaries of the Timalan and Labac Rivers. As none of these sites will be impinged upon by the BCIB infrastructure footprint, it is very unlikely that the project's development will have any effect on individuals of this species. The BCIB viaduct will cross the beach at the landing point but given the narrow footprint and marginality of the beach habitat for *Charadrius alexandrinus*, this is very unlikely to constitute a significant impact on the species. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction. Source: BirdLife International. 2019. *Charadrius 5-131lexandrines* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22727487A155485165. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22727487A155485165.en. Accessed on 20 September 2022.
Chlidonias hybrida Whiskered Tern IUCN status: LC National status: -	A cosmopolitan wetland migrant that breeds in China, Mongolia and Siberia (among other places), *Chlidonias hybrida* winters in Manila Bay and is deemed a critical habitat-qualifying species, based on the numerical significance of the estimated wintering population in relation to estimated global population. Several individuals of this species were observed feeding in open water off the Cavite coast during faunal surveys conducted in the BCIB project area in 2021. There is no evidence of a major concentration of the species in the project area. *Chlidonias hybrida* is found in various wetland habitats but is known to prefer freshwater marshlands. It may also use inland lakes, rivers, fish ponds, stormwater drainage ponds, swamps, river pools, reservoirs, large dams, sewage ponds, flooded saltmarshes, estuaries, coastal lagoons, mudflats and creeks amongst mangroves. Arable fields, pastures and rice paddies may also be visited for feeding. Its diet consists of terrestrial and aquatic insects, spiders, frogs, tadpoles, small crabs, shrimps and small fish. The species generally feeds from the air, by hovering and plunging for fish and other aquatic prey, skimming the water surface for insects on or just below the surface and taking insects on the wing over

Species	Notes on Habitat Loss Impact Potential
	wetland vegetation. The species most commonly forages in small groups or larger mixed-species flocks when on passage and in the winter. The Cavite portion of the BCIB project area offers a number of potential feeding areas for *Chlidonias hybrida*, including fish ponds along the lower Timalan and Labac Rivers, minor mangrove areas along the lower Timalan River and Timbugan Creek, the open estuarine waters of the Timalan and Labac Rivers, rice paddies and fields throughout the area and the open waters of Manila Bay. Given this variety of potential habitats, it is very likely that the species is quite dispersed across the landscape, rather than concentrated around or strongly dependent upon a particular environmental resource. This makes it very difficult to assess the significance of the BCIB project's development on the species. Most of the potential feeding areas listed, including all aquatic systems, will not be impinged upon by the infrastructure and no effect would be expected. An estimated 60% of the 21.2 ha of land within the Cavite ROW consists of fields, pastures and rice paddies and conversion of such areas does represent a potential loss of habitat for *Chlidonias hybrida* but this must be understood in the context of already-ongoing land use change. All areas along the alignment are zoned for non-agricultural uses in the Naic CLUP and there are substantial residential and commercial development proposals already in play. Even if the BCIB were not built, the fields and rice paddies within the ROW area would be very unlikely to persist. The species is also highly mobile and it is therefore unlikely to be subject to any direct impacts associated with the BCIB as it will avoid construction and the operational bridge. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction. Sources: (1) BirdLife International. 2017. *Chlidonias hybrida* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T22694764A111750380. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22694764A111750380.en. Accessed on 20 September 2022. (2) Birdlife Australia. 2022. Whiskered Tern. https://birdlife.org.au/bird-profile/whiskered-tern. Accessed 20 September 2022.
Himantopus himantopus Black-Winged Stilt IUCN status: LC National status: -	A mid-sized migrant wader, *Himantopus himantopus* is deemed a critical habitat-qualifying species for Manila Bay as a whole, based on the numerical significance of the estimated wintering population in relation to estimated global population. This species is typically found along the shores of large inland water bodies, estuaries, river deltas, coastal lagoons, shallow freshwater or brackish pools with extensive mudflats, salt meadows, salt pans, coastal marshes and swamps. Its diet consists mostly of adult and larval aquatic insects but may also include spiders, molluscs, crustaceans, oligochaete and polychaete worms, tadpoles and amphibian spawn, small fish, fish eggs and occasionally seeds. *Himantopus himantopus* rarely swims while foraging, preferring to wade in shallow water up to mid-chest and pluck its prey from at or near the surface with its long bill. *Himantopus himantopus* occupies relatively sheltered coastal sites with extensive shallows and habitats matching this description are in short supply in the BCIB project area. The species was not recorded during faunal surveys conducted in 2021/2022. If any individuals of *Himantopus himantopus* were to use habitat in the project area, the most likely candidate areas would be the estuaries of the Babuyan River (Mariveles) and Timalan River, Timbugan Creek and Labac River (Naic), as well as the sandbars at their mouths (especially the Labac River). As none of these sites will be impinged upon by the BCIB infrastructure, the risk to this species from the project's development can be considered negligible. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction. Sources: (1) BirdLife International. 2019. *Himantopus himantopus* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22727969A155440465. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22727969A155440465.en. Accessed on 20 September 2022. (2) Birdlife Australia. 2022. Black-Winged Stilt. https://birdlife.org.au/bird-profile/black-winged-stilt. Accessed 20 September 2022.
Pluvialis fulva Pacific Golden Plover IUCN status: LC National status: -	A small migratory shorebird, *Pluvialis fulva* is typically found in coastal areas and forages in coastal fields and prairies with short grass, ploughed fields, coastal freshwater pools, saltmarshes, beaches, open mudflats and sandflats and shallow and exposed reefs. This species' diet consists mainly of insects, spiders, molluscs, worms and crustaceans. *Pluvialis fulva* is deemed a critical habitat-qualifying species for Manila Bay, based on the numerical significance of the estimated wintering population in relation to estimated global population. Based on the preferred habitat types listed above, the BCIB project area offers quite limited habitat and the species was not recorded during faunal surveys conducted in the BCIB project area in 2021/2022. The places within the BCIB project area most likely to be frequented by *Pluvialis fulva* are the beaches of Cavite and especially the extensive sandbars around the mouth of the Labac River; lesser beach areas on the Mariveles coast (such as at the mouth of the Babuyan River) and the few sandy beaches of Corregidor Island and Caballo Islands may also be frequented. The only direct displacement impact of the project on sandy beach habitat will be at the landing point in Naic; this will consist of a narrow traverse of the beach at this location and can

Species	Notes on Habitat Loss Impact Potential
	be considered an insignificant potential source of impacts on this species, if it were to be present. Existing residential and commercial development inland from the Cavite coast limits the probability of *Pluvialis fulva* moving inland to feed in fields and pastures, if it were to use the beaches. As a precaution, this species will be subject to the monitoring requirements of the Bird Management Plan. The species will therefore be subject to further consideration prior to construction. Source: BirdLife International. 2019. *Pluvialis fulva* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22693735A155529922. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693735A155529922.en. Accessed on 21 September 2022.

Prescribed Mitigation. The required mitigation for Critical Habitat species has been described above in relation to the threatened species assessment, and does not need to be repeated here. Outlines of the scope and contents for the Bird and Bat Management Plans are presented in the Appendices.

The Bird Management Plan monitoring results will be used to inform an update of the Critical Habitat Assessment and any adaptive management requirements. If a species no longer triggers Critical Habitat, no further action will be required. If a species continues to meet the IFC PS6 thresholds for Critical Habitat, additional conservation actions will be required to ensure the BCIB achieves a Net Gain in conservation value for each relevant species. Measures to achieve a Net Gain will be developed and implemented under the auspices of the Biodiversity Action Plan. Possible impacts on these critical habitat-qualifying species from expected construction activity will be considered later.

IMPACT SUMMARY					
Impact:	Loss of habitat for critical habitat-qualifying species				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Permanent	Scope:	Localized	Significance:	Unknown (likely to be low)
Mitigation:	• Development and implementation of a Bird Management Plan • Development and implementation of a Biodiversity Action Plan				
Residual:	None expected				

5.2.1.12 Enhanced Exploitation Risk to Critical Habitat, Protected Areas & KBAs

Anticipated Impact. Improvement and expansion of road networks inevitably entails improved access to the areas served, whether as a matter of enhanced spatial penetration, growth in overall trips, opportunities for access by larger vehicle classes, or reduction in travel time. Where road network improvements improve access to areas with vulnerable natural resources, increased and possibly unsustainable exploitation in those areas may be expected to emerge as an indirect impact of road development. Illegal and under-regulated logging and mining are significant problems enabled by roads, as is informal settlement. The potential for increased exploitation of forest resources to arise in the case of the BCIB project is considered here.

In both Bataan and Cavite, the BCIB project will be built in areas that have been significantly modified by agricultural, urban, industrial and residential development but in each case, there are substantial forested areas nearby the project infrastructure (Bataan) and nearby some of the roads that will connect with the project infrastructure (in both Bataan and Cavite). The importance of these forested areas is reflected in statutory (protected area) and non-statutory (key biodiversity area) designations.

Bataan. On the Bataan side, the upper and middle slopes of Mt. Mariveles remain mostly forested (significant areas of natural grassland are also present) and the biodiversity values of the forests there are recognized by their inclusion in the Mariveles Mountains KBA. The southern edge of the Mariveles Mountains KBA was determined to qualify as a critical habitat element under Criterion 4, Threshold (b). The Mariveles Watershed Preserve, to the north of Mariveles town, partially overlaps with the KBA. Apart from the Mariveles Watershed Preserve, most of the forest area in the KBA has no statutory protection and can be considered to have been protected mainly by private and community property rights and by the physical challenges that have to be surmounted in order to exploit natural resources: steep slopes and lack of roads.[103]

The BCIB project is expected to result in a significant increase in traffic on the Roman Highway but the project does not include any investment in the road's capacity or in improving or expanding related feeder roads. As such, the project cannot be expected to directly improve physical access to areas outside the Roman Highway corridor, for would-be loggers, miners or settlers. However, it is likely that the induced development effect of the BCIB project will accelerate land development in the Roman Highway corridor; around the north side of Mariveles town; and perhaps also along the Mariveles–Bagac Road corridor. Such development may eventually entail improvement and expansion of local roads, including in the areas uphill of the main road corridors. Steep slopes will remain as a significant constraint on development, including road-building and construction of housing or industrial estates but the spread of informal settlements on the periphery of newly developed areas is a significant probability.

Informal settlement is by definition not subject to zoning bylaws and governmental environmental review in relation to land capability and this can be considered to pose a long-term risk to biodiversity resources uphill from the Roman Highway corridor in particular, within Mariveles and Limay municipalities. The growth of Mariveles town and Alas Asin village, which may reasonably be expected to accelerate after the BCIB comes into operation, is likely to entail some northward spread of unplanned and informal settlement. Increased tourism development potential on the western side of the Bataan peninsula is among the hoped-for outcomes of the BCIB project and lands along and uphill from the Mariveles–Bagac Road, which serves this area, could be expected to come under at least some increased conversion pressure in a minimum scenario—and extensive conversion in a worst case scenario—including from unplanned settlement, over the long term. Indirect induced habitat loss and degradation facilitated by the BCIB could feasibly result in significant adverse impacts to the structure and function of the Mariveles Mountains KBA, a Critical Habitat.

Cavite. On the Cavite side, the nearest significantly forested area remaining is in the hills along the border between western Cavite and northern Batangas. This area is protected within the Mts. Palay-Palay Mataas na Gulod National Protected Landscape. The northern coastal portion of the protected landscape was determined to qualify as a critical habitat

[103] The reference to community property rights here pertains to indigenous communities, which are granted communal ownership of ancestral land under the Indigenous Peoples' Rights Act of 1997 (RA-8371). Part of the area within the Mariveles Mountains KBA, on the eastern flanks of the volcano and mostly in the Municipality of Limay, is covered by a Certificate of Ancestral Domain Title (CADT R03-LIM-1215-196), held by the Ayta Magbukún indigenous community.

element area under Criterion 4, Threshold (b), although it is acknowledged that the precautionary principle was used to arrive at the determination. The southwest portion of the protected landscape, where the most complete forest cover is to be found, is designated as a KBA (Mts. Palay-Palay Mataas na Gulod National Park KBA).

The Mts. Palay-Palay Mataas na Gulod National Protected Landscape is bisected by the Ternate–Nasugbu Highway, a two- to four-lane paved secondary road completed in 2013. The BCIB project can be expected to result in a minor increase in traffic on this highway but will not do anything to improve the road or enhance the development of feeder roads. There is little reason to conclude that a minor traffic volume increase on an existing road will entail increased activity by logging or mining interests. Increased traffic volume could theoretically create incentives for informal settlement linked to opportunities to provide services to road users but the volume increase attributable to the BCIB is very unlikely to be large enough to make a significant impact in this regard (much more significant volume increases are likely to come from the westward expansion of urban and industrial development in Cavite, independent of the BCIB project). Land use in this area, which is mostly 15–25 km from the Cavite terminus of the BCIB project, will depend mostly on enforcement of the zoning provisions in the management plan for the Mts. Palay-Palay Mataas na Gulod National Protected Landscape. It can be considered unlikely that the BCIB project would contribute to development pressure in this area, at least in the medium term, as there is no logical demand factor (e.g., interest from would-be commuters or tourism operators) created by the creation of a transport link to an area of low population density such as Bataan. Improved access from Metro Manila and rapidly growing eastern Cavite (not an effect of the BCIB project) would be expected to have a much stronger effect on development pressure in far western Cavite and northern Batangas. No likely significant impacts are expected on this Critical Habitat.

Interprovincial commodity market effects. It is possible that reducing travel time between Bataan and Cavite could lower the cost-to-market for timber and minerals extracted in the Mariveles Mountains KBA and probably to a much lesser extent for the Mts. Palay-Palay Mataas na Gulod National Protected Landscape area, which is already within the orbit of the CALABARZON industrial heartland. Such a change in price-to-market could in turn drive increased extraction pressure. Quantifying this possible effect is a matter for detailed commodity market analysis and is fraught with uncertainties. For the purposes of this EIA, it can be assumed that the probability of such an effect is high enough to justify long-term monitoring of the threat to the Mariveles Mountains KBA.

Other protected areas and KBAs. In addition to the protected areas and KBAs discussed above, which are nearby the BCIB project area, two other natural areas were determined by the critical habitat assessment to qualify as critical habitat: the sea-proximate fringe of the Manila Bay KBA and the Las Piñas-Parañaque Ecotourism Area (LPPCHEA). Neither of these areas is in a position to experience any effects at all from the BCIB project's development; the Manila Bay KBA is at the head of the bay and 32 km from the BCIB alignment at its nearest point and the LPPCHEA is off the Metro Manila waterfront, 27 km away from the closest part of the project alignment.

Prescribed Mitigation. In view of the above discussion, proactive mitigation is justified to manage enhanced exploitation threats to the main forest areas of the Mariveles Mountains KBA. Given the high uncertainty regarding the level and timeframe of risk, a monitoring and adaptive management approach is appropriate to better understand the baseline and the threats, which will together inform the most appropriate action.

Under IFC PS6 all Critical Habitat must be subject to a Biodiversity Action Plan that will achieve a Net Gain in the receptor's conservation status. An action program is therefore proposed under the auspices of the project's BAP (see report Annexes), entailing establishment of a formal multi-stakeholder partnership to implement a long-term monitoring program and develop such controls on access, land use and resource extraction as may prove necessary based on the detected evolution of the threat. The BAP will outline measures to achieve a Net Gain. This measure shall apply to the forest areas of Mariveles Mountains KBA, within the municipalities of Mariveles and Limay.

Several protected areas trigger Critical Habitat. They will all be subject to actions in the BCIB's BAP. The BAP will achieve a Net Gain in their conservation statuses. The Critical Habitat Assessment is subject to reassessment following the receipt of updated data for various receptors. The final BAP will focus on those receptors that are confirmed to trigger Critical Habitat.

IMPACT SUMMARY					
Impact:	Enhanced exploitation risk for key biodiversity areas and protected areas				
Direction:	Negative	Type:	Indirect	Probability:	Almost Certain
Duration:	Long term	Scope:	Widespread	Significance:	Unknown
Mitigation:	• Adaptive monitoring and management program implemented by formal multi-stakeholder partnership, under auspices of a Biodiversity Action Plan, to achieve a Net Gain in the conservation status of all protected areas that trigger Critical Habitat, particularly Mariveles Mountains KBA				
Residual:	Possible but difficult to predict (dependent on numerous long-term variables)				

5.2.1.13 Impacts on Other Terrestrial Critical Habitat-Qualifying Elements (Mangroves)

Anticipated Impact. Terrestrial habitat types identified as critical habitat elements under Criterion 4, Threshold (b) include mangroves and mudflats. There are very limited mangrove areas within or nearby the BCIB project area and most of those present are beyond the reach of likely project impacts. The exceptions are (1) the patches of mangrove habitat found along the Babuyan River estuary in Mariveles; (2) sparse growth of arboreal mangrove species along the rocky shore in the general vicinity of the Mariveles landing site; and (3) patches of mangrove vegetation along the estuaries of the Timalan River and Timbugan Creek in Naic. None of the mangrove areas mentioned is in a position to be directly affected by the planned placement of the BCIB infrastructure, despite their proximity. The principal risk to these mangroves is possible hydrological and water quality impacts on the Babuyan River, Timalan River and Timbugan Creek from road surface runoff. There are no mudflats anywhere in the BCIB project area, so this critical habitat type is not at risk from the project's development. No significant adverse impacts are expected.

Prescribed Mitigation. No mitigation is needed in relation to placement of the infrastructure footprint; design-driven mitigation of water quality impacts on mangrove habitat in close proximity to the infrastructure is discussed in Chapter 6.

As both mangroves and mudflats trigger Critical Habitat, they will be subject to actions in the BCIB's BAP. The BAP will achieve a Net Gain in their conservation statuses. The Critical Habitat Assessment is subject to reassessment following the receipt or updated data (for various receptors). The final BAP will focus on those receptors that are confirmed to trigger Critical Habitat.

IMPACT SUMMARY					
Impact:	Loss of terrestrial critical habitat elements				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• Development and implementation of a BAP to achieve a Net Gain in the conservation status of any habitat that triggered Critical Habitat.				
Residual:	None expected				

5.2.1.14 Proliferation of Invasive Species

Anticipated Impact. Road development—particularly in the case of newly opened alignments—may have significant potential to facilitate the spread of invasive floral and faunal species, by four primary mechanisms. First, the opening of a new road alignment may create a new low-effort pathway for mobile animals to penetrate previously inaccessible or ecologically hostile areas. Second, development of new roads—and changes to traffic volume and composition on existing roads—may entail inadvertent importation of seeds and other plant material, as well as rodents, snakes and other small animals in cargoes. Third, careless selection of plant species and the import of new soil for use in roadside landscaping may lead to invasive plant species being directly introduced to the local environment. And fourth, roadway maintenance activity (particularly mowing) may enhance the spread of invasives already present, by dispersing seeds and other plant material from one maintenance site to others. Of the four mechanisms outlined, only the third is likely to be of any significance in relation to the BCIB approach roads.

The degree of prior ecological modification in a new or expanded road's landscape is a key determinant in the potential severity of invasive species impacts. Habitats fragmented by human land uses typically already offer easy access by mobile wildlife and already consist mostly of edge habitat and so are less vulnerable to the effects of invasion than newly opened interior habitats. Areas that already feature other roads are likely to have been already exposed to the plant materials and live animals that may hitch a ride on vehicles and thus be less likely to suffer severe new consequences from typical 'hitchhiker' species. The environments in which the BCIB approach roads will be built are highly fragmented and also crisscrossed by a number of existing roads.

New traffic stream introduced by the BCIB is not likely to differ in composition from that already plying the Roman Highway and Antero Soriano Highway and this suggests that a new heightened level of invasion risk is unlikely either in Bataan or Cavite. Although separated by 21 km of water, Bataan and Cavite are both part of the same island land mass and have substantially similar flora and fauna. Of the nine invasive plant species identified in baseline floral surveys of Mariveles and Naic, for example, seven were recorded in both locations and it can be considered extremely likely that the other two species (both commonly planted timber species) would be found in both places without much additional survey work. Both the Bataan and Cavite portions of the BCIB project area are already well connected to other distant regions, including each other and it is unlikely that the opening of a new road corridor between them will engender significant new flows of novel genetic material.

Roadside plantings have significant potential to lead to the proliferation of species that, while they may serve a useful ornamental or functional purpose in a road ROW, cause ecological harm when they reproduce in their new ecological setting. It has been shown, for example, that Mahogany (*Swietenia macrophylla*), an introduced species widely used in the Philippines and elsewhere for reforestation and even ecological restoration, has invasive properties linked to its ability to chemically suppress growth of more ecologically desirable native plant species.[104] Without thoughtful selection of floral species and the careful management of soil for use in embankment protection in the BCIB ROW, the project could contribute to the further erosion of Philippine biodiversity.

Mowing and other roadside maintenance activities are unlikely to be significant concerns in relation to the approach road environments, because of the limited scale of the roadways (any equipment used in maintenance will not travel far). Mowing of embankments is not anticipated.

Prescribed Mitigation. Based on the above discussion of risks, the most appropriate preventive mitigation will be ensuring that only native plant species are used in revegetation of the BCIB ROW and any associated habitat set-asides. Eight of the 10 most planted tree species in reforestation and ecological restoration initiatives in the Philippines, including those under the National Greening Program, are in fact introduced species.[105] Such commonly used species may be tempting candidates for soil stabilization and habitat restoration post-construction, not least because of ready availability and familiarity to landscaping contractors. In this context, a conscious effort is required to ensure that introduced species are not adopted as a default option. Accordingly, exclusive use of native species is indicated in construction specifications, and also prescribed as a measure in the EMP, which includes a dedicated Terrestrial Invasive Species Management Plan. The scope and contents of which are presented in the appendices.

IMPACT SUMMARY					
Impact:	Spread of invasive species				
Direction:	Negative	Type:	Direct/indirect	Probability:	Low
Duration:	Long-term	Scope:	Widespread	Significance:	Low
Mitigation:	• Development and implementation of a Terrestrial Invasive Species Management Plan				
Residual:	Probable but difficult to predict				

5.2.1.15 Physical Impacts on Significant Natural Visual Resources

Anticipated Impact. The VIA conducted for the EIA study (see report Annexes) identified numerous significant natural visual resources that contribute to the character of the landscape. These key terrestrial visual resources include Mt. Mariveles, Mt. San Miguel, Corregidor and Caballo Islands and the forested hills of western Cavite and northern Batangas and the islands and coves of the Five Fingers coastal area. None of these significant resources will be impinged upon or subject to direct degradation by development of the BCIB project. There are no outstanding cultural visual resources, e.g., idiosyncratic historical land use patterns, in the BCIB project area. Potential for impacts on the visual experience of viewers of the landscape, as opposed to physical impacts on the visual resources themselves, is discussed in Chapter 8.

[104] Galano, J.B. and L.J.V. Rodriguez. 2021. Exotic Mahogany Leaf Litter Hinders Growth of Philippine Native Tree Seedlings. Proceedings of the National Institute of Ecology of the Republic of Korea 2(2): 76–81.
[105] Ibid.

Prescribed Mitigation. No mitigation is necessary.

IMPACT SUMMARY					
Impact:	Destruction or degradation of key visual resources				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Permanent	Scope:	Localized	Significance:	Moderate
Mitigation:	• None prescribed				
Residual:	None				

5.2.1.16 Impacts on Physical Cultural Heritage

Anticipated Impact. New infrastructure may displace, impinge upon or otherwise physically degrade physical cultural heritage such as historic buildings, ruins, sacred sites, artifacts and monuments. Even without direct physical effects, infrastructure built in close proximity to elements of physical cultural heritage that are visited by members of the public may significantly impair access, aspects of the visitor experience such as tranquility and the general character of the site. There are no known physical cultural heritage sites in a position to be affected by development of the BCIB project in either Mariveles or Naic. There are numerous highly valued heritage sites on Corregidor Island but as the project will not impinge on the island at all, these will all be safely out of range of potential impacts.

Prescribed Mitigation. No mitigation will be required.

IMPACT SUMMARY					
Impact:	Displacement or degradation of physical cultural heritage or use and appreciation thereof				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• None prescribed				
Residual:	None expected				

5.2.2 Construction Phase Impacts and Mitigation

Construction impacts are those impacts which occur as a direct or indirect result of construction activity and which are subject to mitigative actions that can be implemented by the contractors performing the construction work. Planning for mitigative action will typically and appropriately take place in the period immediately leading up to the start of construction but mitigation will generally be implemented in parallel with construction activity.

5.2.2.1 Vegetation Clearance Impacts

Anticipated Impact. The process of clearing vegetation pre-construction can directly kill animals, particularly less mobile species and species that naturally hide or stay still when threatened. It may also disturb species and force them to move off site. Some species could be forced to congregate in small, isolated remnants of sub-optimum habitat, especially species with limited mobility, e.g. reptiles and amphibians. Vegetation clearance will also reduce the number and extent of available refugia and foraging habitat in the area. Construction related disturbances may further discourage species from nesting, roosting or foraging in habitat close to the construction area, particularly increases in noise. Over time this could affect the local population's ability to reproduce and therefore sustain a viable population. The magnitude of any such effects is, however, likely to be low, localized and only affect common and widespread species.

Prescribed Mitigation. It is best practice to minimize the killing and disturbance of species when clearing habitat. All works must therefore be completed under the guidance of a Habitat Clearance Management Plan. The Plan will be developed by professional ecological professionals with at least 15 years' experience with wildlife management on construction sites. It will be approved by the CSC when the project starts and implemented whenever any habitat is cleared or managed throughout the construction phase and prior to site abandonment. A sample outline for a Vegetation Clearance Management Plan is included in Appendix B to the EMP.

The Plan will detail how all grass, scrub and shrubs will be trimmed initially to a minimum height of 20 cm and left for at least 24 hours, to allow animal species to naturally move out of the area. After the 24-hour period the remainder of any vegetation can be cleared, if needed. Ideally, grass is maintained on the construction sites, albeit, with a short sward to ensure continuous vegetation throughout construction. All trees will be soft felled and all works will be completed outside the breeding bird season.

IMPACT SUMMARY					
Impact:	Wildlife mortality from vegetation clearance				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Long-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs to prepare and implement Habitat Clearance Management Plans				
Residual:	Expected but low				

5.2.2.2 Habitat Loss and Degradation (Staging Areas)

Anticipated Impact. Use of land for construction staging purposes will involve various levels of intensity and hence variable potential for degradation of pre-existing biodiversity values but most staging area uses can be expected to result in near-total loss of habitat over those parts of the site that are actively used. Staging areas are by nature temporary sites and impacts can be largely reversed by subsequent restoration and natural regeneration.

Staging Area 1 in Bataan, the casting yard and drydock facility, will occupy a property that is currently being quarried and is not expected to have much vegetation left by the time works on the BCIB begins. No adverse impacts on habitats with a high nature conservation value are expected at this site. Staging Area 2 in Bataan will occupy an area characterized by grassland which includes some natural grassland habitat, albeit degraded; use of this undulating site for steel storage and worker camps is likely to require earthworks and terracing, removing most trees and other vegetation over an area of approximately 30 ha. This will result in an adverse impact that is reversible. The Cavite staging area (Uniwide site) was at one time subdivided and prepared for residential development and is criss-crossed by an extensive network of wide paved roads and concrete curbs and drains. The site is 86.7 ha and will not require much modification before use, although many small and medium-sized trees may have to be removed. Trees to be removed during clearing of staging sites will be subject to replacement requirements under national law. No adverse impacts on habitats with a high nature conservation value are expected at this site but the loss of trees will result in an adverse impact.

Prescribed Mitigation. Where staging areas must be set up on previously undeveloped land, degradation of habitat and ecosystem services can be minimized by arranging internal site layouts to avoid conversion of natural features such as large trees, wooded areas, riparian habitat and bird nesting and roosting areas. A vegetated buffer should be preserved around all watercourses (10 m each side as measured from top of bank) wherever feasible, including intermittent and seasonal streams. Any steeply sloped portions of the site should be left in a natural state to prevent emergence of erosion problems. All natural site features to be preserved should be fenced off to help ensure that they remain off-limits to all construction-related activity, including materials stockpiling, equipment parking, spoils disposal and use by workers. All workers on site, especially heavy equipment operators, should be educated regarding the reason for the fencing and the requirement to respect it as a hard boundary.

Each contractor responsible for setting up a staging site will be required to apply for a tree-cutting permit from the local-level DENR offices (CENROs) of Mariveles and Naic for the expected removal of trees from within the respective ROWs. Appropriate locations for compensatory tree-planting will be determined through discussion between the contractor and the CENROs, in consultation with community stakeholders as needed.

At the end of the construction phase, staging areas must be properly decommissioned and rehabilitated, including removal of all equipment, materials, residues and wastes; remediation of any soils contaminated by leaks and spills of hydrocarbons from heavy equipment use, maintenance and refueling; reinstatement of stable slopes; and establishment of vegetative cover using native species to prevent emergence of erosion problems. These actions shall be formulated and specified by the relevant contractor in a Staging Area Rehabilitation Plan, to be approved by the CSC at the time of site setup and implemented prior to site abandonment. A sample outline for a Staging Area Rehabilitation Plan is included in Appendix B of the EMP. The staging areas will be set up on land leased from private owners and the landowner will have the right via the terms of lease to give the Contractor alternative instruction in the event that the land is destined to be developed directly for a particular use.

IMPACT SUMMARY					
Impact:	Degradation of habitat and ecosystem services on staging area sites				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Medium term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs to arrange staging area layout to minimize area used, maintain riparian vegetation, preserve significant features (large trees, wooded areas, etc.) and avoid use of steeply sloped areas • Relevant PC to apply for tree-cutting permit and implement compensatory plantings as stipulated by DENR under the conditions of permit approval • PCs to prepare a site-specific Staging Area Rehabilitation Plan, for review and approval of the CSC and fully implement all measures prior to site abandonment				
Residual:	Expected but not significant if rehabilitation is competently executed				

5.2.2.3 Habitat Degradation Outside Works Areas

Anticipated Impact. Habitat outside the works and staging sites may be degraded if construction and construction-related activities are allowed to spill over onto adjacent lands, or if workers enter adjacent lands for purposes of hunting, gathering, lounging, relieving themselves, cooking and so on. Vegetation may be trampled, wildlife may be scared away or depleted and fuelwood species may be excessively exploited.

Prescribed Mitigation. To prevent spillover onto adjacent lands and habitats, the ROW boundary and the boundaries of all associated works sites must be demarcated with substantial and durable fencing; this must be kept well maintained for the duration of the construction phase. Transgression of site boundaries for any purpose, including equipment maneuvering, equipment parking, materials storage, or any personal worker uses such as hunting, gathering, lounging, etc. must be strictly prohibited. Various management plans, as summarized in Appendix B to the EMP will also control and minimize potential indirect affects off-site (e.g., the Soil Erosion Prevention and Runoff Management Plan and the Hazardous and Noxious Materials Management Plan).

IMPACT SUMMARY					
Impact:	Habitat degradation outside works areas				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Medium term	Scope:	Localized	Significance:	Low
Mitigation:	• PCs to fence all work sites with durable and visible fencing and maintain it for the duration of works • PCs to train equipment operators to respect boundary fencing • PCs to prohibit all workers and subcontractors from conducting any work, including materials storage and equipment parking, outside site boundaries • PCs to prohibit workers from going outside site boundaries for any personal activity				
Residual:	None expected				

5.2.2.4 Dust Deposition in Habitat Outside Works Areas

Anticipated Impact. If dust generated on works sites is not controlled, substantial dust deposition may occur outside the site boundaries. Vegetation may suffer impaired photosynthesis, respiration, pollination and fruiting and local watercourses may see significant water quality declines due to siltation and sedimentation. Many of the BCIB sites will be active over a 3–4 year period, so these may not just be transient effects. Dust will be generated from handling of soils and other materials, movement of vehicles and stockpiles of fine materials left exposed to the wind. Dust generation tends to be most prodigious during the dry season but can be a significant problem even during the rainy season, as surfaces may dry out quickly and produce substantial dust even during a single dry afternoon.

Prescribed Mitigation. Dust suppression must be aggressively implemented on all sites where significant dust generation occurs, including both active work sites and staging areas. The most practical means of dust suppression in most contexts is regular light spraying; to be effective, the spraying regime should be tailored to prevailing conditions and stepped up as needed during dry days and times when dust generating activity is particularly intense. Stockpiles of fine materials such as sand and soil and even gravel if it has a lot of fines in it, should be kept well covered with tarpaulins whenever they are not in active use to prevent the entrainment by winds. Alternatively, three-walled storage bunkers with sides at least 2 m taller than the top of the stored material may be used; this is especially practical for sites where large volumes of fine material are routinely stored and accessed. Each PC shall prepare a site-specific Dust Control Plan for review and approval by the CSC prior to the start of works; a sample outline for such a plan is provided in Appendix B of the EMP.

IMPACT SUMMARY					
Impact:	Dust deposition in habitat outside works areas				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs to implement regimen of light spraying of dust-generating surfaces to suppress dust • PCs to keep stockpiles of fine and otherwise dusty materials covered with tarpaulins whenever not in active use, or in 3-walled storage bunkers with walls at least 2 m higher than top of material stored • Each PC to prepare a site-specific Dust Control Plan for review and approval by the CSC prior to the start of works				
Residual:	Expected due to difficult in controlling impacts but minor				

5.2.2.5 Construction Impacts on Threatened Terrestrial Species

Anticipated Impact. The habitat requirements and vulnerabilities of nine threatened avian species, one threatened bat and one threatened tree species were reviewed earlier (Exhibit 5-96) in relation to potential for impacts from loss of habitat taken for development of the BCIB project. None of the species evaluated were considered at significant risk from habitat loss, although there is insufficient quality data to be confident with the assessments for the Philippine Duck, the Philippine Collared Dove and the Island Flying Fox. These three species will be subject to more monitoring and analysis. The 11 threatened species are evaluated again in Exhibit 5-98, this time in relation to construction activity, including noise, light and movement disturbances.

Exhibit 5-98 Potential for Construction Impacts on Threatened Species

Species	Notes on Impact Potential
Anas luzonica Philippine Duck IUCN status: VU National status: VU	*Anas luzonica* uses a range of coastal, riverine and wetland habitats, including mangroves, watercourses inside forests, ponds including fishponds and coastal lagoons. Its diet consists of fish, shrimps, insects, rice and young vegetation. The species is known to be present in the BCIB project area; three individuals were observed feeding along the Timalan River upstream from the Antero Soriano Highway bridge during a faunal survey in 2022. *Anas luzonica* would also be expected to use similar habitat along other watercourses nearby, including Timbugan Creek and the Labac River, as well as fish ponds near the mouths of the Timalan River and Labac River and rice paddies further inland, including along the main alignment and around the interchange site. The species was not observed on the Bataan side and there is far less suitable habitat available there but it is possible that the small mangrove area along the lower Babuyan River may be used on occasion. Construction works within the ROW in Cavite may have a disruptive effect on habitat use by *Anas luzonica* in the west branch of the Timalan River, where an existing bridge will be replaced with a wider one and where the river runs nearby the south side of the interchange site. Noise, visual disturbance and possible water quality impacts would be the operative factors. *Anas luzonica* was not observed in this branch of the river and baseline aquatic surveys indicate very poor habitat quality due to heavy sewage inputs from nearby residential subdivisions, so probability of presence there is deemed very low. Activity on the Cavite staging area (Uniwide site) might be expected to limit the continued use of the east branch of the river by *Anas luzonica*, due to noise and disturbance. On the Bataan side, the principal potential effect of works (if the species were to be present) would be noise and visual disturbance around the viaduct landing site and terminal embankment works but as the Babuyan River estuary is at about 100 m from these work sites, the impact would be slight. *Anas luzonica* is an adaptable species quite tolerant of the presence of human activity (as evidenced by its presence in the highly disturbed Timalan River and reliance on rice paddies and fish ponds for habitat). This suggests that the proximity of works as discussed above is unlikely to result in a severe disruptive effect on individuals of this species. Provided that water quality impacts that may affect feeding success are effectively mitigated, the probable impact are likely to be very low or negligible. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Anas luzonica*. The IUCN Red List of Threatened Species 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 19 September 2022.

Species	Notes on Impact Potential
Accipiter gularis Japanese Sparrowhawk IUCN status: LC National status: EN	*Accipiter gularis* is a migrant raptor that does not breed locally and feeds on passerine birds, as well as bats, insects and rodents. Given that development of the BCIB project will not affect the hawk's breeding sites and that the bird is highly mobile and it's diet is varied and distributed, it is exceedingly unlikely to be adversely affected. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International (2022) Species factsheet: *Accipiter gularis*. Downloaded from http://www.birdlife.org on 19/09/2022.
Bolbopsittacus lunulatus Guaiabero IUCN status: LC National status: EN	This parrot species inhabits lowland forest and nearby cultivated areas and its diet consists primarily of fruit; guava orchards are favored anthropogenic habitats. Small portions of a number mango and guava orchards (total about 1.9 ha) is within properties under consideration as staging areas in Bataan. These areas constitute a minor proportion of orchard area in the general landscape. No fruit trees are expected to be affected by development of staging areas on the Cavite side. The species is tolerant of human activity, which suggests that disturbance effects from construction works are unlikely to have a significant effect on the behavior or general well-being of individuals. No significant impacts are anticipated but the available data to inform this decision is limited. The species will therefore be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Bolbopsittacus lunulatus*. The IUCN Red List of Threatened Species 2016: e.T22684914A93051249. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22684914A93051249.en. Accessed on 19 September 2022.
Haliaeetus leucogaster White-Bellied Sea Eagle IUCN status: LC National status: EN	This resident raptor species is typically found along coasts and around islands and may be observed over open water, in estuaries and mangrove areas and in sea-proximate woodlands. It may also use terrestrial wetlands. *Haliaeetus leucogaster* nests in trees and on rocky outcroppings and feeds on a wide range of prey, including fish, reptiles, other birds and small mammals, as well as carrion. The rugged wooded coastline of Corregidor Island and to a much lesser extent parts of the south Mariveles Coast (such as the lower reaches of the Babuyan River valley) would appear to offer the most favorable habitat in the BCIB project area. *Haliaeetus leucogaster* was recorded along the Tail End of Corregidor Island during faunal surveys in 2022. There is no evidence to suggest that the species is nesting on Corregidor Island or in close proximity to the BCIB so the project's effects are likely to be limited to indirect effects, including increased noise, light and movement disturbance. This species is, however, known to be tolerant of proximity to people and to use resources associated with human activity, including fish pens and garbage dumps. Given this and as the bird is highly mobile, any disturbances are unlikely to adversely affect the species conservation status so no significant impacts are anticipated. The available data to inform this decision are, however, limited and as such the species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2020. *Haliaeetus leucogaster* (errata version published in 2022). The IUCN Red List of Threatened Species 2020: e.T22695097A216253643. Accessed on 20 September 2022.
Haliastur indus Brahminy Kite IUCN status: LC National status: EN	Generally associated with coasts and inland wetlands, this resident raptor species feeds largely on carrion, particularly dead fish and crabs but also hunts, fishes and steals from other predators. There is no evidence to suggest that the species is nesting with the ROW or near the BCIB so the project's affects are likely to be limited to indirect effects, including increased noise, light and movement disturbance. As the bird is highly mobile any such affects are unlikely to adversely affect the species conservation status so no significant impacts are anticipated. However, the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. Haliastur indus. The IUCN Red List of Threatened Species 2016: e.T22695094A93489054. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22695094A93489054.en. Accessed on 20 September 2022.
Lonchura oryzivora Java Sparrow IUCN status: EN National status: EN	*Lonchura oryzivora* is a highly adaptable introduced species capable of thriving even in urban settings, including Metro Manila. Individuals of this species are extremely unlikely to suffer any significant impact from construction noise or visual disturbance. The species has been recorded in the BCIB project area but given the ready availability of suitable habitat in the vicinity, conversion of potential habitat for staging areas is unlikely to be of any consequence. Source: BirdLife International. 2021. *Lonchura oryzivora*. The IUCN Red List of Threatened Species 2021: e.T22719912A183133210. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22719912A183133210.en. Accessed on 21 September 2022.
Pandion haliaetus Western Osprey	This resident raptor species is found around shallow waters, from which it derives its main diet of live fish. Nests are typically found in tall exposed trees near water. The species is tolerant of human proximity and is

Species	Notes on Impact Potential
IUCN status: LC National status: EN	sometimes found in water-proximate suburban and urban environments. *Pandion haliaetus* was recorded along the east coast of Corregidor Island during faunal surveys conducted in the BCIB project area in 2022. Given the known adaptability of *Pandion haliaetus* to the built environment, it is very unlikely that individuals of the species will experience significant disturbance effects from construction activity. No nests or roosts are known in the Project area and the construction disturbances are unlikely to adversely affect foraging behaviors given the extent of suitable foraging habitat in the wider landscape. No significant effects are expected but available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2021. *Pandion haliaetus*. The IUCN Red List of Threatened Species 2021: e.T22694938A206628879. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T22694938A206628879.en. Accessed on 21 September 2022.
Pernis steerei Philippine Honey Buzzard IUCN status: LC National status: EN	This common endemic raptor species inhabits moist lowland and montane forest, with the latter considered of primary importance. An individual of this species was observed in Mariveles during faunal surveys carried out in the BCIB project area in 2021. No conversion of any lowland or montane forest is anticipated for development of construction staging areas. Some noise disturbance is possible but is unlikely to constitute a significant impact. However, available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Pernis steerei*. The IUCN Red List of Threatened Species 2016: e.T22735356A95108828. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22735356A95108828.en. Accessed on 21 September 2022.
Pterocarpus indicus Narra IUCN status: EN National status: VU	*Pterocarpus indicus* is widely planted as a live fence in the Philippines, well outside its native forest context and altitudinal range. Numerous instances of such plantings were recorded in Mariveles and Naic during floral surveys carried out in the project area in 2020 and 2021/2022, to the extent that the tree in planted form was actually the dominant canopy species in some floral sampling plots. Some planted specimens of *Pterocarpus indicus* may be removed to develop staging areas but given that these are in effect an introduced species in the sites where they occur in the project area, the biodiversity significance of this loss can be considered negligible. Source: Barstow, M. 2018. Pterocarpus indicus. The IUCN Red List of Threatened Species 2018: e.T33241A2835450. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T33241A2835450.en. Accessed on 21 September 2022.
Pteropus hypomelanus Island Flying Fox IUCN status: NT National status: EN	Tolerant of human activity, *Pteropus hypomelanus*, in most parts of its range in the Philippines, roosts on small offshore islands and near coastlines but forages in agricultural areas on the mainland, particularly where orchards are found. The species was observed in Mariveles during faunal surveys in the BCIB project area in 2021. No roosting sites were noted anywhere in the vicinity of sites under consideration as staging areas but presence of the species in the ROW is unknown. Small portions of a number of mango and guava orchards (total area 1.9 ha) may be removed to develop staging areas near the Bataan alignment but these areas constitute a minor proportion of orchard area in the general landscape. Their local roosting sites, commuting corridors, foraging sites and any migration patterns are also not understood. Further, large bats may move large distances in a single evening and could easily cross the mouth of the Bay or fly across the alignment of the BCIB. Possible risks associated with direct mortality if bats fly close to the bridge or disturbance from increased light and noise could also affect the species local behaviors. Available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bat Management Plan. Tsang, S.M. 2020. *Pteropus hypomelanus*. The IUCN Red List of Threatened Species 2020: e.T18729A22081642. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T18729A22081642.en. Accessed on 21 September 2022.
Streptopelia dusumieri Philippine Collared Dove IUCN status: VU National status: EN	Introduced populations of *Streptopelia dusumieri* are found in urban areas, indicating high adaptability to dense human presence and activity. Individuals of this species were recorded in Naic during faunal surveys conducted in 2021/2022; although not recorded in Mariveles during the surveys, there is substantial suitable habitat there and presence would not be unexpected. Given the adaptability of this species and the abundance of suitable habitat in the wider landscape, development of the BCIB project area is unlikely to generate significant impacts but available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2018. *Streptopelia dusumieri*. The IUCN Red List of Threatened Species 2018: e.T22727533A132177741. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T22727533A132177741.en. Accessed on 21 September 2022.

Mitigation. Significant adverse impacts are not expected, primarily because most of the threatened species known to be present in the BCIB are highly mobile and adaptable to certain levels of anthropogenic disturbance. Available data to inform this decision is, however, limited and more information on the species' nesting sites, abundance, foraging sites, movement and vulnerability is required. The species will be subject to further consideration prior to construction as part of the Bird Management Plan and the Bat Management Plan. Details of both Management Plans have been provided in the Pre-Construction threatened species assessment and a sample outline for a Staging Area Rehabilitation Plan is included in Appendix B of the EMP.

IMPACT SUMMARY					
Impact:	Construction impacts on threatened species identified in project area				
Direction:	Negative	Type:	Direct	Probability:	Very low
Duration:	Permanent	Scope:	Localized	Significance:	Unknown (likely to be low)
Mitigation:	• Development and implementation of a Bird Management Plan • Development and implementation of a Bat Management Plan • Development and implementation of a Biodiversity Action Plan				
Residual:	None expected				

5.2.2.6 Construction Impacts on Critical Habitat-Qualifying Terrestrial Species

Anticipated Impact. The habitat requirements of all seven critical habitat-qualifying avian species were reviewed in an earlier section on pre-construction impacts (Exhibit 5-97). None of the species evaluated were considered at significant risk from habitat loss, although there is insufficient quality data to be fully confident with all conclusions. Accordingly, each species will be subject to further monitoring and analysis. The same species are evaluated again in Exhibit 5-99, this time in relation to construction activity, including noise, light and movement disturbances.

Exhibit 5-99 Potential for Construction Impacts on Critical Habitat-Qualifying Avian Species

Species	Notes on Construction Related Impact Potential
Anas luzonica Philippine Duck IUCN status: VU National status: VU	*Anas luzonica* uses a range of coastal, riverine and wetland habitats, including mangroves, watercourses inside forests, ponds including fishponds and coastal lagoons. Its diet consists of fish, shrimps, insects, rice and young vegetation. The species is known to be present in the BCIB project area; three individuals were observed feeding along the Timalan River upstream from the Antero Soriano Highway bridge during a faunal survey in 2022. *Anas luzonica* would also be expected to use similar habitat along other watercourses nearby, including Timbugan Creek and the Labac River, as well as fish ponds near the mouths of the Timalan River and Labac River and rice paddies further inland, including along the main alignment and around the interchange site. The species was not observed on the Bataan side and there is far less suitable habitat available there but it is possible that the small mangrove area along the lower Babuyan River may be used on occasion. Construction works within the ROW in Cavite may have a disruptive effect on habitat use by *Anas luzonica* in the west branch of the Timalan River, where an existing bridge will be replaced with a wider one and where the river runs nearby the south side of the interchange site. Noise, visual disturbance and possible water quality impacts would be the operative factors. *Anas luzonica* was not observed in this branch of the river and baseline aquatic surveys indicate very poor habitat quality due to heavy sewage inputs from nearby residential subdivisions, so probability of presence there is deemed very low. Activity on the Cavite staging area (Uniwide site) might be expected to limit the continued use of the east branch of the river by *Anas luzonica*, due to noise and disturbance. On the Bataan side, the principal potential effect of works (if the species were to be present) would be noise and visual disturbance around the viaduct landing site and terminal embankment works but as the Babuyan River estuary is at about 100 m from these work sites, the impact would be slight. It should be acknowledged that *Anas luzonica* is an adaptable species quite tolerant of the presence of human activity (as evidenced by its presence in the highly disturbed Timalan River and reliance on rice paddies and fish ponds for habitat). This suggests that the proximity of works as discussed above is unlikely to result in a severe disruptive effect on individuals of this species. Provided that water quality impacts that may affect feeding success are effectively mitigated, the probable impact on *Anas luzonica* can be considered very minor. No significant impacts are anticipated but the available data to inform this decision

Species	Notes on Construction Related Impact Potential
	is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2016. *Anas luzonica*. The IUCN Red List of Threatened Species 2016: e.T22680214A92849560. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22680214A92849560.en. Accessed on 19 September 2022.
Calidris ruficollis Red-Necked Stint IUCN status: NT National status: -	*Calidris ruficollis* prefers coastal and intertidal mudflats, sheltered inlets, bays and lagoons across its winter range. It may also be found in freshwater, brackish and saltwater wetlands and is reported to use sandy beaches and rocky shorelines occasionally. Its main diet consists of insects, small invertebrates, molluscs, gastropods and crustaceans, plucked from exposed mud surfaces and very shallow water during low water. When feeding in saltmarshes, seeds and other plant material may also be included in the diet. Given this species' reliance on mudflats and other environments featuring sheltered, very low gradient, periodically exposed aquatic substrate, it would not be expected as a frequent or numerous occupant of the BCIB project area and indeed was not documented in faunal surveys conducted in 2021/2022. There are no mudflats in the vicinity of the bridge landing sites. The shoreline in Mariveles and along Corregidor Island is predominantly rocky and the sandy beaches along the Naic shore are steep enough that only a relatively narrow band of sand is exposed during low tide. The shore habitats most likely to attract *Calidris ruficollis* and other small waders are the sandy bars around the mouths of minor local river estuaries (the Babuyan River in Mariveles and the Timalan River, Timbugan Creek and Labac River in Naic) and muddy areas within these estuaries. None of these estuaries is expected to suffer modification as a result of the project's construction. The potential for impacts on *Calidris ruficollis* from the BCIB project's construction can be considered negligible. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Sources: (1) BirdLife International. 2016. *Calidris ruficollis*. The IUCN Red List of Threatened Species 2016: e.T22693383A93401907. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693383A93401907.en. Accessed on 19 September 2022.; (2) Source: Birdlife Australia. 2022. Red-necked Stint. https://birdlife.org.au/bird-profile/red-necked-stint. Accessed 19 September 2022.
Calidris subminuta Long-Toed Stint IUCN status: LC National status: -	In its winter range, *Calidris subminuta* is typically found in shallow inland wetlands, around the edges of permanent and temporary lakes, ponds, reservoirs, lagoons, swamps, streams, river floodplains, marshes, rice paddies, sewage ponds and saltpans and less frequently around tidal estuaries and mudflats. Within any of these habitats, it requires soft, muddy shorelines and short grass, sedges, floating aquatic vegetation, reeds and rushes. The bird's diet consists of insects (notably carabid beetles), small gastropod molluscs, crustaceans, small amphibians and seeds. The exposed beaches within the BCIB project area do not offer suitable habitat for *Calidris subminuta* and the species was not recorded in faunal surveys conducted along the shore (or anywhere else in the project area) in 2021/2022. The most likely candidate habitat areas nearby the BCIB alignment and works sites would be the assortment of fish ponds along the lower Timalan River and near the mouth of the Labac River in Cavite and possibly some limited sites within the estuaries of these rivers and that of the nearby Timbugan Creek. Construction activity is not expected to be carried out within at least 450 m of any of these locations. The principal potential for the BCIB project to affect this species is a generalized disturbance factor from the marine works, which the species (if present at all) may have to navigate through or around to get to estuarine sites. In view of the low probability of presence and diffuseness of the impact source, the potential for impacts on *Calidris subminuta* from the BCIB project's construction can be considered negligible. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International (2022) Species factsheet: *Calidris subminuta*. Downloaded from http://www.birdlife.org on 19/09/2022.
Charadrius alexandrinus Kentish Plover IUCN status: LC National status: -	*Charadrius alexandrinus* tends to frequent sand, silt or dry mud surfaces and generally avoids exposed oceanic coastlines and rocky or broken ground. Typical habitats include sandy, pebbly or muddy shores, dunes, lagoons, marshes, coral limestone shores, estuaries and tidal mudflats. It may also use near-coastal sandy areas by brackish water bodies but does not commonly associate with freshwater. The species' diet consists mainly of insects and their larvae, spiders, gammarids, crabs and other crustaceans, brine shrimp, molluscs, polychaete worms and small pieces of seaweed. *Charadrius alexandrinus* was not recorded during faunal surveys carried out in the BCIB project area in 2021/2022. With their exposed rocky shores and paucity of inland brackish waters, the Mariveles and Corregidor Island portions of the project offer no suitable habitat for this species. The Cavite shore, which is sandy but exposed and without any mudflat area, provides possible habitat that can be considered marginal at best. The most likely habitat for this species within the BCIB project area would be around the bars and

Species	Notes on Construction Related Impact Potential
	inland shores of the estuaries of the Timalan and Labac Rivers (all at least 650 m from expected works sites). No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. The IUCN Red List of Threatened Species 2019: e.T22727487A155485165. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22727487A155485165.en. Accessed on 20 September 2022.
Chlidonias hybrida Whiskered Tern IUCN status: LC National status: -	*Chlidonias hybrida* is found in various wetland habitats but is known to prefer freshwater marshlands. It may also use inland lakes, rivers, fish ponds, stormwater drainage ponds, swamps, river pools, reservoirs, large dams, sewage ponds, flooded saltmarshes, estuaries, coastal lagoons, mudflats and creeks amongst mangroves. Arable fields, pastures and rice paddies may also be visited for feeding. Its diet consists of terrestrial and aquatic insects, spiders, frogs, tadpoles, small crabs, shrimps and small fish. The species generally feeds from the air, by hovering and plunging for fish and other aquatic prey, skimming the water surface for insects on or just below the surface and taking insects on the wing over wetland vegetation. The species most commonly forages in small groups or larger mixed-species flocks when on passage and in the winter. Several individuals of this species were observed feeding in open water off the Cavite coast during faunal surveys conducted in the BCIB project area in 2021. The Cavite portion of the BCIB project area offers a number of potential feeding areas for *Chlidonias hybrida*, including fish ponds along the lower Timalan and Labac Rivers, minor mangrove areas along the lower Timalan River and Timbugan Creek, open estuarine waters of the Timalan and Labac RIvers, rice paddies and fields throughout the area and the open waters of Manila Bay. Given this variety of potential habitats, it is very likely that the species is quite dispersed across the landscape, rather than concentrated around or strongly dependent upon a particular environmental resource. There is no evidence of a major concentration of the species in the project area. The principal threat to *Chlidonias hybrida* from construction works for the BCIB project is a generalized disturbance effect in land and sea areas used for feeding by individuals of the species. Given the species' adaptability (varied diet, numerous habitat types used) and mobility, it is quite unlikely that any significant effect will be generated. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Sources: (1) BirdLife International. 2017. *Chlidonias hybrida* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T22694764A111750380. https://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22694764A111750380.en. Accessed on 20 September 2022. (2) Birdlife Australia. 2022. Whiskered Tern. https://birdlife.org.au/bird-profile/whiskered-tern. Accessed 20 September 2022.
Himantopus himantopus Black-Winged Stilt IUCN status: LC National status: -	*Himantopus himantopus* is typically found along the shores of large inland water bodies, estuaries, river deltas, coastal lagoons, shallow freshwater or brackish pools with extensive mudflats, salt meadows, salt pans, coastal marshes and swamps. Its diet consists mostly of adult and larval aquatic insects but may also include spiders, molluscs, crustaceans, oligochaete and polychaete worms, tadpoles and amphibian spawn, small fish, fish eggs and occasionally seeds. *Himantopus himantopus* occupies relatively sheltered coastal sites with extensive shallows and habitats matching this description are in short supply in the BCIB project area. The species was not recorded during faunal surveys conducted in 2021/2022. If any individuals of *Himantopus himantopus* were to use habitat in the project area, the most likely candidate areas would be the estuaries of the Babuyan River (Mariveles) and Timalan River, Timbugan Creek and Labac River (Naic), as well as the sandbars at their mouths (especially the Labac River). As none of these sites is any closer than 450 m from the BCIB works sites, the risk to this species from construction activity (if it is present at all in the project area) will be limited to a generalized disruption effect from the marine works, which individuals would have to navigate through or around to get to possible habitat. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Sources: (1) BirdLife International. 2019. *Himantopus himantopus* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22727969A155440465. https://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T22727969A155440465.en. Accessed on 20 September 2022. (2) Birdlife Australia. 2022. Black-Winged Stilt. https://birdlife.org.au/bird-profile/black-winged-stilt. Accessed 20 September 2022.

Species	Notes on Construction Related Impact Potential
Pluvialis fulva Pacific Golden Plover IUCN status: LC National status: -	*Pluvialis fulva* is typically found in coastal areas and forages in coastal fields and prairies with short grass, ploughed fields, coastal freshwater pools, saltmarshes, beaches, open mudflats and sandflats and shallow and exposed reefs. This species' diet consists mainly of insects, spiders, molluscs, worms and crustaceans. Based on the preferred habitat types listed above, the BCIB project area offers quite limited habitat and the species was not recorded during faunal surveys conducted in the BCIB project area in 2021/2022. The places within the BCIB project area most likely to be frequented by *Pluvialis fulva* are the beaches of Cavite and especially the extensive sandbars around the mouth of the Labac River; lesser beach areas on the Mariveles coast (such as at the mouth of the Babuyan River) and the few sandy beaches of Corregidor Island and Caballo Islands may also be frequented. Existing residential and commercial development inland from the Cavite coast limits the probability of *Pluvialis fulva* moving inland to feed in fields and pastures, if it were to use the beaches there. The principal potential for the BCIB project to affect this species (if present) is a generalized disturbance factor from the marine works, which individuals of the species may have to navigate through or around to get to beach sites for feeding. No significant impacts are anticipated but the available data to inform this decision is limited. The species will be subject to further consideration prior to construction as part of the Bird Management Plan. Source: BirdLife International. 2019. *Pluvialis fulva* (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2019: e.T22693735A155529922. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693735A155529922.en. Accessed on 21 September 2022.

All seven critical habitat-qualifying avian species are deemed unlikely to sustain significant impacts during construction, but the available data is insufficient to conclude this with a high level of confidence. Of the seven, *Anas luzonica* comes closest to being a concern, due to its confirmed presence in the east branch of the Timalan River, near the Cavite staging area (Uniwide site), which fronts the river. Given the species' adaptability and tolerance of human presence, the potential for impact should not be overstated, but limitation of disturbance along the river frontage of the staging is nevertheless advisable.

Mitigation. The required mitigation for Critical Habitat species has been described above in the discussion regarding the threatened species assessment above; further data is required to inform and update the assessment. The data will be obtained with new monitoring surveys, before and during construction. The monitoring will be a commitment within the Bird Management Plan.

The Bird Management Plan monitoring results will be used to inform an update of the Critical Habitat Assessment and any adaptive management requirements. If a species no longer triggers Critical Habitat after review of the new data, no further action will be required. If the species continues to meet the IFC PS6 thresholds for Critical Habitat, additional conservation actions will be required to ensure the BCIB achieves a Net Gain in conservation value for the species. Measures to achieve a Net Gain will be developed and implemented under the auspices of the Biodiversity Action Plan. Possible impacts on these critical habitat-qualifying species from expected construction activity will be considered.

In addition, durable 2 m-tall fencing will be constructed and maintained 30 m around the riparian habitat to create a protection zone along the west bank of the Timalan River within the Uniwide staging site. This will reduce disturbance of individuals of *Anas luzonica* that may use the river. Measures relating to prevention of water quality impacts in the Timalan River from staging activities are specified in Chapter 6.

IMPACT SUMMARY					
Impact:	Construction impacts on critical habitat-qualifying species				
Direction:	Negative	Type:	Direct	Probability:	Very low
Duration:	Medium term	Scope:	Localized	Significance:	Unknown (likely ot be low)
Mitigation:	• Development and implementation of a Bird Management Plan • Development and implementation of a Biodiversity Action Plan • PCs responsible for Uniwide staging site to establish and maintain, with durable fencing, a 30-m riparian protection zone along the Timalan River to limit disturbance of critical habitat-qualifying species known to use the river (*Anas luzonica*)				
Residual:	None expected				

5.2.2.7 Impacts on Critical Habitat Elements (KBAs, Protected Areas, Mangroves)

Anticipated Impact. The principal construction-phase risk to the KBAs and protected areas in the BCIB project area is exploitation by construction workers. In some contexts, hunting and gathering carried on by workers in their spare time can be a significant drain on local wildlife resources. This is most relevant where large construction camps are located in rural areas close to natural habitat and woodland, protected areas and other significant concentrations of wildlife habitat. It is anticipated that up to several hundred non-local workers may be housed in camps in each of Bataan and Cavite during peak work periods on the BCIB project.

The Bataan portion of the project area is nearby the forests and grasslands of the Mariveles Mountains KBA and it is possible that some hunting pressure from the project workforce could arise. The site identified for construction camps (Bataan Staging Area 2) is nearly 10 km from the nearest substantial forest area, however, so this risk should not be overstated. On the Cavite side, the forests of the Mts. Palay-Palay Mataas na Gulod Protected Landscape can be considered not to be at risk of increased hunting pressure from construction workers, given their distance (over 12 km) from the expected construction camp on the Uniwide staging site.

The minor patches of mangrove vegetation identified within the BCIB project area have limited exposure to construction activity, at least as pertains to direct physical activity (water quality impacts are discussed in Chapter 6). On the Bataan side, estuarine mangroves will not be impinged upon by the project footprint or staging sites but there is some minor potential for displacement of arboreal mangrove species that grow here and there amongst the rocks on the exposed coastline (see baseline survey of coastal vegetation in Section 5.1.4 and Exhibit 5-88). Disturbance of the coastline at the BCIB landing site is expected to be very limited (just the viaduct being installed overhead and development of a narrow jetty access for Bataan Staging Area 2 nearby). Some disturbance of shoreline vegetation is also provisionally anticipated at Bataan Staging Area 1, where development of the drydock may require works within a presently vegetated beach segment; it is not known if any arboreal mangrove species are present at that location but it can be considered possible, based on the scattered distribution of such species along the coast closer to the BCIB landing site. Any necessary removal of mangrove species would likely be very minor and unlikely to significantly affect the conservation status of the habitat. Removal of trees is subject to replacement requirements under national law.

In Naic, the only potential mangrove exposure is at the Uniwide staging site, which borders the Timalan River south of the Antero Soriano Highway. Although this site is near the upper end of tidal reach and a substantial portion of the west riverbank has been armored, mangrove species have been documented nearby (see Exhibit 5-89) and it is possible that some limited mangrove vegetation may still be found in the riparian zone along the site's river frontage. Construction activity carried out on this site could degrade any mangrove patches present on the west bank of the river, if allowed to extend to the riverbank. The river has been deemed too shallow and constrained to be used for barge access to the staging site.

Prescribed Mitigation. Hunting by workers is unlikely to be a significant concern but preventive action is inexpensive and can be implemented on a precautionary basis. All project workers living in camps on the Bataan side shall be prohibited from hunting and gathering in local forest areas; this will be incorporated in the rules of conduct for each camp, as specified in the relevant PCs' Construction Camp Management Plans.

Any coastal trees that have to be removed for staging area access points on the Bataan coast, including any mangrove species that may be among them, will be covered under the tree-cutting permits required for staging site establishment (discussed above); the PCs responsible for setting the staging sites up will also be responsible for obtaining and implementing site-specific tree-cutting permits and rehabilitation at the end of the construction phase. On the Cavite side, PCs using the Uniwide staging site shall establish and maintain, with durable fencing, a 30-m riparian protection zone (as measured from the water's edge) along the entire Timalan River frontage; this is prescribed in relation to other potential impacts as well.

IMPACT SUMMARY					
Impact:	Impacts on critical habitats (KBAs, protected areas and mangroves)				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Medium term	Scope:	Localized	Significance:	Low
Mitigation:	• Each PC operating a construction camp in Mariveles to incorporate prohibitions against worker hunting and gathering in construction camp rules of conduct, within its Construction Camp Management Plan • PCs responsible for setting up staging sites in Bataan to obtain and implement a tree-cutting permit from DENR • PCs using Uniwide staging site in Cavite to establish and maintain a 30-m natural riparian buffer (as measured from water's edge) along the site's Timalan River river frontage to prevent degradation of mangroves				
Residual:	None expected				

5.2.2.8 Proliferation of Invasive Species

Anticipated Impact. As discussed under the impact assessment for pre-construction activities, the opening of new road alignments for the two BCIB approach roads does not in itself present significant risk with respect to invasive species, but careless selection of floral species for plantings and poor management of soil in the ROW could. Most of the tree species commonly used in environmental restoration and reforestation projects in the Philippines are exotic species, and at least one (*Swietenia macrophylla*) has invasive properties. Seedlings and saplings of native species are likely to be less readily available than the more commonly-used exotics, and it will be tempting for contractors to adopt exotics for this reason, potentially encouraging invasions and degrading local native floral assemblages. The risk of invasions will be further enhanced if exotic species are used in compensatory tree planting and in rehabilitation of staging areas prior to abandonment.

Prescribed Mitigation. To help prevent the spread of invasive species, the approach road works contractors shall be required to use only native plant species in slope stabilization and reinstatement of ground cover. Details will be provided in the Terrestrial Invasive Species Management Plan. They shall also be required to use only native plant species in any plantings undertaken outside the ROW as part of compensatory tree planting, under the auspices of their Compensatory Tree Planting Plan. Sample outlines for such plans are provided in Appendix B to the EMP. All PCs shall be required to use only native plant species in rehabilitation of staging areas at the end of the construction phase, in accordance with their Staging Area Rehabilitation Plans (sample outline provided in Appendix B to the EMP).

IMPACT SUMMARY					
Impact:	Spread of invasive species				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Low
Duration:	Long term	Scope:	Localized	Significance:	Low
Mitigation:	• PC1 and PC2 to ensure that only native plant species are used in plantings within the ROW for purposes of slope stabilization and reinstatement of vegetative ground cover • PC1 and PC2 to prepare and implement Terrestrial Invasive Species Plans • PC1 and PC2 to ensure that only native plant species are used in plantings carried out under the auspices of their Compensatory Tree Planting Plans • All PCs to ensure that only native plant species are used in plantings carried out under the auspices of their Staging Area Rehabilitation Plans				
Residual:	None expected				

5.2.2.9 Leaks and Spills

Anticipated Impact. The BCIB project works will involve operation of large amounts of construction equipment over a sustained period and this creates significant potential for contamination of soils on works sites if good management practices are not implemented consistently. Leaks typically arise from poorly maintained motorized equipment and from poorly maintained storage tanks. Spills occur most often where refueling and equipment servicing takes place, whether at sites designated for such purposes, or where fueling and servicing have to take place in the field. On poorly managed staging sites, waste oil may build up in haphazard storage for lack of a proper system for collection and recycling, leading to greater potential for leaks and spills.

Prescribed Mitigation. Leaks and spills are entirely preventable. Contractors should be required to use only modern, late-model equipment (less than 15 years old), which is less likely to have chronic leaks than older, run-down equipment. All motorized equipment should be checked daily to confirm absence of significant leaks; any leaks detected must be repaired immediately. On-site storage tanks for diesel, lubricants and any other noxious fluid used in the construction process must have built-in secondary containment and should be inspected for leaks at least weekly. Designated fluids storage facilities must be established during site set-up; these should be situated at least 20 m from any on-site watercourse or drainage channel and must be positioned so as to not be vulnerable to flash flooding during heavy rain events, above the 100-yr flood level and away from any coastal location potentially vulnerable to storm surge. Fluids storage facilities must have a roof, impermeable floor and continuous perimeter sills to provide secondary containment of any spills. The capacity of secondary containment must be at least 150% of the largest container stored. As the project area is in a seismically active zone, all tanks must be supported on structures capable of withstanding earthquakes of at least Magnitude 6. Spill cleanup tools and materials should be kept stocked in each storage facility and all workers involved in fluids handling should receive spill response training at induction and yearly thereafter.

All refueling must carried out at the designated fluids storage facilities, on impermeable concrete pads with rollover containment sills. As this is often not possible, such as with very large and limited-mobility equipment or on work sites without a fluids storage facility, impermeable drip mats must be available during all field refueling operations. Workers involved in refueling should be given training in refueling best practices and spill cleanup, at induction and yearly thereafter.

Routine equipment maintenance and repair should be carried out in proper maintenance shops set up on site; when this is not possible, drip mats must be deployed for all repairs and maintenance conducted in the field that may involve intentional or inadvertent release of fluids (e.g., from gearboxes, oil pans, pumps, hoses, radiators and tanks). All maintenance technicians should receive training in spill prevention at induction and yearly thereafter.

It is imperative that arrangements be made by the PC, at the time of site set-up, for regular collection of waste oils and other noxious fluids such as coolants by an accredited recycling enterprise. Each PC will be required under national law to register as a hazardous waste generator and document both generation and responsible disposal of waste oils and other hazardous and noxious fluids and solids. All of the mitigation detailed above shall be reflected in each PC's site-specific Hazardous and Noxious Materials Management Plan, to be reviewed and approved by the CSC prior to the start of any works or setup of any staging sites. A sample outline for a Hazardous and Noxious Materials Management Plan is provided in Appendix B of the EMP.

IMPACT SUMMARY					
Impact:	Leaks and spills of hazardous and noxious fluids, leading to soil contamination				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs to use only newer-model equipment (less than 15 years old) in good condition • Each PC to register with DENR as a hazardous waste generator and comply with all DENR requirements regarding documentation of waste generation and disposal • Each PC to prepare and implement a site-specific Hazardous and Noxious Materials Management Plan, to be approved by the CSC prior to staging area set-up and start of works				
Residual:	None expected				

5.2.2.10 Contamination Risks Associated With Demolition of Existing Structures

Anticipated Impact. Demolition of buildings may lead to land contamination (in addition to public and occupational safety risks, to be discussed in Chapter 8) if hazardous substances were used in their construction, were stored in them and not removed prior to abandonment, or were processed in them and left significant residues. The principal material hazards in buildings are typically asbestos-containing materials (e.g., pipe insulation, sheet roofing, siding, vinyl-asbestos floor tiles, asbestos-cement piping) and lead-containing materials (mainly paints). Stored items may include any number of hazardous substances both liquid and solid, with common items being waste oil, fuels, paints, solvents, old lead-acid vehicle batteries and agricultural chemicals. Industrial buildings previously used for vehicle and equipment repair, vehicle wrecking, battery recycling, scrap metal recycling and electronic waste processing may be permeated with toxic dust and soiled with hazardous fluids. When demolition is undertaken without regard for the possible presence of hazardous substances, the probability of spills and releases to the soil and groundwater at the site is increased.

The survey of potentially contaminated sites conducted as part of baseline research for the EIA study did not identify any above-ground structures within the project footprint or on any of the projected possible staging area sites that are suspected of being significant possible sources of contamination. The number of structures to be demolished is quite limited.

Prescribed Mitigation. All structures slated for demolition as part of the project, whether within the project footprint or in areas to be cleared for use as construction support sites, must be carefully inspected prior to site clearance by appropriately accredited technicians in the employ of a DENR-recognized provider of testing and remediation services. An inventory of structures and related suspected hazardous elements shall be created and a systematic plan for removal, transport and disposal in an accredited hazardous waste facility shall be drawn up by the assessment firm. The plan shall be reviewed and approved by the CSC prior to the start of site clearance.

IMPACT SUMMARY					
Impact:	Release of hazardous contaminants during demolition				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs undertaking demolition work to arrange for inspection of all condemned structures prior to start of site clearance by a DENR-recognized provider of testing and remediation services and implement any removal and remediation plans drawn up by said provider				
Residual:	None expected				

5.2.2.11 Hazardous Releases From Pre-Existing Contaminated Sites

Anticipated Impact. Where significant contamination already exists in areas within the project footprint or construction support sites, any soil-disturbing activity, e.g., excavation, grading, grubbing, has significant potential to spread the contamination more widely. The principal pathways for dispersal of disturbed contaminants are release of dust, entrainment of soil in surface runoff and transport of excavated materials to other parts of the site or to other sites for re-use or disposal. The potential severity of such releases is determined primarily by the physical and chemical nature of the contaminants and host materials, the concentration of contaminants in the host material and the scale and intensity of the disturbing activity. The risk of contaminant spread and knock-on effects on public and occupational health and safety is heightened significantly if the contamination is not previously known (and thus no protective management is undertaken) or underappreciated (and thus inadequate management measures are implemented).

The survey of potentially contaminated sites carried out for the BCIB project footprint and anticipated staging sites in 2021/2022 as part of baseline research identified two sites of potential concern within the project footprint, both of them filling stations. The risk of additional sites of concern coming to light during works is considered very low but not negligible.

Mitigation. A Phase II ESA shall be carried out for each of the filling station sites within the footprint (Shell in Bataan, PTT in Cavite) by a DENR-recognized provider of testing and remediation services immediately upon completion of land acquisition and prior to commencement of any clearing or grubbing work. The Phase II ESA shall include soil and groundwater testing to establish the extent and severity of any existing contamination from underground tanks or past surface spills. Risks shall be managed in accordance with a site-specific removal and remediation plan, to be prepared by the assessment provider and approved by the CSC prior to implementation. All removal and/or remediation work is to be completed before the concerned sites are subject to any works activity, subject to verification by the CSC.

With regards to possible additional, as-yet undetected contamination in the ROW or on properties to be used as staging areas, a chance find procedure should be in place to ensure responsible management in the unlikely event that any evidence of potential contamination is discovered during site clearing or earthworks. Process steps to be observed in the event of a chance find are as follows:

Step 1 – Workers immediately stop all ground-disturbing work in the immediate vicinity of the find and inform the Site Engineer;

Step 2 – Site Engineer sets up a precautionary 50-m no-excavation zone around the find;

Step 3 – Site Engineer informs their PC Project Manager and the CSC;

Step 4 – Project Manager arranges for an immediate Phase II ESA, to be carried out by a DENR-recognized provider of testing and remediation services; and

Step 5 – CSC directs PC to adapt works as necessary to accommodate implementation of removal and remediation plan proposed by the assessment firm and issues clearance for return to normal operations once remediation has been completed.

The chance find procedure for possibly contaminated sites shall be incorporated as a method statement in each PC's CEMMAP and all workers and site engineers involved in site clearing, site setup and excavation shall be trained to implement it as appropriate, as part of broader induction and refresher training.

IMPACT SUMMARY					
Impact:	Releases of hazardous materials from pre-existing contaminated sites				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PC1 and PC2 to arrange for conduct of Phase II ESAs by DENR-recognized provider of testing and remediation services for filling station sites identified in P1 footprint (Shell) and P2 footprint (PTT) and oversee full implementation of any removal and remediation plan produced by the provider prior to the start of any site clearing works • Each PC to include a chance find procedure as a method statement in its CEMMAP and include training to workers and site engineers on its correct application, as part of broader induction and refresher training				
Residual:	None expected				

5.2.2.12 Deposition of Solid Waste

Anticipated Impact. Construction and construction-related activity will generate solid waste, including demolition waste, by-products of the construction process and domestic solid waste generated by site facilities such as canteens, construction camps and contractor offices.

Based on the types of structures slated for demolition under the BCIB project, demolition waste can be expected to consist mainly of concrete rubble, assorted masonry, wood, steel and tin roofing, as well as such items as copper wire, plastic piping and glass. There is strong potential for segregation at source, if salvage crews are brought in before land clearing commences to remove marketable components. Clean concrete and masonry, likely the most significant component by volume, may be useful as fill during setup of staging areas. It is understood that owners of structures on lands acquired for the project will be granted the right to salvage materials from those structures prior to handover, without prejudice to their compensation entitlement.[106]

Construction waste typically consists mainly of packaging, pallets, fluid containers, scrap wood and scrap metal. As with demolition waste, there is ample potential for recycling portions of this waste stream, if segregation at source is enabled by integration of recycling systems and expectations into site management.

Regular solid waste generated by workers and in the process of feeding them will typically consist of food and drink packaging, kitchen waste, including a high proportion of organic material and general waste collected from toilet facilities, living spaces and offices. A large proportion of regular solid waste generated on construction sites and in worker camps can be recycled with appropriate collection and worker education and organic waste from kitchens may be readily composted on site where this has been appropriately planned for. The Mariveles and Naic municipal solid waste management plans mandate segregation at source.

Failure to make proactive arrangements for responsible management of demolition waste, construction waste and regular solid waste will result in avoidable disposal of recyclable materials, higher transport and disposal costs and perhaps also ad-hoc adoption of environmentally harmful practices such as on-site accumulation leading to land and water contamination, or on-site burning leading to land contamination and air pollution.

Prescribed Mitigation. Solid waste management must be a key element of each PC's management of works sites and staging areas. Each PC shall prepare a site-specific Solid Waste Management Plan applicable to both construction waste and regular solid waste, for review and approval of the CSC prior to setup of staging sites and commencement of works; a sample outline for such a plan is provided in Appendix B of the EMP. PCs shall be responsible for making the necessary arrangements with municipal or private sanitary landfills, municipal providers of waste collection services, waste haulers and accredited recycling firms, as needed to fully implement their Solid Waste Management Plans. These arrangements, as well as plans for collection and segregation of wastes within all works sites under the contractor's control, shall be incorporated in a Solid Waste Management Plan to be included as a sub-plan of the CEMP.

PCs engaged in demolition works must negotiate agreements with local recyclers for removal of recyclable materials prior to structural demolition and make arrangements with

[106] T.Y. Lin International / Pyunghwa Engineering Consultants Joint Venture. Bataan–Cavite Interlink Bridge Project – Draft Updated Social Safeguards Report, April 29, 2022.

private or municipal landfills for disposal of non-recyclable demolition waste. The arrangements shall be incorporated in a Demolition Waste Management Plan to be prepared by the contractor and this is to be reviewed and approved by the CSC prior to the start of any demolition work. A sample outline for a Demolition Waste Management Plan is provided in Appendix B to the EMP. Inspection and management of asbestos-containing materials and other potential material hazards is discussed in Chapter 8, in relation to occupational health and safety and public health and safety.

IMPACT SUMMARY					
Impact:	Environmental pollution from poor solid waste management				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Long-term	Scope:	Localized	Significance:	Low
Mitigation:	• Each PC to prepare Solid Waste Management plan applicable to both construction waste and regular solid waste from staging sites, for approval by the CSC prior to site setup and start of works • Each PC undertaking demolition works to prepare Demolition Waste Management Plan for review and approval by CSC prior to start of works				
Residual:	None expected				

5.2.2.13 Impacts on Physical Cultural Heritage

Anticipated Impact. There are no known physical cultural heritage sites or objects near the planned works sites or staging areas. Although it is not anticipated, there is nevertheless a non-negligible possibility that the construction works could uncover artifacts and these may be damaged, lost or stolen if not handled properly.

Mitigation. Proactive prevention procedures should be in place to reduce the risk to physical cultural resources in the unlikely event that any are unearthed during works. A chance find procedure will be adopted as a method statement in each PC's CEMMAP and all workers should be made properly familiar with the procedure's rationale and use as part of broader induction and refresher training. Chance find procedures should have five basic steps:

Step 1 – Stop work in the affected area immediately and inform the Site Engineer;

Step 2 – Site Engineer inspects the site and informs CSC, as well as DPWH;

Step 3 – CSC and DPWH Environment, Health and Safety Officer inspect the site and define what they deem a safe buffer around the location of the find and give the go-ahead for resumption of work everywhere else;

Step 4 – CSC contacts Cultural Properties Protection and Regulation Division (CPPRD), under the National Commission for Culture and the Arts; and

Step 5 – CPPRD personnel visit the site to assess the significance of the find and arrange for its safe removal if necessary, giving clearance through the CSC for resumption of work as appropriate.

IMPACT SUMMARY					
Impact:	Loss or damage of previously undetected physical cultural heritage objects				
Direction:	Negative	Type:	Direct	Probability:	Very low
Duration:	Permanent	Scope:	Localized	Significance:	Unknown

IMPACT SUMMARY	
Mitigation:	• Each PC to include a chance find procedure as a method statement in its CEMMAP and include training to workers and site engineers on its correct application, as part of broader induction and refresher training
Residual:	None expected

5.2.3 Operation Phase Impacts and Mitigation

Operation impacts are those impacts which occur as a direct or indirect result of the use of the infrastructure, including any scheduled and unforeseen repair works and maintenance. As with construction impacts, impacts occurring during operation are largely predictable and mitigation is appropriately supported by plans developed in the lead-up to the entry of the infrastructure into normal operation.

5.2.3.1 Wildlife Road Mortality (Bridges and Viaducts)

Anticipated Impact. As described earlier, bridge and viaduct railings may be attractive roosting and perching sites for some bird species, particularly seabirds and the proximity to fast-moving traffic entails elevated risk of collisions with vehicles. Given high uncertainty as to the probability of seabird roosting and perching becoming a problem on the BCIB, including which particular areas might be trouble spots, pre-emptive installation of anti-roosting devices is not justified but an adaptive management approach is prescribed as a precaution.

Prescribed Mitigation. The density of roosting and perching activity, as well as the incidence of vehicle strikes of roosting and perching birds, will be monitored as part of the Bird Management Plan and the Biodiversity Action Plan before construction, during construction and for the first three years of bridge operations. Anti-roosting devices can then be installed where needed.

IMPACT SUMMARY					
Impact:	Bird mortality from collisions with vehicles on bridges and viaducts				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Long-term	Scope:	Localized	Significance:	Unknown
Mitigation:	• Development and implementation of the Bird Management Plan (to monitor vehicle bird strikes and perching/roosting prevalence as part of routine bridge safety monitoring and install anti-roosting devices on railings in problematic locations, if needed).				
Residual:	Expected but likely very minor				

5.2.3.2 Leaks and Spills Associated With Maintenance and Repair Works

Anticipated Impact. Leaks and spills from motorized equipment used in major maintenance and repair works and any fuels, lubricants, paints or other noxious fluids used in the works, will always have some potential to occur and to flow onto roadside soils. The risk of a leak or spill causing substantial soil contamination during active maintenance work is quite low, especially when the works are being carried out on the impervious paved roadway (as opposed to exposed soil).

Prescribed Mitigation. Maintenance contractors shall be contractually obliged to use newer model (less than 15 years old) and well maintained equipment, store all auxiliary noxious fluids in containers with appropriate secondary containment and promptly address any leaks or spills.

IMPACT SUMMARY					
Impact:	Leaks and spills associated with maintenance and repair works				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• Require maintenance contractors to use only newer model equipment in good condition, store all noxious fluids used in works in containers with secondary containment and have demonstrated capacity to clean up spills				
Residual:	None expected				

5.2.3.3 Spills from Road Accidents

Anticipated Impact. Most road accidents do not release large amounts of noxious fluids but those that involve rollovers of large trucks carrying hazardous cargoes are quite likely to. Large spills on the road surface, or into roadside verges, have significant potential to produce localized soil contamination. Spilled liquids are likely to generate more widespread contamination, due to possibly rapid overland flow and infiltration deep into the soil, than dry materials.

Prescribed Mitigation. In order to contain and clean up spills before they can produce land contamination, the Bridge Management Unit will need to have monitoring systems in place and fully operational at all times and accident response crews well trained and equipped to manage a range of possible spilled materials. Spill response plans, including protocols, procedures and provisions for training, equipment and equipment upkeep, shall be specified in the operation-phase Emergency Action Plan, to be prepared and implemented by the Bridge Management Unit. Guidance on preparation of an Emergency Action Plan is provided in the EMP (Section 10.6) and a sample outline for such a plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Contamination due to spills from road accidents				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• Bridge Management Unit to include assessment of spill risk in its operation-phase Emergency Action Plan and make commensurate investments in staffing, training and equipment to enable competent response in the event of a spill				
Residual:	Possible but difficult to predict significance				

5.2.3.4 Deposition of Solid Waste (Littering)

Anticipated Impact. As with any road almost anywhere, the BCIB approach roads are likely to accumulate a certain amount of roadside solid waste, whether from intentional littering or inadvertent releases of material from open windows and improperly secured loads of easily airborne materials. Besides being unsightly, litter that is allowed to build up on roadsides may contaminate soil, water and the general biota over time (this is especially the case with plastics).

Mitigation. Litter is in all cases the result of careless or uncaring behavior on the part of motorists and is therefore amenable to change through education and persuasion. Educational anti-littering signage has been specified in roadway designs, at regular intervals along the roadway.

Cleanup of inevitable litter will be accomplished firstly by the regular weekly pass of a vacuum sweeper (which will be part of the road maintenance regimen in part to reduce contaminants in road runoff) and secondly by maintenance crews assigned to gather litter from off-pavement areas, including embankments, ditches and all other land areas within the ROW.

IMPACT SUMMARY					
Impact:	Deposition of roadside solid waste				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Long term	Scope:	Localized	Significance:	Low
Mitigation:	• Conduct weekly mechanical sweeping of the entire roadway surface (lanes and hard shoulders) • Implement regular roadside litter cleanup (periodicity based on litter buildup rate)				
Residual:	Expected but of very low significance				

6 BASELINE CONDITIONS, ANTICIPATED IMPACTS AND PRESCRIBED MITIGATION (WATER)

The BCIB project will include approximately 26 kilometers of over-water infrastructure. The areas of the bay that will be traversed by the marine viaducts and bridges include a deep channel between Bataan and Corregidor Island, the nearshore marine environment along the east coast of Corregidor Island's Tail End, a second deep channel southeast of Corregidor Island, and a broad shallow subtidal shelf near the Cavite coast. Neither of the on-land portions of the proposed project infrastructure will cross significant watercourses, but several permanent and intermittent streams in both project areas will be in a position to receive runoff during construction or operation of the infrastructure. This section of the report presents a baseline profile of the freshwater and marine environments in the BCIB project area.

6.1 Baseline Conditions

6.1.1 Rivers and Streams

6.1.1.1 Bataan

The surface hydrology of the BCIB project area in Bataan is wholly dictated by the peninsula's volcanic orogeny, as all rivers and streams run to the sea directly from their points of origin on the slopes of Mt. Mariveles, in what can be seen in Exhibit 6-1 to be essentially a radial drainage pattern at the regional scale.

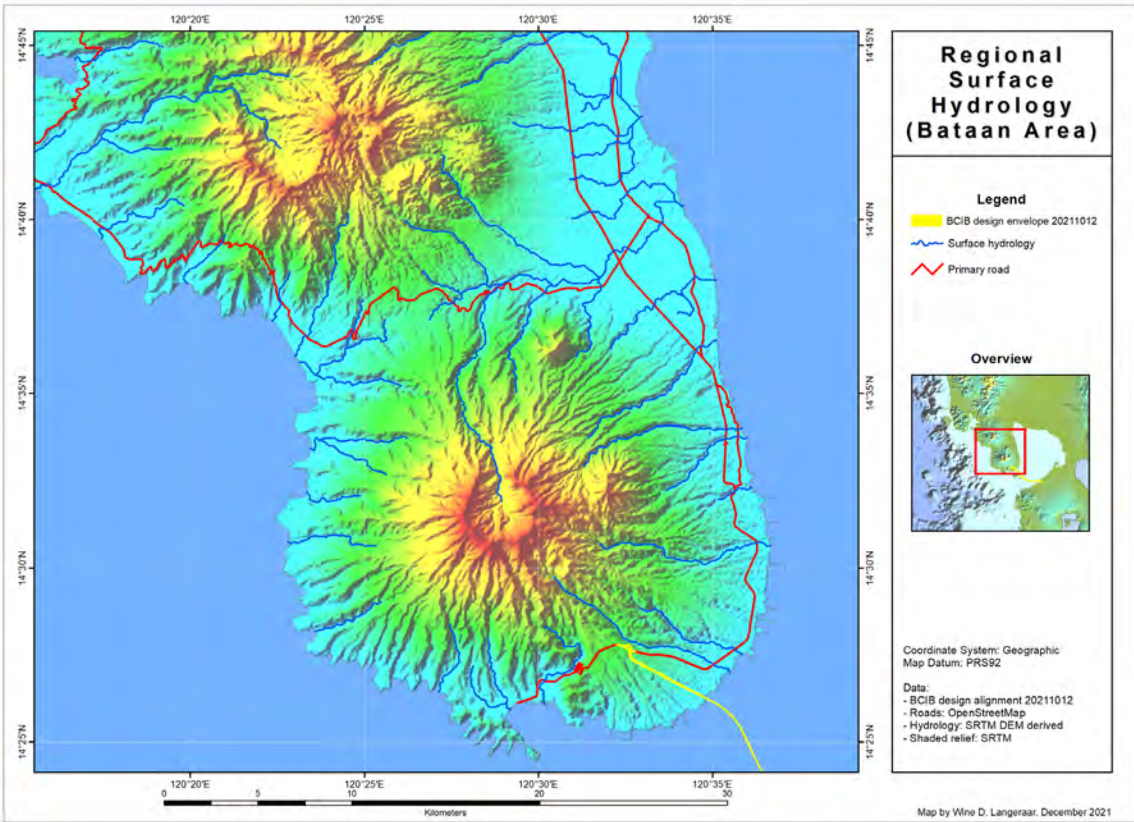


Exhibit 6-1 General Drainage Pattern of Bataan Peninsula

At the local scale, the regional drainage pattern is manifest as a series of nearly parallel streams and rivers of relatively steep gradient, all running in a southeasterly direction to Manila Bay (see Exhibit 6-2). The nearest watercourses to the proposed BCIB infrastructure are the Pangolisanin River (which runs nearby the planned interchange with the Roman Highway); the Babuyan River (whose mouth will be close to the alignment's landing point, and a minor branch of which will be crossed by the alignment); and the San Jose River (of which several minor branches are intersected by the ROW, and which drains the lands where construction staging areas will be set up). There are also a number of small, short and intermittent watercourses and seeps of unknown name to be found close to the alignment's proposed landing point. The rivers and streams of the Bataan portion of the project area are used to a limited extent by local people for watering livestock, fishing, washing clothing and bathing, but are not used for drinking and do not support significant fisheries. The Pangolisanin River is used somewhat for irrigation in its lower reaches.

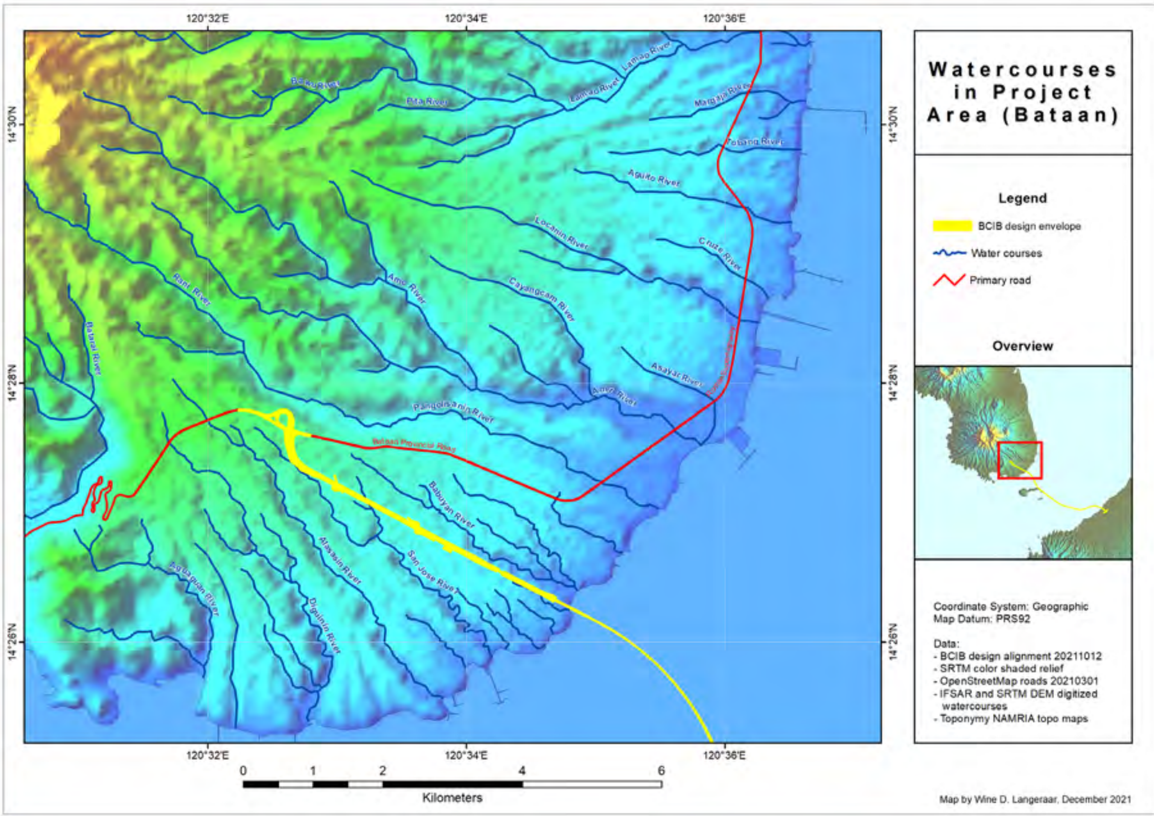


Exhibit 6-2 Streams and Rivers in the BCIB Project Area (Bataan)

Due to the sloped topography and consequent incised nature of most watercourses in Mariveles, flooding that occurs during and after heavy rainfall for the most part does not have significant potential to create widespread inundation (see Exhibit 6-3). The greatest potential for fluvial flood effects on surrounding lands is found in the lower reaches of the Pangolisanin River, where the river moves within a predominantly agricultural alluvial plain; during severe (100-yr) flood events, residential property along the two kilometers of the floodplain inland from Manila Bay would likely be vulnerable to flood damage (Exhibit 6-3).

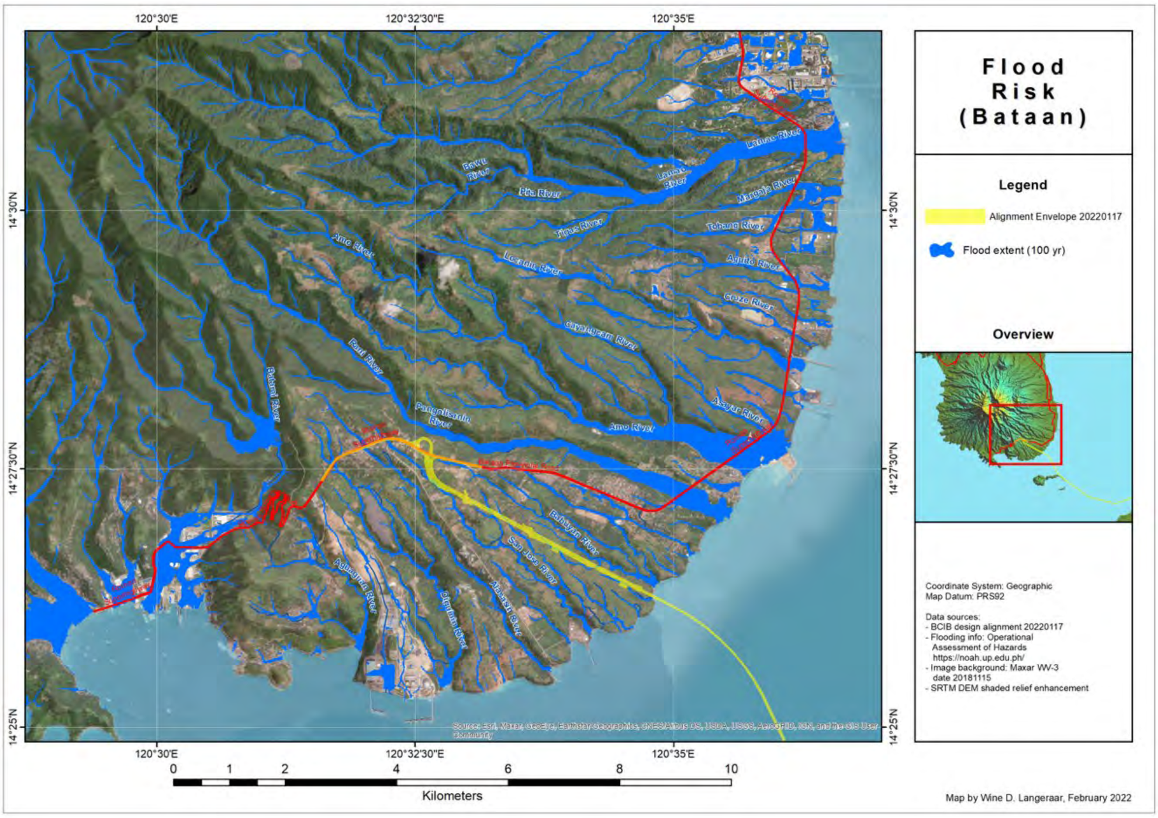


Exhibit 6-3 Flood Risk Map for the BCIB Project Area (Bataan)

6.1.1.2 Corregidor Island

Although there are numerous gullies and ravines shaped by periodic overland flow on Corregidor Island, the island's land area is small and does not generate sufficient runoff or groundwater flows to feed significant permanent streams.

6.1.1.3 Cavite

The regional drainage pattern of Cavite reflects the general northerly slope aspect of the province, the result of prehistoric pyroclastic flows from the Taal Volcano, which is 40 km to the south and was once much taller than it is today. All watercourses in the Cavite portion of the BCIB project area run northwestwards to Manila Bay. Most rivers in the province are relatively young and constrained, with limited meander patterns except where they meet the flat, low-lying coastal areas (see Exhibit 6-4).

The surface hydrology of the BCIB project area is dominated at the local scale by two significant rivers, the Timalan River (to the near northeast of the proposed alignment, with one branch passing nearby the interchange with the Antero Soriano Highway) and the Allemang River (also known as the Bucana or Labac River) to the southwest (see Exhibit 6-5). Both of these rivers are estuarine in their lower reaches, with tidal influence being felt 1–2 km inland, and support significant aquacultural activity. In addition to the Timalan and Allemang (Bucana/Labac) Rivers, there are a number of small watercourses draining the lands around the proposed on-land infrastructure and possible staging area sites; some of these are intermittent, filling only after heavy or sustained rains.

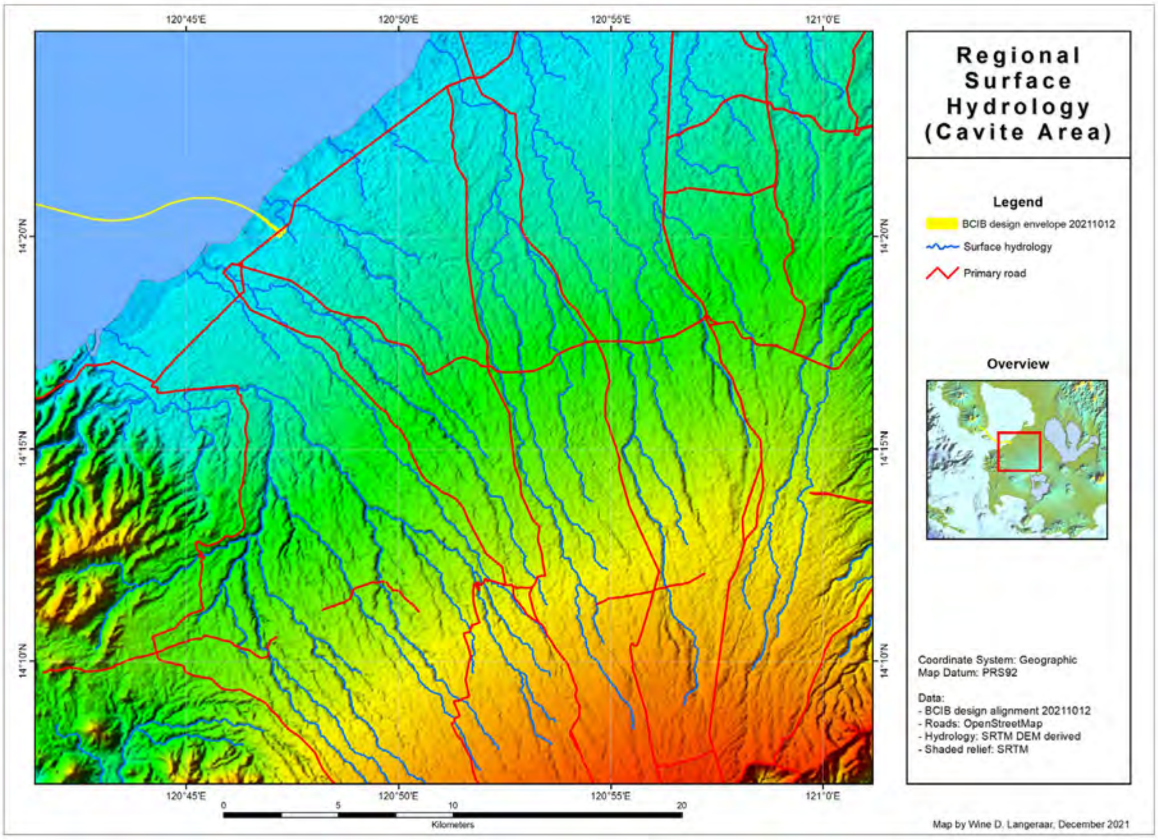


Exhibit 6-4 General Drainage Pattern of Cavite

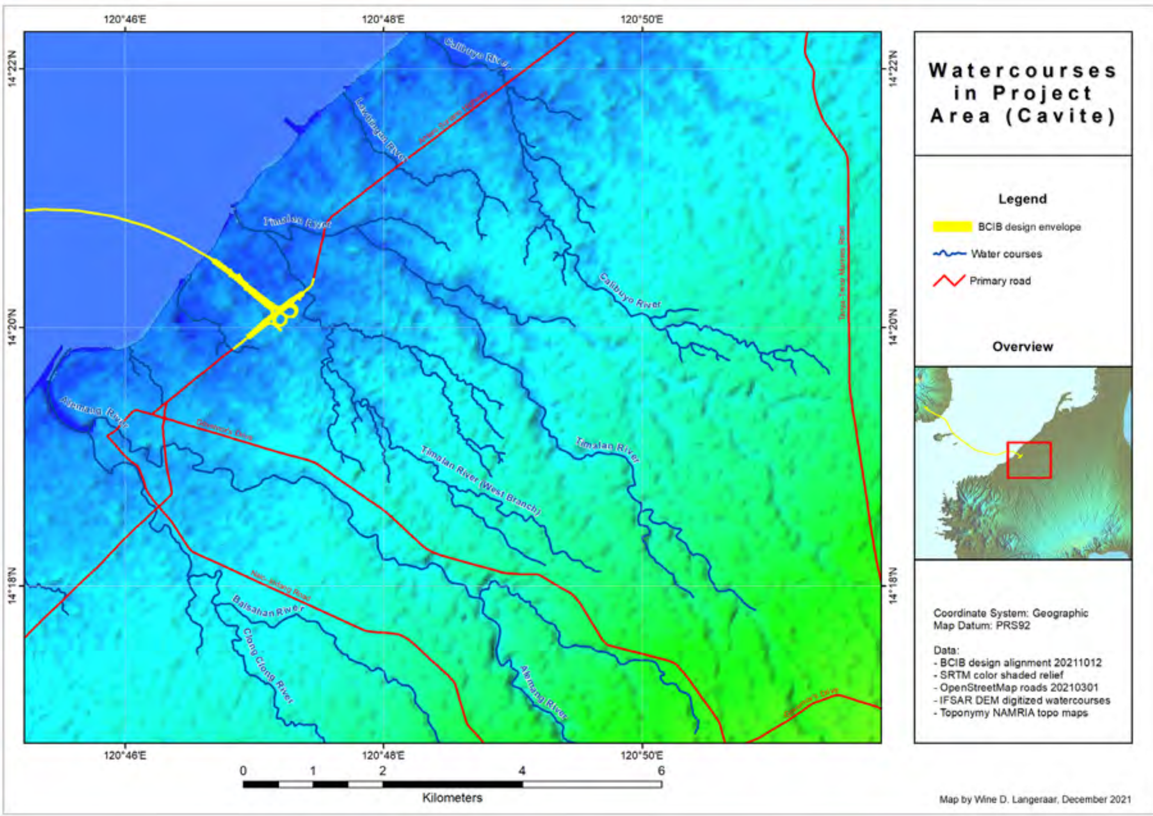


Exhibit 6-5 Watercourses of the BCIB Project Area (Cavite)

The general vicinity of the proposed project infrastructure and staging areas in Naic is low-lying, and prone to flooding during periods of heavy rainfall. A flood risk map for this area is shown in Exhibit 6-6. The principal flood risk in this area is from the Timalan River, which can be expected to inundate adjacent lands even in a 5-yr flood event. Interestingly, the expected extent of inundation during a 100-yr event is not significantly broader than for 5- and 25-yr floods. The area around the proposed approach road alignment in Naic is reported by the Naic Municipal Disaster Risk Reduction and Management Office to have flooded in 2014, 2019 and 2020, in all three cases associated with the passage of typhoons. Extreme rainfall during Typhoon Glenda in 2014 flooded the entire low-lying area within Naic to a depth of almost 1 m, and the experience was repeated in 2019 during Typhoon Tisoy, and again in 2020 with Typhoon Rolly. Inadequate drainage systems were considered to have been a significant contributing factor in the flooding during these events.[107] Representatives of the Naic MENRO and MAO indicated during an interview in 2022 that flooding, when it has occurred in Naic, has tended to be quite short-term, and not cause severe economic dislocation or hardship due to the short duration.

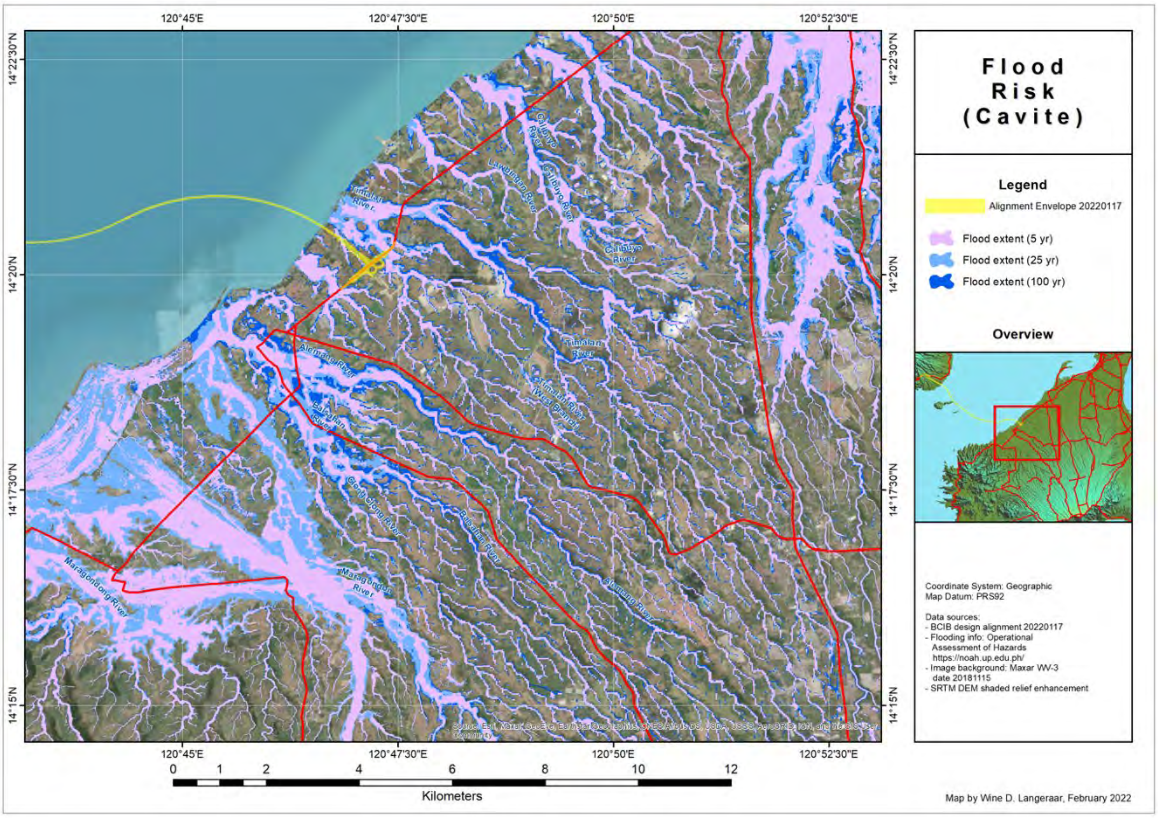


Exhibit 6-6 Flood Risk Map for the BCIB Project Area (Cavite)

6.1.2 Freshwater and Estuarine Ecology

Stream surveys were conducted during 2021 and 2022 in the project area in Bataan and Cavite, in order to construct baseline ecological profiles for the main watercourses within range of possible project impacts. Streams were selected for sampling based on their proximity to the BCIB project footprint and expected construction support sites, and likely exposure to the effects of project activities during the construction and operation of the project.

[107] Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (August 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

The survey of stream ecology encompassed (1) measurement of basic water quality variables (dissolved oxygen, pH, temperature, total dissolved solids, electrical conductivity, salinity); (2) assessment of habitat quality following a US EPA methodology for physical habitat assessment; (3) sampling and laboratory analysis of the abundance and diversity of phytoplankton, zooplankton and macrobenthic organisms; (4) observation of local fishing activity and discussion with locals of fish species, abundance and catch effort; and (5) field interviews with residents regarding typical local uses of aquatic resources. A summary of the findings from the survey are presented and discussed separately for the Bataan and Cavite portions of the BCIB project area in the subsections that follow.

6.1.2.1 Surveyed Streams (Bataan)

A total of three streams were surveyed in Bataan: the Pangolisanin River (three sampling stations), Babuyan River (two stations), and San Jose River (two stations). The locations of the streams and sampling stations are shown in Exhibit 6-7.

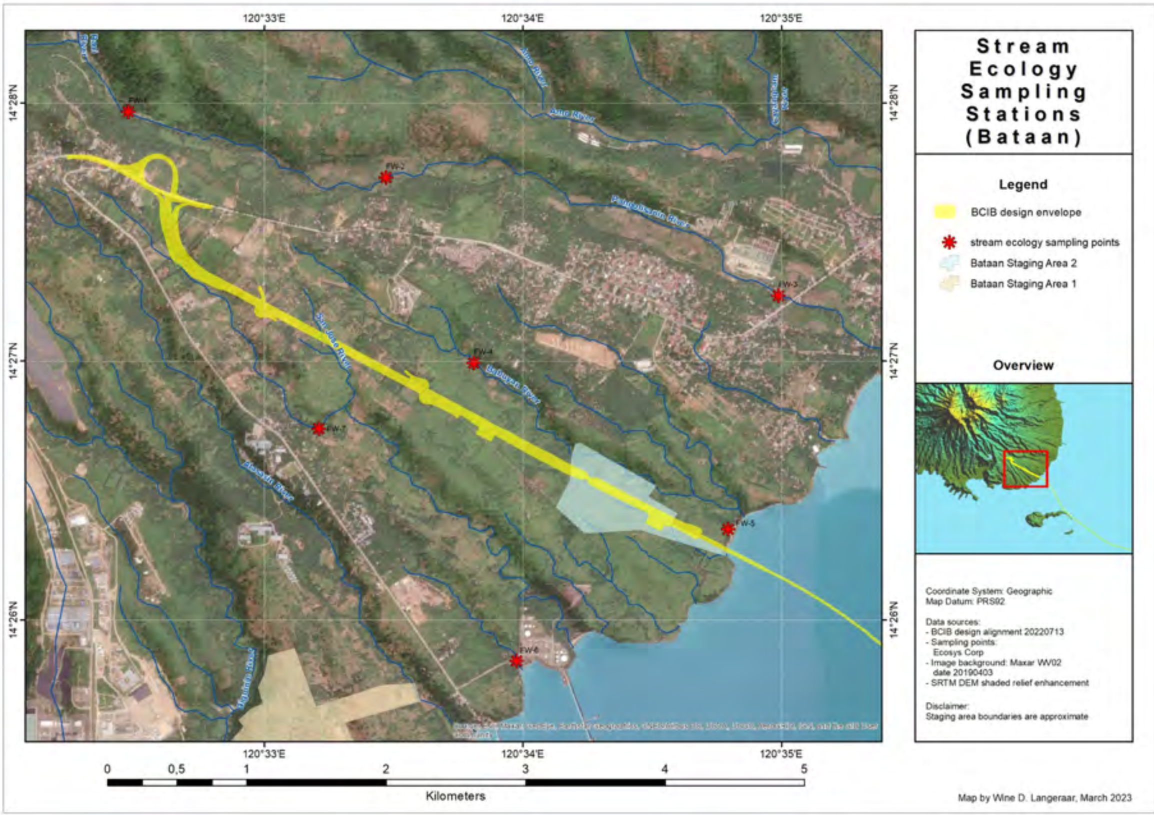


Exhibit 6-7 Freshwater Ecology Sampling Locations (Bataan)

Pangolisanin River

The Pangolisanin River is a substantial rocky stream with a moderate gradient and channel width 8–11 m in its lower reaches. The river has its source in forested land on the steep upper slopes of Mt. Mariveles and runs through mainly agricultural land in a deep valley along the northeast side of the BCIB project area, before discharging to Manila Bay between Mt. View and Cabcaben, about 1.8 km northeast of the alignment. The Pangolisanin River passes within 200 m of the BCIB interchange with the Roman Highway, and is fed by a prominent gully that extends into the interchange ROW. The interchange is the only part of the BCIB project that will generate runoff destined for this river.

As might be expected, the upper reaches of the Pangolisanin River, which drain forest land, are characterized by predominantly natural conditions, while the lower reaches that pass through farmland and settlements (including a new housing development on its banks) are more disturbed. Gravel and sand mining operations exploiting the river's alluvial plain are in evidence upstream of the BCIB project area. Exhibit 6-8 provides a summary of findings from the freshwater ecology assessment of the Pangolisanin River.

Exhibit 6-8 Ecological Assessment of Pangolisanin River

Parameters	Key Findings	Notes
Water quality	• Generally good, mostly compliant with Class C standards and aligned with expected values for TDS and EC	• Low dissolved oxygen (slightly below minimum Class C standard) in downstream station attributed to dumping of sewage and solid waste
Physical habitat conditions	• Optimal upstream, suboptimal midstream, marginal downstream	• Presence of modifications for irrigation and bank protection (armoring), as well as use for waste dumping, contribute to lower habitat quality values in midstream and downstream sections
Phytoplankton communities	• Moderate diversity • Dominated by *Baccillariophyta* genera overall • Some *Melosira* and *Aulacoseira* present at downstream station	• Dominance of diatoms indicative of oligotrophic (nutrient-poor) conditions • Presence of *Melosira* and *Aulacoseira* downstream possibly indicative of eutrophic conditions there
Zooplankton communities	• Zooplankton largely absent	• Absence of zooplankton likely due to strong and turbulent current upstream, and to deleterious effects of waste deposition in lower-energy downstream areas
Macrobenthos	• Moderate diversity overall, with low dominance and high evenness at all stations • Diversity higher in upstream section than downstream section • Presence of insect orders *Ephemeroptera*, *Trichoptera* and *Plecoptera* upstream but not downstream	• Higher diversity in upstream section attributed to lower anthropogenic disturbance • Insect orders *Ephemeroptera*, *Trichoptera* and *Plecoptera* are usually indicators of good water quality
Fish and fishing	• Fish diversity low • *Oreochromis niloticus* (Tilapia) most commonly caught species, followed by *Channa* spp (Snakehead); both are introduced • One native species (*Giuris margaritaceus*) observed, native eel *Anguilla* sp. seldom caught anymore • Freshwater crabs reported caught by locals	• River is not a significant source of fishing livelihood, and is not known to harbor any species of special conservation concern
Habitat classification	• Upstream sections natural habitat (lightly degraded), far downstream section modified habitat	

Babuyan River

The Babuyan River is a stream with several branches which drains a modest catchment in the BCIB project area, mainly between the built-up area of Mt. View and the alignment itself. The western part of the catchment is mostly covered in grassland and farmland, while the eastern part drains residential areas along the Roman Highway. The lower portion of the river is estuarine, and features significant mangrove vegetation. The BCIB alignment crosses one minor seasonal branch of the Babuyan River, and meets the shoreline about 150 m from the river's mouth. Exhibit 6-9 provides a summary of findings from the freshwater ecology assessment of the Babuyan River.

Exhibit 6-9 Ecological Assessment of Babuyan River

Parameters	Key Findings	Notes
Water quality	• Mostly compliant with Class C standards (for parameters assessed), and aligned with expected values for TDS and EC	• Low dissolved oxygen (below minimum Class C standard) in upstream sample attributed to human waste inputs from nearby homes, as well as dumping of solid waste • Elevated salinity in downstream segment linked to estuarine conditions
Physical habitat conditions	• Both upstream and downstream segments assessed as marginal	• Low quality assessment due mainly to heavy modification of riparian vegetation and proximity of residences, as well as heavy use of river for bathing and laundry
Phytoplankton communities	• Mean density moderate to high, but diversity low • Strong dominance of *Cyanophyta* (blue-green algae), especially *Microcystis*	• Dominance of Microcystis is indicative of eutrophic and ecologically unstable waters, attributed in this case to inputs of untreated sewage from river-adjacent residences and drainage from livestock operations (piggeries)
Zooplankton communities	• No zooplankton found	• Absence of zooplankton communities attributed by surveyors to
Macrobenthos	• Moderate diversity, with high evenness values • Dominance of mollusc *Melanoides turricula* and insect family *Tipulidae* recorded	• High relative abundance of algae-grazing *Melanoides turricula* is suggestive of nutrient-enriched conditions favorable to strong algal growth • High relative abundance of *Tipulidae* indicative of high organic matter, possibly linked to inputs of sewage and livestock waste
Fish and fishing	• Fish diversity very low, with only the introduced *Oreochromis niloticus* (Tilapia) and *Channa* spp. (Snakehead) reported • Tilapia is most commonly caught species	• River is fished actively by locals, but is not a significant source of livelihood • River is not known to support any species of special conservation concern
Habitat classification	• Fairly extensive modification of riparian zone, heavy inputs of fecal matter and apparent dominance of introduced species support classification as modified habitat	

San Jose River

The San Jose River is a modest watercourse whose catchment occupies the western side of the BCIB project area; several minor branches of the river will be traversed by the alignment, and some of these will require re-routing. The San Jose River's upper reaches extend as far north as the edge of Alas Asin village, and is likely to receive some urban runoff. The river meets Manila Bay at Alas Asin Beach, about 1.2 km west of the alignment. Exhibit 6-10 provides a summary of findings from the freshwater ecology assessment of the San Jose River.

Exhibit 6-10 Ecological Assessment of San Jose River

Parameters	Key Findings	Notes
Water quality	• Compliant with Class C standards for parameters assessed, and aligned with expected values for TDS and EC • pH surprisingly high (close to upper limit of standard) given generally acidic profile of local soils	• Relatively high water pH despite generally acidic soils in the area may be indicative of inputs from industrial and residential properties in the catchment
Physical habitat conditions	• Both upstream and downstream segments assessed as marginal	• Low quality assessment due principally to heavy agricultural modification of the riparian zone, use for laundry and bathing, and sedimentation

Parameters	Key Findings	Notes
Phytoplankton communities	• Moderate diversity upstream, with relatively high evenness • Low diversity downstream, with strong dominance of one taxon (blue-green algae *Microcystis*) • Overall dominance of Cyanophyta (generally suggestive of eutrophic conditions)	• Strong dominance of *Microcystis* in lower reaches is indicative of eutrophication • Presence of diatom taxa *Aphanothece* and *Surirella* in upstream location may indicate less eutrophic conditions
Zooplankton communities	• No zooplankton found	• Surveyors attribute absence of zooplankton to pollution by industrial and domestic activity in close proximity to the river
Macrobenthos	• Moderate diversity both upstream and downstream, with low dominance and high evenness • Dominant taxa were *Oligochaeta* worms and the mollusc *Melanoides turricula*	• Dominance of *Oligochaeta* and *Melanoides turricula* is often considered indicative of eutrophic conditions, as these taxa are known to feed on organic matter and algae
Fish and fishing	• Locals report that the San Jose River is not favored for fishing because of its polluted condition • No fish were recorded or reported	• The river can be considered unlikely to support significant populations of native fish, and appears to provide negligible fishing subsistence livelihood
Habitat classification	• Extensive modification of the riparian zone, industrial effluents and widespread use of the river for laundry and bathing support classification as modified habitat	

6.1.2.2 Surveyed Streams (Cavite)

Four watercourses were surveyed in Cavite: the Labac River (one sampling station), Timbugan Creek (one station), the main stem of the Timalan River (six sampling stations), and the unnamed west branch of the Timalan River (one station). The locations of the watercourses and sampling stations are shown in Exhibit 6-11. The stations on the Timalan river and Timbugan Creek are of principal interest here, as the BCIB infrastructure and a major staging area are to be sited in the catchments of these rivers.

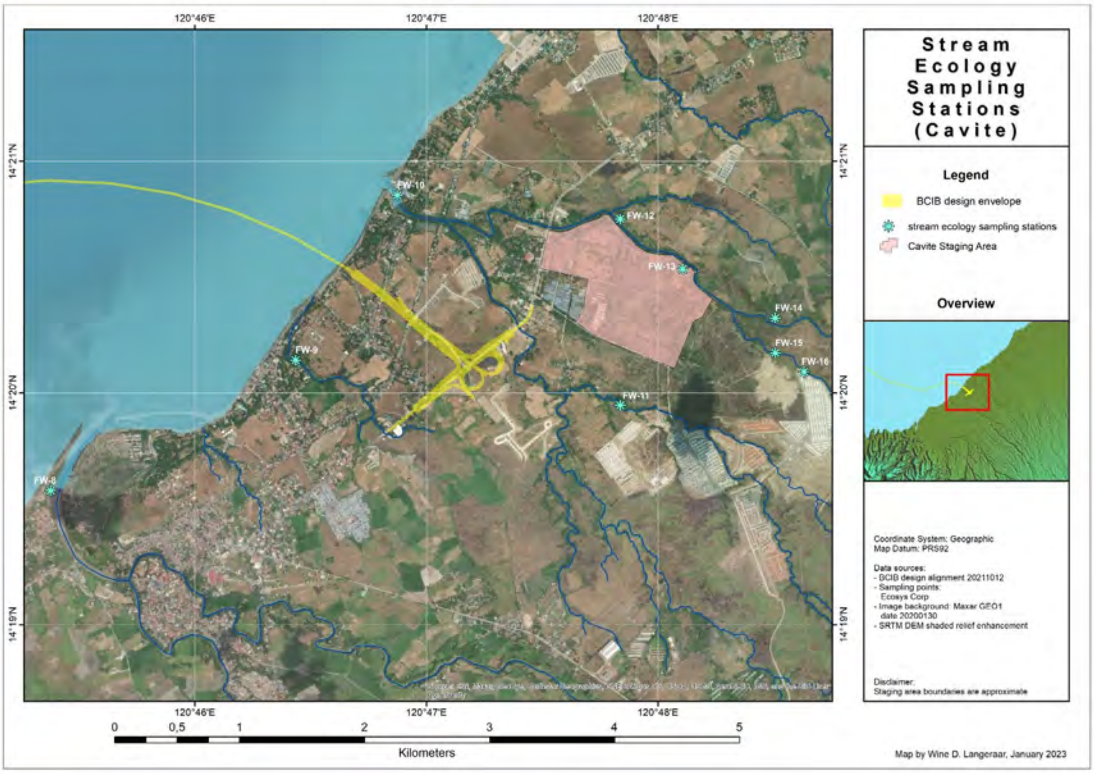


Exhibit 6-11 Freshwater Ecology Sampling Locations (Cavite)

Labac River

The Labac River (also known as the Bucana River and Allemang River) has an estuary and a dynamic set of sandbars at its mouth, which is about 2.2 km southwest of the BCIB alignment's landing point in Timalan Concepcion. The river passes through the center of Naic town, and its eastern branch reaches as far as the provincial capital Trece Martires, a large town that has seen significant residential development in recent years. Accordingly, the river is assumed to receive considerable inputs of urban wastewater and runoff, in addition to agricultural runoff from its mostly semi-rural catchment. The lower reaches of the Labac River feature some mangrove vegetation, and are subject to significant aquaculture and various forms of capture fishery activity. Neither the BCIB project footprint nor the expected staging area will impinge on any part of the catchment of the Labac River, although it is expected that significant project-related haul traffic will traverse the catchment. Exhibit 6-12 provides a summary of findings from the freshwater ecology assessment of the Labac River.

Exhibit 6-12 Ecological Assessment of Labac River

Parameters	Key Findings	Notes
Water quality	• Compliant with Class C standards for parameters assessed, and aligned with expected values for TDS and EC in estuarine environments	
Physical habitat conditions	• The river at the location sampled was assessed as having marginal habitat conditions	• The low quality assessment reflects widespread armoring of riverbanks, housing built over the water in many locations, heavy boat traffic and substantial evidence of solid waste
Phytoplankton communities	• Low diversity, with only six taxa recorded • Moderate density and high evenness • Most abundant taxon is *Aphanothece*, a toxic blue-green algae associated with nutrient-enriched waters	• Abundance of *Aphanothece* is concordant with the observed presence of discharges of raw sewage from residences and other buildings built over the water
Zooplankton communities	• Very low diversity, with only two taxa recorded • Very low abundance, with only one individual identified per taxon recorded	• Surveyors attribute low zooplankton abundance and diversity to heavy inputs of solid waste and generally heavy disturbance by boat traffic
Macrobenthos	• Moderate diversity, with low dominance and high evenness • Most abundant taxon is *Oligochaeta* worms, followed by the gastropods *Melanoides tuberculata* and *Nassarius*	• *Oligochaeta* worms are associated sediments rich in organic matter, and their relative abundance may indicate high anthropogenic inputs of organic matter in the form of sewage, aquaculture effluents, and solid waste
Fish and fishing	• *Oreochromis niloticus* (Tilapia) and *Mugil cephalus* (Mullet) are fished for subsistence purposes, although the river is reportedly not favored as a fishing ground due to abundant evidence of human waste pollution • Shrimp (possibly *Macrobrachium*) and crabs are also reported to be fished here, for subsistence	• The survey likely underestimates the diversity of species present, given that some portions of the estuary are lined with significant mangrove patches • Although there is no evidence of a commercial fishery, subsistence fishing may be of significance for some locals
Habitat classification	• Based on widespread bank modification, heavy boat traffic, use of the river for aquaculture, accumulation of solid waste and plentiful inputs of sewage, the lower portion of the Labac river is classified as a modified habitat	

Timbugan Creek

With its mouth about 450 m southwest of the BCIB landing point, Timbugan Creek is the closest watercourse to the main approach road alignment. This small watercourse is mostly estuarine, and has some minor patches of mangrove vegetation. The upper reaches of the small catchment include the western end of the BCIB interchange works footprint, and one branch of the creek passes beneath the Antero Soriano Highway at this location. Most of the Timbugan Creek catchment consists of land under agricultural use (mainly rice paddies and pasture), but limited residential and commercial development can be found along road corridors. Exhibit 6-13 provides a summary of findings from the freshwater ecology assessment of Timbugan Creek.

Exhibit 6-13 Ecological Assessment of Timbugan Creek

Parameters	Key Findings	Notes
Water quality	• Extremely low level of dissolved oxygen (1.2 mg/L) recorded	• Dissolved oxygen levels below 2.0 mg/L are typically deadly for many fish species
Physical habitat conditions	• Habitat quality was assessed as poor • Channelization, direct sewage discharges and foul odor were recorded	• The lower reaches of Timbugan Creek are mostly channelized (with concrete walls) and surrounded by a resort complex and a residential area
Phytoplankton communities	• Low diversity, with only five taxa recorded • High mean density of phytoplankton, almost all of which was accounted for by the blue-green algae *Microcystis*	• High dominance of *Microcystis* is strongly indicative of intense enrichment
Zooplankton communities	• No zooplankton were recorded	• Absence of zooplankton is not surprising, given foul smell and very low dissolved oxygen levels, both indicative of anoxic conditions
Macrobenthos	• No macrobenthic animals were recorded	
Fish and fishing	• No fishing activity was reported in the surveyed segment of Timbugan Creek, and no fish or fishing were observed	• Absence of fishing activity is unsurprising, given apparent anoxic conditions
Habitat classification	• The lower Timbugan Creek is a highly modified environment. Upstream segments of the creek were not surveyed, but based on land use, it is considered unlikely that they would be considered natural habitat, despite not being as heavily modified as the lower part.	

Timalan River (Main Stem)

The Timalan River has a significant catchment that drains a mixed landscape of cultivated land (mostly rice paddies) and residential developments, and occasional industrial facilities. There is a partly functional sluice gate on the east branch of the river about 3 km linear distance upriver from the mouth, and a dam with a 15-ha reservoir approximately 7 km from the mouth. The lower reaches of the river feature some mangrove vegetation, and are intensively used for aquaculture and capture fisheries. Exhibit 6-14 provides a summary of findings from the freshwater ecology assessment of the main stem of the Timalan River.

Exhibit 6-14 Ecological Assessment of Timalan River (Main Stem)

Parameters	Key Findings	Notes
Water quality	• Dissolved oxygen levels very low across all six stations sampled in this river, ranging from 1.8 mg/L to 3.7 mg/L (Class C standard is 5.0 mg/L) • Downstream samples reflect estuarine conditions with respect to salinity, TDS and EC, while upstream samples reflect freshwater conditions	• Low dissolved oxygen levels are likely attributable to direct and minimally treated sewage from structures built directly over the river and upstream residential subdivisions, and possibly also aquacultural effluents

Parameters	Key Findings	Notes
Physical habitat conditions	• Habitat quality classified as marginal at all six sampling stations, with channel alteration, riparian width, shading and basin land cover contributing especially to the assessment	• Significant portions of the riverbank are armored with concrete • Many homes are built directly over the water • Patches of arboreal mangrove vegetation are found along the river
Phytoplankton communities	• Low diversity, with high dominance values and low evenness • Overall abundance moderate • *Cyanophyta* (blue-green algae) were dominant in all segments, with the toxic *Aphanothece* most abundant in the upper reaches, and *Microcystis* most abundant in downstream locations	• Prevalence of *Aphanothece* in upstream locations is likely attributable to the presence of several medium-density residential estates in the area, with high nutrient inputs to be expected from minimally-treated sewage • Prevalence of *Microcystis* in downstream locations is indicative of enrichment, but also may indicate dilution of human waste inputs from upstream housing to levels unfavorable to dominance of *Aphanothece*
Zooplankton communities	• Generally low diversity and abundance, with only moderate variation across stations • *Arthropoda* dominant, accounting for 75% of individuals counted • Significant presence of *Rotifera* taxa documented, accounting for nearly 25%	• Presence of *Rotifera* is usually indicative of eutrophic conditions, as they tend to thrive on detritus, bacteria and algae
Macrobenthos	• Taxa richness relatively high when counting all stations, but ranging from low to moderate within stations • *Annelida* and *Mollusca* dominant, in approximately equal proportions • Oligochaeta dominant among Annelida, Melanoides dominant among Mollusca • No *Insectidae* taxa documented	• Dominance of Oligochaeta is suggestive of high organic matter, which may come from human waste • Dominance of algae-grazing *Melanoides* is suggestive of eutrophication • Presence of *Insectidae* such as *Ephemeroptera*, *Plecoptera* and *Trichoptera* is usually indicative of good water quality, and absence of these taxa across all six stations strongly corroborates other indications of poor water quality along the Timalan River
Fish and fishing	• Five fish species reported or observed in the Timalan River, including *Oreochromis niloticus* (Nile Tilapia), *Sarotherodon melanotheron* (Blackchin Tilapia), *Glossogobius giuris* (Bar-Eye Goby), *Hemiramphidae* spp. (Half-Beaks) and *Tetraodontidae* spp. (Pufferfish)	• Fishing carried out on the river is for subsistence only, and appears to be a very marginal activity • Three fish species documented are native species, while two are introduced (all are listed as Least Concern by IUCN)
Habitat classification	• In view of significant channel modification, prevalence of housing built over the river, and heavy inputs of sewage strongly shaping species composition, the main stem of the Timalan river is appropriately classified as modified habitat.	

Timalan River (West Branch)

The west branch of the Timalan River is shorter and smaller than the main stem, and includes most of the BCIB interchange site in its catchment. The river passes under the Antero Soriano Highway just east of the interchange, and is within the project works footprint at this location. This branch of the river is estuarine and appears to have some mangrove vegetation, but is not as intensively used for aquaculture as the main stem. Most of the catchment is still agricultural, although some quite large housing estates have been built in recent years. Exhibit 6-15 provides a summary of findings from the freshwater ecology assessment of the west branch of the Timalan River.

Exhibit 6-15 Ecological Assessment of Timalan River (West Branch)

Parameters	Key Findings	Notes
Water quality	• Extremely low levels of dissolved oxygen recorded (1.8 mg/L) • Levels of salinity, EC and TDS indicate that the sampled location is freshwater rather than estuarine • Foul odor was noted	• DO levels below 2.0 mg/L are inhospitable (deadly) to most fish • Low DO levels at the sampled location are very likely the result of three residential subdivisions having been built directly upstream
Physical habitat conditions	• Based on the single sampling location selected, habitat quality was classified as poor, with low scores for all habitat parameters	•
Phytoplankton communities	• Low diversity, with just four taxa documented • Strong dominance of *Cyanophyta*, principally *Microcystis* and *Aphanothece*	• Dominance of *Microcystis* and *Aphanothece* is strongly indicative of eutrophic conditions, which accords with low levels of DO
Zooplankton communities	• No zooplankton were recorded	• Absence of zooplankton is consistent with apparently anoxic conditions
Macrobenthos	• No macrobenthic animals were recorded	• Absence even of macrobenthic fauna is indicative of severe pollution, in this case almost certainly coming from subdivisions directly upstream
Fish and fishing	• No fish or fishing activity were documented at or near the location selected for sampling	• Presence of fish would be surprising at this location, given an evident lack of oxygen, zooplankton and macrobenthic animals
Habitat classification	• Given heavy pollution producing conditions generally hostile to aquatic life, the west branch of the Timalan River is appropriately classified as modified habitat.	

6.1.3 Freshwater Quality (Surface water)

Surface water quality was assessed by analysis of samples collected from several streams in the project area. Streams were selected for sampling based on their anticipated exposure to project-related activities, taking account of both the construction and operation phases of the project. A first round of sampling was carried out on a subset of streams in February 2000, based on preliminary information then available regarding the expected project footprint and construction support sites. A second round of sampling was conducted in October 2021 and May 2022 to complement the earlier data and build a comprehensive surface water quality dataset covering the project sites as understood at the late detailed design stage.

All surface water samples were subject to analysis by an accredited laboratory in relation to 25 parameters, and the results were compared to the Class C standards specified by DAO 2016-08 Water Quality Guidelines and General Effluent Standards of 2016, as updated by DAO 2021-19 Updated Water Quality Guidelines (WQG) and General Effluent Standards (GES) for Selected Parameters. The choice of applicable standard is based on the prescribed uses of the water body rather than measured water quality. All of the sampled watercourses were considered to be Class C, which applies to waters used for the propagation and growth of fish and other aquatic resources; boating, fishing, or similar activities; and for agriculture, irrigation and livestock watering. Only one of the sampled watercourses, the Timalan River in Cavite, has been specifically classified by DENR-EMB; Class C was the assigned designation.

It is appropriate to note here that water quality in surface water bodies, particularly streams and rivers, is typically highly variable over time, and the data presented here are most appropriately understood as a snapshot that can inform a general understanding of the relevance of anthropogenic disturbance factors, and of the diversity of conditions that exist across watercourses within the BCIB project area. The data presented below are not to be taken as a pre-construction baseline, against which construction-phase and operation-phase monitoring data are to be compared to draw inferences regarding project impacts. Monitoring of water quality during construction and operation will more appropriately detect causality by means of comparison between upstream-downstream data pairings.

6.1.3.1 Bataan Watercourses

Water samples were collected from eight sampling stations representing seven rivers and streams around the Mariveles portion of the BCIB project area (see Exhibit 6-16). The sampled streams were the Diguinin River (FW1), Real River (tributary of the Pangolisanin River – FW2), Pangolisanin River proper (FW3, FW4), Babuyan River (FW8), San Jose River (FW9), Alas Asin River (FW11) and Amo River (FW11). The BCIB project footprint and proposed staging areas are located within the catchments of five of these watercourses. Results from laboratory analysis of the samples collected are presented in Exhibit 6-17

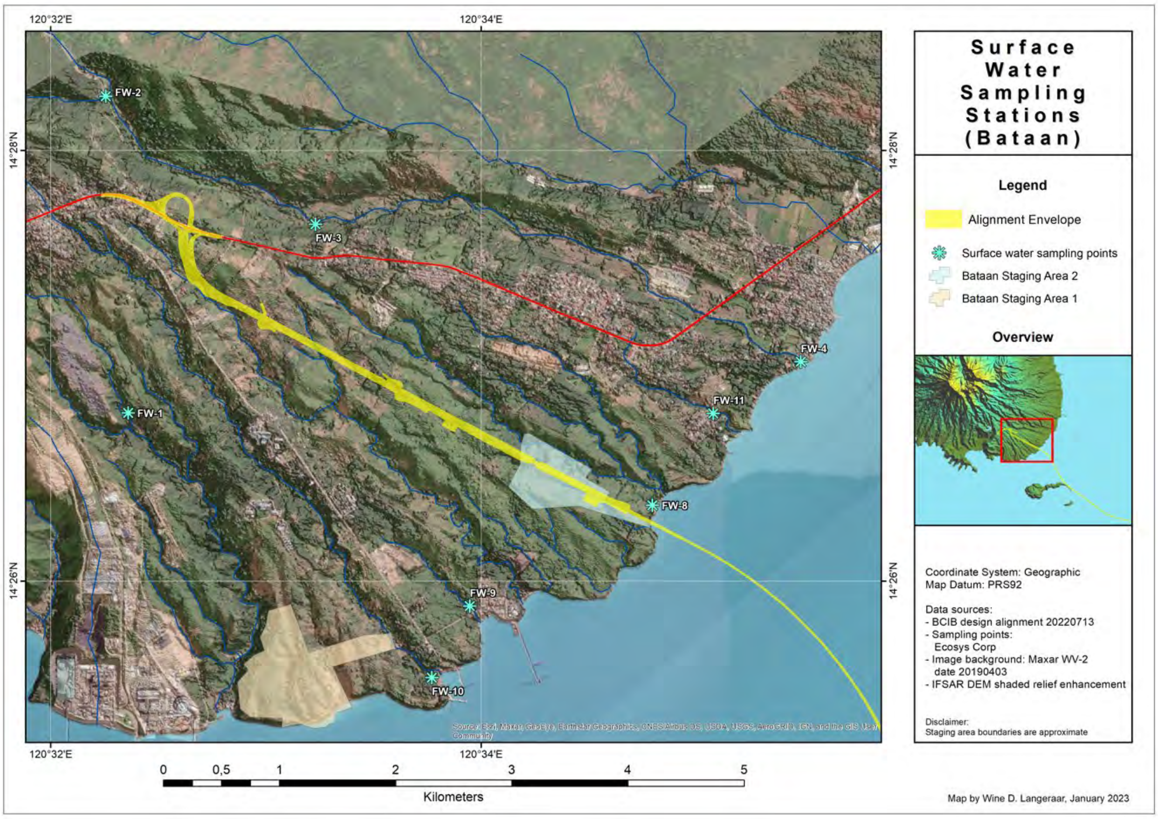


Exhibit 6-16 Surface Water Sampling Stations, Mariveles

Exhibit 6-17 Results from Analysis of Surface Water Samples, Mariveles

Parameter	Unit	DAO 2016-08[1] Class C	FW1	FW2	FW3	FW4	FW8	FW9	FW10	FW11
Temperature	°C	25–31	26.7	25.7	26.7	25.7	28.3	29.1	29.3	28.1
pH	-	6.5-9.0	6.40	7.90	7.58	7.70	7.2	6.9	7.1	7.6
TDS	ppm	-	55	149	50	1260	1,780	51	2,220	88
BOD	mg/L	7	2.3	4.4	ND	8.0	2.8	4.3	3.7	2.2

Parameter	Unit	DAO 2016-08[1] Class C	FW1	FW2	FW3	FW4	FW8	FW9	FW10	FW11
Color	TCU	75	10	10	5	10	25	30	25	10
COD	mg/L	-	21	32	34	38	65	8	84	17
DO	mg/L	5	3.26	1.72	3.21	4.31	5.66	6.31	6.23	5.48
Turbidity	NTU	-	2.2	1.2	1.3	1.6	19.0	35.0	28.0	8.9
Salinity	ppt	-	0.3	ND	0.4	0.7	1.0	ND	1.1	ND
TSS	mg/L	80	ND	ND	ND	ND	11	8	25	8
Oil & Grease	mg/L	2	ND	ND	ND	ND	ND	ND	2.3	ND
Cyanide	mg/L	0.1	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate	mg/L as N	7	0.67	0.96	0.50	0.35	0.15	0.36	1.26	1.77
Phosphate	mg/L as P	0.025	0.036	0.156	0.043	0.067	0.021	0.042	0.045	0.032
Chloride	mg/L	350	8	37	7	1,210	574	10	654	18
Ammonia	mg/L as N	0.06	ND	0.59	ND	ND	ND	ND	ND	ND
Fecal coliform	MPN/ 100ml	200	2,200	700	940	2,800	17,000	14,000	2,200	14,000
Arsenic	mg/L	0.02	0.004	0.004	0.004	0.004	<0.00697	<0.00697	<0.00697	<0.00697
Cadmium	mg/L	0.005	0.001	0.001	0.001	0.001	<0.000723	<0.000723	<0.000723	<0.000723
Hexavalent chromium	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND	ND
Lead	mg/L	0.05	0.005	0.005	0.005	0.005	<0.00365	<0.00365	<0.00365	<0.00365
Mercury	mg/L	0.002	ND	ND	ND	ND	<0.00007	<0.00007	<0.00007	<0.00007
Nickel	mg/L	0.2	0.002	0.002	0.002	0.002	<0.00973	<0.00973	<0.00973	<0.00973
Zinc	mg/L	2	0.010	0.010	0.010	0.010	<0.00712	<0.00712	<0.00712	0.0158
Vanadium	mg/L	-	0.133	0.133	0.133	0.133	<0.561	<0.561	<0.561	<0.561

Notes

[1] As updated by DAO 2021-19

ND = none detected; Red type indicates exceedance of national standard

The data presented in Exhibit 6-17 indicate a series of samples that meet the Class C standards in relation to most parameters, but none of the samples meet the standard for every parameter. The most frequently violated standard is for fecal coliform (all stations non-compliant), phosphate (six of eight non-compliant) and dissolved oxygen (four of eight below the allowable minimum level). Less frequent exceedances were recorded for pH, ammonia, chloride, and oil and grease. It is notable that none of the samples came anywhere close to exceeding the limits on any of the metals and major cations. Specific incidences of non-compliance are discussed in turn below.

pH. Only one station showed pH outside the prescribed range of 6.5–8.5; this was FW1 in the Diguinin River. The recorded level was only slightly below the lower end of the range, at 6.4. It is unclear if or how this minor exceedance might be attributable to any particular site condition.

Biological oxygen demand (BOD). The sample from only one station (FW4) exceeded the maximum limit, with 7.99 mg/L as compared to the standard of 7.00 mg/L. This sampling station was located near the mouth of the Pangolisanin, downstream of where the river passes through agricultural areas and then the built-up area of Cabcaben, a location where an exceedance should not be particularly surprising.

Dissolved oxygen. Low levels of oxygen were recorded at FW1, FW2, FW3 and FW4. All were significantly below the minimum level of 5.00 mg/L. Dissolved oxygen in the sample at FW2 was very low, at just 1.72 mg/L. Low dissolved oxygen is perhaps unsurprising at the FW1 station (downstream from a series of pastures) and at FW4 (in the middle of a built-up area), where enrichment may well have played a factor. The more surprising readings are at the FW2 and FW4 stations, which were both on relatively steep-gradient rocky watercourses draining mostly forested land, which might normally be expected to produce good aeration and relatively low temperature. Micro-local factors such as eddies or septic outfall may have been contributing factors at these sampling stations.

Oil and grease. Only one sample, from the FW10 station, showed any detectable oil and grease, and this was an exceedance (2.27 mg/L as compared to the Class C standard of 1.00). This sampling station was located within a small streamside community, and it seems probable that the oil and grease recorded was due to an instance of dumping waste oil, a leaking tank, or deposition of solid waste in the stream.

Phosphate. Excessive phosphate in surface water can typically be attributed to agricultural land use (fertilizer use and livestock), and also to use of detergents in laundry and other domestic cleaning tasks. Phosphate levels were high at most stations; only the samples collected at station FW2, on a river with a forested catchment, and at station FW8, which is in a mangrove area, had acceptable levels.

Chloride. Measured levels of chloride at stations FW4, FW8 and FW10 were well in excess of the upper Class C limit, and hundreds of times higher than levels at the other stations. This outlier status is almost certainly linked to the coastal locations of these stations, as they also have the highest observed levels of total dissolved solids and salinity.

Ammonia. Only one sample, collected at station FW2, had any detectable ammonia, and at a level 10 times higher than the maximum specified for Class C. Elevated ammonia in surface water can be attributed to numerous possible factors, both natural and anthropogenic. Based on the characteristics of the Real River and land use in its catchment, septic leakage or perhaps a small livestock operation upstream, or disturbance of rotting sediments around the sampling site, seem like the most likely cause. Sample from this station also had very low dissolved oxygen, probably linked to the same cause as the elevated ammonia.

Fecal coliform. Measured levels of fecal coliform ranged from 700–17,000 MPN/100 ml across the eight Mariveles stations, well in excess of the 200 MPN/100 ml allowable for Class C waters. Septic leakage, raw human waste discharge and runoff from livestock pens and pastures are the principal causes of elevated fecal coliform in surface water. The exceedances in all stations are a testament to the lack of any sewage treatment beyond septic in all settled areas of Mariveles, as well as the prevalence of livestock on the landscape. The

FW8 station, with the highest observed level, was located on the Babuyan River, which is known to have a number of piggeries in its catchment.

6.1.3.2 Cavite Watercourses

Water samples were collected from seven sampling stations representing three watercourses around the Naic portion of the BCIB project area (see Exhibit 6-18). The watercourses sampled are the two main branches of the Timalan River (FW5, FW6, FW7, FW16, FW17, FW18), Timbugan Creek (FW13, FW14), and a small unnamed creek to the northeast of the Timalan River (FW15). The west branch of the Timalan River and the upper reaches of Timbugan Creek intersect the project footprint near the interchange site, while the proposed staging area serving the Cavite side of the project will have about 1.6 km of frontage on the east branch of the Timalan River. The unnamed creek to the northeast of the project area was sampled because a spoils disposal site had been proposed for its catchment at one time (it is no longer under consideration at the time of writing).

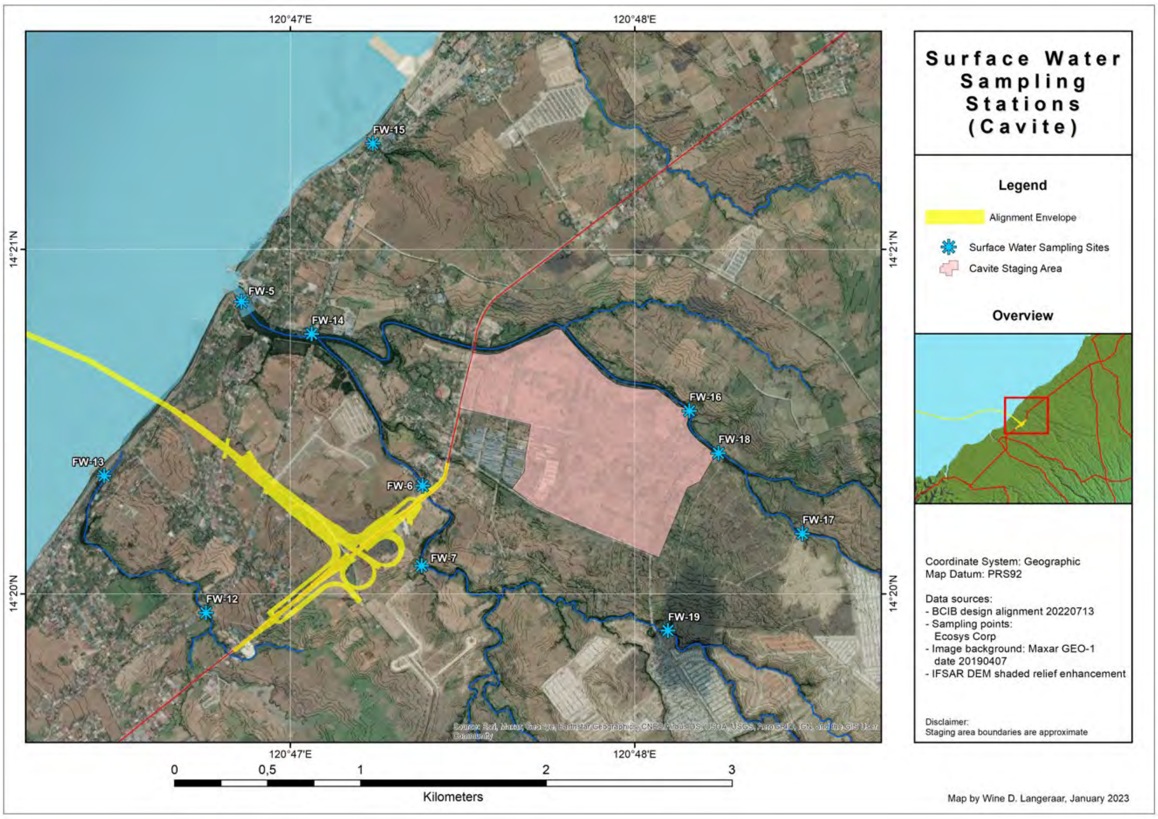


Exhibit 6-18 Surface Water Sampling Stations, Naic

Results from laboratory analysis of the collected samples are presented in Exhibit 6-19. Patterns of strong exceedance of prescribed limits are evident in relation to some parameters; these are discussed in turn below.

Temperature. Five of the 11 stations sampled exceeded the upper limit of the prescribed temperature range for Class C waters. This can be attributed to shallowness and stagnation, as well as a lack of shading by tree canopies, at the non-compliant stations.

Biological oxygen demand (BOD). Water sampled at nine of the eleven Cavite stations had BOD levels in excess of the maximum level stipulated in the standard. Some samples were very substantially over the limit; measured BOD was more than twice as high as permitted at FW7 and FW13, more than three times as high at FW19, and about four times the specified maximum at FW6. The observed pattern of non-compliance is readily attributed to heavy inputs of nutrients and organic matter from agricultural activity and settlements; FW19 is located next to a large housing estate and likely receives at least part of its sewage output, for example, and FW6 and FW7 are situated in rice-growing areas, where fertilizer use is likely heavy (and are also downstream from the same residential estate). The FW13 station is within a residential area, and next to a beach resort.

Dissolved oxygen (DO). Levels of DO were found to be quite low across the board, and even the four stations meeting the minimum standard did not do so by large margins. Some stations (notably FW6, FW7 and FW13) showed DO levels that are below 2 mg/L, which is considered to be a deadly level for most fish. Low levels of DO can be caused by several factors, in this case most likely concentrated decomposition taking place in the water column, a response to excessive inputs of organic materials from runoff or waste disposal. The elevated BOD noted above is certain to be linked to the low-DO conditions documented.

Phosphate. Exceedances were documented in relation to phosphate levels at all of the stations sampled in Cavite. Water sampled at some stations was dramatically over the prescribed maximum; phosphates measured at FW19 (adjacent to a housing estate) were about 80 times the limit. Even the most favorable result (at FW12) was still nearly three times the maximum permitted under the standard. High phosphate levels are commonly attributed to use of fertilizers on agricultural land and urban lawns, as well as discharges from residential areas, which may contain phosphates from detergents and minimally-treated sewage. Even slightly elevated phosphorus is often linked to depleted DO (as noted above), because it typically causes oxygen-hungry algal growth.[108]

Chloride. Water samples collected at five stations (FW5, FW13, FW14, FW15, FW16) showed high chloride levels. All of these stations were in estuarine settings, and all but one also had high salinity, making it probable that the chloride measured was mostly in the form of sodium chloride. This is to be expected for estuarine waters.

Ammonia. Ammonia in surface water is toxic to aquatic organisms, commonly causing impaired growth, reduced gill function and other problems, and in extreme cases, massive fish kills. Ammonia also tends to deplete dissolved oxygen due to its promotion of decomposition and fertilizing effect on algae. Ammonia in surface water is commonly derived from fertilizer use and livestock and human waste.[109] Samples from 10 of the 11 stations showed exceedances in relation to ammonia, and all exceedances were large; even the most favorable measurement was nine times higher than the prescribed limit.

Fecal coliform. Only one station of the 11 sampled met the maximum limit of 200 MPN specified in the national standard for fecal coliform in Class C waters, and then only just. Most of the samples had levels many times the limit. These results are indicative of the very limited extent of sewage treatment in the project area. The elevated fecal coliform documented corroborates the other findings discussed above, in relation to BOD, phosphates, ammonia, and DO.

[108] US EPA. 2022. National Aquatic Resource Surveys – Indicators: Phosphorus. https://www.epa.gov/national-aquatic-resource-surveys/indicators-phosphorus.
[109] US EPA. 2022. CADDIS Volume 2 – Ammonia. https://www.epa.gov/caddis-vol2/ammonia.

Exhibit 6-19 Results from Laboratory Analysis of Surface Water Samples, Cavite

Parameter	Unit	DAO 2016-08[1] Class C	FW5	FW6	FW7	FW12	FW13	FW14	FW15	FW16	FW17	FW18	FW19
Temperature	°C	25–31	30.5	28.5	28.5	27	29	29.9	31.5	33.2	33.7	33.5	33.1
pH	-	6.5-9.0	7.6	7.7	7.5	7.2	7.3	7.2	7.3	7.1	7.4	7.3	7.5
TDS	ppm	-	24,100	922	496	117	6,150	8,730	430	8,306	3,548	3,080	4,493
BOD	mg/L	7	11.1	27.9	17.1	9.7	15.1	10.0	9.1	2.8	7.9	3.7	23.1
Color	TCU	75	25	25	25	30	25	25	25	15	15	15	25
COD	mg/L	-	335	80	61	31	147	240	35	6	34	24	45
DO	mg/L	5	4.54	1.97	1.76	3.45	1.90	2.73	4.76	5.80	5.50	5.90	5.90
Turbidity	NTU	-	40.0	45.0	39.0	50.0	24.0	12.0	50.0	10.0	4.2	7.9	18.0
Salinity	ppt	-	20.9	0.7	0.4	ND	7.7	8.0	0.3	7.3	0.4	0.3	0.5
TSS	mg/L	80	80	51	54	50	37	11	52	NA	NA	NA	NA
Oil & Grease	mg/L	2	1.1	1.4	1.3	ND	ND	ND	ND	ND	ND	ND	ND
Cyanide	mg/L	0.1	0.09	ND	ND	ND	ND	ND	ND	0.06	ND	ND	ND
Nitrate	mg/L as N	7	0.12	0.44	0.65	0.86	0.25	0.15	0.52	0.32	0.04	0.68	0.04
Phosphate	mg/L as P	0.025	0.510	1.390	1.430	0.069	0.778	0.604	0.506	1.000	0.590	0.838	2.120
Chloride	mg/L	350	15,900	260	40	26	5,640	5,890	945	4,550	28	50	48
Ammonia	mg/L as N	0.06	2.40	7.74	8.73	1.12	1.74	4.22	ND	0.55	12.40	2.43	88.00
Fecal coliform	MPN/100ml	200	3,500	9,200	9,200	17,000	3,300	1,300	7,900	200	3,600	1,100	11,000
Arsenic	mg/L	0.02	0.004	0.004	0.004	<0.00697	<0.00697	<0.00697	<0.00697	<0.00416	<0.00416	<0.00416	<0.00416
Cadmium	mg/L	0.005	0.001	0.001	0.001	<0.000723	<0.000723	<0.000723	<0.000723	<0.000727	<0.000727	<0.000727	<0.000727

Parameter	Unit	DAO 2016-08[1] Class C	FW5	FW6	FW7	FW12	FW13	FW14	FW15	FW16	FW17	FW18	FW19
Hexavalent chromium	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	mg/L	0.05	0.005	0.005	0.012	<0.00365	<0.00365	<0.00365	<0.00365	<0.00517	<0.00517	<0.00517	<0.00517
Mercury	mg/L	0.002	ND	ND	ND	<0.00007	<0.00007	<0.00007	<0.00007	<0.095	<0.095	<0.095	<0.095
Nickel	mg/L	0.2	0.002	0.002	0.002	<0.00973	<0.00973	<0.00973	<0.00973	<0.00128	<0.00128	<0.00128	<0.00128
Zinc	mg/L	2	0.01	0.01	0.01	<0.00712	<0.00712	<0.00712	<0.00712	<0.0102	<0.0102	<0.0102	<0.0102
Vanadium	mg/L	-	0.133	0.133	0.133	<0.561	<0.561	<0.561	<0.561	<0.133	<0.133	<0.133	<0.133

Notes [1] As updated by DAO 2021-19; ND = none detected; NA = not analysed; Red type indicates exceedance of national standard

6.1.4 Groundwater Quality and Availability

6.1.4.1 Bataan

Being downslope of a mostly forested, lightly populated mountainside, the Bataan portion of the BCIB project area is well positioned to benefit from groundwater recharge occurring in upslope areas. The groundwater map in Exhibit 6-22 indicates that the southern coast of the Bataan peninsula falls within a 'difficult area' for groundwater; this is an apparent reflection of the preponderance of volcanic rock, which in many cases may not favor formation of significant aquifers.[110] However, there are numerous municipal and private wells within the built-up areas near the proposed BCIB alignment, and all water supplied to this part of Mariveles by the Mariveles Water District is sourced from wells (the FAB has its own surface water reservoir and water supply system, and supplies some barangays, but not those in the immediate project area). Groundwater is not reported to be a significant concern in the project area.

A total of six wells were sampled in the Bataan portion of the BCIB project area; the locations of the sampled wells are shown in Exhibit 6-20. Results from laboratory analysis of the samples collected are presented in Exhibit 6-21.

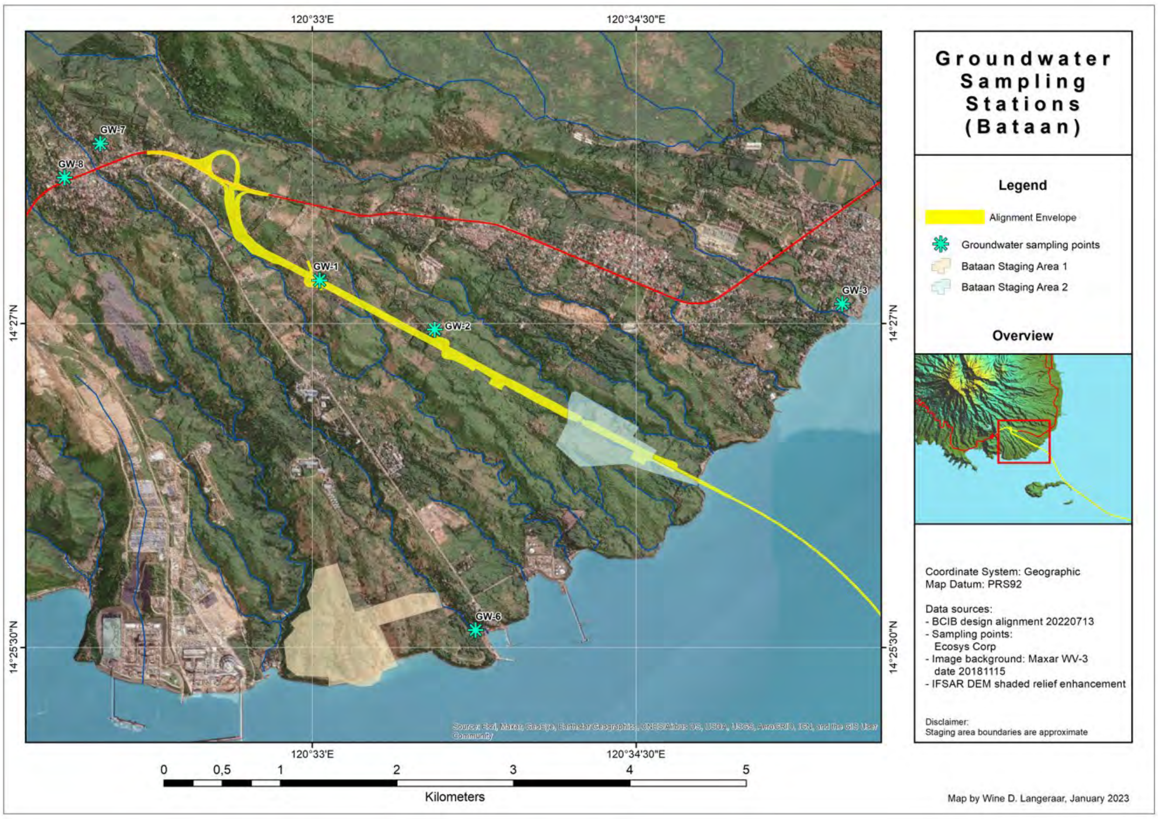


Exhibit 6-20 Groundwater Sampling Stations in Mariveles

[110] PEMSEA and MBEMP-MBIN. 2007. Manila Bay Area Environmental Atlas. PEMSEA Technical Report 20. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and the Manila Bay Environmental Management Project (MBEMP) – Manila Bay Area Information Network (MBIN), Quezon City.

The data presented in Exhibit 6-21 are broadly indicative of groundwater compliant with the national drinking water standards. Exceedances were found in relation to only a few parameters at selected wells; these are discussed below.

Exhibit 6-21 Results from Analysis of Groundwater Samples, Mariveles

Parameter	Unit	PNSDW 2017[1]	GW-1	GW-2	GW-3	GW-6	GW-7	GW-8
Temperature	°C	-	26.9	27.7	26.3	26.9	27.3	27.1
pH	-	6.5-8.5	9.2	6.8	7.1	6.8	6.7	6.2
TDS	ppm	600	66	80	388	44	65	74
BOD	mg/L	-	5.29	2.35	5.59	6.98	ND	4.88
Color	TCU	10	5	5	5	30	5	5
COD	mg/L	-	12	20	20	21	8	14
DO	mg/L	-	3.17	1.91	1.34	2.91	2.25	2.35
Turbidity	NTU	5	6.3	6.7	6.9	12.0	0.8	4.3
Salinity	ppt	-	0.37	ND	0.24	ND	ND	ND
TSS	mg/L	-	5.4	ND	6.4	7.4	ND	7.4
Oil and Grease	mg/L	-	ND	ND	ND	ND	ND	ND
Cyanide	mg/L	0.5	0.105	ND	ND	ND	ND	ND
Nitrate	mg/L as N	50	0.78	0.84	0.04	0.28	7.25	3.18
Phosphate	mg/L as P	-	0.043	0.033	0.295	0.024	0.018	0.012
Chloride	mg/L	250	6.0	8.0	44.0	43.3	19.4	7.3
Ammonia	mg/L as N	-	0.162	0.425	0.140	ND	ND	ND
Fecal Coliform	MPN/ 100ml	-	23	3	23	>8	>8	>8
Arsenic	mg/L	0.01	0.007	0.007	0.007	<0.00697	<0.00697	<0.00697
Cadmium	mg/L	0.003	0.001	0.001	0.001	<0.000723	<0.000723	<0.000723
Hexavalent Chromium	mg/L	-	ND	ND	ND	ND	ND	ND
Lead	mg/L	0.01	0.004	0.004	0.004	<0.00365	<0.00365	<0.00365
Mercury	mg/L	0.001	ND	ND	ND	<0.000070	<0.000070	<0.000070
Nickel	mg/L	0.07	0.010	0.010	0.010	<0.00973	<0.00973	<0.00973
Zinc	mg/L	5	0.007	0.007	0.007	<0.00712	<0.00712	<0.00712
Vanadium	mg/L	-	0.140	0.140	0.140	<0.561	<0.561	<0.561

Notes

[1] Philippine National Standards for Drinking Water of 2017 (Department of Health Administrative Order DOH 2017-0010)

Data in red type indicates a violation of the national standard

ND = none detected

The acceptable pH range indicated in the national standards is 6.5–8.5, and samples from two stations were outside of this range. pH at GW-1 was recorded as 9.22; this alkalinity is of some potential concern because of the coincidence of ammonia in the sample. High pH in combination with ammonia may be indicative of the presence of ammonium hydroxide. This compound, which is used as a herbicide, fungicide and sterilant, has moderate mammalian toxicity and is thought to have some potential for bioaccumulation.[111] The inferred presence of ammonium hydroxide may be attributable to an agricultural application or leak from storage in the vicinity of the sampled well. The well is situated in an area where orchards are prevalent.

The low pH value recorded at GW-8 is less of a concern, and is likely to reflect background soil acidity. With the exception of the high reading at GW-1, samples from all of the wells had pH levels in the lower end of the permissible pH range. Antipolo Clays, which are the predominant soil type in Mariveles, are known to be strongly acidic.[112]

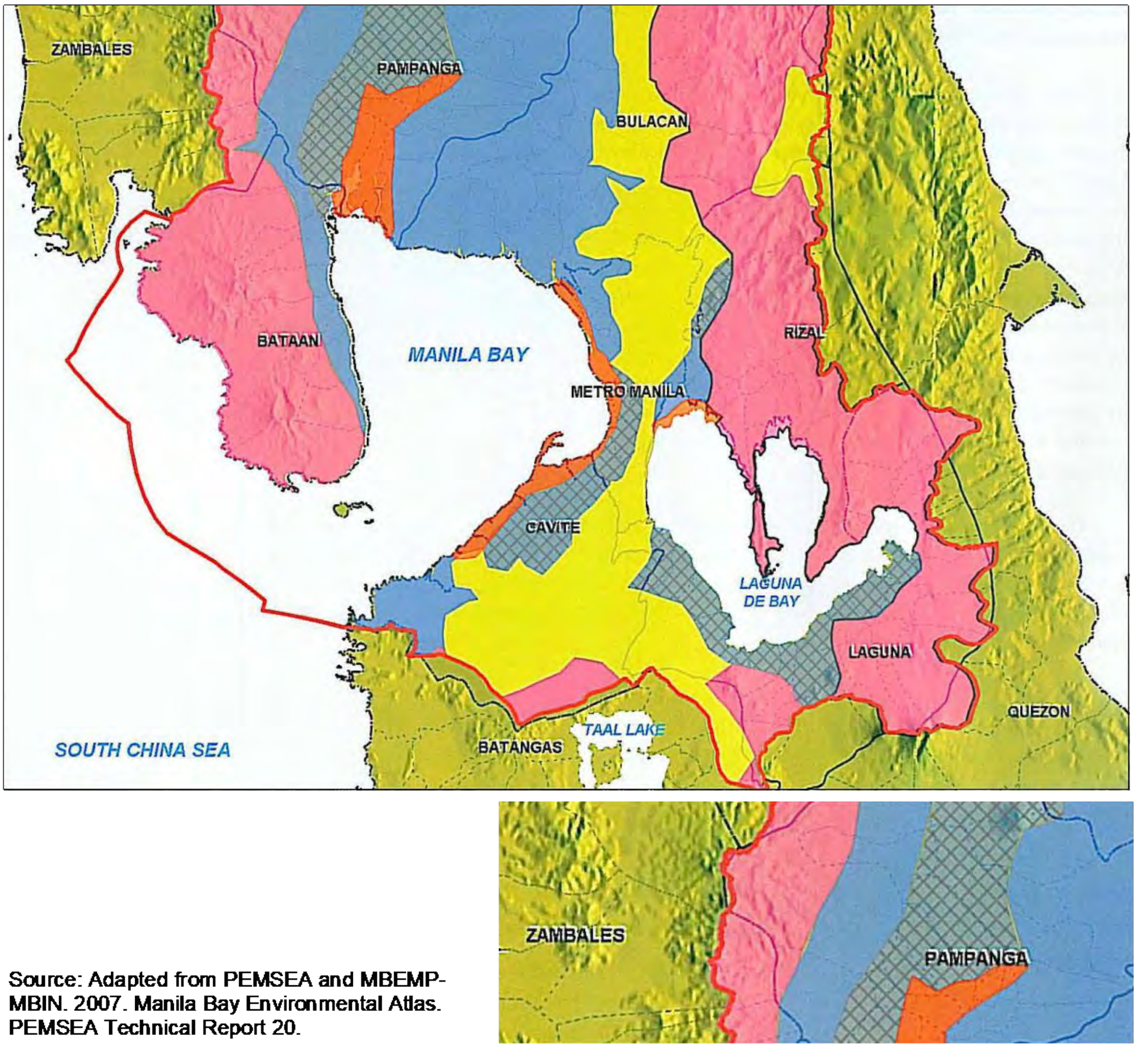
Four of the six sampled wells in Mariveles had turbidity levels over the limit specified in the national standard for drinking water, and one had significant color that could be perceived by eye at the time of sampling. The sampling team attributed these exceedances to the wells being over-exploited, such that they did not contain deep settled water columns from which to sample. All of the wells sampled in Mariveles appeared to have been hand-dug rather than bored.

6.1.4.2 Cavite

As can be seen in Exhibit 6-22, most of Cavite falls within favorable groundwater zones, and this is related to substantial recharge zones in the southern part of the province, around Tagaytay Ridge. However, the availability of groundwater is uneven, with significant aquifers in some areas, and limited water-bearing capacity in areas where the bedrock is dominated by particularly fine-grained tuffs and sandstones. The coastal zone of Cavite is low-lying and underlain partly by sandstones, and these factors make groundwater resources vulnerable to saltwater intrusion. The entire Cavite portion of the BCIB project area is within a coastal band considered to have at least some potential for salinity intrusion during dry periods when groundwater extraction may outpace natural recharge. Many wells in the densely populated Cavite City area have been abandoned due to salinity intrusion. Water demand already outstrips groundwater supply in more densely populated part of the province even without considering agricultural demand, and there is well-founded concern that heavy pumping around population centers away from the coast, such as Dasmariñas, Silang and General Trias, will inevitably lead to salinity intrusion there as well. Groundwater elevation has fallen over 25 m in some centers of intense extraction.[113] Water demand in Naic is not yet drastically in excess of sustainable extraction potential, but increasing density of development is inevitably leading the municipality in that direction. Concerns have been expressed by the National Water Resources Board regarding all of the industrial and residential development interest focused on Cavite. Naic municipal officials report that shallow wells near the coast in Naic are already subject to some salinity intrusion (not so yet for deep wells), and some farmers in Naic who are reliant on irrigation have had

[111] Lewis, K.A., Tzilivakis, J., Warner, D. and Green, A. (2016) An international database for pesticide risk assessments and management. *Human and Ecological Risk Assessment: An International Journal*, **22**(4), 1050-1064. DOI: 10.1080/10807039.2015.1133242.
[112] Calubaquib, M.A.M. 2014. Edaphological characteristics of selected Philippine acid upland soils as affected by soil amendments and fertilizers. MS Thesis, University of the Philippines–Los Baños.
[113] Province of Cavite. 2012. Cavite Integrated Water Resource Management Master Plan.

to fallow an increasing proportion of their lands in dry periods due to groundwater availability constraints.[114]



Source: Adapted from PEMSEA and MBEMP-MBIN. 2007. Manila Bay Environmental Atlas. PEMSEA Technical Report 20.

Exhibit 6-22 Groundwater Resource Favorability in Manila Bay Region

For the present baseline study, groundwater was sampled at existing wells spaced around the immediate project area in Mariveles and Naic, in three sampling phases. An initial set of samples was collected in February 2020, based on preliminary information then available regarding the likely placement of project infrastructure and temporary construction support sites. Later sampling in October 2021 generated data from additional locations, complementing the earlier data and establishing a comprehensive dataset covering all project sites as understood at the early detailed design stage. Subsequent to an additional possible staging area being identified in Cavite, further sampling was conducted in Cavite only in May 2022. In all sampling phases, access to wells on private property was a constraint on sampling well selection, but a reasonably even distribution across the two project areas was nevertheless achieved.

Groundwater samples were subject to analysis in relation to 25 parameters by Hi-Advance, a laboratory testing center accredited by DENR, located in Magallanes EDSA, Makati,

[114] As discussed in a meeting with representatives of Naic MENRO and MAO, 29 March 2022.

Metro Manila. The travel time from Mariveles to Makati City is approximately 4 hours; preservatives were accordingly used avoid deterioration of samples during travel. The results of analysis were compared to the Philippine National Standards for Drinking Water of 2017 (as specified in Department of Health Administrative Order DOH 2017-0010).

Seven wells were sampled within the project area on the Cavite side; the locations of the sampled wells are shown in Exhibit 6-23. Results from laboratory analysis of the groundwater samples collected are presented in

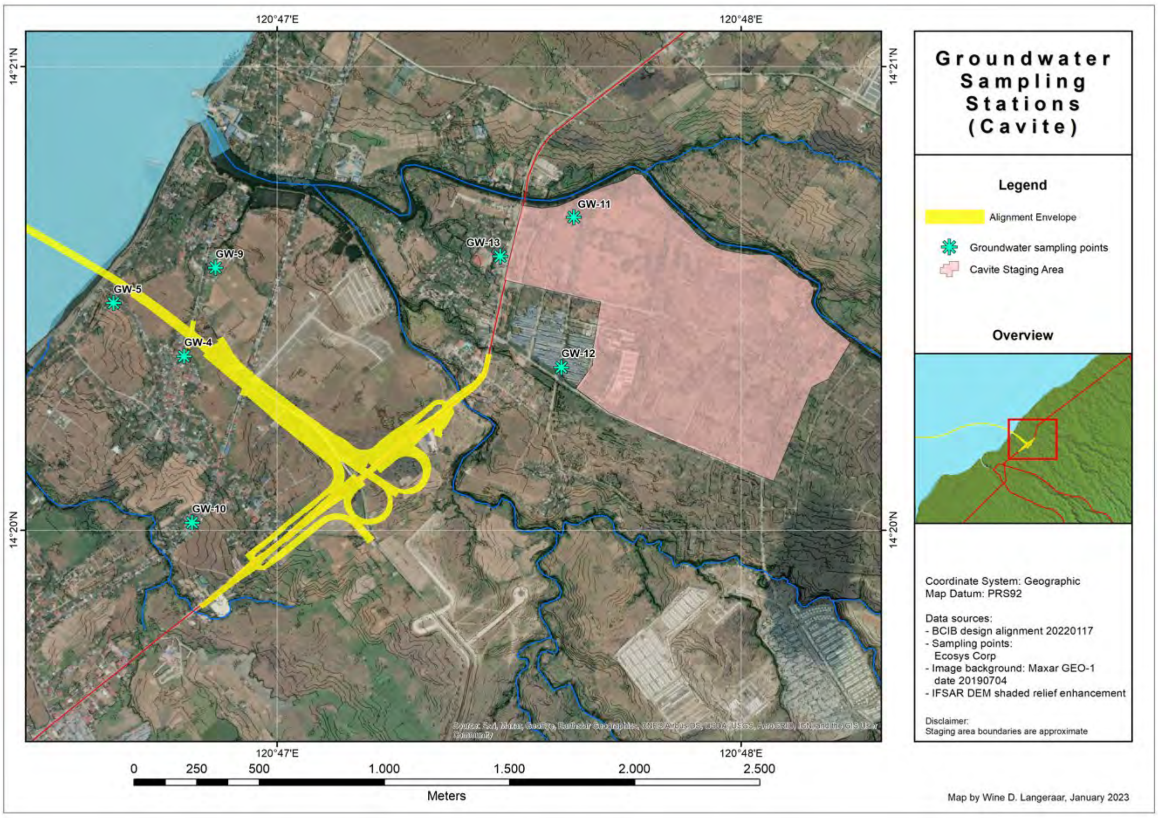


Exhibit 6-23 Groundwater Sampling Stations in Naic

The results shown in Exhibit 6-24 indicate nearly comprehensive compliance with the national drinking water standard. The most prominent exception pertains to total dissolved solids (TDS), for which exceedances were recorded for six of the seven sampled wells. Some of the exceedances are quite large, with the highest levels documented in the three wells within the Timalan River catchment. Elevated TDS is usually indicative of hard water, which is typically a function of the chemical composition of the water-bearing rock and subsoil, but in coastal areas may also be linked to salinity intrusion. Chloride and salinity levels were not especially high at any of the sampled wells, which would tend to suggest that the high TDS is more strongly associated with rock characteristics than salinity intrusion.

The other exceedance of note is a finding of mercury in one sample, from the GW12 station. This was attributed by the sampling technicians to probable localized contamination, as there are a number of workshops and other commercial establishments in the direct vicinity, including a vulcanizing shop and fuel station. The locality has no history of use by heavy industry or as a landfill, so there is little reason to suspect a broader contamination issue.

Exhibit 6-24 Results from Analysis of Groundwater Samples, Cavite

Parameter	Unit	PNSDW 2017[1]	GW4	GW5	GW9	GW10	GW11	GW12	GW13
Temperature	°C	-	29.2	28.7	29.3	26.6	31.0	29.7	31.1
pH	-	6.5-8.5	7.7	7.4	7.1	6.6	7.4	6.9	6.8
TDS	ppm	600	893	1,020	453	651	2,405	4,886	3,218
BOD	mg/L	-	3.19	2.92	12.7	ND	ND	ND	ND
Color	TCU	10	5	5	5	5	5	5	5
COD	mg/L	-	11	12	34	31	11	10	17
DO	mg/L	-	1.26	1.40	2.24	1.89	7.9	8.0	7.6
Turbidity	NTU	5	0.7	4.9	0.8	0.9	1.8	ND	ND
Salinity	-	-	0.6	0.7	0.3	0.5	0.3	0.5	0.4
TSS	mg/L	-	ND	ND	ND	ND	NA	NA	NA
Oil and Grease	mg/L	-	ND	ND	ND	ND	ND	ND	ND
Cyanide	mg/L	0.5	ND	ND	ND	ND	ND	0.07	ND
Nitrate	mg/L as N	50	2.42	1.93	0.02	2.26	0.29	ND	0.44
Phosphate	mg/L as P	-	0.174	0.128	0.071	0.120	0.557	0.727	0.627
Chloride	mg/L	250	135	215	23	59	29	22	40
Ammonia	mg/L as N	-	ND	ND	ND	ND	0.13	ND	ND
Fecal Coliform	MPN/100ml	-	ND	ND	>8	>8	>8	<1.1	4.6
Arsenic	mg/L	0.01	0.007	0.007	<0.00697	<0.00697	<0.00697	<0.00697	<0.00697
Cadmium	mg/L	0.003	0.001	0.001	<0.000723	<0.000723	<0.000723	<0.000723	<0.000723
Hexavalent chromium	mg/L	-	ND	ND	ND	ND	ND	ND	ND
Lead	mg/L	0.01	0.004	0.004	<0.00365	<0.00365	<0.00365	<0.00365	<0.00365
Mercury	mg/L	0.001	ND	ND	<0.00007	<0.00007	<0.00007	0.032	<0.00007
Nickel	mg/L	0.07	0.01	0.01	<0.00973	<0.00973	<0.00973	<0.00973	<0.00973
Zinc	mg/L	5	0.007	0.007	<0.00712	<0.00712	<0.00712	<0.00712	<0.00712
Vanadium	mg/L	-	0.140	0.140	<0.561	<0.561	<0.561	<0.561	<0.561

Notes

[1] Philippine National Standards for Drinking Water of 2017 (Department of Health Administrative Order DOH 2017-0010)

Data in red type indicates a violation of the national standard

ND = none detected

NA = not analysed (no data returned from laboratory)

6.1.5 Oceanography

Manila Bay is a semi-enclosed embayment, with total surface area of approximately 1,800 km^2 and a coastline about 190 km long. The bay extends about 54 km inland along a southwest–northeast axis from the South China Sea (West Philippine Sea), and is 18 km wide at its narrowest point near the mouth and 60 km at its widest inside point inside.

A total of 131 rivers and creeks discharge to Manila Bay, draining a combined watershed of about 17,000 km^2. These watercourses pour an estimated 25 km^3 of freshwater into the bay each year on average, with the heaviest discharge typically coming in August, and the lowest inputs in April. The bay has a predominantly diurnal tidal cycle and an average tidal range of 1.2 m during spring tide and 0.4 m during neap tide. Median salinity at all depths varies from 30–35 parts per thousand.[115] This compares to a typical salinity range in the South China Sea (offshore north of Lubang Island) of 34.0–34.4.[116] By some measures, Manila Bay is considered an estuary.

6.1.5.1 Bathymetry

The average depth of Manila Bay is 17 m, with waters of depth less than 10 m covering about 64% of the bay's area. The general bathymetric slope is gently upwards (approximately 1 m/km) from the outer mouth towards the predominantly deltaic north and northeast shores in Bulacan, Pampanga, and northern Bataan, where extensive mudflats are found (see Exhibit 6-25). Manila Bay is estimated to have a total volume of about 31 km^3.[117]

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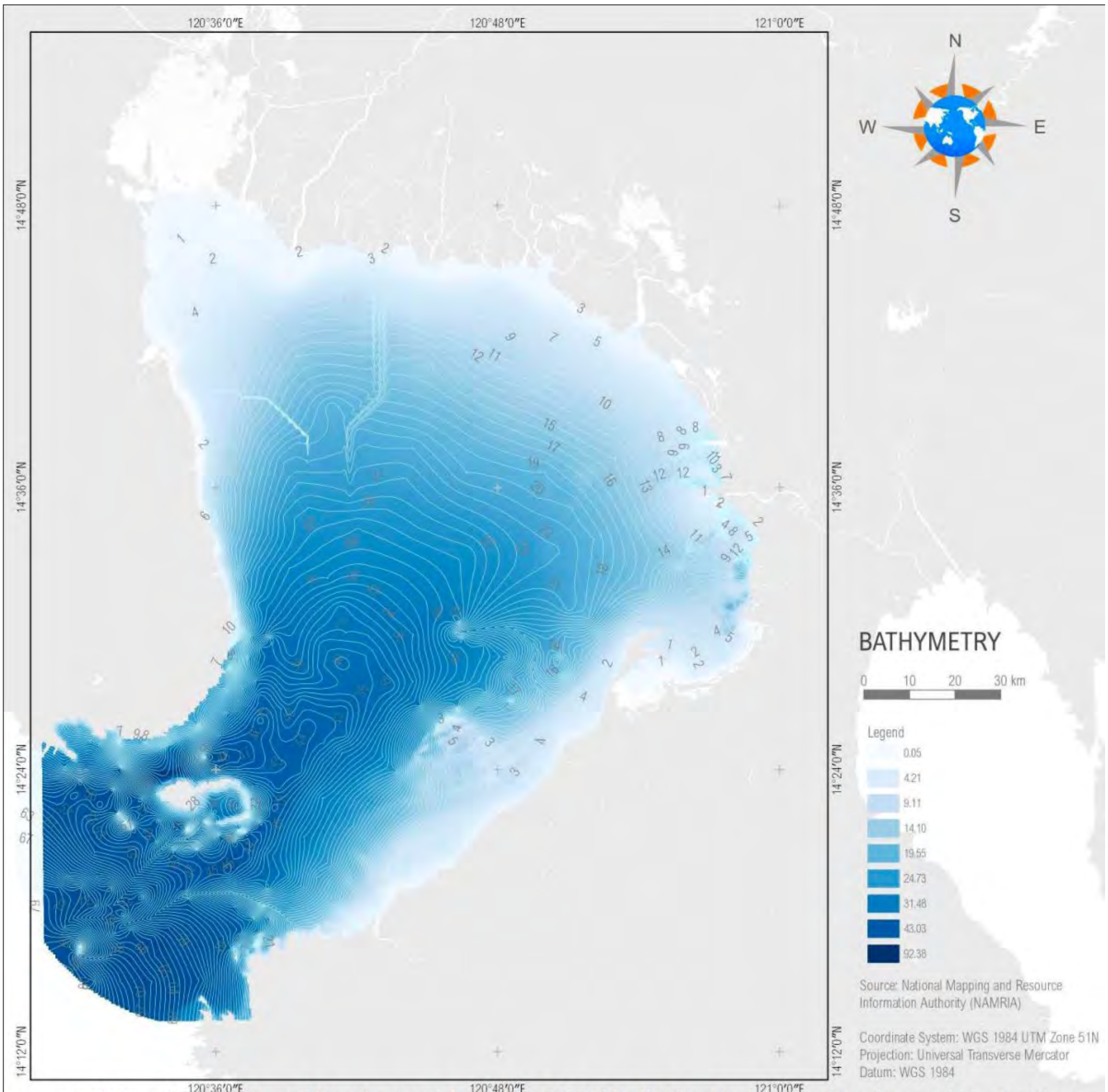
[115] Ibid.

[116] Rojana-anawat, P., N. Sukramongkol and S. Pradit. 2000. Characteristics of Water in the South China Sea, Area III: Western Philippines. Pp. 291-307 of Proceedings of the Third Technical Seminar on Marine Fishery Resources Survey in the South China Sea, Area III: Western Philippines, 13-15 July 1999. Bangkok, Thailand: Secretariat, Southeast Asian Fisheries Development Center.

[117] PEMSEA and MBEMP-MBIN. 2007. Manila Bay Area Environmental Atlas. PEMSEA Technical Report 20. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and the Manila Bay Environmental Management Project (MBEMP) – Manila Bay Area Information Network (MBIN), Quezon City.



Source: National Economic and Development Authority. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 6-25 General Bathymetry of Manila Bay

In the BCIB project area, around the mouth of the bay, the bathymetric profile is quite varied, due to the influence of volcanic orogeny. The seafloor slopes down steadily from the Bataan shore, which constitutes a toe slope of the Mt. Mariveles volcano, and reaches depths in excess of 90 m less than 2 km from the shore, before rising again more steeply up the slope of the Corregidor seamount. The bathymetric slopes around Corregidor and Caballo islands are generally steep, over 20% in many places (see Exhibit 6-26). The seafloor rises gradually from depths of 40–50 m off the southeastern side of the Corregidor seamount to the Cavite shore. There is an extensive shallow sandy-muddy terrace along the Cavite coast, but very limited mudflat areas. Water depth along the proposed BCIB alignment, which avoids the more extreme bathymetric lows, is thought to range from 0 m to approximately 50-60 m; a detailed bathymetric survey had not yet been completed at the time of this report's preparation.

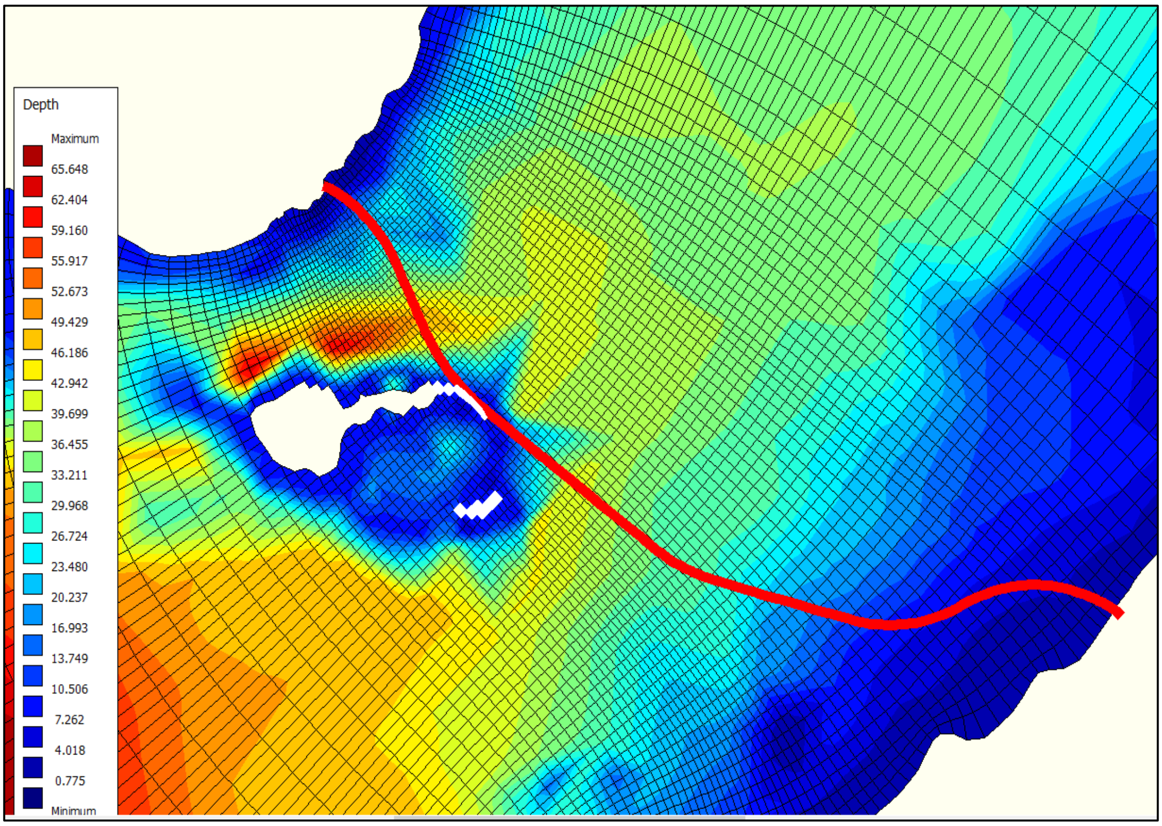


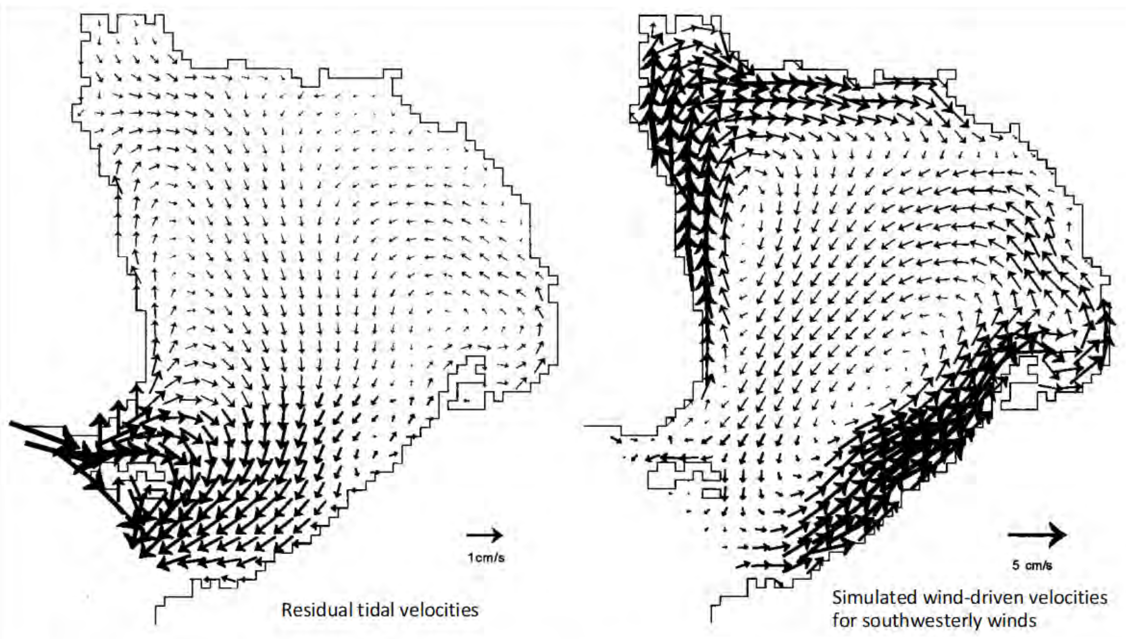
Exhibit 6-26 Bathymetry of BCIB Project Area

6.1.5.2 Circulation Pattern

Circulation in Manila Bay is driven by the tidal cycle, winds, river discharges, and temperature differentials related to solar warming of surface layers. All of the forces driving circulation are variable, and the balance between them in shaping the bay's circulation is a dynamic one.[118] Tidal influence is strongest near the mouth of the bay, and is the overall dominant driver of circulation, except in shallower areas near shore, where winds are thought to play a stronger role in driving currents.[119] Three prevailing wind patterns affect the Manila Bay area: northeasterlies from October to January (average wind speed 5 m/s), southeasterlies from February to May (3–6 m/s), and southwesterlies from June to September (5–7 m/s).[120] Exhibit 6-27 shows the results of a modeling exercise carried out for tidal and wind-driven circulation, using a wind pattern typical of the southwest monsoon season. The side-by-side comparison reveals that the general circulation pattern promoted by both sets of forces is one of water (and the sediments it carries) moving into the bay along the north and south coasts, and back out towards the mouth via the central area of the bay. The tidally-driven clockwise circulation around Corregidor and Caballo Islands remains operational regardless of wind direction, but the configuration of gyres in the inner bay, including the direction of their rotation, changes through the seasons along with the

[118] Pokanovich, T. and K. Nadaoka. 2006. Three-Dimensional Hydrodynamics Simulation of Manila Bay. Symposium on Infrastructure Development and the Environment, 7–8 December 2006. SEAMEO-INNOTECH, University of the Philippines, Diliman.
[119] Villanoy, C. and M. Martin. 1997. Modeling the Circulation of Manila Bay: Assessing the Relative Magnitudes of Wind and Tide Forcing. Science Diliman 9 (1&2):26–35.
[120] Pokanovich, T. and K. Nadaoka. 2006. Three-Dimensional Hydrodynamics Simulation of Manila Bay. Symposium on Infrastructure Development and the Environment, 7–8 December 2006. SEAMEO-INNOTECH, University of the Philippines, Diliman.

prevailing winds. Typical retention time for freshwater entering the bay from rivers is estimated to range from two to four weeks, depending on the season.[121]

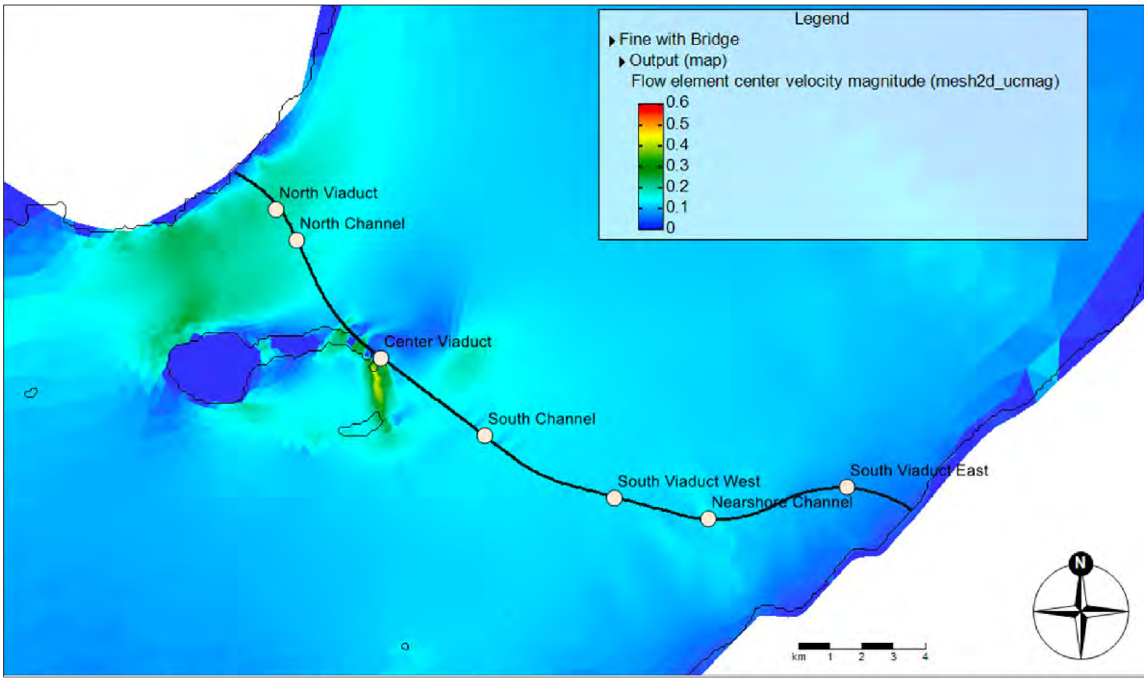


Source: Villanoy, C. and M. Martin. 1997. Modeling the Circulation of Manila Bay: Assessing the Relative Magnitudes of Wind and Tide Forcing. Science Diliman 9 (1&2):26–35.

Exhibit 6-27 Circulation Pattern of Manila Bay as Influenced by Tides and Winds (SW Monsoon)

The dominant driver of circulation within the BCIB project area is the diurnal tidal cycle. The reversing currents set up by the flood and ebb tides produce a dynamic marine environment at all depths. Due to the relatively low tidal range (average 1.2 m during spring tide and 0.4 m during neap tide), the tidal flow velocity is not especially high, even though the bay's mouth is significantly narrower than its inner expanse and is partially constricted by islands. Exhibit 6-28 and Exhibit 6-29 show the modeled tidal currents (depth-averaged) for the BCIB project area. The ebb tide exhibits stronger flow on average than the flood tide; this is due to minor semi-diurnal constituents in the tidal cycle which slow tidal elevation change more for the flood tide than for the ebb tide.[122]

[121] PEMSEA and MBEMP-MBIN. 2007. Manila Bay Area Environmental Atlas. PEMSEA Technical Report 20. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and the Manila Bay Environmental Management Project (MBEMP) – Manila Bay Area Information Network (MBIN), Quezon City.
[122] Bataan–Cavite Interlink Bridge Project: Marine Hydrodynamics Studies – Base Model Development and Calibration. 28 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.

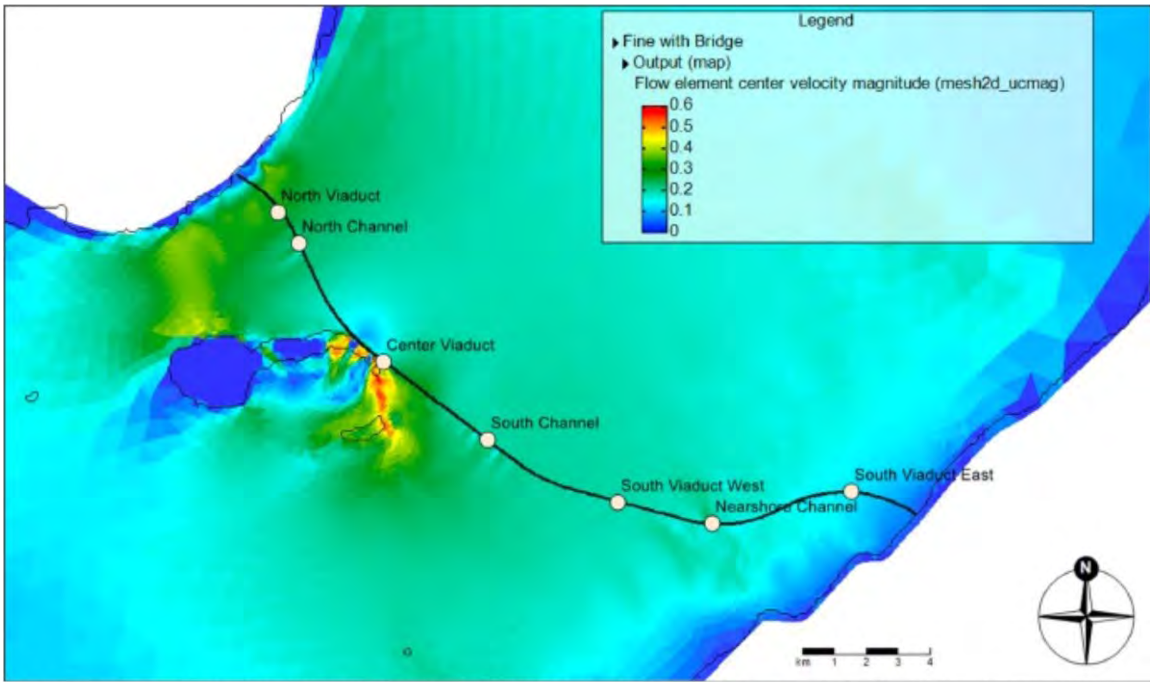


Source: Bataan–Cavite Interlink Bridge Project: Marine Hydrodynamics Studies – Base Model Development and Calibration. 28 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.

Exhibit 6-28 Predicted Maximum Depth-Averaged Flood Velocity (m/s) in BCIB Project Area

As can be seen in Exhibit 6-28 and Exhibit 6-29, tidal currents predicted in the BCIB project area are significantly affected by Corregidor and Caballo Islands and their associated shoal structures. A funneling effect caused by these obstructions enhances currents in the channel between Corregidor Island and Bataan, and restricted depth over the shoals between Corregidor Island and Caballo also causes higher local velocities. The highest velocities are to be found in these two areas, and the lowest are experienced in the lee of Corregidor Island (eastern side during the flood, and western side during the ebb) and in extreme nearshore areas of both Bataan and Cavite. Maximum predicted current velocity anywhere along the BCIB alignment is approximately 0.6 m/s.[123]

[123] Ibid.



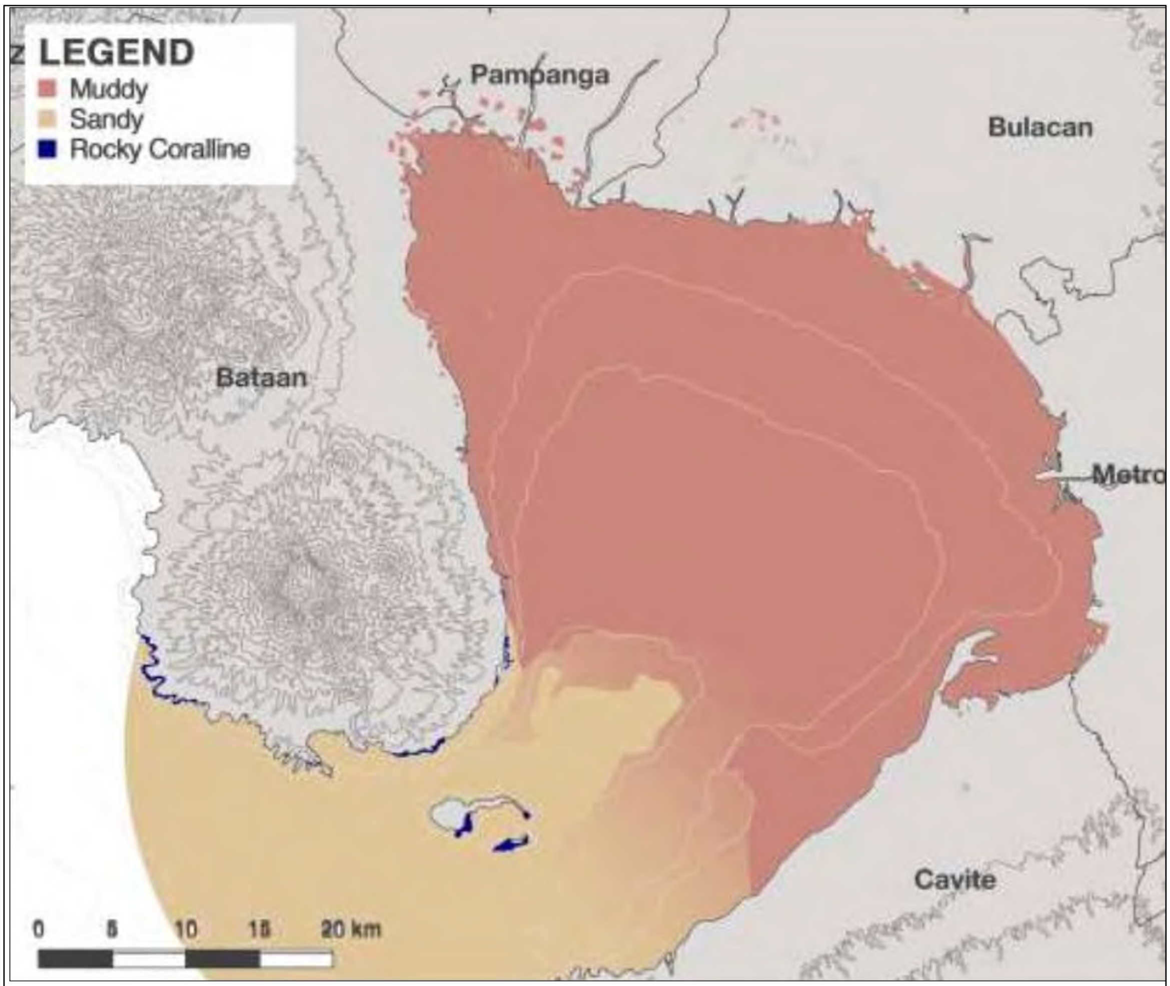
Source: Bataan–Cavite Interlink Bridge Project: Marine Hydrodynamics Studies – Base Model Development and Calibration. 28 October 2021. T.Y. Lin International – Pyunghwa Engineering Consultants Ltd JV.

Exhibit 6-29 Predicted Maximum Depth-Averaged Ebb Velocity (m/s) in BCIB Project Area

6.1.5.3 Seafloor Characteristics

The seafloor of Manila Bay consists overwhelmingly of soft bottom material, including mud and sand. As can be seen in Exhibit 6-30, muddy bottom covers most of the inner portion of the bay, while sandy bottom prevails closer to the mouth. Only a very small proportion of the seafloor area in Manila Bay is rocky or coralline in nature; hard substrate exists almost exclusively as boulder fields and fringing reefs along certain parts of the Bataan peninsula, around Corregidor and Caballo Islands, and off the rocky headlands of far western Cavite and northern Batangas. The seabed under the proposed BCIB alignment is primarily sand, except near the Mariveles shore and along the east coast of Corregidor Island (where reefs are present), and in the shallow nearshore area off Naic, which is in a transition zone between muddy and sandy bottom areas. The bottom type distribution reflects the general sediment transport pattern prevailing in Manila Bay, which is characterized by inward (northeastward) sediment drift along the Cavite coast, very limited to no corresponding outward drift along the northern side of the mouth, and long-term accumulation in the inner bay.[124]

[124] Fuji-Ie, W., T. Yanagi and F.P. Siringan. 2002. Tide, Tidal Current and Sediment Transport in Manila Bay. La mer 40: 137-145 (Societé franco-japonaise d'océanographie, Tokyo).



Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 6-30 Distribution of Seafloor Types in Manila Bay

Sediment samples were gathered in February 2020 from 14 sampling stations spread out along the proposed BCIB alignment and in the near vicinity of the landing sites to assess the physical nature and chemical properties of sediments for the purposes of understanding potential for re-suspension. The sampling station locations are shown in Exhibit 6-31. Dry sieve analysis of the sediments was done following ASTM D4464: 15 Standard Test Method for Particle Size Distribution of Catalytic Materials.

Results from grain size analysis conducted on the collected sediment samples are presented in Exhibit 6-32. The data indicate a general prevalence of coarser sands and gravels across the middle sections of the proposed BCIB alignment and near the Mariveles shore, and a predominance of silt, clay and finer sands near the Naic shore. Notable exceptions to this general observation are the strong presence of fine materials at the BNS-2 station (which is nearby the mouth of the Babuyan River in Mariveles), and at the MBS-1 and MBS-2 stations; which are likely to be influenced by discharges from multiple modest streams discharging along the southeast Bataan coast.

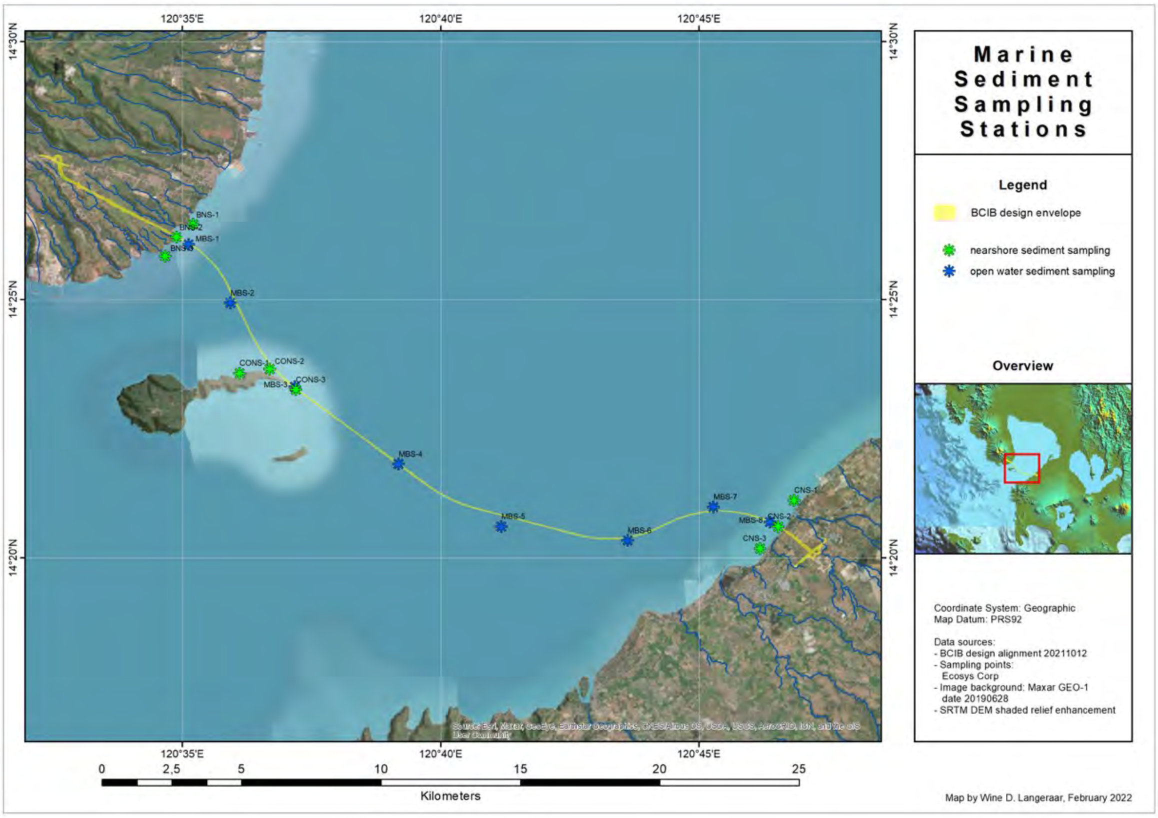


Exhibit 6-31 Locations of Marine Sediment Sampling Stations

The strongest presence of fine materials (clay, silt and very fine sand) was documented at CNS-1 (88% total clay, silt and very fine sand); MBS-2 (83%); MBS-8 (79%); MBS-7 (77%); CNS-3 (60%) and MBS-1 (45%). Sediments in the areas represented by these stations can be considered to have the greatest potential for resuspension. The highest proportions of coarse materials (coarse sand, very coarse sand and gravel) were observed at BNS-1 (96% total coarse sand, very coarse sand and gravel); BNS-3 (94%); CONS-2 (71%); MBS-4 (69%); MBS-5 (68%) and CONS-1 (56%). Sediments in the areas represented by these sampling stations can be considered to present somewhat lower potential for lasting resuspension, although some of the stations mentioned do have significant fine sand components.

Coastal processes (sediment movement, erosion and deposition) on the Cavite shoreline in the vicinity of the St Nicholas Shoal are understood to be dynamic and have the potential to cause undesirable effects on coastal geomorphology. There are no data available to inform an assessment of the potential for impacts on deposition and erosion due to the Project, or the implications of natural coastal process on construction. Coastal processes will be considered as part of a specialist study completed prior to construction.

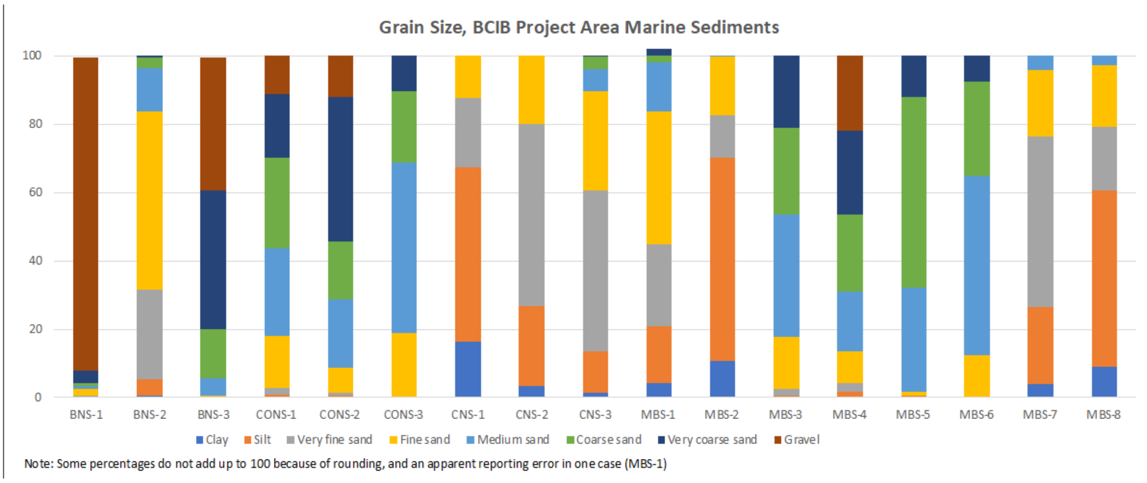


Exhibit 6-32 Grain Size in Bottom Sediments Along Proposed BCIB Alignment

6.1.6 Coastal Features

6.1.6.1 Bataan Shore

The shoreline in the Bataan portion of the BCIB project area is characterized by relatively narrow and flat beaches with moderately- to steeply-sloped backshore well vegetated with coast-adapted trees, shrubs and grasses. Generally, these beaches are composed of finer-grained sediments with pebbles, coral rubbles and broken shell fragments, and in some places feature a moderately dense matrix of boulders derived from the pyroclastic flows that make up the toe slope of Mt. Mariveles. Drift material is prevalent; this includes modest amounts of dried macroalgae (mainly the seaweed *Sargassum*) and driftwood, as well as significant volumes of plastic detritus. Marine intertidal communities along the Mariveles shore are established on both hard and sandy coastal substrates.

Exhibit 6-33 Typical Beach Conditions Along Mariveles Shore

The shoreline directly beneath the proposed bridge alignment is mostly rocky, but a sandy beach extends from this point to the Babuyan River, a creek which enters the bay approximately 120 m northeast of the alignment. A small estuary lined on both sides with riparian mangrove vegetation extends a short way inland along the Babuyan River.

Exhibit 6-34 Babuyan River Estuary, Mariveles Shore

The Mariveles coastline is mostly unpopulated in the direct vicinity of the proposed BCIB landing site, but there are a few structures set back from the beach by the Babuyan River, and the southern edge of the residential built-up area of Barangay Mt. View comes close to the shore about 0.5 km northeast of the alignment. A further 1 km from there lies the densely built-up seafront and harbor of Barangay Cabcaben, at which a large cargo handling facility, including approximately 20 ha of reclaimed land and a deepwater T-jetty, has been under development since 2018.

The stretch of coastline extending southwest from the proposed bridge landing site is uninhabited, with grassland and grassy fallow extending almost to the shore. The first developed area along this shore is a small resort by a pocket beach, about 3 km from the alignment and hidden from it behind a headland. Adjacent to this beach is the Hyatt Oil Terminal, a shoreside complex with numerous oil storage tanks and a 500-m jetty extending out from the shore.

6.1.6.2 Corregidor Island Eastern Shore

The intertidal zone of Corregidor Island facing the proposed bridge alignment is generally rocky. Rocky intertidal zones found in temperate climates tend to be highly productive biotopes, in which rocks washed by nutrient- and food-bearing ocean waters provide firm attachment points for the holdfasts of many species of large algae or seaweed, which provide both shelter and food supply for dense populations of small marine vertebrates and invertebrates. The rocky beaches along Corregidor, in contrast, are limited in their productive potential, because at low tide, especially in summer, the rock surface is subjected to intense heating and desiccation by the sun; this effectively prevents the establishment of a vigorous growth of large algae. Only a few species of brown algae (*Sargassum* and *Turbinaria*) and green algae (*Caulerpa*) were observed along the shore during site reconnaissance. Due to the absence of algal shelter in this harsh environment, the fauna of Corregidor rocky beaches is limited mostly to animals that inhabit crevices, holes and the undersides of boulders, or else are mobile forms capable of retreating to deeper areas as the tide goes out.

Above the rocky intertidal zone is the narrow and moderately steep slope of the exposed beach proper, which consists of fine to coarse sand with pebbles and shell fragments, cobbles and boulders. Similar to the beaches of Mariveles, the exposed coastal beaches of Corregidor Island are heavily peppered with solid waste washed up by the sea, most of it plastics.

The backshore along the beaches of eastern Corregidor Island is comprised of a dense thicket of trees, brush and grasses, extending upwards—steeply in places—from the high water mark. This part of the island is a restricted area, and has been left largely undisturbed for several decades.

Exhibit 6-35 Typical Beach Environment on East Shore of Corregidor Island

6.1.6.3 Cavite Shore

The outstanding feature of the Naic coastline in the vicinity of the proposed bridge shore approach is the sandy beach and absence of exposed rocks, which is a marked contrast with the shorelines of Mariveles and Corregidor Island. The gentle slope evident on most the beaches continues below low tide mark, so the coastal strip is generally fronted by a wide belt of subtidal shallows which accumulates mud deposits. The intertidal slope tends to be narrow and to consist of somewhat finer-grained sand (blackish in color), while the subtidal shallows consist of fine sandy-muddy substrate (greyish black in color). The intertidal slope is subject to alternate wetting and drying with the rise and fall of the tide, and marine life is limited to organisms adapted to this extreme fluctuation. Shorebirds that feed on organisms that live in the shallows and burrow in the sand are fairly common, though not observed in large numbers, along this coast. Some of the beaches are known as nesting sites for marine turtles.

Exhibit 6-36 Typical Beach Conditions Along Naic Shore

Above the intertidal slope occurs a coastal strip of exposed beaches of varying width and relatively flat topography which also tend to consist of sandy substrate. The backshore is more or less overgrown with trees (predominantly palms), with residential properties set amongst them. Parts of the backshore are densely settled, while others (including the area in the immediate vicinity of the proposed bridge landing) are occupied by scattered structures with extensive fields to landward. In some places, extensive fish ponds have been developed in backshore areas. The beaches are used by local fisherfolk, who pull their boats up on the sand daily, and fishing gear is very much in evidence in many areas. Several beach resorts can also be seen southwest of the proposed site for the bridge shore approach, and there are others to the northeast beyond the mouth of the Timalan River, in the neighboring municipality of Tanza. There are a handful of marine industrial operations (principally boat repair and fishing services) found along this stretch of coast.

River estuaries are the most important type of intertidal environment, in terms of ecological and economic importance, along the Naic coast. Because of the extremely abundant supply of nutrients and the high oxygen levels (among other factors), estuarine habitats are generally highly productive. Many marine species use the protective and nourishing spaces found in estuaries as nurseries, in which offspring spend the earliest stages of life after hatching. Estuaries are rich in nutrients because they concentrate and mix nutrients carried 'down' by stream flow and carried 'up' from the ocean by the incoming tide. In addition, estuaries accumulate excess organic matter in their sediments; this undergoes degradation by bacteria and provides an energy source for burrowing animals, particularly for meiofauna. Organic detritus (decayed bodies of marsh grasses, crustaceans, worms, fishes, bacteria, algae, and so on) may be consumed directly by detritus feeders, such as clams, oysters, lobsters, and crabs. There are two significant river estuaries in Naic: the Timalan River, which has its mouth in Barangay Timalan Balsahan, about 750 m northeast of the proposed BCIB landing site, and the Labac River (also known as the Allemang River or Bucana River), which meets the bay in Barangays Bucana Sasahan and Bucana Malaki, about 1.75 km southwest of the landing site. Both of these estuaries are navigable by local fishing boats. The Timalan River estuary is well known for the oyster farming (*talabahan*) that takes place there, while the Labac River estuary is valued by local fisherfolk for hook-and-line and gillnet fishing.

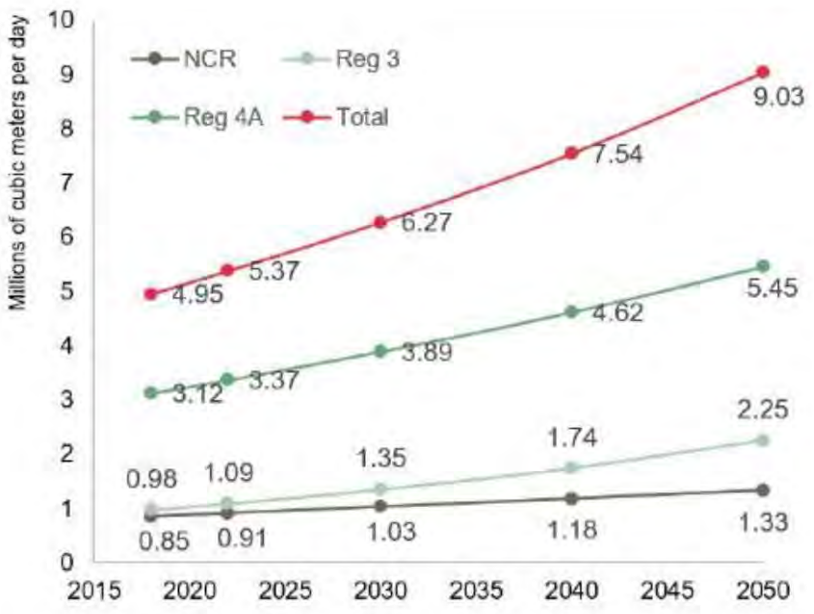
6.1.7 Marine Water Quality

Manila Bay is one of the busiest waterways in the Philippines, and is home to a megacity, major port facilities and dense shipping activity, and extensive aquaculture operations. The bay's waters receive large volumes of urban runoff, untreated domestic and industrial wastewater, and inputs from several rivers draining inland agricultural, urban and industrial lands. Most prominent among the rivers emptying into Manila Bay is the Pasig River, which winds through the center of Manila and drains large portions of the southern half of Metro Manila, and which also is the sole outflow channel from Laguna de Bay, a large shallow lake to the south of Metro Manila that is surrounded by urban, industrial and agricultural land. The Marilao-Meycauayan-Obando River system, which drains the northern half of Metro Manila and has been identified as one of the 30 dirtiest river systems in the world, also discharges to Manila Bay. The Pampanga and Angat Rivers, with their predominantly rural catchments, bring in runoff from intensive agricultural land use on the plains of north-central Luzon to the northern part of the bay.

It is estimated that about 3.1 million m^3 of wastewater is generated each day in the Manila Bay Region (defined as the bay and all catchments draining to it), about 40% of which is produced within Metro Manila. As of 2020, only 7.1% of residents of the Manila Bay region had a sewer connection where they lived, and only 27% of the wastewater generated in the region was passed through a wastewater treatment plant before discharge to a water body.[125] The volume of wastewater destined for the bay is projected to rise steadily as a function of population growth over the coming decades, even with planned expansions of sewerage and wastewater treatment (see Exhibit 6-37).[126]

Besides point-source discharges of wastewater, massive inputs of pollutants make their way to Manila Bay waters from agriculture and aquaculture. The rivers and creeks whose waters end up in Manila Bay drain a land area of 17,000 km^2, most of which is agricultural, and carry heavy loads of eroded soil, chemical fertilizers and pesticides, manure and other organic matter. The annual input of nitrogen to Manila Bay from cropland has been estimated at over 26,000 MT.[127]

[125] NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.
[126] Sotto, L.P.A., A.H.W. Beusen, C.L. Villanoy, L.F. Bouwman and G.S. Jacinto. 2015. Nutrient Load Estimates for Manila Bay, Philippines using Population Data. Ocean Science Journal 50(2):467–474.
[127] Montojo, U.M., B.J.S. Baldoza, K.B.S. Perelonia, F.D. Cambia and L.C. Garcia. 2015. Estimation of Nutrient Load from Aquaculture Farms in Manila Bay, Philippines. The Philippine Journal of Fisheries 27(1): 30-39.

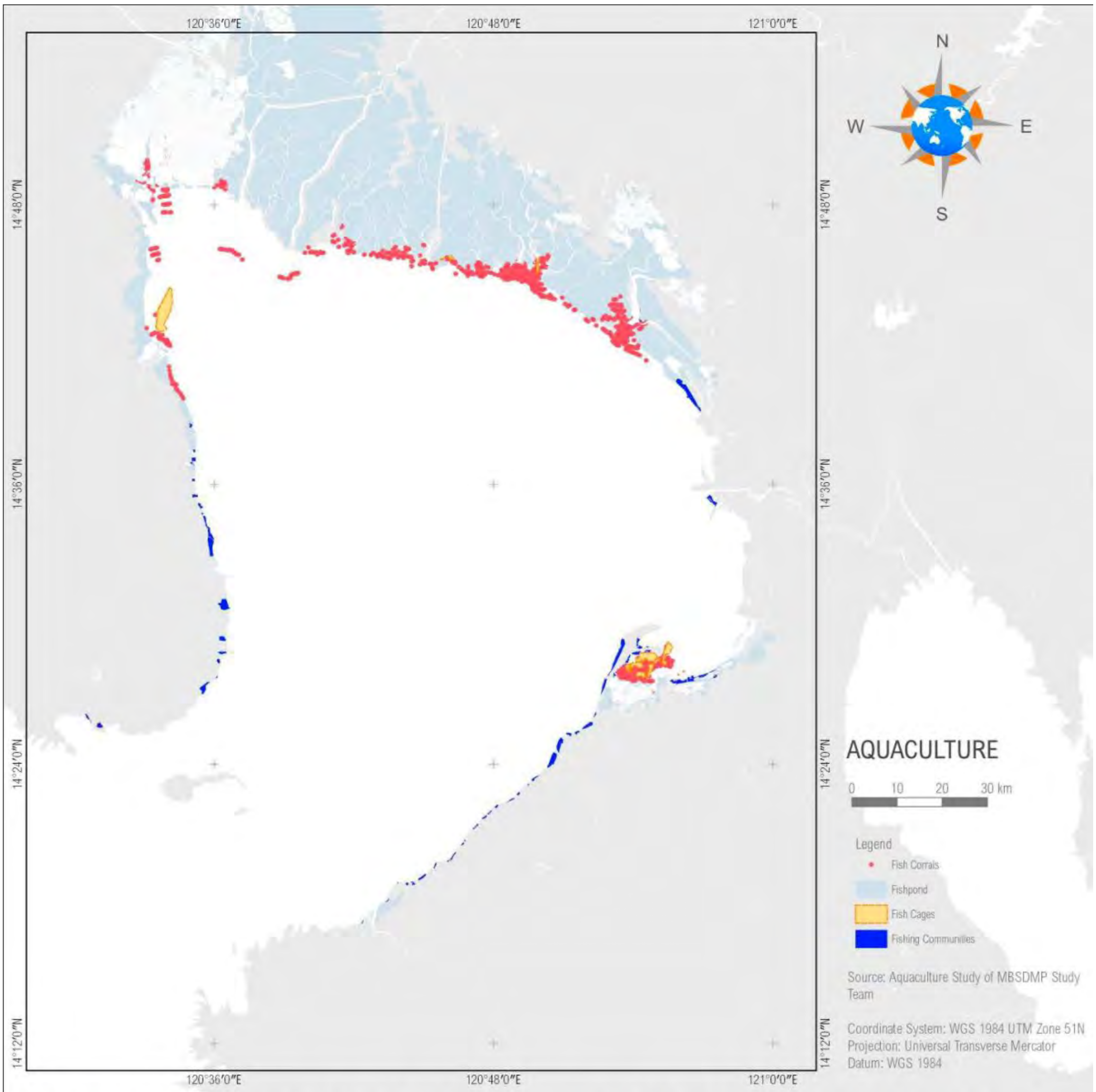


Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 6-37 Projected Wastewater Generation in Manila Bay Region, 2015–2050

Extensive floating and submerged aquaculture operations have been developed along the shoreline, and vast areas of mangrove swamp, mud flats and other low-lying brackish water areas have been converted over the decades to ponds for growing fish and shrimp, particularly at the head of the bay (see Exhibit 6-38). This intensive agglomeration of aquacultural activity produces large volumes of effluent rich in fecal matter and nutrients from uneaten processed feed. Annual inputs of nitrogen and phosphorus from aquaculture have been estimated at 12,700 MT and 2,400 MT, respectively; 88% of nitrogen releases and 86% of phosphorus are attributed to fish pens and cages, with the remainder coming from fish ponds.[128]

[128] Ibid.

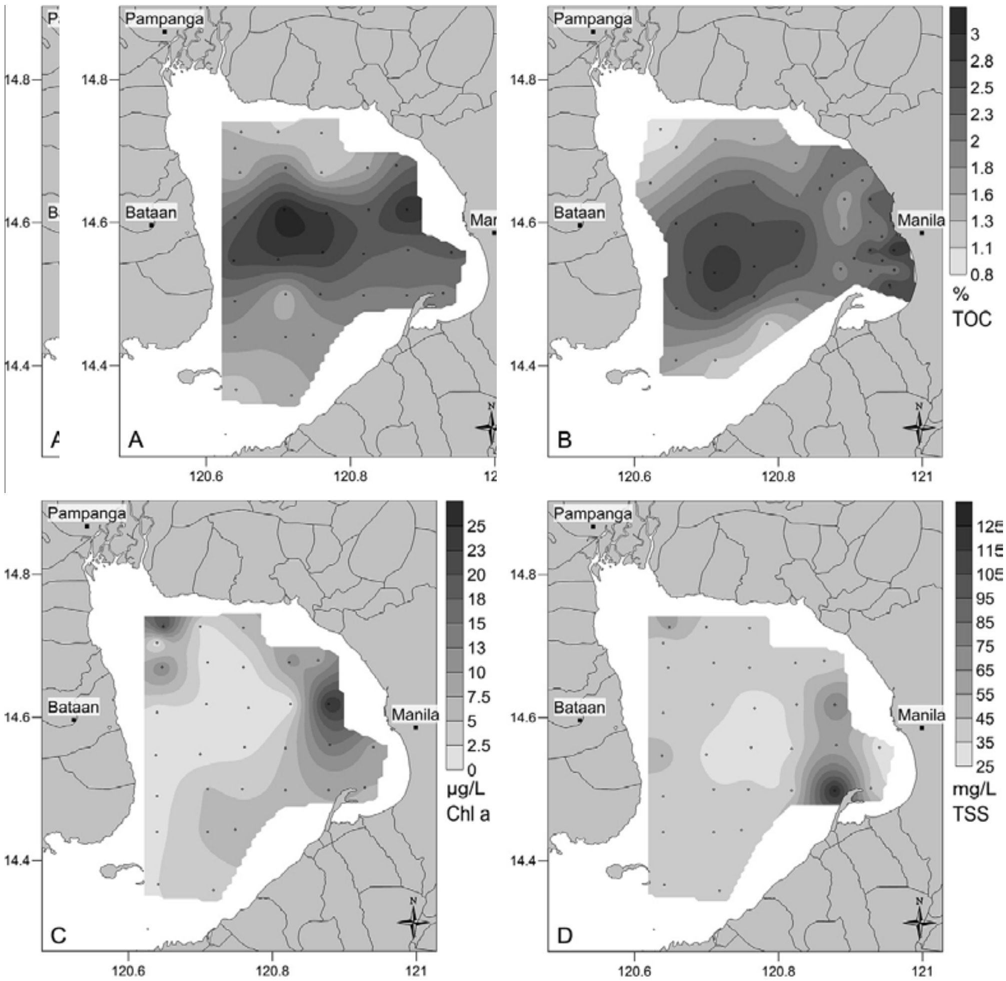


Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 6-38 Extent of Aquaculture Operations in and Around Manila Bay

Heavy nutrient loading of the waters of Manila Bay produces generally eutrophic conditions, and hypoxia (defined as concentration of dissolved oxygen below 2.8 mg/L) is an increasingly widespread and frequent development, particularly in lower portions of the water column across the middle section of the bay. As can be inferred from Exhibit 6-39, dissolved oxygen (DO) levels are negatively correlated with levels of a number of nutrient-loading indicators measured in seafloor surface sediments, including total organic carbon (TOC), phosphorus (PO_4), nitrogen (NO_3) and silicates (SiO_2).[129]

[129] Jacinto, G.S., L.P.A. Sotto, M.I.S. Senal, M.L. San Diego-McGlone, M.T.L. Escobar, A. Amano and T.W. Miller. 2011. Hypoxia in Manila Bay, Philippines During the Northeast Monsoon. Marine Pollution Bulletin 63: 243–248.



3.4. Chlorophyll a and total suspended solids

Surface chlorophyll *a* levels ranged from 0.2 to 25.5 µg L^{-1} (avg. 5.11 µg L^{-1}) for the whole bay. The distribution of chlorophyll *a* showed high levels (5.7–25.5 µg L^{-1}) in the northwestern and eastern parts of the bay near Pampanga and Manila, respectively (Fig. 2C). TSS for the whole bay ranged from 26.7 to 128.4 mg L^{-1} (avg. 43.0 mg L^{-1}), with high TSS values also in the northwestern and eastern parts of the bay.

3.5. Nutrient levels

Table 1 provides a summary of nutrient concentrations in Manila Bay. Bottom phosphate, silicate, and nitrate concentrations (Figs. 3A–C) were high in the midsection of the bay from east to west, thus coinciding with the area of hypoxic bottom water. In this area, bottom nutrient concentrations ranged from 5.57 to 16.32 µM (avg. 11.60 µM) for nitrate, 35.03 to 62.53 µM (avg. 50.22 µM) for silicate, and 0.66 to 2.00 µM (avg. 1.23 µM) for phosphate. Total inorganic nitrogen (TIN) (Fig. 3D) was also elevated at the midsection of the bay ranging from 6.96 to 25.9 µM (avg. 15.1 µM) in the area.

Similar spatial distributions were found for nitrate (Fig. 3C) and TIN (Fig. 3D) indicating the dominance of nitrate among the inorganic nitrogen species.

4. Discussion

Chang et al. (2009) reported widespread hypoxia in Manila Bay in June 2008 during the southwest monsoon (i.e., the rainy season);

soon. Marine

Pollution Bulletin 63: 243–248.

Exhibit 6-39 Dissolved Oxygen Levels and Nutrients in Bottom Sediments, Manila Bay

Eutrophic conditions in Manila Bay are manifest most prominently by mass blooming events involving various phytoplanktonic species (including microalgae and cyanobacteria). Harmful algal blooms (HABs) have occurred with increasing frequency in recent decades. Two broad categories of HAB have been documented in Manila Bay: (i) blooms of toxin-producing species, which produce illness, including headaches, diarrhea and neurological effects such as paralytic shellfish poisoning, in people who consume shellfish from affected waters; and (ii) mass blooms of non-toxic species that rapidly consume available dissolved oxygen (through respiration, as well as decomposition of dead algae and cyanobacteria), leading to significant fish kills. Many of the phytoplanktonic species involved in these types of HAB are naturally present in the bay, and do not cause problems under most conditions. The occurrence of HABs can be traced principally to large inputs of nutrients (especially nitrogen and phosphorus) from the urban and agricultural watersheds surrounding the bay, but seasonal fluctuations in salinity and water temperature are also thought to work in concert with enrichment to produce optimal conditions for mass blooms.[130] Both physicochemical parameters and phytoplanktonic density are highly variable within Manila Bay, on both spatial and temporal scales; in general, concentrations of nutrients contributing to HABs are highest in the eastern and northern parts of the bay, where inputs from rivers, urban effluents and aquaculture are most intense.[131]

Apart from definable HAB events, the eutrophic conditions prevailing in Manila Bay maintain phytoplanktonic densities that are likely significantly elevated relative to pre-industrial levels. High levels of phytoplanktonic production play a significant role in producing the generally turbid water that can be observed throughout the bay, along with direct inputs of organic matter and other suspended solids, and resuspension of sediments.[132]

It bears emphasis that Manila Bay is a large and dynamic ecosystem, with significant spatial heterogeneity in relation to both oceanographic conditions (depth, currents, salinity, exposure to winds and ocean swells, freshwater influx) and anthropogenic inputs (urban and agricultural discharges and runoff, aquacultural effluents, atmospheric deposition). Water quality conditions are accordingly quite diverse, and this can be seen in the series of maps in Exhibit 6-40, which present interpolated data from 81 stations sampled in a bay-wide water quality study carried out in late 2020 under the auspices of the Manila Bay Sustainable Development Master Plan.[133]

It can be inferred from Exhibit 6-40 that the area around the mouth of Manila Bay is less affected by key water quality degradation factors than some other parts of the bay, being well removed from notable hotspots for most parameters. The BCIB project area is within a favorable zone for dissolved biological oxygen demand and dissolved oxygen, although the influence of built-up areas around Mariveles Bay and along the Naic shore can be seen in the maps for both of these parameters, as well as for fecal coliform. Elevated levels of suspended solids and nitrates can be seen near the Naic shore, likely associated with inputs from the Labac and Timalan Rivers. The least favorable map in the series for the BCIB project area is for nitrates, which indicates enrichment along the southeast coast of Bataan and extending to the area around Corregidor Island; and the nitrate levels recorded in these areas were within the national standard for Class SB marine waters.

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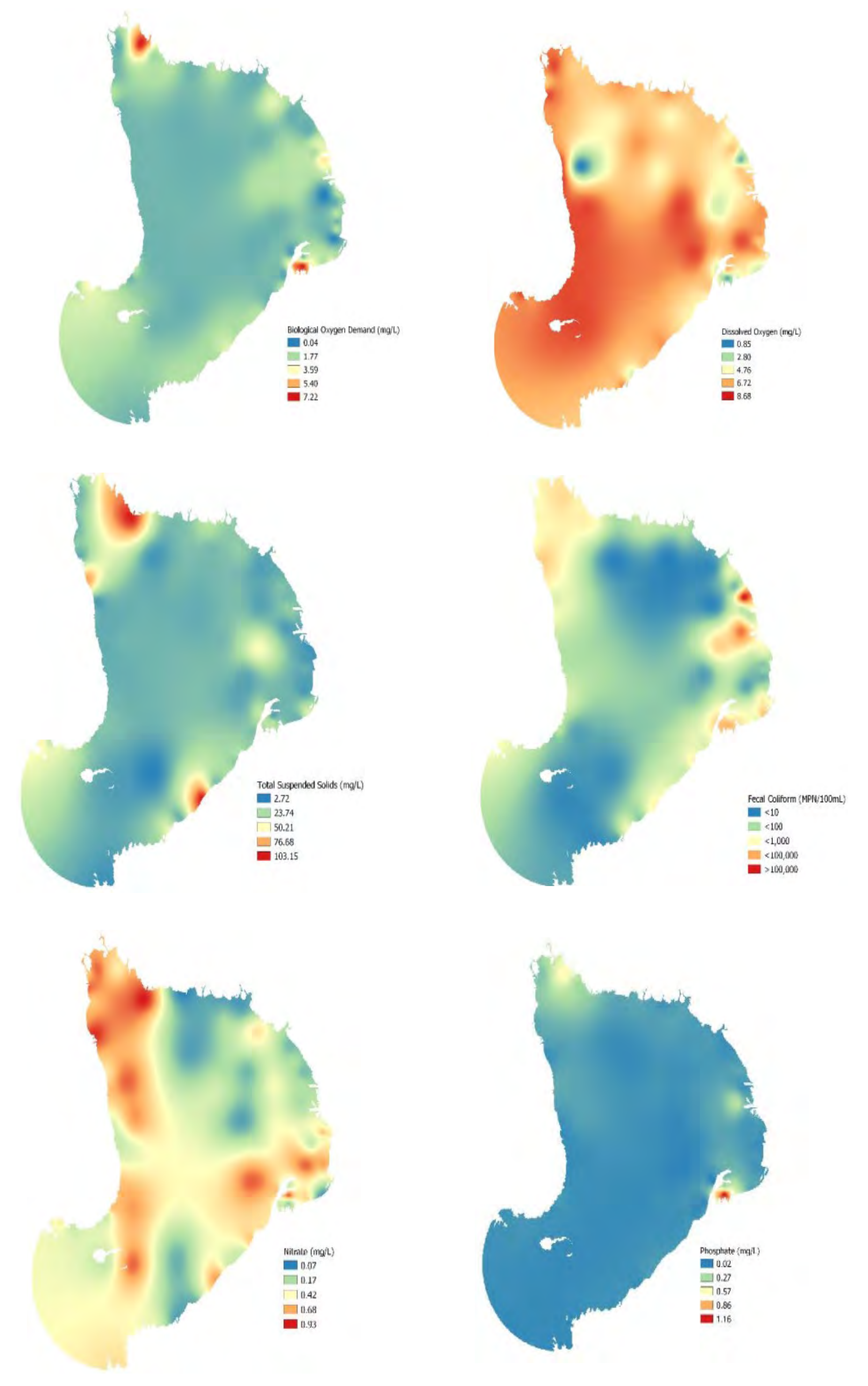
[130] Borja, V.M., E.F. Furio, N.C. Gatdula and M. Iwataki. 2019. Occurrence of Harmful Algal Blooms Caused by Various Phytoplankton Species in the Last Three Decades in Manila Bay, Philippines. Philippine Journal of Natural Sciences 24:80–90.

[131] Chang, K., A. Amano, T.W. Miller, T. Isobe, R. Maneja, F.P. Siringan, H. Imai and S. Nakano. 2009. Pollution Study in Manila Bay: Eutrophication and Its Impact on Plankton Community. In Y. Obayashi, T. Isobe, A. Subramanian, S. Suzuki and S. Tanabe, Eds. Interdisciplinary Studies on Environmental Chemistry—Environmental Research in Asia. pp. 261–267.

[132] Ibid.

[133] NEDA. 2020. Manila Bay Sustainable Development Master Plan and Investment Report – Annex 12: Water Quality Assessment Report. December 2020.



Source: Adapted from NEDA. 2020. Manila bay Sustainable Development Master Plan and Investment Report – Annex 12: Water Quality Assessment Report. December 2020.

Exhibit 6-40 General Pattern of Water Quality for Key Parameters in Manila Bay, 2019

Manila Bay is categorized as Class SB by DENR-EMB, in accordance with DAO 2016-08. Class SB waters are those considered suitable for (1) commercial propagation of shellfish and intended spawning areas for milk fish and similar species; and (2) tourist zones for ecotourism and recreational activities involving primary contact, e.g., bathing, swimming, skin diving, etc.[134]

[134] DENR Administrative Order 2016-08 - Water Quality Guidelines and General Effluent Standards of 2016.

To build upon the general understanding of water quality in Manila Bay and establish a baseline profile of marine water quality conditions in the vicinity of the proposed BCIB project, water sampling was conducted at stations representing open water and nearshore conditions. Ten open water sampling stations spaced along the proposed alignment (MBS-1 through MBS-10) were sampled at three separate depths: surface (S), at the mid-point of the water column (M), and near the bottom (B). Water depth at sampling stations along the alignment ranged from 4.3 m to 37.4 m, as measured by sonic depth sounder at the time of sampling. Nine nearshore water sampling stations were established in shallow water near the alignment's shore approaches at Mariveles (BNS-1 to BNS-3), Naic (CNS-1 to CNS-3) and the west shore of Corregidor Island (CONS-1 to CONS-3). For the nearshore areas, only surface water was collected for sampling. Water depth, as measured at the time of sampling, ranged from 2.3 m to 9.9 m for the nearshore sampling stations. The locations of both open water and nearshore sampling sites are shown in Exhibit 6-41. Sampling for all stations was conducted in February 2020. Conditions prevailing during the sampling were sunny, with low wind and waves less than 20 cm.

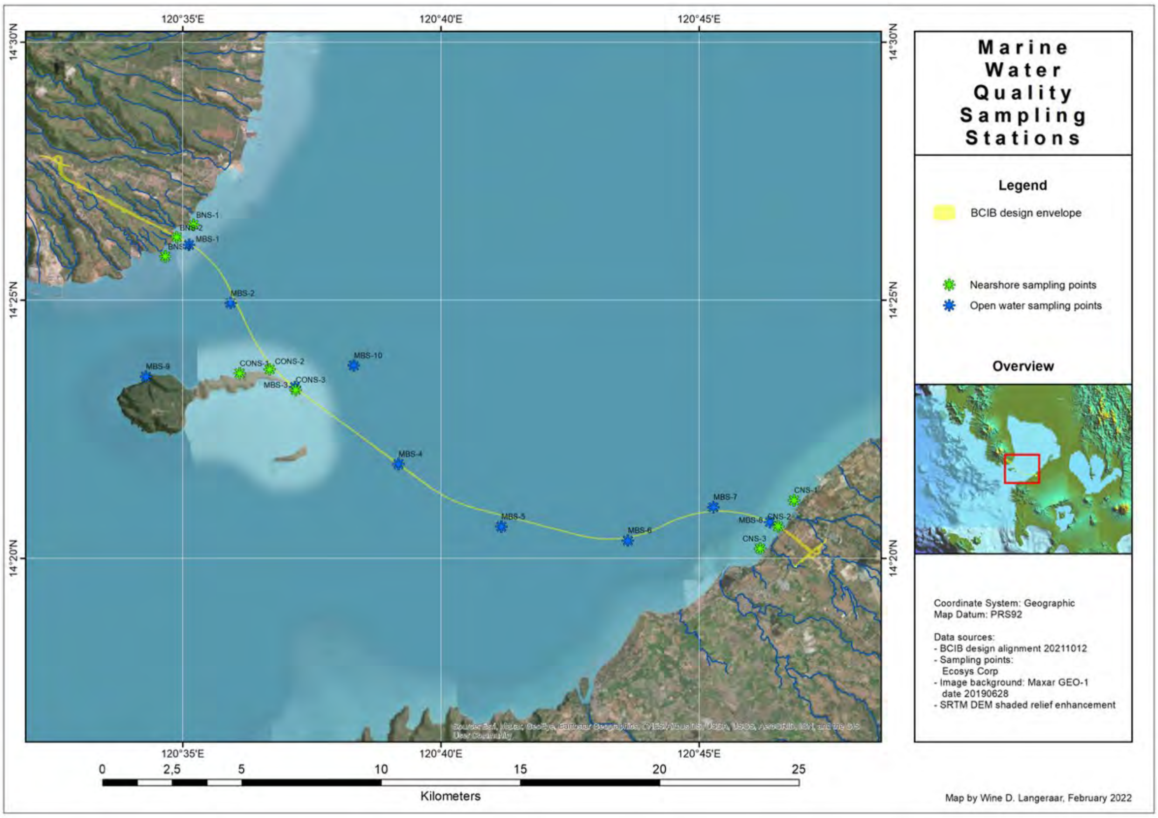


Exhibit 6-41 Marine Water Sampling Stations

All collected water samples were subject to analysis in relation to 25 parameters by an accredited laboratory, and results were compared to the standards specified in DAO 2016-08 – Water Quality Guidelines and General Effluent Standards of 2016 (as updated by DAO 2021-19), for Class SB marine waters. For selected sampling stations that fall within the Corregidor Islands Marine Park (discussed in a later section), data were additionally compared to the standard for Class SA marine waters. Sampling results are presented and discussed below.

It is important to note here that the BCIB project area is a dynamic marine environment, and water quality parameters can be expected to exhibit considerable variability over various temporal scales (hourly to decadal), under the influence of tidal currents, seasonal wind pattern shifts and influxes of runoff, atmospheric conditions affecting sea surface temperature and rates of photosynthesis, and local economic activities such as dredging, construction, shipping and fishing. Accordingly, the baseline data presented here should be understood as constituting a spatially comprehensive snapshot that can inform a general understanding of the diversity of conditions along the BCIB alignment and highlight the relevance of anthropogenic influences, but not as a representative baseline for comparison to water quality monitoring data collected during construction of the infrastructure. In such a dynamic environment, construction-phase monitoring data are appropriately compared to data from real-time control stations, rather than to historical snapshots, or even to longitudinal monitoring data (which does not exist for the project area).

6.1.7.1 Open Water Sampling Stations

The results from samples collected from the multi-depth stations in open water locations along the alignment are shown below. For space reasons, the results from the 10 open water stations are presented in two batches; data for Stations MBS-1 through MBS-5 (surface, mid-depth and bottom) are in Exhibit 6-42 and data for Stations MBS-6 through MBS-10 are in Exhibit 6-43. Values shown in red type in the tables are those that do not meet the standard for Class SB marine waters, as indicated in DAO 2016-08.

Exhibit 6-42 Results From Laboratory Analysis of Marine Water Samples (Open Water Stations 1–5)

Parameters	DAO 2016-08 Standards for Class SB†	MBS-1 (depth = 8.9 m)			MBS-2 (depth = 31.0 m)			MBS-3 (depth = 7.6 m)			MBS-4 (depth = 37.4 m)			MBS-5 (depth = 23.8 m)		
		S	M	B	S	M	B	S	M	B	S	M	B	S	M	B
Physicochemical Properties																
1. pH	7.0-8.5	8.16	8.25	8.30	8.32	8.32	7.68	8.45	8.52	8.31	8.51	8.46	8.29	8.38	8.44	8.45
2. Temp (°C)	26-30	28.9	28.1	27.4	29.4	29.4	28.9	32.4	25.3	29.3	28.3	26.9	27.9	26.8	29.4	27.2
3. Color (TCU)	50	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
4. Oil and grease	2.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5. Turbidity (NTU)*	-	1.4	1.1	2.1	0.8	0.9	1.4	1.7	0.8	1.0	1.1	1.3	2.0	1.3	1.3	1.0
6. Salinity (ppt)*	-	29.0	29.0	29.5	29.2	29.7	30.0	28.9	29.4	29.5	31.0	30.8	31.1	30.9	31.1	31.1
7. BOD (mg/L)	N/A	7.55	6.65	2.02	ND	ND	8.16	2.12	ND	ND	8.48	6.35	7.55	ND	ND	ND
8. COD (mg/L)*	-	1,730	1,360	1,150	1,510	1,410	1,680	1,780	1,750	1,300	2,050	1,990	1,980	1,890	1,710	1,390
9. TDS (mg/L)*	-	36,100	36,500	36,600	36,600	35,200	36,600	36,800	37,200	37,600	39,100	39,200	40,200	38,700	38,700	39,400
10. TSS (mg/L)	50.0	ND	ND	ND	6.4	ND	ND	ND	ND	ND	9.0	ND	ND	ND	ND	ND
11. DO (mg/L)	6	3.78	4.31	4.42	4.84	4.84	3.25	7.55	6.50	9.62	7.71	3.94	3.71	7.72	7.42	7.29
Inorganic Non-Metallic Parameters																
12. Cl (mg/L)	N/A	20,000	20,500	20,700	19,900	20,500	19,200	20,000	21,200	17,700	19,200	22,700	22,200	22,000	22,600	23,500
13. NO_3-N (mg/L)	10.000	ND	ND	0.7890	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14. P (mg/L)	0.500	0.0530	0.0484	0.0473	0.0496	0.0473	0.0564	0.0439	0.0496	0.0404	0.0473	0.0473	0.0541	0.0416	0.0575	0.0575
15. Cyanide (mg/L)	0.02	0.129	0.129	0.219	0.138	0.124	0.126	0.139	0.149	0.145	0.139	0.131	0.134	0.119	0.137	0.108
16. Ammonia (mg/L as N)	0.050	0.693	0.121	0.118	0.110	0.133	0.962	ND	ND	0.103	0.498	0.844	0.591	0.577	0.696	0.467

Parameters	DAO 2016-08 Standards for Class SB†	MBS-1 (depth = 8.9 m)			MBS-2 (depth = 31.0 m)			MBS-3 (depth = 7.6 m)			MBS-4 (depth = 37.4 m)			MBS-5 (depth = 23.8 m)		
		S	M	B	S	M	B	S	M	B	S	M	B	S	M	B
Bacteriological Parameters																
17. Fecal Coliform (MPN/ 100mL)	100	110	130	140	79	140	140	9	17	46	13	79	49	23	49	70
Metals and Major Cations mg/L																
18. Arsenic	0.010	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416
19. Cadmium	0.003	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073
20. Hexavalent chromium	0.050	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21. Lead	0.010	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517
22. Mercury	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23. Nickel	0.040	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	0.00194	0.00237	<0.00128	<0.00128	<0.00128	<0.00128	0.00287	0.00293
24. Zinc	0.050	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102
25. Vanadium*	-	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133

Notes

(1) * indicates no standard specified under DAO 2016-08

(2) † As updated by DAO 2021-19.

(3) S = Surface; M = Middle; B = Bottom; ND = Not detected at or above reporting limit; N/A = Not applicable according to DAO 2016-08

(4) Samples collected 15 February 2020

(5) Indicated water depth are as measured with a depth sounder at the time of sampling.

Exhibit 6-43 Results from Laboratory Analysis of Marine Water Samples (Open Water Stations 6–10)

Parameters	DAO 2016-08 Standards for Class SB†	MBS-6 (depth = 6.1 m)			MBS-7 (depth = 5.5 m)			MBS-8 (depth = 4.3 m)			MBS-9 (depth not recorded)			MBS-10 (depth not recorded)		
		S	M	B	S	M	B	S	M	B	S	M	B	S	M	B
Physicochemical Properties																
1. pH	7.0-8.5	7.50	8.26	8.47	8.35	8.31	8.31	8.44	8.47	8.48	8.32	8.26	8.14	8.17	8.43	8.39
2. Temp (°C)	26-30	26.2	26.7	26.4	25.5	28.9	26.9	25.6	25.3	25.2	29.4	28.9	28.2	26.5	27.4	28.7
3. Color (TCU)	50	10	10	10	10	10	10	10	10	10	5	5	5	5	5	5
4. Oil and grease	2.00	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5. Turbidity (NTU)*	-	2.0	2.8	3.0	6.1	4.5	5.6	3.1	7.3	5.4	0.9	0.9	0.8	1.6	0.7	1.0
6. Salinity (ppt)*	-	31.0	30.9	30.8	30.9	30.8	26.6	30.5	30.8	30.7	29.2	29.0	29.3	29.9	29.7	29.3
7. BOD (mg/L)	N/A	ND	5.18	6.38	7.28	6.05	6.98	3.02	2.82	6.05	5.18	5.75	5.78	ND	ND	4.55
8. COD (mg/L)*	-	1,860	2,010	1,690	1,630	2,100	1,540	1,290	1,120	1,100	2,150	1,810	1,740	1,430	2,290	2,030
9. TDS (mg/L)*	-	38,600	38,700	38,400	39,100	39,300	39,300	39,000	38,800	38,700	36,800	37,000	37,000	37,000	37,600	37,600
10. TSS (mg/L)	50.0	16.8	11.0	7.5	17.5	16.8	16.8	8.8	26.7	41.6	5.7	ND	5.9	6.9	ND	ND
11. DO (mg/L)	6	8.28	8.09	8.11	5.72	6.60	6.30	7.65	8.33	8.31	4.84	7.09	7.17	8.36	4.20	5.86
Inorganic Non-Metallic Parameters																
12. Cl (mg/L)	N/A	21,200	21,500	22,500	22,100	21,500	20,600	20,400	20,600	20,900	20,600	20,500	20,600	21,000	20,400	21,000
13. NO_3-N (mg/L)	10.000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14. P (mg/L)	0.500	0.0564	0.0632	0.0632	0.0746	0.0861	0.0678	0.0986	0.0553	0.0644	0.0473	0.0427	0.0507	0.0450	0.0473	0.0518

Parameters	DAO 2016-08 Standards for Class SB†	MBS-6 (depth = 6.1 m)			MBS-7 (depth = 5.5 m)			MBS-8 (depth = 4.3 m)			MBS-9 (depth not recorded)			MBS-10 (depth not recorded)		
		S	M	B	S	M	B	S	M	B	S	M	B	S	M	B
15. Cyanide (mg/L)	0.02	0.146	0.128	0.130	0.123	0.135	0.142	0.142	0.138	0.135	0.136	0.160	0.137	0.136	0.127	0.135
16. Ammonia (mg/L as N)	0.050	0.602	0.106	1.110	0.456	0.472	0.118	0.693	0.420	0.655	0.153	0.932	0.269	ND	0.189	0.956
Bacteriological Parameters																
17. Fecal Coliform (MPN/ 100mL)	100	70	79	70	170	540	220	1,600	350	170	49	79	140	33	170	79
Metals and Major Cations mg/L																
18. Arsenic	0.010	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416
19. Cadmium	0.003	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073	<0.00073
20. Hexavalent chromium	0.050	ND	ND	ND	0.00640	0.00745	0.01240	ND	ND	ND	ND	ND	ND	ND	ND	ND
21. Lead	0.010	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517
22. Mercury	0.001	ND	ND	ND	ND	ND	ND	0.000722	ND	ND	ND	ND	ND	ND	ND	ND
23. Nickel	0.040	<0.00128	<0.00128	0.00292	<0.00128	<0.00128	0.00299	0.00299	<0.00128	0.00265	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128
24. Zinc	0.050	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102
25. Vanadium*	-	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133

Parameters	DAO 2016-08 Standards for Class SB†	MBS-6 (depth = 6.1 m)			MBS-7 (depth = 5.5 m)			MBS-8 (depth = 4.3 m)			MBS-9 (depth not recorded)			MBS-10 (depth not recorded)		
		S	M	B	S	M	B	S	M	B	S	M	B	S	M	B

Notes

(1) * indicates no standard specified under DAO 2016-08

(2) † As updated by DAO 2021-19.

(3) S = Surface; M = Middle; B = Bottom; ND = Not detected at or above reporting limit; N/A = Not applicable according to DAO 2016-08

(4) Samples collected 15 February 2020

(5) Indicated water depths are as measured with a depth sounder at the time of sampling. Depths were not reported for MBS-9 and MBS-10.

The data presented in Exhibit 6-42 and Exhibit 6-43 indicate that the waters along the proposed BCIB alignment easily met the DAO 2016-08 standards for Class SB water for most parameters, but that exceedances of the specified standards were observed in relation to pH, temperature, dissolved oxygen (DO), cyanide, ammonia and fecal coliform. These exceedances are discussed in turn below. In addition, although turbidity is not subject to a standard under DAO 2016-08, and levels of total suspended solids were not found to exceed the maximum specified in the standard under DAO 2016-08, observed levels for these parameters are also discussed briefly below because of their special relevance to marine construction impacts.

pH levels. The results indicate that the waters along the alignment are generally quite basic, with most samples showing pH levels very near the upper end of the acceptable range (7.0–8.5) for Class SB waters as specified in DAO 2016-08 (very minor exceedances of the upper limit were found at two stations). The average pH documented across all samples was 8.3. The global average pH of seawater is 8.1, which is a decline from the pre-industrial average of 8.2, reflecting an acidification trend associated with increasing atmospheric carbon dioxide concentration. In general, it may be said that slightly more basic seawater is preferable to less basic seawater, as lower pH conditions are known to slow or counteract formation of calcium-based materials, a critical element of shell-building in bivalves and in the building and maintenance of coral reefs. Relatively high pH conditions in the waters of the BCIB project area may help to buffer acidifying effects of algal blooms driven by excess nutrient inputs, but may also heighten the severity of effects from elevated ammonia.

Temperature. Water temperature plays a vital role in shaping marine habitat, particularly as a regulator of the distribution of sessile and mobile species. Only one sample was found to overtop the upper limit of the temperature range specified in DAO 2016-08, which is 26–30°C; this was a surface sample from the MBS-4 station, near the south navigation channel, in which the recorded temperature was 32.4°C. Interestingly, a sample from the depth midpoint at the same station was 25.3°C, below the lower limit for temperature. Four other samples taken at stations MBS-9 and MBS-10, were found to be marginally colder than the specified minimum.

Dissolved oxygen (DO). The minimum acceptable level of DO for SB waters, as specified in DAO 2016-08, is 6 mg/L. Oxygen is crucial for the survival of marine organisms, except for those adapted to anoxic conditions, and elevated DO over extended periods can generally be expected to lead to poor success and eventually deaths of fish and other organisms, and also abandonment of otherwise suitable habitat by mobile species. Most fish species experience distress when DO falls below 4 mg/L, and mortality at levels below 2 mg/L. Low levels of DO can be caused by several factors, often in combination, but two prominent factors are concentrated algal growth due to elevated inputs of phosphorus and nitrogen, and concentrated decomposition taking place in the water column, a response to excessive inputs of organic materials from runoff or waste disposal. Elevated water temperature and cloudy weather are also often involved in creating low-DO conditions.[135]

Low DO levels were documented at several sampling locations, as can be seen in Exhibit 6-44. Overall, 11 of the 30 samples collected failed to meet the minimum standard for DO. The average DO level across all sampled open water sites was just 6.4 mg/L.

[135] Francis-Floyd, R. 2003. Dissolved Oxygen for Fish Production. University of Florida IFAS Extension Paper FA27.

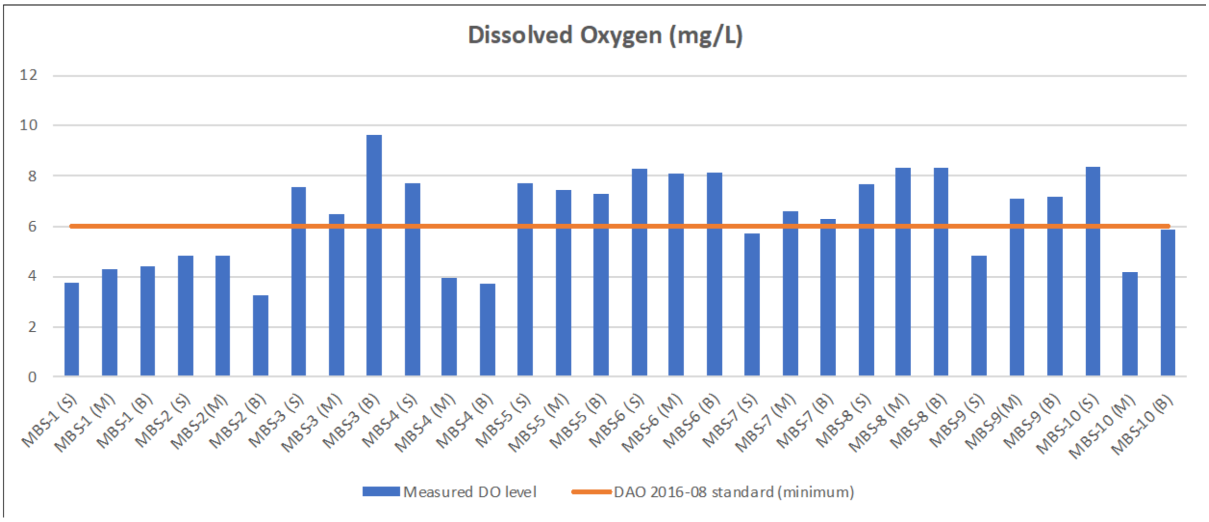


Exhibit 6-44 Dissolved Oxygen Levels in Water Samples Collected Near Proposed Alignment

The lowest DO values were recorded at MBS-1 (3.78 mg/L at surface), MBS-2 (3.25 mg/L at bottom) and MBS-4 (3.94 mg/L at mid-depth, 3.71 mg/L at bottom). These are all below the level at which most fish begin to experience distress. The low DO measurements at MBS-1 can likely to be attributed in part to inputs of pollutants from the rivers draining into Manila Bay from Mariveles, particularly the Pangolisanin River, which drains agricultural lands and runs close by the built-up areas of Barangays Mountain View and Cabcaben, and the San Jose River, which has the built-up area of Alas-Asin within its catchment. Similarly, low DO at MBS-9, which is just 50 m off the shoreline of Corregidor Island, may be attributable to inputs of human waste from facilities on the island. Causation is less easily inferred for the observed low levels of DO at stations MBS-2, MBS-4 and MBS-10, which are all in open water well away from inhabited land areas; larger-scale dynamics are likely to be dominant contributing factors there. The highest DO concentration recorded in the marine sampling was 9.62 mg/L, from the bottom depth of MW-3 near the east coast of Corregidor Island; this measurement bodes well for marine life in this area.

As might be expected based on differences in land use intensity and mixing driven by wave action and tides, the DO levels recorded along the proposed BCIB alignment compare favorably with DO levels for Manila Bay as a whole. In a bay-wide sampling program conducted at the same time of year (mid-February, northeast monsoon) as the one presented here, but in 2010, average DO across all bottom samples was found to be 4.49 mg/L, with range 0.79–7.25 mg/L.[136] The average across the 10 bottom samples collected along the BCIB alignment was 6.40 mg/L, with range 3.25–9.62.

Cyanide. All water samples collected showed cyanide concentrations substantially higher than the maximum permissible level specified in DAO 2016-08, which is 0.02 mg/L (see Exhibit 6-45). Cyanide concentrations in the samples ranged from 0.108 mg/L to 0.219 mg/L. The average value across all locations was 0.137 mg/L.

Cyanide contamination in marine water may be caused by discharge of effluents from electroplating processes, gold and silver extraction, and production of medicines and plastics. Ions of cyanide interfere with cell respiration, and are a fast-acting poison that most

[136] Jacinto, G.S., L.P.A. Sotto, M.I.S. Senal, M.L. San Diego-McGlone, M.T.L. Escobar, A. Amano and T.W. Miller. 2011. Hypoxia in Manila Bay, Philippines During the Northeast Monsoon. Marine Pollution Bulletin 63: 243–248.

severely affects parts of the body that metabolize oxygen most quickly.[137] In the Philippines, cyanide is widely (and illegally) used in fishing, particularly in the lucrative live fish trade. As can be seen in Exhibit 6-45, the cyanide levels measured along the proposed alignment are fairly even, which suggests that elevated cyanide is a generalized occurrence rather than something that can be traced to a particular local source.

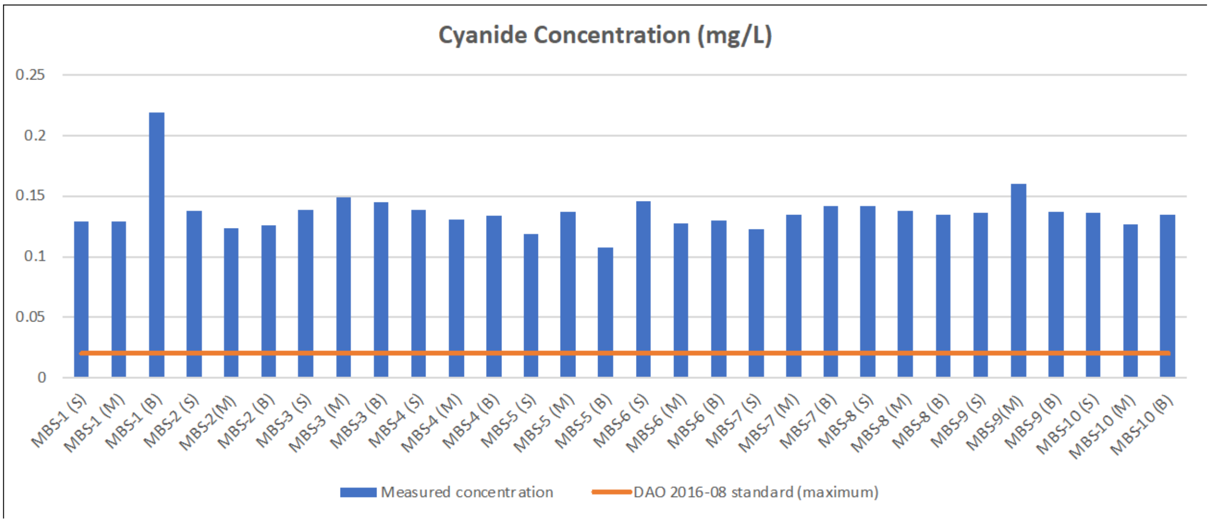


Exhibit 6-45 Cyanide Levels in Water Samples Collected Near Proposed Alignment

Ammonia. With the exception of three samples in which no ammonia was detected, the level of ammonia recorded in the open water samples was generally in excess of the maximum acceptable limit (0.05 mg/L) specified in DAO 2016-08. For 12 of the 30 samples, the documented ammonia level was more than 10 times higher than the standard maximum.

Although ammonia is produced naturally in the environment via various processes (such as in decomposition of organic material and defecation by most animals), elevated levels can typically be attributed to human economic activity. Ammonia is used in agricultural fertilizers, metal finishing and production of pharmaceuticals, and may be present in high concentrations in sewage discharges and agricultural runoff, as well as facilities that congregate high densities of excrement-producing animals (including aquaculture operations). Amongst other effects on aquatic and marine species, elevated ammonia reduces the effectiveness of nitrogen excretion (leading to harmful buildup in tissues) and decreases efficiency of oxygen use, thereby affecting growth and abundance of more sensitive species, and ultimately reduced species diversity.[138]

There is no clear pattern observable in the data across samples, in relation to either station location or sample depth, which would make attribution to particular sources problematic without further site-specific research. One station (MBS-3 off the east coast of Corregidor Island), does stand out for comparatively low ammonia levels at all three depths.

[137] Jaszczak, E., Z. Polkowska, S. Narkowicz and J. Namiesuik. 2017. Cyanides in the environment – analysis – problems and challenges. Environmental Science and Pollution Research International 24(19: 15929–15948.

[138] US Environmental Protection Agency. Causal Analysis/Diagnosis Decision Information System (CADDIS). Volume 2 (Sources, Stressors and Responses) – Ammonia. Available online at epa.gov/caddis-vol2/ammonia.

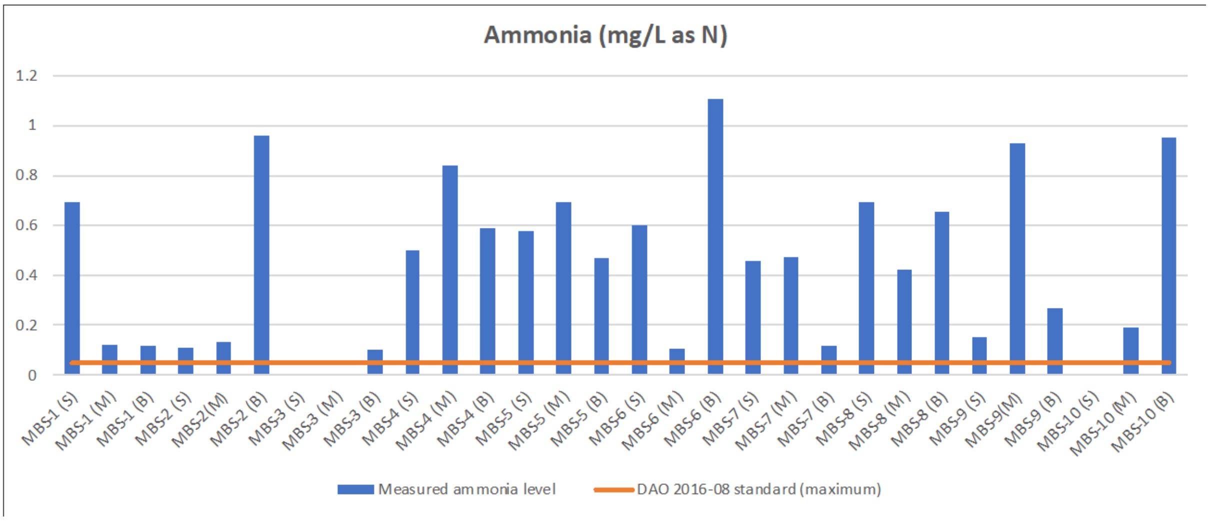


Exhibit 6-46 Ammonia Levels in Water Samples Collected Near Proposed Alignment

Fecal coliform. Levels of fecal coliform were found to be below the maximum specified in DAO 2016-08 for Class SB waters for approximately two thirds of the samples collected. Significant spikes in coliform levels can be seen at the sampling stations closest to the Naic shore (MBS-7 and MBS-8). There are significant built-up areas along this shore that discharge untreated sewage. These stations are also nearby the mouths of the Timalan and Bucalan Rivers, which receive some sewage effluents, support significant aquacultural activity, and pass through rural areas where livestock are raised. In addition, there is a significant agglomeration of fish ponds in the coastal zone not far from the affected sampling stations.

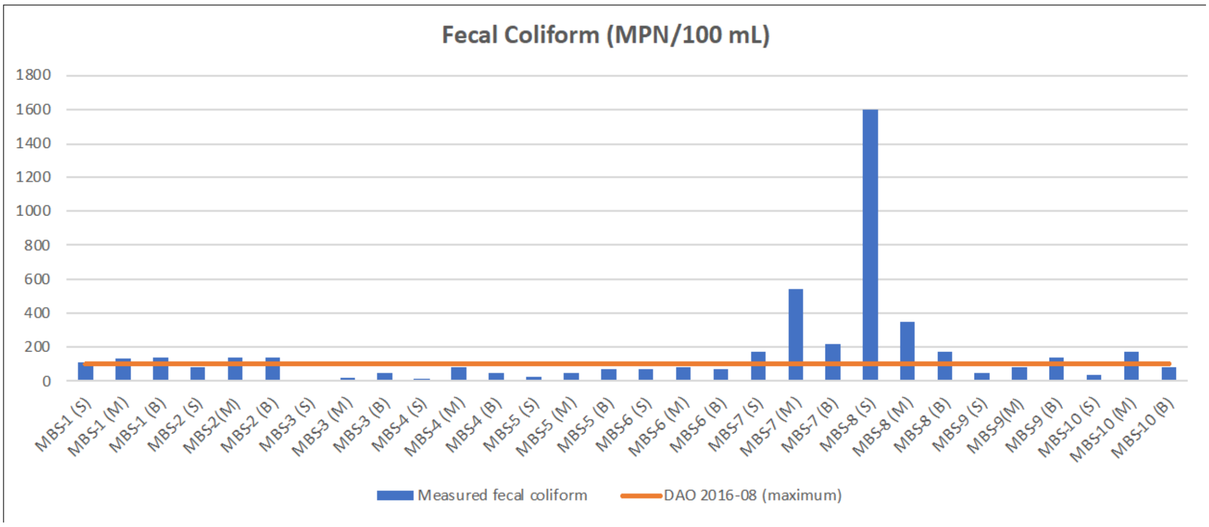


Exhibit 6-47 Fecal Coliform Levels in Samples Collected Near Proposed Alignment

Turbidity. Turbidity is a measure of light attenuation by suspended materials in the water column, and exerts strong influence on the availability of light for photosynthesis and on the ability of predator species to locate and catch their prey. Elevation of turbidity levels in a particular marine environment may arise as a result of natural processes (e.g., wave action, currents, river inputs) and anthropogenic causes (e.g., soil erosion, industrial and domestic effluents, marine construction activities, boat propeller wash). As a point of reference, turbidity levels of 0–3 NTU are sometimes cited as typical for 'pristine' tropical reef environments, although many reef species and assemblages are adapted to turbidity well outside this 'typical' turbidity range, and thrive on reefs that experience high natural turbidity.

The open water sampling results along the proposed BCIB alignment indicate moderate turbidity, with a well-defined spike in turbidity at the MBS-6, MBS-7 and MBS-8 stations, all of which represent the extensive shallow zone near the Naic shore. Two significant rivers empty into the bay in this area, and the shoreline is fairly densely populated. There are also substantial on-shore fish ponds here. The bottom sediments in this area are known to be somewhat muddier than in other areas around the mouth of the bay (see Exhibit 6-30), and the shallow water depth puts them within reach of even moderate wave action. The observed elevated turbidity in this part of the survey area is therefore unsurprising.

Turbidity is highly variable over time in many contexts, and this is especially true in environments characterized by pronounced seasonality of precipitation, and in those affected by intensive human activity. The Philippines has a wet-dry tropical climate; inputs of turbidity-causing nutrients, sediments and organic matter from river discharge and direct runoff are typically much higher during the wet season, which in the Manila Bay area extends from May to October, than during the driest depths of the dry season (January through April). The samples discussed above, which were collected in mid-February, likely represent the lower end of the annual turbidity range that would be expected in this area, at least as influenced by precipitation.

Of special note in this particular survey area is the presence of dredging projects, most notably in the nearby San Nicolas Shoal area, from where much of the fill material needed for land reclamation projects ongoing in the nearshore areas of Metro Manila is being sourced. The boundaries of two active seabed mining concessions extend to within 600 m of the proposed BCIB alignment, and a number of other dredging projects are proposed around the bay. The baseline turbidity documented in this survey thus may not be very representative of background levels present during construction of the proposed BCIB project.

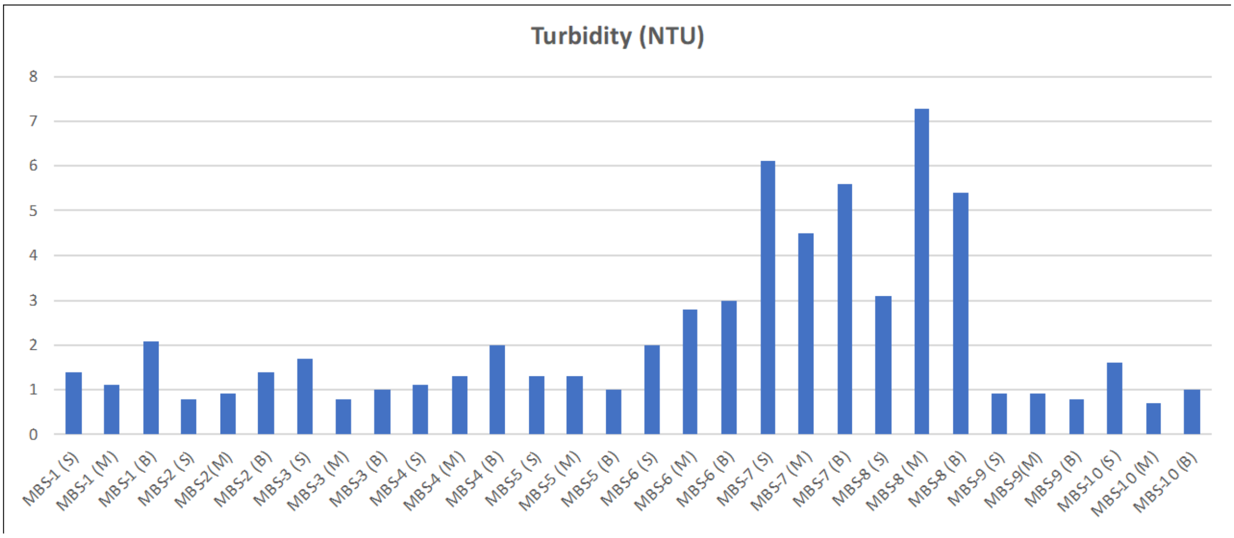


Exhibit 6-48 Turbidity Levels in Water Samples Collected Near Proposed Alignment

Total suspended solids (TSS). Suspended solids may include a great many types of particles, including such things as soil particles from on-land erosion and waste discharges; bottom sediments re-suspended by wave action, boat propellers, fishing activities such as bottom trawling, dredging and other in-water works; atmospheric depositions of dust and pollutants; organic detritus; and plankton. In line with the turbidity results, elevated TSS was notable at stations MBS-6, MBS-7 and MBS-8, all near the shallow zone off the Naic shore. About half of samples returned results indicating that TSS had not been detected at or above the reporting limit for the analytical method used; this is likely to reflect low test sensitivity, rather than near-total absence of suspended solids.

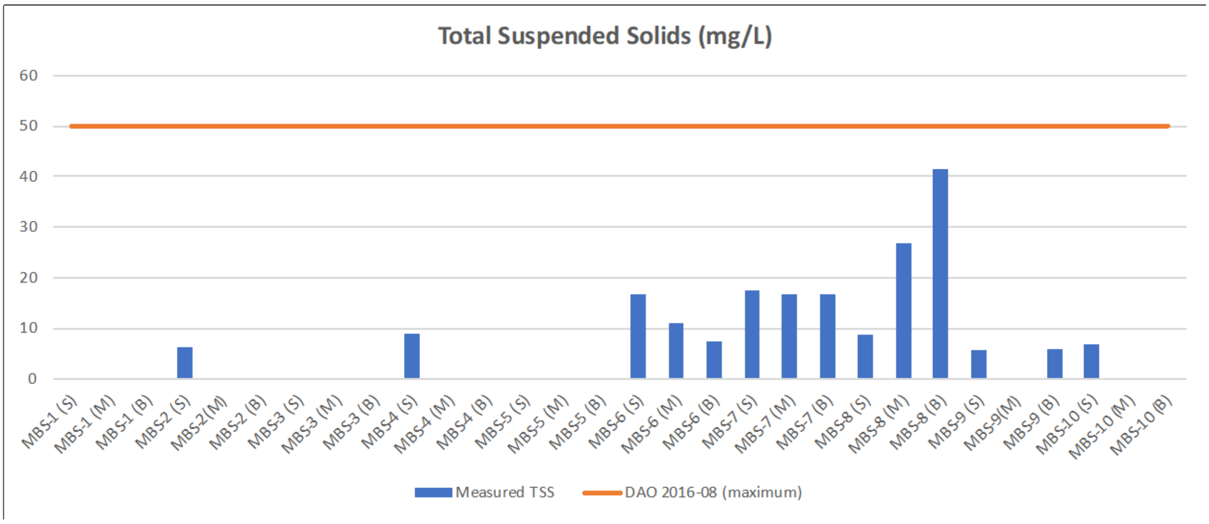


Exhibit 6-49 Total Suspended Solids Levels in Water Samples Collected Near Proposed Alignment

6.1.7.2 Nearshore Sampling Stations

The results from analysis of samples collected from the nine nearshore sampling stations at Mariveles (BNS-1 through BNS-3), the eastern coast of Corregidor Island (CONS-1through CONS-3) and Naic (CNS-1 through CNS-3) are presented in Exhibit 6-50. Values in red type in the table are those that do not meet the standard for Class SB marine waters under DAO 2016-08. As the nearshore sampling stations were all in shallow water locations, samples were collected from the surface only.

Exhibit 6-50 Results From Laboratory Analysis of Nearshore Marine Water Samples

Parameters	DAO 2016-08 Standards for Class SB†	Mariveles Nearshore			Corregidor Island Nearshore			Naic Nearshore		
		BNS-1	BNS-2	BNS-3	CONS-1	CONS-2	CONS-3	CNS-1	CNS-2	CNS-3
Physicochemical Properties										
1. pH	7.0-8.5	7.90	8.26	8.43	8.29	8.38	8.45	7.30	7.38	8.44
2. Temp (°C)	26-30	25.4	25.8	25.8	29.7	29.0	32.4	26.1	26.2	26.6
3. Color (TCU)	50	5	5	5	5	5	5	25	10	10
4. O&G	2.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
5. Turbidity (NTU)*	-	0.6	1.1	0.8	0.7	0.9	1.7	4.1	5.6	3.4
6. Salinity (ppt)*	-	28.8	29.0	29.2	29.5	29.7	29.5	30.1	30.3	30.1
7. BOD (mg/L)	N/A	8.86	7.69	6.79	4.58	5.78	ND	54.30	4.59	7.38
8. COD (mg/L)*	-	1,290	1,630	2,020	1,430	1,460	355	595	1,070	670
9. TDS (mg/L)*	-	34,200	35,300	35,600	37,000	36,200	36,000	35,300	34,600	35,500
10. TSS (mg/L)	50.0	6.3	6.6	ND	ND	ND	ND	15.1	20.9	13.8
11. DO (mg/L)	6	4.85	4.94	4.34	5.08	5.53	7.55	4.10	4.28	4.72
Inorganic Non-Metallic Parameters										
12. Cl (mg/L)	N/A	21,100	21,200	21,500	22,500	22,400	20,900	23,100	22,900	21,400
13. NO3-N (mg/L)	10.000	ND	ND	ND	ND	ND	ND	ND	0.0514	ND
14. P (mg/L)	0.500	0.0472	0.0542	0.0437	0.0461	0.0450	0.0439	0.0681	0.0692	0.0681
15. Cyanide (mg/L)	0.020	0.151	0.220	0.157	0.131	0.142	0.125	0.129	0.123	0.115
16. Ammonia (mg/L as N)	0.050	0.154	0.158	ND	0.438	0.502	0.426	1.170	0.189	0.202

Parameters	DAO 2016-08 Standards for Class SB†	Mariveles Nearshore			Corregidor Island Nearshore			Naic Nearshore		
		BNS-1	BNS-2	BNS-3	CONS-1	CONS-2	CONS-3	CNS-1	CNS-2	CNS-3
Bacteriological Parameters										
17. Fecal Coliform (MPN/ 100mL)	100	940	94	17	49	110	79	130	79	110
Metals and Major Cations										
18. Arsenic	0.010	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416	<0.00416
19. Cadmium	0.003	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727	<0.000727
20. Hexavalent chromium	0.050	ND	ND	ND	ND	ND	ND	ND	ND	ND
21. Lead	0.010	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517	<0.00517
22. Mercury	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND
23. Nickel	0.040	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128	<0.00128
24. Zinc	0.050	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102	<0.0102
25. Vanadium*	-	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133	<0.133

Notes

(1) * indicates no standard specified under DAO 2016-08

(2) † As updated by DAO 2021-19

(2) ND = Not detected at or above reporting limit; N/A = Not applicable according to DAO 2016-08

(3) Samples collected 12–13 February 2000 (Bataan stations), 13 February 2020 (Cavite stations), 15 February 2000 (Corregidor Island stations)

The nearshore sampling results present a similar set of concerns as the open water results. For most of the 25 parameters measured, the DAO 2016-08 standard was easily met, but the same cannot be said for DO, cyanide, ammonia and fecal coliform.

pH. The average pH recorded at the surface in the nearshore areas was 8.09; this is significantly lower than the 8.30 average across the 10 offshore sites. It may be speculated that algal blooms driven by nutrient loading from stream discharges contribute to observed variation in pH at the nearshore sites as the lowest pH levels were recorded at BNS-1 near the mouth of the Pangosalinin River in Mariveles and CNS-1 and CNS-2, near the mouth of the Timalan River in Naic (see Exhibit 6-51).

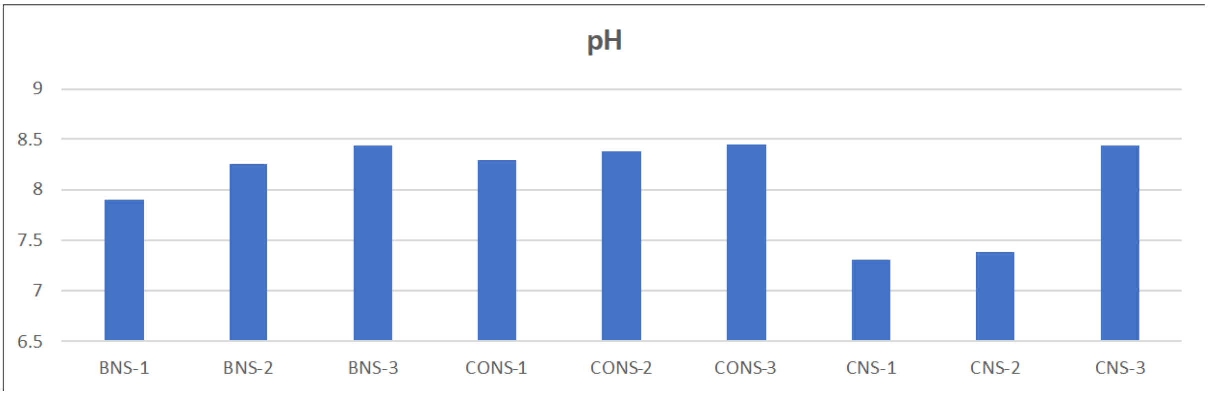


Exhibit 6-51 pH Levels Recorded at Nearshore Marine Sampling Sites

Temperature. Average surface temperature for the nearshore stations was 27.4ºC; four of the nine samples fell outside the standard-specified temperature range of 26–30ºC (one exceedance and three below the minimum).

Dissolved oxygen. Only one of the nearshore sampling stations met the standard for dissolved oxygen (minimum 6 mg/L). In general, DO levels were highest at the Corregidor Island nearshore locations, and lowest at the Naic shore locations (see Exhibit 6-52).

Cyanide. Levels of cyanide were above the DAO 2016-08 standard for all nearshore stations (Exhibit 6-52). The highest levels were found along the Mariveles shore; this corroborates a spike in cyanide recorded at MBS-1, the open water sampling station closest to the Mariveles shore (see Exhibit 6-45).

Ammonia. Except for one station in, all samples collected in nearshore locations showed ammonia levels in excess of the DAO 2016-08 standard of 0.05 mg/L. The highest level recorded was at CNS-1, a station 200 m off a populated section of the Naic shore and 400 m from the mouth of the Timalan River. The Timalan River is heavily used for aquacaulture, and also drains a large catchment with agricultural, residential and industrial land uses.

Fecal coliform. A notable spike in fecal coliform can be seen on the data from the nearshore sampling station closest to inhabited areas of Brgy Cabcaben in Mariveles, and the mouth of the Pangosalanin River (BNS-1); this is almost certainly linked to discharges of sewage to the river and directly to the bay. Septage and dilution are the only forms of wastewater treatment used in this part of Mariveles. Much smaller exceedances of the DAO 2016-08 maximum limit for fecal coliform (100 MPN/100 mL) were recorded at three other stations (see Exhibit 6-52).

Exhibit 6-52 Data for Key Water Quality Parameters, Nearshore Marine Samples

Turbidity and TSS. Unsurprisingly given the nature of on-land and riverine activity in Naic, the data show elevated turbidity and TSS at the three nearshore sampling stations there (see Exhibit 6-52). This can be attributed to particularly shallow water, bottom sediments containing a mild mud component, and discharges from the Timalan and Bucalan Rivers. Given these factors, the recorded levels of turbidity and TSS are actually quite moderate; the conditions prevailing at the time of sampling (dry season, calm winds, low sea state) may explain this.

6.1.8 Contaminants in Marine Sediments

Despite the flushing action of tidal and wind-driven currents, many water-borne contaminants directly and indirectly introduced to the marine environment of Manila Bay are known to have accumulated in sediments within the bay. Contaminants of particular concern and focus in research conducted on Manila Bay sediments to date include heavy metals, polychlorinated biphenyls (PCBs) and organotins. The dominant pathways for contaminant delivery to bay sediments are the rivers that drain industrial areas of Metro Manila, as well as the agricultural catchments to the north of the bay in Bulacan, Pampanga and northeastern Bataan. In addition to these primary pathways, numerous lesser rivers and creeks containing runoff and point-source discharges from residential, industrial and agricultural areas, and numerous direct discharges and leakages from waterside industrial facilities, ports and shipyards, and aquaculture operations contribute to contaminant accumulation in the bay's sediments.[139]

The distribution of contaminants in sediments within the bay is uneven, and depends on particular spatial configurations of contaminant sources and prevailing currents. In general, concentrations of contaminants of concern have been found to be highest in the inner bay, especially near the mouth of the Bulacan River on the heavily industrial north side of Metro Manila, and to decline towards the mouth of the bay. Although heavy metal enrichment is evident in bay sediments, the severity of contamination is considerably lower than has been measured in many other major harbors around the world, and concentrations of heavy metals and trace elements are not substantially higher than inferred background levels in most areas of the bay. There are indications, from comparison of research results over time, that inputs of contaminants to Manila Bay sediments may be lessening, probably due to a combination of stronger environmental regulation, global market forces and technological change.[140]

A survey of potentially contaminated sites relevant to the BCIB project footprint and expected construction work areas was conducted by Ecosys Corp. in 2021/2022, covering both on-land and marine sites. The marine portion of the survey considered the potential for marine sediment contamination based on (1) review of a previous risk assessment of munitions and explosives of concern (MEC) in the project area to determine if any munitions dumps are known to exist in the area; (2) comparison of results from laboratory analysis of sediment grab samples collected along the BCIB alignment against applicable benchmark values for heavy metals in marine sediments, and (3) review and analysis of the research literature presenting sediment analyses pertinent to the project area.

Review of the previous MEC risk assessment confirmed a lack of any evidence of munitions dumps anywhere in the BCIB project area. The presence of scattered unexploded ordnance is considered a distinct possibility due to the heavy bombardment of Corregidor Island and use of sea mines in the North Channel during WWII, but a significant concentration of potentially leaking munitions, as would be probable in the case of an intentional munitions dump, is considered a very unlikely scenario.

Marine sediments were sampled at 17 locations along the BCIB alignment in February 2020 in conjunction with baseline sampling for water quality, and subject to laboratory analysis for grain size and concentrations of eight heavy metals. Locations where grab samples were obtained are shown in Exhibit 6-53. There are no national standards or guidelines for marine sediment quality in the Philippines; the results of the sediment sample analysis were compared to the United States National Oceanic and Atmospheric Administration (NOAA)

[139] (1) Prudente, M.S., H. Ichihashi and R. Tatsukawa. 1994. Heavy Metal Concentrations in Sediments from Manila Bay, Philippines and Inflowing Rivers. Environmental Pollution 86:83–88.; (2) Olivares, R.U., E.J. Santa Maria and E.Z. Sombrito. 2019. Environmental Assessment of Metal Pollution in Manila Bay Surface Sediments. Philippine Journal of Science 149(SI):183–195.; (3) Diwa, R.R., C.C. Deocaris and L.P. Belo. 2021 (preprint). River Influx Drives Heavy Metal Pollution in Manila Bay, Philippines: An Insight from Multi-Variate Analyses. Preprints (www.preprints.org) doi: 10.20944/preprints202106.0470.vl.
[140] Olivares, R.U., E.J. Santa Maria and E.Z. Sombrito. 2019. Environmental Assessment of Metal Pollution in Manila Bay Surface Sediments. Philippine Journal of Science 149(SI):183–195.

sediment quality guideline screening benchmark values for the metals included in the sampling set.[141] The results of the comparison are presented in Exhibit 6-54.

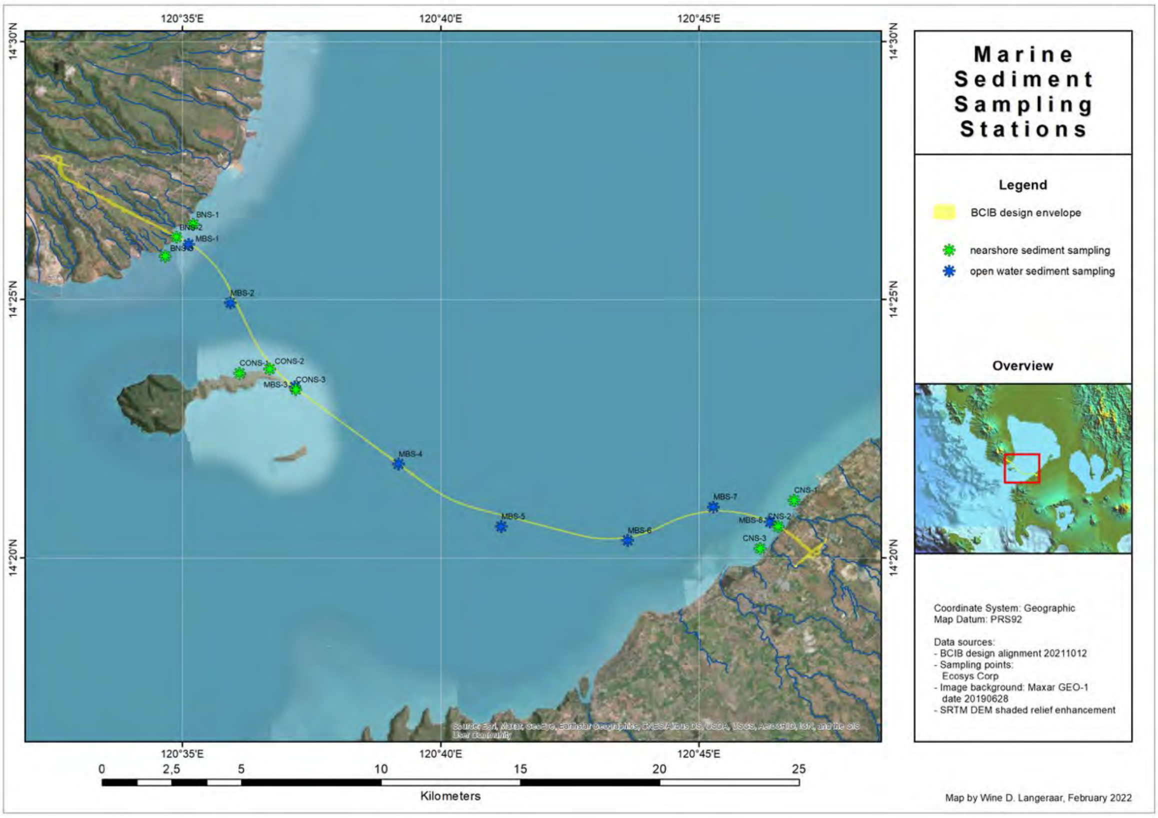


Exhibit 6-53 Marine Sediment Sampling Locations

Most chemical contaminants measured were found to be well below the corresponding screening value; this was not the case with arsenic, and this is discussed below. Two other parameters which were not analyzed, but which are commonly of concern in marine sediments in urbanized waterways (polychlorinated biphenyls and organotins) are also discussed, with reference to previous research findings.

Arsenic. The screening exercise indicates that levels of arsenic are somewhat elevated in all of the sediment samples, with significant exceedances noted at two stations (MBS5 and MBS6), both of which lie in deep water between the South Channel Bridge site and the shallows off the Cavite shore. Typical background arsenic levels in unpolluted nearshore and estuarine sediments range from 5–15 mg/kg globally, and many of the samples measured lie below or only slightly above the high end this range.[142] Arsenic is produced naturally by volcanism, and elevated levels are reported in groundwater in some parts of central Luzon, so it may reasonably be speculated that natural background levels in Manila Bay sediments are higher than average, with arsenic being added to the bay by both

[141] As published in National Oceanic and Atmospheric Administration (NOAA). Screening Quick Reference Tables. Office of Response and Restoration Report 08-1. The NOAA screening values do not represent a hard standard or constitute criteria for remediation. The values are expected to guide initial assessment of potential for contamination by chemicals of potential concern (COPCs). Comparison of observed concentrations to the benchmark values is a useful basis for determining the potential existence of a contamination problem, and where exceedances are observed, a detailed ecological risk assessment and possible remediation or other special management may be advised, depending on the nature of proposed activities that could increase risk of exposure to specific COPCs for humans or sensitive species and ecosystems.

[142] Neff, J.M. 1997. Ecotoxicology of Arsenic in the Marine Environment. Environmental Toxicology and Chemistry 16(5):917–927.

atmospheric deposition of volcanic particulates and runoff from weathered volcanic soils. Arsenic is also produced as a by-product of high-temperature processes such as combustion of coal in power plants and burning vegetation, and is used in wood preservers, agricultural pesticides, marine anti-fouling paints and manufacturing, so there are also many probable local anthropogenic sources of the arsenic found in marine sediments of Manila Bay.[143]

Exhibit 6-54 Comparison of Marine Sediment Quality Findings to NOAA Screening Benchmarks

Sampling Station	Analytes (All concentrations in mg/kg dry weight)							
	Arsenic	Nickel	Cadmium	Chromium	Lead	Vanadium	Zinc	Mercury
BNS1	19.0	0.9	ND	2.2	ND	7.4	18.6	ND
BNS2	10.6	2.7	ND	7.1	4.8	47.6	35.6	ND
BNS3	19.2	3.7	ND	2.8	ND	8.3	10.3	ND
CNS1	15.8	2.3	ND	9.7	1.2	51.7	12.6	ND
CNS2	15.4	0.8	ND	3.9	0.9	19.7	8.2	ND
CNS3	11.6	1.8	ND	6.8	2.2	57.9	17.5	ND
CONS1	13.8	5.2	ND	5.5	14.2	50.9	74.2	ND
CONS2	10.5	3.5	ND	3.6	8.7	45.2	65.1	ND
CONS3	12.6	3.5	ND	3.7	8.1	47.9	50.4	ND
MBS1	17.4	3.7	ND	8.2	3.9	32.1	34.7	ND
MBS2	15.6	12.1	ND	19.6	9.9	74.7	92.8	ND
MBS3	13.9	1.6	ND	5.7	1.8	41.6	14.0	ND
MBS4	38.7	10.3	ND	12.1	7.8	36.7	35.6	ND
MBS5	108.0	10.2	ND	20.9	ND	65.8	27.5	ND
MBS6	54.7	4.8	ND	8.7	1.3	44.9	22.6	ND
MBS7	15.7	4.4	ND	6.8	5.2	98.1	60.9	ND
MBS8	39.9	8.0	ND	8.3	5.0	64.2	50.6	ND
Probable Effects Level[1,2]	41.6	42.8	4.2	160.0	112.0	-	271.0	0.7

Notes

ND = none detected

Exceedances of benchmark values are shown in red type

[1] Probable Effects Level (PEL) = Concentration above which adverse effects are expected to be frequently observed (geometric mean of 50th percentile of concentrations in effects data set and 85th percentile of concentrations in no effects data set)

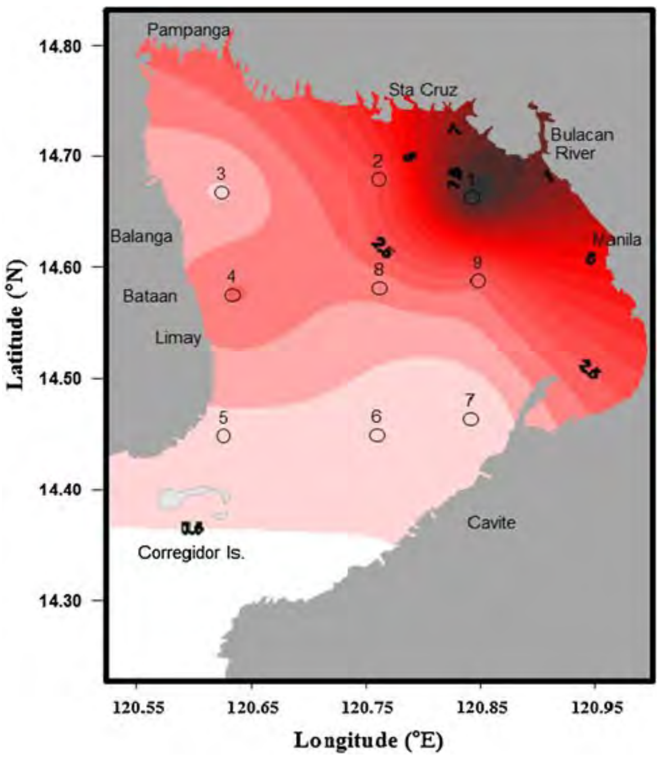
[2] As indicated in National Oceanic and Atmospheric Administration (NOAA). Screening Quick Reference Tables. Office of Response and Restoration Report 08-1.

[143] Background information on arsenic sources from: International Programme on Chemical Safety (IPCS). 2001. Environmental Health Criteria 224: Arsenic and Arsenic Compounds, Second Edition. World Health Organization. Available at https://inchem.org/documents/ehc/ehc/ehc224.htm#1.3.

Polychlorinated biphenyls (PCBs). PCBs are a class of suspected carcinogens that are commonly of concern in marine sediments, particularly as they are known to bioaccumulate in shellfish that may be consumed by humans. PCB levels were not analyzed in the sediment samples collected in the vicinity of the proposed BCIB alignment, but valuable insight is provided by a 2010 study which included a sampling station very nearby the Cavite end of the alignment, outside the mouth of the Timalan River.[144] Results from that study, which measured levels of 13 PCB species in both sediments and oyster soft tissues at 15 nearshore sites, indicated total PCBs for the Timalan River mouth sampling station were 0.9 ppb in sediments and 7.0 ppb in oyster tissue. By comparison, the NOAA Probable Effects Level (TEL) benchmark for total PCBs in marine sediments is 189 ppb. These results and comparison to the NOAA screening reference values suggest that PCBs in sediments around the Cavite end of the BCIB alignment at least, while concerning by their presence, are unlikely to be found at extreme concentrations elsewhere in the Cavite nearshore environment. The Timalan River has a large catchment that includes numerous areas under industrial and residential land uses, and may be considered among the most significant source of waterborne pollutants along this part of the coast. There is no similar data available on PCB levels in sediments or shellfish in the Bataan nearshore area; this coastline does not have a river comparable to the Timalan River in terms of pollutant loading potential (the Pangolisanin River, which empties into the bay at Cabcaben, drains a significantly less industrialized catchment).

Organotins. Another waterborne class of contaminants of concern in historically busy port areas around the world are the organotins, most notably tributyltin (TBT), which has long been a key ingredient of anti-fouling paints used on ship and other boat hulls, buoys, fish cages, crab pots, and dock pilings. TBT is also used in insecticides, fungicides, bactericides and wood preservatives, and as a biocide in cooling systems, power plants, pulp and paper mills, breweries, leather processing plants and textile mills. TBT has low solubility in water, and so adsorbs readily to suspended particles, facilitating precipitation to sediments. Being fat-soluble, TBT bioaccumulates effectively when ingested by marine organisms. TBT is highly toxic to marine molluscs (hence its use in anti-fouling paints).[145] A 2013 study of distribution of TBT in Manila Bay sediments, based on sampling of sediments and mussel tissues, has shown that the highest concentrations are to be found in the northeast corner of the bay, around the Bulacan River (discharge point for the heavily polluted Marilao-Meycauayan-Obando river system), in the north part of Metro Manila (see Exhibit 6-55).[146] Concentrations fall off towards the mouth of the bay, with the three sampling stations nearest the BCIB project area (stations 5, 6 and 7 on the map in Exhibit 6-55) showing levels in the range of 0.5–0.8 ng Sn g^{-1} dry weight, as compared to 9.0 ng Sn g^{-1} near the Bulacan River. For all organotins measured, stations 5, 6 and 7 ranged from 4.5 to 11.5 ng Sn g^{-1}, as compared to 57.4 at the most severely contaminated station, again at the Bulacan river mouth. The study report indicates that the levels observed at stations 5, 6 and 7 are near the lower detection limit for TBT (and below the detection limit for two other species of organotin), and infers that there is likely no major local source of TBT contamination in this part of the bay.

[144] Villeneuve, J.P., C. Cattini, C.M. Bajet, M.F. Navarro-Calingacion and F.P. Carvalho. 2010. PCBs in Sediments and Oysters of Manila Bay, The Philippines. International Journal of Environmental Health Research 20(4):259–269.
[145] International Programme on Chemical Safety (IPCS). 1990. Environmental Health Criteria 116 : Tributyltin Compounds. World Health Organization. Available at https://inchem.org/documents/ehc/ehc/ehc116.htm#SectionNumber:1.1.
[146] Olivares, R.U., S. Tabeta and E.Z. Sombrito. 2013. Tributyltin in Marine Sediments and Green Mussels (*Perma viridis*) in Manila Bay. Journal of Science and Technology 18:212-219.



Source: Olivares, R.U., S. Tabeta and E.Z. Sombrito. 2013. Tributyltin in Marine Sediments and Green Mussels (*Perna viridis*) in Manila Bay. Journal of Science and Technology 18:212-219.

Exhibit 6-55 Distribution of Tributyltin in Manila Bay Sediments

6.1.9 Marine Biodiversity

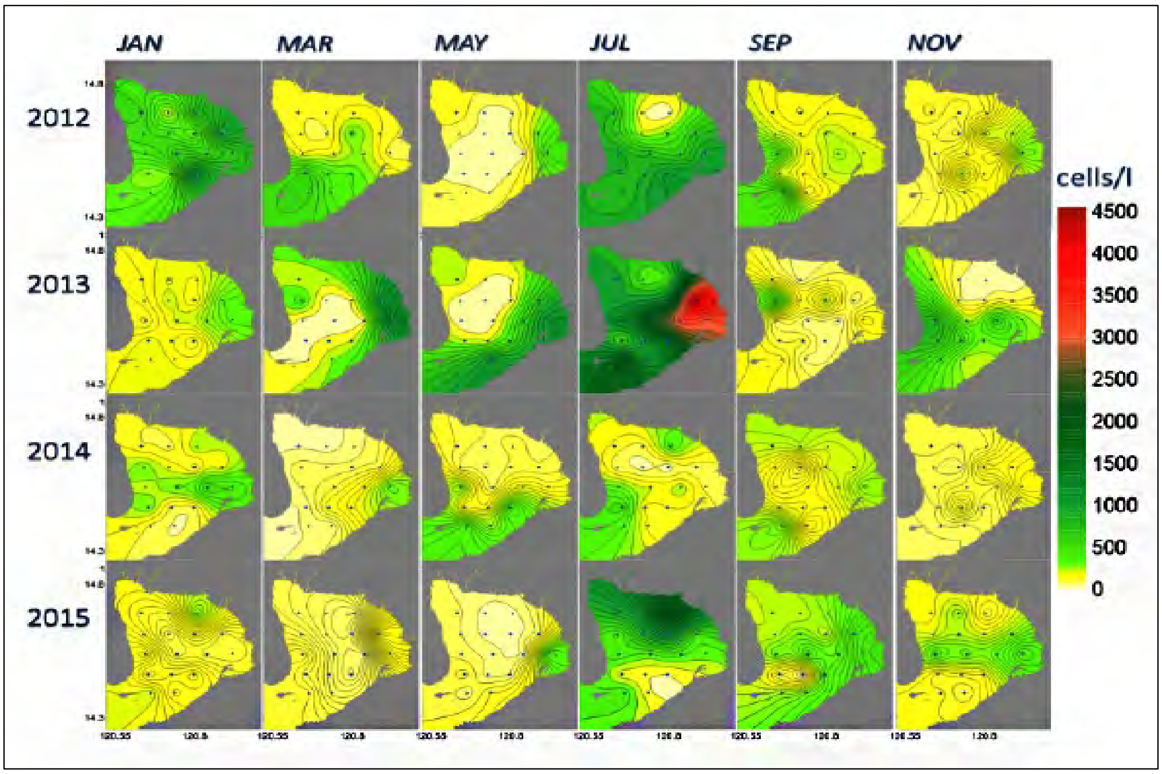
6.1.9.1 Planktonic Communities

Plankton is a term used to describe collectively small, mostly microscopic, organisms that have very limited or no swimming abilities and mostly drift passively in surface waters, both fresh and marine. Plankton includes both plant forms (phytoplankton) and animal forms (zooplankton). Phytoplankton (or photosynthetic microalgae) are made up of representatives of at least five very diverse taxonomic groups within the plant kingdom and represent the primary producers or 'grass of the sea', occupying the base of the food web upon which almost all marine animal life depends. In contrast, zooplankton are consumer organisms and depend upon the phytoplankton, and to some extent on dead organic matter, for food and energy This section of the baseline study reports on planktonic communities in the BCIB project area, based on field sampling and secondary sources.

Previous Plankton Studies in the Project Area

No previous plankton studies have been carried out specifically around the mouth of Manila Bay, although a number have been undertaken at the bay-wide level and in the inner bay, and offer some useful context. Of particular value are the multi-year studies of spatio-temporal distribution of phytoplankton and zooplankton carried out by the National Fisheries Research and Development Institute (NFRDI) and published in the Philippine

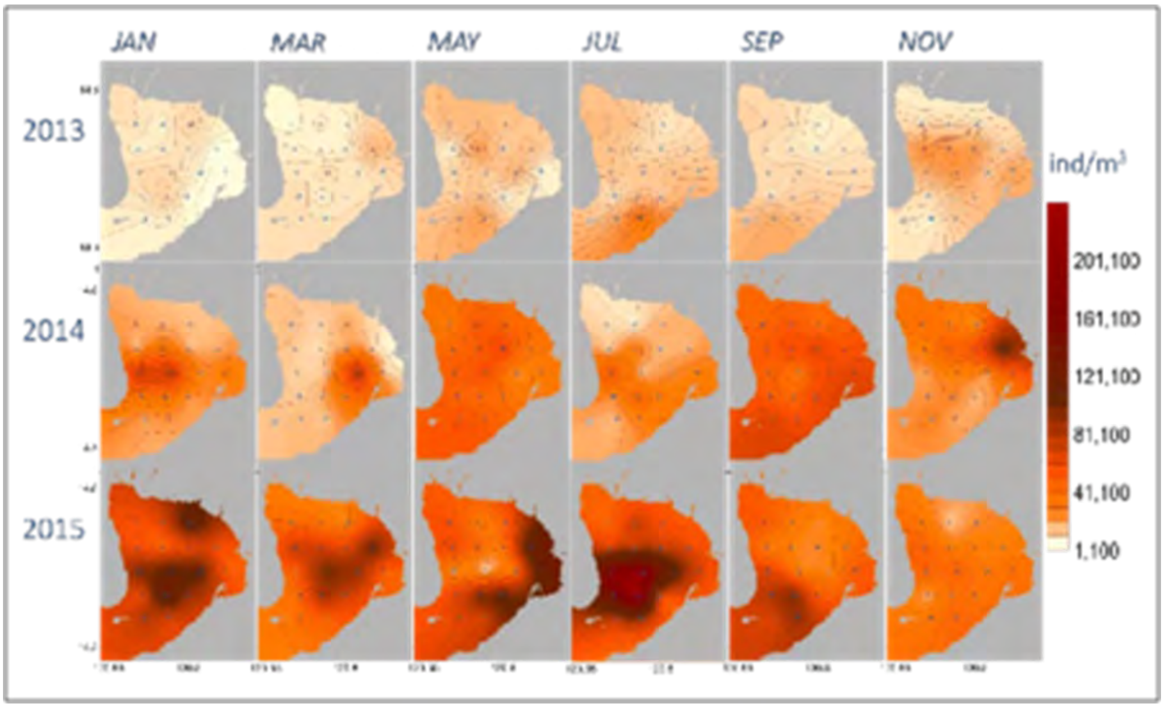
Journal of Fisheries in 2017.[147] These studies draw out the tremendous dynamism of planktonic distribution and abundance in response to seasonal weather patterns, in particular the northeast and southwest monsoons and the changes they bring about in relation to currents, salinity, temperature and inputs from land areas via rivers. The studies also highlight the very substantial diversity of water quality conditions within Manila Bay, related in part to varied exposure to rivers, urban areas and tidal exchange with the open ocean, especially as concerns patterns of nutrient enrichment and development of pockets of eutrophication that may favor or discourage particular patterns of planktonic abundance. The times series of phytoplankton abundance maps in Exhibit 6-56, and a similar series for zooplankton in Exhibit 6-57, illustrate the dynamism of plankton distribution in Manila Bay.



Source: Gatdula, N.C., V.M. Borja, J.A. Santiago and E.F. Furio. 2017. Spatio-Temporal Distribution and Abundance of Phytoplankton in Manila Bay. Philippine Journal of Fisheries 24(1): 106-115.

Exhibit 6-56 Dynamism of Phytoplankton Distribution in Manila Bay

[147] (1) Gatdula, N.C., V.M. Borja, J.A. Santiago and E.F. Furio. 2017. Spatio-Temporal Distribution and Abundance of Phytoplankton in Manila Bay. Philippine Journal of Fisheries 24(1): 106-115.; (2) Jose, E.C., V.M. Borja, N.C. Gatdula, J.D.D. Vergara, E.B. Metillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Variability of Zooplankton Distribution and Abundance in Manila Bay from 2013–2015. Philippine Journal of Fisheries 24(1): 94–105.; (3) Tobias, M.L., A.G.A. Sy, V.M. Borja, E.B. Matillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Distribution of Ichthyoplankton in Manila Bay in Relation to Oceanographic Conditions. The Philippine Journal of Fisheries 24(1): 83–93.; (4) Vergara, J.D.D., E.C. Jose, V.M. Borja, N.C. Gatdula, E.B. Metillo, M.D. Santos and E.F. Furio. 2017. Effect of Nutrient Over-Enrichment on Spatio-Temporal Variability of Phytoplankton in Manila Bay, Philippines. Philippine Journal of Fisheries 24(1): 140–165.



Source: Jose, E.C., V.M. Borja, N.C. Gatdula, J.D.D. Vergara, E.B. Metillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Variability of Zooplankton Distribution and Abundance in Manila Bay from 2013–2015. Philippine Journal of Fisheries 24(1): 94–105.

Exhibit 6-57 Dynamism of Zooplankton Distribution in Manila Bay

Collection and Analysis of Plankton in the BCIB Project Area

Plankton assemblages in the BCIB project area were sampled in mid-February 2020. Samples were collected in two different settings: nearshore and offshore (sampling locations are shown in Exhibit 6-58). Both phytoplankton and zooplankton were evaluated. A conventional plankton net with stainless circular frame and detachable cod end (30 cm mouth diameter, 20 µm mesh size and 1-m length) was used to sample marine phytoplankton and zooplankton. Duplicate plankton samples were collected by vertical hauling of the net from approximately near the bottom to the surface at each station; this allowed sampling of all levels of the water column, minimizing the bias effect of variations brought about by diurnal migration of plankton. A calibrated flowmeter was attached to the mouth of the net to obtain an estimate of the volume of water filtered during each haul. Samples were transferred and stored in 250 ml polyethylene bottles and preserved in 10% buffered seawater formalin, and brought to a laboratory for sorting, identification, counting and recording of the phytoplankton and zooplankton.

In the laboratory, the biomass of plankton was determined for each sample using the 'wet' displacement volume method. The numerical density of phytoplankton and zooplankton organisms was determined using a 1-ml aliquot. Aliquot samples were examined under compound light and epifluorescence microscopes with camera attachment to determine the identity of the components represented, and subsequently placed in a Sedgewick-Rafter counting chamber to determine the frequencies of species present. Individual phytoplankton and zooplankton were identified to the lowest possible taxon. Density of phytoplankton and zooplankton organisms was estimated as number of cells (phytoplankton) and organisms (zooplankton) per cubic meter of seawater. Total plankton biomass was determined for each sample by the wet displacement volume method (using a graduated cylinder), yielding measurements in mL/m^3.

A supplemental plankton study was conducted in late October 2021, at four open water sampling sites (see Exhibit 6-58). The methodology was identical to that used in the February 2020 sampling and analysis, except for the mesh size of the net used (64 microns in 2021 as opposed to 20 microns in 2020). The 2021 plankton study also did not measure biomass. Given the sampling technology difference, data on abundance and species composition from the two field studies are not compared at the level of absolute numbers of cells or individuals in the presentation and discussion that follows. Rather, comparison is undertaken at the level of intra-study relative abundance and general spatial patterns, and discussion is focused on the extent to which the two datasets may corroborate or complement each other, or highlight seasonal distribution.

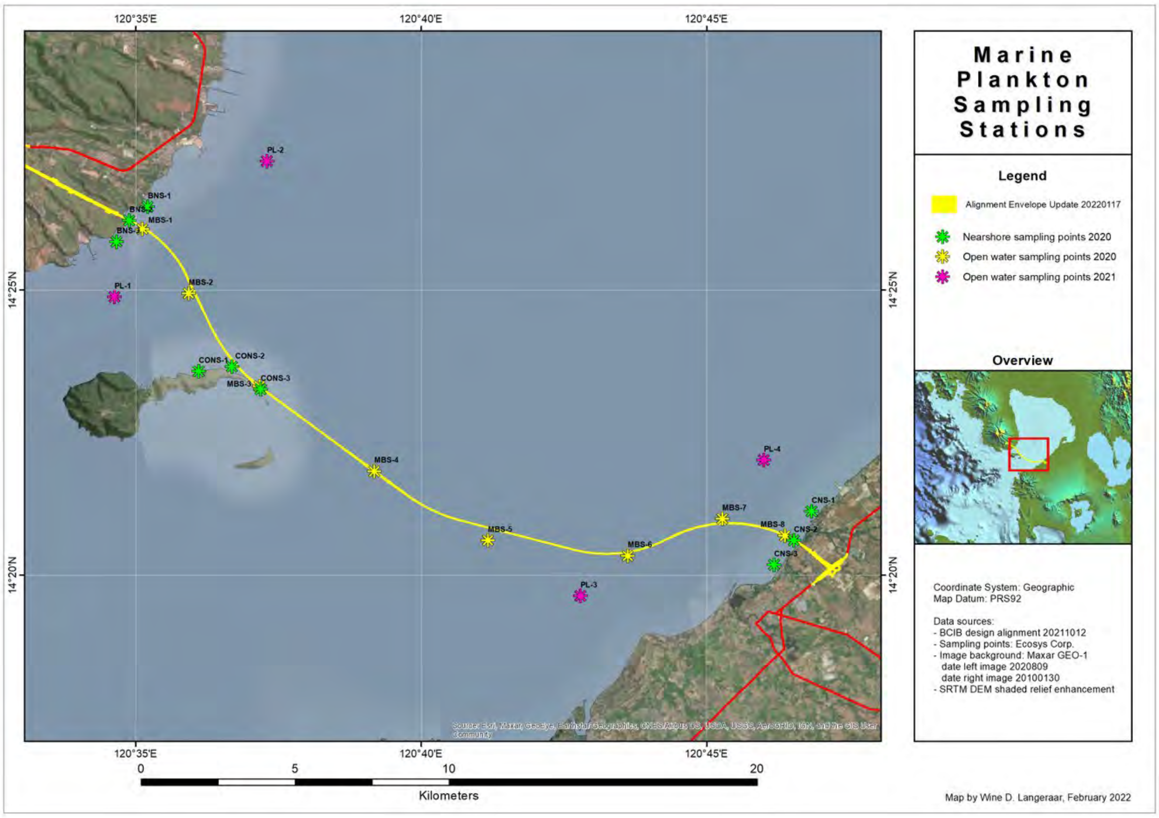


Exhibit 6-58 Plankton Sampling Sites, February 2020 and October 2021

Phytoplankton

Most freshwater phytoplankton are made up of green algae and cyanobacteria (also known as blue-green algae). Marine phytoplankton is mainly comprised of microalgae known as diatoms (class Bacillariophyceae) and dinoflagellates (class Dinophyceae), although other algae and cyanobacteria can be present as well. Diatoms are microscopic representatives of the plant phylum Chrysophyta which possess characteristic silica-impregnated cell walls, and may be extremely abundant in nearshore or bay ecosystems. Diatoms make the largest single contribution to global oceanic net primary production.[148]

Nearshore Phytoplankton

Bataan nearshore (February 2020). The phytoplankton population as sampled at the three nearshore sites off the south Mariveles coast (BNS1–BNS3) was composed of three major

[148] Geider, R.J., C. M. Moore and D.J. Suggett. Ecology of Marine Phytoplankton 17. Ecology and the Environment 483 (2014).

groups: diatoms, blue-green algae, and dinoflagellates. Diatoms were by far the most numerous, with mean relative abundance of 97.85% (see Exhibit 6-59). A total of 17 taxa were recorded: 12 diatoms, one blue-green alga, and four dinoflagellates. *Skeletonema*, *Chaetoceros*, *Thalassionema*, *Rhizosolenia*, and *Pseudo-nitzschia* were the most dominant among the diatoms, while *Protoperidinium*, *Noctiluca scintillans*, and *Ceratium furca* dominated the dinoflagellate population. The blue-green algae were represented only by *Trichodesmium erythraeum*, which was found in relatively low densities.

The total number of phytoplankton organisms in the three nearshore station samples ranged from 7,976,190 to 15,328,338 cells/m^3, with an average of 12,678,901 cells/m^3. Biomass ranged from 11.51 to 15.32 mL/m^3, with an average of 14.00 mL/m^3.Variation in the plankton biomass by sampling station showed a similar general pattern to that of the total number of phytoplankton. (See Exhibit 6-60.) This consistency may be explained by the overwhelming dominance of diatoms in all samples.

Corregidor Island nearshore (February 2020). The phytoplankton population as sampled at the three nearshore Corregidor Island stations (CONS1–CONS3) comprised only two major groups, these being diatoms (average relative density 97.88% across all samples), and dinoflagellates (2.12%) (see Exhibit 6-59). A total of 14 taxa were recorded: nine diatoms and five dinoflagellates. *Skeletonema*, *Chaetoceros Thalassionema*, *Rhizosolenia* and *Pseudo-nitzschia* were most dominant among the diatoms, while *Noctiluca scintillans*, *Ceratium fusus* and *Protoperidinium* dominated the dinoflagellate component.

The total number of phytoplankton specimens in the Corregidor Island nearshore samples ranged from 10,451,846 to 23,660,716 cells/m^3, with an average of 17,319,213 cell/m^3. Phytoplankton biomass ranged from 10. to 22.62 mL/m^3, with an average of 16.70 mL/m^3. Both the total phytoplankton numbers and plankton biomass were higher than those recorded at the Bataan nearshore stations. As with the BNS1–BNS3 stations, phytoplankton biomass and total number of phytoplankton were highly covariant (see Exhibit 6-60).

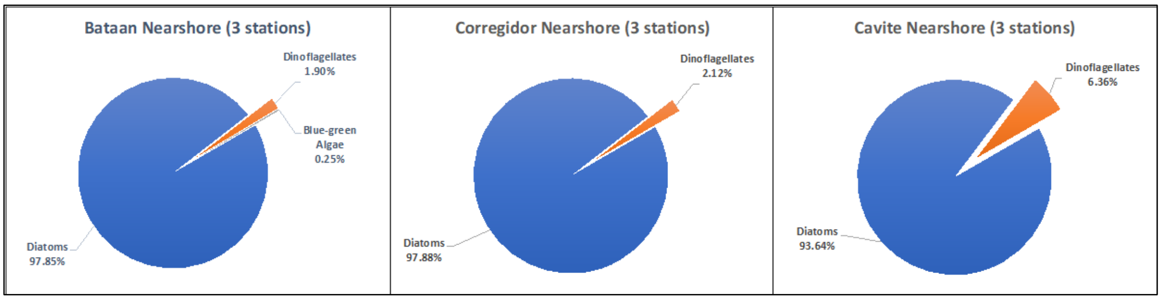


Exhibit 6-59 Mean Relative Abundance of Phytoplankton Groups, Nearshore (February 2020)

Cavite nearshore (February 2020). Like the Corregidor Island nearshore samples, phytoplankton in the Cavite nearshore samples was composed of only two major groups, again dominated by the diatoms (mean relative abundance 93.64%); mean relative abundance for dinoflagellates was 6.36%. Dominance of diatoms was somewhat lower than at the Bataan and Corregidor Island nearshore sites. Just 11 taxa were recorded: eight diatoms and three dinoflagellates. In the Cavite nearshore samples, *Rhizosolenia*, *Skeletonema*, *Odontella*, *Coscinodiscus* and *Pseudo-nitzschia* were the most dominant among the diatoms, while *Protoperidinium*, *Ceratium furca* and *Prorocentrum micans* dominated the dinoflagellates population.

The total number of phytoplankton specimens in the Cavite nearshore samples ranged from 1,875,000 to 2,673,611 cells/m^3, with an average of 2,374,768 cell/m^3. Phytoplankton biomass ranged from 5.56 to 7.74 mL/m^3, with an average of 6.42 mL/m^3. (See Exhibit 6-60. Variation in the plankton biomass by sampling station showed a similar general trend to that of the total number of phytoplankton specimens Exhibit 6-59).

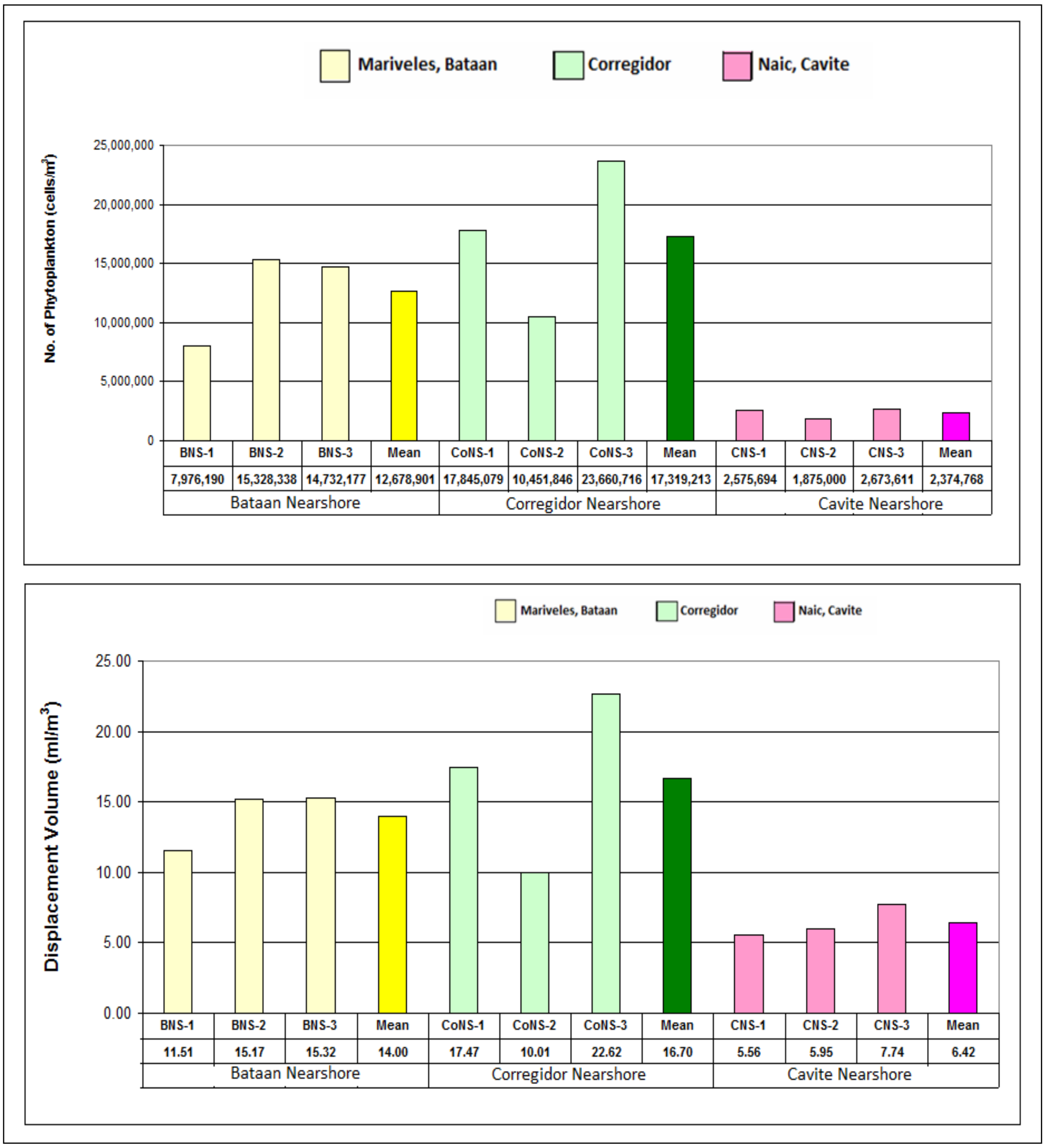


Exhibit 6-60 Total Phytoplankton and Phytoplankton Biomass, Nearshore Sampling Stations

Comparing nearshore phytoplankton stations (February 2020). Considerable variation was observed between the three sampled nearshore zones, with the mean abundance for the Cavite stations being markedly lower than for the Bataan and Corregidor stations (see Exhibit 6-60). This difference may be attributable to water clarity; turbidity is generally high along the Cavite shore due to both natural and anthropogenic factors, and this is likely to be a limiting factor for photosynthesis, and consequently the success of phytoplankton. Biomass is also considerably lower for the Cavite nearshore stations. Another pattern of note is the slightly lower dominance of diatoms in the Cavite stations compared to the Bataan and Corregidor Island stations (Exhibit 6-59).

Offshore /Open Water Phytoplankton

Phytoplankton collected from the eight stations spaced out along the BCIB alignment in February 2020 was typically composed of three major groups: diatoms, dinoflagellates and blue-green algae (see Exhibit 6-61). Overall, the phytoplankton population was dominated by the diatoms (average relative density 96.74%) followed by the dinoflagellates (3.22%) and blue-green algae (0.04%). A total of 26 taxa were recorded from the eight stations: 15 diatoms, 10 dinoflagellates and one blue-green alga. *Skeletonema*, *Chaetoceros*, *Thalassiosira*, *Rhizosolenia* and *Thalassionema* were the most dominant among the diatoms, while *Ceratium furca*, *Protoperidinium*, *Ceratium fusus* and *Dinophysis caudata* dominated the dinoflagellates. The blue-green alga *Trichodesmium erythraeum* also occurred, but was only found at one station near the Bataan coast (Station MBS-1).

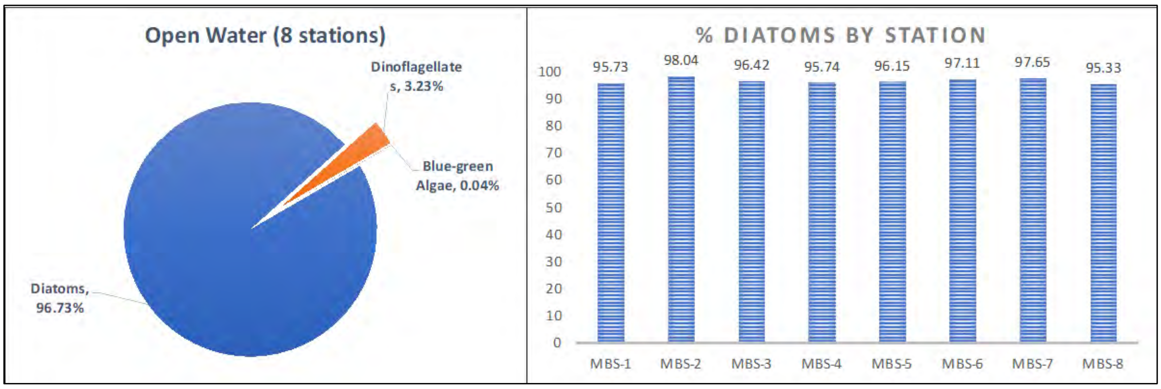


Exhibit 6-61 Mean Relative Abundance of Phytoplankton Groups, Offshore (February 2020)

The total number of phytoplankton ranged widely, from 5,382,254 to 16,776,231 cells/m^3, with an average of 11,452,155 cell/m^3. Biomass also ranged widely across stations, from 6.16 to 18.52 mL/m^3, with an average of 11.32 mL/m^3. Higher total phytoplankton numbers and plankton biomass were recorded in the northwestern part of the project area between Bataan and Corregidor Island, particularly at Stations MBS-1, MBS-2, and MBS-3, while lower total phytoplankton number and plankton biomass were recorded in the southeastern part between Corregidor and Cavite, except at one particular station (MBS-7) where high total phytoplankton and plankton biomass were recorded (see Exhibit 6-62). Phytoplankton biomass showed a similar general cross-station trend to that of the total number of phytoplankton.

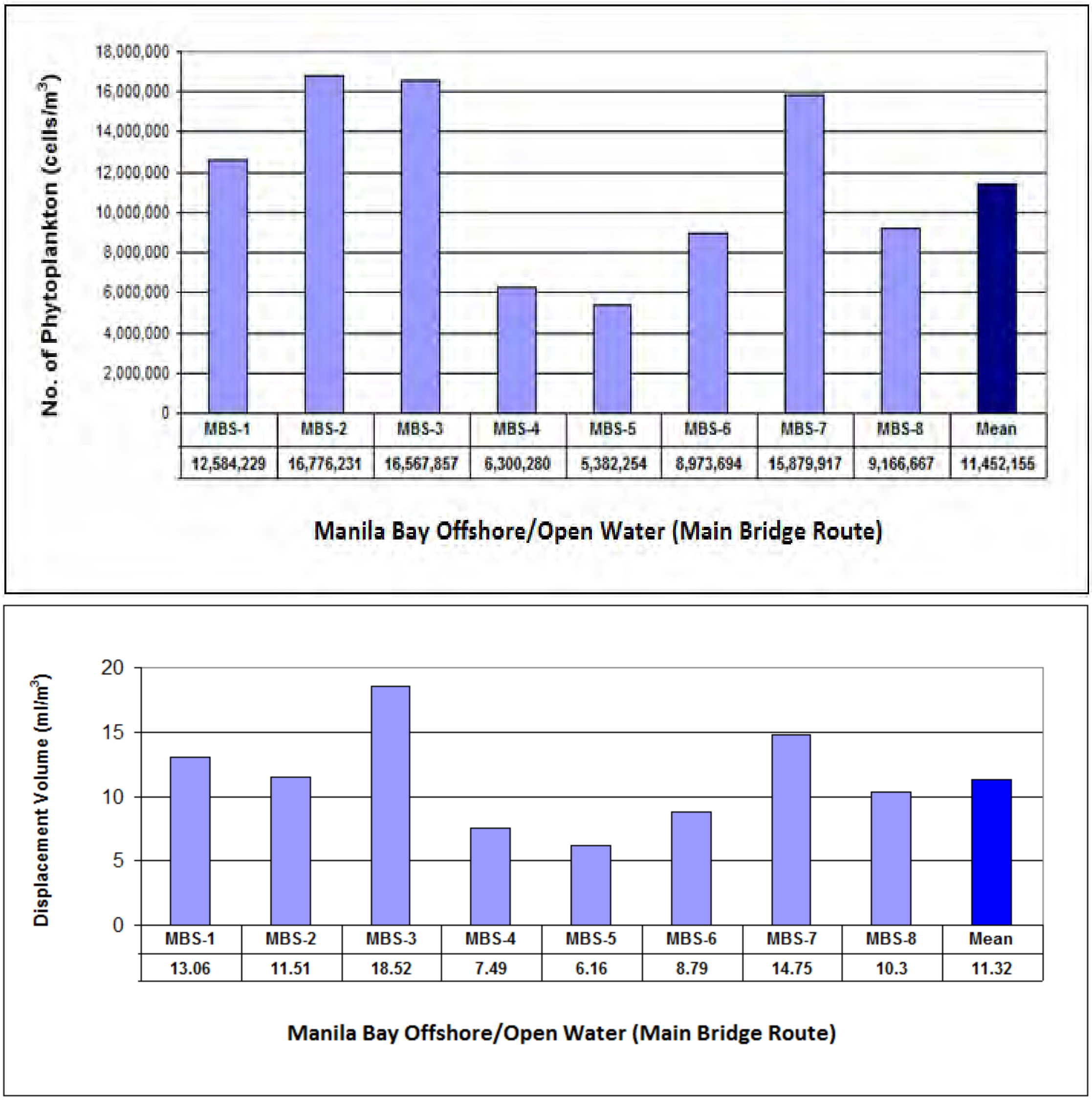


Exhibit 6-62 Total Phytoplankton and Phytoplankton Biomass, Offshore (February 2020)

The October 2021 offshore sampling yielded a very similar finding regarding the overall composition of phytoplankton communities, with diatoms accounting for 94.7% of organisms counted, and dinoflagellates comprising 5.3% across the four sampling stations (see Exhibit 6-63). There was greater variation in the diatoms to dinoflagellates ratio amongst the four 2021 stations than amongst the eight 2020 stations, due to a relatively strong representation of dinoflagellates at the PL4 station (16.2% mean relative density, as compared to values ranging from 1.6% to 4.3% at the other three stations). The somewhat higher proportion of dinoflagellates observed at PL4 may indicate eutrophic conditions, possibly attributable to domestic and industrial wastewater runoff; occurrences of high densities of dinoflagellates in Manila Bay have generally been attributed to high organic inputs from rivers, and PL4 is positioned about 2 km from the mouth of the Timalan River.[149]

[149] Azanza, R.V., Austero, N.M., Dungca, J.C.R., Caspe, F.J.O., and L. Khandeparker. 2018. Phytoplankton and bacterial communities at South Harbor, Manila Bay, Philippines. Asean Journal on Science and Technology for Development, 35 (1-2): 107-113.

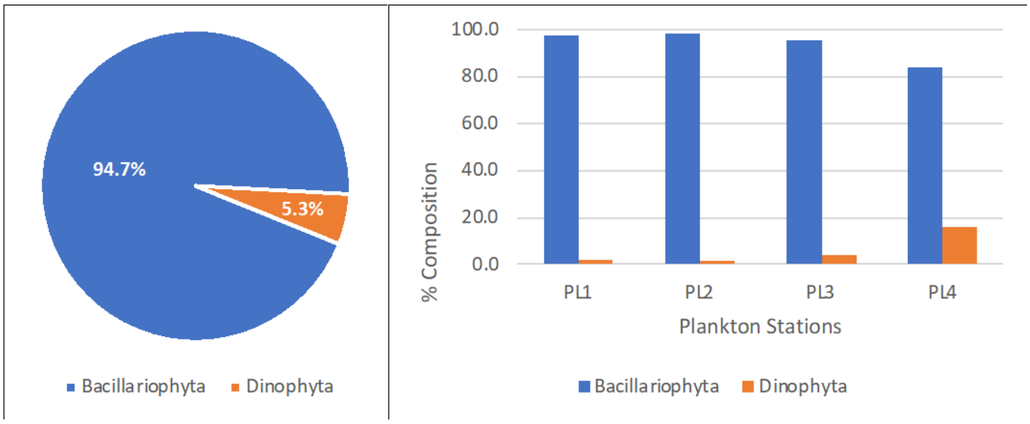


Exhibit 6-63 Mean Relative Abundance of Phytoplankton Groups, Offshore (October 2021)

Mean density varied significantly between stations, with a factor of four difference between the low of 28,789 cells/m^3 (PL3) and the high of 118,163 cells/m^3 (see Exhibit 6-64). Mean density across the four stations was 60,885 cells/m^3. There does not appear to be any clear commonality between abundance distributions for the February 2020 open water and October 2021 open water samples.

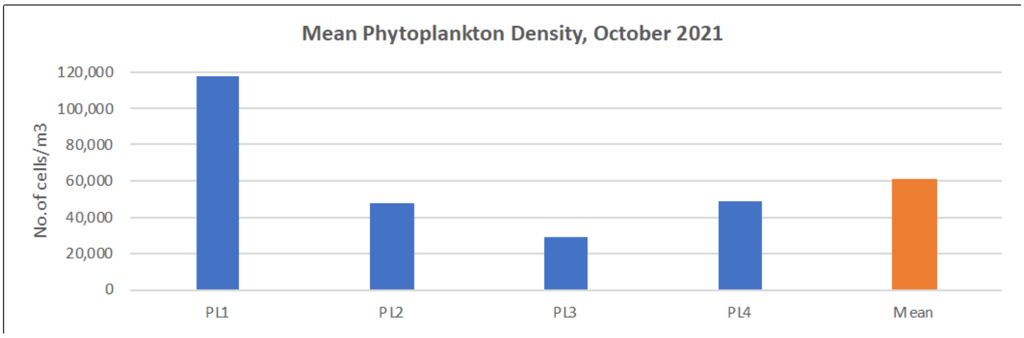


Exhibit 6-64 Mean Phytoplankton, Offshore (October 2021)

Overall, 19 taxa were recorded at the four stations sampled in 2021, 13 of which were diatoms, and 6 of which were dinoflagellates. *Chaetoceros* sp. 1 was the most abundant taxon, with mean relative density of 37.8%, followed by *Lauderia* (8.6%), *Rhizosolenia setigera* (6.6%), *Thalassionema* (6.2%) and *Stephanopyis* (6.1%). *Chaetoceros* consistently dominated at the four surveyed stations, with a relatively higher proportion recorded at PL1 (53%) compared with that observed for the rest of the stations (20%–28%). The overall dominance of diatoms, particularly *Chaetoceros* and *Rhizosolenia*, is common in tropical coastal waters, and has also been reported from Singapore Strait and in the Philippine Sea off the northeast coast of Luzon.[150] The presence of high densities of diatoms at the study site may be attributed to high organic matter and nutrient loading, a connection that has been made by other plankton research in Manila Bay.[151]

[150] (1) Gin, K.Y-H., Lin, X, and S. Zhang. 2000. Dynamics and size structure of phytoplankton in the coastal waters of Singapore. Journal of Plankton Research, 22(8):1465-1484.; (2) Cordero-Bailey, K. , Bollozos, I.S., Palermo, J.D.H., Silvano, K.M., Escobar, M.T.L., Jacinto, G.S., San Diego-McGlone, M.L., David, L.T. and Yn˜iguez, A.T. 2021. Characterizing the vertical phytoplankton distribution in the Philippine Sea off the northeastern coast of Luzon. Estuarine, Coastal and Shelf Science, 254 107322.

[151] Azanza, R.V. and L.N. Miranda. 2001. Phyoplankton composition and P. bahamense toxic blooms in Manila Bay, Philippines. Journal of Shellfish Research, 20 (3): 1251-1255.

Zooplankton

Nearshore Zooplankton

Bataan nearshore (February 2020). Zooplankton composition in the nearshore area of Bataan includes three taxa belonging to only one major group, the Copepods (see. Copepod nauplius larvae (74.67%) dominated the zooplankton community at 74.67% mean relative density, followed by the adult calanoid copepods (13.24%) and adult cyclopoid copepods (12.09%). Total numbers of zooplankton ranged from 199,693 to 362,903 individuals/m^3, with an average of 277,920 individuals/m^3.

Corregidor Island nearshore (February 2020). Only two zooplankton taxa were recorded in the nearshore samples around Corregidor Island, belonging to two major groups: the ciliates and copepods. Copepod nauplius larvae were the most dominant (95.02% mean relative density), with the ciliate tintinnids far behind at 4.98%. Total numbers of zooplankton ranged from 62,539 to 148,810 individuals/m^3, with an average of 107,183 individuals/m^3 (see.

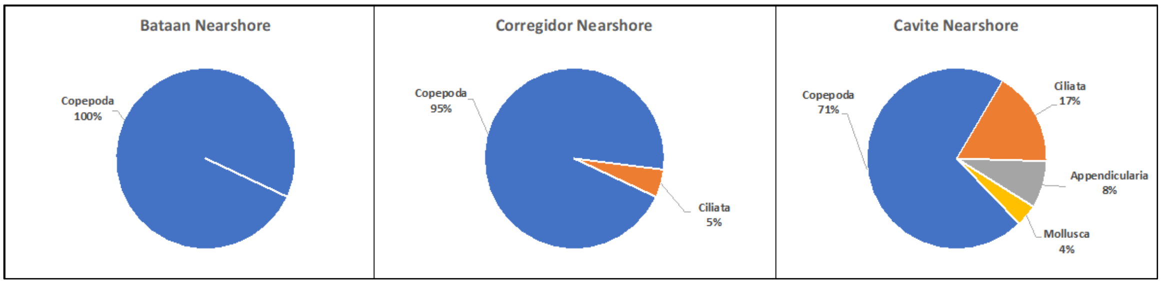


Exhibit 6-65 Mean Relative Abundance of Zooplankton Groups, Nearshore (February 2020)

Naic nearshore (February 2020). A total of five zooplankton taxa were recorded in the Naic nearshore samples, belonging to only two major groups: the copepods (mean relative density 59.14%) and ciliates (40.86%). The copepod nauplius larvae were the most dominant (mean relative density 43.19%), followed by the ciliates *Codonellopsis* (28.41%) and tintinnids (12.45%), adult calanoid copepods (10.89%), and adult cyclopoid copepods (5.06%). Total numbers of zooplankton ranged from 327,382 to 486,111 individuals/m^3, with an average of 424,934 individuals/m^3.

Comparing nearshore zooplankton stations (February 2020). A marked variation in zooplankton abundance can be observed across the three sets of nearshore sampling locations (see Exhibit 6-65). Notably, mean zooplankton abundance recorded at the Corregidor Island nearshore stations is only 39% of that found at the Bataan nearshore stations, and just 25% of mean abundance documented in Cavite nearshore waters. The pattern may be attributable to the presence of river estuaries along the two mainland coasts, which may be associated with higher availability of organic matter as a food source. This inference is drawn with relatively low confidence, however, since there is some evidence that phytoplankton abundance may typically be a much stronger determinant of zooplankton success than inputs of riverine detritus near estuaries.[152]

[152] See Schlacher, T.A., R.M. Connolly, A.J. Slattington and T.F. Gaston. 2009. Can export of organic matter from estuaries support zooplankton in nearshore, marine plumes? Aquatic Ecology 2009: 383-393.

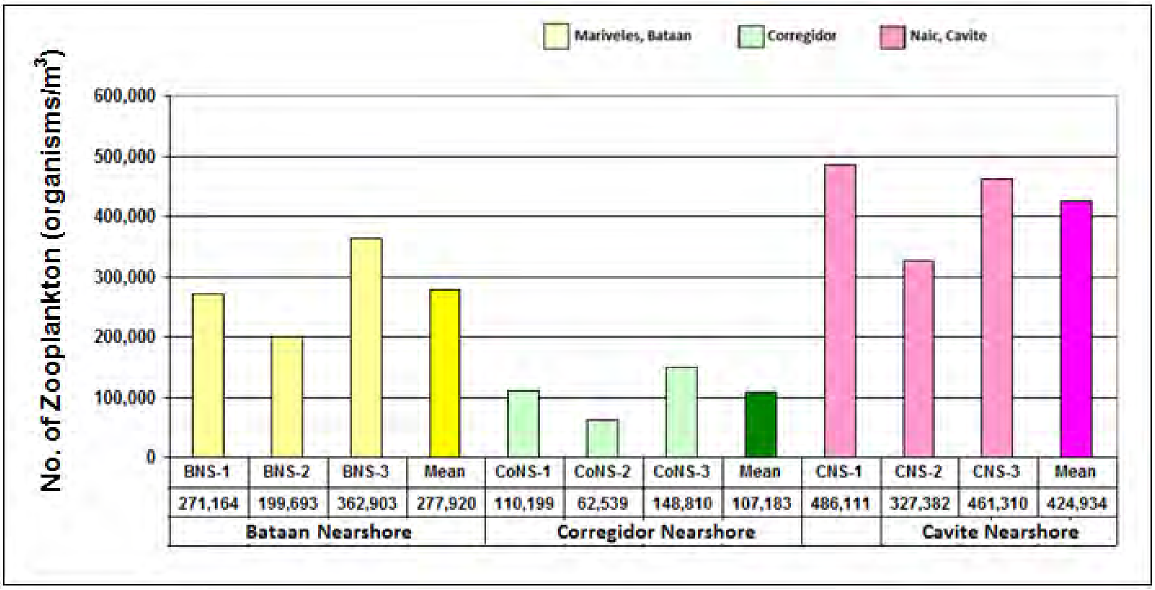


Exhibit 6-66 Total Zooplankton, Nearshore (February 2020)

Zooplankton diversity also showed a distinct pattern of difference across the station groups, with five taxa from four major groups found at the Cavite nearshore stations, three taxa from one major group documented at Bataan, and two taxa from two major groups at Corregidor Island (Exhibit 6-64). It may be speculated that the somewhat higher zooplankton diversity in the Cavite nearshore zone could be linked to the presence of a prevailing southwesterly longshore current on that side of the bay mouth, which might be expected to bring a steady supply of new planktonic organisms from outside the bay; however, the diversity contrast is not all that strong, and could just as easily be explained by the small number of samples included in the study.

Offshore/Open Water Zooplankton

The zooplankton population revealed by sampling at eight stations along the BCIB alignment in February 2020 is composed of four major groups, namely Ciliates, Copepods, Molluscs, and Appendicularians. Copepods represent the bulk of the individuals counted, at 70.75% mean relative density, followed by Ciliates (16.94%), Appendicularians (8.39%) and Molluscs (3.92%). A total of eight taxa were recorded: four Copepods, two Ciliates, one Mollusc, and one Appendicularian. Copepod nauplius larvae comprised fully half of overall Copepod density. Exhibit 6-67 breaks down the distribution of taxa across the eight stations, and shows that representation of the Copepods is strongest across the board, but subject to significant variation (ranging from 44% to 92% of total individuals counted at their respective stations). However, other groups are strongly represented relative to the Copepods at the stations closest to the Cavite shore (MBS6, MBS7, MBS8); this corroborates the finding, discussed above, of greater zooplankton diversity at the Cavite nearshore stations.

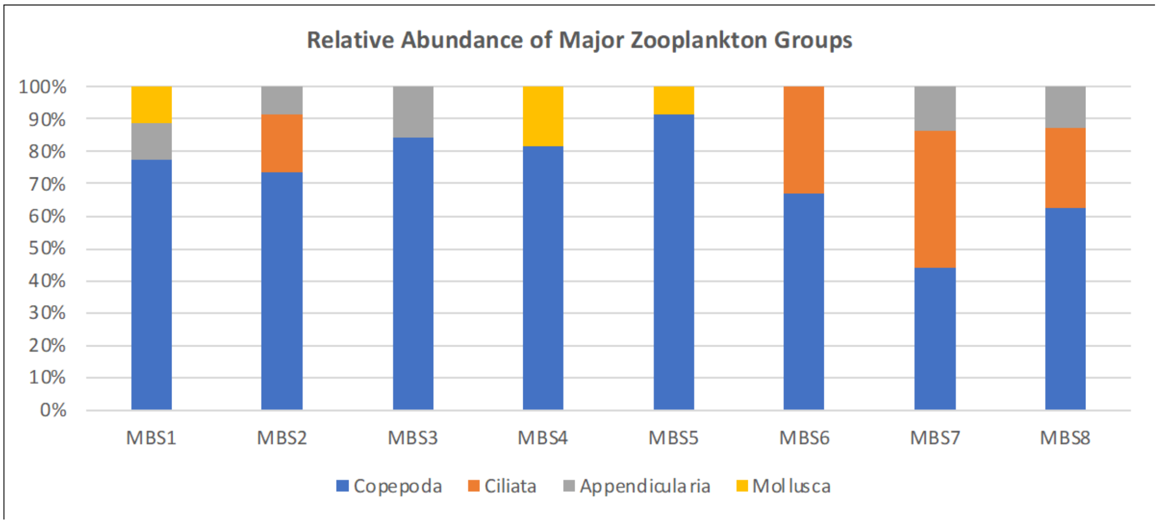


Exhibit 6-67 Distribution of Zooplankton Groups Across Offshore Stations (February 2020)

The total numbers of zooplankton ranged from 123,656 individuals/m^3 to 239,331 individuals/m^3, with an average of 162,521 individuals/m^3. Variation between stations does not show a strong pattern (see Exhibit 6-68), although it can be said that the relative abundances (i.e., highest in Cavite) shown above for the nearshore stations (Exhibit 6-66) are at least partially corroborated.

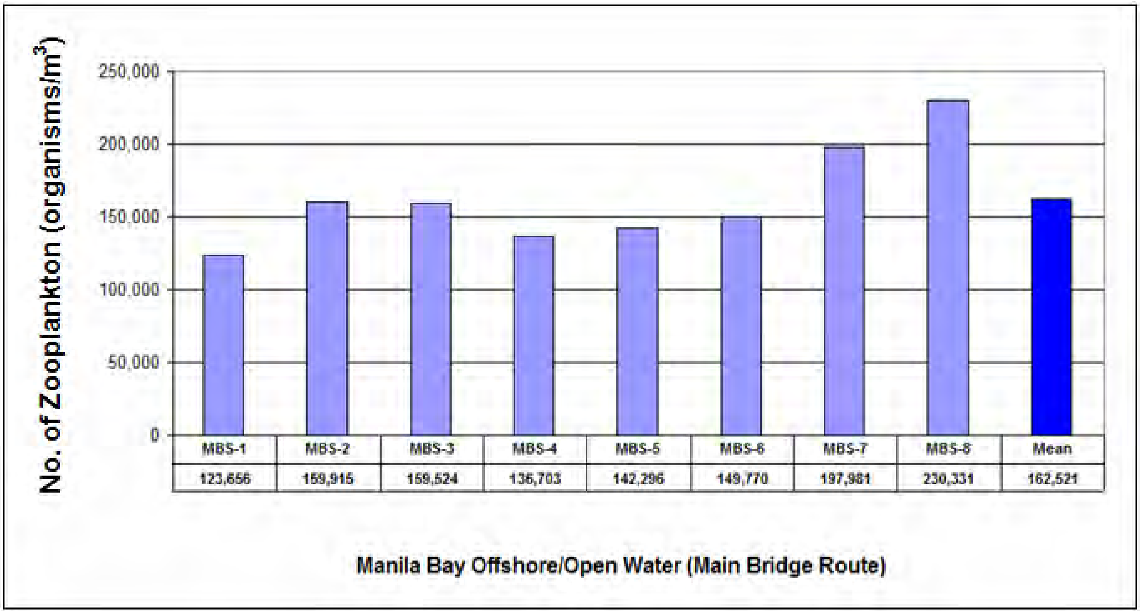


Exhibit 6-68 Total Zooplankton Abundance, Offshore (February 2020)

Sampling at four offshore stations in October 2021 reveals a somewhat analogous pattern with regards to zooplankton community composition, with 54% of all individuals counted across the four stations being Arthropods, 99% of which were Copepods (see Exhibit 6-69). This dominance is broadly comparable to the finding of overall Copepod dominance from the eight February 2020 stations, in which Copepods accounted for 71% of individuals counted. The moderate proportion of Protozoa, and high density of *Parafavella* in particular, documented at all four stations are suggestive of enrichment with organic matter from anthropogenic sources. Protozoa tend to be abundant in aquatic systems with high organic matter, since they feed primarily on algae, detritus, and bacteria.

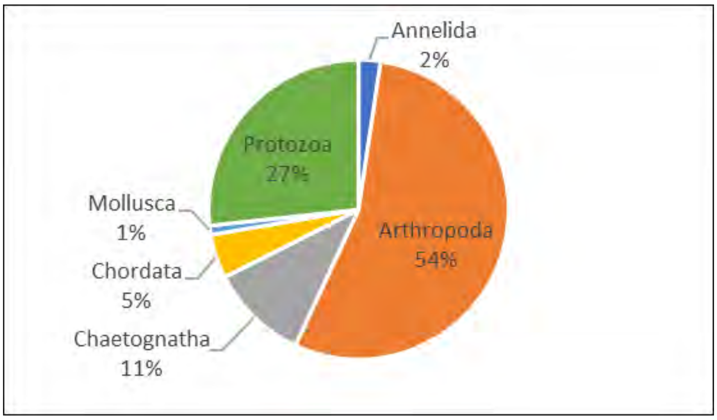


Exhibit 6-69 Composition of Zooplankton, Offshore (October 2021)

Only minor variability in community composition between stations was documented in the October 2021 samples (see Exhibit 6-70). Lower variability for October 2021 than for February 2020 may principally reflect the similarity of the 2021 stations in terms of their positioning relative to the coastline; all four 2021 stations are roughly the same distance from shore, while the eight 2020 stations represent a broad range of spatial relationships to landmasses.

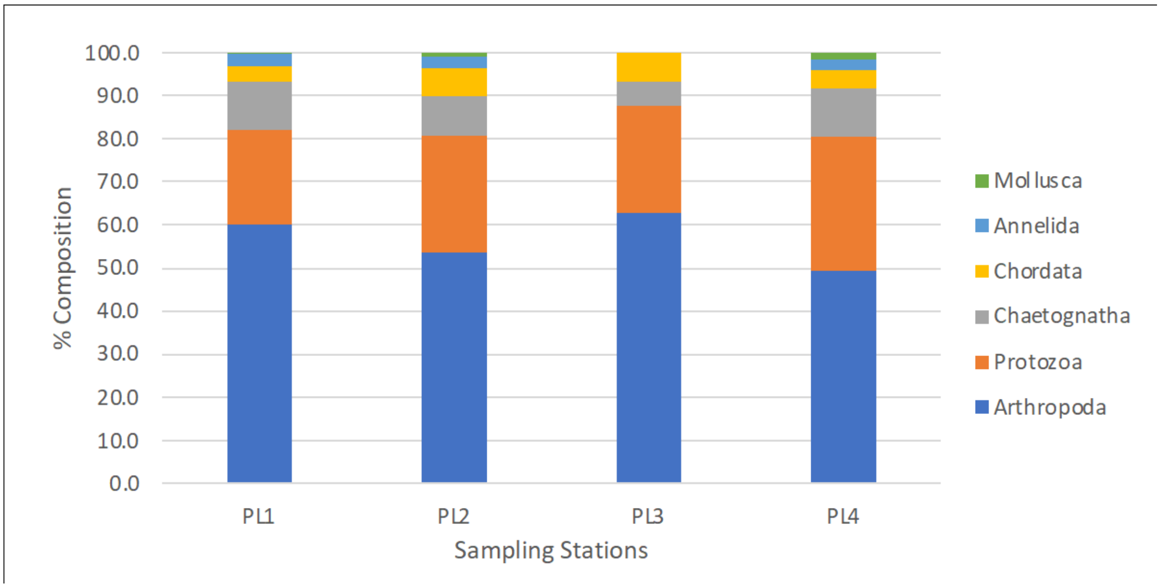


Exhibit 6-70 Relative Abundance of Zooplankton Groups by Station (October 2021)

With regards to zooplankton abundance, substantial variation was documented between the four October 2021 stations (see Exhibit 6-71), with the highest-ranking station (PL4 off Cavite) showing over seven times the density recorded at the lowest-ranking station (PL3, also off Cavite). For the Bataan offshore stations, zooplankton density was more than twice as high at PL1 as it was at PL2. The field study report on the October 2021 sampling suggests that the observed differences are likely to be linked to site-specific anthropogenic disturbances, including boat traffic and inputs of domestic wastes from nearby river mouths.

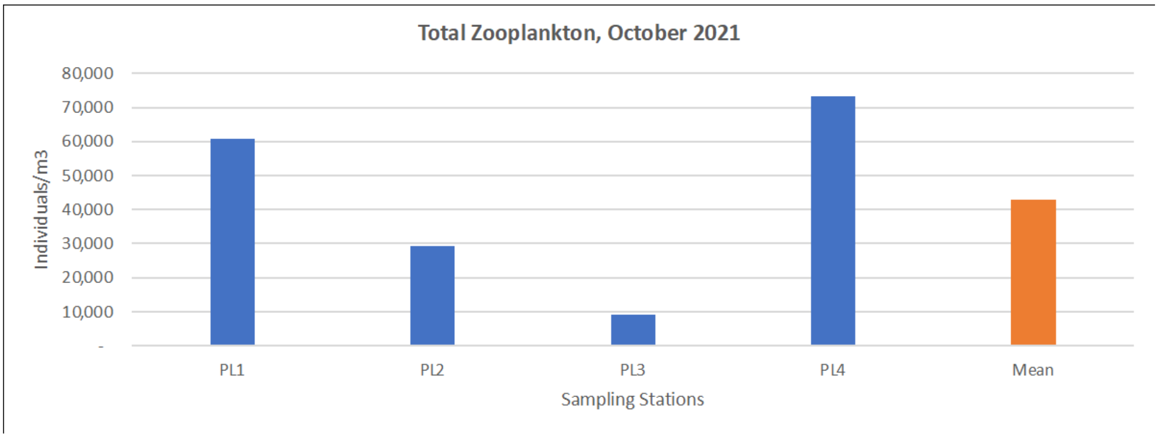


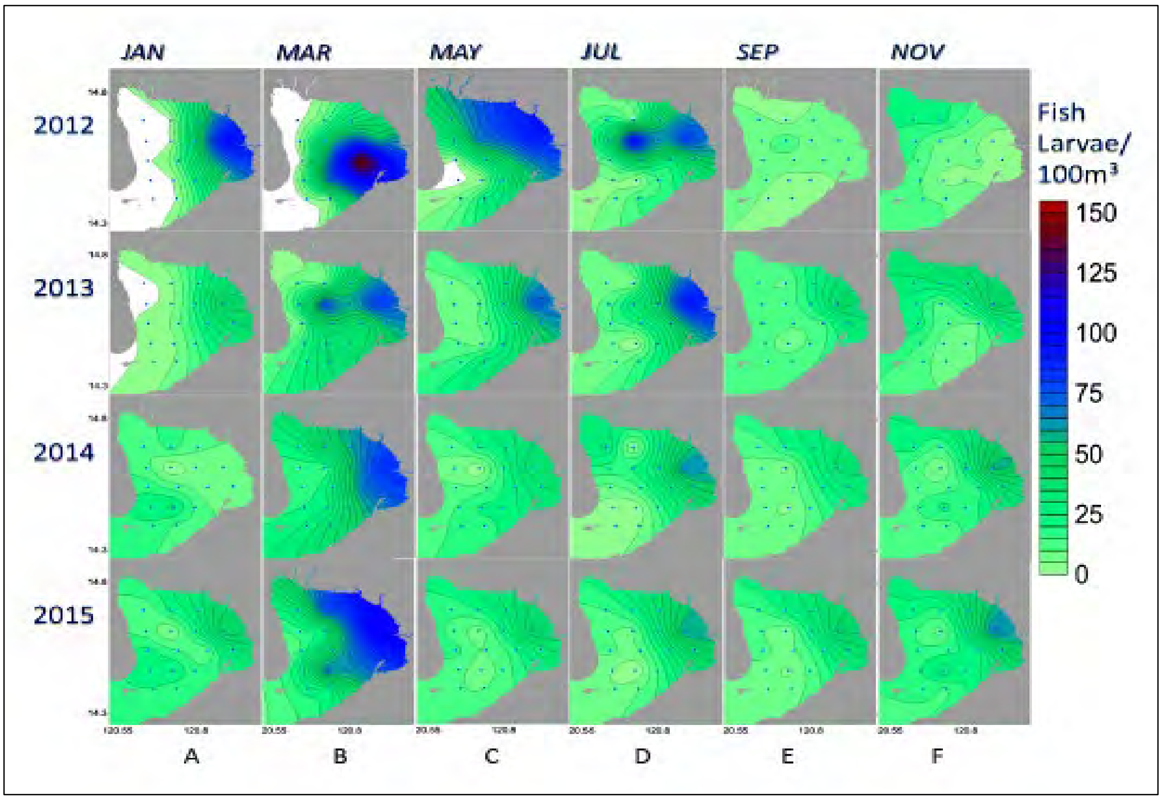
Exhibit 6-71 Total Zooplankton, Offshore (October 2021)

Ichthyoplankton

A four-year survey of the distribution, abundance and taxonomic composition of ichthyoplankton (fish eggs and fish larvae) was carried out in Manila Bay from 2012 to 2105 by scientists from the NFRDI, and this remains the most instructive source on the topic.[153] The study sampled every second month (six times per year) for four years at consistent sampling stations using a Bongo net pulled behind a fishing boat. Two of the eight sampling stations set up for the study were located in the vicinity of the BCIB alignment, and this offers some limited local insight in addition to the broader bay-wide picture.

The ichthyological survey identified larvae of 34 fish families over its four-year run, with the most abundant family in all 24 sampling periods being Clupeidae (herrings, shads and sardines), accounting for 27% of all larvae counted. Species in the Leiognathidae family (ponyfishes, slipmouths and slimies) comprised 15% of the larval catch, Mugilidae (mullets) accounted for 10%. Rounding out the top five families were Nemipteridae (breams and snappers) at 8%, and Sillaginidae (smelts and whitings) at 7%. Strong seasonal variation was documented, with the northeast monsoon (represented by samplings done in March) being the time of greatest larval concentrations in three of four years (see Exhibit 6-72). The study's authors indicate that high larval concentration is spatially correlated with concentrations of phytoplankton, zooplankton and nutrients, which are found principally towards the eastern side of the bay. During the period of greatest concentration (March 2012), Sampling Station 2, which appears to have been located about 6–7 km east of the BCIB alignment, was specifically named as a high-concentration zone.

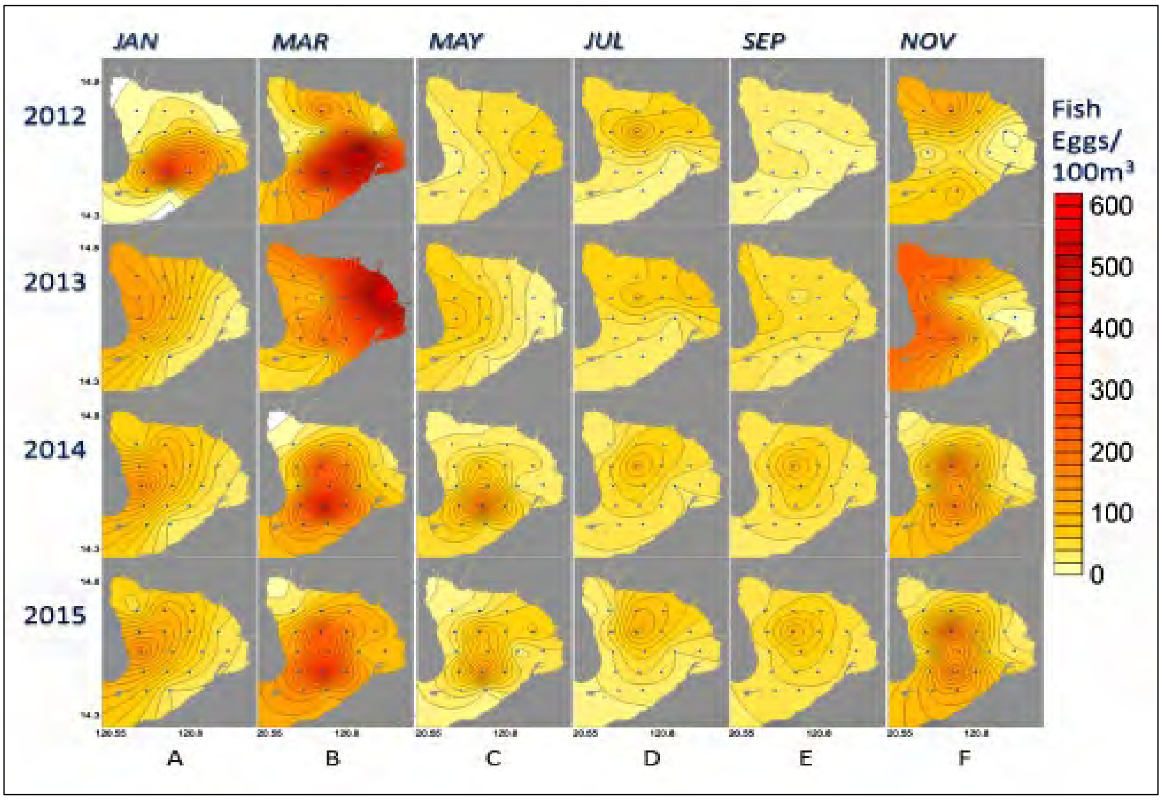
[153] Tobias, M.L., A.G.A. Sy, V.M. Borja, E.B. Matillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Distribution of Ichthyoplankton in Manila Bay in Relation to Oceanographic Conditions. The Philippine Journal of Fisheries 24(1): 83–93.



Source: Tobias, M.L., A.G.A. Sy, V.M. Borja, E.B. Matillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Distribution of Ichthyoplankton in Manila Bay in Relation to Oceanographic Conditions. The Philippine Journal of Fisheries 24(1): 83–93.

Exhibit 6-72 Distribution and Abundance of Fish Larve in Manila Bay, 2012–2015

The distribution of fish egg concentrations was found to follow a similar, though more regularized, pattern as was documented for fish larvae (see Exhibit 6-73). Egg concentrations appear more consistently aligned with the northeast monsoon than larvae, with the March sampling period a time of high concentration every year, and spikes occurring infrequently in other periods. The spatial distribution of fish eggs is somewhat less biased towards the east side of the bay, with sizeable concentrations occurring in the center and west side in some sampling periods. The study suggests that the more even distribution of eggs may be reflective of a shoreward drift of free-floating eggs. Sampling Station 2 is highlighted in the study as an area of high egg concentration during two sampling periods (March 2012 and March 2014).



Source: Tobias, M.L., A.G.A. Sy, V.M. Borja, E.B. Matillo, M.D. Santos and E.F. Furio. 2017. Spatio-Temporal Distribution of Ichthyoplankton in Manila Bay in Relation to Oceanographic Conditions. The Philippine Journal of Fisheries 24(1): 83–93.

Exhibit 6-73 Distribution and Abundance of Fish Eggs in Manila Bay, 2012–2015

Propensity for Harmful Algal Blooms

Harmful algal bloom (HAB) is a blanket term for ephemeral events characterized by proliferation of microscopic diatoms, dinoflagellates and cyanobacteria in aquatic environments, leading either to toxic effects on people and wildlife from bioaccumulation of toxins naturally produced by certain planktonic species, mass fish kills derived from severe depletion of dissolved oxygen when large concentrations of phytoplankton decay, or degradation of the aesthetic qualities of surface waters. Algal blooms are a natural process occurring in all aquatic environments (riverine, lacustrine, brackish, estuarine, oceanic) and all regions of the world, and are typically classified as HABs when poisonings of people and visible wildlife such as birds occur, when fisheries livelihoods are threatened by deaths of wild and farmed species, and when amenity values of coastal waters are reduced due to turbidity, discoloration and foul odors. HABs have been known for centuries, as reflected in cultural prohibitions on consumption of shellfish during certain times of the year in some places, but it is commonly accepted that HABs have been on the increase in coastal environments globally over at least the last five decades.[154]

The focus of much attention regarding the global coastal HAB increase has been on enhanced nutrification from land-based sources, and increasingly also on climate change as a possible driver, but planktonic proliferations are acknowledged to be incredibly complex phenomena, with any particular bloom event typically being the result of a confluence of

[154] Berdelet, E., L.E. Fleming, R. Gowen, K. Davidson, P. Hess, L.C. Backer, S.K. Moore, P. Hoagland and H. Enevoldsen. 2016. Marine harmful algal blooms, human health and wellbeing: challenges and opportunities in the 21st century. Journal of the Marine Biological Association of the United Kingdom 96(1): 61–91.

anthropogenic contributors (e.g., urbanization, agricultural and aquacultural practices, sewage management, river basin management, land reclamation and in-water infrastructure) and natural variables (e.g., circulation, stratification, upwelling, cloud cover, winds, air temperature, rainfall patterns, water temperature).[155]

Manila Bay is reported to have experienced numerous HABs over the decades, going back to at least 1908. A bloom on the western side of Manila Bay (off Orion and Limay in Bataan) involving the toxic dinoflagellate *Pyrodinium bahamense* var. *compressum* lasted from August to December 1988, and was blamed for 121 cases (65 of which were officially validated) of paralytic shellfish poisoning, and four deaths. *Pyrodinium* blooms were observed annually in the same part of the bay until 1998, and were linked to a total of 1,108 poisoning cases and 44 deaths.[156] Lower concentrations of *Pyrodinium*, insufficient to dominate phytoplankton communities, were also detected in the Bacoor Bay area of Cavite during the 1988–1998 period.[157]

The series of *Pyrodinium bahamense* blooms from 1988 to 1998 is the only known instance of a toxic algal bloom causing illness in Manila Bay and there is only one record of a significant fish kill caused by an algal bloom (in 1908). Numerous phytoplanktonic species known to have toxic effects or that have been commonly associated with fish kills, have been detected in Manila Bay, but not in sufficient concentrations to result in poisonings or fish kills (although discoloration and foul odor have been noted in some cases). Exhibit 6-74 presents the known record of presence and bloom activity of phytoplanktonic species detected within Manila Bay since 1908, as enumerated in a recent published review.[158]

Exhibit 6-74 Manila Bay Phytoplankton Species With HAB Associations

Planktonic Taxon	Characteristics, Presence and Recorded Blooms
Pyrodinium bahamense var. *compressum*	• Toxic, capable of producing paralytic shellfish poisoning • Notable annual bloom on western side of Manila Bay 1988–1998 • Linked to 1,108 reported cases of paralytic shellfish poisoning and 44 deaths
Green *Noctiluca scintillans*	• Non-toxic • Annual blooms in west side of Manila Bay 1999–2013, causing green discoloration and foul smell
Red *Noctiluca scintillans*	• Non-toxic • Visible bloom in western part of Manila Bay in 2014, and detected but not sufficiently concentrated to be visible from 2015–2018
Alexandrium tamiyavanichii *Alexandrium minutum*	• Toxic, capable of producing paralytic shellfish poisoning • Detected in western part of Manila Bay in 2018, prompting issuance of a Shellfish Bulletin by BFAR, but no cases of poisoning were reported
Gymnodinium catenatum	• Toxic, capable of producing paralytic shellfish poisoning • Has been detected in low concentrations in western part of Manila Bay since 1990, but has not been associated with any significant blooms or cases of shellfish poisoning in the bay

155 Sellner, K.G., G.J. Doucette and G.J. Kirkpatrick. 2003. Harmful algal blooms: causes, impacts and detection. Journal of Industrial Microbiology and Technology 30: 383–406.
156 Borja, V.M., E.F. Furio, N.C. Gatdula and M. Iwataki. 2019. Occurrence of Harmful Algal Blooms Caused by Various Phytoplankton Species in the Last Three Decades in Manila Bay, Philippines. Philippine Journal of Natural Sciences 24:80–90.
157 Azanza, R.V. and L.N. Miranda. 2001. Phyoplankton composition and P. bahamense toxic blooms in Manila Bay, Philippines. Journal of Shellfish Research, 20 (3): 1251-1255.
158 Borja, V.M., E.F. Furio, N.C. Gatdula and M. Iwataki. 2019. Occurrence of Harmful Algal Blooms Caused by Various Phytoplankton Species in the Last Three Decades in Manila Bay, Philippines. Philippine Journal of Natural Sciences 24:80–90.

Planktonic Taxon	Characteristics, Presence and Recorded Blooms
Dinophysis miles *Dinophysis caudata* *Dinophysis hastata*	• Toxic, capable of producing diarrhetic shellfish poisoning • First recorded in Manila Bay in 1941, but have not been associated with any significant blooms or cases of poisoning in the bay
Protoperidinum species	• Group of 11 species sometimes associated with large blooms capable of producing mass fish kills • Commonly detected in Manila Bay • Significant bloom involving species of the group occurred in the western part of Manila Bay in 1908, but none have been recorded since
Cochlodinium polykrikoides	• Non-toxic • Detected in Manila Bay for first time in 2004 • Not known to have produced significant blooms in Manila Bay
Ceratium furca	• Non-toxic • Known from Manila Bay since at least 1941 • Produced visible reddish discoloration during blooms in September 2012 and September 2017, in the eastern part of Manila Bay, but concentration was insufficient to produce fish kills
Trichodesium erythraeum	• Non-toxic marine filamentous cyanobacterium • Found to be present in significant concentrations in May 2014 and May 2015, but has never been associated with a major bloom in Manila Bay
Pseudo-nitzschia pungens *Nitzschia navis-varingica*	• Toxic, capable of producing amnesic shellfish poisoning • Has been detected in Manila Bay, but has never been connected to any cases of poisoning there

Several of the phytoplankton taxa mentioned in Exhibit 6-74 (*Noctiluca scintillans*, *Dinophysis caudata*, *Protoperidinium* spp., *Ceratium* furca, *Trichodesium erythraeum*, *Protoperidinium*, *Ceratium furca*, *Trichodesium erythraeum* and Pseudo-*nitzschia*) were detected during the plankton surveys conducted in the BCIB project area in February 2020 and October 2021, although none were anywhere close to being dominant, and no visible blooms of any species were observed during sampling. Recorded blooms in Manila Bay occurred within the bay, mostly on the western side; there is no record of significant blooms in the vicinity of the bay's mouth, and it may reasonably be hypothesized that daily tidal mixing, oxygenation from regular exposure to wave action, and distance from major river mouths and large urban areas help to prevent bloom formation there. That said, in the survey results presented above, planktonic assemblages indicative of eutrophic conditions (particularly the dominance of *Chaetoceros* spp.) do suggest that some of the factors commonly associated with algal blooms are present.

6.1.9.2 Soft Bottom Infauna

As described earlier, a large proportion of the seafloor in the BCIB project area is characterized by sandy and sand-muddy surface deposits (see 6.1.5.3). The organisms that live within such soft bottom materials are referred to as infauna, while those that inhabit the soft seafloor surface are known as epifauna. Consisting of a range of organisms including various kinds of worms, molluscs, crustaceans and single-celled foraminifera, soft bottom fauna are an important part of the ecology of marine environments, serving as food for many fish species, performing a vital role in the decomposition of organic detritus and wastes, enhancing productivity of microbiological communities and contributing to biogeochemical cycling. Because the low mobility of infaunal organisms forces them to adapt to disturbance *in situ*, and because the taxonomic diversity of infaunal assemblages enables study of a wide range of responses to stressors, infaunal communities are commonly assessed as prime indicators of marine habitat quality.[159] Soft bottom communities in Manila Bay have, in general, not received a great deal of research attention, and no studies have been undertaken on this topic in the BCIB project area.

Sampling and Analysis of Soft Bottom Organisms

To develop a baseline profile of soft bottom communities in the project area, sampling was carried out in February 2020 at nine intertidal stations, nine nearshore subtidal stations, and eight offshore stations spaced out along the project alignment (see Exhibit 6-75). Replicate samples were collected at all stations, for a total of 54 samples. Intertidal sediment samples were collected using a metal frame covering an area of 0.0225 m^2. The metal frame was pushed into the substrate and all sediments found within the frame were hand shovelled into a plastic container. Subtidal sampling was done using an Ekman bottom grab sampler, also with an area of 0.0225 m^2. In offshore/open water sites, samples were collected by SCUBA divers, using a 0.0225 m^2 metal frame and trowel. Each sample, regardless of collection method, was sieved through a 0.5-mm mesh in the field, and retained material was placed in a plastic container, stained with Rose Bengal and fixed in 10% formalin. In the laboratory, samples were washed with tap water to get rid of excess formalin, then sorted using a stereo zoom microscope. Identified organisms were placed in vials containing 70% alcohol and classified to family level, and species level when possible. Specimens were counted to determine their density, expressed as the number of individuals/0.5 m^2. An index of diversity of benthic organisms was computed for each station using the Shannon-Weaver Diversity Index. Biomass of the benthic infauna was also measured and expressed in terms of wet weight in grams per square meter (wwt g/m^2).

Supplemental infaunal sampling was carried out in October 2021 at nine nearshore stations (see Exhibit 6-75). Replicate samples were obtained at each station, for a total of 18 samples. Sediment samples were collected by SCUBA divers from an estimated area of 0.02 m^2 using Trowels. Collected sediments were carefully placed in sealed plastic bags, and preserved with 10% formalin upon being brought to the surface. In the laboratory, sediment samples were passed through a sieve with 1 mm mesh size, and all animals retained were identified under the microscope using taxonomic keys, illustration guides and checklists, and their number counted. Abundances of soft bottom animals were reported as number of individuals/0.02 m^2. Biomass was not measured.

Due to the differences in methodology employed, data on abundance and species composition from the February 2020 and October 2021 are not compared at the level of absolute numbers of individuals in the presentation and discussion that follows. Rather, comparison is undertaken at the level of intra-study relative abundance and general spatial patterns, and discussion is focused on the extent to which the two datasets may corroborate or complement each other.

[159] Gillett, D.J., L. Gilbane and K.C. Schiff. 2021 Characterizing Community Structure of Benthic Infauna From the Continental Slope of the Southern California Bight. Frontiers in Marine Science 8:605858. doi: 10.3389/fmars.2021.605858

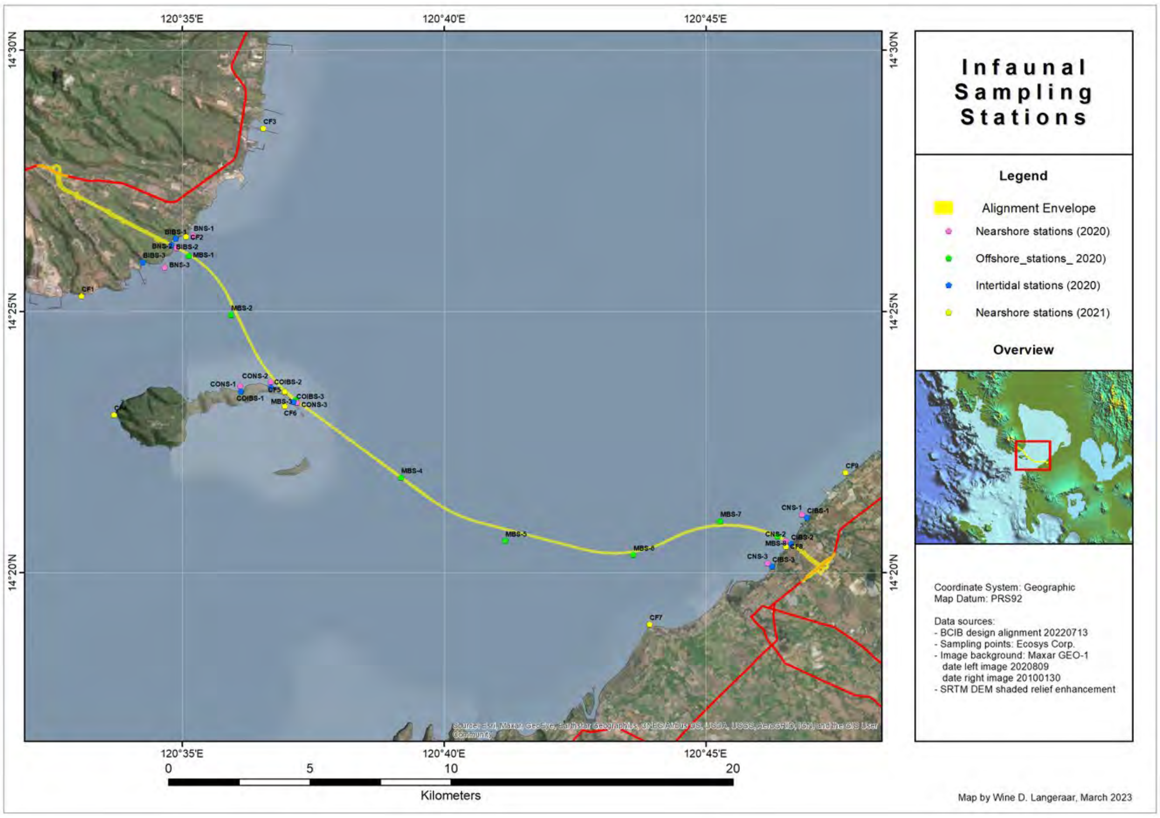


Exhibit 6-75 Locations of Infaunal Sampling Stations, February 2020 and October 2021

Intertidal Sampling Results (February 2020)

Sampling at the nine intertidal stations turned up organisms in eight phyla (see Exhibit 6-76 and Exhibit 6-77), with the number of taxa represented ranging from a low of 5 to a high of 22. The Annelids were particularly strongly represented by polychaeta worms in Bataan and Corregidor Island, while Foraminifera dominated in Cavite. Three of the eight phyla accounted for very small portions of overall abundance, and infaunal communities at the three station groupings overwhelming consisted of some mix of the phyla Annelida (represented exclusively by Polychaeta worms), Foraminifera, Mollusca, Arthropoda (all crustaceans) and Nematoda.

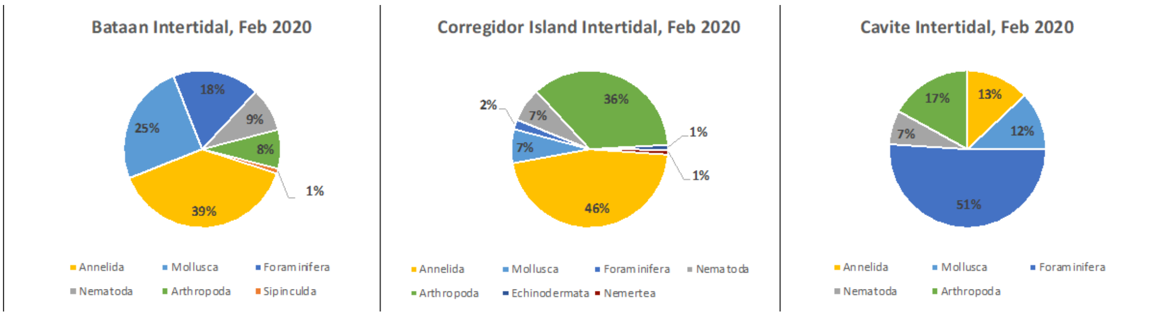


Exhibit 6-76 Mean Relative Abundance of Infaunal Phyla At Intertidal Stations, February 2020

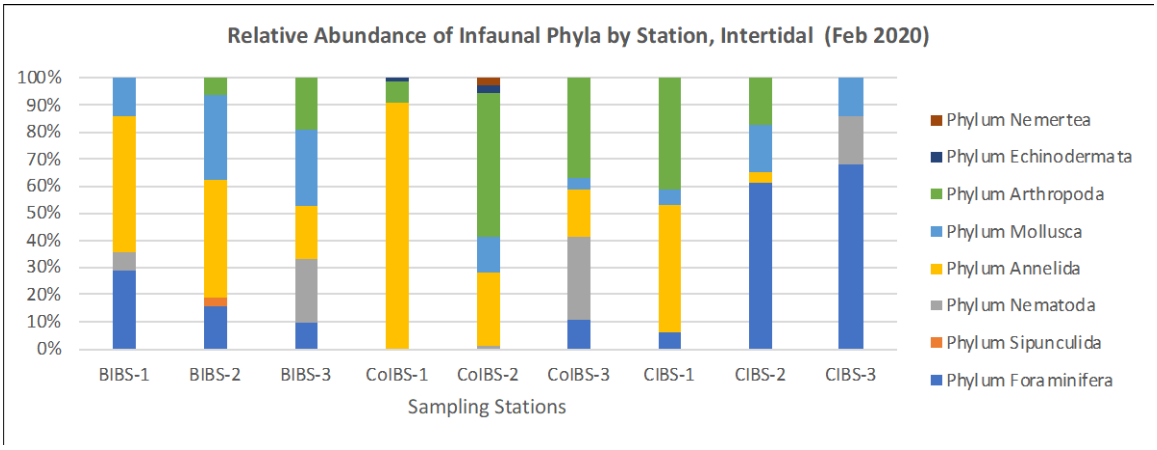


Exhibit 6-77 Mean Relative Abundance of Infaunal Phyla by Intertidal Station, February 2020

Shannon-Weaver Diversity Index values (H') calculated for each station indicate somewhat higher and more consistent diversity for the Bataan stations as a group than for the stations on Corregidor Island and in Cavite (see Exhibit 6-78). Overall, the diversity values computed are on the low end of the commonly cited typical range of 1.5–3.5 (and rarely exceeding 5.0) for most ecosystems.[160] Only one very low H' value was recorded out of nine stations.

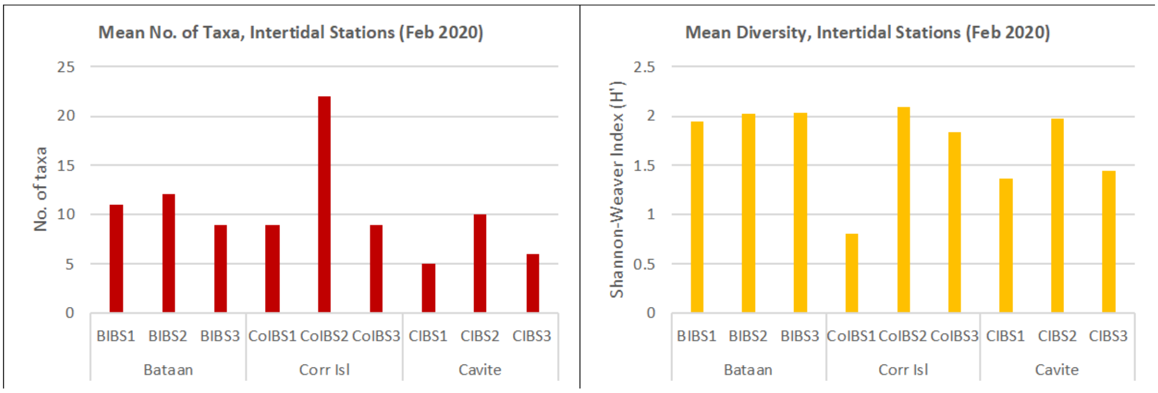


Exhibit 6-78 Infaunal Diversity at Intertidal Stations, February 2020

With respect to abundance of infaunal organisms, the Corregidor Island stations stand out, with mean abundance more than double the levels documented at the Bataan and Cavite stations (Exhibit 6-79). Biomass levels tell a partially corroborative story, with one station on Corregidor Island standing out rather dramatically from an otherwise unremarkable field; the same station also shows the highest abundance, but not by such large margins relative to its peers. The relatively high biomass at the CoIBS2 station appears to be attributable to high numbers of gammarids, syllid worms and the gastropod Neretina sp.

[160] (1) Ortiz-Burgos, S. 2016. Shannon-Weaver Diversity Index. In: Kennish, M.J., ed. Encyclopedia of Estuaries. Encyclopedia of Earth Sciences Series. Springer, Dordrecht. https://doi.org/10.1007/978-94-017-8801-4_233: (2) Francé, J., I. Varkitzi, E. Stanca, F. Cozzoli, S. Skejić, N. Ungaro, I. Vascotto,P. Mozetič, Ž.N. Gladan, G. Assimakopoulou and A. Pavlidou. 2021. Large-scale testing of phytoplankton diversity indices for environmental assessment in Mediterranean sub-regions (Adriatic, Ionian and Aegean Seas). *Ecological Indicators*, *126*, p.107630.

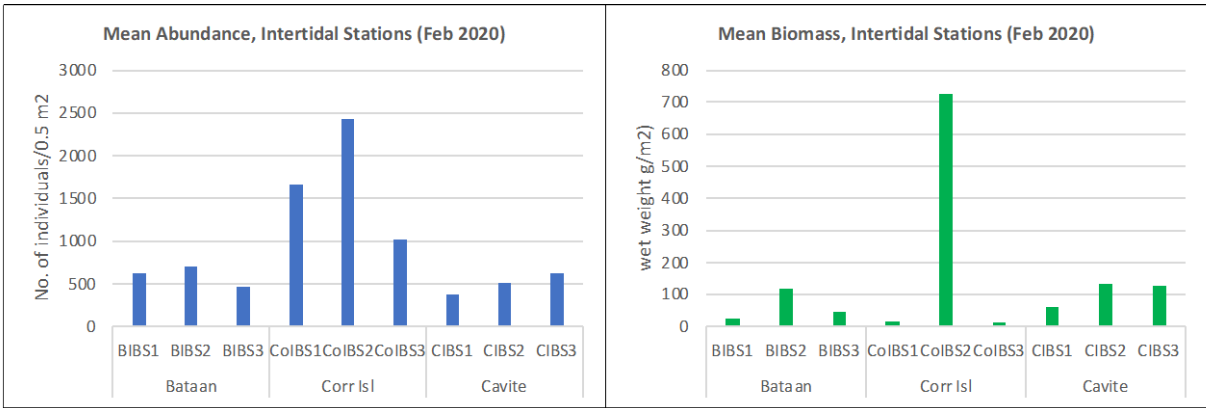


Exhibit 6-79 Infaunal Abundance and Biomass at Intertidal Stations, February 2020

Nearshore Subtidal Sampling Results (February 2020 and October 2021)

Results from sampling at nine nearshore subtidal stations in February 2020 show a predominance of arthropods (all crustaceans), with Annelids (all polychaeta worms) also accounting for significant proportions of overall abundance at the Bataan and Cavite stations (see Exhibit 6-80). The chart in Exhibit 6-81 indicates moderate to strong consistency across stations within each of the general sampling areas, in particular the Corregidor Island stations, at which the arthropods are strongly dominant across the board. The Cavite stations are also very consistent as regards the dominance of arthropods, but vary in relation to the relative importance of molluscs and annelids as the second-most dominant phyla.

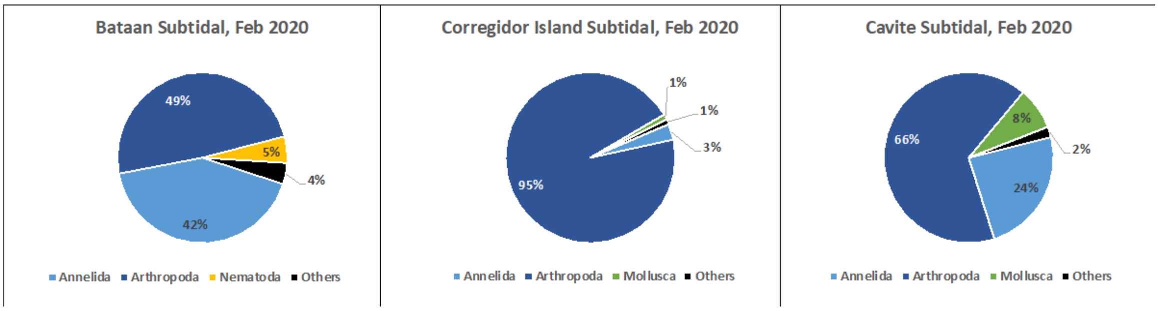


Exhibit 6-80 Mean Relative Abundance of Infaunal Phyla, Nearshore Stations (February 2020)

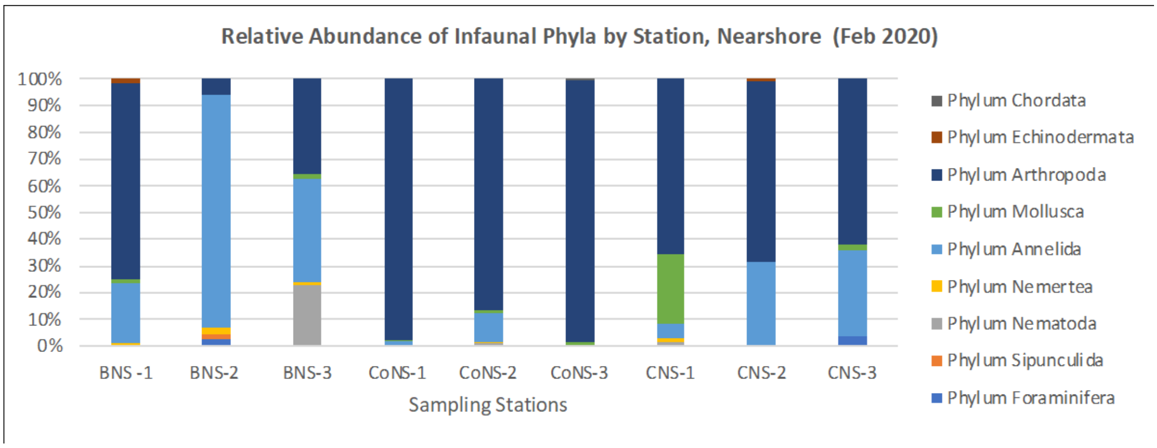


Exhibit 6-81 Mean Relative Abundance of Infaunal Phyla, Nearshore Stations (February 2020)

Species richness was found to be highest at the Bataan stations and lowest at the Cavite stations (see Exhibit 6-82). In a pattern similar to that documented at the intertidal stations in February 2020, diversity as calculated using the Shannon-Weaver Diversity Index is highest at the Bataan stations, where H' values can be considered to be in the low–moderate range. Diversity values are closer to the low end of the typical range for most ecosystems at the Corregidor Island and Cavite stations, with all stations below H'=1.5, and one very low reading, below H'=0.5.

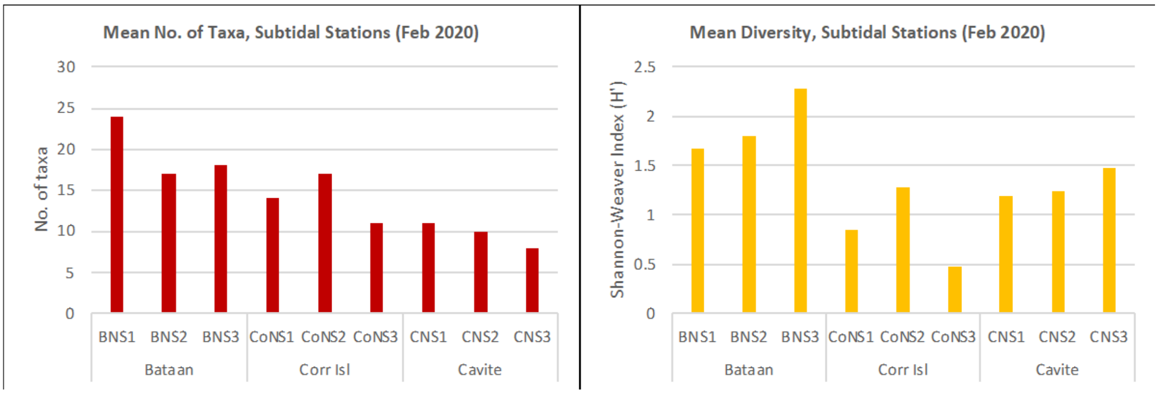


Exhibit 6-82 Infaunal Diversity at Nearshore Stations, February 2020

Abundance data for the February 2020 subtidal stations again mirror the pattern observed at the subtidal stations, with mean density being higher in the Corregidor nearshore zone than the Bataan and Cavite ones (Exhibit 6-83). This general pattern carries through to biomass, where the Corregidor Island Stations again show notably higher levels than the two mainland-proximate sampling areas. These findings (for both intertidal and nearshore subtidal stations) may suggest better conditions for infaunal organisms further from inhabited areas, but the diversity data may, conversely, suggest somewhat higher resilience in Bataan and Cavite. High diversity values are not found anywhere in the intertidal or subtidal data, however, perhaps suggesting reduced ecosystem resilience in the project area overall.

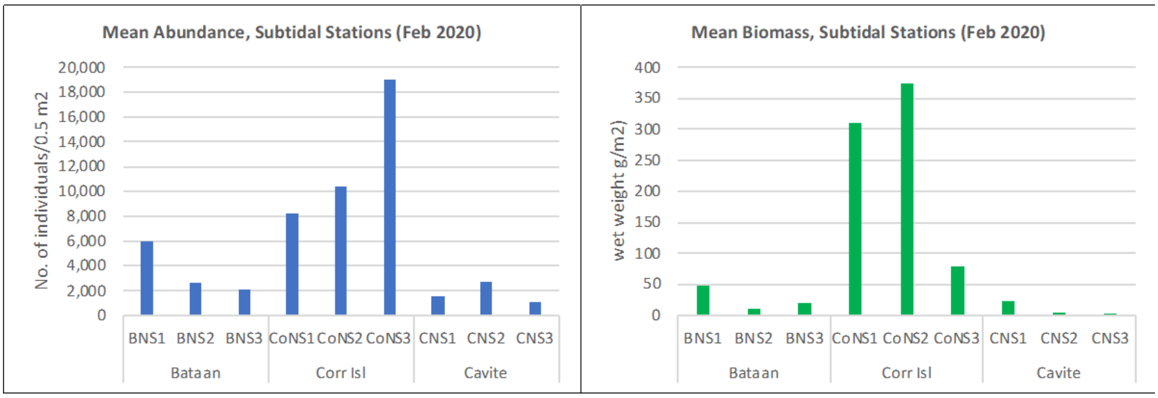


Exhibit 6-83 Infaunal Density and Biomass at Nearshore Stations, February 2020

Results from the infaunal sampling carried out in October 2021 show some striking variation with regards to taxonomic makeup of the sampled assemblages (see Exhibit 6-84). Most obvious is the very strong dominance of Foraminifera at the Corregidor stations, which contrasts with the total absence of that phylum at the Bataan and Cavite stations, where Mollusca and Annelida predominate. The by-station breakdown of composition data (see

Exhibit 6-85) shows that the dominance of Foraminifera actually applies to only two of the three Corregidor Island stations. Infaunal density was low at most stations in the October 2021 sampling, and the total dominance of Annelida at CF6 is based on a sample yield of a single individual syllid worm.

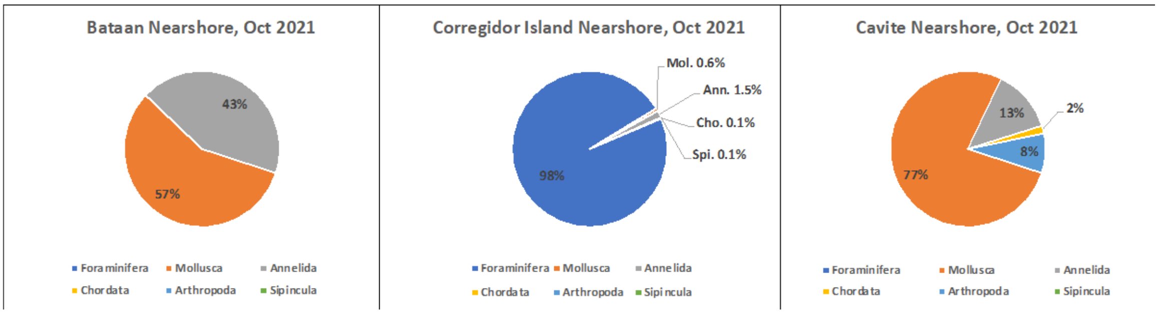


Exhibit 6-84 Mean Relative Abundance of Infaunal Phyla at Nearshore Stations, October 2021

The dominance of the large-sized foraminifera *Calcarina* at CF4 and CF5 at Corregidor Island may indicate a relatively healthy benthos there, as dominance of other large-sized foraminifera such as *Operculina* and *Cocloclypeus* have been suggested elsewhere as an indicator of water quality conducive to reef growth and recovery from disturbance.[161] However, the relatively low abundance of *Calcarina* observed in the present study, compared with levels documented in benthic sediments around reef systems elsewhere in the Philippines, may conversely indicate less than optimal conditions even at Corregidor Island.

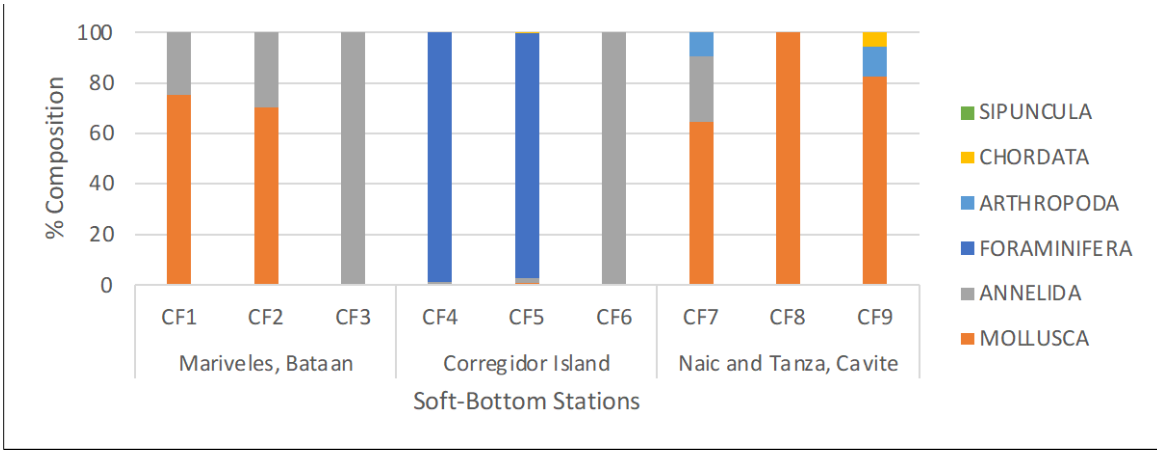


Exhibit 6-85 Mean Relative Abundance of Infaunal Phyla by Nearshore Station, October 2021

With regards to infaunal diversity, the October 2021 nearshore sampling reveals variable taxa richness, ranging from a low of one taxon recorded at the CF6 station off Caballo Island to a high of 17 taxa at the CF7 station off Naic (see Exhibit 6-86, left side). This may be compared unfavorably with the range of 8–24 taxa documented at the stations sampled in the February 2020 nearshore survey, although the difference in mesh size used for sample screening (0.5 mm in 2020; 1.0 mm in 2021) may account for a significant part of the

[161] Hallock, P., B.H. Lidz, E.M. Cockey-Burkhard and K.B. Donnelly. 2003. Foraminifera as bioindicators in coral reef assessment and monitoring: the FORAM INDEX. Environmental Monitoring and Assessment **81**: 221–238.

difference. The Shannon-Weaver Diversity Index was not calculated for the October 2021 nearshore data.

As has been mentioned above, the density of infaunal organisms documented at the nearshore stations sampled in October 2021 is very low at most stations; indeed, at five of the nine stations, the total number of organisms found within the sampling frame was less than 10 animals. There are two outliers in this regard (see Exhibit 6-86, right side); stations CF4 and CF5 show dramatically higher infaunal abundance than the other October 2021 stations. While methodological differences prevent direct comparison of abundance numbers, data for the February 2020 stations do offer some corroboration. The February 2020 stations CoNS2 and CoNS3, which are both in the general vicinity of CF5, are the stations with the second-highest and highest mean density values, respectively (see Exhibit 6-83). Taken together, these data from the two sampling efforts would seem to suggest that the east coast of Corregidor Island's Tail End may have particularly favorable conditions for infaunal organisms to thrive, at least relative to other parts of the BCIB project area.

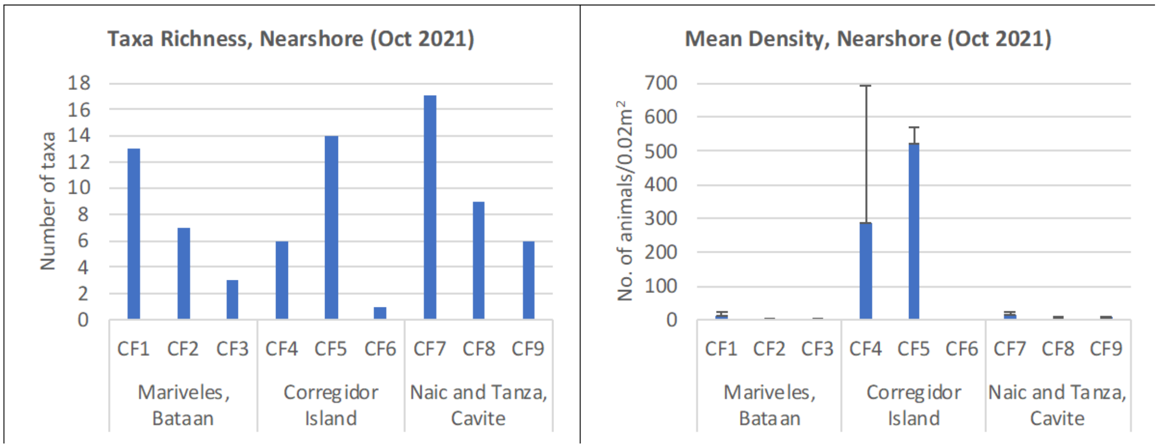


Exhibit 6-86 Taxa Richness and Mean Infaunal Abundance at Nearshore Stations, October 2021

Offshore/Open Water Sampling Results (February 2020)

Infaunal sampling at eight stations spaced out along the proposed BCIB alignment in February 2020 turned up a total of 970 individual organisms; the mean number of individuals per station was 122. The documented organisms represented a total of 54 taxa from nine phyla (see Exhibit 6-87). Arthropods (almost all of which were crustaceans) were most numerous, followed by annelids (all polychaetes) and foraminiferans. Referring to the by-station relative abundance data (see Exhibit 6-88), it is apparent that the overall dominance of the arthropods can be traced to a particular concentration at the MBS3 station, which was located just off the eastern shore of the Tail End portion of Corregidor Island, and is appropriately compared to the nearshore sampling stations in the same general vicinity (CoNS2 and CoNS3 from the February 2020 nearshore sampling). Both CoNS2 and CoNS3 also exhibited relatively high infaunal density, as well as strong dominance of arthopods. Interestingly, the CF5 station from the October 2021 nearshore survey survey is also nearby, and had high infaunal density relative to other stations in the 2021 dataset, but almost no arthropods (foraminifera accounted for 98% of individuals at the station), but it is to be remembered that a larger mesh size was used in the October 2021 survey, so direct comparison is problematic. In any case, the MBS3 data do seem to corroborate the inference drawn above regarding possibly favorable conditions for infaunal communities off the east coast of Corregidor Island, at least relative to the other areas sampled.

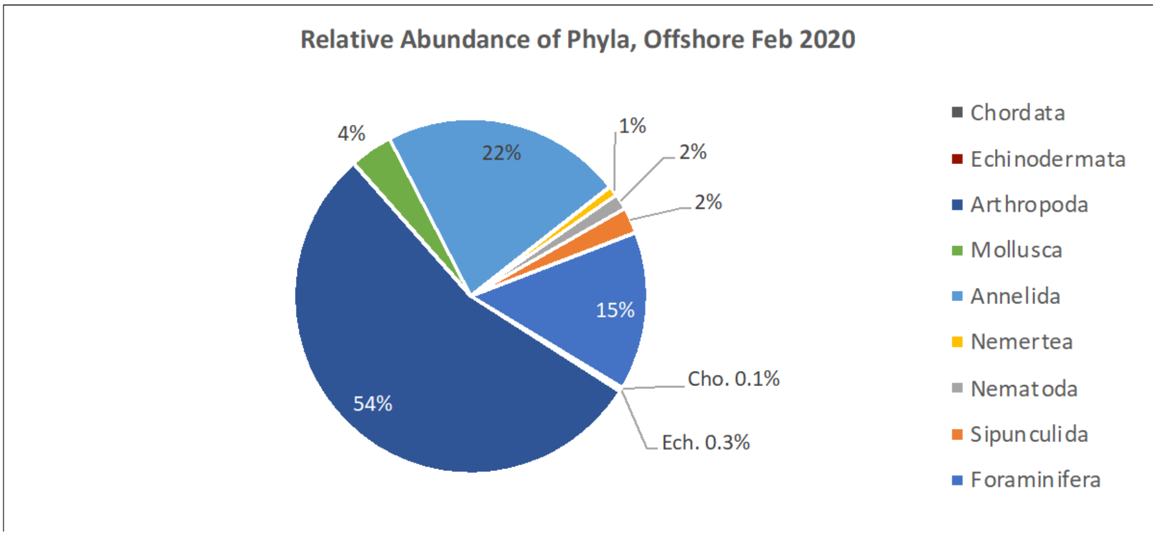


Exhibit 6-87 Mean Relative Abundance of Infaunal Phyla at Offshore Stations, February 2020

Annelids are well represented, appearing at most stations and showing a particularly strong presence at the MBS1 and MBS8 stations

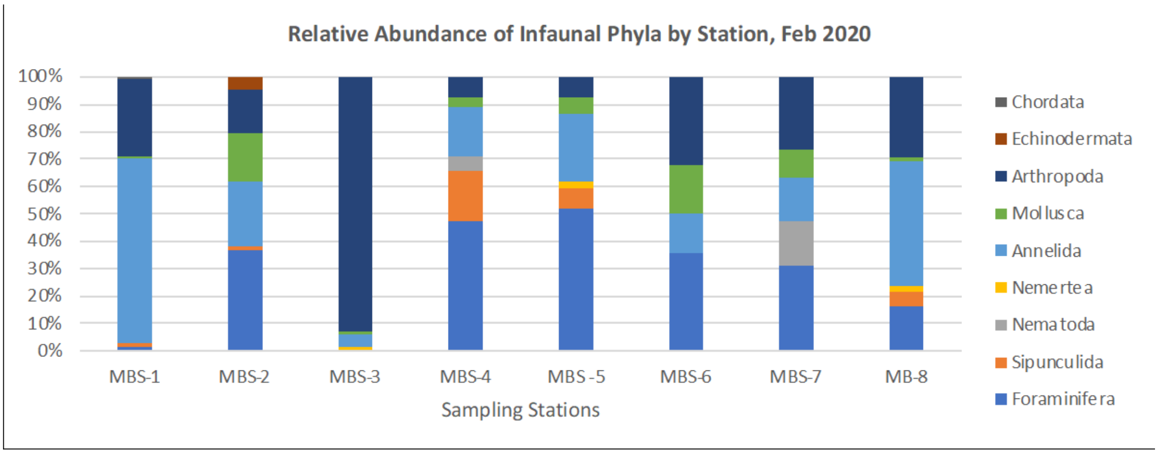


Exhibit 6-88 Mean relative Abundance of Infaunal Phyla by Offshore Station, October 2021

The number of taxa recorded at the eight offshore stations is generally high (range 14–23, median 19) relative to results reported above for the other sampling sets (Intertidal stations 2020: range 5–22, median 9; Nearshore stations 2020: range 8–24, median 14; Nearshore stations 2021: range 1–17, median 7). Diversity values as calculated using the Shannon-Weaver Diversity Index are also notably higher than for the other sets of sampling stations, with six of the eight stations scoring above 2.0, and just one station receive a score lower than 1.0. Infaunal diversity at the offshore stations (with the exception of MBS3) can be considered moderate, which is suggestive of fairly good conditions and at least moderate ecosystem resilience.

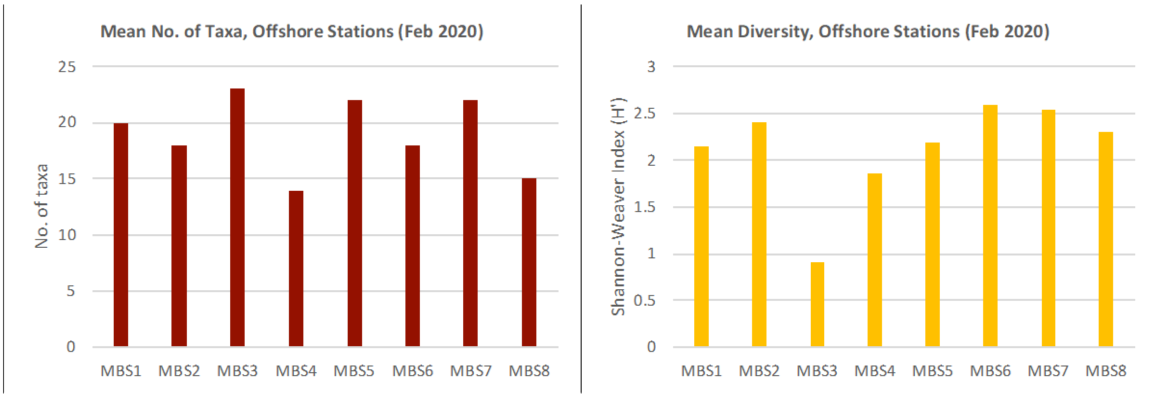


Exhibit 6-89 Infaunal Diversity at Offshore Stations, February 2020

Infaunal abundance at the eight offshore stations is fairly even and moderate, with the exception of the outlier MBS3 which, as has been discussed above, appears to reflect particularly favorable conditions off the east coast of Corregidor Island, as corroborated by data from nearshore stations in the same general vicinity (see Exhibit 6-90). Overall, infaunal abundance is somewhat lower at the offshore stations than at the February 2020 nearshore stations (Exhibit 6-83), and higher than at the February 2020 intertidal stations (Exhibit 6-79). Infaunal biomass is higher and more even overall for the offshore stations than for the intertidal and nearshore (2020) stations. The relatively high biomass documented at the MBS3 station is reflective of an abundance of arthropods (mainly crustaceans) and annelids (mainly polychaetes) there. The notable biomass spike at MBS5 is attributable to the presence of (relatively massive) gastropods.

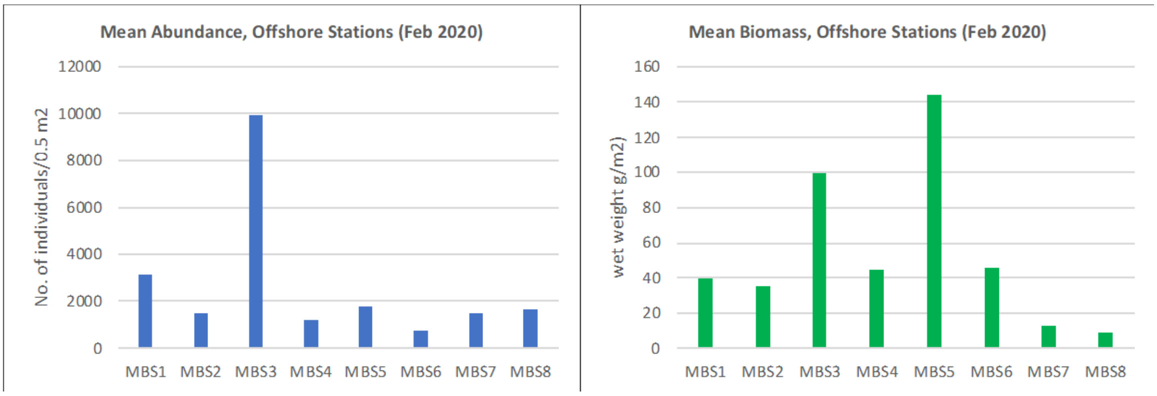


Exhibit 6-90 Infaunal Density and Biomass at Nearshore Stations, February 2020

Implications of Infaunal Findings

The results of the infaunal sampling do not indicate significant anthropogenic influences on benthic communities.

6.1.9.3 Coral Reef Communities

Manila Bay in general is not well endowed with coral reefs, principally for lack of biophysical conditions suitable to support durable coral colonization and reef-building. As has been discussed above, Manila Bay is an estuary which receives massive influxes of freshwater from many rivers, some of them large, particularly during the rainy season. Salinity levels in the inner bay are both typically below the optimal salinity range for most corals, and subject to periodic rapid salinity changes which are not well tolerated by most corals. Also due in part to large riverine inputs, the waters of the inner bay are naturally turbid, and this limits light availability; although some coral species are adapted to fairly turbid conditions, most rely on relatively clear waters and good light penetration to enable photosynthetic activity by algae living symbiotically within their bodies. The larvae of most coral species also need hard substrate to settle upon and begin building colonies, and the vast majority of the seafloor in Manila Bay consists of mud and sand. Sediment transport and accumulation are substantial in most parts of Manila Bay, and few coral species are capable of successfully managing heavy sediment loading.

Given the conditions mentioned, it is unlikely that Manila Bay would ever have been characterized by large expanses of coral, even in pre-industrial times. However, it is highly probable that coral extent and density within the bay has been diminished by anthropogenic stressors. Inputs to the bay's waters, such as agricultural and urban runoff, untreated and minimally treated human waste, nutrient outflows from aquacultural activity, and industrial discharges worsen the scenario for corals, since they tend to elevate turbidity and increase sediment loading, and likely produce various toxic effects in coral and associated algal organisms. Solid waste deposition on the seafloor has a deleterious smothering and light-blocking effect on all benthic life. And a long-standing pattern of over-fishing, as well as the use of damaging and illegal fishing methods such as trawling, dynamite fishing and fish poisoning, both inflict physical damage to coral colonies and dramatically reduce populations of fish that play important roles in coral reef maintenance.

In spite of generally unfavorable natural background conditions and exacerbating anthropogenic stressors, corals do persist and even thrive in limited locations within Manila Bay. Where the seafloor is relatively steep due to volcanic orogeny, such as around the southern Bataan peninsula, Corregidor and Caballo Islands, and far western Cavite and northern Batangas, corals have sufficient exposed rocky substrate for colony formation. These areas are all near the bay's mouth, where salinity is higher and more stable, the estuarine turbidity regime is moderated by the influence of active tidal flushing with oceanic water, and sediment transport and accumulation are much reduced compared to the inner bay.[162] In addition, pollutant loading is significantly less intense at the bay's mouth, given the distance from Metro Manila, the mouths of major rivers, and the principal aquaculture production zones (see discussion of marine water quality in Section 6.1.7 above). This general distribution is illustrated by coral habitat mapping produced by the Allen Coral Atlas and by NAMRIA, using remotely sensed information, which indicates presence of coral only near the mouth of Manila Bay.

The Allen Coral Atlas generates benthic habitat distribution maps by applying advanced machine learning methodology to high-resolution PlanetScope (Dove) satellite imagery and bathymetric data. The organization's coral distribution maps are probabilistic representations of locations where coral and coral-associated algae are detected in sufficient density to infer a greater than 60% probability that corals are present.[163] Exhibit 6-91 shows the predicted extent of coral reefs based on the Allen Coral Atlas methodology.

[162] DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.
[163] Allen Coral Atlas. 2022. Science and Methods. https://allencoralatlas.org/methods/. Accessed 20 May 2022.

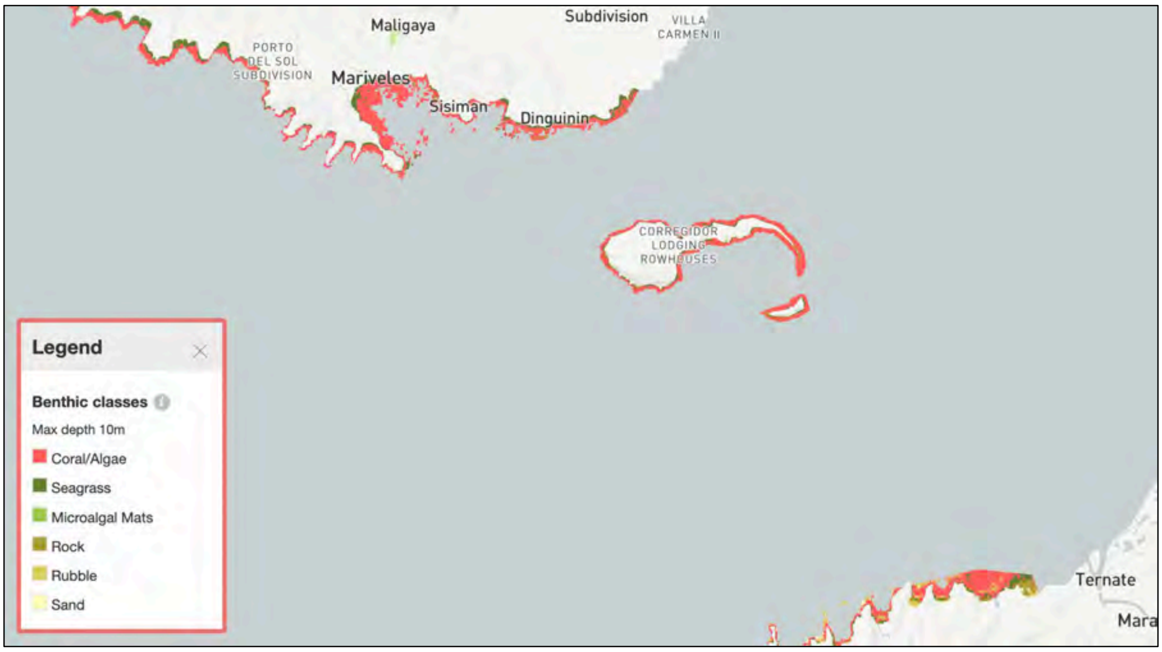
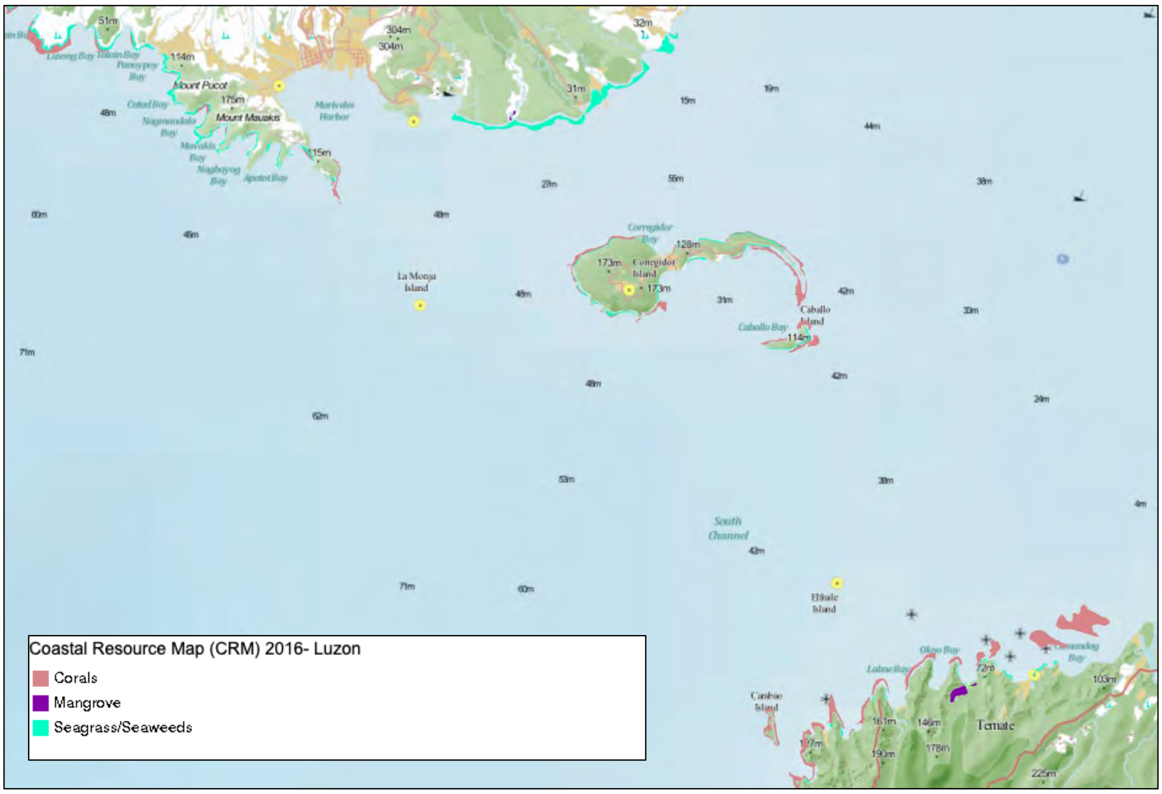


Image credit: Allen Coral Atlas

Exhibit 6-91 Predicted Coral Cover for Manila Bay (Allen Coral Atlas)

NAMRIA has produced mapping of coastal resources for the whole country, using digital and visual analysis of Landsat 8 satellite imagery in conjunction with some limited field verification. Distribution of coral reefs, seagrass/seaweed and mangroves are delineated with drawn vector outlines on the NAMRIA coastal resources maps.[164] Exhibit 6-92 and Exhibit 6-93 show the coral distribution in Manila Bay from the original mapping produced in 2016 and updated data generated by NAMRIA in 2021, respectively. It is not clear to what relative extent methodological differences and real-world conditions may have contributed to the differences in predicted coral cover in the study area.

[164] NAMRIA. 2016. Coastal Resources Map 2016 – Luzon (metadata). https://geoportal.gov.ph. Accessed 18 May 2022.



Source: NAMRIA. Coastal Resource Map 2016 – Luzon. https://geoportal.gov.ph.

Exhibit 6-92 Coastal Resources Around Manila Bay Mouth (NAMRIA 2016)

The corals of Manila Bay have not been intensively studied, but findings from five field surveys are available to lend further insight regarding both the distribution and condition of coral in and around the BCIB project area. In chronological order, these are (1) a coral assessment undertaken by BFAR for the coastal zone of Cavite in 2017;[165] (2) a survey of coral condition carried out in 2018 by the DENR's Ecosystems Research and Development Bureau (DENR-ERDB) across multiple sites around the mouth of Manila Bay, as part of a bay-wide vulnerability assessment;[166] (3) a survey carried out in early 2020 as part of a rapid resource assessment under the auspices of the MBSDMP process;[167] (4) a 2020 survey commissioned by the Corregidor Foundation Inc. (CFI) to assess potential for dive tourism around Corregidor Island;[168] and (5) a survey of six locations around Corregidor Island and the nearshore of southern Mariveles, conducted to support the present EIA.[169] The findings of each are discussed in turn below.

[165] Olaivar, W. and E. Anjam. 2017. Coral Reef Assessment in the Province of Cavite. Bureau of Fisheries and Aquatic Resources, Region IV-A.
[166] DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.
[167] NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory (December 2020).
[168] Corregidor Foundation, Inc. (2020, unpublished). Corregidor Dive Sites: Preliminary Assessment. Consultant's report.
[169] Field study undertaken by Ecosys Corp. under contract to the DED Consultant.

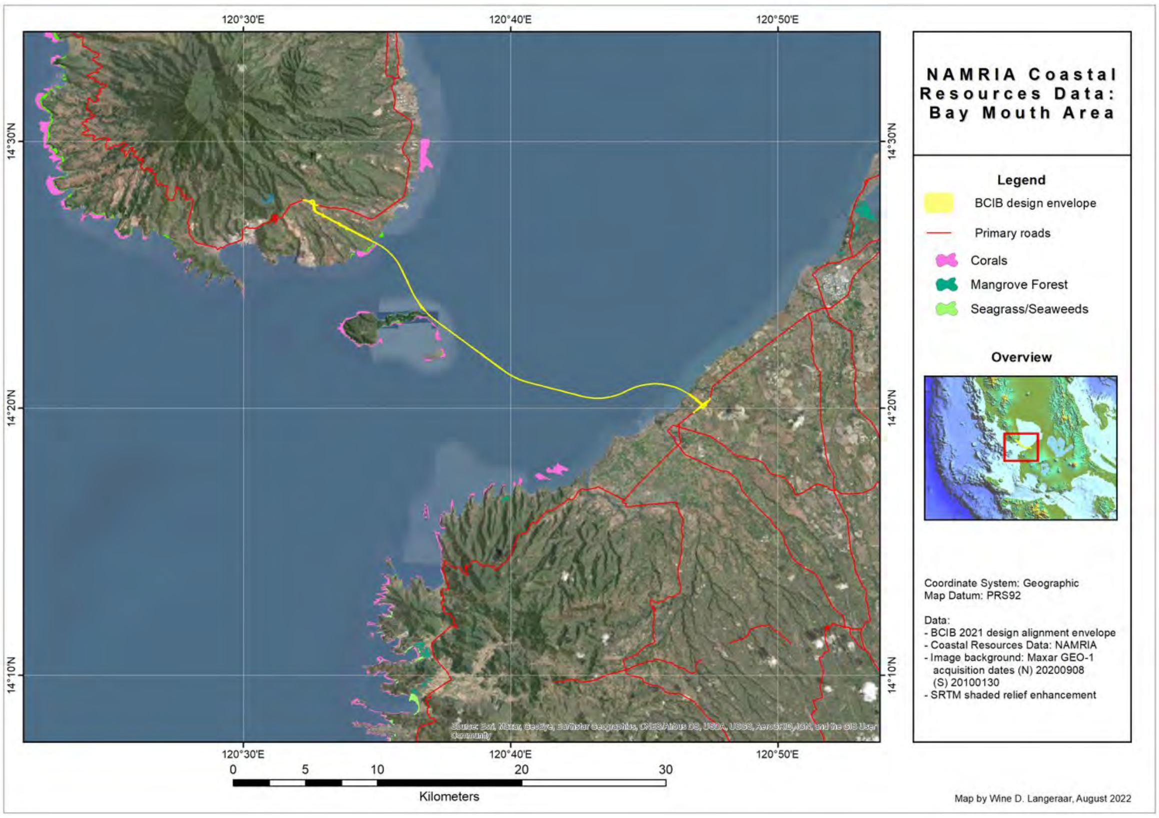


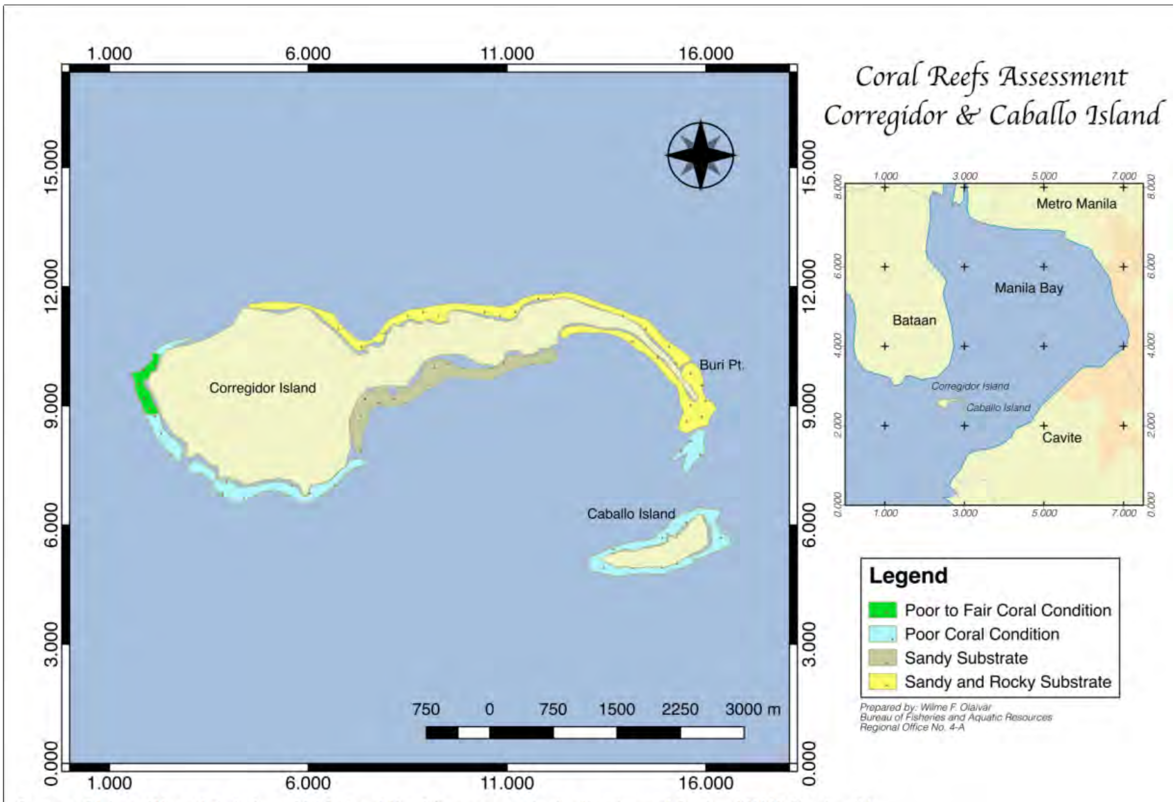
Exhibit 6-93 Coastal Resources Around Manila Bay Mouth (NAMRIA 2021 Update)

BFAR Coral Reef Assessment in the Province of Cavite (2017)

A field survey of coral resources around Corregidor and Caballo Islands by BFAR in May 2017, as part of a broader survey of nearshore benthic resources in Cavite. Two survey methods were employed: a manta tow for purposes of mapping coral reef extent, and 50-m Line Intercept Transects for assessing the condition of identified reef areas. The precise locations of tows and transects are not provided in the study report, and this limits the potential for drawing conclusions about coral near the BCIB alignment from the results presented; however, general findings are outlined and discussed here.

The 2017 BFAR coral study indicates that coral habitat is found primarily around the western end of Corregidor Island, all around Caballo Island, and in the shallow saddle between the eastern tip of Corregidor Island and Caballo Island (see Exhibit 6-94). These general distributional findings are contradicted by more detailed and rigorous survey data from other studies (discussed below), particularly as concerns the area shaded in yellow and designated as 'sandy and rocky substrate' on the map in Exhibit 6-94; other studies show that coral growth is present in at least some locations within this area, as does predictive mapping.

With regards to coral condition, the 2017 BFAR study report assesses most identified coral as being in 'poor' condition, with a relatively limited zone at the western tip of Corregidor Island designated as 'poor to fair' (see Exhibit 6-94). Poor coral condition is defined in the study report as hard coral cover in the range of 0–24.99%, and fair condition as 25–49.99% hard coral cover.



Source: Olaivar, W. and E. Anjam. 2017. Coral Reef Assessment in the Province of Cavite. BFAR, Region IV.

Exhibit 6-94 Coral Habitat and Condition Per 2017 BFAR Coral Assessment

The BFAR assessment report provides data tables for three 50-m transects in the vicinity of Corregidor and Caballo Islands; the benthic cover data presented therein are summarized in Exhibit 6-95.

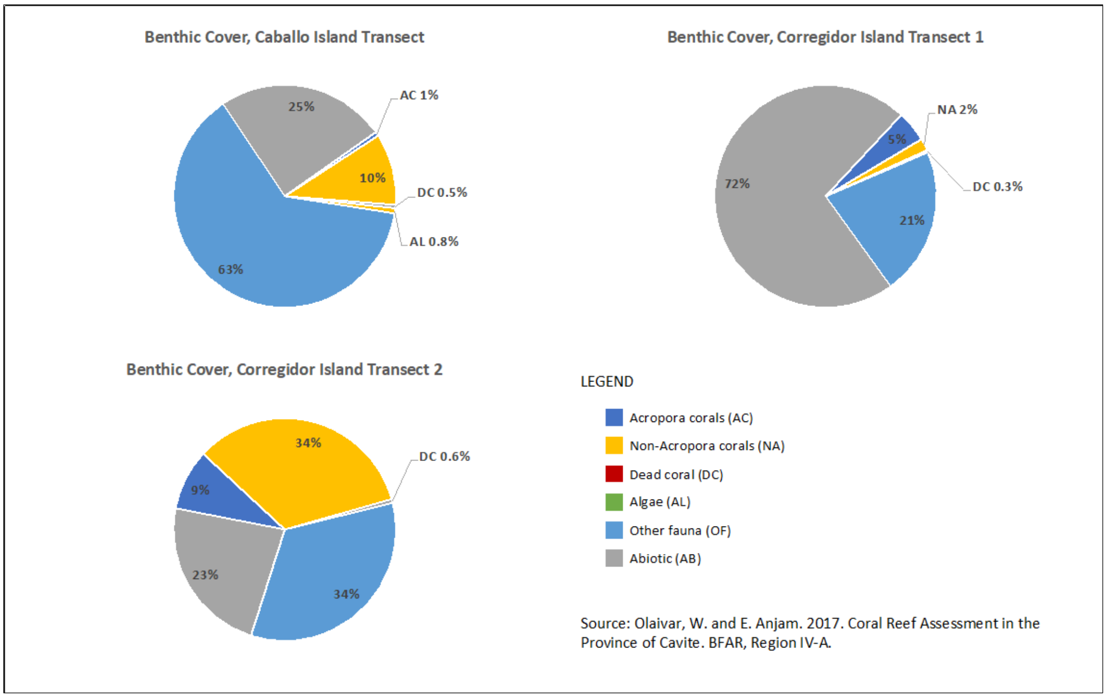


Exhibit 6-95 Benthic Cover Under Three Transects (2017 BFAR Coral Assessment)

The data summarized in Exhibit 6-95 indicate quite substantial benthic cover at two of the three stations, with abiotic (mostly rock and sand) accounting for just a quarter of the transect length.

Hard corals occupied 45% of the benthic surface intersected by the transect line at Corregidor Island Transect 2, which is well above the commonly cited national average (22.8%) and Indo-Pacific average (22.1%).[170] The Acropora corals at this location were all reported to be of the branching type; non-Acropora corals were dominated by encrusting forms, and lesser extents of foliose and sub-massive types. In addition to hard corals, roughly a third of the benthos at the same site was characterized by growths of 'other fauna'; at this site, the largest contributor to the 'other fauna' category was zoanthids, followed by soft corals, sponges and unspecified additional faunal organisms. Just 0.6% of the seafloor under the transect consisted of dead coral.

The Caballo Island transect had somewhat lower hard coral cover, almost all of which was composed of non-Acropora species. The most frequently occurring non-Acropora corals were encrusting types, and some sub-massive forms were also noted. The large 'other fauna' component of benthic cover at the Caballo Island site was dominated by soft corals (accounting for about half), followed by sponges, zoanthids and other organisms. Dead coral cover accounted for just 0.5% of the benthos. Despite being rated 'poor' by the narrow hard coral cover metric, the data for the Caballo Island transect are suggestive of reasonably vibrant coral reef habitat.

Benthic cover at the Corregidor Island 1 sampling station was considerably more sparse than at the other two locations discussed, with the abiotic category (consisting mostly of sand at this location) accounting for nearly three quarters of the transect length. Hard coral cover was low, at just over 5%, and virtually all living cover fell into the 'other fauna' category. At this location, 'other fauna' was split almost evenly between sponges (10.95%) and other faunal organisms (10.55%); no soft corals or zoanthids were documented. Almost no dead coral was recorded, and no algae. The predominance of sand in the large abiotic component recorded under this transect suggests that the absence of hard substrate is likely a significant limiting factor for development of durable biotic cover of hard coral, soft coral and other sessile fauna.

DENR-ERDB Vulnerability Assessment (2018)

The coral survey carried out by DENR-ERDB in 2018 encompassed 14 dive survey stations off Mariveles (1 station), Corregidor Island (4 stations), Caballo Island (3 stations), Ternate (2 stations) and Maragondon (4 stations). Sampling was conducted at each station using the photo-quadrat method. A single 100-m transect was established at each sampling station, parallel to the bathymetric contour, and benthic assemblages along the entire transect were photographed using a tetrapod-mounted camera. During image analysis, quadrat images covering a 1 m x 1 m seafloor area were extracted from the image set and used to characterize lifeform structure and substratum cover. Photographs were analyzed using the software Coral Point Count with Excel extensions (CPCe 4.1).Ten randomly selected points

[170] National estimate is derived from Licuanan, W.Y., R. Robles and M. Reyes. 2019. Status and recent trends on coral reefs of the Philippines. Marine Pollution Bulletin 142 (6283): 544–550. Indo-Pacific average is taken from Bruno JF, Selig ER (2007) Regional Decline of Coral Cover in the Indo-Pacific: Timing, Extent, and Subregional Comparisons. PLoS ONE 2(8): e711. doi:10.1371/journal.pone.0000711.

were overlaid on each photo frame, and the life forms intersecting with each point were identified. Coral colonies found within the quadrats were identified to the genus level.

Across all of the 14 sampling stations, benthic assemblages exhibited substantial variability, with most benthic cover categories ranging from near zero to over 30%. Hard coral cover ranged from under 1% to 59%. The range in cover conditions, as well as mean values, for all recorded benthic cover categories, are shown in Exhibit 6-96. The surveyed reef areas in Maragondon were found to be in generally better condition than the reefs elsewhere, and the surveyed reef areas around Corregidor Island were generally on the lower end of the spectrum with respect to condition.

Exhibit 6-96 Benthic Cover Across 14 Sampling Stations (DENR-ERDB, 2019)

Benthic Category	% Cover (Low)	% Cover (High)	% Cover (Mean)
Hard coral cover (HCC)	0.91	59.00	24.30
Soft coral cover (SCC)	0.00	15.00	2.57
Dead coral cover (DCC)	0	34.44	10.58
Other fauna (sponges, ascidians, bryozoans, etc.)	0	49.50	21.42
Algae	0	33.16	7.00
Abiotic (bare substrate)	1.00	85.00	34.13

Source: DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.

Seven of the 14 stations surveyed in the DENR-ERDB study were located in relative proximity to the BCIB alignment, and are of special interest here; these stations are shown on the map in Exhibit 6-97.

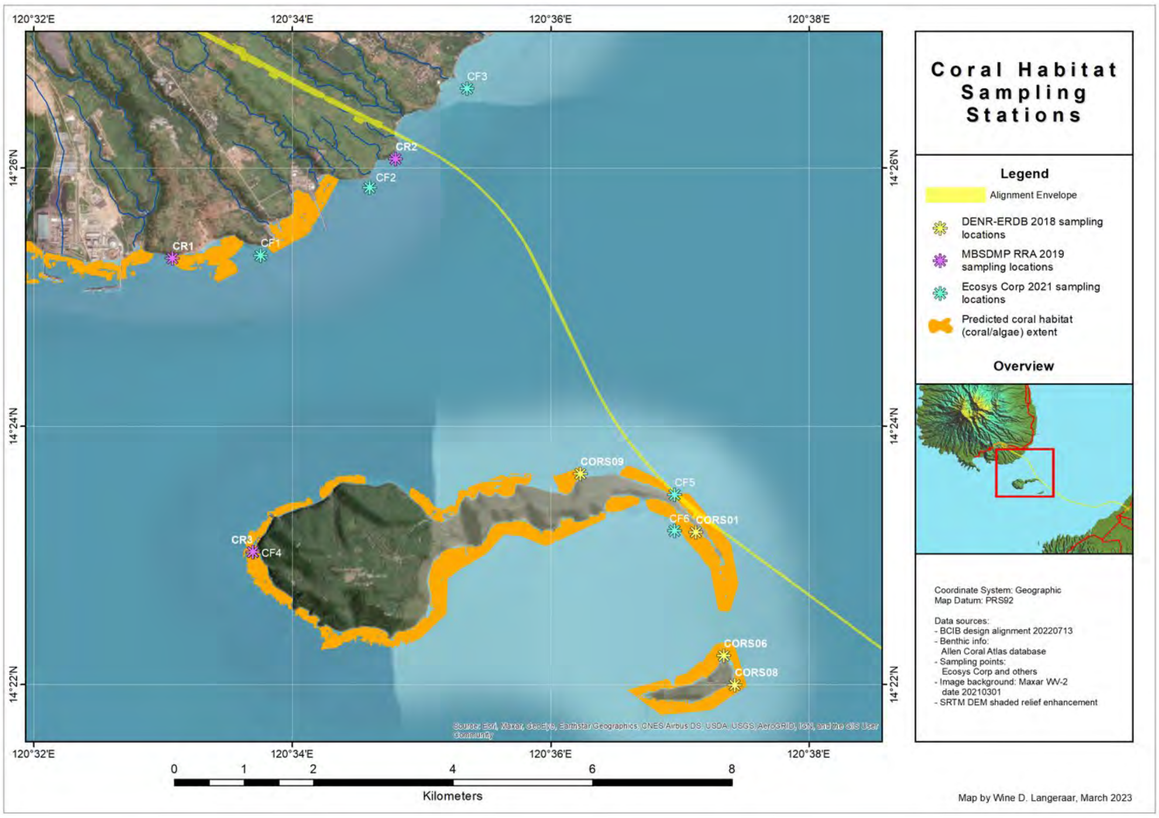


Exhibit 6-97 Coral Habitat Sampling Stations in Vicinity of BCIB Project Alignment

A breakdown of coverage by the six categories of benthic cover used in the study is provided for the seven BCIB-proximate stations in Exhibit 6-98. A comparison of the category means for the seven stations to the category means across all stations around the mouth of Manila Bay indicates that hard coral cover was on average lower for the BCIB-proximate stations, which accords with the general finding that the reefs around Corregidor Island appeared to be in generally worse condition. However, dead coral cover at the BCIB-proximate stations was lower than average, and abiotic cover significantly higher than average. Taken together, these latter figures may suggest that challenges to establishment of coral colonies at the BCIB-proximate locations play more of a role in lower coral cover than factors that lead to the death of established corals. Two of the stations had hard coral cover significantly higher than the estimated national average (22.8%) and estimated Indo-Pacific average (22.1), and a third was just below the Indo-Pacific average.

Exhibit 6-98 Benthic Cover Across BCIB-Proximate Stations (DENR-ERDB, 2019)

Sampling Station	Hard Coral Cover (%)	Soft Coral Cover (%)	Dead Coral Cover (%)	Other Fauna (%)	Algae (%)	Abiotic (%)
CORS 01	6.63	3.14	0.69	15.86	10.73	62.95
CORS 04	1.00	0.00	0.00	5.00	9.00	85.00
CORS 09	2.00	0.00	0.00	22.00	8.00	68.00
CORS 10	38.00	2.00	6.00	28.00	0.00	26.00
CABS 06	19.33	7.00	0.00	37.22	6.00	30.44

Sampling Station	Hard Coral Cover (%)	Soft Coral Cover (%)	Dead Coral Cover (%)	Other Fauna (%)	Algae (%)	Abiotic (%)
CABS 07	40.00	3.33	5.00	23.33	0.00	28.33
CABS 08	0.91	0.00	0.00	49.09	3.64	46.36
% Cover (mean of BCIB-proximate stations)	15.41	3.21	1.67	25.79	5.34	49.58
% Cover (mean of all 14 stations)	24.30	2.57	10.58	21.42	7.00	34.13
Station key: CORS = Corregidor Island; CABS = Caballo Island						

Source: Adapted from DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.

The DENR-ERDB study evaluated coral reef condition with reference to three scales: (1) a live coral condition scale;[171] (2) a hard coral cover scale;[172] and (3) a coral mortality index (CMI) scale.[173] The seven BCIB-proximate stations generally scored poorly (four poor and three fair) on the LCC condition scale, and modestly better on the HCC condition scale (see Exhibit 6-99). However, values for the CMI were fairly low across the seven stations, with four having no evidence at all of coral mortality, and the highest being 0.14 (which equates to 14% of live and dead coral area being dead). The evaluation again draws attention to possible low suitability of the substrate for coral attachment and colony development, or the operation of factors that limit coral recruitment, as is noted by the report authors.

Exhibit 6-99 Evaluation of Coral Condition at BCIB-Proximate Stations (DENR-ERDB, 2019)

Station	Live Coral Cover (LCC) %[1]	LCC Condition Scale[2]	Hard Coral Cover (HCC) %	HCC Condition Scale[3]	Coral Mortality Index (CMI)[4]	CMI Rating[5]
CORS 01	9.77	Poor	6.63	Poor	0.09	Low
CORS 04	1.00	Poor	1.00	Poor	0.00	Low
CORS 09	2.00	Poor	2.00	Poor	0.00	Low
CORS 10	40.00	Fair	38.00	Good	0.14	Low
CABS 06	26.33	Fair	19.33	Fair	0.00	Low
CABS 07	43.33	Fair	40.00	Good	0.11	Low

[171] As developed by Gomez, E.D., A.C.Alcala and A.C. San Diego. 1981. Status of Philippine coral reefs. Pp. 275–282 in Proceedings of the 4th International Coral Reef Symposium. LCC condition scale is as follows: Poor = 0–25%; Fair = >25–50%; Good = >50–75%; Excellent = >75%

[172] As developed by Licuanan, A.M., M.Z. Reyes, K.S. Luzon, M.A.A. Chan and W.Y. Licuanan. 2017. Initial findings of the national assessment of Philippine coral reefs. Philippine Journal of Science 146: 177-185. HCC condition scale is as follows: Poor = 0–22%; Fair = >22–33%; Good = >33–44%; Excellent = >44%

[173] As proposed by the authors of the DENR-ERDB study, based on the coral mortality index developed by Licuanan, A.M., M.Z. Reyes, K.S. Luzon, M.A.A. Chan and W.Y. Licuanan. 2017. Initial findings of the national assessment of Philippine coral reefs. Philippine Journal of Science 146: 177-185. Coral mortality index values are calculated as dead coral cover (DCC) divided by the sum of LCC and DCC, and are used to assess coral condition independent of substrate suitability.

Station	Live Coral Cover (LCC) %[1]	LCC Condition Scale[2]	Hard Coral Cover (HCC) %	HCC Condition Scale[3]	Coral Mortality Index (CMI)[4]	CMI Rating[5]
CABS 08	0.91	Poor	0.91	Poor	0.00	Low

Station key: CORS = Corregidor Island; CABS = Caballo Island

Notes:

[1] LCC is the sum of hard coral cover percentage and soft coral cover percentage

[2] LCC condition scale used is as follows: Poor = 0–25%; Fair = >25–50%; Good = >50–75%; Excellent = >75%

[3] HCC condition scale used is as follows: Poor = 0–22%; Fair = >22–33%; Good = >33–44%; Excellent = >44%

[4] Coral mortality index values are calculated as dead coral cover (DCC) divided by the sum of LCC and DCC, and are used to assess coral condition independent of substrate suitability.

[5] A 3-point rating scale (low-moderate-high) was based on the finding reported in national surveys that CMI was below 0.5 in 84% of sampled reefs, thus it is inferred that low would be approximately 0.2 or less, moderate 0.3–0.5, and high above 5.0.

Source: Adapted from DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.

With respect to the coral genera and coral forms that characterized the sampled reef areas, significant variability was reported across the seven stations. A total of 13 genera were identified, with site-level richness ranging from one genera to six (see Exhibit 6-100). The highest coral cover percentages were associated with *Porites*, which was also found at the most stations (5) of any genera. The most frequently recorded coral form was massive, of which exemplars were found at six of the seven stations. Branching forms were documented at four stations, and submassive forms at three. The study notes that species of *Porites* are known to be tolerant of relatively high turbidity and disturbed conditions due to effective shedding of sediments, fast tissue regeneration, and ability to metabolize organic nutrients from plankton and suspended particulates to compensate for lower photosynthesis associated with murky waters, and suggests that these factors explain the apparent preponderance of *Porites* in Manila Bay.

Exhibit 6-100 Coral Genera and Forms Recorded at BCIB-Proximate Stations (DENR-ERDB, 2019)

Coral genus/form	CORS 01	CORS 04	CORS 09	CORS 10	CABS 06	CABS 07	CABS 08
CORAL GENUS (% Cover)							
Acropora	-	-	-	-	3.00	-	-
Alveopora	-	-	-	-	-	1.67	1.00
Euphillia	-	-	-	-	-	3.33	-
Favites	-	-	-	1.00	-	-	-
Fungia	-	-	-	1.00	-	-	-
Goniopora	-	-	-	-	-	6.67	-
Leptoseris	-	-	-	-	-	1.67	-
Lobophyllia	-	-	-	-	-	5.00	-
Pachyseris	-	-	-	1.00	-	-	-
Platygyra	-	-	-	4.00	-	-	-

Coral genus/form	CORS 01	CORS 04	CORS 09	CORS 10	CABS 06	CABS 07	CABS 08
Pocillopora	-	1.00	-	-	-	-	-
Porites	6.28	-	1.00	2.00	7.00	18.33	-
Seriatopora	-	-	-	4.00	-	-	-
Total genera	1	1	1	6	2	6	1
CORAL FORM (% Cover)							
Acropora branching	-	-	-	6.00	6.33	3.33	-
Coral branching	-	1.00	-	4.00	-	-	-
Coral encrusting	0.34	-	-	1.00	-	-	-
Coral massive	6.28	-	2.00	25.00	13.00	33.33	0.91
Coral mushroom	-	-	-	1.00	-	-	-
Coral submassive	-	-	-	1.00	-	3.33	-

Source: Adapted from DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.

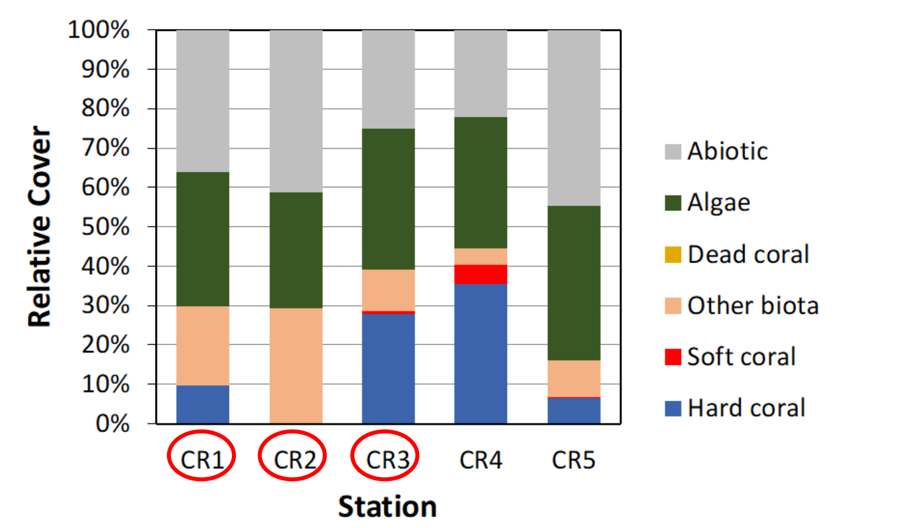
MBSDMP Rapid Resource Assessment (2019)

The rapid resource assessment (RRA) of coral resources in Manila Bay encompassed five sampling stations around the mouth of the bay, of which two were in Mariveles (off Barangays Alas Asin and Mt. View), one off the northwest tip of Corregidor island, and two within marine protected areas off the coast of Ternate. Three parallel transects 50 m long and 10 m apart were laid down at each station along a uniform depth contour, and a frame-mounted camera was used to obtain 51 photographs along each one. Images were analyzed using the CPCe 4.1 software. Ten randomly selected digital points were overlaid on each photo frame, and life forms intersecting with each point were identified. Corals were identified up to the genus level. Various statistical tools and methods were used to analyze differences and similarities across transects within stations, and across stations, and to characterize species dominance.

Of the five stations included in the RRA study, three (CR1, CR2, CR3) are relatively nearby the BCIB alignment, and are singled out for attention here. These stations are shown on the map in Exhibit 6-97. Benthic cover data as presented in the RRA report are shown in Exhibit 6-101. Live coral cover at CR1, off Alas Asin, was found to be relatively low, with a mean of 9.61%, and consisted entirely of hard corals; no soft corals were identified. Considerable growth of other sessile fauna was documented at this station, bringing the mean faunal coverage to about 30%. No corals (hard or soft) were recorded at the CR2 station; the RRA report characterizes the benthos in this area (off Mt. View) as an unusual stable assemblage dominated by corallimorpharians and macroalgae, singling it out for further study and protection. The findings from the CR3 station, on the western tip of Corregidor Island, indicate comparatively high mean hard coral cover, at 27.78%, which is above the estimated national average of 22.8% and the Indo-Pacific average (as of 2007) of 22.1%; a minor soft coral cover component was also recorded. The faunal component comprised nearly 40% at this station and macroalgae about 35%, leaving just 25% for bare substrate; this is the second-lowest abiotic proportion recorded across the stations of the RRA study, and is lower than what was found at any of the stations in the DENR-ERDB study discussed above. The

RRA study's authors highlight the relatively high topographic complexity of this station (and CR4), due to a preponderance of large boulders and colonization by hard corals.

It is noteworthy that dead coral was not found at all in any of the sampled stations in the RRA study; this may be taken as a measure of (at least short-term) stability, although it is possible that some of the macroalgal component of benthic cover is established on dead coral as opposed to rocky substrate. The absence of dead coral largely concurs with the findings from the BCIB-proximate stations surveyed in the DENR-ERDB study, where dead coral accounted for a very minor proportion of overall cover. This is also consistent with the BFAR assessment.



Source: Adapted from NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory (December 2020).

Note: BCIB-proximate station labels are circled in red

Exhibit 6-101 Relative Benthic Cover (MBSDMP RRA, 2020)

With regards to the makeup of the coral cover documented in the BCIB-proximate stations, the RRA study found significant differences between the CR1 and CR3 stations (no corals were documented at CR2). Data from CR1 show lower diversity, with just six genera represented, as compared to 14 genera at CR3 (see Exhibit 6-102). *Porites* was clearly dominant at CR1, accounting for 81.6% of the mean hard coral cover documented at this station. At the CR3 station, *Turbinaria* accounted for the greatest share of mean hard coral cover, with 12.61%, followed by *Porites* at 9.48%. The dominance of species from these two genera, which tend to be well adapted to turbid conditions and resilient in relatively disturbed contexts, is broadly consistent with the conclusions drawn by the DENR-ERDB study discussed above, although *Turbinaria* was not documented in that study.

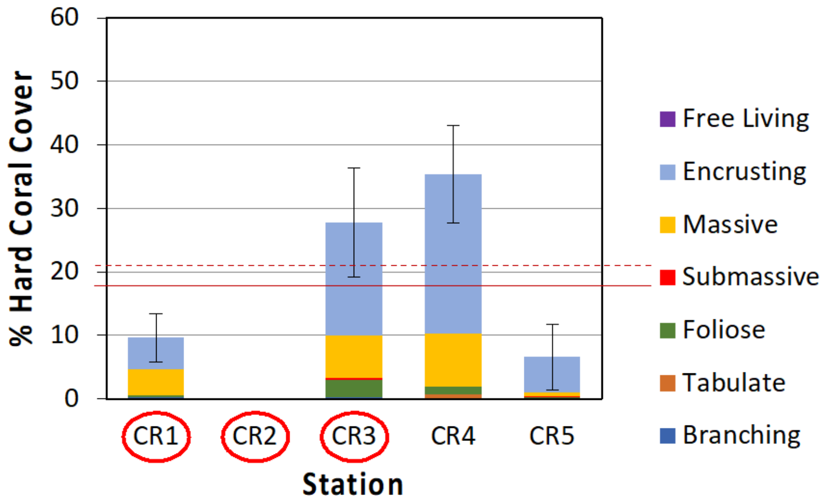
Exhibit 6-102 Hard Coral Genera Recorded at BCIB-Proximate Stations (MBSDMP RRA, 2020)

Coral genus	CR1 (% cover)	CR2 (% cover)	CR3 (% cover)
Favia	-	-	0.98
Favites	0.07	-	0.59
Galaxea	-	-	0.26

Coral genus	CR1 (% cover)	CR2 (% cover)	CR3 (% cover)
Goniastrea	0.13	-	0.46
Goniopora	0.98	-	0.13
Heliopora	-	-	0.65
Hydnophora	-	-	0.46
Isopora	-	-	0.13
Millepora	0.20	-	0.46
Montipora	-	-	0.26
Pavona	-	-	0.65
Porites	7.84	-	9.48
Symphyllia	-	-	0.13
Turbinaria	0.39	-	12.61
Mean hard coral cover	9.61	0.00	27.78
Total number of genera	6	0	14

Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory (December 2020).

Coral forms data reported by the MBSDMP RRA study show a predominance of encrusting hard corals, with massive forms accounting for a significant, though lesser, proportion of overall hard coral cover (see Exhibit 6-103). At the CR1 station, encrusting forms were found to be just slightly more abundant than massive forms, while encrusting forms were considerably more prevalent at CR3. Foliose forms make a small contribution to hard coral cover recorded at both stations, and a minor submassive component was documented at CR3. These findings are somewhat different from those reported by DENR-ERDB, which found only a minor presence of encrusting forms at two of seven stations, with massive forms strongly predominant and a significant presence of branching forms. There is little spatial overlap between the zones represented by the BCIB-proximate stations of the two studies; the DENR-ERDB stations do not represent the Mariveles nearshore at all, and the CORS10 (DENR-ERDB) and CR3 (MBSDMP RRA) stations, while both off Corregidor Island, are 1.2 km apart and have somewhat different exposure to waves and currents.



Source: Adapted from NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory (December 2020).
Note: BCIB-proximate station labels are circled in red.

Exhibit 6-103 Hard Coral Forms (MBSDMP RRA, 2020)

CFI Ecotourism Potential Survey (2020)

This dive survey commissioned by CFI was carried out by a private consultant in July 2020, and focused on dive sites with good access from the primary coastal tourist zones on Corregidor Island, which are located around the ferry terminal on the north side of the island and around South Beach, on San Jose Bay. The survey comprised dives at nine sites: three in the North Channel, six on the south side of Corregidor Island, and two on the north side of Caballo Island. The survey was oriented to assessing the presence of reef areas with coral and reef-associated mobile organisms that could be expected to generate interest from recreational divers, and did not include formal habitat sampling. Rather, the survey report details general conditions and the presence of charismatic fauna such as seahorses, reef fish, moray eels, and colorful nudibranchs. The report is of interest to the present baseline study primarily for its commentary on general underwater conditions in the study area, parts of which are nearby the BCIB alignment. Specifically, the report highlights the apparent influence of key stressors, noting the prevalence of dynamite fishing (as evidenced by damaged coral and an unexploded dynamite bottle found on the seafloor), active gear fishing (trawl tracks were found), and abundant plastic wastes in the water column and on the seafloor. Perhaps significantly, the report also indicates that areas of apparent juvenile coral growth were observed, which would seem to indicate conditions still suitable for coral recruitment and establishment of colonies. Photographs included in the survey report suggest the continued existence of rich marine life in at least some locations around Corregidor and Caballo Islands, in spite of the stressors noted (see Exhibit 6-104).

Exhibit 6-104 Benthic Life Off Corregidor and Caballo Islands (CFI Dive Site Assessment, 2020)

Ecosys Corp Coral and Reef Fish Survey (2021)

A survey of coral and reef fish assemblages in the BCIB project area was carried out by Ecosys Corp. in October 2021; a synopsis of methodology and key findings as related to benthic cover is presented here (findings pertaining to reef fish are discussed in Section 6.1.9.5). The study encompassed six sampling stations, three of which were located in the nearshore area of Mariveles in the general vicinity of the BCIB landing point, and three of which were situated around Corregidor Island (see map in Exhibit 6-97). A cursory camera drop survey was undertaken at three further potential sampling station locations in the vicinity of the BCIB landing point in Naic to verify the expectation, gathered from available coral distribution mapping, that this area would not have any coral reef resources on which to base a survey (this was confirmed, and these locations are not discussed any further here).

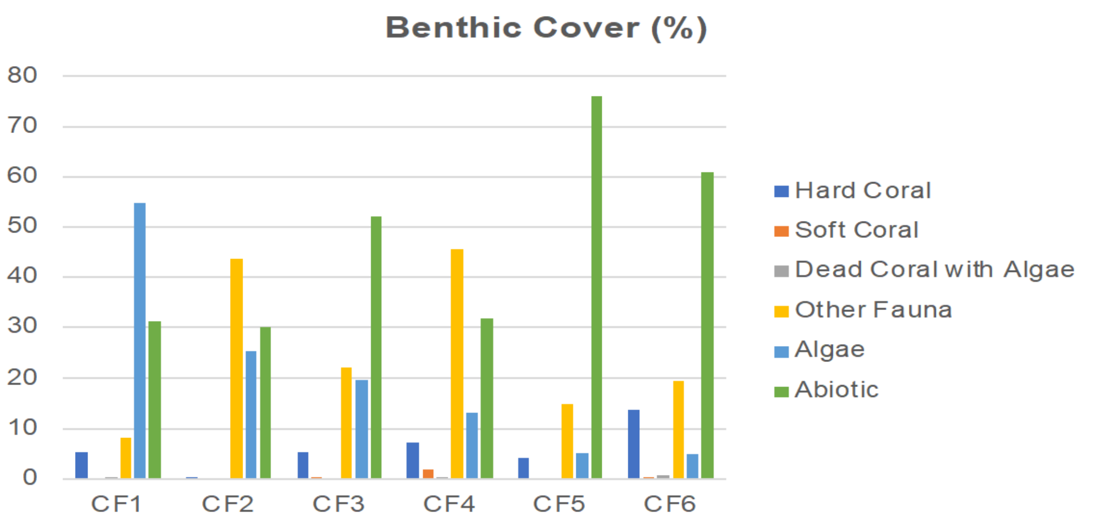
The methodology used in the Ecosys Corp. Survey was identical to that employed for the MBSDMP RRA, as regards the benthic cover aspect of the study. Three parallel 50-m transects were placed 10 m apart, following the depth contour, at each sampling station. Photographs were taken at 1-m intervals along each transect, and images were analysed using the CPCe 4.1 software. Ten randomly selected digital points were overlaid on each photo frame, and life forms intersecting with each point were identified. Corals were identified up to the genus level. Various statistical tools and methods were used to analyze differences and similarities across transects within stations, and across stations, and to characterize species dominance.

Findings with respect to benthic cover for the six stations surveyed in the Ecosys Corp. study are shown in Exhibit 6-105. Hard coral cover was found to account for a low proportion of overall cover, exceeding 10% at only one station (CF6); this puts all stations well below the national average of 22.8%, and earns the surveyed reef areas a 'poor' rating using the reef condition scale developed by Licuanan *et al*. and used by most coral studies in the Philippines.[174] The study report attributes the generally low coral cover—and correspondingly high coverage by other invertebrates and algae—to water quality factors, principally turbidity and sedimentation, but also the limiting effects of organic pollution on larval recruitment. Low abundance of herbivorous fish, due to overfishing, is also named as a probable factor favoring displacement of corals by algae.

Hard coral was found to be almost non-existent at the CF2 station, with 'Other fauna' being the dominant benthic cover alongside a substantial macroalgal component; this corroborates the findings reported in the MBSDMP RRA for the nearby CR2 station (about 540 m separates the two stations). Although less pronounced, this phenomenon can also be seen in the Ecosys Corp. data for the CF4 station, where 'Other fauna' was the dominant cover, far outstripping hard coral; interestingly, the MBSDMP RRA found significantly higher hard coral cover (~28%) and algal cover (~35%) at its very nearby CR3 station.

As displayed in Exhibit 6-105, the 'Abiotic' category accounts for a high proportion of benthic cover in most stations, most strikingly at CF3 (52%), CF5 (76%) and CF6 (61%); this is consistent with the findings of the DENR-ERDB study, particularly for the Corregidor Island stations CORS 01 (63%), CORS 04 (85%) and CORS 09 (68%). This concurrence strengthens the tentative hypothesis, proposed by the authors of the DENR-ERDB study, that suitability of the substrate or other environmental factors may be constraining colonization by not only hard corals, but also other benthic life forms.

[174] Licuanan, A.M., M.Z. Reyes, K.S. Luzon, M.A.A. Chan and W.Y. Licuanan. 2017. Initial findings of the national assessment of Philippine coral reefs. Philippine Journal of Science 146: 177-185. HCC condition scale is as follows: Poor = 0–22%; Fair = >22–33%; Good = >33–44%; Excellent = >44%.



Sampling Station	Hard Coral (%)	Soft Coral (%)	Dead Coral with Algae (%)	Other Fauna (%)	Algae (%)	Abiotic (%)
CF1	5.50 ± 0.23	-	0.46 ± 0.17	8.06 ± 3.84	54.74 ± 2.97	31.23 ± 5.10
CF2	0.33 ± 0.17	-	0.2 ± 0.2	43.86 ± 8.4	25.42 ± 3.08	30.2 ± 5.94
CF3	5.49 ± 2.70	0.52 ± 0.35	0.07 ± 0.07	22.16 ± 49.3	19.67 ± 2.94	52.09 ± 10.24
CF4	7.10	1.78 ± 0.52	0.53 ± 0.07	45.65 ± 2.57	13.07 ±1.7	31.87 ± 3.16
CF5	4.05	-	-	14.77 ± 0.68	5.23 ± 2.25	75.9 ± 1.89
CF6	13.59 ± 1.60	0.39 ± 0.3	0.72 ± 0.36	19.28 ± 4.92	4.97 ± 2.81	61.05 ± 4.76

Exhibit 6-105 Benthic Cover (Ecosys Corp. Study, 2021)

The composition of hard coral assemblages reported in the Ecosys Corp. study shows a familiar pattern relative to the previously discussed DENR-ERDB and MBSDMP studies, in that *Porites* species were found again to be clearly dominant. As can be readily seen in Exhibit 6-106 and Exhibit 6-107, *Porites* (encrusting and massive forms combined) accounted for a large proportion of hard coral cover, with all stations showing at least 50% coverage with species of this genus. Taxa richness was found to be variable across the six stations; just three genera were recorded at each of CF1 and CF2, while 19 genera were found at CF4. The high number of genera at CF4 is consistent with the findings from the very nearby CR3 station in the MBSDMP RRA, which had the highest number of genera (14) of the BCIB-proximate stations. In line with the previously discussed studies, the Ecosys Corp. study report ties the dominance of *Porites* to background environmental conditions, particularly high turbidity and sediment loading.

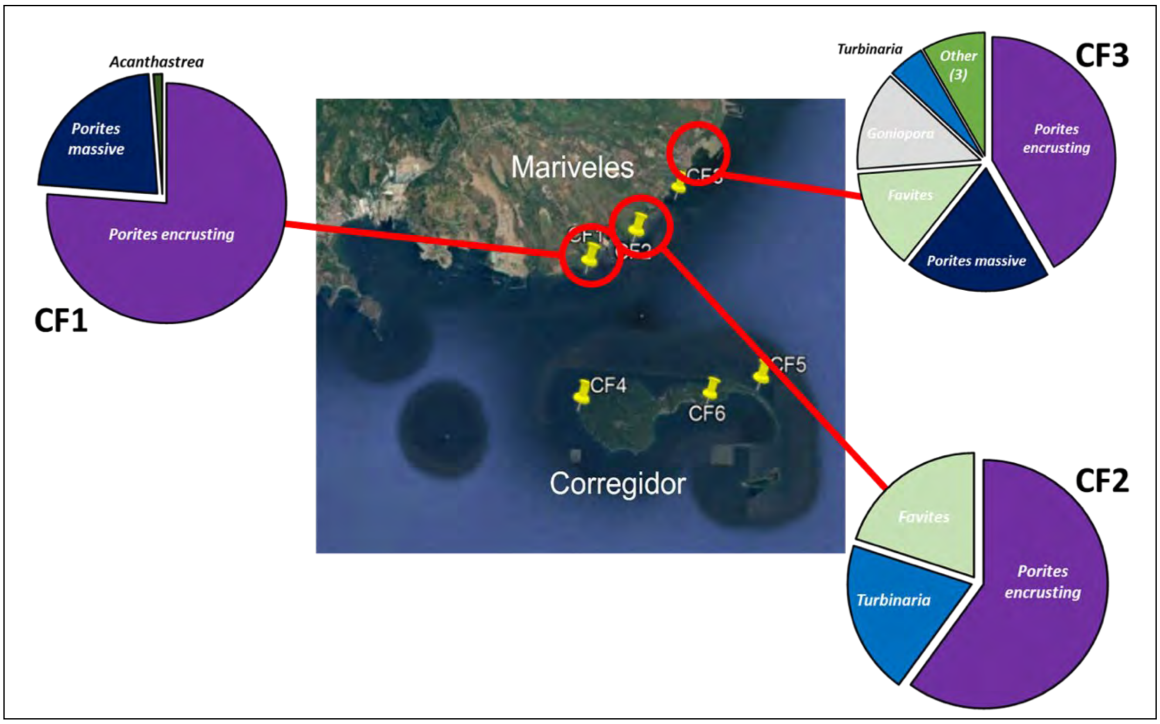


Exhibit 6-106 Hard Coral Genera at Mariveles Stations (Ecosys Corp. Study, 2021)

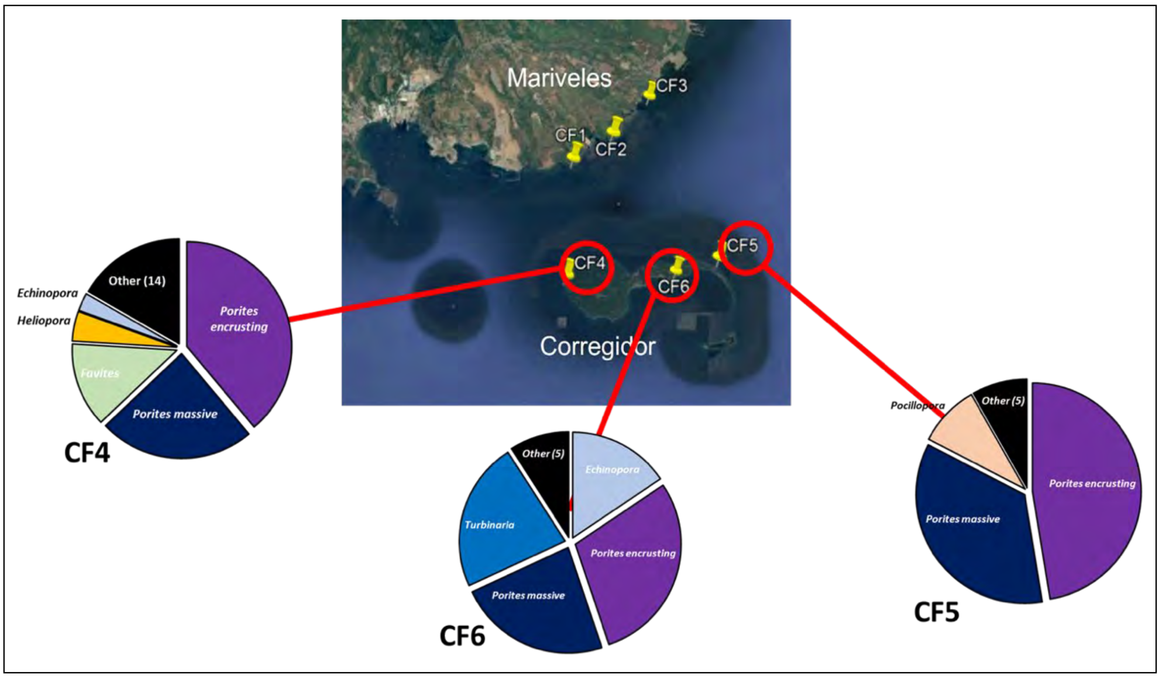


Exhibit 6-107 Hard Coral Genera at Corregidor Island Stations (Ecosys Corp. Study, 2021)

Synthesis

Taken together, the coral reef studies discussed constitute a fairly consistent portrait of coral reef habitat in the vicinity of the BCIB alignment. Although there is considerable variation in benthic cover and coral diversity observed across the 19 sampling stations subject to scientific assessment, the overall picture is of coral habitat of relatively low coral diversity and exhibiting a preponderance of benthic life other than coral, including other sessile, semi-sessile and mobile invertebrates, as well as macroalgae. A high incidence of uncolonized bare substrate is evident in many locations. Hard coral assemblages appear to be dominated by genera adapted to turbid and disturbed conditions, and benthic biota overall is fairly sparse, leaving sizable proportions of the substrate uncolonized. Nevertheless, the coral that exists in the study area, while of low diversity, does appear to thrive, as evidenced by the very low incidence of dead coral recorded in four of the five studies. Photographic evidence from the less formal CFI survey of potential dive sites around Corregidor and Caballo Islands indicates the existence of vibrant assemblages in at least some locations, in spite of ample evidence of anthropogenic stressors such as dynamite fishing, use of active trawl gear and both macro- and micro-plastics. The coral habitats present in the BCIB project area, in spite of less-than-ideal natural background conditions and multiple active human-induced threats, still manage to hang on, and represent a significant natural resource in the context of Manila Bay.

6.1.9.4 Seagrass and Seaweed

It is generally considered likely that seagrass meadows would have occupied significant portions of the seabed in the shallower fringes of Manila Bay at one time. These sensitive habitats support grazers such as dugongs and some marine turtles, and the modern absence of dugongs within the bay can likely be attributed principally to the loss of seagrass. Seagrass meadows also offer shelter to numerous invertebrates and fish, and are increasingly recognized as having major potential to capture and store carbon, thereby helping to mitigate climate change. Historical seagrass extent in Manila Bay is not well understood, but the prevailing scientific consensus is that this habitat type has experienced heavy losses due to increased sedimentation from land-based activity; elevated turbidity; coastal eutrophication; conversion for aquaculture, salt production and development; bottom trawling and dredging.[175] The state of knowledge regarding present seagrass distribution in Manila Bay is also very weak, as seagrass resources have not been subject to extensive study. Reporting from limited surveys conducted in the 1990s and early 2000s identified the presence of several seagrass species, but lacked locational specificity, and have been of limited utility with respect to reflecting on historical distribution or rates of seagrass loss.[176]

Seagrass generally requires clear water conditions to thrive, as turbidity constrains photosynthesis. Most seagrass species also require stable sandy or muddy bottom substrates, which allow effective root penetration, and are generally not found in areas with a preponderance of very coarse sand, pebble, gravel, rubble or rock.[177] It is likely that some areas near the mouth of Manila Bay have sufficient water clarity to sustain seagrass, but there are relatively few locations near the mouth of the bay that also have favorable sandy or muddy substrate at shallow depths, so distribution would be expected to be quite narrow. The map in Exhibit 6-108 shows the entire predicted extent of seagrass in Manila Bay, as calculated by the Allen Coral Atlas using machine learning applied to high-resolution PlanetScope (Dove) satellite imagery.[178] The distribution suggests a low probability of significant seagrass beds being found in the BCIB project area.

[175] NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situation Analysis. Focal Theme Report, Environmental Protection. December 2018.
[176] DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.
[177] Ibid.
[178] See Allen Coral Atlas. 2022. Science and Methods. https://allencoralatlas.org/methods/. Accessed 20 May 2022.

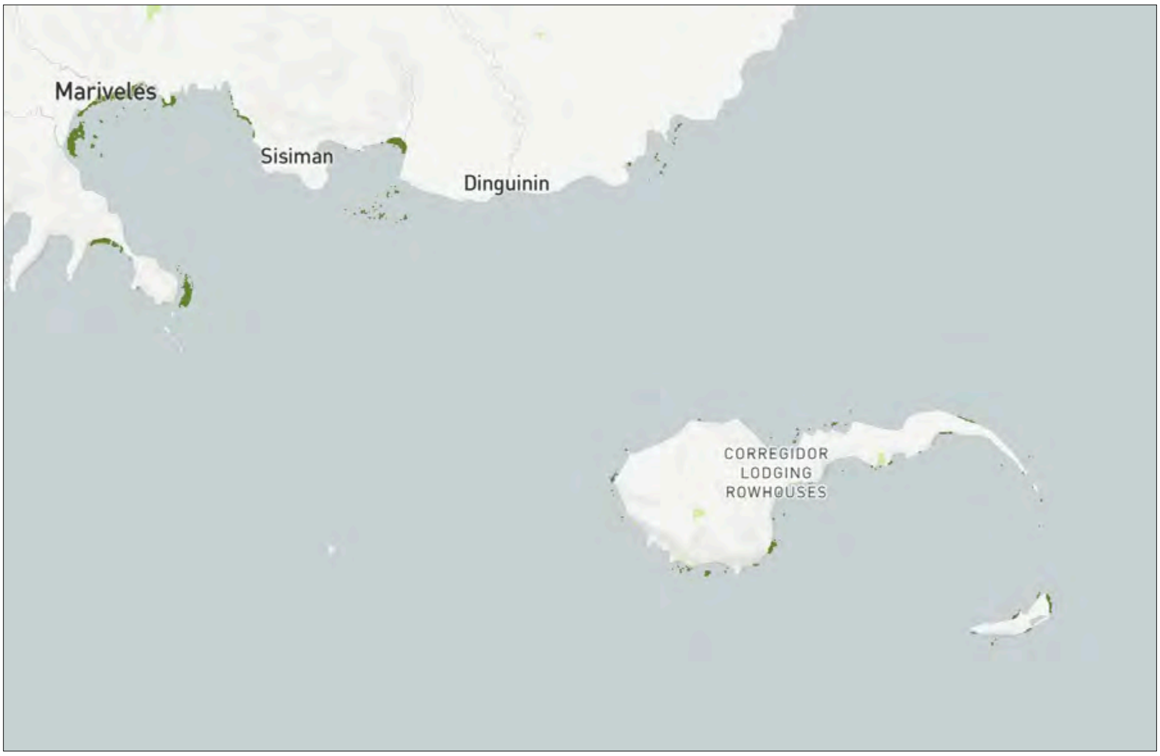


Image credit: Allen Coral Atlas

Exhibit 6-108 Predicted Seagrass Extent in Manila Bay

NAMRIA has also generated mapping pertaining to seagrass, as presented in its Coastal Resources Map – Luzon (2016, updated 2021), based on interpretation of Landsat 8 imagery coupled with limited field verification.[179] Seagrass and seaweed are combined in a single category in the NAMRIA mapping, so it is difficult to infer distribution of seagrass alone, but the limited distribution of even the combined category (see Exhibit 6-109) is not indicative of a strong probability of seagrass in the BCIB project area.

Seaweeds, or macroalgae, provide numerous important functions in the marine environment, including providing food for grazers, epiphytes and detritus feeders; shelter for both juveniles and adults of small fish and invertebrate species; and protected nurseries for the earliest stages of life of numerous types of organisms. Seaweeds also generate and release oxygen as a by-product of their photosynthetic process, and are thought to play a possibly significant role in carbon sequestration.[180]

As with seagrass, seaweeds in Manila Bay have been the subject of very little research. A field study carried out in the mid-1990s found that seaweeds in Mariveles and Corregidor Island exhibited low mean abundance, but high mean diversity, but gave little information useful in determining distribution.[181] Seaweeds around the mouth of the bay were subject to cursory survey by DENR-ERDB in 2018-2019 as part of its vulnerability assessment;

[179] See NAMRIA. 2016. Coastal Resources Map 2016 – Luzon (metadata). https://geoportal.gov.ph. Accessed 18 May 2022.
[180] PEMSEA and MBEMP TWG-RRA. 2004. Manila Bay: Refined Risk Assessment. PEMSEA Technical Report No. 9.
[181] Ibid.

modest colonies of *Sargassum spp.* were noted in the nearshore of Mariveles, but detailed sampling and analysis were not conducted, and specific locations were not indicated.[182]

Seaweeds are vulnerable to elevated turbidity, which limits photosynthesis, as well as sedimentation, use of active fishing gear such as bottom-trawls, and contaminants from urban and agricultural runoff and industrial discharges, such as heavy metals, oil and grease, and pesticides.[183] Although historical trends of seaweed cover in Manila Bay are completely unknown due to the lack of research attention, it can be considered likely that seaweed has suffered some measure of decline, and remains under threat, given the continuing presence of such deleterious factors.

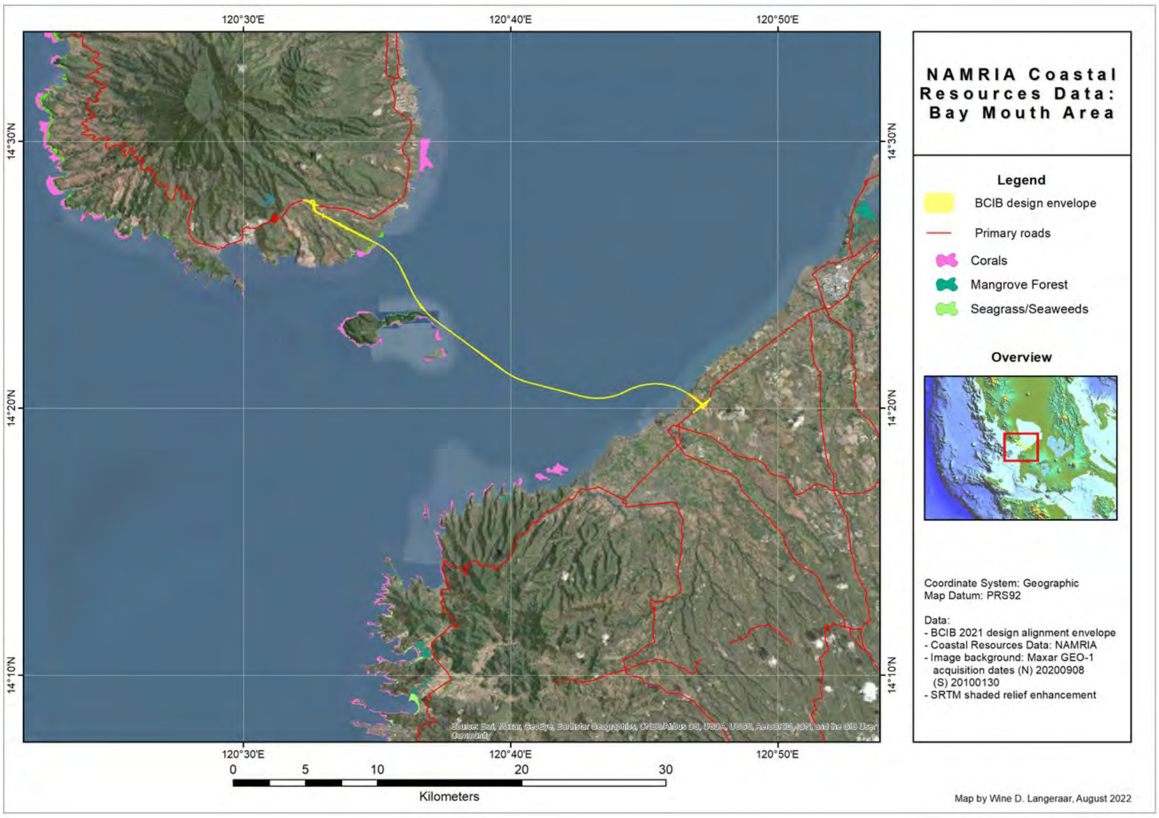


Exhibit 6-109 Coastal Resources Including Seagrass/Seaweed (NAMRIA 2021)

A field survey of seagrass and seaweed resources was conducted in the BCIB project area in October 2021 by Ecosys Corp., to characterize local seagrass and seaweed resources and provide a basis for scoping the potential for the project to generate impacts on them; the findings of the survey are summarized below. Five sampling areas were selected, based on the expected positioning of the BCIB infrastructure: one on each side of the Mariveles landing point, one where the alignment will pass close to Corregidor Island, and one on each side of the Naic landing point.

The sampling methodology employed by Ecosys Corp. followed that specified in BMB Technical Bulletin 2017-05 – Technical Guide on the Assessment of Coastal and Marine

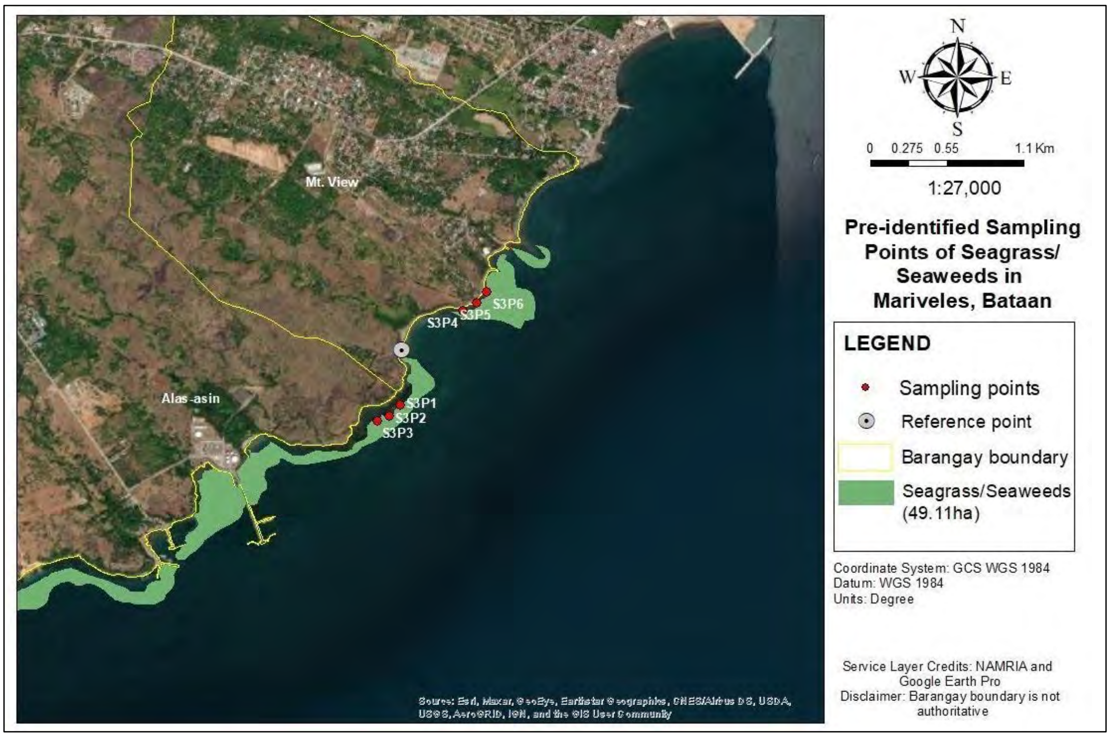
[182] See DENR-ERDB. 2019. Manila Bay Vulnerability Assessment: Application of GIS and Remote Sensing Technologies, and Information Convergence. Technical Report, Department of Environment and Natural Resources-Ecosystems Research and Development Bureau. College, Laguna, Philippines.
[183] PEMSEA and MBEMP TWG-RRA. 2004. Manila Bay: Refined Risk Assessment. PEMSEA Technical Report No. 9.

Ecosystems. At each sampling area, a 50-m transect was laid down perpendicular to the shore, with two replicate transects of the same length placed on either side at a distance of 50–100 m. Transect length was adjusted as necessary to account for the shapes of seaweed patches. Along each transect, a 0.5 m x 0.5 m PVC quadrat frame with internal string divisions making 25 sub-frames to assist with percent-cover estimations was placed on the bottom at 5 m intervals, starting at the 0 m mark. Each quadrat was photographed. All species within each quadrat were identified to species level. Percent cover was also estimated following the percent cover estimation standard for seagrass, as specified in BMB Technical Bulletin 2017-05. Sediment composition within each quadrat was categorized as mud, fine sand, sand, coarse sand, or gravel.

The sampling locations off Mariveles and Corregidor Island were situated within areas shown as 'seagrass/seaweeds' on the NAMRIA Coastal Resource Map 2016 – Luzon. The map shows no such habitat near the Naic shore, so it was not expected that much seagrass or seaweed would be found there, but sampling was conducted in the areas nearby the BCIB landing point regardless, to verify the mapping and confirm the expected absence of risk from the project to seagrass or seaweed resources in the Cavite coastal zone.

Mariveles

The locations of the two sampling locations in the nearshore waters of Mariveles are shown in Exhibit 6-110. The areas on the map indicated as 'Seagrass/Seaweeds' are as shown on NAMRIA's Coastal Resource Map 2016 – Luzon.



Source: Ecosys Corp.

Exhibit 6-110 Seagrass/Seaweed Sampling Stations, Mariveles

No seagrass was detected at either of the two sampling stations off the Mariveles shore, within the sampled quadrats or anywhere else along the transects or in the general vicinity. The substrate in this location was rocky and sloped, and generally unsuitable for seagrass establishment.

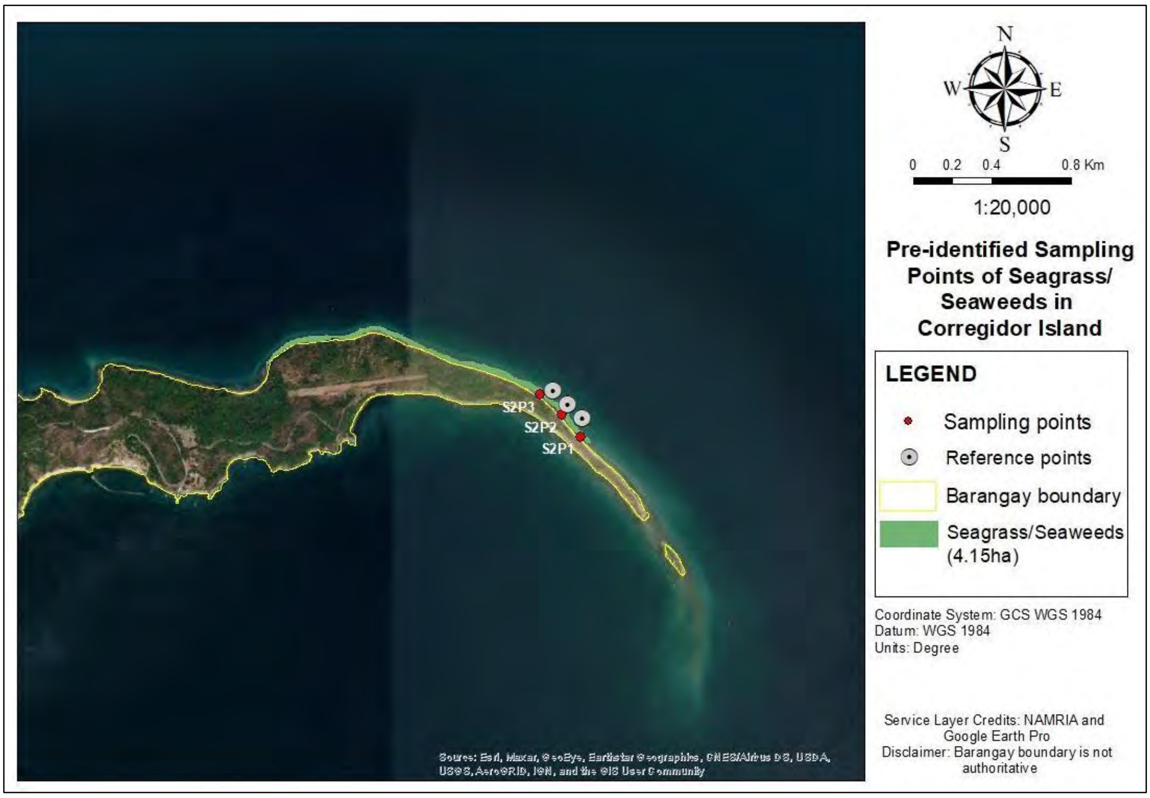
Seaweed was present in abundance, with 35% cover across the two stations (see Exhibit 6-111). The macroalgal community recorded at the two sampling stations was found to be composed of five species belonging to three major divisions: Rhodophyta (red algae), Chlorophyta (green algae) and Phaeophyta (brown algae). Three species were observed at the Alas Asin station (southwest of the BCIB landing point), while four were recorded at the Mt. View station (northeast of the alignment). The most abundant species at both stations was *Valoniopsis* sp., a filamentous green algae found attached to intertidal rocks, dead coral and other hard substrate, which occupied in excess of 20% the benthic surface on average at both sampling stations. *Sargassum* sp. was a codominant species at the Alas Asin station, accounting for 12.00% of cover. *Galaxaura* sp. was codominant at the Mt. View station, at 7.27%. In addition to the five species documented in the sample quadrats, growths of *Caulerpa* sp. (phylum Chlorophyta) and *Padina* sp. (Phaeophyta) were noted in nearby areas. Photographs of the seaweed species documented are shown in Exhibit 6-114.

Exhibit 6-111 Seaweed Cover by Species, Mariveles

Division/Phylum	Family	Species	% Cover	
			Station 3	Station 4
Chlorophyta	Valoniaceae	*Valoniopsis* sp.	20.13	22.67
Chlorophyta	Halimedaceae	*Halimeda* sp.	2.87	0.33
Chlorophyta	Boodleaceae	*Cladophoropsis* sp.	-	5.00
Phaeophyta	Sargassaceae	*Sargassum* sp.	12.00	-
Rhodophyta	Galaxauraceae	*Galaxaura* sp.	-	7.27
Totals		5	35.00	35.27

Corregidor Island

The location of the seagrass/seaweed sampling station off Corregidor Island is shown in Exhibit 6-112. The areas on the map indicated as 'Seagrass/Seaweeds' are as shown on NAMRIA's Coastal Resource Map 2016 – Luzon.



Source: Ecosys Corp.

Exhibit 6-112 Seagrass Seaweed Sampling Station off Corregidor Island

No seagrass was detected at the Corregidor Island sampling station, either within the sample quadrats or anywhere else along the transects or in the general vicinity. The foreshore seabed along the east coast of the Tail End part of the island is dominated by boulders, has a substantial slope, and is exposed to strong wave action, especially during the northeast monsoon; these physical conditions can be considered to offer very unsuitable seagrass habitat.

Seaweed cover was found to be considerably lower at the Corregidor Island sampling station than at the two stations across the North Channel in Mariveles. Total seaweed cover was just 9.40%, as compared to 35.00% and 35.27% at the Alas Asin and Mt. View stations. The Ecosys Corp. report suggests that the lower seaweed cover at Corregidor Island is likely due to at least two factors, these being exposure to extreme warming of the shallows and intertidal zone during hot sunny weather, and exposure to strong wave action for part of every year, both of which can be considered to make it more difficult for at least some seaweed species to thrive.

The seaweed community observed at the Corregidor Island station comprised five species belonging to three major divisions: Rhodophyta (red algae), Chlorophyta (green algae), and Phaeophyta (brown algae). *Valoniopsis* sp. accounted for the highest proportion of cover at 5.33%, followed by *Galaxaura* sp. and *Gracilaria* sp. (see Exhibit 6-113). Photographs of the seaweed species documented are shown in Exhibit 6-114.

Exhibit 6-113 Seaweed Cover by Species, Corregidor Island

Division/Phylum	Family	Species	% Cover
Chlorophyta	Valoniaceae	*Valoniopsis* sp.	5.33

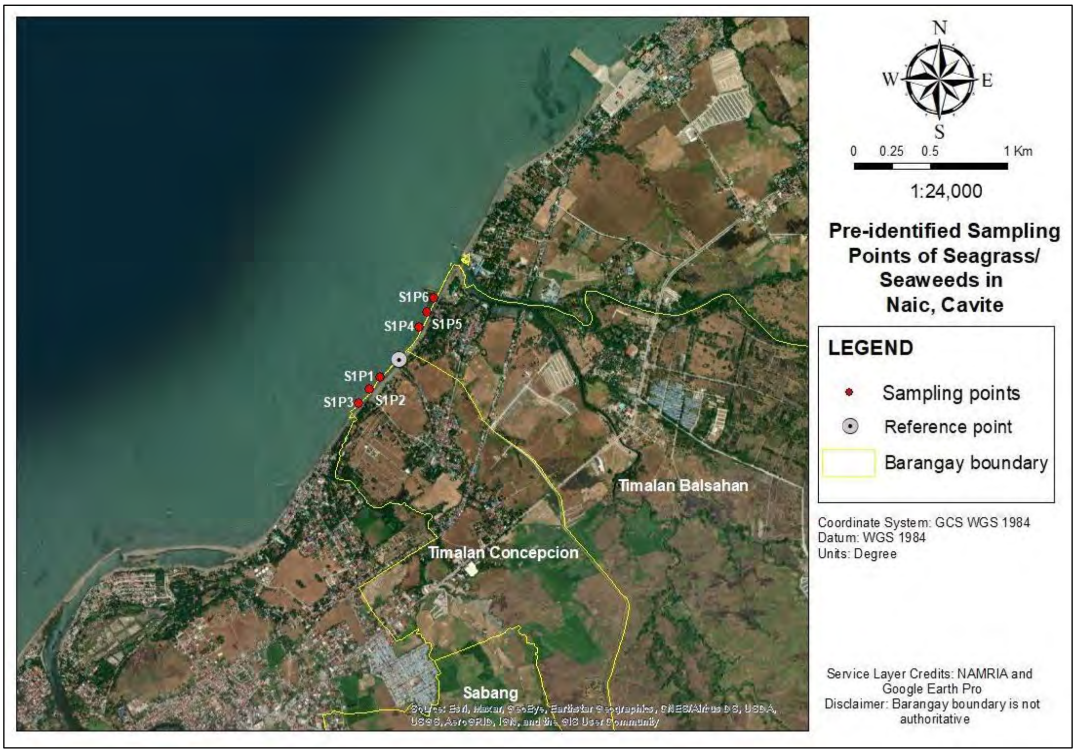
Division/Phylum	Family	Species	% Cover
Phaeophyta	Dictyotaceae	*Dictyota* sp.	0.20
Phaeophyta	Sargassaceae	*Sargassum* sp.	0.07
Rhodophyta	Galaxauraceae	*Galaxaura* sp.	3.67
Rhodophyta		*Gracilaria* sp.	0.13
Totals		5	9.40

Key: (A) *Sargassum* sp.; (B) *Valoniopsis* sp.; (C) *Halimeda* sp.; (D) *Gracilaria* sp.; (E) *Caulerpa* sp.; (F) *Padina* sp.

Exhibit 6-114 Seaweed Species Recorded at Mariveles and Corregidor Island Stations

Naic

The two sampling stations selected near the BCIB landing point on the Naic shore are shown in Exhibit 6-115. Conditions at the two sampling stations in the Naic nearshore confirmed the expectation, based on the NAMRIA mapping, that neither seagrass nor seaweed would be prevalent. The water at both stations was found to be extremely turbid, to the point where low visibility made even a cursory visual survey of the seabed difficult. No seagrass or seaweed was encountered. Although the seafloor in this area could probably be considered quite suitable for seagrass growth, due to fairly gentle slope and preponderance of fine sand and mud, such turbid conditions (which are reported to be normal in this area) can be considered strongly prohibitive of photosynthesis by any organism not floating at or near the surface, including both seagrass and seaweed. Seaweeds would face the additional challenge of having virtually no hard substrate upon which to anchor.



Source: Ecosys Corp.

Exhibit 6-115 Seagrass/Seaweed Sampling Stations, Naic

Since a dive survey was not possible at Naic, a survey of people present on the beach was conducted. A total of 15 people (mostly fisherfolk, 12 male and 3 female) were asked to share their experiential knowledge of seagrass or seaweed in the area, as evidenced during fishing or from detritus washing up on the beach. Participants universally indicated that neither seagrass nor seaweed is present in the area. Some indicated that a kind of seaweed known locally as *gulaman* sometimes washes up on the beach, particularly during the northeast monsoon, but suggested that it comes from other parts of the bay, rather than being something that grows in the local waters. Some debris of water hyacinth was found on the beach at the time of the interviews.

6.1.9.5 Fish

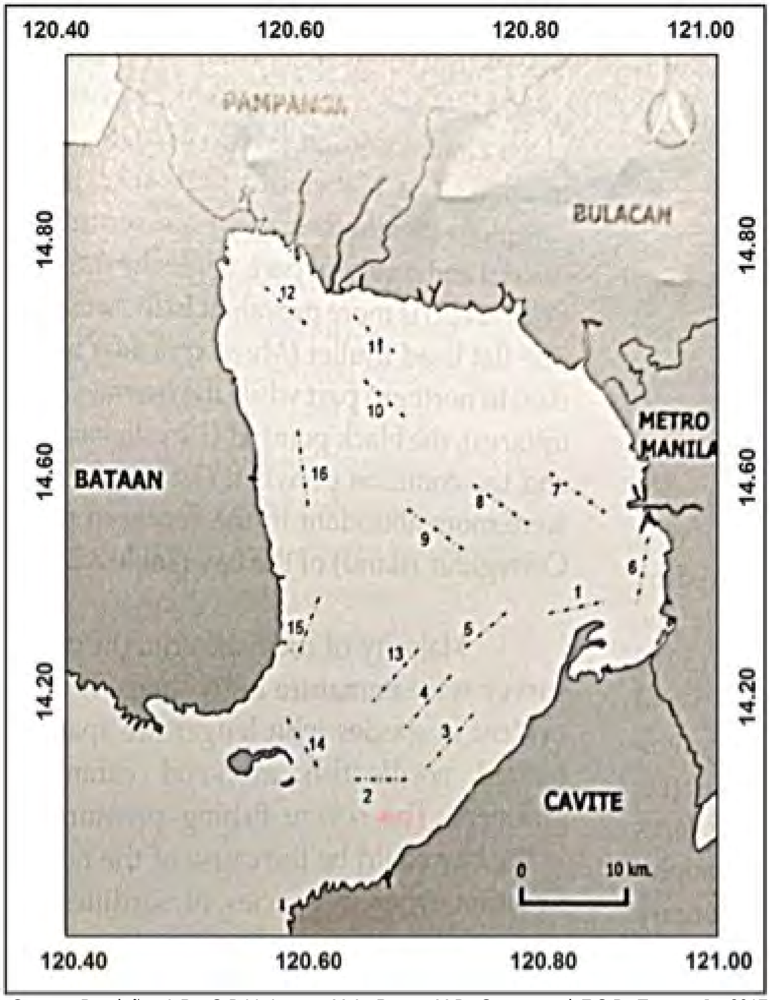
Historically, Manila Bay has supported rich fisheries resources, and still serves as the basis of livelihood for many thousands of fisherfolk spread across the dozens of fishing communities located around the perimeter of the bay. Due to multiple environmental stressors and economic pressures, fish populations and catches have been in decline for several decades, and absent significant change, the future does not look promising. Overfishing, persistence of destructive (and illegal) fishing practices such as bottom trawling and dynamite fishing, water pollution from urban, agricultural and aquacultural sources, dredging, land reclamation and sedimentation all continue to take a toll on fish and fish habitat.[184] On the other hand, marine protected areas are being actively developed by

[184] National Economic Development Authority. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

coastal municipalities, helped in no small part by a comprehensive initiative under the auspices of the Manila Bay Sustainable Development Master Plan to increase the number of marine protected areas, expand the overall area under this form of protection, and improve the management of existing marine protected areas.[185] Three general classes of fish, which overlap to a certain extent, are considered in the following discussion of fisheries resources in Manila Bay: demersal fish (mostly bottom-dwelling), pelagic fish (those that roam deep open water) and reef-associated fish.

Demersal and Pelagic Fish in Manila Bay

A series of trawl surveys conducted by researchers at the NFRDI from March 2014 to October 2015 in 16 locations around Manila Bay documented 146 marine fish and invertebrate species from 18 families at non-negligible levels of abundance; Exhibit 6-116 shows the survey locations, while the names and abundance of species documented are presented in Exhibit 6-116.[186]



Source: Bendaño, A.P., G.D.V. Lopez, M.A. Perez, M.D. Santos and F.S.B. Torres, Jr. 2017. Species Composition , Distribution, Biomass Trends and Exploitation of Dominant Fish Species in Manila Bay Using Experimental Trawl Survey. The Philippine Journal of Fisheries 24(1): 31–46.

[185] National Economic Development Authority. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan + Investment Report. Annex 6: PAPs Profiles. December 2020.
[186] Bendaño, A.P., G.D.V. Lopez, M.A. Perez, M.D. Santos and F.S.B. Torres, Jr. 2017. Species Composition , Distribution, Biomass Trends and Exploitation of Dominant Fish Species in Manila Bay Using Experimental Trawl Survey. The Philippine Journal of Fisheries 24(1): 31–46.

Exhibit 6-116 Sampling Locations for 2014–2015 Trawl Survey (Bendaño et al 2017)

The highest species diversity was recorded in the trawling areas nearest Cavite, with 100 species, followed by stations in the Pampanga-Bulacan area with 93 species, and stations near Metro Manila with 80 species represented. A total of 55 species were found during the surveys at the transects near Bataan, while 42 species were recorded from the transect off the east coast of Corregidor Island.

Exhibit 6-117 Marine Species Documented in 2014–2015 Trawl Surveys (Bendaño et al 2017)

Species	Common name	Abundance by trawl sector[a,b]					IUCN status[c]	Habitat and habit notes[d]
		1	2	3	4	5		
MOST FREQUENT DEMERSAL SPECIES								
Arius maculatus	Spotted catfish	-	†	†	†	-	not evaluated	M F B D Potamodromous 50–100 m
Eleuteronema tetradactylum	Fourfinger threadfin	†	†	†	†	-	not evaluated	M F B P-N Amphidromous 1–23 m
Elops hawaiensis	Hawaiian ladyfish	†	†	†	†	-	DD	M F B P-N Anadromous 1–30 m
Gazza minuta	Toothpony	-	†	†	†	†	LC	M B D 10–110 m
Gerres filamentosus	Whipfin silver-biddy	†	†	†	†	-	LC	M F B D Amphidromous 1–50 m
Johnius belangerii	Belanger's croaker	†	†	†	†	-	LC	M B D Amphidromous ?–40 m
Lagocephalus lagocephalus	Oceanic puffer	†	†	††	†	†	LC	M B-P Oceanodromous 10-476 m
Leiognathus bindus	Orangefin ponyfish	†	†	†	†	††	not evaluated	M B D Amphidromous 2–160 m
Leiognathus elongatus	Elongate ponyfish	-	-	†	†	††	not evaluated	M D Depth range unknown
Leiognathus equulus	Common ponyfish	†	†	†	†	††	LC	M F B D Amphidromous 10–100 m
Leiognathus splendens	Splendid ponyfish	†	†	†	†	-	LC	M B D Amphidromous 10–100 m
Mene maculata	Moonfish	†	†	†	†	†	not evaluated	M B R-A 50–200 m
Mugil cephalus	Flathead grey mullet	-	†	†	†	-	LC	M F B Catadromous 0–120 m
Nematalosa nasus	Bloch's gizzard shad	-	†	†	†	-	LC	M F B P-N Anadromous 0–30 m
Parastromateus niger	Black pomfret	†	†	†	†	††	LC	M B R-A Amphidromous 15–105 m
Rhabdamia cypselurus	Swallowtail cardinalfish	-	-	†††	-	-	not evaluated	M R-A 2–15 m

Species	Common name	Abundance by trawl sector[a,b]					IUCN status[c]	Habitat and habit notes[d]
		1	2	3	4	5		
Sarotherodon melanotheron	Blackchin tilapia	-	†	†	-	-	LC	M F B D 0–3 m
Scatophagus argus	Spotted scat	†	†	†	†	-	LC	M F B R-A Amphidromous 0–5 m
Sphyraena obtusata	Obtuse barracuda	†	†	†	†	-	not evaluated	M B R-A 5–200 m
Sphyraena putnamae	Sawtooth barracuda	†	†	†	†	†	not evaluated	M R-A 3–20 m
Terapon jarbua	Jarbua terapon	-	†	†	†	†	LC	M F B D Catadromous 20–350 m
Valamugil buchanani	Bluetail mullet	-	-	†	†	-	LC	M F B P-N Catadromous 0–10 m
Valamugil seheli	Bluespot mullet	†	††	††	†	†	not evaluated	M F B R-A Catadromous 0–3 m
MOST FREQUENT PELAGIC SPECIES								
Alepes djedaba	Shrimp scad	†	†	†	†	-	LC	M R-A Amphidromous Depth range unknown
Atule mate	Yellowtail scad	†	†	†	†	†	LC	M B R-A 1–80 m
Caranx ignobilis	Giant trevally	†	†	†	†	†	LC	M B R-A 10–188 m
Chanos chanos	Milkfish	-	†	-	†	-	LC	M F B B-P Amphidromous 1–30 m
Decapterus macrosoma	Shortfin scad	††	-	†	-	-	LC	M R-A 20–214 m
Dussumieria acuta	Rainbow sardine	†	-	†	†	†	LC	M F B P-N 10–20 m
Encrasicholina devisi	Devis' anchovy	†	†	††	†††	††††	not evaluated	M B R-A 1–13 m
Megalops cyprinoides	Indo-Pacific tarpon	†	†	†	†	†	DD	M B B-P Amphidromous 50–? m
Rastrelliger brachysoma	Short mackerel	†	†	†	†	†	DD	M B P-N Oceanodromous 13–200 m
Rastrelliger kanagurta	Indian mackerel	†	†	†	†	†	DD	M P-N Oceanodromous 20–90 m
Sardinella fimbriata	Fringescale sardinella	††	††††	††	††	†	LC	M B P-N 0–50 m
Sardinella gibbosa	Goldstripe sardinella	††	†	††	††	†	LC	M P-N 10–70 m
Sardinella lemuru	Bali sardinella	†	†	†	†	-	NT	M P-N Oceanodromous 15–100 m
Scomberoides lysan	Doubespotted queenfish	-	†	†	†	-	LC	M B R-A 0–100 m
Scomberoides tala	Barred queenfish	†	†	†	†	†	LC	M R-A 10–13 m

Species	Common name	Abundance by trawl sector[a,b]					IUCN status[c]	Habitat and habit notes[d]
		1	2	3	4	5		
Scomberomorous commerson	Narrow-barred Spanish mackerel	†	†	†	†	†	NT	M P-N Oceanodromous 10–70 m
Scomberomorous guttatus	Indo-Pacific king mackerel	-	†	†	†	†	DD	M B P-N Oceanodromous 15–200 m
Selaroides leptolepis	Yellowstripe scad	†	†	†	†	†	LC	M B R-A Amphidromous 1–50 m
Stolephorus commersonnii	Commerson's anchovy	†	††	†	†	†	LC	M B P-N Anadromous 0–50 m
Stolephorus indicus	Indian anchovy	-	†	-	-	-	LC	M B P-N Oceanodromous 20–50 m
Trichiurus lepturus	Largehead hairtail	††	†	†	††	††	LC	M B B-P Amphidromous 0–589 m
Tylosurus crucodilus	Hound needlefish			[e]			LC	M R-A Oceanodromous 0–13 m
MOST FREQUENT INVERTEBRATE SPECIES/TAXA								
Acetes spp.	Sergestid shrimps	†	†	†	†	-		M B
Photololigo chinensis	Mitre squid	†	†	†	†	-	DD	M D 50–170 m
Photololigo duvauceli	Indian squid	†	†	†	†	†	DD	M D 3–170 m
Photololigo edulis	Swordtip squid	†	†	†	†	†	DD	M D Oceanodromous 30–170 m
Portunus armatus	Blue swimming crab	-	†	†	†	†	not evaluated	M B D R-A 0–65 m
Squilla spp.	Mantis shrimps	†	†	†	†	-		M D Shallow water

Notes:
[a] Trawl sectors in Manila Bay survey: 1=Bataan; 2=Bulacan-Pampanga; 3-Metro Manila; 4=Cavite; 5=Corregidor Island
[b] Abundance key: - = not found; †=less than 5% of hauls; ††=5–20%; †††=20–30%; ††††=greater than 30%
[c] Conservation status checked against www.fishbase.se database and confirmed against www.redlist.org as needed.
CR=critically endangered; EN=endangered; VU=vulnerable; NT=near threatened; LC=least concern; DD=data deficient
[d] Notes based on species profiles in www.fishbase.se and www.sealife.ca databases. M=marine; B=Brackish; F=freshwater; D=demersal; R-A=reef-associated
[e] Abundance of *Tylosurus crucodilus* was omitted from the main haul composition breakdown table in the source study, but this species identified as the 12th most abundant by biomass in another table, accounting for 1.67% of total hauls.

Source: Adapted and expanded from Bendaño, A.P., G.D.V. Lopez, M.A. Perez, M.D. Santos and F.S.B. Torres, Jr. 2017. Species Composition, Distribution, Biomass Trends and Exploitation of Dominant Fish Species in Manila Bay Using Experimental Trawl Survey. The Philippine Journal of Fisheries 24(1): 31–46.

Exhibit 6-118 presents the 20 most abundant species documented in the trawl survey, ranked in order of biomass and proportion of the total catch. The most abundant fish were small pelagic species, mostly planktivorous and of low trophic level. All of the top five species by abundance are small species with maximum length under 30 cm; together, these five species accounted for 55% of the catch. The majority of specimens netted in the trawl survey were immature, particularly for longer-lived species. Many sexually mature individuals caught were significantly smaller than expected for their species; this finding was suggested by the study's authors as probable evidence of long-term overfishing.[187]

Exhibit 6-118 Top 20 Species Documented in 2014–2015 Trawl Survey in Manila Bay

Rank	Species	Common Name	Biomass (kg/km^2)	Relative Abundance in Catch (%)
1	*Encrasicholina devisi*	Devis' anchovy	59.85	15.23
2	*Sardinella gibbosa*	Goldstripe sardinella	51.16	13.02
3	*Sardinella fimbriata*	Fringescale sardinella	40.25	10.25
4	*Rhabdamia cypselurus*	Swallowtail cardinalfish	39.63	10.09
5	*Sardinella lemuru*	Bali sardinella	25.69	6.54
6	*Photololigo edulis*	Swordtip squid	23.70	6.03
7	*Johnius belangerii*	Belanger's croaker	19.77	5.03
8	*Lagocephalus lagocephalus*	Oceanic puffer	16.24	4.13
9	*Mugil cephalus*	Flathead grey mullet	15.98	4.07
10	*Valamugil seheli*	Bluespot mullet	11.53	2.93
11	*Stolephorus commersonnii*	Commerson's anchovy	6.78	1.73
12	*Tylosurus crucodilus*	Hound needlefish	6.55	1.67
13	*Trichiurus lepturus*	Largehead hairtail	6.34	1.61
14	*Arius maculatus*	Spotted catfish	5.86	1.49
15	*Eleuteronema tetradactylum*	Fourfinger threadfin	5.42	1.38
16	*Leiognathus equulus*	Common ponyfish	4.83	1.23
17	*Megalops cyprinoides*	Indo-Pacific tarpon	3.63	0.92
18	*Mene maculata*	Moonfish	3.53	0.90
19	*Parastromateus niger*	Black pomfret	3.38	0.86
20	*Stolephorus indicus*	Indian anchovy	3.31	0.84
Top 20 species			353.43	89.95
All other species (126)			39.43	10.04

Source: Bendaño, A.P., G.D.V. Lopez, M.A. Perez, M.D. Santos and F.S.B. Torres, Jr. 2017. Species Composition, Distribution, Biomass Trends and Exploitation of Dominant Fish Species in Manila Bay Using Experimental Trawl Survey. The Philippine Journal of Fisheries 24(1): 31–46.

The findings of the 2014–2015 trawl survey were compared by the study's authors to results from seven previous trawl surveys conducted in Manila Bay since 1947. Longitudinal analysis indicates substantial variability in the distribution of both fish species and fish biomass, even across short time frames (differences were noted between the trawl survey results from the 2014 and 2015 trawls, for example). The most striking long-term trend drawn out by the comparison across multiple studies is a large decline in stock density; overall fish biomass is estimated to have dropped by approximately 90% between 1947 and

[187] Ibid.

2015. Other trends include a qualitative shift in species composition, with larger, longer-lived and more commercially valuable species declining precipitously in abundance, and smaller, mostly pelagic and mostly less commercially valuable species accounting for an increasingly dominant proportion of overall fish biomass. The study's authors identify Malthusian overfishing (unchecked growth in the number of fishers), prevalence of destructive fishing practices, and declines in water quality as the leading probable causes of such long-term trends.[188]

Reef Fish in the BCIB Project Area

A survey of reef fish in the direct vicinity of the BCIB alignment was conducted by Ecosys Corp. in October 2021, in conjunction with the survey of coral cover and assemblages. A synopsis including overview of the survey methodology and key findings is presented below. The same six stations and transects (three transects per station) as were established for the coral survey were used for the fish census (see Exhibit 6-119).

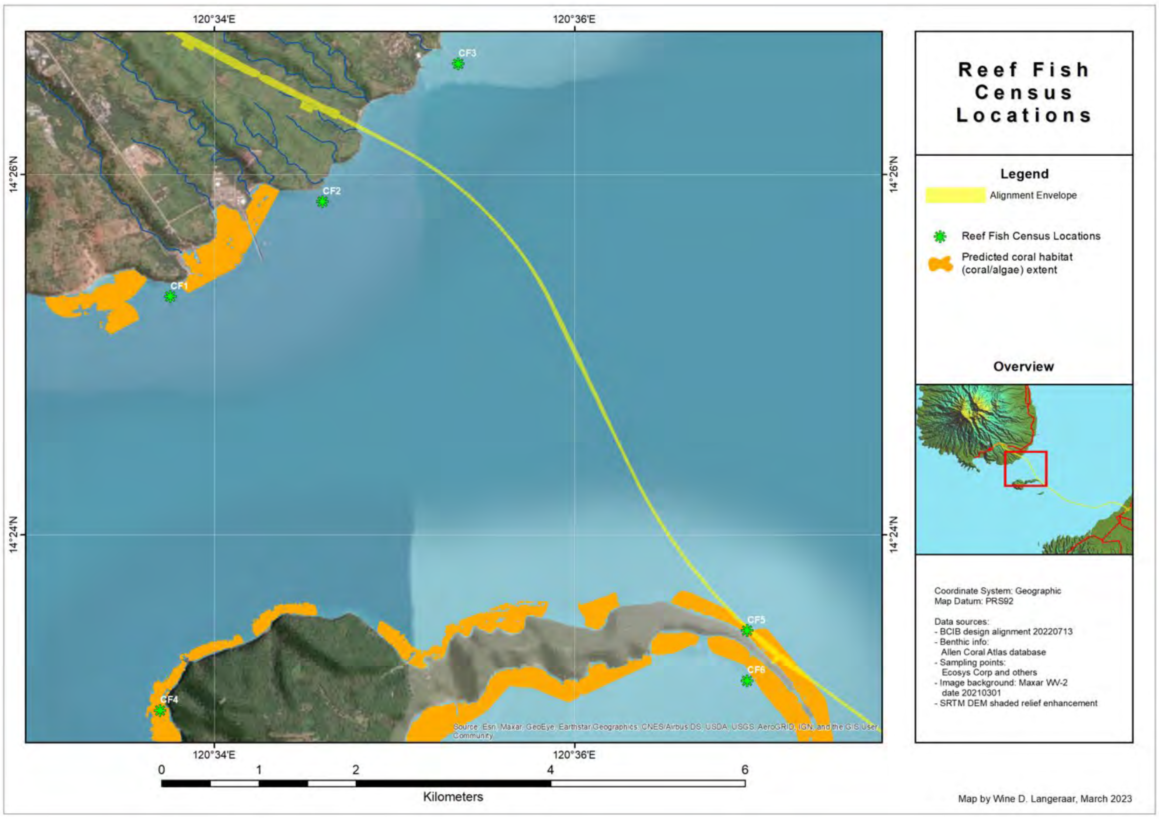


Exhibit 6-119 Locations of Fish Census Sampling Stations

Reef fish were surveyed using a fish visual census methodology to assess fish species diversity, abundance and biomass. After waiting 5–10 minutes following laying of the transect lines and after any coral surveying activity to allow potentially disturbed fish to return to their normal behavior, two SCUBA divers slowly transited the line, stopping at 5-m intervals. At each interval, two 5 m x 5 m imaginary quadrats (one to the left of the transect, one to the right) were viewed. Each transect covered an area of 500 m^2 (50 m long x 10 m width), thus each 3-transect station comprised a survey area of 1,500 m^2. In all, 9,000 m^2 of reef area was surveyed, across six sampling stations. All visible fish were identified

[188] Ibid.

up to species level (if possible), and their numbers and estimated sizes were recorded. Fast-moving fishes were counted first, followed by slower-moving ones. The sizes of fish observed were assessed in terms of total length, estimated to the nearest centimeter. Reef fish biomass was later calculated based on species-specific length-to-mass information, using the formula

$$W = aL^b$$

where: W is the weight in grams
a and b are growth coefficient values taken from published data
L is the length of the fish in centimeters

Fish observation data on species richness were calculated as species per 1,000 m^2, abundance was expressed as number of individual fish per 500 m^2, and biomass data were converted to metric tons per km^2, for comparison with assessment scales commonly used in the Philippines (see Exhibit 6-120). The conservation status of all fish species identified was determined with reference to the IUCN Red List, and cross-checked and corroborated as needed with information available in the global online fish information database Fishbase.

Documented fish were also categorized in relation to three relevance classes: (1) *indicator species*, whose presence and abundance offers insight as to the condition of the overall coral reef ecosystem at the site level; (2) *target species*, which are commercially important; and (3) *major species*, which includes all non-indicator and non-target species.

Exhibit 6-120 Reef Fish Population Assessment Scales

Scalar Category	Metric
SPECIES RICHNESS SCALE[1]	Number of Species per 1,000 m^2
Very Poor	0–23
Poor	24–47
Moderate	48–74
High	75–100
Very High	>100
ABUNDANCE SCALE[1]	Number of Individuals per 500 m^2
Very Poor	1–201
Poor	202–666
Moderate	667–2,267
High	2,268–7,582
Very High	>7,582
FISH BIOMASS SCALE[2]	Biomass in MT per km^2
Very Low	<5
Low	6–10
Medium	11–20
High	`21–40
Very High	>41

Source: Ecosys Corp.

Fish Species Richness

In all, 86 fish species representing 30 families or sub-families were recorded in the reef fish survey at the six nearshore sampling stations off Bataan and around Corregidor Island. A total of 47 species representing 19 families were documented across the three Bataan stations, while a total of 72 species representing 26 families were found at the three Corregidor Island stations. Exhibit 6-122 (left side) shows the breakdown of richness data by station. In general, the number of species recorded per 1,000 m^2 was higher at the Corregidor Island stations than at the stations along the Bataan coast, although the CF3 station to the northeast of the BCIB landing point had a greater affinity with the Corregidor Island stations than the other Bataan stations. Comparison of the data on fish species recorded per 1,000 m^2 to the species richness scale shown in Exhibit 6-120 revealed that fish species richness could be considered 'very poor' at the CF1 and CF2 stations off Bataan, while species richness at all of the remaining four stations fell within the 'poor' category. This suggests generally low diversity of reef fish in the BCIB project area.

KEY:

1. *Apogon aureus* (Ring-Tailed Cardinalfish)
2. *Abudefduf bengalensis* (Bengal Sergeant)
3. *Zanclus cornutus* (Moorish Idol)
4. *Pomacentrus tripanctus* (Threespot Damselfish)
5. *Neopomacentrus cyanomos* (Regal Demoiselle)
6. *Apogon cavitiensis* (Whiteline Cardinalfish)
7. *Parupeneus multifasciatus* (Manybar Goatfish)
8. *Lutjanus biguttatus* (Two-Spot Snapper)
9. *Pomacentrus cuneatus* (Wedgespot Damsel)
10. *Ctenochaetus binotatus* (Two-Spot Surgeonfish)
11. *Scolopsis vosmeri* (Whitecheek Monocle Bream)
12. *Apogon chrysopomus* (Spotgill Cardinalfish)

Exhibit 6-121 Selection of Reef Fish Photographed During Fish Census

High proportions of the fish documented at all of the sampling stations were deemed to fall into the 'major species' category, i.e., representing neither a target species nor a coral indicator species. Averaged across all six stations, individuals of major species accounted for 82% of all fish recorded. Exhibit 6-122 (right side) shows the number of fish representing species in the target and indicator groups at each station. Perhaps the most remarkable aspect of this chart is the low numbers of coral indicator fish. This is likely to reflect the character of the reef areas surveyed, which generally show relatively low density of biotic benthic cover, and high proportions of uncolonized substrate (often consisting of sand). Density of target species is higher than for indicator species, but still low; this is almost certainly attributable to heavy and sustained fishing pressure.

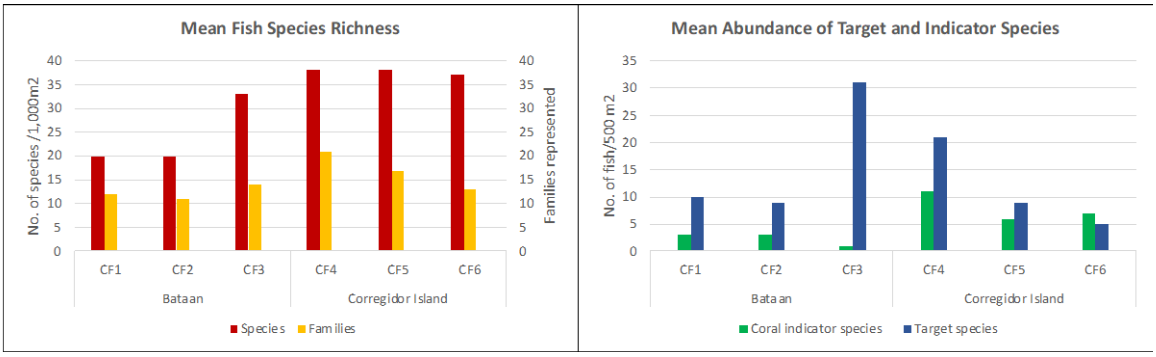


Exhibit 6-122 Species Richness and Presence of Target and Indicator Species

Comparison of the species lists from the fish census to the IUCN Red List online database (www.redlist.org) indicated that none of fish species recorded are considered critically endangered, endangered or vulnerable. Just one of the species recorded, *Scarus hypselopterus* (Yellow-Tail Parrotfish), was classified as near threatened. Exhibit 6-123 provides a breakdown of the IUCN conservation status of species recorded along the survey transects in Bataan and Corregidor Island.

Exhibit 6-123 Conservation Status of Species Recorded in Reef Fish Census

IUCN Category	Bataan Stations	Corregidor Island Stations
Total species recorded	47	72
Critically Endangered (CR)	-	-
Endangered (EN)	-	-
Vulnerable (VU)	-	-
Near Threatened (NT)	-	1
Least Concern (LC)	34	49
Data Deficient (DD)	-	1
Not Assessed (NA)	13	21

Fish Abundance

The fish census data indicate generally low fish abundance in the surveyed reef areas. Abundance was found to be somewhat higher on average at the Bataan stations than at the Corregidor Island stations (see Exhibit 6-124), but still do not rate favorably on the fish abundance scale shown in Exhibit 6-120. Comparison of by-station abundance data to the scale yielded a 'very poor' rating for five of the six stations in the survey. Only one station (CF3 in Bataan) had sufficient fish numbers to make it into the 'poor' category.

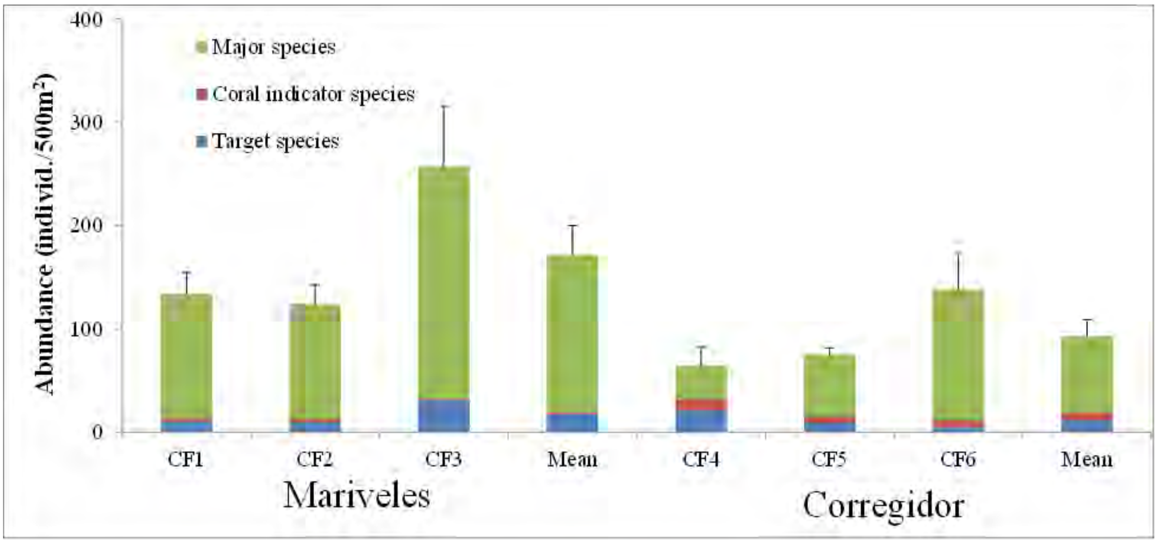


Exhibit 6-124 Mean Abundance of Fish at Surveyed Reef Areas

Examination of by-species abundance data reveals that just two species account for over half of all fish recorded: *Pomacentrus cuneatus* (Wedgespot Damsel), comprising 36% of all individuals, and *Neopomacentrus cyanomos* (Regal Demoiselle), with 21%. Exhibit 6-125 shows the species that made the largest contribution to overall fish abundance as recorded across all six sampling stations.

Exhibit 6-125 Ten Most Frequently Recorded Species in Fish Census

Species	Family	Common Name	Abundance (indiv./500 m^2)
Pomacentrus cuneatus	Pomacentridae	Wedgespot Damsel	47
Neopomacentrus cyanomos	Pomacentridae	Regal Demoiselle	27
Thalassoma lunare	Lab-Corinae	Moon Wrasse	6
Apogon aureus	Apogonidae	Ring-Tailed Cardinalfish	6
Zanclus cornutus	Zanclidae	Moorish Idol	4
Abudefduf bengalensis	Pomacentridae	Bengal Sergeant	4
Apogon cavitiensis	Apogonidae	Whiteline Cardinalfish	4
Scolopsis vosmeri	Nemipteridae	Whitecheek Monocle Bream	4
Halichoeres nigrescens	Lab-Corinae	Bubblefin Wrasse	3
Lutjanus lutjanus	Lutjanidae	Bigeye Snapper	3
Other (76 species)			24
		Total	132

Fish Biomass

Fish biomass values calculated based on the fish census are quite low overall, with mean biomass ranging from 4.5–10.1 MT/km^2 (see Exhibit 6-126). Using the fish biomass scale shown in Exhibit 6-119, three of the six stations have biomass values that can be considered 'very low', while the other three fall into the 'low' category. The station showing highest biomass, CF4 off the western tip of Corregidor Island, almost meets the threshold for classification as 'medium'.

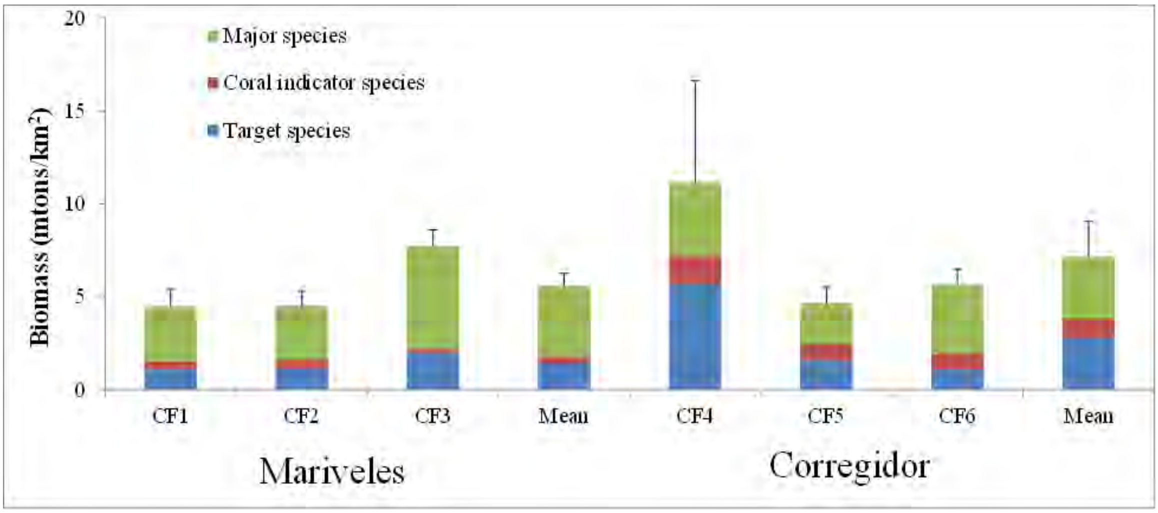


Exhibit 6-126 Mean Fish Biomass at Surveyed Reef Areas

The contribution of particular species to overall fish biomass is not as skewed as was the case for abundance, with no species accounting for more than 10% of biomass. By-species contribution to overall biomass across the six surveyed stations is shown in Exhibit 6-127.

Exhibit 6-127 Ten Leading Constituent Species in Reef Fish Biomass

Species	Family	Common Name	Biomass (MT/km^2)
Zanclus cornutus	Zanclidae	Moorish Idol	0.6
Neopomacentrus cyanomos	Pomacentridae	Regal Demoiselle	0.6
Pomacentrus cuneatus	Pomacentridae	Wedgespot Damsel	0.6
Scolopsis vosmeri	Nemipteridae	Whitecheek Monocle Bream	0.5
Ctenochaetus binotatus	Acanthuridae	Two-Spot Surgeonfish	0.4
Pempheris oualensis	Pempheridae	Copper Sweeper	0.4
Thalassoma lunare	Lab-Corinae	Moon Wrasse	0.4
Parupeneus multifasciatus	Mullidae	Manybar Goatfish	0.3
Halichoeres nigrescens	Lab-Corinae	Bubblefin Wrasse	0.3
Abudefduf bengalensis	Pomacentridae	Bengal Sergeant	0.2

Species	Family	Common Name	Biomass (MT/km^2)
Other (76 species)			2.0
		Total	6.4

Synthesis

Taking account of the data presented above on fish species richness, fish abundance and fish biomass, the current state of reef-associated fish populations in the BCIB project area can be considered quite poor. This conclusion is drawn from just six sampling locations, but given the readily observed fishing pressure in the area, it seems unlikely that these stations are outliers. No fishing seasons are enforced in Manila Bay, and numerous small boats can be seen actively fishing the nearshore zones of Mariveles, and especially Corregidor Island, on virtually any day when weather conditions and sea state are favorable. There is little enforcement of prohibitions on fishing by local small-boat fisherfolk outside their own municipal waters, and no catch quotas are prescribed, so reef fish are essentially an open-access resource. Very poor to poor fish abundance and very low to low fish biomass at the reef areas sampled in the fish census are very likely to reflect the resulting tendency to over-exploitation. It is also probable that degradation of water quality exerts some downward pressure on stocks of reef fish, although water quality is not so poor around the mouth of the bay that this would be expected to have as strong an influence as relentless fishing pressure.

6.1.9.6 Marine Mammals

No previous research has been conducted regarding the presence, distribution, abundance, movements or habits of marine mammals specifically in Manila Bay. However, limited data are available for extraction from a series of comprehensive reports on marine mammal strandings across the Philippines, and these data offer insight as to the presence of certain species within and nearby Manila Bay.[189] A limited number of media reports corroborate the presence within Manila Bay of species identified in that report series. It is also possible to construct reasoned probability profiles for the presence of marine mammal species in Manila Bay, based on review of distribution maps and habitat preferences of all known marine mammals extant in in the Philippines. Exhibit 6-128 presents the results of such an exercise, which is acknowledged to be a weak substitute for long-term field monitoring, but is a systematic means of scoping the range of marine mammal species that may be vulnerable to project impacts. In all, eight marine mammal species (all cetaceans) have been confirmed within Manila Bay, while an additional five species can be considered to have a medium–high probability of frequenting the bay at least as transients. A further nine species were deemed to have low or very low probability of presence in Manila Bay, but could not be decisively ruled out.

[189] (1) Aragones, L.V., H.L.M. Laggui and A.K. Salinas Amor. 2017. The Philippine Marine Mammal Strandings from 2005 to 2016. Technical Report Series 1, Philippine Marine Mammal Stranding Network; (2) Aragones, L.V. and H.L.M. Laggui. 2019. Marine Mammal Strandings in teh Philippijnes From 2017 to 2018: Initial Biennial Analysis. Technical Report Series 2, Philippine Marine Mammal Stranding Network.; (3) Aragones, L.V., A.N.L. Morado and H.L.M. Laggui. 2022. Marine Mammal Strandings in the Philippines From 2019 to 2020. Technical Report Series 3, Philippine Marine Mammal Stranding Network.

Exhibit 6-128 Marine Mammals of the Philippines and Likelihood of Presence in Manila Bay

Species	IUCN status	Notes on Distribution and Habitat Preferences	Estimated Probability
Balaenoptera borealis Sei Whale	EN	Frequenting mainly deep ocean waters far from coastlines, this species has not been documented in Manila Bay, and is considered very unlikely to be found there even as a transient visitor.[1]	Extremely low
Balaenoptera edeni Bryde's Whale	LC	This species is known to feed on schools of herring and sardines in nearshore habitats, including embayments. It is reported mostly from the southern Philippines (Bohol and Palawan), but several strandings have been reported from Batangas, which indicates probable presence further up the western side of Luzon as well.[2]	Low
Balaenoptera musculus Blue Whale	EN	Blue Whales are thought to be very uncommon in the Philippines, and there are no known sightings of this species within Manila Bay. All documented sightings in the Philippines since the late 19th century have come from the Bohol Sea.[2]	Extremely low
Balaenoptera omurai Omura's Whale	DD	Distribution of this species in the Philippines is not well known, but most historical reports are from the Bohol Sea, where it was hunted up until the 1990s. A stranding was reported in Zambales, and another in Metro Manila, although the latter is thought to have been brought into the bay already dead on the bulbous bow of a ship. The stranding in Zambales suggests presence on the west coast of Luzon Island, and thus the probability of presence in Manila Bay can be considered non-trivial.[2,3]	Low
Balaenoptera physalus Fin Whale	VU	There is only one recorded sighting of this species in the Philippines, in the Sulu Sea off Palawan. The species feeds in the open ocean, and occasionally in deep waters close to land, but is not known to frequent shallow bays.[2]	Extremely low
Dugong dugon Dugong	VU	Dugongs were reportedly once extant in Manila Bay long ago, but have not been seen there since the 1970s. The local decline of this species is likely linked to the reduction of seagrass, its primary food. Recent range maps do not indicate expected presence anywhere on the west side of Luzon Island.[2]	Zero
Feresa attenuata Pygmy Killer Whale	LC	This species is considered uncommon in Philippine waters, and has been reported mostly from the Bohol Sea. Strandings have been reported from Zambales, and also Bulacan (inside Manila Bay), which confirms some measure of presence.[2,3]	Confirmed presence
Globicephala macrorhynchus Short-Finned Pilot Whale	LC	This whale is considered fairly common in Philippine waters, including the west coast of Luzon, and has been documented mostly over steep underwater terrain such as continental slopes, where it feeds mainly on squids. It is often found in association with other delphinids, including Fraser's, spinner, spotted, Risso's, bottlenose and rough-toothed dolphins, as well as pygmy killer whales. There have been strandings of this species in western Bataan and Zambales, which indicates presence near Manila Bay and some probability of transient presence within the bay, but its habitat preferences are not strongly suggestive of regular presence.[2,3]	Medium
Grampus griseus Risso's Dolphin	LC	This dolphin is a fairly common species in Philippine waters, including off western Luzon Island. It is known to prefer areas with steep underwater terrain, such as continental shelf breaks, and has usually been found in waters from about 100–1000 m depth. A stranding of this species was recorded in Bulacan, inside Manila Bay.[2,3]	Confirmed presence
Indopacetus pacificus Tropical Bottlenose Whale	LC	This species is considered extremely rare in the Philippines, and has only been reported from a few deep-water locations in the southern half of the country.[2]	Extremely low

Species	IUCN status	Notes on Distribution and Habitat Preferences	Estimated Probability
Kogia breviceps Pygmy Sperm Whale	LC	This species is thought to be uncommon in the Philippines, but is notoriously difficult to detect because it breathes without a noticeable blow and rarely allows much of its body to break the surface. It feeds mainly on deep water species. A stranding of the species was recorded in Cavite, inside Manila Bay, and others have been reported from Batangas, so it may be reasonably common in the area.[2,3]	Confirmed presence
Kogia sima Dwarf Sperm Whale	LC	*Kogia sima* is thought to be fairly common in the Philippines, but as with *Kogia breviceps*, is quite cryptic. It is considered to be mainly a deep pelagic species. Strandings of this species have been reported from Batangas, Bataan and Zambales, and one was also documented in Metro Manila.[2,3]	Confirmed presence
Lagenodelphis hosei Fraser's Dolphin	LC	This is a primarily oceanic species, but often frequents steep continental slopes and sometimes shallower bays. It is common throughout the Philippines, and often seen in association with other dephinids, particularly Melon-Headed Whales when in shallower waters. Strandings have been recorded in Batangas and Zambales, indicating presence along the west Luzon coast in the general vicinity of Manila Bay.[2,3]	Medium
Megaptera novaeangliae Humpback Whale	LC	This species is well-documented in the Babuyan Islands, and to a lesser extent in waters off the northeast coast of Luzon; a stranding was also recorded in Zambales. The waters around the northern tip of Luzon are thought to represent the southern limit of the breeding range of the North Pacific population of humpbacks, but the reported stranding in Zambales suggests at least occasional transient presence further south along Luzon's west coast, perhaps even as far as Manila Bay.[2,3]	Very low
Mesoplodon densirostris Blainville's Beaked Whale	LC	An uncommon species in the Philippines, this whale has been documented mostly in the southern part of the country, and mostly in deep open water areas. Juveniles are reportedly more likely to use inshore areas. Presence of this species in Manila Bay can be considered possible, but of relatively low probability.[2]	Very low
Mesoplodon gingkodens Gingko-Toothed Beaked Whale	DD	There is only one record of this poorly-understood beaked whale species in the Philippines (a stranding in Zambales); the species is known mostly from Taiwan and Japan. Given the stranding in Zambales, probability of presence around Manila Bay would appear to be non-trivial.[3,4]	Very low
Neophocaena phocaenoides Indo-Pacific Finless Porpoise	VU	Range maps indicate that the range of this species within the Philippines is limited to the southern end of Palawan.[5]	Zero
Orcaella brevirostris Irawaddy Dolphin	EN	Range mapping indicates that the Philippine range of this species is limited to two minor pockets in the southern part of the country, far from Manila Bay.[6]	Zero
Orcinus orca Orca	DD	Although this species is found in a wide range of waters worldwide, it is reportedly quite uncommon in the Philippines, with known sightings reported only from the Sulu Sea and Visayas Sea.[2]	Extremely low
Peponocephala electra Melon-Headed Whale	LC	This is a fairly common species in the Philippines, including in shallow waters. It is known to school in large numbers, often in association with other dephinids. The species is known to enter Manila Bay, from both strandings and sightings of large groups offshore.[2,3]	Confirmed presence
Physeter macrocephalus Sperm Whale	VU	A large whale that feeds at great depths in oceanic waters, this species is considered uncommon in the Philippines, but has been known to wash up dead on shore on occasion. Manila Bay does not offer any suitable habitat for this species.[2,3]	Very low
Pseudoorca crassidens False Killer Whale	NT	A primarily deep water oceanic species that occasionally enters nearshore waters, *Pseudoorca crassidens* is considered uncommon in the Philippines. A stranding has been recorded in Zambales, which indicates presence off the western coast of Luzon, and suggests at least non-trivial probability of occasional presence around Manila Bay.[2,3]	Very low

Species	IUCN status	Notes on Distribution and Habitat Preferences	Estimated Probability
Sousa chinensis Indo-Pacific Humpback Dolphin	VU	There is only one documented report of this species in the Philippines (a stranding of an individual in the far southwest of the territorial waters, thought to have strayed from a known resident population in nearby Borneo). A resident population in the Philippines has not been confirmed. Although Manila Bay provides suitable habitat for the species, which prefers inshore and estuarine areas, the lack of recorded sightings anywhere near Luzon suggests negligible probability of presence there.[2]	Zero
Stenella attenuata Pantropical Spotted Dolphin	LC	This species is considered abundant in the Philippines, and is often seen in nearshore waters, and in association with other delphinids, especially spinner dolphins. Presence in Manila Bay is confirmed by a stranding in Pampanga.[2,3]	Confirmed presence
Stenella coeruleoalba Striped Dolphin	LC	A delphinid of deep oceanic waters that rarely comes in past the edge of the continental shelf, this species is considered uncommon in the Philippines. A stranding has been recorded in Zambales, which indicates presence on the western side of Luzon, and its presence was reported by locals in interviews conducted in the BCIB project area in late 2021.[2,3]	Confirmed presence
Stenella longirostris Spinner Dolphin	LC	This is the most abundant dolphin species in the Philippines, and is found in both deep ocean and nearshore habitats, often in association with other delphinids and whales. Strandings have been recorded in Bataan, Cavite and Metro Manila, confirming presence in Manila Bay. This species was also recognized by locals in interviews conducted in the prohect area in 2021.[2,3]	Confirmed presence
Steno bredanensis Rough-Toothed Dolphin	LC	Considered uncommon in the Philippines, this species usually frequents deep oceanic waters, but is sometimes seen in shallow coastal waters, typically in association with other dolphins and whales. Strandings have been recorded in Zambales, Bataan and Batangas, indicating presence along the west coast of Luzon, and suggesting strong probability of presence at least around the mouth of Manila Bay.[2,3]	High
Tursiops aduncus Indo-Pacific Bottlenose Dolphin	NT	This species is very similar to the Common Bottlenose Dolphin, and only recently differentiated as a separate species. It inhabits primarily shallow inshore areas, feeding on benthic organisms. The species is known from strandings in Zambales (Subic Bay), as well as Bataan, and can be considered to have a solid probability of presence in Manila Bay, based on both habitat and the record of nearby strandings.[2,3]	High
Tursiops truncatus Common Bottlenose Dolphin	LC	In the Philippines, this common species is most often seen in shallow inshore waters, in association with other dolphins and whales. A stranding has been recorded in Batanagas. This species can be considered probable in Manila Bay.[2,3]	High
Ziphius cavirostris Cuvier's Beaked Whale	LC	A deep-water species thought to be uncommon in the Philippines, this beaked whale has only been documented in the southern half of the country.[2]	Very low

[1] Cooke, J.G. 2018. Balaenoptera borealis. The IUCN Red List of Threatened Species 2018: e.T2475A130482064. https://dx.doi.org/10.2305/IUCN.UK.2018-2.RLTS.T2475A130482064.en. Accessed on 20 April 2022
[2] The Field Museum. 2010. Synopsis of Philippine Mammals. https://archive.fieldmuseum.org/philippines_mammals/species.asp.
[3] (1) Aragones, L.V., H.L.M. Laggui and A.K. Salinas Amor. 2017. The Philippine Marine Mammal Strandings from 2005 to 2016. Technical Report Series 1, Philippine Marine Mammal Stranding Network; (2) Aragones, L.V. and H.L.M. Laggui. 2019. Marine Mammal Strandings in teh Philippijnes From 2017 to 2018: Initial Biennial Analysis. Technical Report Series 2, Philippine Marine Mammal Stranding Network.; (3) Aragones, L.V., A.N.L. Morado and H.L.M. Laggui. 2022. Marine Mammal Strandings in the Philippines From 2019 to 2020. Technical Report Series 3, Philippine Marine Mammal Stranding Network.
[4] Rosso, M., M. Lin, F. Caruso, M. Liu, L. Dong, A. Borroni, W. Lin, X. Tang, A. Bocconcelli, and S. Li. 2021. First live sighting of Deraniyagala's beaked whale (*Mesoplodon hotaula*) or ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*) in the western Pacific (South China Sea) with preliminary data on coloration, natural markings, and surfacing patterns. Integrative Zoology 16(4): 451–461.
[5] Wang, J.Y. & Reeves, R. 2017. *Neophocaena phocaenoides*. *The IUCN Red List of Threatened Species* 2017: e.T198920A50386795. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T198920A50386795.en.
[6] Minton, G., Smith, B.D., Braulik, G.T., Kreb, D., Sutaria, D. & Reeves, R. 2017. *Orcaella brevirostris* (errata version published in 2018). *The IUCN Red List of Threatened Species* 2017: e.T15419A123790805. https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T15419A50367860.en.

1 *Source: Compiled by Consultant*

The analysis presented in Exhibit 6-128 does not and cannot reflect on local abundance or distribution of marine mammals in the project area, and the dearth of research on marine mammals specifically in Manila Bay precludes drawing conclusions on these matters from prior work. However, it can be reasonably speculated that the abundance of mammal species whose diet consists mainly of fish is probably quite low in Manila Bay, based on the known long-term decline of local fish stocks under intense human fishing pressure (as discussed earlier), and the low levels of reef fish abundance and biomass documented in the fish census reported earlier in this chapter.

6.1.9.7 Threatened Marine Vertebrates

The presence, abundance and distribution of non-commercial marine species in Manila Bay are in general poorly understood, as the vast majority of Philippine marine research effort outside of the realm of fisheries management has been directed at biodiversity hotspots and other relatively pristine environments in other parts of the country. No studies have been conducted on marine species of conservation concern in Manila Bay, and much of what is known is based on anecdotal reports and media accounts of sightings of large and charismatic species. This subsection summarizes the key findings of a threatened marine species presence survey conducted by Ecosys Corp. in 2021-2022, drawing from published and unpublished research and records, as well as a field survey of key informants in the BCIB project area and consultation with experts from adademe, government and the NGO sector.

The threatened species presence survey aimed to uncover evidence of the presence of marine species classified as critically endangered or endangered by IUCN, or classified as threatened and protected under Philippine national laws and supporting regulations in the project area and Manila Bay more generally. A target list of such species was developed with reference to a marine species proximity screening carried out by ADB in September 2021 using the IBAT, and to threatened species lists contained in administrative orders issued by DENR-BMB. The academic and governmental literatures were subject to systematic and comprehensive search, and a small number of previous studies were obtained and reviewed for relevant credible insights and information. This was aided by consultation with six prominent members of the marine science community in Manila. Relevant government units and non-governmental entities in Bataan and Cavite were contacted to obtain such reports as may have been produced under their remits, as well as data pertaining to implementation of conservation programs (e.g., marine turtle hatchery data). Finally, an interview survey was conducted with key informants thought likely to possess experiential knowledge of the presence of species on the target list in the general BCIB project area, including municipal and provincial conservation officers, local fisherfolk, and groundskeepers and other personnel at coastal establishments. Visual species identification keys were used in the interviews. In all, 23 key informants were interviewed in 15 one-on-one and small group interviews conducted in Mariveles, on Corregidor Island, and in Naic.

Species were considered to have a significant probability of presence if they were identified by at least one information source (IBAT screening list, research literature, key informant interview). It is to be acknowledged that these different types of information sources have their strengths and weaknesses as indicators of local presence. Inclusion in the IBAT screening list can be understood as a relatively weak indicator because the spatial scope used in screening is 50 km from the project alignment, and this tends to capture species that rely on habitat types not actually present within the much narrower project vicinity; on the other hand, species records picked up by the IBAT screening are generally based on scientifically documented evidence. Key informant interviews capture local knowledge, but identification by lay people based on a visual guide has inherent potential for mis-identification. And mentions in the research literature can usually be considered reliable indicators of presence, but may lack specificity to the project area. In view of these considerations, the presence of those species indicated by more than one of these sources may reasonably be assigned a higher degree of confidence. The Ecosys Corp. study did not collected information about local abundance, nor did it provide a basis for strong conclusions about local distribution; longitudinal empirical survey effort is required to access those dimensions of species presence.

The study data indicate the probable presence of 63 threatened marine vertebrate species in the BCIB project area, including 11 cetaceans (whales and dolphins), 5 marine turtles, 25 sharks, and 22 other cartilaginous fish (rays, sawfish and wedgefish). No threatened bony fish species have been documented. The list of probable species is presented in Exhibit 6-129.

Exhibit 6-129 Threatened Marine Species With Probability of Presence in BCIB Project Area

Species (Common name)	IUCN Status	National Conservation Status	Source of information[1]		
			IBAT	RL	KII
TURTLES					
Chelonia mydas (Green Turtle)	EN	protected[a]	Y	Y	Y
Dermochelys coriacea (Leatherback)	VU	protected[a]	Y		
Eretmochelys imbricata (Hawksbill Turtle)	CR	protected[a]	Y	Y	Y
Lepidochelys olivacea (Olive Ridley)	VU	protected[a]	Y	Y	Y
Caretta caretta (Loggerhead)	EN	protected[a]			Y
Total			4	3	4
CETACEANS					
Balaenoptera borealis (Sei Whale)	EN	protected (EN)[c]	Y		
Balaenoptera musculus (Blue Whale)	EN	protected (EN)[c]	Y		
Globicephala macrorhyncus (Short-finned pilot whale)	LC	protected (EN)[c]		Y	
Grampus griseus (Risso's dolphin)	LC	protected (EN)[b]		Y	
Kogia breviceps (Pygmy sperm whale)	LC	protected (EN)[c]		Y	
Peponocephala electra (Melon-headed whale)	LC	protected (EN)[c]		Y	Y
Physeter macrocephalus (Sperm Whale)	VU	protected (EN)[c]	Y		
Stenella coeruleoalba (Striped dolphin)	LC	protected (EN)[b]			Y
Stenella longirostris (Spinner dolphin)	DD	protected (EN)[b]		Y	Y
Steno bredanensis (Rough-toothed dolphin)	LC	protected (EN)[b]		Y	
Tursiops aduncus (Indo-Pacific bottlenose dolphin)	NT	protected (EN)[b]		Y	
Total			3	7	3
SHARKS					
Alopias pelagicus (Pelagic Thresher)	EN	protected[d]	Y		
Alopias superciliosus (Bigeye Thresher)	VU	protected[d]	Y		Y
Alopias vulpinus (Common Thresher)	VU	protected[d]	Y		
Carcharhinus albimarginatus (Silvertip Shark)	VU		Y		
Carcharhinus borneensis (Borneo Shark)	EN		Y		Y
Carcharhinus falciformis (Silky Shark)	VU	protected[d]	Y		Y
Carcharhinus longimanus (Oceanic Whitetip Shark)	CR	protected[d]	Y		
Carcharhinus melanopterus (Blacktip reef shark)	VU			Y	

Species (Common name)	IUCN Status	National Conservation Status	Source of information[1]		
			IBAT	RL	KII
Carcharhinus plumbeus (Sandbar Shark)	VU		Y		Y
Carcharodon carcharias (Great White Shark)	VU	protected[d]	Y	Y	Y
Centrophorus squamosus (Leafscale Gulper Shark)	VU		Y		
Eusphyra blochii (Winghead Shark)	EN		Y		
Hemigaleus microstoma (Sickelfin Weasel Shark)	VU		Y		Y
Hemipristis elongata (Snaggletooth Shark)	VU		Y		Y
Hemitriakis leucoperiptera (Whitefin Topeshark)	EN		Y		
Isurus oxyrinchus (Shortfin mako shark)	EN		Y		
Isurus paucus (Longfin mako shark)	EN		Y		
Nebrius ferrugineus (Tawny Nurse Shark)	VU		Y		
Rhincodon typus (Whale Shark)	EN	protected[d]	Y		Y
Sphyrna lewini (Scalloped Hammerhead)	CR	protected[d]	Y		
Sphyrna mokarran (Great Hammerhead)	CR	protected[d]	Y		
Sphyrna zygaena (Smooth Hammerhead)	VU	protected[d]	Y		Y
Squalus montalbani (Philippine Spurdog)	VU		Y		
Stegostoma tigrinum (Zebra Shark)	EN		Y		
Total			23	3	9
RAYS, SAWFISH and WEDGEFISH					
Aetobatus ocellatus (Spotted Eagle Ray)	VU		Y		Y
Aetomylaeus nichofii (Banded Eagle Ray)	VU		Y		Y
Aetomylaeus vespertilio (Ornate Eagle Ray)	EN		Y		Y
Himantura uarnak (Reticulate Whipray)	VU		Y		Y
Himantura undulata (Honeycomb Whipray)	VU		Y		
Maculabis macrura (Sharpnose Whipray)	EN				
Mobula alfredi (Reef Manta Ray)	VU	protected[d]	Y		
Mobula birostris (Giant Manta Ray)	VU	protected[d]	Y		
Mobula kuhlii (Shortfin Devilray)	EN	protected[d]	Y		
Mobula mobular (Giant Devilray)	EN	protected[d]	Y		Y
Mobula tarapacana (Sicklefin Devilray)	EN	protected[d]	Y		Y
Mobula thurstoni (Bentfin Devilray)	EN	protected[d]	Y		
Pateobatis jenkinsii (Jenkins' Whipray)	VU		Y		Y
Pristis pristis (Largetooth Sawfish)	CR		Y		
Pristis zijsron (Green Sawfish)	CR		Y		Y
Rhina ancylostoma (Bowmouth Guitarfish)	CR		Y		
Rhinoptera javanica (Javanese Cownose Ray)	VU		Y		
Rhynchobatus australiae (Bottlenose Wedgefish)	CR		Y		
Rhynchobatus springeri (Broadnose Wedgefish)	CR		Y		
Taeniurops meyeni (Blotched Fantail Ray)	VU		Y		Y
Urogymnus asperrimus (Porcupine Ray)	VU		Y		
Urogymnus granulatus (Mangrove Whipray)	VU		Y		Y
Total			21	0	10
GRAND TOTAL			51	13	26
Conservation status: CR = critically endangered; EN = endangered; VU = vulnerable, NT = near-threatened; LC = least concern					

Species (Common name)	IUCN Status	National Conservation Status	Source of information[1]		
			IBAT	RL	KII

Notes
[1] IBAT = Integrated Biodiversity Assessment Tool; RL = review of literature; KII = key informant interview
[a] DAO 2004-15, Establishing The List Of Terrestrial Threatened Species And Their Categories, And The List Of Other Wildlife Species Pursuant To Republic Act No. 9147,Otherwise Known As The Wildlife Resources Conservation And Protection Act Of 2001.
[b] FAO 1992-185, Ban on the taking or catching, selling, purchasing and possessing, transporting and exporting of Dolphins.
[c] FAO 1997-185-1, Amending Sections 1 and 2 of FAO No.185 by adding whales and porpoises in the ban on the taking or catching, selling, purchasing and possessing, transporting and exporting of Dolphins.
[d] FAO 1998-193, Ban on the taking or catching, selling, purchasing and possessing. transporting and exporting of Whale sharks and Manta Rays.

Source: Ecosys Corp.

Of all the species listed, the marine turtles are a special case with regards to knowledge of distribution and abundance within the BCIB project area, in that they are readily detected because adult females come up on the beach periodically to nest. Hatchery data with nest locations was collected from MENRO hatchery programs operating in both Mariveles and Naic, and nesting beaches were identified through key informant interviews and from a list of known priority nesting sites contained within BMB Technical Bulletin 2020-05 – Guidelines on the Protection of Marine Turtle Nesting Habitats.

In Mariveles, hatchery records indicate that 20,227 eggs were collected from 14 distinct locations between 2013 and 2021, with an average of 2,528 eggs per year. In Cavite, 13,260 eggs were gathered from 16 distinct locations between 2018 and 2021, with an average of 3,315 per year. Of course, hatchery program volunteers do not get to all nesting sites on all beaches every year, nor do they find all nests at the beaches they visit, so the numbers cited should be interpreted as a low-end indicator of nesting activity. The Mariveles hatchery data indicates species, and all eggs over the entire 14-year period were recorded as *Lepidochelys olivacea* (Olive Ridley). The hatchery data from Naic do not list the species, but the vast majority are reported by Naic MENRO officers to be *Lepidochelys olivacea* (Olive Ridley). Despite the apparently strong predominance of *Lepidochelys olivacea*, key informant interviews indicated that *Chelonia mydas* (Green Turtle), *Eretmochelys imbricata* (Hawksbill) and *Caretta caretta* (Loggerhead) are seen most years. Nesting beaches have also been documented in neighboring municipalities in Bataan (Limay, Bagac and Morong) and Cavite (Labac, Tanza and Ternate). Hawksbill turtles were last observed in 2020 laying eggs at the south beach of Corregidor Island; this is based on key informant interviews in the field. Further details of the numbers of hawksbill turtles and the occurrence of nesting in other years in this location are not known. A map of reported turtle nesting beaches is shown in Exhibit 6-130.

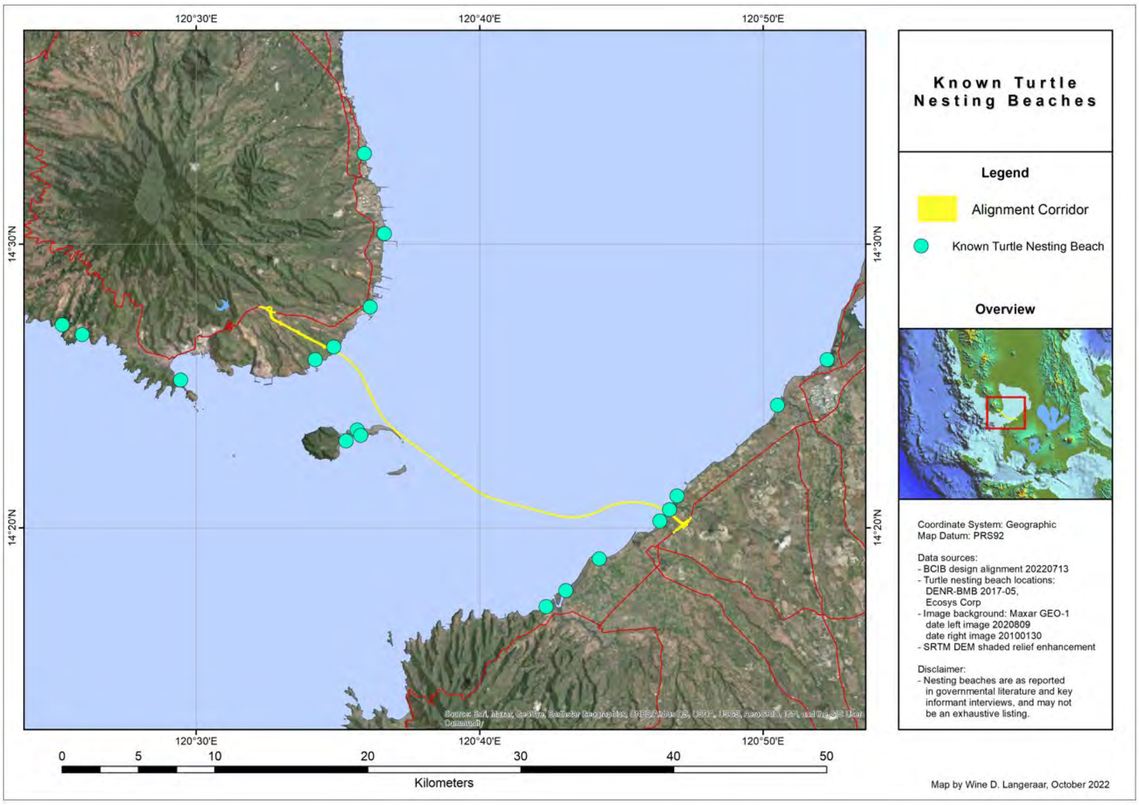


Exhibit 6-130 Beaches in the Project Area With Reports of Marine Turtle Nesting Activity

6.1.9.8 Marine Habitat Classification

As can be inferred from the earlier presentation and discussion of data pertaining to water quality and the anthropogenic inputs of contaminants and nutrients from land- and water-based human activity, Manila Bay is quite far from being a pristine marine environment. That said, the waters and benthic habitats in the vicinity of the proposed BCIB alignment are considerably less heavily impacted than many areas near the head of the bay and around the Metro Manila waterfront. Despite the presence of multiple environmental stressors, the marine environment retains a significant complement of pre-industrial marine community types and species assemblages, albeit in somewhat degraded form. Some key community types (e.g., seagrass meadows and mangroves) are known to occupy smaller areas than they have historically,[190] and certain easily-observed species have been locally extirpated (e.g., dugongs) or exist at much lower densities than they would if Manila Bay had not been subjected to earlier and existing pressures, but significant coral and macroalgal benthic cover is still present, and numerous indigenous species of reef fish, demersal and pelagic fish, cetaceans and marine turtles are reportedly still present. Only one invasive marine species (the mussel *Mytella strigata*) was documented in any of the studies discussed in the previous pages. Following the criteria of IFC GN6, the marine environment in the project area is more appropriately classified as natural habitat (degraded) than modified habitat.[191]

[190] (1) NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.; (2) NEDA. 2018. Manila Bay Sustainable Development Master Plan – Situation Analysis. Focal Theme Report, Environmental Protection. December 2018.

[191] International Finance Corporation. 2012. Performance Standard 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012.; (2) International Finance Corporation. 2019. International Finance Corporation's Guidance Note 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources. June 27, 2019 update.

6.1.9.9 Critical Habitat Determinations

A comprehensive critical habitat assessment was carried out for the BCIB project in 2021-2022, encompassing both terrestrial and marine species and habitats (see the full Critical Habitat Assessment Report in the report Annexes). No marine species were deemed eligible qualifying species for a critical habitat determination, based on consideration of information concerning habitat requirements, known extent of occurrence, estimated global populations where available, and probability of the area of analysis providing habitat to support local populations sufficient to meet critical thresholds specified in IFC PS6. One suspected possible exception is the critically endangered Hawksbill Turtle; further consideration of the status of this species and the potential for it to trigger critical habitat will be undertaken prior to construction as part of the Marine Turtle Management Plan. Some marine protected areas meet the definition of qualifying critical habitat elements under Criterion 4, Threshold (b). The local distribution of marine protected areas is discussed briefly below; the distribution of coral reefs and seagrass in Manila Bay have been detailed in Sections 6.1.9.3 and 6.1.9.4 above.

Marine Protected Areas

As established by the critical habitat assessment carried out for the BCIB project, some of the marine protected areas (MPAs) within the project area may be considered critical habitat elements under Criterion 4, Threshold (b) because locally-managed MPAs (LMMPAs) have been identified as the primary tool for pursuing marine biodiversity protection under the auspices of regional and national conservation policies and initiatives, most recently and specifically the MBSDMP. There are numerous LMMPAs in various states of formulation and implementation around Manila Bay, and reliable, up-to-date information about their precise locations, areal extent, boundaries, ecological features, management objectives and current state of management activity is difficult to obtain.[192] Twelve LMMPAs were nevertheless identified within Manila Bay based on various sources; these areas are listed in Exhibit 6-131. Most of the LMMPAs were conceived as fish sanctuaries, with the primary objective driving establishment being the protection of a habitat node enabling enhanced production of wild fish biomass in the vicinity of fishing zones used by local fishing communities, rather than biodiversity conservation, and as such these are not relevant to the consideration of critical habitat. All were established by municipal ordinances or agreements between municipal governments and local-level partners. None of the MPAs listed have been designated as part of the ENIPAS, and it is unclear if any eventually will be. The six LMMPAs located within 10 km of the BCIB alignment are shown in Exhibit 6-132. Of these only two are designated for nature conservation, Corregidor Islands Marine Park and Bulakan Mangrove Area. The latter is 23 km from the Project site.

Exhibit 6-131 Locally Managed Marine Protected Areas in Manila Bay

LMMPA Name	Year established	Area (ha)	Municipality	Distance from BCIB (km)[1]
Orion Kent Fish Sanctuary	1994	25	Orion (Bataan)	~23[2]
PNOC Fishery Reserve Area	2001	25	Mariveles (Bataan)	10
Naic Fish Sanctuary	2003	59	Naic (Cavite)	0.8
Tanza Fish Sanctuary	2009	45	Tanza (Cavite)	10
Bulaklakin Reef Fish Sanctuary	2005	13	Ternate (Cavite)	7

[192] There is an online database of Philippine maintained by the MPA Support Network, but this was reported by the MPA Support Network's coordinator to be unavailable for an indefinite period due to organizational transitions (Personal communication, Prof. Porfirio Aliño, 26 March 2022). Some basic information was obtained from the organization's website.

LMMPA Name	Year established	Area (ha)	Municipality	Distance from BCIB (km)[1]
Limay Fish Sanctuary	2005	8	Limay (Bataan)	~16[2]
Rosario Marine Protected Area	2013	nd	Rosario (Cavite)	~15[2]
Carabao Island Fish Sanctuary	2015	57	Maragondon (Cavite)	12
Ternate Marine Park	2019	614	Ternate (Cavite)	5
Corregidor Islands Marine Park	2021	508	Cavite City (Cavite)	0 (overlapping)
Abucay Fish Sanctuary	nd	500	Abucay (Bataan)	~31[2]
Bulakan Mangrove Reserve Area	nd	23	Bulakan (Bulacan)	~45[2]

Notes
[1] Shortest straight-line distance between any part of the BCIB marine infrastructure and any part of the MPA
[2] Distance is approximated, as no mapping of this MPA was available
Sources
(1) MPA Support Network. Marine Protected Areas List. https://database.mpasupportnetwork.com/#mpa-list. Accessed 12 November 2021; (2) Provincial Government of Cavite. 2017. State of the Coasts of Cavite Province. ; (3) Provincial Government of Bataan. 2017. State of the Coasts of Bataan Province.; (3) Provincial profiles of progress in integrated coastal management compiled by Sea Knowledge Bank. https://seaknowledgebank.net/content/bulacan. Accessed 1 December 2021.; Corregidor Island Marine Park Management Plan; Ternate Marine Park Management Plan

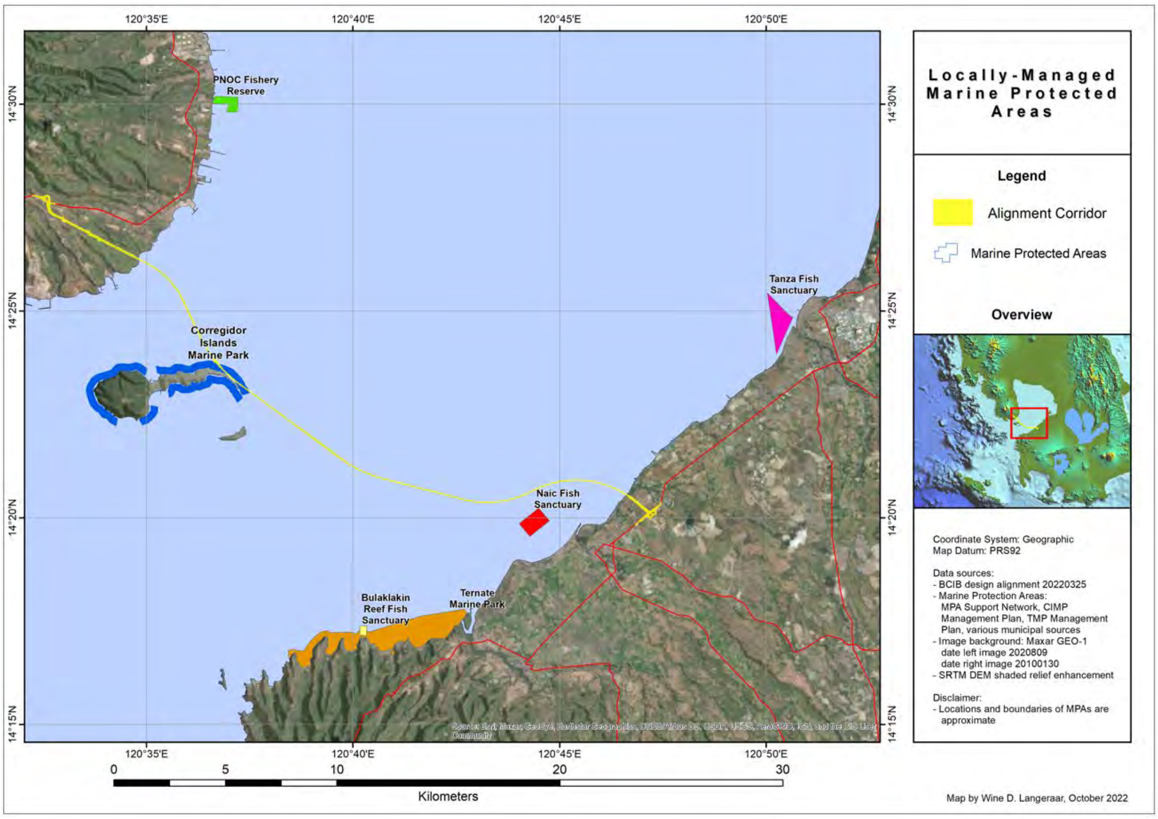


Exhibit 6-132 Locally-Managed Marine Protected Areas Near the BCIB Project Area

Two of the LMMPAs listed are designated as marine parks (Corregidor Islands Marine Park and Ternate Marine Park), and are significantly larger than the others. These MPAs are multi-use protected areas consisting of a series of management zones, ranging in purpose from strict preservation to extractive uses. Although both have been established through municipal ordinances, they are conceived as collaborative initiatives involving numerous institutional stakeholders, and their planning and management is overseen by multi-stakeholder management boards; a secretariat for each has been established within the

Cavite provincial office of DENR (PENRO).[193] The zoning map for the Corregidor Islands Marine Park is shown in Exhibit 6-133, for reference.

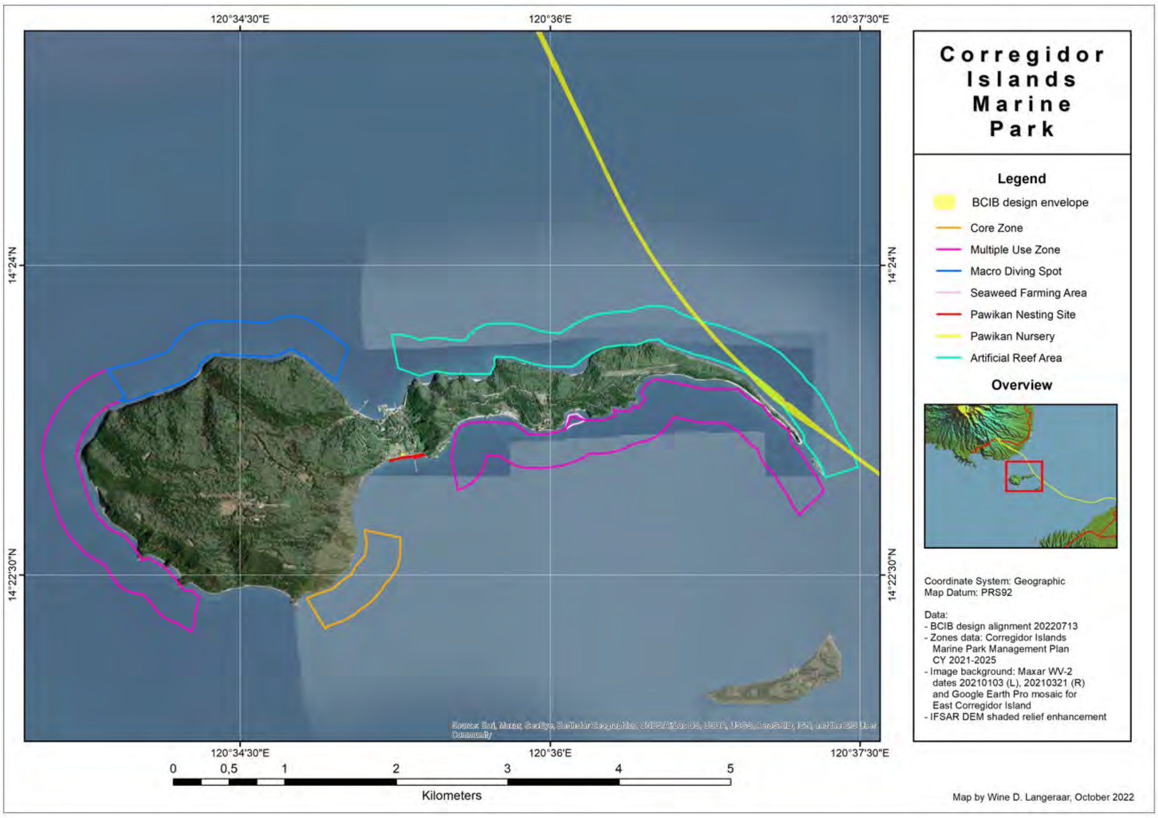


Exhibit 6-133 Management Zones of Corregidor Islands Marine Park

6.1.10 Physical Cultural Heritage

There are many known shipwrecks in Manila Bay, most of them in the waters area around Corregidor Island. Some of these are historic naval wrecks from World War II battles between Japanese and Allied forces. The locations of known wrecks are shown in Exhibit 6-134. None of the mapped wrecks are particularly close to the BCIB project alignment, the nearest being an unnamed wreck about 700 m west of the alignment, in waters about 25–40 m deep off the north side of the Tail End of Corregidor Island. There is another unnamed wreck on the other side of the North Channel, closer to the Bataan shore; this wreck lies at a depth of about 30–40 m, approximately 1,000 m east of the BCIB alignment. Shipwrecks are covered under RA 4846 (as amended by PD 374), but no individual wrecks in this area are listed under the Philippine Registry of Cultural Properties (PRECUP). The Philippines has yet to ratify the 2001 Convention on the Protection of Underwater Cultural Heritage (2001).

[193] (1) Cavite City LGU/DENR PENRO Cavite. Corregidor Islands Marine Park Management Plan CY 2021–2025.; (2) Municipality of Ternate LGU/DENR PENRO Cavite. Ternate Marine Park Management Plan CY 2020–2022.

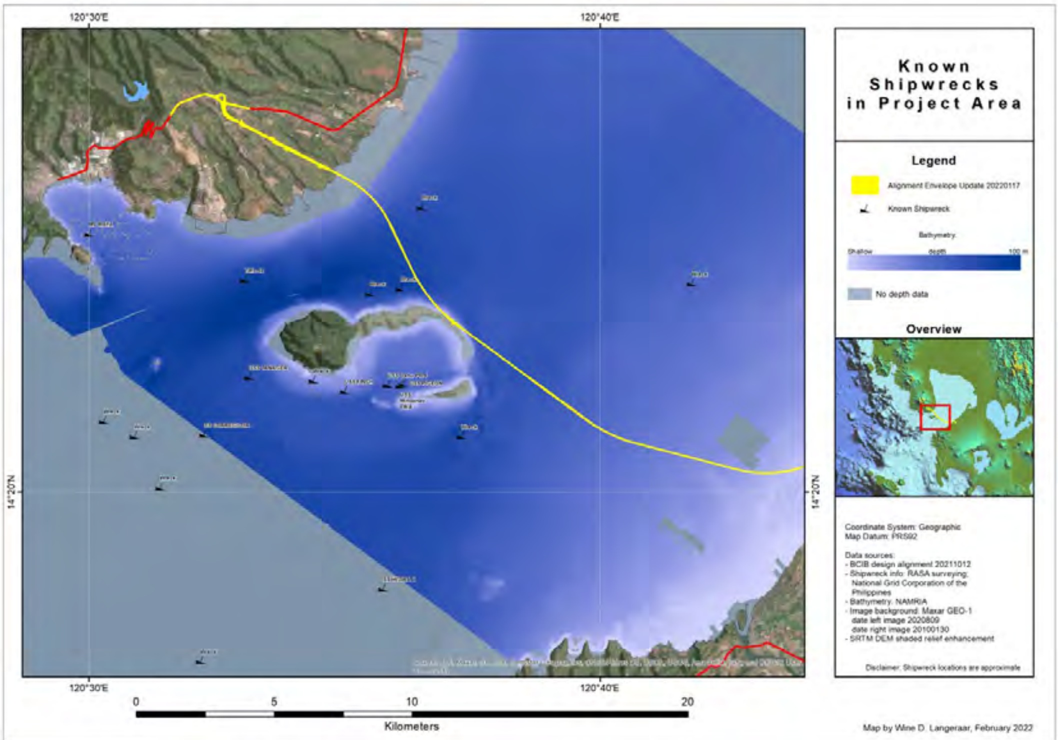
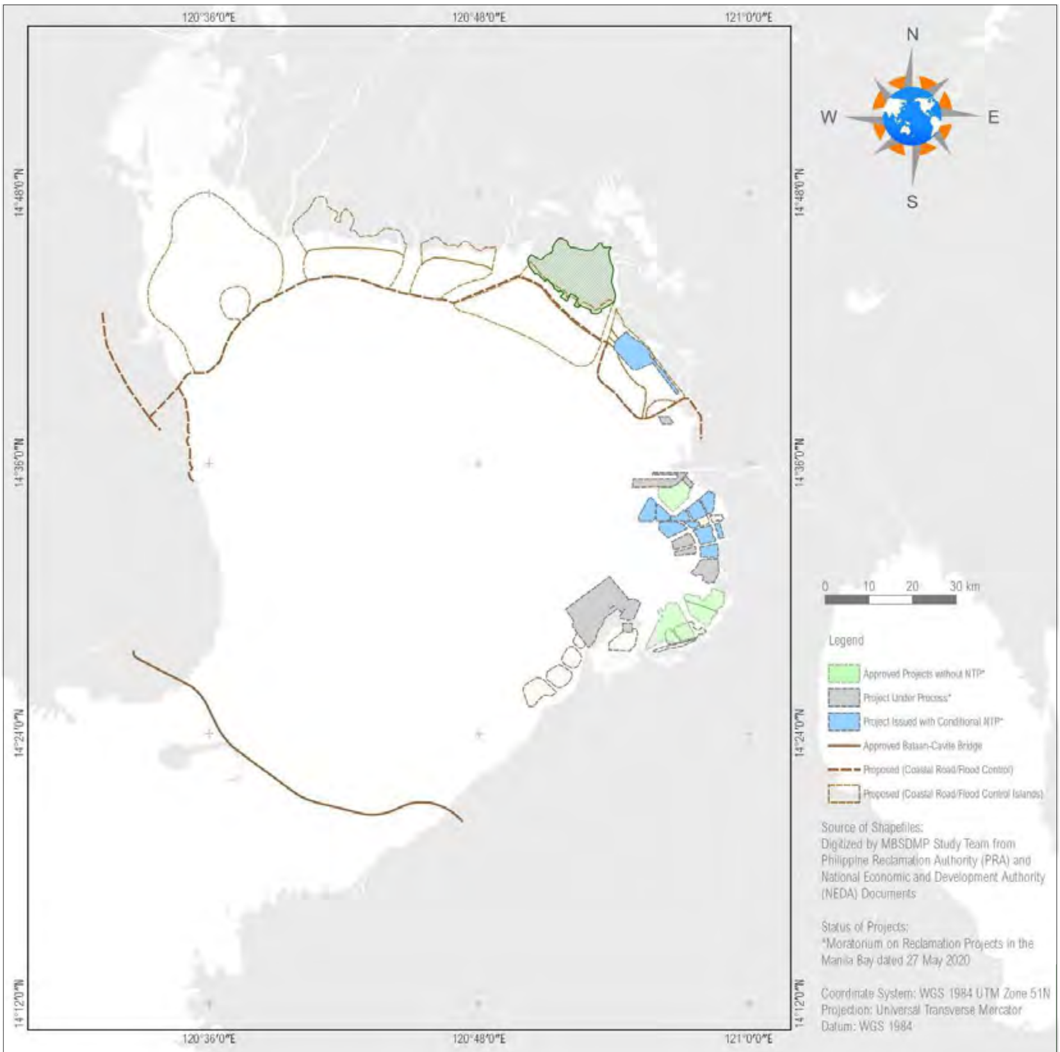


Exhibit 6-134 Shipwrecks in the BCIB Project Area

Although the marine communities that typically form on shipwrecks are most appropriately understood as fouling communities and may have significantly different species assemblages than natural reefs, shipwrecks can nevertheless become locally significant biodiversity hotspots over time, particularly when the surrounding benthic environment is lacking in other hard substrates. The shipwrecks in the BCIB project area have not been systematically surveyed for marine life, but most have been in place for at least several decades, and are likely to have accumulated rich assemblages of reef-associated species, and can be considered a biodiversity resource in their own right. Those that lie in shallower waters within safe reach of recreational divers may have significant tourism potential as well, based on both their historical value and diverse marine life.

6.1.11 Other Significant Marine Developments

There are numerous land reclamation, seabed quarrying and in-water building projects recently completed, underway or planned within Manila Bay; the map in Exhibit 6-135 conveys the scale of major reclamation and road projects proposed around the bay's coasts as of 2020.



Source: NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 3: Manila Bay Atlas.

Exhibit 6-135 Proposed Land Reclamation and Coastal Road Projects Around Manila Bay

In addition to broader set of major reclamation projects proposed largely for the inner portions of the bay, there are a number of significant coastline developments that may affect the ecology of the coastal zone in the vicinity of the BCIB project—some already built, some presently under construction, some still at the proposal stage. These are outlined briefly below.

Major Existing Shoreline Developments

Seafront Townsite Corp. Shipping Terminal (Mariveles)

Approximately 3 km northeast along the Mariveles shore from the proposed BCIB alignment at the Barangay Cabcaben waterfront, a port terminal has been under construction since 2018. This development has so far involved construction of a reclaimed land area of 20 ha with several warehouses, as well as a T-jetty extending 400 m out from the original shoreline with a 400 m-long face dock. This facility is being developed under the auspices of the FAB.[194]

Hyatt Oil Terminal (Mariveles)

Built in the 2002-2005 period, the Hyatt Oil Terminal occupies a small point of land next to the mouth of the Alas-Asin River, about 1.6 km west of the proposed BCIB shore approach. The modest terminal has a trestled loading pier extending 500 m from shore.

GN Power Coal Fired Power Plants (Mariveles)

The GN Power Mariveles Plant (2 x 316 MW) stands on the Mariveles shore 5 km west of the BCIB alignment; the plant began operating in 2013. The adjacent GN Power Dinguinin Plant (Phase 1 668 MW) was developed starting in 2016 and began operating in 2020. Phase 2 of the Dinguinin plant (also 668 MW) is under development.[195] Each of the GN Power facilities is equipped with a 300-m trestle pier to accommodate coal ships.

Cavite Gateway Terminal (Tanza, Cavite)

A container barge terminal has been under development since 2018 by International Container Terminal Services, Inc., about 2.1 km northeast of the BCIB landing site in Naic. The 6-ha facility comprises warehouses, container yards and a roll-on-roll-off wharf extending about 300 m perpendicular to the shore. The facility, which can serve only barges due to shallow water, will have the capacity to transfer 115,000 20-ft containers per year.[196]

Proposed Shoreline Developments

Glass Factory Pier (Mariveles)

A large glass factory is planned by a private entity for the south Mariveles shore in Mt. View. The factory would be served by a new pier extending up to 1 km southeastwards from the shore, capable of accommodating Panamax ships.[197] It is anticipated that the pier would be constructed mainly on pilings. It is not known when (or if) this project may be developed.

Freeport Area of Bataan Container Port (Mariveles)

A significant component of the vision for future development of the FAB is an international container port in Mariveles Bay. It is envisioned that this would be built on reclaimed land at the eastern edge of the bay, abutting Barangay Sisiman; this would be about 8 km west of the BCIB alignment.[198] It is not known when this project may be developed.

Tanza–Nasugbu Coastal Road

A road along the shoreline from Tanza (immediately northeast of Naic) to the Nasugbu area in northern Batangas has been proposed, for both transportation and flood control purposes. This project is reportedly in the early feasibility stage, and it is not known when or if it may be developed.

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[194] Personal communication, Engr. Hazel de Guzman, Head of Infrastructure and Facilities, Freeport Area of Bataan (24 March 2022).
[195] See GN Power, Ltd. 2022. GNPower Projects. https://www.gnpower.com.ph/projects/. Accessed 20 October 2022.
[196] See project description at www.ictsi.com/CGT.
[197] T.Y. Lin International/Pyunghwa Engineering Consultants Joint Venture. 2022. Land Use Study and Future Development Plan Study Report (7 July 2022 Draft).
[198] Authority of the Freeport Area of Bataan. 2018. Final Comprehensive Master Development Plan (December 2018). Prepared by UP PLANADES.

6.1.12 Seabed Quarrying

In recent years, the seabed of Manila Bay has attracted growing interest from private mining firms, as well as the Philippine Reclamation Authority (PRA). This interest is linked in part to the various land reclamation schemes proposed around the shores of the bay. Government Seabed Quarry Permits (GSQPs) have already been granted by DENR-MGB for four mining tenements totalling some 14,000 ha (see Exhibit 6-136), and areas subject to Government Seabed Quarry Permit Applications (GSQPAs) add up to around 66,000 ha. Exploration Permit Applications (EXPLAs) also cover large areas. Altogether, mining tenements falling under the three classes mentioned cover upwards of 80% of the total area of Manila Bay. It goes without saying that benthic habitat, fishing grounds and water quality in the bay will be seriously degraded (far more seriously than they are at present) if all of the mining intentions indicated by the map in Exhibit 6-136 come to fruition.

Exhibit 6-137 highlights the multiple mining tenement areas directly overlapping with the proposed BCIB alignment; this includes two areas (yellow polygons in Exhibit 6-136) covering the San Nicolas Shoal, in which mining activity is already underway to supply reclamation projects in the waters off central Manila.

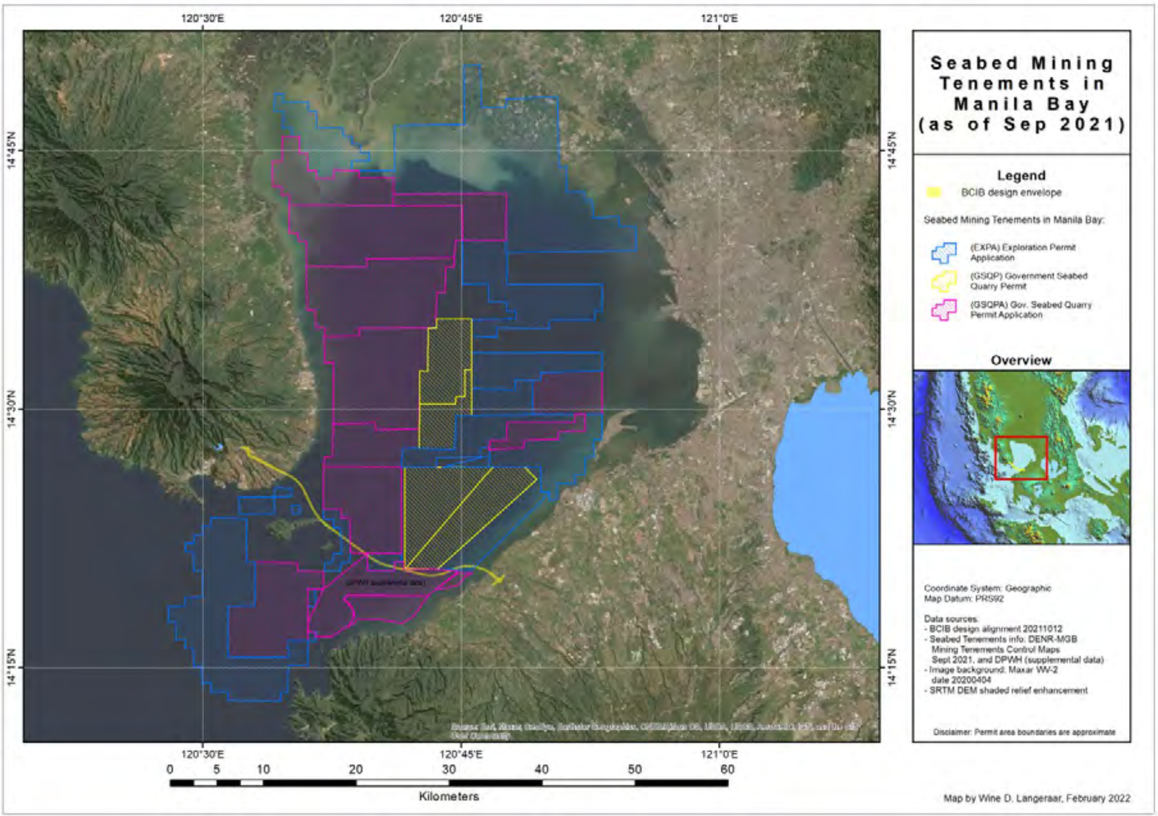


Exhibit 6-136 Seabed Mining Tenements in Manila Bay

6.2 Anticipated Impacts and Prescribed Mitigation

6.2.1 Preconstruction Impacts and Mitigation

Pre-construction impacts are those impacts which, although they may be manifest during construction or operation, actually originate during planning, design and procurement, and can therefore be mitigated at least partially through decisions taken as part of these pre-construction activities. In many cases it makes sense to re-visit these impacts in relation to the construction and/or operation phase, as a residual component of impact may remain to be addressed closer to the time of impact occurrence.

6.2.1.1 Freshwater Quality and Flow

Road Runoff Impacts

Anticipated Impact. The principal effects on surface water quality from roads during operation are derived from runoff from the road surface. Road runoff usually contains contaminants derived from pavement wear, vehicle wear, fluid leaks, exhaust, cargo leakage and spills, material tracked from off-road areas, and atmospheric deposition. Typical runoff contaminants include various heavy metals, volatile and semi-volatile organic compounds including PCBs and PAH, oil and grease, soil particles, fecal coliform, and the nutrients nitrogen and phosphorus. Road drains that lead directly to nearby surface water bodies provide a direct contamination pathway. Contaminated road surface runoff may lead to various short- and long-term ecological effects, including siltation and sedimentation, eutrophication and bioaccumulation of heavy metals and organic chemical compounds. During heavy rainfall events, direct drainage of road runoff to nearby surface water bodies may produce a surge of contaminants, particularly after extended dry periods, during which contaminants can build up on the road surface.

The linkage between chronic low-level contamination of road runoff and ecological effects can be quite weak; while many studies have measured contaminant levels in roadway and bridge stormwater, and some have found evidence of accumulation of certain chemical constituents in benthic sediments, remarkably few have documented causation of significant ecological change. Most regulations put in place in the United States and other places are driven more by logical expectation of potential for ecological effects than by data-driven problem-solving.[199] It is also appropriate to acknowledge here that the BCIB is not projected to be an especially high-volume roadway (AADT 37,000 passenger car units by the tenth year of operation); although traffic volume is just one of several determinants of runoff contaminant concentrations, relatively low traffic volume does at least suggest reduced contamination risk.

In addition to contaminant loads, large influxes of stormwater from roads during and after heavy rainfall events may produce sudden temperature changes, water level rise, increase in current velocity, change in water chemistry, and erosion of stream bank and stream beds, in turn leading to siltation, sedimentation and other ecological stresses. In the case of the BCIB approach roads, sensitive marine environments in Manila Bay are found just a short distance downstream, principally in Bataan, where patches of coral occupy shallow waters along the coast, including near the mouths of the San Jose, Babuyan and Pangolisanin Rivers; all of these watercourses stand to receive at least some runoff from the approach road or interchange. The lower Babuyan River is also a known mangrove habitat (as detailed earlier in relation to the survey of coastal vegetation). Both coral reefs and mangroves are deemed critical habitat in the context of the BCIB project, in accordance with Criterion 4, Threshold (b) of the critical habitat assessment methodology stipulated in IFC Performance Standard 6 (see Critical Habitat Assessment Report, in the Annexes). The approach road will cross over one branch of the Babuyan River by means of a bridge, and several minor branches of the San Jose River will either be crossed using culverts or be re-routed to run

[199] Taylor, S., M. Barrett, G. Ward, M. Leisenring, M. Venner and R. Kilgore. 2014. Bridge Stormwater Analysis and Treatment Options. National Cooperative Highway Research Program Report 778.

along the edge of the ROW; these are the most likely places for direct discharges to surface water bodies to occur.

Vulnerability of critical habitat to the effects of road runoff from the BCIB approach road and interchange in Naic is somewhat lower, because the waters off the Naic coast are not suitable for coral due to high natural turbidity. There are, however, patches of mangroves found in the estuaries of each of the rivers and streams in the project area, including the Timalan River. The west branch of the Timalan River is crossed by the Antero Soriano Highway within the footprint of the BCIB interchange. The smaller Timbugan Creek, nearby the west side of the approach road alignment, also contains mangrove habitat, as well as one branch of the creek which passes beneath the project footprint near the eastern end of the interchange.

Changes to water flow can occur due to in-water structures such as culverts and bridge stanchions. Alterations (acceleration or deacceleration) can have implications for erosion, deposition and for fauna and flora. The bridge over an intermittent branch of the Babuyan River (Alas Asin Waterway Bridge) is to be a free span. The replacement bridge on the Antero Soriano Highway (east end of interchange site) in Cavite will also be a free span. There is insufficient information on flow rates to assess potential for constriction at culverts, but all drainage structures are supposed to be designed to accommodate increased flows as climate change adaptation.

Prescribed Mitigation. During operation effective mitigation of road runoff effects on surface water bodies rests on elimination or reduction of the contamination pathway, and this can be achieved by means of drainage designs that enable in-situ filtration and infiltration of runoff before it can make its way directly to a surface water body. Filtration may be pursued by forcing runoff to flow through a filtering medium after leaving the road surface; a thick mat of vegetative growth (biofilter) can serve this function. Thickly vegetated road verges can be effective in attenuating various contaminants and allowing their bioremediation by natural processes, at very little cost, although this may not be feasible for steep embankments, where the risk of erosion from runoff is highest. Infiltration may be achieved by directing runoff to stormwater basins or bioswales, where runoff can sink into the ground. Thickly vegetated bioswales and stormwater basins achieve both filtration and infiltration.

Incorporation of measures for enhanced roadside infiltration was discussed amongst the project engineers, and it was decided that the financial and transaction costs required to expand the ROW to make space for infiltration was not justifiable based on a risk that is partly hypothetical and probably of minor significance given low projected traffic volume. As a precaution, a risk assessment using a sources-pathway-receptor model is prescribed to further conceptualize the risk to specific sensitive surface and ground waters, and inform design of engineering adaptations where appropriate.

IMPACT SUMMARY					
Impact:	Impacts to water quality and aquatic habitat suitability (including in Manila Bay) from direct discharge of road runoff to watercourses				
Direction:	Negative	Type:	Direct/indirect	Probability:	High
Duration:	Long-term	Scope:	Localized	Significance:	Low
Mitigation:	• Risk assessment to be undertaken to identify locations where additional mitigation for contaminated surface water run off would be justified				

Residual:	Residual risk expected, but minor

Hazardous Spills

Anticipated Impacts. During operations, spills of hazardous substances may occur on the road surface or elsewhere in the ROW as a result of accidents. Fluids used in vehicles, including fuels, lubricants, coolants and hydraulic fluid may be released directly during accidents, but usually in modest amounts. The more significant spill concern for nearby watercourses is rollovers or major ruptures involving tanker trucks or other trucks carrying large hazardous cargoes, particularly when the vehicle in question leaves the road, which makes containment and cleanup much more difficult, and brings the spill that much closer to any water body that may be in the vicinity. Spill risk is inherent to road operations.

Prescribed Mitigation. The most effective design adaptation typically considered for mitigating spill risk to sensitive surface waters is to modify the alignment to increase the distance between the roadway and water bodies, thereby limiting risk exposure. The Bataan alignment was actually shifted approximately 50 m to the southwest during detailed design to avoid gullies associated with the westernmost tributaries of the Babuyan River; although this was done to reduce the need for fill and bank stabilization works, it also reduced risks to the Babuyan River and marine life downstream. As with everyday runoff risks, a risk assessment using a sources-pathway-receptor model is prescribed on a precautionary basis to further conceptualize the risk to specific sensitive surface and ground waters, and inform design of engineering adaptations where this is deemed appropriate.

IMPACT SUMMARY					
Impact:	Contamination of watercourses and downstream aquatic habitats from spills of hazardous materials				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• Risk assessment to be undertaken to identify locations where additional mitigation for contaminated surface water run off would be justified				
Residual:	Residual risk expected, but minor				

Groundwater Quality

Contamination From Road Accidents

Anticipated Impacts The principal risk to groundwater resources from operating roads is spills of hazardous materials of sufficient toxicity, concentration, volume and in-soil mobility to make their way to the water table before containment and cleanup can occur. The discussion above regarding spill threats to surface water also pertains here, although vegetation and soil may demobilize or slow down a significant portion of the spilled substance. The risk to groundwater is thus considerably lower than the risk to surface waters, but a serious spill that reaches the water table may be a difficult matter to address.

Prescribed Mitigation. A risk assessment using a sources-pathway-receptor model is prescribed on a precautionary basis to further conceptualize the risk to specific sensitive surface and ground waters, and inform design of engineering adaptations if this is deemed appropriate.

IMPACT SUMMARY					
Impact:	Contamination of groundwater in the vicinity of the approach roads by spills of hazardous materials				
Direction:	Negative	Type:	Direct	Probability:	Very low
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• Risk assessment to be undertaken to identify locations where additional mitigation for contaminated surface water run off would be justified				
Residual:	Residual risk expected, but minor				

Loss of Groundwater Recharge Capacity

Anticipated Impact. Conversion of land for hard infrastructure inevitably entails a loss of environmental services, and in the case of roads, the principal impairment is a reduction of groundwater recharge capacity due to replacement of infiltration-capable vegetated ground surfaces with impervious surfaces whose associated runoff is efficiently channeled to surface water bodies and evacuated from the locality. Loss of recharge capacity may be of special significance in locations where groundwater scarcity is already a problem (as is becoming the case in near-coastal areas of Cavite), and preventing such loss is often promoted as a means of increasing climate change resilience even where groundwater shortages are not yet a matter of concern.

Prescribed Mitigation. This impact can be mostly prevented by ensuring that most or all runoff from the impervious road surface is given the opportunity to infiltrate to the water table rather than being directed to a stream or river. As discussed above in relation to contaminated runoff management, incorporation of design measures to enhance infiltration was deemed infeasible due to the high financial and transaction cost of the land acquisition necessary to make space for infiltration ponds or swales. In Naic, local landowners expressed strong opposition to drainage of road stormwater onto the land, based on their perception that this would exacerbate existing poor drainage and flooding issues. In Bataan, most stormwater will drain to surrounding pasture, where flooding is not a concern, and this will mitigate loss of recharge capacity there. The loss of recharge capacity under the Naic approach road will be a residual impact.

IMPACT SUMMARY					
Impact:	Loss of groundwater recharge capacity				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• No design-driven mitigation is considered feasible				
Residual:	Expected, but of relatively minor significance				

6.2.1.2 Marine Water Quality

Contamination by Bridge Deck Runoff

Anticipated Impacts. Bridge decks pose special challenges compared to on-land roads in relation to contaminated road surface runoff because of their position directly over water, which entails a direct pathway for contamination of aquatic or marine biota. Structural options for managing bridge deck runoff are constrained by space, weight, strength, aesthetic and cost concerns. For short bridges, channeling deck runoff to land for remediation is the preferred solution, but this becomes less feasible as bridge length increases. As a very long bridge with multiple grade reversals and high clearance requirements at navigation channels, the BCIB presents very limited potential for on-land remediation, and direct drainage of deck runoff has been assumed in the design.[200]

Bridge deck runoff presents four ecological risks: (1) siltation and sedimentation; (2) chemical contaminant loading; (3) nutrient loading; and (4) bacteriological pollution. Three input scenarios also enter into the risk equation: (1) chronic low-level loading; (2) short-duration elevated loading in storm events following prolonged rain-free periods; and (3) sudden concentrated discharges from accidents involving trucks carrying large quantities of fluid material. Generally speaking, risk is a function of exposure and vulnerability.

Exposure in this context is defined by the amount of contaminants that would be introduced to the environment in bridge deck runoff. Contaminant loading in road surface runoff may be positively correlated with traffic volume for some constituents, and the US Federal Highways Administration formulated a general benchmark in the 1990s on this basis. AADT of 30,000 vehicles per day was taken as a lower threshold, below which no effects of runoff would be discernible, and above which effects would begin to be expected, at least for freshwater environments. An upper threshold of 180,000 vehicles per day, above which severe impacts would begin to be expected, was also defined.[201] By this general metric, the projected traffic volume on the BCIB (AADT 37,000 passenger car units by the tenth year of operation) is suggestive of relatively low potential exposure. However, many factors contribute to concentration of contaminants in road surface runoff in addition to traffic volume (e.g., traffic composition, fleet condition, congestion factor, road surface material, road surface age and condition, location relative to regional air pollution sources, and precipitation patterns), so use of traffic volume as the sole indicator of exposure requires caution. Numerous studies have documented toxic levels of contaminants in runoff from road and bridge surfaces, and measurable elevations of a range of contaminants in aquatic environments credibly traced to runoff from nearby bridges, in both high-traffic and low-traffic contexts.[202] Direct drainage from the BCIB is thus characterized as a potentially new source of contaminants in the marine environment.

Vulnerability in the BCIB context is defined by the sensitivity of the Manila Bay marine ecosystem to inputs of bridge deck contaminants. Inputs of particulates may elevate turbidity and reduce photosynthesis, limit respiration efficiency in fish and invertebrates, interfere with prey-finding, and in extreme cases, lead to burial of fish eggs and smothering of sessile benthic organisms. Elevated levels of heavy metals, PCBs, PAH and hydrocarbons in the water column and in bottom sediments may have harmful effects on bodily functions and reproductive success in marine animals, whether through direct contact and ingestion, or ingestion of other organisms in which bioaccumulation has occurred. The nutrients nitrogen and phosphorus play important roles in algal blooms and bacterial consumption of dissolved oxygen, and elevated levels affect the suitability of water as habitat for fish and

[200] The following discussion is excerpted from an environmental brief prepared by the EIA team in March 2022, as an input to decision-making regarding the preferred drainage design.
[201] (1) Dupuis, T.V. 2002. Assessing the Impacts of Bridge Deck Runoff Contaminants in Receiving Waters – Volume 1: Final Report. National Cooperative Highway Research Program Report 474.; (2) Georgia Department of Transportation. 2021. Investigation on Water Quality Impacts of Bridge Stormwater Runoff From Scupper Drains on Receiving Waters. Georgia DOT Research Report 18-09, Final Report.
[202] (1) Bartlet-Hunt, S.L., E.G. Jones and R. Barrios. 2015. Characterization of Bridge Deck Runoff. Report on research sponsored by Nebraska Department of Roads.; (2) Hart, T. 2017. Assessment of Water Quality Issues and Best Management Practices for Stormwater Management for the Interstate 95 Highway Bridge Over the Norwalk River in Norwalk, Connecticut. Technical Report to the Norwalk Harbor Management Commission.; (3) Georgia Department of Transportation. 2021. Investigation on Water Quality Impacts of Bridge Stormwater Runoff From Scupper Drains on Receiving Waters. Georgia DOT Research Report 18-09, Final Report.

invertebrates; proliferation of cyanobacteria linked to development of toxic compounds in certain fish and shellfish consumed by local people is also enabled by nutrient enrichment. High levels of fecal coliform put swimmers and consumers of shellfish at greater risk of gastro-intestinal illness.

Traffic volume and bridge runoff composition are weak predictors of ecological effects from bridge deck runoff, because the probability of effects is strongly determined by the characteristics of the receiving waters, e.g., volume, turbulence, dispersive capacity, background contamination, and presence of sensitive species and human uses. Water bodies with robust circulation, e.g., oceanic bays, estuaries and large, fast-moving rivers, are less vulnerable to toxicity effects than are small and enclosed ones with weak circulation, e.g., ponds and swamps. A 2002 study of the San Francisco–Oakland Bay Bridge provides an instructive example in this regard; despite traffic volume of 250,000 vehicles per day, and runoff shown through laboratory bioassays to have toxic effects for some local species, no bridge-associated elevation of heavy metal content was found in sampled sediments, and no ecological effect could be discerned based on habitat assessment or analysis of infaunal assemblages. The dynamism of the estuarine environment had prevented ecological effects that persistent inputs of significantly contaminated bridge runoff might have been expected to produce.[203] A comprehensive study involving upstream-downstream comparisons with respect to various ecological parameters at a series of 10 river bridges in North Carolina similarly failed to turn up compelling evidence of ecological effects from bridge runoff in aquatic environments, despite documented elevation of some contaminants in runoff samples and in the water column.[204] The large volume of Manila Bay and presence of tidal and wind-driven currents in the BCIB project area are indicative of low vulnerability to contaminated bridge deck runoff.

Dilutive and dispersive capacity notwithstanding, the BCIB alignment will pass through waters known to contain sensitive marine habitats such as coral reefs, some of which are included in a marine protected area (Corregidor Islands Marine Park). Several endangered marine species protected under national law have been documented in the project area. Local fisherfolk harvest fish and shellfish in waters close to the BCIB alignment, and this indicates potential human health vulnerability linked to bioaccumulated contaminants. In addition, analysis of water samples collected along the alignment indicates that national marine water quality standards are sometimes violated, including for parameters implicated in bridge deck runoff. Additional inputs of contaminants from the BCIB would tend to increase the frequency of standards violation, which is suggestive of increasing vulnerability to ecological change.

Regulators' interest in controlling bridge deck runoff in the United States and elsewhere is typically driven by the expectation that the runoff will contribute to the worsening of existing degradation or increase threats to natural resources considered particularly sensitive by stakeholders, rather than hard science indicating actual or predicted effects.[205] Manila Bay is perceived by many direct stakeholders, governmental agencies, non-governmental entities and the general public as an ecosystem under threat, and its cleanup has been a central concern of environmental policy in the Manila Bay region for at least three decades.

[203] Dupuis, T.V. 2002. Assessing the Impacts of Bridge Deck Runoff Contaminants in Receiving Waters – Volume 1: Final Report. National Cooperative Highway Research Program Report 474.
[204] URS Corporation–North Carolina. 2012. Stormwater Runoff from Bridges: Final Report to Joint Legislation Transportation Oversight Committee, in Fulfillment of Session Law 2008-107. North Carolina Department of Transportation.
[205] Taylor, S., M. Barrett, G. Ward, M. Leisenring, M. Venner and R. Kilgore. 2014. Bridge Stormwater Analysis and Treatment Options. National Cooperative Highway Research Program Report 778.

The Continuing Writ of Mandamus issued in 2008 by the Supreme Court assigns responsibility for *improving* water quality in Manila Bay (i.e., not just preventing further degradation) to 14 government agencies.

Modest expectations for overall contaminant production, coupled with large assimilative capacity, are suggestive of low direct ecological risk in relation to bridge deck runoff from the BCIB. However, the Manila Bay ecosystem is widely acknowledged to be impaired by existing stressors, and therefore vulnerable to addition of new sources of contamination. While direct drainage of BCIB runoff to the bay may not ultimately produce measurable ecological effects on its own, it would nevertheless contribute to the cumulative negative impact of development on a threatened marine ecosystem. In this context, it is appropriate for the project to attempt to reduce possible runoff impacts to the maximum extent practicable.

Prescribed Mitigation. Several design-driven mitigation options drawn from the research literature were considered for the BCIB project, but most were deemed infeasible due to some combination of bridge geometry, cost, design complexity, management complexity, and uncertain effectiveness.[206] Only two design-related measures described in the literature were judged to have some potential utility in the context of the BCIB: (1) rumble strips installed across the bridge-bound lanes on both approach roads, to facilitate vibrational shedding of loose particles from passing vehicles prior to their entry onto the over-water road surfaces; and (2) aggressive capture and bioremediation of runoff from the on-land components of the project (by use of bioswales and retention ponds), as an offset for the non-treatment of discharge from the bridge and viaduct decks.

The rumble strip contaminant removal concept is based on the observation that grease patches tend to form over time on the 'downstream' side of discontinuities in highway surfaces, indicating vibration-induced shedding of fugitive lubricants. It is thought that the same mechanism could remove, for the modest cost and complexity of installing and periodically cleaning simple rumble strips, some measure of contaminants that might otherwise end up on the bridge and viaduct decks. This is still an unproven approach, however, and implementation in the BCIB context would be essentially experimental. Regular operation-phase sweeping with regenerative air sweepers appears to be a much stronger option, with research results already supporting its effectiveness, so rumble strips are not considered a priority measure.

A second design-driven means of mitigating contamination from direct discharge of runoff to Manila Bay is to aggressively pursue biofiltration and infiltration for runoff from the on-land project components, as an offset for untreated discharges (sometimes referred to as a remediation swap). For reasons already discussed above, measures to enhance infiltration along the approach roads were ruled out, so the remediation swap was removed from consideration in favor of operation-phase mitigation. The use of regenerative air sweepers to remove pollutants directly from the roadway is prescribed.

IMPACT SUMMARY					
Impact:	Contamination of marine waters by direct drainage of bridge deck runoff				
Direction:	Negative	Type:	Direct	Probability:	High

[206] Refer to brief in Annexes for full discussion of mitigation options.

IMPACT SUMMARY					
Duration:	Long-term	Scope:	Localized	Significance:	Low
Mitigation:	• No design-driven mitigation is prescribed				
Residual:	Expected, but of very minor significance				

6.2.1.3 Loss of Benthic Habitat

Potential Impacts. Construction of the BCIB marine viaducts and navigation bridges will require placement of approximately 2,288 piles of differing diameters (2.5 m, 2.8 m and 3 m), as well as 104 pier supports built on spread-foot foundations, four massive caisson foundations for the cable-stayed bridge towers, and six caisson foundations for the bridge anchor piers. The immediate result of these installations will be a direct displacement loss of seafloor habitat. Virtually all seafloor area provides some kind of ecological service, including provision of food for organisms higher up the food chain; attachment points for filter feeders, plants and algae; hiding places and nurseries for prey species; and so on. In tropical waters, coral reefs and seagrass beds are accorded particular importance for their role as nurseries and feeding sites for a diversity of marine species; they are also increasingly recognized as a globally significant sink for atmospheric carbon dioxide, and thus a key component of climatic regulation. To the extent that a major project like the BCIB removes the seafloor area within its direct physical footprint from the ecosystem services equation, the loss may be locally significant. The area of benthic habitat lost to the BCIB pilings can be calculated as the sum of the footprints of all structural components placed in the seafloor. Based on the schedule of substructure components considered current at the time of writing, the area lost in this way will be about 29,000 m^2, over the entire 26-km marine alignment.

The loss of benthic habitat under the seafloor footprint of the bridges and viaducts will be offset by the addition of hard substrate to the benthic environment. The hard, stable surfaces of bridge pilings and foundations offer favorable sites for attachment and accumulation of sessile marine organisms, and it is typical for artificial marine structures installed in soft marine environments to become colonized by assemblages of algae, coral, sponges, bivalves and other types of organisms, and to build up significant marine biomass. Artificial structures usually become colonized by early-succession species within a matter of months, and in many contexts may acquire thick growth representing a large variety of species and accumulation of biomass even within the first decade following installation.[207] Marine grazers, decomposers and predators are attracted to such growth, and the plentiful interstices within the evolving ecological architecture offer shelter to many small fish and invertebrate species. Clusters of pilings are typically valued as sheltering niches by prey species, including juveniles of large predatory and pelagic fish, especially when installed in relatively uniform soft bottom environments where other shelter is limited.[208] The attractiveness of offshore pilings and other artificial structures to various fish species is well established, with evidence supporting both recruitment of fish from surrounding areas (no net increase in fish biomass) and establishment of new population centers (incremental increase in total fish biomass) attributable to the introduction of the artificial hard substrate.[209] One cross-regional study even found that dock pilings in Belize served as a

[207] Schulze, A., D.L. Erdner, C.J. Grimes, D.M. Holstein and M.P. Miglietta. 2020. Artificial Reefs in the Northern Gulf Of Mexico: Community Ecology Amid the "Ocean Sprawl". Frontiers in Marine Science 7: Article 447.
[208] Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. The Scientific World Journal. Volume 2012, Article ID 386713.
[209] Schulze, A., D.L. Erdner, C.J. Grimes, D.M. Holstein and M.P. Miglietta. 2020. Artificial Reefs in the Northern Gulf Of Mexico: Community Ecology Amid the "Ocean Sprawl". Frontiers in Marine Science 7: Article 447.

refuge for rare fish species extirpated from nearby natural reefs.[210] Where filter feeders such as bivalves take advantage of the plentiful attachment sites on pile surfaces in large numbers, substantial filtration capacity can develop, with significant implications for local and even extra-local water quality.[211]

The growths that develop on underwater artificial structures are appropriately termed marine fouling communities and cannot be expected to have identical species assemblages to those found on natural reefs. Many variables (e.g., light availability, exposure to currents, characteristics of the materials introduced, proximity of propagule and recruitment sources, etc.) affect the density and species composition of fouling communities, but their presence may generally be expected to increase local diversity and biomass.[212] The photographs in Exhibit 6-137, showing dock pilings off Corregidor Island, illustrate the kind of sea life that might reasonably be expected to accumulate on many of the pilings of the BCIB.

Images credit: Corregidor Foundation, Inc. (unpublished). Corregidor Dive Sites: Preliminary Assessment. Consultant's report.

Exhibit 6-137 Marine Life on Pilings Off Corregidor Island

A basic comparison of the footprints of pilings and foundations foreseen for the BCIB marine structures on the one hand (a measure of benthic habitat displacement) with estimated exposed underwater piling and foundation surface area (an indicator of colonization potential) suggests that the BCIB project's introduction of new hard substrate will add much more benthic surface than it will take away. As shown in Exhibit 6-138, the area of underwater steel and concrete surfaces available for colonization by marine life will be about 500,000 m^2 (50 ha) overall, which is approximately 17.5 times greater than the

[210] Brandl, S.J., J.M. Casey, N. Knowlton and J.E. Duffy. 2017. Marine dock pilings foster diverse native, cryptobenthic fish assemblages across bioregions. Ecology and Evolution 2017(7): 7069–7079.
[211] Layman, C.A., Z.R. Jud, S.K. Archer and D. Riera. 2014. Provision of ecosystem services by human-made structures in a highly impacted estuary. Environmental Research Letters 9(4): 044009.
[212] Walker, S.J., T.A. Schlacher and M.A. Schlacher-Hoenlinger. 2007. Spatial heterogeneity of epibenthos on artificial reefs: fouling communities in the early stages of colonization on an East Australian shipwreck. Marine Ecology 28(4): 435-445.

area of soft bottom habitat displaced. Although these surfaces will not be a direct analog for displaced benthos, the tradeoff would appear likely to be quite favorable for marine life along the project alignment over the long term.

A sometimes significant and often unrecognized ecological benefit of offshore installations of pilings and other infrastructure is the inadvertent protective effect they can confer upon the surrounding benthic ecology simply by making bottom trawling more difficult to carry out. Infrastructure arranged in arrays such as in offshore wind farms and tidal energy ranges are particularly effective in this regard, as they typically occupy relatively large blocks of ocean space laced with networks of marine cables.[213] This protective effect is less pronounced in the case of linear infrastructure like a bridge, but the BCIB would still be expected to offer protection from bottom trawling over an area of about 750 ha, assuming trawlers are unlikely to venture closer than 150 m to the bridges and viaducts. Even though bottom trawling is illegal within the municipal fishing zones that cover most of the waters along the bridge alignment, some trawling is known to still take place in some of these areas.

Exhibit 6-138 Area of Benthic Habitat Displacement vs. New Hard Substrate Surface Area

Component	Installed supports	Benthic habitat displaced[1,2]	Area of new hard substrate[3]
North Channel Bridge caissons	2 caissons (each 56 m diameter)	4,926 m^2	11,612 m^2
North Channel Bridge anchor pier caissons	2 caissons (each 34 m diameter)	1,816 m^2	7,156 m^2
South Channel Bridge caissons	2 caissons (each 83 m diameter)	10,821 m^2	17,470 m^2
South Channel Bridge anchor pier caissons	4 caissons (each 34 m x 56 m rectangular)	7,616 m^2	19,296 m^2
Exposed pier supports for viaducts and high-level bridge approaches[4]	1,466 pier supports (diameter and water depth variable)	3,660 m^2	449,071 m^2
Total		28,839 m^2	504,605 m^2

[1] Assumes that caissons will effectively displace seafloor habitat over their whole cross-sectional area even though they will rest on a series of pilings, because of the proximity of their bottom surfaces to the seafloor (touching in some cases).

[2] Assumes most benthic habitat area destroyed by dredging for installation of shallow foundations (225 m^2 per foundation, minus 7 m^2 cross-section of upright) will eventually be available for recolonization, so is not counted as a permanent displacement loss.

[3] Calculated based on water depth and underwater dimensions of exposed pier supports and caissons.

[4] Includes piles (total 1,466) and vertical legs on spread-foot foundations (total 104).

Prescribed Mitigation. In view of the expected offset effect of marine fouling communities that will form on the bridge pilings and foundations, and of the trawling-preventive effect of the bridge's presence, the net effect of placement of the BCIB project's marine infrastructure in the seafloor is judged more likely to be positive than negative, perhaps strongly so. Accordingly, no mitigation is prescribed in relation to this particular impact. Degradation of benthic habitat during construction is another matter; this will be discussed later on, in Section 6.2.2.3.

[213] Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. The Scientific World Journal. Volume 2012, Article ID 386713.

IMPACT SUMMARY					
Impact:	Direct displacement of benthic habitat by infrastructure				
Direction:	Net positive	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low–Moderate
Mitigation:	• None prescribed				
Residual:	Expected, positive				

6.2.1.4 Light Pollution in the Marine Environment

Anticipated Impacts. Bridges typically emit light to the water surface from three main sources: direct fugitive light from roadway lighting, reflected light from decorative undercarriage lighting, and reflected light from decorative floodlighting of the upper bridge structure. The BCIB viaducts will not have undercarriage lighting. The ecological effects of artificial light at night (ALAN) in marine and estuarine environments have not been extensively studied, but ALAN is thought to affect various aspects of marine ecology, including (but by no means limited to) spawning cycles of fish and corals, fish aggregation, timing of vertical movements of zooplankton in the water column, temporal extension of predation, and sea-finding by marine turtle hatchlings.[214] Light emissions from LED fixtures, which have exploded in popularity in recent decades for multiple reasons, are known to penetrate marine environments more readily than light from incandescent and low-sodium fixtures, due to a typically higher proportion of short-wavelengths.[215] The introduction of permanent new light sources all along the BCIB alignment may generate long-term, ecological change that may be experienced indirectly at some distance from the alignment itself. The nature and implications of such change are largely unpredictable.

The range of organisms experiencing direct effects of ALAN is likely to be broader in shallow water areas than deeper areas, as the relatively diffuse light emissions typical of a bridge are unlikely to penetrate all the way to the benthos at biologically significant intensities. The shallowest and therefore most vulnerable areas along the BCIB alignment are near the Mariveles shore (0–15 m depth; distance along the alignment approximately 1 km), along the eastern coast of Corregidor Island (0–15 m depth; linear distance along alignment 1.5 km), and near the Cavite shore (0–15 m depth; 3.5 km linear distance along alignment). A potential ALAN direct impact zone of 30–50 m each side of the bridge and viaduct structures (outside edge of deck) is posited for these shallow areas in the absence of effective mitigation. Emissions in these areas would consist exclusively of fugitive light from roadway lighting, as the decoratively-lit cable-stayed bridges are both in deep water. The ecological significance of light emissions in these shallow zones is unknown, but are assumed to be non-negligible, and should be mitigated to the extent feasible. Direct impacts of ALAN on benthic life beyond 30–50 m from the alignment and in all areas deeper than

[214] (1) Ayalon, I., L.F. de Barros Marangoni, J.I.C. Benichou, D. Avisar and O. Levy. 2019. Red Sea corals under Artificial Light Pollution at Night (ALAN) undergo oxidative stress and photosynthetic impairment. Global Change Biology 2019; 25:4194–4207.; (2) Diamantopoulou, C., E. Christoforou, D.M. Dominoni, E. Kaiserli, J. Czyzewski, N. Mirzai and S. Spatharis. 2021. Wavelength-dependent effects of artificial light at night on phytoplankton growth and community structure. Proceedings of the Royal Society B 288:20210525. (3) Zapata, M.J., S.M.P. Sullivan and S.M. Gray. 2019. Artificial lighting at night in estuaries—Implications from individuals to ecosystems. Estuaries and Coasts 42: 309-330.; (4) Becker, A., A.K. Whitfield, P.D. Cowley, J. Järnegren and T.F. Næsje. 2013. Potential effects of artificial light associated with anthropogenic infrastructure on the abundance and foraging behaviour of estuary-associated fishes. Journal of Applied Ecology 50(1): 43-50.

[215] Davies, T.W., D. McKee, J. Fishwick, S. Tidau and T. Smyth. 2020. Biologically important artificial light at night on the seafloor. Scientific Reports 2020:12545.

15 m are assumed to be of lesser significance, but should also be mitigated as much as possible.

The potential effect of ALAN from the bridges and viaducts on marine turtles merits some discussion. Marine turtle hatchlings are photo-sensitive in the first hours after hatching, and rely on natural light sources over the ocean (moon, stars, atmospheric glow on the horizon) to orient themselves and find their way into the waves. In a pristine environment, such natural light sources are an unambiguous source of guidance. On-land artificial light sources, typically many times brighter than the moon, add much potential for confusion, and may lead hatchlings to head away from the water, where they are likely to fall victim to predation, dehydration or exhaustion.[216] The lighting on the BCIB bridges and viaducts may be mostly unproblematic in this regard, since it will all be offshore.

Prescribed Mitigation. The amount of artificial light that reaches the marine environment from bridge and viaduct lighting can be reduced through design. For the BCIB, rail-mounted roadway lighting was considered as a possible means of reducing light emissions to the water, but was found to be infeasible for reasons related to cost, safety and durability. The selected alternative is pole-mounted overhead luminaries that incorporate shielding for precise targeting of light to land only on the road surface.

A residual ecological effect from bridge lighting is expected, even after mitigation, as reflected light will produce a local atmospheric glow that may be sufficient to influence at least some ecological processes, including reproduction of corals and reef fish. Some shallow inshore and nearshore zones identified above as being most vulnerable to ALAN emissions are known to support coral habitat. Since coral habitat is considered a critical habitat in the context of the BCIB project, the light-derived impacts are appropriately factored into consideration of overall loss of biodiversity values attributable to the project. This and other residual marine biodiversity losses will be compensated with a biodiversity offset to be formulated as an action program under the auspices of the project's Biodiversity Action Plan (see Annexes).

Given the potential sensitivity of marine turtles to ALAN, further location-specific assessment and formulation of any nearshore lighting design modifications and management measures deemed appropriate will be undertaken, culminating in a Marine Turtle Management Plan.

IMPACT SUMMARY					
Impact:	Light pollution effects in the marine environment from bridge and viaduct lighting				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Certain
Duration:	Long-term	Scope:	Localized/Widespread	Significance:	Moderate
Mitigation:	• Marine Turtle Management Plan to be prepared				
Residual:	Expected, and to be addressed through biodiversity offset for impacts on coral habitat, under auspices of Biodiversity Action Plan				

[216] Thums, M., S.D. Whiting, J. Reisser, K.L. Pendoley, C.B. Pattiaratchi, M. Proietti, Y. Hetzel, R. Fisher and M.G. Meekan. 2016. Artificial light on water attracts turtle hatchlings during their near shore transit. Royal Society Open Science 3(5): 160142.

6.2.1.5 Shading Effects

Anticipated Impacts. Numerous marine organisms and relationships between them are governed at least in part by levels of natural light filtering down from the water surface. Photosynthetic organisms in particular, including phytoplankton, non-planktonic algae, zooxanthellae (coral-associated algae) and seagrass and seaweed, are highly dependent on sunlight, and their respective distributions in the marine environment are largely determined by light availability. To the extent that over-water infrastructure shades the water surface, it may limit the success of these lifeforms at the micro-local level. The decks of the marine viaduct and navigation bridges will inevitably cast some shade on the water below. The shading will be most intense where the decks are closer to the water, and less intense where higher decks offer more opportunity for reflected and refracted light to enter the water below. Even the lowest viaduct decks will be about 20 m above the surface, and many sections are much higher than that, so very deep shade should not be expected anywhere, but even some shading effect could well reduce light availability below a survivability threshold for corals that happen to lie within the relatively narrow band of shading that reaches the seafloor. It is difficult to quantify the significance of this potential loss, as the areal extent of coral directly within the shading zone (which will move over the course of each day) and light thresholds of the species present are not known with sufficient precision. Given the relatively high average height of the decks and the movement of the shade zone with the sun's tracking across the sky, it is reasonable to expect at most a minor impact.

Although photosynthetic organisms would be expected to suffer from shading, some mobile species may actually benefit, as darker zones—and discontinuities between lighter and darker zones—may offer hiding places; this may apply to both prey and predators. This potential positive effect is also impossible to quantify, as the species assemblages and particular predator-prey relationships that predominate in any particular area along the alignment are unknown.

Prescribed Mitigation. There are no feasible options for preventing or minimizing the effects of shading from bridges and viaducts, and a residual effect is expected. In coral habitat zones along the alignment (critical habitats in the context of the BCIB project), this residual impact is subject to offset, under the auspices of the Biodiversity Action Plan (see report Annexes).

IMPACT SUMMARY					
Impact:	Shading effects on benthic organisms				
Direction:	Negative/positive	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• None feasible				
Residual:	Expected, and to be addressed through biodiversity offset for impacts on coral habitat, under auspices of Biodiversity Action Plan				

6.2.1.6 Hydrodynamic and Coastal Process Impacts

Anticipated Impacts. The placement of a large number of pilings in a line across the mouth of Manila Bay may reasonably raise concerns about constriction or alteration of existing tidal and wind-driven flow patterns in and out of the bay. If the magnitude of this kind of change were significant, the knock-on implications for the bay's ecology could be far-reaching and complex, affecting such processes as nutrient distribution, flushing of urban wastewater and aquacultural effluents, and sedimentation. However, the hydrodynamic model developed in support of scour risk assessment found that the effect of the line of pilings and foundations will have only a minor effect on the existing circulation. Due to a low tidal range and despite the relative narrowness of the bay's mouth and partial constriction by islands, currents in the BCIB project area are not particularly strong (maximum 0.6 m/s). The bridge piers will be spaced every 100 m in most places and every 60 m in shallow water locations, and the piers themselves will not have very large cross-sections, so the bridge structure will not offer significant resistance to the ebb and flow of tidal currents. The potential for the marine viaducts to alter coastal processes (erosion and deposition of sediment), and produce unfavorable effects on coastal resources and uses, has not been assessed.

Proposed Mitigation. Given the insignificance of the anticipated hydrodynamic impact, no mitigation is currently prescribed. As a precaution, a supplemental desktop study of potential coastal process risks will be undertaken to identify any mitigation that may be appropriate to consider.

IMPACT SUMMARY					
Impact:	Ecological disruption due to hydrodynamic alterations				
Direction:	Negative	Type:	Indirect	Probability:	Certain
Duration:	Permanent	Scope:	Widespread	Significance:	Negligible
Mitigation:	• Supplemental desktop study of potential coastal process risks to be undertaken				
Residual:	Expected, but negligible				

Impacts on Threatened Marine Vertebrate Species

Anticipated Impact. The presence of numerous threatened marine vertebrate species is confirmed or strongly suspected in the BCIB project area, but the distribution and abundance of all is poorly understood. As all of the confirmed or suspected threatened species are mobile, there is no basis to conclude that the BCIB infrastructure, once completed, will have any significant effect on the ability of these species to continue moving through or using habitat resources within the project area. As discussed earlier (Section 6.2.1.3), displacement of benthic habitat by the infrastructure footprint will be quite minor, and likely to be completely offset by the expected enhancement of habitat diversity from addition of many hectares of new hard substrate (much of it with better light availability than the seafloor), promoting the development of algal and hard coral communities .

Marine turtles are the one group of species for which available information can indicate reliance on specific environmental resource sites, in that the turtles make periodic use of sandy beaches with significant backshores for nesting. The BCIB project will not impinge upon any beach of this description on the Bataan side; the shoreline at the landing point in Mariveles is predominantly rocky, with only a minor sandy foreshore (in a limited number of locations) fronted by an intertidal boulder field and backed by a narrow rocky backshore and steep wooded coastal slope (see Exhibit 6-139). The infrastructure will not impinge upon any of the beaches along the east coast of Corregidor Island, which are, in any case, very rocky and not suitable nesting sites. At the Cavite end, the project infrastructure will make landfall on a known turtle nesting beach, and this will constitute a direct impingement. The on-ground infrastructure footprint at this location is not actually expected to occupy any part of the beach itself, as the penultimate pier of the marine viaduct will be in the nearshore area just off the beach, and the last will be inland from the sandy backshore (see

Exhibit 6-140). Thus, the potential effect on turtle nesting habitat at this location will entail the loss of viable nesting sites due to shading of the beach by the overhead viaduct deck (covering approximately 400 m^2 of backshore beach area), as well as reduced viability of the adjacent beach areas due to traffic noise (estimated distance of noise is 50 m each side of the viaduct, which yields an additional area of reduced habitat viability of approximately 2,000 m^2). Spillage of light from terrestrial sections of roadway have not been assessed, and effects on marine turtles will be further assessed during formulation of the Marine Turtle Management Plan. Further possible impacts on threatened marine species will occur as a result of construction activity; these are discussed in section 6.2.2.

Exhibit 6-139 Beach at BCIB Landing Site, Mariveles

Exhibit 6-140 Placement of Alignment and Footings BCIB Landing Site, Naic

Prescribed Mitigation. Mitigation for habitat loss and potential disturbance to turtle nesting habitat will be managed through the **Marine Turtle Management Plan**. Additional baseline studies will be undertaken as part of plan formulation, to understand the pre-construction use of this habitat area by turtles. Monitoring of turtle use of the beach affected during operations will be used to design an adaptive management approach to mitigation.

Based on the discussion above, no design-driven mitigation is indicated in relation to impacts on most threatened marine species. For marine turtles, an area of lost and reduced habitat viability (2,400 m^2) has been identified at the Naic landing site. Following a precautionary approach, this residual will be subject to a biodiversity offset to be formulated under the auspices of the project's Biodiversity Action Plan. Further assessment of existing turtle use of the beach at the Naic landing site, undertaken as part of the Marine Turtle Management Plan, will support the offset's formulation.

IMPACT SUMMARY					
Impact:	Loss of habitat viability for threatened marine vertebrate species				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• Marine Turtle Management Plan to be prepared, including supplemental baseline study				
Residual:	Expected residual effect on marine turtle nesting habitat at Naic landing site (reduced viability over 2,400 m^2), to be addressed through offset under auspices of Biodiversity Action Plan				

6.2.1.7 Impacts on Critical Habitat

Anticipated Impact. The BCIB alignment will directly impinge upon coral habitat in the Corregidor Islands Marine Park (CIMP), which has also been deemed a qualifying critical habitat element. Approximately 1,850 m of the alignment will cross critical habitat (550 m of coral habitat in the Mariveles nearshore zone, and 1,300 m of coral habitat in the nearshore zone along the east coast of Corregidor Island). About 1,800 m of the alignment will be within the boundary of the CIMP. Impacts on coral habitat and the CIMP from the BCIB infrastructure once completed (i.e., not from construction activity, which is discussed later on) will include water quality impacts from bridge deck runoff (refer to Section 6.2.1.2), physical displacement (Section 6.2.1.3), light pollution (Section 6.2.1.4) and shading (Section 6.2.1.5). Water quality impacts from bridge deck runoff can be significantly minimized through management measures during operations, and significant residual effects are not anticipated. Physical displacement impacts cannot be prevented or minimized, but are expected to be subject to an incidental offset from the addition of hard substrate with good light availability, and are thus considered insignificant over the long term. Shading effects cannot be prevented or minimized. Light pollution can be greatly minimized through design of roadway lighting, but some minor residual effect is expected, as the prescribed mitigation cannot account for reflected light.

Prescribed Mitigation. Mitigation has been prescribed above for bridge deck runoff impacts and light pollution. Residual effects in relation to shading and light pollution will be subject to offsets under the auspices of the Biodiversity Action Plan (see report Annexes). No further design-driven mitigation is prescribed.

IMPACT SUMMARY					
Impact:	Impacts on critical marine habitat				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• No additional design-driven mitigation is prescribed				
Residual:	Modest residual impacts from shading and light pollution expected, to be addressed through biodiversity offset under auspices of the Biodiversity Action Plan				

6.2.2 Construction Phase Impacts and Mitigation

Construction impacts are those impacts which occur as a direct or indirect result of construction activity, and which are subject to mitigative actions that can be implemented by the contractors performing the construction work. Planning for mitigative action will typically and appropriately take place in the period immediately leading up to the start of construction, but mitigation will generally be implemented in parallel with construction activity.

6.2.2.1 Impacts on Streams and Other Freshwater Bodies

Siltation and Sedimentation of Watercourses

Anticipated Impacts. Technical and potable water supply for construction activities, such as concrete making, dust suppression, potable and domestic use in labor camps have not been determined as of the time of writing. These will be subject to site-specific Water Use Management Plans to be developed by the PCs prior to construction, and reviewed and approved by the CSC. A sample outline is provided in Appendix B to the EMP.

Construction activity inherently has high potential to expose small particles to entrainment by running water, and sediment-laden runoff from construction sites poses a persistent threat to the quality of water and aquatic habitat in nearby water bodies. If not adequately managed on site, runoff is very likely to result in siltation (elevated turbidity due to suspended soil particles) and sedimentation (buildup of soil particles that have settled out of suspension). Siltation can impair fish gill function, limit photosynthesis by aquatic plants and algae, and make it difficult for aquatic predators to find their prey, among other ecological effects. Sedimentation may smother aquatic plants and bury spawning beds, and substantially change the nature of the benthos over time.

The BCIB project sites, particularly the staging areas, will be operational for an extended duration, 3–4 years in many cases, and most will have significant potential to generate sediment-laden runoff for much of that time. On the Bataan side, the ROW lies within the catchments of the Pangolisanin River (which drains the interchange site), Babuyan River which mostly drains the east side of the ROW), and San Jose River (whose tributaries drain the lands to the west of the alignment). While all three rivers have suffered significant degradation due to prevailing land uses within their catchments, they are used by local people for irrigation, bathing and fishing, and are likely to be a significant resource for terrestrial wildlife. All three rivers drain to Manila Bay, emptying any sediment they carry in nearshore areas that support coral reefs and numerous species of fish, many of which are threatened. In the case of the Babuyan River and San Jose River, minor estuarine mangrove habitat near their mouths would also receive excess sediment originating from upstream construction sites, possibly impairing their utility as habitat for aquatic species. The consequences of uncontrolled sediment delivery to these streams may therefore have significant effects that go well beyond the immediate locality. The project sites on the Bataan side will include the casting yards and drydock facility, where concrete batch plants will be set up and operated intensively. Batch plants and associated areas used for washing concrete-handling equipment typically produce large outputs of runoff heavily laden with fine cementitious particles which take a relatively long time to settle out of runoff, and thus are more easily carried for longer distances downstream, extending the potential reach of impact zones.

The Cavite portion of the BCIB project area is topographically and hydrologically quite different from the Bataan side, and this influences the potential for siltation and sedimentation impacts. The most significant scope for impacts concerns the west branch of the Timalan River, which will be spanned by a new bridge to be built near the eastern extremity of the Antero Soriano Highway interchange. This watercourse also loops around the southern side of the interchange site, passing within less than 100 m of the ROW there. A minor upper branch of Timbugan Creek is intersected by the project footprint near the western end of the interchange works. No other watercourses are in a position to be affected to any significant extent by the works taking place within the project footprint, although parts of the ROW are prone to occasional flooding, and a flood event occurring during active works would have significant potential to carry exposed soil to the Timalan River or Manila Bay directly. The Timalan River has significant potential exposure to works activity taking place on the Cavite Staging Area (Uniwide site), as it runs along the eastern edge of the site for approximately 1.6 km.

Prescribed Mitigation. Several measures are prescribed to limit the amount of sediment reaching local water bodies from the BCIB works and staging sites; these can be grouped into measures that aim to limit the amount of soil that ends up in runoff (i.e., erosion prevention and minimization), and measures that aim to remove entrained sediment from runoff before it can get into receiving waters (i.e., runoff treatment). Both are necessary, as erosion prevention is rarely 100% effective on busy construction sites.

Erosion prevention. Erosion potential can be significantly lowered by covering exposed soils with materials that protect them from the erosive effects of rain; this may include mulches of locally available loose organic material such as crop residues and wood chips, fiber mats made from such materials as coconut coir and jute, and geotextiles. Stockpiles of erodible material, such as sand, backfilling material, reserved topsoil and gravel with a high proportion of fines should be kept covered with tarpaulins whenever they are not being actively used; for high-turnover situations, it may be advantageous to erect temporary fabric buildings to house materials stockpiles. Finally, erosion potential can be lowered by planning construction site a staging area drainage to encourage diffuse runoff to surrounding areas of natural vegetation (avoiding concentrated flows) and channeling concentrated runoff away from exposed soils and stockpiles, with armored channels as needed. For construction sites and staging areas established on land with existing permanent watercourses, site design shall be arranged to avoid disturbance of such watercourses, and maintain a minimum setback of 10 m from the existing channel edges. For sites established on significantly sloped land (as is likely in Mariveles), terracing should be used to avoid works taking place on slopes; inter-terrace embankments shall be protected from erosion using gabions, riprap or other suitable slope protection measure.

Runoff treatment. The principal objective of construction site runoff treatment is to slow the water down, to the point where entrained sediments can be settled out for later removal.

Simple check dams made with bales of crop residues, rock gabions, or a combination of the two, can be installed along runoff channels. To be effective, these must (1) have adequate capacity to avoid significant overflow during heavy rainfall events; and (2) be maintained regularly, including removal of accumulated sediment and repair of any damage sustained over time. Sediment removed should be disposed of in a dedicated spoils management area. Each PC shall ensure that runoff to watercourses is of sufficient quality to prevent exceedance of national surface water quality standards (DAO 2016-08 as updated by DAO 2021-19) in the receiving watercourse, as confirmed by upstream-downstream sampling at the point of discharge.

Each PC shall prepare and implement a Soil Erosion Prevention and Runoff Management Plan, detailing both erosion prevention methods and runoff treatment methods; these plans shall be reviewed and approved by the CSC prior to the start of works. A sample outline for a Soil Erosion Prevention and Runoff Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Siltation and sedimentation of surface waters				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized/widespread	Significance:	High
Mitigation:	• Each PC shall prepare site-specific Soil Erosion Prevention and Runoff Management Plan, for review and approval by CSC prior to set-up of staging areas and work sites, and thoroughly implement said plans • Each PC shall ensure that all runoff discharged from sites under their control is of sufficient quality to prevent violation of surface water quality standards as specified in DAO 2016-08 (as updated by DAO 2021-19) in the receiving watercourse, as confirmed by upstream-downstream sampling at the point of discharge				
Residual:	Probable, but minor				

Surface Water Impacts From Concrete Process Water

Anticipated Impact. Mixing and placement of concrete generates substantial amounts of washout, principally from washing of concrete handling equipment. Concrete washout is composed of water, aggregates, sand and fine cementitious particles, and is quite caustic, with a pH of near 12.[217] The main ingredient in concrete slurry, Portland cement, typically contains various metals, including aluminum, barium, cadmium, hexavalent chromium, copper, iron, magnesium, manganese, nickel, vanadium and zinc, and these contaminants are therefore often present in concrete washout.[218] If discharged to the environment, concrete washout can generate severe swings in water chemistry, impairing gill function and reproduction in fish, among other effects. The principal on-land source of concrete washout on the BCIB project will be the casting yard and drydock facilities.

Prescribed Mitigation. Each concrete batch plant site on the project must be equipped with a facility for concrete washout collection and treatment. Given the scale of concrete works, these should be permanent installations integrated in the casting yard designs, and of adequate capacity to process the projected average daily washout volume from the associated batching operation. All aqueous discharges from settling tanks must be filtered to remove sand, metals and cement fines, and lower pH. Discharged water shall

[217] US EPA. 2012. Stormwater Management Best Practice – Concrete Washout. EPA 833-F-11-006. February 2012. www.epa.gov/npdes/pubs/concretewashout.pdf.
[218] CALTRANS. 2005. Concrete Washout Selection and Estimating Guideline - Summary Report. December 2005. CTSW-RT-05-138-04.1.

preferentially be pumped to the batch plant for use in slurry production; if discharged to the environment, it must meet the effluent standard specified for Class C surface water in DAO 2016-08, as amended by DAO 2021-19. Solids recovered from washout treatment shall be stored under cover of tarpaulins while awaiting recycling in the batch plant, to prevent cementitious fines and sand from being washed or blown to nearby surface waters.

Each PC for operating or overseeing operation of a concrete batch plant shall prepare and implement a Concrete Batch Plant Management Plan, to be reviewed and approved by the CSC prior to the setup of any batch plant. A sample outline for such a plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Surface water impacts from concrete process water				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	High
Mitigation:	• Each PC operating or overseeing operation of a concrete batch plant shall prepare a Concrete Batch Plant Management Plan, to be reviewed and approved by the CSC prior to the setup of each plant, and shall thoroughly implement said plan for the duration of plant operation • Each PC operating or overseeing operation of a concrete batch plant shall ensure that washout is recycled to the maximum extent possible as per EPA 833-F-11-006 • Each PC operating or overseeing operation of a concrete batch plant shall ensure that any discharge of washout water to the environment meets effluent standards as specified in DAO 2016-08 (as updated by DAO 20121-19)				
Residual:	None expected				

Impacts From Spoils Disposal

Anticipated Impact. Initial clearing and grubbing of the on-land ROWs will inevitably generate some spoils, although the total amounts generated may be relatively low, given existing vegetative cover and the limited amount of cutting. If piled on land without regard for erosion prevention, spoils can become a significant long-term source of sediment-laden runoff.

The more significant source of spoils will be the marine works, specifically excavation of pile interiors and dredging of seafloor material to make way for pier foundations and to attain adequate draft to float the bridge caissons out of the drydock facility.

Prescribed Mitigation. Each contractor that will generate spoils shall be required to prepare either a Spoils Management Plan or Marine Spoils Management Plan as appropriate; these plans will be reviewed and approved by the CSC prior to the start of works. Sample outlines for both a Spoils Management Plan and Marine Spoils Management Plan are provided in Appendix B of the EMP.

For on-land spoils, dedicated spoils management sites of sufficient capacity for the projected spoils amounts must be established prior to the start of clearing; sites selected shall be subject to the approval of the CSC. The best option for spoils is to seek a market for their use elsewhere, such as for fill. In the event that onward sale is anticipated, spoils should be stored in areas away from concentrated flows of runoff and kept covered with tarpaulins until removed from the spoils management site. For permanent spoils disposal, spoils shall be arranged such as to avoid creation of steep slopes and exposure to concentrated runoff, and protected from the elements as soon as possible after permanent placement with plantings of perennial vegetative cover. Permanently disposed spoils shall be subject to periodic follow-up inspection to identify and correct any emerging erosion problems, including from failure to establish viable vegetative cover.

For marine spoils, the geotechnical characteristics of the dredged material will be assessed, and if suitable, spoils are expected to be sold for re-use elsewhere, and will be transported by barge directly from the marine works site to the buyer without bringing them on land for storage or disposal. In the event that some spoils are considered unsuitable for re-use, the relevant PC shall arrange for a Best Practical Environmental Options study to be carried out, and disposal of the spoils shall be in accordance with the preferred method identified, subject to approval and supervision by the CSC.

IMPACT SUMMARY					
Impact:	Water quality impacts from improper spoils management				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Long-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• Each PC shall establish a spoils management site approved by the CSC prior to the start of any clearing work • Each PC shall prepare a Spoils Management Plan for review and approval of the CSC prior to the start of works • Each PC operating or supervising operation of a spoils management site shall ensure that all runoff discharged from the site is of sufficient quality to prevent violation of surface water quality standards as specified in DAO 2016-08 (as updated by DAO 2021-19) in the receiving watercourse, as confirmed by upstream-downstream sampling at the point of discharge • Each marine works PCs shall prepare a Marine Spoils Management Plan for review and approval of the CSC prior to the start of works, and a Best Practical Environmental Options Study in the event that spoils are foud to be unsuitable for re-use				
Residual:	None expected				

Enrichment of Watercourses

Anticipated Impact. Seepage and direct discharge from toilets for worker use at construction sites, staging areas and construction camps can contribute to eutrophication of nearby surface waters. As the construction workforce on the BCIB project will be large and present for a sustained period of at least 2–3 years at many sites, this can become a significant problem leading to ecological change, even well downstream and in the nearshore waters of Manila Bay, if proper arrangements are not made for on-site treatment.

Prescribed Mitigation. There are no existing wastewater treatment plants in the BCIB project area, so collecting sewage for transport and offsite treatment is not a feasible option. All toilet facilities established on semi-permanent sites including staging areas and construction camps must be equipped with proper septic tanks and leaching fields (designed in accordance with the National Plumbing Code of the Philippines and approved by the relevant LGU, of adequate capacity to accommodate maximum projected use. Pit toilets shall be prohibited. Septic systems shall not be placed within 50 m of existing wells on adjacent properties. For construction sites, portable toilets shall be provided for worker use, and the collected contents collected as needed for disposal in the septic systems set up at longer-term sites. The septic systems shall be designed to accommodate such inputs from portable toilets used on temporary works sites.

Each PC shall prepare a site-specific Human Waste and Sanitation Management Plan, to be reviewed and approved by the CSC prior to the setup of any work site, staging area or construction camp. A sample outline for a Human Waste and Sanitation Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Enrichment of watercourses with human waste				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• Each PC shall prepare a site-specific Human Waste and Sanitation Management Plan. to be reviewed and approved by the CSC prior to site setup, and thoroughly implement said plan • Each PC to ensure that all septic systems, including those set up to manage raw sewage collected from mobile toilets, are designed and operated in accordance with the National Plumbing Code of the Philippines and approved by the relevant LGU				
Residual:	None expected				

Contamination of Watercourses From Leaks and Spills

Anticipated Impact. Noxious and hazardous materials used in the construction process, including but not necessarily limited to fuels, lubricants, hydraulic fluid, coolants, solvents, paints, glues and admixtures, can end up in watercourses if not properly managed, and lead to short-term and long-term toxic effects on aquatic organisms. Leaks are usually associated with poorly maintained motorized equipment, and poorly maintained storage tanks. Spills occur most often where refueling and equipment servicing takes place, whether at sites designated for such purposes, or where fueling and servicing have to take place in the field. On poorly managed construction sites, waste oil may even be dumped intentionally, for lack of a proper system for collection and recycling.

Prescribed Mitigation. Leaks and spills are entirely preventable. Contractors should be required to use only modern, late-model equipment, which is less prone to chronic leaks than older equipment. All motorized equipment should be checked daily to confirm absence of significant leaks; any leaks detected should be repaired immediately. On-site storage tanks for diesel, lubricants and any other noxious fluid used in the construction process should have built-in secondary containment, and should be inspected for leaks at least weekly. Designated fluids storage facilities should be established during site set-up; these should be situated at least 10 m from any on-site watercourse or drainage channel, and must be positioned so as to not be vulnerable to flash flooding during heavy rain events, above the 100-yr flood level, and away from any coastal location potentially vulnerable to storm surge. Fluids storage facilities should have a roof, impermeable floor, and continuous perimeter sills to provide secondary containment of any spills. The capacity of secondary containment must be at least 150% of the largest container stored. As the project area is in a seismically active zone, all tanks must be supported on structures capable of withstanding earthquakes of at least Magnitude 6. Spill cleanup tools and materials shall be kept stocked in each such facility, and all workers involved in fluids handling should receive spill response training at induction and yearly thereafter.

All refueling should ideally be carried out at the designated fluids storage facilities, on impermeable concrete pads with rollover containment sills. As this is often not possible, such as with very large and limited-mobility equipment or on sites without a fluids storage facility, provision should be made for impermeable drip mats to be used during all field refueling operations. Workers involved in refueling should be given training in refueling best practice and spill cleanup, at induction and yearly thereafter.

Routine equipment maintenance and repair should be carried out in proper maintenance shops set up on site; when this is not possible, drip mats must be deployed for all repairs and maintenance conducted in the field that may involve intentional or inadvertent release of fluids (e.g., from gearboxes, oil pans, pumps, hoses, radiators and tanks). All maintenance technicians shall receive training in spill prevention at induction and yearly thereafter.

It is imperative that arrangements be made by the PC, at the time of site set-up, for regular collection of waste oils and other noxious fluids such as coolants by an accredited recycling enterprise; this and all measures discussed in the preceding paragraphs will be among the provisions of each PC's Hazardous and Noxious Materials Management Plan, to be reviewed and approved by the CSC prior to the start of works. A sample outline for a Hazardous and Noxious Materials Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Leaks and spills of hazardous and noxious fluids, leading to contamination of aquatic biota				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium term	Scope:	Localized	Significance:	Moderate
Mitigation:	• All PCs to use only recent-model (less than 15 years old) equipment maintained in good condition • Each PC shall prepare a site-specific Hazardous Materials Management Plan for review and approval of the CSC prior to site setup, and shall thoroughly implement said plan				
Residual:	None expected				

Direct Physical Degradation of Freshwater Habitat

Anticipated Impact. The project works will directly impinge upon watercourses in several locations. In Bataan, channel diversions and culvert installations will be required on some minor intermittent upstream branches of the San Jose River to enable development of the approach road embankment (see Exhibit 6-141). Also in Bataan, a bridge will be constructed in the main approach road alignment to span a broad gully formed by an intermittent branch of the Babuyan River. These works have some potential to result in siltation and sedimentation in downstream areas, including in the nearshore zone of Manila Bay, where coral reef habitat is present.

Exhibit 6-141 Locations of Works Affecting Watercourses, Bataan

On the Cavite side, a new four-lane bridge will be installed over a branch of the Timalan River at the eastern end of the interchange works, on the main line of the Antero Soriano Highway (see Exhibit 6-142). This is the only location on the alignment where the Cavite will impinge upon a watercourse.

Establishment of staging areas will inevitably impinge upon existing minor watercourses, including both permanent and intermittent drainages, and these will effectively lose all value as habitat for aquatic organisms that live in them. Such watercourses are likely to be driven through, filled in, re-rerouted through armored channels, or piped in order to enable site development. Larger streams should be accommodated in site design, but are likely to be disturbed unless given specific protection. Some of the properties proposed as staging areas in Mariveles have minor seasonal watercourses.

Prescribed Mitigation. Work in or near to surface fresh water will be managed according to the relevant PC's In-Water Works Management Plan, in which site-specific detailed method statements will be provided. The basic requirements of these plans are set out as follows. To minimize the potential for water quality impacts from diversion and culvert installation works on intermittent branches of the San Jose River, these works should be carried out during the dry season, and any necessary bank protection measures should be in place before the return of wet season flows. Construction of the bridge over the intermittent west branch of the Babuyan River should not require works in the waterway itself, but care should be taken to avoid disturbance of the channel by earthworks and movement of heavy machinery during construction. The riparian zone should be fenced off at a distance of at least 5 m from the channel edge on both sides, and a temporary berm should be established outside the fence along both sides of the watercourse to prevent runoff from abutment works reaching the stream. A temporary drop-in bridge should be used to provide access across the watercourse for machinery and vehicles during the works (as opposed to allowing machinery and vehicles to drive through. The work shall preferably be carried out during the dry season.

Exhibit 6-142 Location of Works Affecting Watercourses, Cavite

The bridge works at the Timalan River in Cavite should be carried out with special care to avoid widespread downstream siltation and sedimentation impacts and impacts due to changes in flow rate due to constrictions and obstructions. Durable silt curtains must be installed in the water around the works to contain siltation from excavation and concrete work. Silt curtains should be configured as tightly as possible while still permitting adequate space to work, to limit the area subject to siltation. Excavation and in-water work should be conducted during the dry season, and all designed bank protection measures (e.g., riprap, gabions, armoring) must be installed before the return of wet season flows.

On staging areas, minor seeps, swales and intermittent rivulets can reasonably be modified as needed to permit site development. Streams with definable channels, riparian vegetation and evidence of significant running water for at least part of the year should be either set aside and protected with natural vegetated buffers extending at least 10 m from the channel edge on both sides (preferred), or be subject to full physical and ecological restoration upon site closure. Restoration should entail, at a minimum, removal of culverts and hard channels, re-establishment of the original course, and planting of native riparian species. Watercourse restoration measures shall be specified in a site-specific Staging Area Rehabilitation Plan, to be reviewed and approved before site setup by the CSC (a sample outline for such a plan is provided in Appendix B to the EMP). Disturbance of watercourses on staging sites can be minimized by installing steel plates to permit crossing by heavy equipment, as opposed to allowing equipment to drive through the water and riparian vegetation. Conditions for working in flowing water will be indicated in an In-Water Works Management Plan to be prepared by each relevant contractor; a sample plan outline is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Direct physical degradation of freshwater habitat from staging area development				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PC1 shall conduct channel diversion and culvert installation works on branches of the San Jose River in Alas Asin during the dry season, and shall ensure that all designed bank protection measures (e.g., riprap) are in place before the return of wet-season flows • PC1 to protect west branch of Babuyan River in Alas Asin from disturbance during construction of the Alas Asin Waterway Bridge, by fencing off the waterway at a distance of at least 5 m from channel's edge on both sides, establishing a berm outside the fencing to prevent inflow of sediment from abutment works, and using a drop-in temporary bridge to enable crossing of the watercourse by machinery and vehicles during works • PC2 shall maintain durable silt fencing in the water around bridge works at the Timalan River (west branch) and to contain siltation and sedimentation impacts to the smallest area possible • PC2 to conduct bridge works at Timalan River during dry season, and ensure that all permanent bank and abutment protection measures (e.g., riprap, gabions, armoring) are in place before the return of wet season flows • PCs shall design staging area layout to avoid conversion or modification of any watercourse with a definable channel, riparian vegetation and evidence of substantial running water for at least part of the year, and establish a 10-m setback from the channel edge on both sides • PCs shall install steel plate crossings over existing small watercourses to prevent equipment from driving through them • PCs shall fully restore any watercourse altered, damaged or otherwise degraded by site development before site decommissioning, including, at a minimum, re-establishment of the original course and planting of native riparian species, under the auspices of its Staging Area Rehabilitation Plan • PCs to prepare In-Water Works Management Plans for review and approval of the CSC prior to the start of works				
Residual:	None expected				

6.2.2.2 Impacts on Groundwater

Groundwater Contamination

Anticipated Impact. As with surface water, noxious and hazardous materials used in the construction process, including but not necessarily limited to fuels, lubricants, hydraulic fluid, coolants, solvents, paints, glues and admixtures, can end up in groundwater if not properly managed, and lead to possible impacts on local users of groundwater. Leaks are usually associated with poorly maintained motorized equipment, and poorly maintained storage tanks. Spills occur most often where refueling and equipment servicing takes place, whether at sites designated for such purposes, or where fueling and servicing have to take place in the field. On poorly managed construction sites, waste oil may even be dumped intentionally, for lack of a proper system for collection and recycling.

Prescribed Mitigation. Leaks and spills are entirely preventable. Contractors should be required to use only modern, late-model equipment, which is less likely to have chronic leaks than older, run-down equipment. All motorized equipment should be checked daily to confirm absence of significant leaks; any leaks detected should be repaired immediately. On-site storage tanks for diesel, lubricants and any other noxious fluid used in the construction process should have built-in secondary containment, and should be inspected for leaks at least weekly. Designated fluids storage facilities should be established during site set-up; these should be situated at least 10 m from any on-site watercourse or drainage channel, and must be positioned so as to not be vulnerable to flash flooding during heavy rain events, above the 100-yr flood level, and away from any coastal location potentially vulnerable to storm surge. Fluids storage facilities should have a roof, impermeable floor, and continuous perimeter sills to provide secondary containment of any spills. The capacity of secondary containment must be at least 150% of the largest container stored. As the project area is in a seismically active zone, all tanks must be supported on structures capable of withstanding earthquakes of at least Magnitude 6. Spill cleanup tools and materials should be kept stocked in each such facility, and all workers involved in fluids handling should receive spill response training at induction and yearly thereafter.

All refueling should ideally be carried out at the designated fluids storage facilities, on impermeable concrete pads with rollover containment sills. As this is often not possible, such as with very large and limited-mobility equipment or on sites without a fluids storage facility, provision should be made for impermeable drip mats to be used during all field refueling operations. Workers involved in refueling should be given training in refueling best practice and spill cleanup, at induction and yearly thereafter.

Routine equipment maintenance and repair should be carried out in proper maintenance shops set up on site; when this is not possible, drip mats must be deployed for all repairs and maintenance conducted in the field that may involve intentional or inadvertent release of fluids (e.g., from gearboxes, oil pans, pumps, hoses, radiators and tanks). All maintenance technicians should receive training in spill prevention at induction and yearly thereafter.

It is imperative that arrangements be made by the Contractor, at the time of site set-up, for regular collection of waste oils and other noxious fluids such as coolants by an accredited recycling enterprise; this will be among the provisions of each PC's Hazardous and Noxious Materials Management Plan, to be reviewed and approved by the CSC prior to the start of works. A sample outline for a Hazardous and Noxious Materials Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Leaks and spills of hazardous and noxious fluids, leading to groundwater contamination				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Medium term	Scope:	Localized	Significance:	Low
Mitigation:	• PCs shall use only recent-model equipment (less than 15 years old) maintained in good condition • Each PC shall prepare a site-specific and materials-specific Hazardous and Noxious Materials Management Plan, for review and approval by the CSC prior to the start of works, and thoroughly implement said plan				
Residual:	None expected				

Local Groundwater Scarcity

Anticipated Impact. Large concrete-intensive infrastructure projects can require large amounts of water during construction. In addition to concrete work, water also must be supplied to work sites and worker camps, for worker hydration, washup and showers, and canteen kitchens. In water-scarce environments, major construction projects have the potential to exacerbate existing well water issues and create new ones for groundwater users in nearby areas. The Mariveles portion of the BCIB project area is not known to have existing groundwater availability issues, and geohydrological parameters (position downslope from forested mountain slopes, preponderance of rivers and streams in the landscape) are not suggestive of future problems during the project's construction phase. In Cavite, groundwater shortage is a known problem that already constrains agricultural production. At the time of writing, amounts and phasing of water consumption for the Cavite Staging Area had not been projected, but it can be considered likely that water use by the

BCIB project will place unwelcome strain on groundwater resources, and proactive mitigation is warranted.

Prescribed Mitigation. The most practical means of reducing the amount of groundwater required for concrete work is recycling of washout water. Washout water can be recycled by either re-using the clear water effluent from washout collection and treatment facilities installed at batch plants for further washout activity, or piping the effluent back to the batch plant for use as an ingredient of concrete slurry; both of these recycling methods are included in US EPA Best Management Practice for Stormwater Management – Concrete Washout, and this guidance should be followed by the relevant contractors.[219] Each PC operating or supervising operation of a concrete batch plant shall prepare a site-specific Concrete Batch Plant Management Plan for review and approval by the CSC prior to site setup; a sample outline for such a plan is provided in Appendix B to the EMP. Each PC shall also prepare—regardless if a batch plant is to be used—a site-specific Water Use Management Plan (sample outline provided in Appendix B to the EMP).

IMPACT SUMMARY					
Impact:	Local groundwater scarcity induced or worsened by water demands of construction process				
Direction:	Negative	Type:	Direct	Probability:	Medium (Cavite)
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate (Cavite)
Mitigation:	• Each PC operating or overseeing operation of a concrete batch plant shall prepare a site specific Concrete Batch Plant Management Plan for review and approval prior to plant setup • Each PC operating or overseeing operation of a concrete batch plant shall ensure that washout is recycled to the maximum extent possible as per EPA 833-F-11-006. • Each PC to prepare a Water Use Management Plan for review and approval of the CSC prior to the start of works				
Residual:	Expected, since water use cannot be eliminated completely				

6.2.2.3 Direct Physical Damage to Marine Benthic Habitat

Anticipated Impact. The construction process can be expected to generate direct physical effects on the marine benthos that will range in severity from mild temporary disturbance to total destruction; the individual sources of impacts falling within this range are discussed in turn below.

Placement and removal of temporary rock jetties. Six temporary rock jetties up to 400 m long and 15 m wide will be needed at the land-water interface in Bataan to enable transfers of materials and pre-cast components from on-land sources and storage areas to the work front. Five jetties will be built at the drydock and casting yard facility (Bataan Staging Area 1) on the Mariveles shore to enable loading of pre-cast components and other materials onto barges, and another will be needed to serve Bataan Staging Area 2, where large quantities of steel will be stored and workers will be housed. The jetties will be of boulder-and-fill construction. All benthic life within the footprints of the jetties (amounting to about 3.6 ha for all six) will be destroyed. Recolonization of the substrate by some species will begin immediately upon removal of the jetties, but full recovery of benthic life to pre-project conditions is likely to take at least a decade.

[219] See US EPA. 2012. Stormwater Management Best Practice – Concrete Washout. EPA 833-F-11-006. February 2012. www.epa.gov/npdes/pubs/concretewashout.pdf.

Spread-foot foundation works. Due to the presence of competent rock beneath relatively thin layers of seafloor sediments along much of the southeastern end of the alignment, shallow foundations will be the most commonly used method there (134 viaduct piers). At each of the foundation sites, approximately 2 m of overburden will be excavated using clamshell dredging rigs over a 15 m x 15 m seabed area. Each foundation will require excavation of approximately 450 m^3 of material, and all benthic organisms within the excavation footprint will be removed to the receiving barge. The overall area of disturbance, across all foundation-supported piers, is estimated at about 6 ha. Sediments can be expected to fill in around the new foundations fairly quickly in most locations (sediment transport is substantial off the Naic coast), and recolonization by infaunal and epifaunal invertebrates could be expected to follow shortly after. As there is thought to be very limited macroalgal growth (and no seagrass) in these turbid soft bottom habitat areas, in-migration of mobile invertebrates may be the principal mode of benthic recovery.

Dredging for drydock access channel. Approximately 1.8 ha of seafloor colonized by corals and macroalgal communities will be dredged to establish sufficient draft (minimum 12 m) for the bridge foundation caissons to be floated to the installation sites. All sessile organisms and low-mobility epifaunal and infaunal invertebrates will be removed. Although colonization of the rocky substrate will begin from the first coral spawns and releases of algal spores in nearby areas following dredging, full recovery of sessile benthic life (corals, other sessile invertebrates, epifauna and infauna, and macroalgal communities) is likely to take a long time. Background stressors such as poor water quality, active use by construction vessels, siltation and sedimentation during removal of adjacent jetties, and fishing activity post-construction can be expected to limit the rate of recovery.

Vessel operation and anchoring. Some benthic habitat will be in range of propeller wash, thruster surge and hull strikes; while potentially quite damaging at the micro-scale, these factors are unlikely to occur with a frequency or density sufficient to generate severe effects over a significant area of seafloor. The more damaging activities will be placement of barge struts and anchoring.

Most work barges involved in piling, foundation work and pile cap construction will be supported by struts (spuds) extended to the seafloor. Benthic life in the micro-sites where the strut feet land will be crushed, but as the struts will not be particularly large-diameter and will not be put down repeatedly, this impact can be considered of fairly low significance. Recovery should be relatively fast, given the availability of colonizing organisms in untouched habitat all around.

Very large barges, such as crane barges, and other barges used in water too deep for struts, will be anchored using conventional anchors and long cables, usually four per barge. Anchors will create significant localized disturbance and damage in locations far away (as much as 300–400 m) from the work sites. Anchor cables that drag the bottom during anchor setting and retrieval can also be expected to damage sessile benthic life, but this may be rather limited given that the prevailing bottom habitat in the deeper areas along the alignment is most likely to be of the soft bottom variety. Although a single anchoring event is likely to produce only light and localized effects on the seafloor, the cumulative effect of sequential anchoring activity at multiple piers in the same general portion of the alignment may become significant.

Taken together, vessel operation and anchoring are likely to produce light to moderate physical degradation of benthic life over a generalized swath of seafloor extending up to

400 m on each side of the alignment. Benthic disturbance will be dispersed within this zone, and of variable severity depending on particulars of anchoring activity in particular (scope of anchor cables and frequency of anchoring). Overall, light to moderate disturbance of the seafloor will affect about 2,000 ha along the 26-km alignment. Approximately 110 ha of this zone is thought to be characterized by coral and macroalgal reef assemblages (44 ha in Mariveles nearshore, 66 ha in Corregidor Island nearshore), and degradation is assumed to have potential to be more severe in these habitats compared to the more disturbance-adapted soft bottom habitat expected over the much larger proportion of the degradation zone.

Prescribed Mitigation. Direct physical impacts on benthic life are inherent to marine construction, and most of the impacts discussed above are unavoidable. Anchoring impacts can theoretically be reduced by the use of dynamic positioning systems in place of physical anchors, but these come with their own impacts (underwater noise, thruster surge, fuel consumption). None of the other impacts discussed is amenable to significant prevention or minimization.

In view of the above, predicted losses of benthic habitat will have to be subject to compensatory mitigation. Because coral reefs are considered a critical habitat (where protected) in the context of the BCIB project (see Critical Habitat Assessment in report Annexes), compensation for moderate to severe degradation of coral habitat over approximately 42 ha within the Corregidor Islands Marine Park from the works will be developed as a biodiversity offset under the auspices of the project Biodiversity Action Plan (see Annexes), specifically by supporting enhanced protection of benthic resources over a much larger area within the Corregidor Islands Marine Park.

IMPACT SUMMARY					
Impact:	Direct physical destruction and degradation of benthic habitat by marine construction activity				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Medium-term	Scope:	Localized/widespread	Significance:	High
Mitigation:	• No feasible mitigation options are available				
Residual:	Expected, and to be addressed by a biodiversity offset under the Biodiversity Action Plan				

6.2.2.4 Enhanced Siltation and Sedimentation in the Marine Environment

Anticipated Impact. The marine works can be expected to generate elevated levels of suspended particulates in two ways: (1) resuspension of seafloor sediments by work activity that disturbs them; and (2) at-surface releases of particulates to the water column by materials handling and concrete works. Elevated particulates in the water column limit photosynthetic activity by phytoplankton, macroalgae and the algae living symbiotically within coral tissues; affect gill function in fish; and may, in extreme instances, upset predator-prey relationships by limiting visibility. Sedimentation occurs when suspended material settles in excessive amounts on benthic habitat, stressing and even overwhelming coral, other sessile invertebrates, and macroalgae; burying small limited-mobility epifauna; and filling in habitat niches on the seafloor used by various mobile organisms. To the extent that construction activity on the BCIB project creates these effects, it could lead to significant degradation of sensitive marine habitats, particularly the coral reef habitats around Corregidor Island and in the Mariveles nearshore zone.

Resuspension. The potential for resuspension—and for it to have significant effects on the marine environment—is highly dependent on the grain size of seafloor sediments; coarser sands have very limited propensity for remaining in suspension long enough to drift more than a few meters before sinking to the bottom again, while finer sands, silt and clay may stay suspended long enough to drift over hundreds or even thousands of meters. Resuspension will occur primarily during areal dredging for the drydock facility and excavation for spread-foot pier foundations, both of which are expected to be carried out using clamshell dredging rigs. The process of placing piles, both driven and bored, into the seafloor is considered unlikely to produce significant resuspension.

At-surface releases from material handling. At-surface releases can be expected as a result of spillage during excavation of pile interiors (bored and driven piles); spillage during concrete pouring; dewatering of dredged material placed in barges; and releases of concrete process water from floating batch plants. Silts and clays in excavated material, and fine cementitious materials released from concrete works, have a particular propensity for drift. As indicated in Chapter 3 (Project Description), it is anticipated that spoils from dredging, excavation for spread-foot foundations, and excavation of pile interiors will be shipped directly to customers elsewhere in need of fill material, and will not be disposed of at sea, so no siltation and sedimentation impacts from disposal are considered here.[220]Concrete works at marine sites will be supplied from floating batch plants, and large amounts of raw materials will be transferred from supply barges; this will entail a risk of spillage. Concrete washout may also leak from the batch plants or be released after settling.

Suspension of particulate matter (resuspension and at-surface releases) would be expected to be a relatively short-term concern at any one site; excavation of a 15 m x 15 m seabed area for a spread-foot foundation would take no more than a few hours, for example, and excavation of pile interiors for a typical viaduct pier with multiple piles might be accomplished in a matter of a few days. The short duration of activity at particular sites will tend to moderate the potential for persistent siltation and sedimentation.

A preliminary sediment dispersion analysis was carried out using grain size data from 17 locations across the project area, to provide an initial scoping of risk to sensitive marine habitat areas from resuspension, and to help determine parameters for a possible full sediment plume analysis. Dispersion in the absence of currents (a hypothetical generic aqueous environment) was modeled based on common dispersal coefficients for different grain sizes drawn from the accumulated body of sediment plume studies. The generic dispersion pattern for locations along the BCIB alignment is shown in Exhibit 6-143.

From the generic dispersion model results shown below, it is clear that the risk of sediment movement into areas of critical habitat is very high without mitigation, even before tidal and wind-driven currents and other mixing factors are considered. Coral habitat areas in the Mariveles nearshore zone will be subject to siltation from re-suspension of silt present in sediments nearby, as will the Naic Fish Sanctuary. Sediments are more coarse-grained along the alignment near Corregidor Island, but fine sands present in this area have clear potential to cause siltation effects over a wide swath of coral habitat in the nearshore zone off the east of the island's Tail End, and extending into San Jose Bay between Corregidor and Caballo Islands. Based on this preliminary analysis, it was concluded that a full sediment plume analysis taking account of currents would be certain to show sufficient dispersal into critical habitat to warrant active mitigation during marine works. The expense of performing such an analysis was thus not justified, and the need for tight sediment control in the vicinity of critical habitat was considered a trustworthy assumption. Dispersion potential from at-

[220] The high interest in seabed mining within Manila Bay is a testament to the strength of the local market for fill material.

surface releases is assumed to be similar for any silts and fine sand that may be present in material excavated from pile interiors, and also for cementitious material in concrete washout generated by floating batch plants; although the volume of fugitive releases from these sources is likely to be orders of magnitude lower that what would be expected from re-suspension during dredging, foundation excavation and jetty works.

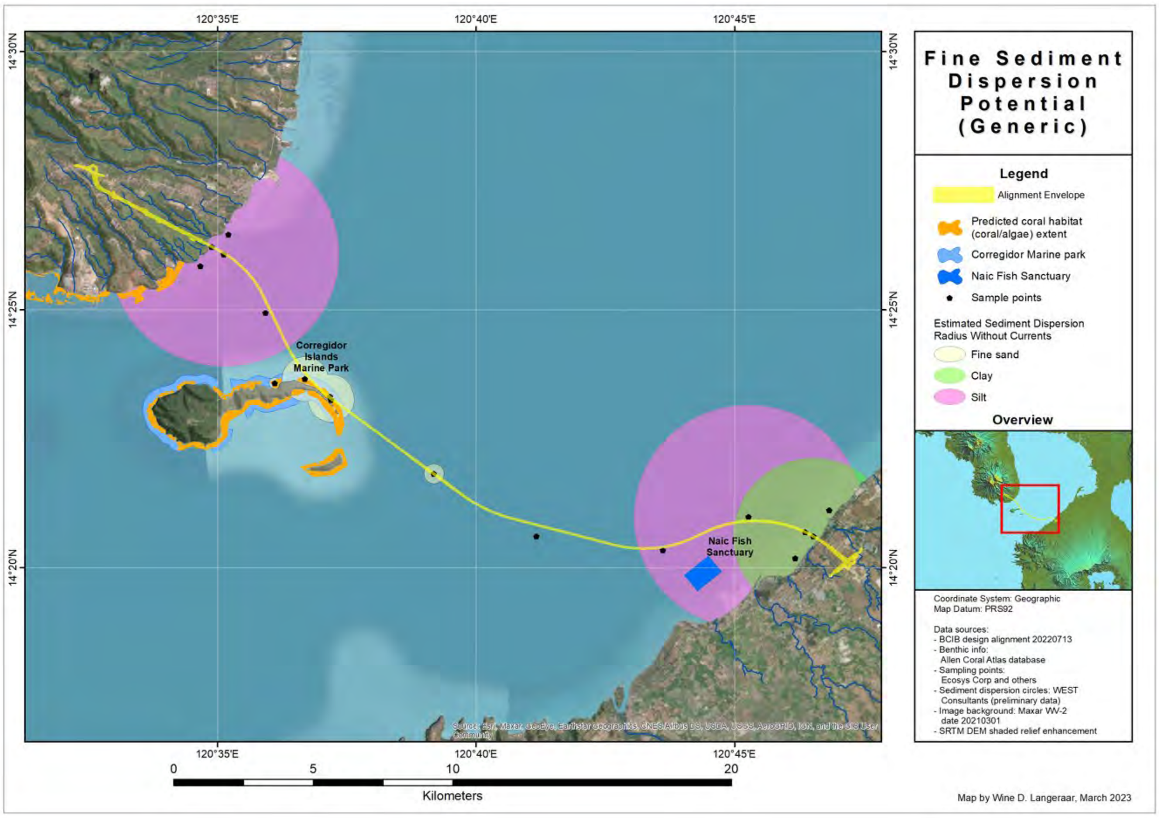


Exhibit 6-143 Generic Sediment Dispersion Model Based on Grain Size

Prescribed Mitigation. Based on the analysis discussed above, aggressive mitigation of siltation and sedimentation impacts from sediment resuspension and at-surface releases is prescribed for all marine works (including dredging, excavation, placement and removal of temporary jetties, excavation of pile interiors and concrete pouring) in the following zones: (1) Mariveles nearshore zone (0–25 m depth), including both the alignment and drydock facility; (2) Corregidor Island nearshore zone (0–25 m depth); and (3) Naic nearshore zone (0–25 m depth). Mitigation shall consist of careful deployment of surface-to-seafloor silt curtains around foundation works (localized dredging), pile installation works (handling of material removed from pile interiors), dredging works and jetty construction/removal (Mariveles shore), and concrete pouring works. Wherever feasible, silt curtains should be deployed in a tight configuration around individual work sites rather than used in a broader areal containment strategy encompassing many work sites within a single curtained zone, in order to limit the area of seafloor exposed to intense siltation and sedimentation. At sensitive locations, automated monitoring buoys will be used to record turbidity in real time. Thresholds will be set based on baseline monitoring and acceptable thresholds of turbidity above the instantaneous ambient level to protect vulnerable receptors such as coral habitat and protected areas. In response to an exceedance, construction work will be adaptively managed including the possibility of stopping work until turbidity returns to acceptable levels.

Concrete washout generated by floating batch plants must be captured, recycled, and treated in a manner consistent with international best practice (US EPA or similar).[221] Solid components of washout should be recycled back into the batch plant or disposed of with other spoils. Any discharge of the liquid washout component from floating batch plants after on-barge treatment must be confirmed by testing to meet the DAO 2016-08/DAO 2021/19 standard for discharge to Class SB waters (outside the CIMP and Mariveles nearshore zone) or Class SA waters (within the CIMP and Mariveles nearshore zone). Each marine works PC operating or overseeing operation of a floating batch plant shall prepare a Concrete Batch Plant Management Plan, for review and approval of the CSC prior to the start of works. A sample outline for such plans is provided in Appendix B to the EMP.

As mentioned above, sea disposal of marine spoils including dredged and excavated seafloor sediments and material excavated from pile interiors is not expected at the time of writing, but contractors may be tempted to adopt this method if not expressly prohibited from doing so. Each PC involved in marine works generating spoils shall be required to prepare an activity- and site-specific Marine Spoils Management Plan including a Best Practical Environmental Options study to identify the most appropriate reuse or disposal route, for review and approval of the CSC before any spoils-generating activity begins. The plan must specify arrangements for direct shipping to identified customers, and may only include sea disposal among the approved method statements if it is the best option. A sample outline for a Marine Spoils Management Plan is provided in Appendix B to the EMP.

Mitigation of sediment impacts cannot be expected to be 100% effective, so there will be a residual impact in coral habitat areas within which works are carried out, even with competent deployment of silt curtains. For critical habitat areas in the vicinity of the marine works, residual effects will have to be compensated (along with other marine degradation from other impact sources) through a biodiversity offset to be formulated as an action plan under the auspices of the project's Biodiversity Action Plan. Provided that silt curtains are deployed as indicated near the Naic Fish Sanctuary, the residual impact of fugitive suspended material on this critical habitat element can be considered negligible, given the distance between the alignment and northern boundary of the sanctuary (approximately 750 m).

IMPACT SUMMARY					
Impact:	Siltation and sedimentation				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Widespread	Significance:	Moderate
Mitigation:	• Each PC responsible for marine works involving dredging, placement and removal of temporary jetties, excavation for spread-foot foundations, excavation of pile interiors or concrete pouring shall ensure competent and consistent deployment of surface-to-seabed silt curtains in a tight configuration around said works whenever they are carried on within the following zones : (1) Mariveles nearshore zone (0–25 m depth), including both the alignment and drydock facility; (2) Corregidor Island nearshore zone (0–25 m depth); and (3) Naic nearshore zone (0–25 m depth) • Each marine works PC operating or overseeing operation of a floating batch plant shall prepare a Concrete Batch Plant Management Plan, for review and approval of the CSC prior to the start of works • Each marine works PC shall confirm by testing that any discharges of washout water from floating batch plants after on-barge treatment meet the DAO 2016-08/DAO 2021/19 standard for discharge to Class SB waters (outside the CIMP and Mariveles nearshore zone) or Class SA waters (within the CIMP and Mariveles nearshore zone)				

[221] US EPA. 2012. Stormwater Management Best Practice – Concrete Washout. EPA 833-F-11-006. February 2012. www.epa.gov/npdes/pubs/concretewashout.pdf.

IMPACT SUMMARY	
	• Each PC responsible for generating marine spoils, including dredged and excavated seafloor sediments and material excavated from pile interiors, shall identify buyers for said fill material prior to the start of works, and shall only dispose of spoils by sale, and never by sea disposal • Each PC responsible for generating marine spoils, including dredged and excavated seafloor sediments and material excavated from pile interiors, shall prepare a Marine Spoils Management Plan, for review and approval by the CSC prior to the start of works, and implement said plan thoroughly and consistently for the duration of works
Residual:	Expected, to be addressed in relation to critical habitat areas under auspices of Biodiversity Action Plan

6.2.2.5 Marine Contamination from Spills and Leaks

Anticipated Impact. Many of the same noxious and hazardous substances that are used in on-land construction, such as fuels, lubricants, coolants and hydraulic fluid, will also be present on the vessels and platforms employed on the marine works. Leaks from motorized equipment and fuel spills may either wash off decks, or end up in vessel bilges and get pumped out periodically along with bilge water. Single inadvertent releases of hydrocarbons via these pathways are unlikely to cause acute problems due to the very large assimilative capacity of the bay's waters, but will contribute to the overall cumulative impact of pollutants already affecting water quality and marine life in the project environment, and must be prevented as a matter of responsible practice. It is anticipated that at least one fueling station will be operated at the waterfront in Mariveles to serve project vessels, and this would be considered a relatively high-risk site for spills derived from careless operation, irregular inspection, and facility design that takes inadequate account of exposure to rough weather and possible vessel strikes.

On the floating batch plants that will supply the marine concrete works, a number of hazardous materials will be stored and handled. Portland cement typically contains a number of heavy metals, and is strongly caustic. Fly ash, which is commonly used to improve the workability of concrete slurry, is quite variable in chemical composition, depending on the characteristics of the coal of whose combustion it is a by-product, but often contains heavy metals including arsenic and lead. Various chemical admixtures, typically in liquid form, may also be used. The floating batch plants will be re-supplied on a regular basis from supply barges, and the potential for spills will likely be greatest during transfer between vessels, particularly in rougher weather.

Paving work on the bridge and viaduct decks presents some potential for releases of sealing oil and loose asphalt to the waters below. This is a short-term and probably low-magnitide risk, but should nevertheless be mitigated to the extent possible.

Prescribed Mitigation. To prevent leaks of noxious fluids, contractors shall be required to use only newer-model (less than 15 years old) machinery, including boats, pumps, cranes, pile drivers and any other motorized equipment. All motorized equipment should be inspected daily for leaks, and any leaks documented should be repaired at the earliest convenience, before the situation worsens. All storage tanks should also be inspected daily, including the security of the arrangements for keeping them in place despite wave action. In general, on-board storage should be avoided if possible, in favor of frequent re-supply from supply vessels, to reduce the risk of a large spill happening in rough weather.

Each contractor shall maintain adequate supplies of spill containment and cleanup equipment and material (e.g., floating booms, absorbent and adsorbent materials, pumps, etc.) on board each vessel as appropriate, and provide regular training to all regular personnel in its deployment. Each marine PC shall prepare a Marine Spill Prevention and

Response Plan for its on-the water operations, including protocols for determining under what sea and weather conditions transfers of material between vessels should be not be attempted. Regular training should be provided to vessel operators and barge work crews on proper implementation of the plan in the event of a spill. A sample outline for a Marine Spill Prevention and Response Plan is provided in the report Annexes. The CSC shall review and approve the plan prior to the start of any marine works.

Any fueling stations set up to serve project vessels must be designed to withstand wave action and storm surge typical of local conditions during a strong typhoon, as well as direct hits from vessels due to operator error. The CSC shall review and approve designs and operation procedures for all waterside fueling stations.

During paving works, paving contractors shall be required to seal off all deck scuppers to prevent spillage of sprayed oils and loose asphalt, and to sweep up loose asphalt left after paving.

IMPACT SUMMARY					
Impact:	Marine contamination from spills and leaks				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized/widespread	Significance:	Moderate
Mitigation:	• Each marine works PC shall prepare a Marine Spill Prevention and Response Plan, for review and approval by the CSC prior to the setup of any marine works • Each marine works PC shall consistently maintain supplies and equipment for spill response and cleanup on each vessel or platform where noxious fluids are handled, in accordance with its Marine Spill Prevention and Response Plan, for the entire duration of marine works • Each marine works PC shall provide regular training to all on-the-water personnel regarding spill prevention and response, in accordance with its CSC-approved Marine Spill Prevention and Response Plan, for the duration of marine works • Each PC responsible for operating or overseeing operation of a waterside fuel station shall ensure that the facility is designed to withstand wave action and storm surge typical of local conditions during a strong typhoon, as well as vessel strikes, and shall obtain the approval of the CSC for facility designs and operating procedures prior to facility setup • Each PC overseeing paving works on the bridges or viaducts shall ensure that paving contractors seal off all deck scuppers before starting works, and sweep up all loose asphalt after paving, to limit releases to the water below					
Residual:	None expected				

6.2.2.6 Marine Water Enrichment From Poor Human Waste Management

Anticipated Impact. Large numbers of workers will be involved in the marine works, with rolling shifts around the clock and crews working far from land for hours on end; thus, significant human waste will be generated on work vessels and platforms. The dispersive and assimilative capacity of the bay waters is such that direct discharges of this human waste output would be unlikely to cause noticeable local effects in most areas along the alignment, although it is possible that a localized eutrophication effect could be produced in very nearshore locations during calm weather. However, daily releases of sewage from the workforce would contribute to the cumulative impact of the massive amounts of untreated human waste that finds its way to the waters of Manila Bay every day, and should be strictly avoided as a matter of good practice.

Prescribed Mitigation. With the exception of small runabouts that visit land frequently throughout the day, every vessel and work platform shall be equipped with toilets for the use of workers. Each toilet facility shall be connected to a holding tank which can either be pumped out by a collection vessel, or emptied when the boat returns to shore. Dedicated septic systems shall be built at on-land staging areas on both sides of the bay to process the human waste pumped ashore.

Each marine works PC shall prepare a Marine Sanitation and Solid Waste Management Plan, including provisions for at-sea human waste collection and on-land treatment, for the review and approval of the CSC prior to the start of marine works. A sample outline for a Marine Sanitation and Solid Waste Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Enrichment of marine waters from inadequate human waste management at marine work sites				
Direction:	Negative	Type:	Direct/indirect	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	Low
Mitigation:	• Each marine works PC shall prepare a Marine Sanitation and Solid Waste Management Plan, for review and approval of the CSC prior to the start of works • Each marine works PC shall consistently ensure that adequate toilet facilities are provided for all offshore workers, and that human waste is collected and properly treated on land, in accordance with the Marine Sanitation and Solid Waste Management Plan, for the duration of the marine works • Each marine works shall develop on-land septic treatment for human waste collected offshore, meeting specifications of the National Plumbing Code of the Philippines and subject to approval of the Mariveles LGU				
Residual:	None expected				

6.2.2.7 Marine Solid Waste Impacts

Anticipated Impacts. The waters of Manila Bay are generally already heavily affected by solid waste, predominantly plastics, and the BCIB project area is no exception. Solid wastes generated in the course of marine construction works will add to this existing problem if not adequately managed.

Prescribed Mitigation. Dumping and inadvertent release of any kind of solid waste at sea shall be strictly prohibited. Secure waste collection receptacles (firmly anchored and with tight fitting lids) shall be provided on every vessel and work platform, and the waste collected shall be brought to shore on a regular basis. Each shore base shall have a waste management facility, where waste brought from offshore sites and vessels can be sorted and temporarily stored prior to collection by municipal waste collection services and recycling firms.

Each marine works PC shall prepare a Marine Sanitation and Solid Waste Management Plan, including provisions for at-sea collection of solid waste and appropriate on-land storage, segregation, recycling and disposal, for the review and approval of the CSC prior to the start of marine works.

IMPACT SUMMARY					
Impact:	Contribution to marine solid waste problem of Manila Bay				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	Low
Mitigation:	• Each marine works PC shall strictly prohibit dumping, littering and careless waste handling by any person involved in marine operations under its control • Each marine works PC shall preapre a Marine Sanitation and Solid Waste Management Plan, including provisions for at-sea collection of solid waste and appropriate on-land storage, segregation, recycling and disposal, for the review and approval of the CSC prior to the start of marine works, and thoroughly and consistently implement all provision of said plan for the duration of the works				

IMPACT SUMMARY	
	• Each marine works PC shall install and properly operate and maintain a solid waste management facility at shore sites to receive, and store solid waste brought ashore from vessels and work platforms, and process waste for onward recycling and disposal in accordance with the marine Sanitation and Solid Waste Management Plan
Residual:	None expected

6.2.2.8 Ecological Effects of Artificial Light at Night (ALAN)

Anticipated Impact. As discussed above in relation to bridge lighting concerns, artificial light at night is known to disrupt numerous aspects of marine ecology. It is anticipated that the marine works on the BCIB project will have to proceed around the clock in order to meet the implementation schedule, and work lighting will, accordingly, be intensively deployed over water for the duration of the marine works. Although the exact ecological consequences of high-intensity work lighting in any particular locations along the alignment are difficult to predict, it can be expected to have a significant localized impact on marine life for the duration of lighting use at each work station. Some ecological effects, such as those involving fish aggregation and dispersal of coral larvae, are likely to cascade well beyond the immediate work area. This will be a temporary and relatively short-term impact in many locations, but intensive work sites like the four monopole towers, bridge anchor piers and turnaround structure are likely to be lit consistently for well over two years. The significance of these effects is not known, but may not be negligible, and should be mitigated on a precautionary basis.

Prescribed Mitigation. The impacts of work lighting at marine construction sites cannot be eliminated, but there is significant scope for minimizing light emissions to the water surface. All work lighting should be equipped with shielding in order to reduce lateral emissions. Lighting should be tightly focused on work surfaces (mostly the decks of barges and work platforms) to prevent direct light emissions to the water surface to the extent possible. General areal lighting should be strictly limited to what is necessary to ensure safety of the work process (particularly as regards operation of cranes and booms) and safety of navigation.

There will be an unavoidable but unquantifiable residual effect in relation to work lighting. For critical marine habitat areas under the alignment (Mariveles nearshore coral zone, Corregidor Islands Marine Park, this residual effect will be factored into a biodiversity offset to be formulated and implemented under the auspices of the Biodiversity Action Plan. Effects on the turtle nesting beach at Naic will be managed through a Marine Turtle Management Plan.

IMPACT SUMMARY					
Impact:	Ecological effects of work lighting used at marine works sites				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Certain
Duration:	Medium-term	Scope:	Localized	Significance:	Unknown
Mitigation:	• Each marine works PC to equip all work lighting used on marine works sites with shielding to reduce lateral light emissions, and position work lighting to light only work surfaces, avoiding direct light emissions to the water surface to the extent possible • Each marine works PC to limit general areal lighting on marine work sites to that which is necessary to ensure the safety of workers and safety of navigation				
Residual:	Expected, and to be addressed for critical habitats (Mariveles nearshore coral zone, Corregidor Islands Marine Park) under Biodiversity Action Plan				

6.2.2.9 Direct Injury of Marine Wildlife

Anticipated Impact. Larger mobile marine animals, such as whales, sharks, rays and turtles, are susceptible to vessel strikes; the risks are highest in the case of fast-moving vessels and those with deep hulls and propellers, and for species that spend significant time at or near the surface for purposes of feeding or breathing (mostly marine mammals and marine turtles). In areas where many vessels and other noise sources are operating simultaneously, marine species may be more likely to become confused, potentially lowering the effectiveness of their vessel avoidance behaviors. Most of the large marine species present in the BCIB project area are threatened species, and many are protected by national law. Minimizing the risk of vessel strikes should therefore be considered a priority.

Prescribed Mitigation. In order to reduce the risk of vessel strikes, the operating speed of all vessels involved in construction shall be strictly limited to 10 knots when within 200 m of observed marine wildlife or at the instruction of a marine fauna observer (MFO). A standard Marine Wildlife Protection Protocol for use in the event that readily observable marine megafauna such as whales, dolphins, sharks and marine turtles are detected shall be adopted by all marine works contractors. Dedicated MFOs will be employed to identify large marine vertebrates in the vicinity of the works. In addition vessel watch keepers will be given training and awareness raising in marine fauna collision avoidance and observation The Marine Wildlife Protection Protocol shall be followed whenever marine megafauna are observed (by anyone) within 2 km of marine works sites, and shall be as follows:

1. Initial observer immediately issues radio alert to all marine works contractors on shared project channel, indicating general type of marine wildlife spotted, position of the wildlife, direction of travel of the wildlife (if discernible).

2. Operators of all project vessels within 2 km of the indicated wildlife position immediately go into slow operation mode (vessel speed 3 knots or less) and station a spotter on the bow to alert the helm of any wildlife spotted.

3. All subsequent observations of the reported wildlife (by anyone) shall be re-reported with updated position.

4. All vessels operating within 2 km of the original siting position shall remain in slow operation mode with a spotter stationed on the bow until one of two conditions is met: (1) the wildlife is observed moving to a location more than 2 km outside the works zone; or (2) the wildlife has not been reported again for a period of one hour.

Prior to the start of marine works, the CSC shall establish a project-specific radio call channel, and this shall be designated as the channel for to be used when activating the Marine Wildlife Protection Protocol. Each marine works shall incorporate the Marine Wildlife Protection Protocol as described here as a method statement in its CEMMAP, and the CSC shall verify its inclusion. Each marine works PC shall provide training to its personnel and personnel of its sub-contractors, as part of induction training and refresher training.

IMPACT SUMMARY					
Impact:	Direct injury and mortality of marine megafauna due to vessel strikes				
Direction:	Negative	Type:	Direct	Probability:	Low

IMPACT SUMMARY					
Duration:	Medium-term	Scope:	Localized	Significance:	Unknown
Mitigation:	• Each marine works PC shall ensure that operators of all vessels involved in works under its control consistently observe a maximum speed limit of 10 knots during daylight hours and 5 knots from dusk to dawn (vessels with displacement over 3 MT), or 12 knots during daylight hours and 7 knots from dusk to dawn (vessels with displacement 3 MT or less) • Each marine works PC shall incorporate the standard project Marine Wildlife Protection Protocol as a method statement in its CEMMAP, to be confirmed by the CSC during review and approval of each CEMMAP • Each marine works PC shall provide training to all of its on-the-water personnel, and all on-the-water personnel of its sub-contractors, in proper use of the Marine Wildlife Protection Protocol as part of regular induction and refresher training				
Residual:	Expected, but significance unknown				

6.2.2.10 Underwater Noise and Vibration

Anticipated Impact. Anthropogenic marine noise has received increasing attention from policy makers and the general public alike over the last decade, spurred by dissemination in mainstream media of oceanic acoustical studies that have revealed just how noisy the unseen environment beneath the waves has become due to the global growth of shipping, undersea mineral exploration, military sounding activity, and offshore sustainable energy installations.[222] Perhaps the greatest concern has been accorded marine mammals, as ocean noise has increasingly been suspected as a possible causative factor in highly visible mass beach strandings of various cetacean species around the world, but recent acoustical and ecological research has shown that the impact of anthropogenic marine noise is experienced in many previously unappreciated ways, and by many other types of organisms besides marine mammals. Among other phenomena, studies have documented noise-related avoidance behaviors affecting habitat use and reproduction; deafness and mortality in fish and invertebrates; behavioral effects in crustaceans; and broad influence on the loss of biodiversity.[223] Experimental work on seagrass suggests that noise may also affect the growth, success and distribution of marine flora.[224]

Marine construction comprises an inherently noisy set of activities typically involving heavy machinery and vessels with powerful drivetrains; percussive processes including impact pile-driving, vibrational pile-driving, and inadvertent contact between heavy steel items; and frictional-abrasive activities like boring of pile shafts. Underwater noise from marine construction is, in contrast to other forms of marine pollution, quite ephemeral; when the noise emission ceases, the underwater soundscape returns to normal very quickly. Research on animal behavioral responses (e.g., site avoidance, changes in communication and feeding activity) to marine construction noise emissions have been shown to subside to negligible levels within a few days after cessation, at least for the mammal species studied.[225] However, it is probable that when high-intensity construction noise sufficient to

[222] (1) Duarte et. al. 2021. The soundscape of the Anthropocene ocean. Science 05 Feb 2021, Vol. 371, Issue 6529.; (2) Hastings, M.C. 2008. Coming to Terms With the Effects of Ocean Noise on Marine Animals. Acoustics Today (April 2008): 22–34.

[223] (1) Popper, A.N and A.D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology 2019; 94: 692–713.; (2) Tidau, S. and M. Briffa. 2016. Review on beahavoioral impacts of aquatic noise on crustaceans. Proceedings of Meetings on Acoustics, Vol. 27, 010028 (2016), Acoustical Society of America.; (3) Mooney, T.A., M.H. Andersson and J. Stanley. 2020. Acustic Impacts of Offshore Wind Energy on Fishery Resources: An Evolving Source and Varied Effects Across a Wind Farm's Lifetime. Oceanography 33(4): 82–95.; (4) Herbert-Read, J.E., L. Kremer, R. Bruintjes, A.N. Radford and C.C. Iannou. 2017. Anthropogenic noise pollution from pile-driving disrupts the structure and dynamics of fish shoals. Proceedings of the Royal Society B (284: 20171627.

[224] Solé, M., M. Lenoir, M. Durfort, J-M Fortuño, M. van der Schaar, S. De Vreese and M. André. 2021. Seagrass *Posidonia* is impaired by human-generated noise. Communications Biology (2021) 24:743.

[225] Brandt, M.J., A. Diederichs, K. Betke an G. Nehls. 2011. Response of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Marine Ecology Progress Series 421: 205–216.

cause hearing loss, injury, death, or behavioral changes is emitted for an extended period in one general work location (as when large numbers of piles are driven for an offshore windfarm, long bridge, or major pier works), fundamental and lasting ecological change may be triggered. For example, absence or reduced presence of grazing species over a period of many months may allow algal species to grow unchecked and crowd out other types of benthic organisms, or extended absence of top predators may allow populations of their prey to get out of control and decimate populations of faunal and floral species lower down the food chain. These kinds of knock-on ecological change are very difficult to predict.

Marine pile installation is the underwater noise source of greatest concern in relation to the BCIB project, due to the intensity of noise generated by impact driving, which is expected to be the preferred method for about 45–66 % of the 2,288 piles that will be installed.[226] Pile driving will be carried on more or less continuously for a period of 43 months, and for all but seven months of that time, more than one piling rig will be operational (see Exhibit 6-144).

Exhibit 6-144 Projected Temporal Overlap in Piling Rig Operation

Number of Rigs in Operation	Duration in Months
1	7
2	14
3	10
4	12
	Total months of piling: 43

Piling work will be a critical path activity in the project's construction schedule, and it is anticipated that piling rigs will have to operate 24 hours per day, seven days per week in order to keep the project on track. The expected high-intensity, continuous operation of impact piling rigs is significant, because noise exposure effects are cumulative. While the peak sound energy (and speed of the rise and fall to and from the peak) of impulsive noise emissions is central to understanding injury potential, the frequency of peaks (which determines recovery time) and number of peaks in a given time period (i.e., how many times a potentially injurious pulse is experienced by the tissues of an organism) are also critical.[227] Piling with impact hammers is by nature highly repetitive (estimated number of hits per day is 7,000 for the rigs working the BCIB project), and piling activity carried on continuously for months on end can be expected to have an outsized cumulative dimension as regards potential for effects on organisms near the work location.

The vulnerability of marine species to pile driving noise is a function of both proximity and physiology. Sound energy degrades with increasing distance from the source, and those species present nearest the sound source due to the particular habitat resources found there are obviously most susceptible to being exposed to damaging levels of noise energy. Those species that are not able to move away from the noise source due to low mobility, or because suitable alternative habitat is not available in the vicinity, are especially vulnerable.

[226] For about 21% of piles, installation may be either by driving or boring, depending on the contractor's assessment of feasibility.

[227] Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Heter, H. Rogers, B.L. Southall, D.G. Zeddies and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered With ANSI. ASA S3/SC1.4 TR-2014.

The distribution of mobile marine species in the zone along the BCIB alignment is very poorly understood, beyond the general association of demersal species with soft bottom habitat and of reef-dwelling species with coral reef habitat. As nearly all of the Manila Bay seafloor consists of soft bottom habitat, most demersal species can probably be considered unlikely to face significant limitation on migration away from the piling zone for the duration of the works. Most pelagic species not strongly associated with coral reefs can similarly be expected to move away from the works without difficulty finding suitable alternative habitat. Some research has shown that marine mammals tend to avoid marine construction works and associated vessel traffic, at least temporarily.[228] The more mobile reef organisms living on the reef areas along the Mariveles nearshore slope may be able to migrate to areas of similar habitat character found both to the northeast and southwest of the alignment, and those found in the coral habitat zone close to the works near Corregidor Island should be able to move to more sheltered reef locations further along the island's northern shore and within San Jose Bay; however, some research suggests that site fidelity of at least some reef-associated species may limit the propensity for migration to quieter locations.[229] Sessile and limited-mobility faunal organisms, including corals, sponges, zoanthids, molluscs, and the many small crustaceans and other invertebrates living within and on the seafloor, have no means of escape, and those located in close proximity to piling works will inevitably be exposed to extreme levels of acoustic energy.

With regards to physiology, current science indicates that different types of species are more and less likely to experience various kinds of trauma from extreme noise exposure. Species with swim bladders (including many of the bony fishes), are vulnerable to internal rupture of these essential organs by high-amplitude percussive sound, while those that do not (including most cartilaginous fishes) are less likely to sustain injuries.[230] Species that have internal ears and other auditory-sensory organs (which includes all marine mammals, marine turtles and fish) may sustain temporary or permanent impairment of hearing, affecting their ability to communicate, detect prey and predators, and avoid approaching vessels.[231] Species that rely on sonar for navigation, prey-finding and communication (e.g., the toothed whales, including dolphins) are considered highly susceptible to disruption of these basic subsistence activities by anthropogenic noise, in a phenomenon known as masking (extraneous sound overwhelming or modifying the sound signals normally accessed).[232] Baleen whales do not use echolocation, but rely extensively on vocal communication, which is also likely to be subject to disruption by large and multi-source inputs of anthropogenic sound energy. Very little is known about the physiological effects of noise from pile driving on sessile reef animals such as corals and sponges, but it may reasonably be hypothesized that extreme noise is at least potentially capable of affecting

[228] Culloch, R.M., P. Anderwald, A. Brandecker, D. Herlin, B. McGovern, R. Pinfield, F. Visser, M. Jessop and M. Cronin. 2016. Effects of construction-related activities and vessel traffic on marine mammals. Marine Ecology Progress Series 549: 231–242.

[229] Iafrate, J.D., S.L. Watwood, E.A. Reyier, D.M. Scheidt, G.A. Dossot and S.E. Crocker. 2016. Effects of Pile Driving on the Residency and Movement of Tagged Reef Fish. PLoS ONE 11(11): e0163638.

[230] Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Heter, H. Rogers, B.L. Southall, D.G. Zeddies and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered With ANSI. ASA S3/SC1.4 TR-2014.

[231] Mooney, T.A., M.H. Andersson and J. Stanley. 2020. Acoustic Impacts of Offshore Wind Energy on Fishery Resources: An Evolving Source and Varied Effects Across a Wind Farm's Lifetime. Oceanography 33(4): 82–95.

[232] Perry, C., 1998. A review of the impact of anthropogenic noise on cetaceans. In Scientific Committee at the 50th Meeting of the International Whaling Commission (27): 1-27.

sensory functions vital to feeding (coral are known to respond to non-anthropogenic reef noises such as surf breaking), if not injury to bodily tissues.

To help assess the risk of underwater noise impacts from the BCIB project, an acoustic modeling study was carried out in 2022-2023 by Illingworth & Rodkin, Inc., based on assumptions gathered from the marine design teams regarding key parameters affecting noise generation (e.g., pile numbers, pile diameters, pile locations, water depth, construction schedule, energy delivered by piling rigs, number of hits per day) and noise propagation (e.g., bathymetry, seabed material). Noise impacts were modeled for marine mammals in three hearing frequency groups (high frequency – HF; mid frequency – MF); low frequency – LF). The modeling report is included in the Annexes to this EIA report.[233]

Marine mammals. As discussed in the marine baseline profile, the distribution and abundance of marine mammals in Manila Bay and nearby offshore waters are not well known, but probability of presence can be inferred from range maps, habitat preferences, scientific literature, media reports and eyewitness accounts. It is known that all marine mammals present in and around Manila Bay are cetaceans; dugongs were extirpated decades ago, and there are no seals or sea lions in Philippine waters. Exhibit 6-145 lists all cetacean species considered to have a non-negligible probability of at least transient presence in the BCIB project area, and the hearing frequency group of each species. The hearing frequency range of cetaceans is thought to influence potential noise exposure effects, much as the audible range of the human ear is recognized in assessments of air-propagated noise. Pile driving noise tends to be concentrated in the lower end of the frequency spectrum.[234]

Exhibit 6-145 Marine Mammals by Hearing Frequency Group and Probability of Local Presence

Species	IUCN Status	National Conservation Status	Frequency Group	Probability of Presence
Balaenoptera edeni (Bryde's Whale)	LC	protected (EN)	LF	Low
Balaenoptera omurai (Omura's Whale)	DD	protected (EN)	LF	Low
Feresa attenuata (Pygmy Killer Whale)	LC	protected (EN)	MF	Confirmed
Globicephala macrorhyncus (Short-Finned Pilot Whale)	LC	protected (EN)	MF	Medium
Grampus griseus (Risso's Dolphin)	LC	protected (EN)	MF	Confirmed
Kogia breviceps (Pygmy Sperm Whale)	LC	protected (EN)	HF	Confirmed
Kogia sima (Dwarf Sperm Whale)	LC	protected (EN)	HF	Confirmed
Lagenodelphis hosei (Fraser's Dolphin)	LC	protected (EN)	MF	Medium
Megaptera novaeangliae Humpback Whale	LC	protected (EN)	LF	Very low
Mesoplodon densirostris Blainville's Beaked Whale	LC	protected (EN)	MF	Very low
Mesoplodon gingkodens Gingko-Toothed Beaked Whale	DD	protected (EN)	MF	Very low

[233] Bataan–Cavite Interlink Bridge Project – Underwater Acoustic Assessment. April 14, 2023. Prepared by Illingworth Rodkin, Inc.
[234] Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Heter, H. Rogers, B.L. Southall, D.G. Zeddies and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered With ANSI. ASA S3/SC1.4 TR-2014.

Species	IUCN Status	National Conservation Status	Frequency Group	Probability of Presence
Peponocephala electra (Melon-headed whale)	LC	protected (EN)	MF	Confirmed
Physeter macrocephalus (Sperm Whale)	VU	protected (EN)	MF	Very low
Pseudoorca crassidens (False Killer Whale)	NT	protected (EN)	MF	Very low
Stenella attenuata (Pantropical Spotted Dolphin)	LC	protected (EN)	MF	Confirmed
Stenella coeruleoalba (Striped dolphin)	LC	protected (EN)	MF	Confirmed
Stenella longirostris (Spinner dolphin)	DD	protected (EN)	MF	Confirmed
Steno bredanensis (Rough-toothed dolphin)	LC	protected (EN)	MF	High
Tursiops aduncus (Indo-Pacific bottlenose dolphin)	NT	protected (EN)	MF	High
Tursiops truncatus (Common Bottlenose Dolphin)	LC	protected (EN)	MF	High
Ziphius cavirostris (Cuvier's Beaked Whale)	LC	protected (EN)	MF	Very low
Hearing frequency groups: LF = low frequency; MF = medium frequency; HF = high frequency				

Source: Compiled by consultant

The breakdown of species by hearing class and probability is further drawn out in Exhibit 6-146, illustrating that most species thought to be present are mid-frequency species. Of the confirmed species, six are mid-frequency and two are high-frequency. Low-frequency species are not thought to have a strong presence within Manila Bay, but are likely present in nearby offshore waters. All marine mammal species are protected under Philippine law.

Exhibit 6-146 Probability of Manila Bay Cetaceans by Hearing Class

Hearing Frequency Class	Total Species	Probability of Species Presence in Manila Bay				
		Confirmed	High	Medium	Low	Very low
High-frequency (HF)	2	2	-	-	-	-
Mid-frequency (MF)	16	6	3	2	-	5
Low-frequency (LF)	3	-	-	-	2	1
All	21	8	3	2	2	6

The underwater noise impact modeling results for mammals indicate that the effects of pile driving noise will be felt at considerable distances from the alignment. Exhibit 6-147 shows the distances at which mammals in the three hearing frequency classes will experience problematic effects based on the ‘simple case’ of pile driving at a single pier with two piles, with and without the use of bubble curtains as mitigation. Effects are referenced to thresholds used in marine assessments in the United States, as defined by the national Marine Fisheries Service, pursuant to the Marine Mammal Protection Act. Bubble curtains are a commonly used underwater noise mitigation technology. Generally speaking, structural discontinuities occurring in any medium through which sound waves are propagating tend to disrupt and degrade the propagation, thus partially attenuating sound energy; the boundaries of air bubbles occurring in water are one kind of discontinuity. Bubble curtains harness the power of discontinuities to attenuate piling noise by continuously flooding the water column surrounding a repeatedly vibrating pile with a high density of small bubbles. The bubbles are generated by forcing air from a barge-mounted compressor through a perforated pipe positioned in a circular configuration on the seafloor around a pile or group of piles. Bubble curtains have been deployed effectively in water up to 50 m deep, which is the approximate maximum water depth along the BCIB alignment.[235]

The problematic effects categories shown in Exhibit 6-147 are Level A (direct physical injury, including hearing loss) and Level B (behavioral effects). Hearing loss in at least part of the auditory spectrum usually accessible to the ear may affect an individual's ability to communicate, forage, navigate or perceive and avoid dangers, and is likely to lead to eventual physical decline and death. Physical internal injury can reasonably be expected to threaten short-term or long-term survival. Behavioral effects of exposure to high-energy underwater noise may include avoidance (moving away and diving), startle responses, stress, faster and frenzied swimming, and cessation of feeding and vocalization, and may lead to deterioration of physical condition from excess energy use and reduced food intake, reduced social interaction, and even injury from excessive deep diving.[236]

Exhibit 6-147 Modeled Piling Noise Impacts on Marine Mammals (Single 2-Pile Pier)

<table>
<tr><th rowspan="2">Species</th><th colspan="2">Level A Criterion[1]</th><th colspan="2">Level B Criterion[2]</th></tr>
<tr><th>With BC (m)</th><th>Without BC (m)</th><th>With BC (m)</th><th>Without BC (m)</th></tr>
<tr><td>HF</td><td>2,225</td><td>7,830</td><td rowspan="3">3,667</td><td rowspan="3">21,464</td></tr>
<tr><td>MF</td><td>106</td><td>373</td></tr>
<tr><td>LF</td><td>4,071</td><td>14,324</td></tr>
<tr><td colspan="5">[1] Level A harassment is defined by the National Marine Fisheries Service as "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild."
[2] Level B harassment is defined as "Any act of pursuit, torment, or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering."</td></tr>
</table>

Source: Illingworth & Rodkin, Inc.

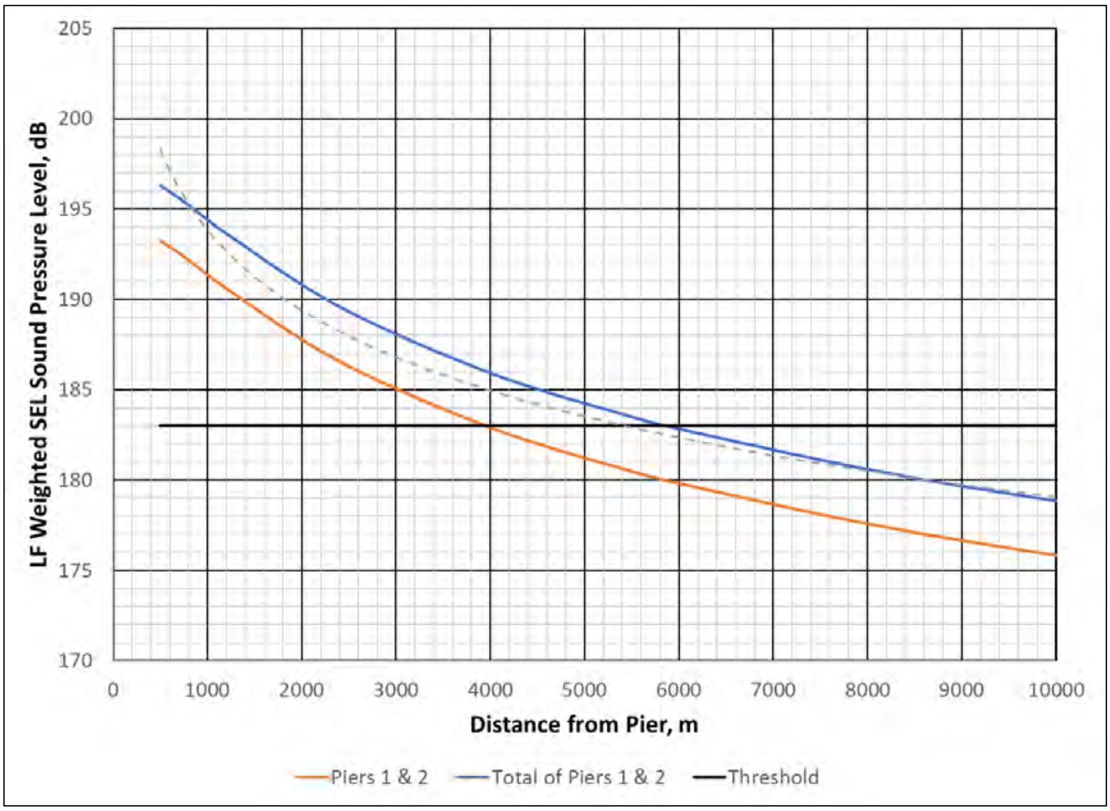
It is readily inferred from Exhibit 6-147 that bubble curtains can sharply reduce the injury zones for all hearing frequency classes, with about a two-thirds reduction in the Level A zonal radius on average. However, the modeling data also indicate substantial impact zones even with effective bubble curtain deployment, with injuries likely for HF species found within about 2 km of piling works, and LF species out to approximately 4 km. The remainder of this analysis assumes that bubble curtains will be used at all BCIB piling sites, since the no-mitigation scenario is unlikely to be acceptable to stakeholders, even based just on 'simple case' assumptions. It is understood at the time of writing that the engineering teams consider the use of bubble curtains on all piling works to be potentially feasible.

Cumulative noise exposure is compounded when multiple piling rigs are located close to each other, such that their sound fields overlap. Organisms in overlap zones can be expected

[235] Currents are a significant complicating factor, as they make it difficult to maintain the bubble field in a consistent conformation around the entire submerged length of the pile, so maximum feasible depth of application may be less than 50 m at places and times where strong currents are predicted (the BCIB project area does not typically experience strong currents).
[236] It has been credibly hypothesized, for example, that some beaked whale deaths associated with military sonar exposure may actually be caused by a behavioral response (atypical diving behavior, producing gas bubble formation in tissues) rather than physical injury from the sonar itself; see Nowacek, D.P., L.H. Thorne, D.W. Johnston and Peter L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 2007, Volume 37(2): 81-115.

to experience increased hit frequency (reduced recovery time between peak sound energy) and increased cumulative exposure (at least double the number of hits per day), as compared to organisms within the sound field of just a single piling rig. This compounding will have the effect of expanding the widths of the impact zones near locations along the alignment where simultaneous piling rig activity is concentrated. The main zones of overlap on the BCIB alignment will be at and around the two cable-stayed bridge sites, where intense piling activity will be required at each of the monopole towers, and where piling rigs will also be at work simultaneously on adjacent portions of the high approach and viaduct sections.

To illustrate the compounding effect, Exhibit 6-148 presents a comparison of the individual and combined noise emissions modeled for pile driving at two piers 2,000 m apart, for LF species. The distance at which the Level A threshold is met (implying physical injury) is approximately 4,000 m for each of the piers individually, but expands to nearly 6,000 m when the two simultaneous piling operations are considered together, an increase of about 50%. Adding a third proximate piling rig to the scenario would be expected to expand the impact zones even further.



Source: Illingworth & Rodkin, Inc.

Exhibit 6-148 Effect of Piling at Proximate Piers on Injury Zone, With Bubble Curtain

It should, in theory, be possible to influence the size of the impact zones by coordinating the piling works to avoid proximate operation, and the piling schedule suggests that at least some such coordination can be accommodated. However, determining optimal spatio-temporal configuration of the piling works will require more detailed modeling than has been possible to date, ideally supported by data from in-situ test piling. If more detailed pre-construction modeling indicates significant potential for minimization of the effects zones by adjustment of the piling schedule, this should be pursued as a priority, as the sizes of some impact zones indicate that the piling works will be strongly disruptive of marine mammals even with full deployment of bubble curtains, certainly causing behavioral effects and possibly causing temporary and permanent hearing loss. Given the length of time the piling activity will be carried on, it can be considered more likely than not that local and possibly regional cetacean populations in the HF and LF classes will suffer. Without much better data than is presently available on cetacean distribution and abundance in and around Manila Bay and in the eastern South China Sea more generally, estimating the significance of project effects on cetacean populations is problematic, but the effects do seem unlikely to be minor at the individual level, at least for HF and LF species.

Whether hearing impairment and abnormal behavior will ultimately translate into cetacean deaths and strandings is unknown, but this does at least seem like a possibility. There is some evidence to suggest that anthropogenic noise may be linked in some cases to stranding events, although the science is far from conclusive as to causation or the mechanisms that may be involved.[237] The positioning of the BCIB project across the mouth of semi-enclosed Manila Bay may be cause for special concern. With simultaneous pile-driving activity distributed across at least half of the bay mouth during the heaviest piling periods, it is possible that cetaceans may become trapped within the bay by their responses to the wall of noise, and either stray into the shallows along its north and east sides and get stranded, or suffer physical decline and death due to insufficient local sources of food. Such a trapping effect cannot be predicted with any confidence. However, media coverage of whale stranding events commonly raises (rightly or wrongly) the possibility of a link to anthropogenic noise, and it is likely that this will happen if any strandings do occur in or around Manila Bay during the BCIB construction phase.

Fish. Fish of all kinds rely on hearing for orientation, navigation, migration, habitat selection, detection of prey and predators, communication and reproductive behavior; some fish also produce sound. Interference with the functioning of fish hearing by anthropogenic noise has potential to reduce fitness and ultimately to affect survival. Impact pile driving is one of the few anthropogenic sound sources capable of causing direct mortal injury to fish.[238] Loss of individuals to direct physical injury may become significant at the population level if proximate exposure is frequent, and certainly piling work that is carried on day after day for many months, as will be the case with the BCIB piling works, provides ample opportunity for close exposure.

Effects on fish hearing may be just as significant, and perhaps more so, than death from physical injury, as they are experienced at greater distance from the noise source, and thus over a wider area. Physical impairment of fish hearing (temporary threshold shift – TTS) prevents fish from perceiving and responding to biologically relevant sounds, including sounds made by their prey, predators and potential mates, thus decreasing near-term survival prospects and fecundity at the population level. TTS and masking of biologically relevant sounds by incessant high-intensity piling noise can be expected to affect intra-specific communication and perception of sound cues used in navigation.

Behavioral responses to sound are also important; there is some evidence that fish may alter migration routes due to intense noise, and to abandon preferred habitats, including favorable

[237] (1) Ketten, D.R. 2014. Sonars and Strandings: Are Beaked Whales the Aquatic Acoustic Canary? Acoustics Today (Summer 2014): 46–56.; (2) Bradshaw, C.J.A., K. Evans and M.A. Hindell. Mass Cetacean Strandings – A Plea for Empiricism. Conservation Biology 20(2): 584–586.
[238] Popper, A.N and A.D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology 2019; 94: 692–713.

spawning grounds.[239] Knock-on habitat effects can be expected from these kinds of changes in fish behavior, and also on the livelihoods of local fisherfolk. The American National Standards Institute (ANSI) guidelines for sound exposure from pile driving, which specify quantitative exposure thresholds for mortal injury, recoverable injury and hearing impairment, are shown in Exhibit 6-149**Error! Reference source not found.**.[240]

Exhibit 6-149 ANSI Pile Driving Noise Exposure Guidelines For Fish (Objective Criteria Only)

Fish Hearing Type	Mortality or Potential Mortal Injury	Recoverable Injury	Temporary Threshold Shift
No swim bladder (detects particle motion); e.g., flatfishes, eulachon	>219 dB SEL$_{cum}$ or >213 dB peak	>216 dB SEL$_{cum}$ or >213 dB peak	>>186 dB SEL$_{cum}$
Swim bladder not involved in hearing (detects particle motion); e.g., Pacific salmon	210 dB SEL$_{cum}$ or >207 dB peak	203 dB SEL$_{cum}$ or >207 dB peak	>>186 dB SEL$_{cum}$
Swim bladder involved in hearing (primarily detects pressure); e.g., walleye pollock and cod	207 dB SEL$_{cum}$ or >207 dB peak	203 dB SEL$_{cum}$ or >207 dB peak	>>186 dB SEL$_{cum}$
Eggs and larvae	>210 dB SEL$_{cum}$ or >207 dB peak		

Source: Illingworth & Rodkin, Inc.

The 2014 ANSI thresholds listed in Exhibit 6-149 were integrated with the modeled noise propagation for the BCIB piling (singe-pier case, with and without bubble curtain) to generate estimated impact zones for the various pairings of fish physiology and noise effects; these are shown in Exhibit 6-150.

Exhibit 6-150: Distance to 2014 ANSI Thresholds for Fish, With and Without Bubble Curtains

Fish Hearing Type	Mortality or Potential Mortal Injury (m)		Recoverable Injury (m)		Temporary Threshold Shift (m)	
	With BC	Without BC	With BC	Without BC	With BC	Without BC
No swim bladder	54	191	79	279	3,458	12,171
Swim bladder not involved in hearing	169	594	407	1,433	3,458	12,171
Swim bladder involved in hearing	246	867	407	1,433	3,458	12,171
Eggs and larvae	169	594				

Source: Illingworth & Rodkin, Inc.

The data shown in Exhibit 6-150 suggest a high probability that the BCIB piling works will result in fish kills and also in the death of eggs and larvae that happen to be near the piling

[239] Popper, A.N and A.D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. Journal of Fish Biology 2019; 94: 692–713.

[240] Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Heter, H. Rogers, B.L. Southall, D.G. Zeddies and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered With ANSI. ASA S3/SC1.4 TR-2014

sites, with the mortality zone extending up to about 250 m from each piling rig, even with effective deployment of bubble curtains. Hearing impairment would be expected up to about 3,500 m from a piling rig, for all classes of fish. Quantitative thresholds for behavioral effects have not been formulated by ANSI, but it can be surmised that behavioral effects would occur somewhat further out than the edge of the hearing impairment zone. In view of these potential effects, it may not be unreasonable to expect significant impacts on fish populations and fisherfolk prospects several kilometers from the alignment.

It is very difficult to predict how significant the kills, recoverable injuries, hearing impairment and behavioral effects from BCIB pile driving works will be to local fish populations; however, it is known that fish populations in the project area and throughout Manila Bay have been subject to overfishing and dynamite fishing for decades, and losses to pile driving should be understood as a cumulative impact.

Marine turtles. The importance of sound in the foraging, navigation, interactive and reproductive activities of marine turtles is not well understood, but all marine turtle species do have ears that seem suited to hearing while underwater.[241] It is probable that hearing enables turtles to perceive, and take action to evade, physical threats such as approaching vessels. Marine turtles are thought to prefer quiet conditions while nesting. The limited research on the hearing range of marine turtles suggests that all species perceive sound mainly towards the lower end of the frequency spectrum.[242] The 2014 ANSI guidelines for sea turtle exposure to underwater sound are shown in Exhibit 6-151.[243]

Exhibit 6-151 ANSI Pile Driving Noise Exposure Guidelines For Marine Turtles

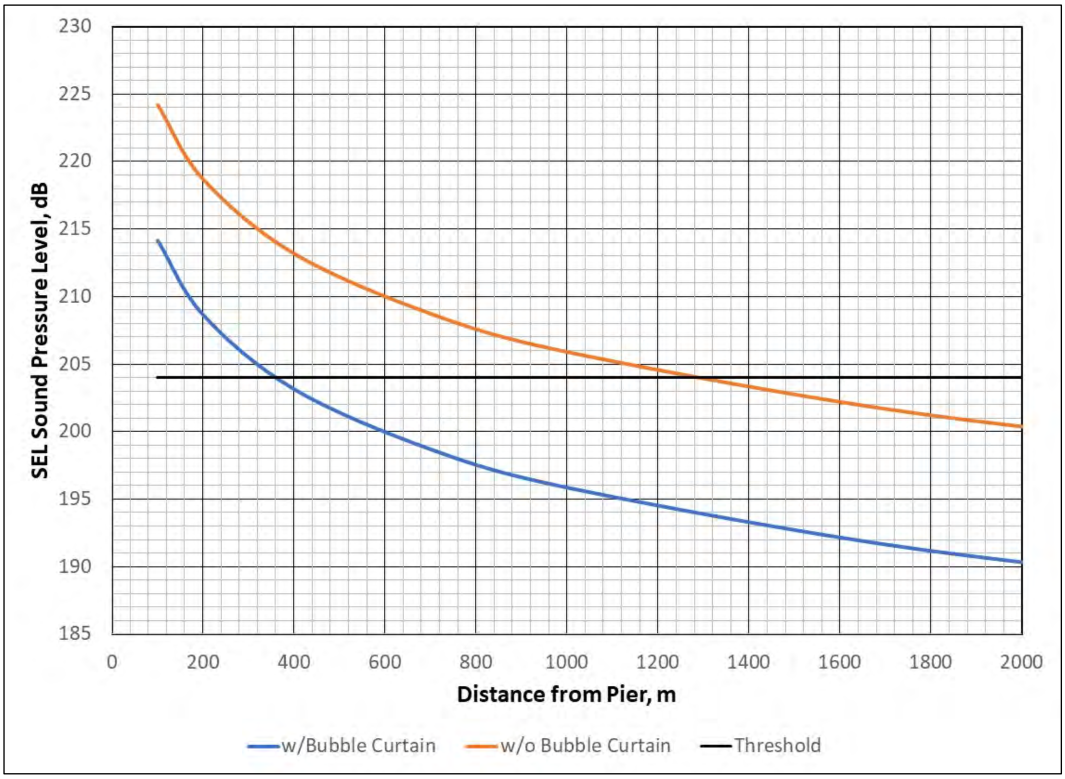
Type of Animal	Mortality and Potential Mortal Injury	Impairment			Behavior
		Recoverable Injury	TTS	Masking	
Sea turtles	210 dB SEL_{cum} or >207 dB peak	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Note: Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I) and far (F).					

The noise exposure modeling results for marine turtles in the BCIB context indicate that the injury threshold is likely to be met for turtles passing within about 360 m of an active piling rig (see Exhibit 6-152). There are no turtle nesting beaches within 360 m of any expected piling sites, based on the piling plan as it stands at the time of writing. However, adult and juvenile turtles transiting or otherwise present within the immediate works zone could be expected to suffer injury. Marine turtle science has not yet advanced to the point where quantitative thresholds can be defined for recoverable injury, hearing loss, masking and behavioral effects for turtles, but these lesser impacts can be assumed to be felt at

[241] Ibid.
[242] Nelms, S.E., W.E.D. Piniak, C.R. Weir and B.J. Godley. 2016. Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation 193(2016): 49–65.
[243] As published in Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Heter, H. Rogers, B.L. Southall, D.G. Zeddies and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered With ANSI. ASA S3/SC1.4 TR-2014

substantially greater distances from the noise source. Masking and behavioral responses are probable at intermediate range.

Given the expectation of behavioral change at intermediate range, it seems probable that the intense and prolonged noise emissions from BCIB piling activity will discourage female turtles from entering Manila Bay to nest, at least for the duration of the piling works, even with mitigation. This effect is likely to be observed not just at the eight known nesting beaches close by the BCIB alignment, but also at all of the nesting beaches further into the bay (at least five beaches), given that turtles must pass through the proposed works zone to access them. This loss of turtle access to local beaches, which will endure for about 3.5 years based on the piling schedule, will be a significant (and noticeable) impact. Consequences for juveniles and non-nesting adults using habitat near the piling zone are more difficult to predict.



Source: Illingworth & Rodkin, Inc.

Exhibit 6-152: Distance to ANSI Injury Threshold for Turtles, With and Without Bubble Curtains

Prescribed Mitigation. Measures to manage the impacts of underwater noise on marine fauna and fisheries resources will be developed in the Marine Underwater Noise Management Plan. An essential component of this plan will be the acquisition of additional baseline information on species vulnerable to the effects of underwater noise. The data generated will be provide a more robust seasonal baseline of species presence in the area potentially subject to the effects of underwater noise. As has been shown above, deployment of bubble curtains competently and consistently around all piling rigs can achieve substantial reductions in the areas over which piling noise can produce disruptive and injurious effects on marine mammals, fish and marine turtles. It will be required of all marine contractors operating or overseeing the operation of a piling rig to ensure that bubble curtains are used properly. This will be the top priority mitigation option for piling noise.

It is possible that piling noise impacts can also be minimized somewhat by coordinating the operations of the different contractors responsible for piling work, to avoid as much as possible the compounding effect of overlapping sound fields. This should be pursued to the extent possible, informed by results of pre-construction test piling and further acoustic modeling to be arranged by the relevant marine works PCs. Coordination of the piling operations shall be overseen by the CSC.

A third mitigation option is to train and appoint marine fauna observers MFOs for each of the piling rigs to detect the presence of any marine megafauna (whales, dolphins, sharks, turtles) in the vicinity while piling is going on. For marine mammals passive acoustic monitoring (PAMs) will be used in addition to visual observations or as a substitute during the night. The MFOs will be equipped with high-powered binoculars, and infrared imaging equipment for night time and will be required to regularly and systematically scan the waters around the works from the piling platform (preferably from an elevated position), and alert the site engineer in the event that any are spotted, so a temporary pause can be made until the animal or animals clear out of the area. It is somewhat doubtful that many large animals will approach the piling rigs, given that piling will be going on around the clock, but this measure should be adopted and implemented as a precaution.

It will be clear from the analysis of marine mammal impact zones earlier that there will be a substantial residual impact with regards to underwater noise. Compensatory measures are appropriate and necessary to offset possible impacts. These impacts will be experienced by threatened and non-threatened marine species including marine mammals, and will extend to critical marine habitats in the immediate project area, which include coral habitat in the Mariveles nearshore zone and Corregidor and Caballo Islands nearshore zones, and two MPAs in the immediate project area (CIMP and Naic Fish Sanctuary). Compensatory measures for noise-related and other critical habitat degradation will be formulated as a biodiversity offset to be implemented within the CIMP; this has been proposed as an action program under the auspices of the project's Biodiversity Action Plan (see Annexes). An action program has also been proposed under the Biodiversity Action Plan to address residual impacts on marine mammals using a monitoring and adaptive management approach. As fisherfolk will be affected, a livelihood restoration program is also proposed, under the Social Development Plan; this will be implemented by DPWH in partnership with BFAR, through the local FARMCs and fisherfolk representative organizations.

<table>
<tr><th colspan="6">IMPACT SUMMARY</th></tr>
<tr><td>Impact:</td><td colspan="5">Marine wildlife mortality, injury and habitat avoidance due to underwater noise and vibration</td></tr>
<tr><td>Direction:</td><td>Negative</td><td>Type:</td><td>Direct/Indirect</td><td>Probability:</td><td>High</td></tr>
<tr><td>Duration:</td><td>Medium-term</td><td>Scope:</td><td>Localized/Widespread</td><td>Significance:</td><td>Unknown</td></tr>
<tr><td>Mitigation:</td><td colspan="5">• A Marine Underwater Noise Management Plan shall be prepared for the project immediately following project approval
• Each marine PC operating or overseeing operation of an impact piling rig shall ensure that a bubble curtain is consistently and thoroughly deployed around the pile for the full duration of driving
• PCs undertaking marine piling works shall arrange for installation of test pilings and further acoustic modeling based on test data by a qualified firm during the pre-construction phase to generate a more refined assessment of noise impacts and enable optimal coordination of piling operations to minimize overlapping sound fields
• CSC to manage coordination of contractor piling operations to ensure optimal spacing for noise impact minimization
• Each marine PC operating or overseeing operation of an impact piling rig shall appoint, train and equip sufficient personnel to serve as marine fauna monitors during all piling undertaken during daylight hours, and empower said personnel to advise the site engineer to issue a temporary stop work order in the event a whale, dolphin, shark or marine turtle is spotted within 500 m of the piling rig</td></tr>
</table>

	• DPWH to implement a marine biodiversity offset in the CIMP to address degradation of critical habitat, under the auspices of the Biodiversity Action Plan • DPWH to implement a monitoring and adaptive management program for marine mammals under the auspices of the Biodiversity Action Plan • DPWH to implement a livelihood restoration program for fisherfolk, in partnership with BFAR, under the auspices of the Social Development Plan
Residual:	Expected, to be addressed through the Biodiversity Action Plan and Social Development Plan

6.2.2.11 Hydrodynamic Modification

Anticipated Impact. All water bodies have established patterns of internal flow that govern the availability of oxygen, nutrients and food sources; distribution and movements of aquatic organisms; and processing and removal of detritus and wastes. Insertion of temporary infrastructure into the aquatic environment to support construction activity has the potential to alter such patterns and lead to both predictable and unpredictable effects on various trophic relationships.

As outlined in the project description, six temporary rock jetties up to 400 m long and 15 m wide will be needed at the land-water interface in Bataan to enable transfers of materials and pre-cast components from on-land sources and storage areas to the work front. Five jetties will be built at the drydock and casting yard facility (Bataan Staging Area 1) on the Mariveles shore to enable loading of pre-cast components and other materials onto barges, and another will be needed to serve Bataan Staging Area 2, where large quantities of steel will be stored and workers will be housed. The jetties will be of boulder-and-fill construction. The construction phase for the BCIB marine components will endure for 4–5 years, so these structures, while temporary, will be present for a medium-term duration.

Placement of rock jetties perpendicular to the Mariveles shore risks impeding longshore circulation, potentially depriving coral and macroalgal communities in the vicinity of usual flows of nutrients and food, and possibly also leading to accumulation of sediment (or conversely, increased scouring). Present understanding of currents in the nearshore zone is very weak, so there is no basis for further characterization or quantification of effects on nutrient flows and water quality, but they seem very unlikely to be negligible. Existing sediment transport in this area is also not well understood, but is likely to concern mainly sediment outputs of nearby streams, rather than broad-scale longshore transport, which is not thought to be substantial.[244] It seems likely the dispersal of sediments discharged from the Pangolisanin, Babuyan, San Jose, Alas Asin and Diguinin Rivers may be altered at least somewhat by the placement of the jetties. Although the jetties are to be removed at the end of their useful life of 4–5 years, it can be expected that recovery to pre-project benthic conditions will take some years after restoration of normal longshore circulation.

While the nature and significance of impacts on benthic life in the vicinity of the jetties are impossible to predict without detailed measurement and modeling, zones of modified circulation (and assumed ecological degradation) are posited on both the east and west sides of the jetty serving Bataan Staging Area 2 and also east and west of the multiple jetties (taken as a group) serving the drydock facility. Each such zone is conceptualized as a roughly triangular area of about 8 ha, thus suggesting an overall area of modified circulation about 32 ha along the Mariveles coast.

[244] Fuji-Ie, W., T. Yanagi and F.P. Siringan. 2002. Tide, Tidal Current and Sediment Transport in Manila Bay. La mer 40: 137-145 (Societé franco-japonaise d'océanographie, Tokyo).

Prescribed Mitigation. Prior to construction a coastal processes impact assessment will be undertaken to identify potential risks on erosion and deposition of sediment due to the project. This study will also inform risks to the project from erosion and deposition of sediment. The potential for ecological effects from hydrodynamic modification by the rock jetties can be partially mitigated by provision of cross-circulation in the jetty structures. To this end, the contractors responsible for constructing the jetties shall be required to install 5-m circulation gaps in the jetty structures at 50-m intervals, consisting either of pipe culverts or sheet-piled open channels bridged by drop-in plates.

The mitigation prescribed is considered unlikely to be 100% effective in preventing circulation-related ecological effects, and the residual impact on critical habitat (coral reefs) will be appropriately subject to biodiversity offset, and is factored into a broader offset proposed to compensate for marine degradation under the auspices of the project's Biodiversity Action Plan.

IMPACT SUMMARY					
Impact:	Ecological change due to modified hydrodynamic regime				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Medium
Duration:	Medium-term	Scope:	Localized	Significance:	Low–Moderate
Mitigation:	• PCs responsible for installing rock jetties to serve Bataan Staging Area 1 and Bataan Staging Area 2 to install 5-m circulation gaps (pipe culverts or sheet-piled open channels bridged by drop-in plates) at 50-m intervals along all jetties to permit long-shore circulation • Prior to construction a desk top coastal processes study will be undertaken to inform project risks to coastal processes				
Residual:	Modest residual expected, to be factored into biodiversity offset under auspices of the Biodiversity Action Plan				

6.2.2.12 Impacts due to Invasive Species

Anticipated Impacts Invasive marine species may be introduced in the project area during construction via marine vessels and machinery. Invasive species can survive on the hulls of vessels as fouling, and in bilges and vessel sea chests. Invasive species can also survive as spores or dormant forms on small vessels, buoys, and rigging such as ropes, cables and chains. Once established, invasive species may quickly colonize and cause significant harm to indigenous populations, and ultimately spur broad ecological change.

Prescribed Mitigation. An invasive species risk assessment will be undertaken prior to construction as part of the Marine Invasive Species Management Plan. Vessels on passage into the project area from outside Philippine waters will be subject to international controls on bilge water management. Small vessel marine plant and equipment will be cleaned prior to use.

IMPACT SUMMARY					
Impact:	Impacts from invasive marine species				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Medium
Duration:	Long-term	Scope:	Widespread	Significance:	Potentially high
Mitigation:	• Each marine works PC to prepare a Marine Invasive Species Management Plan, for review and approval of the CSC prior to the start of works				
Residual:	Difficult to predict				

6.2.2.13 Impacts on Threatened Marine Vertebrate Species

Anticipated Impact. The presence of numerous threatened marine vertebrate species is confirmed or strongly suspected in the BCIB project area, but the distribution and abundance of all is very poorly understood. Threatened species considered probable residents or transients comprise 62 species overall, including 11 cetaceans (whales and dolphins), 5 marine turtles, 24 sharks, and 22 other cartilaginous fish (rays, sawfish and wedgefish). No threatened bony fish species are known from the project area. The primary threats to threatened marine species during construction are likely to be underwater noise, vessel strikes, and general disturbance; loss of benthic habitat is not expected at a scale sufficient to predict significant population level effects for any species.

Given the lack of solid information on movement and abundance of threatened marine vertebrate species in Manila Bay, it is impossible to predict the impacts on these species from underwater noise emissions, vessel strikes and general disturbance. All of the threatened marine species confirmed or suspected in the project area can be assumed likely to experience at least moderate to severe disturbance from piling works over a period of anywhere from about 12 months up to 41 months (depending on their location), and it may also be assumed that many or most may avoid favored habitat areas and transit routes because of this disturbance. Precautionary mitigation has been prescribed above in relation to vessel strikes and underwater noise. In both cases, a residual is expected, although the significance of the residual is unknown, given high uncertainty regarding local abundance and distribution of threatened marine species.

Prescribed Mitigation. The expected existence of residual impacts on threatened marine species, although poorly understood and not quantifiable, is appropriately subject to compensatory action. In the absence of data, a proactive and precautionary management approach is indicated. Two action programs have been formulated under the auspices of the Biodiversity Action Plan, in relation to marine mammals and marine turtles. The first will encompass capacity-building for existing local marine mammal stranding response teams (a pre-emptive precaution to address possible increased stranding events due to trapping by construction noise) and pre-construction/post-construction acoustic monitoring to assess the extent of residual impacts and consequent need for longer-term support for marine mammal conservation efforts (see Biodiversity Action Plan in the report Annexes). The second action program will devote resources to enhancing and expanding existing local marine turtle hatchery programs, with the intent of offsetting probable reduced nesting activity on beaches within Manila Bay during the BCIB construction phase by boosting survival rates of hatchlings over an extended period.

IMPACT SUMMARY					
Impact:	Underwater noise impacts and vessel strike risks for threatened marine vertebrate species				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized/Widespread	Significance:	Unknown
Mitigation:	• Mitigation prescribed separately for underwater noise and vessel strike risk; no additional mitigation is prescribed specifically for threatened species				
Residual:	Expected, and to be addressed through action plans fomulated under the auspices of the Biodiversity Action Plan				

6.2.2.14 Impacts on Critical Marine Habitat

Anticipated Impact. Marine construction activity will result in direct degradation of benthic habitat within coral habitat areas in the Mariveles nearshore and Corregidor island nearshore zones. This has been discussed above in relation to physical damage to benthic habitat from dredging, placement and removal of rock jetties, excavation for spread-foot foundations, and disturbance from anchors, hull strikes, and propellor wash; siltation and sedimentation effects; underwater noise; and ecological effects of hydrodynamic change due to jetties. Significant residual effects are expected from these activities, which are mostly difficult or impossible to prevent or greatly minimize.

Prescribed Mitigation. The expected residual impacts of marine construction activity on coral habitat areas will be subject to mitigation by implementation of a biodiversity offset requiring formation of a long-term partnership of DPWH with institutional stakeholders of the Corregidor Islands Marine Park, involving augmentation of the conservation programs already articulated for this existing protected area. The offset is to be formulated and implemented under the auspices of the project's Biodiversity Action Plan.

IMPACT SUMMARY					
Impact:	Impacts on critical marine habitat from construction activity				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	Low-Moderate
Mitigation:	• Feasible mitigation options have been prescribed separately for some impacts				
Residual:	Significant residual expected, to be addressed under auspices of Biodiversity Action Plan				

6.2.2.15 Impacts on Marine Cultural Heritage

Anticipated Impact. Marine construction activity may result in the disurbance of marine cultural heritage. Culturally important artifacts on the seabed and intertidal areas may be disturbed or damaged.

Prescribed Mitigation. A chance find procedure shall be adopted by all marine works PCs to ensure that any underwater cultural heritage objects are encountered; this is most likely to occur during dredging work. Process steps to be observed in the event of a chance find are as follows:

Step 1 – Stop work in the affected area immediately and inform the Site Engineer;

Step 2 – Site Engineer confirms the find and informs CSC, as well as DPWH;

Step 3 – CSC and DPWH Environment, Health and Safety Officer visit the site and define what they deem a safe buffer around the location of the find and give the go-ahead for resumption of work everywhere else;

Step 4 – CSC contacts Cultural Properties Protection and Regulation Division (CPPRD), under the National Commission for Culture and the Arts; and

Step 5 – CPPRD personnel visit the site to assess the significance of the find and arrange for its safe removal if necessary, giving clearance through the CSC for resumption of work as appropriate.

The chance find procedure shall be incorporated as a method statement in each marine PC's CEMMAP and all workers and site engineers involved in seafloor-disturbing work shall be trained to implement it as appropriate, as part of broader induction and refresher training.

6.2.3 Operation Phase Impacts and Mitigation

Operation impacts are those impacts which occur as a direct or indirect result of the operation and maintenance (including scheduled and unforeseen repair works), and which are mitigated by the infrastructure owner or its designated operating entity, or by contractors engaged to carry out maintenance and repair activities. As with construction impacts, impacts occurring during operation are largely predictable, and mitigation is appropriately supported by plans developed in the lead-up to the entry of the infrastructure into normal operation.

6.2.3.1 Contaminated Runoff Impacts

Anticipated Impact. As discussed in detail in Section 6.2.1.2 above, contaminated bridge deck runoff has some potential to degrade water quality and contaminate benthic biota. Most of the contaminant loading of the roadway surfaces will be in the form of particulates, and other contaminants adsorbed onto particulates.

Prescribed Mitigation. Given the importance of particulates to contamination risk, preventing or minimizing the transfer of particulates from the bridge and viaduct decks to the water is the most appropriate focus of mitigation. Experiments conducted in the United States with street sweeping have established that regular removal of dry particulates (especially fine particulates) from the road surface can achieve significant reductions in contaminant loading of road runoff. Weekly removal of fine particles from the road surface using advanced vacuum-assisted sweepers and regenerative air sweepers (which loosen particulates from surfaces and crevices using air jets, and immediately vacuum them up) has been found to reduce total suspended solids concentration in runoff by up to 90% for residential streets and by up to 80% for major arterials.[245] A substantial reduction of dissolved metals also seems likely, since timely sweeping would prevent dissolution from occurring on the deck surface. A single sweeper unit should be sufficient to conduct a weekly sweep of all four lanes, plus the shoulder lanes, of the BCIB. Sweeping equipment is necessary for maintenance of safe operating conditions anyway, so the incremental cost of more frequent sweeping should be modest.

Weekly vacuum sweeping (weather permitting) of the entire road surface of the bridges and viaducts, including the shoulder lanes, will be incorporated in the BCIB Operations & Maintenance Plan, and supported by a suitable budget for purchase, upkeep, operation and scheduled replacement of a regenerative vacuum sweeper.

IMPACT SUMMARY					
Impact:	Impaired marine water quality and contamination of benthic biota from contaminated bridge deck runoff				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Long-term	Scope:	Localized	Significance:	Low

[245] (1) Dupuis, T.V. 2002. Assessing the Impacts of Bridge Deck Runoff Contaminants in Receiving Waters – Volume 1: Final Report. National Cooperative Highway Research Program Report 474.; (2) Georgia Department of Transportation. 2021. Investigation on Water Quality Impacts of Bridge Stormwater Runoff From Scupper Drains on Receiving Waters. Georgia DOT Research Report 18-09, Final Report.; (3) Taylor, S., M. Barrett, G. Ward, M. Leisenring, M. Venner and R. Kilgore. 2014. Bridge Stormwater Analysis and Treatment Options. National Cooperative Highway Research Program Report 778.; (4) US EPA. 2005. National Management Measures to Control Nonpoint Source Pollution from Urban Areas. EPA-841-B-05-004. November 2005.

Mitigation:	• Weekly sweeping of entire bridge and viaduct roadway surface (including shoulder lanes) with a regenerative vacuum sweeper
Residual:	Expected, but of very minor significance

6.2.3.2 Spills From Accidents

Anticipated Impact. While the vast majority of traffic accidents do not result in the release of large amounts of noxious fluids, those that involve rollovers or ruptures of large trucks carrying hazardous cargoes are quite likely to. High-volume spills on the BCIB bridge and viaduct decks have some potential to produce sudden localized influxes of contaminants to the water below. Given the very large volume and dynamism of the bay, dilution and dispersion of pollutants could be expected to rapidly reduce the risk of acute toxic effects from most liquid discharges. Solid materials and liquids with toxic constituents likely to precipitate upon contact with seawater could result in a very localized deposition of hazardous material on the seafloor at the spill site. In both scenarios, the long-term significance of a single spill event is unlikely to be very great. That said, spills draining to the waters of the bay will contribute to the generalized pollution and contamination from urban and industrial sources, and should be mitigated to the extent possible.

Prescribed Mitigation. Mitigation of hazardous spills on the BCIB decks can be pursued in two ways: accident prevention and rapid spill response. The probability of accidents can be addressed by strictly enforcing speed limits on the bridge, and by including monitoring of driver behavior in the bridge surveillance routine. Instituting a regimen of spot safety checks to help reduce the number of unsafe trucks using the crossing can also lower the risk of accidents and spills. All three of these measures should be included in the BCIB Operations and Maintenance Plans.

In order to contain and clean up spills before they can reach scuppers on the deck and drain to the waters below, the Bridge Management Unit for the BCIB will need to have monitoring systems in place and fully operational at all times, and accident response crews well trained and equipped to manage a range of possible spilled materials. Spill response plans, including protocols, procedures, and provisions for training, equipment and equipment upkeep, shall be specified in the operation-phase Emergency Action Plan, to be prepared and implemented by the Bridge Management Unit. Guidance on preparation of an Emergency Action Plan is provided in the EMP, and a sample outline for such a plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Marine contamination from accident-derived spills on the bridge and viaduct decks				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• Institute strict speed enforcement on the BCIB • Include monitoring of driver behavior in bridge surveillance routines • Institute a regimen of spot safety checks to reduce the number of unsafe trucks using the bridge • Establish, equip and train accident response crews for quick response to accidents, under auspices of operation-phase Emergency Action Plan				
Residual:	Expected, but very low frequency and unlikely to be significant				

6.2.3.3 Water Quality Impacts From Maintenance Activity

Anticipated Impact. Spills of noxious substances used in maintenance and repair works, such as bitumen, oil coating, fresh asphalt, sealants and paints, as well as fuels used in maintenance equipment, will always have some potential to occur, and to flow to the water below. The risk of a large spill causing significant contamination during active maintenance work is very low. If sandblasting is carried out as part of repair works, significant dust, sand and paint may end up in the water, contributing to localized elevated turbidity and contamination.

Prescribed Mitigation. Maintenance and repair work contractors shall be contractually obliged to seal deck scuppers during repaving to prevent leakage of oil coating and spillage of uncured asphalt into the water. If sandblasting is part of repair works, under-girder canvas slings and a vacuum collection system must be used to minimize inputs of paint, sand and dust to the bay. Maintenance and repair work contractors shall be required to prepare and implement a Hazardous and Noxious Materials Management Plan.

IMPACT SUMMARY					
Impact:	Water quality impacts from maintenance activity				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• Require maintenance and repair works contractors to seal deck scuppers during repaving to prevent leakage of oil coating and spillage of uncured asphalt into the water • Require maintenance and repair works contractors to deploy under-girder slings and vacuum collection system to minimize inputs of paint, sand and dust to the water if sandblasting is undertaken • Require maintenance and repair works contractors to prepare and implement Hazardous and Noxious Materials Management Plans				
Residual:	None expected				

6.2.3.4 Deposition of Solid Waste (Littering)

Anticipated Impact. Public use of the BCIB crossing will generate a certain amount of solid waste, whether from intentional littering or inadvertent releases of material from open windows and improperly secured loads of easily airborne materials. Some of this will end up in Manila Bay, where it will contribute to the already prevalent problem of solid waste pollution.

Prescribed Mitigation. Litter is in all cases the result of careless or uncaring behavior on the part of motorists, and is therefore amenable to change through education and persuasion. Educational anti-littering signage will be posted at regular intervals along the roadway. Cleanup of inevitable litter will be accomplished firstly by the regular weekly pass of a vacuum sweeper (which will be part of the road maintenance regimen to reduce contaminants in road runoff), and secondly by maintenance crews assigned to regularly gather litter accumulated on the bridge and viaduct decks and scupper grates.

IMPACT SUMMARY					
Impact:	Deposition of roadside solid waste				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Long term	Scope:	Localized	Significance:	Low
Mitigation:	• Conduct weekly sweeping (with regenerative air sweeper) of the entire roadway surface (driving lanes and emergency lane) • Implement regular roadside litter cleanup (periodicity based on litter buildup rate)				
Residual:	None expected				

7 BASELINE CONDITIONS, ANTICIPATED IMPACTS AND PRESCRIBED MITIGATION (AIR)

The BCIB project will introduce to the mouth of Manila Bay an entirely new transport corridor, which brings the potential for new sources of emissions and noise to local airsheds. Understanding the nature of existing local air quality conditions and degradation factors, characteristics of the local acoustic environment, weather patterns, and climate is an important part of assessing the impact of new emissions and noise sources. In addition, local weather and climate, as well as the effects of climate change, are typically key determinants of certain environmental risks and impacts associated with the construction process, as well as the long-term sustainability of the completed infrastructure. This section of the EIA report presents a baseline profile of air quality conditions and characteristics of the acoustic environment in the landside portions of the project area, provides an overview of prevailing local weather patterns, and identifies key climate change trends that are projected to affect the Manila Bay region. The chapter also assesses the likelihood and significance of impacts on local air quality and the local acoustic environment in light of the expected project activities as detailed earlier in the Project Description and defines mitigation measures appropriate to the identified risks. Assessment of impacts and development of mitigation prescriptions takes in the pre-construction phase, construction phase and operation phase, in that order.

7.1 Baseline Conditions

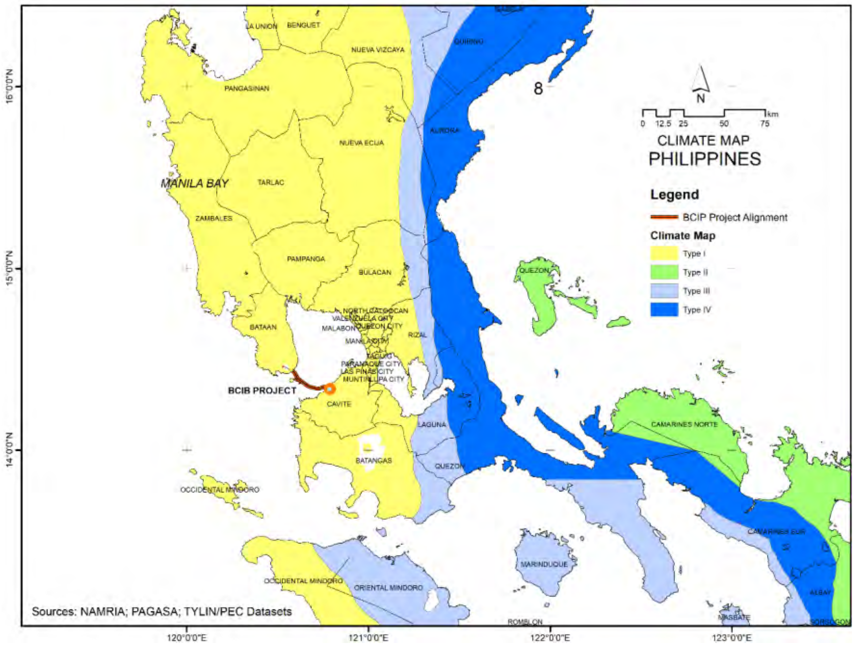
7.1.1 Climate and Weather

The climate of the Manila Bay region is classified as Type 1 under the Modified Coronas Classification System, a predominantly rainfall-based system used by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). Exhibit 7-1 shows the climate zones relative to the BCIB project. Locations falling within Type 1 can generally be expected to experience two pronounced seasons: dry from approximately November to April and wet from approximately May to October. This precipitation pattern is driven by the monsoonal winds that prevail during different times of the year. The Manila Bay area is affected by the southwest monsoon (known locally as the *Habagat*) and the northeast monsoon (local name *Amihan*).

The southwest monsoon normally influences central Luzon from May to September, and the northeast monsoon from October to April. In general, the southwest monsoon brings hot, humid conditions, with frequent development of cumulus cloud and heavy rainfall. By contrast, the northeast monsoon generally sweeps colder, drier air across the archipelago, resulting in cold weather and a predominance of cirrus clouds bringing infrequent light rainfall. This generalized seasonal pattern is subject to modification by the country's complex topography and highly convoluted layout of land and sea areas, yielding localized variances with respect to daily weather.

There are no weather stations located within or very nearby the BCIB project area that could provide an unambiguous picture of local meteorological conditions, so some triangulation is necessary. The nearest PAGASA weather stations to the BCIB project area are at Sangley

Point Naval Station, Cavite (31 km east-northeast of the project centroid, and 21 km northeast of the Cavite terminus, elevation 3 m) and Cubi Point in Subic Bay, Zambales (59 km northwest of the project's centroid, and 45 km northwest of the Bataan terminus, elevation 19 m). Longitudinal data from these two stations has been drawn upon to help develop the climate profile presented below.



Source: Bataan–Cavite Interlink Bridge Project – Climate Risk and Vulnerability Report. T.Y. Lin International – Pyunghwa Engineering Consultants, Ltd. JV (Prepared by Ecosys Corp.)

Exhibit 7-1: Climate Zones of Central Luzon Under Modified Coronas Classification System

Based on the locations of the two stations relative to the BCIB alignment (see Exhibit 7-2), it can be gathered that the Sangley Point station is considerably closer to the BCIB project area, and therefore probably the more relevant station. However, the project area is substantially more exposed to the open South China Sea than is Sangley Point and shares this degree of proximity to the open sea with the Cubi Point Station. In addition, it is to be acknowledged that the BCIB project area is not a single location but spans approximately 31 km; the distance from the Bataan terminus to Cubi Point is only about 7 km more than the distance to Sangley Point. Taking these factors into account, both stations can be considered to add meaningful input to a generalized qualitative interpolation for the BCIB project area. Longitudinal data for precipitation, temperature and winds collected by the Sangley Point and Cubi Point stations are presented and considered side by side in the subsections that follow, and together provide an inferred understanding of the weather conditions that may be experienced at the project sites. The data used cover the 1991–2020 period for Sangley Point, and 1994–2020 for Cubi Point. Additional data relating to observed baseline extremes of temperature and precipitation at the province level for Bataan and Cavite, as reported in the Philippine Climate Extremes Report 2020, are also considered as appropriate.[246]

[246] DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020: Observed and Projected Climate Extremes in the Philippines to Support Informed Decisions on Climate Change Adaptation and Risk Management. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines. 145 pp.

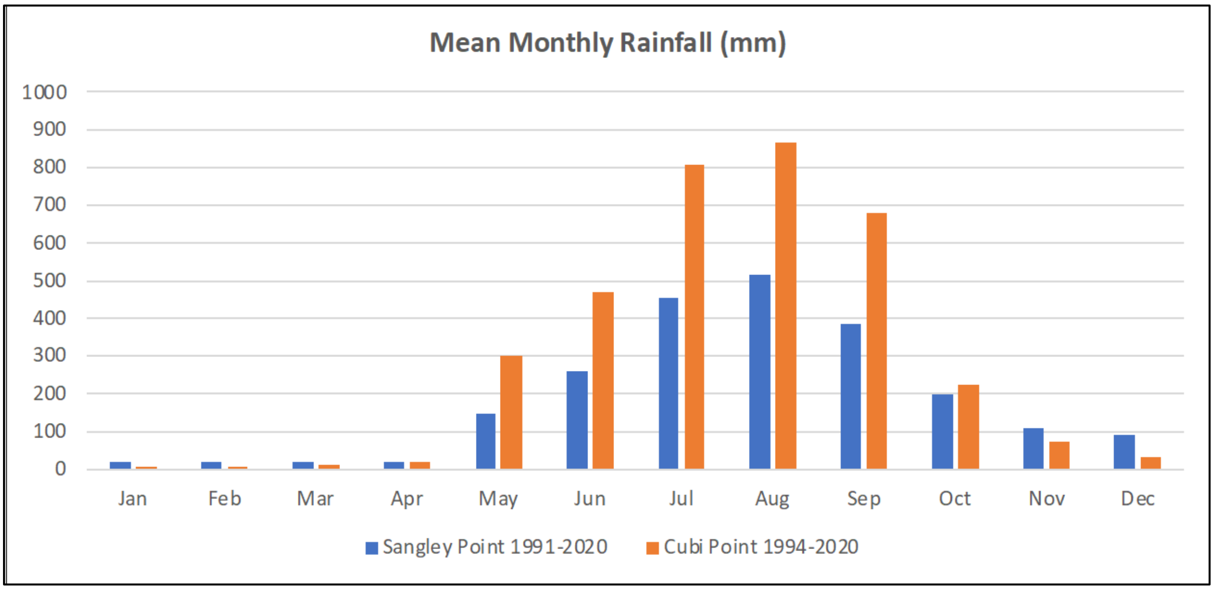
Exhibit 7-2 Locations of Referenced Weather Stations

Rainfall

Average monthly rainfall shows a similar overall distribution for Sangley Point and Cubi Point, with both stations experiencing their wettest periods during the southwest monsoon (see Exhibit 7-3). The highest average monthly rainfall reaches 514 mm at Sangley Point and 864 mm at Cubi Point, both in August, while the lowest recorded is 18 mm at Sangley Pt. in March and 5 mm at Cubi Point in February. This is consistent with the general pattern of the Type I climate class.

The average annual rainfall at Sangley Point from 1991-2020 was 2,241 mm, with an average of 130 rainy days per year. At Cubi Point, average annual rainfall from 1994-2020 was 3,493 mm, with the number of rainy days per year averaging 125. The highest annual rainfall at Sangley Point was recorded in 2013, with 3,562 mm; highest documented single-day rainfall at this station was 475 mm, in August 2013. At Cubi Point, the highest recorded annual rainfall was in 2011, with 5,463 mm. The highest single-day rainfall documented at Cubi Point was 436 mm, in July 2018.

Generally, Cubi Point receives substantially more rain during the southwest monsoon than does Sangley Point, which is likely attributable to favorable geophysical conditions for orographic precipitation (Cubi Point is by the ocean and at the western base of the Zambales Range). It is possible that the Bataan portion of the BCIB project area may benefit from a similar effect and thus tend to be wetter than the Cavite portion during the southwest monsoon, although it is not clear how much the orographic uplift expected in association with Mt. Mariveles would extend to the southern toe slope of the mountain, where the BCIB Project in Bataan terminus lies. By the same token, the Cavite end of the project area lies downwind of the substantial hills around Nasugbu, along the border of western Cavite and northern Batangas, and thus is likely to experience a partial rain shadow effect during the southwest monsoon. As can also be seen in Exhibit 7-3, Sangley Point is somewhat wetter than Cubi Point outside of the southwest monsoon, when the rainshadow effect would be less relevant; Sangley Point has more rainy days on average than does Cubi Point during the October–February drier season.



Source: DOST-PAGASA. Climatological Normals, Sangley Point, Cavite 1991-2020; DOST-PAGASA. Climatological Normals, Cubi Pt. Olongapo City, Zambales 1994–2020.

Exhibit 7-3 Rainfall Patterns for Sangley Point and Cubi Point Weather Stations

Modeled baseline data on weather extremes at the provincial level offer additional insight into weather patterns in the BCIB project area. Exhibit 7-4 shows the baseline extreme values adopted for Bataan and Cavite by the downscaled modeling effort presented in the Philippine Climate Extremes Report 2020.[247] These data are not actual recorded extremes, but rather 'best estimate' predicted extremes interpolated from weather station data and averaged across grid cells of 0.25° and 0.5° resolution, as computed by the Southeast Asian Climate Assessment and Dataset, and subsequently averaged across all grid cells corresponding to each province and filtered using probability thresholds.[248] Although they are considered likely to be more moderate than actual extremes recorded at the source weather stations, the interpolated and averaged province-level 'best estimate' values may have heightened applicability to the BCIB project area, given the distant relative positioning of Sangley Point and Cubi Point.

The baseline extreme values shown in Exhibit 7-4 corroborate the weather pattern profile developed above. Bataan is generally wetter than Cavite, with substantially higher values on most parameters; total wet-day rainfall is 47% higher in Bataan, average daily rainfall intensity 50% higher, and maximum 5-day rainfall 48% higher. Differences are much less significant for maximum single-day rainfall (Bataan just 14% higher) and number of very

[247] See DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020: Observed and Projected Climate Extremes in the Philippines to Support Informed Decisions on Climate Change Adaptation and Risk Management. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines. 145 pp.
[248] See van den Besselaar, E.J.M., G. van der Schrier, R.C. Cornes, A. Sunondo, Iqbal, and A.M.G. Klein Tank. 2017. SA-OBS: A Daily Gridded Surface Temperature and Precipitation Dataset for Southeast Asia. Journal of Climate 30: 5151–5165. doi: http://dx.doi.org/10.1175/JCLI-D-16-0575.s1.

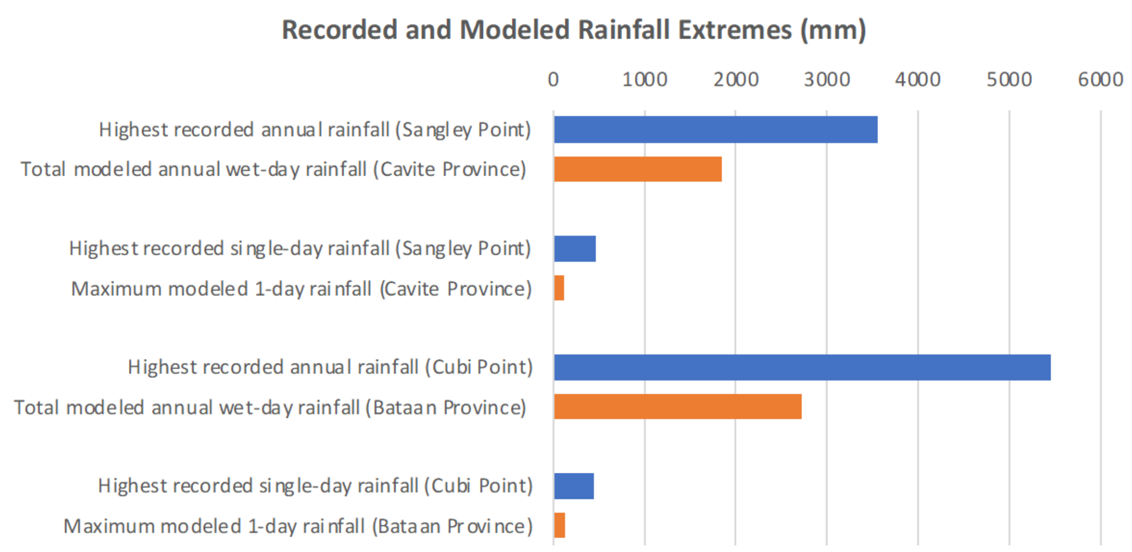
wet and extremely wet days (close to equal for the two provinces). It is interesting to note that, despite being wetter overall, Bataan is predicted to experience considerably longer dry spells than Cavite.

Exhibit 7-4 Modeled Baseline Rainfall Extremes for Bataan and Cavite

Category of Baseline Extreme	Bataan	Cavite
Total wet-day rainfall (mm)	2727.1	1850.1
Average daily rainfall intensity (mm/day)	19.9	13.3
Maximum 1-day rainfall total (mm)	133.2	116.4
Maximum 5-day rainfall total (mm)	360.6	243.2
Rainfall on very wet days (mm)	68.3	45.5
Rainfall on extremely wet days (mm)	115.3	87.1
Total rainfall from very wet days (mm)	685.1	500.1
Total rainfall from extremely wet days (mm)	206.5	162
Number of very wet days	6.9	7
Number of extremely wet days	1.5	1.4
Longest wet spell (days)	25	18.5
Longest dry spell (days)	83.7	51.9

Source: DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020. PAGASA, Quezon City.

There are significant disparities between the recorded rainfall extremes at Sangley Point and Cubi Point, on the one hand, and the modeled extremes for Bataan and Cavite on the other; this is illustrated in Exhibit 7-5. Recorded maximum annual rainfall at Sangley Point is four times higher than the predicted extreme annual wet-day rainfall for Cavite Province, and recorded maximum daily rainfall is twice as high as predicted extreme 1-day rainfall. For the Cubi Point–Bataan Province pairing, the highest annual rainfall recorded at the weather station is a bit over three times the predicted extreme annual wet-day rainfall for Bataan Province, and recorded maximum daily rainfall is twice as high as predicted extreme 1-day rainfall. Although significant portions of the observed differences can no doubt be attributed to imprecision inherent in interpolation and the application of averaging and thresholds, the comparison may also suggest real differences in the rainfall regime experienced at weather stations on the very edges of their respective provinces and conditions that prevail in other parts of those provinces. Specifically, the data comparison may suggest that the BCIB project area in north-central Cavite is likely to be somewhat drier than Sangley Point, and that the project area in far southern Bataan is likely to receive somewhat less rainfall than Cubi Point.



Source: DOST-PAGASA. Climatological Extremes, Sangley Point, Cavite, to 2020; DOST-PAGASA. Climatological Extremes, Cubi Pt., Subic Bay, Olongapo City, Zambales, to 2020; DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020. PAGASA, Quezon City.

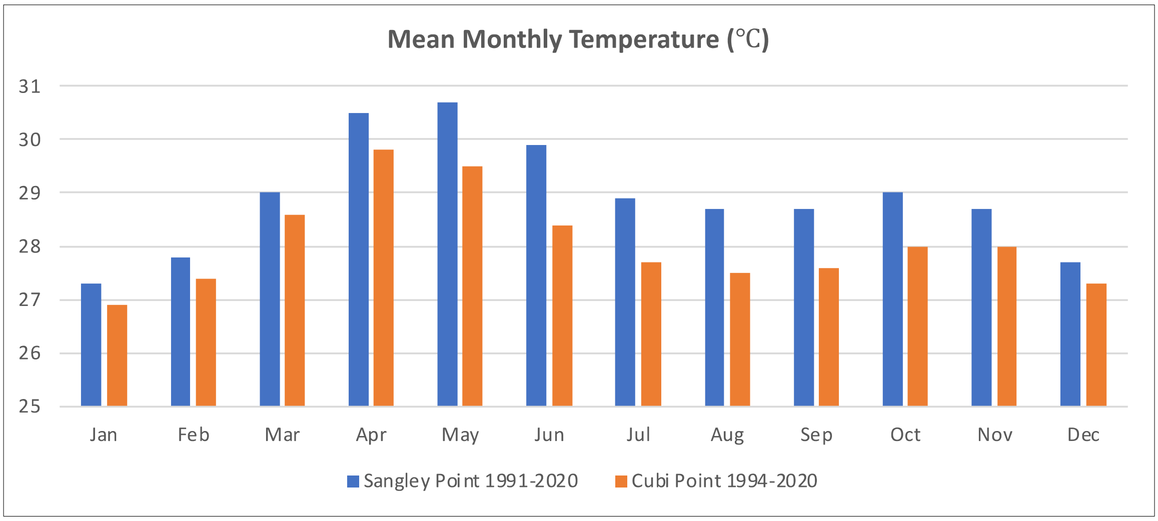
Exhibit 7-5 Recorded Rainfall Extremes (Sangley Point and Cubi Point) vs. Modeled Extremes (Cavite Province and Bataan Province)

Temperature

Air temperature in the Manila Bay region is fairly stable throughout the year. Mean annual temperature was 28.9°C at Sangley Point over the 1991–2020 period, with monthly mean temperature ranging from 27.3–30.7°C. The highest average temperatures at Sangley Point are experienced from April to September, roughly corresponding to the southwest monsoon (see Exhibit 7-6 and Exhibit 7-7). The highest air temperature recorded since 1974 at Sangley Point was 38.5°C (in May 1987), and the record low was 18.0°C (February 1982).

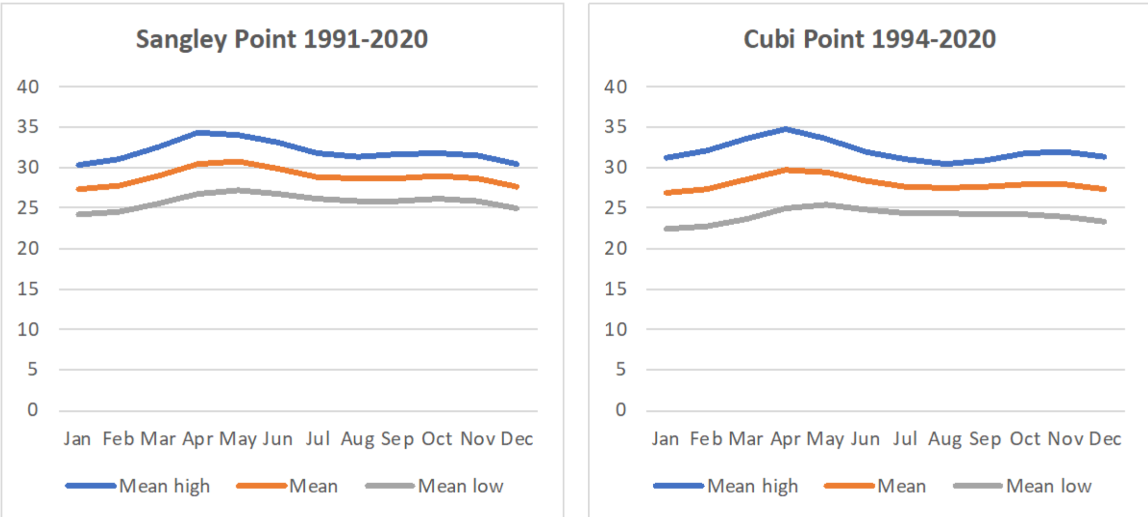
Temperature data from Cubi Point, averaged over the 1994-2020 period, indicate a generally warmer and more stable temperature regime than at Sangley Point. Mean annual temperature at Cubi Point was 28.1°C, with monthly mean temperature ranging from 26.9–29.8°C. Fluctuations in air temperature over the year at Cubi Point do not appear to follow the same southwest monsoon-associated pattern as at Sangley Point; temperatures are highest in April and May, but the temperature is otherwise quite stable, even though the dry season. The record high daily temperature at Cubi Point (since 1994) was set in April of 2018, at 39.2°C, and the record low was 17.3°C, set in February of 2020.

The generally cooler conditions at Sangley Point may be attributable in part to exposure, as the station is located on a long narrow peninsula jutting out into Manila Bay, surrounded by water and exposed to winds from all directions. By contrast, the Cubi Point station is positioned within a narrow and moderately protected bay and is sheltered from the northeast monsoonal winds by the Zambales Range; it may be reasonably speculated that an adiabatic warming effect may prevail there during the northeast monsoon, preventing development of a cooling trend similar to that experienced during the same time of year at Sangley Point.



Source: DOST-PAGASA. Climatological Normals, Sangley Point, Cavite 1991-2020; DOST-PAGASA. Climatological Normals, Cubi Pt. Olongapo City, Zambales 1994–2020.

Exhibit 7-6 Mean Monthly Temperature at Sangley Point and Cubi Point Weather Stations



Source: DOST-PAGASA. Climatological Normals, Sangley Point, Cavite 1991-2020; DOST-PAGASA. Climatological Normals, Cubi Pt. Olongapo City, Zambales 1994–2020.

Exhibit 7-7 Mean Monthly Highs and Lows, Sangley Point and Cubi Point

As with rainfall, modeled baseline data on weather extremes at the provincial level offer additional insight into the temperature regime in the BCIB project area. Exhibit 7-8 shows the baseline extreme values adopted for Bataan and Cavite by the downscaled modeling effort presented in the Philippine Climate Extremes Report 2020.

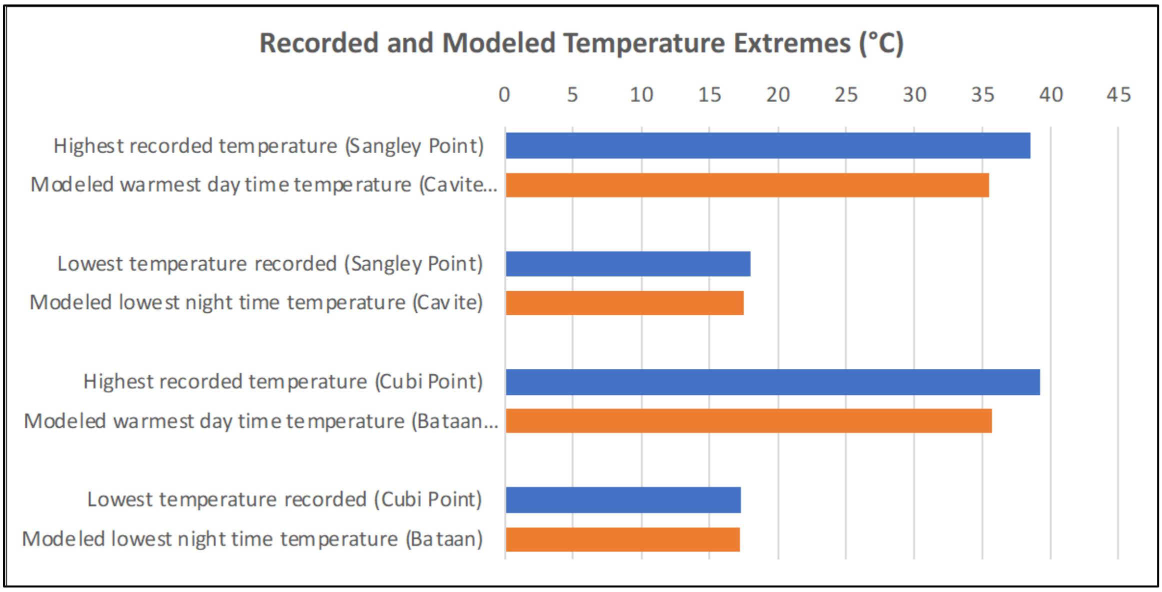
Exhibit 7-8 Modeled Baseline Temperature Extremes for Bataan and Cavite

Category of Baseline Extreme	Bataan	Cavite
Coldest nighttime temperature (°C)	17.2	17.5
Average nighttime temperature (°C)	22.2	22.4
Warmest nighttime temperature (°C)	25.5	25.6
Coldest day time temperature (°C)	25.4	24.9

Category of Baseline Extreme	Bataan	Cavite
Average day time temperature (°C)	31.3	31.0
Warmest day time temperature (°C)	35.7	35.5
Daily temperature range (°C)	9.0	8.6
Fraction of cold nights (%)	11.6	11.3
Fraction of warm nights (%)	11.7	11.2
Fraction of cool days (%)	11.6	11.4
Fraction of hot days (%)	11.5	11.5
Warm Spell Duration Index (days)	10.8	5.2

Source: DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020. PAGASA, Quezon City.

The modeled temperature extremes for Bataan and Cavite are strikingly similar, with values for virtually all temperature extreme parameters varying by less than 5% between the two provinces. The most significant disparity, by far, regards the Warm Spell Duration Index values; Bataan is expected to experience warm spells lasting nearly 11 days, while Cavite would be expected to see warm spells only half that long. Unlike the rainfall values discussed above, the temperature extremes observed at the Sangley Point and Cubi Point weather stations do not diverge particularly strongly from the modeled extremes for Cavite and Bataan Provinces (see Exhibit 7-9).



Source: DOST-PAGASA. Climatological Extremes, Sangley Point, Cavite, to 2020; DOST-PAGASA. Climatological Extremes, Cubi Pt., Subic Bay, Olongapo City, Zambales, to 2020; DOST-PAGASA, Manila Observatory and Ateneo de Manila University. 2021. Philippine Climate Extremes Report 2020. PAGASA, Quezon City.

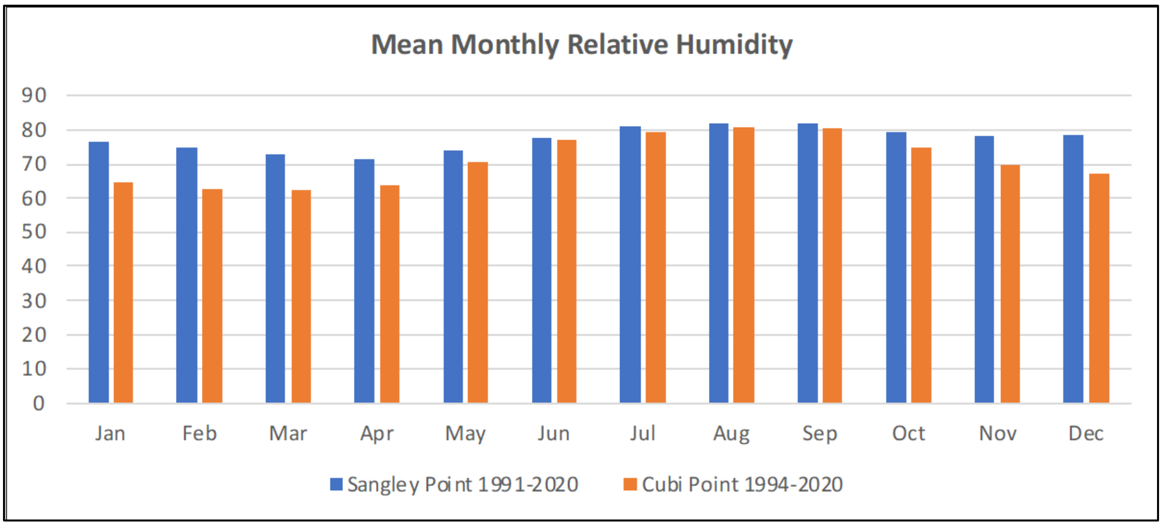
Exhibit 7-9 Recorded Temperature Extremes (Sangley Point and Cubi Point) vs. Modeled Extremes (Cavite and Bataan)

A significant difference can be seen in relation to high temperature, with the observed record highs at both weather stations exceeding the modeled warmest day time temperature for the respective provinces by 8-10%. It might be surmised that altitude may account for much of the difference between the point and grid-averaged values, except that no similar divergence can be seen for observed and modeled lows. Overall, the data comparison in Exhibit 7-9 suggests that temperature data from Sangley Point and Cubi Point may represent temperature conditions at the Cavite and Bataan portions of the BCIB project area reasonably well.

Relative humidity

Relative humidity is a measure of how much water vapor is in the air, compared to how much water vapor the air is physically capable of holding at a given temperature, and is a primary determinant of interaction between surfaces and their immediate atmospheric environments. High relative humidity (over about 65%) makes hot weather feel more uncomfortable, as it inhibits cooling of the skin surface by evaporation. Very high relative humidity (100%) provides one of the essential ingredients in the formation of fog, which in turn may affect the safety of various forms of transportation.

Longitudinal data from the Sangley Point and Cubi Point weather stations indicate that relative humidity is generally high for both; this is to be expected, given the stations' proximity to the sea. Annual average relative humidity at Sangley Point for the period 1991–2020 was 77.3%, and the same measure at Cubi Point for the period 1994–2020 was 71.2. August and September are the most humid months for both Sangley Point and Cubi Point, with relative humidity over 80% at each. The least humid month at Sangley Point is April, and March is least humid for Cubi Point (see Exhibit 7-10). Cubi Point is significantly less humid than Sangley Point outside the southwest monsoon months.



Source: DOST-PAGASA. Climatological Normals, Sangley Point, Cavite 1991-2020; DOST-PAGASA. Climatological Normals, Cubi Pt. Olongapo City, Zambales 1994–2020.

Exhibit 7-10 Mean Relative Humidity at Sangley Point and Cubi Point

Wind regime

As noted above, central Luzon is subject to pronounced seasonal shifts in prevailing wind direction, due to the general monsoonal circulation experienced throughout Southeast Asia. This is readily seen in wind rose diagrams generated from longitudinal wind data collected at the Sangley Point and Cubi Point weather stations (see Exhibit 7-11 and Exhibit 7-12). A wind rose diagram is a graphical presentation that depicts a bi-variate frequency distribution of wind speed and wind direction. It shows what percentage of the time the wind speed is within a certain range, for each of the 16 points of the compass. The wind rose displays the frequency distribution data as spokes radiating from a hub, with one spoke for each compass point. The length of each speed interval's segment of a spoke is related to its frequency, with longer segments representing higher frequencies. For purposes of wind rose interpretation, a wind speed scale is provided in Exhibit 7-13. The scales used in the individual wind roses are dependent on the actual wind speeds recorded for the month in question, and thus are different for each; this allows all wind roses to be the same size but requires careful reading and comparison across months. Data used in the wind rose analysis covers the 1988–2017 period for Sangley Point, and 1994–2017 for Cubi Point.

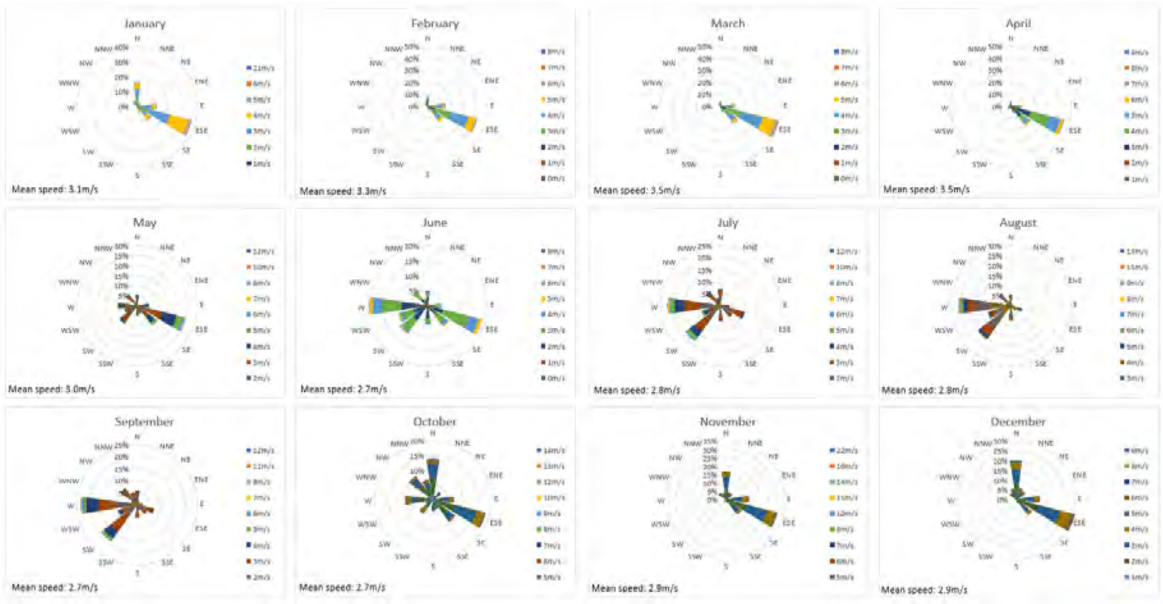


Exhibit 7-11 Monthly Wind Rose Diagrams, Sangley Point

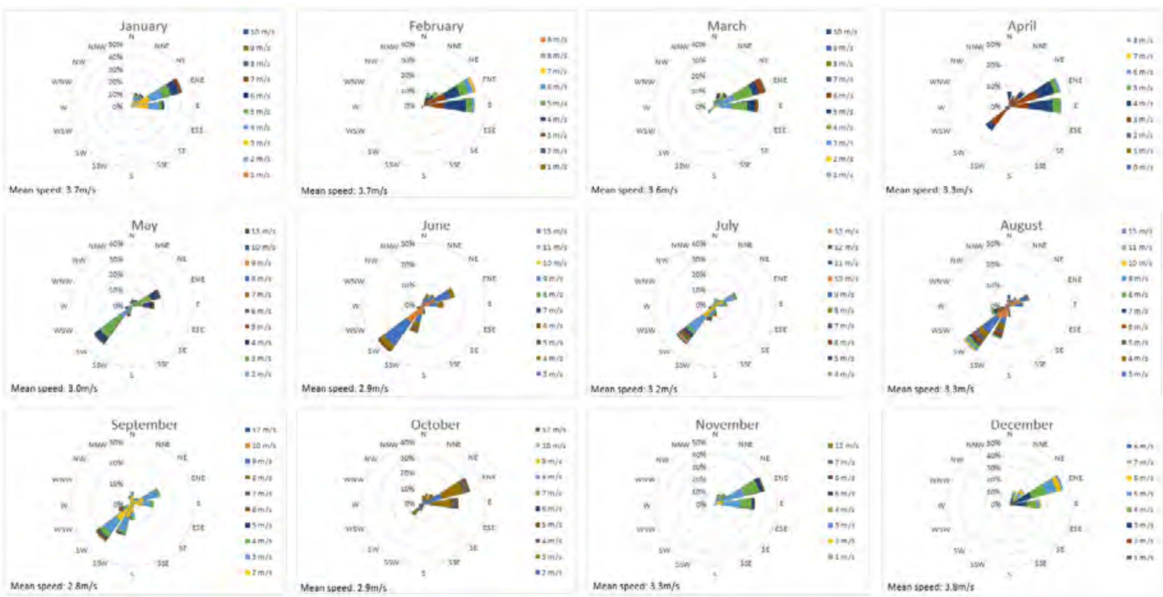


Exhibit 7-12 Monthly Wind Rose Diagrams, Cubi Point

Exhibit 7-13 Wind Speed Scale

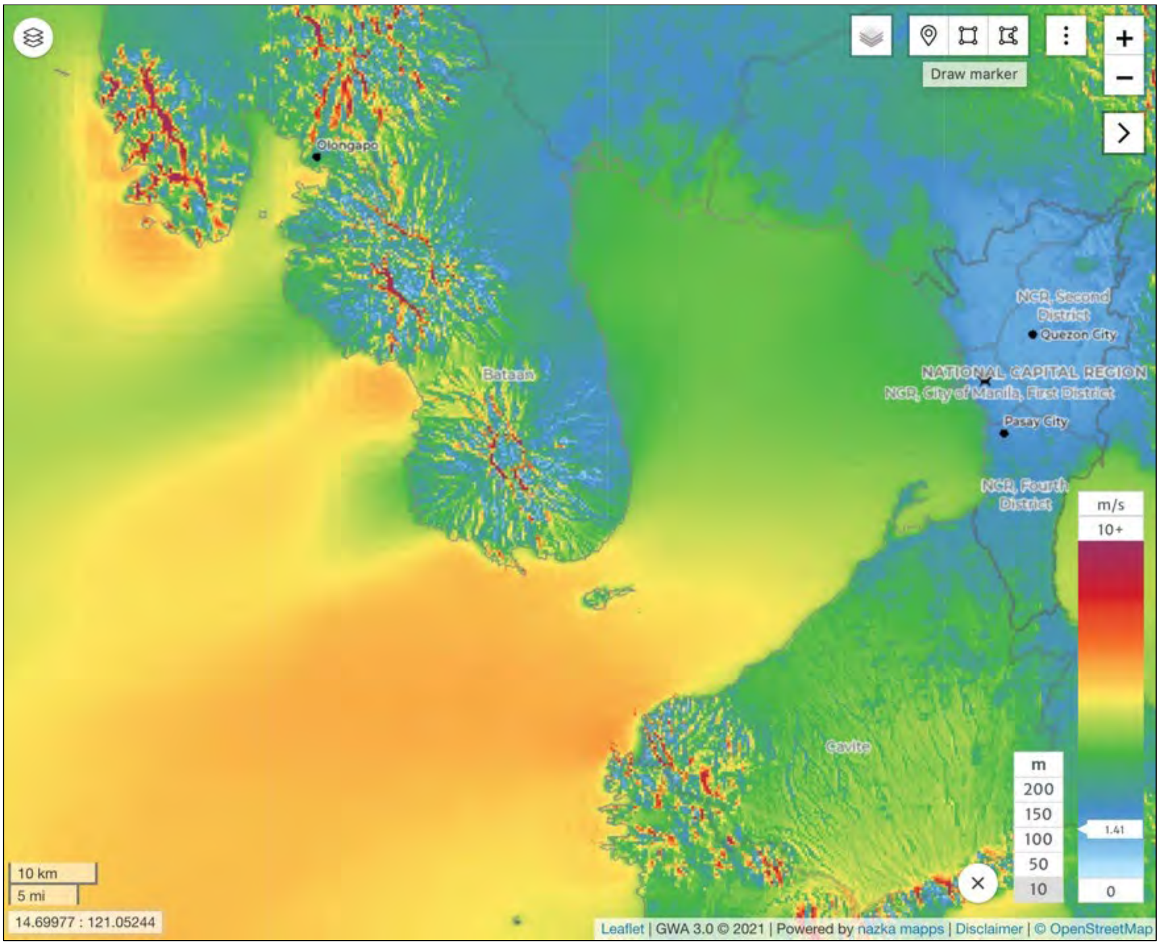
Wind Speed			Qualitative Description
(m/s)	knots	km/hr	
1–4	1.9–7.8	3.6–14.4	Light
5–8	9.7–15.6	18.0–28.8	Moderate

Wind Speed			Qualitative Description
(m/s)	knots	km/hr	
9–12	17.5–23.3	32.4–43.2	Moderate to Strong
13–16	25.3–31.1	46.8–57.6	Strong
17–24	33.0–46.7	61.2–86.4	Very Strong
Above 24	Above 46.7	Above 86.4	Violent

Several noteworthy observations can be gleaned from the wind rose diagrams in Exhibit 7-11 and Exhibit 7-12. First, there is indeed a marked seasonal shift in average wind direction, with easterlies prevailing from October to May, and westerlies dominant from June to September, at both Sangley Point and Cubi Point. Second, the nature of easterlies and westerlies is somewhat different for the two stations. Easterlies at Sangley Point are mainly ESE, and westerlies have a bimodal distribution, with W and SW experienced in approximately equal frequency. At Cubi Point, easterlies are a mix of ENE and E, while westerlies are less ambiguous, with SW clearly dominant. Topography and the orientation of the land–sea interface likely play a strong role in shaping these differences. The third pattern of note is that mean wind speeds at both stations are quite low, and relatively stable through the year. Mean annual wind speed at Sangley Point is 3.0 m/s and exhibits only moderate variability (mean Oct–May 3.1 m/s, mean Jun–Sep 2.8 m/s). At Cubi Point, mean annual wind speed is slightly higher at 3.3 m/s, but no more volatile (mean Oct–May 3.4 m/s, mean Jun–Sep 3.1 m/s).

Topography can influence the local distribution of wind speed, and in the case of the BCIB project area, the effect is significant, with higher mean wind speed expected in the mouth of Manila Bay than at Sangley Point. This can be seen on the wind speed map in Exhibit 7-14 (taken from the Global Wind Atlas 3.0), which clearly indicates an area of higher mean wind in the mouth of the bay, apparently due to the constrictive-accelerative effect created by the positioning of Mt. Mariveles and the hills around Nasugbu on either side of the bay mouth. This effect can also be seen just to the north, where easterlies must funnel through the gap between Mt. Mariveles and Mt. Natib. According to point data gleaned from the wind atlas application, predicted mean wind (at 10 m altitude) would be 4.7 m/s at the BCIB's Bataan landing site, 5.3 m/s off the Tail End of Corregidor Island, and 4.8 m/s at the Cavite landing site. [249]

[249] Global Wind Atlas 3.0 (https://globalwindatlas.info)



Source: Global Wind Atlas 3.0 (https://globalwindatlas.info)

Exhibit 7-14 Mean Wind Speed (m/s) in Manila Bay Area

A generally mild wind regime notwithstanding, central Luzon is subject to extreme wind on occasion. Exhibit 7-15 shows the record wind speeds recorded as of 2020 at Sangley Point and Cubi Point. These extreme wind speeds are presumed to be mostly associated with cyclonic storm systems; cautioning that many of the extreme winds listed are from a direction that is atypical for the time of year, indicating a disruptive system operating by a different mechanical logic than the relatively stable monsoon pattern. Sangley Point has generally experienced higher peak winds (historical peak wind 194 km/h; mean monthly peak wind 110 km/h) than has Cubi Point (historical peak wind 144 km/h; mean monthly peak wind 94 km/h). This difference is likely to be influenced by topography, as the Cubi Point station is offered substantial shelter by the Zambales Range to the east and the Redondo Peninsula to the west.

Exhibit 7-15 Record Winds at Sangley Point and Cubi Point as of 2020

Sangley Point			Month	Cubi Point		
Max Speed (m/s)	Max Speed (km/h)	Direction		Direction	Max Speed (m/s)	Max Speed (km/h)
17	61	ESE	JAN	ENE	25	90
15	54	ESE	FEB	NE	21	76
24	86	ESE	MAR	ENE	19	68
16	58	ESE	APR	ENE	17	61

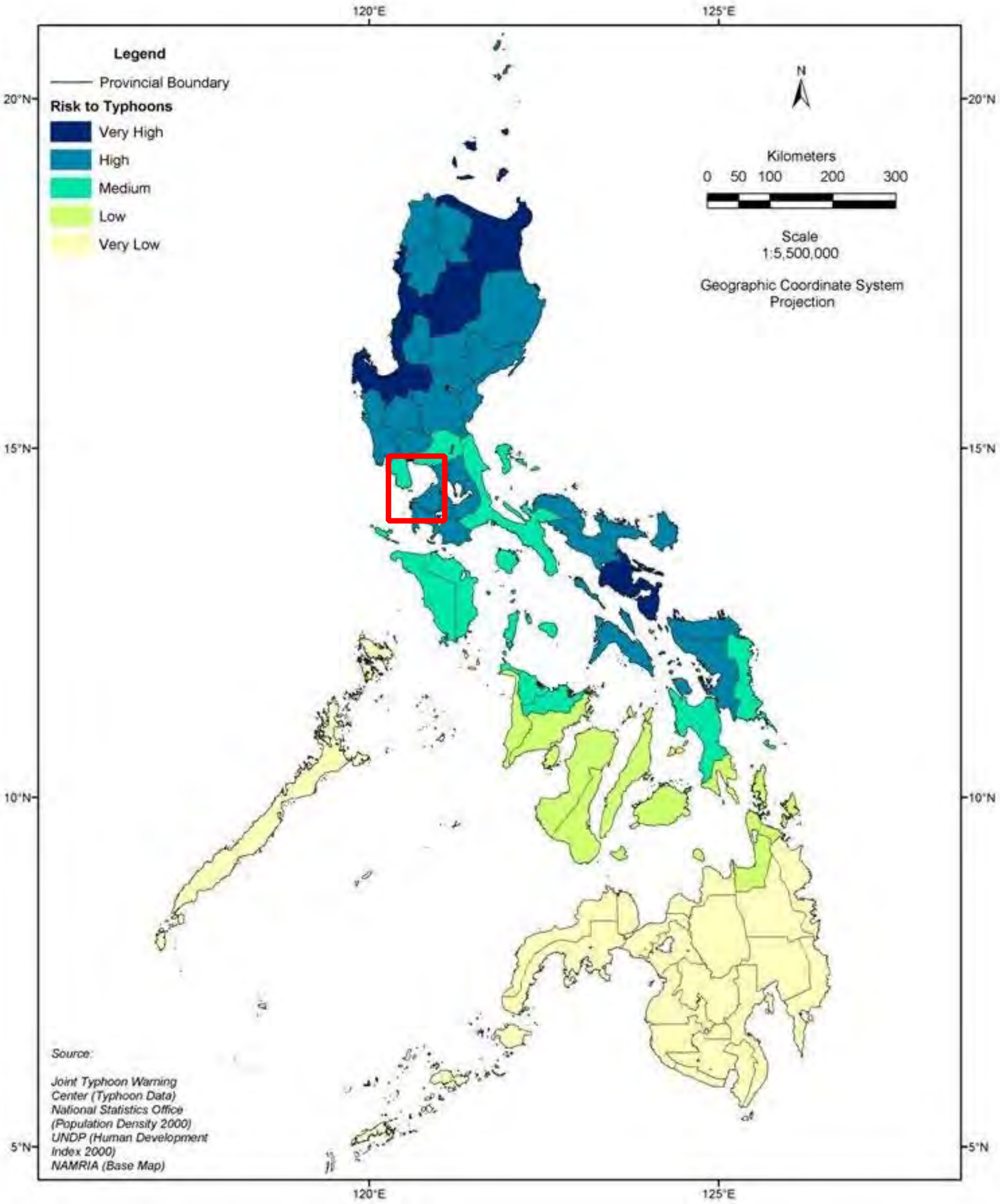
Sangley Point			Month	Cubi Point		
Max Speed (m/s)	Max Speed (km/h)	Direction		Direction	Max Speed (m/s)	Max Speed (km/h)
27	97	SW	MAY	WSW	27	97
25	90	SE	JUN	SW	28	101
54	194	E	JUL	ENE	29	104
30	108	W	AUG	SW	25	90
44	158	NNW	SEP	WSW	34	122
45	162	NW	OCT	SW	30	108
49	176	NW	NOV	ENE	40	144
22	79	NNW	DEC	E	20	72

Source: DOST-PAGASA. Climatological Extremes, Sangley Point, Cavite, to 2020; DOST-PAGASA. Climatological Extremes, Cubi Pt., Subic Bay, Olongapo City, Zambales, to 2020

Tropical Cyclones

In common with much of the Philippines, Luzon is vulnerable to tropical cyclones, which most often develop over the Western Pacific and track northwestwards across the archipelago. Much less frequently, cyclonic storms also form over the South China Sea and move eastwards to affect the country. Cyclone tracks can be quite irregular, and some do depart from this general pattern. DOST-PAGASA categorizes cyclones, based on their sustained wind speed, as follows: (1) tropical depressions (sustained winds 61 km/h or less); (2) tropical storms (62–88 km/h); (3) severe tropical storms (89–117 km/h); (4) typhoons (118–220 km/h); and (5) super typhoons (sustained winds greater than 220 km/h). From 1948 to 2020, DOST-PAGASA recorded an annual average of 20 tropical cyclones in the Philippine Area of Responsibility, with an average of nine passing over Philippine landmasses.

Cyclone risk is not distributed evenly across the country; in general, northern areas are more likely to be hit than southern areas, but the pattern is not linear, and risk is quite uneven within the northern half of the archipelago. Exhibit 7-16 shows estimated typhoon risk as determined by DOST-PAGASA, which may also be indicative of exposure to lesser cyclonic storms. Manila Bay is surrounded by zones of high and medium typhoon risk; Bataan and Bulacan are considered to be at medium risk, while Pampanga, Metro Manila and Cavite fall into the high-risk category.

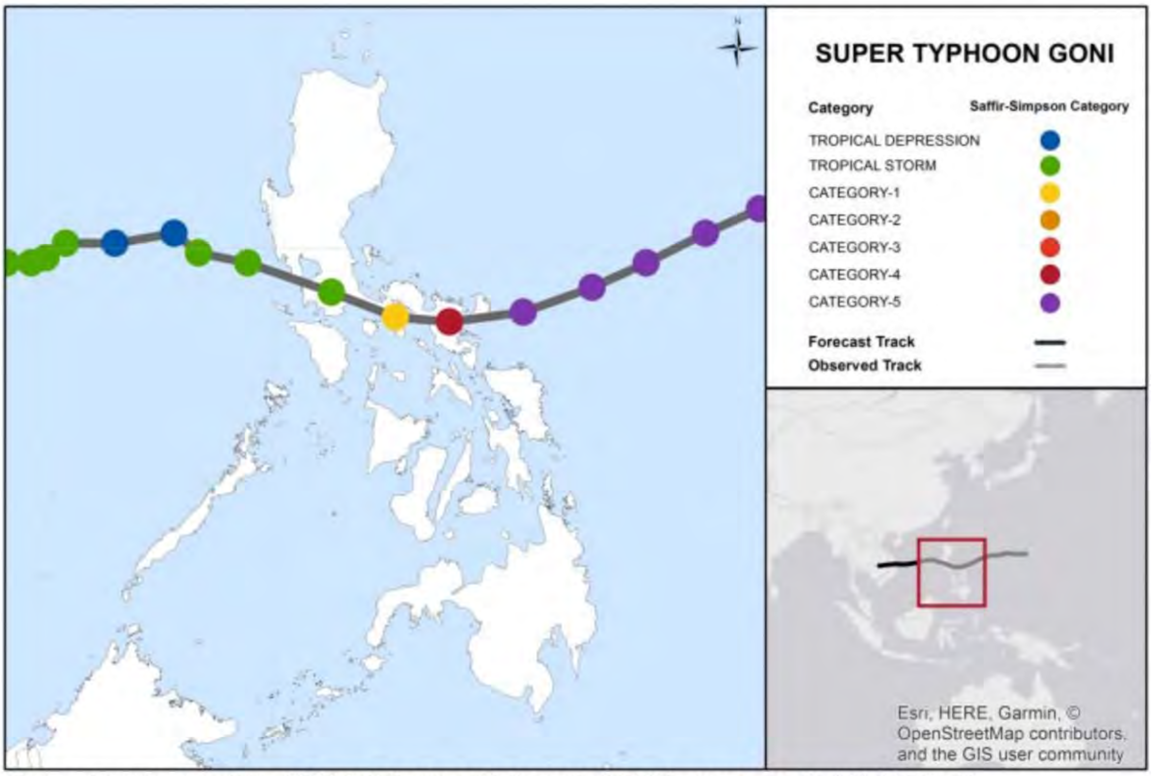


Source: Joint Typhoon Warning Center (Typhoon Data 1945-2005) National Statistics Office (Popu
(Human Development Index 2000) NAMRIA (Base Map 1998)

Source: http://mapsanddata.observatory.ph/wp-content/uploads/2015/10/Risk-to-Typhoons_Philippines-Produced_2008-739x1024.jpg

Exhibit 7-16 Typhoon Risk Zones of the Philippines

Direct hits from the stronger cyclones can have serious consequences. For example, Super Typhoon Rolly (international name Goni) transited the country from 20 October to 1 November 2020. With sustained winds over 220 km/h, the storm made its first landfall over Bato, Catanduanes, and a second landfall in Tiwi, Albay. It then weakened to typhoon status and made its third landfall in San Narciso, Quezon, and fourth landfall in Lobo, Batangas. The storm caused severe flooding in 23 different zones, two landslides, one lahar flow, uprooted trees in seven areas, and one maritime incident by the time it departed the Philippine Area of Responsibility, Rolly had left 25 people dead, 399 injured and six missing. Over 170,000 houses were damaged. In all, 2,030,130 persons across multiple regions were affected. The total cost of damage to infrastructure was estimated at Php 13 billion, and the damage to agriculture at Php 5 billion. Super Typhoon Rolly (by then weakened to 'tropical storm' status) skirted the south end of Metro Manila and passed directly over the mouth of Manila Bay on its way to the South China Sea (see Exhibit 7-17).



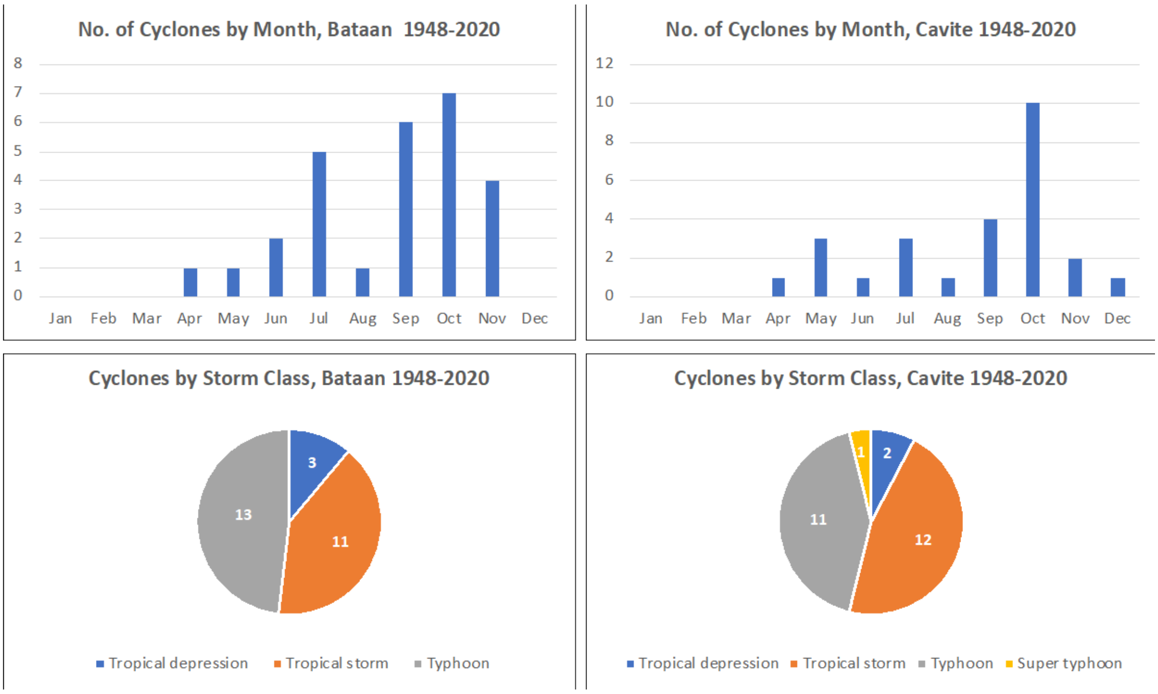
Source: Guy Carpenter & Co. CAT-I Bulletin: Super Typhoon Goni (Rolly). guycarp.com/insights/2020/cat-i-bulletin-super-typhoon-goni-rolly.html. Accessed 7 May 2022. (original source cited as Joint Typhoon Warning Center)

Exhibit 7-17 Track of Super Typhoon Rolly (Goni) in 2020

Between 1948 and 2020, Bataan and Cavite have been traversed by 27 and 26 cyclones, respectively (see Exhibit 7-18). More of these have occurred in October than in any other month, in both provinces, but there is not a particularly strong modal distribution. Only January, February and March have been cyclone-free for both Bataan and Cavite.

With regards to storm strength, the lion's share of cyclonic storms passing through Bataan and Cavite have consisted of tropical storms and typhoons; these two storm classes have made up 89% of tracked storms in Bataan, and 88% in Cavite. Only one super typhoon (Rolly/Goni) has been recorded, and the 'severe tropical storm' class is unrepresented in the data.

The cyclone data presented somewhat understate the extent to which the BCIB project area is affected by the passage of cyclones, at least in relation to larger storms. A large storm can be expected to have strong effects across a broad band extending out on both sides of the path of the storm's eye, and any substantial cyclonic storm passing over either Bataan or Cavite is likely to bring heavy weather to the mouth of Manila Bay. In view of this, adding the cyclone data for Bataan and Cavite together (53 cyclonic storms between 1948 and 2020) may give the most realistic picture of storm activity for the BCIB project area.



Source: Adapted from Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Exhibit 7-18 Cyclones Recorded in Bataan and Cavite, 1948–2020

7.1.2 Climate Change

The Climate Risk and Adaptation Assessment (CRAA) prepared for the BCIB project considered climate projections based on two global Representative Concentration Pathways (RCPs): RCP4.5 (medium global emissions scenario) and RCP8.5 (high global emissions scenario) and three future time periods (early future: 2020–2039; mid-future: 2046–2099; late future: 2080–2099). The baseline climate scenario used was as reflected in data available for the 1986–2005 period. From the assessment, a series of projections were developed in relation to the climate risk parameters that are of relevance to the project over its 100-yr designed lifespan, which is expected to approximately correspond to the 2030–2130 period. The parameters for which projections were made for the BCIB project area are temperature, rainfall and related flooding and landslide risk, wind, sea level rise and storm surge and associated flood risk. The projections for each of the parameters mentioned are summarized below. More detailed discussion of each parameter and expected changes to them can be found in the CRAA report, which is included in the EIA report Annexes.

Climate Change Projections for the BCIB Project Area

Temperature

Comparison of projected temperature for key indicators against 1986–2005 baseline values reveal a linear upward trajectory for both mean daily maximum temperature and yearly high temperature, for both Bataan and Cavite (see Exhibit 7-19). Mean daily maximum temperature is projected to increase 1.5°C by the end the present century under the RCP4.5 scenario, and 3.2° by under RCP8.5. Projected temperature rises are of similar proportions for yearly high temperature. More striking is the projected change in relation to the frequency of very hot days; the percentage of days exceeding the 90th percentile threshold for high temperature (baseline 11.5% or 42 days) is projected to jump to above 60% (222 days for Bataan and 234 days for Cavite) by the end of this century under the RCP4.5 scenario, and to about 90% (331 days for Bataan and 334 days for Cavite) under RCP8.5.

Exhibit 7-19 Projected Change in Temperature Regime (2020–2099), Bataan and Cavite

Scenario	Period	Bataan			Cavite		
		TXm	TXx	TX90p	TXm	TXx	TX90p
Baseline Value	1986-2005	31.3	35.5	11.5	31.0	35.7	11.5
Moderate Emission (RCP4.5)	Early (2020-2039)	31.8 (0.5)	36.3 (0.6)	23.6 (12.1)	31.6 (0.6)	36.0 (0.5)	25.5 (14.0)
	Mid (2046-2065)	32.5 (1.2)	37.0 (1.3)	49.3 (37.8)	32.2 (1.2)	36.7 (1.2)	53.2 (41.7)
	Late (2080-2099)	32.8 (1.5)	37.3 (1.6)	60.9 (49.4)	32.5 (1.5)	37.0 (1.5)	64.1 (52.6)
High Emission (RCP8.5)	Early (2020-2039)	32.0 (0.7)	36.6 (0.9)	31.7 (20.2)	31.8 (0.8)	36.3 (0.8)	33.4 (21.9)
	Mid (2046-2065)	32.9 (1.6)	37.4 (1.7)	60.6 (49.3)	32.6 (1.6)	37.2 (1.7)	65.1 (53.6)
	Late (2080-2099)	34.5 (3.2)	39.3 (3.6)	90.6 (79.1)	342 (3.2)	39.1 (3.6)	91.4 (79.9)

Key: TXm = Mean daily maximum temperature (°C); TXx = Maximum daily maximum temperature (°C); TX90p = Percentage of days on which temperature exceeds 90th percentile threshold (%)

Note: Values in parentheses indicate absolute change from 1986–2005 baseline values

Data source: DOST-PAGASA, Manila Observatory and Ateneo de Manila University (2021). Philippine Climate Extremes Report 2020: Observed and Projected Climate Extremes in the Philippines to Support Informed Decisions on Climate Change Adaptation and Risk Management. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines.

Source: Adapted from Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Rainfall

Bataan and Cavite are more divergent in relation to projected change in rainfall than they are for expected temperature changes. Bataan generally received higher maximum daily rainfall over the baseline period than Cavite, but the gap between them is projected to narrow somewhat under both emissions scenarios (see Exhibit 7-20). Maximum daily rainfall in Bataan is projected to rise 2.6% above the baseline of 133.2 mm by century's end under RCP4.5, and peak at 137.7 mm (6.3% above baseline) by the second half of the century before falling back to nearly the same as the baseline by 2100 under the RCP8.5 scenario. For Cavite, maximum daily rainfall is projected to rise 8.2% above the baseline of 116.4 mm by 2100 under RCP4.5 and do the same by mid-century under the RCP8.5 scenario.

The 99th percentile for daily rainfall is projected to fall modestly for Bataan, for all time periods under both emissions scenarios, while the total rainfall received on days over the 99th percentile (i.e., extremely wet days) presents a mixed picture, ranging from 4.5% above baseline in the middle of the century under the RCP4.5 scenario to 18.1% below baseline in late century under RCP8.5.

For Cavite, the 99th percentile for daily rainfall is projected to rise for all time periods under both scenarios, with rises being a little stronger under the RCP4.5 scenario than under RCP8.5. Total rainfall received on extremely wet days is significantly higher than baseline for most time/emissions scenarios, with the highest values projected for mid-century under both the RCP4.5 (24.8% above baseline) and RCP8.5 (17.3% above baseline) scenarios.

It can be considered likely that an increased incidence of landslides will accompany the projected increases in maximum daily rainfall, since landslide risk is associated with soil saturation. This applies only to the Bataan portion of the BCIB project area, as the Cavite side does not have any underlying landslide risk due to very gentle topography. The mixed picture with regards to future trends in maximum daily rainfall and rainfall received on extremely wet days for Bataan suggests that landslide risk, at least insofar as it relates to soil saturation levels, may be likely to fluctuate over the next century, rather than seeing a generalized linear increase.

Flooding that is derived from rainfall (as opposed to storm surge or sea level rise) can be expected to become more frequent, commensurate with increased maximum daily rainfall and rainfall on extremely wet days; this is a concern principally in Cavite, where flooding has been a problem historically, and is linked in substantial measure to rainfall events of sufficient volume and intensity to overwhelm local drainage channels and structures.

Exhibit 7-20 Projected Change in Rainfall Regime (2020–2099), Bataan and Cavite

Scenario	Period	Bataan			Cavite		
		Rx1day	P99	R99p	Rx1day	P99	R99p
Baseline Value	1986-2005	133.2	115.3	206.5	116.4	87.1	162
Moderate Emission (RCP4.5)	Early (2020-2039)	128.9 (-4.3)	113.4 (-1.9)	181.0 (-25.5)	118.0 (1.6)	89.1 (2.0)	169.9 (7.9)
	Mid (2046-2065)	135.9 (2.7)	11 5.2 (-0.1)	215.7 (9.2)	121.0 (4.6)	96.5 (9.4)	202.2 (40.2)
	Late (2080-2099)	136.7 (3.5)	112.1 (-3.2)	203.6 (-2.9)	124.6 (8.2)	94.9 (7.8)	184.4 (22.4)
High Emission (RCP8.5)	Early (2020-2039)	137.7 (4.5)	113.6 (-1.7)	189.3 (-17.2)	116.9 (0.5)	87.3 (0.2)	151.5 (-10.5)
	Mid (2046-2065)	141.6 (8.4)	114.1 (-1.2)	227.4 (20.9)	124.6 (8.2)	95.4 (8.3)	190.0 (28.0)
	Late (2080-2099)	132.9 (-0.3)	102.7 (-12.6)	169.2 (-37.3)	122.9 (6.5)	92.3 (5.2)	183.8 (21.8)

Key: Rx1day = Maximum daily rainfall (mm); P99 = 99th percentile value for daily rainfall (mm); R99p = Total rainfall on days when rainfall exceeds 99th percentile value (mm)

Note: Values in parentheses indicate absolute change from 1986–2005 baseline values

Data Source: DOST-PAGASA, Manila Observatory and Ateneo de Manila University (2021). Philippine Climate Extremes Report 2020: Observed and Projected Climate Extremes in the Philippines to Support Informed Decisions on Climate Change Adaptation and Risk Management. Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City, Philippines.

Source: Adapted from Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Wind

The CRAA report projects that maximum wind speed in the BCIB project area will increase substantially by 2100 (see Exhibit 7-21); this conclusion is based on a spatial extrapolation from the historical maximum at Sangley Point to three general locations within the project area, and applying a multiplication factor to account for an expected increase, derived from the literature, in tropical cyclone peak winds in the region. Based on this projection method, wind speeds during tropical cyclone events in the project area could potentially reach as high as 315 km/hr (87.5 m/s).

Exhibit 7-21 Projected Maximum Wind Speed in Project Area

Alignment Section	Mean Wind Speed Range(m/s)[1]	Estimated Maximum Wind Speed (kph)[2]	Projected Maximum Wind Speed Taking Account of Climate Change[3]
Bataan	6.61 – 7.05	231	300
Corregidor	6.96 – 7.19	236	307
Cavite	6.60 – 7.37	242	315

[1] At 100 m altitude. Values are taken from the Global Wind Atlas 3.0 (htps://globalwindatlas.info).

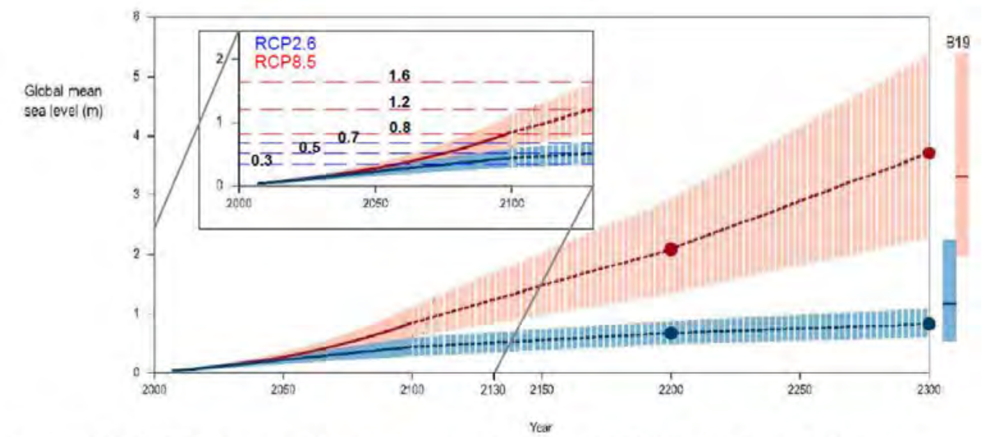
[2] Values are extrapolations based on (1) the historical peak wind speed of 194 kph recorded at Sangley Point Station; and (2) the ratio between modeled mean wind speed at Sangley Point (5.91 m/s) and modeled wind speed at each of three points along the BCIB alignment.

[3] Maximum wind speeds in tropical cyclones are projected to increase by 1.2–1.4 times the historical record by the end of the 21st Century under the influence of climate change, per Xu, H., et al. 2020. Design Tropical Wind Speed When Considering Climate Change. https://ascelibrary.org.doi/pdf/10.1061/%28ASCE%29ST.1943-541X.0002585.

Source: Adapted from Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Sea Level Rise

The CRAA report estimated future regional sea level change for the Philippines by considering together both global sea level rise projections from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) — specifically recent results presented therein from the Ocean and Cryosphere in a Changing Climate (SROCC) study report — and regional non-uniform patterns of sea level change around the Philippines. The reference year selected for the estimation exercise was 2130, the indicative final year of the BCIB infrastructure's design life. The projection based on the global data yielded a range of 0.3 m to 0.7 m rise by 2130 under the RCP4.5 scenario, and 0.8 m to 1.6 m rise by 2130 under the RCP8.5 scenario (see Exhibit 7-22).

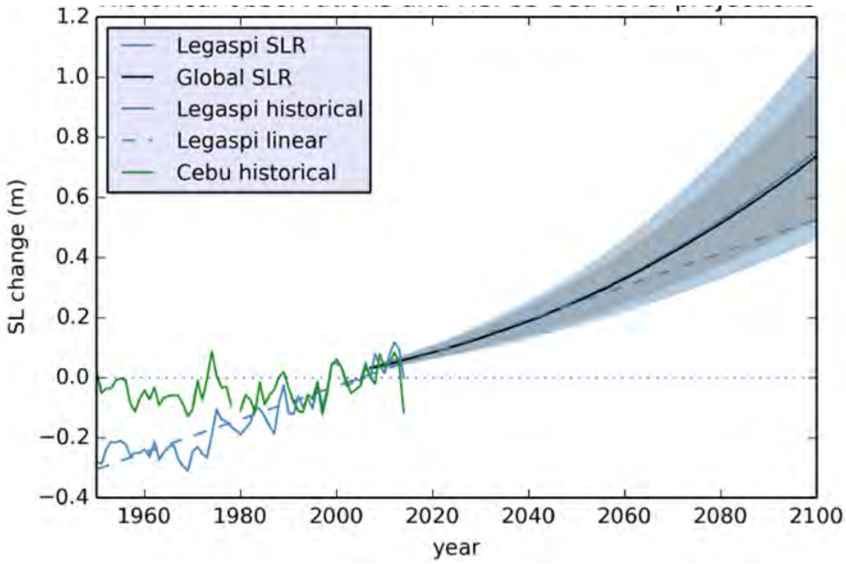


Source: IPCC. 2019. The Ocean and Cryosphere in a Changing Climate (SROCC) Report Chapter 4: Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. p.327.

Source: Appendix 3 of Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Exhibit 7-22 Projection of Global Sea Level Rise After 2100

Comparison against projection data for the Philippines, based on the 2016 United Kingdom Department for International Development (DFID) study Projections of Mean Sea Level Change for the Philippines, was found to suggest that sea level rise was likely to slightly exceed the global average (by about 3–5%) under the RCP8.5 emissions scenario, at least through 2100 (see Exhibit 7-23).

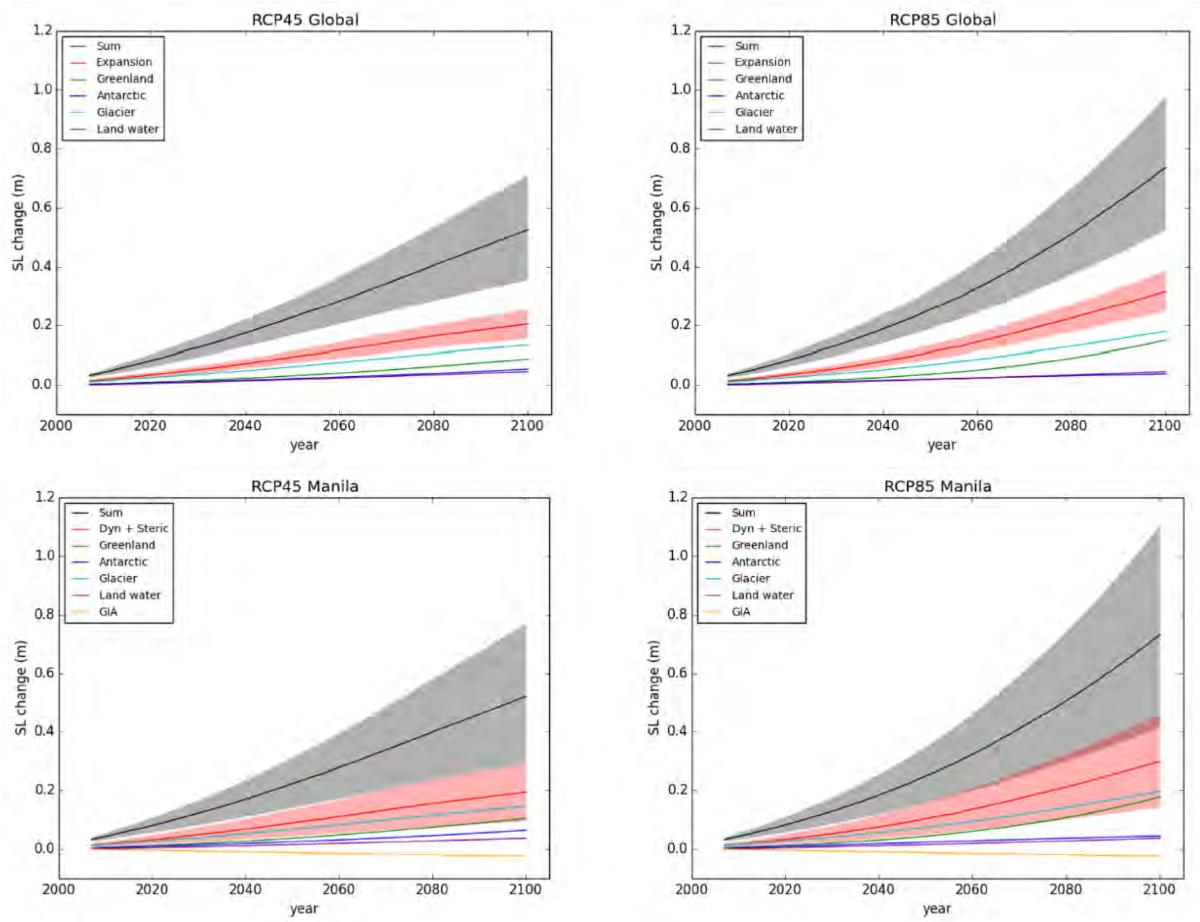


Source: Appendix 3 of Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Exhibit 7-23 Comparison of Philippine and Global Projections for Sea Level Rise

A summary comparison of projections (global mean vs. Manila) to 2100 for both RCP4.5 and RCP8.5 scenarios is shown in Exhibit 7-24. Three features of the graphs shown are readily noted: (1) the width of the range bands widens substantially from left to right, indicating reduced confidence as temporal distance from the present increases into the future; (2) the width of range bands is wider for the Manila projections than for the global ones, reflecting lower confidence due to reliance on a much smaller dataset; and (3) the 2100 end point of the central estimate of sea level rise (solid black line) for Manila is essentially indistinguishable from global mean, under both RCP4.5 and RCP8.5, indicating that the global mean projection is an appropriate stand-in for the sea level rise that can be expected in the BCIB project area by 2100.

Following the SROCC projection (of AR5) that the sea level rise is likely to be in the range of 0.80 to 1.60 m by 2130[250], the BCIB project engineering team adopted a sea level rise of 1.2 m by 2130 as the base design assumption for pile caps, clearances and other aspects of the infrastructure design relevant to sea level. This estimate represents the medium confidence line, which other major projects in Southeast Asia (e.g., Cadangan Project Jambatan Temburong Bridge in Brunei, and others in Hong Kong) have comfortably relied upon. [251]



Source: Appendix 3 of Bataan–Cavite Interlink Bridge Project – Draft Climate Risk and Assessment Report (September 2022). Prepared by T.Y. Lin International – Pyunghwa Engineering Consultants Joint Venture.

Note: The solid line represents the central estimate and shaded area represents the uncertainty of the range

Exhibit 7-24 Projected Global vs. Philippines Sea Level Rise to 2100 Under RCP4.5 and RCP8.5

Storm Surge

Historical data indicate that storm surge has not been a large-magnitude phenomenon in the project area but is a typical accompaniment to the passage of large typhoons. Consultations

[250] While preparing this EIA, the adopted SROCC projection (of AR5) was relied upon. However, since this period AR6 has been adopted, the difference being approximately 0.1m in SLR over the 100-year timespan. The team recognizes this change, however the design of the BCIB accommodates well above the SLR projections and therefore updates per the newly adopted AR6 were deemed unnecessary at this time.

[251] The rationale underpinning the sea level rise assumption for the BCIB project is explained in greater detail in a design memorandum developed by the project engineering team, which is appended to the CRRA report (EIA report Annexes).

carried out with community stakeholders during preparation of the CRAA identified evidence, including eye-witness accounts and shoreline erosion above normal high-water marks, in both Bataan and Cavite. Modeling discussed in the CRAA suggests that storm surge within Manila Bay from even a major typhoon would not be expected to exceed 0.91 m, based on historical data, and that 1 m surge height would be the maximum expected after adding a 10% increment to account for likely strengthening of typhoons under the influence of climate change. It is to be acknowledged that storm surge, sea level and spring tides have an additive effect, such that a 1-m storm surge occurring several decades in the future will be more consequential due to higher baseline sea level, and a surge-producing storm event that happens to coincide with the highest-magnitude phase of the tidal cycle will see its effects magnified. Storm surge, especially in combination with a very high tide, may also impede the outflow of rain-swollen rivers, increasing the probability and magnitude of flooding in surrounding lands. Given its gentle topography and preponderance of low-lying land, the Cavite is significantly more vulnerable than is Bataan to the effects of storm surge, whether in combination with these other factors, or in isolation.

7.1.3 Ambient Air Quality

Ambient air quality in the BCIB project area was measured at 11 sampling stations (5 in Mariveles, 6 in Naic) in mid-February 2020 as part of baseline work for the first iteration of the EIA. Supplementary sampling was carried out in early November 2021 at 6 additional locations (3 in Mariveles and 3 in Naic), to build a more comprehensive dataset, based on updated knowledge of the infrastructure footprint and strengthened assumptions regarding the probable locations of key construction support sites such as casting yards. Additional sampling also aimed to better capture conditions near the roads that will serve BCIB traffic. Following subsequent identification of a large new potential construction support site in Naic. Sampling data for all stations were compiled to yield a comprehensive dataset for each project area. The ambient air quality profiles presented below for each project area are based largely on analysis of the assembled sampling data, with additional insights gathered from a review of prevailing land use activity and air quality degradation factors.

Methods

Sampling was conducted for five air quality parameters: particulate matter under 2.5 microns ($PM_{2.5}$), particulate matter under 10 microns (PM_{10}), total suspended particulates (TSP), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). The sampling methodology used was in accordance with the standard methods of the DENR, as prescribed in DAO 2000-81, the Implementing Rules and Regulations of the Philippine Clean Air Act of 1999 (RA 8749). Ambient air samples were collected for periods of 1 hour and 24 hours for each parameter per station. Ambient temperature and pressure in the area were also recorded at each station during sampling. The collected samples were brought to ELARSI Laboratory, Inc., a DENR-recognized laboratory, for analysis. Methods for sampling and analysis of samples are outlined in Exhibit 7-25.

Two limitations of the study methodology are to be acknowledged here. First, the time slots selected for 1-hr sampling were not standardized within or across field sampling periods or aligned consistently with peaks in traffic. This requires careful interpretation of the 1 hr-averaged results. Secondly, baseline levels of air pollutants sampled in the three field periods represent quantitatively distinct periods in the emissions history of the Manila Bay region and project area, given the timing of the global COVID-19 pandemic and the imposition and adjustment of the Community Quarantine Guidelines as a response. In common with most urban and peri-urban areas around the world, the project area is known to have experienced substantial reductions in traffic during 2020 and 2021, with noticeable effects lasting well into 2022. Sampling results from the February 2020 field period are considered to represent 'pre-pandemic' traffic levels, while the supplemental November 2021 results represent still-substantially reduced traffic, and the Fall of 2022 results were minimally reduced level of traffic. This inconsistency—and the implication that the November 2021 data may understate normal baseline levels for at least some stations—has to be considered in interpretation of the survey findings and selection of representative baseline values for impact modeling.[252]

Exhibit 7-25 Methods Used in Sampling and Analysis

Parameter	Methods
$PM_{2.5}$ PM_{10} TSP	$Pm_{2.5}$, PM_{10} and TSP were collected using a high-volume sampler and analyzed by a DENR-recognized laboratory using the High-Volume Gravimetric Method. A PTFE filter was used for $PM_{2.5}$, and a glass fiber (GF) filter for PM_{10} and TSP. Sampling was carried out over a period of 24 hours at each station. The concentrations of $PM_{2.5}$, PM_{10} and TSP samples in µg/Ncm were computed using the mass of collected particles in µg divided by the total volume of air sample in Ncm.
NO_2	Nitrogen dioxide samples in ambient air were collected in a midget impinger connected to a gas sampler (NOSHOK RAC3 or equivalent). The air was bubbled through an absorbing solution and analyzed using the Griess Saltzman Reaction Method. The concentrations of NO_2 in µg/Ncm were computed using the mass of collected NO_2 gases, divided by the total volume of air sampled in Ncm.
SO_2	Sulphur dioxide samples in ambient air were collected in a midget impinger connected to the gas sampler (NOSHOK RAC3 or equivalent). The air was bubbled through an absorbing solution and analyzed using the Tetrachloromercurate Absorber-Pararosaniline Method. The concentrations of SO_2 samples in µg/Ncm were computed using mass of collected SO_2 gases and divided by the total volume of air sampled in Ncm.

Applicable Standards

The applicable national air quality standards for the sampled pollutants are the national Ambient Air Quality Guideline Values (NAAQGVs) specified in DAO 2000-81 (for TSP, PM_{10}, NO_2 and SO_2) and DAO 2013-03 (for $PM_{2.5}$).[253] ADB's SPS indicates that for projects considered for ADB financing, national and prevailing international standards are to be compared, and the more stringent standards applied. The World Health Organization's Ambient Air Quality Guidelines (2005, 2021), which are also adopted by the World Bank Group through the IFC Environmental, Health and Safety Guidelines, are taken as the applicable standard in relation to air quality concerns for the BCIB project, for $PM_{2.5}$, PM_{10}, NO_2 and SO_2. The 2021 IFC guideline values are the most stringent, but do not include a standard for 1 hr-averaged NO_2, so the 2005 guideline is applied for that parameter. Neither the 2005 nor 2021 IFC guidelines specify standards for TSP (24-hr or 1-hr) or for 1-hr $PM_{2.5}$, PM_{10}, or SO_2, so the national guideline values are taken as the applicable standard for those parameters. The Philippine and IFC standards for the five pollutants measured for this EIA study are compared in Exhibit 7-26.

Exhibit 7-26 Ambient Air Quality Guideline Values

Parameter	Averaging Time	NAAQGVs (µg/Ncm)	IFC (2005) (µg/m^3)	IFC (2021) (µg/m^3)
$PM_{2.5}$	24 hrs	50	25	15
	1 hr	-	-	-
PM_{10}	24 hrs	150	50	45

[252] Seasonality may also give pause for careful nuance in interpreting the dataset, although this may be less clear-cut, as rain was noted during sampling at some stations during the 'dry season' in February 2020.
[253] (1) DENR Administrative Order No. 81, Series of 2000. Implementing Rules and Regulations of the Philippine Clean Air Act of 1999.; (2) DNER Administrative Order No. 03, Series of 2013. Establishing the Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 ($PM_{2.5}$).

Parameter	Averaging Time	NAAQGVs (µg/Ncm)	IFC (2005) (µg/m³)	IFC (2021) (µg/m³)
	1 hr	200	-	-
TSP	24 hrs	230	-	-
	1 hr	300	-	-
NO_2	24 hrs	150	-	25
	1 hr	260	200	-
SO_2	24 hrs	180	40	40
	1 hr	340	-	-

Source: DAO 2000-81, DAO 2013-13, IFC Air Quality Guidelines (2005 & 2021)

In addition to considering compliance or non-compliance with formal standards, this section of the EIA also refers to the air quality indices (AQIs) presented in DAO 2000-18 (Annex A), which enable generalized characterization of ambient air quality in lay terms for purposes of channelling concern and directing environmental management efforts. The AQIs are shown in Exhibit 7-27.

Exhibit 7-27 DENR Air Quality Indices

Classification	TSP (µg/Ncm, 24-hr)	PM_{10} (µg/Ncm, 24-hr)	SO_2 (µg/Ncm, 24-hr)*	NO_2 (ppm, 1-hr)*
Good	0 to 80	0 to 54	0 to 88.8	--
Fair	81 to 230	55 to 154	91.4 to 376.2	--
Unhealthy for sensitive groups	231 to 349	155 to 254	378.8 to 627.4	--
Very unhealthy	350 to 599	255 to 354	587.8 to 794.2	--
Acutely unhealthy	600 to 899	355 to 424	796.8 to 1577.9	1,220.5 to 2,328.3
Emergency	900 and above	425 to 504	1580.5 to 2100.3	2,347.0 to 3,079.3
*Conversion factors: SO_2: 1 ppm = 2,612.4 µg/Ncm; NO_2: 1 ppm = 1,877.6 µg/Ncm				

Source: DAO 2000-81 (Annex A)

Bataan

The Bataan portion of the BCIB project area is characterized by rural, semi-rural and urban land uses, and sampling stations were selected to represent the range of settings and prevailing conditions. The Roman Highway corridor within Alas Asin and Mt. View is characterized by patchy, low-density strip development consisting of homes, shops and other commercial businesses. The Roman Highway is a full four-lane road throughout this area. Within Alas Asin village, the road corridor is a busy commercial area, backed by residential areas served by low-volume local barangay roads. The Kamaya Point Road extending south from Alas Asin village is a four-lane road which serves truck traffic associated with an oil terminal and a quarry.

Residences and most other buildings within the project area are typically single-story, and there is abundant vegetation, including large trees and dense shrubbery within the villages and along the highway corridor. South of Alas Asin village and west of Mt. View village, and extending all the way to the Manila Bay shore, the landscape is predominantly agricultural, characterized mainly by fruit orchards and grassland/scrubland, most of which is used as pasture and is periodically burned to bring on new grass for grazing.

At the micro-local level, the principal influences on ambient air quality within the Bataan portion of the BCIB project area are vehicle emissions (persistent throughout the year) and smoke from burning of grazing land (periodic). However, the project area is surrounded at close- to mid-range by numerous industrial facilities, including two 316 MW coal-fired power plants, two oil terminals, a cement terminal and processing facility, an oil refinery, an industrial park for plastics manufacturing, and at least one substantial active quarry. It is to be expected that the power plants, which are located just over 3 km southwest of the BCIB alignment, influence local air quality especially during the southwest monsoon; this effect may be moderated significantly by their use of tall stacks. Locations of industrial facilities around the project area in Bataan are shown in Exhibit 7-28.

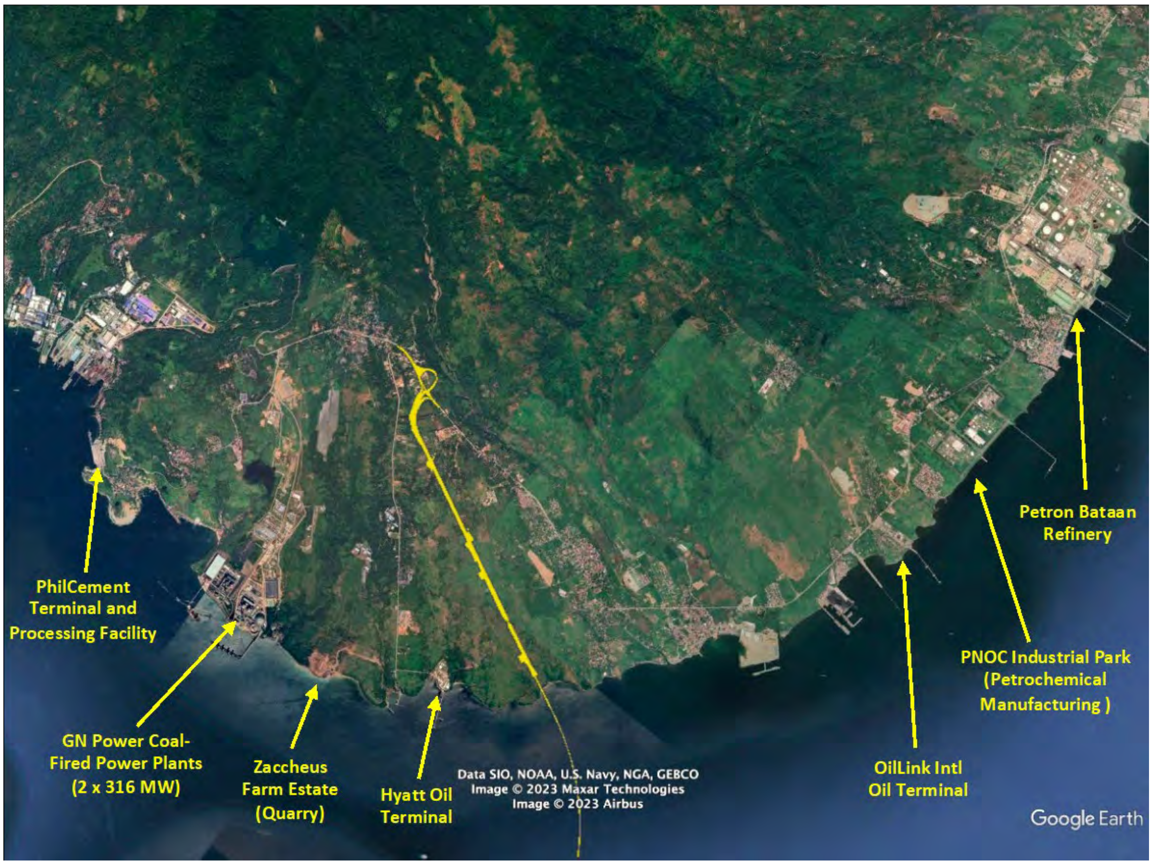


Exhibit 7-28 Industrial Facilities in Vicinity of BCIB Project, Bataan

The regional dynamics of air pollution dispersion from Metro Manila are not well understood, but it can be surmised that the semi-annual monsoonal reversal of general circulation likely has some influence on background levels of at least some pollutants in the BCIB project area. It may be reasonable to expect that background levels of urban-originated pollutants would be lower in the project area during the southwest monsoon from about May to September, and higher during the northwest monsoon, which typically prevails from October to May. However, there are many factors operating at the micro and meso scales to influence behavior of aerosol pollutants within and around Manila, including topography and the shapes of coastlines, cloud cover, precipitation, the strength and duration of land and sea breezes, and the composition, sources and timing of pollution emissions.[254] Air quality in the Manila Bay region is also known to be influenced by long-range transport of aerosols from biomass burning in Indonesia and Malaysia during the southwest monsoon, as well as biomass burning and other sources in mainland Southeast Asia at other times.[255] Modeling at the Manila Bay scale is constrained by a low density of air quality sampling stations outside Metro Manila.

Sampling stations

Eight stations were sampled within the Bataan portion of the BCIB project area. For both the sampling conducted in February 2020 and supplemental sampling carried out in November 2021, ambient noise and ambient air quality were sampled by the same team, and the sampling station locations were the same for both. Stations were selected to provide representation of the range of conditions in relation to both air quality and noise, including busy roadsides, commercial areas, residential areas and rural open spaces, as well as sensitive receptor sites (schools). Details of the sampling stations and their immediate environs are provided in Exhibit 7-29. The station locations are shown in relation to the BCIB infrastructure and major staging areas on the map in Exhibit 7-30.

Exhibit 7-29 Air and Noise Sampling Stations in BCIB Project Area, Bataan

Station	Coordinates	Description and Observations	Photograph of Station Environs
A1	14°27'42.74"N 120°32'32.43"E	Hard soil ground and open area was dusty and surrounded by trees. 20m away from main road, 30m away from residential area. Sunny weather with light wind. Noise source was mostly vehicles passing the main road and crickets at night. Moderate then light traffic was observed.	
A2	14°27'32.98"N 120°32'41.90"E	Near Godspeed Garden Memorial Park. Open field trees and grass surrounded the area. Sunny weather condition with strong winds. Around 50m away from main road and 30m from residential area. Noise came from insects during nighttime. Light traffic was observed.	

[254] Cruz, M.T., J.B. Simpas, A. Sorooshian, G. Betito, M.O.L. Cambaliza, J.T. Collado, E.W. Eloranta, R. Holz, X.G.V. Topacio, J.D. Socorro and G. Bagtasa. 2023. Impacts of wind circulations on aerosol pollution and planetary boundary layer structure in Metro Manila, Philippines. Atmospheric Environment 93(15): 119455.

[255] Braun, R.A., M.A. Aghdam, P.A. Bañaga, G. Betito, M.O. Cambaliza, M.T. Cruz, G.R. Lorenzo, A.B. MacDonald, J.B. Simpas, C. Stahl and A. Sorooshian. Long-range aerosol transport and impacts on size-resolved aerosol composition in Metro Manila, Philippines. Atmos. Chem. Phys. 20: 2387–2405. https://doi.org/10.5194/acp-20-2387-2020, 2020.

Station	Coordinates	Description and Observations	Photograph of Station Environs
A3	14°27'11.43"N 120°33'0.28"E	Slash and burn agriculture are evident in this area. Grassy ground surrounded by banana trees. Sunny weather with light winds. Around 30m away from access road. Source of noise from crickets and other insects at night.	
A4	14°26'57.80"N 120°33'34.04"E	Land near the station contained cows. Grassy ground surrounded by banana trees. Sunny weather with light winds Around 20m away from Maharlika St. Source of noise mainly animals and insect during nighttime. Light traffic was observed.	
A5	14°26'25.93"N 120°34'11.04"E	Swidden fallow agriculture is evident in this area. Grassy area surrounded by trees and grass. Sunny weather with strong winds. Main road 3km away from sampling point. Source of noise from insect during nighttime. No observed presence of residents. Light traffic was observed.	
AQ12	14°27'31"N 120°33'24"E	Located adjacent to the Roman Highway. Near roadside residences and a few businesses (small shops, hotel). Abundant roadside vegetation, including large trees.	
AQ13	14°27'43"N 120°31'49"E	Adjacent to a barangay road in Gumamela, corner Zinnia Street. Low-density residential area with many trees. Sampling station approximately 100 m away from busy commercial section of Roman Highway.	

Station	Coordinates	Description and Observations	Photograph of Station Environs
AQ14	14°27'40"N 120°31'58"E	Located inside the Alas-Asin Elementary School compound. School is near intersection of barangay road and busy commercial section of Roman Highway. Sampling station located approximately 40 m from barangay road, and 60 m from Roman Highway.	

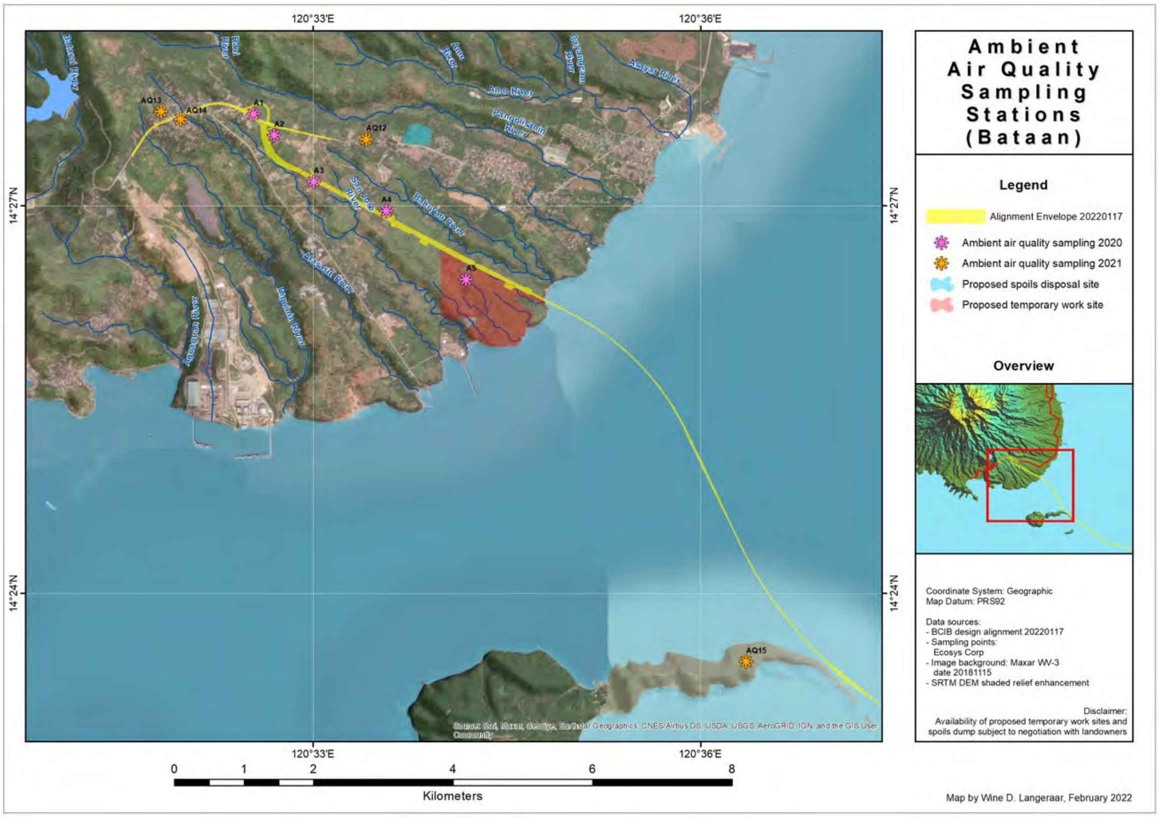


Exhibit 7-30 Air and Noise Sampling Stations, Bataan

Results

The results of ambient air sampling and analysis for the Bataan portion of the BCIB project area are presented in Exhibit 7-31. Measured levels for most parameters are far below the upper limits indicated in both the Philippine and IFC standards, for both 24-hr and 1-hr averaging periods. The notable exception to this general trend is $PM_{2.5}$, which was found to moderately exceed the IFC standard of 15.0 µg/m3 at three stations (A1, A4, A5) for the 24-hr averaging period. All three of these stations were located near potential dust-generating surfaces, and dry, sunny weather with wind was noted during sampling in each case; these can be considered probable explanatory factors for the exceedances. Levels of PM_{10} were similar to those for $PM_{2.5}$ for these three stations, which would tend to support this conclusion. With regards to the AQIs, results for TSP, PM_{10} and SO_2 all fall well below the upper threshold of the 'good' interval for all stations, which suggests that air quality may generally be considered quite good in the broader project area.

Exhibit 7-31 Ambient Air Sampling Results for Stations in Bataan Project Area

Station	Time & Date	Concentrations in µg/Ncm				
		$PM_{2.5}$	PM_{10}	TSP	NO_2	SO_2
24-HOUR SAMPLING						
A1	2255H 15Feb20 – 2255H 16Feb20	15.2	21.0	28.2	BDL	BDL
A2	2005H 14Feb20 – 2005H 15Feb20	9.44	13.9	23.5	BDL	BDL
A3	1725H 13Feb20 – 1725H 14Feb20	10.0	13.5	19.9	3.91	BDL
A4	1430H 12Feb20 – 1430H 13Feb20	16.3	16.0	17.2	3.11	BDL
A5	1110H 11Feb20 – 1110H 12Feb20	19.2	19.2	33.6	3.59	BDL
AQ12	1745H 07Nov21- 1745H 08Nov21	1	31	42	5.63	7.70
AQ13	1430H 06Nov21- 1430H 07Nov21	<1	31	33	3.11	5.51
AQ14	1103H 05Nov21- 1103H 06Nov21	8	17	28	7.31	7.04
DENR Standard: (24-hr average)		50.0	150.0	230.0	150.0	180.0
IFC Guideline Values, 2005 (24-hr average)		25.0	50.0	-	-	40.0
IFC Guideline Values, 2021 (24-hr average)		15.0	45.0	-	25.0	40.0
1-HOUR SAMPLING						
A1	2315H 16Feb20 – 0015H 17Feb20	BDL	46.4	51.6	BDL	BDL
A2	2020H – 2120H 15Feb20	BDL	49.2	61.1	BDL	BDL
A3	1735H – 1835H 14Feb20	BDL	BDL	69.2	BDL	BDL
A4	1445H – 1545H 13Feb20	BDL	51.7	63.6	BDL	BDL
A5	1120H – 1220H 12Feb20	BDL	BDL	64.7	BDL	BDL
AQ12	1602H – 1702H 07Nov21	2	7	60	6.91	33.43
AQ13	1242H – 1342H 06Nov21	4	13	27	8.90	23.40
AQ14	0939H – 1039H 05Nov21	1	8	44	43.98	32.92
DENR Standard (1-hour average)		-	200.0	300.0	260.0	340.0
IFC Guideline Values, 2005 (1-hr)		-	-	-	200.0	-

Station	Time & Date	Concentrations in µg/Ncm				
		$PM_{2.5}$	PM_{10}	TSP	NO_2	SO_2
IFC Guideline Values, 2021 (1-hr)		-	-	-	-	-
Notes: (1) Exceedances of DENR standard are indicated by green type, IFC standard by red type; (2) BDL = Below detection limit						

Cavite

The Cavite portion of the BCIB project area is a semi-rural landscape undergoing urbanization. Although there remains significant open space including some farmland, it is increasingly hemmed in by strip development along local roads, and by new low-rise medium-density residential estates and industrial parks. Many open spaces in the area have already been subdivided for future urban developments. The Antero Soriano Highway is the main artery through the project area, and is nominally four lanes, although obstructions and on-road parking make it effectively two lanes in many places. Numerous small, paved barangay roads crisscross the landscape, and few spots are more than about 300 m from a road. The Antero Soriano Highway corridor is a busy commercial zone close to and within Naic town, but elsewhere (including around the BCIB interchange site) is characterized by substantial open stretches broken here and there by small agglomerations of commercial activity and property entrances. Strip development along lesser, low traffic roads is predominantly residential. Many trees and shrubs are found along all roads in the area, including in roadside residential properties.

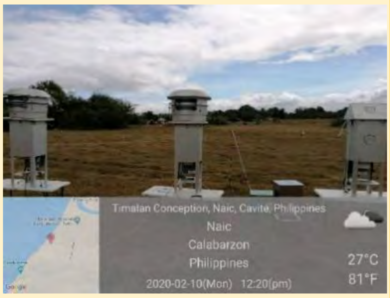
The principal influence on ambient air quality within the Cavite portion of the BCIB project area is vehicle emissions, as significant industrial emitters are largely absent. The nearest substantial point source appears to be a diesel-powered generating station near Rosario, which serves the export-processing zone there.

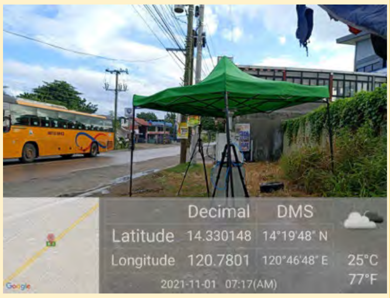
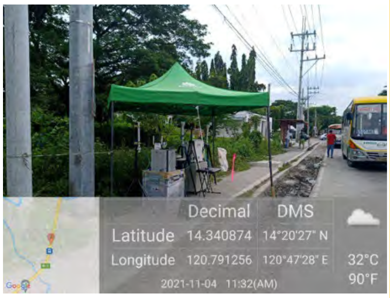
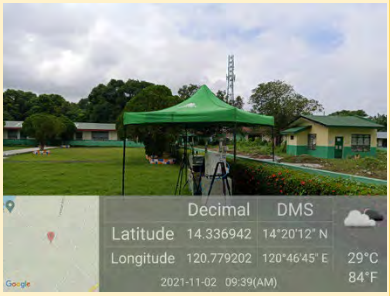
As discussed above in relation to the Bataan portion of the BCIB project area, the possible influence of regional dispersion of pollutants from Metro Manila on local air quality in southwest Cavite is poorly understood. It is reasonable to expect that background air quality in the Cavite portion of the project area, like in the Bataan portion, is shaped by emissions dispersed from both Metro Manila and further removed sources elsewhere in Southeast Asia.

Sampling stations

For both the sampling conducted in February 2020 and supplemental sampling carried out in November 2021, ambient noise and ambient air quality were sampled by the same team, and the sampling station locations were the same for both. Details of the stations are provided in Exhibit 7-29, and locations are shown in Exhibit 7-30. Stations were selected to provide representation of the range of conditions in relation to both air quality and noise, including busy roadsides, commercial areas, residential areas and rural open spaces, as well as sensitive receptor sites (schools).

Exhibit 7-32 Air and Noise Sampling Stations in BCIB Project Area, Cavite

Station	Coordinates	Description and Observations	Picture
A6	14°20'28.68"N 120°46'38.08"E	Slash and burn agriculture are evident in this area. Grassy open area surrounded by trees and grass. Sunny with strong winds. Around 150 m from access road. Cows observed within the area. Source of noise from noise and vehicles.	
A7	14°20'11.74"N 120°46'47.01"E	Grassy area surrounded by trees and grass. Cloudy to sunny weather with moderate winds and frequent rainfall. Around 50m away from access road. Burning of leaves around 1800H-1900H was observed. Source of noise mainly from vehicles passing the road and insects at nighttime. Moderate then light traffic was observed.	
A8	14°20'15.85"N 120°46'54.56"E	Grassy open area surrounded by trees and grass. Cloudy weather with light to moderate winds and frequent rainfall. Around 20m away from road. Animals such as goats, cows and dogs were observed. Sources of noise were mostly from residential noise, and crickets and insects at night. Light traffic was observed.	
A9	14°20'12.96"N 120°46'57.42"E	Concrete ground in access road inside private property. Grass cutting occurred during 0800H-0900H. Sunny to partial cloudy weather with light to moderate winds and frequent rainfall. 20 m away from road and 5 m away from nearest house. Source of noise from vehicles and insect at nighttime. Trucks observed passing access road. Light traffic was observed.	
A10	14°20'1.54"N 120°46'11.95"E	Concrete ground near main gate of a private property surrounded by trees and grass. Burning of leaves were observed. Dogs and cows were observed. Sunny weather with light to moderate winds. Sources of noise were birds, cows, dogs, chicken, vehicles, residents, and insects at night. Station was positioned around 10 m away from low-volume barangay road. Light traffic was observed.	

Station	Coordinates	Description and Observations	Picture
A11	14°20'13.23"N 120°46'44.26"E	Grassy ground in the middle of quadrangle and beside stage area. Near a debris lot. Sunny to cloudy with occasional rainfall. Kids playing basketball. Sources of noise were mainly vehicles passing the road.	
AQ16	14°19'48"N 120°46'48"E	Located adjacent to the Antero Soriano Highway. Station positioned in low-density commercial area, between a restaurant and entrance to a lumber yard, across the road from a large vacant area with trees and grassland.	
AQ17	14°20'27"N 120°47'28" E	Located adjacent to the Antero Soriano Highway. Near bus stop. Across road from vacant lot with trees.	
AQ18	14°20'12"N 120°46'45" E	Located inside the Timalan Elementary School compound. School is in a low-rise residential area, near the intersection of two local barangay roads, where there is a bus stop and some small shops.	

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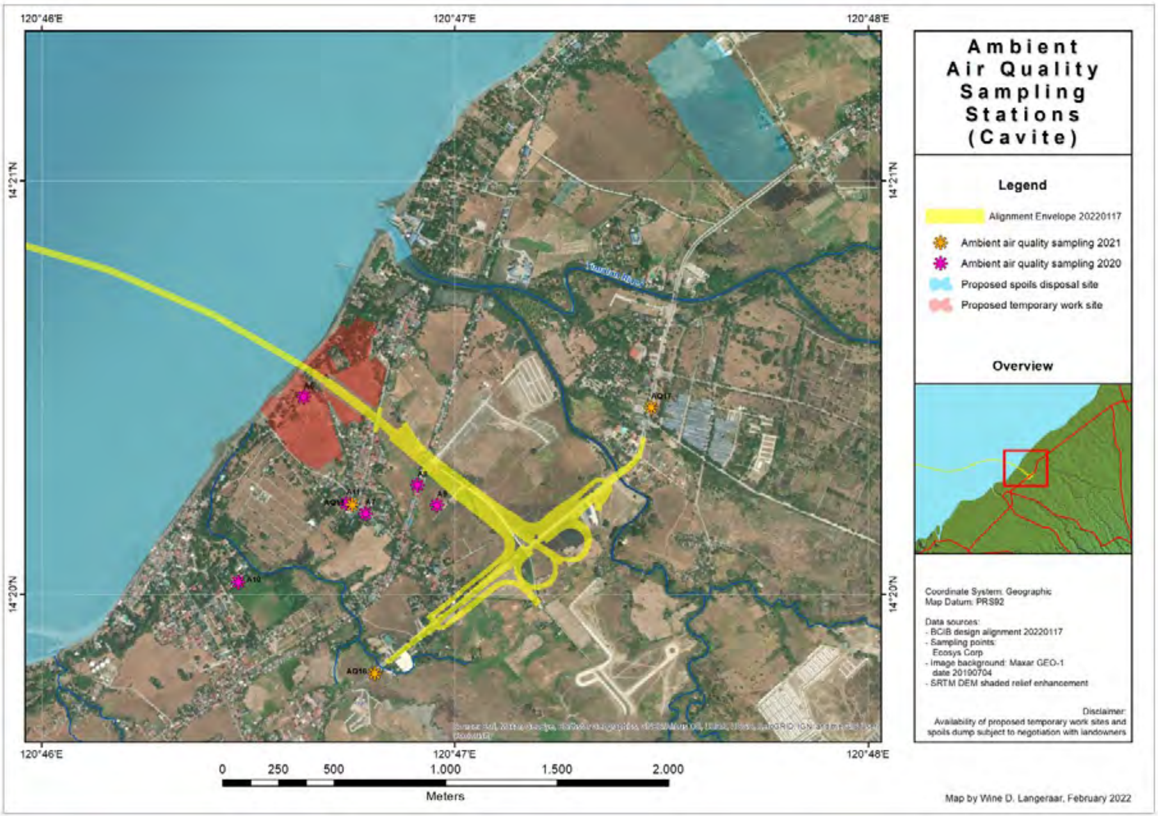

Exhibit 7-33 Air and Noise Sampling Stations, Cavite Project Area

Results

The results of ambient air sampling and analysis for the Cavite portion of the BCIB project area are shown in Exhibit 7-34. Measured levels of $PM_{2.5}$ were found to moderately exceed the IFC standard of 15.0 µg/m^3 (24-hr) at three stations (A6, A9, A10). Micro-local conditions at the time of sampling are likely to have contributed to the observed elevations of $PM_{2.5}$ (and PM_{10}, of which levels were commensurate). The A6 station was located in a pastured area near the coast, with sandy soils; presence of grazing cattle and strong winds during sampling were recorded by the sampling team. A period of grass-cutting activity was noted at A9, and this could help explain elevated particulate levels there. At A10, burning of leaves by a nearby resident was documented. There are no obvious broader scale contributing factors at any of these stations.

It can be seen from Exhibit 7-34 that $PM_{2.5}$ levels at the A8 (14.5 µg/m^3) and AQ17 (14.5 µg/m^3) stations were also elevated, being just below the IFC standard of 15.0 µg/m^3 (24-hr). There do not appear to be any clear micro-local contributing factors at A8, but it bears mention that the AQ17 station was located directly beside the Antero Soriano Highway, very nearby a bus stop and in the post-stop acceleration zone for buses.

Levels of TSP (1-hr) were found to be substantially elevated at the AQ17 station, with 455 µg/m^3 recorded, as compared to the DENR limit of 300 µg/m^3 (IFC does not have a standard for TSP). The 1-hour sampling period was in late morning on a Wednesday and, as mentioned above, elevated particulates would not be unexpected given the station's siting. The 1-hr levels for $PM_{2.5}$ and PM_{10} at this station are not commensurate with the TSP levels, however, which yields a somewhat ambiguous picture.

The exceedances just discussed are outliers in a field of results that, overall, suggests generally good air quality in the Naic portion of the BCIB project area. For the most part, levels of the five parameters measured were found to be well below the upper limits indicated in both the Philippine and IFC standards, for both 24-hr and 1-hr averaging periods. With regards to the AQIs, 24-hr results for TSP, PM_{10} and SO_2 all fall well below the upper threshold of the 'good' interval for all stations.

Exhibit 7-34 Ambient Air Sampling Results for Stations in Cavite Project Area

Station	Time & Date	Concentrations in µg/Ncm				
		$PM_{2.5}$	PM_{10}	TSP	NO_2	SO_2
24-HOUR SAMPLING						
A6	2030H 9Feb20 – 2030H 10Feb20	21.8	21.8	25.4	4.82	BDL
A7	1620H 7Feb20 – 1620H 8Feb20	BDL	10.5	11.3	3.89	BDL
A8	1400H 6Feb20 – 1400H 7Feb20	14.5	14.2	18.9	3.66	BDL
A9	1130H 5Feb20 – 1130H 6Feb20	18.5	25.3	44.4	BDL	BDL
A10	0915H 4Feb20 – 0915H 5Feb20	28.1	30.5	34.6	5.55	BDL
A11	1825H 8Feb20 –1825H 9Feb20	12.1	11.8	12.2	3.19	BDL
AQ16	1439H 31Oct21 – 1439H 01Nov21	5	20	88	4.54	10.64
AQ17	1227H 03Nov21 – 1227H 04Nov21	14	38	50	5.86	11.31
AQ18	1844H 01Nov21 – 1844H 02Nov21	1	9	24	4.52	9.82
DENR Standard (24-hr average)		50.0	150.0	230.0	150.0	180.0
IFC Guideline Values, 2005 (24-hr average)		25.0	50.0	-	-	40.0
IFC Guideline Values, 2021 (24-hr average)		15.0	45.0	-	25.0	40.0
1-HOUR SAMPLING						
A6	2040H – 2140H 10Feb20	BDL	42.3	31.6	BDL	BDL
A7	1630H – 1730H 8Feb20	BDL	BDL	36.1	BDL	BDL
A8	1420H – 1520H 7Feb20	BDL	BDL	BDL	10.0	BDL
A9	1140H – 1240H 6Feb20	50.1	51.4	53.8	BDL	BDL

Station	Time & Date	Concentrations in µg/Ncm				
		$PM_{2.5}$	PM_{10}	TSP	NO_2	SO_2
24-HOUR SAMPLING						
A10	0926H – 1026H 5Feb20	55.9	70.4	102.0	BDL	BDL
A11	1835H – 1935H 9Feb20	BDL	37.8	53.7	BDL	BDL
AQ16	1244H – 1344H 31Oct21	<1	90	141	26.23	44.25
AQ17	1030H – 1130H 03Nov21	<1	18	455	25.19	53.47
AQ18	1712H – 1812H 01Nov21	5	45	49	16.34	45.64
DENR Standard (1-hour average)		-	200.0	300.0	260.0	340.0
IFC Guideline Values, 2005 (1-hr)		-	-	-	200.0	-
IFC Guideline Values, 2021 (1-hr)		-	-	-	-	-
Notes: (1) Exceedances of DENR standard are indicated by green type, IFC standard by red type; (2) BDL = Below detection limit						

7.1.4 Ambient Noise and Vibration

Ambient noise in the BCIB project area was measured at 11 sampling stations (5 in Mariveles, 6 in Naic) in mid-February 2020, under the auspices of baseline research for the previous version of the EIA. Supplementary sampling was carried out in November 2021 at 6 additional stations (3 in Mariveles and 3 in Naic), to build out a more comprehensive dataset, based on updated knowledge of the infrastructure footprint and strengthened assumptions regarding the probable locations of key construction support sites such as casting yards. Following subsequent identification of a large new potential construction support site in Naic. Sampling data for all stations were combined to yield a comprehensive ambient noise dataset for each project area. The ambient noise profiles presented below for each project area are based largely on analysis of the assembled sampling data, with additional insights gathered from a review of local land use and relevant local sources of noise.

Ambient vibration was not sampled for the baseline study. A vibration screening was carried out to determine the potential for vibration impacts during construction and operation; this is presented and discussed later in this chapter.

Methods

Noise sampling at 11 stations in February 2020 was carried out using the Lutron Sound Level Meter, equipped with an A-weighted, dB (A), frequency filter to approximate the sounds humans hear. This digital sound level meter was calibrated using an Extech 407766 Sound Level Calibrator. Sampling was carried out continuously at each station for 24 hrs, with a sampling interval of one second. Sampling data were segmented according to the four time periods specified in DAO 2000-81 (Morning 0500–0900; Daytime 0900–1800; Evening 1800–2200; Nighttime 2200–0500), and the equivalent noise level (L_{eq}) was computed for each period at each station.

Supplemental noise sampling at six stations in November 2021 and six stations in Fall 2022 was conducted using a Centertek 323 Datalogging sound level meter. Sampling was carried out continuously at each station for one hour during each of the four periods specified in DAO-2000-81 (morning, daytime, evening and nighttime), with a sampling interval of 30 seconds, yielding 121 noise readings per hour sampled. L_{eq} was computed for each period at each station, taking the data for the 1-hr period as a proxy for the entire respective periods.

For all sampling conducted, L_{eq} in dB (dBA in this case, an A-weighted sound level centered at 1 kHz frequency) was calculated using the equation.

$$L_{eq} = 10 \log \left(\frac{1}{t2 - t1} \int_{t1}^{t2} \frac{pa^2}{po^2} dt \right)$$

Where: L_{eq} = equivalent continuous sound pressure level in dB

t1= start time of measurement

t2= end time of measurement

dt = time interval of measurement

po= reference sound pressure level (20 µPascal or $2\text{x}10^{-5}$ Pa)

pa= acquired sound pressure level

The acquired sound pressure level (*pa*) is derived from the measured noise level in dB and the reference sound pressure level (*po*), using the equation

$$pa = po\ x\ 10^{(dB/20)}$$

Applicable Standards

Ambient Outdoor Noise

The applicable national ambient noise standards are those stipulated in the National Pollution Control Commission (NPCC) Memorandum Circular No. 002 Series of 1980, Section 78 – Ambient Noise Quality and Emission Standards for Noise. Per ADB's SPS, prevailing international standards are to be adopted for projects being evaluated for ADB financing, where the international standards are more stringent. The international noise standards applied in the case of the BCIB project are those specified in the IFC EHS Guidelines – Noise Management (2007), which are in turn derived from the IFC's Guidelines for Community Noise (1999). Guideline values from the two relevant NPCC guideline documents are shown in Exhibit 7-35, and the IFC guideline values in Exhibit 7-36.

Exhibit 7-35 NPCC Noise Guidelines, 1980

Class	Maximum Allowable Noise Level (dBA)			
	Morning Period (5AM – 9AM)	Daytime Period (9AM to 6PM)	Evening Period (6PM to 10PM)	Nighttime Period (10PM to 5AM)
Guidelines for Noise in General Areas				
AA	45	50	45	40

Class	Maximum Allowable Noise Level (dBA) Morning Period (5AM – 9AM)	Daytime Period (9AM to 6PM)	Evening Period (6PM to 10PM)	Nighttime Period (10PM to 5AM)
A	50	55	50	45
B	60	65	60	55
C	65	70	65	60
D	70	75	70	65
Noise Standards for Areas Directly Fronting or Facing a Four-Lane or Wider Road				
AA	55	60	55	50
A	60	65	60	55
B	70	75	70	65
C	75	80	75	70
D	80	85	80	75

Notes:

AA - a section or contiguous area which requires quietness, such as within 100 m of school sites, nursery schools, hospitals and special homes for the aged

A - a section or contiguous area which is primarily used for residential purposes

B - a section or contiguous area which is primarily a commercial area

C - a section primarily reserved as a light industrial area

D - a section which is primarily reserved as a heavy industrial area

Source: NPCC Memorandum Circular No. 002 Series of 1980, Section 78 – Ambient Noise Quality and Emission Standards for Noise

Exhibit 7-36 IFC Noise Level Guidelines, 2007

Receptor	One Hour L_{Aeq} (dBA) Daytime (0700–2200)	Nighttime (2200–0700)
Residential; Institutional; Educational	55	45
Industrial; Commercial	70	70

Source: International Finance Corporation. Environmental, Health and Safety Guidelines – Noise Management (April 30, 2007)

As can be seen in Exhibit 7-35 and Exhibit 7-36, the applicable guideline value is dependent on the location of the sampled site relative to different types of receptors and features. Each station sampled in the ambient noise baseline survey was classified according to the criteria listed in the standards, and measured noise levels were compared to the appropriate guideline values as per the selected station class.

Vibration

The Philippine government has no guidelines on vibration. Vibration guidelines developed by the California Department of Transportation (CALTRANS) in its Transportation and Construction Vibration Guidance Manual (September 2013) are adopted for the vibration assessment. The guidelines reference criteria for human response to steady state vibration, continuous vibration from traffic, and transient vibration; these are shown in Exhibit 7-37.

Exhibit 7-37 CALTRANS Vibration Criteria

Peak Particle Velocity (inch/sec)	Human Response
STEADY STATE VIBRATION	
3.6 (at 2 Hz) – 0.4 (at 20 Hz)	Very Disturbing
0.7 (at 2 Hz) – 0.17 (at 20 Hz)	Disturbing
0.10	Strongly perceptible
0.035	Distinctly perceptible
0.012	Slightly perceptible
CONTINUOUS VIBRATION FROM TRAFFIC	
0.4 – 0.6	Unpleasant
0.2	Annoying
0.1	Begins to annoy
0.08	Readily perceptible
0.006 – 0.019	Threshold of perception
TRANSIENT VIBRATION	
2.0	Severe
0.9	Strongly perceptible
0.24	Distinctly perceptible
0.035	Barely perceptible

Source: CALTRANS. Transportation and Construction Vibration Guidance Manual (September 2013).

In addition to effects of vibration perceived and felt by the human body, vibration from construction and operation of infrastructure can damage nearby structures, including buildings and objects of cultural heritage significance; the American Association of State Highway and Transportation Officials (AASHTO) has specified criteria with respect to the vulnerability of buildings and other structures and objects to intermittent vibration from construction and maintenance activities (see Exhibit 7-38).

Exhibit 7-38: AASHTO Maximum Vibration Levels to Avoid Damage

Type of Situation	Limiting Velocity (inch/sec)
Historic sites or other critical locations	0.1
Residential buildings, plastered walls	0.2 – 0.3
Residential buildings in good repair with gypsum board walls	0.4 – 0.5
Engineered structures, without plaster	1.0 – 1.5

Source: AASHTO. 1990. Standard recommended practice for evaluation of transportation-related earthborne vibrations. Washington, DC. (as cited in CALTRANS. Transportation and Construction Vibration Guidance Manual (September 2013).

Bataan

The immediate and near-range vicinity of the planned BCIB infrastructure sites in Bataan have very little in the way of noisy industrial activity, although several industrial sites, for example the GN Power generating stations, are found at mid-range. The principal sources of ambient noise within the project area are vehicle and road noise, associated especially with the Roman Highway corridor and to a lesser extent the Kamaya Point Road, as well as dispersed construction activity. Local barangay roads are mostly lightly travelled, and agricultural activity in the area, which consists primarily of fruit orchards and extensive grazing, is not mechanized to any great extent. Outside the built-up areas of Alas Asin and Mt. View, and the Roman Highway corridor and Kamaya Point Road, a very peaceful environment prevails.

Sampling stations

For both the sampling conducted in February 2020 and supplemental sampling carried out in November 2021, ambient noise and ambient air quality were sampled by the same team, and the sampling station locations were the same for both. Details of the stations were provided earlier, in Exhibit 7-29, and locations were shown in Exhibit 7-30. Stations were selected to provide representation of the range of conditions in relation to both air quality and noise, including busy roadsides, commercial areas, residential areas and rural open spaces, as well as sensitive receptor sites (schools). In the Bataan project area, six stations were considered residential (Class A), one station was in a school compound (Class AA), and one was adjacent to a 4-lane highway in a commercial zone (Class B).

Results

The results of ambient noise sampling at the stations in the Bataan portion of the BCIB project area are presented in Exhibit 7-39. It will be immediately evident that ambient noise as measured is generally not within the guideline values. Out of 32 sampled periods, exceedances were found in 26, with 20 of these involving exceedance of both the national and IFC guideline values.

Exhibit 7-39 Ambient Noise Sampling Results, Bataan

Sampling Station	Date	Sampling Time	Noise Period	Recorded (dBA)	NPCC Standard (dBA)	IFC Standard (dBA)[1]
A1 Residential Class A	15/02/20–16/02/20	0500H–0900H	Morning	63	50	45
	15/02/20–16/02/20	0900H–1800H	Daytime	64	55	55
	15/02/20–16/02/20	1800H–2200H	Evening	63	50	55
	15/02/20–16/02/20	2200H–0500H	Nighttime	54	45	45
A2 Residential Class A	14/02/20–15/02/20	0500H–0900H	Morning	57	50	45
	14/02/20–15/02/20	0900H–1800H	Daytime	57	55	55
	14/02/20–15/02/20	1800H–2200H	Evening	55	50	55
	14/02/20–15/02/20	2200H–0500H	Nighttime	49	45	45
A3 Residential Class A	13/02/20–14/02/20	0500H–0900H	Morning	46	50	45
	13/02/20–14/02/20	0900H–1800H	Daytime	49	55	55
	13/02/20–14/02/20	1800H–2200H	Evening	53	50	55
	13/02/20–14/02/20	2200H–0500H	Nighttime	42	45	45
A4 Residential Class A	12/02/20–13/02/20	0500H–0900H	Morning	49	50	45
	12/02/20–13/02/20	0900H–1800H	Daytime	49	55	55
	12/02/20–13/02/20	1800H–2200H	Evening	47	50	55
	12/02/20–13/02/20	2200H–0500H	Nighttime	45	45	45

Sampling Station	Date	Sampling Time	Noise Period	Recorded (dBA)	NPCC Standard (dBA)	IFC Standard (dBA)[1]
A5 Residential Class A	11/02/20–12/02/20	0500H–0900H	Morning	53	50	45
	11/02/20–12/02/20	0900H–1800H	Daytime	50	55	55
	11/02/20–12/02/20	1800H–2200H	Evening	52	50	55
	11/02/20–12/02/20	2200H–0500H	Nighttime	54	45	45
AQ12 4-lane road Commercial Class B	08Nov2021	050009H–060009H	Morning	76.0	70	70
	08Nov2021	112015H–122015H	Daytime	76.8	75	70
	07Nov2021	180529H–190529H	Evening	74.6	70	70
	07-08Nov2021	232001H–002001H	Nighttime	67.2	65	70
AQ13 Residential Class A	07Nov2021	055508H–065508H	Morning	58.7	50	45
	07Nov2021	110008H–120008H	Daytime	67.7	55	55
	06Nov2021	180501H–190501H	Evening	62.1	50	55
	06-07Nov2021	231024H–001024H	Nighttime	57.9	45	45
AQ14 School Class AA	06Nov2021	050041H–060041H	Morning	45.2	45	45
	05Nov2021	111029H–121029H	Daytime	67.3	50	55
	05Nov2021	183539H–193539H	Evening	58.1	45	55
	05-06Nov2021	230513H–000513H	Nighttime	46.0	40	45

Color key: Black – compliant; Green – exceeds NPCC standard; Blue – exceeds IFC standard; Red – exceeds both standards

[1] Four-hour continuous 'morning' samples (2020 stations) are compared to the IFC 'nighttime' value. One-hour continuous 'morning' samples (2021 and 2022 stations) are compared to the IFC nighttime value, as all were completed prior to 7am.

Exceedances of the relevant national guideline value averaged 7.7 dBA across the non-compliant samples, with the largest-magnitude overages being at the AQ14 and AQ13 stations. The magnitude of differences between the guideline values and measured levels at the lesser number of compliant stations was smaller, averaging just 4 dBA. These patterns are illustrated in Exhibit 7-40 (in relation to the applicable NPCC guideline values) and Exhibit 7-41 (for the applicable IFC values).

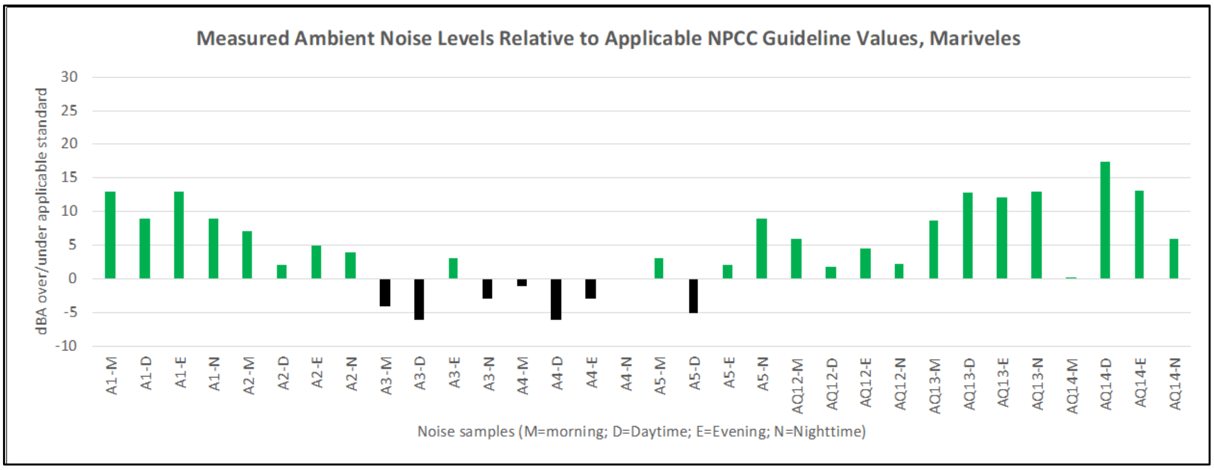

Exhibit 7-40 Pattern of NPCC Ambient Noise Guideline Exceedances, Bataan

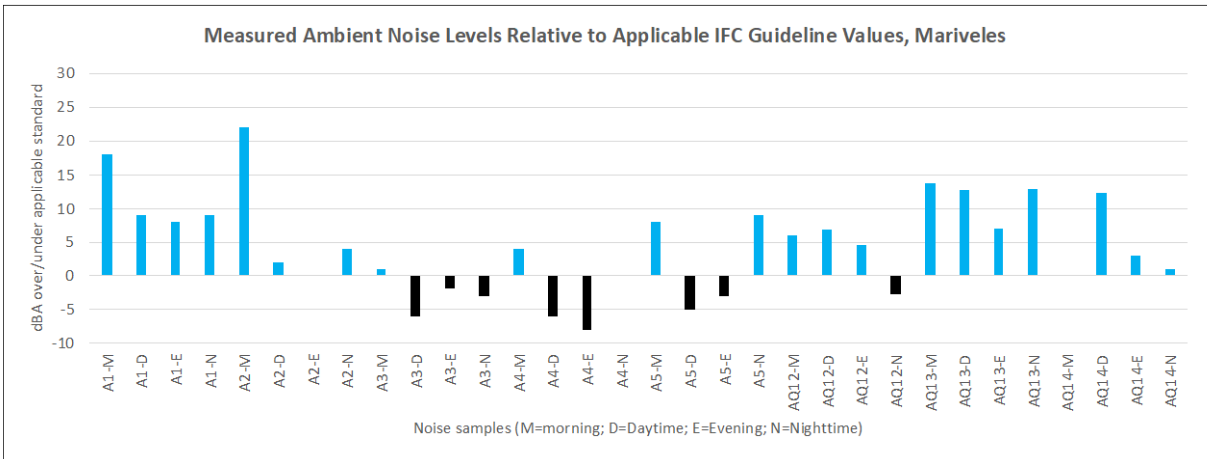

Exhibit 7-41 Pattern of Exceedances of IFC Ambient Noise Guideline Values, Bataan

As can be seen from the two charts above, compliant ambient noise measurements are to be found almost exclusively at the three very rural stations (A3, A4, A5), and even those stations exhibit exceedances for some time periods. With so many sampled periods being non-compliant, some adjustment of benchmarks is required to enable meaningful impact assessment and monitoring with regards to noise emissions from the BCIB infrastructure's construction and operation. Per the IFC's General EHS Guidelines : Environmental Noise Management, noise emissions of a project should not result in an increase of more than 3 dBA compared to background levels at the nearest receptor location.

Cavite

Although there is substantial open space remaining in and around the BCIB project area in Naic, few locations are very far from a road, commercial area or construction site, and there is sufficient human activity that the landscape would not be considered particularly peaceful. There are few industrial sites that would be considered major noise emitters, and the principal sources of noise are roads and construction activity. Farm equipment may be a significant source for limited periods during preparation for planting and later during the harvest, at least in areas under rice cultivation. The four-lane Antero Soriano Highway Corridor, which is a busy commercial strip in some sections nearby the project area, is the noisiest zone, but other lesser roads also see substantial traffic serving built-up residential areas and industrial parks. There are several residential estates, industrial parks and commercial complexes under development in the area, and noise from construction works and construction traffic likely contributes to an overall elevation of ambient noise.

Sampling stations

For both the sampling conducted in February 2020 and supplemental sampling carried out in November 2021, ambient noise and ambient air quality were sampled by the same team, and the sampling station locations were the same for both. Details of the stations were provided earlier, in Exhibit 7-32, and locations were shown on the map in Exhibit 7-33. Stations were selected to provide representation of the range of conditions in relation to both air quality and noise, including busy roadsides, commercial areas, residential areas and rural open spaces, as well as sensitive receptor sites (schools).

Results

The results of ambient noise sampling at the stations in the Cavite portion of the BCIB project area are presented in Exhibit 7-42. Ambient noise as measured is generally not within the guideline values. Out of 36 sampled periods, exceedances were documented in 32 periods; 24 of the sampled periods exceeded both the NPCC and IFC guideline values.

Exhibit 7-42 Ambient Noise Sampling Results, Cavite

Sampling Station	Date	Sampling Time	Noise Period	Recorded (dBA)	NPCC Standard (dBA)	IFC Standard (dBA)[1]
A6 Rural Class A	09//02/20–10/02/20	0500H–0900H	Morning	56	50	45
	09//02/20–10/02/20	0900H–1800H	Daytime	55	55	55
	09//02/20–10/02/20	1800H–2200H	Evening	52	50	55
	09//02/20–10/02/20	2200H–0500H	Nighttime	54	45	45
A7 Rural Class A	07/02/20–08/02/20	0500H–0900H	Morning	57	50	45
	07/02/20–08/02/20	0900H–1800H	Daytime	62	55	55
	07/02/20–08/02/20	1800H–2200H	Evening	63	50	55
	07/02/20–08/02/20	2200H–0500H	Nighttime	55	45	45
A8 Rural Class A	06/02/20–07/02/20	0500H–0900H	Morning	50	50	45
	06/02/20–07/02/20	0900H–1800H	Daytime	59	55	55
	06/02/20–07/02/20	1800H–2200H	Evening	57	50	55
	06/02/20–07/02/20	2200H–0500H	Nighttime	53	45	45
A9 Residential Class A	05/02/20–06/02/20	0500H–0900H	Morning	57	50	45
	05/02/20–06/02/20	0900H–1800H	Daytime	55	55	55
	05/02/20–06/02/20	1800H–2200H	Evening	54	50	55
	05/02/20–06/02/20	2200H–0500H	Nighttime	52	45	45
A10 Rural Class A	04/02/20–05/02/20	0500H–0900H	Morning	54	50	45
	04/02/20–05/02/20	0900H–1800H	Daytime	55	55	55
	04/02/20–05/02/20	1800H–2200H	Evening	51	50	55
	04/02/20–05/02/20	2200H–0500H	Nighttime	53	45	45

Sampling Station	Date	Sampling Time	Noise Period	Recorded (dBA)	NPCC Standard (dBA)	IFC Standard (dBA)[1]
A11 School Class AA	08/02/20–09/02/20	0500H–0900H	Morning	52	45	45
	08/02/20–09/02/20	0900H–1800H	Daytime	56	50	55
	08/02/20–09/02/20	1800H–2200H	Evening	52	45	55
	08/02/20–09/02/20	2200H–0500H	Nighttime	47	40	45
AQ16 4-lane road Commercial Class B	01Nov2021	050514H-060514H	Morning	72.1	70	70
	31Oct2021	110005H-120005H	Daytime	75.2	75	70
	31Oct2021	181514H-191514H	Evening	73.7	70	70
	31Oct-01Nov2021	230514H-000514H	Nighttime	71.2	65	70
AQ17 4-lane road Commercial Class B	04Nov2021	050504H-060504H	Morning	71.4	50	45
	03Nov2021	110550H-120550H	Daytime	73.1	55	55
	03Nov2021	180514H-190514H	Evening	77.3	50	55
	03-04Nov2021	231014H-001014H	Nighttime	65.6	45	45
AQ18 School Class AA	02Nov2021	050020H-060020H	Morning	50.9	45	45
	02Nov2021	115855H-125855H	Daytime	47.1	50	55
	01Nov2021	180519H-190519H	Evening	50.1	45	55
	01-02Nov2021	231019H-001019H	Nighttime	45.8	40	45

Color key: Black – compliant; Green – exceeds NPCC standard; Blue – exceeds IFC standard; Red – exceeds both standards

[1] Four-hour continuous 'morning' samples (2020 stations) are compared to the IFC 'nighttime' value. One-hour continuous 'morning' samples (2021 and 2022 stations) are compared to the IFC nighttime value, as all were completed prior to 7 am.

Exceedances of the relevant NPCC guideline value averaged 8.0 dBA across the non-compliant samples, with the largest-magnitude overages being at the AQ17 station (which is in the acceleration zone of a bus stop on the Antero Soriano Highway). Only one sample period in the IFCle dataset for Cavite was below its applicable NPCC guideline value; four others were exactly equal to the standard. With respect to the IFC guideline values, 27 of 36 sampled periods were found to be non-compliant, some being more than 20 dBA above the specified maximum. Performance was similar to what was seen in relation to the NPCC values, with nine sampled periods being either below or equal to the IFC maximum, and average exceedances across non-compliant samples 8.2 dBA. These patterns are illustrated in Exhibit 7-40 (in relation to the applicable NPCC guideline values) and Exhibit 7-41 (for the applicable IFC values).

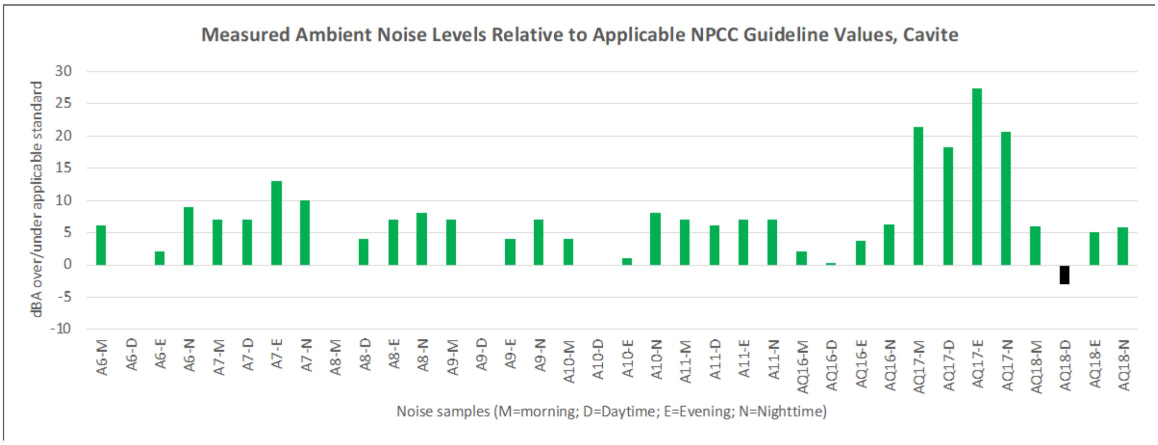

Exhibit 7-43 Pattern of NPCC Ambient Noise Guideline Exceedances, Cavite

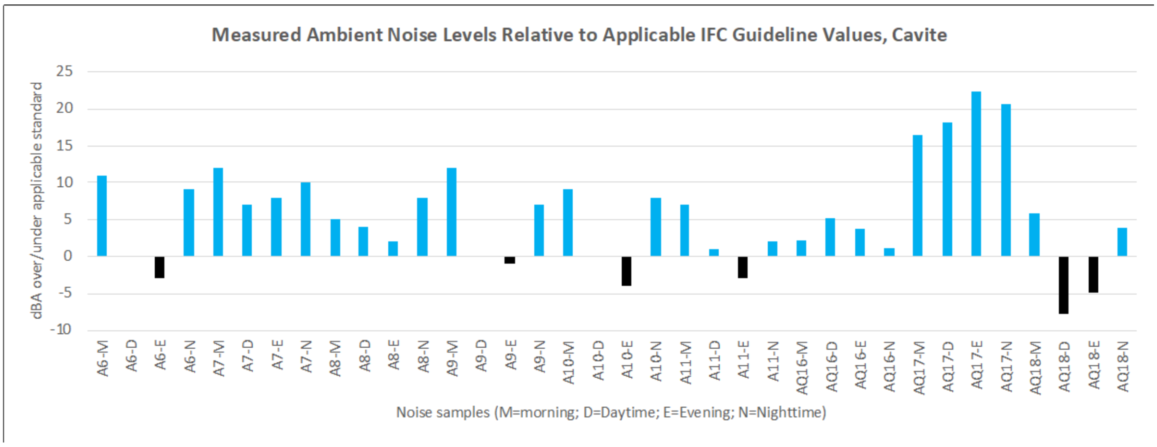

Exhibit 7-44 Pattern of Exceedances of IFC Ambient Noise Guideline Values, Cavite

The patterns illustrated above, which include some surprising exceedances for stations in lightly populated places (e.g., A6, A9 and A10, where dense insect activity in morning and nighttime is hypothesized as the probable culprit) and quite substantial overages even in places with light traffic (suggesting a significant role for domestic noise sources such as music, conversation, vendor activity, home workshops and the like), indicate a need to define and adopt adjusted benchmarks for the different classes as the basis for impact assessment. Per the IFC's General EHS Guidelines: Environmental Noise Management, noise emissions of a project should not result in an increase of more than 3 dBA compared to background levels at the nearest receptor location.

7.2 Anticipated Impacts and Prescribed Mitigation

7.2.1 Preconstruction Impacts and Mitigation

Pre-construction impacts are those impacts which, although they may be manifest during construction or operation, actually originate during planning, design and procurement, and can therefore be mitigated at least partially through decisions taken as part of these pre-construction activities. In many cases it makes sense to re-visit these impacts in relation to the construction and/or operation phase, as a residual component of impact may remain to be addressed closer to the time of impact occurrence.

Greenhouse Gas Emissions

Anticipated Impact. Greenhouse gases emitted directly or indirectly as a result of the construction and operation of the BCIB project will not have any measurable effect within the project area but will contribute to well-documented global climate change trends, and are of concern for that reason, as a cumulative impact. The Climate Risk Assessment and Adaptation (CRAA) report provided a quantitative GHG assessment to estimate the potential GHG emissions of the project through the methodology of the Inter-governmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories and ADB Guidelines for Estimating GHG Emissions of ADB Projects (Additional Guidance for Transport Projects).[256] The guidelines provide suggested methodologies in calculating GHG emissions in different transport subsectors.

Based on GHG emissions estimation, the total quantum of fuel and electricity to be consumed for marine viaduct, navigational bridge, interchanges and viaducts on land, and approach ramps construction was converted to equivalent CO_2 emissions using the Philippine-specific emission factors. Similarly, the embodied CO_2 in construction materials and/or fuels used was estimated using specific values. The CO_2 estimation results for the construction phase of the BCIB project is found in Exhibit 7-45. Given these, the construction of the project releases 89,049 tons of CO_2 (tCO_2) annually. Based on ADB's threshold of 100,000 tCO_2/year, the project's construction is an insignificant source of emissions.[257] Throughout the 5-year construction period, about 445,200 tCO_2 are attributed to the BCIB project.

The BCIB will be responsible for gross total direct and indirect emissions of 4,412,514 tCO_{2eq} over its lifetime, of which about 10% will be attributable to the project's construction, and 90% of which will be emitted over the projected 100 years of operation. Emissions estimates for the project are detailed in Exhibit 7-45.

It is noted in the CRAA report that DPWH will be required, in accordance with Executive Order No. 23 and the pursuant DENR Memorandum Order No. 2012-02, to donate 145,000 tree saplings to DENR for use in carbon sequestration projects under the National Greening Program (100 saplings for every tree over 15 cm diameter at breast height that has to be removed). Although the sequestration potential of the 65.68 ha of lands within the Bataan and Cavite approach road was not quantified, the CRAA report implicitly assumes that planting 100 saplings for each of the 1,450 trees to be removed will offset the permanent loss of capacity for carbon sequestration across the entire area converted for the two approach road ROWs. This will assist in mitigating for the loss of agricultural or degraded grassland, and 145,000 trees should cover 145 ha at an average stocking density of 1,000 trees per hectare.[258] Taking into account inevitable losses due to such things as weather, pest issues, inadequate stand tending, poor site selection, illegal extraction, and so on, the mandated donation of saplings can be considered a generous but not substantially mismatched offset for lost carbon storage potential.

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[256] ADB. 2016. *Guidelines for estimating greenhouse gas emissions of Asian Development Bank projects additional guidance for transport projects*. Manila, Philippines. 21p.

[257] ADB. 2009. Safeguard Policy Statement. https://www.adb.org/sites/default/files/institutional-document/32056/safeguard-policy-statement-june2009.pdf.

[258] Using the Global Removals Database designed by Winrock International with IUCN support, a 145-ha hardwood plantation in Bataan would be expected to sequester approximately 73,370 tCO_2 over the first 20 years after planting.

Exhibit 7-45 GHG Emissions Projections for BCIB Construction and Operation

	Emissions Sources/Sinks	Estimated Emissions (tCO_{2eq})
CONSTRUCTION PHASE (5 YEARS)		
1	GHG emission in producing the main materials	828
2	GHG emission in transporting the main materials	82,677
3	GHG emissions from equipment	361,368
4	GHG emission for buildings, vehicles, and road facilities	371
5	Lost sequestration capacity from conversion of right-of-way	- [1]
6	Donation of 145,000 saplings for plantations under NGP	- [2]
	Subtotal construction phase	445,244
	Average of the 5 year construction period	*89,049*
OPERATION PHASE (100 YEARS)		
7	GHG emissions from BCIB traffic (average 34,717 tCO_{2eq} / year[3])	3,471,700
8	Lighting	461,000
9	Buildings, road facilities and service vehicles	34,570
	Subtotal operation phase	3,967,270
OVERALL PROJECT EMISSIONS (105 YEARS[4])		4,412,514

[1] Not quantified, but assumed to be canceled out by planting of 145,000 trees in DENR-sanctioned plantations elsewhere
[2] Not quantified, but assumed to be sufficient to offset lost sequestration capacity over ROWs
[3] Emission average is based on the 2030-2050 timeframe, after which it is anticipated that the proliferation of electric vehicles may result in further reducing GHG emissions.
[4] the 105 years include both the 100-year lifespan and the initial 5 years of construction.

Source: BCIB Project Draft Climate Risk Assessment and Adaption Report (December 2022 update)

The CRAA report calculates, using a 'with project'/'without project' comparison, that the BCIB project will generate a substantial reduction in emissions across the NCR's road network due to reduced congestion and travel times; this reduction is estimates to be an annual average of 79,182 tCO_2 during the appraisal period. Results also indicated GHG reductions of about 20,900 tCO_2 in the opening year and about 1.6 million tCO_2 during the entire appraisal period (2030-2050).

There is little basis for strong assumptions regarding evolution over time in the relationship between the project's emissions derived from vehicular use of the infrastructure, on the one hand, and the emissions savings across the NCR road network that are attributable to the BCIB's operation, on the other. However, emissions from operation of the BCIB (including vehicular use, lighting and buildings and monitoring and maintenance activity) are projected at 3,967,270 tCO_2e. The absolute GHG emissions from vehicular movements are about 30,000 tCO_2e without project scenario and 9,100 tCO_2e with project scenario in 2030. The estimated emissions are about 148,200 tCO_2e (without project) and 45,200 tCO_2e (with project) in 2050. If the annual 'excess offset' amount from network-wide savings is applied to the construction-derived emissions of 445,244 tCO_{2eq}, the construction emissions can be assumed to be fully offset by about the 6th year of operations (see Exhibit 7-45). This suggests that determination of the scope of emissions offsets, which are to be subject to negotiation between DPWH and the Region III and Region IV-A offices of DENR in accordance with the project's ECC, should focus on the period after the second decade of operations, and consider whether the linear assumptions (regarding emissions growth and network-wide emissions savings) are likely to be applicable through that later time frame.

Prescribed Mitigation. Although it appears that emissions reduction across the NCR's roads network may lower net emissions for the BCIB project below zero for at least the first 1–2 decades of operation, the net emissions picture beyond that time frame is quite unclear, and it is, in any case, a matter of best practice to make all reasonable attempts to reduce greenhouse gas emissions from any infrastructure project. This can be done by (1) reducing the generation of emissions through thoughtful design choices; and (2) offsetting emissions by enhancing carbon sequestration.

Reducing generation of emissions. A number of measures have been incorporated in the BCIB project's design for the express purpose of reducing GHG emissions; these are identified in Exhibit 7-46.

Exhibit 7-46 Design Measures Adopted to Reduce Greenhouse Gas Emissions

	Measure	Project Location/Component
1.	Use of low-carbon concrete	Throughout BCIB – Packages 1-7
2.	Use of Polymer Modified Stone Mastic Asphalt	Throughout BCIB – Packages 1-7
3.	Use of LED lighting fixtures to minimize power usage	Throughout BCIB – Packages 1-7
4.	Use of pervious hard surfaces to minimize increased heating surfaces	Operation and Maintenance Yard

Source: BCIB Project Draft Climate Risk Assessment and Adaption Report (December 2022 update)

Carbon sequestration. Per the project's ECC, DPWH is required to develop and implement a carbon sink program in line with the National Greening Program (NGP). Offsets under the NGP may take the form of direct measures by a project's proponent, such as establishment of tree plantations, or indirect measures including financial or in-kind contributions (e.g., seedlings or saplings) to plantation programs already functioning as approved offsets under the NGP. Given the lack of available land for offset plantations in the BCIB project area, the latter approach will be pursued for the BCIB project. As indicated in the ECC, DPWH shall negotiate the scale and means of the carbon sink program in coordination with DENR-EMB Region III, DENR-EMB Region IV-A, the concerned PENROs and CENROs , and submit the program to DENR-EMB Central Office prior to the start of project implementation.

IMPACT SUMMARY					
Impact:	Contribution to global climate crisis from greenhouse gas emissions				
Direction:	Negative	Type:	Cumulative	Probability:	Certain
Duration:	Long-term	Scope:	Widespread	Significance:	Low
Mitigation:	• DPWH-PMT to secure 145,000 native tree saplings and donate them to DENR as per DENR Memorandum Order No. 2012-02 to offset expected loss of 1,450 trees to ROW • DPWH-PMT to develop Carbon Sink Program in collaboration with DENR-EMB Region III, DENR-EMB Region IV-A, the concerned PENROs and CENROs, and submit the program to DENR-EMB Central Office prior to the start of project implementation • DPWH-PMT to allocate funds for the Carbon Sink Program's implementation prior to the start of project implementation				
Residual:	None expected, provided negotiated Carbon Sink Program is sufficient to offset projected net emissions				

Local Air Quality Impacts

Emissions of pollutants from highway traffic are derived from combustion of fuels (principally diesel, gasoline and compressed natural gas) in engines (i.e., tailpipe emissions) and from tire wear, road wear, vehicle wear and resuspension of road dust, which yield particulate by-products. Tailpipe emissions are both gaseous and particulate in nature, while tire/road wear emissions are exclusively particulate. Air pollutants derived from both tailpipe and non-tailpipe sources can have significant implications for human health and well-being if present at elevated levels. Air pollution from highway traffic is typically more a problem of chronic exposure than of acute toxicity, affecting mainly people who live and work near the roadside. For this EIA study, the expected concentrations of four pollutants in road-proximate areas were modeled: particulate matter under 2.5 microns ($PM_{2.5}$), particulate matter under 10 microns (PM_{10}), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).

Particulate matter consists of small solid and liquid particles of dirt, soot, metals, and organic matter that are emitted directly from sources such as power plants, motor vehicles, and forest and crop residue fires, and also sometimes form in the atmosphere from chemical reactions between other pollutants. Particulates 10 microns in diameter and smaller pose the greatest health problems because they are able to make it past the natural filtration systems of the nose and throat to enter deep into the lungs, heart, and even the bloodstream. Effects of short-term exposure include irritation of the airways, difficulty breathing, aggravation of asthma, irregular heartbeat, nonfatal heart attacks, and death in people with heart or lung problems. Long-term exposure can produce reduced lung function, chronic bronchitis and premature death. Children, the elderly, and people of all ages with lung and heart conditions are the most vulnerable to the effects of fine particulate matter.[259]

Nitrogen dioxide is a gas produced primarily by burning fuels in internal combustion engines and power plants and is a significant irritant to the human respiratory system. Short-term exposure is known to aggravate airways, particularly in people with asthma. Long-term expose is thought to actually lead to the development of asthma, and possibly also increase susceptibility to respiratory infections. Children, the elderly, and asthmatics of all ages, are most vulnerable to NO_2 exposure.[260]

Sulfur dioxide is another gaseous pollutant derived from combustion. The principal source of SO_2 in the lower atmosphere is burning of fossil fuels in power plants and heavy industry, but heavy machinery such as ships, construction equipment, generators and trucks powered by diesel or fuel oil that has a high sulfur content may be significant sources. Diesel-powered vehicles are the main source of SO_2 in highway emissions. The human health effects of exposure to elevated SO_2 are similar to those for NO_2, with irritation of the airways and aggravation of asthma being the most common symptoms. Children with asthma are considered particularly sensitive and vulnerable to SO_2 exposure.[261]

Pollutant dispersion modelling for the BCIB approach roads was conducted using the AERMOD model developed through collaborative effort of the American Meteorological Society and the US EPA. AERMOD is a steady-state plume model which assumes the concentration distribution in the stable boundary layer to be Gaussian in both vertical and horizontal planes. The model incorporates air dispersion based on the planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.[262]

[259] US EPA. Particle Pollution and Your Health. EPA-452/F-03-001. September 2003, Office of Air and Radiation.
[260] US EPA. 2022. Nitrogen Dioxide (NO_2) Pollution. https://www.epa.gov/no2-pollution/basic-information-about-no2#Effects. Accessed 13 September 2022.
[261] US EPA. 2022. Sulfur Dioxide (SO_2) Pollution. https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#what%20is%20so2. Accessed 13 September 2022.
[262] This outline of the AERMOD model is based on US EPA (Office of Air Quality Planning and Standards). 2004. AERMOD: Description of Model Formulation. EPA-454/R-03-004. September 2004.

The AERMOD atmospheric dispersion modeling system is an integrated system that includes three modules:

1. A steady state dispersion model designed for short range (up to 50 km) dispersion of direct air pollutant emissions;
2. A meteorological data preprocessor (AERMET) that accepts surface meteorological data, upper air soundings, and (optionally) data from on-site instrument towers, and calculates atmospheric parameters needed by the dispersion model, such as turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux; and
3. A terrain preprocessor (AERMAP) which defines physical relationships between terrain features and the behavior of the air pollution plumes, generates location and height data for each receptor location, and generates information that allows the dispersion model to simulate ground-interactive effects such as air flowing over hills or splitting to flow around them.

For the present pollutant dispersion modelling exercise, the preprocessed meteorological data were obtained from the Ninoy Aquino International Airport (Manila) synoptic station of PAGASA, for the whole year of 2017. The terrain data of the study area were obtained from the National Aeronautics and Space Administration (NASA) - Shuttle Radar Topography Mission (SRTM), at resolution 90 m x 90 m. Emission factors for year 2020 (EURO II vehicle classes) from the United Kingdom were used to predict pollutant concentrations at source.

Noise and Vibration Impacts

Noise emissions from operation of road infrastructure can have substantial implications for the well-being of the people who live and work nearby. Chronic exposure to elevated noise such as may be emitted from roads can cause or contribute to multiple physiological, mental, cognitive, and interpersonal communication problems. Particularly vulnerable sectors of the population include children, the elderly, the hearing-impaired, and those with genetic or lifestyle-related predispositions for hypertension, heart disease and mental illness.[263]

Vibration produced by the operation of roads is generally not considered to have significant potential for human health effects. The principal impacts of road construction-related vibration are minor annoyance and would not result in damage to homes and other structures, and road operation typically does not generate strong vibration effects, except in some cases where very heavy truck traffic encounters sharp discontinuities in the road surface, e.g., expansion joints, pot holes and uneven joints in concrete slab roads.[264] These conditions will not be present on the BCIB approach roads, so vibration is not considered a relevant issue requiring mitigative attention at the design stage.

The potential for noise emissions impacts during the operation phase was modelled for the Bataan and Cavite project areas, using the Traffic Noise Model (TNM) Version 3.1 of Federal Highway Administration (FHWA), which is widely used around the world. This noise model was developed to predict sound levels experienced by receptors at different distances from a roadway's edge, based on assumptions regarding vehicle types, roadway slope and pavement type, with adjustments made for traffic volume, traffic speed, traffic

[263] Berglund, B., T. Lindvall and D.H. Schwela, eds. 1999. Guidelines for Community Noise. World Health Organization, Geneva.
[264] CALTRANS. 2013. Transportation and Construction Vibration Guidance Manual (September 2013).

flow, and shielding effects of topography, vegetation and structures in the space between roadway and receptors. Noise receptors in road-proximate areas are identified prior to modeling, and the model computes and then aggregates the predicted noise contribution at each receptor from each of multiple paired configurations of road segment characteristics and vehicle type. TNM 3.1 relies on a database of noise measurements from approximately 6,000 vehicles in five vehicle classes traveling on four different pavement types, including maximum A-weighted sound pressure levels for pass-by events and corresponding one-third octave-band spectra, to provide assumptions of vehicle noise emissions levels. The key output of a run-through of the model on a project area is a prediction, for each pre-identified receptor point, of the maximum sound level that will be experienced during peak traffic.[265]

Exhibit 7-47 Traffic Projections for BCIB, 2030 and 2050

Year	Direction	Motorcycle	Car	Jeepney	Bus	Truck	Total
DAILY TRAFFIC (PCU)							
2030	Eastward	6,675	6,233	897	1,332	4,405	19,542
	Westward	6,591	6,341	444	1,536	3,425	18,337
2050	Eastward	9,491	12,671	0	2,586	8,993	33,740
	Westward	9,491	12,113	0	2,586	5,780	29,970
AM PEAK HOUR TRAFFIC (PCU)							
2030	Eastward	601	561	70	107	221	1,560
	Westward	660	666	35	123	206	1,690
2050	Eastward	672	1014	0	182	450	2,318
	Westward	855	1091	0	205	289	2,440
PM PEAK HOUR TRAFFIC (PCU)							
2030	Eastward	534	499	63	80	133	1,309
	Westward	528	318	27	93	137	1,103
2050	Eastward	760	887	0	156	360	2,163
	Westward	855	970	0	156	174	2,155

Source: BCIB Project Study, May 2023 (DCCD)

Bataan

Anticipated Impact. There are relatively few receptors present along the Bataan alignment. Based on preliminary analysis, noise barriers are to be added to the approach road design at one location in Bataan. This is not the only location where operation-phase road noise is expected to exceed IFC standards at receptors but is the only place where use of barriers is technically feasible, because the approach road is a new alignment that will not have direct access from properties. The frequency of property entrances limits the potential effectiveness of noise barriers along the Roman Highway, rendering them infeasible. The planned barriers will be 1 m high and made of concrete and are expected to reduce noise levels between 6 and 10 dB. The planned barriers in Bataan will extend for about 200 m between 1+750 and 2+250, on both sides of the road (see Exhibit 7-48). The line shown on the map

[265] Federal Highway Administration (US Department of Transportation). 2019. Technical Manual – Traffic Noise Model 3.0. FHWA-HEP-20-012. December 31, 2019.

indicates the general location of the barrier only, not precise positioning. A more detailed analysis of the effectiveness of these barriers may render them unnecessary.

Exhibit 7-48 Location of Planned Noise Barrier, Bataan Approach Road

Prescribed Mitigation. Aside from the noise barriers already incorporated in the roadway design, no additional design-driven mitigation is indicated for the Bataan approach road. Elevated traffic noise experienced at locations where barriers are infeasible will be a residual impact.

Cavite

Anticipated Impact. Based on preliminary analysis, noise barriers are to be added to the Cavite approach road design at two locations: from 32+100 to 32+300 (both sides of the road), corresponding to the location of the Timalan Balsahan Underpass, and from 32+440 to 32+540 (southwest side of the road only); these are shown on the map in Exhibit 7-49 (again, lines indicate approximate location, not precise positioning). As with the Bataan side, there may be locations along the Antero Soriano Highway where increased traffic from the BCIB will push noise levels above the IFC benchmarks, but the prevalence of property entrances is expected to render noise barriers (which need to be continuous to be effective) infeasible. Similar to the Bataan analysis, a more detailed analysis of the effectiveness of the noise barriers may render these barriers unnecessary.

Exhibit 7-49 Locations of Planned Noise Barriers, Cavite Approach Road

Prescribed Mitigation. Aside from the noise barriers already incorporated in the roadway design, no additional design-driven mitigation is indicated for the Cavite approach road. Elevated traffic noise experienced at locations where barriers are infeasible will be a residual impact.

IMPACT SUMMARY					
Impact:	Traffic noise impacts				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Long-term	Scope:	Localized	Significance:	Moderate
Mitigation:	No additional design-driven mitigation is prescribed, beyond barriers incorporated in design				
Residual:	Expected, due to infeasibility of barriers at some locations				

7.2.2 Construction Phase Impacts and Mitigation

Construction impacts are those impacts which occur as a direct or indirect result of construction activity, and which are subject to mitigative actions that can be implemented by the contractors performing the construction work. Planning for mitigative action will typically and appropriately take place in the period immediately leading up to the start of construction, but mitigation will generally be implemented in parallel with construction activity. Compensatory actions to address residual effects originating from construction activity may run well into the operation phase.

Greenhouse Gas Emissions

Anticipated Impact. Emissions from construction equipment are projected to generate roughly 360,000 tCO_{2eq} over the course of the construction phase, accounting for about 80% of construction-phase emissions. Although these emissions are expected to be offset over time by emissions savings across the NCR roads network, failure to reduce them as much as possible will be a missed opportunity to help mitigate the global climate crisis and can thus be considered a contribution to a cumulative impact.

Prescribed Mitigation. The most readily implemented option for reducing greenhouse gas emissions from construction equipment is to use well-maintained, fuel-efficient equipment. Use of newer-model equipment can be expected to lower the amount of fuel burned per unit of work performed; this can make a substantial difference on a project the size of the BCIB. In order to implement this measure, all PCs shall be contractually required to ensure that all motorized equipment used by them or by their subcontractors on sites under their control is less than 15 years old and maintained in proper working order.

IMPACT SUMMARY					
Impact:	Contribution to global climate crisis				
Direction:	Negative	Type:	Cumulative	Probability:	Certain
Duration:	Medium-term	Scope:	Widespread	Significance:	Low
Mitigation:	• All PCs to ensure that all motorized equipment used by them or by their subcontractors on sites under their control is less than 15 years old, and maintained in proper working order				
Residual:	Expected, but of minor significance due to offsets				

Air Quality Impacts

Potential air quality impacts from the BCIB project's construction will pertain mainly to fugitive dust and engine emissions. These are of special concern in locations where residential and commercial community areas are in relatively close proximity to intense activity, including project work sites, batch plants and associated materials handling sites, and haul routes. Exhibit 7-50, Exhibit 7-51 and Exhibit 7-52 illustrate proximity factors around the Bataan sites and haul routes, while Exhibit 7-53, Exhibit 7-54 and Exhibit 7-55 do the same for the site and routes on the Cavite side. Dust and engine emissions impacts, and means of mitigating them, are discussed further below.

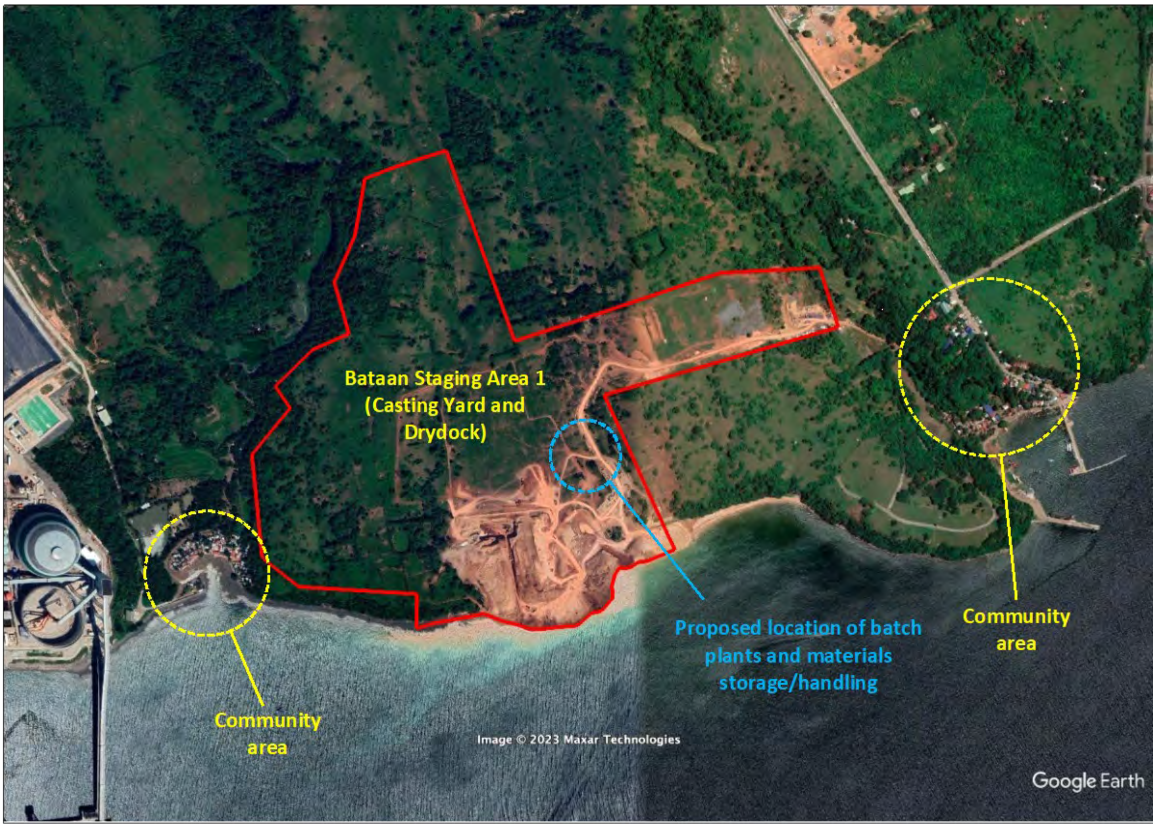

Exhibit 7-50 Proximity of Community Areas to Bataan Staging Area 1

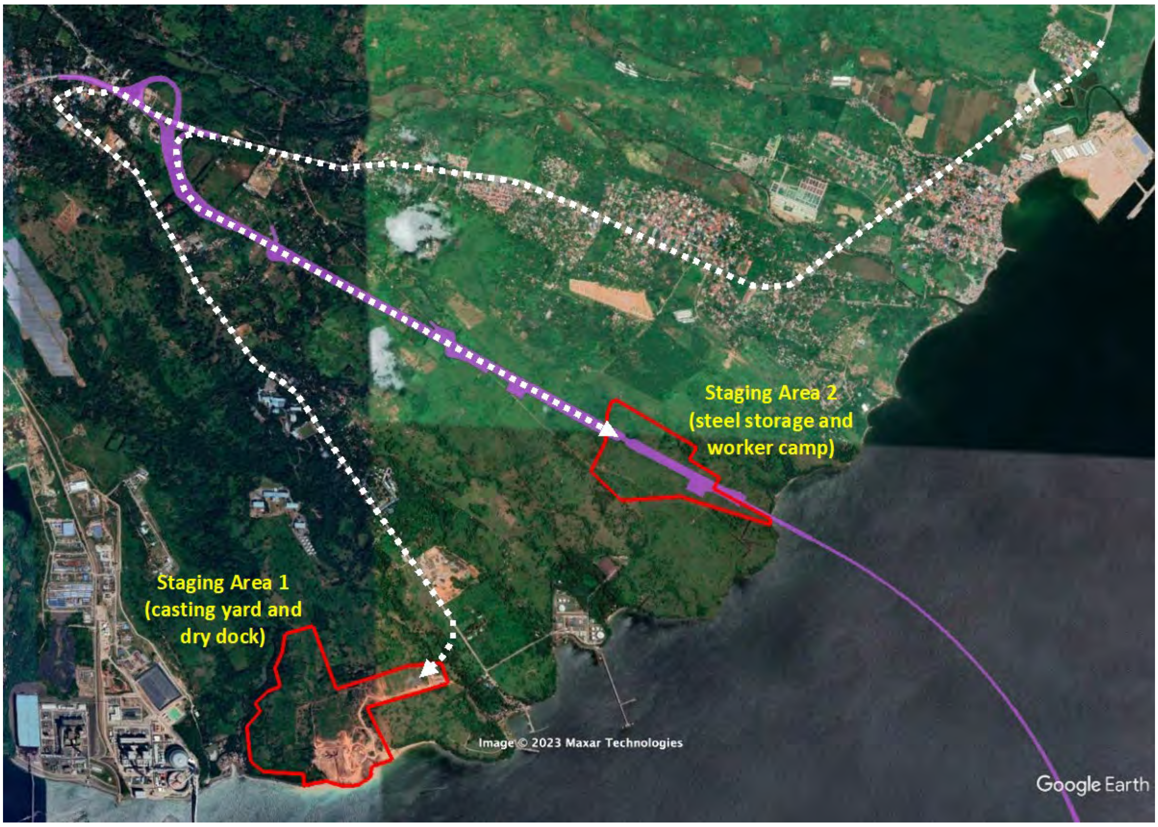

Exhibit 7-51 Expected Haul Routes, Bataan

Exhibit 7-52 Proximity of Community Areas to Bataan Work Sites and Haul Routes

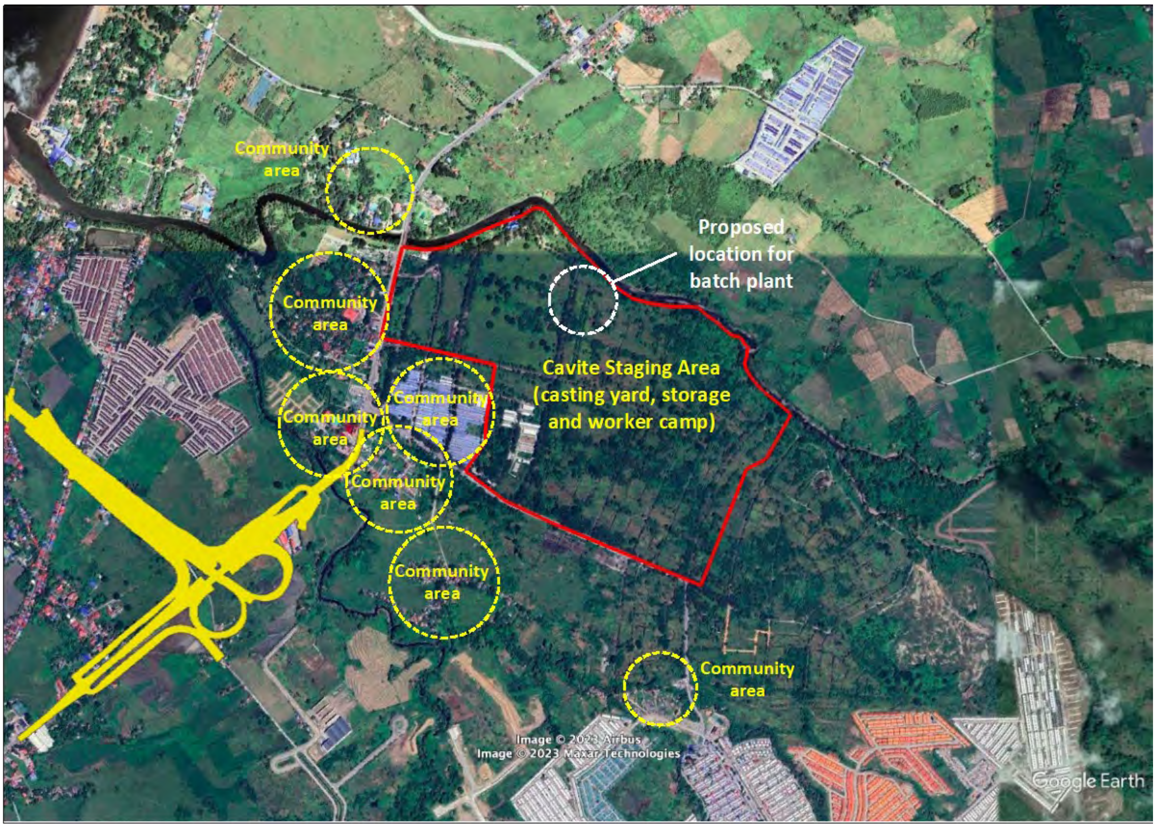

Exhibit 7-53 Proximity of Community Areas to Cavite Staging Area

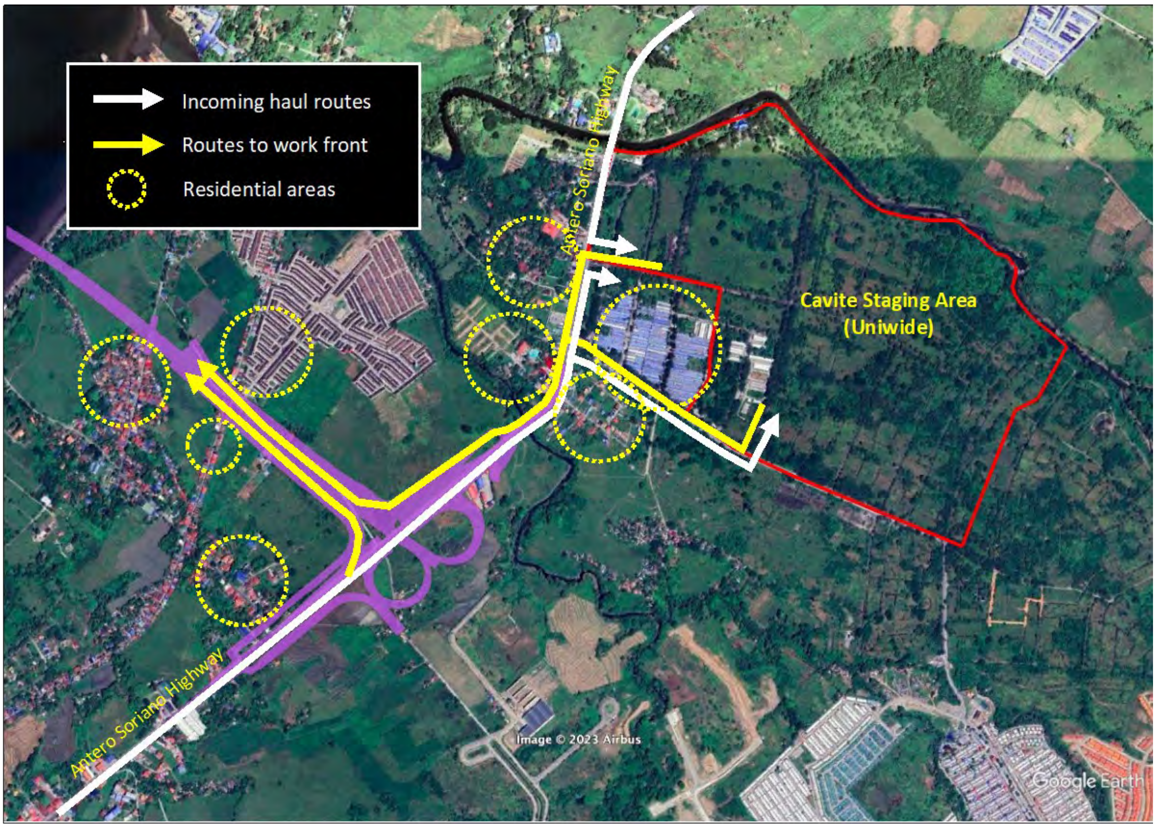

Exhibit 7-54 Haul Routes in Relation to Residential Areas, Cavite

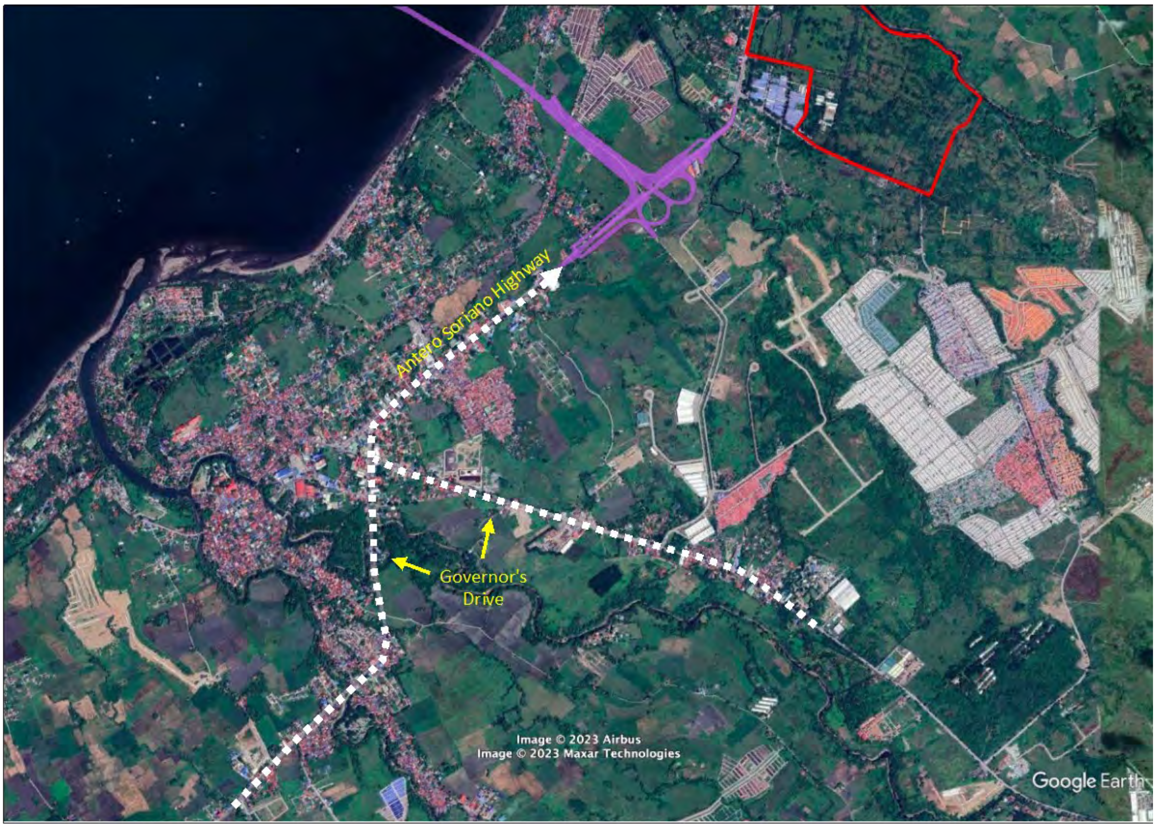

Exhibit 7-55 Haul Routes Through Naic Town, Cavite

Dust

Anticipated Impact. The most significant source of air quality impacts during BCIB construction will be dust generated by site clearing and earthworks; materials storage, handling and transport; movement of vehicles on unsealed roads and yard surfaces; and operation of concrete batch plants. Fine airborne particulate matter present in construction dust can penetrate deep into the finer spaces of the lungs, where it can produce irritation and reduced lung function, difficulty breathing, aggravation of asthma, and heart effects including irregular heartbeat and heart attacks. Particulate matter can be a significant health hazard where exposure is prolonged or particularly concentrated, and where people with pre-existing asthma, lung disease or heart disease are present.[266] Dust emissions from concrete batch plants in which fly ash is used as a concrete ingredient may be particularly concerning, as fly ash can contain heavy metals such as mercury, arsenic, copper and chromium.[267] In addition to being a human health hazard, airborne dust from construction sites and haul routes can also cause declines in crop yields in nearby fields and orchards if deposition is heavy, by impairing photosynthesis, respiration and pollination.[268]

The BCIB works will be enabled by staging activity at three sites that will see intensive operation for up to 4–5 years. Staging Area 2 in Bataan will have limited potential for air quality impacts, as it will be used mainly for steel storage and worker camp accommodations and is located in a rural area with very few inhabited properties nearby (see Exhibit 7-51) and would not be expected to have significant potential for dust generation. By contrast, both Staging Area 1 in Bataan and the Uniwide staging area in Cavite will have concrete batch plants and substantial storage and handling of aggregates, and these components will have very substantial potential for dust generation. Both of these sites are spacious and have ample potential for arranging final layout such that batch plants and associated aggregates handling areas are kept at a considerable distance (at least 500 m) from the nearest community area (see Exhibit 7-50 and Exhibit 7-53).

The works themselves will be a significant potential source of dust impacts in adjacent areas In Bataan, the principal point of concern will be the interchange site and adjoining sections of the Roman Highway, particularly the westward side, which lies within Alas Asin village (see Exhibit 7-52). On the Cavite side, there a number of residential areas adjacent to the ROW, and these areas will be especially vulnerable to dust impacts from the works (see Exhibit 7-54). The duration of earthworks at any one location will be fairly limited, and through-traffic of haul trucks on the ROWs is likely to generate more dust from these sites than the works themselves.

Both of the approach road ROWs will be used as haul routes for much of the construction phase. The potential for dust generation to become a problem in nearby areas is very significant. The principal potential trouble spot on the Bataan ROW is at the north end near the interchange, which is bordered by low-density residential areas on both sides (see Exhibit 7-52). The ROW on the Cavite side is bordered by several residential areas (see Exhibit 7-54), and these locations will be of special concern, since all haul traffic serving the marine working front over a period of 4 years will travel along the unpaved roadbed.

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[266] US EPA. 2022. Health and Environmental Effects of Particulate Matter (PM). https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm. Accessed 3 September 2022.

[267] Agency for Toxic Substances and Disease Registry. 2018. Coal Ash. https://www.atsdr.cdc.gov/substances/coalAsh.html. Accessed 3 September 2022.

[268] Kameswaran, S., Y. Gunavanthi and P.G. Krishna. 2019. Dust Pollution and its Influence on Vegetation: A Critical Analysis. Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences 5(1): 341. DOI: 10.26479/2019.0501.31.

Hauling activity taking place on paved highways will be less of a dust concern than hauling on the unpaved ROWs, but significant impacts will still be likely due to fugitive dust from loads of fine materials such as sand and gravel with a high fines content.

Prescribed Mitigation. Dust generation can be substantially mitigated by implementing several commonly prescribed measures, as discussed below.

Preventive measures. To help prevent dust impacts associated with Staging Area 1 in Bataan and the Uniwide staging area in Cavite, concrete batch plants must be fitted with dust collection systems to catch and contain dust from cement and fly ash silo vents, hopper vents and the mixing zone, as appropriate to each plant's design and operation. Operation of each batch plant shall be managed in such a way as to maintain emissions in conformance with the US EPA AP-42 Controlled Emission Factors for Concrete Batch Plants. Sand and aggregate stored for active use at the batch plant sites shall be contained within three-sided bunkers with sides extending at least 1.5 m above the level of the highest pile surface, to limit wind entrainment potential. Each PC that will operate a concrete batch plant (or oversee one operated by one of its sub-contractors) shall prepare a Concrete Batch Plant Management Plan for the review and approval of the CSC prior to site setup; a sample outline for such plans is provided in Appendix B to the EMP. The PCs responsible for Bataan Staging Area 1 and the Uniwide staging area shall be required to ensure that final site layout design avoids positioning and batch plants and aggregates handling and storage facilities any closer than 300 m from the nearest residence.

Both on staging area sites and at the ROW works sites, stockpiles of bulk materials, including sand, topsoil and gravel with a substantial fine's component must be kept covered with tarpaulins when not being actively handled, to limit the potential for wind to pick up fine particles. Tarpaulins must be properly sized to cover the entire stockpile, kept thoroughly secured, and replaced when worn.

To help prevent dust impacts from hauling, all haul trucks serving on the project, including those of sub-contractors and materials vendors, shall be required to have tight-fitting tarpaulin systems installed, and to use them without exception. A speed limit of 10 kph shall be enforced for any haul truck travelling on an unsealed construction site surface, to reduce dust generation.

Active dust suppression. A regular regimen of light spraying of dust-generating surfaces with water shall be implemented at all work sites, staging areas and haul routes, as dictated by the nature and location of active work activity, as well as atmospheric and soil moisture conditions. Each PC shall include adequate spraying units in its equipment list and monitor at least daily for dusty conditions. Spraying shall be stepped up whenever significant airborne dust is observed. Each PC shall prepare a site-specific Dust Control Plan for the review and approval of the CSC prior to the start of works; a sample outline for such plans is provided in Appendix B to the EMP.

At staging area sites expected to see intensive use and generate significant dust (casting yards and drydock), continuous air quality monitoring equipment shall be installed in strategic locations (e.g., at batch plants and materials handling areas, and near site boundaries where sensitive receptors are found); spraying shall be instituted anytime ambient dust levels reach 75% of the maximum permissible levels for either $PM_{2.5}$ or PM_{10} (whichever is reached first) specified in the World Bank Group Environmental Health and Safety Guidelines: Air Emissions and Ambient Air Quality.

IMPACT SUMMARY					
Impact:	Air quality impacts due to fugitive dust				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Medium-term	Scope:	Localized	Significance:	High
Mitigation:	• Each PC to prepare a site-specific Dust Control Plan for review and approval of the CSC prior to the start of works • PCs to ensure that all haul trucks involved in works under their control, including those supplied and operated by sub-contractors and suppliers, are equipped with tight-fitting tarpaulins, and that these are used at all times • PCs to impose and enforce a maximum speed limit of 10 kph for all vehicles operating on unpaved project roads and other site surfaces • PCs to ensure that all stockpiles of fine materials, including gravel with significant fines component, are kept covered with tarpaulins when not in active use • PCs to ensure that adequate spraying equipment for use in dust suppression is procured and available on site before the start of works • PCs to visually monitor on a daily basis for dust in all works areas, including haul routes, under their control, and implement spraying as needed whenever airborne dust is apparent • Each PC operating or overseeing operation of a concrete batch plant to prepare a site-specific Concrete Batch Plant Management Plan for review and approval of the CSC prior to batch plant setup • PCs to ensure that all concrete batch plants used in works under their control are equipped with dust collection systems on cement and fly ash silo vents, hopper vents and the mixing zone, as appropriate to plant design and operation, and that plants are operated in such a way as to maintain emissions in conformance with US EPA AP-42 Controlled Emission Factors for Concrete Batch Plants • PCs to install (as applicable) continuous air quality monitoring systems at long-term staging sites including casting yard batch plants and materials handling yards and implement dust suppression by regular light spraying with water whenever the measured $PM_{2.5}$ and PM_{10} levels reach 75% of the maximum permissible levels for either $PM_{2.5}$ or PM_{10} (whichever is reached first) specified in the World Bank Group Environmental Health and Safety Guidelines: Air Emissions and Ambient Air Quality				
Residual:	Expected, and to be balanced against positive project impacts				

Air quality degradation by engine emissions

Anticipated Impact. Construction of the BCIB project will require massive inputs of machinery use-hours, mostly involving diesel engines. Exhaust from diesel engines contains numerous harmful constituents derived from incomplete combustion, including nitrogen oxides, aldehydes, and fine soot particles. These contaminants are known to cause irritation of the nose and eyes, airway inflammation, lung function changes, headache and nausea.[269] Emissions will be quite diffuse, as construction activity will be spread across numerous work sites on land and over water. The greatest potential for concentrated emissions in proximity to human receptors will be at the casting yards, where batch plants powered by diesel engines (or electricity backed by diesel generators) will operate more or less continuously for 3–4 years. On the Bataan side, the combined casting yard and drydock facility (Staging Area 1) will have the highest concentration of engine use. There are two community areas near the boundaries of the site (see Exhibit 7-50); however, the part of the site proposed for the batch plant and associated materials storage and handling is approximately 750 m from the community area to the west of the site, and about 650 m from the community area at the foot of Kamaya Point Road, to the east of the site. Impacts from engine emissions are thus unlikely to be significant in these locations. Works will also take place in close proximity to community areas around the Roman Highway interchange site,

[269] Sydbom, A., A. Blomberg, S. Parnia, N. Stenfors, T. Sandström and S-E. Dahlén. 2001. Health Effects of Diesel Exhaust Emissions. European Respiratory Journal 2001(17): 733–746.

although the duration of works there will be minor compared to the activity at Staging Area 1. Most of the approach road works will take place in a lightly populated rural landscape.

On the Cavite side, significant potential for impacts from equipment engine emissions will exist primarily at the Uniwide staging area, which will have a casting yard and will be used for materials storage. At the time of writing, the proposed location of the concrete batch plant and associated aggregates storage and handling is nearly 500 m from the nearest substantial community area (see Exhibit 7-53), and it will be important for the PC responsible for the yard's layout to ensure that this distance is maintained when the site is designed and set up.

Some haul routes may also experience sustained elevation of diesel emissions, particularly when traffic congestion causes large numbers of haul trucks to have to stand at idle. On the Bataan side, the primary routes of concern with respect to hauling-derived air quality impacts are the Roman Highway through Mt. View and Cabcaben, and the northern section of Kamaya Point Road, near the interchange (see Exhibit 7-51 and Exhibit 7-52). On the Cavite side, the most critical location is the haul route along the Antero Soriano Highway between the Uniwide staging area and the working front over the bay, which will see double construction traffic (from haul trucks bringing materials to the staging area, and others bringing materials from the storage yard to the front (see Exhibit 7-54). The Antero Soriano Highway and Governor's Drive routes through Naic town are also of significant concern, due to the density of community areas along the roadside in some places (see Exhibit 7-55).

Prescribed Mitigation. Engine emissions are an unavoidable side-effect of construction projects and cannot be prevented. There are two good options for minimization of emissions themselves: using engines that are fuel-efficient and in top operating condition, and proactive management of construction traffic to avoid congestion as much as possible. In addition, the impacts of emissions on people living and working near work sites can be minimized through thoughtful siting of large stationary emitters and materials handling facilities.

All PCs shall be required to ensure that all motorized equipment used in works under their control, including that supplied and used by sub-contractors, is of recent manufacture (less than 15 years old), rated above the industry within-class average for fuel consumption, and maintained in top working condition at all times.

To help ensure that construction haul traffic does not lead to undue elevation of emissions in populated areas along the projected haul routes, each PC shall prepare its own route-specific Construction Traffic Management Plan, for review and approval by the CSC prior to the commencement of works. The plans will be appended to the respective PCs' CEMMAPs. It can be expected that there will be temporal and spatial overlap between the hauling operations of the various contractors, and this will require strong coordination to ensure that traffic safety impacts are not multiplied at certain times and locations. The CSC shall coordinate the hauling activity of the PCs to help limit emergence of emissions trouble spots.

With regards to large stationary emissions sources, which include generators and concrete batch plants, mitigation should entail designing the layouts of staging area sites such that these sources are installed as far as feasible from off-site receptors. Similarly, the materials handling facilities within staging areas, which will see the most intense, repetitive and prolonged use of heavy machinery, should be set up so as to maximize distance to off-site receptors. Preliminary proposals for staging area layouts already indicate favorable positioning of batch plants and associated aggregates handling, but the PCs shall be required, during site set-up, to ensure that a minimum of 300 m is maintained between the locations of off-site residences and stationary generators, concrete batch plants, and high-volume aggregate handling areas within staging areas.

IMPACT SUMMARY					
Impact:	Air quality degradation due to concentrated diesel engine emissions				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate–High
Mitigation:	• All PCs shall ensure that all motorized equipment used in works under their control, including that supplied and used by sub-contractors, is of recent manufacture (less than 10 years old), rated above the industry within-class average for fuel consumption, and maintained in top working condition at all times. • Each PC shall prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC shall closely coordinate the hauling activity of the PCs to avoid possible multiplication of emissions impacts from simultaneous hauling operations • PCs to ensure, through staging area layout design, that large stationary generators, concrete batch plants and high-volume aggregates handling areas are set up no closer than 300 m to any offsite residence				
Residual:	Expected, and to be balanced against positive project impacts				

Asphalt batch plant emissions

Anticipated impact. Asphalt batch plants typically produce heavy combustion by-product emissions from heating units, in addition to the strong concentrated off-gassing of polycyclic aromatic hydrocarbons (PAH) from the heated bitumen itself. When asphalt batch plants are located near inhabited areas, residents may experience intense degradation in the quality of the air they have to breathe. Headaches, nausea and exacerbation of other ailments are common side effects, in addition to annoyance. Dust and noise from aggregates handling and operation of the batch plant machinery may be quite considerable at these sites. Asphalt batch plants typically operate in one location for some time, generating chronic exposure for people who live nearby.

At the time of writing, it is anticipated that one asphalt batch plant will be established in each of Bataan and Cavite, and that these will be set up within Bataan Staging Area 1 (casting yard site) and the Cavite Staging Area (Uniwide site), respectively. It is expected the batch plants will be needed for a relatively short time (2–3 months) near the end of the construction phase.

Prescribed mitigation. There is ample space on both of the anticipated staging area sites to permit placement of emissions-intensive activity well away from the nearest community areas (see Exhibit 7-50 and Exhibit 7-53). The PCs responsible for setup and operation of the asphalt batch plants shall be required to ensure that final placement avoids positioning any plants and associated aggregates handling any closer than 300 m from the nearest residence.

IMPACT SUMMARY					
Impact:	Asphalt batch plant emissions				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Short-term	Scope:	Localized	Significance:	Moderate–High

IMPACT SUMMARY	
Mitigation:	• PCs responsible for setup and operation of asphalt batch plants shall ensure that the plants and associated aggregates handling are positioning no closer than 300 m to the nearest residence
Residual:	None expected

Noise and Vibration Impacts

Anticipated Impact. Prolonged exposure to noise of the kind expected from construction may induce or aggravate numerous physical and mental health concerns, including high blood pressure, heart disease, anxiety, depression, immune disorders, insomnia, difficulty concentrating and learning, and social isolation.[270] The intensity, duration and timing of acoustic emissions are key factors shaping the significance of noise impacts; in general, it may be said that noise is more easily tolerated when it occurs at lower intensity (single-source and multi-source), occurs for shorter durations, and occurs during times when background tends to be elevated, e.g., during normal daytime working hours. Also of major importance is the proximity of receptors to the noise source, as noise energy decays quite rapidly with distance (approximately 6 dB drop with each doubling of distance). Given typical distance decay of noise emissions, locations more than 100 m from a construction site are unlikely to experience very bothersome noise unless heavy pile driving is part of the activity. Exhibit 7-57 shows typical noise emissions for common construction equipment.

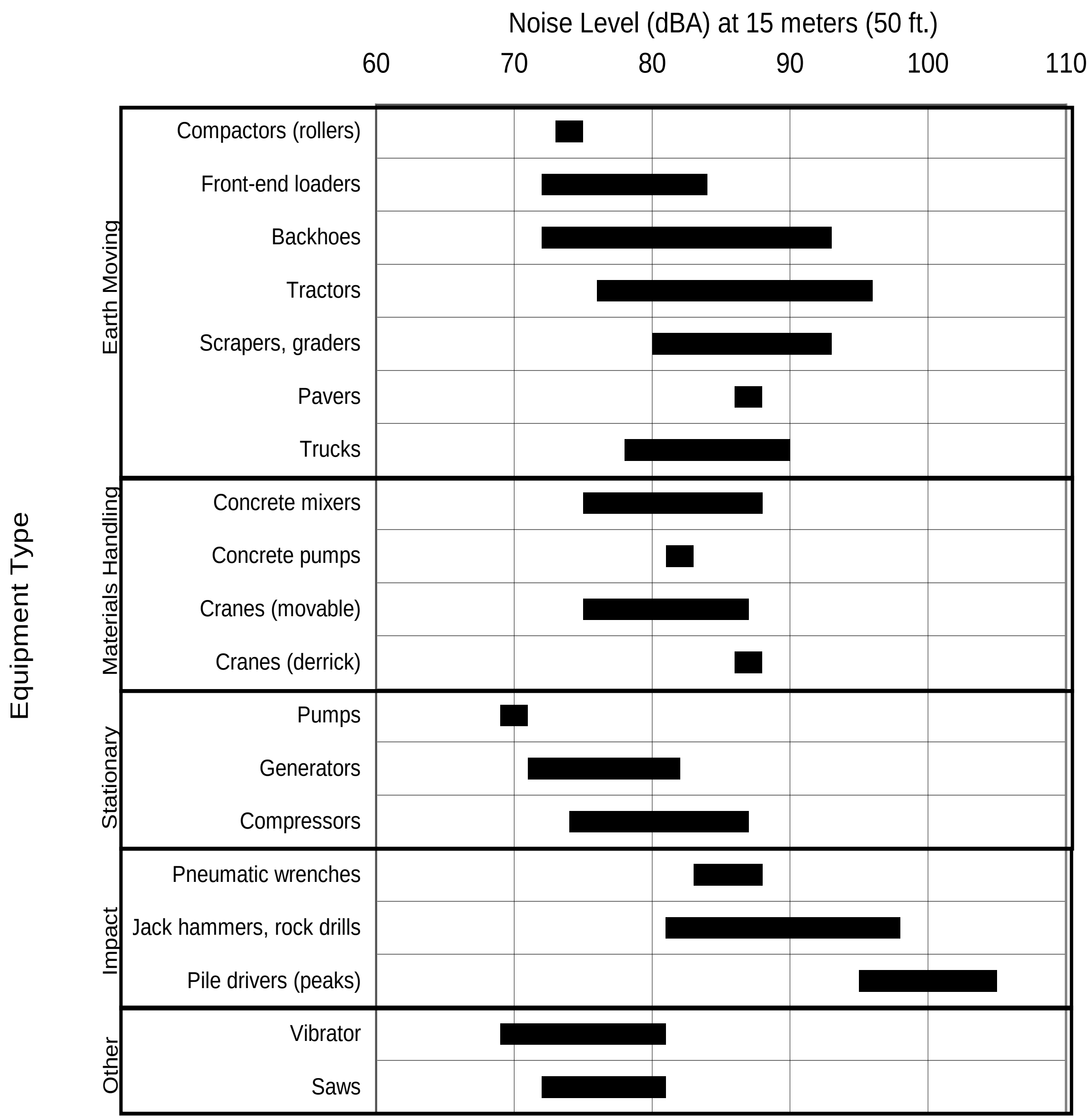
Construction-phase noise impacts from the BCIB project will be derived from works on the approach roads and interchanges, from materials hauling activity needed to support both on-land and marine construction works, and from activity taking place within staging sites. Noise impacts associated with the marine works primarily concern underwater noise, which has been discussed in Chapter 6. Potential for impacts from airborne noise emissions from the marine works is quite limited due to a lack of human receptors nearby the noisiest sites, which will be mainly offshore (pile-driving for the cable-stayed bridge foundations).

Vibration from road construction works can damage nearby structures and may interfere with operation of sensitive equipment used in nearby facilities, such as laboratories and hospitals; vibration may also be annoying to people living in the vicinity. There are no laboratories or hospitals nearby the project footprint. After reviewing the anticipated relocation plans, structures are not within 15 m from major structural elements that would require utilizing vibration- inducing impacts.

Operation of heavy trucks, large cranes, and excavators can result in periodic, temporary generation of ground-borne vibration, but pile drivers and vibratory rollers are the equipment of greatest concern. Piling work for the approach road and interchange works on the BCIB project is expected to be completed using the boring method, rather than impact or vibratory drivers, so the principal anticipated source of vibration during the works will be vibratory rollers, which will be used during embankment construction. A typical vibratory roller generates approximately 0.11 inch per second peak particle velocity (PPV) at 15 m distance.[271] This is slightly above the 'strongly perceptible' threshold for humans of 0.10 inch per second PPV. Older buildings, i.e., older than 50 years, may sustain damage at

[270] EPA Victoria (Australia). 2020. Civil Construction Building and Demolition Guide. Victoria State Government Publication 1834, November 2020.
[271] CALTRANS. 2020. Transportation and Construction Vibration Guidance Manual. April 2020 Update.

0.25 inch per second PPV, which suggests that use of vibratory rollers would be unlikely to have much potential for causing structural issues along the BCIB ROW.[272]



Source: EPA, 1971 and WSDOT, 1991.

Source: US EPA. 1971. Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances. Document Number NTID 300.1.

Exhibit 7-56 Typical Noise Emissions from Common Construction Equipment

Approach road works. The principal source of noise from the approach road works will be operation of heavy machinery and haul trucks. As piling work for the foundations of the limited viaduct sections is to be done using the boring method rather than with impact hammers, noise emissions from that common source will not be an issue.

Most of the Bataan approach road alignment passes through sparsely populated lands with few buildings of any kind. However, the interchange works and associated work on the approach ramps will take place in close proximity to a number of homes and businesses,

[272] CALTRANS. 2013. Transportation and Construction Vibration Guidance Manual. September 2013.

principally along the Roman Highway segment to the northwest of the interchange site, which is on the edge of Alas Asin village (see Exhibit 7-57). There are also some rural homes nearby the alignment from 1+850 to 2+400. Altogether, there are approximately 90–100 residential receptors (dwelling units) within 100 m of the Bataan ROW boundary. The works at these locations are likely to generate bothersome noise, but on an intermittent basis over a relatively short period of active construction. There are no sensitive receptors such as schools, daycare facilities, playgrounds, hospitals or nursing homes in close proximity to the works sites in Bataan.

Exhibit 7-57 Zones With Residential Receptors Within 100 m of ROW Boundary, Mariveles

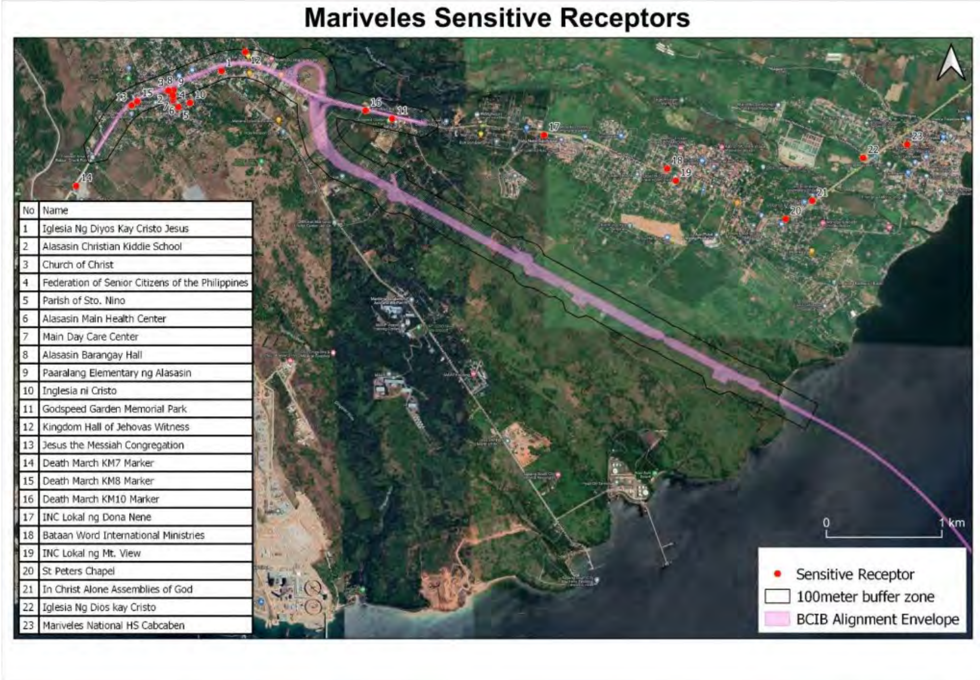
On the Cavite side, most of the approach road alignment passes through rural lands, but there are significant clusters of mainly residential structures in close proximity to the ROW, most notably at a new housing estate near the mid-point, where existing roads intersect the project alignment, and around parts of the interchange (see Exhibit 7-58). An estimated 280–300 residential receptors are found within 100 m of the Cavite ROW boundary. The construction works at these locations can be expected to produce elevated noise on an intermittent basis over a relatively short period.

Hauling. The supply of bulk materials used in the approach road and marine works is expected to be delivered primarily by road, and materials hauling is expected to be carried out on more or less sustained basis for most of the construction phase. Hauling will be a significant medium-term source of noise impacts on people living along the haul routes.

On the Bataan side, hauling will occur mainly via the Roman Highway. The highway passes through areas of moderately dense residential and commercial development in Mt. View, Cabcaben and Townsite (see Exhibit 7-51). The Alas Asin segment of the Roman Highway westward from the Kamaya Point Road turnoff is not expected to see significant haul traffic. There is a high school located directly beside the Roman Highway in Cabcaben, and this will be the most directly affected sensitive receptor in relation to haul traffic; a primary school and preschool in Alas Asin village are close to the Roman Highway, but as noted, this part of the highway is not expected to see significant haul traffic (see Exhibit 7-59). There are also 10 houses of worship located in close proximity to the Roman Highway, six of which are along the haul route east of the interchange (see Exhibit 7-59).

Exhibit 7-58 Zones With Residential Receptors Within 100 m of ROW Boundary, Naic

The Kamaya Point Road will be used to bring materials to Staging Area 1; this road is bordered mostly by open land and industrial facilities in various stages of development. The campus of the Maritime Academy of Asia and the Pacific is located along this road, about halfway to the coast, and some campus buildings are positioned close to the road. The southern end of Kamaya Point Road, where these is a fishing community, will be bypassed by haul traffic, using a new direct site access road to be established north of the village by the site's owner.

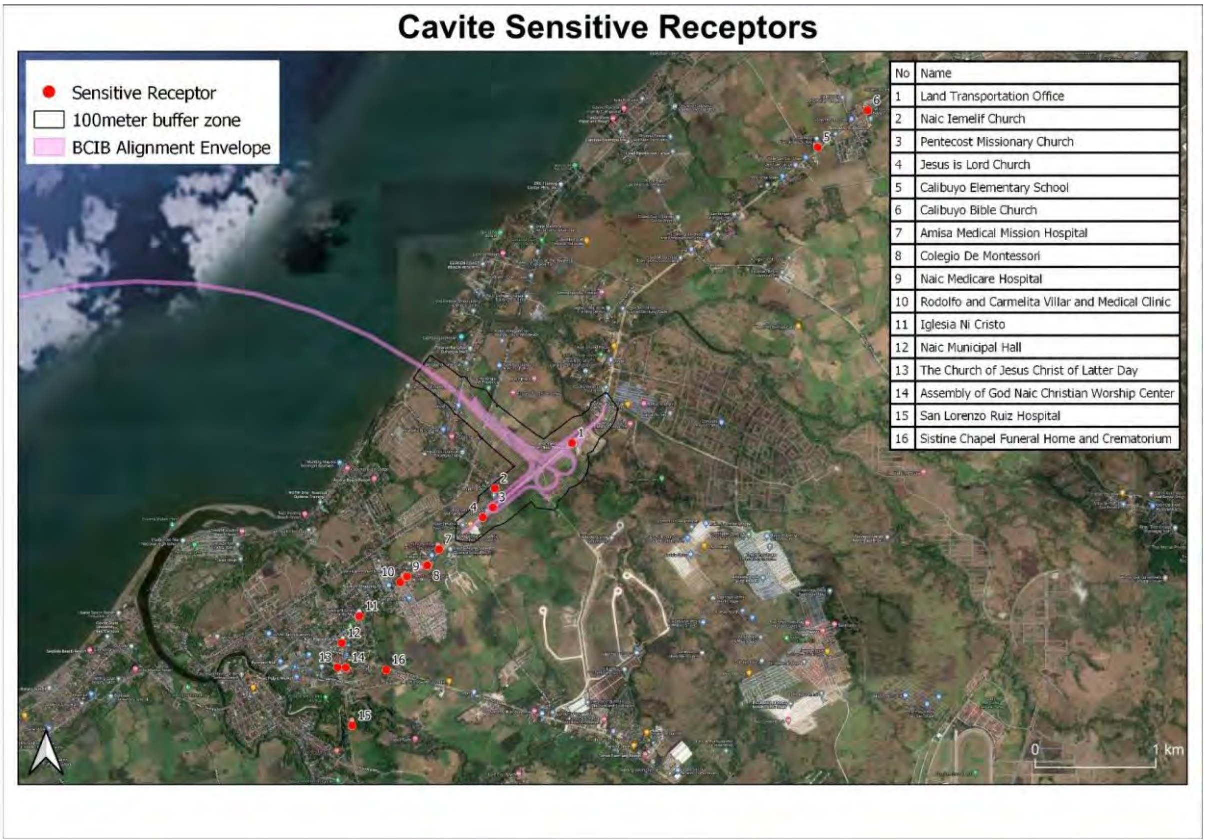


Source: Ecosys Corp.

Exhibit 7-59 Potential Sensitive Receptor Sites in Project Area, Bataan

On the Cavite side, most hauling is expected to occur via the Antero Soriano Highway and Governor's Drive and pass through part of Naic town. Particularly intense hauling activity will take place between the Uniwide site, where much storage is expected to take place, and the working front offshore, where large amounts of materials will be needed by the floating batch plants serving the in-situ casting operations there. Haul trucks using the 2.2-km route between the Uniwide storage yard and marine viaduct landing will necessarily follow the Antero Soriano Highway for 0.6 km to cross two branches of the Timalan River on existing highway bridges (see Exhibit 7-54). This road segment will serve both between-site haul traffic and trucks arriving from materials sources to the west and south of the project area.

There are two schools located directly beside the Antero Soriano Highway within the near project hauling zone, and also two hospitals adjacent to the highway, and a third hospital next to Governor's Drive (see Exhibit 7-60). These sensitive receptor sites can be considered vulnerable to possible noise impacts from project hauling. There are eight houses of worship located beside the Naic portion of the Antero Soriano Highway.



Source: Ecosys Corp.

Exhibit 7-60 Potential Sensitive Receptors Identified in Cavite Project Area

The marine construction works are expected to require more or less continuous activity in order to meet a tight construction schedule, and it is estimated that they will proceed 24 hours per day during a period of 3.5 years. In order to keep the offshore operations supplied around the clock, it is expected that some hauling activity will have to take place at night. This will affect residents mainly on the Cavite side, where materials will have to be transported from storage at the Uniwide site to the work front, using the ROW (by contrast, materials will be stored near the shore on the Bataan side, so nighttime resupply operations would not involve movement along the ROW).

Staging activity. Activity within some parts of the designated staging areas will be noisy and conducted on an intensive basis over much of the construction phase. The noisiest sites will be the concrete batching operations and the aggregates handling areas (at Bataan Staging Area 1 and Cavite Uniwide staging area). The batch plants will be powered by large diesel engines and have numerous noisy components including mixing drums, hopper chutes, and pneumatic vacuum pumps, and their operation will be accompanied by heavy use of loaders and trucks. The batch plants are expected to run around the clock for a significant portion of the construction phase to produce the pre-cast elements for the bridges and viaducts. Materials handling yards will see intense activity for most of the construction phase. As the batch plants and materials handling yards will be single-location facilities, the noise generated by them will be a persistent medium-term impact on the quality of life of people who live and work nearby. As indicated earlier, however, the sites are sufficiently spacious to enable placement of batch plants and aggregate handling facilities at considerable distance from residential areas (see Exhibit 7-50 and Exhibit 7-53).

Prescribed Mitigation. Impacts from construction noise cannot be prevented entirely, but can be minimized through equipment selection, phasing of activity, use of physical noise barriers in selected locations, and thoughtful layout of staging areas.

Antiquated, poorly maintained equipment and vehicles (especially those with missing or non-functional mufflers, worn bearings and poor lubrication) can be expected to produce elevated noise; well-maintained machinery and vehicles equipped with the latest noise abatement technology can be expected to perform significantly better in this regard. The PCs shall be contractually required to use only equipment that is modern (less than 15 years old) and maintained to a high standard on the works and sites under their control. This shall apply to equipment supplied and operated by both the PCS and their sub-contractors.

Construction noise emissions are particularly impactful when they affect people's ability to sleep and to carry on interactive household and community activity such as meals and socializing. Limiting construction works and hauling to daylight hours (6:00 am to 6:00 pm) can help reduce the severity of noise impacts. This measure is expected to be feasible in relation to the approach road construction works and most activity at the staging areas and shall be expected of the PCs in those contexts.

With regards to hauling activity, it is sometimes necessary to strike a balance between avoiding night hauling and limiting traffic congestion impacts. It is preferable for hauling activity to be concentrated during off-peak traffic hours (typically 9:00 am – 4:00 pm), and this shall be considered the priority measure for simultaneously limiting noise and congestion impacts from hauling. However, if this is found insufficient to accommodate the necessary hauling activity, arrangements may need to be negotiated with local municipal authorities to allow some limited night hauling, subject to carefully stated conditions. Each PC shall prepare a Construction Traffic Management Plan for review and approval prior to the start of works, and the CSC shall coordinate the hauling activity of the PCs. If night hauling is deemed necessary, the CSC and DPWH-PMT shall jointly pursue an agreement with the relevant municipal and barangay leaders to define appropriate conditions.

As noted above, it is already expected that hauling from the Uniwide staging area in Cavite will be necessary to serve the marine works, which will proceed around the clock for at least part of the construction phase. It will be appropriate for temporary noise barriers (Jersey barriers or similar, at least 1 m in height and placed in a continuous line directly adjacent to the haul route lane) to be installed along the haul route sections where residences are located close to the ROW boundary, to limit the nighttime noise emissions for residents.

Also as indicated above, it is expected that some activity on the staging areas will have to continue after normal working hours at least some of the time, including operation of batch plants and handling of aggregates, but that there is sufficient room within the designated staging areas to arrange site layout so as to keep batch plants, generators and high-intensity materials handling well away from residential areas beyond the site perimeters. The PCs shall be required, during site set-up, to ensure that a minimum of 300 m is maintained between the locations of off-site residences and stationary generators, concrete batch plants, and high-volume aggregate handling areas within staging areas.

In addition to existing sensitive receptors, construction crew may experience loss of hearing after being subject to long durations of operating varying degrees of noisy equipment.

IMPACT SUMMARY					
Impact:	Noise impacts from works, staging activity and hauling				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	• Medium-term	Scope:	Localized	Significance:	High
Mitigation:	• All PCs shall ensure that all motorized equipment used in works under their control, including that supplied and used by sub-contractors, is of recent manufacture (less than 10 years old), rated above the industry within-class average for fuel consumption, and maintained in top working condition at all times. And Prohibit aboveground jack-hammering and impact pile driving during nighttime hours. • Unless otherwise approved by the CSC, all PCs shall limit noisy work activity and hauling to daylight hours (6:00 am–6:00 pm) • Each PC shall prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC shall closely coordinate the hauling activity of the PCs and to arrange for as much hauling activity as possible to take place in off-peak traffic hours (9:00 am–4:00 pm), and assist DPWH-PMT to negotiate with relevant municipal and barangay authorities' permission and conditions for any necessary avoid possible multiplication of emissions impacts from simultaneous hauling operations • PCs involved in hauling from Uniwide staging area in Cavite to working front to install and maintain temporary noise barriers (Jersey barriers or similar, at least 1 m in height and placed in a continuous line directly adjacent to the haul route lane) in all places where residences are located within 100 m of the road, to limit noise impacts from night hauling. • PCs to ensure, through staging area layout design, that large stationary generators, concrete batch plants and high-volume aggregates handling areas are set up no closer than 300 m to any offsite residence. • CSC should routinely monitor noise levels and evaluate when the following measures should be considered: o Install construction site noise barrier wall by noise-sensitive receivers or movable noise barriers at the source of the construction activity. o Implement noise-deadening measures for truck loading and operations. o Use acoustic enclosures, shields, or shrouds for equipment and facilities. o Minimize the use of generators or use whisper quiet generators to power equipment. • Workers should be prescribed to wear appropriate personal protective equipment (PPE) to conform to OSH guidelines.				
Residual:	Expected, to be balanced against positive impacts expected from project				

7.2.3 Operation Phase Impacts and Mitigation

Operation impacts are those impacts which occur as a direct or indirect result of the normal use of the infrastructure, as well as operation and maintenance (including scheduled and unforeseen repair works), and which are mitigated by the infrastructure owner or its designated operating entity, or by contractors engaged to carry out maintenance and repair activities. As with construction impacts, impacts occurring during operation are largely predictable, and mitigation is appropriately supported by plans developed in the lead-up to the entry of the infrastructure into normal operation.

Air Quality Impacts

Anticipated Impact. The National Ambient Air Quality Guideline Values and Standards for air quality are presented in Exhibit 7-61 and the interpretative indices are presented in Exhibit 7-62 below

Exhibit 7-61 National Ambient Air Quality Guideline Values and Standards

DAO 2000-81	TSP(µg/Ncm)	PM10 (µg/Ncm)	SO2 (µg/Ncm)	NO2 (µg/Ncm)
24-hour sampling (NAAQGV)	230	150	180	150
1-hour sampling (NAAQGV)	300	200	340	260

Exhibit 7-62 Air Quality Indices

Type Classification	**TSP, µg/Ncm** (24-hour average)	**PM10, µg/Ncm** (24-hour average)	**SO2, µg/Ncm** (24-hour average)*	NO2, ppm (1-hour average)*
Good	0 to 80	0 to 54	0 to 88.8	-
Fair	81 to 230	55 to 154	91.4 to 376.2	-
Unhealthy for sensitive groups	231 to 349	155 to 254	378.8 to 627.4	-
Very unhealthy	350 to 599	255 to 354	687.8 to 794.2	-
Acutely unhealthy	600 to 899	355 to 424	796.8 to 1577.9	1,220.5 to 2,328.3
Emergency	900 and above	425 and above	1580 and above	2,347.0 to 3,079.3

The hourly and 24-hour predicted ground level pollutants concentration summaries are presented in Exhibit 7-63 using the UK 2020 emission factors, however to be conservative in anticipating vehicle emissions, Exhibit 7-64 conveys the results from following the UK 2009 emission factors because the conversion to cleaner-emission vehicles may be delayed in the Philippines.

Exhibit 7-63 Summaries of Maximum Predicted Pollutant Level using UK 2020 Emission Factors

Parameters	Averaging Time	Maximum Predicted Concentration in ug/m^3	
		Bataan Side	Cavite Side
PM as TSP	1hr	-	-
	24hrs	-	-
NO2	1hr	135.41	138.86
	24hrs	57.08	58.24
PM10	1hr	17.18	16.83
	24hrs	5.15	4.78
SO2	1hr	1.91	1.87
	24hrs	0.57	0.53

Exhibit 7-64 Summaries of Maximum Predicted Pollutant Level using UK 2009 Emission Factors

Parameters	Averaging Time	Maximum Predicted Concentration in ug/m^3	
		Bataan Side	Cavite Side
PM as TSP	1hr	224.78	194.56
	24hrs	59.68	53.99

Parameters	Averaging Time	Maximum Predicted Concentration in ug/m³	
		Bataan Side	Cavite Side
NO2	1hr	1,751.51	1,515.09
	24hrs	464.43	420.50
PM10	1hr	169.64	157.17
	24hrs	44.78	46.16
SO2	1hr	38.00	34.32
	24hrs	9.83	9.54

The predictable air quality modeling does not demonstrate any exceedances against the National Ambient Air Quality Guideline Values and Standards when applying the UK 2020 emission factors. Higher emissions are attributed to an older vehicle fleet. Under the future years of 2020 and 2030, pollutants from vehicle emissions decrease based on expected future improvements in inspection and maintenance programs, improved vehicle fuel efficiency and the increasing onset of electric vehicles. This may be one justification why the preliminary results show an anomaly for the NO2 emissions exceedance under the UK 2009 emission factors. The potential for air quality exceedances concerns a very narrow area along the BCIB footprint within which there are no sensitive receptors in Bataan. And in Cavite, where residential receptors will be adjacent to the BCIB, they are still distant from the actual travel lanes of the BCIB due to the retained fill embankment needed to position the roadway at the height to transition to the marine viaduct.

The operation-phase air quality impacts of the project are determined during design and are not amenable to mitigation during the operation phase itself. The only air quality impact that can be influenced at all during operations concerns dust and engine emissions from equipment associated with infrastructure maintenance and repair works. Regular upkeep of the approach roads is not expected to generate significant dust or require large inputs of machinery operation hours. Although infrequent and mostly very limited in intensity and spatial scope, repair and replacement works do have somewhat more potential for generating localized air quality impacts, particularly if excavation, sandblasting or concrete work is involved.

Prescribed Mitigation. The BCIB Management Entity shall contractually require all maintenance contractors to use only modern, fuel-efficient equipment in good condition, to limit emissions impacts in road-adjacent areas. For major repair and replacement work, the contractors shall be required to implement dust suppression measures sufficient to ensure that dust emissions do not reach nuisance level or worse. These measures shall include regular light spraying, keeping any materials stockpiles kept on site covered with tarpaulins when not in active use, and requiring all haul trucks involved in the works to be equipped with tight-fitting covers.

IMPACT SUMMARY					
Impact:	Air quality impacts from engine emissions and dust emitted during major repair and replacement works				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Low

IMPACT SUMMARY	
Mitigation:	BCIB Management Entity to require contractors to use only modern, fuel efficient equipment in major repair and replacement works on approach roads Contractors on major repair and replacement works shall be required to implement competent dust suppression, including regular light spraying, keeping materials stockpiles covered with tarpaulins, and requiring all haul trucks to be equipped with tight-fitting covers
Residual:	Expected, but of no practical significance

Acoustic Impacts

Anticipated Impact. Operation-phase noise impacts are determined mostly during roadway design, and mitigation will have been incorporated long before the road opens. Significant additional noise impacts, beyond what has been accounted for during design, are not anticipated.

Noise will be generated by regular maintenance activity, most notably weekly sweeping with a regenerative air sweeper, which is prescribed as a measure to reduce the risk of contamination of surface water by road runoff. This activity will be intermittent and short-lived at any one location and will have only a negligible impact. More substantial repair and replacement works can be expected to produce more intense noise, but these are expected to be very infrequent, and relatively short duration. Significant vibration would not be expected even as part of repair and replacement works.

Prescribed Impact. No mitigation is prescribed for operation-phase noise impacts.

IMPACT SUMMARY					
Impact:	Noise and vibration impacts from roadway operation and maintenance				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Long-term	Scope:	Localized	Significance:	Very minor
Mitigation:	None prescribed				
Residual:	Expected, but of negligible significance				

8 BASELINE CONDITIONS, ANTICIPATED IMPACTS AND PRESCRIBED MITIGATION (PEOPLE)

The BCIB project will establish, for the first time, a land transport connection between the provinces of Bataan and Cavite. The residents of the municipalities of Mariveles and Naic will be the front-line receptors of the changes that this novel linkage will bring to the two provinces. This chapter of the EIA report presents baseline profiles of Mariveles and Naic, with a focus on the portions of these municipalities where the BCIB infrastructure will be built, assesses the likelihood and significance of impacts on the social attributes of these areas in light of the expected project activities as detailed earlier in the Project Description, and defines mitigation measures appropriate to the identified risks. Assessment of impacts and development of mitigation prescriptions takes in the pre-construction phase, construction phase and operation phase, in that order.

8.1 Baseline Conditions

8.1.1 Bataan

8.1.1.1 Demographics

Bataan is a lightly populated province. Population data from the 2020 Census of Population and Housing place it amongst the lowest provinces within Region III in terms of population, with 853,373 people; the province makes up 6.9% of the total population of Region III. Population density is slightly above the average for all provinces in Region III, as Bataan accounts for 6.2% of the region by area. The province's population has experienced rapid growth in recent decades, with an approximate doubling between 1990 and 2020. Population trends for Bataan Province are shown in Exhibit 8-1.

Exhibit 8-1 Population Trends for Bataan Province, 1990–2020

	1990	2000	2010	2020
Population	425,803	557,659	687,482	853,373
Average annual growth rate since previous census	-	+2.7%	+2.1%	+2.2%
Population density (inhabitants per km²)[1]	310/km²	406/km²	501/km²	622/km²
[1] Land area used in density calculations obtained from Philippine Standard Geographic Code				

Source: Philippines Statistical Authority (2019 Philippine Statistical Yearbook; 2020 Census of Population and Housing)

Within Bataan, Mariveles is the largest of 12 municipalities by area, and has had the largest municipal population since at least 1990. The population of Mariveles more than doubled (+146.7%) between 1990 and 2020; this is the strongest growth rate of any municipality in Bataan over the same period and is rivalled only by the growth in Limay (+139.9%) and Hermosa (+123.6%). Although the municipality's highest annual average growth rates came in the 1990s, growth has remained strong in the most recent decade, at nearly 3%. Within the 2010–2020 time period, annual average growth was 2.5% from 2010–2015, and 3.2%

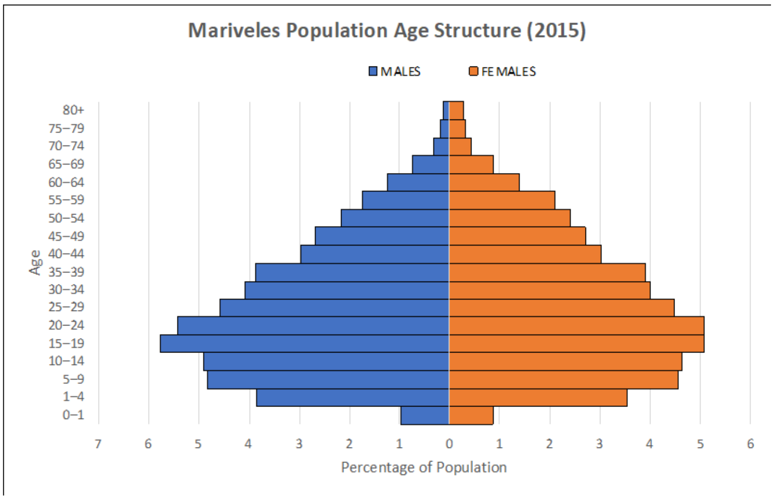
from 2015–2020, indicating a significant acceleration. General population trends for Mariveles are shown in Exhibit 8-2.

Exhibit 8-2 Population Trends for Municipality of Mariveles, 1990–2020

	1990	2000	2010	2020
Population	60,761	85,779	112,707	149,879
Average annual growth rate since previous census	-	+3.5%	+2.8%	+2.9%
Population density	382/km^2	539/km^2	708/km^2	941/km^2

Source: Philippines Statistical Authority (2019 Philippine Statistical Yearbook; 2020 Census of Population and Housing) and Municipality of Mariveles (2019 Socio Economic Profile)

The overall population of Mariveles was very evenly divided between males and females in 2015 (the most recent year for which sex data were available at the time of writing), although disparities in the sex ratio exist within various age cohorts. Sex distribution is skewed towards males in the earlier age cohorts, and transitions to a predominance of females by the 40–44 years cohort, skewing ever more strongly female with advancing age; there were more than twice as many 80 years and older women than men in 2015. Mariveles has a youthful population, with 58.5% of the population under age 30 in 2015, and 74.3% under age 40. The largest age cohort in 2015 was 15–19-year-olds. The 2015 composition of the municipal population is shown in Exhibit 8-3.



Source: Philippine Statistical Authority

Exhibit 8-3 Demographic Profile for Municipality of Mariveles, 2015

The Municipality of Mariveles is subdivided into 18 barangays. Of these, two (Alas Asin and Mt. View) will host parts of the physical footprint of the proposed infrastructure, while several other nearby barangays are traversed by roads linking to the BCIB crossing (Exhibit 8-4).

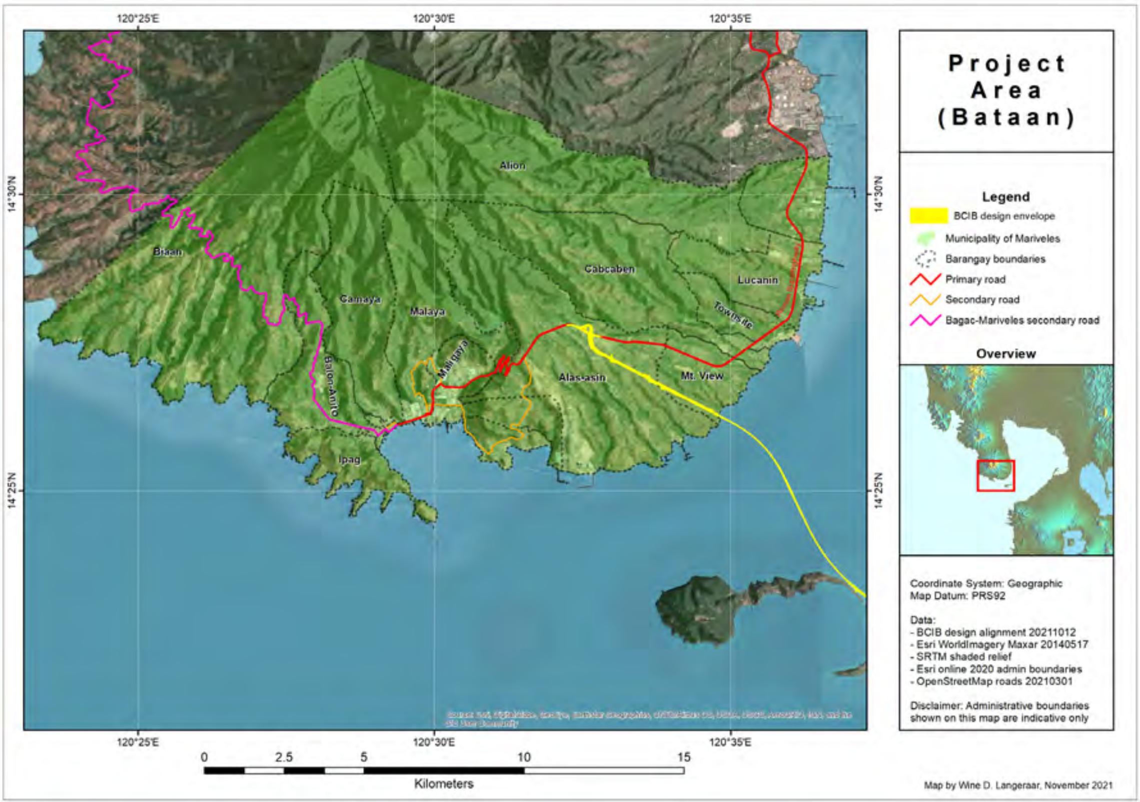


Exhibit 8-4 Municipality of Mariveles and the BCIB Project Footprint

The population of Mariveles is concentrated near the coastline, particularly in the south of the municipality (around Mariveles Bay) and east (along the Roman Highway corridor); this can be explained largely by topography, as the land slopes up from the coasts to the summits of Mount Mariveles, and suitability for road building and agricultural potential decline with increasing slope and elevation. The 2020 populations of the barangays in Mariveles are shown in Exhibit 8-5. Population distribution and density over time are shown in Exhibit 8-6.

Exhibit 8-5 Population and Population Density of All Barangays in Mariveles, 2020

Barangay	Land Area (ha)	Population (2020)	Population Density (2020)
Mariveles Municipality	15,920	149,879	941/km²
Alas-Asin	2,370	18,868	796/km²
Alion	652	3,389	520/km²
Balon-Anito	888	15,820	1,782/km²
Baseco Country (Nassco)	264	4,781	1,811km²
Batangas II	558	5,811	1,041/km²
Biaan	6,004	2,663	44/km²
Cabcaben	1,629	7,665	471/km²

Barangay	Land Area (ha)	Population (2020)	Population Density (2020)
Camaya	412	18,803	4,564/km²
Ipag	662	11,503	1,738/km²
Lucanin	300	7,189	2,396/km²
Malaya	500	4,939	988/km²
Maligaya	692	4,442	642/km²
Mountain View	482	13,082	2,714/km²
Poblacion	31	8,458	27,284/km²
San Carlos	2	1,481	74,050/km²
San Isidro	25	6,515	26,060/km²
Sisiman	67	7,267	10,846/km²
Townsite	380	7,203	1,895/km²

Sources: Philippines Statistics Authority (2020 Census of Population and Housing and Municipality of Mariveles (2019 Socio Economic Profile); Philippine Standard Geographic Code

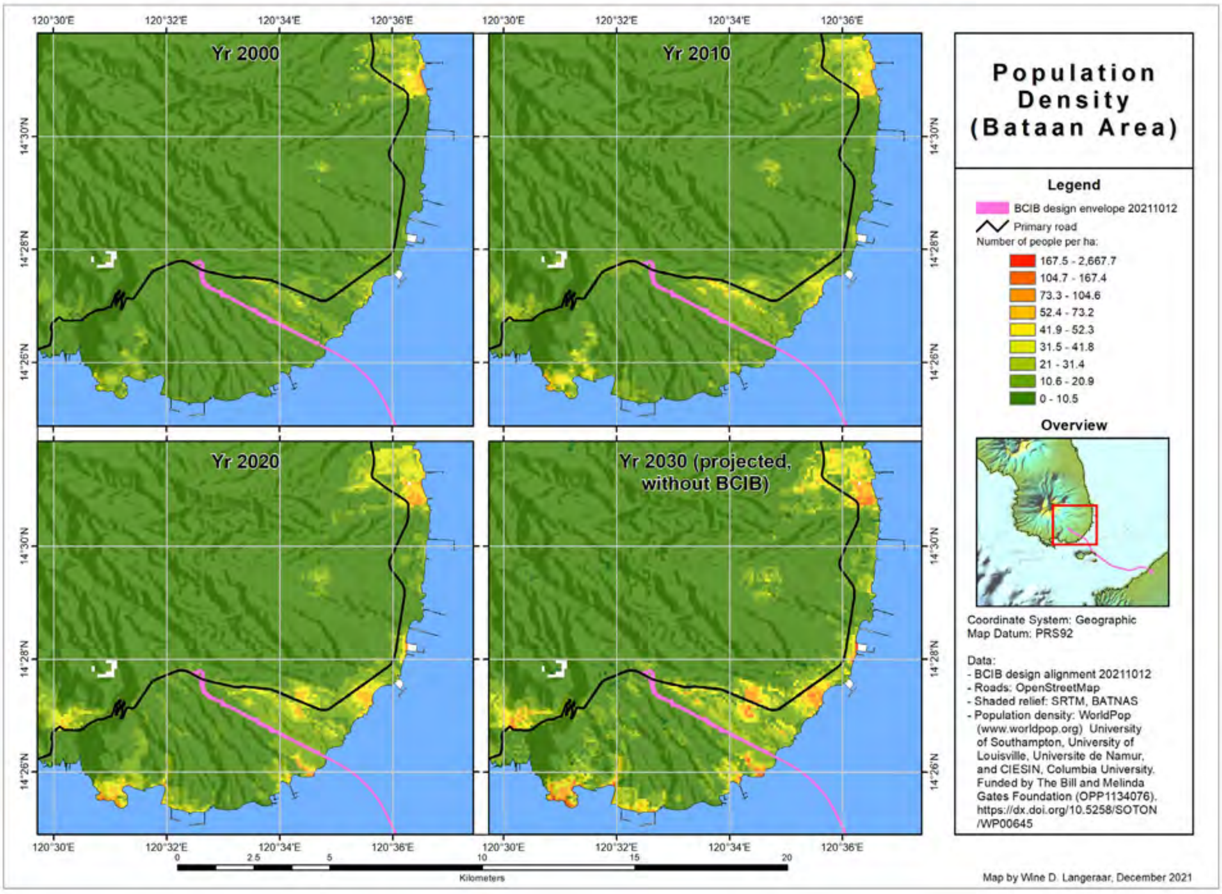


Exhibit 8-6 Distribution and Density of Population in Southeast Mariveles

8.1.1.2 Livelihoods

With the establishment of major industrial facilities along the coast and the expansion of the Freeport Area of Bataan, employment in the industrial sector accounts for the largest share of earned income in the project area. Light manufacturing enterprises within the FAB alone are estimated to provide employment to about 40,000 people, and significant expansion of the workforce is foreseen in the coming decade.[273] Other industrial estates in Mariveles with significant workforces include the PNOC Industrial Estates in the northeast corner of the municipality (with enterprises engaged mainly in petrochemical products manufacturing) and the Basseco Compound in Mariveles Bay (brewery, shipyard, grain terminal and port facility). Major employers outside industrial estates include the GN Power coal-fired generating stations, as well as various oil terminals and shipyards along the coast. Significant employment is also to be found in the tertiary sector, mostly in small-to-medium sized enterprises in retail, business services, food services, real estate and transportation. Tourism is considered to have significant potential given the scenic and historic resources within the municipality but is not yet a major employer.[274]

A perception survey was conducted in the Mariveles portion of the BCIB project area in 2022 as part of the preparation of the updated EIA, covering the five barangays around the BCIB planned infrastructure sites and along nearby portions of the Roman Highway corridor (Alas Asin, Cabcaben, Lucanin, Mt. View, Townsite). In all, 350 people participated in the survey, 225 of whom indicated an occupation when asked. The survey found people engaged in 38 different occupations; the five most frequently indicated occupations are shown in Exhibit 8-7. A sizable portion of survey participants (29% of male respondents; 41% female) did not indicate an occupation, other than 'none'. [275]

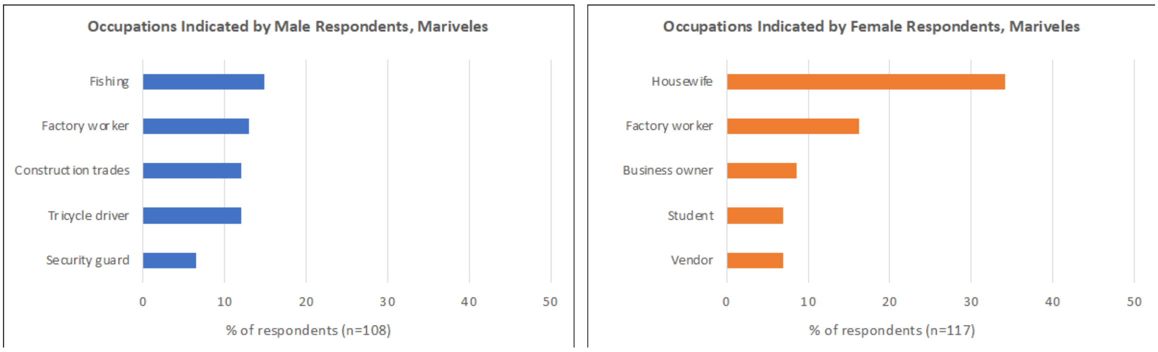
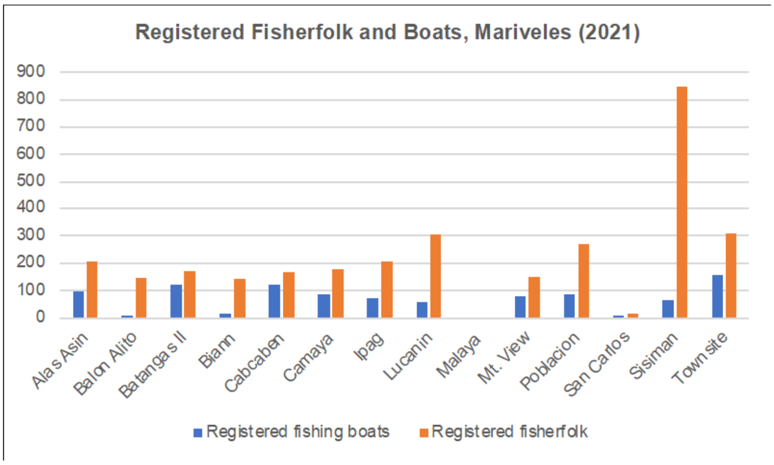


Exhibit 8-7 Top Five Occupations Indicated by Perception Survey Respondents, Mariveles

Agriculture employs only about 5% of the population of Mariveles, primarily due to relatively limited land suitability. There is little wet rice cultivation, with agricultural production consisting mostly of casava, corn, and tree fruits.[276] Agricultural activity observed in the vicinity of the BCIB project footprint consists primarily of fruit orchards (principally mango and guava) and extensive grazing (principally cattle and sheep).

[273] Personal communication, Ms. Hazel de Guzman, Head of Infrastructure and Facilities, Authority of the Freeport Area of Bataan, 23 March 2022.
[274] Municipality of Mariveles. Socio-Economic Profile of 2019.
[275] The perception survey was not a formal census, and the data presented in Exhibit 8-7 are not statistically representative of the populations of these barangays; however, the data do offer some indication of the general character of the occupational landscape in the Mariveles portion of the project area.
[276] Ibid.

Despite the municipality's long coastline, fishing does not account for a significant share of employment or income.[277] There were 3,126 registered municipal fisherfolk with 984 registered fishing boats across all barangays in the municipality in 2021.[278] A breakdown of these numbers by barangay is shown in Exhibit 8-8. The largest numbers of fisherfolk are found in the barangays of Sisiman (850), Townsite (310), Lucanin (304), Alas Asin (208) and Ipag (207). The ratio of fisherfolk to boats is quite varied, ranging from an average of about 1.4 fisherfolk per boat up to nearly 13 per boat. This reflects boat size and range; the notable outlier in the chart in Exhibit 8-8 is Barangay Sisiman, where numerous fishing canoes upwards of 12 m in length can often be seen moored in Sisiman Bay. Several fishing communities are found along the shore in the general vicinity of the BCIB project landing point, in Alas Asin, Mt. View and Cabcaben.



Source: Mariveles LGU fisheries representatives

Exhibit 8-8 Registered Fisherfolk and Fishing Boats by Barangay, Mariveles

The boundaries of the municipal fishing zone of Mariveles can be seen in Exhibit 8-9. Nearshore areas within the municipal waters are designated as 'traditional' fishing areas, where practices such as such as hook and line (*kawil*), spear gun (*pamana*), scoop net (*panalok*), snares (*panukot*), and cover pot (*pangilaw*) are commonly used by subsistence fishers. Trawling and modified Danish seine and other destructive forms of fishing such as dynamite fishing are strictly prohibited in municipal waters but are known to be used, nonetheless. Fisherfolk are active year-round in Mariveles, with peak seasons during the rainy months of June to August and summer months of March to May. The major gears being used in Mariveles are bottom gillnet (*panting lubog*), bottom set longline (*kitang*), drift gill net (*panting paanod*), trawl (*Norway*), crab gill net (*panti pang alimasag*), motorized push net (*pang alamang*), crab pot (*bubo pang alimasag*), and squid trap (*bubo pang pusit*). Both pelagic and demersal fish species are targeted by local fisherfolk. Blue Swimming Crab (*Portunus pelagicus*) and other marketable crabs such as Crucifix Crab (*Charybdis feriata*) are also sought after. The demand for crabs is mainly for local consumption and domestic demand of nearby areas (including Metro Manila) and a crab meat processing plant in Orion (Bataan). The fishing grounds of crab fishermen using passive gear like crab gill nets (for nighttime fishing) and crab pots (for daytime fishing) are concentrated along the shoreline, down to depths of up to 20 m. Based on interviews of

[277] Ibid.

[278] According to a Fisheries Summary Report 2021, supplied to the EIA team during a meeting with LGU and fisherfolk representatives in a meeting on 22 March 2022 at the Barangay Alas Asin municipal hall. The tally in the report appears to include only 'municipal' and 'traditional' class fisherfolk and boats, and not large commercial fishing vessels that mainly ply the waters of the West Philippine Sea.

crab pot fishermen of Alas Asin (Marina Beach) in 2020, August usually has the highest catch of swimming crabs, especially when typhoons have recently passed through the area.

The North Channel appears to be a particularly popular fishing area for small craft; this is due in part to the presence of a mixing zone that sets up during particular parts of the tidal cycle, where fisheries productivity is especially high. Large agglomerations of fishing craft can sometimes be seen in this area, which lies 1.5–2.0 km north of Corregidor Island, when conditions are favorable (see Exhibit 8-10).

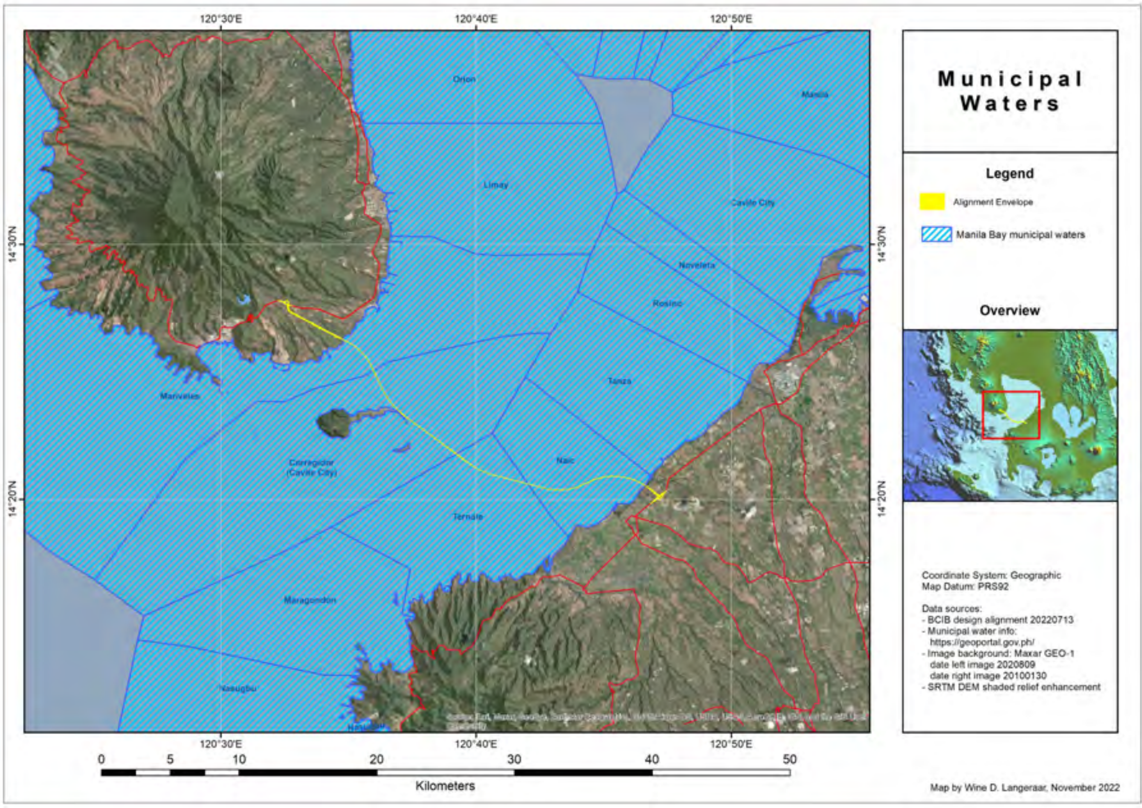


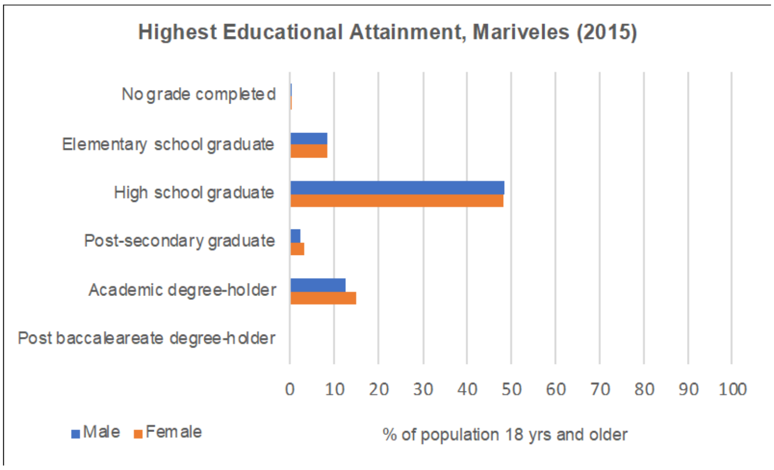
Exhibit 8-9 Municipal Fishing Grounds Around Western Manila Bay

Exhibit 8-10: Concentrated Fishing Activity by Small Craft in North Channel (March 2022)

8.1.1.3 Education and Educational Facilities

As of 2019, Mariveles had 18 public elementary schools and nine private ones, and 14 secondary schools, of which seven were public and seven private. There were four post-secondary institutions in the municipality, including the Bataan branch of the Polytechnic University of the Philippines, Maritime Academy of Asia, and the Pacific, and two technical-vocational schools.[279]

Approximately two thirds of the municipal population aged 18 and older in 2015 had achieved a high school diploma or higher diploma or degree, while about 8% of the same population reported elementary school graduation as their highest educational qualification (see Exhibit 8-11). The Mariveles LGU Socio Economic Profile 2019 cites government survey data from 2014 indicating that 14.6% of children aged 6–12 were not attending school, and 26.6% of children aged 13–16 were not.



Source: Mariveles LGU Socio-Economic Profile 2019

Exhibit 8-11 Educational Attainment, Mariveles (2015)

The perception survey conducted within the Mariveles portion of the BCIB project area (Barangays Alas-Asin, Cabcaben, Lucanin, Mt. View and Townsite) in 2022 recorded the educational attainment of the 350 respondents. Although the categories of attainment used in the perception survey are less refined than those used in the national census as reported for the whole municipality, the survey results are suggestive of a similar pattern for the project area, with secondary school being the most frequently indicated category (see Exhibit 8-12.[280] It is probable that the higher percentages indicated for secondary school attainment in the project area perception survey mostly reflect the inclusion of people who completed some high school but did not graduate.

[279] Mariveles LGU. Socio-Economic Profile 2019.
[280] As has been noted previously, the project area perception survey was not constructed as a census, and no claim is made to strictly statistical representation of the local population.

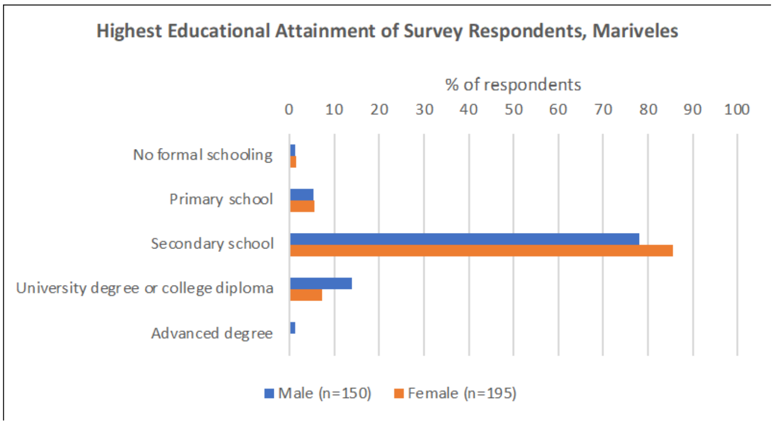


Exhibit 8-12 Educational Attainment of Perception Survey Respondents, Mariveles Project Area

8.1.1.4 Health Services

The Mariveles Socio Economic Profile 2019 indicates that the municipal population is served by four hospitals, including one district hospital (newly opened in 2018), one private hospital, one cooperative hospital, and one large (500-bed) mental hospital. A 2018 survey identified 10 medical and diagnostic clinics in the municipality. There were three rural health units operated by the Mariveles LGU. Each of the 18 barangays had its own barangay health station, and there were 15 additional barangay health satellite posts across the municipality. Additional health facilities included an animal bite treatment center and a rehabilitation center for people with disabilities. There were two paramedics, on call 24 hrs, to serve the municipality as of 2018.[281]

8.1.1.5 The Built Environment

The Bataan portion of the BCIB project area is characterized by low-rise development, with the vast majority of buildings consisting of single-story and two-story homes and business establishments. Buildings with more than three stories are rare. The predominant building material is masonry in more built-up areas, although wood and corrugated tin construction can be observed in marginal urban and rural settings. According to the municipality's Socioeconomic Profile 2019, informal settlers, whose dwellings would typically be more rustic than average, are found in 15 of the 18 barangays, with concentrations ranging from 0.5% of households up to 19.8% of households. Data from the 2015 Census of Population and Housing indicate that the walls of 84% of occupied housing units in Mariveles were found to be made of 'concrete/brick/stone', and a further 8% were ' half concrete/brick/stone and half wood'. About 86% of roofs on occupied dwelling units were 'galvanized iron/aluminum', while 5% were 'tile/concrete/clay tile', and another 5% were a combination of metal and cementitious materials. By far the most common wall-roof combination in the municipality was 'concrete/brick/stone' walls with 'galvanized iron/aluminum' roofing. Institutional buildings, particularly multi-storied ones, such as schools, governmental offices and service centers, clinics and banks are universally constructed of concrete and masonry.

[281] Ibid.

Exhibit 8-13 Built Environment in Alas Asin Village (left) and Mariveles Town (right)

8.1.1.6 Transport Networks

Road network

The communities in the BCIB project area in Bataan are linked to the rest of the country by the Roman Highway and the Bagac-Mariveles Road. Of these, the Roman Highway, a four-lane highway undergoing gradual expansion to six lanes, is the primary and most efficient means of access. The Bagac-Mariveles Road is a two-lane highway which follows a tortuous and hilly route up the west coast of the Bataan Peninsula and is a slower means of access to the Subic Bay area, despite being shorter. The provincial capital Balanga is 39 km away via the Roman Highway, and the nearest connection to the national expressway system is 58 km away. Distances and typical travel times from Barangay Alas-Asin to selected destinations are shown in Exhibit 8-14.

Exhibit 8-14 Road Travel Times to Selected Destinations from Barangay Alas-Asin, Mariveles

Destination	Distance (km)	Peak Period Travel Time (mins)	Off-Peak Period Travel Time (mins)
Balanga (Provincial Capital)	36	56	45
National Expressway System (E4 at Hermosa)	57	67	64
Subic Bay International Airport	83	91	91
Clark International Airport	112	116	108
Central Manila (City Hall)	155	191	169
Ninoy Aquino International Airport	173	192	174

Notes:

1 Distances calculated based on Google Maps directions function, fastest route

2 Peak period travel time estimates derived from Google Maps direction's function, 8:00 am local time, Wednesday

3 Off-peak period travel time derived from Google Maps direction's function, 2:00 am local time, Wednesday

4 Travel times are reflective of late-stage pandemic conditions September 2022, and may understate travel times relative to pre-pandemic conditions

Airports

There are no airports in the Municipality of Mariveles, or anywhere on the Bataan Peninsula. There is a disused military airstrip on nearby Corregidor Island, but this does not presently offer commercial passenger service. The nearest airport is at Subic Bay (86 km by road from Mariveles town), a former American air base that served as a Fedex shipping hub for a number of years, and now offers a limited number of regularly scheduled commercial passenger flights, to Manila only. The main airport serving Bataan is Clark International Airport in Angeles, Pampanga (112 km by road from Mariveles town), with regularly scheduled domestic passenger flights to two other airports in the Philippines, and international service to several regional and extra-regional hubs, including Singapore, Hong Kong, Shanghai, Shenzhen, Seoul and Doha.

Rail service

There is no rail network of any kind on the Bataan Peninsula.

Sea routes

Numerous small ports in Mariveles serve local commercial and industrial shipping needs, most notably the port in Mariveles Bay, which has a large grain terminal and is the core of the Freeport Area of Bataan, serving numerous manufacturing and import-export enterprises. Private passenger ferry companies offer regularly scheduled service between Mariveles Bay and the Manila waterfront (1 hr), and between Manila and Orion (1 hr), with land shuttle to Mariveles. Direct ferry service from Manila to the Camaya Coast Resort is also sometimes available. There is no ferry service between Bataan and Corregidor Island (ferries serve the island from Manila only), or between Bataan and Cavite.

8.1.1.7 Public Utilities

Water supply

The Mariveles Water District (a government-owned and controlled corporation) supplies piped water to 14 of the 18 barangays in the municipality, including all of the barangays in the immediate BCIB project area. The utility sources water from 24 deep wells; most of the pumping stations have chlorination units and backup generators. Residual chlorine is tested daily, bacteriological parameters are subject to monthly testing, and testing of physico-chemical parameters is done on a semi-annual basis.[282] As of May 2021, monthly water production was about 615,000 m^3. There were 19,702 active service connections, of which about 69% were residential connections, just over 30% were at commercial establishments, and less than 1% served government facilities. Total water consumption was 68% residential, 28% commercial, and nearly 4% government customers.[283] In addition to the wells operated by the Mariveles Water District, there are an estimated 124 wells owned and operated by private individuals, barangay administrations, and private enterprises. Most of these are in built-up areas.

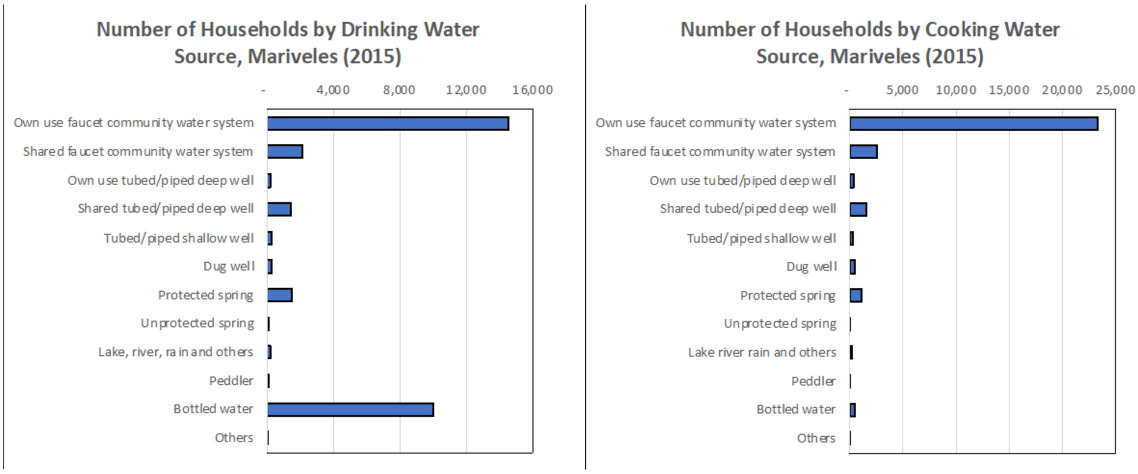
The Freeport Area of Bataan (FAB) has its own water supply, from a dam, treatment plant and distribution system established in the 1970s, during the FAB's earlier formulation as the Bataan Export Processing Zone. The dam, which has a capacity of 9 million m^3, is positioned uphill from Mariveles Bay, and captures runoff from the mostly forested slopes

[282] Municipality of Mariveles Comprehensive Land Use Plan (2017–2026), Volume I.
[283] Local Water Utilities Administration, Groundwater Data Bank. Philippine Water Districts - Average Production and Consumption Data as of 1/7/2022. Accessed via lwua.ph.gov.

of Mt. Mariveles. The treatment plant has a daily capacity of 53 million liters per day. This water system serves the enterprises and residents within the FAB area only.[284]

According to the Mariveles CLUP 2017–2026, approximately 94% of households in the municipality had access to a safe water source as of 2014. Data from the 2015 Census of Population and Housing indicate that only 54% of households used municipal piped water (from a private or shared faucet) for drinking, while 32% of households relied on bottled water for that purpose, and 5% got their drinking water from a private or communal deep well. Nearly 5% of households in Mariveles obtained their drinking water from a protected spring (see Exhibit 8-15).

Use of bottled water for cooking was much less common than for drinking; less than 2% of households used bottled water for cooking, and 84% reported using municipal piped water. Slightly more than 6% of households derived their cooking water from deep wells (private and communal). The disparities in sourcing of drinking water and cooking water would seem to indicate that residents perceive the public water supply is safer for cooking than for drinking, which suggests the principal concern is bacteriological contamination (which is addressed by boiling) or unpleasant taste (which may be less noticeable in food cooked with the water than it is when water is ingested directly).



Source: Philippines Statistics Authority (2015 Census of Population and Housing)

Exhibit 8-15 Domestic Water Sources, Mariveles (2015)

Sanitation

Although there are rudimentary storm sewers along some road segments through built-up areas in Mariveles, there is no public wastewater collection or treatment system outside of the FAB, which has its own collection and treatment system. All domestic wastewater goes either to on-property septic systems, or is discharged to nearby surface waters, either directly or via a sewer. The Mariveles CLUP 2017-2026 indicates that about 96% of households had 'sanitary toilet facilities', which means a water-sealed or flush toilet.

Electricity

Electricity is supplied throughout Mariveles by the Peninsula Electric Cooperative, Inc. (PENELCO), which gets its bulk supply from the state-owned National Power Corporation (NPC). The electricity is brought in from outside Mariveles via transmission lines operated by the National Grid Corporation of the Philippines (NGCP). All of the barangays in

[284] Municipality of Mariveles Comprehensive Land Use Plan (2017–2026), Volume I.

Mariveles have been electrified, although there remain unelectrified pockets, and poor households without service connections.[285]

Solid Waste Management

The BCIB project area is served by a municipal solid waste collection system operated at the barangay level. The municipality has a solid waste management plan which specifies segregation at source to ensure capture of the recyclable segment of the waste stream and reduce landfilling needs, but this does not yet happen to any significant extent. A waste compacting machine was procured by the municipality several years ago but has not yet been implemented.[286] The FAB has its own solid waste management collection system and waste handling facility. All municipal solid waste collected by the barangays outside FAB is taken to the FAB's waste handling facility, and the municipality pays a volume-based fee to the AFAB.

There is no legal landfill in Mariveles; all solid waste collected at the FAB waste handling facility is trucked to a sanitary landfill operated by the Metro Clark Waste Management Corporation in Pampanga (138 km from the FAB). Metro Clark also operates a hazardous waste facility; hazardous wastes generated in Mariveles and at the FAB are trucked there directly, bypassing the FAB solid waste handling facility.

8.1.1.8 Public Safety

The principal public safety matter of relevance to the development of the BCIB project is accident risk on the roads of the project area; key road segments are shown in Exhibit 8-16. Traffic heading from the BCIB interchange area towards Mariveles town is split along two routes. Light vehicles including cars and motorcycles are permitted to continue southwestward on the Roman Highway, descending into the north side of the FAB and Mariveles town via a series of switchbacks. Trucks and buses, meanwhile, are required to use the EPZA Bypass Road, which descends southwards to the coast near Sisiman Bay, and then along the shoreline to the port and Mariveles town. The EPZA Bypass Road is less tortuous than the Roman Highway route, but passes through settled areas, including Barangay Basseco Country (where it winds through the heart of the village), Barangay Sisiman (where it skirts the built-up area), and the western part of Barangay Sisiman (where it winds through a coastal strip with dense informal settlement on both sides).

Safety conditions on the Roman Highway and EPZA Bypass Road are variable. Although all sections of the Roman Highway within Mariveles (except the so-called zigzag section descending into the back side of Mariveles town) have four paved lanes, the outer lanes are significantly affected by permanent obstructions (trees, utility poles), frequent parking activity, and ROW encroachments, and these effectively limit road capacity to two safely operable lanes in some places. Road safety signage is conspicuous, and there are many crosswalks, although many of these do not coincide with actual pedestrian routes (some were observed to end awkwardly at roadside drains). The Roman Highway from is currently undergoing an upgrading project from Mariveles to Balanga, involving widening to six lanes in most places and addition of sidewalks; this is proceeding gradually as funds allow.

[285] Municipality of Mariveles. Comprehensive Land Use Plan 2017–2026, Volume I.
[286] As discussed in a meeting with Mariveles MENRO representatives on 22 March 2022.

Exhibit 8-16 Alternate Routes from BCIB Interchange to Port of Mariveles

The EPZA Bypass Road has been widened to four lanes in some places, but in settled areas is mostly a two-lane road with narrow shoulders and few sidewalks and has inadequate capacity to safely handle the truck and bus traffic serving the Mariveles town, its port facilities, and the FAB. Frequent stoppages and slowdowns can be observed throughout the day, many caused by large vehicles inching past each other in tight spots and congested areas. In some locations, residents have erected informal safety signage and traffic calming features, an apparent reflection of perceived unsafe conditions.

Exhibit 8-17 Conditions Observed Along EPZA Bypass Road

Vehicular accident data supplied by the Bataan 2nd District Engineering Office for the 2016-2021 period (see Exhibit 8-18) indicates that the local road segment with the most accidents is the EPZA Bypass Road, with an average of 40 accidents per year over the 2016-2021 period, followed by the Roman Highway (average 34).[287]

[287] The data supplied by the District Engineering Office lack the specificity necessary for calculation of accident rates, and do not differentiate between incidents based on severity.

Exhibit 8-18 Vehicular Accident Data for Key Road Segments in BCIB Project Area, Mariveles

Year	No. of Vehicular Accidents	Attributed Cause	
		Human Error	Mechanical Failure
Roman Highway			
2016	18	18	
2017	32	30	2
2018	23	23	
2019	50	47	3
2020	33	33	
2021	48	48	
Average 2016–2021	34		
EPZA Bypass Road			
2016	29	28	1
2017	67	65	2
2018	25	25	
2019	12	12	
2020	47	47	
2021	60	59	1
Average 2016–2021	40		
Mariveles Port Road (Zigzag Section)			
2016	6	6	
2017	11	11	
2018	3	3	
2019	9	9	
2020	5	5	
2021	18	18	
Average 2016–2021	9		

Source: DPWH (Bataan 2nd District Engineering Office, Balangas)

8.1.2 Cavite

8.1.2.1 Demographics

Cavite Province is only marginally larger by area than Bataan but has significant urban agglomerations and thus has a much higher population and population density. With a 2020 population of over four million, Cavite is the most populous province in Region IV-A, accounting for 27% of the region's overall population. As the immediate southwest neighbor of Metro Manila, Cavite has experienced a surge of industrial and residential development in line with Manila's emergence and ongoing expansion as a global megacity. The province's population underwent a nearly four-fold expansion between 1990 and 2020, and for much of that period, expanded at a greater annual rate than Metro Manila itself. The rate of expansion in Cavite has slowed over the last two decades but was still a very strong 3.4% in the 2010–2020 period. Average annual growth was 3.57% for 2015–2020, a modest increase over the previous 2010–2015 period (3.37%). General population trends for Cavite Province are shown in Exhibit 8-19.

Exhibit 8-19 Population Trends for Cavite Province, 1990–2020

	1990	2000	2010	2020
Population	1,152,534	2,063,161	3,090,691	4,344,829
Average annual growth rate since previous census	-	+5.8%	+4.0%	3.4%
Population density (inhabitants/km^2)	755/km^2	1,352/km^2	2,025/km^2	2,847/km^2

Source: Philippines Statistical Authority (2019 Philippine Statistical Yearbook; 2020 Census of Population and Housing)

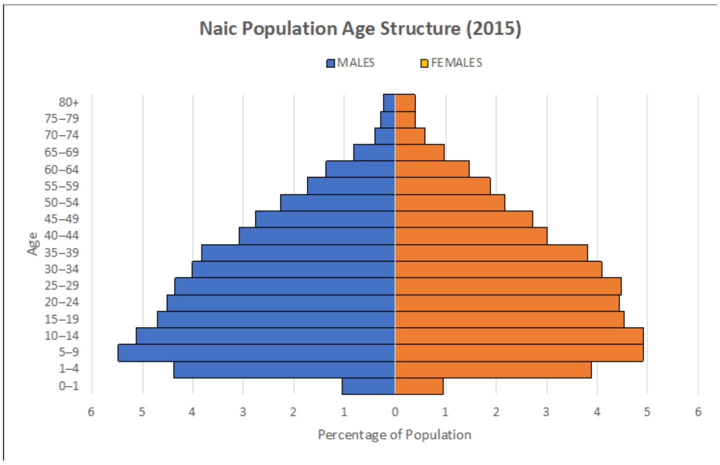
The population of Cavite Province is spatially skewed, with municipalities on the northeast and east sides, bordering Metro Manila and the industrial growth pole along Laguna de Bay, being much more densely populated than those further west. Naic is close to the average for all municipalities in the province in terms of area but is well below the average for population density.

Exhibit 8-20 Population Trends for Municipality of Naic, 1990–2020

	1990	2000	2010	2020
Population	51,629	72,683	88,144	160,987
Average annual growth rate since previous census	-	+3.4%	+1.9%	+6.0%
Population density (inhabitants/km^2)	600/km^2	845/km^2	1,025/km^2	1,872/km^2

Source: Philippines Statistical Authority (2019 Philippine Statistical Yearbook; 2020 Census of Population and Housing) and Municipality of Naic (Comprehensive Land Use Plan 2011–2020)

The overall population of Naic was evenly divided between males and females in 2015. Males are more strongly represented in age cohorts up to 20–24 yrs, after which the distribution evens out. From the 55–59 yr cohort onwards, women become progressively more numerous than men. Naic has quite a youthful population, with 57.7% of the population under age 30 in 2015, and 73.4% under age 40. The largest age cohort in 2015 was 15–19-year-olds. The 2015 composition of the population is shown in Exhibit 8-21.



Source: Philippine Statistical Authority

Exhibit 8-21 Demographic Profile for Municipality of Naic, 2015

Naic municipality is subdivided into 30 barangays, of which two (Timalan Balsahan and Timalan Concepcion will be impinged upon by the infrastructure footprint (Exhibit 8-22).

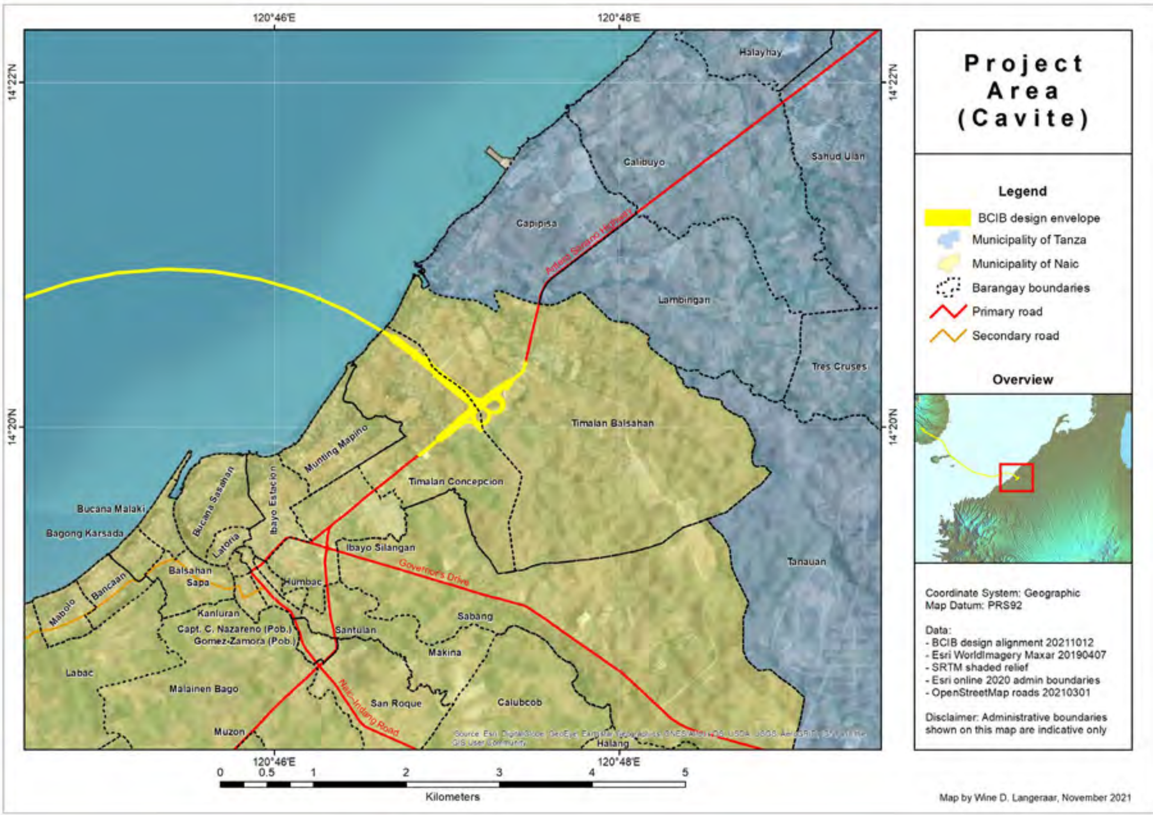


Exhibit 8-22 Municipality of Naic and the BCIB Project Footprint

An additional nine barangays are positioned nearby and along primary and secondary roads that connect fairly directly to the areas around the proposed land approaches of the bridge. The populations of the two host barangays and others nearby and along major connecting routes are indicated in Exhibit 8-23. The distribution and density of population in the general project area over time are shown in Exhibit 8-24.

Exhibit 8-23 Population and Population Density of Selected Barangays in Naic, 2020

Municipal Entity	Land Area (ha)	Population (2020)	Population Density (2020)
Naic Municipality	8,600	149,879	1,743/km^2
Bucana Malaki[2]	96	1,356	1,412/km^2
Bucana Sasahan[2]	122	5,960	4,885/km^2
Calubcob[2]	262	7,391	2,821/km^2
Capt. C. Nazareno[2]	66	543	823/km^2
Ibayo Estacion[2]	52	5,057	9,725/km^2
Ibayo Silangan[2]	52	10,541	20,271/km^2
Munting Mapino[2]	131	5,443	4,155/km^2
Sabang[2]	1,519	21,938	1,444/km^2

Municipal Entity	Land Area (ha)	Population (2020)	Population Density (2020)
Sapa[2]	95	1,412	1,486/km^2
Timalan Balsahan[1]	184	18,179	9,880/km^2
Timalan Concepcion[1]	112	4,563	4,074/km^2

Source: Philippines Statistics Authority (2020 Census of Population and Housing) and Municipality of Naic (CLUP 2011–2020)

In addition to barangays within Naic, the proposed BCIB infrastructure will be built nearby the neighboring municipality of Tanza. Four nearby barangays in southwest Tanza are traversed by the Antero Soriano Highway, one the two main feeder routes for the BCIB.

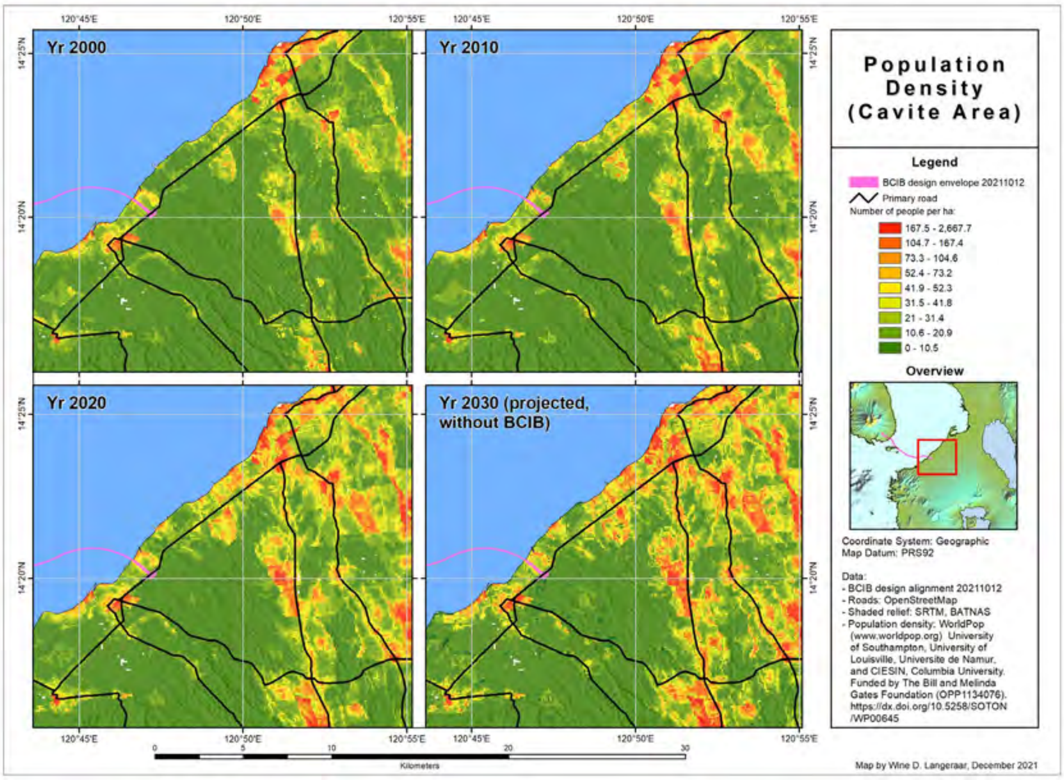


Exhibit 8-24 Population Distribution and Density in the BCIB Project Area

8.1.2.2 Livelihoods

Traditionally dominant sources of livelihood in Naic include agriculture (principally rice and vegetable cultivation), fishing and aquaculture, but the development of manufacturing and export processing capacity in municipalities to the northeast (e.g., Tanza, Rosario, Cavite City) and to a lesser extent within Naic itself has generated substantial new employment opportunities, even as agricultural land has increasingly transitioned to other uses (near the coast and transportation corridors) and Manila Bay-wide overfishing has led to the decline of fishing as a viable full-time livelihood. Growth in the coastal tourism sector (there are at least 15 resorts in various stages of development along the Naic beachfront) is also notable. With strong recent expansion of residential and commercial development, employment in construction and related service provision is also likely to be a common source of livelihood.

A perception survey was conducted in the Naic portion of the BCIB project area in 2022 as part of the preparation of the updated EIA, covering the two barangays that will host the

BCIB infrastructure directly (Timalan Balsahan and Timalan Concepcion), and several others traversed by the road corridors that will serve bridge traffic and construction traffic. In all, 300 people participated in the survey, 223 of whom indicated an occupation when asked. The survey found people engaged in 22 different occupations; the five most frequently indicated occupations are shown in Exhibit 8-7. A significant portion of survey participants (26% of male respondents; 24% of female) did not indicate an occupation other than 'none'.[288]

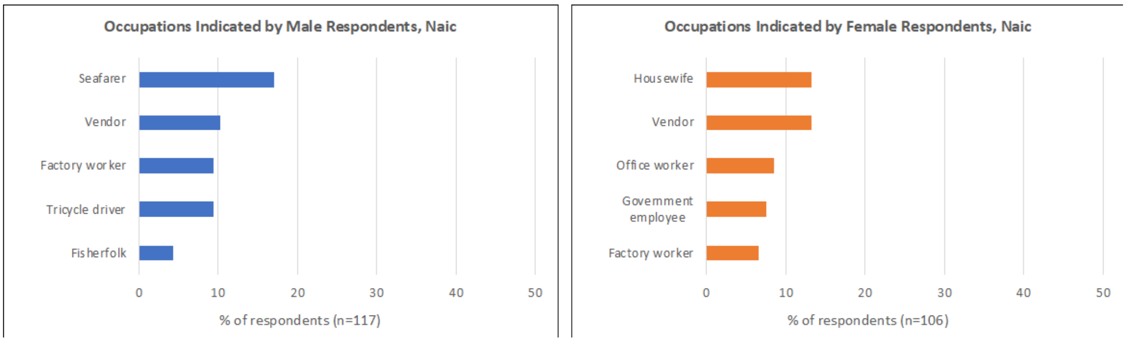


Exhibit 8-25 Top five Occupations Indicated by Perception Survey Respondents, Naic

The Naic Comprehensive Land Use Plan 2022–2032 notes that despite diversification of livelihoods, the local economy remains dependent on farming and fishing. Approximately 60% of Naic's land area was considered agricultural as of 2015.[289] in In 2019, 2,320 people in Naic derived income from farming of some kind.[290] The leading agricultural products grown in Naic are shown in Exhibit 8-26; rice is the dominant crop by area planted and number of farmers involved, followed by mango. Farming activity is increasingly constrained in the coastal and near-coastal parts of the municipality, due to conversion of land for residential, commercial and industrial uses, and this trend can be expected to continue; the lands in the BCIB project area are no longer zoned for agricultural use in the recently prepared Naic Comprehensive Land Use Plan 2022-2032.

Exhibit 8-26 Summary of Agricultural Production, Naic (2015)

Crop	Area planted (ha)	Production	Number of farmers
All crops	3,487	20,299 MT	-
Rice	3,046	14,582 MT	1,877
Vegetables	44	675 MT	339
Coconut	51	102,000 coconuts	33
Banana	2	16 MT	2
Mango	345	4,956 MT	35

Source: Province of Cavite. 2015. Cavite Social-Economic and Physical Profile (SEPP) 2015.

[288] The perception survey was not a formal census, and the data presented in Exhibit 8-25 are not statistically representative of the populations of these barangays; however, the data do offer some indication of the general character of the occupational landscape in the Naic portion of the project area.
[289] Province of Cavite. 2015. Cavite Social-Economic and Physical Profile (SEPP) 2015.
[290] Municipality of Naic, Comprehensive Land Use Plan 2022–2032.

The Naic Comprehensive Land Use Plan 2022–2023 indicates that in 2019, 41,395 persons derived income from coastal fishing; just 43 people earned income from aquaculture. It is very probable that many or most of those earning income from coastal fishing do not subsist entirely on this source of livelihood; around Manila Bay generally, it is very common for fisherfolk to have other jobs and run small enterprises to supplement increasingly meager and unreliable fishing income.[291] The numbers of registered fisherfolk in the nine coastal barangays of Naic, as reported by the Naic Municipal Agriculture Office for 2019, are shown in Exhibit 8-27. Just 412 people are registered as fisherfolk, 80% of whom are engaged in capture fishery.

Exhibit 8-27 Registered Fisherfolk in Naic, 2019

Barangay	Fish Capture	Aquaculture	Vendor	Total
Timalan Balsahan	34	27	-	61
Bagong Kalsada	60	-	1	61
Munting Mapino	55	-	15	70
Sabang	-	9	-	9
Labac	30	1	12	43
Mabolo	11	-	16	27
Bancaan	48	-	1	49
Bancaan Malaki	18	-	-	18
Timalan Concepcion	-	-	-	-
Bucana Sasahan	74	-	-	74
Total	330	37	45	412

Source: Municipal Agriculture Office (MAO), Naic, Cavite

The numbers provided by the MAO are known to be an under-representation, as no registered fisherfolk are listed for Timalan Concepcion, but during visits to the beach there (adjacent to the BCIB landing site) in 2020 and 2022, numerous fishing boats and other evidence of fishing activity were observed (see Exhibit 8-28).

Exhibit 8-28 Fishing Boats and Fishing Activity, Timalan Concepcion (April 2022)

The municipal fishing grounds of Naic are shown in Exhibit 8-29. In common with their counterparts from other municipalities, the Naic fisherfolk are known to fish well beyond the boundaries of the official municipal fishing grounds, and commonly travel to the waters

[291] See NEDA. 2020. Manila Bay Sustainable Development Master Plan – Final Master Plan, Action Plan and Investment Report. Annex 9: Rapid Resource Inventory (December 2020).

around Corregidor and Caballo Islands to fish. Based on field interviews in February 2020, fisherfolk in Timalan Balsahan and Timalan Concepcion use mainly bottom-set gillnets and drift gillnets. The catch consists mostly of Short Mackerel or *hasa hasa* (*Ratrilliger brachysoma*) and Largehead Hairtail or *espada* (*Trichiurus lepturus*); other species caught in lesser quantities include Crescent Grunter or *bagaong* (*Terapon jarbua*), Saddle Grunt or *bakoko* (*Pomadasys maculatus*), and Bluespot Mullet or *aligasin* (*Valamugil seheli*). Crab gillnets are also commonly used to target Blue Swimming Crab (*Portunus pelagicus*) and Crucifix Crab (*Charybdis feriata*). Fisherfolk involved in aquaculture are primarily engaged in oyster farming along the Timalan River estuary.

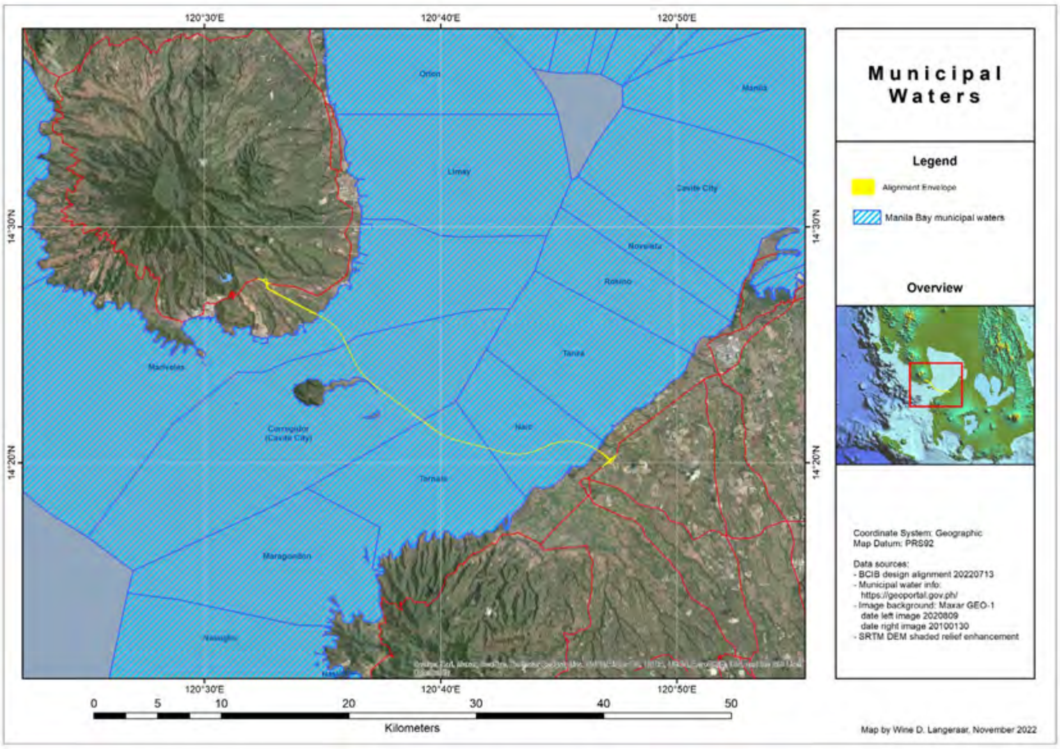


Exhibit 8-29 Municipal Fishing Grounds

There is no designated fish landing site in either Timalan Balsahan or Timalan Concepcion, so local catches intended for sale are unloaded at the landing site in nearby Munting Mapino. Other designated fish landing sites are at barangays Labac, Bucana Malaki and Bancaan. Fishing is carried on throughout the year in Naic, with peak seasons during the rainy months from June to August and during the summer months of March to May.

8.1.2.3 Education and Educational Facilities

Naic has both public and private educational institutions at the elementary, secondary, technical and vocational, and higher education levels. As of 2015, there were 40 elementary schools in the municipality, of which 22 were public and 18 private. The teacher-pupil ratio at the elementary level was 1:40, which is classified as 'manageable ratio' by the Department of Education. There were 4 public secondary schools and 12 private secondary schools in Naic as of 2015; the teacher-pupil ratio was 1:31.[292] More recent data indicates a worsening picture, with the elementary ratio increasing to 1:45 for 2018-2019 (well above the target

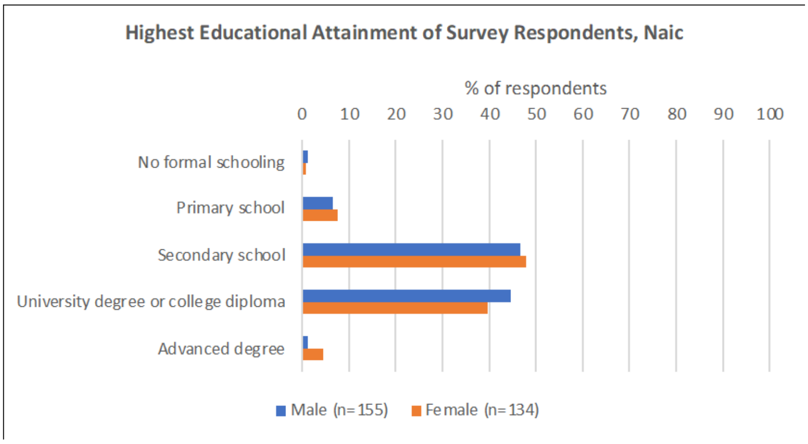
[292] Province of Cavite. 2015. Cavite Social-Economic and Physical Profile (SEPP) 2015.

maximum of 1:35) and the secondary school ratio at 1:40 (right at the target maximum).[293] The Naic Comprehensive Land Use Plan 2022–2032 notes that with the current strong trend to residential development in the municipality, a shortage of classrooms and teachers is becoming an urgent concern. Over the two-year period 2017/2018–2019/2020, enrollment in public elementary schools grew 13%, and 18% at public secondary schools; enrollment in private elementary schools grew 10% of the same period, and 12% at private secondary schools. It is estimated that 90 additional elementary teachers will be needed by 2030 as compared to 2022 levels, and an additional 50 secondary school teachers.[294]

Disparities in the gender of graduates have been recorded at both the elementary and secondary levels. In the 2014-2015 school year, 53% of elementary school graduates were male and 47% female; the imbalance was smaller at the secondary level, with graduates being 51% male and 49% female. It is notable that the number of secondary school graduates in 2015 (730) was just 36% of the number of elementary school graduates.[295] This significant gap can likely be attributed to a combination of factors, including students leaving the education system in order to work at a young age, and parents sending their elementary school graduates to high schools outside the municipality. The Naic Comprehensive Land Use Plan 2022–2032 asserts a 99% literacy rate among municipal residents 10 years old and older, but this is somewhat dubious, as literacy is assumed based only on a person's having attended at least one year of elementary education.

There were three institutions of higher education in Naic as of 2020, one public, and the other two private. These are the Cavite State University–Naic Campus (public) and Western Colleges, Inc. (two campuses in Naic) and Granby Colleges of Science and Technology.[296]

The perception survey conducted within the Naic portion of the BCIB project area in 2022 recorded the educational attainment of the 300 respondents. The survey results are suggestive of a more highly educated population than that of Bataan, with 45% of male survey respondents and 39% of female respondents reporting a university degree or college diploma as their highest level attained (see Exhibit 8-30, and compare to Exhibit 8-12).[297] Historical ease of access to institutions of higher learning is the most probable explanatory factor behind the difference suggested by the survey data.



[293] Municipality of Naic. Comprehensive Land Use Plan 2022–2032.
[294] Ibid.
[295] Province of Cavite. 2015. Cavite Social-Economic and Physical Profile (SEPP) 2015.
[296] Municipality of Naic. Comprehensive Land Use Plan 2022–2032.
[297] As has been noted previously, the project area perception survey was not constructed as a census, and no claim is made to strictly statistical representation of the local population.

Exhibit 8-30 Educational Attainment of Perception Survey Respondents, Naic Project Area

8.1.2.4 Health Services

As of 2019, Naic was served by three hospitals (one pubic and two private), as well as a Rural Health Unit (RHU) with two locations run by the LGU. The capacities of these facilities are shown in Exhibit 8-31.

Exhibit 8-31 Summary of Key Health Facility Capacities, Naic (2019)

Facility	Beds	Doctors	Nurses	Midwives	Sanitary Inspector	Others
Rural Health Unit Clinics (2)	-	4	7	15	3	16
Naic Medicare Hospital (public)	10	3	4	1	-	7
First Filipino Saint Hospital (private)	40	36	47	3	-	-
Naic Doctors Hospital (private)	30	15	31	2	-	-

Source: Municipality of Naic. Comprehensive Land Use Plan 2022–2032

The RHU offers a range of services including general family medicine, treatment of minor injuries, family planning, pre-natal and maternal care, and disbursement of prescriptions. The unit also runs a sanitation inspection and promotion program, as well as a permanent anti-tuberculosis campaign. There are also 17 private clinics across the municipality, offering services ranging from general family medicine to maternal care to rehabilitation to dental services. The Naic Comprehensive Land Use Plan 2022-2032 acknowledges that health services will come under increasing demand pressure as the municipality's rapid urbanization progresses and identifies expansion of services as a key priority.[298]

8.1.2.5 The Built Environment

Similar to Mariveles, most buildings in Naic are single-story and two-story, and buildings over three stories are uncommon. The predominant building material is masonry, although wood and corrugated tin construction can be observed in marginal urban and rural settings, particularly along waterways and in informal settlements. Data from the 2015 Census of Population and Housing indicate that the walls of 73% of occupied housing units in Mariveles were found to be made of 'concrete/brick/stone', with 11% being wood and a further 11% were 'half concrete/brick/stone and half wood'. About 88% of roofs on occupied dwelling units were 'galvanized iron/aluminum', while 7% were 'half galvanized iron and half concrete'. About 3% of roofs were some kind of thatch, such as nipa (a kind of palm that grows in mangrove areas) or cogon grass. By far the most common wall-roof combination in the municipality was 'concrete/brick/stone' walls with 'galvanized iron/aluminum' roofing. Institutional buildings, particularly multi-storied ones, such as schools, governmental offices and service centers, clinics and banks are almost universally constructed of concrete and masonry, although steel-framed buildings are predominant in emerging industrial areas.

[298] Ibid.

Exhibit 8-32 Typical Street Scenes in Naic Showing Built Environment

8.1.2.6 Transport Networks

Road network

The BCIB project area in Cavite is more integrated with regional road transport networks than is the project area in Bataan. The primary road links into and out of the area are the Antero Soriano Highway (a four-lane highway linking to the national expressway system at Kawit, just 22 km away from the proposed BCIB terminus) and Governor's Drive (another four-lane road giving access to the provincial capital Trece Martires, 13 km away). The center of Manila is just 43 km away, and the many urban and industrial centers that constitute the southern part of Metro Manila are within easy reach. Additional expressways are planned for this part of Cavite; the Cavite–Laguna Expressway (CALAX), which is already under construction, will pass about 10 km to the east of the BCIB project area, and an extension of the Cavite Expressway (E3 - CAVITEX) has been proposed to link up with the Antero Soriano Highway southwest of Rosario, just 7–8 km from the proposed BCIB terminus. Road distances and travel times from the project area to selected destinations are shown in Exhibit 8-33.

Exhibit 8-33 Road Travel Times to Selected Destinations from Barangay Timalan Balsahan, Naic

Destination	Distance (km)	Peak Period Travel Time (mins)	Off-Peak Period Travel Time (mins)
Trece Martires (Provincial Capital)	14	22	19
National Expressway System (E3 at Kawit)	19	40	23
Sangley Point Airport	24	54	31
Nino Aquino International Airport	33	59	35
Central Manila (City Hall)	41	88	52
Batangas City	111	145	128

Notes:
1 Distances calculated based on Google Maps directions function, fastest route
2 Peak period travel time estimates derived from Google Maps directions function, 8:00 am local time, Wednesday
3 Off-peak period travel time derived from Google Maps directions function, 2:00 am local time, Wednesday
4 Travel times are reflective of late-stage pandemic conditions (September 2022), and may understate travel times relative to pre-pandemic conditions

Airports

The nearest international airport to the BCIB project area is the Ninoy Aquino International Airport in Metro Manila, the country's main air gateway to the world. The former military air base at Sangley Point is currently being repurposed to serve domestic traffic but lacks a modern passenger terminal and does not yet provide a significant offering of commercial passenger service. A major expansion of this airport into an international passenger hub, which would require large-scale land reclamation, has been proposed.

Rail service

The BCIB project area is not served by any rail infrastructure. An extension of Line 1 of the Manila Light Rail Transit System is presently under construction, with planned future terminus at Bacoor, about 20 km northeast of the BCIB project area.

Sea routes

There are several minor local ports up and down the Cavite coast, but these handle local and fishing-related business only. A new cargo wharf and terminal, the Cavite Gateway Terminal, was opened in 2018, about 2 km northeast of the proposed BCIB landing point in Tanza. This facility features roll-on-roll-off docks, a container yard and reefer accommodations, and is intended to provide a direct sea access point for the growing export processing and manufacturing sectors of Cavite and Laguna, bypassing the congested Port of Manila. There is no regular passenger ferry service from the Naic shore, either to Bataan or Metro Manila; the nearest ferry (with service to the Manila waterfront) is at Cavite City.

8.1.2.7 Public Utilities

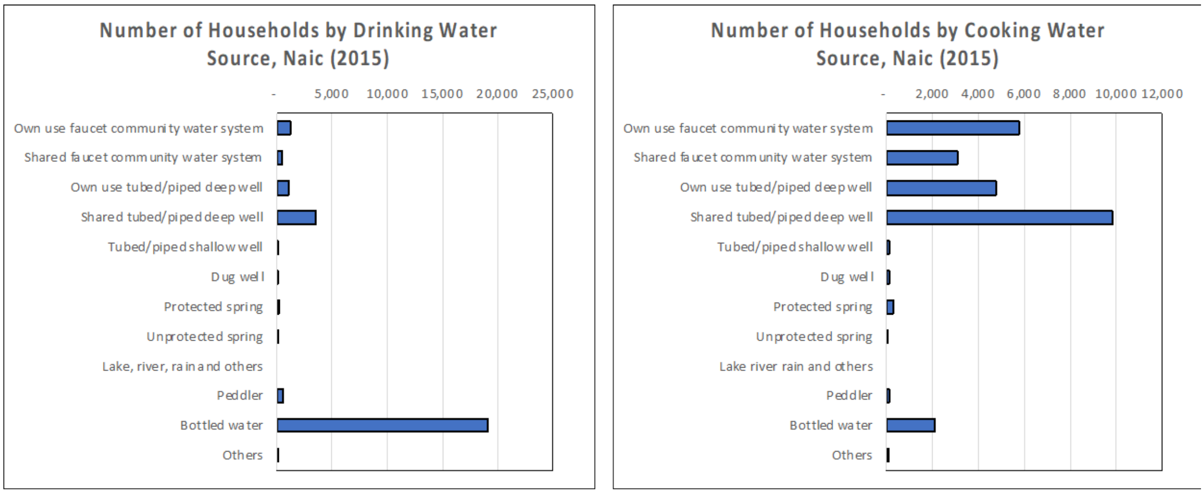
Water supply

Piped water is supplied to most of Naic town by the Naic Water Supply Corporation, a private water service provider; there is no public water utility. The main source of water for domestic purposes is groundwater, which the supplier obtains from a combination of deep well and artesian wells. Most households outside Naic town are served by public wells installed by the municipality and private wells, many serving multiple households. Most residential estates have their own water supply systems. The Naic CLUP recognizes that, with the expected growth of the municipality, water supply is poised to become a critical issue.[299]

Data from the 2015 Census of Population and Housing indicate that just over 6% of households used piped water from a private or communal faucet for drinking, while 73% relied on bottled water. Deep wells (private and communal) were the source of drinking water for 17% of households. Heavy reliance on bottled water suggests that residents have reason not to trust the quality of local water supplies.

With respect to water used for cooking, 34% of households relied on municipal piped water for that purpose, and 56% drew cooking water from private or communal deep wells. About 8% of households in Naic used bottled water for both drinking and cooking. As with households in Mariveles, the differences between water sourcing for drinking and cooking suggests that bacteriological contamination may be the main concern for residents, in the case of both municipal piped water and water from deep wells.

[299] Muncipality of Naic. Compehensive Land Use Plan 2022–2032.



Source: Philippines Statistics Authority (2015 Census of Population and Housing)

Exhibit 8-34 Domestic Water Sources, Naic (2015)

Sanitation

There is no centralized wastewater treatment system in Naic, and no sewerage aside from rudimentary local storm sewers along roadways. On-site septic systems (single-household and multi-household) are the principal method of domestic wastewater disposal (see Exhibit 8-35). Barangays Timalan Balsahan an Timalan Concepcion have significantly higher incidence of septic system use than the municipality as a whole. Only a small percentage of household wastewater is reported to be discharged directly to land and surface waters, although it is likely that septic system seepage and overflow to water bodies is quite substantial.

Exhibit 8-35 Means of Domestic Wastewater Treatment, Naic (2019)

Destination	Percent of Households					
	Septic System	Other Sealed Depository	Closed Pit	Open Pit	Pail System	Direct to Environment
Naic	88.3	9.9	0.1	0.1	1.0	0.6
Timalan Balsahan	98.6	1.1	0.0	0.0	0.1	0.1
Timalan Concepcion	94.6	3.9	0.0	0.0	0.0	0.5

Source: Naic CLUV 2022–2032

Electricity

Power is supplied to residences and other entities in Naic by the National Power Corporation through the Manila Electric Company (MERALCO). The capacity of the sub-station supplying the municipality is 8 MVA, with 5 MVA (63%) load; this supply is considered to be sufficient for Naic at present, but it is anticipated that increased supply will need to be arranged to accommodate expected industrial, commercial and residential development in the medium term. Some areas (coastal and upland areas) do not yet have supply lines, but coverage has expanded considerably in recent years; the number of connections grew from 27,732 to 38,936 over the 2017–2019 period.[300]

[300] Muncipality of Naic. Compehensive Land Use Plan 2022–2032.

Solid Waste Management

Solid waste generated in Naic is collected by the municipality and processed locally in two municipal facilities: a Material Recovery Facility (sorting and recycling) and a Residual Containment Area (removal of biodegradables and other recoverable residuals). Residual waste after removal of recyclables and recoverables is trucked by a private hauler to a sanitary landfill in Taysan, Batangas. In 2019, average daily solid waste production for the whole municipality was just over 30,000 kg, of which 81% was from residential sources, 18% from commercial and industrial, and just 1% from institutional facilities.[301] A new sanitary landfill is presently under development by a private sector firm in neighboring Maragondon, and this facility will become the destination for all of Naic's municipal solid waste residuals upon opening (expected within 2022).[302]

8.1.2.8 Public Safety

Road safety data applicable to the BCIB project area are not available from the Cavite 1st District Engineering Office, which does generally collect such data, but suffered a data loss during a recent office migration.[303] Road accident statistics provided in the Naic CLUP (derived from police records) suggest a very low incidence of reported accidents, with just nine accidents reported in 2017, five in 2018, and 11 in 2019.[304] Of course, it is likely that the actual number of accidents is somewhat higher than those that are recorded by police.

Official statistics notwithstanding, some road safety concerns are evident in the project area, most notably along the Antero Soriano Highway and Governor's Drive. These roads have been widened from two lanes to four, but in many places, ROW expansion, tree removal and re-location of utility poles have not been done to fully clear the new lanes of obstructions (see Exhibit 8-36). This situation creates many choke points where accidents are more likely occur and decreases road capacity. Shops and other structures extend right to the edge of the pavement in many places, there are no parking lanes, sidewalks are far from universal. The risk of accidents is accordingly elevated by the frequent use of the outside lanes by pedestrians and for parking. Road safety signage is found only in the most built-up areas, and while numerous crosswalks can be seen, many of them do not line up with actual pedestrian routes and are lightly used. There are currently no plans to widen either the Antero Soriano Highway or Governor's Drive; removal of trees and utility poles is a standing objective, being pursued by the Cavite 1st District Engineering Office in cooperation with the relevant LGUs and utility companies.[305]

[301] Muncipality of Naic. Compehensive Land Use Plan 2022–2032.
[302] As discussed in a meeting with personnel of Naic Municipal Environment and Natural Resources (MENRO), 29 March 2022.
[303] As discussed in a meeting with personnel of the 1st District DEO in Tagaytay, 30 March 2022
[304] Muncipality of Naic. Compehensive Land Use Plan 2022–2032.
[305] As indicated by personnel of the DEO in a meeting on 30 March 2022 at DEO headquarters in Tagaytay.

Exhibit 8-36 Obstructions on Local Highways (Antero Soriano Highway and Governor's Drive)

8.2 Anticipated Impacts and Prescribed Mitigation

8.2.1 Preconstruction Impacts and Mitigation

Pre-construction impacts are those impacts which, although they may be manifest during construction or operation, actually originate during planning, design and procurement, and can therefore be mitigated at least partially through decisions taken as part of these pre-construction activities. In many cases it makes sense to re-visit these impacts in relation to the construction and/or operation phase, as a residual component of impact may remain to be addressed closer to the time of impact occurrence.

8.2.1.1 Community Change

Anticipated Impact. New road infrastructure inevitably leads to or contributes to change in the places it serves or passes through. In the case of the establishment of a novel regional road transport linkage where no link of any kind has existed previously, as will be case with the BCIB, notable change can be expected. The approach roads themselves are unlikely to represent a significant alteration of the character of their host communities or social interaction within them as a matter of direct physical imposition, as underpasses and the roadway designs have provided underpasses and slip roads to accommodate all pre-existing roads. The principal effect of the BCIB on community life in both Mariveles and Naic will be its contribution to the broader process of urbanization already underway. The urbanization process is considered a broadly positive one by both municipalities, as reflected in their current CLUPs (see discussion in Chapter 5), and the introduction of the BCIB infrastructure, which can be understood as a cumulative impact, does not stand out as a particularly incongruous or otherwise negative element of the overall urbanization trajectory welcomed by the two municipalities.

Prescribed Mitigation. No mitigation is prescribed.

IMPACT SUMMARY					
Impact:	Community change from introduction of major new infrastructure				
Direction:	Positive	Type:	Indirect/cumulative	Probability:	High
Duration:	Permanent	Scope:	Widespread	Significance:	Low
Mitigation:	• None prescribed				
Residual:	Not applicable				

8.2.1.2 Impacts on Livelihoods

Impacts on land-based livelihoods

Anticipated Impacts. The development of the BCIB project has as one of its principal objectives the enablement of increased economic activity, and it can be considered likely that many people in Bataan and Cavite will experience positive economic benefits, whether from increased employment and business opportunities, or from other factors such as improved transportation options and decreased traffic congestion. Development of the BCIB is expected to give a boost to business activity and employment in Mariveles in particular, as the addition of a cross-bay road link increases the attractiveness of southern Bataan as a business location, but an economic multiplier effect can be expected in both Bataan and Cavite. Many existing local enterprises near the two BCIB termini will no doubt benefit from increased transit of potential customers through the area, and the presence of the high-profile and visually interesting infrastructure may incentivize development of restaurants, hotels and residential real estate in locations with good views of it.

Although less significant than the indirect livelihood potential, the BCIB project may also provide direct employment opportunities to local people (jobs in administration, infrastructure and ROW maintenance, emergency response, equipment maintenance and groundskeeping at the BMMC), and opportunities for local enterprises to secure contracts for maintenance and repair works.

A small number of landowners whose properties fall within the ROW will experience loss of livelihood as derived from existing uses, or may suffer long-term livelihood impairment associated with relocation, but such losses should be fully compensated under the Land Acquisition and Resettlement Plan (LARP).

Data from the Perception Survey suggest that local residents expect that the BCIB project will benefit them and their communities to a greater extent than it will harm them (see Exhibit 8-37). This is the case especially for Mariveles, where solid majorities of respondents expected both personal and community benefits from the project. Respondents in Naic were less optimistic, with positive expectations only marginally higher than negative ones. This difference between the two locations is not surprising, as the development of Bataan and alleviation of pressures on Metro Manila figure more prominently in the rationale for the BCIB project than does the improvement of conditions in Cavite. Male and female response patterns differ notably; in Mariveles, male respondents were more optimistic about benefits and female respondents were less pessimistic about possible negative effects, while in Cavite, female respondents were both more optimistic and more pessimistic than male respondents. Female respondents were more likely to expect negative effects for themselves and their communities than male respondents, with roughly one-third anticipating negative effects. Data from open-ended follow-ups do not yield any useful insights as to what may lie beneath these patterns.

Exhibit 8-37 Expected Impacts as Indicated in Perception Survey, Mariveles and Naic (2022)

Survey Response	Male	Female	All
MARIVELES	(n=152)	(n=198)	n=350
Expect to benefit personally from BCIB project	58%	50%	53%
Expect community to benefit from BCIB	72%	64%	68%
Expect to personally experience negative effect from BCIB	9%	3%	5%

Survey Response	Male	Female	All
Expect community to experience negative effect from project	20%	15%	17%
NAIC	(n=160)	(n=140)	(n=300)
Expect to benefit personally from BCIB project	25%	30%	28%
Expect community to benefit from BCIB	29%	38%	32%
Expect to personally experience negative effect from BCIB	8%	29%	18%
Expect community to experience negative effect from project	14%	37%	25%

Amongst the reasons given by respondents for expecting positive personal and community effects, transportation-related benefits were most often cited by a wide margin, in both Mariveles and Naic. Reasons related to disruption of livelihood were most often cited by respondents in both Mariveles and Naic as an expected source of negative personal and community effects, but it is not clear from the survey data which types of livelihoods were perceived to be at risk. It bears mention that response rates on follow-up survey questions asking for specific reasons for expecting positive or negative effects were much lower than for questions calling for a yes/no answer or rating using a scale.

Prescribed Mitigation. Based on the discussion above, no mitigation is prescribed for inclusion in the EMP; impacts on livelihoods associated with displacement are addressed in the LARP.

Prescribed Enhancement. Direct local employment by the project and participation of local enterprises in maintenance and repair works can be enhanced through deliberate action by DPWH, including (1) prioritizing local residents in hiring of personnel for operations maintenance work performed in-house; (2) requiring contractors engaged for major repair and maintenance works to hire local labor in proportions at least meeting the minimum local labor requirements for construction projects as per RA6685; and (3) organize informational events to announce tenders to local contractors, to encourage local bids on maintenance and repair contracts. These items are prescribed as part of the project's Social Development Plan (SDP), which is embedded in the EMP.

IMPACT SUMMARY					
Impact:	Impacts on land-based livelihoods				
Direction:	Positive	Type:	Direct/Indirect	Probability:	Certain
Duration:	Long-term	Scope:	Localized/Widespread	Significance:	Low–Moderate
Enhancement:	• Prioritize hiring of local people for jobs in infrastructure and ROW maintenance, administration, emergency response crews, security, equipment maintenance and groundskeeping at the BMMC, under auspices of SDP • Require contractors engaged for major repair and replacement works to hire local labor in proportions at least meeting the minimum local labor requirement for construction projects as per RA 6685, under auspices of SDP • Organize informational events to announce tenders to local contractors, to encourage local bids on maintenance and repair and replacement contracts, under auspices of SDP				
Residual:	No significant negative residual expected				

Impacts on fisherfolk livelihoods

Anticipated Impacts. The development of a 26-km link across Manila Bay will inevitably affect fisheries resources. The entire marine portion of the project area is an active fishing zone, used by local fisherfolk operating in motorized outrigger canoes ranging in length from about 4–8 m. The BCIB bridges and viaducts, once completed, will not pose any difficulty with respect to movement of such craft. Most impacts on fisherfolk livelihoods will be generated during the construction phase and will be discussed in the appropriate section later on.

The main potential impact that relates to the BCIB project's development is the loss of fisheries productivity due to the direct loss of benthic habitat that lies within the footprint of the bridge on the seafloor. However, as has been discussed already in relation to the ecological dimension of this displacement (see Chapter 6), there is reason to expect that the addition of new hard substrate in the form of pilings will enhance structural diversity and attract significant aggregations of marine life. The net effect on fish biomass, including of species targeted by local fisherfolk, is likely to be neutral at worst, and moderately positive. To the extent that the presence of the BCIB viaducts frustrates the use of harmful active trawling gear by larger non-local boats, this may also result in a modest benefit to the local fisherfolk who rely on marine resources within the project area.

A second protective effect relates to a broader contextual issue, which is that much of the seafloor of Manila Bay is subject to potential seabed mining concessions, which if developed as extractive operations, will incur widespread degradation of benthic habitat and fisheries resources. A permanent 1-km mining-exclusive buffer has been adopted for each side of the BCIB alignment to prevent any possible hydrodynamic and operational safety risks to the infrastructure from operation of seabed mines, and this may be seen as offering some protective effect for marine resources within that buffer zone.

Prescribed Mitigation. In view of the conclusion that the net impact on fisheries resources and local fisherfolk livelihoods from benthic habitat displacement is likely to be at least neutral and possibly even a net positive, no mitigation is prescribed for this potential impact. Fisherfolk livelihood impacts from construction activity will be discussed in a later section.

Prescribed Enhancement. It may be feasible to further enhance the expected positive effect of the BCIB infrastructure for fish biomass and local fisherfolk livelihood by establishing a fish sanctuary along the entire length of the alignment, the presence of which should, in theory, enhance the availability of target species available for capture in nearby waters. DPWH should pursue an agreement with the four municipalities whose waters the BCIB alignment will cross (Mariveles, Cavite City, Ternate and Naic) and the Philippine Coast Guard to publicly declare the bridge alignment as a fish sanctuary and set up a support partnership to ensure long-term surveillance and enforcement by municipal *bantay dagats* (local volunteer fishery law enforcement bodies), using the BCIB infrastructure itself as a platform for surveillance. Although this would only be implemented during the operation phase (assuming the municipalities are agreeable), discussions and development of concepts, agreements and support partnerships should be undertaken beginning in the pre-construction phase. This is prescribed under the project SDP.

In order for the protective effect of the bridge in relation to seabed mining operations mentioned above to be realized, it will be necessary for DPWH to take action to ensure that the no-dredge buffer is actively enforced ; this is addressed later on, in relation to operation-phase mitigation.

IMPACT SUMMARY					
Impact:	Impacts on fisherfolk livelihoods				
Direction:	Positive	Type:	Indirect	Probability:	Medium
Duration:	Long-term	Scope:	Widespread	Significance:	Low
Enhancement:	• DPWH-PMT to pursue discussions, agreements and support partnerships towards establishment of a contiguous series of municipal fish sanctuaries along the full length of the BCIB alignment, beginning with a consultation meeting with the four affected municipalities and Philippine Coast Guard during the pre-construction phase, under the auspices of the SDP				
Residual:	Not applicable				

Loss and Degradation of Ecosystem Services

Anticipated Impact. People derive multiple benefits, or services, from the ecosystems around them, including (1) provisions (e.g., food, drinking water, wood); (2) safety and stability provided by natural regulating processes (e.g., carbon storage and sequestration, buffers against natural hazards); (3) cultural values such as may be attached to natural sites and objects (e.g., sacred sites and significant trees, contemplative places and recreational spaces); and (4) natural processes that sustain primary industries including agriculture, forestry and fishing (e.g., biogeochemical cycling, soil formation, river flows and ocean currents, and primary production). Infrastructure development often entails some losses or degradation of ecosystem services, and these are amongst the tradeoffs against desired project outcomes. Valuation (quantified or qualitatively appreciated) of specific ecosystem services helps to sharpen understanding of project tradeoffs, and may also inform prioritization and enhancement of mitigation.

Various risks to ecosystem services from the BCIB project have been identified in the preceding chapters. Prominent among these are direct loss and induced conversion of farmland, direct loss of terrestrial and marine habitat, increased extraction pressure and land conversion risk to biodiversity resources in the Mariveles Mountains KBA, degradation of fisheries resources near the alignment, and threats to local populations of marine mammals and marine turtles. Mitigation (including compensatory measures) has been prescribed to address those impacts, but it is likely that mitigation strategies can be further developed through valuation of affected ecosystem services. Presently available information is insufficient to support valuation.

Prescribed Mitigation. Further study should be carried out in the early pre-construction phase—as soon as possible following project approval—to develop a further understanding of the valuation of ecosystem services and inform possible enhancement and leverage of proposed mitigation, including compensatory measures. Two ecosystem services studies (one focused on marine ecosystem services and one on terrestrial) are recommended. Each study shall assess the valuation of affected services, quantifying wherever possible, following methodological guidance of IFC and/or World Resources Institute, and shall encompass consideration of (1) provisioning services; (2) regulating services; (3) cultural services; and (4) supporting services. Valuation shall be informed by stakeholder consultations, and collection of further baseline information as necessary. Development of findings shall be oriented to supporting possible enhancement or other modification of proposed mitigation, or specification of new measures if appropriate. Conduct of the ecosystem services studies, as well as such updating of mitigation approaches and measures to reflect findings as needed, will be the responsibility of the CSC, and should be arranged as soon as the CSC is engaged.

IMPACT SUMMARY					
Impact:	Loss and degradation of ecosystem services				
Direction:	Negative	Type:	Direct/Indirect	Probability:	High
Duration:	Long-term	Scope:	Localized/widespread	Significance:	High
Mitigation:	• CSC to conduct ecosystem services valuation studies pertaining to the marine and terrestrial environments, and propose enhancement of mitigation strategies as appropriate prior to the start of works.				
Residual:	Expected, to be weighed against anticipated project benefits				

8.2.1.3 Public Safety Impacts

Impacts on road safety

Anticipated Impacts. The BCIB project is expected to increase traffic on the existing roads that will connect to it, principally the Roman Highway in Bataan, and the Antero Soriano Highway in Cavite. The projected increases vary by road segment but are significant in all cases. Exhibit 8-38 shows traffic projections for the morning peak hour in 2025 and 2035, which can be taken as roughly indicative of projected conditions shortly after start of operations and the tenth year of operations, respectively. The table shows both the projected percentage increase in traffic volume on the receiving roads, and the expected effect on level of service (LOS). LOS is a qualitative measure of the speed, convenience, comfort and security of transportation facilities and services as experienced by road users. Full roadway capacity is reached when LOS equals 1.00. A measure of less than 1.00 indicates traffic is likely to move freely at the roadway's design speed, whereas LOS greater than 1.00 indicates potential congestion and travel speeds slower than for what the roadway was designed. The letter component of LOS (A, B, C, D or F) is an assigned grade indicating the degree of congestion, where F indicates saturated conditions.

The data in Exhibit 8-38 suggest that traffic on existing roads will increase sharply when the BCIB opens and continue to grow over the first decade of operation. Significantly, LOS for all segments except the Roman Highway southbound is expected to deteriorate to an F rating under the 'with project' scenario, at least for the morning peak hour. This is suggestive of increased potential for accidents on receiving roads, but this is not possible to quantify, as the baseline accident rate is poorly understood (refer to Section 8.1.1.9 above).

Exhibit 8-38 Projected Peak Hour Traffic and Level of Service, 2030 and 2050

Roadway Facility	Volumes of Vehicles without Project (PCU)	Volumes of Vehicles with Project (PCU)	Percent Change	Total Lane Capacity (PCU/HR)	Projected volume/ capacity without/ with project		Projected Level of service without/ with Project
	2030						
Roman Highway (eastbound)	1441	1996	39%	2000	0.36	0.50	B / B
Roman Highway	1368	1895	39%	2000	0.34	0.47	B / B

(westbound)							
Antero Soriano Highway (eastbound)	3041	3496	15%	2000	0.76	0.87	D / E
Antero Soriano Highway (westbound)	3102	3567	15%	2000	0.78	0.89	D / E
BCIB (Eastbound)		1,560		2000		0.39	B
BCIB (Westbound)		1,690		2000		0.42	B
	2050						
Roman Highway (eastbound)	2613	3,593	38%	2000	0.65	0.90	C / E
Roman Highway (westbound)	2481	3,411	37%	2000	0.62	0.85	C / D
Antero Soriano Highway (eastbound)	4,676	5,445	16%	2000	1.17	1.36	F / F
Antero Soriano Highway (westbound)	4,771	5,555	16%	2000	1.19	1.39	F / F
BCIB (Eastbound)		2,318		2000		0.58	C
BCIB (Westbound)		2,440		2000		0.61	C
Note: PCU = Passenger Car Unit; LOS = Level of Service Source: DCCD, March 28, 2023.							

The LOS projections shown in Exhibit 8-38 assume that both the Roman Highway and Antero Soriano Highway are four-lane roads; although this is nominally true of both roads, in practice neither yet has four fully functional lanes, as has been discussed above. The Roman Highway is currently undergoing an upgrading project, involving widening to six lanes and addition of sidewalks; this is proceeding gradually as funds allow, and it is to be expected that these works will have been mostly completed by the time the BCIB opens to traffic. The Bataan 2nd District Engineering Office is reportedly exploring options for the EPZA Bypass Road, which is recognized as a constraint on operation and growth of the FAB in addition to being a safety concern, but no formal proposal has been put forward and it is unclear whether any remedy will be in place before the BCIB begins sending significantly increased traffic westward to Mariveles town. This is the principal safety concern on the Bataan side.

On the Cavite side, initiatives to remove obstructions from the Antero Soriano Highway and twin the present two-lane bridge over the Timalan River are ongoing, and it is reasonable to expect that these will be completed by the time the BCIB link opens. No further investments are yet planned to increase capacity or augment safety provisions on the Antero Soriano Highway, and in the absence of such investments, it can be expected that the capacity issues projected in Exhibit 8-38 (which are based on the four-lane assumption) will come to bear, and that public safety risks will elevate as a result. Other highway projects, including a direct link from the BCIB interchange to the CALAX and a Cavite coastal road have been floated, and would likely alter the traffic volume assumptions for the Antero Soriano Highway if implemented.

Prescribed Mitigation. Proactive planning and project development will be required on the part of DPWH to ensure that public safety risks on the roads that will handle BCIB traffic do not become worse after the project is completed. On the Bataan side, a solution to the existing concerns with circulation between the BCIB and Lower Mariveles (Mariveles town, port, and FAB) will have to be devised and implemented, preferably before the BCIB opens. On the Cavite side, the feasibility of investments in capacity and safety features on the Antero Soriano Highway should be considered in the context of other initiatives, including new road corridors, and projects developed as appropriate. Implementation of these recommendations is beyond the scope of the BCIB project, but first steps can nevertheless be initiated through the project's EMP. Accordingly, it is recommended here that the DPWH project management team (DPWH-PMT), on behalf of the UPMO RMC II, formally convene two multi-stakeholder master planning workshops (one for Mariveles and one for Naic) to assess the local road capacity and safety context and scope solutions as the basis for possible project development. The workshops shall be convened within the pre-construction phase, and shall include, at a minimum, representatives of the UPMO RMC II, DPWH Planning Service, the relevant District Engineering Office, host municipalities, and provincial transportation agencies. The Mariveles workshop should include the AFAB as well.

IMPACT SUMMARY					
Impact:	Elevated public safety risks as a result of BCIB-driven increases in traffic volume				
Direction:	Negative	Type:	Indirect	Probability:	High
Duration:	Long-term	Scope:	Widespread	Significance:	Moderate
Mitigation:	• DPWH-UPMO RMC II to convene multi-stakeholder master planning workshop to scope solutions to BCIB–Lower Mariveles road transport improvement options • DPWH-UPMO RMC II to convene multi-stakeholder master planning workshop to scope solutions to expected long-term road safety concerns on the Antero Soriano Highway				
Residual:	Expected, but difficult to predict due to dependence on multiple factors beyond the project scope				

Impacts on marine safety

Anticipated Impacts. Addition of bridge infrastructure to a formerly unobstructed sea area may sometimes bring elevated risk of marine accidents, due to creation of constriction points that concentrate vessel movement, or increased incidence of vessels getting into danger in rough weather due to an inability to move freely through the zone. In the case of the BCIB, these concerns have been minimized by design. The alignment, including the locations and orientation of the two cable-stayed bridges was designed to avoid the need for changes to the existing navigation channels, which means that there will effectively be no change to marine traffic patterns as a result of the project's development; large vessels will continue to move in and out of Manila Bay via the same marked channels just as they do now, only they will pass beneath bridges as they do so. With regards to small vessels such as local fishing boats, the design of the marine aqueducts also imposes no restriction on movement, including movement to seek shelter in rough weather, as adequate overhead clearance has been provided to permit passage of small and mid-sized vessels, and the 60–100 m spacing of the support piers offers no barrier to movement. Small vessels will be able to cross the alignment at will, without any need to join the large vessel traffic in the navigation lanes.

Prescribed Mitigation. As safety concerns have been effectively addressed at the design stage, no further mitigation is indicated.

IMPACT SUMMARY					
Impact:	Impacts on marine safety				
Direction:	Negative	Type:	Direct/Indirect	Probability:	High
Duration:	Permanent	Scope:	Localized	Significance:	Low
Mitigation:	• None prescribed				
Residual:	Expected, but of minor significance				

8.2.1.4 Visual Impacts

Impacts on static viewsheds

Anticipated Impact. Although no impact is anticipated directly on visual resources themselves, the BCIB project does have some potential to affect people's views of the landscape from fixed locations external to the infrastructure (static viewsheds). The BCIB project's on-land components will be relatively low-profile, and will have limited effect on people's ability to appreciate significant visual resources. The over-water components of the infrastructure will have greater potential to affect static viewsheds, in both positive and negative ways. The potential visual impacts of the BCIB project are analyzed in some detail in the Visual Impact Assessment Report, which can be found in the EIA report Annexes; locations where potential for adverse visual impacts is expected are discussed briefly below.

From some vantage points on the shore in Mariveles, the marine viaduct and North Channel bridge will influence the view to Corregidor Island; potential for adverse effects will be significantly mitigated by distance, and counterbalanced by many viewers' appreciation for the structures themselves. For viewers positioned upslope in the vicinity of Alas Asin village, the bridge and viaduct will not block the view of the North Channel and Corregidor Island and may in fact be expected to provide a complementary landscape element, thus enhancing appreciation of these visual resources. The visual impact in Mariveles is thus a mixed picture, which is on balance likely to be mildly beneficial.

For viewers positioned on Corregidor Island, the two high cable-stayed bridges will be new and prominent additions to the landscape. Analysis of static viewsheds from various tourist-accessible vantage points on the island suggests that the visual effect is likely to be limited, as there are few eastward-looking sites, and much of the Corregidor Tail End portion of the island, which is closest to the planned BCIB infrastructure, is off-limits to tourists. A number of tourist viewpoints will have mid-range and long-range views of parts of the viaduct and one or both bridges. The site with greatest potential for negative visual impact is the Mindanao Memorial overlooking San Jose Bay, the long-rugged tip of the island known as Hooker's Point, and Caballo Island. Viewers at this site will have an end-on view of the South Channel Bridge, and also a short-range view over the viaduct where it closely parallels Hooker's Point. The view to Hooker's Point presently has a strong 'wild nature' aesthetic (see Exhibit 8-39), and the viaduct is likely to be perceived by some as an incongruous element. Most other sites on the island will have either quite oblique or quite distant views of the infrastructure, which limits the potential for visual impact.

Exhibit 8-39 Present View from Mindanao Memorial, Corregidor Island

The site with greatest bridge viewing potential is the viewpoint nearby the Pacific War Memorial, at the top of the main part of the island. From here, the viewer will be able to take in a wide panorama from Mt. Mariveles at left to Caballo Island and the Cavite shore at right, and will be in a position to see nearly the entire over-water portion of the project, including both bridges and much of the marine viaduct (see Exhibit 8-40). This sweeping view should give the viewer a coherent, comprehensive visual understanding of the project. The aesthetic guidelines applied to BCIB design are intended to impress those who have the opportunity to see it from such vantage points.

Exhibit 8-40 Easterly View (Composite Panorama) from Pacific War Memorial, Corregidor Island

From the Naic shore, the two tall cable-stayed bridges will be distant features, and of low visual consequence, but the nearshore sections of the marine viaduct have potential to affect viewers' appreciation of some key landscape features. The project alignment does not extend straight out from the shore in Naic, but curves in a nearshore arc towards the west, placing it directly in the viewshed of people using the beachfront, a group that includes visitors to any of the 10–15 beach resorts that line the shore (see Exhibit 8-41). The visual impact will be mitigated by distance, as most built-up areas along the beachfront are at least 2 km from the alignment.

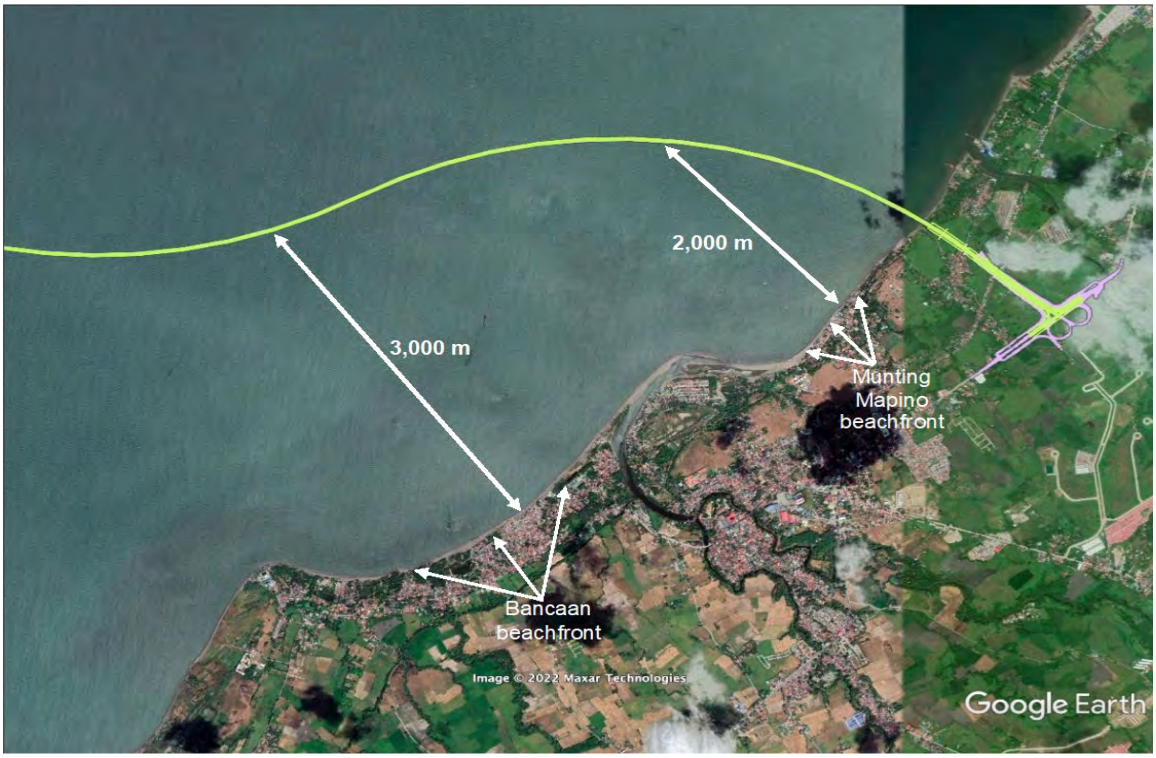


Exhibit 8-41 BCIB Alignment Near Naic Beachfronts

The viaduct will not impede views of Mt. Mariveles across the bay but will impinge on sight lines to Corregidor and Caballo Islands, which lie lower on the horizon. The presence of the viaduct across the field of view may also be expected to change the beach-positioned viewer's perception of the horizon, although not dramatically. Design specifications for roadway lighting indicate that luminaries will be shielded and given appropriate directionality to limit lateral light emissions, and this should minimize the viaduct from appearing as a string of lights on the horizon after dark, or generating glare. The viaduct will not have undercarriage lighting, and this will also render the viaduct inconspicuous at night. Overall, the visual impact of the project for viewers on the Naic shore is expected to be modest.

People living inland near the BCIB alignment will experience views of the embankment, which will be approximately two stories high, and will run perpendicular to existing local roadways. Most of the embankment will be sloped and vegetated, but one section approximately 300 m long will be of mechanically stabilized earth (MSE) construction and will appear to the viewer as a wall. The embankment may only be visible from within 100–200 m, since the roadways are narrow and tree-lined, but its height will be nearly double the height of many homes and other structures in the vicinity, and its presence may give the viewer the feeling of a barrier or division of the community. Viewers of the embankment will consist of residents, small business owners, and tourists traveling to and from the shoreline. The following measures have been incorporated in the embankment design to minimize the visual impact:

1. All hardscapes (MSE retaining walls, sound walls, and fences along the right of way) will include patterns, colors and/or motifs that are congruent with the culture and heritage of the fishing and tourist community of Cavite and incorporate surfaces unfavorable for graffiti. Fencing should be durable and include full screening and thorny plantings to deter entry by graffiti artists.

2. Soil embankments will be vegetated to include native shrub species, compatible with maintenance and safety considerations. Where such plantings are not acceptable for drainage or maintenance reasons, columnar trees shall line the base of the embankment to the exterior of the drainage ditches to reduce the visual dominance of the embankment slope. Tall columnar and drought-resistant trees shall be identified that can also mitigate residual lateral light leakage from the roadway. Native species selected shall not be ones know to have aggressive root systems, and careful planting details will restrict roots from intruding on adjacent property.

3. The facades of the underpasses will be designed to connote a gateway, with night lighting and features to allow easy passage by pedestrians and cyclists in addition to vehicles, to reduce the sense of the BCIB embankment as a community barrier.

Prescribed Mitigation. The measures identified above, already incorporated in designs or specifications, are considered adequate to address expected impacts on static viewsheds. No further design-driven mitigation is prescribed.

IMPACT SUMMARY					
Impact:	Visual impacts on static viewsheds				
Direction:	Negative/Positive	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Localized/Widespread	Significance:	Low
Mitigation:	• None recommended beyond measures already specified for project design				
Residual:	No significant residual is anticipated				

Impacts on dynamic viewsheds

Anticipated Impact. Two types of dynamic viewsheds are affected by the BCIB project: those experienced by motorists using the new infrastructure, and those experienced by people passing through the project area on a vessel, such as ferry passengers, fisherfolk, pleasure craft operators, and merchant marine crews.

The dynamic viewshed of BCIB motorists will be entirely new, so there is no potential for impact (positive or negative) on an existing viewshed. The opportunity to drive across the along the BCIB will be a novel one for all and will open up visual resources not presently accessible to any motorist. It is reasonable to expect that the dynamic viewsheds made possible by the BCIB will be subject to enthusiastic approval from the traveling public, and the visual impact can therefore be considered strongly beneficial.

With respect to the dynamic viewsheds of people who will experience the project area from the water as they move through one of the formal navigation channels or through the coastal zones of Mariveles and Naic, the introduction of the BCIB to the landscape will inevitably have some effect. The nature of the effect will be different for different viewers. Those who presently appreciate views of Corregidor and Caballo Island from the east will find that the bridges and viaducts partially obstruct those views. In particular, the viaduct sections between the NCB and SCB will partly block sight lines from all eastward locations to the rugged Hooker's Point (see Exhibit 8-42). This feature is quite attractive, particularly from the North Channel, and construction of the BCIB will prevent viewers from appreciating the shifting perspective on it that is presently available from the deck of a tourist ferry from Manila, for example. On the other hand, approaching and passing beneath the North Channel Bridge and South Channel Bridge is likely to be a visually stimulating experience for anyone on the deck of a vessel, particularly at night, and seems certain to become a highlight of amenity-driven boat trips, such as tourist ferries serving Corregidor Island and Mariveles from Manila. On balance, the impact of the project on vessel-based dynamic viewsheds is likely to be neutral to mildly positive because of this tradeoff.

Exhibit 8-42 View of Corregidor Island's Tail End from Ferry in North Channel

Prescribed Mitigation. Given that the visual impacts with regards to dynamic viewsheds can be expected to be positive on balance, no mitigation is prescribed.

IMPACT SUMMARY					
Impact:	Visual impacts on dynamic viewsheds				
Direction:	Negative/Positive	Type:	Direct	Probability:	Certain
Duration:	Permanent	Scope:	Widespread	Significance:	Low
Mitigation:	• None prescribed				
Residual:	Expected, but adverse effects are outweighed by positive effects				

8.2.1.5 Visual impacts from litter

Anticipated Impact. Roadside litter is unfortunately inevitable, whether as a result of intentional behavior or carelessness. Litter may derive from both the human occupants of vehicles and from poorly secured loads containing items amenable to being picked up by wind. Over time, litter can be expected to build up on roadsides and in road-proximate aquatic environments and become unsightly.

Prescribed Mitigation. Littering can be partially limited by persuasion, and signage bearing educational and coercive messaging is typically one component of litter control. Appropriate signage has been included in the BCIB roadway designs.

IMPACT SUMMARY					
Impact:	Visual impacts from roadside litter				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Long-term	Scope:	Localized	Significance:	Low
Mitigation:	• None prescribed, beyond what has been included in roadway designs				
Residual:	Expected, but to be addressed in operation phase				

8.2.2 Construction Phase Impacts and Mitigation

Construction impacts are those impacts which occur as a direct or indirect result of construction activity, and which are subject to mitigative actions that can be implemented by the contractors performing the construction work. Planning for mitigative action will typically and appropriately take place in the period immediately leading up to the start of construction, but mitigation will be implemented in parallel with construction activity. Compensatory actions to address residual effects originating from construction activity may run well into the operation phase.

8.2.2.1 Impacts on Community Life

Social conflict due to influx of construction workers

Anticipated Impact. When construction crews are brought in from outside the local project area, including from faraway parts of the country, conditions may be ripe for conflict with local residents.[306] Local people may resent outside workers for having 'stolen' jobs from laborers in the communities that have to bear the construction impacts, and cultural and linguistic differences can easily lead to misunderstandings and disagreements. There may also be a perception that outside workers place an undue burden on public services, local amenity spaces, and natural resources. Rowdy or otherwise disruptive behavior (including public drunkenness, harassment of local women and girls, and use and abuse of sex workers) on the part of workers during time off may not help. Given the right circumstances, these potential irritants and triggers can blossom into violence. Conflict is more likely when the ratio of outside workers to the local population is high, such as may be the case with a large project implemented amongst small communities in a remote area, and when the local economy is such that construction jobs are a desperately needed opportunity for local people, for want of good alternative livelihood options. By the same token, when the ratio is low and local people have access to a variety of livelihood options that compare favorably to construction jobs, such as with projects implemented near or in large population centers and economically diversified areas, potential for conflict will generally be lower.

[306] See World Bank. 2021. Good Practice Note – Assessing and Managing the Risks of Adverse Impacts on Communities from Project-Related Labor Influx. 2nd Edition, June 2021.

The BCIB project will have a large construction workforce (approximately 2,000 workers at the peak), distributed between the Bataan and Cavite sides in similar proportions. Although national law (RA 6685) requires that project contractors meet minimum thresholds for local labor (at least 50% local unskilled labor, at least 30% local skilled labor), this leaves considerable latitude for contractors to hire workers from elsewhere, and it can be considered probable that non-local workers will form a substantial proportion of the workforce. Neither Mariveles nor Naic can really be considered a deeply impoverished rural backwater devoid of economic opportunity (both have significant industrial bases and have been experiencing strong growth in employment in non-primary sectors), and both have local populations that dwarf any potential outside workforce, so the risk of social conflict from an influx of non-locals may be relatively low. However, unemployed and underemployed able-bodied people in marginalized sectors of the local population in both locations are likely to perceive outside laborers as competitors.

Prescribed Mitigation. The most effective mitigation for social conflict at the pre-construction phase is to minimize the need for outside workers by recruiting (and training, if necessary) local people to fill as many project jobs as possible, exceeding the minimum requirements for local participation under RA 6685 to the greatest extent possible. This requires timely and rigorous scrutiny of contractors on the part of the project proponent during the lead-up to the start of construction, exercised through the CSC.

If significant numbers of outside workers must be hired despite best efforts to recruit locally potential for social conflict can be reduced by seeking housing options for outside workers within the host communities rather than housing workers all together in camps. Housing workers within the community potentially benefits local owners of accommodations and local businesses such as shops, public markets and eateries, and lessens the tendency for outside workers to be perceived as a concentrated bloc of 'others'. Common problems with construction camps, such as pollution of local water supplies by improperly managed sewage and emergence of hubs for prostitution, can also be avoided if large camps do not have to be set up at all. Contractors should be required to demonstrate to the CSC a lack of sufficient local options for worker accommodation before proposals for construction camps will be accepted. In considering the need for camps, the CSC shall consider the local availability of housing, in consultation with the respective LGUs, to avoid creating or contributing to housing shortages.

Where construction camps are deemed unavoidable, those that are established must be properly planned, set up and managed, in accordance with international best practice (as exemplified by IFC/EBRD guidance on worker accommodations).[307] For each construction camp proposed by a PC or any of its sub-contractors, a site-specific Construction Camp Management Plan must be prepared and submitted by the PC for the review and approval of the CSC prior to camp establishment. The approved plan, which should include rules governing resident worker behavior on and off site, will be appended to the PC's CEMMAP, and be considered an enforceable component of it. A sample outline for a Construction Camp Management Plan is provided in Appendix B to the EMP.

[307] See International Finance Corporation/European Bank for Reconstruction and Development. 2009. Workers' Accommodation: Processes and Standards – A guidance note by IFC and the EBRD. August 2009.

IMPACT SUMMARY					
Impact:	Social conflict due to influxes of outside workers				
Direction:	Negative	Type:	Direct/Indirect	Probability:	Low–Medium
Duration:	Medium-term	Scope:	Localized/Widespread	Significance:	Low–Moderate
Mitigation:	• Proponent to implement (through CSC) recruitment and training programs for local workers in both Mariveles and Naic to increase potential for local hiring by PCs and sub-contractors, under auspices of Social Development Plan • PCs and sub-contractors to adhere strictly to requirements under RA6685 with regards to employment of local labor (including for its sub-contractors), and go beyond the base requirement to the maximum extent possible • PCs to demonstrate, subject to review and approval by the CSC, that reasonable effort has been made to secure accommodations for its workers and those of its sub-contractors in existing facilities within the community before proposals for construction camps will be considered • PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors				
Residual:	Expected, but minor				

Access disruptions

Anticipated Impact. Construction works and materials transport carried out in public rights-of-way typically have significant potential to temporarily block public access to private and public property, including homes, businesses, institutions and agricultural land. The consequences can include minor inconvenience, lost livelihood, personal safety risk from using improvised alternative access routes, and even premature death (as might occur when ambulance access to a hospital is delayed by works). The on-land BCIB construction works will take place in public rights-of way only at the two interchange sites, which significantly limits potential for disruptions.

With regards to the marine works, all will be carried out in a public right-of-way, that being Manila Bay. The construction process for the two cable-stayed bridges, each of which spans a formal shipping channel, will be staggered to ensure that at least one of the two channels is open to traffic at any given time, so the potential for serious access disruptions is low. Disruption of access for fisherfolk, who do not need to use the main navigation channels, are discussed below in relation to fisherfolk livelihood impacts.

Prescribed Mitigation. All sideroads, established pedestrian footpaths, sidewalks, driveways and entryways shall either be kept open during works, or an alternative route or means of access provided whenever closure is required for safety or logistical reasons for more than a short time. If a public way has to be closed off for more than one hour, this should be announced with signage at least 24 hours in advance. If a private means of ingress and egress, e.g., a driveway, gate or doorway will have to blocked for more than one hour, the contractor or sub-contractor involved shall inform the property owner and any other users via printed notice at least 24 hours in advance and make direct verbal contact if possible. Blocked means of access must be restored by temporary or permanent means prior to the end of the workday, so circulation and access can proceed safely and more or less as normal after hours. Each PC conducting works in public ways shall include the measures indicated here as method statements in their CEMMAP.

IMPACT SUMMARY					
Impact:	Disruption of access to private and public property and land and natural resources due to construction in public rights-of way				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Short-term	Scope:	Localized	Significance:	Low–Moderate
Mitigation:	• PCs to ensure that all public and private ways are kept open to the maximum extent feasible, taking account of safety considerations • In the event of closure of a public way exceeding 1 hr, PCs to provide 24 hrs advance notice using signage • In the event of closure of a private way exceeding 1 hr, PCs to post notice 24 hrs in advance and attempt direct verbal contact with property owners and users prior to blockage • PCs to ensure that all blocked public and private ways are restored to a safe and useable state by the end of the workday, or provide a safe alternative for use after hours				
Residual:	None expected				

Utility disruptions

Anticipated Impact. Construction works in public rights-of-way may require–or inadvertently cause–stoppages of electrical, communications and water service, leading to inconvenience and hardship for utility customers. There is no in-ground gas distribution in the BCIB project area. Surveys have been conducted to identify service infrastructure in the works areas, and advance coordination with the relevant utilities will be undertaken both before the commencement of works and as the works proceed, so that they can provide reasonable notice of any planned temporary outages to customers. Advance planning and coordination should prevent the occurrence of inadvertent stoppages and minimize the duration of planned ones, but careless work process management and lax supervision may lead to failure in this regard.

Prescribed Mitigation. Proper training of workers involved in excavation and operation of machinery that has potential to contact utility poles and overhead wires will help reduce the likelihood of inadvertent utility stoppages. The relevant PC's site engineers must maintain a constant presence on site whenever excavation is conducted near in-ground infrastructure or heavy machinery is used near overhead wires, to provide adequate supervision.

IMPACT SUMMARY					
Impact:	Inadvertent disruptions of utility service				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• PCs to provide training to all workers involved in excavation and use of tall machinery near overhead wires to reduce the likelihood of inadvertent utility disruptions • PCs to ensure that site engineers with access to utility maps maintain constant presence and supervision during any work with the potential to damage in-ground or overhead utility infrastructure				
Residual:	None expected				

8.2.2.2 Livelihood Impacts

Impacts on land-based livelihoods

Anticipated Impact. The principal risks to land-based livelihoods from construction works are impairment of customer access to businesses, degradation of the customer experience due to elevated noise and dust, and direct property damage by works and storage activities that flow over the ROW boundary. Failure to strictly observe good construction site management practices and the ROW boundary, such that materials stockpiling, machinery operation, parking, spoils disposal and other activity damages crops and buildings on adjacent lands, may burden landowners with lost livelihood and repair and replacement costs, or affect property value.

With respect to marine works, there is significant potential for viaduct foundation works (seabed excavation/dredging for footings) carried out in the Naic nearshore zone to generate high turbidity in inshore waters used for swimming by visitors to beach resorts. This may lower the amenity values sought by beach tourists, and consequently affect the financial viability of affected resorts. The effect would be relatively short-term (lasting as long as a few months), but serious enough to warrant mitigation to the extent possible.

In addition to the potential negative livelihood impacts identified above, the BCIB has considerable potential for positive impacts in the host communities during the construction phase, in the form of jobs on the project (in construction, administrative and support positions) and increased business opportunities related to the provision of goods and services to project-involved contractors and to construction workers. Livelihood opportunities accruing during the construction phase can be considered a significant economic benefit of the project and are appropriately balanced against negative impacts in the overall consideration of project risks and benefits; local livelihood opportunities should be enhanced wherever possible to help ensure that the communities that bear the greatest negative impacts during construction also get to participate in the benefit stream.

Prescribed Mitigation and Enhancement. Contractor dedication to best practices for construction site management, particularly as they relate to providing safe alternative access to businesses, as well as dust suppression, can minimize the probability of livelihood impacts. Tight supervision by site engineers in work locations close to businesses is essential. Physical damage outside the ROW can be prevented entirely by installation and maintenance of durable fencing all along the ROW boundary, and training workers and site engineers to respect the boundary at all times.

In the event that undue hardship is experienced due to access impairment, excessive dust, or physical property damage, the affected landowner may file a grievance and request for remedy through the GRM. In the case of property damage, sub-contractors shall be directed to refer complainants to the GRM rather than providing remedy informally, so that the transaction is properly documented and subject to review of the appropriateness, fairness and thoroughness of implementation by the PC, CSC and Grievance Redress Officer.

Mitigation of turbidity impacts on the amenity values of beach resorts along the Naic shore, the relevant marine works contractor (PC4) shall be required to use surface-to-seafloor silt curtains around all foundation works for the duration of excavation activity to contain disturbed sediments; this shall apply to all footings within 2 km of the shore.

Local opportunities for enhancement of land-based livelihoods can be enhanced by (1) ensuring that minimum local hiring quotas as stipulated by RA 6685 (at least 50% local unskilled labor, at least 30% local skilled labor) are strictly observed by the PCs and their sub-contractors; (2) providing training during pre-construction to ensure that local people who wish to secure jobs on the project can acquire the necessary skills in order to do so; (3) facilitating local people's access to the hiring process; and (4) facilitating local business entities' access to the procurement process for goods and services that may reasonably be obtained locally by project contractors. Monitoring and enforcement of the RA 6685 quotas is included as a required measure in the project EMP. Training programs for would-be local project workers is to be provided by a training services provider engaged by DPWH, under the auspices of the Social Development Plan (SDP). Recruitment events with compulsory participation of PCs and sub-contractors will be organized by DPWH-PMT before and during construction to help connect local workers with contractors and sub-contractors, also under the SDP. And similar 'marketplace connection events' will be arranged by DPWH-PMT, during the pre-construction phase and continuing periodically into the construction phase, to facilitate access of local enterprises to opportunities to supply goods and services to contractors and sub-contractors; this will also be pursued under the SDP, with mandatory participation by PCs and sub-contractors.

IMPACT SUMMARY					
Impact:	Impacts on land-based livelihoods during construction				
Direction:	Negative/positive	Type:	Direct/Indirect	Probability:	Medium
Duration:	Short-term	Scope:	Localized	Significance:	Low–High
Mitigation:	• PCs to provide enhanced training and stepped-up supervision of construction site management by sub-contractors at works near businesses and where access to private property entrances may be constrained at any time during works, in order to minimize negative effects on local businesses • PCs to instruct sub-contractors to provide contact information for the GRM in the case of property damage incurred outside the ROW boundary • PC4 to ensure that surface-to-seafloor silt curtains are consistently and competently deployed around all viaduct footing sites within 2 km of the Naic shore, for the duration of footing excavation activity • PCs to ensure that the workforce hired on works under their control consistently meets quotas for local unskilled and skilled labor under RA 6685 • DPWH to engage training services contractor to develop and deliver skills training for local people interested in securing employment on the BCIB project, in both Mariveles and Naic, beginning at least 6 months prior to the start of works (under auspices of SDP) • DPWH-PMT to arrange recruitment events with compulsory participation of PCs and sub-contractors to facilitate hiring of local workers, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP) • DPWH-PMT to arrange marketplace connection events with compulsory participation of PCs and sub-contractors to facilitate procurement of good and services from local business entities, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP)				
Residual:	None expected				

Impacts on fisherfolk livelihoods

Anticipated Impact. The key livelihood impacts that might be expected from construction activity in an active fisheries area are (1) temporary loss of access to fishing areas within the construction safety perimeter (project exclusion zone - PEZ) along the alignment and around staging areas; (2) difficulties in transiting the construction zone, leading to lost fishing time and higher fuel costs from making extended detours; and (3) loss of fish biomass available for capture due to degradation of benthic habitat, impaired fish health and reproduction, and mortality or injury of fish vulnerable to the effects of underwater noise. The first two of these impacts will be temporary, but of medium-term duration (3–4 years). The third will also be temporary, but longer in duration; recovery of degraded fisheries resources is more likely to take years after the end of construction, rather than weeks or months. The presence of other stressors in the marine environment (fishing pressure, destructive fishing practices, unfavorable water quality) will tend to extend recovery time.

Impacts from access restrictions. The area possibly affected by marine construction works accounts for a small proportion of the fishing grounds is apportioned to each affected municipality (see Exhibit 8-43). The most significant effect will be seen in Naic, where the PEZ will account for about 4.1% of municipal fishing grounds. It should also be acknowledged that enforcement of fishing ground access by the municipalities—particularly in relation to small boats— is not particularly robust, and possible that many fisherfolk regularly fish outside their home municipal waters. In particular, it is probable that most fishing effort in the waters around Corregidor and Caballo Islands is expended by fisherfolk from Naic, Ternate and especially nearby Mariveles, rather than fisherfolk from the much more distant fishing communities of Cavite City. Taking all the four municipal fishing grounds together, the PEZ is approximately 1.5% of the overall fishing grounds of the affected municipalities. These low percentages indicate that the magnitude of potential income losses from imposition of a PEZ during the construction phase is unlikely to be particularly high. The apparent flexibility enjoyed by local fisherfolk in choice of fishing grounds should also be expected to help limit the impact of potential PEZ transit difficulties.

Exhibit 8-43: Temporary Fishing Area Access Loss as Percentage of Municipal Fishing Grounds

Municipality	Area of Municipal Waters (ha)	Alignment PEZ (ha)[2]	Staging Area PEZ (ha)	Total PEZ During Construction (ha)	% of Municipal Waters
Mariveles	10,427	95	40	135	1.3
Cavite City	25,740[1]	256	-	256	1.0
Ternate	10,528	166	-	166	1.6
Naic	6,292	260	-	260	4.1
All	52,987	777	40	1,075	1.5

[1] Bay mouth portion only, minus areas within Corregidor Islands Marine Park

[2] Length of alignment in municipal waters x 300 m (150 m each side of centerline)

Impacts on fish stocks. Impacts on fish during construction will be most intense in the immediate vicinity of the alignment, particularly in relation to seafloor disturbance by anchors and cables, propellor wash and thruster surge, and hull contact. These benthos-disruptive activities are unlikely to produce heavy degradation over a wide area and can be considered not to have potential to generate significant livelihood impacts for local fisherfolk.

Siltation and sedimentation impacts are also likely to be most severe in the immediate vicinity of works but have the potential to affect the well-being of fish, their eggs and larvae, and food sources over much larger areas. Some marine construction activities—most notably dredging for the drydock facility and excavation of the seabed to enable installation of spread-foot pier foundations—may generate heavy silt loading. Although siltation is likely to occur over a relatively short time in any one location, the cumulative effect of many repetitions within the same general area may be substantial.

The most worrisome impact of marine construction activity for fish is underwater noise from pile driving. Acoustic modeling undertaken using assumptions regarding pile driving needs generated from the preliminary design process indicate that pile driving activity (involving multiple piling rigs at times) can be expected to result in a fish kill zone in proximity to each driven pile, which means the impact may be experienced day after day for many months. Apart from direct mortality to fish very nearby the piling rigs, noise emissions from piling are expected to cause temporary and permanent hearing loss, as well as numerous behavioral effects, at considerable distances from the alignment. These sub-mortal effects are likely to have both direct effects on fish feeding, communication, migration and reproduction, and indirect effects on habitat areas used by fish (see discussion of underwater noise impacts in Chapter 6). As piling will go on for at least 43 months, multiple generations of some species may be affected. Areas along the deep-water portions of the project alignment where impact piling will be required (principally the North Channel and South Channel) may experience significant declines in fish biomass, potentially with knock-on effects for fish stocks in nearby areas. It is likely that local fisherfolk will be affected, potentially significantly and for an extended period after construction ends. Fish stocks in Manila Bay already suffer from overfishing and water pollution, so the resilience of fish populations in and around the project area is appropriately assumed to be on the low end; recovery from extended pile driving activity is unlikely to be rapid.

Prescribed Mitigation. Livelihood losses resulting from fisherfolk exclusion from the construction zone, although not expected to be significant, can be minimized by using a dynamic approach to PEZ implementation, whereby the boundaries of the zone are adjusted as work proceeds. Using this approach, exclusion would only be indicated in work areas with ongoing activity, while areas with no current work activity that would pose a hazard to fisherfolk would be indicated as open for fishing until further notice. Such a flexible approach would require more intensive communication with fisherfolk communities to ensure solid understanding of the more dynamic rules, and occasional extra effort would be needed to change markings on the exclusion zone boundary buoys, but the incremental costs associated with these needs would be quite minor.

Fisherfolk hardship associated with difficulties in transiting the marine work zone can be almost entirely prevented by setup of safe transit lanes at reasonable intervals along the alignment. Safe transit lanes should be clearly marked, and communication with local fisherfolk prior to the start of marine works would be necessary to explain the marking system and rules governing transit. Transit lanes may only be necessary during the most intense periods of work in nearshore locations, when even the dynamic approach to PEZ implementation might leave few areas unrestricted.

Losses to fisherfolk livelihood from effects on fish stocks due to siltation can be minimized by targeted use of silt curtains to limit the spread of suspended particulates. It is expected that competent, site-appropriate implementation of silt curtains will limit effects on fish stocks to the immediate vicinity of the project alignment, and thus reduce potential for effects on fisherfolk to a negligible level.

Losses to fisherfolk livelihood from effects on fish stocks due to piling noise can be significantly minimized by use of bubble curtains at all times around piling rigs, and this shall be required of the marine works contractors. Even with competent, consistent deployment of bubble curtains, however, a significant residual impact on fish stocks is anticipated, and compensatory action will be required to address this residual. DPWH shall develop a partnership with BFAR to formulate and implement context-appropriate fisherfolk livelihood restoration program, under the auspices of the Social Development Plan.

Although basic data are available on the numbers of registered fisherfolk in the municipalities near the BCIB project area (some were cited earlier in this chapter), the number of fisherfolk who derive income from waters nearby the alignment, and for that those that do, the proportion of their total personal fishing income derived from these areas, are not well understood at the time of writing. This kind of information will be gathered as an early step in implementation of the fisherfolk livelihood restoration program.

IMPACT SUMMARY					
Impact:	Impacts on fisherfolk livelihoods from construction activity				
Direction:	Negative	Type:	Direct/Indirect	Probability:	High
Duration:	Medium-term	Scope:	Widespread	Significance:	Low
Mitigation:	• PCs, in collaboration with the CSC, to employ a dynamic approach to the PEZ to limit access restrictions only to those zones with active ongoing works and/or construction-related hazards present • PCs to provide clearly marked safe transit zones through the marine work zone, adjusting as necessary to accommodate work process • PCs to conduct informational meetings with local fisherfolk before the start of marine works and as needed during construction to explain operation, markings and rules regarding observance of PEZ and safe transit lanes • PCs to ensure that silt curtains are competently deployed around all sites where dredging or seabed excavation take place, and kept in place for at least 24 hrs after cessation of sediment-generating activity • PCs to ensure that piling contractors competently and consistently deploy bubble curtains or comparably effective underwater noise attenuation technology at all impact piling sites, without exception • DPWH to enter into a partnership with BFAR to formulate and implement a fisherfolk livelihood restoration program, under the auspices of the Social Development Plan				
Residual:	Expected, but minor				

8.2.2.3 Public Safety Risks

Traffic safety impacts

Anticipated Impact. Elevated safety risks will derive from two sources: (1) works carried out on existing road corridors that will remain in use throughout construction (primarily at the interchange sites, but also at the local roadway crossings; and (2) intensive project materials hauling activity.

Works in public rights-of way. Works carried out in existing rights of way, in which normal traffic flow must be accommodated for the duration of construction, pose formidable risks to the travelling public. Elevated risks are typically related to (1) motorists having to navigate unfamiliar, frequently changing, and often tortuous, uneven and constrained temporary routes through or around the construction zone; (2) mobile heavy machinery working in close proximity to occupied traffic lanes; and (3) congestion related to driver uncertainty, reduced speed limits within the work zone, and periodic traffic stoppages to allow certain construction activities that must impinge temporarily on a traffic lane.

Haul traffic. The extent of materials hauling to the project sites is not well understood at the time of writing, because materials sourcing studies have so far only identified probable sources for the approach road works. However, it is known that many of the sourcing sites for materials such as gravel, sand, cement and asphalt identified at the time of writing are inland from the two project termini, so it can be assumed that a large proportion of hauling will take place by road. It is possible that materials that are more likely to be sourced overseas, such as steel piling tubes and structural steel components, will be brought to the project sites by barge, principally the storage yard adjacent to the Bataan approach road alignment, which will have direct access to a purpose-built temporary rock jetty at the landing point.

On the Bataan side, all locally- and regionally-sourced gravel and sand will come from north of the project area, which indicates that the Roman Highway route through Mountain View, Cabcaben and Townsite will experience the vast majority of construction traffic; the Kamaya Point Road, which will serve the casting yards and drydock facility, will also see heavy haul traffic (see Exhibit 8-44. It is anticipated that a new temporary connector road will be established between this road and the casting yard/drydock site, in order to avoid the need for truck traffic to pass through the small community at Kamaya Point (as traffic from the site does at present).

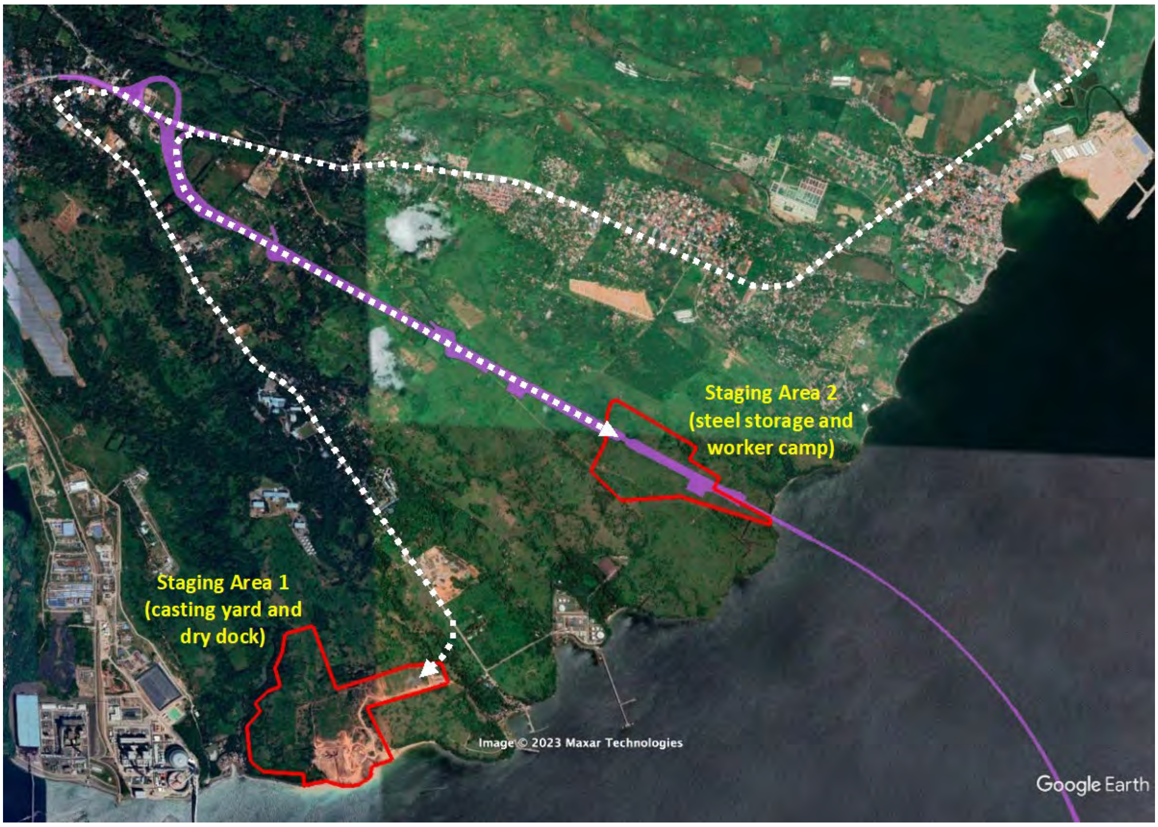
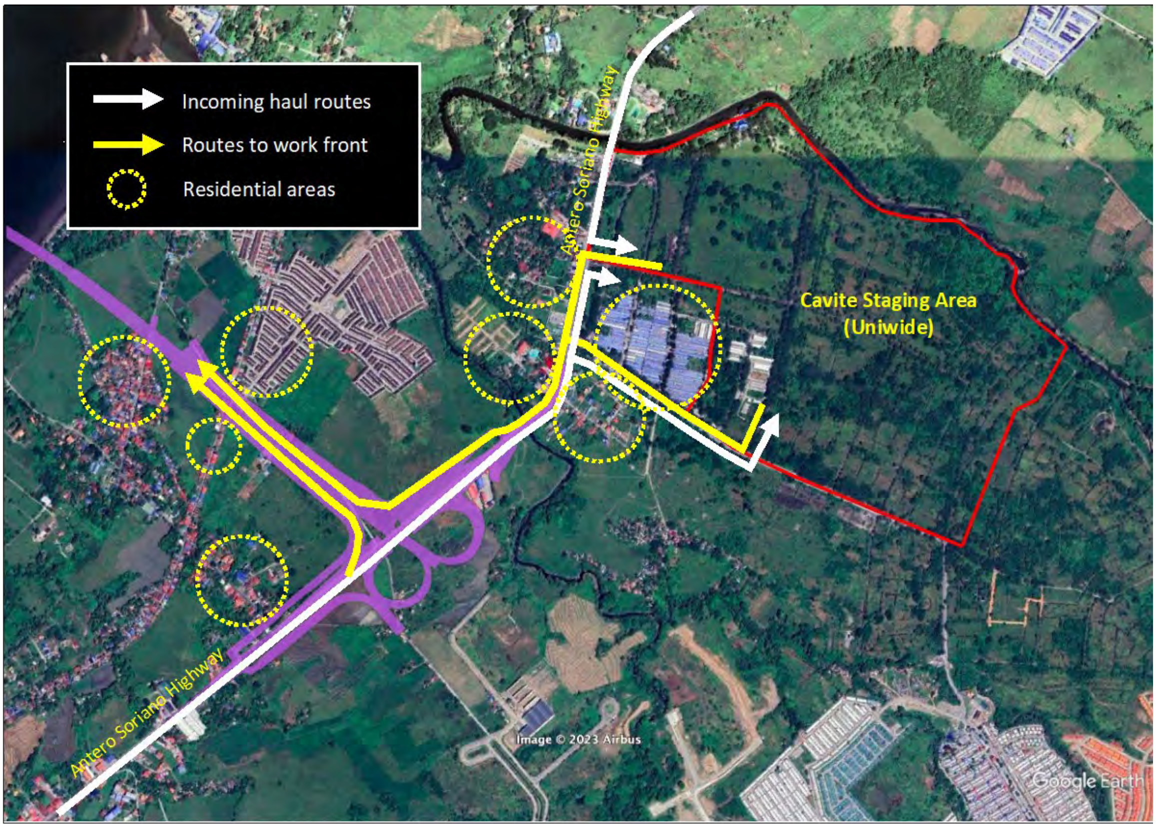


Exhibit 8-44 Haul Routes on Bataan Side

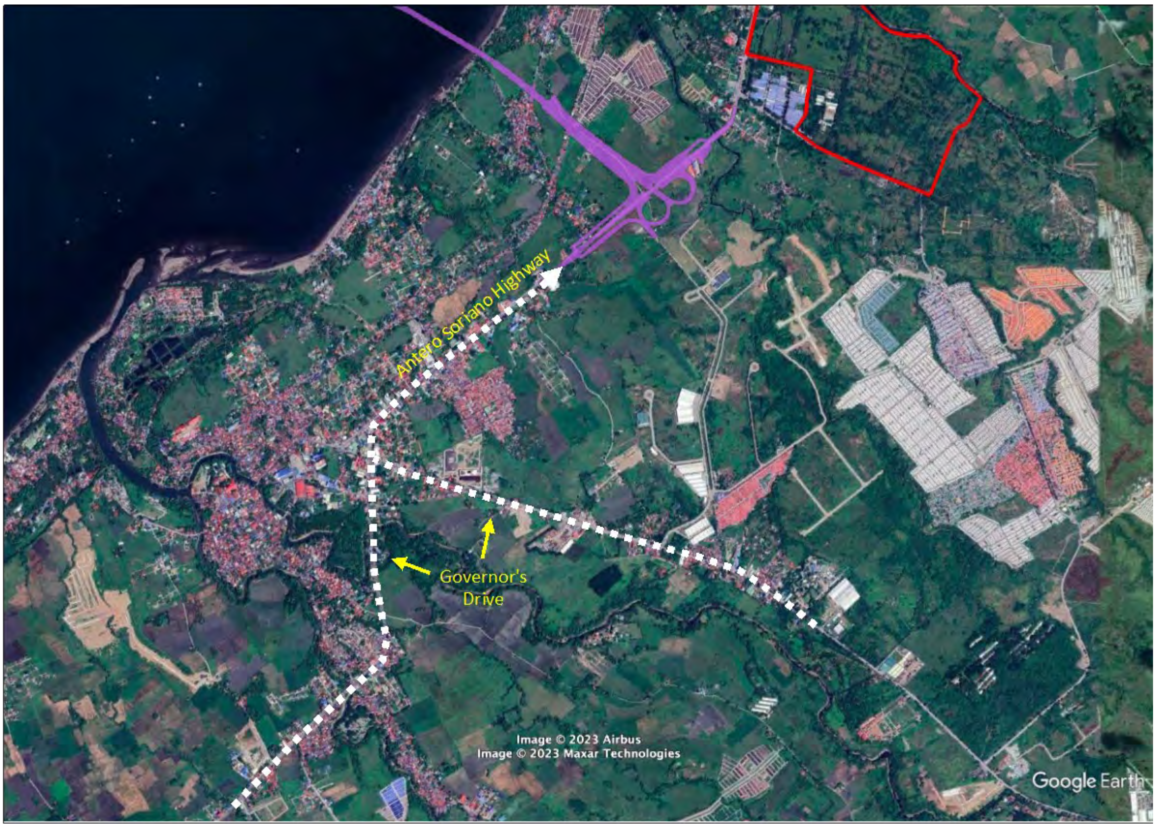
The principal point of concern with respect to safety during hauling on the Bataan side will be the intersection of Kamaya Point Road and the Roman Highway, which is in a commercial/residential area on the edge of Alas Asin village (see Exhibit 8-45). It is expected that supplies of Portland cement for the Bataan casting yard and drydock are likely to be sourced from PhilCement, which has a terminal and production facility in Barangay Sisiman, within Mariveles Bay. Hauling by land between the terminal site and the casting yard site requires use of the EPZA Bypass Road, which is notoriously congested and has numerous safety concerns, and also passing through congested Alas Asin village to reach Kamaya Point Road; use of this route would certainly add to existing safety concerns.

On the Cavite side, it is expected that materials will be brought to the works sites and Uniwide staging area by way of the Antero Soriano Highway, primarily from the northeast. Significantly, hauling on the Cavite side will also take place between the Uniwide site, where materials will be stored and some pre-casting activity will take place, and the BCIB landing point at the waterfront; materials hauled will comprise mainly pre-cast concrete components and concrete slurry to supply in-situ casting needs at the work front. Haul trucks using the 2.2-km route between the Uniwide storage yard and landing point will necessarily follow the Antero Soriano Highway for 0.6 km to cross two branches of the Timalan River on existing highway bridges. This road segment is expected to see intensive use, as it will serve both between-site haul traffic and trucks arriving from materials sources to the east and south of the project area (see Exhibit 8-46) and will be the principal point of concern from a public safety perspective. A second area of concern is the route through the often-congested built-up area of Naic town on Antero Soriano Highway and Governor's Drive (see Exhibit 8-47), which would be the two main expected haul routes for materials sourced to the south and southwest of the project area.

Exhibit 8-45 Proximity of Community Areas to Haul Routes, Alas Asin Village

1 

2 Exhibit 8-46 Haul Routes Around Antero Soriano Interchange and Uniwide Site, Naic

3 

4 Exhibit 8-47 Haul Routes Through Built-Up Area of Naic Town, Cavite

Prescribed Mitigation. To address the elevated accident risk associated with the interchange works, the P1 and P2 contractors shall be required to prepare site-specific Road Works Safety Management Plans, for the review and approval of the CSC prior to the start of works. The plans will be appended to the respective PCs' CEMMAPs. A sample outline for a Road Works Safety Management Plan is provided in Appendix B to the EMP.

To help ensure that construction haul traffic does not lead to undue elevation of public safety risks along the projected haul routes, each PC shall prepare its own route-specific Construction Traffic Management Plan, for review and approval by the CSC prior to the commencement of works. The plans will be appended to the respective PCs' CEMMAPs. It can be expected that there will be temporal and spatial overlap between the hauling operations of the various contractors, and this will require strong coordination to ensure that traffic safety impacts are not multiplied at certain times and locations. The CSC will coordinate the hauling activity of the PCs and their sub-contractors. The CSC will also be responsible for setting and enforcing rules regarding the timing of hauling activity, particularly in relation to peak traffic periods, to minimize elevation of safety risks.

The worsening of road safety concerns on the EPZA Bypass and in congested Alas Asin village due to hauling of large quantities of Portland cement from the PhilCement terminal in Sisiman to Staging Area 1 can be completely avoided by requiring the relevant PCs to transport cement between these locations only by barge.

IMPACT SUMMARY					
Impact:	Increased risk of accidents due to work in right-of-way and haul traffic				
Direction:	Negative	Type:	Direct	Probability:	Very high
Duration:	Medium-term	Scope:	Widespread	Significance:	High
Mitigation:	• PC1 to prepare Road Works Safety Management Plan for the works at and around the Roman Highway interchange and underpasses for existing roads, for review and approval by the CSC, prior to the start of works • PC2 to prepare Road Works Safety Management Plan for the works at and around the Antero Soriano Highway interchange and underpasses for existing roads, for review and approval by the CSC, prior to the start of works • Each PC to prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC to closely coordinate the hauling activity of the PCs and all sub-contractors to avoid possible multiplication of safety impacts from simultaneous hauling operations • CSC to set and enforce rules regarding timing of hauling activity to prevent avoidable elevation of safety risks by hauling • PCs responsible for operation of the Bataan casting yard and drydock shall transport Portland cement from the PhilCement facility in Barangay Sisiman only by barge, to avoid increasing truck traffic on EPZA Bypass Road				
Residual:	Expected, and to be balanced against positive project impacts				

Marine traffic safety impacts

Anticipated Impact. The BCIB construction zone will spread out across the entire bay mouth, and construction will proceed under the four marine works packages simultaneously. Works for the two cable-stayed bridges will take place—over an extended period—close by both sides of the two shipping lanes, and this is where the greatest risk of accidents might be expected, just as a matter of proximity. That said, neither shipping lane will be modified, and there will be spaces between each of the bridge tower work sites and the navigation channel boundaries (50 m for North Channel Bridge and 75 m in the case of the South Channel Bridge, within which construction vessels will be able to operate without entering the lane; this will significantly curtail collision risk. The lanes will be closed by order of the Philippine Coast Guard (through a Notice to Mariners) when necessary to permit installation of the bridge decks and cable stays, and marine traffic will use the other lane during these times (the lanes will never be closed at the same time), thus there will be no risk to shipping from falling objects or having to pass amongst construction vessels engaged in the installation of these overhead components. It is not anticipated that either of the two navigation channels will become dangerously congested during times when the other is closed. Overall, safety risks at the navigation channels would appear to be quite low.

The other marine traffic risk factor concerns small craft, particularly those operated by local fisherfolk. A PEZ of width 150 m will be established in coordination with the Philippine Coast Guard along the entire BCIB alignment, except at the two navigation lanes, to prevent entry of vessels into the work zone, where collisions with construction-engaged vessels, work platforms and infrastructure components in various stages of completion would be possible. Provided that the safety exclusion zone is marked and enforced effectively, marine traffic safety impacts should be negligible. The safety effectiveness of the PEZ will be reduced if mariner awareness is weak and enforcement is lax, and these potential issues should be proactively addressed.

Prescribed Mitigation. DPWH should undertake an awareness campaign in local coastal communities on both sides of the bay prior to the start of works to explain to fisherfolk and other mariners about the purpose of the PEZ, how it will be marked. Additionally, each PC involved in the marine works shall be required to implement a reporting protocol, whereby all workers are instructed to report to the site engineer any observed incursion by a non-project vessel, and site engineers in turn report the incident to the CSC.

IMPACT SUMMARY					
Impact:	Elevated risk of marine accidents due to marine construction activity				
Direction:	Negative	Type:	Direct	Probability:	Low–Medium
Duration:	Medium-term	Scope:	Localized	Significance:	Low
Mitigation:	• DPWH, with support of CSC and in consultation with the Philippine Coast Guard, to establish a system for demarcating the PEZ and associated rules for mariners • PCs, in collaboration with the CSC, to demarcate the PEZ • PCs to provide clearly marked safe transit zones through the marine work zone, adjusting as necessary to accommodate work process • PCs, in collaboration with CSC, to conduct informational meetings with local fisherfolk before the start of marine works and as needed during construction to explain operation, markings and rules regarding observance of PEZ and safe transit lanes • PCs to require sub-contractors and workers to report unsafe incursions into the PEZ by non-project vessels to the PC's site engineer for enforcement action				
Residual:	None expected				

8.2.2.4 Public Health Risks

Spread of infectious disease due to influx of outside workers

Anticipated Impact. Increased incidence of infectious diseases, particularly sexually transmitted ones, amongst the general local population is sometimes anticipated from large construction projects that require importation of significant numbers of workers from outside the region. This is typically more of a concern where the host communities are small and isolated, with low standards of public health services and public health education and limited other interaction with the outside world. As has been discussed above, many if not most of the necessary workers for the BCIB project should be drawn from within the host provinces, in compliance with RA 6685. Additionally, the host communities for the BCIB project are integrated with Metro Manila and have fairly cosmopolitan labor markets already because of the presence of manufacturing and export processing activity. Nevertheless, to the extent that there will be construction camps set up, there is always a risk that crowded conditions and through-rotation of crews from different regions could elevate the probability of outbreaks, and that the camps, populated mostly by working-aged men far from their families, could become local hubs for sex work and consequently pathways for spread of sexually transmitted diseases.

Prescribed Mitigation. Disease risks associated with construction camps can be minimized by good camp setup and management, such that overcrowding is avoided, unsanitary conditions do not prevail, workers are well informed of their potential role in disease spread, and sex work is not enabled. Camp design, setup and operation should follow the IFC/EBRD guidance on worker accommodations.[308] For each construction camp proposed by a PC or any of its sub-contractors, a site-specific Construction Camp Management Plan must be prepared and submitted by the PC for the review and approval of the CSC prior to camp establishment. A sample outline for a Construction Camp Management Plan is provided in Appendix B to the EMP. The Construction Camp Management Plan should include rules governing worker behavior on and off site, as well as access to the camp by locals. Additionally, any PC with a camp under its control shall provide induction training on sexually transmitted disease prevention to all incoming workers, monitor for emerging sex work concentrations around camps, and collaborate with municipal public health and public safety officials as necessary to address concerns that arise in this regard.

IMPACT SUMMARY					
Impact:	Spread of infectious disease associated with influx of outside workers				
Direction:	Negative	Type:	Indirect	Probability:	Low
Duration:	Medium-term	Scope:	Localized/Widespread	Significance:	Low
Mitigation:	• PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors • PCs responsible for construction camps to provide STD prevention training to all incoming workers • PCs responsible for construction camps to monitor for evidence of sex work around camps, and collaborate as needed with municipal public health and public safety authorities to address any emerging concerns				
Residual:	Expected, but of very minor significance				

Water-borne illness due to poor human waste management

Anticipated Impact. Concentrations of workers, whether on construction sites or in camps, will inevitably produce significant volumes of human waste daily, and if this waste stream is not properly managed, it is probable that water bodies used by local people for bathing, laundry, fishing, aquaculture, irrigation and livestock watering will receive an influx of raw or minimally altered effluent bearing human pathogens. Outbreaks of intestinal illness including diarrhea, cholera and emerging zoonotic viral infections, may become more likely as a result.

[308] See International Finance Corporation/European Bank for Reconstruction and Development. 2009. Workers' Accommodation: Processes and Standards – A guidance note by IFC and the EBRD. August 2009.

Prescribed Mitigation. There are no existing wastewater treatment plants in the BCIB project area, so collecting sewage for transport and offsite treatment is not a feasible option.

Each PC shall be required to prepare site-specific Human Waste and Sanitation Management Plans for its work sites and staging areas, for review and approval by the CSC prior to the start of any works. Plans shall be based on carefully considered projections of worker numbers over the life of each site. All toilet facilities established on semi-permanent sites including staging areas and construction camps must be equipped with proper septic tanks and leaching fields designed in accordance with capacity and construction specifications in the Philippine Sanitation Code (IRR of 1995 and Supplemental IRR 2003) and approved by the relevant LGU's Health Officer. Pit toilets shall be prohibited. For construction sites, portable toilets shall be provided for worker use, and the collected contents collected as needed for disposal in the septic systems set up at longer-term sites. The septic systems shall be designed with extra capacity to accommodate regular inputs from portable toilets used on temporary works sites. A sample outline for a Human Waste and Sanitation Management Plan is provided in Appendix B of the EMP.

IMPACT SUMMARY					
Impact:	Increased incidence of waterborne illness				
Direction:	Negative	Type:	Indirect	Probability:	Medium
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• Each PC to prepare site-specific Human Waste and Sanitation Management Plans, for review and approval of CSC prior to the start of works • PCs to provide portable toilets for use of workers at temporary and marine work sites, and transport contents as needed to septic systems set up at semi-permanent staging areas • PCs to provide all toilets with proper septic systems and leaching fields of adequate capacity to accommodate maximum projected use, including inputs from portable toilets used at temporary works sites				
Residual:	None expected				

8.2.2.5 Occupational Health and Safety Risks

Physical hazards on work sites

Anticipated Impact. Workers on the BCIB project will face numerous and typical construction site physical hazards, including falling and flying objects, falls from high places, embankment collapses, and contact with heavy machinery. Those who are involved on works in public rights of way (the two interchange sites and four underpasses) will be additionally at risk of being struck by passing vehicles. Lax construction site management and supervision, inadequate provision and use of context-appropriate PPE, and low levels of worker knowledge and awareness of safety practices can all contribute to elevation of these inherent construction site risks.

Workers on marine construction sites face additional risks not relevant to land-based workers, including drowning, getting crushed between vessels and work platforms during rafting and docking, and getting thrown by violent wave action. Use of cranes and booms will be especially frequent in the course of the marine works, and will pose significant risk to workers, particularly during rough weather.

Prescribed Mitigation. All PCs shall ensure that international best practices for construction site management are implemented consistently by their own personnel and by all of their sub-contractors. Task- and context-appropriate PPE—including, at a minimum, hardhat and protective footwear for anyone entering the site—shall be provided and replaced as necessary, and workers shall be provided with workplace safety training at induction and periodically for the duration of their involvement of the works. All vessels and platforms involved in marine works shall be equipped with life-saving equipment (throwable flotation and victim recovery slings), and all workers present on marine sites shall be required to wear an approved personal flotation device at all times.

Each staging area shall be provided with a continuously stocked first aid station, and a trained medical professional with traumatic injury stabilization capabilities shall be present on-site during working hours. Each PC's approved CEMMAP shall include site-specific Occupational Health and Safety Plans; a sample outline for such plans is provided in Appendix B to the EMP. For marine work sites, the relevant Occupational Health and Safety Plan shall specify protocols for determining the scope of permitted operations based on weather and sea state conditions, including when work shutdown and evacuation orders should be triggered in response to approaching storm systems. Occupational Health and Safety Plans shall conform to requirements in Department of Labor and Employment DO No. 198-2018 and shall take guidance as appropriate from the World Bank Group's EHS Guidelines 2.0 – Occupational Health and Safety.

IMPACT SUMMARY					
Impact:	Injury and death due to physical hazards on construction sites				
Direction:	Negative	Type:	Direct	Probability:	Low-Medium
Duration:	Medium-term	Scope:	Localized	Significance:	High
Mitigation:	• PCs to prepare site-specific Occupational Health and Safety Plans, for review and approval of the CSC prior to the start of works, to ensure that international best practices for construction site management are implemented consistently by their own personnel and by all of their sub-contractors • PCs to strictly require and ensure that task- and context-appropriate PPE—including, at a minimum, hardhat and protective footwear for anyone entering the site—is provided to workers and replaced as necessary • Marine PCs to ensure that all vessels and platforms involved in marine works are equipped with life-saving equipment (throwable flotation and victim recovery slings), and strictly require that all workers present on marine sites wear an approved personal flotation device at all times • Marine PCs to include protocols for determining when weather and sea state conditions shall require halting of certain activities, general work stoppages and evacuations				
Residual:	Expected, but of low significance				

Risks from works conducted in existing rights-of-way

Anticipated Impact. Workers involved in construction in highway rights-of way that have to remain open to traffic during the works face special risks due to the proximity of moving traffic. Without effective implementation of measures to shape driver behavior and maintain physical separation between construction activity and traffic flow, the risk of worker injury and death from vehicle strikes will be elevated. This concern is applicable to the Roman Highway interchange and underpasses for existing local roads on the Bataan side, and to the Antero Soriano Highway interchange and slip roads and underpasses for existing local roads on the Cavite side.

Prescribed Mitigation. To reduce the risks to workers, PC1 and PC2 shall be required to prepare site-specific Road Works Safety Management Plans covering the works at the interchanges and underpasses, for the review and approval of the CSC prior to the start of works. The plans will be appended to the respective PCs' CEMMAPs. A sample outline for a Road Works Safety Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Elevated accident risk during works in public rights-of way				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium-term	Scope:	Localized	Significance:	High
Mitigation:	• PC1 to prepare site-specific Road Works Safety Management Plans covering the works at the Roman Highway interchange and underpasses on the Bataan side, for the review and approval of the CSC prior to the start of works • PC2 to prepare site-specific Road Works Safety Management Plans covering the works at the Antero Soriano Highway interchange and underpasses on the Cavite side, for the review and approval of the CSC prior to the start of works				
Residual:	Expected, but of low significance as residual				

Geophysical hazards during construction

Anticipated Impact. The BCIB project area is at risk of earthquakes and tsunamis, both of which can strike suddenly and physically threaten workers on project sites. Earthquakes may topple structures that happen to be at a preliminary stage of erection, cause collapse of open trenches and materials stockpiles, and knock over large tanks. A significant tsunami during the marine works could swamp and sink barges, knock work platforms off kilter, cause vessels to smash against each other, the shore and partially completed bridge piers, and wash workers into the sea. Volcanic eruptions are also possible nearby the project area, but these typically come with significant advance warning, and are not appropriately conceptualized as a workplace risk. Flooding and storm surge are also predictable and can be prepared for.

Prescribed Mitigation. The principal means of reducing safety risks from earthquakes and tsunamis during active construction are preparedness and planning. Buildings and structures such as elevated tanks and batch plants should be designed and built to withstand at least a Magnitude 6 temblor, to reduce the risk of workers being crushed or collapsed. Context-specific earthquake response plans must be developed prior to the start of construction works, covering such matters as search and rescue (on land and on water), electrical shutoff, post-quake inspection, and protocol for clearance to resume work. The earthquake response measures should be an integral component of each PC's Emergency Action Plan (see Section 10.6 of the EMP, and Appendix B to the EMP).

Each PC must make certain to set up a system for receiving notifications from the PHIVOLCS tsunami early warning system data feed and develop contingency plans for rapid evacuation of workers from marine and shore-proximate work sites in the event that a non-negligible tsunami is predicted based on undersea earthquake detections. Contingency plans should also indicate 'shelter-in-place' measures for implementation in the case of a tsunami that is projected to arrive too soon to permit meaningful prior evacuation, and a protocol for deciding what should be done under different wave height and arrival time scenarios. Context-specific plans for post-tsunami response, covering such matters as rapid mobilization of vessels for marine search and rescue and clearance of hazards should also be developed. The tsunami measures should be an integral component of each PC's Emergency Action Plan.

Earthquake and tsunami response plans will only be useful if workers and site managers are well versed in their contents. Induction training must include modules pertaining to these elements of each PC's Emergency Action Plan, and annual refresher training with drills should be provided. The CSC will perform an annual check to ensure that such refresher training has been conducted by each PC.

IMPACT SUMMARY					
Impact:	Injury and death from geophysical hazards occurring during construction				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Widespread	Significance:	High
Mitigation:	• PCs to set up system for receiving notifications from the PHIVOLCS tsunami early warning system data feed • PCs to design temporary structures, elevated storage tanks and batch plants on their work sites to withstand at least Magnitude 6 earthquakes • PCs to develop measures pertaining to preparedness, response and recovery in the event of earthquake or tsunami during construction, and include said measures in their comprehensive Emergency Action Plans • PCs to provide induction training regarding implementation of the Emergency Action Plan, including earthquake and tsunami procedures, for all workers and site engineers, and annual refresher training including drills, to be verified by the CSC • CSC to verify, annually during the construction phase, that each PC is providing refresher training in accordance with its Emergency Action Plan				
Residual:	To be expected in extreme event scenario (significance impossible to predict)				

Unexploded ordnance

Anticipated Impacts. The marine portion of the BCIB project area, particularly in the vicinity of Corregidor and Caballo Islands, is known to have been subject to heavy bombardment and some marine mining during WWII, and it is considered possible that some unexploded ordnance (UXO) may still remain in the area, on or buried in seafloor sediments. Although any UXO still present on or in the seabed will by now be over 70 years old and likely to have been compromised by corrosion, it is possible that some potentially explosive items may remain, and these could pose a safety risk to workers involved in such construction activities as seabed excavation, dredging and pile driving. A magnetic side scan survey was conducted along the project alignment in 2022 as part of the marine geotechnical survey work to detect any items of concern. At the time of writing, the UXO survey report was not yet available.

Prescribed Mitigation. Each PC involved in marine works shall study the results of the seabed UXO scan survey prior to the start of works to determine the presence of any suspected UXO within its work area and arrange for removal or neutralization by a qualified specialist contractor prior to beginning any physical works, if needed. Works shall not begin until all items of concern have been safely cleared.

IMPACT SUMMARY					
Impact:	Injury and death from UXO disturbed during marine works				
Direction:	Negative	Type:	Direct	Probability:	Low
Duration:	Short-term	Scope:	Localized	Significance:	High
Mitigation:	• Each marine PC to study results of UXO scan survey and arrange for removal or neutralization of any items of concern within its working area by a qualified specialist contractor prior to the start of works				
Residual:	To be expected in extreme event scenario (significance impossible to predict)				

Hazards in construction camps

Anticipated Impacts. Poorly planned and managed construction camps can present significant safety hazards to their occupants. Crowded dormitories and eating halls with insufficient means of egress are potential firetraps. Lack of mosquito netting elevates the risk of contracting diseases such as malaria and dengue, as does poor drainage of shower and washup facilities. Poorly constructed dormitories (often taking the form of rough tin shacks with dirt floors) with numerous sharp edges and protrusions pose a risk of cuts and eye injuries, especially after dark. And rudimentary and often exposed wiring offers ample opportunity for both electrocution and fire. All of these common scenarios are amenable to full prevention.

Contractors sometimes elect to house workers in temporary structures on works sites rather than setting up proper separate camps on other land, which exposes workers to elevated dust, mud and generally chaotic and dangerous living conditions. In these situations it is often left to subcontractors to set something up for their crews in a disused corner of a construction site or construction yard, and workers end up living in makeshift shacks with access to only the most rudimentary toilets, washup facilities and food preparation spaces.

Prescribed Mitigation. Housing construction workers in makeshift camps within works sites shall be strictly prohibited; the areas selected for staging areas have adequate space to permit development of separate, properly appointed residential facilities for the workforce. Staging area layout shall be arranged such that worker camps are located at least 200 m away from dusty and noisy components of the staging sites, including concrete batch plants, aggregate handling facilities and generators.

All construction camps established under the auspices of the BCIB project must have a Construction Camp Management Plan approved by the CSC and appended to the relevant PC's CEMMAP prior to setup, including camps to be established and operated by sub-contractors, and including camps proposed after approval of the CEMMAP and start of construction. Development of each Construction Camp Management Plan should follow the 2009 guidance developed by IFC and EBRD.[309] A sample outline for a Construction Camp Management Plan is provided in Appendix B to the EMP.

IMPACT SUMMARY					
Impact:	Worker injury, illness and death due to hazards in poorly designed and managed construction camps				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate–High
Mitigation:	• PCs to develop Construction Camp Management Plan for each camp established, including those to be set up and operated by sub-contractors and those proposed after approval of the PC's CEMMAP • CSC to review and approve all Construction Camp Management Plans, with reference to 2009 IFC-ERDB guidance on worker accommodation and other relevant international best practice • CSC to enforce prohibition on housing workers in makeshift structures on works sites, and ensure that camps established on staging area sites are physically separated from work spaces and located at least 200 m from dusty and noisy staging site components including concrete batch plants, aggregate handling facilities and generators				
Residual:	None expected				

309 See International Finance Corporation/European Bank for Reconstruction and Development. 2009. Workers' Accommodation: Processes and Standards – A guidance note by IFC and the EBRD. August 2009.

Elevated risk of disease and infestations

Anticipated Impact. Crowded and unsanitary conditions, and practices such as hot bedding (whereby beds are shared by workers of more than one shift), in project construction camps significantly raise the risk of disease outbreaks and infestations of lice, scabies and other pests amongst workers. Numerically inadequate, poorly managed and inadequately sanitized toilet and washup facilities on job sites elevate the risk of intestinal ailments, as do poorly equipped and unsanitary camp kitchens and canteens and failure to consistently provide clean drinking water. The potential risks borne by workers subjected to poor conditions include mild and serious illness, loss of livelihood, and in rare cases even death.

Prescribed Mitigation. All construction camps, including those established by sub-contractors, must be designed, planned, set up and managed in accordance with international best practice, including the 2009 IFC/EBRD guidance on worker accommodations (mentioned above). Hot bedding shall be prohibited. In camps and at job sites, toilets shall be provided at the ratio of at least one toilet for every ten workers consistently present on site. Washup sinks shall be provided in similar proportions. Camp kitchens and canteens shall be housed in proper semi-permanent buildings equipped with concrete floors, adequate counter space, refrigeration and other off-floor and rodent-protected food storage space, a clean source of running water, and gas or electric stoves (not wood fires). Contractors shall institute a strict cleaning and sanitation regimen for all toilets, washup facilities and kitchens in camps and at work sites. PCs responsible for construction camps shall monitor for incidence of infestations, and work with municipal public health authorities as needed to address any that are detected. All of the camp measures identified here shall be covered in the Construction Camp Management Plan prepared by the PC and approved by the CSC before site setup.

IMPACT SUMMARY					
Impact:	Elevated risk of disease and infestations				
Direction:	Negative	Type:	Direct	Probability:	Medium
Duration:	Medium-term	Scope:	Localized	Significance:	Low
Mitigation:	• PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors • PCs to provide at least one toilet per 10 workers on job sites, as well as washup sinks in same proportion • PCs to institute strict regular cleaning and sanitation regimen for all toilets, washup facilities, kitchens and canteens on work sites and in camps				
Residual:	None expected				

Exposure to noxious and hazardous materials

Anticipated Impact. Construction workers are likely to be exposed to unhealthy levels of airborne dust, including general ground dust and cementitious dust from concrete works. Workers in batch planting operations may also be exposed to fly ash if this is used as an ingredient in concrete, as well as volatile organic compounds and metals. Dust exposure may lead to both short-term and long-term respiratory problems, as well as skin ailments and irritation of internal organs. Workers involved in equipment maintenance may be exposed to hazardous substances such as waste oils and solvents, which can be carcinogenic and may release harmful vapors leading to headaches, nausea and neurological deterioration. Those involved in demolition work during initial site clearing may be exposed to hazardous substances including asbestos (a carcinogen) and lead (a threat to neurological function).

Of the potential exposures identified above, the most significant for the BCIB project will be dust, and most particularly at the concrete batch planting operations. This includes major batch plants at the casting yard and drydock facility in Mariveles and the casting yard at the Uniwide site in Naic, as well as the several floating batch plants that will serve the concrete slurry needs of in-situ casting on the bridges and viaducts. Workers involved in running these operations and supplying the raw materials will be at greatest risk of harmful dust exposure.

Prescribed Mitigation. Exposure to elevated levels of general dust on construction sites can be effectively mitigated by implementing thorough dust suppression by means of regular spraying of dust-generating surfaces. The PCs shall ensure that adequate spraying units are allocated to the sites under their control, and that spraying is conducted at time intervals appropriate to work activity and weather conditions. Each PC shall prepare a site-specific Dust Control Plan, for review and approval of the CSC; a sample outline for such plans is provided in Appendix B to the EMP.

All batch plants shall be equipped with industry-standard dust collection systems on cement and fly ash silo vents, hopper vents, conveyors and the mixing zone, and other technology as appropriate to plant design and operation, in order to minimize dust emissions affecting ambient dust on the construction sites. Such measures shall be configured and operated in such a way as to consistently meet the US EPA AP-42 Controlled Emissions Factors for Concrete Batch Plants. Each PC operating a batch plant (including floating batch plants) shall prepare a Concrete Batch Plant Management Plan specifying, amongst other things, how dust will be controlled and monitored; a sample outline for Concrete Batch Plant Management Plans is provided in Appendix B to the EMP.

Task-related exposure to dust, including cementitious dust and fly ash will have to be mitigated by aggressive implementation of PPE. All workers involved in handling Portland cement and fly ash shall be provided with P100-rated respirators (capable of filtering out 99.9% of particles 0.3 microns and larger, if fitted properly) including regular replacement filter cartridges, as well as tight-fitting goggles, and given training on proper and mandatory respirator use during handling operations. Workers involved in handling of other dusty materials shall be provided with facemasks certified to the N95 standard (and regular replacement of same) and required to use them whenever close-quarters exposure is expected. Respirators, masks and replacements shall be provided at no cost to the worker.

With respect to demolition works, all condemned structures shall be subject to pre-demolition inspection by a qualified hazardous materials assessment contractor to identify suspected hazardous materials including asbestos-containing materials (ACM), and the same contractor shall prepare a removal plan if any are found. If ACMs are discovered, an ACM Removal and Disposal Plan shall be prepared by the assessment contractor in accordance with ADB's Good Practice Guidance for the Management and Control of Asbestos (2022).[310] Workers involved in hazardous materials removal, handling and

[310] ADB. 2022. Good Practice Guidance for the Management and Control of Asbestos: Protecting Workplaces and Communities. March 2022.

transport shall be given appropriate training and protective equipment in accordance with removal plans.

IMPACT SUMMARY					
Impact:	Exposure to harmful levels of noxious and hazardous materials				
Direction:	Negative	Type:	Direct	Probability:	HIgh
Duration:	Medium-term	Scope:	Localized	Significance:	Low-Moderate
Mitigation:	• Each PC to prepare site-specific Dust Control Plan, for review and approval of CSC prior to start of site clearing and set-up • Each PC operating a concrete batch plant (including floating batch plants) to prepare a facility-specific Concrete Batch Plant Management Plan, for review and approval of CSC prior to plant set-up and commissioning • Each PC operating a concrete batch plant to ensure that plant is equipped with industry-standard dust collection and suppression features capable of keeping emissions within limits set by US EPA AP-42 Controlled Emissions Factors for Concrete Batch Plants • Each PC operating a batch plant to provide workers involved in handling Portland cement and fly ash with P100-rated respirators, including regular filter cartridge replacements, and training on their proper and mandatory use • Each PC to provide all workers involved in handling dusty materials other than cement or fly ash with N95-rated facemasks (including regular replacements) and require their use • Each PC involved in demolition works to arrange pre-demolition inspection of condemned structures by a qualified hazardous materials assessment contractor, and implement the ACM Removal and Disposal Plan prepared by said contractor, if and as needed				
Residual:	Expected but insignificant				

Dehydration and heat exhaustion

Anticipated Impact. Day-shift workers on the BCIB project will spend long days under the tropical sun and will be at significant risk of severe dehydration and heat exhaustion, both of which can be life-threatening.

Prescribed Mitigation. All PCs shall ensure that all workers, including those in the employ of their sub-contractors, are provided with unlimited access to clean drinking water on site at all times. They shall also ensure that all workers are provided access to shaded rest areas, including workers at marine sites.

IMPACT SUMMARY					
Impact:	Dehydration and heat exhaustion				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Short-term	Scope:	Localized	Significance:	High
Mitigation:	• PCs to ensure that all workers, including those in the employ of their sub-contractors, are provided with unlimited access to clean drinking water at all times • PCs to ensure that all workers are provided access to shaded rest areas, including workers at marine sites				
Residual:	None expected				

8.2.2.6 Visual Impacts

Light leakage and visual disturbance

Anticipated Impact. It is expected that many construction activities will have to proceed around the clock in order for the project to be completed within the desired timeframe. Lighting at semi-permanent construction facilities such as the casting yards may, if not designed appropriately, be bothersome to people in nearby areas. High-intensity temporary work lighting will also be of concern along the nearshore portions of the alignment in the Naic nearshore area due to the preponderance of seaside homes and tourist accommodations (see Visual Impact Assessment in the Annexes).

The marine construction activity will be impossible to hide behind fencing, and an array of viaduct components in various stages of completion may be considered an unpleasant sight by some visitors to local beach resorts; this may lead to a decline in amenity value and business for the resorts nearest the landing point, at least until the viaduct is completed in the nearshore area.

Prescribed Mitigation. Light leakage can be minimized by use of shielded luminaries designed to direct light downward only, without any lateral emissions; all luminaries installed at all construction staging areas shall be of this type. With regards to temporary high-intensity task lighting, glare impacts can be minimized by both shielding and thoughtful placement. PCs shall be required to ensure that only task lighting arrays that can be shielded and directed downwards to minimize lateral light emissions are used on sites under their control, and to continuously monitor the use of task lighting, and direct crews to adjust lighting orientation to prevent glare for any nearby residential or tourist areas. There will inevitably some residual effect, as it is difficult to eliminate emissions of reflected light, but this should be of minor significance.

To minimize potential financial losses for beach resorts due to visual disturbance, the PCs shall prioritize these establishments in selecting local accommodations for some of their workforce (for example, foremen and site engineers).

IMPACT SUMMARY						
Impact:	Impairment of amenity values due to light leakage from nighttime construction activity					
Direction:	Negative	Type:	Direct	Probability:	HIgh
Duration:	Medium-term	Scope:	Localized	Significance:	Moderate
Mitigation:	• PCs to ensure that facility lighting at staging areas employs only shielded luminaries designed to direct light downward, to minimize lateral light emissions • PCs to ensure that only task lighting arrays that can be shielded and directed downwards to minimize lateral light emissions are used on sites under their control • PCs to continuously monitor use of high-intensity task lighting at sites under their control, and direct crews to adjust lighting orientation to minimize glare where lateral emissions are found to be occurring • PCs to give priority to beachside resorts nearest BCIB landing in Naic when selecting local accommodations for personnel					
Residual:	Expected, but of very minor significance					

8.2.3 Operation Phase Impacts and Mitigation

Operation phase impacts are those impacts which occur as a direct or indirect result of the operation and maintenance of the completed infrastructure (including scheduled and unforeseen repair works), and which are mitigated by the infrastructure owner or its designated operating entity, or by contractors engaged to carry out maintenance and repair activities. As with construction impacts, impacts occurring during operation are largely predictable, and mitigation is appropriately supported by plans developed in the lead-up to the entry of the infrastructure into normal operation.

8.2.3.1 Livelihood Impacts

Anticipated Impact. As discussed in Section 8.2.1.2, development of the BCIB infrastructure is considered likely to generate net long-term benefits for fisherfolk during the operation phase, based on the expectation that the bridge and viaduct footings and pilings will tend to increase habitat diversity and enhance fish biomass at the local scale. It has been suggested that this effect will be enhanced by creation of municipal fish sanctuaries along the BCIB alignment through joint enforcement of a no-fishing zone under and adjacent to the bridges and viaducts, using the BCIB as a surveillance platform. Development of discussions and planning towards initial set-up of the proposed fish sanctuaries has been prescribed for the pre-construction phase (in the SDP), but this is mentioned again here, because ongoing action will be required in the operation phase, when the enforcement activity will actually take place.

It is also anticipated that the presence of the BCIB will have a protective effect against activities taking place or expected to take place in the general project area that have deleterious effects on fisheries, specifically seabed mining operations. A no-dredge zone of width 1 km on both sides of the alignment is to be adopted to protect the BCIB infrastructure from possible scour risks derived from nearby dredging, and this should confer a measure of protection for fisheries resources within this zone. Realizing this incidental enhancement of fisheries protection will require enforcement of the no-dredge buffer zone throughout the operation phase.

Prescribed Enhancement. For the fisheries enhancement potential of fish sanctuaries along the BCIB alignment to come to fruition during the operation phase, it will be necessary for the DPWH-BMU to sustain its collaboration with the four municipalities involved. The DPWH-BMU should convene an annual coordination meeting with the four municipalities crossed by the alignment to ensure that surveillance using the BCIB infrastructure as a platform continues to be conducted in a safe and effective way, and that enforcement action is followed through to the satisfaction of all parties. This is prescribed under the project SDP.

With regards to enforcement of the no-dredge buffer zone, the DPWH-BMU shall undertake the following actions for the duration of the operation phase, under the auspices of the SDP: (1) monitoring of applications for seabed mining permits and their progress through the DENR-MSG vetting process; (2) participation in scoping, consultations and hearings regarding ECC applications for mining permits in nearby waters, to ensure that the buffer zone is acknowledged and avoided; and (3) regular visual monitoring along the alignment for dredging activity that threatens to impinge upon the buffer zone.

IMPACT SUMMARY					
Impact:	Impact on fisherfolk livelihoods				
Direction:	Positive	Type:	Indirect	Probability:	Moderate
Duration:	Long-term	Scope:	Widespread	Significance:	Moderate
Mitigation:	• DPWH-BMU to convene a meeting with the four municipalities crossed by the BCIB alignment at least annually to sustain collaboration on BCIB-based surveillance activity and enforcement action for long-term protection of municipal fish sanctuaries along the alignment, under the SDP • DPWH-BMU to monitor on a quarterly basis for the submittal of new applications for ECCs by proponents of seabed mining operations				

IMPACT SUMMARY	
	• DPWH-BMU to participate as necessary in scoping, consultations and hearings regarding ECC applications for seabed mining operations proposed nearby the BCIB alignment, to ensure that the non-dredge buffer zone is acknowledged and respected • DPWH-BMU to visually monitor at least monthly for the presence of seabed mining activity threatening to impinge on the no-dredge buffer zone
Residual:	Not applicable

8.2.3.2 Traffic safety risks

Anticipated Impact. Traffic safety risks on the BCIB roadways will be similar to the risks for other roadways of comparable capacity and will be derived from driver behavior (e.g., speeding, distracted driving, reckless driving, congestion, and unsafe egress and ingress maneuvers), as well as vehicle breakdowns. Unlike most other roadways in the country, accidents and breakdowns occurring on the long viaduct sections may be many kilometers from land, where help will not be available in the near vicinity; this heightens the importance of preventing occurrence to the greatest extent feasible. A number of measures have been included in the BCIB design and operations plans to reduce traffic safety risks. Tricycles, bicycles, pedestrians and vendors will not be allowed on the approach roads or viaducts, and non-emergency stopping in the shoulder lane will be prohibited. There will be a live video surveillance system, with camera equipment mounted at intervals along the crossing and connected to a central monitoring station, to enable timely detection of accidents and breakdowns so emergency response can be mobilized. Variable message signage will be mounted on gantries near on the Roman Highway and Antero Soriano Highway on both approach roads to alert drivers to any dangerous situations that may be underway, and also on either side of the mid-span turnaround structure to direct traffic flow in the event of situations requiring reversal of traffic flow or other alternative circulation measure.

As a long sea crossing in a region subject to occasional extreme weather (principally intense winds and heavy rain), the BCIB will present special concerns in relation to the safety of motorists. Deck drainage structures have been designed to accommodate projected maximum daily rainfall well above historical averages to account for expected climate change-derived increases, so flooding and hydroplaning should not present any special concern, but rain-induced low visibility and high incidence of drivers pulling onto the shoulder to wait out heavy rain may well increase accident risk. High winds may raise the risk of accidents derived from loss of control and truck blow-overs. As noted above, motorists involved in accidents on the long crossing may find themselves waiting for some time before help can be mobilized, and during very heavy weather, will be in a particularly exposed position while waiting.

Prescribed Mitigation. The probability of safety risks related to driver behavior and vehicle condition can be reduced by strictly enforcing speed limits on the crossing and including monitoring of driver behavior in traffic surveillance routines. A regimen of spot safety checks should be instituted by the DPWH-BMU to help reduce the number of unsafe vehicles using the crossing. As accident and breakdown risk cannot be reduced to zero, the DPWH-BMU must develop and maintain sufficient capacity for rapid response to incidents including accidents and breakdowns; it is understood that emergency response capacity is being addressed in Operations & Maintenance planning, which is still at an early stage at the time of writing.

With regards to weather-related risks, the DPWH-BMU must develop and implement a conditions-based bridge closure protocol, to prevent motorists and vehicles from being exposed to extremely heavy rain capable of reducing visibility, and to wind speeds (taking account of both sustained winds and gusts) sufficient to cause blow-overs and loss of control.

IMPACT SUMMARY					
Impact:	Traffic safety risks				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Short-term	Scope:	Localized	Significance:	Low
Mitigation:	• DPWH-BMU to strictly enforce speed limits on the BCIB • DPWH-BMU to include monitoring of driver behavior in bridge surveillance regimen, and strictly enforce traffic laws • DPWH-BMU to institute a regiment of spot safety checks to reduce the number of unsafe vehicles using the BCIB • DPWH-BMU to develop and implement a conditions-based protocol for bridge closure due to actual or predicted wind and rain events that may produce safety risks to infrastructure users				
Residual:	Expected, but of minor significance				

8.2.3.3 Occupational health and safety impacts

Anticipated Impact. Workers involved in maintenance of the BCIB infrastructure, from simple cleaning and monitoring tasks to more substantial repair and replacement works, will face risks associated primarily with passing vehicular traffic and work at height, and to a lesser extent with working from vessels. The bridge and viaduct girders have been designed to accommodate safe inspection, and custom-built equipment has been specified to permit inspection, upkeep and repair work on the outsides and undersides of the decks to be performed from deck-positioned booms. It is understood that measures to ensure the safety of workers involved in foreseeable upkeep, repair and replacement tasks on the BCIB infrastructure will be specified in the Operations & Maintenance plans, which are still at an early stage of formulation at the time of writing. Worker safety during maintenance works will be a function of observance of best safety practices by regular maintenance personnel and personnel of maintenance contractors engaged for specialized inspections and repairs, or for major replacement and repair works.

Prescribed Mitigation. To ensure the safety of workers during inspection, maintenance, and repair and replacement work, DPWH-BMU shall provide its personnel with infrastructure-specific, task-relevant training upon hiring, and annual refresher safety training thereafter. Outside contractors shall be contractually required by DPWH to prepare and implement detailed activity-specific occupational safety plans.

IMPACT SUMMARY					
Impact:	Occupational hazards during maintenance work				
Direction:	Negative	Type:	Direct	Probability:	High
Duration:	Short-term	Scope:	Localized	Significance:	High
Mitigation:	• DPWH-BMU to provide all of its maintenance personnel with infrastructure-specific, task-relevant safety training upon hiring, and annual refresher training • DHWH to contractually require all contractors engaged for inspection, maintenance, repair and replacement work to prepare and implement detailed occupational safety plans				
Residual:	Expected, but of minor significance				

8.2.3.4 Visual Impacts

Aesthetic degradation from solid waste issues

Anticipated Impact. Accumulation of roadside litter is to be expected with any roadway, and the BCIB approach roads will be no exception in this regard. In addition to creating water and soil pollution issues, roadside litter is unsightly, and detracts significantly from amenity values. Roadside litter is derived both from intentional action by motorists, and from inadvertent releases from open windows and inadequately secured cargoes. Anti-littering signage has been included in the roadway designs, but further action is likely to be necessary during operations.

Prescribed Mitigation. As part of continuous bridge monitoring for accidents, congestion and other problems, more serious litter generators (such as large, uncovered waste trucks) can be detected and pulled over at the other end of the bridge. Proper securement of loads can also be checked as part of periodic spot checks carried out for safety reasons (as discussed above).

Cleanup of inevitable litter will be accomplished firstly by the regular weekly pass of a vacuum sweeper (which will be part of the road maintenance regimen in part to reduce contaminants in road runoff), and secondly by maintenance crews assigned to gather litter from off-pavement areas, including embankments, ditches and all other land areas within the ROW.

IMPACT SUMMARY					
Impact:	Unsightly deposition of roadside solid waste				
Direction:	Negative	Type:	Direct	Probability:	Certain
Duration:	Long term	Scope:	Localized	Significance:	Low
Mitigation:	• DPWH-BMU to incorporate detection of uncovered trucks with easily airborne cargoes in bridge traffic monitoring, and enforce anti-littering rules on violators • DPWH-BMU to incorporate detection of uncovered trucks with easily airborne cargoes in safety spot-check regimen • DPWH-BMU to implement regular roadside litter cleanup (periodicity based on litter buildup rate)				
Residual:	Expected, but of very minor significance				

9 STAKEHOLDER ENGAGEMENT

As a matter of policy, public infrastructure projects need to take into account the interests and concerns of the people and institutions who will be affected (stakeholders), from the earliest stages of planning and design. Effective communication between the proponents of a project and the people whose lives will be affected by it (1) helps to ensure that positive impacts of the infrastructure are maximized while negative ones are prevented or minimized; (2) honors basic democratic principles; and (3) aids in forestalling development of social and political conflict surrounding allocation of public resources and provision of state permissions for projects that may cause or be accompanied by significant environmental and social change. This chapter of the EIA report details the stakeholder engagement efforts made by the consulting teams charged with preparing the first version of the EIA report in parallel with the feasibility and preliminary design, and the present updated EIA report alongside the detailed design process.

9.1 Key Requirements for Stakeholder Engagement

Effective stakeholder engagement requires that a range of stakeholders have an opportunity to learn about infrastructure proposals (disclosure) and are given an effective means of providing their knowledge and voicing their concerns as inputs to project planning and implementation (consultation). Both the Asian Development Bank (through its Safeguard Policy Statement) and the Government of the Philippines (through DAO 2017-15) mandate timely disclosure of project information and consultation with people and institutions that stand to be affected by their implementation throughout the project cycle; the specific requirements of each have been identified and compared in some detail in Chapter 2 of this EIA report.[311]

9.1.1 Disclosure

The SPS requires that project information is made publicly available at key stages of project development and implementation. At a minimum, basic details of the project rationale, objectives, preliminary infrastructure proposals and operation-phase activity need to be disseminated as part of consultations during the project preparatory phase, and the IEE needs to be disclosed on ADB’s website for at least 120 days prior to approval of the enabling loan.

Under DAO 2017-15, disclosure is formally required during early public scoping prior to the start of the EIS study; during the EIS study as part of Information, Education and Consultation (IEC) activities; when the Draft EIS study (and an accompanying summary report) is completed ; in connection with public hearings based on the Draft EIS; when the revised EIS report reflecting public comment is issued; and when the project’s ECC is issued. Disclosures are to be posted on the DENR-EMB website, and by other means at the community level as defined for different steps in the environmental assessment process.

[311] For reference, see (1) ADB. 2009. Safeguard Policy Statement. June 2009. Manila.; (2) DENR Administrative Order No. 2017-15, Guidelines on Public Participation Under the Philippine Environmental Impact Statement System.

9.1.2 Consultation

The SPS and DAO 2017-15 mandate that consultations should be carried out, at a depth commensurate with the significance of the expected impacts of the infrastructure, as an integral part of the environmental and social assessment process. The particular form that consultation may take is appropriately tailored to the cultural and social context, as well as the types of infrastructure and project activities that are proposed. Consultations often involve a combination of interviews with key informants, public meetings, focus group discussions and surveys of local knowledge and perceptions. In the two stages of the EIA study for the BCIB project, consultation relied on key informant interviews, public meetings and a perception survey.

9.2 Stakeholder Identification

Identification of stakeholders in the context of the BCIB project has, across the two study phases spanning four years, cast a wide net. Identification of stakeholders during the first round of stakeholder engagement conducted during the project's preliminary design stage (2019–2021) followed the pro-forma stakeholder identification matrix provided in the Revised Procedural Manual for DENR Administrative Order 2003-30; this format places emphasis on the political-administrative jurisdictions that will host a project's infrastructure and identifying within them relevant local governmental entities (departments and offices) and social sectors, e.g., groups representative of women, youth, elderly people, religions, people with disabilities, traditional livelihood types and so on. Subsequently, during preparation of this updated version of the EIA concurrent with the project's detailed design (2021–2023), stakeholder identification was enriched with reference to the World Bank guidance note ESS10: Stakeholder Engagement and Information Dissemination (1st edition, June 2018). The framework indicated in ESS10 focuses attention on identifying 'affected parties' (e.g., people and entities that might be expected to experience positive or negative effects of a proposed project or have responsibilities in relation to its implementation or oversight) and 'other interested parties', which may include entities that are not themselves expected to be directly affected by a proposed project, but whose missions relate to advocacy on matters of public interest (e.g., environmental sustainability, biodiversity conservation, climate change, social justice, poverty alleviation, economic development), and who may consider the project's implementation to support or detract from progress in line with their missions. In some situations, 'other interested parties' may have resources and skill sets that can be mobilized in relation to project mitigation and oversight. 'Other interested parties' might typically include NGOs (local and extra-local), certain government agencies, and academic research institutes. Exhibit 9-1 presents a list of potential stakeholders targeted for engagement based on application of the two stakeholder identification frameworks mentioned.

Exhibit 9-1 List of Stakeholders Identified for BCIB Project

Stakeholder Class	Stakeholders
GOVERNMENTAL AND QUASI-GOVERNMENTAL STAKEHOLDERS	
Proponent	Department of Public Works and Highways (DPWH)
Relevant national government agencies	Department of Environment and Natural Resources (DENR) Bureau of Fisheries and Aquatic Resources (BFAR) Philippine Coast Guard Philippine Navy
Provincial government agencies	Bataan Provincial DENR (PENRO) Cavite Provincial DENR (PENRO)
Local governments	Municipality of Mariveles - Barangay Alas Asin - Barangay Mt. View - Other nearby barangays Municipality of Naic - Barangay Timalan Balsahan - Barangay Timalan Concepcion - Other nearby barangays Municipality of Ternate
Governmental research institutes	National Fisheries Research and Development Institute (NFRDI) Marine Science Institute
Economic development entities	Authority of the Freeport Area of Bataan (AFAB) Tourism Infrastructure and Enterprise Zone Authority (TIEZA)
CIVIL SOCIETY ENTITIES	
Local representative entities	Fisherfolk associations Faith-based groups Youth groups Homeowners' associations Women's groups Overseas Filipino workers associations
Quasi-governmental local councils	Fisheries and aquatic resources management councils (FARMCs) Municipal-level community forestry programs
Non-governmental organizations	Corregidor Foundation, Inc. El Gancho (Naic) Haribon Foundation Philippine Marine Mammal Stranding Network Marine Wildlife Watch Pawikan Conservation Society Wild Bird Club of the Philippines World Wildlife Fund-Philippines Conservation International-Philippines
PRIVATE SECTOR ENTITIES	
Maritime entities	Association of International Shipping Lines MBHPP Marine Services, Inc. Ferry operators Tour boat operators Tourism associations

Stakeholder Class	Stakeholders
Land transport-related entities	Trucking companies Bus companies Taxi companies Tourist resorts
Other business entities	Industrial site operators in project area in Bataan Industrial site operators in project area in Cavite Private contractors
INDIVIDUAL STAKEHOLDERS	
Local people in project area	Landowners Small business owners Independent taxi and tricycle operators Fisherfolk Farmers Residents of project area

9.3 Disclosure Activity

The BCIB project was disclosed to stakeholders initially through early information and coordination meetings with provincial and local government bodies, as well as concerned regional and federal governmental bodies, beginning at the feasibility stage in early 2019. More recently, a video prospectus was produced for wide dissemination on the internet, and a Project Information Brochure (PIB) was produced for local distribution in the BCIB project area. The PIB and link to the prospectus video is included in the report Annexes.

9.4 Overview of Consultations

Consultation meetings, coordination meetings and interviews conducted in relation to environmental assessment over the course of the project's preparatory phase are listed in Exhibit 9-2. Detailed documentation of consultation encounters, including formal meeting notes and attendance sheets, are provided in the EIA report Annexes.

Exhibit 9-2: Summary of Consultation Encounters, 2019-2023

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
15 Apr 2019	Coordination meeting	• Philippine Coast Guard • DENR (9 participants)	• Need to coordinate with LGUs regarding access to public and private lands and municipal waters for technical surveys • Notice to Mariners will be needed to alert vessels of marine geotechnical survey work • Exact location of submarine cable off Cavite should be determined before marine geotechnical survey work • Special clearance is needed for marine geotechnical survey work near Caballo Island, which is a restricted zone
2 May 2019	Coordination meeting	• Corregidor Foundation, Inc. • Bureau of Fisheries and Aquatic Resources • Philippine Coast Guard Cluster 9 • Maritime Industry Authority (14 participants)	• Maritime Industry Authority will need to issue a permit for any foreign-registered vessel involved in marine survey work • Coordination needed between marine survey contractors and Corregidor Foundation, Inc. regarding survey work near Corregidor Island • BFAR representative indicated that there is a fish sanctuary in Naic that is close to the proposed alignment, and coordination with Naic LGU will be necessary to determine the boundaries of the fish sanctuary and possible access for survey work
7 Oct 2019 Mariveles Municipal Hall	Disclosure and consultation meeting	• Mariveles LGU (multiple offices)	• Economic benefits of project welcomed • Need to take small-scale fisheries into account in study and planning • Possible restrictions on fishing areas during construction • Source of funding, concern that it will be funded by China and built by Chinese contractors • Just compensation for landowners and informal settlers • Environmental study needs to be thorough and the findings need to be communicated to the community so people can understand what the effects will be • Project cost will be very high, and taxpayers will ultimately have to foot the bill • Who will be displaced, and where will they be resettled • Increased traffic, along with increased dust, pollution and criminal activity • Unclear how local people will benefit, despite having to bear the impacts of traffic diverted from Metro Manila - seems like Metro Manila gets the benefits, while Mariveles might just get impacts • Resettlement of fisherfolk - will they be resettled near the coast so they can continue with their livelihoods? • Suggest just connecting to the existing pier at Marina instead of building a whole new landing and approach road • Consultation needs to be good, unlike many projects in the past, and the ECC should not be granted until the local people know the impacts and agree • Need to coordinate with other agencies to ensure no utility disruptions • Possible effects on navigation • Construction specifications need to be followed so there won't be shoddy work like on some past projects • Is the construction schedule realistic? Other bridge projects have taken years longer than expected • Very difficult to file grievances on other projects - will this one be better? • Traffic disruption on other road and bridge projects have been severe and long lasting

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
			• Compensation on other projects for land lost has been unequal - hope this will be better • Monitoring and evaluation always seems to get ignored on projects • Need to coordinate with other developments along the shore • Effects on Corregidor Island - will it be overwhelmed by vehicles? • Loss of livelihood and possible alternative livelihood options for boat operators serving Corregidor Island • Need to have air quality monitoring system, like we do around GN Power • Will there be tolls? • Distribution of benefits - Mariveles will absorb impacts, but boom in tourism on Corregidor will only benefit Cavite • How will the project affect the success of efforts to clean up the bay per the Writ of Mandamus • Possible effects on ancestral domains or historic sites
9 Oct 2019 Naic Municipal Hall	Disclosure and consultation meeting	• Naic LGU	• Threat to submarine cables during construction • Routes expected to get additional traffic from bridge • How will the project fit with efforts to protect Manila Bay, such as under the Manila Bay Coastal Strategy? • Potential impacts on marine turtles and marine conservation projects • Local recruitment of workforce for construction • How can the host municipality benefit financially? We should get some of the toll amount • Construction schedule • Potential for disruption of fisherfolk and aquaculture livelihoods • Potential for incidents in the community • Potential for effects on farmers • Importance of proper process of consultation, assessment and approval
22 Oct 2019 Mayor's Office, Mariveles	Consultation meeting	• Mariveles LGU (multiple offices) (18 participants)	• Accuracy of the project maps shown and the barangays that will be affected • Impact of the project on fisherfolk • Identification of those who will be resettled • Resettlement plans for those who will need to be relocated and the accompanying compensation scheme • Toll on the proposed bridge • Impact on Bataan's security (public safety) concerns given the accessibility that the bridge will provide and the lack of toll gates on the bridge
21 Oct 2019 Mayor's Office, Naic	Consultation meeting	• Naic LGU (multiple offices) (16 participants)	• Accuracy of the project maps shown and the barangays that will be affected • Impact of the project on fisherfolk • Identification of those who will be resettled • Resettlement plans for those who will need to be relocated and the accompanying compensation scheme
31 Oct 2019 Corregidor Island	Key informant interviews	• Corregidor Foundation, Inc • Island service providers	• A road link to the island could be good for the project because it will boost tourism • A road link would be helpful in providing a way to get potable water and electricity to the island

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
		• Personnel of on-island enterprises (15 participants, as interviewees)	• With a road link, the island could be overtaken by cars, and this will negatively affect the historic values • Corregidor should stay the same - a road link can be helpful, but not if it means the ecology and historical sites of the island get destroyed • A road link will make it easier to evacuate the island in the event of typhoons
11 Nov 2019 Mayor's Office, Cavite City	Consultation meeting	• Cavite City LGU (multiple offices) • Chairperson of Barangay 53B (Corregidor Island) (15 participants)	• Clarification on the optional ramp leading to the Island • CPDO clarified that the latest information on the airstrip in the Island is that it will be maintained for its historical value but will not be operational • Project's alignment with the Sangley viaduct leading to Cavitex • Clarification on whether the alignment will directly lead to Cavite City • Clarification on whether the alignment will be connected to Calax • Timeline for commencing the project; Mayor Paredes is anxious to witness the project since it is already his last term as mayor
21 Jan 2020 Barangay Timalan Concepcion	Barangay level consultation meeting	• Barangay head and officials • Representatives of following sectors: ▪ youth ▪ senior citizens ▪ women ▪ transport ▪ fisherfolk ▪ academe ▪ persons with disabilities ▪ barangay health workers (42 participants)	• Vehicular traffic near and along Timalan Concepcion Elementary School will increase, and the school will also be affected by the planned road widening in the area • Ensuring safety in the area/community once construction begins and roads become busy • Allowing tricycles to use the bridge.
21 Jan 2020 Barangay Sibang	Barangay level consultation meeting	• Barangay head and officials • Representatives of following sectors: ▪ youth ▪ senior citizens ▪ women ▪ transport ▪ faith-based ▪ persons with disabilities ▪ barangay health workers (34 participants)	• Consideration of community welfare by the project • Plans for those who are within the project alignment • Compensation for those whose properties will be affected by the project • Benefit from the project in terms of employment

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
22 Jan 2020 Barangay Alas Asin	Barangay level consultation meeting	• Department of Education • Barangay Alas Asin (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including: ▪ youth ▪ senior citizens ▪ women ▪ homeowners ▪ faith-based ▪ transport ▪ academe ▪ persons with disabilities ▪ barangay health workers ▪ daycare workers (50 participants)	• Inclusion of exit to Corregidor on the BCIB alignment • When to expect the development and traffic from the Cavite and Bataan entry points (project timeline) • Concern regarding the pollution that the BCIB project will cause • Access of fisherfolk
22 Jan 2020 Barangay Mt. View	Barangay level consultation meeting	• Department of Education • Barangay Mt. View (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including: ▪ youth ▪ senior citizens ▪ women ▪ homeowners ▪ fisherfolk ▪ academe ▪ persons with disabilities ▪ barangay health workers (35 participants)	• Specific areas and sitio to be traversed by the BCIB alignment • Concern regarding the pollution that will be caused by the construction activities for the BCIB Project • Entity responsible in cleaning the pollutants generated during and after the construction • Inclusion of toll gates
7 Feb 2020	Scoping meeting	• Naic LGU	• Locations of marine sampling activities for the EIA study
11 Feb 2020	Scoping meeting	• Mariveles LGU	• Locations of marine sampling activities for the EIA study

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
			• Hiring of locals to support sampling activity • Existence of artificial reef project near Alas-Asin pier
21 Oct 2021 Online	Consultation and coordination meeting	• Institutional stakeholders in Corregidor Islands Marine Park Management Team (24 participants)	• Marine sampling locations for EIA study • Impingement of BCIB alignment on Corregidor Islands Marine Park
22 Mar 2022 Mariveles Municipal Hall	Consultation meeting	• Mariveles MENRO (7 participants)	• Existing environmental concerns • Solid waste management system in project area • Status of local groundwater and any previous studies of same • Safety and environmental concerns on EPZA Bypass Road • Ongoing widening of Roman Highway • Potential long-term effects of project on forests in Mariveles Mountains KBA due to enhanced access
22 Mar 2022 Barangay Hall, Alas Asin	Consultation meeting	• Barangay Chairperson and council • Fisherfolk representatives • Local fisherfolk (15 participants)	• Construction jobs for local fisherfolk • Numbers of active fisherfolk • Movements and preferred fishing areas of local fisherfolk • Typical daily income of fisherfolks • Past experience with artificial reef projects • Support for aquaculture as an alternative livelihood
23 Mar 2022 Authority of Freeport Area of Bataan, Mariveles	Consultation and fact-finding interview	• Authority of Freeport Area of Bataan (4 participants)	• Solid waste management system in Mariveles • FAB facilities proposed and under development near approach road alignment • Role of BCIB in AFAB development plans
28 Mar 2022 Corregidor Island	Consultation and fact-finding interview	• Corregidor Foundation, Inc. (Mr. Jerry Rollin) (2 participants)	• Likely visual impacts of the project for island visitors • Plans for the island's development • Status and plans for the CIMP • Fishing activity around island • State of coral resources in surrounding waters • Ecology of the island's forest cover • How the BCIB could support development of tourism on the island
29 Mar 2022 Cavite PENRO, Trece Martires	Consultation meeting	• Cavite PENRO (19 participants)	• Impingement of BCIB project alignment on CIMP • Likely impacts and mitigation under consideration • Presence of likely critical habitat and probable need for Biodiversity Action Plan per ADB requirement • Current situation with setup and operation of CIMP management programs • Project's expected return on investment

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
29 Mar 2022 Naic Municipal Hall	Consultation meeting	• Naic MENRO • NAIC MAO (8 participants)	• State of municipal solid waste management arrangements and how project waste will be managed • Groundwater availability concerns • Flooding occurrence and severity • Agriculture in the project area • Marine turtle use of local beaches • Location and management status of Naic Fish Sanctuary
29 Mar 2022 Naic Municipal Hall	Consultation meeting	• Naic MENRO • NAIC MAO • Local fisherfolk from four coastal barangays (19 participants)	• Current fisherfolk movement patterns and favored fishing areas • Impact of construction on access to fishing grounds • Interest of fisherfolk in construction jobs and need for alternative livelihood support for older fisherfolk if displaced • Relationship of project to ongoing seabed mining activity off Cavite coast (which is not popular locally)
30 Mar 2022 Cavite Capitol Building, Trece Martires	Consultation meeting	• Institutional stakeholders in Corregidor Islands Marine Park Management Team (18 participants)	• Impingement of BCIB project alignment on CIMP • Likely impacts and mitigation under consideration • Presence of likely critical habitat and probable need for Biodiversity Action Plan per ADB requirement • Current situation with setup and operation of CIMP management programs
25 May 2022 (morning) Barangay Timalan Balsahan (also open for online participation)	Barangay level consultation meeting	• Barangay Timalan Balsahan (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including: ▪ fisherfolk ▪ senior citizens ▪ women ▪ youth ▪ persons with disabilities ▪ business ▪ faith-based (34 participants)	• Access to fishing areas during construction • Types of vehicles that will be allowed on the bridge • Displacement of residents by project and expected location of resettlement • Solid waste management
25 May 2022 (afternoon) Barangay Timalan Balsahan (also open for online participation)	Barangay level consultation meeting	• Barangay Timalan Balsahan (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including:	• Local hiring for project jobs - how to get hired • Provision of alternative livelihood if fisherfolk displaced by project • Types of project jobs that may be available to local people • Possible flooding in the area due to project • Access to project information for those unable to attend • Existing seabed quarrying in Manila Bay and relationship to BCIB

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
		▪ fisherfolk ▪ senior citizens ▪ women ▪ youth ▪ persons with disabilities ▪ business ▪ faith-based (21 participants)	• Mitigation for marine impacts from BCIB and seabed quarrying
28 May 2022 Barangay Timalan Concepcion (also open for online participation)	Barangay level consultation meeting	• Barangay Timalan Concepcion (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including: ▪ fisherfolk ▪ senior citizens ▪ women ▪ youth ▪ business (30 participants)	• Land acquisition • Compensation • Bridge resilience to earthquakes • Displacement of residents by project • Types of vehicles that will be allowed on bridge • Toll fee • Access to fishing areas during construction • Compensation for displaced fisherfolk • Mode of compensation
15 Jun 2022 Barangay Alas Asin (also open for online participation)	Barangay level consultation meeting	• Barangay Alas Asin (Barangay Council and multiple officers of different departments and sub-councils) • Representatives of local civil society sectors including: ▪ senior citizens ▪ women ▪ business owners ▪ homeowners disabilities (40 participants)	• Final tagging of affected structures • Date of relocation • Contact person in case of accidents • Compensation • Eligibility for relocation and other entitlements
18 Jun 2022 Barangay Alas Asin (also open for online participation)	Barangay level consultation meeting	• Representatives of local civil society sectors of Barangays Alas Asin and Mt. View, including: ▪ senior citizens ▪ women	• Displacement and compensation • Mitigation measures for environmental impacts • Coral reef protection • Access to fishing areas during construction • Project timeline

Date and Place	Type of Engagement	Entities/Sectors Engaged	Concerns Raised and Discussed
		▪ business owners ▪ homeowners disabilities (16 participants)	• Local hiring for construction jobs
30 June 2023	NGO Consultation meeting	▪ World Wildlife Fund (WWF) Philippines ▪ Corregidor Island Foundation, ▪ Wetlands International ▪ Wild Bird Club of the Philippines ▪ Academics from the University of Philippines ▪ Center for Philippine Environment ▪ Marine Science Institute	• Corregidor Island access and impact • Biodiversity impacts and expansion opportunities • Visual access • Scientific monitoring and data gathering • Protection for fisherfolk • Sustainability and resiliency • Accommodate utility transmission lines • Stormwater conveyance

9.5 Perception Survey

In order to gain some insight into the social acceptability of the BCIB project, a perception survey questionnaire consisting of 18 substantive questions was developed in 2021, and administered in Bataan and Cavite during two field periods (February 2022 and May–July 2022).[312] A copy of the perception survey questionnaire is provided in the report Annexes.

The in-person perception survey questionnaire was administered directly by field staff using an interview methodology, in which the surveyor reads questions to the respondent, and the surveyor records responses on the questionnaire. This method has the advantage of enabling survey of people with limited literacy, and typically also results in a more complete dataset than independent completion of questionnaires by respondents. The questionnaire was accompanied by a visual reference guide comprising a map and five artistic renderings of different parts of the proposed BCIB infrastructure, and this was shown to respondents immediately prior to administration of the questionnaire, thus ensuring that all respondents had a consistent basic understanding of where the infrastructure will be constructed and what it will look like.

Administration of the survey questionnaire focused primarily on respondents living and working in the general vicinity of the project footprint, but respondents were also sought along the road corridors that will receive BCIB traffic.

In all, 650 people participated in the in-person perception survey, with 350 from Mariveles and 300 from Naic. Respondents were 57% female and 43% male in Mariveles, and 46% female and 54% male in Naic. The median age of respondents was 32 in both Mariveles and Naic. In both Mariveles and Naic, 86% of respondents indicated that their highest level of educational attainment was either secondary school, college diploma or university degree. Median income range reported by respondents in both Mariveles and Naic was 5,001–10,000 PHP per month, although the Mariveles respondent group skewed lower (78% with monthly income 10,000 PHP or less) than the Naic group (51% reporting monthly income 10,000 PHP or less).

Most survey participants in both Mariveles and Naic indicated that they knew at least 'a bit' about the BCIB project before participating in the survey (see Exhibit 9-3).

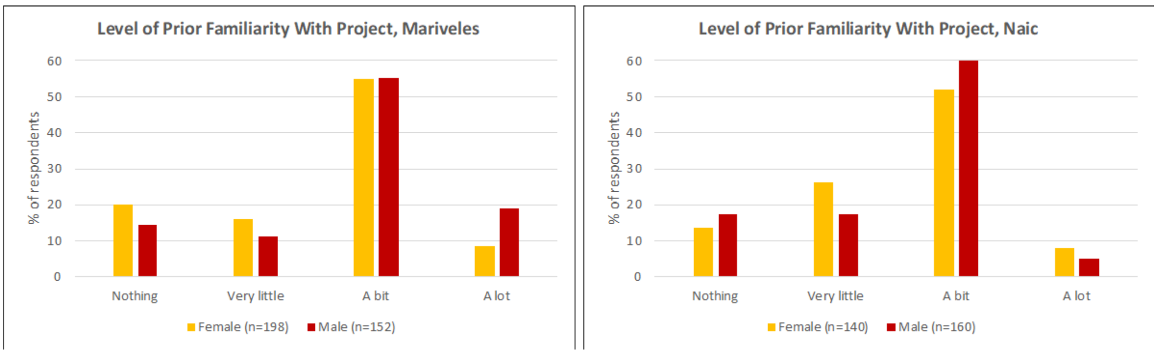


Exhibit 9-3 Respondents' Pre-Survey Familiarity With the BCIB Project

[312] An online version of the perception survey questionnaire was also developed, but failed to garner significant interest. The results reported in this chapter are from the in-person questionnaires only.

9.5.1 Summary of Perception Survey Findings

The following summary presents perception survey findings for the Bataan and Cavite portions of the BCIB project area in tandem. Although the surveys carried out on either side of the bay were standalone surveys and data was processed separately, there are numerous interesting points of comparison that can be drawn out with side-by-side presentation. All data presented have been disaggregated by gender, to illuminate and enable reflection upon possible differential perception of project effects with regards to the project.

Perception of Existing Conditions

Survey respondents were asked to reflect on the present, pre-project state of the local environment, with the following question:

- *Our natural environment (air, water, plants, animals, sea life, land, open space, etc.) affects the quality of our lives. On a scale of 1 to 5, where "1" is "very bad" and "5" is "very good," how do you feel about the quality of the natural environment in this area right now?*

The overall pattern of responses was broadly consistent across both parts of the project area, with the most frequently assigned rating being the second-least favorable response category (see Exhibit 9-4). Respondents in Mariveles were somewhat more moderate than their counterparts in Mariveles, assigning fewer 'very bad' ratings. In Naic, women were somewhat more positive about the state of the local environment than were men, whereas there were relatively minor differences in the distribution of ratings given by women and men in Mariveles.

An open-ended follow-up question asking respondents to identify specific salient environmental problems in the respective local areas did not yield useful data, as most responses were coded as 'other', so the survey offers no basis for reflection on why Naic respondents may have had a more positive view of the local environment than respondents in Mariveles. It is possible that the proximity of polluting industries in Mariveles, including the very prominent GN Power coal-fired generating station, may have contributed to greater negativity in the Mariveles data.

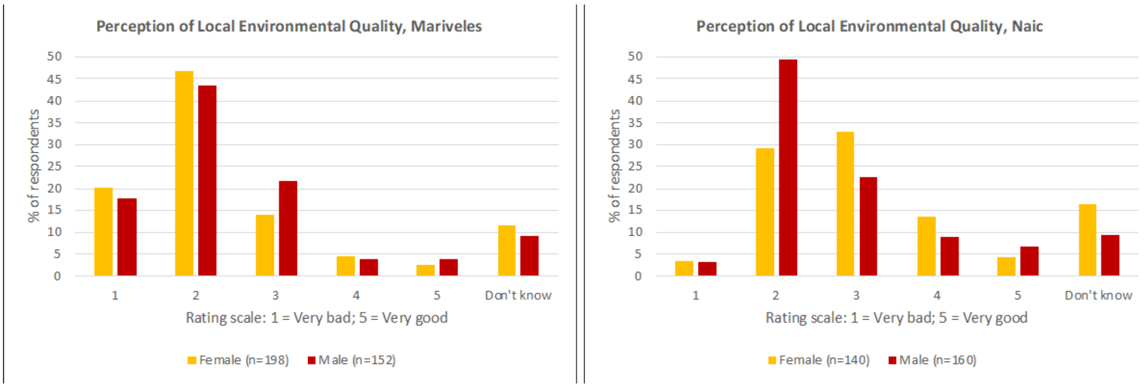


Exhibit 9-4 Perception of Pre-Project State of the Local Environment

A similar question solicited perceptions regarding prevailing socioeconomic conditions, in advance of the project's implementation:

- *How do you feel about social and economic conditions in this area right now? Please rate your answer on a scale of 1 to 5, where "1" is "very bad" and "5" is "very good."*

The second-most unfavorable rating category was again most frequently selected in both Mariveles and Naic, and Naic respondents were again somewhat less disparaging than respondents in Mariveles (see Exhibit 9-5). The overall distribution of responses is broadly similar for the two locations. Only minor differences between female and male responses were evident in Mariveles, whereas women in Naic tended to rank local socioeconomic conditions more favorably than men.

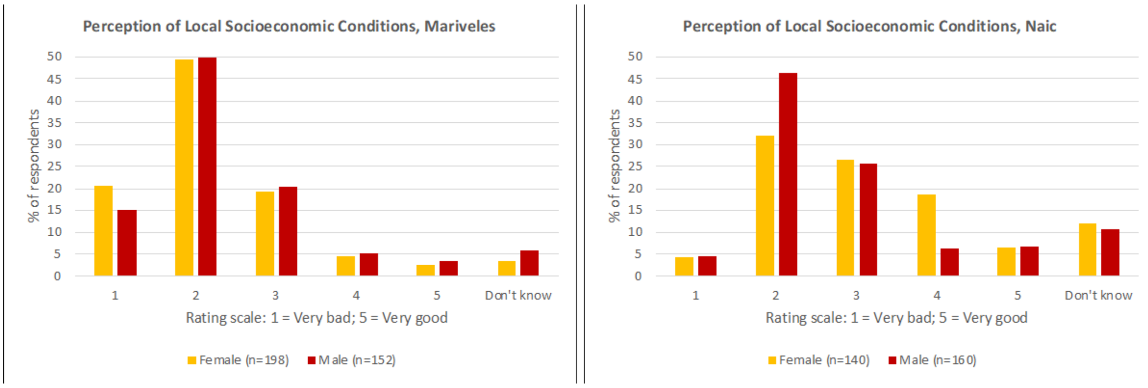


Exhibit 9-5 Perception of Prevailing Local Socioeconomic Conditions

Anticipated Effects of the BCIB Project

Perception survey respondents were asked to indicate their expectations for the project with respect to (1) effects on the local environment (during the construction phase and operation phase); (2) effects on local socioeconomic conditions (construction and operation); and (3) their own well-being and that of the broader community.

Expected Project Effects on the Local Environment and Socioeconomic Conditions

Respondents' expectations regarding possible project effects on the local environment were solicited with separate open-ended questions for the construction and operation phases:

- *Thinking about the <u>construction works</u> that would take place around here under the project, how do you think they could affect environmental conditions, compared to the situation now?*

- *Thinking about the bridge <u>once it is in operation</u>, how do you think it could affect environmental conditions, compared to the situation now?*

For the construction phase, increased pollution of some kind (e.g., air pollution, noise pollution, water pollution, land pollution) emerged as the top concern in both Mariveles and Naic (see Exhibit 9-6). Qualitative response data were not disaggregated by pollution type. In Naic, habitat destruction was also a significant a preoccupation for respondents, much more so than for Mariveles respondents. The difference between the two surveyed area in this regard could be related to surveyor coding, but it is also possible that the heightened concern about habitat in Naic is linked to current controversy surrounding seabed mining, which recently started near the San Nicolas Shoals off Cavite. During meetings with fisherfolk in Naic in March 2022, it came to light that some local people perceived a connection between the locally unpopular dredging operations and the BCIB project.

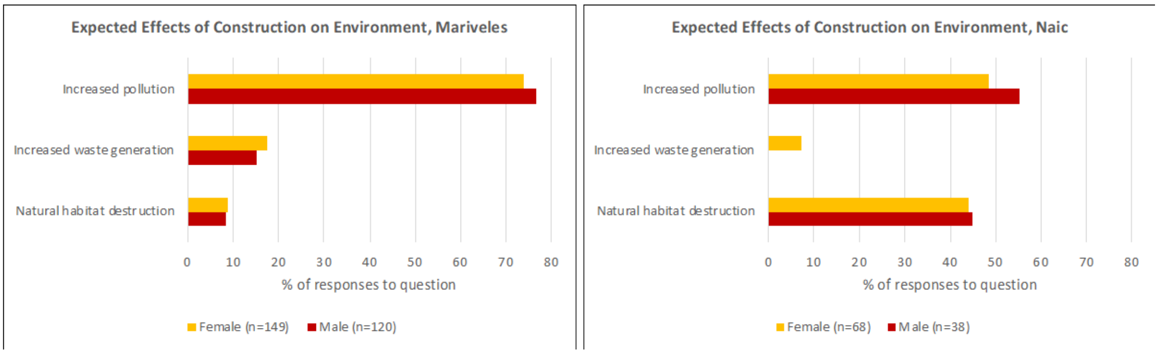


Exhibit 9-6 Anticipated Construction Effects on Local Environmental Quality

With regards to the BCIB's operation phase, 100% of responses from both women (n=57) and men (n=58) in Mariveles related to increased pollution. In Naic, 83% of female responses (n=42) regarding operation phase environmental concerns and 96% of male responses (n=25) related to pollution, with the entire remainder in both cases being responses indicating increased waste generation as a concern.

Two further qualitative open-ended questions attempted to gauge respondents' expectations regarding the possible effects of construction activity and later bridge operation on local socioeconomic conditions:

- *Thinking about the construction works that would take place around here under the project and the expected influx of non-resident workers, how do you think they could affect social and economic conditions, compared to the situation now?*

- *Thinking about the bridge once it is in operation, how do you think it will affect social and economic conditions, compared to the situation now?*

The responses regarding construction-phase effects were a mix of concerns and hopes, with respondents listing effects coded into four negative categories and one positive one (see Exhibit 9-7). Respondents anticipate that the BCIB's construction will bring opportunities for employment to local communities, but also fear that fisherfolk livelihoods and public safety will be compromised, that some will have to be resettled, and that traffic will increase. The perceived threat to fisherfolk livelihoods was expressed more frequently in Naic than in Mariveles.

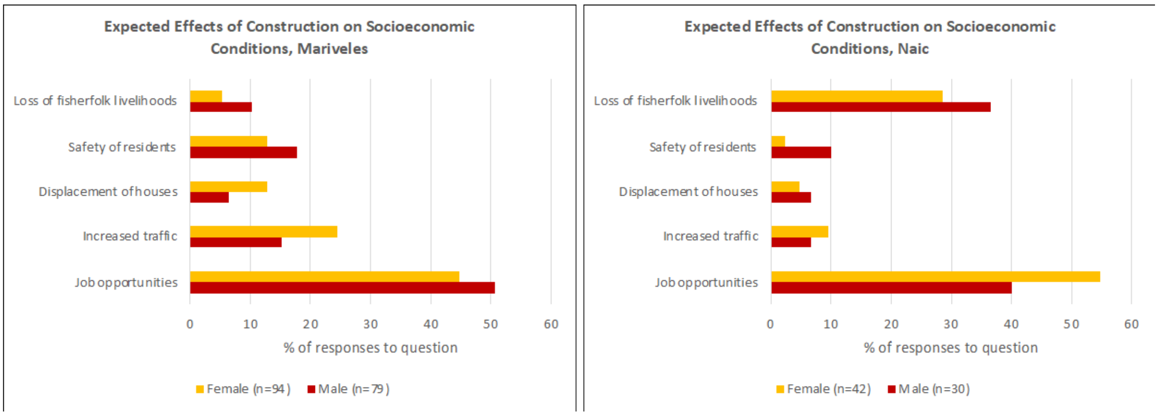


Exhibit 9-7 Anticipated Effects of Construction on Local Socioeconomic Conditions

By contrast, respondents' expectations for the operation phase of the BCIB project were all positive (Exhibit 9-8). Respondents in both Mariveles and Naic indicated most frequently that the project would bring a benefit through the creation of a transportation link, with a little over a third of respondents indicating this in Mariveles, and about half doing the same in the Naic survey. Aside from the transport benefit, all other coded categories developed from the data pertain to economic benefits.

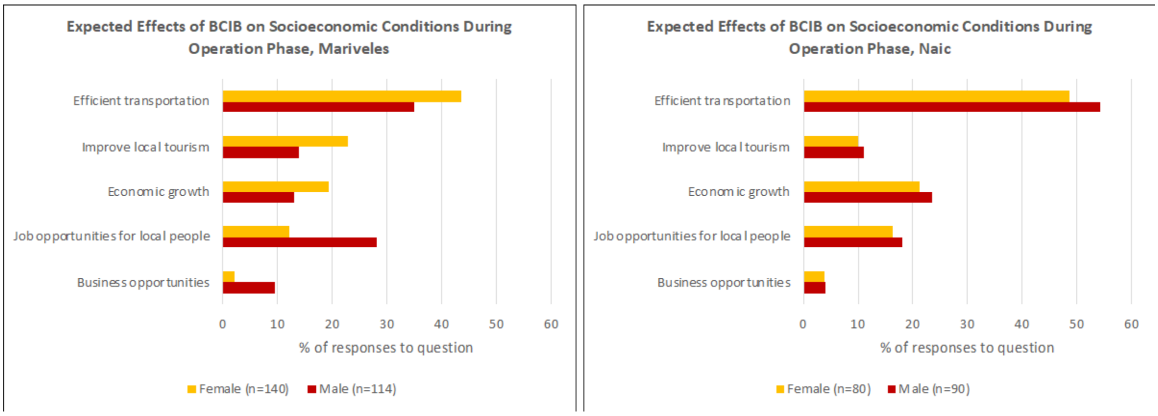


Exhibit 9-8 Anticipated Effects of Project's Operation on Local Socioeconomic Conditions

Expected Effects on Personal and Community Well-Being

Participants in the perception survey were asked four questions regarding their expectations for possible benefits and negative effects from the BCIB project, for themselves and for the community at large:

- *Based on what you know of the project right now, do you expect to benefit personally from it, and if so, in what ways?*
- *Do you expect the community in general would benefit from the project, and if so, in what ways?*
- *Based on what you know of the project right now, would you expect to personally experience any negative effects from its implementation, and if so, what?*
- *Based on what you know of the project right now, would you expect the community in general to suffer any negative effects from the project's implementation, and if so, what?*

Patterns of responses to these questions are shown together in Exhibit 9-9. Respondents in Mariveles indicated quite positive expectations for benefits from the project, with over 50% saying they expected to benefit personally, and over 65% expecting benefits to accrue for the broader community. Much lower percentages of respondents in Mariveles foresaw negative effects from the project, for themselves or for their community. Male respondents in Mariveles were both more frequently positive about potential benefits and more frequently negative about possible negative effects than female respondents.

Expectations of benefits from the project were more muted in Naic than in Mariveles, with less than a third of respondents foreseeing personal or community benefits, and similar percentages expecting negative effects. Interestingly, women in Naic were about three times as likely as men to anticipate negative personal and community effects. Unfortunately, responses to the qualitative component of the expectations questions were infrequent and mostly coded as ‘other’, so there is little basis for analysis of possible reasons for the observed gender differences; however, responses coded as ‘disruption of livelihood’, ‘heavy traffic’ and ‘habitat destruction’ were the most frequently non-‘other’ answers recorded, and women in Naic were especially likely to indicate disruption of livelihood as a concern. This may suggest a need to place emphasis on ensuring strong participation by women in job training, project recruitment and facilitative support for local enterprises, as proposed under the Social Development Plan embedded in the EMP (see Chapter 10).

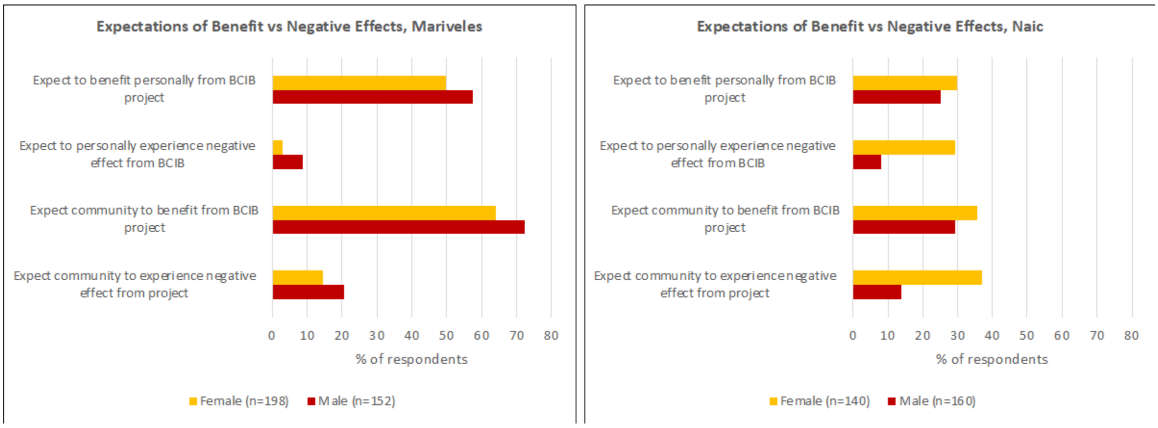


Exhibit 9-9 Expectations of Project Effects on Personal and Community Well-Being

Building on the theme of possible personal benefits from the BCIB project, respondents were asked to indicate if they would like to secure a job on the project, during or after construction:

- *Given the chance and if qualified, would you be interested to work in the construction project?*
- *Given the chance and if qualified, would you be interested to work in the bridge operation and maintenance at post-construction?*

Responses to this question illuminated some interesting bases for comparison. To begin with, men in Mariveles seem significantly more interested in jobs during both the construction and operation phase than women (which may not be particularly surprising, as it accords with traditional gender roles), while men and women in Naic expressed nearly identical levels of interest in jobs on the project (see Exhibit 9-10). Meanwhile, women's interest in project jobs is very similar in Mariveles and Naic, for both project phases, but male respondents in Mariveles are about twice as eager for project jobs as their male counterparts in Naic. These data may be suggestive of differences in the labor markets of Mariveles and Naic; men in Naic may well have a wider range of employment prospects due to Cavite's relatively close integration with the dynamic economy of Metro Manila and adjacent portions of CALABARZON. The data also suggest that hiring local workers for construction jobs is likely to be viewed very favorably in Mariveles, and that facilitation of local hiring through involvement in recruitment, training and enforcement under the Social Development Plan needs to be especially thorough there.

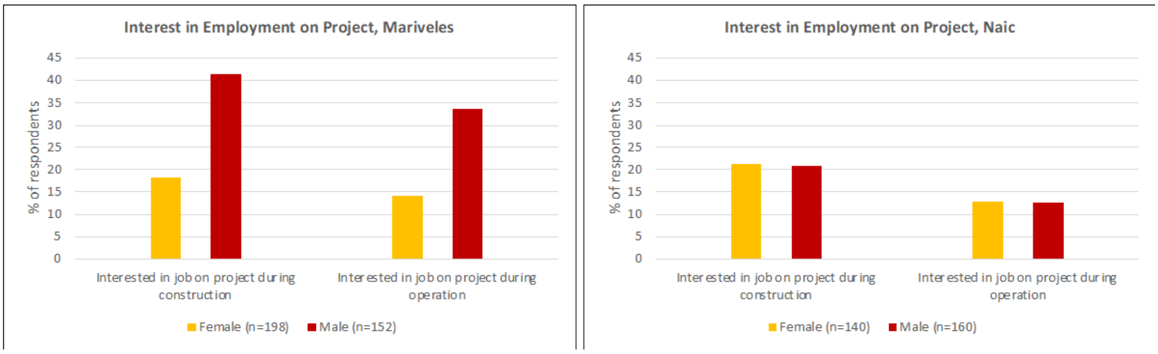


Exhibit 9-10 Respondents' Interest in Employment of the Project

Aesthetic Considerations

Perception survey participants were asked to comment on two aspects of the BCIB project's aesthetics, these being the attractiveness of the planned infrastructure itself, and the visual effect of placing the infrastructure into the local landscape. Participants were shown a series of artistic renderings of the BCIB infrastructure prior to being presented with the following questions:

- *Based on the drawings in the handout, please rate your impression regarding the likely attractiveness of the bridge on a scale of 1 to 5, where 1 is "not very aesthetically pleasing" and 5 is " very aesthetically pleasing ".*

- *Based on the drawings, please rate your impression of the likely visual effect of the bridge on the landscape and/or the view, on a scale of 1 to 5, where 1 is "not very aesthetically pleasing" and 5 is " very aesthetically pleasing ".*

Respondents expressed an overall unfavorable impression with respect to the project infrastructure's expected appearance, but a marked contrast can be seen between perceptions of respondents in Mariveles and Naic (see Exhibit 9-11). In the Mariveles results, the two most unfavorable rating categories together account for over 80% of responses, and 'not very aesthetically pleasing' is the leading category. Only 12% of Naic respondents, on the other hand, rated the BCIB infrastructure as 'not very aesthetically pleasing', and the two least favorable rating categories collectively accounted for just under 40% of overall responses there. Responses on the positive end of the scale were considerably more prevalent in Naic than in Mariveles.

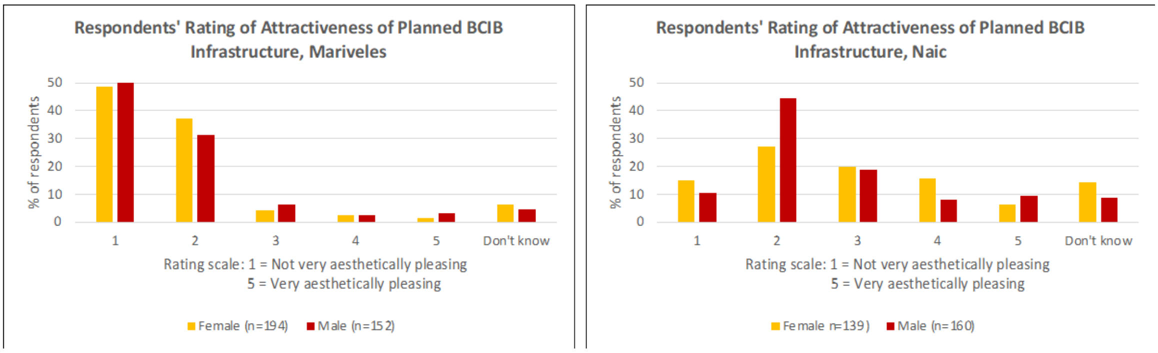


Exhibit 9-11 Perceptions of Proposed BCIB Infrastructure's Aesthetic Qualities

A nearly identical similar response pattern was illuminated with respect to the visual impact the BCIB infrastructure may have on the host landscape; responses skewed negative in general, but markedly less so in Naic than in Mariveles (see Exhibit 9-12).

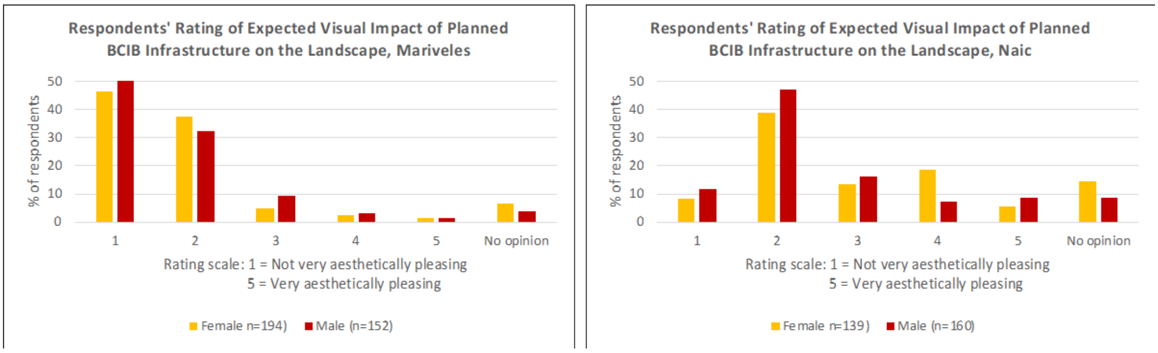


Exhibit 9-12 Perceptions of Likely Visual Impact of BCIB Project

Overall Project Favorability

The final question in the perception survey questionnaire aimed to get respondents to step back from specifics and indicate an overall sense of their current position as to the acceptability of the BCIB project as they understood it:

- *On a scale of 1 to 5, where 1 is "strongly disapprove" and 5 is "strongly approve", how would you rate your overall feeling about the possible implementation of this project?*

Results from this final 'summing up' question indicate some sharp, and somewhat surprising, contrasts between responses from Mariveles and Naic (see Exhibit 9-13). Mariveles respondents indicated an overall negative view, with about 80% of responses assigning a rating in the two least favorable approval categories. Only 6–7% of respondents in Mariveles had no opinion. Naic respondents were more moderate in their ratings, with less than 10% making use of the 'strongly disapprove' category, and noticeably more responses nearer the middle of the approval range. Interestingly, about a quarter of respondents in Naic had no opinion at all.

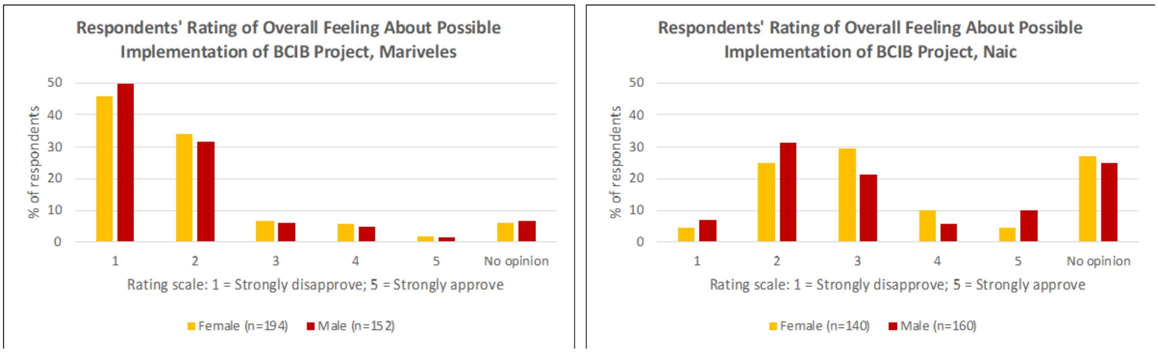


Exhibit 9-13 Overall Favorability Ratings for BCIB Project

The overall favorability findings for Mariveles are somewhat surprising, in that they seem to contradict data presented earlier regarding respondents' hopes in relation to project benefits. Specifically, respondents from Mariveles generally expressed more positive expectations for personal and community benefits from the project than did Naic respondents (see Exhibit 9-9), and responses from men in Mariveles indicated strong interest in project employment (Exhibit 9-10). At the same time, however, responses regarding anticipated construction-phase effects of the project on the local environment (Exhibit 9-6) showed considerable concern in Mariveles regarding various kinds of pollution already affecting the local environment and possibly worsened by the project, and it may be that this sensibility had some influence on ratings assigned on overall favorability.

9.6 Ongoing and Future Stakeholder Engagement

Stakeholder engagement is appropriately conceived as an ongoing process occurring throughout the project cycle and does not end with project approval. Leading into the public distribution of this Environmental Impact Assessment DPWH and ADB have reached out to Non-governmental Organizations and academic resources to obtain input on existing environmental resources, range of impact that should be considered and seeking the interest and potential for partnerships in mitigation planning and implementation.

Late June of 2023, NGO stakeholders attended a meeting either in person at the ADB Manila office or connected via the Teams Meeting virtual platform. Approximately 13 participants attended the meeting, including 2 project team members, and 4 staff from ADB. Of the 20 NGOs invited, seven attended. The organizations present included World Wildlife Fund (WWF) Philippines, Corregidor Island Foundation, Wetlands International, Wild Bird Club of the Philippines, academics from the University of Philippines, Center for Philippine Environment, and the Marine Science Institute. The meeting was held from 9am to approximately 11:30am Manila time.

During this meeting, the BCIB Environmental team presented an overview of the BCIB features, a summary of the existing conditions present around the BCIB alignment and affiliated staging areas. The presentation covered the range of impacts along with a preliminary list of mitigation measures and highlighted the resources areas where avoidance measures may be inadequate to reduce the impact to less than significant. The team focused on these residual impacts and called upon the NGO community to offer critic, suggestions and fielded general inquiries. Themes most mentioned included:

- Strong interest in the BCIB facilitating direct access to Corregidor Island
- Concerns about indirect impacts on sensitive resources on and around Corregidor Island, such as impacts on marine protected areas, food sources that might impact extensive bird life, and noise impacts
- Plan for stopping locations for persons to take-in the aesthetic features of the BCIB
- Opportunities in the project for expanding sensitive habitats, such as mangroves and wetlands
- Recommend that replacement planting tree species should be native varieties with assurance for successful propagation with a suggestion to begin early to order appropriate species well in advance of planting schedule
- Expressed interest in using of piers and underwater elements for mounting scientific monitoring and data gathering
- Potential for bicycle access
- Protection for fisherfolk – both during the construction and operational phases
- Collective interest in reviewing and commenting upon the Biodiversity Action Plan and measures
- Call for the project to use sustainable materials and plan for resiliency against climate change risks
- Request that the BCIB accommodate utility transmission lines
- Plan for intense rain events in stormwater conveyance

Following the discussion, ADB representatives explained the next steps for engagement and continued discussions that involve the review and comment period of the Draft EIA. They committed to responding and providing clarity on where their comments were considered and if not, why not.

Further engagement will be necessary at various points going forward, in the pre-construction phase, construction phase and operation phase; as a general rule, stakeholder engagement is appropriate in advance of any key inflection point after the project preparatory phase, including (1) prior to the start of construction, with a special focus on safety and quality of life impacts during the construction phase; (2) following any major change in construction methods or design adaptations that may change the nature, scale or severity of potential environmental and social impacts; (3) prior to the start of facility operations; and (4) following any significant emergency or accident involving construction sites. The project proponent will be responsible for carrying out such engagement, and the project EMP includes a Stakeholder Engagement Plan, and resource needs estimate for its implementation, to help ensure that this happens (see EMP in Chapter 10).

One step remains after disclosure of the Draft EIA: formal public comment. The Draft EIA report will be disclosed on the ADB website for at least 120 days, during which time interested parties will have the opportunity to raise questions and concerns with ADB. Meanwhile, the Draft EIA will be disclosed on the DENR website, and interested parties will have the opportunity to submit written comment and/or participate in one or more public hearings. The EIA will be finalized once these disclosure and comment steps have been carried out, and any necessary adaptations have been incorporated.

10 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Purpose and Objectives of the Environmental Management Plan

The EMP is the primary vehicle for ensuring that implementation of the proposed infrastructure is conducted in compliance with national laws and in accordance with ADB safeguards requirements. The function of the EMP is to translate environmental analysis and prescriptions for mitigation and enhancement, as laid out in the EIA report, into enforceable requirements for action, oversight and follow-up. The EMP will be reviewed and approved by DENR-EMB and its full implementation a central condition of approval of the amended ECC.[313] The EMP will be the chief mechanism for complying with the terms of the ECC throughout the project life cycle. Once the project is approved for implementation, the EMP will be made part of the bidding packages for civil works, and implementation of relevant provisions will become contractual obligations under each of the primary construction contracts. Finally, the EMP will serve as the principal tool for integrating and coordinating the actions between the entities who have an essential role in ensuring that the project is delivered in an environmentally and socially responsible manner, across the pre-construction, construction and operation phases.

The key objectives of the EMP are as follows:

1. To present a comprehensive and systematic list of measures for mitigating and enhancing anticipated environmental and social impacts, as discussed and prescribed in Chapters 5 through 8 of the EIA;
2. To define and specify institutional arrangements to support implementation of the prescribed measures;
3. To clearly assign responsibility for implementation of each prescribed measure;
4. To clearly assign responsibility for systematic monitoring of implementation of the prescribed measures and overseeing corrective action as needed;
5. To establish a system for regular reporting on EMP implementation;
6. To identify training and capacity-building needed to enable effective implementation of the EMP; and
7. To provide estimates of the costs that will have to be budgeted by various entities to enable full and effective implementation of all prescribed measures to address likely impacts.

The organization of the EMP reflects the objectives listed. First, the institutional framework, responsibilities and roles are defined, and this is followed by the environmental and social management plans. Subsequently, the plan anticipates emergency situations, outlines monitoring responsibilities, and indicates commitments for keeping the public aware and

[313] The ECC granted by DENR-EMB for the BCIB project (ECC-CO-2101-0011) in April 2021 was referenced to the EIS prepared for the project during the preliminary design stage. The ECC will be subject to amendment based on an Environmental Performance Report and Management Plan (EPRMP) that will identify design and site changes introduced during the detailed design stage, and provide the updated EMP.

updated through regular outreach. Finally, the plan describes the additional institutional capacities needed to carry out specified functions, and estimates the costs associated with EMP implementation.

10.2 Institutional Plan for EMP Implementation

Effective implementation of the project's EMP will rely on inputs from multiple entities, spanning the pre-construction, construction and operation phases of the project. Specific tasks are identified and assigned in the Environmental Impacts Management Plan and Environmental Monitoring Plan, which appear in the subsequent sections of this EMP (Sections 10.3 and 10.7 respectively). The general roles and responsibilities of each entity in implementation of the EMP are explained below, beginning with an outline of the entities that will be involved.

10.2.1 Entities With Roles in EMP Implementation

10.2.1.1 DPWH Unified Project Management Office – Roads Management Cluster II

One of three departments of the national government developing and implementing major infrastructure projects, DPWH is mandated to undertake the planning, design, construction and maintenance of national roads and bridges, flood control and water resources projects, and other public works. DPWH is the Proponent and Executing Agency for the BCIB project and will be the owner of the finished infrastructure.

As Proponent and Executing Agency, DPWH will have ultimate responsibility for ensuring that the project is implemented in accordance with applicable national laws, in compliance with the project's ECC, and in line with environmental covenants under the ADB loan. DPWH will be responsible for allocating adequate resources for implementing the project EMP, and for securing any coordination agreements with other agencies and entities necessary to ensure timely and effective implementation of the EMP, including monitoring.

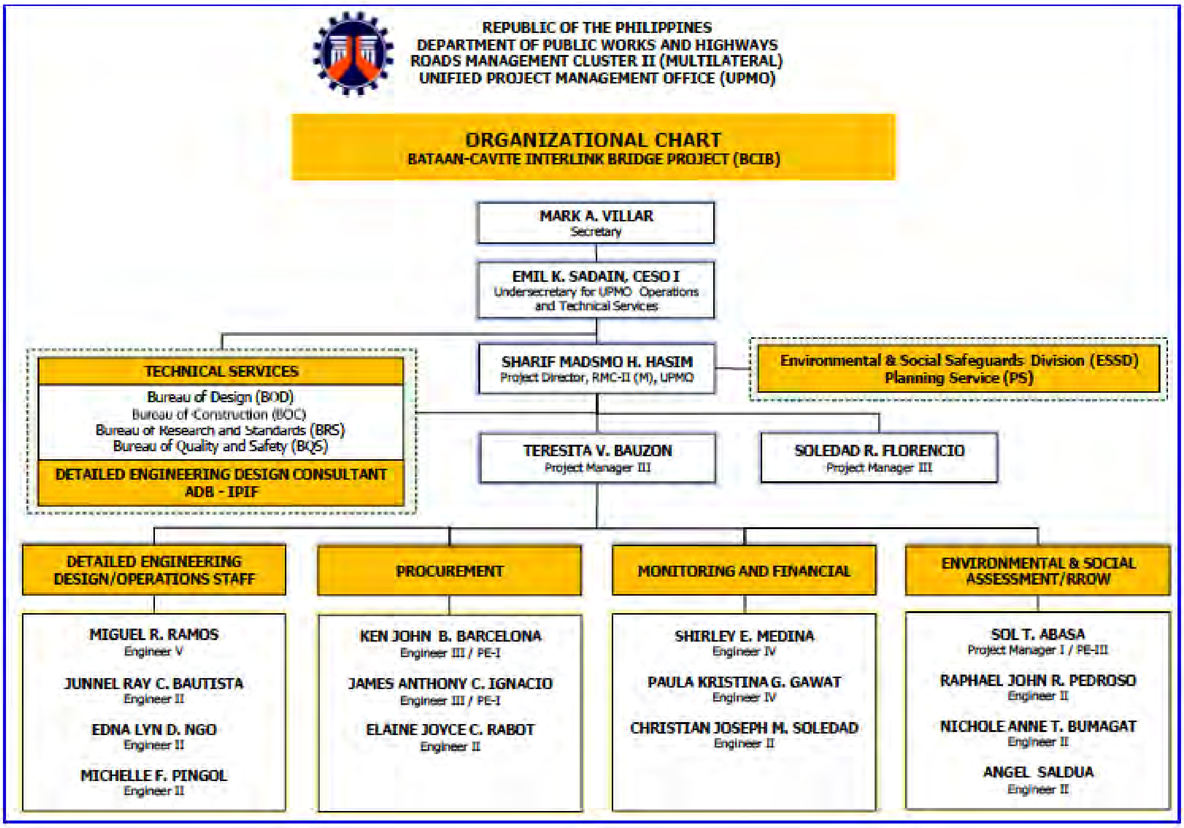
DPWH has five Unified Project Management Offices (UPMOs) to develop and implement different classes of infrastructure projects. The BCIB project has been proposed and set up under the auspices of the UPMO for the Roads Management Cluster II (Multilateral Projects), or UPMO-RMC II, which is dedicated to developing and overseeing road and highway projects proposed for financing by multilateral development institutions including ADB. The UPMO-RMC II and the other four UPMOs come under the direct supervision of the Undersecretary for UPMO Operations and Technical Services, who answers to the Secretary of Public Works and Highways.

10.2.1.2 DPWH BCIB Project Management Team

The UPMO-RMC II has assigned a project management team (BCIB-PMT) to direct and oversee implementation of the BCIB project, from early planning and design through to the start of operations. The BCIB-PMT comprises several divisions, including Detailed Engineering Design/Operations, Procurement, Monitoring & Financial, and Environmental & Social Assessment/Right-of-Way. The BCIB-PMT is headed by a Project Director, who answers to the Undersecretary for UPMO Operations and Technical Services. The organizational structure for the BCIB-PMT is shown in Exhibit 10-1.

The Environmental & Social Assessment/Right-of-Way Division (ESARD) of the BCIB-PMT leads and oversees implementation of the project's major safeguards plans, including the EMP, the Land Acquisition and Resettlement Plan (LARP) and the Gender Action Plan

(GAP). The ESARD has primary responsibility for reviewing and approving the safeguards documents and ensuring that competent mitigation and comprehensive monitoring of required planning steps and mitigation actions takes place, and all reporting is on time and of high quality.



Source: Bataan–Cavite Interlink Bridge (BCIB) Project – Environmental Impact Assessment Report. 3rd Issue, 11 February 2021. Ove Arup & Partners Hong Kong Ltd.

Exhibit 10-1 Organizational Chart of Unified Project Management Office

10.2.1.3 DPWH Environmental and Social Safeguards Division

The Environmental and Social Safeguards Division (DPWH-ESSD), under the Planning Service of DPWH, is responsible for guidance of safeguards implementation in relation to all DPWH projects. The DPWH-ESSD primarily has a review function and is involved in all stages of the EIA and LARP processes of each DPWH project, from early scoping and formulation through to oversight of monitoring in the construction phase. During the pre-construction and construction phases, the DPWH-ESSD's main roles will be review and approval of the EIA and other safeguards documents; verification of the procurement of all necessary permits, clearances and agreements; confirmation of the integrity of monitoring activities carried out by contractors and other designated parties; providing operation guidance for the project's Multi-Partite Monitoring Teams; review and approval of the consolidated monitoring reports prepared for submission to DENR-EMB and ADB; and supporting the DPWH-PMT as needed to address emerging safeguards compliance concerns, including major grievances. The DPWH-ESSD will also have a role in helping and advising the DPWH-PMT to manage coordination with DENR-EMB, other regulatory agencies, and ADB.

During operation of the completed infrastructure, DPWH-ESSD will provide its review and guidance function in relation to safeguards implementation by the DPWH entity (Bridge Management Unit or similar) with responsibility for operating and maintaining the project infrastructure, including its monitoring activity. Also, during the operation phase, the DPWH-ESSD will participate in review and oversight of medium-term and long-term biodiversity monitoring programs under the auspices of the project's Biodiversity Action Plan (BAP).

10.2.1.4 DPWH Environmental Unit

As indicated in the General Conditions of the project ECC, DPWH must establish an Environmental Unit (DPWH-EU) prior to project implementation to coordinate timely and effective actions to ensure continuous compliance with the project EMP and project ECC, including monitoring requirements and oversight of contractor and sub-contractor compliance. The ESARD of the BCIB-PMT will serve as the project's Environmental Unit (DPWH-EU), and will coordinate closely with the Primary Contractors implementing the seven construction packages; the other units of the BCIB-PMT; and the safeguards specialists of the construction supervision consultant to discharge the required duties. The senior project manager who heads the ESARD will be the designated Project Environment Officer (PEO).[314]

10.2.1.5 DPWH Environment, Health and Safety Officers

In view of the magnitude of activity and multitude of works sites both on land and in the marine environment, several Environment, Health and Safety Officers (DPWH-EHSOs) will be required at the site level to support the DPWH-EU's monitoring and oversight function. The DPWH-EHSOs will be dedicated full-time positions, rather than secondary duties assigned to site engineers, and those hired for the positions will be stationed at the works sites. In some cases, it may be appropriate for a DPWH-EHSO to be assigned to multiple closely-grouped minor works sites, but a frequent presence on each site will be a standard expectation. The DPWH-EHSOs will be trained environmental professionals capable of assessing environmental processes and conditions on-site; performing confirmatory monitoring of contractors' compliance monitoring; verifying performance of appropriate environmental sampling by Primary Contractors; supervising supplementary sampling by an outside sampling contractor when needed for verification or problem investigation; and providing guidance as needed to contractors and sub-contractors regarding implementation of best management practices and corrective action. The DPWH-EHSOs will be divided amongst two teams, based in Bataan and Cavite, respectively; each team will be headed by a Field Monitoring Supervisor (DPWH-FMS).

10.2.1.6 DPWH Bridge Management Unit

Before the end of the construction phase, DPWH will establish a Bridge Management Unit (DPWH-BMU) to run the infrastructure for its full design life. The DPWH-BMU will be responsible for implementing the EMP provisions applicable to the operation phase, and for monitoring and reporting to DENR-EMB and ADB until such time as these entities may grant relief from reporting requirements.

10.2.1.7 Primary Contractors

The BCIB project's construction will be carried out under seven work packages, and although it is possible that some firms could hold more than one of the packages, it is foreseeable that there will be as many as seven Primary Contractors (PCs). The PCs will set up and have control over the works sites, and will direct and oversee the implementation of

[314] Capacity considerations related to the DPWH-ESARD's functioning as the Environmental Unit are addressed later, in Section 10.10.1.2 of the EMP.

good site management practices in relation to environmental, health and safety aspects of the works, including all mitigation prescribed in the EMP.

Each PC will be required to prepare a Contractor Environmental Management and Monitoring Action Plan (CEMMAP) covering all of the works and related sites under its control, including all works and sites conducted and set up by its sub-contractors. The CEMMAP shall cover all aspects of the PC's responsibilities under the EMP, including the permits it must obtain; the specialized management plans it must prepare and implement (e.g., Waste Management Plan, Construction Traffic Management Plan, Construction Camp Management Plan, Soil Erosion Prevention Plan, etc.); and responsibilities for self-monitoring and reporting to DPWH. The CEMMAPs must be prepared and approved before the PC can begin any works. A sample outline for CEMMAPs is shown in Appendix A to the EMP, and outlines for prescribed specialized sub-plans are provided in the Appendix B.

Primary Contractor Environment, Health and Safety Representative

Each PC will be required to appoint an Environment, Health and Safety Representative (PC-EHSR) to ensure effective implementation of mitigation and best practices prescribed in the EMP. The PC-EHSRs will organize and oversee regular site monitoring and monthly reporting to the DPWH-EU, in conjunction with their respective PCs' monthly work progress reporting. The PC-EHSRs will be key participants in the oversight work of the DPWH-EU and will be charged with ensuring prompt and effective implementation of any corrective actions identified through PC self-monitoring or confirmatory monitoring activities of the DPWH-EU, as well as timely resolution of complaints received through the Grievance Redress Mechanism that are related to contractor activities. Each appointed PC-EHSR will appoint EHS officers (PC-EHSOs) as needed to undertake daily work site monitoring of EHS matters. The PC-EHSOs will be field staff who will be expected to have a daily presence at assigned work sites and staging areas.

Sub-Contractors

As is usual on large, complex projects, it can be expected that a significant portion of the BCIB works will be carried out by sub-contractors, most of which will be local firms. Accordingly, sub-contractors and their workers will do much of the physical work of mitigation as prescribed in the EMP. The PC-ESHRs will be responsible for ensuring that sub-contractors observe and implement prescribed mitigation competently and observe construction site best practices more generally.

10.2.1.8 Construction Supervision Consultant

A construction supervision consultant (CSC) will be engaged to guide the project construction process to a successful completion. As part of its oversight of the construction works from engineering and project management standpoints, the CSC will be required to devote supervisory attention to ensuring that the PCs' contractual commitments with respect to EMP implementation and ECC compliance are met consistently and completely, through adherence to their CEMMAPs. The CSC should have a constant presence on the sites and will be in a position to support the DPWH-EU, DPWH-EHSOs and PC-EHSRs in addressing observed compliance issues in a timely and context-informed manner. The CSC will be expected to provide guidance to the DPWH-EU in preparation of the required monitoring reports for submission to DENR and ADB.

In addition to supervising the works and EHS compliance, the CSC will have substantial responsibilities with respect to development of training and other capacity-building activities, including training provided to sub-contractors and workers, as well as the DPWH-

EHSO corps and personnel of the DPWH-EU involved in preparing monitoring reports. The CSC will also assist DPWH-EU in setting up biodiversity monitoring programs to be developed under the auspices of the project's BAP.

The CSC will be required to have qualified international and national EHS specialists on its staff to evaluate and advise in relation to EHS concerns; this should include, at a minimum:

- International EHS Monitoring Specialist;
- National EHS Monitoring Specialist;
- International Biodiversity Monitoring Specialist; and
- National Biodiversity Monitoring Specialist.[315]

10.2.1.9 DENR-EMB

DENR-EMP Central Office

The central office of DENR-EMB (DENR-CO) is the key regulatory authority for the project, and will engage with DPWH and other regulatory agencies as needed to direct resolution of significant compliance issues. The DENR-CO will receive and review environmental monitoring reports, assess the adequacy of efforts to meet key EMP requirements such as periodic stakeholder engagement processes, evaluate and process proposed amendments to the ECC, and confirm compliance with the conditions of the ECC for the life of the project.

DENR-EMB Regional Offices

The BCIB project will be implemented across two regions of the country (Regions III and IV-A), and as such will require regulatory scrutiny from two regional offices (DENR-ROs) of the DENR-EMB. The DENR-ROs will receive and review environmental monitoring reports, confirm the compliance of the project with the terms of the ECC, provide guidance and oversight to Multipartite Monitoring Teams (see below) and conduct field monitoring and investigations as needed to detect and correct violations of national laws and standards.

10.2.1.10 Multi-Partite Monitoring Team

Under DAO 2017-15 and DAO 2018-18, project proponents are required to establish a multi-stakeholder entity to enable local governments, civil society, and relevant agencies to exercise independent verification of the project's compliance with the terms of the ECC. These Multi-Partite Monitoring Teams (MMTs) review the monitoring reports of the Proponent, conduct their own observational verification monitoring, and follow up on grievances submitted by members of the public or entities in the project area.

MMTs are expected to prepare and submit semi-annual verification reports to the DENR-EMB ROs. Because the BCIB project is large and spread across two jurisdictions separated by a substantial body of water, it will be appropriate for there to be two MMTs for the project, for Bataan and Cavite respectively. Establishment of the MMTs will be initiated by DPWH, through a Memorandum of Agreement with the DENR-EMB CO, and subject to agreement of the parties that will supply representatives. As the Proponent, DPWH will support operation of the MMTs by providing financial resources and training. Oversight and guidance for MMT monitoring and reporting activity will be provided by the applicable DENR-EMB ROs.

[315] Personnel needs for the CSC are discussed in Section 10.10.1.3

MMT-Bataan

The MMT-Bataan should include representatives of the Mariveles LGU, Mariveles MENRO, Mariveles MAO and Bataan PENRO, as well as representatives of locally active civil society organizations including fisherfolk representative groups, and should concern itself with the monitoring activity carried out on project works implemented within Mariveles and marine works implemented from a shore base located in Mariveles. Since some of these marine works will be undertaken within the municipal waters of Cavite City and within the Corregidor Islands Marine Park, representatives of Cavite City, Cavite PENRO and Corregidor Foundation, Inc. should also be included in the MMT-Bataan.

MMT-Cavite

The MMT-Cavite should be made up of representatives of the Naic LGU, MENRO and MAO; Ternate LGU, MENRO and MAO (a portion of the BCIB alignment will cut across the municipal waters of Ternate), and Cavite PENRO, as well as representatives of active civil society organizations including fisherfolk representative organizations, El Gancho (a local NGO involved in management of the Naic Fish Sanctuary) and Cavite State University, which has been involved in coastal resource management over the years.

10.2.1.11 ADB

As the financing institution, ADB will exercise its due diligence and oversight functions, and maintain strong interaction with the DPWH-PMT and DPWH-ESSD. As part of its oversight, ADB may conduct periodic site visits; undertake supervision missions with detailed review by its safeguards officers and specialists. ADB will receive and review semi-annual monitoring reports from the DPWH-PMT, and drive corrective action where warranted. The project EIA (including any updated versions) and semi-annual monitoring reports will be publicly disclosed by ADB on its website. ADB will also play a lead oversight role in relation to implementation of the Biodiversity Action Plan (BAP), which will continue into the project's operation phase. Finally, ADB will prepare a project completion report that assesses whether the objectives and desired outcomes of the safeguard plans have been achieved, considering the baseline conditions and the results of monitoring.

10.2.1.12 External Monitoring Agent

ADB's SPS 2009 requires borrowers to retain qualified and experienced external experts or qualified NGOs to verify monitoring information for projects with significant impacts and risks. External experts are defined in the SPS as experts not involved in day-to-day project implementation or supervision. As the BCIB project will entail significant impacts and risks, an external monitoring agent (EMA) will be required for the BCIB project. The EMA will be identified upon approval of the amended ECC and the decision to proceed with implementation, and terms of reference defining the scope and periodicity of the EMA's responsibilities formulated at that time, through consultation between ADB and DPWH-UPMO RMC II.

10.2.2 Summary of General EMP Responsibilities

The responsibilities of each of the entities identified above are summarized in general terms in Exhibit 10-2. Assigned responsibilities for specific action items are detailed in the Environmental Impacts Management Plan Responsibility Matrix shown in the next section of the EMP. Capacity development and training needed to ensure all of the entities with assigned responsibilities will be able to discharge them effectively are outlined in Section 10.10 of the EMP.

Exhibit 10-2 General EMP Implementation Responsibilities by Entity

Entity	Responsibilities in EMP Implementation
DPWH Unified Project Management Office-Roads Management Cluster II (DPWH-UPMO RMC II)	• Designate an Environmental Unit and Project Environment Officer for the project • Ensure that all aspects of EMP implementation, including monitoring provisions, are adequately resourced • Facilitate strong coordination between DPWH-EU and other divisions of the DPWH-PMT • Facilitate interaction with DENR-EMB, other regulatory agencies and ADB as needed
DPWH Environmental Unit (DPWH-EU)	• Oversee and manage all environment-related aspects of the project during the pre-construction and construction phases • Ensure that all contractors and subcontractors strictly comply with the relevant conditions of the project ECC and measures prescribed in the EMP • Ensure that all monitoring and reporting are carried out as specified in the EMP • Liaise with DENR-EMB Regional Offices and other regulatory agencies as needed to ensure strong compliance with relevant laws and conditions of the project ECC
DPWH Project Environment Officer (PEO)	• Lead Environmental Unit (DPWH-EU), providing direction and oversight to management team and site-level personnel • Coordinate with other units of DPWH-PMT as needed • Oversee preparation of quarterly and semi-annual environmental monitoring reports as required under the Philippine Environmental Impact Statement System (PEISS) and ADB loan covenants
DPWH Environment, Health and Safety Officers (DPWH-EHSOs)	• Maintain a steady presence on construction sites to monitor activity, detect emerging issues, and liaise with EHS representatives of the primary contractors (PC-EHSRs) • Conduct regular confirmatory monitoring of site conditions and implementation of EMP-prescribed measures • Observe monitoring activity, including environmental sampling) carried out by PC-EHSRs • Enable as-needed problem-focused environmental sampling by outside monitoring contractor • Support CSC in delivery of EHS training at the site level
DPWH Environmental and Social Safeguards Division (DPWH-ESSD)	• Review and approve EIA and EMP • Verify procurement of all necessary clearances and agreements • Review monitoring reports prepared by DPWH-EU prior to submission to DENR-EMB • Participate in activities of Grievance Redress Committees as needed • Advise and assist DPWH-UPMO RMC II and DPWH-EU in managing relations with DENR-EMB, other regulatory agencies and ADB regarding project environmental issues • Review and approve monitoring reports prepared by the DPWH-BMU during the operation phase, prior to submission to DENR-EMB and ADB • Advise DPWH-BMU on continuing compliance with EMP and ECC during operation phase • Participate in oversight of the project's BAP
Primary Contractors (PCs)	• Prepare and implement Construction Environmental Management and Monitoring Action Plan (CEMMAP) covering all works and staging area sites under their control • Appoint an EHS Representative (PC-EHSR) to drive implementation of CEMMAP on all sites under their control • Conduct regular compliance and effects monitoring of works sites and staging area sites and submit monthly CEMMAP implementation monitoring reports to DPWH-EU • Direct and monitor the activities of all of its sub-contractors to ensure correct implementation of EMP-prescribed mitigation and compliance with all relevant national laws
Primary Contractor EHS Representatives (PC-EHSRs)	• Ensure that all aspects of the CEMMAP are implemented effectively • Direct and manage regular site monitoring, and prepare monthly monitoring reports for the DPWH-EU • Cooperate with DPWH-EU, DPWH-EHSOs, CSC and site engineers to resolve compliance issues • Take prompt action to resolve grievances received from stakeholders (directly or through the Grievance Redress Mechanism) regarding activity of the PC and its sub-contractors
Construction Supervision Consultant (CSC)	• Review and approve CEMMAPs and all specialized mitigation sub-plans specified in the EMP, providing guidance to PCs as needed to achieve high-quality CEMMAPs • Design and deliver EHS training as specified in the EMP • Maintain a steady presence on construction sites to verify PC and sub-contractor compliance with the CEMMAPs and EMP • Monitor and guide the works, and proactively address emerging EHS issues in coordination with DPWH-EU, DPWH-EHSOs and PC-EHSRs • Participate in the functioning of the Grievance Redress Mechanism as needed • Develop and implement training programs as specified in the EMP • Provide guidance and assistance to DPWH-EU in development of site-level monitoring protocols and plans

Entity	Responsibilities in EMP Implementation
Multi-Partite Monitoring Teams (MMTs)	• Receive and review self-monitoring reports prepared by DPWH-EU • Monitor and verify the self-monitoring activity conducted by DPWH-EU • Investigate complaints received from the public or any party regarding alleged ECC or EMP violations in connection with project sites or activities • Prepare semi-annual compliance verification reports for submission to DENR-EMB
DENR-EMB Regional Offices (DENR-ROs)	• Receive and review quarterly self-monitoring reports prepared by DPWH-EU • Receive and review semi-annual compliance verification reports prepared by MMTs • Provide operational guidance to the MMTs • Conduct site visits as needed to verify compliance with ECC and EMP, and to support investigation of alleged or suspected violations • Liaise with DPWH-EU regarding compliance issues (construction phase) • Liaise with DPWH-ESSD regarding compliance issues (operation phase)
DENR-EMB Central Office (DENR-CO)	• Receive and review monitoring reports prepared by DPWH-EU • Receive and review monitoring reports prepared by MMTs • Guide and support ROs in addressing higher-order compliance issues • Liaise with DPWH-EU as necessary to address ECC compliance issues
External Monitoring Agent (EMA)	• Conduct independent monitoring and evaluation of the project's environmental performance and report to DPWH-UPMO RMC II and ADB, as per Terms of Reference agreed by DPWH and ADB
ADB	• Receive and review semi-annual environmental monitoring reports prepared by DPWH-EU, and provide direction and guidance for corrective action as needed • Organize field missions and site visits by its safeguards specialists as deemed appropriate • Disclose EIA and semi-annual monitoring reports on ADB website • Receive and review evaluation reports prepared by EMA, and liaise with DPWH-UPMO RMC II as needed to improve performance • Lead oversight of BAP implementation in cooperation with DPWH

10.3 Environmental Impacts Management Plan

The findings of the environmental impact analysis are presented in Chapters 5 though 8 of the EIA report. The potential impacts and corresponding measures that are prescribed in order to mitigate the negative impacts or enhance positive ones are collected in the Impacts Management Plan Responsibility Matrix (Exhibit 10-3) below. Also included in Exhibit 10-3 are measures required to satisfy the conditions of approval specified in the project ECC, as issued by DENR-EMB in April 2021. Additional studies to refine impact assessments will be undertaken following disclosure of the EIA and the start of construction. Additional measures may be identified.

The measures prescribed in Exhibit 10-3 apply to the pre-construction, construction and operation phases of the BCIB project. All measures listed are requirements, not suggestions or recommendations, and each is assigned to a specific entity that will be expected to carry it out in a manner consistent with an applicable standard or to the satisfaction of the entity that will monitor performance under the Environmental Monitoring Plan. All measures assigned to PCs should be evaluated in relation to their cost and capability implications, and reflected in the CEMMAPs prepared by successful bidders following contract execution.

Cost estimates are specified in Exhibit 10-3 for items that can be considered to constitute a significant incremental cost to the implementor, as compared to normal expected day-to-day performance of site or process management. Such special incremental costs are reflections of required mitigation appropriate to the project context or conditions and resources affected (and as such may be incremental to expectations for a 'typical' project of this type); would not normally be part of operations; or are unlikely to be implemented successfully unless the implementor has foreseen the necessary expenditure and budgeted accordingly. The cost estimates are indicated primarily to highlight items that may stand outside standard expectations; it will be up to the assigned implementing entity to evaluate the specified amounts for these items and decide how best to reflect the item in its resource allocation in bids and budgets. Most items are marked 'NIC' for 'no incremental cost', as their execution can be considered standard-expected-practice and thus no special resource allocation is definable.

Exhibit 10-3: Impacts Management Plan Responsibility Matrix

Key: **CSC:** Construction Supervision Consultant; **DPWH-BMU:** BCIB Bridge Management Unit; **DPWH-ESSD:** DPWH Environmental and Social Safeguards Division; **DPWH-EU:** DPWH Environmental Unit; **DPWH-PMT:** BCIB Project Management Team; **DPWH-UPMO RMC II:** Unified Project Management Office, Roads Management Cluster II; **NIC:** No Incremental Cost; **PC:** Primary Contractor; **PC1:** Primary Contractor, Package 1; **PC2:** Primary Contractor, Package 2; **PC3:** Primary Contractor, Package 3; **PC4:** Primary Contractor, Package 4; **PC5:** Primary Contractor, Package 5; **PC6:** Primary Contractor, Package 6; **PC7:** Primary Contractor, Package 7

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
A. PRE-CONSTRUCTION PHASE						
I. IMPLEMENTATION READINESS						
1. Permits and licenses	• Project not in compliance with all requirements under ECC and relevant national and local-level regulations	• Confirm that all required permits, licenses, endorsements and any other clearance items have been secured before commencement of works, including those required by the PCs	• DPWH-EU	• All required permits, licenses, endorsements and any other clearance items have been secured prior to commencement of works, including those required by the PCs	• NIC •	Project implementation budget
2. Tree-cutting permit	• Project not in compliance with ECC requirement for tree-cutting permits	• DPWH to secure approval of tree-cutting permits from DENR (CENROs) for Bataan and Cavite ROWs • PCs to secure approval of tree-cutting permit for each staging area site where tree removal is anticipated	• DPWH-EU • PCs as applicable	• Tree-cutting permit granted by DENR for Bataan ROW • Tree-cutting permit granted by DENR for Cavite ROW • Tree-cutting permit granted by DENR for each Contractor site where tree removal is anticipated	• NIC •	Project implementation budget Anticipated in PC bid amounts
3. Pre-construction IEC activities	• Works begin without local stakeholders having been informed and prepared for what to expect, leading to confusion and resentment	• Conduct public information campaign to make people in host communities aware of the nature and timing of construction activities	• DPWH-PMT	• General public information campaigns conducted in Mariveles and Naic prior to construction • Navigation safety information campaign conducted with shipping interests • Outreach conducted with fisherfolk regarding construction-phase safety exclusion zone and safe navigation through project area	• 290,000	Project implementation budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
4. Contractor compliance	• Works begin without prescribed mitigation and monitoring measures having been reflected in PCs' planned work methods and procedures, leading to failed EMP implementation	• Contractor Environmental Mitigation and Monitoring Plan (CEMMAP) prepared by each PC immediately upon contract award, including all applicable specialized site-specific sub-plans, as follows: • Compensatory Tree Planting Plan (as applicable) • Concrete Batch Plant Management Plan (as applicable) • Construction Camp Management Plan (as applicable) • Construction Traffic Management Plan (all PCs) • Dust Control Plan (all PCs) • Demolition Waste Management Plans (as applicable) • Dredging Management Plan (as applicable) • Emergency Action Plan (all PCs) • Habitat Clearance Management Plan (as applicable) • Hazardous and Noxious Materials Management Plan (all PCs) • Human Waste and Sanitation Management Plan (all PCs) • In Water Work Management Plan (as applicable) • Marine Invasive Species Management Plan (as applicable) • Marine Sanitation and Solid Waste Management Plan (as applicable) • Marine Spill Prevention and Response Plan (as applicable) • Marine Spoils Management Plan (as applicable) • Occupational Health and Safety Management Plan (all PCs) • Road Works Safety Management Plan (as applicable) • Soil Erosion Prevention and Runoff Management Plan (all PCs) • Solid Waste Management Plan (all PCs) • Spoils Management Plan (as applicable) • Staging Area Rehabilitation Plan (as applicable) • Terrestrial Invasive Species Management Plan (as applicable)	• All PCs	• CEMMAP including all required component sub-plans prepared by each PC and submitted to CSC for review and approval	• PC1 4,000,000 • PC2I 4,000,000 • PC3 4,000,000 • PC4 4,000,000 • PC5 4,000,000 • PC6 4,000,000 • PC7 1,000,000	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
5. Contractor compliance	• Works begin without prescribed mitigation and monitoring measures having been reflected in PCs' planned work methods and procedures, leading to failed EMP implementation	• CSC to review and approve CEMMAP prepared by each PC, including all appropriate specialized sub-plans, prior to commencement of any work, including staging area set-up. Plan review shall confirm that CEMMAPs and sub-plans specify measures sufficient to enable conformance with relevant national laws and standards, as well as international best practice as appropriate. CEMMAP review shall confirm inclusion of well-specified self-monitoring plans.	• CSC	• CEMMAP including all required component sub-plans reviewed and approved by the CSC prior to commencement of any work, including staging area set-up	• NIC	Anticipated in CSC bid amount
6. Land acquisition and resettlement	• Works begin without all land acquisition and resettlement measures having been undertaken and outstanding issues resolved	• Confirm that all measures specified in the Land Acquisition and Resettlement Plan (LARP) have been implemented and any outstanding acquisition issues have been fully resolved prior to the start of any ROW clearing work	• DPWH-EU	• All LARP measures implemented and there are no outstanding land acquisition disputes or lingering holdups regarding acquisition	• NIC	Project implementation budget
7. Capacity-building for DPWH-EU	• DPWH-EU cannot adequately manage all supervision and reporting responsibilities, leading to lax enforcement and poor EHS performance	• Positions filled as per proposed organigramme in Section 10.10.1.1 of the EMP • Adequate budget allocations made for onsite transport (light motorbikes and runabout vessels) and onsite office space for EHSOs and FSMs to enable successful execution of monitoring duties	• DPWH-UPMO RMC II	• Sufficient positions established, supported by budget allocations, and filled with appropriately qualified people to ensure strong likelihood that DPWH-EU can adequately fulfill its oversight responsibilities (at least 6 months prior to the start of construction) • Suitable budget allocations have been made for onsite office space and on-site transport for EHSOs and FSMs (at least 6 months prior to the start of construction)	• 168,000,000	Project implementation budget
8. Provision of training to support EMP implementation	• Entities responsible for aspects of EMP implementation lack the requisite knowledge, leading to poor EHS performance	• Training for DPWH-EU personnel as proposed in Section 10.10.2.1 of the EMP, at least 3 months prior to start of works • Training for sub-contractors as proposed in Section 10.10.2.2 of the EMP, before start of works and whenever new sub-contractors are engaged	• CSC	• Training implemented for DPWH-EU personnel as proposed in Section 10.10.2.1 of the EMP, at least 3 months prior to start of works • Training implemented for sub-contractors as proposed in Section 10.10.2.2 of the EMP,	• 975,000	Anticipated in CSC bid amount

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Training for workers as proposed in Section 10.10.2.3 of the EMP, before start of works, whenever new crews are brought onstream, and annually for duration of construction		before start of works and whenever new sub-contractors are engaged • Training for workers implemented as proposed in Section 10.10.2.3 of the EMP, whenever new crews are brought onstream, and annually for duration of construction		
9. Coordination with Manila Bay Rehabilitation Program	• Possible lack of coordination and consistency between project EMP implementation and municipal and agency actions under the Manila Bay Rehabilitation Plan	• Coordinate with Manila Bay Coordinating Office (MBCO) to ensure complementarity of mitigation and monitoring under project EMP and municipal and agency actions taken under the Manila Bay Rehabilitation Program	• DPWH-EU	• Advance coordination meeting held with MBCO, DENR and MENROs prior to start of works	• NIC	Project implementation budget
10. Establishment of functional MMTs	• Works begin before MMTs become operational, leading to ineffective monitoring	• Constitute MMT-Bataan in a manner consistent with DAO 2017-15 and DAO 2018-18 • Establish replenishable Environmental Monitoring Fund (EMF) to cover all costs attendant to the operation and monitoring activities of the MMT-Bataan, by MOA with DENR-EMB Region III • Constitute MMT-Cavite in a manner consistent with DAO 2017-15 and DAO 2018-18 • Establish Environmental Monitoring Fund (EMF) to cover all costs attendant to the operation and monitoring activities of the MMT-Cavite, by MOA with DENR-EMB Region IV-A	• DPWH-EU	• MMT-Bataan constituted and EMF established to support it • MMT-Cavite constituted and EMF established to support it	• TBD	Project implementation budget
11. Grievance Redress Mechanisms set up	• People who feel that have been wronged by some aspect of the project's implementation lack a fair and transparent means of seeking redress, leading to resentment towards the project	• Establish a Grievance Redress Mechanism with grievance reception points in Mariveles, Naic and Manila, as per Section 10.9 of the EMP, immediately after receipt of the amended ECC and before the start of any project implementation activity, including land acquisition and set-up of staging areas	• DPWH-EU	• Grievance Redress Mechanism established as per Section 10.9 of the EMP	• NIC	Project implementation budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
12. Primary Contractor insurance	• Works begin without PCs having secured insurance adequate to cover costs of environmental damage, response and repair arising from non-compliance with EMP and CEMMAP or other negligence	• Negotiate with DENR-EMB the amount of Contractor's All Risk Insurance (CARI) coverage to be required of PCs in place of the Environmental Guarantee Fund (EGF), as per earlier MOA between DPWH and DENR-EMB • Confirm that each PC has secured Contractor's All-Risk Insurance (CARI) providing coverage of environmental damage related to non-compliance and/or negligence, in the amount agreed with DENR-EMB	• DPWH-UPMO RMC II	• Each PC has provided documentation verifying acquisition of CARI in an amount no less than agreed between DPWH and DENR-EMB	• NIC	Project implementation budget
13. Carbon Sink Program formulated and funded	• Condition of ECC not met; net emissions from project contribute to global climate crisis	• Formulate Carbon Sink Program in collaboration with DENR-EMB Region III, DENR-EMB Region IV-A, the concerned PENROs and CENROs, and submit the program to DENR-EMB Central Office prior to the start of project implementation • Allocate funds for the Carbon Sink Program's implementation	• DPWH-UPMO RMC II	• Carbon Sink Program successfully formulated and submitted to DENR-EMB CO • Fund established to pay for implementation of Carbon Sink Program	• TBD	Project implementation budget
14. Biodiversity Management Plans	• Management of risks to key biodiversity receptor groups require pre-construction longitudinal monitoring and specialized plans based on information gained from pre-monitoring	• Ensure expeditious engagement of CSC upon project approval to enable longitudinal monitoring to begin as early as possible, informing development of: Bird Management Plan Bat Management Plan Natural Grassland Management Plan Marine Turtle Management Plan Underwater Noise Management Plan	• DPWH-UPMO RMC II	• Longitudinal biodiversity monitoring underway as early as possible after project approval	• NIC	Project implementation budget
15. Biodiversity Action Plan	• Residual significant impacts on biodiversity receptors that trigger Critical Habitat to be addressed through offsets and adaptive management measures	• Establish necessary partnerships and institutional arrangements to ensure successful implementation of the programs specified in the ADB-approved BAP	• DPWH-UPMO RMC II	• Necessary partnerships and institutional arrangements established for each of the monitoring and adaptive management programs specified in the ADB-approved BAP	• NIC	Project implementation budget
16. Fund created for implementation of Biodiversity Action Plan	• Residual impacts on critical habitat and natural habitat that require offsets and/or long-term monitoring and	• Establish a dedicated fund to support long-term implementation of the BAP, under a trusteeship approved by ADB	• DPWH-UPMO RMC II	• Biodiversity Action Plan Fund established under a trusteeship approved by ADB	• TBD	Project implementation budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
	partnerships for adaptive management that are not appropriately addressed through the EMP					
17. DPWH Emergency Coordination and Communication Plan	• DPWH unprepared to serve vital coordination and communication role in event of an emergency	• DPWH to review each PC's CSC-approved Emergency Action Plan and formulate its own Emergency Coordination and Communication Plan prior to the start of works	• DPWH-EU	• DPWH Emergency Coordination and Communication Plan prepared by DPWH-EU prior to the start of works	• NIC	Project implementation budget
II. LAND						
18. Terrestrial biodiversity impacts	• Permanent loss of 12.3 ha of natural grassland in Mariveles • Loss of trees in ROWs	• Arrange for preparation and implementation of a Natural Grassland Management Plan to achieve no net loss in conservation value of natural grassland for the duration of the BCIB's designed lifespan, including ecological translocation and reestablishment of at least 12.3ha of grassland on remnant parcels along the Bataan alignment, identification and enhanced management of an additional 12 ha of grassland in a suitable location. • Design and implement additional conservation actions aimed at achieving a net gain to account for the time lag in planting habitat post-construction, under auspices of a Biodiversity Action Plan. • Apply for tree-cutting permits for ROWs and ensure that compensatory plantings are implemented as stipulated by DENR under conditions of approval	• DPWH-EU	• Preparation of the Natural Grassland Management Plan • 24.3 hectares of natural grassland planted and under long-term protective management • Tree-cutting permits secured for ROWs	• 100,000,000 • • NIC (tree-cutting permits	Project implementation budget Biodiversity Action Plan Fund (biodiversity set-asides, if required)
19. Terrestrial biodiversity impacts	• Enhanced exploitation risk in the Mariveles Mountains KBA and Mariveles Watershed Preserve due to bridge-induced development and lower price-to-market for commodities	• Develop a multi-stakeholder partnership to implement long-term monitoring of land use and resource exploitation trends in southern and eastern portions of Mariveles Mountains KBA within Mariveles and Limay municipalities, under Biodiversity Action Plan. Identify actions that will be informed by the baseline monitoring and result in a net gain in the conservation status of the KBA. • Achieve a net improvement in the conservation objectives of the KBA through better protection and management, or enhancing the conservation status of its constituent habitats and species, under the Biodiversity Action Plan	• DPWH	• Long-term monitoring and adaptive management partnership for Mariveles Mountains KBA under implementation as per Biodiversity Action Plan. • Measurable improvements to the KBA's conservation objectives	• Accounted for in BAP cost estimate	Biodiversity Action Plan Fund

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
20. Terrestrial biodiversity impacts	• Avian disturbance and mortality from the BCIB, including collisions with moving vehicles and the cable-stayed bridge components (particularly night migrants) and disorientation of birds caused by the lights.	• Develop a long-term and detailed bird monitoring program (that will start before construction) to confirm the species that use the airspace near the BCIB at all times of the year, including vantage point and transect surveys in Bataan, Corregidor Island and Cavite four times a year for all pre-construction years, throughout construction and for at least three years during operation • Develop an adaptive Bird Management Plan based on data from monitoring, including mitigation measures as needed (e.g. modified lighting schemes, need for bird deterrents etc.)	• CSC	• Monitoring and adaptive management program to develop and test programming protocol for bird-friendly application of decorative flood lighting under implementation	• Monitoring – 120,000,000 • • Adaptive Management – 250,000,000 (precautionary)	Anticipated in CSC bid amount
21. Terrestrial biodiversity impacts	• Mortality and disturbance to bats from habitat loss, collisions with vehicles and cable-stay bridge components	• Develop a long-term and detailed bat monitoring program (that will start before construction) to confirm the species that use the airspace near the BCIB at all times of the year, including vantage point and transect surveys, with the use of technology such as infrared cameras, four times a year for all pre-construction years, throughout construction and potentially for three years during operation (dependent on the findings of the initial surveys). • Develop an adaptive Bat Management Program based on data from monitoring, including mitigation measures as needed (e.g. habitat planting, roost creation or modified lighting schemes.	• CSC	• Monitoring and adaptive management program to develop and test programming protocol for bat-friendly application of decorative flood lighting under implementation	• Monitoring 100,000,000 • • Adaptive management 150,000,000 • (contingency)	Anticipated in CSC bid amount
III. WATER						
22. Fresh water	• Operational impacts due to spills and runoff from carriage ways into sensitive surface water	• Arrange for supplemental site-specific operation phase spill risk assessment using source-pathway-receptor model to determine if any design adaptations are necessary to protect sensitive waters	• CSC	• High risk sections of carriageway identified and pollution control design adaptations considered and adopted if appropriate	• 300,000	Anticipated in CSC bid amount
23. Marine biodiversity impacts	• Ecological effects on coral habitat from artificial light at night (ALAN) • Ecological effects on coral habitat from shading by bridge and viaduct decks	• Develop biodiversity offset for impacts on coral habitat, under Biodiversity Action Plan	• DPWH • CSC	• Biodiversity offset for residual impacts of ALAN and shading on coral under implementation as per Biodiversity Action Plan	• Accounted for in BAP cost estimate	Biodiversity Action Plan Fund

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
24. Marine biodiversity impacts	• Underwater noise impact on marine wildlife	• Arrange for conduct of longitudinal pre-construction baseline acoustic monitoring and preparation of Underwater Noise Management Plan based on knowledge gained of local abundance, distribution and movements of marine mammals	• CSC	• High risk periods and locations for marine mammals identified to inform adaptive management during construction • Comprehensive Underwater Noise Management Plan prepared	• Monitoring 5,000,000 • • Adapative management 5,000,000 (contingency)	Anticipated in CSC bid amount
25. Marine biodiversity impacts	• Impacts on marine turtles from direct disturbance to nesting beaches, vessel collisions and effects of lighting	• Arrange for conduct of longitudinal pre-construction baseline monitoring (including post-nesting tracking and specific surveys for critically endangered hawksbill turtles) and preparation of Marine Turtle Management Plan based on knowledge gained of local abundance, movements and habitat use of marine turtles in project-proximate areas • Implement biodiversity offset for loss of nesting habitat on beach at Naic landing point, under Biodiversity Action Plan	• CSC	• High risk nesting sites, transit routes and foraging areas identified to inform adaptive management during construction • Comprehensive Marine Turtle Management Plan prepared • Biodiversity offset under implementation as per Biodiversity Action Plan	• Monitoring • 5,000,000 • • Adaptive management 5,000,000 (contingency) • • Offset cost accounted for in BAP cost estimate	Anticipated in CSC bid amount (monitoring and management plan) Biodiversity Action Plan Fund (offset)
26. Marine coastal processes	• Risk of coastal process change along Cavite shore either caused by the project or endangering the long-term integrity of the project infrastructure	• Arrange for supplemental desktop coastal processes risk assessment to be conducted prior to construction to identify project risks and propose engineering adaptations or management measures as needed	• CSC	• Coastal processes risk assessment completed, including identification of risks and proposal of engineering adaptations or management measures as needed	• Risk assessment 1,000,000 • • Adaptive management • 2,000,000 (contingency) • •	Project implementation budget
IV. AIR						
27. Contribution to global climate crisis	• Loss of carbon sequestration capacity due to tree removal in ROWs	• DPWH-PMT to secure 145,000 native tree saplings and donate them to DENR as per DENR Memorandum Order No. 2012-02 to offset expected loss of 1,450 trees to ROW	• DPWH-PMT	• At least 145,000 native tree saplings procured and donated to DENR	• 24,000,000	Project implementation budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
V. PEOPLE						
28. Livelihoods	• Potential enhancement of land-based livelihoods	• DPWH to engage training services contractor to develop and deliver skills training for local people interested in securing employment on the BCIB project, in both Mariveles and Naic, beginning at least 6 months prior to the start of works (under SDP) • DHWH to arrange recruitment events with compulsory participation of PCs and sub-contractors to facilitate hiring of local workers, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP) • DPWH to arrange marketplace connection events with compulsory participation of PCs and sub-contractors to facilitate procurement of goods and services from local business entities, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP)	• DPWH-PMT	• Skills training for residents of Mariveles and Naic interested in securing work on the project underway at least 6 months prior to the start of works, as per SDP • Recruitment events with participation of PCs and sub-contractors held in Mariveles and Naic at least 3 months before the start of works, as per SDP • Marketplace connection events with participation of PCs and sub-contractors held in Mariveles and Naic at least 3 months before the start of works, as per SDP	• Accounted for in SDP cost estimate	SDP allocation under project implementation funds
29. Fisherfolk livelihoods	• Potential enhancement of fisherfolk livelihoods by creation of fish sanctuaries along BCIB alignment • Livelihood restoration for fisherfolk substantially affected by construction works	• DPWH-PMT to pursue discussions, agreements and support partnerships towards establishment of a contiguous series of municipal fish sanctuaries along the full length of the BCIB alignment, beginning with a consultation meeting with the four affected municipalities and Philippine Coast Guard during the pre-construction phase, under the auspices of the SDP • DPWH-PMT to implement fisherfolk livelihood restoration program, as defined under SDP	• DPWH-PMT	• Discussions between DPWH and municipalities regarding formation of partnerships to establish fish sanctuaries along BCIB underway by start of construction phase, as per SDP • Partnerships between DPWH and municipalities to establish and operate fish sanctuaries along the BCIB in place by end of construction phase, as per SDP • Fisherfolk livelihood program under implementation as per SDP	• Accounted for in SDP cost estimate	SDP allocation under project implementation funds
30. Ecosystem services	• Potential impacts on marine and freshwater ecosystem services	• Prepare a supplemental desktop study to assess potential impacts on marine ecosystem services, which will inform further assessment of impacts on marine protected areas designated for fisheries enhancement	• CSC	• Potential effects on marine ecosystem services evaluated and mitigation strategies enhanced	• 1,000,000	Anticipated in CSC bid amount

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
31. Ecosystem services	• Potential impacts on terrestrial ecosystem services	• Prepare a supplemental desktop study to assess potential impacts on terrestrial ecosystem services, which will inform further assessment of impacts on terrestrial protected areas designated or protected for the security of local timber, agriculture, biodiversity and watersheds	• CSC	• Potential effects on terrestrial ecosystem services evaluated and mitigation strategies enhanced	• 1,000,000	Anticipated in CSC bid amount
32. WWater use	• Local water scarcity as a result of project's water consumption	• Prepare a Project Water Demand Study to model the project's water needs for camps and worksites, onshore and offshore concrete batching, dust control and other activity as applicable; • Prepare a Water Use management Plan, identifying and assessing the capacity of suitable local water sources; matching demand to capacity, accounting for temporal variability and a suitable safety factor; and stipulating appropriate water conservation measures • Coordinate with PCs and municipal authorities to set up mutually acceptable water access arrangements	• CSC	• Water Use Management Plan prepared • No adverse impacts on public water supplies reported	• 300,000	Anticipated in CSC bid amount
33. Public safety impacts	• Elevated risk of accidents on roads receiving increased traffic volume due to BCIB development in Mariveles (EPZA Bypass Road and Roman Highway segments through Alas Asin, Mt. View and Cabcaben)	• Convene multi-stakeholder master planning workshop prior to start of construction phase to assess local road capacity and safety context and scope solutions, as the basis for development of projects to address foreseeable safety concerns, with participation from DPWH Planning Service, Bataan 2nd District engineering Office, Municipality of Mariveles (LGU, MPDO, MENRO, affected barangays) and AFAB	• DPWH-UPMO RMC II	• Multi-stakeholder master planning workshop convened prior to start of construction phase in Mariveles to assess local road capacity and safety context and scope solutions to observed safety issues on receiving roads • Project concepts formulated to address projected safety problems	• 50,000	Project implementation funds
34. Public safety impacts	• Elevated risk of accidents on roads receiving increased traffic volume due to BCIB development in Naic (Antero Soriano Highway in Naic and Tanza, Governor's Drive in Naic)	• Convene multi-stakeholder master planning workshop prior to the start of construction phase to assess local road capacity and safety context and scope solutions, as the basis for development of projects to address foreseeable safety concerns, with participation from DPWH Planning Service, Cavite 1st District Engineering Office, Municipalities of Naic and Tanza Mariveles (LGU, MPDO, MENRO, affected barangays)	• DPWH-UPMO RMC II	• Multi-stakeholder master planning workshop convened prior to start of construction phase in Naic to assess local road capacity and safety context and scope solutions to observed safety issues on receiving roads • Project concepts formulated to address projected safety problems	• 50,000	Project implementation funds

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
B. CONSTRUCTION PHASE						
I. LAND						
35. Terrestrial biodiversity impacts	• Degradation or destruction of habitat	• PCs to prepare Compensatory Tree Planting Plans in conformance with tree-cutting permits obtained by DPWH for respective ROWs, for review and approval of the CSC prior to the start of clearing. • PCs to arrange staging area layout to minimize area used, maintain riparian vegetation, preserve significant features (large trees, wooded areas, etc.) and avoid use of steeply sloped areas • PCs to apply for tree-cutting permits for staging areas and implement compensatory plantings as stipulated by DENR under the conditions of permit approval • Each PC to prepare a site-specific Staging Area Rehabilitation Plan, for review and approval of the CSC and fully implement all measures prior to site abandonment	• PC1 (Bataan ROW) • PC2 (Cavite ROW) • PC3 (staging sites) • PC4 (staging sites) • PC5 (staging sites) • PC6 (staging sites)	• Compensatory tree planting implemented for trees lost in ROWs by PC1 and PC2 • Staging area layouts optimized to reserve trees and wooded areas and riparian zones, which are protected by fencing • Compensatory tree planting implemented for trees removed for staging area development • Staging area sites revegetated with native species assemblages as part of pre-abandonment rehabilitation	• PC 5,000,000 • PC2 5,000,000 • PC3 5,000,000 • PC4 5,000,000 • PC5 5,000,000 • PC6 5,000,000 • PC7 NIC	Anticipated in PC bid amounts
36. Terrestrial biodiversity impacts	• Mortality and disturbance to wildlife during habitat clearance	• PCs to prepare Habitat Clearance Management Plans detailing how impacts to flora and fauna will be minimized, for review and approval by the CSC prior to the start of clearing	• All PCs	• All vegetation cleared in accordance with the approved Habitat Clearance Management Plan • No wildlife deaths reported by local people or detected by compliance monitoring	• PC1 1,000,000 • PC2 1,000,000 • PC3 1,000,000 • PC4 1,000,000 • PC5 1,000,000 • PC6 1,000,000 • PC7 NIC	Anticipated in PC bid amounts
37. Terrestrial biodiversity impacts	• Habitat degradation outside works areas due to spillover of construction activity and hunting and gathering by workers	• PCs to fence all work sites with durable and visible fencing and maintain it for the duration of works • PCs to train equipment operators to respect boundary fencing	• All PCs	• All works areas fenced with durable and visible fencing • Low incidence of right-of-way and staging area boundary transgressions	• NIC	Anticipated in PC bids

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• PCs to prohibit all workers and subcontractors from conducting any work, including materials storage and equipment parking, outside site boundaries • PCs to prohibit workers from going outside site boundaries for any personal activity				
38. Terrestrial biodiversity impacts	• Dust deposition on vegetation in habitat outside work areas	• PCs to implement regimen of light spraying of dust-generating surfaces to suppress dust • PCs to keep stockpiles of fine and otherwise dusty materials covered with tarpaulins whenever not in active use, or in 3-walled storage bunkers with walls at least 2 m higher than top of material stored • Each PC to prepare a site-specific Dust Control Plan for review and approval by the CSC prior to the start of works	• All PCs	• Low incidence of dust buildup on vegetation near work areas	• NIC	Anticipated in PC bid amounts
39. Terrestrial biodiversity impacts	• Potential disturbance of habitat along the Timalan River subject to occasional use by individuals of critical habitat-qualifying species Anas luzonica (Philippine Duck) • Potential disturbance of mangrove habitat along Timalan River by construction staging activity on Uniwide site	• PCs responsible for Uniwide staging site to establish and maintain, with durable fencing, a 30-m riparian protection zone along the Timalan River to limit disturbance of critical habitat-qualifying species known to use the river (Anas luzonica)	• PC4	• 30-m riparian buffer zone (as measured from top of bank) established with durable fencing along Timalan River for full river frontage of site area used (Uniwide site)	• PC4 300,000	Anticipated in PC bid amounts
40. Terrestrial biodiversity impacts	• Depletion of wildlife in Mariveles Mountains KBA due to hunting and gathering by construction workers in their time off	• Each PC operating a construction camp in Mariveles to incorporate prohibitions against worker hunting and gathering in construction camp rules of conduct, within its Construction Camp Management Plan	• PC1 • PC3 • PC5 • PC6 • PC7	• Prohibitions on worker hunting and gathering included in construction camp rules of conduct (Mariveles camps only)	• NIC	Anticipated in PC bid amounts
41. Terrestrial biodiversity risks	• Proliferation of invasive species	• PCs to prepare Terrestrial Invasive Species Management Plans, for review and approval of the CSC prior to the start of any works, including site clearing	• All PCs	• All works carried out in accordance with relevant Terrestrial Invasive Species Management Plan	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Road works PCs to ensure that only native plant species are used in plantings within the ROW for purposes of slope stabilization and reinstatement of vegetative ground cover • Road works PCs to ensure that only native plant species are used in plantings carried out under the auspices of their Compensatory Tree Planting Plans • All PCs to ensure that only native plant species are used in plantings carried out under the auspices of their Staging Area Rehabilitation Plans		• Only native plant species used in slope stabilization and reinstatement of ground cover in ROW • Only native tree species used in compensatory tree plantings • Only native plant species used in staging area rehabilitation		
42. Soil contamination	• Soil contamination from leaks and spills of fuels, lubricants, coolants, hydraulic fluid and other noxious substances used in construction	• PCs to use only newer-model equipment (less than 15 years old) in good condition • Each PC to register with DENR as a hazardous waste generator and comply with all DENR requirements regarding documentation of waste generation and disposal • Each PC to prepare and implement a site-specific Hazardous and Noxious Materials Management Plan, to be approved by the CSC prior to staging area set-up and start of works	• All PCs	• No evidence of active leaks observed on machinery or on ground beneath machinery • All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
				• Evidence of leaks and spills of fuels and lubricants is not observed on soil		
43. Soil contamination	• Soil contamination risks associated with demolition of existing structures	• Each PC undertaking demolition work to arrange for inspection of all condemned structures prior to start of site clearance by a DENR-recognized provider of testing and remediation services and implement any removal and remediation plans drawn up by said provider	• PC1 (ROW) • PC2 (ROW) • PC4 (Uniwide site)	• Pre-demolition inspection of all condemned structures conducted by a DENR-EMB-recognized provider of testing and remediation services • Safe removal of hazardous materials from condemned structures according to plan prepared by DENR-EMB-recognized provider of testing and remediation services, where pre-demolition survey identified hazardous materials	• PC1 500,000 • PC2 500,000 • PC4 250,000	Anticipated in PC bid amounts
44. Soil contamination	• Hazardous releases from pre-existing contaminated sites	• PC1 and PC2 to arrange for conduct of Phase II ESAs by DENR-recognized provider of testing and remediation services for filling station sites identified in P1 footprint (Shell) and P2 footprint (PTT) and oversee full implementation of any removal and remediation plan produced by the provider prior to the start of any site clearing works • Each PC to include a chance find procedure as a method statement in its CEMMAP and include training to workers and site engineers on its correct application, as part of broader induction and refresher training	• PC1 • PC2	• Phase II ESA conducted for Shell filling station site in Alas Asin, and removal/rehabilitation plan implemented if recommended by assessment firm • Phase II ESA conducted for TPP filling station in Timalan Concepcion, and removal/rehabilitation plan implemented if recommended by assessment firm • Chance find procedure for potential hazardous materials incorporated in CEMMAPs	• PC1 750,000 • PC2 750,000	Anticipated in PC bid amounts
45. Land contamination	• Contamination from improper management of construction-associated solid waste	• Each PC to prepare Solid Waste Management Plan applicable to both construction waste and regular solid waste from staging sites, for approval by the CSC prior to site setup and start of works	• All PCs	• Absence of solid waste buildup, dumping, burning or other evidence of poor waste management on construction and staging area sites	• NIC	Anticipated in PC bid amount

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Each PC undertaking demolition works to prepare Demolition Waste Management Plan for review and approval by CSC prior to start of works		• Demolition waste completely removed from ROW and demolition-applicable staging areas, except where clean concrete rubble is reserved for use in fill		
46. Physical cultural heritage	• Loss of hitherto unknown culturally significant features and artifacts	• Each PC to include a chance find procedure as a method statement in its CEMMAP and include training to workers and site engineers on its correct application, as part of broader induction and refresher training	• All PCs	• Chance find procedure included in each PC's CEMMAP and included in induction and refresher training	• NIC	Anticipated in PC bid amounts
II. WATER						
47. Impacts on freshwater ecology	• Siltation and sedimentation	• Each PC shall prepare a site-specific Soil Erosion Prevention and Runoff Management Plan, for review and approval by CSC prior to set-up of staging areas and work sites, and thoroughly implement said plans • Each PC shall ensure that all runoff discharged from sites under their control is of sufficient quality to prevent violation of surface water quality standards as specified in DAO 2016-08 (as updated by DAO 2021-19) in the receiving watercourse, as confirmed by upstream-downstream sampling at the point of discharge	• All PCs	• Observed clarity/turbidity of runoff from works sites and staging areas • Water quality in receiving watercourses downstream from site drainage discharge points is comparable to water quality upstream, as confirmed by upstream-downstream sampling and laboratory analysis • Water quality in receiving watercourses downstream from drainage discharge points meets DAO 2016-08/2021-19 Class C standard, unless upstream water quality does not	• NIC (monitoring costs accounted for under environmental monitoring plan)	Anticipated in PC bid amounts
48. Impacts on freshwater ecology	• Contamination, siltation and water chemistry change from emissions of concrete washout	• Each PC operating or overseeing operation of a concrete batch plant shall prepare a Concrete Batch Plant Management Plan, to be reviewed and approved by the CSC prior to the setup of each plant, and shall thoroughly implement said plan for the duration of plant operation • Each PC operating or overseeing operation of a concrete batch plant shall ensure that washout is recycled to the maximum extent possible as per EPA 833-F-11-006	• PC3 • PC4 • PC5 • PC6	• Concrete washout management consistent with guidance in US EPA Best Management Practice for Stormwater Management – Concrete Washout • Quality of any water discharged to the environment from washout collection and treatment facilities meets DAO	• NIC (sampling costs accounted for under environmental monitoring plan)	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Each PC operating or overseeing operation of a concrete batch plant shall ensure that any discharge of washout water to the environment meets effluent standards as specified in DAO 2016-08 (as updated by DAO 20121-19)		2016-08/2021-09 standard for industrial discharges to Class C waters, as confirmed by sampling and laboratory analysis		
49. Impacts on freshwater ecology	• Siltation and sedimentation from improper spoils management	• Each PC shall establish a spoils management site approved by the CSC prior to the start of any clearing work • Each PC shall prepare a Spoils Management Plan for review and approval of the CSC prior to the start of works • Each PC operating or supervising operation of a spoils management site shall ensure that all runoff discharged from the site is of sufficient quality to prevent violation of surface water quality standards as specified in DAO 2016-08 (as updated by DAO 2021-19) in the receiving watercourse, as confirmed by upstream-downstream sampling at the point of discharge	• All PCs	• No disposal of spoils occurring outside dedicated spoils management sites • Low incidence of erosion at spoils management sites	• NIC (sampling costs accounted for under environmental monitoring plan	Anticipated in PC bid amounts
50. Impacts on freshwater ecology	• Enrichment of watercourses from improper management of human waste	• Each PC shall prepare a site-specific Human Waste and Sanitation Management Plan. to be reviewed and approved by the CSC prior to site setup, and thoroughly implement said plan • Each PC to ensure that all septic systems, including those set up to manage raw sewage collected from mobile toilets, are designed and operated in accordance with the National Plumbing Code of the Philippines and approved by the relevant LGU	• All PCs	• Portable toilets provided at temporary works sites, and contents transported to septic systems on semi-permanent staging areas • All non-portable toilets on works sites and staging areas are connected to proper septic systems of capacity adequate to accommodate use • Septic systems are installed no closer than 50 m to site boundaries • No evidence of raw sewage on ground, in cesspools or in nearby watercourses	• PC1 1,000,000 • PC2 500,000 • PC3 500,000 • PC4 750,000 • PC5 500,000 • PC6 500,000 • PC7 100,000	Anticipated in PC bid amounts
51. Impacts on freshwater ecology	• Contamination of watercourses from leaks and spills	• All PCs to use only recent-model (less than 15 years old) equipment maintained in good condition	• All PCs	• No evidence of active leaks observed on machinery	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Each PC shall prepare a site-specific Hazardous Materials Management Plan for review and approval of the CSC prior to site setup, and shall thoroughly implement said plan		• All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident • Evidence of leaks and spills of fuels and lubricants is not observed on soil		
52. Impacts on freshwater ecology	• Direct physical degradation of watercourses from bridge and diversion works on Mariveles approach road	• PC1 to prepare In-Water Works Management Plan for review and approval by CSC prior to start of works • PC1 shall conduct channel diversion and culvert installation works on branches of the San Jose River in Alas Asin during the dry season, and shall ensure that all designed bank protection measures (e.g., riprap) are in place before the return of wet-season flows • PC1 to protect west branch of Babuyan River in Alas Asin from disturbance during construction of the Alas Asin	• PC1	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Channel diversion works (some minor branches of San Jose River in Alas Asin) conducted during dry season, with designed bank protection measures (e.g., riprap) in place	• PC1 500,000	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Waterway Bridge, by fencing off the waterway at a distance of at least 5 m from channel's edge on both sides, establishing a berm outside the fencing to prevent inflow of sediment from abutment works, and using a drop-in temporary bridge to enable crossing of the watercourse by machinery and vehicles during works		before return of wet season flows • Babuyan River protected by fencing, berms and drop-in temporary crossing plate during bridge works on Alas Asin Waterway Bridge		
53. Impacts on freshwater ecology	• Direct physical degradation of watercourses from bridge works on Antero Soriano Highway interchange west of interchange (Timalan River west branch)	• PC2 to prepare In-Water Works Management Plan for review and approval by CSC prior to start of works • PC2 shall maintain durable silt fencing in the water around bridge works at the Timalan River (west branch) and to contain siltation and sedimentation impacts to the smallest area possible • PC2 to conduct bridge works at Timalan River during dry season, and ensure that all permanent bank and abutment protection measures (e.g., riprap, gabions, armoring) are in place before the return of wet season flows	• PC2	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Bridge works carried out during the dry season to limit potential for erosion of unprotected earthworks • In-water silt curtains appropriately and competently used around bridge abutment works (Timalan River west branch near interchange) to contain siltation • Permanent bank protection promptly installed around abutments • Water quality in receiving watercourses downstream from site drainage discharge points is comparable to water quality upstream, as confirmed by sampling and laboratory analysis • Water quality in receiving watercourses downstream from drainage discharge points meets DAO 2016-08/2021-19 Class C standard, unless upstream water quality does not	• PC2 200,000	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
54. Impacts on freshwater ecology	• Direct physical degradation of watercourses from staging area setup and use	• PCs to prepare In-Water Works Management Plan for review and approval of the CSC prior to the start of any staging area setup activity • PCs shall design staging area layout to avoid conversion or modification of any watercourse with a definable channel, riparian vegetation and evidence of substantial running water for at least part of the year, and establish a 10-m setback from the channel edge on both sides • PCs shall install steel plate crossings over existing small watercourses to prevent equipment from driving through them • PCs shall fully restore any watercourse altered, damaged or otherwise degraded by site development before site decommissioning, including, at a minimum, re-establishment of the original course and planting of native riparian species, under the auspices of its Staging Area Rehabilitation Plan	• All PCs	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Unnecessary modification of pre-existing watercourses avoided during set-up of staging areas • Steel plates used as appropriate to bridge watercourses on staging area sites, in lieu of filling, driving through or placing a culvert • Pre-existing watercourses on staging areas that are modified to enable efficient site use are restored to their original courses and planted with riparian vegetation prior to site decommissioning	• NIC	Anticipated in PC bid amounts
55. Impacts on groundwater	• Contamination of groundwater from leaks and spills	• PCs shall use only recent-model equipment (less than 15 years old) maintained in good condition • Each PC shall prepare a site-specific and materials-specific Hazardous and Noxious Materials Management Plan, for review and approval by the CSC prior to the start of works, and thoroughly implement said plan.	• All PCs	• No evidence of active leaks observed on machinery • All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
				carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident • Evidence of leaks and spills of fuels and lubricants is not observed on soil		
56. Impacts on groundwater	• Local groundwater scarcity worsened by withdrawals for casting works (Uniwide site)	• Each PC operating or overseeing operation of a concrete batch plant shall prepare a site specific Concrete Batch Plant Management Plan for review and approval prior to plant setup • Each PC operating or overseeing operation of a concrete batch plant shall ensure that washout is recycled to the maximum extent possible as per EPA 833-F-11-006	• PC3 • PC4 • PC5 • PC6	• Concrete washout recycling consistent with guidance in US EPA Best Management Practice for Stormwater Management – Concrete Washout	• NIC	Anticipated in PC bid amount
57. Marine biodiversity impacts	• Destruction of coral habitat by dredging works for drydock in Mariveles • Direct physical damage to coral habitat from shallow water construction works (barge spuds, anchoring, hull contact, prop and thruster wash)	• Implement biodiversity offset for loss and degradation of benthic habitat under Biodiversity Action Plan	• DPWH-PMT	• Biodiversity offset for loss and degradation of coral habitat under implementation as per Biodiversity Action Plan	• Accounted for in BAP cost estimate	Biodiversity Action Plan fund
58. Marine biodiversity impacts	• Siltation and sedimentation of coral habitat in Mariveles and Corregidor Island nearshore zones • Siltation and sedimentation of fish habitat in Naic Fish Sanctuary nearby project alignment	• Each PC responsible for marine works involving dredging, placement and removal of temporary jetties, excavation for spread-foot foundations, excavation of pile interiors or concrete pouring shall ensure competent and consistent deployment of surface-to-seabed silt curtains in a tight configuration around said works whenever they are carried on within the following zones : (1) Mariveles nearshore zone (0–25 m depth), including both the alignment and drydock facility; (2) Corregidor Island	• PC3 • PC4 • PC5 • PC6	• Silt curtains consistently deployed around marine foundation works in waters to depth of 25 m in Mariveles nearshore, Corregidor Island nearshore and Naic nearshore • Silt curtains consistently deployed around dredging and jetty placement/removal works (Mariveles nearshore)	• PC3 12,000,000 (silt curtains) • PC4 15,000,000 (silt curtains) • PC5 5,000,000(silt curtains)	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
	• Impacts of suspended solids on critical habitat (e.g. Corregidor Islands Marine Park	nearshore zone (0–25 m depth); and (3) Naic nearshore zone (0–25 m depth) • Each PC responsible for marine works involving dredging, placement and removal of temporary jetties, excavation for spread-foot foundations, excavation of pile interiors or concrete pouring shall deploy real-time turbidity monitoring buoys around work sites near sensitive locations to enable timely corrective action if fugitive suspended solids are detected • Each PC responsible for generating marine spoils, including dredged and excavated seafloor sediments and material excavated from pile interiors, shall undertake a Best Practical Environmental Options Study to identify reuse or disposal options and permitting requirements for any disposal considered • Each PC responsible for generating marine spoils, including dredged and excavated seafloor sediments and material excavated from pile interiors, shall prepare a Marine Spoils Management Plan, for review and approval by the CSC prior to the start of works, and implement said plan thoroughly and consistently for the duration of works		• Silt curtains consistently deployed during concrete pouring work, for piers within or nearby critical habitat (5+900–7+100; 11+800–13+800; 25+800–28+000) • No observable turbidity plume reaching critical habitat areas or marine protected areas • Marine water quality in sample at nearest critical habitat area is comparable to water quality in sample from nearby control station • Marine water quality meets DAO 2016-08/2021-19 standard for Class SA waters at critical habitat area nearest the designated foundation work and dredging sites, unless sample from nearby control station does not meet the same standard • Appropriate permits obtained for any sea disposal of spoils	• PC6 5,000,000 (silt curtains)	
59. Marine biodiversity impacts	• Siltation and water chemistry change from release of concrete washout from floating batch plants	• Collect and recycle all concrete washout generated on floating batch plants back to the plant • Recycle solid washout components back into batch plants, or transfer to a sealed barge for removal to one of the established on-land spoils sites • Confirm by prior testing that any washout water destined for release after filtration meets DAO-2016-8/2021-19 standard for discharge to Class SB waters (outside CIMP) or Class SA waters (inside CIMP)	• PC3 • PC4 • PC5 • PC6	• Concrete washout generated on floating batch plants is recycled back to the plants, to the maximum extent feasible • Solid washout components recycled back into batch plants to the maximum extent feasible, or transferred to a sealed barge for removal to one of the established on-land spoils sites • Any washout water released after onboard treatment meets DAO-2016-8/2021-19 standard for discharge to Class SB waters	• NIC (sampling cost accounted for under environmental monitoring plan)	Anticipated in PC bids

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
				(outside CIMP) or Class SA waters (inside CIMP)		
60. Marine water quality impacts	• Contamination of marine biota from spills and leaks of fuels, lubricants, hydraulic fluids, coolants and other noxious fluids	• Each marine works PC shall prepare a Marine Spill Prevention and Response Plan, for review and approval by the CSC prior to the setup of any marine works • Each marine works PC shall consistently maintain supplies and equipment for spill response and cleanup on each vessel or platform where noxious fluids are handled, in accordance with its Marine Spill Prevention and Response Plan, for the entire duration of marine works • Each marine works PC shall provide regular training to all on-the-water personnel regarding spill prevention and response, in accordance with its CSC-approved Marine Spill Prevention and Response Plan, for the duration of marine works • Each PC responsible for operating or overseeing operation of a waterside fuel station shall ensure that the facility is designed to withstand wave action and storm surge typical of local conditions during a strong typhoon, as well as vessel strikes, and shall obtain the approval of the CSC for facility designs and operating procedures prior to facility setup	• PC3 • PC4 • PC5 • PC6	• Each marine contractor maintains adequate supplies and equipment for spill response and cleanup on each vessel or platform where noxious fluids are handled • Low incidence of marine spills • Prompt and effective cleanup of any spills that occur • All fuel docks designed to withstand heavy wave action and vessel strikes	• PC3 2,000,000 • PC4 2,000,000 • PC5 2,000,000 • PC6 2,000,000	Anticipated in PC bids
61. Marine water quality impacts	• Contamination of marine biota from spillage of loose asphalt and sprayed oil during paving operations	• Seal off all deck scuppers during paving operations to prevent spillage • Sweep up all loose asphalt material left after paving, and before scuppers are re-opened	• PC3 • PC4 • PC5 • PC6	• Bridge and viaduct deck scuppers thoroughly sealed during paving works • Loose asphalt material swept up and removed from bridge and viaduct decks before unblocking deck scuppers	• NIC	Anticipated in PC bids
62. Marine biodiversity impacts	• Localized eutrophic effects from human waste emitted from marine works sites and vessels	• Each marine works PC shall prepare a Marine Sanitation and Solid Waste Management Plan, for review and approval of the CSC prior to the start of works • Each marine works PC shall consistently ensure that adequate toilet facilities are provided for all offshore workers, and that human waste is collected and properly treated on land, in accordance with the Marine Sanitation	• PC3 • PC4 • PC5 • PC6	• All large vessels and work platforms are equipped with toilets appropriate to the number of workers, each equipped with a holding tank • Human waste collected daily or as needed from all vessels and work platforms	• PC3 4,000,000 • PC4 4,000,000 • PC5 4,000,000	Anticipated in PC bids

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		and Solid Waste Management Plan, for the duration of the marine works • Each marine works shall develop on-land septic treatment for human waste collected offshore, meeting specifications of the National Plumbing Code of the Philippines and subject to approval of the Mariveles LGU		• No evidence of raw sewage being dumped from project vessels or work platforms • Dedicated human waste transfer facility and septic systems built and competently operated at on-land staging areas, with sufficient capacity to handle human waste collected from offshore vessels and work sites	• PC6 4,000,000 • (Estimates reflect probable sharing of equipment and costs by PCs)	
63. Marine biodiversity impacts	• Deleterious effects on marine organisms from solid waste discarded from marine works sites and vessels	• Each marine works PC shall strictly prohibit dumping, littering and careless waste handling by any person involved in marine operations under its control • Each marine works PC shall preapre a Marine Sanitation and Solid Waste Management Plan, including provisions for at-sea collection of solid waste and appropriate on-land storage, segregation, recycling and disposal, for the review and approval of the CSC prior to the start of marine works, and thoroughly and consistently implement all provision of said plan for the duration of the works • Each marine works PC shall install and properly operate and maintain a solid waste management facility at shore sites to receive, and store solid waste brought ashore from vessels and work platforms, and process waste for onward recycling and disposal in accordance with the marine Sanitation and Solid Waste Management Plan	• PC3 • PC4 • PC5 • PC6	• No evidence of intentional or inadvertent solid waste deposition from project vessels or work platforms • All vessels and work platforms are equipped with secure waste collection receptacles (firmly anchored in place and with tight-fitting lids) • Solid waste management facility established and competently operated at shore site to receive, sort and store solid waste brought ashore from vessels and work platforms	• PC3 1,000,000 • PC4 1,000,000 • PC5 1,000,000 • PC6 1,000,000 • (Estimates reflect probable sharing of equipment and costs by PCs)	Anticipated in PC bid amounts
64. Marine biodiversity impacts	• Ecological effects of construction lighting used on marine works sites	• Each marine works PC to equip all work lighting used on marine works sites with shielding to reduce lateral light emissions, and position work lighting to light only work surfaces, avoiding direct light emissions to the water surface to the extent possible • Each marine works PC to limit general areal lighting on marine work sites to that which is necessary to ensure the safety of workers and safety of navigation	• PC3 • PC4 • PC5 • PC6 • DPWH (BAP)	• All work lighting used on marine works sites equipped with shielding to reduce lateral light emissions • All work lighting positioned to light only work surfaces, avoiding direct light emissions to the water surface	• PC3 8,000,000 • PC4 8,000,000 • PC5 8,000,0000 • PC6 8,000,000	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Implement biodiversity offset for expected residual impact from work lighting on coral habitat, under Biodiversity Action Plan. • PCs to manage work lighting in accordance with the project Marine Turtle Management Plan		• Biodiversity offset for expected residual impact of work lighting on coral habitat under implementation as per Biodiversity Action Plan • Work lighting managed in accordance with Marine Turtle Management Plan	• DPWH (BAP) Included in BAP cost estimate	
65. Marine biodiversity impacts	• Injury and mortality of threatened marine species due to vessel strikes	• Each marine works PC shall incorporate a Marine Wildlife Protection Protocol as a method statement in its CEMMAP, for activation in the event that readily observable marine megafauna such as whales, dolphins, sharks and marine turtles are detected near the work sites • Marine works PCs shall employ dedicated marine fauna observers (MFOs) to identify large marine vertebrates in the vicinity of the works • Each marine works PC shall ensure that operators of all vessels involved in construction shall be strictly limited to 10 knots when within 200 m of observed marine wildlife or at the instruction of a Marine Fauna Observer (MFO) • Each marine works PC shall provide training to all of its on-the-water personnel, and all on-the-water personnel of its sub-contractors, in proper use of the Marine Wildlife Protection Protocol as part of regular induction and refresher training	• PC3 • PC4 • PC5 • PC6	• Low incidence of vessel strikes on marine fauna	• NIC	Anticipated in PC bid amounts
66. Marine biodiversity impacts	• Disturbance, injury and mortality of threatened and protected marine species due to underwater noise emissions from marine works	• Each marine PC operating or overseeing operation of an impact piling rig shall ensure that a bubble curtain is consistently and thoroughly deployed around the pile for the full duration of driving • CSC to manage coordination of contractor piling operations to ensure optimal spacing for noise impact minimization • Each marine PC operating or overseeing operation of an impact piling rig shall appoint, train and equip sufficient personnel to serve as marine fauna monitors during all piling undertaken during daylight hours, and empower said personnel to advise the site engineer to issue a temporary	• PC3 • PC4 • PC5 • PC6 • CSC • DPWH (BAP)	• Works carried out in accordance with Underwater Noise Management Plan • Bubble curtains or other equally effective noise attenuation technology consistently deployed at all marine piling sites where impact hammers are used • Biodiversity offset for residual effects of underwater noise and other construction impacts on	• PC3 1,930,000,000 • PC4 940,000,000 • PC5 580,000,000 • PC6 1,930,000,000 • DPWH (BAP) Included	Anticipated in PC bid amounts (noise attenuation) Biodiversity Action Plan Fund (DPWH)

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		stop work order in the event a whale, dolphin, shark or marine turtle is spotted within 500 m of the piling rig • DPWH to implement a biodiversity offset for noise and other construction impacts on critical habitat in cooperation with CIMP, under auspices of Biodiversity Action Plan • DPWH to implement monitoring and adaptive management program regarding noise impacts on marine mammals, under auspices of Biodiversity Action Plan		critical habitat under implementation as per Biodiversity Action Plan • Monitoring and adaptive management program for marine mammal impacts under implementation as per Biodiversity Action Plan •	in BAP cost estimate	
67. Marine biodiversity impacts	• Medium-term hydrodynamic modification leading to ecological change in vicinity of temporary jetties	• PCs responsible for installing rock jetties to serve Bataan Staging Area 1 and Bataan Staging Area 2 to install 5-m circulation gaps (pipe culverts or sheet-piled open channels bridged by drop-in plates) at 50-m intervals along all jetties to permit long-shore circulation	• PC3 • PC4 • PC5 • PC6	• Gaps left every 50 m along nearshore jetties (bridged by steel plates or drop-in trestles) to allow cross-circulation, to minimize ecological change	• PC3 10,000,000 • PC5 10,000,000 • PC6 10,000,000	Anticipated in PC bid amounts
68. Physical cultural heritage	• Loss or damage of hitherto unknown culturally significant underwater artifacts	• Each marine PC to include a chance find procedure as a method statement in its CEMMAP and include training to workers and site engineers on its correct application, as part of broader induction and refresher training	• PC3 • PC4 • PC5 • PC6	• Chance find procedure included in each PC's CEMMAP and included in induction and refresher training	• NIC	Anticipated in PC bid amounts
III. AIR						
69. Greenhouse gas emissions during construction	• Unduly elevated GHG emissions due to use of outdated, poorly maintained construction equipment and vehicles	• Ensure that only modern (age less than 15 years) and fuel-efficient (rated above the industry within-class average for fuel consumption) construction equipment and vehicles are used, including equipment and vehicles supplied and operated by sub-contractors	• All PCs	• Only modern (age less than 15 years) and fuel-efficient (rated above the industry within-class average for fuel consumption) construction equipment and vehicles are in use on project sites, including equipment and vehicles supplied and operated by sub-contractors	• NIC	Anticipated in PC bid amounts
70. Air quality impacts	• Localized degradation of air quality from concentrated diesel engine emissions	• All PCs shall ensure that all motorized equipment used in works under their control, including that supplied and used by sub-contractors, is of recent manufacture (less than 15 years old), rated above the industry within-class average for fuel consumption, and maintained in top working condition at all times.	• All PCs	• Only modern (age less than 15 years) and fuel-efficient (rated above the industry within-class average for fuel consumption) construction equipment and vehicles are in use on project	• NIC (monitoring costs accounted for under environmental monitoring plan	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Each PC shall prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC shall closely coordinate the hauling activity of the PCs to avoid possible multiplication of emissions impacts from simultaneous hauling operations • PCs to ensure, through staging area layout design, that large stationary generators, concrete batch plants and high-volume aggregates handling areas are set up no closer than 300 m to any offsite residence		sites, including equipment and vehicles supplied and operated by sub-contractors • No large stationary engines located within 300 m of a residence or school • No emissions of black or blue smoke observed coming from exhaust pipes of equipment and vehicles used project sites • Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5, PM10, SO2 and NO2, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Hauling activity by PCs sufficiently well-coordinated as to avoid significant hauling-related congestion • Low incidence of complaints from the public about construction-related traffic congestion and emissions		
71. Air quality impacts	• Air quality degradation due to fugitive dust	• Each PC to prepare a site-specific Dust Control Plan for review and approval of the CSC prior to the start of works • PCs to ensure that all haul trucks involved in works under their control, including those supplied and operated by sub-contractors and suppliers, are equipped with tight-fitting tarpaulins, and that these are used at all times • PCs to impose and enforce a maximum speed limit of 10 kph for all vehicles operating on unpaved project roads and other site surfaces	• All PCs	• Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5, and PM10, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Dust emissions as measured at batch plants consistently	• NIC (monitoring costs accounted for under environmental monitoring plan)	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• PCs to ensure that all stockpiles of fine materials, including gravel with significant fines component, are kept covered with tarpaulins when not in active use • PCs to ensure that adequate spraying equipment for use in dust suppression is procured and available on site before the start of works • PCs to visually monitor on a daily basis for dust in all works areas, including haul routes, under their control, and implement spraying as needed whenever airborne dust is apparent • Each PC operating or overseeing operation of a concrete batch plant to prepare a site-specific Concrete Batch Plant Management Plan for review and approval of the CSC prior to batch plant setup • PCs to ensure that all concrete batch plants used in works under their control are equipped with dust collection systems on cement and fly ash silo vents, hopper vents and the mixing zone, as appropriate to plant design and operation, and that plants are operated in such a way as to maintain emissions in conformance with US EPA AP-42 Controlled Emission Factors for Concrete Batch Plants • PCs to install (as applicable) continuous air quality monitoring systems at long-term staging sites including casting yard batch plants and materials handling yards and implement dust suppression by regular light spraying with water whenever the measured PM2.5 and PM10 levels reach 75% of the maximum permissible levels for either PM2.5 or PM10 (whichever is reached first) specified in the World Bank Group Environmental Health and Safety Guidelines: Air Emissions and Ambient Air Quality		meets levels specified in US EPA AP-42 • Low incidence of complaints from public about project-related dust		
72. Air quality impacts	• Air quality degradation due to operation of asphalt batch plants	• PCs responsible for setup and operation of asphalt batch plants shall ensure that the plants and associated aggregates handling are positioned no closer than 300 m to the nearest residence	• PCs as relevant	• Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5, PM10, So2 and NO2 as specified in the WBG's Environmental, Health and	• NIC (monitoring cost accounted for under environmental monitoring plan	Accounted for in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
				Safety Guidelines: Air Emissions and Ambient Air Quality • Low incidence of complaints from public about project-related dust and fumes		
73. Noise impacts	• Effects on quality of life and health in nearby community areas from high-intensity, long-duration noise from works, staging activity and hauling	• All PCs shall ensure that all motorized equipment used in works under their control, including that supplied and used by sub-contractors, is of recent manufacture (less than 15 years old) and maintained in top working condition at all times. • Unless otherwise approved by the CSC, all PCs shall limit noisy work activity and hauling to daylight hours (6:00 am–6:00 pm) • Each PC shall prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC shall closely coordinate the hauling activity of the PCs and to arrange for as much hauling activity as possible to take place in off-peak traffic hours (9:00 am–4:00 pm), and assist DPWH-PMT to negotiate with relevant municipal and barangay authorities' permission and conditions for any necessary avoid possible multiplication of emissions impacts from simultaneous hauling operations • PCs involved in hauling from Uniwide staging area in Cavite to working front to install and maintain temporary noise barriers (Jersey barriers or similar, at least 1 m in height and placed in a continuous line directly adjacent to the haul route lane) in all places where residences are located within 100 m of the road, to limit noise impacts from night hauling • PCs to ensure, through staging area layout design, that large stationary generators, concrete batch plants and high-volume aggregates handling areas are set up no closer than 300 m to any offsite residence • Each PC to Include noise sensitivity guidelines in induction and refresher training for equipment operators	• All PCs	• Only modern (age less than 15 years) construction equipment and vehicles are in use on project sites, including equipment and vehicles supplied and operated by sub-contractors • Absence of work activity between 8 pm and 6 am at any work site within 500 m of residences • Noise levels as measured at selected receptor sites do not exceed WBG's Environmental, Health and Safety Guidelines: Environmental Noise Management standard (55 dB daytime, 45 dB night) • Low incidence of complaints from public about project-related noise	• NIC (monitoring cost accounted for under environmental monitoring plan	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		and drivers, to reduce careless conduct of noisy activity near off-site receptors				
IV. PEOPLE						
74. Community impacts	• Social conflict due to influx of outside construction workers	• Proponent to implement (through CSC) recruitment and training programs for local workers in both Mariveles and Naic to increase potential for local hiring by PCs and sub-contractors, under auspices of Social Development Plan • PCs and sub-contractors to adhere strictly to requirements under RA6685 with regards to employment of local labor (including for its sub-contractors), and go beyond the base requirement to the maximum extent possible • PCs to demonstrate, subject to review and approval by the CSC, that reasonable effort has been made to secure accommodations for its workers and those of its sub-contractors in existing facilities within the community before proposals for construction camps will be considered • PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors	• DPWH-PMT • All PCs	• Workforce on each construction package, including workers in the employ of sub-contractors, does not exceed the maximum allowable percentage of outside workers specified in RA 6685 • Construction camps, including those operated by sub-contractors, are managed in accordance with the CSC-approved Construction Camp Management Plan • Low incidence of complaints from the public and municipal officials regarding off-site behavior of workers and other negative interactions between camp residents and the host community	• DPWH Cost accounted for under SDP (recruitment and training support) • PCs NIC	Anticipated in PC bid amounts
75. Community impacts	• Disruption of access to private and public property due to construction in public rights-of-way	• PCs to ensure that all public and private ways are kept open to the maximum extent feasible, taking account of safety considerations • In the event of closure of a public way exceeding 1 hr, PCs to provide 24 hrs advance notice using signage • In the event of closure of a private way exceeding 1 hr, PCs to post notice 24 hrs in advance and attempt direct verbal contact with property owners and users prior to blockage • PCs to ensure that all blocked public and private ways are restored to a safe and useable state by the end of the workday, or provide a safe alternative for use after hours	• PC1 • PC2	• Low incidence of complaints from public about problems accessing property, businesses and institutions	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
76. Community impacts	• Inadvertent disruptions of utility service	• Provide training to all workers involved in excavation and use of tall machinery near overhead wires • Ensure that site engineers with access to utility maps maintain constant presence and supervision during any work with the potential to damage in-ground or overhead utility infrastructure	• PC1 • PC2	• Low incidence of complaints from public about utility stoppages	• NIC	Anticipated in PC bid amounts
77. Livelihoods	• Potential enhancement of livelihoods due to employment in construction and other types of jobs on the project • Potential enhancement of local livelihoods due to provision of goods and services to project contractors and workers by local enterprises	• PCs to ensure that the workforce hired on works under their control consistently meets quotas for local unskilled and skilled labor under RA 6685 • DPWH to engage training services contractor to develop and deliver skills training for local people interested in securing employment on the BCIB project, in both Mariveles and Naic, beginning at least 6 months prior to the start of works (under auspices of SDP) • DPWH-PMT to arrange recruitment events with compulsory participation of PCs and sub-contractors to facilitate hiring of local workers, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP) • DPWH-PMT to arrange marketplace connection events with compulsory participation of PCs and sub-contractors to facilitate procurement of good and services from local business entities, in both Mariveles and Naic, before the start of works and periodically as needed according to the works schedule (under auspices of SDP)	• All PCs • DPWH-PMT	• Workforce on each construction package, including workers in the employ of sub-contractors, does not exceed the maximum allowable percentage of outside workers specified in RA 6685 • Pre-construction job training program implemented in Mariveles and Naic as per SDP • Local hiring facilitation plan implemented in Mariveles and Naic as per SDP • Local service provider support program implemented in Mariveles and Naic as per SDP	• PCs - NIC • DPWH Cost accounted for under SDP	• Anticipated in PC bid amounts • Project implementation funds (DPWH costs)
78. Livelihoods	• Impacts on land-based livelihoods from poor construction site management, e.g., property damage from boundary transgressions, impacts on property value and business viability due to excessive dust	• PCs to provide enhanced training and stepped-up supervision of construction site management by sub-contractors at works near businesses and where access to private property entrances may be constrained at any time during works, in order to minimize negative effects on local businesses • PCs to instruct sub-contractors to provide contact information for the GRM in the case of property damage incurred outside the ROW boundary	• PC1 • PC2	• Low incidence of complaints from public about property damage and loss of business due to sloppy construction site management	• NIC	Anticipated in PC bid amounts
79. Livelihoods	• Impacts on fisherfolk livelihoods from restrictions on access to fishing	• Marine works PCs, in collaboration with the CSC, to employ a dynamic approach to the PEZ to limit access	• PC3 • PC4	• Low incidence of complaints from fisherfolk about difficulty accessing fishing grounds	• PC3 15,000 • PC4 50,000	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
	grounds within construction zone	restrictions only to those zones with active ongoing works and/or construction-related hazards present • PCs to provide clearly marked safe transit zones through the marine work zone, adjusting as necessary to accommodate work process • PCs to conduct informational meetings with local fisherfolk before the start of marine works and as needed during construction to explain operation, markings and rules regarding observance of PEZ and safe transit lanes	• PC5 • PC6		• PC5 15,000 • PC6 15,000 • (costs for fisherfolk outreach activity over construction phase)	
80. Livelihoods	• Impacts on fisherfolk livelihoods from siltation and sedimentation caused by marine works • Impacts on fisherfolk livelihoods from underwater noise generated by marine works	• PCs to ensure that surface-to-seabed silt curtains are competently deployed around all marine works sites in waters 0–25 m depth • PCs to ensure that piling contractors competently and consistently deploy bubble curtains or comparably effective underwater noise attenuation technology at all impact piling sites, without exception • DPWH to implement fisherfolk livelihood restoration program to compensate for expected impacts of pile driving noise, under auspices of Social Development Plan	• PC3 • PC4 • PC5 • PC6 • DPWH	• Surface-to-seabed silt curtains competently deployed around marine works in all waters 0–25 m depth • Bubble curtains used at all marine piling sites where impact hammers are used to limit impacts (fish kills and injury) on fish biomass and fisherfolk livelihoods • Fisherfolk livelihood restoration program under implementation as per Social Development Plan	• PCs NIC (accounted for above in relation to biodiversity impacts) • DPWH - Accounted for under Social Development Plan	PC costs anticipated in bid amounts DPWH costs to be anticipated in project implementation budget
81. Livelihoods	• Lost revenue for Naic beachfront resorts due to degradation of amenity values by siltation of inshore waters from marine works	• PC4 to ensure that surface-to-seafloor silt curtains are consistently and competently deployed around all viaduct footing sites within 2 km of the Naic shore, for the duration of footing excavation activity	• PC4	• Silt curtains consistently implemented during excavation for spread foot foundations in Naic nearshore work zone (29+800–31+800) to minimize siltation of water at beachfront resorts • Low incidence of complaints from resort owners	• PC4 - NIC (cost accounted for above in relation to biodiversity impacts)	Anticipated in PC bid amount
82. Public safety impacts	• Increased risk of accidents due to works in public rights-of-way and heavy haul traffic	• PC1 to prepare Road Works Safety Management Plan for the works at and around the Roman Highway interchange and underpasses for existing roads, for review and approval by the CSC, prior to the start of works	• All PCs • CSC	• Low incidence of accidents in interchange works zones • Low incidence of accidents involving haul trucks	• NIC	Anticipated in PC and CSC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• PC2 to prepare Road Works Safety Management Plan for the works at and around the Antero Soriano Highway interchange and underpasses for existing roads, for review and approval by the CSC, prior to the start of works • Each PC to prepare a Construction Traffic Management Plan, for review and approval by the CSC, prior to the start of works • CSC to closely coordinate the hauling activity of the PCs and all sub-contractors to avoid possible multiplication of safety impacts from simultaneous hauling operations • CSC to set and enforce rules regarding timing of hauling activity to prevent avoidable elevation of safety risks by hauling • PCs responsible for operation of the Bataan casting yard and drydock shall transport Portland cement from the PhilCement facility in Barangay Sisiman only by barge, to avoid increasing truck traffic on EPZA Bypass Road		• Low incidence of complaints from public about safety impacts of works and hauling activity		
83. Public safety impacts	• Elevated risk of marine accidents due to marine construction activity	• DPWH, with support of CSC and in consultation with the Philippine Coast Guard, to arrange for demarcation of the PEZ and issuance of associated Notice to Mariners • PCs, in collaboration with the CSC, to demarcate the PEZ • PCs to provide clearly marked safe transit zones through the marine work zone, adjusting as necessary to accommodate work process • PCs, in collaboration with CSC, to conduct informational meetings with local fisherfolk before the start of marine works and as needed during construction to explain operation, markings and rules regarding observance of PEZ and safe transit lanes • PCs to require sub-contractors and workers to report unsafe incursions into the PEZ by non-project vessels to the PC's site engineer for enforcement action	• DPWH • PC3 • PC4 • PC5 • PC6 • CSC	• Pre-construction IEC activity conducted with fisherfolk in Mariveles (involving fisherfolk from all coastal barangays) to explain PEZ rules • Pre-construction IEC activity conducted with fisherfolk in Naic (involving fisherfolk from all coastal barangays) to explain PEZ rules	• DPWH NIC • PC3 1,000,000 • PC4 1,000,000 • PC5 500,000 • PC6 500,000	Project implementation funds (DPWH) Anticipated in PC bid amounts (implementation)
84. Public health risks	• Increased incidence of infectious disease	• PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and	• PCs as applicable	• Construction camps set up and managed in accordance with	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
	associated with influx of outside workers	other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors • PCs responsible for construction camps to provide STD prevention training to all incoming workers • PCs responsible for construction camps to monitor for evidence of sex work around camps, and collaborate as needed with municipal public health and public safety authorities to address any emerging concerns		CSC-approved Construction Camp Management Plans to help prevent outbreaks of communicable disease • STD prevention training provided to all incoming resident workers by PCs • Incidence of complaints from public and local authorities regarding sex work around construction camps		
85. Public health risks	• Increased incidence of water-borne illness due to poor human waste management	• Each PC to prepare site-specific Human Waste and Sanitation Management Plans, for review and approval of CSC prior to the start of works • PCs to provide portable toilets for use of workers at temporary and marine work sites, and transport contents as needed to septic systems set up at semi-permanent staging areas • PCs to provide all toilets with proper septic systems and leaching fields of adequate capacity to accommodate maximum projected use, including inputs from portable toilets used at temporary works sites	• All PCs	• Portable toilets provided at temporary works sites, and contents transported to septic systems on semi-permanent staging areas • All non-portable toilets on works a sites and staging areas are connected to proper septic systems of capacity adequate to accommodate use • Septic systems are installed no closer than 50 m to site boundaries • No evidence of raw sewage on ground, in cesspools or in nearby watercourses • Low incidence of open defecation by workers	• PCs NIC (costs accounted for above in relation to surface water quality)	Anticipated in PC bid amounts
86. Occupational health and safety risks	• Injuries and deaths from physical hazards on construction sites	• PCs to prepare site-specific Occupational Health and Safety Plans, for review and approval of the CSC prior to the start of works, to ensure that international best practices for construction site management are implemented consistently by their own personnel and by all of their sub-contractors • PCs to strictly require and ensure that task- and context-appropriate PPE—including, at a minimum,	• All PCs	• All workers use task- and site-appropriate PPE at all times • All marine workers properly wear an approved personal flotation device at all times • All vessels and platforms involved in marine works are equipped with life-saving	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		hardhat and protective footwear for anyone entering the site—is provided to workers and replaced as necessary • Marine PCs to ensure that all vessels and platforms involved in marine works are equipped with life-saving equipment (throwable flotation and victim recovery slings), and strictly require that all workers present on marine sites wear an approved personal flotation device at all times • Marine PCs to include protocols for determining when weather and sea state conditions shall require halting of certain activities, general work stoppages and evacuations		equipment (throwable flotation and victim recovery slings) • Low incidence of worker deaths and injuries		
87. Occupational health and safety risks	• Elevated accident risks during works in public rights-of-way (interchange and underpass sites)	• PC1 to prepare site-specific Road Works Safety Management Plans covering the works at the Roman Highway interchange and underpasses on the Bataan side, for the review and approval of the CSC prior to the start of works • PC2 to prepare site-specific Road Works Safety Management Plans covering the works at the Antero Soriano Highway interchange and underpasses on the Cavite side, for the review and approval of the CSC prior to the start of works	• PC1 • PC2	• Safety practices prescribed in CSC-approved Road Works Safety Management Plans and Construction Traffic Management Plans implemented • Low incidence of worker-involved accidents in Roman Highway and Antero Soriano Highway interchange works zones • Low incidence of vehicle-involved worker injuries and deaths in interchange works zones • Low incidence of complaints from workers about safety risks in interchange works zones	• NIC	Anticipated in PC bid amounts
88. Occupational health and safety risks	• Risk of serious injury and death from disturbance of unexploded ordnance (UXO) during marine works	• Each PC involved in marine works shall study the results of seabed UXO scan survey conducted as part of marine geotechnical surveys to determine presence of any suspected UXO within their work areas, and arrange for removal or neutralization by a qualified specialist contractor prior to beginning any physical works, if needed	• PC3 • PC4 • PC5 • PC6	• Seabed UXO identified in survey report neutralized or removed by a qualified specialist contractor in advance of any physical works, if needed	• TBD	Anticipated in PC bid amounts
89. Occupational health and safety risks	• Injury and death from geophysical hazards occurring during construction	• PCs to set up system for receiving notifications from the PHIVOLCS tsunami early warning system data feed	• PCs	• All temporary structures, elevated storage tanks and batch plants on work sites and staging areas are designed to	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• PCs to design temporary structures, elevated storage tanks and batch plants on their work sites to withstand at least Magnitude 6 earthquakes • PCs to develop measures pertaining to preparedness, response and recovery in the event of earthquake or tsunami during construction, and include said measures in their comprehensive Emergency Action Plans • PCs to provide induction training regarding implementation of the Emergency Action Plan, including earthquake and tsunami procedures, for all workers and site engineers, and annual refresher training including drills, to be verified by the CSC • CSC to verify, annually during the construction phase, that each PC is providing refresher training in accordance with its Emergency Action Plan		withstand at least Magnitude 6 earthquakes • Each PC has implemented all preparedness components of CSC-approved Emergency Action Plan, including training, prior to the start of works • PCs provide annual refresher training, including drills, on Emergency Action Plan procedures to all workers and site engineers		
90. Occupational health and safety risks	• Worker injury, illness and death due to hazards in poorly designed and managed construction camps • Elevated risk of infectious disease and infestations due to poor conditions in construction camps and on construction sites	• PCs to develop Construction Camp Management Plan for each camp established, including those to be set up and operated by sub-contractors and those proposed after approval of the PC's CEMMAP • CSC to review and approve all Construction Camp Management Plans, with reference to 2009 IFC-ERDB guidance on worker accommodation and other relevant international best practice • PCs to prepare site-specific Construction Camp Management Plan, following IFC/EBRD guidance and other international best practice and subject to review and approval of the CSC, for any camp proposed by it or by any of its sub-contractors • CSC to strictly enforce prohibition on housing workers in makeshift structures on works sites, and ensure that camps set up on staging areas are physically separate from work areas and situated at least 200 m from dusty and noisy site components including concrete batch plants, aggregate handling facilities and generators • PCs to provide at least one toilet per 10 workers on job sites, as well as washup sinks in same proportion	• All PCs • CSC	• No workers found living on construction sites • Low incidence of physical hazards including fire and electrocution risks, falling and tripping hazards, poor lighting, sharp objects, etc. observable in construction camps • Low incidence of unhygienic conditions in toilet and washup facilities, kitchens, food storage, mess halls and dormitories • Low incidence of overcrowding and hot-bedding in dormitories • Unlimited supply of clean drinking water available in camp for worker use, meeting Philippine National Standards for Drinking Water of 2017 (as specified in Department of	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• PCs to institute strict regular cleaning and sanitation regimen for all toilets, washup facilities, kitchens and canteens on work sites and in camps		Health Administrative Order DOH 2017-0010) • Low incidence of worker injuries and illness attributable to conditions in construction camps • Low incidence of intestinal ailments and other communicable illnesses reported amongst workers		
91. Occupational health and safety risks	• Exposure to harmful levels of noxious and hazardous dust	• Each PC to prepare site-specific Dust Control Plan, for review and approval of CSC prior to start of site clearing and set-up • Each PC operating a concrete batch plant (including floating batch plants) to prepare a facility-specific Concrete Batch Plant Management Plan, for review and approval of CSC prior to plant set-up and commissioning • Each PC operating a concrete batch plant to ensure that plant is equipped with industry-standard dust collection and suppression features capable of keeping emissions within limits set by US EPA AP-42 Controlled Emissions Factors for Concrete Batch Plants • Each PC operating a batch plant to provide workers involved in handling Portland cement and fly ash with P100-rated respirators, including regular filter cartridge replacements, and training on their proper and mandatory use • Each PC to provide all workers involved in handling dusty materials other than cement or fly ash with N95-rated facemasks (including regular replacements) and require their use • Each PC involved in demolition works to arrange pre-demolition inspection of condemned structures by a qualified hazardous materials assessment contractor, and implement the ACM Removal and Disposal Plan prepared by said contractor, if and as needed	• All PCs	• Ambient dust at selected dust-intensive site locations remains consistently below the maximum permissible limits for PM2.5 and PM10, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Low incidence of complaints from workers about dust levels on work sites • Low incidence of respiratory ailments, illness or injury attributable to inhalation of hazardous dust, including that from Portland cement and fly ash	• NIC	Anticipated in PC bid amounts

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
92. Occupational health and safety risks	• Dehydration and heat exhaustion	• PCs shall ensure that all workers, including those in the employ of their sub-contractors, are provided with unlimited access to clean drinking water at all times • PCs shall ensure that all workers are provided access to shaded rest areas, including workers at marine sites	• All PCs	• Unlimited drinking water available on all work sites, at no charge to workers • Low incidence of complaints from workers about drinking water quality and availability • Shaded rest areas of adequate size for the number of workers are provided on all work sites, including at marine works • Low incidence of heat-related illness and death amongst workers	• NIC	Anticipated in PC bid amounts
93. Visual impacts	• Impairment of amenity values due to light leakage from nighttime construction activity (near Naic beachfront)	• PCs to ensure that facility lighting at staging areas employs only shielded luminaries designed to direct light downward, to minimize lateral light emissions • PCs to ensure that only task lighting arrays that can be shielded and directed downwards to minimize lateral light emissions are used on sites under their control • PCs to continuously monitor use of high-intensity task lighting at sites under their control, and direct crews to adjust lighting orientation to minimize glare where lateral emissions are found to be occurring • PCs to give priority to beachside resorts nearest BCIB landing in Naic when selecting local accommodations for personnel, under auspices of	• PC4	• Low incidence of glare from nearshore marine works, as observed from the beaches along the Naic waterfront • Low incidence of complaints from beachfront residents and resort operators about light emissions from nearshore marine works	• PC4 NIC (Cost already accounted for above in relation to biodiversity impacts)	Anticipated in PC bid amounts
C. OPERATION PHASE						
I. LAND						
94. Terrestrial biodiversity impacts	• Avian mortality on bridges and viaducts due to perching and roosting on railings • Avian mortality on bridges due to collisions with cables or	• Implement the Bird Management Plan, including monitoring vehicle bird strikes and perching/roosting prevalence as part of routine bridge and viaduct safety monitoring, and install anti-roosting devices on railings in problematic locations, if needed	• DPWH-BMU	• Incidence of bird mortality from vehicle strikes, and traffic accidents and mishaps due to presence of roosting and perching birds monitored periodically, and of anti-perching devices installed in trouble spots, if justified	• NIC (Potential cost reflected above in Bird Management Plan cost)	DPWH-BMU O&M operating budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
	disorientation from the lighting scheme			• Incidence of bird mortality with the BCIB (collision with cables or disorientation from the lighting scheme)		
95. Soil contamination	• Leaks and spills associated with maintenance and repair works	• Require maintenance contractors to use only newer model equipment in good condition, store all noxious fluids used in works in containers with secondary containment, and have demonstrated capacity to clean up spills	• DPWH-BMU	• Requirement to use only newer model equipment in good condition, store all noxious fluids used in works in containers with secondary containment, and have demonstrated capacity to clean up spills included in bidding documents and contracts for maintenance and repair works	• NIC	DPWH-BMU operating budget
96. Soil contamination	• Contamination due to spills from road accidents	• Bridge Management Unit to include assessment of spill risk in its operation-phase Emergency Action Plan and make commensurate investments in staffing, training and equipment to enable competent response in the event of a spill	• DPWH-BMU	• All preparedness components of the Emergency Action Plan implemented prior to opening of the infrastructure	• NIC (plan preparation) • TBD (preparedness investments)	DPWH-BMU operating budget (plan preparation) BCIB O&M budget (preparedness investments)
97. Land contamination	• Contamination from build-up of roadside litter	• Conduct weekly mechanical sweeping of the entire roadway surface (lanes and hard shoulders) • Implement regular roadside litter cleanup (periodicity based on litter buildup rate)	• DPWH-BMU	• Minimal evidence of roadside litter	• NIC	BCIB O&M budget
II. WATER						
98. Marine water quality impacts	• Contamination of marine waters from direct drainage of bridge deck runoff	• Weekly sweeping of entire bridge and viaduct roadway surface (including shoulder lanes) with a regenerative air sweeper	• DPWH-BMU	• Sweeping of entire bridge, viaduct and approach road surfaces (including shoulder lanes) with a regenerative air sweeper conducted on a weekly basis, weather permitting	• 11,000,000 (capital cost for sweeper)	BCIB O&M budget
99. Marine water quality impacts	• Contamination of marine waters from accident-derived spills of hazardous materials on bridge and viaduct decks	• Institute strict speed enforcement on the BCIB • Include monitoring of driver behavior in bridge surveillance routines • Institute a regimen of spot safety checks to reduce the number of unsafe trucks using the bridge	• BCIB-BMU	• Speed limit on BCIB strictly enforced to reduce risk of accidents involving hazardous cargoes	• NIC	BCIB O&M budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		• Establish, equip and train accident response crews for quick response to accidents, under auspices of operation-phase Emergency Action Plan		• Monitoring of driver behavior included in bridge surveillance routines • Periodic spot safety checks conducted to reduce the number of unsafe trucks using the bridge • Low incidence of accidents involving spills		
100. Marine water quality impacts	• Contamination of marine waters from spills and leaks during maintenance works	• Require maintenance and repair works contractors to seal deck scuppers during repaving to prevent leakage of oil coating and spillage of uncured asphalt into the water • Require maintenance and repair works contractors to deploy under-girder slings and vacuum collection system to minimize inputs of paint, sand and dust to the water if sandblasting is undertaken • Require maintenance and repair works contractors to prepare and implement Hazardous and Noxious Materials Management Plans	• DPWH-BMU	• Deck scuppers sealed during re-paving works to prevent leakage of oil coating and spillage of uncured asphalt into the water • Under-girder slings and vacuum systems deployed as appropriate to minimize inputs of paint, sand and dust to the water • Hazardous and Noxious Materials Management Plans prepared and implemented by maintenance and repair works contractors	• NIC	BCIB O&M budget
101. Marine water quality and biodiversity impacts	• Contamination of marine biota by litter emanating from bridges and viaducts	• Conduct weekly sweeping (with regenerative air sweeper) of the entire roadway surface (driving lanes and emergency lane) • Implement regular roadside litter cleanup (periodicity based on litter buildup rate)	• DPWH-BMU	• All four traffic lanes and both emergency pull-out lanes swept weekly	• NIC	BCIB O&M budget
III. AIR						
102. Air quality impacts	• Air quality impacts from major road repair and replacement works (approach roads)	• Require contractors to use only modern (less than 15 years old), fuel efficient (rated above the industry within-class average for fuel consumption) equipment in major repair and replacement works on approach roads • Require contractors on major repair and replacement works to implement competent dust suppression, including regular light spraying, keeping materials stockpiles	• DPWH-BMU	• Bid documents and contracts for major repair and replacement works on approach roads require contractors to use only modern (less than 15 years old), fuel efficient (rated above the industry within-class average for fuel consumption) equipment	• NIC	DPWH-BMU operating budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		covered with tarpaulins, and ensuring that all haul trucks are equipped with tight-fitting covers		• Bid documents and contracts for major repair and replacement works on approach roads require contractors to implement competent dust suppression, including regular light spraying, keeping materials stockpiles covered with tarpaulins, and ensuring that all haul trucks are equipped with tight-fitting covers		
IV. PEOPLE						
103. Livelihood enhancement	• Employment and business opportunities accrue to local people from BCIB operation	• Prioritize hiring of local people for jobs in infrastructure and ROW maintenance, administration, emergency response crews, security, equipment maintenance and groundskeeping at the BMMC, under auspices of SDP • Require contractors engaged for major repair and replacement works to hire local labor in proportions at least meeting the minimum local labor requirement for construction projects as per RA 6685, under auspices of SDP • Organize informational events to announce tenders to local contractors, to encourage local bids on maintenance and repair and replacement contracts, under auspices of SDP	• DPWH-BMU	• Local people make up at least 50% of proposed initial hires for permanent BCIB workforce • Workforce engaged by contractors for major maintenance and repair works meet the minimum local labor requirements for construction projects as per RA 6685 • Evidence of local advertisement of tenders for maintenance and repair contracts	• Accounted for under SDP	Allocation for SDP implementation under DPWH-BMU operating budget
104. Livelihood enhancement	• Potential enhancement of fisherfolk livelihood prospects by long-term protection of fisheries resources along alignment in proposed municipal fish sanctuaries and no-dredge zone	• DPWH-BMU to coordinate with the municipalities crossed by the BCIB alignment at least annually to help ensure safety of BCIB-based surveillance activity and effectiveness of enforcement action for long-term protection of municipal fish sanctuaries along the alignment • DPWH-BMU to monitor on a quarterly basis for the submittal of new applications for ECCs by proponents of seabed mining operations • DPWH-BMU to participate as necessary in scoping, consultations and hearings regarding ECC applications for seabed mining operations proposed nearby the BCIB	• DPWH-BMU	• Annual coordination meeting held • Quarterly monitoring check on ECC applications documented • Monthly monitoring for presence of dredging activity near or within no-dredge zone documented	• NIC	BCIB O&M budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
		alignment, to ensure that the non-dredge buffer zone is acknowledged and respected • DPWH-BMU to visually monitor at least monthly, as part of normal bridge monitoring activity, for the presence of seabed mining activity threatening to impinge on the no-dredge buffer zone				
105. Public safety	• Road safety risks due to driver behavior and unsafe vehicles • Road safety risks related to wind and heavy precipitation	• DPWH-BMU to strictly enforce speed limits on the BCIB • DPWH-BMU to include monitoring of driver behavior in bridge surveillance regimen, and strictly enforce traffic laws • DPWH-BMU to institute a regimen of spot safety checks to reduce the number of unsafe vehicles using the BCIB • DPWH-BMU to develop and strictly implement a conditions-based protocol for bridge closure due to actual or predicted wind and rain events that may produce safety risks to infrastructure users	• DPWH-BMU	• Speed limit on BCIB strictly enforced to reduce accident risk • Monitoring of driver behavior included in bridge surveillance routines • Periodic spot safety checks conducted to reduce the number of unsafe vehicles using the bridge • Conditions-based bridge closure protocol to reduce accident risks related to blow overs, low visibility and hydroplaning developed prior to BCIB opening • Active monitoring of wind speed and precipitation along the alignment included in bridge surveillance routines • Accident rate	• NIC	BCIB O&M budget
106. Occupational health and safety risks	• Physical hazards during maintenance works	• DPWH-BMU to provide all of its maintenance personnel with infrastructure-specific, task-relevant safety training upon hiring, and annual refresher training • DHWH to contractually require all contractors engaged for inspection, maintenance, repair and replacement work to prepare and implement detailed occupational safety plans	• DPWH-BMU	• Safety training given to maintenance crews on an annual basis • Bid documents and contracts for maintenance and inspection contractors require preparation and implementation of detailed activity-specific occupational safety plans	• NIC	DPWH-BMU operating budget

Topic of Concern	Potential Impacts and/or Issues	Mitigation/Enhancement Measures	Implementing Entity	Performance Indicators	Estimated Cost (PHP)	Source of Funds
107. Visual impacts	• Aesthetic degradation from solid waste build-up	• DPWH-BMU to incorporate detection of uncovered trucks with easily airborne cargoes in bridge traffic monitoring, and enforce anti-littering rules on violators • DPWH-BMU to incorporate detection of uncovered trucks with easily airborne cargoes in safety spot-check regimen • DPWH-BMU to implement regular roadside litter cleanup (periodicity based on litter buildup rate)	• DPWH-BMU	• Monitoring of littering and inadvertent waste release from uncovered loads in bridge surveillance routines • Periodic spot checks conducted to reduce the number of inadequately covered loads crossing the bridge • Roadside litter cleanups carried out as needed • Low incidence of roadside litter build-up	• NIC	BCIB O&M budget

10.4 Social Development Plan

The BCIB project has the potential to bring significant positive impacts (e.g., employment, local economic growth, increased mobility) for people and communities within the immediate area of influence, and in many cases there will be an explicit or implicit tradeoff between such positive impacts and the negative effects (e.g., increased noise, air quality decline, increased traffic on local roads) that may be experienced. In order to maximize the potential for positive impacts to accrue to local people and businesses as a result of the project, a Social Development Plan is a required component of the EMP, as indicated in the Revised Procedural Manual (DAO 2003-30). The SDP also serves as a vehicle for ensuring that negative economic impacts of the project not assessed under the project LARP and addressed through its compensatory framework are adequately and appropriately offset. This function this applies to fisherfolk who derive income from fishing in the BCIB project area, and whose fishing incomes may be affected by disruption of access to normal fishing grounds during construction or degradation of fish stocks by underwater noise and benthic habitat disturbance.

This section of the EMP identifies a number of possible mechanisms for enhancing positive social and economic impacts of the project for local people and communities, and a livelihood restoration program for affected fisherfolk. The matrix in Exhibit 10-4 defines the identified mechanisms, assigns responsibility and a timeframe for implementation of measures to activate them, specifies performance indicators, and estimates their cost. The Social Development Plan is expected to be complemented by other development initiatives proposed in relation to the LARP and Gender Action Plan (GAP).

Exhibit 10-4: Proposed Social Development Plan

Social Development Aim	Prescribed Measures	Implementing Entity	Timing	Performance Indicators	Estimated Cost (PHP)
A. CONSTRUCTION PHASE					
1.Capture direct employment benefits	• Provide training to local people interested in securing employment on the project, in construction, administration, security, site maintenance and BAP implementation activities (Mariveles) • Provide training to local people interested in securing employment on the project, in construction, administration, security, site maintenance and BAP implementation activities (Naic)	• Private training contractor engaged by DPWH-EU	• Training to start at least 6 months before the projected start of works • Recruitment events to be organized at least 3 months prior to the start of works, and repeated on a quarterly basis during the first year of construction phase	• Training program developed and delivered by private training contractor in Mariveles and Naic • Participation in training by local people	1,000,000
2. Capture direct employment benefits	• Organize in-person recruitment events with compulsory PC and key sub-contractor participation in Mariveles to facilitate hiring of local workers • Organize in-person recruitment events with compulsory PC and key sub-contractor participation in Naic to facilitate hiring of local workers	• DPWH-EU	• Recruitment events to be organized at least 3 months prior to the start of works, and repeated on a quarterly basis during the first year of construction phase	• Recruitment events held in Mariveles and Naic, with participation of PCs and key sub-contractors	100,000
3.Maximize opportunities for local enterprises	• Organize marketplace connection events to facilitate PC and sub-contractor procurement of goods and services from local enterprises in Mariveles (with mandatory participation by PCs and key sub-contractors) • Organize marketplace connection events to facilitate PC and sub-contractor procurement of goods and services from local enterprises in Naic (with mandatory participation by PCs and key sub-contractors)	• DPWH-EU	• Marketplace connection events to be organized at least 3 months prior to the start of works, and repeated on a quarterly basis during the first year of construction	• Marketplace connection events held in Mariveles and Naic, with participation of PCs and key sub-contractors	100,000
4. Enhance long-term livelihood potential of local fisherfolk by protecting BCIB-adjacent fish habitat in a contiguous fish sanctuary	• Engage planning consultant to (1) facilitate discussions with four municipalities whose municipal waters are crossed by the BCIB alignment (Mariveles, Cavite City	• DPWH	• Planning consultant to be engaged by DPWH during the pre-construction phase	• Planning consultant engaged • Formal Memoranda of Agreement between DPWH	2,500,000

Social Development Aim	Prescribed Measures	Implementing Entity	Timing	Performance Indicators	Estimated Cost (PHP)
	(Corregidor), Ternate and Naic) regarding the proposed contiguous fish sanctuary along the full length of the alignment; (2) develop a proposed collaborative model; (3) deliver necessary capacity-building to enable municipal bodies such as FARMCs and bantay dagats to conduct effective surveillance and enforcement using the BCIB as a platform; and (4) assist municipal authorities with preparation of draft sanctuary management plans.		• Target date for formation of support partnerships (including support mechanism) is 1 year prior to end of construction • Target for declaration of sanctuaries and finalization of draft management plans is first year of BCIB operations	and each of four municipalities signed • Capacity-building activities for municipal surveillance and enforcement entities completed • Draft sanctuary management plans prepared • Sanctuaries formally established by municipalities	
5. Compensate fisherfolk for livelihood losses due to anticipated residual effects on fisheries resources from piling noise	• Enter into partnership with BFAR to develop and implement a fisherfolk livelihood restoration program for local fisherfolk of Mariveles, Naic,Ternate and Cavite City (Corregidor fleet) • Engage consultant to (1) assist BFAR with identification of fisherfolk active in the project area, defined as 5 km either side of the BCIB alignment; (2) formulate proposals for context-appropriate fisheries resource rehabilitation and enhancement projects, alternative income projects and livelihood support mechanisms to be implemented through local FARMCs; and (3) develop and deliver capacity-building programs for FARMCs in collaboration with BFAR	• DPWH	• Beginning directly after project approval and continuing through construction phase	• Formal Memorandum of Agreement between DPWH and BFAR signed • Planning consultant engaged to assist BFAR, formulate program proposals and deliver capacity-building • Capacity-building activities for FARMCs completed • Fisheries resource rehabilitation and enhancement projects, alternative income generation projects and livelihood support mechanism operational by mid-point of construction phase	1,207,000,000[316]

[316] The largest component of this estimated cost (PHP 1,200,000,000) is for cash compensation for lost fishing livelihood. This is calculated based on the following assumptions: (1) up to 1,000 fisherfolk derive a substantial portion of their fishing income from fishing within 5 km of the BCIB alignment; (2) impacts on fisherfolk livelihood will endure approximately 5 years; (3) fair compensation (based on compensation currently paid to fisherfolk affected by seabed mining on the San Nicolas Shoals) is PHP 20,000/month. This is acknowledged to be a preliminary estimate only, and is put forward as such at the time of writing to ensure that adequate funds are allocated for this element of the SDP. The actual number of affected fisherfolk and amount of eligible fishing activity may be smaller than assumed here, and program costs may consequently be lower than estimated.

Social Development Aim	Prescribed Measures	Implementing Entity	Timing	Performance Indicators	Estimated Cost (PHP)
	• Establish Fisherfolk Livelihood Restoration Fund to support implementation of rehabilitation and enhancement projects, alternative income projects and livelihood support mechanisms, as well as engagement of consultant			• Fisherfolk Livelihood Restoration Fund established	
B. OPERATION PHASE					
6. Capture direct employment benefits	• Prioritize hiring of local people for jobs in infrastructure and ROW maintenance, administration, emergency response crews, security, equipment maintenance and groundskeeping at the BMMC • Require contractors engaged for major repair and replacement works to hire local labor in proportions at least meeting the minimum local labor requirement for construction projects as per RA 6685	• DPWH-BMU	• During initial recruitment for permanent positions • During tendering for maintenance and repair works contracts	• Proportion of BMU staff who are from Mariveles or Naic exceeds 50% • Stipulation for hiring of local workers in proportions at least equal to those prescribed for construction projects under RA 6685 included in bid documents and contracts for maintenance and repair works	-
7. Maximize opportunities for local enterprises	• Organize informational events to announce tenders to local contractors, to encourage local bids on maintenance and repair and replacement contracts	• DPWH-BMU	• Each time a tender is issued	• Informational events organized each time there is a tender issued • Participation by local firms in events • Bids from local firms on tenders	25,000
Total estimated cost for Social Development Plan					1, 210,725,000

10.5 Decommissioning Policies and Guidelines

The design life of the BCIB project infrastructure is 100 years, which makes it rather dubious to stipulate appropriate decommissioning procedures before it is built. It can be safely assumed that decommissioning best practice will have advanced to some significant extent by the end of 100 years, and that prevailing best practice should simply be followed at that time.

The matter of decommissioning is more applicable to staging areas and other support sites used temporarily during the project construction process. The Proponent shall be responsible for submitting an abandonment plan to DENR-EMB CO 90 days prior to abandonment of each site. Items addressed through implementation of the abandonment plan for each site shall include the following:

1. Removal of all construction equipment and remaining supplies and materials;
2. Dismantling and removal of all temporary construction facilities and structures;
3. Appropriate disposal of any wastes present;
4. Clean-up and remediation of any contaminated soil or water credibly linked to use of the site during construction (i.e., not known to have pre-dated site set-up);
5. Reinstatement of site surfaces such that no steep, unstable or easily eroded slopes, and no potential physical hazards, are left upon abandonment;
6. Successful revegetation of bare soils;
7. Restoration of any pre-existing watercourse altered during site set-up or use to its original condition, including re-establishment of its original course and planting of riparian vegetation;
8. Inspection of the site by the CSC to confirm successful completion of all foregoing items.

To aid the submission of abandonment plans to DENR-EMB CO, each PC shall prepare a Staging Area Rehabilitation Plan for each of the sites under its control, to the same specifications as listed above, no less than 120 days prior to planned abandonment. A sample outline for a Staging Area Rehabilitation Plan is provided in the Appendices to the EMP (Appendix B).

10.6 Emergency Action Plan Guideline

Emergencies are unforeseen events or episodes that may be caused by natural forces or human actions or inactions which may result in negative effects to people, property, and the surrounding environment. Advance preparations for the sudden arrival of an emergency can, in many situations, make it easier to mount a timely and effective response, and may help to limit environmental damage, damage to the infrastructure, and loss of life and limb. The BCIB project should have policies and plans in place to establish some measure of preparedness for emergency situations that may arise during construction or operation.

Because of its size, complexity and varied environment, the BCIB project is poorly suited to having a single Emergency Action Plan for the construction phase, to be implemented in top-down fashion by a single entity with command authority over the entire project area spanning two provinces and regions separated by water, and crews and equipment of multiple contractors and even more sub-contractors. It will be more appropriate for each of the PCs—who own the equipment, manage the work sites, know who and where their workers are, and have high familiarity with the specific environments in which their crews are working—to have its own Emergency Action Plan. A primary purpose of this section of the EMP, then, is to specify a common set of risk assumptions and guidelines to be used by each PC in developing an Emergency Action Plan specific to its work sites, equipment, personnel and working environment. Each PC must have an Emergency Action Plan—reviewed and approved by the CSC—in place before the start of any works, including site setup; it is to be emphasized that having an Emergency Action Plan in place means not only that a plan has been written and approved, but also that investments in resources for preparedness, such as equipment and training, have been made.

Notwithstanding the appropriateness of investment in emergency action planning for the construction phase being carried out primarily by the PCs, it will be necessary for DPWH to be fully informed of all PC response actions during an emergency. DPWH will lead communication with the news media ongoing emergency response, and coordinate support from other national government agencies as necessary. Accordingly, DPWH-EU should carefully review the Emergency Action Plans prepared by each of the PCs and develop a communication and coordination strategy prior to the start of works. The focal point for coordination and communication shall be the PEO.

During operation of the BCIB infrastructure, a single comprehensive Emergency Action Plan will be appropriate, and will be under the remit of the Bridge Management Unit. Risk assumptions and guidelines applicable to the operation phase and to preparation of an Emergency Action Plan by the BCIB Management Entity are detailed below, alongside those for the construction phase. The Bridge management Unit must have an Emergency Action Plan—reviewed and approved by the DPWH-ESSD—in place before the start of operations.

10.6.1 Scoping Potential Emergency Situations

Th first step in developing an effective emergency response policy and subsidiary plans is to identify the potential emergency scenarios that may realistically occur and produce significant threats to the project's successful implementation, to the project infrastructure, or to the people who will build and use it. Exhibit 10-5 presents a series of plausible emergency scenarios.

Exhibit 10-5 Plausible Emergency Scenarios for the BCIB Project

Type of Emergency	Likely Causes	Potential Effects
• CONSTRUCTION PHASE		
Earthquakes	• Movement/rupture of nearby fault lines • Volcanic eruption	• Failure of gantries, toppling of storage tanks • Toppling of partially installed girders • Injury and mortality of construction workers • Injury and mortality of infrastructure users • Releases of stored fuels to the environment

Type of Emergency	Likely Causes	Potential Effects
Tsunami	• Movement/rupture of nearby fault lines • Volcanic eruption • Underwater landslide	• Drownings and injury of construction workers • Sinking of construction vessels • Injuries and fatalities to personnel • Damage to partially completed bridge • Releases of stored fuels to the environment
Flooding	• Location of project in typhoon-prone area • Climate change	• Loss and damage of equipment and materials • Releases of fuels and materials to environment
Storm Surge	• Location of the Philippines as a typhoon prone area • Coincidence of extreme weather and high tide	• Loss and damage of equipment and materials • Releases of fuels and materials to environment
Fire	• Electrical short-circuits, overloading of equipment • Inappropriate storage of combustible materials • Poor standard of equipment maintenance • Arson	• Partial or total loss of equipment and property • Injuries and fatalities of construction workers
Major work accidents	• Improper training and supervision of personnel • Operator error • Equipment failure and facility failure	• Injury and mortality of workers • Partial or total loss of equipment • Releases of fuels and materials to the environment
• OPERATION PHASE		
Very strong earthquake	• Movement/rupture of nearby fault lines • Volcanic eruption	• Damage to infrastructure • Injury or mortality of infrastructure users
Major tsunami	• Movement/rupture of nearby fault lines • Volcanic eruption • Underwater landslide	• Damage to infrastructure
Direct hit from major typhoon	• Location of project in typhoon-prone area • Climate change	• Damage to infrastructure
Multi-vehicle pile-up	• Unsafe driver behavior • Lax enforcement of speed limit • Bad weather	• Injury and mortality of infrastructure users
Collision of large vessel with bridge or viaduct	• Bad weather • Operator error • Mechanical or technological failure	• Damage to infrastructure • Injury or mortality of infrastructure users
Explosion of large flammable or explosive cargo on bridge	• Unsafe driver behavior • Lax enforcement of speed limit • Bad weather	• Damage to infrastructure • Injury or mortality of infrastructure users
Large spill of hazardous cargo on bridge	• Unsafe driver behavior • Lax enforcement of speed limit • Bad weather	• Release of hazardous material to environment
Terrorist attack or sabotage	• Radicalization • Political unrest	• Injury and mortality of infrastructure users • Damage to infrastructure
War	• Geopolitical instability	• Injury and mortality of infrastructure users • Damage to infrastructure
Unforeseen failure of infrastructure	• Inadequate inspection • Deferred maintenance	• Injury and mortality of infrastructure users

10.6.2 Framework for Emergency Action Plan Development

Effective emergency response is underpinned by advance preparation of measures in three areas: preparedness, response, and recovery. Emergency preparedness refers to the things an entity can do to in anticipation of emergencies to enable real-time response when the time comes, such as making plans, allocating resources, establishing coordination mechanisms, and training. Response encompasses all that should swing into action when the entity is faced with an actual unfolding emergency. And recovery refers to the measures that will be necessary to return to safe operations and build resilience for possible future emergencies. Exhibit 10-6 provides a framework for emergency planning by PCs (construction phase) and the DPWH-BMU (operation phase), using the preparedness–response–recovery rubric.

Exhibit 10-6 Preparedness–Response–Recovery Framework for Emergency Scenarios

Type of Emergency	Preparedness	Response	Recovery
• CONSTRUCTION PHASE			
Earthquakes	• Design all installed construction-related facilities (elevated tanks, batch plants, buildings, storage facilities) to withstand strong earthquakes • Develop protocols for post-incident inspection and work resumption • Institute training programs for managers and workers for effective deployment of earthquake response measures • Train and equip internal disaster response team with emergency medical assistance and search and rescue capabilities • Proactively develop coordination with regional medical evacuation units	• Immediately stop work, evacuate personnel from buildings and structures, and account for all personnel • Deploy disaster response team as necessary • Coordinate with disaster response authorities as needed	• Inspect all facilities for damage and make repairs as needed • Inspect all partially completed infrastructure for damage and collapse risk and make repairs as needed • Assess active risk based on information coming from PHIVOLCS to make decisions regarding resumption of work
Tsunami	• Set up staging areas so that vulnerable components (construction camps, fuel storage) are beyond projected tsunami risk zone • Set up automatic notification from tsunami early warning system • Develop protocols for works stoppage and evacuation in the event of warnings	• Secure work sites and evacuate personnel in the event of a qualifying tsunami warning	• Inspect all work sites and staging areas for damage to structures and make repairs as needed • Clear debris and repair site surfaces and drainage structures as needed
Flooding	• Develop weather forecast monitoring system to ensure advance and real-time assessment of flood risk to staging areas and work sites • Set up staging areas so that vulnerable components (construction camps, fuel storage, materials storage) are beyond flood risk zone	• Implement procedure for pre-flood site closure and securement, including measures for equipment and materials removal, electrical system shutdown and drainage system clearance	• Inspect all work sites and staging areas for damage to structures and make repairs as needed • Clear debris and repair site surfaces and drainage structures as needed

Type of Emergency	Preparedness	Response	Recovery
	• Develop procedure for pre-flood site closure and securement, including measures for equipment and materials removal, electrical system shutdown and drainage system clearance		
Storm Surge	• Develop weather forecast monitoring system to ensure advance and real-time assessment of storm surge risk to staging areas and work sites • Set up staging areas so that vulnerable components (construction camps, fuel storage, materials storage) are beyond storm surge risk zone • Develop procedure for pre-storm site closure and securement, including measures for equipment and materials removal, electrical system shutdown and drainage system clearance	• Implement procedure for pre-flood site closure and securement, including measures for equipment and materials removal, electrical system shutdown and drainage system clearance	• Inspect all work sites and staging areas for damage to structures and make repairs as needed • Clear debris and repair site surfaces and drainage structures as needed
Fire	• Ensure that all electrical systems on work sites and staging sites are designed and installed in accordance with national building code • Ensure that storage of flammable materials is separate from other facilities • Ensure that all work sites and staging areas are supplied with fire suppression equipment commensurate with fire risk • Provide regular training to site managers and workers on fire prevention • Provide regular training, including drills, to site managers and workers on fire response and correct operation of firefighting equipment • Develop regular fire safety inspection regime for all staging areas	• Deploy fire suppression	• Inspect and repair as necessary all facilities and equipment affected by fire
Major work accidents	• Train and equip internal disaster response team with emergency medical assistance and search and rescue capabilities • Proactively develop coordination mechanisms with regional medical evacuation units • Provide regular workplace safety training to site managers and all workers • Ensure that all heavy equipment is properly maintained	• Immediate deployment internal disaster response team for emergency medical assistance and/or search and rescue as needed • Evacuate inured personnel in coordination with regional medical evacuation units	• Inspect and repair or replace equipment and facilities damaged in the incident • Investigate causes of incident and amend training, oversight and emergency response measures as appropriate

Type of Emergency	Preparedness	Response	Recovery
• OPERATION PHASE			
Very strong earthquake	• Develop protocols for infrastructure closure based on earthquake strength • Train and equip disaster response team with search and rescue capabilities	• Immediately close infrastructure • Evacuate infrastructure users	• Inspect infrastructure to ensure safety prior to reopening • Implement any necessary repairs to infrastructure
Major tsunami	• Set up automatic notification from tsunami early warning system • Develop protocols for infrastructure closure in the event of warnings	• Close infrastructure and clear of users upon receipt of actionable warning	• Inspect infrastructure to ensure safety prior to reopening • Implement any necessary repairs and debris clearance
Direct hit from major typhoon	• Monitor typhoon track and strength projections • Develop protocols for infrastructure closure in the event of typhoon approach	• Close infrastructure and clear of users upon receipt of actionable information regarding typhoon track and strength	• Inspect infrastructure to ensure safety prior to reopening • Implement any necessary repairs or debris clearance
Multi-vehicle pile-up	• Implement traffic surveillance system to detect stoppages and accidents quickly • Train and equip rapid incident response team • Proactively develop coordination mechanisms with regional medical evacuation units	• Deploy rapid incident response team • Coordinate as needed with regional medical evacuation units	• Clear all disabled vehicles and debris from infrastructure • Implement any necessary repairs to infrastructure
Collision of large vessel with bridge or viaduct	• Develop monitoring system to quickly detect imminent and already-occurring collisions • Develop protocols for infrastructure closure based on vessel tonnage and location of collision • Train and equip disaster response team with search and rescue capabilities	• Close infrastructure and clear of users for qualifying incidents • Deploy disaster response team as appropriate to incident severity	• Inspect infrastructure to ensure safety prior to reopening • Implement any necessary repairs
Explosion of large flammable or explosive cargo on bridge	• Implement traffic surveillance system to detect incidents quickly • Train and equip rapid incident response team • Proactively develop coordination mechanisms with regional medical evacuation units	• Immediately close infrastructure and clear of users • Deploy rapid incident response team • Coordinate as needed with regional medical evacuation units	• Clear all disabled vehicles and debris from infrastructure • Implement any necessary repairs to infrastructure
Large spill of hazardous cargo on bridge	• Implement traffic surveillance system to detect incidents quickly • Train and equip rapid incident response team with hazardous material containment and clean-up capabilities	• Deploy rapid incident response team • Clear disabled vehicles and complete clean-up	• Not applicable

Type of Emergency	Preparedness	Response	Recovery
Terrorist attack or sabotage	• Implement bridge surveillance system to detect incidents quickly • Train and equip disaster response team with search and rescue capabilities • Proactively develop coordination mechanisms with national security authorities	• Close infrastructure and clear of users • Coordinate with security authorities • Deploy disaster response team as appropriate to nature of incident	• Inspect infrastructure to ensure safety prior to reopening • Implement any necessary repairs
Unforeseen catastrophic failure of infrastructure	• Develop and implement rigorous infrastructure inspection to detect possible evidence of problems • Train and equip disaster response team with search and rescue capabilities	• Close infrastructure and clear of users • Deploy disaster response team as appropriate to nature of failure	• Implement any necessary repairs • Inspect infrastructure to ensure safety prior to reopening

10.6.3 Framework for Allocation of Effort and Resources in Emergency Action Plans

A clear idea of what challenges will be faced and what kinds of needs will become manifest in an emergency situation needs to be developed and used as a basis for decisions regarding organizational and command structures, resource allocations, and decision protocols in Emergency Action Plans to be prepared by both the PCs (construction phase) and the DPWH-BMU (operation phase). Exhibit 10-7 provides an indicative breakdown of planning considerations in relation to all three stages of emergency action. The indicative planning and implementation actions are generic, and applicable to formulation of plans by both PCs and the Bridge Management Unit. A sample outline for an Emergency Action Plan is provided in Appendix B to the EMP.

Exhibit 10-7 Key Elements of Emergency Action Plan Formulation and Implementation

Action Category	Key Tasks
• PREPAREDNESS	
Plan	• Ensure that a clear chain of command for emergency situations has been formulated, and specific people have been assigned by name to all positions, e.g., Incident Commander, Backup Incident Commander, Coordination Lead, Operations Lead, Communications Lead • Ensure all plausible emergency scenarios have been considered and can be responded to properly with the teams, equipment and mobilization resources allocated under the plan • Ensure that necessary internal and external coordination mechanisms are specified in the plan and proactively negotiated • Ensure that protocols for decision-making have been formulated and tested as appropriate
Allocate	• Ensure that capital, human and liquid financial resources are allocated commensurate with the range of plausible emergency scenarios, taking account of scale • Establish a financial contingency that can be mobilized quickly, and a protocol for deciding when it is appropriate to use it
Coordinate	• Establish proactive dialogue and jointly agreed mechanisms for coordination with other entities, to lessen the need for improvisation in emergency situation
Train	• Formulate and provide regular, iterative training on implementation of the emergency action plan, including drills and involving everyone in the entity
• RESPONSE	

Action Category	Key Tasks
Assess	• Quickly gather information from as many sources as possible • Characterize the nature, scale, severity, urgency and locational aspects of the emergency • Account for all personnel
Prioritize	• Determine how mobilization resources would best be allocated based on differentials pertaining to density, severity, accessibility, potential for stopping spread, potential for saving lives and property
Decide	• Select option or suite of options for implementation • Communicate decisions to designated leads in the team
Mobilize	• Give the go-ahead for each team, in the appropriate order • Release financial resources as needed
Monitor and Adapt	• Track the activity of each team and the progress of the emergency situation • Adapt team actions as necessary
Coordinate	• Activate pre-arranged external coordination mechanisms as needed • Identify and improvise new external coordination mechanism as needed
Communicate	• Keep action teams and all entity personnel informed of the emergency and status of actions to manage it • Maintain active communication with local and extra-local emergency management authorities • Inform affected members of public (e.g., property owners) of response actions that may affect them • Release information to the general public on a regular basis, through media
• RECOVERY	
Assess	• Systematically characterize the nature, scale and severity of damages, taking account of differences across emergency-affected sites
Prioritize	• Determine what needs to happen right away, and what can safely wait
Mobilize	• Assign responsibilities and give the go-ahead • Release financial resources as needed
Learn	• Evaluate what went well, what went poorly in the response • Identify reasons for successes and failures
Adapt	• Consider suitability of prior resource allocations, organizational structure and scale of emergency plan • Adjust emergency action plan as needed

10.7 Environmental Monitoring Plan

10.7.1 Purpose of Environmental Monitoring

The purpose of environmental monitoring is to ensure that the EMP is fully and competently implemented across all phases of the project's implementation, and to provide a basis for appropriate and timely corrective action when it is found not to be. The environmental monitoring process should be understood not only as a means of supervision and enforcement, but also as a vehicle for organizational learning and progress towards international best practice in construction site and facility management. Effective monitoring can also be a vital tool in forestalling conflict with the communities most likely to suffer the consequences of negative environmental impacts, as problems can be identified and corrected in a timely manner, before they grow to nuisance or dangerous levels.

10.7.2 Modes of Environmental Monitoring

Environmental monitoring consists of assessing both the degree to which the project proponent and its contractors and facility operators are fulfilling their responsibilities to implement measures specified in the EMP to manage impacts (*compliance* monitoring), and the degree to which their impact management efforts are successful in preventing harmful environmental conditions from arising (*effects* monitoring). Compliance monitoring typically makes use of checklists to confirm or disconfirm that prescribed measures are being properly implemented, while effects monitoring involves quantitative and/or qualitative environmental sampling at designated locations. Both types of monitoring need to be conducted on a regular and consistent basis, to ensure the comparability of results across monitoring periods.

Environmental sampling for effects monitoring should begin before the start of any physical works or site set-up, so an environmental baseline (i.e., pre-project conditions) can be established for key environmental parameters, including for sampling locations which may not have been included in general baseline studies due to access difficulties and uncertainty about the precise placement of project infrastructure and works sites; this is particularly relevant in relation to effects monitoring at construction staging areas, whose precise locations, uses and internal layouts cannot be definitively known at the time of EMP preparation. Each CEMMAP shall contain a refined monitoring protocol to guide environmental sampling during construction, based on advanced knowledge of site locations and the placement of high-impact activities within them, relative to impact receptors such as watercourses and residential areas.

Although the appropriate intensity of monitoring activity will vary as project implementation proceeds, monitoring should continue throughout the life of the project. The frequency of monitoring should be different for different parameters, and should be determined by the nature of activities and the urgency of corrective action, not by the required reporting schedule. Some parameters should be measured continuously by automatic sampling equipment (e.g., dust and noise on sites with intense, locationally consistent impact sources), and the sampling interval for periodically sampled parameters may range from daily (e.g., dust suppression and PPE use) to yearly (e.g., checks on certifications of lifting equipment and fire suppression equipment). Each CEMMAP shall include a refined monitoring plan that specifies monitoring activity by location and frequency, based on site layout and projected scale and nature of particular work activities.

10.7.3 Monitoring Entities and Processes

As has been noted above in relation to the roles and responsibilities in EMP implementation, environmental monitoring for the BCIB project will involve multiple processes and be carried out by multiple entities.

10.7.3.1 Construction Phase Monitoring

Five interwoven monitoring process streams can be delineated for the construction phase of the BCIB project. These are described below, and represented in Exhibit 10-8.

Proponent's Self-Monitoring

As the project proponent, DPWH will implement a self-monitoring process to ensure that the implementation activities under the project are in compliance with the EMP and the ECC, and report the results to the DENR-EMB ROs in quarterly Self-Monitoring Reports (SMRs) and semi-annual ECC Compliance Reports (CMRs).[317] DPWH will also prepare Semi-Annual Environmental Monitoring Reports (SEMRs) for submission to ADB. The

[317] The CMRs will be appended to the 2nd and 4th Quarter SMRs.

SMRs, CMRs and SEMRs will be prepared by the DPWH-EU, with guidance and review provided by DPWH-ESSD.

Contractors' Self-Monitoring

To support its quarterly reporting, DPWH will require each of the PCs to monitor sites under its control, including those operated by its sub-contractors. Each PC's CEMMAP shall include provisions for preparation of monthly CEMMAP implementation monitoring reports, to be submitted to the DPWH-EU in conjunction with regular monthly progress reporting on implementation of the civil works. The monthly monitoring reports prepared for submission to the DPWH-EU shall include the findings of both compliance monitoring (i.e., confirmation that prescribed measures are being implemented) and effects monitoring (i.e., confirmation that emissions and effluents generated are not violating relevant environmental quality standards). The PCs will have the option of conducting effects monitoring in-house or out-sourcing it to a qualified monitoring firm, but in either case, associated laboratory analysis must be carried out by a DENR-accredited laboratory.

Proponent's Confirmatory Monitoring of Primary Contractors

Contractors may perceive a strong incentive to cut corners on their self-monitoring to cover up lax performance and save resources, and monitoring activity on the part of the Proponent is typically necessary to help counteract this (close scrutiny of received monitoring reports is also critical in this regard). The DPWH-EU, with the guidance of the CSC and DPWH-ESSD, will conduct confirmatory monitoring of each PC's monitoring activity to ensure monitoring integrity. The objective of confirmatory monitoring is not to duplicate the monitoring activity of the PCs. Rather, a more limited sampling approach to monitoring is appropriate, in which monitoring is conducted at lower frequency for most parameters, with the spot check being an important modality. Monitoring at the site level will be carried out by the DPWH-EHSOs. The DPWH-EU will need to develop a refined monitoring protocol for the works of each PC, based on the monitoring plan contained in the PC's CEMMAP; the CSC shall provide guidance and assistance in this regard, including for development of checklists and appropriate frequencies for regular and spot checks.

The confirmatory monitoring activity of the DPWH-EHSOs should include observation environmental sampling activity carried out by the PC or its sampling contractor; this can enable effective oversight without expensive duplication of field sampling and laboratory analysis. However, DPWH-EU may find it necessary to conduct independent field sampling on occasion in order to investigate issues that emerge at times between the PC's sampling scheduled sampling dates (perhaps in response to complaints from people affected by impacts), or to counteract any coordination between construction activity and sampling dates on the part of the PC. For this reason, the DPWH-EU should allocate resources to engage an outside sampling contractor on an occasional as-needed basis. As a rough estimate and basis for a monitoring allocation, such sampling monitoring activity is assumed to amount to about one tenth of the environmental sampling effort and expense of the monitored PC. The DPWH-EHSOs shall facilitate access to project sites by the outside contractor when such spot sampling is arranged.

Monitoring by Multi-Partite Monitoring Teams (MMTs)

Two MMTs will be set up to conduct verification monitoring of the Proponent's performance and the integrity of its self-monitoring activity, on behalf of project stakeholders in Bataan and Cavite. The MMTs will report their findings to the DENR-EMB ROs for their respective regions in semi-annual Compliance Monitoring and Validation Reports (CMVRs).

Monitoring by DENR-EMB ROs

The regional offices of DENR-EMB (Regions III and IV) will conduct field monitoring as they deem appropriate to verify the quality of the proponent's self-monitoring, and to investigate particular concerns brought to light by monitoring results, stakeholder complaints, or other means. The DENR-EMB ROs will submit semi-annual Compliance Evaluation Reports (CERs) to the DENR-EMB CO on the proponent's compliance with the ECC.

Monitoring by External Monitoring Agent

The EMA will conduct monitoring of the overall performance of the project in relation to the EMP and EMoP. The specific scope, nature and frequency of the EMA's monitoring activity will be determined through discussions between DPWH and ADB prior to preparation of a Terms of Reference and selection of the firm or NGO that will serve as the EMA. Monitoring activity by the EMA is not shown in Exhibit 10-8.

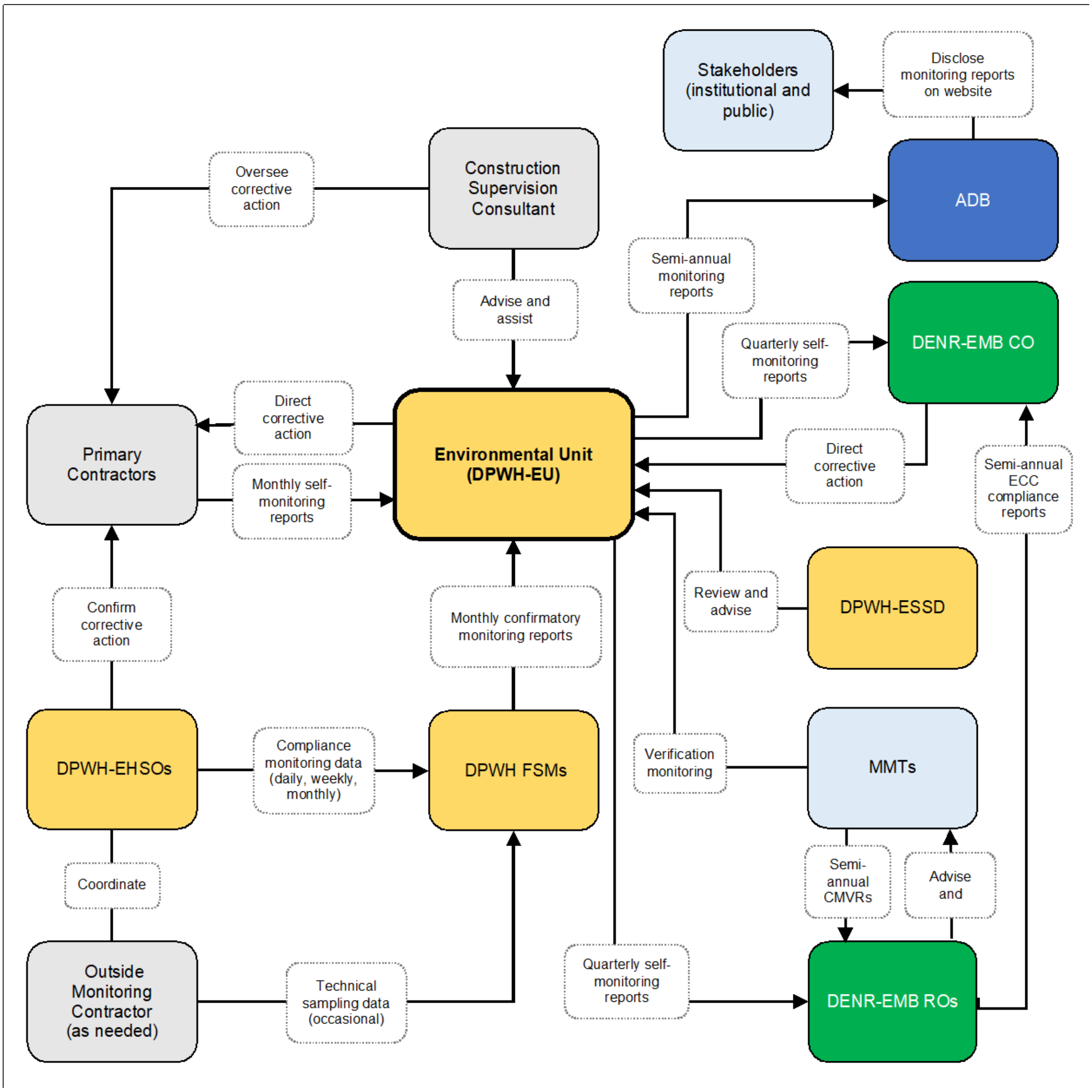


Exhibit 10-8 Schematic of Monitoring Processes in Construction Phase

10.7.3.2 Operation Phase Monitoring

Project implementation activity—and the scope and scale of impacts—will change dramatically with the end of the construction phase, and monitoring activity will evolve accordingly. The configuration of monitoring activity for the project's operation phase is shown in Exhibit 10-9.

Proponent's Self-Monitoring

During the operation phase, the DPWH-BMU will replace the DPWH-UPMO RMC II and its BCIB-PMT as the BCIB project's implementing body, and will become responsible for self-monitoring activity and attendant reporting. The DPWH-BMU will submit quarterly SMRs to the DENR-EMB ROs of Regions III and IV, unless the Proponent applies for and is granted relief from the ECC during the operation phase, which is indicated as a possibility in the present ECC. The DPWH-BMU shall submit SEMRs to ADB until such time as ADB assesses that the occurrence and significance of impacts during operations do not warrant continued reporting.

Monitoring by Multi-Partite Monitoring Teams (MMTs)

The MMTs will continue monitoring project impacts and the Proponent's compliance with the terms of the ECC and reporting on a semi-annual basis unless the Proponent applies for and is granted relief from the ECC during the operation phase, or the members of the MMTs and/or the respective DENR-EMB ROs determine that continued monitoring and reporting are not warranted.

Monitoring by DENR-EMB ROs

The DENR-EMB ROs of Regions III and IV will continue to monitor the Proponent's compliance with the terms of the ECC until such time as the proponent applies for and is granted relief from the ECC.

Monitoring by External Monitoring Agency

The monitoring activity of the EMA will continue into the operation phase, but the duration of operation-phase monitoring has not been determined. The specific scope, nature and frequency of the EMA's monitoring activity will be determined through discussions between DPWH and ADB prior to preparation of a Terms of Reference and selection of the firm or NGO that will serve as the EMA. Monitoring activity by the EMA is not shown in Exhibit 10-9.

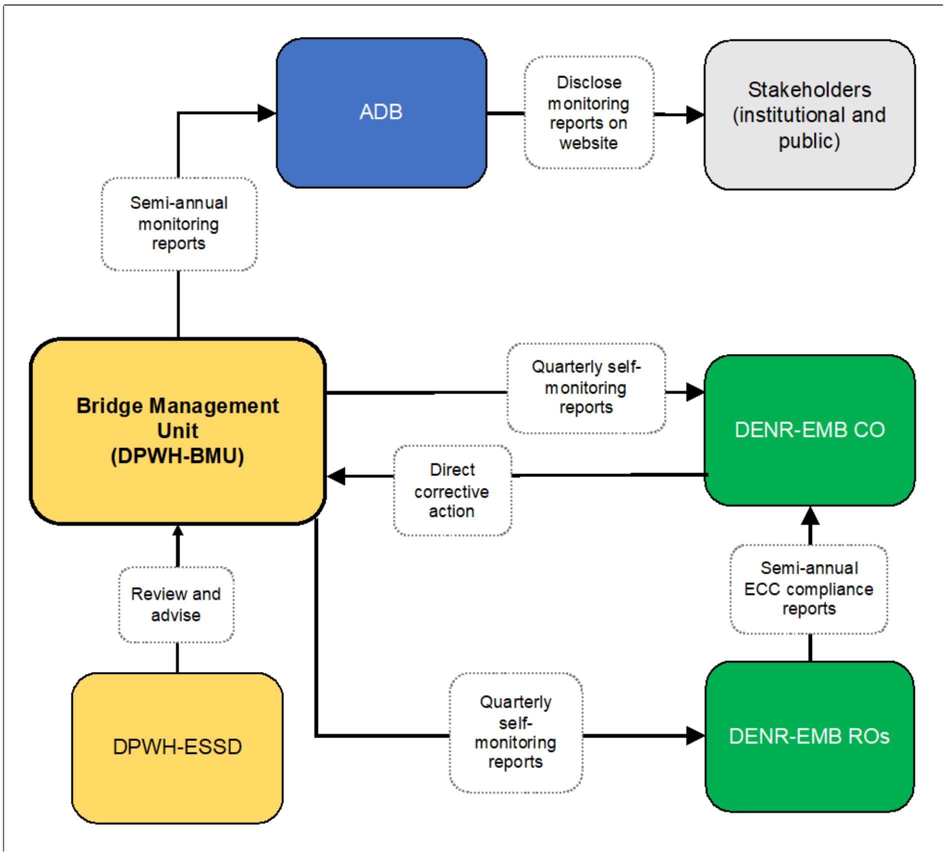


Exhibit 10-9 Schematic of Monitoring Activity in Operation Phase

10.7.3.3 Monitoring Reports

The reporting responsibilities of the various entities that will conduct monitoring activity during the construction and operation phases, as detailed above, are summarized in Exhibit 10-10, for clarity. Prescribed formats for reports submitted to DENR-EMB are provided in DAO-2003-30. A sample outline for SEMRs submitted by DPWH-EU to ADB is provided in Appendix C of the EMP. A sample outline for PC self-monitoring reports submitted to DPWH-EU by PCs appears in Appendix D.

Exhibit 10-10 Summary of Required Environmental Monitoring Reports

Report Type	Prepared By	Submitted To	Frequency
CONSTRUCTION PHASE			
PC Self-Monitoring Reports	PC EHSRs	DPWH-EU	Monthly
Self-Monitoring Report (SMR)	DPWH-EU	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Quarterly
ECC Compliance Monitoring Report (CMR)	DPWH-EU	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Semi-annually[1]
Compliance Monitoring and Validation Report (CMVR)	MMT	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Semi-annually

Compliance Evaluation Report (CER)	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	DENR-EMB CO	Semi-annually
Semi-Annual Environmental Monitoring Reports (SEMRs)	DPWH EO	ADB	Semi-annually
OPERATION PHASE			
Self-Monitoring Report (SMR)	DPWH-BMU	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Quarterly
ECC Compliance Monitoring Report (CMR)	DPWH-EU	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Semi-annually[1]
Compliance Monitoring and Validation Report (CMVR)	MMT	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	Semi-annually
Compliance Evaluation Report (CER)	DENR-EMB RO (Region III) DENR-EMB RO (Region IV-A)	DENR-EMB CO	Semi-annually
[1] Appended to 2nd and 4th quarter SMRs			

10.7.4 Monitoring Parameters, Modalities and Responsibilities

Performance indicators were identified for each prescribed impact management measure specified in the Environmental Impacts Management Plan Responsibility Matrix (Exhibit 10-3) above. Specific monitoring responsibilities in relation to these indicators, including the responsible entity and monitoring timetable for each, are detailed in the Environmental Monitoring Plan Responsibility Matrix in Exhibit 10-11 below. Each line item in Exhibit 10-3 is matched by a corresponding line item (with the same numbering) in Exhibit 10-11.

Under DAO 2003-30, a standard protocol for determining appropriate action in response to monitoring results is defined. The protocol consists of three Environmental Quality Performance Levels (EQPLs), with each level triggering a pre-specified response action. The EQPL system provides a means for project stakeholders to subjectively select, through negotiation with and by agreement of the Proponent, action-triggering levels for specific parameters that are lower than the maximum limit indicated in the relevant standard (lower EQPLs are typically expressed as percentages of the regulatory limit for quantitative standards). This may be considered desirable where, for example, the project environment already has elevated levels of the parameter of concern, or where the project environment is perceived as being especially sensitive and likely to suffer effects at levels below the maximum permissible limit. Per DAO 2003-30, the Proponent may choose whether to have EQPLs defined before obtaining the ECC, or defer until the post-ECC period. In the case of a deferral, the regulatory limit is the default value for determining compliance, and lower EQPLs are not specified in monitoring plans. DPWH elected to defer prior to applying for the ECC for the BCIB project, so only the regulatory limit applies unless stakeholders, acting in the context of an MMT post-ECC, advocate for lower EQPLs on particular parameters. Reflecting the current status, Exhibit 10-11 indicates only the regulatory limit in relation to quantitative standards.

Exhibit 10-11: Environmental Monitoring Plan Responsibility Matrix

Key: **CSC:** Construction Supervision Consultant; **DPWH-BMU:** BCIB Bridge Management Unit; **DPWH-BMU ES:** BCIB Bridge Management Unit Environment Specialist; **DPWH-EHSOs:** DPWH Environment, Health and Safety Officers; **DPWH-ESSD:** DPWH Environmental and Social Safeguards Division; **DPWH-EU:** DPWH Environmental Unit; **DPWH-PMT:** BCIB Project Management Team; **NQE:** No Quantifiable Expenditure; **PC1:** Primary Contractor, Package 1; **PC2:** Primary Contractor, Package 2; **PC3:** Primary Contractor, Package 3; **PC4:** Primary Contractor, Package 4; **PC5:** Primary Contractor, Package 5; **PC6:** Primary Contractor, Package 6; **PC7:** Primary Contractor, Package 7

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
D. PRE-CONSTRUCTION PHASE								
I. IMPLEMENTATION READINESS								
1. Permits and licenses	• All required permits, licenses, endorsements and any other clearance items have been secured prior to commencement of works, including those required by the PCs	Inspect documentation	Once prior to start of construction	RMC II HQ	DPWH-ESSD	NQE	Any required item not secured prior to scheduled start of works	Direct delay in start of works unless missing item pertains to an activity beginning later in the project cycle
2. Tree-cutting permits	• Tree-cutting permit granted by DENR for Bataan ROW • Tree-cutting permit granted by DENR for Cavite ROW • Tree-cutting permit granted by DENR for each Contractor site where tree removal is anticipated	Inspect documentation On-site verification of tree-cutting needs	Once prior to start of clearing Once prior to start of PC site setup	RMC II HQ	DPWH-ESSD	NQE	Necessary permit not obtained prior to scheduled start of ROW clearing works Necessary permit not obtained prior to scheduled start of PC staging area setup	Direct delay in start of clearing until correct permit secured
3. Pre-construction IEC activities	• General public information campaigns conducted in Mariveles and Naic prior to construction	Inspect documentation	3 months prior to start of construction	RMC II HQ	DPWH-ESSD	NQE	IEC activity not adequately conducted at least 3 months prior to scheduled start of construction	Direct immediate conduct of supplemental IEC activity, to be completed at least 1 month prior to start of works
4. Contractor compliance	• CEMMAP including all applicable specialized sub-plans prepared by each PC and submitted to CSC for review and approval	Inspect plans	3 months prior to start of works	RMC II HQ	DPWH-ESSD	NQE	CEMMAPs not submitted at least 3 months prior to scheduled start of works	Direct PC to expedite CEMMAP preparation unless PC is not scheduled to begin works until later in the project cycle

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
5. Contractor compliance	• CEMMAP including all applicable specialized sub-plans reviewed and approved by the CSC prior to commencement of any work, including staging area set-up	Inspect documentatio n	3 months prior to start of works	RMC II HQ	DPWH-ESSD	NQE	CEMMAPs not yet approved at least 3 months prior to start of scheduled works	Direct CSC and PC to expedite necessary CEMMAP improvements and secure approval before scheduled start of works, unless PC is not scheduled to begin works until later in project cycle
6. Land acquisition and resettlement	• All LARP measures implemented and there are no outstanding land acquisition disputes or lingering holdups regarding acquisition	Inspect documentatio n	Once prior to start of clearing	RMC II HQ	DPWH-ESSD	NQE	Unsettled acquisition and resettlement issues remain	Direct a delay in start of clearing for the relevant ROW until issue settled legally
7. Capacity-building for DPWH-EU	• Sufficient positions established, supported by budget allocations, and filled with appropriately qualified people to ensure strong likelihood that DPWH-EU can adequately fulfill its oversight responsibilities (at least 6 months prior to the start of construction) • Suitable budget allocations have been made for onsite office space and on-site transport for EHSOs and FSMs (at least 6 months prior to the start of construction)	Review staffing plan and budget allocations	Once, 6 months before start of construction	RMC II HQ	DPWH-ESSD	NQE	Required positions not yet established, funded and filled with suitable candidates	Direct expedited action on filling the required positions, recommend delay in start of works unless prompt action results
8. Provision of training to support EMP implementati on	• Training implemented for DPWH-EU personnel as proposed in Section 10.10.2.1 of the EMP, at least 3 months prior to start of works • Training implemented for sub-contractors as proposed in Section 10.10.2.2 of the EMP, before start of works and whenever new sub-contractors are engaged • Training for workers implemented as proposed in Section 10.10.2.3 of the EMP, whenever new crews are brought	Inspect refined training plans and documentatio n from training events Observe training events	3 months before start of construction Before construction Periodically during construction	CSC Offices	DPWH-ESSD	NQE	All required training for DPWH-EU personnel not started at least 3 months before start of construction Required training for sub-contractors not competed prior to start of works Initial training for workers not completed prior to start of works	Direct expedited start of training activities to ensure completion of DPWH-EU training at least 1 month before start of works Direct a delay in start of works for still-untrained contractors Direct a delay in start of works for still-untrained contractors

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	onstream, and annually for duration of construction							
9. Coordination with Manila Bay Rehabilitation Plan	• Advance coordination meeting held with MBCO, DENR and MENROs prior to start of works	Observe event	Once 3 months prior to start of works	TBD	DPWH-ESSD	NQE	Coordination meeting not yet arranged 3 months prior to scheduled start of works	Direct responsible party to make arrangements immediately
10. Establishment of functional MMTs	• MMT-Bataan constituted and EMF established to support it • MMT-Cavite constituted and EMF established to support it	Inspect documentation	Once 3 months prior to start of works	RMC II HQ	DPWH-ESSD	NQE	Either of MMTs not yet fully constituted and training underway by 3 months prior to scheduled start of works	Direct responsible party to expedite MMT formation and capacity-building, and direct a delay in the start of works if either MMT is not constituted and training by 1 month before scheduled start of works
11. Grievance Redress Mechanisms set up	• Grievance Redress Mechanism established as per Section 10.9 of the EMP	Inspect documentation	1 month prior to start of works	RMC II HQ	DPWH-ESSD	NQE	Grievance reception points not yet set up 1 month prior to start of works	Direct responsible party to expedite set-up, direct a delay in the start of works if grievance reception points not set up by the scheduled start of works
12. Primary Contractor insurance	• Each PC has provided documentation verifying acquisition of CARI in an amount no less than agreed between DPWH and DENR-EMB	Inspect documentation	Once prior to start of works	RMC II HQ	DPWH-ESSD CSC	NQE	Any PC has not yet provided proof of CARI at agreed coverage amounts	Prevent PCs lacking sufficient CARI coverage from beginning any activity until proof of coverage is produced
13. Carbon Sink Program formulated and funded	• Carbon Sink Program successfully formulated and submitted to DENR-EMB CO • Fund established to pay for implementation of Carbon Sink Program	Inspect documentation	Once prior to start of works	RMC II HQ	DPWH-ESSD	NQE	Set-up of Carbon Sink Program not yet completed	Direct responsible party to establish a timeline for establishment and take the remaining necessary steps as soon as possible, so implementation can be completed within the period of validity of the ECC

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
14.Biodiversity Management Plans	• Longitudinal biodiversity monitoring underway as soon as possible after project approval	Inspect documentation	Immediately following project approval	RMC II HQ	DPWH-ESSD ADB	NQE	Longitudinal monitoring not yet getting underway	Direct responsible party to expedite engagement and mobilization of CSC and monitoring contractors
15. Biodiversity Action Plan	• Necessary partnerships and institutional arrangements established for each of the monitoring and adaptive management programs specified in the ADB-approved BAP	Inspect documentation Observe planning meetings	Once prior to start of works	RMC II HQ	DPWH-ESSD ADB	NQE	Partnership formation for component programs not yet completed	Direct responsible party to expedite negotiation of partnerships, with priority placed on programs whose implementation should start early in the construction phase
16. Fund created for implementation of Biodiversity Action Plan	• Biodiversity Action Plan Fund established under a trusteeship approved by ADB	Inspect documentation	Once prior to start of works	RMC II HQ	DPWH-ESSD ADB	NQE	Implementation fund not yet established	Direct responsible party to expedite fund establishment so that time-sensitive programs can begin implementation
17. DPWH Emergency Coordination and Communication Plan	• DPWH Emergency Coordination and Communication Plan prepared by DPWH-EU prior to the start of works	Inspect plan	1 month prior to start of works	UPMO RMC II HQ	DPWH-ESSD	NQE	Plan not yet finalized 1 month prior to start of works	Direct expedited action on completing plan
II. LAND								
18. Terrestrial biodiversity impacts	• Preparation of the Natural Grssland Management Plan • 24.3 hectares of natural grassland planted and under long-term protective management • Tree-cutting permits secured for ROWs •	Inspect documentation	Beginning early in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for timely program implementation not progressing adequately	Direct responsible party to set arrangements in motion

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
19. Terrestrial biodiversity impacts	• Long-term monitoring and adaptive management partnership for Mariveles Mountains KBA under implementation as per Biodiversity Action Plan	Inspect documentation Observe planning process	Three years before end of construction	RMC II HQ	DPWH-ESSD ADB	NQE	Arrangements for timely program implementation not progressing adequately	Direct responsible party to set arrangements in motion
20.Terrestrial biodiversity impacts	• Monitoring and adaptive management program to develop and test programming protocol for bird-friendly application of decorative flood lighting under implementation	Inspect documentation Observe monitoring	Beginning in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for timely program implementation not progressing adequately	Direct responsible party to set arrangements in motion
21.Terrestrial biodiversity impacts	• Monitoring and adaptive management program to develop and test programming protocol for bat-friendly application of decorative flood lighting under implementation	Inspect documentation Observe monitoring	Beginning in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for timely program implementation not progressing adequately	Direct responsible party to set arrangements in motion
III. WATER								
22. Fresh water impacts	• High risk sections of roadways identified and pollution control design adaptations considered and adopted if appropriate	Inspect risk assessment documentation	Early in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for timely risk assessment not progressing adequately	Direct responsible party to set arrangements in motion
23. Marine biodiversity impacts	• Biodiversity offset for residual impacts of ALAN and shading on coral under implementation as per Biodiversity Action Plan	Inspect documentation Observe planning process	As needed, during construction phase	RMC II HQ	DPWH-ESSD ADB	NQE	Arrangements for timely program implementation not progressing adequately	Direct responsible party to set arrangements in motion
24.Marine biodiversity impacts	• High risk periods and locations for marine mammals identified to inform adaptive management during construction	Inspect documentation	Beginning in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for acoustic monitoring and plan preparation not progressing adequately	Direct responsible party to set arrangements in motion

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Comprehensive Underwater Noise Management Plan prepared							
25.Marine biodiversity impacts	• High risk nesting sites, transit routes and foraging areas identified to inform adaptive management during construction • Comprehensive Marine Turtle Management Plan prepared • Biodiversity offset under implementation as per Biodiversity Action Plan	Inspect documentation	Beginning in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for acoustic monitoring and plan preparation not progressing adequately Arrangements for timely program implementation not progressing adequately (BAP)	Direct responsible party to set arrangements in motion
26. Marine coastal processes	• Coastal processes risk assessment completed, including identification of risks and proposal of engineering adaptations or management measures as needed	Inspect documentation	Beginning in pre-construction	CSC office	DPWH-ESSD	NQE	Arrangements for acoustic monitoring and plan preparation not progressing adequately	Direct responsible party to set arrangements in motion
IV. AIR								
27. Greenhouse gas emissions during construction	• At least 145,000 native tree saplings procured and donated to DENR as per Memorandum Order No. 2012-02 to offset loss of 1,450 trees to ROW	Inspect documentation	Before end of first year of construction	RMC II HQ	DPWH-ESSD	NQE	Saplings not yet procured and delivered	Direct responsible party to expedite action to ensure ECC compliance before end of construction phase
V. PEOPLE								
28. Livelihoods	• Skills training for residents of Mariveles and Naic interested in securing work on the project underway at least 6 months prior to the start of works, as per SDP • Recruitment events with participation of PCs and sub-contractors held in Mariveles and Naic at least 3 months before the start of works, as per SDP	Inspect documentation	6 months prior to start of works 3 months prior to shart of works	RMC II HQ	DPWH-ESSD	NQE	Skills training not yet implemented 6 months prior to start of works Recruitment and marketplace connection events not implemented 3 months prior to start of works	Direct responsible party to expedite training provision to avoid delay in start of works

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Marketplace connection events with participation of PCs and sub-contractors held in Mariveles and Naic at least 3 months before the start of works, as per SDP							
29. Fisherfolk livelihoods	• Fisherfolk livelihood program under implementation as per SDP • Discussions between DPHW and municipalities regarding formation of partnerships to establish fish sanctuaries along BCIB alignment underway by start of construction phase, as per SDP • Fisherfolk livelihood program under implementation as per SDP	Inspect documentatio n	Before start of construction	RMC II HQ	DPWH-ESSD	NQE	Fisherfolk livelihood program not yet under implementation six months prior to start of construction Formal discussions regarding fish sanctuary planning not yet underway by start of construction Partnerships not yet in place before midway point of construction phase	Direct responsible party to expedite action
30. Ecosys tem services	• Potential effects on marine ecosystem services evaluated and mitigation strategies enhanced accordingly	Inspect ecosystem services study	Pre-construciton	CSC office	DPWH-ESSD	NQE	Ecosystem services study not yet complete	Direct responsible party to expedite action
31. Ecosys tem services	• Potential effects on terrestrial ecosystem services evaluated and mitigation strategies enhanced accordingly	Inspect ecosystem services study	Pre-construction	CSC office	DPWH-ESSD	NQE	Ecosystem services study not yet complete	Direct responsible party to expedite action
32. Water Use	• Water Use Management Plan prepared	Inspect plan	Pre-construction	CSC office	DPWH-ESSD	NQE	Plan not yet prepared	Direct responsible party to expedite action
33. Public safety impacts	• Multi-stakeholder master planning workshop convened prior to start of construction phase in Mariveles to assess local road capacity and safety context and scope solutions to observed safety issues on receiving roads • Project concepts formulated to address projected safety problems	Inspect documentatio n Observe workshop	By end of first year of construction	TBD	DPWH-ESSD	NQE	Workshop not yet convened	Direct responsible party to expedite arrangements

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
34. Public safety impacts	• Multi-stakeholder master planning workshop convened prior to start of construction phase in Naic to assess local road capacity and safety context and scope solutions to observed safety issues on receiving roads • Project concepts formulated to address projected safety problems	Inspect documentation Observe workshop	By end of first year of construction	TBD	DPWH-ESSD	NQE	Workshop not yet convened	Direct responsible party to expedite arrangements
E. CONSTRUCTION PHASE								
I. LAND								
35. Terrestrial biodiversity impacts	• Compensatory tree planting implemented for trees lost in ROWs by PC1 and PC2 • Staging area layouts optimized to reserve trees and wooded areas and riparian zones, which are protected by fencing • Compensatory tree planting implemented for trees removed for staging area development • Staging area sites revegetated with native species assemblages as part of pre-abandonment rehabilitation	Inspect proposed site layouts Inspect documentation of plantings On-site observation	Once before construction Once during site set-up Once before site abandonment	PC offices Sites	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
36. Terrestrial biodiversity impacts	• All vegetation cleared in accordance with the approved Habitat Clearance Management Plan • No wildlife deaths reported by local people or detected by compliance monitoring	Observe planning meetings	Weekly	Work sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Habitat Clearance Management Plan not yet prepared Wildlife deaths documented	Direct responsible party to set arrangements in motion
37. Terrestrial biodiversity impacts	• All works areas fenced with durable and visible fencing	On-site observation	Once at site set-up	Work sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Low incidence of ROW and staging area boundary transgressions		Weekly during construction					
38. Terrestrial biodiversity impacts	• Low incidence of dust buildup on vegetation near work areas	On-site observation	Weekly during construction	Work sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify corrective action and timeline for implementation
39. Terrestrial biodiversity impacts	• 30-m riparian buffer zone (as measured from top of bank) established with durable fencing along Timalan River for full river frontage of site area used at Cavite Staging Area (Uniwide site)	Inspect documentation On-site observation	Once before site set-up Prior to site abandonment	Staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify corrective action and timeline for implementation
40. Terrestrial biodiversity impacts	• Prohibitions on worker hunting and gathering included in construction camp rules of conduct (Mariveles camps only)	Inspect documentation	Once at time of camp plan review	PC offices	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify corrective action and timeline for implementation
41. Terrestrial biodiversity risks	• All works carried out in accordance with relevant Terrestrial Invasive Species Management Plan • Only native plant species used in slope stabilization and reinstatement of ground cover in ROW • Only native tree species used in compensatory tree plantings • Only native plant species used in staging area rehabilitation	Inspect documentation On-site observation	Before approval of planting plans	PC offices Landing and drydock sites	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify corrective action and timeline for implementation
42. Soil contamination	• No evidence of active leaks observed on machinery or on ground beneath machinery • All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where	On-site observation Inspect documentation (waste oil pick-ups)	Weekly during construction	Work sites	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident • Evidence of leaks and spills of fuels and lubricants is not observed on soil							
43. Soil contamination	• Pre-demolition inspection of all condemned structures conducted by a DENR-recognized provider of testing and remediation services • Safe removal of hazardous materials from condemned structures according to plan prepared by DENR-recognized provider of testing and remediation services, where pre-demolition survey identified hazardous materials	Review inspection report and removal plan, if any On-site observation	Once before site clearing As needed during demolition works	PC offices ROW sites	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed procedures not adequately implemented	Issue stop work order and direct immediate remedy
44. Soil contamination	• Phase II ESA conducted for Shell filling station site in Alas Asin, and removal/rehabilitation plan implemented if recommended by assessment firm • Phase II ESA conducted for TPP filling station in Timalan Concepcion, and removal/rehabilitation plan implemented if recommended by assessment firm	Review Phase II reports On-site observation	Once before start of clearing As needed during demolition	PC offices Demolition sites	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed procedures not adequately implemented	Issue stop work order and direct immediate remedy

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
45. Land contamination	• Absence of solid waste buildup, dumping, burning or other evidence of poor waste management on construction and staging area sites • Demolition waste completely removed from ROW and demolition-applicable staging areas, except where clean concrete rubble is reserved for use in fill	On-site observation	Once after site clearing Weekly during construction	PC offices	CSC PC-EHSRs DPWH-EHSOs	NQE	Evidence of improper management of solid waste and demolition waste	Specify site-specific corrective action and timeline for implementation
46. Impacts on physical cultural heritage	• Chance find procedure included in each PC's CEMMAP and included in induction and refresher training	Check documentation	Before approval of CEMMAPs Before start of works and annually during construction	PC offices	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
II. WATER								
47. Impacts on freshwater ecology	• Observed clarity/turbidity of runoff from works sites and staging areas • Water quality in receiving watercourses downstream from site drainage discharge points is comparable to water quality upstream, as confirmed by upstream-downstream sampling and laboratory analysis • Water quality in receiving watercourses downstream from drainage discharge points meets DAO 2016-08/2021-19 Class C standard, unless upstream water quality does not	On-site visual assessment Upstream-downstream sampling and lab analysis	Weekly throughout construction phase (visual checks) Monthly throughout construction, when runoff present (sampling)	Runoff discharge points to watercourses, all sites as applicable	PC-EHSRs DPWH-EHSOs (weekly) PC-EHSRs (monthly sampling)	PC1 1,320,000 PC2 528,000 PC3 264,000 PC4 528,000 PC5 264,000 PC6 - 264,000 PC7 - 132,000 (monthly upstream-downstream water sampling)	Runoff from work sites and staging areas visibly turbid Water quality in downstream samples significantly worse than in corresponding upstream samples Water quality in downstream samples does not meet DAO 2016-08/2021-19 Class C standard, while standard is met by corresponding upstream samples	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
48. Impacts on freshwater ecology	• Concrete washout management consistent with guidance in US EPA Best Management Practice for Stormwater Management – Concrete Washout • Quality of any water discharged to the environment from washout collection and treatment facilities meets DAO 2016-08/2021-09 standard for industrial discharges to Class C waters, as confirmed by sampling and laboratory analysis	On-site observation of facilities and practices Discharge sampling with laboratory analysis	Check facility prior to start of construction Weekly observation of management practices Discharge sampling monthly (if any discharge)	All on-land batch plants	PC-EHSRs DPWH-EHSOs PC-EHSRs (monthly sampling of discharge)	PC3 528,000 PC4 528,000 PC5 528,000 PC6 528,000	• Batch plant washout observed not to be collected, recycled and treated in a manner consistent with guidance in US EPA Best Management Practice for Stormwater Management – Concrete Washout Washout water discharged to the environment does not meet DAO 2016-08/2021-09 standard for industrial discharges to Class C waters, as confirmed by sampling and laboratory analysis	Specify site-specific corrective action and timeline for implementation
49. Impacts on freshwater ecology	• No disposal of spoils occurring outside dedicated spoils management sites • Low incidence of erosion at spoils management sites	On-site observation	Before start of construction (plan) Monthly during construction (spoils management)	PC offices Works sites and spoils sites	CSC (plans) PC-EHSRs DPWH-EHSOs (spoils management)	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
50. Impacts on freshwater ecology	• Portable toilets provided at temporary works sites, and contents transported to septic systems on semi-permanent staging areas • All non-portable toilets on works sites and staging areas are connected to proper septic systems of capacity adequate to accommodate use • Septic systems are installed no closer than 50 m to site boundaries • No evidence of raw sewage on ground, in cesspools or in nearby watercourses	On-site observation	One check prior to construction Monthly during construction	All works sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
51. Impacts on freshwater ecology	• No evidence of active leaks observed on machinery • All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident • Evidence of leaks and spills of fuels and lubricants is not observed on soil	On-site observation Inspect records (oil recycling)	One check prior to construction (fuel storage facilities) Weekly during construction	All works sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
52. Impacts on freshwater ecology	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Channel diversion works (some minor branches of San Jose River in Alas Asin) conducted during dry season, with designed bank protection measures (e.g., riprap) in place before return of wet season flows • Babuyan River protected by fencing, berms and drop-in temporary crossing plates during bridge works on Alas Asin Waterway Bridge	On-site observation	As needed based on work timing	Bataan approach road work sites	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
53. Impacts on freshwater ecology	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Bridge works at Timalan River carried out during the dry season to limit potential for erosion of unprotected earthworks • In-water silt curtains appropriately and competently used around bridge abutment works (Timalan River west branch near interchange) to contain siltation • Permanent bank protection promptly installed around abutments • Water quality in receiving watercourses downstream from site drainage discharge points is comparable to water quality upstream, as confirmed by sampling and laboratory analysis • Water quality in receiving watercourses downstream from drainage discharge points meets DAO 2016-08/2021-19 Class C standard, unless upstream water quality does not	On-site observation Water sampling with laboratory analysis	Weekly while bridge works are underway Water sampling monthly	Antero Soriano Highway bridge works	PC-EHSR DPWH-EHSOs PC-EHSR (water sampling)	PC2 264,000	Prescribed measures not adequately implemented Sediment plume visible downstream from work sites Water quality in downstream samples significantly worse than in corresponding upstream samples Water quality in downstream samples does not meet DAO 2016-08/2021-19 Class C standard, while standard is met by corresponding upstream samples	Specify site-specific corrective action and timeline for implementation
54. Impacts on freshwater ecology	• All works conducted in accordance with PC's approved In-Water Works Management Plan • Unnecessary modification of pre-existing watercourses avoided during set-up of staging areas • Steel plates used as appropriate to bridge watercourses on staging area sites, in lieu of filling, driving through or placing a culvert	Inspect layout plans On-site observation	Once prior to staging area set-up (plans) As needed prior to staging area abandonment (rehabilitation plans and	All staging areas	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Pre-existing watercourses on staging areas that are modified to enable efficient site use are restored to their original courses and planted with riparian vegetation prior to site decommissioning		restoration activity)					
55. Impacts on groundwater	• No evidence of active leaks observed on machinery • All storage tanks on site have secondary containment or are stored in a structure that provides such containment • Fuel and lubricants storage structures established on all project sites where fuel consumption and servicing activity are sufficient to warrant regular on-site storage, each with roof, impermeable floor, and secondary containment capacity at least 150% of the volume of the largest container stored • Refueling and maintenance and repair activity is consistently carried out using impervious drip mats or in repair shops and sealed-surface fueling areas • Waste oil is regularly collected by an accredited recycling enterprise, and no build-up of stored waste oil is evident • Evidence of leaks and spills of fuels and lubricants is not observed on soil	On-site observation Inspect records (oil recycling)	One check prior to construction (fuel storage facilities) Weekly during construction	All works sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
56. Impacts on groundwater	• Concrete washout recycling consistent with guidance in US EPA Best Management Practice for Stormwater Management – Concrete Washout	Inspect CEMMAPs On-site observation	Once prior to construction Weekly during construction	All concrete batch plants	CSC PCEHSRs DPWH-EHSOs	NQE	Concrete washout water observed not to be recycled as indicated in US EPA Best Management Practice for Stormwater Management – Concrete Washout	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
57. Marine biodiversity impacts	• Biodiversity offset for loss and degradation of coral habitat under implementation as per Biodiversity Action Plan	Inspect documentation Observe planning process	As needed, during construction phase	RMC II HQ	DPWH-ESSD ADB	NQE	Arrangements for timely implementation of program not adequately progressing	Direct responsible party to expedite arrangements
58. Marine biodiversity impacts	• Silt curtains consistently deployed around marine foundation works in waters to depth of 25 m in Mariveles nearshore and Corregidor Island nearshore, and Naic nearshore • Silt curtains consistently deployed around dredging and jetty placement/removal works (Mariveles nearshore) • Silt curtains consistently deployed during concrete pouring work, for piers within or nearby critical habitat (5+900–7+100; 11+800–13+800; 25+800–28+000) • No observable turbidity plume reaching critical habitat areas • Marine water quality in sample at nearest critical habitat area is comparable to water quality in sample from nearby control station • Marine water quality meets DAO 2016-08/2021-19 standard for Class SA waters at critical habitat area nearest the designated foundation work and dredging sites, unless sample from nearby control station does not meet the same standard	On-site observation Water quality sampling	Daily during works at applicable sites (observation) Monthly for water quality sampling	Mariveles nearshore zone Corregidor Island nearshore zone Naic nearshore zone and around Naic Fish Sanctuary	CSC PC-EHSRs DPWH-EHSOs	PC3 2,448,000 PC4 1,632,000 PC5 1,224,000 PC6 1,224,000	Silt curtains observed not to be consistently deployed at designated work sites Turbidity plume observed to reach critical habitat areas Marine water quality in sample at nearest critical habitat area is comparable to water quality in sample from nearby control station Marine water quality in sample at nearest critical habitat area does not meet DAO 2016-08/2021-19 Class SA standard, while standard is met by sample from corresponding nearby control station	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
59. Marine biodiversity impacts	• Concrete washout generated on floating batch plants is recycled back to the plants, to the maximum extent feasible • Solid washout components recycled back into batch plants to the maximum extent feasible, or transferred to a sealed barge for removal to one of the established on-land spoils sites • Any washout water released after onboard treatment meets DAO-2016-08/2021-19 standard for discharge to Class SB waters (outside CIMP) or Class SA waters (within CIMP)	Inspection of method statements in CEMMAPs On-site observation Sampling and laboratory analysis	Once prior to construction (plans) Weekly (batch plant operation) As needed based on discharge frequency	All floating batch plants	CSC (plans) PS EHSRs DPWH-EHSOs (weekly observation) PS EHSRs (sampling)	PC3 1,632,000 PC4 1,632,000 PC5 1,632,000 PC6 1,632,000	Prescribed measures not adequately implemented or adverse effects evident Washout water released to the environment after on-board treatment does not meet DAO 2016-08/2021-19 standard for discharge to Class SB waters (outside CIMP) or Class SA waters (within CIMP)	Specify site-specific corrective action and timeline for implementation
60. Marine water quality impacts	• Each marine contractor maintains adequate supplies and equipment for spill response and cleanup on each vessel or platform where noxious fluids are handled • Low incidence of marine spills • Prompt and effective containment and cleanup of any spills that occur	Reviews plans On-site inspection and observation Inspect records	Prior to construction (plans) Monthly (inspections)	PC offices (plans) All vessels and work platforms	CSC (plans) PC-EHSRs DPWH-EHSOs	NQE	PCs do not maintain adequate supplies and equipment for spill response and cleanup Spills reported or observed Spills not promptly and effectively contained and cleaned up	Specify site-specific corrective action and timeline for implementation
61. Marine water quality impacts	• Bridge and viaduct deck scuppers thoroughly sealed during paving works • Loose asphalt material swept up and removed from bridge and viaduct decks before unblocking deck scuppers	On-site observation	Daily during paving works	All bridges and viaduct segments	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented	Specify immediate site-specific corrective action
62. Marine biodiversity impacts	• All large vessels and work platforms are equipped with toilets appropriate to the number of workers, each equipped with a holding tank • Human waste collected daily or as needed from all vessels and work platforms	On-site observation	Prior to start of works (inspection of transfer stations and septic systems)	All marine works sites On-land transfer stations and septic system locations	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• No evidence of raw sewage being dumped from project vessels or work platforms • Dedicated human waste transfer facility and septic systems built and competently operated at on-land staging areas, with sufficient capacity to handle human waste collected from offshore vessels and work sites		Weekly during construction					
63. Marine biodiversity impacts	• No evidence of intentional or inadvertent solid waste deposition from project vessels or work platforms • All vessels and work platforms are equipped with secure waste collection receptacles (firmly anchored in place and with tight-fitting lids) • Solid waste management facility established and competently operated at shore site to receive, sort and store solid waste brought ashore from vessels and work platforms	On-site observation	Prior to start of marine works (on-shore waste transfer facility) Weekly during construction	All marine works sites On-shore transfer stations	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
64. Marine biodiversity impacts	• All work lighting used on marine works sites equipped with shielding to reduce lateral light emissions • All work lighting positioned to light only work surfaces, avoiding direct light emissions to the water surface • Biodiversity offset for expected residual impact from work lighting on coral habitat under implementation as per Biodiversity Action Plan • Work lighting managed in accordance with Marine Turtle Management Plan	On-site observation Inspect documentation Observe planning process	Weekly during night-working periods (lighting) As needed during construction (BAP)	All marine work sites where night work is conducted	PC-EHSRs DPWH-EHSOs DPWH-ESSD (BAP)	NQE	Prescribed measures not adequately implemented or adverse effects evident Arrangements for timely implementation of BAP program not adequately progressing	Specify site-specific corrective action and timeline for implementation Direct responsible party to expedite arrangements for BAP program implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
65. Marine biodiversity impacts	• Low incidence of vessel strikes on marine fauna	On-site observation Inspect records	Weekly Monthly (records)	All marine work areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
66. Marine biodiversity impacts	• Works carried out in accordance with Underwater Noise Management Plan • Bubble curtains or other equally effective noise attenuation technology consistently deployed at all marine piling sites where impact hammers are used • Biodiversity offset for residual effects of underwater noise and other construction impacts on critical habitat under implementation as per Biodiversity Action Plan	On-site observation Inspect documentation and/or observe planning process (BAP)	Daily (bubble curtain use) As appropriate during construction phase (BAP)	Marine work sites where impact hammers are used	PC-EHSRs DPWH-EHSOs DPWH-ESSD (BAP)	NQE	Prescribed measures not adequately implemented or adverse effects (e.g., marine organism mortality) evident Arrangements for timely implementation of BAP program not adequately progressing	Specify immediate site-specific corrective action Direct responsible party to expedite arrangements for BAP program implementation
67. Marine biodiversity impacts	• Gaps left every 50 m along nearshore jetties (bridged by steel plates or drop-in trestles) to allow cross-circulation, to minimize ecological change	On-site observation	As needed during jetty construction	Jetty sites	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
68. Physical cultural heritage	• Chance find procedure included in each marine PC's CEMMAP and included in induction and refresher training	Check documentation	Before approval of CEMMAPs Before start of works and annually during construction	PC offices	CSC PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation
III. AIR								
69. Greenhouse gas emissions	• Only modern (age less than 15 years) and fuel-efficient (rated above the industry within-class average for fuel consumption) construction equipment and vehicles are in use on project sites,	On-site observation	Monthly during construction	All work sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
during construction	including equipment and vehicles supplied and operated by sub-contractors							
70. Air quality impacts (engine emissions)	• Only modern (age less than 15 years) and fuel-efficient (rated above the industry within-class average for fuel consumption) construction equipment and vehicles are in use on project sites, including equipment and vehicles supplied and operated by sub-contractors • No large stationary engines located within 200 m of a residence or school • No emissions of black or blue smoke observed coming from exhaust pipes of equipment and vehicles used project sites • Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5, PM10, SO2 and NO2, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Hauling activity by PCs sufficiently well-coordinated as to avoid significant hauling-related congestion • Low incidence of complaints from public about project-related air quality concerns	On-site observation Air quality sampling Inspect PC and GRM records	Monthly during construction	All work sites and staging areas PC offices CSC offices	PC-EHSRs DPWH-EHSOs PC-EHSRs (sampling)	PC1 660,000 PC2 660,000 PC3 800,000 PC4 2,528,000 PC5 800,000 PC6 800,000 PC7 132,000	Prescribed measures not adequately implemented • Emissions of black or blue smoke observed • Ambient air quality as measured at selected receptor sites exceeds the maximum permissible limits for $PM_{2.5}$, PM_{10}, SO_2 and NO_2, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Complaints received from public about project-related air quality concerns	Specify site-specific corrective action and timeline for implementation
71. Air quality impacts	• Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5 and PM10,	On-site observation Air quality sampling	Daily during construction	At batch plant sites	PC-EHSRs DPWH-EHSOs	PC1 660,000 PC2 660,000 PC3 800,000	Prescribed measures not adequately implemented or adverse effects evident	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
(fugitive dust)	as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Dust emissions at batch plants consistently meet levels prescribed in US EPA AP-42 • Low incidence of complaints from public about project-related dust		Continuous (automatic dust sampling) Monthly (other dust sampling)			PC4 2,528,000 PC5 800,000 PC6 800,000 PC7 132,000PC7	Complaints received from public about construction-related dust Ambient dust as measured at selected receptor sites exceeds maximum permissible limits for $PM_{2.5}$ and PM_{10}, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality Emissions as measured at batch plants exceed levels specified in US EPA AP-42	
72. Air quality impacts (asphalt batch plants)	• Ambient air quality as measured at selected receptor sites remains consistently below the maximum permissible limits for PM2.5, PM10, SO2 and NO2, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Low incidence of public complaints about project-related air quality degradation	Air quality sampling Review of grievance register	Monthly during plan operation	At batch plant sites At PC offices	PC-EHSRs DPWH-EHSOs	PC1 75,000 PC2 75,000 PC3 75,000 PC4 75,000 PC5 75,000 PC6 75,000 PC6 75,000	Prescribed measures not adequately implemented or adverse effects evident Ambient air quality as measured at selected receptor sites exceeds the maximum permissible limits for $PM_{2.5}$, PM_{10}, SO_2 and NO_2, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality Complaints received from public about construction-related dust	Specify site-specific corrective action and timeline for implementation
73. Noise impacts	• Only modern (age less than 15 years) construction equipment and vehicles are in use on project sites, including equipment and vehicles supplied and operated by sub-contractors	Site observation Noise sampling	Monthly	All works sites and staging areas PC and CSC offices	PC-EHSRs DPWH-EHSOs	PC1 660,000 PC2 660,000 PC3 800,000 PC4 2,528,000 PC5 - 800,000	Prescribed measures not adequately implemented or adverse effects evident • Night work observed to be taking place within 500 m of residences	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Absence of work activity between 8 pm and 6 am at any work site within 500 m of residences • Absence of hauling activity between 8 pm and 6 am (unless this has been agreed with the relevant LGU as a means of reducing congestion during peak travel times) • Temporary acoustic barriers used where noisy work must be carried out within 50 m of a sensitive receptor site • Noise levels as measured at selected receptor sites do not exceed WBG's Environmental, Health and Safety Guidelines: Environmental Noise Management standard (55 dB daytime, 45 dB night) • Low Incidence of complaints from public about project-related noise	Inspect PC and GRM records				PC6 - 800,000 PC7 - 132,000	• Unapproved night hauling observed • Hauling activity by PCs poorly coordinated, leading to unduly heavy haul traffic • Complaints received from public about construction-related noise • Noise levels as measured at selected receptor sites exceed WBG's Environmental, Health and Safety Guidelines: Environmental Noise Management standard (55 dB daytime, 45 dB night) •	
IV. PEOPLE								
74. Community impacts	• Workforce on each construction package, including workers in the employ of sub-contractors, does not exceed the maximum allowable percentage of outside workers specified in RA 6685 • Construction camps, including those operated by sub-contractors, are managed in accordance with the approved Construction Camp Management Plan • Incidence of complaints from the public and municipal officials regarding off-site behavior of workers and other negative	Inspect PC records On-site observation Inspect GRM records	Monthly during construction	PC offices Construction camps, including those operated by sub-contractors CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Percentage of workers on any construction package, including those working for sub-contractors, exceeds the permissible limit specified in RA 6685 Complaints received from pubic about camps and/or worker conduct	Direct relevant PC to freeze hiring of outside workers Specify corrective action regarding camp management and/or worker behavior, and a timeline for action

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	interactions between camp residents and the host community							
75. Community impacts	• Incidence of complaints from public about problems accessing property, businesses and institutions	Inspect PC and GRM records	Monthly during construction	PC and CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Complaints received from public about problems accessing property, businesses and institutions	Specify site-specific corrective action and timeline for implementation
76. Community impacts	• Incidence of complaints from public about utility stoppages	Inspect PC and GRM records	Monthly during construction	PC and CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Complaints received from public about utility stoppages	Specify site-specific corrective action and timeline for implementation
77. Livelihoods	• Workforce on each construction package, including workers in the employ of sub-contractors, does not exceed the maximum allowable percentage of outside workers specified in RA 6685 • Pre-construction job training program implemented in Mariveles and Naic as per Social Development Plan • Local hiring facilitation plan implemented in Mariveles and Naic as per Social Development Plan • Local service provider support program implemented in Mariveles and Naic as per Social Development Program • Pre-construction job training program implemented in Mariveles and Naic as per Social Development Plan	Inspect training and support program records	As per schedule of programs	UPMO RMC II HQ	DPWH-ESSD	NQE	Percentage of workers on any construction package, including those working for sub-contractors, exceeds the permissible limit specified in RA 6685 Training and support programs not implemented per schedule	Direct relevant PC to freeze hiring of outside workers Direct responsible parties to expedite implementation to ensure effectiveness
78. Livelihoods	• Low incidence of complaints from public about property damage and loss of business due to sloppy construction site management	Inspect PC and GRM records	Monthly during construction	PC and CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Complaints from public about property damage and loss of business due to sloppy construction site management	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
79. Livelihoods	• Low incidence of complaints from fisherfolk about difficulty accessing fishing grounds	Inspect PC and GRM records	Monthly during construction	PC and CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Complaints from fisherfolk about difficulty accessing fishing grounds due to construction activity	Specify site-specific corrective action and timeline for implementation
80. Fisherfolk livelihoods	• Surface-to-seabed silt curtains competently deployed aroud. marine works in all waters 0–25 m depth • Bubble curtains used at all marine piling sites where impact hammers are used to limit impacts (fish kills and injury) on fish biomass and fisherfolk livelihoods • Fisherfolk livelihood restoration program under implementation as per Social Development Plan	On-site observation Inspect livelihood restoration program records	Daily during piling works As per schedule of program	Marine works in water depth 0–25 m Marine works sites where impact hammers are used UPMO RMC II HQ	PC-EHSRs DPWH-EHSOs DPWH-ESSD (SDP)	NQE	Prescribed measures not adequately implemented or adverse effects evident Livelihood restoration program not implemented per schedule	Issue stop work order and direct immediate remedy Direct responsible parties to expedite program implementation to ensure effectiveness
81. Livelihoods Naic beach resorts)	• Silt curtains consistently implemented during excavation for spread foot foundations in Naic nearshore work zone (29+800–31+800) to minimize siltation of water at beachfront resorts • Low incidence of complaints from resort owners	On-site observation Inspect PC and GRM records	During nearshore foundation works	Naic nearshore zone PSC and CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Prescribed measures not adequately implemented or adverse effects evident Complaints received from resort owners	Specify site-specific corrective action and timeline for implementation
82. Public safety impacts	• Low incidence of accidents in interchange works zones • Low incidence of accidents involving haul trucks • Low incidence of complaints from public about safety impacts of works and hauling activity	Inspect PC incident records Inspect GRM records	Monthly	CSC offices PC offices	PC-EHSRs DPWH-EHSOs	NQE	Measures prescribed in Road Works Safety Plans and Construction Traffic Management Plans not adequately implemented or adverse effects evident Accidents recorded in interchange works zone Accidents involving haul trucks recorded Complaints received from public about safety impacts of works and hauling activity	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
83. Public safety impacts (marine works)	• Pre-construction IEC activity conducted with fisherfolk in Mariveles (involving fisherfolk from all coastal barangays) to explain PEZ rules • Pre-construction IEC activity conducted with fisherfolk in Naic (involving fisherfolk from all coastal barangays) to explain PEZ rules	Inspect IEC records Review protocol	Once before construction	UPMO RMC II HQ	DPWH-ESSD	NQE	IECs with fisherfolk on PEZ not organized in timely manner or poorly attended	Direct responsible parties to expedite, expand or repeat IEC activities to ensure strong fisherfolk awareness Direct CSC and PCs to expedite protocol development
84. Public health risks	• Construction camps set up and managed in accordance with approved Construction Camp Management Plans to help prevent outbreaks of communicable disease • STD prevention training provided to all incoming resident workers by PCs • Incidence of complaints from public and local authorities regarding sex work around construction camps	On-site observation Inspect PC training records Inspect PC and GRM records	Once at camp set-up Monthly (training and complaints records)	All construction camps CSC offices PC offices	CSC PC-EHSRs DPWH-EHSOs	NQE	Camps not set up and operated as per approved Construction Camp Management Plans Outbreak of communicable disease in construction camp STD prevention training not delivered to incoming resident workers Complaints received from public or local authorities regarding sex work around construction camps	Specify site-specific corrective action and timeline for implementation
85. Public health risks	• Portable toilets provided at temporary works sites, and contents transported to septic systems on semi-permanent staging areas • All non-portable toilets on works a sites and staging areas are connected to proper septic systems of capacity adequate to accommodate use • Septic systems are installed no closer than 50 m to site boundaries • No evidence of raw sewage on ground, in cesspools or in nearby watercourses	On-site observation	Once at site set-up Monthly during construction	All works sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Measures prescribed in approved Human Waste and Sanitation Management Plans not implemented adequately Evidence of raw sewage on ground, in cesspools or in nearby watercourses Evidence of open defecation by workers Outbreak of waterborne intestinal illness traced to project sites	Specify site-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Low incidence of open defecation by workers							
86. Occupational health and safety risks	• All workers use task- and site-appropriate PPE at all times • All marine workers properly wear an approved personal flotation device at all times • All vessels and platforms involved in marine works are equipped with life-saving equipment (throwable flotation and victim recovery slings) • Low incidence of worker deaths and injuries • Observed work practices in compliance with national occupational health and safety standards as specified in RA 11058	On-site observation Inspect safety supplies	Weekly (safety practices) Monthly (inspect safety supplies)	All works sites	CSC PC-EHSRs DPWH-EHSOs	NQE	Measures prescribed in approved Occupational Health and Safety Plans not implemented adequately Workers observed not using task-appropriate and context-appropriate PPE Observed work practices not in compliance with national occupational health and safety standards as specified in RA11058 and DO 198-2018 Injuries reported Deaths reported	Specify site-specific corrective action and timeline for implementation In the case of serious injuries or death, issue stop-work order and initiate investigation and associated corrective action to prevent further occurrences
87. Occupational health and safety risks (works in public way)	• Safety practices prescribed in approved Road Works Safety Management Plans and Construction Traffic Management Plans implemented • Low incidence of worker-involved accidents in Roman Highway and Antero Soriano Highway interchange works zones • Low incidence of vehicle-involved worker injuries and deaths in interchange works zones • Low incidence of complaints from workers about safety risks in interchange works zones	On-site observation Inspect accident and dangerous situation records Inspect PC and GRM records of worker complaints about safety	Monthly	Interchange works sites PC offices CSC offices	PC-EHSRs DPWH-EHSOs	NQE	• Safety practices prescribed in approved Road Works Safety Management Plans and Construction Traffic Management Plans not properly implemented • Worker-involved traffic accidents recorded • Vehicle-involved worker injuries and deaths recorded • Complaints received from workers about safety risks at interchange works sites	Specify site-specific corrective action and timeline for implementation In the case of serious injuries or death, request stop-work order and initiate investigation and associated corrective action to prevent further occurrences
88. Occupational health and	• Seabed UXO identified in survey report neutralized or removed by a qualified	Review UXO survey report	Once before start of marine works	PC offices	CSC PC-EHSRs	NQE	Necessary removals/neutralization not carried out before start of marine works	Issue stop-work order until necessary removal/neutralization work has been carried out

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
safety risks (UXO)	specialist contractor in advance of any physical works, if needed	Inspect PC records			DPWH-EHSOs			
89. Occupational health and safety risks (geophysical hazards)	• All temporary structures, elevated storage tanks and batch plants on work sites and staging areas are designed to withstand at least Magnitude 6 earthquakes • Each PC has implemented all preparedness components of approved Emergency Action Plan, including training, prior to the start of works • PCs provide annual refresher training, including drills, on Emergency Action Plan procedures to all workers and site engineers	Review PC Emergency Action Plans Inspect PC records	Once before construction (preparedness investments) Annually (training records)	PC offices	CSC PC-EHSRs DPWH-EHSOs	NQE	Preparedness components of PC Emergency Action Plan not adequately implemented	Warn PC to expedite preparedness investments or risk stop-work order, and provide timeline for compliance
90. Occupational health and safety risks (construction camps)	• No workers living on construction sites • Low incidence of physical hazards including fire and electrocution risks, falling and tripping hazards, poor lighting, sharp objects, etc. observable in construction camps • Low incidence of unhygienic conditions in toilet and washup facilities, kitchens, food storage, mess halls and dormitories • Low incidence of overcrowding and hot-bedding in dormitories • Unlimited supply of clean drinking water available in camp for worker use, meeting Philippine National Standards for Drinking Water of 2017 (as specified in Department of Health Administrative Order DOH 2017-0010	On-site observation Inspect PC records Drinking water quality testing	Once at camp set-up Monthly (observation and records checks)	All construction camps PC offices	PC-EHSRs DPWH-EHSOs	PC1 264,000 PC2 264,000 PC3 264,000 PC4 264,000 PC5 264,000 PC6 264,000 PC7 264,000	Workers found living on construction sites Unsafe and/or unsanitary conditions observed in construction camp Overcrowding and/or hot-bedding detected in construction camp Worker injuries and illness attributable to camp conditions recorded Drinking water supply found to be insufficient for number of resident workers Drinking water supply in construction camp found not to meet Philippine National Standards for Drinking Water of 2017 (as specified in Department	Specify location-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
	• Low incidence of worker injuries and illness attributable to conditions in construction camps • Low incidence of intestinal ailments and other communicable illnesses reported amongst workers						of Health Administrative Order DOH 2017-0010)	
91. Occupational health and safety risks (concrete batch plants and dusty materials handling sites)	• Ambient dust at selected dust-intensive site locations remains consistently below the maximum permissible limits for PM2.5 and PM10, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality • Incidence of complaints from workers about dust levels on work sites • Incidence of respiratory ailments, illness or injury attributable to inhalation of hazardous dust, including that from Portland cement and fly ash	Air quality sampling Inspect PC records Inspect GRM records Talk with workers	Monthly (all)	Works sites and staging areas with significant dust potential	PC-ESHRs DPWH-EHSOs	NQE (PC monitoring costs accounted for above in relation to general dust emissions)	Workers observed working in dusty conditions without masks or respirators as appropriate to dust source (P100 respirator for cement and fly ash, N95 mask for regular soil/road dust) Respiratory illnesses attributable to dust inhalation recorded • Ambient dust at selected dust-intensive site locations exceeds maximum permissible limits for $PM_{2.5}$ and PM_{10}, as specified in the WBG's Environmental, Health and Safety Guidelines: Air Emissions and Ambient Air Quality	Specify location-specific corrective action and timeline for implementation
92. Occupational health and safety risks	• Unlimited drinking water available on all work sites, at no charge to workers • Low Incidence of complaints from workers about drinking water quality and availability • Shaded rest areas of adequate size for the number of workers are provided on all work sites, including at marine works • Low incidence of heat-related illness and death amongst workers	Site observation Inspect PC records Talk with workers	Monthly (all)	All work sites and staging areas	PC-EHSRs DPWH-EHSOs	NQE	Complaints from workers about quantity and/or quality of drinking water made available on work sites Adequate shaded rest areas not provided by PC Heat-related illness or death recorded amongst workers	Specify location-specific corrective action and timeline for implementation

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
93. Visual impacts	• Incidence of glare from nearshore marine works, as observed from the beaches along the Naic waterfront • Low incidence of complaints from beachfront residents and resort operators about light emissions from nearshore marine works	On-site observation Inspect PC and GRM records	Monthly during periods of night work in Naic nearshore zone (if any)	Naic waterfront PC offices CSC offices	PC-EHSRs DPWH-EHSOs	NQE	Glare observed from beaches near BCIB landing point Complaints received about offshore work lighting from resort owners and guests	Specify location-specific corrective action and timeline for implementation
A. OPERATION PHASE								
I. LAND								
94. Terrestrial biodiversity impacts	• Incidence of bird mortality from vehicle strikes, and traffic accidents and mishaps due to presence of roosting and perching birds monitored periodically, and of anti-perching devices installed in trouble spots, if justified • Incidence of bird mortality with the BCIB (collision with cables or disorientation with the lighting scheme)	Inspect monitoring records Talk with DPWH-BMU about findings	Annually	BMMC	DPWH-ESSD	NQE	No monitoring conducted No mitigative action when warranted by monitoring results	Specify location-specific corrective action and timeline for implementation
95. Soil contamination	• Requirement to use only newer model equipment in good condition, store all noxious fluids used in works in containers with secondary containment, and have demonstrated capacity to clean up spills included in bidding documents and contracts for maintenance and repair works	Review draft bid documents and contracts	Prior to tendering for maintenance and repair works	BMMC	DPWH-ESSD	NQE	Prescribed requirements not included in bid documents and contracts	Direct responsible party to incorporate prescribed requirements before bid documents and contracts are finalized
96. Soil contamination	• All preparedness components of the Emergency Action Plan implemented prior to opening of the infrastructure	Inspect preparedness investment records Talk with DPWH-BMU	One year prior to BCIB opening	BMMC	DPWH-ESSD	NQE	Preparedness components of approved Emergency Action Plan not yet subject to sufficient action or investment to ensure readiness for opening	Direct responsible party to expedite implementation to ensure BMU is ready to handle an emergency from day one of operations

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
		about progress						
97. Land contamination	• Minimal incidence of roadside litter buildup	On-site observation	Monthly	Along both approach roads	DPWH-BMUES	NQE	Substantial litter buildup on roadside	Direct responsible party to increase frequency of roadside cleanups
II. WATER								
98. Marine water quality impacts	• Sweeping of entire bridge, viaduct and approach road surface (including shoulder lanes) with a regenerative vacuum sweeper conducted on a weekly basis, weather permitting	Review work records	Quarterly	BMMC	DPWH-BMUES	NQE	Sweeping not conducted weekly during favorable weather windows	Direct responsible party to increase frequency of sweeping as per O&M plan
99. Marine water quality impacts	• Speed limit on BCIB strictly enforced to reduce risk of accidents involving hazardous cargoes • Monitoring of driver behavior included in bridge surveillance routines • Periodic spot safety checks conducted to reduce the number of unsafe trucks using the bridge • Incidence of accidents involving spills	On-site observation Inspect operations records	Quarterly	BMMC	DPWH-BMUES	NQE	Prescribed preventive measures not adequately implemented Occurrence of accidents involving spills of hazardous materials	Direct responsible party to enhance application of preventive measures
100. Marine water quality impacts (contamination during maintenance works)	• Deck scuppers sealed during re-paving works to prevent leakage of oil coating and spillage of loose asphalt into the water • Under-girder slings and vacuum systems deployed as appropriate to minimize inputs of paint, sand and dust into the water • Hazardous and Noxious Materials Management Plans prepared and implemented by maintenance and repair works contractors	On-site observation Inspect operations records	During major maintenance and repair works	On site BMMC	DPWH-BMUES	NQE	Prescribed preventive measures not adequately implemented Occurrence of accidents involving spills of hazardous materials	Direct responsible party to enhance application of preventive measures

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
101. Marine water quality and biodiversity impacts	• All four traffic lanes and both emergency pull-out lanes swept weekly	Inspect operations records	Quarterly	BMMC	DPWH-BMU ES	NQE	Prescribed litter-prevention measures not adequately implemented Litter evident on bridge and viaduct decks	Direct responsible party to enhance application of preventive measures
III. AIR								
102. Air quality impacts	• Bid documents and contracts for major repair and replacement works on approach roads require contractors to use only modern (less than 15 years old), fuel efficient (rated above the industry within-class average for fuel consumption) equipment • Bid documents and contracts for major repair and replacement works on approach roads require contractors to implement competent dust suppression, including regular light spraying, keeping materials stockpiles covered with tarpaulins, and ensuring that all haul trucks are equipped with tight-fitting covers	Review draft bid documents and contracts	As needed	BMMC	DPWH-ESSD	NQE	Prescribed requirements not included in bid documents and contracts	Direct responsible party to incorporate prescribed requirements before bid documents and contracts are finalized
IV. PEOPLE								
103. Livelihoods	• Local people make up at least 50% of proposed initial hires for permanent BCIB workforce • Workforce engaged by contractors for major maintenance and repair works meet the minimum local labor requirements for construction projects as per RA 6685 • Evidence of local advertisement of tenders for maintenance and repair contracts	Inspect operations records	During hiring for permanent staff During tendering for major maintenance and repair works contracts	RMC II HQ BMMC	DPWH-ESSD DPWH-BMU ES	NQE	Local people do not make up 50% or more of proposed hires for permanent positions Prescribed requirements not included in bid documents and contracts	Direct responsible party to devote more effort to recruit local people Direct responsible party to incorporate prescribed requirements before bid documents and contracts are finalized

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
104. Livelihoods (fisherfolk)	• Annual coordination meeting held to help sustain collaborative operation of municipal fish sanctuaries along BCIB alignment • Quarterly monitoring check on ECC applications for seabed mining operations in vicinity of BCIB conducted and documented • Monthly monitoring for presence of dredging activity near or within no-dredge zone conducted and documented	Inspect operations records	Quarterly and monthly	BMMC	DPWH-BMUES	NQE	Prescribed measures not adequately implemented	Direct responsible party to improve implementation
105. Public safety	• Speed limit on BCIB strictly enforced to reduce accident risk • Monitoring of driver behavior included in bridge surveillance routines • Periodic spot safety checks conducted to reduce the number of unsafe vehicles using the bridge • Conditions-based bridge closure protocol to reduce accident risks related to blow overs, low visibility and hydroplaning developed prior to BCIB opening • Active monitoring of wind speed and precipitation along the alignment included in bridge surveillance routines • Accident rate	On-site observation Inspect operations records	Quarterly	BMMC	DPWH-BMUES	NQE	Prescribed preventive measures not adequately implemented Elevated accident rate	Direct responsible party to enhance application of preventive measures
106. Occupational health and safety risks	• Safety training given to maintenance crews on an annual basis • Bid documents and contracts for maintenance and inspection contractors require preparation and implementation of detailed activity-specific occupational safety plans	Review training records Review draft bid documents and contracts	Annually (records) As needed (bid documents and contracts)	BMMC	DPWH-BMUES (training records) DPWH-ESSD (bid documents	NQE	Safety training not delivered annually Prescribed requirements not included in bid documents and contracts	Direct responsible party to restore prescribed training schedule Direct responsible party to incorporate prescribed requirements before bid documents and contracts are finalized

EMP Topic	Performance Indicator	Sampling & Measurement Plan			Monitoring Entity	Annual Estimated Cost (PHP)	EQPL Management Scheme	
		Method	Frequency / Timing	Location			Environmental Quality Performance Level	Management Measure
							Limit	Limit
					and contracts)			
107. Visual impacts	• Monitoring of littering and inadvertent waste release from uncovered loads in bridge surveillance routines • Periodic spot checks conducted to reduce the number of inadequately covered loads crossing the bridge • Roadside litter cleanups carried out as needed • Low incidence of roadside litter build-up	Inspect operations records On-site observation	Quarterly	BMMC	DPWH-BMU ES	NQE	Prescribed preventive measures not adequately implemented Elevated incidence of unsightly roadside litter buildup	Direct responsible party to enhance application of preventive measures

10.8 Information, Education and Communication (IEC) Plan

Stakeholder engagement should be implemented by DPWH throughout the project cycle, from early formulation to the end of the operation phase and decommissioning. Information disclosure, consultation and other stakeholder participation activity conducted during the feasibility stage and detailed design stage of the project have been described elsewhere in the EIA report. This section of the EMP specifies the information disclosure, consultative and participatory activities that should be undertaken during implementation of the project going forward, beginning during preconstruction and continuing through the construction and operation phases.

10.8.1 Planned and Unforeseen Stakeholder Engagement Needs

Outreach should occur prior to each project construction milestone and anticipate procedures for unexpected circumstances to efficiently disseminate information as needed. This means disclosure and consultation should be both planned and subject to a contingency allocation. The anticipated and possible as-needed stakeholder engagement steps during the construction and operation phases are listed in Exhibit 10-12. The cost estimate for stakeholder engagement over the life of the project includes a substantial contingency amounting to one third of the expected overall IEC cost. These funds are allocated to enable consultation in the case of unforeseen events that may result in impacts on stakeholders, should they occur. Responsibility for planning, initiating, conducting and responding to the listed stakeholder engagement activities—whether foreseeable and planned, or unforeseen and funded from a contingency amount—rests with the Proponent.

10.8.2 Stakeholder Engagement and EMP Evolution

The implementation of a large and complex project like the BCIB, with an estimated five-year construction phase and a design life of 100 years, will be continually buffeted by new information, social and environmental change, stochastic events, political and economic crises, and various other phenomena external to the project. Designs and methods may be required to respond to such factors, and impacts may also change over time, either directly because of dynamism in the project environment, or due to design and methods changes made to reflect new realities. The EMP should, accordingly, be considered a living document, to be updated when and as needed by DPWH, which will be its custodian. Ongoing consultation should play a central role in defining the adaptations that will be needed to ensure that the EMP continues to serve the purpose of safeguarding biophysical and socioeconomic values in the project environment. This is reflected in Exhibit 10-12, both in the categories of implementation steps, changes and events that should trigger stakeholder engagement, and in the fourth column of the table, which identifies EMP adaptations that may come out of or be shaped by consultative activity.

Exhibit 10-12: Stakeholder Engagement During Project Implementation

Trigger for Engagement Activity	Modes of Engagement	Key Topics	Key Target Stakeholders	Possible EMP Adaptation	Estimated Cost for Engagement (PHP)
Impending start of physical works	• Public notices • Public meetings in construction-affected areas	• Location and nature of first works activities • Construction schedule • Grievance Redress Mechanism and how to use it	• Construction-affected people and enterprises	• Adaptation of planned mitigation if appropriate	300,000 (expected)
Change in design or construction methods (if significant implications for impacts)	• Public notices • Meetings with people affected by impacts of design or methods change	• Nature of changes and locations and work activities affected • Adaptations of mitigation plan to accommodate changes •	• People and enterprises most affected by design or method changes	• Adaptation of planned mitigation if appropriate	200,000 (contingency)
Significant accident or hazardous environmental release	• Public notice • Public information meetings with affected people	• Information about incident • What has been done to investigate the cause(s) • What is being done to prevent reoccurrence	• General public • Stakeholders most affected by impacts of incident	• Adaptation of mitigation if appropriate • Compensation if appropriate	200,000 (contingency)
Emergence of new information revealing unforeseen impact or worsening of predicted impacts	• Public notice • Public information meetings with affected people	• Information about the newly revealed situation • How the project will adapt • What it will mean for local community and natural resources	• Stakeholders most affected by new or worsened impacts	• Adaptation of planned mitigation • Compensation if appropriate	200,000 (contingency)
Start of operations	• Public notice • Public meetings in affected areas	• Opening schedule, including any phasing of opening • What to expect in the way of traffic changes • What kinds of vehicles are allowed on the BCIB • Speed limit on the BCIB	• General public • People and enterprises most likely to be affected by the start of operations	• Adaptation of planned mitigation if appropriate	300,000 (expected)

Trigger for Engagement Activity	Modes of Engagement	Key Topics	Key Target Stakeholders	Possible EMP Adaptation	Estimated Cost for Engagement (PHP)
Major maintenance works (periodic, repeated)	• Public notice • Public meetings in affected areas	• Nature and duration of works • Expected effects on traffic • Possible impacts on public safety, and how to help prevent them	• Project-affected people • Project-affected enterprises	• Adaptation of planned mitigation if appropriate	1,500,000 (expected)
Major repair works	• Public notice • Public meetings in affected areas	• Nature and duration of works • Expected effects on traffic • Possible impacts on public safety, and how to help prevent them	• Project-affected people • Project-affected enterprises	• Adaptation of planned mitigation if appropriate • Compensation if appropriate	200,000 (contingency)
•	•			• Total (expected):	2,100,000
•	•			• Total (contingency):	800,000

10.9 Grievance Redress Mechanism

In accordance with the SPS, a functional and accessible mechanism must be provided to enable people and entities who feel that they have been wronged by some aspect of the project's implementation to have their concerns addressed in a timely, even-handed and transparent way. A grievance redress mechanism (GRM) is a formal structure for accepting, acknowledging, evaluating and responding to complaints people may have about the project's implementation.

A project-specific GRM should be accessible and applicable to all members of the public and entities within the project's zone of influence, and can be expected to address such matters as property damage; worker behavior in the community; excessive dust, noise and disturbance; traffic congestion; safety concerns; prolonged blockage of access to businesses and homes; effects on livelihood; and disruptions to public services such as electricity, water and sewerage.

GRMs should also extend to workers, who may have grievances related to working conditions, living conditions in construction camps, safety and health issues, labor rights violations, mistreatment, or other matters. All laborers, skilled workers, and site engineers employed on site by the PCs or by any of their subcontractors should have access to the mechanism. Access to a GRM should not be contingent on the terms of any worker's employment, and should apply equally regardless of whether their engagement is considered full-time, part-time, permanent, casual, fixed-term, salaried, or contracted on a per-unit basis.

A GRM is not intended to replace regular legal, administrative and political means of seeking redress for negative impacts experienced by community members, entities and workers that arise as a result of project implementation. The existence of a project GRM does not in any way limit or negate the pursuit of corrective action through complaints lodged with regulatory agencies like the DENR, DOH, and DOLE, or with trade unions, municipal and provincial governmental bodies, or elected representatives. Rather, a GRM offers a responsive, low-transaction-cost way to deal with concerns early and promptly within the project management context, which can often make recourse to other more time-consuming and costly means unnecessary. A functional GRM can thus be advantageous for complainants, contractors, the project proponent, and ultimately also the public purse.

The project GRM is generally applicable to the construction phase, which is the part of the project cycle involving the greatest potential for negative impacts to be experienced. The project proponent should normally institute some form of grievance management system in the context of its regular operating procedures to ensure that complaints arising from infrastructure operations, including maintenance and repair works, are addressed.

10.9.1 GRM Structure

10.9.1.1 GRM Design Principles

The design of a GRM should aim for simplicity and consistency, so the process of filing a complaint is understandable to all and is the same for everyone, no matter their education, social status or political affiliation. In operation, a GRM should be:

1. Physically accessible (complainants should be able to submit grievances locally);
2. Functionally accessible (verbal complaints should be accepted and responded to just as for written ones so even people of limited literacy can lodge a complaint);

3. Free to use (no complainant should be required to make payment of any kind for grievance submission or resolution);
4. Gender-responsive (complainants should have the opportunity to have their grievances heard and responded to by a person or persons of their gender if desired);
5. Culturally appropriate (complainants should be heard and responded to in their own language whenever possible); and
6. Time-bound (timelines for responses should be publicized and strictly observed so complaints are never left languishing, unresolved).

10.9.1.2 Institutional Seat of the GRM

As the proponent of the BCIB, DPWH will be responsible for establishing and operating a GRM. The GRM will be set up within the DPWH-UMPO RMC II, under the supervision of the DPWH-EU. A Grievance Redress Officer (GRO) will be appointed to manage the GRM for the whole BCIB project, with responsibilities to include establishment and operational support of local level mechanisms for receiving and resolving grievances, supervision and support of local-level counterparts, maintenance of a central grievance register, and managing a centralized GRM function to address higher-order, non-local and intractable grievances.

Because the BCIB project area is fundamentally divided by Manila Bay, there are effectively two separate project areas populated by separate groups of communities and stakeholders; this circumstance requires that a dedicated branch of the GRM be implemented for each of Bataan and Cavite. A Local Grievance Redress Officer (LGRO) will be appointed by the DPWH-UPMO RMC II to manage each of the Bataan and Cavite branch GRMs. Responsibilities of the LGROs will include establishment and operational support of a Local Grievance Redress Committee (LGRC), maintenance of a local grievance register, and communication with complainants and their representatives regarding grievance resolution matters.

Although most grievances are likely to be local in nature, it is foreseeable that some will be raised by parties not based in either Bataan or Cavite, by complainants acting in the general public interest, or by those who perceive that their grievance is not appropriately addressed by either local GRM because of the scale or location of the originating effect (e.g., a shipping or ferry company whose operations have been unduly hindered by some aspect of the bridge works, or a public interest group objecting to incomplete implementation of mitigation measures all along the marine alignment). Such grievances—as well as grievances that prove unresolvable by one of the local GRMs—will appropriately be managed by the GRO and a Central Grievance Redress Committee (CGRC).

10.9.1.3 Grievance Reception Points

The Manila offices of the DPWH-UPMO RMC II are not favorably located for submission of complaints by people most likely to be directly affected by construction of the BCIB project. Accordingly, arrangements must be made for grievance reception points (GRPs) at the local level. The local office of the CSC can normally host the GRP, provided the office is in a location easily known and accessible to the general population. In the case of the BCIB project, it is expected that the CSC will maintain site offices in each of Mariveles and Naic, and that the DPWH-UPMO RMC II will be provided with office space within each of these offices. The LGROs will manage the Bataan and Cavite GRMs out of the local DPWH-UPMO RNC II offices.

The DPWH-UPMO RNC II headquarters in Manila will serve as the GRP for grievances that do not originate in Bataan or Cavite, or are raised by complainants from outside Bataan or Cavite; the GRO will be responsible for managing the reception of grievances at the DPWH-UPMO RNC II headquarters. In the event that a grievance raised through the Manila GRP is deemed to be most appropriately addressed at the local level under either the Bataan or Cavite GRM, it will be referred by the GRO to the relevant LGRO.

10.9.1.4 Grievance Redress Committees

Local Grievance Redress Committees

An LGRC will be required for each of Mariveles and Naic to adjudicate and resolve complaints that cannot be resolved directly by the contractor implicated in the complaint or by the LGRO. Each LGRC will be convened and chaired by the UPMO-appointed LGRO, and its membership should include

1. the highest site-level official of each PC fulfilling one of the construction packages pertaining to project activities within the municipality, such as the Project Manager or Construction Superintendent;
2. the Project Environment Officer (PEO) or their designated representative;
3. the most senior Environment, Health and Safety (EHS) specialist employed by the CSC overseeing the construction site or activity in question;
4. the Mayor of the relevant municipality, or their representative;
5. the Barangay Captain of each barangay in which the project works are being implemented within the municipality;
6. a representative of the relevant regional office of DENR-EMB; and
7. a representative of the relevant PENRO.

Other members, such as representatives of relevant public interest advocacy organizations, may be added to the LGRC at the discretion of the LGRO, as may be warranted by the nature of the grievance or circumstances of the complainant. The LGRCs must be constituted prior to the beginning of land acquisition and site clearing but will convene only when needed.

Central Grievance Redress Committee

A CGRC will be required to address grievances that have proved unresolvable at the local level, or which transcend the local scale (affecting people in both Bataan and Cavite and perhaps elsewhere as well). The CGRC will be convened by the GRO only when needed, and will be chaired by the Project Director. The membership of the CGRC should include

1. the GRO;
2. the PEO;
3. the most senior Project Manager of each of the PCs holding one of the main works packages;
4. the Team Leader of the CSC;
5. a senior officer of the DPWH Environment and Social Safeguards Division (under the Planning Service);
6. a senior representative of the DENR-EMB Regional Office (Region III);

7. a senior representative of the DENR-EMB Regional Office (Region IV-A);
8. the Mayor of the Municipality of Mariveles;
9. the Mayor of the Municipality of Naic; and
10. the Mayor of Cavite City LGU.

Other members, such as representatives of relevant public interest advocacy organizations and governmental entities with remits pertinent to the grievance issue at hand, may be added to the CGRC at the discretion of the Project Director or GRO.

10.9.1.5 Communication of GRM

The existence, purpose, procedures and contact details of the GRM, including its Bataan, Cavite and central components, must be publicized to ensure the GRM's accessibility. The GRM will be explained during pre-construction stakeholder consultations, and written information will be prepared and disseminated in the project's most directly affected communities. Written material should include (1) informational posters put up (and regularly maintained) outside all major project work sites, at each designated GRP, and at the municipal offices of each concerned LGU and barangay; and (2) a simple brochure to be distributed at any consultation meeting or other public encounter concerning the project. Information included in the posters and brochures should include (1) a general overview of the project; (2) explanation of the GRM's purpose; (3) description of the grievance redress process including time limits; and (4) instructions for submitting complaints, including GRP locations and contact information for the LGROs and GRO. All workers employed on the project, including those hired by sub-contractors, must receive an orientation to the GRM during their induction training.

10.9.1.6 Grievance Registers

A grievance register is a database of complaints received and addressed, and includes, for each complaint received,

1. the original submission (via standard form or transcribed from verbal communication);
2. all communications surrounding the complaint and its attempted resolution;
3. records of meetings held, proposals for resolution considered, and resolution actions implemented; and
4. the outcomes of resolution attempts, including a closure statement signed by the complainant in the case of successful resolution.

A grievance register will be maintained by each LGRO. The LGROs will be required to make the local registers available for inspection by any member of the public upon request, and also by the Multi-Partite Monitoring Teams (MMTs) for the project. New entries in the local grievance registers shall be promptly forwarded by the LGROs to the GRO, for inclusion in a central grievance register for the project. In addition to preserving local grievance records, the GRO will record any higher-order grievances received through the Manila office of the UPMO. Like the local grievance registers, the central register shall be made available for inspection by any member of the public upon request, and also by the MMTs.

New entries added to the local and central grievance registers during each monitoring and reporting period shall be listed and described in the quarterly Self-Monitoring Reports (SMRs) prepared by DPWH for submission to DENR-EMB, and in the Semi-Annual

Environmental Monitoring Reports (SEMRs) submitted by DPWH to ADB. The MMTs will also review the contents of the relevant grievance registers, and evaluate the GRM's performance in their semi-annual Compliance Monitoring and Validation Reports (CMVRs) to DENR-EMB.

10.9.2 Grievance Redress Process

The Bataan and Cavite GRMs will follow a three-tiered process to ensure that grievances are dealt with at the most appropriate level of capability and authority. Grievances will normally first enter the GRM process at the first level, and proceed further only if acceptable resolution is not possible there. The three layers of the local GRMs, and the procedures to be followed within each, are explained below, and shown in Exhibit 10-13.

GRM Level 1. Complaints received by the LGRO will first be referred to the PC implicated in the complaint, for resolution by the PC's EHS Representative, in cooperation with the relevant sub-contractor(s). The PEO and CSC shall be informed by the LGRO that a complaint has been received. Each complaint shall be investigated immediately upon receipt by the PC, and a resolution implemented by the PC within 5 working days. Investigation of grievances will normally involve in-person consultation with the complainant, as well as witnesses, other affected people, sub-contractors and their employees, and such other parties as may be relevant and appropriate (e.g., barangay officials or local community organization representatives). If the complainant is a woman, arrangements shall be made for a female mediator to be involved in the interaction. If the complainant cannot communicate in Tagalog or English, arrangements shall be made for an interpreter.

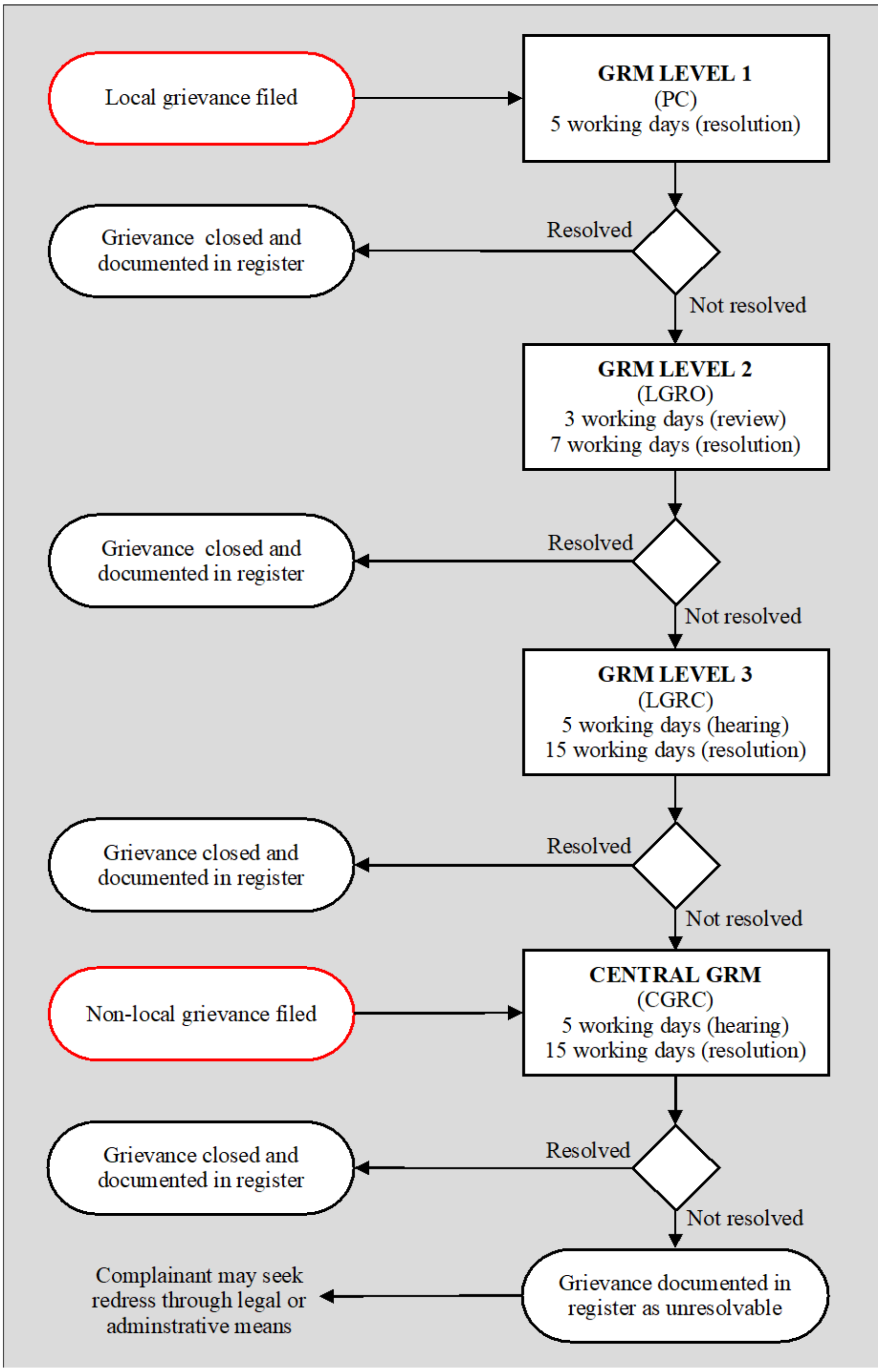


Exhibit 10-13 Grievance Redress Process

All documentation related to the attempted resolution shall be promptly transmitted by the PC EHS Representative to the LGRO for compilation in the grievance register. If the grievance has not been resolved or been mutually acknowledged to be on its way to being resolved after 5 working days, it will be referred by the PC EHS Representative back to the LGRO for consideration as a Level 2 grievance.

GRM Level 2. Unresolved grievances referred to Level 2 will be investigated by the LGRO directly within 3 working days of the referral. The LGRO will review the documentation from the Level 1 attempted resolution, discuss the situation with the complainant and the implicated PC, and conduct any site visits and interviews that may be necessary to understand the situation. The LGRO may also discuss the matter with the CSC and PEO as needed. The LGRO will propose a course of action—to be implemented by the PC within 7 working days—to resolve the grievance to the satisfaction of the complainant. If the proposed resolution is acceptable to the complainant and successfully implemented, a closure statement signed by the complainant will be completed and added to the case records in the grievance register. If the resolution proposed by the LGRO is unacceptable to the complainant, the grievance will be referred to Level 3.

GRM Level 3. When a grievance is referred to Level 3, the LGRO shall convene a meeting of the LGRC within 5 working days of the referral. The GRC will review the documentation from the Level 1 and Level 2 processes, and hold a hearing to give the complainant the opportunity to present his or her concerns and proposal for resolution, through a representative if desired. If the complainant is a woman, arrangements shall be made for a female mediator to be involved in the interaction. If the complainant cannot communicate in Tagalog or English, arrangements shall be made for an interpreter. The hearing process will aim to facilitate resolution through mediation and consensus. If consensus proves impossible to achieve, a simple majority vote of the LGRC members will decide the proposed resolution. The LGRO, as Chair, will break any tie votes. The LGRC will indicate corrective measures at the field level and assign clear responsibilities for implementation of its decision, which must take place within 15 working days. The outcome of the hearing will be communicated to the complainant by the LGRO in writing, or verbally with a written transcript kept if the complainant has limited literacy. Minutes of the hearing and copies of all communication will be preserved in the grievance redress database.

If the grievance is resolved, a closure statement signed by the complainant will be completed and added to the register. If the resolution proposed by the GRC is unacceptable to the complainant, the grievance will be recorded as unresolvable at the local level, and referred to the GRO for consideration by the CGRC.

Central Grievance Redress Committee. Grievances referred to the CGRC from the local level, as well as grievances received through the Manila GRP and deemed non-local, will be addressed through a single hearing and resolution attempt. The GRO shall convene the CGRC within 15 working days of the referral from the Bataan or Cavite GRM or direct receipt of the legitimately non-local grievance. The members of the CGRC will review all prior documentation related to the grievance before the hearing. In the hearing, the shall have the opportunity to present his or her concerns and proposal for resolution, through a representative if desired. If the complainant is a woman, arrangements shall be made for a female mediator to be involved in the interaction. If the complainant cannot communicate in Tagalog or English, arrangements shall be made for an interpreter. The hearing process will aim to facilitate resolution through mediation and consensus. If consensus proves impossible to achieve, a simple majority vote of the CGRC members will decide the proposed resolution; the Project Director, as CGRC Chair, shall break any tie votes.

The CGRC will indicate corrective measures at the field level and assign clear responsibilities for implementation of its decision, which must begin within 15 working days. The outcome of the hearing will be communicated to the complainant by the GRO in writing, or verbally with a written transcript kept if the complainant has limited literacy. Minutes of the hearing and copies of all communication will be preserved in the central grievance redress database. If the resolution proposed by the CRGC is acceptable to the complainant and successfully implemented, a closure statement signed by the complainant will be completed and added to the register. If the resolution proposed by the CGRC is not acceptable to the complainant, the complainant will be advised of his or her right to pursue redress through the legal system or through such administrative remedies as may be available through DENR-EMB or other agencies, if so desired. In such a case, the grievance will be recorded in the central grievance as unresolvable through the duly executed procedures of the project GRM.

10.10 Capacity Development and Training Needs for EMP Implementation

Incomplete or otherwise inadequate EMP compliance tends to be largely a function of three factors: (1) inadequate capacity in entities charged with EMP implementation; (2) inadequate capacity of entities responsible for *oversight* of EMP implementation, including monitoring; and (3) a low level of awareness and knowledge on the part of local sub-contractors and their workers. Measures to address each of these potential areas of weakness can and should be proactively built into the EMP—with resources earmarked to enable them to be instituted—to enable a robust and durable implementation trajectory for the EMP throughout the life of the project.

10.10.1 Capacity Development

Management and oversight of EMP implementation will rest, during the pre-construction and construction phases, on the DPWH-EU, with the review function support and guidance of DPWH-ESSD, and guidance of the CSC. During the operation phase, the Bridge Management Unit will be responsible for continued implementation of mitigation prescribed in the EMP, and DPWH-ESSD will assume the lead supervisory role. Capacity considerations are discussed for each of these entities in turn below.

10.10.1.1 DPWH-EU

Although the DPWH-ESSD has been formally enjoined in an advisory and oversight capacity to the DPWH-PMT through the feasibility and design stages of the project's development, capacity for actual implementation of the oversight measures prescribed in the EMP in relation to the late pre-construction phase and construction phases will be required within the DPWH-PMT, specifically the DPWH-ESARD.

Present Situation

The DPWH-ESARD—which will transition to become the Environmental Unit (DPWH-EU) required by the project's ECC—presently comprises five project managers and a number of junior engineers serving as assistants.[318] Most management team members are early- to mid-career professionals with significant experience as regards navigation of the safeguards requirements for large infrastructure projects, including those implemented with multilateral financing. All of the DPWH-ESARD team members are engineers who have received at least some supplemental environmental training. At the time of writing, the experienced senior project manager leading the DPWH-ESARD had recently retired, and a replacement has not been found yet. The DPWH-ESARD does not presently have capacity for carrying out monitoring activity on the ground, and the need for capacity building to meet the substantial oversight demands of the BCIB project is acknowledged. The management team is cognizant of the fact that the BCIB, which will be DPWH's longest bridge project to date by a considerable margin, represents a significant opportunity for organizational learning, including with regards to environmental oversight.

With regards to substantive knowledge, there would appear to be strong understanding on the DPWH-ESARD team about the safeguards implementation process, i.e., permitting

[318] The following discussion draws from a meeting with the DPWH-ESARD team on 23 March 2022.

needs, reporting requirements, and steps in the project development and approval process, particularly as pertains to the national EIA process. However, team members acknowledge that expertise is relatively weak in the area of monitoring processes and methodologies, and there is strong interest in training in this substantive area. The breadth of monitoring that will have to take place in order to ensure effective oversight of the BCIB project is formidable, given that there will be seven construction packages implemented simultaneously over five years, with works taking place in both terrestrial and marine environments and around the clock in some cases. Training on the rationales, process, methodologies, reporting and follow-up action involved in monitoring is considered a critical need.

Future Needs

Given the size, complexity and long implementation period of the BCIB project, it is imperative that sufficient oversight capacity be developed, based on analysis of the demands placed on the oversight entity. Five main workflows can be delineated based on the particular needs associated with safeguards requirements of the project (see Exhibit 10-14), and each of these will require dedicated human resource capacity.

Exhibit 10-14 Anticipated DPWH-EU Workflows and Associated Human Resource Needs

Key Workflow	Main Work Activities	Estimated Human Resource Needs
1. Permitting	• Secure all necessary permits prior to start of construction • Secure renewals of permits as needed • Ensure that PCs have obtained all necessary permits and are keeping them current • Secure any permits necessary for operation phase	• Permitting Manager (1 FTE for 6 yrs.) • Permitting Assistant (1 FTE for 6 yrs.)
2. Confirmatory Monitoring	• Develop refined plan for confirmatory monitoring based on final work site arrangements selected by PCs and adjusted project implementation schedule • Conduct in-house monitoring to confirm validity of PC self-monitoring • Hire and supervise outside monitoring firm for technical effects monitoring to confirm validity of PC self-monitoring • Review and compile reporting of EHSOs and outside monitoring firm	• Monitoring Manager (1 FTE for 6 yrs.) • Field Monitoring Supervisor Bataan (1 FTE for 6 yrs.) • Field Monitoring Supervisor Cavite (1 FTE for 6 yrs.) • Team of 15 EHSOs (15 FTE for 6 yrs.)
3. Reporting	• Develop template for SMRs and SEMRs and information management system for monitoring results coming from multiple sources • Review and consolidate monitoring results from PC for each work package • Review and consolidate in-house confirmatory monitoring results for each work package • Prepare comprehensive SMR (quarterly) and SEMR (semi-annually) based on PC monthly self-monitoring reports and DPWH-FSM confirmatory monitoring reports	• Reporting Manager (1 FTE for 6 yrs.) • Report Preparation Specialists (2 FTE for 6 yrs.)

Key Workflow	Main Work Activities	Estimated Human Resource Needs
4. Coordination On Corrective Action And Emerging Concerns	• Meet monthly with PC-EHSRs, CSC EHS monitoring specialists and DPWH-EHSOs, in parallel with monthly implementation progress meetings to review compliance matters • Coordinate with PC-EHSRs, CSC EHS monitoring specialists, DPWH-FMSs, DPWH-EHSOs, site engineers and other relevant actors to ensure formulation and implementation of corrective action in response to compliance issues identified in PC and DPWH-EHSO monitoring reports	• Compliance Manager (1 FTE for 6 yrs.) • Compliance Assistants (2 FTE for 6 yrs.)
5. Operating Grievance Redress Mechanism	• Manage operation of local GRMs through Local Grievance Officers • Convene Central Grievance Redress Committee when needed • Maintain consolidated grievance register	• Grievance Redress Officer (0.5 FTE for 6 yrs.) • Local Grievance Redress Officers (2 x 0.5 FTE for 6 yrs.)

Based on the workflow analysis presented in Exhibit 10-14, the DPWH-EU team should comprise 30 personnel, of whom 9 would be seated at UPMO RMC-II in Manila, 14 would be stationed in Mariveles, and 7 would be stationed in Naic. A schematic of the proposed organization of the DPWH-EU is presented in Exhibit 10-15. It may be noted that the number of project managers approximates the management corps of the present DPWH-ESARD, but that substantial new allocations for technical roles in Bataan and Cavite, as well as the Manila offices of UPMO RMC-II, are proposed. It is assumed here that capacity for implementation of other project safeguards actions, specifically those specified in relation to the LARP and GAP, will be established separately from the DPWH-EU.

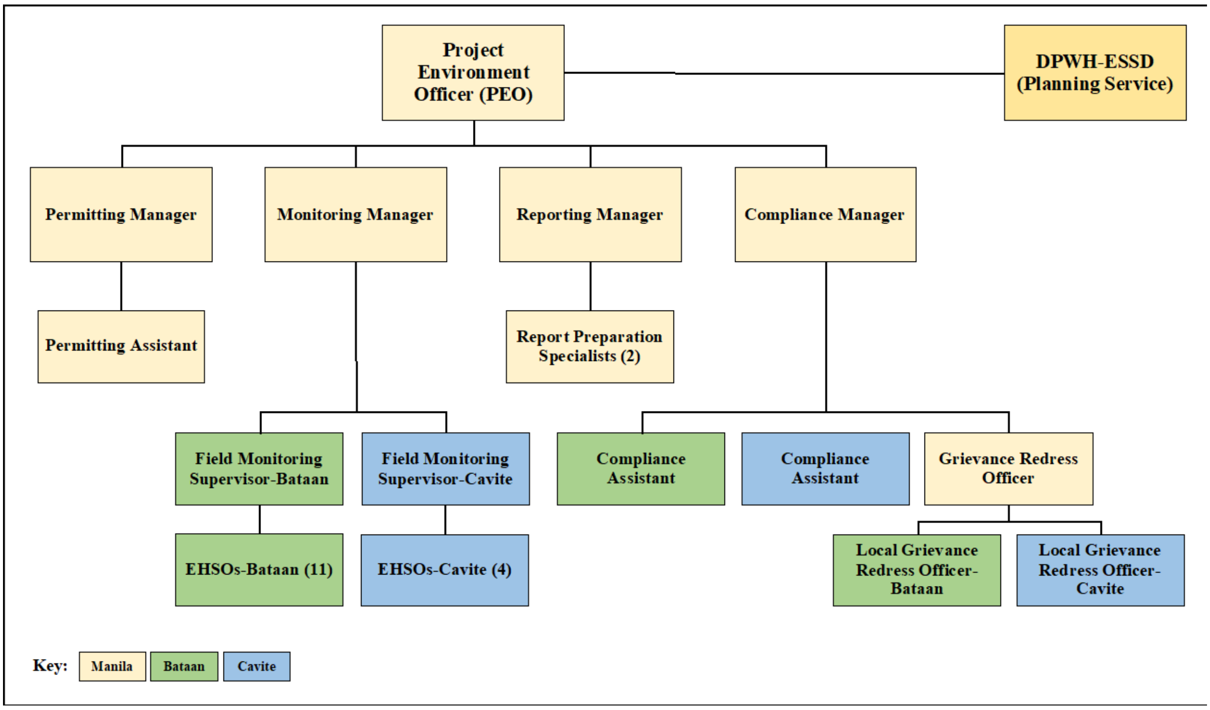


Exhibit 10-15 Proposed Organization of DPWH-EU for the BCIB Project

It is estimated that 15 EHSOs will be required to adequately cover the works of all PCs, some of whom will work around the clock for a portion of the construction phase. The EHSOs should be qualified EHS professionals with prior training and experience on large construction projects, preferably projects carried out with multilateral support and subject to international safeguards requirements. Although the people recruited for these positions should have substantial prior environmental knowledge, they should be engaged at least three months before the start of construction to allow for orientation and training to ensure consistent understanding of the project activities, common appreciation of the scope and nature of planned monitoring and other responsibilities, and on-site safety including safe operation of their means of transport. The EHSOs will be organized into two teams, based in Mariveles and Naic respectively. Each EHSO team will be led and managed by a Field Monitoring Supervisor (DPWH-FSM). The number of EHSOs proposed overall, and the relative weighting of the Bataan and Cavite teams, are based on the scale of the works to be carried out by the PCs they will be assigned to supervise, the locations of major staging areas, and the expectation that some PCs will need to work 24 hours per day for part of the construction phase, requiring both daytime and nighttime monitoring activity. The optimal configuration of the EHSO teams may change as construction planning evolves, but the overall number of EHSOs needed is expected to remain stable.

A qualified local monitoring contractor will be engaged on an occasional basis to carry out spot monitoring tasks requiring specialized technical field sampling expertise and equipment, including water quality, air quality and noise sampling. The DPWH-EHSOs will assist the technicians with safe access to work sites.

The EHSO teams will need on-site office space in Mariveles and Naic, to facilitate consistent presence and to enable preparation of site monitoring reports. EHSOs and FMSs will also need means of transport suitable to the assigned sites, to support independent movement for daily, weekly and monthly monitoring activities. EHSOs assigned to land sites shall be provided with light motorbikes (or similar) and light runabout vessels should be provided for those assigned to monitoring marine works. One monitoring vessel will be required on the Cavite side, and two will be needed to enable independent movement of EHSOs supervising the very substantial works supported from sites on the Bataan side. Motorbikes would be required only for the EHSOs monitoring the approach road works and spread-out yard sites (estimated total 4–5 bikes).

10.10.1.2 DPWH-ESSD

A permanent review and oversight body positioned within the Planning Service of DPWH, the DPWH-ESSD has 21 permanent personnel dedicated to ensuring that DPWH projects meet all relevant safeguards requirements adequately and appropriately. Providing such oversight for the BCIB project is within the normal remit of the DPWH-ESSD, and it can be assumed that the entity has sufficient capacity to do so. Capacity development for DPWH-ESSD is not considered a necessary or appropriate component of the EMP for the BCIB project.

10.10.1.3 Construction Supervision Consultant

The firms or joint ventures that can be expected to bid on the CSC contract will be international entities with extensive experience and expertise in safeguards oversight, which is always a key component of construction supervision. This does not necessarily mean that they will allocate sufficient personnel and resources without direction from the Proponent. In the case of the BCIB project, there are substantial project-specific monitoring and training needs implied by both the EMP and Biodiversity Action Plan that will require support from specialized expertise from within the CSC team. A proposed allocation of specialists, to be reflected in the bid documents for the construction supervision contract, is provided in Exhibit 10-16.

Exhibit 10-16 Proposed Specialist Positions for Construction Supervision Team

Proposed Specialist Position	Key Responsibilities	Estimated Person-Months
EHS Monitoring Expert (International)	• Develop and guide delivery of updated and site-specific Environmental Monitoring Plan encompassing all works and staging and support sites, based on confirmed selections of staging measures, construction methods and staging sites • Advise and support PCs in development of high-quality CEMMAPs • Liaise with DPWH-EU, PC-EHSRs, DPWH-EHSOs, and PC engineers to develop suitable solutions to compliance problems, as needed • Participate in GRM resolutions as needed • Develop and guide delivery of training programs for DPWH-EU personnel, sub-contractors, and workers • Develop and guide delivery of training program for would-be construction workers under the Social Development plan • Support and supervise 2 National EHS Monitoring Specialists	36
Biodiversity Monitoring Expert (International)	• Pursuant to the Biodiversity Action Plan, assist DPWH to build multiple partnerships to formulate and implement action programs to address the project's residual impacts on biodiversity values, in consultation with the scientific community, NGOs and ADB • Assist DPWH and identified partners to finalize BAP action programs • Oversee early implementation of BAP action programs, including by facilitation of planning meetings, vetting contractors, validating field methodologies and troubleshooting • Support and supervise 2 National Biodiversity Monitoring Specialists	36
EHS Monitoring Specialist 1 (National)	• Support and collaborate with International EHS Monitoring Expert	72
EHS Monitoring Specialist 2 (National)	• Support and collaborate with International EHS Monitoring Expert	72
Biodiversity Monitoring Specialist 1 – Terrestrial (National)	• Support and collaborate with International Biodiversity Monitoring Expert	72
Biodiversity Monitoring Specialist 2 – Marine (National)	• Support and collaborate with International Biodiversity Monitoring Expert	72

10.10.1.4 Contractors and Sub-Contractors

International construction contractors working in the Philippines are well aware of both national and ADB safeguards requirements, and knowledgeable on global best practices in impact mitigation and site management, and will be expected to engage sufficient personnel to ensure the required EMP implementation tasks, including preparation and implementation of a high-quality CEMMAP and delivery of monthly self-monitoring reports, are executed successfully. Effective oversight and enforcement, rather than additional capacity-building, are needed to ensure strong EMP performance from these firms.

The local firms acting as sub-contractors, which will undertake much or most of the physical work of infrastructure development, can in many cases be expected to be less aware and less experienced regarding safeguards requirements, and less concerned with adhering to international standards of practice. Although it does not appropriately fall to the BCIB project's EMP to build these firms' capacity for EHS management, their performance on the

BCIB project will be enhanced by proactive training to strengthen their knowledge and awareness of safeguards requirements and international best practice.

10.10.1.5 MMTs

Two MMTs are proposed for the BCIB project, for the Bataan side and Cavite side respectively. These bodies will be composed of representatives of various entities active at the local and provincial levels, and will be formed specifically for the project, i.e., they will not be pre-existing entities with a familiar mandate. These teams should be expected to have considerable collective environmental expertise and knowledge of the project environment and host communities, but most members will not have extensive prior practical experience with EHS monitoring in any context, let alone in the context of an infrastructure project of a scale similar to the BCIB project. In order to serve their function as prescribed under national law, the MMTs will require both financial resources (for member honoraria, transport and materials) as well as training and operational guidance. As indicated in the ECC, DPWH will be responsible for funding and capacity-building for the MMTs. Operational guidance and oversight will be provided by the DENR-EMB RO for Region III (for Bataan MMT) and by the DENR-EMB-RO for Region IV-A (Cavite MMT).

10.10.1.6 Bridge Management Unit

Although the bulk of impact potential associated with the BCIB project will pertain to the construction phase, there are a limited number of mitigation measures applicable to the operation phase, and the Bridge Management Unit will be responsible for implementing them. This includes continuing DPWH's participation in implementation of biodiversity monitoring programs set up during the pre-construction and construction phases, and providing EHS oversight of contractors engaged for maintenance and repair and replacement works. Accordingly, the Bridge Management Unit will need to have a qualified Environment Specialist on its staff. General responsibilities of the Environment Specialist are as follows:

1. Ensure that all mitigation measures assigned to the Bridge Management Unit in the EMP are implemented effectively, developing and guiding implementation of appropriate corrective action as needed;
2. Prepare appropriate EHS compliance requirements for inclusion in bid documents for procurement of contractors to undertake maintenance and repair and replacement works;
3. Oversee EHS compliance by contractors engaged for maintenance and repair and replacement works;
4. Conduct EHS monitoring of bridge operation activity and prepare and submit quarterly SMRs and semiannual CMRs to DENR-EMB, until such time as DENR-EMB may grant relief from the ECC;
5. Implement DPWH responsibilities in relation to long-term monitoring and adaptive management programs set up under the BCIB project's Biodiversity Action Plan; and
6. Provide timely inputs to decision-making with regards to implementation of the Emergency Action Plan (particularly as pertains to post-emergency recovery).

10.10.2 Proposed Training Programs

10.10.2.1 DPWH-EU

Strengthening the DPWH-EU's understanding and expertise with respect to environmental monitoring has been identified as a critical training need. Both the managers and EHSOs of the DPWH-EU should receive training on concepts and methods in monitoring to enable effective oversight of EMP implementation. This training will be completed prior to the start of construction works. The training program shall be developed and delivered by the CSC, specifically its EHS Monitoring Specialists (international and national). An outline, including cost estimate, for the training program for DPWH-EU personnel is provided in Exhibit 10-17.

Exhibit 10-17 Outline of Training Program for DPWH-EU Personnel

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
MODULE 1 – CONCEPTS IN ENVIRONMENT, HEALTH AND SAFETY MONITORING				
• Purpose and objectives of EHS monitoring • Compliance monitoring • Effects monitoring • Quantitative measurement • Qualitative assessment • Appropriate periodicity of monitoring for different parameters and activities • Consistency in monitoring • Adapting monitoring plans to evolving construction activity • Trend assessment • Uses of monitoring results • Follow-up and corrective action • Communication of monitoring results • Use and supervision of outside monitoring providers	• DPWH-EU Managers • DPWH-EU Field Monitoring Supervisors • DPWH-EU EHSOs	Classroom	3 hrs	PHP 6,000
MODULE 2 – MONITORING METHODOLOGIES (CLASSROOM)				
• Compliance monitoring • Common EMP non-compliance issues • Assessing degrees of compliance • Documentation of compliance monitoring • Effects monitoring • Common failures leading to measurable effects • Qualitative and quantitative field methods • Documentation of effects monitoring	• DPWH-EU Managers • DPWH-EU Field Monitoring Supervisors • DPWH-EU EHSOs	Classroom	3 hrs	PHP 6,000
MODULE 3 - MONITORING METHODOLOGIES (ON-THE-JOB PRACTICUM)				
• Compliance monitoring • Common EMP non-compliance issues • Assessing degrees of compliance • Documentation of compliance monitoring • Effects monitoring • Common failures leading to measurable effects • Qualitative and quantitative field methods • Documentation of effects monitoring	• DPWH-EU Field Monitoring Supervisors • DPWH-EU EHSOs	Field practicum at start of key construction phases (clearing and site setup, hauling, road works, casting works, marine works)	8 field sessions (4 hrs each)	PHP 30,000

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
MODULE 4 – SAFETY IN FIELD MONITORING				
• Safety risks and scenarios in monitoring different types of on-land sites • Safety risks and scenarios in monitoring marine works • Safety equipment for monitoring personnel • Safe operation of vehicles and vessels used in monitoring • Ensuring safe access for outside monitoring contractors	• DPWH-EU Field Monitoring Supervisors • DPWH-EU EHSOs	• Classroom • Hands-on practicum	3 hrs classroom 3 hrs field instruction	PHP 12,000
MODULE 5 – EVALUATION, COMPILATION AND REPORTING				
• Evaluating credibility of contractor SMRs • Correction of poor contractor self-monitoring performance • Evaluating quality of effects monitoring data from outside monitoring providers • Correction of poor outside monitoring provider performance • Communicating corrective action needs identified in contractor SMRs and DPWH-EHSO confirmatory monitoring to contractors • Follow-up on corrective action directives • Characteristics of high-quality SMRs and SEMRs • Performance trend assessment • Supporting documentation	• DPWH-EU Managers • DPWH-EU Field Monitoring Supervisors	Classroom	3 hrs	PHP 6,000
Total estimated cost				PHP 60,000

[1] Costs are inclusive of materials, transportation and refreshments, and exclusive of personnel costs, which are accounted for under staffing costs of the CSC. Training venues are assumed to be CSC offices and field sites.

10.10.2.2 Sub-Contractors

Poor EHS compliance on construction projects is ultimately the responsibility of the PC, but often originates with a lack of appreciation for EHS compliance requirements and international best practice on the part of sub-contractors. Providing proactive training to the project managers and site engineers of the sub-contractors before they come on the project can be a useful step towards better compliance, at lower transaction cost than addressing non-compliance later. Such training should be designed and delivered by the CSC. An outline for a training program for sub-contractors engaged to work on landside works and marine works is provided in Exhibit 10-18.

Exhibit 10-18 Outline of Training Program for Sub-Contractors

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
MODULE 1: Environment, Health and Safety (EHS) Safeguards Requirements on International Projects				
• Rationale for safeguards requirements in infrastructure development (environment, health and safety) • National safeguards requirements • ADB safeguards requirements	• Sub-contractor project managers • Sub-contractor site engineers • Sub-contractor EHS officers	Classroom	1 hr per session delivered (NB: delivered together with Module 2 or Module 3,	n/a (cost included in Module 2 and Module 3 estimates)

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
• Primary contractors' legal and contractual responsibilities with respect to compliance with national environmental and labor rules • EHS monitoring processes and enforcement			depending on audience)	
• MODULE 2: Environment, Health and Safety – International Best Practices (On-Land Works)				
• Best practices in construction site management • Best practices in environmental impact prevention and minimization • Best practices in on-site occupational health and safety risk avoidance	• Sub-contractor project managers • Sub-contractor site engineers • Sub-contractor EHS officers	Classroom	3 hrs per session delivered	120,000[2]
MODULE 3: Environment, Health and Safety – International Best Practices (Marine Works)				
• Best practices in construction site management • Best practices in environmental impact prevention and minimization • Best practices in on-site occupational health and safety risk avoidance	• Sub-contractor project managers • Sub-contractor site engineers • Sub-contractor EHS officers	Classroom	3 hrs per session delivered	120,000[2]
Total estimated cost				PHP 240,000

[1] Costs are inclusive of materials and refreshments, and exclusive of personnel costs, which are accounted for under staffing costs of the CSC. Training venues are assumed to be CSC offices.

2 Assumes that there may be as many as 30–40 sub-contractors working on the project at various times, and that they will be trained as they are brought on. Also assumes that sub-contractors can be bundled together for training in some cases.

10.10.2.3 Workers

Primary contractors and their sub-contractors should provide adequate training to workers in their employ to ensure safe and sanitary workplaces and full compliance with all prescriptions of the EMP, but often fall short in this regard. Workplace safety is an especially common weak point in EHS compliance, and laborers may often be unaware that their employers have an obligation to provide a safe workplace, and to supply them with task-appropriate PPE. It is therefore often useful and appropriate for supplemental worker training to be provided, to help create a strong culture of EHS compliance on the project sites and forestall emergence of compliance issues. Training sessions are also an opportunity to make workers aware of the Grievance Redress Mechanism (GRM), its availability to them, and how to access it. Such training should be designed and delivered by the CSC. Worker training should be provided prior to the start of construction, and whenever new sub-contractors and crews of workers are brought onstream; refresher training should be given any time site monitoring reveals recurrent patterns of non-compliance that can be attributed to lack of worker knowledge or awareness. Refresher training is appropriately delivered at the job sites, such as at motor pool areas, in mess halls and in construction camps. An outline for the worker training is shown in Exhibit 10-19.

Exhibit 10-19 Outline of Training Program for Workers

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
• MODULE 1: Environment, Health and Safety on the Job Site – On-Land Personnel				
• Rationale for EHS requirements on construction sites	• All skilled workers and laborers engaged in on-land works	Classroom (induction)	2 hrs	150,000 (induction)

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
• Workplace safety practices, including, but not limited to, proper use of task-appropriate personal protective equipment • Safety procedures for working at heights and in the presence of overhead lifting activity • Safe handling of noxious substances used in construction • Fire safety, including fire prevention and use of fire extinguishers • Reporting observed spills, leaks, physical hazards and other potentially urgent matters to site managers • Proper solid waste disposal practices • Sanitation and personal cleanliness in toilets, cooking and eating areas, wash-up facilities and employer-provided accommodations • Existence and use of the Grievance Redress Mechanism		Jobsite (refresher)		187,500 (annual refreshers)
MODULE 2: Environment, Health and Safety – Marine Personnel				
• Rationale for EHS requirements on construction sites • Workplace safety practices, including, but not limited to, proper use of task-appropriate personal protective equipment • Safety at sea topics, e.g., safe boarding and disembarkation, use of personal flotation devices and harnesses, and proper securement and handling of heavy objects on moving platforms • Safety procedures for working at heights and in the presence of overhead lifting activity • Safe handling of noxious substances used in construction • Fire safety, including fire prevention and use of fire extinguishers • Reporting observed spills, leaks, physical hazards and other potentially urgent matters to site managers • Proper solid waste disposal practices • Sanitation and personal cleanliness in toilets, cooking and eating areas, wash-up facilities and employer-provided accommodations • Existence and use of the Grievance Redress Mechanism	• All skilled workers and laborers engaged in marine works	Classroom (induction) Jobsite (refresher)	2 hrs	150,000 (induction) 187,500 (annual refreshers)
Total estimated cost				PHP 675,000
[1] Costs are inclusive of materials and refreshments, and exclusive of personnel costs, which are accounted for under staffing costs of the CSC. Training venues are assumed to be CSC offices. [2] Assumes unit cost of PHP 100/trainee for induction training, and PHP 50/trainee for refresher training, and a trainee population of 3,000 for induction training and workforce of 1,500 averaged over the construction phase for refresher training.				

10.10.2.4 Multipartite Monitoring Teams

In order to perform their intended function effectively, the MMTs will require foundational training on the purposes and objectives of their work, verification monitoring methodologies, and reporting requirements. DPWH is responsible for providing such training. The CSC will develop and deliver the training on behalf of DPWH. An outline of the MMT training program is provided in Exhibit 10-20.

Exhibit 10-20 Outline of Training Program for MMTs

Key Content	Participants	Format	Duration	Estimated Cost (PHP)[1]
• Purpose and objectives of an MMT • Basis for MMTs in national law • Operational guidance to be expected from DENR-EMB ROs • Reporting responsibilities • Project EMP and ECC • Proponent's self-monitoring program • Modes of verification monitoring appropriate to MMT role • Safety considerations for site observation • Receipt, review and evaluation of complaints from stakeholders • Report format and preparation	• All members (Bataan MMT) • All members (Cavite MMT)	Classroom	6 hrs	30,000 per session
Total estimated cost				PHP 60,000
[1] Costs are inclusive of materials and refreshments, and exclusive of personnel costs, which are accounted for under staffing costs of the CSC. Training venues are assumed to be CSC offices. The two MMTs will be given training separately, and it is assumed that each session will have approximately 10 participants. Honoraria for participants are accounted for separately, under MMT operational costs.				

10.11 Cost Estimates for EMP Implementation

Most measures listed in the Environmental Mitigation Plan Responsibility Matrix (Exhibit 10-3) and Environmental Monitoring Plan Responsibility Matrix (Exhibit 10-11) are appropriately considered a routine and expected part of regular operations for the implementing parties, and it is impractical to attempt a segregation and numerical determination of the cost of these measures. For a subset of the prescribed measures, which may fall outside the scope of normal operating procedure or 'business as usual' for the national context and involve hiring specialized personnel, using non-standard materials, outsourcing things like laboratory analysis to technical providers, and providing training and capacity-building, a rough cost estimate has been generated. Taken together, these estimates represent the incremental expenditure attributable to efforts to mainstream environmental and social sustainability in the BCIB project's implementation. These segregated quantifiable costs are tallied in Exhibit 10-21 are preliminary.

Exhibit 10-21 Cost Estimates for EMP Implementation

Item No.	Item Description	Assumptions/Uncertainties	Estimated Cost - Low End (PHP)	Estimated Cost - High End (PHP)
DPWH				
1.	Capacity building for DPWH-EU	• Estimated salaries of proposed new hires over project construction phase (assumed 6 years) • Subject to increase if construction phase extended	168,000,000	168,000,000
2.	Stakeholder engagement (pre-construction and construction phases)	• High end estimate reflects contingency for changes in the project implementation and/or project environment	600,000	1,200,000
3.	Stakeholder engagement (operation phase)	• High end estimate reflects contingency for changes in the project implementation and/or project environment	1,500,000	3,500,000
4.	Environmental Monitoring Fund (operation of MMTs)	• EMF amount subject to negotiation between DPWH and DENR • Training costs accounted for in CSC amount	TBD	TBD
5.	Social Development Plan	• As itemized in Exhibit 10-4	1,210,725,000	1,210,725,000
6.	Biodiversity Management Plans (Terrestrial)	• Bird Management Plan • Bat Management Plan • Natural Grassland Management Plan	200,000,000	500,000,000
7.	Biodiversity Management Plans (Marine)	• Marine Turtle Management Plan • Underwater Noise Management Plan	100,000,000	300,000,000
8.	Biodiversity Action Plan	• Action programs in BAP subject to further negotiation between implicated entities • High end estimate reflects contingency for more severe impact scenarios	1,000,000,000	3,000,000,000
9.	Environmental mitigation measures	• As itemized in Exhibit 10-3	24,100,000	24,100,000
10.	Carbon Sink Program	• Carbon Sink Program subject to negotiation between DPWH and DENR	TBD	TBD
11.	Construction phase confirmatory monitoring	• Calculated as 10% of combined PC-assigned monitoring costs	15,364,500	15,364,500
12.	External Monitoring Agent	• Selection of agent and scope of assignment subject to negotiation between DPWH and ADB	TBD	TBD
	Subtotal DPWH		2,720,289,500	5,222,889,500
CONSTRUCTION SUPERVISION CONSULTANT (CSC)				
13.	Training programs (non-personnel costs)	• As itemized in Section 10.10.2	1,035,000	1,035,000
14.	EHS Monitoring Specialists	• 1 international specialist (36 person-months) • 2 national specialists (each 72 person-months)	95,000,000	95,000,000

Item No.	Item Description	Assumptions/Uncertainties	Estimated Cost - Low End (PHP)	Estimated Cost - High End (PHP)
15.	Biodiversity Monitoring Specialists	• 1 international specialist (36 person-months) • 1 national terrestrial specialist (72 person-months) • 1 national marine specialist (72 person-months)	95,000,000	95,000,000
16.	Supplemental studies and management plan development	• Terrestrial ecosystem services valuation • Marine ecosystem services valuation • Coastal processes risk assessment • Operation phase hazardous spill risk assessment • Water Use Management Plan • Longitudinal bird monitoring and Bird Management Plan • Longitudinal bat monitoring and Bat Management Plan • Longitudinal turtle monitoring and Marine Turtle Management Plan • Longitudinal cetacean acoustic monitoring and Underwater Noise Management Plan	235,000,000	234,000,000
	Subtotal CSC		430,035,000	430,035,000
PRIMARY CONTRACTOR, P1 CONTRACT (PC1)				
17.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
18.	Construction phase mitigation	• As itemized in Exhibit 10-3	8,750,000	8,750,000
19.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 2.5 years	8,985,000	8,985,000
	Subtotal PC1		21,735,000	21,735,000
PRIMARY CONTRACTOR, P2 CONTRACT (PC2)				
20.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
21.	Construction phase mitigation	• As itemized in Exhibit 10-3	7,950,000	7,950,000
22.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 3.5 years	10,701,000	10,701,000
	Subtotal PC2		22,651,000	22,651,000
PRIMARY CONTRACTOR, P3 CONTRACT (PC3)				
23.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
24.	Construction phase mitigation	• As itemized in Exhibit 10-3 • Uncertainty regarding PC3/PC4/PC5/PC6 sharing of staging areas	1,974,515,000	1,974,515,000

Item No.	Item Description	Assumptions/Uncertainties	Estimated Cost - Low End (PHP)	Estimated Cost - High End (PHP)
25.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 4 years • Uncertainty regarding PC3/PC5/PC6 sharing of staging areas	30,219,000	30,219,000
	Subtotal PC3		2,008,734,000	2,008,734,000
PRIMARY CONTRACTOR, P4 CONTRACT (PC4)				
26.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
27.	Construction phase mitigation	• As itemized in Exhibit 10-3 • Uncertainty regarding PC3/PC4/PC5/PC6 sharing of staging areas	979,350,000	979,350,000
28.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 4 years • Uncertainty regarding PC3/PC5/PC6 sharing of staging areas	48,747,000	48,747,000
	Subtotal PC4		1,032,097,000	1,032,097,000
PRIMARY CONTRACTOR, P5 CONTRACT (PC5)				
29.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
30.	Construction phase mitigation	• As itemized in Exhibit 10-3 • Uncertainty regarding PC3/PC4/PC5/PC6 sharing of staging areas	617,015,000	617,015,000
31.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 4 years • Uncertainty regarding PC3/PC5/PC6 sharing of staging areas	24,267,000	24,267,000
	Subtotal PC5		645,282,000	645,282,000
PRIMARY CONTRACTOR, P6 CONTRACT (PC6)				
32.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	4,000,000	4,000,000
33.	Construction phase mitigation	• As itemized in Exhibit 10-3 • Uncertainty regarding PC3/PC4/PC5/PC6 sharing of staging areas	1,967,015,000	1,967,015,000
34.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 4.75 years • Uncertainty regarding PC3/PC5/PC6 sharing of staging areas	30,057,000	30,057,000
	Subtotal PC6		2,001,072,000	2,001,072,000
PRIMARY CONTRACTOR, P7 CONTRACT (PC7)				
35.	CEMMAP and specialized sub-plan development	• As itemized in Exhibit 10-3	1,000,000	1,000,000

Item No.	Item Description	Assumptions/Uncertainties	Estimated Cost - Low End (PHP)	Estimated Cost - High End (PHP)
36.	Construction phase mitigation	• As itemized in Exhibit 10-3	100,000	100,000
37.	Construction phase monitoring	• Yearly cost as estimated in Exhibit 10-11 • Assumed period of activity 0.75 years	669,000	669,000
	Subtotal PC7		1,769,000	1,769,000
	Estimated EMP Implementation Expenditures (quantifiable incremental)		8,883,664,500	11,386,264,500

APPENDICES TO THE ENVIRONMENTAL MANAGEMENT PLAN

APPENDIX A: Sample Outlines for Contractor Environmental Management and Monitoring Action Plans (CEMMAPs)

APPENDIX B: Sample Outlines for Specialized Sub-Plans Included in CEMMAPs

(1) Compensatory Tree Planting Plan (as applicable)
(2) Concrete Batch Plant Management Plan (as applicable)
(3) Construction Camp Management Plan (as applicable)
(4) Construction Traffic Management Plan (all PCs)
(5) Demolition Waste Management Plans (as applicable)
(6) Dredging Management Plan (as applicable)
(7) Dust Control Plan (all PCs)
(8) Emergency Action Plan (all PCs)
(9) Habitat Clearance Management Plan (as applicable)
(10) Hazardous and Noxious Materials Management Plan (all PCs)
(11) Human Waste and Sanitation Management Plan (all PCs)
(12) In Water Work Management Plan
(13) Marine Invasive Species Management Plan
(14) Marine Sanitation and Solid Waste Management Plan (as applicable)
(15) Marine Spill Prevention and Response Plan (as applicable)
(16) Marine Spoils Management Plan (as applicable)
(17) Occupational Health and Safety Management Plan (all PCs)
(18) Road Works Safety Management Plan (as applicable)
(19) Soil Erosion Prevention and Runoff Management Plan (all PCs)
(20) Solid Waste Management Plan (all PCs)
(21) Spoils Management Plan (as applicable)
(22) Staging Area Rehabilitation Plan (as applicable)
(23) Terrestrial Invasive Species Management Plan

APPENDIX C: Sample Outlines for Other Project Plans

(1) Bat Management Plan
(2) Bird Management Plan
(3) Marine Turtle Management Plan
(4) Natural Grassland Restoration Plan
(5) Underwater Noise Management Plan
(6) Water Use Management Plan

APPENDIX D: Sample Outline for Semi-Annual Monitoring Reports to ADB

APPENDIX E: Sample Outline for Monthly Contractor Self-Monitoring Reports to DPWH

APPENDIX A

Contractor Environmental Management and Monitoring Action Plan (CEMMAP) – Sample Outline

1. Purpose of the Plan

- Objectives
- Relationship to project Environmental Management Plan (EMP)
- Relationship to project Environmental Compliance Certificate (ECC)
- Relationship to specialized mitigation plans
- Applicability of plan to sites under Contractor's control
- Appointment of Contractor's Environment, Health and Safety Representative

2. Roles and Responsibilities in Plan Implementation

- Contractor's Environment, Health and Safety Representative
- Sub-contractors
- Site engineers
- Emergency response focal persons
- Skilled workers
- Laborers

3. Legal Requirements

- Environmental and occupational health and safety laws and regulations pertinent to the works
- Licenses and permits required and obtained
- Proof of insurance (CARI)

4. Contractor's Scope of Work

- Description of infrastructure plan
- List and description of works to be delivered by Contractor
- List and description of work locations
- List of Contractor-operated support sites needed

5. Contractor's Work Plan

- Project construction schedule
- Contractor works schedule
- Mobilization schedule
- Coordination needs and dependencies

6. Contractor's Equipment

- Detailed equipment list (model, date of manufacture, horsepower, fuel consumption, installed pollution control technology, expected usage hours on project)
- Equipment maintenance facilities
- Equipment transport to project site
- Equipment storage

7. Contractor's Workforce

- Contractor personnel
  - Contractor engineering and management personnel
  - Contractor-hired manual workforce
- Sub-contractors
  - List of sub-contractors

- Expected workforce by sub-contractor

8. Contractor-Controlled sites

- Description by site
  - Physical description (boundaries, area, previous uses)
  - Natural features (topography, soils, land cover, general hydrology)
  - Detailed inventory of permanent and intermittent watercourses on and adjacent to site)
  - Surrounding land use
  - Sensitive receptor sites near site boundaries
  - Prevailing winds
  - Road access
  - Access to project sites
  - Electricity and water supply
  - Leasing agreements
  - Internal site layout plan

9. General Method Statements for Site Operations

- Boundary establishment and fencing
- Site layout to avoid on-site sensitive features, off-site sensitive receptors
- Site layout to respect environmental constraints
- Appointment of site manager/supervisor
- Public posting of contact information
- Site security
- Lighting
- Parking capacity
- Measures to minimize safety risks at public way entrances
- Minimum PPE requirements for entrance to site
- Fire suppression equipment
- Safety signage
- Building standards for on-site temporary structures
- Stormwater drainage plan
- Normal operating hours
- Permitted activities outside normal operating hours
- Worker behavior
- Vegetation management

10. Specialized Sub-Plans

- Plans required of all Contractors
  - Construction Traffic Management Plan
  - Dust Control Plan
  - Emergency Action Plan
  - Habitat Clearance Management Plan
  - Hazardous and Noxious Materials Management Plan
  - Human Waste and Sanitation Management Plan
  - Occupational Health and Safety Management Plan
  - Soil Erosion Prevention and Runoff Management Plan
  - Solid Waste Management Plan
  - Staging Area Rehabilitation Plan
  - Terrestrial Invasive Species Management Plan
- Plans required as applicable to Contractor works and sites
  - Compensatory Tree Planting Plan

- Concrete Batch Plant Management Plan
- Construction Camp Management Plan
- Demolition Waste Management Plans
- Dredging Management Plan
- In-Water Work Management Plan
- Marine Invasive Species Management Plan
- Marine Sanitation and Solid Waste Management Plan
- Marine Spill Prevention and Response Plan
- Marine Spoils Management Plan
- Road Works Safety Management Plan
- Spoils Management Plan

11. Monitoring and Reporting Plan

- Contractor's monthly monitoring and reporting responsibilities per project EMP
- Compliance monitoring parameters and methods
- Effects monitoring parameters and methods
- Monitoring equipment
- Site-specific monitoring checklists
- Record-keeping and chain-of-custody procedures
- Selected sampling contractor and laboratory services provider
- Monitoring schedule by site and parameter
- Monitoring report format and outline
- Monitoring report quality assurance/quality control
- Corrective action specification and communication
- Corrective action follow-up

12. Training Needs and Plans

- Training needs assessment
- Training targets and content
- Training plan

APPENDIX B

Sample Outlines for Specialized Sub-Plans Included in CEMMAPs

(1) Compensatory Tree Planting Plan (as applicable)
(2) Concrete Batch Plant Management Plan (as applicable)
(3) Construction Camp Management Plan (as applicable)
(4) Construction Traffic Management Plan (all PCs)
(5) Demolition Waste Management Plans (as applicable)
(6) Dredging Management Plan (as applicable)
(7) Dust Control Plan (all PCs)
(8) Emergency Action Plan (all PCs)
(9) Habitat Clearance Management Plan (as applicable)
(10) Hazardous and Noxious Materials Management Plan (all PCs)
(11) Human Waste and Sanitation Management Plan (all PCs)
(12) In Water Work Management Plan
(13) Marine Invasive Species Management Plan
(14) Marine Sanitation and Solid Waste Management Plan (as applicable)
(15) Marine Spill Prevention and Response Plan (as applicable)
(16) Marine Spoils Management Plan (as applicable)
(17) Occupational Health and Safety Management Plan (all PCs)
(18) Road Works Safety Management Plan (as applicable)
(19) Soil Erosion Prevention and Runoff Management Plan (all PCs)
(20) Solid Waste Management Plan (all PCs)
(21) Spoils Management Plan (as applicable)
(22) Staging Area Rehabilitation Plan (as applicable)
(23) Terrestrial Invasive Species Management Plan

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(1) Compensatory Tree Planting Plan – Sample Outline

Note: The purpose of the planting plan is to fully assess the existing tree resources on the development site and specify an implementable strategy for ensuring that the net medium-term effect of the site's development on local arboreal resources is at least neutral relative to existing conditions, and in compliance with Tree-Cutting Permit requirements and conditions. The planting plan is to be developed by the Contractor, and approved by the Construction Supervision Consultant prior to the start of construction. Only tree species native to the project area shall be acceptable for planting under the plan.

1. Plan Rationale and Requirements

- Objectives of plan
- Brief description of clearing activity producing need for plan
- Tree-Cutting Permit requirements and process steps
- Roles and responsibilities

2. Baseline Profile of Tree Resources on the Development Site

- General description of tree cover
  - proportion of site covered
  - hydrological, soil and site use factors influencing distribution of tree cover on site
  - notable species assemblages
  - ecological functions of existing trees and groups of trees
  - existing uses of on-site trees
- Inventory of existing trees on site
  - full inventory of all trees over 2 m height, tabulated by species and size (height, diameter at chest height, crown width) and native/introduced status
  - list of identified significant specimens (trees that are highly valued for any reason, e.g., very large size; serve as a social meeting place; medicinal importance; rare or endangered)

3. Trees Designated for Preservation, Removal and Planting

- Inventory of trees to be preserved, based on site master plan
  - list of trees by species and location
  - map of preserved trees
  - planned method of protecting trees during site clearing and construction
- Inventory of trees to be removed, based on site master plan
  - list of trees by species and location
  - map of clearance areas
  - planned method of removing trees and disposal of timber
- Inventory of spaces for compensatory planting
  - number of trees to be planted, based on anticipated removals (at least 2:1 ratio)
  - list and description of available on-site areas
  - list and description of off-site areas identified in consultation with relevant LGU
  - map of suitable on-site and off-site planting areas

4. Compensatory Planting Plan

- Constraints and opportunities
  - survey of suitable native sapling sources (native saplings at least 2 m tall, in sufficient number to have at least two trees planted for each tree removed)
  - estimation of sapling costs by species
  - seasonal factors affecting planting
  - minimum and optimal spacing requirements for different species
- Selected native species and planting locations
  - identification of priority native species based on site conditions
  - confirmation of species that must not be used for planting (e.g. non-natives)
  - identification of priority planting locations based on site conditions
  - master planting plan map
  - establishment of a nursery to grow all requisite plants
- Planting strategy
  - timing of planting activity
  - procurement of saplings, soil amendments and mulches
  - procurement of labor for planting
- Plantation maintenance strategy
  - identification of maintenance needs by species and location (watering, mulching, fertilization, trimming, weeding)
  - maintenance schedule

  - arrangement of labor and responsibility for on-site plantation maintenance
  - arrangement of labor and responsibility for off-site plantation maintenance

5. Cost Estimates

- Estimated initial costs for planting
- Estimated recurring costs for plantation maintenance

6. Monitoring of Implementation

- Monitoring parameters (e.g., tree survival rate, maintenance performance)
- Method and frequency of monitoring
- Definition of feasible corrective actions in the case of poor performance

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(2) Concrete Batch Plant Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- National laws and standards applicable to water quality, air quality, noise and occupational health and safety impacts of batch plants
- Inventory of batch plants to be operated by the Contractor
- Roles and responsibilities in plan implementation

2. Description of Contractor's Batch Plant [complete this section for each batch plant]

- Location
- Capacity
- Works served
- Power source
- Water source and expected water consumption
- Expected duration of operation for project
- Expected operating hours
- Loading equipment used on site
- Slurry trucks used on site
- Cement pumps used on site
- On-site materials storage capacity
- Installed dust control technology
- Installed noise attenuation technology
- Washout management facilities
- Plant layout
- Site layout
- Proximity of sensitive receptors
- Receiving watercourse for discharges

3. Method statements

- Washout management practices (shall adhere to guidance in *US EPA Best Management Practice for Stormwater Management – Concrete Washout EPA 833-F-11-006. www.epa.gov/npdes/pubs/concretewashout.pdf.*)
  - Prohibition on discharge of untreated washout to environment
  - Water recycling

    - Filtration and neutralization
    - Solids recycling and disposal
- Continuous air quality monitoring
    - Installed monitoring equipment
    - Placement of monitoring equipment
    - $PM_{2.5}$, PM_{10} levels triggering activation of dust suppression action
- Site dust suppression
    - Stockpile enclosures (3 sided, walls at least 2 m higher than pile height)
    - Stockpile coverage (tarpaulins used when stockpiles not in use)
    - Spraying regimen
    - Spraying equipment
    - Use of paved surfaces and sweeping
- Provision and replacement of respiratory protection for plant personnel
    - Respiratory protection for workers handling cement and fly ash (P100 respirators)
    - Respiratory protection for workers in vicinity (N95 masks)

4. Monitoring of Plan Implementation

- Performance indicators
- Method and frequency of monitoring

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(3) Construction Camp Management Plan – Sample Outline

Note: Preparation and review of the Construction Camp Management Plan should be guided by: IFC/EBRD. 2009. Workers' accommodation: processes and standards – A guidance note by IFC and the EBRD. August 2009. Each camp should have its own management plan. Housing workers on construction sites is strictly prohibited.

1. Purpose of the Plan

- Objectives
- Relationship to CEMMAP and project EMP
- Applicable national occupational health and safety laws and standards
- Relevant international best practice guidance on construction camps
- Roles and responsibilities in plan implementation

2. Environmental and Social Context of Construction Camp

- Location
- Road access and distance to work sites
- Available service infrastructure
- Topography
- Prevailing wind
- Drainage
- Nearby water bodies
- Surrounding land use
- Local communities
    - proximity

  - population
  - ethnic makeup
  - employment and livelihoods

3. Camp Capacity and Resident Profile

- Projected number of resident workers during different phases of work
- Expected number of accompanying family members
- Expected number of support staff living on site
- Expected ethnic makeup of camp residents

4. Camp Infrastructure Plan (specify capacities for all items)

- Site area and layout
- Internal roadways
- Parking
- Fencing
- Kitchens and food storage
- Eating facilities
- Toilets and septic system
- Wash-up facilities
- Dormitories (specify space per resident and provide layout drawings)
- Personal storage
- Recreational space
- Water supply and water heating
- Electricity
- Cooking fuel
- Backup generators
- Firefighting equipment
- Ingress and egress standards
- Camp construction schedule

5. Cleaning and Maintenance Plan

- Cleaning and sanitation
  - responsibilities
  - methods
  - schedule
- Facility inspection and maintenance
  - responsibilities
  - inspection methodology
  - inspection schedule
  - maintenance schedule

6. Wastes and Waste Management

- Solid waste
  - expected composition of solid waste stream
  - collection and management of recyclables
  - collection and management of non-recyclables
  - collection and composting of organic waste
- Liquid waste
  - expected composition of liquid waste stream
  - management of gray water

- management of sewage

7. Rules Governing Resident Behavior

- Rules for conduct when in camp
- Rules for conduct outside camp
- Family members policy
- Visitor policy
- Rules regarding alcohol and illegal drugs
- Procedure for adjudicating disputes among residents

8. Training

- Good practices for disease prevention
- Camp safety and fire suppression
- Wildlife management
- Fire control
- Poaching and firewood collection from neighboring land
- Invasive species control measures

9. Camp decommissioning

- Responsibility for decommissioning
- Procedure for decommissioning
- Timing of decommissioning

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(4) Construction Traffic Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objective of plan
- Relationship of plan to CEMMAP and project EMP
- Contractor sites and works activities where need for traffic management measures is expected
- Roles and responsibilities for plan implementation

2. Protocol for Determining Level of Construction Traffic Management

- Critical congestion thresholds (e.g., traffic density, number of haul trucks per hour)
- Accident risk level
- Nuisance assessment
- Classification of traffic management levels
- Decision flowchart to guide activation

3. Standards of Practice

- Coordination with police and local authorities
- Signage
- Dedicated lanes
- Speed limits for different situations
- Haul route selection and establishment
- Disruption avoidance
- Phasing of hauling activity

- Coordination with other project Contractors
- Temporary closures
- Haul truck maintenance level
- Conflict management
- Accident response

4. Monitoring and Enforcement

- Monitoring methods and periodicity
- Driver compliance
- Subcontractor compliance
- Observed effects on safety
- Observed effects on congestion
- Complaints from public
- Sanctions for non-compliance

5. Training

- Training for drivers
- Training for site managers and subcontractors
- Training program (content, materials, training hours, training methods)

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(5) Demolition Waste Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Brief description of Contractor's sites, including those to be operated by sub-contractors
- National laws and standards governing waste management
- Registrations and permits obtained
- Roles and responsibilities in plan implementation

2. Projected Volumes of Demolition Waste by Class

- Methodology for site survey/other basis for volume projections
- Reusable/saleable items
- Recyclable concrete
- Recyclable metals including abandoned vehicles
- Reusable wood
- Mixed waste/non-recyclable
- Other (as applicable)

3. Method Statement: Pre-Demolition Inspection for Hazardous Materials

- Inspection and risk assessment methodology
- Selected inspection services provider
- Asbestos-containing materials (ACM) removal and disposal plan, if needed
- Removal and disposal plan for other hazardous materials, if needed
- Selected and confirmed destination hazardous waste management facility
- Transportation plan for hazardous demolition wastes

4. Method Statement: Demolition

- Demolition equipment
- Occupation and public safety measures
- Dust suppression

5. Method Statement: Demolition Waste Recycling

- Segregation methods and plan
- Selected and confirmed providers of recycling services
- Storage and re-use plan for clean concrete, as applicable
- Transport of recyclable materials

6. Method Statement: Demolition Waste Disposal

- Decision protocol for disposal in project spoils disposal site vs landfill
- Description of spoils disposal site and transport plan
- Selected and confirmed destination landfill and transport plan

7. Monitoring of Implementation

- Performance indicators
- Method and frequency of monitoring

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(6) Dredging Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Linkage to Marine Spoils Management Plan
- Relevant laws and regulations
- Permits and notifications required
- Roles and responsibilities in plan implementation

2. Description of Contractor's Dredging Works

- Purpose of dredging
- Location of dredging
- Seabed area subject to dredging
- Expected volume of dredged material
- Expected composition of dredged material (grain size, % breakdown by class)
- Dredging method(s)
    - dredging equipment (type)
    - dredging equipment (model and size)
    - collection method (barge vs pump to land)
    - dewatering
- Expected duration and phasing of dredging activity

3. Dredged Material Disposal

- Confirmed disposal option from linked Marine Spoils Management Plan
- Permits required for selected disposal option

- Agreements required for selected disposal option

4. Method Statements

- Demarcation of safety perimeter (where appropriate)
- Dredging rig anchoring/stabilization
- Requirement for use of silt curtains to contain siltation in all waters up to 20 m deep
- Silt curtain deployment
  - Type selected (permeable/impermeable, open bottom/closed bottom)
  - Placement in relation to dredge site
  - Anchoring methods
  - Method for enabling barge ingress/egress
  - Minimum settling time before curtain removal
  - Inspection regimen to ensure consistently effective containment

5. Allocations

- Allocation for silt curtain procurement
- Allocation for personnel to deploy silt curtains

---

(7) Dust Control Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Relevant air quality and occupational health and safety laws and regulations
- Applicable international (World Bank Group) air quality standard for $PM_{2.5}$ and PM_{10}
- Roles and responsibilities in plan implementation

2. Description of Contractor's Work Activities on Project Sites and Staging Areas

- General work activities by site
- Expected duration of work activity by site
- Equipment used by site
- Materials stored and handled by site
- Expected hauling activity

3. Dust Generation Risk Assessment by Site and Activity

- Inventory of dust generating surfaces by site
- Inventory of dust generating activities by site
- Inventory of dusty materials handled by site
- Wind exposure by site
- Locations of dust receptors by site
  - On-site workers
  - Off-site residences
  - Off-site crops and natural areas

4. Method Statements

- Dust monitoring
  - Fixed-location continuous monitoring (dust-intensive sites only)
  - Mobile monitoring (quantitative)
  - Mobile dust monitoring (qualitative)

- Dust reduction
  - Materials storage for reduced dust (e.g., 3-sided open enclosures for constantly used stockpiles, tarpaulins for less frequently accessed stockpiles)
  - Protocol for limiting handling based on wind speed/humidity
  - Installed dust control equipment (batch plants)
  - Dust control measures for haul trucks
  - Vehicle speed measures
- Dust suppression
  - Spraying regimen
  - Description of spraying equipment
  - Spraying methods
  - Priority locations
  - Protocol for activating spraying regimen (monitoring-based)
  - Protocol for activating spraying regimen (complaints-based)

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(8) Emergency Action Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Linkage to other Contractor Emergency Action Plans
- Preparedness – Response – Recovery framework
- Inventory of Contractor's work sites and staging areas to which the plan will be applicable

2. Scoping of Risk and Risk Scenarios as Applicable to Contractor's Sites and Activities

- Construction phase risks – scoping and ranking of probability and significance
  - earthquake
  - tsunami
  - flooding
  - storm surge
  - fire
  - major work site accidents
- Operation phase risks – scoping and ranking of probability and significance
  - very strong earthquake
  - very large tsunami
  - direct hit by major typhoon
  - many-vehicle pile-up accident
  - large ship collision with bridge or viaduct
  - large explosion of inflammable/explosive cargo on bridge
  - high-volume spill of hazardous cargo on bridge
  - terrorist attack or sabotage
  - catastrophic failure of infrastructure (stochastic or linked to design/construction deficiency)

3. Emergency Action Plan : Preparedness

- Roles and responsibilities
- Resource allocation
- Capacity-building
- Equipment procurement

- Training
- Drills
- Mechanisms for coordination
- Plan communication
  - to coordinating entities
  - to potentially affected persons and communities
  - to general public
- Plan review and updating schedule

4. Emergency Action Plan : Response

- Chain of command
- Internal and external coordination needs
- Incident Commander and Backup Incident Commander
  - Names, contact information
  - Responsibilities
- Other key personnel (Coordination Lead, Communication Lead, Response Team Leads)
  - Names, contact information
  - Responsibilities
- Response team descriptions [complete for each team]
  - core function and responsibilities
  - human resources
  - equipment and supplies
  - mobilization capacities
  - preparedness training regimen
- Inventory of coordinating entities and focal points
  - DPWH-EU
  - other project contractors
  - sub-contractors
  - local authorities
  - provincial authorities
  - national authorities
  - medical entities
- Contingency resource allocations
  - equipment
  - liquid financial resources
- Communication plan
  - PC – DPWH communication
  - PC – PC communication
  - PC – worker communication
  - PC – affected persons communication
  - DPWH – media communication

5. Emergency Action Plan : Recovery

- Roles and responsibilities
- Recovery plan formulation
  - Methodology for scoping recovery needs
  - Methodology for prioritizing recovery objectives
  - Consultation needs
  - Action steps for recovery plan development
  - Timeline for recovery plan development

    - Resource allocations for recovery plan development
- Recovery plan implementation
    - Pre-placed organizational capacities
    - Pre-placed resource allocations (equipment, funds, people)
    - Mechanism for contingency resource allocations (equipment, funds, people)
    - Mechanism for mobilization of volunteers
    - Coordination mechanisms
- Communication plan
    - PC – DPWH communication
    - PC – PC communication
    - PC – worker communication
    - PC – affected persons communication
    - DPWH – media communication
- Post-recovery evaluation
    - methodology for evaluation of plan effectiveness
    - mechanism for incorporating lessons learned in plan update process
    - methods for sharing lessons learned with stakeholders

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(9) Hazardous and Noxious Materials Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Inventory of Contractor's work sites and staging areas to which the plan will be applicable
- Roles and responsibilities in plan implementation
- Designation of presiding Site Engineer as Spill Incident Response Coordinator

2. Record-keeping

- Inventory of hazardous and noxious substances
    - Material Safety Data Sheets
    - Location of storage
    - Amount stored
- Responsibility for record-keeping
- Records update schedule

3. Spill and Leak Risk Assessment

- Hazardous and noxious materials present on Contractor's sites, by volume
- Potential release pathways
    - Releases from storage
    - Releases during handling
- Release scenarios ranked by probability and significance

4. Fire and Explosion Risk Assessment

- Inflammable and explosive materials present on Contractor's sites, by volume
- Potential ignition scenarios during storage
- Potential ignition scenarios during handling and use
- Ignition scenarios ranked by probability and significance

5. Method Statements: Leak Prevention and Response (Stored Substances)

- Prohibition on tanks without secondary containment (integral or non-integral) sufficient to contain catastrophic tank failure
- Prohibition on underground tanks
- Prohibition on storage of drums and other containers outside of a storage facility with roof, sealed floor and containment sill, with secondary containment capacity at least 150% of largest container stored
- Requirement for elevated tanks, storage buildings and containment structures to be designed to withstand Magnitude 6 earthquake
- Inspection regimen for tanks and storage facilities
- Protocol for remedy of detected leaks

6. Method Statements: Leak Prevention and Response (Machinery)

- Inspection regimen for motorized machinery
- Protocol for leak response in context

7. Method Statements: Spill Prevention and Response

- Container handling protocol
- Requirement for impervious surfaces in refueling areas
- Requirement for impervious surfaces in equipment servicing shops
- Requirement and specifications for impervious spill mats used in field refueling
- Requirement and specifications for impervious spill mats used in field servicing and repairs
- Spill response supplies
    - Specifications
    - Minimum amounts on hand
    - Locations and accessibility
- Spill response procedures

8. Method Statements: Fire and Explosion Prevention and Response

- Prohibition on smoking within 10 m of inflammable materials storage facilities
- Inspection regimen for electrical circuitry in inflammable materials storage facilities
- Fire suppression equipment at inflammable materials storage facilities
    - Type
    - Capacities
    - Inspection and renewal regimen
- Secure storage procedures for pressurized tanks
- Inspection and replacement regimen for pressurized tanks

9. Method Statements: Waste Oils

- Requirement for record-keeping on waste oil generation and recycling
- Requirement for storage of waste oils in sealed containers
- Maximum allowable on-site waste oil storage volume
- Selected provider of waste oil recycling services

10. Training Needs

- Training for Site Engineers (Spill Incident Response Coordinators)
- Training for construction workers
- Periodicity of training

---

(10) Human Waste and Sanitation Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Relevant laws and regulations pertaining to human waste management, water quality and occupational health and public health
- Inventory of Contractor's work sites and staging areas to which the plan will be applicable
- Roles and responsibilities in plan implementation

2. Inventory of Sites and Human Waste Management Needs

- Requirement for provision of functional toilets at all work sites and staging areas
- List of works sites and staging areas under Contractor's control
- Projected workforce by site and project phase
- Calculation of toilet capacity needs (minimum ratio 1 toilet per 10 workers)
- Protocol for determining suitability of fixed vs portable toilets based on site characteristics
- Map of planned fixed and portable toilet facilities

3. Fixed Toilet Facilities

- Prohibition on pit toilets, vault toilets and over-water privies
- Locations and capacities of fixed toilet facilities
- Design description of septic systems including leaching fields
- Restrictions on placement of septic systems in relation to wells
- Septic system inspection and maintenance regime
- Associated hand-washing or sanitization stations
- Grey water management (as applicable)
- Toilet facility inspection, cleaning and sanitation regimen

4. Portable Toilet Facilities

- Locations and capacities
- Design description of portable toilet systems
- Rules to ensure safe placement on site
- System and equipment for waste removal and transport to fixed septic system
- Associated hand-washing or sanitization stations
- Portable inspection, pump-out, cleaning and sanitation regimen

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(11) Marine Sanitation and Solid Waste Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- National laws and international conventions relevant to plan
- Inventory of Contractor's work sites, vessels and work platforms to which the plan will be applicable
- Registrations and permits obtained
- Roles and responsibilities in plan implementation

2. Projected Monthly Human Waste Generation at Marine Works Sites

- Size of workforce
- Assumptions

3. Method Statement: Human Waste Collection at Marine Works Sites

- Prohibition on sea disposal of human waste from project vessels and work platforms
- Ratio of toilets to workers at marine work sites
- Locations of toilets (platforms, vessels)
- Design description of toilets provided at marine works sites
- Design description of pump-out equipment and vessel
- Collection frequency
- Responsibility for collection

4. Method Statement: Onshore Human Waste Management

- Design description of Contractor's human waste reception facility at shore staging area
- Design description and location of Contractor's septic system for waste brought from vessels and work platforms
- Method of waste transfer from pump-out facility to septic system
- Monitoring and maintenance schedule of septic system

5. Projected Monthly Solid Waste Production at Marine Works Sites by Waste Class

- Regular solid waste
- Recyclable waste
- Organic waste
- Hazardous solid waste

6. Method Statement: Solid Waste Collection at Marine Works Sites

- Specifications for design and placement of work site waste receptacles
- Collection vessel
- Collection frequency
- Responsibility for collection

7. Method Statement: Onshore Waste Management

- Design description of Contractor's waste reception and handling facility at shore site
- On-site handling and storage facilities for non-recyclables
- On-site handling and storage facilities for recyclables
- On-site handling and storage facilities for organic wastes
- On-site handling and storage facilities for hazardous wastes

8. Method Statement: Solid Waste Disposal

- Selected and confirmed destination landfill for non-recyclables
- Transportation plan for non-recyclables
- Selected and confirmed providers of recycling services
- Transportation plan for recyclables
- Selected and confirmed destination for organic wastes
- Transportation plan for organic wastes
- Selected and confirmed destination hazardous waste management facility
- Transportation plan for hazardous wastes

9. Monitoring of Plan Implementation

- Performance indicators
- Method and frequency of monitoring

---

(12) Marine Spill Prevention and Response Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- National laws and international conventions relevant to plan
- Inventory of Contractor's work sites, vessels and work platforms to which the plan will be applicable
- Roles and responsibilities in plan implementation

2. Spill Risk Assessment

- Hazardous and noxious fluids present on vessels and work platforms, by volume
- Potential release pathways
- Release scenarios ranked by probability and significance

3. Method Statements: Spill Prevention

- Materials storage on vessels
- Materials storage on work platforms
- Tie-downs and anchors for non-integral containers
- Container handling
- Protocol for halting inter-vessel transfers of material due to sea state
- Secondary containment provisions and capacities
- Inspection regimen for on-board engines and storage
- Bilge inspection regimen
- Proactive bilge contaminants cleanup
- Prohibition on bilge pumping in nearshore areas

4. Method Statements: Spill Response

- Designation of presiding Site Engineer as Spill Incident Response Coordinator
- Onboard containment and cleanup equipment and supplies
  - Minimum equipment requirement by vessel/platform size and function
  - Minimum on-hand supplies by vessel/platform size and function
- In-water containment and cleanup equipment and supplies
  - Minimum equipment requirement by vessel/platform size and function
  - Minimum on-hand supplies by vessel/platform size and function
- Disposal of collected spill substance
- Notifications

5. Training Needs

- Training for Site Engineers (Spill Incident Response Coordinators)
- Training for vessel operators and crew
- Training for construction workers
- Periodicity of training

6. Resource Allocations

- Allocations for materials supply and resupply
- Allocations for repetitive training

---

(13) Marine Spoils Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Purpose of plan
- Relationship of plan to project EMP (stipulations in same)
- Contractor activities expected to generate spoils

2. Spoils Generation Estimates

- Expected generation (volume and tonnage) of spoils by material class
- Expected generation (volume and tonnage) by work location
- Expected water content of spoils by spoils class
- Contamination

3. Spoils Market and Prospective Customer Base -Best Practical Environmental Options Study

- Options for reuse and disposal
- Assessment criteria
- Expected suitability of spoils for off-project uses
- Expected local demand by spoils material class
- List of identified prospective spoils customers
- List of Memoranda of Understanding signed with prospective customers
- Disposal options
- Best Practical Environmental Option Assessment

4. Method Statements

- Spoils extraction and handling
- Spoils dewatering
- Containment of siltation during extraction, handling and de-watering
- Temporary barge storage of spoils
- Direct shipping to end user

5. Capacities

- Equipment for spoils handling
- Equipment for spoils dewatering
- Equipment for siltation containment
- Required barge capacity for temporary storage
- Required barge and tug capacity for transport to end users

6. Verification Systems

- Record-keeping on spoils generation
- Chain-of-custody system to guarantee against unauthorized marine disposal

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(14) Occupational Health and Safety Plan – Sample Outline

1. Plan Rationale and Requirements

- Objective of plan
- Relationship of plan to CEMMAP and project EMP
- Applicable national occupational health and safety laws and standards
- List of Contractor sites to which the plan is applicable
- Contractor workforce
- Roles and responsibilities in plan implementation and supervision

2. Identification of Health and Safety Risks Specific to Sites and Activities [prepare for each Contractor work site and staging area]

- Inventory of hazards inherent to work site
- Inventory of dangerous activities
- Inventory of weather and sea state conditions that heighten safety risks
- Inventory of hazardous materials used and stored on site
- Inventory of health risks for workers

3. Method Statements for Risk Reduction Practices

- Task-appropriate PPE and its proper use
- Operating heavy machinery
- Working in proximity to mobile heavy machinery
- Working at height
- Working in trenches and holes
- Working in underground enclosed spaces
- Working on and around vessels and marine work platforms
- Working while exposed to wave motion and strong winds
- Protocol for issuing stop-work orders due to sea state and wind
- Protocol for issuing stop-work orders due to heavy precipitation/flood risk
- Protocol for issuing stop-work orders due to excessive heat
- Protocol for issuing stop-work orders due to approaching extreme weather
- Electrical work
- Handling hazardous materials
- Handling and storing explosive and flammable materials
- Use of cranes
- Lifting
- Arc welding
- Power cutting and grinding
- Dust suppression
- Spill prevention and response
- Fire suppression
- Personal hygiene on the work site
- Provision of first aid station and supplies
- Provision of urgent health care professional

4. Work Site Setup and Maintenance Specifications

- Provision and placement of fire suppression equipment
- Provision and placement of spill containment and cleanup supplies
- Safe storage spaces for hazardous, flammable and explosive materials
- Barriers and fencing
- Provision of adequate toilets based on worker population

- Provision of adequate wash-up facilities based on worker population
- Provision of unlimited drinking water meeting national standard for drinking water
- Provision of shaded break areas
- Food preparation and eating facilities

5. Training

- Induction training (content and timing)
- Refresher training (content and timing)
- Health and safety meetings
- Specialized tasks training (e.g., for heavy equipment operators and at-height workers)

6. Monitoring

- Site health and safety audits (methods, parameters, frequency, documentation)
- Spot check system
- Framework for follow-up and corrective action

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(15) Road Works Safety Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objective of plan
- Relationship of plan to CEMMAP and project EMP
- National laws, standards and guidelines applicable to safety in road construction and maintenance
- Contractor work sites and activities requiring work in public right-of-way
- Roles and responsibilities in plan implementation

2. Protocol for Determining Level of Safety Management

- Critical thresholds (e.g., traffic density)
- Nature and duration of disruptive activity
- Accident risk level
- Decision flowchart to guide activation

3. Method Statements (as applicable)

- Fencing
- Safety perimeters
- Barriers
- Signage (including sight line and distance thresholds)
- Personnel visibility
- Speed controls
- Flagging procedures
- Signal lights
- Lane modification
- Constricted lanes
- Alternating single-lane management
- Segregation of traffic streams (including pedestrian and non-motorized vehicle traffic)
- Detour selection and establishment
- Temporary closures
- Nighttime safety procedures
- Accident response

4. Equipment

- Equipment standards (signage, barriers, markers)
- Wearable visibility equipment
- Communication equipment

5. Training

- Personal safety training content
- Traffic management training content
- Accident response training content
- Training program (materials, training hours, training methods)

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(16) Soil Erosion Prevention and Runoff Management Plan – Sample Outline

Note: Erosion risk and vulnerability of receiving surface waters to sediment in runoff are site-specific, and this limits the utility of generic plans. The Soil Erosion Prevention and Runoff Management Plan should account for conditions on each site to which it is applicable. Sections 2 and 3 of the plan should provide information for each of the Contractor's sites in turn.

1. Plan Rationale and Requirements

- Objective of plan
- Relationship of plan to EMP and CEMMAP
- Applicable water quality standards
- Roles and responsibilities for plan implementation
- List of Contractor's work sites and staging areas

2. Identification of Erosion Risks and Runoff Receptors [prepare for each site]

- Site topography
- Erodibility of natural site soils
- Erodibility of fill materials
- Erodibility of stockpiled building materials
- Seasonal rainfall patterns
- Vulnerability to flash floods, fluvial flooding)
- Inventory of permanent and intermittent/seasonal watercourses on site
- Inventory of off-site watercourses that will receive site runoff

3. Drainage Plans [prepare for each site]

- Inventory of on-site catchment areas and drainage channels
- Inventory of site drainage discharge points
- Natural watercourses that will be avoided through site layout design and setbacks
- Natural watercourses that will be altered (rechanneled, piped) to enable site use
- Planned changes to site topography (borrowing, leveling, terracing)
- Inventory of planned 'hard' drainage infrastructure (armored channels, gabion check dams, sediment traps)
- Inventory of 'soft' drainage infrastructure (vegetated swales, infiltration basins, protected natural channels, earthen check dams)
- Drainage plan map

4. Method Statements

- Timing of earthworks to limit erosion risk (seasonal and weather-related)
- Mulching (materials, application, maintenance, sourcing)
- Temporary ground covers (e.g., jute mats, geotextiles)
- Long-term slope protection measures (e.g., gabions, geocells, riprap)
- Check dams (design, capacity, construction, maintenance)
- Sediment traps (design, capacity, construction, maintenance)
- Temporary armored runoff channels (design, capacity, construction, maintenance)
- Vegetated runoff infiltration swales (design, maintenance)
- Stockpile covers (tarpaulins)
- Stockpile containment dams
- Setbacks and buffers for natural watercourses

5. Monitoring and Correction

- Method of site monitoring for active erosion and erosion risk
- Frequency of site monitoring for active erosion and erosion risk
- Practices for correcting different types of erosion (sheet, rill, gully, mass movement)
- Follow-up to corrective actions

---

(17) Solid Waste Management Plan – Sample Outline

1. Plan Rationale and Requirements

- Objectives of plan
- Relationship of plan to CEMMAP and project EMP
- Relevant national laws and standards
- Inventory of Contractor's sites to which the plan will be applicable
- Registrations and permits obtained
- Roles and responsibilities in plan implementation

2. Classes of Solid Waste Produced by Type of Site

- Work sites
- Staging sites
- Construction camps
- Offices

3. Projected Monthly Waste Production by Class

- Regular solid waste
- Recyclable waste
- Organic waste
- Hazardous solid waste

4. Method Statement: Solid Waste Reduction and Recycling

- Waste reduction methods
- Recyclable materials
- Organic materials
- Segregation methods

5. Method Statement: Solid Waste Collection

- Collection and segregation methodology
- Collection frequency
- Responsibility for collection
- On-site handling and storage facilities for non-recyclables
- On-site handling and storage facilities for recyclables
- On-site handling and storage facilities for organic wastes
- On-site handling and storage facilities for hazardous wastes

6. Method Statement: Solid Waste Disposal

- Selected and confirmed destination landfill non-recyclables
- Transportation plan for non-recyclables
- Selected and confirmed providers of recycling services
- Transportation plan for recyclables
- Selected and confirmed destination for organic wastes
- Transportation plan for organic wastes
- Selected and confirmed destination hazardous waste management facility
- Transportation plan for hazardous wastes

7. Monitoring of Implementation

- Performance indicators
- Method and frequency of monitoring

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(18) Spoils Management Plan – Sample Outline

1. Purpose of the Plan

- Objectives
- Performance indicators
- To be read in conjunction with the natural grassland restoration plan, the habitat clearance management plan and the terrestrial invasive species management plan.

2. Description of Spoils Management Site

- Site location, area, boundaries
- Road access
- Distance and route from spoils origin sites
- Topography
- Existing drainage and watercourses on site
- Nearby water bodies
- Prevailing wind
- Surrounding land use
- Proximity of residences

3. Spoil Characteristics

- Sources of spoils
- Expected volume of spoils
- Expected timeframe/phasing of spoils generation
- Expected materials
- Erodibility of expected materials

4. Spoils Site Plan

- Site access
- Spoils placement locations
- Planned height/depth of spoils piles/fill
- Setbacks from watercourses and site boundaries
- Progressive rehabilitation plan
- Site map

5. Method Statements

- Fencing and site security
- Temporary storage of spoil materials destined for sale or donation
- Placement and shaping of spoils for permanent disposal
- Maximum permissible slopes
- Dust suppression
- Temporary measures for spoils surface protection (mulches, geotextiles)
- Revegetation
- Pre-closure monitoring for vegetation cover and slope stability
- Site closure

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(19) Staging Area Rehabilitation Plan – Sample Outline

1. Plan Rationale and Requirements

- Objective of plan
- Relationship of plan to CEMMAP and project EMP
- Relationship to Tree-Cutting Permit
- Site or sites to which the plan is applicable
- Roles and responsibilities for implementation and supervision

2. Inventory of Contractor Staging Areas Covered Under the Rehabilitation Plan

- Location
- Area
- Owner of site (lessor)
- Terms of lease concerning site condition upon final vacancy
- Activities carried out by Contractor on site during construction

3. Site Conditions [complete for each staging area site covered under plan]

- Original land cover before use by Contractor
- Watercourses on site before use by Contractor
- Proportion of site used by Contractor during project
- Number of trees over 2 m height removed during site clearing
- Modifications made to original watercourses during site set-up and use
- Original structures on site at time of occupation
- Structures removed during site clearing
- Structures and infrastructure installed by Contractor on site
- Proportion of site paved at end of Contractor use
- Proportion of site exposed soil at end of Contractor use

4. Site Rehabilitation Plan [complete for each staging area site covered under plan]

- Equipment removal

- Waste removal
- Removal of structures (unless leaving structures specified by lessor)
- Remediation of contaminated soil
- Removal of paving and hard drainage infrastructure (unless specified otherwise)
- Resolution of erosion problems as applicable
- Tree planting as per Tree-Cutting Permit and Compensatory Tree Planting Plan
- Restoration of watercourses and riparian vegetation
- Map of plantings and watercourse/riparian restoration
- Sourcing of key materials
  - saplings
  - root stock
  - seed
  - soil amendments
  - mulches and other soil-protective materials (e.g., jute mats)
- Implementation schedule
- Monitoring of rehabilitation to measure effectiveness
- Follow-up measures in case of poor results in vegetation establishment and/or erosion control

5. Method Statements

- Assessment and remediation of contaminated soil
- Resolution of erosion problems
  - maximum permissible slope and stabilizing measures
  - gully remediation measures
- Vegetation establishment
  - Total revegetation area
  - Pre-planting soil suitability assessment and soil amendment
  - Timing of plantings in relation to seasonal constraints
  - Selected native species
  - Tree planting
  - Bare root planting
  - Seeding
  - Use of mulches and other protective materials
  - Watering (by vegetation type)
  - Weeding, thinning and trimming (by vegetation type)
- Metrics and methods for measurement of vegetation establishment success (e.g., vigor, survival rate by time period, density, coverage)
- Documentation and reporting of vegetation monitoring results
- Criteria for replanting and infill planting
- Site inspection and evaluation criteria

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(20) Habitat Clearance Management Plan – Sample Outline

1. Purpose of the Plan

- Context – the project will clear c.150 ha of habitat that supports flora and fauna. UN-controlled clearance may cause the avoidable killing and disturbance of species and spread or introduce invasive species (this plan is to be read in conjunction with the Terrestrial Invasive Species Management Plan)
- Objectives – to complete all construction with zero mortality of wildlife
- Performance indicators

2. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4. Clearance Methodologies

- Detailed methods of how all vegetation within the ROW and staging areas will be carefully and systematically removed to avoid all wildlife mortality.
- Specifications will be made for how the clearance works will be planned, who will be responsible for managing the correct implementation of this plan, when works will be measures in the case of an emergency (e.g. injured animal)
- Measure must include:
    - o The initial stimming of all grass and shrub to a minimum height of 20cm, confirmation that it will be left for at least 24 hours for the species to naturally move out of the area. After the 24-hour period the remainder of any vegetation can be cleared, if needed, in one direction
    - o The timing of the clearance (time of day and season), especially to avoid the main nesting bird season
    - o The use of wildlife proof fencing to keep the construction sites free of wildlife once cleared
    - o Management requirements to keep the construction sites clear of vegetation that may attract wildlife (e.g. regular mowing or removal of young growth).
    - o Confirmation of which methods are not permitted to clear vegetation (e.g. fire)
    - o Confirmation of the equipment permitted and not permitted to clear vegetation
    - o Confirmation of how the vegetation clearance will be managed and monitored by a full time Ecological Clerk of Works

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(21) Terrestrial Invasive Species Management Plan – Sample Outline

1. Purpose of the Plan

- Context – Invasive and non-native species are already present on site and in the local area. Proactive actions must be taken to avoid the spread of these species and the potential re-introduction of others.
- Objectives – achieve all construction activities with absolute zero spread or introduction of invasive species
- Performance indicators

2. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4. Assessment of risk from in water work

- Identification of all known terrestrial invasive species
- Creation of a log/data base for all known and all future invasive species
- Assessment of risks for all invasives within the ROW and staging areas
- Assessment of risks for all invasives close to the ROW and staging areas
- Assessment of risks for the introduction of possible invasive species

5. Control of impacts from in water work

- Detailed methodologies for the control and eradication of each invasive species (flora and fauna) present within the ROW and staging areas
- Detailed methodologies for the control of disturbance to all invasive species close to the ROW and staging areas
- Detailed methodologies for the transport and storage of all new soil, spoil and aggregate to avoid the introduction of invasive species.
- Detailed methodologies for the cleaning of all vehicles on arrival and departure from site
- Detailed emergency procedures if new invasive species are recorded on site during construction.

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(22) In-Water Work Management Plan – Sample Outline

1) Purpose of the Plan

- This management plan provides guidance on the conduct of work near or in water
- The objectives of the plan are to mitigate the potential effects of in-water work on:
    - the physical structure of surface waters system (e.g. erosion or deposition) as consequence of alterations in flow rate;
    - Alterations in water quality and
      the biological features of the surface water that may be sensitive to changes in flow rate or water quality
    - The plan will reduce potential adverse impacts on surface waters and associated resources to an acceptable level

2) Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3) Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4) Assessment of risk from in water work

- Locations where construction activity may physically interact with flow (culverts stations etc) or where surface water run off may flow into a surface water will be identified.
- The magnitude of predicted changes in hydrology (flow rate) and water quality will be predicted in relation to the structure of the surface water (e.g. bank and bed stability and type) ecological sensitivity (impairment of aquatic biota movement up or down stream) and socio economic use (fishing, domestic water use).
- Where there is the potential for adverse effects, mitigation measures will be identified.

5) Control of impacts from in water work

- Where there is a risk of adverse effects on hydrology and water quality mitigation measures will be identified, these may include design amendments to reduce current speed, retention of potentially contaminated run -off, protection of bank systems, salvage of potentially affected fauna and restoration of banks site habitat

6) Adaptive Management

- Detailed explanation of the measures that will be taken if adverse impacts are detected or if the proposed works change.
- Likely issues must be presented with exemplar, practical solutions, inclusive of details, timing, methods, roles and responsibilities and budgets
- All changes will require the risks and opportunities to be reassessed
- All adaptive management must be reviewed and approved by external technical experts and the CSC.

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(23) Marine Invasive Species Management Plan – Sample Outline

1. Purpose of the Plan

- Context – Invasive and non-native species may already present on site and in the local area. Proactive actions must be taken to avoid the spread of these species and the potential re-introduction of others.
- Objectives – achieve all construction activities with absolute zero spread or introduction of invasive species
- Performance indicators

2. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this plan

3. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan’s actions
- Party accountable for successful implementation of the plan

4. Assessment of risk from in water work

- Identification of all known marine invasive species
- Creation of a log/data base for all known and all future invasive species

- Assessment of risks for all invasives within the ROW and staging areas
- Assessment of risks for all invasives close to the ROW and staging areas
- Assessment of risks for the introduction of possible invasive species

1. Control of impacts from in water work

- Detailed methodologies for the control and eradication of each invasive species present within the ROW and staging areas
- Detailed methodologies for the control of disturbance to all invasive species close to the construction areas
- Detailed methodologies for the inspection and cleaning of all vessels used during construction.
- Detailed emergency procedures if new invasive species are recorded on site during construction.

APPENDIX C

(1) Bat Management Plan
(2) Bird Management Plan
(3) Marine Turtle Management Plan
(4) Natural Grassland Restoration Plan
(5) Underwater Noise Management Plan
(6) Water Use Management Plan

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(1) Bat Management Plan – Sample Outline

1. Purpose of the Plan

- Context – the project has the potential to adversely impact bats but the data is insufficient to confirm the current assessment with confidence.
- Objectives – desk top studies and field surveys must be completed to determine the baseline, inclusive of species, abundance, behavior, movement and seasonality. This data will be used to reassess the impacts on bats and if required to design the respective mitigation
- Performance indicators

2. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4. Baseline Survey Methodology

- Define survey objectives.
- Define minimum qualifications of technical bat lead who will be responsible for implementing this management plan (minimum of 20 years' experience with bat survey design and impact assessment)
- Define Vantage Point surveys for fruit bats and Transect Surveys for Microchiroptera, inclusive of defining exact survey routes, survey methods, timings, the minimum years of experience for all surveyors, the equipment to be used and the frequency of surveys
- Define the need for infra-red and radio tracking surveys inclusive of defining exact survey routes, survey methods, timings, the minimum years of experience for all surveyors, the equipment to be used and the frequency of surveys
- Define the permits required for all surveys, if relevant

5. Impact Reassessment

- The field data must be supplemented with desk based data that will be obtained from research and consultation
- Using the data obtained by the field surveys the impact assessment must be updated
- Confirm which species use the airspace near the BCIB, when, in what abundance and why
- Determine the likelihood of any adverse impacts, including collision with the BCIB or its vehicles, disturbance from the physical structure or its lighting.
- Define the conclusions and requirement for any mitigation

6. Development of Bat Mitigation Measures

- Dependent on the results of the impact assessment mitigation must be defined
- Measure may include:
    - On-going monitoring
    - Landscape planting to encourage or discourage bats from using certain areas (e.g. habitat screens or the provision of fruiting trees)
    - Amendments to the construction working hours (and their lighting schemes)
    - Amendments to the BCIB lighting schemes

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(2) Bird Management Plan – Sample Outline

1. Purpose of the Plan

- Context – the project has the potential to adversely impact birds, including species that trigger Critical Habitat but the data is insufficient to confirm the current assessment with confidence.
- Objectives – desk top studies and field surveys must be completed to determine the baseline, inclusive of species, abundance, behavior, movement and seasonality. This data will be used to reassess the impacts on bats and if required to design the respective mitigation
- Objective must be clear that the data and the subsequent assessment is to inform potential impacts of:
    - Birds flying through the mouth of the Bay and colliding with or being disturbed by the BCIB (e.g. disorientated by the lights)
    - Birds flying near the BCIB e.g. along its alignment between Bataan / Cavite and colliding with or being disturbed by the BCIB
    - Birds roosting or perching on the BCIB and being struck by moving vehicles.
- Performance indicators

2. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan’s actions
- Party accountable for successful implementation of the plan

4. Baseline Survey Methodology

- Define survey objectives.
- Define minimum qualifications of technical bird lead who will be responsible for implementing this management plan (minimum of 15 years' experience with bird survey design and impact assessment)
- Define Vantage Point and Transect Surveys for a variety of species including shorebirds, sea birds, raptors and passerines, inclusive of defining exact survey routes, survey methods, timings, the minimum years of experience for all surveyors, the equipment to be used and the frequency of surveys.
    - Vantage Point Surveys from Cavite, Bataan and Corregidor Island to determine the species that may be at risk of colliding with or being disoriented by the BCIB's lighting.
    - Transect surveys on Cavite, Bataan and Corregidor Island to determine the presence of nesting birds, particularly large species that may be disturbed by the construction works.
    - Observation surveys of the BCIB as it is being constructed and neighboring infrastructure to determine the likelihood of birds roosting or perching on it.
- All baseline surveys must be completed quarterly for a minimum of five years.
- Details must confirm the minimum quality of the binoculars and scopes to be used
- Data recording techniques must be confirmed before any surveys commence to ensure consistency across all years.

5. Impact Reassessment

- The field data must be supplemented with desk based data that will be obtained from research and consultation
- Using the data obtained by the field surveys the impact assessment must be updated
- Confirm which species use the airspace near the BCIB, when, in what abundance and why (behavior)
- Determine the likelihood of any adverse impacts, including collision with the BCIB or its vehicles, disturbance from the physical structure or its lighting.
- Define the conclusions and requirement for any mitigation

6. Development of Bird Mitigation Measures

- Dependent on the results of the impact assessment mitigation must be defined
- Measure may include:
    - On-going monitoring
    - The timing of works to avoid disturbing nesting species (e.g. raptors on Corregidor Island)
    - The requirement to install bird deterrents along the bridge to prevent roosting or perching birds
    - Amendments to the construction working hours (and their lighting schemes)
    - Amendments to the BCIB lighting schemes

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(3) Marine Turtle Management Plan – Sample Outline

1) Purpose of the Plan

- The Plan is intended to provide specific mitigation measures to prevent adverse impacts on marine turtles. The nationally protected olive ridley turles are known to nest in close proximity to the works on Cavite shore and frequent the coastal areas of outer Manila bay in the project areas. Critically endanged hawksbill turtles have been recorded nesting on the south shore of Corrigedor Island.
- The objectives of this plan is to provide a frame work for informed decision making and management of the risks to marine turtles during construction
- The management plan will reduce the need for offsetting of turtle habitat to as low as practical

2) Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3) Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4) Baseline Survey Methodology

- Additional baseline studied are required to inform the management of marine turtles by the project
  - The behavior of nesting and inter-nesting olive ridley turtles in relation to the project site and nesting beaches by tracking
  - The presence or absence of hawksbill turtles on South Corregidor Island by surveys during the nesting season

5) Additional Assessment

- For locations where marine turtles are shown to be present additional assessment will be undertaken to evaluate the potential for direct disturbance during nesting and from construction lights.
- Operational road lighting from terrestrial section of the carriageway will also be assessed.
- A marine turtle specialist will need to be retained to undertaken this work

6) Development of Marine Turtle Mitigation Measures

- Where adverse impacts are predicted additional mitigation will be required, this may include alterations to layout of construction areas, changes to lighting arrangements, safeguarding of important habitats during the nesting period.

(4) Natural Grassland Restoration Plan – Sample Outline

1) Purpose of the Plan

- Context - the project will result in the loss of 12.3ha of natural grassland, which must be restored, recreated or other, local grassland must be enhanced to achieve a no net loss in the conservation value of this habitat.
- Objectives
- Performance indicators

2) Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3) Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

4) Baseline Survey Methodology

- Objective of the surveys
- Minimum surveyor qualification (15 years and grassland knowledge)
- Grassland survey methods including timings, locations, data recording protocols and reporting
- Soil survey methods including timings, locations, data recording protocols and reporting for both the receptor and donor sites (do the donor sites have the right soil structure and chemistry?).
- Reporting of grassland baseline inclusive of species lists, species composition, invasive species, identification of species missing that should be present in the sward and recommendations for the translocation of the grassland, seedbank and its management
- Reporting of soil baseline inclusive of soil profile, soil chemistry and recommendations for the translocation of the soil

5) Impact Reassessment

- Using the data obtained by the field surveys the impact assessment must be updated
- Confirm if 12.3 ha of natural grassland be permanently lost?
- Confirm exact extent and location of natural grassland to be lost
- Confirm exact extent and location of the potential donor sites
- Confirm if c.24 ha of donor sites for natural grassland can be created on contiguous land, adjacent to existing natural grassland and with suitable soil structure and chemistry

6) Development of Bat Mitigation Measures

- Update the propose mitigation plan inclusive of the following options to ensure a certain net gain in the conservation status of the local natural grassland:
  - Avoiding the loss of natural grassland
  - Minimizing the loss of natural grassland
  - Translocating the area of habitat lost to suitable donor sites

  - Creating new natural grassland in adjacent contiguous sites
    - Establishing a nursery for grassland species
  - Protecting and enhancing retained natural grassland

7) Translocation Methodology

- Objective of the translocation
- Exact location and extent of donor grassland(s) to be translocated
- Exact location and exact of the receptor grassland site(s)
- Minimum qualifications and experience of management, translocation team
- Requirement for external auditors (e.g. local relevant academics)
- Specification of the equipment to be used
- Maximum distance that soil can be transported
- Extent and details of turf to be translocated
- Extent and details of soil seedbank to be translocated
- Methods for collecting seeds if required
- Methods for growing new grassland without the seedbank
- Timing of the works
- Specifications of any topsoil storage (maximum heights and timings)
- Protection of topsoil storage
- Requirement for the new grassland to be established within two years of construction starting
- Validation and accountability methods

8) Grassland Monitoring Methodology

- Objective of the monitoring
- Minimum qualifications and experience of monitoring team
- Monitoring methods
- Frequency of monitoring per year
- Requirement for the grassland to be monitored for at least three years
- Annual key Performance Indicators for restoration
- Reporting
- Validation and accountability methods

9) Grassland Management Methodology

- Objective of the management
- Minimum qualifications and experience of management team
- Management methods
- Timing of annual management
- Reporting
- Validation and accountability methods

10) Adaptive Management

- The translocation of 12.3 ha of natural grassland will not achieve the no net loss required, as described in the EIA. Additional measures are required. Measures could include the procurement of at least another 12 ha of possible receptor land. If this is possible the above translocation actions can be carried out on this additional land, supplemented with the collection of seeds and the sowing of a comparable species composition.

- If this is not possible additional conservation actions are required to enhance grassland elsewhere. Detailed methods are required to direct this process.

- Methods are also required to direct the management of the translocated grassland should the monitoring indicated the new grassland is not developing as planned.

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(5) Underwater Noise Management Plan – Sample Outline

1) Purpose of the Plan

- The Plan is intended to provide specific mitigation measures to prevent adverse impacts due to underwater noise, primarily on sea mammals. Sea mammals are nationally protected and are vulnerable to impacts from underwater noise such as that caused by pile driving. Implementation of standard mitigation practices may impact construction scheduling
- The objectives of this plan is to provide a frame work for informed decision making and management of the risks to mammals during construction

2) Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

3) Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan’s actions
- Party accountable for successful implementation of the plan

4) Baseline Survey Methodology

- Additional baseline studied are required to inform the management of marine mammals by the project
  - The seasonal use of marine mammals in the project area will be established using visual observation and hydrophone arrays.
  - The monitoring will establish which sea mammal sies use the area and when the periods of greatest risk are.

5) Additional Assessment

- Once the additional information has been obtained it will be used to inform whether the pile driving schedule needs to be changes to minimize the potential for harm to marine mammals and disruption to the construction schedule.
- A marine mammal specialist will need to be retained to undertaken this work

6) Development of Marine Mammal Mitigation Measures

- Where adverse impacts are predicted additional mitigation will be required, this may include alterations to scheduling, deployment of passive acoustic monitoring devises, deployment of marine fauna observers, and adoption of piledriving and rock drilling techniques.

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(6) Water Use Management Plan – Sample Outline

2. Purpose of the Plan

- This management plan provides guidance on the management of water resources by the project during construction. There is a potential for the project to use large volumes of domestic (including potable) and technical water. Where this water is obtained from sources shared with other stakeholders there is the potential for conflict
- The objective of the plan is to ensure that no stakeholders have access to, or quality of compromised by the project water use.

3. Mitigations Hierarchy

- How the mitigation hierarchy will be used within this Plan

4. Roles and Responsibilities

- Responsible parties for implementing the plan
- Responsible parties for validating the plan's actions
- Party accountable for successful implementation of the plan

5. Approach

- Each construction contractor will be required to submit a water use plan that will include the following details:
    - Estimated volumes of technical and potable water required, by construction phase and location
    - Sources of water in the area of the construction scope and estimated capacity
    - Sources which are planned to be used by the project and estimated volumes required
    - Water used by third parties including communities and industry
    - Assessment of water supply impacts of the project on stakeholders
    - Mitigation plans if the project may have adverse effects on other stakeholders.

APPENDIX D

2. Sample Outline of Semi-Annual Environmental Monitoring Report for ADB

1. Introduction

- Report purpose
- Overview of project components and construction packages
- Summary of project implementation progress to date

2. Construction Package 1

2.1 Summary of Contractor's Work Activity During Monitoring Period

2.2 Review of Contractor Self-Monitoring Reports

- Reports submitted/outstanding
- CEMMAP compliance issues identified by Contractor
    - Corrective actions specified
    - Corrective actions implemented
    - Current issue status
- Standards violations identified by Contractor
    - Corrective actions specified
    - Corrective actions implemented
    - Current issue status

2.3 Proponent's Confirmatory Monitoring

- Confirmatory monitoring activity during monitoring period
- CEMMAP compliance issues identified by DPWH
    - Notices of Non-Conformance issued
    - Corrective actions implemented
    - Current issue status
- Standards violations identified by DPWH
    - Notices of Non-Conformance issued
    - Corrective actions implemented
    - Current issue status

2.4 Grievances Recorded

- Grievances brought to Contractor
- Grievances recorded in project Grievance Register
- Resolution history and current status of grievances

2.5 Appendix to Package 1 Summary Report (Documentation)

- Photographs
- Notices of Non-Conformance

[REPEAT SECTIONS 2.1–2.5 ABOVE FOR EACH OF REMAINING CONSTRUCTION PACKAGES]

3. APPENDIX E

4. Sample Outline for Monthly Contractor Self-Monitoring Reports to DPWH

1. Introduction

- Report purpose
- Overview of construction package
- Summary of progress to date
- Summary of work activities ongoing during monitoring period
- List of sub-contractors active during monitoring period

2. Summary of Monitoring Activity in Current Month

- Activity of PC-EHSR and field staff
- Activity of sampling contractor
- Summary of monitoring methods
- Special circumstances affecting monitoring activity

3. Monitoring Results

3.1 Compliance Monitoring

- CEMMAP compliance issues identified
  - Corrective action directives issued
  - Corrective actions implemented
  - Current issue status

3.1 Effects Monitoring

- Standards violations identified
  - Corrective action directives issued
  - Corrective actions implemented
  - Current issue status

4. Grievances Recorded

- Grievances brought to Contractor
- Grievances recorded in project Grievance Register
- Resolution history and current status of grievances

5. Appendix (Documentation)

- Photographs
- Corrective action directives issued by PC-EHSR
- Notices of Non-Conformance received from DPWH